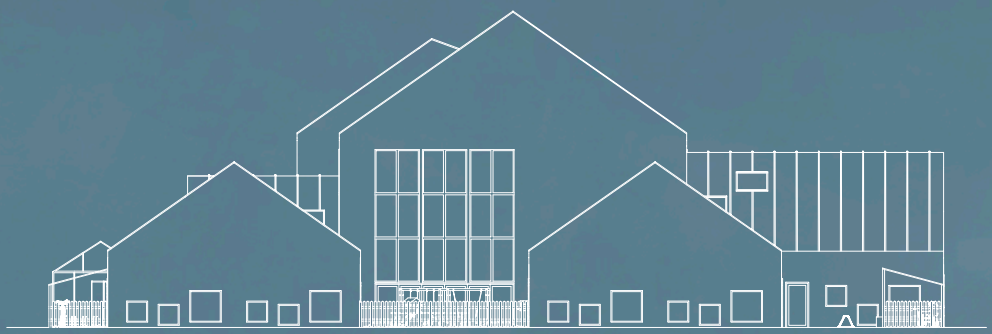


CHILDREN'S VILLAGE

Sustainable Integrated Day Care Centre

Group 5, ma4-ark5, May 2020

Annika Kristensen & Gülay Eryüce

TITLE PAGE

Title	Children's Village
Working title	Sustainable Integrated Day Care Centre
Project	Master Thesis
Spezialization	Sustainable Architecture
Study	Master of Science in Engineering (Architecture)
Department	Architecture & Design
Place	Aalborg University AAU
Semester	MSc04 SUS ARC, Spring 2020
Project period	03.02.2020 - 28.05.2020
Group	Group 5, ma4-ark5
Main supervisor	Lars Brorson Fich
Technical supervisor	Rasmus Lund Jensen
Pages	214
Appendix	10

Annika Kristensen

Gülay Eryüce

ABSTRACT

This master thesis presents the design of a Sustainable Integrated Day Care Centre located at Stigsborg Havnefront in Nørresundby. The project will provide the framework for a future children and young universe, which will be an attractive and a central part of the new district of Aalborg. The project is based on various researches about children´s well-being, learning and development, as well as the influence of the physical spaces, all with focus on sustainability.

The concept of the project is based on creating a "Children Village" with playful and colourful facades that creates an inspiring and identifiable universe for children, and at the same time, attract people to the area so it will become a central place for cultural meetings in the future.

Through the building´s spatial organizing, spaces have been created for various activities to stimulate children´s senses, motor function and cognitive development. Different materials and colours are used, to create a safe and motivating environment. Flexibility have been a great part of the design, and various zones are created so the children can play both in smaller and bigger groups. The use of various materials further helps to create a creative place for the children, which stimulate them and strengthen their learning and development.

In addition, the indoor climate has been an important part of the design, in order to create a healthy and comfortable environment for the users of the building.

TABLE OF CONTENT

INTRODUCTION

This project concerns the development of a Sustainable Integrated Day Care Centre, which will be an institution that houses both nursery and kindergarten. The user group of the centre will be children in the age of 0-6 years. The institution will be estimated to house 160 children in total, 60 nursery children and 100 kindergarten children. The project will be located at Stigsborg Havnefront in Nørresundby, a new district of Aalborg.

Children's brain develops mostly during the first 3 years of their life. (Forstadt, 2011) The daycare centre is the children's second home, while they spend a big part of their time there. It is therefore important in the institution, to have a strong focus on stimulating their brain and senses, so they can develop satisfactory, as the first years forms the basis for the rest of their life.

The architecture has a big influence on providing the children good learning environments. Thus, the focus will be, to create educational spaces, which stimulates the children´s sensory experiences, motor function and cognitive development.

A focus will be on creating interaction between space, architecture and interior design, which will contribute to children´s learning and development opportunities. In order to achieve a good learning environment, the rooms should be designed so it has positive effect on their behavior, by making them feel safe and creating them stimulating environments that allows the children to develop and learn.

Another focus will be on the learning about sustainability, to make them aware of the environmental issues already from their childhood, so that sustainability become an integral part of their life. This will impact their attitude and forming their behavior in a positive way. (Brorström and Frøkjær, 2018)

MOTIVATION

The motivation for choosing this topic, is personal interest in children's well-being, learning and development.

Children use a lot of their time in institutions, while their parents are at work. We found it interesting to see, if we can create an environment that could have a positive effect on them.

We want to challenge ourselves and see if we can use our knowledge and skills, to design a place that provides the framework for the children, to grow up in a healthy and safe place, with a lot of possibilities to learn and develop.

We want to design a sustainable building, with a greater focus on the social and environmental qualities. As we are doing a user-based design the aspect of a good indoor climate is important, to ensure the users health and well-being. As the aim is to achieve a sustainable building with a low environmental impact the choice of materials and passive- and active strategies are important too.

Our interest in children's well-being, learning and development combined with our interest in sustainable architecture, sets the foundation for our project, which is a Sustainable Integrated Day Care Centre, located at Stigsborg Havnefront.

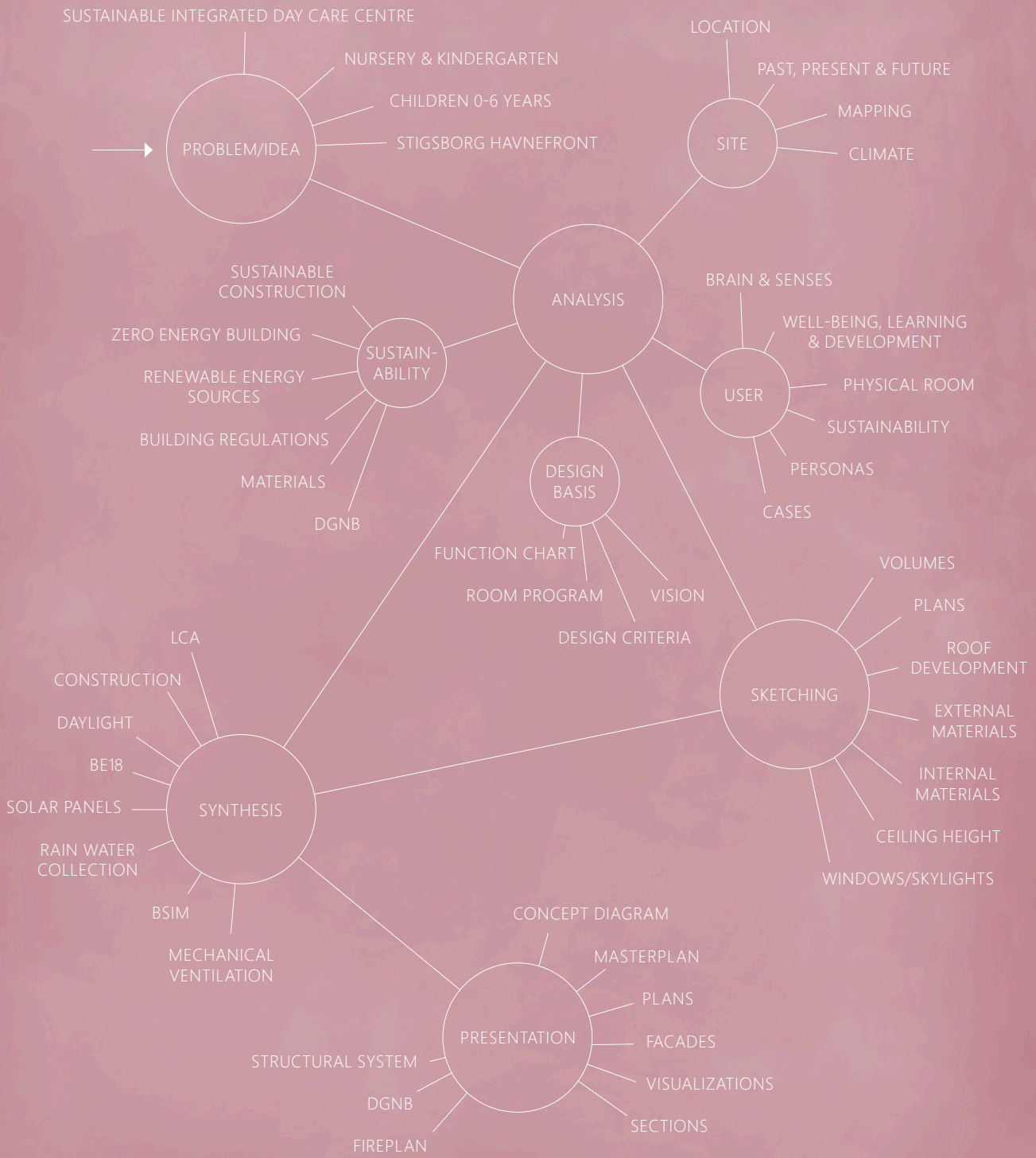
WHY STIGSBORG HAVNEFRONT?

Population growth rises and more and more residents are arriving to Aalborg Municipality. In 2019 the population has increased by 1.763 people according to Denmark's Statistics see app. 01 (Statistikbanken, 2020).

Aalborg Municipality is an attractive place for young families to settle. Therefore, in order to keep up with the increasing number of children, a big amount of money is invested in three new day care institutions in Aalborg, according to the budget proposal for 2020-2023 (Aalborg Kommune, 2019).

In connection with the development of Aalborg Havnefront, a new district is established in Nørresundby, Stigsborg Havnefront. Here, a new children and young universe gets an attractive and central location. It will be the landmark for the area, and the child and youth universe will be the central point for both family and city life in the new district. We want to be a part of this and set our footprint at the area.

METHODOLOGY



12 | Ill. 1. Integrated Design Process

INTEGRATED DESIGN PROCESS - IDP

The Integrated Design Process by Knudstrup (2004) consist of five phases; problem/idea, analysis, sketching, synthesis and presentation. The method is an iterative process, that helps to ensure a holistic design with both architectural and engineering aspects.

The first phase – problem/idea – is the initial problem that forms the project. As presented, the population growth rises, and more young families are arriving to Aalborg. In connection to keep up with the increasing number of children, a new children and young universe are going to be built at Stigsborg Havnefront. This project will contribute with the design of a Sustainable Integrated Day Care Centre, that at the same time sets the frame for the city life in the new district of Aalborg.

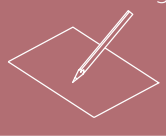
The second phase – analysis – are the phase where research, registrations and analysis of the site, users and sustainability are made. This includes the area's past, present and future, including the vision and microclimate for the future area. Various research of the children's brain, well-being, learning and development are made, and different institutions are visited – all to get a better knowledge of the case. Lastly different aspects which should be considered when designing a sustainable institution, will be presented as well. The phase ends with the design basis for the projects, such as design criteria and vision.

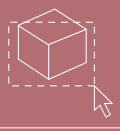
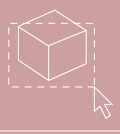
The third phase – sketching – is where the design process really begins. Based on the initial problem, the various analysis, as well as the design basis, the process of concept development of different plans and volumes starts. There is a major focus on the users of the building, in terms of scale, materiality, view, sensory stimulation, learning and everyday life in the building in general.

The fourth phases – synthesis – is where the design achieved during the sketching phase is detailed and optimized. To achieve a holistic design, there is a focus on sustainable qualities, especially in relation to creating a safe place where the users feel health and well-being, for which a good indoor climate is an ultimatum. This is ensured using simulation tools such as BSim and VELUX Daylight Visualizer, which can give an insight into the atmospheric, thermal and visual experience of the rooms in the building.

The fifth phase – presentation – is the phase where the final design is presented. It is communicated through plans, sections, facades, visualizations and descriptions of the qualities of the future Sustainable Integrated Day Care Centre.

METHODOLOGY SCHEME

	METHOD	DESCRIPTION	HOW TO USE IT	PURPOSE
ANALYSIS	Illustrations/ diagrams 	Illustrations and diagrams that visualize the point of the text.	Illustrations and diagrams are made by using Illustrator and/ or Photoshop.	To facilitate reading and visualize what the text describes and clarify the point of it.
	Sense of place 	The area is visited and photographed.	The area is physically observed with the senses, especially the sense of sight. In addition, the area is documented through photos of views and special elements, relevant for the design of the institution	To get a feel of the atmosphere, as well as experience the special views and elements, and photograph them to use and remember during the design phase.
	Mapping 	Mapping is a method by James Corner (1999), to describe the context of the site.	The context is divided into categories that are described and visualized through maps.	The purpose of the method is to understand the context, for designing the institution in relation to it.
	Qualitative studies of site 	Looked into the visions for the area, including the local plan, to gain an understanding of the future area, Stigsborg Havnefront.	As the area currently appears as an empty field, visions and plans for the area have been looked into, to gain an insight of the future master plan.	To gain insight into how the area will function and be experienced in the future, but also what the role of the institution will be in the new city district.
	Quantitative studies of site 	Study of the microclimate in relation to wind and sun.	Diagrams are used to illustrate the weather conditions at the site.	The purpose is to be able to create a good indoor climate by using renewable energy sources, as well as to create comfortable outdoor spaces.
SKETCHING	Hand sketching 	Hand sketching is a method to show a simple idea and design by a quick drawing.	Create a visualization for understanding of the idea by freehand drawing.	Quicker method to discuss and show the current ideas and designs.

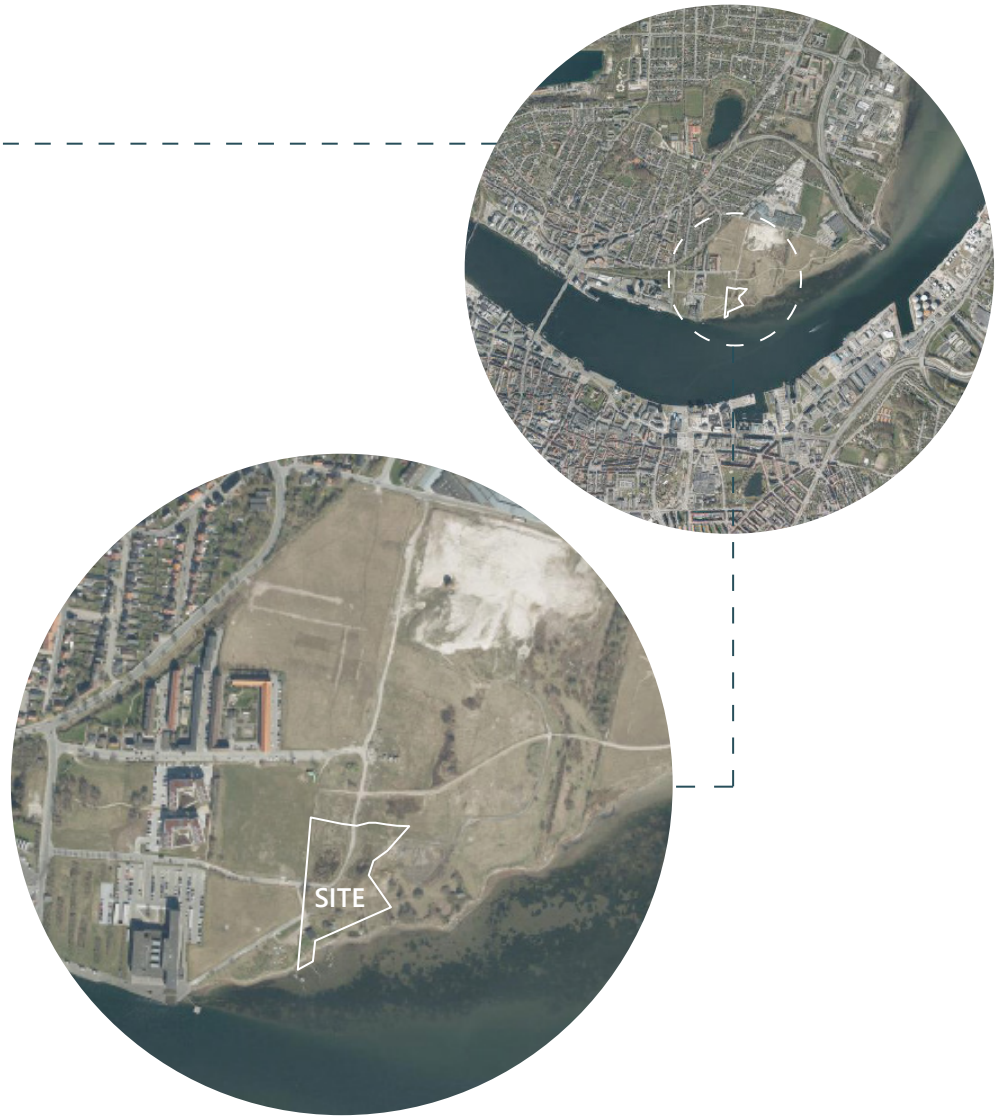
	METHOD	DESCRIPTION	HOW TO USE IT	PURPOSE
SKETCHING	3D modelling 	3D modelling is used to develop a visual representation of the various design proposals.	Creating shape, form and geometry by using 3D modelling software such as Sketchup.	Creates a more detailed understanding of the form and geometry of the design proposals.
	Environmental design 	Software creates a possibility to see the environmental impact of the building design, by using software such as Be18, VELUX Daylight Visualizer and BSim.	Modelling and simulating the various design proposals to compare the environmental impact by using different software.	For example, analyzing the wind and sun's impact on the building.
SYNTHESIS	Simulation software 	Work with various building simulation software, including VELUX Daylight Visualizer, BSim and Be18.	The simulations are made by providing the software with the information it needs, such as the size and geometry of the building or building parts.	To get an idea of how the building or elements in it will perform, both in relation to the indoor climate, but also in relation to environmental aspects.
	Calculations 	Calculations are made for example glass area, U-values and solar panels.	Using calculator or Excel, different calculations are made.	To ensure that the building meets the requirements for example daylight and energy consumption.
PRESENTATION	3D modelling 	Making 3D model to present the building.	Using software to create a 3D model, which produce plan, sections, renderings and technical drawings.	Visualizing the final design proposal.
	Illustrations/ diagrams 	Visualize the final building proposal graphically through illustrations and diagrams.	Making graphical communication by using InDesign, Illustrator or Photoshop.	To present the building design graphically, to give a visual understanding of the final building design.

SITE ANALYSIS

LOCATION

Stigsborg Havnefront is centrally located in an attractive area in Nørresundby. It is considered as a new district of Aalborg, and is closely connected to Aalborg Centrum with its location by Limfjorden and view to Aalborg City.

The area is 54 hectares and have an almost 2 kilometer long coast- and harbor line south facing Limfjorden. Nørresundby is known as the sunny side of Aalborg. (Stigsborg Havnefront, 2020)



Ill. 4. Location (SDFE, 2020)

HISTORY OF STIGSBORG HAVNEFRONT - PAST

Stigsborg Havnefront is known as an industrial area. In 1960's the factory "Dansk Svovlsyre- og Kunstgødningsfabrikken Limfjorden" also known as "Syren" was located at the area. The factory produced fertilizer.

It changed its name to "Superfos" in 1971. In 1989 it was bought by a Finnish fertilizer factory and the factory was now known as "Kemira".

In 1900`s the factory got fines, because of environmental failure, including gas and dust emissions, which is detrimental to human health. Due to the environmental damage of the factory over time, Nørresundby municipality decided that the area needed new expansion options and in 1998 the factory was closed.

Aalborg municipality bought the area in 2001, where the factory was demolished, except an acid container "syrebeholderen", which is a landmark for the area and symbolize the industrial history.

EXISTING BUILDINGS

West in the former factory area, the municipal administration building "By- og Landskabsforvaltningen" are located. The building attracts both citizens and employees to the area because of its function. Next to this building is the factory "Hedegaard Agro".

South in the former factory area "Syrens Bådelaug" is located. It is a smaller dinghy harbor, which dates to World War II. Today both boat bridges and club house have been established, which brings outdoor life to the area. (Aalborg Kommune, 2020)

Ill. 5. History of Stigsborg Havnefront - 1:10.000 | 21

VISIT TO STIGSBORG HAVNEFRONT - PRESENT

In the past Stigsborg Havnefront has been a factory area, why the soil is contaminated. Now, the area is an empty field, where Aalborg municipality is in process to purify the area for human-caused substances.

As a landmark of the industrial history, the area still retains the acid container from the factory. The industrial buildings such as; Hedegaard Agro, By- og Landskabsforvaltningen and Syrens Bådelaug has been preserved as well.

A visit to the site showed that most of the area is closed for access, because of the undergoing purification process. However, some paths are built so one can move around the area a bit.

 Ill. 6. Paths in the area

VISIONS OF STIGSBORG HAVNEFRONT - FUTURE

Stigsborg Havnefront is one of the largest coastal development projects in Denmark. The area is going to be developed as a new district of Aalborg City. It is a part of the transformation of Aalborg going from an industrial city, to a modern cultural study city.

The development is expected to last 25-30 years, why the strategy is to create a dynamic but also financially secure concept for the area. Because, no one knows how the technology, architecture or need will look like in the future.

The ambition for Stigsborg Havnefront is to add to the area all it takes, to create a living city including different types of housing, institution, school, nursing home, offices, stores and cafes. And because of its unique location, it should take advantage of the qualities of the city park and fjord.

The area of Stigsborg Havnefront is divided into 3 new districts: The harbor district, park district and beach district. The development will be divided into three stages, this project will be a part of stage 1, which is the central part of the area. Stage 1 includes the park district, as well as a part of the harbor district. (Aalborg Kommune, 2020)

Stage 1 is an area of 33 hectares in total, including the city park, Stigsparken, which will become the biggest city park in Aalborg. (Stigsborg Havnefront, 2020)

VISION

Stigsborg Havnefront should in the future carry the historical DNA in its structure, scale and character. It will be a classic city district with a deep imprint from the urban context, the park and fjord. Stage 1 will set the standard for all the area, in its identity, soul and city life.

MATERIALITY AND DETAILING

The area should have greenery and the landscape in focus. This should appear in green urban spaces between the buildings as well as a city park. A green central city street, will create identity for the new city district, and all the way have a view to the fjord, which will be a central element for the city space and quality of housing.

As main impression the city district should appear as a brick town with variation in example; nuances, bricks or pattern. The primary façade material should be bricks, secondary materials could be tree, stones, glass, metal or concrete in limited amount.

The chosen materials should appear as natural as possible, a focus should be on materiality, patience and durability.

The character of the buildings must be characterized by the classic city's detailing, with clear horizontal divides in the façade; base, main façade and roof. (Stigsborg P/S, 2020)

One of the main points in Stigsborg Havnefront is the future children- and young universe, which will include nursery, kindergarten and school. It will be located directly to the park and near the fjord, and with its central location it will be a landmark for the area, which also can be spotted from Aalborg. (Aalborg Kommune, 2020)

Ill. 8. Stigsborg Havnefront - Vision | 25

MAPPING OF THE FUTURE AREA

STRUCTURE

The area is designed as a grid structure, where the street system defines different building sites that vary in size. The division is made so that as many building sites as possible have access to some of the area's qualities such as fjord, park, beach or Syrestien.

The buildings should be placed along the streets, to the edge and around the corners of the building sites, to emphasize the structure and create spaces between the buildings. Along the streets, the building sites have edge zones, these are defined for different purposes such as private front yards or public areas with benches and vegetation. (Aalborg Kommune, 2017)

TYPOLOGY

The buildings in the different districts will vary in density, character, function and type. There will be a mix between townhouses, tower blocks and story buildings, which will appear as blocks on each building site due to the structure. The density increases towards the fjord and gradually rise in height towards the park and fjord. (Aalborg Kommune, 2017)

FUNCTIONS

The area becomes a mixed district with different types of housing, business, institutions, retail and culture. The urban-life-creating-functions are particularly located around the city street and along the harbor and beach promenade.

Centrally located in the area at the crossroad between Syrestien and the city street, the future children and young universe is located. It will be a landmark for the area, which can be spotted from Aalborg. The area will create culture and urban life, as the school will have functions that can be used by the entire district. (Aalborg Kommune, 2017)

With its location directly to the park and near the fjord, it is obvious to take advantage of nature and the maritime atmosphere in the design of the institution.

Along the city street space is reserved for business, institutions and retail. Through the promenades there is space for example cafes, restaurants and studios that attract people and create urban life in the area. (Aalborg Kommune, 2017)

- Business
- Institution
- Retail
- Public function/culture
- Café/restaurant etc.
- Evt. liberal profession
- Flex site

GREENERY

The structure of the buildings result in blocks that create courtyards. These courtyards are divided into private gardens up to the building, and common courtyard in the middle. All the common courtyards are connected to either park, local street or city street. On the outside of the blocks, green gardens are created, which are included as part of the edge zone. (Aalborg Kommune, 2017)

LANDSCAPE

The landscape includes paths, promenade, park, beach and fjord. Syrestien is a green belt that runs through the area. It is a path that connects the city with the beach, city park and harbor. It has preserved its name from the industrial history and is an extension of the existing path constructed in the former railroad track, that previously led to the factory area. (Aalborg Kommune, 2017)

Along the edge of the three building districts is a promenade, that connects them. The promenade is divided into the harbor, park and beach promenade. The promenade will be a path for bicycles and pedestrians. The width of the promenade makes it possible to use it for living and playing, as well as for café life and cultural functions. Several places the promenade is drawn in between the building sites, which creates smaller common spaces. (Aalborg Kommune, 2017)

CITY STREET

The straight views from the existing context, continue in the new area. A central street is created, which connects the city with the fjord. It is designed with separate sidewalks and cycle paths in both directions and has vegetation that is staggered to reduce traffic speed. (Aalborg Kommune, 2017)

The city street becomes the central street for business, institutions and retail. It is designed with large trees along the road and is expressed as a classic boulevard. The road is raised at the crossroad where Syrestien passes, to ensure the transition to the park and children and young universe.

The roadside edges are designed so that rainwater and water from cloudbursts are led down to Fjordpladsen, where it is cleaned in pipe forest basins, before it hits the fjord. (Aalborg Kommune, 2017)

- Private garden
- Common courtyard
- Green garden
- City street

Ill. 10. Greenery & city street

- Syrestien
- Promenade
- Stigsparken
- Green areas
- Beach
- Limfjorden

Ill. 11. Landscape

STIGSPARKEN

Stigsparken will become the biggest city park in Aalborg and is a supplement to the other city parks. It has a unique location and is a great quality for the new area. In the future, the park will attract people of all ages as it will provide a framework for a variety of activities such as sport activities and cultural functions. (Aalborg Kommune, 2017)

The park's geometric shapes with hills and slopes are inspired by gravel and limestone excavations, which has had a great influence on Aalborg's industry and landscape history. Near the future children and young universe, different activity areas are integrated into the terrain. Example a movement and learning area is established, which strengthen the children's motor function and stimulate their senses, through play, balancing, climbing, etc. Along the promenade, activities such as playground, multi-purpose pitch, skate- and sport areas will be established. As the vision of the buildings the activity areas should consist, as far as possible, of natural materials too. (Aalborg Kommune, 2017)

VEGETATION

The vegetation in Stigsparken is planned with great diversity among the trees and plants, to ensure variety, different nature expression during all the year and contribute to biodiversity. The trees form groves that create smaller spaces and shelter in the park. To reflect the activities there are lawns at sport areas, paths are covered with gravel and towards the fjord is a meadow. (Aalborg Kommune, 2017)

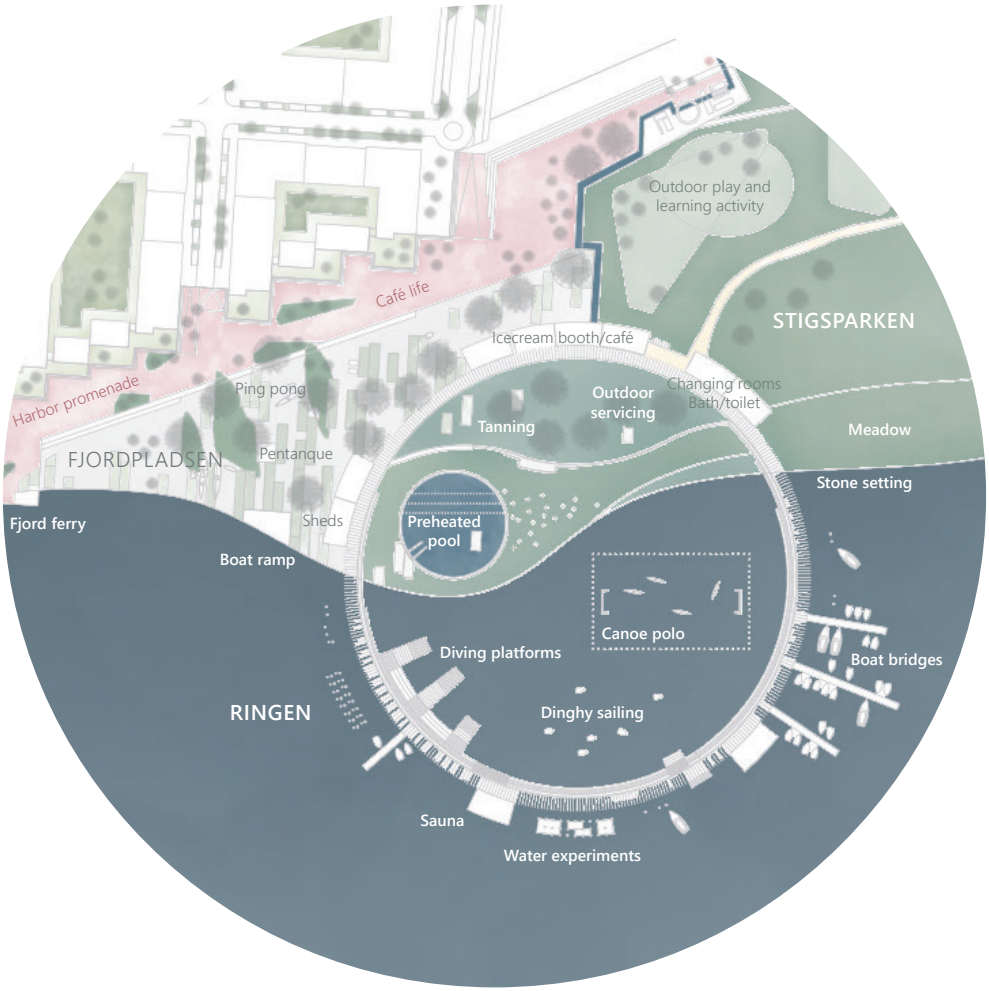

Sport
Park promenade
Grove
STIGSPARKEN
Grove
Sport
Park promenade
SYRESTIEN
Grove
Beach promenade
Activities
Hill
Beach
Activities
Activities
Meadow
FJORDPLADSEN
RINGEN

RINGEN

Ringen becomes a symbol of the development of Stigsborg Havnefront and for the new history of the area. It connects the area with the fjord and create life by attracting people, through various fjord related attractions such as harbor bath and water activities.

Ringen is located at the end of the city street and is a central element of the area. It is a wooden bridge with a diameter of 145 m and a walk distance of 440 m. There are activities on both sides of Ringen, both inside and outside. From the ring is a great view to both directions of the fjord, as well as to Aalborg Centrum. (Aalborg Kommune, 2017)

In the southern part of the ring there is space for various water activities and experiments, which can be used by the institution as a great learning environment. As mentioned in the history of Stigsborg Havnefront, Syrens Bådelaug does a great part for the outdoor life of the area. To continue this, clubhouse and boat bridges are placed in extension with the ring. The northern end of the ring is connected to Fjordpladsen and Stigsparken. Fjordpladsen is a gathering place with lot of activities where people can meet and stay and do different activities. (Aalborg Kommune, 2017)


Outdoor play and learning activity
Café life
STIGSPARKEN
Icecream booth/café
Harbor promenade
Ping pong
Outdoor servicing
Changing rooms
Bath/toilet
Tanning
Meadow
FJORDPLADSEN
Pentanque
Stone setting
Fjord ferry
Sheds
Preheated pool
Boat ramp
Canoe polo
Diving platforms
Boat bridges
RINGEN
Dinghy sailing
Sauna
Water experiments

PARKING

Various parking options will be created in the future area. There will be 2-3 parking houses, and possibility for parking in the basement, at some of the building sites along the harbor. Furthermore, there is opportunity of parking along the roads and in smaller pockets at the individual building sites. (Aalborg Kommune, 2017)

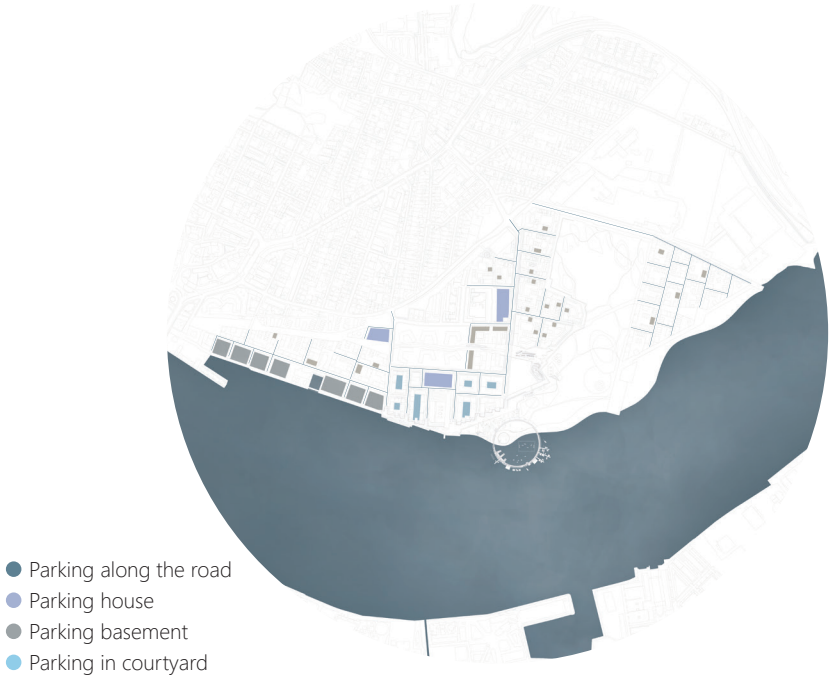
INFRASTRUCTURE

The roads have different character, which are divided into access road, distribution roads and local roads. The distribution roads are connected to the existing access road, Engvej. From the distribution roads, there are local roads, which define the building sites.

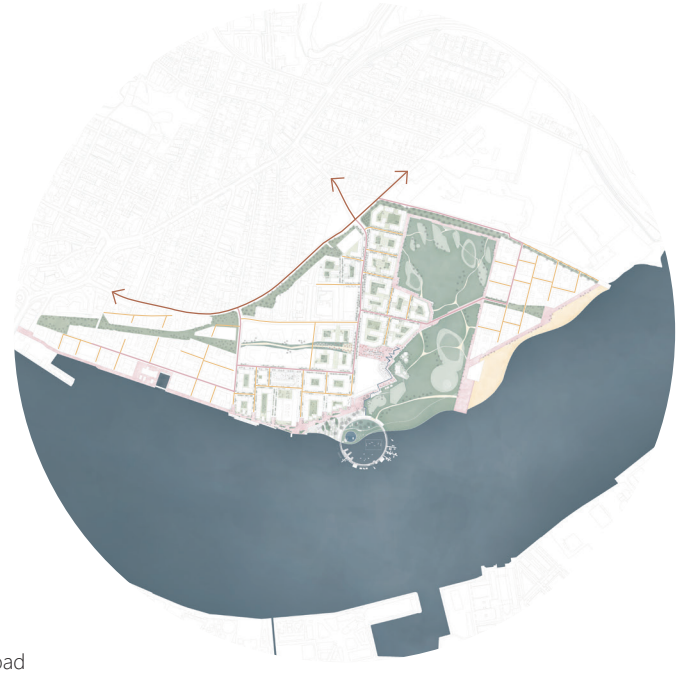
The overall strategy for the roads is that all north-south roads are straight, to keep the view from the existing context. All west-east roads are staggered for climate reasons to break the wind, but also to divert the traffic safely. (Aalborg Kommune, 2017)

Bicycles travel beside the cars, and the area is planned so that the residents have no need to take the car, that the various functions, activities and paths are located so that there is easy access by walking or bicycle. Public transport is limited today but will be upgraded in the future to provide an alternative to the car.

In order to connect Aalborg Centrum with the new district, a fjord ferry will commute between Fjordpladsen and Aalborg Havnefront, at Toldboden and Musikkens Hus. It will be possible to bring the bike on the ferry, which creates an attractive shortcut and increase the interest for the area, as it will be easy to commute between the waterfronts. (Aalborg Kommune, 2017)

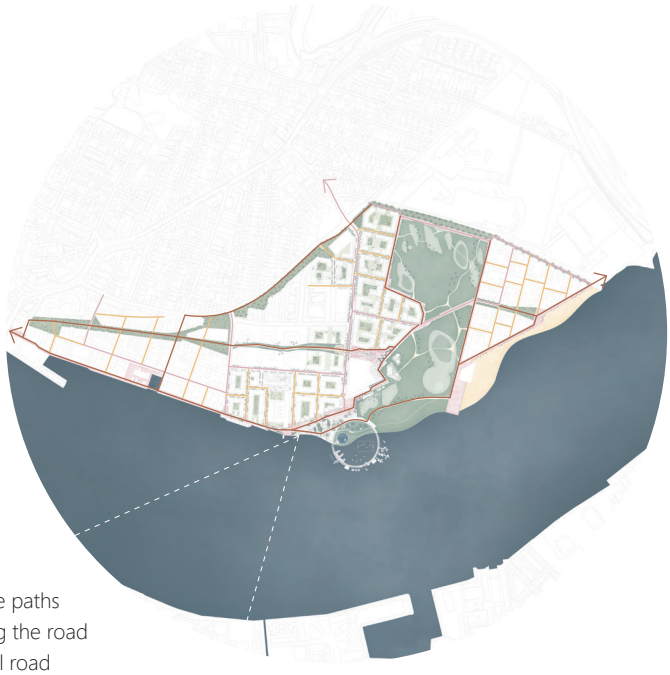


Ill. 14. Parking



- Access road
- Distribution road
- Local road

Ill. 15. Road character



- Car-free bicycle paths
- Bike path along the road
- Bicycle on local road
- -- Fjord ferry

Ill. 16. Walking and cycling paths

CLIMATE

WIND ROSE

The wind rose shows the direction and speed of the wind during the year. The wind rose shows that the south-west wind is the most dominant wind at the site. In relation to the design of the day care centre, the wind rose is relevant to determine the placement and size of the openings in the building, so that the wind can be utilized as best as possible for natural ventilation.

The shape and height of the building is relevant as well, to create comfortable living areas outdoors, that are sheltered from the wind. As mentioned in the "infrastructure", the east-west turned roads in the area, are staggered to avoid or break the direct wind from the west.

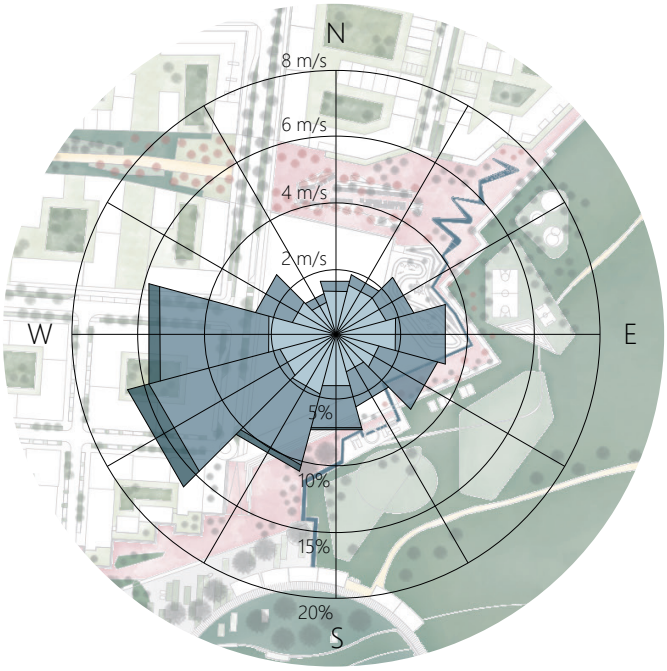
An active strategy may be to use the wind energy to produce electricity for the building.

SUN PATH

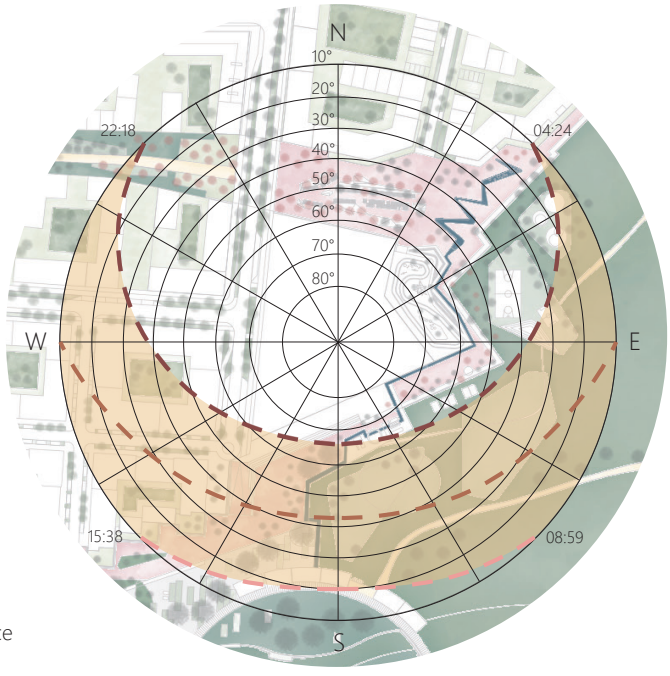
The sun path shows the orbit and angle of the sun, relative to the site, during the year. The sun path is relevant in relation to the design of the day care centre, as the orientation and design of the building can take advantage of the sun's rays.

An active strategy may be, to utilize the energy from the sun's rays and convert it into heat and power, that can be used to heat the domestic hot water and space heating, as well as the electricity in the building.

The sun path is also important in relation to place the openings to achieve a comfortable indoor climate in the institution, by ensuring adequate daylight, creating views and avoiding overheating from the sun.



Ill. 18. Wind rose - (DMI, 1999)



Ill. 17. Sun path

SUB-CONCLUSION

Being located at Stigsborg Havnefront provides various qualities, that can be implemented in the design. The area has a special potential as it is being transformed from an industrial area with historical character to a modern study city with urban and cultural life.

The soil in the area is contaminated because of its use for industry in many years. The area is now an empty field, where Aalborg Municipality is in an ongoing process of purify the soil from human-caused-substances.

Stigsborg Havnefront is going to be developed as a new district of Aalborg city. The ambition for the area is to create a living city including; different types of housing, institution, school, nursing home, offices, stores and cafes.

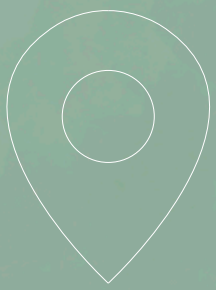
A focus in Stigsborg Havnefront is a children and young universe with nursery, kindergarten and school. It will offer different design potentials for the building, as it will be a landmark for the entire area and create, a cultural and urban life in the new city district.

In addition, a focus will be to maintain the vision for the area, by implementing greenery and natural materials in the design.

The institution should take advantages of the unique location next to the park and near the fjord. Both in terms of accessibility, access roads, activities and views.

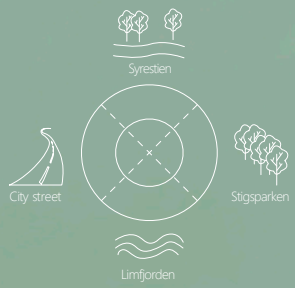
It should have nature in focus, and the playgrounds can be inspired by the park's design and the use of natural materials for the activities.

It will be possible to park near the building site, but the design of the outdoor spaces should support the area's vision of making it attractive to take the bike or walk to and from the institution. So, there must be space for both bikes and prams near the entrances to the building.

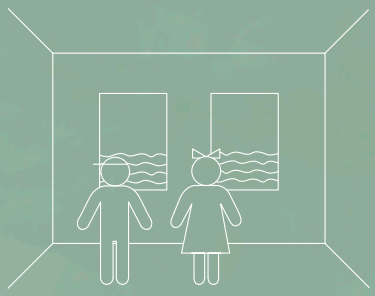


LANDMARK

CREATIVE & INSPIRING UNIVERSE



VIEWS FROM THE SITE

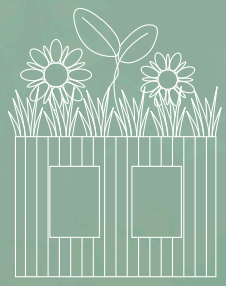


VIEW TO FJORD

STIGSPARKEN

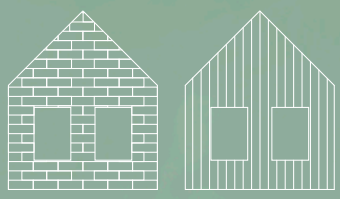
SYRESTIEN

CLOSE CONNECTION TO NATURE

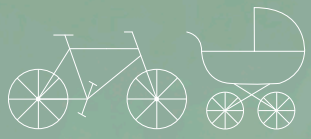


IMPLEMENTING GREENERY

COMFORTABLE OURDOOR SPACES



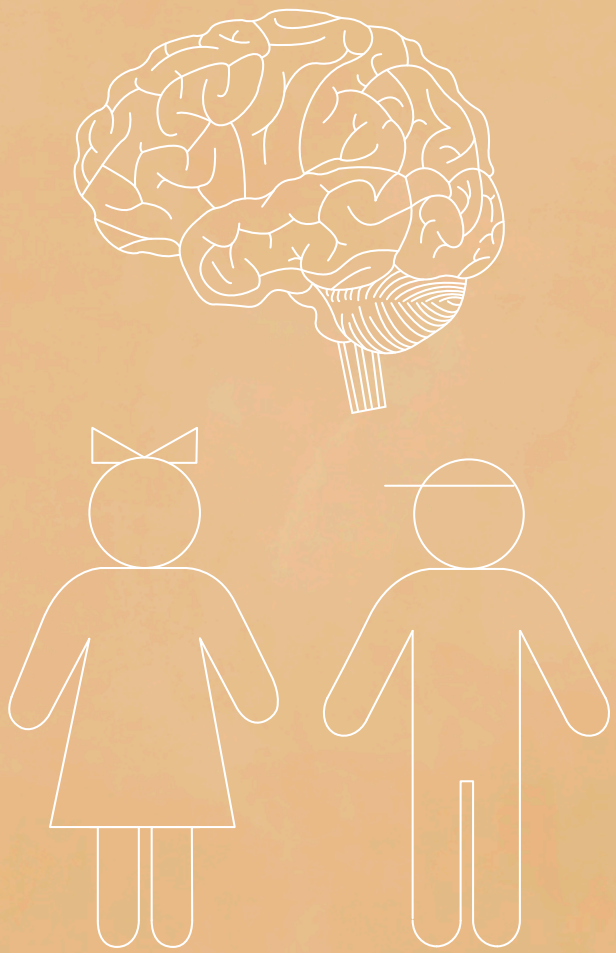
NATURAL MATERIALS



SPACE FOR BICYCLES & PRAMS

BLOCKS WITH COURTYARDS

USER ANALYSIS



CHILDREN'S DEVELOPMENT OF THE BRAIN & SENSES

THE BRAIN

Our most important organ is the brain, it is the foundation of our body. Some organs we can live without, replace by transplantation or repair to varying degrees, but not our brain. (Kjærgård, Støvring and Tromborg, 2014)

The brain develops greatly during the first three years of a child's life. It is important already to have a strong focus on stimulating the brain early in a child's life, so it can develop satisfactory. The first years of a child's life form the basis of the rest of his or her life. (Forstadt, 2011)

The brain controls our functions, both voluntary activities (speaking and walking etc.) and non-voluntary activities (blinking and breathing etc.) (Forstadt, 2011). Our functions are controlled by the hormonal- and nervous system. The nervous system can be divided into; the central nervous system (CNS), which consists of the brain and spinal cord, and the peripherical nervous system, which are the nerves that are in the body. (Sandseter, Hagen and Moser, 2018)

The brain can be divided into the small brain (cerebellum), the big brain (cerebrum) and the brainstem. Both cerebellum and cerebrum have a left and right hemisphere. (Kjærgård, Støvring and Tromborg, 2014)

The cerebellum is important for sensory motor coordination and motor timing, as well as muscle tone, balance and reflexes. The cerebellum has many more nerve cells than the cerebrum but is considerably smaller. The outermost layer of the brain is the cerebrum. It has folds containing billions of neurons (brain nerve cells), each with their own function. The two brain halves of the cerebrum consist of four lobes; the temporal, frontal, parietal and occipital lobe. (Kjærgård, Støvring and Tromborg, 2014)

The brainstem exchanges information between the cerebellum and cerebrum. It connects the motor function and sensory processes between the central and peripherical nervous system. It also controls vital functions as breathing and heart activity. The brainstem thus has a great impact on our survival and motor function. (Kjærgård, Støvring and Tromborg, 2014)

DEVELOPMENT OF THE BRAIN

When the fetus is 3 weeks, the neural plate is formed, from which the central nervous system is created. In week 3-4, the neural plate closes, after which the neural tube is formed. One end of the neural tube becomes the spinal cord, while the other end develops to become the brain structure.

When the fetus is 4-6 weeks, the brain's ventricular system develops. From weeks 6-16, the ventricular system and the neural tube form cells, which develop into supporting cells and neurons. In week 16 and until the baby is born, the brain structure develops. The cells specialize in the functions they are intended to perform.

At birth, the brain is one-fourth the size it will reach during the child's adulthood. The brain develops both after the trans-

mitted genetics the egg has received during fertilization, but also after the influence of the child's environment. (Kjærgård, Støvring and Tromborg, 2014)

The brain has 100 billion neurons (brain nerve cells) and some synapses (connections between the neurons) at birth. The more the neurons develop, the more synapses are formed. At birth, the brain has 2.500 synapses per neuron, after 2-3 years (depending on the child's development) the brain has 15.000 synapses per neuron. (Forstadt, 2011)

As mentioned, the brain develops a lot at the beginning of the child's life, the neurons it uses are strengthened while the remaining ones die. (Kjærgård, Støvring and Tromborg, 2014) If the child is exposed to stress or trauma, the hormone cortisol is released, where the brain sends a signal from hypothalamus to the adrenal cortex, which is a gland to the kidneys. Babies with strong, positive and emotional ties to their nursing staff are showing lower levels of cortisol in their brains, which is important because high amounts of cortisol, can induce brain cells to die. (Forstadt, 2011)

THE SENSES

The interaction between the senses and movement is the first thing developed in a human being. The child has the first sensory experiences even before the birth. (Sandseter, Hagen and Moser, 2018)

"A human being has a total of 7 senses, and it is through the processing of information from these that we experience and relate to the world. (Petersen and Gath, 2015)

The 7 senses are:

- *The visual sense (sense of sight)*
- *The auditory sense (sense of hearing)*
- *The olfactory sense (sense of smell)*
- *The gustatory sense (sense of taste)*
- *The vestibular sense (labyrinthine and equilibrium sense)*
- *The tactile sense (the sense of touch and feeling)*
- *The proprioceptive sense (the muscular- and joint sense and the sense of posture and kinesthetic)"*

(Petersen and Gath, 2015)

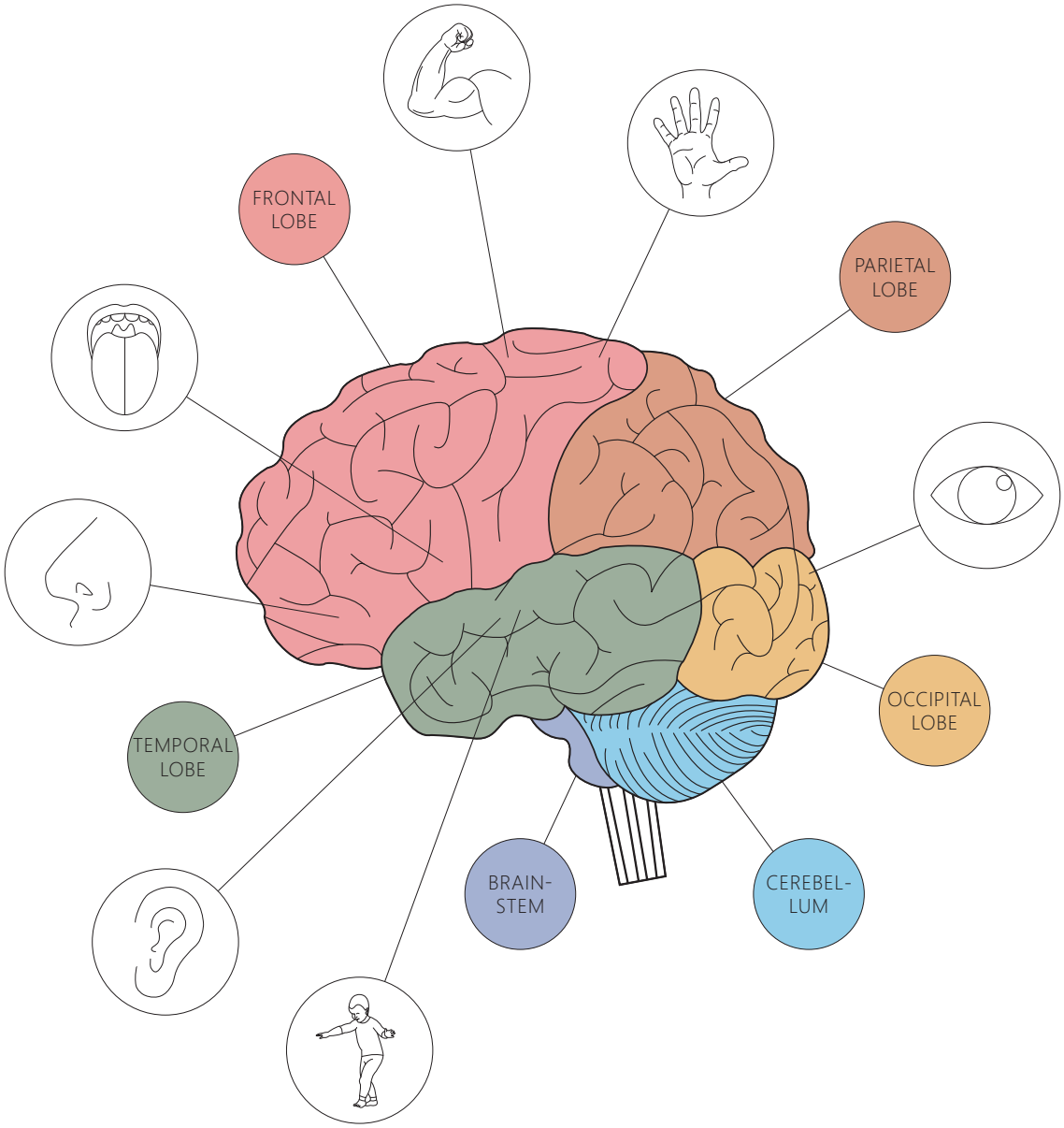
The senses can be divided into outer and inner senses. The outer senses (visual, auditory, olfactory, gustatory and tactile sense) inform about the surroundings, while the inner senses (vestibular and proprioceptive sense) tell how the body and posture must relate to the surroundings.

The senses can also be divided into primary and secondary senses. The primary senses are the vestibular, the tactile and the proprioceptive sense. These are the earliest developed and the basis for the secondary senses to develop. The secondary senses are the visual, the auditory, the olfactory as well as the gustatory sense.

All the senses are important for our movement ability, body awareness and understanding of the surroundings. However, the sense of smell and taste, are less important for the ability to move. (Sandseter, Hagen and Moser, 2018)

DEVELOPMENT OF THE SENSES

Already as a fetus, the basic senses are developed; the tactile, proprioceptive and vestibular sense. These form the basis for the child to understand information about the body's position in relation



Ill. 21. The brain & senses | 45

to its surroundings. Both in relation to space, but also distances to objects etc. (Kjærgård, Støvring and Tromborg, 2014)

The tactile and proprioceptive sense is explored in the early age. When the child is 0-6 months, it can coordinate its movements by the proprioceptive system sending information to the vestibular system. At the same age, the child evolves the link between the motor function and visual sense, which is done with support from the tactile and proprioceptive system.

When the child is 6 months to 10-16 months, it experiments and stimulates the vestibular sense by; lifting the head, sitting up, grab and let go of objects etc. The balance is been trained and developed when the child is 1 year old, by practicing sitting and standing, as well as walking on uneven ground.

At the age of 2-4 years, the child exercises its ability of distance estimation and speed assessment by; running, jumping, throwing and balancing etc. The child learns over time to estimate distance to objects, asses speed of oneself and surroundings, in the complex interaction between the motor function and the visual, vestibular and proprioceptive sense. (Kjærgård, Støvring and Tromborg, 2014)

Children need sensory stimulation to develop. The three primary senses as well as the visual sense must be stimulated to develop their motor function. The brain cannot control the movements of the child unless these senses are stimulated. (Ayres, 2002 cited in Vigsø and Nielsen, 2006, p. 23)

MOTOR FUNCTION

The motor function can be observed, it tells something about our bodily movements and patterns of movement. It tells us what we can and cannot do, as well as how efficiently and safely the individual movement is performed.

The coordination ability says something about the ability to control our body to do what we want; this can be equated with our motor function. The everyday life is full of movements, all the active functions we do require and develop the motor functions. (Gravesen, 2016)

The motor function is crucial to our ability to move and do essentials things like sitting and walking, but also our ability to write and speak, the motor function has an influence on the cognitive development as well. (Kjærgård, Støvring and Tromborg, 2014)

COGNITIVE DEVELOPMENT

Children are born into a world they do not know. Cognition is about how we sense the world and process sensory impressions. (Cecchin, 2015)

Cognitive development is the process of learning and understanding, as well as applying knowledge and skills. Cognitive functions are the brain processes that happen when we put things together. Cognitive functions include language, memory, logical thinking, attention, problem solving, creating and dreaming as well as emotional regulation.

The cognitive development and brain development are closely related. Our brain functions in orbit, therefore our thoughts, will and feelings are interconnected and affect each other. (Cecchin, 2015), (Kjærgård, Støvring and Tromborg, 2014)

CHILDREN'S WELL-BEING, LEARNING & DEVELOPMENT

In Denmark most children in the age of 0-6 years spend a big part of their time in institutions, either day care, nursery or kindergarten, when their parents are at work. (Socialstyrelsen, 2020) The institutions are the secondary precaution after the family, to give the essential opportunities to learn and develop. The institutions can thus have a great influence on the children's well-being, learning and development. (Ringmose and Staffeldt, 2017)

The first years of children's life are the basic for how they will manage the rest of their lives. On that account it is important that the institutions provide the framework for a safe and educational learning environment, where the children can develop and strengthen their competences. (Socialstyrelsen, 2020)

LEARNING ENVIRONMENT

There is a great connection between the child's language, social relations and common attention skills, and between the child's development of language and social development. (Ringmose & Staffeldt, 2009)

Language can be defined as symbols that are put together in a system, it makes it possible to express thought, feelings and ideas, both with ourselves and with others. (Bloom, 2001 cited in Gjems, 2017) The language forms the basis of social relations, through dialogue and communication with others. At the same time, the social relation forms the basis of language, as the child strengthen it by talking and socializing with others. (Ringmose & Staffeldt, 2009) Relation is a term used for thoughts, feelings, expressions and behaviors. The relation occurs through mutual communication over time, both between child and adult, but also between child and child. (Hinde, 1979 cited in Drugli, 2017)

Attention is, that one can focus and concentrate on something specific, to be able to exclude distractions and be persistent about it. Attention thus covers many functions. (Hansen, 1998 cited in Vigsø and Nielsen, 2006, p. 27) Common attention is both the attention children have through communication with each other, but also the attention they have on the pedagogues during activities. The common attention forms the basis for communication and contact between the children, which leads to play between two or more. The common attention thus supports the development of the child's language and social understanding. (Kjærgård, Støvring and Tromborg, 2014)

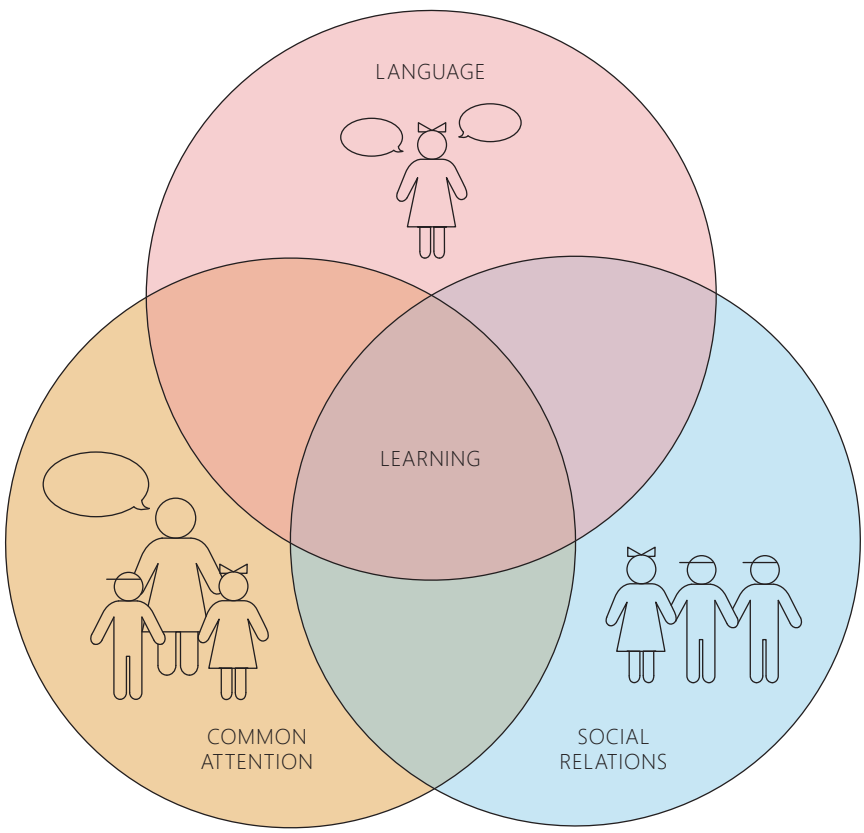
It is therefore a good idea in the learning environment, to create activities that give occasion to common attention, both between children and adults. Children have a special ability to immerse themselves in play with each other and be in flow with the free play, which strengthens their well-being, cognitive development and ability to common attention. However, the adults can challenge the children's brain, by offering activities that involve the children and motivate them to learn, success and develop. It is important to implement functions that lead to natural activities in the room, where the staff can be in contact with the children and focus on motivating and involving them in activities, that

strengthen their cognitive and social development. (Ringmose & Staffeldt, 2009)
"Flow – Is the designation of the state you are in, when you are engulfed in an activity. Flow occurs when there is a perfect balance between challenges and skills." (Kjærgård, Støvring and Tromborg, 2014)

MOTIVATION

Pedagogues are the institution's most important resource in relation to children's development. The pedagogues motivate, support, inspire and stimulate the children, they contribute their knowledge, dedication and behavior, which the children imitate and thereby explore themselves. (Lekhal et al., 2016)

Motivation enhances children's learning as it gives them joy to master and courage to succeed. Children learn most with help from adults who engage in the children's natural interest in exploration and learning. (Hamre et al., 2014; Hansen, 2013 citated in Lekhal et al., 2016) Passive adults can inhibit children's learning, it can also stress children that adults are controlling and leading too much. (Gunnar et al., 2010; Ryhner et al., 2012 citated in Lekhal, 2016) So it is about finding a balance between child-initiating and adult-initiating activities. (Howard and McInnes, 2013 citated in Lekhal, 2016)



PLAY

Learning and play have many similarities, both of which require commitment, encouragement, inspiration and challenge. However, not all learning is play and vice versa. (Samuelsson and Johansson, 2006 citated in Lekhal et al., 2016) For children and young people, in almost all cultures, play is considered to be a significant activity. Play has an impact on our cognitive, social and emotional development. (Schousboe, 2013, citated in Cecchin, 2015) Children develop good relations with other children, while at the same time achieving good mood and well-being through play.

In institutions, for children at the age of 1 year, there are focus on object play, where the children, among other things, strengthen their senses and motor function. When the children are 2-6 years, the object play are replaced by role play, where the children learn to emulate others and reproduce situations and actions, which strengthen their knowledge of roles and relations between others. Role play also strengthen their language, imagination and social skills. (Brorström, 2019)

Play can be categorized into three different categories, the free and educational play, as well as the playful learning.

FREE PLAY

Children's self-organized play is defined as the free play. Research shows that this kind of play has a great development potential. (Elkonin, 1988; Leontjev, 1977; Vygotsky, 1982 citated in Brorström, 2019) Children become more aware and experienced the more they play, the role plays therefore develop into rule play which the children master over time. Rule play is a play where the task and rules are in focus, instead of the roles and situations. (Leontjev, 1977)

EDUCATIONAL PLAY

In the educational play the central is the children's own play. It is the children who control the play, but the pedagogues can enter and influence by contributing learning through the play. For example, it may be play with bricks where the children gain mathematical skills by organize and calculating. (Brorström, 2019)

PLAYFUL LEARNING

There is a focus on the professional content and skills the child can gain through playful learning. An example could be geometric shapes where the children must find or create geometric shapes through play. (Brorström & Frøkjær, 2015)

PHYSICAL ROOM

THE INFLUENCE OF THE PHYSICAL SPACE

The interaction between space, architecture and interior design have a great influence on children's learning and development opportunities. Thus, the children spend a lot of time of their everyday lives in institutions, it is important to create the opportunities through the physical space.

The design of the rooms and the way they are arranged, creates the possibility to make the children feel safe and have a positive effect on their behaviour. The rooms must be designed so they create stimulating environments and make the framework for good play that allows the children to develop and learn. (Ringmose and Staffeldt, 2017)

In order to achieve a good environment where both children and adults are well-being, it is a good idea to focus on the density of the rooms. If there are too many people in a room, it can be difficult to regulate the sound level, which makes it difficult for the users to concentrate, and have a bad effect on their common attention and ability to communicate with eachother. (Ringsmose & Staffeldt, 2009) (Knudsen, 2012)

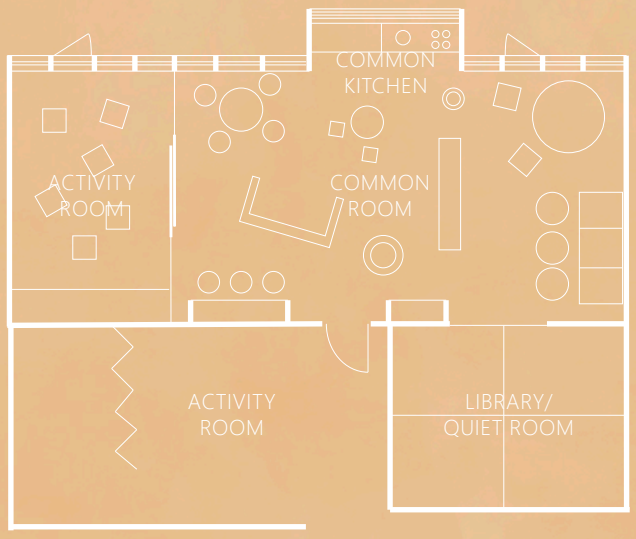
OPEN PLAN VS. DIVIDED FUNCTIONS

Over time, there has been experimented with open plan solutions and plans divided after their function. The open-plan solution provides better opportunities for children's "free play" and socializing, and at the same time allows the pedagogues to cooperate with each other and the children, in an open space. (Knudsen, 2012)

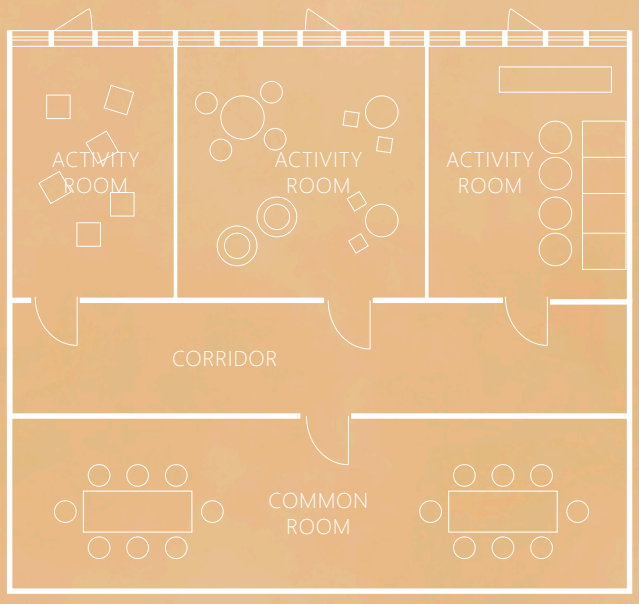
In the 1970s, the day care centres moved away from the open plan solution and were more focusing on the function divided plan solution, which make opportunity to divide the children into smaller groups and create space for specific activities, both calm and intensive activities. In the 1980s, the open-plan solution was reverted, as the function divided plan solution restricted the children's free play, movement and circulation, and weakened the quality of their learning. (Knudsen, 2012)

When looking at the open plan solution compared to the function divided plan solution, both have advantages and disadvantages. One way to organize the space in a good way could be to combine them and have a central common space, with access to various spaces with different activities. Then there would be a common space where all could be together and the pedagogues could keep an eye on all the children, but there would also be individual rooms with different activities so the children's needs would be achieved. Thereby, the children could be active and move more freely and get rest if needed. The combination of open plan solution and function divided plan solution help children to participate in both individual and common activities, when it gives them a better overview and invite them/make the opportunity to do different activities, which will help stimulate their senses. (Knudsen, 2012)

The children can be stimulated by activating their senses through activities in diffe-



Ill. 23. Open plan solution



Ill. 24. Divided plan solution

rent learning spaces. It is important to design the rooms according to the pedagogy, the intentions behind the learning, and the activity that should be done in relation to the physical and social environment. The spaces should allow for learning, as well as invite for the activities to be done. In some spaces there should be an opportunity to screening, so the child can dive into the activity. (Ringmose and Staffeldt, 2017)

Inviting for activities can be done by defining the rooms by putting relevant objects such as pillows, teddy bears and mattresses in quiet rooms to invite the children to relax. It could also be by implementing climbing wall in playrooms, so the children are invited to climb, be active and play wild. In creative spaces there could be boxes with coloured pencils and paper, so the children are invited to paint and be creative etc. To avoid unnecessary and empty spaces, a good idea could be to think about flexible solutions through the interior design and furniture. (Ringmose and Staffeldt, 2017)

"Affordances are the possibilities for use, intervention and action which the physical world offers a given agent and are determined by the 'fit' between the agent's physical structure, capacities and skills and the action-related properties of the environment itself" (Clark, 1999)

Affordance is a term that describe how we relates to objects. It is a property of what needs to be done with the object and supports our interaction with the physical object through visual and physical expression. The objects signal the function to perform, for example, a door handle signals that it should be used to open the door, and a chair signals to sit on it. (UX Planet, 2018)

ORGANIZING ROOMS

Organizing rooms according to the activities in the institution, offers the possibility for both individual and common activities. (Knudsen, 2012) It is a good idea to think of the size of the rooms and separate the users in different rooms or zones according to activities, so that the activities and activity level can be controlled, and thereby avoid or reduce the noise from the users. (Ringsmose & Staffeldt, 2009)

The separation can be solved through physical rooms or by zoning. They can be divided according to the function of the rooms/zones or according to the activity level the children should be in, when doing the activity. Dividing according to activity creates a lot of attention for the activity, which helps the children to relax and focus, thereby avoiding being stressed or distracted by other children. It is also a safety factor for the children to know what is going on. Dividing by activity level means creating areas for both calm and active activities. Such as relaxing rooms for napping, rest or story reading. It could also be playroom, pillow room or playground, where the children can play wild and free and have a high activity level without disturbing others. (Ringsmose & Staffeldt, 2009)

It is a good idea to create rooms for both child-initiating and adult-initiating activities. Children's imagination and independence are enhanced by free play where they are not disturbed by adults. At the same time, children's cognitive development is enhanced through the adult's activities that challenge them to learn. (Ringsmose, 2009)

SPACE ORGANIZATION AND PEDAGOGY

When designing rooms, both organization of the spaces and the pedagogy has a great influence. The design of the rooms can be challenging as they must be a part of children's learning and development. It is important to think about the experience of the physical room.

The experience depends on aspects such as the size, orientation, light, sound, smell, materials and the arrangement of furniture and various objects. It is important to think about places to stimulate children's free play, and create private, semi-private/ semi-open and open spaces. It is also important to create flexible spaces, with the opportunity for multiple activities, an idea could be to use sliding or folding doors in the rooms. In addition to the living rooms, the toilets are also a big part of the institution and must have the same aesthetic qualities as the other rooms.

The wardrobe is a learning space for the children, they learn to be responsible for their possessions and practice their skills to take clothes and shoes on and off. It will be optimal to place the wardrobe at the entrance to the institution and exit to the playground. It is important to divide the wardrobe into several sections and give the children space, so they do not get in the way of each other and their stuff does not end up in a big mess. (Ringmose and Staffeldt, 2017)

COLOUR

The use of colours can create atmospheres, define rooms, help organizing and be used as way finding. In relation to create atmospheres the red colour is an energetic colour that invites to play and activity, the blue has a soothing vibe that initiate to relax, and yellow and orange are warmer colours, that are stimulating for the children. The use of colours can help children to define rooms and separate the different activities. According to organizing the colours can help the children to put toys in the right place, example the toy can be marked with the same colour as the bookshelf it belongs. (Ringmose and Staffeldt, 2017)

CHILDREN'S LEARNING ABOUT SUSTAINABILITY

Children are our future, therefore it is important to make them aware of the environmental issues already from their childhood, because it is an integral part of their life. Therefore, these issues are important to involve in their learning. Studies show that children´s behaviour is influenced by their home and preschool. Both the physical environment, but also by their parents, siblings or by other role models in their society such as pedagogues or friends.

By making children aware of the environmental challenges and introduce them for sustainability and making it a part of their life, this would be a strong tool for developing a sustainable world. It impacts the children's attitude and forming their behaviour in a positive way, which has a good influence on their well-being, health and social behaviour development. Sustainability in preschool can be a part of their learning, by including educational activities that involves the nature and environment.

Research shows that children in the age of 5-6 years, who are going to an "Eco-certified preschool", which have focus on learning of sustainability, have positive response on their functional knowledge. Activities about sustainability are beneficial, because they get acquaintance in this topic. (Borg, Winberg & Vinterek, 2017)

Furthermore, research shows that children who get good experiences in nature get a positive development both cognitively, emotionally and socially. (Brorström and Frøkjær, 2018)

GRØNNE SPIRER

Since 2013 the Danish Ministry of Education has been focusing on a concept called "Grønne Spirer", to increasing knowledge of sustainability in early age. Grønne Spirer is a tool for preschools which inspires and motivate the use of nature and outdoor spaces in the daily life.

Various sustainable activities have been explored, developed, tested and evaluated by a pilot group from Grønne Spirer, so that institutions can use them. The activities are divided into 6 themes:

- *Waste*
- *Recycling/reuse*
- *Water, energy & other resources*
- *Earth to table*
- *Nature awareness*
- *The small steps*

(Grønne Spirer, n.d.)

The pedagogical curriculum in the nursery and kindergarten, have started to focus on, how the learning environment can support children's experiences with nature and the environment. This can be used to stimulate their learning and curiosity, as well as give them the desire to explore nature and gain a broader understanding of sustainable issues. Through educational practice, the pedagogues can promote the understanding of sustainable development, the children will thereby, be able to give ideas on how sustainability problems in the future can be solved. (Brorström and Frøkjær, 2018)

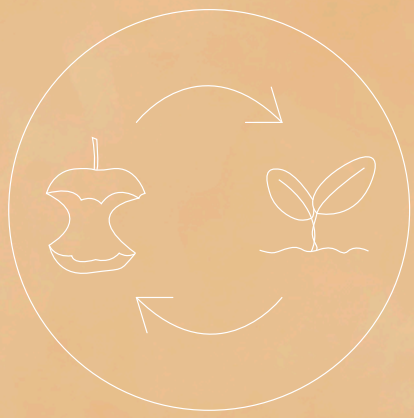
HOW TO USE 'GRØNNE SPIRER' IN DAILY LIFE

The way these themes could be imple-

WASTE

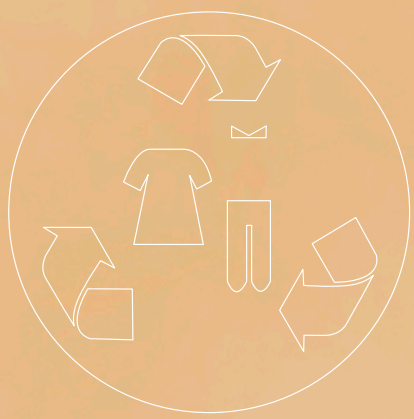
RECYCLING/REUSE

WATER, ENERGY & OTHER RESOURCES



EARTH TO TABLE

NATURE AWARENESS



THE SMALL STEPS

Ill. 25. Children's learning about sustainability | 55

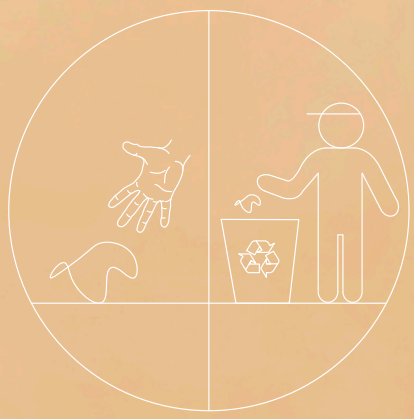
mented in the daily life could be, by using it as a natural part of the children´s learning. For example, the theme "waste" children can participate in garbage collections and sorting waste. The children could go for a walk in the park and collect garbage with the pedagogues and do various experiments on decomposition and compost. By sorting garbage and recycling it, the children can make posters by gluing the garbage, about the knowledge they have gained during the walk, which will also give a broader understanding of the environment.

The theme "recycling/reuse" it is important to learn the children about the environmental issues and to reuse the waste. Thus, the children can learn about various creative processes, where they can recycle. They could example use newspapers to paint or do other creative work with it. The children could also recycle wood or other materials to build sheds, so that they can gain an understanding about, that they can recycle materials.

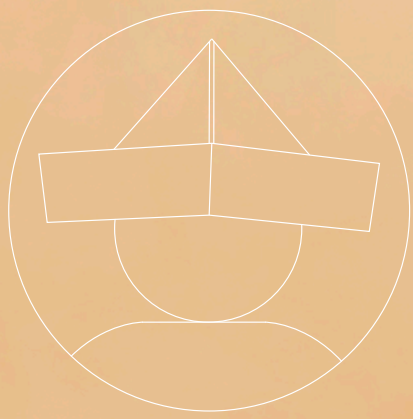
The theme "water, energy & other resources" the children can learn about differences between tap water and rainwater, where they are able to use tap water for drinking water, cooking and washing. And collecting water/rainwater for watering plants, play and rough washing, when their hands are muddy or dirty.

Other topics that are important for the children to learn is food waste, growing vegetables in the garden with compost waste, activating their senses to learn, taste, touch, feel, smell and harvest. Thereby, it is important to integrate human senses in the design of the day care centre, where children's senses as listen, see, hear, taste and feel the nature, are involved in their learning. (Grønne Spirer, n.d.)

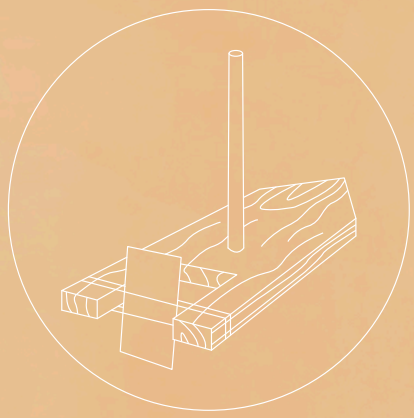
It is a good idea to get the children's to wonder about sustainability, this can be done by walking with the children outside and tell them about the environment, teach them for example about how long the various garbage can take time to decompose, so they are conscious of taking care of the nature. They will thereby become more environmentally challenged as an adult. (Brorström and Frøkjær, 2018)



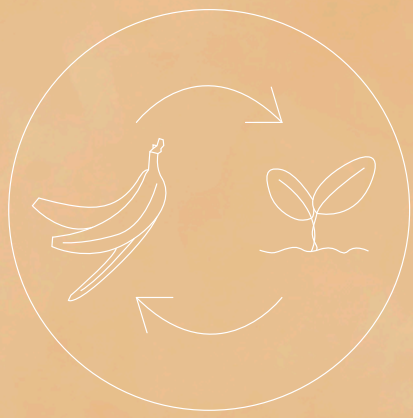
WASTE



RECYCLING/REUSE

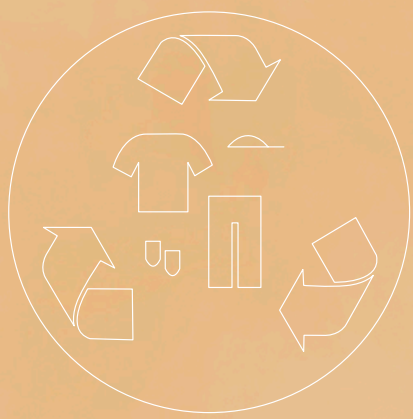


WATER, ENERGY & OTHER RESOURCES



EARTH TO TABLE

NATURE AWARENESS



THE SMALL STEPS

Ill. 26. Children's learning about sustainability | 57

PERSONAS - MAIN USERS

NURSERY CHILD – AGE 0-3

WISHES

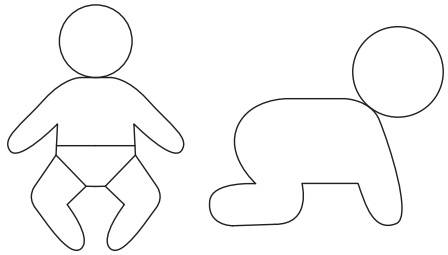
Possibility for zoning both inside and outside, windows in children's eye level.

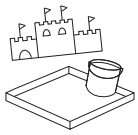
SPACES NEEDED

Common room, group room, quiet room, crib space, wardrobe, outdoor spaces, playground, toilet and storage.

ATMOSPHERE

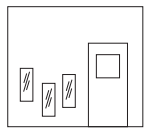
Playful, safe and motivating.





PLAYGROUND

CRIB SPACE



WINDOWS IN EYE LEVEL

One of the main users of the day care centre is nursery children in the age of 0-3 years. They have some specific needs, which should be addressed.

SAFETY

One of the most important factors for nursery children are safety. They both need to be and feel safe in their environment.

One solution for making the children safe is the staff's monitoring of the children, why the building cannot have any blind spots. A good idea is to add windows to the rooms, placed in adult height, so the staff can look inside the rooms an keep an eye on the children when they are playing, without disturbing them.

The children also need to feel safe, therefore windows should be added in their height too, both in the interior walls, so they can look at the staff or other children outside the room they are in. But also, in the external walls, so they can look outside at the surroundings.

NATURE

It is important to the nursery children to be in close contact with the nature for their well-being. Therefore, the nursery children must have an outside crib space for their prams, so they can sleep out in fresh air. They also need their own playground where they can play in safe and separated from the older children of the institution.

 Ill. 27. Personas - Nursery children

06:30 – 07:30

The children are handed in the nursery and welcomed by the staff. During this time, breakfast is served in the common room. Where at the same time, quite activities take place in the common room such as puzzles, lego, drawing etc.

07:30 – 08:15

The children retire to their own group rooms with the associated staff.

08:15 – 08:45

Fruit and bread are served as a snack.

08:45 – 10:30

Various activities take place either in the group rooms, on the playground or on trips out of the house. Some children take a nap.

10:30 –11:00

Lunch in the common room (eventually outside in the summertime).

11:00 – 13:30

The children are changed diapers, after which they are sleep either in the crib or quite room inside the group room. Most children are sleeping in the crib space.

13:30 – 14:00

The children wake up and are served fruit.

14:30 – 16:45

Various activities take place either in the group rooms, wardrobe, common room or on the playground (mostly in the summer half year).

Ill. 28. Time schedule nursery children | 59

KINDERGARTEN CHILD – AGE 3-6

WISHES

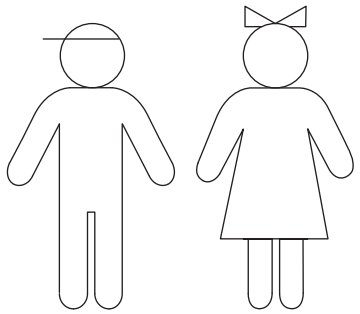
Outdoor toilet, possibility for zoning both inside and outside, kitchen, windows in children's eye level.

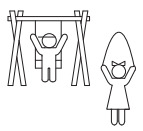
SPACES NEEDED

Common room, group room, activity rooms, quiet room, workshop, wardrobe, outdoor spaces, playground, toilet and storage.

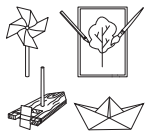
ATMOSPHERE

Playful, safe and motivating.

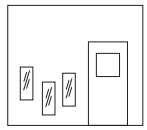




PLAYGROUND



ACTIVITY ROOMS



WINDOWS IN EYE LEVEL

The other main user of the day care centre is the kindergarten children, in the age of 3-6 years, who moves from the nursery section to the kindergarten section. The focus is to make the kindergarten children ready to enter the primary school.

SAFETY

The safety in the day care centre have an impact on the children's well-being, and children are more able to learn if they feel safe and are in a good environment. Children in the age of 3-6 are more aware of the staff, therefore the staff needs to give the children freedom, but still have the possibility to monitor them. This means that the building needs the same types of windows for the kindergarten as for the nursery, and for the same reasons.

ACTIVITY ROOMS

Because there is a big focus on preparing the kindergarten children for school, they have a need for different activity rooms where they can focus on different subjects and activities, so that they can learn and develop.

As the institution focuses on learning about sustainability, there will be a special focus on this both inside and out, while designing activities for the children. Of course, in order to achieve the right learning in all respects.

NATURE

Interaction with the nature provides specific life quality, and children are more able to learn through fresh air and play, why the children need a playground where they can be outdoor. Although it is possible for the institution to use the park for outdoor activities, it is also a good idea that the children have a smaller playground close to the institution, to be in close connection with the nature all the time. In addition, it is a good idea for the larger children to have a workshop where they can learn.

 Ill. 29. Personas - Kindergarten children

06:30 – 08:00

The children are handed in the nursery and are welcomed by the staff. During this time, breakfast is served in the common room. Where at the same time, quite activities take place in the common room such as puzzles, lego, drawing etc.

08:00 – 08:45

The children retire to their own group rooms with the associated staff.

8:45 – 09:15

Fruit and bread are served as a snack.

09:15 – 11:30

The children are divided into smaller learning groups, either in their group rooms, the common room or the activity rooms. Here there is room for deepening and focusing on different learning objectives, including sensory stimulation, motor function and learning about sustainability.

11:30 – 12:00

Lunch in the common room (eventually outside in the summertime).

12:00 –14:00

The children play on the playground, while those who need it (the younger children) sleeps in the quiet rooms.

14:00 – 14:30

The children are served fruit and bread, and those who sleeps are awakened.

14:30 – 16:45

Various activities take place either in the group rooms, wardrobe, common room, activity rooms or on the playground (mostly in the summer half year).

Ill. 30. Time schedule kindergarten children | 61

PERSONAS - SECONDARY USERS

PEDAGOGUE

ROLE

Replaces the role of the parents in the children's everyday life. They need to create a calm atmosphere and a motivating learning environment for the children.

WISHES

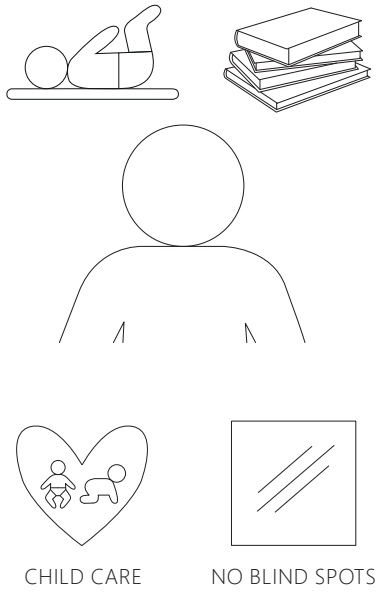
No blind spots so they always can keep an eye on the children. Window in walls/ doors, so they easily can keep eye on the children, without disturbing them.

SPACES NEEDED

Meeting room, canteen, kitchenette, wardrobe, bathroom/toilet and storage.

ATMOSPHERE

Safe, calm and motivating.



PEDAGOGICAL LEADER

ROLE

Organize the everyday life in the day care centre and have an overview of the staff and children.

WISHES

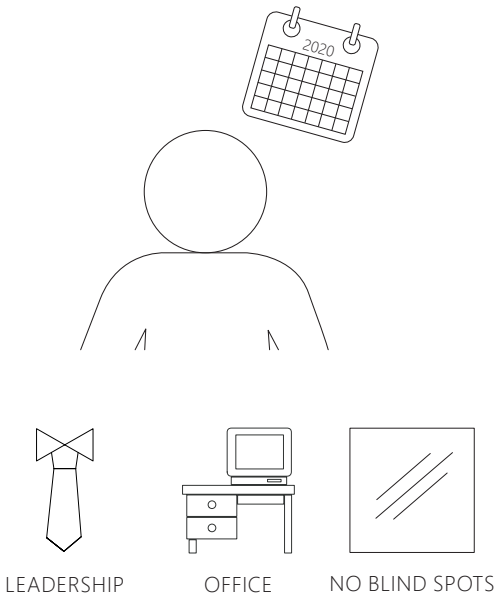
Flexibility of the rooms and zoning.

SPACES NEEDED

Private office, printing room, canteen, kitchenette, wardrobe, bathroom/toilet and storage.

ATMOSPHERE

Structure, calm and safe.



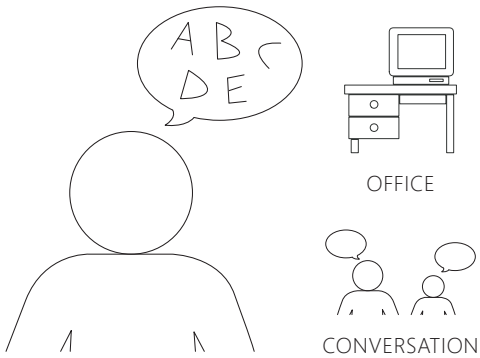
SPEECH THERAPIST

ROLE
Teach the children to communicate.

WISHES
Private and quiet space.

SPACES NEEDED
Meeting room, canteen, kitchenette, wardrobe, bathroom/toilet and storage.

ATMOSPHERE
Calm and private.



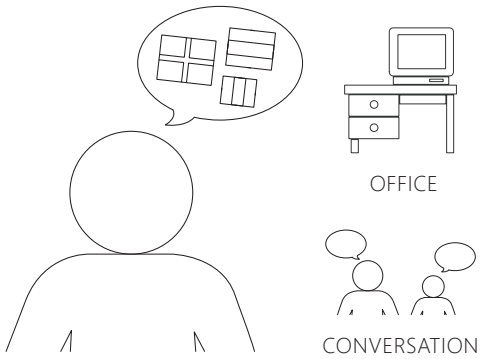
LANGUAGE THERAPIST

ROLE
Teach the children the Danish language.

WISHES
Private and quiet space.

SPACES NEEDED
Meeting room, canteen, kitchenette, wardrobe, bathroom/toilet and storage.

ATMOSPHERE
Calm and private.



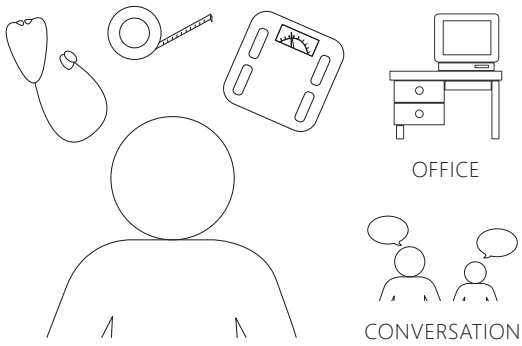
HEALTH VISITOR

ROLE
Check the children´s health.

WISHES
Private space.

SPACES NEEDED
Meeting room, canteen, kitchenette, wardrobe, bathroom/toilet and storage.

ATMOSPHERE
Private.



CHEF

ROLE

Prepare food, cook, dishwash and order food/ingredients.

WISHES

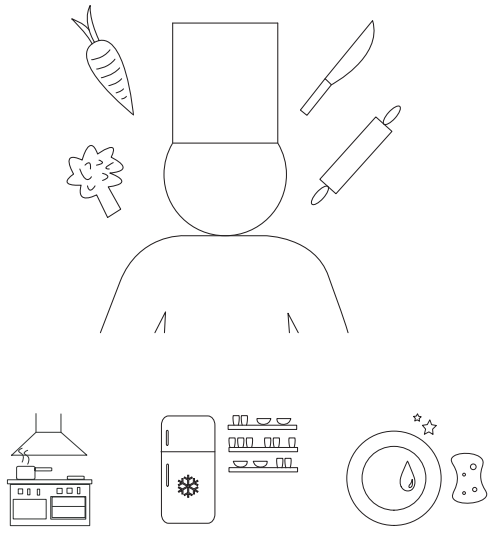
Kitchen for children and storage for trolleys.

SPACES NEEDED

Kitchen for cooking, scullery, larder, cold-storage room, office, bathroom/toilet, wardrobe and storage.

ATMOSPHERE

Clean and private (safe-zone).



CLEANING STAFF

ROLE

Clean the day care centre.

WISHES

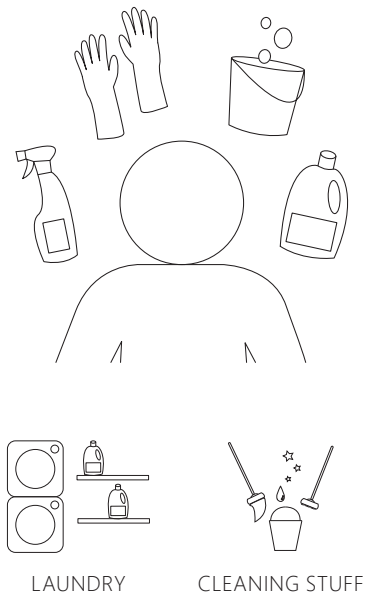
Easy access to cleaning room and cleaning materials.

SPACES NEEDED

Cleaning room, storage, kitchenette, wardrobe and bathroom/toilet.

ATMOSPHERE

Cleaning friendly environment.



JANITOR

ROLE

Keep an eye on the condition of the building and outdoor spaces, and repair if needed.

WISHES

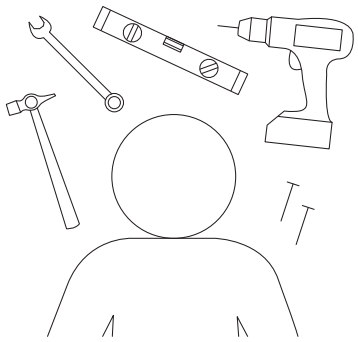
Long-lasting materials, highly functional building and easy access to the technical rooms.

SPACES NEEDED

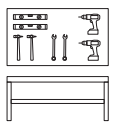
Office/workshop, canteen, kitchenette, wardrobe, bathroom/toilet and storage.

ATMOSPHERE

Private (safe-zone).



TOOLBOX



WORKSHOP

PARENT

ROLE

Brings and pick-up the children from/to the day care centre.

WISHES

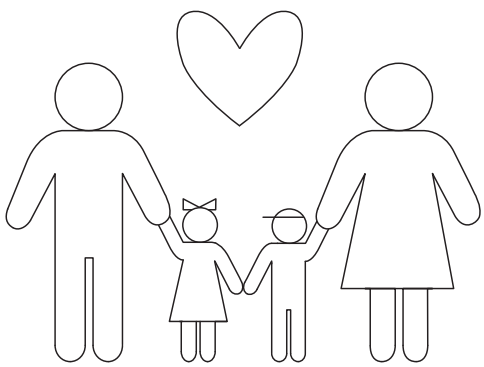
Guest toilet, safety and learning environment for their children.

SPACES NEEDED

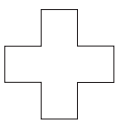
Meeting room (parent consultation).

ATMOSPHERE

Safe, calm, motivating, healthy and clean.



EASY WAYFINDING



HEALTH

SAFE

CASE STUDY - DAGINSTITUTIONEN BORNHOLMSGADE

Daginstitutionen Bornholmsgade is an integrated institution located in Øgadekvarteret, Aalborg. It has an area of 1162 m^2 and is rated for 130 children, 40 nursery children and 90 kindergarten children in the age of 0-6 years.

PLAN AND ROOMS

The day care centre is divided into 3 zones: North, East and South. Each zone consists of 13 nursery children and 30 kindergarten children. The children have shared wardrobes in all the zones, which provide social interaction. In the center of the building, there is an open common room, from where there are access to the different zones. From the common area there are additional access to the administrative too, which is separated from the children and located on the 1st floor. Located in the administration department are: offices, kitchenette, meeting rooms, wardrobe for the pedagogues etc. The building has focus on flexibility, where there is an opportunity to create zones and open/close between different rooms, as well as fordable furniture placed in almost every room.

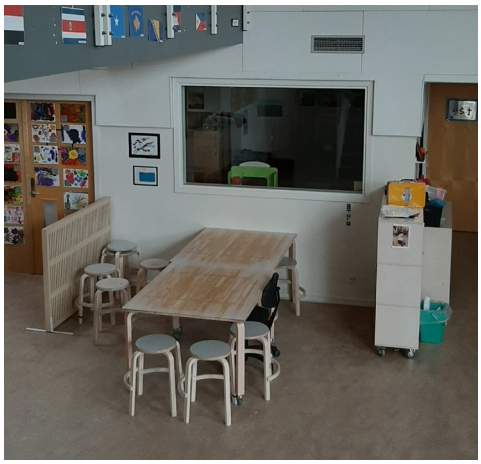
SOCIAL SUSTAINABILITY

In this day care centre, one focus has been on the quality of social interaction between the children. This is example expressed by a common room in the centre of the building, all the different zones have directly entrance from their zone to the common room. The main entrance to the building leads to the common room too. Located in the common room are a kitchen where the children can help cooking from a plateau, which creates interactions between the children and the pedagogues.

In addition, the common room allows for different types of activities, including space for communal dining. The common room are connected and have direct access to different activity rooms, such as playroom, drama room, hobby room and library, in order to create a learning environment with the opportunity for developing.

Outside there is a big common playground for all children. The nursery children have their own smaller private ones, but they are still connected and have access to the big one.

The social quality of the day care centre is seen in the form of views, daylight, skylight, acoustics, shading and nature. The doors and walls have windows in eye level of the children. In some walls in smaller rooms, small doors are placed, that only the children can use. One important thing to add, is that there are no blind sports when it comes to keeping an eye on the children. (Min institution, n.d.)



Ill. 35. Daginstitutionen Bornholmsgade | 67

CASE STUDY - BØRNEHAVEN KAROLINELUND

Børnehaven Karolinelund is located in Aalborg. It has an area of 850 m^2 and is rated for 99 children. It is a relatively new institution constructed in 2016-2017.

SUSTAINABILITY

One special thing for this kindergarten is that it is sustainable, it is the first children's home in Denmark with the DGNB-certification Platin, which is the best medal in the DGNB-system.

The kindergarten has a wide range of sustainable initiatives, according to economy, energy and lifespan. The focus has been on making the building as natural and climate-friendly as possible, why the project is built in wood, both the construction and façade, and in addition, it have a green roof.

Architecture, nature, pedagogy, play and learning have been important elements in the building design. Both spontaneous play and planned activities are possible in the interior, which is made with flexible solutions that form the framework for both large and small common spaces.

The entire building seems very natural using a lot of wood, it has a playful atmosphere with staggered windows, as well as some colourful walls and elements inside.

PLAN AND ROOMS

The kindergarten is divided into three volumes, a service core with staff facilities and two groups. In the center there is a large common room which connects the volumes and creates a social living space, it is also in this room the kitchen is located. The common room has direct access and visual connection to the outdoor spaces, which emphasizes the building's vision of removing the transition between inside and out.

The two groups have entrance to a wardrobe, from which there is access to two group rooms, which further leads to some activity rooms. From the wardrobe there is also access to the toilet, from which there is a toilet which has direct access from the playground outdoor.

Outdoor there is a hilly landscape with playgrounds and workshop, which challenges the children to develop their play and creativity.
(Bjerg, n.d.)

Ill. 36. Børnehaven Karolinelund | 69

SUB-CONCLUSION

Our most important organ is the brain, it is the foundation of our body. The brain develops greatly during the first three years of a child's life, thereby it is important already to have a strong focus on stimulating the brain early in a child's life, so it can develop satisfactory.

A human being has a total of 7 senses, all the senses are important for our movement ability, body awareness and understanding of the surroundings. Stimulating the senses strengthen the motor function and the cognitive development.

It is important to have elements in the institution that stimulate the children's senses, example plateaus and balance beams, that stimulate their vestibular and proprioceptive sense, it could also be a common kitchen that stimulate their olfactory and gustatory sense, or a music room that stimulate their auditory sense.

The institution has a great influence on the children's well-being, learning and development, therefore it is important to create the framework for a safe and educational environment. The interaction between space, architecture and interior design have a great influence on their learning and development as well, thus there should be a focus on the physical space.

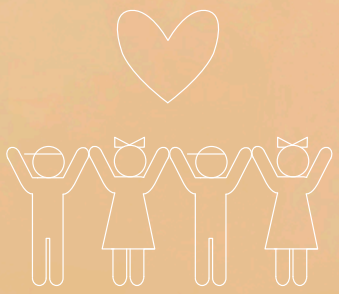
When organize space in a good way, there should be focus on the plan solution, how the different rooms and spaces are connected, and the interior design, how they are furnished and related to their activity. The use of colours could be a good way to make atmospheres and create an inspiring, inviting, motivating, energized and creative institution, and give the possibility to organize the different activities.

When designing the rooms there should be a focus on flexibility and zoning, to control the activities and density in the room. There should also be a focus on both child- and adult-initiating activities, which can be done through play, either free play or play with focus on learning.

In addition, there should be a focus on outdoor spaces too. Nature experiences have a positive effect on the cognitive, emotional and social development. However, the practical aspects of wardrobe and toilet placement must be considered.

Sustainability is a big part of our society, so the children should learn to have focus on how to implement sustainable aspects in their daily life, already in their early age so it becomes a natural part of their thinking and behavior. It could be a part of the institution design, by creating spaces with focus on sustainable activities.

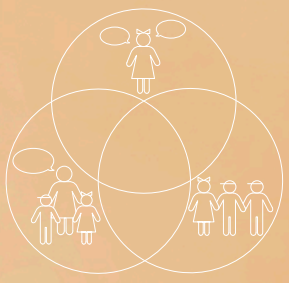
When it is a user-based design, there should be a focus on the different users of the institution. Visit to various institutions helped emphasize the theory about children, how to organize the rooms and achieve an optimal and attractive space that meet the users wishes and needs according to functions, spaces and atmosphere.



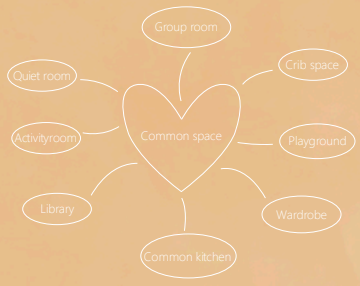
USER BASED DESIGN

HEALTH, SAFETY & WELL-BEING

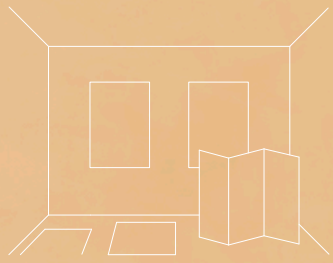
BRAIN & SENSES



LANGUAGE, SOCIAL RELATI-
ON & COMMON ATTENTION

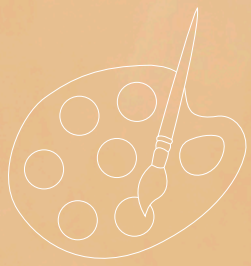


COMMON ROOM CONNECTED TO
OTHER FUNCTIONS

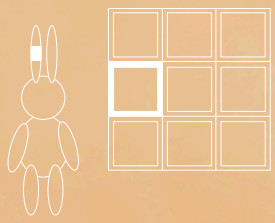


ZONING & FLEXIBILITY

WAYFINDING COLOURS

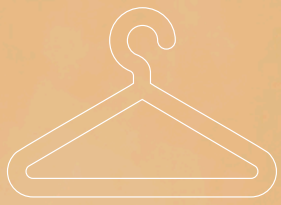


ORGANIZING BY COLOURS



CREATE ATMOSPHERES
THROUGH COLOURS

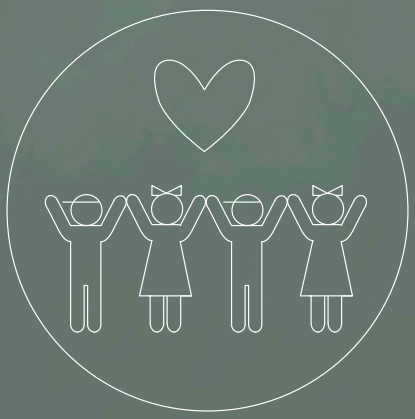
PLAYGROUND & NATURE



WARDROBE

LEARNING ABOUT SUSTAINABILITY

SUSTAINABILITY



SOCIAL QUALITY

ENVIRONMENTAL QUALITY

ECONOMICAL QUALITY

74 | Ill. 38. Sustainable construction

SUSTAINABLE CONSTRUCTION

A sustainable construction consists of three composite qualities the social, environmental and economical quality. The qualities must be balanced according to the construction as whole and its life cycle perspective. The social quality concerns the human health and well-being, the environmental quality has an impact on resources, climate, environment and nature, and the economical quality implies the balance between the quality of the building and its total cost. (Birgisdottir, 2015)

Sustainable construction must be ensured by both long term and broad thinking. When thinking long term, it is essential to observe the entire life cycle of the building. For the social quality, the life cycle perspective is to ensure the framework for health and well-being of all who are in contact with the construction. The environmental quality in a life cycle perspective, is the resource consumption and environmental impact throughout the entire lifetime of the building, all from construction to recycling. The life cycle perspective of the economy is to consider the economic conditions associated with the building life, despite changing needs. To think broadly is to think of the overall perspective of the building, not only of the building but, as part of a larger context. An example could be that you only focus on the economy of the energy use without thinking on the indoor climate, which affect the social and environmental quality in a bad way. (Birgisdottir, 2015)

This project will have a greater focus on the social and environmental qualities. The social quality will be the driving factor for the design, as the users are children who needs a healthy and comfortable place to be. The environmental quality will have focus on the life cycle assessment of the materials used for the building. (Birgisdottir, 2015)

ZERO ENERGY BUILDING - ZEB

A Zero Energy Building, ZEB, is designed to have a low energy demand, which is covered by renewable energy sources. A Zero Energy Building can be achieved through a combination of low energy demand, as well as supply the building with renewable energy sources, such as wind, solar, water or biogas, either from a renewable energy supply system located on the site, or by connecting it to one or more energy infrastructures.

A Zero Energy Building focuses on the user by ensuring a good indoor climate according to the acoustic, atmospheric, thermal and visual comfort. The goal for a Zero Energy Building is to use renewable energy sources, so the consumption of fossil fuels can be completely avoided. (Svendsen, Lund & Heiselberg, 2014)

RENEWABLE ENERGY SOURCES

In order to achieve a Zero Energy Building, it is important to have an energy efficient design, which is possible with use of renewable energy sources. Energy needed for heating and cooling can be minimized by passive strategies. The need for electricity and heating, can be covered by active strategies, so the use of fossil fuels is avoided.

PASSIVE STRATEGIES

BUILDING ENVELOPE

By making a compact building envelope, with good insulation and minimizing of thermal bridges and infiltration, the energy consumption for heating can be reduced. The envelope can also be used for passive heat gain, as the heat can be stored in the construction, which helps keeping the building warm in cold climates and reduce the need for heat. (Poulsen, 2016)

OVERHANG

By implementing overhangs in the building, overheating can be avoided. An overhang can be used as a design strategy for shading. It should screen for the high midday sun in summer and minimize the direct solar heat to achieve a better indoor climate, and still be able to allow the passive heat gain when it's needed in winter. An overhang can also be used to extend the building, by creating covered outdoor spaces. (Bejder, 2018, p. 47)

NATURAL VENTILATION

When using natural ventilation, there are four different design-principles that can be used; single-sided ventilation, cross ventilation, stack ventilation or combined cross and stack ventilation. (Larsen, 2018, p. 3) There are two driving factors of natural ventilation; thermal buoyancy and wind. When implementing natural ventilation, the key parameters are; openings, orientation, building form and air flow movement. (Larsen, 2018)

ACTIVE STRATEGIES

RENEWABLE ELECTRICITY

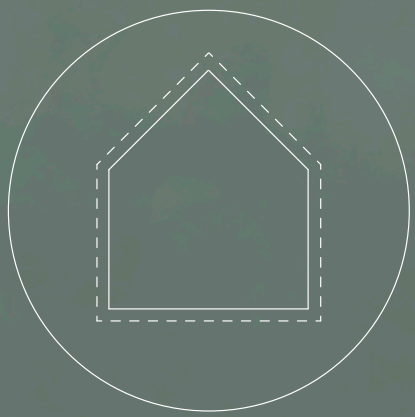
Renewable energy is energy from natural sources such as; wind, sunlight and geothermal heating. An example on how renewable electricity can be made is by photovoltaic panels (solar panels), that convert the energy from the sun into electricity. The amount of the electricity output depends on the angle and orientation of the solar panels. There are three types of solar panels; monocrystalline, polycrystalline, and thin-film panels. (Larsen, 2018, p. 61)

SOLAR THERMAL COLLECTORS

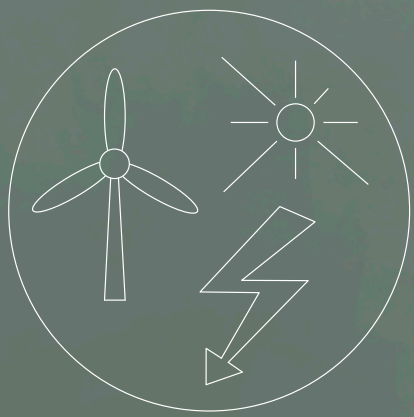
Solar thermal collectors convert the energy from the sun into heat, that can be used for domestic hot water and space heating. The amount of the output depends on the angle and orientation of the collectors. There are two types of solar thermal collectors; flat plane collectors and evacuated tube collectors. (Larsen, 2018, p. 42-44)

GREY WATER HEAT RECOVERY

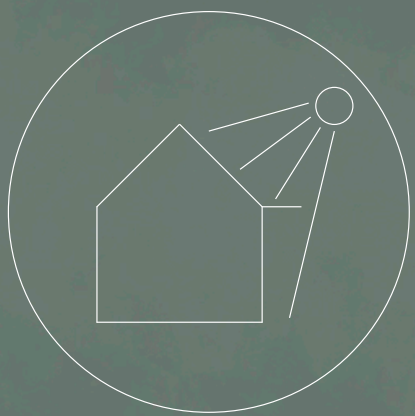
A grey water heat-recovery system uses the heat from bathing or laundry, to heat the cold water. (Dabaieh, 2018, p. 14)



BUILDING ENVELOPE

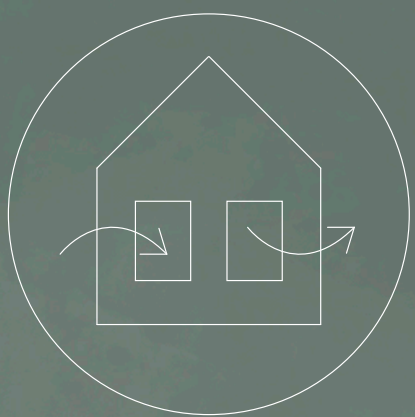


RENEWABLE ELECTRICITY

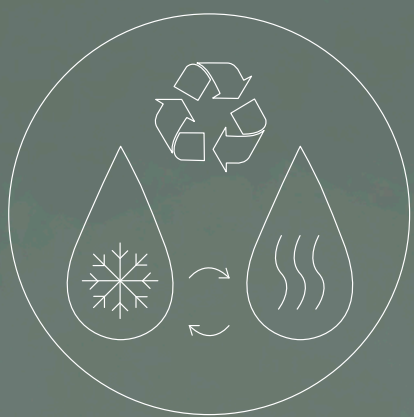


OVERHANG

SOLAR THERMAL COLLECTORS



NATURAL VENTILATION



GREY WATER HEAT RECOVERY

Ill. 39. Renewable energy sources | 77

BUILDING REGULATIONS

The Danish Building Regulations contain requirements which ensure that the building is both healthy and safe to use.

ENERGY FRAME

The energy frame determines how much primary energy a building is allowed to use in terms of heating, domestic hot water, ventilation, cooling and in some cases, lighting. This regulation is made to ensure that the building in terms of energy are as sustainable as possible. (Bygningsreglementet, 2020)

The institutions overall need for supplied energy per heated m^2 floor area, must be max 41,0 kWh/m^2 per year, added 1.000 kWh per year, divided by the heated floor area. (Bygningsreglementet, 2020)

To ensure that the building is as energy friendly as possible, the goal is to achieve the least possible energy frame.

The U-values is the insulation power of the construction. To achieve the goal, the U-values must at least comply with the requirements set in the Danish Building Regulations.

Envelope requirements (U-values):

Roof:	0,20 W/m^2K
Exterior walls:	0,30 W/m^2K
Foundation:	0,20 W/m^2K
Windows:	1,80 W/m^2K

(Bygningsreglementet, 2020)

INDOOR CLIMATE

In order to have a comfortable indoor climate, the building regulation have set some requirements that the building must comply with. The indoor climate can be divided into the experienced indoor climate and the physical indoor climate. The experienced indoor climate is defined by our senses, therefore it is individually how we experience the indoor climate. It can example be influenced by the persons activity level and clothing. The physical indoor climate consists of acoustic, atmospheric, thermal and visual comfort. (Larsen et al., 2017)

ACOUSTIC COMFORT

In a day care centre all rooms where children or adults stay, are considered as living rooms. This includes common rooms, staff areas, offices, corridors, wardrobes, stairwells, workshops, etc., only storage rooms and toilets are other than living rooms. In day care centres, the reverberation time must not exceed 0,4 seconds in living rooms. (Bygningsreglementet, 2020)

ATMOSPHERIC COMFORT

In a day care centre, the CO_2-level in the indoor air concentration should not exceed 1.000 ppm. It is assumed, when calculating air volumes, that the outdoor air concentration of the CO_2-level is 400 ppm. If this increase, a correspondingly higher CO_2-level is accepted inside. It is also assumed that the building consists of low-polluting building materials. (Bygningsreglementet, 2020)

THERMAL COMFORT

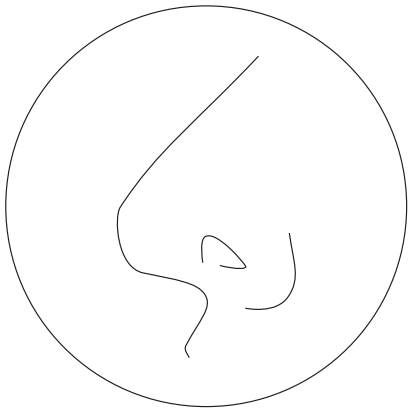
The day care centre must comply with the regulation which states that the tem-

perature must not exceed 26 °C for more than 100 hours, and that only a maximum of 25 hours must be above 27 °C during a year. (Bygningsreglementet, 2020)

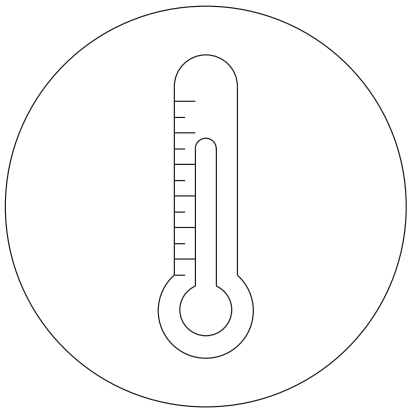
VISUAL COMFORT

To achieve good comfort in the institution it must be ensured, that there is sufficient view and daylight in the living rooms. Why the windows must be placed at a height, and orientation that makes is possible to look at the surroundings. To achieve comfortable daylight, the glass area (without shading) must be at least 10 % of the floor area. A sufficient daylight can also be obtained by the illumination from daylight being a minimum of 300 lux in at least half the room. (Bygningsreglementet, 2020)

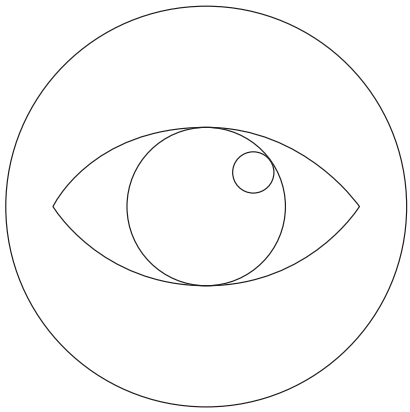
ACOUSTIC COMFORT



ATMOSPHERIC COMFORT



THERMAL COMFORT



VISUAL COMFORT

MATERIALS

In this project there is a focus on the environmental quality of sustainability, which is why it is important to consider the choice of materials for the building.

It is relevant to look at the entire life cycle of the materials, all from production to end-of-life, when assessing whether a material is sustainable or not. These factors are described in the following section, including roof, façade, insulation and interior materials. In addition, it is important to think about cleaning practices, as well as wear and tear when choosing materials for an institution.

The vision for the future area of Stigsborg Havnefront, is that the district should appear as a brick town, supplemented by other natural materials. (Stigsborg P/S, 2020)

The following materials are considered during the design phase, in which some of them are selected and used for the final design.

ROOF MATERIALS

STEEL PLATES
Production:
Steel plates are made of recycled steel, which is galvanized/supplied with a zink coating that protects against rust. The plates can be coloured or painted in any colour.

End-of-life:
Reused or re-melted.

Advantages:
- It is a raw material that is much of in the world
- Easy to recycle
- Cheap
- Easy and fast to install
- Available in any colour

Disadvantages:
- There may be glare if glossy sheets are selected

(Bæredygtigt byggeri, n.d.)

GREEN ROOF
Production:
The roofing solution is carried out, for example, by laying a root-tight membrane, followed by drainage layers, then a felt roof and at the top a layer of soil, in which sedum, moss, grass etc. are planted.

End-of-life:
Recycled, composted or burned, depending on the roof solution.

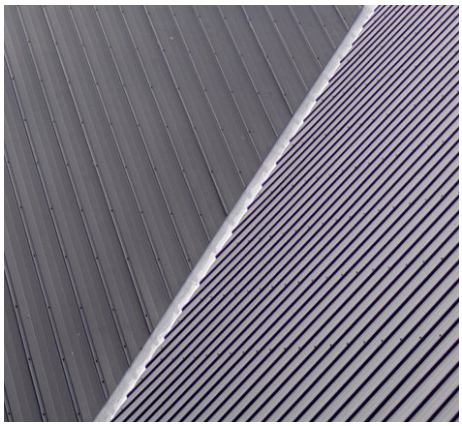
Advantages:
- Helps counteract the greenhouse effect, as it absorbs CO_2 which it converts to oxygen
- High insulation value
- Improve air quality and reduce temperature and noise

Disadvantages:
- Best for no or relatively low pitch (max. 30 degrees)
- Suitable neither for collecting or recycling water

(Bæredygtigt byggeri, n.d.)

FAÇADE MATERIALS

SLATES
Production:



Ill. 41. Steel plates - (Areco, 2020)

Ill. 42. Green roof - (DCS, 2020)

Ill. 43. Slates - (Cupa Danmark, n.d.)

Slate is a rock that can be split into thin slices.
Advantages:
- Durable material that does require maintenance
- Can be used for both façade and roofing
- Natural material

Disadvantages:
- Hard to assemble
- Expensive
- To prevent cracking, it should only be fitted with copper nails/screws

Other
- Life span: +100 years

(Danske boligarkitekter, 2020)

BRICKS
Production:
Bricks are made from clay, which is an easily accessible raw material in Denmark.

End-of-life:
Reused or crushed.

Advantages:
- Contributes to a good indoor climate, as they absorb and release moisture
- Good heat accumulation

Disadvantages:
- Requires a lot of energy to produce as they are burned for a long time at high temperatures

(Danske boligarkitekter, 2020)

WOOD - THUJA
Production:
The tree species Thuja grows in Denmark. It gets between 25-30 meters high. The branches of the tree sit scattered, giving scattered knots, unlike other conifers.

End-of-life:
Reused or burned.

Advantages:
- Light wood with high durability
- Good to use as façade material as it is a light material
- Easy to work with both machine and hand tools

Disadvantages:
- Discoloration is possible if stainless steel screws are not used during installation
- Not particularly strong, why it should only be used as façade material

(Træ, n.d.)

ROCKPANELS COLOUR
Production:
Rockpanel plates is made of the volcanic rock basalt and an organic binder. To maintain its colour, it is bonded with a water-based coating.

Advantages:
- Easily accessible raw material
- Available in any colour

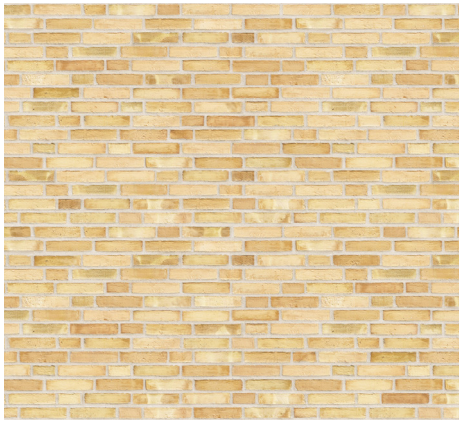
Disadvantages:
- Suitable only as façade material

(Rockpanel, 2017)

INSULATION MATERIALS

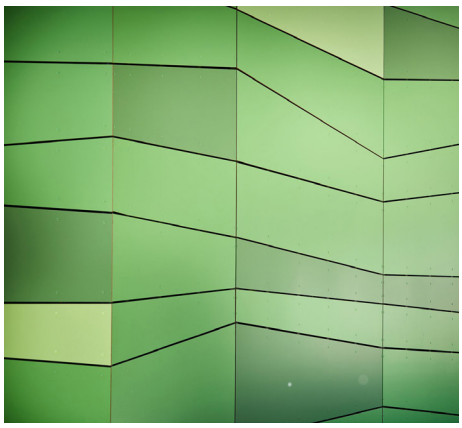
PAPER WOOL
Production:
Paper wool is made from either surplus or used newspapers. The process is done by grinding the newspapers to a fiber mass, after which is added mineral salts, to make the paper wool more resistant to fire.

End-of-life:
After use, the wool can either be burned



Ill. 44. Bricks - (Petersen Tegl, 2019)

Ill. 45. Wood - (M4 Arkitekter, 2019)



Ill. 46. Rockpanels colour - (Heinze, 2020)

or composted, depending on the type.

Advantages:
- Cheap
- Easy to use
- Good soundproofing skills

Disadvantages:
- During production the paper wool may have been added drilling salts to act as a fire retardant

Other:
- Life span: 50 years
- Thermal conductivity: 0.040 W/mK

(Bæredygtigt byggeri, n.d.)

EELGRASS
Production:
Eelgrass is a plant that naturally grows along the coasts of Denmark. The insulation is produced by drying and pressing the leaves of the plant.

End-of-life:
Can be reused.

Advantages:
- 100% natural material
- Contains naturally fire-retardant minerals
- Contributes to a healthy indoor climate

Disadvantages:
- Slightly expensive material

Other:
- Life span: Almost endless
- Thermal conductivity: 0.037 W/mK

(Zostera, n.d.)

INTERNAL MATERIALS
OSB BOARD – ORIENTED STRAND BOARD
Production:
OSB boards are made from glued wood chips, from either the timber industry or the thinning of the forests. To strengthen the boards, they are built up in 3 layers, which is done under pressure and heat.

End-of-life:
Deposited.

Advantages:
- Are made from residual wood
- Cheap
- Uniform product with many application possibilities

Disadvantages:
- Contains adhesives that give off formaldehyde, which can be problem for the indoor climate, if the boards are not manufactured to comply with the limit values

(Træ, n.d.)

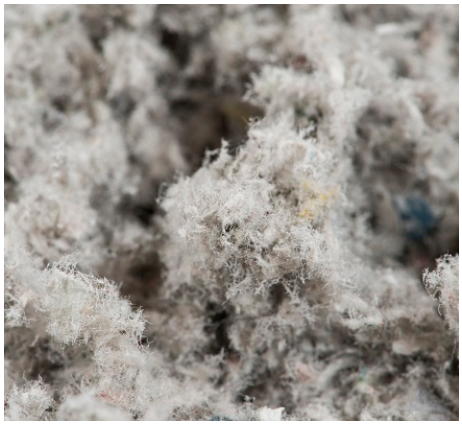
PLASTER BOARD
Production:
Plasterboard is made from either natural plaster excavated by mines, or from plaster granule that arises as a by-product of industrial plants, such as coal-fired power plants.

End-of-life:
Crushed or reused.

Advantages:
- Easy to work with
- Contributes to a healthy and natural indoor environment, because it does not contain any harmful substances, that emit toxic degassing

Disadvantages:
- The boards have a difficulty to emit moisture, so condensation should be avoided and thus prevent mold

(Bæredygtigt byggeri, n.d.)



Ill. 47. Paper wool - (Mads Windfeldt Arkitekter, 2014)

Ill. 48. Eelgrass - (Realdania Byg, 2013)

Ill. 49. OSB board - (Keflico, n.d.)

DGNB

DGNB is an international sustainability certification. It is a tool that can be used to increase the focus on the sustainability of a building process for a building project, but also in the building industry in general. It is a tool that is relevant to everyone whether you want a DGNB certification or not.

DGNB is a set of 40 criteria that can be used to evaluate a building's qualities in relation to the three sustainable aspects: social, environmental and economical quality. However, it is supplemented with process, technical and the area's qualities.

A DGNB certification can be used to create the framework for a holistic approach to sustainability. Using an evaluation matrix, the various criteria are evaluated, thereby obtaining a score that allows for a DGNB sustainability certification in either silver, gold or platinum.

Several criteria from DGNB are described below. These will be considered in the design process as a tool for achieving a more sustainable building. (DGNB, n.d.)

PROCESS QUALITY

- PRO1.2 Integrated Design 1,7%

The integrated design process ensures a holistic design already in the early design process, where both the site, user, indoor climate, sustainability and other technical aspects are envisaged. This ensures interdisciplinarity throughout the design process, and results in a more optimal design solution. (DGNB, n.d.)

ENVIRONMENTAL QUALITY

- ENV1.1 Life Cycle Impact Assessment 7,9%

The building materials has a great impact on the environment, all from the production of the material to disposal. Thus, it is important to consider the life cycle of the materials and investigate the impact of the material on the global warming, ozone depletion and the total primary energy use. (DGNB, n.d.)

- ENV2.3 Land Use 2,3%

This criterion focuses on utilizing the use of the land as efficiently as possible. Thus, the focus must be on reducing the use of useless areas. (DGNB, n.d.)

ECONOMICAL QUALITY

- ECO2.1 Fleksibility and Adaptability 6,4%

The purpose of this criterion is to enable optimal use of the building, where the focus on the building design is on the flexibility and adaptability to provide multiple use of the building. (DGNB, n.d.)

SOCIAL QUALITY

- SOC1.1 Thermal comfort 4,3%

The purpose is to ensure the user a good indoor climate in terms of the thermal comfort, both in summer and winter. The operating temperature, as well as the relative humidity, are considered. (DGNB, n.d.)

- SOC1.2 Indoor Air Quality 2,6%

The purpose is to ensure the health and well-being of the users, by having an optimal indoor air quality. Thereby, this criterion is focusing on avoid harmful odor nuisances by ensuring that the rooms has

a satisfactory air change. (DGNB, n.d.)

- SOC1.4 Visual Comfort 2,6%

This criterion is focusing on the user's visual comfort, both on views to the surroundings and the lighting in the building, including daylight and artificial light as well. (DGNB, n.d.)

- SOC1.5 User Control 1,7%

The purpose is to increase the user's satisfaction, while at the same time saving energy consumption, by allowing the users to regulate the temperature, ventilation, sun protection and artificial light. (DGNB, n.d.)

- SOC1.6 Quality of Outdoor Spaces1,7%

This criterion helps to increase the quality of the outdoor areas around the building. Both the design and quality of the outdoor areas, and view of the surroundings are taken into consideration. (DGNB, n.d.)

- SOC2.1 Design for All 1,7%

The purpose is to ensure that everyone regardless of the disability has equal access to the building's functions, both inside and outside. (DGNB, n.d.)

- SOC2.3 Cyclist Facilities 0,9%

It has positive effects on the environment but also the health on people to cycle, therefore the criterion aims to ensure good cycling conditions for the users of the institution. (DGNB, n.d.)

- SOC3.3 Layout Quality 1,7%

The criterion ensures flexibility and functionality in the floor plan, as well as adaptability for future use. (DGNB, n.d.)

TECHNICAL QUALITY

- TEC1.1 Fire Safety 3,0%

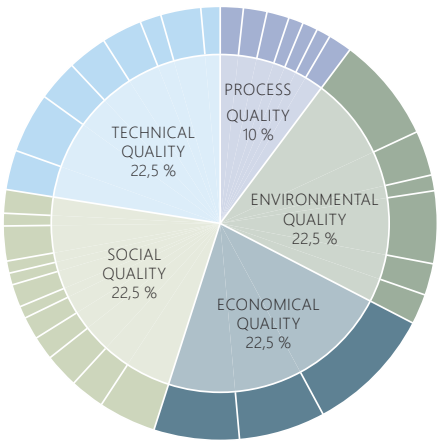
The purpose is to increase the safety of escape routes and access roads, as well as reduce the risk of fire occurring and, in that case, prevent or slow down the spread of fire and smoke in the building. (DGNB, n.d.)

- TEC1.2 Acoustics & Sound Insulation 4,5%

The purpose is to ensure the user a good acoustic comfort in terms of the sound conditions of the rooms, which increases the user's well-being. Sound insulation of technical installations, constructions and external noise is taken into consideration. (DGNB, n.d.)

- TEC1.3 Building Envelope Quality 3,0%

The criterion helps to achieve a good indoor climate as well as a low energy consumption with focus on moisture proof of construction and minimizing heat loss throughout the construction. For example, line losses, moisture protection and the U-value for the individual building parts are considered. (DGNB, n.d.)



SUB-CONCLUSION

The resent years sustainability has become more in focus in our society, therefore it is important to think at sustainable solutions when designing a building. Sustainability involves different qualities, which should be in focus to achieve an optimal building design according to the user's health and well-being and the impact on climate and resources.

To achieve a zero energy building, renewable energy sources will be integrated in the building design. Example the building can reduce its energy consumption for heating by having a compact envelope with good insulation, or it could produce its own electricity by solar panels.

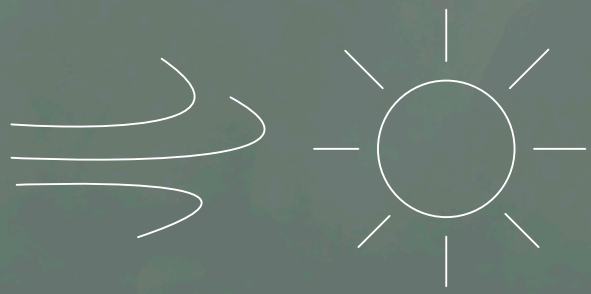
To ensure that the building is both safe and healthy, the requirements in the Danish Building Regulation must be followed. In order to have a comfortable indoor climate there should be a focus on the acoustic, atmospheric, thermal and visual comfort in the building.

An example to achieve good acoustic comfort could be by implementing acoustic plates in the ceiling or on the walls or have objects with sound absorbing capabilities. A good visual comfort could be achieved by having sufficient daylight and place the windows in eye high to make it possible for the users to look at the surroundings.

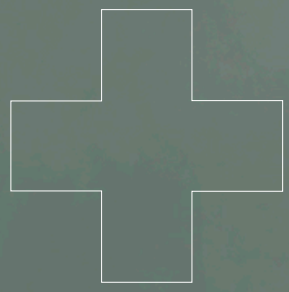
When considering which materials to use, it is important to look at the entire life cycle. It is obvious to choose natural materials when designing a sustainable building, this would also match the vision for the future area.

In order to choose materials that contributes positively to a healthy and good indoor climate, it is relevant to look at aspects such as: accumulation ability, thermal conductivity, ability to absorb and release moisture, etc. Other factors can be price, durability, how easy and safe it is to work with during construction, maintenance and cleaning, etc.

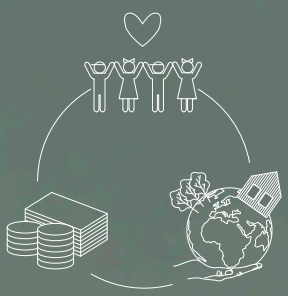
To create the framework for a holistic approach to sustainability the tool DGNB can be used. Several criteria from DGNB have been chosen for this project, in order to create focus and thereby achieve a more sustainable building.



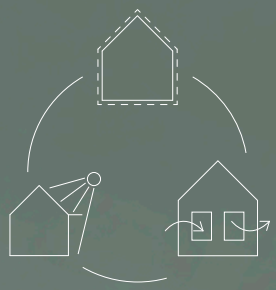
RENEWABLE SOURCES



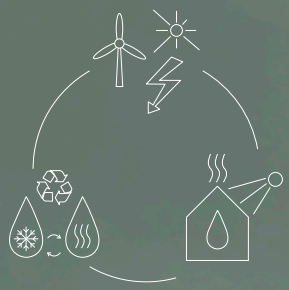
HEALTH & WELL-BEING



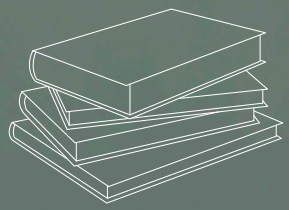
SUSTAINABLE QUALITIES



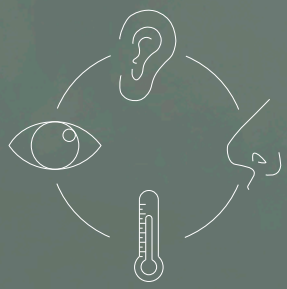
PASSIVE STRATEGIES



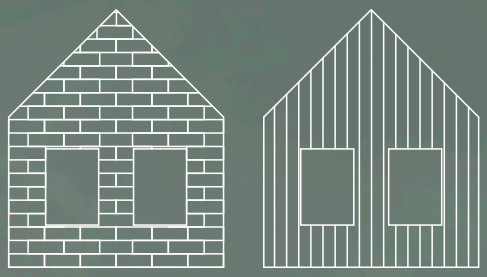
ACTIVE STRATEGIES



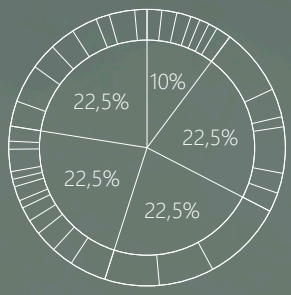
FOLLOW REGULATIONS



COMFORTABLE INDOOR CLIMATE



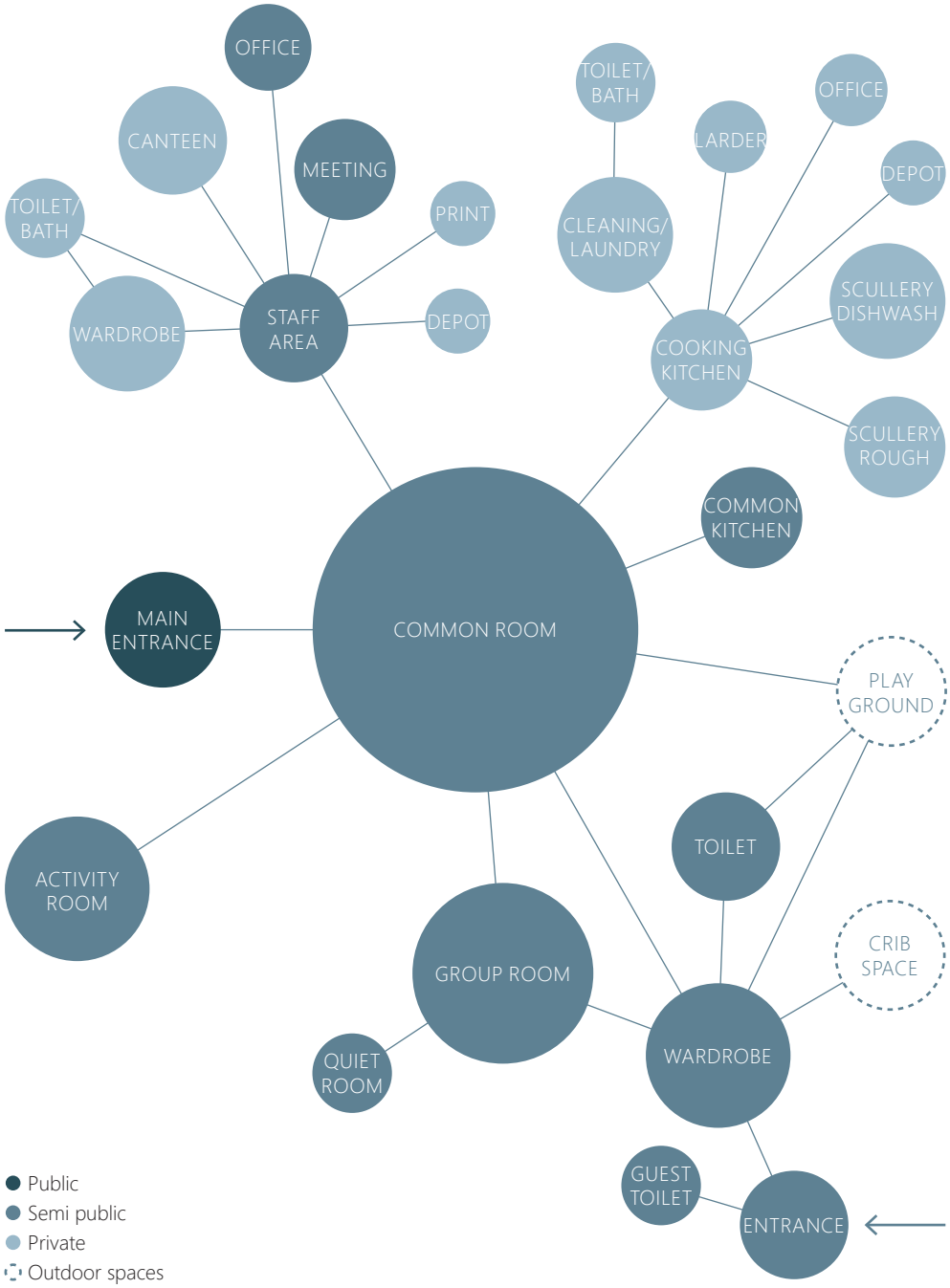
NATURAL MATERIALS



DGNB CRITERIA

DESIGN BASIS

FUNCTION CHART



Ill. 52. Function chart | 93

ROOM PROGRAM

	ROOM	QUANTITY	AREA [m²]	TOTAL AREA [m²]	QUALITY
COMMON ROOM	Main entrance	1	4	4	Warm and welcoming atmosphere.
	Common room	1	200	200	Gathering space with the oppotunity for both common and more private activities. It should be the heart of the building, and centrum for all the functions.
NURSERY	Entrance	2	4	8	Warm and welcoming atmosphere.
	Guest toilet	2	4	8	
	Wardrobe	2	40	80	Warm and welcoming atmosphere. Practical designed with space for learning and connection to the playground.
	Toilet/chaning table	2	15	30	
	Group room	2	45	90	
	Quiet room	2			Calm and relaxing atmosphere. Possibility of screening for daylight.
	Crib space	2	27	54	Outdoor space for prams.
	Playground				Smaller enclosed areas.
KINDERGARTEN	Entrance	2	4	8	Warm and welcoming atmosphere.
	Guest toilet	2	4	8	
	Wardrobe	2	40	80	Warm and welcoming. Practical designed with space for learning and connection to the playground.
	Toilet/chaning table	2	20	40	
	Group room	2	50	100	
	Quiet room	2			Calm and relaxing atmosphere. Possibility of screening for daylight.
	Playground				Enclosed areas with possibility for free play and sustainable learning activities.

ACOUSTIC	ATMOSPHERIC		THERMAL		VISUAL	
REVERBE-RATION	AIR QU-ALITY	VENTILATION	SUMMER	WINTER	ARTIFICI-AL LIGHT	DAY-LIGHT
[s]	[ppm]	[N/M/H]	[°C]	[°C]	[lux]	[%]
	1000	Natural/Hybrid	23.5 ± 2	22 ± 2.5	100	0.7
0.4	1000	Natural/Hybrid	23.5 ± 1	20 ± 1	300	2.1
	1000	Natural/Hybrid	23.5 ± 2	22 ± 2.5	100	0.7
	1000	Mechanical	23.5 ± 2	22 ± 2.5	200	1.4
	1000	Mechanical	23.5 ± 2	22 ± 2.5	200	1.4
	1000	Mechanical	23.5 ± 2	22 ± 2.5	200	1.4
0.4	1000	Natural/Hybrid	23.5 ± 1	20 ± 1	300	2.1
0.4	1000	Natural/Hybrid	23.5 ± 1	20 ± 1	300	2.1
	1000					
	1000	Natural/Hybrid	23.5 ± 2	22 ± 2.5	100	0.7
	1000	Mechanical	23.5 ± 2	22 ± 2.5	200	1.4
0.4	1000	Natural/Hybrid	23.5 ± 1	20 ± 1	300	2.1
	1000	Mechanical	23.5 ± 2	22 ± 2.5	200	1.4
0.4	1000	Natural/Hybrid	23.5 ± 1	20 ± 1	300	2.1
0.4	1000	Natural/Hybrid	23.5 ± 1	20 ± 1	300	2.1
0.4	1000	Natural/Hybrid	23.5 ± 1	20 ± 1	300	2.1

	ROOM	QUAN-TITY	AREA	TOTAL AREA	QUALITY
			[m^2]	[m^2]	
ACTIVITY ROOMS	Play room	1	15	15	Colourfull childish atmosphere. Possibility for various activities, both individual and in small groups.
	Active room	1	15	15	Possibility for various learning activities that stimulate the children's motor function and senses.
	Drama room	1	15	15	Creative space. For use of recycled clothes.
	Exploratorium	1	15	15	Creative and flexible room with space for storage of materials.
	Art room	1	15	15	Creative space with focus on children's learning about sustainability.
KITCHEN	Common kitchen	1	14	14	A place where the children can be a part of the cooking or baking.
	Kitchen	1	20	20	
	Scullery (rough)	1	6	6	
	Scullery (dishwash)	1	8	8	
	Larder	1	3	3	
	Depot	1	6	6	Space for roller tables.
STAFF	Toilet/bath	1	4	4	
	Wardrobe	1	5	5	
	Meeting room	3	12	36	Calm and private atmosphere.
	Office	1	8	8	Calm and private atmosphere.
	Print room	1	3	3	
	Canteen	1	24	24	Calm and private atmosphere.
	Toilet/bath	1	4	4	
OTHER	Cleaning/laundry	2	12	24	Space for washer and dryer.
	Technical room	2	8	16	
	Depot	1	15	15	
	Outdoor toilet	4	4	16	By extension of the indoor toilet.
	TOTAL			1141	

ACOUSTIC	ATMOSPHERIC		THERMAL		VISUAL	
REVERBE-RATION	AIR QU-ALITY	VENTILATION	SUMMER	WINTER	ARTIFICI-AL LIGHT	DAY-LIGHT
[s]	[ppm]		[°C]	[°C]	[lux]	[%]
0.4	1000	Natural/Hybrid	23.5 ± 1	20 ± 1	300	2.1
0.4	1000	Natural/Hybrid	23.5 ± 1	20 ± 1	300	2.1
0.4	1000	Natural/Hybrid	23.5 ± 1	20 ± 1	300	2.1
0.4	1000	Natural/Hybrid	23.5 ± 1	20 ± 1	300	2.1
	1000	Mechanical	23.5 ± 1	20 ± 1	500	3.5
	1000	Mechanical	23.5 ± 2	22 ± 2.5	500	3.5
	1000	Mechanical	23.5 ± 2	22 ± 2.5	500	3.5
	1000	Mechanical	23.5 ± 2	22 ± 2.5	500	3.5
	1000	Mechanical	23.5 ± 2	22 ± 2.5	100	0.7
	1000	Mechanical	23.5 ± 2	22 ± 2.5	100	0.7
	1000		23.5 ± 2	22 ± 2.5	500	3.5
	1000	Mechanical	23.5 ± 2	22 ± 2.5		
0.4	1000	Natural/Hybrid	23.5 ± 1	20 ± 1	300	2.1
0.4	1000	Natural/Hybrid	24.5 ± 1	22 ± 1	300	2.1
0.4	1000	Natural/Hybrid	24.5 ± 1	22 ± 1	500	3.5
0.4	1000	Mechanical	23.5 ± 1	20 ± 1	200	1.4
0.4	1000	Natural/Hybrid	23.5 ± 1	20 ± 1	300	2.1
	1000	Mechanical	23.5 ± 2	22 ± 2.5	200	1.4
	1000	Mechanical	23.5 ± 2	22 ± 2.5	200	1.4
	1000		23.5 ± 2	22 ± 2.5	200	1.4
	1000		23.5 ± 2	22 ± 2.5	100	0.7
	1000	Mechanical	23.5 ± 2	22 ± 2.5	200	1.4

DESIGN CRITERIA

SITE
- Advantages of the unique location – through access and views to park and fjord
- Nature in focus – transition between inside and outdoor in all living rooms, especially in group rooms, common room and activity rooms
- Landmark – a building that attracts people and can be spotted from Aalborg
- Comfortable outdoor spaces – relative to the microclimate

USER
- Brain & senses – focus on stimulation and development
- Safety – make the users feel safe by avoiding blind spots and apply windows in children's eye level
- Play & learning – create spaces that invites and motivates the children to play and learn
- Wishes & needs – fulfill the users wishes and needs

SUSTAINABILITY
- Natural materials – use for both the building and outdoor activities
- Sustainable activities – create spaces for activities with focus on learning about sustainability
- Indoor climate – create a good indoor climate with acoustic, atmospheric, thermal and visual comfort
- Social quality – focus on the users safe, health and well-being
- Environmental quality – choose materials with a focus on the environment
- Zero Energy Building – design a ZEB-building with a low energy demand supplied with renewable energy sources
- Passive & active strategies – integrate passive and active strategies in the building design
- Building Regulations – follow the building regulations to ensure a healthy and safe institution with a low energy consumption
- DGNB – fulfill the chosen criteria

FUNCTIONS & AESTHETICS
- Preferable to take the bike or walk – create good opportunities to park the bike or pram
- Central common space – connecting the other functions of the building
- Activity rooms – focusing on each specific activity
- Flexibility & zoning – decorate the rooms with great flexibility so they are easy to zone divide
- Wardrobe – the wardrobe is a learning environment that should be practical and functional
- Colours – use colours to organize, zone divide, wayfinding and create atmospheres
- Common kitchen – place a common kitchen with plateau so the children can join
- Outdoor toilet – create direct access from playground to toilet
- Crib space – create outdoor spaces for prams where the nursery children can sleep
- Cultural centrum – create a place for cultural meetings outside the building's opening hours

PROBLEM FORMULATION

How to create an inspiring Sustainable Integrated Day Care Centre at Stigsborg Havnefront, that provides the framework for children to grow up in a healthy and safe environment, with a lot of possibilities to learn and develop, and at the same time have focus on sustainability and indoor climate without losing user experience?

VISION

The vision is to design a Sustainable Integrated Day Care Centre located at Stigsborg Havnefront. With its unique location, it must take advantage of the surrounding qualities. The centre should be stimulating and have a safe and inspiring atmosphere, that motivate the children to learn and develop through different activities and playful spaces, both inside and outdoor. The aim is to create a building in relation to the users' wishes and needs. A great focus will be on sustainability, both according to sustainable qualities, but also the children's learning about sustainability.

DESIGN PROCESS

INTRODUCTION

The analysis phase forms the basis for the design phase. Based on studies of the site, user and sustainability, the design process begins.

This chapter includes development of the concept and plans, material investigations, construction, spatial experiences, daylight, indoor climate, energy consumption and development of the urban spaces.

The process of the project has come to life, by using various tools, to get a better knowledge and understanding of the spatial expressions and indoor climate of the building.

CONCEPT DEVELOPMENT

Based on the initial problem, the analysis, as well as the design basis, the design process begins with the development of different concepts. Common to all, a special focus will be on a centrally located common room, which should act as the heart of the building. From here there must be direct access to activity rooms, kitchen, staff area and wardrobes, from which there must be direct access to group rooms, toilets and playground.

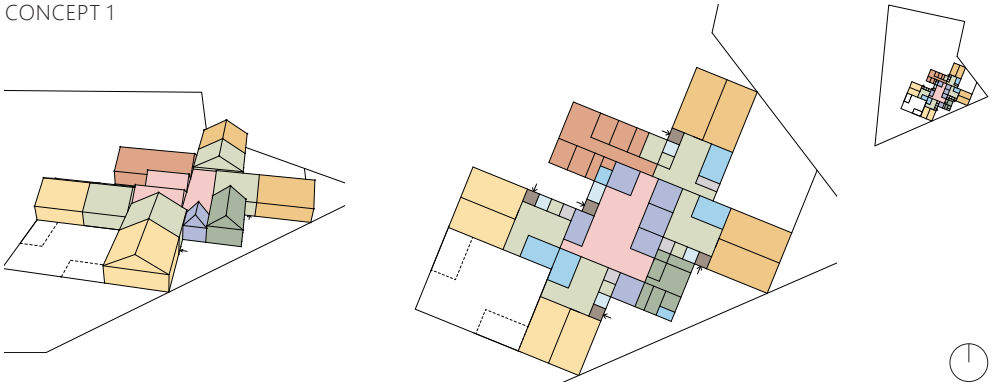
CONCEPT 1
The building appears as several houses protruding from the central common room of lesser appearance. The various activity rooms are in the common room. The focus has been on views from, and space around the group rooms.

CONCEPT 2
The inspiration is a smaller village. The concept appears as a children's village, with a centrally located common room, protruding from the center, like a church in a village. The shape of the houses is inspired by the way children draw houses – rectangular with pitched roofs.

There is direct access and views to the park through the activity rooms. Smaller intimate playgrounds have been created between the group rooms, with direct access from the wardrobes. Furthermore, a common kitchen is in the middle of the common room, to create a central meeting space in the building.

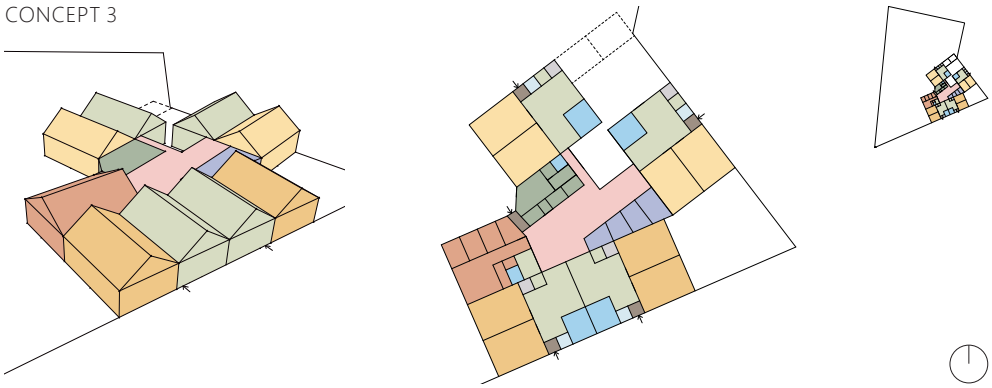
CONCEPT 3
The structure originated from a block but has ended up as rows of harbor houses. A smaller playground is pulled into the common room, which reinforces the connection between inside and out. In this concept, there is not direct access to playground from all wardrobes.

CONCEPT 1



CONCEPT 2

CONCEPT 3



- Entrance
- Nursery group room
- Kindergarten group room
- Common room
- Wardrobe
- Kitchen
- Staff area
- Activity room
- Crib space
- Toilet
- Guest toilet (handicap)
- Technical room

Ill. 53. Concept 1-3 | 105

CONCEPT 4
The shape of the building is inspired by a flower, which creates a playful floor plan. The focus has been on views from, and space around the group rooms. Both the nursery and kindergarten have their own activity room and playground with activities aimed at the user's age.

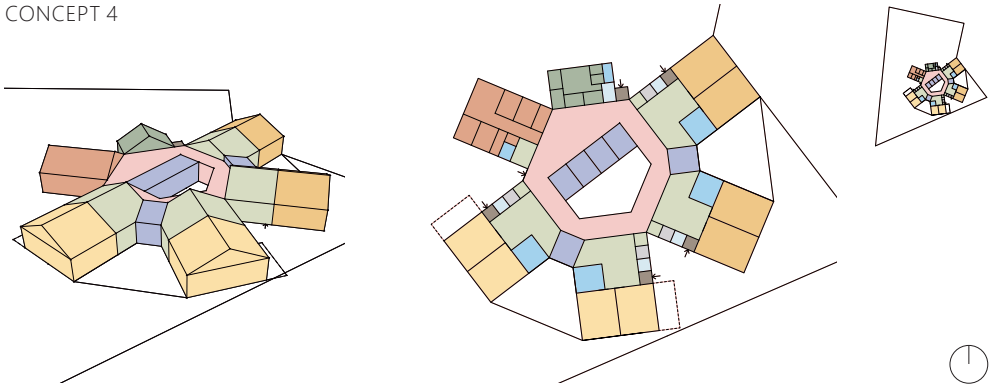
Central in the building is an inner courtyard which connects inside and out. The hallway created around the inner courtyard leads the users to the common room in which the kitchen, activity rooms and staff area are located.

CONCEPT 5
The design of the building is inspired by the park and its industrial history. It is intended that the small paths connecting the common room with the other functions are covered with glass or a similar transparent material, to create the feeling of going outside.

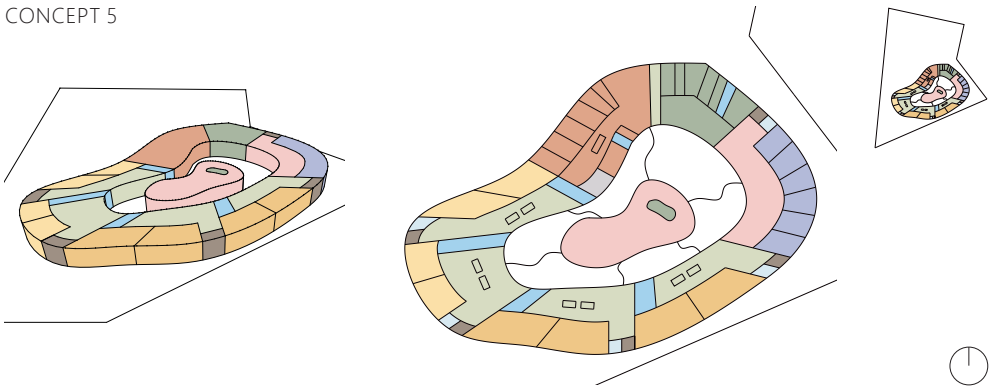
The idea is that staying in the common room should be considered as an experience. Most of the functions of the building are facing the context to create views and a relation to it.

CONCEPT 6
To follow the structure of the context, the building is located along the edge of the building site. The nursery and kindergarten have separate playgrounds for their age. The staff area is intended to be separated from the common room by lamellas, in order to make the department semi-private and create a visual connection to it. The activity rooms have view to the park and direct access to the playground for the kindergarten children.

CONCEPT 4



CONCEPT 5

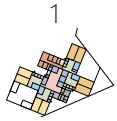
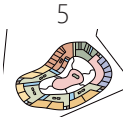
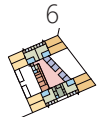


CONCEPT 6

- Entrance
- Nursery group room
- Kindergarten group room
- Common room
- Wardrobe
- Kitchen
- Staff area
- Activity room
- Crib space
- Toilet
- Guest toilet (handicap)
- Technical room

Ill. 54. Concept 4-6 | 107

SCOREBOARD - CONCEPT DEVELOPMENT

		CONCEPT 1	CONCEPT 2	CONCEPT 3	CONCEPT 4	CONCEPT 5	CONCEPT 6
							
SITE	Relation to context	2	3	3	1	3	2
	Views to context	3	3	1	3	3	2
	Outdoor qualities	3	3	1	3	3	2
	Implementing greenery	1	3	1	2	3	2
	Landmark	2	2	1	3	3	1
USER	Relation to users	3	3	1	3	1	1
	Playful and inspiring architecture	3	3	1	3	3	1
	Easy for the children to identify where they belong	3	3	2	3	1	2
	Easy to identify the function	2	3	2	3	1	1
	Connection to common room	1	3	2	2	3	3
	Flexible plan solution	2	3	1	1	2	1
SUSTAINABILITY	Social quality	2	3	2	2	3	2
	Potential for daylight	2	2	1	3	3	3
	Potential for natural ventilation	2	3	1	3	3	2
	Total score	31	40	20	35	35	25

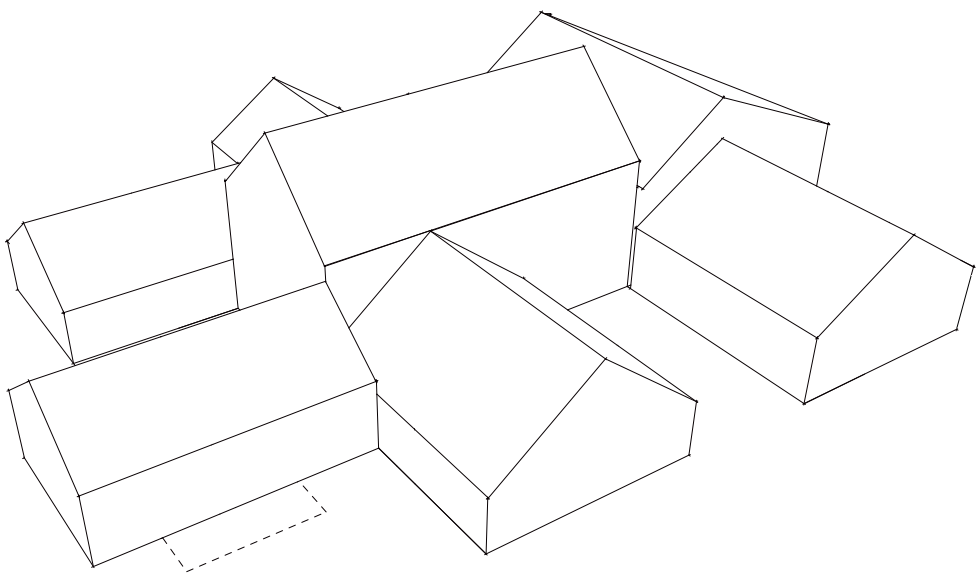
108 | Ill. 55. Scoreboard - Choice of concept

CHOICE OF CONCEPT

Based on different parameters in relation to site, user and sustainability, the concepts are evaluated in relation to each other. They have all received a score for each parameter, which ended up in a total score, which was crucial for the choice of concept.

The scoreboard shows that concept 2 performs as well as possible, on almost all parameters. Only in relation to landmark and potential for daylight it could be better, which can be improved through materials and optimization of the plan

Criteria such as relation to the user, as well as creating a creative and inspiring children universe have been given a high priority to the choice of concept. As it is in line with the vision of the new district to create an identifiable children's universe.



Ill. 56. Choice of concept | 109

PLAN DEVELOPMENT

Based on the choice of concept 2 ill. 55, the plan development could begin.

The first point was to solve the problem of the potential for daylight. Here there was a special focus on the departments to the north, where neither kitchen or the staff department had sufficient windows facing their surroundings.

STEP 1
Step 1 of the development was to add a first floor upstairs the common room, from which the staff could have a view of the common room where the children will play. By moving the staff section, a courtyard was created next to the kitchen, which was an advantage, however, the entrance was located here, so a desire to improve the quality of this arose.

Another thing was to move the toilets in the children's wardrobes, so that they were directly connected to the playgrounds, which was a wish from earlier.

STEP 2
The desired atmosphere for a monumental common room was lost at step 1, as the staff was located on a first floor in the middle of the room. To improve this, an attempt was made to move some of the functions down to the ground floor, next to the kitchen. And place the remaining functions upstairs. This gave the offices a good view of the surroundings, but unfortunately the overview from the staff department to the common room disappeared.

In addition, this proposal created a kind of alley to get to the main entrance, which was not the intention.

STEP 3
In order to maintain the qualities and improve the building, the staff department was moved upstairs to the activity rooms. This gave all the offices a good view of the surroundings including the play areas in the park, together with a great overview of the entire common room.

To improve both the arrival to the main entrance, as well as the courtyard next to the kitchen, these were swapped.

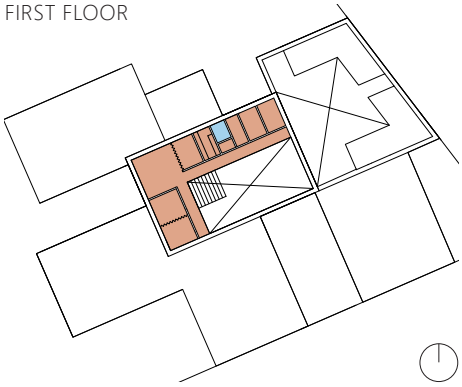
In order to improve the quality of the outdoor spaces at the playgrounds, and to improve the daylight, the group rooms were made smaller, from which some of the square meters were added to the common room.

 Ill. 57. Plan - Chosen concept

STEP 1

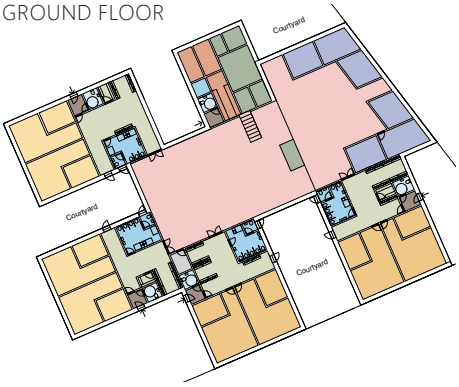
GROUND FLOOR

FIRST FLOOR

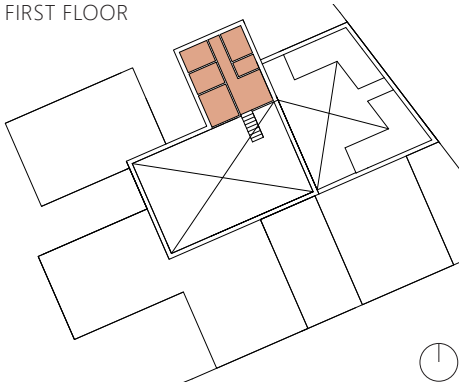


STEP 2

GROUND FLOOR

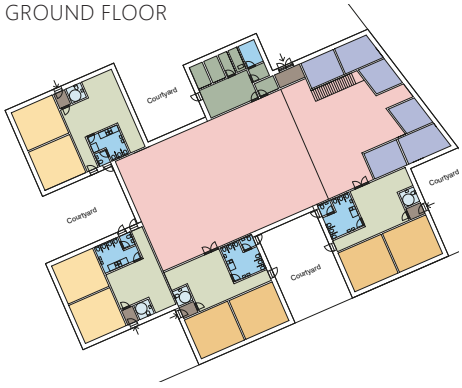


FIRST FLOOR

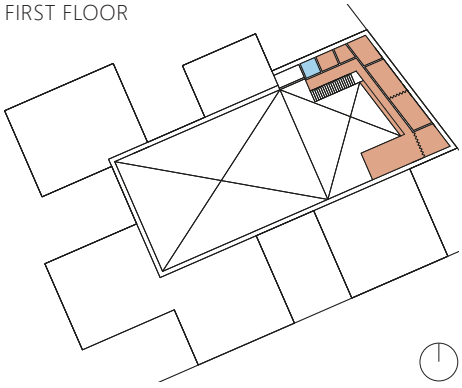


STEP 3

GROUND FLOOR



FIRST FLOOR



- Entrance
- Nursery group room
- Kindergarten group room
- Common room
- Wardrobe
- Kitchen
- Staff area
- Activity room
- Crib space
- Toilet
- Guest toilet (handicap)
- Technical room

ROOF DEVELOPMENT

The roof is an important design element of the concept, therefore it must be able to emphasize the building as a children's city, and at the same time create spaciousness and atmosphere inside the rooms. Various roof designs were then studied.

FLAT ROOF
One of the roof suggestions was the flat roof. This created a uniform facade expression and gave the impression of different sizes of boxes that were put together, and did not appear as a children's city life as desired. As the interior expression, it created a very uniform spatiality. The good thing about this roof design was, that it fit in with the future vision for the area and gave the opportunity to play with skylights inside the rooms.

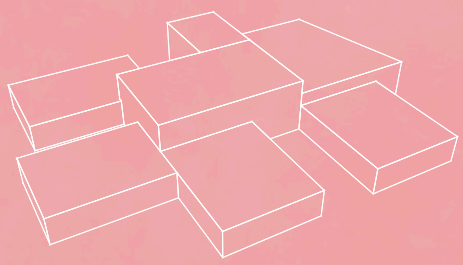
ONE ANGLE
Another roof proposal was the one angle roof. This proposal created a variety and different spatiality in the rooms. However, it did not fit either the context or the desired concept, though it created an interesting atmosphere in the interior.

CHARACTERISTIC SHAFT
This proposal created interesting spaces in the interior, where the idea was to create different heights and skylights in the rooms. This roof proposal gave an entirely different appearance and was very different from the existing context. Although it created excitingly varied interior spaces, this proposal was deselected, as it externally destroyed the concept of creating definable "children's city".

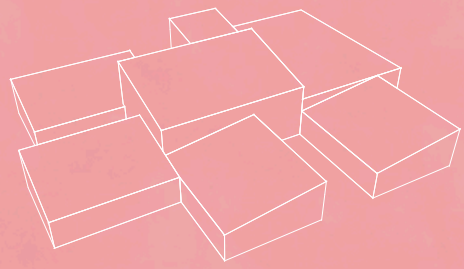
CHARACTERISTIC PITCHED
Then there was studied on different kinds of pitched roofs, to investigate various exterior and interior expressions. Hereby, was one of the investigated pitched roofs the characteristic pitched roof. This proposal created various spatiality in the rooms but differs from the coming and existing context.

PITCHED
This suggestion is the classic pitched roof, it creates different spaces and experiences inside the different rooms, according to their placement in the building. At the same time, it fits well with the existing context and the future area. The buildings with classic pitched roofs, also appears as different houses with different heights put together, which creates a children's city.

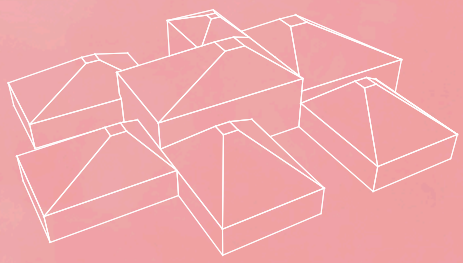
SMALL PITCHED
The last idea that was studied with pitched roofs was to create a clear interior space, which inside the group rooms also appear as pitched roofs. This proposal appears more like harbor houses instead of appearing as a children's city.



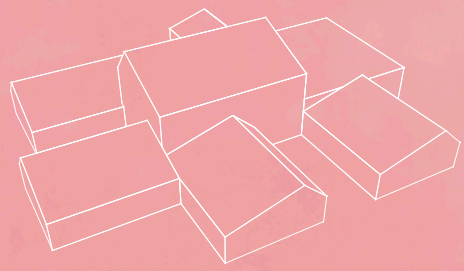
FLAT



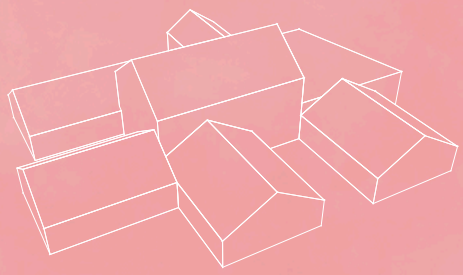
ONE ANGLE



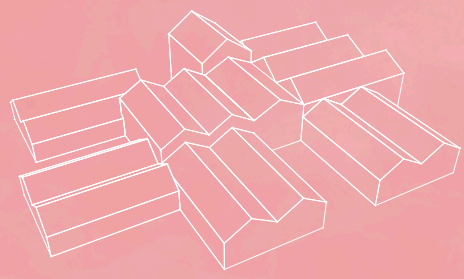
CHARACTERISTIC SHAFT



CHARACTERISTIC PITCHED



PITCHED



SMALL PITCHED

Ill. 59. Roof development | 113

SCOREBOARD - ROOF DEVELOPMENT

	FLAT	ONE ANGLE	PITCHED	CHARACTERISTIC PITCHED	CHARACTERISTIC SHAFT	SMALL PITCHED
						
Internal perception	Uniform spatiality 1	Creates spatiality 2	Creates spatiality 3	Creates various spatialities in the rooms 3	Creates a interesting atmosphere 3	Defines the rooms as houses 3
External perception	Appears as boxes 1	Uninspiring form 1	Appears as a small city 3	Appears as a small city, but does not fit into the context 2	Creates a landmark 3	Seems incomprehensible 1
Relation to the context	Fit into the vision of the future area 3	Nothing similar in the area 1	Both fit to the existing city and future area 3	Nothing similar in the area 1	Nothing similar in the area 1	Appears as habour houses 3
Relation to the users	Uninspiring form 1	Does not fit into the children universe 1	A simpel and traditionel building design 3	Does not fit into the children universe 1	Atypical form 1	A traditionel building design that defines the individuel rooms 2
Surface area	1557 m^2 3	1584 m^2 3	1804 m^2 1	1754 m^2 2	1807 m^2 1	2004 m^2 1
Potential for skylight	Possibility for play- full skylights 3	The form leads the light in 2	The form leads the light in 2	The form leads the light in 2	Good for diffuse light 3	The shape creates shade for itself 1
Potential for solar panels	Does not fit the form 1	Good to integrate in the form 3	Possibility to create the optimal angle 3	Possibility to create the optimal angle 3	Does not fit the form 1	Possibility to create the optimal angle, but less surface 2
TOTAL	13	13	18	14	13	13

114 | Ill. 60. Scoreboard - Roof development

CHOICE OF ROOF DESIGN

Various roof designs were studied, after which they were been giving a score, to compare them. The internal and external perception, the use of solar panels, the relation to the context and users, the different roof designs was taken into consideration by the choice of roof design.

The classic pitched roof was chosen, as it makes the building appears as a children's village very well, while it seems as small houses put together. The classic pitched roof also creates a very child-like design, which is inspired by the way children draw houses. At the same time, the design creates various spatiality inside the building. Furthermore, the roof fit well with the upcoming and existing context and was an optimal choice for both the concept and the use of solar panels and collectors.

EXTERNAL MATERIALS - ROOF & FACADES

This section studies various exterior materials in relation to the roof and facades of the institution. The materials have already been examined during the analysis phase but are now compared in terms of their life cycle, construction and visual experience.

It is important that the chosen materials meet the requirement to be sustainable in relation to LCA, ensures a good building envelope with a low U-value, that the materials are natural, and that they meets the criterion of creating an inspiring and creative children's universe, where children can identify with the building and its functions.

LIFE CYCLE ASSESTMENT – LCA & CONSTRUCTION

It has been chosen to make a lightweight construction in wood, since LCA shows that it performs better compared to a heavy concrete construction. The choice also makes it easier to separate and reuse the construction, when the building needs to be disposed sometimes in the future.

In terms of insulation, eelgrass is chosen over paper wool, as it has a longer lifespan, is 100% natural and at the same time contributes to a better indoor climate.

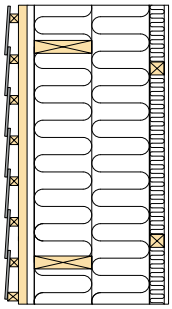
What interior material to use is not yet determined, this requires a more visual experience, which will be studied later in this report, for the wall construction examples on next page, plaster boards are used.

The choice of façade material depends on many factors, as shown on ill. 61 the façade materials: slate, brick, wood and Rockpanel are compared to each other in the tool LCA. They are compared to global warming potential – GWP, ozone depletion – ODP and the primary energy in total – PEtot. The illustration shows that slate performs best, it has the lowest impact on all three parameters.

SLATE FACADE

10 mm slate
60 mm ventilation cavity with 30x30 mm spacing lists
25 mm wood fibre board (wind barrier)
200 mm eelgrass, 50x100 rafters, CC 750
200 mm eelgrass, 50x100 rafters, CC 750
2 mm vapour barrier
50 mm eelgrass, 45x50 spacing list, CC600
15 mm plaster board

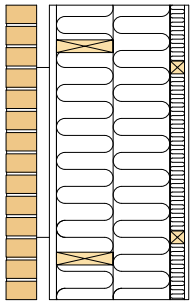
Thikness = 562 mm
U-value = 0,084 W/m^{2}K



BRICK FACADE

108 mm brick
45 mm ventilation cavity with wall ties
25 mm wood fibre board (wind barrier)
200 mm eelgrass, 50x100 rafters, CC 750
200 mm eelgrass, 50x100 rafters, CC 750
2 mm vapour barrier
50 mm eelgrass, 45x50 spacing list, CC600
15 mm plaster board

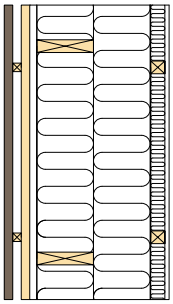
Thikness = 645 mm
U-value = 0,083 W/m^{2}K



WOOD FACADE

30 mm wood cladding
60 mm ventilation cavity with 30x30 mm spacing lists
25 mm wood fibre board (wind barrier)
200 mm eelgrass, 50x100 rafters, CC 750
200 mm eelgrass, 50x100 rafters, CC 750
2 mm vapour barrier
50 mm eelgrass, 45x50 spacing list, CC600
15 mm plaster board

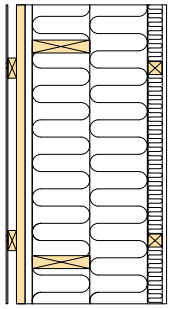
Thikness = 582 mm
U-value = 0,083 W/m^{2}K



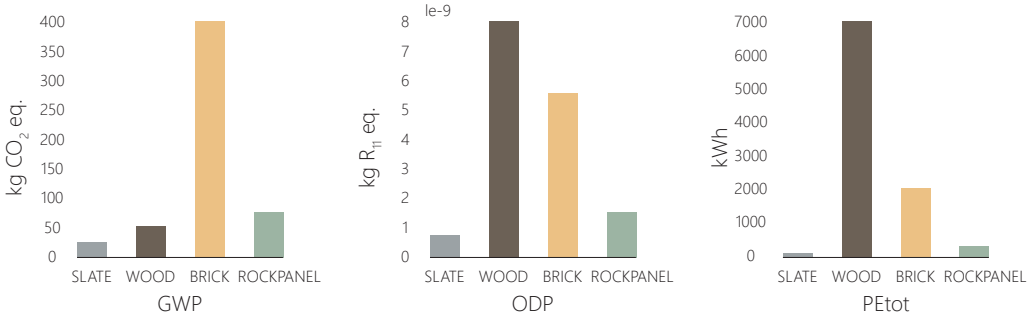
ROCKPANEL FACADE

6 mm rockpanel
60 mm ventilation cavity with 30x30 mm spacing lists
25 mm wood fibre board (wind barrier)
200 mm eelgrass, 50x100 rafters, CC 750
200 mm eelgrass, 50x100 rafters, CC 750
2 mm vapour barrier
50 mm eelgrass, 45x50 spacing list, CC600
15 mm plaster board

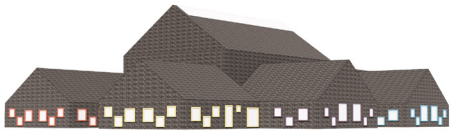
Thikness = 558 mm
U-value = 0,084 W/m^{2}K

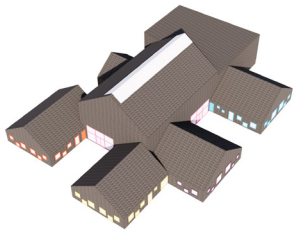


LCA



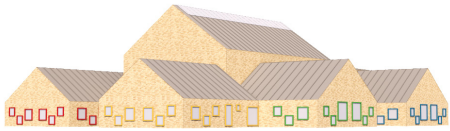
PROPOSAL 1

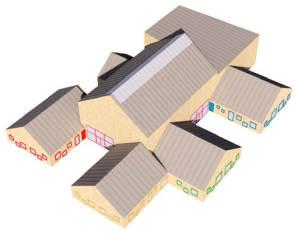




ROOF: SLATE
FACADES: SLATE

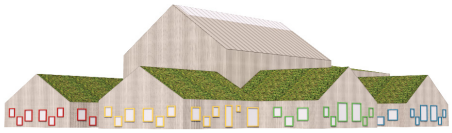
PROPOSAL 2

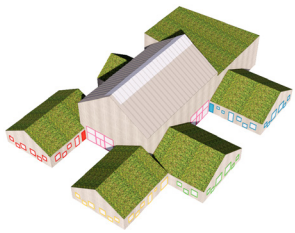




ROOF: STEEL
FACADES: BRICKS

PROPOSAL 3



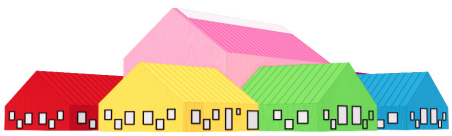


ROOF: GREEN
FACADES: WOOD

PROPOSAL 4

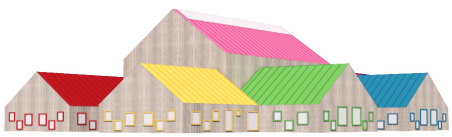
ROOF: ROCKPANELS
FACADES: ROCKPANELS

PROPOSAL 5



ROOF: STEEL
FACADES: PAINTED WOOD

PROPOSAL 6



ROOF: STEEL
FACADES: WOOD

VISUAL EXPRESSION

The visual experience of the building is very important in the selection of exterior materials.

At proposal 1, both roof and facades are covered with slate. This material makes the building appear very uniform. As it is a dark material, it is neither welcoming or child-friendly, which is contradictory to the vision.

Proposal 2 appears very bright and natural. The coloured elements, such as windows and doors, creates a certain dynamic that makes it easy for the children to see, which building they belong to, since each building has its own coloured elements. The building lives up to the vision for the future district, to emerge as a brick town.

At proposal 3, the intention was to use materials that appears as natural as possible, with raw untreated wood and a green roof. The disadvantages of these materials are, that the wood over time becomes ugly, as the Danish climate is not the best for optimal and beautiful patination, while at the same time preventing the green roof, the possibility of collecting and recycling the water.

At proposal 4, the entire building is covered with Rockpanel colour plates. The building is very colourful, and there is no doubt that it is a place for children. However, the materials are not suitable as roofing material, why this option is not possible.

Proposal 5 consists of painted steel roof and painted wooden facades. With this proposal, the colourful expression is obtained as with proposal 4. It creates a certain transparency in the building, that it has a wooden structure and at the same time is covered with wood. In the future, the painted wood will be easy to maintain, as it simply must be painted.

At proposal 6 was the thought that it should be the perfect balance between colourful elements in the form of roofs, windows and doors, while at the same time preserving the natural look the wood provides. However, it did not produce the same effect and atmosphere as proposal 5.

CHOICE OF EXTERNAL MATERIALS

Based on the various criteria, the choice of proposal 5 ended as the final exterior materials for the institution. Having considered the different proposals against each other, this one is decided to be the best solution. Despite the slate performed better in LCA, the visual experience is weighted higher, why painted wood is chosen instead.

The concept scored only 2 on the landscape parameter p. 108, but with this material selection the concept achieves a score of 3. This is because it differs from the context, in a positive way, it manages to attract people. As a plus the universe can clearly be spotted from Aalborg.

MATERIALS & CONSTRUCTION - COMMON ROOM

The idea behind the common room is, that it should have a clear monumental character with a large high ceiling space and visible construction. The common room must stand out clearly both on the exterior and in the interior by its choice of size, design and materials.

Spatial expression is done with different materials and varying amount of visible construction, to study the atmosphere and visual expression of the space inside the common room.

Different rafter designs have been studied for the ceiling, to have a visual idea of which rafter construction, that creates the desired visual impression of the common room. Further, it has been studied whether the construction should be visible on the walls or not. The different rafter structures have been studied with both wooden board and Troldtekt on the ceiling.

The rafter construction shown on the last illustration, has been chosen in conjunction with the Troldtekt ceiling. Since the Troldtekt has a lower reverberation time than wooden boards and will thus be a good choice in relation to the acoustics. Troldtekt is also a lighter material than wooden boards, why it is also a good choice in relation to daylight, that its experienced lighter in the room.

Based on the cleaning of the common room and the visual expression, the visible construction on the walls is deselected. The visible barrier construction in the ceiling creates a better and cleaner visual impression of the room and creates a definable atmosphere.

WALLS: VISIBLE RAFTERS

WALLS: HIDDEN RAFTERS

CEILING: WOOD VISIBLE RAFTERS

CEILING: WOOD SEMI-VISIBLE RAFTERS

CEILING: TROLDTEKT VISIBLE RAFTERS

CEILING: TROLDTEKT SEMI-VISIBLE RAFTERS

MATERIALS - GROUP ROOMS

Various materials in the group rooms have been studied in relation to the user, the atmosphere in the room, and the acoustic skills of the materials. The acoustics and possibility to easy cleaning of the surfaces of the materials, were weighted very high during the choice of materials.

At the ceiling materials such as plaster boards, wooden boards with visible lamellas, acoustic wooden boards and Troldtekt was studied. Both the aesthetic, acoustic and daylight of the materials was taken into consideration. Based on this Troldtekt was chosen, as it has the best acoustic properties, and creates a better daylight level in the room.

On the walls, it is intended that one of the walls should be covered with OSB boards, so the children can draw on them and make the rooms personal. The boards are both easy and cheap to replace, when they need to be changed. On the remaining walls the idea was to use plaster boards, as it creates a clean surface and good daylight level in the group rooms.

On the floor, linoleum was chosen as it is a very durable material, has a good acoustic property, and is easier to clean than wooden floor. Furthermore, linoleum creates a more child-friendly atmosphere that invites them to play, which also allows the use of different colours to create different moods in the room. At the same time, linoleum provides the opportunity to divide the room into different zones, by using different colours that allows the children to be divided into smaller groups, so that they can be more focused on their activity.

WALLS: PLASTER BOARDS (ONE PAINTED) FLOOR: WOOD

WALLS: PLASTER BOARDS FLOOR: LINOLEUM

CEILING: PLASTER BOARDS

CEILING: VISIBLE RAFTERS & WOODEN BOARDS

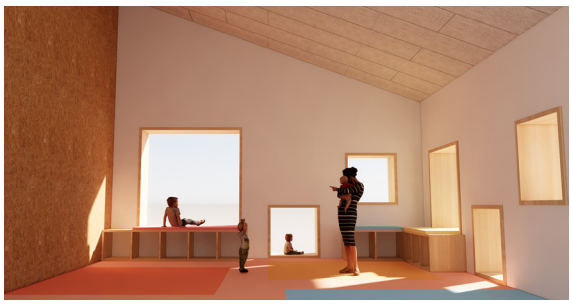
CEILING: ACOUSTIC LAMELLAS

CEILING: TROLDTEKT

CEILING HEIGHT - GROUP ROOMS

To find the optimal room height that creates a safe, spatial and playful environment for the children, both in the nursery and kindergarten, different room heights have been studied. Hereby both ceiling heights of 0°, 10°, 20° and 30°. As seen at the spatial expressions ill. 65 the ceiling heights of 0° and 10° creates a more child-friendly atmosphere for the children, where they can retreat into. The ceiling height of 0° was chosen, as it defines the room more in relation to the children´s scale. It also emphasizes the difference between the big social common room, where there is high to the ceiling. And the smaller and more private and intimate group rooms, where there is low to the ceiling.

30°



20°

10°

0°

WINDOWS - GROUP ROOMS

Windows have a great impact on the atmosphere and daylight in the group rooms. The atmosphere must be safe, playful and allow the children to retreat into their own corner. Thereby, different window sizes and designs have been investigated, to look at different spatial and atmospheric experiences that the window designs create.

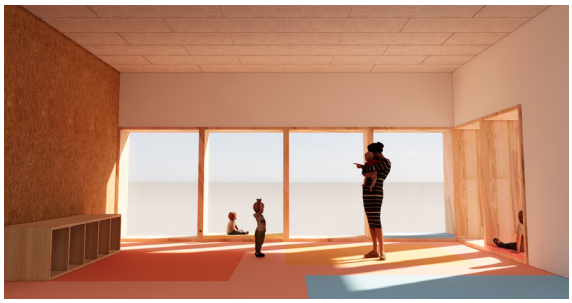
The idea of the window designs was to create sitting niches for the children, that allows a good view to the outside and a satisfactory level of daylight inside the rooms. Below, various windows have been examined.

On ill. 66 the idea was that the windows should covering the entire wall, where the intension was to create direct access to the courtyard from the group rooms. This proposal was deselected, as it is not possible to establish direct connection to the outdoor space, from all group rooms due to their placement, which in some way would make different quality of them. Further, this would not be hygienic as the children would come into the group rooms with their dirty and muddy clothes and shoes.

Another proposal shown on ill. 67 was a combination of sliding doors with square window frames, with built-in furniture. This proposal was deselected too, as the size and design of the windows did not fit into the children scale, they also create a very uniform spatiality, and again, the hygiene aspect of dirty clothes and shoes.

Subsequently, there was studied on large window niches as shown on Ill. 68, where sliding doors and connection from the group room to the outdoor areas were deselected. In terms of window size, the windows still feels too big in relation to the children height and scale. Thus, further work was done on sizing and location of the windows, as this proposal still did not fit into the group rooms.

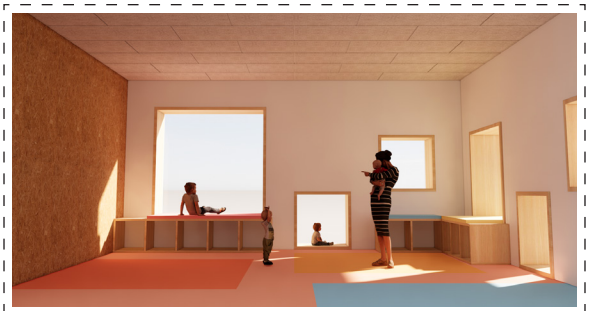
Then a grid-system was created on ill. 69, to divide the windows in a system but still make them look randomly placed. The grid-system divide the walls into smaller square windows, which creates a variation in the rooms and gives possibility for small niches that the children either can sit in or crawl into. This proposal was chosen, as it fits better to the children scale and creates a more childish atmosphere in the group rooms. The design and sizes of the windows creates a playful space both inside the rooms and outside at the façade which fits to the user.



Ill. 66. Windows covering the entire wall

Ill. 67. Combination of sliding doors and square window

Ill. 68. Large window niches



Ill. 69. Windows in grid-system

WINDOWS - COMMON ROOM

The common room is the monumental space in the building, that acts as the heart of the building that connects all the functions. The desire for the common room is to emerge and differ with its window layout from the remaining associated building unit. Various designs of windows for common room have been investigated, to define the height of the room. Good view to the courtyards and the daylight level in the common room was weighted high, during the evaluation of the different windows.

Thereby was the idea of the window designs in the common room, that the windows should define and express the common room. As seen on ill. 70, the first proposal was to create a view and daylight towards the outdoor areas. This proposal was deselected, as it did not define the common room while the size and height of the windows did not create the desired expression and efficient daylight in the room.

Another proposal as shown on ill. 71, was to create a window design that fit with the remaining window designs as in the group rooms. This design of the windows created a playful and atmospheric interior in the common room. The proposal was deselected as it did not give a distinct and different character to the common room, which was desired to be separated by its character from the other functions.

On ill. 72, a proposal is presented, where the design of the windows is inspired by the concept of pitched roof houses, unfortunately it creates a ceremonious atmosphere in the room, which was not intended.

The last proposal was to design a cleaner high ceiling windows, that define the height of the room and follow the visible rafters in the ceiling, as seen on ill. 73. This proposal was chosen, as it creates a warmer and more definable atmosphere of the common room. In addition, the daylight level was also better in this window proposal, compared to the others.

Ill. 70. Standard size window frames

Ill. 71. Playful windows in grid-system

Ill. 72. Pitched windows

Ill. 73. Characteristic windows

SKYLIGHTS - ACTIVITY AREA

The skylights in the activity area are an important characterizing element that defines the atmosphere of the room, which also helps to create the transition between the common room and the activity area. Thereby various skylight proposals to the activity area have been experimented, where both the aesthetical experience and daylight was taken into consideration. The daylight factor was studied, by simulate the various skylight proposals in VELUX Daylight Visualizer, ill. 74.

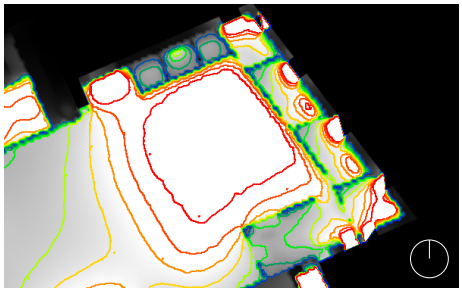
Different proposals were tried out to find the best solution, that helps to create the transition between the buildings. As seen on the illustrations, a vertical and horizontal skylight was tried out. They create a more direct light incident in the activity room.

The aim was to create a more playful light in the room, why a diagonal and random placed skylight was studied. The random placed skylight was chosen, as it matches the playful window placement at the building. They also create a playful light incidence in the activity area and was the proposal that creates the best daylight level in the room.

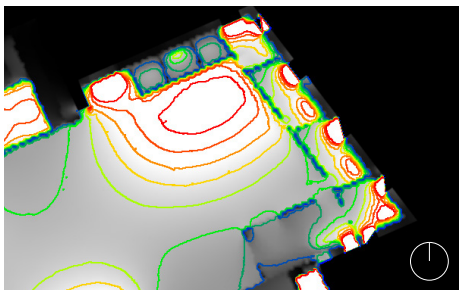
VISUAL EXPRESSION

DAYLIGHT - FIRST FLOOR

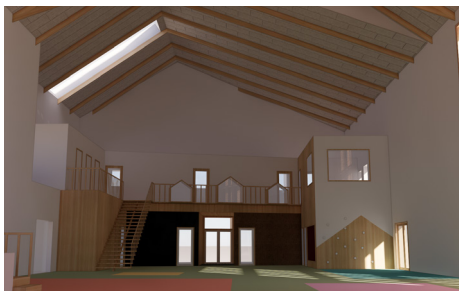
RANDOM

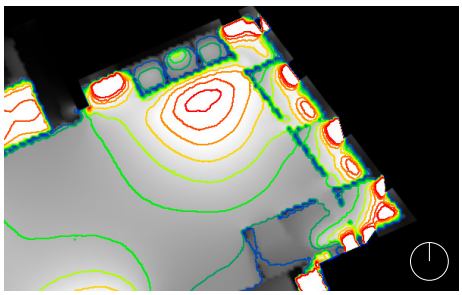


HORISONTAL

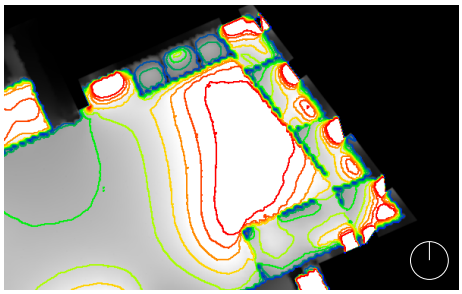


VERTICAL





DIAGONAL



Ill. 74. VELUX Daylight Visualizer | 131

DAYLIGHT

The placement of windows and the use of interior materials in the building, have a major role for the daylight level. In order to approve that the daylight conditions in the building are sufficient, analysis are made of the daylight throughout the building with the tool VELUX Daylight Visualizer for the final windows.

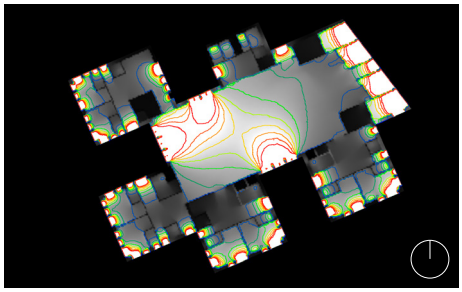
Whitout skylights the daylight level was not sufficient in the wardrobes and toilets, which are some important learning spaces for children, and thus must have good daylight level both during summer and winter. The daylight level in the activity area also needed more daylight. Thus, there have been studied at skylights in these rooms. This both creates different moods and atmospheres in the rooms, and at the same time it also provides a better daylight level in the rooms.

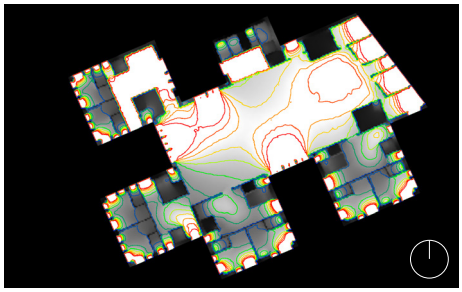
With the use of skylights, the daylight level in the rooms became much better. The skylights also give architectural and mood-related qualities to the building.

÷ SKYLIGHTS

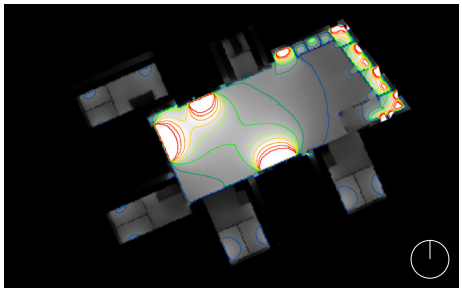
+ SKYLIGHTS

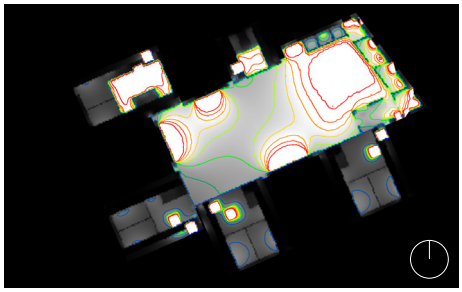
GROUND FLOOR SUMMER



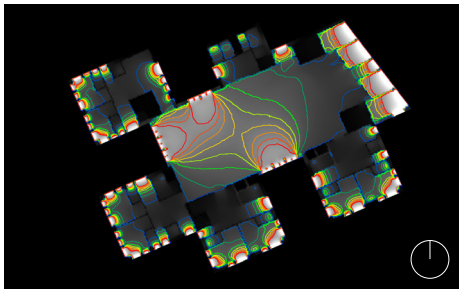


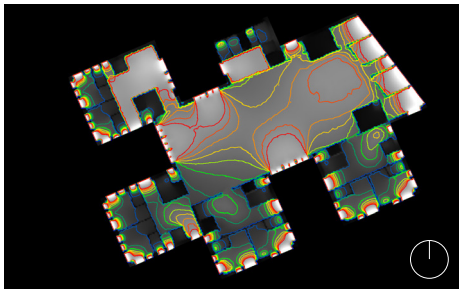
FIRST FLOOR SUMMER



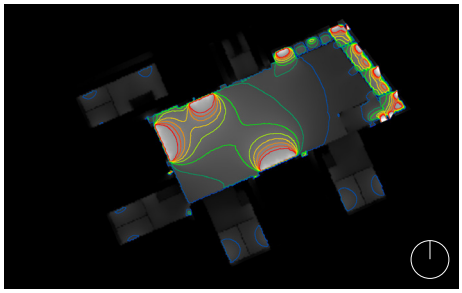


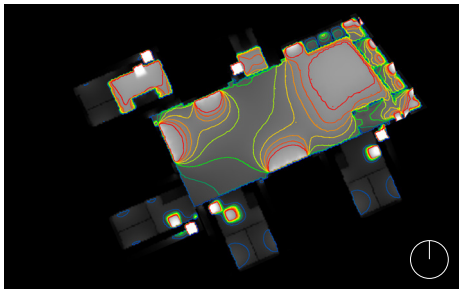
GROUND FLOOR WINTER





FIRST FLOOR WINTER





BSIM

When designing a day care centre, the indoor climate conditions are a very important element. To ensure that the children and staff have a good indoor climate, the simulation tool BSim has been used. By using the simulation tool BSim, it is possible to calculate different aspects of the indoor environment as: the indoor temperature, CO_2-level, humidity in the rooms etc. BSim is used to check if the chosen materials and windows are sufficient for the indoor climate. The critical north-facing group room in the nursery cluster and the critical south-facing group room in the kindergarten cluster, as well as the common room, were analyzed in BSim, to investigate the indoor climate conditions.

ATMOSPHERIC INDOOR CLIMATE

The indoor environment has been calculated both for the most critical group rooms, and for the common room, as it has big south exposed windows and varies in people load throughout the day. The temperature of each rooms is analyzed for the most critical day in summer and winter. Humidity is one of the most unpredictable factors and hard to control. The humidity must be between 25 – 65 % (Arbejdstilsynet, 2018) to maintain a satisfactory humidity, and to avoid mold. One way to achieve a higher humidity could be to ventilate less, but this will create higher temperatures. In summer, natural ventilation is used to maintain a satisfactory humidity.

The CO_2-concentration were also analyzed in these rooms. As seen in the graphs, the level of CO_2 peaks when the amount of people is higher in the common room and group rooms. The level of CO_2-concentration never reaches its maximum, as mechanical ventilation is applied. In the summer, the CO_2-concentration will be lower, as the air flow is increased by using natural ventilation, and because the children are outdoor more of the time.

THERMAL INDOOR CLIMATE

In order to have a satisfactory temperature in the day care centre, the temperature must be between 20-22 °C (Arbejdstilsynet, 2018). To achieve this temperature in the rooms, two ventilation units have been chosen in the building, which must ensure a satisfying indoor climate in the building. This makes it possible to use the CAV-system, as it is a cheaper alternative in long term, as the number of people who loading the building throughout the day is known.

The critical time for the temperature will be in the summer, as the outdoor temperature is higher. In order to maintain a reasonable temperature, a combination of mechanical and natural ventilation will be used, which helps reduce overheating in the rooms. As seen on the temperature diagrams p. 78, 80 and 82, the indoor temperature will decrease using natural ventilation as it complements mechanical ventilation when the temperature achieves 24 °C or above.

Looking at the temperature for winter, floor heating is connected to obtain a satisfactory temperature in the rooms. Floor heating is an energy-friendly heat source, it is switched on all year but regulates the heat so that there is 20 degrees inside the rooms. The floor heating consists of a thermostat that measures how warm the room is. When the room temperature exceeds 22 degrees, the floor heating does not emit heat to the room, as there is no heat demand. This can be used to reduce heat in the summer via floor heating control, so that no unnecessary energy is used in the summer, as the building is heated by solar rays. Furthermore, the floor heating has a passive cooling system, which acts as cooling during the summer months, which can reduce the temperature in the rooms.

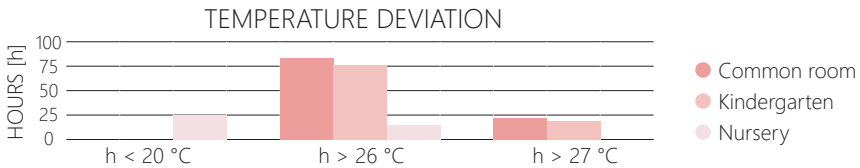
Humidity:
RH = 25 – 65 %
Summer: RH < 65 %
Winter: RH < 45 %

CO_2-concetration < 1000 ppm

Temparature:
Summer: 23.5 ± 2 °C – 24.5 ± 1 °C
Winter: 20 ± 1 °C – 22 ± 2.5 °C

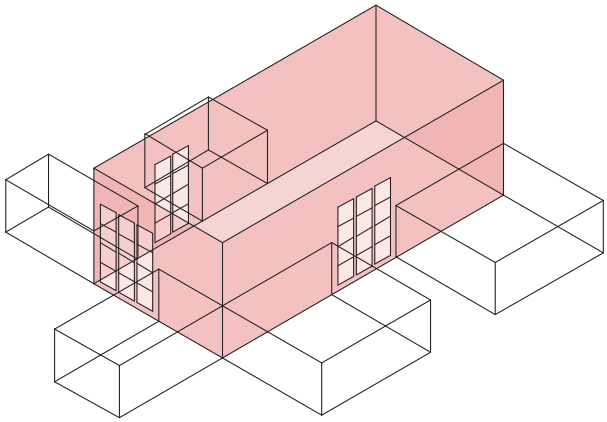
Excess heat:
Max. 100 h > 26 °C
Max. 25 h > 27 °C

Chosen days:
Summer: June 21th 2010
Winter: December 21th 2010

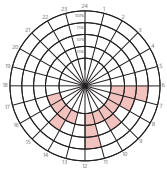


Ill. 76. BSim - Temperature deviation | 135

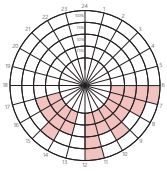
BSIM - COMMON ROOM



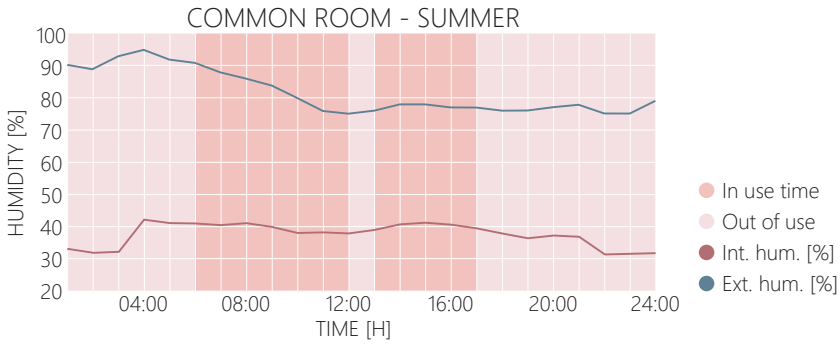
COMMON ROOM

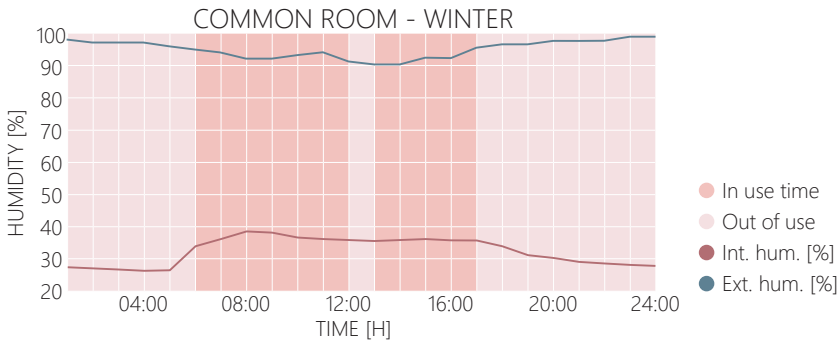


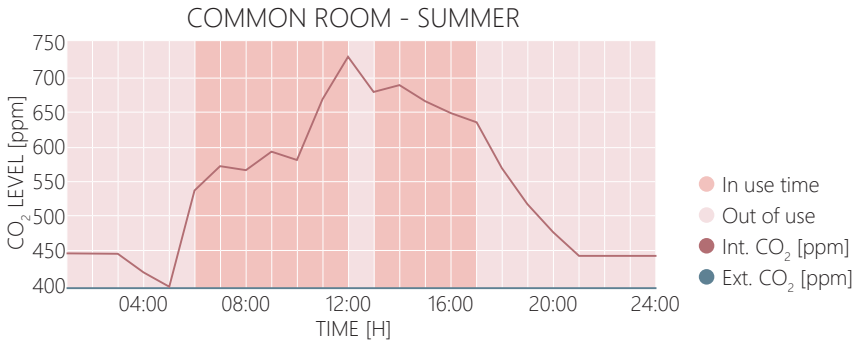
SUMMER

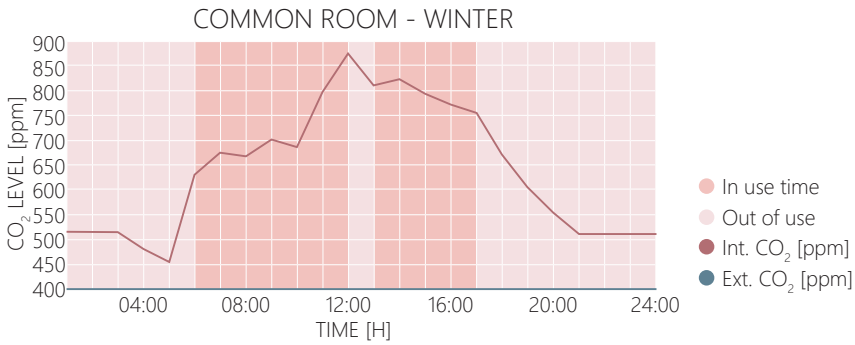


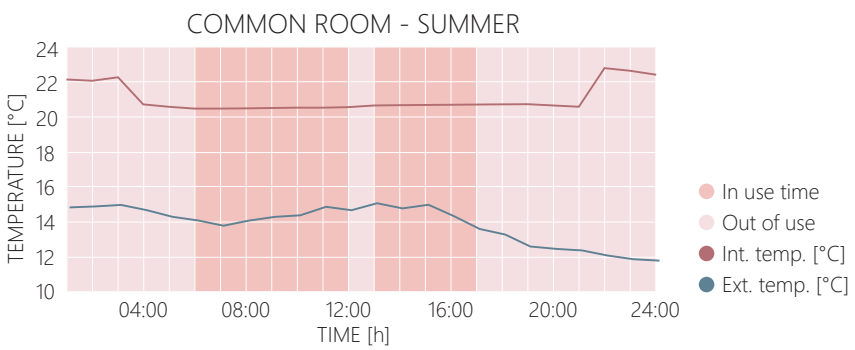
WINTER

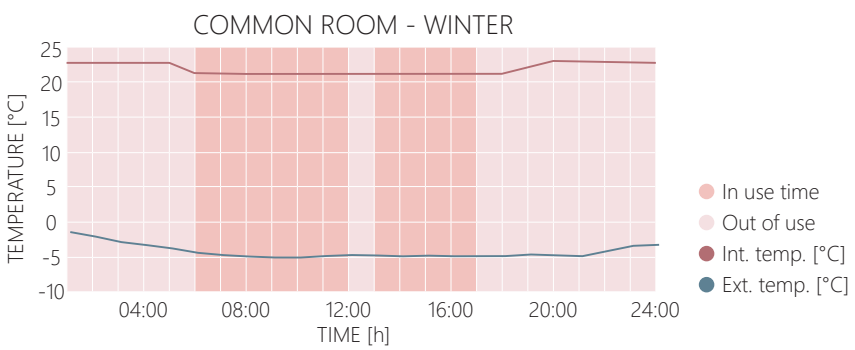




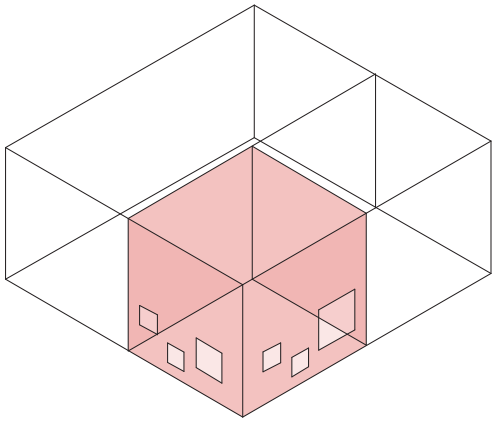

COMMON ROOM - SUMMER
CO_2 LEVEL [ppm]
750
700
650
600
550
500
450
400
04:00
08:00
12:00
16:00
20:00
24:00
TIME [H]
In use time
Out of use
Int. CO_2 [ppm]
Ext. CO_2 [ppm]


COMMON ROOM - WINTER
CO_2 LEVEL [ppm]
900
850
800
750
700
650
600
550
500
450
400
04:00
08:00
12:00
16:00
20:00
24:00
TIME [H]
In use time
Out of use
Int. CO_2 [ppm]
Ext. CO_2 [ppm]

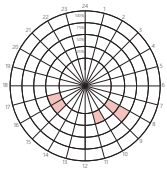

COMMON ROOM - SUMMER
TEMPERATURE [°C]
24
22
20
18
16
14
12
10
04:00
08:00
12:00
16:00
20:00
24:00
TIME [h]
In use time
Out of use
Int. temp. [°C]
Ext. temp. [°C]


COMMON ROOM - WINTER
TEMPERATURE [°C]
25
20
15
10
5
0
-5
-10
04:00
08:00
12:00
16:00
20:00
24:00
TIME [h]
In use time
Out of use
Int. temp. [°C]
Ext. temp. [°C]

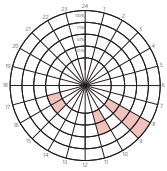
BSIM - KINDERGARTEN GROUP ROOM



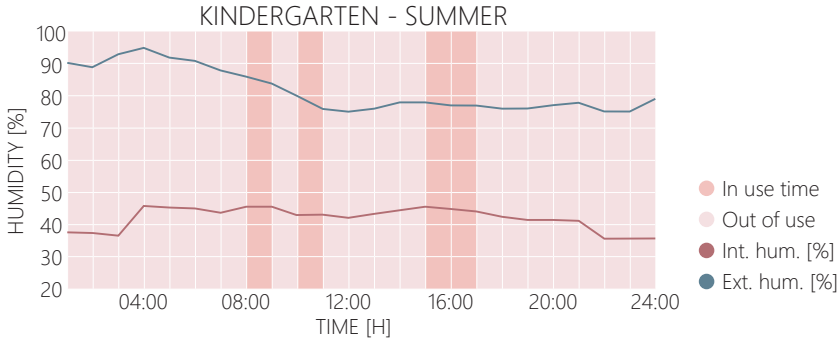
KINDERGARTEN - GROUP ROOM

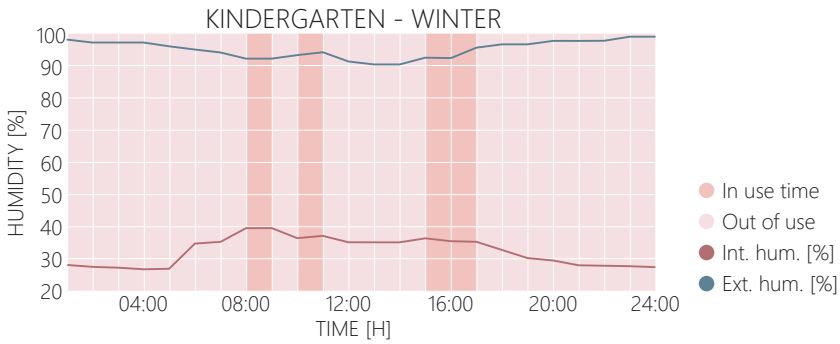


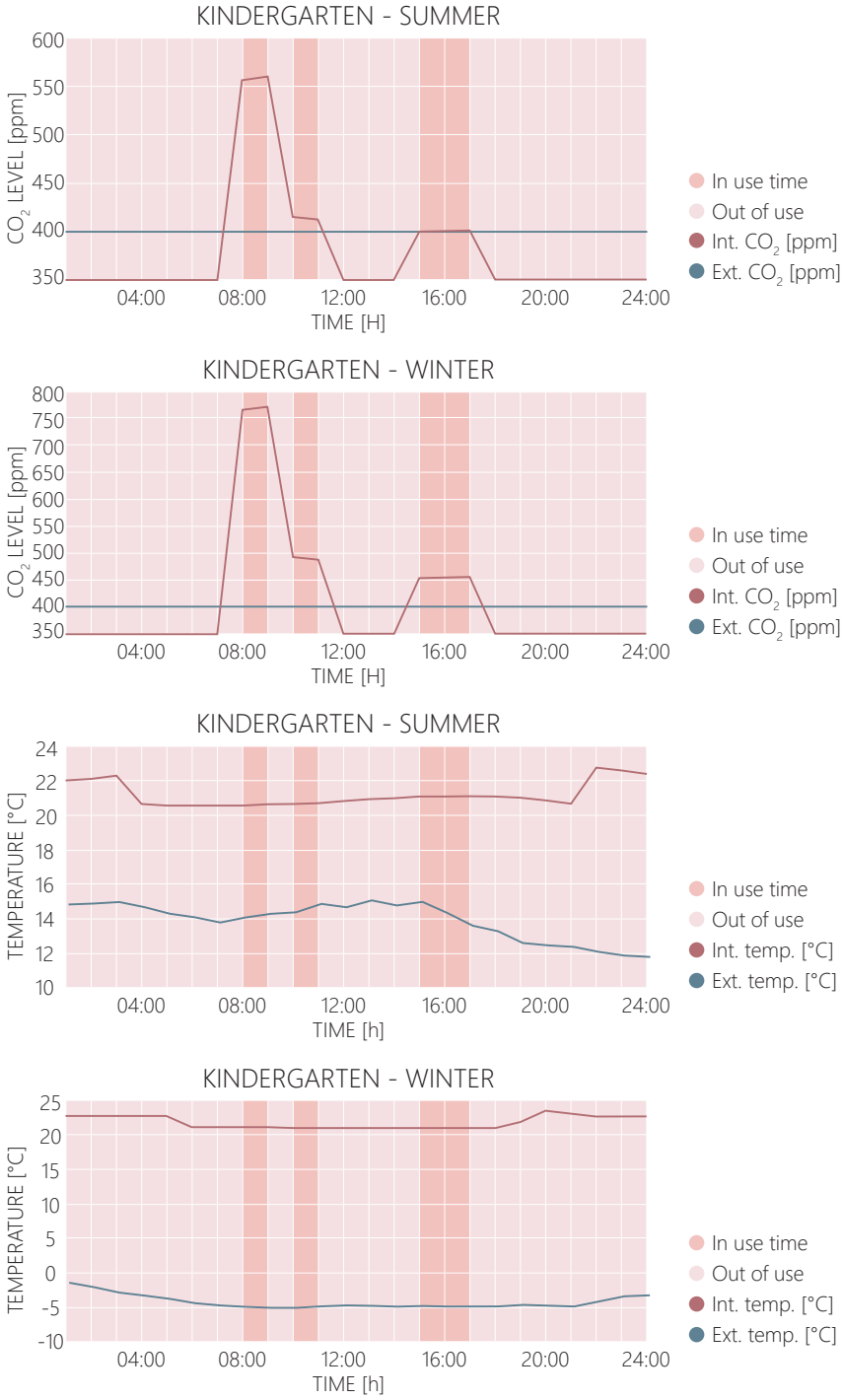
SUMMER



WINTER

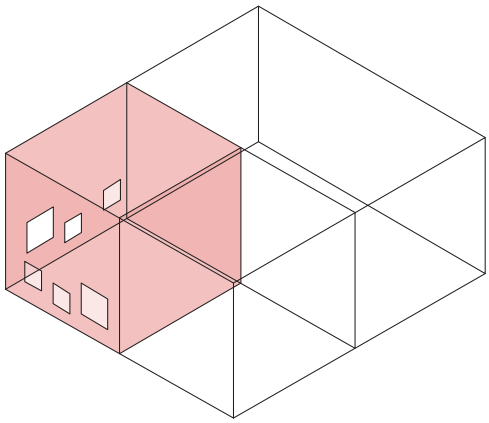




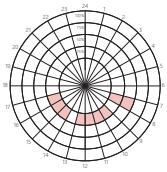


Ill. 80. BSim - Kindergarten group room | 139

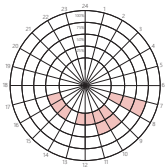
BSIM - NURSERY GROUP ROOM



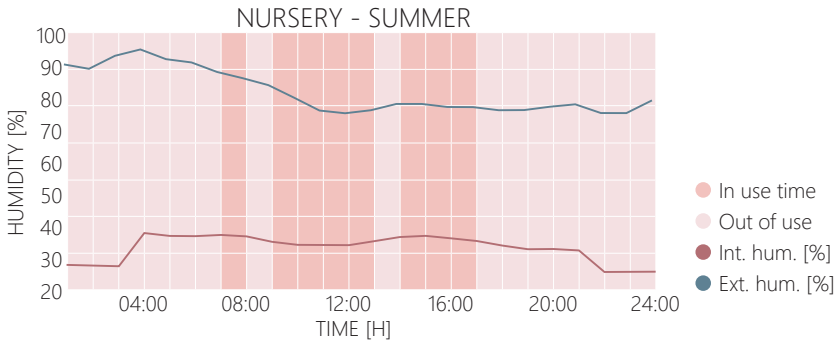
NURSERY - GROUP ROOM

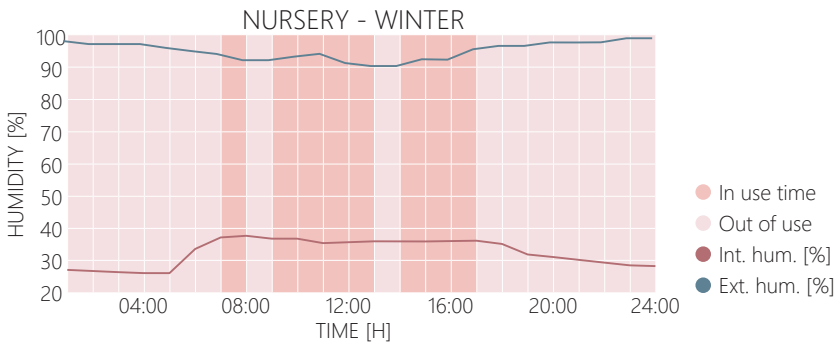


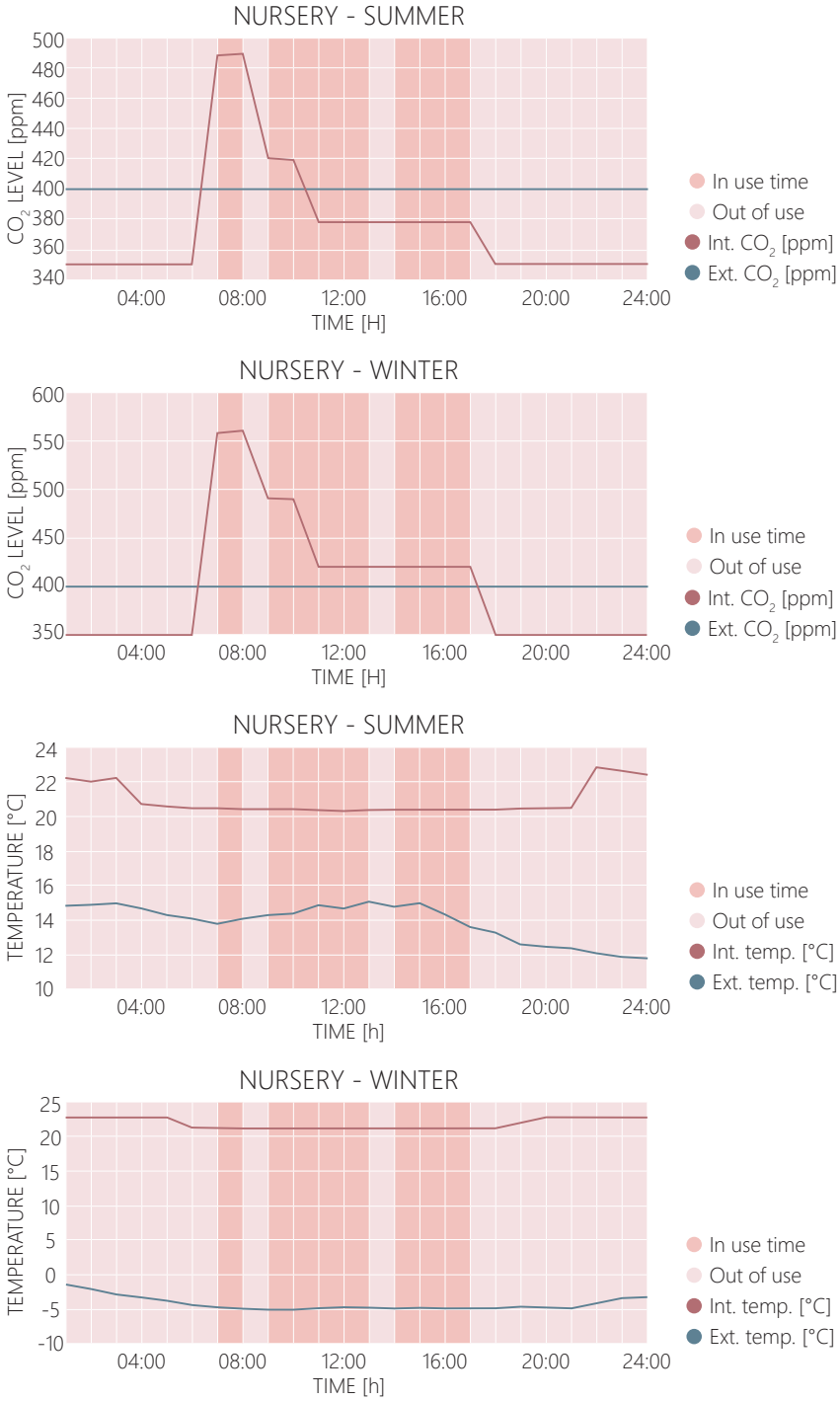
SUMMER



WINTER







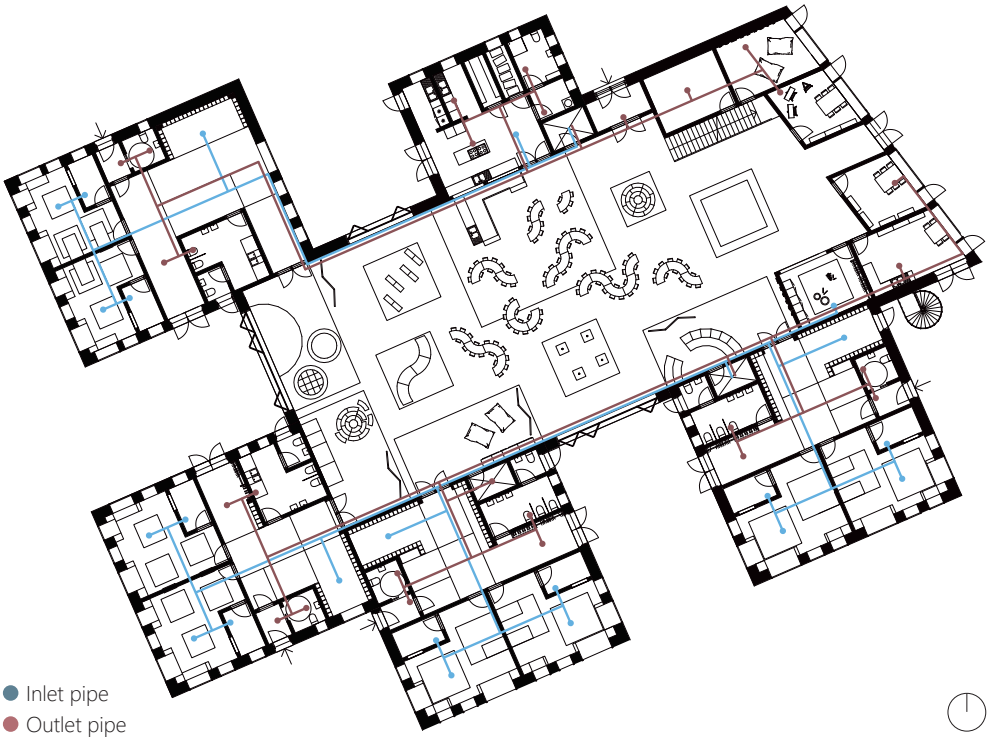
Ill. 82. BSim - Nursery group room | 141

MECHANICAL VENTILATION STRATEGY

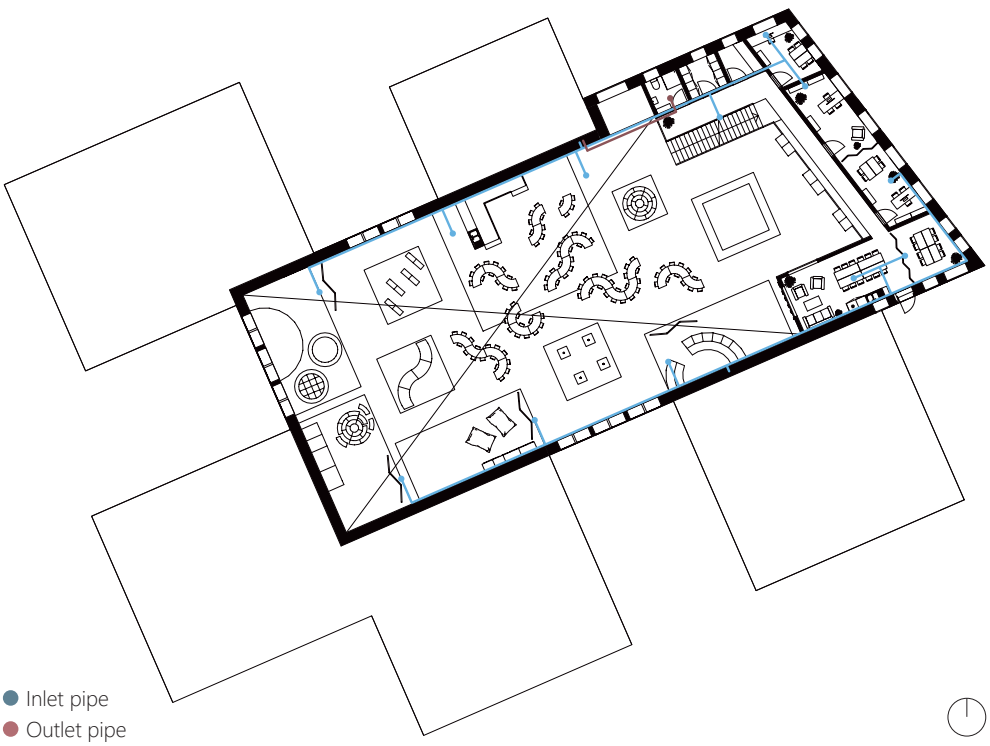
In order to create a satisfactory indoor climate in the building, two ventilation systems have been implemented to supply the entire building. To the mechanical ventilation a CAV-system have been chosen. This is a cheaper way in the long term, while the rooms accommodate the same amount of people almost every day, thus, the ventilation need will be constant in the rooms.

The ventilation units are centrally placed, one in the technical room next to the kitchen, which supply one of the nursery clusters, the common room, and some of the activity rooms and staff area. The other ventilation unit are placed in the centrally placed kindergarten, and supply both kindergarten clusters, the other nursery cluster, common room and the rest of the activity rooms and staff area.

In order to achieve a satisfactory air quality and temperature inside the rooms, it is intended that the ventilation should run one hour before and after the opening hours of the day care centre.



142 | Ill. 83. Mechanical ventilation strategy - Ground floor



Ill. 84. Mechanical ventilation strategy - First floor | 143

BE18

ENVIRONMENTAL SUSTAINABILITY
During the design of the day care centre, the focus has been on creating an eco-friendly design, while reducing the energy consumption of the building, by using passive and active strategies. This has been done during the design process, by using Be18 as a tool, to find the optimal solutions in relation to the window positions and size, building envelope, etc.

HEATING
Passive strategies have been used to reduce the energy consumption in the building.

A building envelope with a low u-value is created, to reduce heat loss through the construction, which reduce the need for heating in the building. A thick building envelope have been used, to obtain spatial qualities inside the rooms and to reach an envelope with low U-values. Example 0.083 W/m^2K for the external walls, app. 02.

To reduce the need for heating, large south-facing windows are placed that act as passive heating. This can cause overheating in the rooms during the summer months but can be solved by using ventilation or shading.

Generally, there was no need for shading in the building, besides the common room. All the windows flush with the external walls because of the architectural qualities, but to avoid the small amount of overheating, this could be solved by applying shading or pull the windows inside the building to flush with the internal walls.

ELECTRICITY
The electricity needs in the building for mechanical ventilation, can be reduced by using natural ventilation during the summer months.

The building has only a small number of equipment, which consists of lighting, kitchen utensils and a few elements in the staff area. This is an advantage as less energy and electricity will be used but have also a disadvantage as it will also reduce the heat flow in the building.

The electricity demand for artificial lighting is reduced, by the big number of windows, and thereby a high daylight level, which minimize the need for artificial lighting. But at the same time, this can create higher heat transmittance, which can cause overheating in the summer or a higher need for heating in winter.

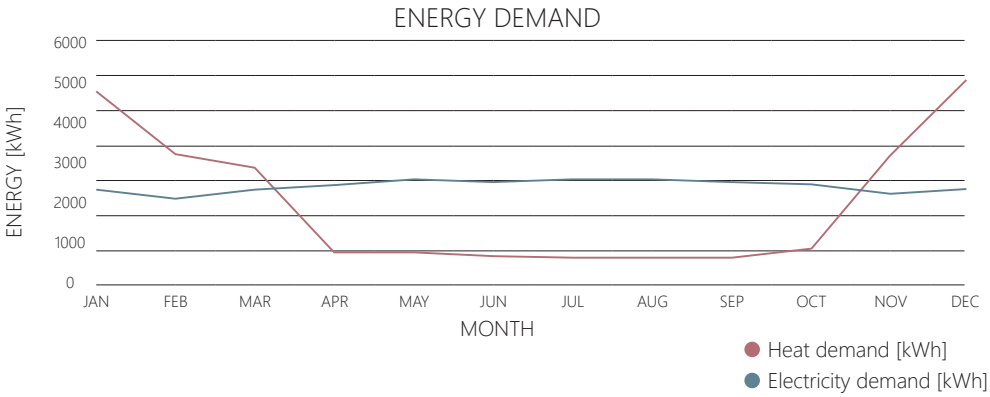
SUB-CONCLUSION
When designing the day care centre, the different aspects such as the architectural qualities, the users and the energy consumption have a great connection to each other, and thereby sometimes there are needed to compromise between different aspects.

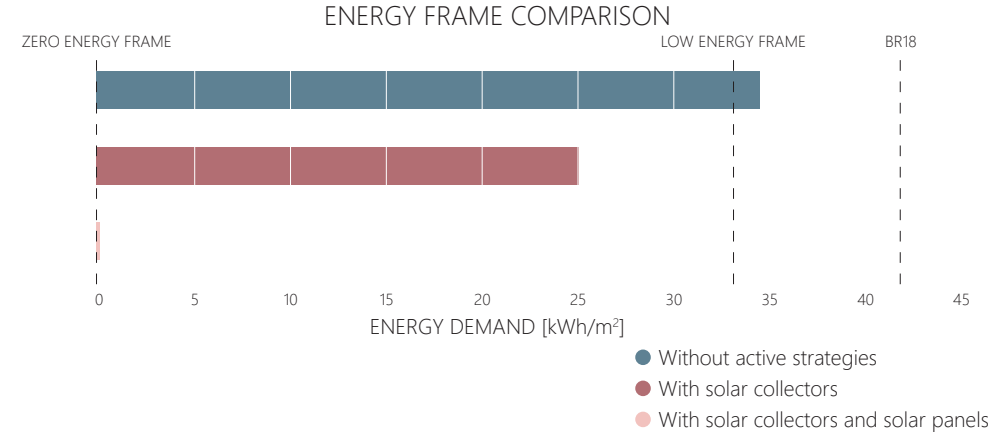
The building has been studied through different aspects, all to find the balance between these elements, and create a proper design for the users, which can achieve requirements for a zero-energy

building.

To achieve an energy frame that comply with BR18, the building is designed with passive strategies and heated with supply from district heating, app. 03. To reduce the energy consumption and reach the energy frame for a low energy building, the building is added an active strategy in form of solar collectors to heat the domestic hot water of the building, app. 04. To reach the goal of a zero-energy building, the building is further added solar panels, to cover the building's electricity consumption, app. 05.

The solar panels in the building are placed above the common room, to avoid disturbing the architectural qualities, and at the same time to define and appear the common room like a monumental building.

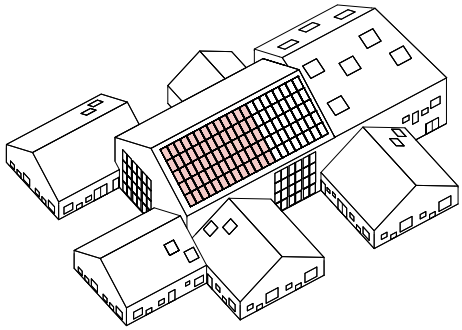




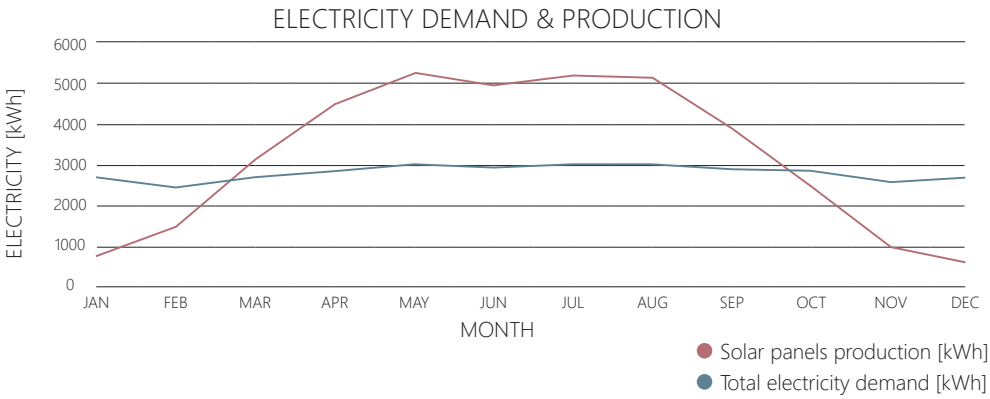
Ill. 85. Be18 - Energy demand & energy frame comparison | 145

SOLAR PANELS

To meet the electricity consumption in the building, solar panels have been added to the south-facing roof of the common room. Even though the solar panels cover the building's need for electricity in total during the year, solar energy is not a stable source of energy, as the amount of electricity produced depends on the sun's rays. Thus, electricity is connected to the grid, where the electricity will be transferred to and from when needed. The calculations for the amount of solar panels can be seen in app. 06.



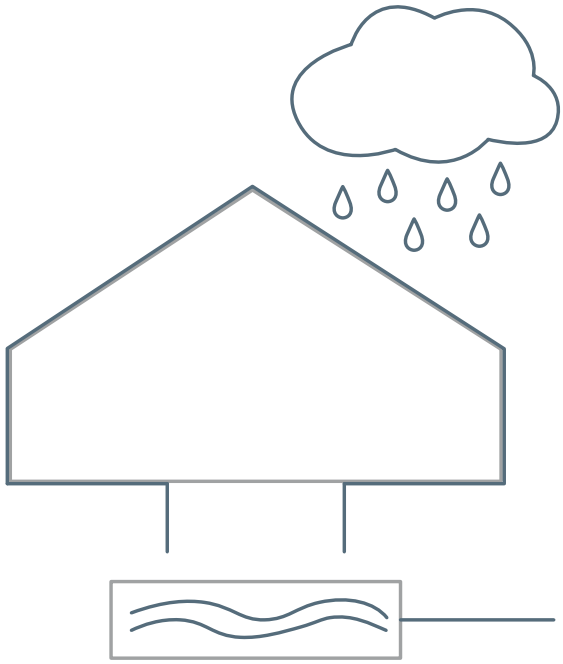
Ill. 86. Solar panels integrated at the building's roof



RAINWATER COLLECTION

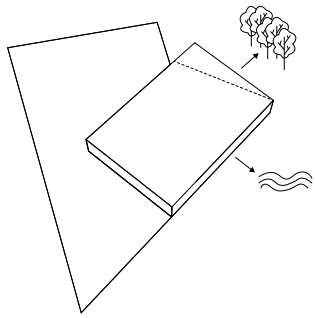
To utilize nature's own resources available on the site, rainwater is collected for grey water. The collected water can be used for either toilet flushing or outdoor use. In an institution, it is not allowed to use grey water for other purposes other than that (Miljøstyrelsen, n.d.).

A calculation has been made for water consumption for the toilet flush, in a kindergarten cluster, and for the amount of water that the roof can collect. This has proven that the roof has a large enough area to cover the toilet flush, and even more, which can be used for outdoor use. See calculation in app. 07.

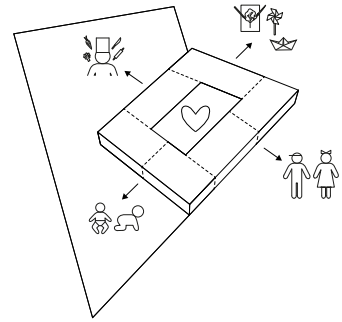


Ill. 88. Rainwater collection - concept | 147

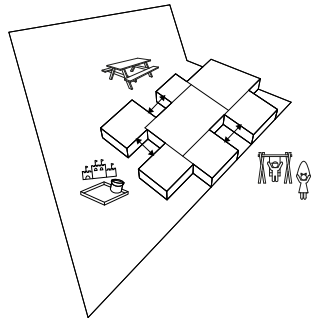
PRESENTATION



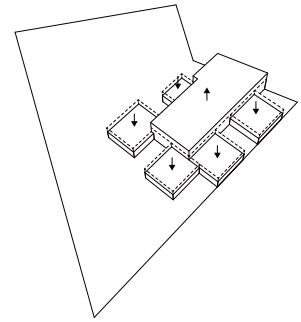
The building is located on the site towards the fjord and the park, to create good views and a safe environment for the children away from the city street.



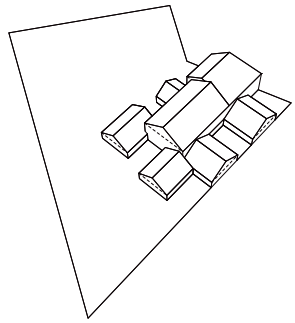
Central in the building the common room is placed, this is the heart of the building, from which all of the other functions are connected.



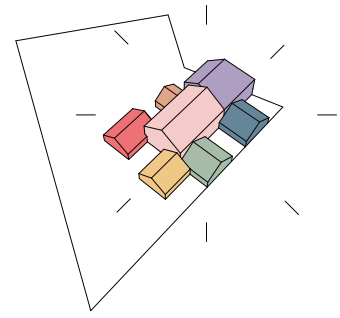
The children clusters are pushed apart, to create small intimate playgrounds for the children, between the buildings. In addition, an outdoor dining space is designed to create a community for the staff and children.



The height of the clusters is made lower, in relation to the children scale, which creates a safe and embracing atmosphere in the rooms. The common room is made taller, to create a definable monumental centre of the building, and to emphasize that it is a social common space.

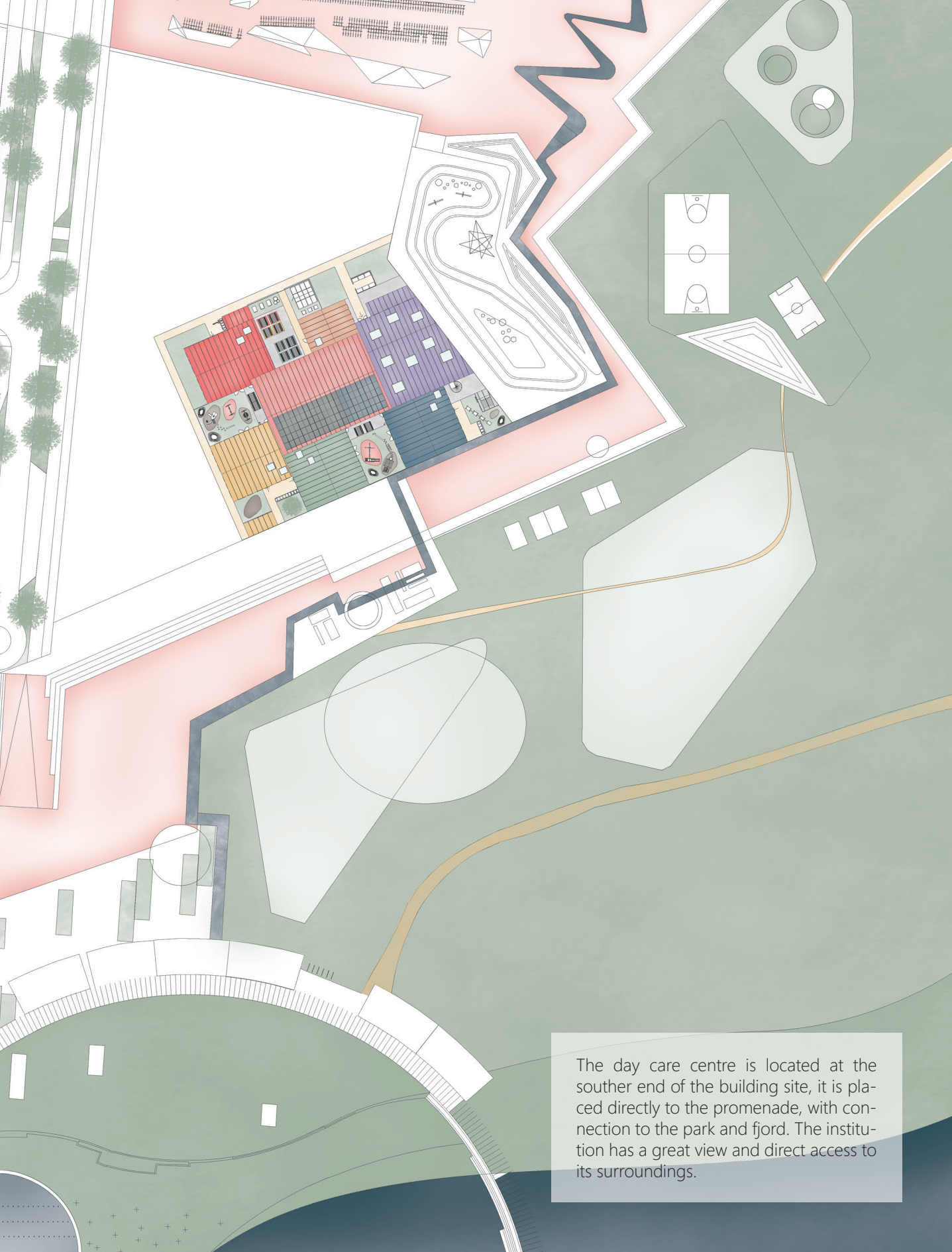


Pitched roofs are selected to create a children's village. The shape is inspired by how children draw houses.

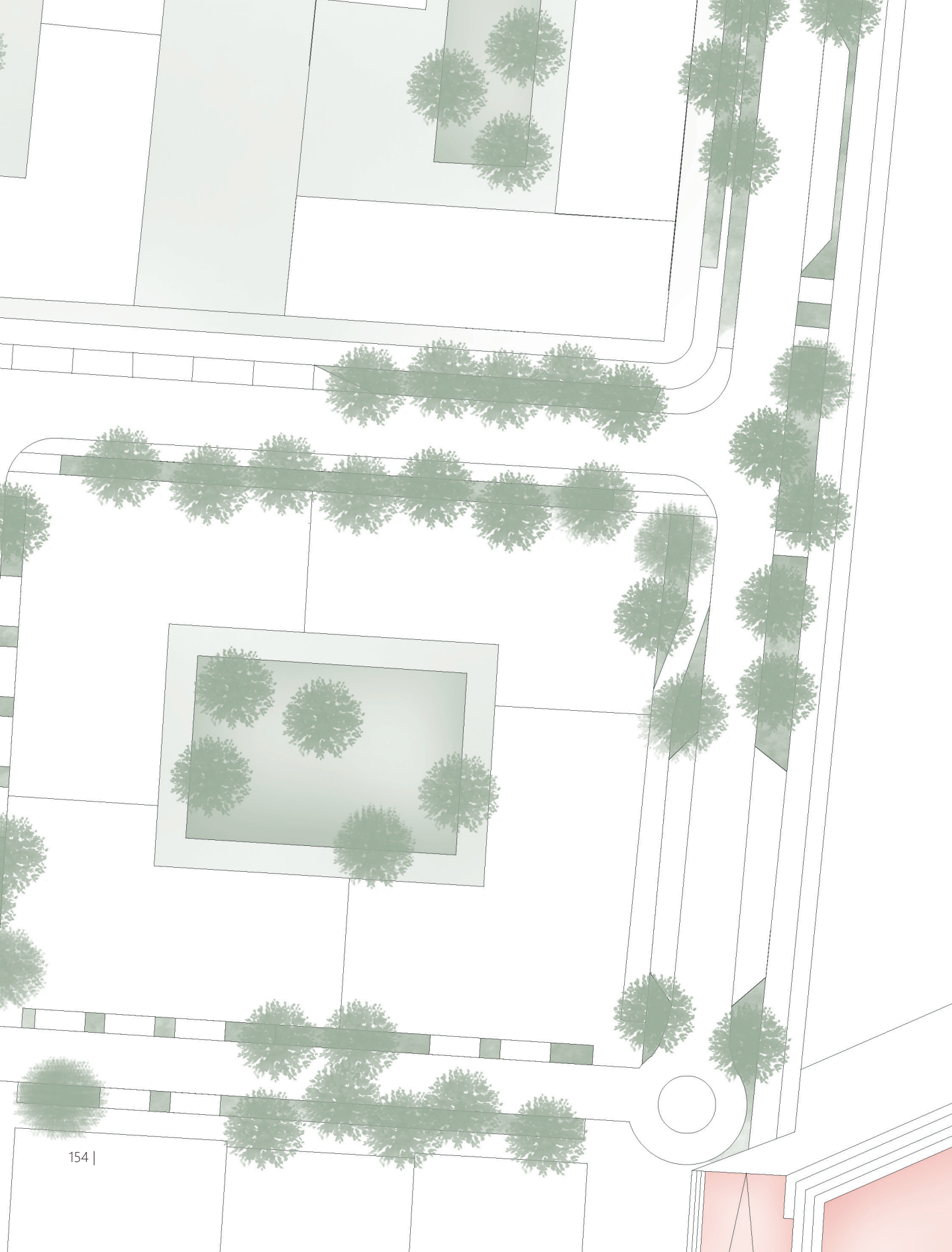


The different clusters and functions are defined with their own colours, which creates a identifiable children's village for the children, and becomes a landmark for the area.

152 | Ill. 90. Masterplan 1:1.000



The day care centre is located at the souther end of the building site, it is placed directly to the promenade, with connection to the park and fjord. The institution has a great view and direct access to its surroundings.



At the building site, the intension is to create a children and young universe with school, kindergarten and nursery. Next to the building site is a multi-purposed pitch placed, with is a space for high-intensity activities, such as moon cars. The idea is that all the departments on the building site should share the space and use it in different times.

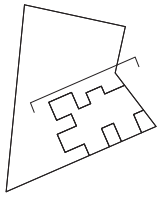
Ill. 91, Masterplan 1:500 | 155

The institution is located along the promenade and set the framework for a cultural meeting point in the area. The monumental common room is designed for cultural activities. Its pink coloured facades connect with the pink elements that will be implemented on Syrestien, and at the promenades in the future area.

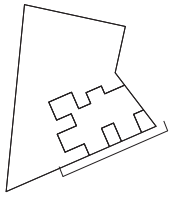
The day care centre appears very inspiring and colourful. Each cluster have its own colour, which makes it identifiable for the children.

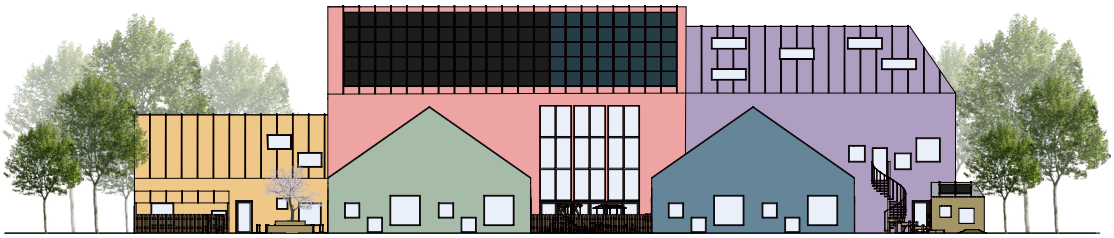
156 | Ill. 92. Visualization - Arrival

FACADES

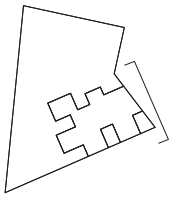


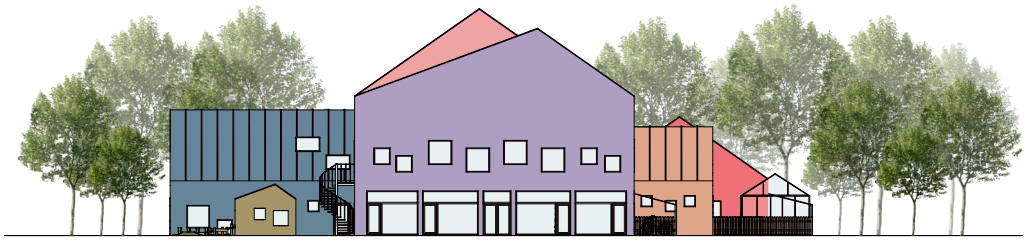
Ill. 93. Facade - North 1:500



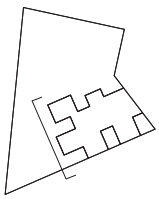


Ill. 94. Facade - South 1:500





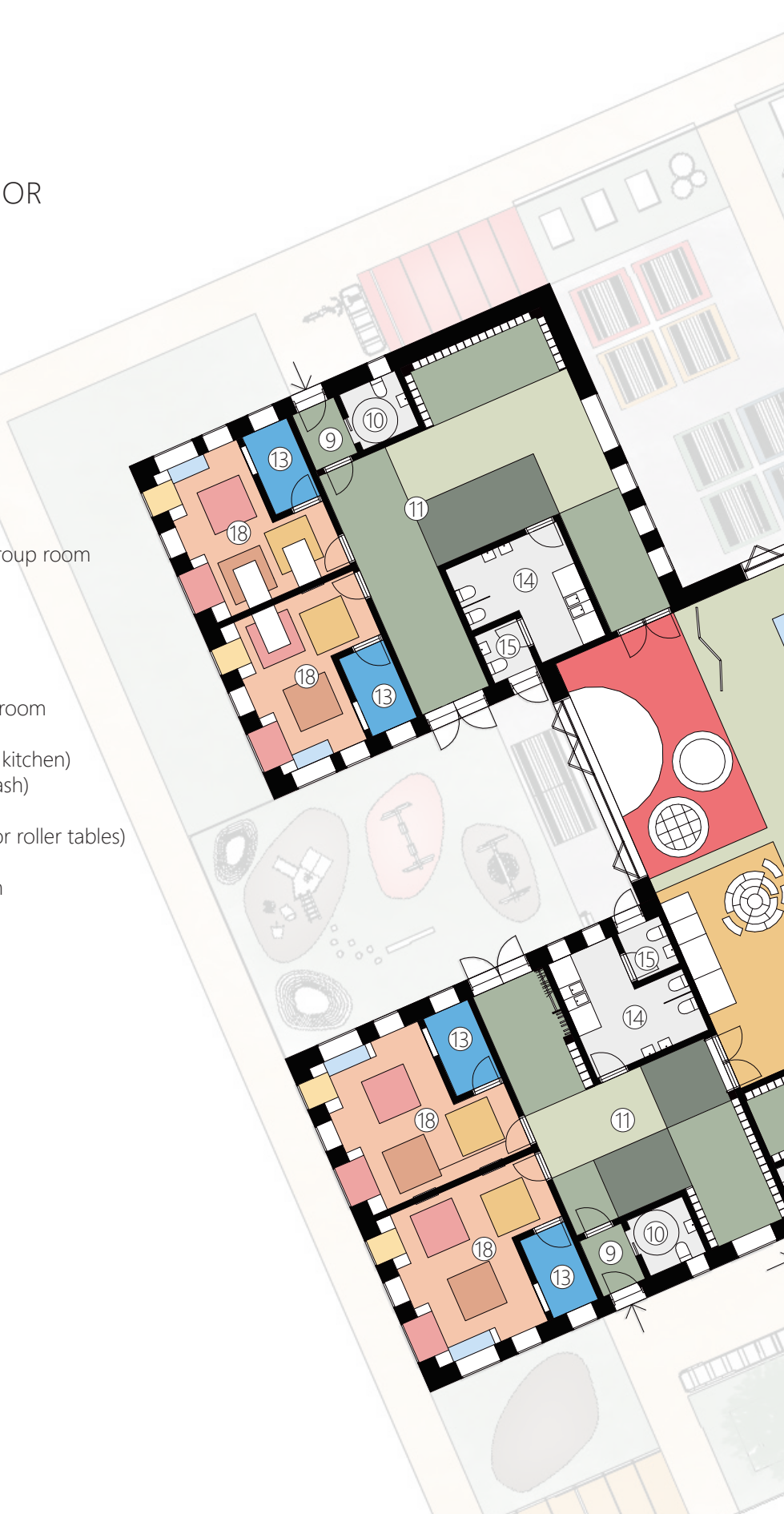
Ill. 95. Facade - East 1:500



Ill. 96. Facade - West 1:500

GROUND FLOOR

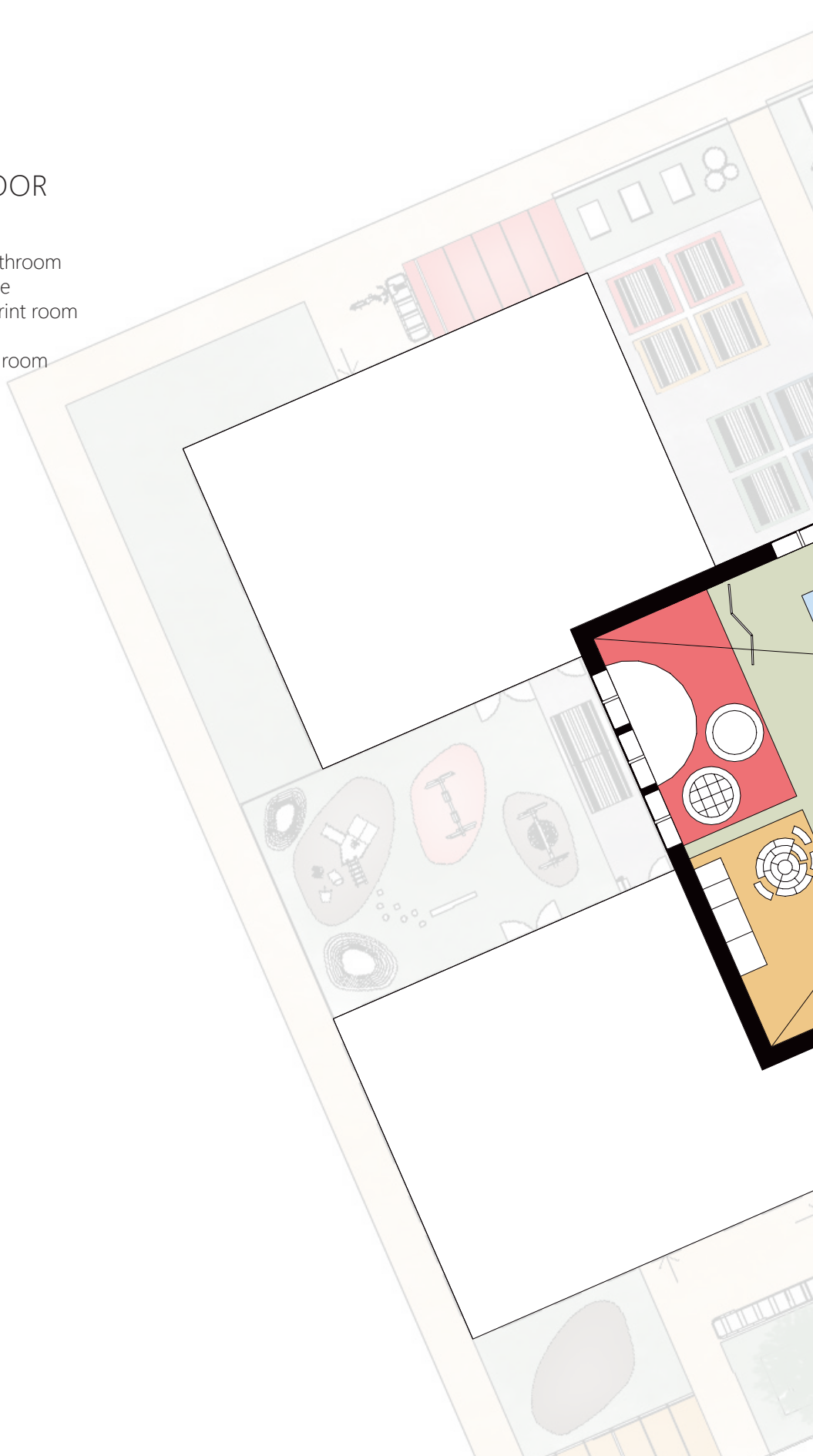
① Main entrance
② Common room
③ Storage
④ Active room
⑤ Art room
⑥ Exploratorium
⑦ Workshop
⑧ Drama room
⑨ Entrance
⑩ Guest toilet
⑪ Wardrobe
⑫ Kindergarten group room
⑬ Quiet room
⑭ Toilet
⑮ Outdoor toilet
⑯ Technical room
⑰ Cleaning room
⑱ Nursery group room
⑲ Kitchen
⑳ Scullery (rough kitchen)
㉑ Scullery (dishwash)
㉒ Larder
㉓ Depot (space for roller tables)
㉔ Laundry
㉕ Toilet/bathroom



Ill. 97. Ground floor 1:200 | 161

FIRST FLOOR

25 Toilet/bathroom
26 Wardrobe
27 Depot/print room
28 Office
29 Meeting room
30 Canteen



Ill. 98. First floor 1:200 | 163

COMMON ROOM

The common room is the heart of the building. It is the central social space, and all the other functions of the building is connected to it.

The floor material is coloured in different colours to create zones. Each cluster have its own zone, with specific activities for the corresponding age group it belongs to. Example there are created a ball pool for the youngest nursery children and reading corner for the oldest kindergarten children.

Through the design and implementation of activities, there have been a focus on stimulating the children's senses. The visual sense is stimulated by using colours in the room and for the different activities, as well as through views to the surroundings. The auditory sense is stimulated by music instruments in the drama room, which can be used on the platform for common morning song, etc. The olfactory and gustatory sense is stimulated in the common kitchen, where the children can join cooking and baking. In addition, is the kitchen courtyard with plant containers and greenhouse where the children can grow vegetables and berries, which they can eat. The tactile sense is stimulated by different materials, both inside the common room and outdoor at the connected playgrounds. The proprioceptive sense is stimulated by climbing wall and movement activities placed spread in the room.

The common room is flexible, and all the stuff can be removed so it can be used for other purposes outside the opening hours.

Between the common room and the activity area in the common room, is a partition wall placed in height, to create and clarify the transition between the areas. The idea is to have an open room, with possibility for overview of the entire space, but still create different atmospheres, when moving from one zone to another.

Ill. 99. Nursery activities

Ill. 100. Kindergarten activities

Ill. 101. Connection to kitchen courtyard

Ill. 102. Common kitchen

Ill. 103. Reading corner

Ill. 104. Axonometry - Common room | 165

The kitchen courtyard is designed with focus on learning about sustainability. In relation to "De Grønne Spirer", the themes: waste, from earth to table and nature awareness is covered.

In relation to waste, compost is placed next to the greenhouse and in relation to earth to table, plant containers, greenhouse and rainwater collectors are added, so the children can grow and water their own vegetables and berries. In relation to nature awareness, children learn that their waste can be composted and later planted, after which it can be harvested and eaten. In this process a lot of their senses is stimulated.

The kitchen courtyard is directly connected with the common room through sliding doors that can be fully opened between the spaces, which creates a transmission between the rooms. The kitchen is also connected to the kitchen courtyard, so the children can be served dinner directly from the kitchen.

Ill. 105. Visualization - Kitchen courtyard | 167

ACTIVITY ROOMS

The activity rooms are designed with focus on stimulating the children's senses, and their learning about sustainability.

The active room ill. 106 includes climbing wall, bean bags, mattresses and pillows, and allow the children to play intensive and stimulate their motor function, vestibular and proprioceptive sense.

The art room ill. 108 is a place where the children can be creative. The sustainable focus is on waste and recycle/reuse, by using waste for creating sculptures, Christmas decorations, paper towel cars and so on. They can make homemade colours and paint on used jars or newspapers. The focus is on stimulating their tactile and visual sense.

The exploratorium ill. 109 is a room where the children can gather their collected waste and make educational posters of it. They learn how to gain knowledge and present it for others. The focus is on stimulating their tactile and visual sense.

The workshop ill. 110 is designed in connection with the outdoor activity courtyard. The intension is to learn the children about renewable resources such as water, wind and sun energy. The children can make homemade windmills, paper boats and rain gauge and test it outdoor in the courtyard. The focus is on stimulating their tactile and visual sense.

The drama room ill. 107 is a place where the children can dress up with reused clothes. There is focus on the small steps, by making theatre and creating scenery of reused stuff. Through theatre they stimulate their visual, vestibular and tactile sense. In addition, they can play music on homemade instruments to stimulate their auditory sense.

Ill. 106. Active room

Ill. 107. Drama room

Ill. 108. Art room

Ill. 109. Exploratorium

Ill. 110. Workshop

Ill. 111. Axonometry - Activity area | 169

The activity courtyard is placed in connection with the workshop. In addition to that, the focus is on learning about sustainability and renewable resources.

In the courtyard is a shed, where the children can learn how to use tools. On the shed wall is a rain gauge and solar panel placed, so the children can learn about water and sun energy.

From the canteen of the staff department, is an escape route in form of a fire staircase.

Ill. 112. Visualization - Activity courtyard | 171

The activity area of the common room has direct connection to the park. Centrally in the area is a removeable platform placed, which can be used for common meetings or announcements, that create community in the common room.

Upstairs the activity rooms, the staff department is placed, from where there is a great overview of the entire common room. In the ceiling there is randomly placed skylights, that creates a changing and playful atmosphere in the room.

Next to the activity area in the common room, is the blue kindergarten cluster located. This cluster is meant for the oldest kindergarten children, who is going to be prepared for primary school, why they are in close connection with the activity rooms.

In the institution the wardrobes function as learning spaces, where the children learns to be independent by taking care of their stuff and practice their skills to take clothes and shoes on and off.

The wardrobe is divided into zones, where smaller niches are created, so the children can play or retreat individually or in smaller groups.

Ill. 114. Visualization - Kindergarten wardrobe (blue cluster) | 175

Directly from the wardrobe there is access to the playground. The two kindergarten clusters are opposite each other, to create a visual transition between the two wardrobes, so the children motivate and invite each other to play and learn.

Next to the playground entrance a drying corner is placed. Where the children can hang their clothes, if it gets wet or dirty in the rain and mud.

Ill. 115. Visualization - Kindergarten wardrobe (green cluster) | 177

The wardrobe is connected with the belonging group rooms.

Common for all group rooms, the floor colour divides the rooms into smaller zones. On one wall there is OSB boards, which can be changed if the children have made them personally by painting on them. On the OBS wall there is flexible folding tables, which can be used for different purposes.

Ill. 116. Visualization - Kindergarten group room | 179

The windows are placed randomly to create a playful and interesting atmosphere in the room. The windows are placed in different heights to relate to the children scale, but also to create various niches with different experiences.

Through various colours, materials, niches and views, the children's motor function, visual, tactile, vestibular and proprioceptive sense is stimulated.

The different activities in the room such as black board and furniture, invites the children to play. A window is placed in the interior wall to the quiet room, so the pedagogues can look inside, without disturbing the relaxing children.

180 | Ill. 117. Visualization - Kindergarten group room


école
1+1=2
Bonjou

When one enters the group rooms there is access to a quiet room, which is a room meant for relaxing/sleeping or a place where the children can retreat either individually or in smaller groups.

The windows, niches, zones and furniture in the nursery group rooms are lower and more closed in relation to the kindergarten group rooms, to relate to the scale and age of the children.

182 | Ill. 118. Visualization - Nursery group room & quiet room

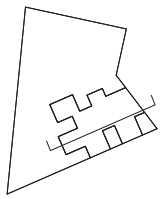
The playground design is inspired by the park's shapes and hilly landscape. A maritime atmosphere is created on the playground, by placing a wooden ship, that relates to the fjord.

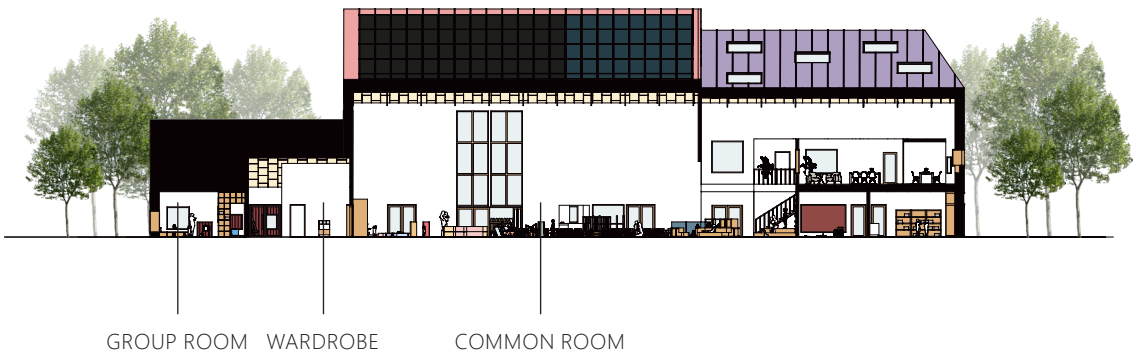
In the nursery playground a focus has been on stimulating the children's motor function and senses. The vestibular sense is stimulated by balance beam, swings, sensory swing, slide, etc. The tactile sense is stimulated by different ground materials such as grass, sand, rubber asphalt and tiles. The olfactory sense is stimulated by the nature and fresh air.

184 | Ill. 119. Visualization - Nursery playground

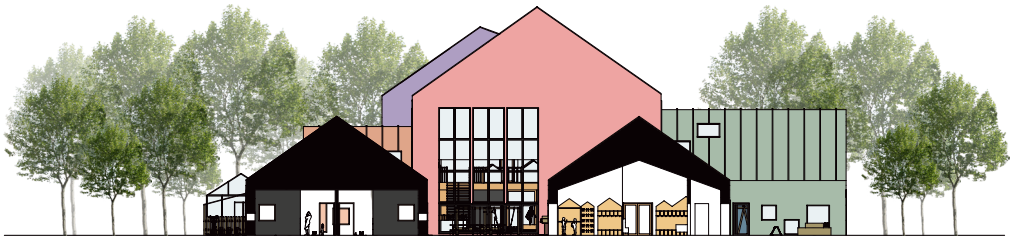
SECTIONS

There has been a focus on creating different moods and atmospheres, by different ceiling heights through the transitions in the building. All from the high monumental social common room, to the lower and more practical wardrobes with entrance from outdoor. Followed by the low intimate group rooms, where the children feel safe and in close connection with the cluster they belong.





186 | Ill. 120. Longitudinal section 1:500

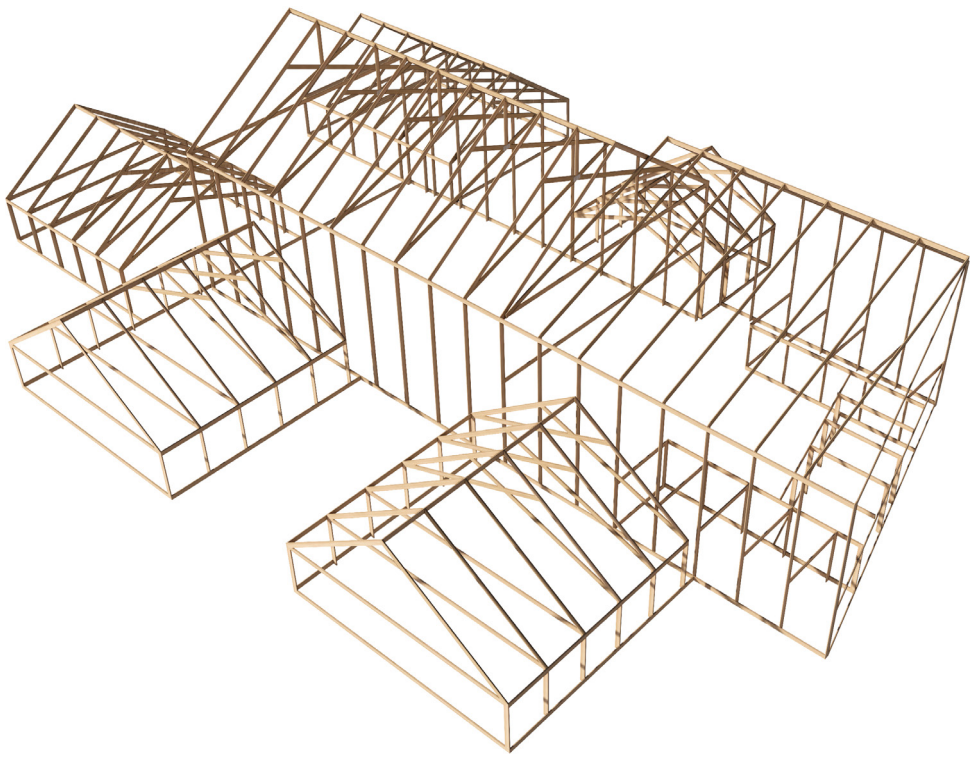


Ill. 121. Width section 1:500 | 187

STRUCTURAL SYSTEM CONCEPT

The illustrations show the structural system of the institution at a conceptual level. The principle of the structural system is a light timber frame construction.

The construction consists of different systems. Visible scissor trusses in the monumental common room, to create a special and interesting atmosphere. Hidden scissor trusses in the wardrobes, to emphasize the pitch of the roof when one enters the building. And hidden trusses in the group rooms, to get flat ceiling that creates a calm and embracing atmosphere.



188 | Ill. 122. Structural system concept

Ill. 123. Visible construction - Common room | 189

DETAIL - WALL & ROOF

WALL CONSTRUCTION

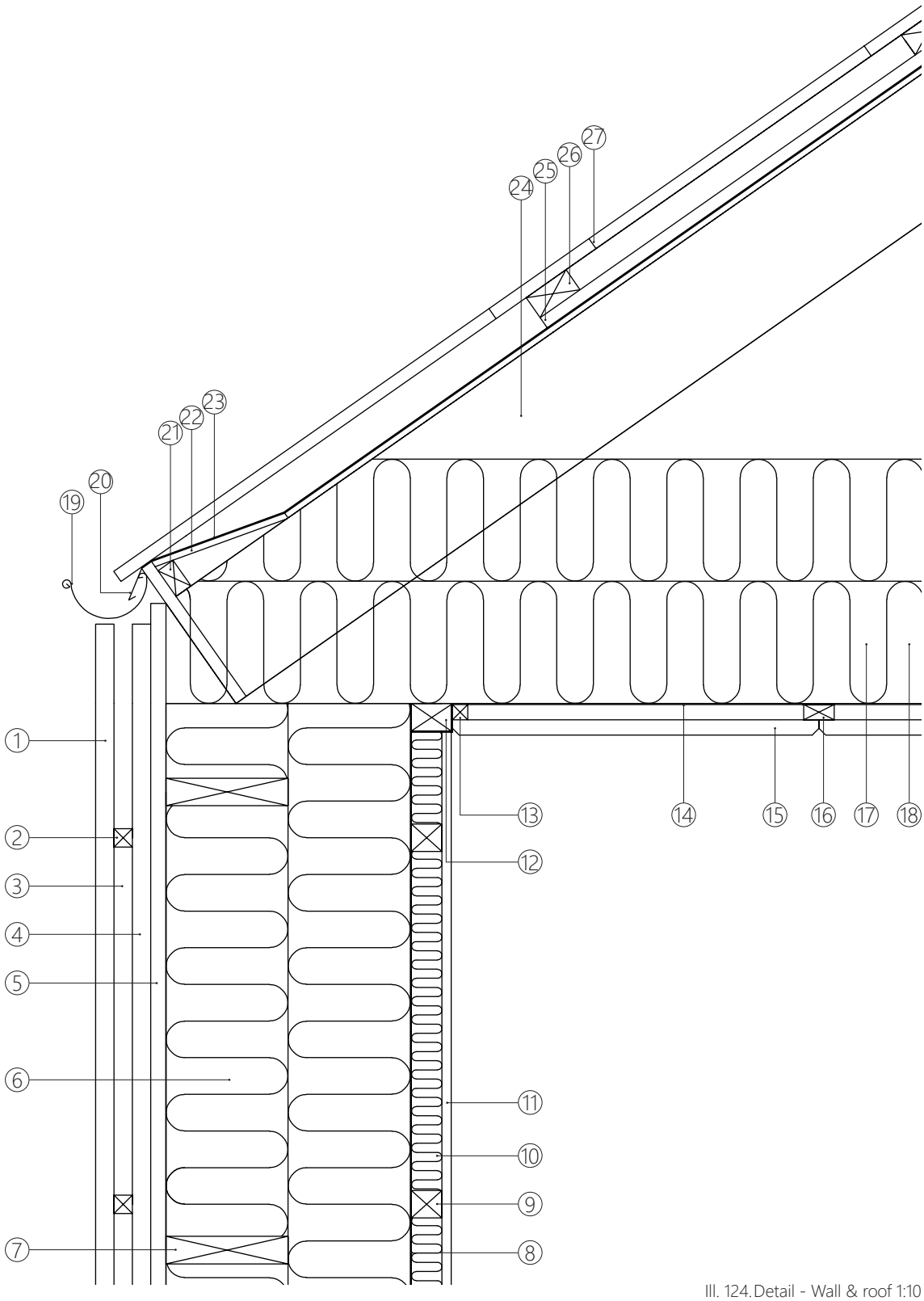
① 30mm wood cladding
② 30x30 mm spacing lists, CC60
③ 60 mm ventilated cavity
④ 30x30 mm spacing list, CC60
⑤ 25 mm wood fibre board (wind barrier)
⑥ 400 mm eelgrass
⑦ 50x100 mm rafters, CC750
⑧ Vapour barrier
⑨ 45x50 mm spacing list, CC60
⑩ 50 mm eelgrass (installation layer)
⑪ 15 mm plaster board

U-VALUE: 0.083 W/m^{2}K

ROOF CONSTRUCTION

⑫ 45x65 mm batten
⑬ 25x25 mm list
⑭ Vapour barrier
⑮ Troldtekt, 600x1200x40 mm
⑯ 25x50 mm spacing list
⑰ 45x200 mm rafters, CC750
⑱ 400 mm eelgrass
⑲ Gutter
⑳ Gutter element (fodblik)
㉑ 30x50 batten
㉒ 10 mm wood fibre board
㉓ Roof underlay
㉔ 45x200 mm rafters, CC750
㉕ 20x40 mm spacing list, CC750
㉖ 40x80 mm spacing list, CC750
㉗ Galvanized steel

U-VALUE: 0.075 W/m^{2}K



Ill. 124. Detail - Wall & roof 1:10 | 191

DETAIL - ROOF & FOUNDATION

WALL CONSTRUCTION

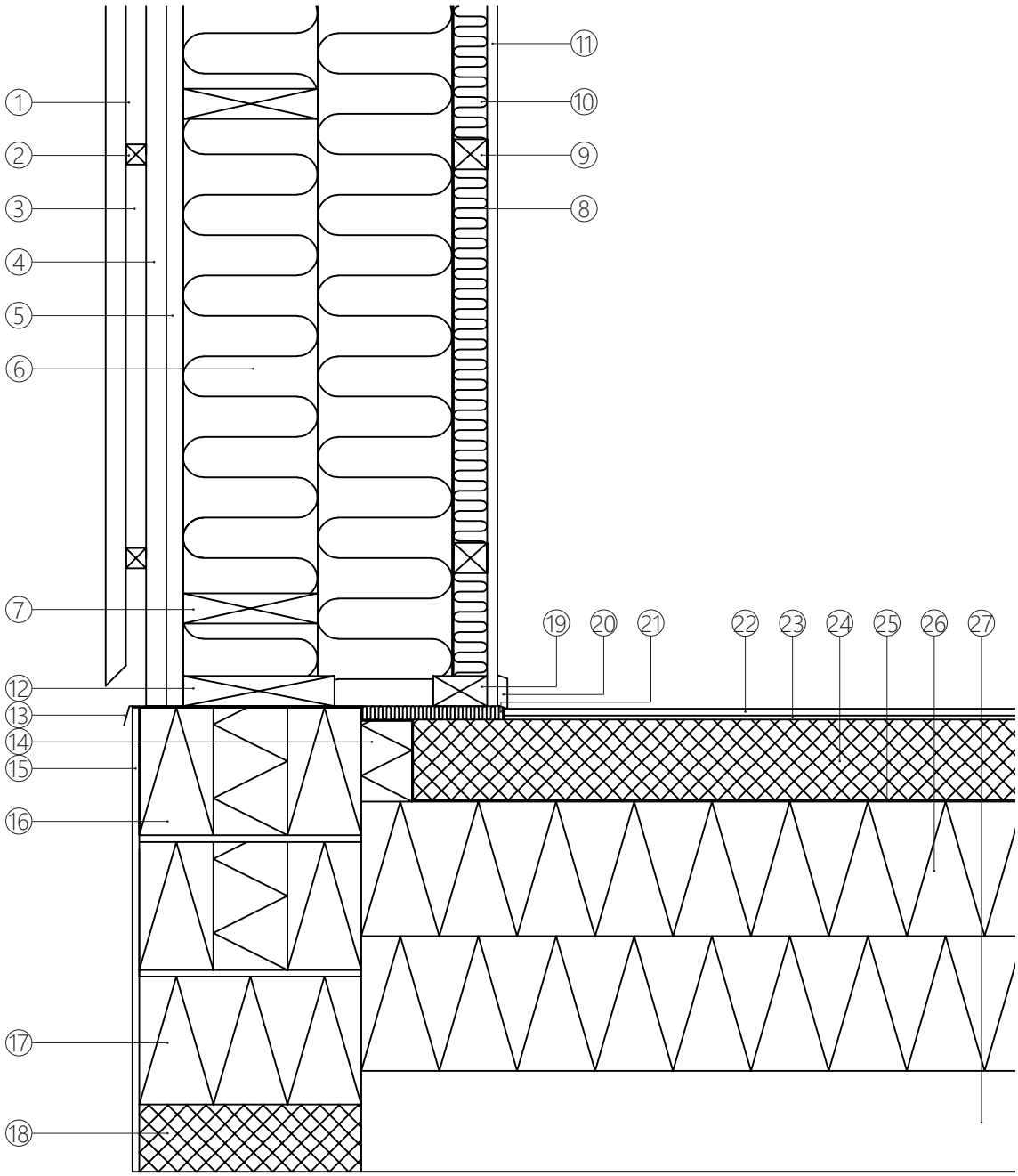
① 30mm wood cladding
② 30x30 mm spacing lists, CC60
③ 60 mm ventilated cavity
④ 30x30 mm spacing list, CC60
⑤ 25 mm wood fibre board (wind barrier)
⑥ 400 mm eelgrass
⑦ 50x100 mm rafters, CC750
⑧ Vapour barrier
⑨ 45x50 mm spacing list, CC60
⑩ 50 mm eelgrass (installation layer)
⑪ 15 mm plaster board

U-VALUE: 0.083 W/m^{2}K

FOUNDATION CONSTRUCTION

⑫ 45x225 mm wall plate
⑬ Drip cap
⑭ 75 mm polystyrene
⑮ Plinth plaster
⑯ 330 mm middle insulated leightweight block
⑰ 330 mm leightweight block
⑱ Concrete foundation
⑲ 45x80 mm wall plate
⑳ Skirting
㉑ Eelgrass
㉒ 10 mm linoleum (marmoleum click)
㉓ 6 mm cork underlay with aluminum
㉔ 120 mm reinforest concrete with underfloor heating
㉕ Vapour barrier
㉖ 400 mm polystyrene
㉗ Sand cushion

U-VALUE: 0.084 W/m^{2}K



Ill. 125. Detail - Roof & foundation 1:10 | 193

DGNB

The criteria from the DGNB selected during the analysis phase, have complemented a sustainable approach in the design process. To describe how they have been achieved, they are each reviewed below.

PROCESS QUALITY

- PRO1.2 Integrated Design 1,7%

The integrated design process is intended from the beginning of the design process during the project. Where both user-friendly design solutions, implementations of sustainable aspects and indoor conditions are investigated in the design solutions to get a more holistic design approach. Different elements such as the use of the sustainable materials and a good indoor climate, creates a design that appeals to the user.

ENVIRONMENTAL QUALITY

- ENV1.1 Life Cycle Impact Assessment 7,9%

During the choice of facade materials, the materials have been examined in LCA, to investigate which materials have the least environmental impact. Hereby, the most optimal materials have been chosen both according to LCA and the user.

- ENV2.3 Land Use 2,3%

Both the location of the building on the building site and the floor plan solution. A focus has been on utilizing the area on the site as optimally as possible. Where the building aligns with the building site, and all the notches between the buildings are utilized either as playground or space for bicycles.

ECONOMICAL QUALITY

- ECO2.1 Fleksibility and Adaptability 6,4%

The design of the building has a flexible floor plan solution, where the entire building is divided into several building units that allow the building to multiple use. The individual rooms and buildings can be adapted for different uses.

SOCIAL QUALITY

- SOC1.1 Thermal comfort 4,3%

In order to ensure a good indoor climate, different rooms in the building are built up in BSim, to ensure that the building has a satisfactory thermal indoor climate. The windows are positioned so that they are possible to use for natural ventilation either stack, cross or single-sided ventilation. To provide adequate indoor temperature for the children, mechanical ventilation and floor heating are incorporated in the building.

- SOC1.2 Indoor Air Quality 2,6%

In order to ensure a good air quality, the air change in the group rooms and the common room has been analyzed in BSim. In addition, adequate air change is ensured in the rooms by using natural and mechanical ventilation.

- SOC1.4 Visual Comfort 2,6%

The design of the building ensures a good visual comfort, where the lighting has been one of the focus points during the design of the building. Large window areas are located in all rooms to ensure a good daylight level inside the rooms, and also in order to create good views of both the outdoor areas and the rooms, which enable the staff to have a visual

contact with the children.

• SOC1.5 User Control 1,7%
It is possible for the users to control the temperature as well as the atmospheric air quality in the building by regulating the floor heating, ventilation and opening of windows. In addition, they can shield for the sunlight and regulate the artificial lighting.

• SOC1.6 Quality of Outdoor Spaces1,7%
The design of the building ensures the users a good interaction between each other in the various courtyards. Social contact is created between the different users in the shared playgrounds, as well as in the common outdoor dining area. In addition, good views of the surroundings are ensured from the living areas of the institution. As a plus for the children, there is direct access from the playground to the toilet.

• SOC2.1 Design for All 1,7%
Easily accessible access roads to the building have been envisaged from the outset. Disabled-friendly toilets are located at entrances to each group room. In general, the work has been done to avoid narrow corridors, and most of the building is in one level.

• SOC2.3 Cyclist Facilities 0,9%
Bicycle racks are located directly at the entrance to encourage employees to cycle to work. In relation to this, wardrobe, bath and dressing room are in the staff department. There is also space for bicycle parking for both the children and their parents during delivery/pick-up.

• SOC3.3 Layout Quality 1,7%
The floor plan is generally very flexible, in the common room for example, all furniture can be pulled aside so that it becomes a large space. In the group rooms there are suspended folding tables so that children can sit and do activities here or look them up and play in the free floor space. The building is designed with separate access roads for each group, which for future use, allows the different departments to be separated.

TECHNICAL QUALITY

• TEC1.1 Fire Safety 3,0%
A fire plan with escape routes has been prepared in case of fire. Sufficient exits are ensured, as well as fire staircase to the first floor directly from the canteen in the staff department.

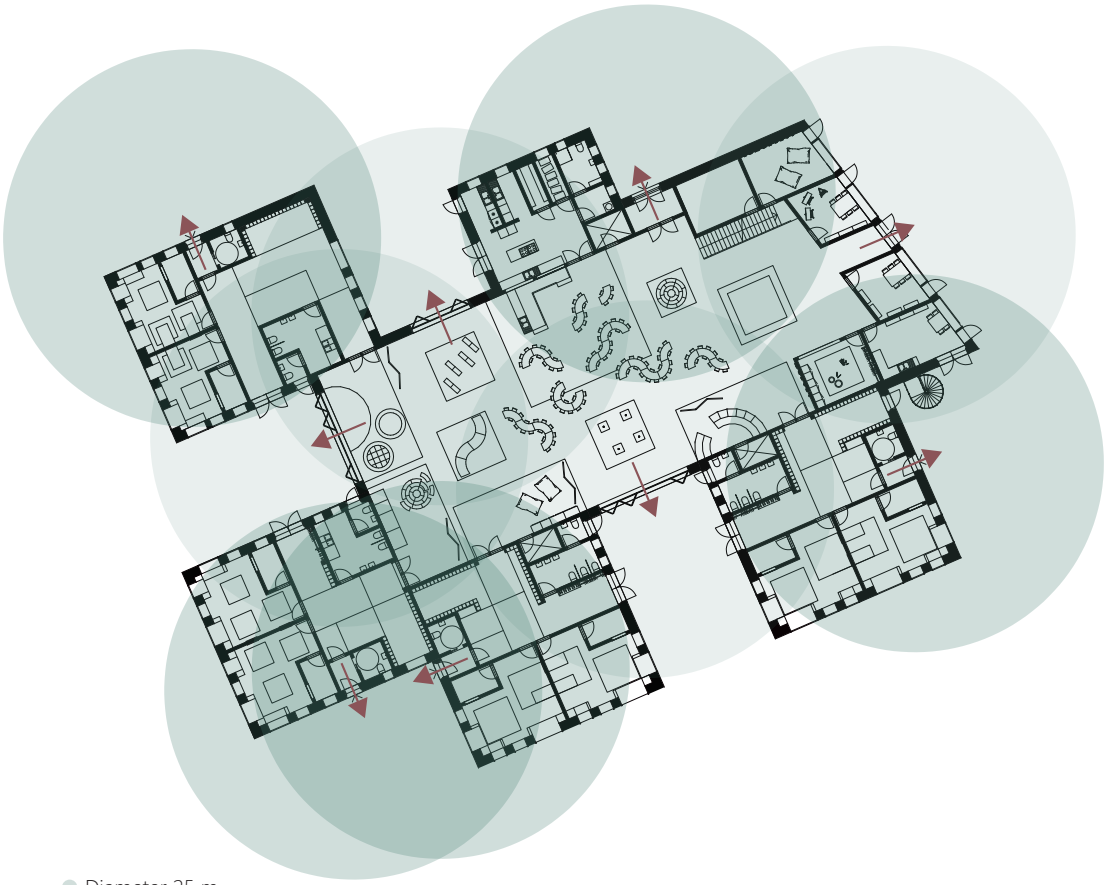
• TEC1.2 Acoustics & Sound Insulation 4,5%
In order to ensure good room acoustics, Troldtekt is used as ceiling material. Furthermore, relatively thick interior walls have been deliberately made with extra insulation to ensure air sound insulation between the individual rooms.

• TEC1.3 Building Envelope Quality 3,0%
In order to achieve a low energy consumption as well as a good indoor climate, a low U-value (which complies with the Building Regulation's requirements) is reached for the individual building elements in the building envelope.

ESCAPE ROUTES

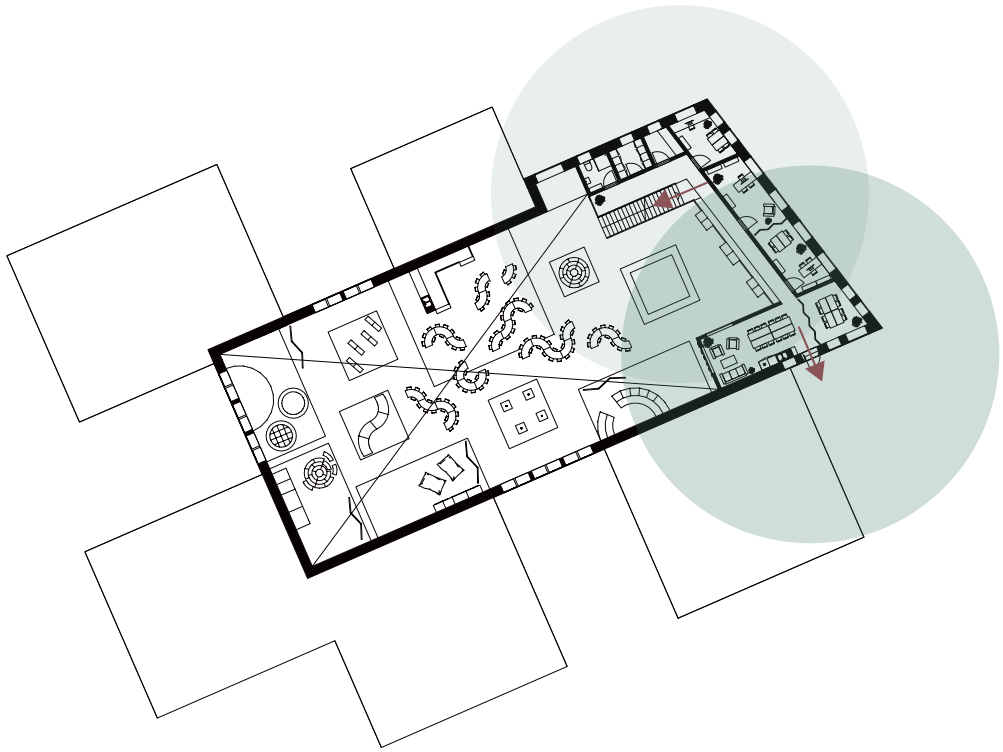
To fulfil the DGNB criteria Fire Safety, a conceptual escape plan is done. The illustrations show that there are a lot of possibilities to escape from the building in case of fire. In addition, there is a fire staircase connected to the staff canteen, to create the possibility of escaping from the staff department.

No place in the institution have more than 25 meters to a fire exit.



Diameter 25 m
Fire exit

196 | Ill. 126. Escape routes - Ground floor 1:500



Diameter 25 m
Fire exit

Ill. 127. Escape routes - First floor 1:500 | 197

CONCLUSION

The institution has ended up as a colourful and playful children's village, with painted facades and classic pitched roofs. The building has a familiar shape, inspired by the way children draw houses. The colourful building is a landmark for the area and draws people's attention because of its distinct appearance. It attracts people and is a great centrum for cultural meetings outside the opening hours of the institution.

The institution benefits from its unique location on Stigsborg Havnefront, by having a view of the surroundings from all living rooms in the building. It has a close relation to the park and fjord via access roads and connection to activities.

To create a safe environment, a focus has been on an identifiable building, by using colours for the different functions and clusters, so the children knows where they belong. In the common room and kitchen courtyard smaller zones is painted at the same colour as the associated cluster, to make it confidently and easy for the children to find.

A good indoor climate is ensured by adhering to standards and regulations set for institutions. Simulations of both daylight, indoor climate and energy consumption have shown that the criteria have been achieved. It strengthens the user's satisfaction that they have the possibility to self-regulate terms as atmospheric air, light and temperature.

Throughout the project period there have been a lot of focus on children's stimulation of their senses, in relation to their development and learning. A special focus has been in the common room, where there are various activities that stimulate all the senses, targeting the different age groups in the institution. In addition, the two cluster courtyards are designed with focus on the children's stimulation of senses and development of motor function.

Selecting different criteria from DGNB has led to a more sustainable way of thinking through the design process. A focus has been on choosing natural materials for the building construction and playground activities.

Both activity rooms and outdoor spaces is designed with great focus on learning about sustainability through different elements, such as composting, growing vegetables and rainwater collection in the kitchen courtyard, learning about renewable resources in the activity courtyard and recycling/reuse of clothes in the drama room, etc.

The shape of the building appeals well to the children's scale and perception. The roofs are designed with the most optimal angle in terms of positioning solar panels and solar collectors, at the same time they also allow rainwater collection.

The plan solution is very well executed in relation to the everyday life of the institution. The clusters each have their own entrance whereby there is space for parking bicycles or prams, depending on the needs of the users.

At the entrances handicapped-friendly guest toilets is placed. Then you enter

directly into the wardrobes, from which there is direct access to the common room, group room, toilet and playground. In addition, a toilet is provided in connection with the toilets to which there is direct access from the playground.

In the common room there is access to the staff department, kitchen and activity rooms. In the staff department, there are meeting rooms for parent consultations, health visitor, speech- and language therapists. The placement of the staff area creates a great overview of the entire common room. Under the staff department, various activity rooms are located, from which there is access to the park and outdoor activity courtyard.

In connection with the kitchen, is a common kitchen where the children can join, in addition, an outdoor courtyard is integrated in the building shape, in which the children can sit outside and eat when the weather permits.

In general, the building is very flexible, with the possibility of zoning. In all living rooms, the floors are divided into zones, to creating the possibility of zone dividing the children into smaller groups, but at the same time have opportunity to gather all together.

REFLECTION

Through the completion of a project, there will always be some elements that can be developed and further worked on, why a reflection is done. It is always possible to go back and do more analysis and develop and refine the design.

FUTURE MASTERPLAN

As the project is based on a future project, it has been challenging to relate to the context, as it presently is an empty field that is in an ongoing cleaning process. It has been difficult to do simulations and adapt to a context which is non existing. It has also been challenging to create a masterplan based on buildings that are not currently located. However, it has been tried to be solved, by getting in touch with the architect behind the vision of the area, whom was not able to give any specific information, as the area is not designed yet, and was only drawn on sketch level.

TECHNICAL ROOM AND VENTILATION SYSTEM

During the design process there have been a lot of focus on the user's needs, including how to create the best possible learning environments for the children. This made it challenging to place a technical room for each cluster, where it ended up with placing two ventilation systems which supplies the entire building. To create a more flexible building that can be separated from each other, this could be solved by placing a technical room for each cluster, that supplies the corresponding building. This will make the building more flexible for other uses in the future.

USERS WITH SPECIEL NEEDS

Another thing that could be worked further on, could be the users with special needs. Overall, the building is designed with disabled-friendly toilets, and the user´s with special needs has easy access on the ground floor. In meetings with people with disabilities, it is intended that this could take place either in the common room or in the activity rooms. However, it would be a problem if they had to come up to the first floor of the staff area, which could be solved by placing an elevator. This would disrupt the atmosphere in the activity rooms, and by talking with the pedagogues at one of the visited institutions, it was made clear that this was not a necessity in their case, why it is not being integrated in the design.

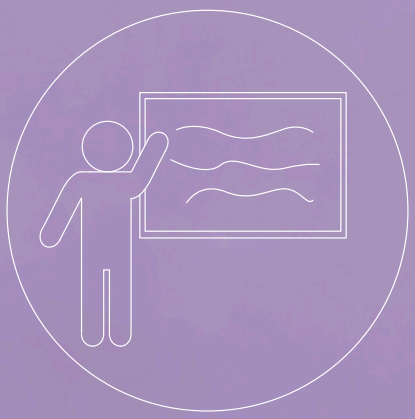
CHALLENGES DUE TO COVID-19

In general, the entire project has been influenced by COVID-19. The planning of the project had to be restructured as the process based on COVID-19 changed. It has been challenging to sit separately, including having online supervision, during much of the project period. It has taken a lot of time and patience due to the uncertainty about the whole situation, both in relation to the project period, submission and exam.

Throughout the course it has been unknown whether it became an opportunity to use the university's facilities or not for making physical models, etc. Therefore, the design process has been quite different from previous projects, where physical models have been a major part of it. For that reason, during this project,

spatial experiences were worked through 3D models and renderings. Another factor has been access to literature, which has also been restricted by the closure of libraries.

LITTERATURE & ILLUSTRATIONS



LECTURES

BOOKS

WEBPAGES

LITTERATURE

LECTURES

Bejder, A. K. (2018) Zero Energy Buildings. Principles – designing holistic Zero Energy Buildings 1/2.

Dabaieh, M. (2018) Integrated Design of Sustainable and Tectonic Architecture. Feather light Design.

Larsen, O. K, (2018) Zero Energy Buildings. Modelling of natural and hybrid ventilation 1/2.

Larsen, O. K, (2018) Zero Energy Buildings and Definitions. Energy Producing Technologies.

Poulsen, M. (2016) Husbyggeri 2: Hygrotermisk bygningsfysik. Kuldebroer og tæthed.

BOOKS

Ayres, A. J. (2002) Sanseintegration hos børn. Hans Reitzels Forlag, København.

Birgisdottir, H. (2015) Bæredygtigt byggeri. bind 2015, 1 udg, Energistyrelsen, København.

Bloom, P. (2001) Précis of how children learn the meanings of words. Behavioral and Brain Sciences, 24, 1095-1103.

Borg, F., Winberg, M. & Vinterek, M. (2017) Children's Learning for a Sustainable Society: Influences from Home and Preschool. Educational Inquiry. Informa UK Limited.

Brorström, S. (2019) Overgange og sammenhænge i børns liv. Akademisk Forlag, København.

Brorström, S. & Frøkjæer, T. (2015) Science i dagtilbud. Børn og pædagoger undersøger naturens lovmæssigheder. Dansk Pædagogisk Forum, København.

Broström, S og Frøkjær, T. (2018) Det ved vi om – Science, bæredygtighed og matematisk opmærksomhed. Det ved vi om. Dafolo A/S og forfatterne, Frederikshavn.

Cecchin, D. (2015) Barndomspædagogik i dagtilbud – Omsorg, udvikling og læring. Akademisk Forlag, København.

Clark, A. (1999) An embodied cognitive science? Trends in Cognitive Science – Vol. 3, No. 9.

Corner, J. (1999) The Agency of Mapping – Speculation, Critique and Invention. Edited by Corgrove, D. Reaktion, London.

Drugli, M. B. (2017) Det ved vi om – Gode rutinesituationer I dagtilbud. Det ved vi om. Dafolo A/S og forfatterne, Frederikshavn.
Elkonin, D. (1988) Legens psykologi. Progress, København.

Forstadt, L. A. (2011) Children and Brain Development: What We Know About How Children Learn. The University of Maine Cooperative Extension.

Gjems, L. (2017) Det ved vi om – Sprogstimulering I dagtilbud. Det ved vi om. Dafolo A/S og forfatterne, Frederikshavn.

Gravesen, D. T. (2016) Pædagogik – Introduktion til pædagogens grundfaglighed. Forfatterne og Hans Reitzels Forlag, Aarhus.

Gunnar, M. R. et al. (2010) The rise in cortisol in family day care – Associations with aspects of care quality, child behavior, and child sex. In Child development, 81, s. 851-869.

Hamre, B. K. et al (2014) Classroom assessment scoring system – Manual Infant. Paul Brookes Publishing, Baltimore.

Hansen, M. (1998) Intelligens og tænkning – En bog om kognitiv psykologi. Forlaget Åløkke.

Hansen, O. H. (2013) Vuggestuen som social læringsmiljø. I Pædagogisk Psykologisk Tidsskrift, 50, s. 50-59.

Hinde, R. A. (1979) Towards understanding relationships. Academic Press, London.

Howard, J. & McInnes, K. (2013) The Essence of Play. Routledge, London.

Kjærgård, H., Støvring, B. og Tromborg, A. (2014) Barnets lærende hjerne - Børnepsykologi, kognition og neuropædagogik. 2nd ed. Forfatterne og Bogforlaget Frydenlund, Frederiksberg C.

Knudsen, L. K. (2012) Børn med særlige behov – hverdagen i dagtilbuddet. 2nd ed. Kommuneforlaget A/S

Knudstrup, M. A. (2004) Integrated Design Process in Problem-Based Learning. Aalborg: Aalborg Universitetsforlag.

Larsen, T. S., Clausen, G., Bekö, G., Heebøll, A., Witterseh, T., Hellgren, E., Knudsen, H. N. & Mortensen, L. H. (2017) Centrale parametre til karakterisering af bygningers indeklima. Realdania Byg, København.

Lekhal, R. et al. (2016) Det ved vi om – Betydningen af kvalitet i dagtilbud. Dafolo A/S og forfatterne, Frederikshavn.

Leontjev, A. N. (1977) Problemer I den psykiske udvikling. 1-3. Rhodos, København.
Ringsmose, C. (2009) 'Kvalitet i daginstitutioner' Danmarks Pædagogiske Universitetsskole, Aarhus Universitet, Kbh.

Ringsmose, C. & Staffeldt, S. (2009) 'Projektets idé: Design af læringsmiljøer i projekt Læring og Udvikling i Daginstitutioner (LUDVI)' Danmarks Pædagogiske Universitetsskole, Aarhus Universitet, Kbh.

Ringmose, C. og Staffeldt, S. R. (2017) Rum og læring for de mindste – om at skabe gode læringsmiljøer i vuggestuen. Dafolo A/S, Dansk Pædagogisk Forum og forfatterne, Frederikshavn.

Ryhner, P. M. et al. (2012) Child Caregivers – Contigent Responsiveness Behaviors During Interactions With Toddlers Within Three Day Care Contexts. In Communication Disorders Quarterly, 34(4), s. 232-241.

Samuelsson, I. P. & Johansson, E. (2006) Play and learning – Inseparable dimensions in preschool practice. In Early Child Development and Care, 176, s. 47-65.

Sandseter, E. B. H., Hagen, T. L. og Moser, T. (2018) Kroppslighet i barnehagen – Pedagogisk arbeid med kropp, bevegelse og helse. 3rd ed. Gyldendal Norsk Forlag AS, Gyldendal Akademisk.

Schousboe, I. (2013) Leg og udvikling af antisociale kompetencer. Psyke & Logos, 24, s. 228-256.

Svendsen, S., Lund, H. & Heiselberg, P. K. (2014), Energineutralt byggeri: Definition og fremtidig rolle i samfundet. SBI forlag, København.

Vigsø, B. og Nielsen, V. (2006) Børn & Udeliv. CVU Vest Press, Esbjerg.

Vygotsky, L. S. (1982) Legen og dens rolle i barnets psykiske udvikling. I Vygotsky, L. S. Om barnets psykiske udvikling. NNF, Arnold Busk, København.

WEBPAGES

Aalborg Kommune. (2017) *Udviklingsplan for 1. etape af Stigsborg Havnefront*. [Online] Available from: https://aalborgkommune.viewer.dkplan.niras.dk/plan/5#/lokalplanid/4438/89522 [Accessed: 8th March 2020].

Aalborg Kommune. (2020) *Lokalplan nr. 1-2-118 – Baggrund og formål*. [Online] Available from: https://aalborgkommune.viewer.dkplan.niras.dk/plan/5#/lokalplanid/4438/58865 [Accessed: 6th February 2020].

Aalborg Kommune. (2020) *Lokalplan nr. 1-2-118 – Området*. [Online] Available from: https://aalborgkommune.viewer.dkplan.niras.dk/plan/5?fbclid=IwAR25jonqskeretH5LrNanano7OZWE_ikcFXNIW37lhesiBUbFgg0MaWoAiA#/lokalplanid/4438/58866 [Accessed: 17th February 2020].

Aalborg Kommune. (2020) ***Lokalplan nr. 1-2-118 – Overordnede principper***. [Online] Available from: https://aalborgkommune.viewer.dkplan.niras.dk/plan/5#/lokalplanid/4438/58870 [Accessed: 6th February 2020].

Aalborg Kommune. (2019) *Magistratens Budgetforslag for 2020-2023*. [Online] Available from: https://www.aalborg.dk/nyheder/alle-nyheder/2019/10/magistratens-budgetforslag-for-2020-2023 [Accessed: 12th February 2020].

Arbejdstilsynet. (2018) Indeklima. [Online] Available from: https://at.dk/regler/at-vejledninger/indeklima-a-1-2/ [Accessed: 13th May 2020].

Bjerg. (n.d.) *Børnehaven Karolinelund*. [Online] Available from: http://www.bjerg.nu/projects/boernehaven-karolinelunden/ [Accessed: 10th February 2020].

Bygningsreglementet. (2020) *Energiforbrug (§ 250 – § 298)*. [Online] Available from: https://bygningsreglementet.dk/Tekniske-bestemmelser/11/Krav [Accessed: 14th February 2020].

Bygningsreglementet. (2020) *Generelt for termisk indeklima*. [Online] Available from: https://bygningsreglementet.dk/Tekniske-bestemmelser/19/Vejledninger/Termisk-indeklima/Kap-1_0#3c879175-63e3-4766-99b6-6996abf1d94c [Accessed: 15th February 2020].

Bygningsreglementet. (2020) *Lydforhold (§ 368 – § 376) – Vejledning til daginstitutionsbyginger*. [Online] Available from: https://bygningsreglementet.dk/Tekniske-bestemmelser/17/Vejledninger/Daginstitutionsbygninger [Accessed: 14th February 2020].

Bygningsreglementet. (2020) *Lys og udsyn (§ 377 – § 384)*. [Online] Available from: https://bygningsreglementet.dk/Tekniske-bestemmelser/18/Krav [Accessed: 15th February 2020].

Bygningsreglementet. (2020) *Ventilation af daginstitutioner og undervisningsrum*. [Online] Available from: https://bygningsreglementet.dk/Tekniske-bestemmelser/22/Vejledninger/Generel_vejledning/Kap-1_7#2d3e9817-998f-4200-899d-bcb59a379e5b [Accessed: 14th February 2020].

Bæredygtigt byggeri. (n.d.) Grønt tag. [Online] Available from: http://xn--bredygtigtbyggeri-rrb.dk/groent-tag/ [Accessed: 11th April 2020].

Bæredygtigt byggeri. (n.d.) Papiruldsisolering. [Online] Available from: http://xn--bredygtigtbyggeri-rrb.dk/papiruldsisolering/ [Accessed: 11th April 2020].

Bæredygtigt byggeri. (n.d.) Ståltag. [Online] Available from: http://xn--bredygtigtbyggeri-rrb.dk/staaltag/ [Accessed: 11th April 2020].

Danske boligarkitekter. (2020) 5 bæredygtige materialer til din bolig. [Online] Available from: https://www.danskeboligarkitekter.dk/boligreportager/billedserier/5-baeredygtige-materialer-til-din-bolig/ [Accessed: 11th April 2020].

Danske boligarkitekter. (2020) Skifer. [Online] Available from: https://www.danskeboligarkitekter.dk/boligreportager/guides/facadematerialer/skifer/ [Accessed: 11th April 2020].

DGNB. (n.d.) Guide til DGNB for bygninger – Certificering af bæredygtige bygninger. [Online] Available from: http://xn--bredygtigtbyggeri-rrb.dk/staaltag/ [Accessed: 3rd May 2020].

Grønne Spirer (n.d.) *Bæredygtighed i børnehøjde – Om at formidle miljø og bæredygtighed i børnehøjde*. [Online] Available from: https://groennespirer.dk/sites/friluftsraadet.dk/files/media/document/baeredygtighed-i-boernehoejde.pdf [Accessed: 7st February 2020].

Miljøstyrelsen. (n.d.) Regnvand. [Online] Available from: https://mst.dk/natur-vand/

vand-i-hverdagen/genbrug-af-vand/regnvand-og-overfladevand/ [Accessed: 16th May 2020].

Min institution. (n.d.) *Daginstitutionen Bornholmsgade*. [Online] Available from: https://www.mininstitution.dk/hjemmeside/forside/index/190 [Accessed: 10th February 2020].

Petersen, M. og Gath, L. (2015) *Sanser og sanseintegration – Sansernes betydning* [Online] Available from: https://www.rigshospitalet.dk/afdelinger-og-klinikker/julianemarie/videnscenter-for-tidligt-foedte-boern/udvikling/Sider/Sanser-og-sanseintegration.aspx [Accessed: 21st February 2020].

Rockpanel. (2017) Rockpanel Colours. [Online] Available from: https://www.rockpanel.dk/produkter/rockpanel-colours/?selectedCat=dokumentation#Dokumentation [Accessed: 1th April 2020].

Socialstyrelsen. (2020) *Om dagtilbud*. [Online] Available from: https://socialstyrelsen.dk/born/dagtilbud/om-dagtilbud [Accessed: 13th February 2020].

Statistikbanken. (2020) *Danmarks Statistik – Statistikbanken – Befolkning og valg*. [Online] Available from: https://www.statistikbanken.dk/BEV22 [Accessed: 12th February 2020].

Stigsborg Havnefront. (2020) *Beskrivelse af området*. [Online] Available from: https://stigsborghavnefront.dk/om-stigsborg-havnefront/beskrivelse-af-omraadet [Accessed: 11th February 2020].

Stigsborg Havnefront. (2020) ***Velkommen til Stigsborg Havnefront***. [Online] Available from: https://stigsborghavnefront.dk/om-stigsborg-havnefront [Accessed: 6th February 2020].

Stigsborg P/S. (2020) ***Kvalitetsprogram for byggeri – Stigsborg Havnefront, etape 1***. [Online] Available from: https://stigsborghavnefront.dk/upload/dokumenter/Stigsborg_kvalitetsprogram_for_byggeri_til_web.pdf [Accessed: 6th February 2020].

Bæredygtigt byggeri. (n.d.) Gips. [Online] Available from: http://xn--bredygtigtbyggeri-rrb.dk/gips/ [Accessed: 11th April 2020].

Træ. (n.d.) OSB. [Online] Available from: https://www.trae.dk/leksikon/osb/ [Accessed: 11th April 2020].

Træ. (n.d.) Thuja - Kæmpethuja. [Online] Available from: https://www.trae.dk/leksikon/thuja-kaempethuja/ [Accessed: 11th April 2020].

UX Planet (2018) *UX Desing Glossary – How to Use Affordance in User Interfaces*. [Online] Available from: https://uxplanet.org/ux-design-glossary-how-to-use-affordances-in-user-interfaces-393c8e9686e4 [Accessed: 27st February 2020].

Zostera. (n.d.) Tangisolering. [Online] Available from: https://www.zostera.dk/tangisolering/ [Accessed: 11th April 2020].

Zostera. (n.d.) Ålegræs. [Online] Available from: https://www.zostera.dk/alegraes/ [Accessed: 11th April 2020].

ILLUSTRATIONS

Areco. (2020) Areco TP 20/220 Pandeplade. [Online] Available from: http://www.areco-profiles.dk/dk/produkter/areco-tagprofiler/areco-tp-20-220-pandeplade/ [Accessed: 11th April 2020].

Cupa Danmark. (n.d.) Facadeskifer – Naturskifer til facader. [Online] Available from: https://cupadanmark.com/produkter/facadeskifer/ [Accessed: 11th April 2020].

DCS. (2020) Grønt tag. [Online] Available from: https://www.danskcarportsystem.dk/groent-tag [Accessed: 11th April 2020].

DMI. (1999) Vindrose. [Online] Available from: https://www.dmi.dk/fileadmin/user_upload/Rapporter/TR/1999/tr99-13.pdf [Accessed: 19th March 2020].

Heinze. (2020) Rockpanel Colours Fassadenplatten. [Online] Available from: https://www.heinze.de/produktserie/rockpanel-colours-fassadenplatten/10043975/1/ [Accessed: 11th April 2020].

Keflico. (n.d.) OSB3 with/without Fer & Note. [Online] Available from: https://keflico.com/produkter/krydsfiner/osb/osb3/ [Accessed: 11th April 2020].

M4 Arkitekter. (2019) Træbeklædning. [Online] Available from: https://m4arkitekter.dk/tag/traebeklaedning [Accessed: 11th April 2020].

Mads Windfeldt Arkitekter. (2014) Tag: Papiruld. [Online] Available from: https://madswindfeldt.dk/blog/tag/papiruld/ [Accessed: 11th April 2020].

Petersen Tegl. (2019) D70. [Online] Available from: https://www.petersen-tegl.dk/mursten/produkter/d70/ [Accessed: 11th April 2020].

Realdania Byg. (2013) Det moderne tanghus på Læsø. [Online] Available from: https://madswindfeldt.dk/blog/tag/papiruld/ [Accessed: 11th April 2020].

SDFE. (2020) SDFE kortviser. [Online] Available from: https://sdfekort.dk/spatialmap? [Accessed: 11th Februar 2020].

The other illustrations are own production.