RETIREMENT CENTRE NORTH

MSc04 ARC - Spring 2017 - Aalborg University

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ABSTRACT

In recent years, progress in the eldercare in Denmark has been taken place, with the wish to improve the life quality of the elderly. Therefore, a substantial amount of money has been assigned from the government to improve the eldercare. This has resulted in a new type of retirement centre called 'retirement centre of the future' which focuses on the wellbeing of the residents and uses integrated care solutions, such as floor sensors, to help with the care of the elderly. And this project is an example of a retirement centre of the future where the residents have dementia of diverse types and degrees.

The centre is called 'Retirement centre North', located in Randers north but still close to the city centre and is based on a competition program from Randers municipality. The centre is divided in to 4 units, with 13 homes, a shared area and courtyard in each, and then a large common area with shopping facilities, gardens, administration and a special unit.

The focus in the project was to make a centre that help the residents to feel at home and maintain a lifestyle that they know from before the moved to the centre. With varying functions, such as shopping, going to the hair dresser, helping with house work or staying in own home. Based on that each person is different and therefore have different wishes and needs to their apartment to make them feel at home, which is made possible by making flexible homes so the residents can personalise their home. As the resident's illness progresses their home can be adapted and so can their movement in the centre, and in the final stages of the illness there is a special unit for the patients where they can get intensive care and not be disturbed by other residents. In the centre, there are multiple outdoor areas, of different characters and uses, but with the mutual idea is that they bring in light and provide views in each area of the building.

The technical aspects of the project have been indoor environment and energy consumption fulfilling the Danish 2020 standards, with the use of passive and active strategies. Therefore, integrated design principles been used in the project, which for instance resulted in the roof shape, that have multiple slopes (one for each home. The slopes are facing south for ideal placement of pv's, bringing in the diffuse northern light in the homes and making a spacious living room area in the homes.

COLOPHON

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READING GUIDE

This report is divided into four parts:
- Analysis
- Presentation
- Process
- Epilogue

Throughout the report there is an indicator text in the bottom of the page showing the phase order of the report, and the current phase.

After the analysis there will be a summary of what was achieved through the analysis, which makes the basis for the vision and therefore also the final design.
The choice of the presentation first and then process, is based on the assumption that it is easier to understand the process when you are familiar with the result.

In this report, the Harvard method has been used as the referencing method.

INTRODUCTION

This master's thesis takes inspiration from the competition to design a retirement centre of the future, the site is at Rindsvej 2 in Randers. Retirement homes in Denmark, are as essential to us as public schools and other general care facilities because of our well-fare system and therefore the goal is to design a special care facility primarily for elderly people with dementia, focusing on their wellbeing and sustainability of the complex.

There will be a focus on social sustainability by interacting with the context and ensuring the wellbeing of the residents. This will be achieved by working with the theories of ¨Healing architecture¨ to create spaces with positive influence on the users, and the concept of ¨missing link¨ to design the private areas as basis for creating homes and the social facilities for various activities.
And considering the amount of retirement centres in Denmark, their usage activity and thereby their energy demand, it is reasonable to design a general sustainable solution and as a minimum achieve the energy standard of BR2020. By using integrated design passive and active strategies will be implemented into the design, such as application of energy efficient envelope and Photovoltaics.

METHODOLOGY

The integrated design process is the basis methodology for this whole master thesis project. The integrated design process method is a problem based oriented method developed by Mary-Ann Knudstrup, a professor at Aalborg University.
The method focuses on integrating the architectural sciences and professional engineering knowledge. This means that the architectural and engineering aspects are equally essential, and the project is executed by using a didactic learning process, by working in a group, where the project is based on a problem in the real world, that should be solved. This means that both disciplines are developed simultaneously, hence it becomes integrated design.

In the integrated design process the manner of working is iterative, and this means that every stage has been reconsidered after gaining new knowledge or insights, and thereby the project has been reviewed and modified several times to end up with the most integrated design achievable. This process can be seen on fig. 7.1
The project has several different main phases, divided in overall subjects with relevant aspects to each phase. The methodology for these phases are described below

The problem:
In this project, the problem is based on an internally developed project framework in the group, with supplementing literature that will be analysed to gain relevant knowledge and thereby determine the direction of the project and which specific goals the team seeks to reach. The problem also takes inspiration from a competition to design a "Retirement home of the future in Randers" Where relevant aspects of the competition material is also used as the basis of the problem.

Analysis:
The analysis in the project is based on relevant competition material, own empiric investigations, and phenomenological impressions. After thorough considerations and inspection of composed analysis and with necessary knowledge and insight, the problem is fully determined, and design parameters are clarified.

Sketching:
In this process, many ideas will be drafted in a creative mind-set, with the only limitation that it should have base in the design parameters. In this way, a lot of conceptual ideas will be generated, both by sketching, physical models, and computer aided models. During this process workshops of varying time will be integrated to focus on one aspect of the design, such as the implementation of PVs, the windows, the flow of the complex, and overall shape.
After each round the ideas will be discussed, with the focus on finding potentials, qualities and challenges, about both the aesthetical and the technical aspect of the ideas.

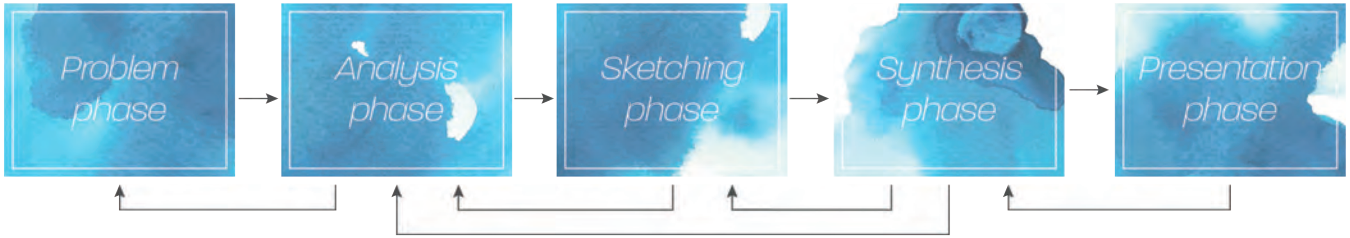


Fig. 7.1 - Methodology diagram

Synthesis:
In the synthesis phase the smaller concepts and ideas for the design will be evaluated and will adapt in to the final design. This will be done by, combining them in to one model, discussing and evaluating it based on the knowledge found through the analyses and the design criteria, to ensure that all aspects, both technical and aesthetical aspects are considered fully.
In the end, the design should have a refined concept, with detailing and a coherence between the technical and ascetical aspects.

Presentation:
In the presentation phase, the result from the different phases throughout the project are presented in a final design, comprising of, descriptions of relevant aspects, illustrations, and relevant calculations, supporting the technical aspects of the project.

Analysis

The analysis phase gives an overview of the challenges and possibilities for the project.
By first understanding the main issues for the project the user group of dementia patients is described, what the illness does and what functions they need to try to restrain it. Then the main focusing area of "home" is investigated, by the theories 'the missing link' and 'what makes a home' these will supply the knowledge for a plan lay-out that will support the needs of the user group and the framework for the residents to make a home. And with the support of the groups opinion of what normality in living is, the theories will also describe the functions needed in the centre.

Secondly how the state of the Danish retirement centres is today will be investigated, by using a national inspection report of the retirement centres from 2016 and an interview with a care taker that has worked in various retirement centres.

To get guidelines to create a good environment at the centre the theory of 'healing architecture' is investigated, because this will together with the functions of the centre help the residents and caretakers wellbeing, by helping create design principles for light intake, materials, connection between in- and outside.

For the shape of the building 'healing architecture', 'the missing link' and sustainability text will be the main factors.

The last part of the analysis introduces the competition program this project is based on and describes the physical factors from the site and the context, to get an understanding of the physical challenges and possibilities of the project.

DEMENTIA

Dementia is the term to describe typically elderly people who get a mental disease that affect their memory and personality, which means that their mental state gradually worsens. There are more than 200 different kinds of diseases that can cause dementia, but the most common disease is Alzheimer's disease being 70 % of all dementia cases and in 2007 it was estimated that care for Alzheimer disease cost USD 300 billion worldwide (Ricci et al. 2012; Perri et al. 2005; Wimo et al. 2007; Prince et al. 2013).

Generally, dementia patients are affected by following mental problems (videnscenterfordemens.dk, 2016)

- Not taking initiative and having less energy.
- DIfficulty finding the right words, and to name certain things-
- Finding directions.
- Trouble of getting an overview and difficulties of problem solving, such as math or day to day tasks
- Forgetting names of persons ans remembering new places

Typically, dementia patients also have more difficulty at social gatherings, because of problems remembering, it can be people, or certain situations (videnscenterfordemens.dk, 2016), and during activities that will be evaluated. All the scenarios can give psychosocial stress and stressing dementia patients worsens the damage of the hippocampus which is the part of the brain, that is first degraded during the Alzheimer disease (Conrad, 2008).

There is no way to prevent dementia or cure it, however research shows that it is possible to prolong a life without dementia, so it arrives much later, and slows down the process for already existing patients.
The lifestyle choices people make, with physical and mental activities can have an affect later in life, on when or whether people get dementia.
The known lifestyle choices and activities that can to some extent prevent or slow down the process of having dementia that is relevant to this project is: (videnscenterfordemens.dk, ... fem gode råd)

Active brain:
It is very good to always learn new things, and to never stop learning something new. Frequent advanced use of the brain helps always develop it and make it stronger, and that helps later, because typically people that have been very active learners their whole life, develop dementia much later than those that haven't been that active in learning something new. As soon as people stop learning they start gradually losing their intellectual functions

Social activities:
Being social, and spending time with family, friends or finding new friends and new interests also stimulates the brain intellectually and thereby also helps maximising the time without dementia.

Healthy lifestyle:
Always staying active physically has also been proven to be important for reducing the risk of getting dementia, because physical activity also stimulates the brain intellectually, but to reduce the risk of getting dementia it is also important to stay healthy in general, and physical activity helps with that. To be healthy, nutritious and healthy food is also essential, foods with fibres, plant oils, vegetables, such as spinach and broccoli and kale seems to reduce the risk of getting dementia as well (videnscenterfordemens.dk, ...fem gode råd)

Slowing down the process of their disease, and making it as comfortable for the patients as possible while living there, can be achieved by creating living conditions that support the patient to have a regular active lifestyle without any stressors. This can be done by a "closed" safe environment, where the patients can move around and easily orient themselves about the inside and outside without wandering away from the retirement centre. Experiments have shown that the layout and design of a room can influence peoples' stress levels: where people were placed in two different rooms and had to preform two tasks, the people that could look out of the room had a lower stress level (Jönsson et al. 2010: Wallergård et al. 2011). Besides, their homes should be adapted to what they want and need, and should be recognisable for them by placing something of significance just outside their home.

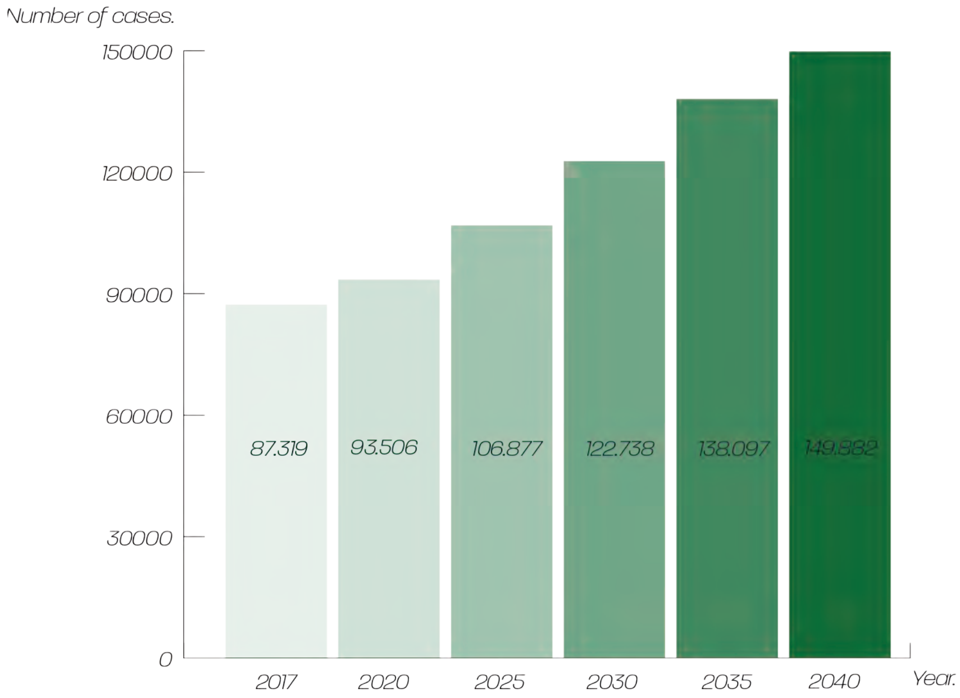


Fig 11.1 - Prognosis for people with dementia in Denmark
(from 2017 - 2040)

THEORY: *THE MISSING LINK*

Fokus på de meget ældre 75+ (focus on the elderly people 75+) is a research study published in February 2006 by two architects, Aase Eriksen – architect MAA ph.D and Karin Skovsbøll – architect MAA. They investigate eldercare in Denmark especially the retirement centres where they focus on the life quality of the elderly and the transition from old home to the new one at the centre and this is where the concept "the missing link" comes from.

The investigation

The Danish system works by the method "stay in own home the longest" (Eriksen et al. 2006: pp. 6), both to save the amount of retirement centres needed and because of the notion that people are happier and better by staying in their own home. But this can have the effect of a large group of elderlies being lonely because they can't handle going out and/or they don't have any close family or friends to come visit them. Therefore it would be better if elderly people move to the retirement centre earlier, but some people can't cope with the transition of homes and feel they left their 'life' behind, hence the notion of happier in own home, and many times the lay-out and daily structure in the retirement centres prevent the elderly of getting the feeling of home in the many centres (Eriksen et al. 2006: pp.. 14-15). This problem is the basis for "the missing link" where the report tries to find a solution by investigating the eldercare system in U.S.A.

The main difference is the amount of different offers, which means that there is something that fits each individual. The most popular care facilities is Continuing Care Retirement Community (CCRC) and Assisted Living Community (AL), which is similar in the sense that it is small communities with shops, different types of residences (apartments and houses), varying activities both social, physical and educational and people as young as the late 50'ies can move in.

In that way they can get to know the area, make social contacts and create their new home as they want it, when they still have the energy to do so.

The difference between CCRC and AL is that AL is for people that need more care and help in their day to day life, and therefore also offers rehabilitation (after illness or accidents), hospice, and departments for severe dementia.

CCRC is different in the way that it can adapt in to the different care solutions the residents need as they gradually aging, which also includes AL services. So, some residents at CCRC don't need any special care but are there for the social aspect and the security of care if needed (Eriksen et al. 2006: pp.. 22-28).

The result

Some of features from CCRC and AL can help with "the missing link", but with CCRC and AL it has to be clear that they are made based on the health care system in U.S.A, hence the residents mostly pay for everything themselves and that some people wants to make a profit out of it. Therefore, the features must be adapted to the Danish healthcare system. The relevant features are the opportunity to move in and have time to create a home, with new social functions, get to know the area, and move in to a residence that can be adapted to their wishes and needs.

Therefore the report ends up with four suggestions, where two of them are Bo Plus 1 and Bo Plus 2, where Bo Plus 1 is like CCRC and Bo Plus 2 is similar to AL. Where Bo Plus 1 is more open community with functions used both by the residents and local community, and the residents can interact with other parts of the local community.

Where Bo Plus 2 is more closed and for people with severe dementia or other health problems, and therefore want more peace and clear boundaries (Eriksen et al. 2006: pp.. 54-61).

Within the closed community there should still be social and physical activities, both in- and outside, so the residents should be able to move around by themselves. The activities could be minor shopping facilities, cafes, interaction in the preparation of meals, the thing to remember is that the lay-out and decorations should be adapted (Eriksen et al. 2006: pp.. 42-46).

The homes should be flexible to fit the individual both in terms of care but also dēcor, so they 'create' their home. The homes should be placed together in groups and each group should have a common area where they can be social potentially over meals, television or just conversation. The general dēcor and layout should be easily recognized so they won't confuse the residents, for example, long hallways, vivid colours, sharp edges and large glass openings could contribute to the identity.

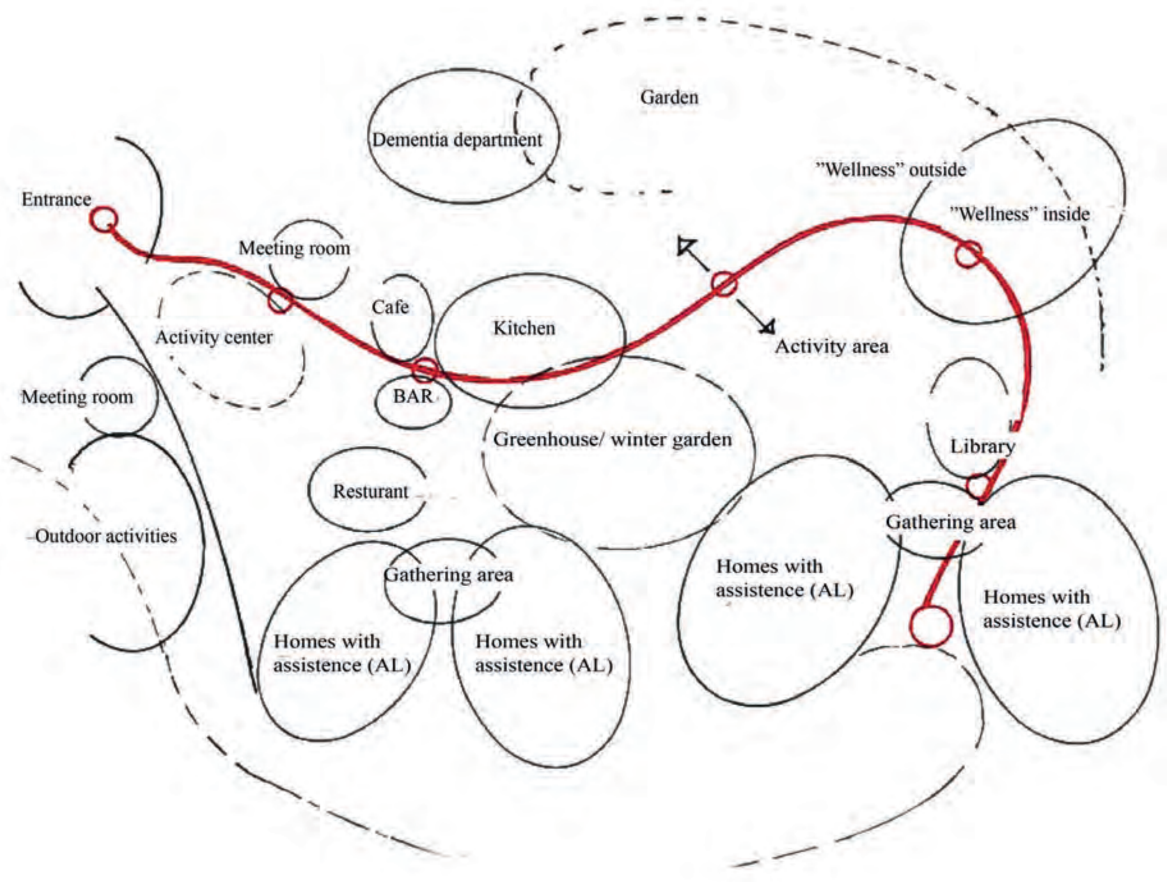


Fig 13.1 - Boplus room diagram

Fig. 14.1 - House/home diagram

WHAT IS A HOME?

To figure out what makes a home some of anthropologist Mark Waher's views have been researched, to get a understanding of the framework of a home, that can help each individual patient feel more at home and at ease in the retirement home, and a possibility to make it their own.

One of the first point that are mentioned is, that a home is something that is gradually done, meaning that a house and a home is not the same. The people living in the house create the home, with the experiences they have over the years and the things we put in the house will determine how it becomes our home. Waher takes the example of moving into a new house. In the beginning, there is an adjustment period, where everything is new, where light swithes are placed, and which way the door turns, and in the beginning, it is just a house, and gradually it turns into a home when people start getting used to everything and start furnishing, painting the walls etc, and when doing certain things has become a routine it has become a home.

"A house is an object. While a home is a state - a relation, a relationship, a connection between a human being and an object. If the object disappears, then suddenly it's possible to articulate the relationship. Paradoxically it is easier for humans to tell what they lost, then to tell what they currently have. They can better describe what a home is, when it is gone." (Wacher)

He describes it very well, where he says the house is a shell, where inside this shell we create our own home, with how we individually decide paint, choice of furniture and placement of the furniture, what each room is used for etc. However, houses can be very different, and therefore the house also influences us, by changing our behaviour according to the individual house. An example is, a certain plan layout will make people behave in a specific manner compared to another different floor plan, and this means that not do we only create the home ourselves, it also changes us, how we behave. Whether we own the house also determines to what extent we make it our home. There is more freedom to individualise the home if we own the house, compared to it we are only renting it.

"We set our mark and write in concrete for eternity, while in a public apartment, are writing on whiteboard, because we always must be ready to erase it"(Wacher)

For most people a home is a place of individuality, that reflects who we are, our values, and what we care about. It is the place where we can relax and take it easy, and we can be completely ourselves. It's the place where we feel safe, and the place where only we decide how we behave. A real home has a warmth that makes us feel at ease, however what feels like a home can vary from person to person, but the basic principles are the same. Some people like a certain style that makes them feel at ease, it can be a certain design style. For someone else a specific design style feels cold to them. And the feeling of home has also changed a lot throughout the years, with the changing society.

A home is not something that architect can make, an architect can only make a spatial framework designed so it is identifiable as a base for a "traditional home". So, that the base can be adjusted to fit the individual user and gradually become their home, where they can be them self and relax.
In the retirement centre, a framework of units will be created for the patients, with simple flexible solutions so that they can adjusted according to different users' whishes, their physical and mental state, and changed it gradually as their illness progress. For example, some interior division walls can be adjusted to change the volumes of rooms, various furnish arrangement opportunities to encourage the residents adjust the interior according to their own characters and interest, such as placement of dining area, placement of television, and entrance space with personal preference.

EXPERIENCE OF NORMALITY

- In public and privat areas

Definition of normality can be difficult to define, since the sense of normality can be very different from person to person. For this project, the sense of normality is from situations that has occurred in the resident's previous life in different places including home, neighbourhood and more public urban areas.

Homes:

Most of people spend a lot of time at home, so the layout, decoration, functions, furniture and daily housework activities creates a sense of normality to them. Different people often have different experience of what feels normal of a home, depending on how they have lived before, in a single-family house in the suburbs or an apartment building in a city centre, with someone or alone. But generally, is a convenient room layout and the placement of furniture also essential to create the normal sense of home, with spaces for various activities like, being social by hosting family and friends over for a cup of coffee/tea. These spaces should be personalised with pictures, individual furniture and other objects they have a personal connection to.

Neighbourhood:

For most people, they have been living in a neighbourhood their whole life, possibly in several different ones over the course of their whole life. This feeling of connection to neighbours can also give the residents the feeling of normality. The definition of the neighbourhood, is a place that is more public, than their own home. A place to meet people living close by, but also being able to withdraw on days where privacy is wanted. A place where it is possible to seek social connection like talking over the hedge, about everything and nothing special. The neighbourhood, has the feeling of several different types of houses, personalities, different design styles, and in a typical neighbourhood in a suburban area it is very clear that there is a lot of individuality.

Neighbourhood can mean different things for different people, some people maybe don't have any communication with their neighbour, either because they are not that social or because that is the general behaviour. This can be very typical for cities, so the neighbourhood should also give this opportunity, and not force people to gather necessarily.

A neighbourhood often also has shared areas where they can meet, like a park, place to play football, a place for children's play etc. for those that like being social this is where they can go individually and meet other people, but also where they can arrange bigger events such as a street party.

Town:

Every person has often been to the city centre, shopping mall, or other stores, for buying groceries, new clothes, to get their hair done, or go out to eat at a restaurant etc. These experiences can give the feeling of normality for most people, because it is something they have done on a regular basis their whole life. The city centre always consists of many kinds of shops and functions, that provide different products or services, and these shops most often vary a lot in their design/expression, just as a residential neighbourhood, but with a more pulsating activity level with calm places in between which gives a varied experience. This is something everyone is familiar with, and therefore this can really give the feeling of normal for most people.

Often activities throughout people's lives can also determine what feels like normal to everyone, however there are some general activities that is common for majority of people. The first part is being able to cook is a very big part of a regular life in Denmark, most people cook their own food, and this is mostly considered as very cosy, and for most people it wakes up very fond memories, because eating food is also very social, both in smaller and larger groups. The pleasant smell of food both of regular food and baking, can give a feeling of home, and remind people of good memories and experiences. Another activity that many people know, and either love or hate is garden work, which can remind people of their past life they had to maintain their garden and/or their old home. Therefore, can an implementation of these activities in to the retirement centre help the residents getting a sense of normality, both as a form of something they can see or smell, but also possibly something they can still be a part of by helping to the extent they can.

CONDITION IN DANISH RETIREMENT CENTRES

The number for elderly over 65 is growing each year (aeldresagen.dk, may 2016) (see fig. 17.1) and some of them move into retirement centres where they in average live 8 months to 2 years (sum.dk,2016). Therefore in 2015, the Danish parliaments' social committee started a national investigation of the conditions in Danish retirement homes, where some of the focuses where (sum.dk, 2016):

- The residents' well-being.
- The staff, the number of staff pr. centre and number pr. resident, their professionalism and the amount of using tempts and unskilled employees.
- The daily routine and activities, with a focus on the individual residents wishes and needs.
- The physical surroundings.
- Diet for the residents.
- The use of medicines.

To research the results there where used facts from the municipalities in Denmark, about number of homes, amount of residents and then 12 anonymous retirement centres did a questionnaire to get an insight of the daily life of the centres.

The investigation concludes on the general state of the retirement centres and what areas there had to be taken initiative for improvements, the areas that will be focused on in this paper is: The life quality and dignity of the residents, and care of dementia patients.
The life quality and dignity of the residents:

The dignity policy will be changed to fit the five focus points of eldercare (sum.dk, 2016):

1. Life quality
2. Self-determination
3. Quality, interdisciplinary and coherence in the care.
4. Food and nutrition.
5. A dignified death.

There has already in 2012 and again in 2016 been given about 50 million. DK-kr. to make this a reality. Where the money will be used to educate the staff in how to adapt the care to everyone, and on activities for the residents such as music, dance, good meals, and trips out of the centre to see culture or nature.

The investigation shows that elderlies life quality becomes better after moving to a retirement centre, because of the personal care, feeling safe, and the daily contact with other people in various activities. The activities should activate the residents both physically and mentally, but mainly where the residents can have a mutual experience and thereby connect with each other. Which also can be over dining or preparing food together and the investigation is implying that centres with their own kitchen have a positive effect on the residents' appetite.

Life quality also comes from the residents' self-determination, on when they want to eat and how they want to organize their own home to show their individuality.

Care of dementia patients:
People with dementia need special care and most times more care than other elderly, therefore there must be taken special consideration in the retirement centres. And therefore, there has been devoted close to 500 million. DK-kr. to improve the care of dementia patients, which includes working with the relatives (for support and involvement with the care of their loved one) and develop more on the use of social pedagogical methods, both in the care from the staff and in the planning of the centres. The social pedagogical method is about

passive strategies to help the dementia patients, such as clear signs for orientation (placement of bathrooms, personal objects to show what is their home) and during the last 15 years the concept of 'living- and housing environment' has been the preferred solution. Here the centre is made into units, that contains a common area (a kitchen and a lounge) which is surrounded with the individual private homes, this gives stability and safety for the residents with dementia. And it is preferred that these units give the residents opportunities to move around on their own, both in- and outside, and that the spaces stimulate them through natural light, smell and touch.

To help ease the care routine the use of technology can support the use of social pedagogical methods and the self determination of the residents. The technology can be ceiling lifts, to help move the residents if needed, self-washing toilets, and floor pressor sensors or GPS' sensors, that can control the whereabouts of the resident, if they have fallen or prevent a fall by turning on the light on if they get out of bed. In this way, the resident is being helped to do normal activities by themselves or are being looked after without feeling it.

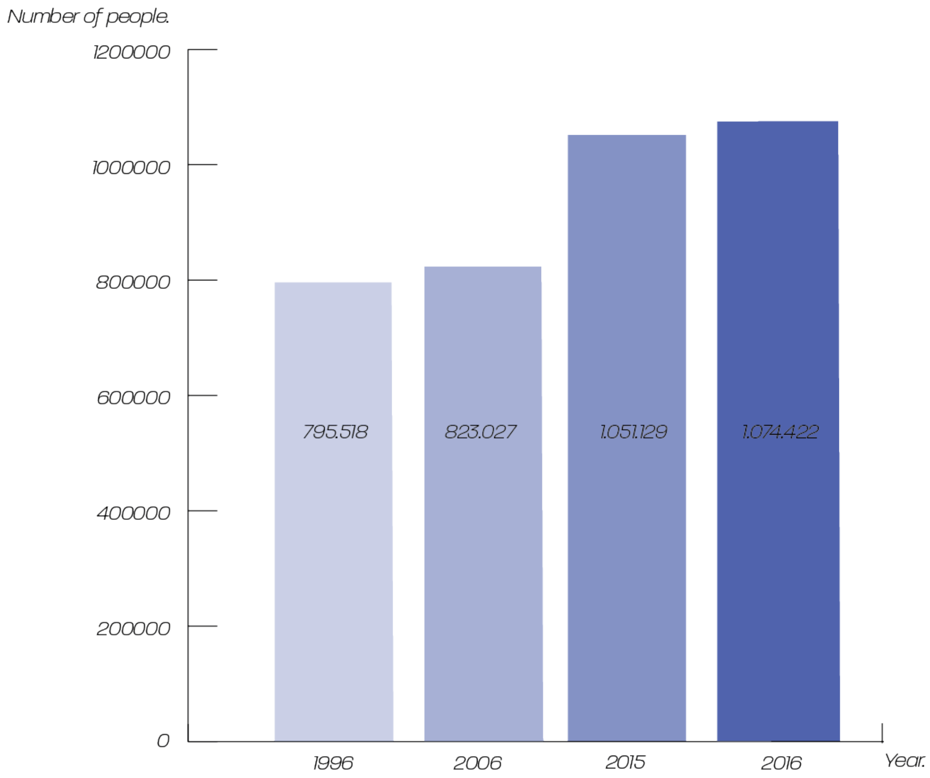


Fig. 17.1 - The rise in number of people over 65 years.

INTERVIEW: *CARETAKER*

An interview has been carried out, talking to a caretaker, which has been working at several different retirement centres. This has been done to get a better indication of what is needed in a good working environment for the employees in a retirement centre, and key insights into what perspective a caretaker has and the generally needed environment in a retirement centre not only as a workplace, but also for the residents. The caretaker and nurses are the employees that are dealing with the day to day operation of a retirement home, and have the contact to and taking care of the residents, therefore they have good insights into what is needed in a retirement centre, and which solutions would work and the ones that wouldn't. The interviewee in question has gained years of experience from four different retirement centres.

One of the first things and the most essential in her own professional opinion is that the retirement home feels like home for the residents. In her view that means that there is room for the residents to have some of their own furniture's, or personal effects of big importance to the individual resident. This also includes space for privacy, and that doesn't have to be very private, but more so there is space for peace when the resident is tired and wants to be alone.

Another thing that is very important is that, there is a clear division between the residents that are generally more mentally healthy, than the ones with more severe dementia. The reason for this being that the clearer residents, don't feel comfortable around the more severely affected residents. To prolong the clear period, it's also important to not stress residents unnecessarily, and seeing other more severe cases can stress them, also because severe dementia patients can be frustrated and get a bit violent.

The caretaker also has the opinion that the use of colours is good for the residents, especially the residents with more severe dementia, because dementia patients often begin to act more like children again, and colours also makes the environment more interesting, however it is important to keep the number of colours balanced, because it shouldn't distract the patients either. Often in retirement homes colours are also used for dividing areas, it can be on the floor or walls and doors, and this can indicate to the residents where they are supposed to go and where they aren't supposed to go. For example, using black squares on the floor isn't recommended, because the dementia patients see it as dangerous, like a hole they can fall into. A certain colour on the door can indicate that they are not supposed to go there etc. The use of colours is helpful but also must be considered carefully and which colour is used in a specific area.

Both private rooms and public areas in the retirement home should to the extent they can, feel open, and spacious and at the same time be peaceful and block as much noise out as possible, to not stress the residents. It is also important that the residents don't feel like they are locked in the building, and that they have room to walk and explore, also because dementia patients are known to be wanderers, so it should feel like they are free to move around and at the same time consider safety measures so they can't escape. It is also important to have a simple plan layout, and certain ways for the residents to find their way back to their room without the help from the caretakers.

When it comes to the design of the spaces it is important to keep it clean and not too many details, because too many details can distract the residents too much, and disorient them. The caretaker's opinion was also that it often is good to have a combination of new and old mixed together. In this case that means that the building design can be clean and new, but the retirement home can be furnished with older furniture. This is more to make the residents feel at home, and some of the furniture can make them feel at ease, because it's something they remember from the past.

The caretaker didn't have many specific requirements for space of the rooms, but in general felt that it should be very spacious

and that architects should really consider and consult caretakers when designing the rooms, the dimensions, and placement of certain things. The caretakers have experience in how much room it takes for specific tasks, and experience from places where it worked well and places where it doesn't work that well. Generally, the task scenario should be kept in mind when designing the spaces, such as bedroom, place in front of the bed, and the bathroom and where each thing is placed, such as toilet, shower and sink.
The caretaker in this interview is taking shifts at various retirement homes, some newer ones, one completely new and older ones, and the biggest difference for her has been the interior design of the bathrooms, where the best ones she has worked in is the newer and newest home. Her experience and wish as a caretaker is to have a bathroom where, sink, is adjustable in height, and if the solution exists she would prefer that the toilet was also adjustable in height. For the shower, she also prefers a bench that can be put up and down, so the resident can sit comfortably while being washed, this both makes it easier for the resident, but also the caretaker.

For accessibility in general the best solution for a lift is the ceiling mounted lift, that can go from the bed to the toilet, and preferably the shortest possible distance, and a spacious area in front of the bed, because in certain cases two caretakers/nurse are needed to help the resident out of the bed. In general, the caretaker also mentioned the importance of designing the room with the different scenarios where the caretaker must aid the residents, the space it requires to do the job most efficiently.

It is also important for the residents to feel like they have a purpose in life while they are living in the retirement centre. There should be enough activities so they don't get easily bored. One example the caretaker mentions is that in one of the centres she has worked at, there are several smaller kitchen units throughout the institution where the residents can help prepare the food, to get the smell of the food, and get their hands dirty, and help set table etc. This makes them remember times from their past that made them feel happy and gives a feeling of home for them. Other activities that she mentioned is light physical activity like dancing, singing or just listening to relaxing music also helps them feel at ease and relaxed. An important aspect is therefore to make room for places for physical activities and create the framework for different kinds of activities.

She also mentioned, that she and her co-workers were asked to come up with their ideal retirement centre from the experience they have gathered throughout the years. The idea they came up with was a centre shaped like a circular ring, where the rooms for residents are placed in the ring, and in the middle of the ring, all public areas are placed, and at centre the staff, because this gives the staff a very good overview over everyone and this is also very important, so they can quickly and efficiently help residents that need help. Another thing she mentioned was that it would be good to create it more like a community, where there are several relevant shops for the residents, so they feel that the centre is more like the real life they are used too from their past, and it makes them feel more alive.

She also mentions garden and green areas as very relevant, because it often calms patients down, and points out that it's not only relevant to use some spaces for stays, but also for places where the resident can be included and help with gardening to the extent they are physically able, because many residents had gardens at their previous home, and this can also make them feel at home and make them feel more normal.

There are several good points from the caretaker, that seem like very relevant aspects to consider, certainly because the caretaker has a good indication how the residents behave and what they typically want, and what they don't want. It is important to point out that it is seen more as inspiration from a caretaker's experience and that it is not a scientifically proven study. This is therefore used as an indication of what direction the design should go into from an employee's point of view.

THEORY:
HEALING ARCHITECTURE

This analysis describes the findings in the study Helende arkitektur, that is considered relevant for this project. The study describes factors that can positively influence the healing process for patients and how architecture can be shaped based on those factors to create the best environment for the patients. The study of sound and noise, and the other aspects in the research report comes from a study made of hospitals, which is a place that should be calm and relaxing for patients.
The factors described, all relate to the body, such as daylight, noise, art, plan layout, choice of material, ventilation etc. The topics are described more in detail, focusing on the aspects that can be the most essential to ensure an ideal environment for the retirement centre. Some of the factors will influence the selection of the design parameters, and thereby also influence some of the design choices throughout this project

The different factors:

Light conditions:
When it comes to light conditions, the research papers show negative effects for patients if the light conditions aren't ideal. Several studies have shown an importance in daylight conditions inside that follows the natural daylight rhythm of the outside. With a good amount morning light, and the gradually decreasing light at the end of the day, supports the patients' natural sleeping pattern, this also helps prevent depression.

This means that it is important to have windows that draw in light and give a visual of the outside surroundings. A lack of windows can cause postoperative delirium, compared to a department with windows. Also, where there are no windows it is easier to get disoriented, according to time and place and create a loss of memory. It is not only important to get daylight, but also an ideal window placement with a good view, because for majority of users, asked in the studies, said that a bad placement and/or a boring view can be as unattractive as no window lack of natural daylight.

Conclusion is that lighting conditions is crucial to the experience for patients, and can influence their mental state and their healing process from injuries, surgery etc. Also for employees at the institution it can improve their performance and make less mistakes. Therefore, the amount of windows, their size, and placement is crucial to get the right light conditions and also a beautiful scenery.

Sound and noise:
The study shows that sound can have a calming effect, and help with the healing process. Noise can disturb sleep and be stressful, when it's experienced as noise it is sudden and unwanted sound, which can come from appliances, technical equipment, workers and other patients. (Frandsen et. al pp. 73)
A big part of the literature in this study is pointing to a conclusion, that says the sound level influences patients physical and mental healing process. (Frandsen et. al pp. 75)
The sound environment can have a big influence of how patients experience the hospital, and periods of quietness during the day, can help relieve or prevent the build-up of stress, anxiety, maintain sense of control, and therefore have an influence on their mental state and healing process (Slevin et al., 2000; Zahr & de Traversay, 1995) (Frandsen et. al pp. 79)
It can be concluded that the amount of noise should be limited, hence the placement of the functions in the retirement centre together with the materials used should help maintain a calm stable sound level for the residents and the people at the centre like relatives and employees.

Air quality:
The air quality is also essential for the patients in a hospital, and their wellbeing. Research shows that smells in hospitals, will have a negative effect on patients, especially in cases that patients are bedridden they can't move away from the smells. Therefore, the ventilation strategy for both a hospital and retirement centre also needs to be addressed properly to guarantee comfortable indoor air quality. Also, material choices in the building should be considered properly, so that they can easily be cleaned and therefore the source of the smells can be removed properly (Frandsen et. al pp. 108)

Plan and flow:
In general, the lay out of the building should be carefully designed, to ensure easy and independent movement throughout the building, to avoid frustration that can stress the patients. This is both relevant for patients, relatives and employees in both personal spaces and public areas in the hospital or retirement centre (Frandsen et. al pp. 113)

Personal and social spaces:
The socialising and having social areas to interact with other on common terms, is equally important as private areas for the patient's privacy, sense of individuality and security. The social areas are essential to maintain a sense of normality, by providing an area that can room family gatherings, and social interaction. Also, research has shown an importance of including relatives in the healing process, because they can motivate them. How the social areas will be used and to what extent, depends on their placement, which is best placed away from trafficked areas in a calm setting, that feels open, but also gives a sense of privacy from the surrounding areas or walkways.
As for the private rooms, it is important that the patient can interact confidentially in front of employees and close family. Also, the room should provide opportunity for individuality, like placing private things of importance to the patient, also to give the feeling of home and comfort. (Frandsen et. al pp. 129)

Outdoor areas:
The outdoor areas are just as important to go out to enjoy, as they are to be appreciated from the inside.
As mentioned before a view can have a positive effect on patients and employees physical and mental state, therefore it is important to focus on the vegetation and trees in the outdoor area, both to create the beautiful views, but also to create experiences and a calming atmosphere walking amongst it (Frandsen et. al pp. 187)

Implementation of the theory in the project:
The research report show that it is important to help maintain the natural stages of human beings, in a calm and safe environment. There will be a focus on light, plan lay out, and air quality, and this analysis gives focus points on what to aim for, and the relevant aspects for stable indoor environment for the residents. The light conditions have to be considered especially carefully, to avoid getting depressed patients, therefore placement of windows, and amount of windows will be a strong focus, and these should give an environment that gives them the experience of the natural day rhythm. For the individuality aspect, the residents also need to be able to adjust the indoor environment, like amount of light, heating temperature, and ventilation, but at the same time it should be mostly automated for the resident's convenience.

SUSTAINABILITY AND PV'S

During the last couple of years, there has been more focus on sustainability both in the aspect of social and energy.
Of the two, social sustainability is more indeterminable because it can be achieved in various ways, because it is how the function and use of the building is appealing to the context and people, and thereby creating connection and 'life' in and around the building. Whereas energy sustainability is easier to describe, because it simply comes down to how large energy consumption a building has. Which depends on the construction of the building and the use of the building, such as indoor climate, because high quality indoor climate is required in nowadays building regulation and energy efficient buildings solutions needs to be employed to fulfil the requirement. For instance, the relevant air change, the use of building, and heating needs to be decided with energy consumption consideration for the BR20 standards with maximum 25 Kw/year. m^2 (bygningsreglementet.dk, 7.2.4 bygningsklasse 2020).

Creating a building with low energy consumption can be achieved by using passive and active strategies. Where passive strategies are designing solutions for buildings to save as much energy as possible and active strategies can create energy for buildings, which can reduce the reliance on grid or municipality energy supply for buildings.

Passive strategies:
Passive strategies include a well-constructed envelope, with no or only minor thermal bridges, a transmission loss on max. 3,7 W. pr. m^2 (for a 1. story building) (bygningsreglementet.dk, 7.2.4 bygningsklasse 2020) insulated windows and doors, to use the least energy on heating the building as possible.
But systems in the building should also be designed to use a minimum of energy, such as heat recovery of minimum 75% in the ventilation system, insulation of heating pipes and the pump. And design principles can be used to minimise the use of the systems, like natural ventilation, preventing overheating with the use of window shadings, or use the sun for heating.

Active strategies:
For active strategies, there are different possibilities but they are all renewable energy methods like geothermal, wind, solar heating and photovoltaics, by using these a buildings energy need for heating and electricity can be covered. However some of the solutions are better to use than others based on the buildings location, such as geothermal and wind is better to use for a farm, with a good distance to the neighbours and have a large area, and some solutions are more manageable and gives a higher yield. Which is the reason why photovoltaics is one of the most popular methods to make renewable energy, because it is easy to setup and solar energy is the largest and most reliable renewable energy source (teknologisk.dk) (See fig.23.1).
Active strategies of renewable energy can always be added later to a building, which is a good idea for the environment but aesthetically, added renewable energy methods, can hardly be good solutions. Therefore, integrated design with consideration from both technical and aesthetical aspects is a necessity.

Sustainability focuses in the project:
In this project, there will be a focus on a few elements that have an influence on the building complex sustainability and elements that are relevant for a retirement home. The first is social sustainability and in this project, it must be achieving both inside the retirement centre, between the various areas and functions, both also between the centre and the context. Inside the centre, it will be achieved by working with 3 area types, that have each their identity and functions, which will give the residents possibility for variations and make the areas dependent of each other to make the centre work properly. The connection between the centre and the context will be done, by inviting the context in to the centre in a controlled way and thereby make shared spaces both in- and outside.
The technical element is ventilation, some investigations suggests that there are problems with the general air quality in retirement homes

and fresh air have to be cleaner because of the elderly' delicate lungs (videnskab.dk,2015) and that the air change should be more frequent to remove bad odour. The other elements are the construction of the envelope to lower the energy consumption, possibly use recycle materials, and the implementation of photovoltaics into it.

As mentioned above there should be taken special consideration based on the function of the building and its residents, therefore the indoor environment in the building is a minimum a category A (based on DS447, DS 474, CR1752). The user' behavior plays a large role in the calculations and the tests of the building indoor environment and energy consumption, because people want different things, numerus tests to investigate different scenarios will be made. Which should make it possible to make a system that adapts to the different areas, whereas in the homes it should be flexible so the individual residents should have a monitor where they can control the heat, shadowing from the sun, artificial light, ventilation ect. where they can also see, the energy used in the home. The unit's common area and the common area should not be controlled by the individual, instead it should have a general system and follow the guides for PMV and PPD still in category A.

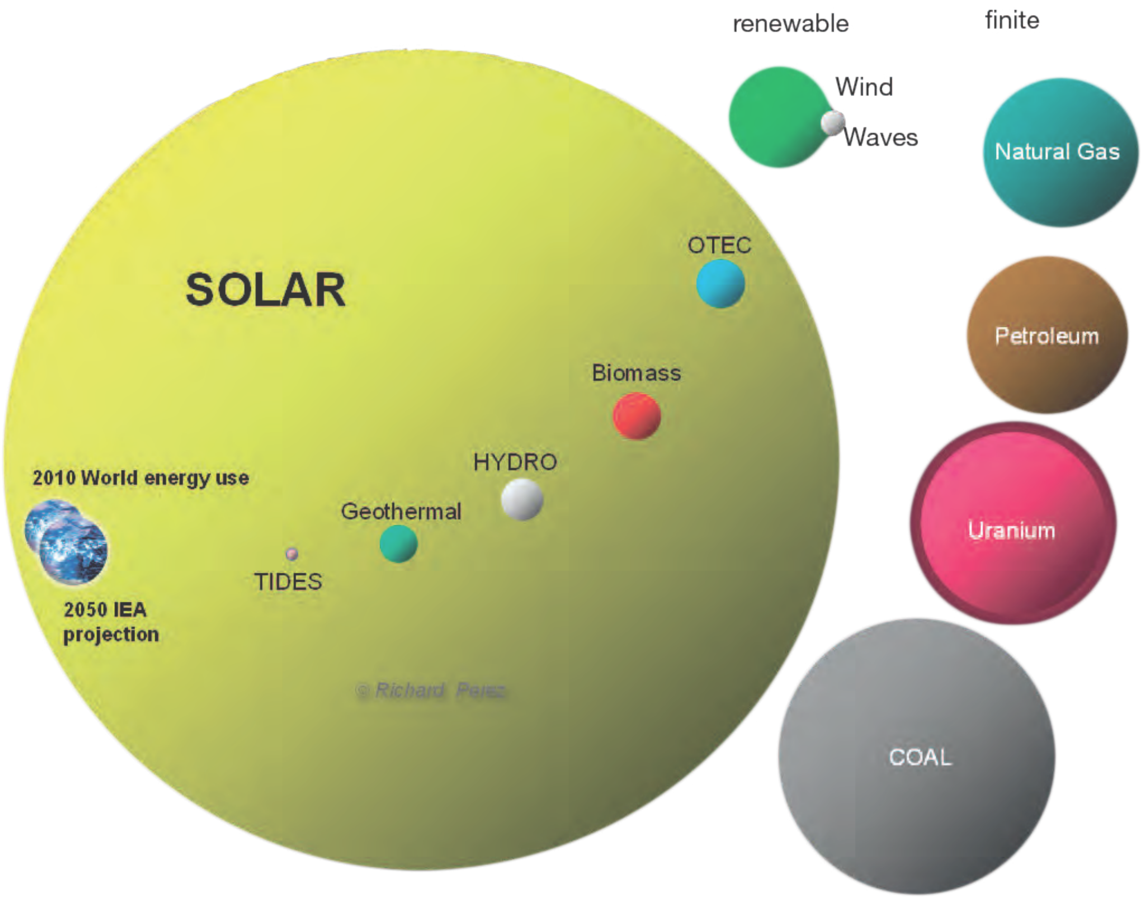


Fig 23.1 - Shows the amount of energy the earth needs per. year and what the different energy sources can produce.

Earth need: 16 TW-yr per. year
Coal energy produce : 900 TW-yr per. year
Solar energy produse: 23.000 TW-yr per. year
(Lehrskov, H. et al, 2012)

COMPETITION MATERIAL

In 2015 a competition for designing a new retirement centre of the future was arranged by the municipality of Randers and the winner of the competition is Friis & Moltke (Randers.dk, 20/5-2016) and the project is expected to be finished in December 2017 (Randers.dk, 3/10-2016).

This master thesis will be based on several relevant aspects of this competition. The competition is set to make both day-care centre for children and a retirement centre where the residents are elderly with dementia or other severe physical or mentally problems.

The vision for the retirement centre is that it should be cosy, feel safe and like a home for the residents. With a focus on quality of life and independence for the residents for instance, by being able to move and walk around on their own even with a walking aid. Therefore, there should be experiences both in- and outside.

The retirement home should be divided into two categories, the common areas and the home unit areas. There are four units and each unit consists of 15 homes (45 homes with 75 m2 and 15 homes of 90 m2 in gross area) and each home should include a private bathroom, small kitchen, storage room, living/dining area, and a bedroom. Bedroom and bathroom need to be located next to each other, for practical reasons, and the walls between the living and bedroom should be adjustable so the resident can decide the size of the rooms or whether there even should be a wall.

In combining the homes, there is a large shared area with a kitchen, dining and living area, where the residents of the units can have meals together and be social, and residents from other units can come to visit as well. In this area, there should be space for the employees from each unit, so that they have an overview over the unit and the residents' whereabouts, and aid throughout the day. Each unit should have a distinctive look to help the residents manoeuvre around and recognize the different places.

The common area of the project is also the arrival area and the hallways between the units. These areas should have both practical and social functions. Practical functions include both staff facilities, offices, receptions, and meeting rooms, and should also include a spa area for the residents. Where they can be bathed, get their hair and nails done, or go to the dentist.

The social functions including a large room for parties or gatherings, cafés, kiosk, workshops for various activities such as baking and woodwork. Also in the outside area, there should be social functions with meeting points both with various sizes, including different paths with various experiences along. Moreover, there is also a wish to include an area for music.

Also, included in the description of the competition is material concerning the more practical aspect of the home such as the amount of parking and approach by car to the site from Rindsvej. Also, the units should be no more than one floor high, whereas some parts of the common areas can be up to three storeys high. The distance from roads to the project there should be at least 3 meters, both to avoid noise problems and to maintain most of the vegetation around the site.

As described in the beginning this thesis will only be based on the competition, therefore the demands from the competition will be discussed based on the group's vision and the theories that will be used, hence the final product possibly doesn't fulfil the competition requirements fully (randers kommune, 2015).

Fig 25.1 - Placement of retirement center and day-care center as described in the competition material.

Fig 26.1 - City of Randers, with the location of the site comparede to the city center

SITE ANALYSIS

The site is at Rindsvej 2 in Randers, between Randers city-centre and north Randers, and is 22.288 m^2(ios.dk).
The site i locatede in a area where the street names have references to Nordic mythology. And Nyvangsvej and Marigervej are some of the main roads, because it connects north Randers with the city centre, therefor create easy acces to the site. Where form Marigervej have to go through to Asavænget (see Fig. 25.1).

The investigating approach for the surroundings was inspired from Gordon Cullens 'Serial Vision' where along a route, a series of pictures or drawings are made to describe the environment the route goes through. The site is already under construction with the winning proposal for the retirement home and day care centre, therefore inspection of the site itself was impossible and the focus was on the nearest context. The investigation should give an understanding of the functions, typologies, and material in the area, that can lead or inspirer the design process.

Apartment complex

Single family house

1. story industrial building

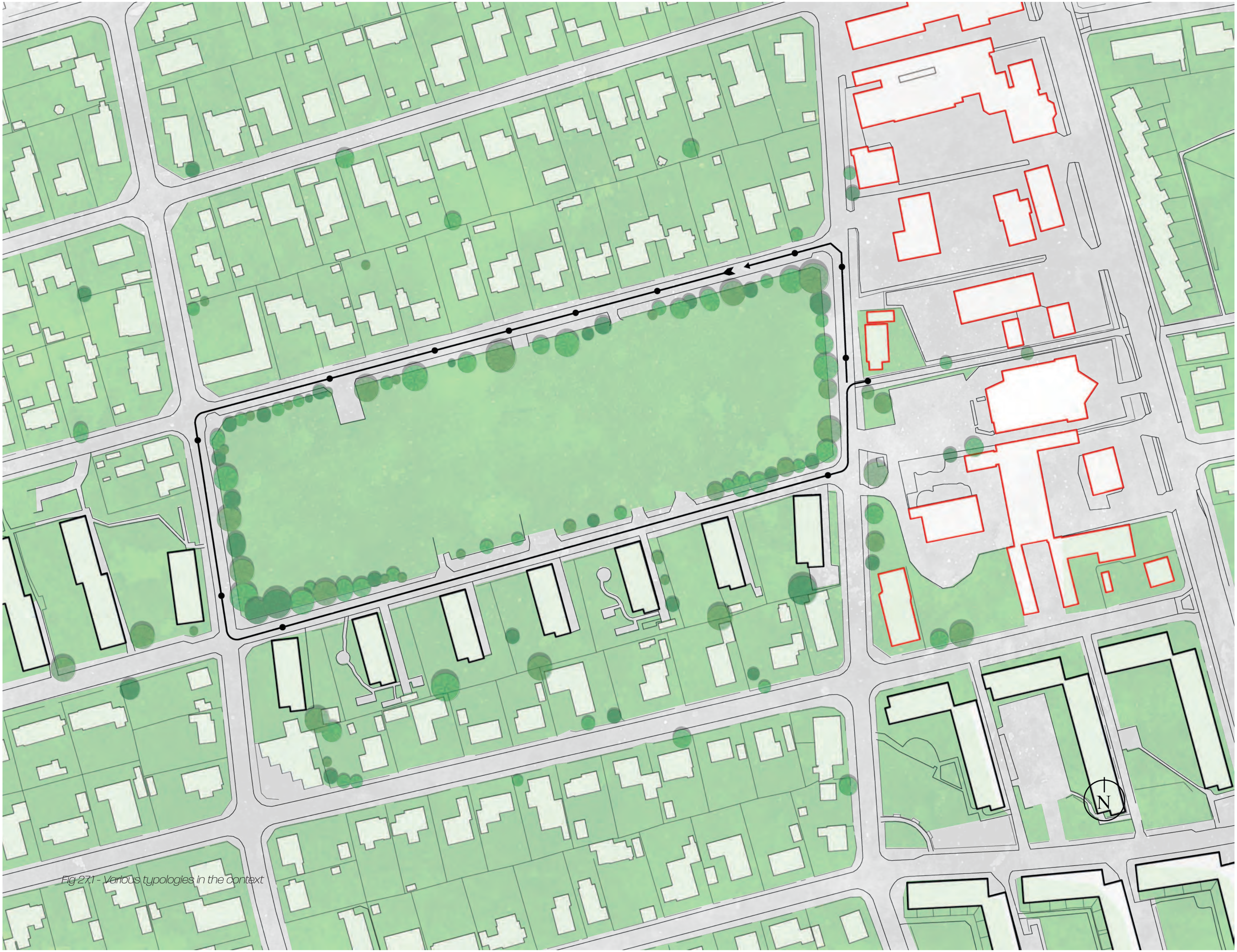


Fig 27.1 - Various typologies in the context


Fig 28.1 - Red tile roof


Fig 28.2 - Sinus steel plates


Fig 28.3 - Red bricks

The following paragraph describes the context of the site, following the route showed on fig. 27.1 and the pictures taken on the route are shown on page 29 in chronological order.

The site is surrounded mainly by residential buildings, with mainly traditional one storey single-family houses made with a mixture of yellow and brown bricks and different colour plastered facades towards north of the site along the road Hermodsvej. To the south/south-east of the site along Rindsvej are mainly apartment complexes around three storeys made of red bricks (see fig. 28.3) and the roof material is a mix of roofing felt and red tiles (see. figures on page 29) on all the residences around the site. But east of the site towards Marigervej there is a smaller industrial area with some industrial buildings like car repairing, gas station, but also a kindergarten, and a religious organisation. The industrial buildings are made of sinus steel plates and bricks of different colours (see fig. 29.11).

Along the site there are placed trees and bushes, with the larges trees towards the south-east corner and on the west side of the site, this together with the apartment complexes, can give shading which should be taken in to consideration in the design of the project, such as placement of photovoltaics. Around the site there are mostly privately owned green areas or smaller green area for the residents in the apartment complexes but none are public areas, this gives potential to create a new public green area, which can strengthen the connection between the site and surrounding context, attract nearby citizens and generate new spatial identity and recognition.


Fig 29.1 - Surrounding houses


Fig 29.2 - Red tiled roof


Fig 29.3 - Gardens in the surrounding area


Fig 29.4 - Simpler gardens in the area


Fig 29.5 - Different materials


Fig 29.6 - Looking along Hermodsvej


Fig 29.7 - Apartment buildings south of the site


Fig 29.8 - Playground


Fig 29.9 - Looking down path to Mariagervej


Fig 29.10 - Mixture of industry and single family homes


Fig 29.11 - Industry


Fig 29.12 - Surrounding area - Different roofs

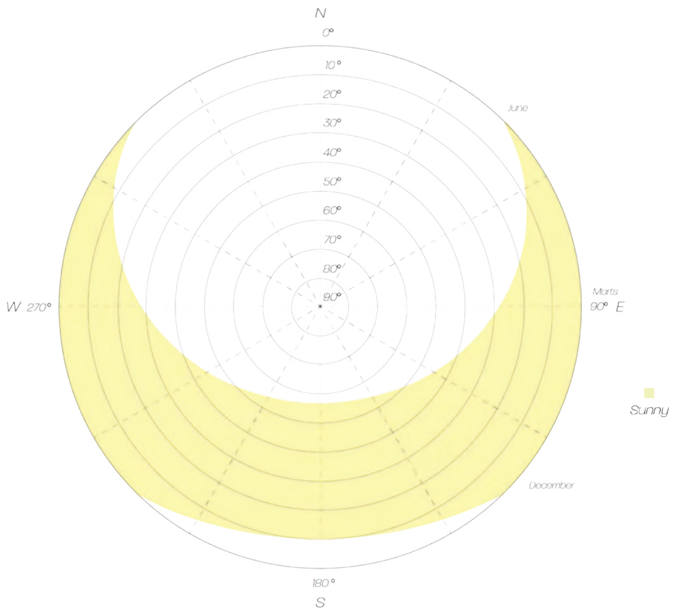


Fig 30.1 - Sun path diagram

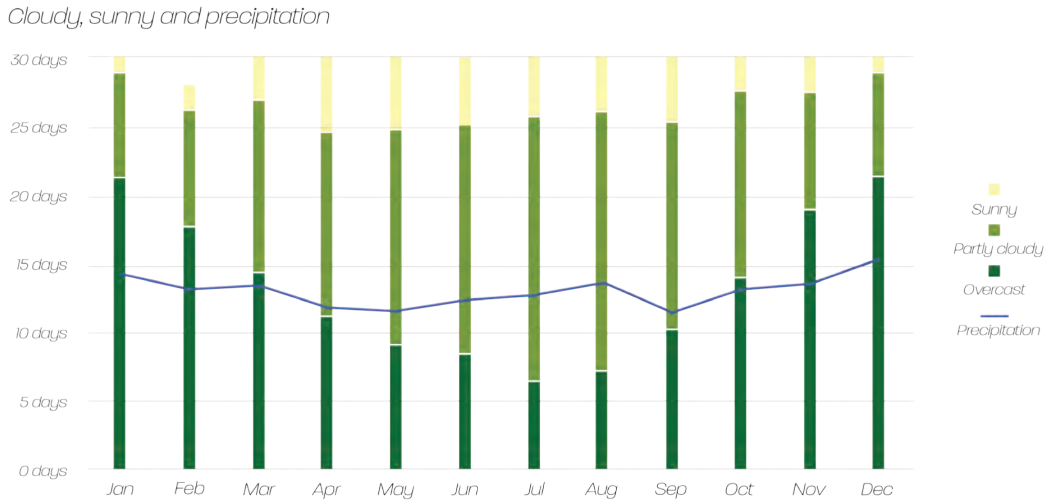


Fig 30.2 - Weather conditions table

SUN PLACEMENT

The sun and daylight conditions on the site have big variations from summer to winter, like most Nordic countries. In summer on the longest days there is almost 18 hours of sun, whereas in winter there is just under 7 hours of sunlight. (Timeanddate.com) (Sunearthtools.com)

Because there is a wish to maintain the current trees on the site from the municipality, this should be kept in mind when placing buildings on the site, because some of the tallest trees might shade certain areas in southeast and southwest on the site, as well as west and east. In south side, opposite of the site there are also apartment building blocks in 3 storeys height, and these can influence placement of buildings as well, though it is expected not to have big influence on the design.

SUN AND DAYLIGHT CONDITIONS

The weather is mostly overcast from November to February, where many days are partially cloudy, and from April to September are the months with most days of partially cloudy. This can be a factor relative to the use of renewable energies, like Photovoltaics or solar collectors, and it should be considered how efficient it can be, or if it can be the only choice of possible renewable energy sources. It also means that there are not that many days in general with sunny weather, and this can be a factor when placing windows, and how many windows are placed, and how much focus is on outdoor areas and the size of the areas.

Amount of days with precipitation doesn't vary much each month. On average, the amount of rainy days is a little under 15 days over the whole year. This should also be considered when making the outdoor areas, depending on what the wish is for the outdoor areas and when they will be in use.

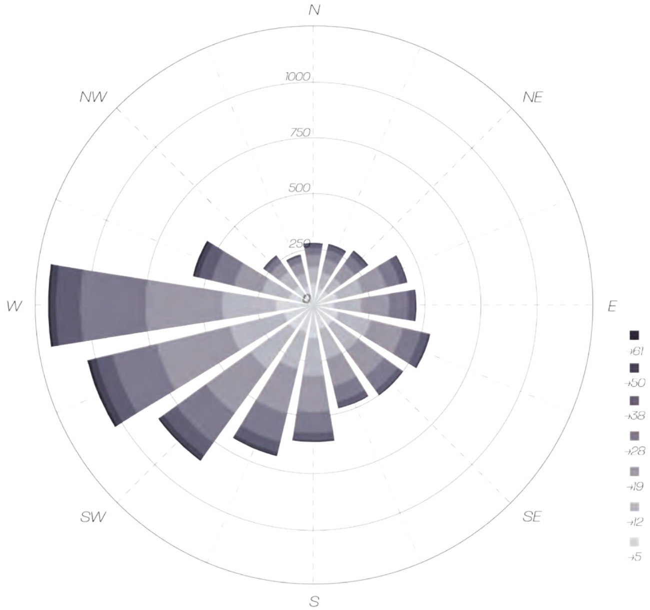


Fig 31.1 - Wind rose diagram

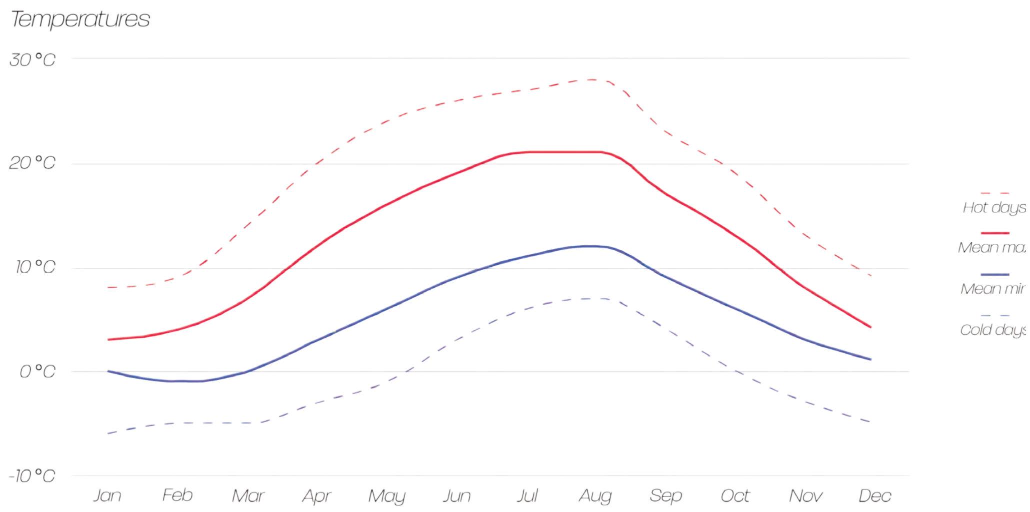


Fig 31.2 - Temperature table

WIND CONDITIONS

As the wind rose shows, the strongest winds range between November and March and coming mostly from west and southwest. Other directions don't show any concern for too much or strong winds. The average wind speeds are mostly in west, south and east at 19 km/h, and in other directions less. In west, and south west there are also many hours at 28 km/h and therefore the most important place to consider the wind conditions when designing outdoor spaces and areas is in these directions. The wind conditions are important for the landscape designs and for placement of outdoor areas.

TEMPERATURES

Highest temperature is in the summer months June, July and august, and lowest from December to end of February.
Mean daily minimum temperatures go from 0 ºC in January to 12 ºC on August and to 1 ºC in December Mean daily maximum go from 3 ºC in January to 21 ºC in June and August to 4 ºC in December.

As seen on the chart, there is a difference in temperatures from winter to summer, and this is a factor in, to what extent outdoor areas are expected to be in use, and how to design so the areas are useful all year around. This also influences ventilation strategies, showing some challenges in using natural ventilation all year long

ANALYSIS SUMMARY

The analysis shows a clear direction for the project. What would be the ideal parameters to work with to get the best retirement centre for both residents and employees, but also the context. The most common conclusions for all analysis is that there should be 3 areas in the centre, the home, the units and the town (the common area). The home is going to give a room for individuality for all residents, because this gives them the opportunity to create their own home within their assigned unit. The unit will provide the residents a cosy neighbourhood environment that they are familiar with. In the common area there are more public places for activities that they used to go to before they moved in this home or when they were young, like social gathering, small shopping etc. and this also helps them staying healthy both mentally and physically. The analysis also several times expresses the need for the dementia residents to feel that they are living in a centre that makes them feel normal, so the living conditions include functions that they know from their past, such as housekeeping, smaller social gatherings and shopping in their homes and the street and town areas.

It is also clear that there is no way for architects to create a feeling of home, because this is for everyone created over time with the things that are put in the home, so the architect can only create the framework for a home. For being social, both for residents and family visiting there should be room for gathering, both more publicly in the common area to talk to other residents and their family, but also for more private gatherings in the homes that only includes family, relatives and closest friends.

Working with the context is beneficial for both the centre and the context. The current context has no connection point, and the new retirement centre and day care creates possibility to improve the area while at the same time also can improve the living conditions for patients. Implementing connection to the surroundings by making shared spaces can give a sense of normality and less institution feeling for residents.

There are also several parameters involved when creating the most ideal and comfortable retirement centre that have been investigated in Healing Architecture. Those parameters include lighting conditions, layout of the plan, the indoor climate and the outdoor areas. Also, the interview with a caretaker with a lot of experience from various centres gives a good perspective on the working conditions a caretaker sees as ideal. These will be more specified later, when the centre is designed in more detail.

In the design phase, more relevant topics will be analysed further, like shadows form the context, variation in light intake, and other aspects that are relevant will be investigated more. Before the design process the room program, design parameters, and vision will be introduced to give the best precondition for the design

VISION

The vision in this project is to design a new retirement centre of the future, for people with dementia. A centre where the resident's wellbeing is in focus.

The principles from Healing Architecture in creating a comfortable environment will be the main inspiration for designing the individual home units for each resident and for creating an ideal working environment for the employees.

The feeling of the centre should have a sense of normality in each unit, but also in common and semi-private areas, and the centre should be able to room activities from everyday life. The activity areas should be flexible and easily adaptable so it can be used for various and individual activities. Also, every unit should be easily adaptable and create the framework for decorating an individual and personal home for the resident, that feels like home for them.

Furthermore, the centre should integrate with the context, by giving opportunity for gathering or passing by in a comfortable and relaxing environment, while also giving the residents a feeling of life, and a peak into the outside world, seeing the young families and their energy. This should be done in a way that compliments both context and centre, while also taking into consideration that the calm and relaxed atmosphere is maintained for the residents at the centre.

The centre should also focus on being as environmentally friendly as possible, because of the expected increasing number of retirement centres in the future. This will be achieved by working with a highly efficient envelope, and implementing PV's in a highly-integrated solution while at the same time ensuring an ideal indoor environment that takes various users and various situations in account, and flexible so it is adaptable to various wishes, rather than looking at standard regulations.

Designparameters:

- *Flexibility*
- *Daylight and visuals*
- *Sustainability*
- *Feeling of home and normality*

USER GROUP

The user group are mainly the residents and secondary workers in the centre. This project will be designed for 60 residents and approximately 60 workers.
The residents all have a form of dementia of various stages with different needs of caring and therefore the centre should be designed to fit the various stages, with simple flexible solution to the homes and the general lay-out of the centre. As a norm, the residents should have a as normal life as they can, with participation in activities of both social and personal characters, but as the residents' illness progress adaptions must be made. Such as to their homes and their movement in the centre, which is composed of 3 areas: the home, the neighbourhood, and the town. The homes should be easily adjustable to fit the need and wishes for each resident as their illness progress, and have integrated care solution technology to supervise the care-takers in their work, such as pressure sensors in the floor that tell if a resident have fallen.

It is difficult to predict how a day for the users is going to be, because each resident need different amount or types of care and it can change from day to day. Therefore, it is assumed that throughout a typical day the residents get three main meals, breakfast in the morning, lunch at noon and dinner in the evening. There is expected to be a range for each meal of two hours. In the morning from 7 am to 9 am, at lunch from 12 pm to 2 pm and dinner from 5 pm to 7 pm. The reason for the expected range is, because residents can wake up at different times and go to sleep at various times, where some go to bed much earlier than others, and naps during the day can vary from person to person. Between the meals the residents are expected to relax, be in their homes, or socialise in the common areas, go for walks in the common areas and/or outside, when the weather allows it.

In-between the areas the "healthier" residents can move around as they want, as going down to "the town" by them self, whereas residents' whose illness has progressed cannot. But they still can move around safely in "the neighbourhood" where they can have social relation with others, go outside, thereby still maintaining a as normal life as possible. This will be done in a design of the areas based on social pedagogical methods, with clear definitions between the areas and placement of the caretakers' areas in the individual areas. Residents whose illnesses have progressed to the last stages of the illness and therefore need full-time care, will be moved to a special "neighbourhood" where they don't get disturbed from other residents, but still in this area there should be a focus on creating an environment based on the theory from healing architecture and space for the individuality.

The layout will also have clear definition of the area for the caretakers and provides them with opportunity to overlook the areas, and the residents without it seeming dominating towards the residents. Because the caretakers need to be available always for helping the residents get out of bed, get to the toilet, take a shower, or if they feel like it go for a walk and socialise in the common areas. It is expected that at least one caretaker is available per resident, however at times two caretakers can be needed, it depends on the resident. It is important that the caretaker is placed in an area where they can always keep an eye on the residents, and if anything is wrong they can quickly go help them.

The usage range is expected to be always on, where at night it is quieter, however dementia patients can have a hard time falling asleep or waking up several times during the night, so in an energy usage perspective the usage time is lower at night, but still expected to be in use to a certain degree. It is difficult to predict how much, and therefore several variations will be calculated for the final design.

ROOM DIAGRAM

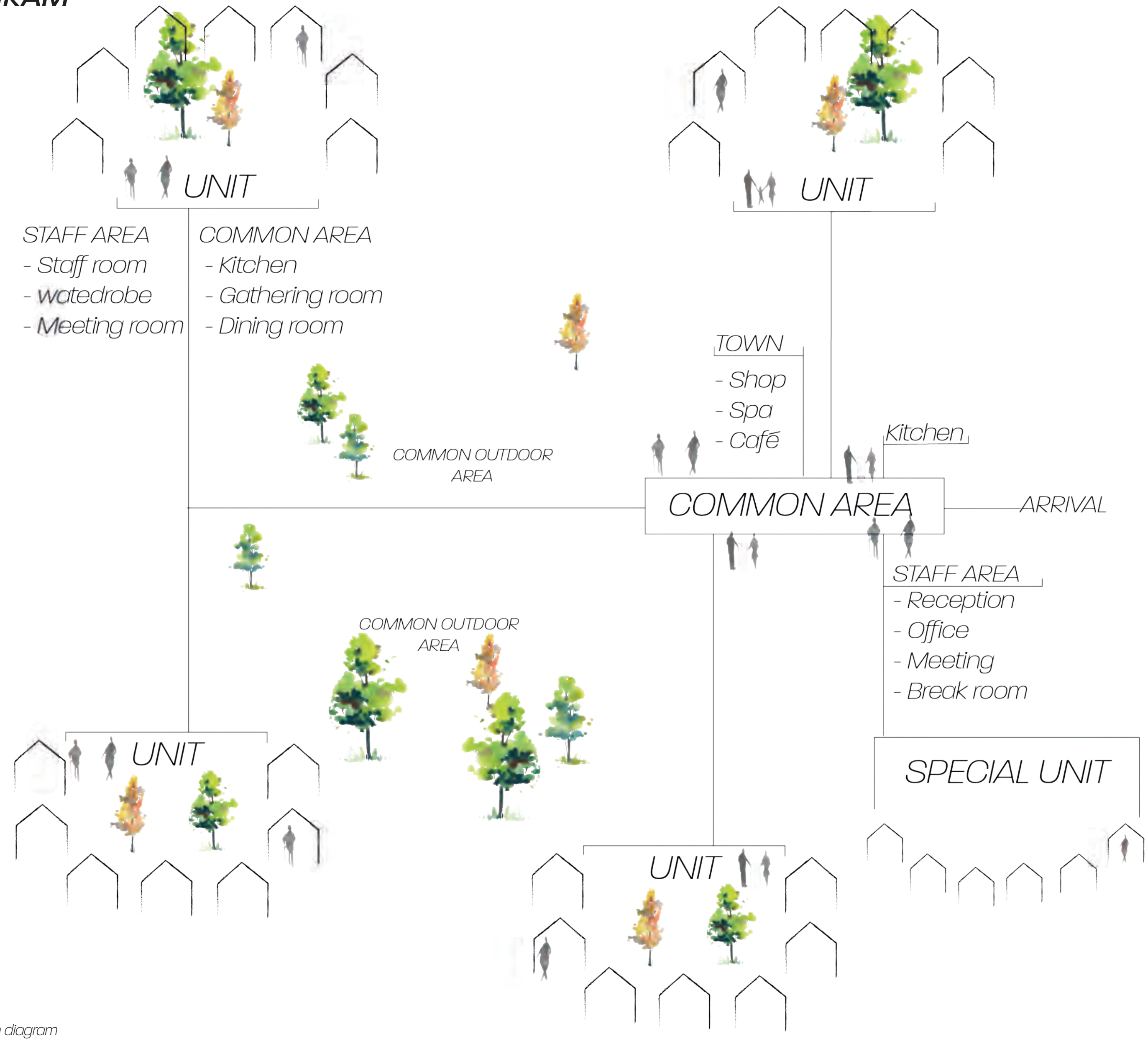


Fig 36.1 - Room diagram

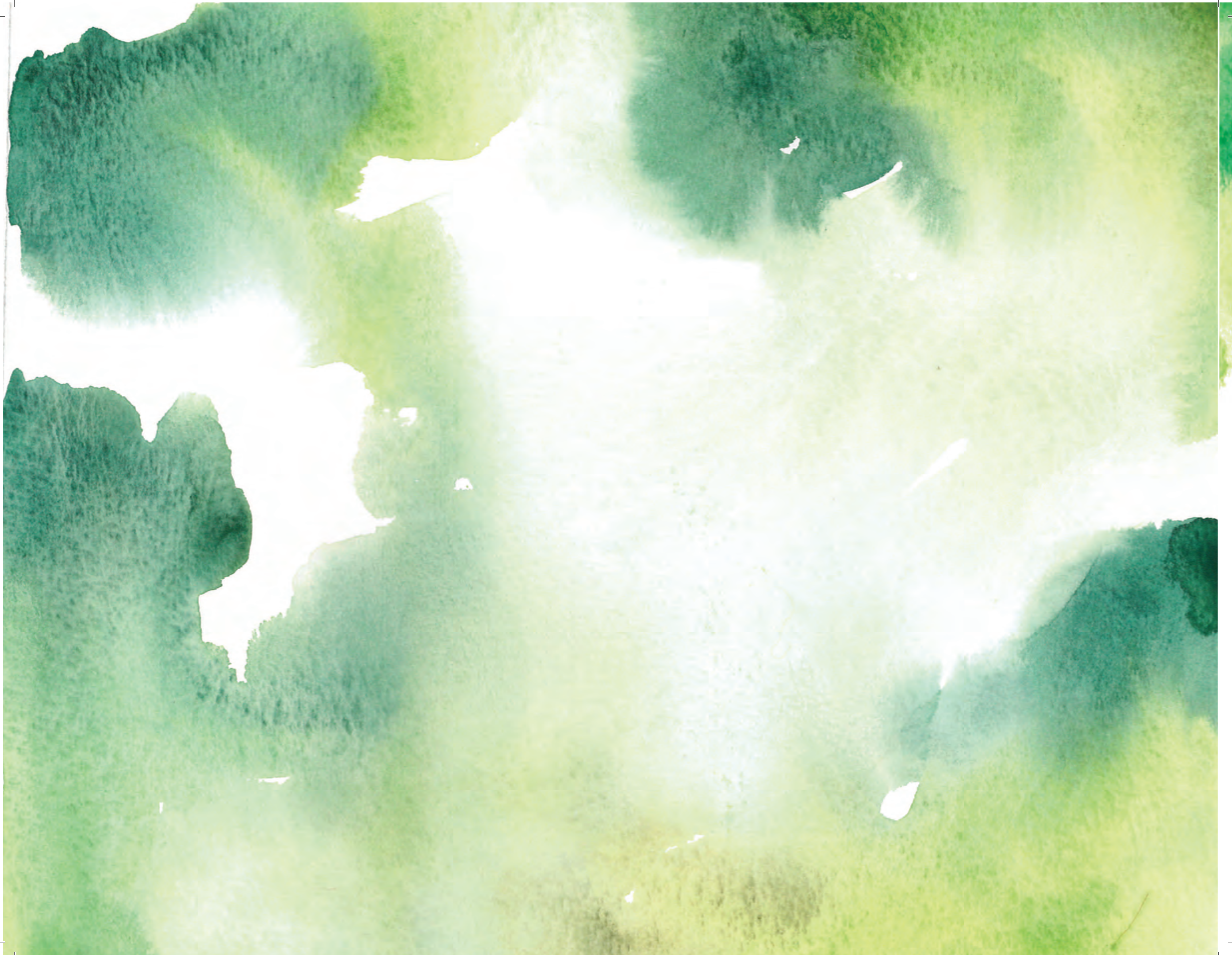
ROOM DIAGRAM
- The different areas: their activities and the environment

The conclusion of the analysis is that it is ideal to have three different main areas in the centre: the private units for home, the common units serve as neighbourhood, and the common area which shall function as a small town for the users in the centre. and where the residents of the context can come in and interact with the residents

The Home:
The private units are for the patients to live and enjoy a relaxed, calm home environment with the normal function of a home, such as make coffee and simple cooking, watch television, sleep, do their indoor hobbies and host small gathering with friends and families. The private units need to be flexible to fit the residents wishes and their need in the different stages of dementia.

The neighbourhood:
The common units are connected to the homes and they extend out to this area, because of a small area outside each home (the front yard) decorated with the residents' private objects to make the homes recognizable for the resident. The common units serve as places for the residents to meet up in small or large groups during the day and do different activities, and can be viewed as an extension of the living rooms of private units, a relative calm area with intimate social neighbourhood functions and people can watch TV together, communicate or help each other about cooking.

The town:
The common area in the centre is consist of several large rooms and a public shopping street-like space. The common rooms are for gathering activities like dancing, parties or concerts etc. while the slow-paced shopping street are hosting normal town life activities like hair salons, café, small shops etc.
In the café and small shop the residents of the centre and the residents of the context can meet, because the functions are available for both and this should make a connection and relationship between the center and the context.



Presentation

The presentation starts with an overall presentation of the centre, explaining the layout of the centre and how the centre is divided in to various areas, by showing the floor plan and the main room program (in squaremeters used). After that the concept is presented, so that it explains the main ideas behind the design of the different areas explained after.

When presenting each area, it starts with an idea diagram of the area and a rendering showing the environment, supported by a plan or section of each area. Thereafter, relevant subjects for the area is described, all from technical aspects to dēcor solution. At last larger general parts of the building, like envelope, energy consumption and indoor environment are presented

With each rendering, plan, section and elevation there are a small icon showing the placement of it.

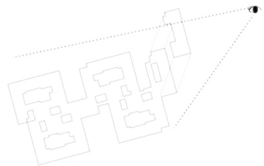


Fig 40.1 - Bird eye view of the project

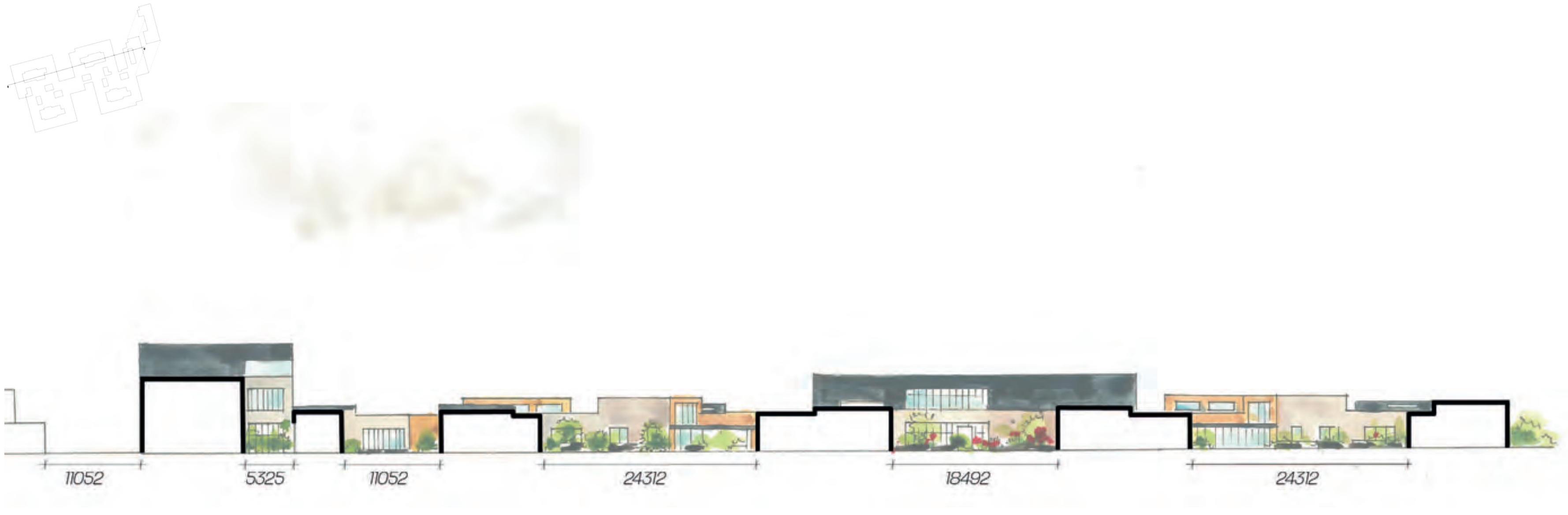


Fig 41.1 - Longitudinal section of the masterplan

Fig 41.2 - Longitudinal section of the masterplan

Fig 42.1 - Masterplan

SQUARE METER	
Site area	22.288 m^2
Center and outdoor area	13.452 m^2
Center: gross area	8.617 m^2

AREAS		NET. AREA (m^2)
Unit 1		1.345
	Homes	728
	Common area	617
Unit 2		1.324
	Homes	728
	Common area	596
Unit 3		1.372
	Homes	728
	Common area	644
Unit 4		1.351
	Homes	728
	Common area	623
Special unit		550
	Homes	320
	Common area	230
Corridor 1		278
Corridor 2		113
Shopping street		547
	Cafe	63
	Shop	55
	Spa	57
	Street	372
Admin. and entrance		738
	Cafe	45
	Aktivity room	127
	Entrance hallway	191
	Recption, offices and meeting	42
	Staff rooms	333

MASTERPLAN

The masterplan of the building consists of four units consisting of 13 homes in each unit, with own common area, with own staff area to each unit and own courtyard.

All four units are connected by corridors. The corridors connect two units, and from each corridor there is views into minor atriums, where each common area in the units also has visuals into, thereby creating a visual connection from corridors to the common areas.

The minor atriums are also implemented to remove the institutional feeling in the courtyard, where the corridor isn't straight at any point and offers sneakpeeks into the units and visuals to vegetation before entering the street or going out of the centre. All of the atriums are also placed to give a visual connection to the outdoor from the staff area in each unit, and it also gives the staff a visual connection to the corridor, and they can thereby keep an eye on who arrives at the unit.

The corridor leads to the street, that functions as the main center for the whole retirement centre. The street is the entrance to the larger world, in this case the larger garden, that gives the feeling of a larger world.

The building is designed with privacy in mind, but also with visuals towards areas in mind. The privacy is kept in the larger gardens as can be seen on fig. 41.1 and 41.2, the distance between buildings is comfortable for the residents

The masterplan gives opportunites for various experiences, and thereby considers various users preferences. Some are more private and indoor persons, while others like to spend time outside and are outgoing. The building offers both possibilities.

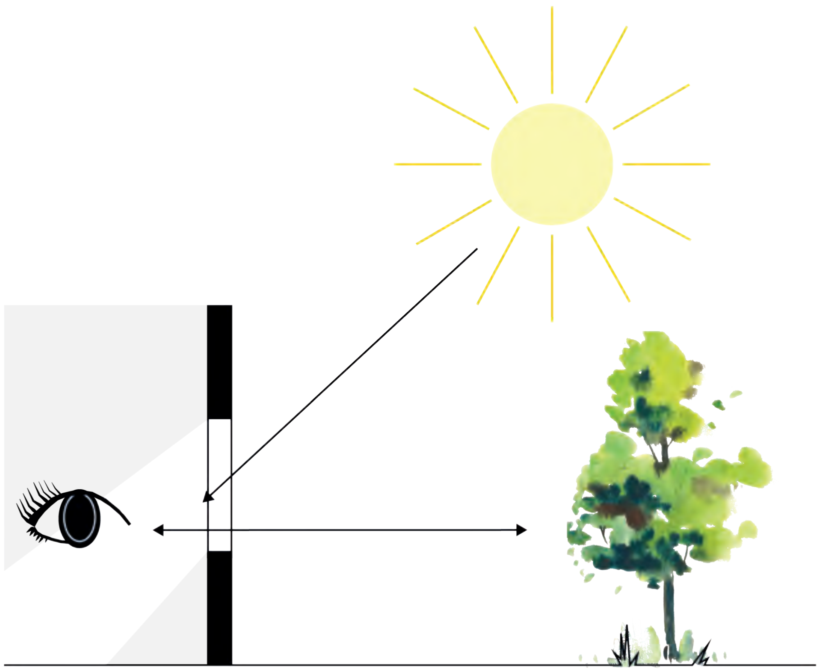


Fig 44.1 - Concept diagram environment

CONCEPT

The main principle in the design of the retirement centre is the wellbeing of the user, which is created by working with the 3 concepts: environments, flexibility and functions. The concepts are based on 'the missing link' on how to make it easier for the residents to feel at home at the centre and 'healing architecture' to create good environments throughout the centre.

Environment:
To make good environments through the whole centre the areas have views to the outside and get natural light that follows the day light rhythm.

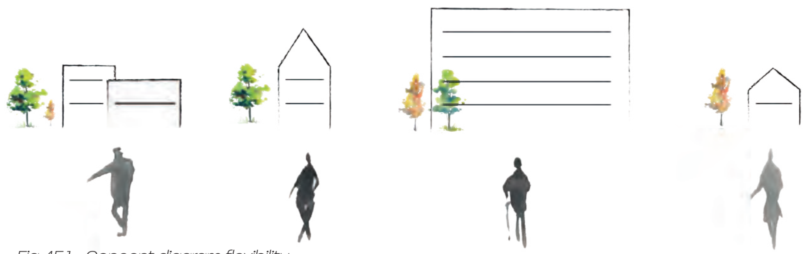


Fig 45.1 - Conecpt diagram flexibility

Flexibility:

All the residents come from diverse backgrounds with different lives and from different home types, hence they have diverse needs in the taste in décor but also in physical needs. Therefore, the homes should be easy to adapt to each resident

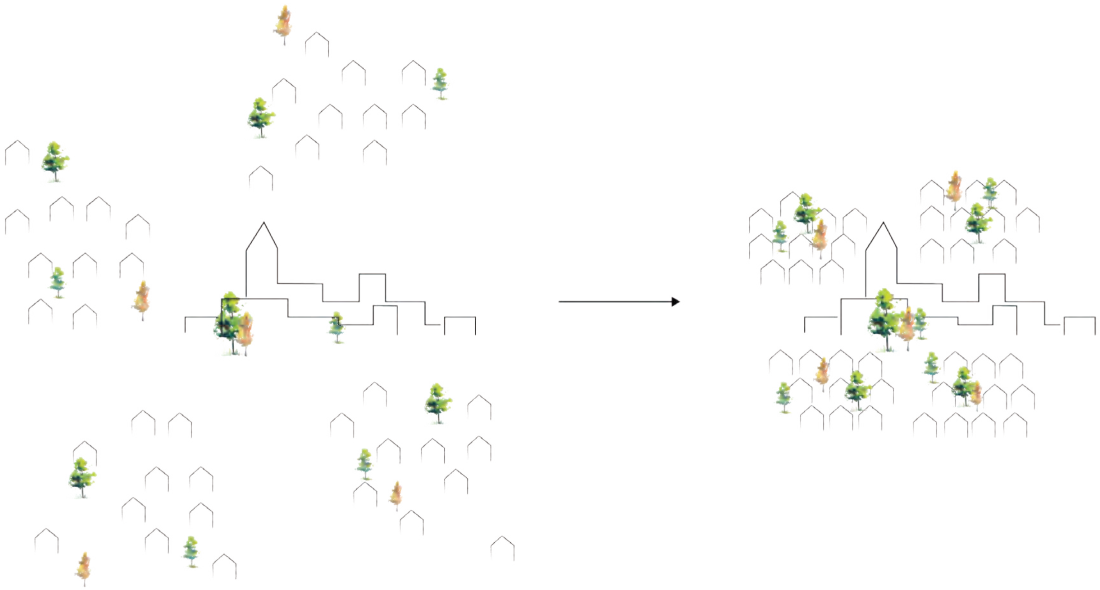


Fig 45.2 - Conecpt diagram functions

Functions:

To make a home, it is more than to make one area that the residents can make personal. It is also about making the opportunity for functions that people are used to in their previous life. Therefor the functions in an average town have been compressed in to one centre.

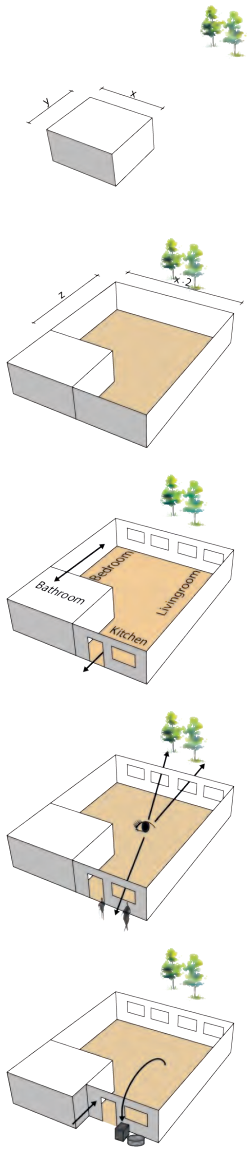


Fig 46.1 - Principle diagram homes

Fig 46.2 - Rendering inside a home

Fig 47.1 - Plan drawing of a home

HOMES

The importance of individuality and personalisation in the homes has been the essential focus from the start of the project.

The focus has also been on creating a simple layout, that is easy to read and navigate in for the resident.

The focus has also been on minimising unuseful area so the layout is efficiently designed.

For example all storage in the home is built in so that it's integrated and has easy access from the living room.
Furthermore there is an adjustable wall (see fig. 50.1 and 50.2) between the living room area and bedroom area, that can be put up in several variations, and this gives the opportunity to individualise the home.

To make it feel like a home warm materials such as wood has been used on floors and ceiling, and helping aids, such as lift and sensors are integrated and hidden (see fig 51.1 and 51.2)

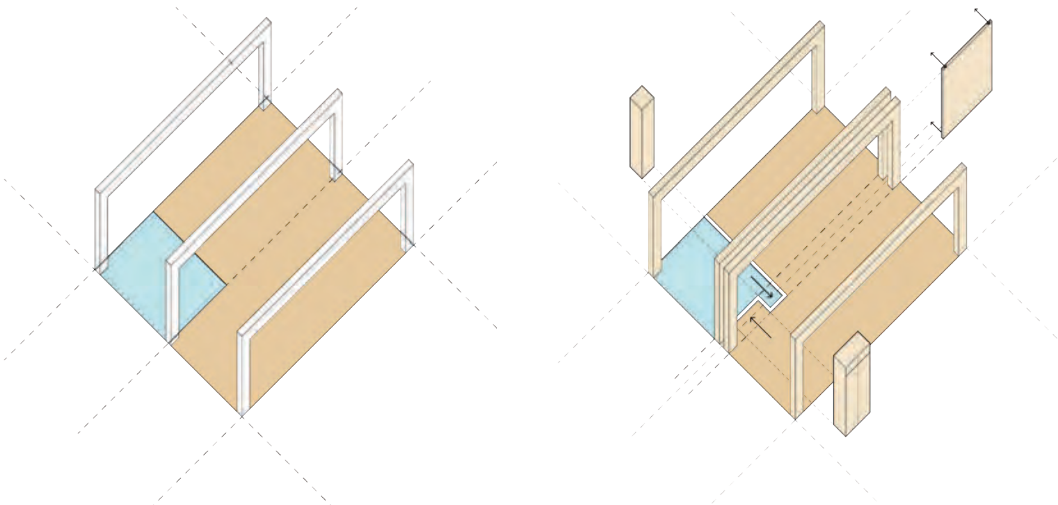


Fig 48.1 - Detailed diagram of the homes

DESIGN PRINCIPLE

From the start the desing of the home was based on a frame system limiting the size of the layout.

The idea was a frame in each end of the home and one in the middle of those frames, also limiting the width of the bathroom. The idea of using the frames is inspired from the 50'ies to 70'ies houses (see page 91, for a brief case study)
After considering how to make the home personal and adding an option to individualise the home, an extra frame in the middle was introduced.

This makes the closets look more integrated, both the ones in the living room and the ones in the bathroom because the space fits with standard sizes of a closet. It also means that the adjustable wall will look integrated and as a natural part of the design no matter the combination. (see fig 48.1)

Furthermore there is left a place in front of the home at the entrance, called the niche, which functions as the homes front garden so the resident the can sit and enjoy a cup of coffee, and socialise with other residents. It is also used as help for the resident to recognise their own home, by the displayed personal belongings in the niche.

As is clear on figures on page 49 the homes have

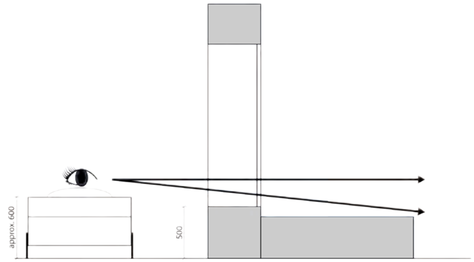


Fig 49.1 - Window height 1 diagram bedroom

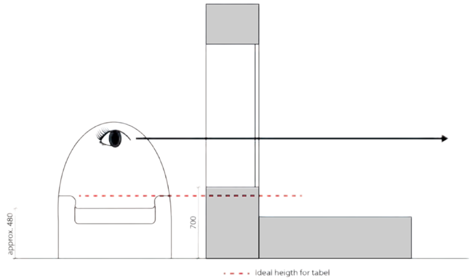


Fig 49.3 - Window height 1 diagram living room

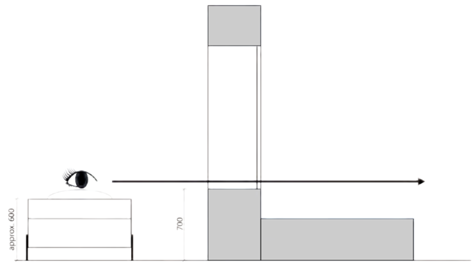


Fig 49.2 - Window height 2 diagram bedroom

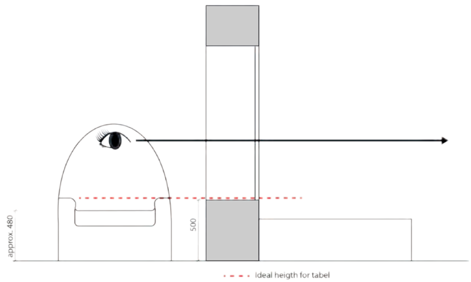


Fig 49.4 - Window height 2 diagram living room

good visuals to the outside, through the large windows. The window area is designed with a focus on the visuals to the outside and also letting as much light in as possible at all times of the day, and also considers privacy concerns and practical use with various heights of the window placement as seen on fig 49.1-4 (A higher window height in bedroom for privacy, and lower window in living room for practical use as table)

The window in top is mainly for letting light in, and the light study in the design process, showed a big improvement compared to no window in top. However the roof is also raised to create a difference in the bedroom area and the living room area, where the living room area has a more open and spacious feeling, compared to the bedroom area that is more warm and intimate, and also for integrating the lift so it is as hidden as possible, to avoid the institutional feeling. See fig 51.2

As can be seen on fig 50.1 the homes are very different, and this is mostly possible because of the adjustable wall

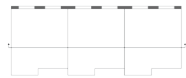


Fig 50.1 - Section of the homes

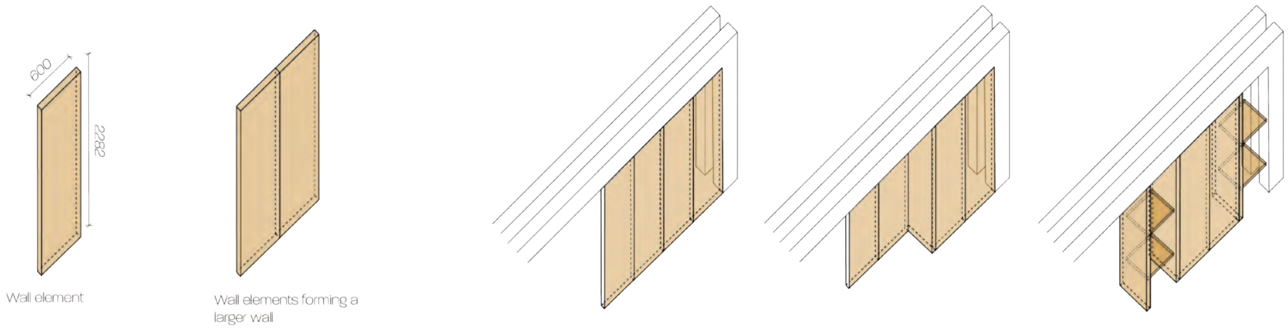


Fig 50.2 - Diagram of adjustable wall

DETAILING: FLEXIBLE SOLUTIONS

The main element for creating the possibility of individulising is the adjustable wall as seen on figures above

The adjustable wall is limited to the frames in the middle, and the elements are always connected to the frame placed under the beam.
Each element is 60 cm wide and the height is the distance from the bottom of the beam down to the floor.

As can be seen there are various ways to set up the wall, a straight wall, a wall divided, creating niches in bedroom and living room, or more like a room separator, that is more open, but still dividing the spaces. As the illness for residents progresses the space required in bedroom also increases and the wall also gives the opportunity to adapt the space.

Another way to individualise and personalise the home is by easily hanging pictures without using any special tools, and also making it easy to change to refresh the home after some time, or for a new resident. The solution is integrated in the beams as sliding elements (see appendix 7)

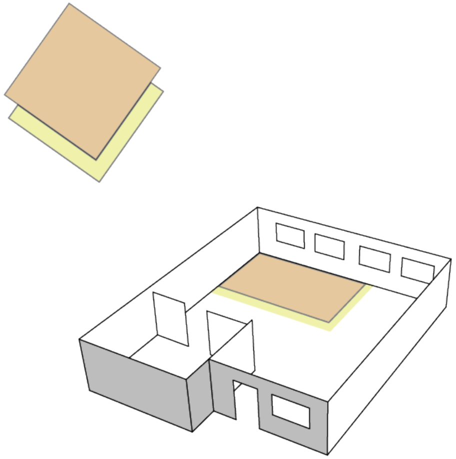


Fig 51.1 - Diagram of floor sensors

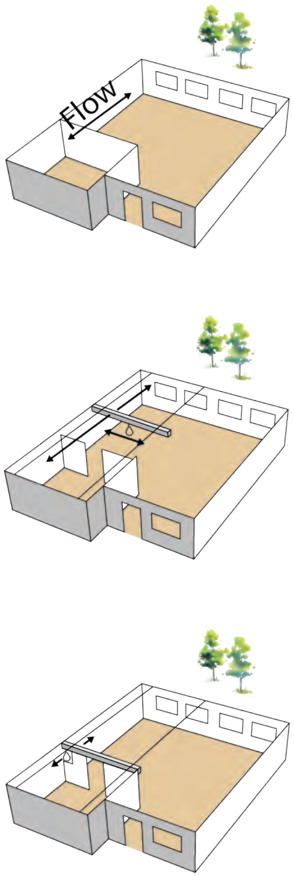


Fig 51.2 - Diagram of lift solution

DETAILING: *HELPING AIDS*

There has also been a focus on integrating solutions that can aid the resident, like turning on the light and also alert the staff in case someone needs help or in case of an emergenzy they can come as soon as possible.

To keep an eye on the residents while they aren't in reach right away, the floor has built in pressure sensors, that can sense if a resident has fallen or if something seems out of the ordinary, such as too much pressure on a place where there shouldn't be pressure, and then the staff gets alerted (see fig. 51.1).

Because of the focus on sense of home and not an instituation, the lift over the bedroom and bathroom, has been integrated in the ceiling, so it is barely visible when it isn't in use. The reason for the space between the lamellas in the ceiling and the wall is to hide the sliding system for the crossing lift beam. This makes the system almost invisible, where the crossing beam is placed on top of the bathroom wall, when it's not in use, and thereby becoming a part of the walls expression (see fig 51.2).

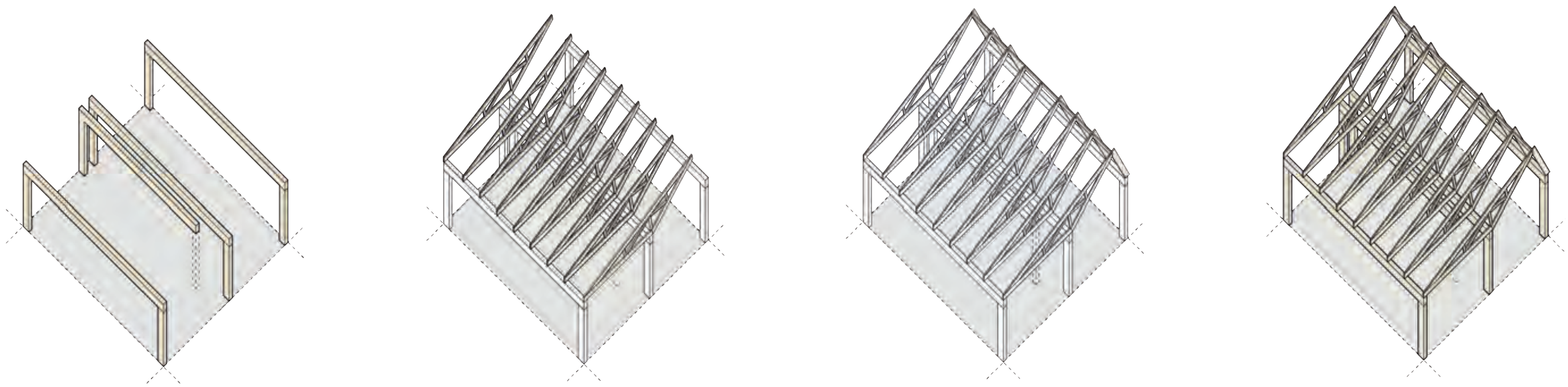


Fig. 52.1 - Structural principle diagram

CONSTRUCTION:

The construction has not been in focus in this project, so the dimension of the beams are assumed to be large enough in dimensions to support the roof for the whole building.

The focus has however been on daylight intake, integrating PV's and ventilation. For that reason a general idea about the construction was necessary.

Mainly the whole building is supported by glue laminated frames as can be seen on step 1 in fig. 52.1 Here a home is shown where there is a frame in each side of the home to support the angled wall and the start of the roof construction. There is also placed a frame in the center of the home to support the inverted truss.

The truss is inverted so that it creates a flat ceiling in the bedroom and bathroom, and then is angled upwards to let light in from the angled wall in top in the living room, this also gives the opportunity to place ventilation inside the truss
The angled wall with an opening is supported by the frame and towards the top of the truss, as can be seen on fig 52.1 step 3.

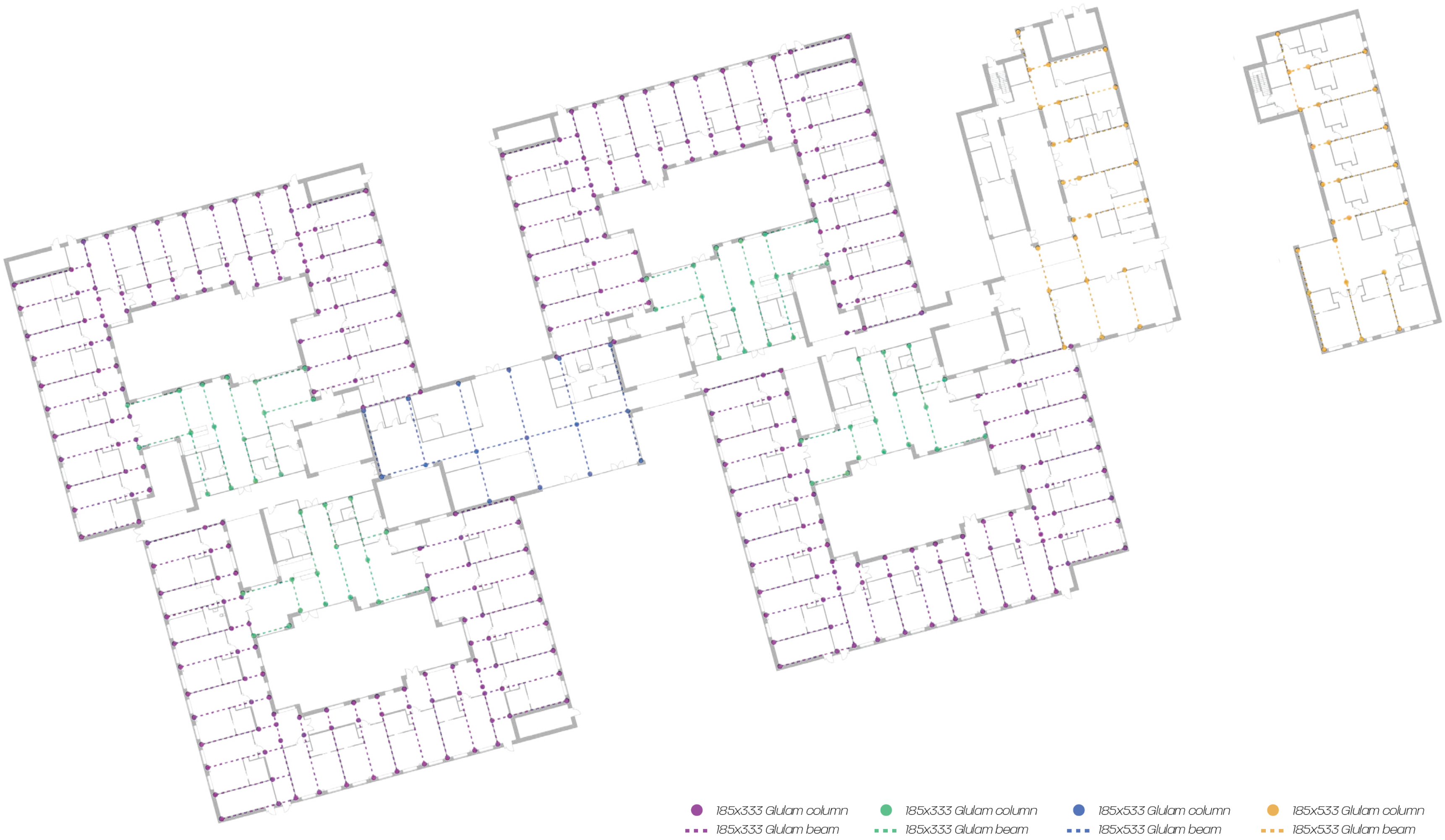


Fig 53.1 - Plan of various frame types

The wall is angled to let more light in, compared to if it was a straight wall.

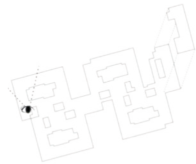
The frame system overall in the building is varied from place to place.

The beams for the homes including the frame for hallway is the same dimension and the same lenght majority of the time, the only place where it is longer is where the niches are in the hallway.

The beams for the frames in the common area have the same dimension as the homes, as do the frames for the administration and special unit.

The only frames that are bigger in dimension are the frames in the street, because it is a larger roof area, and therefore need to support a heavier construction (see fig 53.1).

The beam dimensions were found using a glulam manufactures website calculator, using a light construction as the factor deciding the size of the beams.



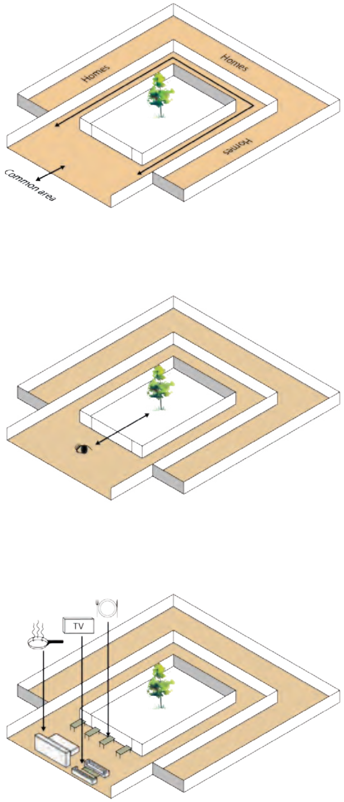


Fig 54.1 - Principle diagram common area

Fig 54.2 - Rendering inside a home

Fig 55.1 - Plan drawing of a home

COMMON AREA IN THE UNIT

From the home to the common area it has been essential that the transition area is a familiar space for the residents, and therefore the hallway is not only a hallway, but will also be a place for stay, and where the residents can sit outside their home and meet other residents, this is shown more in detail on page 58.

It has also been important to create a common area where the residents meet for breakfast, lunch dinner etc. The space offers area for eating, and open to the kitchen where it is possible for the residents that feel like helping, can help, and it leads them back to a time in their life that felt comfortable and at home.
The common area is also where the staff mainly is available, when they are not taking care of residents in their home

Both from hallway and common area there is visibility into the courtyard, and thereby giving interesting visuals out, and offers a more enclosed outdoor area to recharge out in the sun in summer This is presented in more detail on page 62.

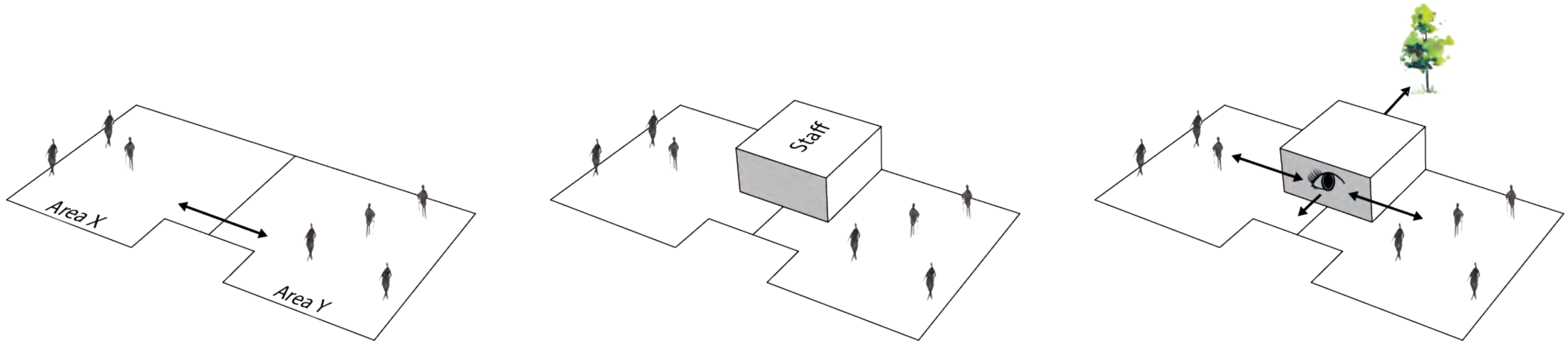


Fig 56.1 - Principle diagram staff area

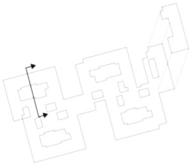
STAFF AREA

The placement of the staff area has been essential for how the common area has been designed, but also how the homes are placed.

There are several areas in the centre where the residents can spend their time, whether it's walking back to or from their home, or staying in the hallway, or relaxing in the common area

It has been important that the staff area is placed so that it is close to every area in the unit, but the most important place is where people spend most of their time. The place that is assumed to be the most used is the common area aside from the homes.

As fig. 56.1 shows, the staff is therefore also placed where there is visual to every area, but also for the staff to have visual to the outdoors for their own wellbeing.



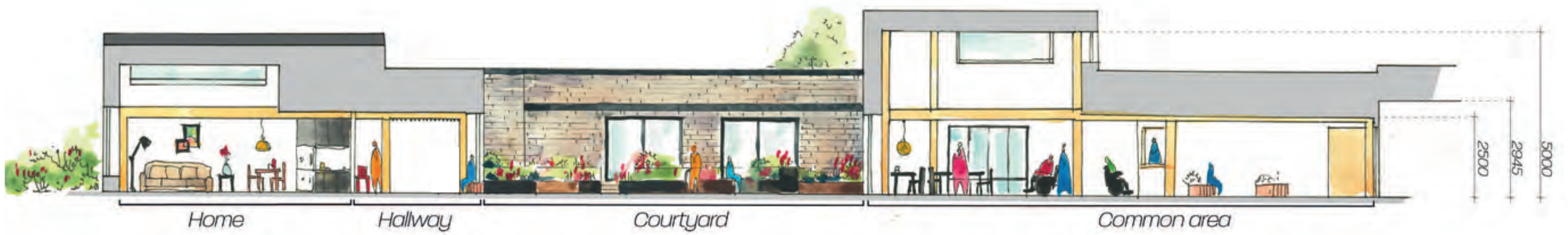


Fig 57.1 - Section of common area

CONNECTIONS: UNIT

The connection between all of the residents, staff, and visitors, whether it is spending time in their home, outside in their niche, walking in the hallway exploring if there is someone to talk to, spending time in the courtyard or in the common area, is the reason why the centre is designed the way it is.

As fig 57.1 shows, there is a good connection from the common area to the courtyard, but also for those spending time in the hallway there is a clear and large view into the courtyard inviting the courtyard into the hallway.

The building is also encouraging interaction, with view from hallway to the common area through the courtyard, while at the same time giving opportunity to draw back and be more private, be it in own home, a corner in the courtyard or in some of the niches in the hallway.

The building offers several different experiences known from the residents previous lives. Residents whose illness has progressed in a way that they can't handle going to the street, can still maintain a sense of nromal life in the unit

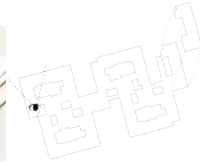


Fig 58.1 - Rendering in the hallway

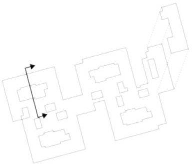


Fig 59.1 - Section of hallway

CONNECTIONS: *HALLWAY*

The hallway is the main transit area for residents, leaving in the morning for breakfast, or at other times during the day, thereby the hallway is a very crucial point of the building and how it is experienced by the residents, staff and visitors.

The hallway should therefore offer various experiences or offer a good feeling transiting in it, on the way to other places.

This has been achieved by, varying the placement of windows, varying the width of the hallway, creating different scales, and not continuos straight walls that would make the hallway seem long. Most of the windows in the hallway go from the floor to the ceiling, creating a connection to the courtyard, and also encouraging exploration of the courtyard, with the green vegetation that can be seen from the inside (see fig. 59.1).

Furthermore, the hallway is so wide that it doesn't feel like a hallway, with the niches in front of the homes, places to sit by the windows facing the courtyard, it becomes more of a street atmosphere known from neighbourhoods,

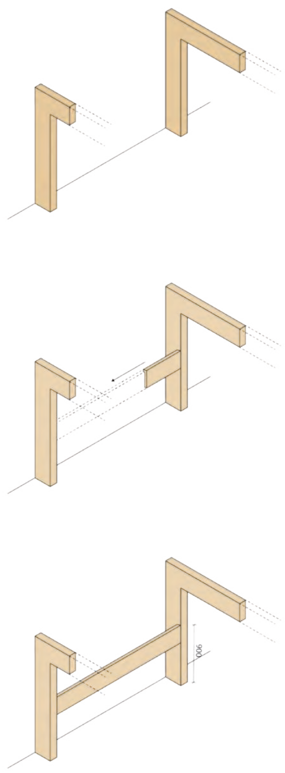


Fig 60.1 - Diagram of the handrail design principle

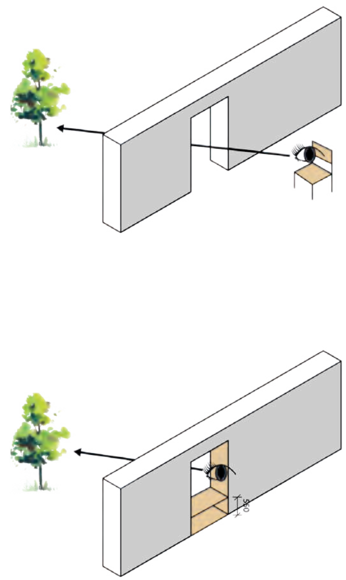


Fig 60.2 - Diagram of the window bookcase/bench design principle

DETAILING

The shape of the hallway in the layout, with niches both towards the courtyard and also in front of the homes in combination with the frames help break down the institutional feeling, however there are other finishing details that also are implemented to further enhance the experience of the hallway.

The hallway needs a railing for the residents that have difficulty walking without support, and this railing has been placed by the walls between the columns (see fig 60.1 and fig 58.1) and they are made so that they look like a natural part of the construction, and at the same time encouraging the residents to hold on to it, and thereby the handrail doesn't look institutional.

The windows going from floor to ceiling have an integrated bookcase/bench where it is possible to sit and enjoy the view to the garden, but also for some of the residents, can occasionally and at the same time be a place to store things the residents use frequently, like, games, books etc, so it is clear people live in the building, helping making it feel more like home, also in the hallway (see fig 60.2).

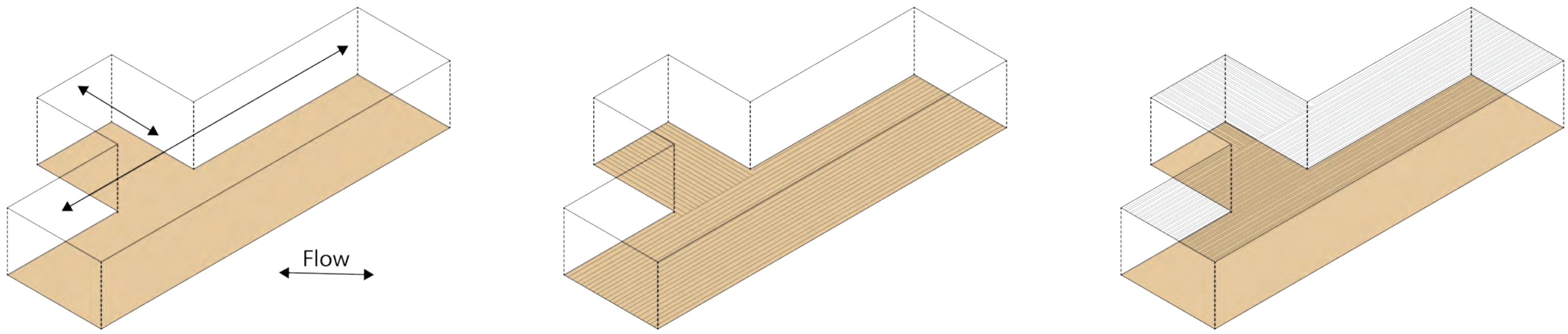


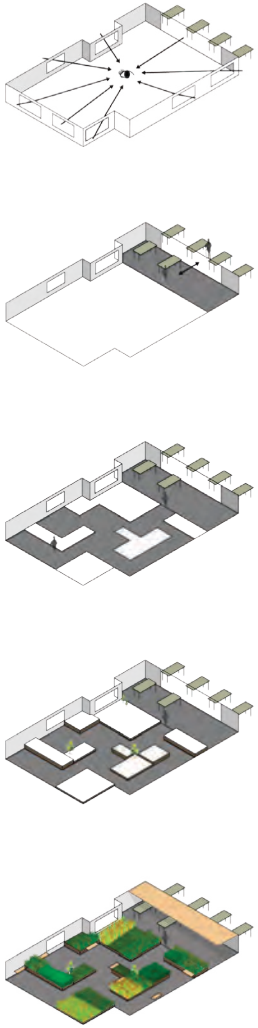
Fig 61.1 - Material direction diagram

FlOOR AND CEILING PRINCIPLE

When working with the design of retirement centres or health care centres in general, it is often easy to come up with a design that has the feeling of an institution, because that is what it is, however the focus has been on breaking up that feeling in the centre.

To make the centre feel like home and comfortable the hallway between the homes has been the most essential place to avoid the feeling of an institution.

The warm wooden materials used in the hallway in ceiling and floor combined withe the frames, the hallway feels similar to the the home, however the materials direction shows the difference in private area and common area, and thereby indicating where the neighbours are allowed and not (see fig 58.1 and 61.1).



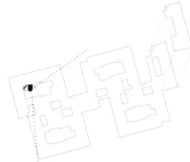


Fig 62.1 - Principle diagram courtyard

Fig 62.2 - Rendering in the courtyard south

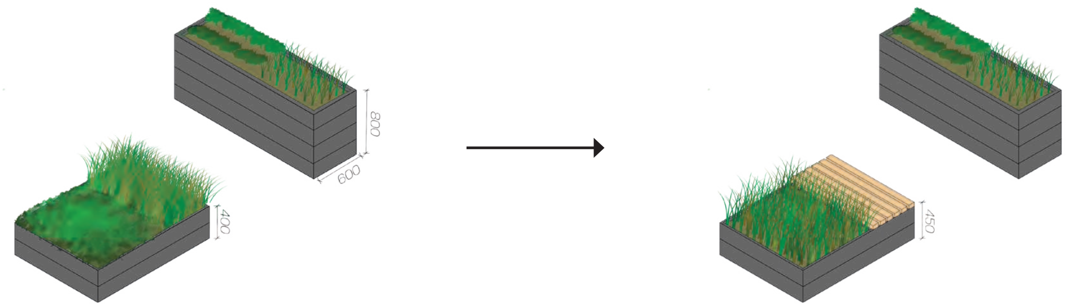


Fig 63.1 - Diagram of flowerbed design principle

COURTYARD

The idea of creating a centre with elements that most people are used to, included outdoor areas, but people are different and come from different backgrounds, and therefore various outdoor areas are created to satisfy different preferences.

The courtyard is the centre of each unit, and can be seen from every area of it.
The common area connects to the courtyard, where on hot summer days it's possible to eat outside, barbeque etc.

Beside the terrace in the courtyard, the courtyard has a path leading in various directions, where in-between the paths there are flowerbeds with various flowers, bushes and small trees. There are places to be more private, but also places for social interaction, while enjoying the plants (see fig 62.2)

The design of the garden is controlled in the expression, giving the feeling of a constrained garden, whereas other places like the garden from the street offers another feeling, this can be seen on page 66.

Detailing: *Flowerbeds*
The most essential part of the courtyard is the flowerbeds, and the way they are designed is important for the atmosphere in the courtyard

As can be seen on fig 63.1 the flowerbeds are varying in height, and the sizes of each flowerbed are different, as they are the space defining element in the courtyard in combination with the vegetation. The higher flowerbeds can be used as railing for residents that need support when walking, while the lower flowerbeds have benches built in, also so the residents can collect some vegetables or herbs comfortably from some of the flowerbeds. The flowerbeds are also placed frequently for the resident's comfort, so when they get tired, a bench is always nearby.

For creating more private corners, where it is possible for the residents to sit on their own enjoying the scent of the beautiful flowers, and hear the birds sing, the vegetation will create the barriers, where in places the vegetation is lower and more open, and in other places it is a bit higher and more dense.

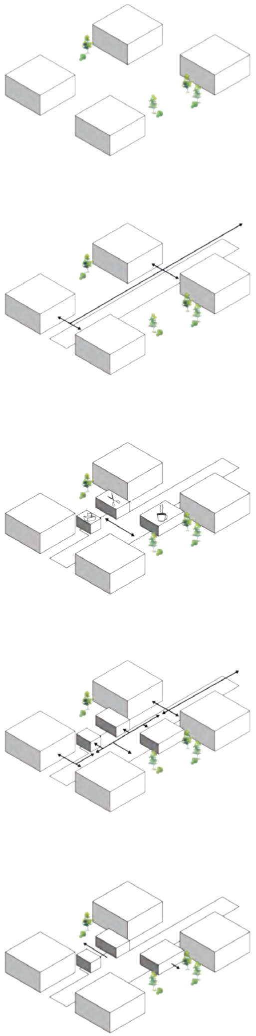


Fig 64.1 - Principle diagram street

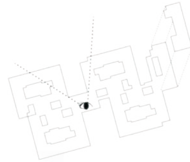


Fig 64.2 - Rendering in the street

Fig 65.1 - Plan drawing of the street

STREET

The general idea of the whole centre is to offer functions for everyone no matter their previous life, and most people are very used to going to the city, some have been living in the city their whole life.

The idea is that the street in the building gives the residents the feeling of a larger world and gives the opportunity for getting out of the house and socialising with a larger crowd or take care of daily shopping, personal grooming and/or going for health-related checks.

The street is the place that broadens the horizons for the residents, where it is possible for them to go get a haircut, a manicure, a very pleasant massage, or in the morning to go get a nice cup of coffee in the cafe, and smelling the newly baked goods or going to the shop to buy some biscuits, milk and coffee for when their relatives and friends come to visit.

The street also has a square for bigger events, and access to the larger garden in south or the smaller garden in north.

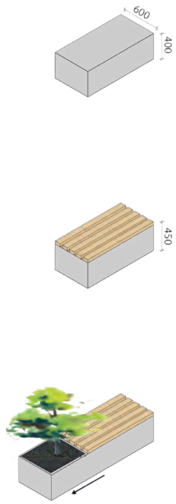


Fig 66.1 - Diagram of benches

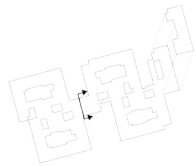


Fig 66.2 - Section of the street

CONNECTIONS: *STREET AND GARDEN*

The idea of the street is that it is a new and different territory for the residents, and that means that the atmosphere is different, however the residents should still feel similarities to the rest of the building so they don't get confused.

The floor is made of light grey concrete tiles, known from streets in the city, or also in some shopping malls.

The frames are the same as in the homes, however the dimensions are different because they carry a bigger load. The cafe has a suspended flat ceiling to create a more intimate atmosphere.

There is access to gardens in both north and south, further opening up to the outside world for the residents.

The garden in south and north are more natural in the design, and don't seem as constrained as in the courtyard, and thereby the gardens offer a different more natural and spacious feeling (see fig. 67.1)

The bench design in the garden is repeated in the street, and takes inspiration from shopping malls, offering a place to sit, while at the same time has an integrated flowerpot, to also offer green elements inside the street (see fig 66.1)

The benches are placed several places, some more private, and others placed so they encourage social interaction

Fig 67.1 - Rendering in the garden

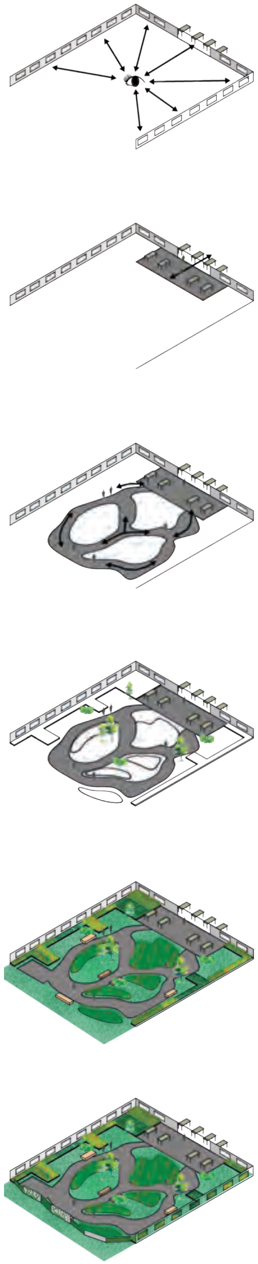
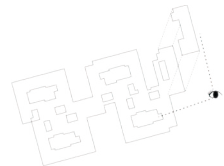


Fig 67.2 - Principle diagram garden



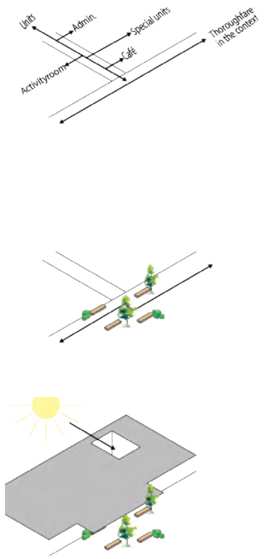


Fig 68.1 - Principle diagram entrance

Fig 68.2 - Rendering of the entrance from outdoor

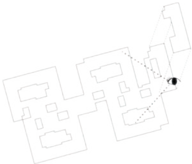


Fig 69.1 - Rendering inside the entrance

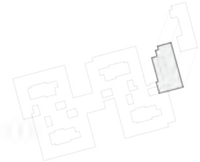
ADMINISTRATION: *ENTRANCE*

The entrance to the retirement centre is placed so that it creates a common area with the entrance to the day-care centre (see fig. 68.2).

The area in front of the centre creates opportunity for social interaction between the different users going to the retirement centre or day care centre, but also for the surrounding area to pass through here.
Entering and exiting the building the reception is to the left, and activity area to the right. This gives the opportunity for the surrounding area to book the activity area for community related activates, when the retirement centre isn't using it.

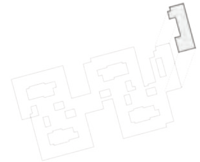
The public cafe is also seen from the entrance (see fig. 69.1) the cafe has a view into a small courtyard and the garden in north. The cafe also offers the opportunity to invite the public to use it, and for the relatives taking the residents here. The special unit is placed on second floor in the administration building, so that it's close to the staff area, because the residents need more care in the special unit. For practical reasons, it must be close to the main entrance, compared to other parts of the building.

The directions of the materials show clearly the directions. Straight ahead to the rest of the centre, to the left enters the administration/special unit



1 Hallway : 120 m²
2 Technical room : 15 m²
3 Janitor : 18 m²
4 Storage : 26 m²
5 Waredrobe woman : 19 m²
6 Waredrobe men : 11 m²
7 Toilet/bath : 5 m²
8 Wc : 4m²
9 Wc : 4m²
10 Bath : 4 m²
11 Staff room : 30 m²
12 Meeting room : 18 m²
13 Office : 13 m²
14 Reception : 13 m²
15 Hallway: 178 m²
16 Acticity room : 127 m²
17 HC Wc : 10m²
18 HC wc : 8 m²
19 WC : 3m²
20 Cleaning room : 10 m²
21 WC : 5m²
22 Kitchen storage : 14 m²
23 Kitchen: 36 m²
24 Cafe : 45 m²

Fig 70.1 - Groundfloor of administration building



1 Storage : 4 m²
2 Storage : 8 m²
3 Washroom : 7 m²
4 Hallway : 92 m²
5 Home : 40 m²
6 Storage : 13 m²
7 Staff room : 9 m²
8 Common area : 4m²
9 Wc : 4m²

Fig 70.2 - 1 st. floor administration building - Special unit

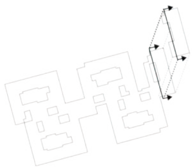


Fig 71.1 - Section administration building

CONNECTIONS: *ADMIINISTRATION AND SPECIAL UNIT*

On groundfloor the courtyard separates the public areas in the layout, while at the same time still offering the feeling of a larger garden, however the public part of the administration also benefits from a look into the garden in north, and thereby making the area seem larger and more spacious and also offers visual connection to the positive energy from the vegetation.

The courtyard gives privacy to the staff in the north end, by a separation of the garden with high bushes (see fig. 71.1)

The special unit is designed with the same principle like the homes, however they are smaller in scale, because it becomes more like a hospital room than an apartment, and therefore the living room area has no use anymore, therefore there is place for lounge furniture for visitors.

There is also a minor common area, however this isn't expected to be used much, but more occasionally for the visitors.
The common area and hallway also have visuals to the courtuyard and the context.

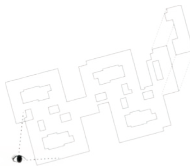


Fig 72.1 - Rendering of facade

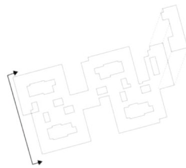


Fig 72.2 - Elevation of facade towards west

Fig 72.3 - Elevation of facade towards west

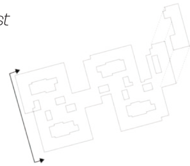


Fig 72.4 - Elevation of facade towards east

Fig 73.1 - Elevation of facade towards south

Fig 73.2 - Elevation of facade towards north

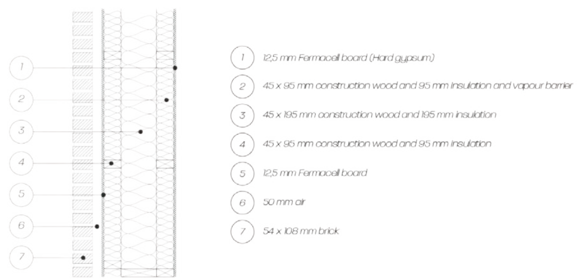


Fig 73.3 - Detail drawing of brick envelope

Fig 73.4 - Detail drawing of wood envelope

FACADE

The facade expression is inspired by elements used in 1950'ies to 70'ies houses, an analysis of that can be seen on page 91.

Two types of materials was chosen as the main materials in the facade expression to give a variation.

When choosing the materials it was important that the materials would fit in and compliment the materials in the context, therefore the bricks were chosen as one of the main materials (see fig 73.3)

The other material used is Pine Thermowood, and this material doesn't occur in the area, however it has a natural wooden color, and therefore doesn't stand out in the area, and shows the sustainable character of the building. For construction of the facade with wood see fig. 73.4.

The distribution of the two materials is mixed according to lines from the windows, where as a general rule, there is always bricks under the windows, and then the variation in the facade is the shift between bricks going up to the top of the lower window, and wood going down to the bottom of the higher placed window from the ground.

Over some of the windows there are also lamellas introducedn to create a pattern. These lamellas are also used for covering the openings for inlets and outlets for the ventilation in the technical rooms.

This means that the facade has a system, but doesn't get an institutional rhythm (see fig. 72.1).

Fig. 74.1 - Plan over escape routes

FIRE STRATEGY: ESCAPE ROUTES

When designing the building, it was important to make sure the distances to and from centre in each unit wasn't too long for practical reasons, and for the comfort level of the residents.

Another important factor which also followed and came naturally when limiting the distances between areas, was the fire strategy.

The fire strategy is shown in fig. 74.1, and there it is clear that in case of fire the building works well, where there is no place in the building the distance to another fire section or to a exit exceeds 25 meters.

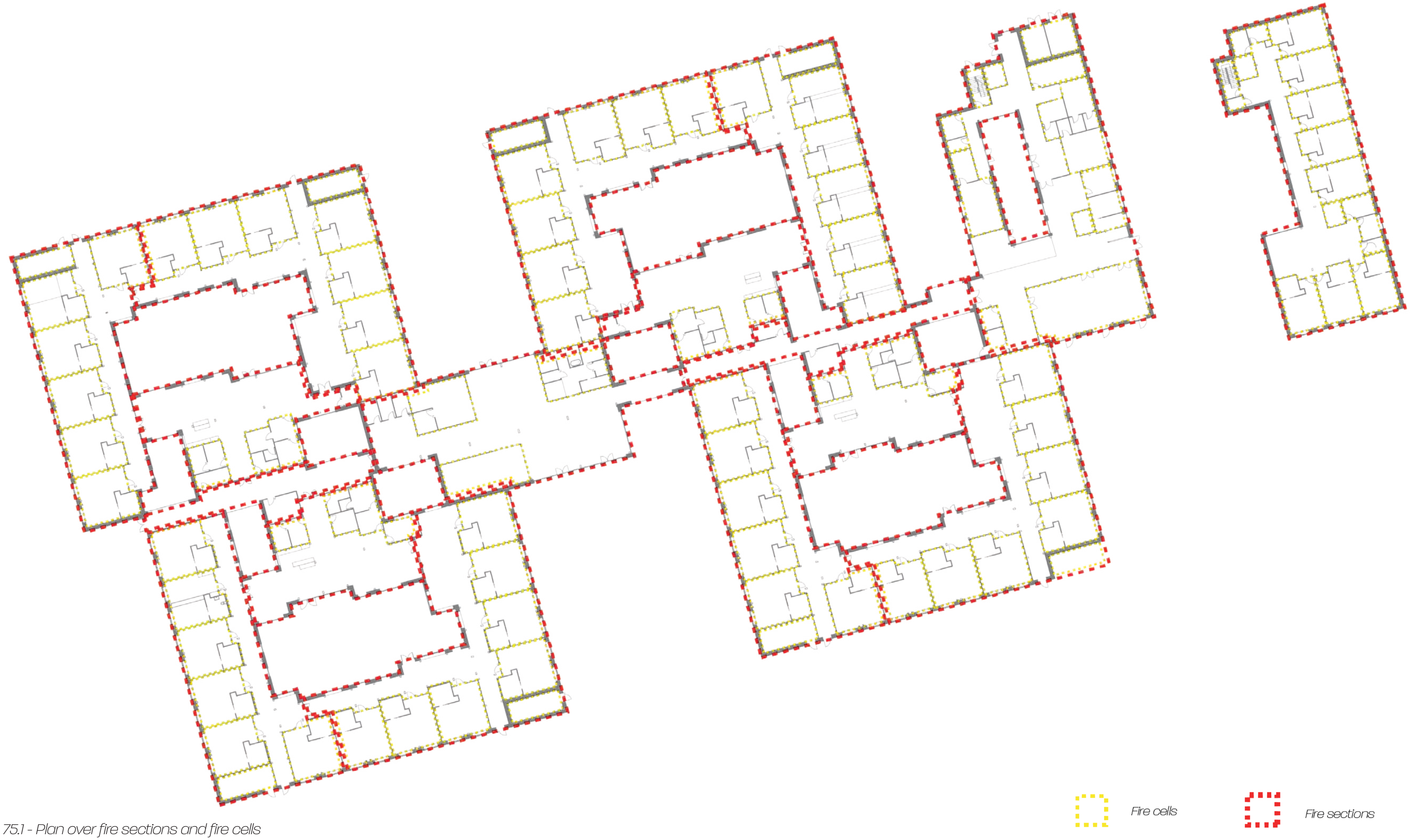


Fig. 75.1 - Plan over fire sections and fire cells

FIRE STRATEGY: SECTIONS AND CEllS

Each unit consists of three fire sections, one consisting of 6 homes, where each home is a fire cell, and every home has more or less a straight path out of the building. the other one consists of seven homes, where each home is a fire cell and also here each home has more or less a straight path to the outdoor.

The third section consists of the common area, and has the staff area and storage and techincal area as fire cells.
The common area is connected to the other fire sections in the unit, but also connected to the corrdor which is it's own fire section, that leads directly out.

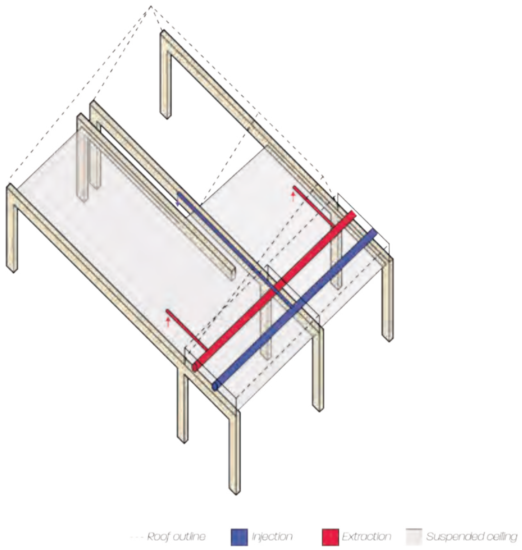


Fig 76.1 - Ventilation principle for outlet and inlet in the homes

Fig 76.2 - Ventilation detail for hiding inlet and outlet behind ceiling

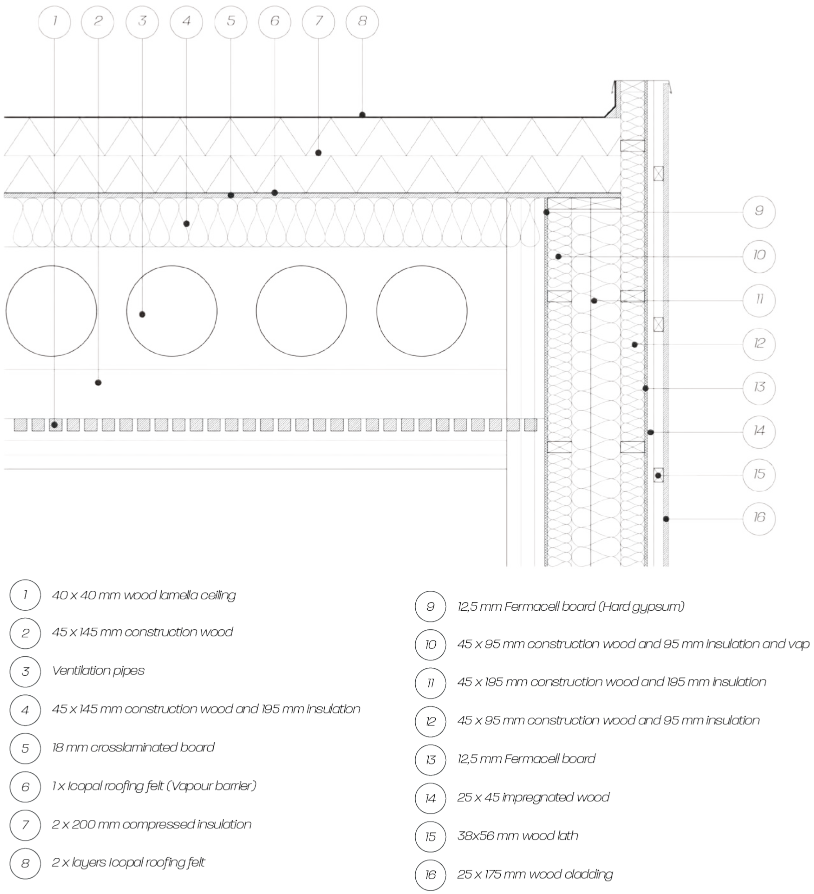


Fig 76.3 - Detail of roof, wall and suspended ceiling with ventilation pipes

VENTILATION

The design of the centre, with its size and functions means that multiple systems are needed and that the systems are VAV (variable air volume). That the systems are VAV means that the systems can adapt the ventilation according to wishes or the needs. During a day the activity in the centre can vary in placement and amount, such as the centre is 'technically' active the whole day but during the night the activity is lower because people are sleeping.

To make a system that is flexible, meaning that it either can regulate itself by having sensors in the area that measure temperature and/or Co2-level or can be regulated by the user. The system is divided based on areas that need similar amount of ventilation (see fig. 77.1), so that the air can be regulated by dampers. For instance, in the units there are two systems, one for all the homes and one that covers the rest (one of the systems covers the common area of two units and a corridor).
A retirement centre can often have problems with bad odor, therefore the air change has been

Fig 77.1 - Ventilation plan over the whole building

decided on that instead of Co2 (see app. 4) which gives a higher air change then the standards, for instance the minimum air change in homes is 0,3 l/s pr. m^2 where as in this project it is 1,2 l/s pr. m^2. But this is only when the system is running on its highest.
The higher level of air change has influence on many aspects in the design of the center. Such as the BE15, where the SEL for the ventilation is 1,1 and the size of the ventilation pipes, which determines the roof and beam construction (see fig. 76.1). The ventilation also influences the ceiling in the centre, with the lamellas which not only give something aesthetic but also help prevent visual in – and out for the ventilation (see fig. 76.2).

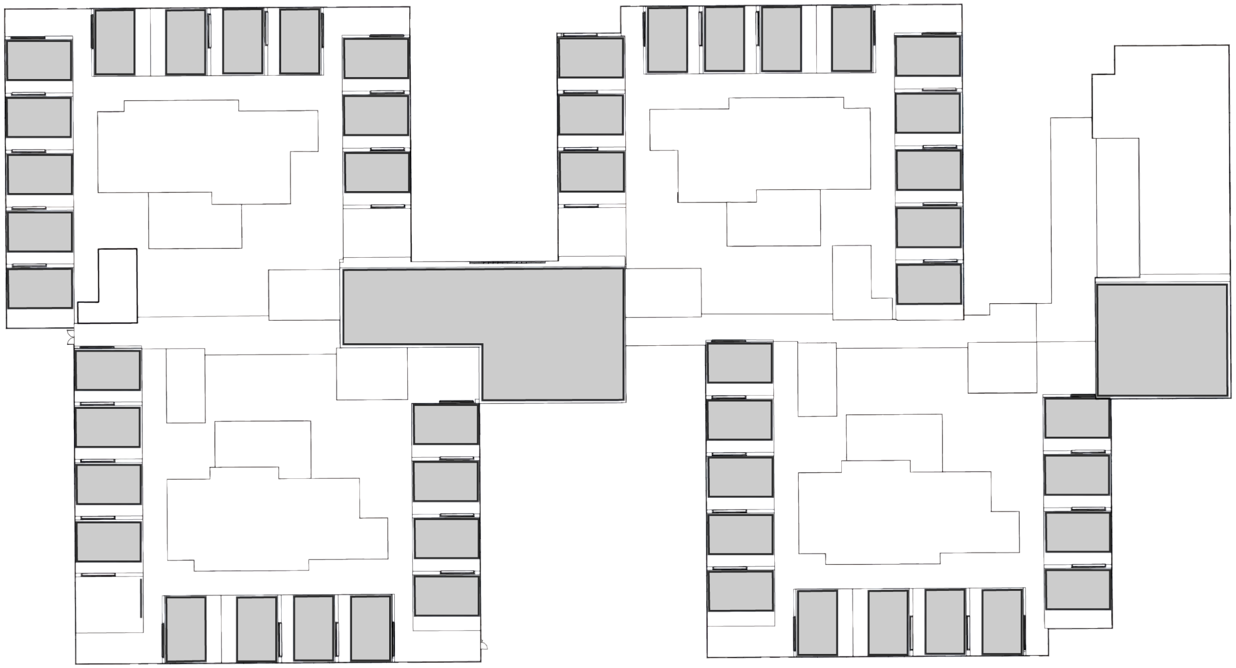


Fig 78.1 - Diagram showing placement of PV's

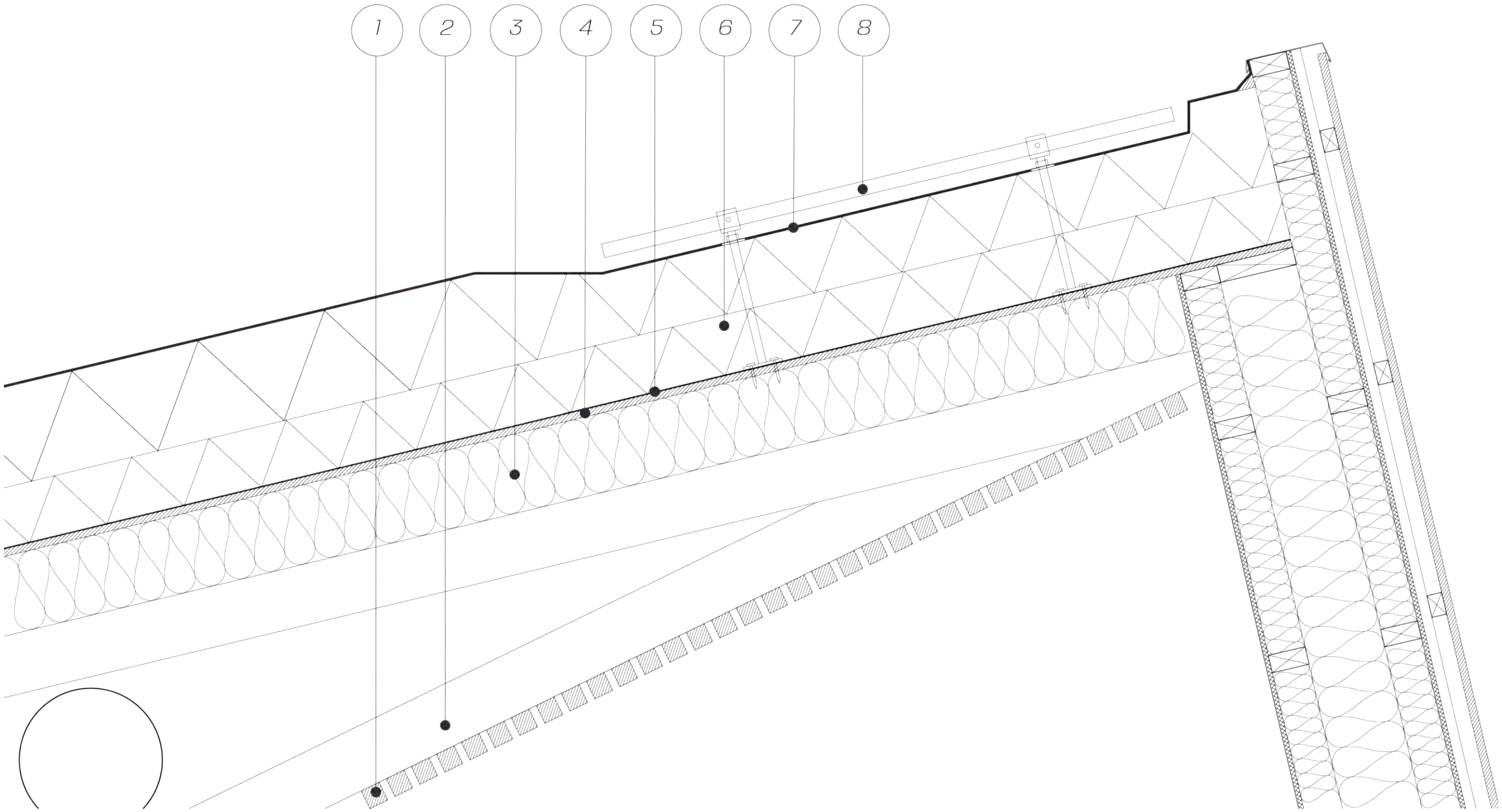
ENERGY CONSUMPTION AND PV'S

Calculating the energy consumption in a retirement centre can be difficult, because of its unique using pattern compared to a school and a normal home. So, it was difficult to find a specific way to calculate it and the material finally found listed a range of diverse ways (mst.dk, 1998-2011) to calculate the plug loads. Which gave various results based on the calculation method, therefore all methods were taken in to consideration in the final calculations. Where they individually had the energy consumption of the systems, ventilation and heat found in BE15, added. So, when using the energy consumption to calculate the amount of PV's, it would be covering for the whole energy consumption.

The PV's are added as an active strategy mainly to get the building to achieve energy frame 2020, but also to get the building as close to producing all its own electricity.

When putting in the amount of PV's into Be15 the amount of PV's produce more than enough electricity to achieve 2020 requirements. The result from Be15 can be seen on page 84.
The placement of PV's on the roof was influenced by the shadow studies, and the buildings shape was influenced by the wish to have a high efficiency PV solution, but also a PV solution that was seamlessly and visually well integrated into the roof (see fig. 79.1)

The shadow study on page 80 has resulted in some roof areas without PV's because they will be shaded most of the day during the whole year.



1	40 x 40 mm wood lamella ceiling	5	1 x Icopal roofing felt (Vapour barrier)
2	Truss	6	1 x 150 mm and 100-200 mm compressed insulation
3	195 mm insulation	7	2 x Icopal roofing felt
4	18 mm crosslaminated board	8	Solar panel monocrystalline

Fig 79.1 - Detail drawing showin roof and angled wall and PV integration


Fig. 80.1 - Shadow analysis - April 1st 8 o'clock


Fig. 80.2 - Shadow analysis - April 1st 12 o'clock

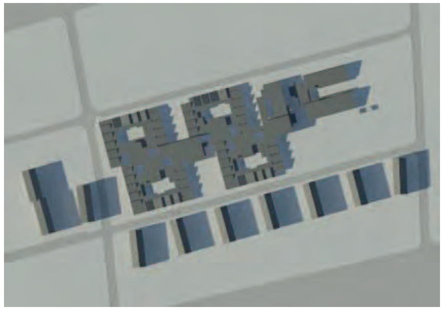


Fig. 80.3 - Shadow analysis - April 1st 16 o'clock


Fig. 80.4 - Shadow analysis - April 1st 8 o'clock


Fig. 80.5 - Shadow analysis - April 1st 12 o'clock

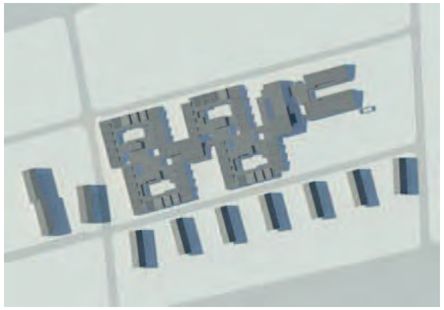


Fig. 80.6 - Shadow analysis - April 1st 16 o'clock

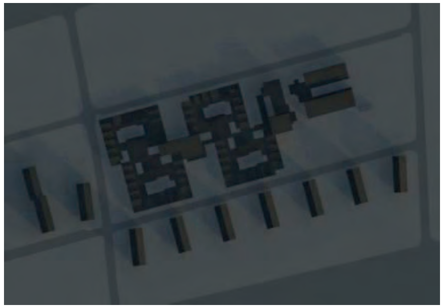


Fig. 80.7 - Shadow analysis - April 1st 8 o'clock

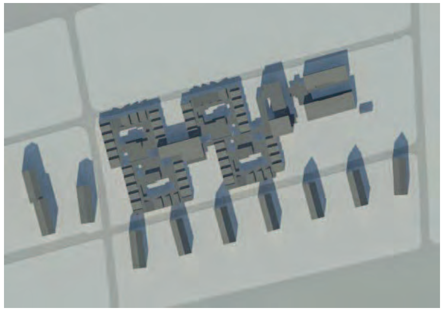


Fig. 80.8 - Shadow analysis - April 1st 12 o'clock


Fig. 80.9 - Shadow analysis - April 1st 16 o'clock

DAYLIGHT

From the analysis in the program it was clear that daylight would be a strong focus in this project.

Throughout the design process the building design was tested for every small variation, and the daylight had a big influence on the shape of the building, both in the overall masterplan, but also a focus on all the different areas in the building. as can be seen on the shadow analysis above, the courtyard isn't shaded most of the time, and whenever it is shaded there is always a part of the courtyard that is not.

The courtyard is also placed to drag in light to the building, both the large courtyards and the atriums. The shadow studies also determined to what degree the PV's could be placed.

Overall the building doesn't shade the surroundings, aside from a little in december.
The shape of the homes been heavily influenced

Fig. 81.1 - Daylight study: North April 21, 8 AM

Fig. 81.2 - Daylight study: South April 21, 8 AM

Fig. 81.3 - Daylight study: North July 21, 11 AM

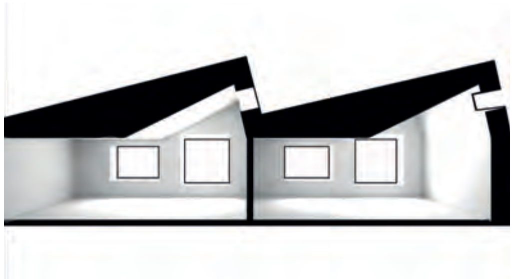


Fig. 81.4 - Daylight study: South July 21, 11 AM

Fig. 81.5 Daylight study: North January 21, 8 AM

Fig. 81.6 - Daylight study: South January 21, 8 AM

by light intake with a combination of placement of PV's

The one-sided slope on the home that was created to give an optimal placement of PV's and to create a separation in the facade, breaking down the institutional look, was also made to raise the ceiling in the home to get a feeling of a more spacious living room area, and at the same time the raised ceiling has a window letting in light from above

The daylight studies above, show how the light from above and windows in the facade create good light intake throughout the year, compared to if there was no window in the raised part

For further light studies from the process see appendix on page xx

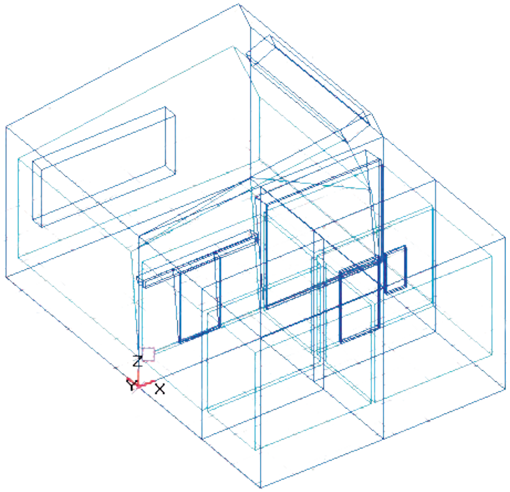


Fig. 82.1 - BSim model of the home

BSIM

A well balanced indoor environment is essential for the wellbeing of the users and therefore various standards (Br2020, CR 1752) gives the guidelines and regulations for an indoor environment. Such as maximum 100 hours above 27 and 25 hours above 28 degrees Celsius (bygningsreglementet.dk, 6.2) and that the environment is a category A level which means that the level of CO2 can't pass over 460 ppm above outdoor level (810 ppm in total). And the mean temperature in the summer should be 23 + 1,0 degree Celsius and in winter 19,00 + 1,5 degree Celsius (CR1752, 1998).

Using Bsim to simulate the conditions of the indoor environment where the homes was the focus. Just as the other aspects of the project, flexibility and individuality was wanted in the homes, because people have diverse needs and habits. But this is also what make the user the most unstable factor when it comes to indoor environment and therefore two scenarios were made, one where the user was in the home most of the day and the internal loads (equipment, light etc.) was high (referred to as scenario 1), and another where the user only used a minimal amount of time in the home (referred to as scenario 2). Together with this the orientation of the home has been taken in to account in Bsim, because some of the homes have their façade or their skylight facing south and this will affect the temperature in the homes. Hence there has been made 8 models (4 orientations, 2 scenarios) to investigate if the systems (ventilation and heating) main settings can help fulfil the guidelines from the standards.

Results:

- Co_2: There is a higher level of CO_2 in scenario 1 because the person is home longer, but it never reaches over the maximum level.
- High temp (→27 and 28): The worst period is in July, August and September and the models with orientation is towards south or east (where the skylight is then towards south) have the largest amount of hours, but it never passes the maximum amount of hours. I the homes with scenario 2 the number of hours is slightly higher, because the user in not home to adapt the temperature during the day (venting was set to only take place, most of the year, when the user is home).
- Mean temp: Is stabile in all cases only slightly higher towards the south and east, stays between max and minimum.

The indoor environment is well balanced and doesn't have a large variation depending on the orientation but more on how much time the resident uses in the home. Because they can't adapt the varied factors in the home during the day, which is of course because some of functions that help regulate the environment is only set to work when the user is home. But in reality, if not everything is automatic, the user needs to be home to do the functions.

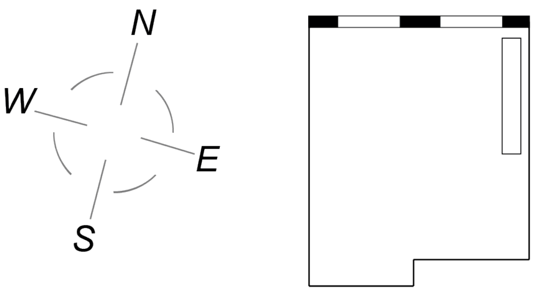


Fig. 83.1 - Plan for BSim facing north

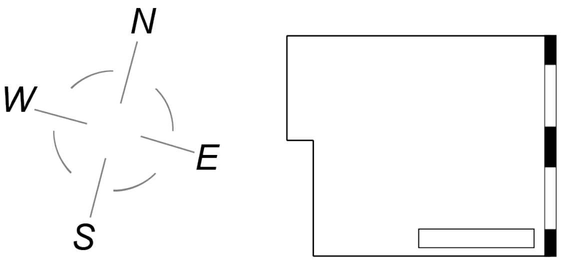


Fig. 83.2 - Plan for BSim facing east

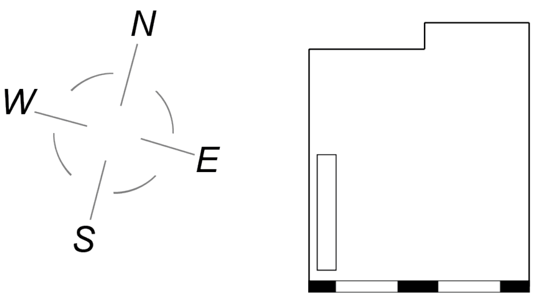


Fig. 83.3 - Plan for BSim facing south

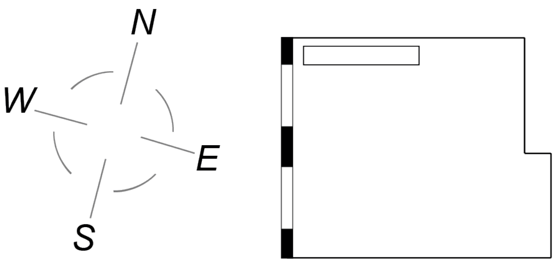


Fig. 83.4 - Plan for BSim facing west

	Co2 ppm	**>27 c** Hours annually	**>28 c** Hours annually	**<19,8 c** Hours annually	**Mean temp** Hours annually
Scenario 1 - User home most of the day	418,0	10	0	28	22,16
Scenario 2 - User home out most of the day	367,7	8	0	73	22,10

Fig. 83.5 - Results from BSim facing north

	Co2 ppm	**>27 c** Hours annually	**>28 c** Hours annually	**<19,8 c** Hours annually	**Mean temp** Hours annually
Scenario 1 - User home most of the day	416,6	55	24	20	22,28
Scenario 2 - User home out most of the day	367,6	55	22	61	22,25

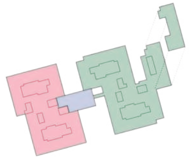
Fig. 83.6 - Results from BSim facing east

	Co2 ppm	**>27 c** Hours annually	**>28 c** Hours annually	**<19,8 c** Hours annually	**Mean temp** Hours annually
Scenario 1 - User home most of the day	416,6	55	24	20	22,28
Scenario 2 - User home out most of the day	367,6	55	22	61	22,25

Fig. 83.7 - Results from BSim facing south

	Co2 ppm /mean	**>27 c** Hours annually	**>28 c** Hours annually	**<19,8 c** Hours annually	**Mean temp** Hours annually
Scenario 1 - User home most of the day	416,9	25	3	24	22,21
Scenario 2 - User home out most of the day	366,9	25	2	55	22,18

Fig. 83.8 - Results from BSim facing west



Energy frame buidings 2020 - *Unit 1 and 2 passive strategies*

Without supplement	Supplement for special conditions	Total energy frame
20,0	0,0	20,0
Total energy requirement		17,3

Contribution to energy requirement		Net requirement	
Heat	17,7	Room heating	17,7
El. for operating of building	3,7	Domestic hot water	14,6
Excessive in rooms	0,0	Cooling	0,0
Selected electricity requirements		**Heat loss from installations**	
Lighting	43,0	Room heating	0,2
Ventilators	3,7	**Output from special sources**	
Total el. consumption	34,4	Solar cells	0,0

Fig. 84.1 - Be15 result for unit 1 and 2 - Passive strategies

Energy frame buidings 2020 - *Street passive strategies*

Without supplement	Supplement for special conditions	Total energy frame
25,0	0,0	25,0
Total energy requirement		49,1

Contribution to energy requirement		Net requirement	
Heat	19,8	Room heating	19,0
El. for operating of building	16,3	Domestic hot water	13,1
Excessive in rooms	0,0	Cooling	0,0
Selected electricity requirements		**Heat loss from installations**	
Lighting	14,4	Room heating	0,1
Ventilators	1,9	**Output from special sources**	
Total el. consumption	22,1	Solar cells	0,0

Fig. 84.2 - Be15 result for street - Passive strategies

Energy frame buidings 2020 - *Unit 3 and 4 and admin passive strategies*

Without supplement	Supplement for special conditions	Total energy frame
20,0	0,0	20,0
Total energy requirement		19,5

Contribution to energy requirement		Net requirement	
Heat	14,3	Room heating	14,1
El. for operating of building	2,9	Domestic hot water	13,1
Excessive in rooms	0,0	Cooling	0,0
Selected electricity requirements		**Heat loss from installations**	
Lighting	39,5	Room heating	0,1
Ventilators	2,9	**Output from special sources**	
Total el. consumption	32,8	Solar cells	0,0

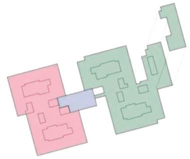
Fig. 84.3 - Be15 result for admin/special unit - Passive strategies

BE15 RESULT:

In this project Be15 has been used during the design process to guarantee the design can meet Danish 2020 building requirements in energy cost - the energy demands not exceeding 20 kWh/m^2 year. (bygningsreglementet.dk, 7.2.4.2)

Be15 is a program developed by SBi, it documents that the energy demands from the Danish Building Regulations and other legislations are obeyed, when constructing new buildings or renovating existing ones. The program can also be used in the design process to calculate the energy need and the energy use of a building, so a good energy economy can be achieved. Due to the different functions in different parts of the project, the project is divided into 3 parts and by separating the Be15 model to get a more realistic and accurate results and through simulation, the 2020 building energy requirement is achieved in the general project.

The whole project is divided into 3 parts for Be15 simulation, the first part consists of 2 normal home units and their common area as well as the shared connection area; the second part consists of 2 normal home units, special unit, administration part and their common area as well as the connection area; the third part is the street area. Both the first and second part are set as detached house as building type in Be15, and the third part is set as other (non residential) building type. The goal is to fulfill 2020 Building regulation as much as possible by only using passive strategies and then apply active strategies to reach a zero energy building in general throughout the whole year. Several passive strategies are applied to the whole project: roofs, exterior walls and foundation are constructed with thick insulation layer to obtain low U-value in order to reduce energy lost in winter and thermal transit in summer; triple layer glass is applied for the exterior windows to obtain low U-value around 0.79. In order to avoid



Energy frame buidings 2020 - *Unit 1 and 2 active strategies*

Without supplement	Supplement for special conditions	Total energy frame
20,0	0,0	20,0
Total energy requirement		-7,7

Contribution to energy requirement		**Net requirement**	
Heat	17,7	Room heating	17,7
El. for operating of building	-6,3	Domestic hot water	14,6
Excessive in rooms	0,0	Cooling	0,0
Selected electricity requirements		**Heat loss from installations**	
Lighting	43,0	Room heating	0,2
Ventilators	3,7	**Output from special sources**	
Total el. consumption	34,4	Solar cells	68,5

Fig. 85.1 - Be15 result for unit 1 and 2 - Passive and active strategies

Energy frame buidings 2020 - *Street active strategies*

Without supplement	Supplement for special conditions	Total energy frame
25,0	0,0	25,0
Total energy requirement		24,1

Contribution to energy requirement		**Net requirement**	
Heat	19,8	Room heating	19,0
El. for operating of building	6,3	Domestic hot water	13,1
Excessive in rooms	0,0	Cooling	0,0
Selected electricity requirements		**Heat loss from installations**	
Lighting	14,4	Room heating	0,1
Ventilators	1,9	**Output from special sources**	
Total el. consumption	22,1	Solar cells	112,1

Fig. 85.2 - Be15 result for street - Passive and active strategies

Energy frame buidings 2020 - *Unit 3 and 4 and admin active strategies*

Without supplement	Supplement for special conditions	Total energy frame
20,0	0,0	20,0
Total energy requirement		-5,5

Contribution to energy requirement		**Net requirement**	
Heat	14,3	Room heating	14,1
El. for operating of building	-7,1	Domestic hot water	13,1
Excessive in rooms	0,0	Cooling	0,0
Selected electricity requirements		**Heat loss from installations**	
Lighting	39,5	Room heating	0,1
Ventilators	2,9	**Output from special sources**	
Total el. consumption	32,8	Solar cells	63,9

Fig. 85.3 - Be15 result for admin/special unit - Passive + active strategies

the overheat effect by getting too much sunlight through the big glass facade in the unit courtyard in summer, a 80cm wide overhang is applied in the courtyard facade. Furthermore, top side lights and skylights are placed in roofs of normal homes and common areas to improve the natural daylight condition and reduce the energy consumption by using artificial lighting. The mechanical ventilation zones are also divided into detailed parts and the Fo factor of ventilation is different in different ventilation zones to obtain more realistic results of the energy consumption, for example, the Fo factor is set as 0.4 in common area and 0.6 in normal home to assume residents spend around 9 hours in common area and 14 hours at home.

The demands for energy class 2020 has been reached by using only passive strategies in part one and part two. Part three the energy consumption of the street is higher than 2020 standard by only using passive strategy. (see app. 2) In order to achieve zero energy building, PV solar panels has been chosen as the renewable energy source for active strategy. Monocrystalline solar panels are selected due to its high efficiency. The amount of PV solar panels needed to cover the total energy frame added by the electricity use for appliances and lightning are calculated (see app. 2). Solar panels are integrated on the roof with 12,4 degree cover most of the home roofs facing south, east and west. The roofs of the street and administration building, is also covered by solar panels. (see fig. 78.1) After applying solar panels, the total energy consumption goes below zero in the whole building: part one and part two of the building produce more electricity than needed and thereby covering the energy need of part three of the building.

Process

The process is divided in to smaller parts that cover either a “considerable” or a “minor” part of the process, but the division is made to explain the project in details.

Overall the process started in the detailing of the centre, with the work of floor plans in the homes, which had to comply with different standards for ideal distance for disabled people. From there the process went further and further out form the homes, by using different methods such as sketching, physical models and 3D models.

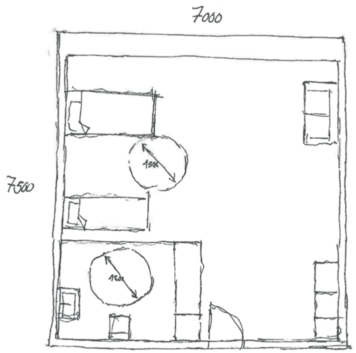


Fig 88.1 - Plan sketch 1

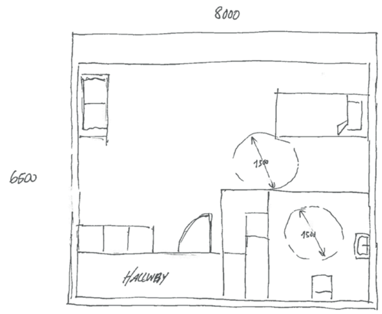


Fig 88.3 - Plan sketch 3

Fig 88.5 - Plan sketch 5

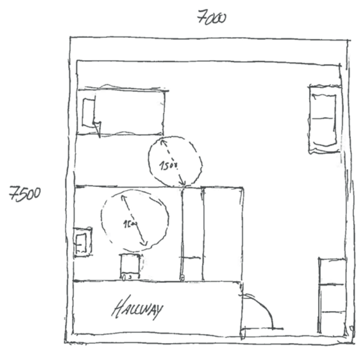


Fig 88.2 - Plan sketch 2

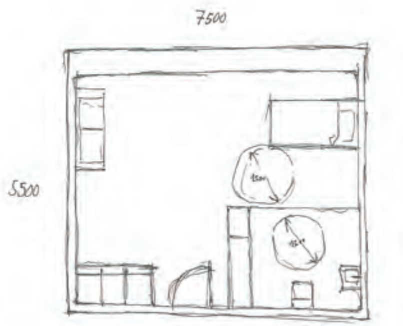


Fig 88.4 - Plan sketch 4

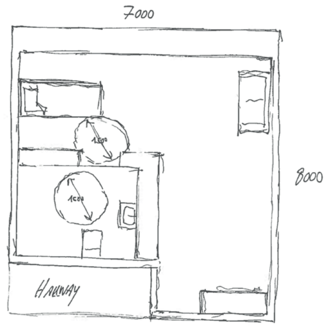


Fig 88.6 - Plan sketch 6

PLANLAYOUT SKETCHING: *HOME*

The biggest deciding factor of the shape of the building and overall layout is the measurements of the home and therefore the process was started with a study of how large the homes should be as a minimum, and a study of various proportions and layout sizes. The studies started out by sketching various layouts in right scale and finding the minimum measurements for bed, bathroom and acceptable area for living, and then those were placed in the various layouts, to see how it worked. Some of the homes were square in the layout, and some were more rectangular. In the end the one that had the most practical space where every area in the home was optimal, while still using as little space as possible was chosen. This process helped determining the size of every home, and for the later process this was fixed.
The studies were both made in sketching in scale, but also in making 3D models to not only see it in 2D, so the proportions of the home were also right.

As it is shown in the sketches above, the various sizes show a big difference in how optimal the layout is depending on the proportions of the home

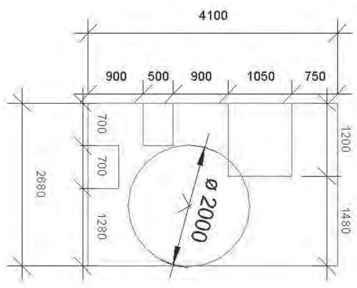


Fig 89.1 - Batroom plan 1

Fig 89.3 - Bathroom plan 3

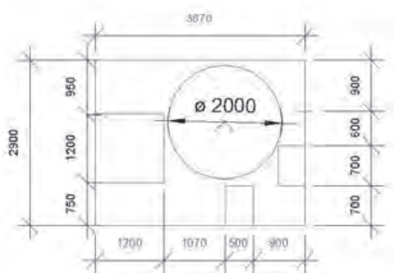


Fig 89.2 - Bathroom plan 2

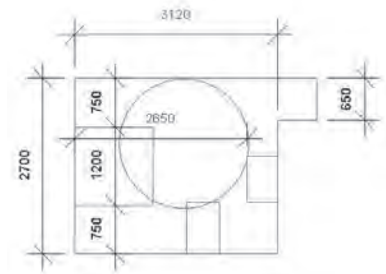


Fig 89.4 - Bathroom plan 4

PLANLAYOUT 3D: *BATHROOM*

When designing a home for dementia patients and older people the bathroom is very important for practical reasons and also for the wokers. There are several technical requirements that need to be fulfilled, however these requirements can be fulfilled in various ways, and there is room for different sizes.

Therefore there was a workshop mainly focusing on trying out various sizes, and combinations.
There is not a big difference of how optimal the bathroom is because of the size, because the requirements make sure there is always enough room to move around, such as turning in a ceiling lift or wheelchairs. Eventhough there isn't a big difference in how optimal the bathroom is, the dimensions of the bathroom can affect the rest of the homes layout, and for that reason the bathroom is made smaller, to use the space most efficiently, while at the same time fulfilling the requirements.

Fig 90.1 - Plan 1

Fig 90.3 - Plan 3

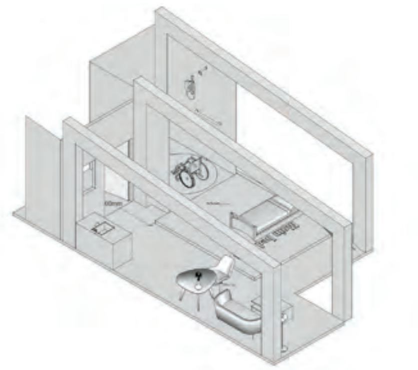


Fig 90.5 - Plan 5

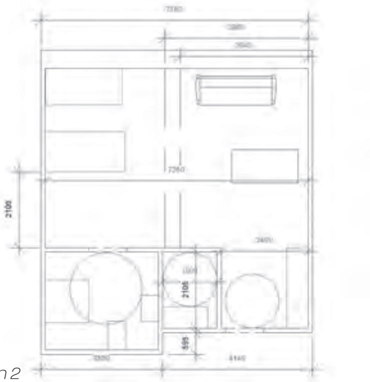


Fig 90.2 - Plan 2

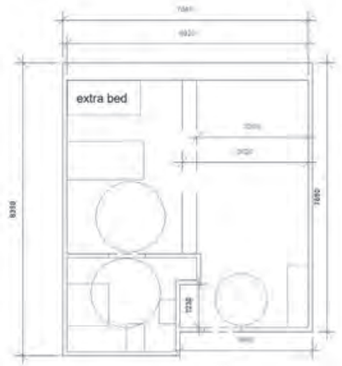


Fig 90.4 - Plan 4

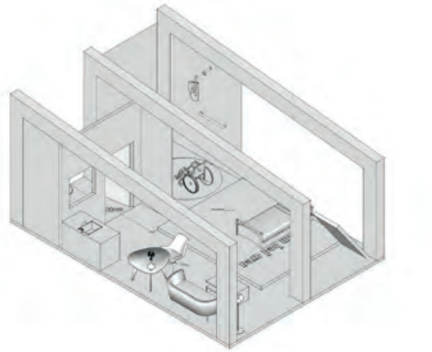


Fig 90.6 - Plan 6

PLANLAYOUT 3D: *HOMES*

The sketching phase of the dimensions of the home was a good indication of which dimensions could work and which couldn't. After also having found the dimensions of the bathroom, the homes were built in Revit, so they could easily be adapted.

In this phase several dimensions of the homes were tested with the fixed bathroom.

Some quite square, others more irregular in shape. Common for them all is that the entrance area is pushed back in relation to the bathroom. This is to create a more private area in front of the door to the homes, but also for the residents to recognise their own home from the outside, by the possibilty to place some of their own furniture like a chair etc. In one of the plans (fig 90.2) the bathroom has an extra storage room, which was a wish from the competition. This room took a lot of area from other rooms when the squaremeter for each apartment was fixed, and also it is clear that the majority of the space in the storage room would be used for maneuvering, the conclusion being that a closet would be much more efficient.

To get a better understanding of the plan it was also modelled in sketchup to see what a shift in the main facade would do. This made the layout more divided and created unefficient corners, therefore the straight facade was maintained (see fig. 90.5).

Fig 91.1 - Utzon's house courtyard

Fig 91.3 - Utzon's house exterior

Fig 91.2 - Plan for Utzon's house

Fig 91.4 - Danish type house

CASE STUDY: *1950 to 1970'IES ARCHITECTURE*

During the process, inspiration from the single-family houses in the Danish architectures golden period more specific the 1950-1970'ies started influencing the design. Therefore a small design study of the period was made, to narrowing down aspects that could be used further on.

World war 1 and 2 resulted in a process in technology and in peoples and societies mindset, which made an evolution in the architecture. Going from ornamentation to clean and honest expression, that was made possible by experimenting with new materials and construction technologies.
This evolution also came to Denmark and the rest of Scandinavia, but here the lack of availability in the new materials and technology resulted in a different expression than the rest of Europe. Here the architects adapted the use of traditional and local materials, as wood and yellow clay for bricks, and evolved on the traditional building methods such as mason (Sheridan, M. 2011)

The other aspects, such as symmetry in the floor plan and use of geometry in the expression was still used. Also was the aspects of adapting buildings to the wellbeing of the user, as good light conditions and connection to the nature, but at the same time practical.

An example of these aspects is Utzon's house for his own family (1950-1952), that have ended up as the main inspiration to the now traditional family 'type houses'. The floor plan was made of 120 cm intervals and all measurements can be exact divisor with 12 cm (one brick and jointing) (Sheridan, M. 2011, pp. 79). The building was made into two parts giving the possibility for good light intake in all areas, and making easy accessible and shared outdoor spaces. The hallway connecting the two parts have multi purposes, that it can also be used as a room for gathering while having connection to the two main shared areas (Sheridan, M. 2011, pp. 87).

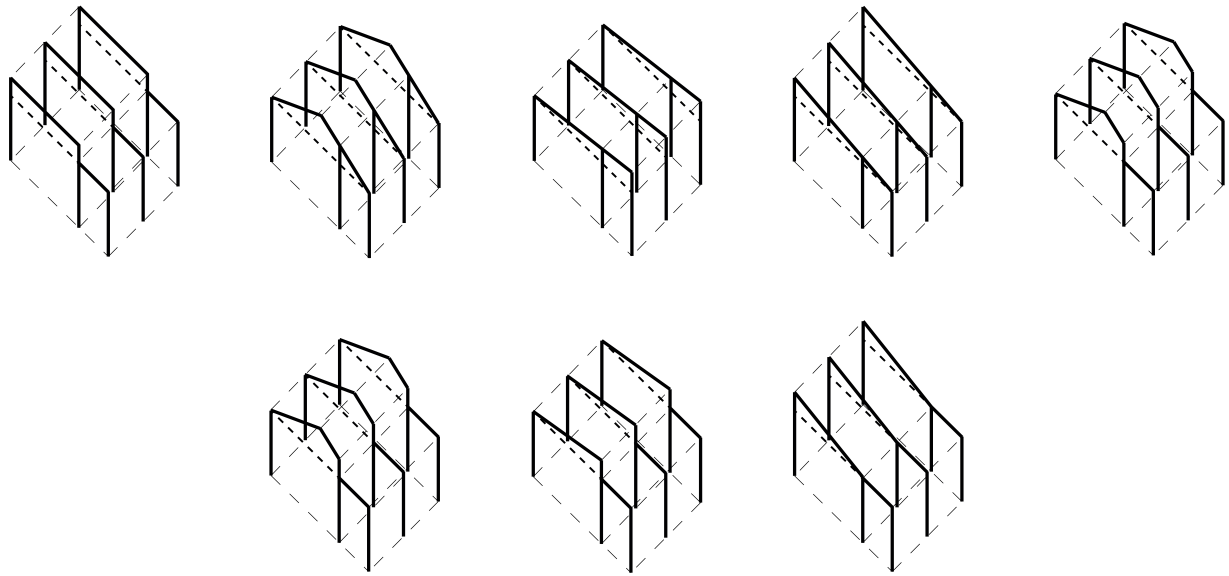


Fig 92.1 - Frame diagram

FRAME SYSTEM

Because the home size is fixed and will always be the same everywhere, it is obvious that a modular system of some sort will benefit the design, both in making it more clear, simple and also more efficient in the way it's constructed. The analysis show that it is best for the residents to have something to relate to, and to make them feel at home, the design has to offer familiarity to their previous life, and therefore the frame system has been chosen as the main modular system. The frames are familiar, because they were used a lot in the 1950'ies and forward for several years.

The frames are placed in the wall between every home, but also in the middle of the home to limit the load lenght and thereby creating a slimmer load bearing construction.

As Fig 92.1 shows there are various ways of using the frame system, and therefore if wouldn't limit the design options that much, but also it will put the design in a modular system that increases the efficiency when constructing it.

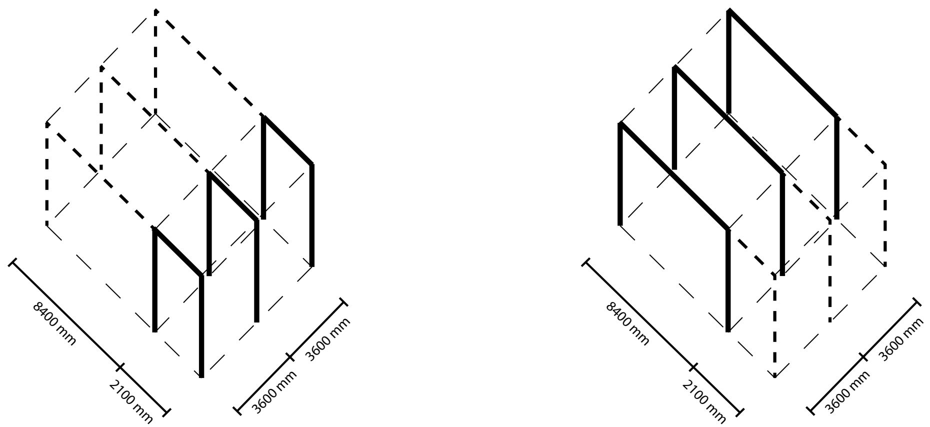


Fig 93.1 - Frame diagram chosen

For the further process the plan layout of each home follows the frame system shown on Fig 93.1

The frame system has been developed based on the previous layout of the home that was considered the most efficient and rational, and then the plan and frame system was adapted to the closest measurement in the 300 mm interval.

The reason for this interval is because of the international standard for measurements of material in the building industry, and hereby the design is designed so that it limits waste.

The measurement in the hallway outside the home also considers the space required in emergency situations, like fire, and also so the hallway feels open and spacious in every day situations.

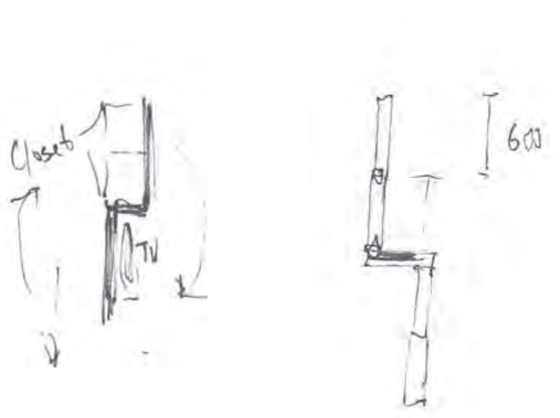


Fig 94.1 - Adjustable wall sketch plan

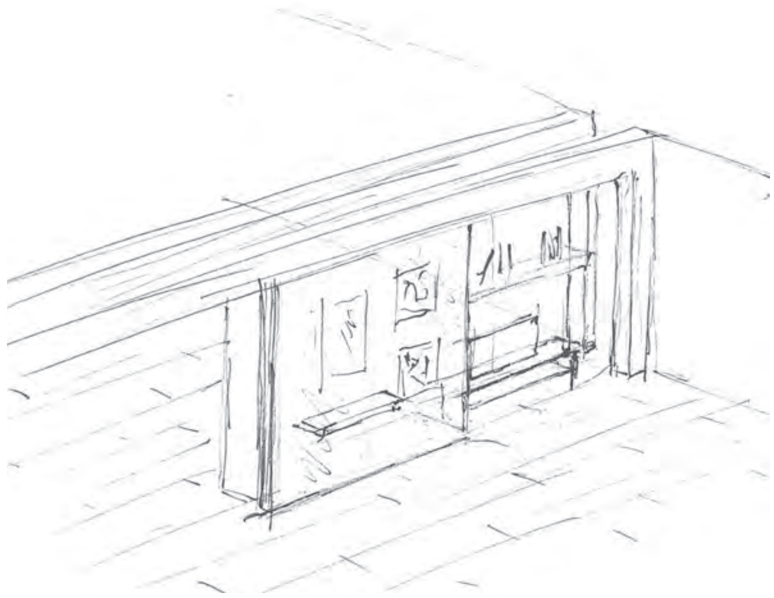


Fig 94.2 - Adjustable wall sketch perspective

ADJUSTABLE WALL

The analysis shows a need for individuality for the residents for them to feel at home in the centre. One frame was placed in the middle of the apartment, where the placement of the bathroom walls were constrained by the beam.

The placement of the middle beam was optimal for introducing some sort of flexible or adjustable object, so the home could be adjusted to everyone's personal preference. This encouraged the idea of introducing a limited easy to use system that can personalize each home. Therefore, the idea of introducing an extra beam so the adjustable system could be limited between the beams, was tried out, and this extra beam also changed the bathroom and kitchen where the placement between the beams was decided by the closet at the entrance and the place for washing machine and dryer in the bathroom. By doing this the frames can be seen over every wall in the apartment, and seems well integrated and as a part of the aesthetic expression in the home, while at the same time giving the opportunity to be used as the limitation in an adjustable system. The adjustable system introduced here is 6x60 cm panels that can be used as dividing the Livingroom area and the bedroom area in various ways.

Fig 95.1 - Adjustable wall 1 - Living room

Fig 95.2 - Adjustable wall 1 - Bedroom

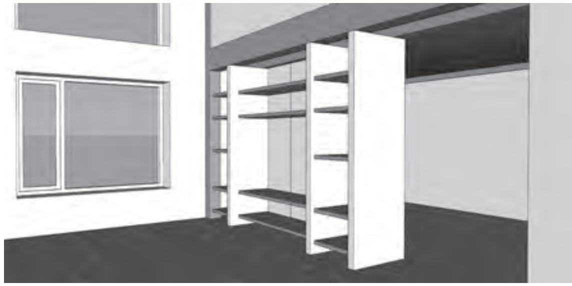


Fig 95.3 - Adjustable wall 2 - Living room

Fig 95.4 - Adjustable wall 2 - Bedroom

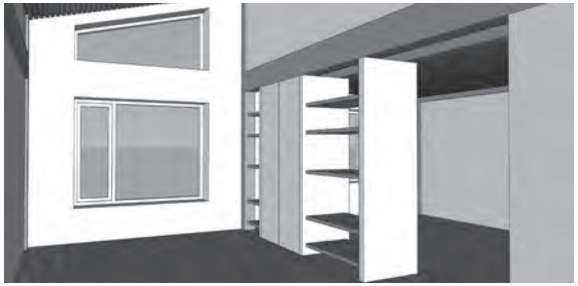


Fig 95.5 - Adjustable wall 3 - Living room

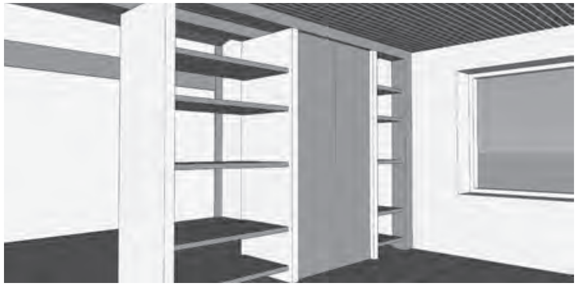


Fig 95.6 - Adjustable wall 3 - Bedroom

To illustrate the possibilities and variations in the adjustable wall, various combinations were modelled in Sketchup, to actually see it in 3D if there would be a feeling of individuality, but also to have a system that has the same expression no matter the combination.

The illustrations show various situations, where some divides the room completely, where others have some areas open, and a third option has it mostly open.
This workshop with the adjustable wall had the purpose of testing a simple system that mainly is the biggest object that can make the home individual.

The workshop show that the homes feel quite different depending on the combination of the adjustable wall.

Every home is the same in the plan layout, and therefore it is limited how individual and personalised the home can get, but this is placed in the living room area, and therefore this has proven to be able to transform the feeling of each home in different ways,

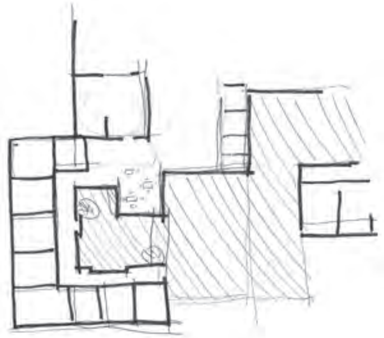


Fig 96.1 - Sketch site 1

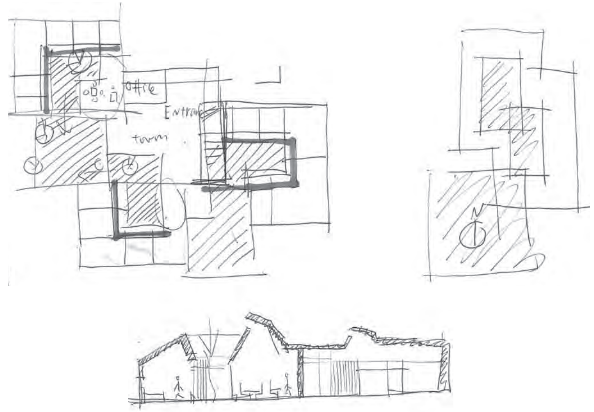


Fig 96.3 Sketch site 3

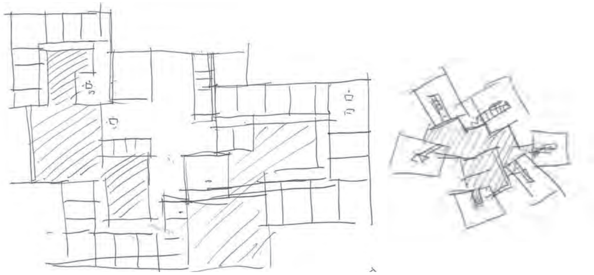


Fig 96.2 Sketch site 2

Fig 96.4 Sketch site 4

PLANLAYOUT: *SITE*

After getting the layout of the homes fixed and the details concerning the frame system and the adjustable wall, the project was ready for the further process.

The next stage was to zoom out and test the homes in a bigger scale, and in a combination with other homes and in the end forming the whole centre.

This phase started out by sketching various combinations of the layout, not only as one home, but how several homes relate to each other and also form a common area, and how the building relates to different parts, and how it's placed on the site.

Mostly the sketches ended up in smaller units, to limit hallways and also when considering potential emergency situations the hallways couldn't be too long, and this gives proposals that consistently show a need to divide the building into smaller parts, and also this puts a lot of focus on how the different parts will relate to each other and gives a building that works socially as a whole

Fig 97.1 - Volume studies 1

Fig 97.2 Volume studies 2

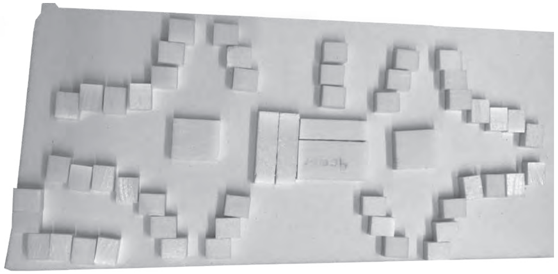


Fig 97.3 - Volume studies 3

Fig 97.4 - Volume studies 4

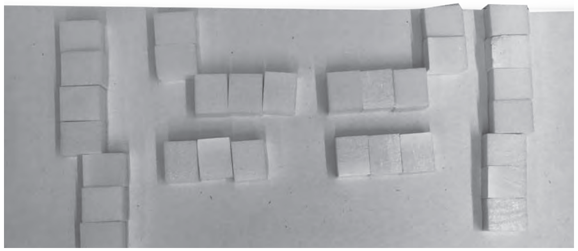


Fig 97.5 - Volume studies 5

Fig 97.6 - Volume studies 6

VOLUME STUDIES

The sketching phase for the site was good, and gave several ideas how to shape the plan layout on the site, however it didn't take enough into consideration the dimensions of the site. This because the skething phase was a free process, where the scale wasn't fully in focus.

To check if any of the proposals from the sketching phase could actually fit on the site, a foam workshop was also made.

In this phase the measurements of each home was cut out into the right scale, and also the number of homes needed.

Very quickly it was evident that the sketches weren't really possible, because the site was too narrow, and this also influenced the next phase of the project. This limited the options of offering space for the surrounding area, and thereby connection to the area. Also in the volume study phase the homes were most often placed in smaller groups, and this further strengthened the idea of arranging the homes in smaller units, and then combine them in a larger building.

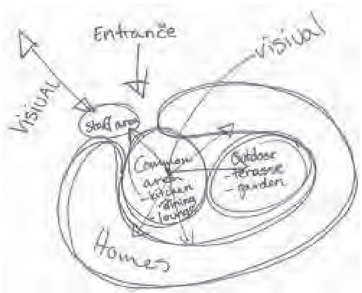


Fig 98.1 - Unit principle

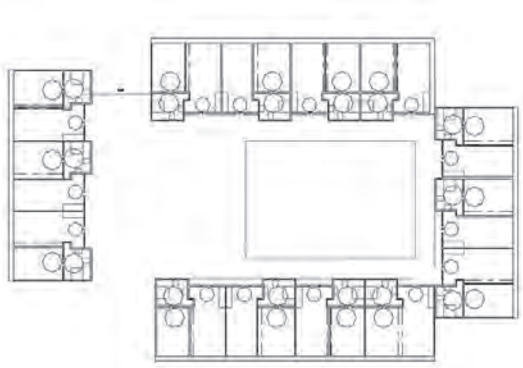


Fig 98.2 - Unit proposal 1

Fig 98.4 - Unit proposal 3

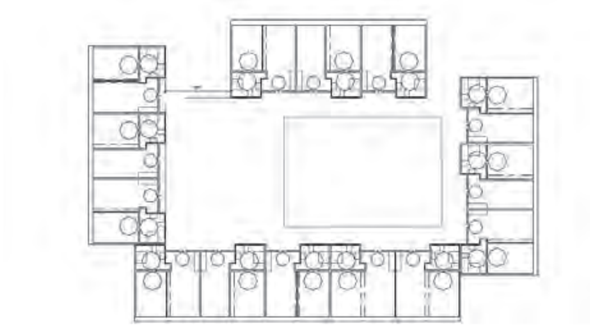


Fig 98.3 Unit proposal 2

Fig 98.5 Unit proposal 4

PLANLAYOUT: *UNITS*

After working with the volume studies it was clear that the homes benefitted from being in smaller groups, and therefore the next step was to check this in scale in Revit.

Before checking it in revit and making variations a discussion about what a unit should include was taken in the group. Based on the analysis each resident should feel at home, and this could happen by, giving them a feeling from their previous life, and therefore aspects from their previous life was included in each unit as seen on (fig 98.1)

There are various ways this can be solved, however some of them are better than others. (fig 98.4) was especcially considered to not be optimal in overall plan layout, because some homes only have a view into a courtyard, that faces other common areas, and these homes wouldn't be as attractive as the others, and also creates a hallway with homes on each side.

Other than that, the combination of the unit will depend on the overall planlayout for the whole design.

The principle of making homes, that surround a courtyard and have a fairly centrally placed common area is chosen for the further process.

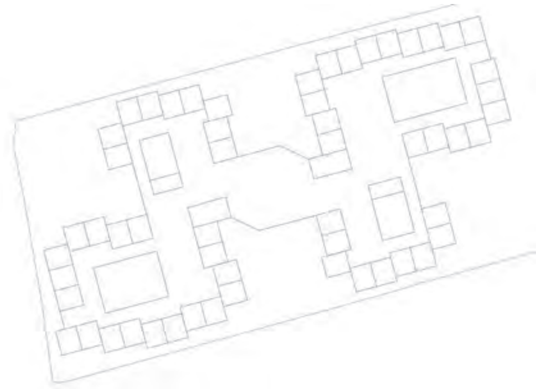


Fig 99.1 - Plan exploration 1

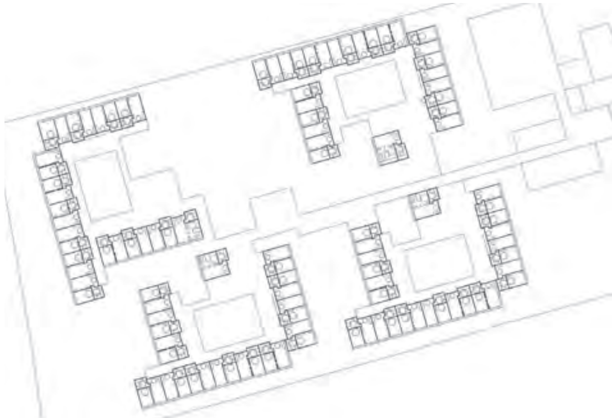


Fig 99.3 - Plan exploration 3

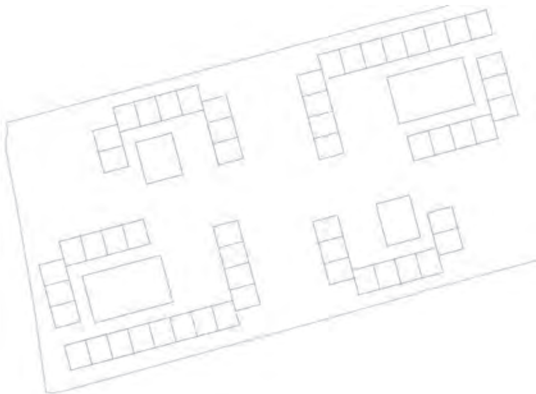


Fig 99.2 - Plan exploration 2

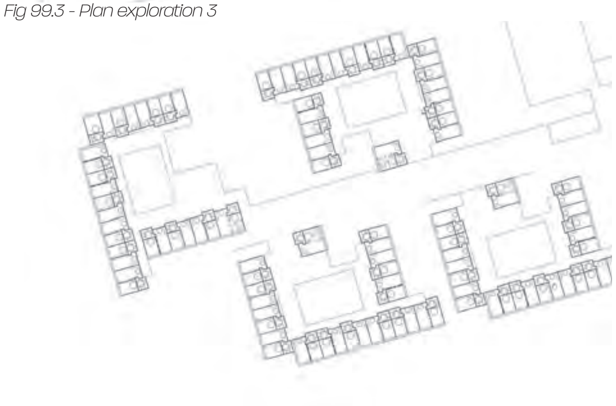


Fig 99.4 - Plan exploration 4

OVERALL PLAN EXPLORATIONS

The process so far has been to look into the different aspects of the building on a smaller scale first and then in the end, end up with a whole centre that works in every small aspect.

Now the next stage is to look at how it all works as a whole.

In this phase the measurements of each home in a combination of the principle as seen in (fig 98.1) was tested. Some suggestions worked with units with various numbers of home in each unit, whereas other proposals worked with the same number and overall shape in each unit.

When looking at practical aspects, various sizes of units wouldn't work or be fair to those workers that have more homes to take care of, and also it creates unfair advantages for certain residents.

Also for the overall expression of the home various sizes of the units might break the building into more parts, and not really work that well as a whole.

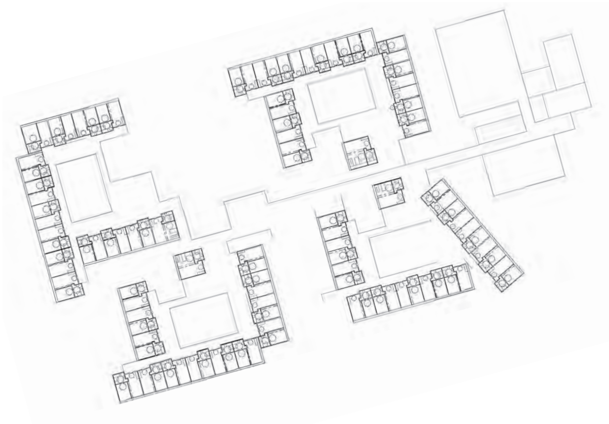


Fig 100.1 - Plan exploration 5

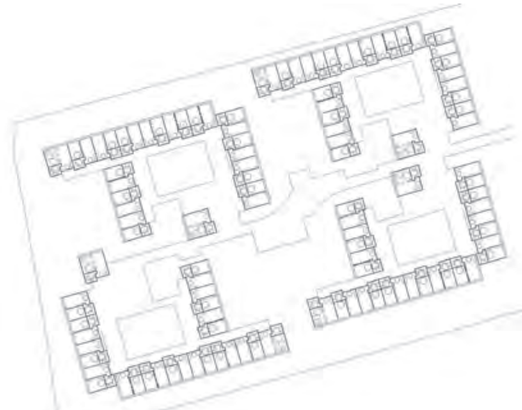


Fig 100.3 - Plan exploration 7

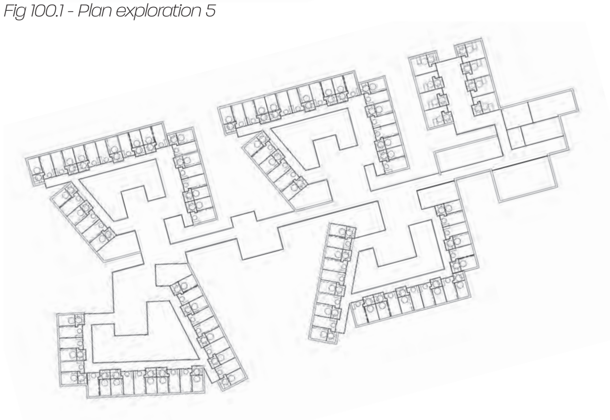


Fig 100.2 - Plan exploration 6

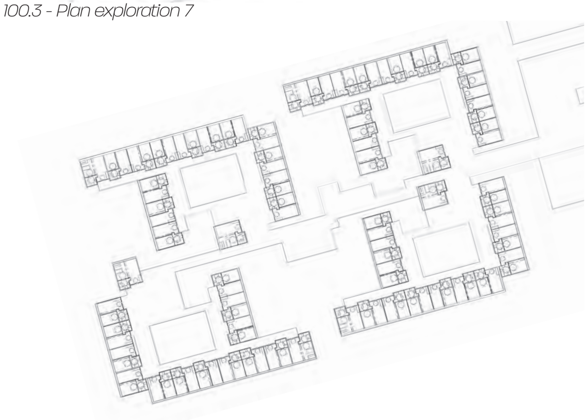


Fig 100.4 - Plan exploration 8

OVERALL PLAN EXPLORATIONS

When working with the planlayouts the light conditions and the privacy aspect has always also been considered, and this means that the homes shouldn't be too close to each other.

Some suggestions have the overall same idea in each unit, however one side has been turned in an angle compared to the rest to see how the light could affect homes, but also to create more irregular outdoor areas and in some areas open the outdoor areas up or narrow them down.

Later it was clear that some homes wouldn't actually get better light with this design, and also the overall layout didn't seem to benefit from the angled part, but rather make the buidling more divided in plan and in expression.

In the end the best suggestion for further development is the one seen on (fig 100.4)

The difference between (fig 100.3) and (fig 100.4) is the street connecting the whole building, this has been explored further later in the process.

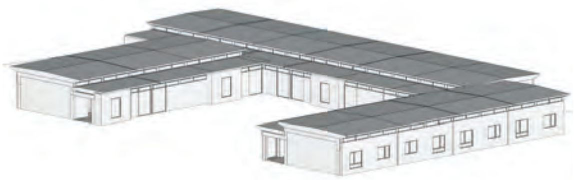


Fig 101.1 - Shape study 1 - South

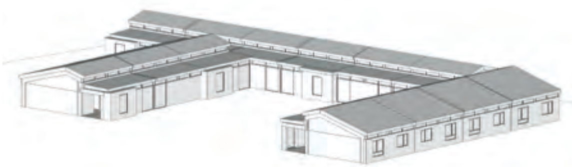


Fig 101.3 - Shape study 2 - South

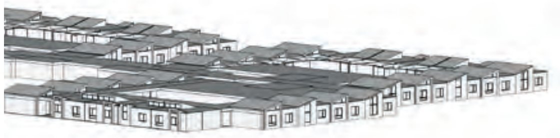


Fig 101.5 - Shape study 3 - South

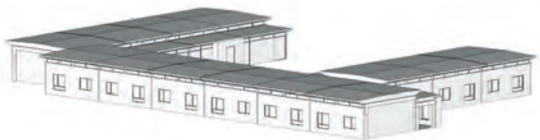


Fig 101.2 - Shape study 1 - North

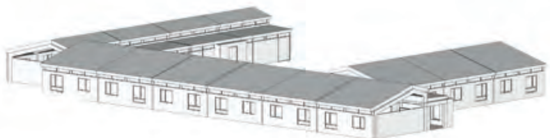


Fig 101.4 - Shape study 2 - North

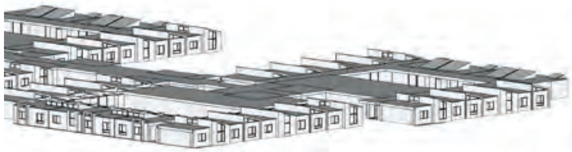


Fig 101.6 - Shape study 3 - North

SHAPE STUDY

As seen in the frame systems on page 92 there are several ways to use the frame system that has been chosen in this project, and these can give very different expressions

After working with planlayouts and not really looking much at the shape of the whole building, the next stage is to try different shapes out

This process was modelled in Sketchup where some of the frame systems were chosen for testing.

Here (fig 101.6) was chosen as the best expression, because the building seemed more individual and not that much like an institution, and also in this model the roof was raised to actually also let light in top of the room in north, and also every roof was facing more or less direct south, and would therefore be very optimal for solar cells.

Fig 102.1 - Plan detailing - Layout units

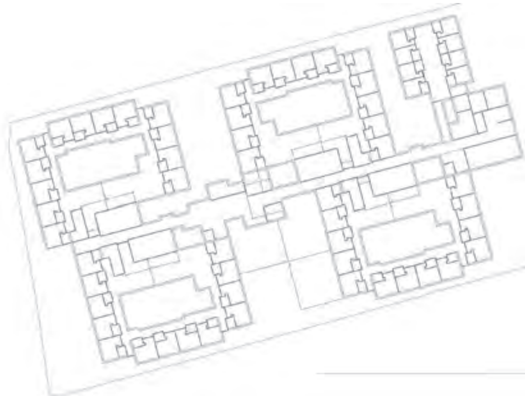


Fig 102.3 - Plan detailing - Street 1

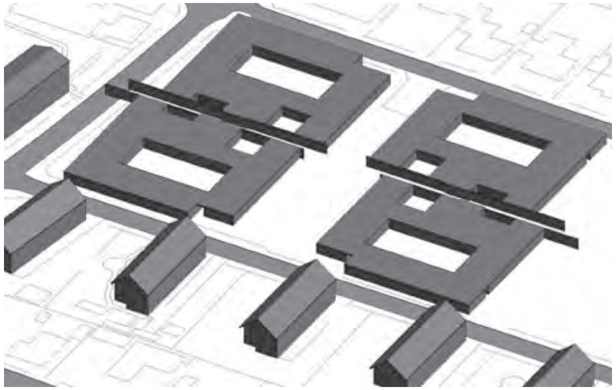


Fig. 102.2 - Plan detailing - 3D

Fig 102.4 - Plan detailing - Street 2

OVERALL PLAN DETAILING

The shape study shows several areas where the building should be simplified in the expression but also looking back on the plans on page 100 there are several areas that don't work in the plan. One of the problems being that some homes are more excluded and the hallways ends out in a dead end, and this leaves an area for those homes that wouldn't be that interesting to spend time in outside the residents entrance.

This means that in this phase these problems have been solved, by making the hallway more fluent, and where every home faces the corridor and is easily visible for everyone

Also in this phase the connection between the units has been tested and worked with.

The idea ends up being that the street between homes gives privacy to each unit, but also the access to the shops in the center, and this is the center for the whole building, and because the street combining the whole building is long it has been important to work with making it interesting with small courtyards and shops in the center.

Fig 103.1 - Home detailing - Bedroom

Fig 103.3 - Home detailing - Windows

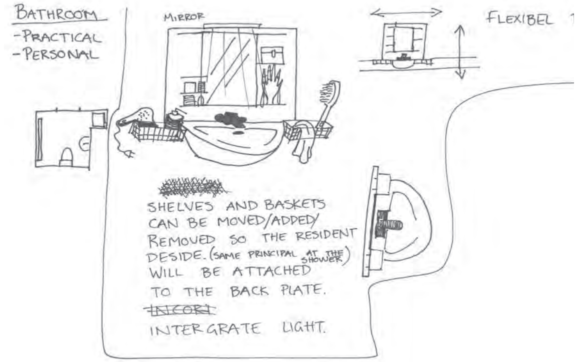


Fig 103.5 - Home detailing - Bathroom sink

Fig 103.2 - Home detailing - Bedroom

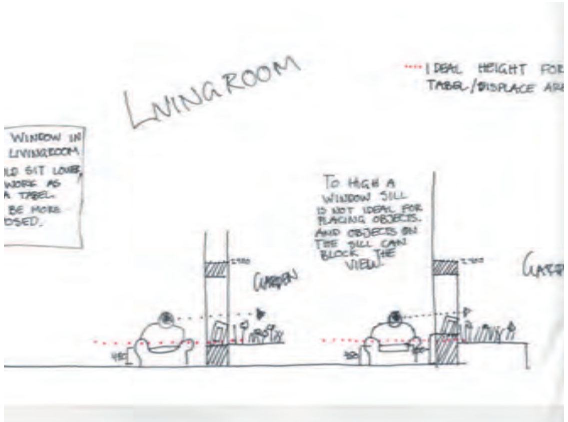


Fig 103.4 - Home detailing - Window height

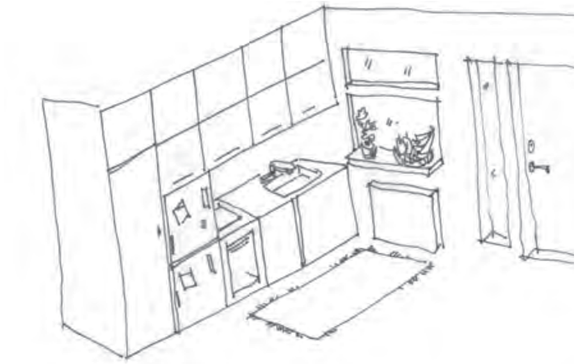


Fig 103.6 - Home detailing - Kitchen

DETAILING: *HOMES*

After working with the plan layout for the whole site and getting close to a good plan, it is time to look into the homes again, and this time go into even more detail.

The sketches shown above are the chosen ones from a workshop to make perspective drawings of the homes where the focus has been to make the homes as comfortable as possible, and envision scenarious to see if the current design works.

In this phase the window placement has also been chosen and tested, where the privacy inside has been in focus and at the same time it has been important to have a visual to the outdoors from inside, also in sitting or lying position.

Details like having a bathroom sink that can be individualised has also been a factor.

Fig 104.1 - Common area detailing - Corridor 1

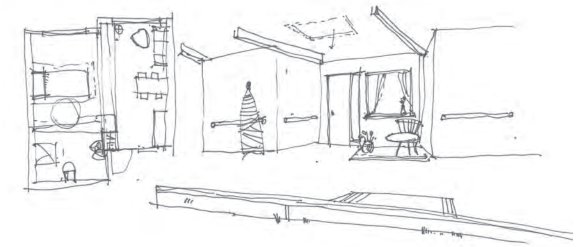


Fig 104.3 - Common area detailing - Entrance to homes

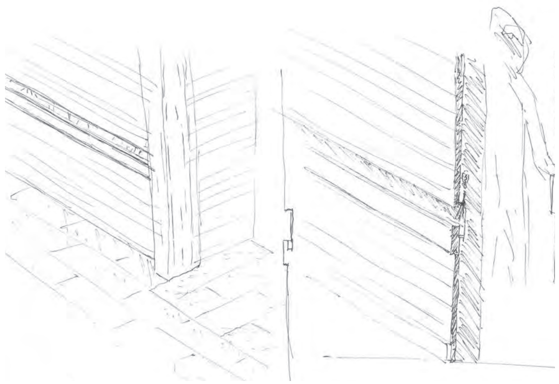


Fig 104.5 - Common area detailing - Handrail 1

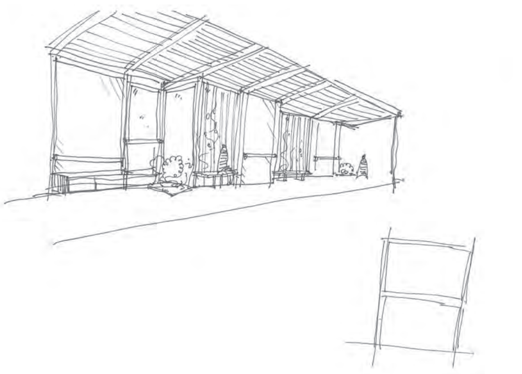


Fig 104.2 - Common area detailing - Corridor 2

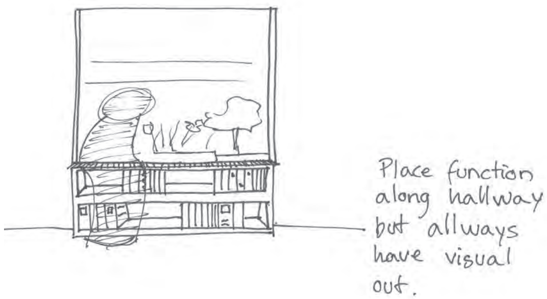


Fig 104.4 - Common area detailing - Windows with shelves

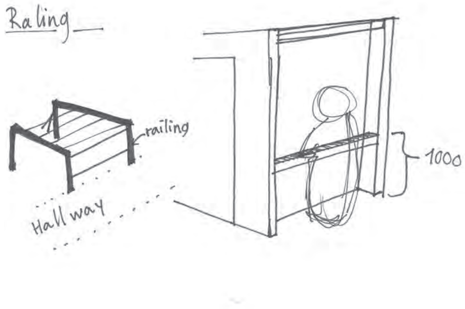


Fig 104.6 - Common area detailing - Handrail 2

DETAILING: *COMMON AREA*

The residents will not only spend a lot of time in their homes, because they also have the area in front of their home where they can sit like it is their front yard, and therefore this area has also been in focus a lot

It's especially important that they don't get the feeling of institution in this area.

Therefore there has been the same process as for the detailing of the homes

The conclusion of this phase is that the corridor and common area has to have the overall same feeling and relate to their home, but at the same time it should feel different and more public

It's also important that the residents that sit outside their home feel a sense of privacy, so the area in front has to be marked in some way both for the user of the home, but also the neighbours so they know where they are not supposed to step into this area.

A detail like how the handrail is solved to not seem institutional has also been important

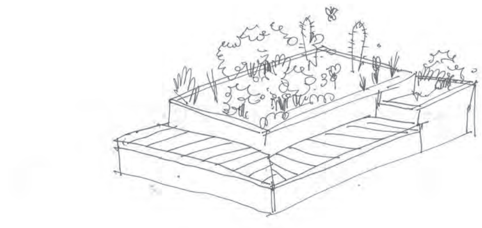


Fig 105.1 - Street detailing - Bench with vegetation 1

Fig 105.3 - Street detailing - Spa area

Fig 105.5 - Street detailing - Administration entrance

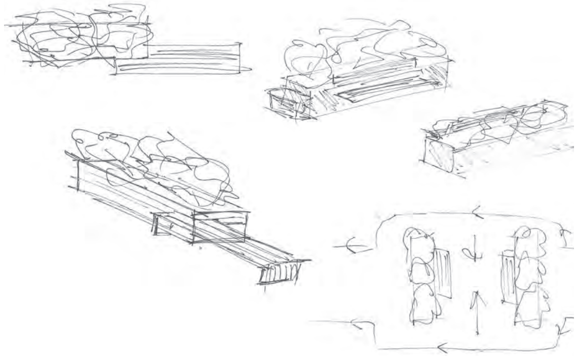


Fig 105.2 - Street detailing - Bench with vegetation 2

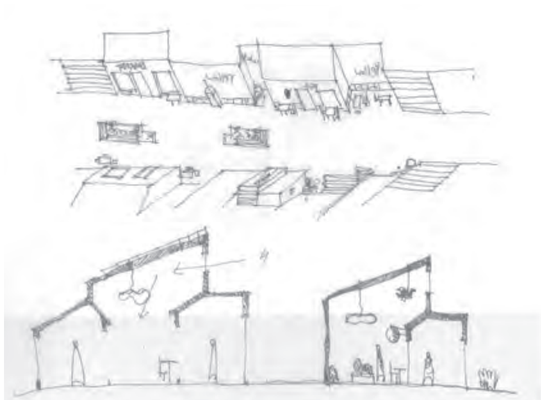


Fig 105.4 - Street detailing - Street principle and light intake

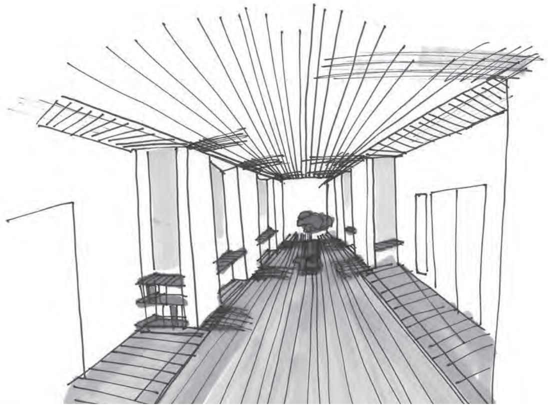


Fig 105.6 - Street detailing - Corridor between units

DETAILING: *STREET*

When it comes to the experience of the home, the neighbourhood and the street, the feeling and atmosphere of the street is equally as important.

Therefore the same process as for the common area in each unit and the home has also been repeated for the street.

The street takes inspiration from shopping centre or in some cases also a shopping street, and it has been important that it has that feeling in this design, and therefore the perspectives above also test if if would actually work in real life.

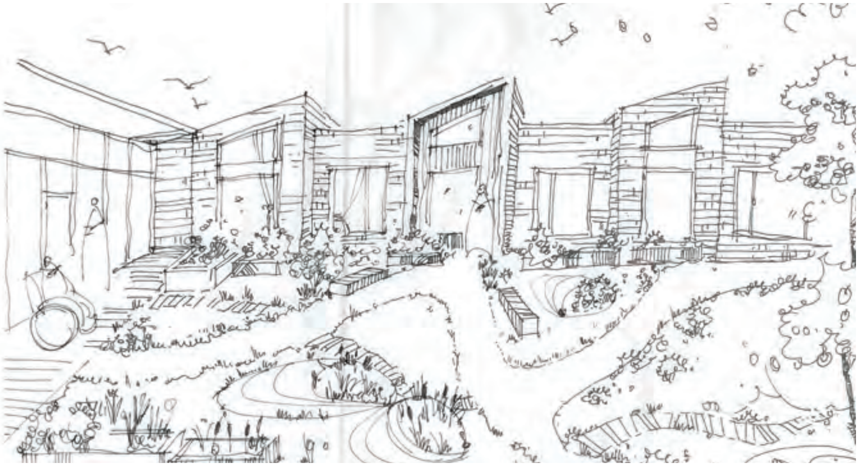


Fig 106.1 - Detailing outdoor - Perspective og public garden

Fig 106.2 - Detailing outdoor - Overall plan of outdoor areas

DETAILING: *OUTDOOR*

One of the very important aspects for the residents is the visuals they have, both from the inside, but also when they stay in the outdoor areas.

In their previous lives most residents are used to a garden of some sort, or occasionally going to a park to relax and recharge

Therefore the detailing of the garden has also been crucial, and this also helps giving various experiences

The sketches above show the chosen proposals, because they give a varied experience, and works with more private garden, like the courtyard, but also larger garden, that are more similar to parks

Also going through the street, there are smaller atriums that can be seen, but not walked into.

As can be seen on the plan (fig. 106.2) The garden design varies, where the courtyard has a more constrained design, and the park has a more natrual feeling.

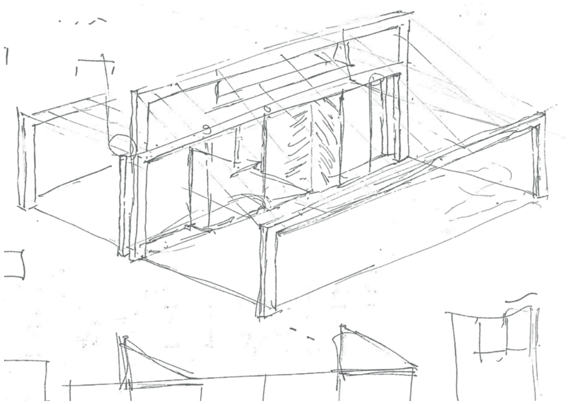


Fig 107.1 - Construction - Structural principle of home

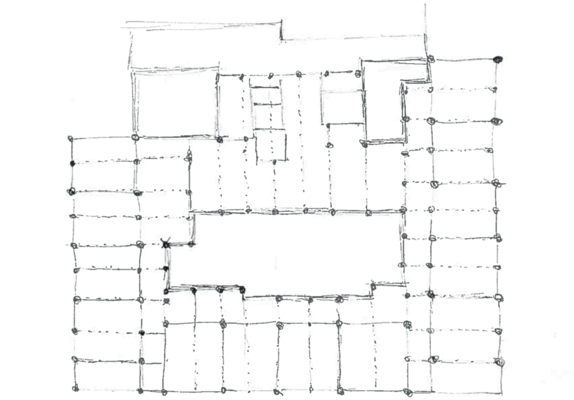


Fig 107.3 - Construction - Placements of frames

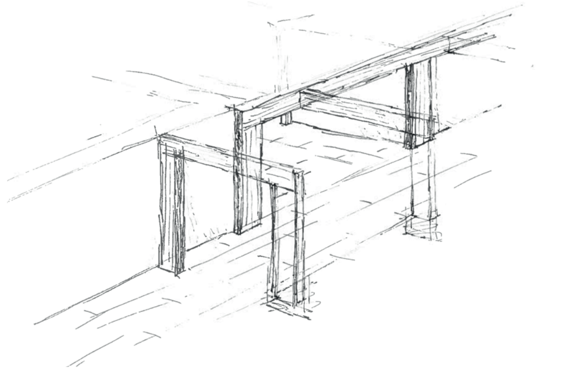


Fig 107.5 Construction - Meeting between various directions of beams 1

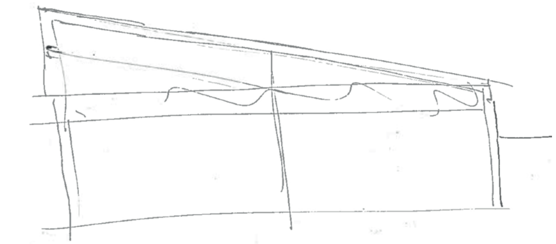


Fig 107.2 - Construction - Simplification of the structural principle home


Fig 107.4 - Construction - Plan of meeting between directions of beams

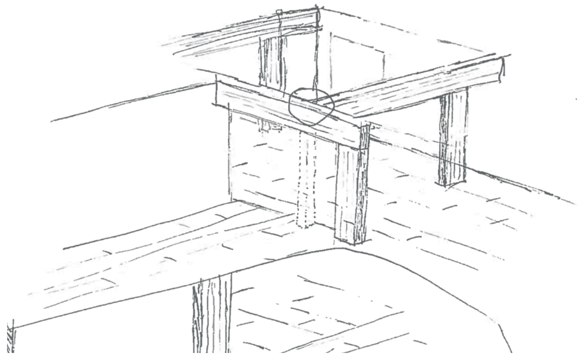


Fig 107.6 - Construction - Meeting between various directions of beams 2

CONSTRUCTION:

In the design of the construction the frame system has been the primary focus.

The main idea for a long time in the process was that the living room in the home was raised in the middle, creating a higher ceiling towards north, east or south, as can also be seen on (fig 107.1)

However through the last stages of the process, the shift between flat roof and sloped roof, and that repetition throughout the whole building wasn't calm in the expression, this will be explained later in the facade phase.

Other aspects that were tested in this phase was how the frame systems fit in an overall unit, and these aspects also helped shaping some of the rooms.

As can also be seen on (fig 107.5) and (fig 107.6) in the area where two beams meet in a corner, there has also been a process of how to solve this point, whether or not there should be a column, or if it is possible to do without, but still look good visually, and also that it can support it without a column.

Fig 108.1 - Facade explorations 1

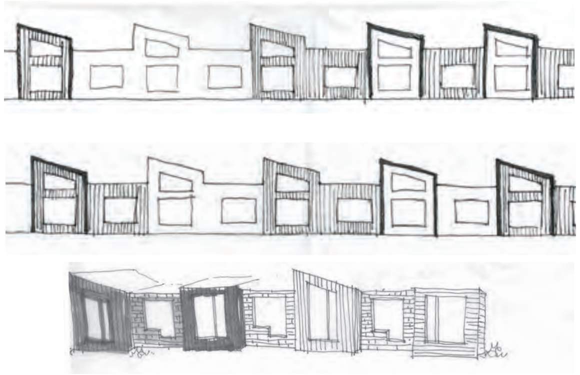


Fig 108.3 - Facade explorations 3

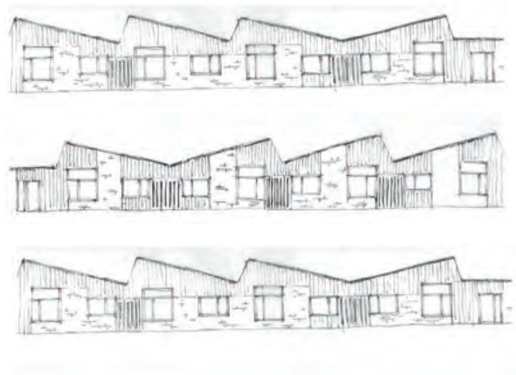


Fig 108.5 - Facade exploration 4

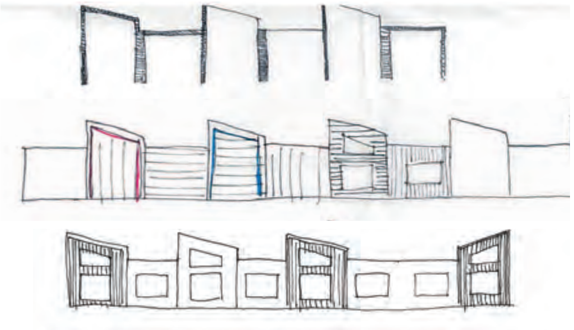


Fig 108.2 - Facade explorations 2

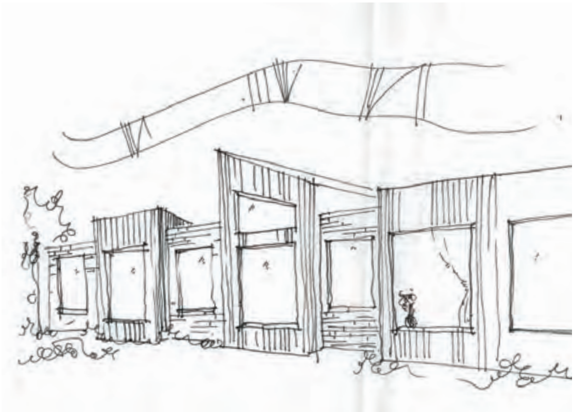


Fig 108.4 - Facade exploration 3 perspective

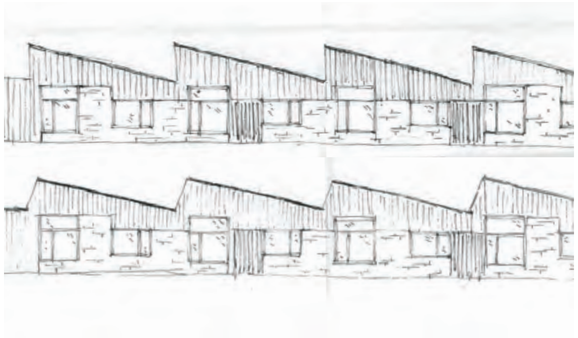


Fig 108.6 - Facade exploration 4 - Straight and angled wall

FACADES:

When the whole plan layout was fixed, and the detailing in every aspect of the building was explored, it was time to look more into the expression of the building.
The plan is fixed at this point, and therefore the shape of the building is limited to the facades and the shape of the roof.

In the sketches above, the facade is seen in many various forms.

The window area for each apartment was also fixed and therefore the main aspects to explore was the shape, the material choice and also how the material is distributed.
As can be seen on (fig 108.4) shifting the depth of the facade makes the building too complex in the expression and the building is too small, so the proportions seem odd. Also the mixture of flat roof and angled roof is too complex, therefore the shape is changed to a single sloped roof for each home, and thereby giving a more calm expression.

The distribution of material creates the variation in the expression as seen on (fig 108.6), and the angled wall gives the building a more seemless expression than the straight wall.

Fig 109.1 - Daylight study: Pitched and large facade window - North

Fig 109.3 - Daylight study: Pitched roof with skylight - North

Fig 109.5 - Daylight study: Pitched roof with sidelight - North

Fig 109.2 - Daylight study: Pitched roof and large facade window - South

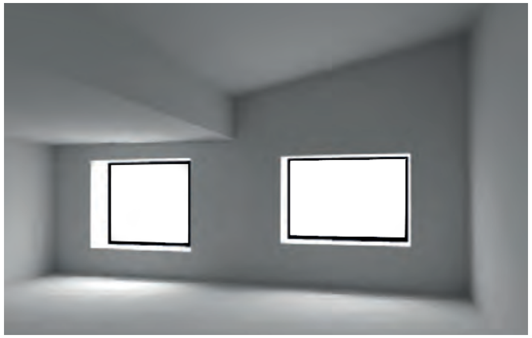


Fig 109.4 - Daylight study: Pitched roof with skylight perspective - North

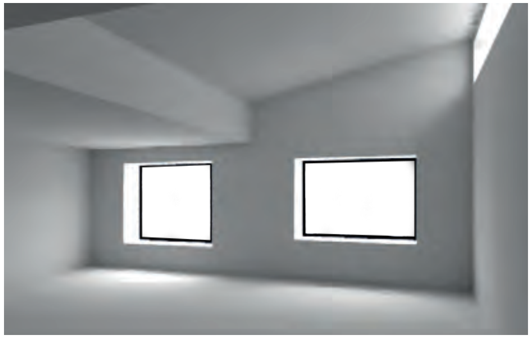


Fig 109.6 - Daylight study: Pitched roof and sidelight perspective - North

DAYLIGHT STUDY:

The analysis in the programme point to a big importance of the daylight or light in a home or institution in order for the resident to feel comfortable and also heal faster.

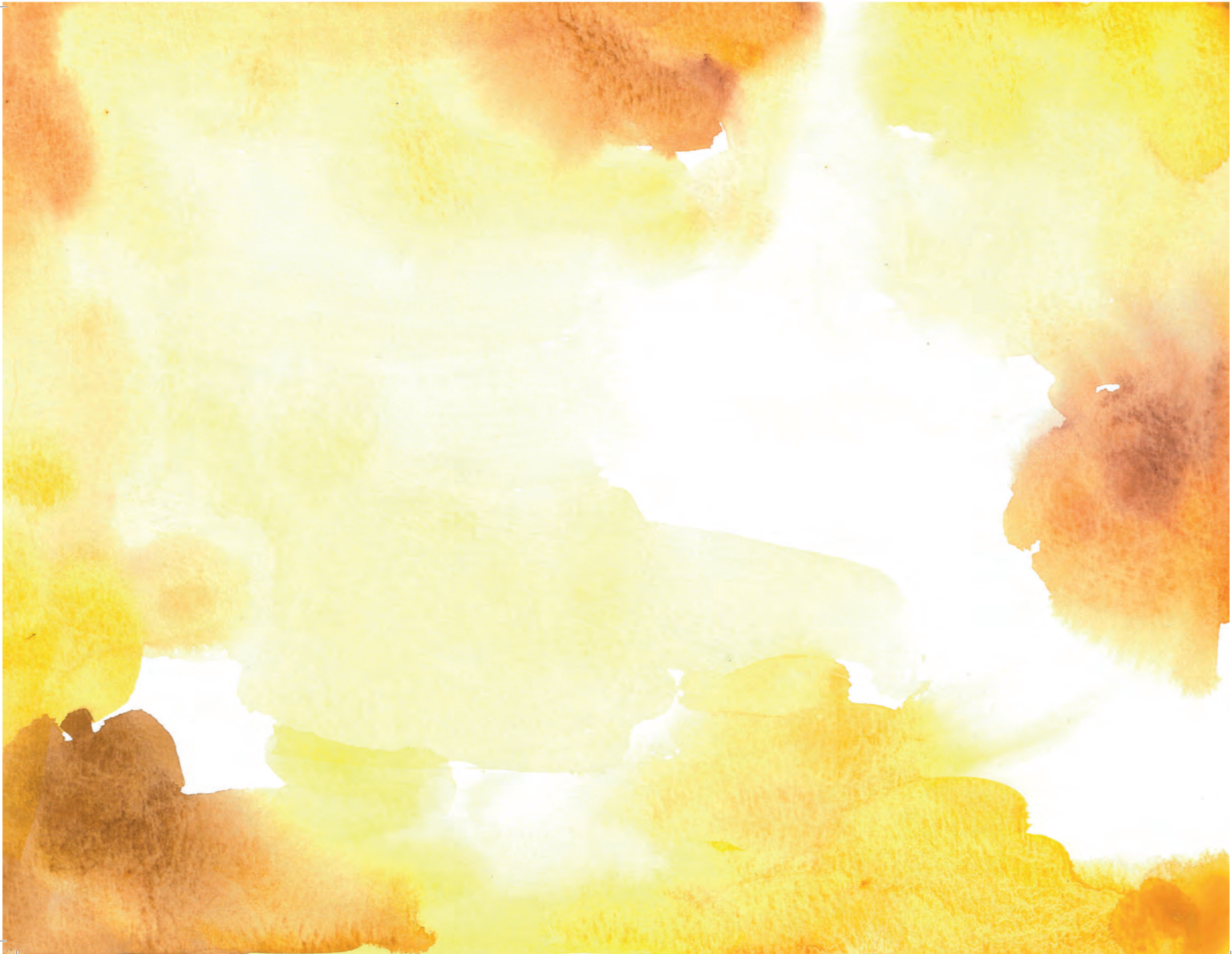
The main idea about the home, both in layout, shape and window area has been modelled so that it can be tested in Velux daylight vizualiser

As can be seen on the simulations above, various openings have been tested. The first one mainly tests only light coming in through the facade with a large window.

The next one tests a smaller window in the facade but then includes a skylight in the middle of the room.

The last one tests where there is a smaller window in the facade, but also a sidelight in top.

From the simulations it's clear that the small window in the facade and the sidelight is the best combination, because it lights the room up most, compared to the others.



Epilogue

CONCLUSION

The final product is a good example of integrated design, where the aesthetics in the design also serves a technical aspect. From the shape of the roof, which is shaped based on the placement of the PV's and bringing in light to the homes but also give a recognizable shape of the building. To the use of lamellas which provide 'invisible' in- and out let of the ventilation and integration of the ceiling lift.
And with the implementation of active a passive strategy the building fulfils Danish energy standards of 2020 and at the same time a good and flexible indoor environment. But most importantly made a centre where the resident can feel at home.
The focus in the project of creating a feeling of normal life for the resident, is done by making it possible for the resident to move around as they want both in- and outside, to the extent their illness allows them. By making the homes flexible in the dĕcor, so that they can decorate their new home to fit with their personal belonging and to their state of illness. The last aspect was to implement functions that they know from before they moved to the centre, such as going to the shopping street, helping with the house work, such as cooking and gardening. The final factor of this is the aesthetics of the centre which is to remove the feeling of institutionalization, which is done by the materials, implementation of beams and the variation of the hallways width. Incorporating the support railings, so that it either looks like a part of the construction or is a taller flower bed in the courtyard.

The variation in function and flexibility gives a good social sustainability to the centre, because the centre would be able to adapt to new needs when they occur. This is the same thing with the indoor environment, with the use of VAV the functions and use can vary but the indoor environment will always be good. However, in the energy consumption of the building, the street area can't fulfil the 2020 standards without active strategies, because of its functions as a non-residential building, but with active strategies the building covers the 2020 standards and more.

REFLECTION

From the beginning of the project the main idea and partly the layout of the centre was set based on the information discovered during the program. Therefore, it can be questioned if the design process was too restricted by the program, and therefore became too superficial and one sided, and that the centre could have had a different layout, expression etc. that would have taken the building to another level or another direction.

Intentionally a strong connection with the context was wanted, with common functions such as green areas where residents of the centre and the context could interact. But due to restrictions for the residents for their own safety and the narrow shape of the site, this wasn't possible to do in the extent initially wanted. The result is the opportunity to observe one another through the windows or over the green fences and interact in the café located in the entrance of the centre, which also works as a public café. However, its placement currently in the building may compromise this function, because it can be difficult to bring people in. Aesthetically there is a connection between the centre and the context, with the variation of building types in the context and the variating façade and roof of the centre. But the centre is still one large building and that set it out from the context in a large way.

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Fig 7.1 - 11.1 own illustrations

Fig 13.1

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Presentation

Fig 40.1 - 85.3 - Own illustrations

Process

Fig 88.1 - 90.6 - Own illustrations

Fig 91.1:

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Photographer: Thomas Loof and Pernille Pedersen

Fig 91.2:

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Fig 91.3:

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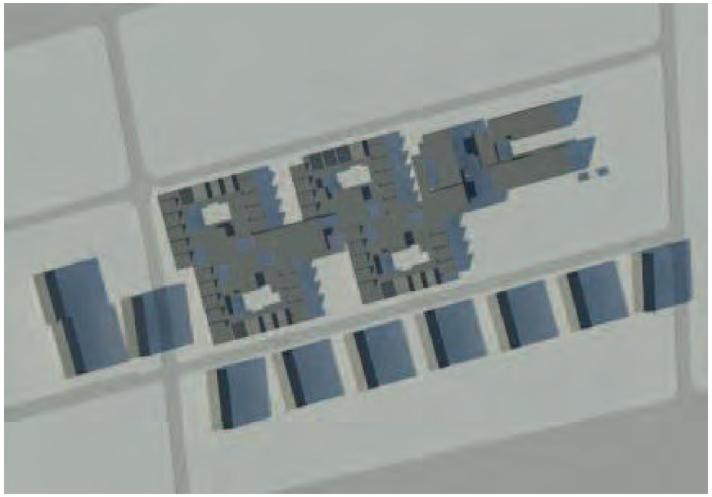
Shadow analysis - April 1st 8 o'clock


Shadow analysis - April 1st 12 o'clock

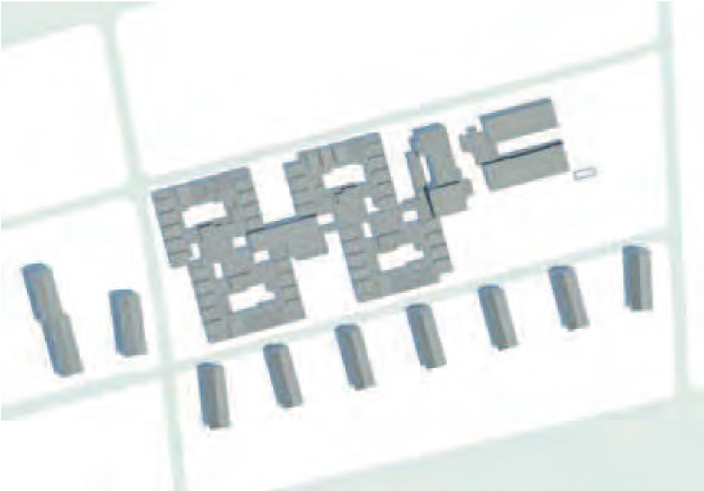

Shadow analysis - April 1st 10 o'clock


Shadow analysis - April 1st 16 o'clock

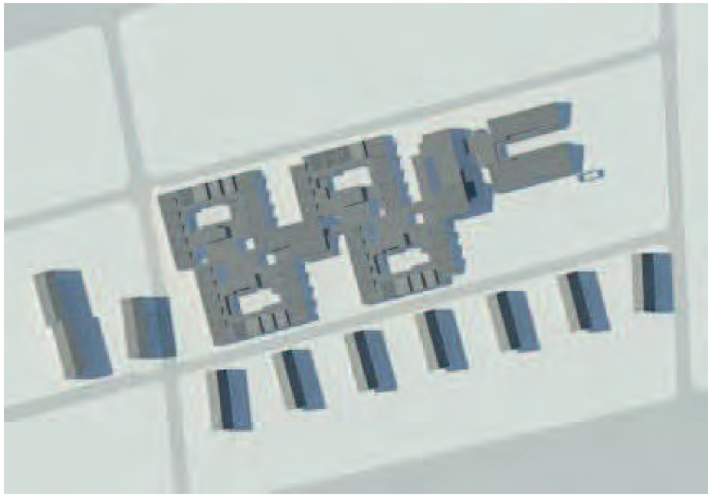
Appendix 1: Shadow study

Shadow analysis - July 1st 8 o'clock

Shadow analysis - July 1st 12 o'clock

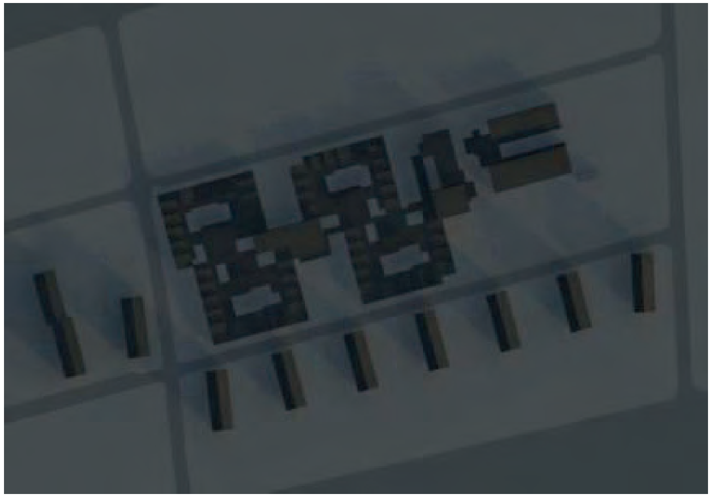


Shadow analysis - July 1st 10 o'clock

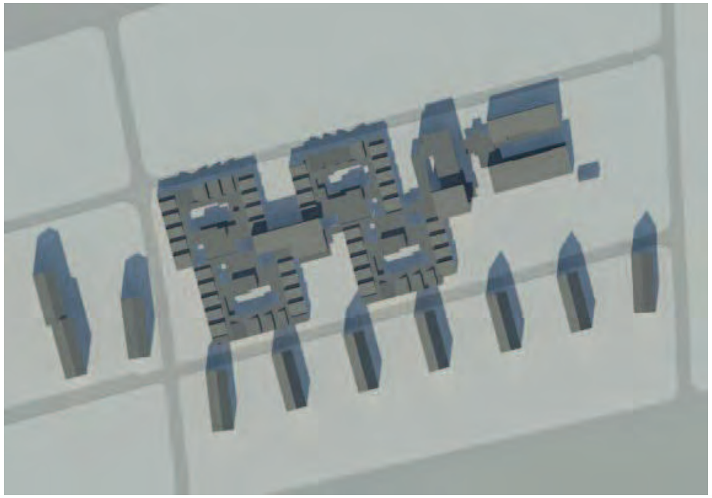


Shadow analysis - July 1st 16 o'clock

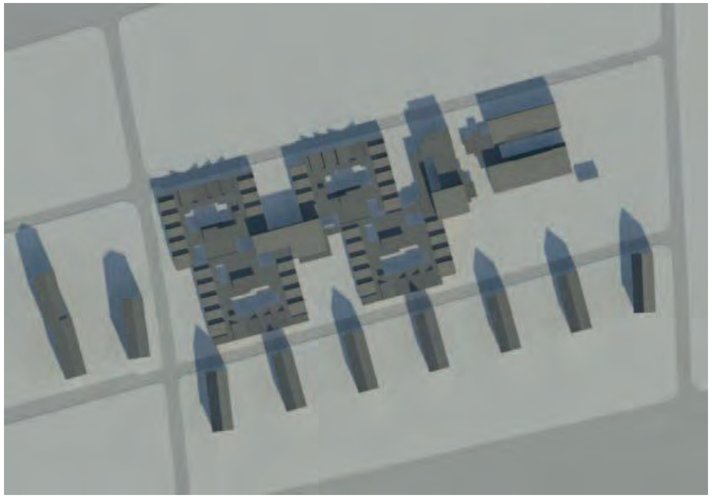
Appendix 1: Shadow study



Shadow analysis - December 1st 8 o'clock



Shadow analysis - December 1st 12 o'clock



Shadow analysis - December 1st 10 o'clock

Shadow analysis - December 1st 16 o'clock

Appendix 1: Shadow study

Key numbers, kWh/m² year

Renovation class 2

Without supplement	Supplement for special conditions	Total energy frame
111.2	0.0	111.2
Total energy requirement		26.9

Renovation class 1

Without supplement	Supplement for special conditions	Total energy frame
53.1	0.0	53.1
Total energy requirement		26.9

Energy frame BR 2015

Without supplement	Supplement for special conditions	Total energy frame
30.4	0.0	30.4
Total energy requirement		23.4

Energy frame Buildings 2020

Without supplement	Supplement for special conditions	Total energy frame
20.0	0.0	20.0
Total energy requirement		17.3

Contribution to energy requirement	
Heat	17.7
El. for operation of bulding	3.7
Excessive in rooms	0.0

Net requirement	
Room heating	17.3
Domestic hot water	14.6
Cooling	0.0

Selected electricity requirements	
Lighting	43.0
Heating of rooms	0.0
Heating of DHW	0.0
Heat pump	0.0
Ventilators	3.7
Pumps	0.0
Cooling	0.0
Total el. consumption	34.4

Heat loss from installations	
Room heating	0.2
Domestic hot water	0.0

Output from special sources	
Solar heat	0.0
Heat pump	0.0
Solar cells	0.0
Wind mills	0.0

Be15 result for unit 1 and 2 - Passive strategies

Key numbers, kWh/m² year

Renovation class 2

Without supplement	Supplement for special conditions	Total energy frame
111.2	0.0	111.2
Total energy requirement		1.9

Renovation class 1

Without supplement	Supplement for special conditions	Total energy frame
53.1	0.0	53.1
Total energy requirement		1.9

Energy frame BR 2015

Without supplement	Supplement for special conditions	Total energy frame
30.4	0.0	30.4
Total energy requirement		-1.6

Energy frame Buildings 2020

Without supplement	Supplement for special conditions	Total energy frame
20.0	0.0	20.0
Total energy requirement		-7.7

Contribution to energy requirement	
Heat	17.7
El. for operation of bulding	-6.3
Excessive in rooms	0.0

Net requirement	
Room heating	17.3
Domestic hot water	14.6
Cooling	0.0

Selected electricity requirements	
Lighting	43.0
Heating of rooms	0.0
Heating of DHW	0.0
Heat pump	0.0
Ventilators	3.7
Pumps	0.0
Cooling	0.0
Total el. consumption	34.4

Heat loss from installations	
Room heating	0.2
Domestic hot water	0.0

Output from special sources	
Solar heat	0.0
Heat pump	0.0
Solar cells	68.5
Wind mills	0.0

Be15 result for unit 1 and 2 - Passive and active strategies

Appendix 2: Be15 result unit 1 and 2 - Hardcase

Key numbers, kWh/m² year

Renovation class 2

Without supplement	Supplement for special conditions	Total energy frame
141.0	0.0	141.0
Total energy requirement		60.5

Renovation class 1

Without supplement	Supplement for special conditions	Total energy frame
74.4	0.0	74.4
Total energy requirement		60.5

Energy frame BR 2015

Without supplement	Supplement for special conditions	Total energy frame
42.9	0.0	42.9
Total energy requirement		60.5

Energy frame Buildings 2020

Without supplement	Supplement for special conditions	Total energy frame
25.0	0.0	25.0
Total energy requirement		49.1

Contribution to energy requirement

Heat	19.8
El. for operation of bulding	16.3
Excessive in rooms	0.0

Net requirement

Room heating	19.0
Domestic hot water	13.1
Cooling	0.0

Selected electricty requirements

Lighting	14.4
Heating of rooms	0.0
Heating of DHW	0.0
Heat pump	0.0
Ventilators	1.9
Pumps	0.0
Cooling	0.0
Total el. consumption	22.1

Heat loss from installations

Room heating	0.4
Domestic hot water	0.0

Output from special sources

Solar heat	0.0
Heat pump	0.0
Solar cells	0.0
Wind mills	0.0

Be15 result for street - Passive strategies

Key numbers, kWh/m² year

Renovation class 2

Without supplement	Supplement for special conditions	Total energy frame
141.0	0.0	141.0
Total energy requirement		35.5

Renovation class 1

Without supplement	Supplement for special conditions	Total energy frame
74.4	0.0	74.4
Total energy requirement		35.5

Energy frame BR 2015

Without supplement	Supplement for special conditions	Total energy frame
42.9	0.0	42.9
Total energy requirement		35.5

Energy frame Buildings 2020

Without supplement	Supplement for special conditions	Total energy frame
25.0	0.0	25.0
Total energy requirement		24.1

Contribution to energy requirement

Heat	19.8
El. for operation of bulding	6.3
Excessive in rooms	0.0

Net requirement

Room heating	19.0
Domestic hot water	13.1
Cooling	0.0

Selected electricty requirements

Lighting	14.4
Heating of rooms	0.0
Heating of DHW	0.0
Heat pump	0.0
Ventilators	1.9
Pumps	0.0
Cooling	0.0
Total el. consumption	22.1

Heat loss from installations

Room heating	0.4
Domestic hot water	0.0

Output from special sources

Solar heat	0.0
Heat pump	0.0
Solar cells	112.1
Wind mills	0.0

Be15 result for street - Passive and active strategies

Appendix 2: Be15 result street - Hardcase

Key numbers, kWh/m² year

Renovation class 2

Without supplement	Supplement for special conditions	Total energy frame
110.8	0.0	110.8
Total energy requirement		21.6

Renovation class 1

Without supplement	Supplement for special conditions	Total energy frame
52.9	0.0	52.9
Total energy requirement		21.6

Energy frame BR 2015

Without supplement	Supplement for special conditions	Total energy frame
30.2	0.0	30.2
Total energy requirement		21.6

Energy frame Buildings 2020

Without supplement	Supplement for special conditions	Total energy frame
20.0	0.0	20.0
Total energy requirement		19.5

Contribution to energy requirement

Heat	14.3
El. for operation of bulding	2.9
Excessive in rooms	0.0

Net requirement

Room heating	14.1
Domestic hot water	13.1
Cooling	0.0

Selected electricity requirements

Lighting	39.5
Heating of rooms	0.0
Heating of DHW	0.0
Heat pump	0.0
Ventilators	2.9
Pumps	0.0
Cooling	0.0
Total el. consumption	32.8

Heat loss from installations

Room heating	0.1
Domestic hot water	0.0

Output from special sources

Solar heat	0.0
Heat pump	0.0
Solar cells	0.0
Wind mills	0.0

Be15 result for admin/special unit - Passive strategies

Key numbers, kWh/m² year

Renovation class 2

Without supplement	Supplement for special conditions	Total energy frame
110.8	0.0	110.8
Total energy requirement		-3.4

Renovation class 1

Without supplement	Supplement for special conditions	Total energy frame
52.9	0.0	52.9
Total energy requirement		-3.4

Energy frame BR 2015

Without supplement	Supplement for special conditions	Total energy frame
30.2	0.0	30.2
Total energy requirement		-3.4

Energy frame Buildings 2020

Without supplement	Supplement for special conditions	Total energy frame
20.0	0.0	20.0
Total energy requirement		-5.5

Contribution to energy requirement

Heat	14.3
El. for operation of bulding	-7.1
Excessive in rooms	0.0

Net requirement

Room heating	14.1
Domestic hot water	13.1
Cooling	0.0

Selected electricity requirements

Lighting	39.5
Heating of rooms	0.0
Heating of DHW	0.0
Heat pump	0.0
Ventilators	2.9
Pumps	0.0
Cooling	0.0
Total el. consumption	32.8

Heat loss from installations

Room heating	0.1
Domestic hot water	0.0

Output from special sources

Solar heat	0.0
Heat pump	0.0
Solar cells	63.9
Wind mills	0.0

Be15 result for admin/special unit - Passive and active strategies

Appendix 2: Be15 result Admin/ special unit - Hardcase

Options Moisture Simulation HeatBalance Parameters Tables

2011 Month Hours Home

Home	Sum/Mean	1 (31 days)	2 (28 days)	3 (31 days)	4 (30 days)	5 (31 days)	6 (30 days)	7 (31 days)	8 (31 days)	9 (30 days)	10 (31 days)	11 (30 days)	12 (31 days)
qHeating	1517,69	280,46	252,12	273,67	105,83	35,10	4,25	0,00	0,03	9,98	70,87	205,01	280,37
qCooling	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
qInfiltration	-3424,55	-437,78	-398,42	-462,87	-298,82	-223,46	-167,17	-112,64	-116,56	-154,10	-252,08	-367,52	-433,12
qVenting	-1142,92	0,00	0,00	-0,45	-88,63	-151,00	-177,81	-263,53	-224,04	-183,84	-53,61	0,00	0,00
qSunRad	1184,05	13,86	39,50	99,59	138,54	186,64	171,48	174,89	152,18	114,72	64,19	20,49	7,97
qPeople	1020,54	86,68	78,29	86,68	83,88	86,68	83,88	86,68	86,68	83,88	86,68	83,88	86,68
qEquipment	2987,16	253,70	229,15	253,70	245,52	253,70	245,52	253,70	253,70	245,52	253,70	245,52	253,70
qLighting	995,14	127,30	91,60	91,40	88,90	87,55	16,75	0,00	84,54	89,20	97,00	99,40	121,50
qTransmissi	-3124,08	-386,79	-346,27	-399,36	-284,12	-221,58	-161,29	-81,79	-103,89	-160,28	-264,00	-328,87	-385,87
qMixing	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
qVentilation	-6,35	62,81	54,70	58,97	9,66	-52,99	-15,52	-57,07	-132,10	-44,22	-1,83	42,45	68,80
Sum	6,67	0,25	0,65	1,33	0,76	0,63	0,08	0,25	0,54	0,86	0,92	0,36	0,03
tOutdoor me	8,1	0,7	0,4	-0,7	7,1	11,5	14,2	17,8	17,9	14,5	9,8	3,4	0,7
tOp mean(°C	22,3	21,8	21,8	21,7	22,0	22,4	22,7	23,4	23,7	22,3	22,1	21,9	21,7
AirChange(/	2,4	1,9	1,9	1,9	2,1	2,6	2,9	3,8	3,7	2,9	2,0	1,9	1,9
Rel. Moistur	36,3	23,4	23,6	21,4	30,3	38,2	48,0	54,6	51,7	48,9	41,9	29,1	24,9
Co2(ppm)	416,6	426,3	426,2	426,1	421,3	413,1	408,6	395,3	399,5	409,1	422,0	425,6	425,9
PAQ(-)	0,4	0,6	0,6	0,7	0,5	0,4	0,2	0,1	0,1	0,2	0,3	0,5	0,6
Hours > 21	8376	691	616	611	720	744	717	744	744	720	744	679	646
Hours > 27	55	0	0	0	0	0	0	23	28	4	0	0	0
Hours > 28	24	0	0	0	0	0	0	9	13	2	0	0	0
Hours < 19,(	20	2	1	6	0	0	0	0	0	0	0	1	10
FanPow	1176,09	97,76	88,30	97,76	94,61	101,11	95,15	102,53	112,41	96,33	97,76	94,61	97,76
HtRec	7002,47	912,76	830,08	962,06	623,77	453,30	334,90	198,22	179,25	309,58	528,06	767,58	902,92

BSim result - Heat balance

Options Moisture Simulation HeatBalance Parameters Tables

Total (None) Values 01-01-20

2011	Min	Mean	Max	1	2	3	4	5	6	7	8	9	10	11	12
TiMean(Hon	19,25	22,28	28,83	21,87	21,83	21,70	22,01	22,37	22,62	23,30	23,56	22,25	22,07	21,92	21,76
TopMean(H	19,27	22,30	28,95	21,82	21,80	21,68	22,03	22,43	22,69	23,39	23,66	22,31	22,08	21,89	21,71
Co2(Home)p	367,5	416,5	430,9	426,3	426,2	426,1	421,3	413,1	408,6	395,3	399,5	409,1	422,0	425,6	425,9

BSim result - Overall important factors

Appendix 3: BSim - Home east hard

Options Moisture Simulation HeatBalance Parameters Tables

2011 Month Hours Home

Home	Sum/Mean	1 (31 days)	2 (28 days)	3 (31 days)	4 (30 days)	5 (31 days)	6 (30 days)	7 (31 days)	8 (31 days)	9 (30 days)	10 (31 days)	11 (30 days)	12 (31 days)
qHeating	1731,27	309,63	280,10	299,46	131,92	46,29	6,54	0,00	0,26	15,23	94,44	236,77	310,62
qCooling	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
qInfiltration	-3419,45	-433,74	-394,54	-458,44	-300,36	-226,61	-164,55	-114,25	-119,96	-159,10	-252,56	-365,80	-429,55
qVenting	-700,97	0,00	0,00	-0,13	-64,12	-80,68	-123,68	-174,96	-131,69	-98,23	-27,47	0,00	0,00
qSunRad	1184,05	13,86	39,50	99,59	138,54	186,64	171,48	174,89	152,18	114,72	64,19	20,49	7,97
qPeople	262,80	22,32	20,16	22,32	21,60	22,32	21,60	22,32	22,32	21,60	22,32	21,60	22,32
qEquipment	2910,07	247,16	223,24	247,16	239,18	247,16	239,18	247,16	247,16	239,18	247,16	239,18	247,16
qLighting	991,14	127,30	91,60	91,40	88,90	87,39	16,75	0,00	81,69	88,20	97,00	99,40	121,50
qTransmissi	-2997,35	-361,42	-326,17	-376,48	-269,56	-218,49	-164,26	-94,89	-108,77	-162,79	-249,68	-305,16	-359,67
qMixing	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
qVentilation	45,21	75,13	66,77	76,45	14,66	-63,38	-2,92	-59,96	-142,66	-57,96	5,52	53,87	79,69
Sum	6,77	0,25	0,65	1,33	0,76	0,63	0,13	0,30	0,54	0,86	0,92	0,36	0,03
tOutdoor me	8,1	0,7	0,4	-0,7	7,1	11,5	14,2	17,8	17,9	14,5	9,8	3,4	0,7
tOp mean(°C	22,3	21,6	21,6	21,4	22,1	22,6	22,5	23,5	23,8	22,6	22,1	21,8	21,5
AirChange(/	2,2	1,9	1,9	1,9	2,0	2,2	2,7	3,5	2,8	2,3	1,9	1,9	1,9
Rel. Moistur	35,3	22,5	22,7	20,5	29,1	37,0	47,6	53,8	50,7	47,4	40,7	28,1	23,9
Co2(ppm)	367,6	369,7	369,6	369,6	369,2	367,6	365,7	361,3	363,2	366,6	369,1	369,5	369,6
PAQ(-)	0,4	0,6	0,6	0,7	0,5	0,4	0,2	0,1	0,1	0,2	0,4	0,6	0,6
Hours > 21	8048	620	549	527	720	744	696	744	744	720	744	648	592
Hours > 27	55	0	0	0	0	0	0	22	29	4	0	0	0
Hours > 28	22	0	0	0	0	0	0	8	12	2	0	0	0
Hours < 19,	61	4	4	27	0	0	0	0	0	0	0	7	19
FanPow	1178,14	97,76	88,30	97,76	94,61	103,05	95,13	102,49	112,53	96,38	97,76	94,61	97,76
HtRec	6971,63	903,83	821,53	952,47	627,20	458,37	330,99	198,66	178,90	310,49	529,96	764,25	894,98

BSim result - Heat balance

Options Moisture Simulation HeatBalance Parameters Tables

Total (None) Values 01-01-20

2011	Min	Mean	Max	1	2	3	4	5	6	7	8	9	10	11	12
TiMean(Hon	18,60	22,25	28,92	21,65	21,61	21,47	22,09	22,52	22,49	23,38	23,73	22,50	22,09	21,83	21,57
TopMean(H	18,62	22,26	29,14	21,61	21,56	21,44	22,11	22,57	22,53	23,45	23,81	22,55	22,09	21,80	21,52
Co2(Home)p	350,0	367,5	428,4	369,7	369,6	369,6	369,2	367,6	365,7	361,3	363,2	366,6	369,1	369,5	369,6

BSim result - Overall important factors

Appendix 3: BSim - Home east light

Options Moisture Simulation HeatBalance Parameters Tables

2011 Month Hours Home

Home	Sum/Mean	1 (31 days)	2 (28 days)	3 (31 days)	4 (30 days)	5 (31 days)	6 (30 days)	7 (31 days)	8 (31 days)	9 (30 days)	10 (31 days)	11 (30 days)	12 (31 days)
qHeating	1591,00	282,44	261,95	297,62	118,02	44,98	5,00	0,00	0,25	13,43	76,96	208,49	281,87
qCooling	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
qInfiltration	-3398,06	-437,59	-397,65	-460,46	-298,71	-217,20	-165,27	-109,53	-108,18	-151,69	-251,56	-367,23	-432,99
qVenting	-794,40	0,00	0,00	-0,48	-35,28	-107,95	-95,01	-184,32	-193,82	-142,40	-35,13	0,00	0,00
qSunRad	358,45	3,75	8,89	21,65	41,70	57,07	66,53	65,28	46,39	26,14	13,40	4,76	2,89
qPeople	1020,54	86,68	78,29	86,68	83,88	86,68	83,88	86,68	86,68	83,88	86,68	83,88	86,68
qEquipment	2987,16	253,70	229,15	253,70	245,52	253,70	245,52	253,70	253,70	245,52	253,70	245,52	253,70
qLighting	1099,34	131,00	97,70	106,00	102,10	100,00	18,55	0,00	96,89	107,30	111,30	105,00	123,50
qTransmissi	-3026,53	-384,45	-339,45	-379,56	-273,59	-201,89	-157,44	-75,90	-90,91	-153,51	-258,97	-325,76	-385,07
qMixing	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
qVentilation	162,93	64,47	61,12	74,85	16,36	-15,36	-1,43	-35,85	-90,98	-28,67	3,63	45,35	69,43
Sum	0,44	-0,00	0,00	-0,00	0,00	0,04	0,33	0,06	0,00	0,00	0,00	-0,00	-0,00
tOutdoor me	8,1	0,7	0,4	-0,7	7,1	11,5	14,2	17,8	17,9	14,5	9,8	3,4	0,7
tOp mean(°C	22,2	21,8	21,7	21,5	22,0	22,1	22,6	23,2	23,2	22,2	22,0	21,9	21,7
AirChange(/	2,3	1,9	1,9	1,9	2,0	2,4	2,6	3,7	3,6	2,6	2,0	1,9	1,9
Rel. Moistur	36,6	23,5	23,7	21,5	30,3	38,9	48,4	55,3	52,9	49,3	41,9	29,2	24,9
Co2(ppm)	418,0	426,3	426,2	426,1	423,5	415,4	412,8	398,9	401,6	411,1	422,8	425,6	425,9
PAQ(-)	0,4	0,6	0,6	0,7	0,5	0,4	0,2	0,1	0,1	0,2	0,4	0,5	0,6
Hours > 21	8330	689	610	582	720	744	715	744	744	720	744	677	641
Hours > 27	10	0	0	0	0	0	0	3	7	0	0	0	0
Hours > 28	0	0	0	0	0	0	0	0	0	0	0	0	0
Hours < 19,8	28	1	1	14	0	0	0	0	0	0	0	2	10
FanPow	1162,50	97,76	88,30	97,76	94,61	97,76	94,61	99,79	106,31	95,46	97,76	94,61	97,76
HtRec	6993,43	912,45	828,87	957,72	624,51	447,19	338,68	203,01	174,35	309,18	527,63	767,20	902,63

BSim result - Heat balance

Options Moisture Simulation HeatBalance Parameters Tables

Total (None) Values 01-01-20

2011	Min	Mean	Max	1	2	3	4	5	6	7	8	9	10	11	12
TiMean(Hon	18,92	22,16	27,72	21,86	21,79	21,58	22,01	22,05	22,53	23,15	23,15	22,12	22,04	21,91	21,75
TopMean(H	18,91	22,16	27,67	21,81	21,74	21,54	22,00	22,08	22,55	23,20	23,21	22,16	22,04	21,88	21,71
Co2(Home)p	368,1	418,0	431,0	426,3	426,2	426,1	423,5	415,4	412,8	398,9	401,6	411,1	422,8	425,6	425,9

BSim result - Overall important factors

Appendix 3: BSim - Home north hard

Options Moisture Simulation HeatBalance Parameters Tables

Month | Hours | Home

Home	Sum/Mean	1 (31 days)	2 (28 days)	3 (31 days)	4 (30 days)	5 (31 days)	6 (30 days)	7 (31 days)	8 (31 days)	9 (30 days)	10 (31 days)	11 (30 days)	12 (31 days)
qHeating	1812,31	311,86	289,15	323,71	143,43	59,40	7,43	0,00	1,15	22,55	101,24	240,26	312,13
qCooling	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
qInfiltration	-3385,32	-433,46	-393,63	-455,87	-299,40	-219,91	-161,69	-109,62	-110,41	-154,81	-251,62	-365,50	-429,39
qVenting	-414,39	0,00	0,00	-0,09	-13,81	-46,65	-48,32	-110,13	-108,45	-74,21	-12,74	0,00	0,00
qSunRad	358,45	3,75	8,89	21,65	41,70	57,07	66,53	65,28	46,39	26,14	13,40	4,76	2,89
qPeople	262,80	22,32	20,16	22,32	21,60	22,32	21,60	22,32	22,32	21,60	22,32	21,60	22,32
qEquipment	2910,07	247,16	223,24	247,16	239,18	247,16	239,18	247,16	247,16	239,18	247,16	239,18	247,16
qLighting	1091,34	131,00	97,70	106,00	101,87	99,09	18,29	0,00	90,58	107,02	111,30	105,00	123,50
qTransmissi	-2877,09	-359,49	-318,85	-356,40	-258,19	-196,01	-157,38	-80,98	-93,90	-151,16	-243,77	-301,95	-358,99
qMixing	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
qVentilation	242,33	76,86	73,34	91,52	23,62	-22,43	14,74	-33,94	-94,83	-36,32	12,72	56,65	80,39
Sum	0,50	-0,00	0,00	0,00	0,00	0,04	0,37	0,09	0,00	0,00	0,00	-0,00	-0,00
tOutdoor me	8,1	0,7	0,4	-0,7	7,1	11,5	14,2	17,8	17,9	14,5	9,8	3,4	0,7
tOp mean(°C	22,1	21,6	21,5	21,3	22,0	22,2	22,3	23,2	23,3	22,3	22,0	21,8	21,5
AirChange(/	2,1	1,9	1,9	1,9	1,9	2,1	2,4	3,2	2,7	2,2	1,9	1,9	1,9
Rel. Moistur	35,7	22,5	22,8	20,6	29,2	37,6	48,0	54,5	52,1	48,0	40,9	28,1	23,9
Co2(ppm)	367,7	369,7	369,6	369,6	369,3	367,9	366,3	361,3	363,7	366,7	369,1	369,5	369,6
PAQ(-)	0,4	0,6	0,6	0,7	0,5	0,4	0,2	0,1	0,1	0,3	0,4	0,6	0,6
Hours > 21	7996	620	543	503	720	744	684	744	744	720	744	641	589
Hours > 27	8	0	0	0	0	0	0	3	5	0	0	0	0
Hours > 28	0	0	0	0	0	0	0	0	0	0	0	0	0
Hours < 19,£	73	5	7	36	0	0	0	0	0	0	0	7	18
FanPow	1160,79	97,76	88,30	97,76	94,61	97,76	94,61	99,46	105,05	95,35	97,76	94,61	97,76
HtRec	6953,75	903,31	819,97	947,66	626,58	449,35	333,59	202,30	173,81	309,49	529,19	763,85	894,64

BSim result - Heat balance

Options Moisture Simulation HeatBalance Parameters Tables

Total | (None) | Values | 01-01-20

2011	Min	Mean	Max	1	2	3	4	5	6	7	8	9	10	11	12
TiMean(Hon	18,49	22,10	27,47	21,64	21,55	21,33	22,04	22,19	22,34	23,15	23,26	22,28	22,05	21,81	21,56
TopMean(H	18,51	22,10	27,36	21,59	21,51	21,29	22,03	22,20	22,35	23,19	23,30	22,30	22,03	21,78	21,51
Co2(Home)p	350,0	367,7	428,7	369,7	369,6	369,6	369,3	367,9	366,3	361,3	363,7	366,7	369,1	369,5	369,6

BSim result - Overall important factors

Appendix 3: BSim - Home north light

Options Moisture Simulation HeatBalance Parameters Tables

2011 Month Hours Home

Home	Sum/Mean	1 (31 days)	2 (28 days)	3 (31 days)	4 (30 days)	5 (31 days)	6 (30 days)	7 (31 days)	8 (31 days)	9 (30 days)	10 (31 days)	11 (30 days)	12 (31 days)
qHeating	1438,65	266,77	232,16	247,71	115,10	43,25	5,03	0,00	0,14	8,97	59,28	189,68	270,56
qCooling	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
qInfiltration	-3430,89	-439,16	-401,13	-466,31	-297,84	-218,81	-165,84	-111,55	-114,96	-155,78	-255,75	-369,66	-434,10
qVenting	-1269,63	0,00	0,00	-0,97	-138,23	-152,66	-131,96	-216,21	-249,96	-261,85	-117,78	0,00	0,00
qSunRad	1604,48	54,59	103,86	185,78	178,64	144,06	111,11	118,14	183,86	220,44	190,91	74,08	39,00
qPeople	1020,54	86,68	78,29	86,68	83,88	86,68	83,88	86,68	86,68	83,88	86,68	83,88	86,68
qEquipment	2987,16	253,70	229,15	253,70	245,52	253,70	245,52	253,70	253,70	245,52	253,70	245,52	253,70
qLighting	880,57	121,30	82,80	77,72	75,50	74,15	17,35	0,00	67,07	75,32	83,16	91,00	115,20
qTransmissi	-3188,03	-395,86	-363,62	-422,18	-277,12	-207,05	-157,69	-83,26	-102,79	-164,56	-278,63	-342,63	-392,66
qMixing	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
qVentilation	-25,11	52,95	40,18	39,76	16,24	-21,90	-6,55	-46,47	-122,11	-49,93	-19,04	29,32	62,44
Sum	17,74	0,97	1,69	1,89	1,69	1,42	0,85	1,03	1,63	2,00	2,54	1,19	0,82
tOutdoor me	8,1	0,7	0,4	-0,7	7,1	11,5	14,2	17,8	17,9	14,5	9,8	3,4	0,7
tOp mean(°C	22,3	21,9	22,0	21,9	22,0	22,2	22,6	23,3	23,6	22,4	22,3	22,0	21,8
AirChange(/	2,5	1,9	1,9	1,9	2,2	2,6	2,7	3,7	3,9	3,1	2,2	1,9	1,9
Rel. Moistur	36,3	23,4	23,4	21,2	30,3	38,7	48,3	54,8	51,9	48,6	41,4	28,9	24,9
Co2(ppm)	416,3	426,3	426,1	426,0	419,0	413,8	410,4	396,9	399,4	406,6	419,6	425,6	425,9
PAQ(-)	0,4	0,6	0,6	0,6	0,5	0,4	0,2	0,1	0,1	0,2	0,3	0,5	0,6
Hours > 21	8438	697	625	639	720	744	714	744	744	720	744	683	664
Hours > 27	48	0	0	0	0	0	0	14	28	6	0	0	0
Hours > 28	14	0	0	0	0	0	0	2	8	4	0	0	0
Hours < 19,(	16	2	1	6	0	0	0	0	0	0	0	1	6
FanPow	1173,34	97,76	88,30	97,76	94,61	97,76	94,61	102,52	112,79	97,09	97,76	94,61	97,76
HtRec	7017,23	915,15	835,29	968,56	622,08	447,00	336,19	200,16	176,10	309,11	531,72	771,14	904,73

BSim result - Heat balance

Options Moisture Simulation HeatBalance Parameters Tables

Total (None) Values 01-01-20

2011	Min	Mean	Max	1	2	3	4	5	6	7	8	9	10	11	12
TiMean(Hon	19,20	22,31	28,60	21,94	21,99	21,88	21,96	22,13	22,55	23,25	23,48	22,33	22,26	22,04	21,81
TopMean(H	19,31	22,33	28,58	21,90	21,97	21,87	22,00	22,18	22,60	23,32	23,58	22,42	22,30	22,02	21,77
Co2(Home)p	367,4	416,2	430,8	426,3	426,1	426,0	419,0	413,8	410,4	396,9	399,4	406,6	419,6	425,6	425,9

BSim result - Overall important factors

Appendix 3: BSim - Home south hard

Options Moisture Simulation HeatBalance Parameters Tables

2011 Month Hours Home

Home	Sum/Mean	1 (31 days)	2 (28 days)	3 (31 days)	4 (30 days)	5 (31 days)	6 (30 days)	7 (31 days)	8 (31 days)	9 (30 days)	10 (31 days)	11 (30 days)	12 (31 days)
qHeating	1622,18	296,71	259,92	272,88	126,76	53,23	7,22	0,00	0,42	9,41	73,66	220,26	301,71
qCooling	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
qInfiltration	-3444,14	-435,45	-397,42	-462,08	-303,34	-224,88	-163,22	-111,61	-121,92	-166,64	-259,29	-367,51	-430,79
qVenting	-635,20	0,00	0,00	-0,27	-56,50	-61,49	-78,29	-142,79	-131,47	-117,50	-46,89	0,00	0,00
qSunRad	1604,48	54,59	103,86	185,78	178,64	144,06	111,11	118,14	183,86	220,44	190,91	74,08	39,00
qPeople	262,80	22,32	20,16	22,32	21,60	22,32	21,60	22,32	22,32	21,60	22,32	21,60	22,32
qEquipment	2910,07	247,16	223,24	247,16	239,18	247,16	239,18	247,16	247,16	239,18	247,16	239,18	247,16
qLighting	874,11	121,30	82,80	77,86	75,00	73,95	17,23	0,00	64,10	72,27	83,31	91,10	115,20
qTransmissi	-3103,39	-371,72	-343,91	-400,00	-276,95	-208,66	-161,42	-89,84	-113,66	-177,51	-272,92	-318,74	-368,05
qMixing	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
qVentilation	-73,08	66,06	53,05	58,24	-2,70	-44,28	7,48	-42,31	-149,16	-99,24	-35,71	41,22	74,28
Sum	17,83	0,97	1,69	1,89	1,69	1,42	0,90	1,06	1,63	2,00	2,54	1,19	0,82
tOutdoor me	8,1	0,7	0,4	-0,7	7,1	11,5	14,2	17,8	17,9	14,5	9,8	3,4	0,7
tOp mean(°C	22,4	21,7	21,7	21,6	22,3	22,5	22,4	23,3	23,9	23,0	22,5	21,9	21,6
AirChange(/	2,2	1,9	1,9	1,9	2,0	2,1	2,6	3,3	2,9	2,5	2,0	1,9	1,9
Rel. Moistur	35,1	22,4	22,5	20,3	28,8	37,1	47,8	54,1	50,5	46,4	39,9	27,9	23,8
Co2(ppm)	367,1	369,7	369,6	369,6	368,6	367,3	365,5	360,9	362,4	364,9	368,2	369,5	369,6
PAQ(-)	0,4	0,6	0,6	0,7	0,5	0,4	0,2	0,1	0,1	0,2	0,4	0,5	0,6
Hours > 21	8152	638	565	573	720	744	691	744	744	720	744	656	613
Hours > 27	59	0	0	0	0	0	0	14	38	7	0	0	0
Hours > 28	17	0	0	0	0	0	0	2	11	4	0	0	0
Hours < 19,5	45	3	3	20	0	0	0	0	0	0	0	3	16
FanPow	1186,22	97,76	88,30	97,76	95,44	99,36	94,61	101,73	115,91	102,70	100,27	94,61	97,76
HtRec	7015,67	907,11	827,25	959,59	634,96	450,99	333,26	200,09	176,24	317,90	543,74	766,99	897,55

BSim result - Heat balance

Total (None) Values 01-01-20

2011	Min	Mean	Max	1	2	3	4	5	6	7	8	9	10	11	12
TiMean(Hon	18,90	22,36	28,85	21,74	21,77	21,66	22,25	22,43	22,42	23,25	23,83	22,89	22,43	21,92	21,63
TopMean(H	19,01	22,37	28,77	21,70	21,74	21,64	22,27	22,47	22,44	23,30	23,91	22,96	22,46	21,90	21,59
Co2(Home)p	350,0	367,1	428,2	369,7	369,6	369,6	368,6	367,3	365,5	360,9	362,4	364,9	368,2	369,5	369,6

BSim result - Overall important factors

Appendix 3: BSim - Home south light

Options Moisture Simulation HeatBalance Parameters Tables

Month Hours Home

Home	Sum/Mean	1 (31 days)	2 (28 days)	3 (31 days)	4 (30 days)	5 (31 days)	6 (30 days)	7 (31 days)	8 (31 days)	9 (30 days)	10 (31 days)	11 (30 days)	12 (31 days)
qHeating	1566,00	281,10	256,42	285,61	117,88	45,87	4,96	0,00	0,18	13,03	74,34	206,35	280,26
qCooling	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
qInfiltration	-3407,65	-437,74	-398,23	-462,08	-298,14	-217,15	-165,86	-111,54	-112,33	-152,17	-251,93	-367,36	-433,14
qVenting	-1141,59	0,00	0,00	-2,43	-104,32	-170,61	-137,52	-247,60	-243,87	-183,24	-52,00	0,00	0,00
qSunRad	968,37	11,83	30,58	73,88	130,54	128,20	116,51	153,92	142,28	96,10	59,01	16,95	8,58
qPeople	1020,54	86,68	78,29	86,68	83,88	86,68	83,88	86,68	86,68	83,88	86,68	83,88	86,68
qEquipment	2987,16	253,70	229,15	253,70	245,52	253,70	245,52	253,70	253,70	245,52	253,70	245,52	253,70
qLighting	981,62	126,20	89,50	89,00	87,30	91,85	17,55	0,00	83,05	85,30	92,37	98,80	120,70
qTransmissi	-3070,27	-385,60	-343,31	-389,87	-274,52	-203,18	-158,32	-88,21	-98,30	-154,69	-261,02	-327,51	-385,74
qMixing	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
qVentilation	110,99	63,85	57,99	67,37	14,43	-13,83	-5,97	-45,56	-108,99	-31,11	0,40	43,46	68,97
Sum	15,17	0,01	0,41	1,86	2,58	1,52	0,74	1,39	2,40	2,62	1,56	0,08	0,00
tOutdoor me	8,1	0,7	0,4	-0,7	7,1	11,5	14,2	17,8	17,9	14,5	9,8	3,4	0,7
tOp mean(°C	22,2	21,8	21,8	21,6	22,0	22,1	22,6	23,3	23,4	22,2	22,1	21,9	21,7
AirChange(/	2,4	1,9	1,9	1,9	2,1	2,6	2,7	3,6	3,8	2,8	2,0	1,9	1,9
Rel. Moistur	36,5	23,4	23,6	21,5	30,3	38,8	48,4	54,8	52,3	49,2	41,9	29,2	24,9
Co2(ppm)	416,9	426,3	426,2	426,0	420,7	413,3	410,9	397,1	399,8	409,2	421,9	425,6	425,9
PAQ(-)	0,4	0,6	0,6	0,7	0,5	0,4	0,2	0,1	0,1	0,2	0,3	0,5	0,6
Hours > 21	8362	690	612	603	720	744	715	744	744	720	744	680	646
Hours > 27	25	0	0	0	0	0	0	12	12	1	0	0	0
Hours > 28	3	0	0	0	0	0	0	1	2	0	0	0	0
Hours < 19,ε	24	1	1	9	0	0	0	0	0	0	0	1	12
FanPow	1169,59	97,76	88,30	97,76	94,61	97,76	94,61	101,83	110,92	95,91	97,76	94,61	97,76
HtRec	6995,53	912,78	830,03	961,02	622,51	446,65	338,86	200,93	175,42	309,02	527,98	767,35	902,98

BSim result - Heat balance

Total (None) Values

2011	Min	Mean	Max	1	2	3	4	5	6	7	8	9	10	11	12
TiMean(Hon	19,17	22,21	28,10	21,86	21,82	21,66	21,98	22,05	22,56	23,25	23,35	22,15	22,06	21,92	21,76
TopMean(H	19,28	22,22	28,07	21,82	21,78	21,63	22,00	22,10	22,60	23,33	23,44	22,20	22,07	21,88	21,72
Co2(Home)p	367,8	416,8	431,0	426,3	426,2	426,0	420,7	413,3	410,9	397,1	399,8	409,2	421,9	425,6	425,9

BSim result - Overall important factors

Appendix 3: BSim - Home west hard

Options Moisture Simulation HeatBalance Parameters Tables

2011 Month Hours Home

Home	Sum/Mean	1 (31 days)	2 (28 days)	3 (31 days)	4 (30 days)	5 (31 days)	6 (30 days)	7 (31 days)	8 (31 days)	9 (30 days)	10 (31 days)	11 (30 days)	12 (31 days)
qHeating	1776,70	310,79	284,05	311,90	137,88	58,58	7,33	0,00	0,70	20,17	96,82	237,57	310,90
qCooling	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
qInfiltration	-3404,25	-433,72	-394,47	-457,83	-299,54	-220,85	-164,00	-112,39	-117,14	-156,87	-252,20	-365,63	-429,60
qVenting	-680,89	0,00	0,00	-1,41	-64,84	-98,90	-80,11	-171,48	-143,52	-98,89	-21,75	0,00	0,00
qSunRad	968,37	11,83	30,58	73,88	130,54	128,20	116,51	153,92	142,28	96,10	59,01	16,95	8,58
qPeople	262,80	22,32	20,16	22,32	21,60	22,32	21,60	22,32	22,32	21,60	22,32	21,60	22,32
qEquipment	2910,07	247,16	223,24	247,16	239,18	247,16	239,18	247,16	247,16	239,18	247,16	239,18	247,16
qLighting	970,35	126,20	89,50	89,00	87,04	90,15	17,31	0,00	77,86	81,50	92,28	98,80	120,70
qTransmissi	-2937,23	-360,49	-323,01	-366,99	-263,44	-199,67	-162,10	-90,27	-105,29	-155,25	-247,06	-303,85	-359,81
qMixing	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
qVentilation	149,31	75,93	70,35	83,83	14,16	-25,45	5,06	-47,87	-121,97	-44,92	4,97	55,46	79,76
Sum	15,22	0,01	0,41	1,86	2,58	1,52	0,79	1,40	2,40	2,62	1,56	0,08	0,00
tOutdoor me	8,1	0,7	0,4	-0,7	7,1	11,5	14,2	17,8	17,9	14,5	9,8	3,4	0,7
tOp mean(°C	22,2	21,6	21,6	21,4	22,1	22,3	22,5	23,4	23,7	22,4	22,1	21,8	21,5
AirChange(/	2,2	1,9	1,9	1,9	2,0	2,2	2,5	3,4	2,9	2,3	1,9	1,9	1,9
Rel. Moistur	35,5	22,5	22,7	20,5	29,2	37,5	47,7	54,0	51,1	47,8	40,8	28,1	23,9
Co2(ppm)	366,9	369,7	369,6	369,6	367,7	366,4	364,4	359,2	362,6	365,9	368,8	369,5	369,6
PAQ(-)	0,4	0,6	0,6	0,7	0,5	0,4	0,2	0,1	0,1	0,2	0,4	0,6	0,6
Hours > 21	8052	619	552	529	720	744	696	744	744	720	744	645	595
Hours > 27	25	0	0	0	0	0	0	13	12	0	0	0	0
Hours > 28	2	0	0	0	0	0	0	1	1	0	0	0	0
Hours < 19,(	55	3	4	21	0	0	0	0	0	0	0	9	18
FanPow	1169,69	97,76	88,30	97,76	94,61	97,76	94,61	101,51	111,40	95,84	97,76	94,61	97,76
HtRec	6960,28	903,89	821,78	951,77	625,33	449,23	336,18	199,46	174,83	309,50	529,14	764,06	895,11

BSim result - Heat balance

Options Moisture Simulation HeatBalance Parameters Tables

Total (None) Values 01-01-21

2011	Min	Mean	Max	1	2	3	4	5	6	7	8	9	10	11	12
TiMean(Hon	18,35	22,18	28,07	21,65	21,60	21,44	22,05	22,23	22,46	23,29	23,59	22,39	22,08	21,82	21,57
TopMean(H	18,46	22,19	28,02	21,61	21,56	21,40	22,06	22,27	22,49	23,36	23,66	22,42	22,07	21,79	21,52
Co2(Home)p	350,0	366,9	428,6	369,7	369,6	369,6	367,7	366,4	364,4	359,2	362,6	365,9	368,8	369,5	369,6

BSim result - Overall important factors

Appendix 3: BSim - Home west light

SMELL													
Room/area	Floor area m2	Height (m)	Volume m3	nr. of people	Number of rooms	Energy pr. person (met)	Pollution from building	q (olf)	c (decipol)	V1 (l/s)	V1 (m3/s)	V1 (m3/h)	n
Unit (south)													
Hallway	360	3,215	1157,4	5		1,4	0,1	43	1	430	0,43	1548	1,3
Hallway 4 letout											0,191111111	688	
Hallway 5 letout											0,238888889	860	
Common area	140	3,215	450,1	9		1,2	0,1	24,8	1	248	0,248	892,8	2,0
	56	5	280	9		1,2	0,1	16,4	2	82	0,082	295,2	1,1
Common in total											0,33	1188	
Common half of it											0,165	594	
Meeting room	14	3,215	45,01	3		1	0,1	4,4	1	44	0,044	158,4	3,5
Waredrobe	12	3,215	38,58	1		1,4	0,1	2,6	1	26	0,026	93,6	2,4
Staff	10	3,215	32,15	2		1,2	0,1	3,4	1	34	0,034	122,4	3,8
Kitchen storage	9	3,215	28,935	1		1,2	0,1	2,1	1	21	0,021	75,6	2,6
Storage	8	3,215	25,72	1		1,2	0,1	2	1	20	0,02	72	2,8
Cleaning	8	3,215	25,72	1		1	0,1	1,8	1	18	0,018	64,8	2,5
unit in total										923	0,923	3322,8	

Ventilation - Airchange

Ventilation dimonsion				
	V1 (m3/s)	Speed (m/s)	Cross section (m2)	Diameter round pipes (m)
	0,43	4	0,11	0,370
	0,248	6	0,04	0,229
	0,082	6	0,01	0,132
	0,044	4	0,01	0,118
	0,026	6	0,00	0,074
	0,034	4	0,01	0,104
	0,021	6	0,00	0,067
	0,02	4	0,01	0,080
	0,018	4	0,00	0,076
	0,923	6	0,15	0,443

Ventilation - Dimension of ventilation pipes

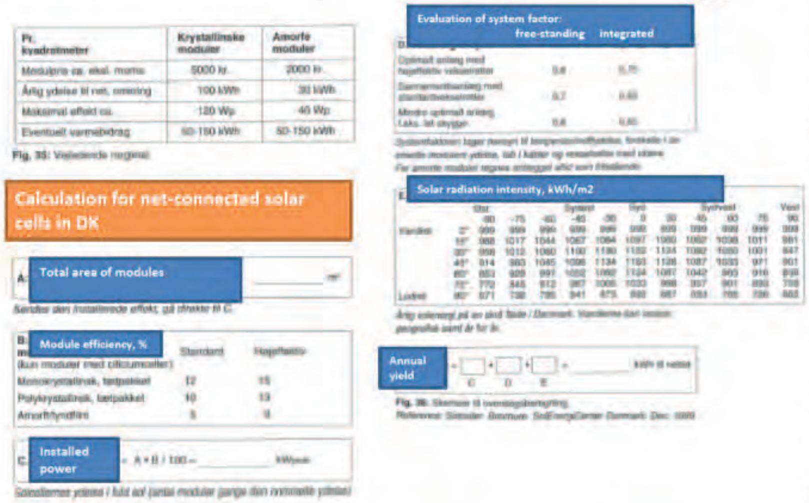
Appendix 4: Ventilation calculati-on Airchange and pipe size

Pressure loss

Distance	Air volume m3/s	Air volume m3/h	Speed m/s	Cross section m2	Channel dimension m (Diameter)	Length m.	Singel resistance	Pressur loss pr. m R (Pa)	Dynamic pressur Pa	Pressure loss (R * lenght) Pa	Pressure loss singel resistance * Dynamic pre.	Loss in total Pa	Summation Pa
AB (unit in total)	0,923	3322,8	6	0,154	0,443	2,5		0,93		2		13	13
B							0,5		22		11		
BD	0,53	1893,20	4	0,131	0,409	6,6		0,49		3		32	45
C og D							2,9		9,82		28		
DE	0,42	1518,80	4	0,105	0,366	7,5		0,49		4		17	62
E							1,75		7,856		14		
EF	0,10	374,40	4	0,026	0,182	5,8		1,08		6		6	
F (out)							0		7,856		0		69
EG	0,42	1518,80	4	0,105	0,366	2,2		0,49		1			
G							1,75		7,856		14		
GH	0,17	594,00	4	0,041	0,229	5,1		1,08		6		20	
H (out)							0		9,82		0		89
GI	0,24	860,00	4	0,060	0,276	7,9		0,59		5		9	97
I							0,5		7,856		4		
IK	0,24	860,00	4,00	0,06	0,28	1,5		0,59		1		15	112
K							1,75		7,856		14		
KJ	0,05	172,00	2	0,024	0,174	1,7		0,31		1		1	
J (out)									2,1604		0		113
KM	0,19	688,00	4	0,048	0,247	7,4		0,79		6			
M							1,75		7,856		14		
ML	0,05	172,00	2	0,024	0,174	3,1		0,31		1		21	
L (out)									2,1604		0		133
MN	0,14	516,00	4	0,036	0,214	12,2		1,23		15			
N							1,75		11,784		21		
NO	0,05	172,00	2,0	0,024	0,174	4		0,31		1		37	
O (out)									2,1604		0		170
NP	0,10	344,00	4,0	0,024	0,174	6,2		0,31		2			
P							1,75		2,1604		4		
PQ	0,05	172,00	2,0	0,024	0,174	1,8		0,3		1		6	
Q (out)									2,1604		0		176
PR	0,05	172,00	2,0	0,024	0,174	13		0,31		4		4	
R (out)									2,1604		0		180
													180

Ventilation - Pressure loss calculation

Appendix 4: Ventilation calculation Pressure loss



m2 of units	South	East	West
April	1860	329	221
July	2268	378	558
December	850	189	315

Street ventilation el — 1870

El. requirement in ventilation plant													
kWh	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Heat coils	0	0	0	0	0	0	0	0	0	0	0	0	0
Ventilators	197	178	197	158	132	109	82	96	138	197	191	197	1870
Total	197	178	197	158	132	109	82	96	138	197	191	197	1870
kWh/m²	0.4	0.3	0.4	0.3	0.2	0.2	0.2	0.2	0.3	0.4	0.4	0.4	3.5

2 units ventilation el — 13422

El. requirement in ventilation plant													
kWh	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Heat coils	0	0	0	0	0	0	0	0	0	0	0	0	0
Ventilators	1383	1249	1383	1077	986	890	794	814	942	1181	1339	1383	13422
Total	1383	1249	1383	1077	986	890	794	814	942	1181	1339	1383	13422
kWh/m²	0.5	0.5	0.5	0.4	0.4	0.3	0.3	0.3	0.4	0.4	0.5	0.5	5.0

2 unit special unit administration ventilation el — 19280

El. requirement in ventilation plant													
kWh	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Heat coils	0	0	0	0	0	0	0	0	0	0	0	0	0
Ventilators	1972	1781	1972	1574	1445	1294	1140	1172	1364	1685	1908	1972	19280
Total	1972	1781	1972	1574	1445	1294	1140	1172	1364	1685	1908	1972	19280
kWh/m²	0.5	0.4	0.5	0.4	0.3	0.3	0.3	0.3	0.3	0.4	0.4	0.5	4.4

Energy consumption - Ventilations use

Appendix 5: Energy consumption 1/3

PV's

calculation is made based on knowledge from MSc02

Annual yield, kWh. (see "The area')

The plug loads	
based on residents	169200
Based on m2 common area	234650
Based on BR15	245065,38
The equpment loads (from BE15)	34572

A: area for each oriantation

0, 15, 30, 45 and so on.. is the angel of the PV (vetical = 90, horisontal= 0)
-90, -75, -60 and -45 and so on... is the oriantation acording to south.

	East		SE			South	SW				West
	-90	-75	-60	-45	-30	0	30	45	60	75	90
0						400					
15	298,62					1655,64					472,5
30											
45											
60											
75											
90											
	79 percent of total area					73 percent of total area					75 percent of total area

B: Modules effeiency, %

	Standart	High efficient
Monokrystallinsk, close packed	12	15
Polykrystallisk, close packed	10	13

C: Installed power , kW/peak
C=(A*B)/100
Made as a beginning that B=15

	East		SE			South	SW				West
	-90	-75	-60	-45	-30	0	30	45	60	75	90
0	0	0	0	0	0	60	0	0	0	0	0
15	44,793	0	0	0	0	248,346	0	0	0	0	70,875
30	0	0	0	0	0	0	0	0	0	0	0
45	0	0	0	0	0	0	0	0	0	0	0
60	0	0	0	0	0	0	0	0	0	0	0
75	0	0	0	0	0	0	0	0	0	0	0
90	0	0	0	0	0	0	0	0	0	0	0

D : Evaluation of system factor

	free-standing	intergrated
Optimal instilation with highefficient inverter	0,8	0,75
Average instation with standart inverter	0,7	0,65
Less optimal instilaiton, fx with light shadow	0,6	0,55

Energy consumption - Solar cell calculation

Appendix 5: Energy consumption 2/3

E: Solar radiation intensity, Kwh/m2		East			SE		South		SW			West
		-90	-75	-60	-45	-30	0	30	45	60	75	90
	0	999	999	999	999	999	999	999	999	999	999	999
	15	988	1017	1044	1067	1084	1097	1080	1062	1038	1011	961
	30	958	1012	1060	1100	1130	1152	1124	1092	1050	1001	947
	45	914	963	1045	1096	1134	1163	1128	1087	1033	971	901
	60	853	928	997	1052	1092	1124	1087	1042	983	916	839
	75	772	845	912	967	1005	1033	998	957	9001	833	759
	90	671	738	795	841	873	892	867	833	785	726	662

Annually yield MADE based on oriantation		East			SE		South		SW			West
A. Y= C*D*E		-90	-75	-60	-45	-30	0	30	45	60	75	90
D is a beginning made to be 0,75	0	0	0	0	0	0	44955	0	0	0	0	0
	15	33191,613	0	0	0	0	204326,672	0	0	0	0	51083,15625
	30	0	0	0	0	0	0	0	0	0	0	0
	45	0	0	0	0	0	0	0	0	0	0	0
	60	0	0	0	0	0	0	0	0	0	0	0
	75	0	0	0	0	0	0	0	0	0	0	0
	90	0	0	0	0	0	0	0	0	0	0	0
Annually yield MADE, kWh		33191,613	0	0	0	0	249281,672	0	0	0	0	51083,15625
In total		333556,4408										
Comparede to annually yeil used (get an minus in front)												
based on residents		-129784,4408										
Based on m2 common area		-64334,44075										
Based on BE15		-53919,06075										

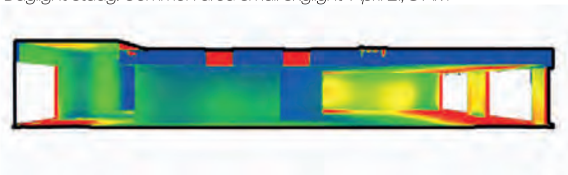
Energy consumption - Solar cell calculation

Appendix 5: Energy consumption 3/3

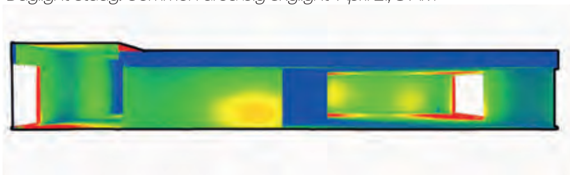
Daylight study: Common area small skylight April 21, 8 AM

Daylight study: Common area big skylight April 21, 8 AM

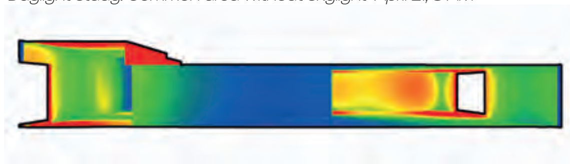
Daylight study: Common area without skylight April 21, 8 AM



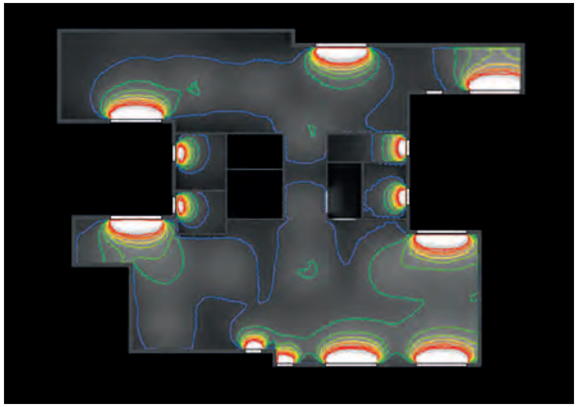
Daylight study: Common area small skylight April 21, 8 AM



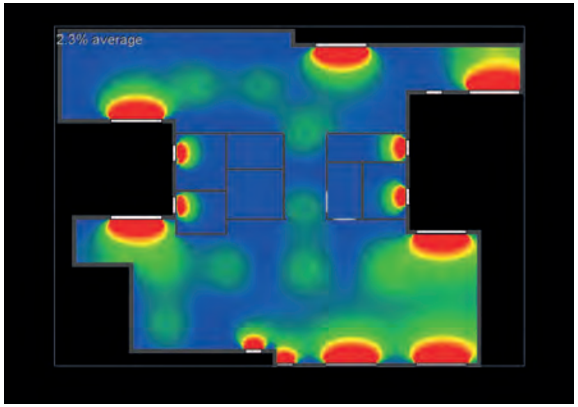
Daylight study: Common area big skylight April 21, 8 AM



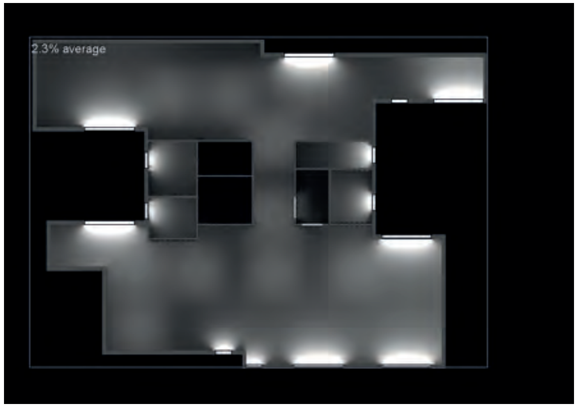
Daylight study: Common area without skylight April 21, 8 AM



Daylight study: Common area small skylight April 21, 8 AM

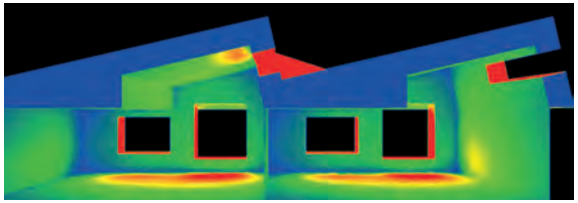


Daylight study: Common area small skylight April 21, 8 AM

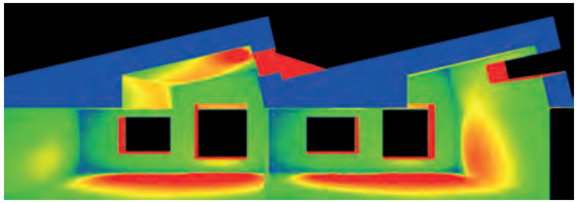


Daylight study: Common area small skylight April 21, 8 AM

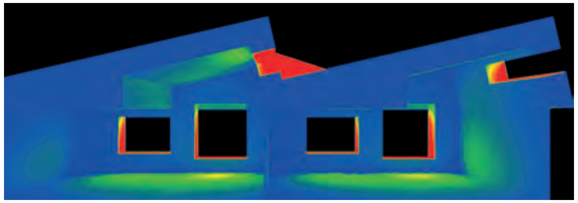
Appendix 6: Daylight study common area



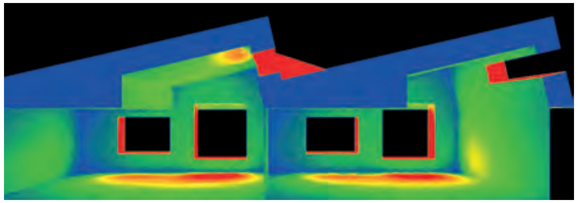
Daylight study: East April 21, 8 AM



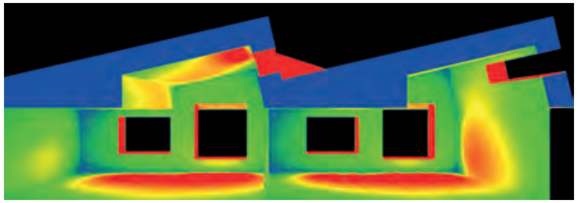
Daylight study: East July 21, 8 AM



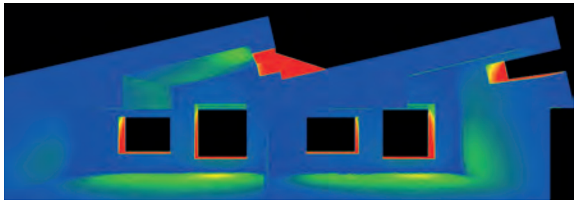
Daylight study: East December 21, 8 AM



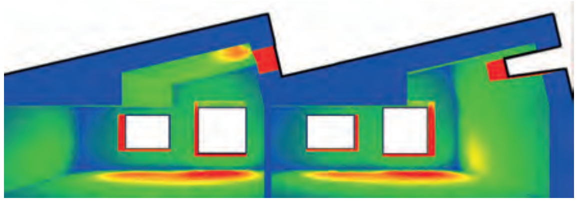
Daylight study: West April 21, 8 AM



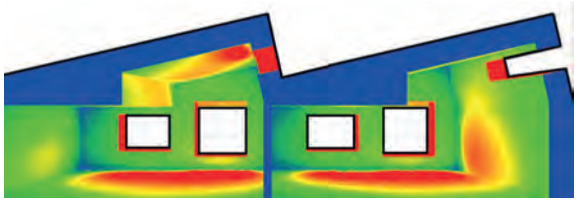
Daylight study: West July 21, 8 AM



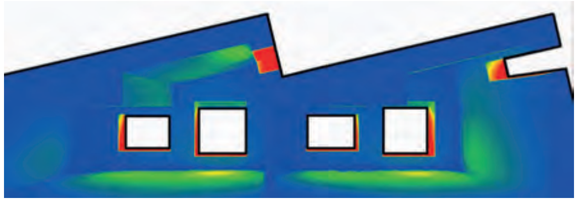
Daylight study: West December 21, 8 AM



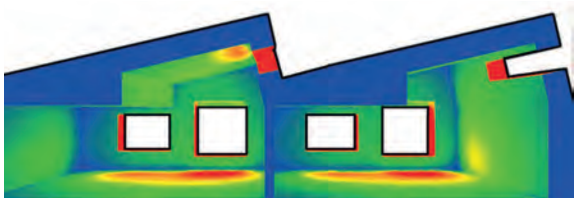
Daylight study: North April 21, 8 AM



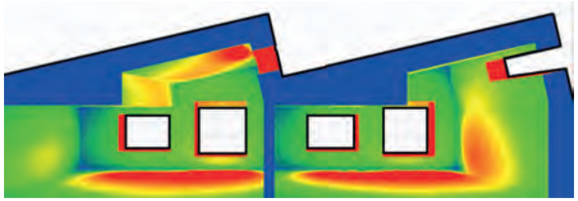
Daylight study: North July 21, 8 AM



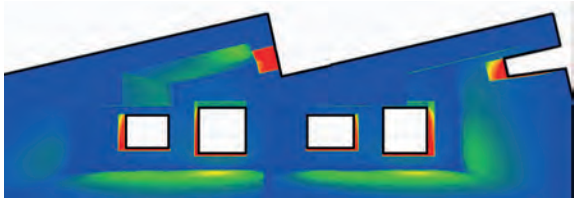
Daylight study: North December 21, 8 AM



Daylight study: South April 21, 8 AM

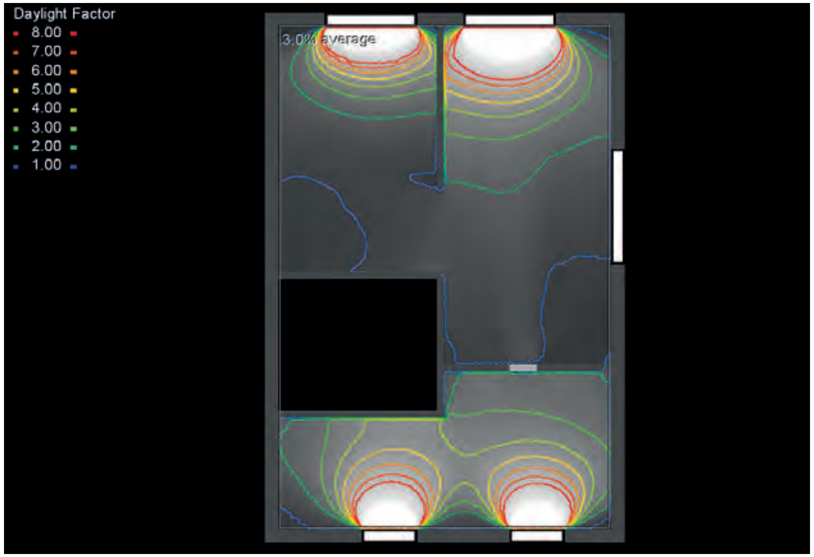


Daylight study: South July 21, 8 AM

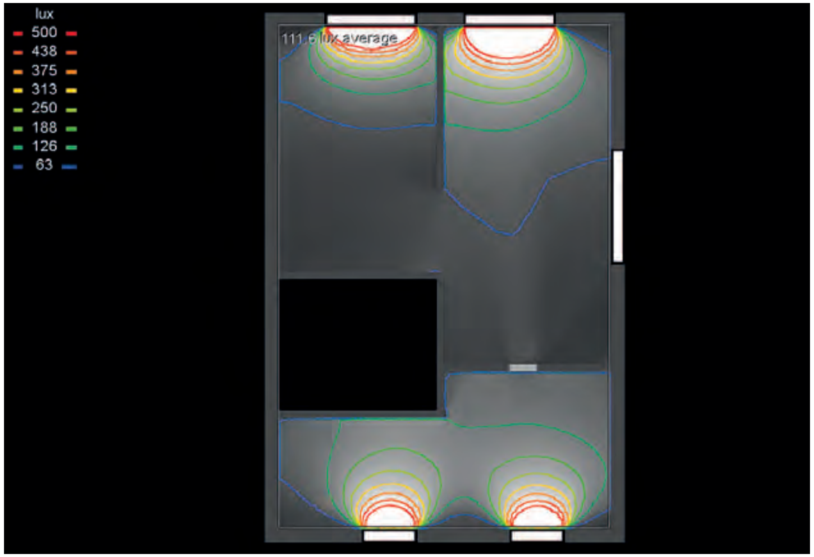


Daylight study: South December 21, 8 AM

Appendix 6: Daylight study - Final

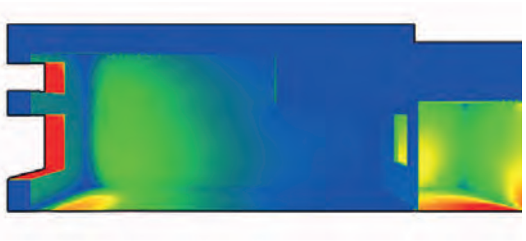


Daylight study: Final daylight factor

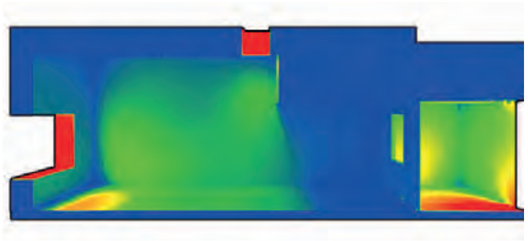


Daylight study: Final Illuminance

Appendix 6: Daylight study - Final

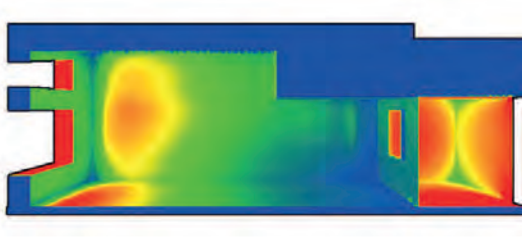


Daylight study: Pitched roof with large facade window - North

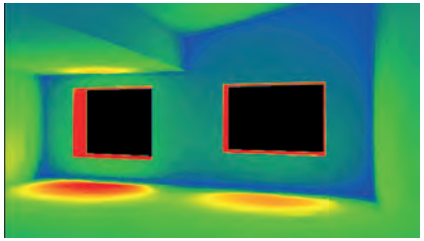


Daylight study: Pitched roof with skylight - North

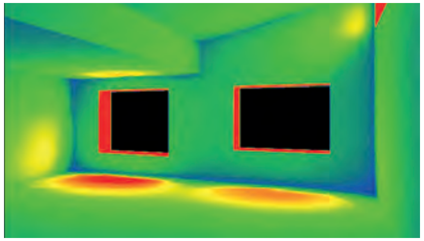
Daylight study: Pitched roof with sidelight - North



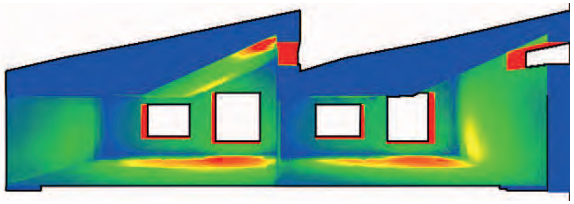
Daylight study: Pitched roof with large facade window - South



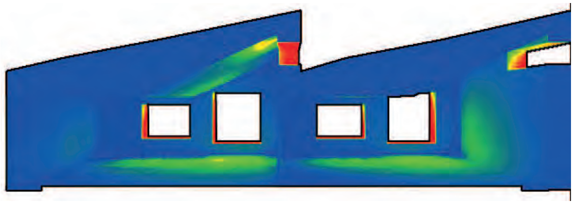
Daylight study: Pitched roof with skylight perspective - North



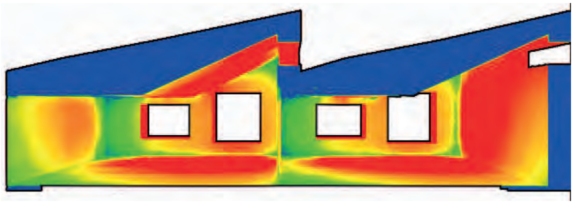
Daylight study: Pitched roof with sidelight perspective - North



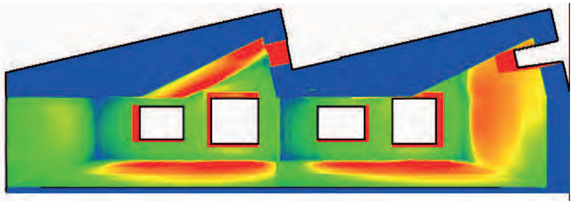
Daylight study: Angled ceiling with straight wall - North april 21



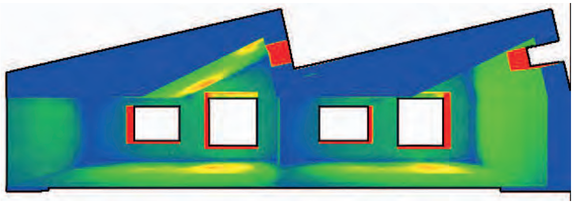
Daylight study: Angled ceiling with straight wall - North july 21



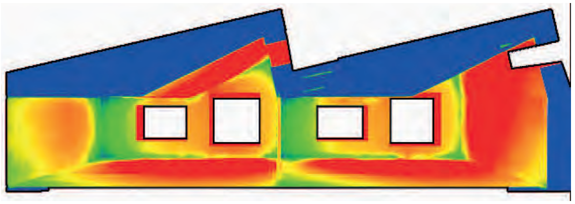
Daylight study: Angled ceiling with straight wall - North july 21



Daylight study: Angled ceiling with angled wall - South april 21



Daylight study: Angled ceiling with angled wall - South july 21



Daylight study: Angled ceiling with angled wall - South july 21

Appendix 6: Daylight study

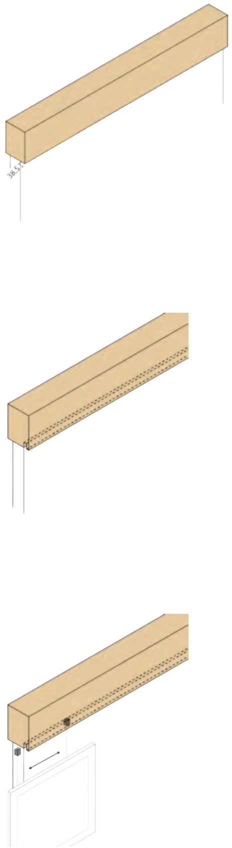


Fig 46.1 - Diagram of hanging pictures system

Appendix 7: Hanging picture frame

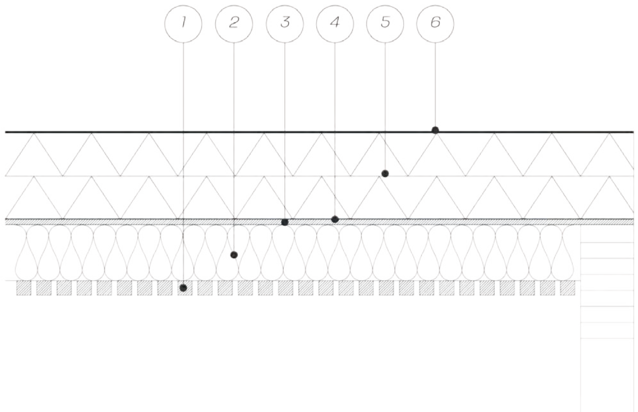


Fig xx.x - Detail drawing of roof construction

1. 40 x 40 mm wood lamella ceiling
2. 45 x 195 mm construction wood and insulation
3. 18 mm crosslaminated board
4. 1 x Icopal roofing felt (Vapour barrier)
5. 2 x 150 mm compressed insulation
6. 2 x Icopal roofing felt

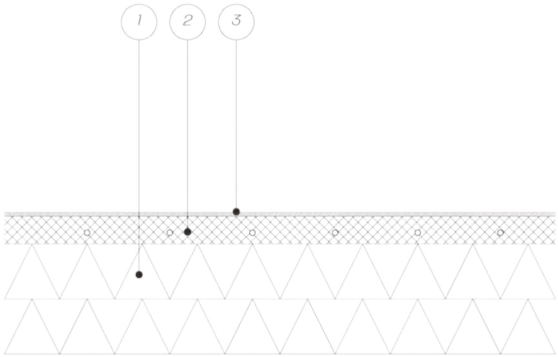


Fig xx.x - Detail drawing of floor construction

1. 2 x 200 mm polystyrene
2. 100 mm reinforced concrete with floor heating
3. 14 mm wood or tile flooring

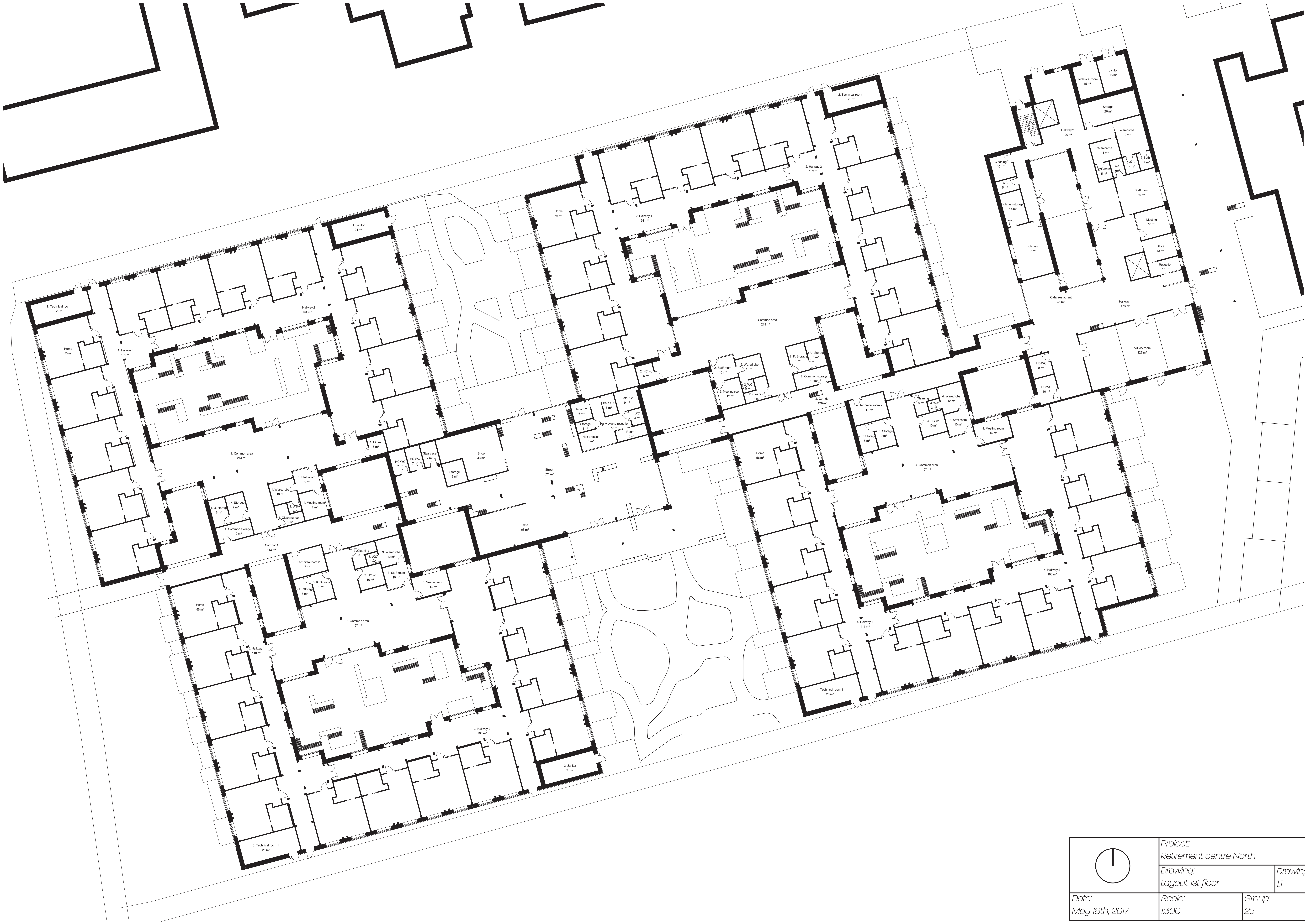
Appendix 8: Roof and floor detail

ARCHITECTURE & DESIGN

Application for Approval of Topic of the Master Thesis – A-study board

Deadline for submission of this form to semester secretary: December 1

Spring semester 2017	Semester start: February 1st - Submission date: May 17th
Specialization	Human oriented architecture
Name and cpr. no. of group members:	Arnbjørn Svavarsson Hammer, Chang Ying Xiang, Nanna Høvring Vernersen,
External partners	
Working title	The future of special care homes for elderly
Project description Please be as specific as possible about which technical focus and methodology that will be used.	This master's thesis takes inspiration from the competition to design a retirement home of the future, where the site is at Rindsvej 2 in Randers. The goal is to design a special care facility primarily for elderly people, focusing on the wellbeing of the residents the and sustainability of the complex. Retirement homes in Denmark, are as essential to us as public schools and other general care facilities because of our well-fare system. Considering the amount of retirement homes in Denmark, their usage activity and thereby their energy demand, it is sensible to design a general sustainable solution and as a minimum achieve the energy standard of BR2020. By using integrated design passive and active strategies will be implemented into the design, such as an energy efficient envelope and Photovoltaics. There will also be a focus on social sustainability by interacting with the context and ensuring the wellbeing of the residents. This will be achieved by working with the theories of 'Healing architecture' to create spaces with positive influence on the users, and the concept of 'missing link' to design the private areas as bases for creating homes and the social facilities for various activities. *Methodology:* Ring Hansen, H. and Knudstrup, M. (2005). *The Integrated Design Process (IDP).* Aalborg: Architecture & Design, Aalborg University. *Litteratur:* - Ryhl, C., Sørensen,N. L. & Frandsen, A. K., (2009): *Helende arkitektur*, Aalborg Universitet, Aalborg, Denmark - Eriksen, A. and Skousbøll, K., (2006): *Fokus på de meget ældre 75+*, Center for bolig og velfærd, Copenhagen, Denmark - Reijenga, T.H. and Kaan, H.F,(2012): *BIPV in Architecture and Urban Planning*, Elsevier Ltd., The Netherlands - Harder, I. and Friis, L. K., (2010) *Nursing home residents' experience in a nursing home*, Sygeplejersken 2010 ;(11), Denmark - Bejder, A. K., Knudstrup, M-A., Jensen, R. L., & Katic, I.(2014): *Zero Energy Buildings – Design Principles and Built Examples: for Detached Houses*, SBI forlag, Aalborg Universitet, Aalborg, Denmark



	Project: Retirement centre North	
	Drawing: Layout 1st floor	Drawing nr: 1.1
Date: May 18th, 2017	Scale: 1:300	Group: 25

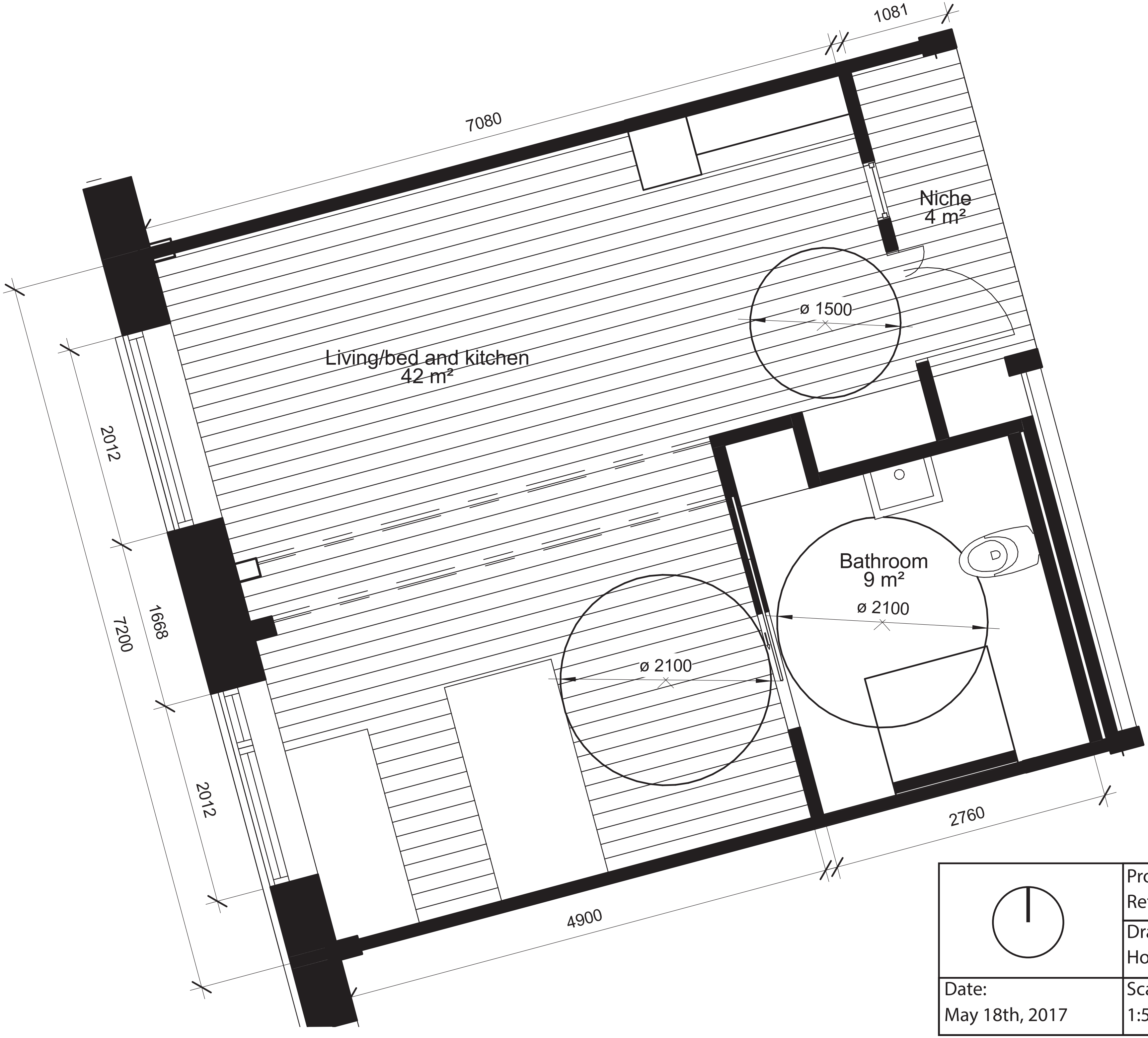
Project:	Retirement centre North
Drawing:	Master plan
Drawing nr.:	1.2
Scale:	1:500
Group:	25
Date:	May 18th, 2017


Project:
Retirement centre North
Drawing:
Unit plan
Scale:
1:200
Date:
May 18th, 2017
Drawing nr:
1.3
Group:
25
32580
51300
660
2547
5172
3540
10020
8952
6552
3. Meeting room
14 m²
3. Hallway 2
198 m²
10200
3. Waredrobe
12 m²
3. Staff room
10 m²
3. WC
3 m²
3. HC wc
10 m²
3. Cleaning
8 m²
3. Common area
197 m²
14472
2519
8652
3. K. Storage
9 m²
3. U. Storag
8 m²
3. Technicla room 2
17 m²
1380
3360
10212
5460
4872
9432
2571
3. Hallway 1
110 m²
Home
56 m²
218

Project:	
Retirement centre North	
Drawing: Special unit plan	Drawing nr: 1.4
Date: May 18th, 2017	Scale: 1:200	Group: 25

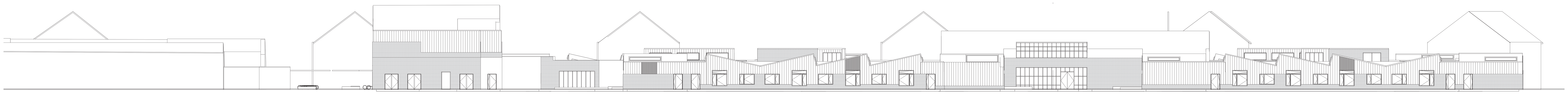
	Project: Retirement centre North	
	Drawing: Street plan	Drawing nr: 1.5
Date: May 18th, 2017	Scale: 1:100	Group: 25

	Project: Retirement centre North	
	Drawing: Administration plan	Drawing nr: 1.6
Date: May 18th, 2017	Scale: 1:200	Group: 25

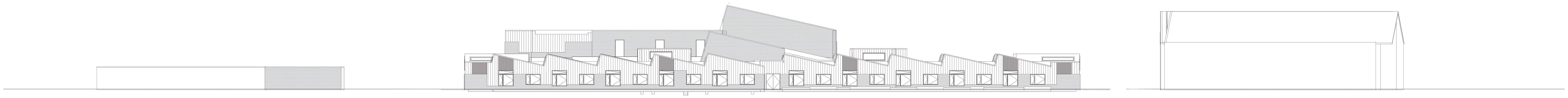


	Project: Retirement centre North		
	Drawing: Home plan		Drawing nr: 1.7
Date: May 18th, 2017	Scale: 1:50	Group: 25	

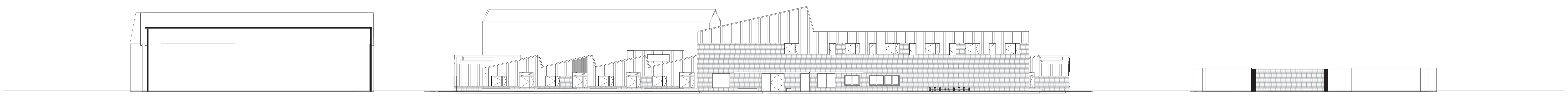
	Project: Retirement centre North	
	Drawing: Layout 2nd floor plan	Drawing nr: 1.8
Date: May 18th, 2017	Scale: 1:300	Group: 25



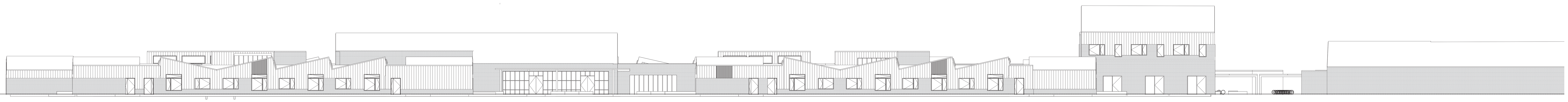
Project: Retirement centre North
Drawing: Northern facade
Drawing nr: 2.2
Date: May 18th, 2017
Scale: 1:200
Group: 25



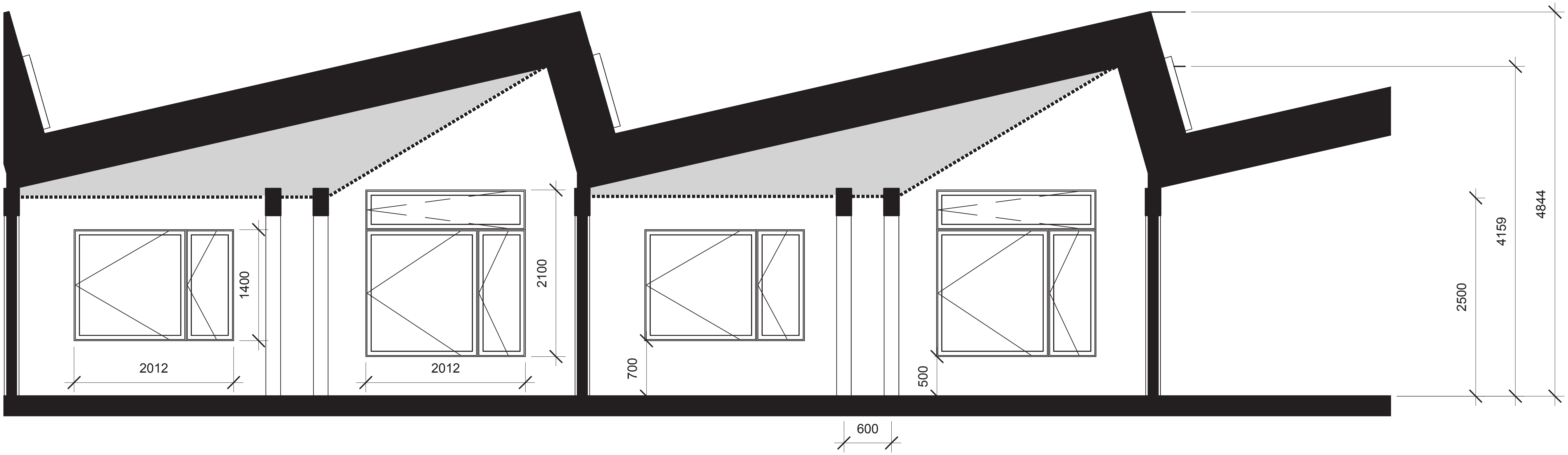
Project: Retirement centre North
Drawing: Western facade
Drawing nr: 2.4
Date: May 18th, 2017
Scale: 1:200
Group: 25



Project: Retirement centre North
Drawing: Eastern facade
Drawing nr: 2.5
Date: May 18th, 2017
Scale: 1:200
Group: 25



Project: Retirement centre North
Drawing: Southern facade
Drawing nr: 2.3
Date: May 18th, 2017
Scale: 1:200
Group: 25



Project:
Retirement centre North

Drawing:
AA Home section

Drawing nr:
3.1

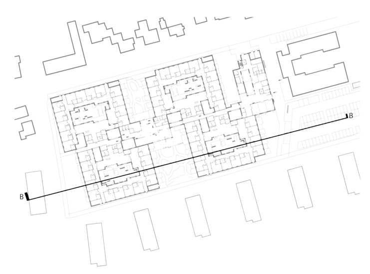
Date:
May 18th, 2017

Scale:
1:50

Group:
25

CC North section

BB South section



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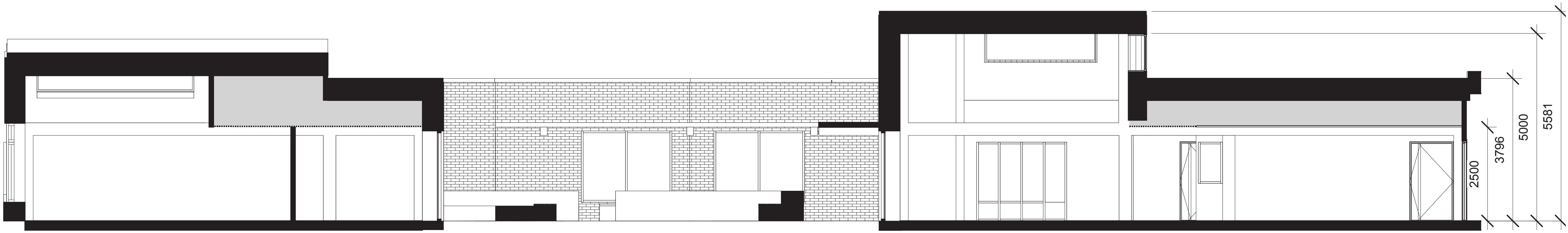
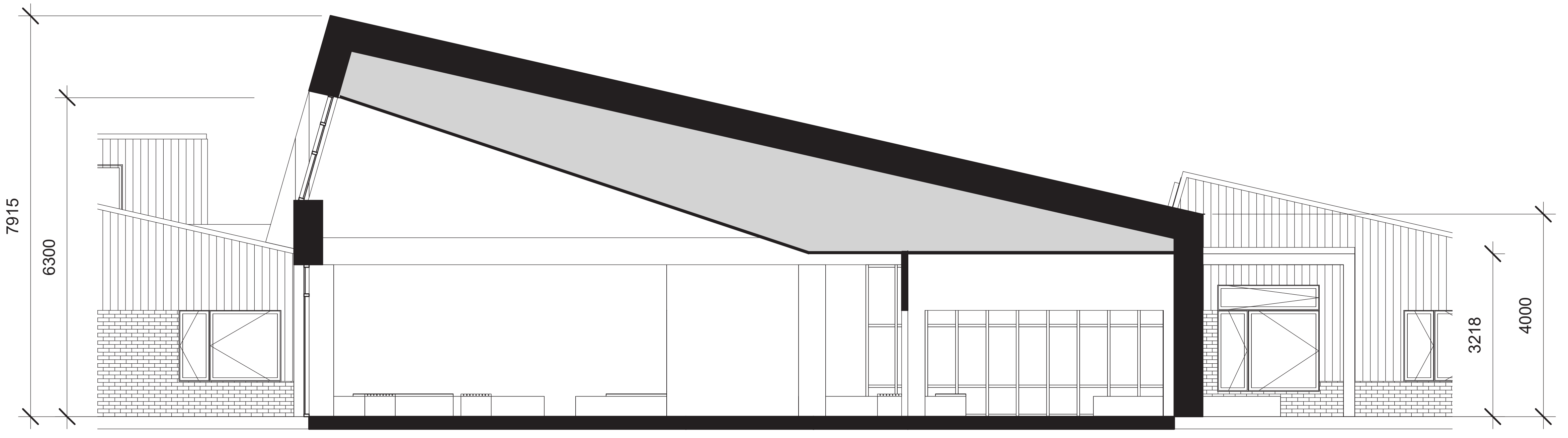
	Drawing: North & south section	Drawing nr: 3.3
Date: May 18th, 2017	Scale: 1:200	Group: 25

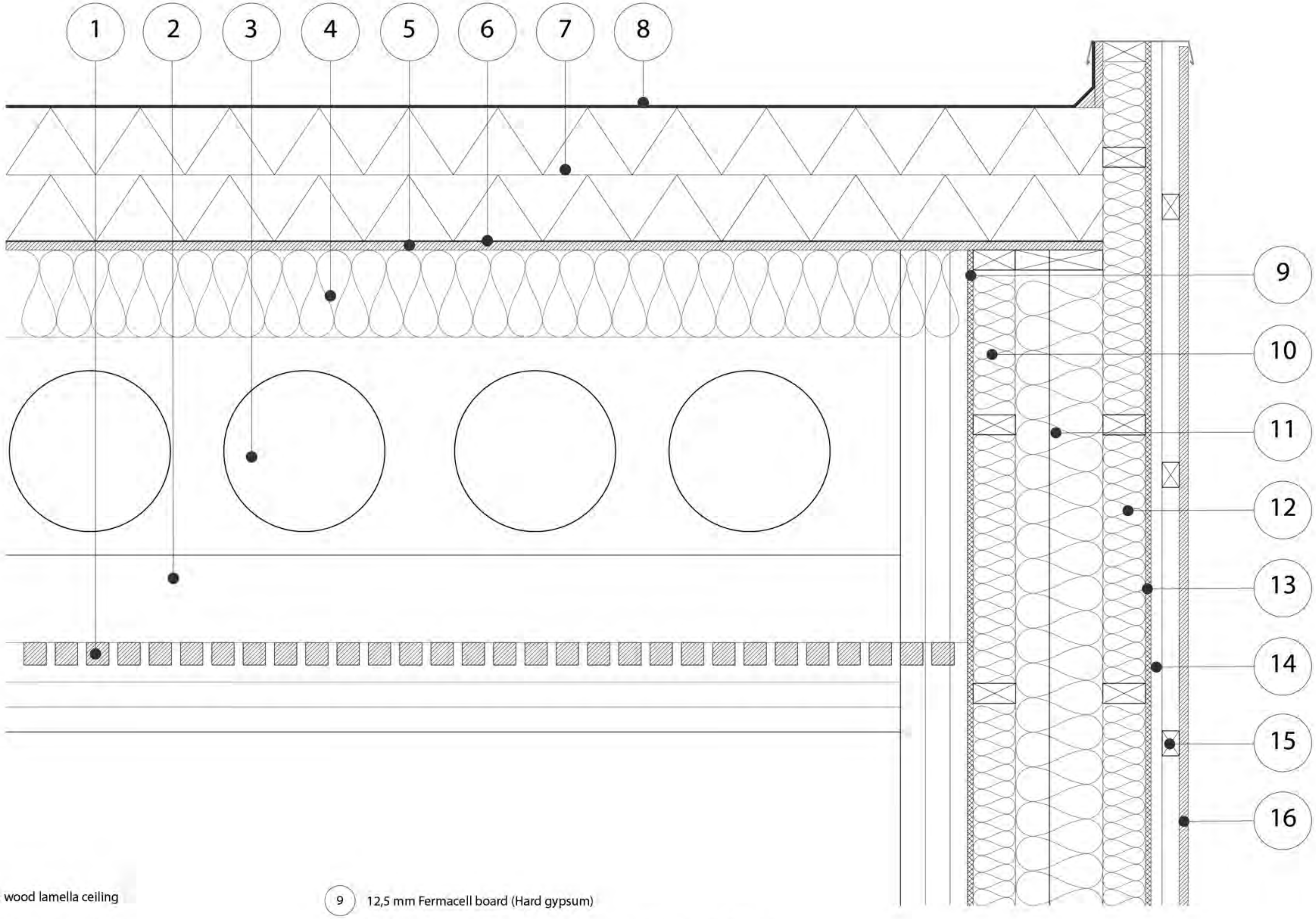


Project: Retirement centre North	
Drawing: DD Unit section	Drawing nr: 3.2
Date: May 18th, 2017	Scale: 1:100	Group: 25



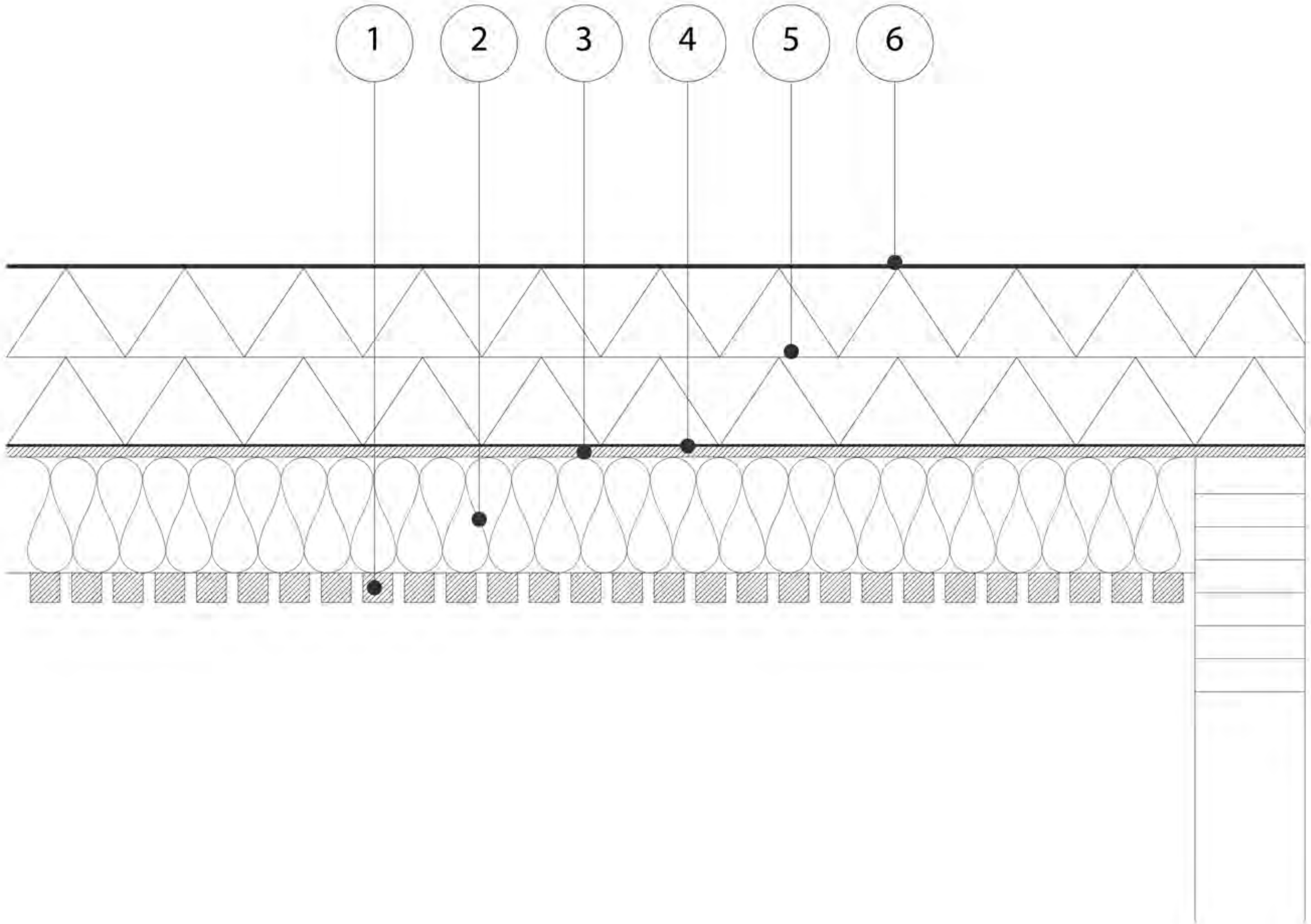
	Project: Retirement centre North		
	Drawing: Street section		Drawing nr: 3.4
Date: May 18th, 2017	Scale: 1:100	Group: 25	

	Project: Retirement centre North	
	Drawing: Administration& 2nd floor	Drawing nr: 3.5
Date: May 18th, 2017	Scale: 1:100	Group: 25



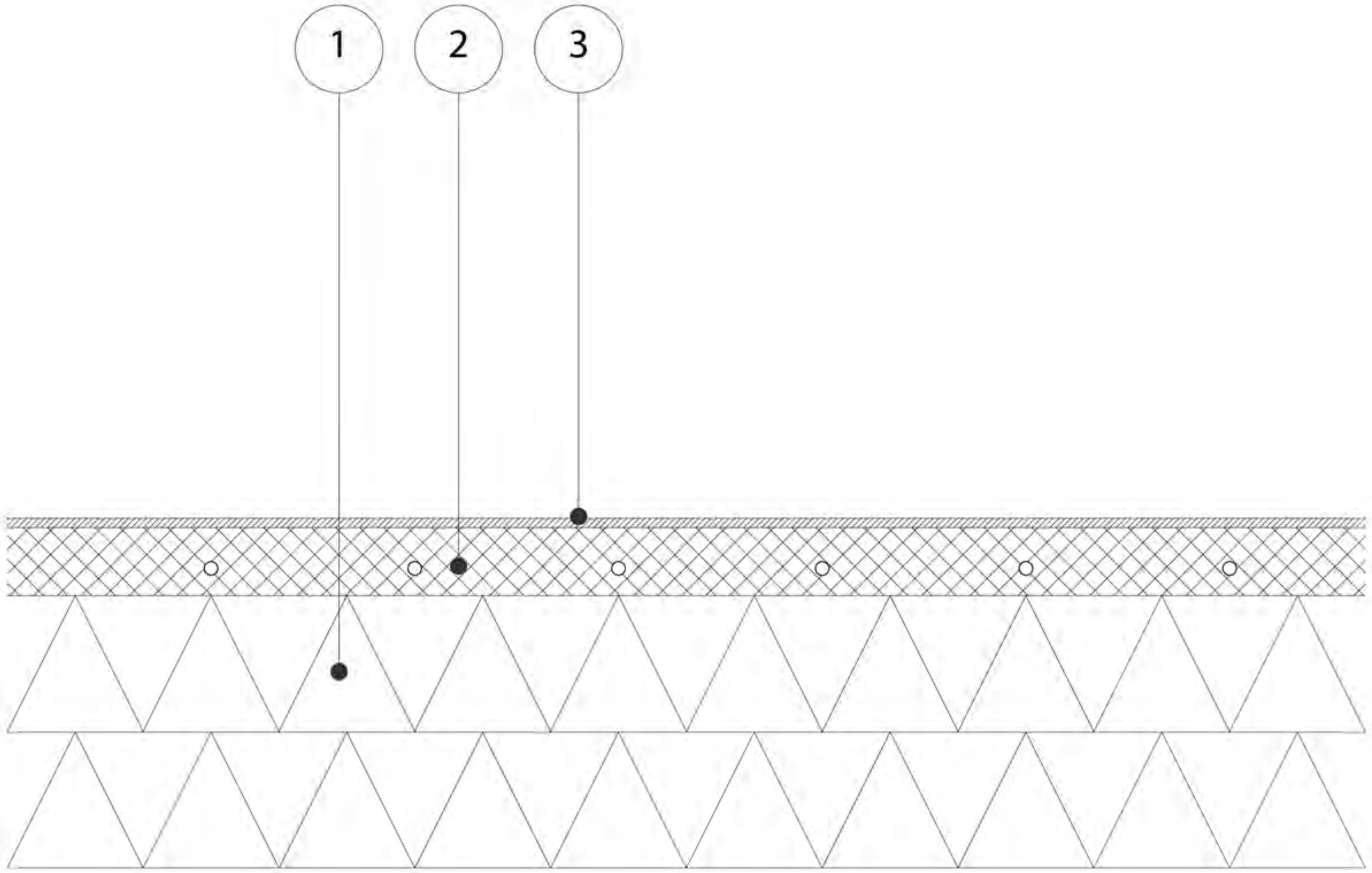
1	40 x 40 mm wood lamella ceiling
2	45 x 145 mm construction wood
3	Ventilation pipes
4	45 x 145 mm construction wood and 195 mm insulation
5	18 mm crosslaminated board
6	1 x Icopal roofing felt (Vapour barrier)
7	2 x 200 mm compressed insulation
8	2 x layers Icopal roofing felt
9	12,5 mm Fermacell board (Hard gypsum)
10	45 x 95 mm construction wood and 95 mm insulation and vapour barrier
11	45 x 195 mm construction wood and 195 mm insulation
12	45 x 95 mm construction wood and 95 mm insulation
13	12,5 mm Fermacell board
14	25 x 45 impregnated wood
15	38x56 mm wood lath
16	25 x 175 mm wood cladding

	Project: Retirement centre North	
	Drawing: Corridor detail	Drawing nr: 4.1
Date: May 18th, 2017	Scale: 1:10	Group: 25



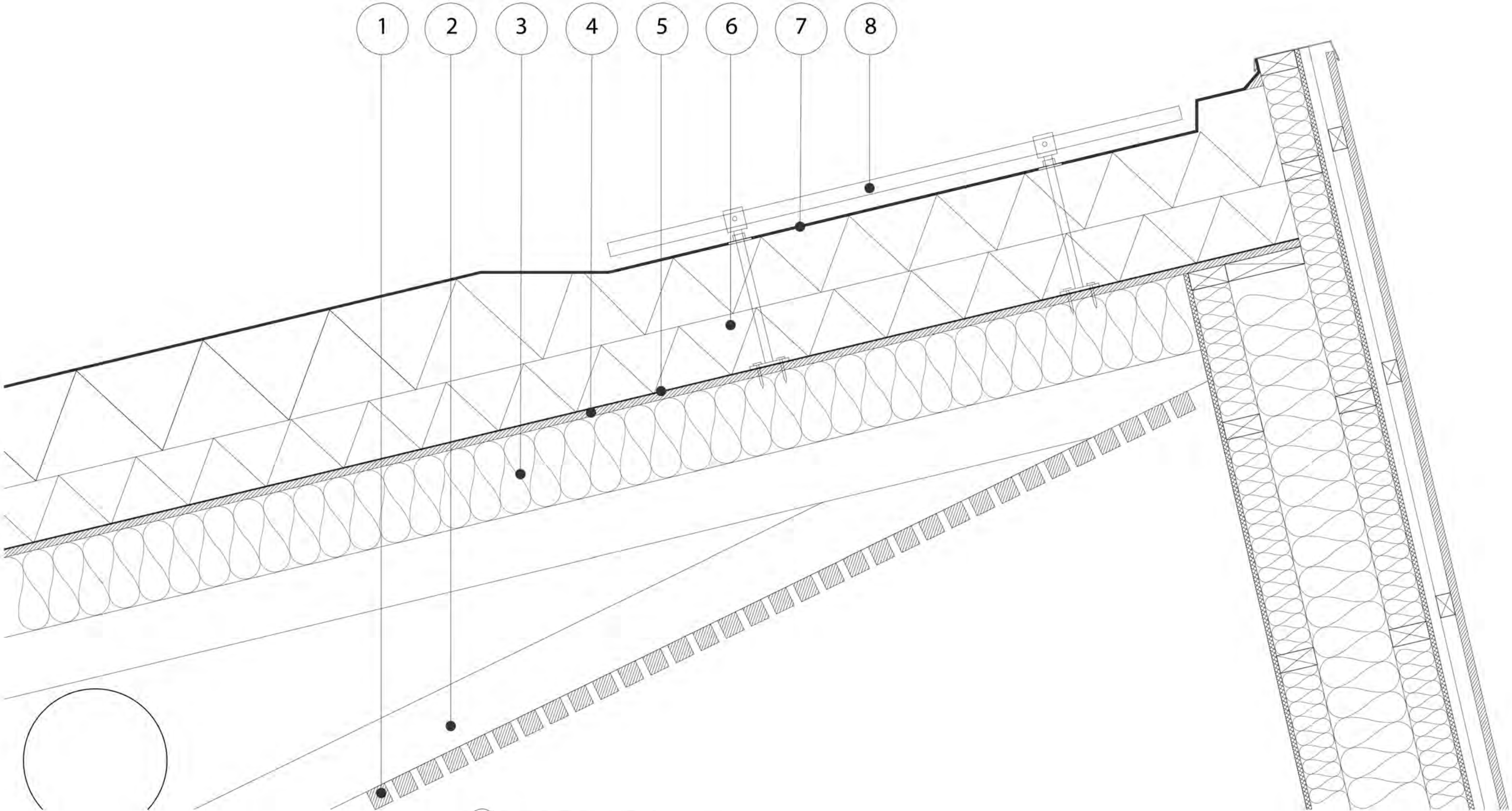
1. 40 x 40 mm wood lamella ceiling
2. 45 x 195 mm construction wood and insulation
3. 18 mm crosslaminated board
4. 1 x Icopal roofing felt (Vapour barrier)
5. 2 x 150 mm compressed insulation
6. 2 x Icopal roofing felt

	Project: Retirement centre North		
	Drawing: Flat roof detail		Drawing nr: 4.2
Date: May 18th, 2017	Scale: 1:10	Group: 25	



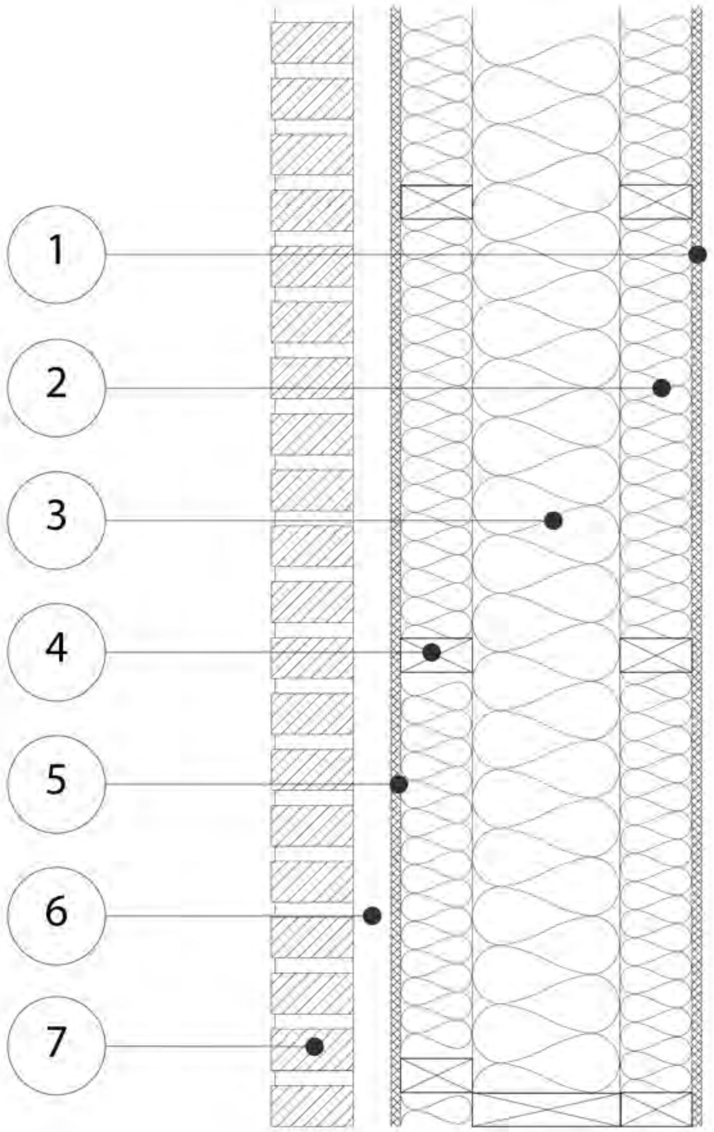
1. 2 x 200 mm polystyrene
2. 100 mm reinforced concrete with floor heating
3. 14 mm wood or tile flooring

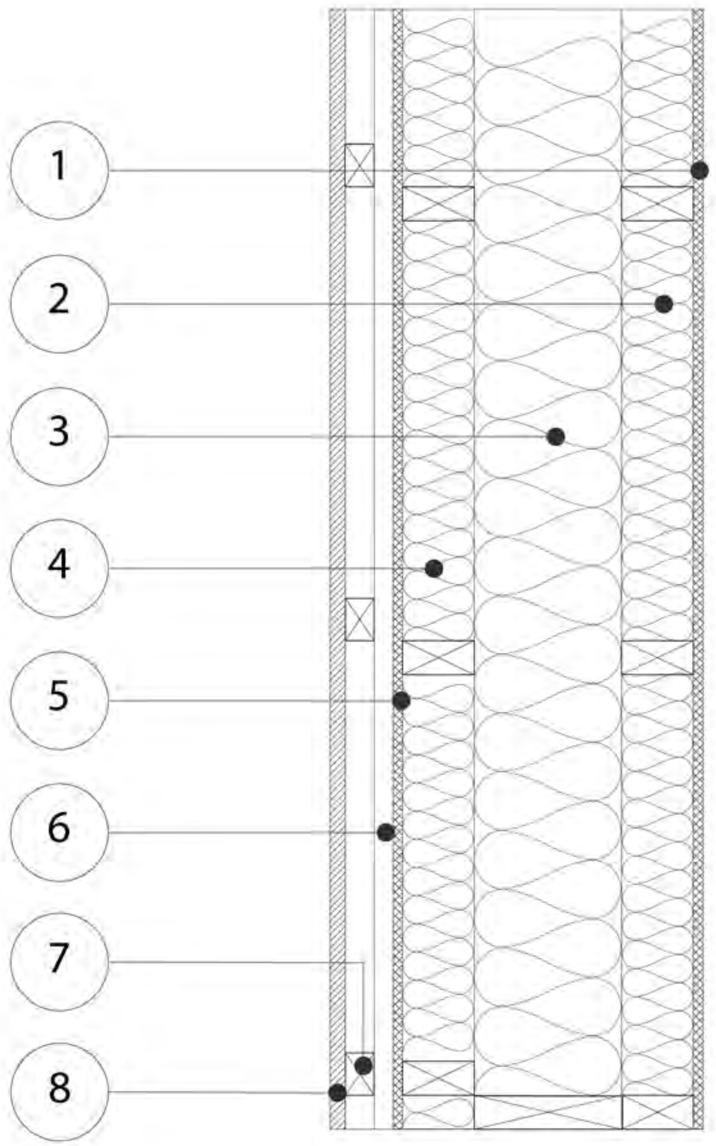
	Project: Retirement centre North	
	Drawing: Floor detail	Drawing nr: 4.3
Date: May 18th, 2017	Scale: 1:10	Group: 25



1. 40 x 40 mm wood lamella ceiling
2. Truss
3. 195 mm insulation
4. 18 mm crosslaminated board
5. 1 x Icopal roofing felt (Vapour barrier)
6. 1 x 150 mm and 100-200 mm compressed insulation
7. 2 x Icopal roofing felt
8. Solar panel monocrystalline

	Project: Retirement centre North	
	Drawing: Sloped roof and PV detail	Drawing nr: 4.4
Date: May 18th, 2017	Scale: 1:10	Group: 25





1. 12,5 mm Fermacell board (Hard gypsum)
2. 45 x 95 mm construction wood and 95 mm insulation and vapour barrier
3. 45 x 195 mm construction wood and 195 mm insulation
4. 45 x 95 mm construction wood and 95 mm insulation
5. 12,5 mm Fermacell board
6. 50 mm air
7. 54 x 108 mm brick

1. 12,5 mm Fermacell board (Hard gypsum)
2. 45 x 95 mm construction wood and 95 mm insulation and vapour barrier
3. 45 x 195 mm construction wood and 195 mm insulation
4. 45 x 95 mm construction wood and 95 mm insulation
5. 12,5 mm Fermacell board
6. 25 x 45 impregnated wood
7. 38x56 mm wood lath
8. 25 x 175 mm wood cladding

	Project: Retirement centre North	
	Drawing: Wall detail	Drawing nr: 4.5
Date: May 18th, 2017	Scale: 1:10	Group: 25