Kildemosen

Christina Bang Holgersen - MA4-ARK16 - June 2014

Preface

The project Kildemosen is developed by Christina Bang Holgersen, as a part of the final semester of the Master education, from the department of Architecture, Design and Media technology at Aalborg University. The aim for the project is to design one united building for four existing kindergarten in the city of Kolding, Denmark. Through the design of a building that meets the demands of a BR2020 building, is the project dealing with different aspects of sustainability. However the focus is on the social sustainability and how it is possible to combine four different institutions in one and still remember their individuality.

The project report consists of three parts, starting with the presentation of the final result. After the presentation is all the analysis and thoughts which underlies the basis for the final outcome presented first in the program and then the process.

Thanks

I would like to say a special thanks to the kindergarten Kildemosen's head of institution Vibeke Mortensen for the cooperation during the first phases of the project. For letting me take one day of your time to give me an excellent and rewarding tour in your institutions. For the notes with your wishes and dreams for a new building, and for answering my many email.

Thanks to the pedagogues in Kildemosen for letting me ask questions during my tour and for your notes and comments.

And of course thanks to all the children from Kildemosen how participated in my little game of "draw you fantasy kindergarten", it was very rewarding and opened my eyes to crazy and exciting possibilities.

And thanks to Marianne Arnsten Dupont, Sanseslottet's head of institution, for showing me your institution and answering my questions.

Title

Group 16
4nd MSc. Arch, Architecture and Design
Institute of Architecture, Design and Media Technology
Aalborg University
Date: 28-05-2013

Title: *Kildemosen*
Period: *3. February - 28. May 2013*
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Technical Supervisor: *Peter V. Nielsen, Civil Engineer*

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Christina Bang Holgersen

Abstract

This project takes it point of departure in the development of a kindergarten, with the main theme "Sustainable Architecture". The kindergarten is designed with the focus on social sustainability and the children in center, their development and needs. Through an understanding of Nordic Architecture, children's development and different pedagogical methods are the final concept developed.

In addition to the development of the building are the surrounding area designed as a supplement that underlines the building and gives the children many ways to challenge themselves.

03 Process

04 Outtro

05 Appendix

Introduction

As the public sector in Denmark is changing, a lot of smaller government owned institutions are closed down and combined in larger institutions. There are a lot of challenges in combining existing institutions and there are of course pros and cons to it too. From an economical point of view it is easier to run a larger institution because its ability to adapt to the changing numbers of children without having to adjust the numbers of pedagogues. But one of the larger challenges is not to forget the children. They are not just one out of many, but they are individuals which all must have the best conditions to evolve. [Rysgaard 2012]

The project takes its point of departure in four existing kindergartens placed in a residential neighborhood in Kolding, Denmark. These were previously independent institutions placed in four different houses; they are now merged into to one collected institution with only one leader, but are still placed in their own respective houses. To increase the feeling of belonging together it is the intention to building one collected building were all the children and the employees will get a feeling of belonging. [By- og Udviklingsforvaltningen 2013]

The building site is chosen from the municipalities plans for an area in close connection to the already existing kindergarten buildings. The site is approximately 15.000 m2 and is now housing old barrack building. In the plans for the site it is thought to be a new residential area with a dense and low development. But it is a wish from the leader of the institution to use the entire plot for the kindergarten, to create an inspiring playground as well as a new house. The placement of the kindergarten will bring life to the neighborhood during the day. [By- og Udviklingsforvaltningen 2013]

The focus in the project will be on merging the kindergartens into one building and still remember that they come from different places. Give them the feeling of home and still make them one unit.

Method

In preparation of this kindergarten the point of departure has been from the Integrate Design Process as explained by Mary Ann Knudstrup in her paper "Integrated Design Process in PBL". [Knudstrup 2004] This method consists of five phases which forms the base for an iterative process were the phases are fluid and not followed chronological. This enables evaluation as the project moves forward and therefor giving possibilities for adjusting and optimizing the project as it goes.

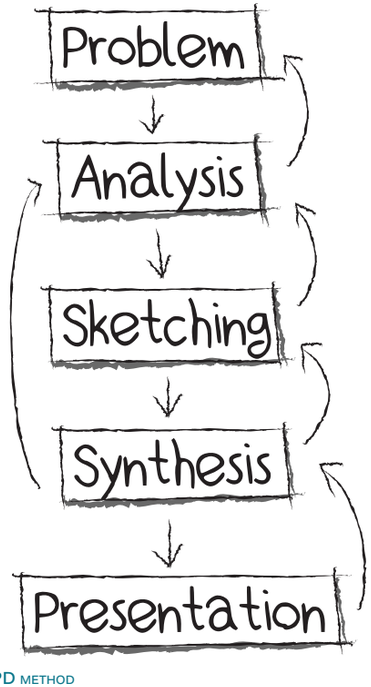
The first phase is Initiating a Problem. This problem is what has to be answered through the following phases. For this project the problem could be e.g.: "How to create a kindergarten that combines the pedagogical practice with good architecture". As there are many way to answer this question the field has to be spread out and specified through the next phases.

Spreading out the field starts in the Analysis Phase. Here all imaginable angles are investigated e.g.: "How could the area influence the design", "Which technical requirement is there for this type of building" and "How does the profession affect the design". All factual data is collected, analyzed with different theoretician and sorted.

With the base of the analysis, the Sketching Phases can begin, making the first lines for the final design. During the sketching new problems could emerge, thus creating a frame for new investigations.

When the design starts to take it form, the project is moving into Synthesis Phases. It is here all the details like construction, flow and materials are starting to take its form. The parameters are optimized and the final design starts to emerge.

The final step is the Presentation. This is where the work are explained and presented so it is understandable. The presentation should be clear in its expression. [Knudstrup 2004]



Ill. 01.02 IPD method

Presentation

Masterplan

Building data

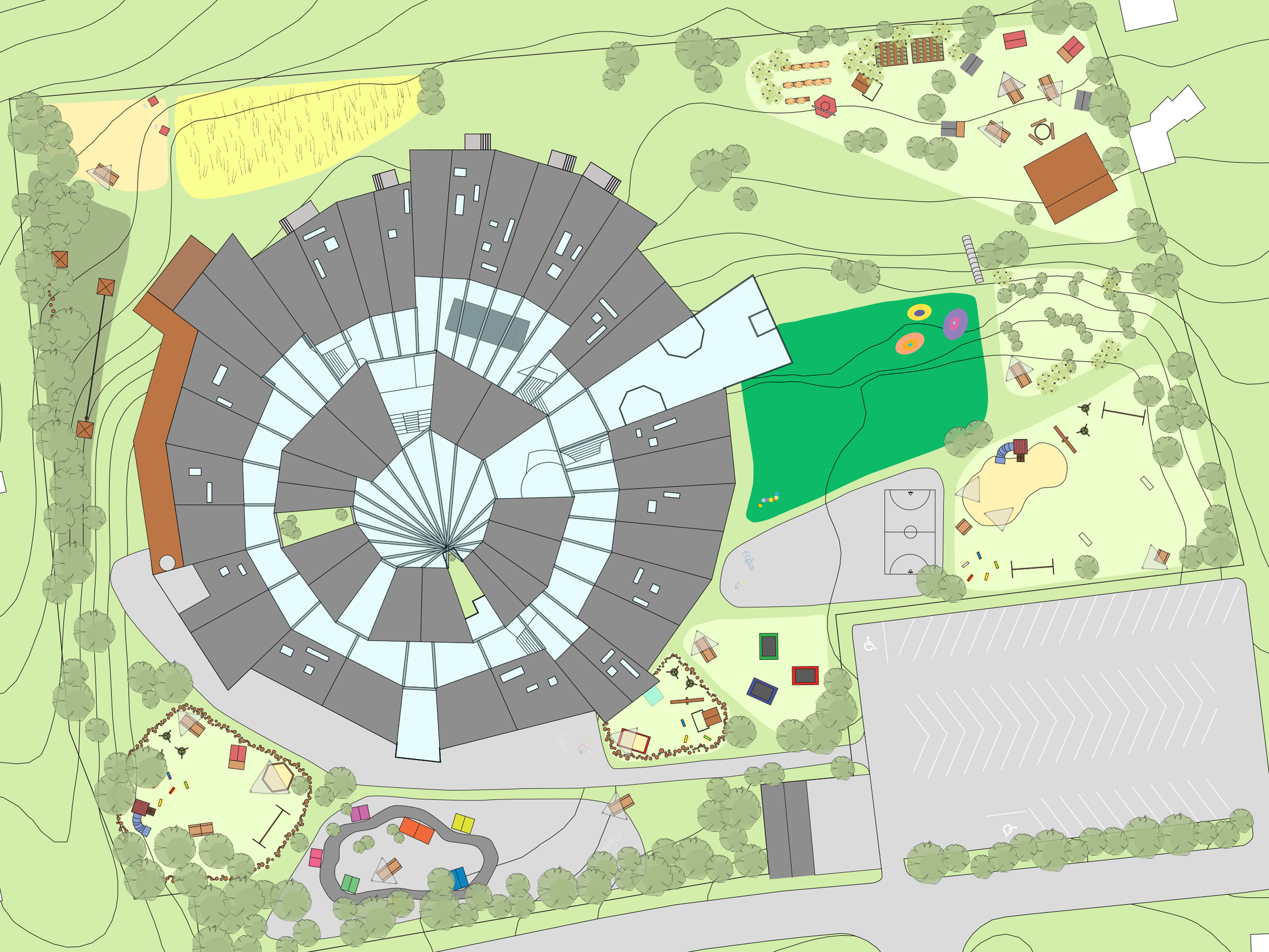
Site area:	15440 m2
Building percent:	29,43%
Heated area:	2705,8 m2
Unheated area:	1837,05 m^2
Building total:	4543,3 m^2
Parking spaces:	60
Handicap parking:	2
Bike parking:	35

6 Kindergarten groups
5 Nursery groups
1 Special Group

The buildings compact shape is creating a large outdoor area with plenty of room for the children to run and play. The area is design to invite to different types of play; an area where the younger kids have the possibilities to play quietly, without the chance of being run over by the larger kids, an area that mimic the allotment garden area connected to the site, introducing a small village with vegetable gardens, a fireplace and animals and a forest like area with swings, trees for climbing and an obstacle course.

Furthermore are there on the playground integrated a small windmill in the village area, only so the children can see the effect it has when it moves and integrated solar panels on the shed where the toilet and outdoor kitchen are placed, they are brought done to the ground level so the children can investigate them.

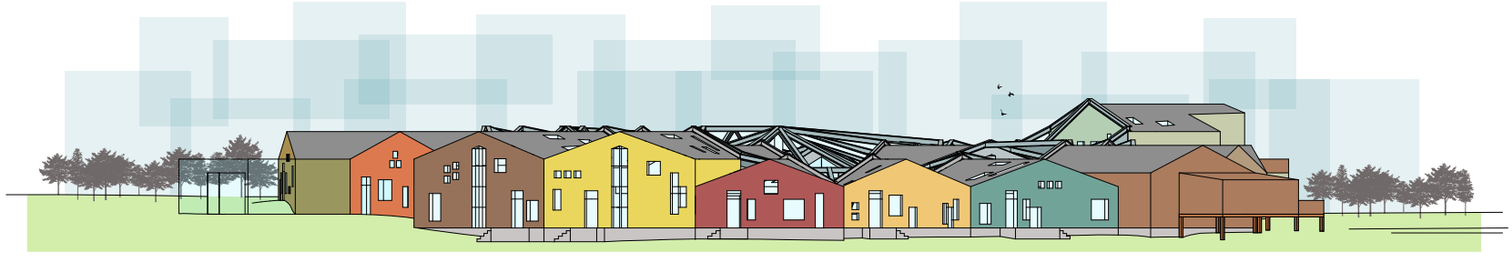
Ill. 02.01 Masterplan - 1:500



Facades

Ill. 02.02 Walk alone the village

All units in the facades have different expression, both in shape and materials. The languages of the units are the same, gabled roofs, but because the width, depth and height are changing so is the slope of the roof. The units are all build in brick, except the stroller room which is wood, but to underline the difference in the building, every unit also has their own individual color. This gives the children a change to find their own group room in this large building, and gives the idea of a small village as you walk along the building facade.



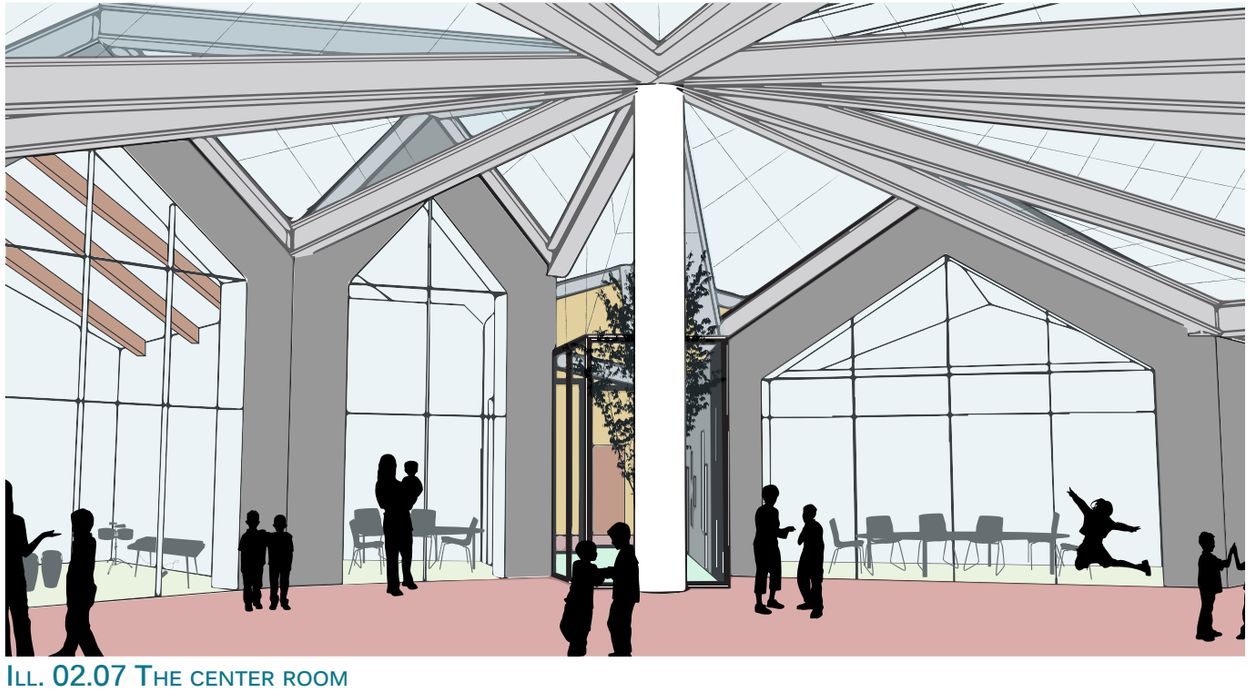
Ill. 02.03 North facade - 1:500

Ill. 02.04 East facade - 1:500

Ill. 02.05 South facade - 1:500

Ill. 02.06 West facade - 1:500

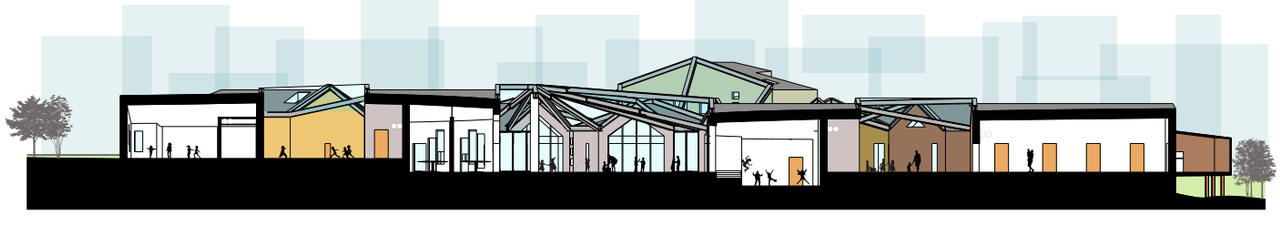
Sections



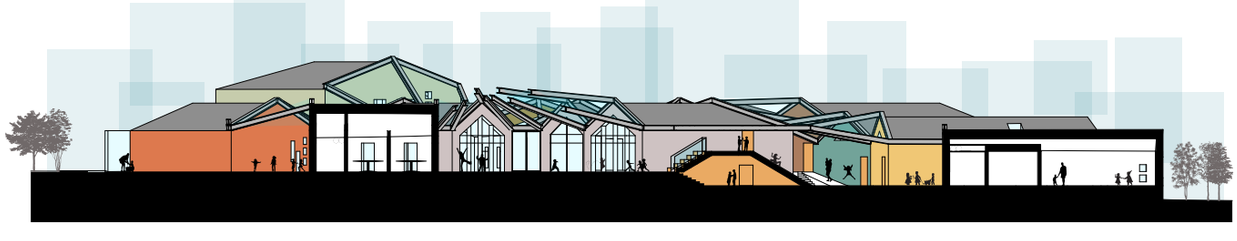
Ill. 02.07 The center room

The sections show the connection between the building mass and the unheated spaces. Section AA shows the lowered multi room that gives the room some extra height and gives it the possibility to be connected to two levels in the building.

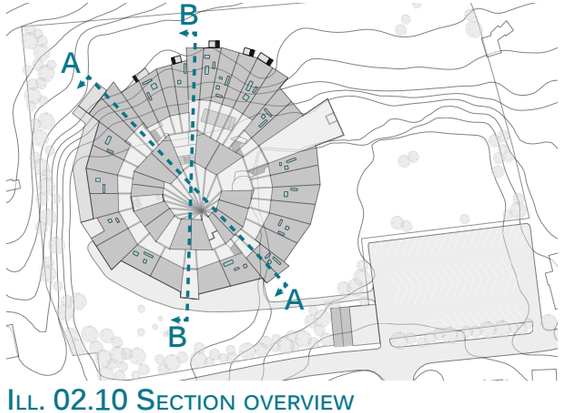
Both sections show the covered hall and how it is changing in expression all the way around in the variation of width and the roofs shape. Section BB also shows the stairs integrated as an amphitheater and climbing wall and underneath it is making room for a small room for different types of play.



Ill. 02.08 Section AA - 1:500

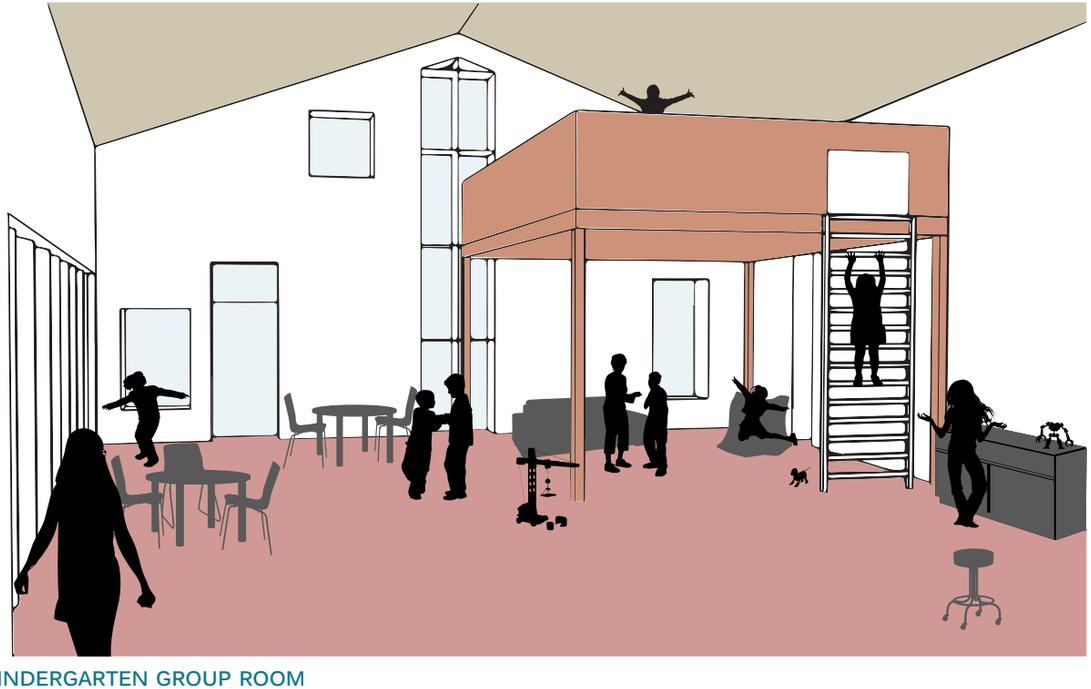


Ill. 02.09 Section BB - 1:500



Ill. 02.10 Section overview

Plan



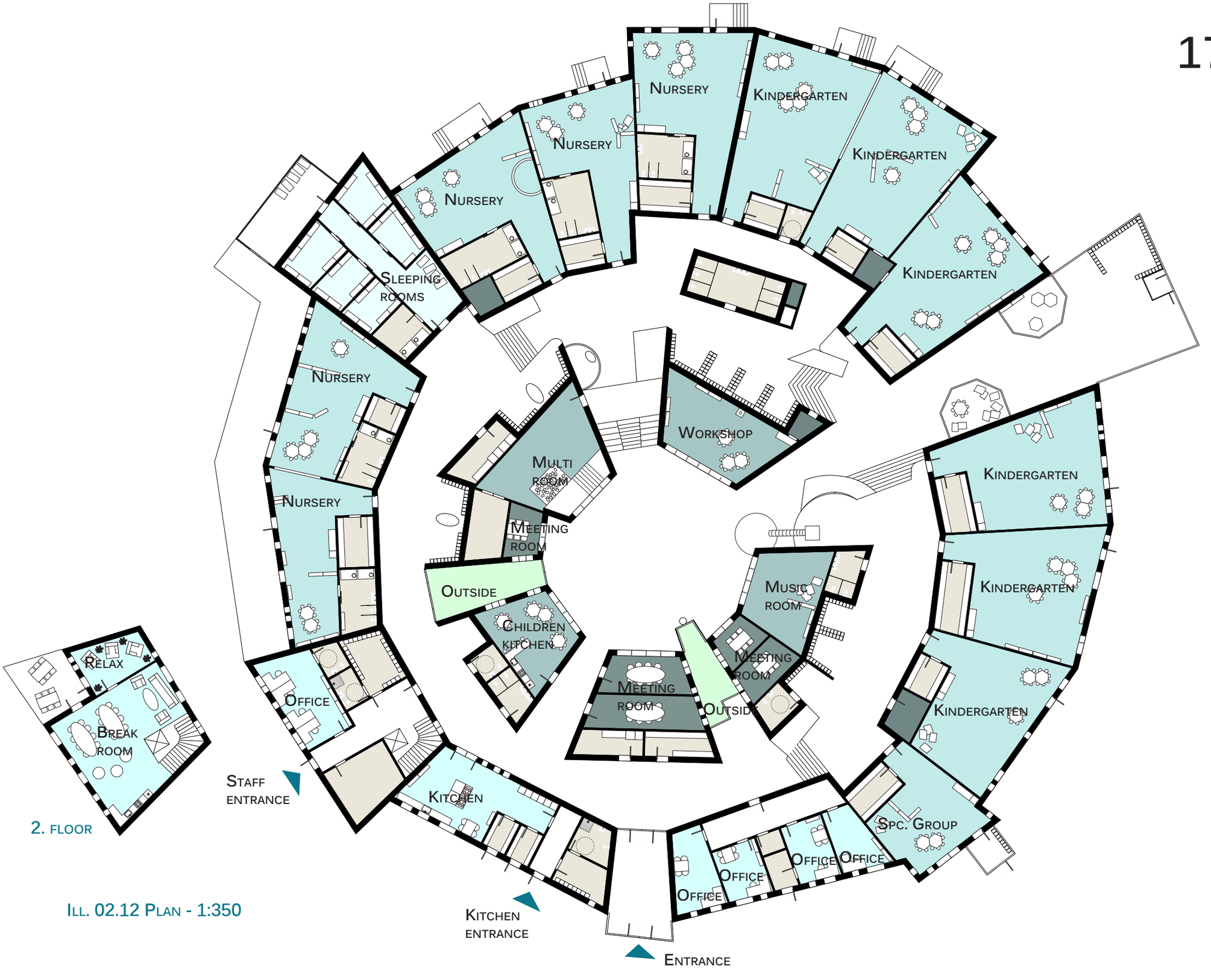
Ill. 02.11 Kindergarten group room

As you walk up to the entrance of the kindergarten you pass by the offices where the leaders and the secretary are sitting, making it easy for newcomers to find, making it easy for the parents so see if they are in for a talk and for them to follow what is happening outside.

From the entrance you arrive at the unheated corridor. This is where the wardrobes are placed in connection to the respective group rooms. There is access to all rooms from the corridor and the distribution of the rooms are made in small clusters, meaning that the different functions are placed in close connection with the rooms that they need to use like all the nurseries are placed in close connection to each other and with easy access to the stroller room.

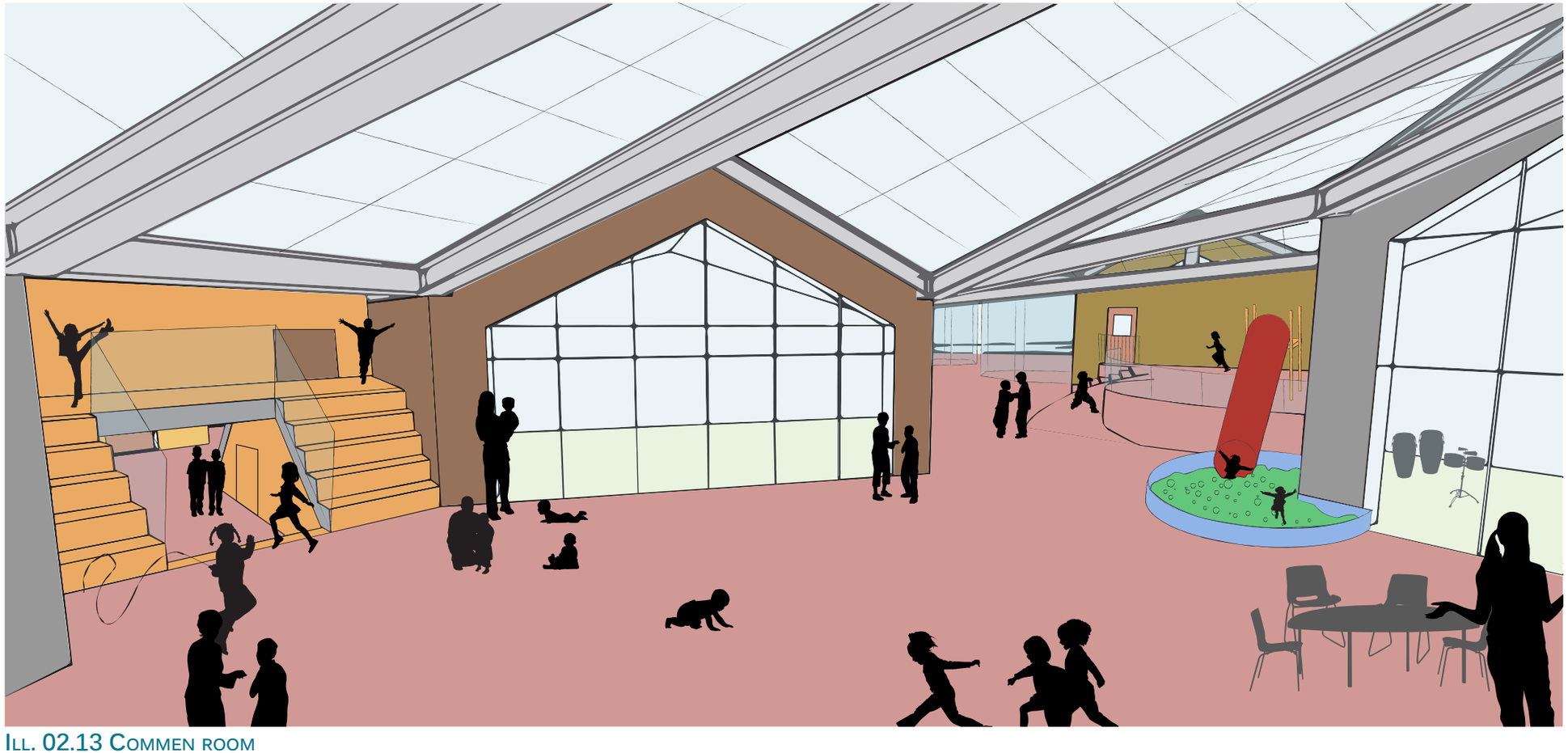
The special group has a more private undertone as it is retracted a bit into the volume so they have the possibility to get the peace that they need, but still be able to be a part of the building.

The common functions are placed in the center of the building giving all the rooms an equal connection to them.

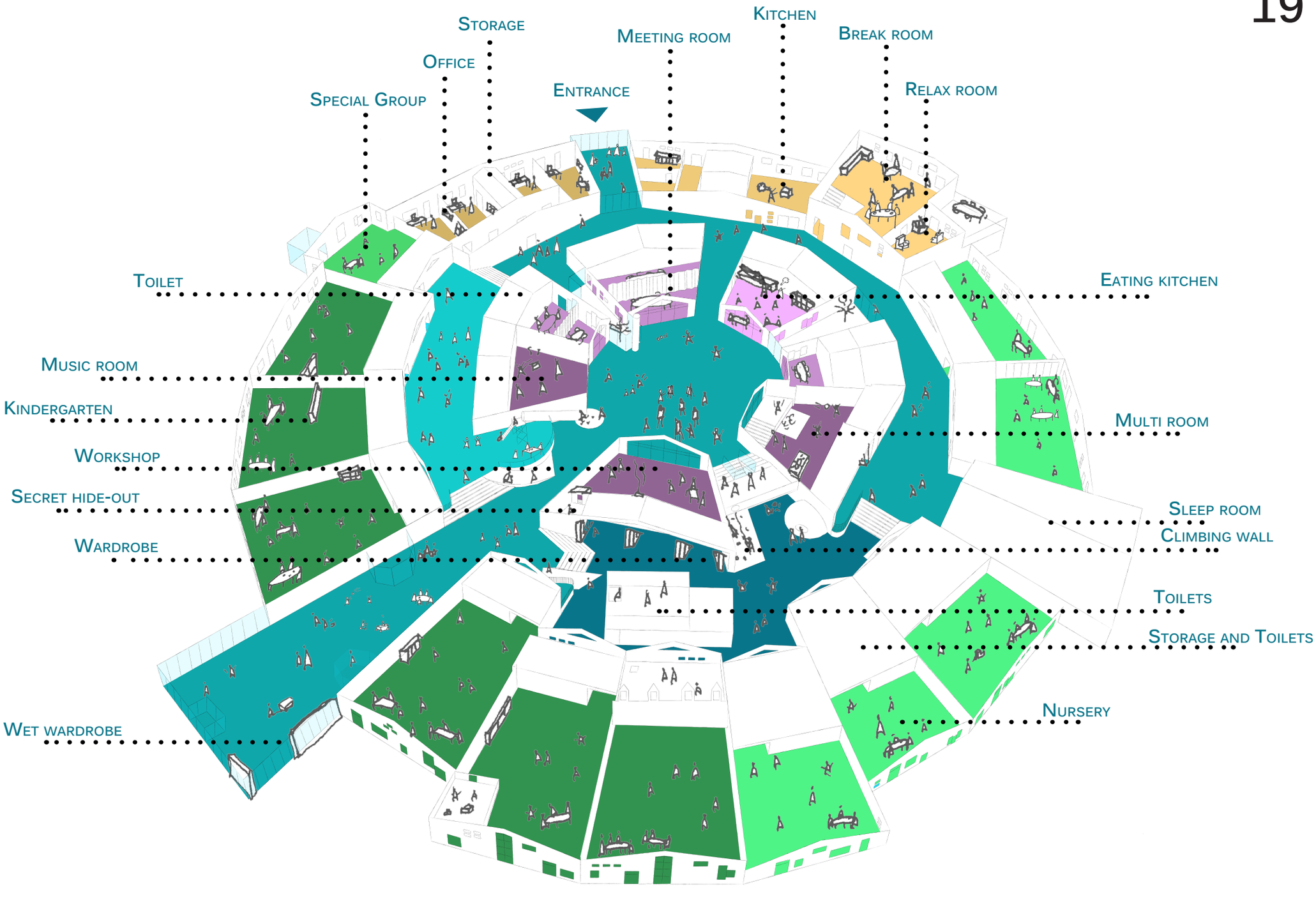


2. floor

Ill. 02.12 Plan - 1:350



Ill. 02.13 Commen room



Ill. 02.14 Spatial drawing

Program

Nordic Architecture

The term Nordic Architecture, can be explained in many different ways and consist of a lot of different subjects. It has in recent year's evoked international interest with its attention to the materials awareness, the traditions of craftsmanship and "the humanly comfort" as Jørn Utzon expresses it. [Kjeldsen 2012; 11] Traditions, history, geographical position and individual experiences that are what creates the Nordic identity, it is personal and social. The Nordic community is often connected with an understanding of wealth. And how is this characterized in the architecture, how is the modern expression of this wealth? [Kjeldsen 2012]

This project is focusing on three factors of Nordic architecture; the context awareness, the light and the materials. The approach of these subjects is described in following sections.

Context awareness

Talking about Nordic architecture, one of the first things that come to mind is the awareness of space and contexts. In Nordic architecture it is significant to understand the culture and community in which the architecture is placed. And as the architecture relate to the surroundings it becomes "a tribute to the landscape" [Kjeldsen 2012; 12] and it gives the locals the opportunity to relate.

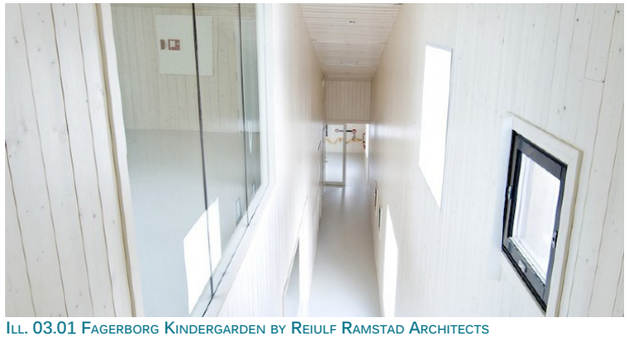
Associated to the understanding of the surroundings, understanding local materials, shapes and economic conditions are also relevant to give the architecture an identity. People relate to architecture through their culture, the local building style and known shapes. Architecture is a reflection of the identity, physical and intangible. [Andersen & Schelde 2012]

It is all about getting people to relate to the architecture, to make a safe environment where they want to dwell. The philosophe Heidegger talks about dwelling and his way of thinking implies that a place to dwell is not just a shelter to keep you from getting cold or wet, it is "the space where life occurs" [Norberg-Schulz 1980; 5], it is the purpose of architecture. [Norberg-Schulz 1980]

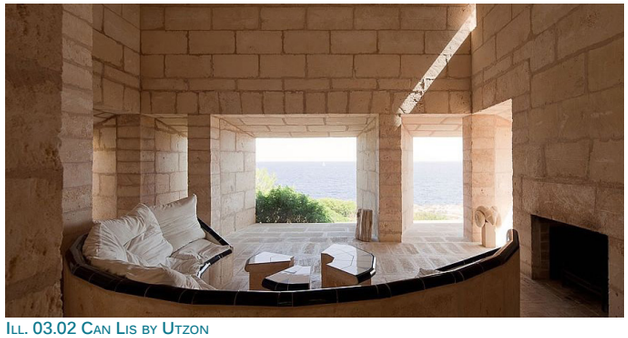
"Man dwells when he can orientate himself with an environemt, or, in short, when he sxperinces the environment as meaningful."
[Norberg-Schulz 1980; 5]

Through this understanding the architecture becomes a small view into the identity of the place and the people living there as well as it create authentic architecture. [Andersen & Schelde 2012]

"Light gives all things their presence"
Louis Kahn
[Norberg-Schulz 1996; 2]



Ill. 03.01 Fagerborg Kindergarden by Reiulf Ramstad Architects



Ill. 03.02 Can Lis by Utzon

Light

Light is not what creates the present of things, but I defines their appearance. It underlines the atmosphere in the room and gives it the present of a feeling. [Norberg-Schulz 1996]

The Nordic approach to light is that it is one of the key factors in how a room is experienced; it is like the sense of place an immaterial substance. Light creates contours and shapes are underlined by shadows. Just by changing opening placement and size the impression of the room will transform and create a different experience. [Rasmussen 1966] To underline the effect natural daylight can have, it is about creating transitions. Transition from darker to lighter, from small rooms to larger rooms, and just by adding more natural light at room will seem more welcoming. [Slavid 2012]

When using natural light it is important to remember that it is linked with the seasons, the weather and the time of day. Remembering this and the architecture could end up benefitting from this instead of suffering under it.

Materials

When talking about materials it is linked to the understanding of the surroundings, just like the sense of place. It is about being true to the local building traditions which includes the local materials. Materials are one of the qualities that can give a building character and the users a sensuous experience. They can be used to combine rooms or separated them with their expression and finish. Materials can also invite to different physical experiences, a smooth surface can invite to a longer stay while a rough surface could encourage to touching.

Looking at the kindergarten in Guntramsdorf by Goya Architects, the use of materials creates a connection between the inside and outside. The interior walls in the hallway continue on the outside creating a visual connection.

Ill. 03.03 Kindergarten Guntramsdorf by GOYA

Sustainability

Sustainability is an expression use a lot these days. It is often used to express a company's take on the environment, to show that they are taking responsibility for their actions and are moving towards a better environmental standpoint. And they use the term without explaining their approach to sustainability, and how they are implementing that in their daily work. [Kongebro & Strømann-Andersen 2012]

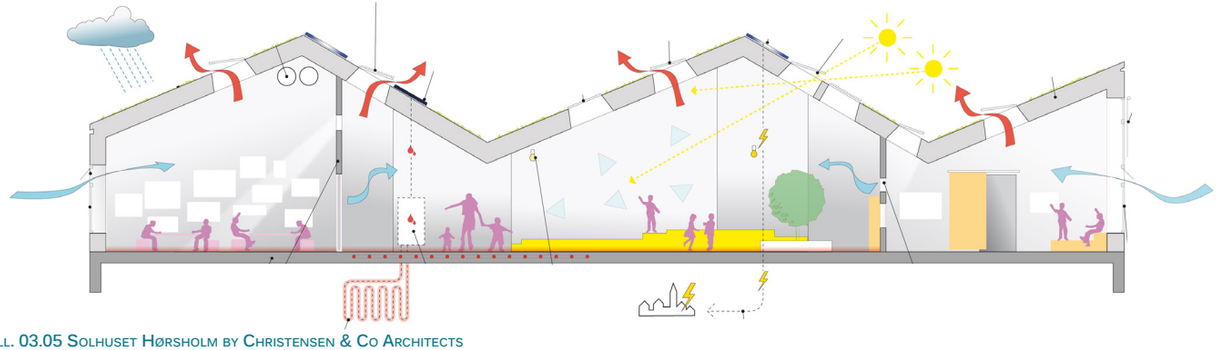
The term sustainability is complex and has a long history. It was in 1987 defined by the World Commission on Environment and Development in their report "Our Common Future" also known as the "Brundtland report". Here one of the conclusions was that the needs for our sustainable present cannot compromise the future generation's needs. [World Commission on Environment and Development 1987]

This is a good starting point, but as the term sustainability is so complex it is necessary to outline the approach to the subject and the focus. [Kongebro & Strømann-Andersen 2012] Sustainability is not just a question of adding more technology; it is to design with knowledge, to take into account not only the energy and environment but also the impact the building will have on the community. [Kongebro 2012, 1] The focus in this report will be on the social and aesthetic aspects as well as on the technical aspects of sustainability, defined in following sections.

Social sustainability

When combining four individual institutions into one single house it is important to remember that they all come from different background, they all have different ways of running their everyday life and suddenly they have to cooperate in getting through the day. The social sustainability is about remembering the community and the impact this building will have. To make this impact a positive one focus must be on not forgetting that they come from different places, give them a place where they can gather and become one unit. [Slavid 2012]

Ill. 03.04 Social sustainability



Ill. 03.05 Solhuset Hørsholm by Christensen & Co Architects

Ill. 03.06 BedZED by Bill Dunster

Aesthetic

Aesthetics is a very used word, which often is used to describe how something looks. In this project the aesthetics will be used to define the approach to how the sustainability is read in the architecture. It is in the interplay between the technology and architecture that there is created energy efficient as well as comfortable and beautiful buildings. [Kongebro 2012, 2] The approach in this project will be on the more modest looking buildings, were the technologies, passive and active, are not so visible, but more integrated into the building mass. Still you have to be able to read the different technologies, passive and active, to make honest architecture.

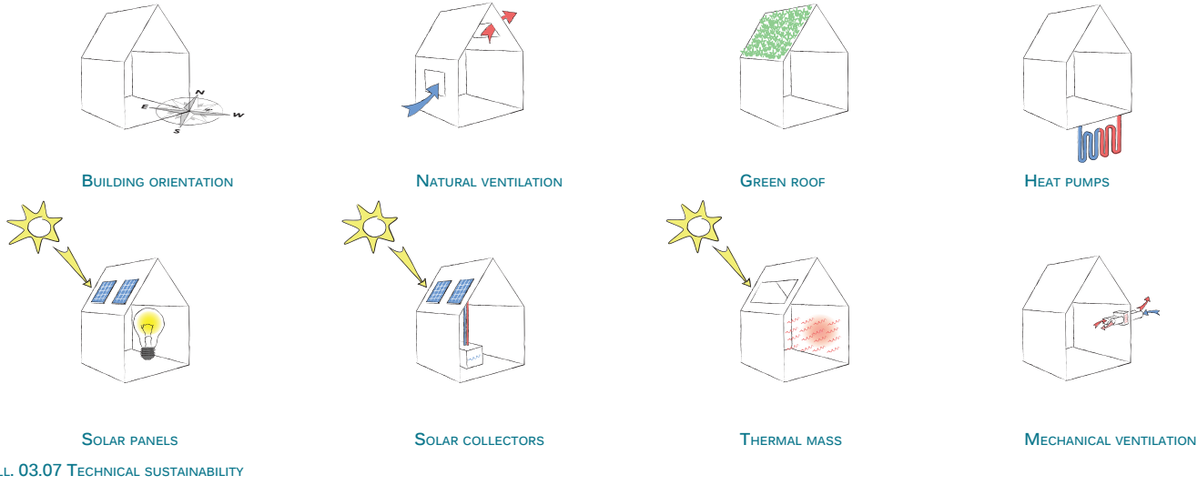
Examples on architecture were the technologies are to visible are the large-scaled sustainable community BedZED in London, England. The buildings are among other things equipped with multicolored chimneys which give the area a distinguished character. Examples on how some of the technologies can be incorporated into the building mass are the kindergarten Solhuset in Hørsholm, Denmark. The roof shape makes it possible to make openings there helps to improve the natural ventilation throughout the building, as well as they create better daylight in the rooms.

Technical sustainability

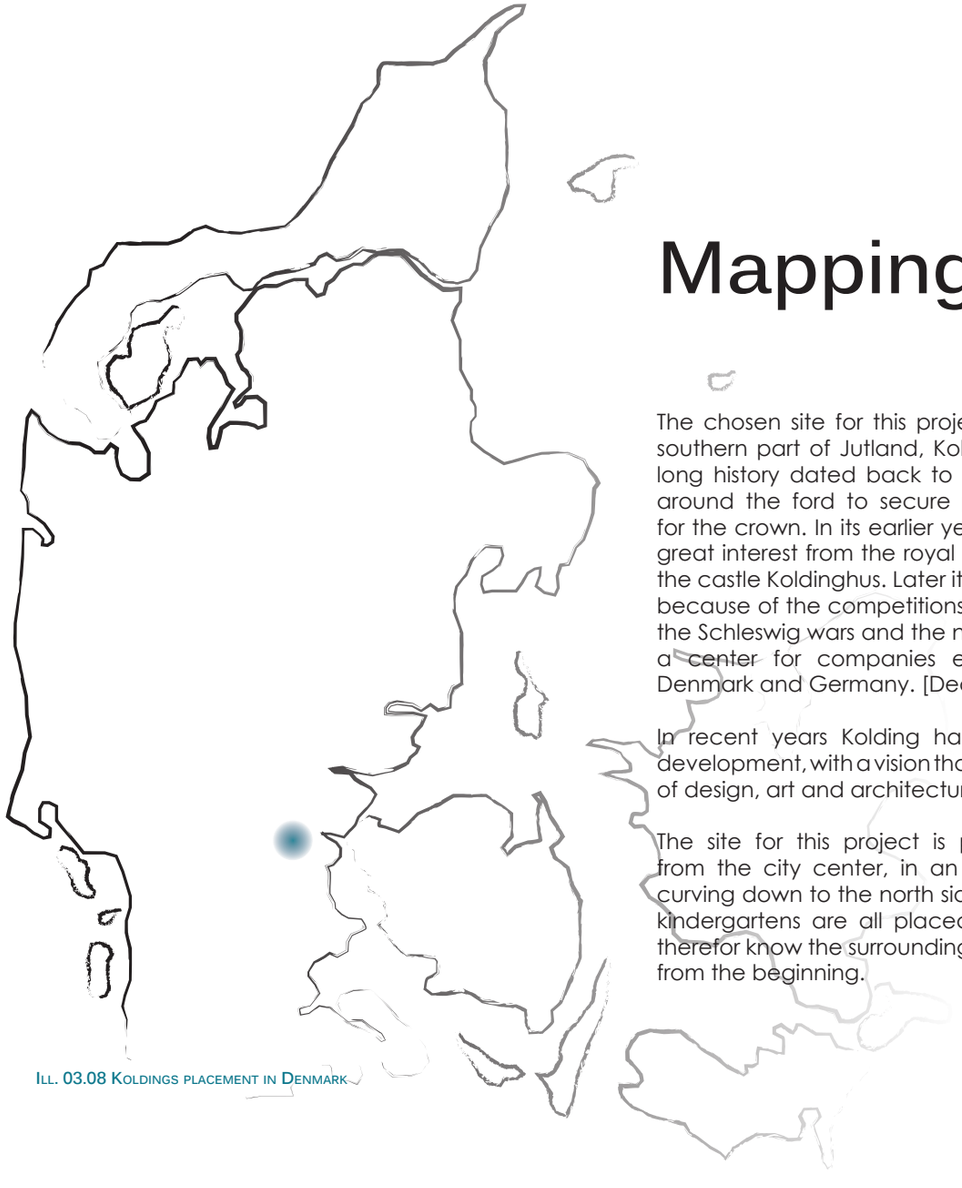
Higher expectation to the performance of the building has led to a lot of challenges when it comes to design buildings that can reach the demands for low energy buildings. The first try to optimize the use of energy led to the so-called "peephole architecture" were the windows were designed so small that almost no daylight entered the buildings, lowering the quality of the buildings. This problematic architecture resulted in new improved types of glass opening up for lighter buildings still reaching the required energy demands. [Lehrskov 2012]

When it comes to optimizing the buildings energy consumption there are two categories to work with. The first is the passive strategies which lay early in the design process. This includes working with the building envelope, the orientation and efficient utilization of solar radiations. The active solutions are elements added on to the building later in the design process, though thought of during the process, like solar panels, heat pumps and mechanical ventilations. [Lehrskov 2012]

These renewable energy sources can be added in different ways. They can be available on the building site, inside the footprint of the building or on the building site itself, or it can be off site, which means that the supply will have to be transported to the site and therefor use more energy for this. [Marszal 2011]



Ill. 03.07 Technical sustainability



Ill. 03.08 Koldings placement in Denmark

Mapping

The chosen site for this project is placed in a city in the southern part of Jutland, Kolding. Kolding is a city with a long history dated back to the 12th century. It emerges around the ford to secure peace and to collect taxes for the crown. In its earlier years the city was marked of a great interest from the royal families who took resident on the castle Koldinghus. Later it struggled as a trading village because of the competitions from surrounding cities. After the Schleswig wars and the new borders, the city became a center for companies exporting products between Denmark and Germany. [Dedenroth-Schou]

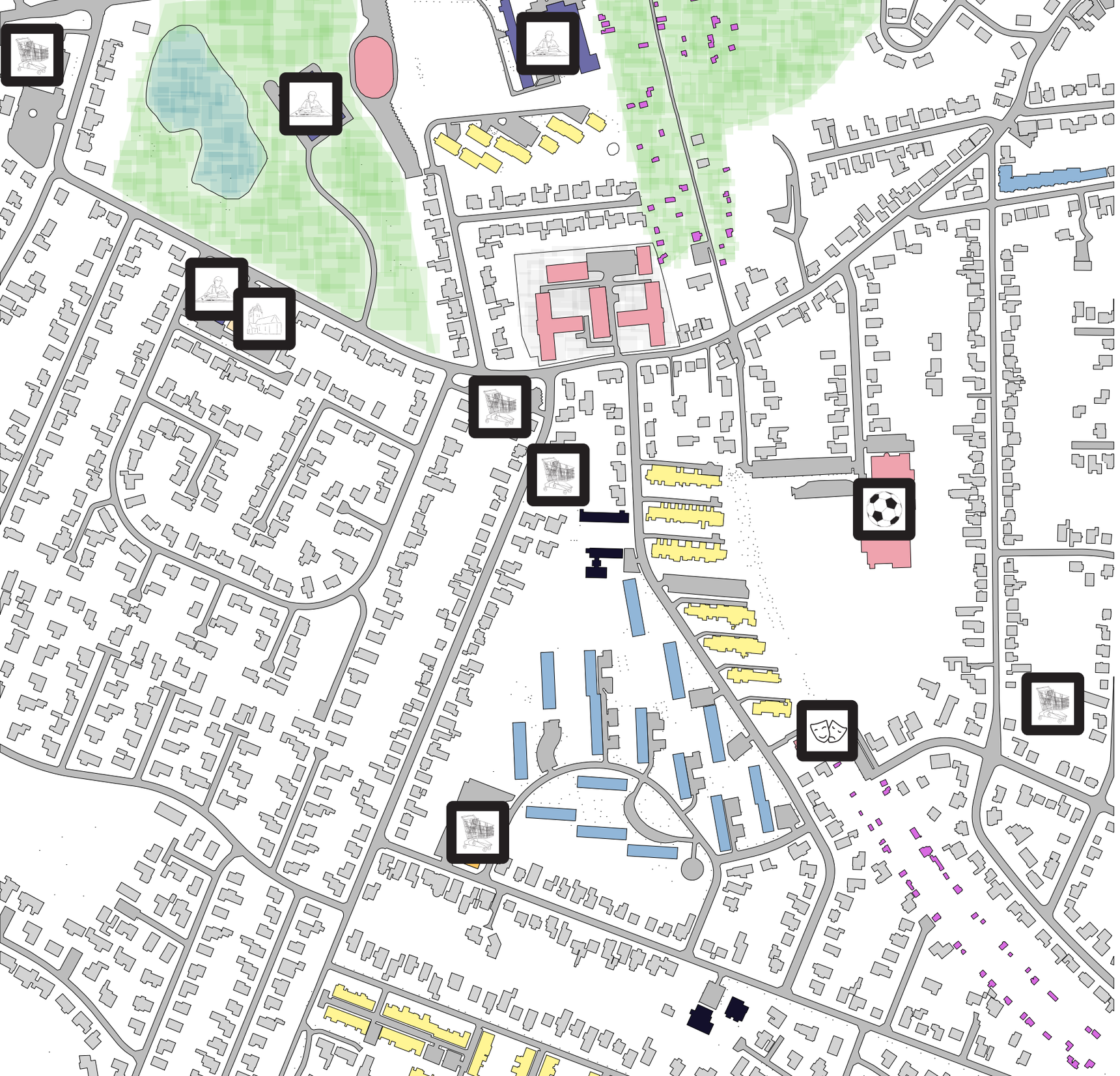
In recent years Kolding has had their focus on urban development, with a vision that focuses on the development of design, art and architecture in the city. [Design Kolding]

The site for this project is placed approximately 2 km from the city center, in an area called Seest, and are curving down to the north side of the site. The existing four kindergartens are all placed near to the site, and they therefor know the surrounding and will be able to use them from the beginning.

The area in close connection to a green belt characterize of allotment garden. This belt expands to a larger area with a small forest. On the building site are there some larger trees, and at the left side of the site is there a larger green area with a small lake. And a forest where the children can play and fish in a small lake is placed approximate 1 km to the south.

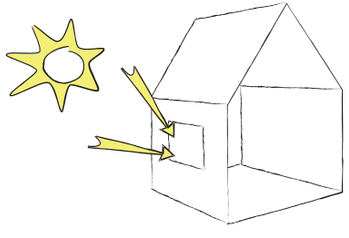
The areas surrounding the site manly consist of residential buildings, both town houses and apartment houses are represented, it is however single-family house there characterizes the area. There are a few other functions like schools, a church, shops and a sports center.

The roads connected to the site are manly suburban street and used for light traffic. But the main road passing the site is connected to a heavy trafficked road that connects the city center with the area. There are small pedestrian paths running in-between some of the buildings, but they manly uses the sidewalk.

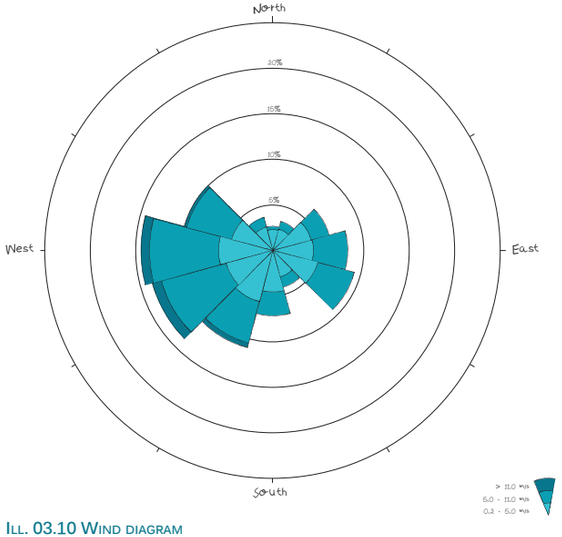


- Different types of shops
- Church
- School
- Sport
- Cultural
- The building site
- Existing kindergartens
- Single family houses
- Town houses
- Apartment building
- Allotment gardens
- Public buildings
- Water
- Green areas

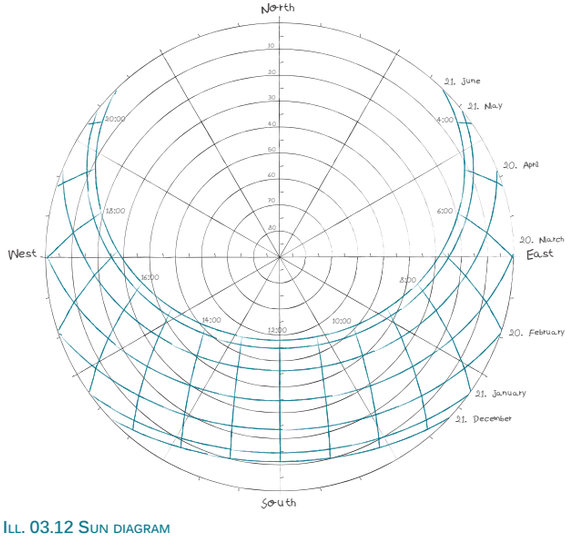
Ill. 03.09 Mapp of the area



Ill. 03.11 The differens between the highest and the lowest altitude of the sun



Ill. 03.10 Wind diagram



Ill. 03.12 Sun diagram

Climatic conditions

Apart from the geographical impacts, the climate has a major influence in the design of architecture.

Sun

As the seasons changes so does the position of the sun. The suns altitude changes from a height in the winter on approximately 10˚, to the summer having a height on 57˚. Likewise changes the path of the sun during the seasons. In winter, in addition to been low on the sky it rises at approx. 8:30 and sets at 15:30, while it in summertime is on the sky from 4:30 to 22:00. This knowledge can be used when shaping a building. To know there to open up and were to create shades.

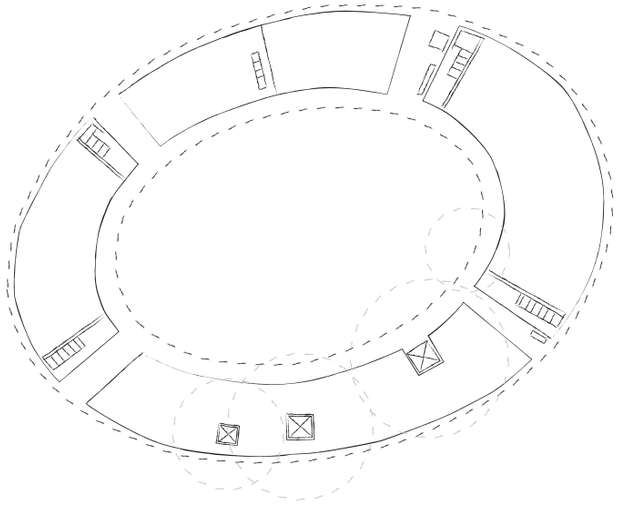
Wind

The wind is zonal and how it acts is affected by the surrounding area. To get an idea of how the wind behaves in the area is measurement from an airfield placed approximately 30 km from the site in Skrydstrup used. That shows that the wind primary comes from west, although when looking at the different months it is shown that the wind shifts from west to southwest. This knowledge can be used when putting in the windows for natural ventilation and when placing the vegetation to create shelter.

Kindergarten architecture

There are a lot of different parameters to consider when designing a kindergarten. The architecture will have to stimulate the imagination of the children as well as preparing them for their further journey in life with creating a strong confident and cooperativeness. It has to been on a level the children understand and at the same time support the pedagogical process. [Klausen 1999] It will have to focus on the children's ability to learn, it is not enough just to create a place where the children can be "parked" while their parents are at work. [Keiding 1999]

Inspiration from different already existing kindergartens is collected in the next section, explaining their origin and why they are used as inspiration. Furthermore a palette of inspiration is showed on a mood board.



Ill. 03.13 Plan drawing not in scale

Fuji Kindergarten

Ill. 03.14 An overall view of the kindergarten

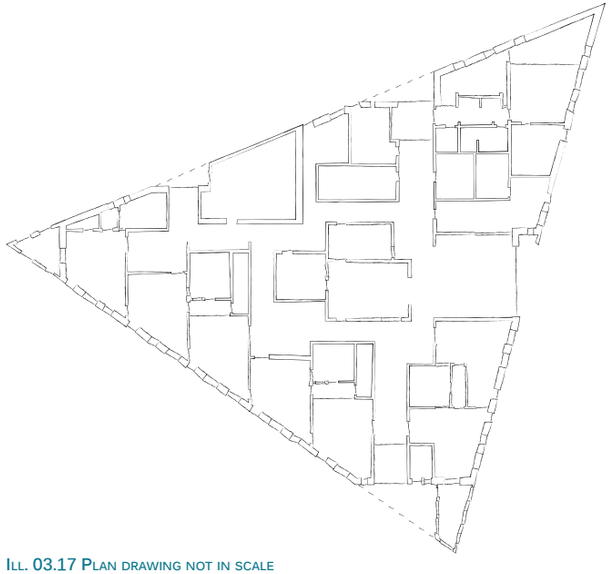
Ill. 03.15 Children playing on the roof

Ill. 03.16 A tree integrated in the interior design

Architect: Tezuka Architects
Location: Tachikawa, Japan
Built: 2007
Size: 1300 m2
Number of children: 500
[Architonic]

The oval shape creates the feeling of a unity, like a small community, even though there is a gap between some of the rooms. The children are free to run in-between them.

They are also allowed up on the roof. This roof create a kind of a race track, children are running laps to see who is faster. But it also creates a possibility for the children to climb the large trees in a safe way. In the preservation of the trees, the kindergarten is built up around them, making an interplay between outside and inside.



Ill. 03.17 Plan drawing not in scale

Solhuset

Architect: Christensen & Co. Architects
Location: Hørsholm, Denmark
Built: 2011
Size: 1300 m2
Number of children: 100
[Horsholm]

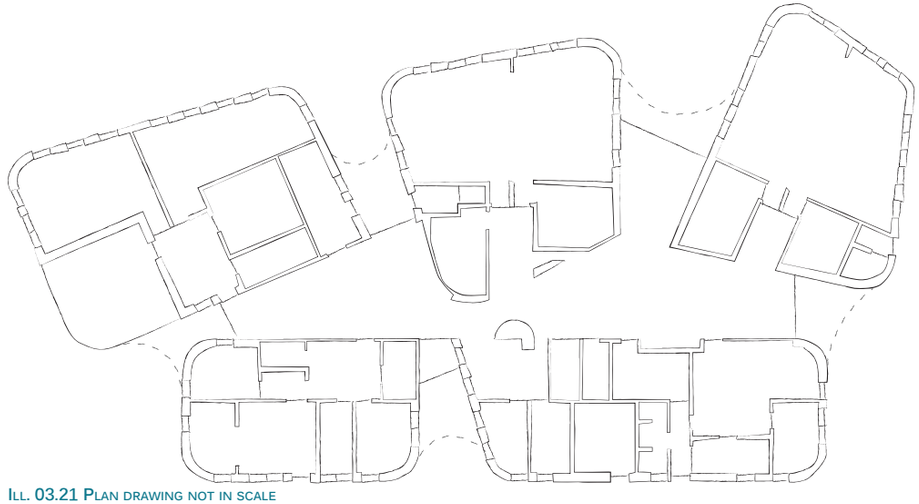
This kindergarten is designed like a small village. The functions are placed in clusters and in-between those runs the streets were the kids can run and play. [Solhuset]

The building shape creates good conditions for both the passive and active technical strategies. The jagged roof shape creates the possibilities for openings that enhance the natural ventilation, while integrated solar panels and collectors can be placed on its south facing surfaces. This makes the kindergarten self-sufficient of energy, the first one in Denmark to produce more than it uses. [Keiding & Skou 2011]

Ill. 03.18 Using the corridors as a part of the play area

Ill. 03.19 Children playing by the window

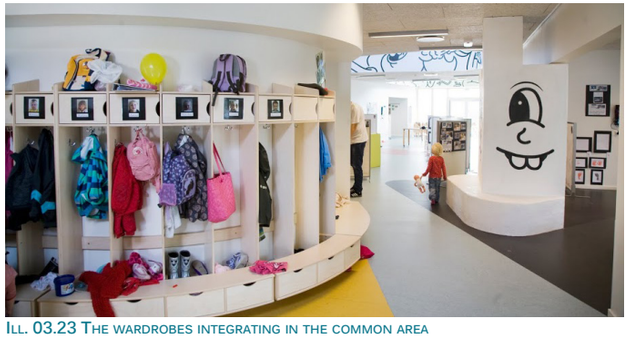
Ill. 03.20 The roof structure covered with solar panels



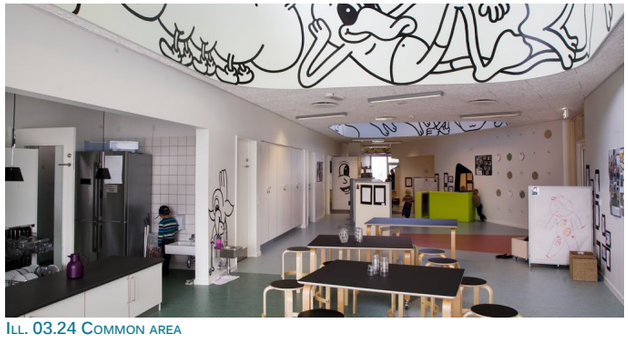
Ill. 03.21 Plan drawing not in scale

Sanseslottet

Ill. 03.22 Outside view of roof structure



Ill. 03.23 The wardrobes integrating in the common area

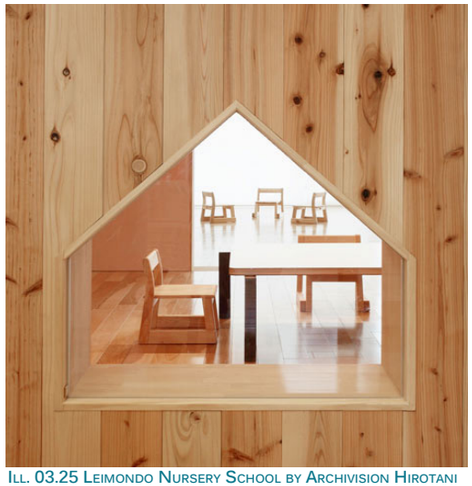


Ill. 03.24 Common area

Architect: CEBRA A/S
Location: Vonsild, Denmark
Built: 2010
Size: 1300 m2
Number of children: 128
[Kolding] [Troldtekt]

This theme institution is a part of the new strategies from Kolding commune. Here design is an important part of the daily routines. Both inside and outside are the children get acquainted with different creative processes. The environment is characterized by art from the artist "HuskMitNavn" and all other details in the building are carefully thought out to underline the playfulness in the institution. [Troldtekt]

The kindergarten is characteristic with the oval shaped volumes, that all creates different shaped rooms. Not to rooms are the same, this challenges the pedagogues to think different in the interior design and gives the children new experiences all though the building.



Ill. 03.25 Leimondo Nursery School by Archivision Hirotani Studio

Ill. 03.26 Tromsø kindergarten by 70°N Arkitektur AS

Ill. 03.27 Pixi Hall Kindergarten by Moriyuki Ochiai Architects

Ill. 03.28 Mirror House by MLRP

Ill. 03.30 Kindergarten in Ramat Hasharon by Lev-Gargir Architects

Ill. 03.29 Taka Tuka Land by Baupiloten

Ill. 03.31 Midtbyens børnehus by Rum Architecture

Ill. 03.32 Unknown

Ill. 03.33 Sjötorget Kindergarten by Rotstein Architecs

Ill. 03.34 Tromsø kindergarten by 70°N Arkitektur AS

Ill. 03.35 Kita Drachenreiter kindergarten by Nathalie Bepler and Lilia Kleemann

Ill. 03.37 Kindergarten Guntramsdorf by GOYA

Ill. 03.36 Timayui Kindergarten by Giancarlo Mazzanti

Users

When designing a kindergarten there are three different user groups. The two main users are the pedagogues and the children. The pedagogues spend an average on 37 hours at the institution, and the children even more. It is their work environment; it is where the children develop. Therefor the building should have a good indoor environment for work, learning and play.

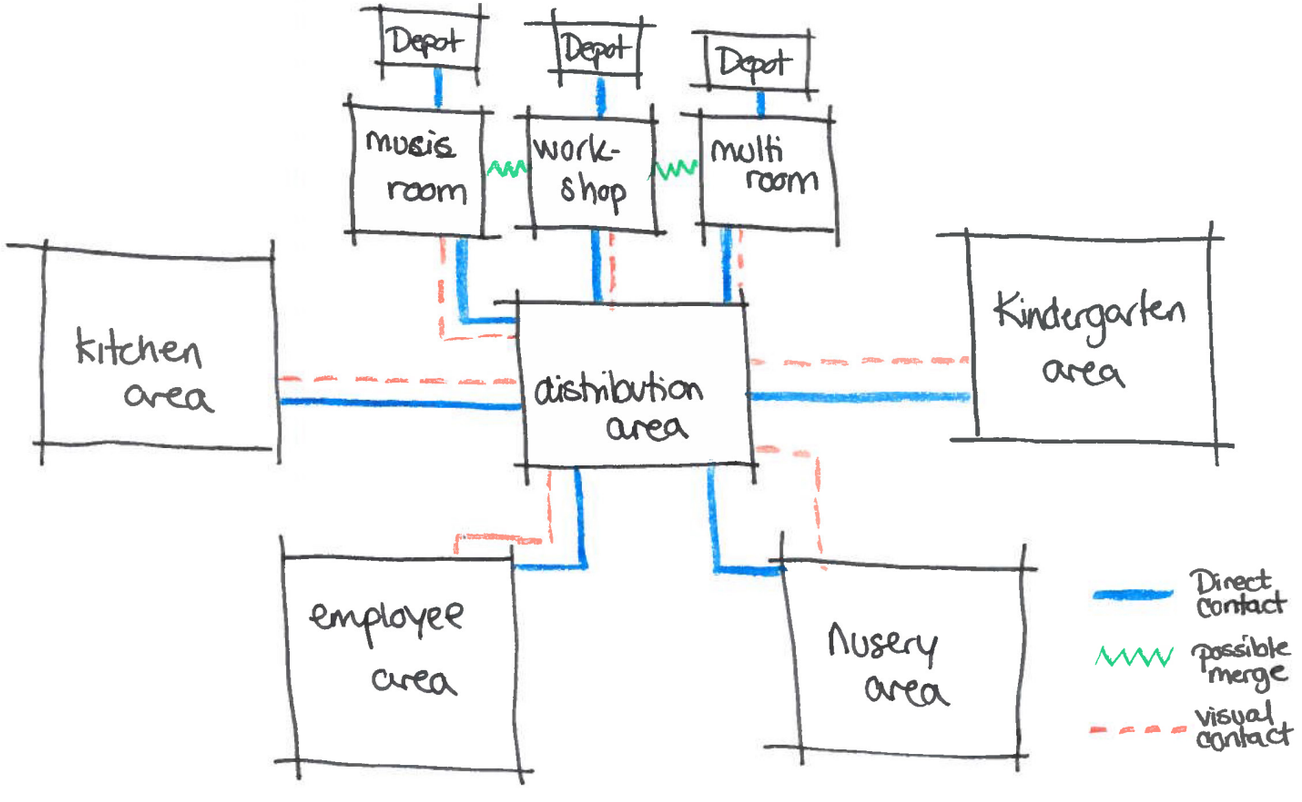
The secondary user group is the parents. Their primary use of the building is delivering and picking up their children and getting information's from the institutions. It should be easy for them to get information's, but as they are secondary users their travel though the building should not be the primarily goal.

Program

This kindergarten is going to create a frame for 184 children, divide into 5 nursery groups, 6 kindergarten groups and 1 special group, and 55 pedagogues and administration staff. The program is made based on a program used for "Børnehuset Mælkevejen" by Frederikhavns Kommune, a conversation with the existing institutions and with inspiration from different literature.

This program created the frame for the design as the first rough sketch. Because of the idea of making an institution that would be able to adapt to the changing number of children is the group room and common rooms in focus, and the wish for making it the highest quality level e.g.: the field guide for new buildings and renovations. [Branchearbejdsmiljørådet]

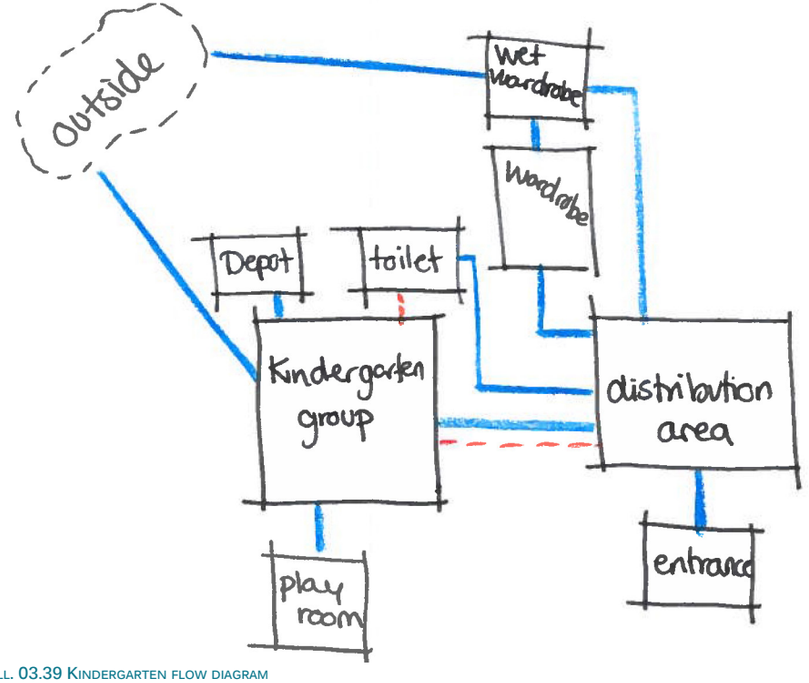
Program					
	Number *[unit]*	**Area** *[m2]*	**Total area** *[m2]*	**Max. People load** *[Children]*	**Max. People load** *[Pedagogues]*
Nurserygroups	5	54	270	12	4
Nursery depot	5	10	50	-	-
Nursery toilet	5	10	50	2	2
Playrooms	5	5	25	3	-
Wardrobe	5	10	50	12	4
Wet wardrobe	5	10	50	12	4
Cleaning room	1	10	10	-	-
Strolerroom	2	50	100	24	8
Kindergartengroups	6	70	420	20	3
Kindergarten depot	6	10	60	-	-
Toilets	3	10	30	4	1
Playrooms	6	5	30	2	-
Wardrobe	6	10	60	20	3
Wet wardrobe	6	10	60	20	3
Special group	1	36	36	8	4
Special depot	1	10	10	-	-
Toilet	1	5	5	2	1
Playroom	2	5	10	2	-
Wardrobe	1	5	5	8	4
Wet wardrobe	1	5	5	8	4
Leader office	3	15	45	-	3
Sekretary	1	10	10	-	3
Print/Copy room	1	5	5	-	2
Print/Copy depot	1	5	5	-	-
Employee offices	1	15	15	-	5
Large meetingroom	2	20	40	-	12
Small meetingroom	6	10	60	-	6
Employee lunch room	1	55	55	-	55
Relax room	1	15	15	-	4
Wardrobe	1	30	30	-	55
Toilet with bath	4	5	20	-	1
Production kitchen	1	50	50	-	5
Depot	1	12	12	-	-
Cold-storage	1	12	12	-	-
Wardrobe (kitchen staff)	1	10	10	5	5
Toilet with bath	1	5	5	1	1
"Children" kitchen	1	6	6	10	2
Eating area	1	30	30	50	10
Music room	1	30	30	20	2
Depot for musicroom	1	10	10	-	-
Multi room	1	50	50	20	2
Depot for multiroom	1	10	10	-	-
Workshop	1	50	50	20	2
Depot for workshop	1	10	10	-	-
Depot	1	20	20	-	-
Cleaning room	1	10	10	-	-
Technical room	1	10	10	-	-
Total area			1951		



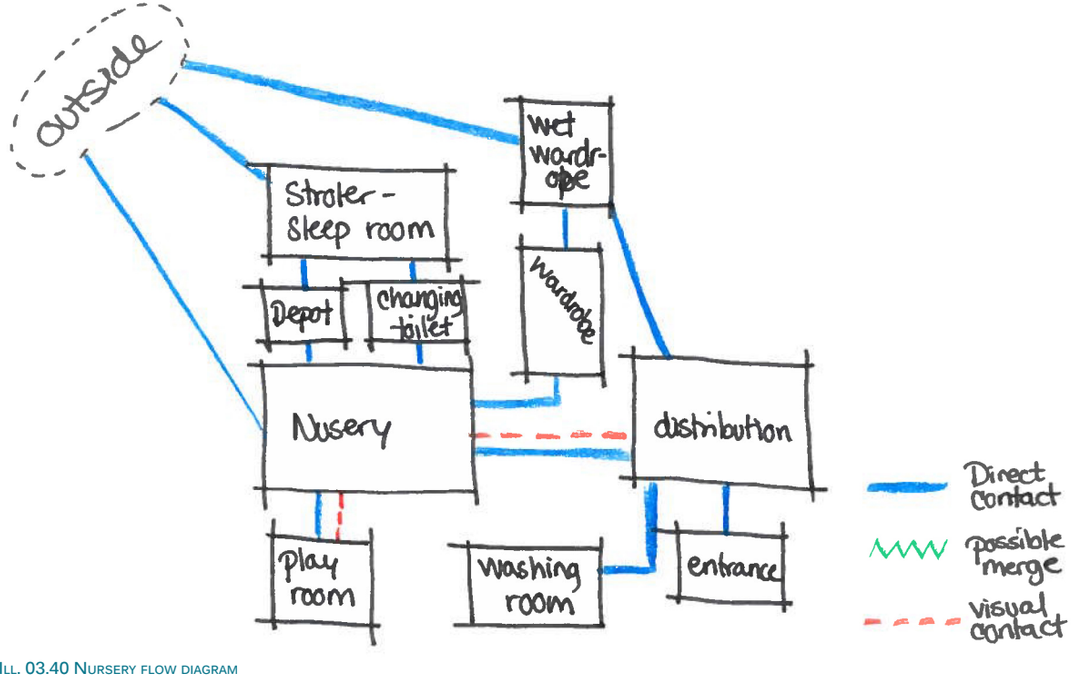
Ill. 03.38 Overall flow diagram

Flow diagram

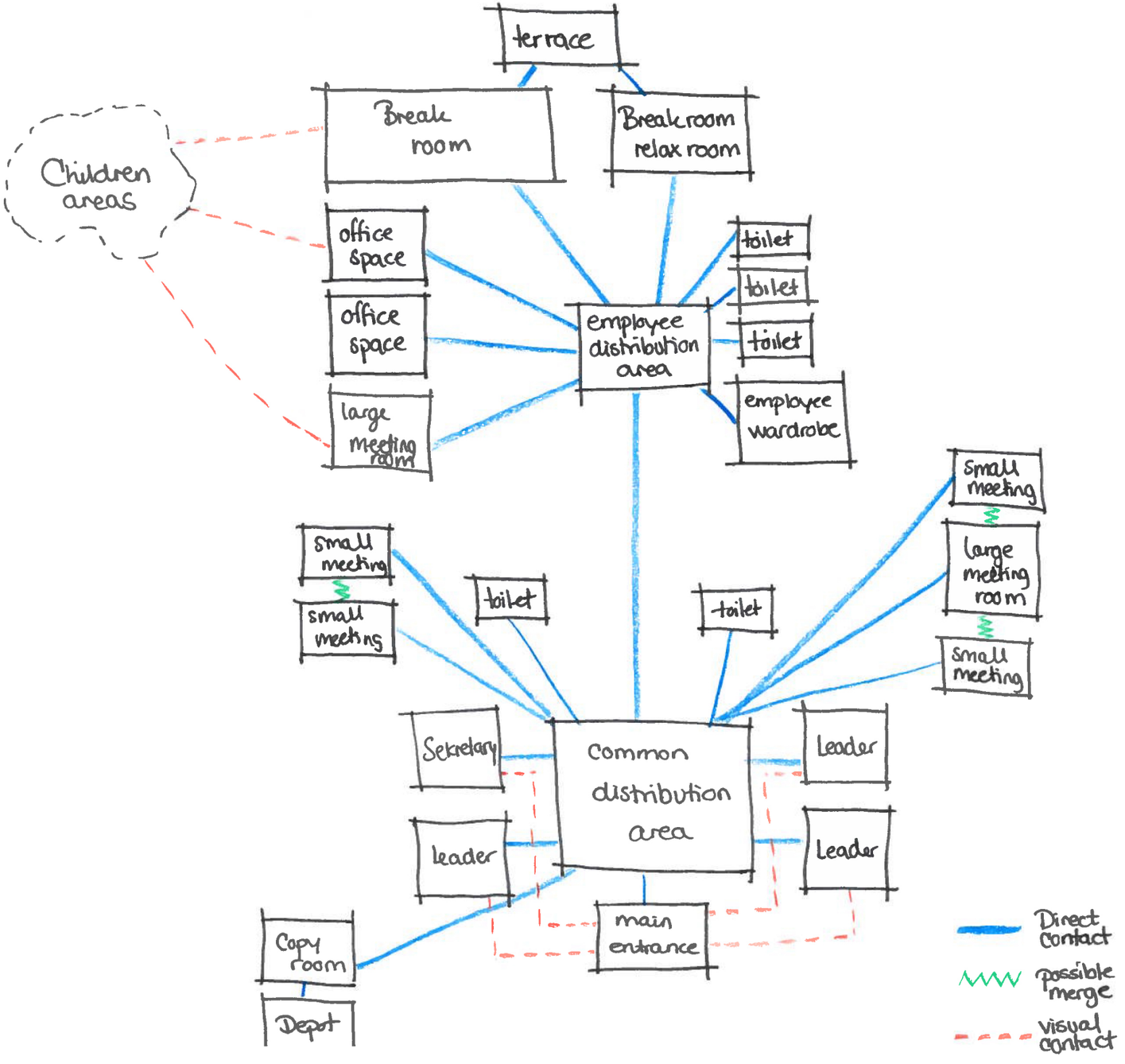
Based on the program and in cooperation with pedagogues and the leader of the existing kindergarten different diagram was made showing the wanted flow in the building. As the kindergarten is a complex building, are the diagrams made separately, one for the overall idea and the connections and the one for each area; kindergarten groups, nursery groups, employees and kitchen.



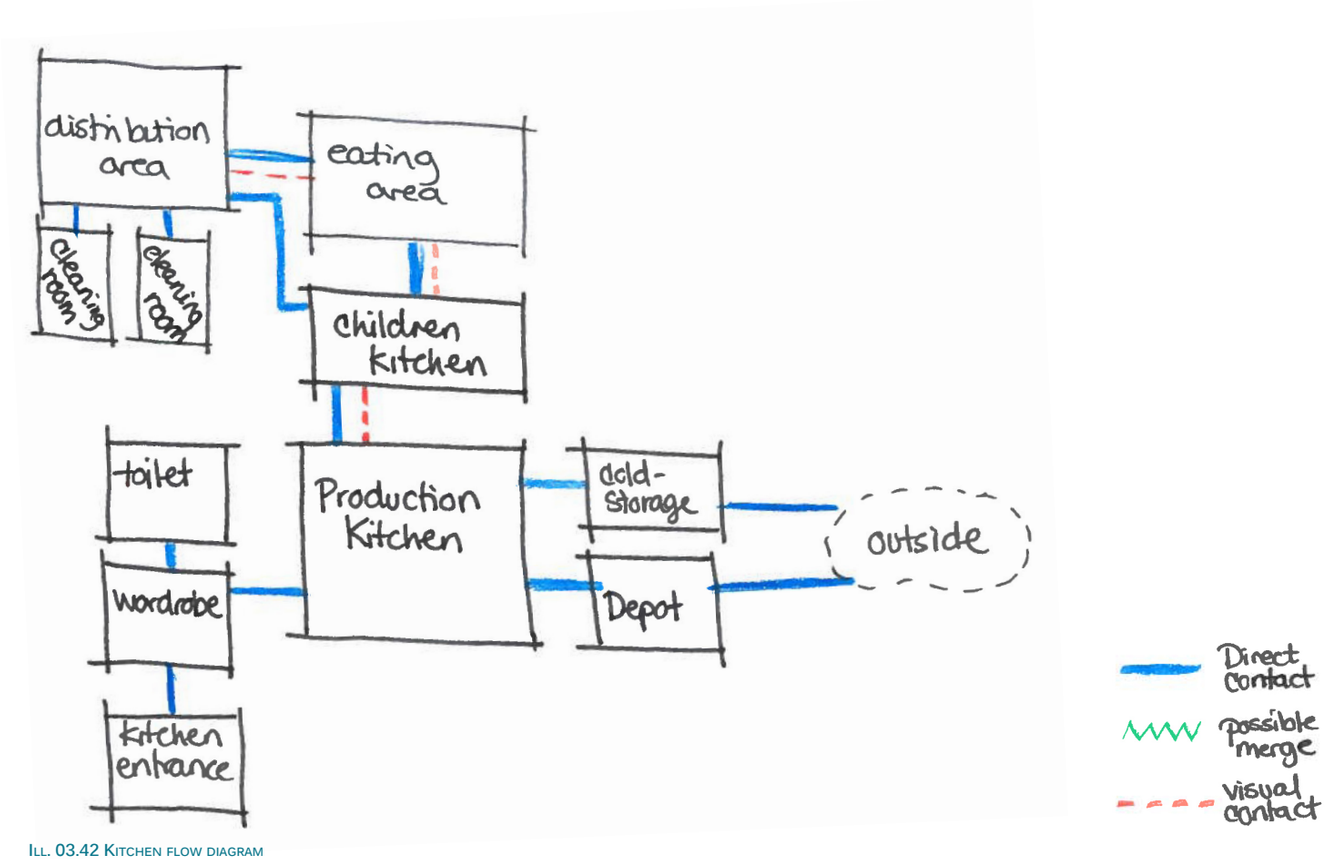
Ill. 03.39 Kindergarten flow diagram



Ill. 03.40 Nursery flow diagram



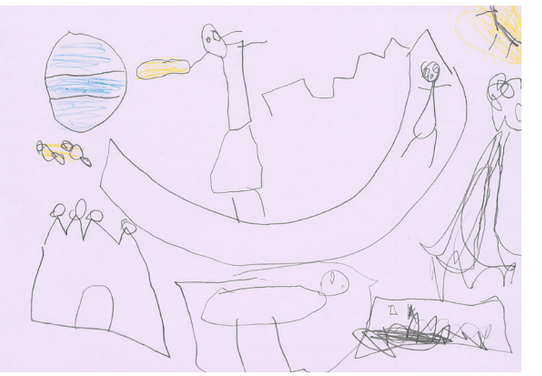
Ill. 03.41 Employees flow diagram



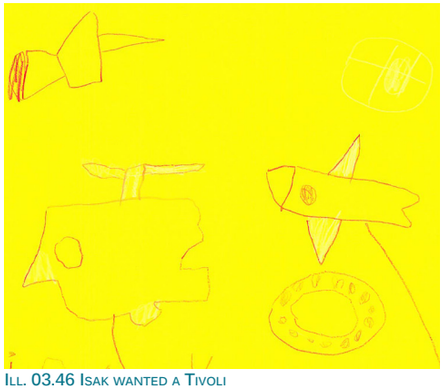
Ill. 03.42 Kitchen flow diagram

Ill. 03.43 Hannah wanted a water rollercoaster

Ill. 03.44 Hannah D. wanted a puppet theatre



Ill. 03.45 Almadina wanted a place for all types of fun



Ill. 03.46 Isak wanted a Tivoli

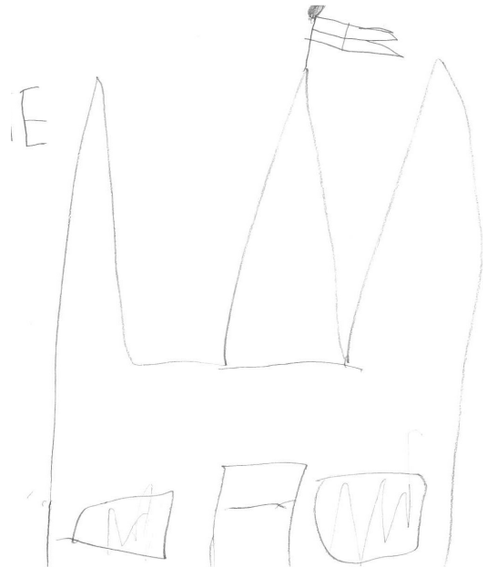
Using pedagogy to shape a building

When designing a kindergarten, architecture and pedagogy has to work together as a unity and not work against each other. To create good kindergarten architecture should the frame support the pedagogical practice, otherwise they could work against each other and that could have some serious consequences. There are three factors that, if they are combined will help to get to the good kindergarten. The first one is the presents of the adults. They have to have the best frames to secure that the children are safe, without feeling suffocated. The second factor is the health related issues that deal with the possibilities for cleaning, but also a good indoor environment. And the last is the security regarding the frames, like the fens around the building have to keep the children on the inside and the floors in the bathroom should not be slippery. [Simonsen 2003]

The pedagogical angle used to shape this kindergarten is found though inspirations from different theory's and though a visit to the four current institutions and talk with their head of institution, the pedagogue and the children. In looking for a pedagogical approach to use in the design there are any number of them to choose from. Some talks about the way to teach kids to be individuals and others focus on how the everyday life should be documented in the kindergarten. The once chosen for this project is based on their ability to be translated into architecture.

The first pedagogical approach chosen is Reggio Emilia. Their theory is based on thoughts from different science like math and biology in combination with different genres of art and technic. One of the distinguished persons in this union was Loris Malaguzzi. He started to talk about the child as competent, and talk about all the qualities that they were born with. [Leksikon] He work with the children's different languages as expressed in his poem; "The child has a hundred languages" which symbolizes the many potentials the child has. [Reggio Children] Another key feature is the importance of the physical environment. It should be seen as a tool for learning; it should underline the pedagogical work, talk to the senses and work like an extra pedagogue. [Leksikon]

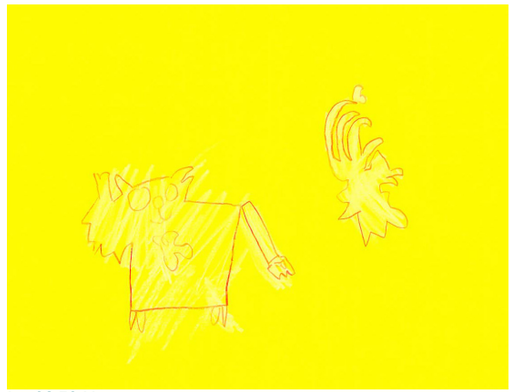
Another teaching that evolves around the focus on the child's abilities is Montessori. Dr. Maria Montessori developed her own institution and form of education in 1907, Rome. She offered the children the opportunity to develop their own potentials in their own pace. She knew that every child was unique and with the guidance of a teacher that they could go far. Furthermore her focus was on the children



Ill. 03.47 Julie wanted a prinsess bouncy castle

Ill. 03.48 Filipa wanted a chicken coop

Ill. 03.49 Freja wanted trolls running around



Ill. 03.50 Hannah wanted a live bear on the playground

Ill. 03.51 Sarah wanted a hamster

being a part of a community. Allowing kids from different age groups to be together in multi-age classrooms made the younger children feel secure and gain confidence, while the older children learned how to mentor and be a role model. And with an environment that supported the child's ability to learn in their own pace the children became well developed in coordination, concentration and independence. [Amshq]

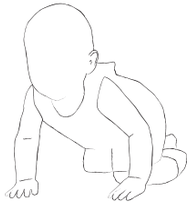
"The aim is to make Kildemosen a "Pedagogical flagship", that is our vision" says the head of the institutions. They want to know what is new and make up their mind about the approach to this knowledge. Apart from this vision is the kindergarten approach to the pedagogical practice is that the children have the ability to learn in alternative ways. The kindergarten uses a lot of time to think "out of the box" and create different experiences. And combined with the design approach laid out from Kolding commune is the dreams for a new building, that it will create opportunities in an aesthetical way.

When asking children what they want, they all have great ideas, and though drawings the children expressed what their wishes for a new kindergarten would be if they could decide. A lot of the children wanted a large slide both placed inside and outside, some of the children wanted a zoo, they wanted to be able to make theater and dance, a boy wanted to have a room that looks like his zombie game on the iPad and a girl were more modest, she just wanted a table for drawing and one for eating her lunch so she didn't need to clean up every time they had to eat. Some of those wishes are illustration in the drawings.

Ill. 03.52 Carla wanted flowers on the playground

Ill. 03.53 Julie wanted a place to eat and a place to draw

1-2 years:
Children at this age are rarely not in motion. They explore the world up and down. At this age it is important to have focus on the balance. [Enghave & Bjerring 2013]
- Walks without support
- Crawls up things
- Throws things
- Runs
[Paarup 2008]



Ill. 03.54

2-3 years:
- Walks forward, backward and sideways
- Jumps
- Can stand on one leg for a short time
- Dances
- Ride a bike with training wheels
- Kick to things
- Catch larger things
[Paarup 2008]

Ill. 03.55

Ill. 03.56

3-4 years:
At this age children becomes more physical active, in play on their own and with other people. [Enghave & Bjerring 2013]
- Walk in stairs
- Run fast
- Walking with balance
- Throw and catch smaller objects
- Starts to draw people, use scissors and play with beads
[Paarup 2008]

Ill. 03.57

4-5 years:
- Can stand on one leg for longer times
- hop on one leg
- Draw things that look real and cut after lines
- Throw things with directions
[Paarup 2008]

Ill. 03.58

5-6 years:
- Ride a bike without training wheels
- Play on swings
- Starts to roller-skate
- Draw detailed
[Paarup 2008]

Motor function

It is believed that our health, both physical and mental is connected to the motor functions. [Paarup 2008] The motor functions are developed through exercises and play, and are not something children are born with. Therefor it is something that can be developed and should be developed through their earlier years. Good motor functions will help the children in their further journey through life, and help them in their interaction with others. [Enghave & Bjerring 2013]

To build up the motor functions children needs to be stimulated in different ways, it has to be allowed for the children to explore their own bodies. You cannot over stimulate a child and therefor they could just be let loose. [Enghave & Bjerring 2013] And as the children in the kindergarten age are spontaneous, they will move and learn if the opportunities are there, so the challenges are to the environment, to create a space that does not prevent the children in their development but underlines it. [Paarup 2008]

This is a rough sketch of the milestones in a child's development as every child is different and learns in their own pace.

Technical Parameters

The technical approach in this project is to create a building that looks to the future, which means that the building will strike to fulfill the requirements for BR2020 building. This means that the collected use of energy form the buildings entire usage cannot exceed 25 kWh p.a. m2. [BR10 2010]

The indoor environment is design after the standards for a new building of category II as it is described in DS/EN 15251. This standard lay out the demands for the thermal and atmospheric environment, required in the building. Combined with the demands from the Danish Building Regulations are following criteria set up.

Thermal comfort explains something about the feeling of the room, the accommodated temperature with the amount of people using the room. To reaches the right thermal comfort the minimum heating requirement for at kindergarten at winter seasons are 17,5˚ and for the summer seasons the maximum for cooling is on 25,5˚ [DS/EN 15251; Table A.2] This means that the temperature cannot go below 17,5˚ in winter or exceed 25,5˚ in summer. Except the allowed tolerance which says that it is allowed to have 100 hours above 26˚ and 25 hours above 27˚ throughout the year. [DS 474]

The atmospheric comfort tells something about the air that the users breathe in, how clean it is. The required atmospheric comfort is expressed in the air quality, which for a category II is set to a maximum pollution of 900 ppm; this is 550 ppm over the outdoor CO2 pollution on 350 ppm. [DS/EN 15251; Table B.4] An inefficient air change could lead to more airborne diseases, and in a kindergarten were children are exposed for diseases though physical contact. Minimizing the change to get a disease would benefit all in the long run. [Hansen 2004]

Other factors that have influents on how buildings are experienced are the daylight factor. It tell something about how lit the room is. The minimum required daylight factor is set from the demands for a BR2020 building and is 3% for workplaces. This could be documented trough hand calculations or through programs like VELUX Daylight Visualizer. [BR10 2010]

Vision

Through a design that focuses on the children and pedagogues safety and health. The aim is to create a sensuous experience for children, where they will have the ability to develop their motor functions, learn how to interact with other children and learn how to become an individual.

It is important that the building reflects that it is a work environment both for children and adults. This would create possibilities for the pedagogues to use their resources where it matters, on the children and their development.

The interplay between the building and the outdoor area will create a frame for investigation where all ages could be heard. The playground should reflect that children uses a lot of time outdoor when they are in the institution. Furthermore it should be divided into spaces to make a base for different types of games and learning.

Design Parameters

With a point of departure in the resent analysis and conversation with the head of the institution, Kildemosen, some parameters for the design has been made. These parameters are the essence of all the analysis and the conclusion is that the building should underline the work of the pedagogues and support the children's development social and individual.

Spaces in a room
- All spaces like; playground, common rooms and group room should be thought of as smaller rooms, so all larger rooms can be divide and small rooms can be combined

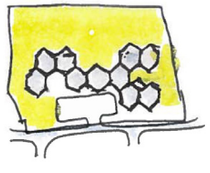
Spaces vs. pedagogy
- The shape of the spaces should underline the pedagogical approach in the kindergarten; to be alternative and think "out of the box"

Spaces for children
- The kindergarten should reflect that the building is thought at child level

Spaces for employees
- The spaces should allow the employees to work at their best without barriers

PROCESS

The design process took its point of departure in the knowledge and investigations from the analysis and the final concept. Though an iterative process, different shapes were chosen to test in regards to organization and the climatic conditions among other things. By combining the qualities the final shape started to emerge.



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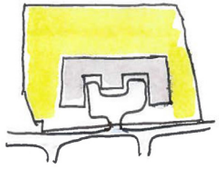

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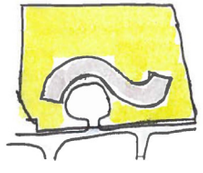

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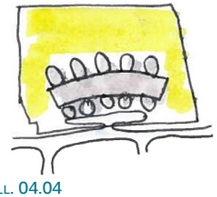

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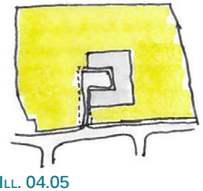

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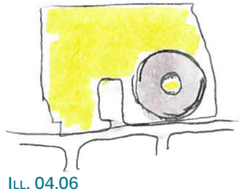

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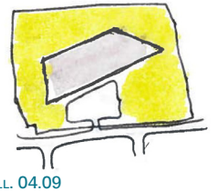

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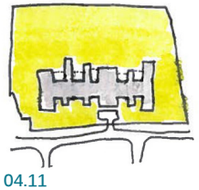

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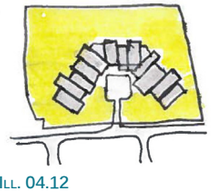

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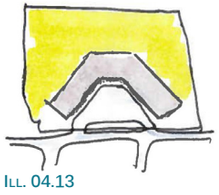

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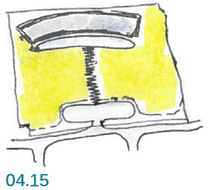

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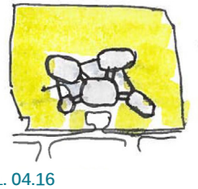
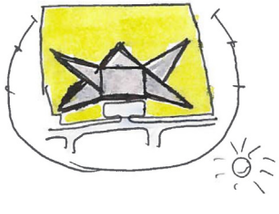


Ill. 04.16

Initial sketching

By working with the Nordic approach in context awareness, the first step in the design process was to get an understanding of the site. In the first initial sketching there were therefor no restrictions and no thoughts of scale, it was an investigation of the sites potential. By drawing small sketches on the plot different shapes and their orientation was investigated. These small sketches should form the basis for further investigations of the shapes that showed the larges potential regarding use of the plot and a promising shape.

Ill. 04.17



Ill. 04.18

Going in scale

These small sketches form the basis for further investigations of the ones with most potential. By using boxes with dimensions from the program some rough sketches was drawn up on the plot. And to get a better understanding of the spaces created by the shapes the same dimensions was used to build models in 1:500.

Still not sure which shape that gave the best conditions for the kindergarten, a great amount of different shapes was investigated. From the model study three different shapes were chosen to try to fit together with the idea for a plan, using the ideas from the flow diagrams.

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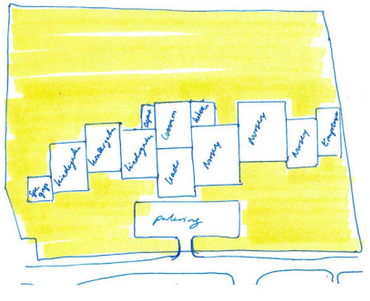

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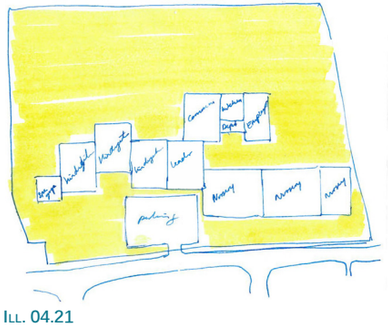

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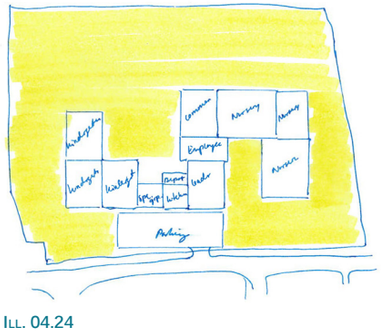

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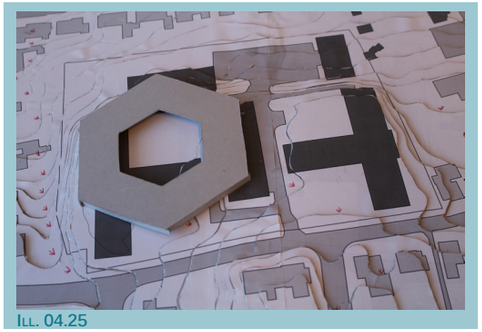
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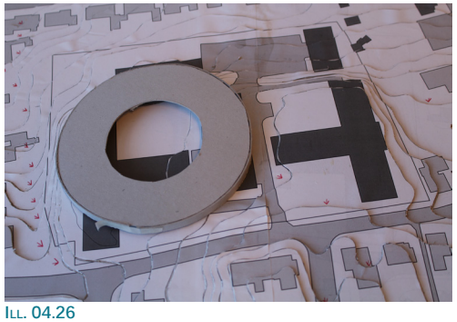
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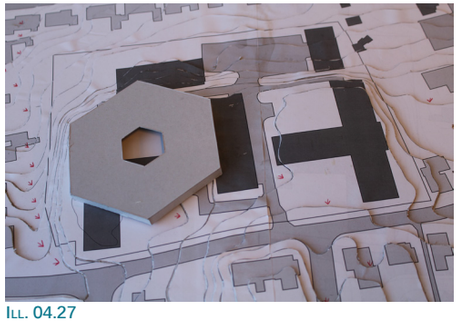
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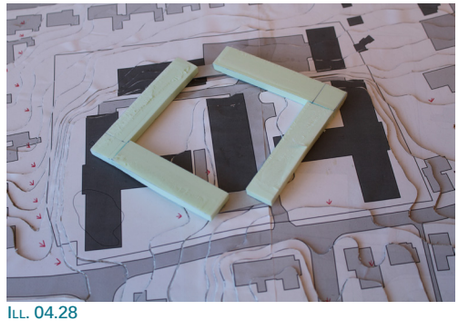
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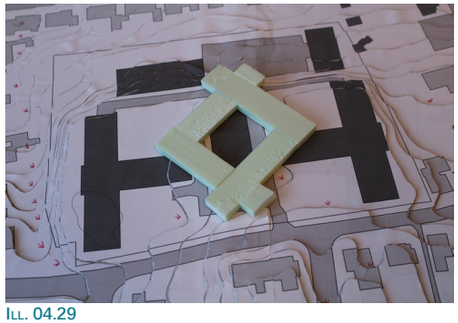
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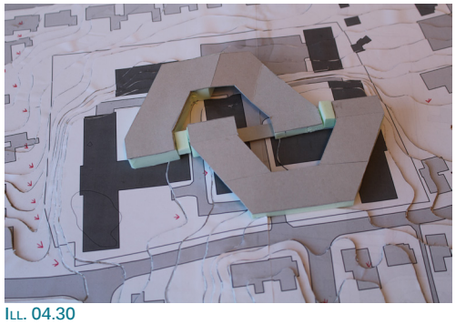
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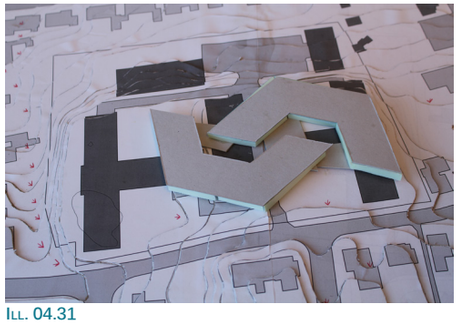
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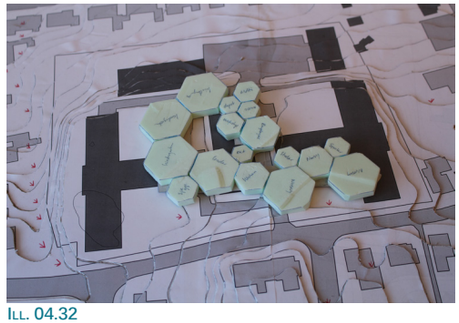
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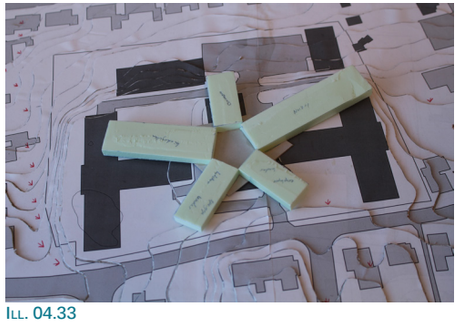
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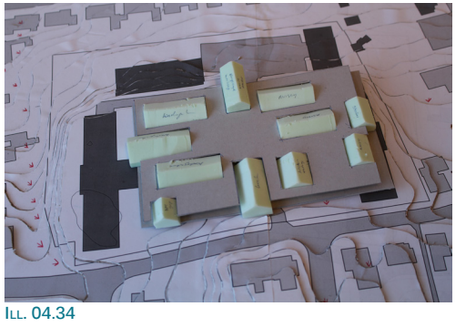
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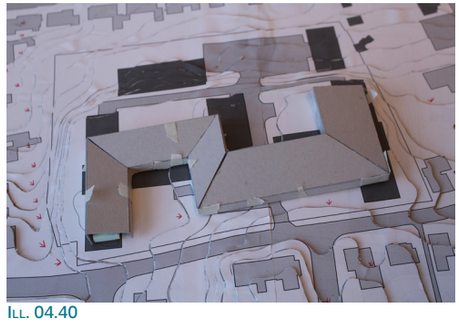
Ill. 04.39


Ill. 04.40

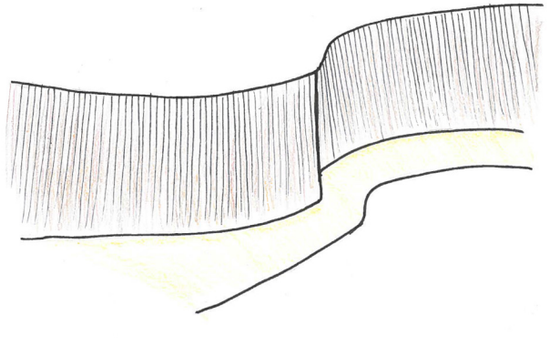
The children's path

Parallel with the modeling the thought was on, how to design the inner of the plans. And because the foundation for this kindergarten was to make it on the behalf of the children the idea of the children's path emerged. This path should give the children another route though the kindergarten, than just the regular "straight ahead path", that the pedagogues would need.

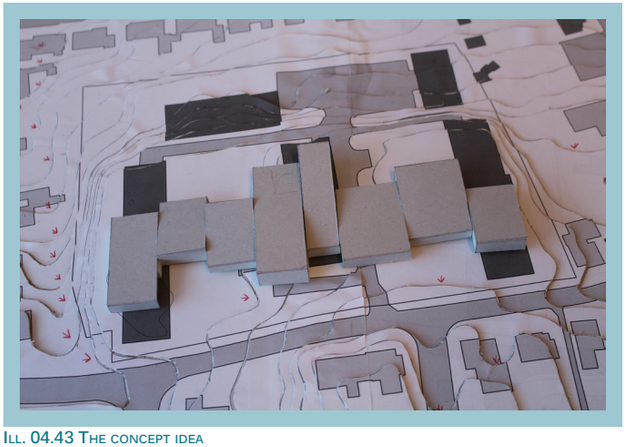
This idea of a path turning and twisting around in the building, was investigated in the three chosen concept to find the building that would underline the idea best, while still create useful areas for the functions.

Like in the movie "The Wizard of Oz", it should be easy to "follow the yellow brick road".

Ill. 04.41 The to path twisting together



Ill. 04.42 The idea of the path like a underline road



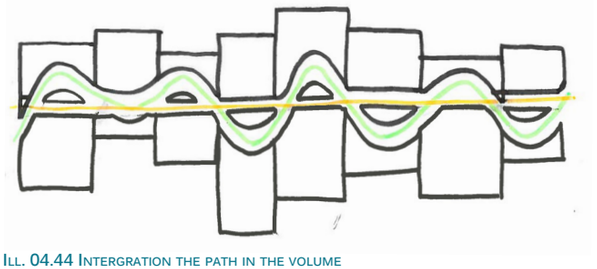
Ill. 04.43 The concept idea

First concept

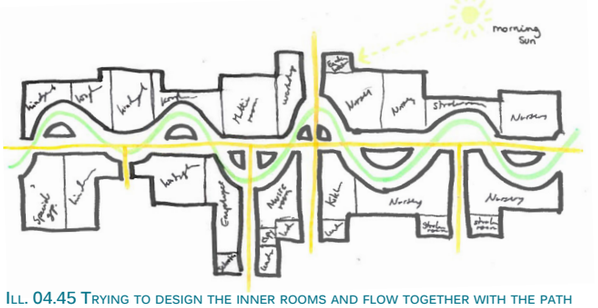
The first shape chosen was a long building consisting of a chain of boxes varying in width and depth fit to the functions that they contained. The boxes were lined up staring with the special group, then the kindergarten groups, the employee's functions and then the nursery.

The building was placed along the roadside of the plot, creating a boundary and bound the playground to the backside of the building and at the same time opened up for the possibilities to create separate entrances for each of the function on the roadside.

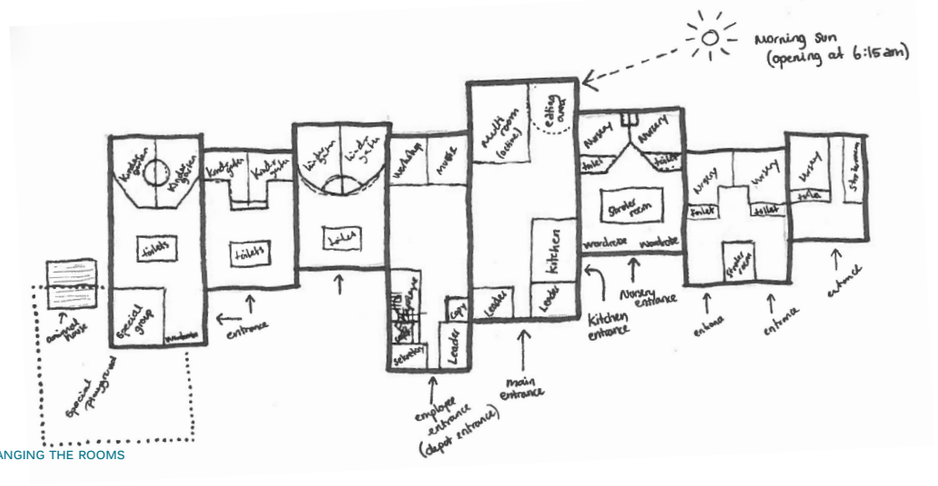
The long building shape was in plan separating the functions and making it hard for the kindergarten and the nursery children to interact and gain knowledge from each other. But one of the qualities existed in the common functions as the central part, making it equal for everybody.



Ill. 04.44 Intergration the path in the volume



Ill. 04.45 Trying to design the inner rooms and flow together with the path



Ill. 04.46 Arranging the rooms

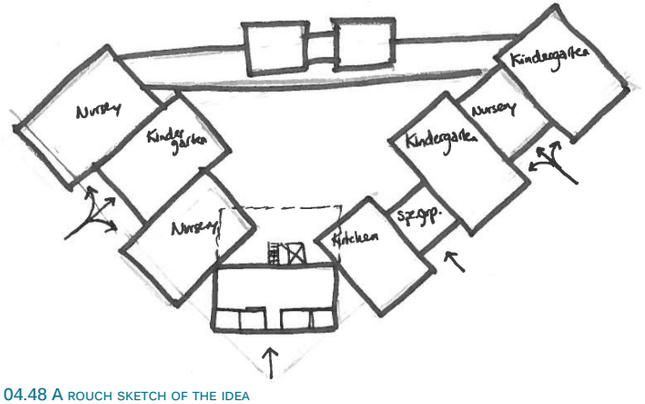
Ill. 04.47 The concept idea

Second concept

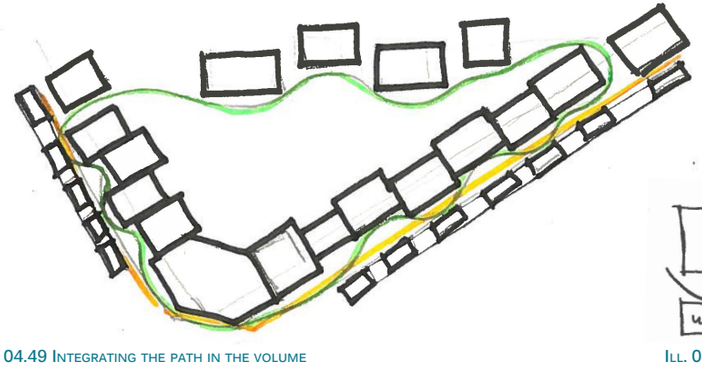
The second concept was a triangular shape that followed two of the plots sides. This shape created a closer internal connection between the functions, but still creating a large gap between the two ends.

By using the plot sides as a boundary for the building, this shape also made it possible to give the different functions their own entrance. It also opened up for the possibility to bring the playground to the front of the plot.

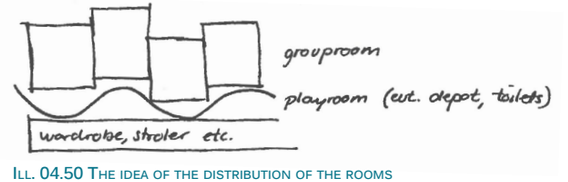
When trying to integrate the children's path into the building, the idea of separating the group rooms from the practical functions emerged. The practical functions, like toilets, storage rooms, cleaning rooms etc. would create a wall shielding the group rooms from the road. Between the practical functions and the group rooms would the path twist and turn creating a common room varying in size and expression.



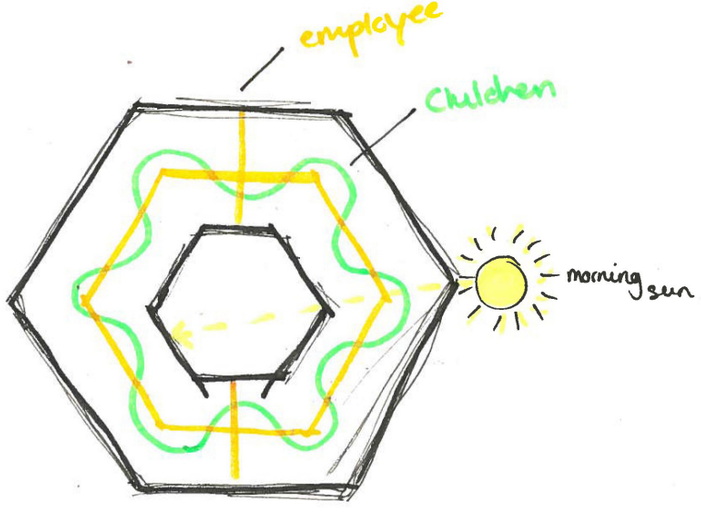
Ill. 04.48 A rouch sketch of the idea



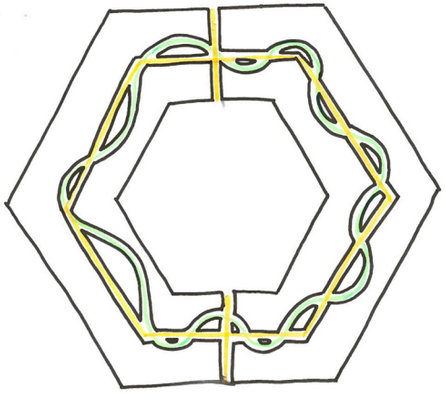
Ill. 04.49 Integrating the path in the volume



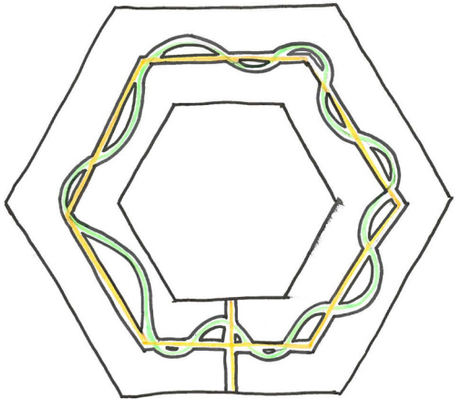
Ill. 04.50 The idea of the distribution of the rooms



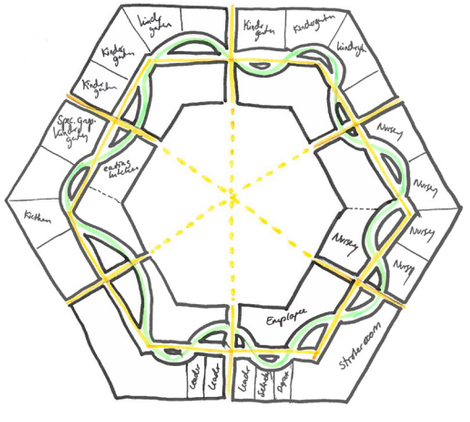
Ill. 04.52 The shape combined with the path



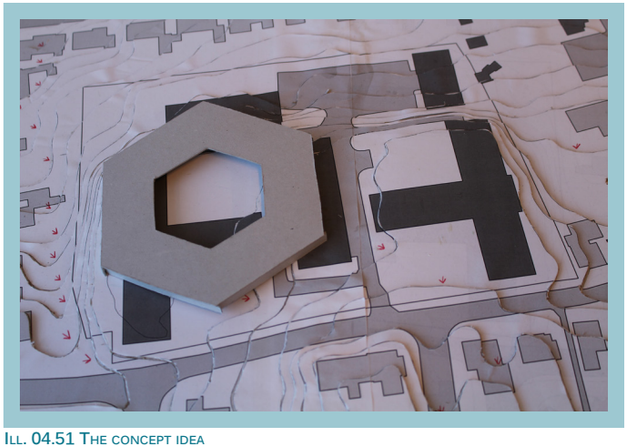
Ill. 04.53 The shape combined with the path



Ill. 04.54 The shape combined with the path



Ill. 04.55 The idea of the distribution of the rooms



Ill. 04.51 The concept idea

Third concept

In this concept the building mass was created of the idea in connecting the functions as closely as possible to have a good indoor relation. In addition to that, this shape gave a larger coherent outdoor area, with a connection to the road.

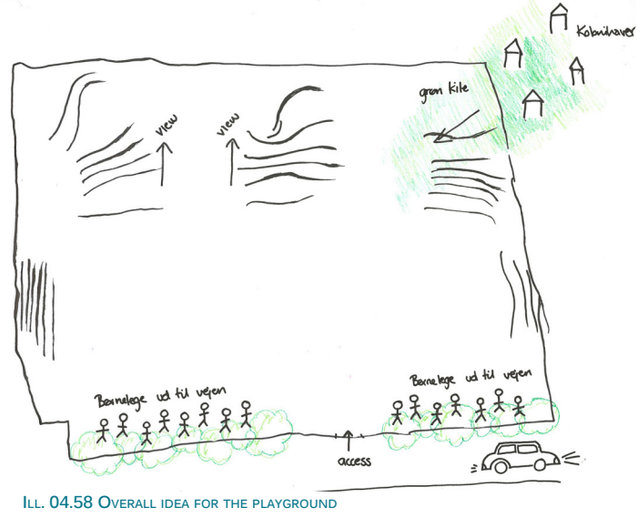
This shape was chosen as the base for the further design, because it contained a lot of the same qualities as the other investigated shapes, but it also gave a large internal connection and because of the wish to create an age-integrated institution and it was found that this shape underlined that the most.

The playground

One of the most used rooms in a kindergarten is the playground. All year around the children are outside, enjoying the season changing. So when placing the building on the site, it was important to remember how the spaces around could be used. The playground was divided in zones creating spaces for different types of play. A place for fast play, for sensuous contemplations and a place to sit quietly and play. Furthermore there was a wish to bring the children out to the road, in that sense that they would bring life to the neighborhood during the day.

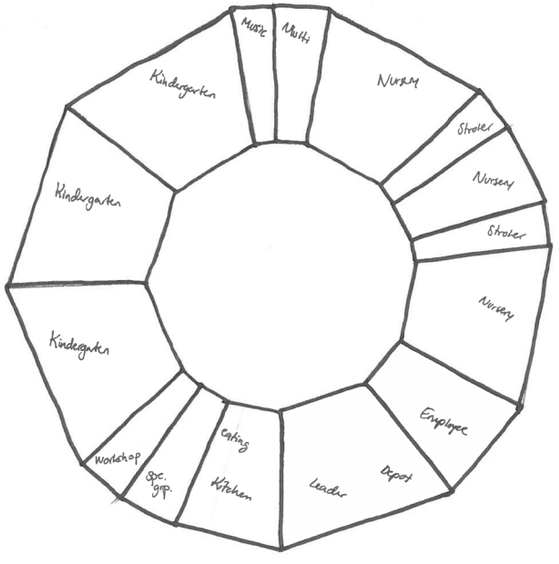
Ill. 04.56 The kindergarten as a boundary towards the roads

Ill. 04.57 Pulling back the kindergarten to create life along the road side

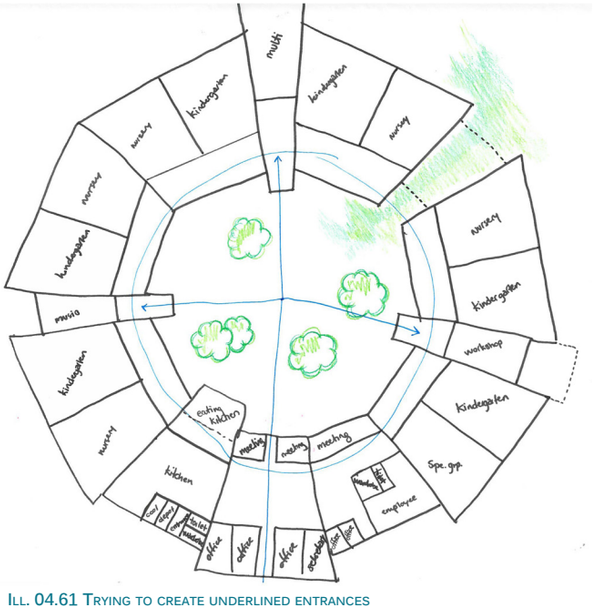


Ill. 04.58 Overall idea for the playground

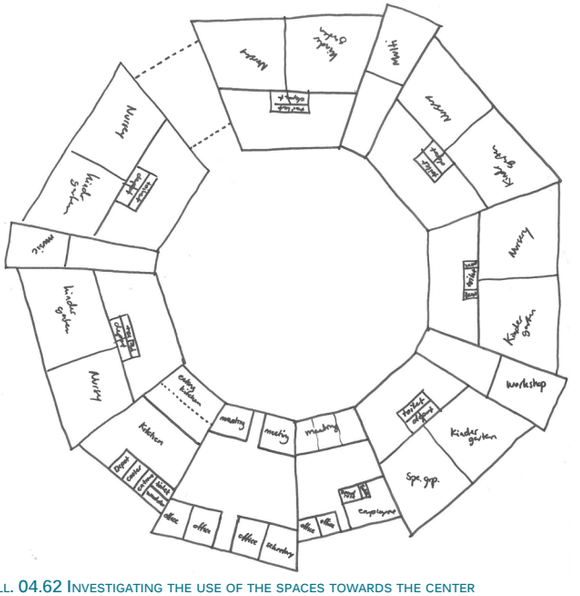
Ill. 04.59 A quick sketch of zones on the playground



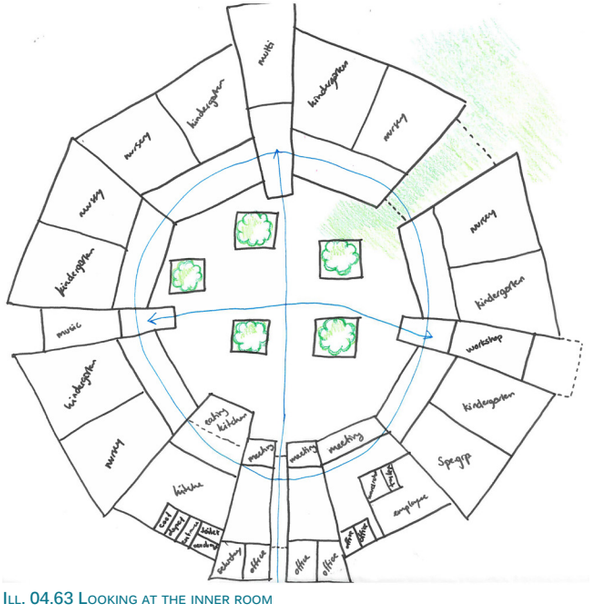
Ill. 04.60 Division of the outer circle



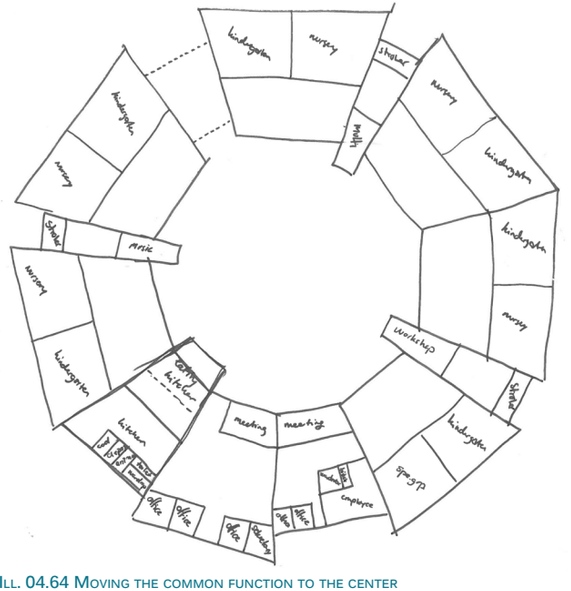
Ill. 04.61 Trying to create underlined entrances



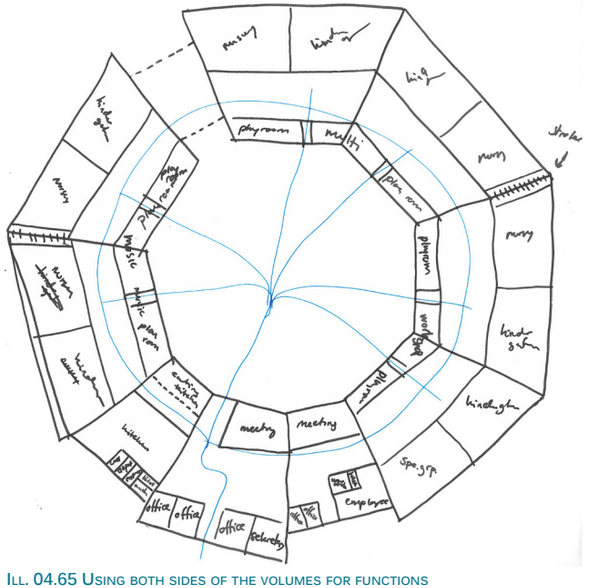
Ill. 04.62 Investigating the use of the spaces towards the center



Ill. 04.63 Looking at the inner room



Ill. 04.64 Moving the common function to the center

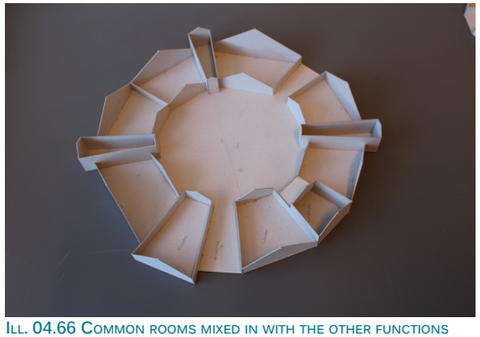


Ill. 04.65 Using both sides of the volumes for functions

Developing the shape

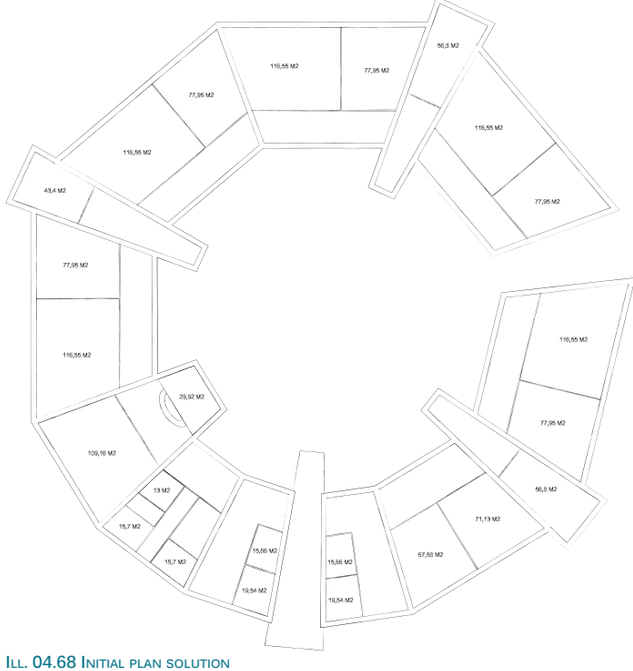
With point of departure in the chosen shape a lot of different possibility for arranging the functions was investigated. It was early discovered that to get the most out of the shape it had to be arranged regarding to the functions. That means that instead of working with a hexagon the numbers of sides should be determinate by the numbers and division of the rooms. In the first tries not every room had their own volume but they were divided up in clusters.

The idea was here to create clusters which contained, respectively the kindergarten, nursery, kitchen, common functions, employees and offices. These clusters were combined in different ways. Some of the sketches had the common functions as an anchor between to clusters creating a place to enter from the larger area in the middle and creating a gathering place for that area, see illustration 04.61-04.64 . In others the cluster got arranges so the group rooms created the outer line for the shape while the common functions got places around the inner room, illustration 04.65. Similar in all these was the repetition in the shape and the same shaped rooms.



Ill. 04.66 Common rooms mixed in with the other functions

Ill. 04.67 Common rooms moved to the center



Ill. 04.68 Initial plan solution

Ill. 04.69 Path sticking out from each opening

Ill. 04.70 A covered inner room with a roof following the buildings roof shape

Ill. 04.71 An open yard with a path all the way around

Ill. 04.72 A covered inner room with open areas for tress

Ill. 04.73 A covered flat inner room

Ill. 04.74 A covered inner room with a bobble like shape

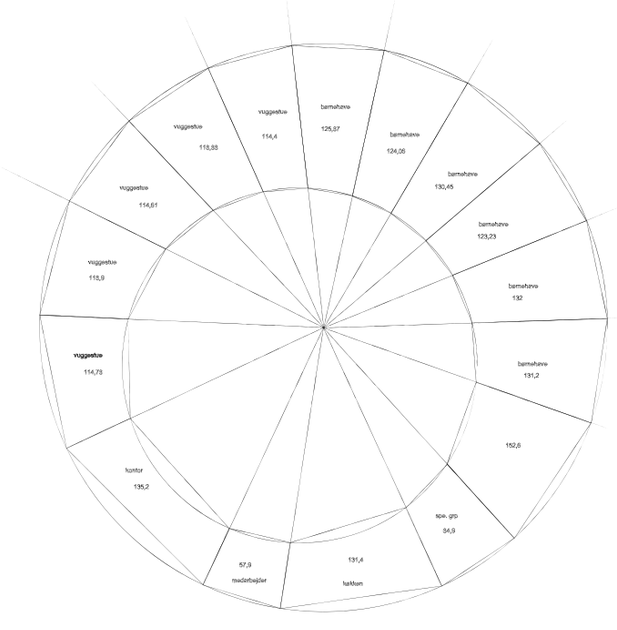
By using a shape that creates a big inner room, it was very important to find the right functions to put here so it would not go unused by. The initial idea for this shape was to use the inner room for the parking space, this would have giving everybody direct access to their area. But by wanting a continuous shape that connected the inside, the shape was closed off and thus creating a space only accessible from the inner rooms.

In the first try, all functions were placed around in a circle, creating the enormous free space in the center. The thought was to use it as a covered in playground. This would create access to all the functions without having to walk all the way around in the volume. But the problem was to find the extra special feature that this room would have, that the outdoor playground did not.

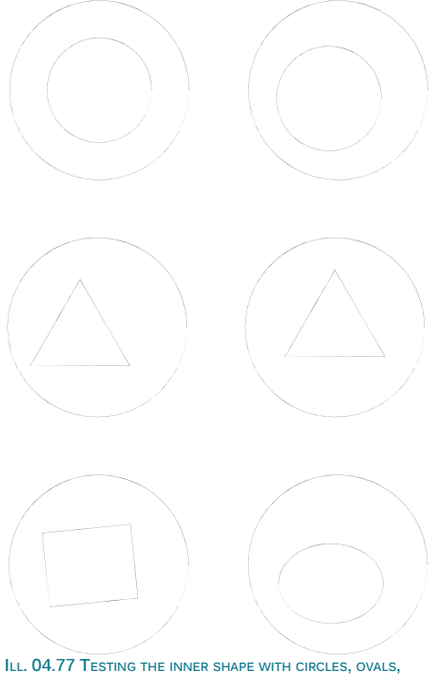
Ill. 04.75 Parking in the center

While trying to find some better use for the inner room it lead to extracting the common functions such as workshop, toilets and wardrobes from the outer circle and place them in the inner yard. At the same time the idea of getting each function in separate building got further developed.

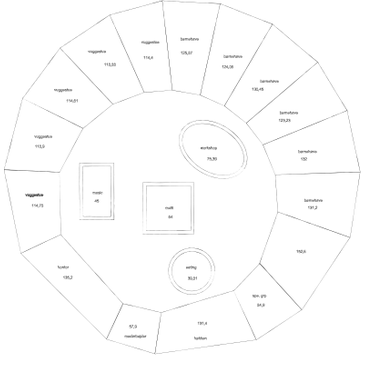
And as the building was controlled a lot by the center of the shape, the wish was to move away from that. This was done by using different shapes to create the inner room and trying to move them away from the outer circles center, see illustration 04.77. By doing that it created diversity in the rooms surrounding the inner yard thus creating a more interesting flow in the building. The circle was finally chosen to shape the inner room, because of its relation to the outer room.



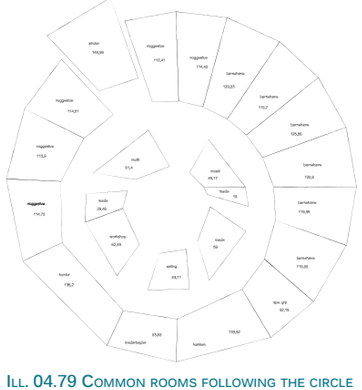
Ill. 04.76 Division of the outer circle



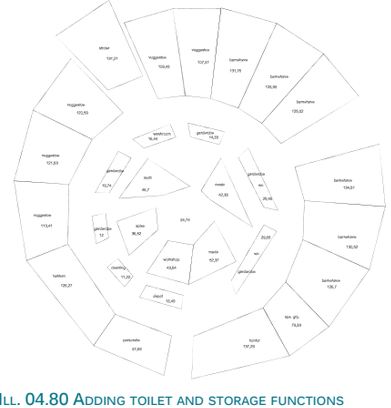
Ill. 04.77 Testing the inner shape with circles, ovals, triangles and squars



Ill. 04.78 Common rooms as random shapes

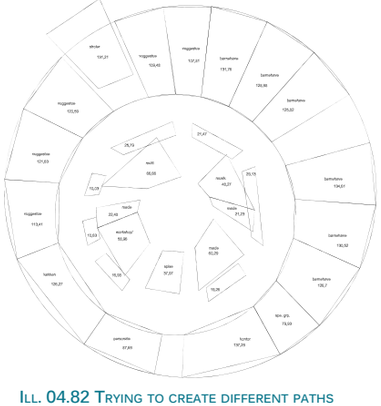


Ill. 04.79 Common rooms following the circle

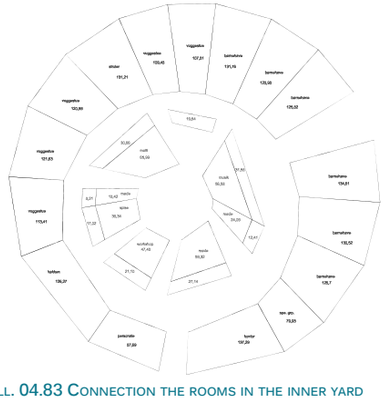


Ill. 04.80 Adding toilet and storage functions

Ill. 04.81 Model of the idea with the inner rooms



Ill. 04.82 Trying to create different paths



Ill. 04.83 Connection the rooms in the inner yard

By extracting the common functions from the outer circle they should now be placed in the inner yard to break out the large volume to smaller spaces. The first idea was to put random shaped volumes in the yard giving the common rooms different identities. By doing this, the inner room needed to be much larger for all the volumes to fit. Illustration 04.78.

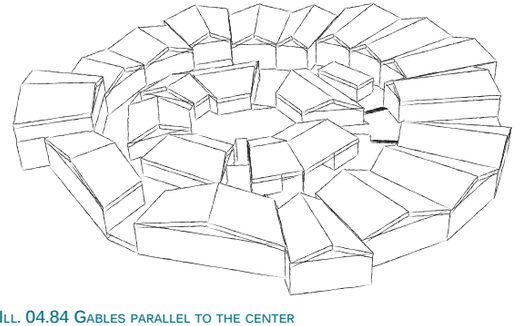
Then the rooms took their shape form the inner rooms shape. An offset circle created the boundary for the walls facing the outer circle and by using the same point of center as that, the rooms became connected to them.

Through a lot of different suggestion to how the inner room could work it ended up, yet again that the circle was pushed a bit to the side, to create a varying flow.

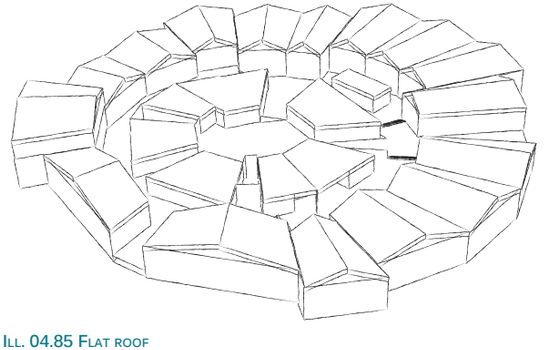
The volumes

From the first stages of the design process it was a wish that the group rooms should have different identities, in both the inner and outer expression. In the first draft for shaping the roof the idea was to shift the slope from side to side. But then the idea of a small village emerged. This small village would be expressed in small gable houses, and because of the differentiated widths of the building, all the buildings would get their own expression. The gables should face the center giving the expression of walking down a road in the inner space.

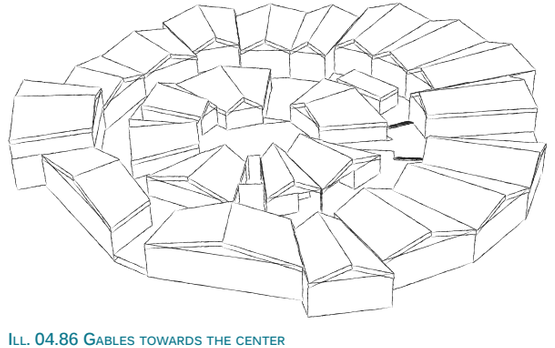
Another question was if the common room should have the same expression or if they should tell a different story. Here it was tested with three different types of roofs. A flat roof, gables turned towards the center and gables parallel with the center. The conclusion was made in coherent with the choices for the roof covering the spaces in between because the best expression here was with a gable roof turned towards the center, like illustration 04.86.



Ill. 04.84 Gables parallel to the center

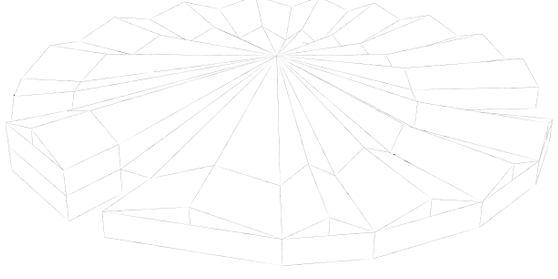


Ill. 04.85 Flat roof

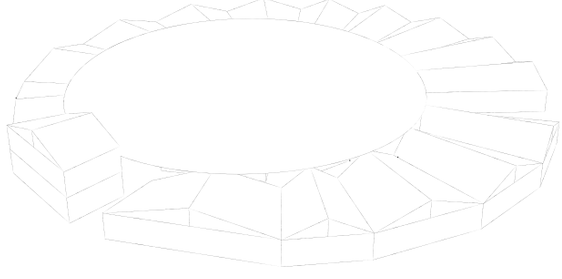


Ill. 04.86 Gables towards the center

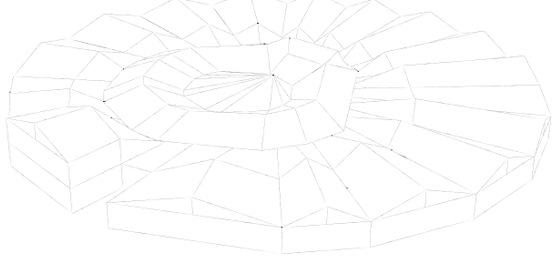
Inner yard



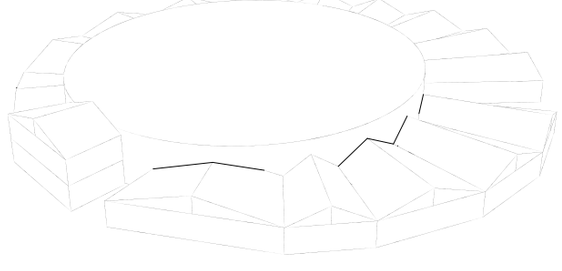
Ill. 04.87 Origami like shape following the roof shape of the outer circle



Ill. 04.88 An oval sphere



Ill. 04.89 Origami like shape following the roof shape of both circles



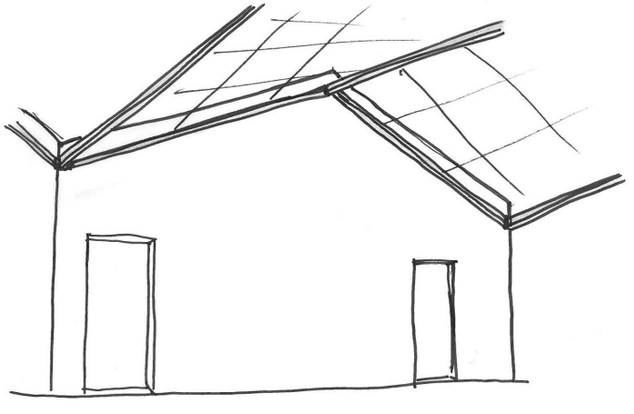
Ill. 04.90 A sqared room

After deciding how to shape the common rooms the challenge was to decide the character of the surrounding spaces. With the wish of being able to use it all year around, but at the same time give the kindergarten a little bit extra and different, it was decided that the room should be a covered unheated space. This means that there would be no direct access to the outside so it would be a closed room, but with no heat so the children would get a feeling of the seasons changing.

The next step was how to shape the roof. This was decided parallel with the decision made for the roof shape on the volumes. Different shapes was tried to fit, one origami like shape that followed the lines of the roof connecting the outer rooms with the inner. One where the origami shape went over the inner rooms, ending in the center point of the building. And two where there was introduced a new shape that was added on top of the buildings.

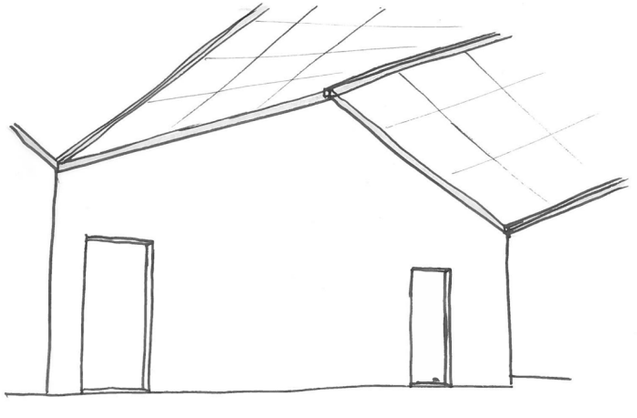
Look to what experience the room should have on the inside, the origami shaped roof was chosen. In the inner room this shape changes the experience as the users would walk around in the room giving them a chance to experience something new all the time.

The next question was how the roof should meet the buildings. Should it lean on top of the buildings so it would be possible to see the entire gable, illustration 04.93-04.94 or should it be attach to the side of the building, illustration 04.91-04.92. These two possibilities gave two different experiences inside the room. But because it all along had been important with the character of the gables, was the roof attached to the top of the buildings underlining the gables.

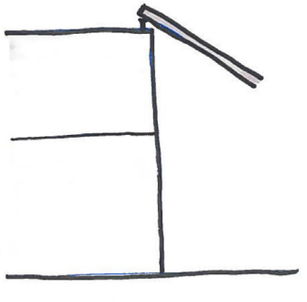


Ill. 04.91 Detail, yard roof attach to the side of the buildings

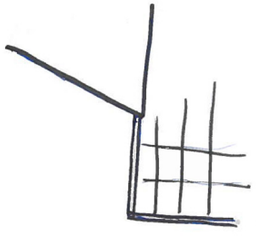
Ill. 04.92 Detail in section



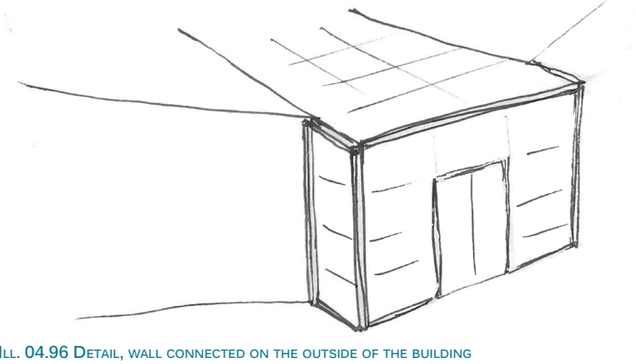
Ill. 04.93 Detail, yard roof laying on top of the buildings



Ill. 04.94 Detail in section

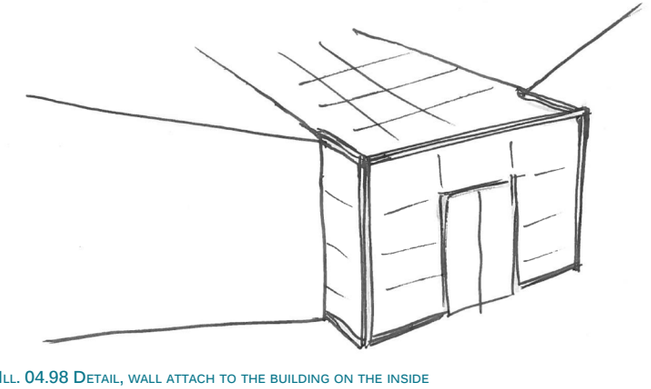


Ill. 04.95 Detail in plan



Ill. 04.96 Detail, wall connected on the outside of the building

Ill. 04.97 Detail in plan



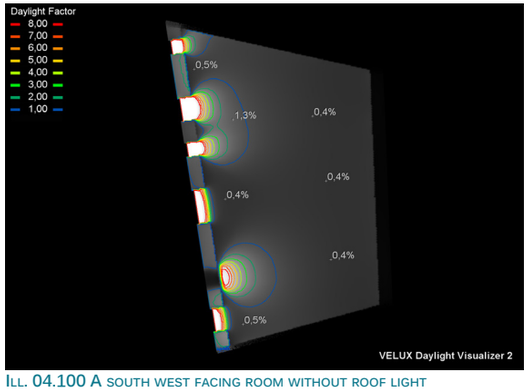
Ill. 04.98 Detail, wall attach to the building on the inside

A similar question did emerge looking at how the extended glass volumes were attached to the building. Was it aligned with the inner wall and attached to the outer wall, illustration 04.95-04.96 or did it underline the corner by being attached on the inner wall, illustration 04.97-04.98. Because the covered unheated space feels like an addition to the building, so should the entrance, and the second example was chosen.

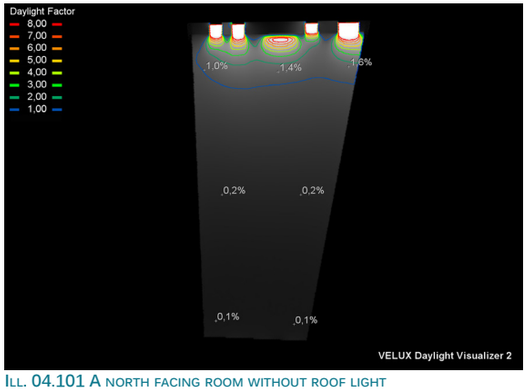
To create an even larger diversity and to bring in the seasons in the cover inner room there were introduced two open outdoor areas. This came from the inspiration in Fuji Kindergarten from Tokyo. These rooms could be used as regular outdoor playrooms, but their manly function is to connect the inner room with outside.

The way this outdoor room would be attached to the yard would be like illustration 04.99, underlining the hierarchy of the volumes, the cover and the outdoor spaces.

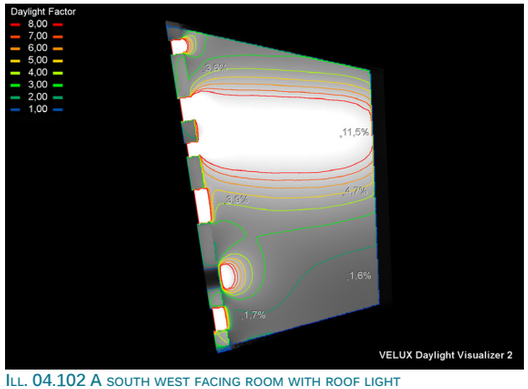
Ill. 04.99 Fuji Kindergarten by Tezuka Architects, Introducing the outside in the inner rooms



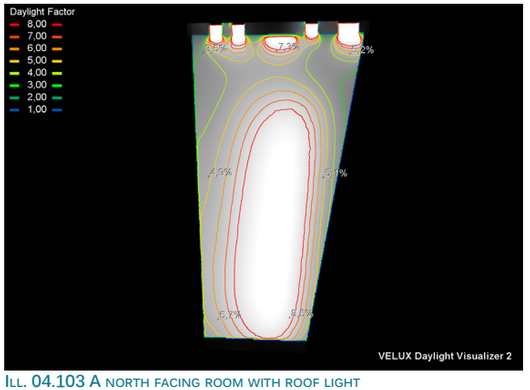
Ill. 04.100 A SOUTH WEST FACING ROOM WITHOUT ROOF LIGHT



Ill. 04.101 A NORTH FACING ROOM WITHOUT ROOF LIGHT



Ill. 04.102 A SOUTH WEST FACING ROOM WITH ROOF LIGHT



Ill. 04.103 A NORTH FACING ROOM WITH ROOF LIGHT

Windows

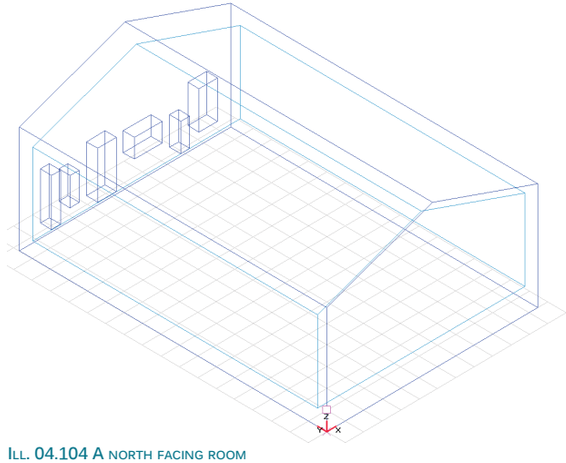
There were different factors that had impact on how the windows got placed. The first factor was that the windows should relate to the children, in placement, but also in dimensions. The second factor is the orientation of the windows, combined with the amount of windows, so south, southeast and southwest facing facades have a smaller amount of windows than the facades facing north, northeast and northwest. The third factor is placement with natural ventilation in mind. The forth factor were placing some of the windows so they could create niches for the children, some on the inside and some on the outside. And the last factor were placement according to use, like in the offices and kitchen area.

In the process of placing the windows, a few studies were made with the program VELUX Daylight Visualizer. This program shows the daylight factor in the room. The first test was made only with windows in the façade. This showed that the inner part of the rooms would be dark. But by adding windows in the roof, these dark areas got dissolve. And as it was the idea that the roof should be used for solar panels it was only the north facing slope that could be used for top light. This gave a natural place for placing the toilet and storage rooms in the volume, always in the south facing side. Final result can be seen in appendix, page 96.

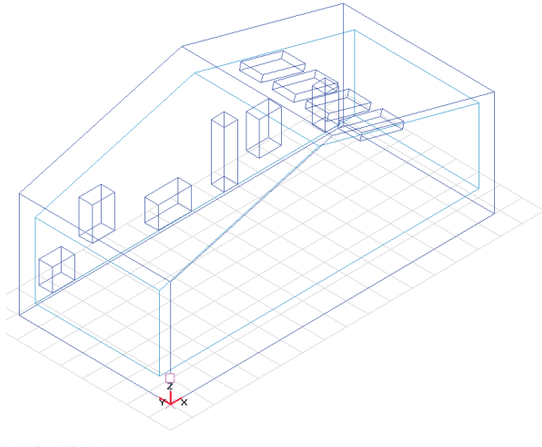
In close connection to testing the daylight in the room, they got tested for their atmospheric and thermal comfort in the program BSim. Because of the irregularity of the building could the program not calculate on the rooms, so there were estimated a shape based on the length of the outer wall with the windows making the room wider on one end than in reality, giving the room a larger buffer which was taken into account when reading the results.

These simulations showed that the amount of windows in the south facing rooms should be smaller, there should be less of them or there should be some kind of shading added to give the right temperature, while the north facing room could have more windows, without changing much in the simulation.

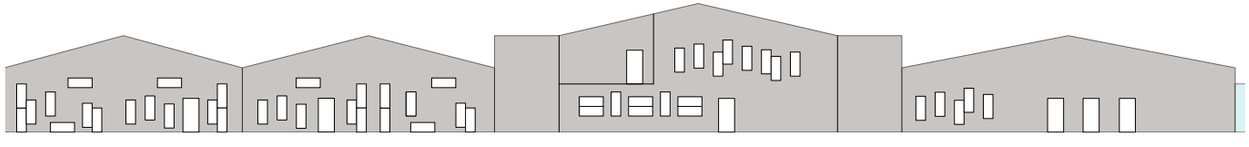
The final simulation and the result can be seen in appendix 04, page 102.



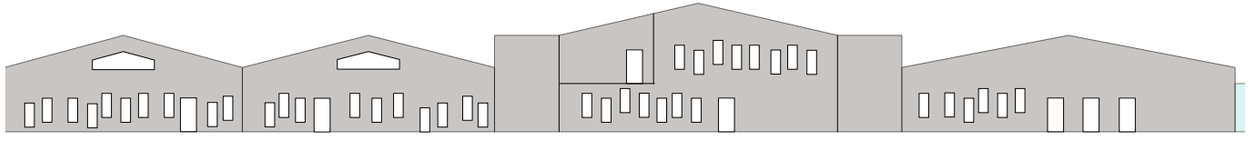
Ill. 04.104 A north facing room



Ill. 04.105 A south west facing room



Ill. 04.106 A section of the first try with a mix of horizontal and vertical windows



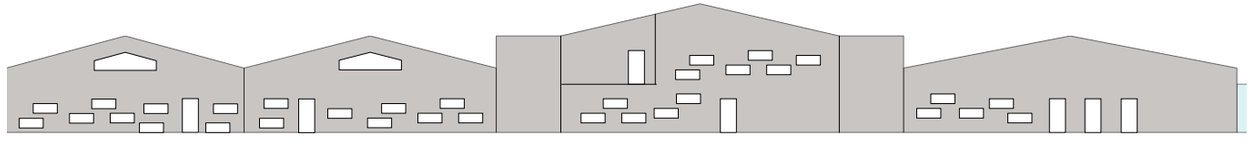
Ill. 04.107 A section of the second try with only vertical windows, plus a top light in all the group rooms

After the investigation regarding atmospheric and thermal comfort and daylight, different suggestions for windows placement were made for the entire building. In the first try the window shape were the same though the entire building, though out together in different ways and some vertical and some horizontal. By using the same size window became like an organized chaos. A lot was happening, and to create diversity in the facades there were a lot of window area.

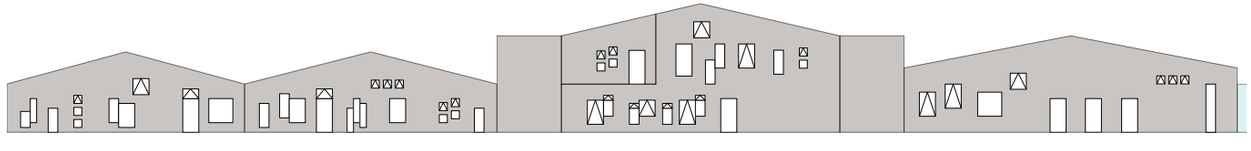
In the second try, it was still the same type of window throughout the whole building, but here they were only vertical. Here there were added a top window in each gable on all the group rooms. This expression was quieter and created a clear line all the way around. Although it did not underline the buildings shape and use as wished.

As the second try, the third also used only one type of windows but this time they were horizontal. This did not create that playful look that there was wanted for the facades.

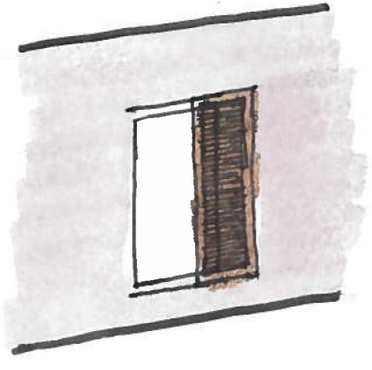
On the final facades the combinations of different windows, placement and use, underline the playfulness of the kindergarten. There are not two rooms there are the same even though the same window types are copied throughout the building.



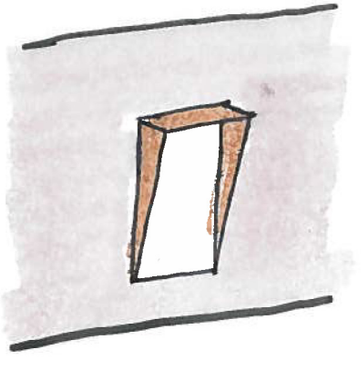
Ill. 04.108 A section of the third try with only horizontal windows and a top light in all the group rooms



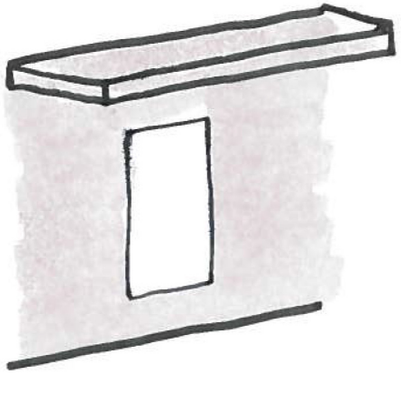
Ill. 04.109 A section of the forth try, a mix of window sizes and placement



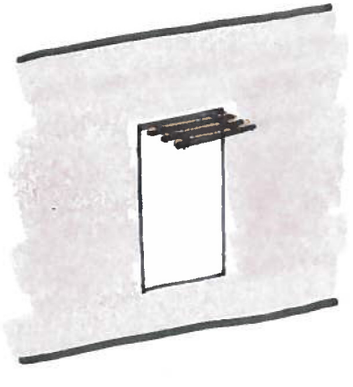
Ill. 04.110 Shutters



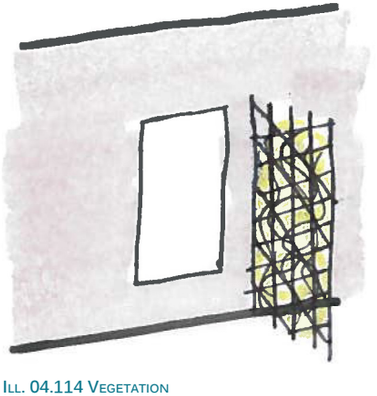
Ill. 04.111 Extended frame



Ill. 04.112 Extended building mass



Ill. 04.113 Lammels



Ill. 04.114 Vegetation

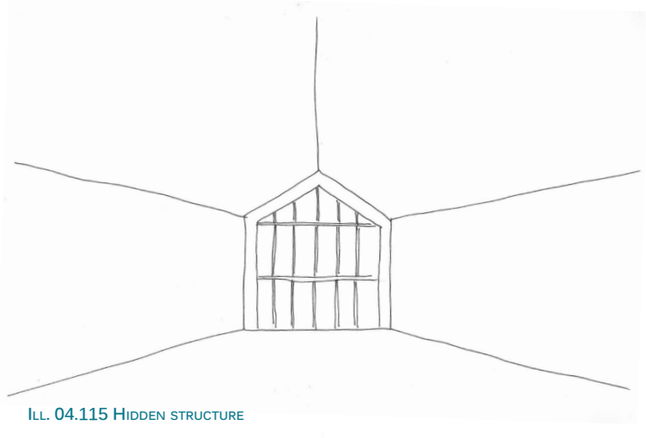
Shading

Because none of the rooms have the same orientation, is the need for shading changing throughout the building. The simulation of the south west facing room shows that it here would be beneficial to have shading because of some over temperatures. Different suggestions were tested, with the focus on them having a double function. It was the wish for creating small niches for the children to use in the outside play, which left the choice on the extended frame as shown in illustration 04.111.

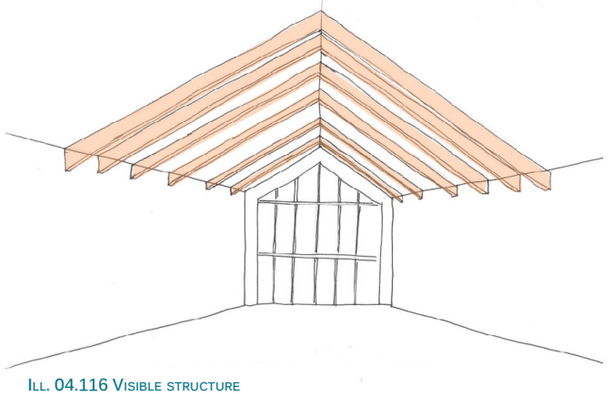
The shading will be combined with a setback of the window in some places to create different experiences on both the outside and the inside of the building. The shading will not occur on every window but on selected windows, and even though the need for the shading do not exist on the north facing will the shading also be added to some of the windows here to create the niches.

Inner expression

For the small gable houses there are works with different expressions on the inside. In the outer circle were all the group rooms, the office and the employees has their rooms there are already happening a lot. Different window shapes on the walls and in the roof, that is why there is chosen a clean look for the entire walls and roof. While there in the common functions not is any roof windows and the windows here are more toned down. Here it was chosen to have a visible roof construction to underline the shape.



Ill. 04.115 Hidden structure



Ill. 04.116 Visible structure

Materials

Ill. 04.117 Three ways to make the transistion between the colors in the facade

Ill. 04.118 The canal houses in Amsterdam, Netherlands

Materials have a large effect on how a room is experienced, visually and also the comfort. In the considerations of materials of course aesthetics has been a large factor, but also the acoustics and the hygiene have had an impact on the final choices.

Outside

Because that all of the larger rooms are placed in their own individual house to look like a village, the idea was to underline that even further and give each "house" their own individual identity in color. This inspiration came from the canal houses in Amsterdam, Netherland. The material chosen for that is brick. This material is chosen because of its strong connection to the Danish building tradition and because of the relation to the sites surroundings.

Two of the building would however be cladded with wood; this is due to the function in them. To relate to the idea of an outdoor shed and the wood would help underline this.

The cladding on the roof would be slate. This material is chosen as a neutral material that does not overpower the brick on the walls.

Inside

For flooring two different types was chosen. One for the covered unheated space, and one for the rest. For the covered unheated space, it is chosen to use is a rubber covering. This is the same material used for surfacing on playgrounds. It gives a shock absorbing surface and it is possible to shape it as liked. Furthermore it would be a warm surface in the unheated spaces compared to concrete. It comes in different colors which could make the covered space more playful and underline the "yellow brick road" wanted for this space. In the rest of the building the flooring would be linoleum. Like the other floor material chosen, this come as well in many different colors, making it possible to differentiate between the different rooms.

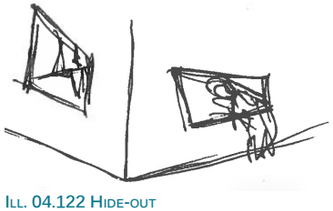
On the roof the inside would be cladded with acoustic panels made with wood and cement in a neutral light color.

Ill. 04.119 Rubber floor

Ill. 04.120 Shaping the rubber flooring

Ill. 04.121 Playful linoleums floor

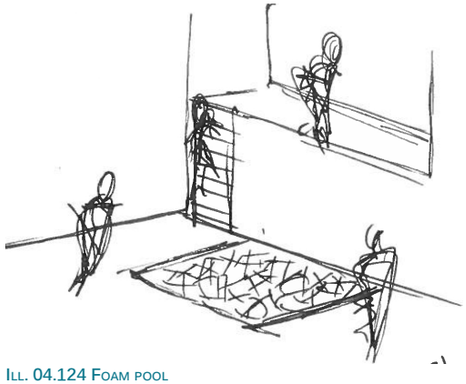
The building as a playground



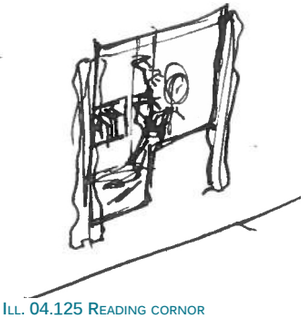
Ill. 04.122 Hide-out

Ill. 04.123 Hide-out

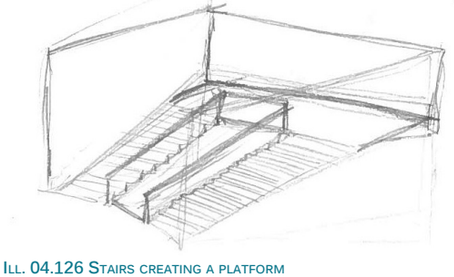
From the analysis it was conclude that the building should talk to the creativity and curiosity in the children, and create a sensuous experience. Through the different steps of the design this elements has slowly started to emerge in smaller and larger scale. A lot of the wild idea came from the children from the existing kindergartens. This consisted of placing things that normally would be outside on the playground, inside. Like a rollercoaster, a carousel or a sandbox inside so it would feel a little bit silly but fun.



Ill. 04.124 Foam pool



Ill. 04.125 Reading cornor



Ill. 04.126 Stairs creating a platform

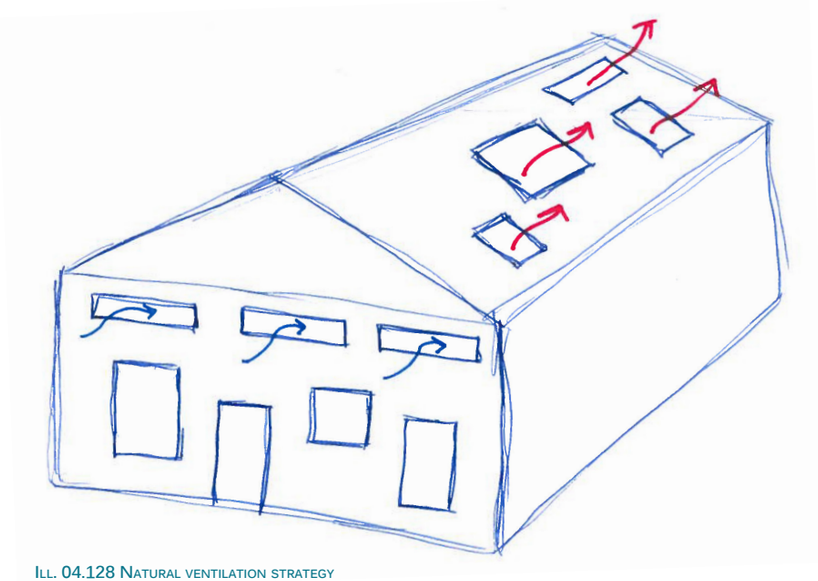
Ill. 04.127 Different ways to use the windows

Interior design

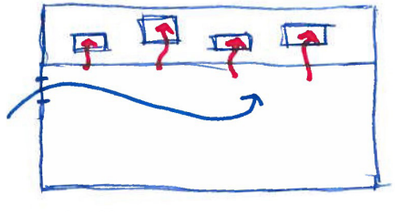
Through the development of the plan, the internal connections between the five different areas; the kindergarten, the nursery, the special group, the employees and the common functions, has changes. The challenge has been to organize it so the work relation between the respective functions was easy but also create a frame for work across the functions. Through different test where all the function was mixed together the conclusion was that they worked better if they were gathered in the respective groups but with close connections in the common spaces.

In the development of the design in the group rooms an important factor was, beside the daylight as mentioned earlier, incorporating the ventilation strategies.

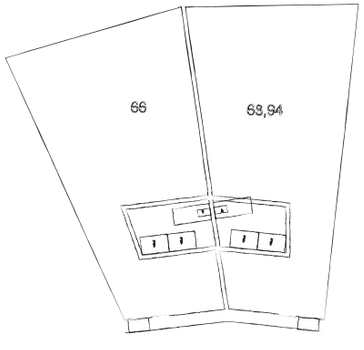
The secondary ventilation strategy for the kindergarten was natural ventilation, this because the buildings change in orientation of every room not making all of them optimal for natural ventilation. And because of the demands for the air quality and air change in BR10. But the strategy used for the natural ventilation will be one sided ventilation with thermic buoyancy, taking in the air from the facades and extruding it from the roof windows.



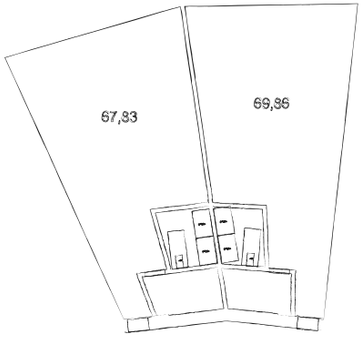
Ill. 04.128 Natural ventilation strategy



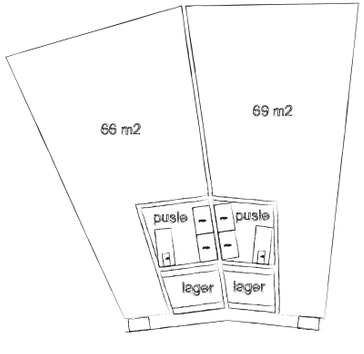
Ill. 04.129 Natural ventilation strategy section



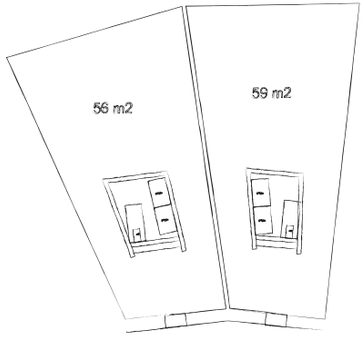
Ill. 04.130 Creating an open storage room at the entrance



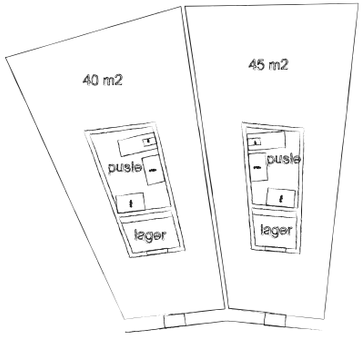
Ill. 04.131 Making a setback for the opening



Ill. 04.132 Creating a closed box in the opening



Ill. 04.133 Using the toilet as an object in the room with small storage space



Ill. 04.134 Using the toilet as an object in the room with storage room

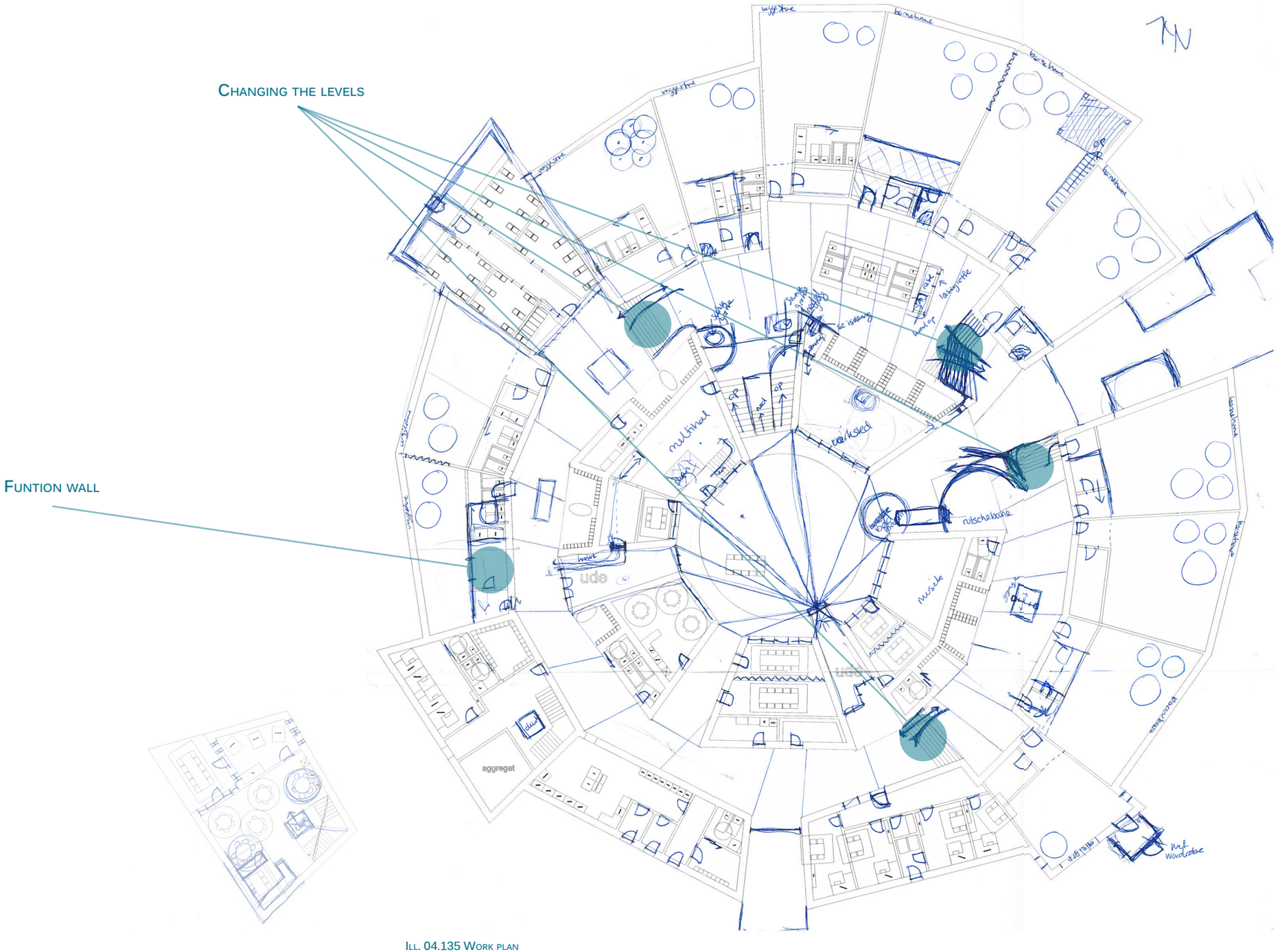
The primary way that the rooms would be ventilated was through the mechanical ventilation, so the channels should somehow incorporate in to the building mass. To find the channel sizes the air change for every room and the maximum speed in the channels was used, calculation can be seen in appendix 02, page 97.

This gave a channel size for the group rooms on 0,4 m and for the common room 0,5. For calculation see appendix 02, page 97.

The idea was to create some type of shaft that could run all the way around the kindergarten, hiding the channels in the group rooms. The investigation was based on the nursery rooms because they were the ones that had to fit a storage room and a toilet whereas the kindergarten only should have a storage room.

CHANGING THE LEVELS

FUNTION WALL



ILL. 04.135 WORK PLAN

The chosen scheme was incorporated in the entire building, making a function wall running on around the building in the group rooms. This function wall consist of storage room and in the nurseries a toilet, making room for a shaft running in the inner roof construction without interfering with the rooms.

It was a wish to work with different levels in trying to work together with the terrain. But to do that and still making the kindergarten accessible for wheelchairs it was decided that the level change should only take place in the cover inner yard instead of lowering the group rooms which would make it much harder. Here it would be possible to make ramps integrated in the flow, not with the right slope for wheelchairs but making it accessible.

Conclusion

The vision for the design of the kindergarten Kildemosen has been on creating a creative and sensuous building with the social aspect in focus. An age-integrated institution that creates the best work environment for the users, the pedagogues and their work with the children and a place where the children could benefit from each other's differences, and develop their own personality at their own pace. In order to achieve this has the attention to the building flow and internal connections been in focus.

The buildings shape and choice of materials creates the idea of a small village, this gives the children a possibility to identify themselves with their group room, not feeling so lost in the large building.

Through the knowledge from the analysis the building started to emerge. A focus on the common function placed them in the center making the circular shape best fitted for the building. The center created a social meeting point for all the surrounding rooms, a place where the children from different groups can interact. While the center holds the building together and creates a gathering point, is all the group rooms orientated towards the surround playground making a connection between inside and outside.

This connection between inside and outside are underlined by the unheated space placed between the group rooms and common rooms. This corridor creates a room that would change in experience but be useful all year around. It creates transition from inside to the outside and introduces outdoor spaces inside the building mass.

Creating different experience throughout the building, is underlined by the shape. Every time you turn a corner something new is happening. And by adding the open wardrobes towards the corridors is the flow changing throughout the entire building. But also the fact that not to rooms have the same dimensions is creating a variation. The width, depth and height are varying in all the rooms and the possibility for connecting or dividing the rooms gives the building a lot of application.

The building is thought as an educational building, where the children see the constructional and technical additions and learn from them. Through an interplay between technical solutions and architectural expressions is the building optimized to create the best conditions for a good indoor environment and to fulfill the requirement for a BR2020 building. And by adding solar panels on the south facing part of the roofs is the BR2020 reached.

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Illustration

If nothing is mentioned is the illustrations my own

Ill. 01.01 Drawing from one of the children from Kilden

Ill. 01.02 Own illustration with inspiration from Mary-Ann Knudstrups method

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Ill. 03.02 *http://www.seemallorca.com/sights/houses/can-lis-portopetro.html* [03-05-2014]

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Ill. 03.08 Own illustration made from Google maps

Ill. 03.09 Own illustration made from kortforsyningen.dk *http://download.kortforsyningen.dk/* [07-02-2014]

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Ill. 03.21 Own illustration made from *http://www2.cebra.info/swfloader.asp?swf=paletten.swf&title=Paletten* [28-02-2014]

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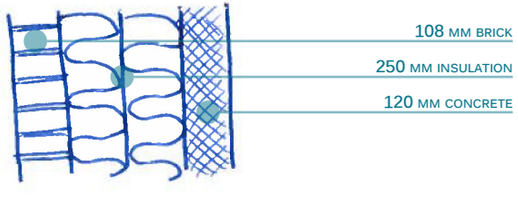
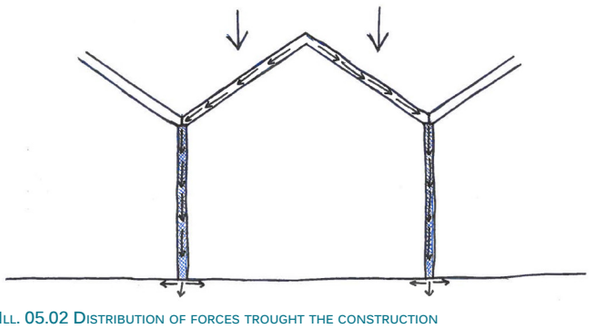
Appendix

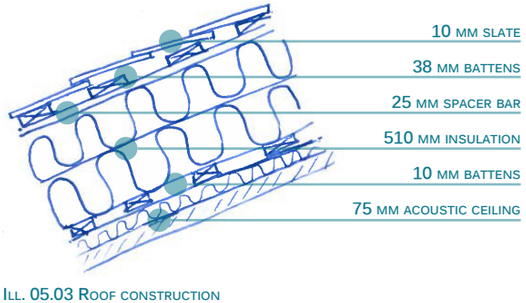
01 Construction



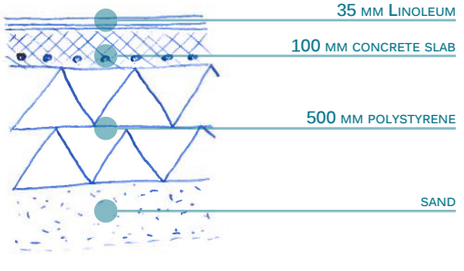
ILL. 05.01 OUTER WALLS CONSTRUCTION



ILL. 05.02 DISTRIBUTION OF FORCES TROUGHT THE CONSTRUCTION



ILL. 05.03 ROOF CONSTRUCTION



ILL. 05.04 FLOOR CONSTRUCTION

The building was designed as volumes with vaulted ceiling. The volumes in the outer circle with hidden trusses, and the volumes in the middle with visible trusses. The roof structures are supported by the walls between the volumes projecting the forces down to the ground.

The u-value for the construction is calculated from the thermal resistance of the materials as following:

$$U = \frac{1}{R_i + R_1 + R_2 + R_3 + \cdots + R_u}$$

Where Ri is the resistance inside, Ru the resistance outside [DS 418 Tabel 6.2] and R1 etc. is calculated as the dimension of the material divided with the materials thermal conductivity.

$$R = \frac{d}{\lambda}$$

For the inhomogeneous layer is the thermal conductivity calculated as following:

$$\lambda = \frac{\text{beam width} * \lambda + \text{insulation width} * \lambda}{total\ length}$$

Væg (Tegl)

	Materiale	Dimension [m]	Varmeledningsevne λ [W/m°C	Isolans R [m²°C/W]
Overgangsisolans ude				0,04
Udvendig beklædning	Tegl	0,108	0,4	0,27
Isolering	Isolering	0,25	0,032	7,81
Indvendig beklædning	Letbeton	0,12	0,2	0,60
Overgangsisolans inde				0,13
Dybde		0,478		

U-værdi væg

0,113 [W/m²°C]

Væg (Træ)

	Materiale	Dimension [m]	Varmeledningsevne λ [W/m°C	Isolans R [m²°C/W]
Overgangsisolans ude				0,04
Udvendig beklædning	Træ	0,025	0,16	0,16
Luftrum	Luft m. Lægter	0,033	0,024	1,38
Isolering	Isolering m lægter	0,15	0,11	1,36
Isolering	Isolering	0,15	0,032	4,69
Indvendig beklædning	Letbeton	0,12	0,2	0,60
Overgangsisolans inde				0,13
Dybde		0,478		

U-værdi væg

0,120 [W/m²°C]

Tag

	Materiale	Dimension [m]	Varmeledningsevne λ [W/m°C	Isolans R [m²°C/W]
Overgangsisolans ude				0,04
Udvendig beklædning	Skifer	0,01	2	0,005
Luftrum med lægter	Tagkrydsfiner	0,038	0,024	1,58
Afstandsliste	Tagkrydsfiner	0,025	0,14	0,179
Undertagsmembran	Klimamenbran			
Isolering	Isolering	0,51	0,032	15,9375
Dampspærre	Klimamenbran			
Lægter	Tagkrydsfiner	0,01	0,14	0,071
Indvendig beklædning	Troldtekt	0,075	0,047	1,596
Overgangsisolans inde				0,1
Dybde		0,668		

U-værdi tag

0,051 [W/m²°C]

Gulv/Terrændæk (Gummibelægning)

	Materiale	Dimension [m]	Varmeledningsevne λ [W/m°C	Isolans R [m²°C/W]
Overgangsisolans inde				0,17
Indvendig beklædning	Gummibelægning	0,004	0,12	0,033
Betondæk	Beton	0,1	0,2	0,500
Isolering	Polystyren	0,5	0,036	13,89
Sandpude				
Overgangsisolans ude				0,04
Dybde		0,604		

U-værdi Gulv/terræn

0,068 [W/m²°C]

Gulv/Terrændæk (Linelium)

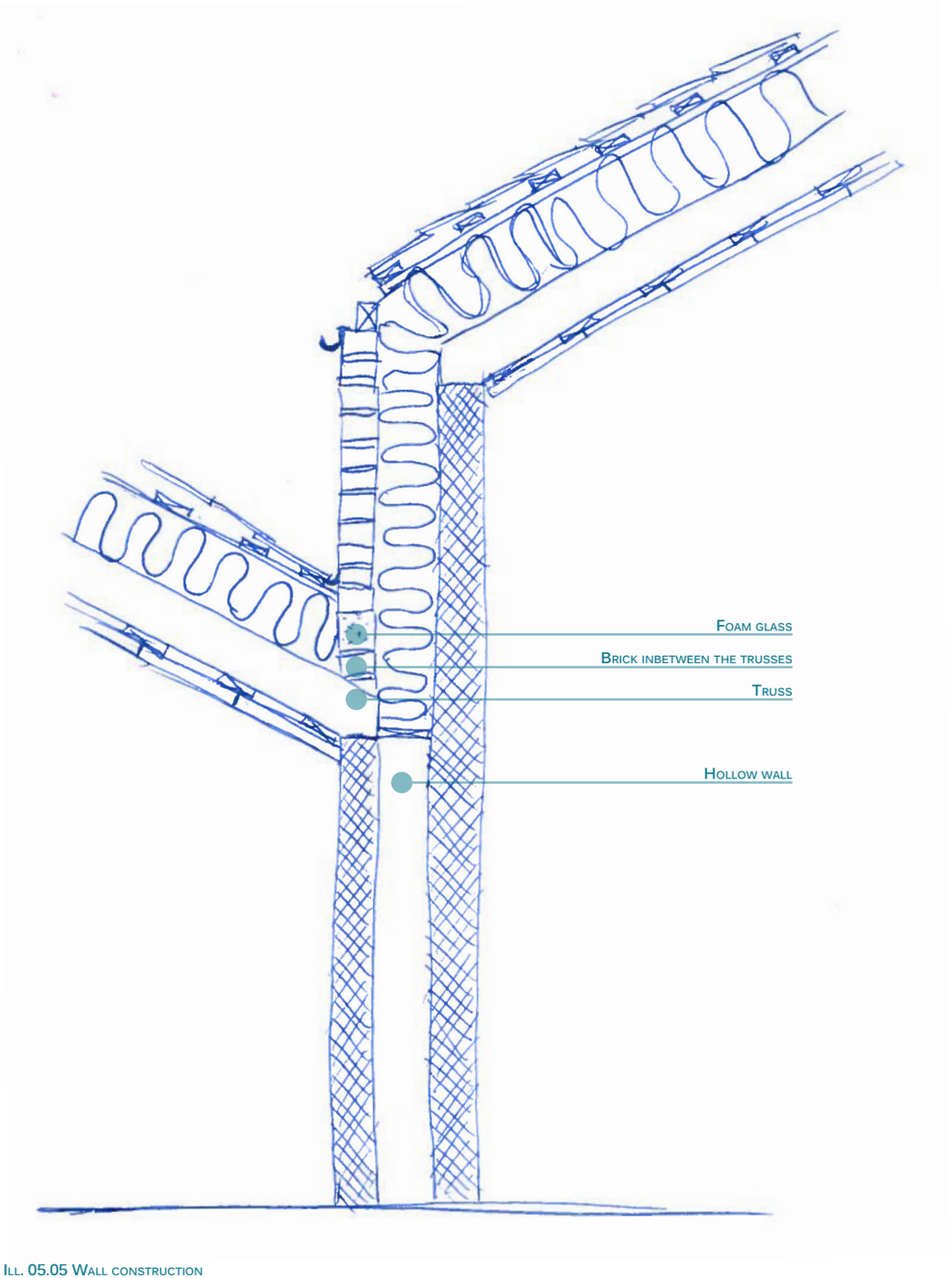
	Materiale	Dimension [m]	Varmeledningsevne λ [W/m°C	Isolans R [m²°C/W]
Overgangsisolans inde				0,17
Indvendig beklædning	Linolium	0,0035	0,2	0,018
Betondæk	Beton	0,1	0,2	0,500
Isolering	Polystyren	0,5	0,036	13,89
Sandpude				
Overgangsisolans ude				0,04
Dybde		0,6035		

U-værdi Gulv/terræn

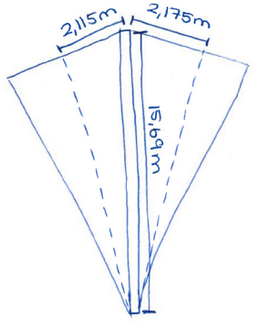
0,068 [W/m²°C]

For the walls that has to carry two roofs and are changing in levels is the construction though as showed on illustration 05.05. The inside wall will be a hollow wall that could be used for built in cabinet. The two roofs will use each their side to rest on. The lowest roof will have a wall built in between the trusses and to break the cold bridge is there added pressure strong foam glass. On top of that is the rest of the wall build as normal.

For detailed drawings in scale of plan, wall, deck, foundation and roof, see the drawing folder or the files on the cd.



Ill. 05.05 Wall construction



Ill. 05.06 The beam and what it has to carry

Glass roof construction

The roof over the unheated room is constructed with steel beams and a glass roof. The longest beam in the construction is in the open room in the middle and is 15,69m long. This beam is dimensioned in correlation with the dead load, snow load and wind load, to decide the dimensions for all the beams.

Snow load:

$$s = u_i * c_e * c_t + S_k$$

ui = 0,8 (determined from Table 4.8 in Teknisk Ståbi)
ce = 1 (determined from Tabel 5.1 in Eurocode 1)
ct = 1 (determined from Eurocode 1)
Sk = 0,9 kN/m2 (determined from Eurocode 1)

$$s = 0{,}8 * 1 * 1 + 0{,}9 \ \frac{kN}{m^2}$$

s = 0,72 kN/m2

Converting to line load:

s = 0,72 kN/m2 * (2,175m+2,115m)
s = 3,09 kN/m

Wind load:

$$q_p(z) = \left(1 + \frac{7}{\ln\left(\frac{z}{z_0}\right)}\right) * \frac{1}{2} * \rho * \left(V_b * k_r * \ln\left(\frac{z}{z_0}\right)\right)^2$$

ρ = 1,25 kg/m3
z0 = 0,3 (determined from Table 4.9 in Teknisk Ståbi)
Vb = windspeed 27 m/s
z = hight 5 m

$$k_r = \left(\frac{z}{z_0}\right)^{0{,}07}$$

$$k_r = \left(\frac{0{,}3}{0{,}05}\right)^{0{,}07}$$

kr = 0,125

$$q_p(5) = \left(1 + \frac{7}{\ln\left(\frac{5}{0{,}3}\right)}\right) * \frac{1}{2} * 1{,}25 kg/m3 * \left(27\ m/s * 0{,}215 * \ln\left(\frac{5}{0{,}3}\right)\right)^2$$

qp = 415 n/m2 = 0,415 kN/m2

Corrections with a factor describing the slope of the roof.
When a = 30° is the correction factor 0,4

0,415 kN/m2 * 0,4 = 0,166 kN/m2

Converting to line load:

Vk = 0,166 kN/m2 * (2,175m+2,115m)
Vk = 0,71 kN/m

The dead load is determined for a heavy construction and are estimated to 1,5 kN/m2

Converting to line load:

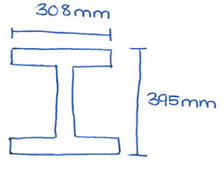
g = 1,5 kN/m2 * (2,175m+2,115m)
g = 6,435 kN/m

Calculating the load combination with the dead loads as the domination factor. From Tabel 4.4 in Teknisk Ståbi is the combination determined to: 1,2 * KFI * g. This gives a load for the beam to carry: 1,2 * 1 * 6,435 kN/m = 7,722 kN/m, whoever is the load calculated if the snow load was the dominating which give the load combination: 1 * KFI * g + 1,5 * 0,3 * KFI * Sk + 1,5 * 0,3 * KFI * Vk
1 * 1 * 6,435 + 1,5 * 0,3 * 1 * 3,09 + 1,5 * 0,3 * 1 * 0,71
= 11,36 kN/m

This is the load that the beam should carry.

Calculating the beam:

Data:
Ix = 848,7 *106 mm4
Es = 0,21 * 10 6 MPa
Wx = 4300 * 103 mm3
fy = 235 MPa
Ymo = 1,1



Ill. 05.07 Beam cross section

Testing the maximum deflection, umax, to see if it goes over the permitted deflection giving by $\frac{L}{300} = \frac{15690}{300} = 52{,}3$ mm

$$u_{max} = \frac{5*p*L^4}{384*E*I}$$

$$u_{max} = \frac{5*11{,}36*15690\ mm^4}{384*0{,}21*10^6*848{,}7*10^6}$$

$$u_{max} = 50{,}3\ mm$$

50,3 mm < 52,3 mm

Testing if the strengthen the conditions are reached.

$$M_{max} = \frac{W*f_y}{Y_{mo}}$$

$$M_{max} = \frac{4300*10^3*235}{1{,}1}$$

$$M_{max} = 918{,}636\ kNm$$

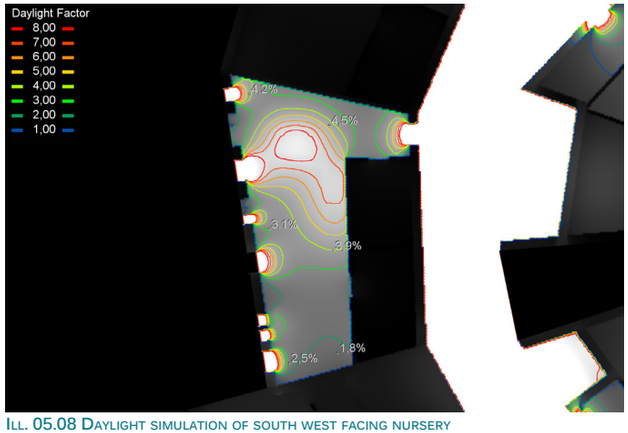
$$M = \frac{1}{8} * p_d * l^2$$

$$M = \frac{1}{8} * 11{,}36 * 15{,}69^2$$

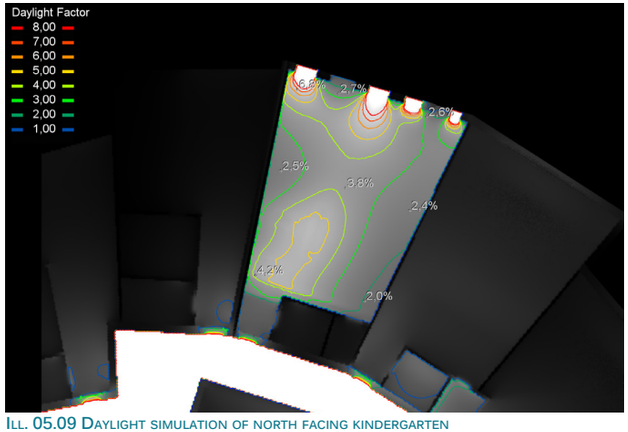
$$M = 22{,}28\ kNm$$

22,28 kNm < 918,636 kNm

This shows that this beam would be able to carry the load from the roof, snow and wind.



Ill. 05.08 Daylight simulation of south west facing nursery



Ill. 05.09 Daylight simulation of north facing kindergarten

02 Indoor climate

Daylight

In creation of a good indoor environment one of the influencing aspects is the daylight factor. It is important to create an even distribution of the light in the room so the different between the dark and light area are not the big. The daylight is evaluated in the program VELUX Daylight Visualizer for two rooms, one facing south west and one facing north. The room facing south west is divide into two light zones, even though the different I daylight factor on approximately 2% this is okay because the wish of create different experience in the room. The same is valid in the north facing room. Here the darkest area is against one of the walls which will be used for smaller play areas which would get different experiences.

Mechanical ventilation

Because of the demands for the ventilation in the institution is the mechanical ventilation the main source of ventilation. According to the Danish Building Regulation 6.3.1.3 stk. 1, is the required ventilation 3 l/s pr. child and 5 l/s pr. adult using the room, plus 0,35 l/s pr. m^2 floor area. This gives different air changes in all rooms because of the variation in people load and size. Calculation the air change for one of the nurseries is done as following;

3 l/s * 12 children + 5 l/s * 4 adults + 0,35 l/s m2 * 72,02 m^2
= 88,466 l/s

Converted to h^{-1}:

88,466 l/s *3600 = 318478 l/h
318478 l/h / 1000 = 318,478 m^3/h
318,478 m^3/h / 249,94 m^3 = 1,01 h^{-1}

This gives the minimum required air change. However the air change has to take into account the pollution of the air, and as the maximum allowed pollution is 900 ppm is the air change calculated for CO_2 production. For sedentary activity is the activity level 1,2 met, while it for an active person is 3 met. It is assumed that the adult will have an activity level on 1,2 met, while the children will have 3 met. This factor is used together with the human production of CO_2 to find the pollution that the ventilation has to get rid of. An adult produces 17 and it is assumed that the children produces 60% of that, 10,2. The calculation for the air change is dons as follows for the nursery.

Internal load [q]:

17 * 1,2 * 4 + 10,2 * 3 * 12 = 448,8 l/h
448,8 l/h / 1000 = 0,4488

Air current [V_L]:

$$V_L = \frac{q}{(c - c_i)}$$

$$V_L = \frac{0{,}4488\,\frac{m_3}{h}}{(0{,}0009\frac{m_3}{m_3} - 0{,}00035\frac{m_3}{m_3})} = 498{,}67\ \text{m3/h}$$

Air change [n]:

$$n = \frac{V_L}{V_R}$$

$$n = \frac{498{,}67\,\frac{m^3}{h}}{249{,}94\,m^3} = 2\ \text{h-1}$$

And as this air change is the larges that is the one needed to provide the room with the right atmospheric comfort.

To dimension the channels for the mechanical ventilation is all the air currents for the rooms added together. This gives an air current on 24904 m3/h, that the system will have to distribute. To reduce the noise from the system it is calculated so the speed in the channels is not over 6 m/s.

Calculation the channel diameter:

24904 m3/h / 3600 = 6,92 m3/s
6,92 m3/s / 6 m/s = 1,153 m2

$$\sqrt{\frac{1{,}153m^2}{\pi}} = 0{,}6\ \text{m}$$

This is the size used close to the aggregate, in the building will the channel size be respectively 0,4 m for the group rooms and 0,5 m for the common areas in the middle of the building.

Calculation air change e.g. BR10

Indtast data

Antal børn	12	
Antal voksne	4	
Areal	92,76	[m^2]
Volumen	316,54	[m^3]

Luftskiftet

318477,6	[l/h]
318,4776	[m^3/h]
1,01	[h^{-1}]

Minimumskrav BR10

Børn	3	[l/s]
Voksne	5	[l/s]
Pr. m^2	0,35	[l/s]

Volumenstrøm

Volumen	17,05	
Luftskifte	2,11	
Luftstrømmen [V_L]	35,98	[m^3/h]

Samlet luftmængde

88,466 [l/s]

Calculation air change e.g. pollution

Indtast data

Antal børn	12	
Antal voksne	4	
Areal	72,02	[m^2]
Volumen	249,94	[m^3]

Aktivitetniveau

Stillesiddende	1,2	[met]
Aktiv	3	[met]

CO2 produktion

Voksne	17
Børn	10,2

CO2 koncentration

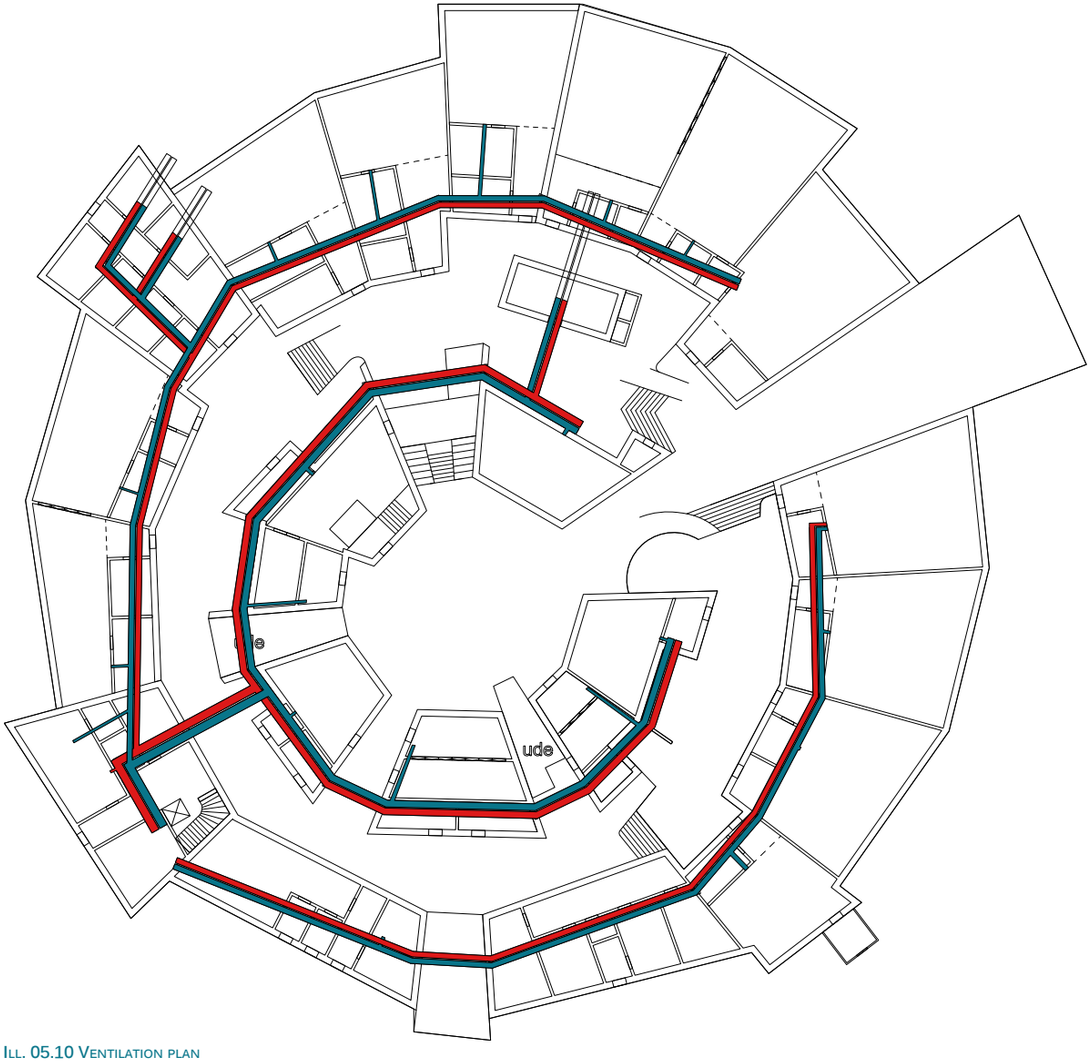
Inde	0,0009	[m^3/m^3]
Ude	0,00035	[m^3/m^3]

Stofbalancen

Internebelastning [q]	448,8	[l/h]
Internebelastning [q]	0,4488	[m^3/h]
Luftstrømmen [V_L]	498,67	[m^3/h]
Luftskiftet [n]	2,00	[h^{-1}]

Volumenstrøm

Volumen	17,05	
Luftskifte	2,11	
Luftstrømmen [V_L]	35,98	[m^3/h]



Ill. 05.10 Ventilation plan

The piping in the building is distributed as shown on illustration 05.10. It is distributed so the system will have the smallest pressure loss throughout the system, by curving as little as possible and breaking through a minimum of fire cells.

Inlet

Outlet

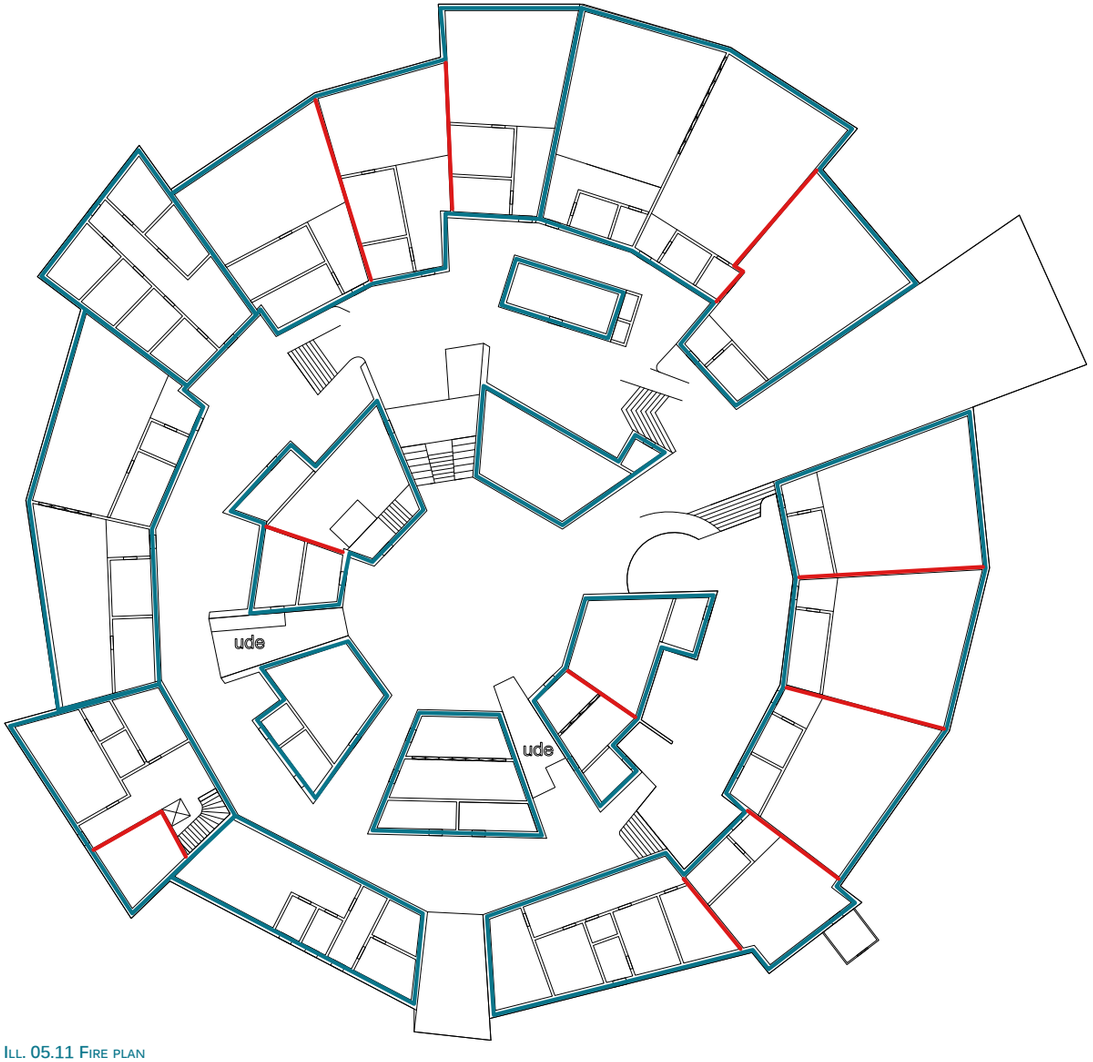
03 Fire demands

The building is designed so evacuation during a fire is easy though escape route. The group rooms are designed with a door to the inner yard and to the outside. The same is valid for en stroller room, the offices and the kitchen, while the employees volume have to floors were the first floor has an opening in each direction and the top floor have a fire escape via the terrace.

To prevent a spread of fire is the building divided into fire cells and sections. The sections are exiting of smaller cells, which are shown on illustration 05.11.

Fire sections

Fire cells



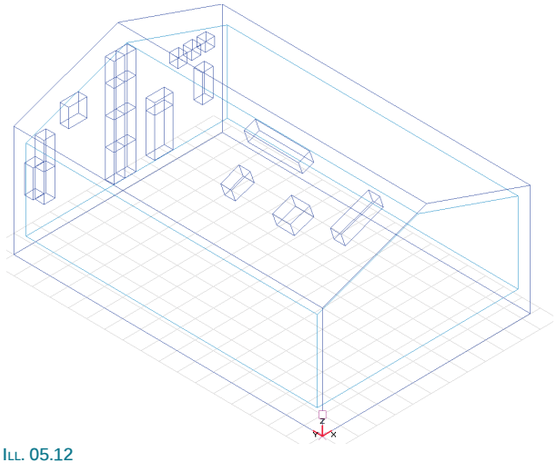
Ill. 05.11 Fire plan

04 Indoor simulation

The indoor climate for the same two rooms that were tested for daylight was simulated using the program BSim. BSim is a program developed to hygrothermal simulations and calculations of indoor climate in buildings, including CO2 levels, cooling, temperatures and humidity. This program was used to control the thermal and atmospheric comfort of the rooms, cf. DS/EN 15251, that stats that a kindergarten should have a temperature between 17,5 and 22,5 during the winter season and 21,5 and 22,5 during the summer seasons. [DS/EN 15251 Tabel A.3]

Because of the programs restriction when it comes to calculate of rooms with double curved surfaces a simplified model of the two rooms was built in the program. This results in a room with a larger volume than in reality, giving the simulation a larger buffer. For the room facing south west is this buffer small because the small difference of the front and back wall, while the north facing room is given a larger buffer. After adding openings and constructions to the room, all the systems that have an impact on the room are added. The rooms are put in a thermal zone and a site is added to the model.

The simulations can be found on the attached cd.



Ill. 05.12

Kindergarten facing North

	Sum/Mean	*January*	*April*	*June*	*September*
tOp mean [˚C]	18,9	17,8	18,7	20	19,8
CO_2 [ppm]	457,8	520	471,1	374	465,8
Hours > 21 ˚C	2764	222	244	193	273
Hours > 26 ˚C	92	0	0	56	0
Hours > 27 ˚C	19	0	0	16	0
Hours < 20 ˚C	5284	489	429	456	363

Kindergarten facing North February 2nd

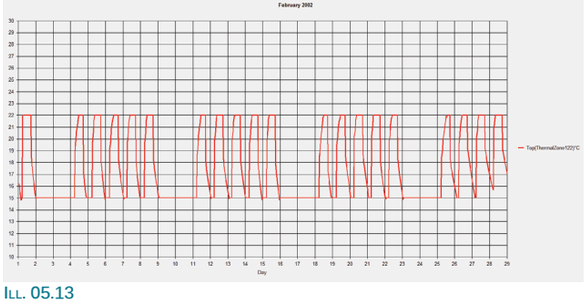
	Minimum	Mean	Maximum
tOp mean [˚C]	14,93	17,72	22
CO_2 [ppm]	361	518,6	894,7

Kindergarten facing North June 2nd

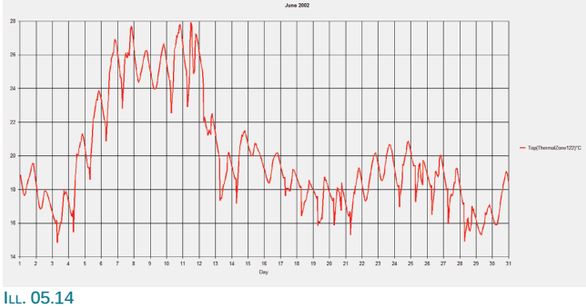
	Minimum	Mean	Maximum
tOp mean [˚C]	14,82	19,98	27,94
CO_2 [ppm]	350	374	701,6

For the north facing room is the people load 20 kids and 3 adults, and because of the focus in the project on the common facilities is it assumed that only 60% of the full load will be there during the day except when it is lunchtime. The loads are also different from winter to summer, because of the possibility to be more outside. The ventilation is set from the calculations done during the dimensioning of the ventilation pipes. The ventilation are turned on one hour before the room are used an runs until an hour after the building closes, this so the air quality, when in use are satisfying, furthermore it is added to run all year because of the demands from BR10 for ventilation of institutions. The floor heating are added to run in the winter season, but adjusted to run at a lower temperature outside the opening hours, this so the system don't have to reheat the entire building every morning.

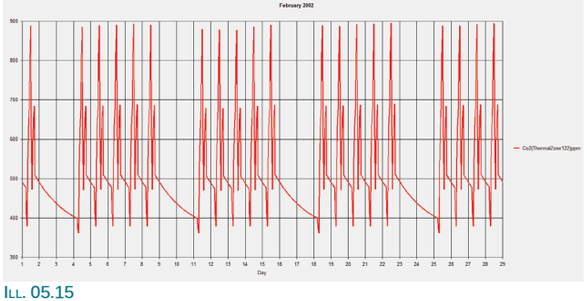
The following schemes show the simulations for the two rooms during all year, the coldest day, the February 2nd and the hottest day, June 2nd, for both thermal and atmospheric comfort. The simulation shows that the room during the summer will get a small over temperature, but this is often happening outside the opening hours of while the room is not in use. The CO2 level in the room is never reaching the highest allowed, so this is satisfying.



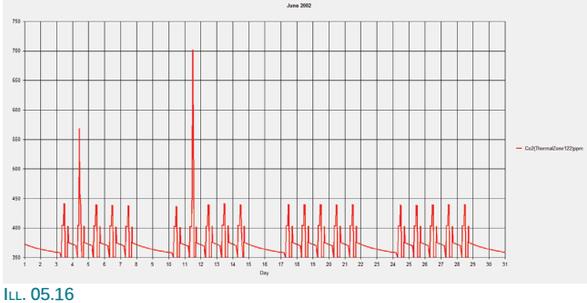
Ill. 05.13



Ill. 05.14



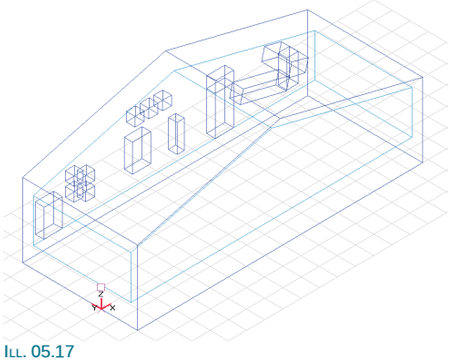
Ill. 05.15



Ill. 05.16

Nursery facing South East

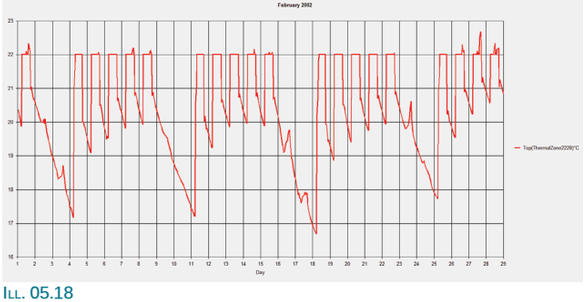
	Sum/Mean	*January*	*April*	*June*	*September*
tOp mean [˚C]	21,7	20,5	21,6	23	22,8
CO_2 [ppm]	429	461	436,2	385,2	431,8
Hours > 21 ˚C	6014	301	504	673	717
Hours > 26 ˚C	172	0	0	62	0
Hours > 27 ˚C	40	0	0	21	0
Hours < 20 ˚C	5284	489	429	456	363



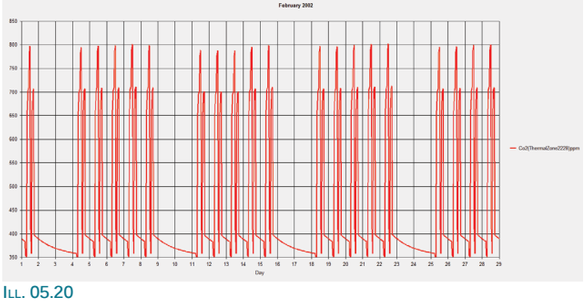
Ill. 05.17

Nursery facing South East February 2nd

	Minimum	Mean	Maximum
tOp mean [˚C]	18,61	19,53	20,17
CO_2 [ppm]	369,2	377,7	388,3



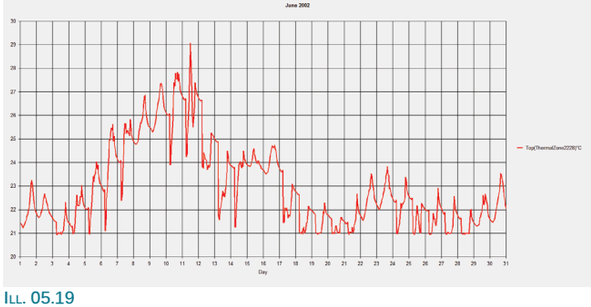
Ill. 05.18



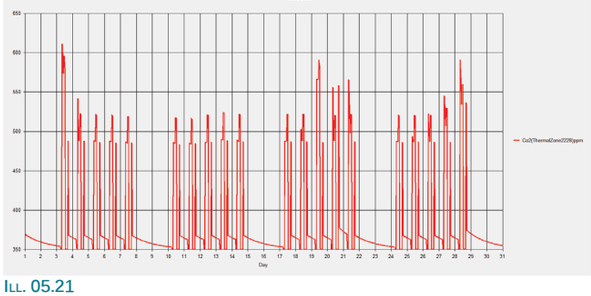
Ill. 05.20

Nursery facing South East June 2nd

	Minimum	Mean	Maximum
tOp mean [˚C]	21,41	21,89	22,81
CO_2 [ppm]	354,7	356,7	359,3



Ill. 05.19



Ill. 05.21

The south west facing room is a nursery and that it why the people load here are different from the north facing room. Here there is calculated with 12 children and 4 adults. But because of the age it is here calculated with a percentage of 80 % during usage instead of the 80% for the kindergarten room. Like the other room is the people load also different from summer to winter and the other systems are added like the north facing too, but with the values calculated for this room.

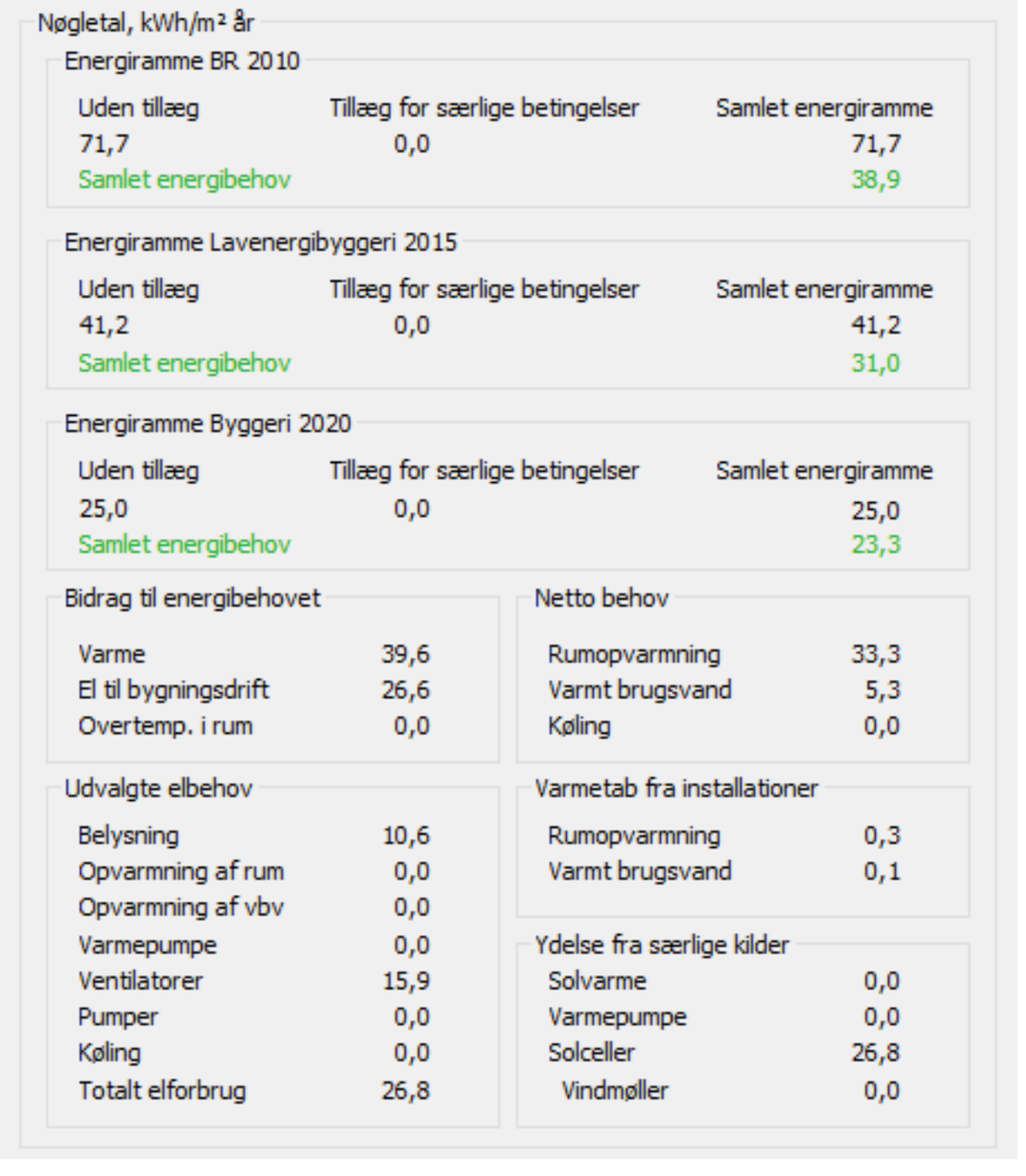
In the simulation this room has a lower temperature than the north facing room. This is due to the orientation of the windows and also the dimensions of the room. The atmospheric comfort for the room is also here satisfying and is not reaching the maximum allowed concentration. But the room is here dealing with some over temperatures; the most of them is outside the buildings opening hours, or during time were the room is not in use like the kindergarten room.

05 Energy frame

Be10 is a tool to estimate the buildings energy frame and is used to test the building up against the regulations for a 2020 building as described in the technical requirement in the program. All the information's about the building are put into the program and it simulates the total energy consumption for the building. Information's like the construction and its u-value, the amount of windows and their orientation, the ventilation rate and the renewable sources.

As renewable energy sources is there in this project used solar panels added to the south facing roof slopes on every volume in the outer circle of the building.

The Be10 simulation is to be found on the attached cd.



Nøgletal, kWh/m² år

Energiramme BR 2010

Uden tillæg	Tillæg for særlige betingelser	Samlet energiramme
71,7	0,0	71,7
Samlet energibehov		38,9

Energiramme Lavenergibyggeri 2015

Uden tillæg	Tillæg for særlige betingelser	Samlet energiramme
41,2	0,0	41,2
Samlet energibehov		31,0

Energiramme Byggeri 2020

Uden tillæg	Tillæg for særlige betingelser	Samlet energiramme
25,0	0,0	25,0
Samlet energibehov		23,3

Bidrag til energibehovet

Varme	39,6
El til bygningsdrift	26,6
Overtemp. i rum	0,0

Netto behov

Rumopvarmning	33,3
Varmt brugsvand	5,3
Køling	0,0

Udvalgte elbehov

Belysning	10,6
Opvarmning af rum	0,0
Opvarmning af vbv	0,0
Varmepumpe	0,0
Ventilatorer	15,9
Pumper	0,0
Køling	0,0
Totalt elforbrug	26,8

Varmetab fra installationer

Rumopvarmning	0,3
Varmt brugsvand	0,1

Ydelse fra særlige kilder

Solvarme	0,0
Varmepumpe	0,0
Solceller	26,8
Vindmøller	0,0

CD

Report
BSim simulations of north facing room
BSim simulations of south west facing room
Be10 calculation
Detail; Plan 1:100
Detail; Wall, Deck and window 1:20
Detail; Foundation 1:20
Detail; Roof 1:20