ABSTRACT

This project deals with a delicate subject, the death. The theme of this master thesis takes its base in creating a set of physical boundaries for terminal ill people, where there is the opportunity to spend their last days in peace in the company of their beloved ones.
The motivation behind this project is to create a place where despite the complications of health, the patients do not die a social death before the physical. One of the primary focus areas will be to create surroundings that can distract the mind from the given situation, which is to be achieved through providing a sensory experience to create memories.
The technical aspect of the thesis focuses on the indoor climate together with the areas of sustainability. The goal is to secure an elevated level of comfort for the patients through integrated design solutions, while simultaneously making the building fulfill the BR2020 demands.
The project is located in the middle of the Tversted plantation, in the northern parts of Jutland. In the scenic landscape of a clearing with an unobstructed view over the north sea. The project focuses on trying to deinstitutionalize the building to build a home for the patients.

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AUTHORS: Jonathan Judes &
Mikkel Nørgaard Pedersen

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MAIN SUPERVIOSER: Marie Frier Hvejsel
Associate Professor
Department of Architeture, Design
& Media Technology

TECHNICAL SUPERVISOR: Per Heiselberg
Professer
Department of Civil Engineering

Jonathan Judes

Mikkel Nørgaard Pedersen

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READING GUIDE

This report is divided into different sections that will explain the project in chronological order. The chapters start off with a small introduction which introduces the content of the following pages.

The booklet starts with an introduction that contains our motivation and the theories used in the project, which is followed by the prealiminary studies that are conducted to understand the hospice philosophy and challenges we see fit to change.

The next chapter presents the site and the environment that we work in, to understand the advantages and disadvantages, which leads to the vision for the project.

The report will then proceed to explain the process of the project. The process is explained through text and diagrams. This process then leads to the final concept of the building.

Finally, there will be a presentation of the project, containing the technical drawings and visualizations. Finished with epilog where we conclude the project and reflect upon it.

The texts will be accompanied by an illustration that helps to explain the content of the belonging pages.

Introduction

01

MOTIVATION

Architecture affects the people in it, but also around it. That is why for the last centuries as cities have been established, architects have tried to understand how people react to different scales and typologies. Not only is it the exterior expression that affects the people that are surrounded by architecture, but also the interior that surrounds us on a daily basis.

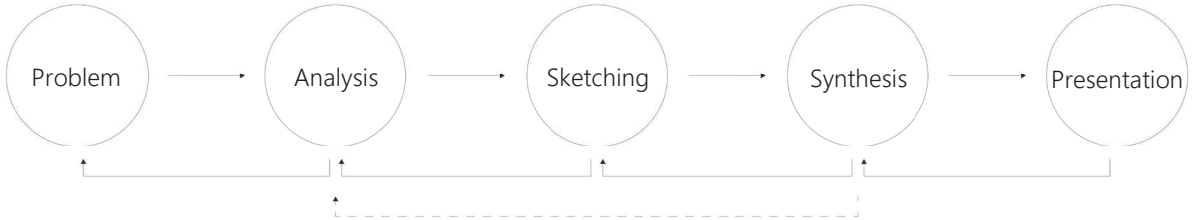
Combined with the fact that we are living in an era where pharmaceutical industry is developing a new medicine for every new disease discovered, means that they can prolong the lives of the patients. Despite the new types of medicine, some terminal illness is never cured but only postponed, and both scenarios result in a prolonged period that patients are in the hospital. When it is time, and the body gives in, some of the patients are in such a bad shape that they have only a few weeks or shorter to spend their last days. ((Nissen, 2009) We have been motivated to investigate how we can give people who are about to live their moments on this earth with the best conditions. What is it that is important at this stage in life? Even though it might only be a small number of people who are going to experience this, it is important that there is a place for them. Hospices are designed to accommodate these individuals, as this is typically a place where competent and professionals are present to take care of them. The thoughts that are put into these projects are heavily inspired by the philosophy, which states that 'it is not about dying, it is about living life.' We are wondering if the location of the hospice can enforce or weaken the overall design and atmosphere that is essential to this type of building, and how known methods and techniques can be improved by looking at some of the existing buildings which are being used for the same kind of treatment. We want to deinstitutionalize the stay at a hospice, and for it to become a sensory experience, which focuses on creating an environment that resembles home as much as possible. The architecture and the interior should be a place where the senses are activated and where the individual can recreate memories.

The atmosphere of the site must be calm and peaceful. We want to investigate how we can design a hospice that takes the mind away from the disease and focuses on living. We want to avoid that the patients die a social death before the physical. Furthermore, it is significant that there is a good flow to the functionality of the building, which one will help make the stay as easy and painless for both patient and relatives. Another dimension to staying at the hospice should be to give the patients the control of their surroundings and thereby feel more comfortable in their environment,

METHOD

The Methodology of this project is based on the integrated design process as defined by Mary-Ann Knustrup (Ring Hansen and Knudstrup, 2005). The IDP is a holistic approach that improves the fusion of the Architectural and engineering field, by ensuring a systematic and repeated development of the tasks. The IDP gives an understanding for the outcome of the early design proposals and allows for the further work to be based on new knowledge. The IDP results in an articulated, interdisciplinary direction for a concept, based on analysis and knowledge from more fields of work. Despite the promises of results, it is merely a tool for controlling a high variety of parameters, that can occur when attempting to solve a more elaborated task, this means, there is no certainty for an aesthetical nor sustainable solution.

In this case, the Integrated Design Process have been utilized to sufficiently implementing the sustainable aspect, as a core value of the project. In more specific terms it is used to determine functional and technical aspects, in combination with aesthetical decisions.



Illu. 1 Integrated design process diagram

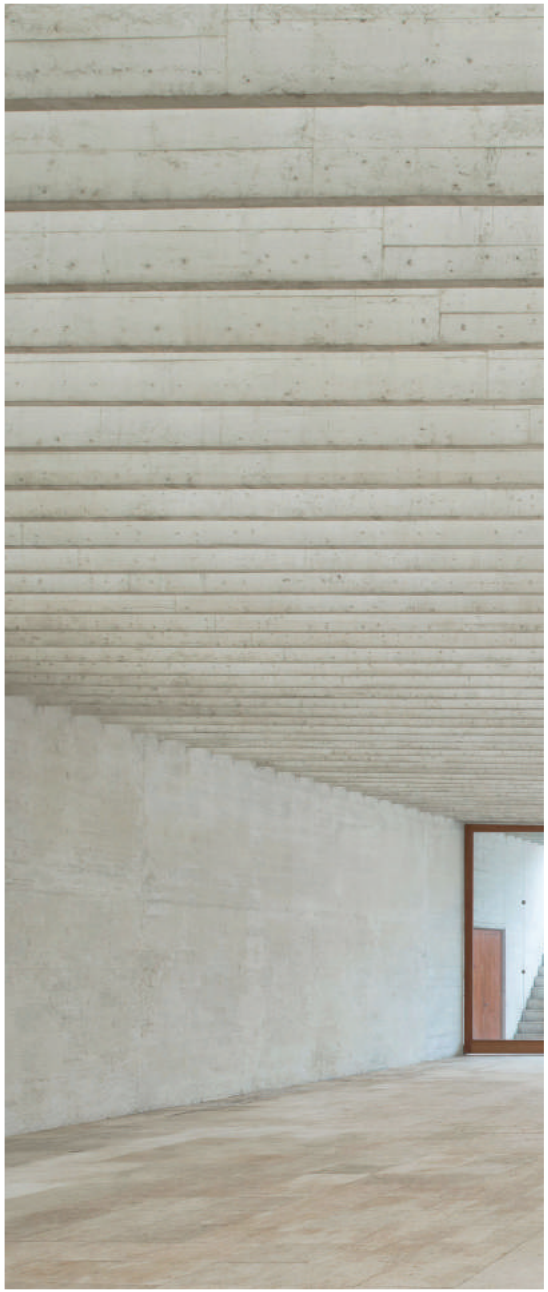
The five phases have different purposes of clarifying various challenges, in a series of loops so make sure new knowledge gets implemented in the first problem. The product should be a symbiosis of both aesthetical and technical parameters.
First, the *Problem phase* is where the framework of the tasks are specified. This is the creation of the challenges which results in a 'Problem' that will become the foundation.
Second, the *Analysis phase* is the first step towards an understanding of the framework. Here the first knowledge is gathered through a sequence of studies, which becomes a new basis for further work.
The third is the *Sketching phase*, which becomes the first step towards a proposal. The new knowledge and studies are put to the test through sketching. There are many ways to come across this phase, as the name implies sketching is one of them. Other useful strategies could be physical or 3D models for a spacious understanding. This phase can look different depending on the number of times it has been encounter, as things being tested will become more accurate and detailed further along in the process.
Fourth is the *Synthesis phase*, where all the pre-knowledge and material of aesthetic, functionality and technical elements are combined into one integrated design proposal. The result of this phase should ultimately present a design proposal that reflects the technical considerations through integrated solutions and a final form.
Last, the Fifth phase, the Presentation phase, is where phase four comes to life through visualizations, illustrations, and explanations. While this phase is a bit different compared to the rest, this phase is important in the communication of the project.

NORDIC ARCHTIECTURE

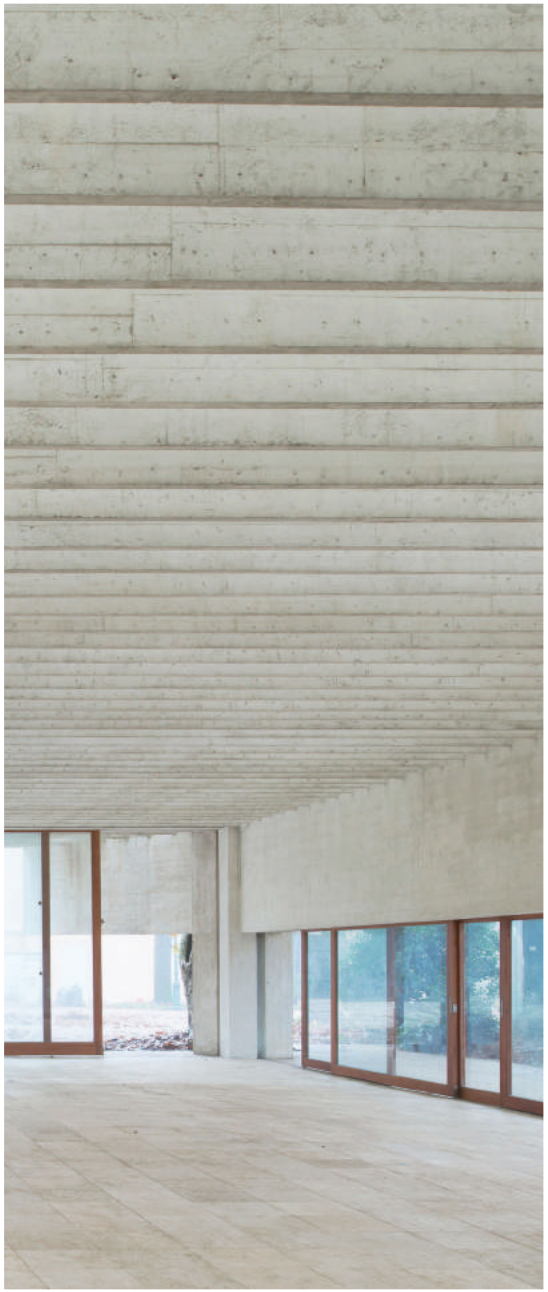
Introduction
Nordic architecture started as a concept in the international context in the early 1900s where it emerged amongst modernists in the Nordic countries. It became known for the minimal use of decorations, the focus on functionality, which often results in an unsurpassed simplicity. Heavily influenced by the natural conditions, many of the Nordic architects developed a special connection with the integration of natural light. (Ibler, 2014)

Nordic traditions
The Scandinavian building traditions have deep roots within the unpredictable environment of the Nordic countries. Known for its harsh conditions that have challenged architects through centuries with high wind speeds, heavy perception, significant variation in the temperature and the absent of light in the winter months. Nordic architects have sought to understand and master the absent of light (Kjeldsen et al., 2012). As Christian Nordberg-Schultz, a Norwegian-born architect, theorist, and author of Nightlands, argues that the sometimes-condemned Nordic light, notorious for its low sun angle creates an ever-changing world of nuances, that also changes the perception of everything that is lit up by it. Therefore it also creates and ever changing the atmosphere and spatial experiences of rooms towards the north. (Norberg-Schulz, 1996)

Nordic architecture has tires deeply connected to the social conditions within the countries and builds upon an understanding that architecture can provide much more than an Iconic piece of art. It is about experiencing something and pass on stories of the context and the culture and materials, through building elements and their composition, an experience that can be traced back to the unpredictable elements of nature.



Illu. 2 Nordic Pavilion in Venice, Sverre Fehn (1962)



THE DOMESTIC SPACE

The domestic space has been of significant value to the Scandinavian people through centuries, as a vital element in the survival. The necessity for a shelter in the past, have influenced today's definition of a home, as this new condition caused reason for people to stay in one place.

'To dwell means to belong to a given place.'

- Christian Nordberg-Schulz

The definition of 'home' have been used for centuries and have become more complex with time. Fundamentally it refers to a place either, country, town or an even small area. It is a place that is influenced by the individual, as the creation of a home begins through associations of objects, emotions or impression which will come from everlasting memories. In the society of today, the home is often perceived as refugium from work, school, etc. where there are no formalities, and the familiarity of the environment is providing the sense of comfort, silence, and peace. (Coolen and Meesters, 2009)
As the daily life changes like kids, being born, growing up or moving out, that home definition will adapt maybe become defined be new memories.

Sub-conclusion:

A hospice must allow for the patient to personalized the room, to create a relation to the home, and become a refugium for the patients where they can retreat away from the company of other and into the comforts of calmness, whenever they feel like it. Combined with the Nordic traditions where the importance of atmosphere is told through a narrative with the use of light, temperature scents and nature. (Norberg-Schulz, 1996)

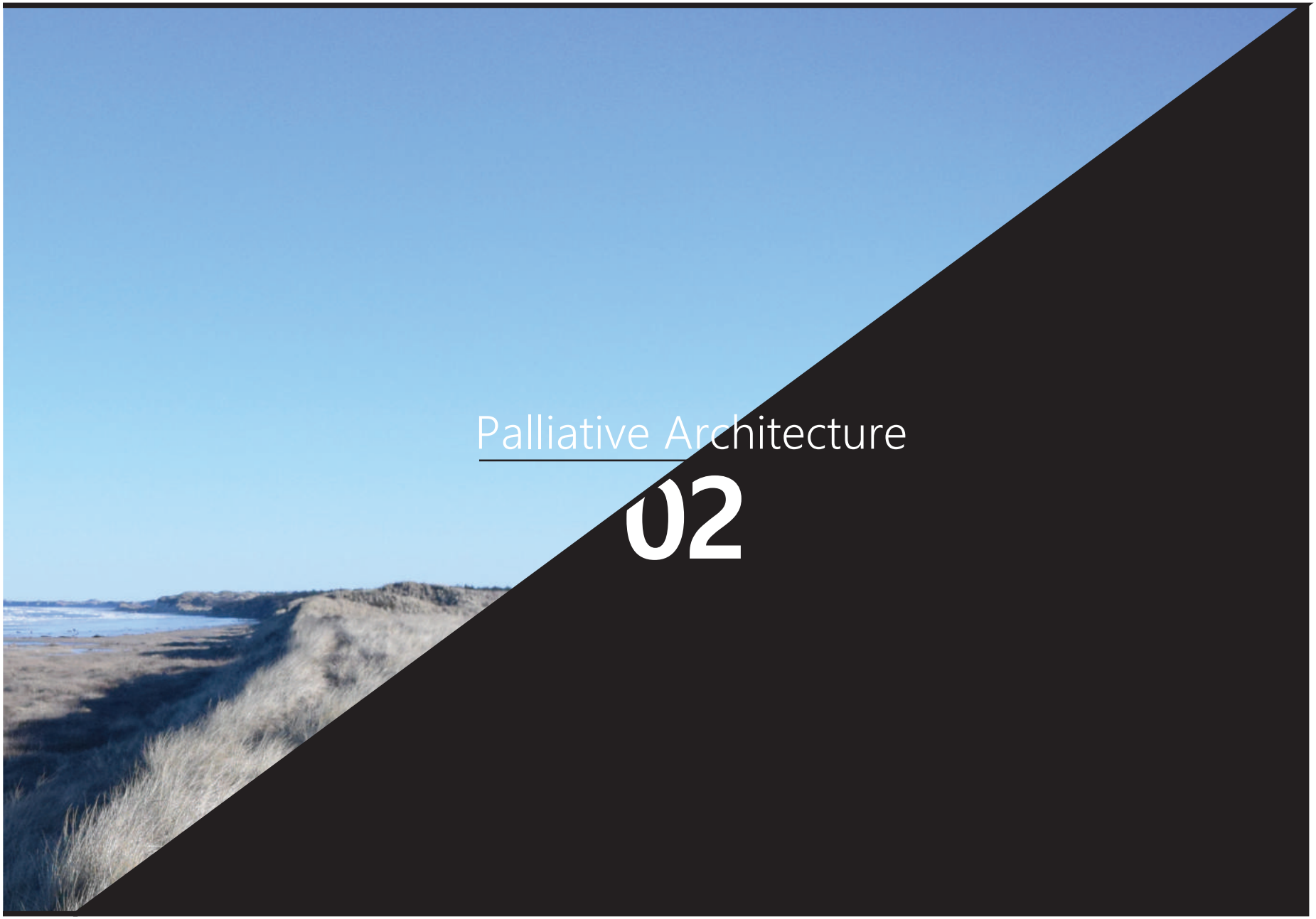
SUSTAINABILITY

Sustainability got known to the world in 1987 through the release of the Brundtland report. The report was the first to focus on sustainability on a global scale. The report took up the complications that the world was faced with the environmental issues. The report addressed four different types of sustainability which included the social, economic, political-institutional and environmental aspect. The environmental sustainability takes it departure in energy consumption and how to keep the environment clean through energy efficiency. The social sustainability takes the comfort of the patients into account and focuses on the health equity, social liability, and culture. This sustainable aspect is the least specific one of the three. The economic sustainability is directly correlated to the costs and raw numbers of the matter. (The Brundtland report, 1987)

The focus of the design of the hospice is going to be on the environmental as well as the social. The social sustainability aspect is an interesting focus when handling a delicate matter as death. The environmental part of the project is going to be for the building to fulfill the 2020 demands of energy consumption, 20kWh/m2 per year

The shape, orientation, surface area of glass etc. are all being held up to the environmental influence. Materials will have a significant impact on both of the aspects. Both on the indoor environment and the environment in production
Designing a sustainable hospice has its challenges. The hospice is full of electric equipment and people, which means this will have an effect on the heat consumption. The hospice is fully occupied 24 hours a day, which implies that all the systems have to be functional during the night time, which means that the energy usage of electricity will be high. The location also puts limitations on how the energy is supplied which means that alternatives must be considered. All of these initiatives must be thought about when designing a building that integrates the solutions in an unobtrusive way while considering the spatial and atmospheric values they add to the building.

Sustainability goals:
- Fulfilling the 2020 energy demands
- Avoiding that the technical elements of sustainability overshadow the perception of the softer values
- Utilizing the site to decrease energy consumption
- Emphasizing the social aspect of sustainability
- Focusing on the comfort and wellbeing of the residents
- Improving social life



Palliative Architecture

02

ARCHITECTURE OF PALLIATIVE CARE

Palliative care is a term used to define an interdisciplinary treatment of patients, which are in the last stage of life due to a life-threatening disease. The purpose is to improve the life quality of the patients and relatives from both physical and mental pain, through the use of spiritual and psychological patientcare (Nissen, 2009).

Dame Cicely Saunders, a nurse that later trained to become a doctor, got inspired by a patient David Tasma, she befriended in 1948, to establish a homely place where people could die in serenity. When Tasma passed away later the same year, he left £500 in the wish for Saunders to pursuit the idea of such a home. In 1967 Saunders opened St. Christopher's Hospice, which started the concept of a modern hospice and palliative care. (Nissen, 2009)

Architecture has been closely connected to the idea of palliative care from the beginning, as it is not only the physical boundaries but also becomes an important tool in the process of helping the residents and workers. This concept has later been defined as 'Healing architecture' and has been used in the development of hospitals, where the focus on wellbeing have been increasing.

The concept of healing architecture is built upon the understanding of the architectural influence, on the quality of daylight, the room atmosphere, colors, acoustics/ sound, privacy, and security. The architecture itself cannot directly cure the patients, though if the right conditions are set in the architecture, it is possible to improve life quality (Frandsen et al., 2009). As Juhani Pallasmaa is describing in 'The body in the Centre' a chapter from his book 'Eye of the skin' the perception of the world is based on earlier haptic and orienting experiences in life. There for the perception of the world is different depending on the individual, as different things can create such an impact that made things memorable (Pallasmaa, 2007).

'It is evident that 'life-enhancing' architecture has to address all the senses simultaneously and fuse our image of self with our experience of the world.'

- Juhani Pallasmaa

Light influences our ability to see. The architecture of present times has turned light into a mere quantitative matter, where the excessive number of windows creates the absence of walls. Walls is what makes us able to hide from the surrounding world, which means that when the light is prioritized, and windows are used for walls, we

are also forced to live in public. The consequence of this tendency is the lack of shadows and intimacy. When shadows and darkness are brought into the architecture, it reduces the ability to see, which creates spaces where the vision no longer is dominant. This forces other senses to step in, reduced sight creates good conditions for thinking and listening.

Acoustics are decisive for our perception of space, as the echo of a room can have different characteristics. Steen Eiler Rasmussen argues in his book 'Experiencing architecture' that a room can be interpreted, as 'cold' because of its acoustical properties, he argues this can happen in a room with too much echo (Rasmussen, 1966). One example to abate such echo would be furniture and decoration such as carpets, curtains, pictures, etc. as these things will refract and soften the echo. The soften echo is what can be discovered in many homes, and is what many people find pleasant as noise will fade away relatively quickly.

Silence like acoustics influences our perception of a space, the use of silence can enhance our perception of the space by silencing the outside noise. It enables us to focus on the present, and the full experience of the architecture.

'Architecture emancipates us from the embrace of the present and allows us to experience the slow, healing flow of time.'
- Juhani Pallasmaa

Most people can recognize the feeling of coming home from a vacation looking at pictures, trying to relive a moment, but ends with the thought that it was more beautiful in person. This tells us something about sight not being everything in order to influence an atmosphere or an understanding of a place and space. How can the hospice building obtain the qualities of the surroundings and become an extraordinary building? And is it possible to make plants a crucial part of the building design, to trigger memorable moments for the patients? And can light quantities and qualities be combined so one does not deteriorate the other?

A HOSPICE

As mentioned above the first 'modern' hospice was established in London in 1967, as a response to the hospitals increasing use of medical treatments (Worpole, 2009). The approach of the hospice philosophy is to help people for which medical treatment no longer are effective, it is not an attempt to extend patients life, nor is it an attempt to shorten it, but merely a place where people can be taken care of in the last stage of life.

The architectural concept of a hospice builds upon the thought of combining an home for the residents; something extraordinary that does not appear as an institution, yet with a full functional workplace for nurses, doctors, physicians, physiologist etc. The challenge lies within giving the residents the feeling of full privacy as there are 12 – 48 residents, plus additional relatives and workers in the building. On the contrary, the building must also provide areas for social interaction, for the patients should not feel isolated from the world. They only should feel this if they want to. It must create an environment that provides a sensory experience (Natur - Pavi, 2017).
This could for instance be achieved by involving the outdoor surroundings or gardens where patients and relatives can bring nature into the building, in a way that stimulate senses. For example, the sound of the roaring ocean nearby, the smell of a damp forest floor, the feeling of sunrays or wind on the skin, things that the patients might not be able to experience otherwise, due to their condition. In addition, the hospice needs to compliment various types of people, people from different social groups, different religious beliefs, etc. It should provide the same comforting, private and secure environment. This means that such building needs to be adaptable, as it should be a home to everyone, and where there is room for the patients to develop an everyday life that is worth living, despite the complications. This everyday life could be interacting socially, something that not everyone has the fortune to do before they come to a hospice. Room for activities that can motivate the residence to take on the last part of life and create memorable moments for the patients and relatives.

Despite the difference from the hospital, the hospice is still a workplace where a certain amount of people should be able to complete their tasks without too much trouble. This can lead to a compromise of the concept, as it is a question of the housing at least of 12 people. Therefore, can the hospice be functional with hallways that are not like the ones in the hospital, which is transit area only? Can the hospice serve the purpose of a home, while simultaneously sway patients to come out of their private rooms and develop a social life that is worth living in their last days despite being terminal ill?

USER GROUPS

The user groups of a hospice can be divided into two groups. With different demands and wishes to the layout of the building, it is important to understand the effect of each demand and take both groups in consideration.

Illu. 3 Patient illustration

Patients –
Statistics says that the average age of the patients is in the late sixties, ranging down to a rare example of the youngest being in the late twenties (Nissen, 2009). This group of people is suffering from some progressive disease, which no longer can be prolonged by medical treatment. A group whom are in the last stage of life and referred to a hospice for palliative treatment. The professional help is there to ease their conditions and prepare them for what they are about to go through, as they face death. These people are the user group that is considered in the main user group.

Illu. 4 Relative illustration

Relatives –
At times the families of patients can go through a tough time themselves, and it is important for the hospice to be able to accommodate them too which could be for example, practical, psychological or existential problems. These are fields that the team at a hospice are trained to deal. Besides, the relatives are also a key element to creating the comfort and homely atmosphere for the patients, as the building should facilitate a normal life for the patients. The conditions could be so bad that the relatives are considered to move in with the patient.

Illu. 5 Staff illustration

Illu. 6 Volunteers illustration

Staff –
This definition covers the professional team in the hospice which includes the psychiatrists, nurses, physicians, administrative helpers, janitor, cooks and so forth. They are present to help the patients during their stay which are all specialist. Due to the many groups of trades, different demands within the staff sector, that needs to be integrated into the design. It is important that they are all in close contact with the residents in a casual manner so that the feeling of being 'hospitalized' is not created.

Volunteers
These people are the other half of the working user group. Without any professional medical knowledge, they are there to help with anything that can relieve the workers from some of the less important duties. For example, maintaining the outdoor area, decoration for indoor rooms, blood transport, making food, some minor administrative tasks, etc. The volunteers can also be a group of people that are invited to use the common areas, as an opportunity to create a vibrant, dynamic atmosphere in the building.

CASE STUDIES

As a part of the project there have been conducted a series of case studies to clarify elements within the field of architecture. The case studies are investigating certain building elements how the design and use are influencing the atmosphere, and how state of the art buildings are implementing certain materials in an innovative way.

The follwing casestudies is choosen to clarify some of the questions form the abovementioned chapter. And to clarify

ANKER FJORD HOSPICE

Ankerfjord Hospice was built the 1st of March in 2005; the hospice was funded by a private donor, Ib Malgaard Lauridsen. He donated 20 million to build a place that would offer patients privacy and comfort in their remaining days, which he thought the public hospitals lacked from personal experiences (Hansen, 2017).

Location
The Hospice is situated in Hvide Sande in the western part of Jutland right next to the coast. The focus of the place was to get as close as possible to nature and create an environment that contributes to the feeling of calmness and home.
Ankerfjord hospice is shaped like an anchor and is a symbol of a place where the patients throw their anchor for the last time. (Hansen, 2017)
The hospice is placed in a flat open landscape with high yellow grass. The landscapes consist of dunes building up towards the sea. The architecture surrounding the buildings are mainly residential buildings and summer cabins.

Capacity
Ankerfjord hospice can house up to 12 patients at a time. They have chosen to make their patient rooms the size of an elder home of 60 m2 to make space for a guest room where relatives can stay over. For every patient, there are 2-3 staff members. The average age is over 40. The personal is focused on maintaining a quiet and peaceful atmosphere.
It has been important to design a place where there are necessities for relatives to visit, which meant that they incorporated rooms where small children can play and rooms for teenagers. (Hansen, 2017)

Sensory experience
They have a special focus on triggering memories and senses. They have both a sensory room and a sensory garden, which are located at the end of the building, where lighting is used to create an atmosphere that invites to reliving and remembering memories. The sensory room can be used for religious purposes as well as a place of meditation and silence. The garden is a place of experiences, where all senses are activated, it contains a broad selection of plants that triggers memories of the patients. It is also a place to gather with visitors and say the last farewell.

Interior
Throughout the building, interior designing has played a significant role in creating the atmosphere of home and calmness. The main goal was to create a place that could resemble a home and is fur-

ther away from the institutionalized feeling as possible. The private funding and donations for the hospice have ensured that the interior both materials, furniture's and décor are all good quality, which also takes away the institutionalized atmosphere. The patient rooms are prioritized when it comes to the view, which means everyone can see the ocean from his or her bed which is one of the key features of the hospice when it comes to people choosing this as their place to spend their final days.Even though it is a rather open plan, they have managed to create graduations of privacy by using the furniture to define a room within the rooms.

Challenges of the hospice
The hallways were used as merely a transitional space. The areas are illuminated by artificial lighting. During the day, the area is dark and becomes an area of movement because where there is no invitation to stay. The arrival at the building is not clearly defined as it is approached from what appears to be the backside. The experience does not start until the building is entered, which results in the building not seeming like a whole.

Sense of place
When entering the hospice in the main lobby the patient and their relatives are received by staff members, who are focused on making the stay as comfortable as possible from the start beginning. One gets the sense of calmness when entering the big hall. The first thing to catch the eye is the beautiful view of the ocean; the architect has purposefully framed the view in a great panorama of windows like a painted picture. The nurses and staff members are not in a rush to avoid a stressful environment and the acoustics of the building helps maintain the peaceful atmosphere they are trying to achieve. Musical therapy is a part of the service offered and only adds to the idyllic feeling of the room. Patients can hear hymns sung by the staff and can choose whether they want to join or stay in their rooms and hear through an open door. When entering the sense-room one almost gets a religious feel. The mosaic painted glass in combination with the sunlight refers to churches and other religious buildings. The sense garden immediately activates smell, vision, hearing and touch. The different plants and the running water gives each different association, which makes the patient forget where and why they are there in the first place by triggering memories.

Conclusion

The overall conclusion on the values chosen for the visit to Anker fjord is to use the nature as an active part of the design. Furthermore, it was seen how important functionality is; there should be a good workflow to make the staff thrive. The use of sensory experiences is to be implemented in the design to trigger the memories of patients. Interior and materials must be of quality and be utilized in a way that defines the usage of the spaces. The calmness of the building is essential to establish the homely atmosphere despite the work environment.
The main problem of the hospice lies within the design of the transitional spaces. The areas are lit up by poor artificial lighting and are directional in their design which resembles the hallways of a hospital.

Illu. 7 Anker Fjord Hospice, 2011

HOSPITAL HALLWAY

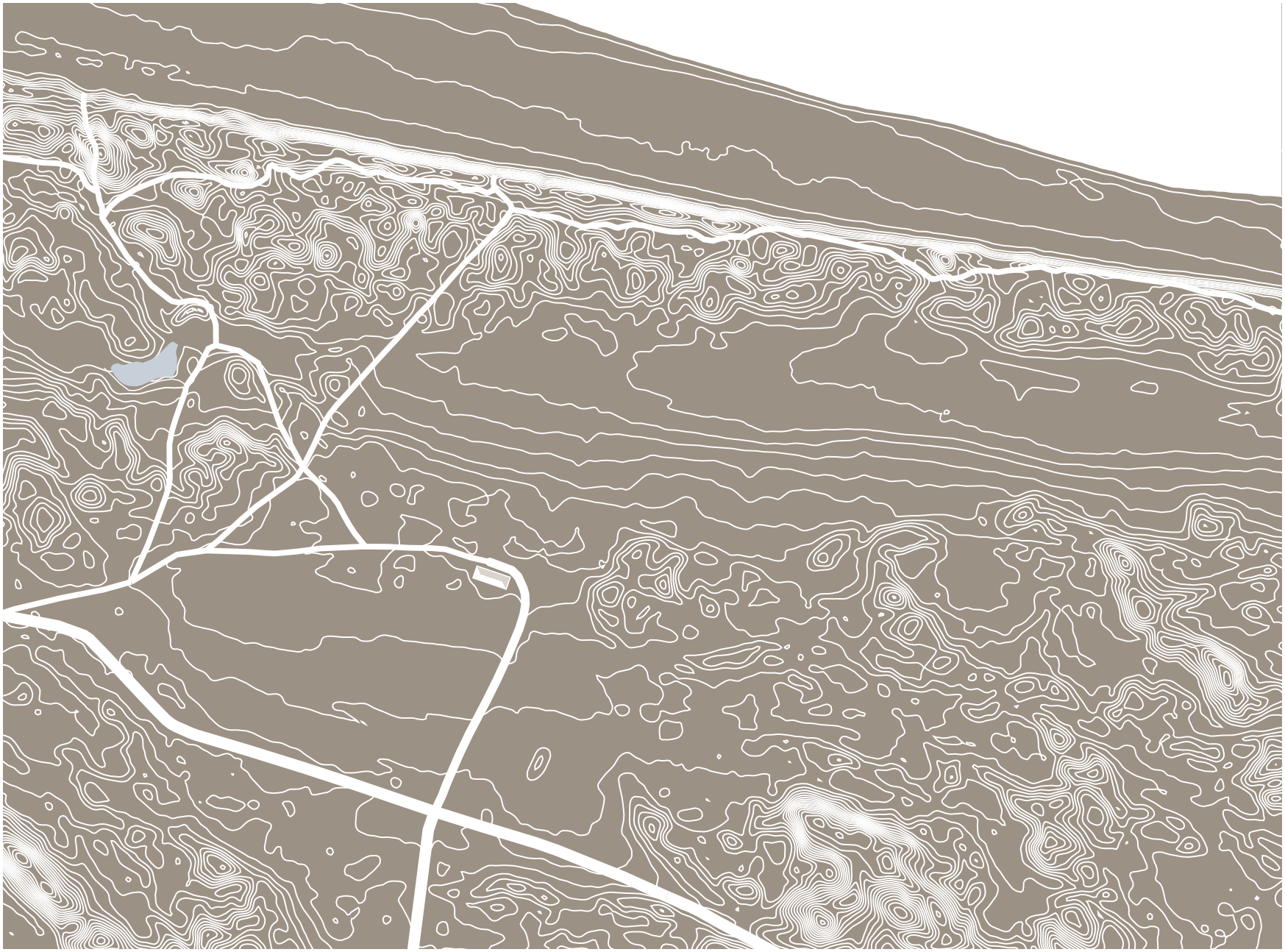
Hospital has become a building that expresses efficiency and cost-effectiveness from the aesthetic of the outside down to the atmosphere inside. Due to the development in modern medicine, more people gets diagnosed and hospitalized, which causes an increase in the number of patients in a modern hospital. Combined with the increasing amount of functions and equipment needed, this has a profound impact on the layout of the building. One of the major design solutions to increase the effectiveness of the building and allows for a compact layout is the hallways. The hallway connects rooms that need to be in close relation and minimize travel time of the staff. From an architectural design perspective, these hallways are also one of the major problems as they are a heavy influence of the atmosphere in the building. They are as mentioned, rooms optimized for working, where aesthetics and atmosphere often are less prioritized, two aspects that in more recent research have been stated to have a significant impact on the healing process of patients (Frandsen, 2009). Therefore, the hallways, as they are known today, is a conflicting element of the environment in which they are located. Being closely connected to patients and their relatives, for which the hospital can become a home for a longer period. The hallways are often placed in the middle with important rooms on each side; rooms such as patient rooms, offices, laboratories, etc. away from the façade and able to connect as many rooms as possible. They are the veins of the hospital, essential for the building of the primary access roads for everyone to get around in the hospital. It is designed as long corridors where beds and equipment of the hospital can pass each other, together with nurses and doctors. The hallways are directional with doors at each end that gives away the destination, which can cause an increased pace of the room. Because the rooms are meant for commuting, the corridors are rarely fitted with areas to sit or slow-down, in general, the possibility for a longer stay is none existing, which minimizes 'the need' for windows and daylight. It results in an atmosphere that is heavily dominated by artificial light and economical, durable materials, where each adjacent room is connected and represented with doors on the side. This creates a rhythm along the already dominating direction of the space. The social interaction in these rooms is designed to be at its minimal, as there are common rooms designed for social interaction elsewhere in the hospital.

As the hospitals get even more stressed the lack of personal contact between staff and patients are increasing, a phenomenon to which these key rooms, at their current state, contributes.

Can the hallways in a hospice be designed in a way, so that they are optimized for working and yet favorite the patients? Is it possible to create transit areas that allow for social interaction, where daylight and premium materials create an atmosphere worthy of a home?

Illu. 8 Hospital hallway


LOCATION
03



Ill. 9 Site illustration

SITE DESCRIPTION

The idea for the project is to create a building where people can live their last weeks in peace together with the people who means the most to them, a place where they can focus on what they find important in this stage of life.

The site has been chosen through thoughts based on the existing hospices in Denmark and most importantly the palliative qualities of the area. It can be argued that there are two types of hospices, based upon where their location. One can be described as the 'urban type' that is located in city close to roads, people and the daily life of other people, a hospice that is usually designed around a peaceful garden for the patients. The other can be described as 'Nature type' that is often located in a more isolated piece of nature which provides a unique experience for the residents, with beautiful views over untouched nature, and where the is a certain distance to the rest of the world.

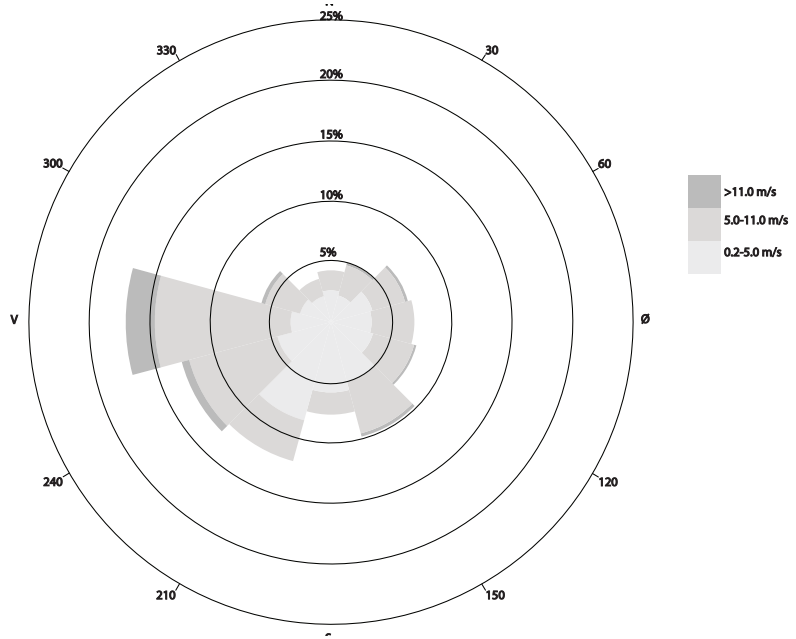
The site is located in the northern parts of Jutland, in the middle of a clearing in the Tversted plantation. In the clearing is one already existing building an older mill that is worthy of preservation. The clearing provides a view over the North Sea while being surrounded by the forest which enhances the feelings of being distanced from the rest of the world.

When choosing a site, that is this distant and remote has both advantages and disadvantages to consider. The distance to other institutions and to the bigger cities were the main concern when considering visitation and transportation of elders. This has to be thought into the functions of the building as well. The motivational factor for choosing the site was the recreational qualities of the location, in a way that would support the palliative motives of the design. The nature surrounding the site will be used, as a part of the palliative thoughts of landscaping as a healing tool in the palliative care, which is the main reason for secluding it from any urban context.

The site is rich in nature which can be used in the theory of activating the patient's senses and triggering memories. The building shape has to take its departure in the weather and landscape to achieve an expression that makes it a part of the site. The patients will experience a view that puts your mind at peace when looking through the open flat country towards the sea.

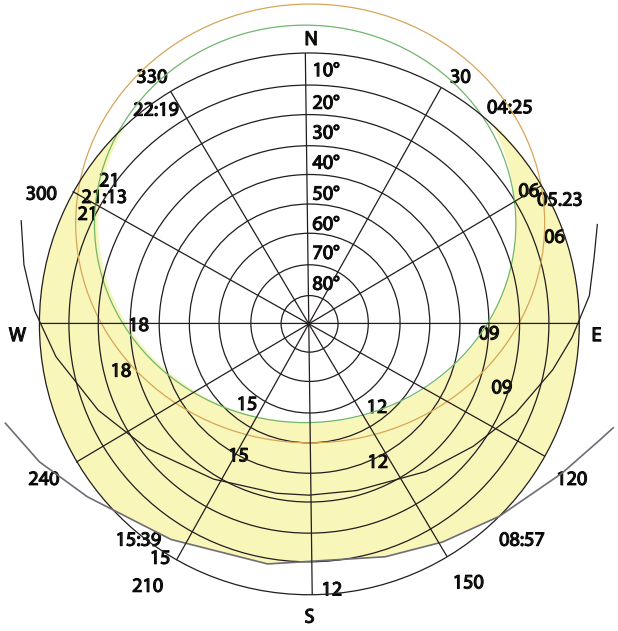
WIND ROSE

The site we have chosen is exposed to a harsh environment concerning the wind at sea. These circumstances must be thought out in the design of the building. In this part of Denmark, the primary wind to be considered is the western/southwestern. The open and flat terrain makes the site very exposed.It is important to create a hospice that allows the patient to enjoy nature and still be sheltered from the harsh wind. Furthermore, it is an excellent opportunity to make use of natural ventilation through pressure difference. (Cappelen and Jørgensen, 2017)



Ill. 10 Wind diagram

SUN ROSE



Ill. 11 Sun diagram

The sun diagram for the northern part of Denmark shows a big variation of sun hours throughout different seasons, which means that in the winter period there the lack of heat gains needs to be compensated. The site location can be an advantage in the pursuit of a healthy indoor climate and energy efficient building. The open flat land towards north allows the northern light to enter the building, while the forest to the south can be used as passive shading and avoid over temperatures. At the same time, the low sun angle in the winter should enter the building without being shadowed by a too dense forest and result in high energy consumption for heating. Furthermore, it is important to work with overhangs and glass properties to achieve the right amount of daylight for the patients. (Gaisma, 2017)

Illu. 12 Site Picture, Nature.

Access

When you access the site, you are led from the from small roads leading through the forest, which means that it is hidden away, until you have actually entered the site. The main road leads to a gravel roads which leads to the site, when this transition is made in combination with forest gives a feeling of completely leaving the city life behind and anything resembling.

Illu. 13 Site Picture, Nature.

Sea and beach

The sea north of the site is the North sea. The site lies within a clearing of a rather flat landscape, and has a direct view to the sea. The view is a quality that should be made use of through the palliative care angle. The waves of the sea can be heard at all times and becomes an element that influences the atmosphere. All these sensory experiences should be utilized in the design of the building.

Vegetation

Surrounding the site is a tree line, which can be used for sheltering purposes. It opens op for the possibility to work with this as a recreational element in the palliative care. The forest contains a combination of needle, birch and beech trees. When you arrive at the site, the landscape changes into a open and flat landscape. Where Lyme grass cover the whole area. The earth is a combination of sand towards the beach and damp earth from the marsh area close by.

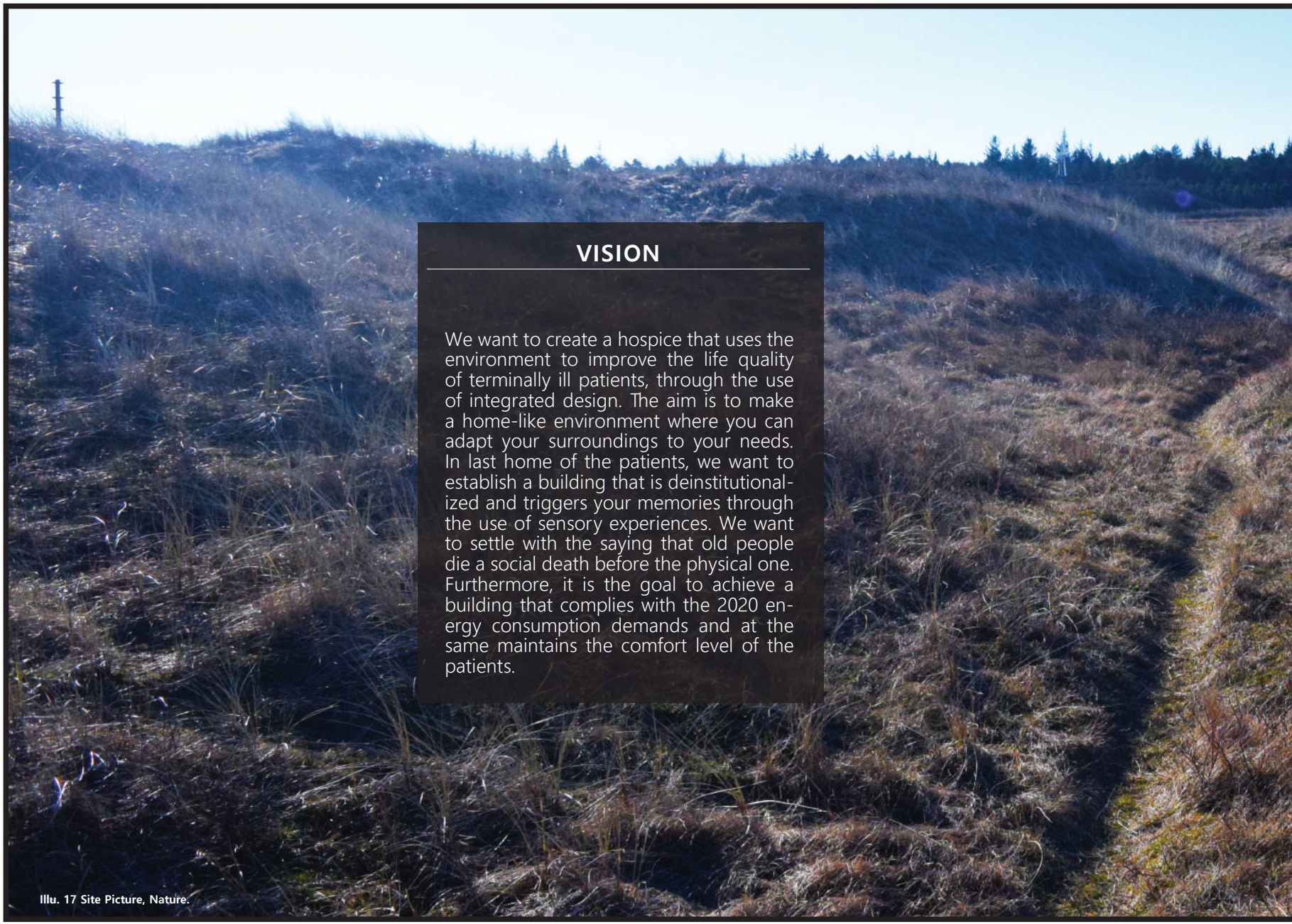
Illu. 14 Site Picture, Nature.

Illu. 15 Site Picture, Nature.

SENSE OF PLACE

When you arrive at the forest before entering the site you leave the day to day life behind. After a stroll through the untamed nature full of life you arrive at the clearing. The first thing you notice is the almost religious old mill placed in the center of the site. The only building on the site that stands firmly in the flat and open landscape. When entering the clearing you immediately hear the sound of the sea. Walking towards the clashing waves, the terrain changes to a hilly landscape, where sand dunes creates small valleys and hills. As you cross these undulating slopes the sound of waves increases for each step. When you reach the last row of dunes you get to the beach and the sea that resembles one of Gustave Courbet paintings from the realism

Illu. 16 Site Picture, Nature.



VISION

We want to create a hospice that uses the environment to improve the life quality of terminally ill patients, through the use of integrated design. The aim is to make a home-like environment where you can adapt your surroundings to your needs. In last home of the patients, we want to establish a building that is deinstitutionalized and triggers your memories through the use of sensory experiences. We want to settle with the saying that old people die a social death before the physical one. Furthermore, it is the goal to achieve a building that complies with the 2020 energy consumption demands and at the same maintains the comfort level of the patients.

Illu. 17 Site Picture, Nature.

VISION
04

DESIGNPROCESS

05

Illu. 18 Site Picture, Nature.

DESIGN PARAMETER

- Deinstitutionalizing the building by creating a home

- Using passive and active strategies to achieve a sustainable building

- Creating a functional building where the workflow is in focus

- Bringing in nature, in a more controlled form

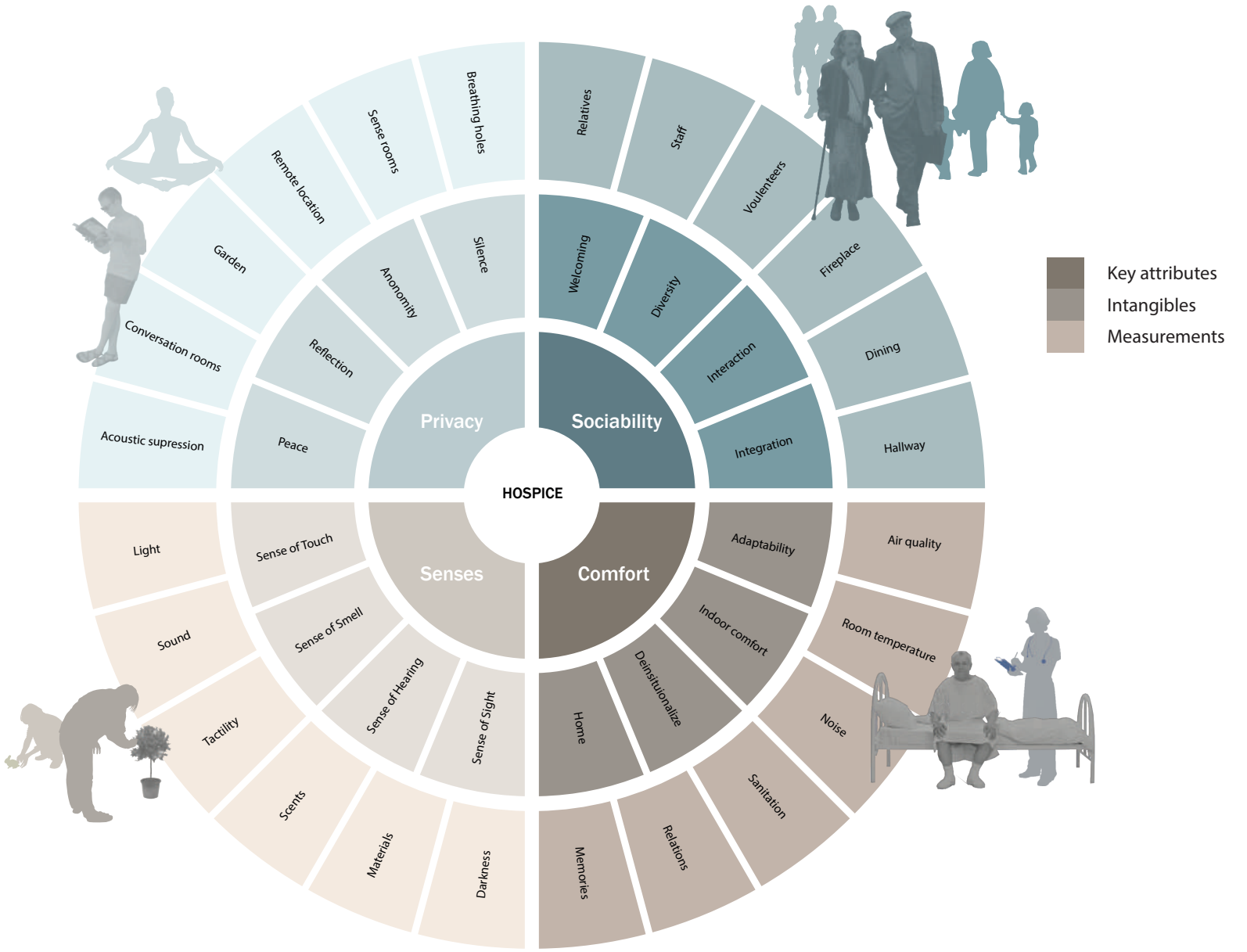
- Creating social interaction between residents by utilizing common spaces

- Activating senses and triggering memories

- Introducing adaptability, to give patients more control in their fragile situation

- Creating spaces where privacy is essential

- Using materiality and its acoustic properties to define the use of the rooms.



Ill. 19 Design parameter illustration

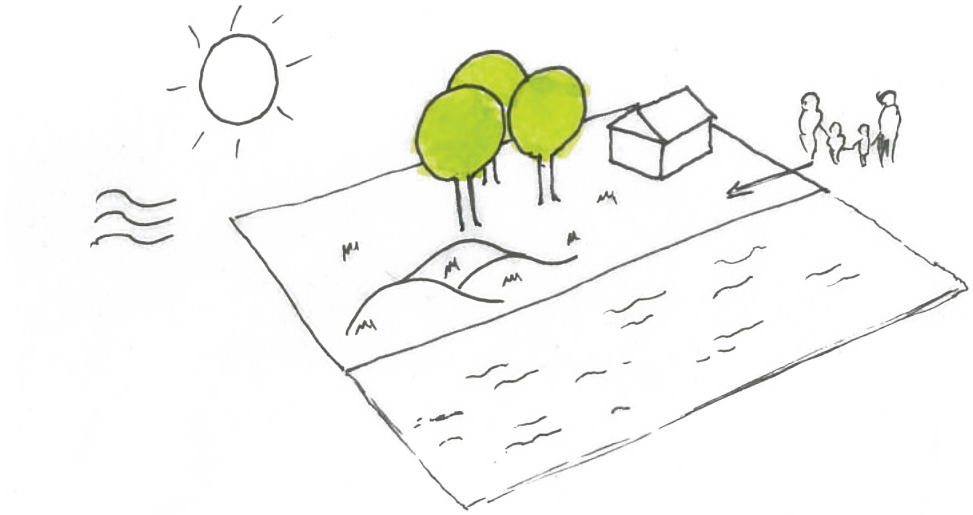
DESIGNPROCESS

SITE AND CONTEXT – PHASE 1

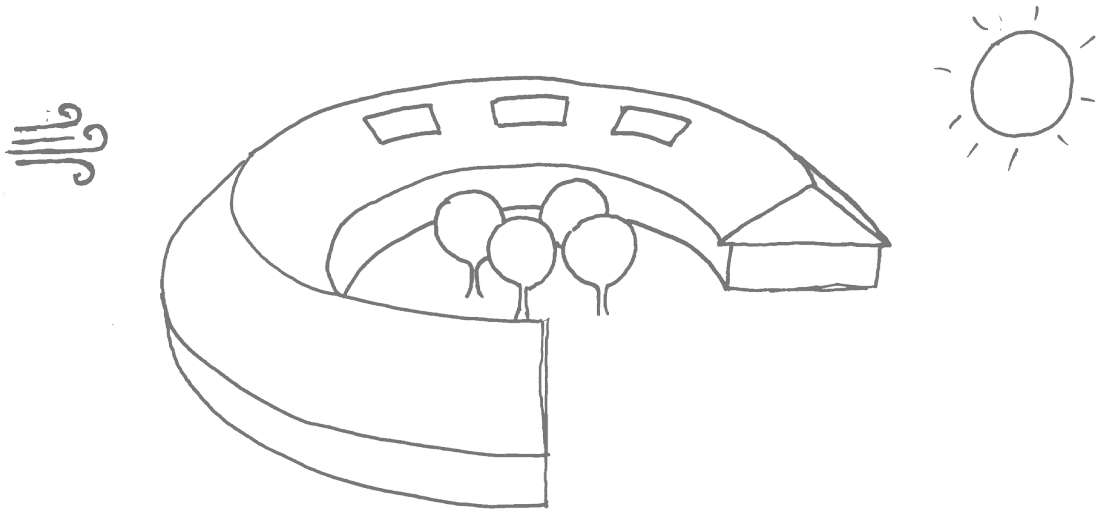
This first step of the design process takes its departure in the context. The aim of this phase was to discover the possibilities of merging the building together with the landscape in a subtle and unobtrusive way. The process of selecting a site was decided through the contextual qualities, concerning the sea, forest, and the location.

The criterion for the site was a distant location and isolated area. This emerged after carefully comparing the advantage and disadvantage of the hospice in the city versus the countryside. The city was attractive mainly because of the accessibility for relatives and the life surrounding the building. Choosing a site which was more remote gave the possibility to implement nature on another level. Also, this would ensure the full attention to the patient when relatives would visit and leave the day-to-day life behind and focus on spending the last days together with their loved ones.

The conclusion derived from this phase was to choose a remote site where the focus would be on relations. The implementation of nature is a focus point.



Illu. 20 Design process - Site and Context



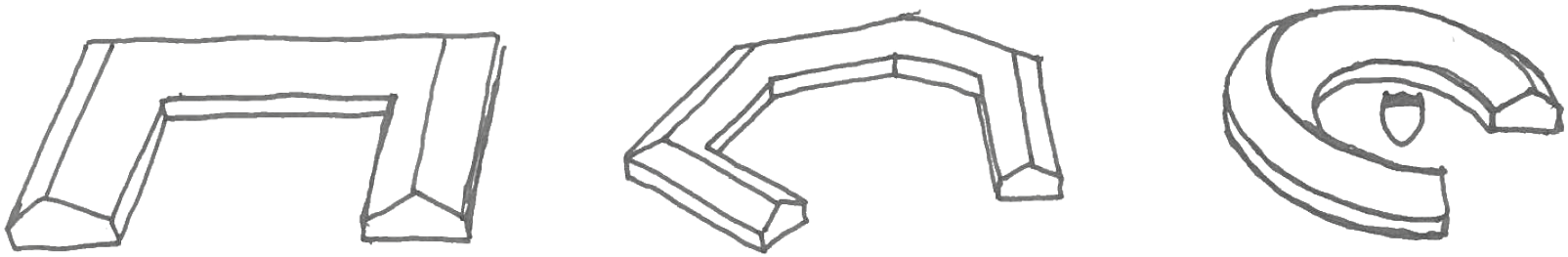
Illu. 21 Design process - Site and Context

DESIGNPROCESS

VOLUME STUDIES – PHASE 2

The study of shape and volume evolved around the previous studies of the context and landscape. The shape is developed through analyzing the macro climate, while keeping a connection to the existing mill on the site. The starting point of the geometry was the three-winged farm using the protective qualities of the shape to create a safe and comforting environment. The shape developed along with the parameters set up through analyzing cases and theory.
The wind played a big factor in the selection of shape and direction of the building. It was important to create an environment that could shelter from the harsh western wind, utilize the view and connect people to nature, both in the interior as well as the exterior.

The building should adapt to the landscape and be implemented in nature without being an unknown element in the context.



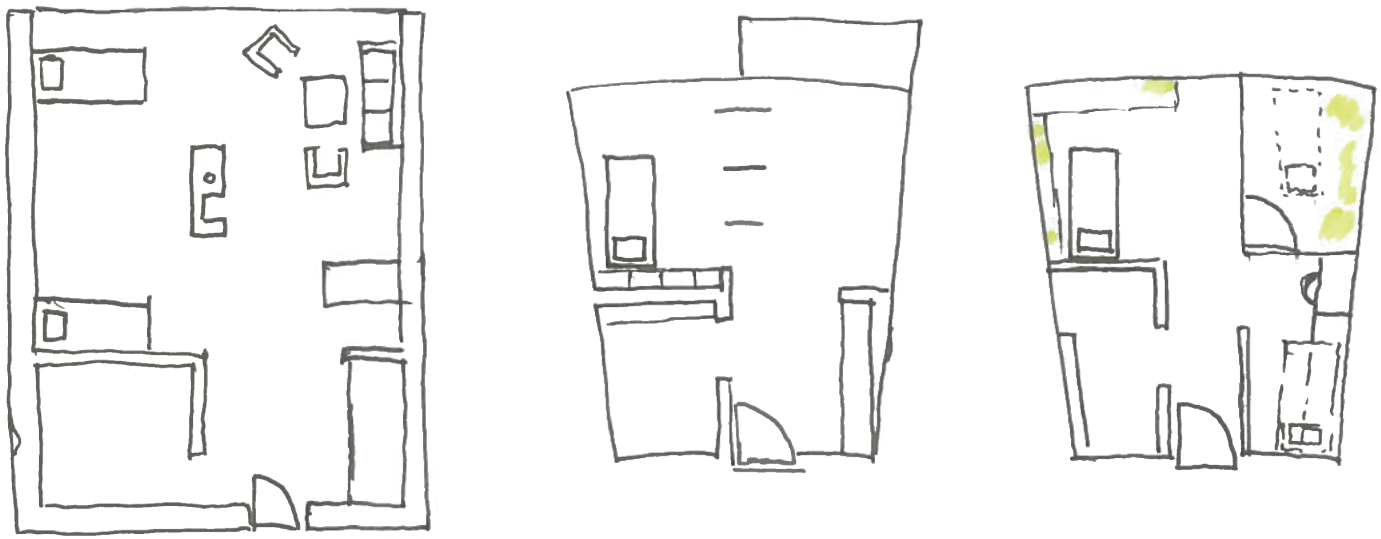
Illu. 22 Design process - Volume studies

DESIGNPROCESS

INTERIOR AND FUNCTIONS - PHASE 3

The aim of this phase was to develop rooms that would meet the requirements of the patients and bring something new to the standardized patient room in the healthcare sector.
The patient rooms derived from a visit to Ankerfjord hospice (ref. to the case) and the program of the good hospice of Denmark (ref. program). The aim was to create the optimal elder home apartment where there wasn't anything lacking in functions. The apartments were around 30-40 square meters. We wanted to challenge the saying that old people die a social death before the physical. The living room area of the apartment was moved out into the common spaces to create an area of social interaction, with other residents and volunteers.
Nature was brought into the room to create a reference to the gardens in the common space and offer the residents the possibility to adapt their room to their personal taste. The garden in the room should act as an unheated winter garden and is equipped with sliding glass panel, which allows the patients to hear the ocean and feel the wind.
The conclusion of this phase was to try and create a room that would be adaptable to the patients' needs and wishes. The room has been minimized, and the living room has been moved out to the common functions.

Light studies
Different studies have been made through the a series of computer programs. First, Ladybug a plugin for grasshopper that is able to messure the daylight in a 3d model in relation to the conditions set up. Later through the use of Velux daylight visualizer, which that are both able to messure but also able to create architectural renderings of a simple room to see a Aesthetic. Last but not latest, the light scenarios have also be investegated through physcal models to get a better understanding of rooms and the light.

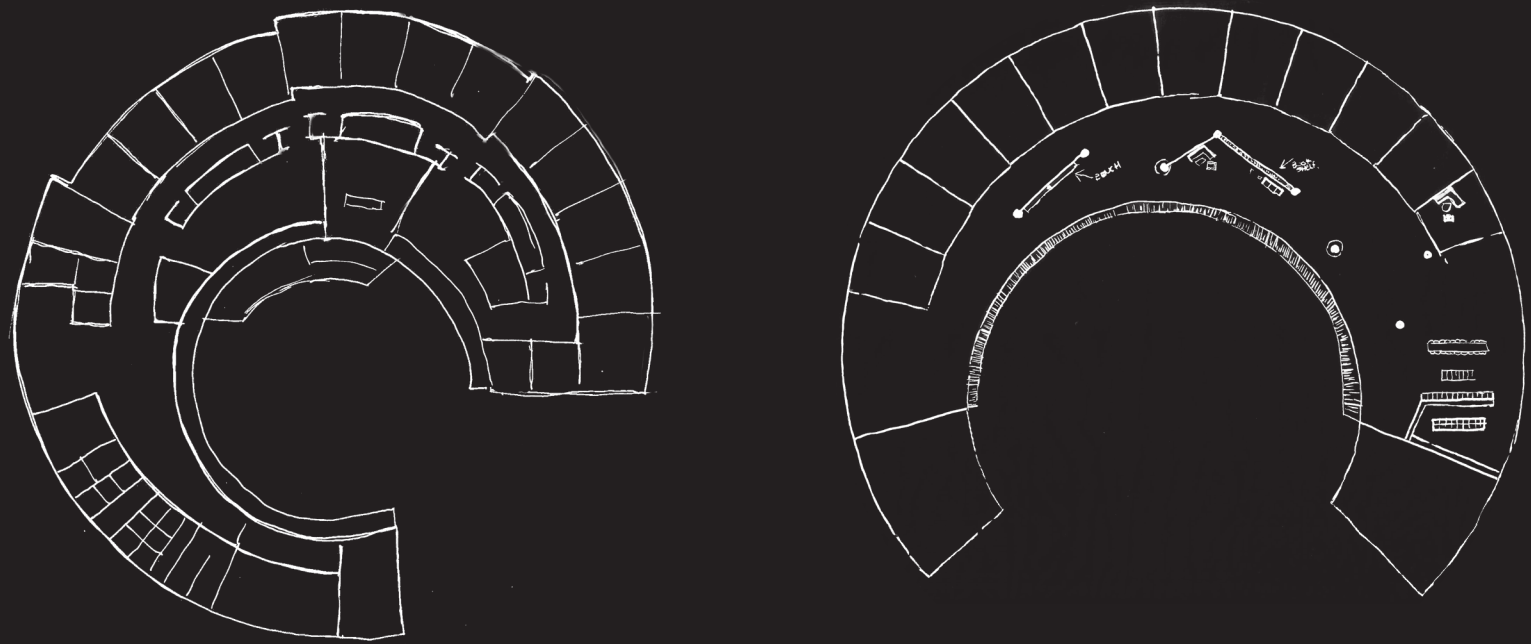


Illu. 23 Design process - Interior and functions studies

DESIGNPROCESS

THE HALLWAY – PHASE 4

This phase concerns the hallway and how to reinterpret the use of the transitional space.
The main goal of the project was to create a place that would feel like home, which led to the term deinstitutionalization. The focus was to redesign the healthcare facility into a place that had no relations to hospitals or cancer centers whatsoever. One of the most associable rooms of the hospital is the hallway, which is why this demanded its design phase. The hallway was significant in the three-winged building, which led to curving the hallway and breaking it up so you would not be able to see your end destination while walking. The other important step was to make it multifunctional, creating small niches and implementing nature in the hallway. This became more than just a transitional space; it became a place of stay.



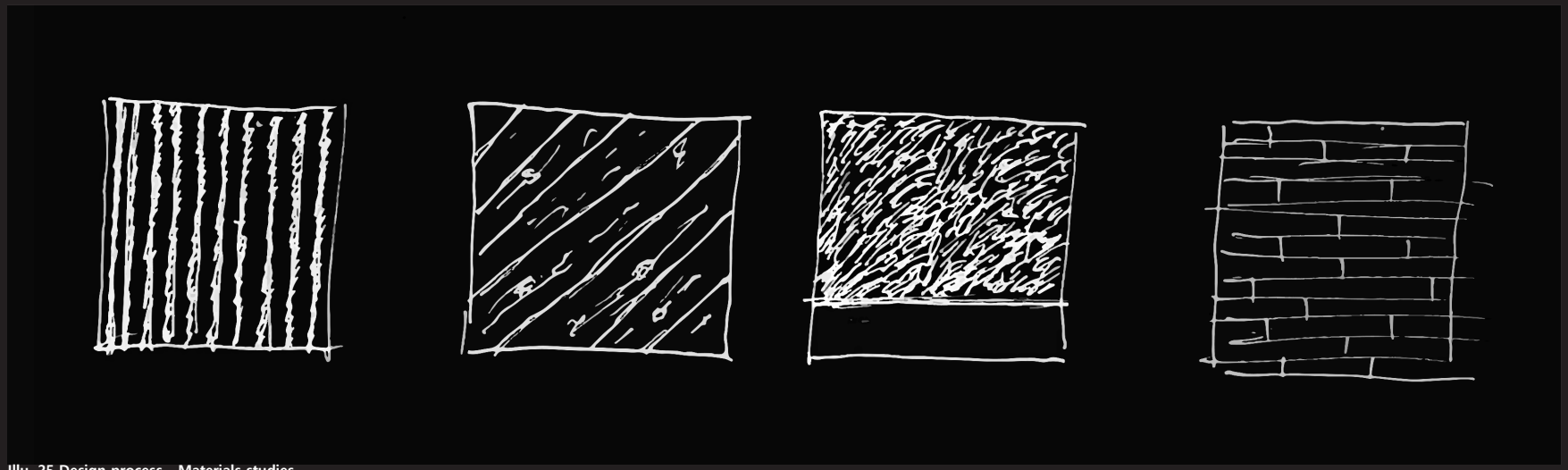
Illu. 24 Design process - The hallway

DESIGNPROCESS

MATERIALS – PHASE 5

When selecting materials, it was important to create an expression that blended in with the surroundings. Furthermore, it was the goal to use materials and solutions that would improve the indoor comfort of the patients while focusing on the sustainable aspect of the materials.
Bricks gave a strong connection to the Danish building tradition and were chosen in other dimensions to create a modern interpretation of the traditional masonry. The thatched roof was reinterpreted in an organic shape and was perfect for the construction difficulties of the organic shape of the roof. The choice of interior materials was based on aesthetics and acoustic properties. The goal was to define different zones and their purpose through the use of different materials. Wood should represent the more sensitive and private spaces, while concrete indicates transitional and works spaces.

Implementing the sustainable aspect has stretched throughout all the phases and influences both the selection of material location on-site and the shape of the building.



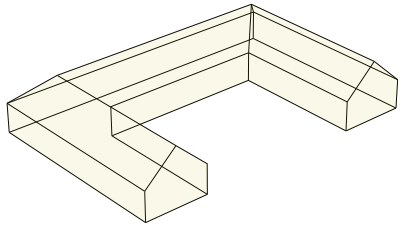
Illu. 25 Design process - Materials studies

CONCEPT
06

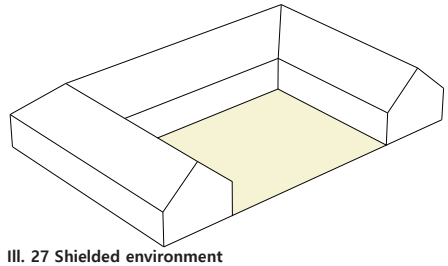
CONCEPT

The main ideology of the building is to create a building within the healthcare department, where the patients can feel at home and utilize this comfort to create a life-enhancing experience. Through work with room arrangement and flow of the building, it is attempted to create different zones, a patient ward, common areas, offices, and support facilities. The building should persuade the residents, to become social active despite their complications, so that a mutual solidarity emerges and provides the comfort and well-being of a home. It should emphasize the possibility to observe the untouched nature, which surrounds the building, from a distance. The lyme grass, sand dunes, heather and the Northern Sea, while it is also possible to indulge in the intimacy and tranquility of the forest.

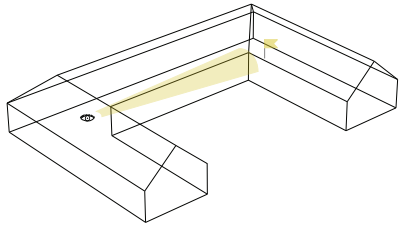
The objective is through the interior, and integration of controlled and uncontrolled nature, to create rooms that represent a home, that will accommodate different users.



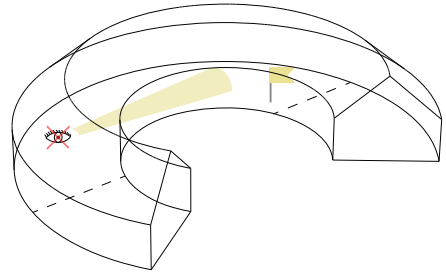
Ill. 26 Contextural coherence



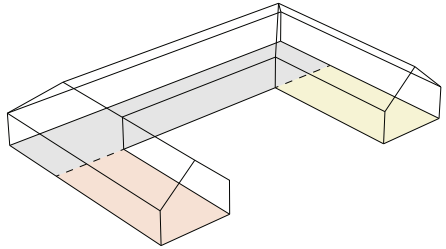
Ill. 27 Shielded environment



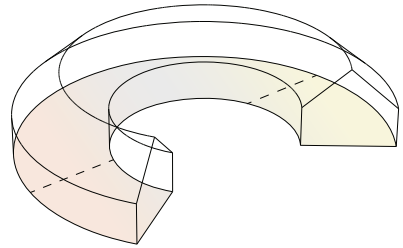
Ill. 28 Vision through entire building



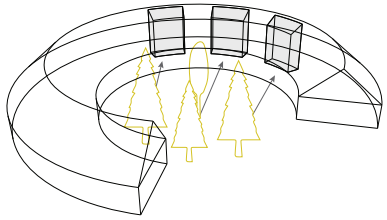
Ill. 29 Vision interupted to slow down pace



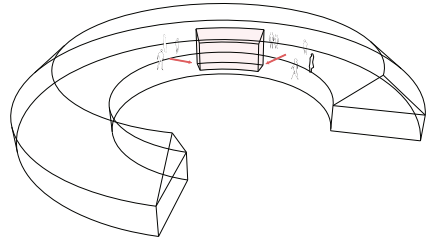
Ill. 30 Zones



Ill. 31 Vision interupted to slow down pace



Ill. 32 Nature as interior



Ill. 33 Central gathering point

PRESENTATION

07

ROOM PROGRAM

The room program of the project is based on the defined room program of Realdania's 'The good hospice program,' *(See app. 3)* which is built on a series of case studies and interviews to clarify what the needs of a Danish hospice is. The program have later in the process been redefine to fit Nordsøens Hospice, where both functions have been added and subtracted in order to accommodate the concept. The room program is divide into four main categories: support facilities, office facilities, communal areas/day center and patient rooms.

SUPPORT FACILITIES

THE PRACTICAL AREA

The support facilities are the area of the building which have less connection to the patients/residents. Yet, it is important for the building to be functional, as it involves distant depots and cleaning facilities.

Room Type	Square meters	Number	Nature sight	Describing Keywords
Kitchen	55 m2	1		Industrial kitchen, that prepares food for the entire building
Distant depot	75 m2	1		Storing area
Changing room men	4 m2	9		Changing facility for staff
Washing room	14 m2	1		Cleaning room for linen and clothe
Linen room	12 m2	1		Storage room for linens and other bedroom articles
Technical/Janitor room	50 m2	1		Technical room and room for janitor to store, tools

Illu. 34 Room program - Support facilities

OFFICES FACILITIES
THE WORKING AREA

The offices make up for the staffs primary working space regarding administration and paper work. It is a place for the staff to retreat, where it should be possible to discuss the situations at the hospice. The office spaces should allow for social interaction, but should also provide a place that allows peace to work. The rest of the administration is located at the reception, meeting rooms, and offices for external functions. An area that should be contiguous/connected to the common area in a subtle way, so that staff is always nearby, yet not so close that the residents feel as if they are being hospitalized.

Room Type	Square meters	Number	Nature sight	Describing keywords
Meeting room	20 m2	1		Meeting with legal counseling and staff meetings
Open office space	50 m2	1		Place of knowledge sharing
Psychiatrist	10 m2	1		A room of privacy and confidentiality
Medicine room	12 m2	1		Room for dosing and preparing medicine
Volunteer office	20 m2	1		Office space for the volunteers
Reception	20 m2	1		Inviting and welcoming space
Entrance	115 m2	1		Room of arrival and first impression

Illu. 35 Room program - Office facilities

COMMON FACILITIES

THE SOCIAL AREA & DAY CENTER

The common area should be for social interaction across all groups in the hospice. The comfort of not being alone should create a dynamic space where people can be together without disturbing each other and gather in a larger area, where visual contact is a key element. Also the staff needs to be visible in this area to ensure that patients feel safe at all times. This area should be available for visitors like other patients that wishes to live at home, but needs treatment or a change of scenery. Relatives should be able spend time with their family member with room for semi-private conversations.

Room Type	Square meters	Number	Nature sight	Describing Keywords
Livingroom	100 m2	1		A place to gather and be a part of a social environment
Dining area	50 m2	1		Gathering spot for family's
Youth room	15 m2	1		Retreat room for the youngest
Kitchen	15-20 m2	1		Allows families to prepare their own meals
Outdoor terrace	- m2	1		A place to get one with nature
Conversation room	15-20 m2	1		A place to ease your mind
Spa	15-20 m2	1		Room of relaxation
Meditation room	40 m2	1		A place where you empty your thoughts

Illu. 36 Room program - Common facilities

PATIENT WARD

THE PERSONAL HOME

The patient's room is the sanctuaries of the building, this is the where the patients and relatives can retreat from the rest of the world, and in which there is room for intimacy. This room should provide the secure feeling, set the boundaries for palliative care and create a type of freedom where patients can find their time to process what they are going through. Using nature, this room should provide a sensory experience that can trigger memories, calmness and the comforts of a home. Access to a protected outdoor area should be possible, despite the wind and weather conditions the patients should have the opportunity to encounter the nature.

Room Type	Square meters	Number	Nature sight	Describing Keywords
Toilet	5-7 m2	12	-	-
Guest room	8 m2	12		A place for the closet relatives to stay
Bedroom	12 m2	12		A sanctuary for the patient, private and comfort
Garden	6 m2	12		A space where you can customize your environment
Multifunctional transitional space	-	1		A semi private area, to gather thoughts close to nature
Conversation room	5 m2	6		A space to spill your mind

Illu. 37 Room program - Patient ward

Illu. 38 Plan - Masterplan

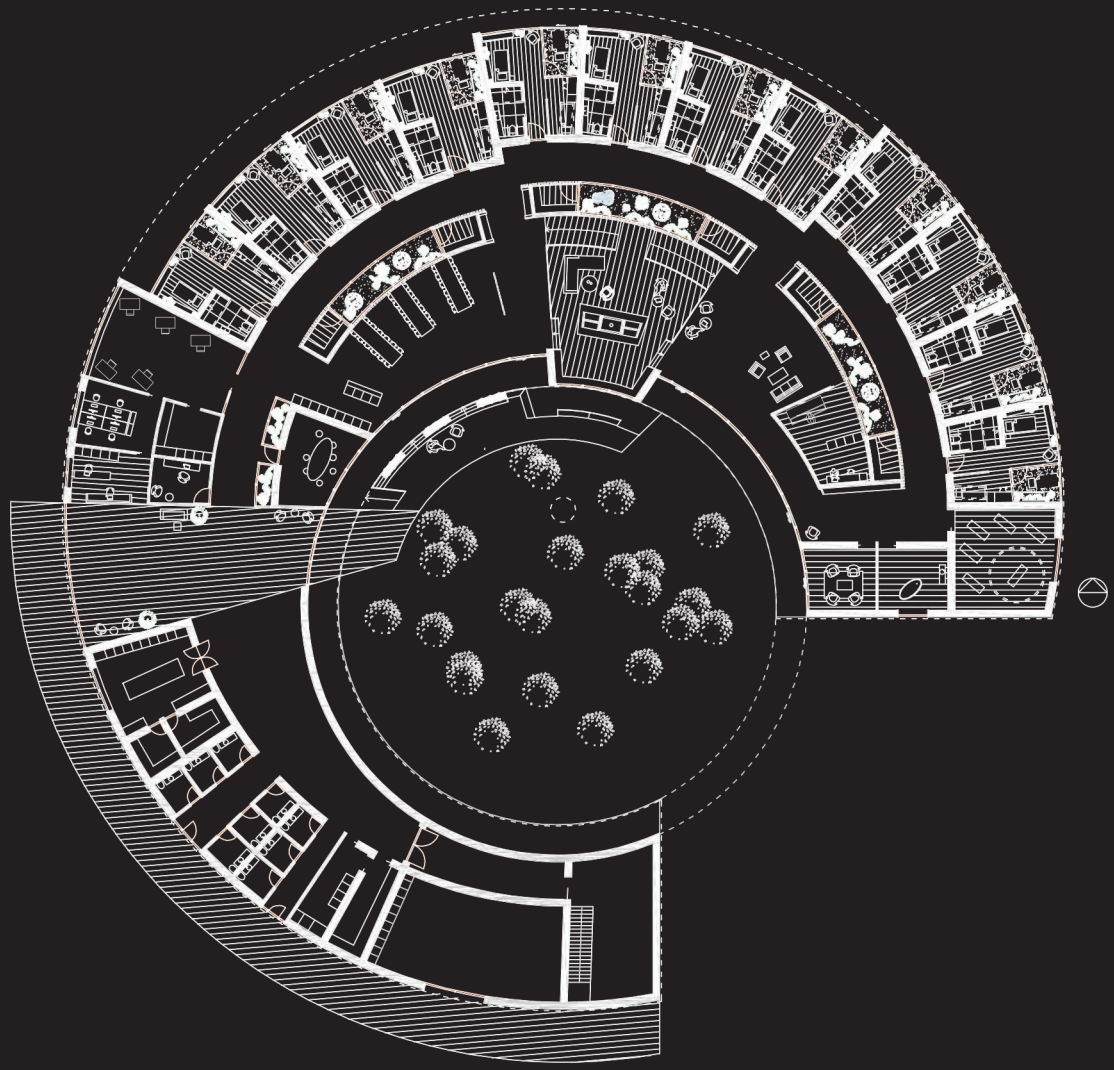
SITE PLAN

SCALE 1:2000

The building is placed in an environment that is remarkable for the beauty of its scenery. The hospice lies on the edge of the forest which means that there is the opportunity to experience the forest up close of the painted scenic view of the sea towards the sea.

PLAN - GROUND FLOOR

SCALE 1:500



Illu. 39 Plan - Gorund floor

VISUALIZAITION

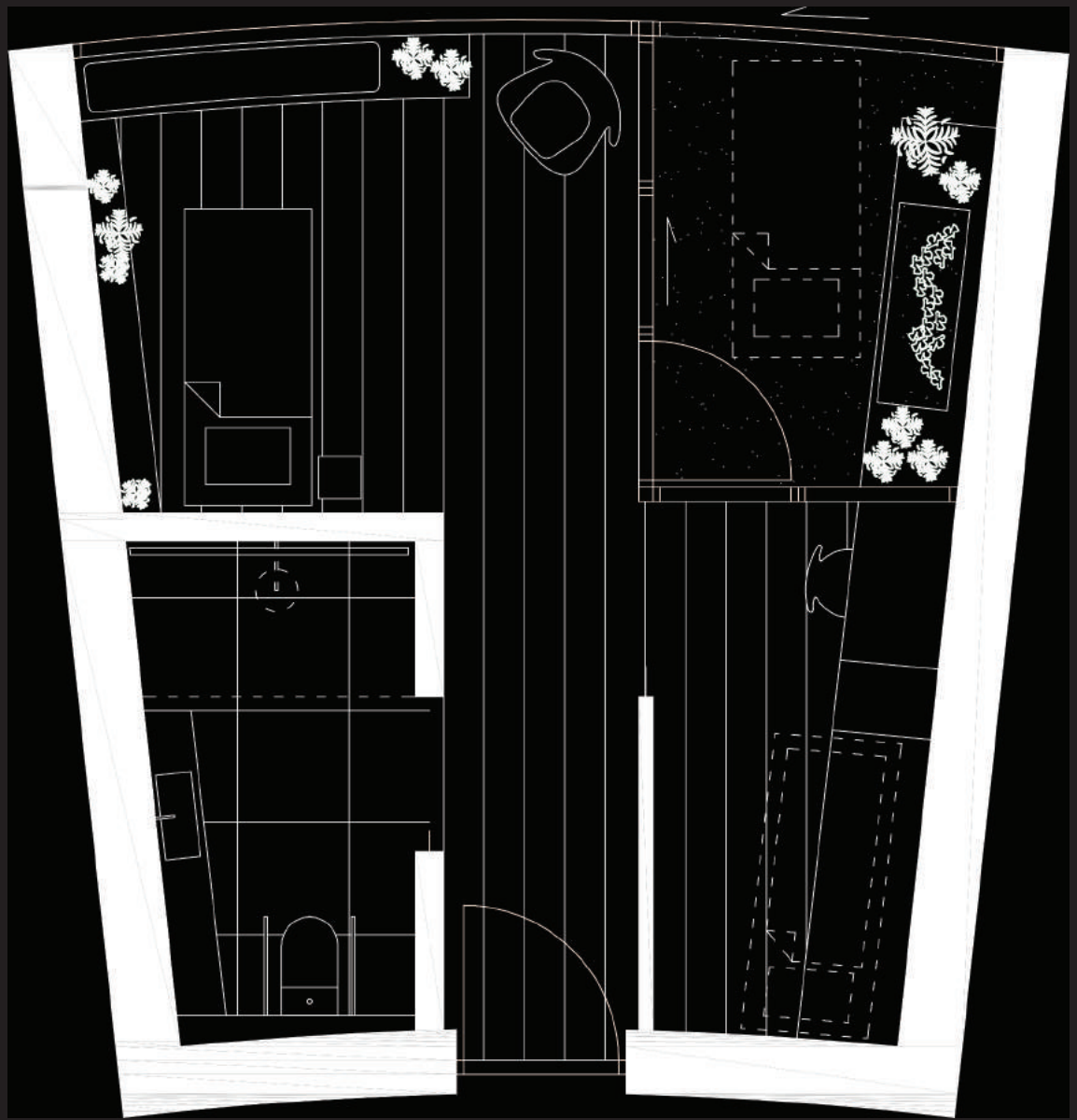
VIEW - COMMON ROOM

Illu. 40 Visualization - Common room

PLAN - PATIENT ROOM

SCALE 1:100

The patient room is orientated towards the sea. The purpose of the room is to offer the patients privacy a place to retreat to and seek comfort. The room is adaptable in its technical properties, which means that the patient can request the desired climate of their choice.



Illu. 41 Plan - Patient ward

VISUALIZATION

FROM RELATIVE ROOM TO PATIENT'S BED

The patient room contains a private garden which is a part of the sensory experience that is staying at the hospice. Her you can move out despite being bedbound to experience the scents of your favorite flower or the cold sea breeze on your skin.

Illu. 42 Visualization - Patient ward

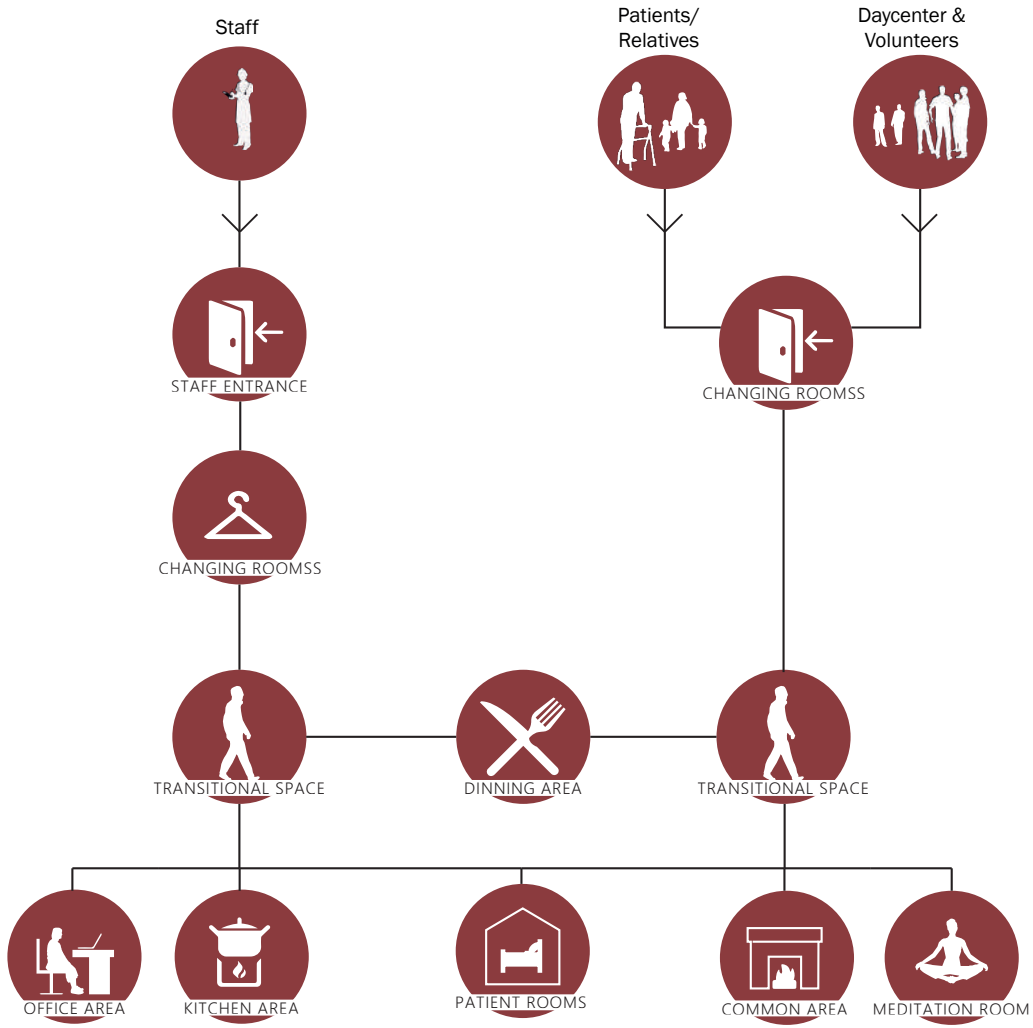
VISUALIZAITION

FROM THE END OF PATIENTS BED

Illu. 43 Visualization - Patients ward

FLOW DIAGRAM

The diagram displays how the different functions are connected to each other and how the pattern of the users interlock with each other.


Staff
Patients/
Relatives
Daycenter &
Volunteers
STAFF ENTRANCE
CHANGING ROOMSS
CHANGING ROOMSS
TRANSITIONAL SPACE
DINNING AREA
TRANSITIONAL SPACE
OFFICE AREA
KITCHEN AREA
PATIENT ROOMS
COMMON AREA
MEDITATION ROOM

SECTIONS

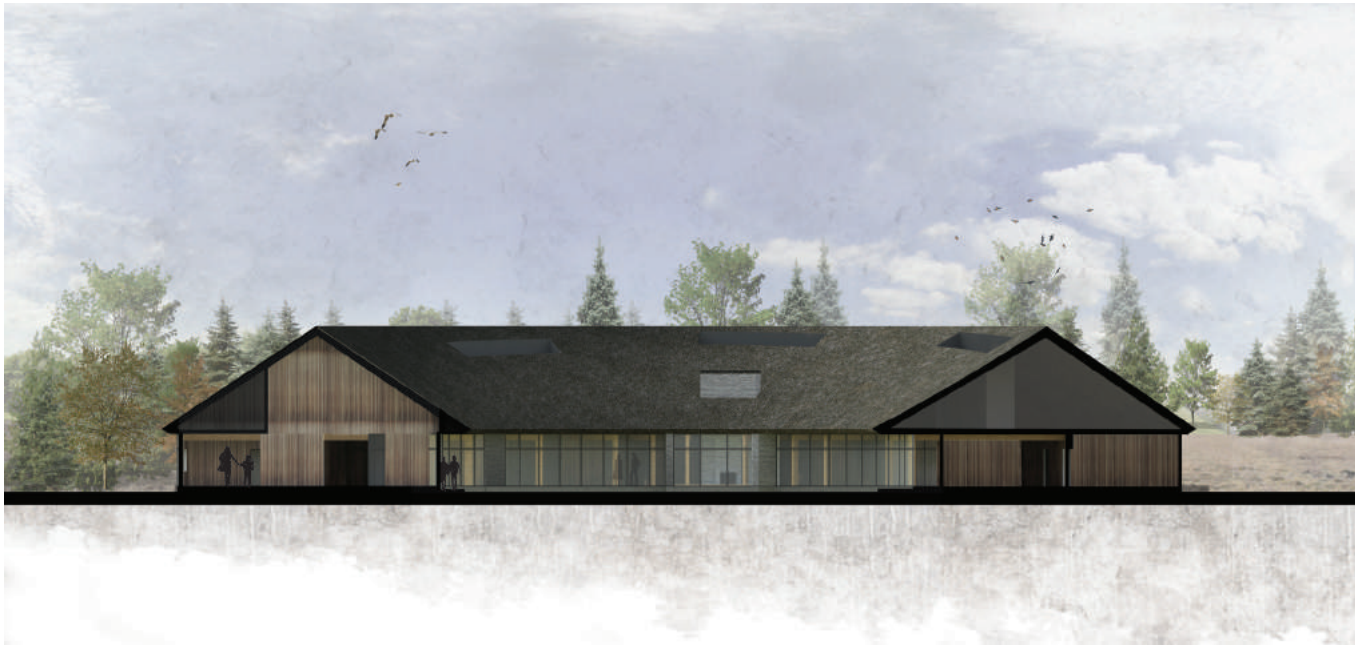
SCALE 1:500

Illu. 45 Section cut

10m

SECTIONS

SCALE 1:500



Illu. 46 Section cut

10m

VISUALIZATION

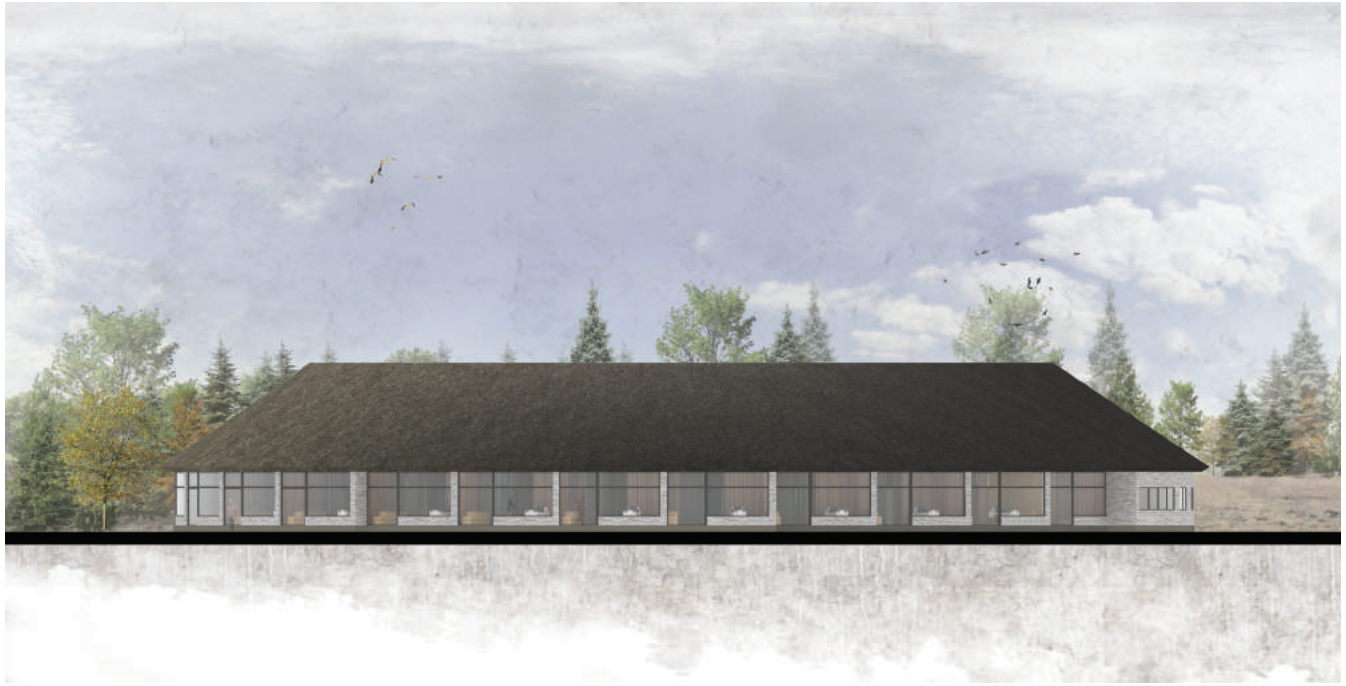
TRANSIT AREA

This would act as a hallway, but space is now more than that, it serves as a multifunctional transitional space. The residents meet around the indoor gardens. The gardens adjoin with small conversational rooms, where the relatives can gather their thoughts or have a private conversation

Illu. 47 Visualization - Hallway

ELEVATION NORT

SCALE - 1:500



Illu. 48 Elevation - North

10m

ELEVATION SOUTH

SCALE - 1:500

Illu. 49 Elevation - South

10m

ELEVATION EAST

SCALE - 1:500

Illu. 50 Elevation - East

10m

ELEVATION WEST

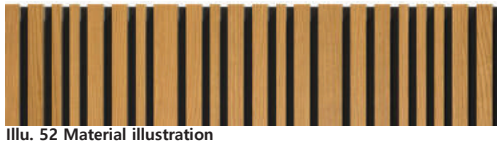
SCALE - 1:500

Illu. 51 Elevation - West

10m

MATERIALS

INTERIOR



Illu. 52 Material illustration

Timber acoustic panels for ceilings and walls:

Width - 25 mm
Gap - 10mm gap,
Back cover - acoustic batts behind

The lamellas system used is made of FSC branded wood. The wood used is local larch, which is one of the more sustainable wood types. The lamella system is used because of the acoustic properties. The sound will be absorbed in the acoustic batts behind the lamella system. The wood gives the room a warm and light atmosphere and fits with the nature context surrounding it. (Stil-acoustics.co.uk, 2017) The timber panels are used to change the directions of the rooms by being perpendicular of the direction, and visually interupts the directional feeling.

Illu. 53 Material illustration

Wooden plank for floor:

Dinesen Grand oak - Hvid olie
Thickness – 30 mm
Width – 350 mm
Length – 1000-5000 mm

The Grand Oak planks are very durable and give an authentic and natural look to the flooring. The flooring will be used in the spaces that should express intimacy. The warmth of the floor should invite the residents and visitors to stay. (Dinesen, 2017)

Illu. 54 Material illustration

Concrete for floor:

Color: grey with a brown gleam

The reason for choosing concrete is the honesty of the material. Concrete is very durable and is optimal for maintaining the sanitation demands. The material supports the simplistic and minimalistic style of the interior. Furthermore, the combination of the wooden floors and concrete gives a beautiful play in contrasts and will be used to define different zones in the building. (Cs-colorscreed.dk, 2017)

MATERIALS

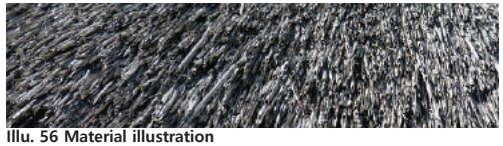
EXTERIOR

Illu. 55 Material illustration

Kolumba tiles for walls:

Dimensions: 528 x 108 x 37 mm
Approx. 38 stones per m2
Color: mix of grey
Product – Mix K70, K71 K91

The Kolumba stone was chosen to mimic the material of the old farm houses. This stone is a reinterpretation of the standard stone with its slender design. The light color is a reference to the whitewashed exterior of the old mills. (Petersen, 2017) The functionality of the interior functions is also reflected through the materials. The tiles place around functions in the building for which the patients are not necessarily involved.



Illu. 56 Material illustration

Thatched reed for roof:

100% nature product
Color: light reed color that turns almost black throughout the patinating of the material

The thatched roof is one of the more sustainable roof solutions on the market. The main reason for choosing this material is the inevitable reference to the old farmhouses in Danish agricultural history. The thatched roof is very adaptable to all kind of shapes, which makes it optimal for curving and organic shapes, using Reed will make the roof seem like one continuous element. (Buildingconservation.com, 2017, Kulturstyrelsen, 2017)

Illu. 57 Material illustration

Oak planks for outdoor walking path and plateaus:

Thickness – 33 mm
Width – 350 mm
Length – 1000-5000 mm

The oak is continued from the interior to the exterior through the glass doors, to erase the line between in and out. It is used to define the spaces where you can make a stay. (Keflico, 2017)

INDOOR CLIMATE

ACOUSTICS

Technical intro

The main focus has been on acoustics, sustainability, and indoor climate because these are some of the necessary measures when it comes to the well-being of both patients, relatives, and staff.

The acoustics are based on creating different atmospheres in different rooms. Some rooms are more private than others which mean that there is a need of a different acoustical environment.

To determine the acoustic of the various spaces in the building we have used Pachyderm (Pachyderm, 2017) to analyze the reverberation time, echo and the definition of the speech. The simulations have been made in the common area, the entrance, the dining space and the patient room. The results are displayed in the diagram. *(See app. 6 for detail results)*

The building shape helped to reduce the reverberation, due to the minimum of parallel surfaces this prevents the sound from reverberating and creating an echo. To absorb sound, there has been working with lamella walls with sound absorbing battens behind it, which is also used on the ceiling. The patient rooms were particularly vulnerable when it comes to privacy, which is why the walls between the rooms are isolated with an extra layer to avoid sound transmission.

The results show that the reverberation time is low and the definition is very clear, which means that the speech will be clear and there will be no echo in the room. This has been achieved through a careful selection process of materials to achieve both aesthetic and acoustic qualities.

Room	T30	Definition
Dining	0.34-0.52s	87.55-96.96%
Patient room	0.2-0.4s	97.33-100%
Common room	0.3-0.6s	95.01-100%
Entrance	0.2-0.6s	91.58-99.85

INDOOR CLIMATE

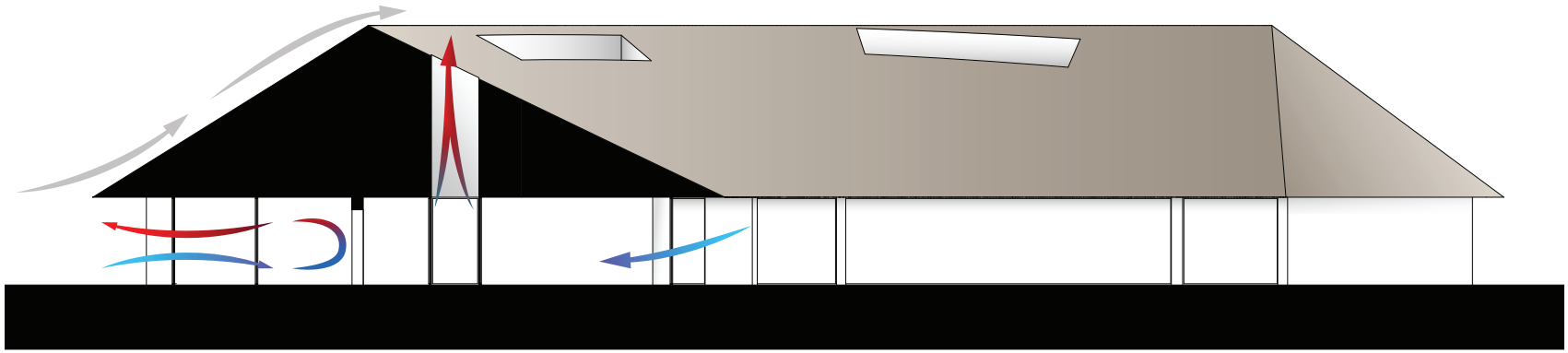
VENTILATION

The ventilation principle in this building will be hybrid ventilation. A combination of natural and mechanical ventilation was chosen to minimize the use of energy.

Mechanical
The air change rate has both been calculated for CO2 as well as sensory pollution to make sure that it is the most critical one for which there will be ventilated. (See app. 4) A mechanical ventilation system is a centralized unit for each area of the building. One for the patient rooms, one for the common areas and office and a third for the support area. The systems have been placed in the attic, and the exhaust has been led through the breathing holes of the building. One is used for intake while the other is for the inlet. By using them, we avoid exhaust holes in the building facades and through the roof. The air outlet is in the breathing hole in the middle, which has its opening on the leeward side of the roof, which means there is suction. The outlet is placed close to the ridge to ensure that no exhaust air enters the building. We have chosen a ventilation unit with 80 percent heat recovery, which lowers the energy consumption of the building. (See app. 5)

The system is DCV controlled, which allows the rooms to be controlled individually through sensors that can be configured to have certain set points regarding temperature and CO2 levels, which means that the energy use will be lower compared to a constant air change rate. (Exhausto, 2017)

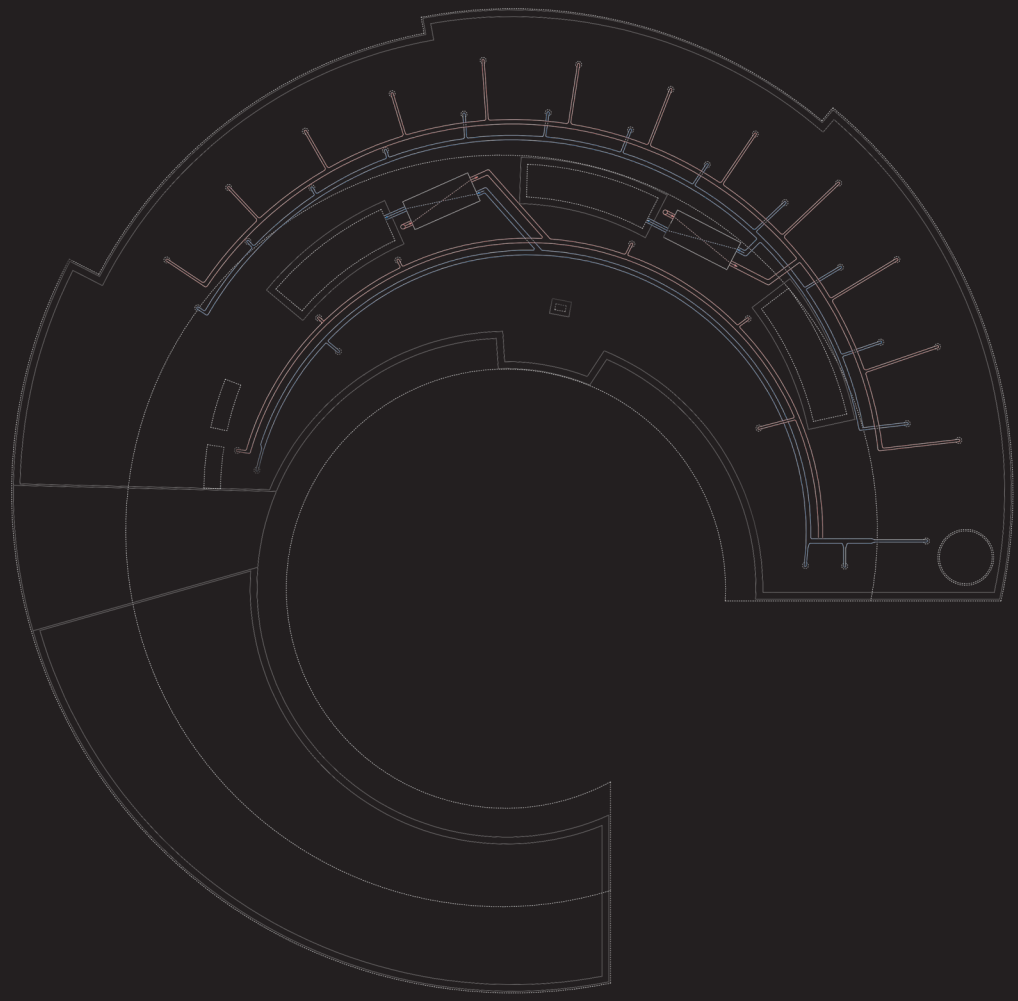
Natural
The natural ventilation in the common rooms is cross ventilation, used between the glass facades towards the south and through the breathing holes in the middle and to the east, because of the low pressure created by the placement on the leeward of the roof. The thermal buoyancy is used to let out the polluted air at the top of the glass pane while the cold and fresh air enters at the bottom. The plants in the breathing hole contribute to the fresh air inlet. Almost every room in the building is facing an exterior wall, meaning that natural ventilation in the form of single sided ventilation. The depth of the rooms is less than 2.5 times the height which allows this type of natural ventilation. The venting is automated to open when the sensors reach the set point; this allows the patients to customize the indoor climate to their specific wishes. Furthermore, it is also possible to open up to the private gardens and ventilate through them.



Ill. 58 Natural ventilation principle illustraion

PLAN - CEILING PLAN

SCALE 1:500



INDOOR CLIMATE

BSIM

To account for the indoor climate, there has been work with BSIM. The criterion were CO2 levels, under and over temperatures.

The view towards North was one of the things that could not be compromised, which means that there would be a lack of solar gains in the rooms. The building envelope is insulated according to the new recommendations to ensure minimum heat loss in the rooms facing north.

The building is ventilated through a hybrid ventilation system, meaning we utilize both natural and mechanical ventilation. The natural ventilation is used in the rooms through manual and automatic venting systems. The breathing holes in the common spaces are used to clear the room for excess dirty air through the principle of thermal buoyancy. The roof structure is placed strategically according to the holes in the roof to create suction through pressure difference. We have chosen to use a ventilation system with heat recovery, which allows us to re-use the heat through air to air transmission.
The requirements for ventilation has been calculated both according to CO2 concentration and sensory experience. (See app. 2)

The rooms towards the south are shaded through passive strategies using the forest. Furthermore, it has been worked with different transmittance values of the glass of the windows and an overhang to ensure that there is the right amount of solar gains.

The CO2 levels are also within the criteria of 700ppm (KILDE). To keep these at a minimum, we have implemented an automatic venting system, that is activated when an overload of heat or CO2 appears. The point is that the patients should be able to adjust their natural and mechanic ventilation to meet their needs to attain comfort. The limit of 700ppm will result in less than 15% unsatisfied, which is the reason why we have also chosen to work with decentralized ventilation systems DCV controlled. Which means that CO2 and temperature sensors will control the amount ventilation. Using this system will save energy and will ensure the best possible indoor climate for the variety of individuals.

Comfort

	Toilet	Værelse	Livingroom	Common room
CO2<700ppm	397ppm	404ppm	489ppm	584ppm
Hours>27	0	0	8	16
Hours>26	0	4	35	45
Hours<18	0	0	0	0

Illu. 59 Bsim result illustraion

INDOOR CLIMATE

BE15

The increasing demands for minimizing energy consumption according to the Danish standard means that there has been implemented passive and active strategies to meet the requirements of 2020. The new requirements state that the use of energy cannot exceed 20 kWh/m2.

The hospice is 2180 m2 in heated floor area. The shape of the building means that there is less surface area than a conventional square building with corners.

A thick building envelope has been created to avoid heat loss. The glass to wall ratio is higher than what is usually advisable, which means excessive heat loss. Furthermore, there are rooms towards north that will lack solar gains; this is also a compromise to utilize the view towards the sea.
The forest has been utilized to act as passive shading to the rooms facing south and added shading in the overhang has been added to increase shade for the high summer sun and let in the lower winter sun.

We have chosen to use a geothermal heat pump (GSHP) because domestic heat is not available, and because there are favorable circumstances for a GSHP system. The layer of soil is a high concentration of sand, which will allow for groundwater to flow through easier, combined with the high water level that is to be found in the low area of the site. The system is thought to be a parallel closed looped system. (*See app. 8 for specific heat pump*)

Nøgletal kWh/m2 år

Renoveringsklasse 2			
	Uden tillæg	Tillæg for særlige betingelser	Samlet energiramme
	127,6	0,0	127,6
Samlet energibehov			26,1

Renoveringsklasse 2			
	Uden tillæg	Tillæg for særlige betingelser	Samlet energiramme
	61,6	0,0	61,6
Samlet energibehov			26,1

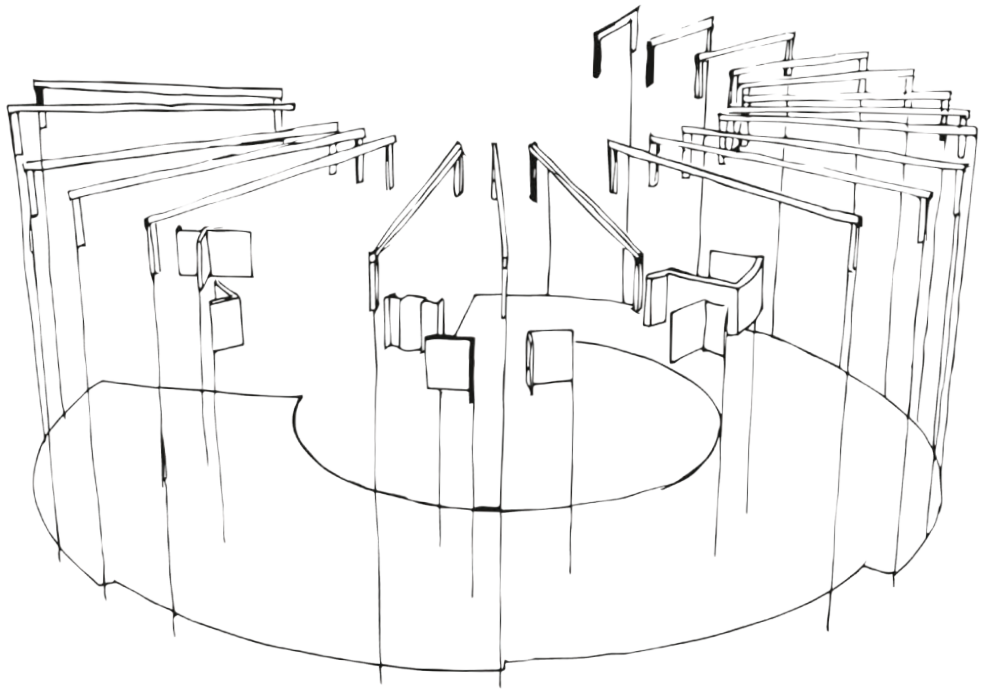
Energiramme Byggeri 2015			
	Uden tillæg	Tillæg for særlige betingelser	Samlet energiramme
	35,5	0,0	35,5
Samlet energibehov			26,1

Energiramme Byggeri 2020			
	Uden tillæg	Tillæg for særlige betingelser	Samlet energiramme
	20,0	0,0	20,0
Samlet energibehov			19,5

Illu. 60 BE15 results

CONCSTRUCTION

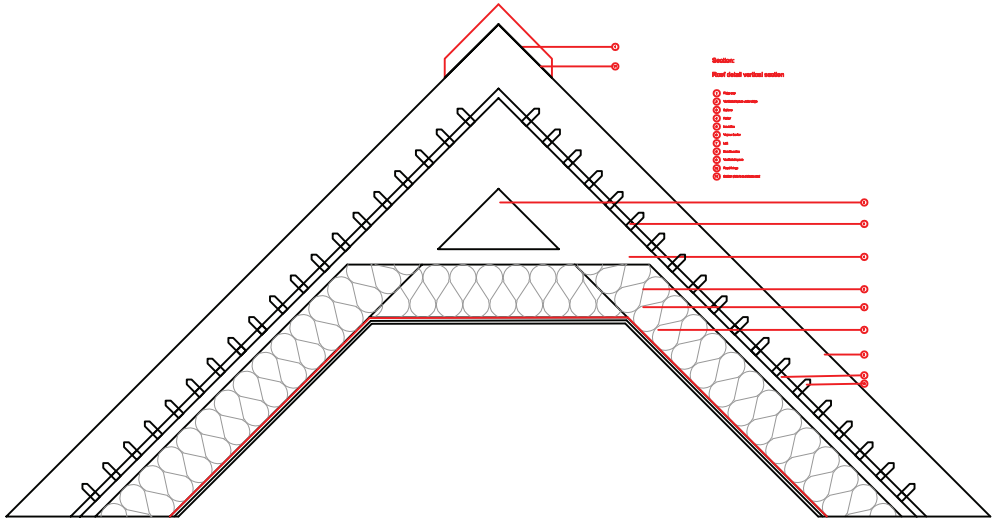
The construction consists of a frame system that allows manipulating the facades with a higher degree of freedom. It was important to choose a bearing system that would ensure maximum utilization of the views in the area. The glass to wall ratio will be high to achieve a light expression in the facades, while the roof will seem more massive due to the dark and closely thatched roof. The shape of the building favors itself by being able to take forces from all directions.
The breathing holes are used as stabilizing core to both ensure that the building can take horizontal as well as vertical loads. The ventilation system is placed strategically on top of these cores to avoid additional supports



Illu. 61 Structural princple illustration

DETAILS

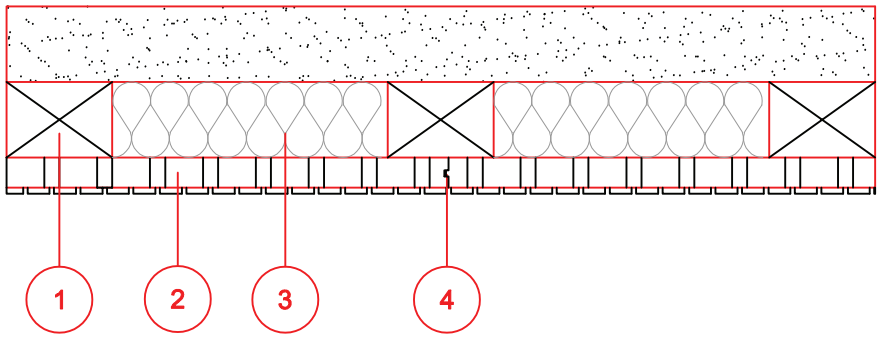
SCALE 1:50



Ill. 62 Roof detail

DETAILS

SCALE 1:10



Ill. 63 Detail - Wall with lamellas

Wall detail horizontal section

1. Batten 70mm fixed
2. Linear Panel
3. Acoustic insulation 50mm
4. Glue and pinned in groove to batten to create a secret fixing

EPILOG

08

CONCLUSION

Conclusion
During this master thesis, we have been focusing on creating a hospice that will act as the final home of the patients. During this project, we have tried to answer the problems formulated in the initial phase
.
Deinstitutionalize
One of the main focuses in the project was to create a place that had no resemblance to the institutionalized feeling of the architecture in the healthcare sector. The building manages to erase the term hallway to a certain point. The shape eliminates that you visually know your end destination like the hallways in the hospitals this automatically lowers the tempo and creates a more interesting space to move around in. The direction of the transitional space is disintegrated by the displacement in the apartments and the views created through the separated breathing holes. The breathing holes are giving the space another purpose than transition. It makes a natural pause and a meeting spaces were social encounters are made. In that way neighbors can gather around a space they where they feel affiliation. The conversation rooms around the gardens are used as a breathing space before entering the room of a terminally ill patient. It is also meant to act as a room where the residents and their relatives can have a conversation in privacy. The materials of the project are based on the Nordic building tradition that includes simplicity, honesty and quality. The materials have a cohesion to the surrounding nature to create a coherence to the site. Using wood gives an expression to the room through the tactility and warmth of the material that differ to the materials in the hospitals. The concrete floor can be seen at a modern interpretation of the stone floors represented in the history of Nordic architecture. The exterior materials are a gesture to the architectural style of agricultural buildings. The stones we have used is a interpretation of the classic stone. The sleek design is giving the building a direction. The color of the stone is a light grey, to counter the heavy expression of the roof. The roof is thatched by reed cropped in Denmark. The material is a direct connection to the old mill on the site. We have used the materials to define the usage of the spaces and tried to erase the line between outdoor and indoor by continuing the materials through the building and out. The materials are chosen on their sustainable properties. concrete because of its reusability, durability and thermal mass. The thatched roof is also The organic shape of the building was chosen, because it gave us the same qualities we wanted to bring to the building from the farm, a protec-

tive environment that creates at barrier against the harsh winds on the site. The circular shape is also energy efficient because of the surface area and minimum transmission loss. The panoramic facades are used to utilize the views towards the undisturbed nature both forest and sea.

Home and the patient room
It was important to create a final home for the patients. The patients should feel comfortable in their surrounding this was achieved by introducing adaptability to the patient rooms. The idea is that the patients should be able to configure their rooms and garden in a way that suits them the best. They will be able to bring the things from their home to call forth their dearest memories. The patient room is the sanctuary where privacy is key where patients can retreat to in calmness. The building provides an untouched view towards the north that ensures privacy. The intimacy of the room is maintained through a careful selection of materials and their acoustic properties. The adaptability aspect is also implemented into the comfort of the patients. Censors in the room makes sure to control venting and ventilation systems, which ensures that the pollution and heating are kept at the right standards.

Sustainability and comfort
We have utilized the tool taught at the university to fulfill the technical demands set out for in the beginning of this thesis. The 2020 energy demands are met by constantly changing the building envelope and technical strategies. More specific we have explored different solution for ventilating and ended up choosing a DCV controlled system. The energy consumption was calculated in in BE15 while the comfort levels was calculated in BSIM. Light simulations has been conducted in Velux daylight simulator and ladybug, but the focus has been on the softer values how does this affect the room experience and how is the quality of the light? This has been investigated through models and 3d visualizations. Finally, we have been making acoustical simulations in order to create the atmosphere of intimacy and privacy. Using Pachyderm acoustics, we have been carefully selecting materials that ensures that the reverberation time is kept at the wanted level.

Memories and senses
Triggering memories takes your thoughts away from the situation you are in. reliving those memories with your relatives gives you the feeling of being in the moment. Whether it's a stroll along the beach, sitting in the grass or sensing the chill of a summer breeze. There is a big focus on using something everyone has a relation to namely the nature. We want the patients to live in the remaining days of their life instead of waiting for death. Therefore, we have created spaces where sensory is in focus and the patient as an individual.

REFLECTION

When designing a new type of building as an architect or student, there is always a steep learning curve, that the individuals must overcome before understanding the project completely. Obviously, the more theories and conditions that are put up in the beginning will increase the learning curve. As this project was new for us, there was a lot of basic knowledge that was needed to be gather to understand, the challenges of a hospice properly. It also became evident how the holistic approach calls for a reflective process during the project, to maintain the full overview and consequences of the processes.

As stated through the report one of the major challenges about the hospice environment is the combination of a functional workspace with the calmness of a home. Simultaneously it is also stated how important it is for the patients, that the hospice becomes a home, to which the can relate in their last days. One can say that the hospice is a contradiction building within its room program, demanding the effectiveness of a working space that does not allow for much aesthetical domination.

The project was attempted solved through the holistic design approach which in broad terms represents a method for combining the technical challenges with softer values.
The challenges of the project in the start has been to obtain knowledge about the problematics because the subject is driven by softer values. It was difficult to measure or attack these problems, without gaining an indebt knowledge. The technical values are more straight forward and approachable, so using these to support the claims of interiority and atmosphere has made the task easier to approach.

There are still some unsolved areas in the building as the support area, which we wanted to detail further. There are some essential authors and researchers that we would have liked to implement to get an even better theoretical understanding of the subject.

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APPENDIX
09

APPENDIX 1

BE15 DATA SHEETS

Nøgletal, kWh/m² år

Renoveringsklasse 2

Uden tillæg	Tillæg for særlige betingelser	Samlet energiramme
127.6	0.0	127.6
Samlet energibehov		26.1

Renoveringsklasse 1

Uden tillæg	Tillæg for særlige betingelser	Samlet energiramme
61.6	0.0	61.6
Samlet energibehov		26.1

Energiramme BR 2015

Uden tillæg	Tillæg for særlige betingelser	Samlet energiramme
35.5	0.0	35.5
Samlet energibehov		26.1

Energiramme Byggeri 2020

Uden tillæg	Tillæg for særlige betingelser	Samlet energiramme
20.0	0.0	20.0
Samlet energibehov		19.5

Bidrag til energibehovet

Varme	0.0
El til bygningsdrift	9.5
Overtemp. i rum	2.4

Netto behov

Rumopvarmning	10.9
Varmt brugsvand	13.5
Køling	0.0

Udvalgte elbehov

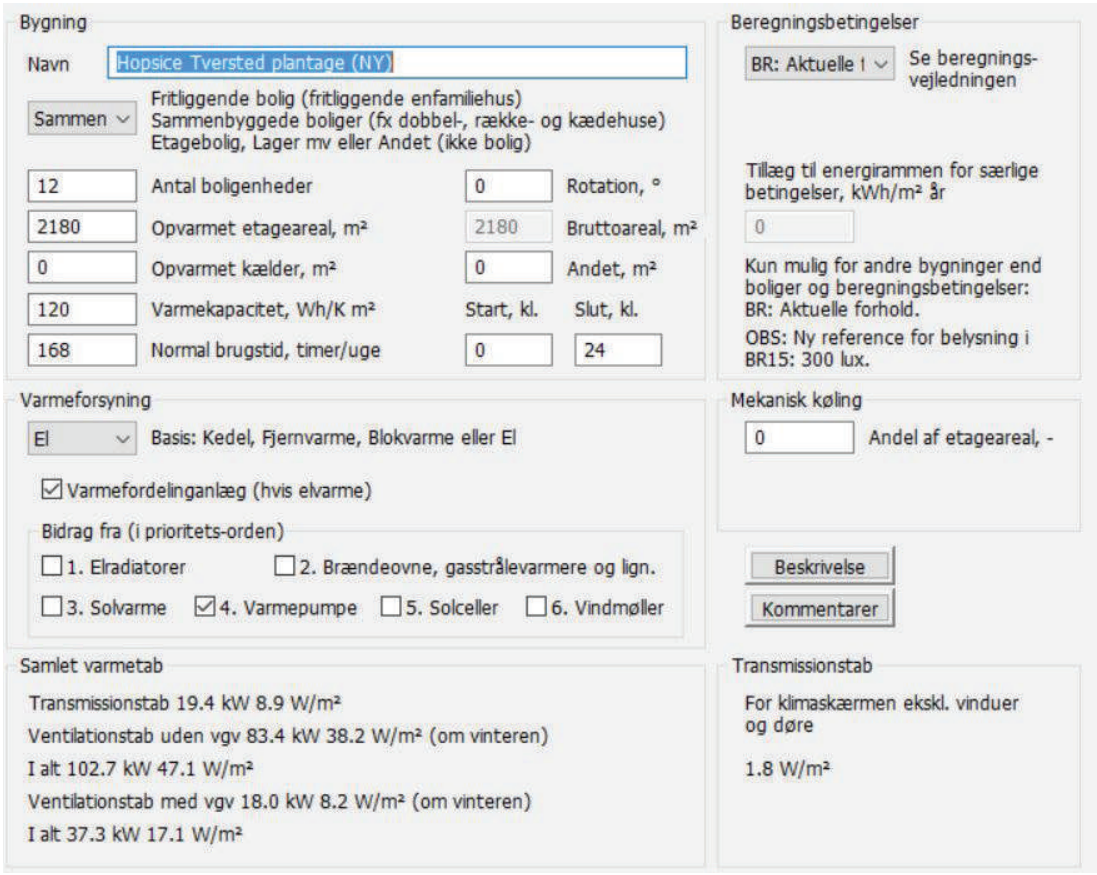
Belysning	15.0
Opvarmning af rum	0.4
Opvarmning af vbv	0.9
Varmepumpe	6.6
Ventilatorer	1.6
Pumper	0.0
Køling	0.0
Totalt elforbrug	40.8

Varmetab fra installationer

Rumopvarmning	0.6
Varmt brugsvand	0.3

Ydelse fra særlige kilder

Solvarme	0.0
Varmepumpe	23.7
Solceller	0.0
Vindmøller	0.0


Bygning
Navn
Hopsice Tversted plantage (NY)
Sammen
Fritliggende bolig (fritliggende enfamiliehus)
Sammenbyggede boliger (fx dobbel-, række- og kædehuse)
Etagebolig, Lager mv eller Andet (ikke bolig)
12
Antal boligenheder
0
Rotation, °
2180
Opvarmet etageareal, m²
2180
Bruttoareal, m²
0
Opvarmet kælder, m²
0
Andet, m²
120
Varmekapacitet, Wh/K m²
Start, kl.
Slut, kl.
168
Normal brugstid, timer/uge
0
24
Beregningsbetingelser
BR: Aktuelle f
Se beregnings-vejledningen
Tillæg til energirammen for særlige betingelser, kWh/m² år
0
Kun mulig for andre bygninger end boliger og beregningsbetingelser: BR: Aktuelle forhold.
OBS: Ny reference for belysning i BR15: 300 lux.
Varmeforsyning
El
Basis: Kedel, Fjernvarme, Blokvarme eller El
Varmefordelinganlæg (hvis elvarme)
Bidrag fra (i prioritets-orden)
1. Elradiatorer
2. Brændeovne, gasstrålevarmere og lign.
3. Solvarme
4. Varmepumpe
5. Solceller
6. Vindmøller
Mekanisk køling
0
Andel af etageareal, -
Beskrivelse
Kommentarer
Samlet varmetab
Transmissionstab 19.4 kW 8.9 W/m²
Ventilationstab uden vgv 83.4 kW 38.2 W/m² (om vinteren)
I alt 102.7 kW 47.1 W/m²
Ventilationstab med vgv 18.0 kW 8.2 W/m² (om vinteren)
I alt 37.3 kW 17.1 W/m²
Transmissionstab
For klimaskærmen ekskl. vinduer og døre
1.8 W/m²

APPENDIX 2

BSIM DATA SHEETS

2011	Min	Mean	Max	1	2	3	4	5	6	7	8	9	10	11	12
Co2(Comm	350.0	586.0	875.3	651.5	647.1	645.5	628.9	577.9	521.5	447.1	451.8	528.8	633.9	651.9	651.5
PAQ(Comm	-0.382	0.433	0.908	0.614	0.616	0.653	0.534	0.424	0.278	0.134	0.172	0.292	0.365	0.531	0.594
Ti(Common	18.72	20.10	28.22	20.02	19.95	19.77	19.77	19.87	20.15	21.02	20.98	19.95	19.79	19.96	19.99
Top(Comm	19.78	20.32	28.07	20.00	20.00	20.00	19.99	20.20	20.53	21.44	21.39	20.32	19.98	20.01	20.00

2011	Min	Mean	Max	1	2	3	4	5	6	7	8	9	10	11	12
Co2(Toilet)r	350.0	397.0	715.4	397.2	397.1	397.1	397.3	397.0	397.0	396.5	396.8	397.1	396.9	396.8	396.9
PAQ(Toilet)	-0.372	0.473	0.979	0.687	0.684	0.717	0.589	0.454	0.286	0.117	0.156	0.300	0.425	0.604	0.669
Ti(Toilet)°C	17.88	20.54	26.04	20.10	20.13	20.05	20.16	20.46	20.88	21.85	21.83	20.68	20.12	20.11	20.05
Top(Toilet)°	20.83	21.92	25.34	22.12	22.17	22.17	21.65	21.57	21.74	22.41	22.38	21.50	21.36	21.89	22.05
Co2(Værels	350.0	469.8	1709.4	429.4	429.7	444.0	449.3	421.1	415.5	673.4	669.6	414.4	422.4	427.0	432.3
PAQ(Værel	-0.408	0.381	0.846	0.580	0.578	0.601	0.497	0.372	0.214	0.071	0.117	0.218	0.290	0.490	0.558
Ti(Værelse)	19.51	22.62	25.98	22.75	22.73	22.83	22.41	22.62	22.82	21.48	21.28	22.94	23.80	23.03	22.79
Top(Værels	19.98	23.70	26.06	24.04	24.03	24.06	23.67	23.95	24.03	21.79	21.56	24.11	24.98	24.26	24.04
Co2(Livingr	350.0	398.4	446.2	400.9	400.8	401.2	395.8	394.9	395.4	396.1	396.3	395.4	402.0	400.8	400.9
PAQ(Livingr	-0.380	0.508	0.938	0.708	0.707	0.740	0.625	0.499	0.334	0.165	0.206	0.351	0.456	0.628	0.687
Ti(Livingroo	17.99	19.38	27.96	19.32	19.28	19.17	18.96	19.04	19.38	20.41	20.33	19.11	18.98	19.20	19.30
Top(Livingr	19.22	20.29	27.63	20.00	20.00	19.98	20.00	20.18	20.49	21.35	21.24	20.21	20.00	20.00	19.99

APPENDIX 3

REALDANIA ROOM PROGRAM

Ward section, 12 beds			
Number	Type of room	Estimated net area per room (m²)	Description and functional demands
12	Ward	25- 35	There should be access to personal bath and toilet. Mirrors should be small and possibly placed so they could be turned away. Lockable door to the ward. Cupboard for personal toiletries. Box for valuables fitted with lock. Control of light (artificial as well as natural), ventilation and opening/ screening towards the outside world. The ward should be handicap friendly and suitable for working. Access to bed from both sides. Possibility to use hoist (see note at the back). All doors with access on one level - also the one opening outside. TV to be placed so it is visible from the bed. Electricity, telephone and data plugs should be located with treatment situations in mind, which demand the use of extra machines like a humidifier, and relatives wishing to work during a visit. Good acoustic regulation between wards, passageways and toilets. Light fittings should be suitable for bedridden patients. Air conditioning should make extra individual ventilation possible, and it should be possible to open windows. Possible installation of oxygen and suction in the ward should be done as discretely as possible, that is, no large visible panels with oxygen supply in the wards. Intimate lighting and work lighting should be separate. Avoid the use of "institutionalised materials" as much as possible, while still considering hygiene and cleaning. Experience shows that, for example, varnished wooden floors are fully functional in the wards and in the communal areas. Patient intercom should be installed in such a way that other patients are not disturbed by possible sounds.
1 or more	Room for relatives (possible extra ward, which could be used by relatives)	15-20 (25-35)	Relatives who do not wish to spend the night in the ward with the patient or where this may not be possible could use the ward for relatives. Separate room for spending the night with bath and toilet for relatives. Space for a double bed, cupboard and a small table for computer work, for example.

Number	Type of room	Estimated net area per room (m²)	Description and functional demands
1	Lounge	Min. 40	Meeting place for patients/relatives and staff. Handicap friendly. Flexible design, is meant to support activities of varying size and character, like birthday parties, Christmas arrangements, smaller lectures, small concerts etc. Should be located centrally and easily visible in the ward section Close to and preferably integrated with service kitchen, also used by relatives (see below)
	Service kitchen used by relatives in connection with lounge		Smaller service kitchen for serving food arriving from the kitchen. Facilities for making coffee, washing up and preparing light meals, if the relatives wish to do so. Space for eating for patients, relatives and volunteers.
1	Reflection room	Min.20	Spiritual, multi-religious room. Accessible for disabled people and bedridden patients Possibility of keeping religious artefacts. Good sound insulation.
1 or more	Conversation room	10-15	Smaller room for private ad-hoc conversations outside the ward/meeting room and the public communal areas. Possibility of closing and locking the door. Primarily for the use of relatives and staff. Limited exposure to maintain discretion.
1 or more	"Resting places"	24	A number of smaller informal open meeting places/niches for informal conversation between patients, relatives, staff, doctors, priest, and on the mobile phone. Space for armchairs or sofa arrangements, café table etc. Should be close to the wards.
1	Medicine room	15	For communal storage and dosage of medicine. Locked and undisturbed.

Number	Type of room	Estimated net area per room (m²)	Description and functional demands
1	Bathroom with bathtub	20	For bath and pain therapy for patients. The use of the room should be relaxing and soothing for the patients. Green plants, music, fragrances and candles may be part of the therapy and should be in the room. Acoustic regulation should be considered when playing music. Should be equipped with adjustable bath, which can be operated from both sides, cupboard with mat for the bath and a bench/chairs. It should be possible to dim the light, and fittings should be located with the bedridden patient in mind. Large full figure mirrors should be avoided. There should be natural light and a washbasin, but attention should be given to minimizing the view directly into the room from outside. The room should not be combined with other functions, like washing room or laundry. Possibility of using hoist (see note at the back). The room could be linked with the rehabilitation/therapy room (see below).
1	Rehabilitation/therapy	15	For massaging the patients. Use of the room should be relaxing and soothing for the patient. Green plants, music, fragrances and candles could be part of the therapy / room. Acoustic regulation should be considered when playing music. Should be equipped with adjustable massage table and moveable massage chair (possibly stored in a depot), which can be operated from both sides, cupboard with sheets/small pillows/linen and possibly a small microwave and a freezer (cold/warm compresses) and a bench/chair for relatives. It should be possible to dim the lights, and fittings should be placed with the bedridden patient in mind. Large full figure mirrors should be avoided. There should be natural light and a washbasin, but attention should be given to minimizing the view directly into the room from outside. The room should not be combined with other functions, like washing room or laundry. Possibility of using hoist (see note at the back). The room could be linked with the bathroom with a bathtub (see above).

Number	Type of room	Estimated net area per room (m²)	Description and functional demands
1	Cleaning room	8	Good ventilation, preferably divided into clean/dirty sections via sluice. Space for boilers, for bedpans, washing and slop sink. Good ventilation to prevent troublesome smells, preferably with a window for ventilation. Central placement with a minimum of one on each floor.
1	Laundry - possibly connected to the door to the cleaning room	8	Space for washing machine and tumble drier, rubbish bin and various cupboards for washing, linen and other equipment.
2 or more	Local depot	15	Storage for hoists, wheelchairs, mattresses, indoor machines and oxygen bottles.
1	Distant depot	50	Could possibly be located in the basement (with access to lift for transport of bigger machines/beds). Possibility of washing beds.
1	Entrance to the ward section	-	Same entrance and exit for patients, relatives and coffins. Clear signposting.
1	Patios	-	There should be good access to south facing patios for patients and relatives, for example via a communal garden, individual garden, sense garden, terrace, balcony or a combination of these. Beds should have level, free access to the patio. Electricity supply in the area. Floor covering and doorframes should be installed with this in mind. Possible patio with shelter against wind, sun and drizzle. Some patients wish to take a nap outdoors, and patios should be equipped with lighting. The construction of the patio may create associations to smaller 'rooms' where groups of 4 - 6 persons can gather.
Sum: 570 - 720 m²			

Staff area			
Number	Type of room	Estimated net area per room (m²)	Description and functional demands
1	Communal staff area Meeting/conversation/ telephone room integrated into the staff area	Approx. 17 m2 per workstation	Communal team based work environment for nursing staff, palliative team, administrative staff, possible volunteer co-ordinators and research staff. Contains work groupings of differing sizes. Access to meeting/studio/ consultation and print/copy rooms. Possibility for 10-15 people to have short, intense meetings close to the journals. Coffee/meeting/snack bar providing possibility of 12-18 persons eating at the same time. Establishing of glass walls or other visual contact with the rest of the ward section, facilities for examination and day hospice. Estimated need for archives (based on experiences from Kamillianer Gaardens Hospice, Aalborg): Ward section, total: 5 lbm. Library: 12 lbm. Leader of Hospice: 2,5 lbm. + 10 lbm. distant archives. Estimated for the palliative team, total: 10 lbm (A larger degree of use of electronic records can be expected to influence the above numbers, reducing the need for archives). Estimated space per workstation is approx. 17m² , which covers meeting room, coffee bar and print/copy. Number of workstations and meeting rooms will depend on actual staffing. Smaller study, meeting, telephone and consulting rooms in connection with the open office. Located so that they screen off individual workstations. Location and number related to work function. Possibility of controlling internal and external views. Acoustically regulated to prevent disturbance of sensitive conversations. The section in the staff area where the palliative team is situated should be secluded from the rest of the staff area to avoid disturbances during telephone consultations and the like. Estimated size for study, meeting, telephone and consulting rooms approx. 7 –12 m / room (included in the total area/workstation).
Sum[40]: 272 m²			

Examination facilities			
Number	Type of room	Estimated net area per room (m²)	Description and functional demands
Min. 1	Consulting room	10-15	The rooms reserved for the examination section will be used by all the patients in the hospice. The consulting room will be used by the palliative team for examination and treatment of patients living at home during consultation at the hospice, patients at day hospice and to some degree patients in the ward section. The consulting room should be equipped with massage table, desk, 2 chairs and a washbasin. If the massage table is moved to the middle of the room, it should be possible to access it from both sides. Journals are expected to be placed in the staff area. The room should be located in close proximity to the staff area.
Min. 1	Waiting area	5-10	Smaller area for patients waiting for consultation, preferably with visual contact to the staff area. Space for chairs/sofa
Sum: 15 - 25 m²			

Day hospice centre, 10 –12 patients			
Number	Type of room	Estimated net area per room (m²)	Description and functional demands
1	Communal area	Approx. 120 m2 [1]	The staff of the day hospice centre sit in the communal staff area, which is located adjacent to the day hospice centre. As the day hospice centre fulfils a social function, this area should have capacity for social activities and arrangements. There should be a tea/service kitchen and the possibility for patients to share a meal. It is expected that, on a daily basis, a maximum of 12 patients and 2-3 employees are there at the same time. Handicap friendly, but no need for access to beds. As the day hospice centre should also function as a space for events in the hospice outside opening hours, the room should be able to accommodate gatherings of 40–60 persons at the same time. The room should preferably access external areas.
1	Washing room	12	As described under the ward section
1	Resting room	10–12	Quiet / resting room for patients feeling unwell. Space for a couch and a small chair.
Sum: 142 - 144 m²			

Support services			
Number	Type of room	Estimated net area per room (m²)	Description and functional demands
1	Kitchen	120	Cold/warm kitchen for ward section, day hospice centre and all staff. Including space for scullery, baking section, cold section, freezing, cooling, storage, rubbish, washing-up, depot, facilities for kitchen staff etc. The proportions of the kitchen should be able to accommodate individual food preferences from the patients and possibly relatives and staff.
1	Caretaker room	10	Office and workshop for handy man. Contains office workspace and space for smaller repairs/tools. Need for archive: 8 lbm. The room should preferably be close to distant depot.
1	Changing room and showers – men	Approx. 20	Changing facilities for staff and volunteers. Include toilet , showers and lockers.
1	Changing room and showers – women	Approx. 30 -40	Changing facilities for staff and volunteers. Include toilet, showers and lockers.
2 or more	Toilets for staff and visitors in the communal areas of the hospice	7	The design of the toilets is to be handicap friendly.
1	Entrance to the hospice		Personal welcome. Entrance signalling openness and possible access to information Possible lift should be on the same architectural level as the main entrance. Easy exit with coffin/stretcher through main entrance.
1	Parking area for cars and bicycles.		Parking bays for staff, relatives and patients, in accordance with regulations in district plan. Experience shows that 20–25 parking bays are the absolute minimum. Plus more parking bays for a possible day hospice centre.
Sum: 194 - 204 m2			

APPENDIX 4

AIR CHANGE CALCULATIONS

Patients room:

Air change base on Sensory load (olf):

q_{uft} = *tilført udeluftstrøm [l/s]*
c_i = *oplevet indeluftkvalitet [dp]*
c_u = *oplevet udeluftkvalitet [dp]*
G = *sensorisk belastning af luften (den samlede forurening fra både bygning og personer)[olf]*
ε_v = *ventilationseffektivitet [-]*

$$qv,u = \frac{10 \cdot G \cdot \frac{1}{\varepsilon_v}}{(c_i - c_u)}$$

People load:	1 olf pr. person	6 *people* · 1 *olf* = 6 *olf*
Building load:	0,3 olf pr. sqm	18 *sqm* · 0,03 *olf* = 0,54 *olf*

$$qv,u = \frac{10 \cdot (6\ olf + 0{,}54\ olf) \cdot \frac{1}{1}}{(1\ dp - 0{,}01\ dp)} = 66{,}06061\ l/s$$

$$qv,u = 66{,}1\ l/s$$

Next we calculate the air change:

$$66{,}06061\ l/s \cdot 3{,}6 = 237{,}8 \frac{m^3}{h}$$

$$n = \frac{237{,}8 \frac{m^3}{h}}{(18\ m^2 \cdot 3\ m)} = 4{,}4 h^{-1}$$

For **BSIM**, *it is converted from* **m3/h** *to* **m3/s**

$$\frac{237{,}8\ m^3/h}{3600} \approx 0{,}066\ m^3/s$$

Air change base on CO_2-Concentration:

$$q_{v,co_2} = 17 \cdot (1{,}0\ met \cdot 6\ people) = 102\ l/h$$

Converting **l/h** *to* **m³/h**

$$q_{v,co_2} = \frac{102 \frac{l}{h}}{1000} = 0{,}102 \frac{m^3}{h}$$

Relative room:

Air change base on Sensory load (olf):

q_{uft} = *tilført udeluftstrøm [l/s]*
c_i = *oplevet indeluftkvalitet [dp]*
c_u = *oplevet udeluftkvalitet [dp]*
G = *sensorisk belastning af luften (den samlede forurening fra både bygning og personer)[olf]*
ε_v = *ventilationseffektivitet [-]*

$$qv,u = \frac{10 \cdot G \cdot \frac{1}{\varepsilon_v}}{(c_i - c_u)}$$

People load:	1 olf pr. person	1 *person* · 1 *olf* = 1 *olf*
Building load:	0,3 olf pr. sqm	7 *sqm* · 0,03 *olf* = 0,21 *olf*

$$qv,u = \frac{10 \cdot (1\ olf + 0{,}21\ olf) \cdot \frac{1}{1}}{(1\ dp - 0{,}01\ dp)} = 12{,}22222\ l/s$$

$$qv,u = 12\ l/s$$

Next we calculate the air change:

$$12{,}22222\ l/s \cdot 3{,}6 \approx 44 \frac{m^3}{h}$$

$$n = \frac{44\ \frac{m^3}{h}}{(7\ m^2 \cdot 3\ m)} \approx 2{,}1 h^{-1}$$

For **BSIM**, *it is converted from* **m3/h** *to* **m3/s**

$$\frac{44\ m^3/h}{3600} \approx 0{,}012\ m^3/s$$

Air change base on CO_2-Concentration:

$$q_{v,co_2} = 17 \cdot (1{,}0\ met \cdot 1\ person) = 17 \frac{l}{h}$$

Converting **l/h** *to* **m³/h**

$$q_{v,co_2} = \frac{17 \frac{l}{h}}{1000} = 0{,}017 \frac{m^3}{h}$$

Toilet:

Air change base on Sensory load (olf):

q_{tot} = *tilført udeluftstrøm [l/s]*
c_i = *oplevet indeluftkvalitet [dp]*
c_u = *oplevet udeluftkvalitet [dp]*
G = *sensorisk belastning af luften (den samlede forurening fra både bygning og personer)[olf]*
ε_v = *ventilationseffektivitet [-]*

$$qv,u = \frac{10 \cdot G \cdot \frac{1}{\varepsilon_v}}{(c_i - c_u)}$$

People load: 1,5 olf pr. person — $1\ person \cdot 1.5\ olf = 1.5\ olf$
Building load: 0,3 olf pr. sqm — $6\ sqm \cdot 0.03\ olf = 0.18\ olf$

$$qv,u = \frac{10 \cdot (1.5\ olf + 0.18\ olf) \cdot \frac{1}{1}}{(1\ dp - 0.01\ dp)} = 16{,}9697\ l/s$$

$$qv,u = 17\ l/s$$

Next we calculate the air change:

$$16{,}9697\ l/s \cdot 3.6 = 61{,}1 \frac{m^3}{h}$$

$$n = \frac{61{,}1\ \frac{m^3}{h}}{(6\ m^2 \cdot 3\ m)} = 3{,}4 \cdot h^{-1}$$

For **BSIM**, *it is converted from* **m3/h** *to* **m3/s**

$$\frac{44\ m^3/h}{3600} \approx 0.017\ m^3/s$$

Air change base on CO_2-Concentration:

$$q_{v,co_2} = 17 \cdot (1{,}2\ met \cdot 1\ person) = 20.4 \frac{l}{h}$$

Converting l/h to **m³/h**

$$q_{v,co_2} = \frac{20.4 \frac{l}{h}}{1000} = 0.0204 \frac{m^3}{h}$$

Total capacity pr. Patients ward: $237{,}8 \frac{m^3}{h} + 44 \frac{m^3}{h} + 61{,}1 \frac{m^3}{h} = 342{,}9 \cdot \frac{m^3}{h}$

Total capacity needed for patient departments: $342{,}9 \cdot \frac{m^3}{h} \cdot 12 = 4114{,}8 \cdot \frac{m^3}{h}$

$$4114{,}8 \frac{m^3}{h}$$

Common area, hearth:

Air change base on Sensory load (olf):

q_{tot} = tilført udeluftstrøm [l/s]
c_i = oplevet indeluftkvalitet [dp]
c_u = oplevet udeluftkvalitet [dp]
G = sensorisk belastning af luften (den samlede forurening fra både bygning og personer)[olf]
ε_v = ventilationseffektivitet [-]

$$qv,u = \frac{10 \cdot G \cdot \frac{1}{\varepsilon_v}}{(c_i - c_u)}$$

People load: 1,5 olf pr. person $15\ person \cdot 1{,}2\ olf = 18\ olf$
Building load: 0,3 olf pr. sqm $97\ sqm \cdot 0{,}03\ olf = 2{,}91\ olf$

$$qv,u = \frac{10 \cdot (18\ olf + 2{,}91\ olf) \cdot \frac{1}{1}}{(1\ dp - 0{,}01\ dp)} = 150{,}6061\ l/s$$

$$qv,u = 150{,}6061\ l/s$$

Next we calculate the **air change**:

$$150{,}6\ l/s \cdot 3{,}6 = 542{,}16 \frac{m^3}{h}$$

$$n = \frac{542{,}16\ \frac{m^3}{h}}{(97\ m^2 \cdot 4\ m)} = 1{,}4\ h^{-1}$$

For **BSIM**, *it is converted from* **m3/h** *to* **m3/s**

$$\frac{542{,}16\ m^3/h}{3600} \approx 0{,}15\ m^3/s$$

Air change base on CO_2-Concentration:

$$q_{v,co_2} = 17 \cdot (1{,}2\ met \cdot 15\ people) = 306\ l/h$$

Converting **l/h** *to* **m³/h**

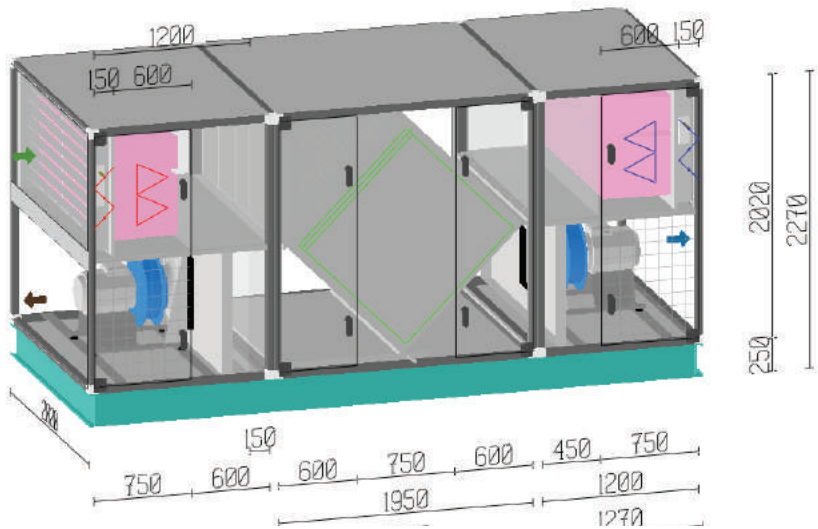
$$q_{v,co_2} = \frac{306\ l/h}{1000} = 0{,}306 \frac{m^3}{h}$$

APPENDIX 5

SYSTEM AIR CAD

Patient ward vemtilation unit.

(SystemAirCAD, 2017)



	Tilluft	Fraluft	
Luftmængde	1.14	1.14	m³/s
Aggregatstørrelse	50	50	
Lufthastighed i aggregat	0.63	0.63	m/s
Temperaturvirkningsgrad, varmeveksler	81.8	%	
	Dimensioner		
Længde	4710	0	mm
Bredde	2020	0	mm
Højde	2270	0	mm
Vægt	1996	0	kg

	Tilluft	Fraluft	
Lydeffektniveau	73	60	dB(A)
Ventilatorvirkningsgrad	61.8	61.8	%
Omdrejningstal	965	967	o/min
Driftsfrekvens	51	51	Hz
Motoreffekt	1.50	1.50	kW
SEL/SFPv, rene filtre inkl. frekvensomformere		1.50	kW/(m³/s)
SEL/SFPv, rene filtre ekskl. frekvensomformere		1.43	kW/(m³/s)
Energi klasse		A+	

Alternativt arbejdspunkt | Lydeffektniveau

Mindre aggregat | Større aggregat

Bemærkninger

Beskrivelse: Danvent DV50 | Sproget i Brugsanvisningen: Dansk

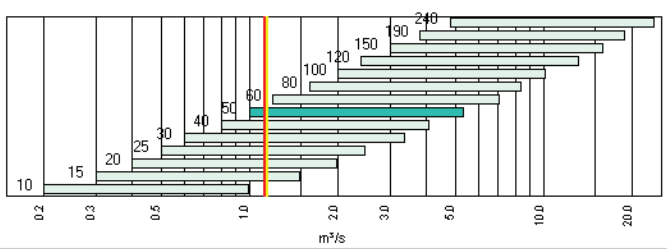
Anlæg: Tilluft 1.14 m3/s | Fraluft 1.14 m3/s

	Tilluft		Fraluft	
Luftmængde (1,205 kg/m³)	1.14	m³/s	1.14	m³/s
Eksternt tryktab	300	Pa	300	Pa

Alternativt arbejdspunkt

Aggregatstørrelse: 50 | 50

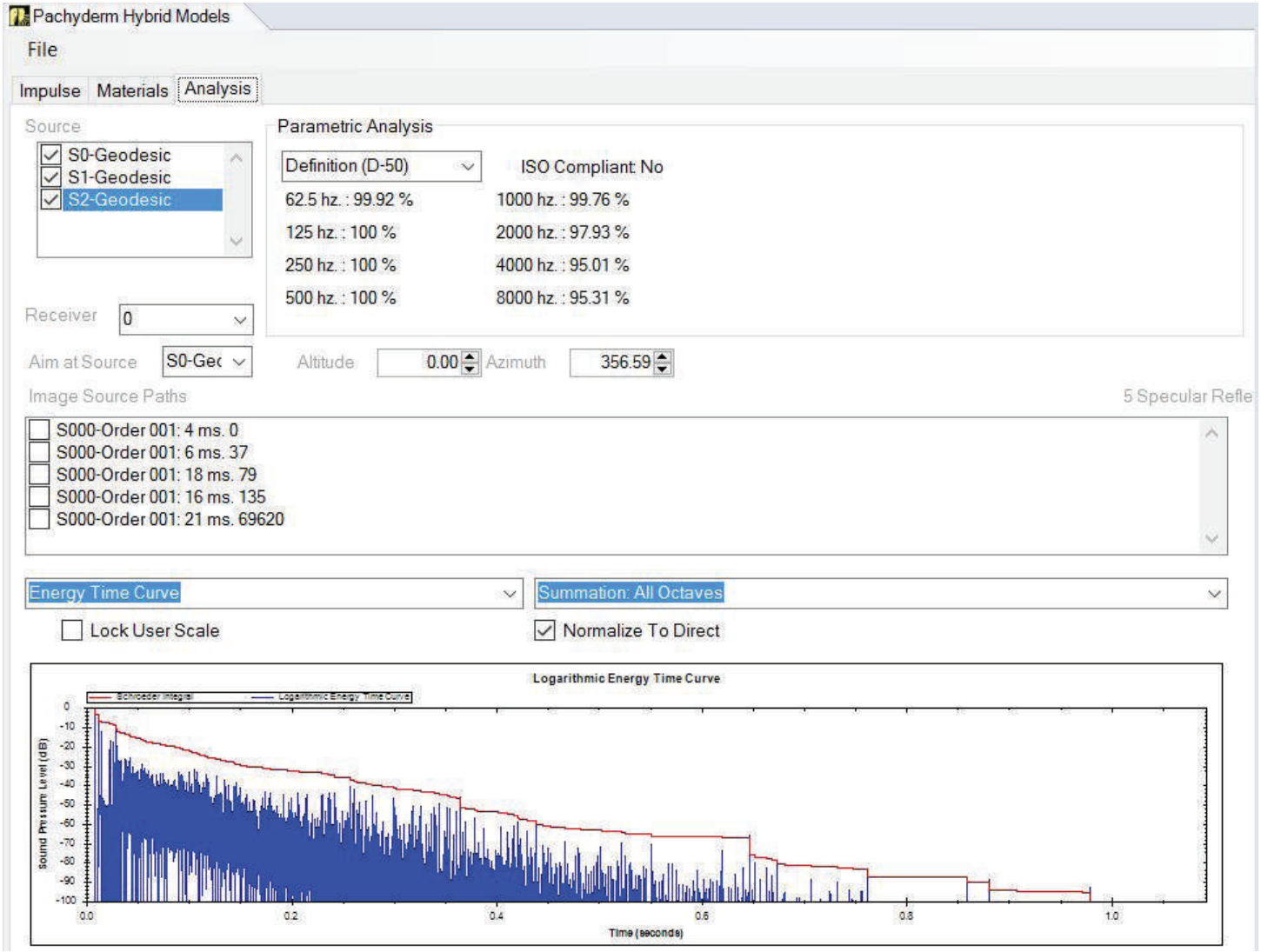
UDELUFT	Sommer		Vinter	
Temperatur	20.0	°C	-12.0	°C
Relativ fugtighed	60	%	90	%
FRALUFT	**Sommer**		**Vinter**	
Temperatur	18.0	°C	18.0	°C
Relativ fugtighed	40	%	40	%

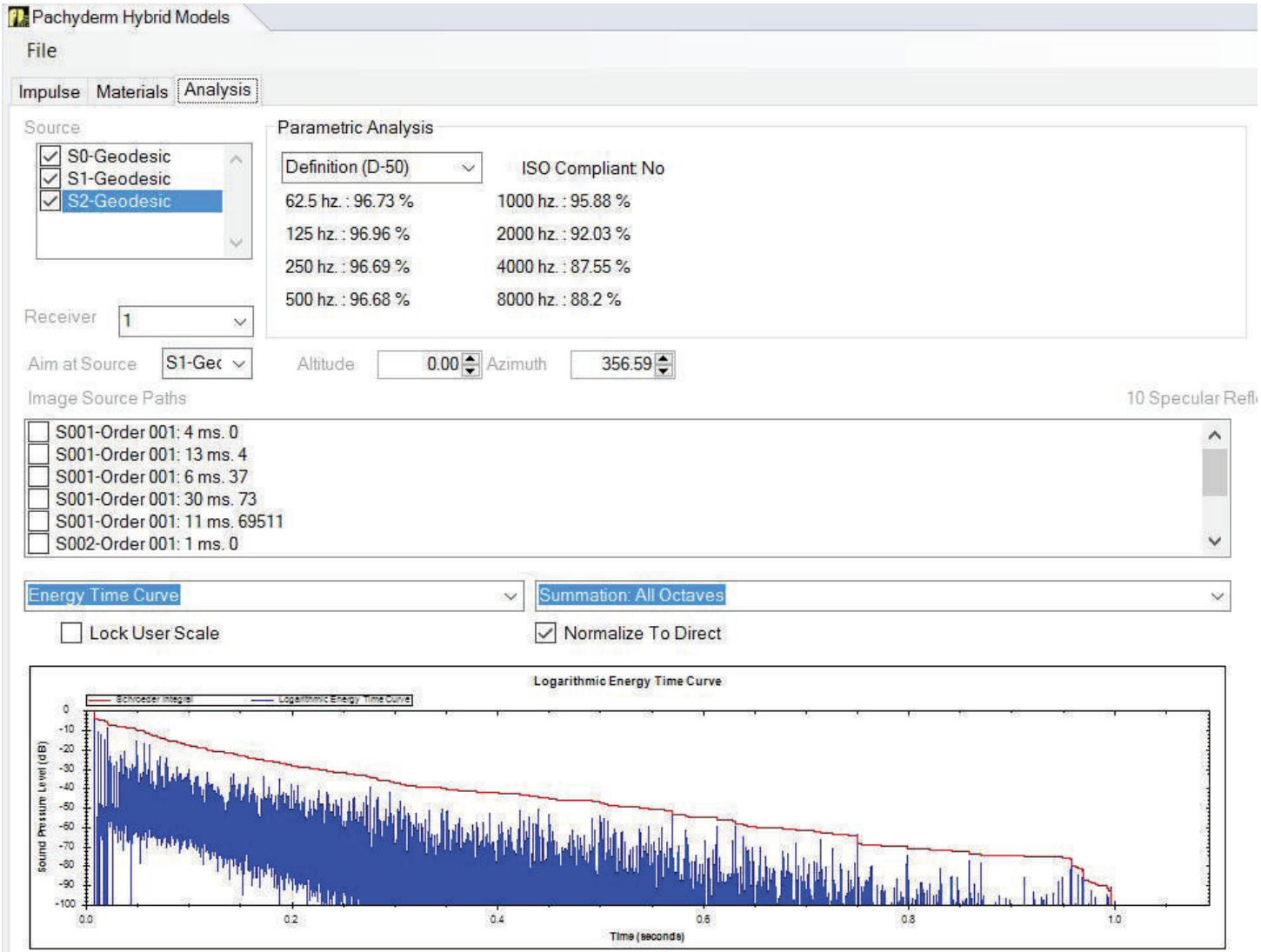


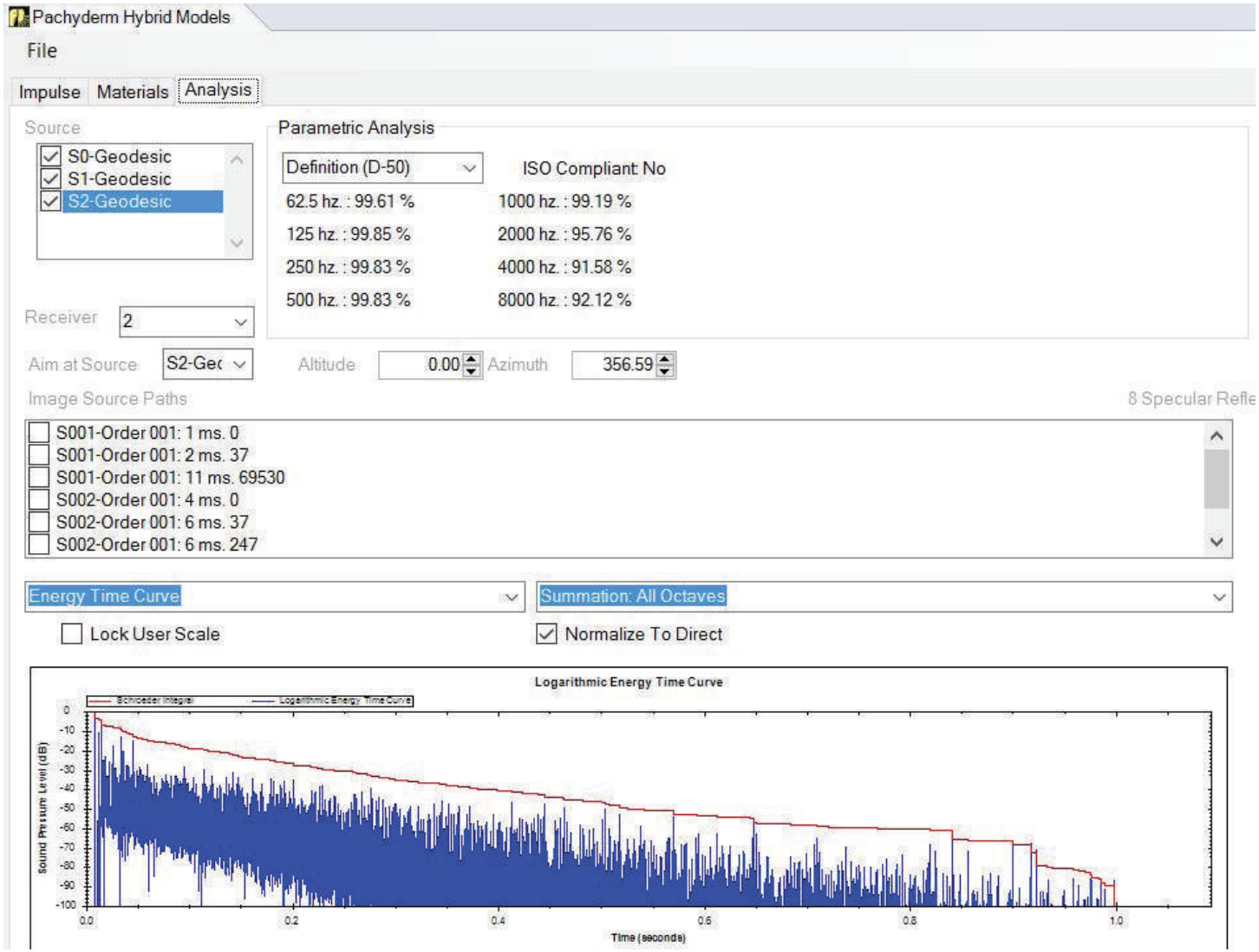
Flere aggregatdata | Tilbehør | Kommentar | Gem som standard

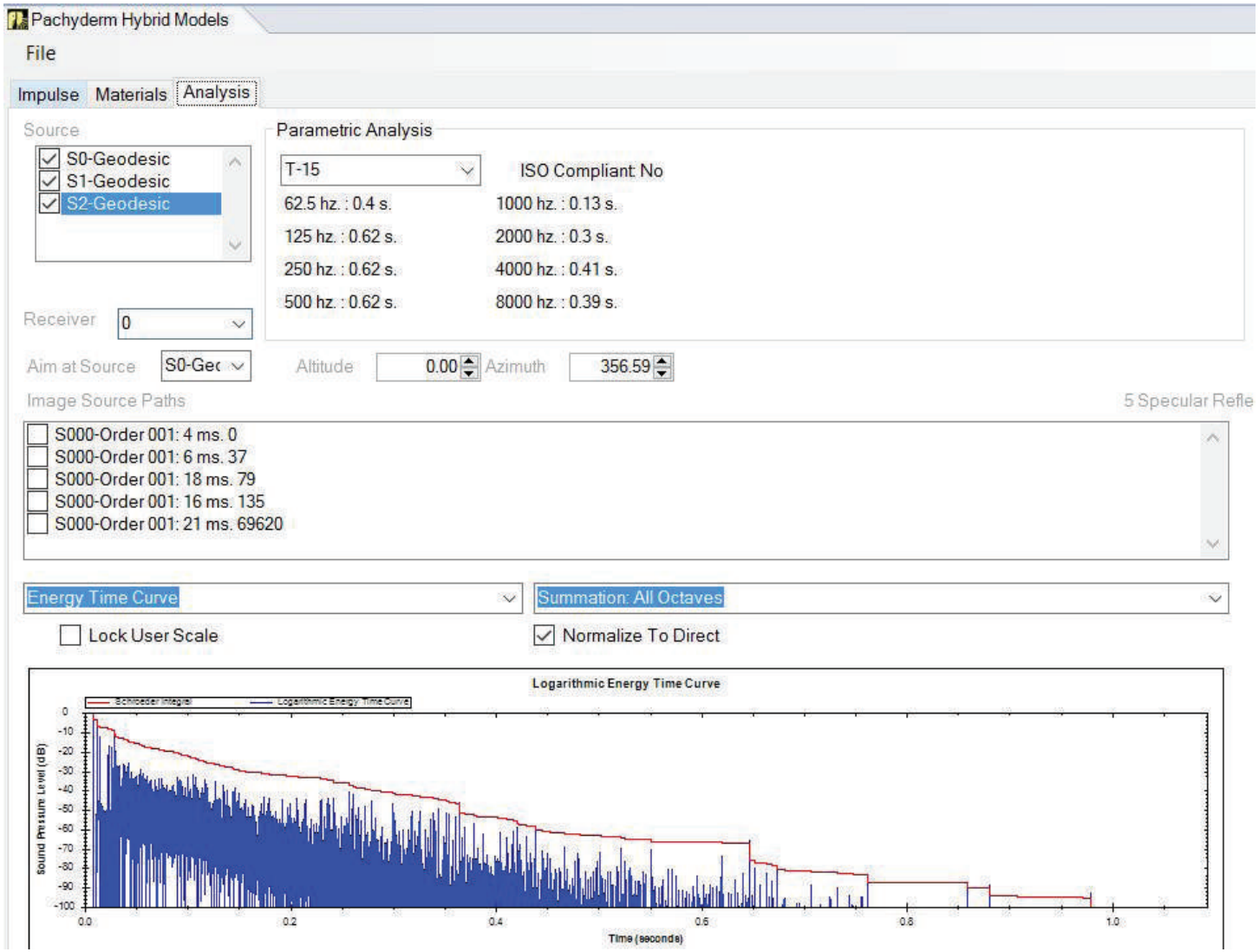
APPENDIX 6

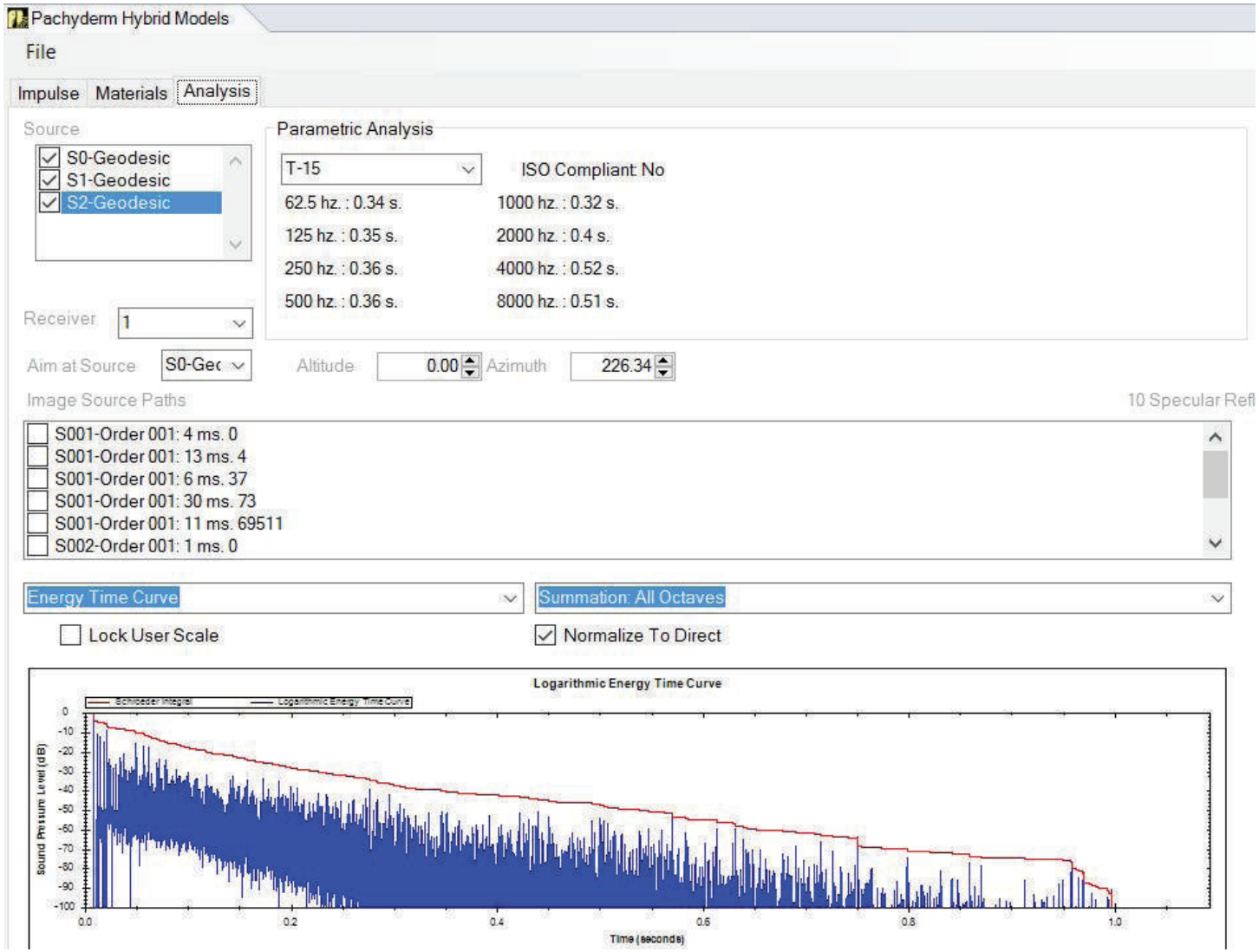
PACHYDERM DATA SHEETS

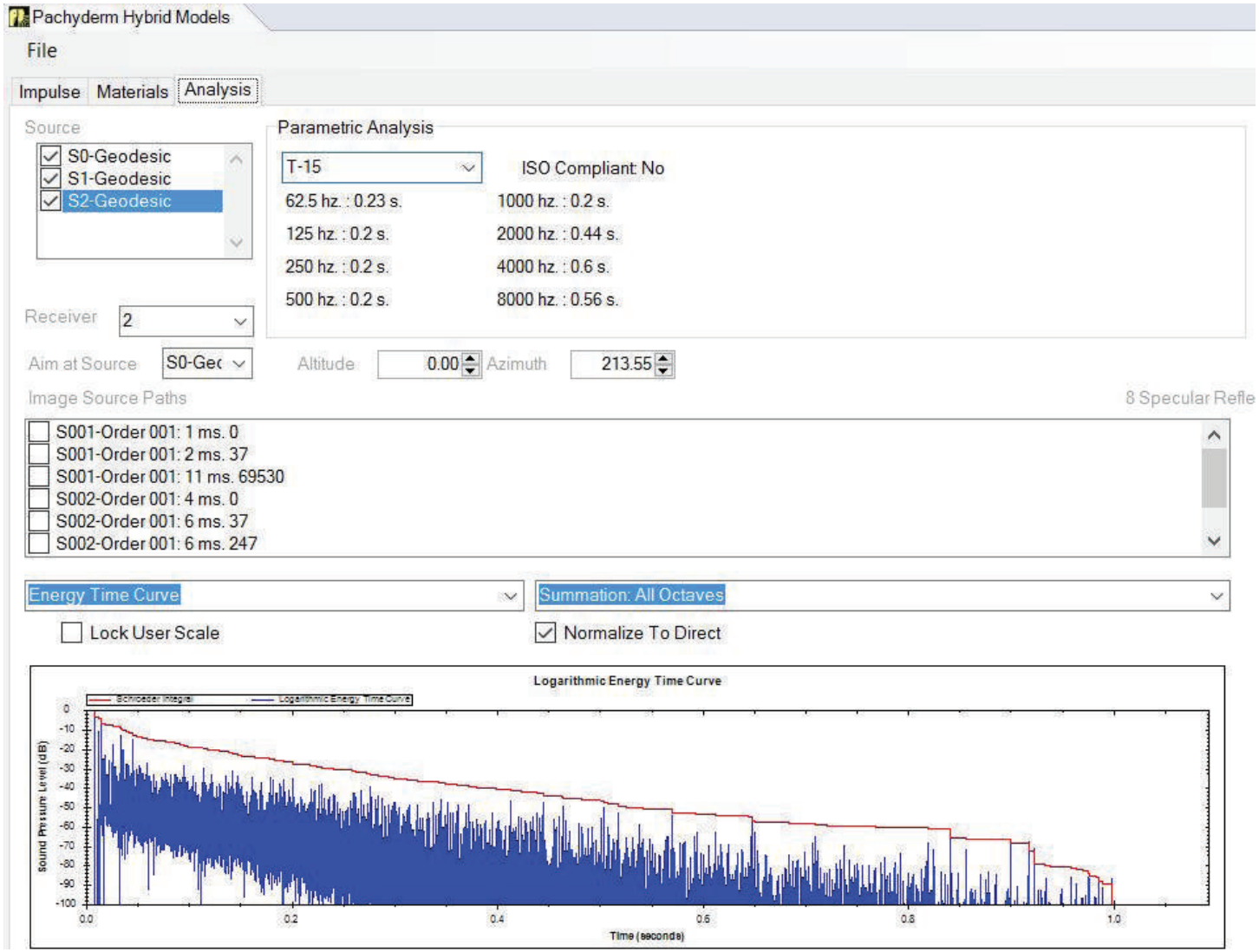



Pachyderm Hybrid Models
File
Impulse
Materials
Analysis
Source
S0-Geodesic
S1-Geodesic
S2-Geodesic
Parametric Analysis
Definition (D-50)
ISO Compliant: No
62.5 hz. : 96.73 %
125 hz. : 96.96 %
250 hz. : 96.69 %
500 hz. : 96.68 %
1000 hz. : 95.88 %
2000 hz. : 92.03 %
4000 hz. : 87.55 %
8000 hz. : 88.2 %
Receiver
1
Aim at Source
S1-Gec
Altitude
0.00
Azimuth
356.59
Image Source Paths
10 Specular Refl
S001-Order 001: 4 ms. 0
S001-Order 001: 13 ms. 4
S001-Order 001: 6 ms. 37
S001-Order 001: 30 ms. 73
S001-Order 001: 11 ms. 69511
S002-Order 001: 1 ms. 0
Energy Time Curve
Summation: All Octaves
Lock User Scale
Normalize To Direct
Logarithmic Energy Time Curve
Schroeder Integral
Logarithmic Energy Time Curve
Sound Pressure Level (dB)
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
0.0
0.2
0.4
0.6
0.8
1.0
Time (seconds)


Pachyderm Hybrid Models
File
Impulse
Materials
Analysis
Source
S0-Geodesic
S1-Geodesic
S2-Geodesic
Parametric Analysis
Definition (D-50)
ISO Compliant: No
62.5 hz. : 99.61 %
125 hz. : 99.85 %
250 hz. : 99.83 %
500 hz. : 99.83 %
1000 hz. : 99.19 %
2000 hz. : 95.76 %
4000 hz. : 91.58 %
8000 hz. : 92.12 %
Receiver
2
Aim at Source
S2-Geo
Altitude
0.00
Azimuth
356.59
Image Source Paths
8 Specular Refle
S001-Order 001: 1 ms. 0
S001-Order 001: 2 ms. 37
S001-Order 001: 11 ms. 69530
S002-Order 001: 4 ms. 0
S002-Order 001: 6 ms. 37
S002-Order 001: 6 ms. 247
Energy Time Curve
Summation: All Octaves
Lock User Scale
Normalize To Direct
Logarithmic Energy Time Curve
Schroeder Integral
Logarithmic Energy Time Curve
Sound Pressure Level (dB)
Time (seconds)

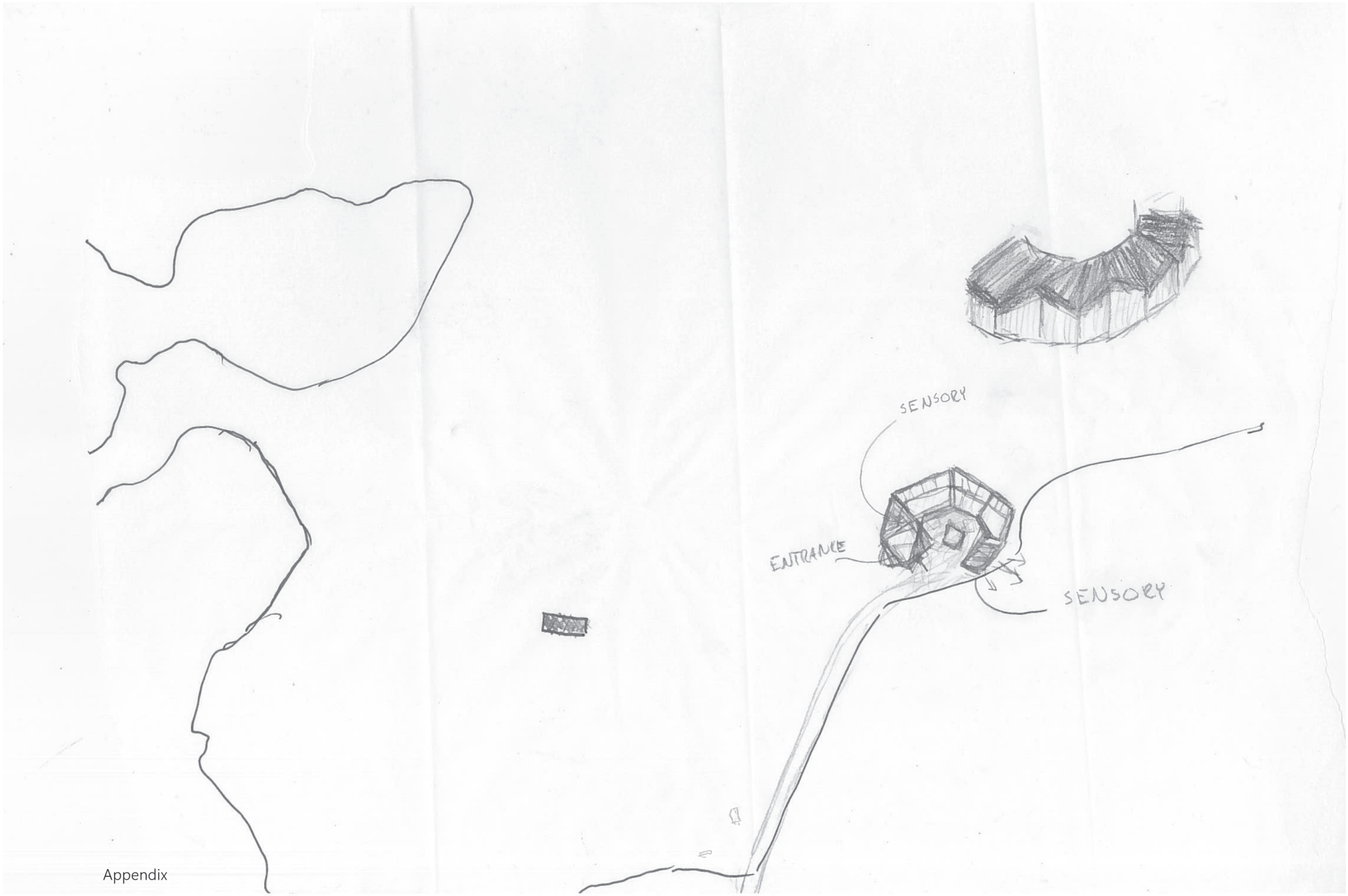

Pachyderm Hybrid Models
File
Impulse
Materials
Analysis
Source
S0-Geodesic
S1-Geodesic
S2-Geodesic
Parametric Analysis
T-15
ISO Compliant: No
62.5 hz. : 0.4 s.
125 hz. : 0.62 s.
250 hz. : 0.62 s.
500 hz. : 0.62 s.
1000 hz. : 0.13 s.
2000 hz. : 0.3 s.
4000 hz. : 0.41 s.
8000 hz. : 0.39 s.
Receiver
0
Aim at Source
S0-Geo
Altitude
0.00
Azimuth
356.59
Image Source Paths
5 Specular Refle
S000-Order 001: 4 ms. 0
S000-Order 001: 6 ms. 37
S000-Order 001: 18 ms. 79
S000-Order 001: 16 ms. 135
S000-Order 001: 21 ms. 69620
Energy Time Curve
Summation: All Octaves
Lock User Scale
Normalize To Direct
Logarithmic Energy Time Curve
Schroeder Integral
Logarithmic Energy Time Curve
Sound Pressure Level (dB)
Time (seconds)

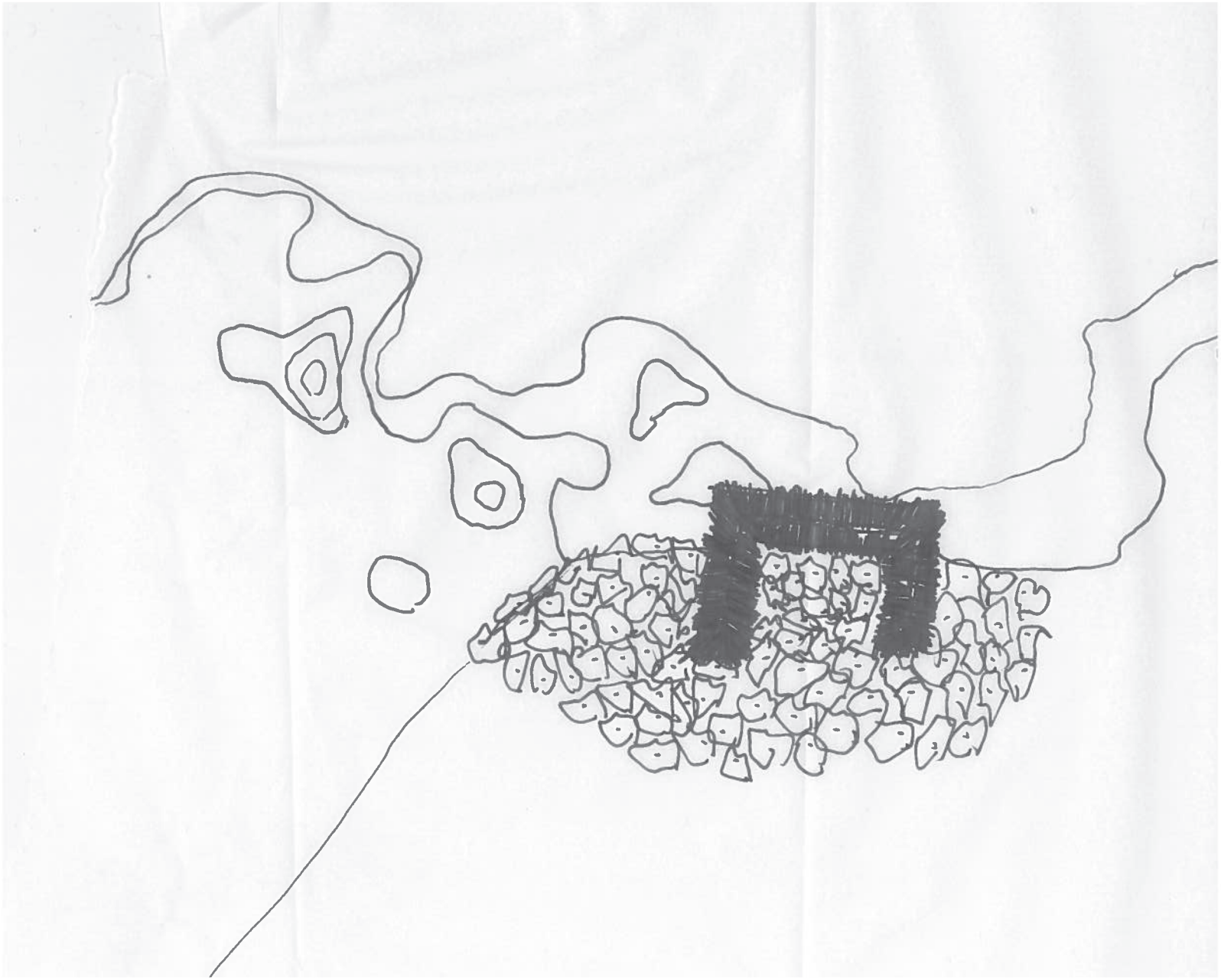

Pachyderm Hybrid Models
File
Impulse
Materials
Analysis
Source
S0-Geodesic
S1-Geodesic
S2-Geodesic
Parametric Analysis
T-15
ISO Compliant: No
62.5 hz. : 0.34 s.
125 hz. : 0.35 s.
250 hz. : 0.36 s.
500 hz. : 0.36 s.
1000 hz. : 0.32 s.
2000 hz. : 0.4 s.
4000 hz. : 0.52 s.
8000 hz. : 0.51 s.
Receiver
1
Aim at Source
S0-Geo
Altitude
0.00
Azimuth
226.34
Image Source Paths
10 Specular Refl
S001-Order 001: 4 ms. 0
S001-Order 001: 13 ms. 4
S001-Order 001: 6 ms. 37
S001-Order 001: 30 ms. 73
S001-Order 001: 11 ms. 69511
S002-Order 001: 1 ms. 0
Energy Time Curve
Summation: All Octaves
Lock User Scale
Normalize To Direct
Logarithmic Energy Time Curve
Schroeder Integral
Logarithmic Energy Time Curve
Sound Pressure Level (dB)
Time (seconds)


Pachyderm Hybrid Models
File
Impulse
Materials
Analysis
Source
S0-Geodesic
S1-Geodesic
S2-Geodesic
Parametric Analysis
T-15
ISO Compliant: No
62.5 hz. : 0.23 s.
125 hz. : 0.2 s.
250 hz. : 0.2 s.
500 hz. : 0.2 s.
1000 hz. : 0.2 s.
2000 hz. : 0.44 s.
4000 hz. : 0.6 s.
8000 hz. : 0.56 s.
Receiver
2
Aim at Source
S0-Geo
Altitude
0.00
Azimuth
213.55
Image Source Paths
8 Specular Refle
S001-Order 001: 1 ms. 0
S001-Order 001: 2 ms. 37
S001-Order 001: 11 ms. 69530
S002-Order 001: 4 ms. 0
S002-Order 001: 6 ms. 37
S002-Order 001: 6 ms. 247
Energy Time Curve
Summation: All Octaves
Lock User Scale
Normalize To Direct
Logarithmic Energy Time Curve
Sound Pressure Level (dB)
Time (seconds)

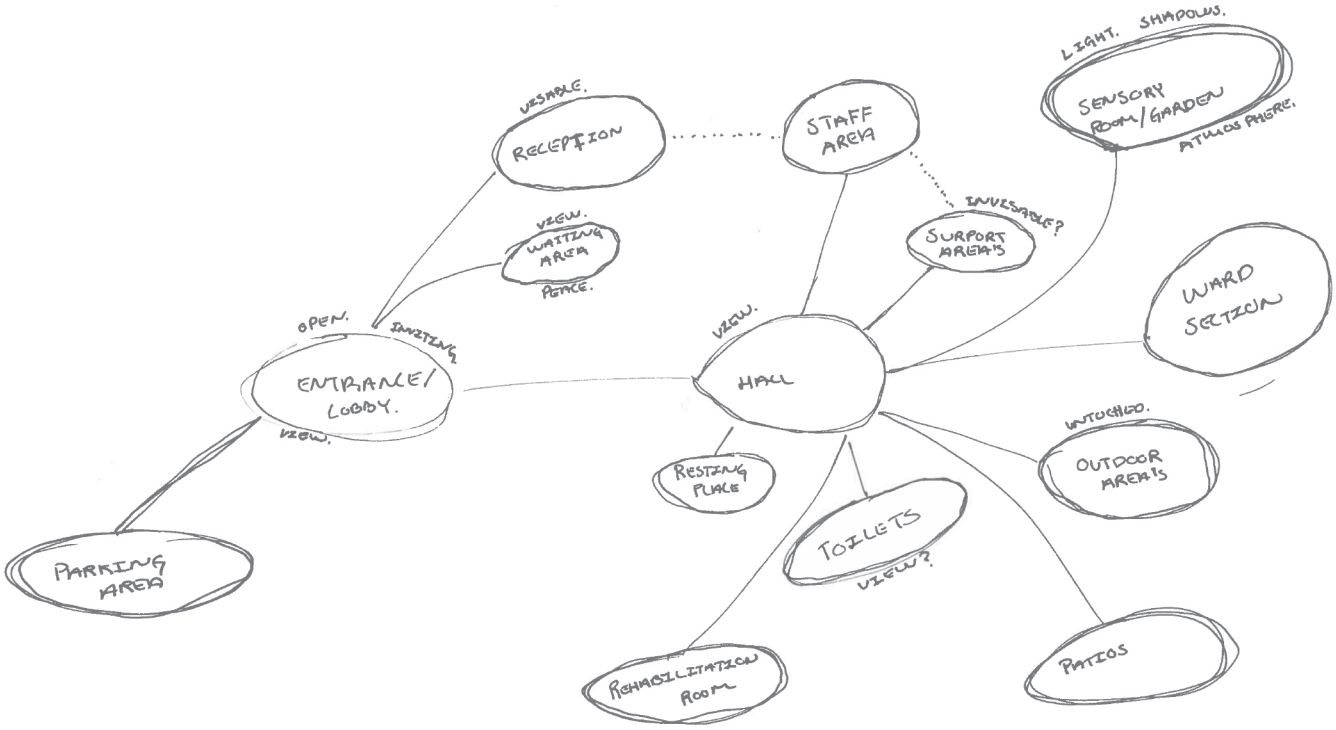
APPENDIX 7

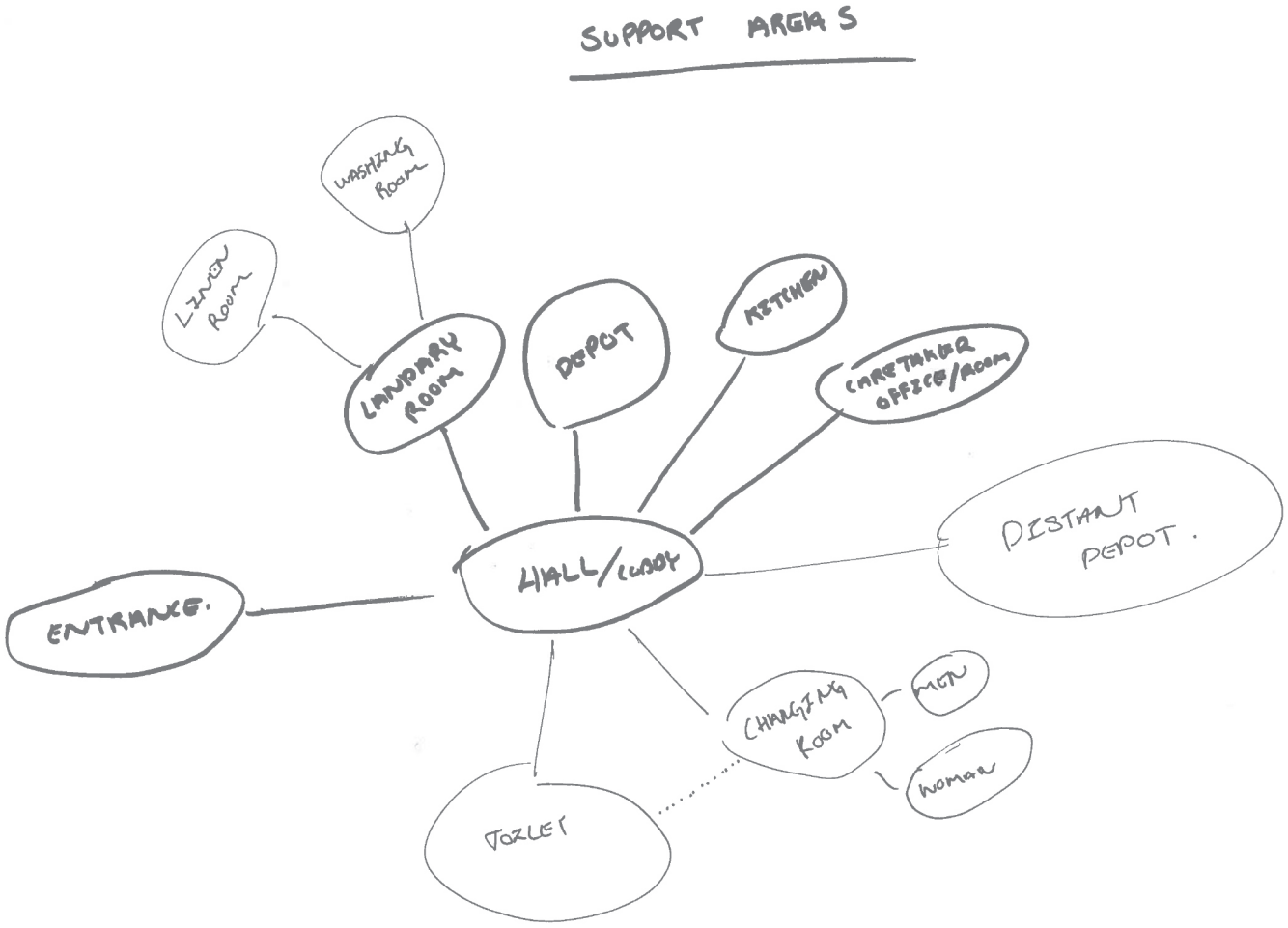
DESIGN PROCESS

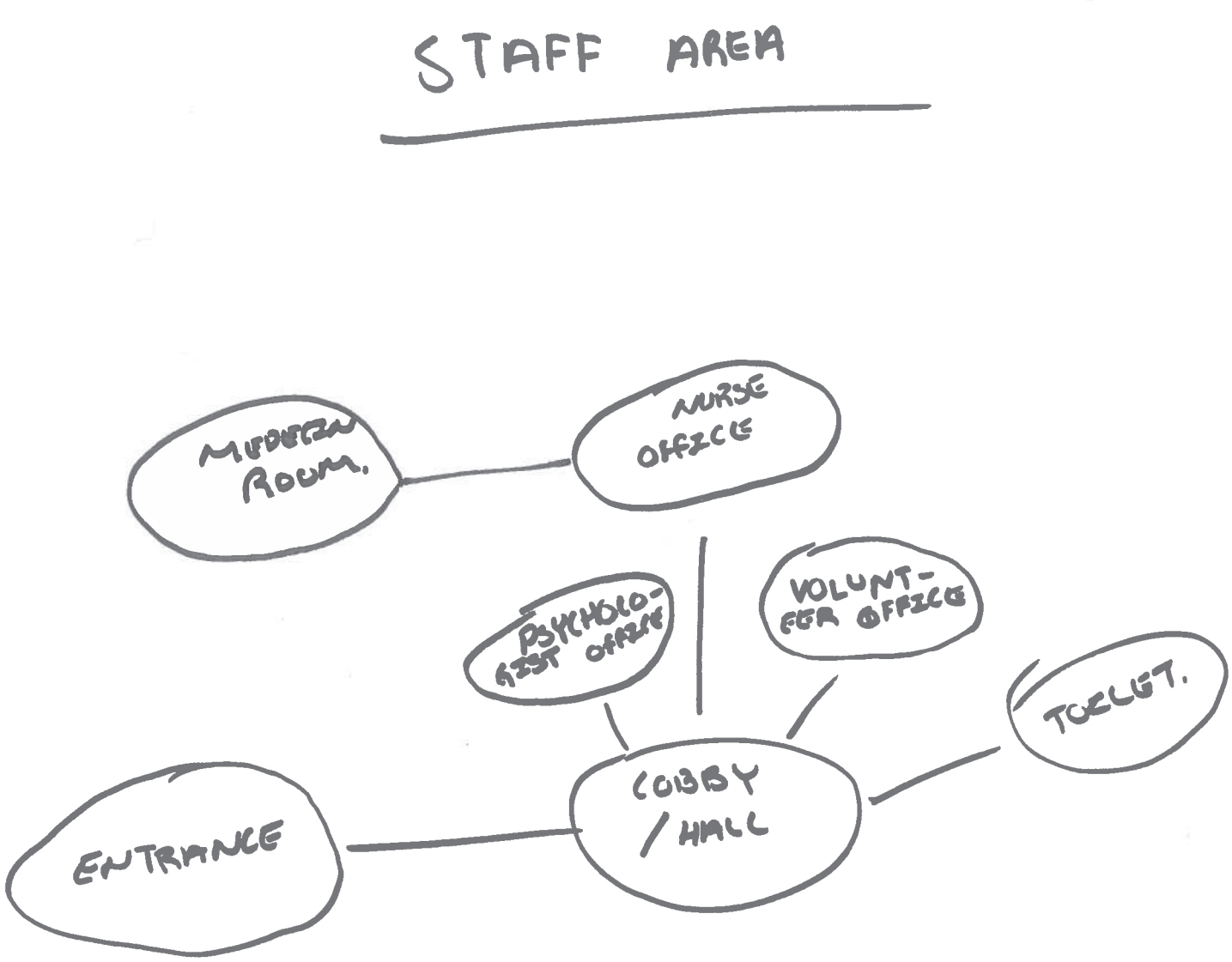


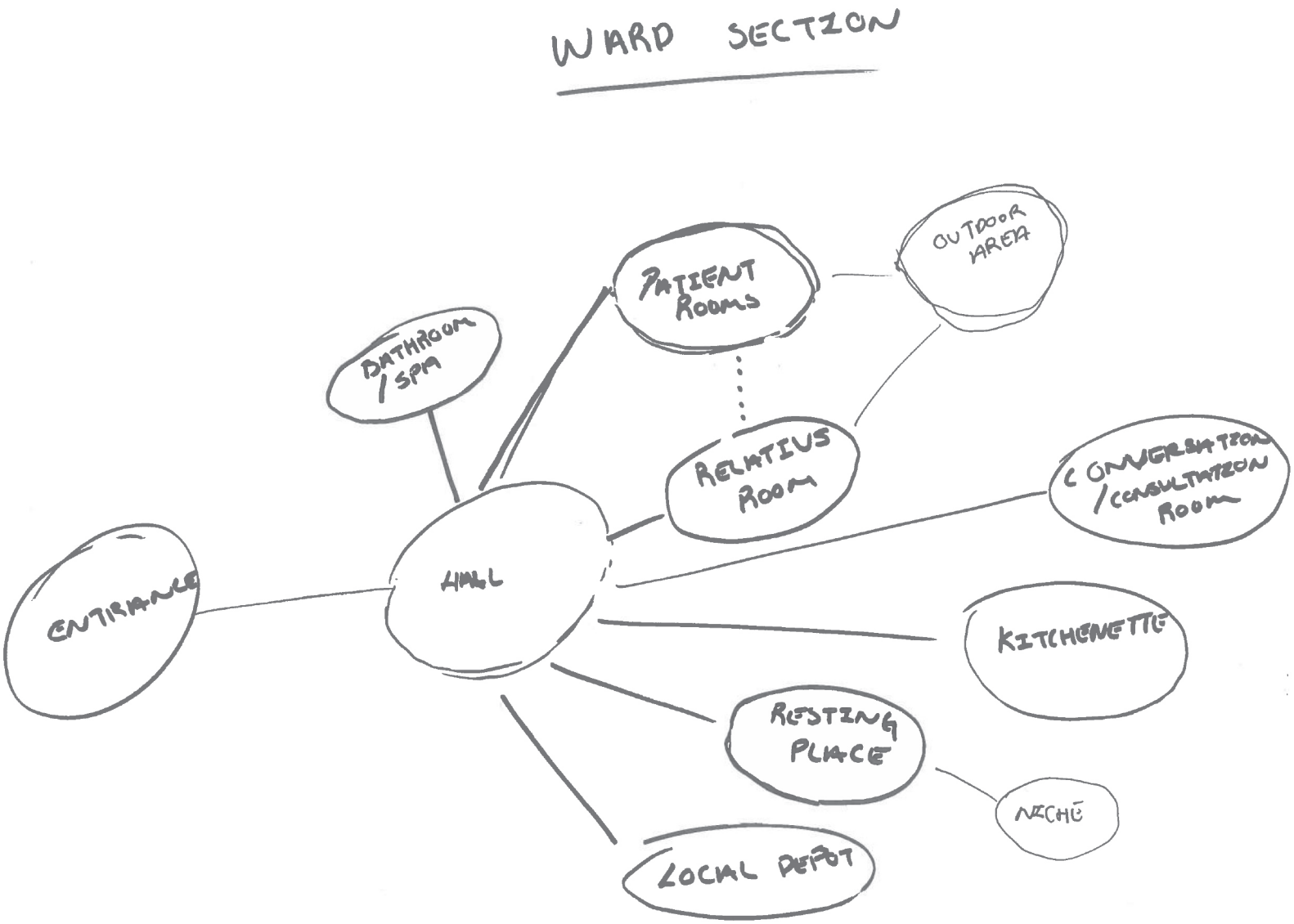


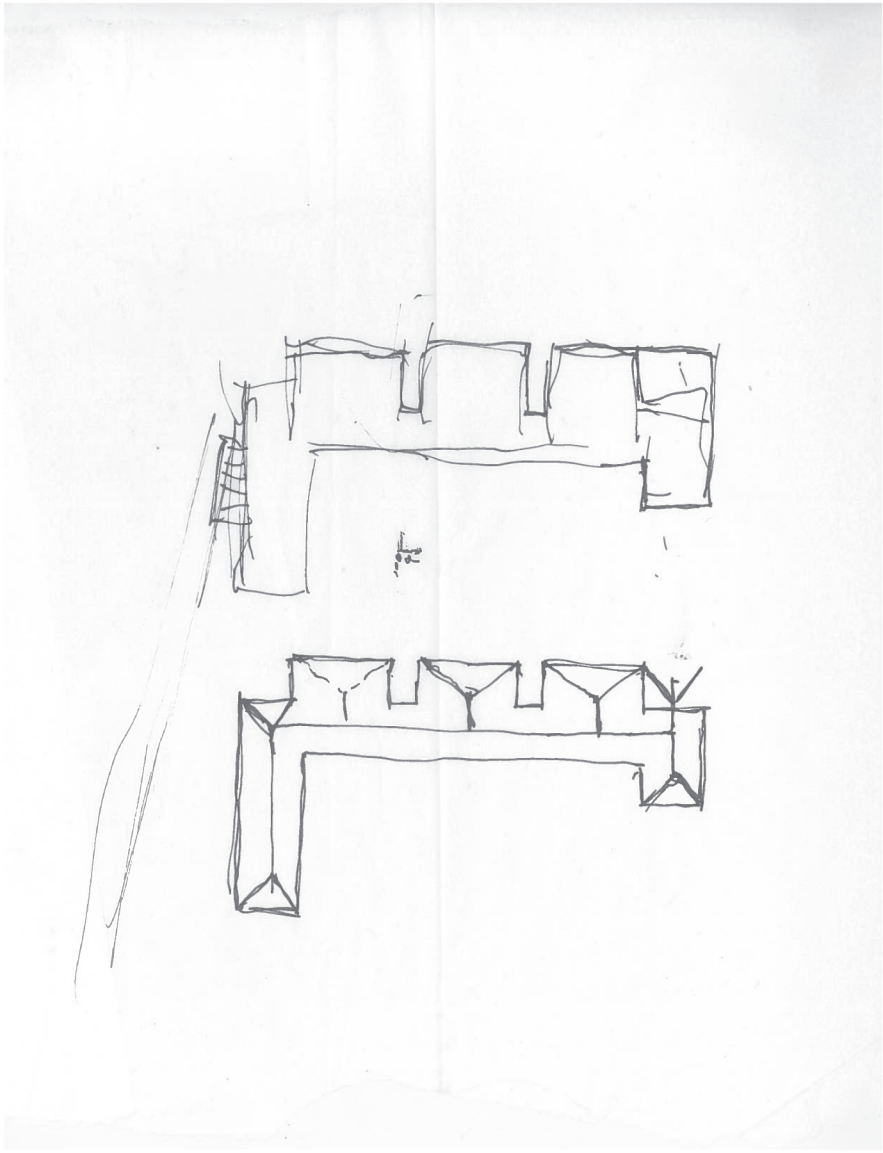
MASTER PLAN

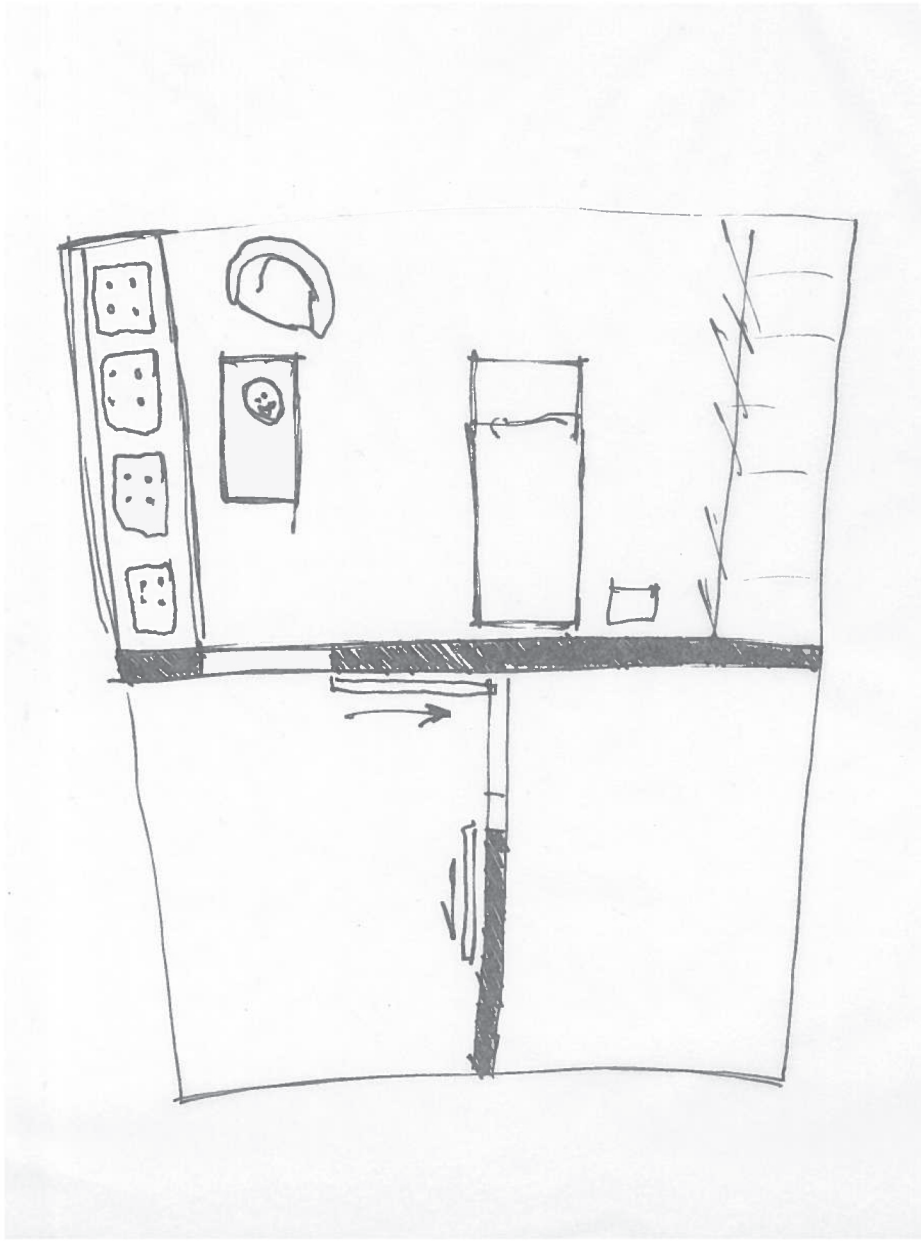

VISABLE.
RECEPTION
STAFF AREA
LIGHT. SHADOWS.
SENSORY ROOM/GARDEN
ATTACHED PHERE.
VIEW.
WAITING AREA
PEACE.
INVISABLE?
SURPORT AREAS
WARD SECTION
OPEN.
INVITING
ENTRANCE/ LOBBY.
VIEW.
VIEW.
HALL
UNTOUCHED.
OUTDOOR AREAS
RESTING PLACE
TOILETS
VIEW?
PARKING AREA
REHABILITATION ROOM
PATIOS

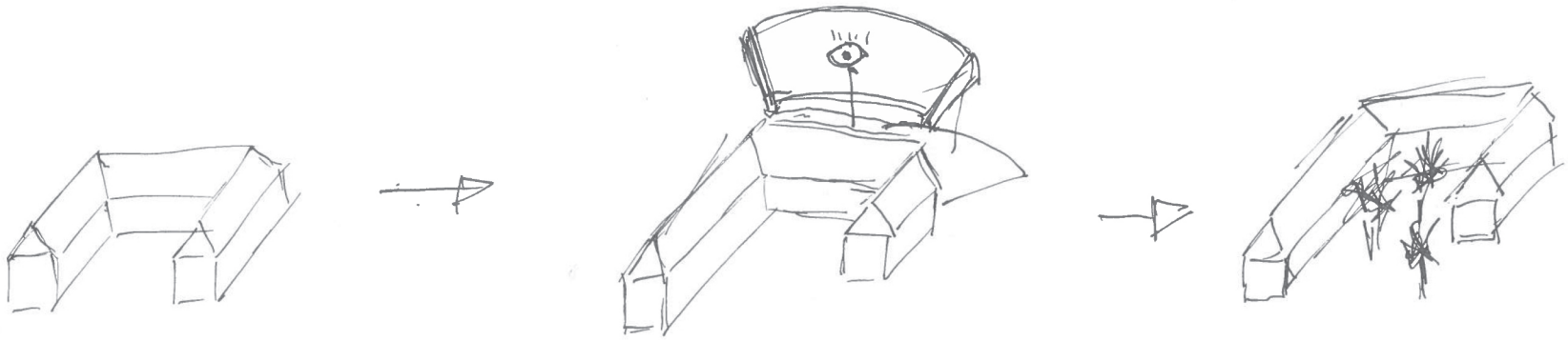

SUPPORT AREAS
WASHING ROOM
LINEN ROOM
LAUNDRY ROOM
DEPOT
KITCHEN
CARETAKER OFFICE/ROOM
HALL/LOBBY
ENTRANCE.
DISTANT DEPOT.
TOILET
CHARGING ROOM
MEN
WOMEN


STAFF AREA
MEDICINE ROOM.
NURSE OFFICE
PSYCHOLOGIST OFFICE
VOLUNTEER OFFICE
TOILET.
ENTRANCE
LOBBY / HALL

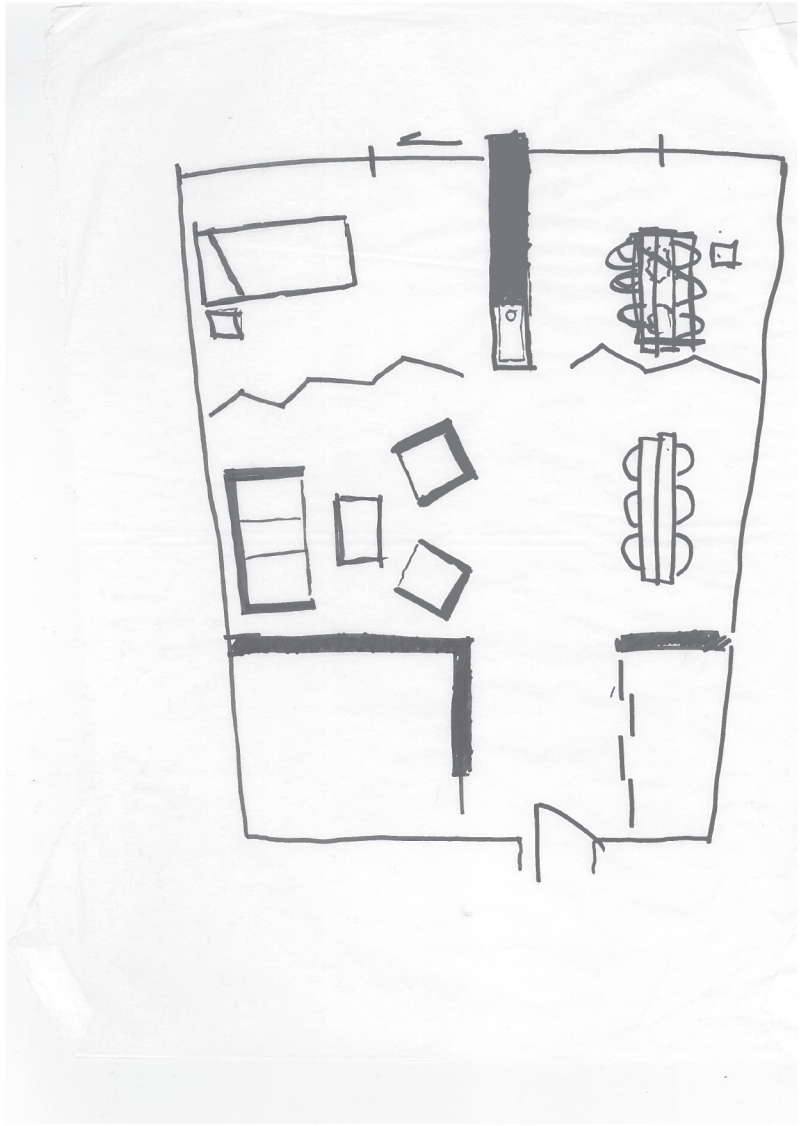

WARD SECTION
PATIENT ROOMS
OUTDOOR AREA
BATHROOM / SPM
RELATIVES ROOM
CONVERSATION / CONSULTATION ROOM
ENTRANCE
HALL
KITCHENETTE
RESTING PLACE
NICHE
LOCAL DEPOT

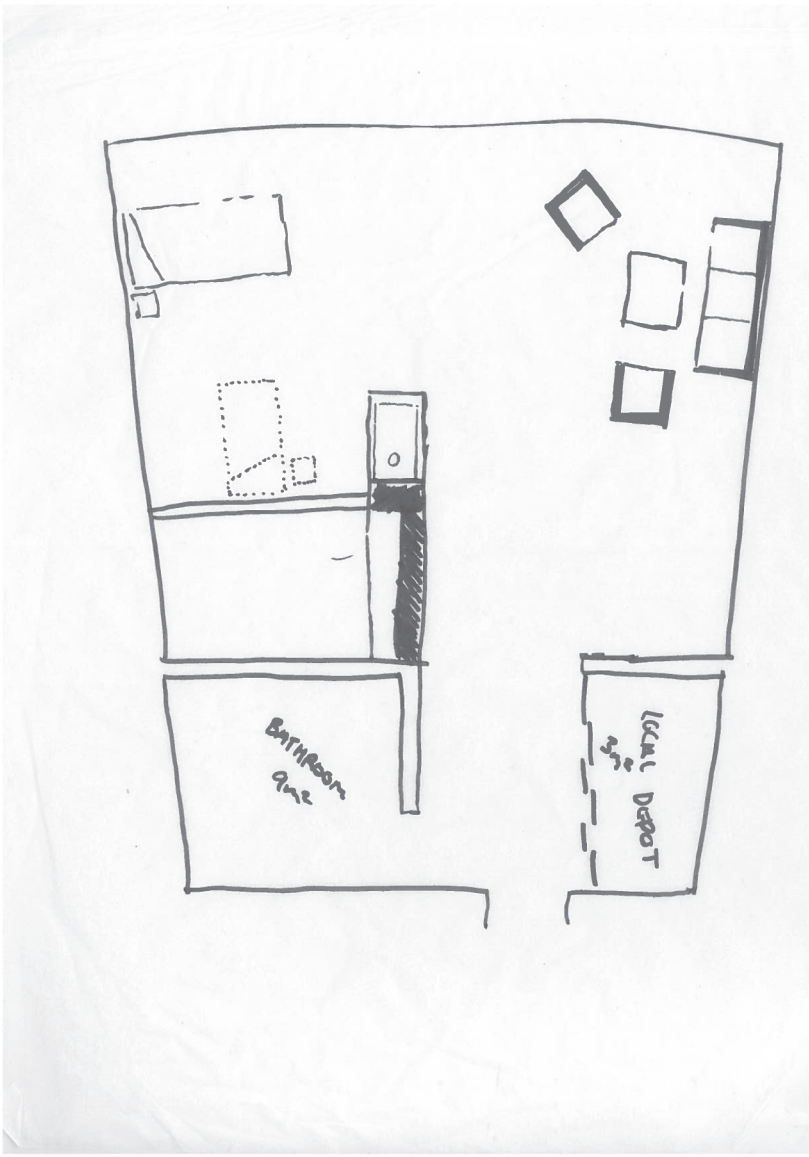


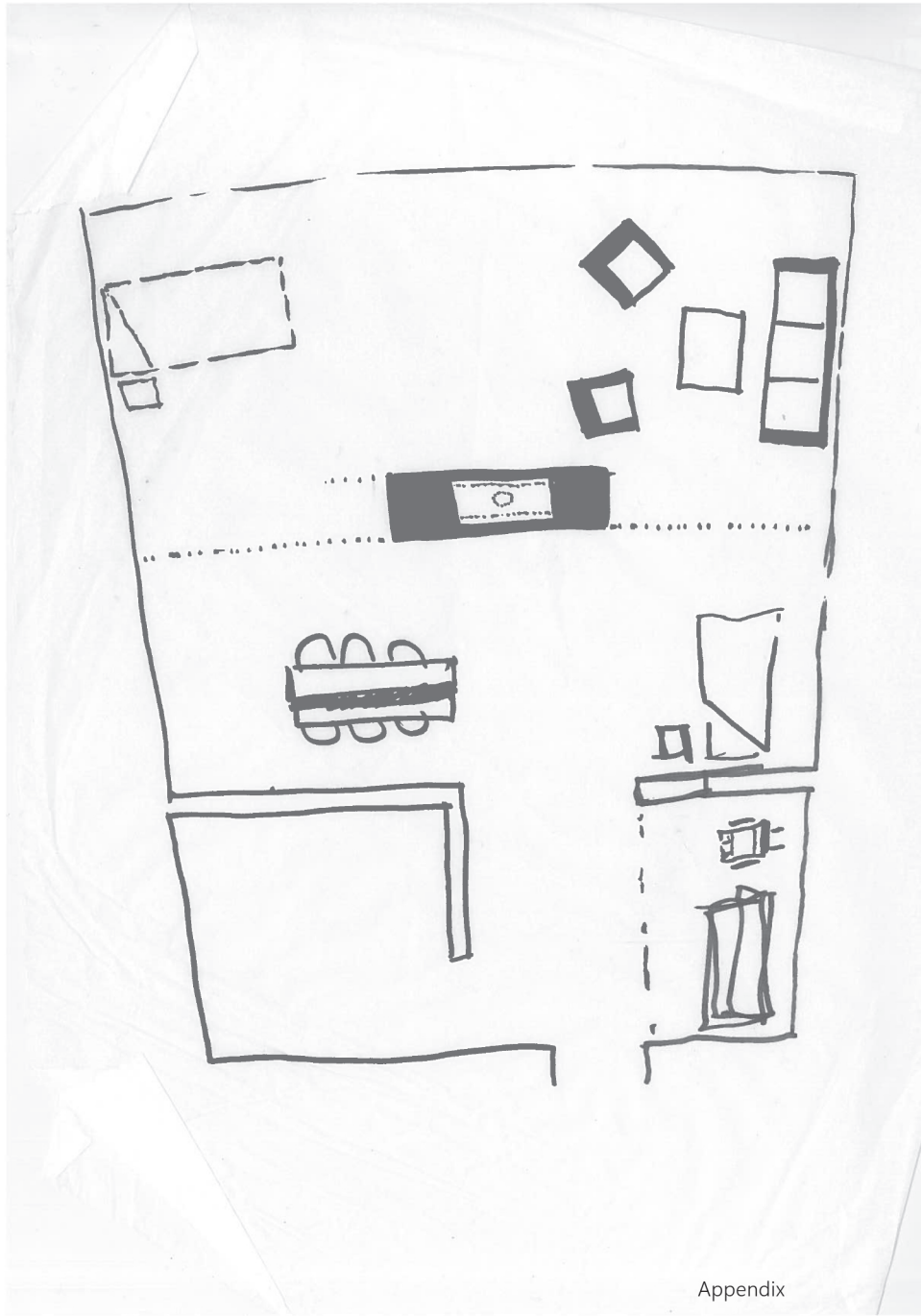


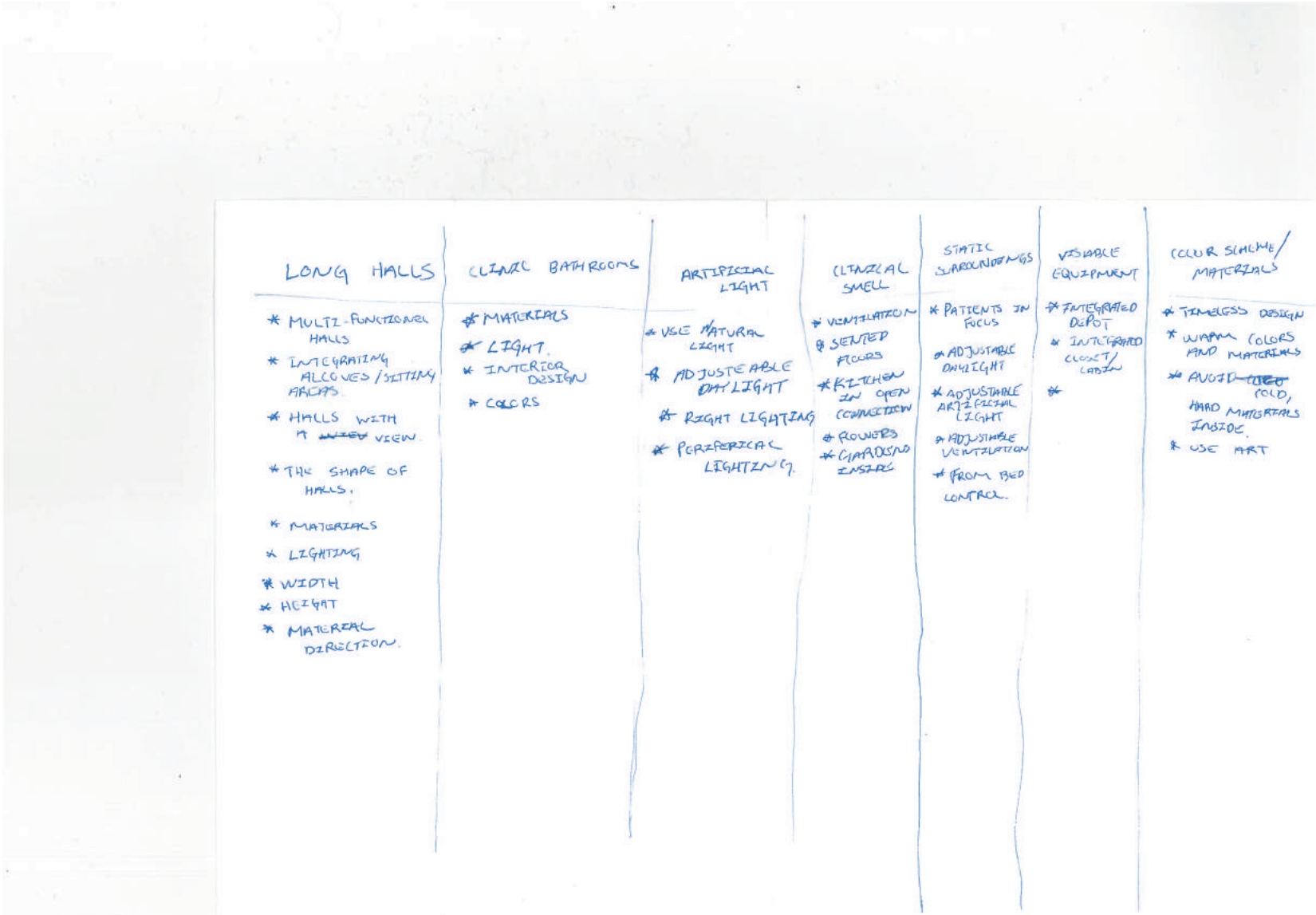


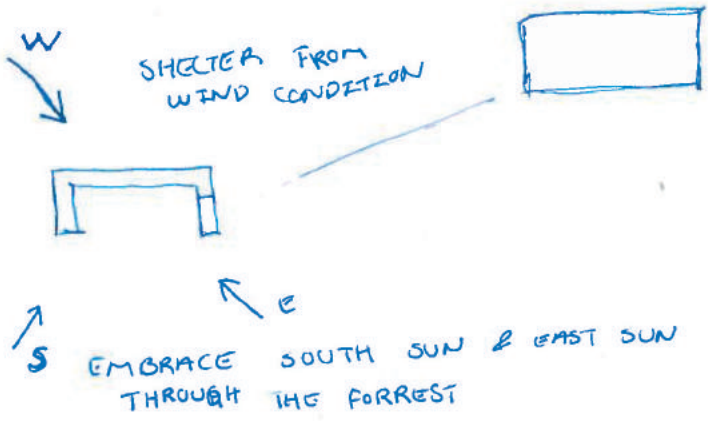

VÆRELSE
GÆSTE VÆRELSE
TOILET BAD
ENTRÉ
TOI.
G. VÆ
VÆ.

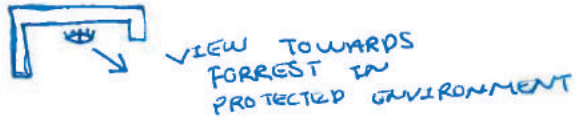


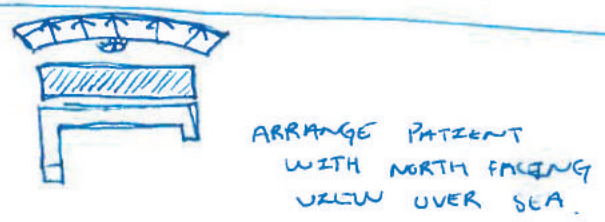

BATHROOM
LOCAL DEPOT

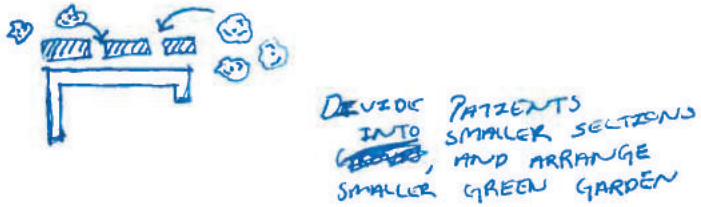


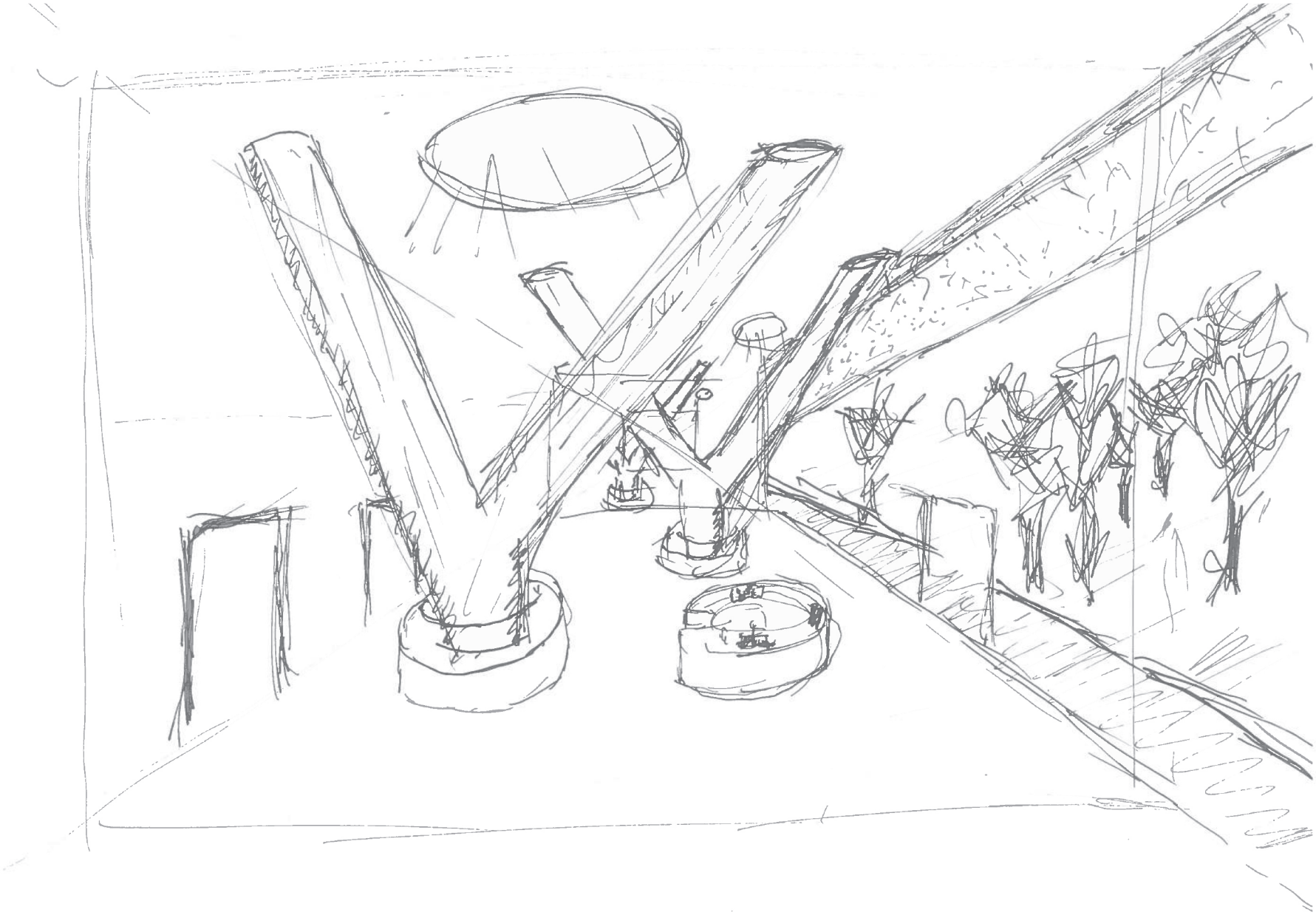

LONG HALLS
* MULTI-FUNCTIONAL HALLS
* INTEGRATING ALCOVES / SITTING AREAS
* HALLS WITH A ~~WIDE~~ VIEW
* THE SHAPE OF HALLS.
* MATERIALS
* LIGHTING
* WIDTH
* HEIGHT
* MATERIAL DIRECTION.
CLINIC BATHROOMS
* MATERIALS
* LIGHT.
* INTERIOR DESIGN
* COLORS
ARTIFICIAL LIGHT
* USE NATURAL LIGHT
* ADJUSTEABLE DAYLIGHT
* RIGHT LIGHTING
* PERIFERICAL LIGHTING.
CLINICAL SMELL
* VENTILATION
* SENTED FLOORS
* KITCHEN IN OPEN CONNECTION
* ROUNDS
* GARBAGE INSIDE
STATIC SURROUNDINGS
* PATIENTS IN FOCUS
* ADJUSTABLE DAYLIGHT
* ADJUSTABLE ARTIFICIAL LIGHT
* ADJUSTABLE VENTILATION
* FROM BED CONTROL
VISIBLE EQUIPMENT
* INTEGRATED DEPOT
* INTEGRATED CLOSET / CABIN
*
COLOR SCHEME / MATERIALS
* TIMELESS DESIGN
* WARM COLORS AND MATERIALS
* AVOID ~~COLD~~ COLD, HARD MATERIALS INSIDE.
* USE ART

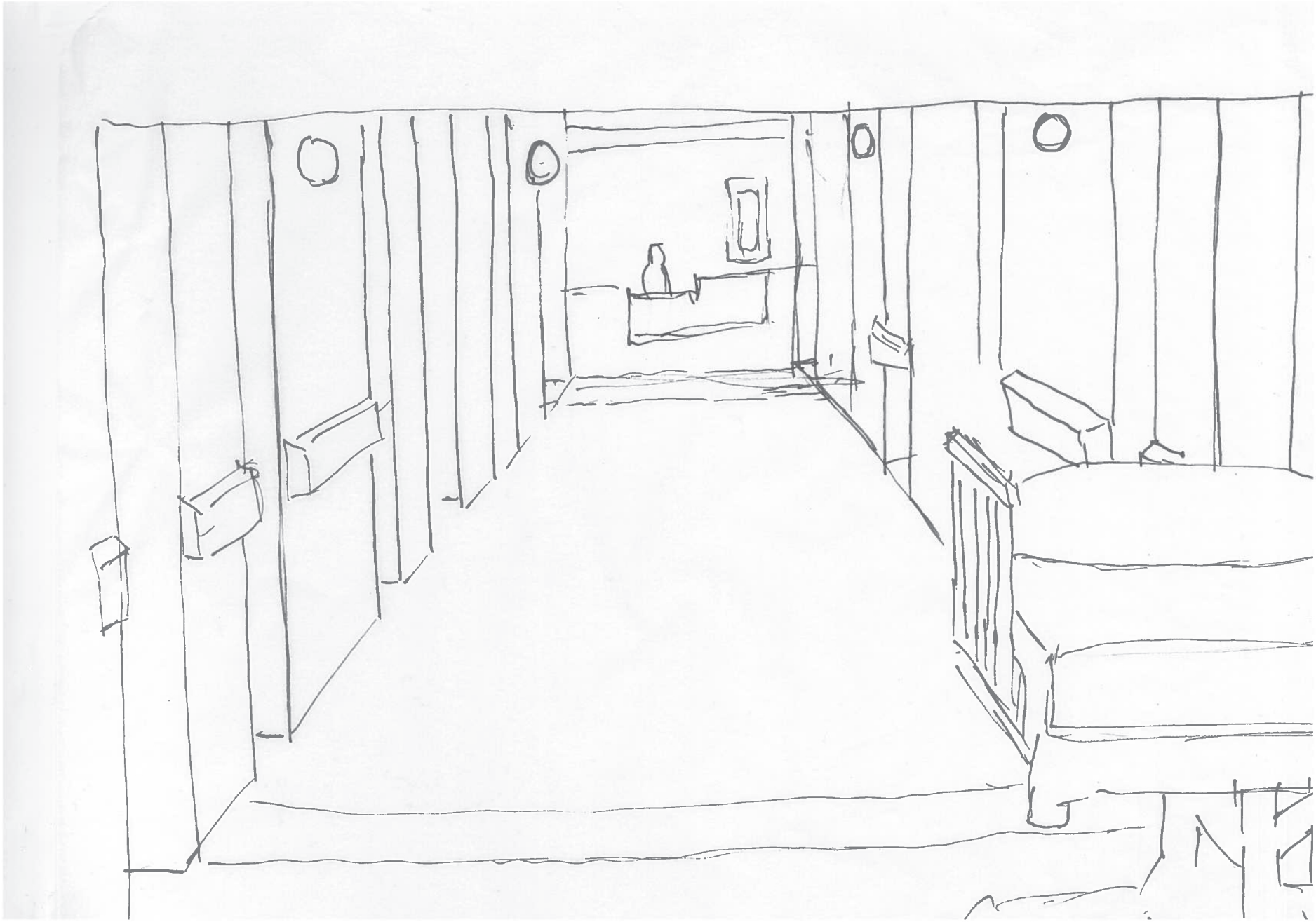

W
SHELTER FROM WIND CONDITION
E
S
EMBRACE SOUTH SUN & EAST SUN THROUGH THE FORREST


VIEW TOWARDS FORREST IN PROTECTED ENVIRONMENT


ARRANGE PATIENT WITH NORTH FACING VIEW OVER SEA.

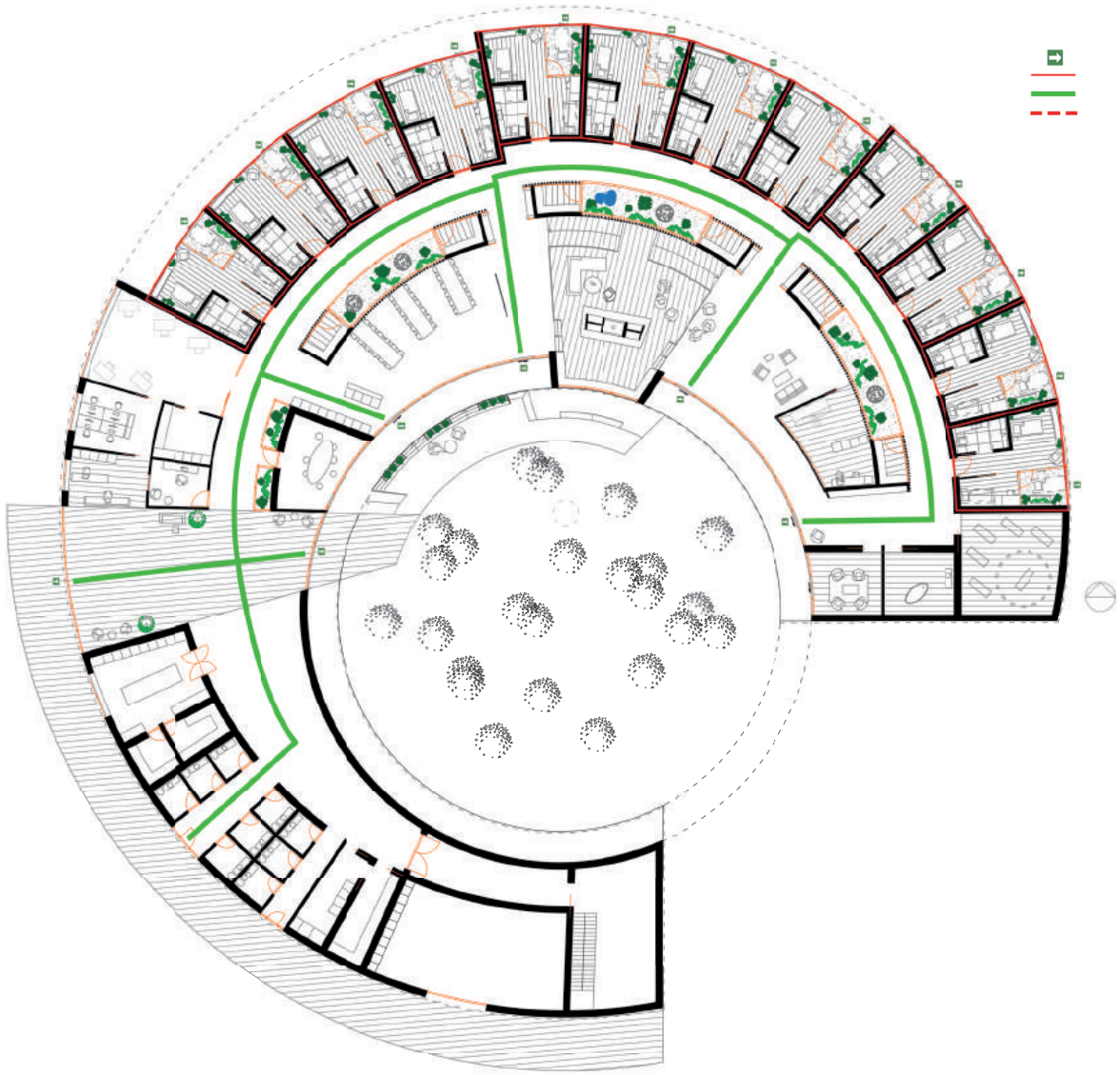

DEVIDE PATIENTS INTO SMALLER SECTIONS, AND ARRANGE SMALLER GREEN GARDEN





APPENDIX 8

FIRE PLAN



Vejledning til udfyldning af inddata i Be15 med Danfoss varmepumper

ENGINEERING TOMORROW

Be15 inddata oversigt.

Jordvarme (Test temperatur 0/35)	Nominel effekt [kW]	Nominel COP	*Rel COP, 50 % last	Særligt hjælpeudstyr	Automatisk standby [W]	ERR
Opti varmepumper						
DHP-L/H Opti 4	4,09	4,09	0,93	0	3	-
DHP-L/H Opti 6	5,33	4,04	0,93	0	3	-
DHP-L/H Opti 8	7,51	4,34	0,99	0	3	-
DHP-L/H Opti 10	9,4	4,24	0,99	0	3	-
DHP-L/H Opti 12	11	4,2	0,99	0	3	-
DHP-L Opti 16	16,4	3,99	0,93	0	3	-
Opti pro + varmepumper						
DHP-L/H Opti Pro+ 6	5,8	4,3	0,99	0	3	-
DHP-L/H Opti Pro+ 8	7,5	4,4	0,99	0	3	-
DHP-L/H Opti Pro +10	10,2	4,8	0,93	0	3	-
DHP-L/H Opti Pro +13	13	4,6	0,99	0	3	-
DHP-L Opti Pro +17	17,2	4,5	1,00	0	3	-
Light commercial						
DHP-S Eco 22	21,9	4,4	0,8	0	3	-
DHP-S Eco 26	25,4	4,4	0,8	0	3	
DHP-S Eco 33	33,5	4,37	0,8	0	3	-
DHP-S Eco 42	41,4	4,31	0,8	0	3	-

Luft/vand (Test temperatur 7/35)	Nominel effekt [kW]	Nominel COP	Rel COP, 50 % last	Særligt hjælpeudstyr	Automatisk standby [W]	ERR
DHP-AQ 6	6,5	4,3	0,93	0	3	2,2
DHP-AQ 9	8,6	4,4	0,97	0	3	2,4
DHP-AQ 11	11,1	4,7	0,93	0	3	2,5
DHP-AQ 13	12,3	4,4	0,98	0	3	2,4
DHP-AQ 16	15,2	4,1	0,93	0	3	2,3
DHP-AQ 18	17,6	4	0,93	0	3	2,3

Varmtvandsbeholder	Varmetab [W/K]
Indbygget 180 ltr (H modeller + Maxi)	1,31
DWH 200	1,31

*Beregningen af relativ COP ved 50% dellast er udført iht. EN/DS 14825 afsnit 7.5.3.1 - *Beregnings procedure for enheder med fast kapacitet.* COP værdien for temperatursættet svarende til 50% dellast er interpoleret ud fra EN/DS 14825 testpunkterne til "average" klima. Hvor degrationskoefficienten "CC" ikke er bestemt ved test, anvendes den i standarten beskrevet værdi på 0,9

31-08-16