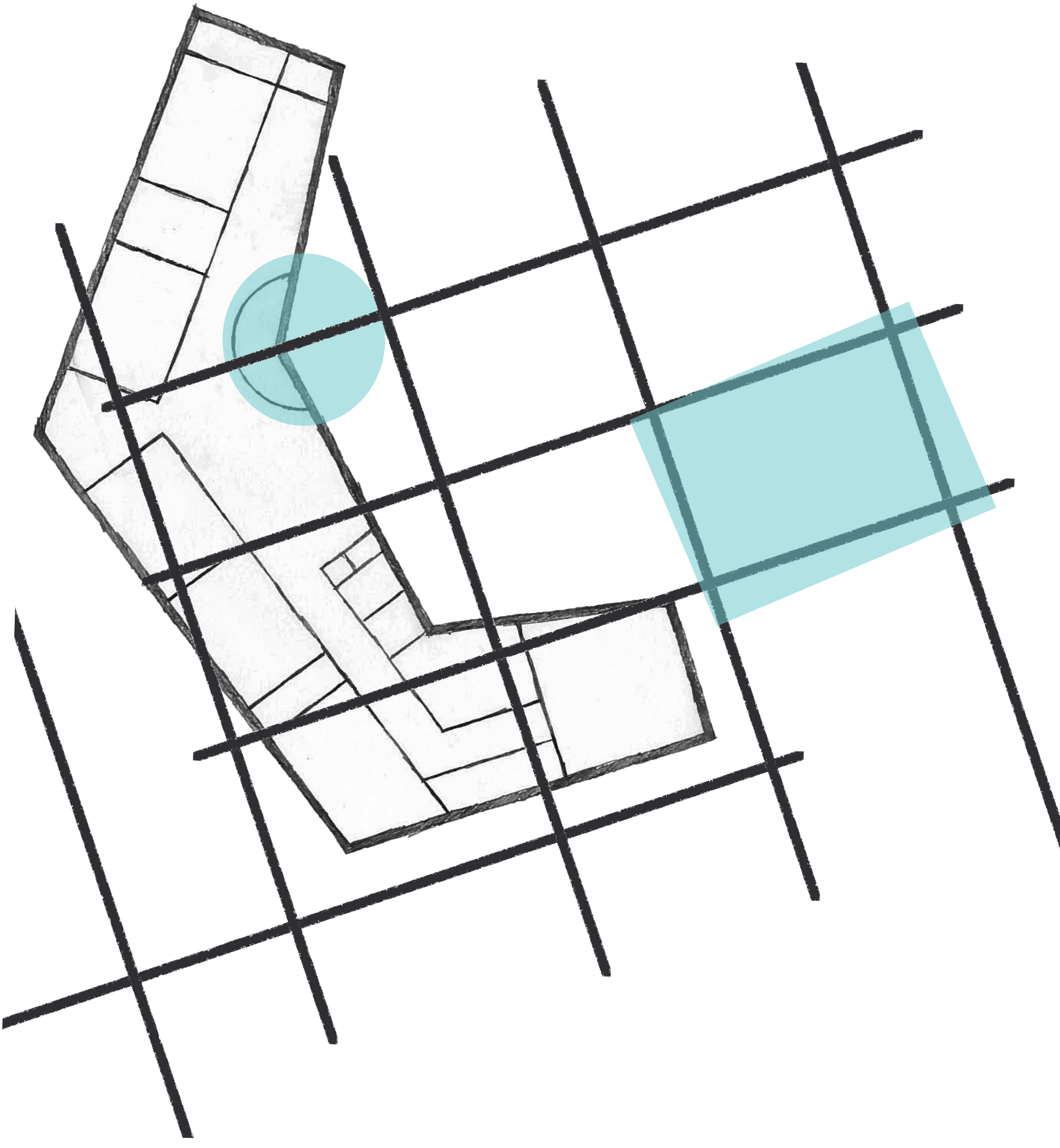
UNENCUMBERED

" Free and unburdened "



May 2014 - MSc.04 Architecture - Group 2 - Alexandra Graarup Vink

Title Sheet

TITLE

Unencumbered

SEMESTER

4MSc.

PROJECT

Kindergarten

THEME

Tectonic

TIMESPAN

Febuary 2014 - June 2014

GROUP #

2

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PAGES

94

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Abstract

This 4. Semester master thesis project has the subject "tectonic design", and is concerned with the design proposal for a kindergarten in Nørresundby, Denmark.
The main concern of the design is to revitalize traditional carpentry methods, in a contemporary context, utilizing old knowledge with modern materials and technologies. While considering the relation between construction and interior qualities.
Besides the structure, material and spatial qualities being of special interest in this project, also the relation to the context will be reflected in the design and in the design process.

Content

Introduction

The world has become more CO_2 crazed and less artistic values are integrated in contemporary building design. The great passive house solutions that have been presented during the past decades are often lacking spatial qualities, that make a building habitable and workable. This thesis will not be a passive or zero energy project, and therefore the focus will be based on tectonic design with the corresponding theory in both art and architecture.

With a focus on tectonic design and a theoretical approach to design and atmosphere, this project is placed in Nørresundby, Denmark in an area around the chalk lake Lindholm kridtgrav. The project the aim the project is to design a kindergarten, where play and interaction with the environment and the spaces will be the main focus. The theories used in this project will be supplementing and giving inspiration to the design. The report written in correlation with the thesis project is however, not based on the theory but on the process of the design. The choice of a kindergarten is due to the playful perception of the world seen through the eyes of a child. Setting aside adult pragmatism and responsibility and re-experiencing the wonders of the world.
The goal of this project is to incorporate the structural integrity of the building as part of the design. Integrating it in the functional- and spatial qualities of the design. The theoreticians being referred to are mainly authors such as, Kenneth Frampton, Gottfried Semper and Marco Frascari. These author's will be studied for a better understanding of the term tectonic and also for clarification of the direction the project is going.

Evolution of thought

In order to better understand what features are needed for a kindergarten and how the children interact with their environment, research on how the mind evolves were iniciated. Recent studies have shown that a child's mind has a limited range of objects that can be stored, known as visual working memory. In tests, the researchers found that 3-year-olds can hold a maximum of 1.3 objects in visual working memory, while 4-year-olds reach capacity at 1.8 objects. Adults hit the ceiling at 3 to 4 objects. the university of Iowa, USA, made this research ("Visual memory research"; 2013). Due to the limited objects they can visualize, children don't have a perception of self until they reach the 3-year mark. They are therefore much more familiar with the place and environment than they are with themselves. There are only a very limited amount of animals in the world that are capable of self-perception, Ravens, Honey badgers, Chimps and Dolphins are amongst the animals with a bigger brain than the standard brain to body correlation than cats and dogs have. In this brain to body ratio lays the possibility to develop thoughts and learn from mistakes.
("The brain and the body"; 2014)

Although children only store and process a limited amount of information, they have a wider range of thoughts than adults. The seemingly most mundane and profoundly uninteresting objects can become the source of the most thrilling adventure. A tablecloth becomes the cape of a superhero or the wings of a bird, a wooden spoon becomes the sword of a pirate and the hanger the hook of captain Hook. The ground seems solid and safe becomes a poisonous sea or deadly lava. The daily life of a child differs greatly from that of an adult, whilst the average adult sees nothing but monotone grey the child experiences vibrant colors and create adventures anywhere and everywhere, from riveting explorations of unknown territory to dramatic fairy-tales. A day through the eyes of a child is never boring.
It is important to enhance this imagination by creating spaces children interact with in an institutional environment, in order promote creativity and play. Institutional architecture can often seem strict and cold, where education is treated as a mass production assembly line system, where quantity is more important than quality.

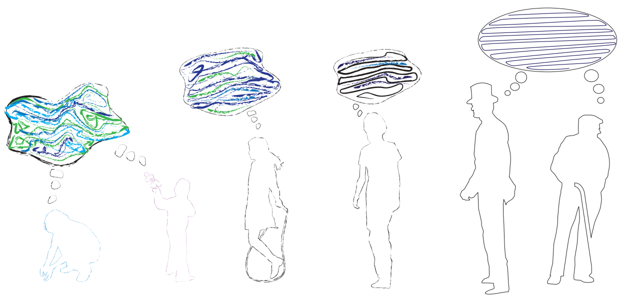


Figure 1.1 Illustration of the evolution of thought

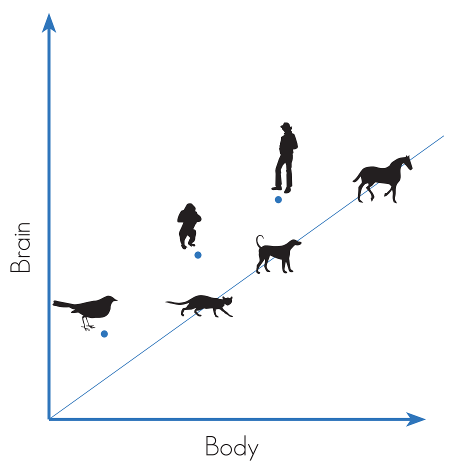


Figure 1.2 Illustration of brain to body ratio

Methodology

An iterative design process is going to be the main method of development. From analyzing child behavior and play, to broaden the understanding of their interaction with the space, and then analyzing the space itself to then analyze the context. The result of this analysis will then be used in the design process, which will have more or less the same structure as the analysis, where the basis of the design will be from the child´s perspective, which will then broaden to the space and then the context. Though this is going to be the main method the term integrated design also comes to play in this iterative process. The integrated design process has been used throughout the semesters at Aalborg University and is seen as a holistic design approach that doesn't only take the aesthetic qualities of a project into consideration but also the technical and functional aspects of a design. This has been introduced in the form of the Vitruvian principles of utilitas, firmitas and venustas (Functionality, structure and aesthetics) are all interdependent within architectural design, for without the structural integrity and functionality there would be no one utilizing a building yet purely functional and structural constructions are often short lived and disposed of after use. In this Iterative process with constant reevaluations of ideas and proposals the evaluation criteria's will not only be based on scientific facts and numbers but also an emotive and phenomelogical factor will have an important role to the entire design process, as it is part of a holistic design approach to take all aspects into consideration.

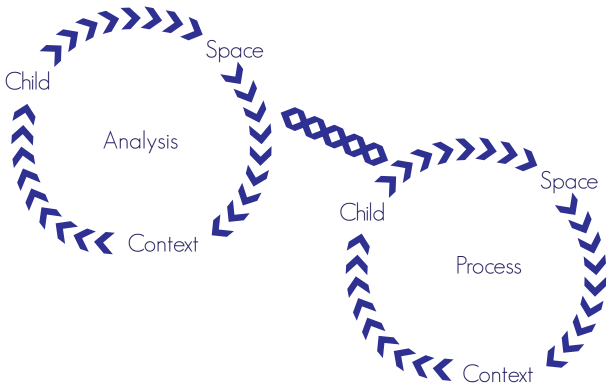


Diagram of iterative design process Fig 1.3

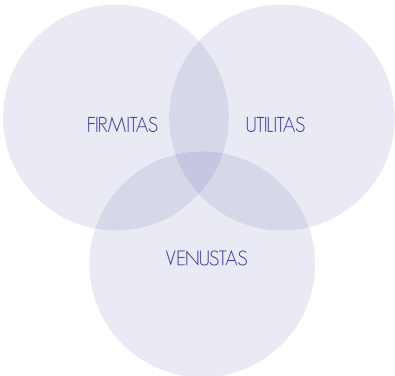


Diagram of Vitruvian principles Fig 1.4

A Kindergarten

A kindergarten, the word itself originates from the German language and literally translated means "childgarden" the term was formed by a Swiss pedagogue Friederich Fröbel (1782 - 1852). In a time where childcare was a woman's job and most children were usually at home with their mothers, a new institution started to emerge where the mothers could have someone else take care of their child while they went about their daily chores without the distraction of their children. However, the places were often in an empty rooms in apartment blocks or houses. Quite often the children were left in the same small area for the entire day without stimulating exercise or play. Children were considered small adults who were a nuisance and useless to society until they grew up. Friederich Fröbel was of a different opinion and developed the prototype for the modern kindergarten. With a great focus on given children space and stimulation, his plan for the kindergarten was an indoor area with a communal spaces where the children had room to play and interact with each other and a wide outdoor area that contained vegetable and wheat gardens so the children could learn through the interaction with nature and nurturing their own plants. The first steps of learning were "Ahnend Begreifen" the intuitive understanding of their surroundings.

The best place to start this project is the institution itself, talking to the educators involved in the children's care and education and the children themselves. This will broaden the understanding of the facilities required for the smooth running of a kindergarten and what other requirements are needed for the furniture and equipment.

The Danish pedagogue Jan Kampmann discusses the kindergartens in Denmark and their design. Most new kindergartens have a minimum space requirement of 3 m^2 per child in the classrooms this is due to the fact that children have different ways to play, boys often play in large groups but with a hierarchy that allows other children to join but not to decide the play itself, these large groups need a large area because boys tend to get territorial and aggressive towards other children invading their space. Girls on the other hand tend to play in smaller groups of 2-3 and need a smaller space, where they can feel safe and enclosed. The smaller the space of the classroom the more restrictive and rigid is the play, which leaves the children noisy and irritated which also leaves the employees irritated and sour. Another important aspect of the kindergarten is the kitchen area, which in Kampmann's opinion should be kept open and communal and let the children have an opportunity to help preparing the food, this also makes it easier for children to try new dishes rather than sticking to what they're used to (T.Holm; Indenfor 2004).

Another important aspect of this project is child psychology, mainly how children interact with the world and gather information. The municipality of Reggio Emilia in Italy is recognized worldwide for its innovative approach to education, the approach was developed in the city of Reggio Emilia after World War II, after such a destructive event it was decided that the children need a new and more personalized education, where differences are nurtured and integrated. In this approach, there is a belief that children have rights and should be given opportunities to develop their potential. Children are believed to be "knowledge bearers", so they are encouraged to share their thoughts and ideas about everything they could meet or do

during the day ("Reggio Emelia history"; 2014).
Plan of a kindergarten made for a competition in Herning, Denmark by Hou og Partnere A/S. The inspiration for this project came from the dune landscape of western Jutland, the building consists of four irregularly shaped building elements, which combined creates an expressive sculpture in the plan. The volumes are not only inspired by the landscape but also relates to it in seize and proportion (N.K.Bjerg; Fremtidens Daginstitution 1997).
The middle section creates the central communal point with many niches and edges, it joins the other functions of the institution and opens towards the outdoor play area.

The classrooms are kept simple in order to keep them as a calm base for the children while the rest of the plan is more open and free to allow a freedom in usage and let the children decide how they're going to use the open spaces.
The project brief stated an interest in reusing the experiences children usually gained by playing without supervision in the courtyards and in the gardens bottom corners overgrown with weeds and plants, to the modern daycare institution. The main themes where "children's secret life" and "childhood ally" a child perception of the institution needs to be stimulated by height differences, light and colors and experience both insecurity and security just like they would at home.

Figure 1.5 Drawing of child play

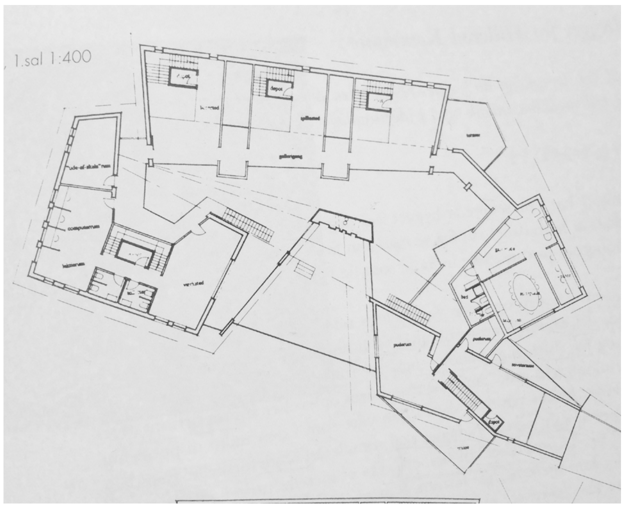


Figure 1.6 Plan of competition project in Herning

Case study

In a study trip to Japan I had the pleasure to visit the Fuji kindergarten by Tezuka architects. The main focus of the design is to allow the children to interact with the space by having to touch, crawl and otherwise physically engage with the space and the design. This was an important approach, in order to counteract the Japanese tendency to interact with virtual worlds rather than physical, especially now with all the smart technologies that allows you portable access to your virtual life with just a click. Situated in the city of Tachikawa, Fuji Kindergarten follows the Japanese architectural tradition of welcoming nature in. In this case, Tezuka Architects built around nature, leaving the classroom's core tree free to grow with the kids. Shaped like a spiral and featuring outdoor and indoor spaces, the classrooms have great views, particularly when looking up. The kindergarten has plenty of natural light, oxygen and a really fun design that encourages kids to grow freely, as the sky is their ceiling. The schools vice principal, Mr. Kato inspired the building's form when he requested a classroom without furniture. The project is a great way to pay homage to a Zelkova tree that survived a terrible typhoon fifty years ago. This tendency of a virtual life is not as pronounced in Denmark but also here it common to see people walking with their smartphone in hand and thereby not perceiving the world around them. ("Nostalgic Future: Tezuka Architects lecture in Columbia" ;2010)

Figure 1.7 Plan of Fuji kindergarten

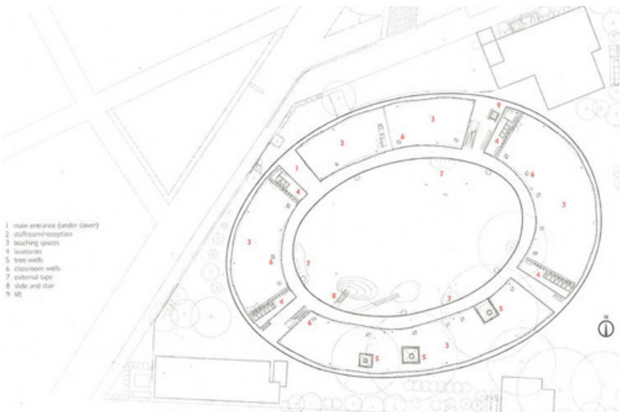


Figure 1.8 Fuji kindergarten by Tezuka Architects

Figure 1.9 Picture of stairwell in Susi Weigel kindergarten

Figure 2.0 Picture of dayrooms in Susi Weigel kindergarten

Bernardo Bader Architects in Bludenz, Austria designed a new kindergarten with an area of 1200.0 sqm built in the year 2013. ("Kindergarten Susi Weigel"; 2014)
This project was inspired by the Swiss children book illustrator Susi Weigel who is mostly unknown, expect for one of her famous works is the book "The little I am I" her illustrations have some very distinct characteristics working with different patterns and layers creating soft collage like characters. The kindergarten works with some of the same qualities the plan and classrooms are kept simple. Original illustration and motifs from Susi Weigel were selected for the glass markers distributed throughout the kindergarten. Sunny yellow and cornflower blue in light soft and dark tones extend from chairs and upholstered furniture, to the wardrobe, back walls and curtains.
The scale of the interior provides an attractive permeability of the outer layers of the space bringing the outside in, the expansion of the play areas and the group work areas represents the inner room sequences that are varied and full of suspense. A very high quality space with diverse insights and perspectives is the architectural target of the project. The project also provides a relation to the context with the solid timber used in the interior and the façade, captures the characteristics of the atmosphere of the garden from city-owned forests.

Figure 2.1 Example of Susi Weigel illustartion http://www.welt-der-frau.at/images/ibi_frei_2klein.jpg

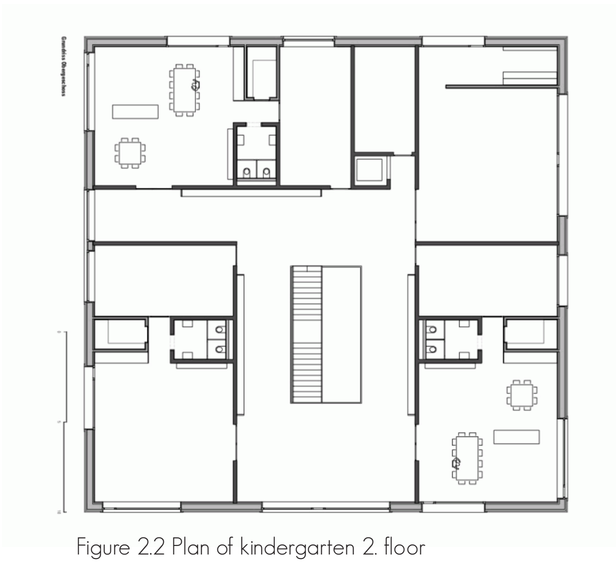


Figure 2.2 Plan of kindergarten 2. floor

Figure 2.3 Perspictive rendering of Seest børneunivers

Figure 2.4 Plan of Seest børneunivers

Seest børneunivers by Plus Kontoret Arkitekter, is a competition for a contemporary kindergarten in Denmark. The plan shows a wide hallway containing the common functions and meeting areas, in order to create an opportunity for children to interact with children from other classes. The hallway isn't just hallway but gains a functional dimension. The classrooms are located in small clusters throughout the building to minimize noise from adjoining classrooms, which gives a calmer environment. The whole kindergarten is kept flexible and available for the children, allowing them to roam about freely without barriers or restrictions. The playground is organized in similar types of clusters, allowing different types of play. There is also a vegetable and fruit garden for the children to grow and eat their own crop, and thus earning by doing. This concept is not appreciated by all daycare institutions, as it is often considered too dirty if the children when they pick up the fruits around the ground and start eating them. However, this is rarely a problem, as it is a scientific fact that children exposed to dirt and nature have a stronger immune system and are less prone to allergies and illness. This kindergarten, as many others, does not have a nurse member in the staff and the staff area is kept away from the dayrooms and common areas, which is slightly inconvenient as the educators are unable to see neither the playground nor the other areas where the children are playing.

Tectonic

As mentioned in the methodology, this project will try and combine both the functional, structural and aesthetic qualities of the architectural design in question. In terms of a kindergarten it is important to let the architecture become part of the stories and fantasies of its users. In order to achieve this, the poetic abilities of the building components and surroundings must all be utilized, not letting one component exclude another. Looking at the word tectonic from an etymological point, (K.Frampton; Labour, work and architecture 2002) the word originates from the Greek word "tekton" meaning carpenter or builder the word is introduced to the English language in 1656 it appears in the glossary meaning "belonging to building". Today architecture has a tendency to be reduced to scenography, meaning the aesthetic of the exterior facade is rated higher than the actual quality of the interior spaces. Especially when considering the new trend in zero energy housing, where the amount of insulation and air tightness needed to reach a zero energy level, completely nullifies the structure. It is left hidden behind masses of insulation, membranes and plaster to shut out the environment, and has no part to play in the interior layout or atmosphere.

The interior is determined by the frame and construction enclosing the space; Gottfried Semper covers this in his theory about the four elements and the primitive hut, where he explains the importance of the frame, in an attempt to explain the origins of architecture. Beginning with the hearth, which is the first element created, for without it there would be no gathering and no need for enclosure to retain the warmth. The frame, formed through weaving, is the second element the element of enclosure; the masonry and the roof are the last two elements and thereby completing the enclosure. This theory on the origins of architecture is very much relevant in this project, as children will need an enclosure to learn and experiment. Especially the frame, reminiscent of the weave that doesn't hide the joint, but uses it as a narrative to convey the process and story of the structure. Roberto Venturi talks about empty space versus empty form in his work "Complexity and Contradictions in Architecture"; the idea is that an empty space is a space designed to have one and only one function and without the function the space loses its identity and idea, while an empty form is both versatile and ambiguous and can be adapted to any kind of situation without damaging the integrity of the space. Examples of an empty from can be Hagia Sofia in Istanbul, Turkey this building has undergone and survived reformation, from Muslim religion to Christian and back again, without any radical changes the space and the building itself. These theories are meant as help and a guide, in order to reaffirm the understanding of tectonics and how it can be implemented in a practical design solution. Not only does the tectonic theme revolve around architecture and structural integrity, but also its relation to the place. Place is the first thing we emerge ourselves in when we are born, it is also through the interaction with the place and environment that we are able to learn and gather experience. Architecture merely creates a frame shielding the place. This environmental shield has however, developed from an important aesthetic and functional element to being an element meant just as a climate barrier. In Kenneth Frampton's collection of essays on architecture and design (K. Frampton; Labour, work and architecture 2002) he discusses the issue of "regional style" to start his writing he uses a quote from Harwell Hamilton-

> "Regionalism has been reduced to a collection of restrictions"

Instead of developing a regional style and aesthetic, it has been replaced by a universal productive method, comprised of repetitive modules leaving the architectural style the same around the world without distinction. In a world that is under globalization it is important to reevaluate the regional style, in order to keep in touch with the history and not entirely forgetting about it.

The joint, how structural members are connected to each other, is also an important aspect when talking about tectonic design. Most structures today have a metal fitting, that is neither aesthetically pleasing, nor an adequate solution for exposed joints, as it is pasted on top of the structural member. Marco Frascari describes the joint and its importance in great detail. He uses a quote from Louis Kahn at the beginning of his essay "Tell the tale detail"

> "Detail is the adoration of nature" -Louis Kahn

Details being a small part in the larger whole all interdepending on each other like joints in that of a skeleton for without the joint it wouldn't function. Just like a building, the joint is just as important, as the beams and columns. It is when these elements work together seamlessly, that the sum of the whole becomes greater than the sum of the parts.

Sustainability

Even though this project has a focus on tectonic architecture, through the construction and detailing of the project. It is also important to look at this project from a sustainable point of view. This does not entail passiv solutions for this building but rather a focus on the materials and usability of the spaces. The idea of superuse, is a term that becomes important in regard to the material choices. Recycling is probably the most common known term in regard to sustainable material reuse however, recycling often results in melting materials, such as aluminum from soda cans. These cans have two components the lid of the can and the body, these components are both aluminum mixes but the lid is aluminum-magnesium mix and the body is a an aluminum-manganese mix. In a traditional recycling process these would be melted together, the result is a weak and less valuable product it is therefore referred to as a Downcycle. (W.Mcdonugh; Cradle to Cradle 2009)
So instead of wasting energy to create a product that is lesser to its original state, a more efficient way to "recycle" materials would be to reuse them in their original state. This has been done in various different ways. One example is Villa Welpeloo in the Netherlands by 2012 Architecten; the architects on this project reused the planks of old cable wheels to clad the facade and old umbrellas as light fixtures for the interior lighting, the main structure is reused steel profiles. In Denmark there have been examples of this in correlation with renovation or demolition projects, where part the materials, such as old beams, columns, windows etc. especially the beams and columns could be an interesting angle for this project. To be able to easily pull all the components apart and reuse them somewhere else. The second picture is of a project by John Wardle, using only reused materials; this includes the nails and metal hardware used to join the construction. The cladding is made of old wooden boards used for water channels during Tasmania's flourishing apple industry.

Figure 2.5 Villa Welpeloo

Figure 2.6 John Wardle's hut

The site

The site is located in Nørresundby, Aalborg, Denmark north of the city center. This area together with the eastern part of Aalborg has a reputation of being a shabby district with a lot of immigrants and crime, however the municipality of Aalborg has been trying very hard to get the image cleaned up with various urban projects in the area. However, the real issue is the cultural differences between the inhabitants that gives cause for a lot of tension and friction. This can be prevented if there is a cultural exchange happening in a light and peaceful manner. For example bringing children together to play and what better place to do this than a kindergarten, where the children spend most of their time. Children are easily influenced and the more they are subjected to different cultures and languages the more accepting they will be in the future. Accepting of people who have different backgrounds from their own. Through the children, the parents can also be brought together through parent meetings and recital events arranged by the children and educators starting a cycle of peaceful cooperation. It is therefore important that the kindergarten is shaped with the possibility of exchange and communal get together, in order to have the maximum amount of opportunities to play and learn together with a wide variety of children.

Figure 2.7 Googleearth of Aalborg The big blue dot indicates the city centre and the small dot the site.

Figure 2.8 Googleearth of Denmark the blue dot representing Aalborg.

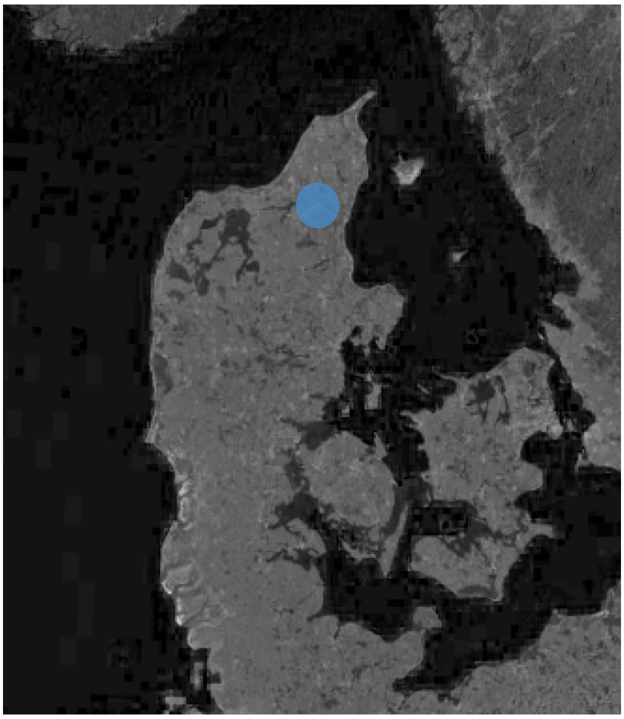


Figure 2.9 - 3.2 Photographs of the site showing a variety of the forrest area and the lake.

The site as mentioned, is located in the northern part of Aalborg by an old chalk and calcium refinery. Denmark is covered in a thick layer of chalk this layer was formed in the geological period from 145.5 million - 65.5 million years during which Denmark was still at the bottom of the ocean. The chalk layer comes to the surface in various places Møns Klint and along the Limfjord are dominant examples of this. The layer consists mainly of seashells and other organic material. This site was originally run by the company DAC (Dansk Andels Cement) in 1913 and ran a flourishing cement production until the 1970ỉs, where the company was taken over by Portland and the production moved to Rørdalfabrikken in Aalborg. The area is now home to a wide range of flora and fauna, the lake is now home to a large variety of birds such as ducks, seagulls, swans and many more 44 species of birds have been registered by the Danish ornithological association. The flora ranges over 50 different species most are in direct association with the chalk at the bottom of the lake, however wild berries and grass can be found on the slopes and the surrounding area of the site.

The site itself seen from a phenomenological view the sensory experience is breath taking, the arrival to the site is from a gravel path, which leads past the forest with mainly birch and oak trees, at the end of the path the spectacular view of the lake and the city. Walking further into the site, the hills and slopes that were formed during the chalk production, shape the area into an almost surreal landscape, with the cobalt blue water in contrast with the barren slopes that are reminiscent of dessert dunes.

Maps

Figure 3.3 Map of green areas the light green area is the site located next to the Lindholm kritgrav. The dark green area is a newly created park corresponding with the new residential building around the lake. The middle green areas are part of the green city conservation programme started in 1999 but as is visible from the map the site around the Lindholm lake is not affected by this.

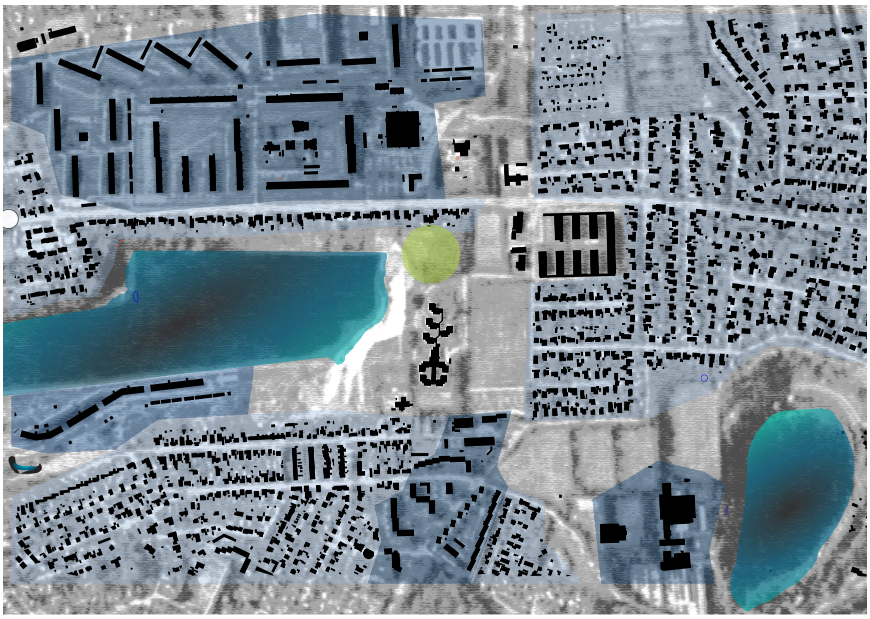


Figure 3.4 Map of residential areas around the site. This area of Nørresundby consists mostly of residential buildings from single-family detached houses to residential blocks. The light blue mark the single family house and the dark blue mark the blocks. There is also a wide range of nationalities in this area, which suggests that the kindergarten needs a high level of integration.

Figure 3.5 Map of accessibility to the site.

Leisurely activity

Bus stops

Services

Kindergarten

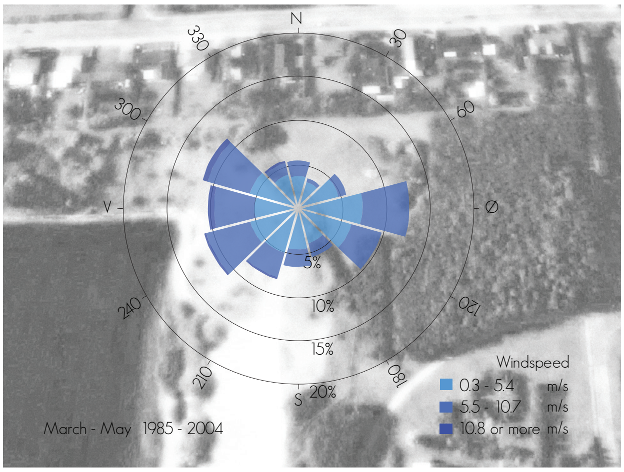
Figure 3.6 Map of function in the area

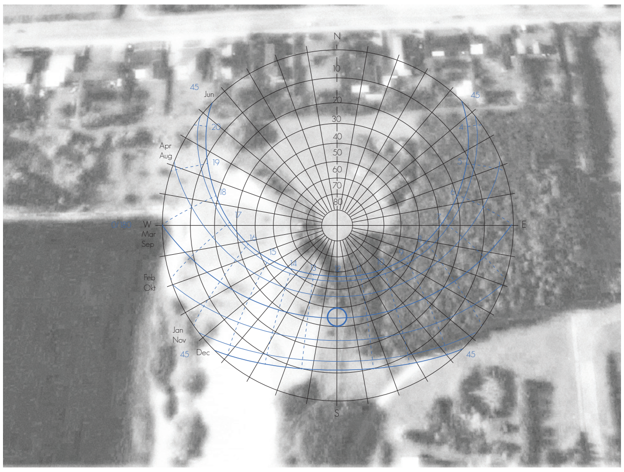
Through these mappings it is visible that the area of the chosen site, is an appropriate area for a kindergarten. This map illustrates the accessibility and the surrounding functions. There are a few kindergartens already in the immediate vicinity of the area, these kindergartens are however, old and outdated with a capacity of approximately 30 children and could do with a refurbishment. As seen from map 1.9 there are plenty of residential buildings near the site to provide children to a new kindergarten. Along the site is an elderly center with a view towards the chalk lake, surrounding the area of this center correlates with the new residential buildings at the foot of the lake. The area is used as a park for leisure and recreational activities, although not in great use at the moment.

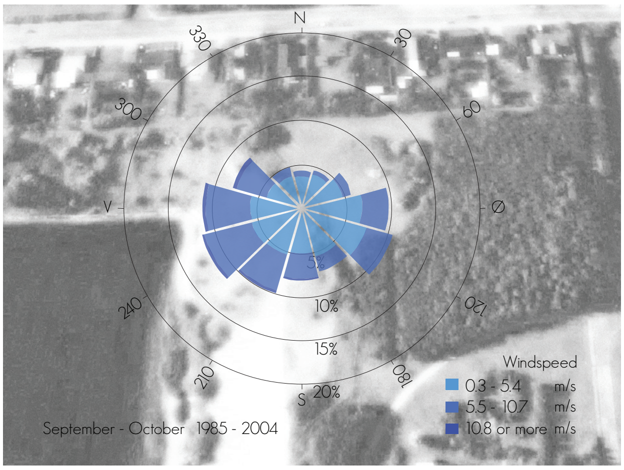
Figure 3.7 Map and examples of kindergartens in the area

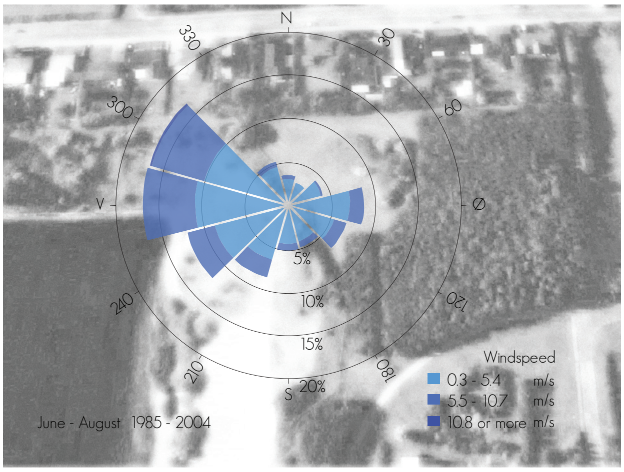
These are some examples of the kindergartens in the area. They all have similar characteristics, for one they're all very out-dated and they have a similar typology of a single family house. The two buildings on the left are configured in traditional brick and the example on the top is a concrete more modern configuration. As mentioned they're all relatively small around 30 - 40 children, they all have small outdoor areas but hardly enough for 30 energetic children. Another problem that will inevitably occur from having kindergartens that resemble the single-family houses in the area is, that the children will have no new impressions from their environment. They get up in the morning in their red brick or yellow brick house walk through the suburb with more brick housing, to then arrive at their destination, which is yet another brick house. This monotony isn't going to engage the mind or the body but rather leaves both the children and the educators in a debauched juxtaposition of wanting to engross in physical and mental activities yet are unable to, due to the lacking facilities.

Weather









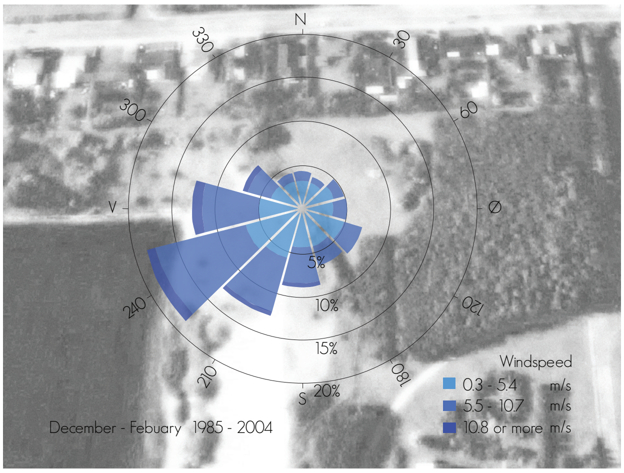


Figure 3.8 - 4.2 Wind charts and solar diagram on the site.

This section has illustrations of the sun and wind path on the site. It is apparent from the diagrams that the most wind is coming from a westerly direction, which suggest the orientation of the kindergarten to close of towards the lake and thereby shielding the east from the harsh winds. The sun diagram shows that the sun is most prominent towards the south so in order to have a decent amount of daylight during the winter, it is important that part of the building is located towards the south.

Conclusion

In conclusion to this analysis of the site, the kindergarten and the children, it is fairly clear that there is not one solution but rather similarities and also disagreements on the matter of the designing a kindergarten. It is obvious that no matter how you look at this research all the architects and theoreticians in question all strive to create a place where the children can both be free and explore and have a structured routine to guide their learning. There is however, a lack of institutions that provide children with these facilities in Nørresundby the kindergartens provided are small and outdated following the pre Fröbler plan of grabbing the first and best available space and establish these places as kindergartens, many of which do not provide outdoor areas or indoor activity spaces. When regarding the projects tectonic aspect, it is not going to be focused on creating the wildest parametric structure, but rather trying to implement historical and traditional joints and buildings methods in a contemporary context. While considering the functionality in a world and context, where architectural history has shifted from a tactile and simplistic focus, to a zero energy and passive house madness that disregards a large portion of the architectural integrity.
This analysis has lead to three main focus points that the design will be based upon.

- Details
Structural details that will morph into the development of the interior letting the structure and construction play a part in the furnishing of the spaces.

- Interior
The interior will be partially determined by the landscape letting the slopes and terrain shine through in the layout. There are some requirements regarding the daylight and acoustics ,that will be taken into consideration in the process as well.

- Materials
Material choices that will compliment the structure and the sensory experience of the children and other users.

Vision

Figure 4.3 - 4.4 Sketch of forrest and an abstract illustration.

The vision with this project is to create a place for children to unfold and develop their imagination and creativity. By combining the architectural aesthetics, the landscape and theories researched to form a place of imagination.
A place of imagination that inspires and allows differences in culture, language and creativity, which all combined will enhance learning through play; play with each other, individual play and organized structured play.

Programme

The average Danish kindergarten has around 40 children with 6 to 7 staff members; this means 5 - 6 children per staff member. The kindergarten I am designing will have a capacity of 90 - 100 children with 18 staff members and the program will be in accordance to the Danish building regulation for day institutions, which not only concerns square meter requirements but also acoustic requirements and ventilation requirements. The furniture in the dayroom and lavatories has to be ergonomically designed to the children's need e.g. dimensioned to fit the proportions of a child. The program is also inspired by the case studies made in the beginning of this chapter, in order to achieve the vision and also test the theories and ideas discussed throughout the analysis. The total amount of square meters will be around 1.100 m^2.

Dayroom	The Dayrooms require 3 square meter per child. The reverbaration time should not exceed 0.4 seconds. The floors should be well insulated and suitable for play and activities.
Staffroom	1.5 m2 per person should contain an area for resting. This area can also be combined with a nurses office this is not a requirement but could be an added quality
Kitchen	The kitchen area needs to be at least 12 square meters plus additional storage.
Eating area	1 m2 per person this area is required to have a view towards the outside
Lavatory	The Lavatories should match the seize and proportions of the children.
Wardrobe	Adequate space for the childrens shoes and coats.
Technic room / Storage	Dimensioned to accommodate the technical equipment
Indoor activity	Indoor activity is also not a requirement however at does increase the quality level and is a pleasant addition to the Dayroom and common areas
Playground	This area is also not a requirement but will also add quality and life to the entire area

Concept

Figure 4.5 Conceptual sketch of the space surrounding the nature and creating a flow around it.

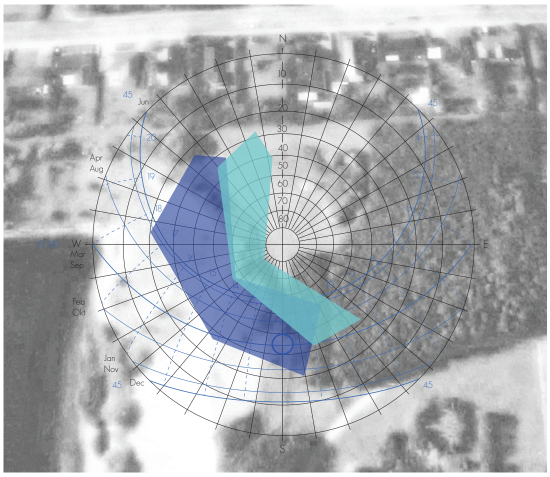


Figure 4.6 Diagram of the sunpath with a conceptual sketch of placement of the kindergarten

From observing the sites qualities, it has become clear that the most important aspect is the landscape and the nature. It is a peculiar site due to its position and shape. It is not often to find a site close to the city center with an abundance of nature. Due to these observations, it is desirable to place the indoor functions of the kindergarten towards the lake, this concerns especially the dayrooms, where the children will be spending a majority of their time. This area will be located towards the western part of the site, allowing sunlight throughout most of the day. The lake and the view will be part of the indoor layout, allowing the children a view towards the lake and landscape, giving them a connection to the place and its atmosphere. It is therefore, the landscape that will be a defining factor in the shaping of the interior spaces. The outdoor functions are then, to be in connection with the forest, the forest will be the main playground area where the children can let out their energy. The surrounding of the site and the analysis of the entire project, inspire the concept for the architecture of the kindergarten. As mentioned several times before the architecture and design is important for the children's learning process, not only for their motor skills but also for their minds to explore and evolve. Making the kindergarten a place of imagination, is therefore a priority. A place of imagination, which enables the user to interpret the space with their own imagination, instead of a formal settings that require no active ingenuity or creativity. The space and architecture will be inspired by the surrounding area, in an attempt to capture the calm of the water and the mysteries of the forest.

Figure 4.7 Picture of Gifu Academy of Forest Science and Culture

Figure 4.8 picture of a Danish timbered house

Japan has a very extensive carpentry tradition, due to earthquakes, monsoon and typhoons, which sweep across the land regularly, the wooden structures needs to be strong but flexible at the same time. The lock connection also known as "Mengoshi" is commonly used in traditional Japanese architecture.However, famous architects such as Shigeru Ban and Atsushi Kitagawara also use this technique in contemporary building design. This lock joint is different from the Danish tradition carpenter joints; it does not require wooden pegs or nails to gain it's full strength, but gains it through the sheer force of the interlocking pieces creates a very firm yet flexible structure. The Danish tradition of "bindingsværkshus" or timbered house is, as mentioned similar, both with interlocking wooden joints. These joints have been the inspiration of many contemporary architectural projects however, not many of them can be seen in Denmark, as it seems we have abandoned our old ways and replaced it with insulation and plaster. However, great care is taken into restoring our historical buildings to the last detail, ensuring that even the windows and other new materials introduced, are authentic. The Japanese take great effort in reinterpretation their traditional methods, they are however, not interested in maintaining authenticity in their maintenance choices. In order to actually construct these wooden architectural pieces, an expert engineer is needed. The engineer responsible for many of the calculations is Prof. Dr. Masahiro Inayama Timber Structural Engineer at Tokyo University Japan, Tokyo; he describes wooden architecture as a constant at a time of cultural change. On the pictures above is an example of a traditional Danish timbered house and a reinterpretation of the traditional Japanese Mengoshi system. The Japanese example is the "Gifu Academy of Forest Science and Culture", it is used for development of wooden structures and as an educational center, for passing on the methods of carpentry and woodwork. (I, Masahiro; Wooden architecture as a constant at a time of cultural change 2005)

Through this research it has become clear that the main structural material will be wood, as it is challenging, yet has a very distinct tactile and sensual experience, with a certain cultural memory and familiarity, yet can be interpreted in a near endless amount of ways. These ways have become apparent through this research and will be explores in this project.

The joint

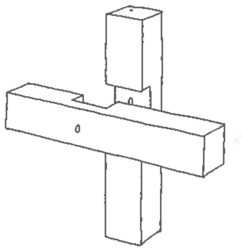


Figure 4.9
Here are some examples of timber joints traditionally used in Denmark. The joints all have in common the way they've been treated, by carving the wood with so much precision that the interlocking will stabilize through the shear force of the joint and the weight of the structure.
On the left is an example of an etched joint, most commonly used in the wall structure both the interior and exterior facade. As it is a fixed joint leaving the entire structure very rigid.

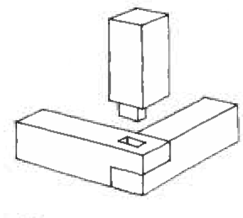


Figure 5.0
In corners of the construction a typical joint is the blade assembly, held together by corner column with a spigot joint. The spigot joint can however, not be made with the full dimension of the timber member. It is still a very strong joint and probably one of the most commonly used methods of assembly in timbered houses.

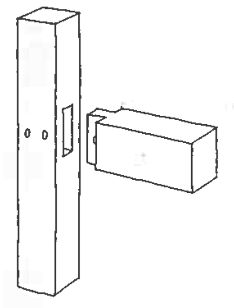


Figure 5.1
A straight spigot joint is another commonly used assembly, mostly used on freestanding columns and corner columns. The tap is always kept short and usually pinned with a wooden or metal nail, in order to keep it in place.

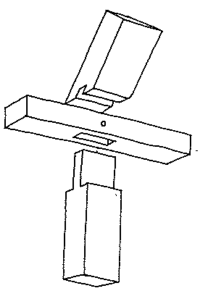


Figure 5.2
This is an example of the roof joint between the rafter shoe along the roof strap and the beam. It is another variation of the spigot joint. This joint is either left as is, with no other means than the interlocking force, or by a nail similar to the straight spigot joint.

DEVELOPMENT

Figure 5.3 Picture of chalk lake

Figure 5.4 Picture of view to the site from the plateau

In order to start the design process, after having made all the emotive and empiric analysis of the site, it was important to start sketching the ideas down that were inspired after the extensive analysis.
These sketches are important, in order to organize the thoughts that have been gathering whilst making the analysis. The most important source of inspiration however, is going to be the landscape, which has been shaped by the machinery used for extracting the chalk in the soil. This process has left a giant whole in the terrain, that consists of many different plateaus and landings with almost geometrical shapes. These shapes are taken and used as part of the shape development for the plan, testing different geometries for their compatibility with the functions. Through a quick preliminary study, it became clear that the geometries best suited for this project, was between the pentagon and the rectangle/square. These shapes, while still having crooked and odd angles, still allow a certain structure that will help organize the plan.

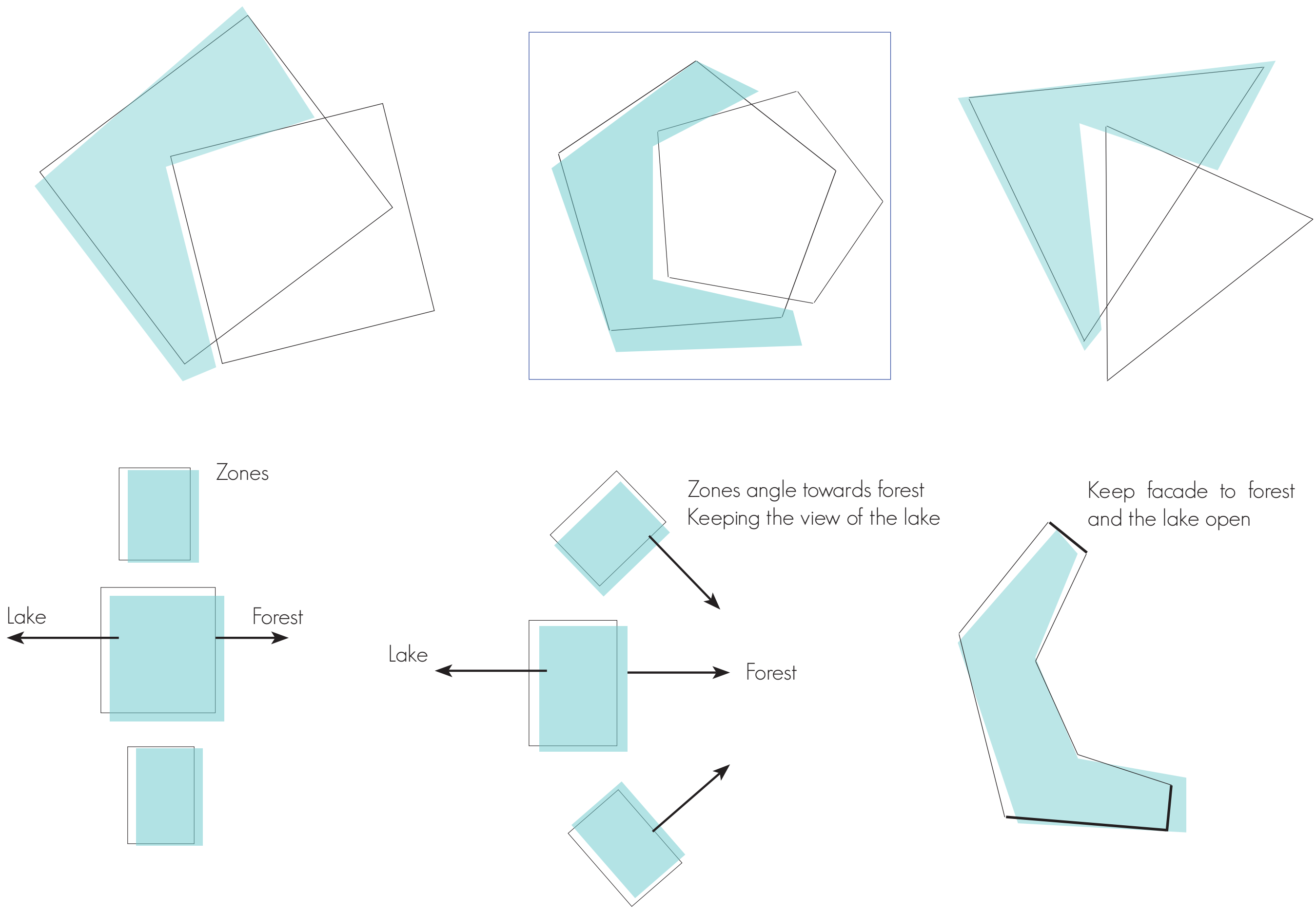


Figure 5.5 Diagram of plan development.

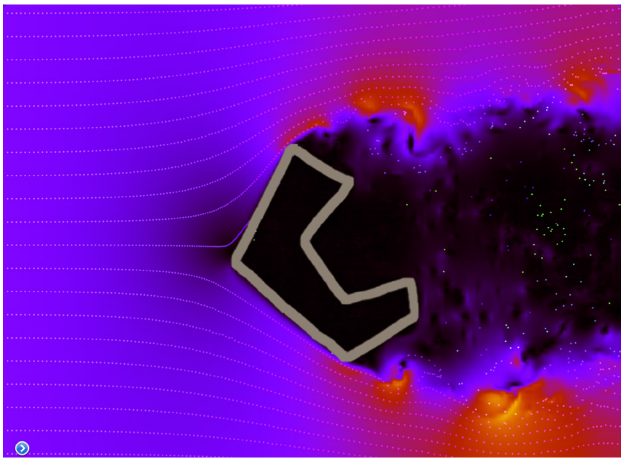


Figure 5.6 Diagram of wind study for the orthogonal plan

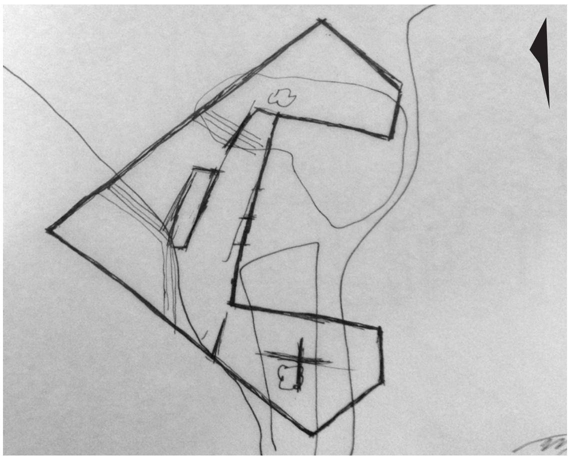


Figure 5.7 Sketch of orthogonal plan

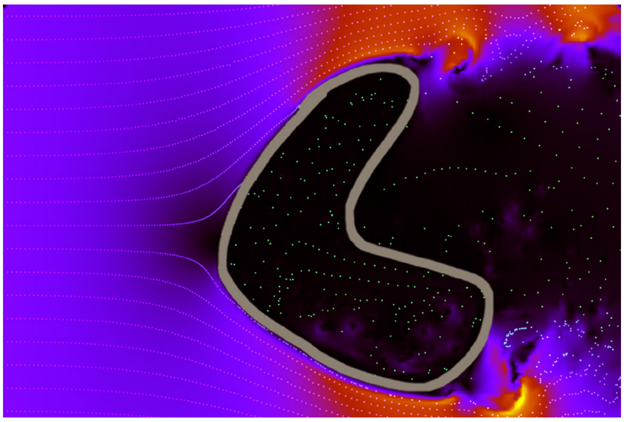


Figure 5.8 Diagram of wind study for the organic plan

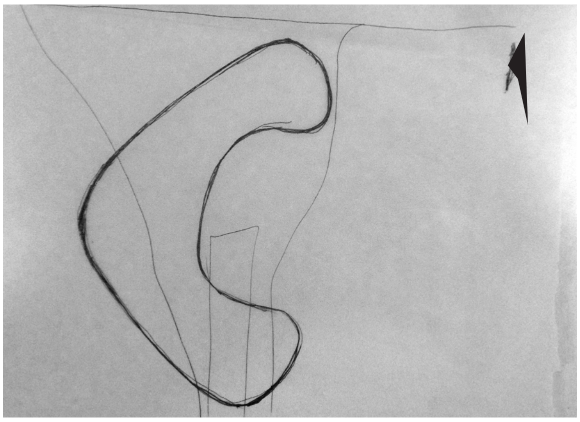


Figure 5.9 Sketch of organic plan

To start organizing the functions of the kindergarten, a play with shapes and placement started the process. The kindergarten is going to have different zones and a natural way of achieving this, is to offset and rotate a square. Although the square often seems like the most functional shape, in this regard it was proving difficult to place the rigid shape in the context.

To try and counter the odd angles that were created in the previous trials some of the edges were shaved of, leaving an almost organic shape. The organic shape however, does not compliment the angular shape of the structure. There were many more shapes being tested this way. Whenever a new shape was under consideration, it would be developed and tested in the same way as the previous. This iteration is used throughout the process as a method of evaluation. Above are examples of wind studies made, in order to see how much the building would shelter, what is later going to be the playground area. As the building is placed on top a hill with a lake towards the west, the prevailing winds will be quite strong, it is therefore necessary for the building to shelter the area, in order to create a pleasant environment for the children.

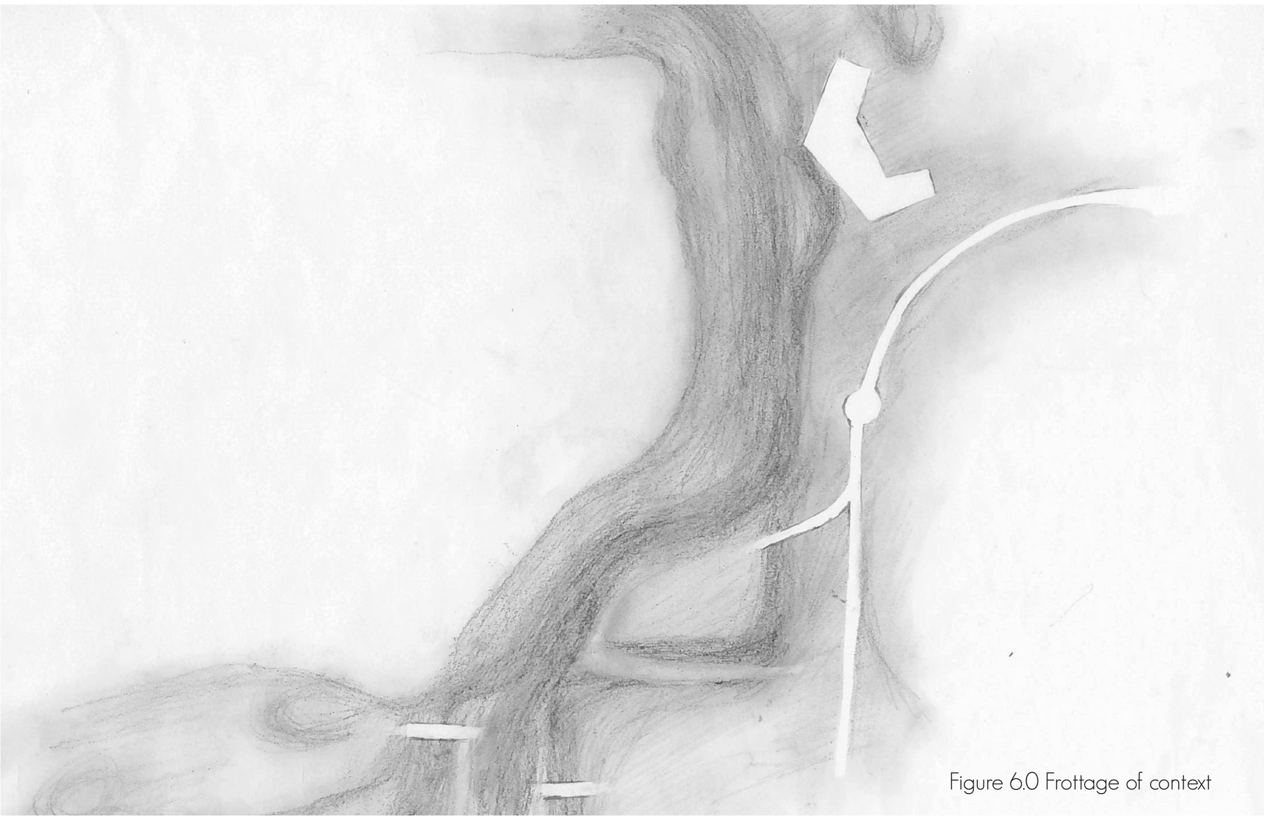


Figure 6.0 Frottage of context

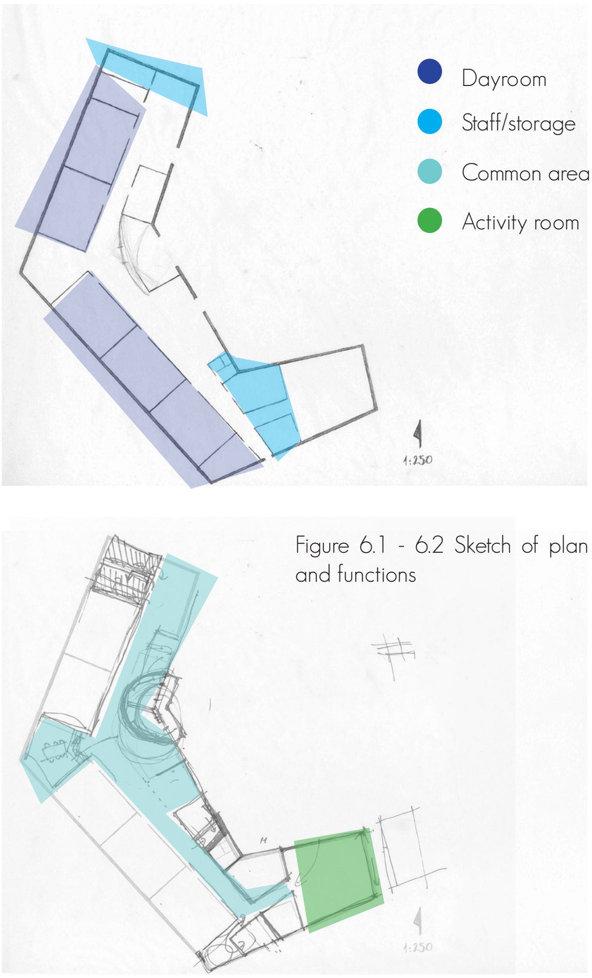


Figure 6.1 - 6.2 Sketch of plan and functions

As mentioned, the inspiration for the plan is inspired by the landscape and the plateau, created by the sites history of being a chalk refinery. In order to better understand and visualize these steps in the terrain, a technique called frottage was used on top of the contour lines. Creating a contrast between the slopes and the landings and how this relationship can be translated into a plan, with a similar narrative and qualities of creating spaces.

The plan has been through several iterations. Working in layers of tracing paper, the composition of the elements from the programme, were tested and rearanged, in order to find a logic and order, in which to place the various functions. As mentioned in the analysis, the dayrooms are kept with a view towards the lake. This is an orientation in a south- and northwest direction, allowing sun throughout most of the day, giving these areas a bright interior with an abundance of daylight. The area surrounding the dayrooms are kept open, except the storage, the area for the staff and the indoor activity room. All other areas are kept open for the children to use freely at their own leisure and convenience. The entire building serves as a blank canvas, ready for the children to project their own thoughts and imagination on to. That is also why the spaces are kept "empty" ready to be filled.

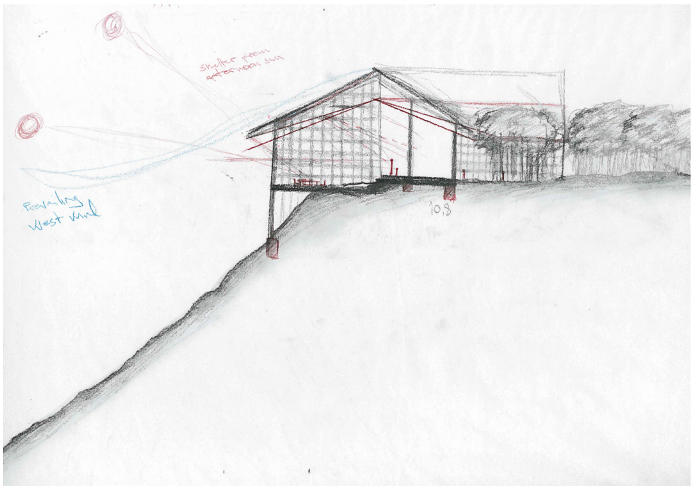


Figure 6.3
Section of the site and concept sketching of the kindergarten. Using the section to sketch different ideas for the design of the building looking at both the environmental factors and interior factors, such as acoustics and levels. This section is of kindergarten cantilevering over the slope towards the lake, with a pitched roof similar to that of a single-family house.

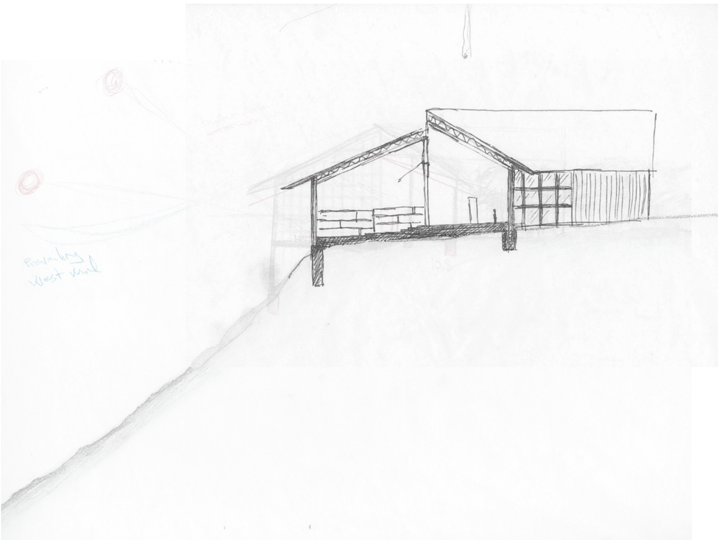


Figure 6.4
The sections were developed according not only to environmental factors, such as wind and sun, but also to the landscape, in order to best place the entire kindergarten. This section is similar to the one above, except the roof is slightly offset, in order to create a natural formed skylight that would go all the across the ridge of the roof. This would also serve as natural ventilation.

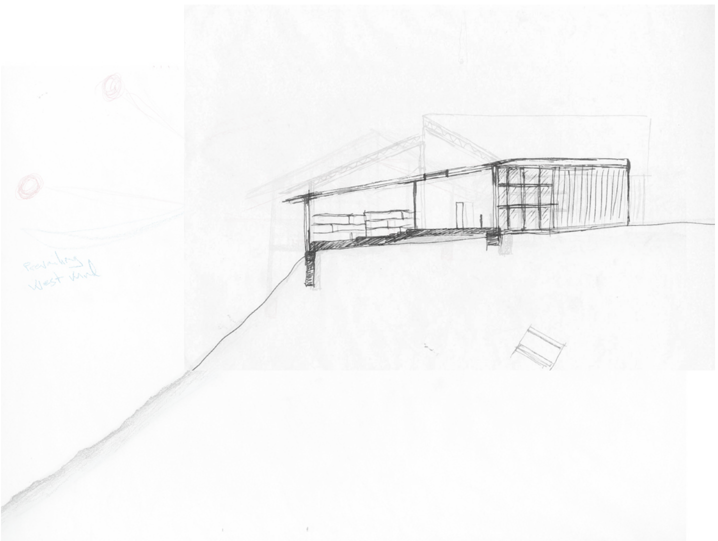


Figure 6.5
While the previous sections all have a pitched roof, this sections explores the flat roof. This type will also provide shading and skylights, which will benefit the indoor climate. This typology however, does have the same single-family house similarity, as most of the houses in the area have a pitched roof.

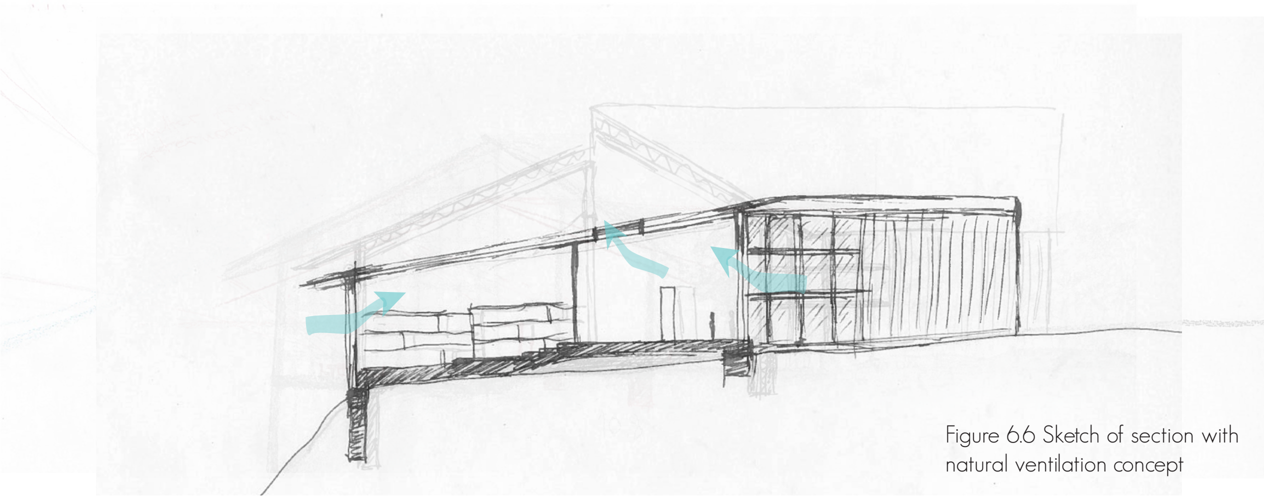


Figure 6.6 Sketch of section with natural ventilation concept

In the end it stood between two sections, the offset pitched roof and the flatroof. Both have qualities for and against them however, the section with the offset pitched roof is too close to the single family house typology, of which there already exists an abundance of in Nørresundby. It was therefore, more desirable to let the roof slope slightly with the landscape towards the lake. This flat shaped roof will also help against the harsh winds, leaving the dominating load snow instead. In order to ensure a good indoor environment it is important to consider the ventilation. The Danish building regulation state that day institutions must be ventilated via mechanical ventilation however, during the summer it is particularly important to supply the building with natural ventilation as well. Through the extensive glass facade and to a great extent the southwest facing facade, there will be plenty of passive solar heat gain and without the help of shading and ventilation the rooms will overheat and be unbearable to remain in.

Above is the sketch of a section through the kindergarten the blue arrows represent the simplified airflow. In the classrooms it will mainly be a one sided ventilation system when the door towards the hall is closed. However, when the door is open to the hall it is possible to get a double sided ventilation.

The ventilation in the hall and common area will be supported with the skylight fixed in the roof, allowing the hot air that will gather in the ceiling an outlet, thus utilizing the thermal buoyancy to create a cross breeze.

Figure 6.8 Model of kindergarten eating area

Figure 6.7 Peter Zumthor's house Leis

Figure 6.9 Model of kindergarten Dayroom doors

Materials

Important for this project was the choice of materials, as the main structural material is glue laminated timber. It is very durable contemporary material, commonly used in most modern timber buildings built in Denmark and Japan. In the past buildings were made from solid timber members, this meant that there was a great variation in strength between the members, as wood is not a homogenous material, such as steel. Its strength varies and decreases through time, it is necause of this weaakness, that glue laminated timber was developed, in order to created a more homogenous strength distribution. This was achieved by cross layering several pieces of wood and gluing them together under compression. This technique is most commonly used for beams and columns, but recently a similar technique called cross-laminated timber has been used for wall panels. This technique is usually used for smaller scales, such as furniture and will be giving the walls a refined and solid appearance. While traditional wooden inner walls are made out of a timber frame and cladded with wooden boards, in order to give it a solid timber appearance. The inner walls in this project will be part of the structure, by providing stability and stiffness by taking the horizontal forces from the wind. This concept was inspired by Peter Zumthor's house Leis. Zumthor is well known for working with an emotive and phenomenological aspect of his design. Especially employing materials that provide a special atmosphere and ambiance to his projects. In this case, the use of wood gave the project a warm and cozy feeling. In Zumthor's project the main material is however, not glue laminated timber but solid timber members as is traditionally used for a timbered house.
This project will be reinterpreting a contemporary material in traditional and non-contemporary way, by using timber joints instead of metal hardware and fittings.
By keeping the structure i.e. the walls, the facade and the roof beams in same material, will give the building a very particular expression. Wood being generally viewed as a warm and comforting material, through its color and cultural status, this will also give the kindergarten a warm and inviting appearance, providing the children and users with shelter and safety.

The materials for the outer cladding and structure should have a similar texture and feel to it, while also taking the contextual and regional materials into considerations. As mentioned ,the main structural material the glue laminated timber, which is normally industrially produced out of white wood timbers.However, there are local producers looking for a more regional mixture of timbers. In Denmark oak, lark and pines are locally found and have been used throughout the centuries for timber structures. These timbers are now also being put into the production of glue laminated timber, in order to give it a unique characteristic, associated with the local produce.
The main type of wood this project will consist of is Oak. Oak is a very durable and versatile material and can be shape into almost any component i.e. window frames, doors, flooring and glue laminated timber. Another reason for choosing Oak, besides its versatile qualities, is its aging process and durability against wind and weather. Oak and also Lark wood age into a silvery black surface, it usually patinas relatively equal and lasts up to a 100 years if not more. The glulam timber also has a very efficient fire performance, with a charring rate of 0.7mm/sec, untreated the only problem will be the charring, the section itself remains intact a simple oversizing of the member however will be able to accommodate this. Not only the structure and cladding will have an Oak based material but also the window frames to give it a unified appearance.
The grey silvery color of the facade, will be mimicked on the roof with zinc roofing, which naturally has a grey silvery finish and as it age's turns to a darker grey matching the facade.

Figure 7.0 Oak panel exterior

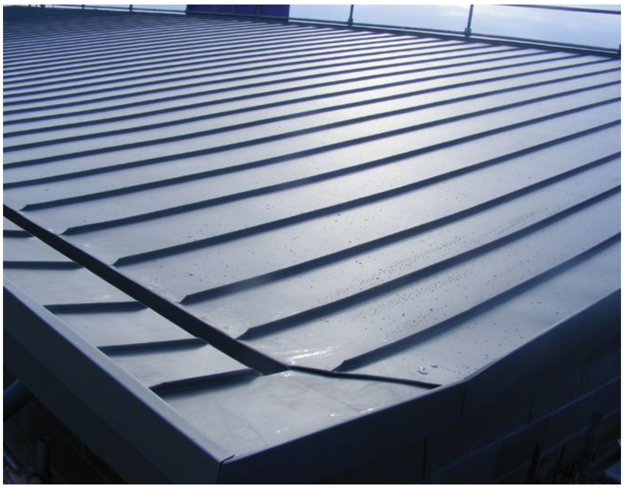


Figure 7.1 Zink roof

Figure 7.2 Natural wood window frames

The playground

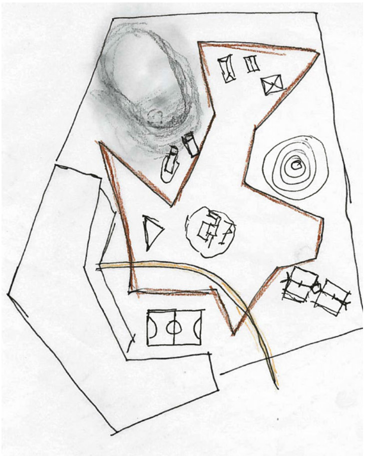


Figure 7.3 Playground sketch angularpath

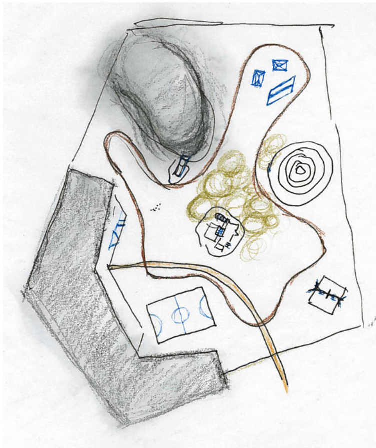


Figure 7.4 Playground sketch organicpath

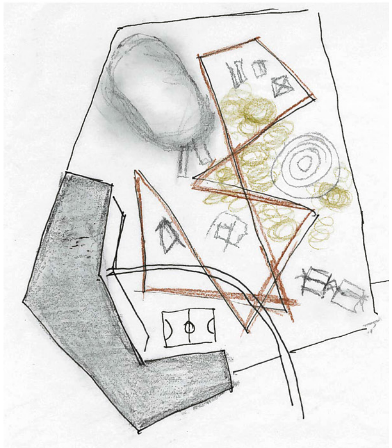


Figure 7.5 Playground sketch angular path

The idea behind the playground schemes is to create different zones, with a central pathway and have the play equipment, such as swing and slides spread throughout the area keeping as much of the forest intact, in order to let the children go explore and emerge themselves in the site. Different path ideas where explored, the first to ideas was to take inspiration in the shape of the building itself. However, this shape was not working with the flow of the terrain. It was therefore more prudent to look at a more organic shape, which would follow the contours of the site. As for the equipment, after contemplating the idea of having them spread throughout the site another idea came to leave the forest equipment free and place small huts and covered areas to explore and leave the equipment near the main building. This idea was quickly discarden, as it would create too much activity in too small an area. The water surrounding the lake, was the main inspiration for the shape of the path. The circles are shaped like water circles, and dictates the organic shape of the playground path.

Figure 7.6 Plan sketch of the playground

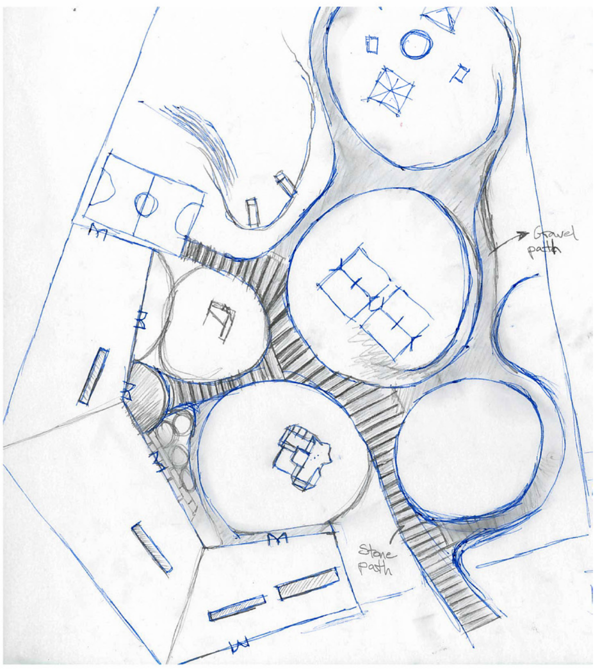
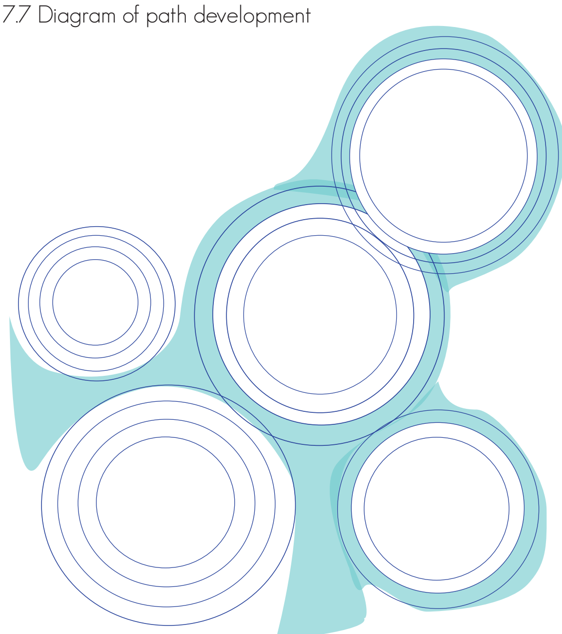


Figure 7.7 Diagram of path development



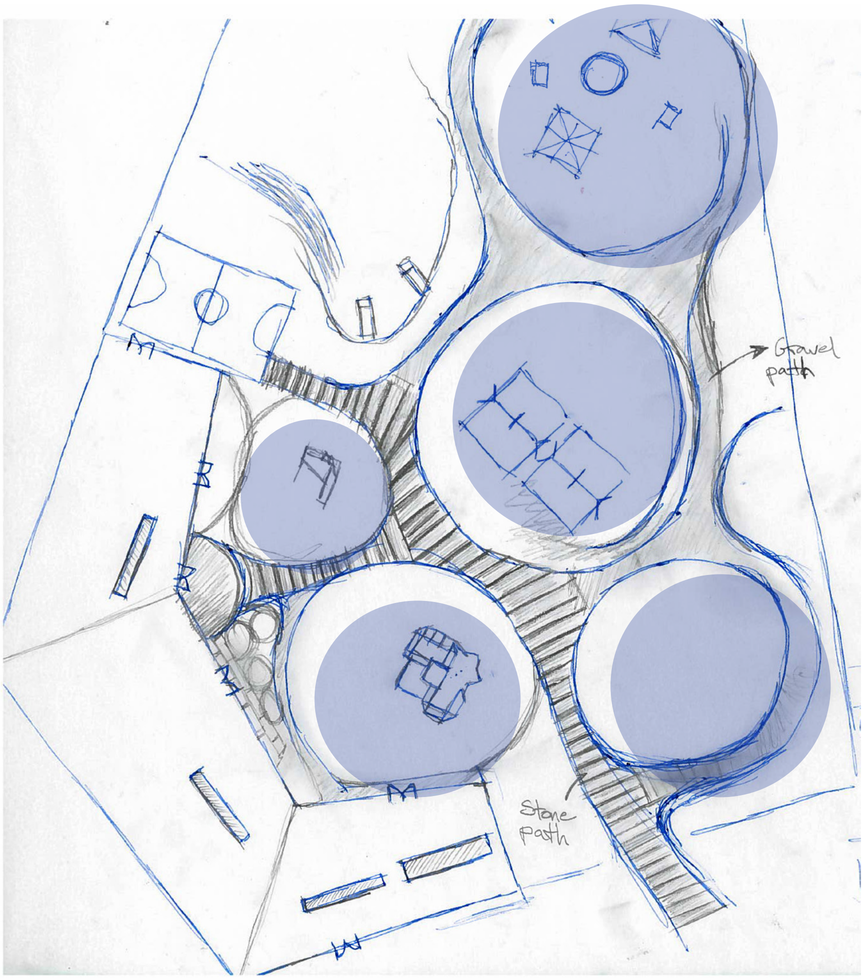


Figure 7.8 Diagram of zones on the playground

The path created from the circles splits the playground into zones, as mentioned earlier, these zones will be fitted with equipment designed for children to strengthen their motor skills. This equipment will bear the appearance of the natural surroundings letting it merge with the forest. The forest will be kept unkempt, except for the areas cleared to allow space for the play equipment. The rest of the area is kept wild and unruly on purpose, in order to create the feeling of freedom and adventure, as they would experience in the farthest corner of a backyard or on a trip with their parents. Although the forest is kept wild, the entire playground will have a fence to ensure that no children get lost, or get the idea of trying to roll down the slope. The playground equipment is also going to be themed according to their area, the area in the top right corner is going to be a small hidden village with small wooden huts, for the children to find shelter on a rainy day. On the hill next to the sports field, is going to have steps for seating and slides following the contours of the hill. There is also going to be an area with swings, water play and a jungle gym designed to enhance and train the balance and muscle development of the users. The areas in front of the kitchens will be kept as small vegetable, fruit and crop gardens, even though this type of garden isn't always appreciated, it is a useful way to teach children the responsibility of looking after their own little area of vegetables. This type of area will also give the children a success moment, when they can use the fruit of their own labor in for example a cooking session with their educator.

Figure 7.9 Picture of natural playground

The two pictures seen on this page inspire the path through the playground. They're both simple paths cutting through the area, leading both towards one object and several different objects at the same time. It is necessary that the path, at least the main section going towards the kindergarten, is made of a firm material, such as a pavement, in order for fire trucks to be able to access the building in case of a fire. Since this kindergarten is going to be made almost entirely out of wood ,this is a very important detail. The path will not just function as a guide but also become part of the narrative of the area, as it will be what envelopes the different zones, thus becoming a key factor in its design use.

Figure 8.0 Image of path throuhg Xixi artist clubhouse

Figure 8.1 Inspiration picture of path through garden

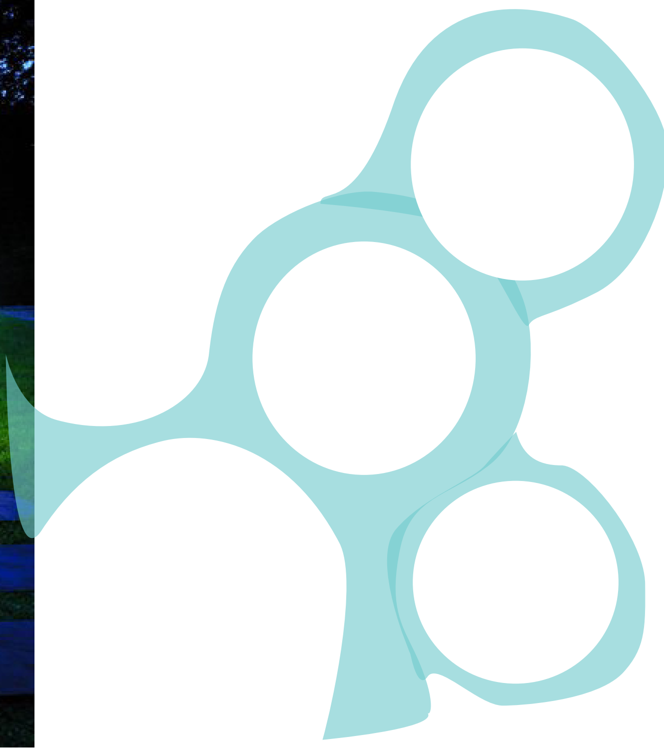


Figure 8.2 Diagram of path

The grid

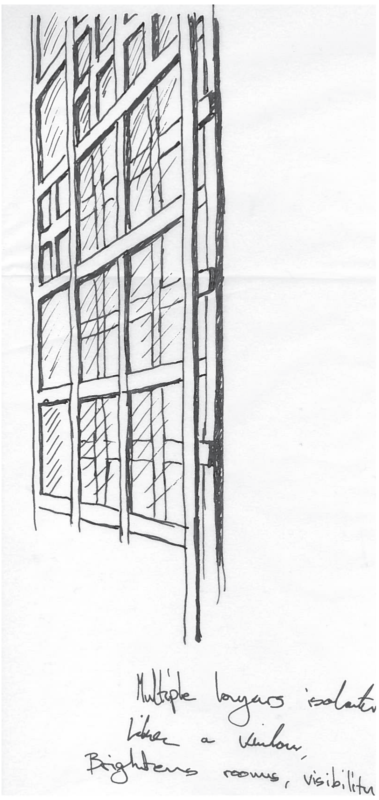


Figure 8.3 Sketch of exterior wall

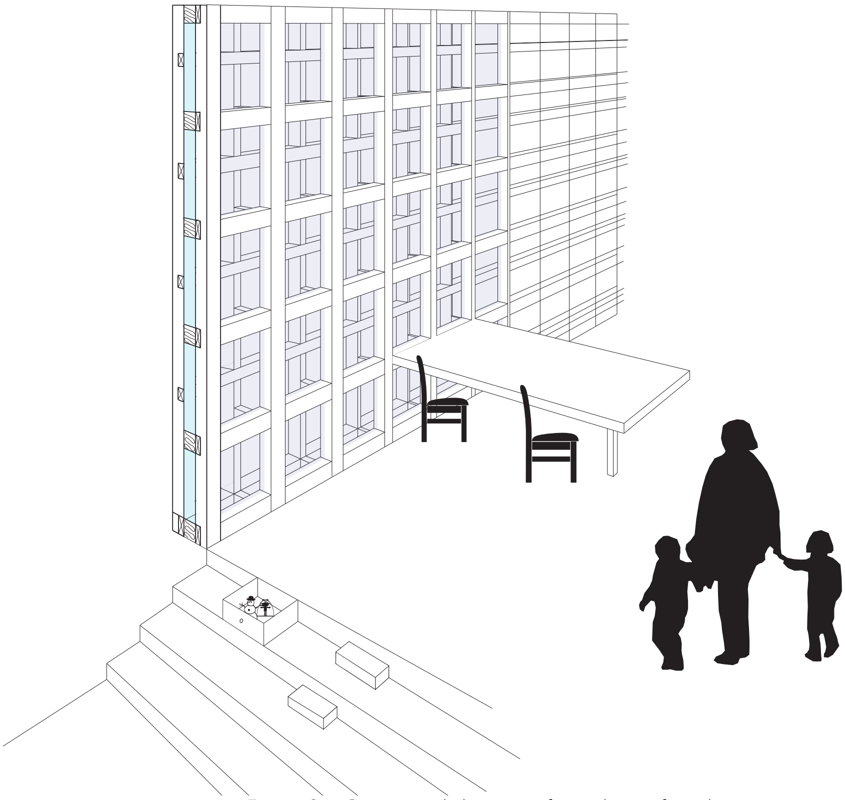


Figure 8.4 Conceptual diagram of translucent facade

The sketch to the left is a representation of the structure, which is light and transparent and allows the viewer to see the stunning landscape of the surrounding lake. Due to the harsh climate of Denmark it is necessary to insulate the buildings properly. On the sketch above, part of the wall has been cut to see the layers. The outer shell consists of a wooden frame with thermal glass, the inner layer consists of the same wood glass composition, in between the frames is a layer of insulation, that will prevent thermal bridges between the frames and the gap will be kept as an air gap.

The stairs and furniture in the room will be shaped by the landscape and the structure. The stairs are thought to be multifunctional storage and lounging area, with a view out towards the lake. On the illustrations above are shown a grid that is offset, in order to minimize the area of contact between. The timber members as it was thought that it would be the area with the most heat loss however, through further studies it became clear that it had a very efficient U-value and it was more appropriate to keep the members aligned.

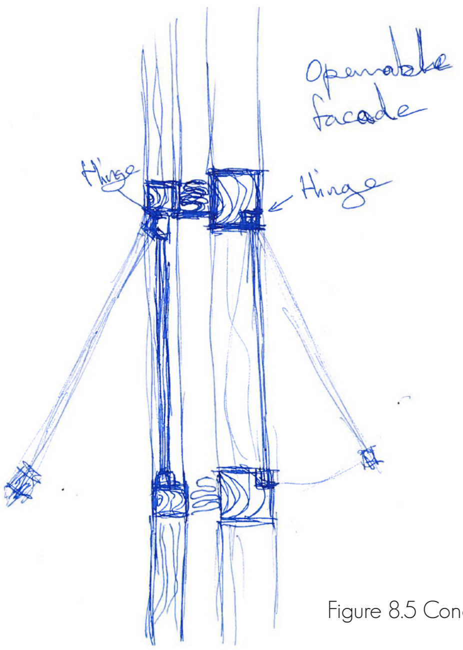


Figure 8.5 Concept sketch of the window and the opening

Having decided to use the grid as the main structural element that will hold the roof beams in and the corresponding loads, it is important that the grid is both structurally sound and is also a proficient climate shield, protecting its users from the harsh Nordic climate.
In this model study the focus was on the joint, in the previous chapter a few different joining methods are described. This study was made, in order to obtain a better knowledge on how the joints work and are made. The material used for this study is Balsa wood, as it is relatively easy to cut. The joints tested here are the etched joint and variation of the spigot joint without the wooden nails.
When making the outline for the cut, it is important to be precise in order to make them fit snugly together. When making these joints without wooden pegs or nails the etching will have to be cut at an angle to allow a tight fit, yet still leaving room the wood to expand.
It is possible through modern CNC machines to cut with a precision down to half a millimeter and it would be possible to make these joints without having to add extra helpers, as was usually done in the old timbered houses whenever a joints was cut to wide wooden pieces would be used to tighten the joint.
This study has giving an insight into the production and precision needed, it has also provided an insight into how strong these connections are, through the shear force of one material.

Figure 8.6 Model of etched joint

Figure 8.7 Model of spigot joint

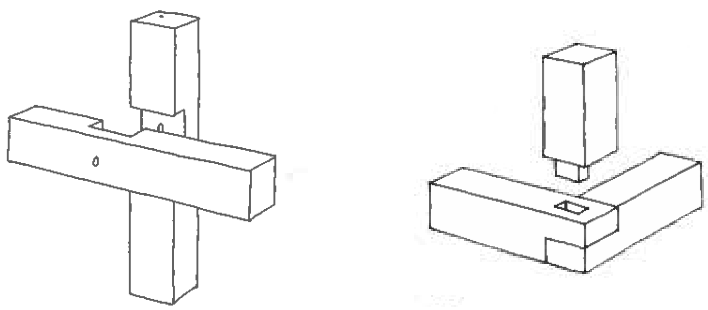


Figure 8.8 - 8.9 Digram of joints

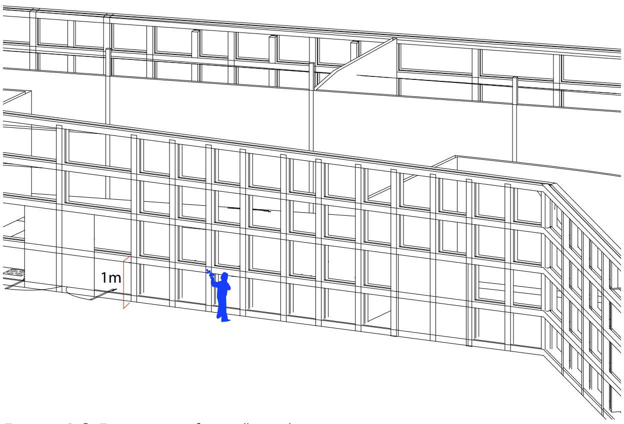


Figure 9.0 Diagram of small grid

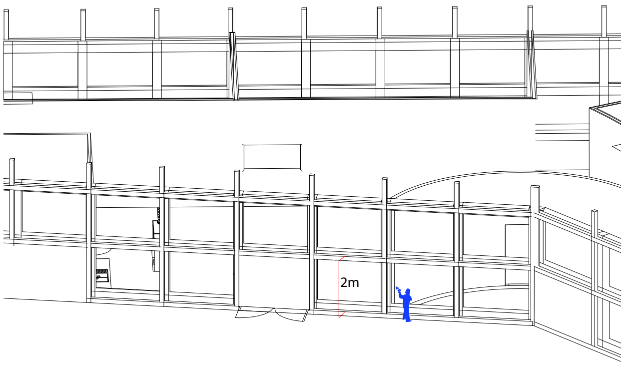


Figure 9.1 Diagram of big grid

Testing the grid. The first grid that was tested had the dimension of 15 x 15 cm with a spacing of 1m x 1m. This grid was a very tight fit, reminiscent of the grid seen in the example from Japan. Leaving the facade very busy. Not only does this facade give a busy expression but it also obstructed the view, rather than framing and enhancing it. The scale of the grid fits with that of a child leaving him or her at eye level with a beam, rather than in the eyelevel of the view, which is part of the whole concept behind having a transparent facade.
The second grid had a spacing of 2.5m x 2m at first the same dimension for the timber members were kept (15m x 15m) this however, turned out to be structurally unstable (for structural analysis see appendix). The dimensions were therefore changed to 30 cm x 30 cm on the inner layer, which is the main bearing construction and kept 15 cm x 15 cm on the outer layer to ensure space for the window frame of the low energy 3 layer windows. This grid allowed the user to look, freely and without obstruction, out towards the beautiful landscape. The increased dimension also meant that the U-value of the structure decreased, enabling it to be a more efficient climate barrier, although the structures strength isn't fully utilized it is kept like this due to its energy efficiency.
It is only the western and eastern facade that is kept open and transparent, the northern and southern facades are kept closed and solid, as a contrast to transparency. The southern facade is kept closed due to the proximity of the road and parking area, the closed surface allows privacy from prying eyes using the path. At was also necessary to keep this facade closed to avoid excessive overheating. The northern facade is kept closed because of the proximity to the sports field and this area also contains a large part of the storage area.

Figure 9.2 Diagram of small beams

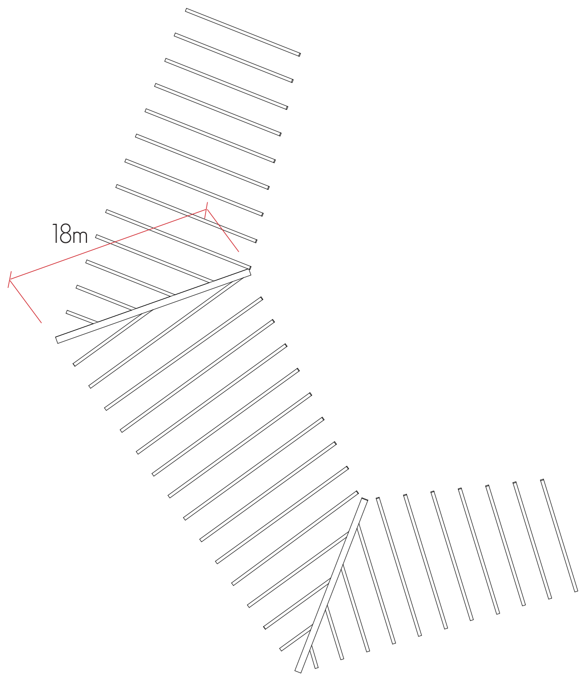


Figure 9.3 Diagram of large beams

As the grid was developed, so was the roof structure, as it is meant to be a flat roof the idea was to let the roof beams follow the columns of the grid, thus keeping the dimensions similar to give the effect of continuity.

The largest span of the beams is 18 meters, it was therefore not possible to have a beam dimensioned the same as either of the grids. In order to support the loads the beams needed to be taller in order to be stronger. A simple hand calculation of the beams was made, in order to determine, which dimension was needed. For the first dimension 15 cm x 15 cm with one meter central distance supports were needed every 5 m in order for them to be structurally sound.

This however doesn't fit with idea of an open area, thus options to avoid supports were explored. A beam the with the dimensions of 50 cm x 90 cm is needed for the largest span of 18 meters the rest of the beams are kept 30 cm x 90 cm to follow the dimensions of the second grid.

Because of the size of the beams, the roof will be very thick also because the channels for the mechanical ventilation and sprinklers for fire protection will be incorporated in the roof. In order to try and minimize the size slightly 30 cm of the beams will be kept exposed and the acoustic ceiling will be fitted in between them.

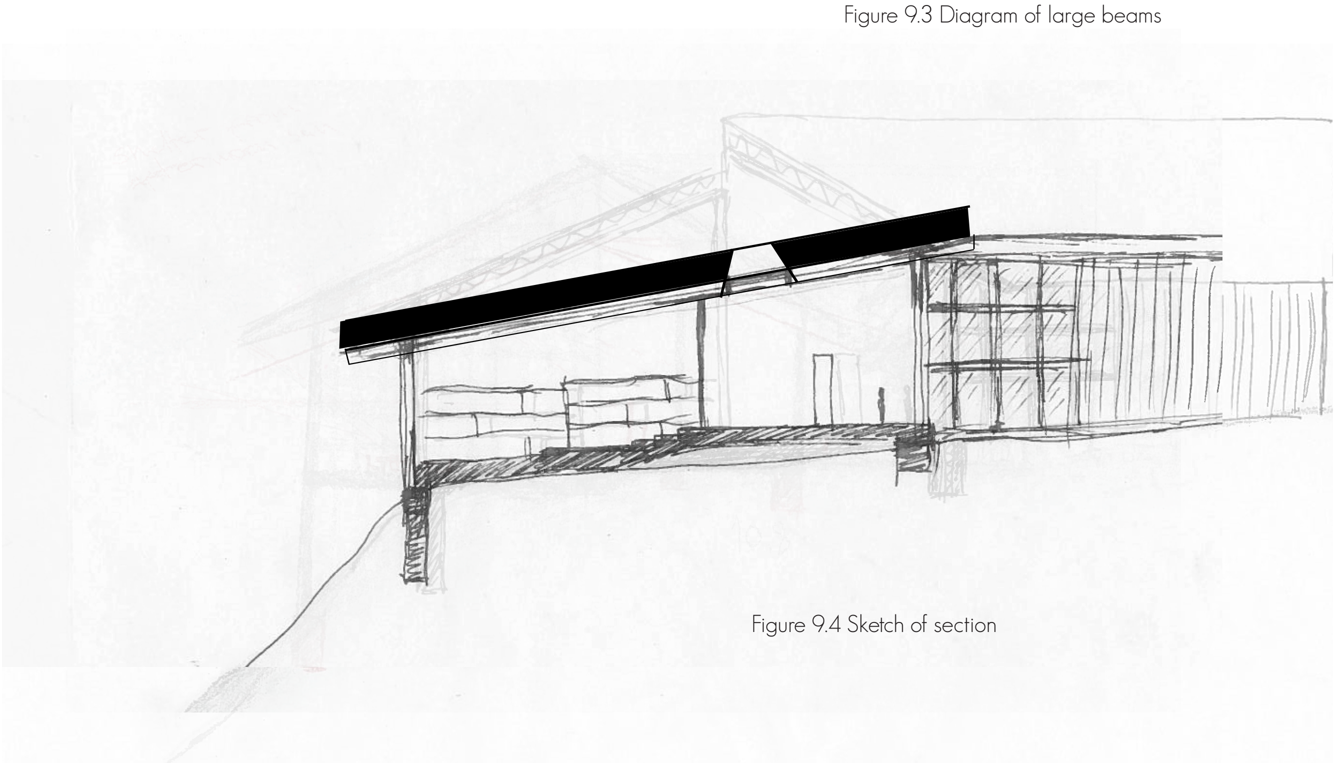


Figure 9.4 Sketch of section

Shading

The issue of shading was mentioned in the previous chapter on the section and the grid, due to the fact that the transparent facade are facing mainly towards the east and west and a large portion of this towards the south-east and south-west, it is inevitable that passive solar heat gain will occur. Passiv solar heat gain, is good for the cold winter months, less so for the spring and summer. As the new building regulations in Denmark require the buildings to be almost airtight and minimize the size and amount of thermal bridges, it is difficult for the heat to escape the enclosed environment. In order to minimize the effect of passive solar heat gain, shading is needed to block out the sunrays and the infrared radiation.

Many low energy windows have an infrared block coating however, this is not enough to prevent overheating during the summer. The roof of the kindergarten will have an overhang of 60 cm this help provide shade during the summer. The shading from the roof is not enough and more local shading needs to be provided for the individual dayrooms and other facilities. Different options were explored one of them was the option of exterior sliding panels, in order to keep the heat out. These panels, although efficient sun blockers, are difficult to adjust individually and would also destroy the continuous appearance of the facade.

Another option was to have the blinds in between the two window sections, this is not the most efficient shading option but will allow more freedom. As they're fitted to each window section the users can therefore decide themselves how much shading will be provided. They would also keep the facade undisturbed and intact. It was thus more suitable to go with blind option rather than the panels.

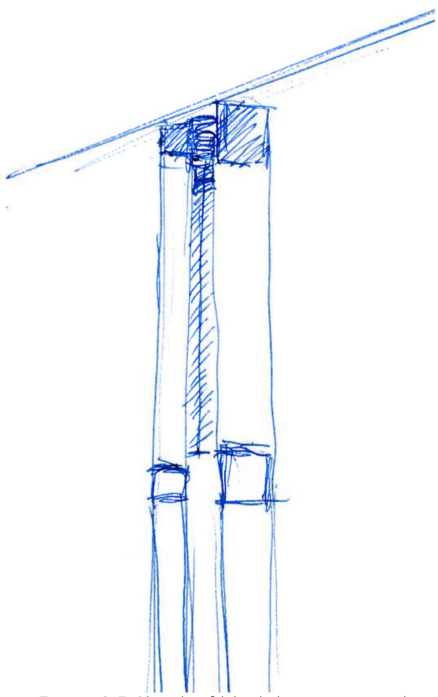


Figure 9.5 Sketch of blinds between windows

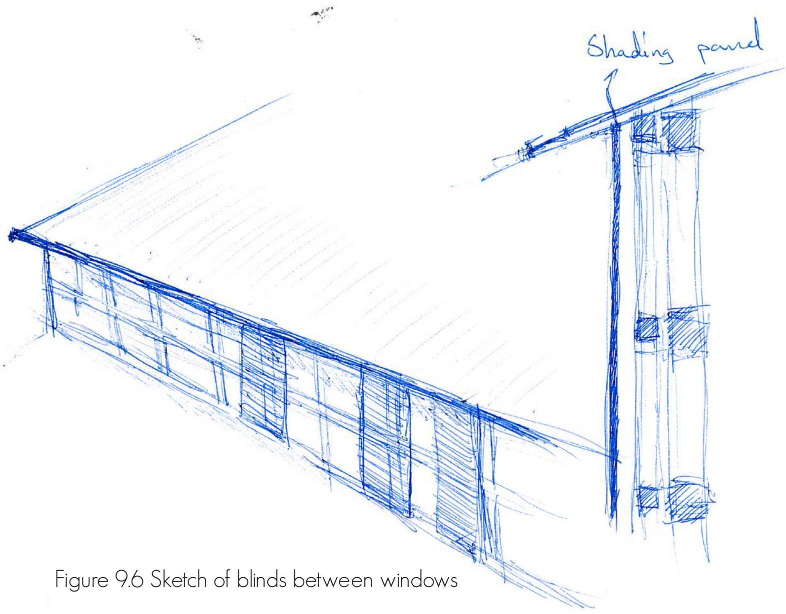
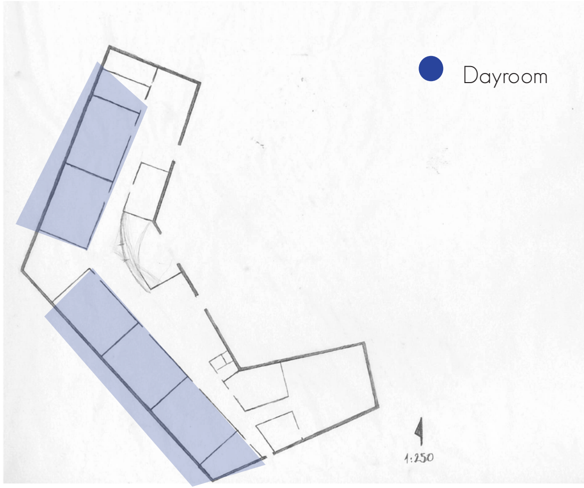


Figure 9.6 Sketch of blinds between windows



The dayroom

The dayroom is a very important room in the kindergarten, as this is the space that the children will spend the majority of their time. Not only is this space their second home but it also serves as an indoor play area and learning area. The need for storage of toys and books, is therefore great, in order to prevent chaos. The idea for the storage is multifunctional shelves, that will serve as storage and play area, this will be achieved by making them into a staircase. This staircase can be connected to a landing around 1.2m from the ground, this will create a space underneath it in the scale of a child that they can use a small alcove and a more protected area. The shelf elements are supposed to be moveable and adjustable, giving the children the opportunity to create their own areas suited for their own kind of play and the ability to project their own thoughts and needs into the space.
The furniture is kept sparse, leaving the space almost furniture less while the stairs in the floor serve as seating area for the children as they're 15 cm high like a normal step, which is the most comfortable height for a child to sit on.

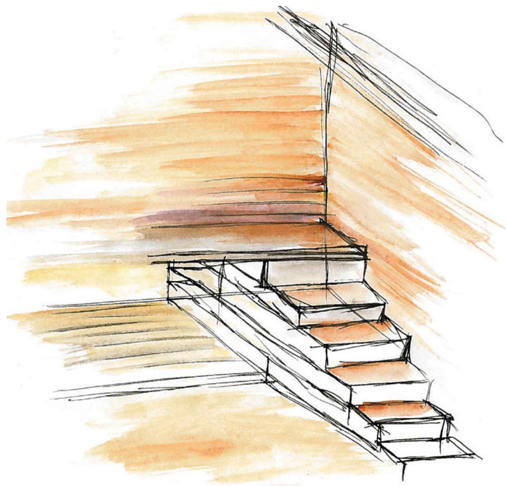
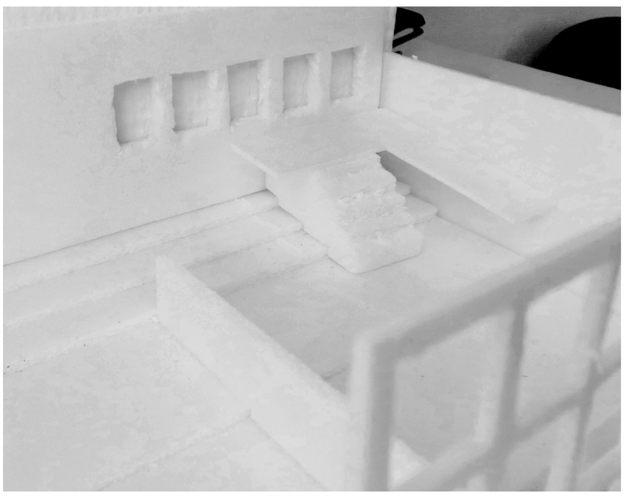


Figure 9.7 Model of dayroom

Figure 9.8 Aquarel of dayroom



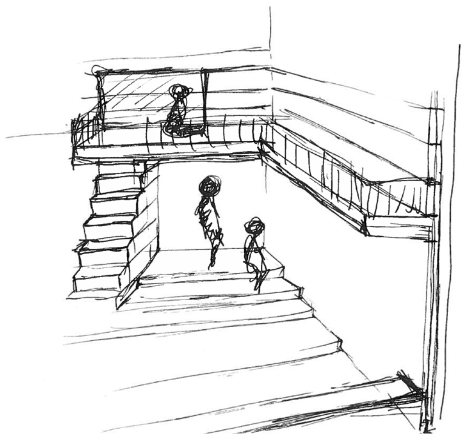


Figure 9.9 Sketch landing and self element in dayroom

Here are examples of the variation made by the furniture and the small landing element. As mentioned earlier, this element is around the scale of child allowing play both on top and below the space. The shelves also serve, as both a mean to divide the space according to the needs of the children and an area for the educators, to shape the space according to more academic needs.
By being able to adjust and push the shelf elements, the children will be able to create spaces at their own whims and leisure, allowing different kind of play in their own created environment. Not only do the shelves function as a division it also serves as a storage for toys, books and other nick knacks, that might be useful to both the children and the employees.
The shelves are stopped by the stairs, the landing and the wooden stabilizing elements of the sideboard in front of the windows, in order not to squish any children between the shelves, or any other accident of that nature. The sideboard in front of the windows serves as a table, to develop the children's finer motor skills, by letting them paste things onto paper, manipulate pencils, brushes and crayons well enough to color, draw and express themselves in an artistic way. These exercises will also help develop their skills to unbutton and unzip their clothes, tie their shoelaces and so forth, as these skills need toned and developed fine muscles. The stabilizing elements of the table, serve as boundaries for the self and support to the board. This composition allows the children to sit and enjoy the view in the front and rambunctious play in the back. The stairs, as mentioned, serve as furniture and natural division while keeping a relation to the context. The educator can teach the children standing in front of the stairs, while the children are sitting faced towards the speaker on the stairs.
In order for this system not to become too complicated and confusing, the dayrooms are kept as a simple rectangle, ready to be altered and fused with the children's stories and fantasies.

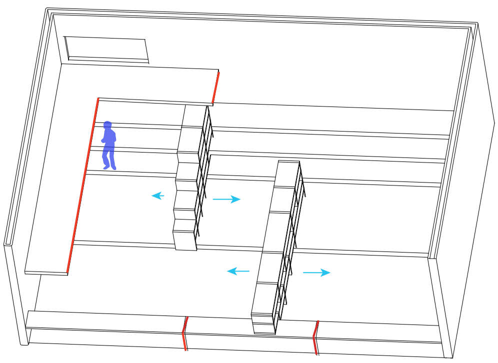


Figure 10.0 Diagram of dayroom varitation1

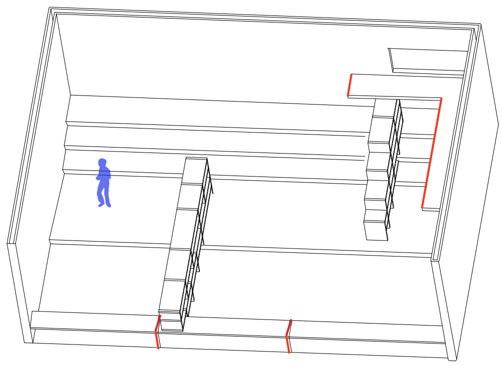


Figure 10.1 Diagram of dayroom varitation2

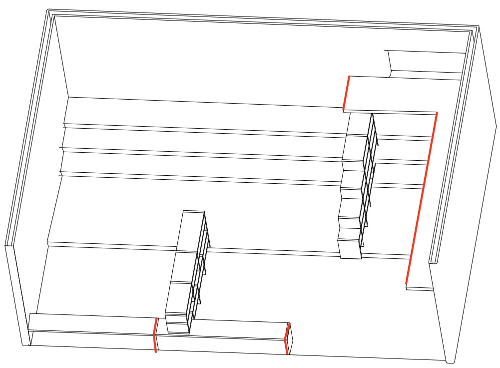


Figure 10.2 Diagram of dayroom varitation3

Daylight in the dayroom is another important aspect. The Danish building regulations state that the minimum daylight factor should be 1; this is however, a very low value considering the daylight factor in a living room should be minimum 2 and preferably around 5. Therefore, the wish for big windows to bring in the light and also open the view to the beautiful surroundings of the chalk lake and plateau landscape is needed. Different variations were tested along with the iteration of the grid. A version of the dayrooms with only one huge window was held up against a separated version created by the structure.

It was evident through this study that the divisions hardly made any difference to the daylight factor, it was only through adding openings towards the hall that the daylight factor was altered. Nevertheless, even without these opening there was already an abundance of daylight provided by the transparent facade, so the openings to the hall weren't needed. It was therefore decided to only have a small openings, as a sneak peak in relation to the elevated landing, to grant the children with diverse views of the kindergarten.

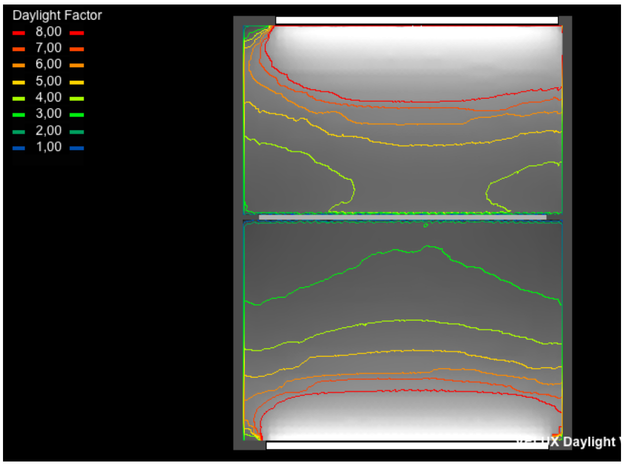


Figure 10.3 Daylight analysis of dayroom with one big window

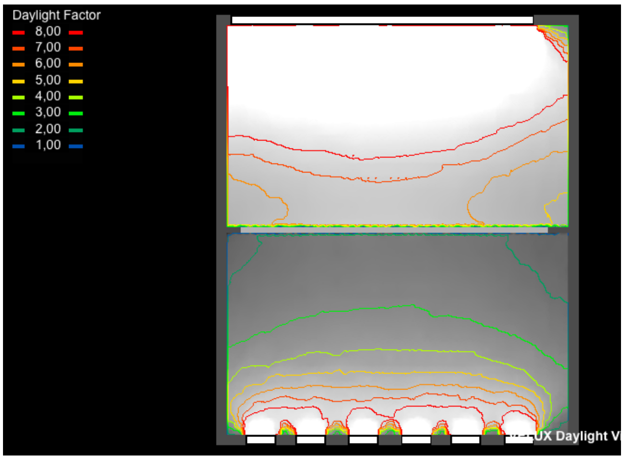


Figure 10.4 Daylight analysis of dayroom with small grid

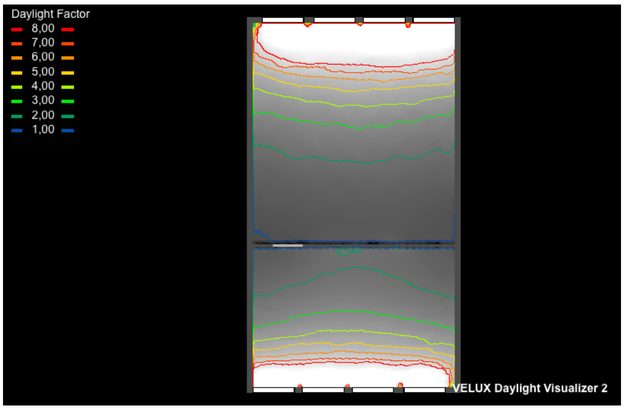
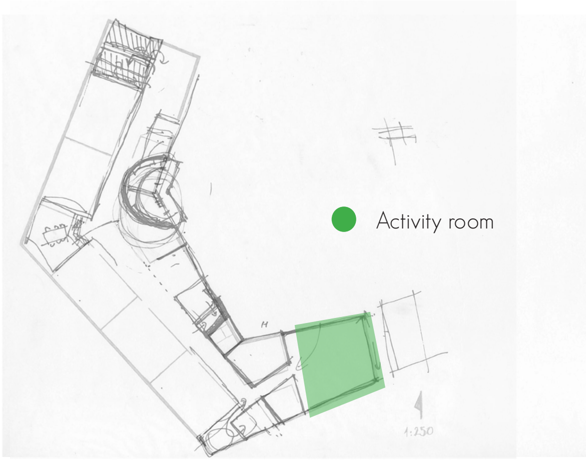


Figure 10.5 Daylight analysis of dayroom with sbig grid



Activity room

The activity room is not a requirement in the Danish building standards. It is difficult to understand why, a room made to improve the Gross motor skills and finer motor skills of children and thus also developing their athletic skills in a world that is becoming heavier and heavier, is not a requirement is baffling and it will therefore be integrated into this project. This room is partially inspired by the shifting planes in the dayrooms but also by the interior of a project for "The New Office" by Anagram Architects, where they redesigned the entire office with a focus on keeping the employees moving, yet allowing places for rest. The green staircase offers both movement and areas for leisure.
In order to develop the motor skills of children, it is important to have both interactive challenges and areas where they can catch their breath. The activity room will be equipped with other tools designed to enhance the Gross motor skills. These skills are mainly the development of the large muscles in the legs, arms and back together with the hand-eye coordination. This development will help the child with everyday skills such as getting out of bed and walking down stairs for breakfast. ("Developing motor skills"; May 2014)

Another necessity for this room is again light, preferably natural light that doesn't obstruct the view by harsh light flares. Therefore the northern facade will be formed with the same grid. Due to the diffused nature of light through north facing windows, it will not bother the users of this area. However, the space is relatively wide and the light will therefore not reach all the way to the back of the area, it therefore needs a skylight to bring in more light and help to naturally ventilate the area during spring and summer.

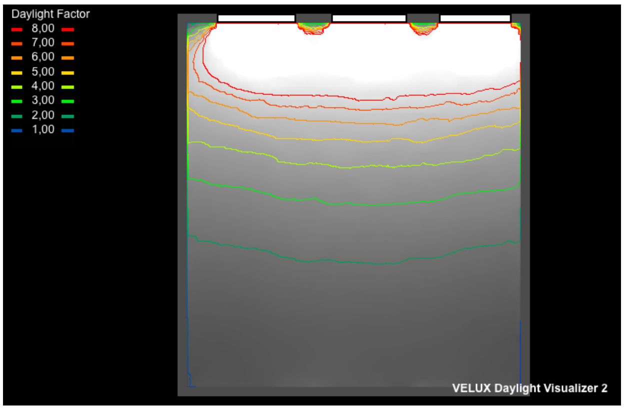


Figure 10.6 Daylight analysis of activity room without skylight

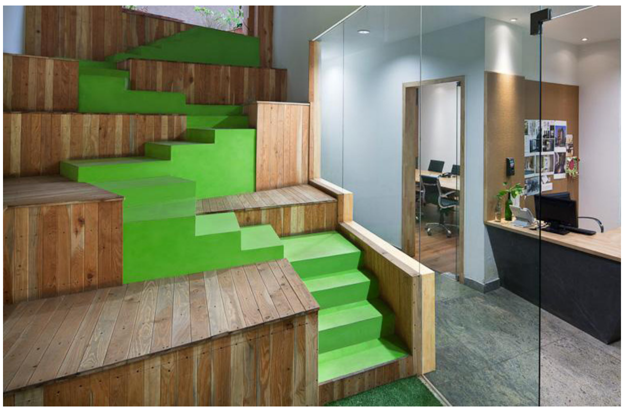


Figure 10.7 New Office staricase

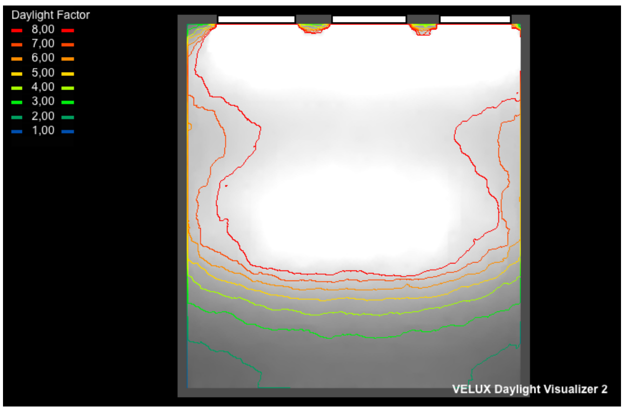
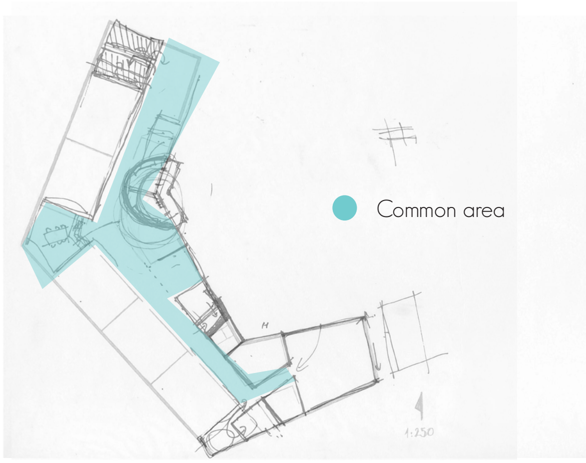


Figure 10.8 Daylight analysis of activity room with skylight



Common area

The common area also went through several iterations, with a desire to keep this area as open as possible for the children roam about and explore, it was necessary to have some functionalities, such as an entrance to place shoes and coats. The entrance would also shield from the wind, from opening the front door. There also needed to be a space for the eating, with an adjoining kitchen area. The kitchen is kept as an open kitchen, in order to be an active part of the children's learning curve. An open kitchen has been used in several other projects, as a method to make children prepare their own food and share their own favorites with the other users, thus exchanging ideas and learning from each other. This is also a valuable opportunity to let the children work together in groups, while preparing lunches and snacks. Not only is this a place for exchange about ideas around food but also a place for communication and verbal exchange. It has also been proven that children are more willing to try new foods and dishes if they have seen and help prepare them.

The two diagrams show different configurations of the area. The first diagram has a very large entrance area that slightly curves around the edge but is otherwise kept perpendicular to the facade. The eating areas are separated to either side of the entrance. This design made the eating areas appear very enclosed, as are squeezed into the space between the walls of the entrance and the walls of the office and the walls to the storage.
The entrance was changed into a circular area instead and reduced in size, in order to leave more space around it the eating area. The softer shape allows the entire common area to appear more open and friendly, whilst still shielding against draft.

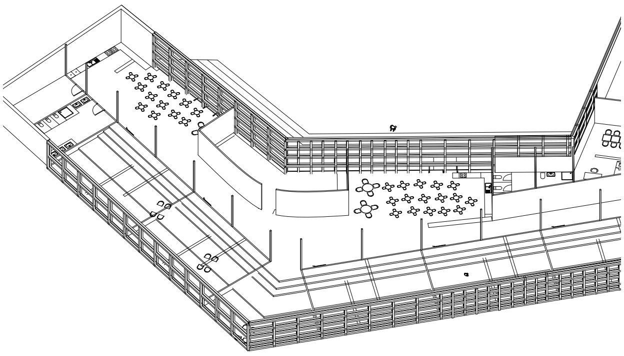


Figure 10.9 Diagram of first common area idea

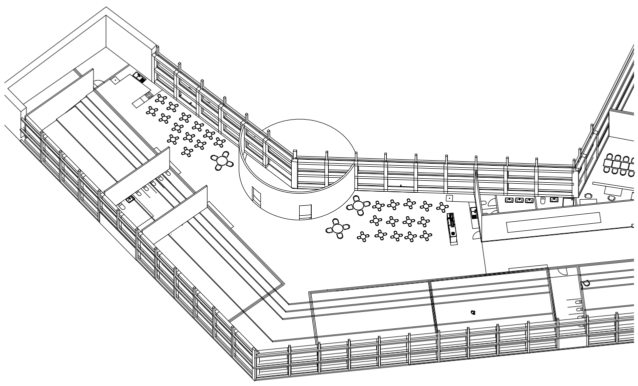


Figure 11.0 Diagram of final common area idea

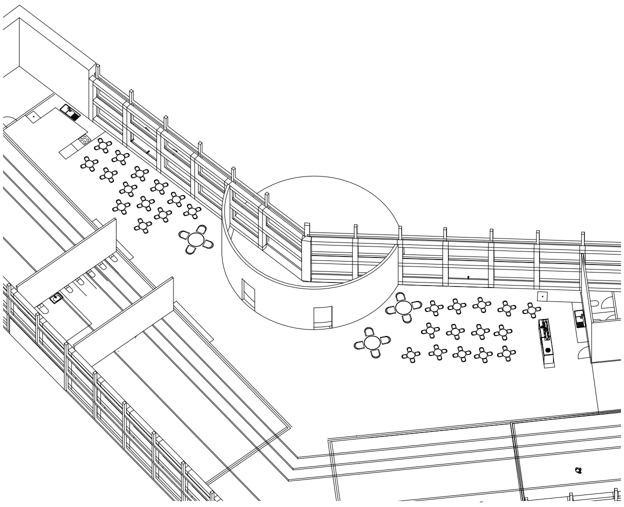


Figure 11.1 Diagram of final common area idea

Figure 11.2 Interactive lamp inspiration

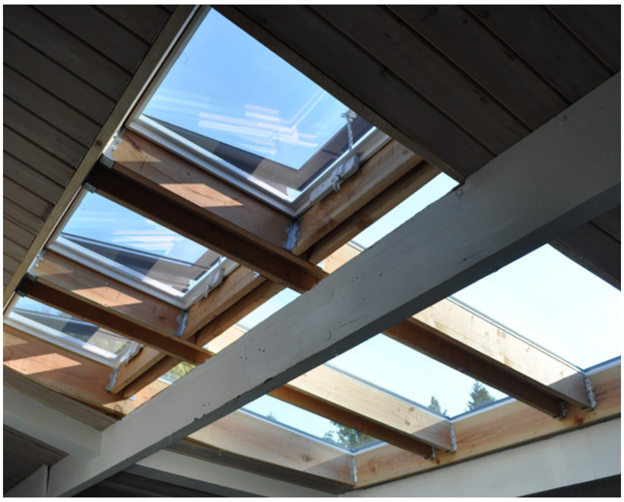
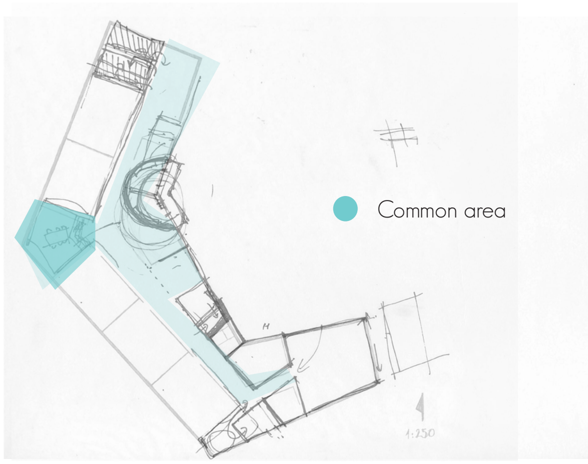


Figure 11.3 picture of skylight with structure showing

The kitchen, as mentioned, is kept open with a counter for the adults and a counter for the children, in order for them to participate in the cooking.
The area will also be fitted with a long and narrow skylight, that will allow light and ventilation but also give a glimpse of the full size of the beams, opposed to the 30 cm visible from the acoustic ceiling fitted to either side of the beam.
There is also a need for artificial lighting, that will be distributed not only in the common area but also in the dayrooms and staffroom. These lighting will have an interactive quality, as energy efficient light bulbs hardly emit any heat, it is safe for the children to use them for artistic purposes leaving their own fingerprint on the area. The areas also have a variation in size, in order to allow the younger children to be in a smaller group, in order not to get overwhelmed.

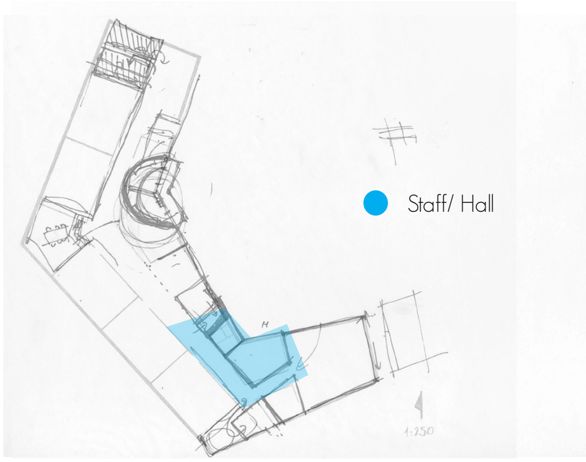


Multiroom

The Multiroom is also part of the common area it is however, slightly more enclosed then the rest of the space. Its shape was formed by the angles of the building and the location of the dayrooms, creating a funnel like shape leading towards the tip, with an almost panoramic view of the area.
Though this space may seem odd and without function, it is partly inspired by the Susi Weigel kindergarten in Switzerland In the project they utilized the space underneath the staircase, which would normally be an unused area, as an open area for the children to sit and relax on the round upholstered furniture, or play on and around them as their shape allows a nonspecific usage.
Another source of inspiration are these pillow stones as they have a similar color and shape to the pebbles in the chalk lake, which gives the water its cerulean blue color. The idea with these pillows, is to distribute them around the area, for the children to move a around and relax on. These pillows are also light and can be rearranged at leisure, again allowing the children to create their own spaces according to their needs, rather than having defined areas fully furnished for specific functions.

Figure 11.4 Susi Weigel kindergarten staircase area

Figure 11.5 Picture of pillow stones



The staffroom/hall

The staffroom is located next to the larger kitchen area, with a view towards the playground. This will enable the staff to keep an eye on the children playing. The plan is kept open, with a similar shelf element and storage elements that are implemented in the dayrooms, in order to separate the space. The staffroom is separated into a meeting and a office area, with the grid only kept partially transparent, with a full transparency by the meeting area, while only the top part of the grid is kept open in the rest of the space, in order to allow privacy for the employees.
The more private area will have office equipment and also a bed for rest and it will also serve, as nurse's office should one the children become ill.
The hall around the staffroom is kept wide, in order to easily carry equipment to the activity room. However, in order to use it as another element for the children, the concept of the landing, used in the dayrooms, is implemented to create small wooden protrusions that serve as seating elements. These element can however, be utilized in a near endless amount of variations. Since the hallway doesn't have any windows on either side, a skylight is implemented here as well, to brighten the hallway and reduce the amount of artificial lighting needed.

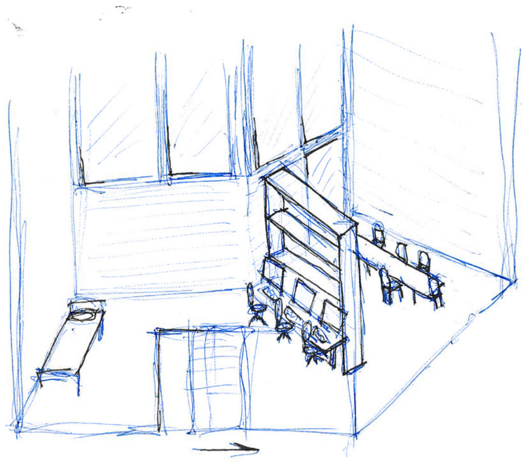


Figure 11.6 Sketch of Staff room

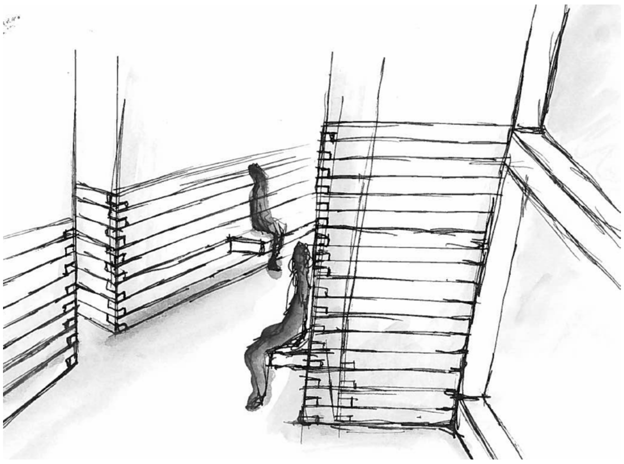


Figure 11.7 Conceptual sketch of hallway

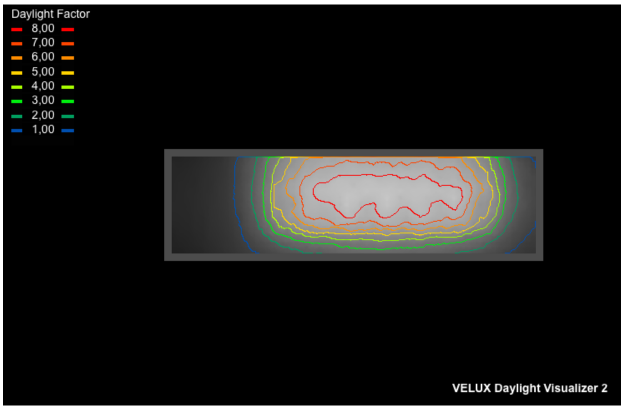


Figure 11.8 Daylight study of long hall

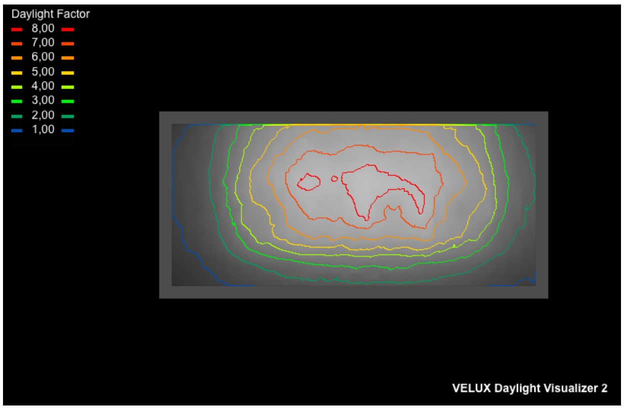


Figure 11.9 Daylight study of short hall

Details

The details, as mentioned in the tectonic chapter, are very important for the project, in order to provide a unified expression and composition. As the structure will mainly consist of timbered joints, it is a desire to also have other elements in the kindergarten follow the same logic and style. As the main bearing elements have an etched joint, experimentation with this style of joint was started on the elements such as, the sliding door, the landing and the wooden elements in the hall area. The main idea behind the sketches for the joint, is to have it merging with the wall elements by carving a slit to fit the wooden members inside, thereby forming a firm joint. Naturally some elements will need more support than the carving can give, these elements will be supported by metal fixtures protruding from the carved area, letting the object appear to be merged with the wall. This technique is often used in furniture's, such as shelves and additional testing and calculations would be needed to evaluate the strength, especially for the landing.

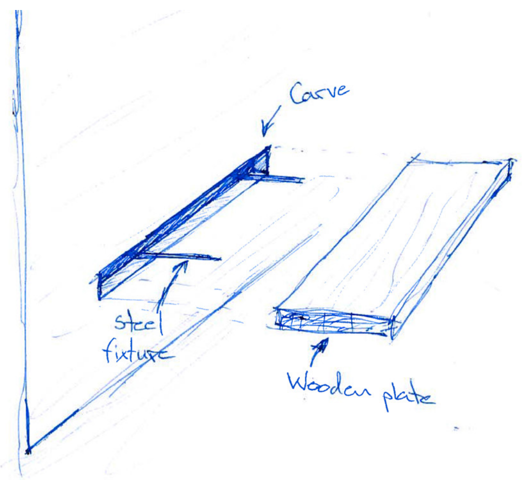


Figure 12.0 Conceptual sketch of bench element for the hall

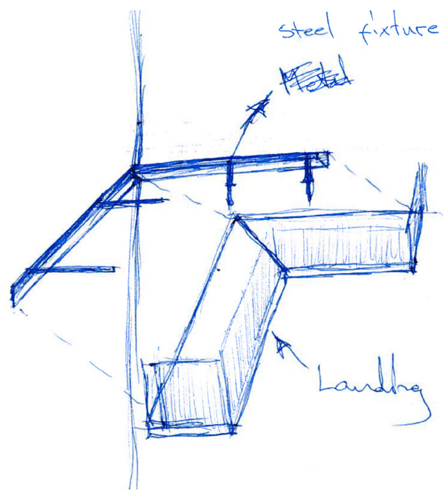


Figure 12.1 Sketch of landing for the dayrooms

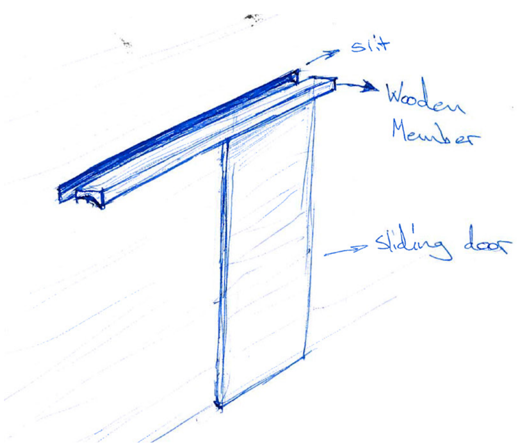
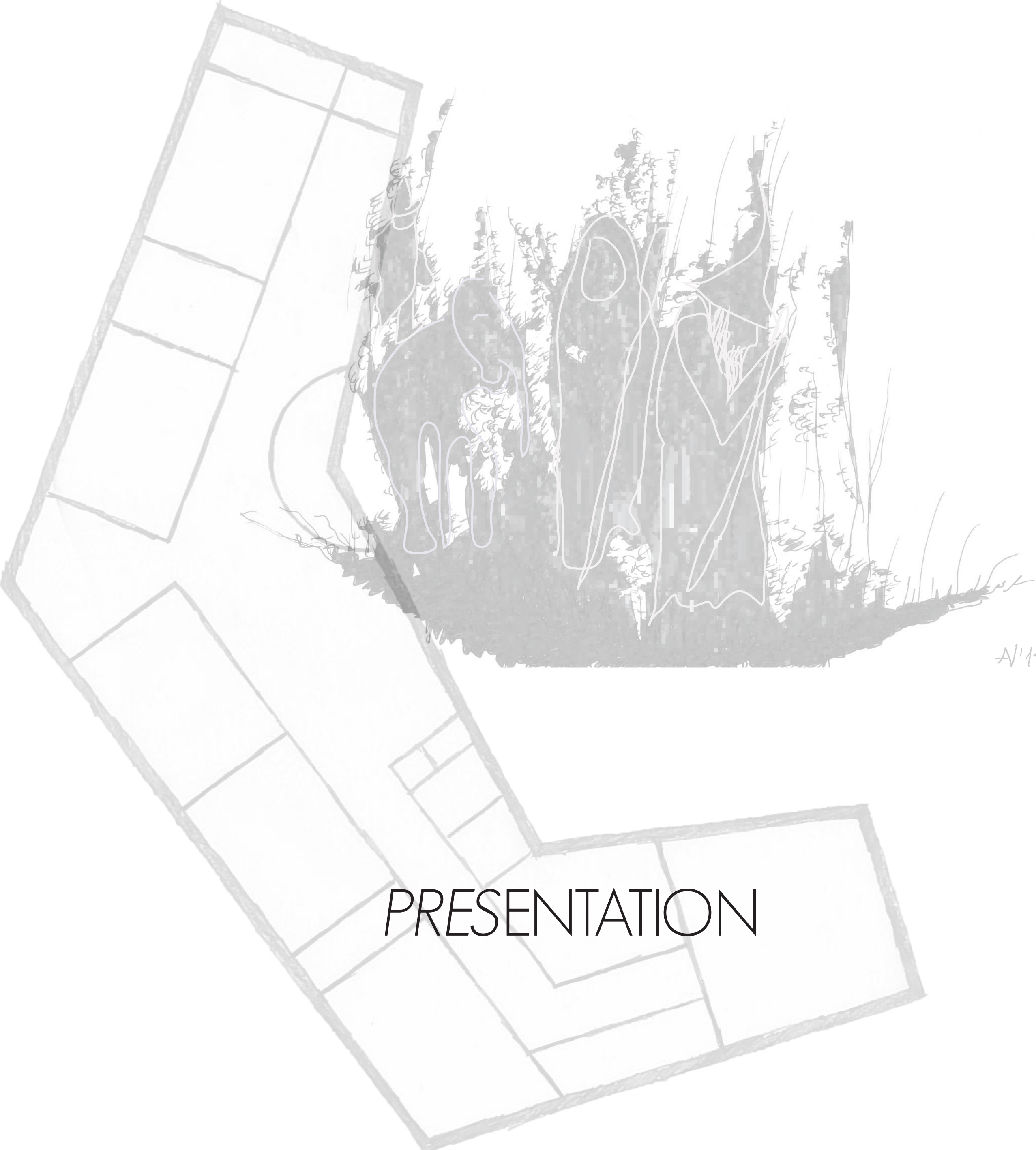


Figure 12.2 Sketch of sliding door element



*PRES*ENTATION

Figure 12.3
Overview of the final programme developed in this project.

Kindergarten	Number	Area Square meter
Dayroom	5	70
Handicap lavatory adult	1	11
Handicap lavatory child	1	6,5
Lavatory Adult	1	17,5
Lavatory child 1	1	16
Lavatory child 2	1	26
Wardrobe	1	27
Kitchen	2	15
Playground Storage	1	26
Kitchen Storage	1	3
Technical Storage	1	28
Activity room	1	117
Multiroom	1	44
Common area	1	280
Staff room	1	57
Total		1039
Playground	1	4350
Parking	30	11,5
Bicycle and Garbage	1	25

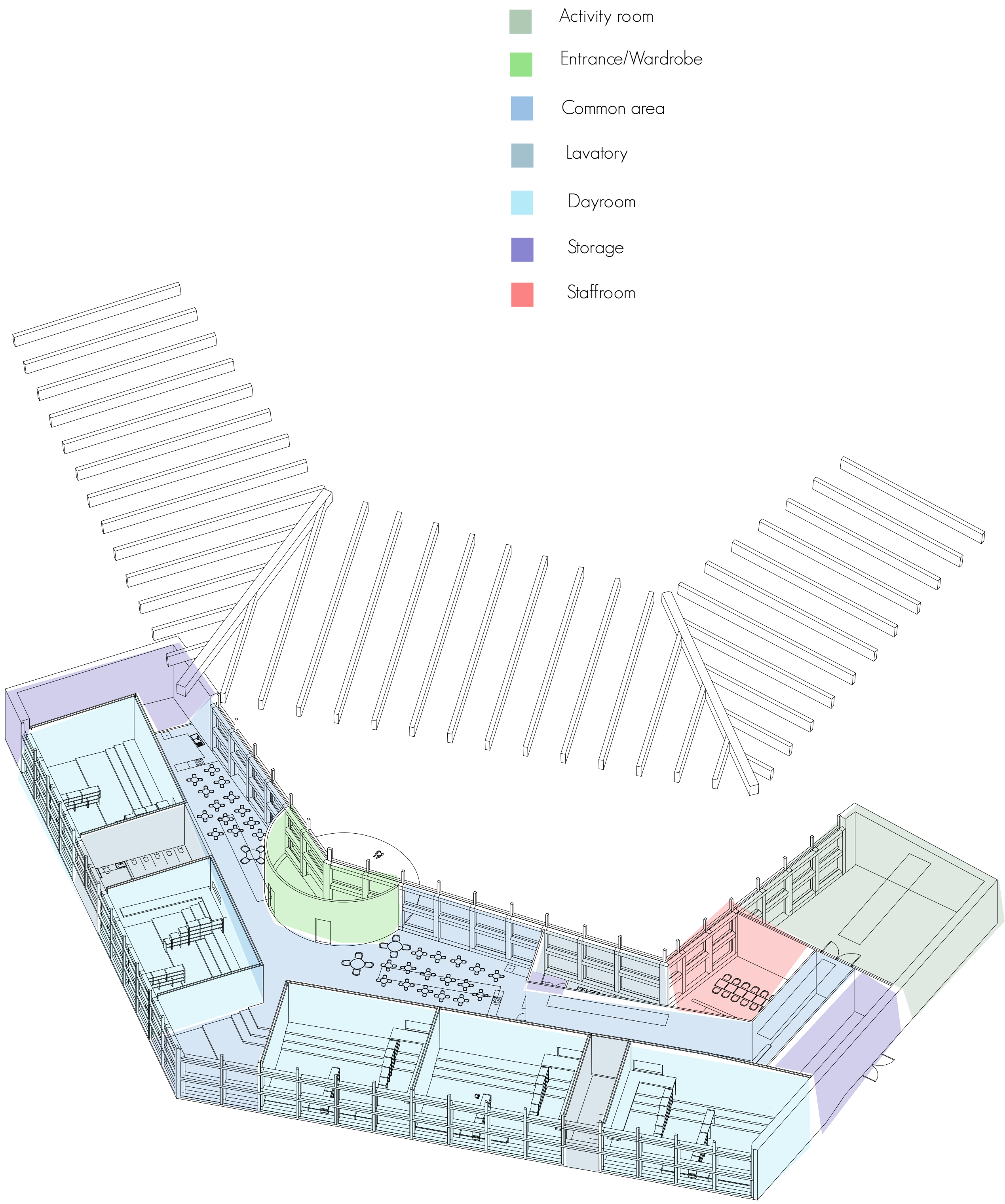
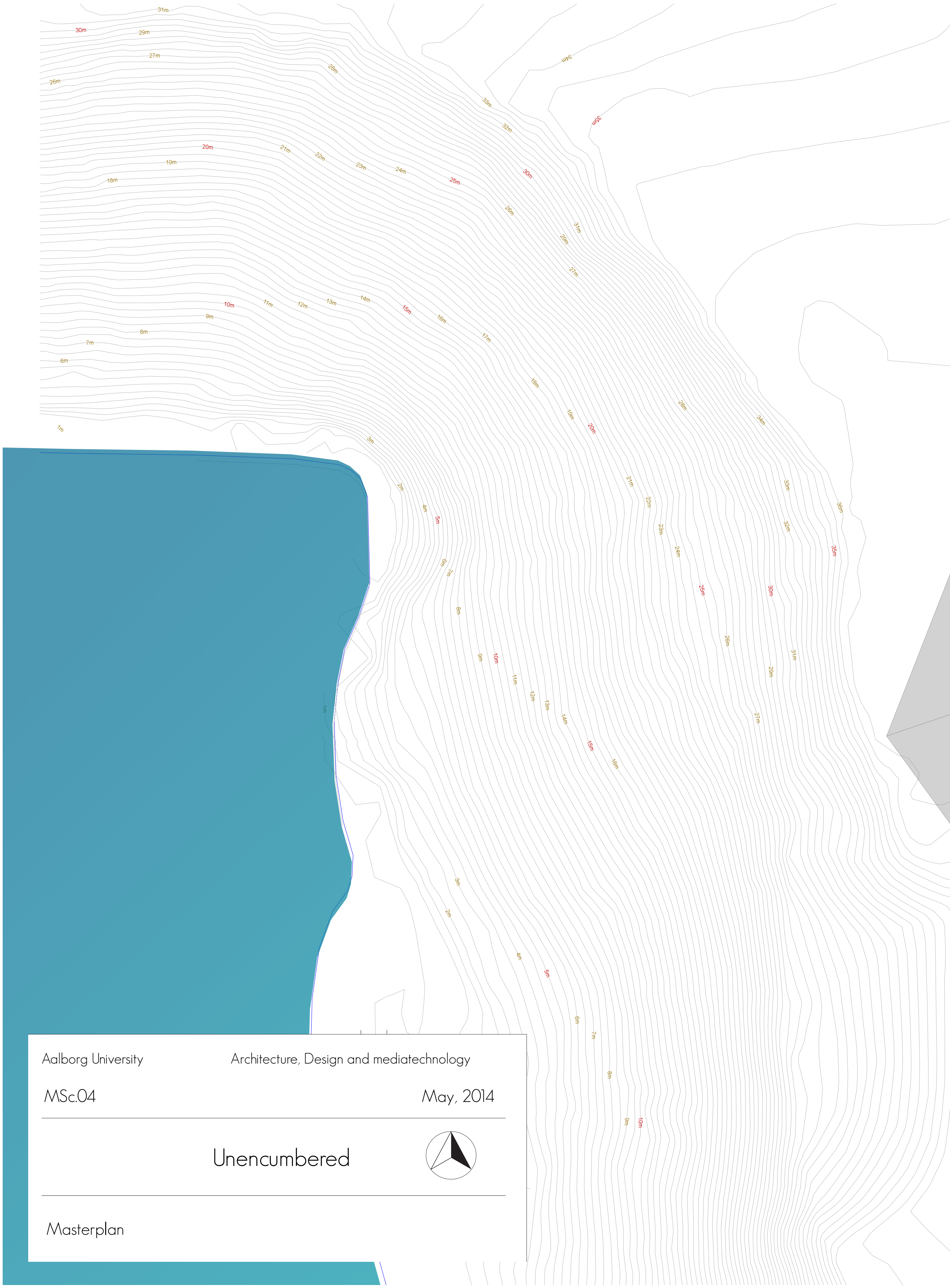


Figure 12.4
Axonometric diagram of functions

Figure 12.5
Plan of finished design. Not in scale



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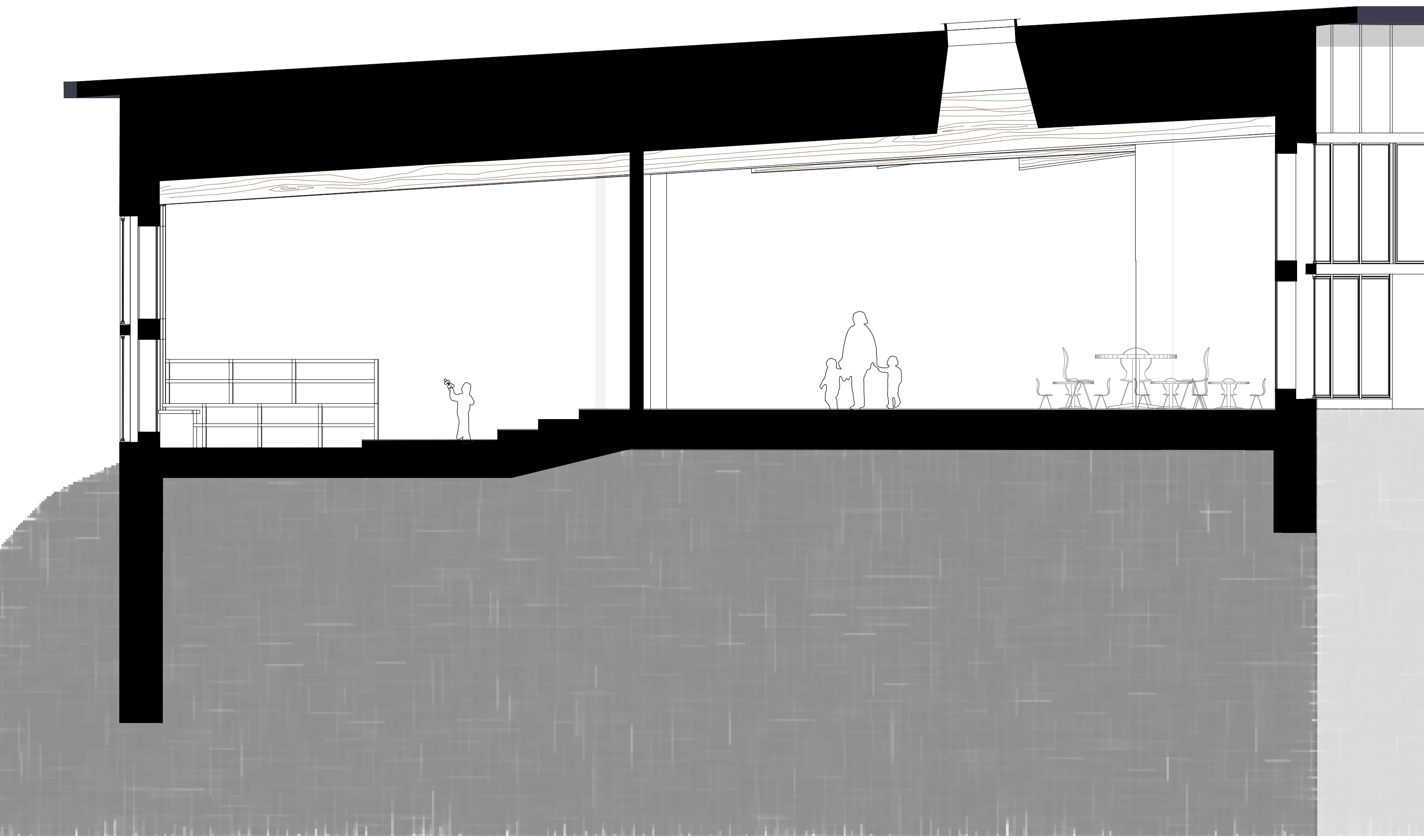
May, 2014

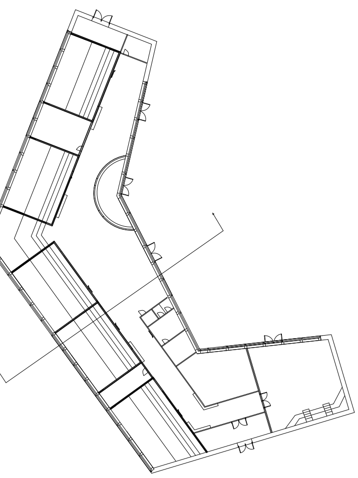
Unencumbered

Masterplan

36m
37m
39m
37m



1m 5m 10 m



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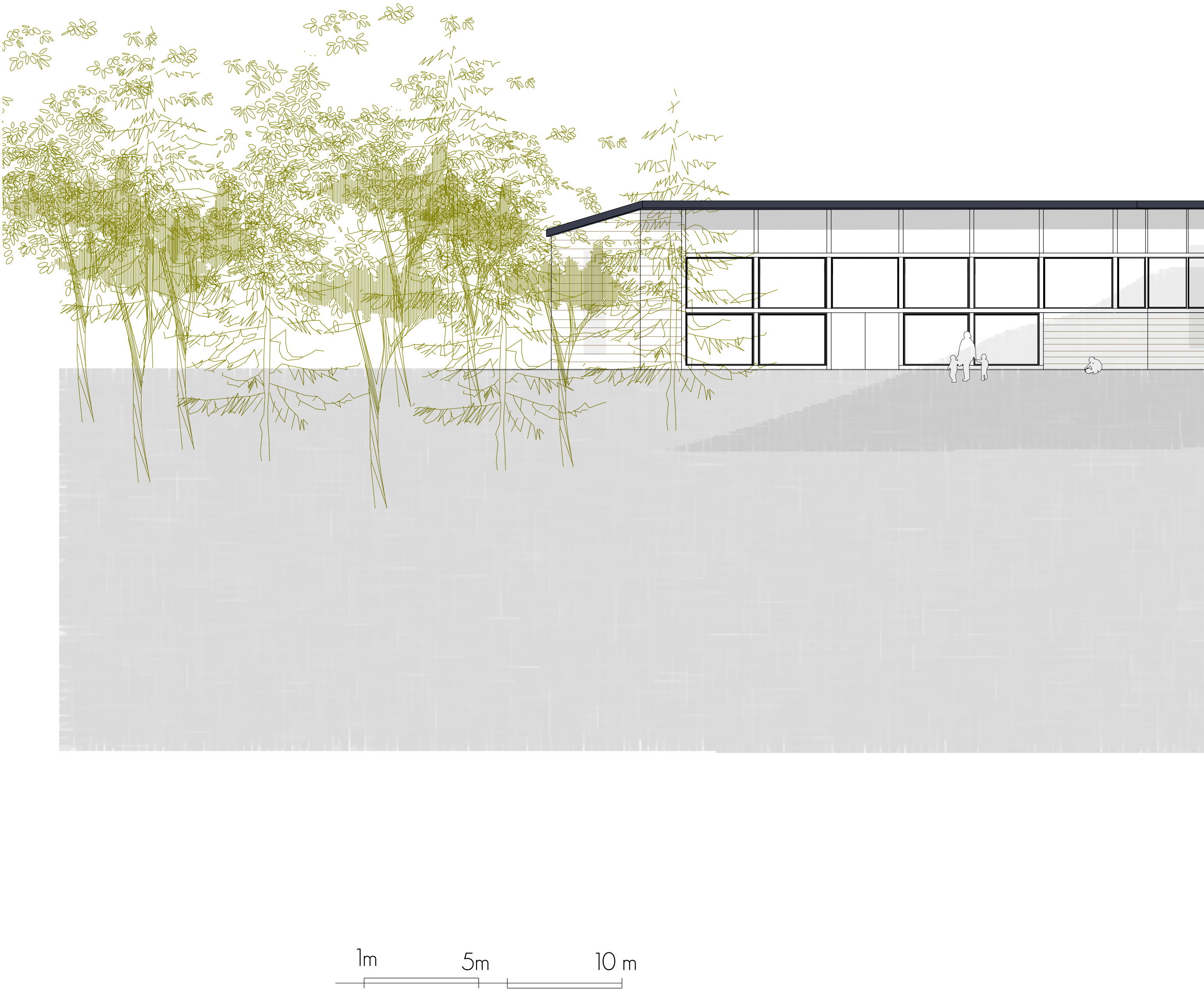
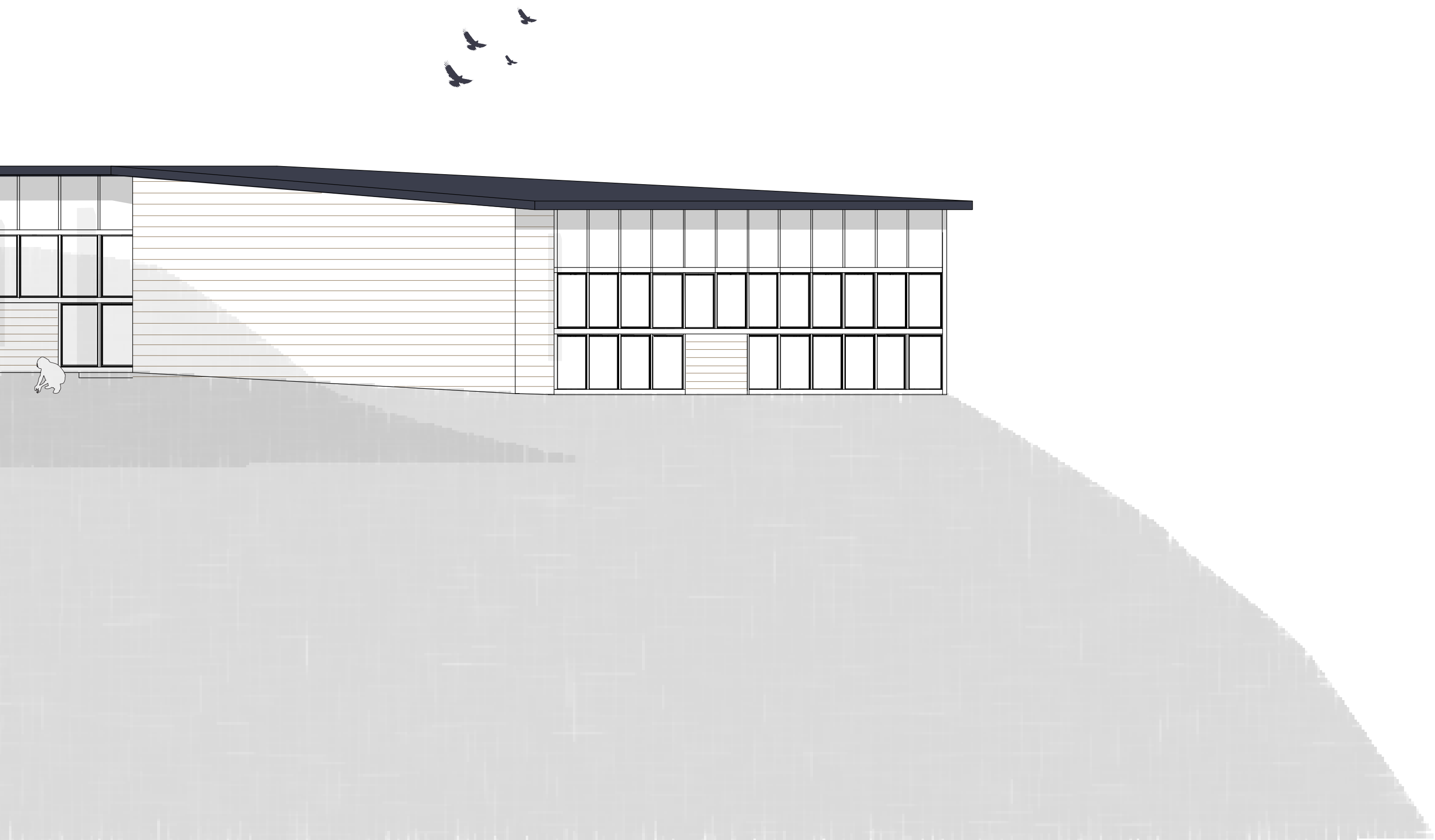
MSc.04 | May, 2014

Unencumbered

Section AA | 1:100


1m
5m
10 m



Aalborg University	Architecture, Design and mediatechnology
MSc.04	May, 2014

Unencumbered

Facade North	1:200

Figure 12.6
Rendering of the dayroom with a view towards the lake.

P r e s e n t a t i o n №3

Figure 12.7
Rendering of the dayroom with a view from the landing element.

Presentation Nº3

Figure 12.7
Rendering of open kitchen and eating area.

Presentation
Nº 3

Figure 12.8
Rendering of the exterior facade and spaces.

Presentation
№3

Conclusion

In conclusion, this project has been challenging in many ways, first the challenge of tectonic design, second the challenge of the context and its regional tradition and lastly the challenge of combining this into kindergarten. Considering the current condition of the kindergartens in the area, it would be very difficult to produce a design that has less activity and relation to the context. Though the current day institutions resemble the single-family house in the area, it is lacking a relation to the natural surroundings. The fact that all kindergartens in question, had no individual identity, was partly why the design was located on a site that wouldn't normally be considered suitable for a kindergarten. This choice of site was also part of the challenge of the project, designing for a site, context and a user group with very specific needs.
The task was not to see either aspect as a hindrance, but rather a guide and help to shape and give the project its own identity, rather than merging it in with the rest of the typologies. This has certainly been achieved, as there are hardly any timbered buildings near the site, only a handful still exist nearer the city centre. Even amongst these remnants of history are there none with same expression as this design. The grid and the shape of the site and its surroundings serves as the logic for the layout of the building, due to the fact this is a design with children as the main focus, a fair amount of freedom is allowed when considering the layout and a more playful and rather unorthodox approach can be used without compromising the functionality of the spaces. The structure helped build and shape the entire design, as it was also one of the focus points, together with the detail. The detail however, is kept subtle in order to let the voluminous timber members stand strong and be appreciated is a whole rather than having minute insignificant parts stick out.
The vision in the beginning of the report state that this kindergarten is to be a place of imagination, with the support of the landscape and context the design certainly has captured the particularities and quirks that makes this place special and imaginative, bringing a fantastical world to life.

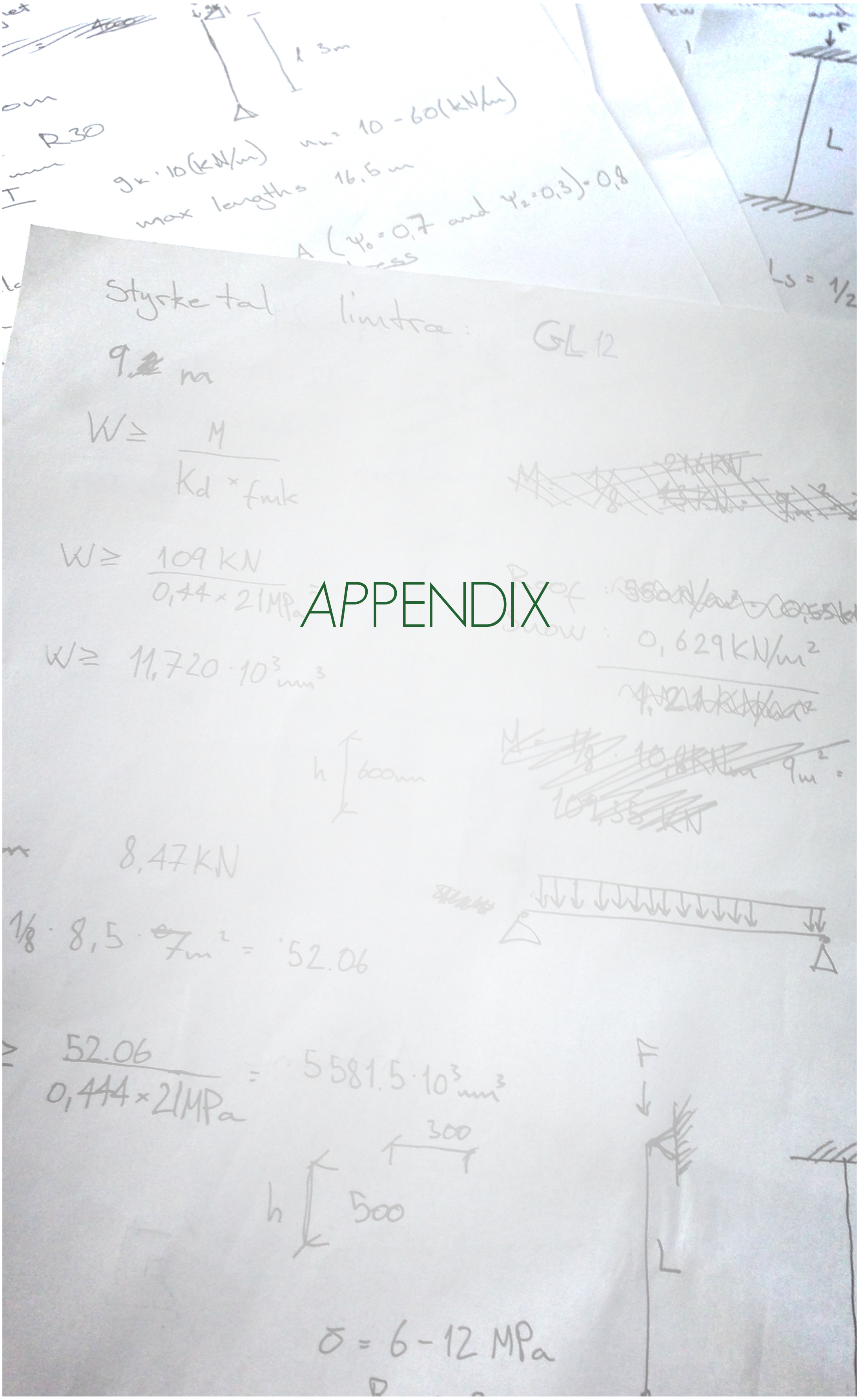
Reflection

It is always difficult to reflect objectively about ones own work, especially when it has been all by yourself however, this chapter will attempt to academically reflect upon the project at hand. Writing an individual thesis in a university with a focus on group work has been a difficult challenge, there are many pros and cons to both group work and individual work. The biggest issue, when working alone, is not having a sparring partner to discuss and exchange ideas and designs with, there is only oneself and the supervisor to discuss these ideas with. It can therefore be argued, that the project isn't as well developed however, it is entirely ones own work and the abilities gathered through five years of study, have been tested and put into practice. It is through the architects visions and ideas that great works of art are created and also great fiascos. It can be said that this project, as it has been developed individually, is also entirely ones own fault both the good and the bad. It has been a great learning experience to see a project through by no other mean than ones own experience and competencies gained through university studies, but also through travels and practical experience. It is quite evident that travels and studies abroad have influenced this project a great deal, without these adventures it may not have configured in the same way. Throughout all these years of group work and report writing the academic reflection has always been the most difficult to describe, due to the fact that a design process hardly ever ends. The projects usually made at the university level are merely proposals, going through several more iterations and detailing processes that aren't reached at this level. It is therefore, even though the projects strive to be final proposals, there are still plenty of details that could be developed further. As this was a project with a focus on tectonic design the details and structure were an important aspect. Nonetheless, more time could have been spent on the joint and the structure but unfortunately the deadline is an ever-constant issue. It is especially the windows, both skylights and the transparent façade, which could have needed extra polishing. Extra polishing in terms of having an expert on the matter consult and be a part of the process to truly develop the theme, for without experts there are no means perform the necessary tasks. Prototyping the various ideas would have been another step in the development, which is often used to develop structures that are out of the ordinary. This would have been a very interesting step, as it is only through the testing and experiencing of the elements involved in architecture, that one will be able to fully understand and appreciate it. Not just the windows and structure could have benefit from an extra polishing, but also the interior details could do with extra time, to refine and fully develop the interior design, as it is now consisting mainly of concepts and ideas.

There has also been focus on the landscape and the context, both in the design of the kindergartens layout and structure, and its exterior spaces. This, even though it has such a big role in the project, could have been taken further, on a very early sketch of the plan paths from the kindergarten were drawn that lead towards the plateaus surrounding the lake, it unfortunate that the idea of the path as an extension of the kindergarten, to try and bring life and reanimate the area, which has been lying dormant ever since the closing of the chalk refinery, could not be developed further. It is as it is with most projects unfortunately the deadline that stopped further development.

In retrospect the projects and all its quirks could do with an extra loving hand, but that again is part of the beauty of a design process, as it is never finished and all mistakes are not really mistakes but a lesson learnt, that would help acquire skills and refine instincts for better solutions in the future.

APPENDIX



max lengths 16.5 m
Styrke tal limtræ: GL 12
W ≥ M / Kd × fmk
W ≥ 109 KN / 0,44 × 21MPa
W ≥ 11,720 · 10³ mm³
8,47 KN
1/8 · 8,5 · 7m² = 52.06
52.06 / 0,444 × 21MPa = 5581.5 · 10³ mm³
0,629 kN/m²
σ = 6 - 12 MPa

Structural analysis

The appendix contains the structural analysis of the longest spanning beam and part of the grid. The section has both a hand calculation of the widest roof beam, and a computational analysis of the grid. The program used is ROBOT structural analysis by Autodesk.
The beam span is illustrated by the top diagram, the arrows represent the span and the thick red lines represent the elements supporting the beams.
On the diagram below is an illustration of the stabilizing elements represented by the red lines. These elements will mainly be taking the horizontal forces, created by the wind and to stiffen the entire building.

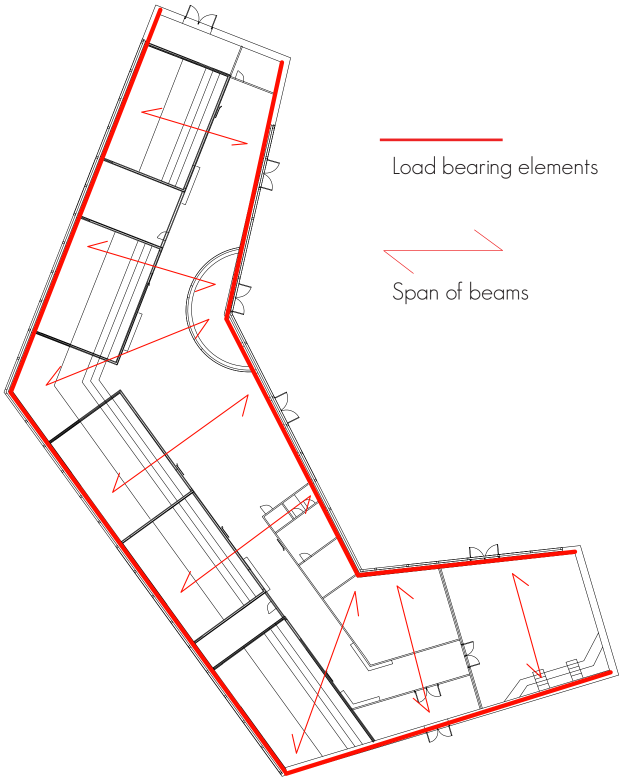


Figure 12.9
Diagram of the span of the bearing elements

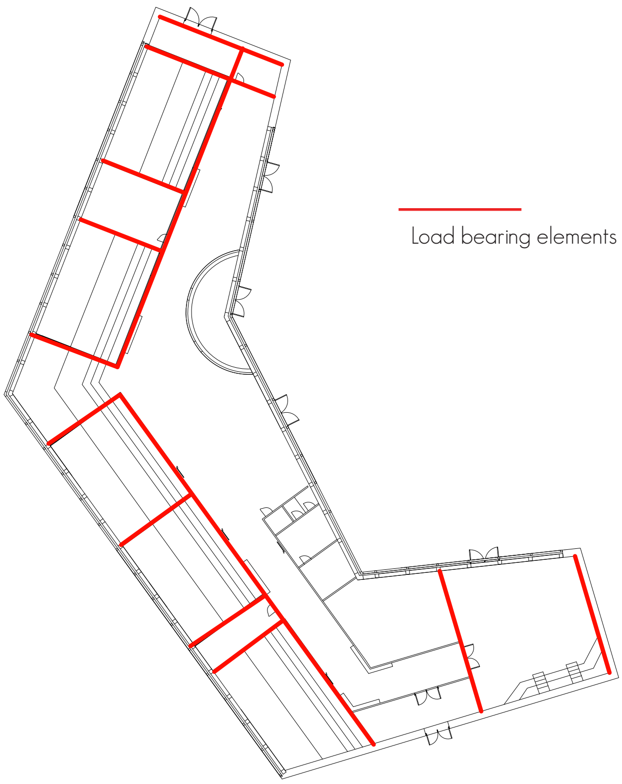


Figure 13.0
Diagram of stabilizing elements

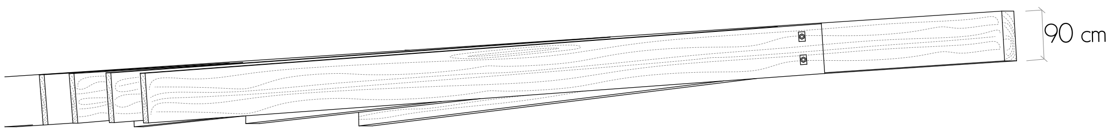


Figure 13.1
View of the roof beams from the side

Detail of a partial piece of the roof structure, this detail illustrates the joining of the roof elements to the central beam. In order for the central beam not to become unstable through the added members on either side, it has been widened to ensure the stability.
The joint of the roof members will be made with a metal bolts instead of a timber joint, as the beam is already almost fully utilized the material loss will have to be minimized. The bolts are not going all the way through the main beam, in order to make the joint as subtle as possible.

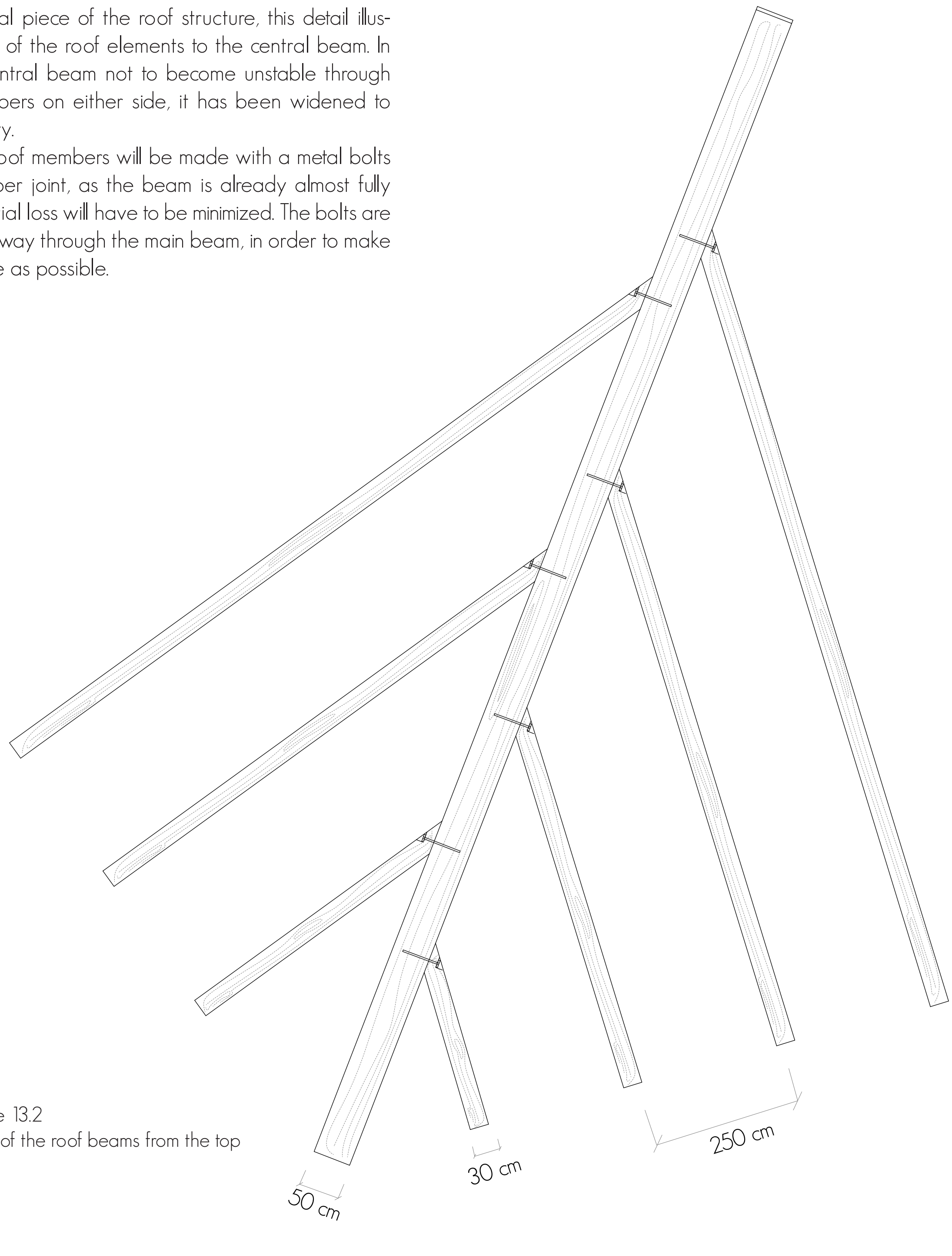


Figure 13.2
View of the roof beams from the top

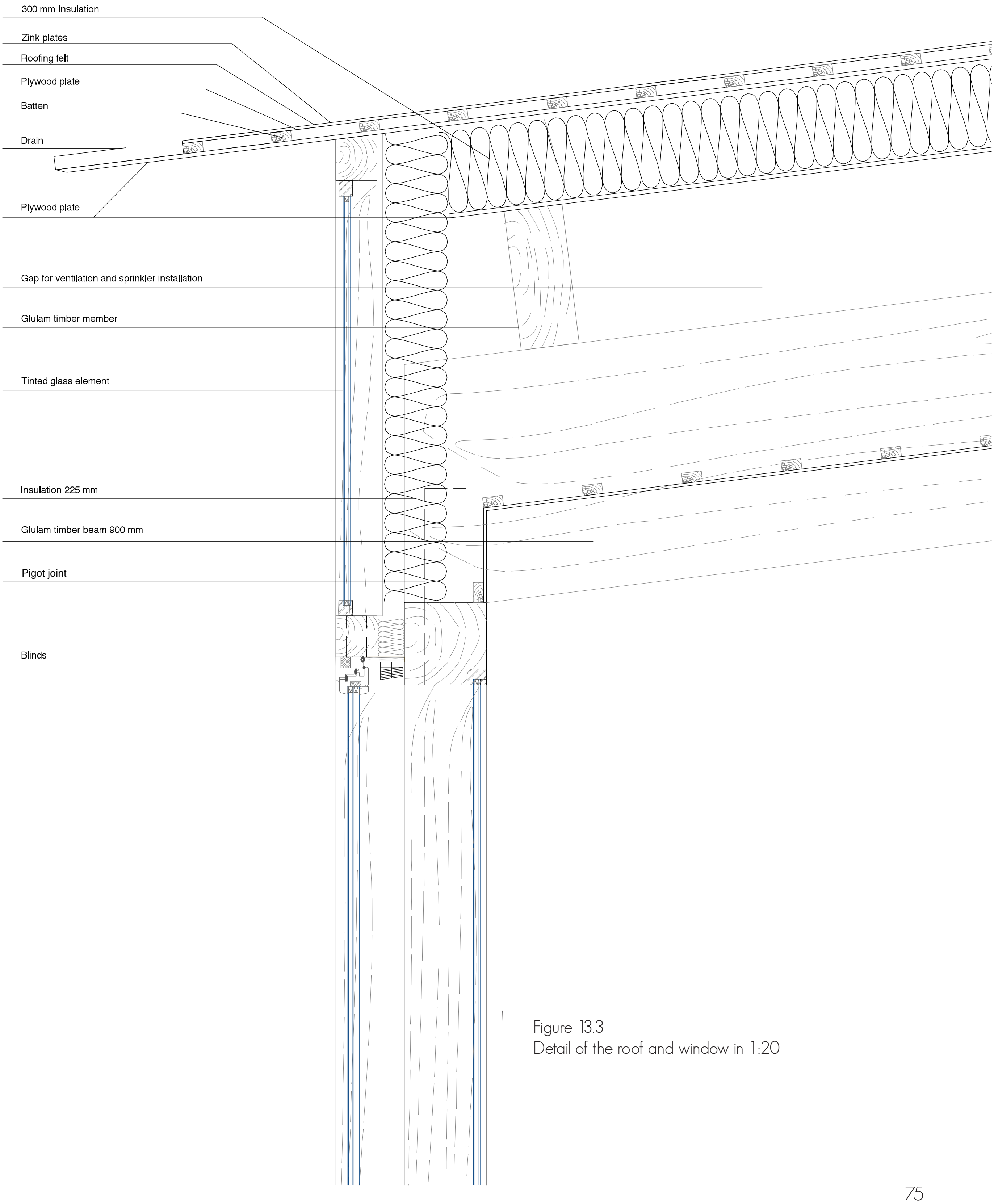


Figure 13.3
Detail of the roof and window in 1:20

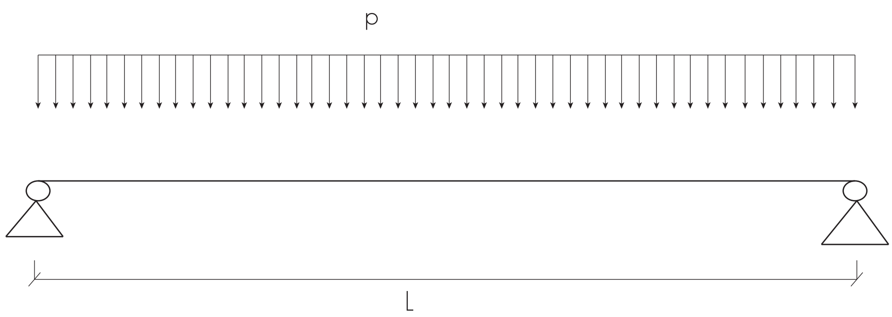
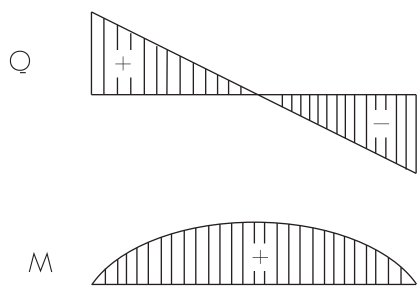
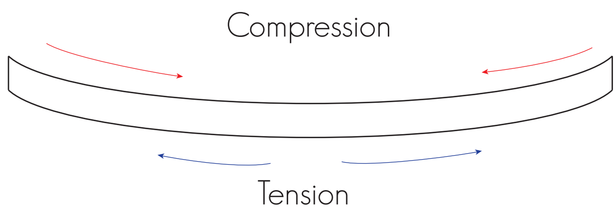
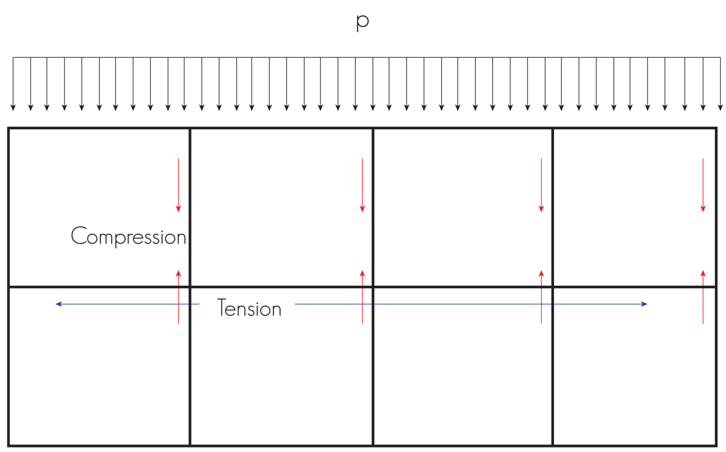


Figure 13.4
This diagram illustrates the formula used the beam calculation. The beam is a simple supported timber member in both ends. The diagram continues to show the moment and bending in such a configuration. The formula for calculating the moment, which will later be used to dimension the beam. It also shows the forces running through the material, as beams mainly take the bending force, there will be compression in the top half and tension in the bottom.

$M_{max} = 1/8 \times p \times L$ ^2







Calculating the snow load:

Characteristic terrain value, St = 0,9 kn/m2

Roof angle, α= 7*

Formfactor is set to be $c_1{}^2$

C_1 = 0,8

$S_k = C_1 \times S_t$ = 0.8 x 0.9 Kn/m^2 = 0.72 Kn/m^2

Calculating the wind load:

$$qpeak = 1 + \frac{7}{\ln\left(\frac{z}{z0}\right)} \times \frac{1}{2}\ \rho \times \left(v_b \times K_r \times \ln\left(\frac{z}{z0}\right)\right)^2$$

ρ = Air density 1.25 kg/m^3

Z_0 = 0.05 (terrain category 1)

Z = 4

V_b = 27 m/s

$$K_r = 0.19 \times \left(\frac{0{,}05}{0.01}\right)^{0.07} = 0.212$$

$$qpeak = 1 + \frac{7}{\ln\left(\frac{4}{0.05}\right)} \times \frac{1}{2} \times 1{,}25 \times \left(27\ m/s \times 0.212 \times \ln\left(\frac{4}{0.05}\right)\right)^2 = 0.629\ kn/m^2$$

Calculating the dead load:

$$g_{beam} = h \times b \times \rho \times g$$

ρ = Material density

Load combination:

$$P_d = \gamma_G \times g_k + \gamma_Q \times q_k$$

γ_G = 1,0 Dimensioning value for loads (Teknisk Ståbi)
γ_Q = 1,0
c/c = 2500 mm central distance between beams
g_k = g_{beam} = 0.9m x 0.3m x 350 kg/m^3 x 9.82 N/kg = 0.927 KN/m^2
q_k = snow load

ULS (Ultimate limit state)

Permanent		Variable (snow)		Live load
(1 x 1 x 0,93 KN/m^2)	+	(1 x 1,5 x 0,3m x 0,72 KN/m^2)	+	(1 x 1,5 x 0)

= 1,254 KN/m^2

SLS (Service limit state)

0, 927 KN/m^2	+	(0.3m x 0,72 KN/m^2)	+	0,0

= 1,143 KN/m^2

Beam verification:

ULS

Max Bending $U_{max} = \frac{1}{400} \times L$

$$U_{max} = \frac{1}{400} \times 18000mm = 45\ mm$$

$$U_{Inst} = \frac{q \times l^4}{8 \times E_0 \times I}$$

Inertia

$$I = {}^{1}/_{12} \times b \times h^3$$

$I = {}^{1}/_{12} \times 500\ mm \times 900\ mm^3 = 30{,}37{\times}10^9\ mm^4$

Bending

$U_{Inst} = \frac{1{,}254KN/m^2 \times 18000^4}{8 \times 12600N/m^2 \times 30{,}37{\times}10^9\ mm^4} = 43{,}00\ mm$ OK!

Moment

$$M = {}^{1}/_{8} \times p \times L^2 \times l$$

$M = {}^{1}/_{8} \times 1{,}254\ KN/m^2 \times (18m)^2 \times 2.5m = 126{,}96\ KNm$

$$\sigma = \frac{M}{h}$$

$\sigma = \frac{126{,}96\ KNm}{0{,}5m \times 0{,}9m} = 28{,}2\ MPa$ OK!

The bending strength of glulaminated timber is from 16,0 MPa -→ 29,3 MPa depending on which type and producer is chosen. It can therefore be concluded the beam in question is structurally sound and within the strength range.

Figure 13.5
To the right is a screenshot of the program ROBOT structural analysis, which gives fast results it is therefore easier and faster to experiment on the size of the grid. This screenshot shows the loads applied to the model it is a combination of the dead load, snow load and wind load. This combination has been used on all the experiments and is based on the values calculated for the beam analysis.

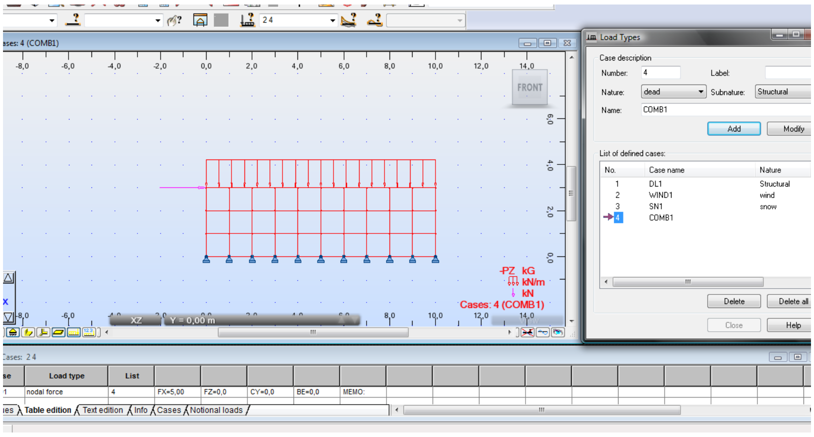


Figure 13.6
This figure is a screenshot of the first analysis of the grid 1m x 1m with a section size of 15 cm x 15 cm with solid timber construction wood C24. The graph gives an over view of the moment and the ratio in order to see how well the material is being used. Not all the members are being used to the optimal strength and therefore the grid size was changed

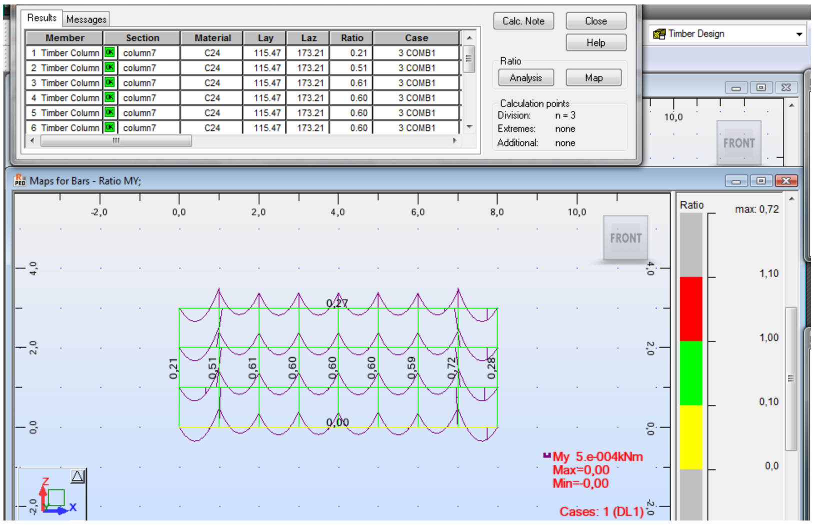
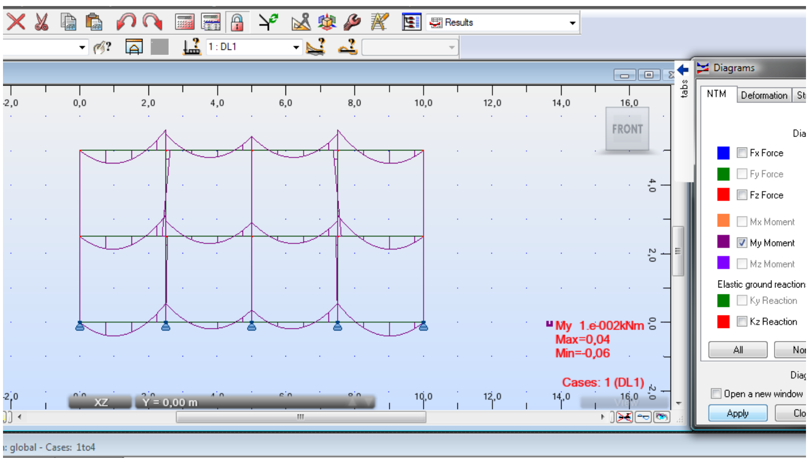


Figure 13.7
On this figure is an illustration of the moment in the new grid. It hasn't changed much from the previous grid.



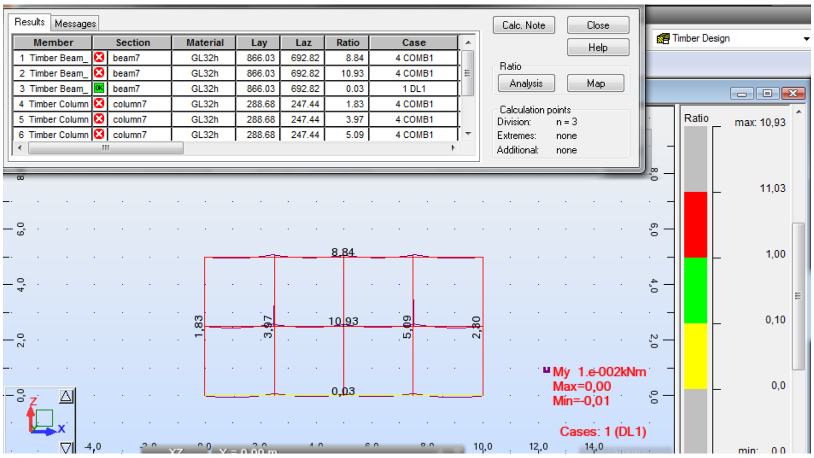


Figure 13.8
Here is an illustration of the changed grid size 2,5m x 2,5m the material was also changed from C24 construction wood to glue laminated timber to increase the strength but the same dimension of the section was kept. It was however, evident from the results that the section was too small and had to be changed.

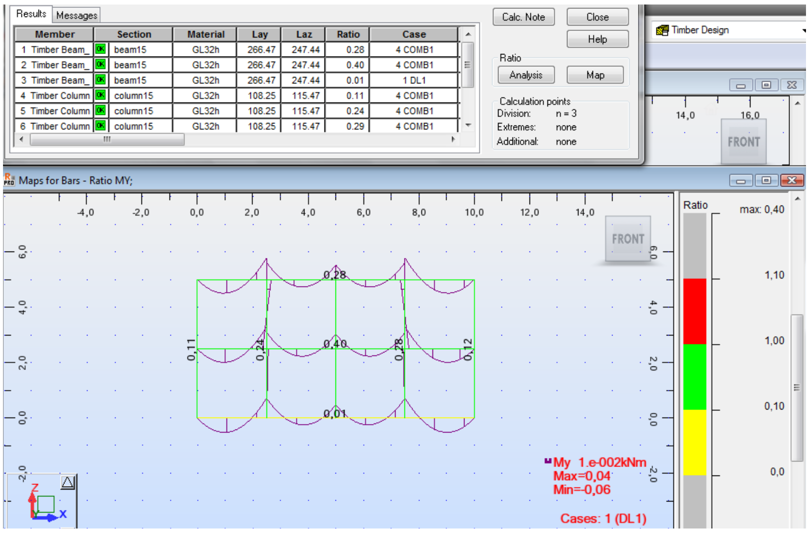
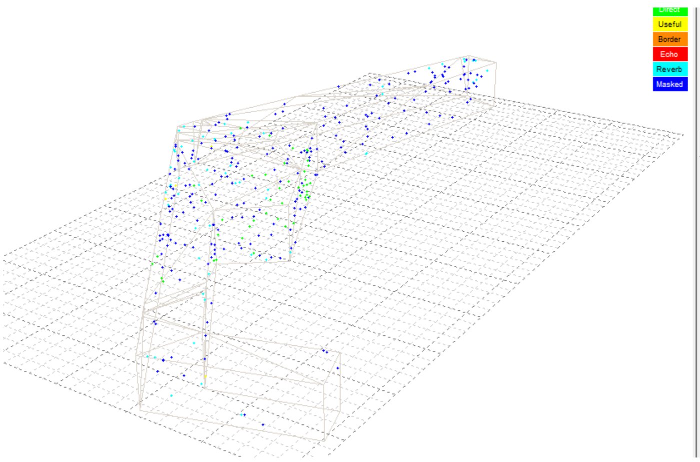


Figure 13.9
In this illustration the sections were changed to the dimensions of 30 cm x 30 cm and thereby doubling the size of the members. This turned out to be structurally sound, although slightly over dimensioned, however the timber members were kept like this, in order to reach a decent U-value to minimize heat loss.

Acoustic analysis

Children have a wide range of sounds some pleasant some very unpleasant and very loud. a child scream can reach up to 100dB and it is therefore necessary to maintain a quite environment with the help of the acoustic performance of a space. In order to determine this an acoustic analysis was made of the common area and the classrooms. There is a required reverberation time set by the Danish building regulations which is 0,4 sec. this value is very low the normal reverberation time for speech is between 0,8 and 1,5 sec. Although the required reverberation time calls for an almost dead space it is understandable when the kindergarten is supposed to accommodate 100 children.
The analysis was made with the Autodesk program Ecotect. Ecotect has three different calculation algorithms for the acoustics number one is the Sabine algorithm which assumes sound decays continuously and smoothly as if the space had no variation in the absorption values of the rooms surfaces. The second formula is Norris-Eyring this attempts the accuracy of the previous algorithm by assuming sound decays intermittently, rather than continuous and thus more accuracy is achieved, however this formula still assumes the surfaces all have the same absorption value. When the materials in a space have a wide variety of absorption values the most accurate result is obtained using the Millington-Sette equation. However this formula calculates highly sound absorbing materials are more efficient than they actually are in reality.
Although all the formulas have their weaknesses they will still give a fairly accurate value for the reverberation time and sound decay. (http://wiki.naturalfrequency.com/wiki/EcotecRTSelection; 2014)

Figure 14.0
This screenshot shows the common area and the particle distribution in the space the surfaces are mainly glass, timber and acoustic ceiling panels. The absorption values for these materials are shown in a table below.



Acoustic absorption	
Acoustic	0,81 a
Glass	0,02 a
Timber	0,08 a

Appendix

N° 4

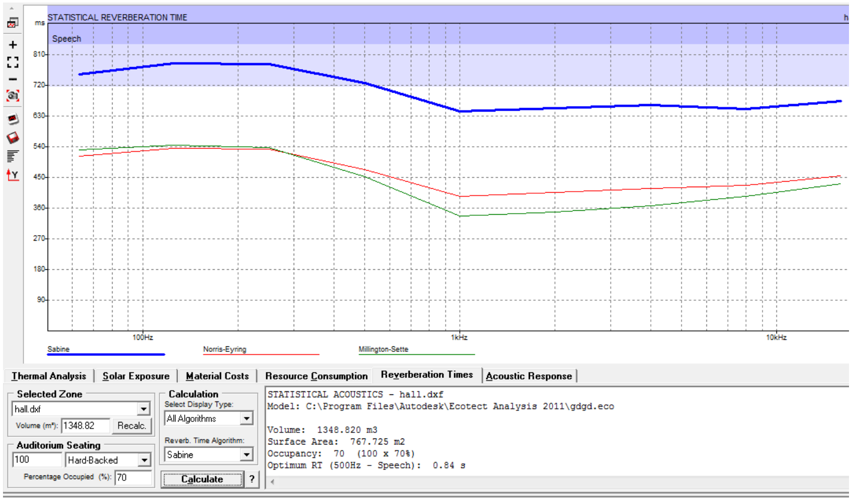


Figure 14.1
A graph of the acoustic reverberation time the values of the Millington-Sette and Norris-Eyring formula are both within the 0,4 sec. It is only the Sabine algorithm, which is set too high, however as mentioned earlier this formula does not take the material into account and is therefore not as reliable as the other equations.

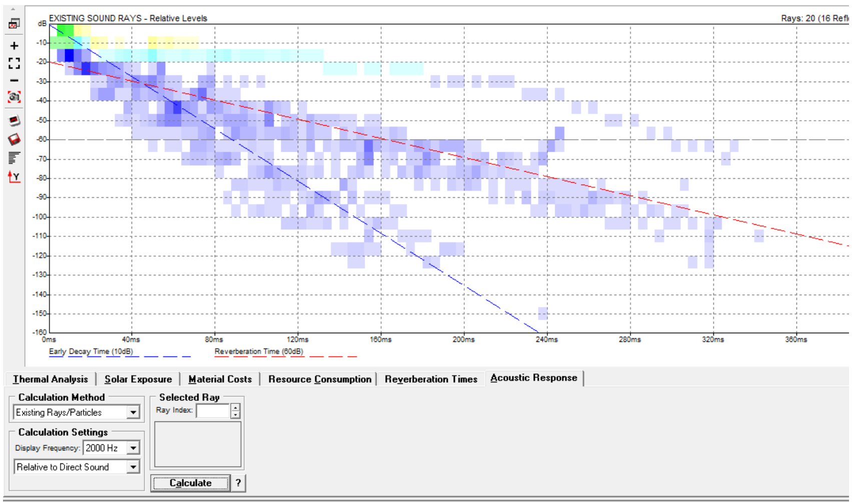


Figure 14.2
This is screenshot is a graph of the sound decay at 2000Hrz in order to check the reverberation and decay in several different frequencies.

Figure 14.3
Screenshot of the classroom again with the particle distribution throughout the space from a single circular sound source.

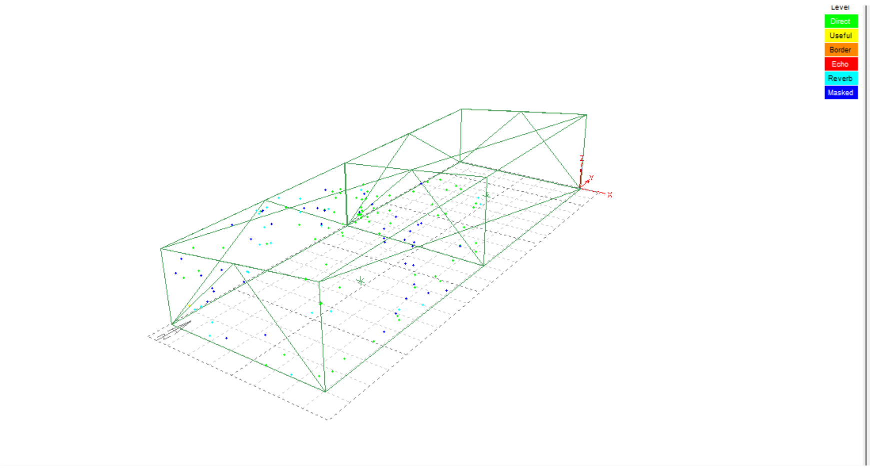
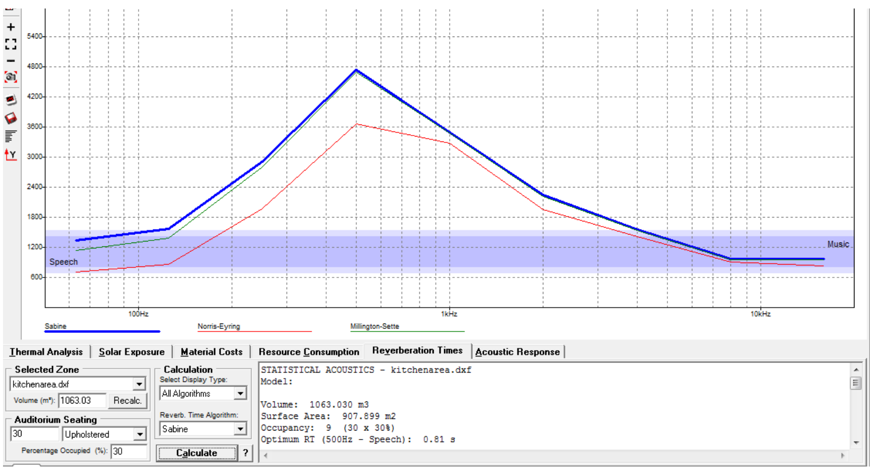


Figure 14.4
This is a graph of the reverberation time in the dayroom without any acoustic panels in the ceiling and entirely clad in timber. This gave a far too lively room that would produce the most horrible echo and would definitely make an uncomfortable environment for both the children and the adults.



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N° 4

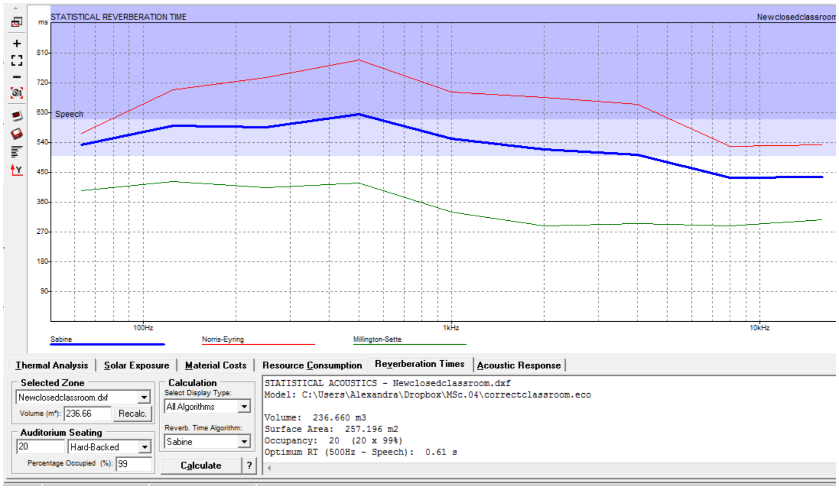

Figure 14.5
Here the acoustic panels have been placed in the ceiling the rest of the materials in the space is timber and glass, which have a very low absorption coefficient.
The graphs are more or less within the required field.

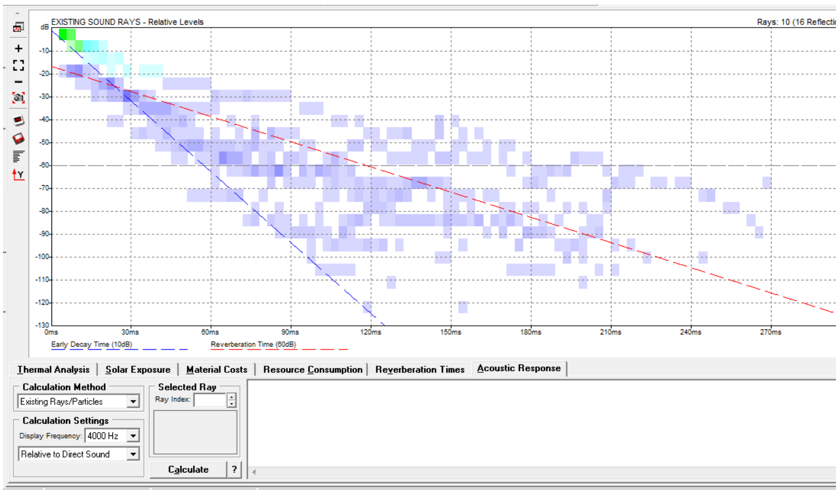

Figure 14.6
The sound decay was also tested for the dayroom for various frequencies here is an example of sound decay at the frequency 4000 Hrz.

Be10

On the scheme below is a list of the U-values and transmission losses of the final design, however as mentioned in a previous chapter the U-values were under constant evaluation. The first grid structure 1m x 1m and 15cm x 15cm had 10 cm insulation between the layers and gave a total U-value of 0,21 W/m2K which is not enough to reach a 2020 energy level even though it is below the 0,30 W/m2K as is the standard today.

Building element	U-value (W/m2K)	**λ-value** (W/mK)	R-value (m2K/W)
Wooden outerwall	0,11		
Wooden pannels		0,12	0,33
Plywood sheet		0,35	0,02
400 mm Insulation		0,034	6,72
Structure		0,12	1,5
Double facade window	0,31		
3-layer low Energyglass			
100 mm Unventilated airgap			0,18
2- layer window			
Double facade Timber members	0,16		
150 mm Glulaminated timber		0,12	1,25
100 mm Insulation		0,035	2,86
300 mm Glulaminated timber		0,12	2,5
Floor	0,14		
Oak flooring		0,182	0,11
72.5 mm Concrete slab with floor heat		2,44	0,04
150 mm Reinforced concrete slab		2,44	0,05
300 mm Insulation		0,034	8,46
Roof	0,13		
Plywood plate		0,35	0,02
300 mm insulation		0,034	6,72
Airgap			0,18
900 mm Glulaminated timber beam		0,12	7,17

A
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Nº 4

Figure 14.7
Detail of foundation, floor and window in the scale of 1:20

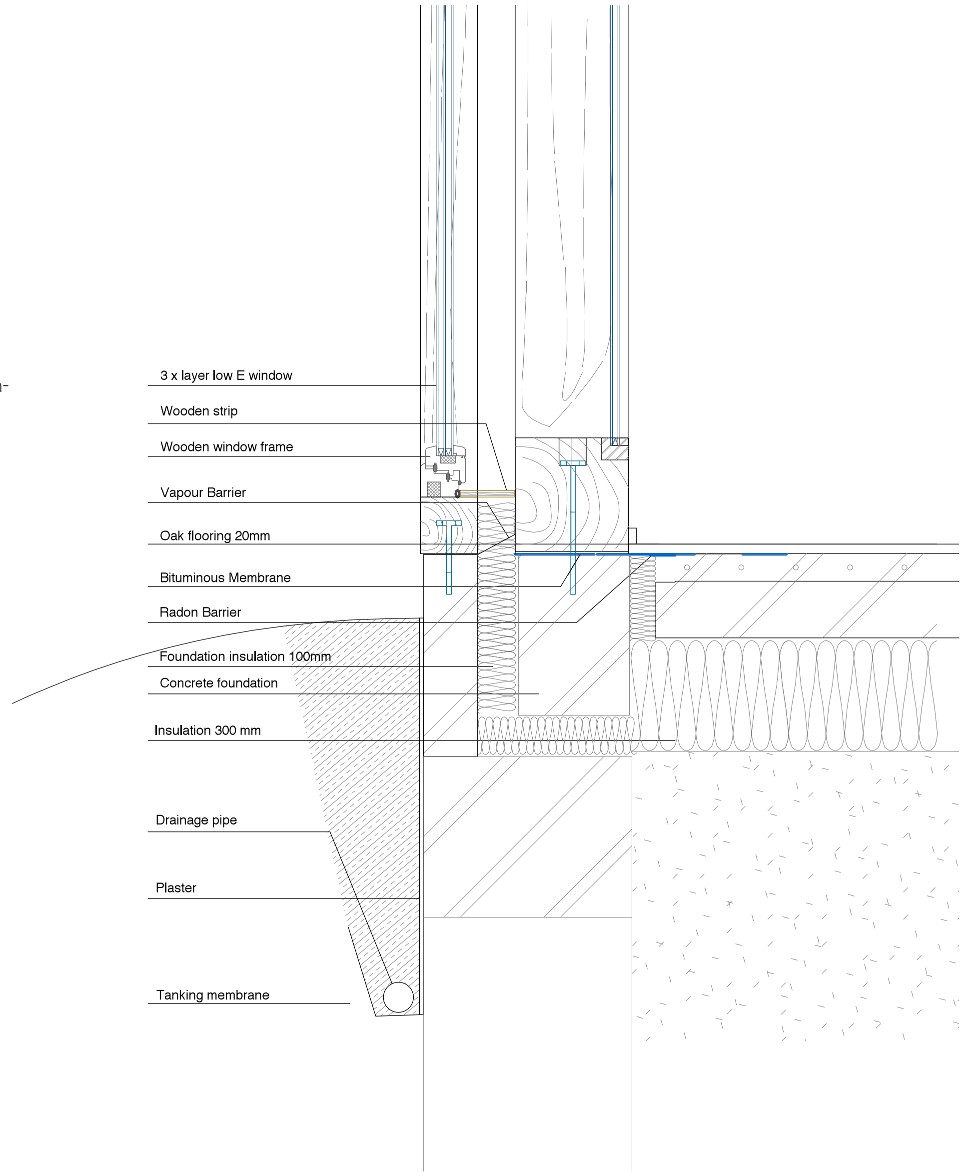
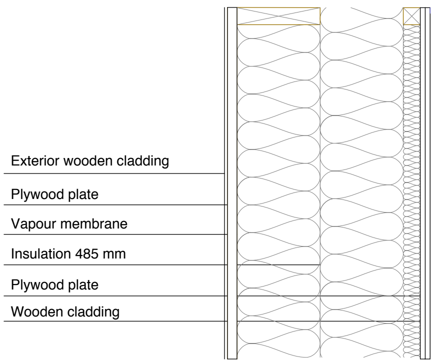


Figure 14.8
Detail of light wooden exterior wall in a scale of 1:20



Not only the U-values of the walls, windows, foundation and roof is needed for the Be10 to make an estimation of the energy consumption. The ventilation rate and the areas that need heating also need to be added to the program. These diagrams give a simple overview of the data applied in the application.

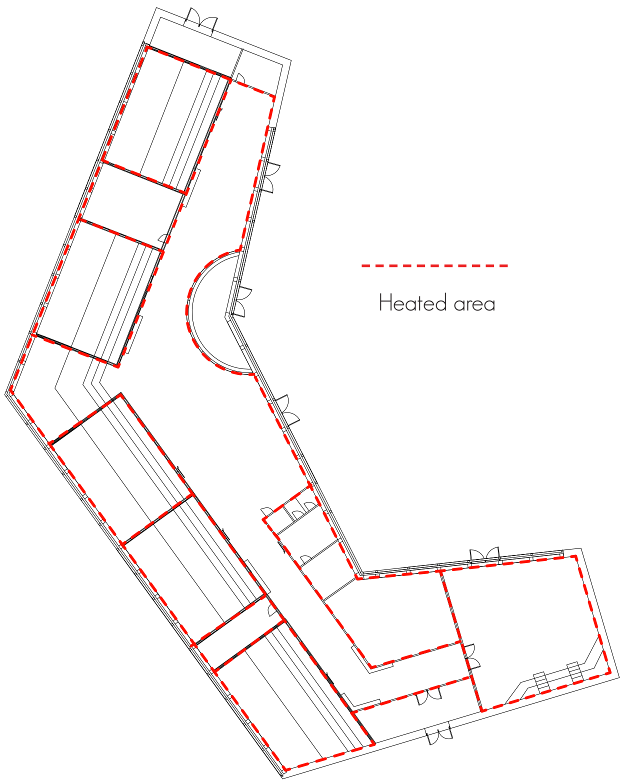


Figure 14.9
A diagram of the building and its spaces. The dashed red line indicates the spaces that are equipped with floor heating

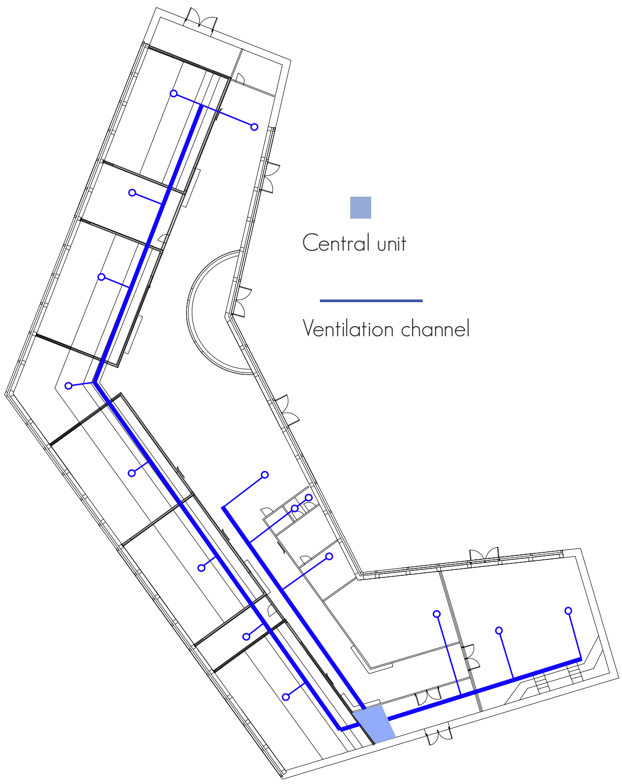
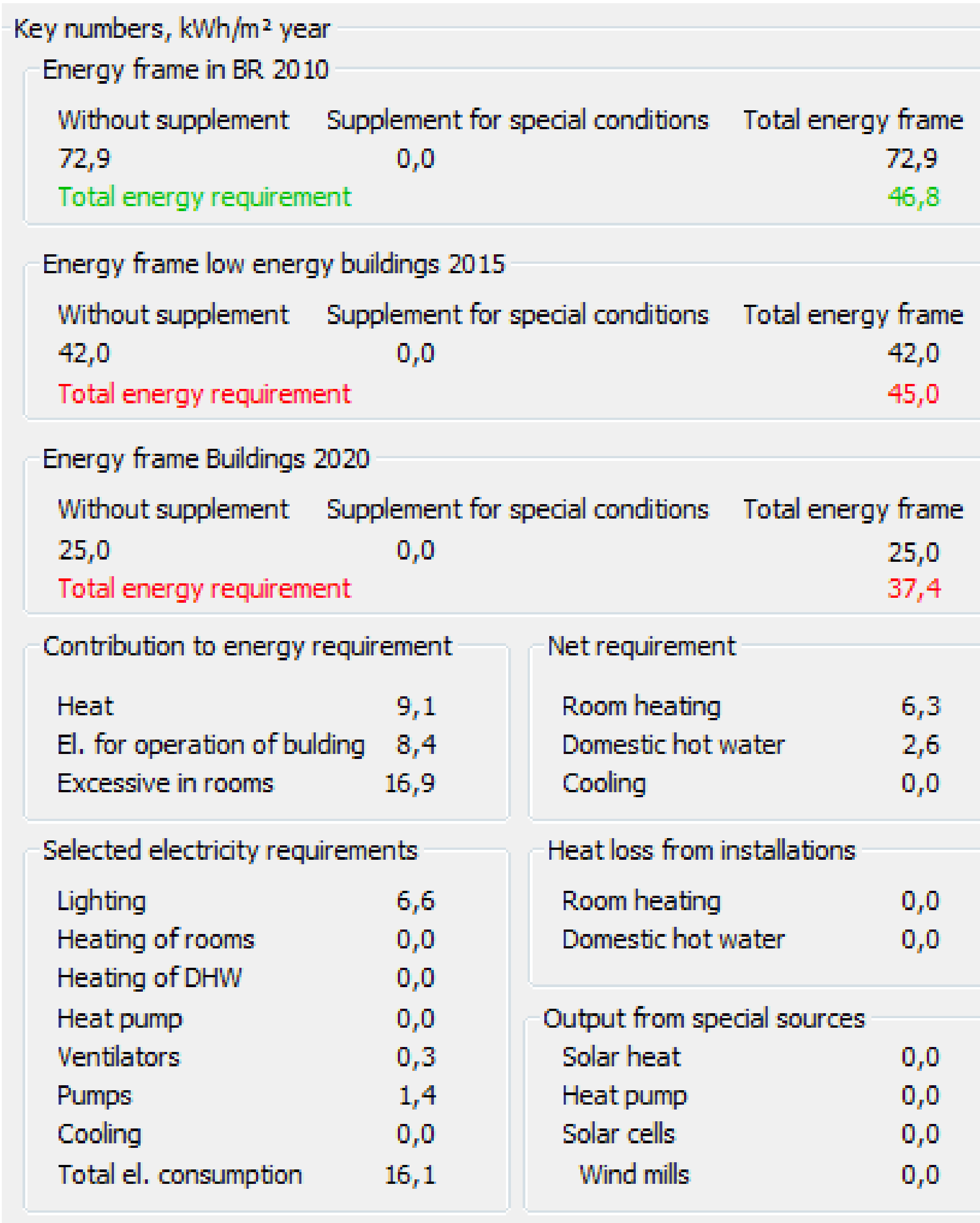


Figure 15.0
A diagram of the building and its spaces. The blue lines are a conceptual idea of how the ventilation channels could flow through the building. The thick lines are the primary channels and the thin lines are the secondary channels providing the facilities with ventilation.
The air supply in a day institution is given by the Danish building regulations the value is set to 0,4 l/s per m^2 and the air exchange rate is $6h^{-1}$

Figure 15.1
A screenshot of the energy key numbers from Be10. This is an overview of the energy consumption of the kindergarten without solar shading.
In the section of "contribution to energy requirement" under the tap "excessive in rooms" gives an indication of overheating in the entire facility. The "Total energy frame" value is calculated different from 2010 to 2020 because it is expected that more renewable energy supply will be present and thus minimizing the energy consumption.



Key numbers, kWh/m² year

Energy frame in BR 2010

Without supplement	Supplement for special conditions	Total energy frame
72,9	0,0	72,9
Total energy requirement		46,8

Energy frame low energy buildings 2015

Without supplement	Supplement for special conditions	Total energy frame
42,0	0,0	42,0
Total energy requirement		45,0

Energy frame Buildings 2020

Without supplement	Supplement for special conditions	Total energy frame
25,0	0,0	25,0
Total energy requirement		37,4

Contribution to energy requirement

Heat	9,1
El. for operation of bulding	8,4
Excessive in rooms	16,9

Net requirement

Room heating	6,3
Domestic hot water	2,6
Cooling	0,0

Selected electricity requirements

Lighting	6,6
Heating of rooms	0,0
Heating of DHW	0,0
Heat pump	0,0
Ventilators	0,3
Pumps	1,4
Cooling	0,0
Total el. consumption	16,1

Heat loss from installations

Room heating	0,0
Domestic hot water	0,0

Output from special sources

Solar heat	0,0
Heat pump	0,0
Solar cells	0,0
Wind mills	0,0

Figure 15.2
A screenshot of the energy key numbers from Be10. These are the final key numbers for the energy consumption of the building with the proper shading. It is quite obvious that the shading helps tremendously with the overheating, as the value is now zero, however this does mean that the energy supply for heating increased a little. This is not a big issue due to the fact that it takes less energy to heat than to cool.

Key numbers, kWh/m² year

Energy frame in BR 2010

Without supplement	Supplement for special conditions	Total energy frame
72,9	0,0	72,9
Total energy requirement		33,2

Energy frame low energy buildings 2015

Without supplement	Supplement for special conditions	Total energy frame
42,0	0,0	42,0
Total energy requirement		30,8

Energy frame Buildings 2020

Without supplement	Supplement for special conditions	Total energy frame
25,0	0,0	25,0
Total energy requirement		22,5

Contribution to energy requirement

Heat	12,1
El. for operation of bulding	8,4
Excessive in rooms	0,0

Net requirement

Room heating	9,3
Domestic hot water	2,6
Cooling	0,0

Selected electricity requirements

Lighting	6,6
Heating of rooms	0,0
Heating of DHW	0,0
Heat pump	0,0
Ventilators	0,4
Pumps	1,4
Cooling	0,0
Total el. consumption	16,5

Heat loss from installations

Room heating	0,0
Domestic hot water	0,0

Output from special sources

Solar heat	0,0
Heat pump	0,0
Solar cells	0,0
Wind mills	0,0

Fire

The kindergarten is made almost entirely out of wood, it is therefore a great necessity to consider the burning rate of the materials and the fire escape routes. The usage category is set to 2

"*comprises building sections for day time occupancy by a modest number of people in each room, in which the people who occupy the building section are not necessarily familiar with the escape routes from the building section but are capable of taking themselves unaided to a place of safety.*"

The escape routes are not allowed to exceed 25 m to the nearest exit and the exit most open out to either a fireproof section or the outdoors. The green lines on the diagram indicates the escape routes none of the routes exceed the limit of 25 meters. The burning rate for the structural elements, this includes the grid, the inner walls and the roof beams are R30, which means it takes up to 30 minutes of direct flames to the material in order for the section to weaken to the point of instability. 30 minutes is more than enough to get 118 people out of a one story building with the required amount of escape exits.
All information to this section was found in BR10 and on KlhUK product information.

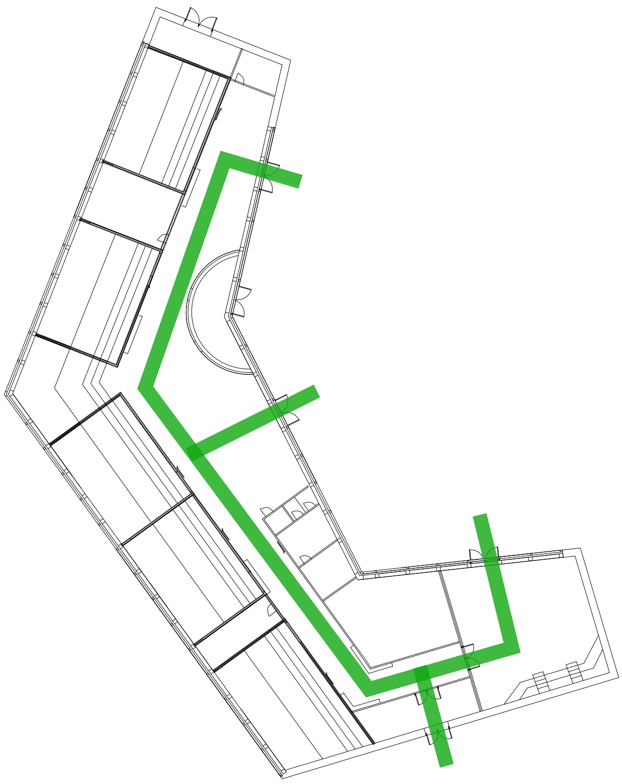


Figure 15.3 Plan of fire escape routes.

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Appendix

N° 4

Illustration list