PROJECT TITLE: Dementia Centre in Aarhus

ABOUT: Master Thesis, MSc04 ARC.
Department of Architecture, Design & Media Technology
Aalborg University

PROJECT PERIOD: 03.02.2016 - 25.05.2016

COPIES: 7

PAGES: 160

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ACKNOWLEDGMENTS

Special thanks to Mary-Ann Knudstrup and Peter Vilhelm Nielsen who were present and very helpful throughout the process of making this project;
Anders Kristian Krogager Andersen and Linn Wittendorff Larsen from Aarhus Dementia centre for lending their time sharing about their everyday life with people having dementia;
Yvonne van Amerongen-Heijer, a founder of nursing home - De Hogeweyk in Netherlands for sharing her vast knowledge and enriching our studies in understanding about the Dementia and Dementia housing;
Lastly, thanks to our families for their support and encouragement during this process;
We appreciate all the feedback and support provided to reach our goal.

SEMESTER FRAMEWORK THEME

"In the final semester the student must be able to develop and integrate thorough engineering considerations in the design of architecture. The student must define a problem based on relevant challenges within a specific theme and integrate indoor climate, energy and structural considerations as a part of the design process, and through thorough documentation of methodological choices develop a solution of high technical and architectural quality" (Semester description, 2016).

OBJECTIVES

"The final semester sets the stage of manifestation of the students' abilities to design solutions for a problem defined in the theme application. The students must define a problem and display the ability to achieve a design proposal in an integrated whole and the solution can be a building component (ex. Façade solution) as well as an entire building. The work must include relevant theories and methodologies and be based on the skills,knowledge and competencies acquired throughout the Master's programme in architecture" (Semester description, 2016).

READING GUIDE

The report of a new Aarhus Dementia Centre proposal is divided into six chapters respectively titled, theme analysis, site analysis, program, design process, presentation and the appendix. The report presents different phases of the project, where focus was on an integrated design process as different parameters influenced each other and iterative process was used as the design developed.

First chapter contains the theme analysis concerning the topic of the master thesis in terms of a user group and condition itself, where different literature and researches had been studied.
Second chapter present different analysis of the site, where it was looked at the climate conditions in the area as well as the surroundings.

Third chapter presents the program of the project with specific parameters and a vision for the design.

Design process is presented in the forth chapter. Here different studies and attempts of different components of the buildings were made that influenced the design and solutions for it.

Fifth chapter contains a presentation material with final design and optimal solutions. Master plan, sections, elevations and floor plans are presented with a descriptive text.

Following the presentation material conclusion with reflections upon the design and it's development are presented.

Sixth chapter contains a appendix with a supplementary material of the particular solutions for the design.

Throughout the report Harvard System of Referencing was used.

Ill.1. View in the site

DANISH SUMMARY

Under temaet demens, undersøger projektet hvorledes trivsel opnås for demente gennem brugen af arkitekturen. Med fordybelse i tektoniske og bæredygtige aspekter, gives arkitekturen kvaliteter der højner menneskets velvære. Med afsæt i nutidige plejehjem der ikke er tilstrækkelige for dementes behov, tages der udgangspunkt i konkurrencen for det nye demenscenter i Aarhus (Se Annex I).

Demente borgere er en stigende målgruppe bestående af mennesker med komplekse problemstillinger. Gennem de senere år er der opnået forståelse for en nødvendig forøgelse af hensyntagen til denne brugergruppe. Med det eksisterende demenscentrum tilbydes demente ikke de bedste vilkår for deres sygdom, derfor er opbygningen af et nyt demenscenter på Skovvangsvej vedtaget.

Demenscenteret udgøre det eksisterende demenscentrum, men skal samtidig forener nødvendige funktioner for den demente og implementere den nyeste viden i et tidssvarende byggeri.
Gennem en integreret proces har analyser og studier formet designprocessen.

Med afsæt i skovvangsvej som den nye placering for demenscenteret, eksistere der en brat overgang fra en typologi til en anden, her skabes der en forbindelse mellem de to ved brugen af bygningsvolumen for at skabe en blid overgang. Layoutet af sitet og bygningsformentager afsæt i studier af de dementes behov, som skal opfyldes for opnåelse af trivsel. Der er taget højde for at kunne træffe forskellige valg, i forhold til det social, omgivelser og oplevelser, ydermere har indeklimaet været essentiel i udformningen af bygningen.

Bygningen er et resultat af forsøget på opnåelse af trivsel, ved tilføjelse af værdier og muligheder i de dementes hverdag.

TABLE OF CONTENTS

PROLOGUE

The point of departure for this Master Thesis is a competition material from Aarhus Dementia and Brain Centre. This competition focus on creating homes for people with dementia in which they could thrive regardless of the condition. The plan is to build 125 homes with good living and working conditions, indoor climate and low energy consumptions. Including the centre, the building area is to be 16.042m2 and it should contain all the required functions. Furthermore, it should fulfill a building class 2020 with an energy frame on 20kWh/m² year without renewable strategies.
The Hogeweyk dementia centre in Holland was a great inspiration for the project, where best aspects of it were used in a Danish context.

"It is important to register the details that are crucial for everyday space functionality and comfortability of the patient."

(Larsen, WL 2016)

MOTIVATION

In Denmark, the elderly population has been increasing rapidly, and, consequently, the number of people with dementia has risen. Today around 90.000 Danes are living with dementia and the number of death has increased twice in the last ten years. Therefore, a dementia alliance was established to set visions and actions for dementia efforts in Denmark. The aim is to make Denmark a pioneer within the field of dementia, and leading within care homes and construction area. (Nationaltvidenscenter for demens, 2016).

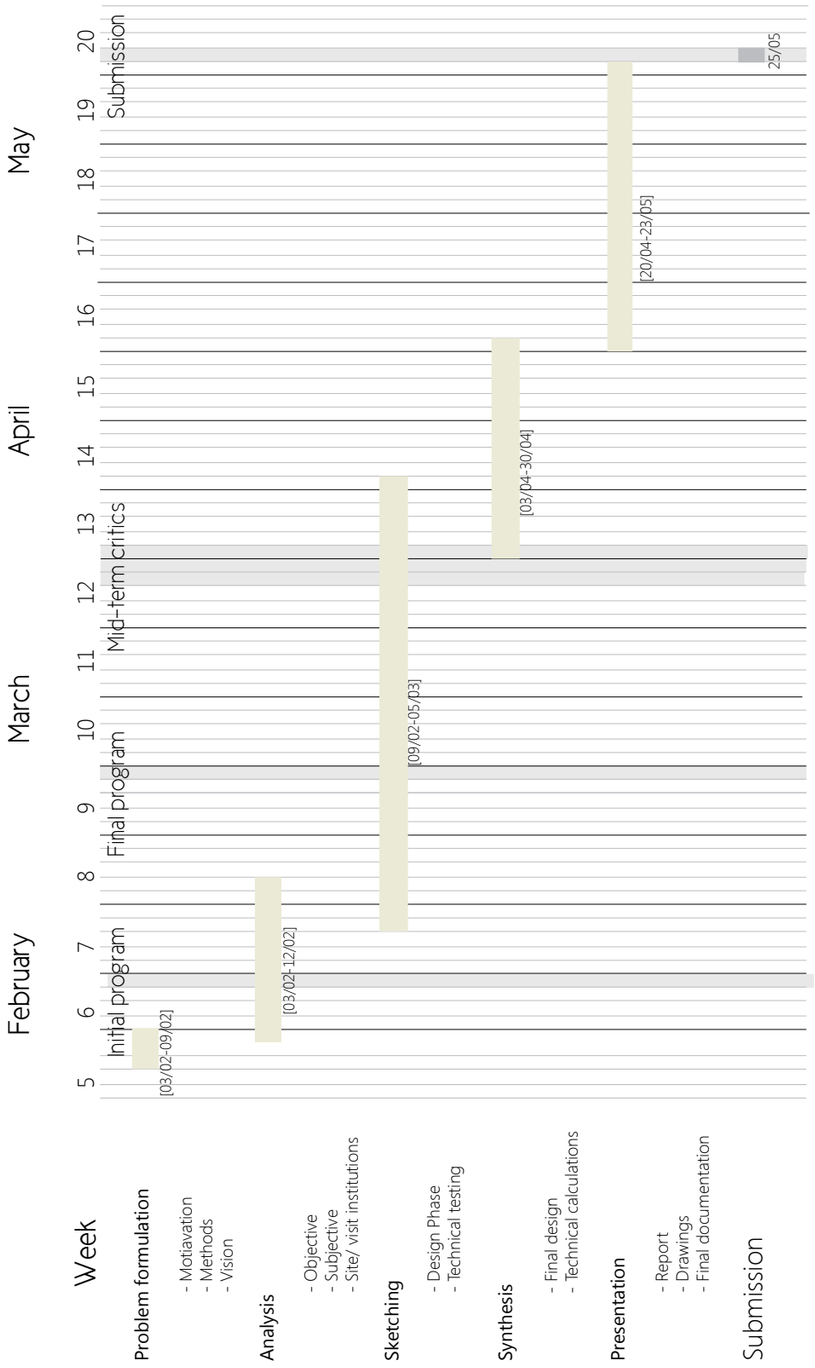
Due to the lack of care homes built for people with Dementia, in most of the care homes residents that functions cognitively, are mixed with residents with different degrees of dementia. This has a huge impact on the resident's well-being. The cognitive resident's gets a stronger experience of institutionalization, when living together with patients having dementia. They feel intimidated by the people having dementia, who often become victims of bullying. To ensure the well-being for people with dementia it is best to separate them from ordinary residents (Møller., K &Kundstrup, M A 2008).

Architecture is all around people in the physical world. It has a great influence on changing peoples emotional and spatial surroundings. It can move people deeply and help the to experience the spatial surroundings in the best possible way when this is done in the finest potential form.

Through the studies of architectural design at Aalborg University we were involved in the cross field of aesthetics, tectonics and the technical aspects of the design process of the architecture. The growing number of people with dementia, both globally and in Denmark made us explore the matter in more detail.

For this project, it was designed for people with dementia who directly react and respond to the design solution, as it is crucial for their health and medical condition. Therefore, medical-academic research and publications where studied, in order to concentrate on human's well- being. In this case, architecture should not be based on the architect's need for aesthetic approval but on the human. With this project, it was therefore important for us to focus on the human relation to architecture.

TIME SCHEDULE



III.2. Timetable of the project

III.3.The design process map (Knudstrup, MA...2004)

METHODOLOGY

The integrated design process, defined by Mary-Ann Krundstrup, was used as a method to structure this thesis project (III.3.) The process is divided in five phases, emphasizing the development from project description to final presentation. These phases includes the problem formulation/project idea, analysis phase, sketching phase, synthesis phase and presentations phase. Throughout the project, this method has been used to create iterative considerations concerning the architectural, functional technical aspects during the design process of a sustainable dementia centre.

The problem phase defines the project's problem formulation and the main idea of how the goal of achieving environmentally sustainable building is going to be reached.

The analyze phase contains analyses of relevant themes as subjective and objective analysis that gave a description of the site and its surroundings. Investigations, gathering of the material, competition brief, requirements from a municipality plan were analyzed. This was presented in the analysis chapter. Room programme, architectural and technical design parameters, vision for the building were included in the program chapter. It started architectural and technical ideas for the design process and thereby created the frames for the project. The two analyses methods contains the elements shown beneath.
Objective analyses: theme analysis, sustainability, local plan, climate analyses, structural analyzes, Kevin Lynch's mapping, quantitative registrations.

Subjective analyses methods: phenomenological analysis, Gordon Cullen's serial vision, photomapping, qualitative registrations.

The sketching phase aims to explore different solutions and in terms of the problem. Here different methods were used to generate and try ideas for problem solution through the design process. Aesthetic, technical and functional considerations were made using hand, computer sketching and both physical and digital models. The sketching phase evaluates the solutions in relation to the aims and criteria's of architecture and engineering that interacts with each other.

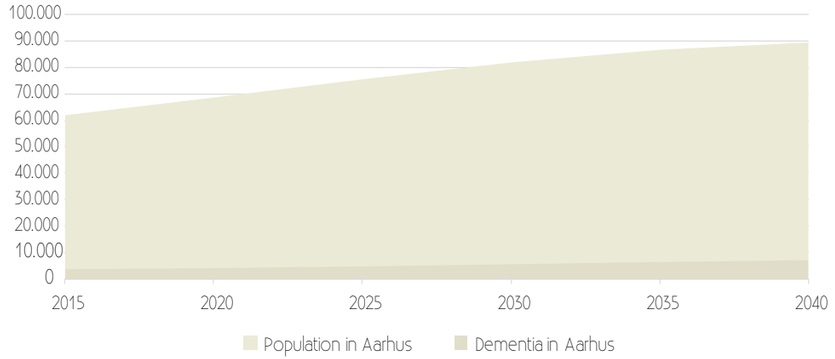
While designing, Vitruvius triangle was important to keep in mind. It consists of aesthetics, technique and function. Together they create architecture. If one of the parameters is lacking, it influences the architecture. Therefore, they were all important design parameters.

The synthesis phase is strongly related to the sketching phase. Here the design of the building and the different requirements goes into a final design with a high detailing level, at this point the design of the project should be an integration between architecture and engineering.

The presentation phase shows the qualities within the project. It shows the details, how problems has been solved. The presentation must be comprehensible. Tools used for this are a report, poster, 3D modeling and models (Møller., K &Kundstrup, M A 2008).

THEME ANALYSIS I

III.4. Elder people



Ill.5. Amount of people with dementia in Aarhus vs Population in Aarhus (Nationalt Videnscenter for Demens, 2016)

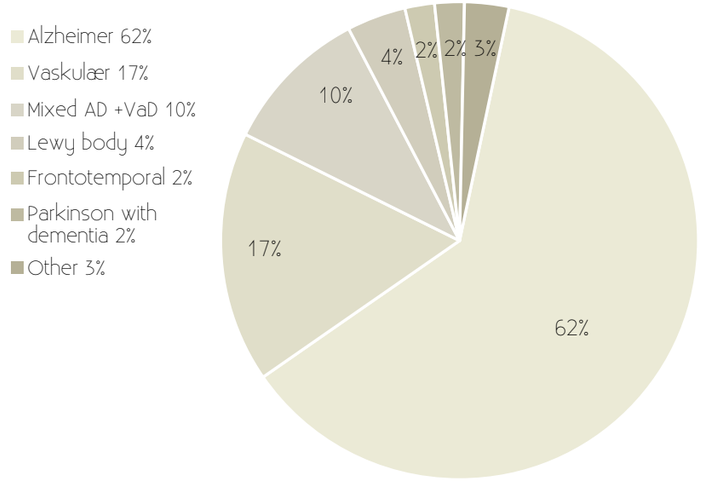
USER GROUP

As a result of the increasing life expectancy and developments in healing, dementia is a growing disease (Nationalt Videnscenter for Demens, 2016). Therefore in the future, more people will have the dementia disease. It was a necessity to study dementia in order to create the best health care center for them and others.

Today, the debilitated elderly live together with elderly affected by dementia. This is not a good solution for either of the users. The tension between the users affects and complicates the creation of a healthy environment. Accordingly, the well-being of both user groups is jeopardized (Nationalt Videnscenter for Demens, 2016).

The creation of centre solely for people with dementia would be, therefore, a good solution for both parties. It would be easier to meet the needs of people having dementia, when the focus would be on their well-being, feelings, challenges and problems. By making their everyday life as good and easy as possible, they would obtain more quality and happiness in their life. Furthermore, this change could also have a positive effect on their relatives. When their affected loved ones are taken well care of, it would bring peace to relatives mind (Nationalt Videnscenter for Demens, 2016).

As seen on ill.5. number with people having dementia is increasing together with the population. The condition occurs for people mostly from the age of 60 and up, therefore this group was chosen as the user group.



Ill.6. Diagram of dementia diseases (Videnscenterfordemens, 2016)

DEMENTIA DISEASES

There are many different types of dementia. People having dementia react and act differently from each other due to their personality and disease. The division of diseases can be seen in ill.6. Even though there are different types of dementia, it was chosen to look at them all as they need the same physical frames and are treated alike.

ALZHEIMER'S
In the first period of the disease, apathy, depression, and anxiety are common symptoms. Later in the disease delusions, hallucinations and agitation becomes a part of the everyday life (Videnscenterfordemens, 2016).

VASCULAR DEMENTIA
Here the person frequently experiences depression and apathy (Videnscenterfordemens, 2016).

LEWY BODY DEMENTIA
The early symptoms can be REM-sleep disorders and in the later stage visual hallucinations often occurs (Videnscenterfordemens, 2016).

FRONTOTEMPORAL DEMENTIA
This disease is a common name for several neurodegenerative diseases, that particularly affect the frontal lobes. The symptoms are: lack of inhibitions, impulsivity, impaired judgment, tendency to eat, drink or smoke uninhibited and exaggerated. Psychiatric symptoms can be applicative behavior, obsessive or ritualistic behavior and perseveration (Videnscenterfordemens, 2016).

Due to all the problems the users are facing every day of their lives, it is important to create them a calm and good surroundings that would make their everyday life easier and better (Videnscenterfordemens, 2016).

Ill.7. Woman in nature

HEALING ARCHITECTURE

Healing architecture is a design concept that represents a vision of architecture, that affects human well-being. Architecture can therefore help strengthen or promote the healing process of the individual (Frandsen et al., 2009).

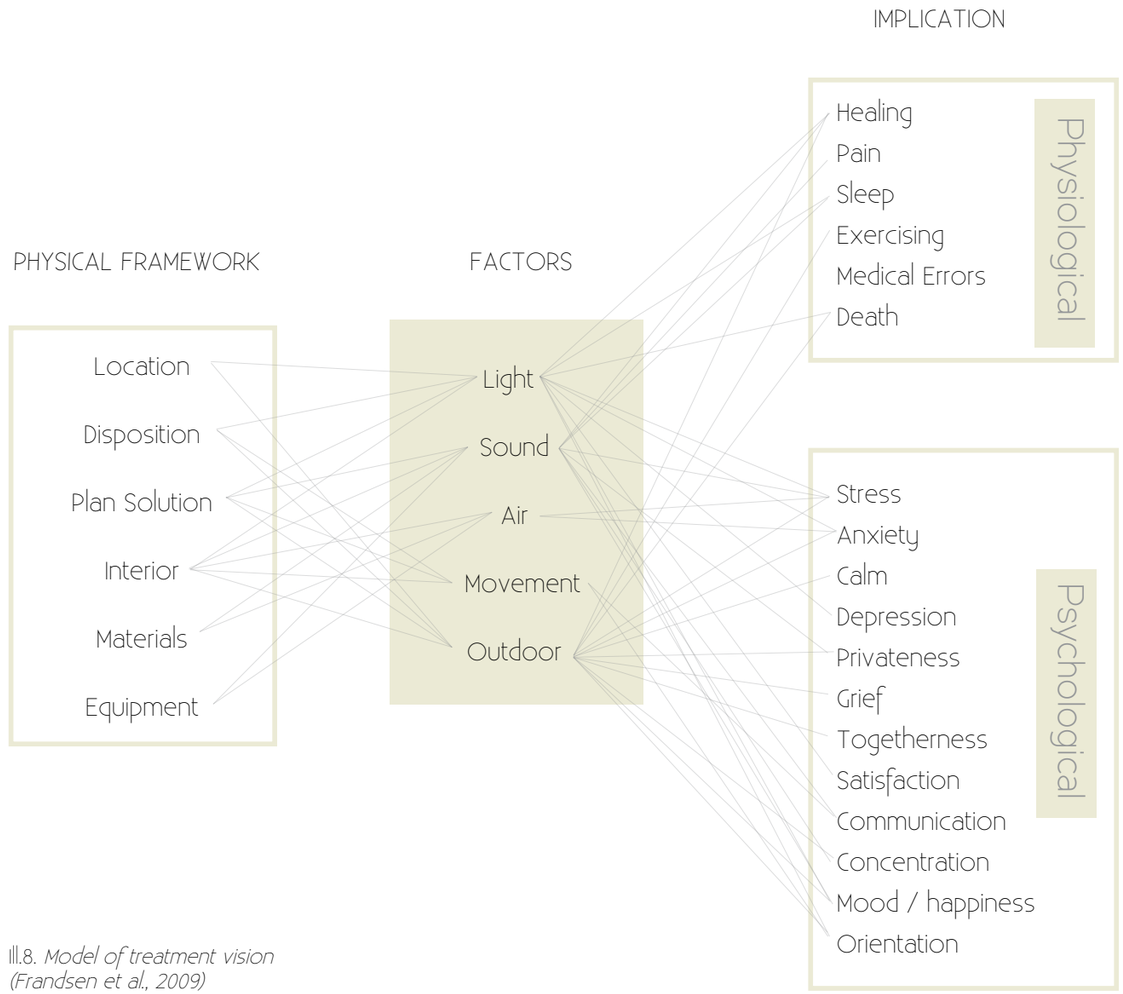
The basic idea is that architecture alone can heal, but the architectural design in terms of the quality of daylight, rooms atmosphere, color, sound and the ability to be private and secure can support the healing that takes place both physically and psychologically. Architecture plays in this conceptual framework a central role as a supportive factor in the human healing process. Initially, the design concept is based on the patient's experience of space and architecture, but also the staff and the relatives' experience of the architectural impact (Frandsen et al., 2009).

There are three inter-related disciplines that needs to be looked at, respectively, healing architecture, healing techniques, healing design. With healing architecture, understanding the factors that affect architecture and space like the wards plan or window location is needed, with healing technique - understanding of engineering-specific factors such as ventilation filters, and with healing design - understanding of industrial design devices and electronic devices is needed (Frandsen et al., 2009).

MODEL

The research, which falls within the area of Healing Architecture, deals with several different factors and scale that ranges from building structure and detail to human's physiology and psychology. As a starting point, it is believed that the architectural design of the building affects human physiology and can be measured in e.g. stress and anxiety - and the literature suggests that an adjustment of architectural factors such as light, sound and plan affects both the overall planning and human physical reaction. As a result of the literature review it is therefore proposed a model for categorizing the different levels and their interaction. The model categorizes the three primary levels respectively: Physical framework, Factors and Consequences (Frandsen et al., 2009). Ill.8. presents a modified version of the model, which was more relevant to the project.

TREATMENT VISION



Ill.8. Model of treatment vision (Frandsen et al., 2009)

WELL-BEING

Well-being is a result of the individual's own judgment or experience from the relationship between oneself and the surroundings. This judgment is based on both one's own needs and expectations, behavior and personal characteristics. The surroundings should be understood broadly and refers to the world that the person is in, with the opportunities and constraints that the outside world holds, in this case - care home with focus on people having dementia. The well-being of the residents is created in a dynamic and changing interaction between each person and the surroundings, and depends on to what degree the conscious and unconscious needs, expectations and achievement of own objectives, which can change over time, have been fulfilled. Well-being has both physical, mental and social dimension. The degree of well-being in other words, is the result of various subjective and objective factors, which may be known or unknown for each individual (Møller., K &Kundstrup, M A 2008).

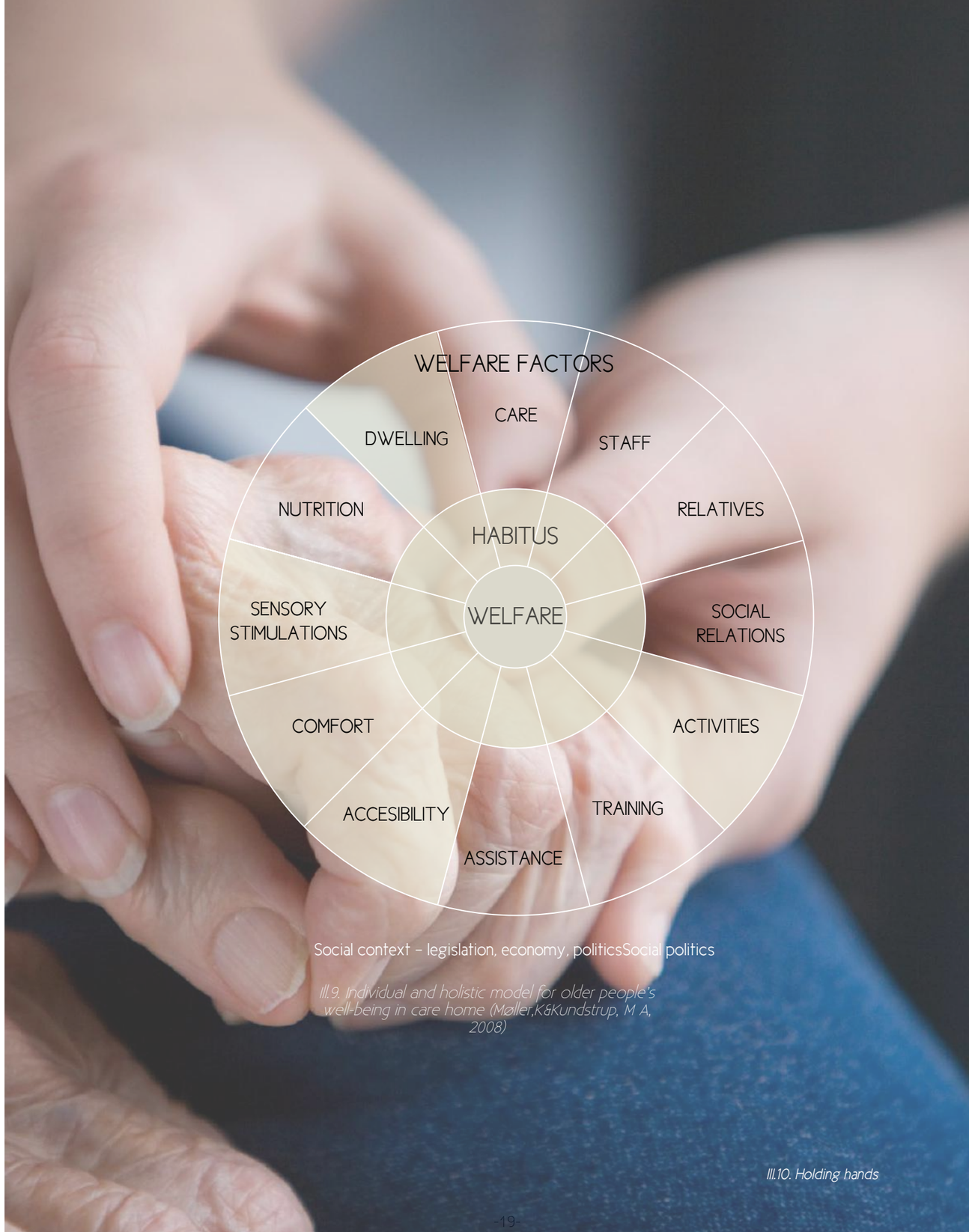
According Lawton, the well-being of nursing home depends on two things. First on individuals with their characteristics and skills, and secondly on the environment they live in (Møller., K &Kundstrup, M A 2008). Among the conscious and unconscious needs, expectations and goals that are important for older people to obtain, there are also other living conditions in a care home that should be fulfilled (Møller., K &Kundstrup, M A 2008).

These are:
- Physical and mental health (care, comfort)
- Safety and Security (safe and accessible environment)
- Independence (ability to take care of their own needs; control over everyday activities, surroundings and possibilities)
-Social relations and interaction (family, friends, staff)
- Meaningful activities (everyday activities, recreational activities, hobbies)
- Self-knowledge (identity, status, life story)

HABITUS

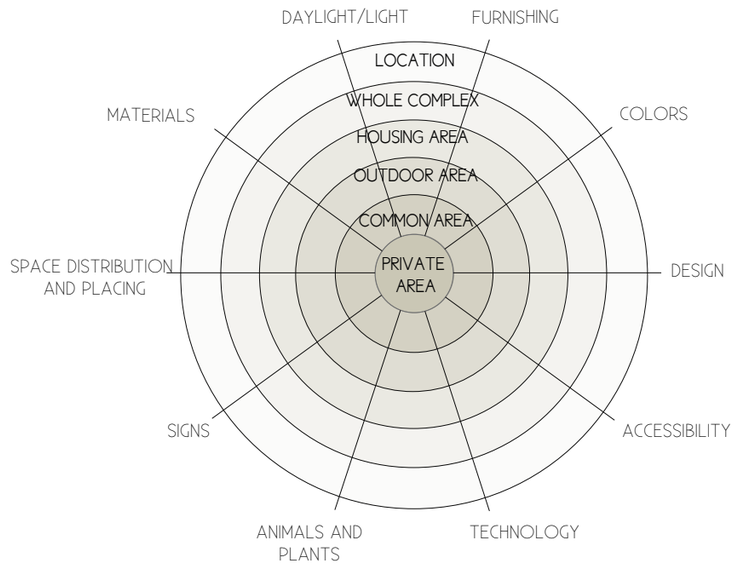
Habitus characterizes a person's inner and outer being, and it includes among other things person's social, physical, psychological and cognitive functioning, lifestyle, life experiences, personality, preferences, values, coping ability, family situation, health situation etc. When designing homes for people with dementia, it is essential not only to take into account the physical and cognitive parts of a person's habitus, but also relationships that relates to the person's psychological and social habitus e.g. conditions in terms of one's lifestyle, sociocultural background, life values etc. (Møller., K &Kundstrup, M A 2008).

In the project it was used Møller, Henriksen and Knudstrup model to show many different factors that affects life in care homes. These can be both external and internal. Selected fields in the ill.9. was a primal focus in this project. Nevertheless, it was minded all the factors as they are very much interconnected.



Ill.9. Individual and holistic model for older people's well-being in care home (Møller,K&Kundstrup, M A, 2008)

Ill.10. Holding hands



Ill.11. Analytical model of care dwelling physical architectural model (Henriksen, N., Møller, K., & Knudstrup, M-A., 2007)

DEMENTIA HOUSING

The starting point for designing a standard dementia home is people's with dementia special needs that require some of the physical surroundings. Lawton presents following requirements for the dementia friendly design: The environment must: 1) reduce problematic behavior, 2) increase social behavior, 3) increase the level of activity, 4) increase positive emotions (Henriksen, N., Møller, K., & Knudstrup, M-A., 2007). At the same time Lawton points that there is a dialectical relationship between the universal design and a dementia specific design and that any design should be based on general universal human needs (Henriksen, N., Møller, K., & Knudstrup, M-A., 2007).

MODEL

In order to identify and systematize the physical elements of the care home's in the project it was used an analytical model of Møller, Henriksen and Knudstrup that outlines a classification of the physical, residential components of the care home (Ill.11.). The model forms together an analytical structure that indicates the different physical-architectural components in a care home.

The circles in the model indicates care dwelling overall spheres, buildings seen from the outside in and vice versa, a movement from the public, the semi-public and semi-private to private sphere. Vectors / keyboard indicates the qualities of the individual spheres, the physical observable factors that characterize the building (Henriksen, N., Møller, K., & Knudstrup, M-A., 2007).

This structure is essential in planning and decision-making process of establishing the nursing homes. Typically the location of the property is first to be decided, next comes the main concept, including what type of housing wanted, after which more detailed decisions on the property type, common areas and outdoor areas, etc. are taken (Henriksen, N., Møller, K., & Knudstrup, M-A., 2007).

Ill.12. Woman in a wheelchair

CARE HOMES IN DANISH CONTEXT

In Denmark for a long time now it has been focused on the concept that elder people should remain in their own homes as long as possible. This concept has both great benefits but also major disadvantages. One of the main drawbacks is that a person first moves in the care center, where he or she is least suitable for it. That usually happens when you are often too sick to adapt to a new environment. If a person instead would move earlier to a residential area that is friendly to a dementia condition having people, but functions as a conventional city or town part, the person would be able to remain in the home environment for the rest of his or her life (Demenskoordinatorer i Danmark, 2015).

Anders Kristian Krogager Andersen and Linn Wittendorff Larsen from Dementia center in Aarhus that was visited confirms that this is a typical procedure and agreed that it worsens people condition as they struggle to adapt to a sudden change of their environment (Larsen, WL 2016).

A lot of elder people in Denmark suffers from loneliness. Finnish study (Caíde study) showed that isolation, loneliness and dementia are linked. The results concluded that people have a higher risk of developing dementia at 50 years old, if they are living alone (Demenskoordinatorer i Danmark, 2015).

Fynsgade care home in Aalborg was visited as an example, which has a welcoming environment for older people. Their day centre offers plenty of various activities, where people from outside can come on daily basis and create new social ties or enjoy each others fellowship.

Ill.13. The main types of care housing in Danmark 1996-2004 (Møller,K&Kundstrup, M A, 2008)

TYPOLOGY

The configuration and arrangement of care homes are of great importance for the elderly's well-being. Elderly with dementia have specific need, in relation to the configuration and the arrangement of the care homes. In order to achieve well-being, there are some transverse factors, which are essential. It is about domesticity, flexibility and a conceptual approach to the care home (Møller, K &Kundstrup, M A., 2008).

Primarily the location of the care home plays a main role in the resident's well-being. The optimal location for well-being is individual, depending on the resident's previous situation and life story. The optimal location for the care home, is a well-known area for the residents, but also an area near the resident's former home (Møller, K &Kundstrup, M A., 2008).

The care home complex consists of the total complex with residential units, administrative and service facilities, etc. The tenement of the care home is a main concept, where a structure is decided, afterwards the various functions of the tenement are placed. The main concept express the basic architectural and functional idea behind the care home, and should be determined at an early stage. Four main concept of care complexes are existing in Denmark: 1) linear - / angle structure, 2) comb structure, 3) yard-/ block structure and 4) group - / cluster structure (Ill.13.)

THE LINEAR/ANGLE STRUCTURE

The linear-/ angle structure is often organized into several floors with one or more residential units, placed around the corridors. The residential units is located on one or both side of the corridor, with one or more common rooms in relation to the corridor. The apartments has typical no direct access to private terraces, instead they have to common terraces.

THE COMB STRUCTURE

The comb structure consists of several residential units, with apartments and common areas along the corridors. Often common green gardens or courtyards and small private terraces can be establish. Larger care home complexes offend contains center facilities, which is located as a transversal center part.

THE YARD/BLOCK STRUCTURE

The yard-/ block structure is partly or completely closed, around an internal common garden or a courtyard. The building is usually disposed with residential units, towards the outside environment, with small private terraces. Through common corridors, there are access to the garden or courtyard area.

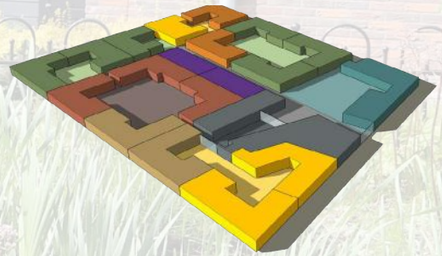
THE GROUP/CLUSTER STRUCTURE

The group-/ cluster structure is characterize by a number of groups with residential units, containing apartments organized around a common kitchen and living area. Each apartment has access to a private terrace, as well as common gardens or courtyards. The residential units are attach to the central located center facilities.

These four typologies can be found in various modifications. Most care homes are built using one of these structures (Møller, K &Kundstrup, M A., 2008). In relation to the four typologies, several new studies have been made, where description of how the layout of the building affects the residents is presented. These have been studied and taken into considerations.

CASES STUDY - DE HOGEWEYK

Architect:
Molenaar & Bol & VanDillenarchitecten & zorgen
Completion: 2009
Area: 12.000m²
Located: Weesp, the Netherlands



Ill.15. Hogeweyk conseptual 3D model

The vision of Hogeweyk is to realize a recognizable environment for residents with dementia. With a closed typology Hogeweyk creates a unique living concept. Here people with dementia have an opportunity of continuing their active life in a free environment with a normal and dignified life. In relation to the care vision, the approach of Hogeweyk is to give old people with dementia the right to continue living as they are used to together with additional care and service (MBVDA, 2016).

The Hogeweyk is an innovative dementia village for 152 patients with dementia, distributed over 23 housing units. The decoration of units are inspired by seven most frequent lifestyles in Netherlands: goois (upper class), homey, christian, artisan, Indonesian and cultural. Every home consists of six to eight people with the same lifestyle. This lifestyle is seen in the decor and layout of the housing units. Every house manages its own household with a permanent staff (Hogeweyk, 2016).

The Hogeweyk forms a certain fortress, a solid wall of apartments and buildings, closing off the outside world with only one entrance to get in and out. On the inside of the walls a self-contained world appears with facilities as cafe, bar, restaurant, a supermarket, parks and squares. Here the residents safely can move around.

The Hogewey is very diverse in design with different outdoor spaces. Any outdoor area serves a different purpose. For example, the theater square is suitable for outstanding street theater. On the boulevard several shops, the general practice and the physiotherapist are located. The green area has various functions for the well-being of the residents. Green areas means relaxing, experiencing the seasons, and health. In Hogewey several gardens and parks are presented, designed by Niek Roozen Garden – and Landscape Architects (Hogeweyk, 2016).
From the personal experience after visiting a Hogeweyk it was very clear that innovation lied not only within community's design but also and primarily in its approach. Her dementia residents experience a true, unrestricted and meaningful life.

Ill.14. One of the inner courts of Hogewey

THEME ANALYSIS II

Ill.16. Kingo houses by Jørn Utzon

TECTONICS

"When a structural concept has found its implementation through construction the visual result will affect it through certain expressive qualities which clearly have something to do with the play of forces and corresponding arrangement of parts in the building yet cannot be described in terms of construction and structure alone. For these qualities which are expressive of a relation of form to force, the term tectonic should be reserved" (Frampton, K 1995).

Tectonics is a seminal concept that defines the nature of the relationship between architectural design and its structural, material and constructional properties. A tectonic approach strives to achieve a continuity and integrity between form, structure and construction, with an emphasis on materiality and detail. It also reflects a phenomenological interest in the 'thingness' of architecture in a Heideggerian sense, which can be seen particularly notably in the architecture of the Nordic countries and in the work of many internationally recognized architects, including Alvar Aalto, Tadao Ando, Sverre Fehn, Steven Holl, Louis Kahn, Rafael Moneo, Juhanni Pallasmaa, Reima Pietilä, Jørn Utzon, and Peter Zumthor (Semester description, 2014).
The notions of 'gesture' (the spatial qualities and invitations for human interaction resulting from the architectural form) and 'principle' (the structural build up of the architectural form) in relation to tectonics have been introduced in the previous semester of master studies. It seeks to outline a linkage between architectural theory and practice applicable in project work. In order to stress the significance of the gesture of space to one's experience of architectural quality the tectonic design approach adopts a particular focus on the human scale (Semester description, 2014).

In this project a focus was not the tectonic design approach, but sustainable design and integrated approach, though tectonic qualities of a chosen spatial details and its impact on the contextual architectural whole surrounding are discussed.

III.17. Model of sustainability

III.18. Caretaker with an old woman

SUSTAINABILITY

Sustainable architecture pursues to minimize the negative environmental impact of buildings by efficiency and moderation in the use of materials, energy, and space. Today, the main idea of sustainability is to ensure that the actions and decisions made do not inhibit the opportunities of future generations. Sustainability in architecture focuses on some important aspects, that are: social, economic and environmental sustainability(III.17). These are the “true” sustainability aspects, and by uniting all three aspects it is possible to create a future sustainable architecture (Hansen et al., 2015).
In the project it was sought to build both a practical understanding and professional commitment to creating a new community that is socially, as well as economically and environmentally, sustainable.

ECONOMIC

Economy is often a part of sustainability that gets least weight, because it is difficult to make profit in relation to sustainability. The reason is that many sustainable technologies still are in the progress phase or are produced in such small numbers, that the price is relatively high. It is essential to understand the economy in a broader perspective, how an improved environment can play a role on the costs in a long term and give a better economy. Social functioning areas has less expenses for repairs, maintenance etc. (DAC, 2014).

The private area is one of the most important parts of the care home well-being. It needs to be spatial, flexible and have a certain size. Here economy can play a big role. The economy also has an effect on other facilities such as common area and the green outdoor areas because of the equipment and fixtures needed to be installed.

Another factor that has a big significance for the people with dementia is the location of the complex. It is impotent to ensure that the people with dementia can remain in their local area and keep in touch with their social network, family and friends. However, this is not always a possibility due to the economic constraints. The building owner tends to buy a site that is affordable, and therefore not always the best in relation to well-being.

When choosing the typology it includes many considerations in terms of well-being, but in practice other things, as the economy is more important, e.g. the operation of the building and the price of the building. Therefore, the priority often lies within the economy instead of the well-being (Møller, K &Kundstrup, M A, 2008).

Economy was one of the factors that needed to be taken into consideration, when creating a care home with dementia friendly environment from a sustainable point of view.

SOCIAL

In this project it tried to explore practical ways in which the new housing settlement could succeed as a community, where people with dementia would want to live. Nevertheless, it had be created a good environment for family visits and staff to work as well.

Social sustainability is an issue of public value as well as the well-being, quality of life and satisfaction of future residents. Residents should have a possibility to choose how much social contact they want to have. It is very personal and also depends on the progress of the condition. Somebody prefers to do activities together with others, whereas some would like to have privacy and does not find it attractive or sometimes possible to be among a lot of people.

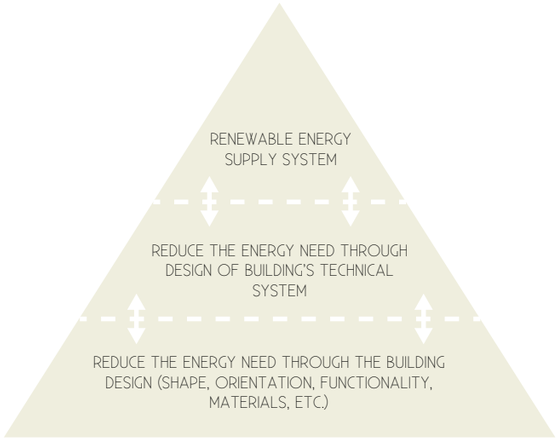
Understanding the social dimensions within the community of people with dementia is crucial for it’s long-term success and sustainability. It demands a new approach to planning, design and development, which needs to be integrate into policy and professional practice.

ENVIRONMENTAL

People need to take care of the earth so that it can remain for next generations. Environmental sustainability is probably what people associate most with sustainability. In 2014 Danish government targeted an ambitious goal of reducing the greenhouse gas emissions by 40 percent in 2020, with an energy agreement, that ensure massive investments in green transition of energy supply in the coming years (Regeringen 2014).

It is a necessary to think about specific initiatives across the climate, energy, environment, and the nature aspects of the organization. Related to an architectural aspect this is about finding architectural solutions that can help with the problem, and the many environmental factors must be considered. The goal is to reduce energy consumption, selecting and recycling the right materials, but simultaneously creating a good indoor climate.

In the project it was used building materials that gives a positive contribution to the health of people with dementia while having minimal impact on the environment. Inside the building, it was aware of the people with dementia health and used materials with minimal gassing and toxicity. It was intended to select materials that maximize the passive solar performance of buildings and use thermal mass to absorb and retain the heat of the sun in winter, while keeping cool in summer making the buildings comfortable year-round. High performance insulation was a solution to increase energy efficiency by minimizing excessive heat loss and gain. All the materials needed to have a balance between energy reductions versus energy needed to create the material.



Ill.19. Overall strategy for designing ZEB (Bejder et al., 2014)

ZERO ENERGY BUILDING

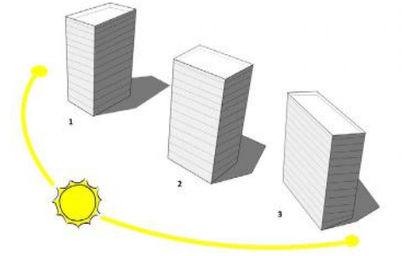
Buildings account for around 40% of total energy consumption and 36% of CO_2 emissions in Europe. Denmark is one of the leading country, in terms of less heat consumption in housing. Danish vision to be a society independent on fossil fuels by 2050 (Regeringens klimaplan 2013).

The Zero Energy Building (ZEB) concept is a solution for the mitigation of CO2 emissions or the reduction of energy use in the building sector. ZEB building has a very high energy performance. The energy, approximately zero or very low, required should to a significant extent be covered by fossil free energy from renewable sources (electrical, thermal, biogas) including renewable energy systems produced on-site or nearby. A ZEB is also characterized by high architectural quality and a good indoor climate with respect to temperature, air quality, good daylight conditions and acoustics, and is designed with respect for the user and the context. Spatial experiences, functionality must be considered and includes as a part of sustainability. (Bejder et al., 2014)

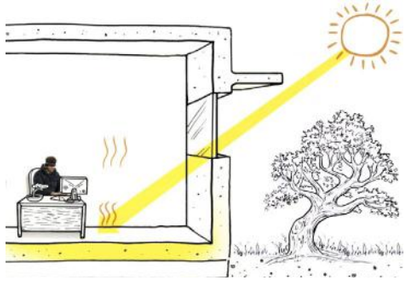
The technical machinery for heating, cooling, heat recovery and ventilation (HVAC) are becoming more and more complex, and the user's awareness, behavior and insight can sometimes cause trouble, when failing to keep up with it. That could be seen in the calculated energy demand and the actual consumption. Here it could be necessary to invest in the information and education of technical machinery to achieve the optimal consumption (Lehrskov et al., 2012). It is always a question about user's behavior when talking about energy consumption, sustainability and ZEB concept to be efficient. Therefore a user guide is necessary showing how the building works for using it optimally. A balance between user's behavior and automatic controlled systems should be created within the building to ensure a preservation of the required energy level.

The cooperation between the architect, engineer and craftsman is necessary to be able to test and optimize an effective energy solutions. The dialog across the professionals in early stage of the process is the way to create a good architecture, which is optimized in terms of energy consumption and meets the budget limitations. (Lehrskov et al., 2012) Focus is on holistic solutions where architecture, comfort, indoor climate, energy and user behavior are integrated parts of an unified building concept. (Bejder et al., 2014)

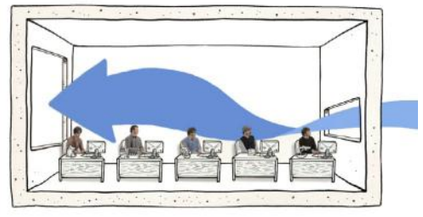
In this project sustainable design that promotes an integrated approach to a development is used. The development considers natural recourse protection and energy consumption through a holistic design approach. The goal was not to make a project - zero energy, but to fulfill the energy frame 2020.



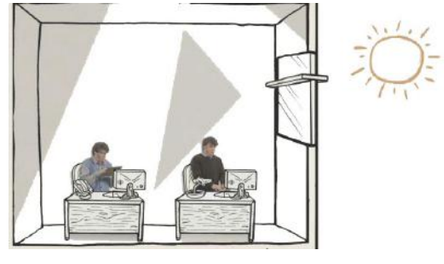
Ill.20. Building shape and orientation



Ill.21. Windows and apertures



Ill.22. Apertures for cooling



Ill.23. Daylighting design

PASSIVE STRATEGIES

Passive design strategies use ambient energy sources. When designing passively it means working with external weather conditions, instead of fighting against them. These strategies include daylighting, natural ventilation, and solar energy (Autodesk, 2016).

BUILDING SHAPE AND ORIENTATION

Building shape and orientation are one of the most important factors in passive heating, cooling, and daylighting. It is important to begin considering passive design strategies in the massing stage, so that the surface areas exposed to sun at different times of day, building height, and building width can all be optimized for passive comfort (Autodesk, 2016).

PASSIVE HEATING

Passive heating uses the energy of the sun to keep occupants comfortable without the use of mechanical systems. It is important to consider:

- Direct solar gain
- Size and orientation of the building
- Windows and apertures
- Thermal mass
- Shading for solar heat gain (Autodesk, 2016)

PASSIVE COOLING

Like passive heating, cooling a building using passive strategies is important for reducing energy usage in the building. Specifically, utilizing passive cooling strategies like natural ventilation, air cooling, and shades can reduce a demand for mechanical cooling while maintaining thermal comfort (Autodesk, 2016).

DAYLIGHT

Daylight is important when designing energy efficient buildings. Daylighting, or using sunlight to illuminate the building, is an effective way to both decrease the building's energy use and make the interior environment more comfortable for people (Autodesk, 2016).

SITE ANALYSIS

Ill.24. Picture from the plane, where site of the project can be seen on the right

Ill.25. Map with local centres marked

OBJECTIVE ANALYSIS

METHODS

Objective analysis were made in order to achieve, defined and precise knowledge of the area. The methods behind objective analysis are: Kevin Lynch mapping, structural analysis and quantitative registrations. Kevin Lynch mapping and structural analyzing are based on some of the same point of views. Therefore when choosing analysis, it is not getting into depth with a specific method, instead it is taken an inspiration from all three, which results analysis of typology, infrastructure, green areas, landmarks and quantitative registrations of the city (Marlling, G, 2011).

KEVIN LYNCH

Kevin lynch's method is based on districts, paths, edges, nodes and landmarks. Districts are understood as areas with common character or functions. Paths cover infrastructure and movement patterns. Edges divide lines between districts. Nodes are focal points in the urban space. Landmarks include external reference points, which act as fixed points in the movement through the area. Kevin Lynch came to this method by studying how observers consume information in the city, he understood the human being and formed a mental map consisting of the five main elements: districts, paths, edges, nodes and landmark.

QUANTITATIVE REGISTRATIONS

Quantitative registrations is focusing on four subjects: 1) furnishing of the city, that registers the benches, trash cans, street lamps, and street signs; 2) the city's functions that registers service sector, public institutions, convenience stores etc. 3) the city's users such as cyclists, motorists, pedestrians, children, young, adults, old, alone, couple, groups etc. 4) the city's buildings that registers things like windows, floors, materials etc. (Marlling, G, 2011).

STRUCTURAL ANALYSIS

Structural analysis, is dividing the city into structures in order to understand it. The city can be divided into three main structures: 1) the building structures, that are looking at the typologies, architecture, square etc., 2) the Green structures, that focus on open space, nature, recreational areas etc., 3) the infrastructure that registers the roads, railways, car parks, etc. (Marlling, G, 2011).

Ill.26. Green areas and functions of Aarhus diagram

QUANTITATIVE REGISTRATIONS

Although there is a large number of care homes in Aarhus, there is only one dementia centre for people with special needs. As mentioned earlier, it is important to keep people with dementia and elderly without separately to avoid misunderstandings and mistreatment between these two parties. Moreover, it is necessary to have more than one dementia centre in bigger cities like Aarhus. Elderly with dementia need to be closer to their local community, family and network so that the well-being is obtained.
Today there is an existing care home for elderly on the site. A part was chosen to be tore down and build a new center for people with dementia exclusively.

GREEN AREAS

The area around the site is relatively green, which is due to the residential areas around the site. Residences has their own garden, around the high block of apartments there is a big green outdoor area. South of the site close to the school a sports field is located and towards East there is a stadium.

Ill.27. Typology diagram

Ill.28. Infrastructure diagram

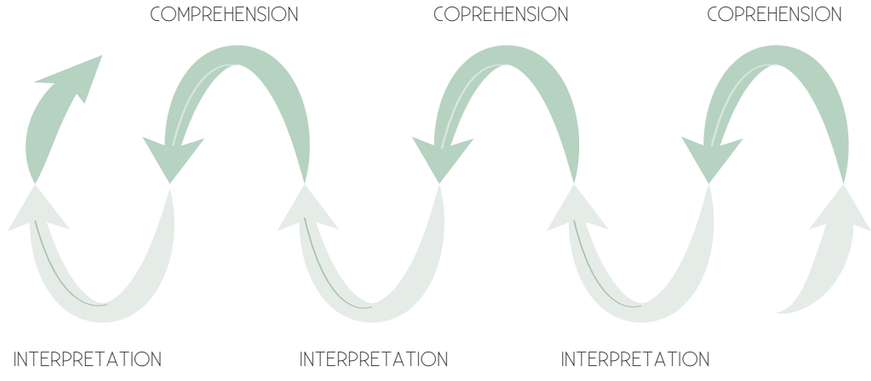
STRUCTURAL ANALYSIS

TYPOLOGY

The site is overall surrounded by housing of open-low typology with some convenience stores, gas stations, schools and the stadium. Towards West, the area is covered with colonial houses, which is a smaller housing units compared to the other open low typology. The architecture is more personal with an intimate scale and low speed feeling. Towards East and Northwest, the site consists of open-tall typology, that is surrounded by open green space. The typology dense-low is divided evenly over the area. Towards South some buildings goes under dense-tall typology.

INFRASTRUCTURE

The site is surrounded by various transport links. Randersvej is the main road towards Aarhus, that also leads to the site. It has a heavy traffic, and a speed limit of 70 km/h. Skovvangevej is a secondary road that is connected to the main road and leads to the site. It has a speed limit at 50km/h. From Skovvangevej small roads are distributed between residential neighborhood. Kirkevangen is connected to the site. This area is surrounded by gravel paths and is only for pedestrians and cyclists, which helps to lower the speed. The area contains relatively different types of traffic, which also ensures a good access to the site.



Ill.29. Hermeneutic spiral diagram

SUBJECTIVE ANALYSIS

PHENEMENOLOGY-HERMENEUTICS

The intention of phenomenology is to describe the phenomena of human life-world. The phenomenon is what appears in people's consciousness in the form of experiences, events or anything material. In phenomenology, human consciousness is understood as a bodily rooted awareness. Phenomenology contributes to a deeper understanding of people's lived experiences by searching behind the perceptions, ideas or stereotypes we usually pay phenomena in our life-world (Martinsen B, Norlyk A. 2011).

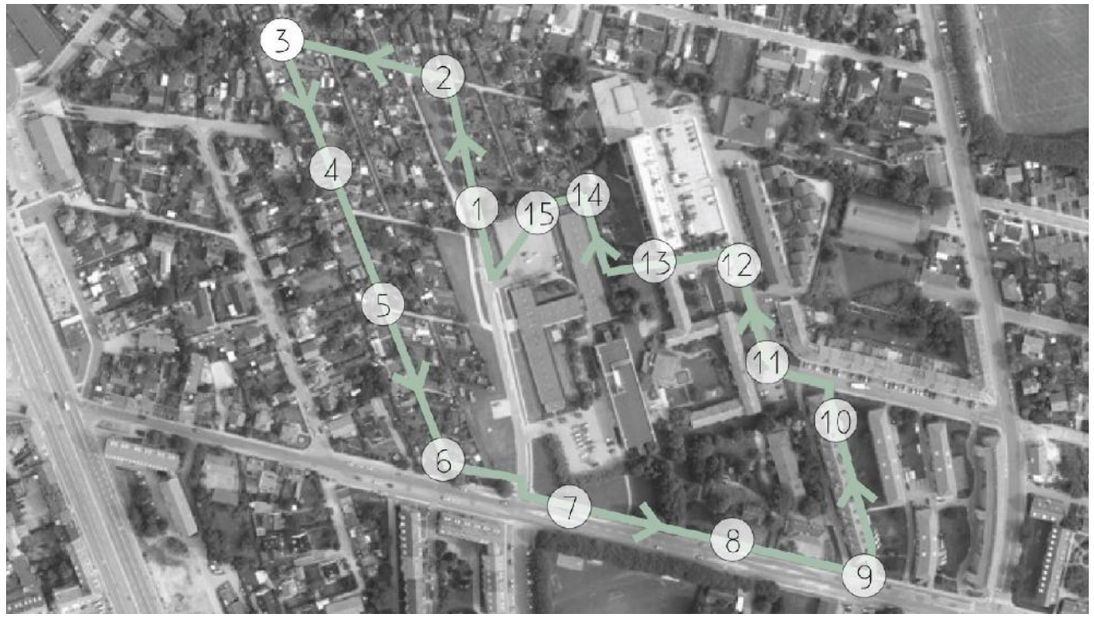
Phenomenological analysis methods examine how architecture affects sensually and emotionally. It examines how the body is affected by space and form. Steen Eiler Rasmussen in his book "About to experience architecture"(1950) writes about phenomenological approach to architecture. In the book he examines, how humans are experiencing and responding to architecture and design. He sets up and explains a number of concepts and tools for designing: space, shapes, mass, light, color, texture, rhythm, scale, ect. (Marlling, G, 2011).

The main question of hermeneutics is what is understanding, and how people can achieve understanding. Heidegger states that hermeneutics is generally about an understanding of one's existential being through interpretation. For Heidegger hermeneutics is a meeting with a human existence through language or action. This is where the human being is expressed, and through interpretation can one achieve a new realization (Martinsen B, Norlyk A. 2011).

The purpose of the hermeneutical analysis is coming from concrete descriptions to a meaningful interpretation, representing a new understanding of how one learns about his/her being (Martinsen B, Norlyk A. 2011).

It was intended to gain an insight into the peoples' with dementia life-world experiences and lessons, therefore phenomenology had been relevant as a starting point for both data collection and analysis. It was taken en inspiration from hermeneutics, based on the way it was related to the preconception in the design process.

"While phenomenologists typically are interested in illustrating how people experience the phenomena in their life world, hermeneutic researchers are dealing with the interpretation of meaning" (Degn, M 2014).



Ill.30. Serial vision route

SERIAL VISIONS

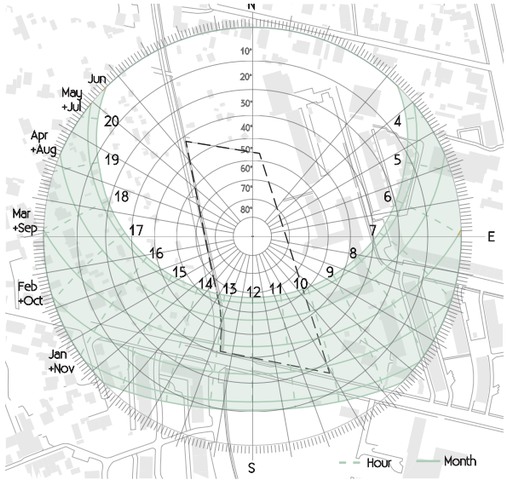
In this method, the city is seen as a whole drama of contrasting visual impressions. It is a concentrated space, which alternates in transparency of light and shadow, in differing scales and different textures. Gordon Cullen in his book “Townscape” states that there physical and mental effects created throughout this drama, where body reacts to spaciousness, effects and movement through a series of spaces. With this method visual experience of the city scape is recorded as it changes while one moves forward through a given distance in the city (Marlling, G, 2011).

The site is located in a relatively quiet residential area, but still close to the city center. The road down toward the site is blind and changes to a path for pedestrians and cyclists, here are children moving to and from school. The path is gradually rising towards north and in the background raises some tall apartment blocks in concrete.

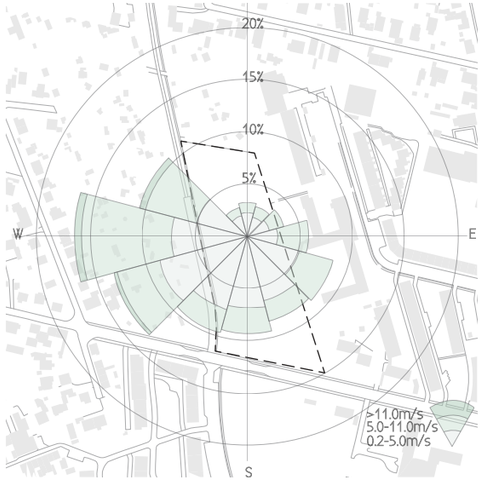
In the west there is a garden association, where roads in be-tween the houses are covered with gravel. The atmosphere here changes to a more intimate and private feeling. View towards the site and the surrounding neighborhood emerges in between the private houses. South from the site there is a school, where school children are constantly moving around on bicycles or on foot.

The cars are driving slowly through the site, though it is a bit busy throughout the day. In the background, the church bells can be heard, and the bell tower is visible further in the west and it appears as a landmark. In the East from the site, there is a residential area with some single apartment blocks. It is surrounded by greens areas, where people can walk their dogs and children can play. The existing care center appears towards north with a six-floor block behind.

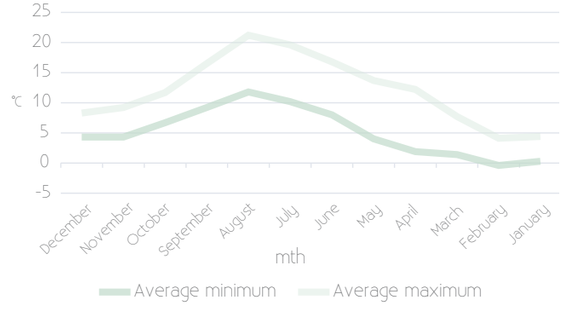
Ill.31. Serial vision pictures



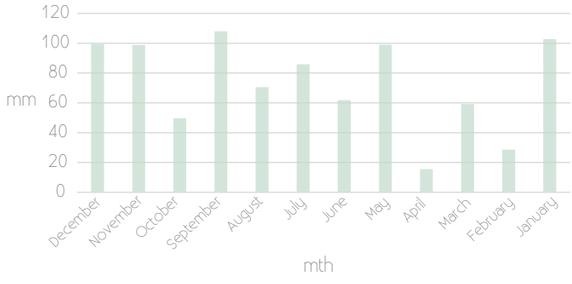
Ill.33. Sun diagram



Ill.34. Wind diagram



Ill.35. Temperature diagram



Ill.36. Precipitation diagram

CLIMATE ANALYSIS

SUN

Observations of the sun path diagram, showed that the sun's position in Denmark is highest from May to July, and is lowest from November to January. When working with elderly it is important to be aware of the sun position during the year in order to create a good indoor climate with no overheating or glare, but at the same time have enough light into the rooms.

Daylight is important due to elderly's deteriorating vision. A sixty-year old person needs six times as much light as a twenty-year old person in order to see. Elderly are also more sensitive to heat difference and glare (Møller, K &Kundstrup, M A 2008).

Sunlight is very important as it increases the production of the hormone serotonin that counteract fatigue and depression and prepares the body to produce more melatonin, which is the hormone that helps one to sleep. Moreover, it is a powerful antioxidant, that stimulates the immune system and prevents cancer (Alun 2009).

In order to create a good indoor climate for the elderly, apartments need to be located in relation to the sun. Architecture has to prevent overheating and glare but also let the necessary amount of daylight in. Passive-and active strategies can be used for that.

The outdoor areas were placed in relation to the sun, in order to create an attractive outdoor space for the elderly, and thereby make it more interesting for them to get fresh air and be active.

WIND

The wind-rose illustrated the average wind speed over a year. The dominant winds come from West, South-west and Northwest. The wind speed is varying from 0.2 m/s to 11 m/s. (Dmi, 2016)

Knowing the direction of the dominating wind, can be an indicator for using a natural ventilation, but also when creating an attractive outdoor area for the elderly, where strong wind should be avoided. It can be an aspect in the design if the wish is to make the architecture partly a shield against the wind. Furthermore, it was important to think about the design of the architecture, so the wind would not create irritating noises for the elderly.

TEMPERATURE

The average of maximum and minimum temperature of the year varies depending on the month and year. In Denmark the air temperature is very low, only from mid-May to September the temperature rises above 15 degrees. Therefore, the aim often is to create a space with possibility to enjoy the warmth all year round. This can be done in different ways, e.g. winter gardens. In summertime, the heat can be intolerable for elderly, and shading is necessary if wanting to stay outdoor. Therefore, it was important to ensure different solutions in order to create a good outdoor area, that could be used for a longer periods. (Dmi, 2016)

RAIN

In the last years the amount of rainy days in Denmark increased significantly. In 2015 880 mm of rain fell, in all 192 days with rain.

The increasing amount of rain causes pressure on the local drainage system and often results floods. (Dmi, 2016)

As a result of the climate change, local drainage of rainwater (ldr) is used more often to decrease the pressure on the local drainage system. It is more sustainable and creates different opportunities for the outdoor area. The redundant amount of water can be used as small lakes, the rainwater can be collected and used for watering flowers, flushing toilets etc.

When designing, it was important to keep the increased amount of rain in mind, in order to create the best solutions for the elderly to be able to use the outdoor space even when it is raining. There could be created e.g. overhangs or shelters.

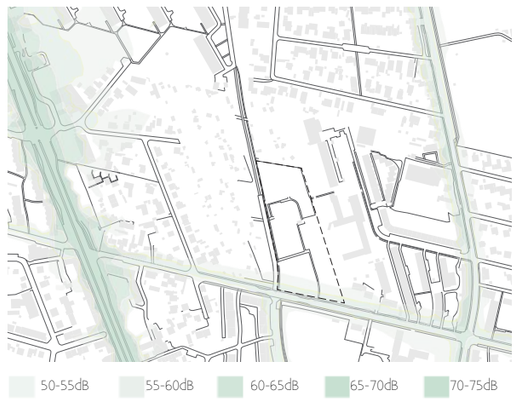
Ill.37. Winter shades (December 21)

Ill.38. Spring shades (March 21)

Ill.39. Summer shades (June 21)

SHADOWS

Studies of the sun and shading were simulated on different month basis. Simulations were made for the 21. June, the 21. December and the 21. March.
This clearly showed the qualifications of the site. Due to the low buildings surrounding the area, hardly any shade reaches the site even under the worst conditions.
This resulted an optimal opportunity for the buildings, outdoor areas and apartments with good light conditions.



Ill.40. Noise simulation in the night

Ill.41. Noise simulation in the day

NOISE

In the southern part of the site, a secondary street Skovvangsvej emits 70dB through the day, whereas in the night it is 65dB. During the day, 60dB reaches the site, where at night almost no noise is heard in the site from the street (Miljø- og fødevareministeriet, 2016). It is recommends that the sound level does not increase 30dB in the day- and evening hours in order to maintain a good indoor climate (Frandsen et al., 2009).
The site is located in the quiet surroundings, therefore it is not necessary to decrease the noise, but if necessary vegetation could be used as a sound absorption to capture the noise.

LOCAL PLAN

In order to fulfill the municipality's wishes for the site and to see which regulations need to be met, the local plan needed to be studied. The local plan was put on hold in 2011, therefore there is no existing local plan of the site today. It was then important to look at the municipality plan. The requirements from the municipality plan for the area is a maximum building height of 8,5 meters, with a maximum of two levels building. Furthermore the maximum of plot ratio can be 45% of the area (See Annex II).

PROGRAM

ANALYSIS
NARRATIVE SUMMARY

In the previous chapters it was presented a current situation on the chosen topic as well as condition of the chosen site.
It was discovered that dementia is becoming more relevant is topic in Denmark as there are only few dementia centers and the number of people with this condition increases rapidly. Moreover, people having dementia are mixed with the ones without it resulting a negative effect on their well-being.
The analysis prepared basis for the further design process and provided with the information that was used in further studies in terms of creating a friendly dementia environment with a sustainable approach.

Ill.42. View over the site

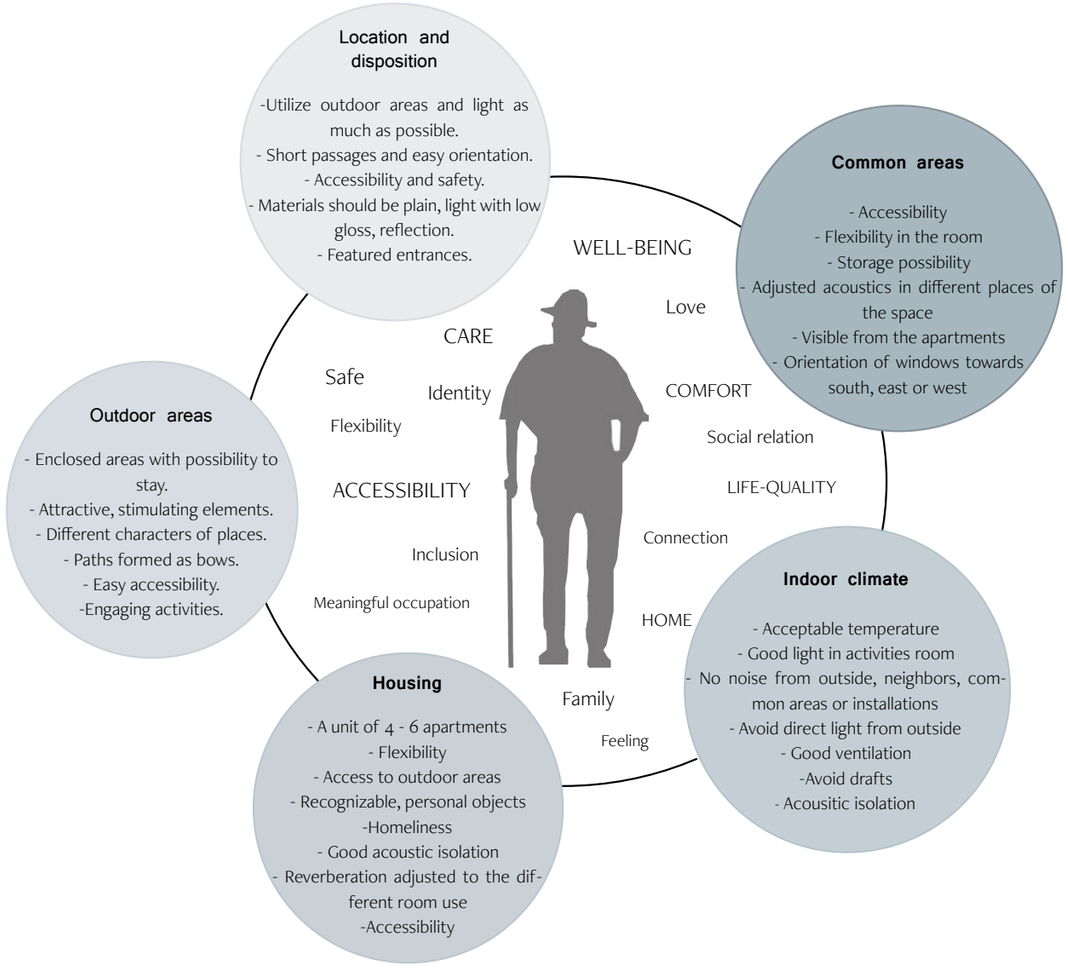
ROOM PROGRAM

Type of room	Area m2	Number	private/non private	view	Ventilation type	Light Type
1-room apartments	35	91	private			
Halway / tea kitchen	5			(+)	natural/mechanical	daylight / artificial light
Living room / Beadroom	22			(+)	natural/mechanical	daylight / artificial light
Bathroom	8			(-)	mechanical	artificial light
Terrace	4			(+)	-	-
1-room apartments in all	3185					
2-room apartments	47	34	private			
Halway / tea kitchen	7			(+)	natural/mechanical	daylight / artificial light
Living room	18			(+)	natural/mechanical	daylight / artificial light
Bedroom	14			(+)	natural/mechanical	daylight / artificial light
Bathroom	8			(-)	mechanical	artificial light
Terrace	4			(+)	-	-
2-room apartments in all	1598					
Relatives room	35	1	private			
Halway / tea kitchen	5			(+)	natural/mechanical	daylight / artificial light
Living room / Beadroom	22			(+)	natural/mechanical	daylight / artificial light
Bathroom	8			(-)	mechanical	artificial light
Common Area	4400	22	nonprivate	(+)	natural/mechanical	daylight / artificial light
Kitchen	9					
Living room	100					
Terrace	21,5					
Other	324		private	(-)	natural/mechanical	daylight / artificial light
Technical room	6	6				
Laundry	8	12				
Staircase	32	6				
Functions						
Combined functions	528		nonprivate	(+)	natural/mechanical	daylight / artificial light
Education rooms / Auditorium / workshop	90					
Daycenter / Cafe	438					
Activities	191		nonprivate	(+)	natural/mechanical	daylight / artificial light
Physiotherapist	50					
Beauty salon	31					
Shop	60					
Sensory room	50					
Administration and staff	203		private	(+)	natural/mechanical	daylight / artificial light
Office	10,5	4				
Dining room	50					
Changing facilities	16	2				
Reception	25					
Offices in units	7	6				
Other	376		nonprivate	(-)	natural/mechanical	daylight / artificial light
In all	1298					

Building area	11.499	m2
Site area	16.042	m2
Outdoor area	5.410	m2
Building persentage	71,68	%

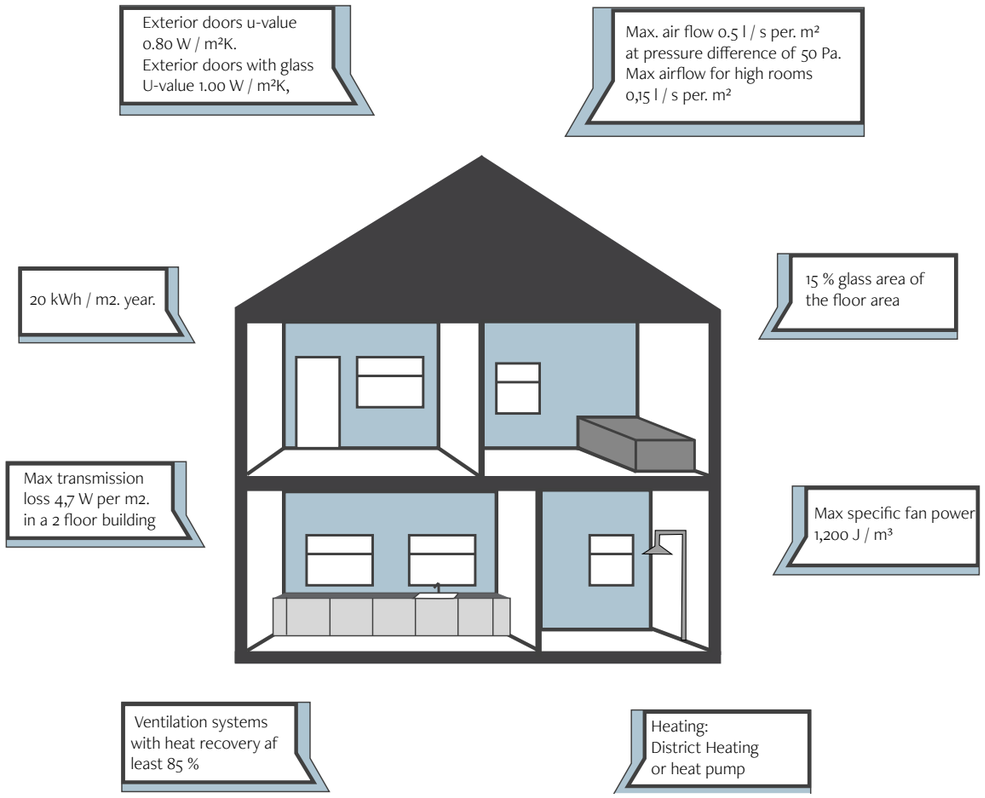
III.43. Room program

DESIGN CRITERIA FOR DEMENTIA FRIENDLY ENVIRONMENT



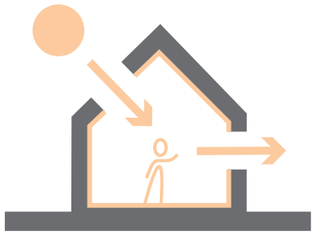
III.44. Design parameters for dementia housing (Møller,K&Kundstrup, M A, 2008)

REQUIREMENTS FOR ENERGY FRAME 2020



Ill.45. Requirements for the energy frame 2020

Ill.46. Thermal comfort



Ill.47. Visual comfort

Ill.48. Atmospheric comfort

Ill.49. Acoustic comfort

COMFORT

Comfort ensures that a building is warm, comfortable and healthy to live in. There should be a comfortable temperature all year round and a good indoor climate. It is important for people with dementia to have a good indoors climate for their well-being as they spend most of their time indoors, because of the weather in Denmark.
Having a good indoor climate also minimizes confusion, anxiety and anger in people having dementia.

THERMAL COMFORT
Maintaining a older people thermal comfort means ensuring that they don't feel too hot or too cold. This means keeping the temperature, humidity, air flow and radiant sources within acceptable range. Old people are less active, therefore a higher temperature is preferable. At the same time they are very sensitive to temperature and warm days in the summer can disturb them. It is important then look at the facades as it is a source of overheating. Protection from sun should be considered (Møller, K &Kundstrup, M A, 2008).

VISUAL COMFORT
Maintaining a visual comfort means ensuring that old people have enough light for their activities, the light has the right quality and balance, and people have good views. Old people needs more light then younger, when reading or doing different activities. Here direct sunlight should be avoided as it causes glare and accidents. It is important for people with dementia to follow changes of the day, weather, season of the year (Møller, K &Kundstrup, M A ,2008).

ATMOSPHERIC COMFORT
It is important that air is clean, fresh, and circulated effectively in the space. It is both for a good indoor climate (temperature, humidity), but also for a health reasons.
Reducing pollution and choosing not synthetical materials, that don't contain toxic substances is essential for atmospheric comfort.

ACOUSTIC COMFORT
Acoustic comfort means ensuring the right level and quality of noise in the space depending on it's function. A lot of older people with dementia have a hearing problems and use a hearing device. It is hard and confusing for them to orientate in crowded and loud surroundings. It is important to have a good isolation to lower the sound level and reverberation time depending on the space function.

Ill.50. Elderly making food with a caretaker

WORKING ENVIRONMENT

When creating dementia housing staff as well as relatives well-being(health and safety) should be taken into account. It is important that employees have a decent working environment - both physically and mentally. Task like correcting posture, assisting, having to move around in shortest routes inside the complex should be performed without extra efforts. Devices like mobile cranes, special beds that helps people with dementia be more independent should be used. Making units visible and marking them in a way it would also be easy to orientate for staff in order to assist more quickly and make it easier for them (Demens alliancen, 2016).

Employees should have their own space, where they could have their breaks or rest, if needed. Changing rooms, possibility to have a shower or meet and be with other personnel should be taken into account. The working environment should be inviting for interaction and natural way of being with the residents. Therefore, creating spaces for residents, along with employees , who can for example participate in making food, garden weeding, cleaning, etc. gives a possibility to be a part of daily chores that can maintain a meaning in life.

Moreover indoor climate that could be adjusted to both groups needs, such as different temperature proffered due to being more active than older people or similar should be taken into account.

Where residents are happy and thriving it makes easier to work, help and assist them. Well- being is then ensured both ways.

VISION

This vision was developed in recognition of the needs for a much greater common understanding and awareness across the fields of healing architecture, on what the architectural contribution to dementia is and what constitutes good life quality-livability for residents and working environment for employees to provide care and treatment in dementia housing. The vision was set in the context of the broader national dementia housing strategy - “Visions for Danish Dementia Homes” commissioned by the Dementia Alliance, that gives inspiration on how to better build, renovate and furnish for people with dementia together with the priority actions for maintaining health and well-being outcomes relating to dementia homes.
The intention was to create a safe and engaging community, where people with dementia could thrive and have supporting surroundings for their everyday life .

DESIGN PROCESS

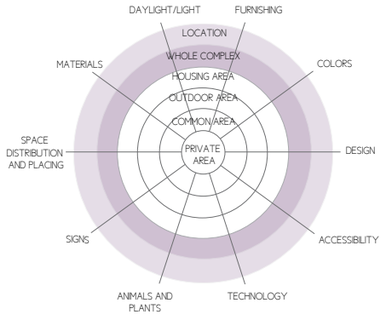
Ill.51. Model of an early design

Ill.52. 10.000 m² in one plate

Ill.53. 10.000 m2 divided in facilities and housing

Ill.54. 10.000 m2 divided into smaller functions

Ill.55. 10.000 m2 divided into needed functions in all

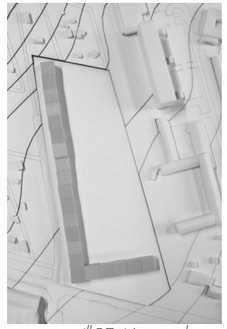


Ill.56. Elements studied in the psychological model of nursery

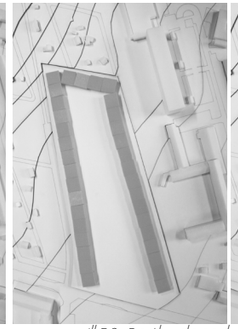
SPACE STUDIES

The competition brief formed the basis for the room program with a description of different functions the dementia center needed to contain. Approximately 1000 m² were given for service functions and for the housing it was approximately 9000 m².
The site is 16.042 m², where the municipality plan allows a maximum gross area of 45% of the site. Although, looking at the site it is not realistic. If the building is of a 10.000 m² the building percentage would be 62,3%. Therefore, it is expected that the municipality's plan would be adjusted for the project as it is a real case, that shows that increased building percentage is necessary in order to keep the buildings functionality. The project would represent a transitional building in the area, where different typologies from the surroundings are combined.

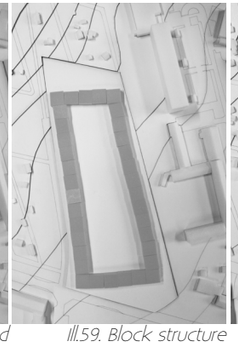
In order to get a spatial understanding of the needed square meters the total area of 10.000 m² was cut out in one floor and placed on the site (Ill.52.).Later it was divided into smaller parts to see the division of the service areas and housing space (Ill.53). After that it was cut into parts of needed space for 1-room and 2-room dwellings, common functions, administration and other functions (Ill.54.). Lastly, it was cut into 25 units with five apartments in each, where common area and kitchen were divided as well (Ill.55)
From function studies it was better to see how much space each function needed. The results showed that it was necessary to build in two floors, if wanting to have a big outdoor areas as well. Moreover, it showed the space needed for different functions. It was obvious that service areas took least space and this is mainly because the residents would not pay for these functions. It would be the municipality's responsibility (Møller, K &Kundstrup, M A ,2008). Therefore, it would be beneficial for the project to combine functions in order to have all the functions needed in the complex. This could be done by making a multi functional spaces.



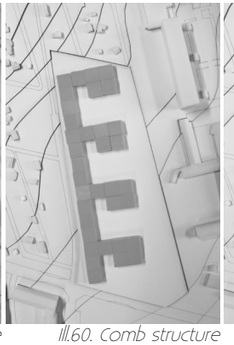
Ill.57. Linear shape



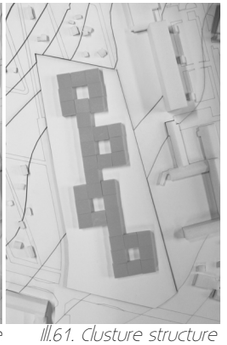
Ill.58. Partly closed block



Ill.59. Block structure



Ill.60. Comb structure



Ill.61. Clusture structure

TYPOLOGY STUDIES

Four typologies has been studied placed on the site. Various parameters were set in order to reflect upon the typologies.

THE LINEAR/ ANGLED SHAPE

Is it able to fulfill the height criteria from the local plan without changing the typology? -
Is the outdoor area shielded and protected? -
Is an outdoor area created big enough? +
Does it shield from the wind? +
Is the main façade achieving a good daylight? +
Are long corridors avoided? -
Is the flow solution good? -
Is an institution feeling solved? -

THE PARTLY CLOSED BLOCK

Is it able to fulfill the height criteria from the local plan without changing the typology? +
Is the outdoor area shielded and protected? -
Is an outdoor area created big enough? +
Does it shield from the wind? +
Is the main façade achieving a good daylight? +
Are long corridors avoided? -
Is the flow solution good? -
Is an institution feeling solved? -

THE BLOCK STRUCTURE

Is it able to fulfill the height criteria from the local plan without changing the typology? +
Is the outdoor area shielded and protected? +
Is an outdoor area created big enough? +
Does it shield from the wind? +
Is the main façade achieving a good daylight? +
Are long corridors avoided? -
Is the flow solution good? +
Is an institution feeling solved? -

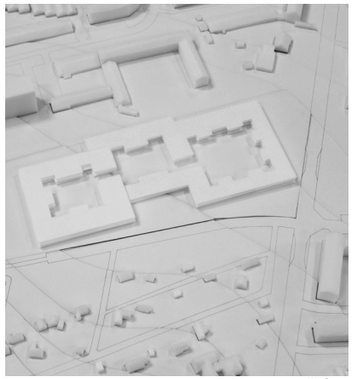
THE COMB STRUCTURE

Is it able to fulfill the height criteria from the local plan without changing the typology? +
Is the outdoor area shielded and protected? -
Is an outdoor area created big enough? -
Does it shield from the wind? +
Is the main façade achieving a good daylight? +
Are long corridors avoided? +
Is the flow solution good? +
Is an institution feeling solved? +

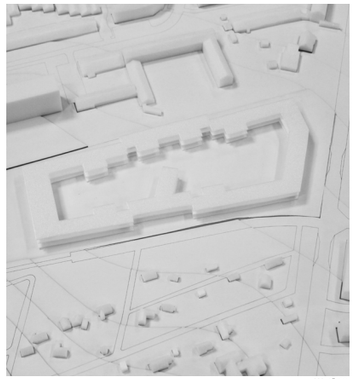
CLUSTER STRUCTURE

The site is too small for this typology. When choosing it, the outdoor areas appeared too small to make an activity in them. If making bigger clusters and few of them, the typology would change to a block structure.

The block structure was chosen as the most suitable typology because of its qualities to create a safe environment for the people with dementia by using the building volume. The big outdoor area could be divided into smaller private spaces. Long corridors could be solved with a layout of the functions.
The other typologies requires a lot of fencing in order to make this possible. It has been noted that too big areas with a fence would have a provoking effect on some people with dementia, where they could begin climbing the fence and try running away (Larsen, 2016).



Ill.62.



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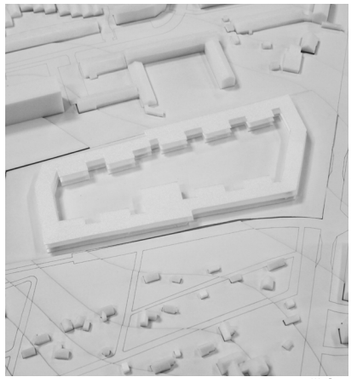

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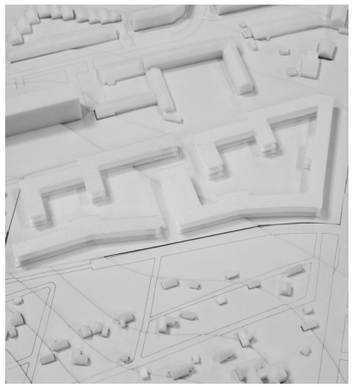
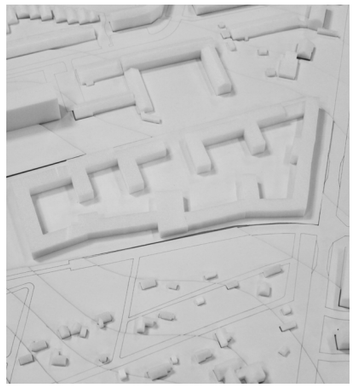
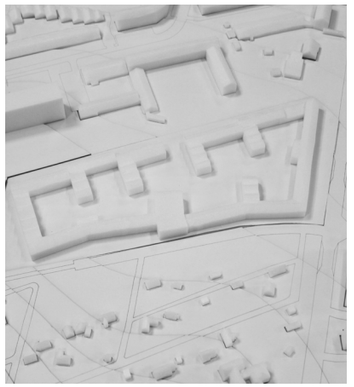


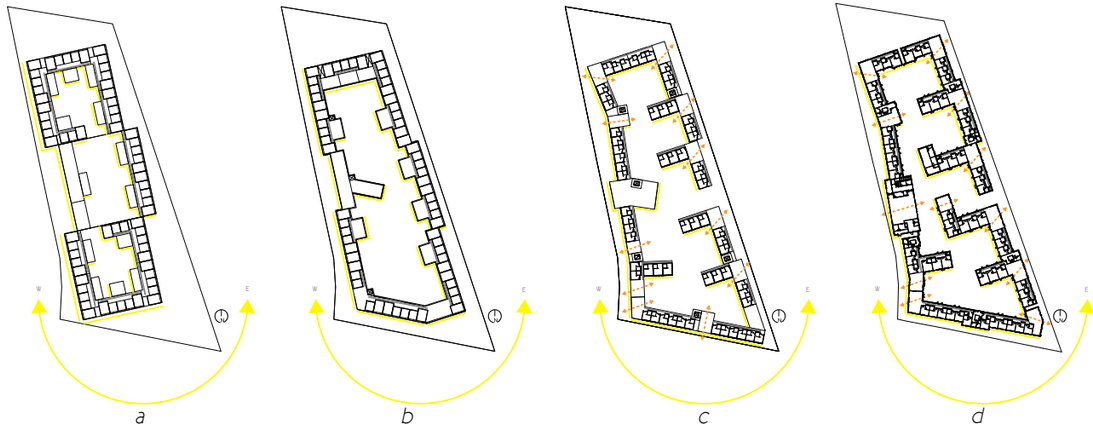
Ill.65.



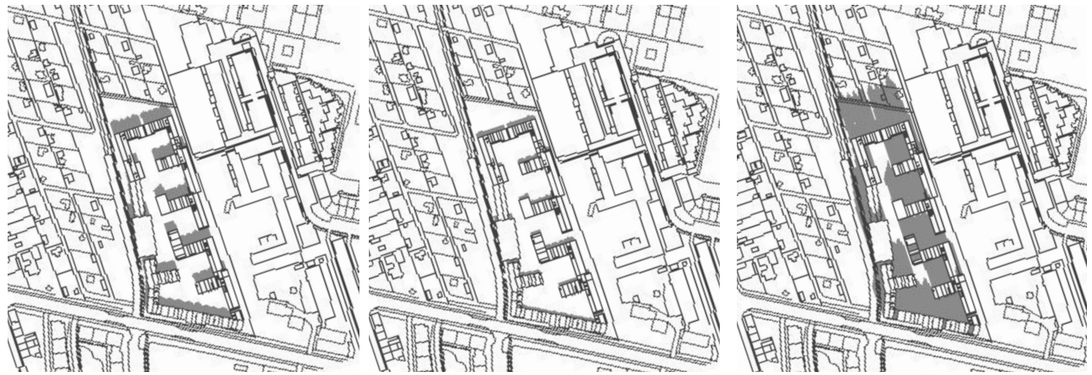
Ill.66.



Ill.67.



Ill.68. Building shaping



e f g

Ill.69. Sun studies on the chosen building shape

VOLUME STUDIES

When working on the building shape it was important to work on the layout of a unit. Many requirements and existing regulations had to be fulfill when designing for people with dementia, in order to create the best environment for them. Detailed design process for the units can be seen at a page 59.

Working with the layout of the building and the building form resulted an iterative process, where both were compared and solved simultaneously.
With point of departure in the block structure, for the form study, different parameters were taken into account besides the general design criteria's.

These are:
- Remove the sense of institution;
- Create a safe outdoor area that would have a potential for having both public and private areas;
- Making a center, containing all service functions;
- Creating a good light conditions inside apartments.

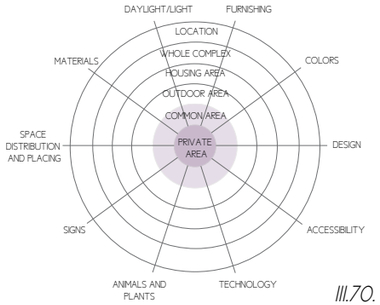
Different iterations had been made in order to create the best environment for the complex residents.

Ill.62., Ill.63., Ill.64. contains unit type from the first proposal (see ill.74). The three proposals had too open outdoor areas, that occurred when trying to avoid shading from the building. There were also too many apartments directed towards north. Even though there was then made a proposal with a big outdoor area, bad light conditions would occur during the day for either the apartments or common room. Still many apartments would still directing towards N and NE (ill.68. a,b). By making the building more clean without many displacements, it brought back an institutional feeling (Ill.64).

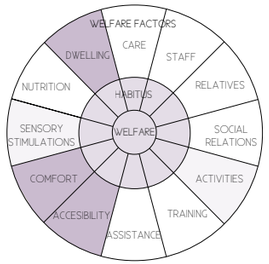
Ill.65., Ill.66., Ill.67. contains a unit typo from the second proposal (see ill.74.). With this type of layout it was possible to use the building volume to divide the outdoor area into smaller spaces that became more defined and intimate. The feeling of institution now began to transform into a sense of a small community.

The amount of sun on the site was studied in order to design the most efficient layout/ form of the building and give the apartments, common rooms the proper amount of daylight without gaining too much passive solar heat. This layout made it possible to achieve that (Ill.68. c, d, Ill.69. e, f, g).

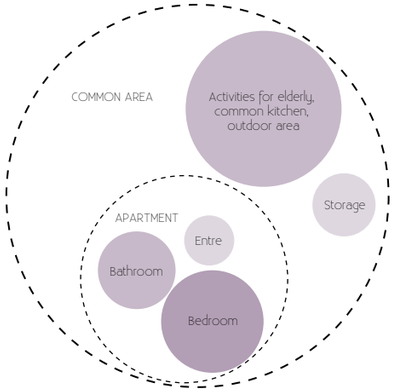
Studies of the volume of the complex was important for the good indoor comfort and for creating big enough outdoor areas.



III.70.



III.71.



III.72. Function diagram of unit

UNIT DEVELOPMENT

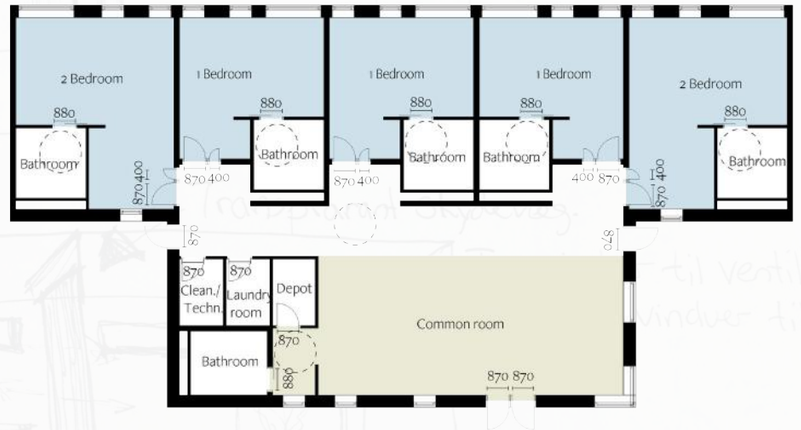
When designing homes for people with dementia, that have a cognitive and intellectual disability, the design of a care home should support their everyday life. Therefore, it is important first to ensure their need for safety and well-being. Accessibility plays a big role here as the goal is to make residents be as much self-reliant and independent as possible. This should be taken into account in the early design process to achieve the best results. Studies of published different researches and study trip to well – known dementia village in the Netherlands, De Hogeweyk, as well as examples in Denmark gave a better understanding and a valuable input for the design process, where different approaches and solutions were tried.

The process of creating homes for people with dementia and ensuring their well-being is complex, and the apartments are not doing it alone, there are many factors in play e.g., the care philosophy and the physical environment. The research indicates that physical conditions such as light, contact with outdoor space and homely atmosphere is essential, when designing homes for people with dementia (Møller&Knudstrup 2008). Daylight, sunlight and view to green areas are important for achieving well-being. Daylight can help people with dementia regulate their daily rhythms and routine (SBI- anvisning 2016). It is therefore important to look at the light condition, when placing the functions.

For people with dementia it is better to live in smaller communities divided in independent units, where they can relate more to family relationships or find friends (SBI- anvisning 2016). The number within each community can variate according different sources, but in the project it was chosen to have 6 people per unit.

The competition brief indicated that there should be 75 one-room special apartments, where 10 of them should be used as adaptive apartments for people moving in, 34 - flexible two-rooms apartments and 16 one-rooms apartments for short–term stays. The size of the apartments was decided by comparing light studies and the requirements of square meters given in the competition brief. The apartments all together were expected to be approximately 9000 m² and service areas approximately 1000m² (See Annex II). The size for the apartments were based on having the best daylight conditions and not exceed the given square meters. One-room apartments was chosen to be 35 m² and the two room apartments are 47 m².

Due to the form of the site and a limited use of square meters, the units had to be designed so that it would have all the required functions in it (III.43.).



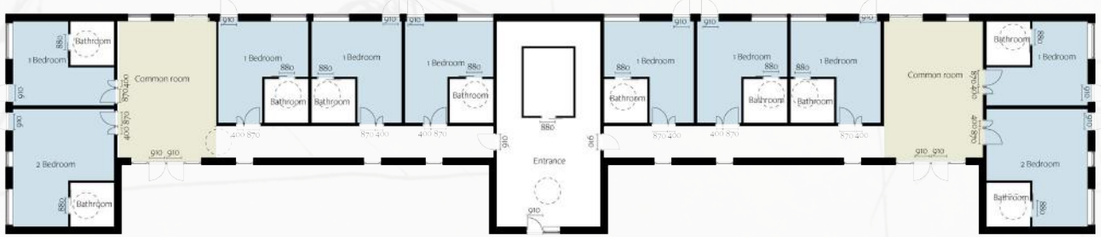
III.73. First proposal of the unit

ACCESSIBILITY

Accessibility has to be ensured into all the apartments aspects, including staff. It includes among others good spaciousness and especially easy operated doors and windows. It is important views from private homes, that is achieved by low-placed windows or window-/ terrace door. There should be a possibility to observe a city life and follow the outside activities. Windows and doors should shield from the sun. Apartments should have a small kitchenette with refrigerator and sink, which could discreetly placed in the entrance. Bathroom should be made to the favor of occupant needs for safety, comfort and dignity. Accessibility should be applied in all the details such as flooring, placement of toilet, shower, sink cupboards and shelves. The bathroom must be able to accommodate a wheelchair and a helper on each side of the toilet and bath. Apartment must be ergonomic, safe and able to be homely. Private garden or terrace are important as an observation post and must be well shielded from the wind and weather. French balcony doors often are sufficient as a private supplement to good common outdoor areas (Møller, K &Kundstrup, M A ,2008). Fire escapes should be easy read and visible (See Annex III). There should be parking places for special vehicles and staff (See Annex IV).

PROPOSAL I

The first proposal was, where a common room was placed in the middle of the unit. Two room apartments were placed at the outer side and three one rooms apartment in the middle. The common rooms are the main spaces, where residents are going to spend most of their time being social and doing activities together. In order for the space to be easy accessible and properly used, it had to be placed close to the apartments (Møller&Kundstrup 2008). It is also important that the room could be divided into smaller spaces with flexible walls or furniture, so that residents could chose where to sit and stay. The kitchen, dining- and living room had to be placed in the same space or close to each other, so that the residents who cannot participate actively, could observe the process of it and stimulate their senses e.g. smell, when food is made (Møller, K &Kundstrup, M A ,2008). This proposal had to be improved as it was limited in its flexibility and didn't fulfill much of a requirements needed for people with dementia.



III.74. Second proposal of the unit

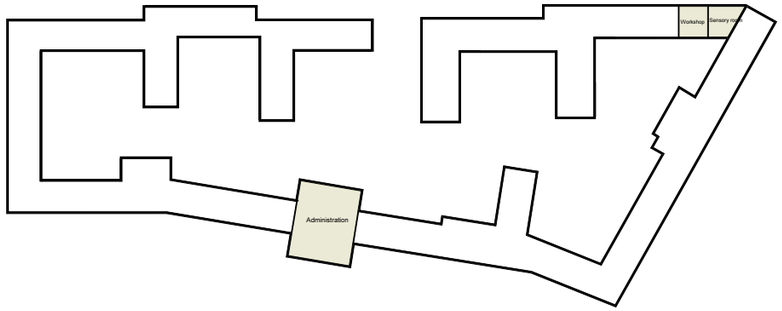
III.75. Final proposal of the unit

PROPOSAL II

The second proposal had longer hallways, which is not optimal for people having dementia as it creates an institution feeling. There should be an organized complex in smaller units with short passages and a clear structure, so the residents can better orientate and find ways (Møller, K &Kundstrup, M A ,2008). The common room was furnished, so that there was a possibility to choose from where to sit and stay. Some of the apartments would not have the best daylight conditions and view to outside due to the placement of the common room. Daylight is essential for well- being of people with dementia. To be able to follow the light variations throughout the day helps to maintain the daily rhythm. It is beneficial for people with dementia to look outside to the surroundings as it helps for them to follow each season of the year. There should also be possibility to go directly out to green areas both from the common room and apartments.

PROPOSAL III

The third and final proposal had the most optimized layout of the unit, containing the required functions. Here all the apartments are located with best possible daylight conditions and view out to green areas. The common room is created in a way that allows different sitting areas for different activities. The room has windows in three facades, so it ensured good daylight conditions and there is a view to both sides of the complex, so the different view can be experienced during the day. The length of the hallway was minimized by placing the common room in the center. The L- shaped units make it possible to have a system, where a common entry with elevator, stairway, laundry and technical room is a central bearing core of two units.



III.76. First proposal of the administration

III.77. Second proposal of the administration

ADMINISTRATION

From the start, the administration with services areas had been placed in the middle of the complex with the intention to be open for the guests from outside and function as public place. It was decided to place facilities such as a reception, cafeteria/restaurant, day center, offices, changing rooms, educational room, auditorium, workshop, sensory room, physiotherapist, beauty salon and a shop. It was important to create an environment for people with dementia, that would meet their needs in the area of the given site.
The first proposal for the administration had facilities located in different areas of the project with the purpose of making the encouraging the activity of people with dementia, where they could walk for the different functions and develop a feeling of a city because of functions displacement. Here the placement of functions wasn't the final one and needed further look to it.

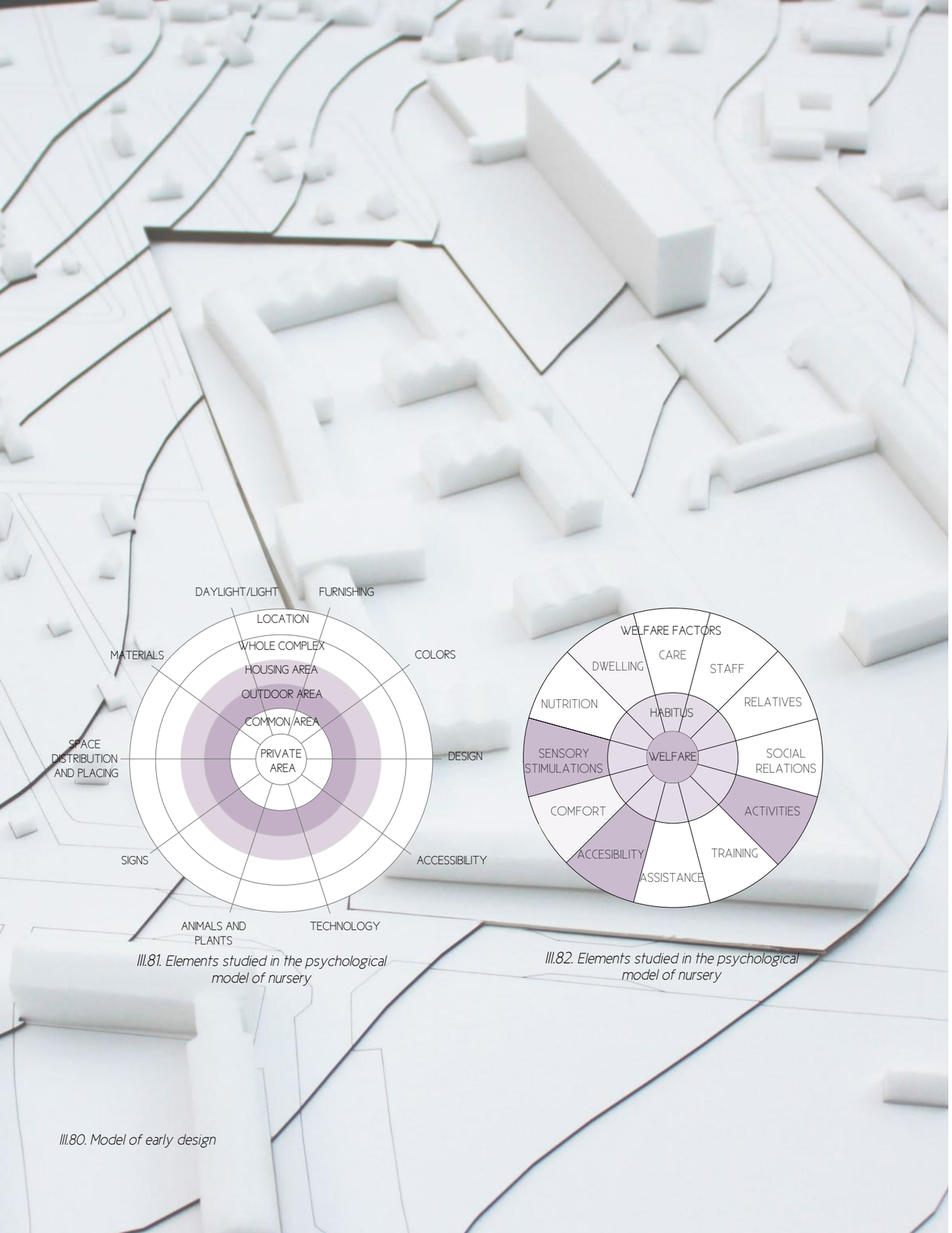
In the second proposal the square was created, where all the services were gathered around it in different buildings. It also gave a public city atmosphere, where people with dementia could go to the hairdresser or have a cup of coffee at the cafeteria. Most of the functions were separated and had their own space with the access only from the inside of the complex.

III.78. Third proposal of the administration

III.79. Final proposal of the administration

In the third design proposal the services functions were placed more around the square and the functions were also oriented both towards in- and outside the complex. Each function had their own space, and were located in individual spaces.

The final proposal was designed to be open and visible for both complex residents and visitors from outside. On the ground floor there was placed a day center and the café/ restaurant as a one space that could be separated in smaller ones with movable wall. There would be only one way to enter and leave the complex for the residents and visitors, which would happen through the receptionist, who could keep an eye on who is coming and leaving the center. On the first floor, offices, dining room and changing rooms for the staff, senses room, physiotherapist and multifunctional room, which could serve for educational activities as a auditorium and workshop, were located. There would be possible to divide the multifunctional room into smaller spaces with movable walls.

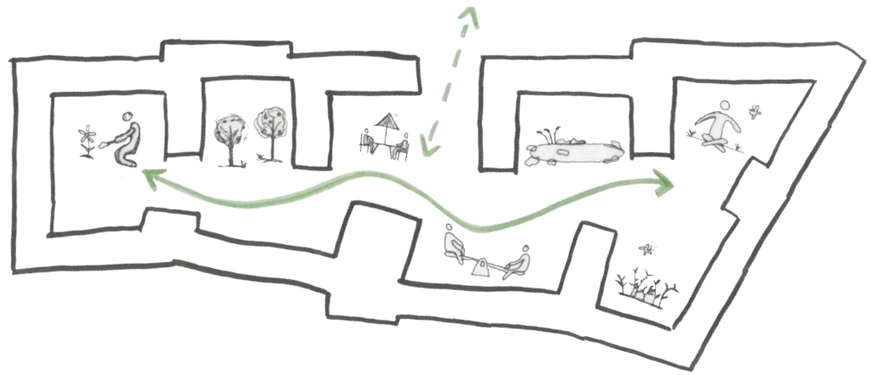


III.81. Elements studied in the psychological model of nursery

III.82. Elements studied in the psychological model of nursery

III.80. Model of early design

Existing care center



III.83. Hand drawing of inside flow

OUTDOOR AREA DEVELOPMENT

While designing outdoor dementia care environment a careful agenda had to be made in terms of recreation and therapeutic opportunities (well-being) beneficial for people with dementia. Special attention was paid to sensory stimulations and physical activity. Such a garden had to facilitate range of activities: from active to passive, from normal and domestic through to facilitated and therapeutic ones. Principles based on research and practice (SBI- Anvisning 259, 2015). that addresses visual access, seating and microclimate, structures, furniture and fixtures, location, plants and planting areas, accessibility and social aspects were used.

Daily routines are crucial for people with dementia, therefore it was important to support existing routines and to promote the new ones. Gardening, picking fruits and berries are activities that are enjoyable and easy to perform for people with dementia, at the same time stimulating their senses and letting them to be active.

Activities that could be shared with family,staff and friends should be supported. Having cafeteria, green house, a playground for kids would encourage social interaction and strengthen social ties.

Paving and structures have a huge impact on people with dementia. It was important to think it through and place installations and fixtures right. Properly defined walking area designed in a bow prevents from “dead ends” and supports a constant movement, where on their way they could be attracted to various activities or senses. The stimulating senses had to be considered carefully, and for this details such as running water, various scents, and colorful plants and flowers are among the considerations.

With such garden design, it was important to focus on what these people are able to experience and how easily they can use it. It should support the engagement of the interest and imagination of residents, families and staff alike. The garden areas should feel welcome and pleasant to be in (The Kings Fund, 2012).

Ill.84. Running water stimulates hearing

Ill.85. Arbour works as a shelter from wind and sun

Ill.90. Water and the sound of it has a healing affect on people.

Ill.91. Different colors and plants stimulates people with dementia brain.

Ill.92.

Ill.93.

Ill.94.

Ill.86.Green house can be uses for growing vegetables

Ill.87. Raised flower beds is more accessible for elder people

Ill.98. Outdoor spaces and activities

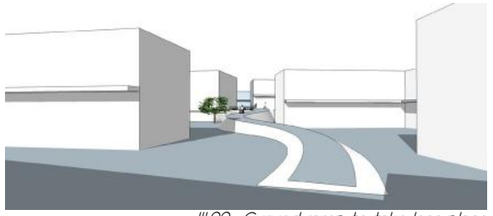
Ill.95. It is important to have possibilities to experience diiferent things.

Ill.88. Wooden shelter protects from wind and rain

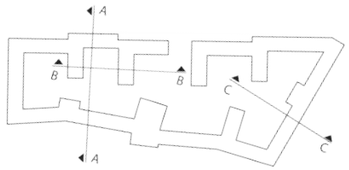
Ill.89. Picking fruits can be enjoyable activity for people with dementia

Ill.96. Playground can be used for families.

Ill.97. Berries stimulates taste senses.

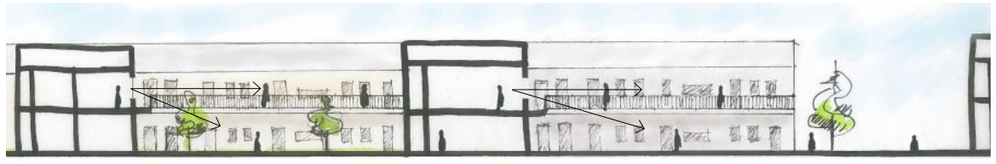


Ill.99. Curved ramp to take less place

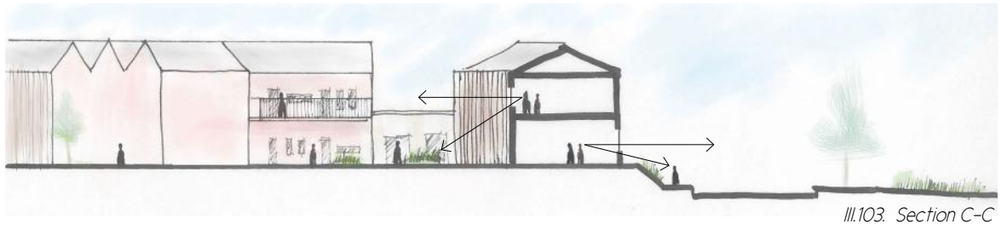


Ill.100.

Ill.101. Section A-A



Ill.102. Section B-B



Ill.103. Section C-C

SECTIONS

Sections of the proposal were made in order to see the scale of the houses in terms of the residents, surroundings and terrain. It also showed what kind of a mood it was created within the inner courts.
Gable roof was tried as it related better to the surroundings and it would create a more familiar feeling for the residents, where they could develop a safety feeling.

Different materials were tried to emphasize each court and give an identity to it reflected in the materials. It was intended to use a city materials (concrete, grey bricks) for the facades and pavements in the public spaces and more suburb type, soft materials(red,yellow bricks,wood) in the private spaces.

Throughout the site there is a 3 meter difference. At first it was intended to use this for the project, but because of the drastic levels formation in the middle of the site (Ill.99.), the proposal was carried out in a same level in order to ensure easy accessibility and movement outside. It was 1,5 meter difference from a main street level to balance the height of the terrain in the site. By doing it a privacy feeling is also created as residents would not be seen directly to from outside, when being inside.

The balance between scales was a focus here. It is a priority to ensure that residents would relate to the area and feel they are at home and safe here.

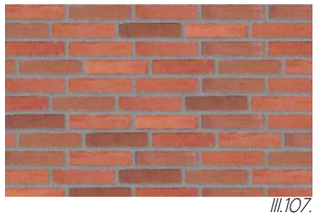
Ill.104. View of the Plaza

Ill.105. View of the fruits trees

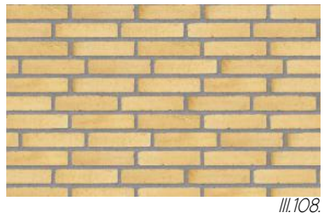
III.106. Final design of outdoor areas

FINAL DESIGN OF OUTDOOR AREA
The final outdoor area was adjusted to the final plan prioritizing various activities and bringing back the level difference into the site. The height throughout the project was reduced to 1 m, where accessibility was solved in more integrated and tectonic way.
The final outdoor area is better divided into public and private spaces. Here the focus was to define a private area in order to create an individual space for residents.

MATERIALS



III.107.



III.108.

III.109.

III.110.

III.111.

III.112. Existing materials in the site

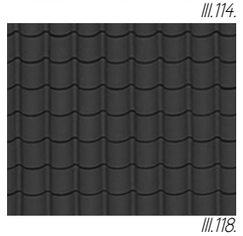
III.113.

III.114.

III.115.

III.116.

III.117.

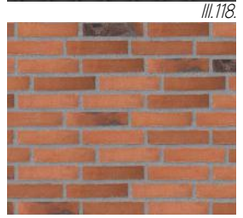


III.118.

III.119.

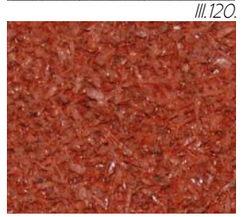
III.120.

III.121.



III.122.

III.123.



III.124.Used materials in the project

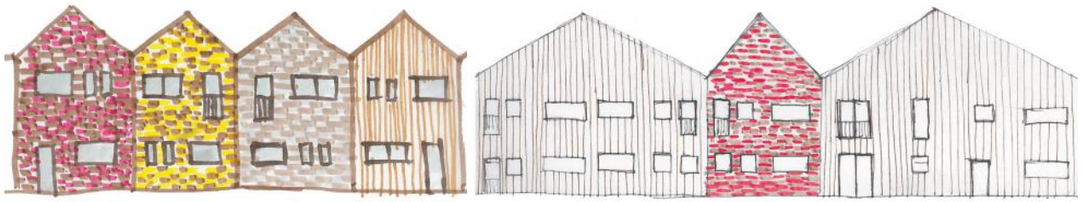
HIGH PERFORMANCE CONCRETE

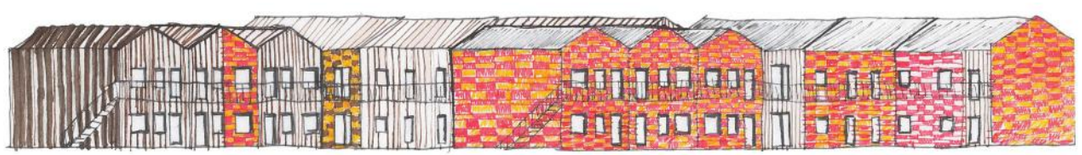
In the project the building system of Connovate sandwich is used, where the main material is high strength concrete. The material itself is only 30mm thin and has an extremely fine and dense structure, which provides:

-Low moisture absorption – long life.
-Good aging qualities.
-Surfaces of high aesthetic quality.
-Good opportunities for dyeing.

By using this material, sandwich elements are highly thinner than conventional sandwich system elements, which allows the whole construction to be very light and easy to work with.
Moreover, the high performance concrete of the Connovate sandwich elements can be crushed and reused for road construction.
For the project the new material combination was beneficial in order to get a better light conditions and to ensure as little CO_2 footprint as possible.

III.125.High performance conctrete in different texture and colour.

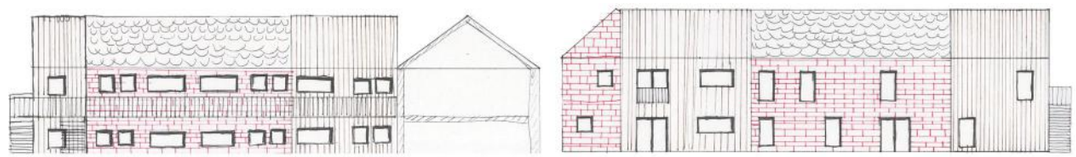


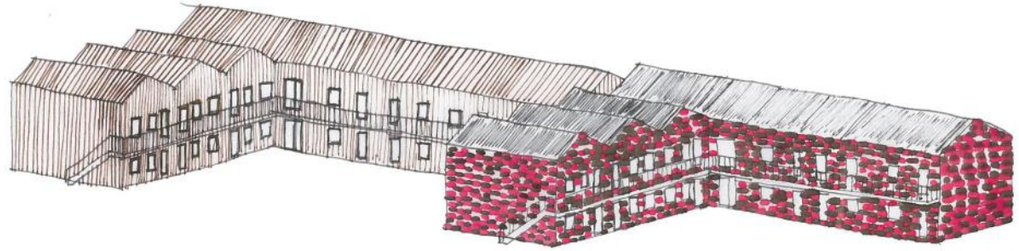


III.126. Facade studies

FACADES STUDIES

The idea for the facades derived from the surroundings and it was meant to emphasize the transition between urban and villa type atmosphere, but still creating a balance between each other. It was a natural process with an effort on avoiding to introduce uncommon and unnatural materials for the houses and have a more architectonic approach. The project itself dictated the choice of used materials, but it had to reflect the function of the buildings. Since the project itself is a selection of houses, the facades needed to have “breaks” in order not to be too heavy in it’s mass and be appealing for the residents and surroundings. Windows were repeated along the whole facade, therefore it was important to create a differentiation in it.
First, different characters to each of the apartment with different materials were tried. The iterations can be seen above (III.126.). Materials as bricks and wood were dominating as it is the most common material in the area. Further experimentations with placing materials along few apartments facade and trying to shape the roof simultaneously to give attraction and identity to the house were made. Different materials were intended to be used for the guiding reasons that people with dementia could recognize their home easier.

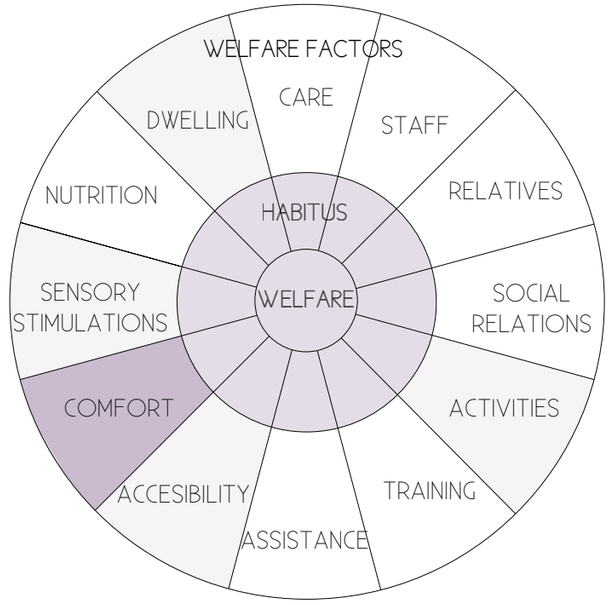




III.127. Facade studies

Different combinations of the materials were tried both on the outside of the buildings, which are facing street and are more the public space, and inside, which is where the private spaces are. On the outside of the buildings,it was attempted to create a presentable impression and use hard materials (bricks, concrete), whereas on the inside the focus was on using more soft materials (wood). At the same time, both sides have a mood that was attempted to be solved through colors, and trying to find a balance among a lot of functions behind the buildings. Next, it was tried to define each unit and give it’s own material both separating the roof color, but also where the material goes all the way around the building. Iterations can be seen above (III.127.). It was also considered whether the entrances should be marked with different material from the rest of the facade or have their own expression.

III.128. Facade studies



III.129. Elements studied in the psychological model of nursery

Administration building was intended to have it's own material and be a guiding volume in terms of guests visiting from outside and for it's functions. Since it is a formal building type, it was tried both more hard and soft materials and it's combination. The goal was that it would fit with the surrounding building, but at the same time stand out as more significant building.

Both frames and shutters were tried on the facade in order to prevent overheating and to see what the impression it gives (III.128.). Further experimentations were made, where the same material was put between the windows, which would gather windows in groups and give more organized impression and emphasize structural grouping. The roof was also experimented with by using different colors for diverse units to give more identity to it (III.128.).

Final decision was to give each unit it's own material on the outside and inside the project and use the same roof color for the whole project. In this way, a balance among a lot of different materials was attempted to create, ant thereby, it would not be confusing, but, at the same time, it would be easy to orientate and become more recognizable for people with dementia.

ENERGY FRAME BUILDINGS 2020 (15 % GLASS AREA)

Without supplement	20,00	Suplement for special conditions	0,00	Total energy frame	20,00
Total energy requirement					29,30

CONTRIBUTION TO ENERGY REQUIREMENT		NET REQUIREMENT	
Heat	8,10	Room heating	8,10
El. Operation of building	0,00	Domestic hot water	0,00
Excessive in rooms	24,40	Cooling	0,00

RESULTS - 15 % GLASS AREA

Month: August tu = 20,5° C
(Calculated when ventlated air has the same temperature as outdoor air):

24-hour average	ti =	24,6	°C
Temperature variation	Dti =	5,6	°C
Max. Temperature	timax =	27,3	°C

Ill.130.

ENERGY FRAME BUILDINGS 2020 (15 % GLASS AREA WITH 50% SHADING FROM GALLERY)

Without supplement	20,00	Suplement for special conditions	0,00	Total energy frame	20,00
Total energy requirement					21,00

CONTRIBUTION TO ENERGY REQUIREMENT		NET REQUIREMENT	
Heat	9,70	Room heating	9,70
El. Operation of building	0,00	Domestic hot water	0,00
Excessive in rooms	15,20	Cooling	0,00

RESULTS - 15 % GLASS AREA WITH 50% SHADING FROM GALLERY

Month: August tu = 20,5 °C
(Calculated when ventlated air has the same temperature as outdoor air):

24-hour average	ti =	21,7	°C
Temperature variation	Dti =	3,2	°C
Max. Temperature	timax =	23,3	°C

Ill.131.

WINDOW STUDIES

ENERGY AND OVERHEATING

In order to fulfill the energy frame for building class 2020 without using renewable strategies, the needed amount of glass area had to be calculated. Estimated calculations were made in Be10 and 24 hours average scheme. The intention was to see the total energy requirement for the whole complex and how much overheating it occurred having 20% and 15% glass area in the critical apartment (Ill.130., Ill.131., Ill.132., Ill.133.). It was important to see, how much shading the gallery gives as it was used as a shading device for all the windows on the ground floor, which means 50% of all windows area.

The results showed that 15% of glass area was needed to fulfill building class 2020 without using renewable energy sources. Although passive strategies as shading was necessary to avoid overheating in the apartments facing south (Bygningsreglementet 2015).

ENERGY FRAME BUILDINGS 2020 (20% GLASS AREA)

Without supplement	20,00	Suplement for special conditions	0,00	Total energy frame	20,00
Total energy requirement					41,60

CONTRIBUTION TO ENERGY REQUIREMENT		NET REQUIREMENT	
Heat	7,80	Room heating	7,80
El. Operation of building	0,00	Domestic hot water	0,00
Excessive in rooms	36,90	Cooling	0,00

RESULTS - 20% GLASS AREA

Month: August tu = 20,5 °C
(Calculated when ventilated air has the same temperature as outdoor air):

24-hour average	ti =	25,3	°C
Temperature variation	Dti =	6,2	°C
Max. Temperature	timax =	28,4	°C

Ill.132.

ENERGY FRAME BUILDINGS 2020 (20% GLASS AREA WITH 50% SHADING FROM GALLERY)

Without supplement	20,00	Suplement for special conditions	0,00	Total energy frame	20,00
Total energy requirement					29,80

CONTRIBUTION TO ENERGY REQUIREMENT		NET REQUIREMENT	
Heat	9,60	Room heating	9,60
El. Operation of building	0,00	Domestic hot water	0,00
Excessive in rooms	24,00	Cooling	0,00

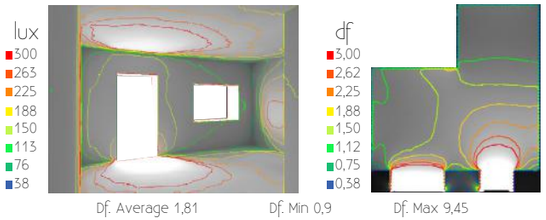
RESULTS - 20% GLASS AREA WITH 50% SHADING FROM GALLERY

Month: August tu = 20,5 °C
(Calculated when ventilated air has the same temperature as outdoor air):

24-hour average	ti =	21,6	°C
Temperature variation	Dti =	3,1	°C
Max. Temperature	timax =	23,1	°C

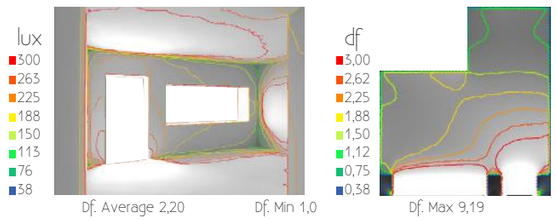
Ill.133.

15 % GLASS AREA WITH 620MM WALL



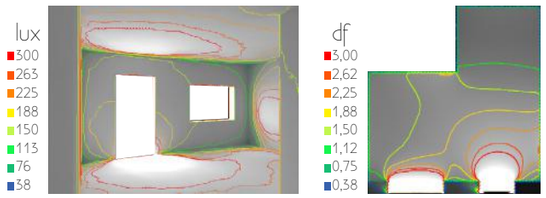
Ill.134.

20 % GLASS AREA WITH 620MM WALL



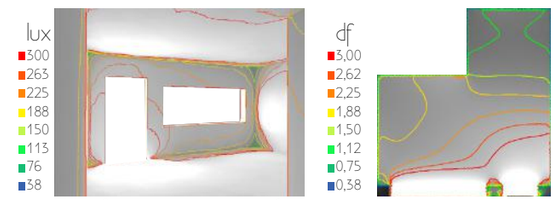
Ill.135.

15 % GLASS AREA WITH 450MM WALL



Ill.136.

20 % GLASS AREA WITH 450MM WALL



Ill.137.

When working with housing in Health Care it is important to create a good light conditions in the apartments, because of its beneficial influence on one's health and comfort. Therefore daylight studies were made for both apartments with 20% and 15% glass area. Velux Daylight Visualizer has been used for these simulations. The calculations are made on an average basis over the year, where no direct sun is used, therefore some days can have more or less daylight.

As seen in the ill.135., the daylight is better with 20 % glass area as an average daylight is 2,2%. Apartments with 15% glass area has a daylight factor of 1,8% (Ill.134.).

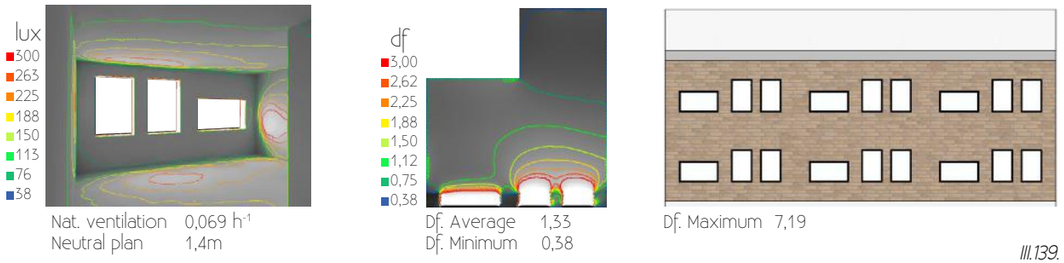
In order to improve the daylight conditions, minimizing the wall thickness is possible. A new improved Connovate wall construction with a U-value at 0,9 W/m²K and a thickness of 300 mm is used for the calculations. The construction system can be seen under page 96.

Using bricks as a facade material, the wall thickness gets to 450 mm. This is used for new calculations to see the difference from the earlier calculation with 620 mm thick walls and a U-value at 0,8 W/m²K (Ill.134.,ill.135.).
As seen in ill.136. daylight factor of the apartment with 15% glass area has been improved from 1,8% to 2,0%.

The 15% glass area is used in the project as the requirements for the average daylight factor, overheating and the total energy requirement is fulfilled.

Ill.138. Facade of one of the living units in Fynsgade centre.

TP. 1



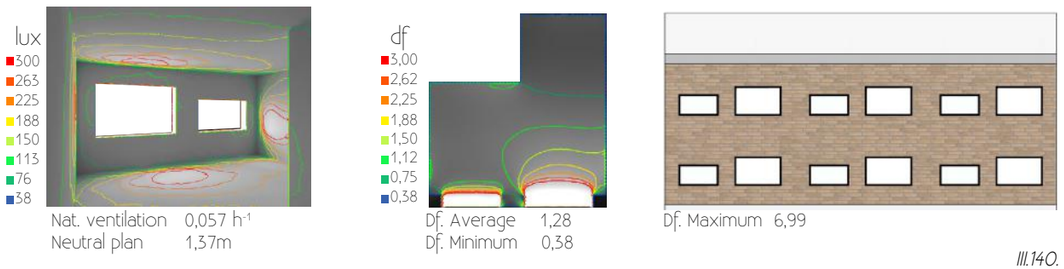
Nat. ventilation 0,069 h^{-1}
Neutral plan 1,4m

Df. Average 1,33
Df. Minimum 0,38

Df. Maximum 7,19

Ill.139.

TP. 2



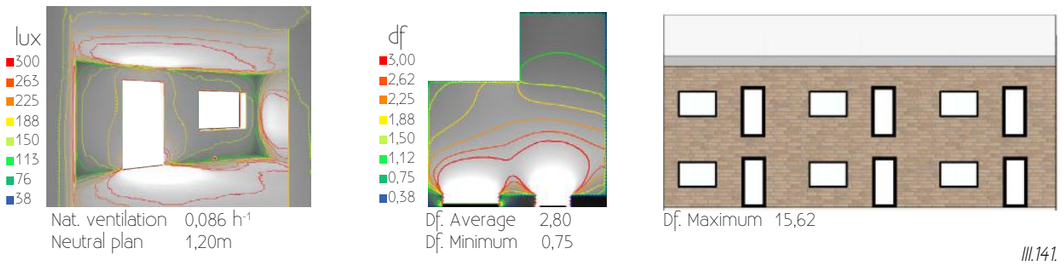
Nat. ventilation 0,057 h^{-1}
Neutral plan 1,37m

Df. Average 1,28
Df. Minimum 0,38

Df. Maximum 6,99

Ill.140.

TP. 3



Nat. ventilation 0,086 h^{-1}
Neutral plan 1,20m

Df. Average 2,80
Df. Minimum 0,75

Df. Maximum 15,62

Ill.141.

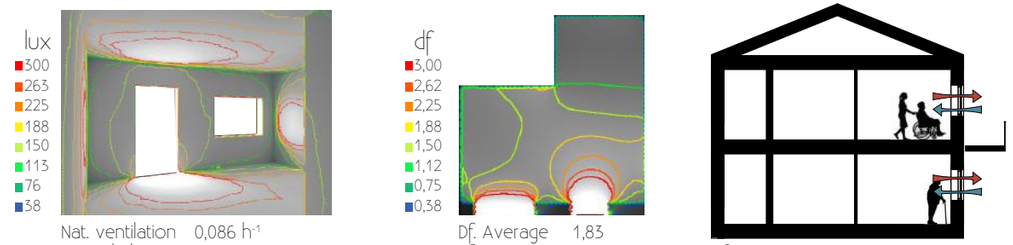
After calculating the glass area, different windows set-ups were tried for single room, double room and common room. It was necessary to keep a good daylight condition, but also look at the facades expression as both had to be integrated in a architectonic way.

SINGLE ROOM APARTMENT

Three single room types have been studied : TP.1, TP.2 and TP.3 (Ill.139., ill.140., ill.141.) TP.3 is the one with the best light conditions as it reaches an average daylight factor of 2,8%, where TP.1 and TP.2 has lower than 2%. TP. 3 also gives better natural ventilation that is 0,086h^{-1}, where TP.1 and TP.2 is around 0,065h^{-1}. A natural ventilation sheet from previous semester was used to calculate the natural ventilation.

Furthermore, the three types were compared for architectural expression. TP.3 were chosen for its possibility to have a terrace or a french balcony and was most appealing for its expression for a single room apartments.

TP. 3 G.



Nat. ventilation 0,086 h^{-1}
Neutral plan 1,20m

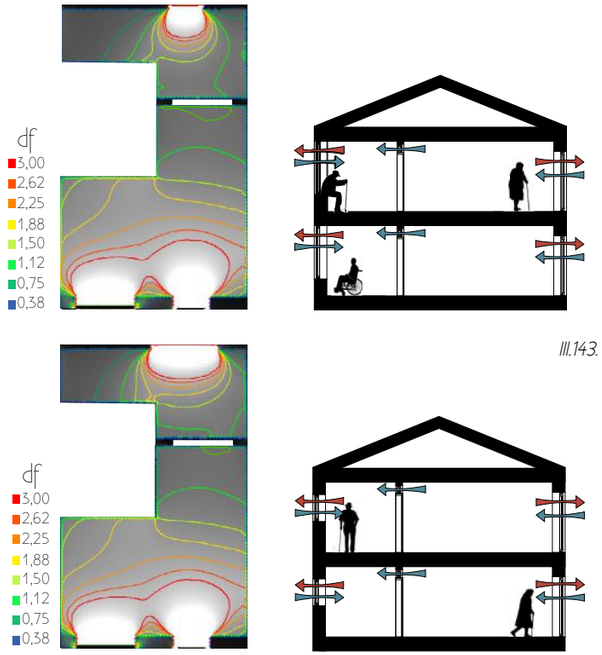
Df. Average 1,83
Df. Minimum 0,38

Df. Maximum 9,24

Ill.142.

TP. 3 W.

TYPE 3 W.	
Nat. ventilation	0,21h^{-1}
Neutral plan	1,29m
	Df%
Df. Average	2,88
Df. Minimum	0,75
Df. Maximum	15,62



Ill.143.

TP. 3 W1.

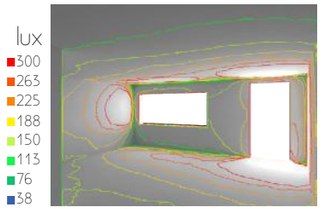
TYPE 3 W 1.	
Nat. ventilation	0,21h^{-1}
Neutral plan	1,29m
	Df%
Df. Average	2,85
Df. Minimum	0,75
Df. Maximum	15,62

Ill.144.

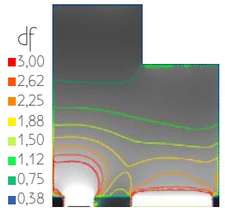
TP.3 was then studied with the gallery as a shading device for the ground floor apartments. From the iterations it can be seen that daylight decreases to 1,83% in the TP.3G (Ill.142.). The priority of having a wider gallery, where a person and a wheelchair could pass each other, made accept the existing daylight factor as eligible.

Further studies were made with TP.3 in order to see, if improvements could be made in relation to the natural ventilation and daylight (Ill.143., ill.144.). A window above the apartment door was placed together with a window in the hallway. Two types were simulated to see which one was better: one with a vertical window - TP.3 W, or one with a high horizontal window -TP.3 W 1. As seen from the results the vertical window gives more secondary light to the room, and can still be used as a resting/sitting area with a view in the hallway(Ill.143.,ill.144.). By doing it, the daylight factor was improved to 2,88% and the natural ventilation to 0,21 h^{-1}.

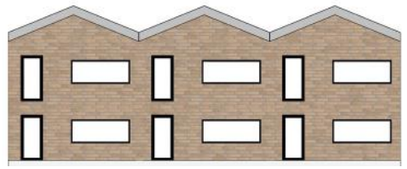
Tp. 1



Nat. ventilation 0,11 h-1
Neutral plan 1,27m



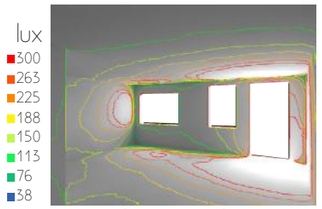
Df. Average 1,66
Df. Minimum 0,38



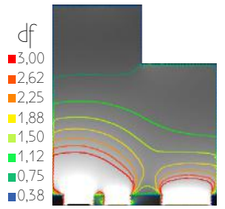
Df. Maximum 10,40

III.145.

Tp. 2



Nat. ventilation 0,11 h-1
Neutral plan 1,29m

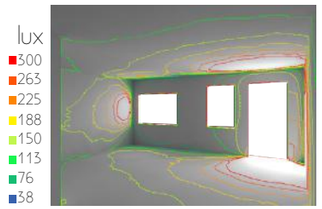


Df. Average 1,95
Df. Minimum 0,38

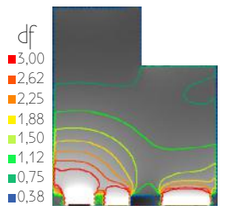
Df. Maximum 10,54

III.146.

Tp. 2 C



Nat. ventilation 0,11h-1
Neutral plan 1,29m

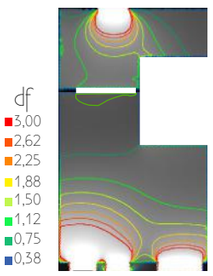


Df. Average 1,4
Df. Minimum 0,38

Df. Maximum 8

III.147.

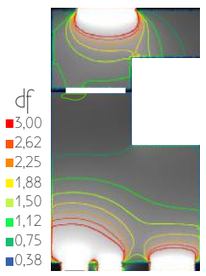
Tp. 2 W.



TYPE 2W.	
Nat. ventilation	0,08h-1
Neutral plan	1,34m
	Df%
Df. Average	2,03
Df. Minimum	0,38
Df. Maximum	10,54

III.148.

Tp. 2 W1.



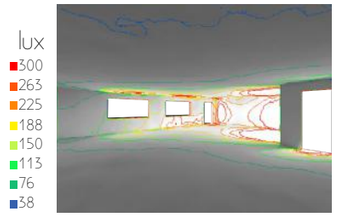
TYPE 2 W1.	
Nat. ventilation	0,08h-1
Neutral plan	1,34m
	Df%
Df. Average	1,99
Df. Minimum	0,38
Df. Maximum	10,54

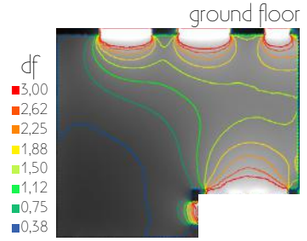
III.149.

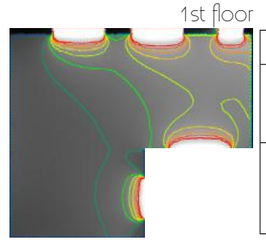
DOUBLE ROOM APARTMENTS

The same approach of placing a window above the apartment door and in the hallway was used for the double rooms, where TP.2(Ill.146.) was chosen as the best window setup. The difference here was natural ventilation, as it would cause a deterioration due to the wind direction towards the building, if windows would be opened in the hallway. . Therefore it was made a fixed window.

Tp. 1



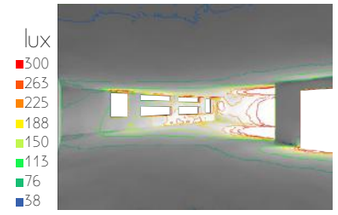


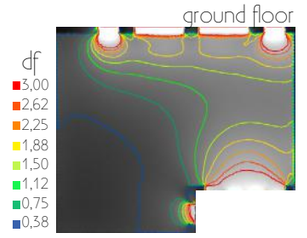


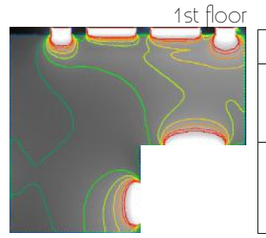
TYPE 1	
Nat. ventilation	2,3h-1
Neutral plan	1,18m
	Df%
Df. Average	1,38
Df. Minimum	0,20
Df. Maximum	8,66

III.150.

Tp. 2



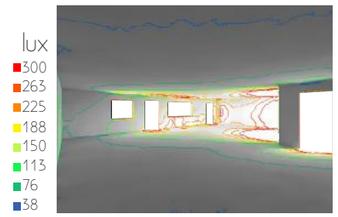


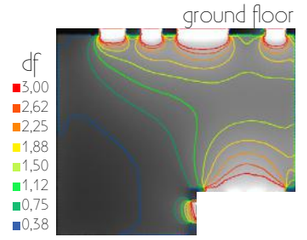


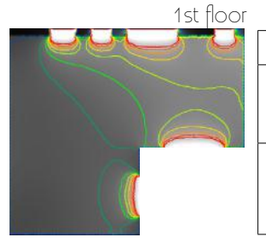
TYPE 2	
Nat. ventilation	1,1h-1
Neutral plan	1,24m
	Df%
Df. Average	1,24
Df. Minimum	0,20
Df. Maximum	8,43

III.151.

Tp. 3



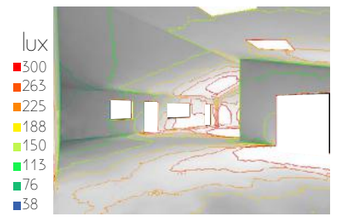


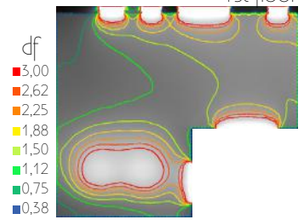


TYPE 3	
Nat. ventilation	2,4h-1
Neutral plan	1,12m
	Df%
Df. Average	1,41
Df. Minimum	0,20
Df. Maximum	9,35

III.152.

Tp. 3 W.





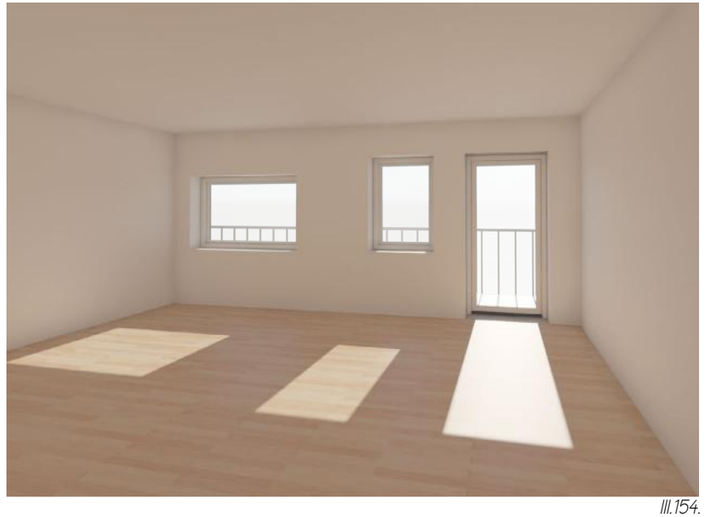
TYPE 3 W	
Nat. ventilation	2,43h-1
Neutral plan	1,127m
	Df%
Df. Average	1,93
Df. Minimum	0,60
Df. Maximum	15,65

III.153.

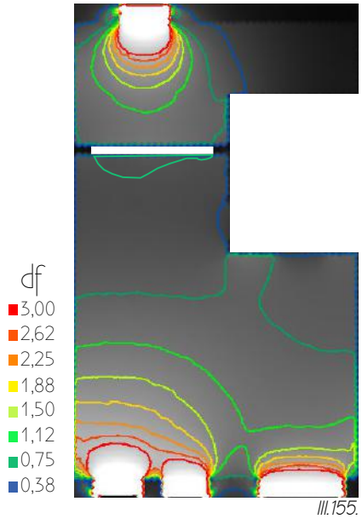
COMMON ROOMS

Three different window setup were studied for the common room (Ill.150., ill.151.,ill.152.,ill.153.). TP. 3 was chosen for the ground floor and TP.3W. for the first floor.

While making different studies of window placements and setups, the important factor was to create a good light conditions in all of the rooms and avoid overheating. The rooms directed towards south have an overheating problem that cannot be solved with a natural ventilation only. Therefore these rooms were studied closer, where shutters and frames were introduced as a shading devices. Different types of shutters and frames were looked at. Parameters like daylight, architectonic expression in the interior and facades, Bsim results were compared.



Ill.154.



Ill.155.

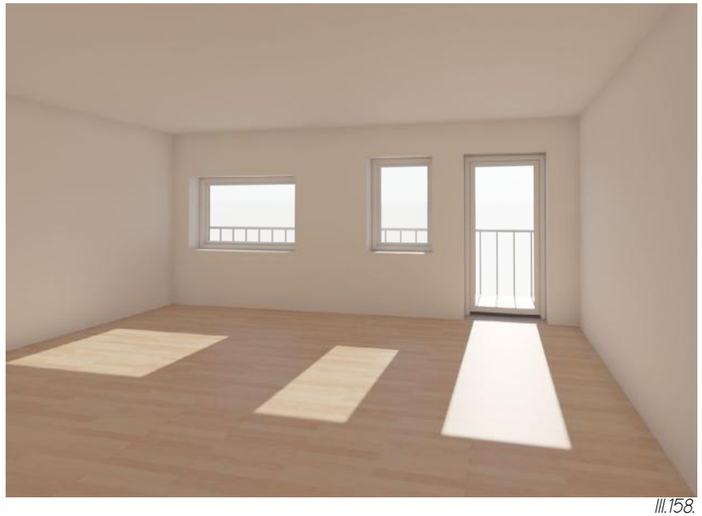
Ill.156.

ONE SIDED FRAME	
Heat demand	795,48kwh
Passive solar heat gain	928,84kw
Fan power	53,34kwh
Co2 level	797ppm
Hours > 21 °C	5560Hrs
Hours > 26 °C	89Hrs
Hours > 27 °C	9Hrs
Df. Average	1,29%
Df. Minimum	0,3%
Df. Maximum	9,62%

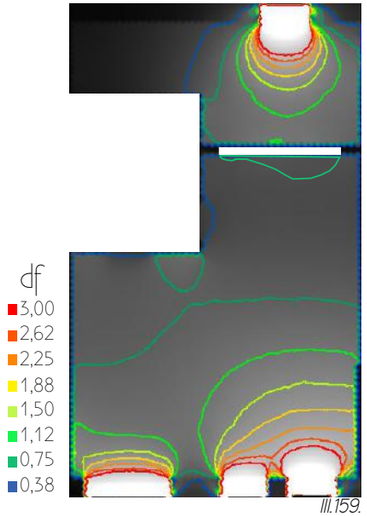
Ill.157.

SHADING DEVICES

ONE SIDED FRAME
The advantages of the one sided frame is that it maintains the full view experience, together with decreasing the overheating all year around. It doesn't have a light difference inside the room, and there is no possibility for more shading, if a person wants to sit in the sun, but still keep the view. It also partly blocks the needed passive solar heat in the winter.



Ill.158.



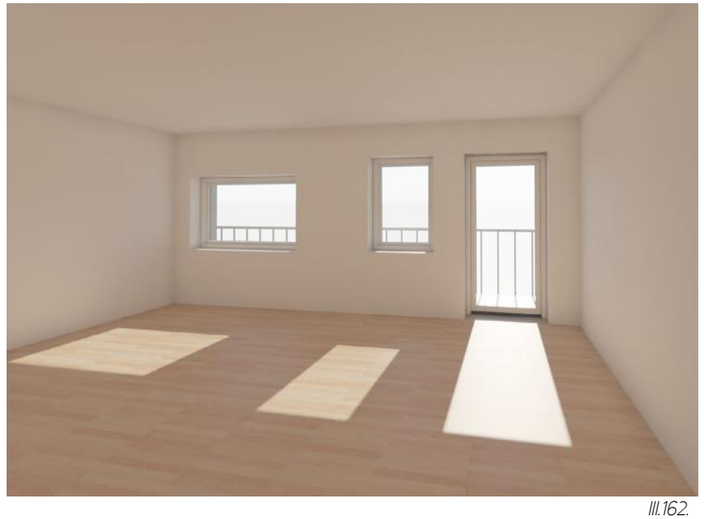
Ill.159.

Ill.160.

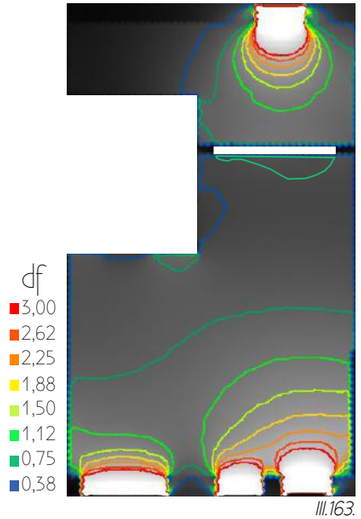
TWO SIDED FRAME	
Heat demand	795,63kwh
Passive solar heat gain	928,84kw
Fan power	53,34kwh
Co2 level	796,4ppm
Hours > 21 °C	5560Hrs
Hours > 26 °C	89Hrs
Hours > 27 °C	9Hrs
Df. Average	1,2%
Df. Minimum	0,3%
Df. Maximum	8,46%

Ill.161.

TWO SIDED FRAME
Like the one sided frame the advantages of two sided frames are that it maintains the full view experience together with decreasing the overheating all year around. It gives also a different expression to the façade. There is no light difference in the room and there is no possibility for more shading if a person sits in the sun but still wants to keep the view.



Ill.162.



Ill.163.

Ill.164.

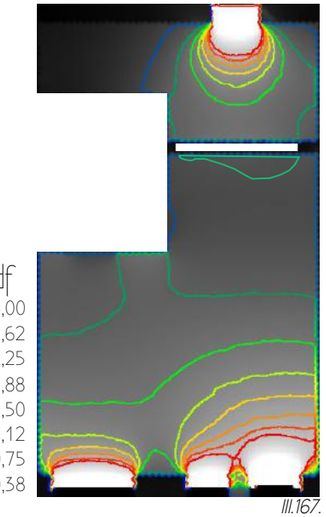
FOUR SIDED FRAME	
Heat demand	795,63kwh
Passive solar heat gain	928,84kw
Fan power	50,67kwh
Co2 level	793,9ppm
Hours > 21 °C	5560Hrs
Hours > 26 °C	89Hrs
Hours > 27 °C	9Hrs
Df. Average	1,11%
Df. Minimum	1,25%
Df. Maximum	8,22%

Ill.165.

FOUR SIDED FRAME

Like the other frames the four sided frame advantages are that it maintains the full view experience, together with decreasing the overheating all year around. It gives a different expression to the façade by. Although there is no light difference inside the room, and there is no possibility to have more shading if a person sits in the sun but still wants to keep the view out.

Ill.166.



Ill.167.

Ill.168.

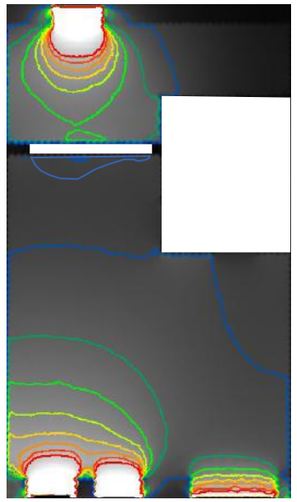
DISPLACED WINDOW	
Heat demand	780,96kwh
Passive solar heat gain	972,50kw
Fan power	53,34kwh
Co2 level	796,9ppm
Hours > 21 °C	5570Hrs
Hours > 26 °C	95Hrs
Hours > 27 °C	9Hrs
Df. Average	1,42%
Df. Minimum	1,07%
Df. Maximum	11,8%

Ill.169.

DISPLACED WINDOWS

The displaced windows had the same qualities of decreasing the overheating all year around while still keeping the full view to outdoor areas. It created a different expression on the façade, but it did not provide more shading. There would also be no possibility to naturally achieve a windowsill.

III.174.



III.175.

III.176.

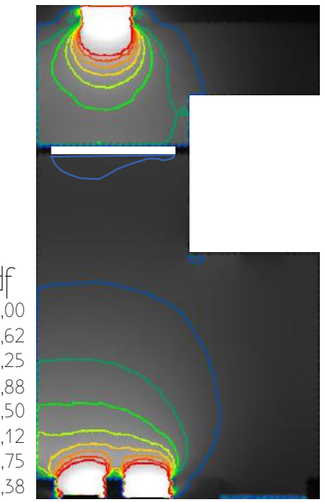
VERTICAL SHUTTER	
Heat demand	771,75wh
Passive solar heat gain	979,625kw
Fan power	52,03kwh
Co2 level	810,3ppm
Hours > 21 °C Hours > 26 °C Hours > 27 °C	5667Hrs 100Hrs 14Hrs
Df. Average Df. Minimum Df. Maximum	0,8% 0% 8,39%

III.177.

VERTICAL SHUTTERS

The advantages of vertical shutters was the possibility to keep the view to the outdoor area. It also gave a different light expression in the room. The facades also adapted different expression because of the residents choices when using shutters.

III.170.



III.171.

III.172.

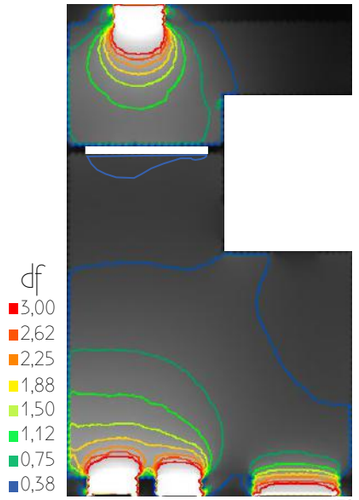
SOLID SHUTTER	
Heat demand	771,52wh
Passive solar heat gain	724,85kw
Fan power	34,75kwh
Co2 level	823,6ppm
Hours > 21 °C Hours > 26 °C Hours > 27 °C	5367Hrs 15Hrs 0Hrs
Df. Average Df. Minimum Df. Maximum	0,63% 0% 7,82%

III.173.

SOLID SHUTTERS

The solid shutters completely blocked the view and light when in use. Although the advantage of it was the effectiveness for decreasing the energy use and overheating. It made the façade seem closed off, but it was moveable and could be adjusted after people's needs.

Ill.178.



Ill.179.

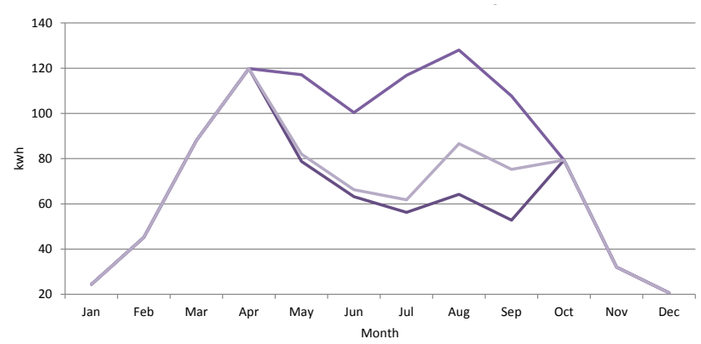
Ill.180.

HORIZONTAL SHUTTER, SLATS 0 DEGREES	
Heat demand	771,75wh
Passive solar heat gain	979,62kw
Fan power	52,03kwh
Co2 level	810,3ppm
Hours > 21 °C	5667Hrs
Hours > 26 °C	100Hrs
Hours > 27 °C	14Hrs
Df. Average	0,9%
Df. Minimum	0%
Df. Maximum	8,7%

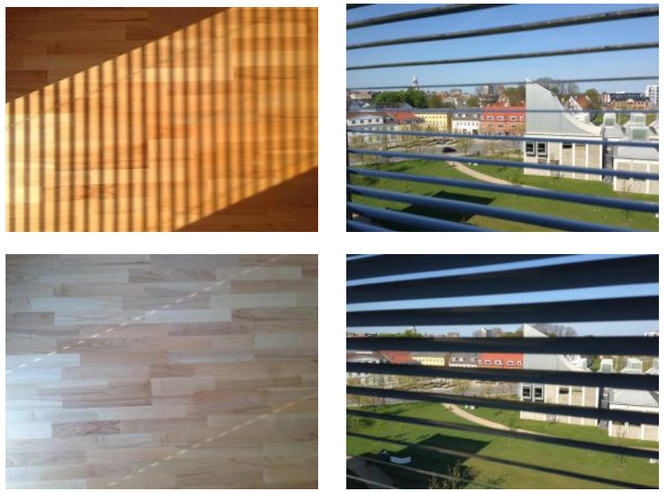
Ill.181.

HORIZONTAL SHUTTERS

The advantages of having horizontal shutters was also the possibility to keep the view to the outdoor area and different expression with the light inside the room. The facades also adapted different expression because of the residents choices when using shutters.



Ill.182. Results from Bsim simulations



0 Degrees

30 Degrees

Ill.183. Realistic view of blinds with angle of 0 and 30 degress.

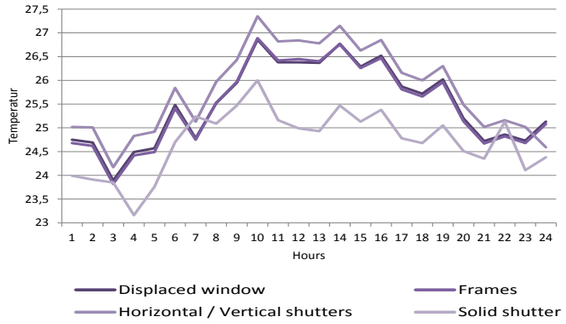
SLATS

Simulations of horizontal shutters with different angle slats were calculated and compared with each other in order to see, how the results change (Ill.183.). Different results from Bsim, Velux Daylight Visualizer of shutters with 30 degrees can be seen in ill.184.
Examples of realistic views of horizontal blinds with different slats angles are shown in ill.183.

HORIZONTAL SHUTTER, SLATS 30 DEGREES	
Heat demand	771,55wh
Passive solar heat gain	781,62kw
Fan power	36,08kwh
Co2 level	817,3ppm
Hours > 21 °C	5287Hrs
Hours > 26 °C	96Hrs
Hours > 27 °C	12Hrs
Df. Average	0,9%
Df. Minimum	0%
Df. Maximum	8,7%

Ill.184.

TEMPERATURE 3. OF JULY



Ill.185.

TECHNICAL ANALYSIS NARRATIVE SUMMARY

Frames and displaced windows that were used in the studies had a limitation of mobility and a user control. It was a fixed solutions that partly blocked passive solar heat in the winter and decreased the daylight factor all year around. Moreover, it could not be used to prevent a glare in the summer and problems could occur at the gallery when the frames were coming out of the façade for people passing by.

The results showed that solid shutter was the most efficient blocker of the sun. In summer when in use, there would almost be no need for a mechanical ventilation for keeping the temperature under 26 degrees. Mechanical ventilation would be necessary for keep a good indoor climate, in order to fulfill category II of a maximum of 850 ppm (Dansk standart, 2007). Additional information can be seen under ventilation studies, page 99 .
By using shutters it was possible to achieve better passive solar heat gain in winter, therefore a less need for heating the apartments would be necessary. It also decreased the energy demand. This applied to all the shutter types studied.

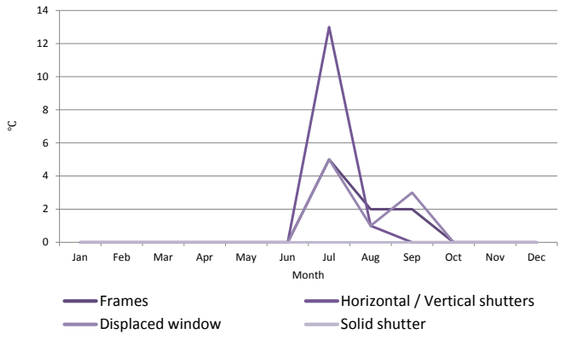
A shutter had a quality for its mobility and flexible user control. It could be both mechanical and manual controlled. Having shutters was important for indoor comfort, but it could also help developing a habit for people with dementia when adjusting it to their needs. A feeling that they are independent and capable of being in control is important for their well being.
If then looking at the solid shutter, it had limitations for the personal needs because when it was in use the view to the outside was blocked.

There are people with dementia that are very little active and spend most of their time looking at things. Using horizontal or vertical shutters could give them an opportunity to follow the outdoors life and a possibility to regulate shutters and adjust it to their needs. The horizontal shutters were chosen due to the architectonic reasons, what the architectural expression on the façades is.

The results of a horizontal shutters were worse than other shading strategies. There was too much passive solar heat and therefore it used more energy for the mechanical ventilation. The reason for that was a slats angle that were set to 0 degrees (Ill.181.). When having slats at a degree of 30, the results were significantly improved (Ill.184.)
Though the daylight factor was decreased noticeably while the shutters would be in use, the rest of the time it was 2%. When having frames and displaced window that was a fixed solution, the daylight factor was always around 1,2%-1,4%.

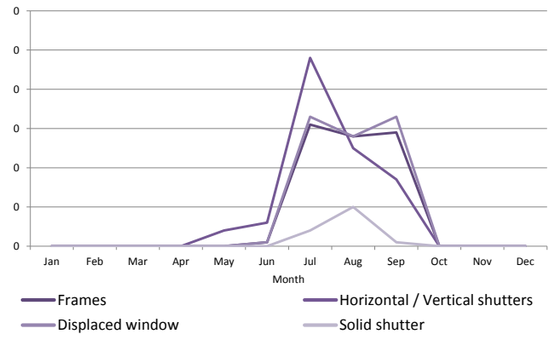
Some people with dementia can interpret black color or dark shades as a hole and it can relate to insecurity for them. When choosing shutters the fact it was creating shading on the floor was taken into account. It is individual and there haven't been made enough studies on the subject yet how many people with dementia reacts to dark tones from shutters and to what level. Nevertheless, it would be possible to close shutters that it would not create patterns on the floor or replace it with blinds in special case to reduce indoor heat gain. The picture showing the shading of the slats

HOURS > 27 DEGREES



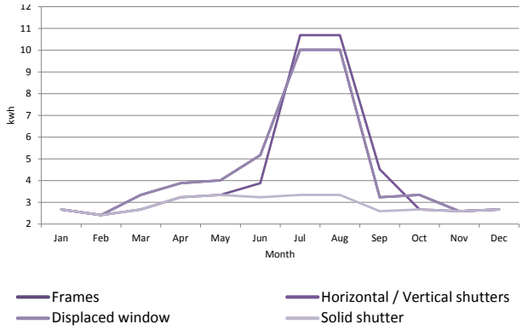
Ill.186.

HOURS > 26 DEGREES



Ill.187.

FANPOWER

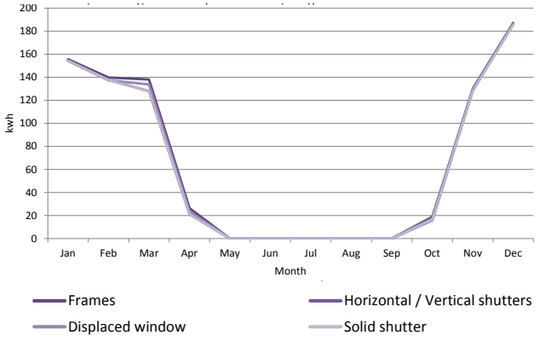


Ill.188.

CO2

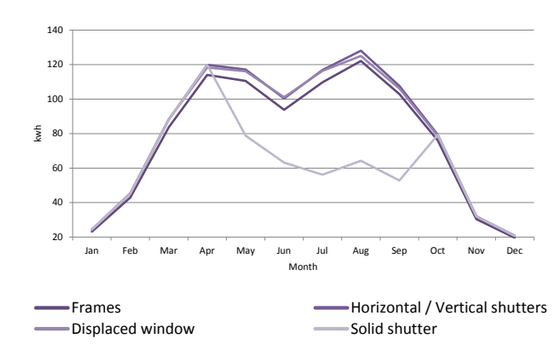
Ill.189.

HEATING

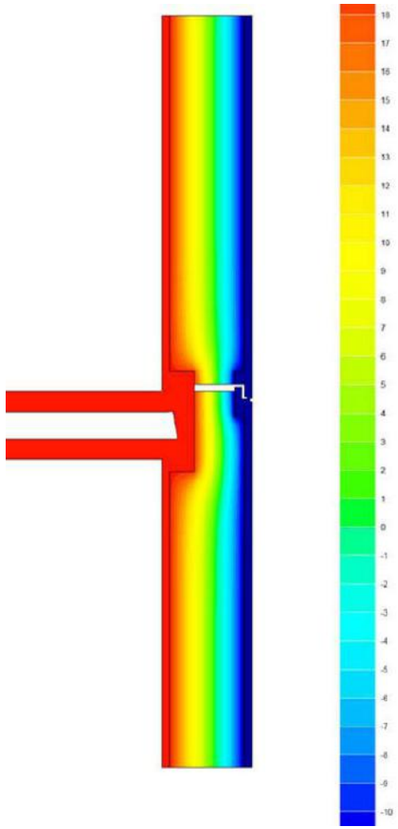


Ill.190.

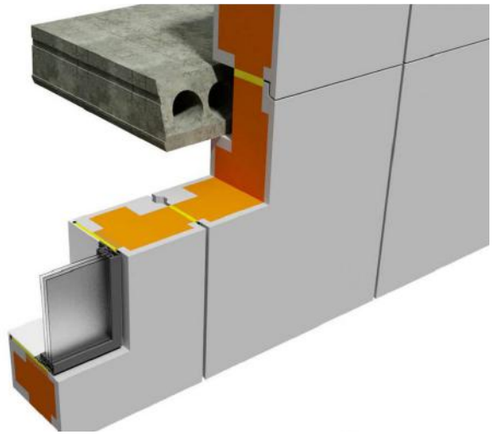
PASSIVE SOLAR HEATGAIN



Ill.191.



III.193.



III.192.

MIN. DEMANDS W/(M2K)NEW BUILDING	BR20 0,09 W/mK
Sandwich elements in high performance concrete with thermoset insulation Thickness:	340mm
Traditional sandwich elements with traditional insulation. Thickness:	620mm

III.194.

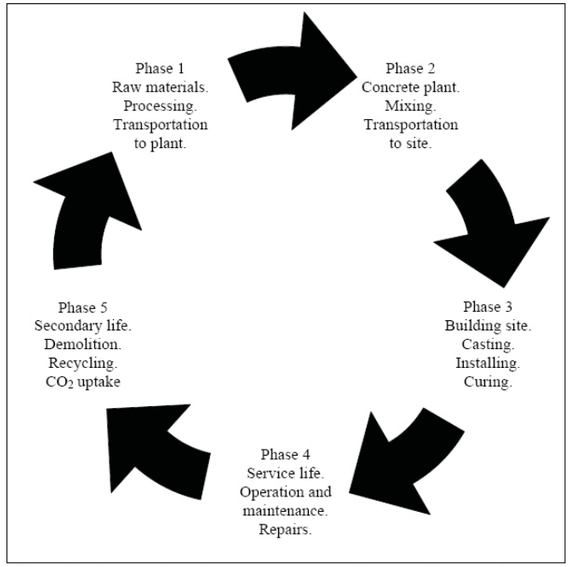
CONSTRUCTION

The building system of the project is carried out in a newly developed Connovate (in cooperation with Ambercon and Arkitema Architects) sandwich elements without thermal bridges, that are high performance low-energy building elements with a high surface finish for quick and easy handling and construction (Connovate, 2016).

The elements are designed as sleek and sturdy sandwich elements, with a front – and back panel in high strength concrete (See Annex V), around a core of high performance pressure-resistant insulation (PIR/PUR insulation). The elements combine maximum insulating properties with a minimum wall thickness (Connovate, 2016).

High performance concrete has several advantages like improved durability characteristics and much lesser micro cracking than normal strength concrete. Improved production methods ensure that the elements can be produced accurately in terms of tolerances and detailing (Connovate, 2016).

The system also uses a newly developed sealing system, where the traditional sealing in silicone or similar is replaced with sealing profiles in stainless steel. Using stainless steel sealings ensures a precise aesthetic appearance and more opportunities for choice of color. In addition the steel sealing is a long life solution compared with traditional grout sealing (Connovate, 2016).



III.195. Life cycle phases from cradle to grave. The arrow between phases 5 and 1 illustrates the sorting and recycling of demolition waste back into the construction industry in general and not necessarily back into concrete production(Nielsen,2008).

SUSTAINABLE MATERIALS

Cement production is one of the big culprits in the building business. The Connovate system's reduction of concrete consumption during element production has a great effect on the overall CO2 numbers and a construction project (Connovate, 2016).

The Connovate elements weigh 1/3 of traditional concrete elements, which results in lower CO2 emissions due to:

-Easier transportation (more elements pr. load)
-Easier fitting = less crane time
-Slimmer building profile
-Easier handling during production = less material in the factory

The high performance concrete of the Connovate sandwich elements can be crushed and reused for road construction. Modified resin thermoset-insulation can be burned or re-used.

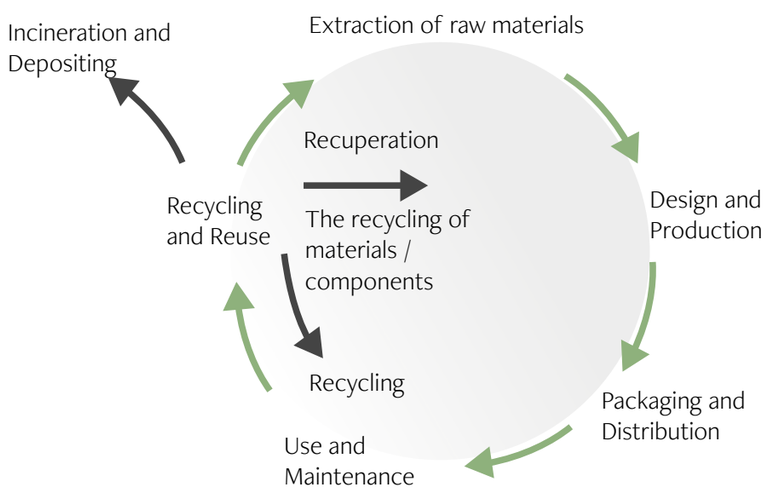
The insulation has been DuBo certified by NIBE, Holland and BREEAM A or A+ certified in the UK.

CO2 FOOTPRINT

Phase 1
The use of high-strength concrete results in a marked reduction the amount of consumed concrete.

Phase 2
When transporting concrete the weight is often the limiting factor. The use of high-strength concrete will reduce the weight of the elements, which will have a positive effect of the energy used when transporting the concrete modules.

Phase 3
Installation of Connovates's concrete modules will reduce the amount consumed energy due to gathered details and simplified work flows (Nielsen, VC 2008).



Ill.196. Lifecycle of the brick

LIFECYCLE OF THE BRICK

To emphasise the context of the surroundings, brick have been chosen as the main cladding so the building will be seen not as an attachment, but as a integrate part of the area. The brick is a traditional Danish building material and most family homes are built in bricks. The material is not only an expression for the surroundings and the architecture. The choice of material is also visualizing the sustainable goal for this project.

The brick is a pure natural material, which consists of a mix of sand, water and clay that does not affect you or the environment. The brick are burned at such high temperature, so they do not contain traces of organic materials. This means that there is no risk of growth biological organisms, which causes many climate genes (Egernsundtegl 2016). The Masonry in the brick wall is natural as it consists of chalk, content, gravel and water. Due to the natural material can 95% of brickwork be recycled (Egernsundtegl 2016).

The brick is a heavy material that accumulates heat and cold, which provides a comfortable indoor climate and saves energy. Brick houses are often more economical and uses less energy for heating, which is an economic benefit when building in bricks.

ATMOSPHERIC POLLUTION	Outdoor air ppm	Indoor air(II) ppm	Air change rate h^{-1}	Airflow rate m3/h	Volume flow l/s
Single room apartments (2 people)	0,00035	0,00085	1,4	76	21
Double room apartments (2 people)	0,00035	0,00085	0,9	76	21
Common room (8 people)	0,00035	0,00085	3,4	850	236

Ill.197.

SENSORY POLLUTION	Pollution load [Olf]	Air flow supply [l/s]	Air change rate [h^{-1}]	Air change rate pr. m^2 [l/s/m^2]
Single room apartments (2 people)	6,5	48,1	3,1	2,1
Double room apartments (2 people)	8,5	63,3	2,8	1,9
Common room (8 people)	28,0	207,4	3,0	2,1

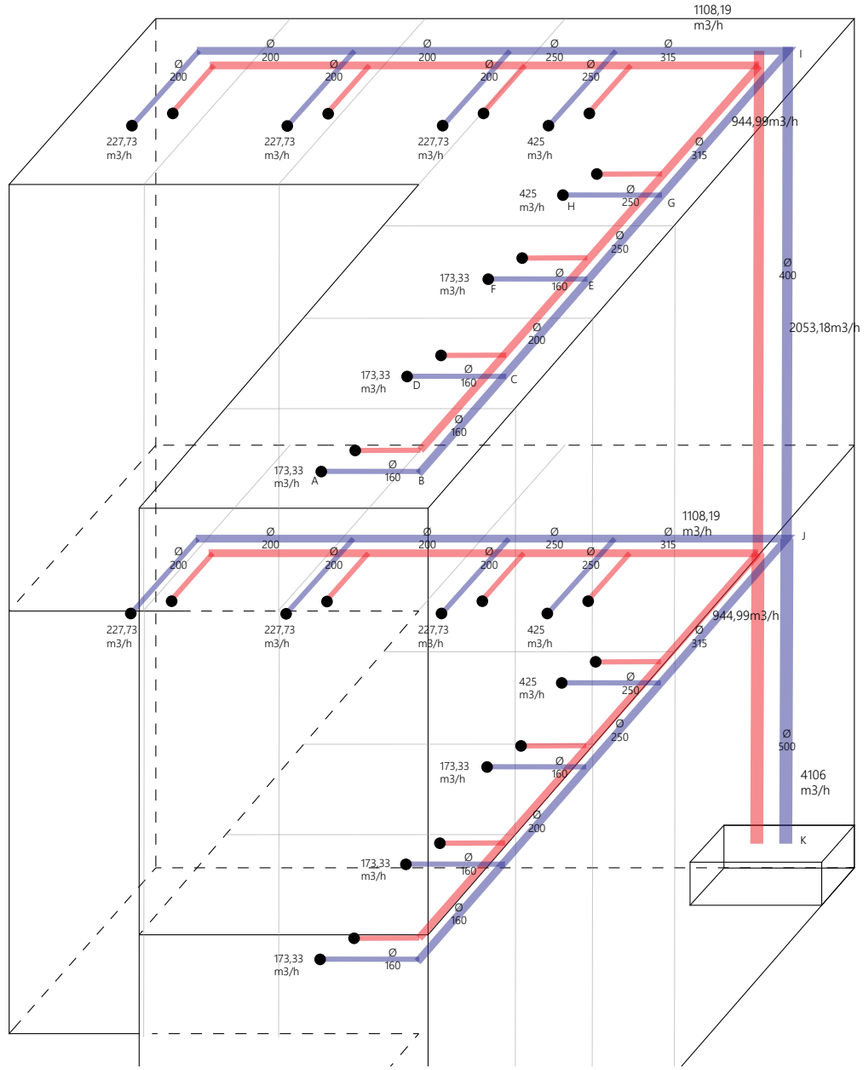
Ill.198.

VENTILATION DUCTS

In order to calculate dimensions for the ventilation ducts, it was first necessary to calculate the air change rate in the different rooms of a sensory and atmospheric pollution. The calculation of the air change rate can be seen in Annex VI.
After the air flow rate was calculated it was possible to find the ventilation ducts dimensions. As it can be seen in the results of the calculation seen in the ill.198. the ducts for the common room needed to be dimensioned for the atmospheric pollution, and the single and double room needed to be dimensioned for the sensory pollution.

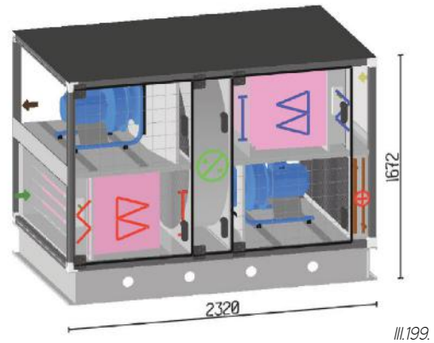
In order not to experience an air draft, the airflow in the connection ducts had been set to 3m/s.
The calculation for dimensioning the ventilation ducts can be seen in Annex VII. The double room apartment were used in the examples.

All the ducts were calculated. The difference in size and air change can be seen in ill. 198.1.

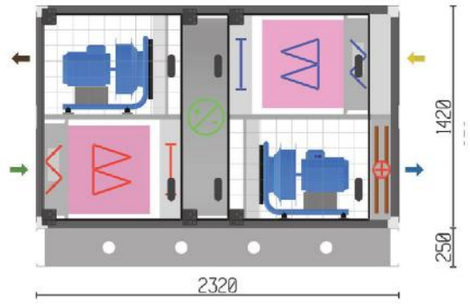


III.198.1. Ventilation ducts diagram

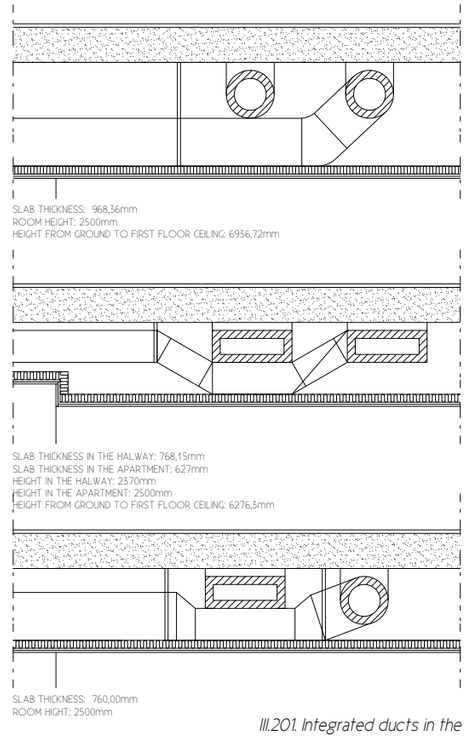
The diagram shows two living units, one on ground floor and one at first floor. This is a simplified sketch of the system, where the inlet and outlet was not placed next to each other. The inlet was placed in the living room. For the double room it was divided into two ducts. Two outlet were needed, one was placed over the kitchen and one in the bathroom.
The two living units are sharing an ventilation aggregate, therefore it needs to have a capacity of 4106 m^3/h.



III.199.



III.200.



III.201. Integrated ducts in the ceiling.

VENTILATION AGGREGATE

In order to see what aggregate could be used to fulfill the energy ,used for the ventilation, regulations, the pressure loss was calculated. The calculation can be seen in Annex VIII.

The aggregate size and type were found by using the external pressure and capacity in a System Air program. The program calculated and found a suitable aggregate.

The aggregate was bigger than first expected, this resulted in changing the placement of the aggregate but also a bigger technical room was needed. First the intention was to place the aggregate on the roof, but this conflicted with the height limit of the building, therefore it was placed on the ground floor, where the technical room was.

HIDDEN DUCTS IN THE CEILING

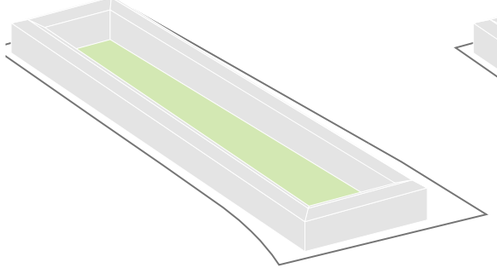
Due to the strict height limit on the site, it was important to use different methods in order to achieve as high rooms as possible and still maintain a notable roof angle. Therefore, different solutions for the placement of the ventilation ducts were tried.

First example that is a cheaper solution with the lowest pressure loss was tried (III.201.). Second and more expensive example with the highest pressure loss was tried. Lastly, en example, where rectangular and circular ducts crossing each other were used. With a solution from the third example best height could be achieved, without the ventilation system being too expensive.

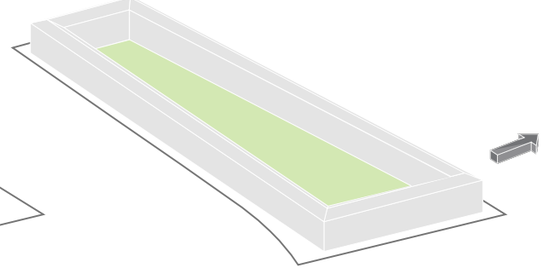
PRESENTATION

III.202. Final model

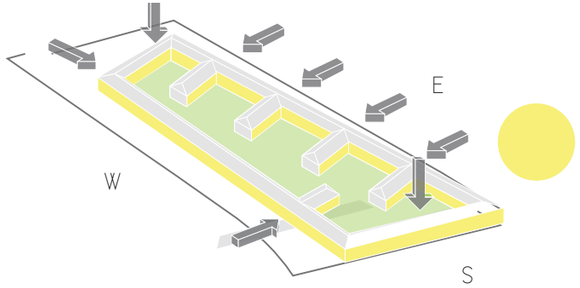
CONCEPT DIAGRAM



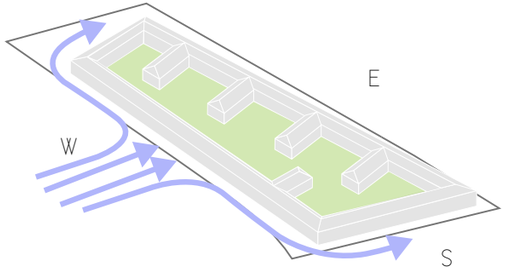
Block structure added to the site.



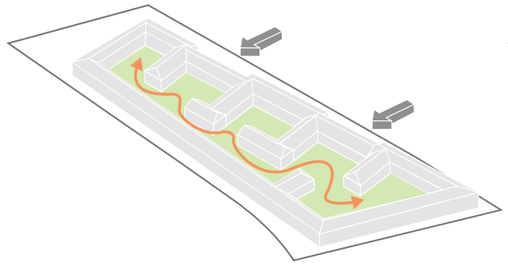
Block structure adjusted after the site boundary.



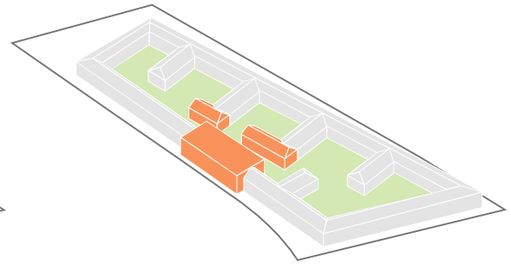
Minimizing height of building and directing facades towards East, South and West to create best daylight conditions for the functions laying behind.



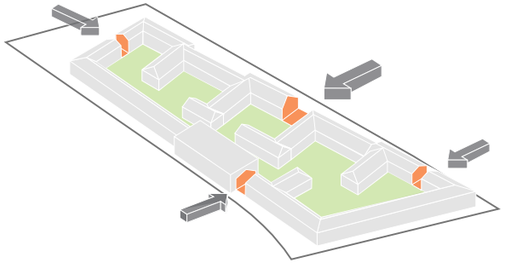
Creating shelter from wind



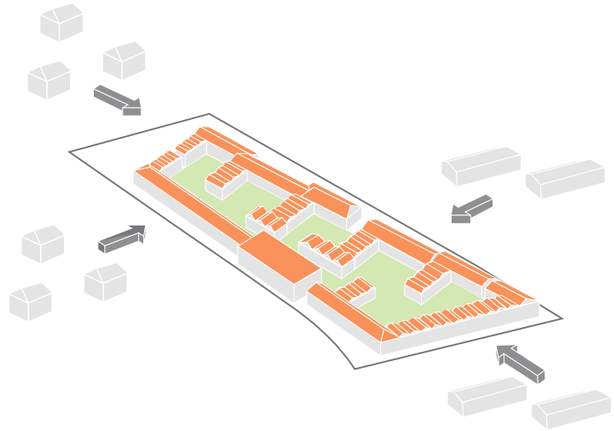
Moving building volume in to create more flow and define spaces.



Creating a city like atmosphere with a boulevard and different city qualities



Creating easy access and escape routes to and from the building complex.



Bringing in the surrounding typology to the complex.

III.203. Concept diagram

MASTER PLAN

As part of the plan from the municipality of Aarhus, the site plan contains a two stories residential complex and a parking area, where existing buildings are removed. The new buildings are indented to contain functions related to the previous ones, but in a new focus on dementia housing. The complex is intended to create a dementia friendly environment with a possibility to connect with another existing care centre in the future. The two storey building, located in the west of the site, is intended to be mixed functions, with among care facilities, retail, cafe and administration. There are 22 units in the project, where each unit has a common room and a private terrace.

The master plan is a result of combining a different typology from the surroundings and beneficial to dementia housing. The basis of a block structure works as a physical frame and the flow is created inside by having a big outdoor area with various activities. The movement would trigger the complex residents to move and exercise reminding them of everyday life they used to have. The main functions are consciously arranged in different places though still gathered in the central area, where city atmosphere with it's qualities is created.

Squares, streets, gardens, buildings, water and objects were designed create a recognizable atmosphere. Various outdoor activities and sensory gardens are located all around with different theme, color, smell, sound that would stimulate residents mind as much as possible as it makes the progress of a condition slower and have a beneficial effect on their well-being. At same time social contacts is created and strengthen.

In these spaces residents should have the freedom to live on their own terms, where they feel they are save and at home, where plenty of opportunities for differences are supported by the design.

AREA:	16.024 m²
BUILDING AREA:	11.500 m²
OUTDOOR AREA:	5410 m²
BUILDING PERCENTAGE:	72%

Ill.204: Masterplan

FUNCTIONS

UNITS:
- 1 room apartment 35 m²
- 2 room apartment 47m²
- Common room ca. 100m²
- Technical room 6m²
- Depot 4m²
- Staff toilet 3 m²

CORE:
- Staircase 32 m²
- Laundry room 8 m²
- Offices 7 m²
- Technical room 6 m²

ADMINISTRATION:
- Offices 7 m² and 14 m²
- Dinning room 50 m²
- Changing room 16 m²
- Depot 13 m²
- Toilets 5 -7 m²

SERVICE AREA:
- Reception 25 m²
- Day centre 274 m²
- Shop 60 m²
- Beauty salon 31 m²
- Education and workshop
- Sensory room 90 m²
- Physiotherapist 50 m²
- Kitchen 52 m²
- Depot 7 m²
- Toilets 16 m²

III.205. Function diagram of the ground floor

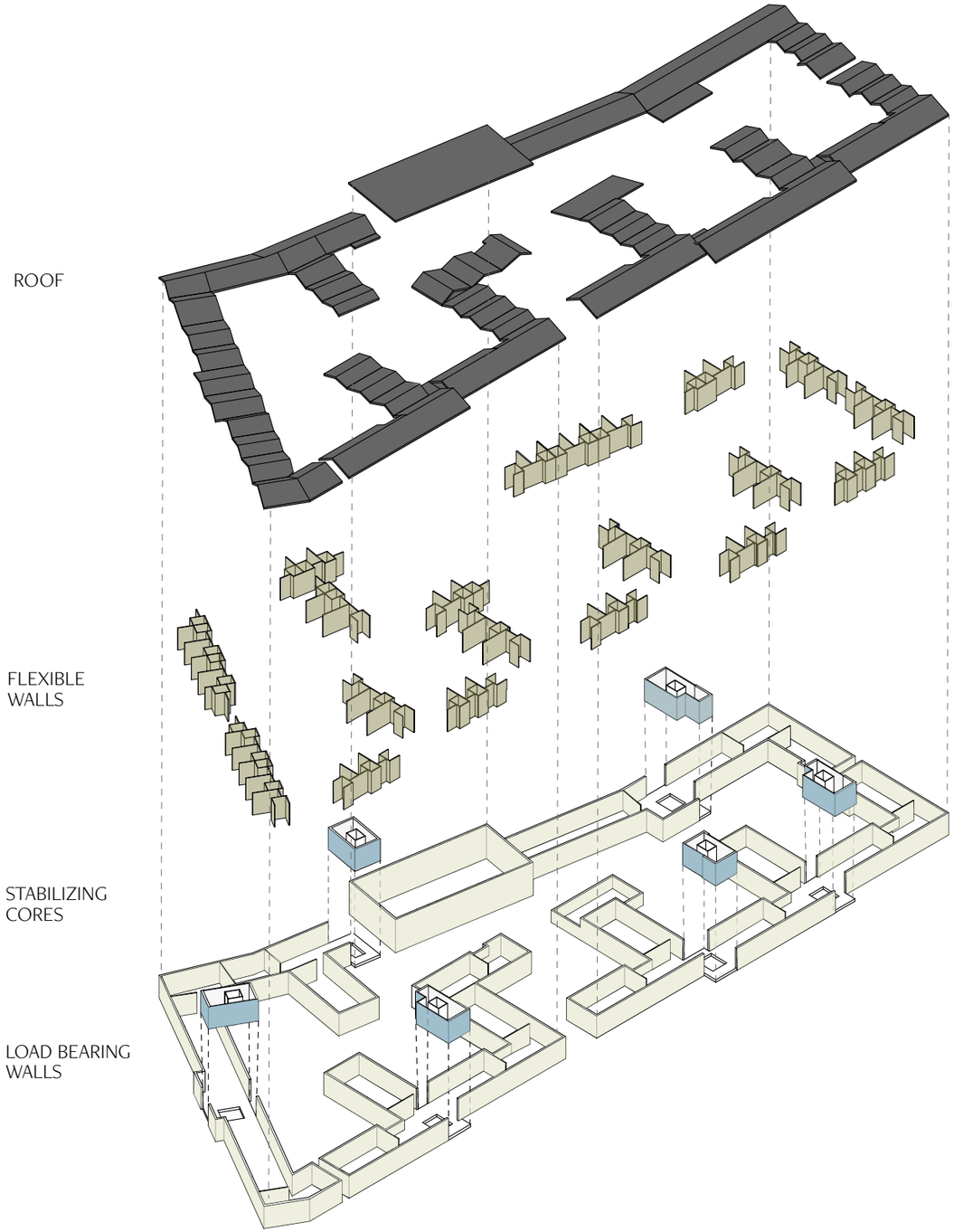
III.206. Function diagram of the the first floor

STRUCTURAL PRINCIPLE

The structural principle of the project is a flat plate construction with load bearing exterior walls of high performance concrete. The principal feature of the flat plate floor is a uniform or near-uniform thickness with a flat soffit which requires only simple form work and is easy to construct. The floor allows great flexibility for locating horizontal services above a suspended ceiling or in a bulkhead. This system has been chosen to keep the construction as thin as possible, due to the best light conditions.

To assist the forces acting in the horizontal direction to stabilize the structure, six staircases acting as a core are placed. Besides the stabilizing effects of the cores, the vertical shafts also contains a common entrance, elevator, stairs, laundry room, technical room and staff offices.

It is important that the complex is flexible in terms of future changes. People with dementia are just as different as all other people in terms lifestyle and needs, therefore it is natural that these differences will change in the future (Møller., K &Kundstrup, M A 2008). Therefore is it important that the spaces could be rearrange in relation to the future changes and needs by having a possibility to tear walls down without affecting the main construction.



III.207. Structural principle

CAFETERIA AREA

Cafeteria area is where all main functions are placed: cafeteria/day center, offices, staff facilities, workshop room/auditorium, senses room and physiotherapist, shop and a beauty salon. The area is defined in a way it would create city feeling with a little plaza, different style buildings and materials used for the facades and pavement. Here city qualities are brought in, where residents could do their shopping, visit a hairdresser, have a walk in the city alley or meet a friend and go to the restaurant.
In front of the restaurant guest/adaptation apartments are placed. Though it is quite open to the public area, there is still a private terrace for each of the apartment that is shielded with a hedge.
Cafeteria are is a central point, where everybody can meet and spend time, be social together. Here the main activities in the day center takes place, where elderly with dementia can also come from outside and spend time.
There is always busy in this area, so people with dementia have a feeling they are living in there own city and can follow with it's daily routine have days going more meaningful and joyful with the qualities it suggests.

III.208. View in the cafeteria area

FRUIT TREE GARDEN

Outdoor area is a space, that has to engage challenge and stimulate different senses of the residents. Here the fruit tree grove is shown, where residents could experience a forest feeling and enjoy the birds singing in the tress. There is a roofed arbor, which can shelter from wind and rain.
Different fruits gives a different smell and colors. Residents can follow it's growth and pick it, when it is ripe. Residents from their apartment also can look into the grove and follow with seasons changing. They have also possibility to go directly outdoors, where they have private terraces.
A shed with trash containers is also placed here as it is a part of daily chores, that they should be engaged in. Further behind the shed, there is a green house, where residents with staff can do different gardening like growing vegetables, herbs or grow different plants. This is also a process for creating and making a complex/ their home more beautiful in terms, how residents want it to be.

III.209. View in the fruit trees garden

VIEW FROM A GALERRY

Another theme is shown in this picture, where wild grass, colorful flowers, different forms and water is dominant things. All these things are to stimulate people with dementia brain. Different units are marked with different color and material for entrances, which makes it easier for staff and residents to orientate and recognize there home.
The greenery creates a possibility for various fauna to live in and therefore residents can observe this process. Water is a calming source that gives a freshness and a feeling of revival. The sound of it has a soothing effect, therefore it contributes to well-being of the residents.
The paths are organized in bows, that it would not have endings and encourage movement around. There are plenty benches and sitting places, where residents can rest on the way or sit with guests. Having a possibility to observe different things happening in these outdoor areas is important part of the residents life, where they can continue having a meaningful life in a safe environment without feeling disabled in any way.

Ill.210. View from the galerry

III.211. Section A-A

COMMON ROOM

Common room is where kitchen, rest room, eating area and living room is. This is where residents would spend most of the time doing various activities like making food together, watching television, playing board games, listening to music and interacting or just being in the room.

The room is placed in the middle of a unit, where there is short distance from residents apartments. The room is dealt in smaller spaces, where smaller groups could do different things or observe things from a distance, if a person is not that active anymore. Passive participation is as much important as active for people whose condition is more progressed than others residents. If a person is not able to participate in making food, the smell of it while making it stimulates they smell senses and can awaken their appetite, which is important for their nutrition.

In the room there are windows from three sides, that gives not only a good daylight, but also a possibility to look outside into different views, where ones are turning to the inner court of the complex and others out to the street, parking area, existing care center or garden association.

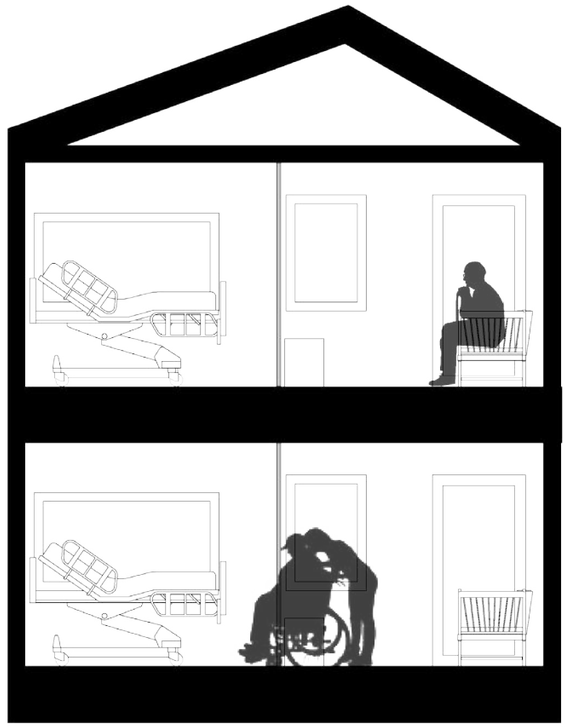
From a common room there is a direct way to common outdoor terrace, where residents can enjoy sun and view to the inner court. In the first floor roof space is used as a quality to make room more spacious with more light coming from a roof windows. In the room there is also a place for an employee, where it is possible to do small tasks without leaving a room, when needed.

Each common room has a storage that is placed further in the unit, but with an appropriate distance.

III.212. Plan of a common room

The feeling of life happening around, where sometimes a little conflict maybe in the kitchen occurs, a discussion over what channel one would like to watch or some guests visiting a family member in the complex is important for people having dementia in order to feel that life continues as before and they are in the company of like-minded people, where they can be who they are with their different personalities and needs, which is essential for there well-being.

III.213. Interior of the common room



III.214. Section B-B

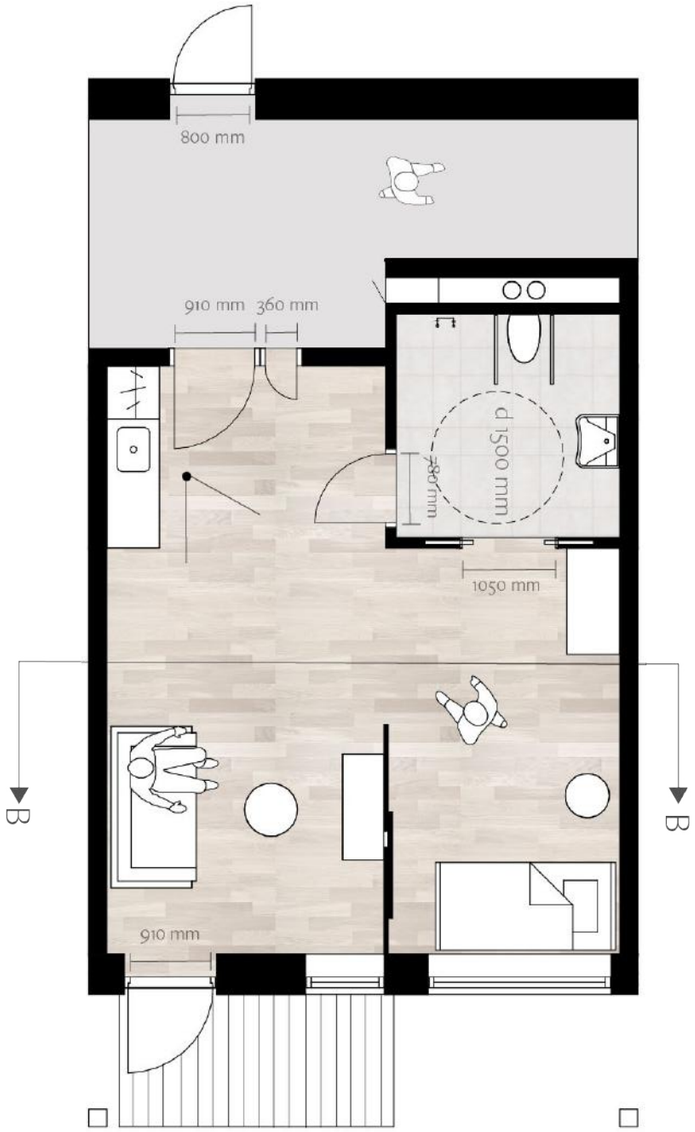
TWO ROOM APARTMENT

It is important for people with dementia to have their own apartment, where they can feel safe and have a private space for themselves.

The apartment is 47 square meters with a flexible wall to make two rooms. In each apartment there is a small entrance, kitchenette with small refrigerator and a sink, spacious bathroom, where all equipment is installed to be easy accessible, e.g. automatic light, adjustable bathroom sinks, special toilets and showers. There is space for a rolling walker or wheelchair to move around in the whole apartment. In the bathroom there is another door for the staff for emergency cases. Robust and natural materials are used in the apartments. The windows are placed low enough that residents could see directly to outside, when sitting. All residents decide, how their apartments are going to look like. It should remind them their original homes and feel safe, therefore details are important. There is a possibility to have a double bed or extra bed in the apartments, if preferred.

Comfort is important in the rooms and therefore shading devices can be both controlled mechanically or manually, where smart home technology could be used by residents themselves. This gives an opportunity for residents to feel self-reliant and be in control of a lot of daily tasks (Møller, K &Kundstrup, M A, 2008).

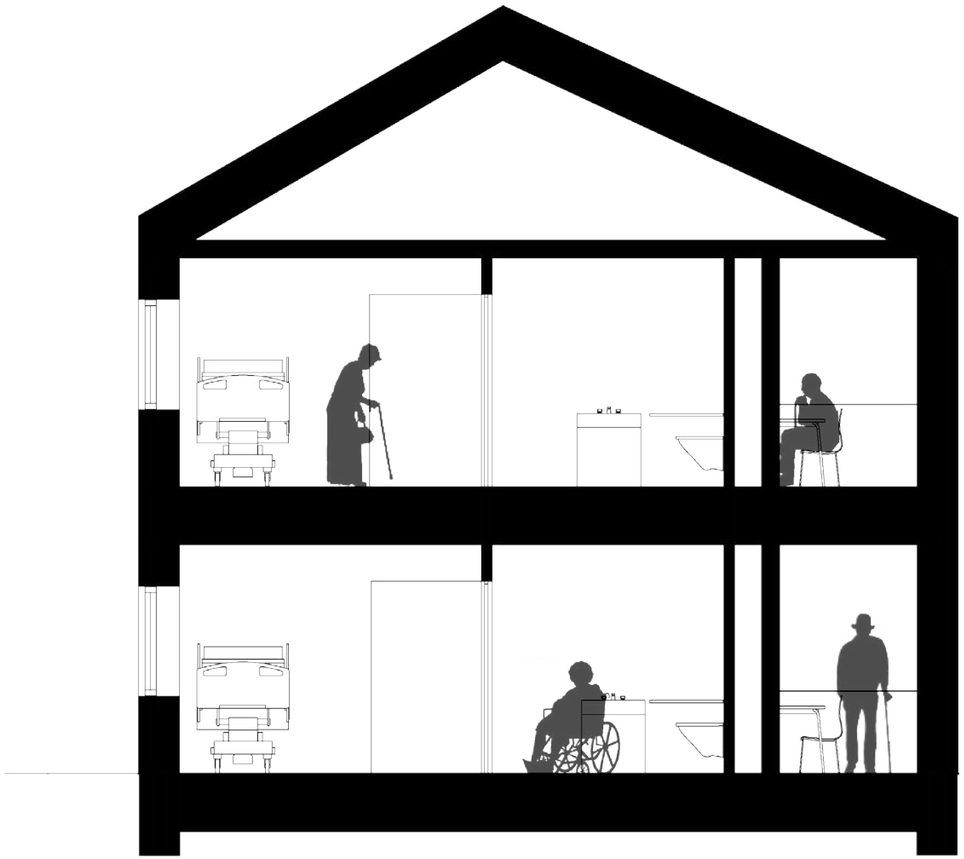
All apartments have a private terrace or a french balcony in south placed apartment, but with a possibility to go out directly outside from the apartment with a direction towards inner court.



III.215. Plan of a two rooms apartment

Apartment is where residents feeling most safe and independent. They are in control her and their privacy should be respected. They can be here without being disturbed, but at the same time close to the common areas, if wanted.
Residents can have guests in there own apartment, where they have an possibility of having their own furniture and decorations to make it their home, how they want it to be.

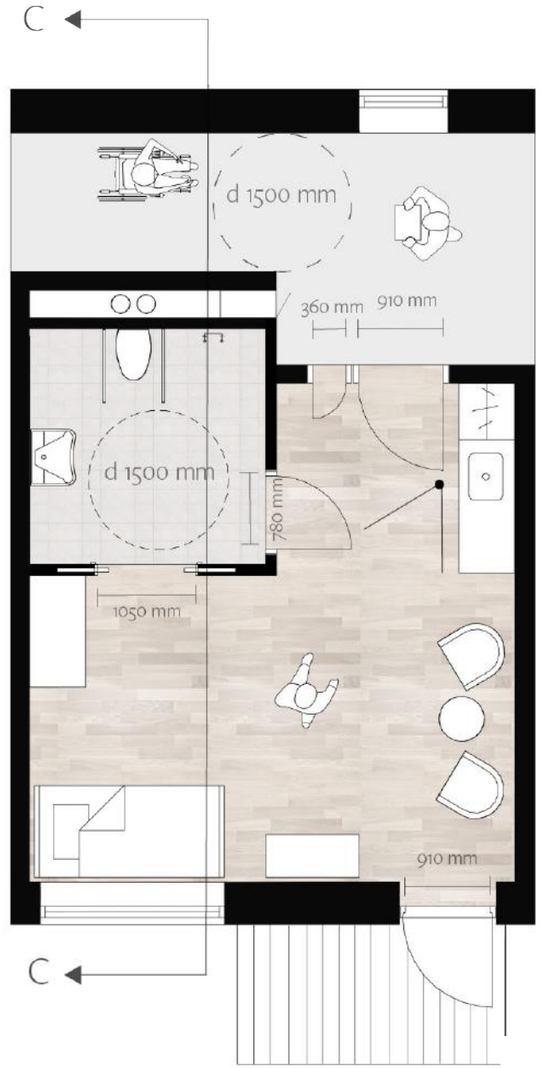
III.216. Interior of two rooms apartment



III.217. Section C-C

ONE ROOM APARTMENT

One room apartment has similar qualities as a two room apartment, but in a smaller space. The space is a 35 square meters together with a terrace. Apartment is more suitable for people with a more difficult condition, where they need to see the whole space without walls or furniture that could stand in a way. This is due to the insecurity feeling they develop, if they suddenly can not see what is happening in the room, or there are too dark shadow cast by the walls.



III.218. Plan of one room apartment

Details are important in furnishing the rooms. It can remind residents of their previous life, what work did they have and what was important to them.

III.219. Interior of one room apartment

III.220. Ground floor plan of the complex

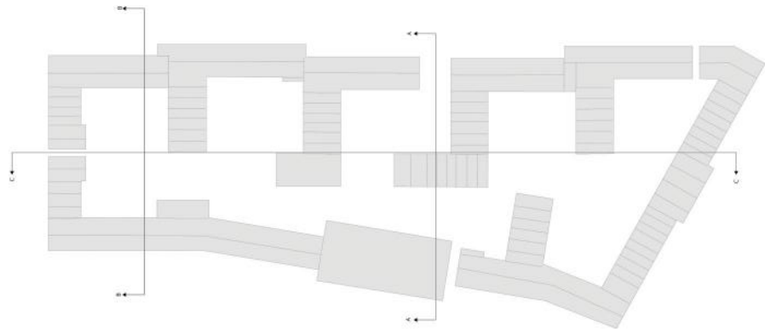
III.221. First floor plan of the complex

III.222. South facade

III.223. North facade

III.224. East facade

III.225. West facade



III.226.

III.227. Section A-A

III.228. Section B-B

III.229. Section C-C

SOCIAL

Indoor climate
User security
Aesthetics
User influence
Flexibility & layout
Green and blue areas
Openness and inclusion of the public
Transport
Culture & History
Social facilities

ENVIRONMENT

Materials & Resources
Water
Behaviour & environment
Energy
Area and area use
Climate adaptation
Biodiversity
Waste

ECONOMY

Construction costs
Operating
Total Economy
Local & social sciences. economy
Robustness & life
Future use

Ill.230. Sustainability diagram

The goal in this project was to meet the requirements of energy frame 2020. It was important to use sustainability as a drive force to achieve the quality inside as well as outside. In order to achieve that different methods were used and it was attempted to meet as many requirements from the social, economic and environmental sustainability as possible. The marked words in the ill.230. are the requirements that are fulfilled with this project.

ENERGY FRAME BUILDINGS 2020		
Without supplement 20,0	Suplement for special conditions 0,00	Total energy frame 20,0
Total energy requirement		19,7

Contribution to energy requirement		Net requirement	
Heat	27,8	Room heating	11,10
El. For operation of building	1,70	Domestic hot water	13,30
Excessive in rooms	0	Cooling	0,00
Selected electricity requirements		**Heat loss from installations**	
Lighting	0,00	Room heating	3,40
Heating of rooms	0,00	Domestic hot water	0,20
Heating og DHW	0,10	**Output from special sources**	
Heat pump	0,00		
Ventilators	1,60	Solar heat	0,00
Pumps	0,10	Heat pump	0,00
Cooling	0,00	Solar cells	0,00
Total el. Consumption	16,60	Wind mills	0,00

Ill.231. Final results from Be15

ENERGY FRAME

In order to fulfill the strict energy requirements of building regulation 2020, an iterative solution-oriented design process was initiated. First, an estimation was made, that showed how much glass area was possible to have without exceeding the energy requirement to much. The bigger glass area the more heat loss is, therefore it was chosen 15 % glass area as the first step towards fulfilling 2020 requirements.

Next, it was necessary to have a building envelope with a low transmission loss. The walls needed to be as thin as possible, in order to achieve a good daylight factor with a glass area of only 15%. A new improved wall construction with a U-value of 0,9 W/m²K and a thickness of 300 mm was chosen (See page 96).

CONSTRUCTIONS
Roof: U-value = 0,059 W/m²k (Isover, 2010)
Foundation: U-value = 0,066 W/m²k (Isover, 2010)
Window: U-value = 0,52 W/m²k (Isover, 2010)
Door: U-value = 0,8 (Bygningsreglement, 2015)

In order to minimize the passive solar heat gain in summer, different shading devises were studied. Shutters with horizontal slats were chosen for the south/south west exposed apartments that were not shaded by the gallery. In order to decrease the temperature, natural ventilation was used in suitable amounts at night with rare exceptions in the day time. This made it possible to reduce the energy need for the mechanical ventilation.

As it can be seen in ill.231., it was possible to fulfill BR2020 requirements. The total energy requirement for the building is 19,7 kWh/m² year. If wanting to fulfill zero energy, active strategies with renewable energy sources could be used. A documentation, where the amount of solar cells could be use for the project was made. Calculation can be seen in Annex IX.

Solar thermal collectors, heat pumps and wind mills could be used as renewable source. More often solar cells and heat pumps are used.

EPILOGUE

III.232. Model, where typologies of the area can be seen

CONCLUSION

ARCHITECTURE FOR
PROTECTED LIVING

The scale of the challenge of caring for people with dementia is enormous. But with new researches coming, which expands knowledge on the subject has demonstrated that it is possible to create a more supportive care environment by applying specific dementia friendly design principles. These supportive design principles must be founded on an understanding of the impact of physical environment on people with dementia and strong partnership working with them, their carers and care staff.
In this project it was tried to create a physical frames for the residents and people staying with them with a building help, where activities and movement is happening inside the complex. The combined typologies let the complex look non-institutional, more integrated in the surroundings and more dementia city like, where privacy, dignity and independency is promoted Home, safety, having control, meaningful life are values supported for residents to achieve.

FUNCTIONS

The complex provides city qualities such as a shop, beauty salon, restaurant/cafeteria, a possibility to do performances, conferences, other arrangements due to the multifunctional room and plenty of outdoor activities. Day centre is open to people from outside, where they can have activities with residents or use care services like senses room or physiotherapist.
The facilities are arrange in a way that it would be easy to reach and accessible form all part of the complex. Among facilities in the main area, there are private common rooms in each units, where residents can do activities if preferred instead of the day centre.
Nature in an important part of dementia city due to it's healing qualities beneficial to human well-being. Outdoor area is designed in a way that it would attract residents with different smell, form, color and they could move around in it and between the buildings.

SUSTAINABILITY

The sustainable approach for the complex is not to be a zero energy, but to fulfill energy frame 2020 and be flexible in the future due to changing needs and wishes of the people, as well as function of the whole complex.
Good indoor climate was prioritized to fulfill the energy frame 2020, but also to ensure that residents feel comfortable at all times. Passive strategies like building orientation, passive heating and cooling were important to achieve that.
Shutters with slats were implemented as it helps not to get too much overheating in the summer, but with a possibility to look outside, if wanted.
In the apartments cross and single ventilation is used where it is possible with a help of a window that is placed above the entrance door. In addition, it gives a secondary light to the apartments from the hallway.
Sustainable and natural materials e.g. innovative Connovate sandwich elements, bricks for the facades are used in the project to ensure healthy environment and have less CO_2 footprint.

A community that is safer and more engaging including livability, age friendly, accessible and dementia friendly environment is created. It enhances the participation of residents with varying needs and capacities to remain healthy, active and engaged in their community, thus improving the quality of their life and therefore well-being.

REFLECTIONS

PROCESS

With this project generic issues of the dementia housing has been touched, where knowledge is not complete and final yet, but rather new discoveries are made all the time. This also influences a future local plans, where government is forced to take this user group into account making adjustments.
People with dementia are as different as all the other people and therefore it is hard to predict, how they would react to some of the architectural solutions in this case e.g. shutters. Investigations are made all the time in order to learn, how to improve the principles creating dementia friendly environment and therefore the project is a result and a part of this process. The focus in this project was a human, therefore material was studied in terms what impact it has on their health and well-being.
Integrated Design Process has been used in a project as a uniting tool for achieving aesthetic and technical qualities to work as one. During the process a lot of iterations have been made in terms of solving problems to achieve a better life quality and indoor climate for people with dementia and employees.
This was a complex and challenging task as a lot of details must be taken into account, when it comes to dementia,e.g. windows height, apartment layout, accessibility, enough outdoor area, materials, colors.

SOLUTIONS

In a project there could be used other strategies to be more sustainable. Green roof in all the buildings would solve an increasing precipitation problem and could be use din the building for flushing the water or in the outdoor area for a pond or drainage that could also work as an aesthetic element.
Since the buildings have a gable roof, the space of it was used only in the common rooms. The possibility would be to use it also in the apartments to add a quality to it.
Daylight is essential for residents, but also for fulfilling energy frame 2020. Higher windows could be made together with increasing a room height for better daylight where it could be better then 2% as it is now. When making windows higher in existing room height it would give more overheating in the summer and mechanical ventilation would be used more, which means more electricity consumption.
There could also be windows next to the entrances or integrated in the part of the doors to the apartments to get better daylight conditions having a non-transparent window for privacy reasons. But this idea was refused because of the reaction of residents when they would see shadows passing by.
If making rooms higher, it would give a possibility to have more glass area and therefore more light in the room. But because of the wish to adjust to the surrounding typology and have more tectonic appearance, it was decided to have a gable roof. This was also due to the regulations, as there is a 8, 5 m limit for buildings height in the site. This could be discussed with a local government for future changes to build more dense and higher.
Active strategies like solar panels could be a solution to become a zero energy building. It could be integrated on the roofs (See Annex IX).

USER GROUP

When designing a dementia housing it is hard to know some things in advance, how the persons would react to architectural solutions and how comfortable they would feel. It is also clear that residents and caretakers reacts to things differently due to their age and activity. This would not only influence their well-being, but also energy used in the complex. The challenge here was to try to fulfill both user groups needs, where it might be conflicting sometimes in terms of indoor climate. Here the focus was to people with dementia and care taker would adjust easier then opposite. In the end, the more residents are happier and thriving, the easier it is to help and work with them.

REFERRENCES

AALBORG UNIVERSITY

Degn, M 2014, Starbucks&Bilka – *A Match made in Heaven ?,* English and International Business Communication, Master's Thesis, Aalborg University[Online] Available at: Aalborg Universitet, Detdigitaleprojectbiblotek [Accessed 2 May. 2016].

Frandsen, A. K., Mullins, M., Ryhl, C., Folmer, M. B., Fich, L. B., Øien, T. B., & Sørensen, N. L., 2009, *Helende arkitektur*. 1st. ed, Denmark. [Online] Available at: VNB: Aalborg Universitets forskningspotal.[Accessed 6 Feb. 2016].

Hansen, V.A., Munk, T. K. S., Nguyen, L. T. N., Nielsen, S, L., Zuzeviciute, R., 2015, *From suburbs to sustainable urban living*, Gr. 9 Msc02 Architecture & Design, Aalborg University[Online] Available at: Aalborg Universitet, Detdigitaleprojektbiblotek [Accessed 20 Apr. 2016].

Henriksen, N., Møller, K., & Knudstrup, M-A., 2007, *Trivsel og Boligform*, Litteraturgennemgang, Odense, Servicestyrelsen. [Online] Available at: VNB : Aalborg Universitets forskningspotal [Accessed 29 Feb. 2016].

Knudstrup, M A,. 2004, *Integrated Design Process in Problem-Based Learning*, Article in the Aalborg PBL Model, red. Kolmoes, A & Fink, K F & Krogh, L. Aalborg University Press 2004. Denmark. [Online] Available at: VNB : Aalborg Universitets forskningspotal. [Accessed 9 Feb. 2016]

Marlling, G.,2011,*Fænomenologi: Byanalyser*[Online] Available at: VNB : Aalborg Universitets forskningspotal. [Accessed 9 Feb. 2016].

Møller, K &Kundstrup, M A.,2008, *Trivsel & plejeboligens udformning*, 1st edition, Servicestyrelsen, Odense. [Online] Available at: VNB : Aalborg Universitets forskningspotal. [Accessed 6 Feb. 2016]

SBI- Anvisning 259, 2015, *Plejeboliger for personer med Demens – Indledende spørgsmål, 2 Plejecentrets omgivelser*. [Online] Available at: SBI - Anvisninger : Aalborg Universitet København. [Accessed 7May. 2016]

Semester description, 2016, *MSc04 ARC, Spring 2016,* Aalborg Universitet.

Semester description, 2014, *MSc01 ARK, Fall 2014,* Aalborg Universitet.

WEBSITES

Alun 2009, *Sov godt – guide til en god natte søvn by Alun Biggart.* [Online] Available at: http://www.alun.dk/soevn-afslapning/sov-godt-guide-til-en-god-natte-soevn.html# [Accessed 11. Feb. 2016].

Autodesk 2016, Sustainability workshop, *Passive Design Strategies* [online] Available at: http://sustainabilityworkshop.autodesk.com/buildings/passive-design-strategies [Accessed 15 May 2016].

Bejder, KA.,Knudstrup, M., Jensen, LR. andKatic, I 2014, *Zero Energy Buildings – Design Principles and Built Examples for Detached Houses.*, 1st ed, Copenhagen: [Online] Available at: VNB: Aalborg Universitetsforskningspotal.[Accessed 25 Feb. 2016].

Bygningsrelementet 2015, *5.2 flugveje og redningsforhold and 5.6.1 Adgangs- og tilkørselsmuliger*, [Online] Available at: http://bygningsreglementet.dk/br15_00_id79/0/42and http://bygningsreglementet.dk/br10_05_id87/0/42/2 [Accessed 14 May 2016]

Bygningsreglementet 2015, *7.2.5.1 Fælles bestemmelser for bygninger omfattet af bygningsklasse 2020*, Stk. 6 [Online] Available: http://bygningsreglementet.dk/br10_05_id5181/0/42 [Accessed 12 May. 2016].

Bygningsrelementet 2015, *2.4.2 Parkeringsaraler*, [Online] Available at: http://bygningsreglementet.dk/br10_05_id262/0/42 [Accessed 14 May 2016]

Connovate 2016, *Teknologi,* [Online] Available at: http://www.connovate.dk/category/teknologi_connovate/.[Accessed 10 May. 2016].
DAC 2014, *Hvad er bæredygtighed?– Dansk Arkitektur Center*. [Online] Available at:http://www.dac.dk/da/dac-cities/baeredygtige-byer/om-baeredygtige-byer/hvad-er-baeredygtighed/[Accessed 9 Feb. 2016].

DMI 2016. *Måned, sæsonen og årets vejer* [Online] Available at: http://www.dmi.dk/vejr/arkiver/maanedsaesonaar/ [Accessed 12 Feb. 2016].
Egersund tegl 2016, *Hvorfor anvende mursten af tegl.*[Online] Available at: http://www.egernsund-tegl.dk/teglmursten[Accessed 11 May 2016]

Hogeweyk 2016, *Urban design* [Online] Available at:http://hogeweyk.dementiavillage.com/en/kenniscentrum/ [Accessed 19 Feb. 2016].

Martinsen, B,. Norlyk, A,. Sygeplejersken 2011; (12):64-8. Dansk sygeplejeråd, *Tre kvalitative forskningstilgange*, [Online] Available at: https://dsr.dk/sygeplejersken/arkiv/sy-nr-2011-12/tre-kvalitative-forskningstilgange [Accessed 9 Feb. 2016].

Miljø- og fødevareministeriet, 2016, *Miljøstyrelsen*[Online] Available at: http://miljoegis.mim.dk/spatialmap?&profile=noise [Accessed 29 Feb. 2016].

Molenaar& Bol &VAnDillenarchitecten&Zorgen 2016, *Zorgwijk de HogeWeyk te Weesp.* [Online] Available at: http://www.mbvda.nl/Hogeweyk.html [Accessed 20 Feb. 2016].

Nationalt videnscenter for demens 2016, *Forekomst af demens i Danmark.* [Online] Available at : http://www.videnscenterfordemens.dk/statistik/forekomst-af-demens-i-danmark/ [Accessed 6 Feb. 2016]

Nationalt videnscenter for demens 2016, *Forekomst af demens i region Midtjylland.* [Online] Available at: http://www.videnscenterfordemens.dk/statistik/forekomst-af-demens-i-danmark/forekomst-af-demens-i-region-midtjylland/ [Accessed 9 Feb. 2016]

Nationalt videnscenter for demens 2016, *Psykiatriske symptomer ved forskellige demenstyper.* [Online] Available at: http://www.videnscenterfordemens.dk/viden-om-demens/demenssygdomme/symptomer-paa-demens/psykiatriske-symptomer/psykiatriske-symptomer-ved-forskellige-demenstyper/ [Accessed 11 Feb. 2016]

BOOKS

Frampton, K 1995, Studies in tectonic culture, *The poetics of construction in Nineteenth and Twentieth century Architecture*, The MIT press, London England

Lehrskov, H., Øhlenschlæger, R., Kappel, K., Kleis, B., Klint, J. and Pedersen, VP 2012, *Energi + Arkitektur*. 2nd ed. Copenhagen, Solar City, pp.3,4 and 13.

Møller, K &Kundstrup, M A, 2008, *Trivsel & plejeboligen, En antologi om trivselsfaktorer i plejeboligen*, Heiselberg, P, Teknologi og det fysiske miljø, Syddansk Universitetsforlag, Odense M.

PDF

Aalborg University, 2015, *Course Zero Energy Buildings*, Lecture 5, Solar cells in Architecture, PVdimensioneringsguide-nomogram [Online] Available at:file:///C:/Users/Stine%20Munk/Downloads/PVdimensioneringsguide-nomogram%20(1).pdf[Accessed 21 May. 2016]

Aarhus Kommune 2015, *Demens- og Hjerne Centrum Aarhus*, Bilag 2.01

Dansk Standard, 2007, *DS/EN 15251, 1. udgave*,Basis for the criteria for indoor air quality and ventilation rates

Demens alliancen, 2016, *Visioner for Danmarks Demensboliger*, [Online] Available at:http://demensalliancen.dk/wp-content/uploads/2015/09/Visioner-for-Danmarks-demensboliger.pdf .[Accessed24Feb. 2016]

Demenskoordinatorer i Danmark, 2015, *Nyhedsbrev 1, 19. årgang Marts 2015*, TEMA: Demensegnede boliger, Demens *og ensomhed – to tabuer vi forsat skal arbejde for at afskaffet* [Online] Availableat : http://www.demens-dk.dk/WordPress/wp-content/uploads/2013/11/DKDK-Nyhedsbrev-1-2015.pdf[Accessed 6 May. 2016]

Hyldgård, CE, Funch, EJ, Steen-Thøde, M, 1997, *Grundlaeggende Klimateknik og Bygningsfysik*, Kap. 1. Indeklima

Isover, 2010, *Komfort Husene – erfaring, viden og inspiration*, Saint-Gobain Isover a/s [Online] Available at:http://www.komforthusene.dk/files/ISOVER_DK/Brochurer/KomfortHusbogen.pdf [21-May-2016]

Nielsen, VC, 2008, *CO² Footprint.* [Online] Available at: http://connovate.dk/wp-content/uploads/2012/10/CO2-Footprint.pdf [Accessed 24 Apr. 2016].

Dansk Standart, 1998, *CR1752,*Sensory pollution load

Regeringen 2014, *Et bæredygtig Danmark – Udvikling i balance*. [Online] Available at: http://mst.dk/media/151517/et-baeredygtigt-danmark_udvikling-i-balance_web_a.pdf [Accessed 10 Feb. 2016].

Regeringens klimaplan 2013, *På vej mod et samfund uden drivhusgasser.*[Online] Available at: http://www.ens.dk/sites/ens.dk/files/dokumenter/publikationer/downloads/klimaplan_2013_web.pdf [Accessed 12 Feb. 2016].

The Kings Fund, 2012, *Improving the patient experience Developing supportive Design for People with Denentia The King's Funds´s Enhancing the Healing Envirmentprogramme 2009, 2012,*[Online] Available at:http://www.kingsfund.org.uk/sites/files/kf/field/field_publication_file/developing-supportive-design-for-people-with-dementia-kingsfund-jan13_0.pdf[Accessed 16 Feb. 2016].

ILLUSTRATION LIST

Illustration list:

Ill. 1 – 2. Own illustration.

Ill. 3. Knudstrup, M A,. 2004, *Integrated Design Process in Problem-Based Learning*, Article in the Aalborg PBL Model, red. Kolmoes, A & Fink, K F & Krogh, L. Aalborg University Press 2004. Denmark. [Online] Available at: VNB : Aalborg Universitets forskningspotal. [Accessed 9 Feb. 2016]

Ill. 4. VIA University College ,2016, Forskning ,*Hvordan bliver Danmark et demensvenligt samfund ?*.[Online] Available at: http://www.via.dk/forskning/sundhed-og-omsorg/aldring-og-demens[Accessed 5. Feb. 2016].

Ill. 5. Nationalt videnscenter for demens 2016, *Forekomst af demens i Danmark.* [Online] Available at : http://www.videnscenterfordemens.dk/statistik/forekomst-af-demens-i-danmark/ [Accessed 6 Feb. 2016]

Ill. 6. Nationalt videnscenter for demens 2016, *Psykiatriske symptomer ved forskellige demenstyper.* [Online] Available at: http://www.videnscenterfordemens.dk/viden-om-demens/demenssygdomme/symptomer-paa-demens/psykiatriske-symptomer/psykiatriske-symptomer-ved-forskellige-demenstyper/ [Accessed 11 Feb. 2016]

Ill. 7. PCHT 2015, *What is Person Centred Dementia Care*[Online] Available at:http://www.pcht.ie/person-centred-dementia-care/[Accessed 9. Feb. 2016].
Ill. 8.Frandsen, A. K., Mullins, M., Ryhl, C., Folmer, M. B., Fich, L. B., Øien, T. B., & Sørensen, N. L.. 2009, *Helende arkitektur.* 1st. ed, Denmark. [Online] Available at: VNB: Aalborg Universitets forskningspotal. [Accessed 6 Feb. 2016].

Ill. 9. Møller, K &Kundstrup, M A ,2008, *Trivsel & plejeboligens udformning*, 1st edition, Servicestyrelsen, Odense. [Online] Available at: VNB : Aalborg Universitets forskningspotal. [Accessed 6 Feb. 2016]

Ill. 10. I Stock, 2008, *Healing touch – Stock image*[Online] Available at:http://www.istockphoto.com/photo/healing-touch-gm175476646-5573081?st=be2c90c. [Accessed20 Feb. 2016].
Ill. 11. Møller, K &Kundstrup, M A ,2008, *Trivsel & plejeboligens udformning*, 1st edition, Servicestyrelsen, Odense. [Online] Available at: VNB : Aalborg Universitets forskningspotal. [Accessed 8 Feb. 2016]
Ill. 12.Politiken, 2015, *Besøgsbabyer indføres på de Københavnske plejehjem*[Online] Available at:http://politiken.dk/indland/ECE3179141/besoegsbabyer-indfoeres-paa-de-koebenhavnske-plejehjem/[Accessed13 Mar. 2016]

Ill. 13. Møller, K &Kundstrup, M A.,2008, *Trivsel & plejeboligens udformning*, 1st edition, Servicestyrelsen, Odense. [Online] Available at: VNB : Aalborg Universitets forskningspotal. [Accessed 6 Feb. 2016]

Ill. 14 - 15. Hogeweyk 2016, *Urban design* [Online] Available at: http://hogeweyk.dementiavillage.com/en/kenniscentrum/ [Accessed 19 Feb. 2016].

Ill. 16. Wikimedia commons, 2011, *File:Fredsensborg Houses 17. Jpg.* [Online] Available at: https://commons.wikimedia.org/wiki/File:Fredensborg_Houses_17.jpg. [Accessed 15 May. 2016].

Ill. 17. Own Illustration

Ill 18. Licitationne, 2015, *Holbæk opfører plejehjem som OPP-projekt.* .[Online] Available at:http://www.licitationen.dk/article/view/202680/holbaek_opforer_plejehjem_som_oppprojekt#.VoFuqfmLQdV. [Accessed 7 Apr. 2016].

Ill. 19 Bejder, KA.,Knudstrup, M., Jensen, LR. and Katic, I 2014, *Zero Energy Buildings – Design Principles and Built Examples for Detached Houses.*, 1st ed, Copenhagen: [Online] Available at: VNB: Aalborg Universitetsforskningspotal.[Accessed 25 Feb. 2016].

Ill. 20 – 23. Autodesk 2016, Sustainability workshop, *Passive Design Strategies* [Online] Available at: http://sustainabilityworkshop.autodesk.com/buildings/passive-design-strategies [Accessed 15 May 2016].

Ill. 24 Google Maps, 2016,*Earth 3D 8200 Aarhus.* [Online] Available at: https://www.google.dk/maps/place/Skovvangsvej,+8200+Aarhus/@56.2097232,10.2048303,917a,20y,175.25h,77.87t/data=!3m1!1e3!4m5!3m4!1s0x464c3fb711a0be11:0x3f6ce68124c88a10!8m2!3d56.1762757!4d10.2102208[Accessed 9Mar. 2016].

Ill. 25. FlyfotoArkivet, 2016, . [Online] Available at:http://geomidt.flyfotoarkivet.dk/. [Accessed 10May. 2016].

Ill. 26. Google Maps, 2016, *Earth 2D Skovvangsvej 8200 Aarhus.* [Online] Available at: https://www.google.dk/maps/place/Skovvangsvej,+8200+Aarhus/@56.1644203,10.1930623,4124m/data=!3m1!1e3!4m5!3m4!1s0x464c3fb711a0be11:0x3f6ce68124c88a10!8m2!3d56.1762757!4d10.2102208. [Accessed 11Mar. 2016].

Ill. 27 -28. Own Illustrations
Ill. 29. Videnskab 2012, *Hvad er Hermeneutik ?,* [Online] Available at: http://videnskab.dk/kultur-samfund/hvad-er-hermeneutik. [Accessed 15 Mar. 2016].
Ill. 30. Google Maps, 2016, *Earth 2D Skovvangsvej 8200 Aarhus.* [Online] Available at: https://www.google.dk/maps/place/Skovvangsvej,+8200+Aarhus/@56.1644203,10.1930623,4124m/data=!3m1!1e3!4m5!3m4!1s0x464c3fb711a0be11:0x3f6ce68124c88a10!8m2!3d56.1762757!4d10.2102208. [Accessed 11Mar. 2016].

Ill. 31. Own illustration
Ill. 33. Hansen, V.A., Munk, T. K. S., Nguyen, L. T. N., Nielsen, S, L., Zuzeviciute, R., 2015, *From suburbs to sustainable urban living*, Gr. 9 Msc02 Architecture & Design, Aalborg University[Online] Available at: Aalborg Universitet, Detdigitaleprojektbiblotek [Accessed 20 Apr. 2016].

Ill. 34 -36. DMI 2016. *Måned, sæsonen og årets vejer* [Online] Available at: http://www.dmi.dk/vejr/arkiver/maanedsaesonaar/ [Accessed 12 Feb. 2016].

Ill. 37- 39. Own illustration, output from AutodeskEcotect.

Ill. 40 – 41.Miljø- og fødevareministeriet, 2016, *Miljøstyrelsen*[Online] Available at: http://miljoegis.mim.dk/spatialmap?&profile=noise [Accessed 29 Feb. 2016].

Ill. 42- 43.Own illustration

Ill. 44 Møller, K &Kundstrup, M A, 2008, *Trivsel & plejeboligen, En antologi om trivselsfaktorer i plejeboligen*, Heiselberg, P, Teknologi og det fysiske miljø, Syddansk Universitetsforlag, Odense M.

Ill. 45. Bygningsrelementet 2015, *7.2.5 Bygningsklasse 2020*, [Online] Available at: http://bygningsreglementet.dk/br10_05_id5180/0/42 [Accessed 17 May 2016]

Ill.46 – 49. Autodesk 2016, Sustainability workshop, *Occupant Comfort.* [Online] Available at: http://sustainabilityworkshop.autodesk.com/buildings/occupant-comfort [Accessed 19 May 2016].

Ill . 50. Madkulturen 2014, *Fællesskabet er afgørende for ældres livskvalitet.*[Online] Available at:http://madkulturen.dk/servicemenu/nyhed/nyhed/faellesskabet-er-afgoerende-for-aeldres-livskvalitet/.[Accessed 5 Apr. 2016].

Ill. 51 – 55. Own illustrations

Ill. 56. Møller, K &Kundstrup, M A.,2008, *Trivsel & plejeboligens udformning*, 1st edition, Servicestyrelsen, Odense. [Online] Available at: VNB : Aalborg Universitets forskningspotal. [Accessed 6 Feb. 2016]
Ill. 57 -68. Own illustrations

Ill. 69 Own illustrations out for Autodesk Revit

Ill. 70 -71. Møller, K &Kundstrup, M A.,2008, *Trivsel & plejeboligens udformning*, 1st edition, Servicestyrelsen, Odense. [Online] Available at: VNB : Aalborg Universitets forskningspotal. [Accessed 6 Feb. 2016]
Ill. 72 -80Own Illustration

Ill. 81 -82. Møller, K &Kundstrup, M A.,2008, *Trivsel & plejeboligens udformning*, 1st edition, Servicestyrelsen, Odense. [Online] Available at: VNB : Aalborg Universitets forskningspotal. [Accessed 6 Feb. 2016]
Ill.- 83. Own Illustration

Ill. 84. Digital Jounal 2011, *Gustav Vigeland´s Sculpture park and Gradens at Frogner, Oslo*, [Online] Available at:http://www.digitaljournal.com/article/305102. [Accessed 8 Apr. 2016]

Ill. 85. Flicker, 2016, [Online] Available at:https://c2.staticflickr.com/2/1351/1394595237_dbb654068b_b.jpg, [Accessed 15 Apr. 2016]

Ill 86. Alpac Lady, 2015, *Benefit Of Having A Greenhouse in your garden*,[Online] Available at:http://www.alpacalady.net/2015/09/benefits-of-greenhouse-in-your-garden/. [Accessed 8 Apr. 2016]

Ill. 87. Design Ruiz, 2016, *Garden Tables Help You to Grow Viggies, Herbs and Flower Anywhere !,* [Online] Available at:http://www.designrulz.com/design/2014/04/garden-tables-help-you-to-grow-veggies-herbs-and-flowers-anywhere/.[Accessed 9 Apr. 2016]

Ill.88. Garden site, 2013, *Forest Burford Pavilion*,[Online] Available at:http://www.gardensite.co.uk/garden-buildings/forest-burford-pavilion.htm. [Accessed 9 Apr. 2016]

Ill.89. Pinterest, 2016, *Mylightyearwarranty.com*, [Online] Available at:https://dk.pinterest.com/pin/145100419216975597/.[Accessed 10 Apr. 2016]

Ill. 90. Sweetiepiesharari, 2011, Touring the Tour – Part 2 : Nashville,[Online] Available at:https://sweetiepieshari.wordpress.com/2011/08/09/touring-the-tour-part-2-nashville/. [Accessed 11 Apr. 2016]

Ill. 91. Sunset, 2016, *Gardening in the parkway strip*,[Online] Available at:http://www.sunset.com/garden/landscaping-design/parking-strip-garden. [Accessed 11 Apr. 2016]

Ill. 92. Gap Gardens, 2016, *Summer border with cortaderiaselloana – Pampas grass and Sedum spectabile*,[Online] Available at:http://www.gapphotos.com/imagedetails.asp?imageno=112334 .[Accessed 12 Apr. 2016]

Ill. 93. Outsidepride, 2016, *UnciniaRubra Seeds*,[Online] Available at:http://www.outsidepride.com/seed/ornamental-grass/uncinia/uncinia-rubra.html . [Accessed 12 Apr. 2016]

Ill. 94. Cottafe Garden Plants, 2016, *Grass CarexComans Small Red*, [Online] Available at:http://www.cottagegardenplants.flowers/ourshop/prod_2803354-Grass-Carex-Comans-Small-Red.html . [Accessed 13 Apr. 2016]

Ill. 95. Lynch Robertson, 2015, Dementia Gardens, [Online] Available at:http://lynchrobertson.co.uk/. [Accessed 13 Apr. 2016]

Ill. 96.Kompan, 2016, The World's No. 1 Playground supplier,[Online] Available at:http://www.kompan.us/contact/. [Accessed 14 Apr. 2016]

Ill. 97. Backyard fruit, 2016, *Dorman Red Raspberry,* [Online] Available at:https://backyardfruit.com/dorman-red-raspberry . [Accessed 14 Apr. 2016]

Ill. 99- 106. Own Illustration

Ill. 107. Renders tegl, 2016 ,*Mursten RT 207 RødBløndstrøgenGandrupTeglværk,* [Online] Available at:http://www.randerstegl.dk/dk/mursten/produkt/rt307gt-classica-roed. [Accessed 14 Apr. 2016]

Ill. 108. Renders tegl, 2016 ,*Musten RT 207 Gul blødstrøgen,* [Online] Available at: http://www.randerstegl.dk/dk/mursten/produkt/rt207-classica-gul . [Accessed 14 Apr. 2016]

Ill. 109. Picz, 2016, *View image*,[Online] Available at:http://www.picz.ge/scripts/view.py?uid=cfed33392988 . [Accessed 15 Apr. 2016]

Ill. 110. Beauty wood design and décor ideas, 2015, *Spectaular plank wood countertop*, [Online] Available at:http://www.wzchutian.com/spectacular-plank-wood-countertop/ . [Accessed 15 Apr. 2016]

Ill. 111. Materilas- World, 2016, *Black Pearl*,[Online] Available at:http://www.materials-world.com/shingles/certainteed/carriagehouse/sub_Black_Pearl.htm . [Accessed 15 Apr. 2016]

Ill. 112. Renders tegl, 2016, *Teglsten RT806 Vingetagsten*,[Online] Available at:http://www.randerstegl.dk/dk/tagsten/produkt/rt806-hoejslev-lille-dansk-format .. [Accessed 16

Apr. 2016]

Ill. 113. Renders tegl, 2016 ,*Musten Gul RT 487 Hedetegl,* [Online] Available at: http://www.randerstegl.dk/dk/mursten/produkt/rt487-classica-hedetegl[Accessed 16 Apr. 2016]

Ill. 114. Picz, 2016, *View image*,[Online] Available at:http://www.picz.ge/scripts/view.py?uid=cfed33392988 . [Accessed 16 Apr. 2016]

Ill. 115.Imgmob, 2015, *Wood Plank texture*, [Online] Available at:http://www.imgmob.net/image/wood-planks/wood-plank-texture[Accessed 17 Apr. 2016]

Ill. 116. Renders tegl, 2016, MurstenGrå RT 542 Appollon, [Online] Available at:http://www.randerstegl.dk/dk/mursten/produkt/rt542-unika-apollon . [Accessed 17 Apr. 2016]

Ill. 117. Beauty wood design and décor ideas, 2015, *Spectaular plank wood countertop*, [Online] Available at:http://www.wzchutian.com/spectacular-plank-wood-countertop/ . [Accessed 15 Apr. 2016]

Ill.118. Renders tegl, 2016 , Tagsten Rt 840 sort enggoberet vingetagsten, [Online] Available at: http://www.randerstegl.dk/dk/tagsten/produkt/rt840-hoejslev-lille-dansk-format . [Accessed 15 Apr. 2016]

Ill. 119.Granitslag, 2016, Grus ogSten, [Online] Available at: http://granitsalg.dk/products/list/15-grus_og_sten . [Accessed 16 Apr. 2016]

Ill. 120 Stark, 2016, herregårdssten – gråmix, [Online] Available at: http://www.stark.dk/produkter/udendors/belaegningssten/Herregardssten/ . [Accessed 16 Apr. 2016]

Ill. 121 Renders tegl, 2016 ,MurstenGrå RT 511 grådæmpetgranit, [Online] Available at: http://www.randerstegl.dk/dk/mursten/produkt/rt511-unika-granit-graadaempet . [Accessed 16 Apr. 2016]

Ill. 122. Renders tegl, 2016,*MurstenRød RT 526 Windsor*, [Online] Available at: http://www.randerstegl.dk/dk/mursten/produkt/rt526-unika-windsor . [Accessed 2 May. 2016]

Ill. 123. Lugher texture, 2015, Wood planks light wood fence, [Online] Available at:http://www.lughertexture.com/wood-old-and-new-hires-textures/wooden-planks-textures/wood-planks-light-wood-fence-639 . [Accessed 25 Apr. 2016]

Ill. 124. Nikostine, 2016, LegepladsGummifliser 4,5 cm – 1 kvm- rød, [Online] Available at: http://www.nikostine.dk/shop/legeplads/gummifliser-4-5-cm-1kvm-sort.htm . [Accessed 26 Apr. 2016]

Ill. 125. Connovate 2016, *Teknologi,* [Online] Available at: http://www.connovate.dk/category/teknologi_connovate/.[Accessed 10 May. 2016].

Ill. 126 – 128. Own illustrations

Ill. 129. Møller, K &Kundstrup, M A.,2008, *Trivsel & plejeboligens udformning*, 1st edition, Servicestyrelsen, Odense. [Online] Available at: VNB : Aalborg Universitets forskningspotal. [Accessed 6 Feb. 2016]
Ill. 130- 133. Own illustrations, output from Be10 and 24- hour average table, Aalborg universitet.

Ill. 134 – 153. Own illustration, output from Velux Daylihgt visualizer.

Ill. 154. Own illustration, output from Revit

Ill. 155. Own illustration, output from.

Ill. 156. Own illustration, output from Revit

Ill. 157 Own illustration, output from Bsim andVelux Daylihgt visualizer

Ill. 158. Own illustration, output from Revit

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Ill. 161 Own illustration, output from Bsim andVelux Daylihgt visualizer

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Ill. 165 Own illustration, output from Bsim andVelux Daylihgt visualizer

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Ill. 169 Own illustration, output from Bsim andVelux Daylihgt visualizer

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Ill. 173 Own illustration, output from Bsim andVelux Daylihgt visualizer

Ill. 174. Own illustration, output from Revit

Ill. 175. Own illustration, output from.

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Ill. 177 Own illustration, output from Bsim andVelux Daylihgt visualizer

Ill. 178. Own illustration, output from Revit

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Ill. 181. Own illustration, output from Bsim andVelux Daylihgt visualizer

Ill. 182. Own illustration, output from Bsim.

Ill. 183. Own illustrations

Ill. 184. Own illustration., output from Bsim and Velux Daylihgt visualizer

Ill. 185- 191. Own Illustration, out put from Bsim.

Ill. 192 – 193 Connovate 2016, *Teknologi,* [Online] Available at: http://www.connovate.dk/category/teknologi_connovate/.[Accessed 10 May. 2016].

Ill. 194. Maardahl, ST, 2011, *Innovation med prfabrikerede elementer i højstyrkebeton*, Via University college, Bygningskostrktør Århus.

Ill. 195. Nielsen, VC, 2008, *CO² Footprint*. [Online] Available at: http://connovate.dk/wp-content/uploads/2012/10/CO2-Footprint.pdf [Accessed 24 Apr. 2016].

Ill. 196. Bygitegl 2016, Teglslivscyklus.[Online] Available at : http://teglapp.dk/livscyklus/beregningsmetoder/[Accessed 11 May 2016]

Ill. 197- 198. Own illustrations.

Ill. 199- 200. Systemair, 2016, Systemair CAD, [Online] Available at :https://www.systemair.com/dk/Danmark/Download/SystemairCAD/ . [Accessed 2 May 2016]

Ill. 201- 230. Own Illustrations.

Ill. 231 Own illustration, output from Be15 .

Ill. 232-237. Own illustration.

Ill . 238. Maardahl, ST, 2011, *Innovation med prfabrikerede elementer i højstyrkebeton*, Via University college, Bygningskostrktør Århus.

Ill. 239. Own illustration

ANNEX

ANNEX I

AARHUS KOMMUNE

Demens- og HjerneCentrum Aarhus
Bilag 1.01

2. Projektbeskrivelse

2.1.2. Beskrivelse af byggeriet

Byggeriet omfatter ny opførelse af 125 boliger med tilhørende servicearealer.
Herudover er der en option på ombygning/renovering de eksisterende 27 plejeboliger i Abildgade 9, så disse bliver egnede til demente borgere og borgere med psykiske lidelser, desuden ombygges en del boliger til lokalcenterfunktion.

Nybyggede boliger
De nybyggede boliger opdeles overordnet i 109 almene plejeboliger og 16 kommunale korttidspladser
De nybyggede boliger opdeles på følgende typer:
75 ét-rums specialboliger hvoraf de 10 vil blive anvendt til indslusningsboliger
34 flexible to-rumsboliger
16 ét-rums korttidspladser

Alle boliger skal være velegnede for beboere med svær demens/psykiatriske lidelser
De 16 kommunale korttidspladser og 75 af de almene plejeboliger skal indrettes som et-rums boliger.
De resterede 34 boliger indrettes som flexible to-rumsboliger med mulighed for omdannelse til et- rumsbolig efter behov. 6-8 af disse boliger indrettes specielt til borgere med Huntingtons sygdom, hvor der er særlige krav til materialevalg.

Servicearealer
Servicearealerne skal rumme træningsfaciliteter for mennesker i tidlig fase, specialdagcenter, uddannelse for pårørende og medarbejdere, pårørende faciliteter, rådgivning/ oplysningsarbejde (demensbutik), videnslære hus, sanserum, undervisningssal /auditorium m.v.

Arealer
Arealmæssigt forventes boligerne at udgøre ca. 9000 m^2 og servicearealerne ca. 1000 m^2.
Alle boligerne skal have samme bruttoareal, men hvor et-rumsboligerne får en større arealmæssig andel i deres fællesarealer, end to-rumsboligerne får i deres fællesarealer.

2.1.3. Overordnet økonomisk ramme

Hovedopgave – nybyggeri i alt 125 boliger
Den samlede anlægssum for nybyggeri forventes at udgøre kr. 210.464.400 ekskl. Moms, inkl. grundkøb og alle omkostninger.
Beløbet fordeler sig med:
kr. 183.950.400 ekskl. moms på boligdelen
Kr. 26.514.000 ekskl. moms på servicearealer

Option – ombygning af Abildgade 9
Den samlede anlægssum for ombygning forventes at udgøre kr. 6.100.00, inkl. alle omkostninger.

ANNEX II

MUNICIPALITY PLAN

Ramme 140224OF - Christiansbjerg

Generelle rammer for anvendelsestypen

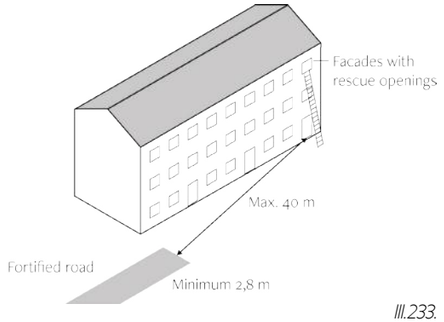
61 - Område til offentlige formål

Områdets anvendelse er fastlagt til offentlige formål.

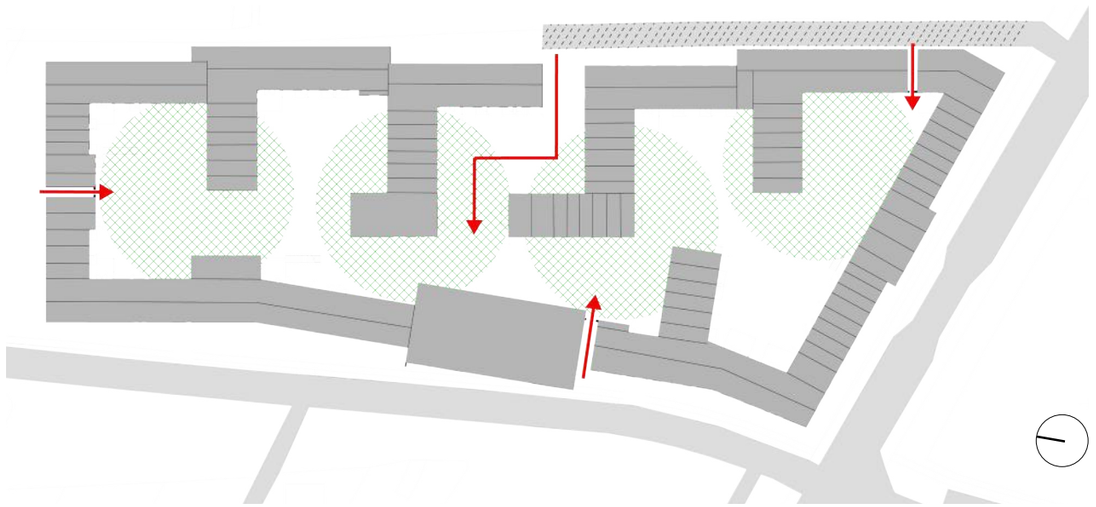
Konkrete bestemmelser for rammeområdet

Max. etageantal: 2 Max. bygningshøjde: 8.5m Max. bebyggelsesprocent: 45 for området under et
Offentlig administration, lokalcenter og lignende.

ANNEX III



III.233.



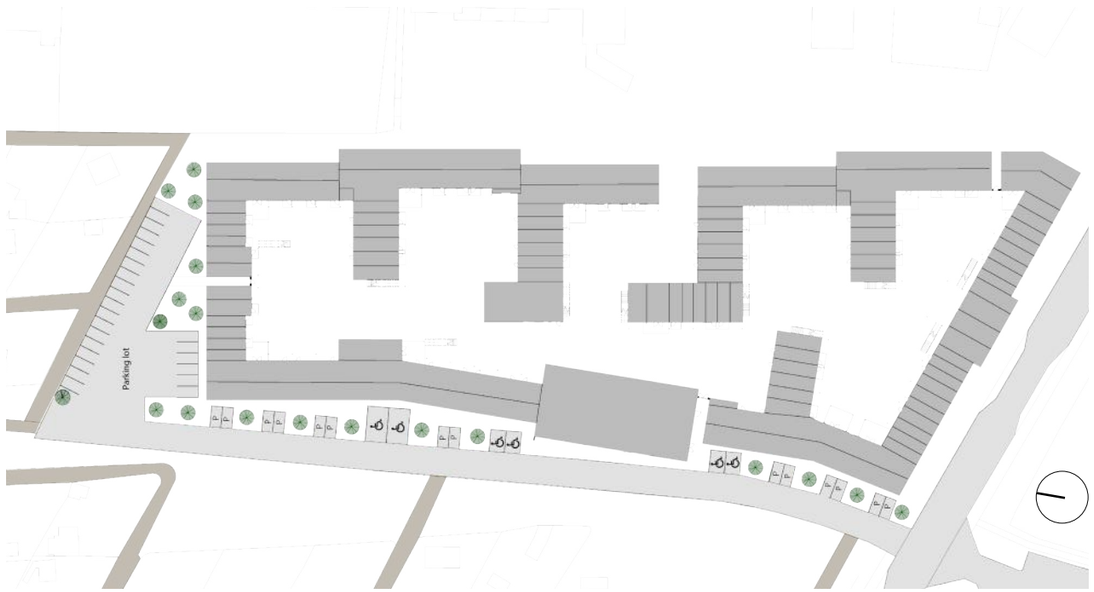
III.234. Fire plan

FIRE

According to the building regulation, building must be constructed and arranged to be safe in terms of fire and fire spread. There should be a possibility for rescue people and for extinguishing work. The buildings have to be design so the evacuation escape route are easy to find and are directly to the outside. Evacuation must happen outside on the terrain in the open air or in a safe place in the building. Escape routes must be independent parts from a building. The exits must be placed in or closely next to the rooms in the opposite end, and the distance from a subject's point in the room to the nearest exit or door to escape should not exceed 25 m (Bygningsreglementet, 2016). The emergency services equipment must be able to be brought to any door outside in the open air. Because of the motor vehicle size and the fire hoses length will it normally be possible if there is less than 40 m from the building doors to a sufficiently wide paved driveway. A driveway should be at least 2, 8 m wide and strengthened to withhold heavy traffic corresponding to fire rescues vehicles (Bygningsreglementet, 2016).

III.235. Fire escape plan of 1st floor

III.236. Fire escape plan of ground floor



Ill.237. Parking plan

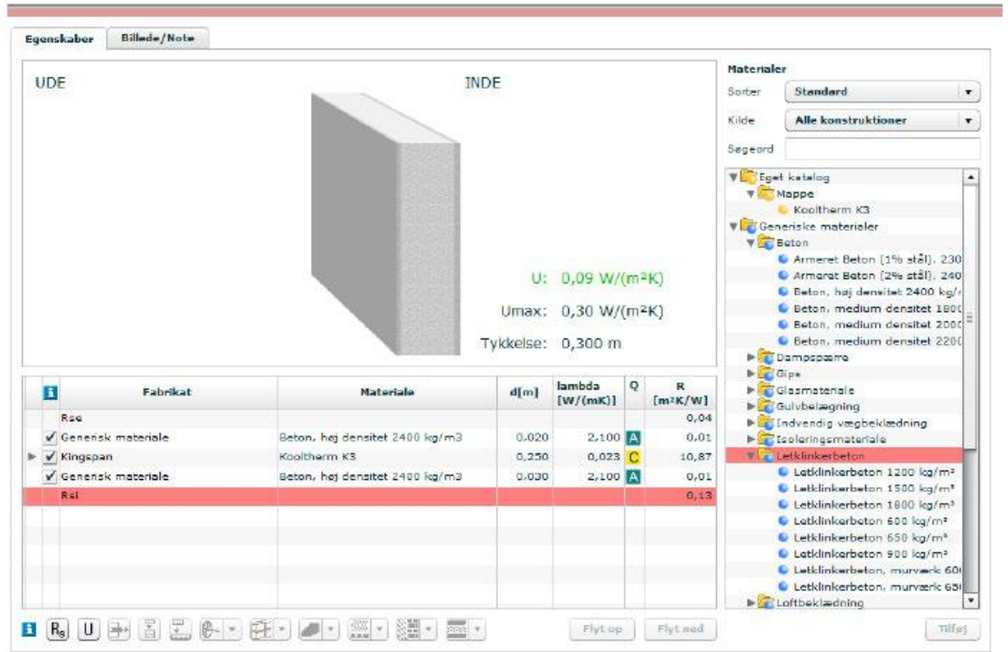
ANNEX IV

PARKING

There should be sufficient parking places for the complex residents, employees, visitors and good delivery etc. The number of parking places that should be in the area is determined by the municipality. There should be a suitable number parking spaces for handicapped people. The parking spots for handicapped must be 3,5 m x 5 m and should be placed as close to the entrance as possible. At least one handicap spot should be 4.5 m x 8 m for a minibus with a lift at the back (Bygningsrelegemanet 2016,).

The amount of parking spots are determined by a document from Aarhus commune that can be seen in the appendix. The document shows divided Aarhus into three zones and set instructions for parking number for each. The site is placed in zone II, and therefore it must be 1 parking spot for 4 residents and 1 for person working on a night shift. There are 125 residents in the whole complex and 6 employed at night shift. Therefore 38 parking spots are required.

ANNEX V



Ill.238. Innovation with prefabricated elements of high performance concrete

ANNEX VI

To achieve the indoor air quality of class II standards, the pollution cannot exceed 850ppm.

The concentration of CO_2 outdoor, in towns with good air quality is 350 ppm and the corresponding CO_2 level above outdoors is 500ppm for category II. (Dansk standard, 2007)

SENSORY POLLUTION

The calculation is made with the following pollution loads

1 person with 1-1,2 met (no smoking): = 1 olf(Dansk standart, 1998)

Building pollution: = 0.2 olf per m^2(Dansk standart, 1998)

Following formula determines the necessary airflow supply in the apartment.

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

c : the experienced air quality [dp] →c = 1,4 dp(Hyldgård, et al., 1997)

c_i : the experienced air quality of the outdoor air [dp] →c_i = 0,05 dp(Hyldgård, et al., 1997)

q : the pollution load [olf]

V_l : the necessary air flow supply [l/s]

To find the air change rate for the double room apartment, the pollution load first needs to be determined:

$$q = 1\ \text{olf} \cdot 2\ \text{people} + 0{,}2 \frac{\text{olf}}{m^2} \cdot 32{,}7 m^2 = 8{,}5\ \text{olf}$$

The necessary airflow supply can then be determined

$$c = c_i + 10 \frac{q}{V_l} \quad \rightarrow \quad V_l = \frac{q \cdot 10}{c - c_i} \quad \rightarrow \quad 1{,}4 = 0{,}05 + 10 \frac{8{,}5}{V_l} \quad \rightarrow \quad V_l = 63{,}3\ \text{l/s}$$

Hereby is the air change rate

$$n = \frac{V_l \cdot 3600s}{1000 \cdot V_{room}} = \frac{63{,}3 \frac{l}{s} \cdot 3600s}{1000\,l \cdot (32{,}7 \cdot 2{,}5m)} = 2{,}8\ h^{-1}$$

ATMOSPHERIC POLLUTION

Floor area double, room apartments: 32,7m^2

Room height: 2,5m

Room Volume: 81,75m^3

People: 2

Activity level: 1met (The rate of energy used, while resting)(Dansk standart, 1998)

Pollution (l/hr) : 19L (Pollution load caused by occupants)(Dansk standart, 1998)

The actual pollution in the room is calculated.

$$19 \cdot 2 \cdot 1met = 38\ l/hr$$

Outdoor air quality = 350ppm → $350 \cdot 10^{-6}$ = 0,000350 ppm

Indoor air quality (category II.) = 850ppm → $850 \cdot 10^{-6}$ = 0,000850 ppm

Then the Air change rate can be found.

Actual pollution $= \frac{0{,}38 m^3/hr}{1000}$

Air change rate $= \frac{0{,}38 m^3/hr}{0{,}000850\ ppm - 0{,}000350 ppm} \cdot 81{,}75 m^3 = 0{,}9\ hr^{-1}$

Airflow rate $= 0{,}9\ hr^{-1} \cdot 81{,}75 m^3 = 76\ m^3/hr$

Volume flow $= \frac{76 m^3/hr}{60 \cdot 60} = 21\ l/s$

ANNEX VII

DIMENSIONING OF VENTILATION DUCTS

First, the airflow needs to be changed from $\frac{m^3}{h}$ to $\frac{m^3}{s}$

$$\frac{227{,}73 m^3/h}{3600 sek} = 0{,}0633\ m^3/s$$

The area of the ducts can be calculated as $\left(\frac{\pi}{4}\right) \cdot d^2$

The airflow $v = 3m/s$

Then it is possible to calculate the ventilation ducts:

$$\left(\frac{\pi}{4}\right) \cdot d^2 \cdot 3m/s = 0{,}0633 m^3/s \rightarrow \quad d^2 \cdot 3m/s = \frac{0{,}0633 m^3/s}{\left(\frac{\pi}{4}\right)} \rightarrow \quad d^2 \cdot 3m/s = 0{,}0806\ m^3/s$$

$$d = \sqrt{\frac{0{,}0806\ m^3/s}{3m/s}} \quad \rightarrow \quad d = 0{,}164m \quad \approx \quad 200mm$$

A duct with the diameter 164mm does not exist, therefore the next duct size is used.

ANNEX VIII

Distance	Diameter	Length	Sum ind. losses	Volume flow	Volume flow	Air speed	Pressure loss dist.	Sum pressure loss
	[m]	Deltal [m]	Σζ [-]	q [m³/h]	q [m³/s]	v [m/s]	ΔP [kPa]	ΣΔP [kPa]
A-B	0,16	4,4	0	173,33	0,048	2,4	1	1
B	0,16		0,33	173,33	0,048	2,4	1	2
B-C	0,16	8,07	0	173,33	0,048	2,4	2	4
C	0,16		1,8	173,33	0,048	2,4	5	9
C-D	0,16	4,4	0	173,33	0,048	2,4	1	11
C-E	0,2	5,5	0	346,66	0,096	3,1	2	12
E	0,2		1,8	346,66	0,096	3,1	8	21
E-F	0,16	4,4	0	346,66	0,096	4,8	4	25
E-G	0,25	5	0	519,99	0,144	2,9	1	26
G	0,25		1,8	519,99	0,144	2,9	8	34
G-H	0,25	4,4	0	519,99	0,262	3,4	2	36
G-I	0,315	9,047	0	944,99	0,262	3,4	10	46
I	0,315		1,8	944,99	0,570	4,5	1	47
I-J	0,4	3,5	0	2053,18	0,570	4,5	21	68
J	0,4		2	2053,18	1,141	5,8	1	69
J-K	0,5	3,5	0	4106	0,000	5,8	1	69

III.239.

The requirements for a ventilation system, is that the energy consumption for air doesn't exceed 1.500 J/m³(Bygningsreglementet, 2015)

The energy use for the system is calculated in system air to be 0.83 kW/(m³/s) this is converted to J/ m³

$$0{,}83\ kW\left(\frac{m^3}{s}\right) * 1000\ kg = 830\frac{J}{m^3} < 1500\frac{J}{m^3}$$

This means that the energy use for the ventilation system is fulfilling building regulation 2015

ANNEX IX

CALCULATION OF SOLAR CELLS

Energy needed for the building to fulfill zero energy requirements by using solar cells, calculation of how many square meters that requires must be made.

Total energy requirement for the building:	19,8kWh/W²year
Total building area:	11499m²
Number of apartments and common rooms:	147pcs
Energy use for appliances and lighting:	1725kwh/year per apartment

$$\left(\frac{19{,}8\text{kWh}}{\text{m}^2\text{year}} \cdot 11.499\text{m}^2\right) + \left(\frac{1725\ \text{kWh}}{\text{m}^2\ \text{year}} \cdot 147\right) = 481.255{,}2\ \frac{\text{kWh}}{\text{m}^2\ \text{year}}$$

Areal of solar cells (A): ?

Solar cells efficiency (B): 18% (Aalborg University, 2015)

Performance in high sun (C_{peek}):

$$\text{C}_{\text{peek}} = \frac{\text{A} \cdot B}{100} \text{or} \qquad \text{C}_{\text{peek}} = \frac{\text{E solar cells}}{\text{D} \cdot \text{E}} = \left(\frac{\frac{481.255{,}2\ \text{kWh}}{\text{m}^2\ \text{year}}}{0{,}8 \cdot 1124}\right) = 535{,}204\text{kW}_{peek}$$

System factor, integrated in the facade (D): 0,8 (Aalborg University, 2015)

Sun radiation, south /south west, 30 degree roof (E): 1124 (Aalborg University, 2015)

$\text{E}_{\text{solar cells}}$: $481.255{,}2\frac{\text{kWh}}{\text{m}^2\ \text{year}}$

$$\text{C}_{\text{peek}} = \frac{A_e \cdot B}{100} \quad \rightarrow \quad A_e = \frac{535{,}2\ \text{kW}_{peek} \cdot 100}{18} = 2973{,}35$$

$$A = \frac{A_e}{1{,}8} = 1651{,}86\ m^2$$

If wanting to fulfill zero energy requirements, 1651,86 m² of solar panels are needed. This corresponds to using 50% of the roof area turned towards south/south-west or using 25% of the total roof area.

The solar cells could also be placed on the shutters or on the railing at the gallery.

AALBORG UNIVERSITY
DENMARK

Project name: Dementia centre in Aarhus		Scale: 1:500
Draw by: Msc04-Arc Gr 35	Drawing No: 1.1	Date: 25-05-2016
Titel: Masterplan		N

AALBORG UNIVERSITY DENMARK	Project name: Dementia centre in Aarhus	Scale: 1:200
	Draw by: Msc04 - Arc Gr 35 / Drawing No: 2.1	Date: 25-05-2016
	Titel: Ground Floor	N

Project name:		Scale:
Dementia centre in Aarhus		1:200
Draw by:	Drawing No:	Date:
Msc04 - Arc Gr 35	1.2	25-05-2016
Titel:		
1. Floor		

AALBORG UNIVERSITY DENMARK

N

AALBORG UNIVERSITY DENMARK	Project name: Dementia centre in Aarhus		Scale: 1:200
	Draw by: Msc04-Arc Gr 35	Drawing No: 3.1	Date: 25-05-2016
	Titel: North		

AALBORG UNIVERSITY DENMARK	Project name: Dementia centre in Aarhus		Scale: 1:200
	Draw by: Msc04-Arc Gr 35	Drawing No: 3.4	Date: 25-05-2016
	Titel: West		

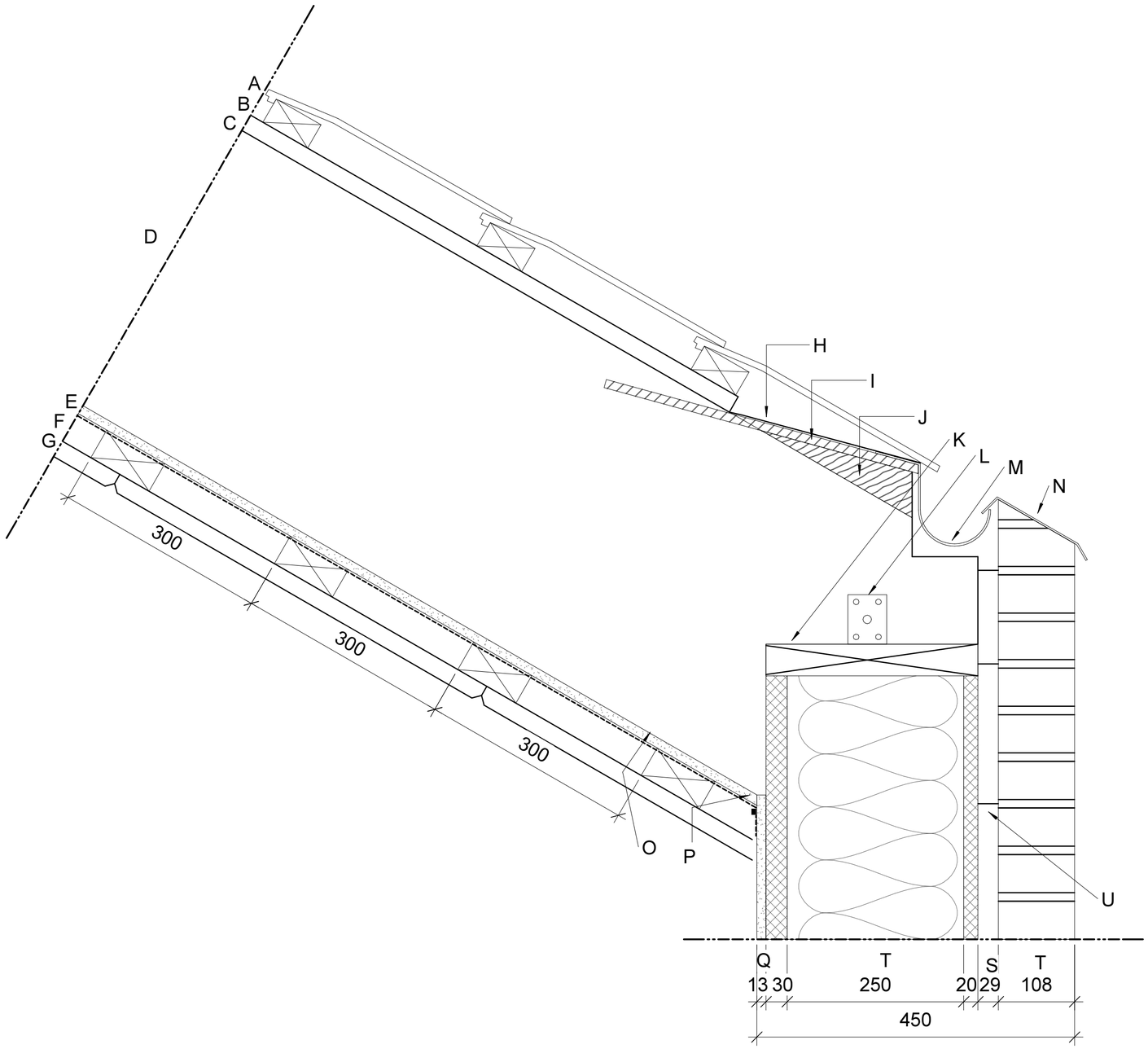
AALBORG UNIVERSITY DENMARK	Project name: Dementia centre in Aarhus		Scale: 1:200
	Draw by: Msc04-Arc Gr 35	Drawing No: 3.2	Date: 25-05-2016
	Titel: East		

AALBORG UNIVERSITY DENMARK	Project name: Dementia centre in Aarhus		Scale: 1:200
	Draw by: Msc04-Arc Gr 35	Drawing No: 3.3	Date: 25-05-2016
	Titel: South		

AALBORG UNIVERSITY DENMARK	Project name: Dementia centre in Aarhus		Scale: 1:200
	Draw by: Msc04-Arc Gr 35	Drawing No: 4.1	Date: 25-05-2016
	Titel: Section A-A		

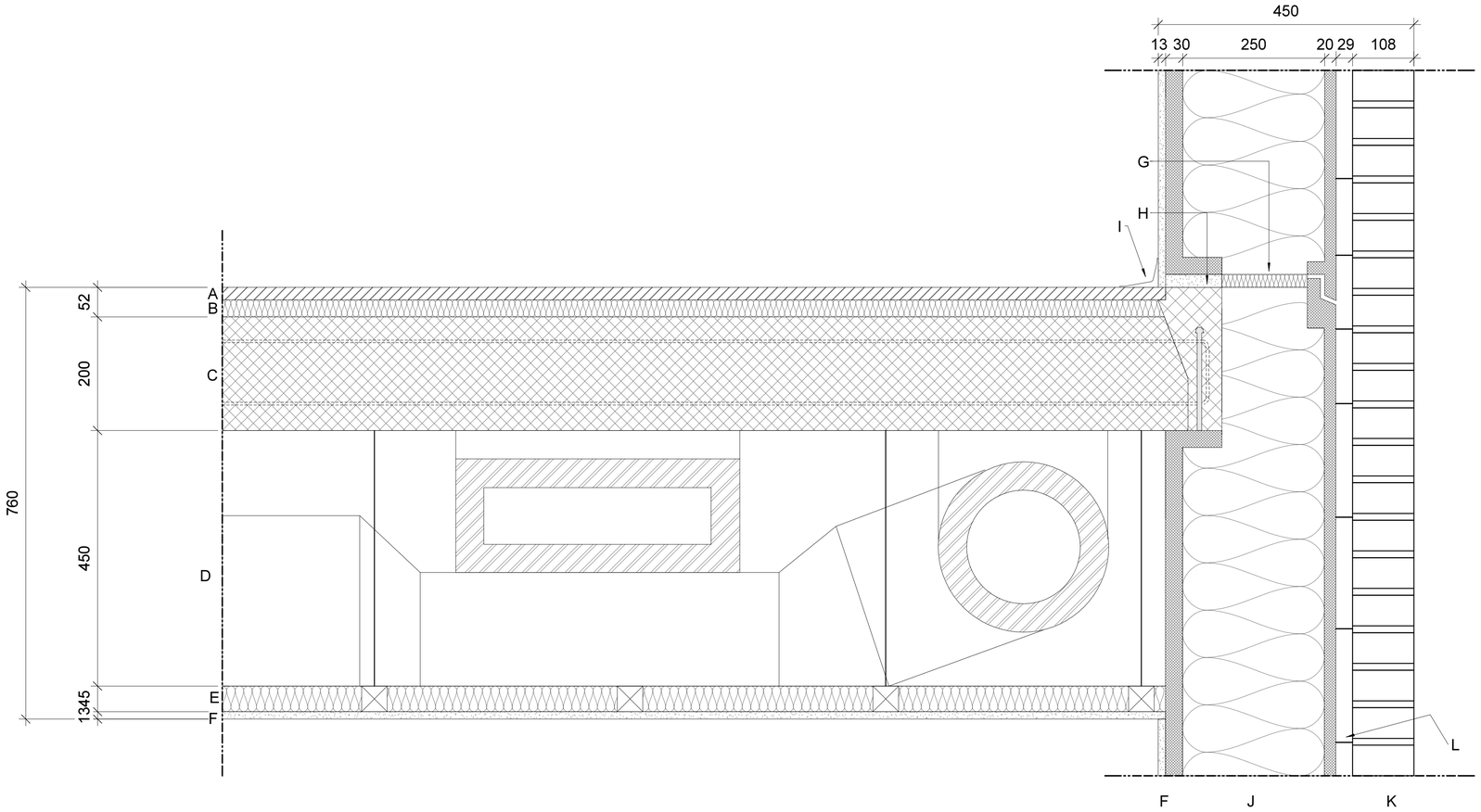
AALBORG UNIVERSITY DENMARK	Project name: Dementia centre in Aarhus		Scale: 1:200
	Draw by: Msc04-Arc Gr 35	Drawing No: 4.2	Date: 25-05-2016
	Titel: Section B-B		

AALBORG UNIVERSITY DENMARK	Project name: Dementia centre in Aarhus		Scale: 1:200
	Draw by: Mac04 Xxc Gr 35	Drawing No: 4.3	Date: 25-05-2016
	Titel: Section C-C		



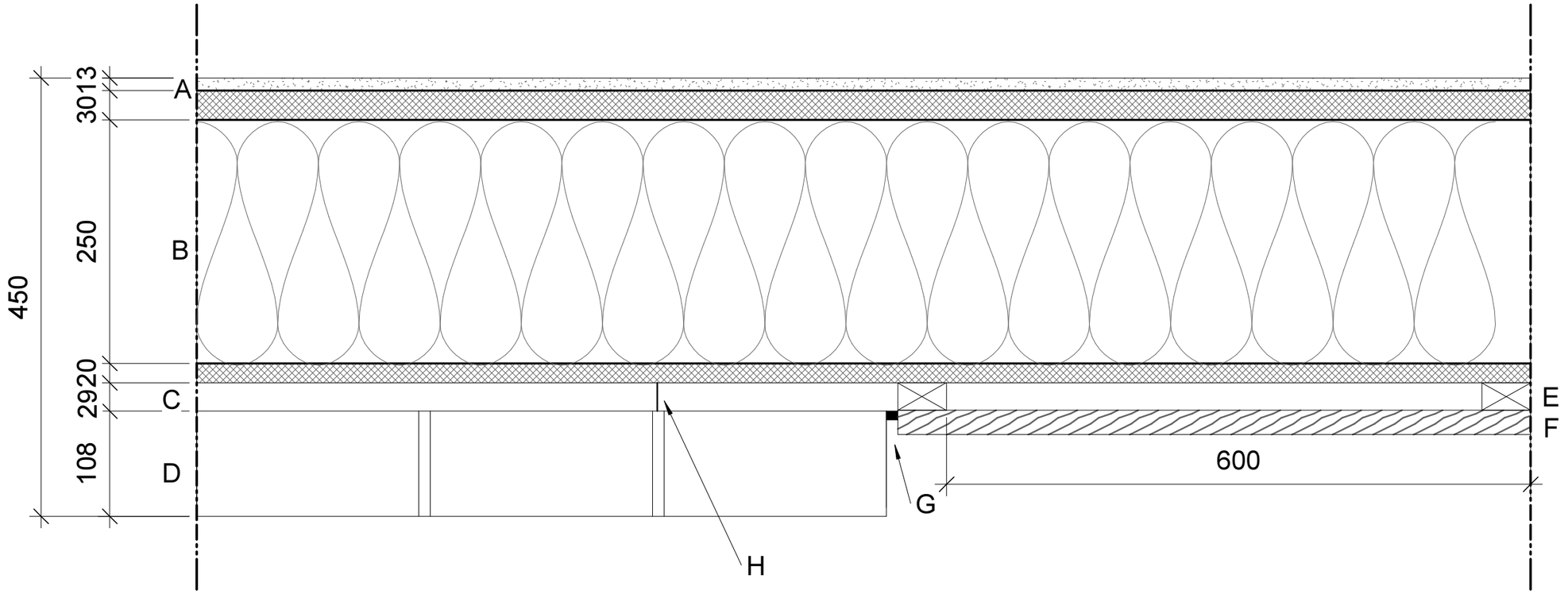
A - Roof tiles
B - Batten 38mm x 73mm
C -Distance list 25mm x 50mm
D - Rafter 450mm
E - Fermacell
F - Batten 45 mm x 95mm
G - Acoustic panels
H - Membrane
I - Plywood
J - Wedge
K- Rem
L -Mounting bracket
M - Gutter
N - Zinc
O - Vapor barrier
P - Grout
Q - Fermacell
R - High performance concrete system
S - Ventilation
T- Brick wall
U- Wall tie

AALBORG UNIVERSITY DENMARK	Project name: Dementia centre in Aarhus		Scale: 1:5
	Draw by: Msc04-Arc Gr 35	Drawing No: 5.1	Date: 25-05-2016
	Titel: Roof		



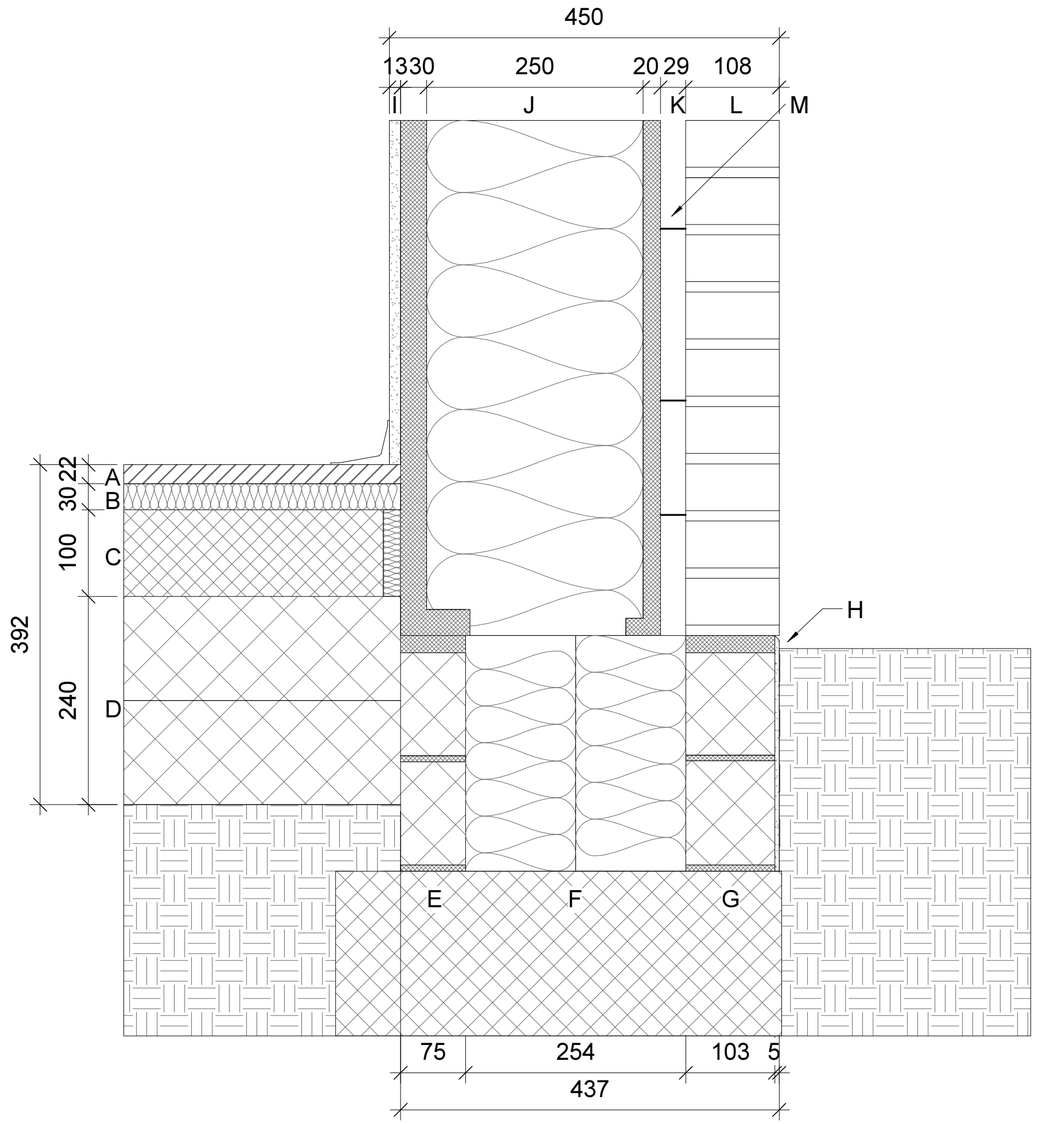
A - Wood flooring
B - Hard insulation
C - Concrete deck with reinforcement
D - Ventilation pipes
E - Batten 45mm x 45mm +Insulation
F - Fermacell
G - Insulation
H - Below casting
I - Wall base
J - High performance concrete system
K- Brick Wall
L- Wall tie

AALBORG UNIVERSITY DENMARK	Project name: Dementia centre in Aarhus		Scale: 1:5
	Draw by: Msc04-Arc Gr 35	Drawing No: 5.2	Date: 25-05-2016
	Titel: Floor slab		



A - Fermacell
B - High performance concrete system
C - Ventilation
D - Brick wall
E - Batten 28 mm x 95 mm
F - Wood cladding 25 mm
G - Grout
H - Wall tie

AALBORG UNIVERSITY DENMARK	Project name: Dementia centre in Aarhus		Scale: 1:5
	Draw by: Msc04-Arc Gr 35	Drawing No: 5.3	Date: 25-05-2016
	Title: Wall		



A - Wood flooring
B - Hard insulation
C - Concrete deck
D - Terrain insulation
E - Leca blocks
F - insulation
G - Lace blocks
H- Plinth plaster
I - Fermacell
J - High performance concrete system
K - Ventilation
L - Brick wall
M - Wall tie

AALBORG UNIVERSITY DENMARK	Project name: Dementia centre in Aarhus		Scale: 1:5
	Draw by: Msc04-Arc Gr 35	Drawing No: 5.4	Date: 25-05-2016
	Titel: Foundation		