An institution for the future

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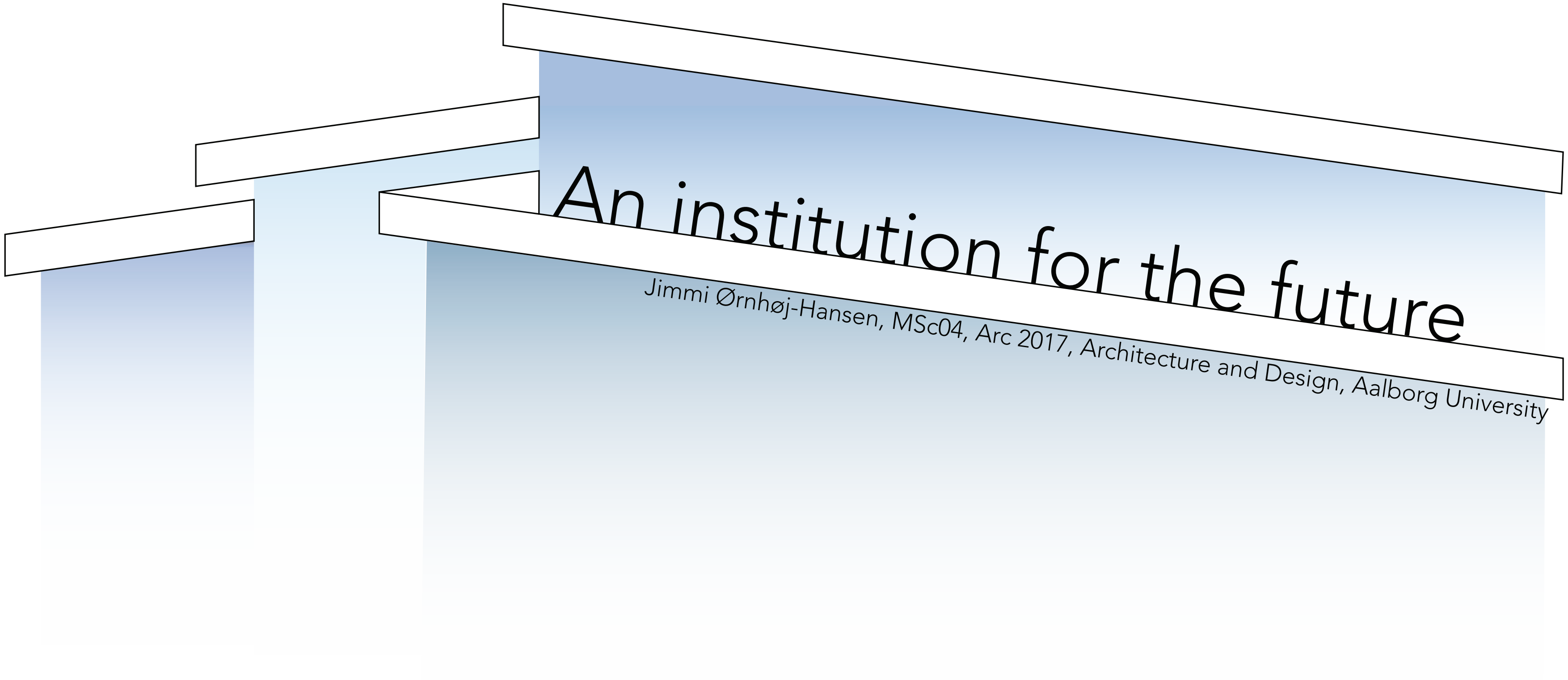

An Institution For The Future

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Institution:
Aalborg University

Department:
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Course:
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Readers guide

The report by your hand will introduce the development of a sustainable integrated institution in Vejle, Denmark.
The structure of the report contain six chapters which allow you as a reader to get the full understanding of the design and the proces of it.

Chapter 01: Prologue
The chapter introduces the project and inform the reader about which approach that has been made for the project.

Chapter 02: Program
The program chapter contain the analyses made of the site to contribute a better understanding of the area wherein the project is located. The chapter also contain a function diagram, a room program, the vision, design parameters and potential design principles.

Chapter 03: Design Process
The chapter containing the design process presents the main steps which has been guiding the project to the final design solution. It is presented in a logical order instead of chronological, to enhance the understandability of the process.

Chapter 04: Presentation
In this chapter the final design is presented. This is done through the use of plans, sections, elevations and details. The technical aspects such as sustainable strategies and calculations are presented together with the architectural solutions in respect of the integrated design process.

Chapter 05: Epilogue
Within this chapter appears the conclusion and reflection of the project and those are followed by the literaturelist and illustration references.

Chapter 06: Appendix
The content of the appendix is important documentation of calculations , tables and software results which has been part of the process.

A b s t r a c t

The institutional sector is in a great need of being renovated and/or renewed. More than 50 % of the employees, in 9 out of 10 institutions, feel harrased by noise and/or bad atmospheric indoor environment - it can be assumed that this also have an effect on the children. Therefore this project report aims to create a sustainable integrated institution, which not only takes care of problems with bad indoor climate and noise, but also support the daily users, and helps them to develop through a building designed especially for them.

The thesis offers a 360° promotion of sustainability in the design of an integrated institution in the city centre of Vejle. Furthermore it is a catlayst for sensory- and motor development, accomplished through an integrated designproces, including studies of child development behaviour, brain architecture and the pedagogical approach of Reggio Emilia. To support the proces a survey has been created, and used, to combine theory and praxis. This ensures that the design is both inspiring in a development manor for the children, but also functions and support the pedagogues in a daily working environment.

The institution contain 48 nursery kids and 80 kindergarten kids divided in two interrelated departments having a total gross area of 1800 m^2.

The environmental sustainability is processed through a design which meet the energyframe 2020 without active strategies. At the same time all considered materials for the design has gone through an analysis to ensure a minimal footprint on the environment.

Enjoy.

Empiricism and methodology

Questionaire

Initially it has been chosen to make a survey as a part of the empirically material for the thesis. The survey will ensure a wider perspective on the subject which will be analyzed quantitatively. The reason for doing the new survey is that search for similar and recent studies has not been succesfull, and therefore the search does not cover the areas which is chosen to investigate, being the institution in an old building, a new institution and an institution using the Reggio Emilia approach. Due to the relatively short time and resources for the thesis, employees of three selected integrated institutions, have been chosen as respondents and these cover the before mentioned areas that I want to investigate. The question guide has been included in the appendix. The purpose of the survey and quantitative outcome is to strengthen the design process.

The integrated design process

Together with the empirically developed material I will be using 'The Integrated design process' by Mary-Ann Knudstrup as methodology. This method does not ensure either aesthetics or sustainability in the project itself, but is a work tool that ensures a wide insight and control of the many parameters to be considered, and implemented, in the architectural project. Using 'The integrated design process' increases the opportunity of a more holistic sustainable architecture being produced (Knudstrup M.A., 2005).

The integrated design process is interdisciplinary and seeks to combine architecture with engineering skills. Combining the two knowledges, technique and aesthetics forms a whole.
The method implies 5 phases. Both altogether and each of the phases helps controlling the process and implementation of different elements. The phases are as following; Problem formulation, analysis, sketching, synthesis and finally presentation phase.

The first phase is the problem formulation which is where the problem/project is described.

In the analysis phase all the information considered to be important is investigated. It adds some specific parameters which are worthy to have in mind when entering the sketching phase. Examples of analyzes could be site information such as municipality plans, topography, vegetation, sun, main wind direction, flood risk etc. It is also able to provide information according to special qualities of the area. In the analysis phase the contractor is involved in the process. With him/her one makes a room program, becomes aware of logistic measures and makes a chart of functions. It is also in the analysis phase that the passive design strategies should be investigated to enhance the possibility to design a sustainable building with

an optimum indoor climate in all the different aspects.
The passive strategies should be developed whilst considering local climate conditions. The end product of the analysis should be a statement of aims and a program for the building.

The third phase is the sketching phase. Here the goal is to combine professional know-how of the architect and the engineer and hereby provide mutual inspiration to enable the possibility to meet the demands and/or wishes for the building. All criterions and targets are in this phase considered when developing the project. The precondition for the phase to be the most effective is, that one repeatedly make estimations of how every choice will affect the final outcome.

The fourth phase, being the synthesis phase is where the building finds its final form. All parameters considered flow together or interact and create a symbiosis. Everything implemented should be optimized, and hereby the performance of the building should be improved and afterwards calculated and documented – As an example this could be the indoor climate aspects such as thermal and atmospheric climate.
The presentation phase is the final phase. In this phase the qualities of the project is presented. It is also a phase for emphasizing how the criterions and aims of the project have been fulfilled. (Knudstrup M.A., 2005).

M o t i v a t i o n

Children are very much affected by their surroundings. Their everyday environment concerning for example air quality, light quality and acoustic quality has an impact on their wellbeing and brain architecture. Also their physical environment influences them. It is important for them to have an environment that stimulates and support their motor- and sensory development. During the last 5-10 years the integrated institution has gained ground on behalf of the traditionally separated nursery and kindergarten. (bupl - amount of institutions, 2016) The government has made a quality fund which has devoted 22 billion for co-financing restoration an new construction in the sector, between 2009-2018. The attitude about integrated institutions are varied but mostly it is very much welcomed by parents, since it offers the families an easy transit from nursery to kindergarten, and also gives the opportunity to have children of different ages at the same place. In Denmark we somehow are a little conservative according to the development of institutions. (see case study page 26-29)

Due to maintenance and economy the area available for a child is low, and all materials chosen are chosen according to the aspects of maintenance and the technical aspect of the materials such as acoustic properties. The problem with this is that the architecture does not support the development of children, in an integrated way. Instead of the building functioning as a catalyst for child development the building becomes a storage room wherein a lot of furnishing is put to support the development of children. This thesis is an attempt to revitalize and rethink the concept of an institution in a Danish context. This is to be done through a sustainable approach combined with theory of Brain architecture, The Reggio Emilia pedagogical approach and by studying the development of children. In this way the project seeks to make a project to enhance the possibility of children to develop most effectively and hereby enhance sustainability in the sector.

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The concept of sustainability
Sustainable development as a trident
Approach of Reggio Emilia

Introduction

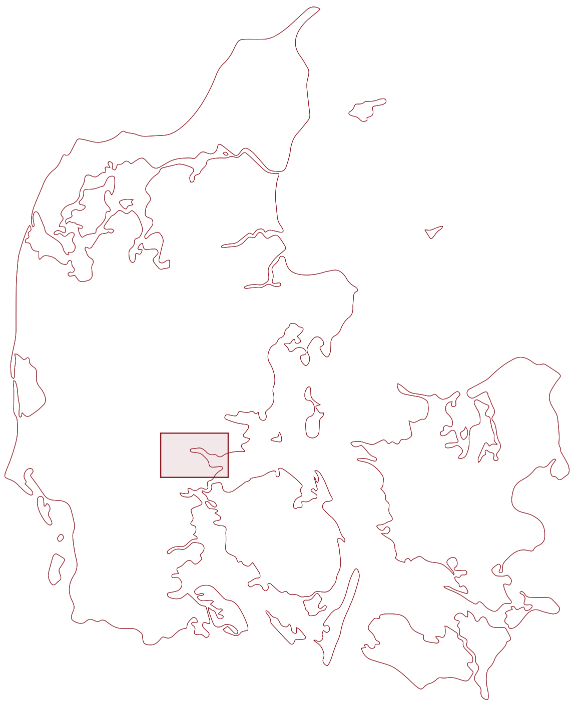
The area of the new integrated institution is placed in downtown Vejle close to the railway station, the main pedestrian street and a lot of residential areas. The site is today occupied by car parking. Close to the project site lies the old postoffice ground which has been planned to be transformed into a large residential area. Vejle is a city in the southern of Denmark with app. 55.000 inhabitants. The city is seen as a practical place to live according to a relative short distance to a lot of bigger cities with possible jobs, such as Århus, Herning, Kolding and Odense. This makes the railway station a big point of transit for commuters. The city center is of a semi-dense character with some historical buildings, and at the same time the countryside is only 5-10 minutes away.

A: Project site - Havneparken, Vejle

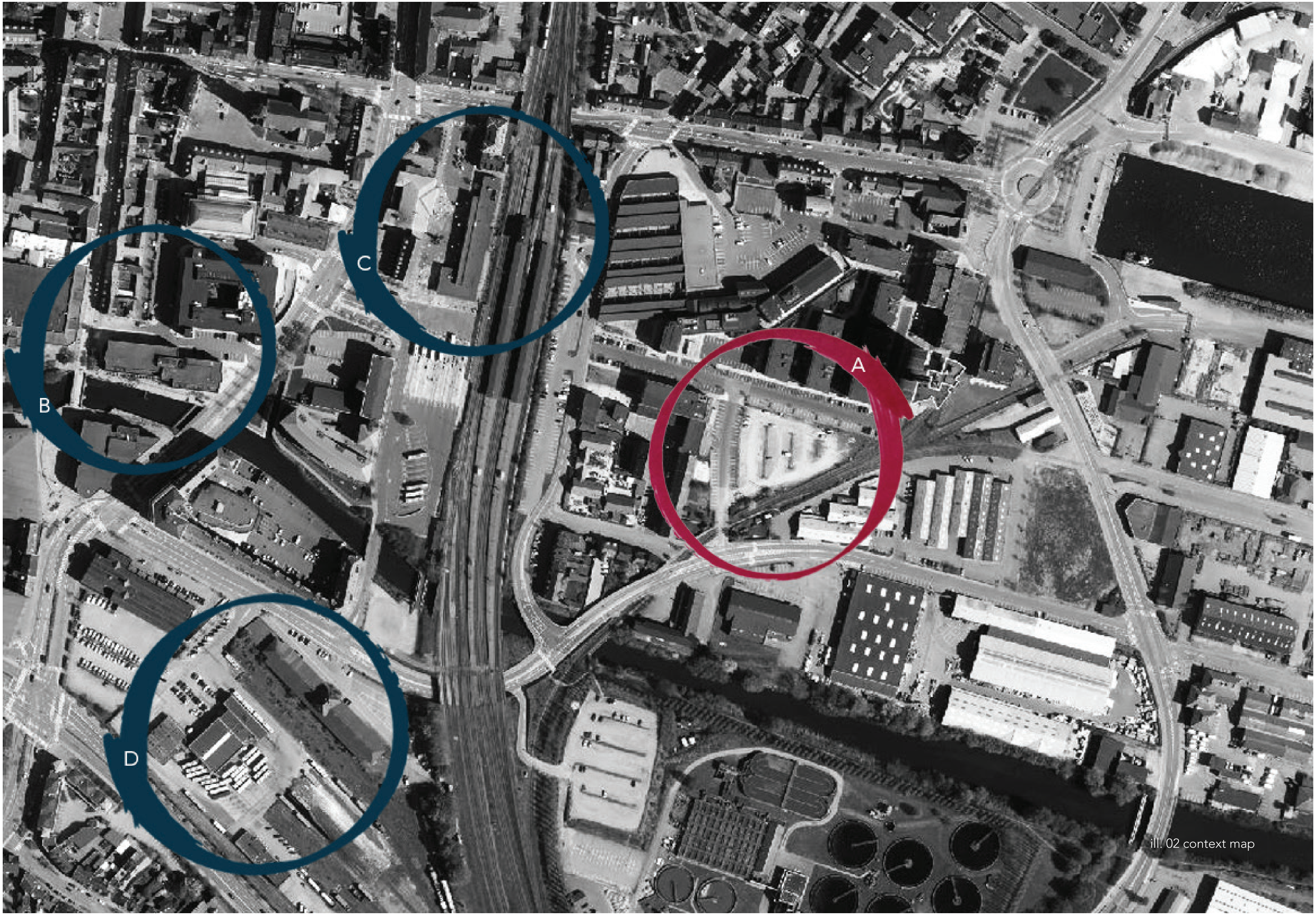
B: Future residential area

C: Railway- and bus station

D: Start of main pedestrian street - Søndergade



ill. 01 DK map



ill. 02 context map

Introduction to the concept of sustainability

It is important to remember that the opinion of sustainability as a concept is everchanging and therefore the solutions used now are most certainly not considered relevant or best practice in 15 or 20 years. Sustainability and the opinion about sustainability has through history changed very much and in some cases drastically. This is best accounted for when considering that Sustainability arguably started around the middle of the 19th century with the publication of the text "Civil Disobedience". This presented some sort of sensitivity towards nature, that at a certain point denied the western cultures anthropocentric point of view. [Encyclopedia.com, 2009]

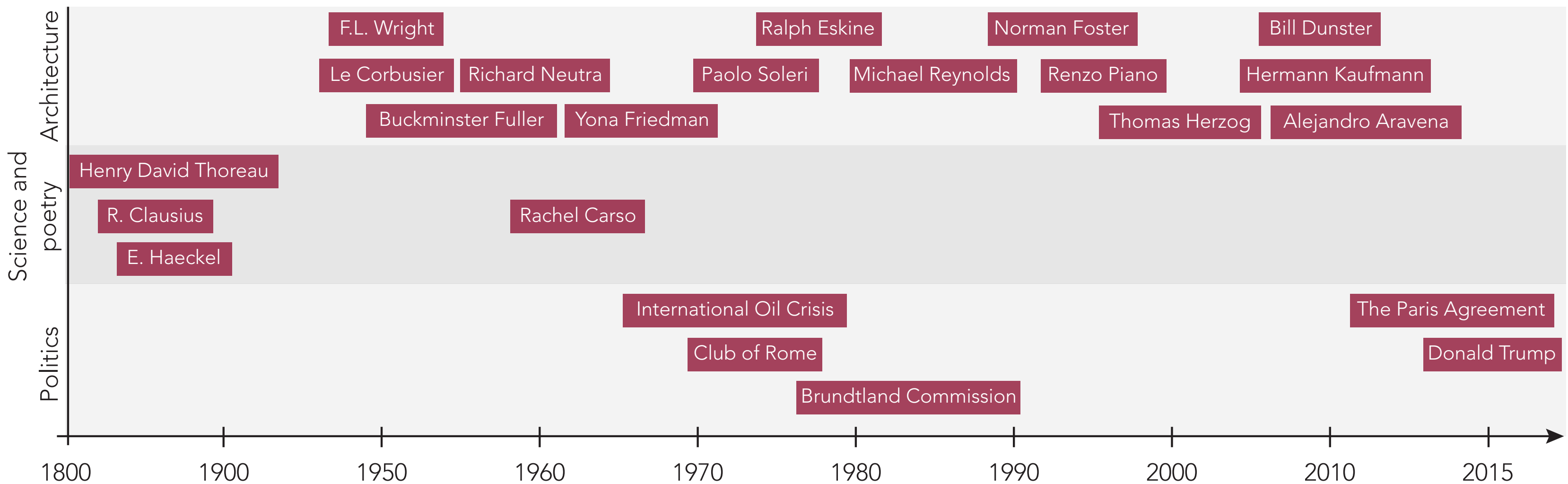
In the following decades two concepts widely considered being of sustainable manor saw the light – those were Ecology and Entropy. Ecology was "invented", so to speak in 1862, when R. Clausius - a physicist, defined the dispersion of matter and energy in relation to the second law of thermo¬dynamics. He also coined the word entropy which four years later was defined by zoologist E. Haeckel. [Encyclopedia, 2004] The drastic counter part to this approach and concern about the environment is the fact that the newly elected president of the United States has claimed that global warming is invented by China and not a reality (Trump, 2012). This shows us that it is hard to foresee how the concept will evolve over time.
Ecology and entropy was a very spaw start of sustainability which has developed further through history with for an instance Le Corbusier and F.L Wright. Though having a big impact on the industrial culture in the middle of the 20th century, Le Corbusier and F.L. Wright must be con-sidered proto-ecologists. For an instance Wright referred to organic architecture and his desire to build into nature. Le Corbusier was working with the green city and a desire to build above nature [University of Nevada, Las Vegas 2017]

In the early 1970's, the sustainable architecture movement began as a direct response to and effect of the oil crisis. Arguable it started with the Club of Rome's book "Limits to growth" which analyzed factors such as environmental pollution and the use of natural resources. [Club of Rome, 2017] The ideas though started around a decade before with the publication of "Silent Spring", a text by Rachel Carso that for many people initiated a modern environ¬mental movement [NRDC, 2015]
Others again believe that sustain¬able architecture started a lot ear¬lier, with the vernacular architectural forms spread across the world. In the pre-industrial period, soci¬eties strived to balance between a built and a natural environment when settling. Their focus was different though, since what they wanted to achieve was not a sustainable ar¬chitecture. Instead they very pragmatically tried to define a set of conditions of comfort by the use of tools available at the time.

The before mentioned sustainable architecture of the Seventies was a reaction to the construction industry, and the fact that buildings were a major cause of a rapidly increasing energy consumption.
The big change started during the international oil crisis in 1973, when the Arab oil producing countries imposed an oil embargo against the United States of America and other countries that were supporting Israel. Even though the em-

bargo only continued for six months it had severe economic effects for several years from then. More precisely it created a ten-year energy crisis which kick-started the attention of research in alternative energy designs.
In 1983 the Brundtland Commission was formed. This was an organization that focused on environmental and development problems. The purpose was to make an international community who shared the same goals for sustainability. The Commission published a report -"Our Common Future" in which it was defined what sustainable development was. [DAC, 2016]
Another important part was the statement of three main pillars of sustainable development being, environmental protection, social quality and economic growth. Three pillars which today still is considered the fundamental aspects of sustainability.

[UNEP, 2011]
In recent times we have the before mentioned opinion of president Donald Trump which is hatred by many but on the other hand also very respected by others. In architecture specifically different approaches are apparent. An example of this is Thomas Herzog who works with sustainability from mainly an aesthetic point of view where on the other hand Bill Dunster is more oriented towards the effectiveness of sustainable solutions and does not hesitate to scrap a solutions which is aesthetically beautiful if another solution is just a little more effective in relation to sustainability. All this shows us that sustainability is not only one solution or one approach, but a result of time, and development.

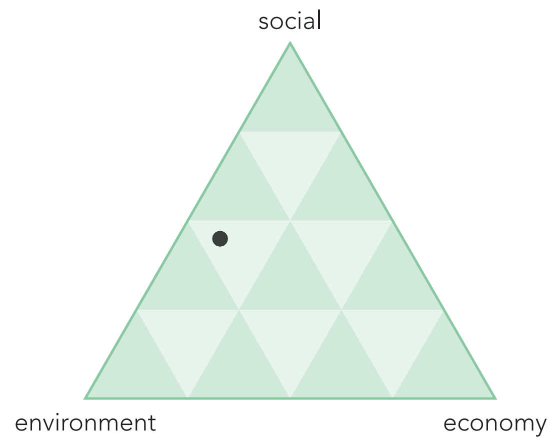


ill. 03 Bibliography

Sustainable development as a trident

The project in the context of sustainability

The sustainability triangle visualizes how the project is located in relation to the means of the three pillars of sustainability. Economic sustainability is the aspect being articulated the least but is relevant when thinking about making cost-benefit analysises in relation to increased child development.



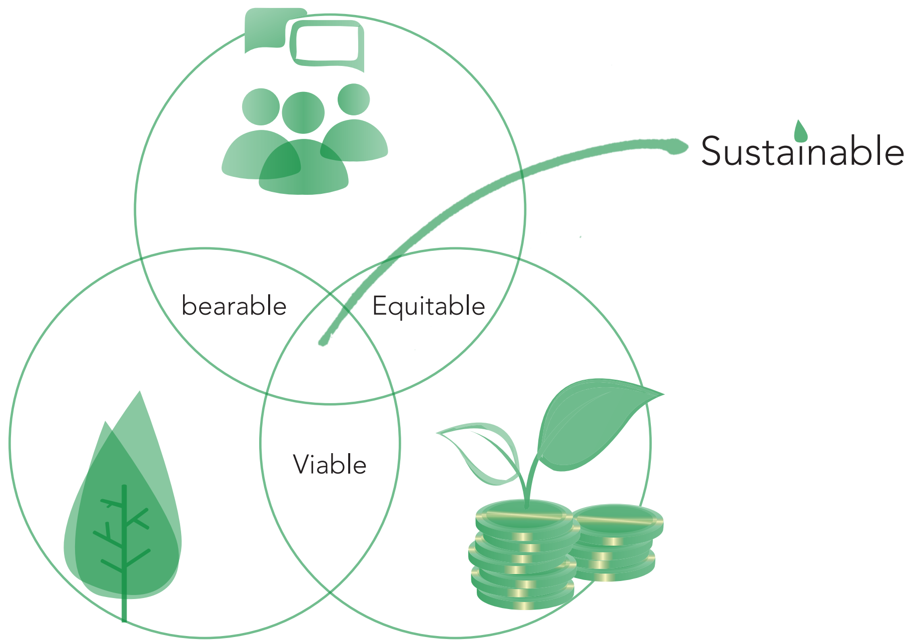
ill. 04 Trident of sustainability

Environmental protection

Living within the means of our natural resources ensures environmental sustainability. It is defined as being, "the maintenance of the factors and practices that contribute to the quality of environment on a long-term basis". [businessdictionary.com, 2017] This means that our consumption of natural resources such as wood, fuels and water is at a sustainable rate. Needless to say some resources are more abundant than others, which have to be considered along with the damage they do to environment when extracted and/or processed. The re-usability is also bigger for some materials than others. The nature is able to process certain amounts of pollution over time meaning that it is necessary to avoid pollution or at least keep it at a rate where nature has the capacity to process it. Also it is needed to consider if resources can be kept within circular economy principles. Often sustainability as a whole is confused with environmental sustainability. Sustainability works as a trident and consist of three pillars being environmental, economic and social sustainability. [circularecology.com, 2017].

Economic growth
Economic sustainability might be described as the business of staying in business. Looking at small-scale level a business could be a corporation, and on a larger scale it could potentially be a country. No matter the scale the essence is resource-efficiency and responsibility. To operate sustainable, a consistent production plays a big role to ensure an operational profit. Normally supply and demand determine the limits of production together with resource availability. [circularecology.com, 2017].

Social sustainability
A society or social system's ability to maintain a good social well-being is referred to as being social sustainability. By ensuring social sustainability the wellbeing of a country, an organization or a community is secured on a long term level. [circularecology.com, 2017].
The Hawke institute has in a publication defined five means to social sustainability being: 1. Equity, 2. diversity, 3. interconnectedness, 4. quality of life and 5. democracy and governance. [McKenzie, 2004]



ill. 05 degrees of sustainability

Approach of Reggio Emilia

The Reggio Emilia approach is an educational philosophy based on preschool children. It is primarily based on the image of the child and human beings as having a great potential to develop and sees them as being able to learn and grow the best through relationships to others. It describes the child as having a hundred languages being robbed the 99 in traditional school and institution. The meaning of this that the child has a hundred ways to think of everything but will lose this ability through normal education. It is a global educational project having its origin in the Reggio Emilia, Italy which has inspired preschools all over the world. The approach has a foundation of a number of distinctive characteristics being:

1. The participation of families.
2. The collegial work of all the personnel.
3. The importance of the educational environment.
4. The presence of the atelier.
5. The in-school kitchen.
6. The pedagogical coordinating team.

It strives, through the atelier spaces, to offer opportunities to encounter a great amount of materials, expressive languages and points of view. Also it motivates the children to actively work with their hands, minds and emotions. Hereby they will have a lot of different experiences to evolve their brain architecture. This approach values the expressiveness and not least creativity of every individual child in the group or institution. [reggiochildren.it, 2017]

In Reggio Emilia light, shadow, form and color has a big role and is used every day. It is the children's approach to the projects that form them – Only some guidelines are made to ensure that the children reach some learning goals. Mainly the materials used are of REMIDA origin meaning that it is reused material from for example the production industry. (Remida.dk, 2017) This is a part of the sustainable thinking in Reggio Emilia. From an architectural point of view, this ever changing and non-predictable approach to learning, has the needs of a physical environment, that can be changed according to the needs of the children. The internal and external rooms must be designed and organized in mutually connected forms with the purpose of enhancing the interaction, independency, curiosity and communication between the children and between children and adults. [scuolenidi.re.it, 2017]

The impact on the architecture caused by using the Reggio Emilia approach as a foundation will be a project that celebrate the light and what it does to us as human beings. The natural light will be the backbone of the project. In use Reggio Emilia, will also cause an effect on the architecture due to the way the pedagogical approach works. This for an instance is by having children make installations that play with and manipulate the light. Functionally the area will be larger than what is normally seen in a Danish context to improve the possibility of children to express themselves.

ill. 06 Reggio instalation

0 2 P r o g r a m

Brain architecture in relation to indoor environment
The development of children
Case study: Nokken, Islands Brygge (conventional institution)
Case study: Børnehuset, Lille Dalby (Reggio Emilia institution)
Questionaire
Development plan
Infrastructure
Flood risk
Soil pollution
Climate: Sun and wind
Climate: Direct sun
Summary

Brain architecture in relation to indoor environment

In relation to Reggio Emilia it is very relevant to investigate the brain architecture and development of a child due to indoor environment and, in this particular case, the light quality of a room. Reggio Emilia has a great focus on light, shadow and the interplay in between these two. The presence of daylight, and in some cases, artificial light, is very important for a child to develop. The human vision is based on a stereoscopic vision. This means that the correlation between the retinal images in each eye is important. For that to be possible the child must develop a visual system. This is normally developed in the first weeks after birth and evolves due to impressions from contrasts, a lot of colors and likely movement. The first two years of life is also called the sensor-motor phase in the development of the child. In this phase the child learn about the relation between sensory perception and motor behavior. This for example relates to knowing how far to stretch to grab something. A close relation between the visual sense and the balance sense is apparent. To support this the child must be able to focus on a specific point. To make this possible small contrasts that the eye can focus on must be apparent. In this way the child will develop the ability to keep its balance while moving. Diffused light blurs the contrasts meaning that having only indirect and/or diffused light is bad for the development of sight and motor skills of a child. At the age of three children start to use the visual sense at a more experienced level. They develop a more precise interaction between the visual sense and the balance. For that manor it is important for children to have access to light conditions that support the ability to focus and also the light has to support the practice in coordinating between physical and visual impressions. This is for example the case in eye-hand coordination.

As mentioned light is not the only important factor for children to develop physically and psychologically. The atmospheric indoor environment is also very important according to developing the architecture of the brain. Early experiences and exposure to toxic substances affects the architecture of the brain and hereby the development of a child. The brain architecture is the foundation of all future learning, behavior and health. Looking at the physics of a house – if the foundation is weakened it will for sure decrease the quality and strength of the house and the same processes are apparent when a child has to develop. The brain is constructed through an ongoing process which starts before birth and proceeds into adulthood. Basically it is neural connections that become more and more complex due time. After a rapid proliferation the first years of life the connections will be reduced after a "use or loose", principle. This process makes the brain circuits more efficient. The interaction of genes caused by experiences is what shapes the developing brain. The genes given from the parents are the blueprint for the formation but the brain circuits are reinforced by repeated use. One major aspect in the developmental process is the so called serve and return interaction that is present between children and their parents or other caregivers. If there is an absence of caregiving the brain architecture will not form as it was supposed to or expected and this might give disparities in learning and behavior. [Harvard University, brain architecture, 2017]

Experiences put a chemical "signature" on genes that changes how the genes are expressed. Those signatures are called epigenome. It is in the early development that the brain will respond to experiences the easiest. Experiences from outside sparks a signal between the neurons and in response the create proteins – proteins that will have an effect on either the attraction or repellence of enzymes. [Harvard University, Gene-environment, 2017] As an example rich learning opportunities will function as a positive experience for the brain. These can be secured by improving indoor environment and by making integrated installations which can work as catalyst for a positive development of the childs physical and psycological attributes. on the other hand, malnutrition or environmental toxins are negative experiences for the brain. Common to them is that the experiences are able to change the chemistry of the brain – changes that can be temporary or permanent. These changes are called epigenetic modification. [Harvard University, Gene-environment, 2017]

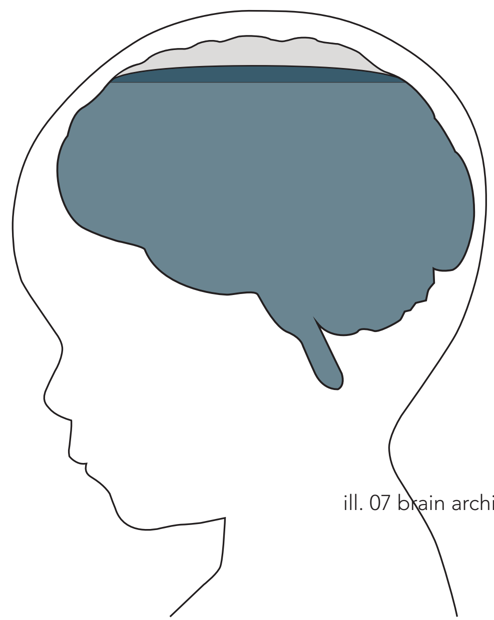
The functions of the brain operate in coordination with one another. The well-being of a child and social competence will provide the strong foundation needed to develop cognitive abilities. Social skills and cognitive-linguistic capacities apparent in the early years are very important to ensure success in school, worklife and the community. [Harvard University, brain architecture, 2017]

Chemicals disrupt many of the biochemical processes that are normal in the brain. These processes are important to develop a sound and durable brain early in life. The chemicals can occur from many places such as synthetic materials in paint, dust or soil. The chemicals are present in mixtures that break down over time. This break down process releases individual toxins which enter bodies of children – and adults, in different ways such as skin absorption, eating, or inhalation. Transferred to the building industry this break down is called degassing and is possible in a lot of building materials and referred to as VOC's. [Harvard University, "early exposure...", 2017]

Brain architecture makes it relevant to pay attention to the materials used in the project to ensure an indoor environment as harmless to child development as possible. A tool to do this is materialscreening including life cycle assesments.

90%

of a child's brain development happens before age 5



ill. 07 brain architecture

The Development of Children

Children in different ages have different needs for development of their attributes. This is determined by the brain activity and how they react to different stimuli. In the age between 0-3 years the brain has a latency of 3-4 minutes. This means that the brain has to be awakened "again" to keep the attention of the child. To do that the environment have to include surprises, changes in activity, a great amount of sensory inputs mainly focused around taste, smell and the sense of touch. The reason for this is that these senses activate the cortex. This has the effect of children learning to do the cross movements needed to both crawl and walk. Examples of furnishing that enhances the development of children between 0-3 years are corners with pillows for storytelling, music and singing opportunities, rest spaces that are not activity determined and a great amount of free floor area. [Børn og unge - Århus kommune, 2008]

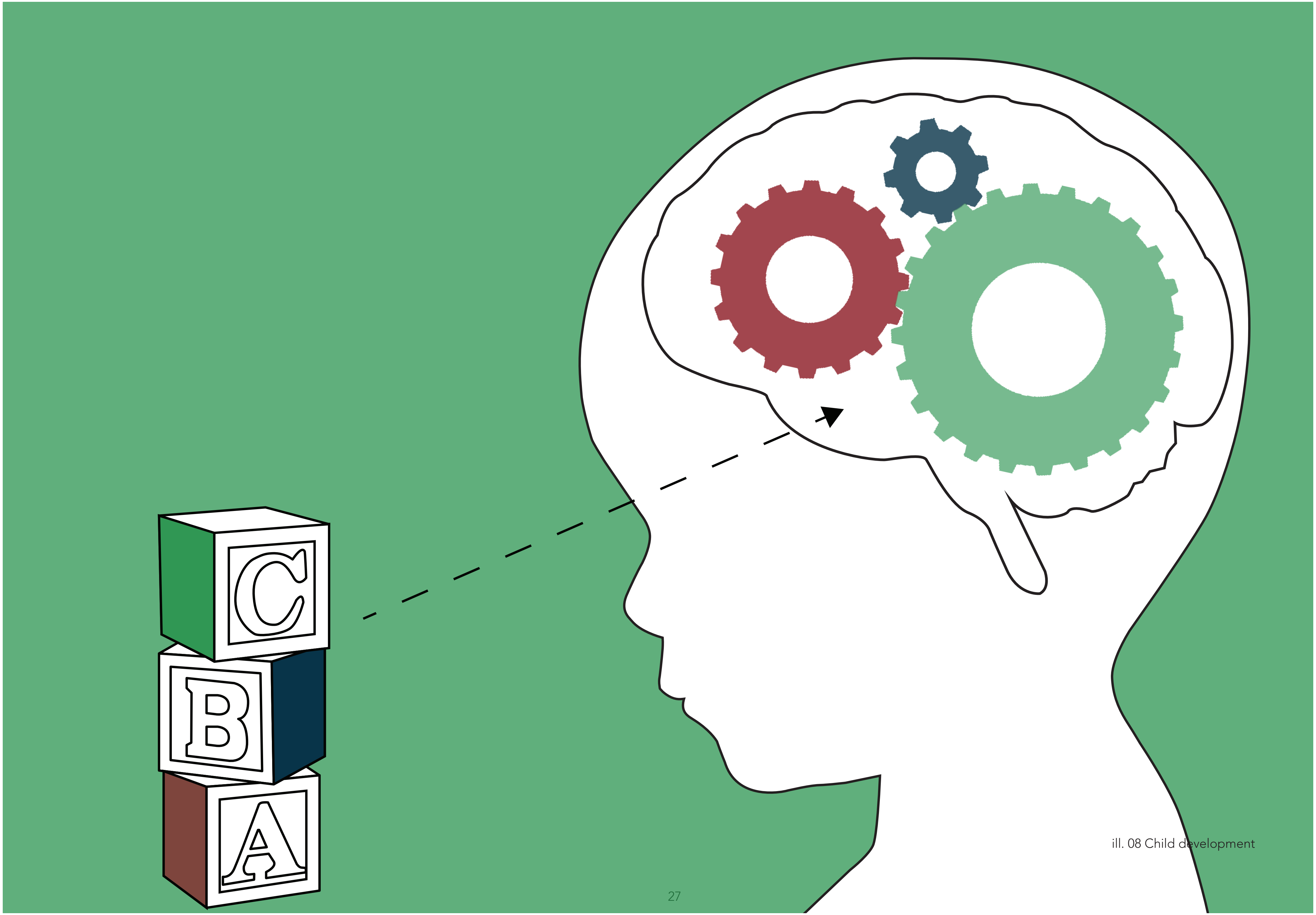
Studies, of 3-5 years old, show that with the same child/adult ratio children in smaller groups (app. 12-14 children) show a greater willingness of social interaction with other children or adults. This is compared to groups of approximately 24 children. The children were more cooperative and took verbal initiative at a higher rate. They were also less aggressive and had fewer conflicts. Also the kids in smaller groups scored higher in pre-school tests. On the other hand there were indications of better development of children in groups with a smaller child/adult ratio.

The reason for this could be the possibility for the staff to have more contact to each child during the day and hereby stimulate the child in different aspects of the development. [SFI, 2014]

Between the ages of 3 and 6 years being the kindergarten age the children need to be stimulated with games that train their memory. It is very important that the focus is on motor skills, musicality, perception of space and language since this will give the child so called reserve capacity to be able to learn at school age. Both indoor and outdoor playrooms must be furnished according to versatile stimuli of the brain. The latency time of the child is still relatively short so management by adults is necessary.

The children between 3-6 years have different needs according to furnishing than the smaller children. This furnishing could, for an instance, be playgrounds, a woodshop, tables and chairs, atelier or the like and theater/scene. [Børn og unge - Århus kommune, 2008]

Children in general seem to react and develop differently due to the physical environment apparent and for this reason there are regulations on the area available for each child. The minimum area (class C) is 2sqm for kindergarten children and 3sqm for nursery children. In the thesis, class A is the goal being 4,5sqm pr. child in daycare and 3,5sqm pr. child in kindergarten. [SBi, 2013]



ill. 08 Child development

Case Study: Nokken, Islands Brygge

Name of institution: New Daycare, Islands Brygge
Pedagogical approach: Howard Gardener
Year of construction: 2014
Gross area: 1200 sqm
Energy Frame: 2010
Architectural counselor: Christensen & Co. Arkitekter A/S

The new daycare on Islands Brygge is placed in between the sailing clubs on Islands Brygge, Copenhagen, Denmark.

Entering

The institution is organized in a square like form organized around a central yard. The nursery area and the kindergarten area is placed on each side of this yard having the main entrance area in between functioning as distribution area for the entire building. The area is very well lit with both sidelight and skylight giving a very bright room that appears welcoming. From the entrance area a view to the yard is possible giving the opportunity to experience outdoor areas in several directions. From here the daycare does not appear to be placed in a big city. Left of the entrance is the main kitchen that serves both the kindergarten and the nursery.

Wardrobes

From the entrance area one can proceed to the wardrobes. This is the first sign of an architecture that stands out compared to other institutions build today. The wardrobes are colored in different strong colors such as red and bright yellow. The contrast and colors are, as mentioned in the chapter

ill. 09 Nokken, wardrobe

about Brain architecture and child development, fundamental for the development of the vision and other senses of the child and the colors are apparent in most of the building which is good in that manor. Something about the colors that might not be very appropriate is for an instance the use of the strong red color. This relies on color psychology. Red is known as a color that enhance feelings such as excitement and aggression and refers to passion but also danger and intensity. [Colorpsychology.org, 2017] Excitement and passion as a feeling is not at all bad, but one might prefer the child to be calm and focused in the wardrobe area. The argument for this is that it might have a positive effect on the process and maybe it would be easier for the child to focus on self-reliance and hereby motor development.

Group rooms and common rooms

The group rooms and common rooms are just as the entrance area very well-lit with both side light and skylights which make a comfortable bright room.. The spaces appear inviting and friendly. The material on the walls are varying from colored gypsum over bended aluminum to colored tiles. The rooms offer different materials to touch and experience and hereby the sensory development is enhanced. In this way the daycare enhance the social sustainability according to the development of children but the amount of integrated aspects is limited and might be a manor of economy.

Limits of development opportunities

As mentioned the wall materials and colors all enhance the development of the children, but this is it. No furniture in the rooms are integrated. In this way it becomes a room that could have the purpose of so much else than a daycare instead of having a room that is focused on developing the children and

ill. 10 Nokken, common room

only that. It becomes the furniture that support the children in for example the motor development instead of the room which then could have additional furnishing to even further enhance development possibilities. The new daycare on Islands Brygge is an example of a daycare in a Danish context were it obviously has been considered who the users are and some choices has been made to enhance development possibilities. The lesser degree of building integrated development possibilities support the idea of Danish architecture being a little conservative and cautious according to the development of institutions.

Case Study: Børnehuset Lille Dalby

Name of institution: Children's House Lille Dalby
Pedagogical approach: Reggio Emilia
Year of construction: 2010
Gross area: 900 sqm
Energy frame: 2010
Architectural counselor: Pluskontoret

Børnehuset Lille Dalby is placed in the eastern part of Jutland in the outskirts of the small town Hedensted.

Entering

One enters the building through a rather narrow hallway into the common room which is well lit with both skylights and panoramic windows towards south. By letting in natural light from both south and north the room seems inviting and kind. The common room does, beside being a play area, function as an area were all the children can eat together. The production kitchen is in direct open contact with the eating area letting the kids interact with the kitchen staff and help with the food.

Learning across ages

The commonroom connects the institution and allow children to interact across ages. The idea of interacting across ages is very coherent with the Reggio Emilia approach. Studies show that a 5 year old will have a great outcome by interacting with for example a three year old even though they are on different stages of their development. The reason for this is that by interacting with a child, being either younger or older, one will have great possibilities to develop his or her social interaction skills or hereby it will over time become easier to interact in different social connections. This is a big contribution to the development of a child's brain architecture.


ill. 11 Lille Dalby, common room

Areas determined by age

Left of the common room is the nursery area. This area is only usable for pedagogues and nursery kids. The area is divided by a long hallway with group rooms to the right (south) and wardrobes, nursing facilities and crib room to the left (north). The hallway is furnished with different building integrated tools which are a to be used by the kids. In this way the long corridor has small zones that interrupt the direct line. This

arguably make the children run less and interact more with the furnishing, due to psychology. A problem with the corridor which is also apparent in the kindergarten area is, that a lot of square meters are used without getting anything positive out of it. It seems like the zones in the corridors are made as a solution to the long uninteresting path instead of the hallway being a result of the zones.
The kindergarten area which instead is completely open to the common area, is arranged in the same way as the nursery area.

ill. 12 Lille Dalby, atelier

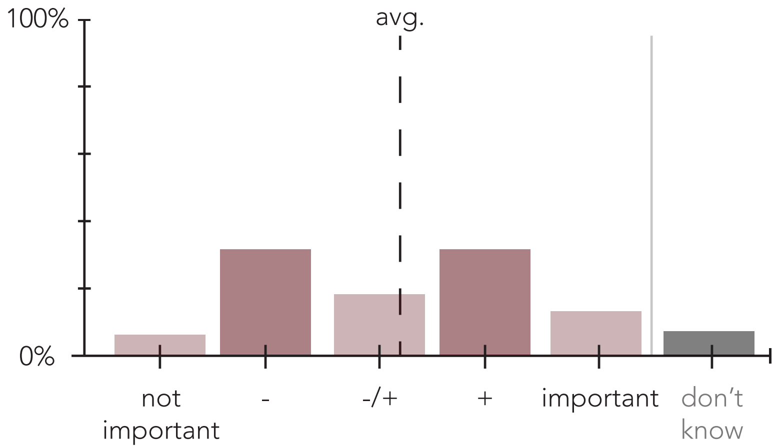
Reggio Emilia influence

In both sections there is an atelier which is ordinary practice in a Reggio Emilia institution. It allows the children to paint, make sculptures and use their creative sides in general. A lot of the material apparent in the ateliers is reused material from a ReMida Center in Odense. A ReMida center is a center that distributes surplus materials from the industry. [Remida.dk, 2017] ReMida is an integrated part of Reggio Emilia and the idea is completely on a sustainable level with the purpose of upcycling.
Instead of using conventional toys like for example moon cars the kids play with homemade toys, old logs given new life and the like. The institution has some animals (sheeps and hens) which are used on daily basis for pedagogical purposes such as feeding them and harvest eggs. The outdoor spaces are very much activated but this also has a negative side, since the hallways and common room mostly will seem a little vanished due to the lack of children in relation to outdoor/indoor area available.

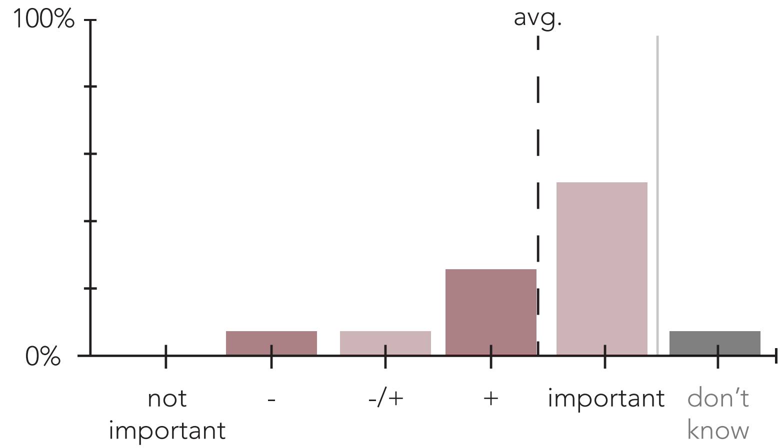
Questionnaire - What does the users want?

One thing is what studies show another is what the users think about child development and the physical environment that surrounds them. The answers from the questionnaire are almost evenly distributed between users (staff) of an old and a new institution and an institution having had the pedagogical approach of Reggio Emilia as a catalyst when the building was designed. This provides a result where it is possible to analyze and designate important aspects of the design pointed out by the end-user. On the next page (ill. 13), some of the most interesting feedback has been analyzed. These support the idea of making an institution that is something else than what is traditionally made. On the other hand, the survey also enlightens the fact that not one of the institutions being old, new or Reggio Emilia seem completely satisfying in relation to child development. Therefore, it seems appropriate to combine the best from all of them harmoniously in one solution, also to ensure that it does become a new type of institution instead of just a variation of something already apparent. The survey questions can be found in appendix xx and all answers can be found on the USB-stick.

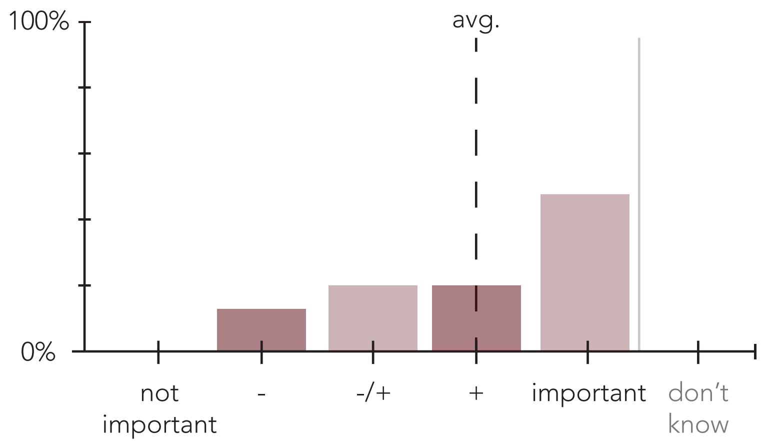
04. It is important to have a playground, which is divided by age



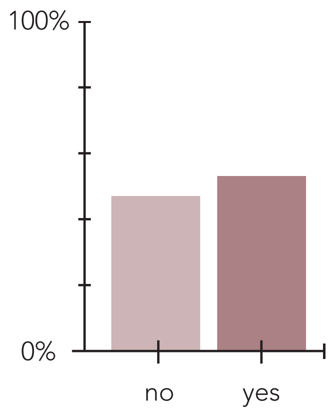
15. I find it relevant that children can interact with different surfaces indoor in relation to sensory development



16. A building with varying levels to enhance motor development is relevant



20. Do you think that the architecture of your institution support the development of the children?



why/why not?

"different levels, a climbing wall and better light would be improving"

"..most institutions has a lack of space"

"Great possibilities to make smaller rooms in the room are apparent"

"There is not much that develops the senses of the children"

ill. 13 questionaire results

Development Plan

The site chosen for the project is in the area of local plan 1020, *centerarea at Havneparken*, Vejle. Today the area is occupied by a parking area which support the commercial buildings to the south and residential area to the north. To the northwest at a distance of 200 meters are the railway station and the bus terminal. To the west is Bryggen, a department store. The last development plan is from 2008 and therefore most of the areas has already been renewed according to this. The plan states that it is allowed to build up to six stories in the area except towards havnegade where only 3 and a half story is allowed and 4 stories towards Toldboden. The localplan gives the opportunity to use the area for, commercial purposes, dwellings, restaurants, institutions, parking, offices and other functions that can be considered normally present in the city center. At the project site it is allowed in some areas to build up to 4 stories and in some up to 10 stories, meaning that the placement of an institution will not exceed the limits. [Vejle Kommune, 2008]

ill. 14 Development plan

Infrastructure

The project site is almost situated in Vejle's epicenter of infrastructure. All roads adjacent to the project site have a speed limit of 50km/h since it is in the city zone. The area lies in between a large residential area to the north and commercial area to the south. The traffic therefore is most frequent in the morning and in the afternoon. Sjællandsgade to the south might be a source of noise in relation to the project site. The potential noise needs to be taken into consideration when making the masterplan for the project, so potential genes can be avoided. Havneparken to the north is a road in the residential area which naturally make the traffic move more slowly in that area and hereby the noise from here is lower. The old railway tracks on the south side are only used for transporting goods to the harbor area and is therefore rarely used.

The bus station and railway station is apparent only 200 meters to the north and from here it is possible to take a bus to everywhere in and around Vejle or take the train to somewhere further, such as Århus, Odense, Herning or Kolding - Cities which are all in the distance of maximum 45 min. Since Vejle is one of the railway stations in Denmark, where all trains stop, the trains do not drive that fast when passing by the project site. It is a source of noise, but the limited speed and amount of trains makes it a source of noise similar to the noise from the streets. Therefore it will be taken care of in the same way.

ill. 15 Infrastructure

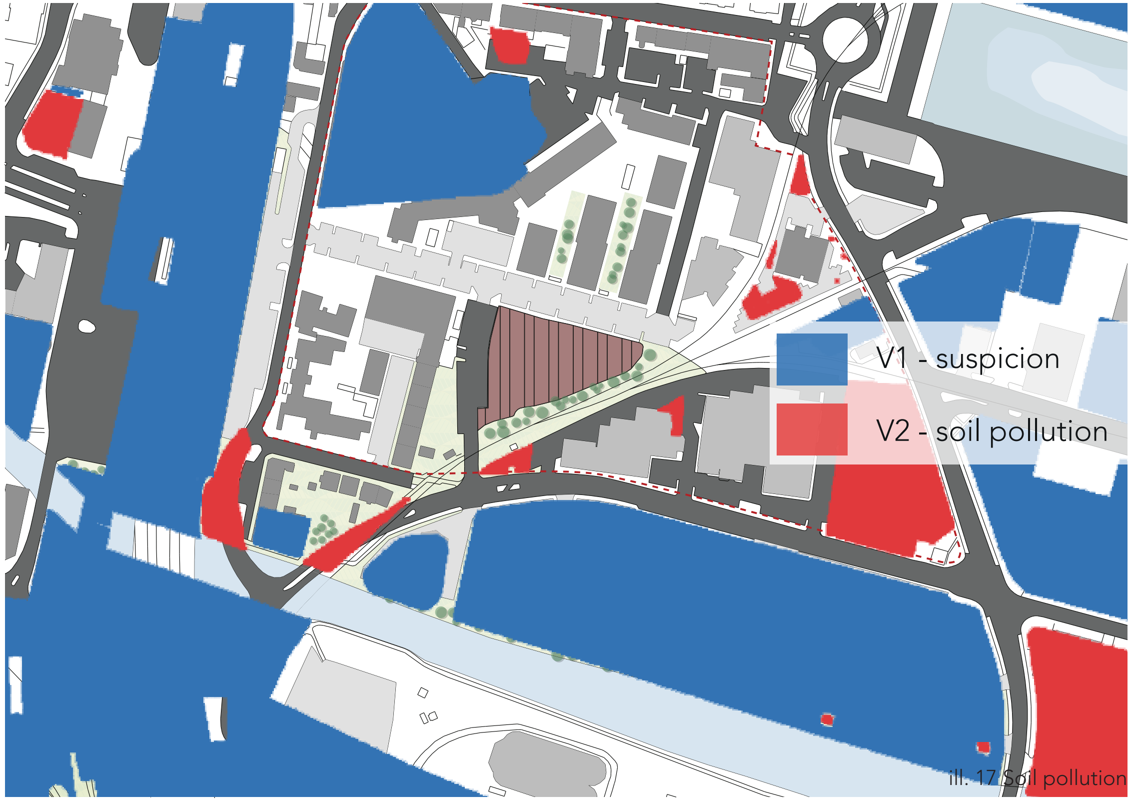
Flood Risk

Flood Risk:
Vejle city center is close to the surface of the ocean and therefore there are potential risks of flooding in the city. The stream also goes through the whole city which is also a potential risk. Therefore, it has been investigated if the project site is in any risk of being flooded due to rising water levels. The investigation shows that taking into consideration climate changes until 2050 the area is at risk of being flooded and so is about 20% of the whole city. (ill. 16) For that reason, it must be taken into consideration how to secure the area from flooding. For an instance this could be done by using solutions that either use or distribute the water.


ill. 16 Flood risk

S o i l   P o l l u t i o n

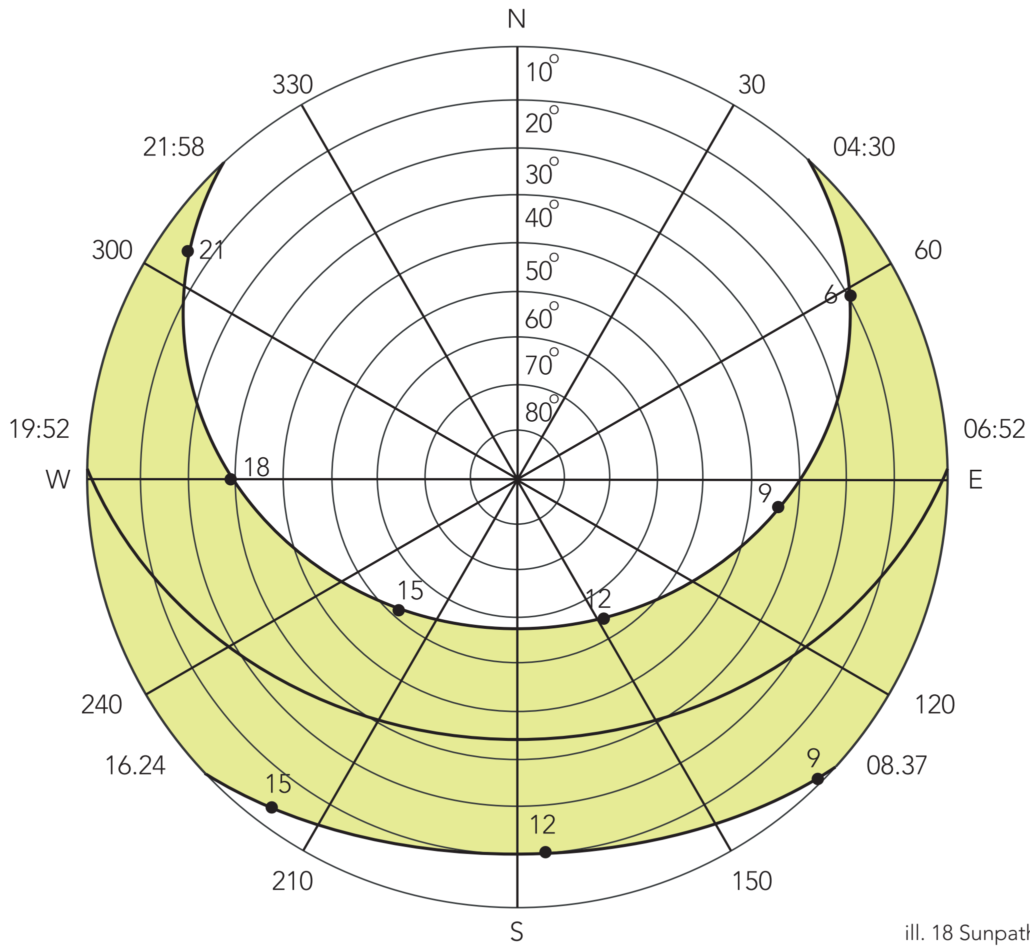
Soil Pollution:
The project site has been analyzed to verify it the soil is polluted or not. The ground can be considered not polluted or have a knowledge level V1 or V2. V1 describes an area that is under suspicion of being polluted due to former usage. V2 descibes an area which is considered polluted on a level that is unhealthy. By far the most grounds under suspicion are after investigation acquitted for being polluted. [din-geo.dk, 2016] It is verified that the soil on the project site is not polluted (ill. 17) This is also supported by the fact that the municipality plan to build dwellings in the development area. [Vejle Kommune, 2008] In the case of pollution it would have been important to concider how to take care of this by either elevating the building from the ground, cleaning the area or some third solution.



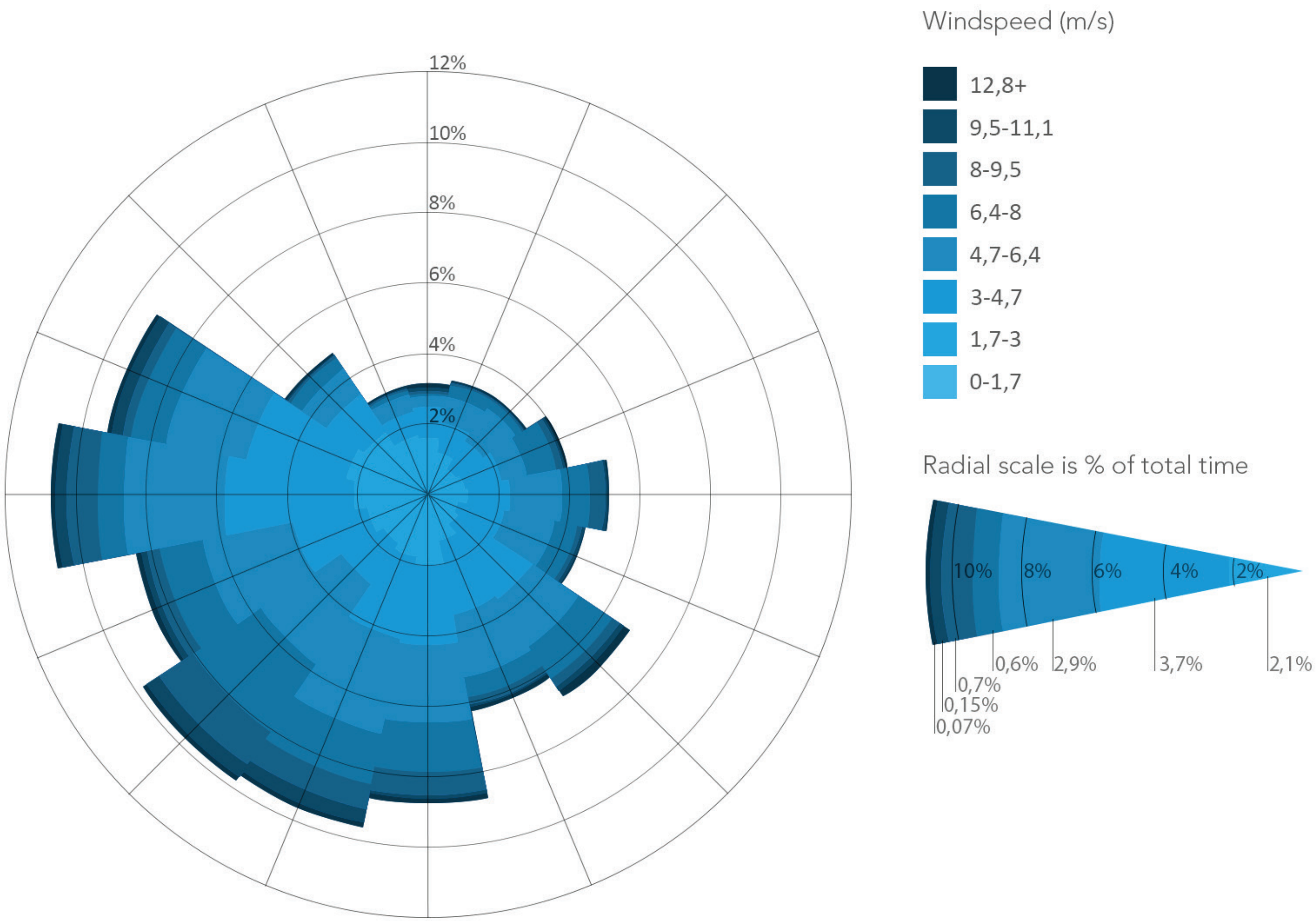
ill. 17 Soil pollution

C l i m a t e
Sun and wind

The climate analysis is used as a design driver for the project. It will strongly influence the volume geometry, opening sizes and not lest orientation. This is both to enhance the performance of the building itself but also to improve the quality of outdoor spaces. The purpose is to make the architectural decisions fully exploit the natural forces, such as solar radiation and/or wind speed and direction, to improve the building energy efficiency and user comfort.
To reach the maximum potential of these natural occurring forces, changes, based on local experience through phenomenological investigations and assumptions, will be made, since the climate analysis is based upon data from the airport and not local data. The data consumed are visualized in ill. 19 windrose and ill. 18 sunpath. Looking at the windrose reveals that the main winddirections are west and south west. This gives an idea of how to arrange the building volume due to creating the best conditions for outdoor spaces. In this case some sort of windblocker towards the main winddirection is relevant. This could both be building mass and/or vegetation.
The sunpath informs how the sun is positioned at certain times in the year and day. In that way it can be analysed how to for an instance optimize and control the external heat gains.



ill. 18 Sunpath



ill. 19 windrose

Climate
Direct sun

The quality of the outdoor spaces is strongly influenced by the weather conditions. One thing is how the path of the sun is and what the primary wind direction is, but the most interesting aspect according to the outdoor spaces might be the number of hours with direct sunlight. Therefore, it has been analyzed how many hours of direct sunlight, will be apparent, in specific areas of the building plot. In this way the organization of the building and hereby the outdoor spaces can enhance the quality of the last due to a larger amount of sunhours to make a thermally comfortable outdoor space. The analysis is based on the latest plan of the development area. In this way the analysis has been made in correlation to the future plan of the area instead of the existing context. The analysis is made in between 07.00 AM and 05.00 PM being the timespan where most institutions are open. This leaves a maximum of 10 hours of direct sunlight. Ill. 20-23 show the building plot with analysis of direct sun on four different dates being spring and fall equinox, summer solstice and winter solstice. As it is seen the eastern part of the site is in the winter period mainly in shadow due to adjacent buildings. To avoid this amount of shadow a solution could be to change the terrain-height to recieve more direct sun in that part of the outdoor space and eventually benefit from more passive heat in the winter.

ill. 20 Direct sun - March 21st

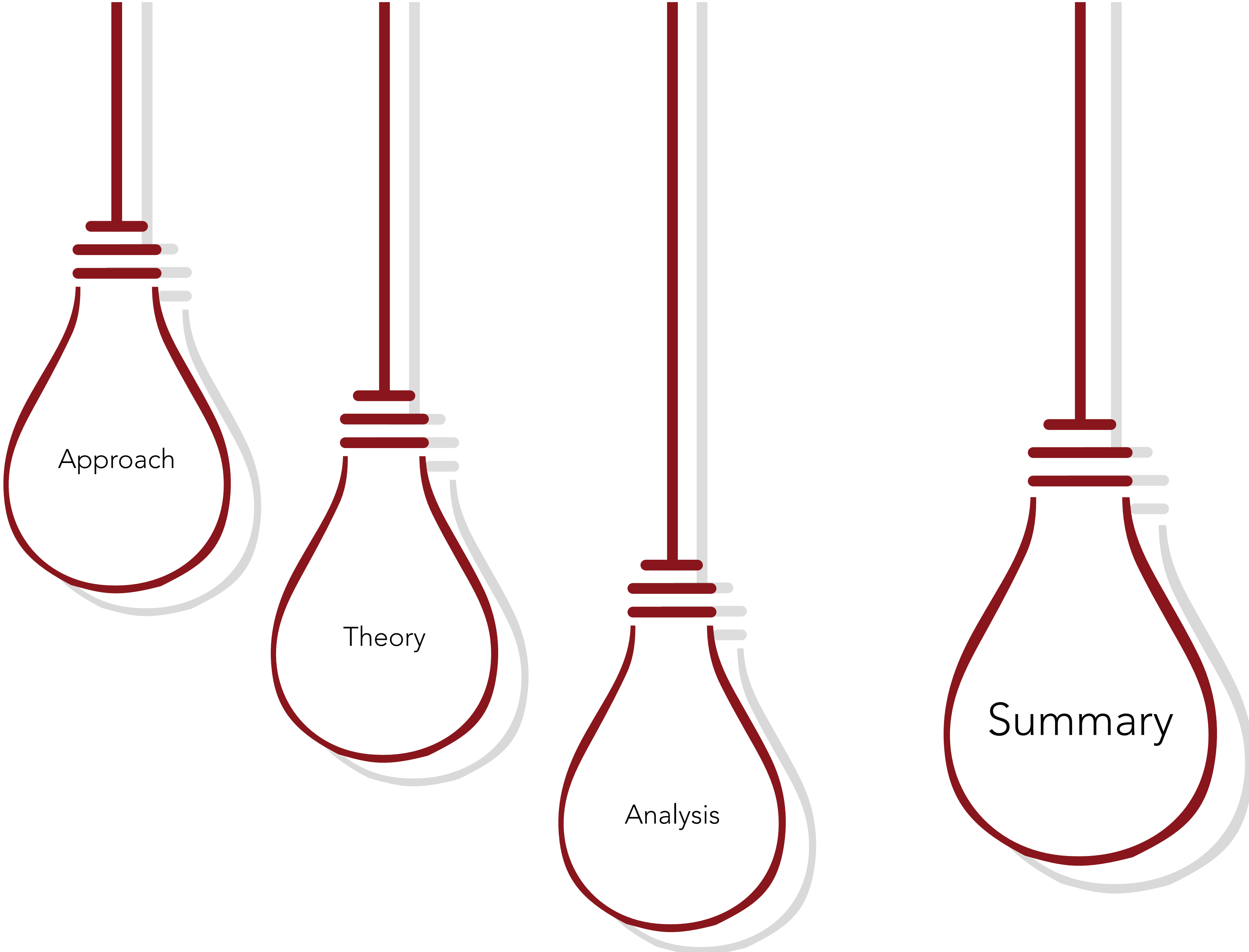
ill. 21 Direct sun - September 21st

ill. 22 Direct sun - June 21st

ill. 23 Direct sun - December 21st

Summary

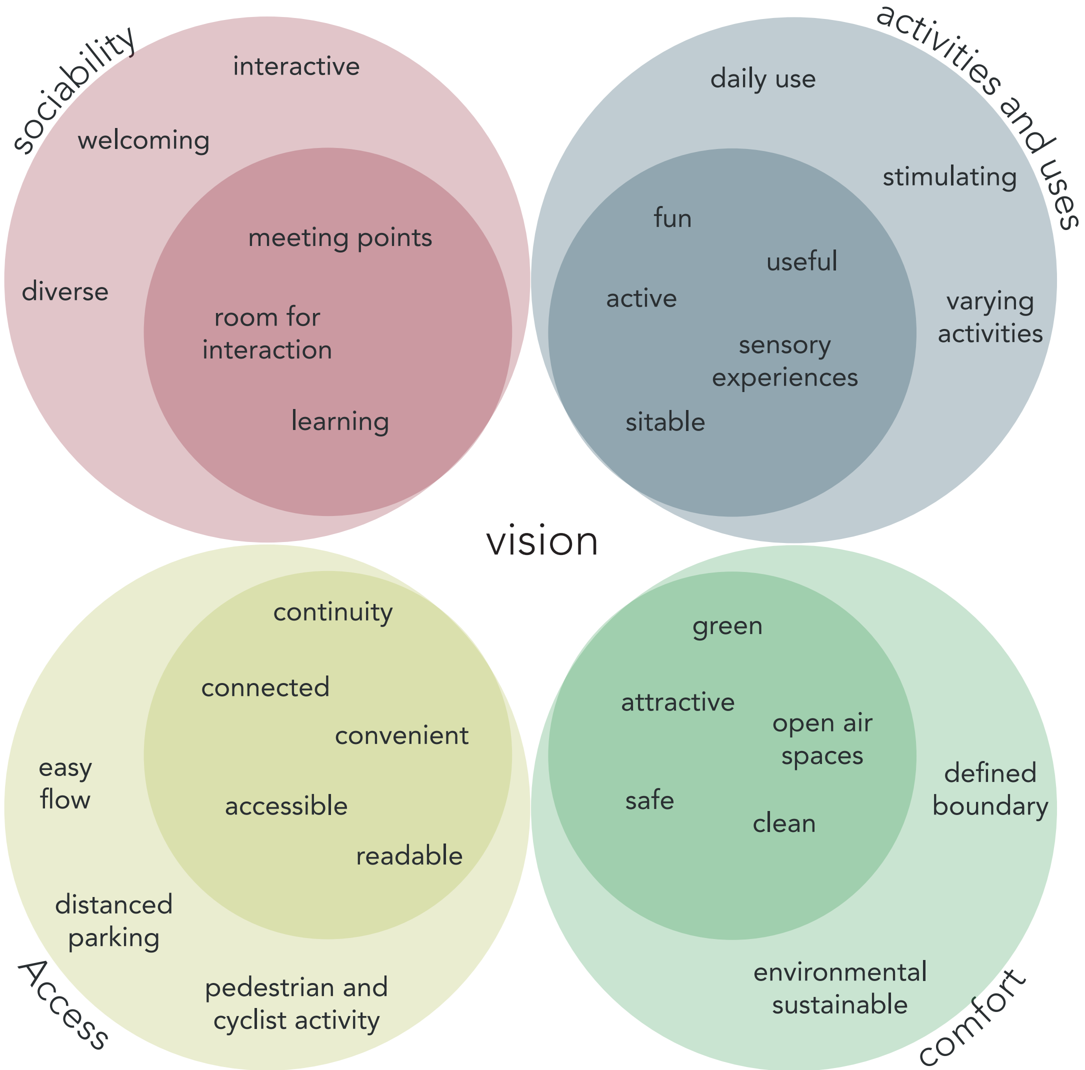
Starting with the big picture - the site analysis, the development plan for the area is as good as non-existing due to the age of the local plan. This means that what is present in the area at the moment will probably be the same in 10-20 years arguably. The project site is placed near to the center of the development area having low-rise commercial building to the south and residential buildings to the north. Therefore it is necessary to take into consideration how to use the sun optimally in the winter period where the altitude is low and how to avoid some of the sun in the summer period were the altitude is high. A lot of public functions will occur around the site and it has to be investigated how to use this as a positive aspect of the design. This could be the relation to the nearby train station for parents who take the train to work or the relation to the life in other areas of the development plan and not least the city. Most traffic appear at the southern perimeter of the development area at Sjællandsgade being at a short distance to the project site. Because of that it seems logic to arrange the building according to this street. This is both in the manor of noise from the street but also since it logistically will work the best as the street to arrive from when going to the institution to drop off children. In this way the building volume turned towards Sjællandsgade must both function as a welcoming façade but also the noise must be reduced from that direction. That conflict is to be solved very delicately to not undermine any of the aspects. The railway is another source of noise that must be considered, to avoid genes from the trains passing by. This could for an instance be done with a boundary edge of either building volume or vegetation.
The wind might be a problem if not considered in the design phase since the common wind direction is minimally blocked by neighboring buildings. Outdoor comfort analyses are to made for several building layouts to ensure the quality of the outdoor spaces and secure the buildings ability to create places that are nice to stay in, not only indoor but also outdoor.
The analysis makes it clear that the smallest children do not have a big need of changing environment all the time, and therefore it seems logical to make an architecture that integrates the learning aspect of the kids not necessarily being changeable. The kindergarten children, on the other hand has the need of changes and new experiences all the time to be stimulated. By that it can be extracted that the kindergarten has a bigger need of flexibility/changeability than the nursery. This must be considered wisely in the layout of plans and integration of development elements.


Approach
Theory
Analysis
Summary

Vision

To articulate a direction for the project, a vision has been specified. The vision is to create an integrated institution that, first of all, enhances the possibility of child development, and secondly, enhances all three sustainability aspects, being environmental, social and economic manners. It is a wish to create a building where the development of children is thought into the architecture, so that the building itself becomes a catalyst for development. One of the most important aspects according to making integrated development possibilities is that children, at different ages, react different to certain impressions. Therefor it has to be wisely considered how the integration is achieved without compromising the needs of children at certain ages. If achieved "an institution for the future" will be the result. This is a place where children, at different ages, and with different development stages, can interact with each other, and the pedagogues, and at the same time develop their motor- and sensor skills and cognitive abilities. To make a foundation of securing an institution for the future an illustration has been made that will function as a tool to visualize focal points of the design process.

Ill. 24 visualizes which parameters should be considered the most important when designing the institution and outdoor spaces. It is based upon inputs from the survey, analysis and phenomenological experiences. By doing this it works as a tool to emphasize the sociocultural and economic sustainability. From outside and inwards are the key attributes to ensure an institution for the future and next are the tools that might be valuable to reach the key attributes. Closest to the center are the possible measurements to verify the effectiveness of the tools.



ill. 24 vision

Design parameters

A set of design parameters has been made by concluding on the analyses, to articulate the wanted elements of the final project. Those are visualized in ill. 25. The parameters are divided in four subcategories being outdoor spaces, child interaction, lerning environment and sustainability. These subcategories are chosen in relation to the focus point of the thesis, and as mentioned the analyses, and are concidered being sufficient and adequate to reach the goal of an institution of the future. The four subcategories are in some way interrelated which is visualized by the placement of each parameter in the category. In relation to the design parameters different design principles has been made. These are to visualize how different parameters are possibe to work with but on a very draft level. The design parameters that on this stage has been worked witch are:

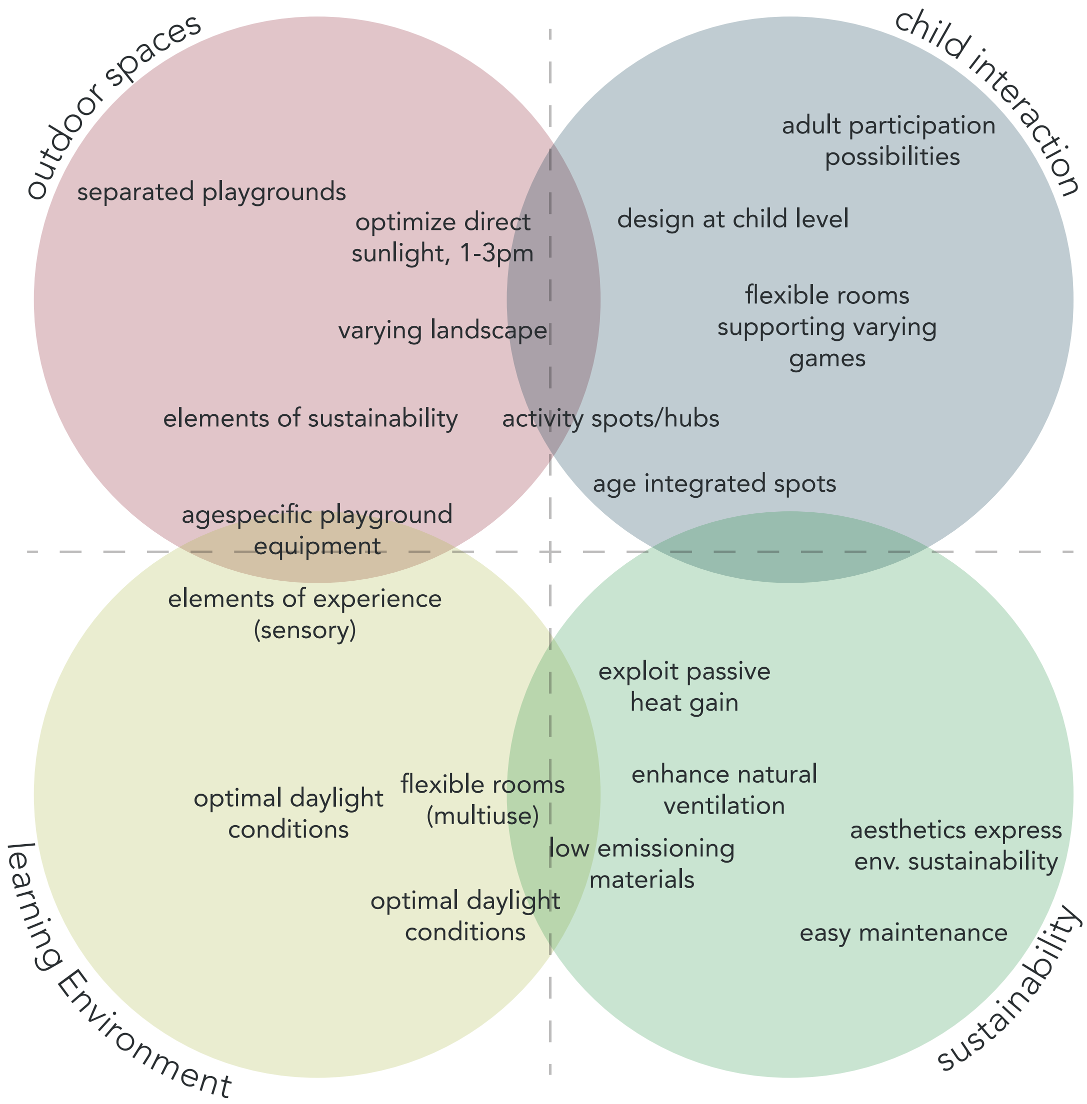
Outdoor spaces
- varying landscape
- Separated playgrounds

Learning environment
- optimal daylight conditions

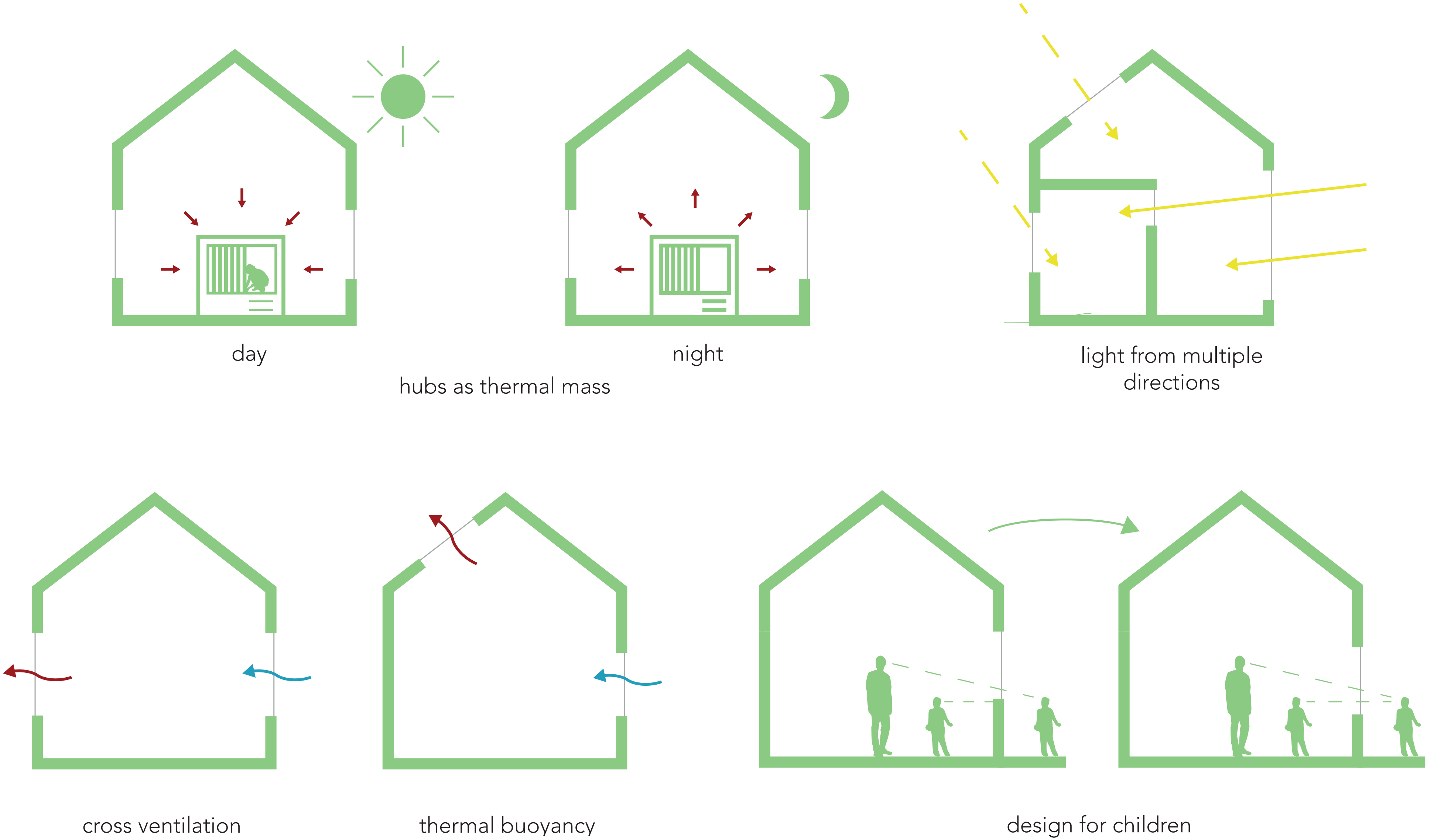
Sustainability
- enhance natural ventilation
- exploit heat gain

Child interaction
- activity spots/hubs
- design at child level

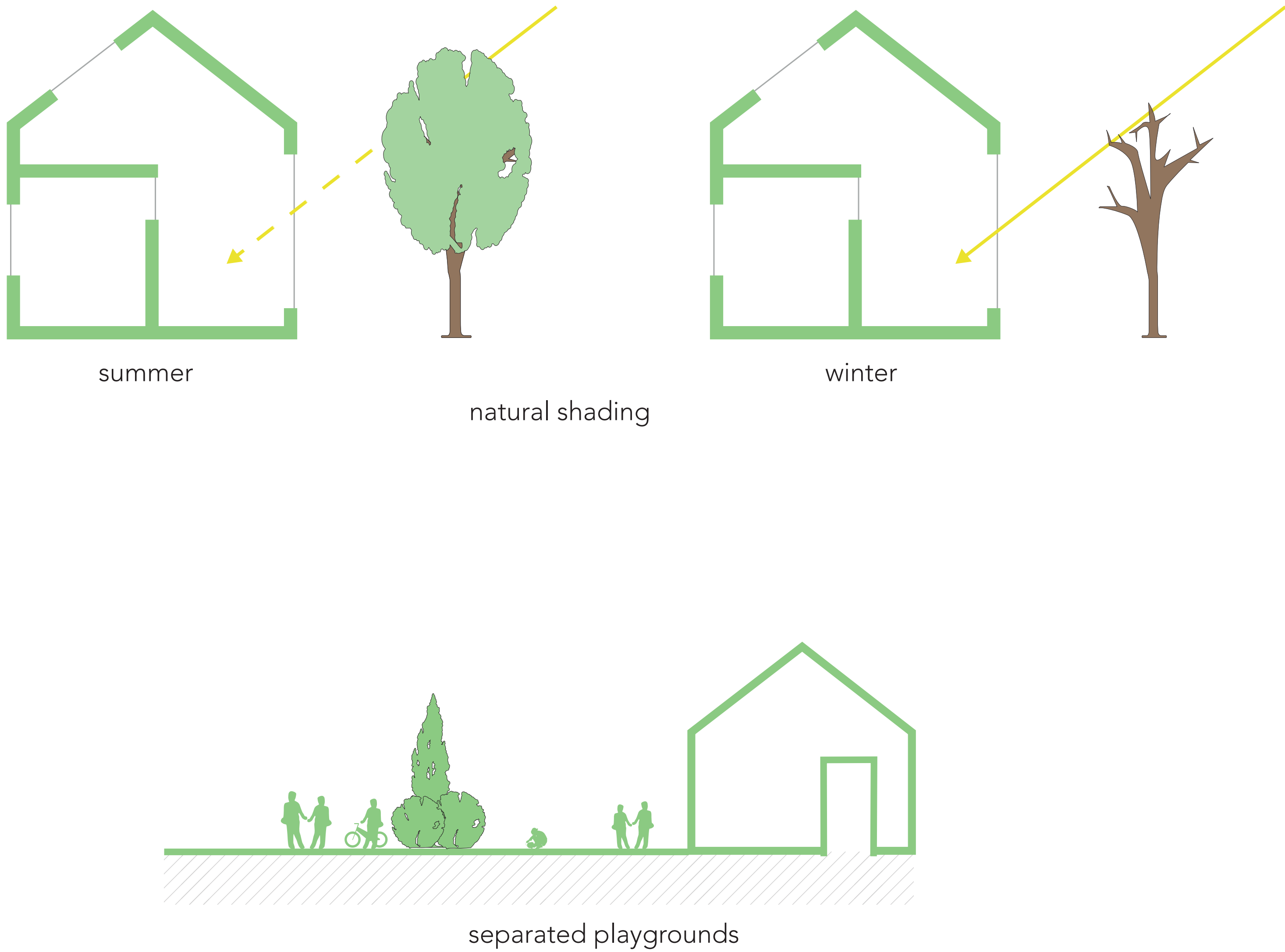
The principles are shown in ill. 26-27 on next spread



ill. 25 design parameters



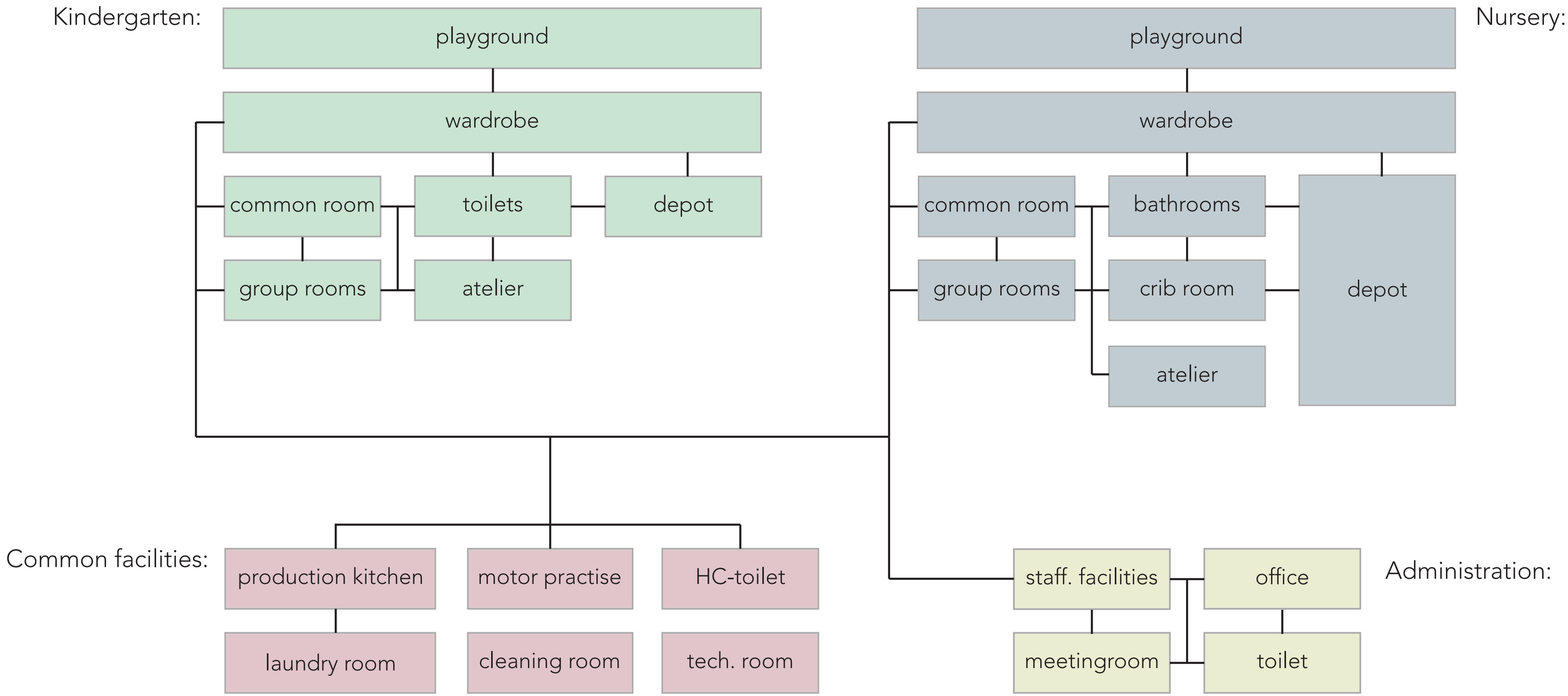
ill. 26 design principles 01



ill. 27 design principles 02

Programming

The analyses have applied the foundation of the project in relation to the site and the concept of an integrated institution. This sub chapter is regarding the programming of the institution in relation to the connection between functions and the daily routine. The institution is divivded in four subparts being kindergarten, nursery, common facilities and staff facilities. These one another contain several functions that will be interrelated in a logic and efficient way in relation to enhance the functionality for both children and employees. Then again the subparts are related to each other. The Kindergarten and the nursery will be two individual functions having some common functions to strengthen the interaction between kids at different ages.



ill. 28 function diagram

Nursery specific rooms	Children pr. unit	Amount	Unit area (sqm)	Total area (sqm)
Group room	12	4	30	120
Common room	1-48	1	280	280
Bathroom	-	2	15	30
Crib room (incl. storage)	1-48	1	90	90
Small atelier/orangery/workshop	4-6	2	12	24
Depot	-	1	5	5
Wardrobe	-	1	50	50
Kindergarten specific rooms				
Group room	20	4	50	200
Common room	1-80	1	350	350
Toilet	-	1	24	24
Large atelier/orangery/workshop	6-12	1	30	30
Wardrobe	-	1	55	55
Common facilties				
Production kitchen w. storage and toilet	-	1	40	40
Room for motor practice	6-18	1	50	50
Laundry room	-	1	5	5
Technical room	-	1	15	15
HC-toilet	-	2	5	10
Cleaning room	-	1	5	5
Administration				
Office	1-2 (adults)	1	12	12
Meeting room	2-8 (adults)	1	12	12
Staff facilities	1-12 (adults)	1	25	25
Toilet	-	2	3	6
Total				1437

ill. 29 room program

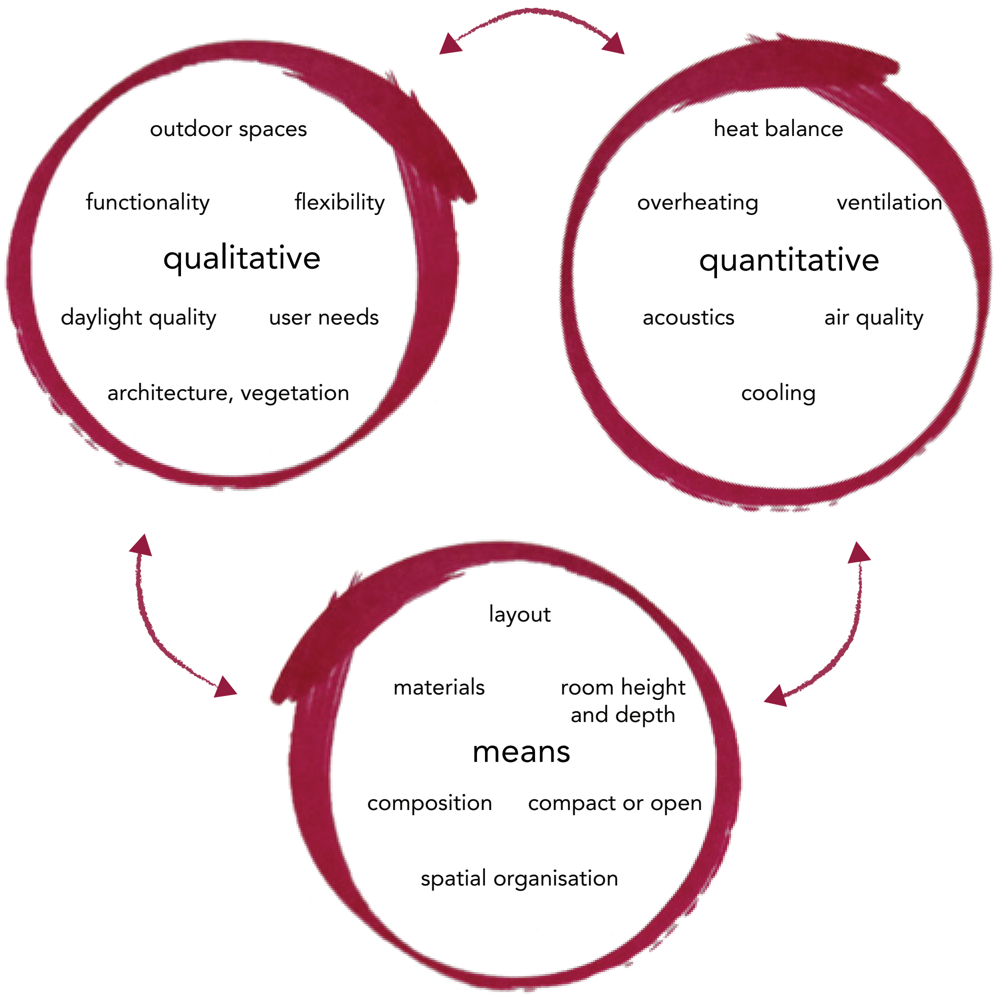
03 Design phase

Introduction
Preliminary formfinding
Plan layout
Daylight and ventilation studies
Facade
Materials - Life cycle assessment, aesthetics, acoustics
Landscape design

Introduction

The design process that develops the project is an integrated one and hereby a lot of considerations including aesthetics and technical aspects, are made. In the first chapter, that covered the methodology, the integrated design process was mentioned. It works by moving back and forth between the different phases to always have the knowledge of consequences related to each choice made. Despite that the following chapter is divided in different topics to enable an overview of the work on the design instead of presenting what has been done chronologically. The reason for this is that the process, due to the integrated process, has not been linear and therefore it has been decided to simplify the investigations made throughout the project. Making the design has not only been about the aesthetics, nor has it only been the technical aspects. This relates to the Triade of Vitruvius. He stated that the complete theory of architecture always concern the three interrelated terms firmitas, utilitas and venustas (i.e., structural stability, appropriate spatial accommodation and attractive appearance.) [global.britannica.com, 2016]

In the case of this thesis, these aspects are related to quality, quantity and means which is illustrated in ill. 30 which also gives examples of how the aspects are apparent in the design process. To ensure that all three aspects are treated adequate the development of the design has been done through, computer simulations, calculations, plans, physical models and sketches of various character.



ill. 30 articulation of Vitruvius

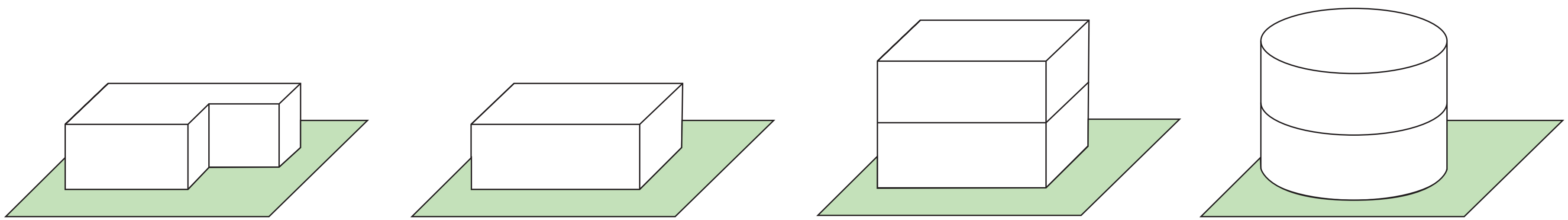
Preliminary formfinding

As a begining different forms has been investigated and evaluated in relation to possibilities and disadvantages. On the following page one will see some of the general forms that have been investigated being a U-shape, I-shape, L-shape and Z-shape. All of them have different qualities and disadvantag-es. As an example the I-shape is efficient in relation to benefit from a lot of passive heat gain whilst on the other hand does not create a very interesting og articulated exterior space. The U-shape has the quality of creating outdoor spaces of different quality just by the form but will most certainly contain prob-lems in relation to the acces road on the western perimeter. If mirrored horizontally this would instead block a lot of sunlight for the outdoor space.
The natural forces has been a primary factor to chose the gen-eral form. As mentioned the heatgain possibility is relevant for the building, but the sunhours in the outdoor spaces are also very important. Therefore an analysis have been made to find out which general form performs the best in relation to create a nice warm outdoor space. This is seen in ill. 36. The forms have been placed in two positions to investigate positive and negative aspects of mainly creating a bigger windbarrrier towards south-west.
All simulations have been made with adequate floor areas, and outdoor space and as two storey buildings. The latter to secure compactness of the building in relation to energycon-sumption and in particular heat loss and potential of passive heat gain. On the following page an example of the effect of compactness is apparent. Another quality of the two storey building is that the functions in general will be closer to each other, and hereby the functionality will be enhanced due to more interrelated functions.

Floor area	900sqm
Glass area	30%
Average u-value building envelope	0.1 W/m^2K
U-value window	0.8 W/m^2K

Calculation is made in the heating period november - march with dimensioning temperatures being:

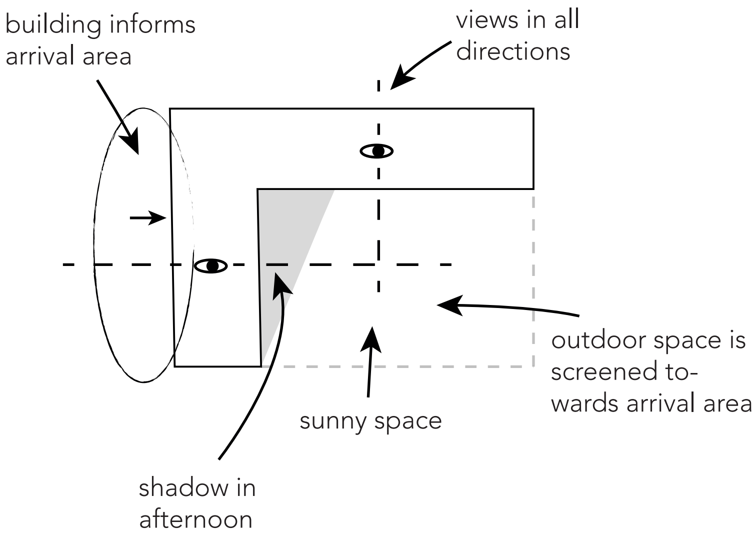
Indoor temperature	21°C
Average outdoor temperature	1.2°C



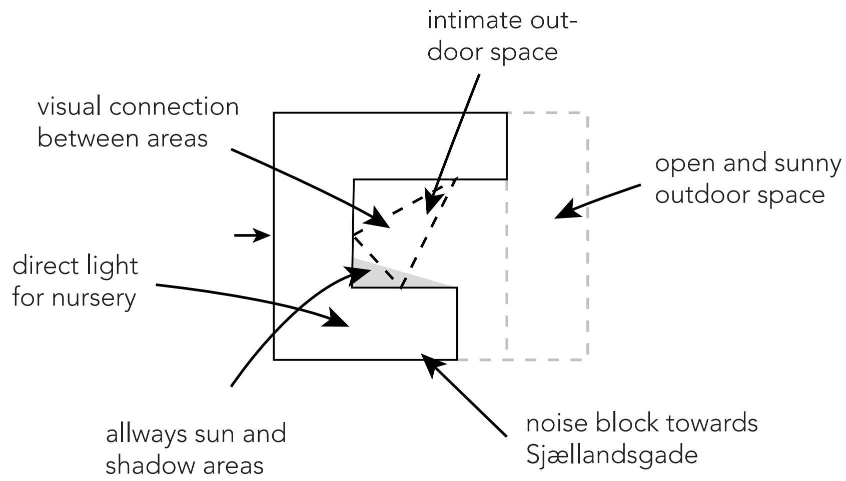
L-shape, 1 storey		Square, 1 storey		Square, 2 stories		Circle, 2 stories	
Envelope	4295.2 W	Envelope	4222.4 W	Envelope	2515.2 W	Envelope	2389.55 W
Window	3744 W	Window	3744 W	Window	3744 W	Window	3744 W
Sum	8039.2 W	Sum	7966.4 W	Sum	6259.2 W	Sum	6133.55 W
	→	Reduction	1% →	Reduction	21.4% →	Reduction	2%

Biggest reduction while keeping optimal functionality

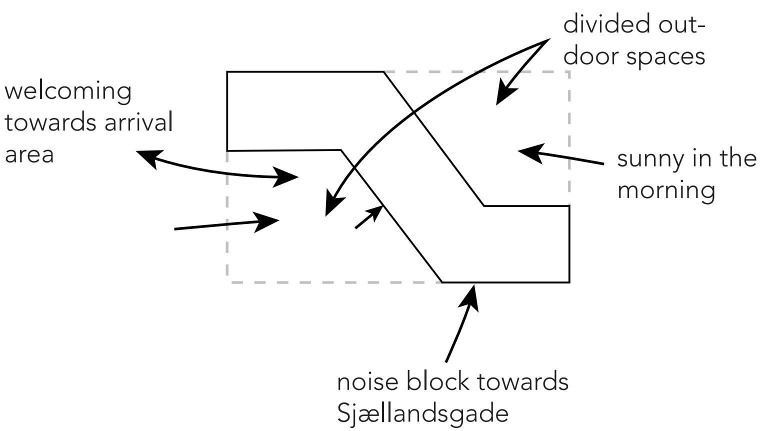
ill. 31 Transmission loss



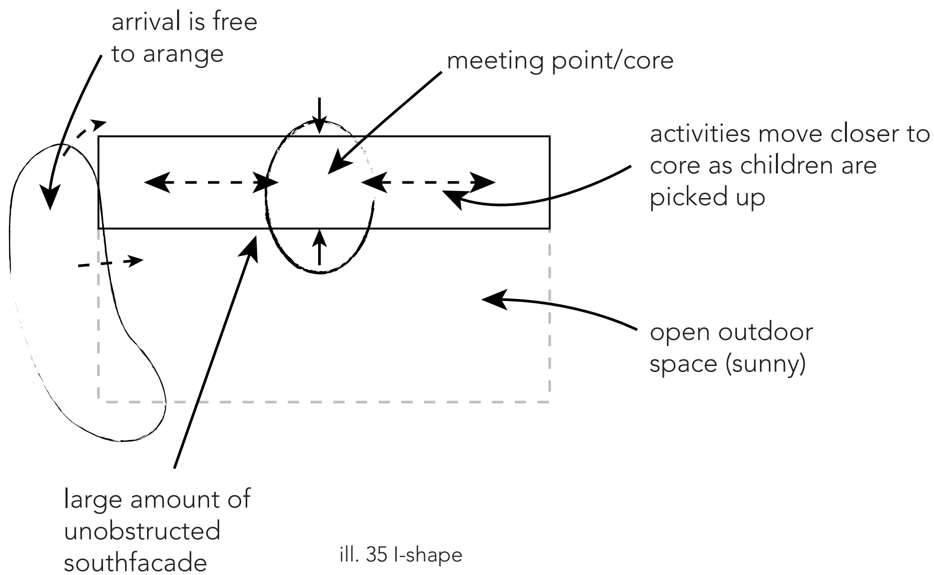
ill. 32 L-shape



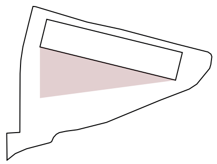
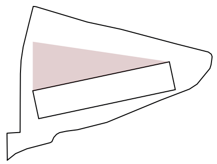
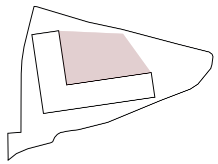
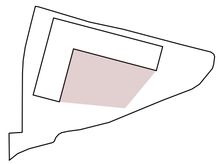
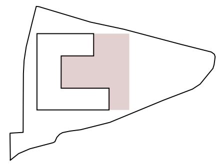
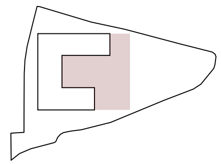
ill. 33 U-shape



ill. 34 Z-shape



ill. 35 I-shape

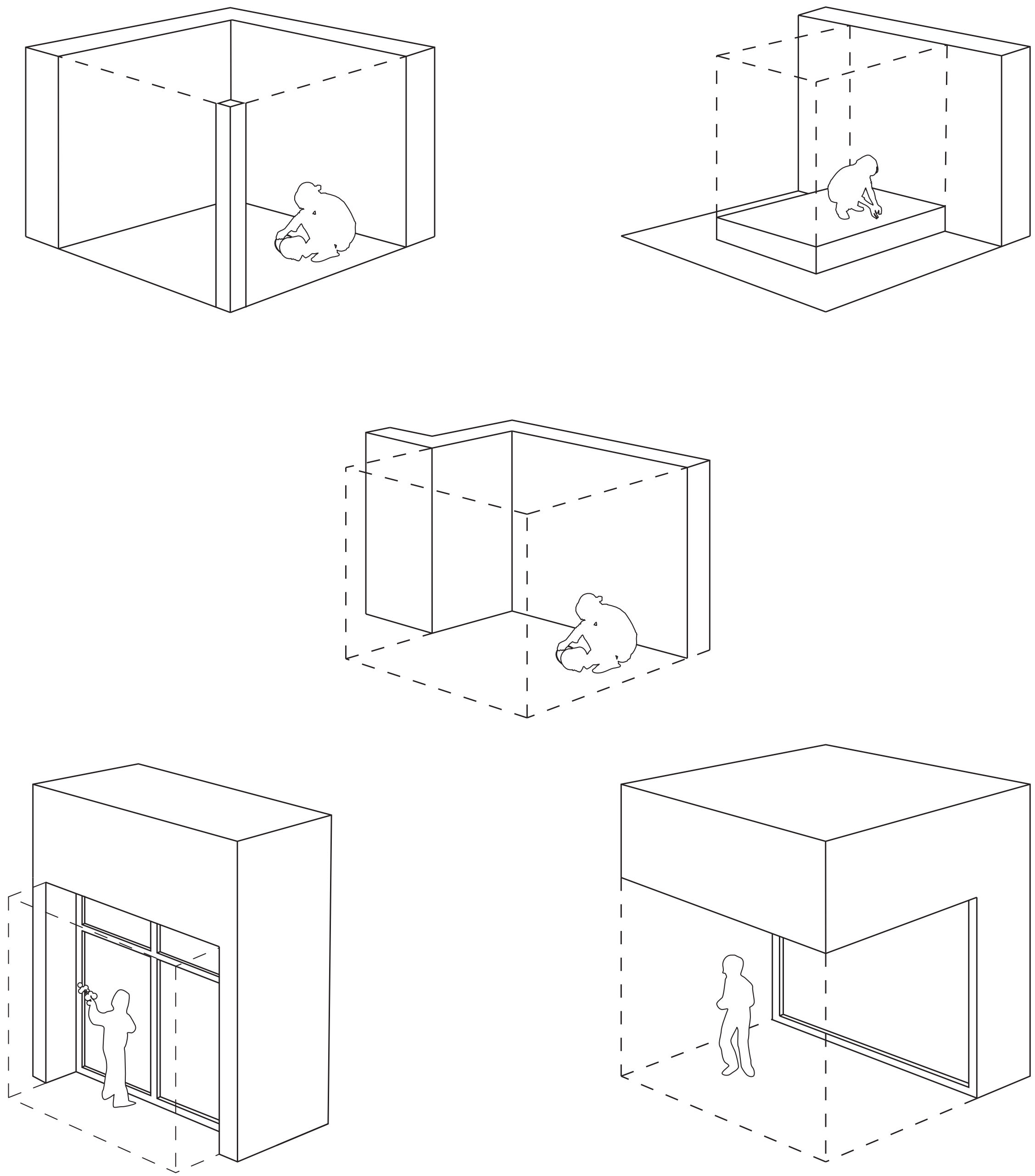
							
03.21	09.00-11.00am	12.4℃	10.1℃	12.9℃	13℃	12.5℃	12.6℃
	01.00-03.00pm	15.2℃	13.7℃	15.5℃	15.7℃	15℃	15.3℃
06.21	09.00-11.00am	15℃	11.3℃	13.2℃	15.3℃	14.1℃	14.6℃
	01.00-03.00pm	17.9℃	14.2℃	15.1℃	17.3℃	16.1℃	16.8℃
09.21	09.00-11.00am	12.3℃	10℃	12.7℃	12.9℃	12.4℃	12.7℃
	01.00-03.00pm	15.5℃	13.6℃	15.4℃	15.5℃	15.1℃	15.2℃

ill. 36 outdoor comfort

Solid/void theory

In the program it has been stated that children in nursery and kindergarten need direct light, shadow and contrasts in their everyday environment to optimally develop the sight and other senses related to this. This is why solid/void theory has been taken into concideration. This subchapter is a study on how to use solid/void theory actively in relation to make these before mentioned light/shadow contrasts and to make integrated motor development possibilities.
In this case the solid/void theory both has a functional purpose of making better development possibilities for the children, and on the other hand it has an aesthetic purpose since it will articulate the visual aspect of the project. Some of the solutions have been investigated in relation to the 2020 energyframe too. This is in the case of either increasing og decreasing envelope area and the effect thereof. Others have been investigated in relation of using them as an aspect of the structure. This is for example columns or room creating partition walls.

The last aspect of the solid/void theory is that it in many cases creates the so called activity zones that are required in relation to the class A mentioned in the subchapter “development of children”.



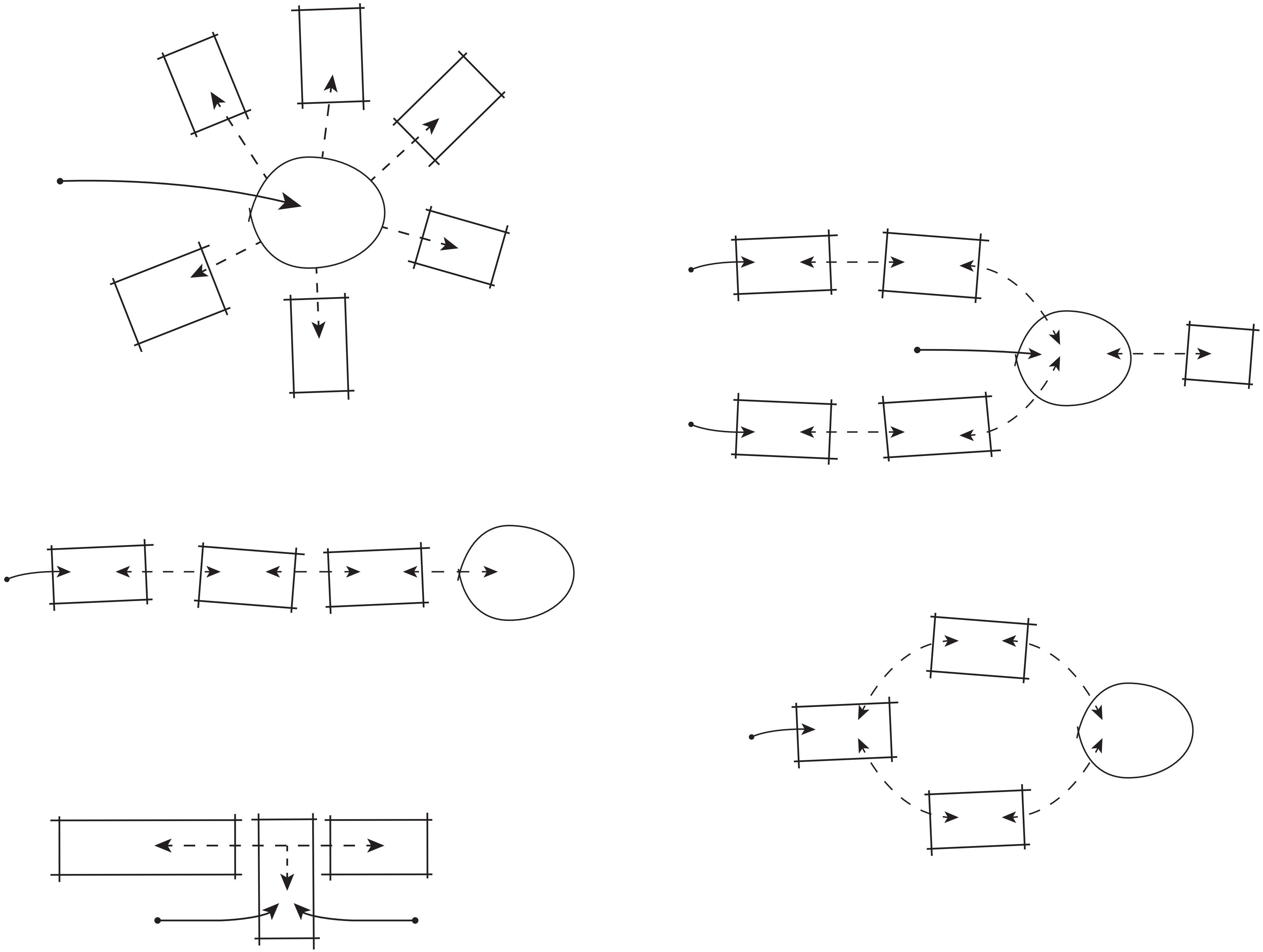
ill. 37 solid-void

Plan layout and disposition

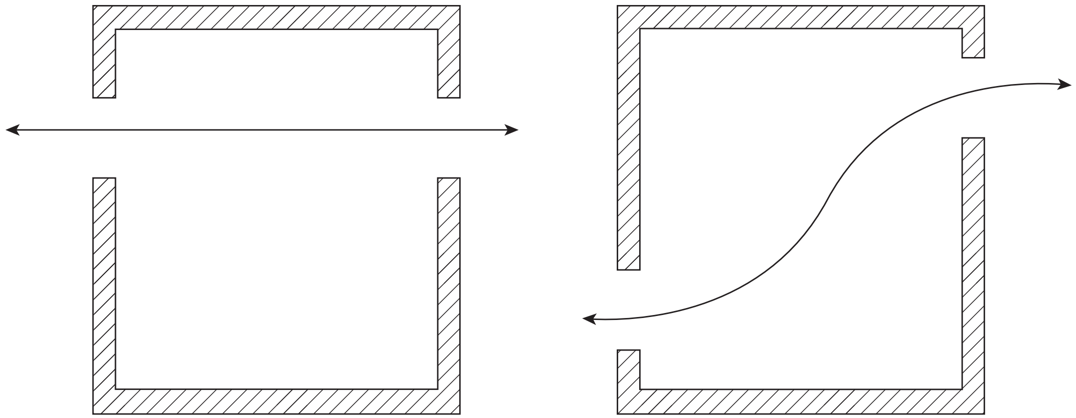
The design of the plan layout starts before making the plans. Different dispositions have been investigated in relation to how the building should optimally function when taking into concideration the knowledge from the program chapter. (ill. 38)

More detailed circulation paths have been concidered. This is shown in ill. 39 and 40. This support child behaviour and are implemented in the further plan work to secure a layout that enhances the functionality without compromizing the needs of the children. Obstructions is in this case not only walls, but can also be activityzones and the like, that might catch the attention of the children.

Afterwards 2D plans have been designed in relation to the general formfinding chapter. Here it has been investigated which general form was the optimal to work further with, and move away from the very rigid form. (ill. 41) After doing 2D drawings, 3D has been implemented, to make a research of how the plans work in section and hereby the functionality of these. At last the Final form have been altered and specified. (ill. 43)

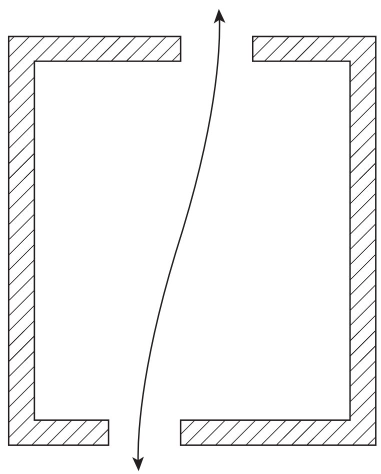


ill. 38 disposition



undesireable circulation

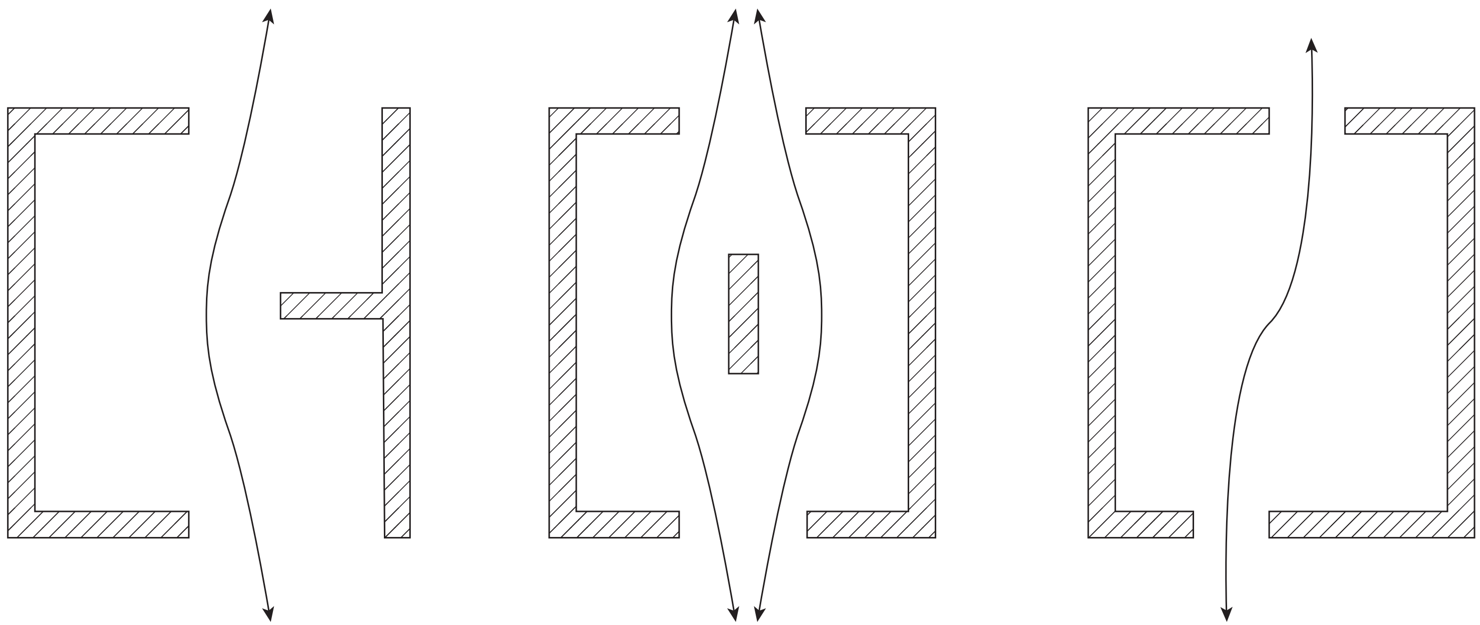
too direct - running children
too obstructed - traffic bicets activities



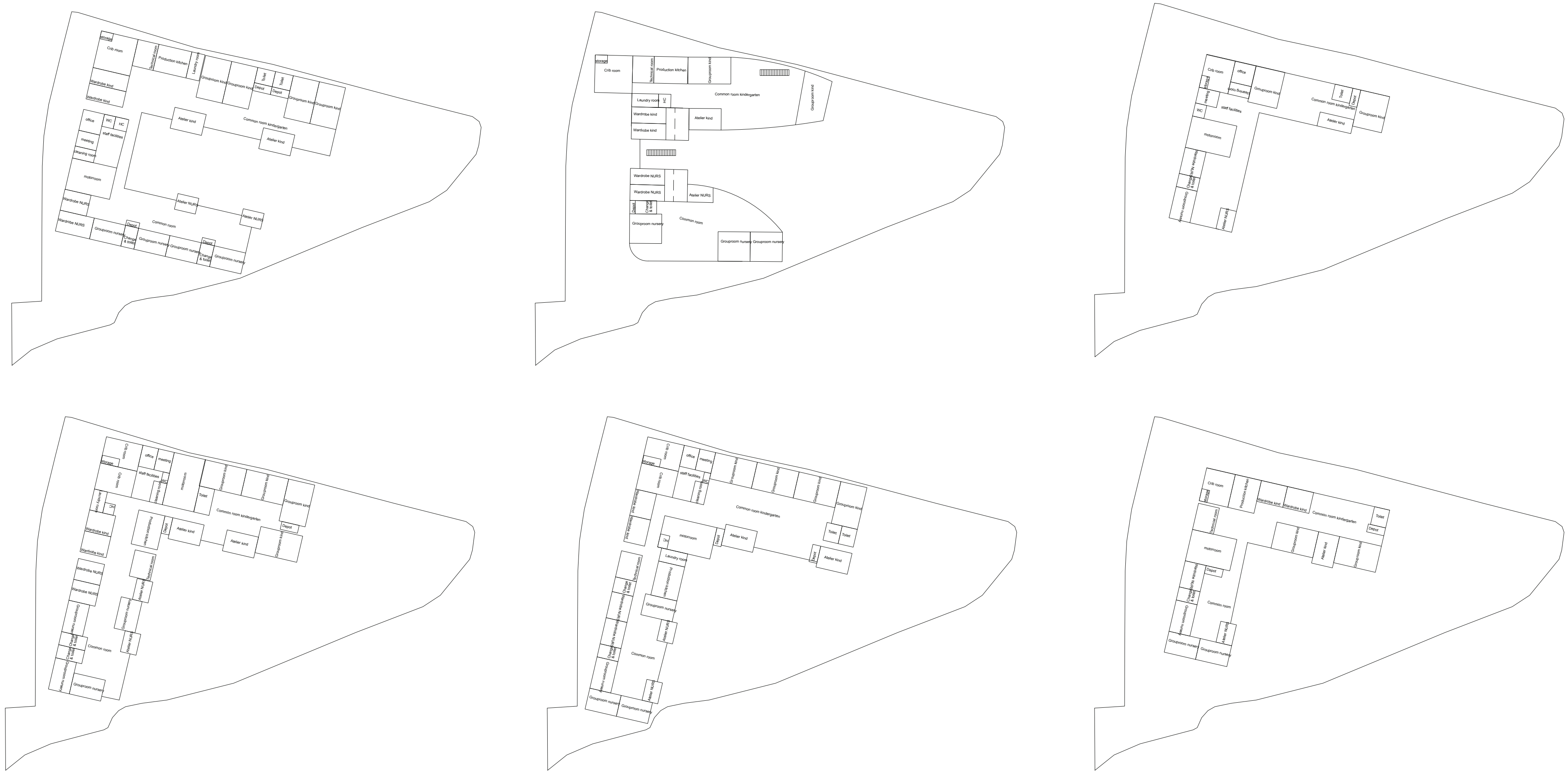
desireable circulation

slight obstruction reduce tendency of running
“denial and reward”

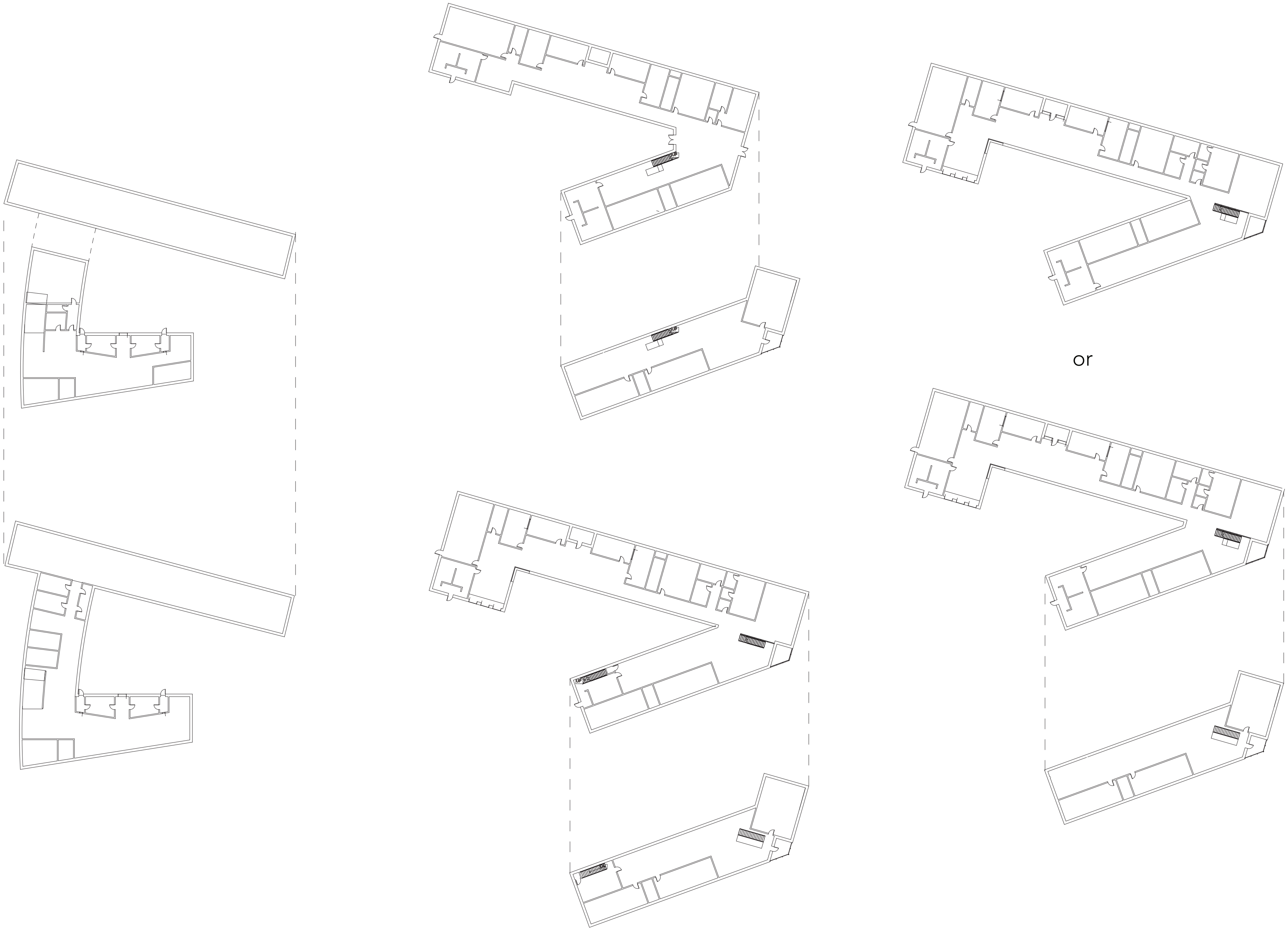
ill. 39 initial ciculation study



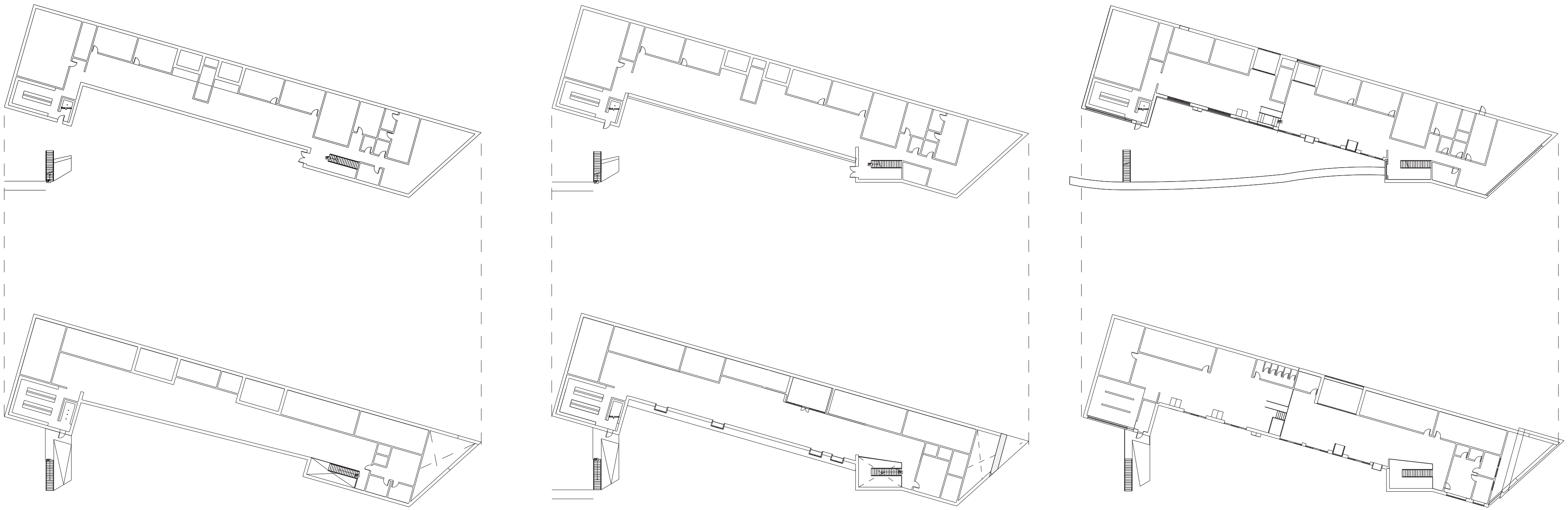
ill. 40 further ciculation studies



ill. 41 initial plans



ill. 42 3D plan work



ill. 43 I-shape catalyst

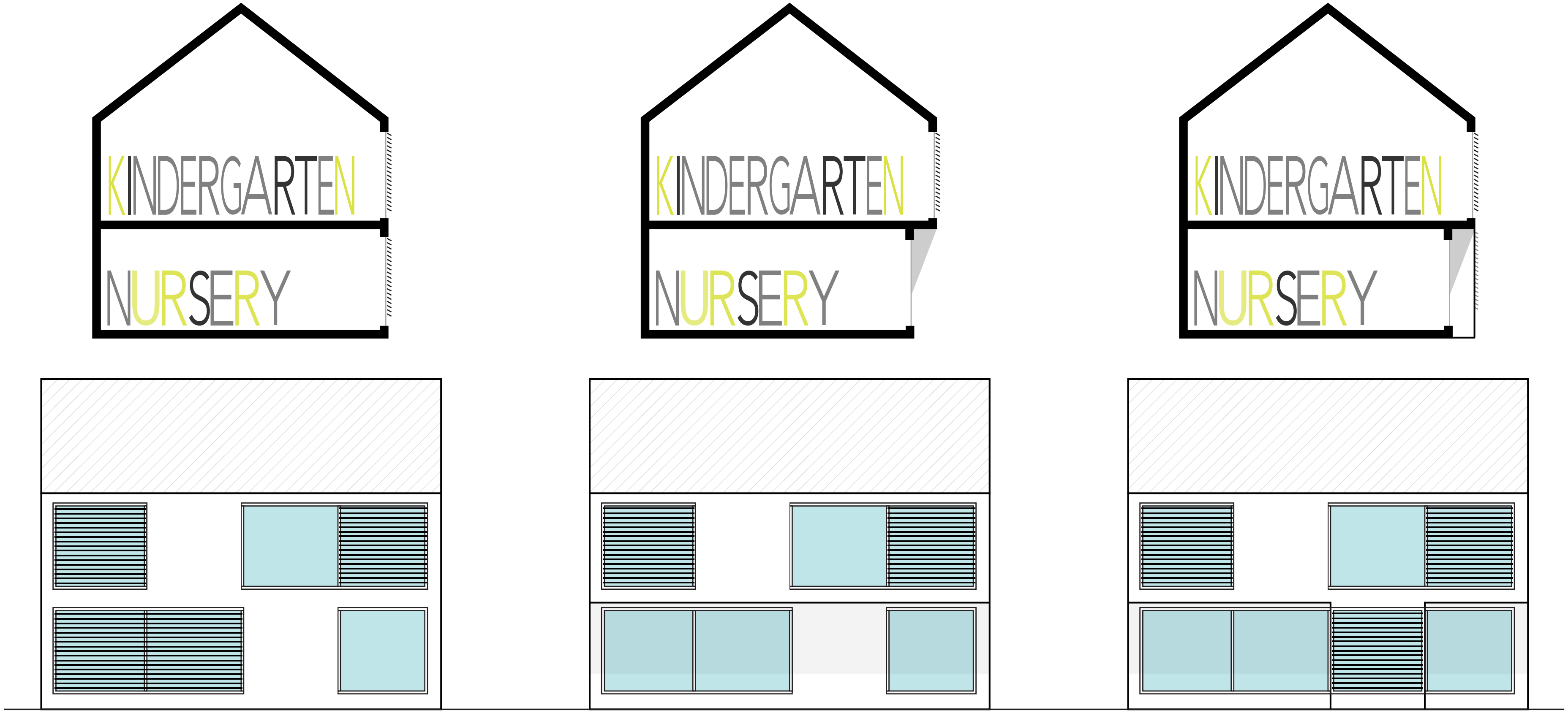
ill. 44 unfurnished final plans

Facades

Aesthetics, daylight and natural ventilation

The work with the facades has been made taking into concideration aesthetics, daylight, direct light, quality of light and energy frame.
Initially the basic facadesystem has been chosen investigating different solutions for shading device (ill. 45) It was chosen to work further with a solution where the facadematerial would work as sunshading and hereby make the sunshading integrated. This to enhance the economic sustainability aspect. The solution was a (wooden) cladding system. See subchapter "materials" for the reason of wood as material. The effectiveness of the cladding were investigated in BSim and as expected the horizontal cladding were the most effective due to mostly blocking summer sun were the shading is relevant. In Bsim it was investigated how big the amount of shading had to be, to provide a sufficcient indoor climate. The result was that, approximately 30% of the glazing should be shaded to meet the thermal comfort criterias. Afterwards different solutions with a 30% shading, still making natural ventilation effective, were investigated.

In ill. 47 it can be seen how the energydemand and daylight factor have been affected from having no shading to the final shading layout. As it can be seen, the final shading decrease the energy consumption whilst maintaining the avg. daylight factor. Also it arguably provide a more interesting light/shadow interplay and contrast on the interior side.



01. flat facade with exterior shading

+ easy to read the building
+ easy to adjust passive heat gain
+ departments float together visually, just as they do functionally

− solar shading is added, not integrated

02. cantilevered first floor

+ differentation between nursery and kindergarten
+ integrated solar shading at ground floor
+ transparent ground floor

− entire ground floor in shadow at noon in the summer

03. groundfloor partly pushed back

+ dynamic facade (visually)
+ departments float together visually, just as they do functionally
+ niches in nursery are integrated in building design and create exterior zones

− partly added solar shading

ill. 45 initial facade study

01. facadematerial as sunshading (vertical)

+building integrated sunshading

+economically sustainable (no extra funds for sunshading

+sun shading is a counterpart to the horizontal direction of the building

÷vertical sun shading is not as effective as horizontal

02. facadematerial as sunshading (horizontal)

+building integrated sunshading

+economically sustainable (no extra funds for sunshading

+departments float together visually, just as they do functionally

03. facadematerial as sunshading (dynamic)

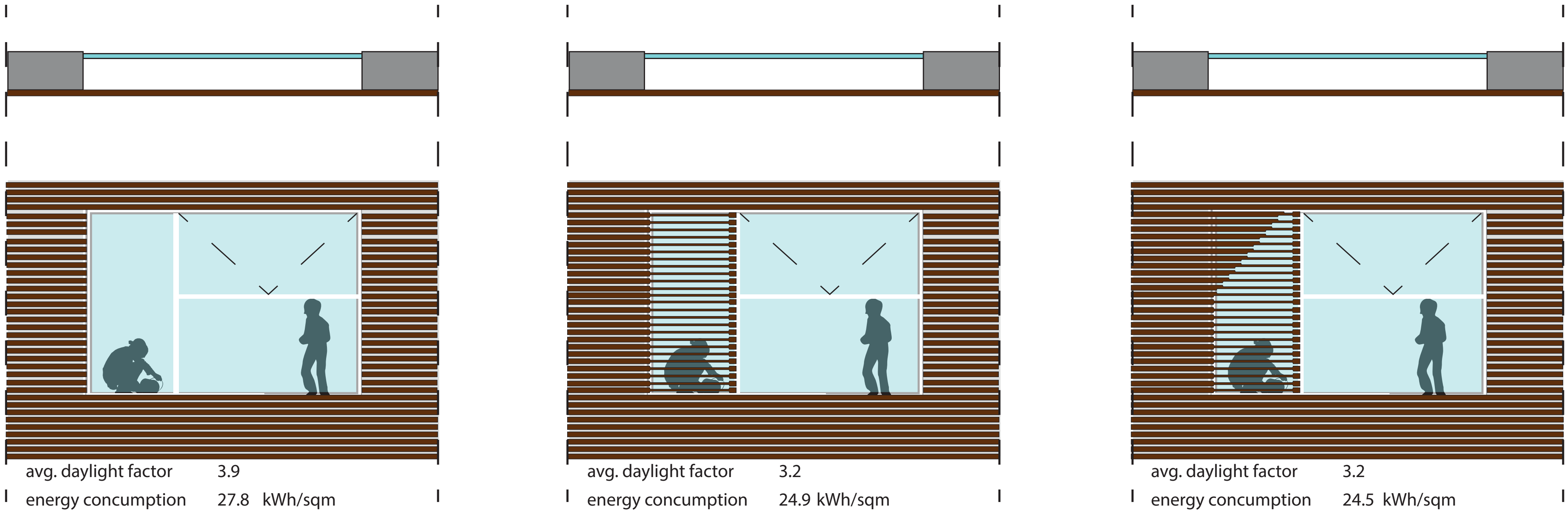
+building integrated sunshading

+makes the horizontal direction more dynamic due to variaty

+departments float together visually, just as they do functionally

÷a lot of different material lenghts (more expensive)

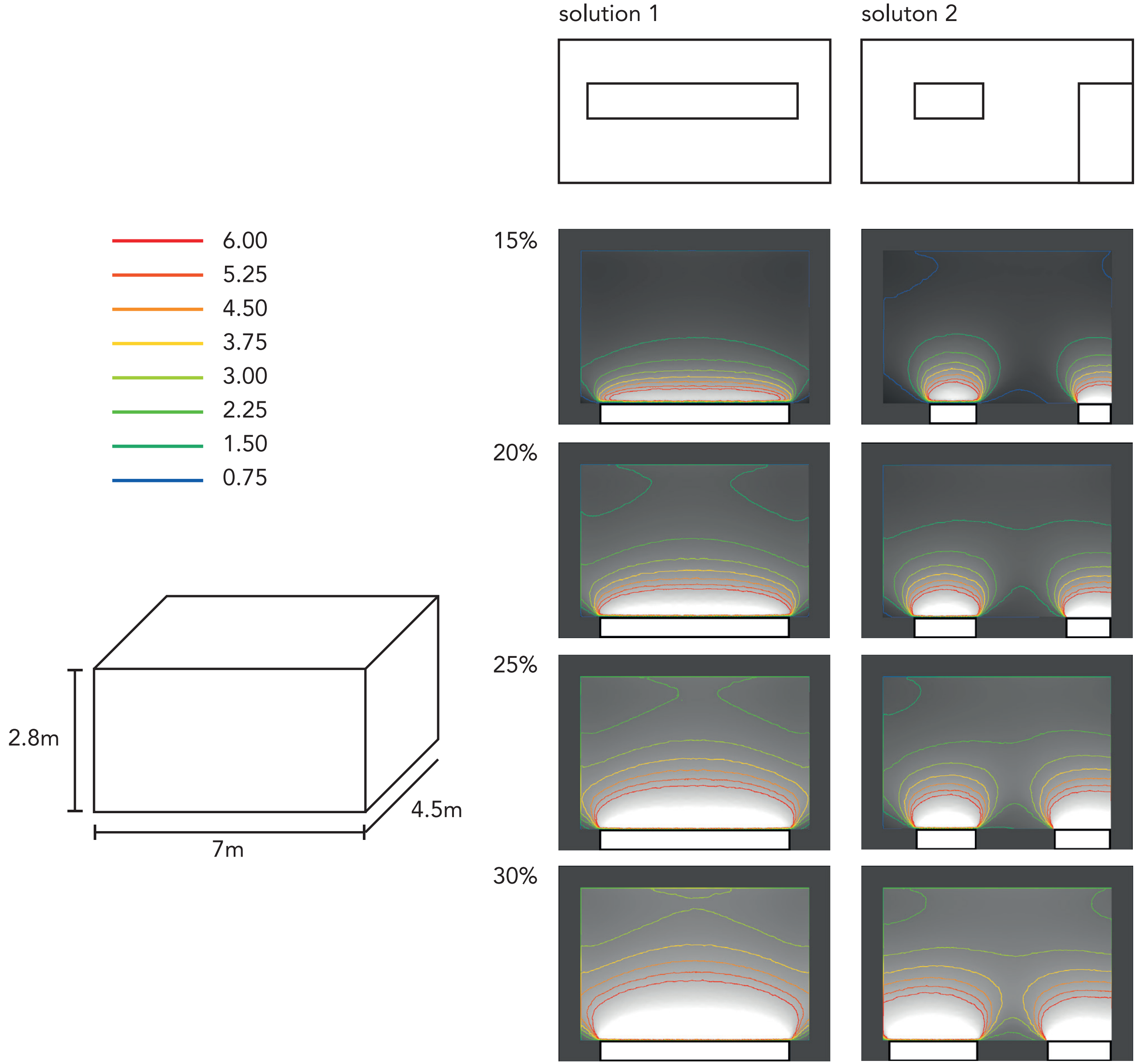
ill. 46 facade alterations



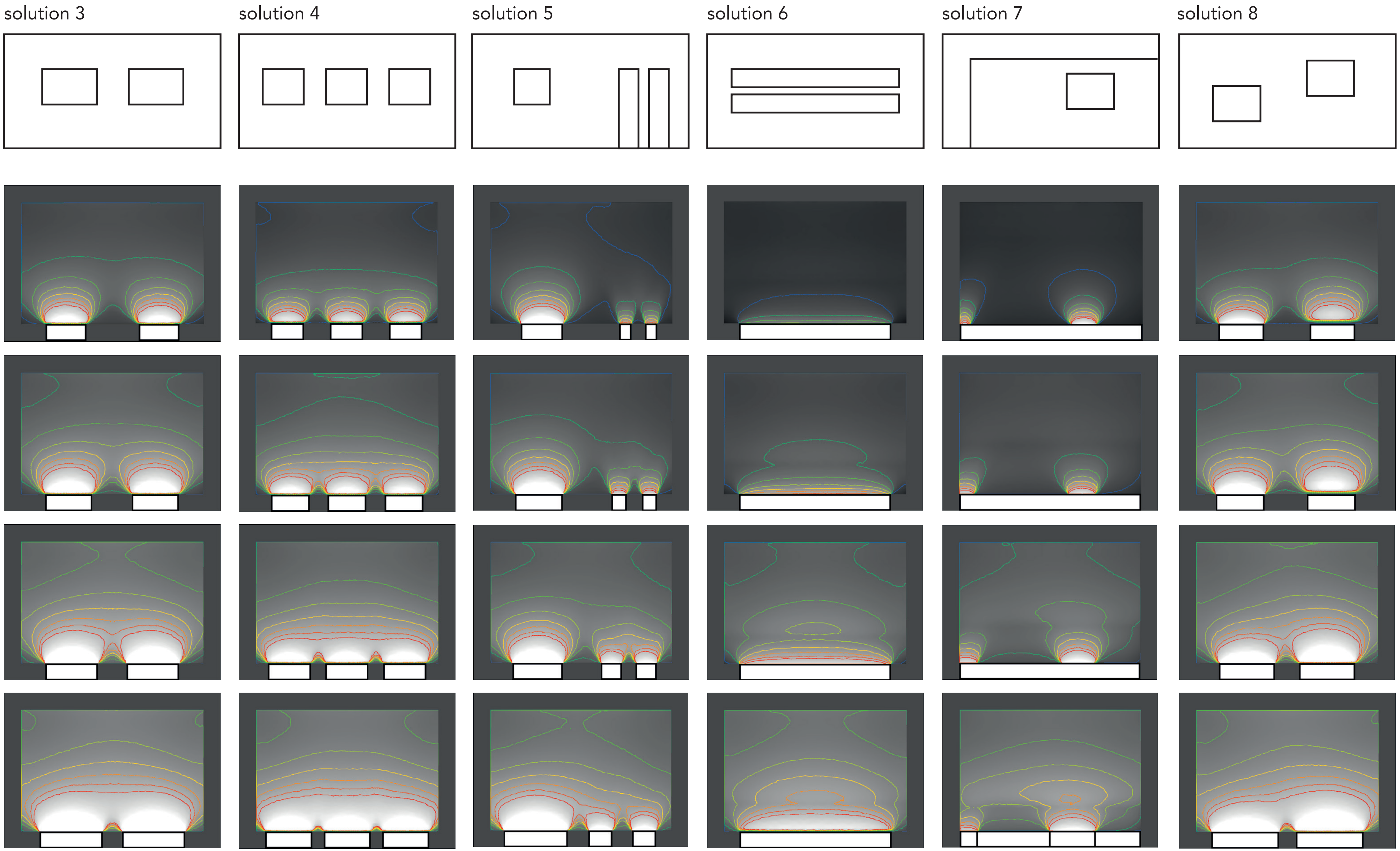
ill. 47 shade optimization

The northern facade is mainly consisting of windows towards group rooms and therefore it was interesting to work with the interrelation between distribution of daylight and potential of natural ventilation.

Firstly different window layouts were investigated according to daylight properties. The purpose was not to gain the largest amount of daylight but to get the most interesting dayligt that would also provide contrasts between light and shadow for the case of child development and visually create zones in the room. Solution 8 was the one that was decided alter further on. The reason was a potential light/shadow contrast and an obvious posibility to create nice natural ventilation properties due to thermal buoyancy.

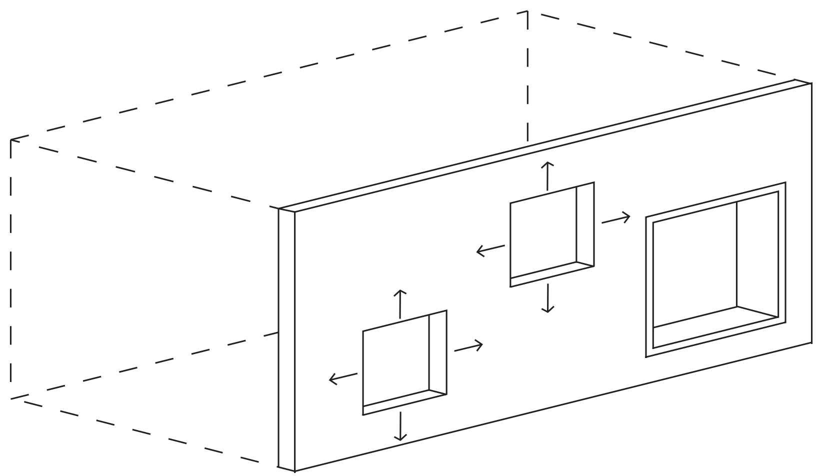


ill. 48-55 window layout - daylight study



ill. 48-55 window layout - daylight study

The layout of the windows have been altered by using the galapagos plug-in for Rhino>Grasshopper. It was chosen to fix the large window in the grouproom and focus on the smaller windows which were relevant for making the natural ventilation work. A system was created that were able to calculate both the avg. daylight factor, the distribution of daylight and the maximum airchange possible via natural ventilation. An initial handcalculation showed that by setting a minimum window dimension the needed airchange would be met at all times and by that it was possible to let the system calculate the best crossdisciplinary results. Some weighing were done so that the airchange were contributed a factor 0.2 and the DF had a factor 0.8. The air change were already secured and therefore the DF were more important than just improving the possible air change rate. This could be done by increasing the vertical distance between center of windows to increase pressure differences.
The model allowed the windows to be changed in dimensions and to be replaced both horizontally and vertically in the facade. Ill. 57 shows the results from the analysis.



ill. 56 analysis model sketch

	generation 0	generation 1	generation 2	generation 3	generation 4	generation 5
Avg. Daylightfactor	4.1	4.1	4.0	4.1	4.0	4.1
% with DF > 2	57.1%	57%	49.6%	52%	51%	51.2%
Max air change	$3.76h^{-1}$	$3.76h^{-1}$	$4.08h^{-1}$	$3.45h^{-1}$	$3.76h^{-1}$	$3.45h^{-1}$
	generation 6	generation 7	generation 8	generation 9	generation 10	generation 11
Avg. Daylightfactor	4.0	4.1	4.1	4.1	4.1	4.1
% with DF > 2	50%	52%	49.6%	50.2%	49.8%	50.6%
Max air change	$3.76h^{-1}$	$3.45h^{-1}$	$3.45h^{-1}$	$3.45h^{-1}$	$3.45h^{-1}$	$3.45h^{-1}$
	generation 12	generation 13	generation 14	generation 15	generation 16	generation 17
Avg. Daylightfactor	4.0	4.1	4.1	4.1	4.1	4.3
% with DF > 2	50.8%	49.8%	46.4%	46.2%	45.8%	47.6%
Max air change	$3.76h^{-1}$	$3.45h^{-1}$	$3.45h^{-1}$	$3.45h^{-1}$	$3.45h^{-1}$	$2.82h^{-1}$
	generation 18	generation 19	generation 20	generation 21		
Avg. Daylightfactor	4.1	4.0	4.1	4.1		
% with DF > 2	45%	44.1%	44.1%	45.2%		
Max air change	$3.45h^{-1}$	$3.76h^{-1}$	$3.45h^{-1}$	3.45^{-1}		

ill. 57 galapagos results

Materials
environmental influence

The materials of the project has been chosen with great care. These have been analysed in relation to the environmental impact in all stages (production/use/end-of-life) through Life Cycle Assesments. In this way the materials with the least environmental impact could be specified. All LCA calculations made in the following chapter are based on environmental product declarations (EPD) which all are developed in accordance with the European standard EN 15804, to ensure the comparability of the LCA calculations for materials.

Three different aspects have been investigated, being insulation, construction type, and wood type. (ill. 58-609 The result is a wooden construction with organic cotton insulation and an internal gypsumboard finish. If comparing the impact in relation to global warming potential the final construction has an impact that saves CO2 according to 54 Peugeot 107 cars driving for ten years compared to a concrete construction with glass wool. At the same time the solution contain less toxins such as formaldehyde than the other constructions.

The construction is made of Gluelam components and the exterior cladding is made of Kebony Wood, which is pinewood that have been threated through an environmentally friendly process giving the wood properties as hard wood such as larch. (Kebony, 2017)

insulation materials	global warming potential [g. CO2-Equiv pr. m2/y]		ozone depletion potential [mikrogram R11-Equiv pr. m2/y]		primary energy used [kwh/m2/y]	
lifespan	50 years	80 years	50 years	80 years	50 years	80 years
material						
rock wool	301	188	0.380	0.238	1.06	0.659
paper insulation	29.6	18.5	0.074	0.046	0.197	0.123
hemp	205	128	0.045	0.028	3.37	2.11
organic cotton	-224	-140	0.003	0.002	1.58	0.986

ill. 58 LCA insulation

wooden facade materials	global warming potential [g. CO2-Equiv pr. m2/y]		ozone depletion potential [mikrogram R11-Equiv pr. m2/y]		primary energy used [kwh/m2/y]	
lifespan	50 years	80 years	50 years	80 years	50 years	80 years
material						
kebony Scotch Pine	152	95	50.4	27.2	2.38	1.49
siberian larch wood	149	187	8.49	10.6	1.48	1.86
thermal ash	158	198	9.27	11.6	1.63	2.03
norwegian sawn wood	84	79	4.15	3.89	1.53	1.43

ill. 59 LCA wooden facade

exterior wall
construction
u-value = 0.09

lifespan	global warming potential [g. CO2-Equiv pr. m2/y]		ozone depletion potential [mikrogram R11-Equiv pr. m2/y]		primary energy used [kwh/m2/y]	
material	50 years	80 years	50 years	80 years	50 years	80 years
brick cotton insulation brick plaster	195	124	0.07	0.46	1.81	1.13
brick cotton insulation concrete plaster	155	97	0.04	0.02	1.48	0.93
concrete cotton insulation concrete plaster	171	124	0.69	0.45	0.98	0.67
wood cladding wooden construction gypsum	38	51.3	1.5	0.99	1.81	1.22

ill. 60 LCA construction

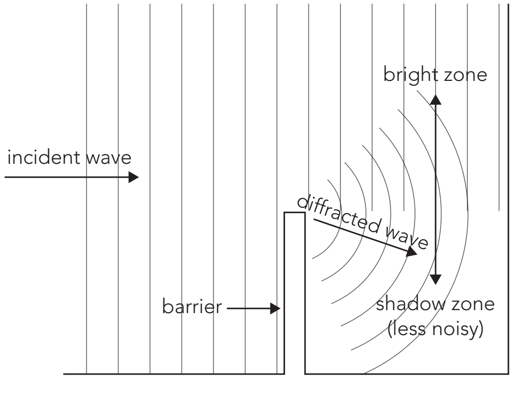
Materials

acoustics

Acoustics have a great effect on the perception of indoor environment. Many people concern noise as being the aspect of indoor environment that is the most annoying (BUPL - noise, 2017) and therefore it is concidered as being very relevant to investigate optimization possibilities in relation to noise in general and how to use it as a designparameter.
The danish building regulations state that rooms with children in daycares, nursery, institutions has to have a reverbration time below or equl to 0.4 s (BR15 - acoustic indoor environment, 2016)
Also, the absorption area in rooms with a volume greater than 300m^3 has to be above or equal to 1.2*m^2. (BR15 - acoustic indoor environment, 2016)

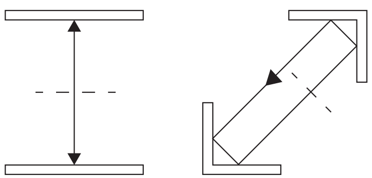
On the following page different ideas of how to handle and manipulate the sound is to be seen. this is according to avoid echo, control the reverbration time, and how to use the knowledge about sound as a catalyst for the room layout.
Ill. 64 show materials investigated in the process to optimize the acoustic environment of the institution.
The human voice is normally apparent in the spectre between 200hZ and 8khZ. (Ingeniørhøjskolen Aarhus, 2017) Female voices generally has a higher frequenze than their male counterparts and again children voices have a higher frequence than female voices. (Ingeniørhøjskolen Aarhus, 2017) This is important in relation to which of the frequences that are the most relevant to handle. For example the 125hZ frequence would almost never be apparent when talking but might be when playing music.

zoning:



ill. 61 zoning

echo:



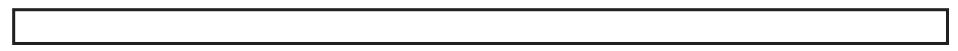
solutions:

- furniture
- hubs
- plan layout

ill. 62 echo

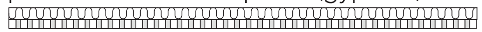
acoustic animation:

plan ceiling/wall (plaster)



+ great reflection of light
+ unbroken surface
÷ acoustic properties of material are very relevant
÷ no contrast (child development)

perforated acoustic panel (gypsum)

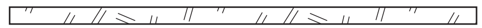


+ small diffusion
+ great absorption
÷ only small amount of light/shadow contrast

lamelas (most certainly wood)

+ diffusing
+ absorbing
+ great amount of light/shadow contrast
+ tactility
÷ quite expensive

woodcrete (panel or entire surface)



+ great absorber
+ tactility
÷ small amount of light/shadow contrast

ill. 63 acoustic animation

absorbance coefficients (potential materials)	frequenzy (Hz)					
	125	250	500	1k	2k	4k
plaster	0.14	0.10	0.06	0.04	0.04	0.05
soft wood	0.30	0.25	0.20	0.17	0.15	0.10
hard wood	0.42	0.21	0.10	0.08	0.06	0.06
gypsum	0.29	0.10	0.05	0.04	0.07	0.09
woodcrete (Troldtekt®)	0.35	0.60	1.00	0.90	0.90	1.0
3/4" acoustic tile	0.68	0.81	0.68	0.78	0.85	0.80
floor - wooden	0.15	0.11	0.10	0.07	0.06	0.07
floor - linoleum/vinyl	0.02	0.04	0.05	0.05	0.10	0.05
heavy plate glass	0.18	0.06	0.04	0.03	0.02	0.02
window glass	0.35	0.25	0.18	0.12	0.07	0.04

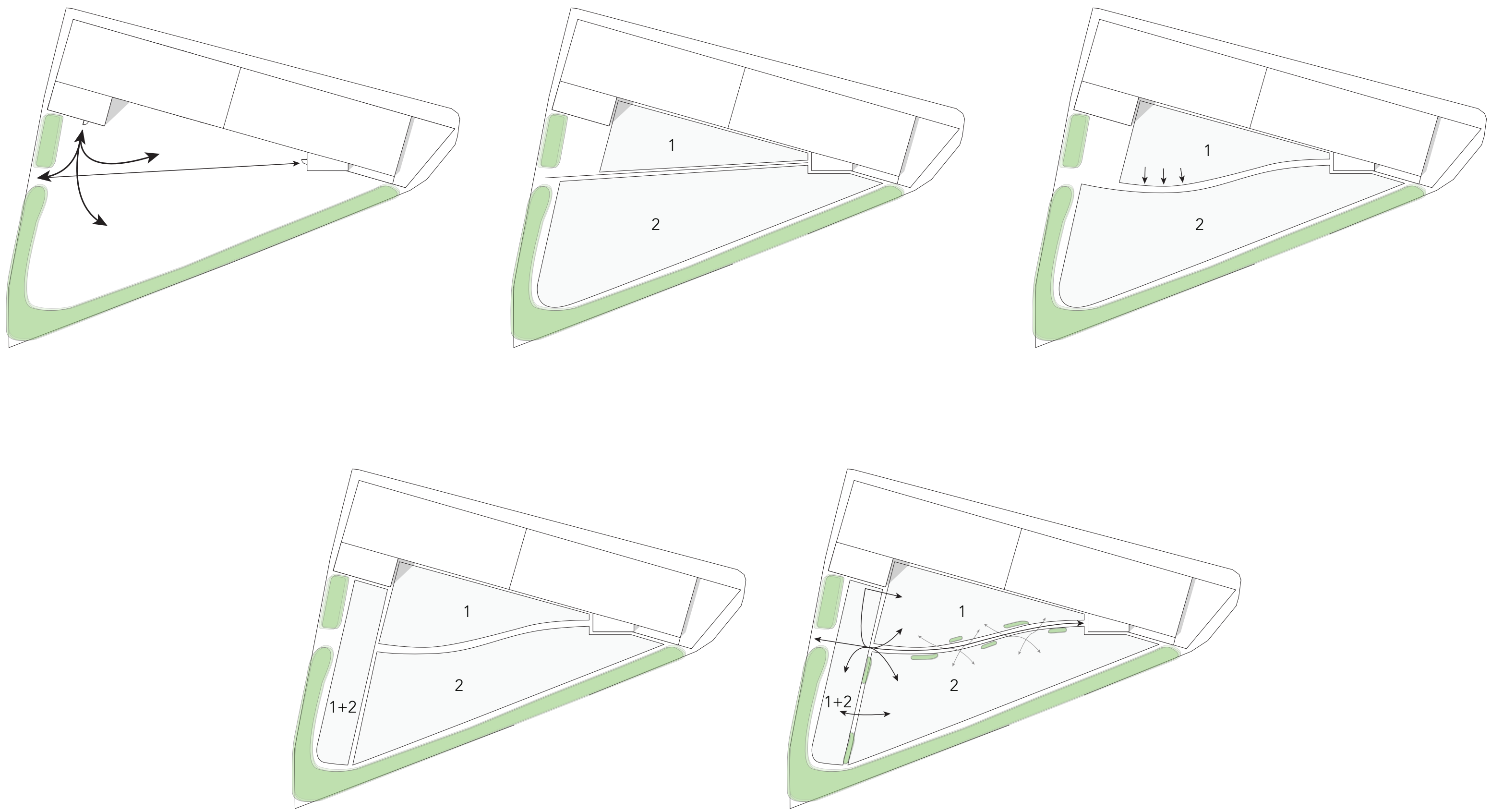
ill. 64 absorbance coefficients

ill. 93 Troldtekt

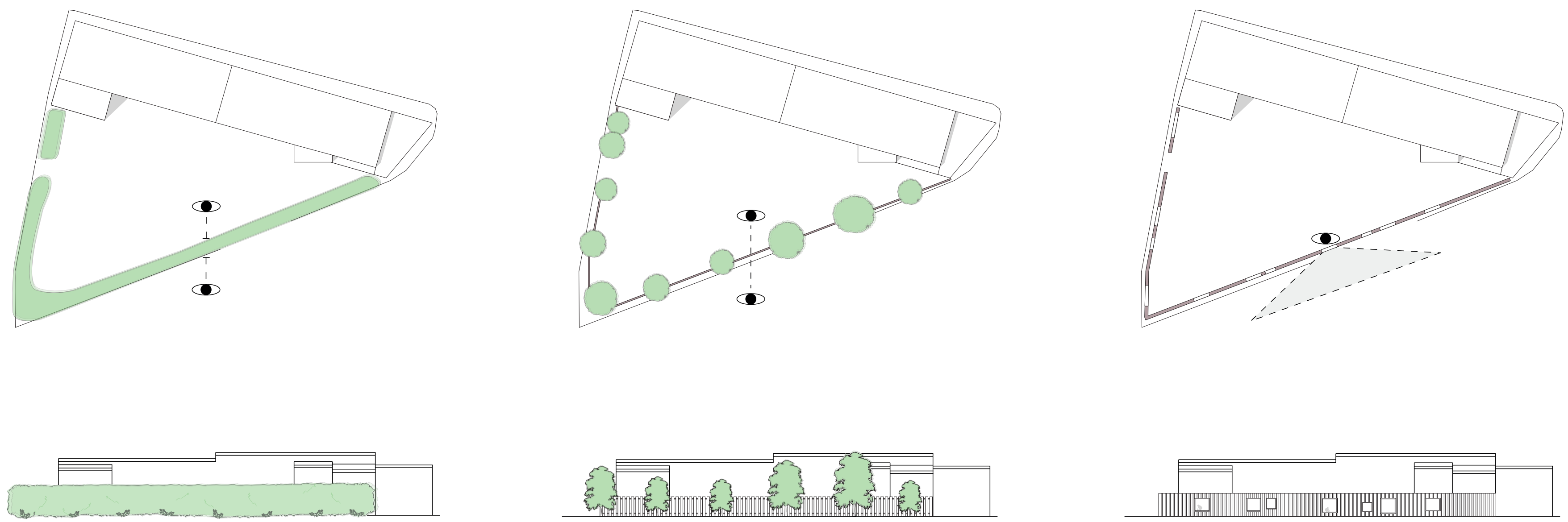
Landscape design

When designing the landscape the knowledge from the program chapter has been taken into concideration. This is both according to sun, shade, flood risk and interesting contextual aspects such as the train station or city centre. The flowlines of the area in relation to the building volume has been the main designfactor and this separates the outdoor space in three ares with different functions being, kindergarten area, nursery area and common area.

The entire site is divided in two levels to take care of heavy rain and in the future potential flooding due to climate changes. The southwestern corner is the one that is the lowest to make the water seek this corner and potentially keep the rest of the area dry and usable. The perimeter is articulated by a fence which it has been investigated how to design to optimize the purpose of screening towards the industry and noise from freighttrains to the south but not enclose the area completely from the outside. The result is a fence with additional windowareas to sit in an behold the context on the outside.



ill. 66 flow design



ill. 67 perimeter design

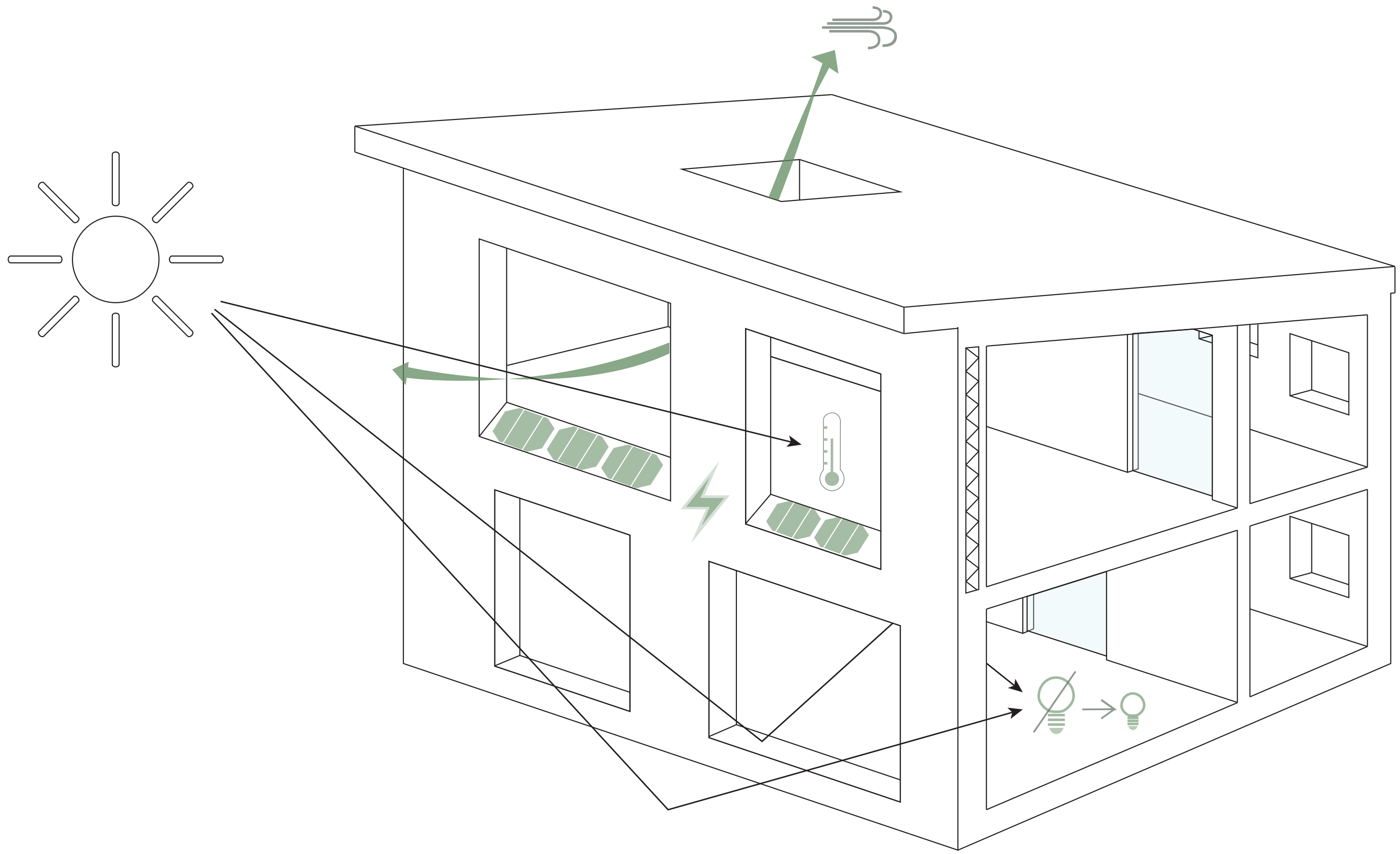
04 Presentation

Active and passive strategies
Concept
Masterplan
Masterplan section
Plandrawings
Sections
Elevations
Thermal and atmospheric comfort
Acoustics
Ventilation
Daylight
Construction and structure
Energy frame 2020

Active and passive strategies

The project contain mainly passive strategies. One of these is exploiting the passive heat gain. The volume of the building is altered so that it can exploit the sun in relation to optimizing the heat gain. The result of this is a reduced energy need for heating in mainly the heating season. Next up is the use of natural ventilation in all rooms for daily use. All window layouts provide the possibility to exploit thermal buoyancy and hereby improve the impact made by natural ventilation. An effective natural ventilation decrease the need of mechanical ventilation and hereby the energydemand. The 3rd passive strategy implemented is a great amount of thermal insulation providing a low u-value and by this a low transmission loss through the envelope. Daylight has throughout the proces been a factor that has been very informing in relation to the design. The reason of this is the importance of daylight, direct light and contrast in child development. The daylight factor of the main rooms are more than sufficient and in this way it is possible to decrease the use of electrical lighting and hereby the total energy consumption.

PV's being an active strategy is concidered optional in this project. The 2020 energyframe is met without using active strategies but the energy demand can of course be lowered by using them. Then the concideration would be if the effect of applying them is good enough compared to the energy that would have to be used when producing the PV's.



ill. 68 active and passive strategies

C o n c e p t

1) Volume placed centrally on site

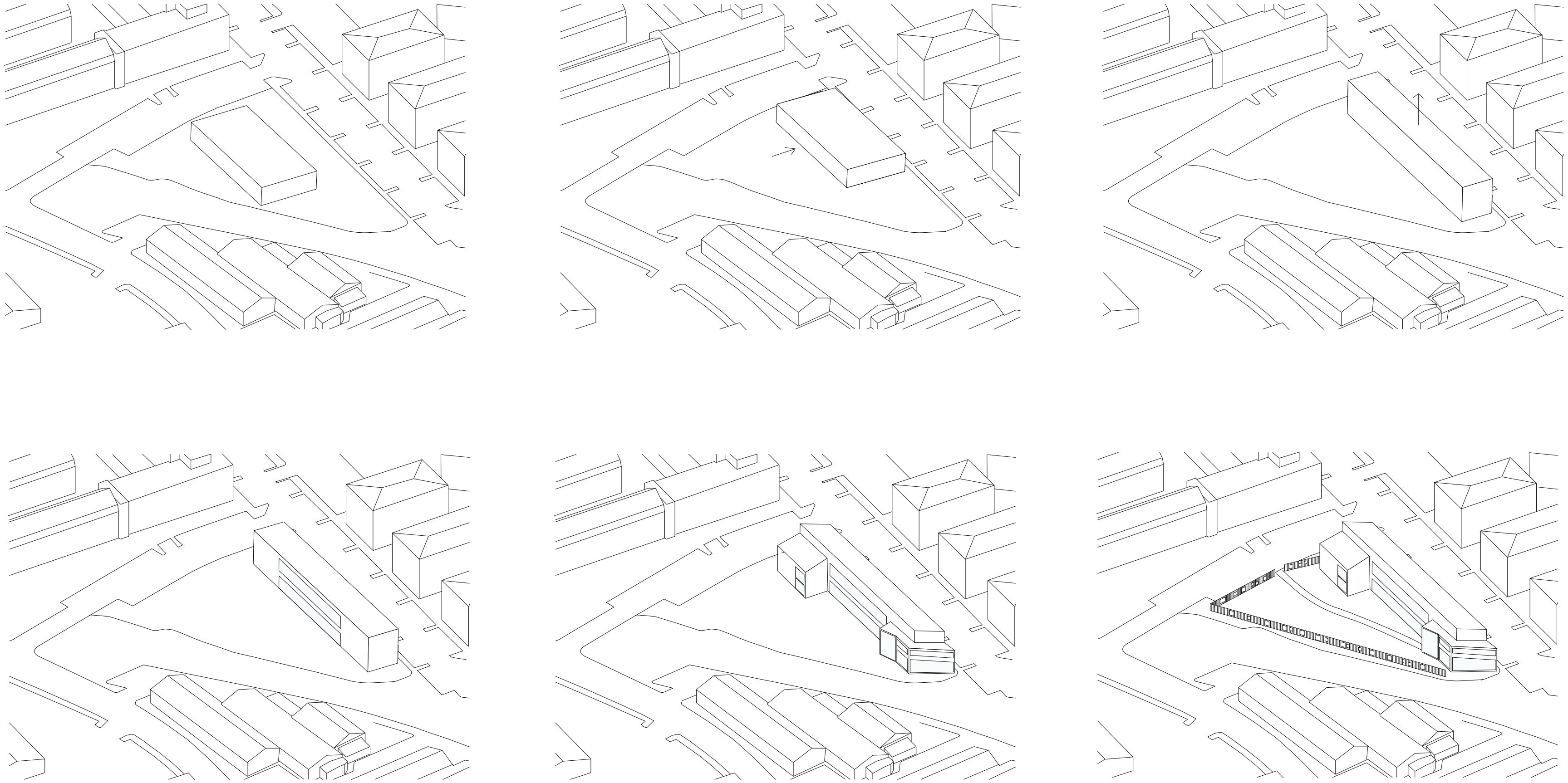
2) Volume pushed towards north for connected outdoor space and closer relation to dwelling area

3) Volume stacked in two storeys for increased direct ligth and dayligt

4) Large glazing areas added for sunlight and passive heat gain

5) Entrances and eating area added as focal points

6) space dividing access path is added and privacy is secured with fence contain peep windows for interaction with context



ill. 69 concept

Masterplan

The project site is fitted in between light industry and dwelling areas. Therefore the masterplan has been tailored to fit in this varying context. The building volume is placed in the northern area closest to the dwelling area, train station and city centre and the outdoor spaces are placed in the southern part to be exploited to the most sun but also because of the industry towards south. By screening towards the industry, shadow is provided and is needed in the outdoor spaces. Therefore the visual screening becomes a quality it would not have been if in front of the building volume.

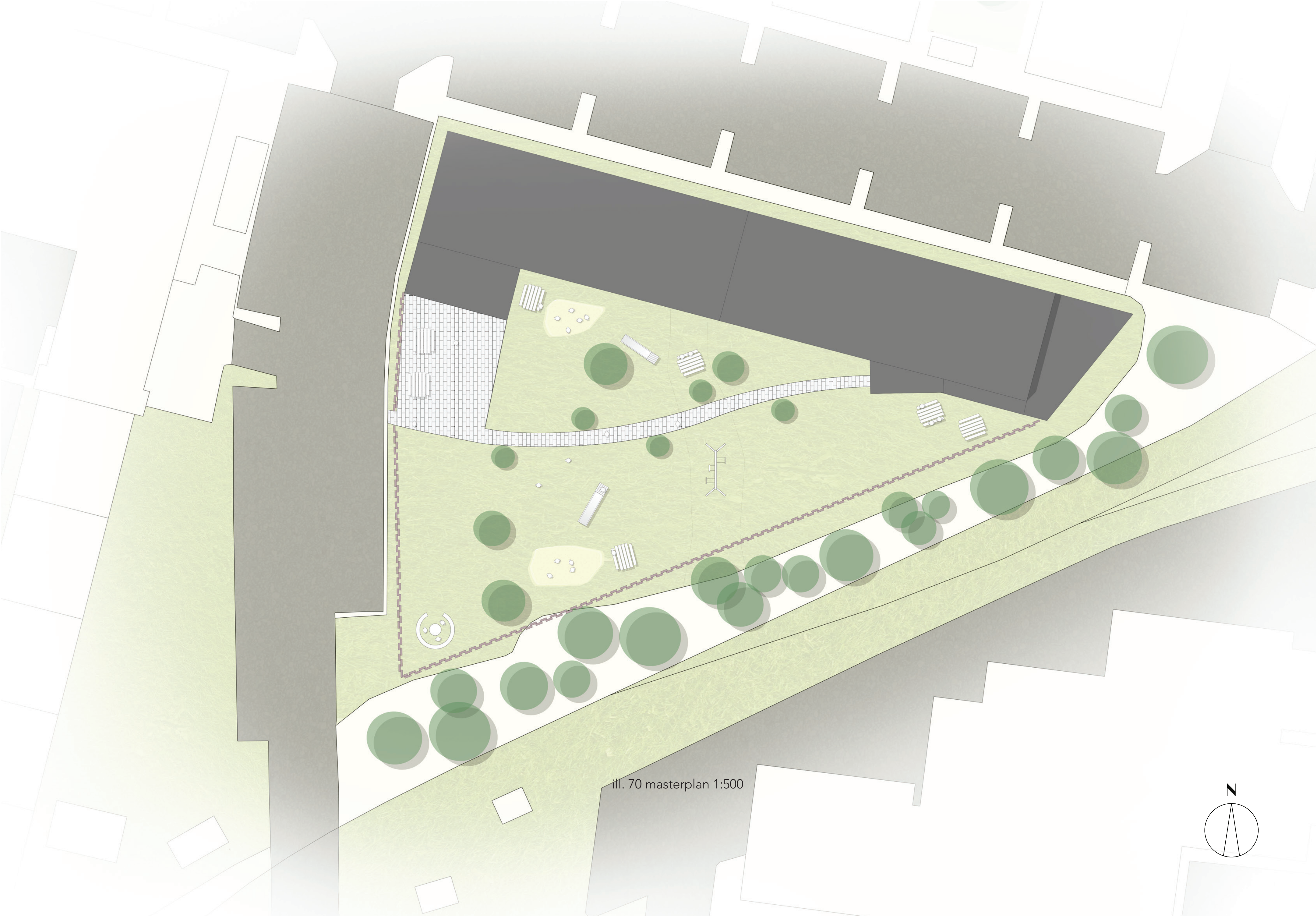
The main entrance to the site is in the western perimeter. The citycentre and train station is placed north west of the site and therefore it is assumed that commuters either would benefit from the close relation between entrance and trainstation, or that the entrance and parking area will be a natural stop for those who is by car and have to leave the city in south/east direction towards E45, Kolding, Fredericia, Odense etc.
The southern and western perimeter is articulated by a fence with window holes. In this way the outdoor spaces are screened towards the context but at the same time provide space for the kids to sit and see what happens on the others side of the fence.

The entrance area is paved to ease the transition from parking space to wardrobe. From here a paved path bends across the outdoor space to the main/guest/staff entrance which is angled directly towards the entrance of the site. Rest of the outdoor space is a variation of grass, sand, and gravel.

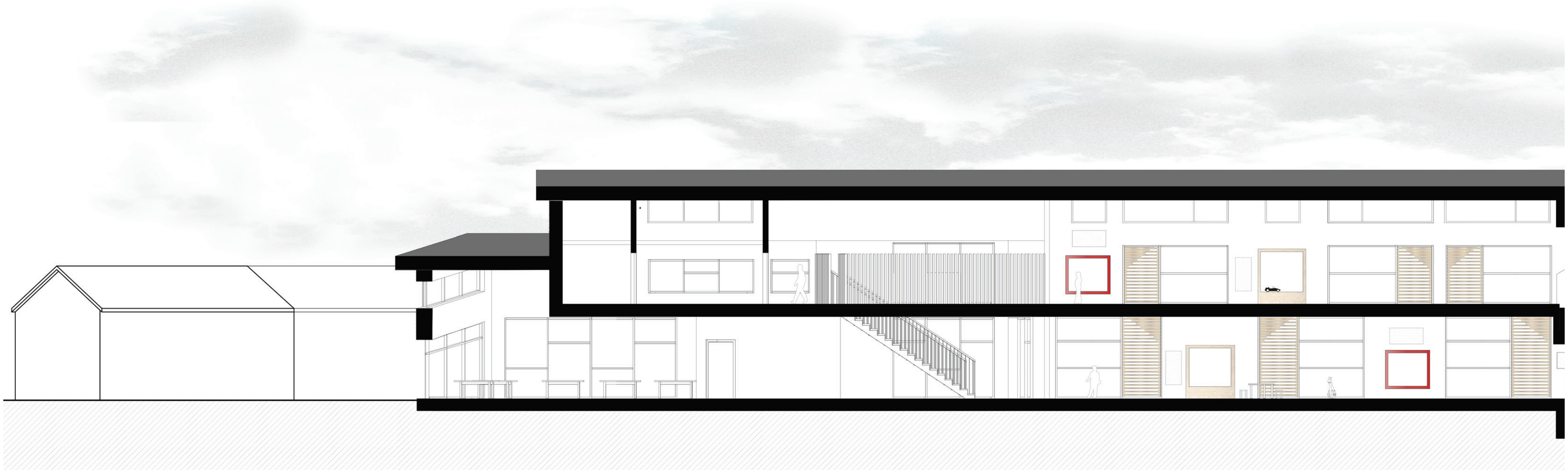
The space is divided in three areas being 1: an area for the nursery kids closest to the building, 2: an area for kindergarten kids towards the southern perimeter and 3: a common area adjacent to the western perimeter including the entrance area. The areas are not completely separated. This is for the reason of the benefits of kids of different ages playing together to enhance social behaviour development and does also relate to the results from the questionaire.

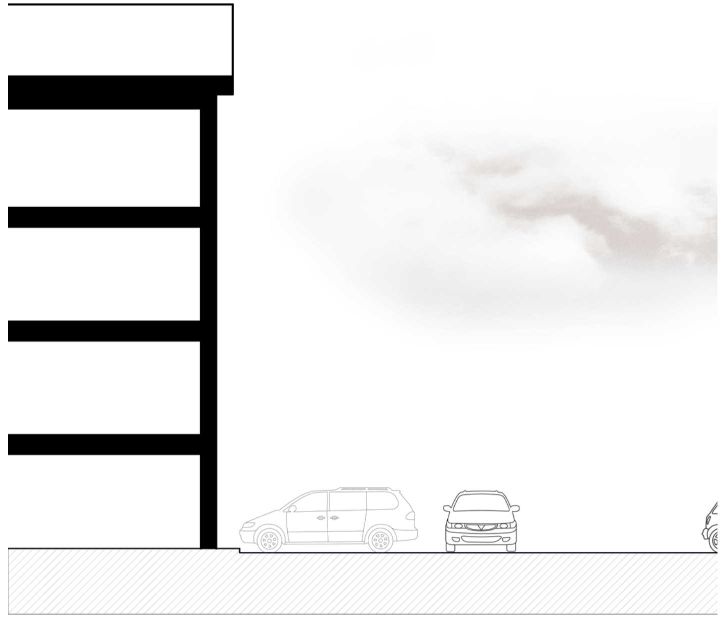
The greenery in the outdoor spaces provide shadow and function as windblocking devices to provide areas of different sensory and phenomenological experience.

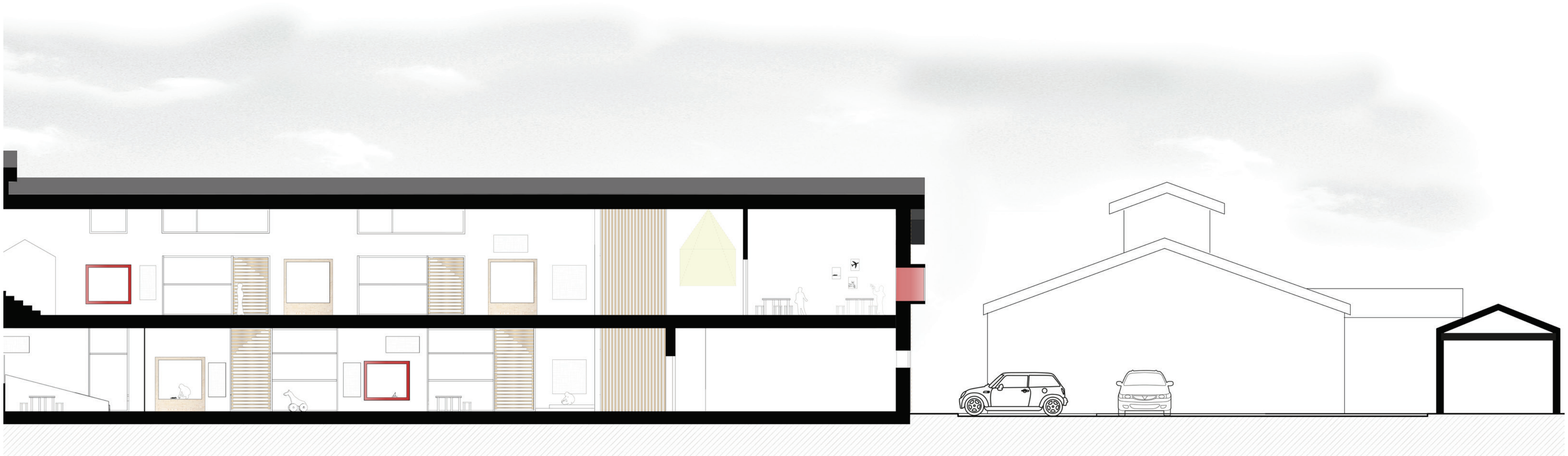
The entire area is in different levels so that the eastern part is elevated from the western part. The south eastern area is the place which is the lowest. When having rain or eventually flooding this is the area that will be filled first before rest of the area is influenced. The different levels are extended to the inside where it provide a natural motory challenge in the form of stairs and ramps.



ill. 70 masterplan 1:500





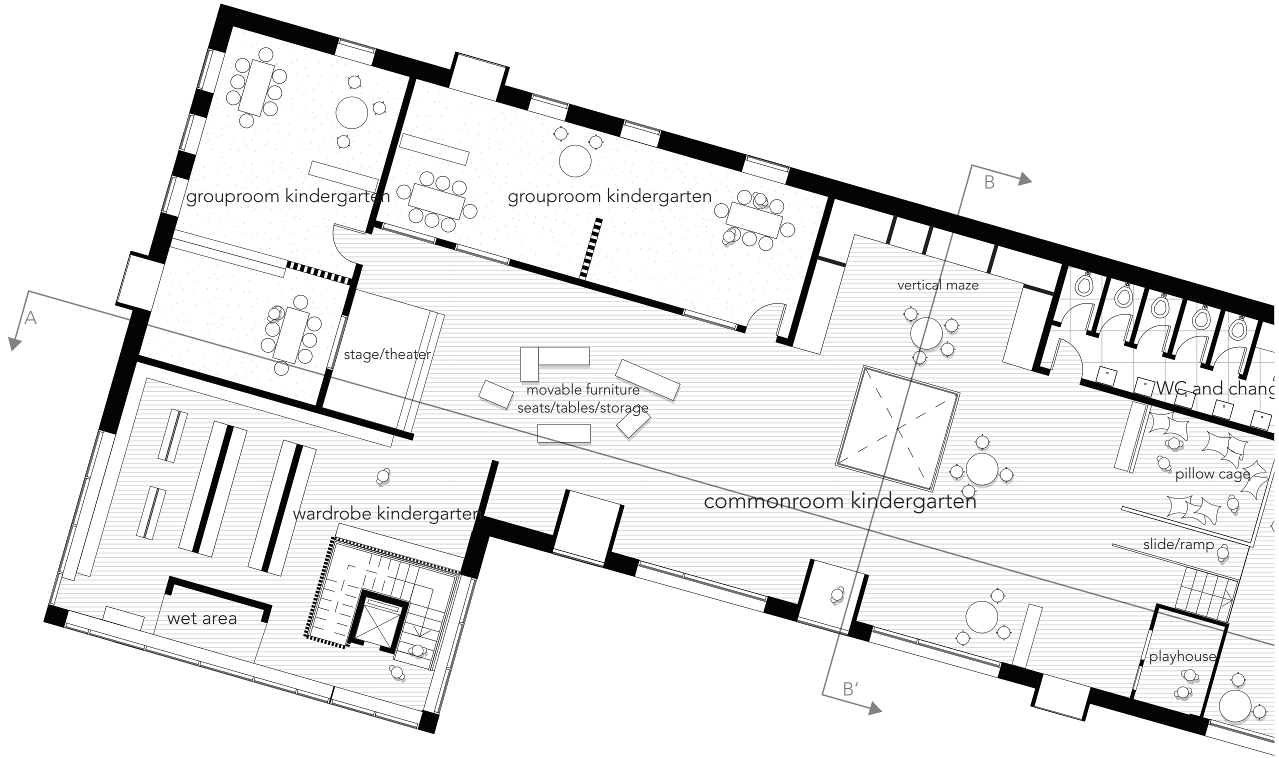


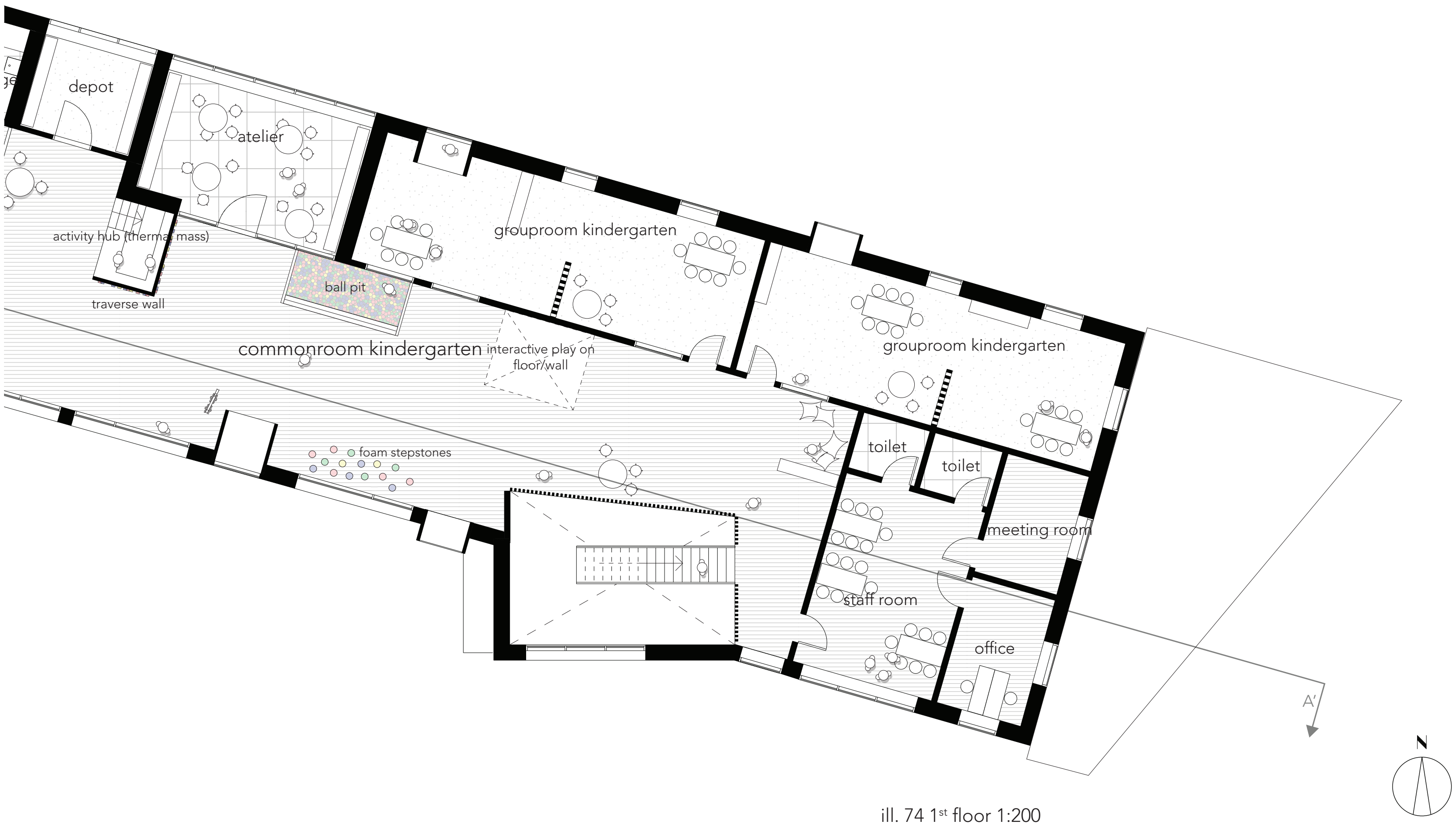
ill. 71 masterplan section A-A 1:200

ill. 72 masterplan section B-B 1:200

Plan drawings

ill. 73 groundfloor 1:200


grouproom kindergarten
grouproom kindergarten
B
A
vertical maze
stage/theater
movable furniture
seats/tables/storage
WC and chang
pillow cage
commonroom kindergarten
wardrobe kindergarten
slide/ramp
wet area
playhouse
B'



ill. 74 1st floor 1:200

Sections

ill. 75 section A-A 1:200

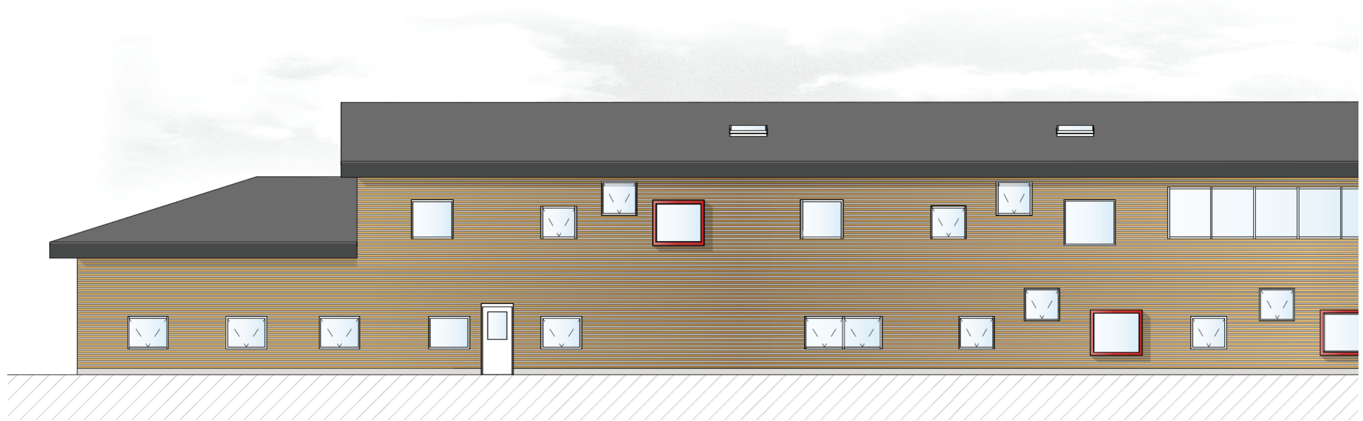
ill. 76 section B-B 1:100

ill. 77 grouproom kindergarten

Elevations

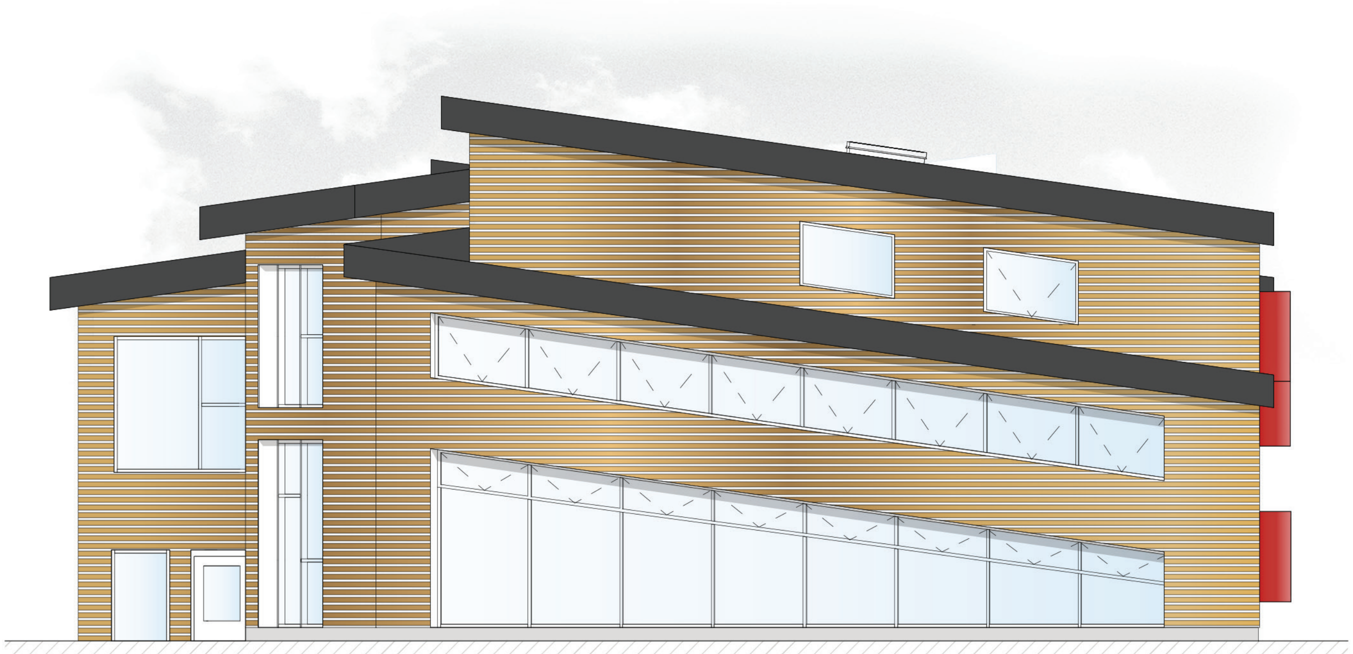
The institution is a wooden construction with wood cladding on the exterior walls. This relates closely to the wish of making a sustainable building due to the small emissions from wood, both in the construction phase, user phase and demolition phase. The material provide a warm atmosphere and tactility in relation to child development.
The windows are, on the southern facade, very dominating and allow a lot of direct light to the rooms which is needed in relation to the subchapters of brain architecture and child development. The large glazing area also provide a daylight factor which is more than sufficient. The Kebony wood cladding extends in front of some of the window area to provide sunscreen - This cladding is horizontally attached, to mostly block the high summer sun and let in the heat in heating season. The combination of large unobstructed glazing areas and relatively small shading areas gives a transparent facade were interaction between the kids are possible from inside to outside of the building.

ill. 78 arrival



ill. 79 south elevation 1:200

ill. 80 north elevation 1:200

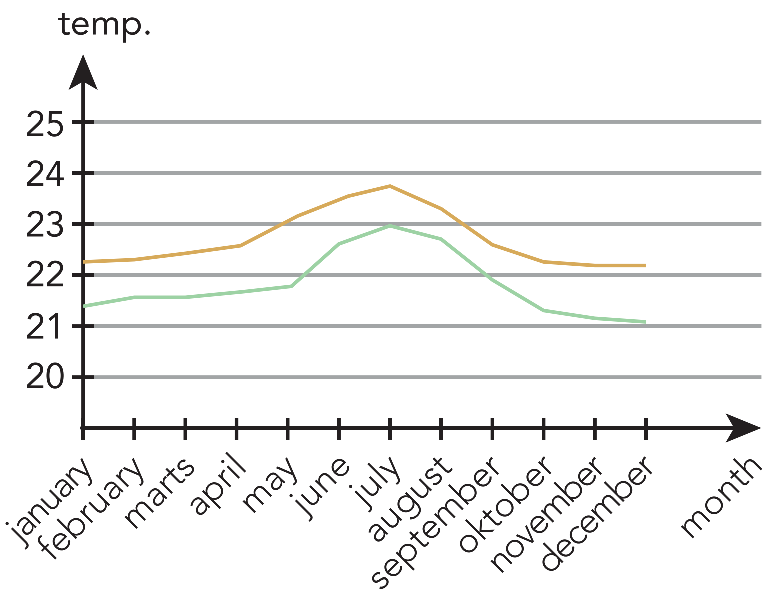


ill. 81 east elevation 1:100

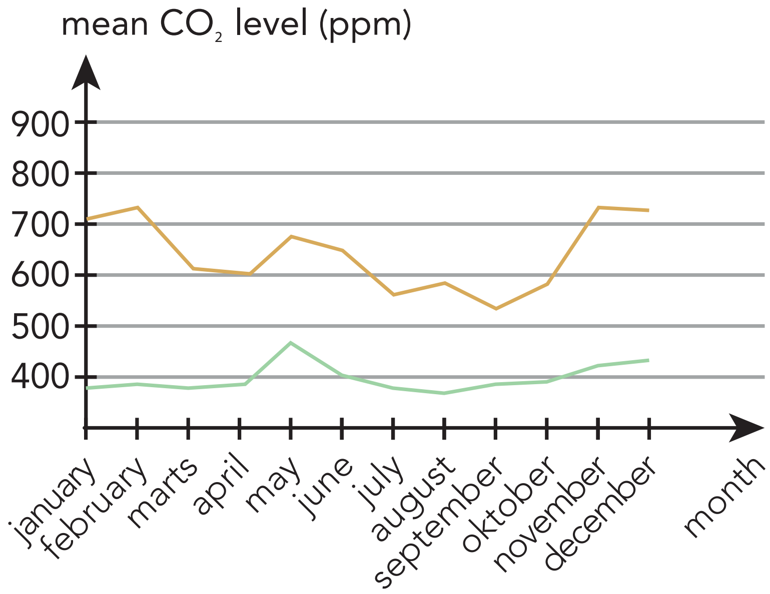
ill. 82 west elevation 1:100

Thermal and atmospheric indoor environment

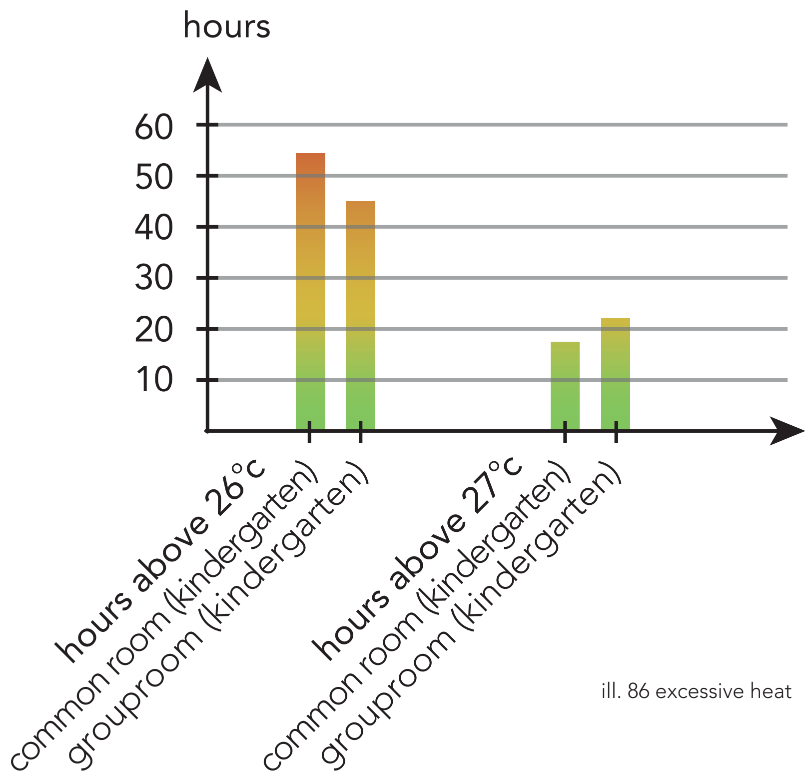
BSim software has been used to make a dynamic thermal/atmospheric simulation to investigate if the institution fulfill the requirements for indoor climate stated in the Danish building regulations.
The kindergarten common room and grouproom has been chosen to analyse. The common room has the biggest volume/person ratio of the two common rooms and the grouproom has the smallest ratio and is on the same time the grouproom which is inluenced by the biggest amount of radiation, transmission loss etc.
In the calculation the common room and the group room are in two different thermal zones. The ventilation system is natural in the summertime and mechanical in the heating season being fully automatic and is not to be overruled by users.
The analysis of the common room is an analysis of only the lower level, with the loads of half the kindergarten users to simplify the model. Arguably the two halfs of the common room has the same indoor environment conditions and therefore the "invisible wall" towards the upper level in the analysismodel is determined as meeting an identical climate zone. Systems of heating, ventilation, venting, people load, infiltration and equipments has been implemented. venting is excluded in the heating season. The operational temperature in the common room is 21-23°c in the common room during the year and 22-23.7°c in the group room. (ill. 84) A limit of 100 hours above 27°c and 25 hours above 28°c has been set and can be seen fulfilled in ill. 86 and the appendix. This is normally only mandatory for living spaces, but has been chosen to work as a guideline in this project also.
In the summertime the venting provide natural cooling to keep the temperatures low and a shading system works as a passive strategy to decrease the heatload from the sun and hereby excessive heat.
The construction can be seen specified in the subchapter "construction and structure" on page 127.
The sufficient supply of fresh air used in the calculation is based on hand calculations for CO2 level and sensory air pollution (olf) see appendix 01. Also the potential fresh air supply in relation to window layout has been concidered.



ill. 84 temperatures



ill. 85 CO2 level

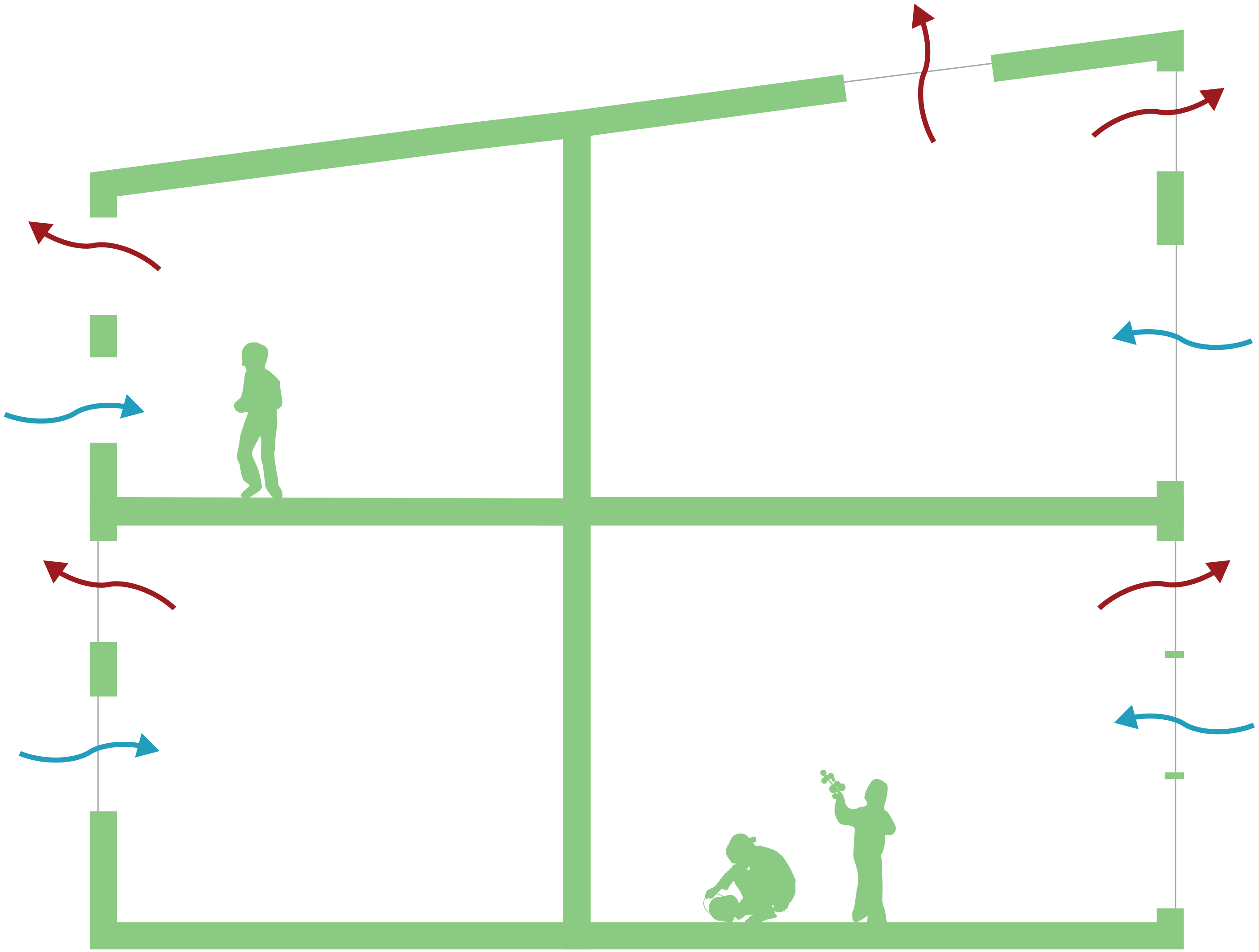


ill. 86 excessive heat

Ventilation

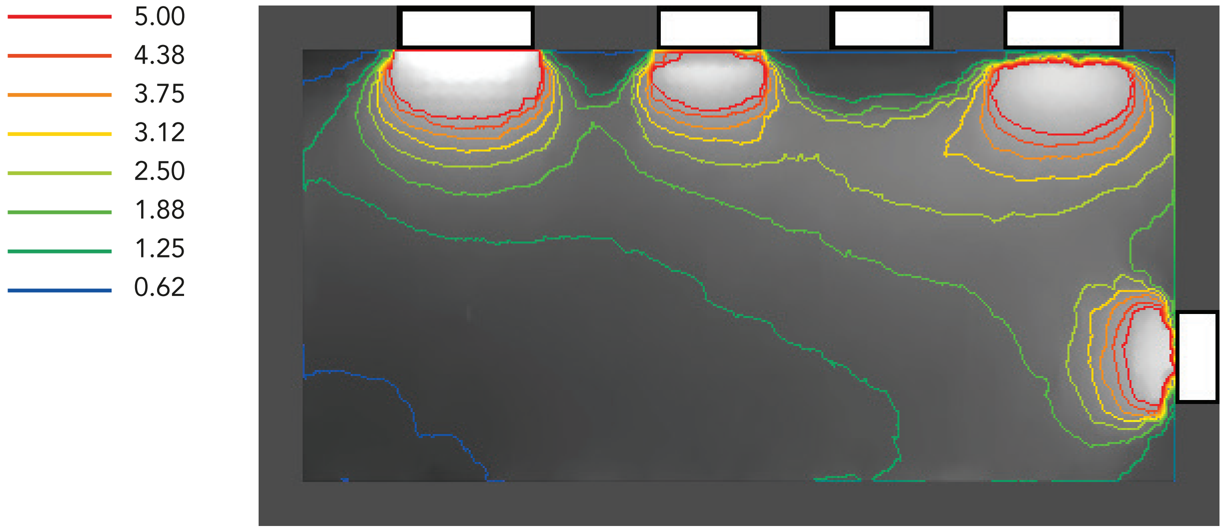
The layout of the building is designed to enhance the natural ventilation potential. For that reason the maximum room depth is 8,5m to make it possible to ventilate by the use of thermal buoyancy and in some areas by crossventilating through the ateliers. The roomdepth/height ratio has to be below 5 to effectively ventilate naturally. The thermal buoyancy performs greatly with the exception of outdoor temperatures being 21-23°c since these are too close to the indoor temperature. (Hyldgård, 2001)

An example of calculation of window openings is available in appendix 03. An average windspeed has been calculated as being 4.8m/s. This calculation can be seen in appendix xx. Coefficients used for the window opening calculation are for low-rise buildings sourrounded by obstacles about the same height as the building. The air change rates for the common room and the group rooms were very important in relation to achieve a sufficient air quality.



ill. 87 ventilation

Daylight



ill. 88 DF grouproom

As mentioned before, the dayligth has been of a great concern in relation to the developent posibilities of children in the institution. As it can be seen in ill. 88 the daylight factor is more than sufficient, but the quality of the light is even more interesting. The calculation reveal that there are areas which are not having a very high DF value but in this cse that is a good thing. In this way both light and shadow are aparent and the contrasts in between these. This creates zones and strengthen the development possibilities for the children.

ill. 88 daylight

A c o u s t i c s

The relevant rooms have been investigated and optimized in relation to the acoustic environment. The results show that the demands of the building regulations have been met. in almost all frequencies and rooms and the average is sufficient.
In the staff room, no children are apparent. This mean that the reverbration time of this room only has to be below 0.6 s instead of 0.4 s according to the building regulations.

The manipulation of sound has been an interaction between the technical and aesthaetic properties of materials and the way that they are applied.

Materials used:

- Kebony (truss ceilings)
- gypsum walls
- woodcrete panels
- soft wood flooring

acoustic properties	reverbration time (T, sec.)						
Relevant rooms	125	250	500	1k	2k	4k	avg.
grouproom nursery	0.41	0.44	0.35	0.40	0.41	0.37	0.40
grouproom kindergarten	0.40	0.43	0.34	0.39	0.40	0.36	0.39
common room nursery	0.40	0.43	0.34	0.39	0.40	0.36	0.39
common room kindergarten	0.39	0.42	0.33	0.38	0.39	0.35	0.38
eating area	0.43	0.46	0.38	0.42	0.43	0.40	0.42
staff room	0.47	0.50	0.41	0.46	0.47	0.43	0.47
avg. all rooms							0.41
avg. rooms with children							0.40

ill. 89 reverbration time

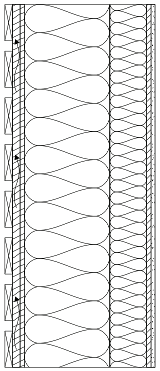
Construction and structure

The structural system of the institution is a frame which relies on gluelaminated columns (280x280mm) and glue laminated beams. (studs, 280x100mm). The construction is made rigid by having internal wallconstruction with studs so that these can also carry load and stabilise the structure in different directions.
In relation to the three pillars of sustainability the components used are recyclable, biodegradeable and not least renewable. The energy used for a wooden construction is small compared to steel or concrete. This can be seen in the material chapter. In addition wood is stronger than the others in relation to weight.
Another positive aspect of the wooden construction is that the building is warmer in heating season and cooler in summer - also the acoustic properties are better for a wooden construcion than the counterparts. The reason for this is woods ability to absorb sound better due to being a light material. This prevents noise and echo.
In the case of fire safety, GL is inherently fire resistant - This mean that if there is a case of fire the surface of the component will carbonize and protect the load carrying center.

The column/beam structure (skeleton structure) enhance the flexibility and adaptability of the building. This can be concidered in relation to the ECO2.1 DGNB criteria. Some of the partition walls are not load bearing and can therefore be altered/removed/changed or recycled.

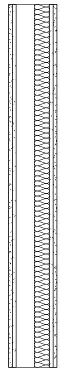
In the material subchapter different materials were investigated to find the material that had the least impact on the environment, and did not degase. The organic cotton proved to be the material that made the least impact and therefore this was chosen. in addition the cotton is recyclable at the end-of-use stage.

exterior wall, u-value 0.09 W/m^2K



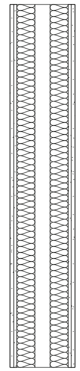
120x25mm kebony wood cladding
ventilation layer - 25x25mm battens
15mm painted plywood
280mm organic cotton insulation
+ I-timber studs
vapor barrier
120mm organic cotton insulation
2x12.5mm gypsum board

partition wall



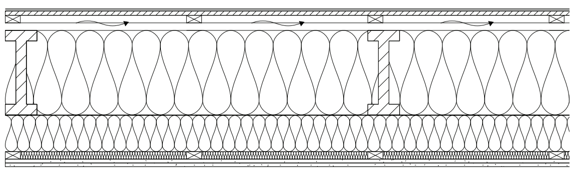
2x12.5mm gypsum board
110mm timber uprights + 60mm
organic cotton insulation
2x12.5mm gypsum board

partition wall - acoustic



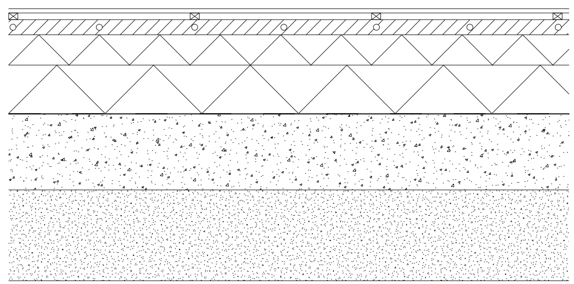
2x12.5mm gypsum board
60mm timber uprights + 60mm
organic cotton insulation
air layer
60mm timber uprights + 60mm
organic cotton insulation
2x12.5mm gypsum board

roof, u-value 0.09 W/m^2K



2x4mm asphalt, bitumen
15mm plywood
cross and counter battens - ventilation
280mm organic cotton insulation + I timber studs
vapor barrier
120mm organic cotton insulation
50x25mm battens, dist. 600mm + 25mm insulation
2x12.5mm gypsum board

ground floor, u-value 0.09 W/m^2K



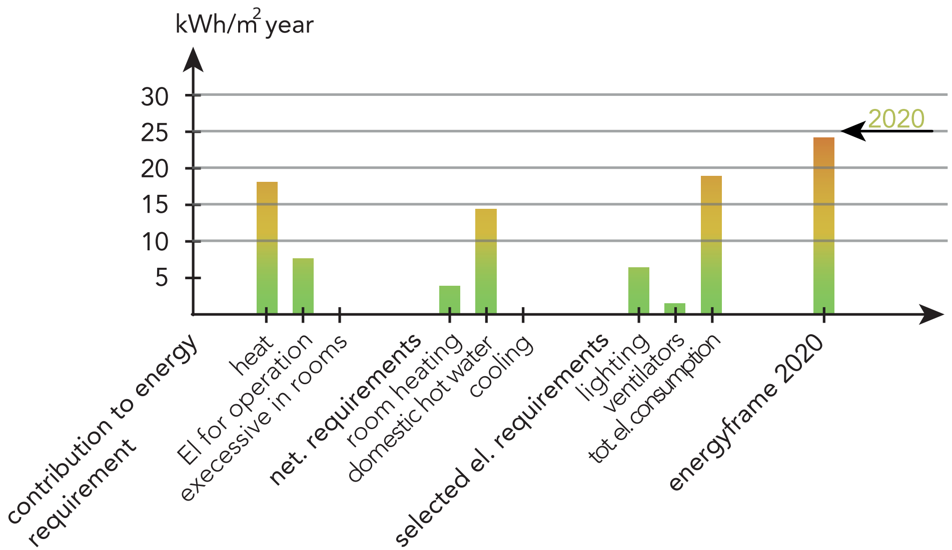
14mm wooden flooring
25mm crossbattens
50mm anhydrid layer (floor heating)
100m polystyrene insulation
160mm polystyrene insulation
vapor barrier
250mm capillary layer
300mm sand

ill. 90 construction details

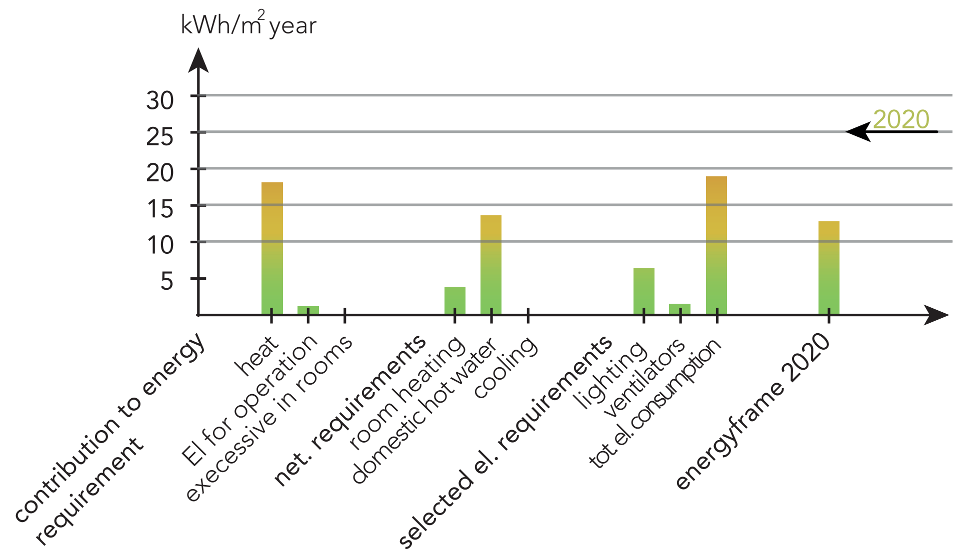
Energy frame 2020

The energy demand of the building has been calculated in Be15 in relation to the 2020 energyframe. The calculation is for the entire building including energy for electrical lighting which is a demand when calculating something else than dwellings. Making the Be15 is not a proof that the indoor environment is sufficient since it calculates the building as an entire component and does not differ between rooms with different environmental conditions. The building is calculated as a non-residential building having an energyrequirement of less thant 20kWh/m^2/year. The energy demand of the building turned out to be 24.5kWh/m^2/year. During the proces it has been lower than this but it has been decided to increase the window area towards south to enhance the daylight properties instead and in this way improve the environment in relation to child development.

As mentioned PV's is concidered optional in this case, but if applying them on the southern roof the energydemand would be 12.9kWh/m^2/year.



ill. 91 energy frame



ill. 92 energy frame with PV's

05 Epilogue

Conclusion

The institution for the future seeks to improve the the social, environmental and economic sustainability in the institutional sector. Mainly the social sustainability potential have been tested.

The project reveal that it is possible and makes sense to integrate child development possibilities in the designproces and make these form the project both technically and aestetically. The interesting aspect is that the work with child development and environmental aspects are interrelated and can be altered in co-relation so that one solution in some cases solves both aspects - This is a very holistic approach to institutional buildings.

At some points it has been neccesary to choose between environmental and social sustainability. This was for example the case with glazing area towards south. In this case the outcome were a special attention to social sustainability and increased daylight conditions.

The close interrelation between staff functions and the two departments support, together with the created indoor environment, a good working environment which both pedagogues and children benefit of.

Reflection

Initially the project was about assumptions and ideas of how it was possible to create an institution designed both 'by' and for kids. The analysis phase made all the assumptions more palpable due to having examples of how potentially to begin the proces.
However, I am not a pedagogue or a 4 year old, nor am I a sociologist og neuroscientist. The timespan does not allow for a research to a fulfilling extent to get knowledge about the subjects, methods and possibilities in the sektor. Therefore the research have been on a general level working with certain age groups but not with varying ethnicity, family background or potential chronical diseases. A goal for the thesis design was the energy frame 2020 which is reached via an integrated designproces working with the envelope, heat gains etc. That is very measurable. A thing that is not very measurable is social sustainability and the future economic sustainability hereof. One thing is that the building works as a catalyst or child development, but it is hard to measure and compare these results to something else. Great development means that children will grow up and become an asset for the society. A cost-benefit analysis is needed to find out if the children will become an asset proportionally big enough or bigger than the expends in relation to building nonconventionally institutional buildings.

DGNB has been of some interest in the proces but has not directly been applied or elaborated. It could be interesting to see how a building mainly designed for increasing social sustainability would score in a sustainability certification system - also taking into concideration the differences between the DGNB goals and the danish building regulation.

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ill. 93 books

Illustration list

06 Appendix

Air change rate calculations
BSim results
window opening calc. example
neutral plane calculation
Be15 results
Be15 results with PV's
Window specs.

Appendix 01 - Air change rate calculations

Air change rate: Sensory air pollution (olf)

Pollution:
x persons, 1 olf/person (cf. table 1.6 GKB)
Materials = 0.1 olf/m^2 (cf. table 1.6 GKB)
Area = 294 m^2
Room volume = 882 m^2

$$q = x * 1 + 0.1 * m^2$$

Air change rate:

$$c = c_i + 10\frac{q}{V_l}$$

c – experienced air quality (dp) / 1.0 dp (cf. fig. 1.18, GKB)
c_i – experienced air quality outdoors (dp) / 0.05 dp (cf. fig. 1.18, GKB)
q – pollution load (olf)
V_l – necessary air flow supply (l/s)

$$1.0 = 0.05 + 10\frac{q}{V_l}$$

Nursery common room:

$$q = 60 * 1 + 0.1 * 294 = 89{,}4\,olf$$

Air change rate:

$$1.0 = 0.05 + 10\frac{89{,}4}{V_l} \rightarrow V_l = \ 941 l/s \rightarrow \ 3.84h^{-1}$$

The requirements calculated for sensory air pollution is higher and therefore the value used for ventilation dimensioning is this one.

Air change rate: CO_2 level

Pollution:
x persons, 10l/min*adults, 6l/min*children
concentration = 0.04
Area = 294 m^2
Room volume = 882 m^2

$$q = 0.04 * x * 10$$

Air change rate (equilibrium concentration):

$$c = \frac{q}{nV} + c_i$$

c – max. CO_2 level (ppm) / c_i+450ppm (DS/EN 15251) Category A
c_i – outdoors CO_2 level (ppm) / 350ppm
n – air change (h^{-1})
V – room volume (m^3)

$$800 = 1\,000\,000 * \frac{q}{n * m^3} * 350$$

Nursery common room:

$$q = (0.04 * 48 * 6) + (0.04 * 12 * 10) = 16{,}32\,l/min = 0.98\,m^3/h$$

Air change rate:

$$800 = 1\,000\,000 * \frac{0.98m^3}{n * 882m^3} + 350 = 2.47$$

Appendix 02 - BSim results

Options | Moisture | Simulation | HeatBalance | Parameters | Tables

2011 | Month | Hours | ThermalZone Con

ThermalZor	Sum/Mean	1 (31 days)	2 (28 days)	3 (31 days)	4 (30 days)	5 (31 days)	6 (30 days)	7 (31 days)	8 (31 days)	9 (30 days)	10 (31 days)	11 (30 days)	12 (31 days)
qHeating	1844,12	301,68	98,47	27,08	11,85	0,00	0,00	0,00	0,00	11,04	193,44	493,53	911,58
qCooling	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
qInfiltration	-18709,10	-2588,19	-2340,28	-2317,91	-1761,33	-1231,03	-750,30	-633,41	-642,08	-920,71	-1375,03	-1800,71	-2348,13
qVenting	-730,47	0,00	0,00	0,00	0,00	-309,34	-99,11	-115,56	-174,34	-32,12	0,00	0,00	0,00
qSunRad	12850,43	614,75	916,84	1177,02	1307,87	1388,18	1311,35	1325,78	1435,00	1251,86	1009,52	682,17	430,10
qPeople	7194,72	766,08	729,60	563,04	514,08	538,56	538,56	423,36	463,68	538,56	514,08	802,56	802,56
qEquipmen	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
qLighting	1153,03	232,83	134,39	87,31	20,54	3,42	1,71	0,00	5,14	40,23	129,26	224,27	273,92
qTransmiss	-10884,58	-1276,88	-1340,75	-1339,11	-1058,47	-858,23	-529,14	-449,67	-396,56	-577,28	-773,19	-997,94	-1287,36
qMixing	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
qVentilation	-2412,64	-450,21	-398,11	-397,41	-34,38	-8,90	0,00	0,00	0,00	-22,43	-98,03	-403,75	-782,63
Sum	5,51	0,06	0,16	0,01	0,17	1,21	1,73	1,58	0,22	0,15	0,06	0,12	0,03
tOutdoor me	7,7	-0,5	-1,0	1,7	5,6	11,3	15,0	16,4	16,2	12,5	9,1	4,8	1,5
tOp mean(°(	21,9	21,6	21,6	21,4	21,3	22,9	22,6	22,7	22,9	21,3	21,2	21,4	21,4
AirChange(/	4,6	5,5	5,5	5,5	5,5	1,6	3,4	3,4	3,5	5,5	5,5	5,5	5,5
Rel. Moistur	37,2	24,0	21,9	24,7	30,3	37,4	50,5	55,0	52,0	52,3	39,7	33,7	25,0
Co2(ppm)	389,2	390,6	393,2	379,6	378,2	468,2	377,4	370,3	371,9	378,6	377,0	393,5	392,1
PAQ(-)	0,5	0,7	0,7	0,7	0,6	0,4	0,2	0,2	0,2	0,3	0,5	0,6	0,7
Hours > 21	4548	363	352	300	225	672	545	585	612	168	148	272	306
Hours > 26	45	0	0	0	0	8	6	12	16	3	0	0	0
Hours > 27	22	0	0	0	0	7	4	7	3	1	0	0	0
Hours < 20	1	1	0	0	0	0	0	0	0	0	0	0	0
FanPow	3216,91	423,31	88,80	23,31	45,14	3,89	0,00	0,00	0,00	45,14	23,31	45,14	2423,31
HtRec	7899,04	1836,27	309,50	318,82	704,80	61,12	0,00	0,00	0,00	219,01	67,20	361,33	7554,32
ClRec	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
HtCoil	323,07	67,25	41,12	25,39	25,39	0,00	0,00	0,00	0,00	0,00	21,86	26,13	56,28
ClCoil	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Humidif	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
FloorHeat	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
FloorCool	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
CentHeatPu	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
CentCooling	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
CentHeatPu	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
CentCooling	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00

Common room

Options | Moisture | Simulation | HeatBalance | Parameters | Tables

2011 | Month | Hours | ThermalZone GR

ThermalZor	Sum/Mean	1 (31 days)	2 (28 days)	3 (31 days)	4 (30 days)	5 (31 days)	6 (30 days)	7 (31 days)	8 (31 days)	9 (30 days)	10 (31 days)	11 (30 days)	12 (31 days)
qHeating	955,01	147,82	143,45	161,14	122,10	34,87	0,00	0,00	0,00	14,85	94,48	99,96	136,35
qCooling	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
qInfiltration	-3083,43	-414,38	-373,80	-369,46	-288,47	-179,04	-137,38	-113,30	-121,42	-158,06	-235,51	-307,63	-384,98
qVenting	-835,07	0,00	0,00	0,00	0,00	-186,24	-191,39	-166,33	-183,43	-107,68	0,00	0,00	0,00
qSunRad	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
qPeople	3597,36	383,04	364,80	281,52	257,04	269,28	269,28	211,68	231,84	269,28	257,04	401,28	401,28
qEquipmen	858,00	69,30	66,00	75,90	69,30	72,60	72,60	69,30	75,90	72,60	69,30	72,60	72,60
qLighting	686,40	55,44	52,80	60,72	55,44	58,08	58,08	55,44	60,72	58,08	55,44	58,08	58,08
qTransmiss	-1164,12	-109,78	-133,87	-128,96	-105,93	-69,55	-71,20	-56,79	-63,60	-63,12	-92,98	-128,39	-139,96
qMixing	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
qVentilation	-1014,15	-131,43	-119,37	-80,86	-109,49	0,00	0,00	0,00	0,00	-85,96	-147,77	-195,91	-143,37
Sum	0,00	-0,00	-0,00	0,00	-0,00	-0,00	-0,00	0,00	-0,00	0,00	0,00	-0,00	0,00
tOutdoor me	7,7	-0,5	-1,0	1,7	5,6	11,3	15,0	16,4	16,2	12,5	9,1	4,8	1,5
tOp mean(°(	22,8	22,7	22,6	22,0	22,2	22,3	23,7	23,7	24,1	22,1	22,4	23,4	22,9
AirChange(/	1,8	2,1	2,1	2,1	2,1	1,1	1,2	1,2	1,3	2,4	2,1	2,1	2,1
Rel. Moistur	37,1	26,9	24,4	26,1	30,6	40,0	47,7	51,6	48,6	50,6	38,9	33,4	26,4
Co2(ppm)	639,4	709,4	730,3	606,5	598,1	665,7	654,8	560,1	583,2	525,4	584,1	735,6	719,7
PAQ(-)	0,4	0,5	0,6	0,6	0,5	0,4	0,2	0,1	0,1	0,2	0,4	0,4	0,5
Hours > 21	5069	381	331	340	345	495	542	569	570	348	360	419	369
Hours > 26	54	0	0	0	1	4	7	11	25	6	0	0	0
Hours > 27	18	0	0	0	0	2	3	6	5	2	0	0	0
Hours < 20	0	0	0	0	0	0	0	0	0	0	0	0	0
FanPow	896,09	114,79	103,68	114,79	111,09	0,00	0,00	0,00	0,00	111,09	114,79	111,09	114,79
HtRec	5373,64	924,23	865,64	823,51	597,55	0,00	0,00	0,00	0,00	280,96	446,03	612,45	823,27
ClRec	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
HtCoil	910,08	142,66	128,61	147,54	114,50	0,00	0,00	0,00	0,00	82,57	70,77	94,54	128,89
ClCoil	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Humidif	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
FloorHeat	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
FloorCool	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
CentHeatPu	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
CentCooling	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
CentHeatPu	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
CentCooling	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00

group room

Appendix 03 - window opening calc. example

Natural ventilaton common room/nursery

Pressure Coefficient		Windfactor	0,56		Pwind	8,1	pa
Windward	0,06	Vmeteo	4,8	m/s	Pmin	-3,1	pa
Leeward	-0,38	Vref	3,6	m/s	Pmax	0,5	pa
roof	-0,38						

Location of neutral plan,	1,8 m	Buildingvol.	4800	m3		
Outdoor temperature	12 C	Volume	870	m3/section/floor		
Zone temperature	21 C					
Discharge coefficient	0,7	Internal pressure	pa	-0,48		-0,48
Air density	1,25 kg/m3					

	Area m2	Eff. Area m2	Height m	Thermal Buoyancy pa	AFR (thermal) m3/s	Pres Coefficient	Wind pressure pa	AFR Wind) m3/s	Wind pressure pa	AFR total m3/s
Inlet window:	1,4	0,900	1,3	0,169	0,47	0,06	0,966	1,119	0,966	1,213
Outlet windo	1,4	0,900	2,2	-0,169	-0,47	0,06	0,966	1,119	0,966	1,016
empty	0	0,000	0	0,658	0,00	0	0,480	0,000	0,480	0,000
empty	0	0,000	0	0,658	0,00	0	0,480	0,000	0,480	0,000
Roof/empty	0	0,000	0	0,658	0,00	0	0,480	0,00	0,480	0,000
				Massebalance	0,00		Massebalance	2,24		2,23

Appendix 04 - neutral plane calculation

Reference wind speed – for natural ventilation calculation

$V_{ref} = V_{mete0,10} * k * h^a (m/s)$
For city area k=0.35 and =0.25

$V_{ref} = 6m/s * 0.35 * 8.7^{0.25} = 6\, {}^{m}/_{s} * 0.6 = \underline{3.6m/s}$

Internal pressure – for natural ventilation calculation

Equation to calculate internal pressure:

$$P_i = {}^1/_2\, p_u * V^2{}_{ref} * \frac{A^2{}_{in} * C_{p,in} + A^2{}_{out} * C_{p,out}}{A^2{}_{in} + A^2{}_{out}}$$

$A = height\ of\ window$
$C = pressure\ coefficient\ on\ face$
$p_u = air\ density$

$$P_i = {}^1/_2\, 1.25 * \left(\frac{3.6m}{s}\right)^2 * \frac{(6m)^2 * 0.06 + (6m)^2 * 0.06}{(6m)^2 + (6m)^2} = \underline{0.486\ (Pa)}$$

Calculation of neutral plane

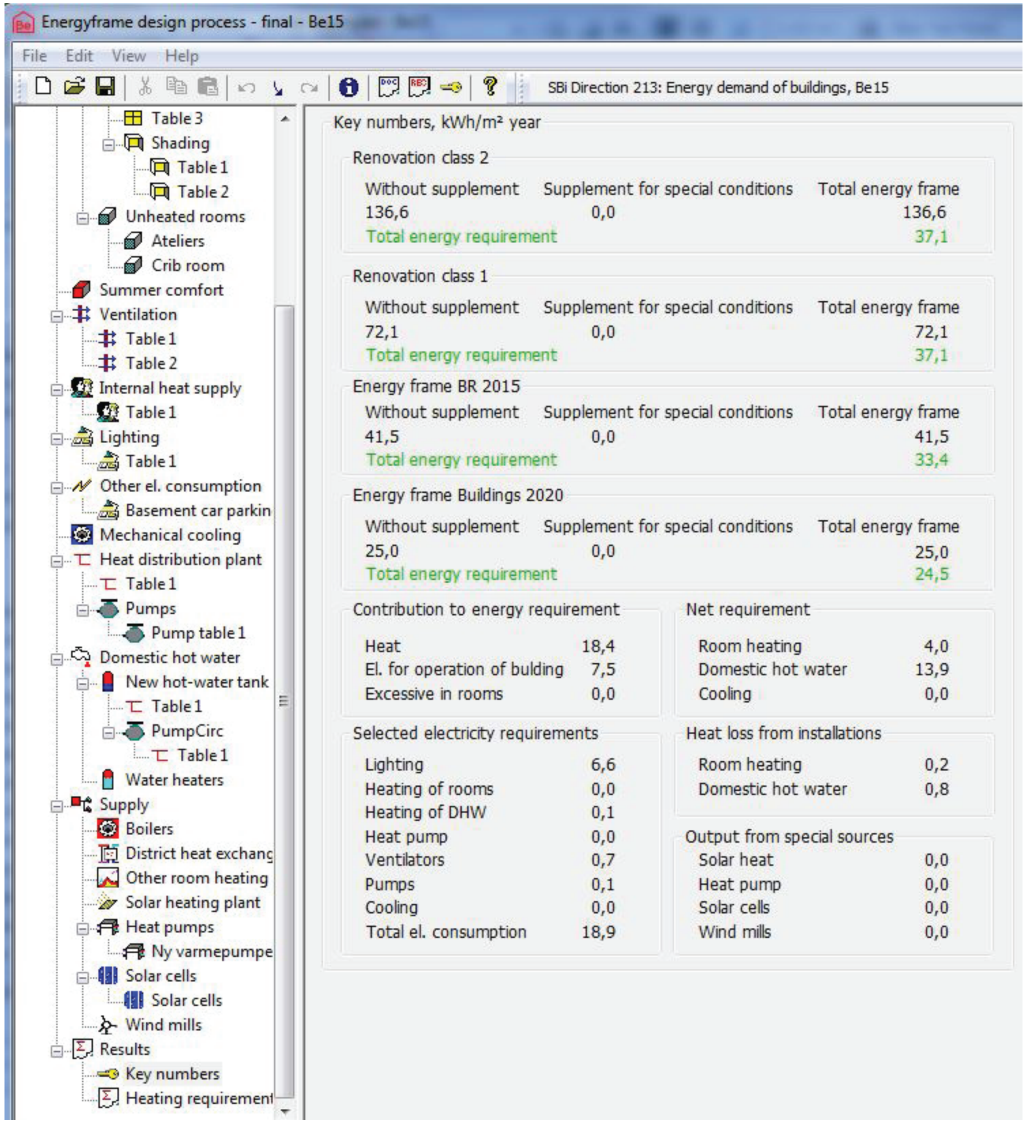
In the cases where one inlet window (or several identical windows at same level) is apparent and one outlet window (or several identical windows at same level) the calculation looks like this. If the case consists of inlet windows at various levels, the first part is added with new values and then the calculation for the outlet part is subtracted afterwards.

Example: inlet + inlet - outlet.

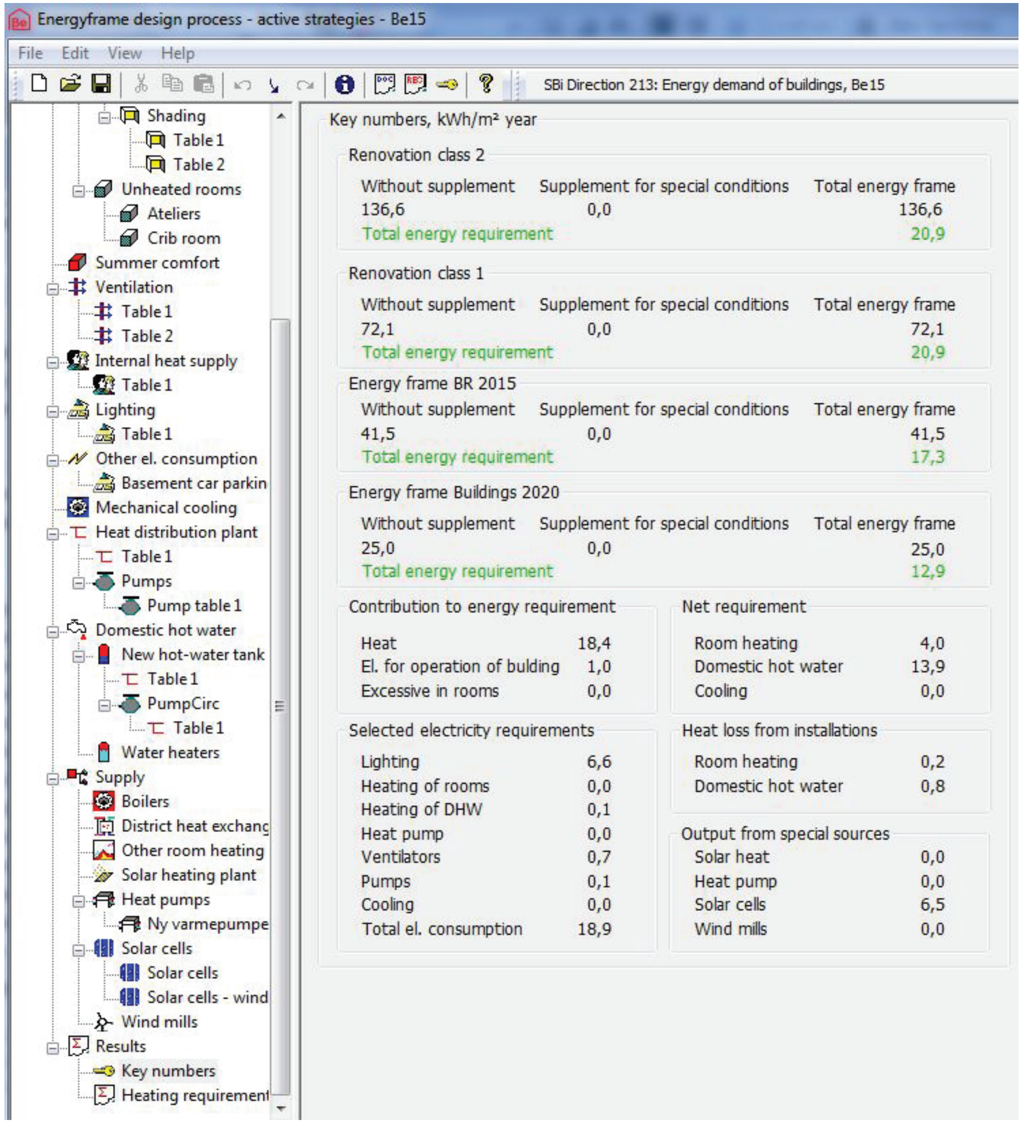
inlet outlet

$$p_u C_{d1} A_1 \left(\frac{2\Delta T g (H_0 - H_1)}{T_i}\right)^{1/2} - p_i C_{d2} A_2 \left(\frac{2\Delta T g (H_2 - H_0)}{T_u}\right)^{1/2}$$

Appendix 05 - Be15 results



Appendix 06 - Be15 results with PV's



Appendix 07 - Window specs.

Declaration of Performance / Ydeevnedeklaration / Leistungserklärung Ribo træ A m. optim. rude

Date / Dato / Datum: Horsens, 2016/08/04, Revision : W-EV-VO-2016/08/04

	10	12	01	07	09	29	31
Element type	**Fixed window**	**Topguided**	**Sidehung**	**Sideguided**	**Sideswing**	**Fully reversible**	**Casement door**
Opening direction	-	Outward	Outward	Outward	Outward	Outward	Outward
Element type	**Fast vindue**	**Topstyret**	**Sidehængt**	**Sidestyret**	**Sidevende**	**Vendevindue**	**Vindues Dør**
Åbningsretning	-	Udadgående	Udadgående	Udadgående	Udadgående	Udadgående	Udadgående
Fertigteil Typ	**Stationär Fenster**	**Klapflügel Fenster**	**Drehflügelfenster**	**Drehflügelfenster mit Putzspalte**	**Wendefenster**	**Schwingfenster**	**Fenster Tür**
Öffnungs Richtung	-	Nach außen öffenend	Nach außen öffenend	Nach außen öffenend	Nach außen öffenend	Nach außen öffenend	Nach außen öffenend
4.2 Resistance to wind load / Modstandsevne overfor vindlast / Widerstandsfähigkeit gegen Windlast	**1600Pa (C4)**	**1600Pa (B4)**	**1600Pa (B4)**	**1600Pa (C4)**	**1600Pa (C4)**	**1600Pa (C4)**	**1600Pa (C4)**
Test and Classification / Test og klassifikation / Leistungsklasse und Wert	EN 12211:2000 EN 12210:2000	EN 12211:2000 EN 12210:2000	EN 12211:2000 EN 12210:2000	EN 12211:2000 EN 12210:2000	EN 12211:2000 EN 12210:2000	EN 12211:2000 EN 12210:2000	EN 12211:2000 EN 12210:2000
Notified body / notificeret organ / Notifizierte Stelle auf der Grundlage von Prüfungen	NB 1314	NB 1314	NB 1314	NB 1314	NB 1314	NB 1314	NB 1314
Test report, issue date / Test rapport, udgivelsesdato / Prüfbericht, Publikationsdatum	Chilt/p12056/11 February 2013	Chilt/P12056/09/A 2013-02-13	Chilt/P12056/10 February 2013	Chilt/p12056/13 February 2013	Chilt/p12056/13 February 2013	Chilt/P12056/22 2013-02-13	Chilt/P12056/17 February 2013
Tested size (frame width x height, WxH), testet størrelse (element bredde x højde) Geprüfte grösse (Auswendiger Rahmen Breite x Höhe)	2490 x 2400	1797 x 1568	935 x 1800	1000 x 1600	1000 x 1600	1600 x 1600	2340 x 2400
4.5 Watertightness / Vandtæthed / Schlagregendichtheit	**600Pa (9A)**	**600Pa (9A)**	**600Pa (9A)**	**600Pa (9A)**	**600Pa (9A)**	**600Pa (9A)**	**600Pa (9A)**
Test and Classification / Test og klassifikation / Leistungsklasse und Wert	EN 1027:2000 EN 12208:2000	EN 1027:2000 EN 12208:2000	EN 1027:2000 EN 12208:2000	EN 1027:2000 EN 12208:2000	EN 1027:2000 EN 12208:2000	EN 1027:2000 EN 12208:2000	EN 1027:2000 EN 12208:2000
Notified body / notificeret organ / Notifizierte Stelle auf der Grundlage von Prüfungen	NB 1314	NB 1314	NB 1314	NB 1314	NB 1314	NB 1314	NB 1314
Test report, issue date / Test rapport, udgivelsesdato / Prüfbericht, Publikationsdatum	Chilt/p12056/11 February 2013	Chilt/P12056/09/A 2013-02-13	Chilt/P12056/10 February 2013	Chilt/p12056/13 February 2013	Chilt/p12056/13 February 2013	Chilt/P12056/22 2013-02-13	Chilt/P12056/17 February 2013
Tested size (frame width x height, WxH), testet størrelse (element bredde x højde) Geprüfte grösse (Auswendiger Rahmen Breite x Höhe)	2490 x 2400	1797 x 1568	935 x 1800	1000 x 1600	1000 x 1600	1600 x 1600	2340 x 2400
4.6 Dangerous substances / Farlige stoffer / Gefährliche Substanzen	**None**	**None**	**None**	**None**	**None**	**None**	**None**
4.8 Load-bearing capacity of safety devices / Sikkerhedsudstyrs bæreevne / Tragfähigkeit von Sicherheitseinrichtungen	**-**	**(350N/60s), optional**	**(350N/60s), optional**	**(350N/60s), optional**	**(350N/60s), optional**	**(350N/60s)**	**(350N/60s), optional**
Test and Classification / Test og klassifikation / Leistungsklasse und Wert	-	EN 14609:2004	EN 14609:2004	EN 14609:2004	EN 14609:2004	EN 14609:2004	EN 14609:2004
Notified body / notificeret organ / Notifizierte Stelle auf der Grundlage von Prüfungen	-	NB 1314	NB 1314	NB 1314	NB 1314	NB 1314	NB 1314
Test report, issue date / Test rapport, udgivelsesdato / Prüfbericht, Publikationsdatum	-	Chilt/P13059, 2013-03-25	Chilt/P13059, 2013-03-25	Chilt/P13059, 2013-03-25	Chilt/P13059, 2013-03-25	Chilt/P13059, 2013-03-25	Chilt/P13059/02, 2013-03-25, Chilt/P12056/12 2013-02-13
Tested size (frame width x height, WxH), testet størrelse (element bredde x højde) Geprüfte grösse (Auswendiger Rahmen Breite x Höhe)	-	-	-	-	-	-	-
4.11 Acoustic performance / Akustisk / Schallschutz	**See table below, Se tabel nedenfor Rw (C;Ctr)**						
Test and Classification / Test og klassifikation / Leistungsklasse und Wert	-	EN ISO 10140-2:2010	EN ISO 10140-2:2010	EN ISO 10140-2:2010	EN ISO 10140-2:2010	EN ISO 10140-2:2010	-
Notified body / notificeret organ / Notifizierte Stelle auf der Grundlage von Prüfungen	-	NB 1314	NB 1314	NB 1314	NB 1314	NB 1314	-
Test report, issue date / Test rapport, udgivelsesdato / Prüfbericht, Publikationsdatum	-	Chilt/Z12014/Bc/Ar1	Chilt/Z12014/Bc/Ar1	Chilt/Z12014/Bc/Ar1	Chilt/Z12014/Bc/Ar1	Chilt/Z12014/Bc/Ar1	-
Tested size (frame width x height, WxH), testet størrelse (element bredde x højde) Geprüfte grösse (Auswendiger Rahmen Breite x Höhe)	-	1230 x 1480	1230 x 1480	1230 x 1480	1230 x 1480	1230 x 1480	-
4-20-4-18-6 Energy/Clear/Energy WE w. Argon	-	38 (-1;-5) dB	38 (-1;-5) dB	38 (-1;-5) dB	38 (-1;-5) dB	38 (-1;-5) dB	-
4-20-4-18-6,4 Toughened Energy/Clear/Laminated Energy WE w. Argon	-	39 (-1;-6) dB	39 (-1;-6) dB	39 (-1;-6) dB	39 (-1;-6) dB	39 (-1;-6) dB	-
4-20-4-20-4 Energy/Clear/Energy WE w. Argon	-	34 (-1;-5) dB	34 (-1;-5) dB	34 (-1;-5) dB	34 (-1;-5) dB	34 (-1;-5) dB	-
4-20-4-18-6,8 Toughened Energy/Clear/Laminated Energy WE w. Argon	-	39 (-3;-8) dB	39 (-3;-8) dB	39 (-3;-8) dB	39 (-3;-8) dB	39 (-3;-8) dB	-
6-18-4-16-8,8 Toughened Energy/Clear/Laminated SOUND Energy WE w. Argon	-	42 (-1;-5) dB	42 (-1;-5) dB	42 (-1;-5) dB	42 (-1;-5) dB	42 (-1;-5) dB	-
4-18-4-18-8,8 Energy/Clear/Laminated SOUND Energy WE w. Argon	-	40 (-1;-5) dB	40 (-1;-5) dB	40 (-1;-5) dB	40 (-1;-5) dB	40 (-1;-5) dB	-
6,8-16-4-16-8,8 Laminated Energy/Clear/Laminated Energy WE w. Argon	-	40 (-1;-5) dB	40 (-1;-5) dB	40 (-1;-5) dB	40 (-1;-5) dB	40 (-1;-5) dB	-
4-18-4-16-9,5 Energy/Clear/Laminated Energy WE w. Argon	-	39 (-1;-5) dB	39 (-1;-5) dB	39 (-1;-5) dB	39 (-1;-5) dB	39 (-1;-5) dB	-
4.12 Thermal transmittance / Termisk transmissionskoefficient / Wämedurchgangskoeffizient	**0,7 (W/m2K)**	**0,8 (W/m2K)**	**0,8 (W/m2K)**	**0,8 (W/m2K)**	**0,8 (W/m2K)**	**0,8 (W/m2K)**	**0,8 (W/m2K)**
Note	Thermal transmission coefficient (4.12) and radiation properties (4.13) of a specific product is provided in quotations and order confirmations in accordance with EN 14351-1:2006 + A1:2010, Table E.2, Note d.						
Note	Thermal transmissionskoefficient (4.12) og strålingsegenskaber (4.13) for et specifikt produkt er angivet på tilbud/ordrebekræftelse i overensstemmelse med EN 14351-1:2006 + A1:2010, Tabel E.2, Note d.						
Note	Wärmedurchgangskoeefizient und Strahlungseigenschaften von einem bestimmten Produkt wird in Angeboten und Auftragsbestätigungen nach EN14351-1:2006 + A1:2010 angegeben.						
Test and Classification / Test og klassifikation / Leistungsklasse und Wert	EN 10077-2: 2003/2012	EN 10077-2: 2003/2012	EN 10077-2: 2003/2012	EN 10077-2: 2003/2012	EN 10077-2: 2003/2012	EN 10077-2: 2003/2012	EN 10077-2: 2003/2012
Notified body / notificeret organ / Notifizierte Stelle auf der Grundlage von Prüfungen	NB 1235	NB 1235	NB 1235	NB 1235	NB 1235	NB 1235	NB 1235
Test report, issue date / Test rapport, udgivelsesdato / Prüfbericht, Publikationsdatum	0108/694351, 2016-04-15	0108/694351, 2016-04-15	0108/694351, 2016-04-15	0108/694351, 2016-04-15	0108/694351, 2016-04-15	0108/694351, 2016-04-15	0108/694351, 2016-04-15
Tested size (frame width x height, WxH), testet størrelse (element bredde x højde) Geprüfte grösse (Auswendiger Rahmen Breite x Höhe)	1230 x 1480	1230 x 1480	1230 x 1480	1230 x 1480	1230 x 1480	1230 x 1480	1230 x 1480
4.13 Radiation properties / Strålingsegenskaber / Strahlungseigenschaften	**g 0,61 / LT 0,75**	**g 0,61 / LT 0,75**	**g 0,61 / LT 0,75**	**g 0,61 / LT 0,75**	**g 0,61 / LT 0,75**	**g 0,61 / LT 0,75**	**g 0,61 / LT 0,75**
4.14 Air permeability / Lufttæthed / Luftdurchlässigkeit	**600Pa (4)**	**600Pa (4)**	**600Pa (4)**	**600Pa (4)**	**600Pa (4)**	**600Pa (4)**	**600Pa (4)**
Test and Classification / Test og klassifikation / Leistungsklasse und Wert	EN1026:2000 EN12207:2000	EN1026:2000 EN12207:2000	EN1026:2000 EN12207:2000	EN1026:2000 EN12207:2000	EN1026:2000 EN12207:2000	EN1026:2000 EN12207:2000	EN1026:2000 EN12207:2000
Notified body / notificeret organ / Notifizierte Stelle auf der Grundlage von Prüfungen	NB 1314	NB 1314	NB 1314	NB 1314	NB 1314	NB 1314	NB 1314
Test report, issue date / Test rapport, udgivelsesdato / Prüfbericht, Publikationsdatum	Chilt/p12056/11 February 2013	Chilt/P12056/09/A 2013-02-13	Chilt/P12056/10 February 2013	Chilt/p12056/13 February 2013	Chilt/p12056/13 February 2013	Chilt/P12056/22 2013-02-13	Chilt/P12056/17 February 2013
Tested size (frame width x height, WxH), testet størrelse (element bredde x højde) Geprüfte grösse (Auswendiger Rahmen Breite x Höhe)	2490 x 2400	1797 x 1568	935 x 1800	1000 x 1600	1000 x 1600	1600 x 1600	2340 x 2400

Appendix 08 - Questionaire

Arkitekturen i en integreret institution

Side 1

Hej!
Jeg er i gang med mit speciale i Arkitektur & Design på Aalborg Universitet. Mit speciale omhandler arkitektur i en integreret institution, hvor der tages højde for barnets udvikling og læring (herunder motorik og sanser).
Jeg håber du vil tage dig tid til, at svare på spørgeskemaet, som tager 10-15 min. Spørgeskemaet er anonymt og benyttes kun i specialesammenhæng.
Hvis du afslutningsvis skriver din email adresse, har du mulighed for at vinde 1 biografpakke, som tak for hjælpen.

Mvh. Jimmi Ørnhøj-Hansen

Side 2

Indledende spørgsmål

1. Hvor gammel er du?

- ◯ 18-25
- ◯ 26-35
- ◯ 36-45
- ◯ 46-55
- ◯ 56+

2. Er du fortrinsvis tilknyttet vuggestue eller børnehave? *

- ◯ Vuggestue
- ◯ Børnehave
- ◯ Begge dele
- ◯ Andet

3. Hvor vigtig finder du arkitekturen/bygningens udformning i jeres dagligdag i institutionen? *

	Slet ikke vigtig	-	-/+	+	Meget vigtigt	Ved ikke
-	◯	◯	◯	◯	◯	◯

Side 3

Institutionens udeområder

4. Jeg finder det vigtigt med en aldersopdelt legeplads (Henholdsvis vuggestue og børnehave) *

	Slet ikke vigtigt	-	-/+	+	Meget vigtigt	Ved ikke
-	◯	◯	◯	◯	◯	◯

5. Uddyb gerne

[ ]

6. Det er relevant med udeområder, der ikke er aktivitets bestemte, såsom græsarealer m.m. *

	Slet ikke vigtigt	-	-/+	+	Meget vigtigt	Ved ikke
-	◯	◯	◯	◯	◯	◯

7. Udeområdet skal være af varierende karakter, herunder underlag, niveauer, beplantning m.m. *

	Slet ikke vigtigt	-	-/+	+	Meget vigtigt	Ved ikke
-	◯	◯	◯	◯	◯	◯

Side 4

Husets opbygning og opdeling

8. Jeg synes det er vigtigt med opdeling i aldersgrupper yderligere end vuggestue (0-3 år) og børnehave (3-6 år) *

	Slet ikke vigtigt	-	-/+	+	Meget vigtigt	Ved ikke
-	◯	◯	◯	◯	◯	◯

9. Faste grupperum for vuggestuen er vigtige? *

- ◯ ja
- ◯ nej

10. Faste grupperum for børnehaven er vigtige? *

- ◯ ja
- ◯ nej

11. Fælles zoner og rum er vigtige? *

	Ja	Nej	Ved ikke
Vuggestue	◯	◯	◯
Børnehave	◯	◯	◯
Mellem vuggestue og børnehave	◯	◯	◯

12. Jeg ser det som en kvalitet at rum kan ændres fx ved hjælp af skillevægge *

	Slet ikke vigtigt	-	-/+	+	Meget vigtigt	Ved ikke
-	◯	◯	◯	◯	◯	◯

13. Garderoben kan være fælles for både vuggestue og børnehave? *

- ◯ ja
- ◯ nej

14. Uddyb gerne

Side 5

Du er nu halvvejs i spørgeskemaet, godt gået! Tak fordi du tager dig tid til at hjælpe.

Det næste omhandler kvaliteten ved bygningsintegrerede læringszoner, herunder motorik og sanser.

15. Jeg finder det relevant, at børnene kan interagere med (bygningens) overflader indendørs, af forskellig karakter, i relation til sanser. *

	Slet ikke vigtigt	-	-/+	+	Meget vigtigt	Ved ikk
-	◯	◯	◯	◯	◯	◯

16. Jeg finder en bygning i forskellige niveauer (indendørs), der fordrer motorisk udvikling relevant? *

	Slet ikke vigtigt	-	-/+	+	Meget vigtigt	Ved ikke
-	◯	◯	◯	◯	◯	◯

Side 6

Elektronik i hverdagen, integreret i bygningen, kvalitet heraf og mængde

17. Elektroniske hjælpemidler er vigtige for personale i hverdagen (eks. iPads, projektor, musik og lyd m.m.) *

	Slet ikke vigtigt	-	-/+	+	Meget vigtigt	Ved ikke
-	◯	◯	◯	◯	◯	◯

18. Det er vigtigt, at kunne styre lyd og lysforhold i de forskellige rum *

	Slet ikke vigtigt	-	-/+	+	Meget vigtigt	Ved ikke
-	◯	◯	◯	◯	◯	◯

19. Det er relevant, at børnene kan interagere direkte med elektronik? *

	Slet ikke vigtigt	-	-/+	+	Meget vigtigt	Ved ikke
Ipads	◯	◯	◯	◯	◯	◯
Touch skærme	◯	◯	◯	◯	◯	◯
Lys og lydinstallationer	◯	◯	◯	◯	◯	◯

Side 7

Mangler ved nuværende arkitektur som kunne bruges i hverdagen?

20. Synes du institutionens nuværende arkitektur fordrer børnenes udvikling (motorik, læring og sanser) *

- ◯ ja
- ◯ nej

21. Hvorfor/hvorfor ikke?

22. Hvilke forbedringer foreslår du?

23. Synes du institutionens nuværende arkitektur understøtter dig i dit daglige arbejde? *

- ◯ ja
- ◯ nej

24. Hvorfor/Hvorfor ikke?

25. Hvilke forbedringer foreslår du?

Side 8

Mange tak for din deltagelse, hvis du ønsker at deltage i konkurrencen om en biografpakke, skriv venligst din email nedenfor.

26. Emailadresse

Email

» Redirection to final page of Online Undersøgelse