FORMALITIES

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Synopsis

This Master Thesis presents an architectural design proposal of a Hospice situated in the outskirts of Skanderborg. The focal points of the project have been to create a relieving environment for the patients and the relatives as well by the means of the physical frames of the hospice that will represent an embodiment of the theories of Nordic and Healing architecture.

Ill. 1.1 Forest floor in blossom

1.02 //

TABLE OF CONTENT

1.03 //

METHOD

This section presents the chosen methods and tools utilized in the thesis.

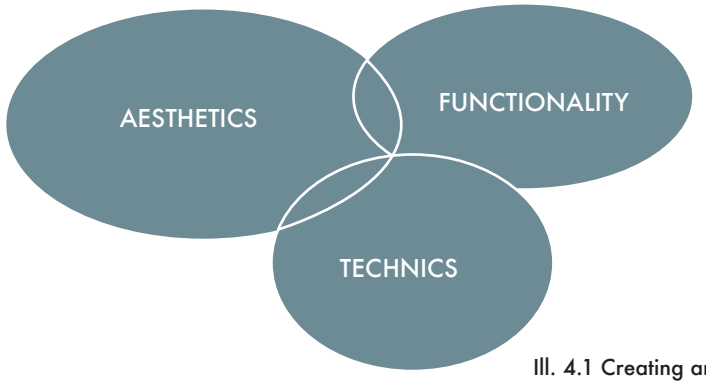
In order to create an integrated building design, this project is based on the method of the Integrated Design Process(IDP). This is a method based on how the functional, technical and aesthetical aspects should interplay. These aspects are implemented from the initial stage and are a part of the final design. In relation to this project, the three aspects are being incorporated in a Low Energy hospice, consisting of different functions that should merge together in one flow. The indoor climate and the physical frames of the hospice should furthermore enhance life qualities of the patients, while creating good conditions for a workplace.

Five phases

The Integrated Design Process is an iterative process consisting of five phases:

The process takes point of reference in the problem statement, which has been deduced from the chapter Motivation.

Following analysis consist of the different themes within hospice philosophy, Nordic architecture, Healing architecture and technical aspects. The knowledge from this analysis phase is to be used in the further development of the design in the sketching phase.



Ill. 4.1 Creating an integrated design concept

Ill. 4.2 Integrated Design Process (Knudstrup, 2004)

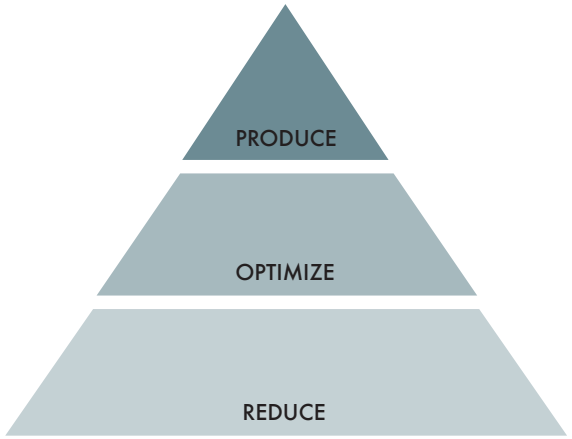
The sketching phase is where ideas and knowledge from the previous phase is being merged together in an architectural concept, which is also based on the three above mentioned aspects – functional, technical and aesthetical.

This leads to the synthesis phase, where the majority of the project is being detailed. Finally the project is being presented trough visualizations and drawing material in order to give a general overview of the project.

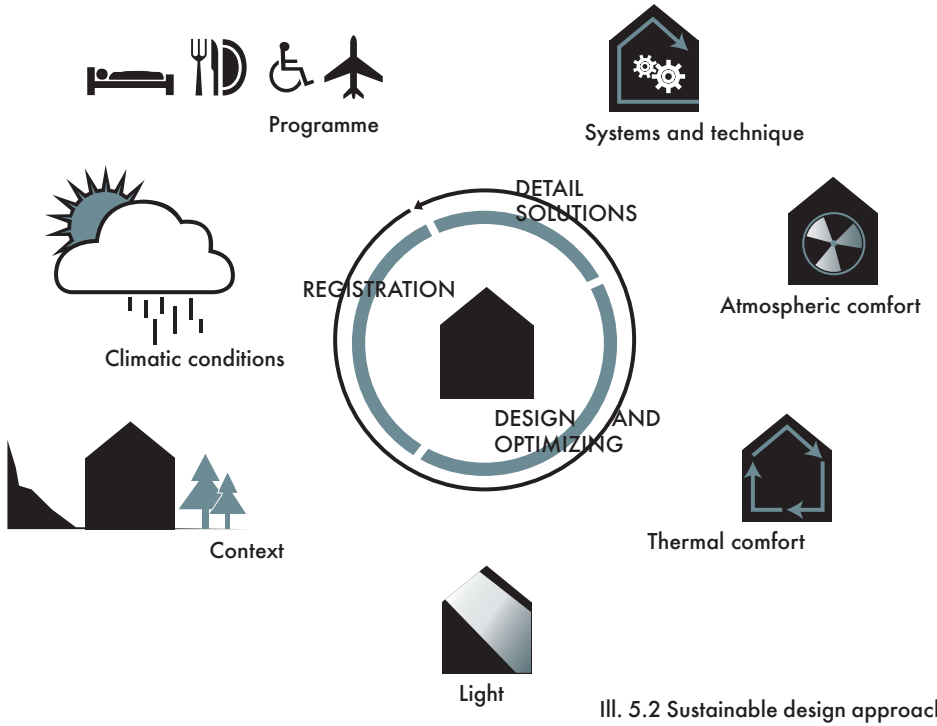
EVIDENCE BASED DESIGN

The five phases will ensure an integrated building design with an evidence-based approach. Evidence Based Design suggests that decisions made during the planning, design and construction of a built environment should be based on research and, in this case, healthcare professionals. [McCullough, C., 2009]

The chosen design strategies along with the additional literature presented in the analysis phase will form the base of the Evidence Based Design. In this manner, decisions will be based on evidence-rooted argumentations throughout the design phase.



Ill. 5.1 Sustainable design approach (HLA, 2012)



Ill. 5.2 Sustainable design approach (HLA, 2012)

Use of tools

During the five phases, different methods will be used in order to achieve an integrated design. The phenomenological approach is the predominant method, mainly during the analysis phase. This method is being used in the shape of the case studies (visiting two hospices), interviews, mapping and site analysis. During the sketching phase, both physical and 3D models are being used in order to get a spatial understanding of the sketches. Finally, in order to verify the technical goals of the indoor climate there will be elaborated Daily Average with the purpose of simulating the indoor climate during the process, where BSim is being used as a dynamic simulation of the indoor climate. To verify the achieved low energy class, according to the energy frame of the Danish Building Regulation 2020, there will be elaborated an energy consumption.

Sustainable design approach

In relation to the Integrated Design Process it is possible to describe the notion of designing sustainable as a pyramid structure (Ill. 5.1). It is important to incorporate the aspects of the energy consumption of the building early in the process in order to reduce this. If the building is rightly thought through it will give the optimum opportunities to take advantages of the passive potentials of the building according to the indoor climate and optimize the opportunity for heating, cooling, ventilation and daylight. In this way the design is energy reducing on its own, while the need is minimized. Later, the design can be optimized further by integrating technical solutions and finally the design can end up producing energy. Therefore it is important to take the necessary steps (Ill. 5.2) in the right sequence starting with a registration and analysis of the program, climatic and lighting conditions in order to start at the bottom at the pyramid and reducing the energy consumption through the initial sketches and considerations [HLA, 2012] .

1.04 //

MOTIVATION

Following topics are seen as focal points in relation to designing a hospice and are therefore seen as sources of inspiration.

STATISTICS

The first hospice in Denmark was founded in 1992 and since then 16 hospices have been established, but in the year 2013, Denmark, with approximately 200 beds, is still in need of more hospice beds.

According to Tove Videbæk from Hospice Forum Denmark, in order to become future-proof she recommends around 500 hospice beds in Denmark, in relation to the increasing amount of average hospitalization, which has increased with nearly 80 percent within 2008 – 2013 [Ritzau, 2013]. Furthermore according to statistics, the increasing elderly population with chronical diseases other than cancer, shows a critical need for hospice beds. [Pavi 1, 2012]
The statistics and the increased popular support of the palliative philosophy verify the need of hospice beds, which gives the qualifications to progression.

HEALING ARCHITECTURE

Society's increased acknowledgement of the need for hospices, has throughout recent years brought attention to the physical frame of hospices and the field within healing architecture. According to research collected by Realdania, healing architecture is used as a tool to enhance life quality and well-being of people. In relation to a hospice, healing architecture will not at least have an influence on the patients, but the relatives and staff as well. Some of the most important elements which are perceived as having a great influence are daylight, artificial lighting, acoustics, materials and colours, these are elements within the field of architecture. Furthermore, art is also seen as having a great impact on the healing process and the level of stress. Thereby it is the spatial and physical impact of senses which is center of the relieving effort. [Realdania, 2008]

NORDIC ARCHITECTURE

In correlation with healing architecture, the spirit of Nordic architecture contains some of the same features, especially the functional approach, combining light and refined materials. Another subtopic with great importance is the context – understanding the character of the place and designing a context related building. Based on this focus, it is often strived to create a relation between human and nature.

ENERGY OPTIMIZATION AND INDOOR CLIMATE

Within the last decades, there has been an increased interest of designing energy optimized buildings, therefore it is relevant to accommodate the Low Energy Class of the 2020 standards, in order to make the hospice future-proof. This stresses the need of-focusing on the indoor climate and the comfort of the patients by fulfilling the standards of category A in the patient's wards in favour of the well-being of patients.

The motivation for designing a hospice is based on a desire of creating spaces that promote the well-being of humans in the delicate and fragile situation of being terminally ill. This combined with the cherished principles of Nordic Architecture will become the foundation of the healing physical frames of a hospice.

Ill. 7.1 Forest floor

PROGRAMME

This programme concerns the necessary and most essential aspects, theories and analysis in order to create a profound understanding of the humane philosophy and beauty of a Hospice. The programme will form the basis of the final design of the Hospice.

PROGRAMME 1.0

1.6 //

PALLIATIVE CARE IN DENMARK

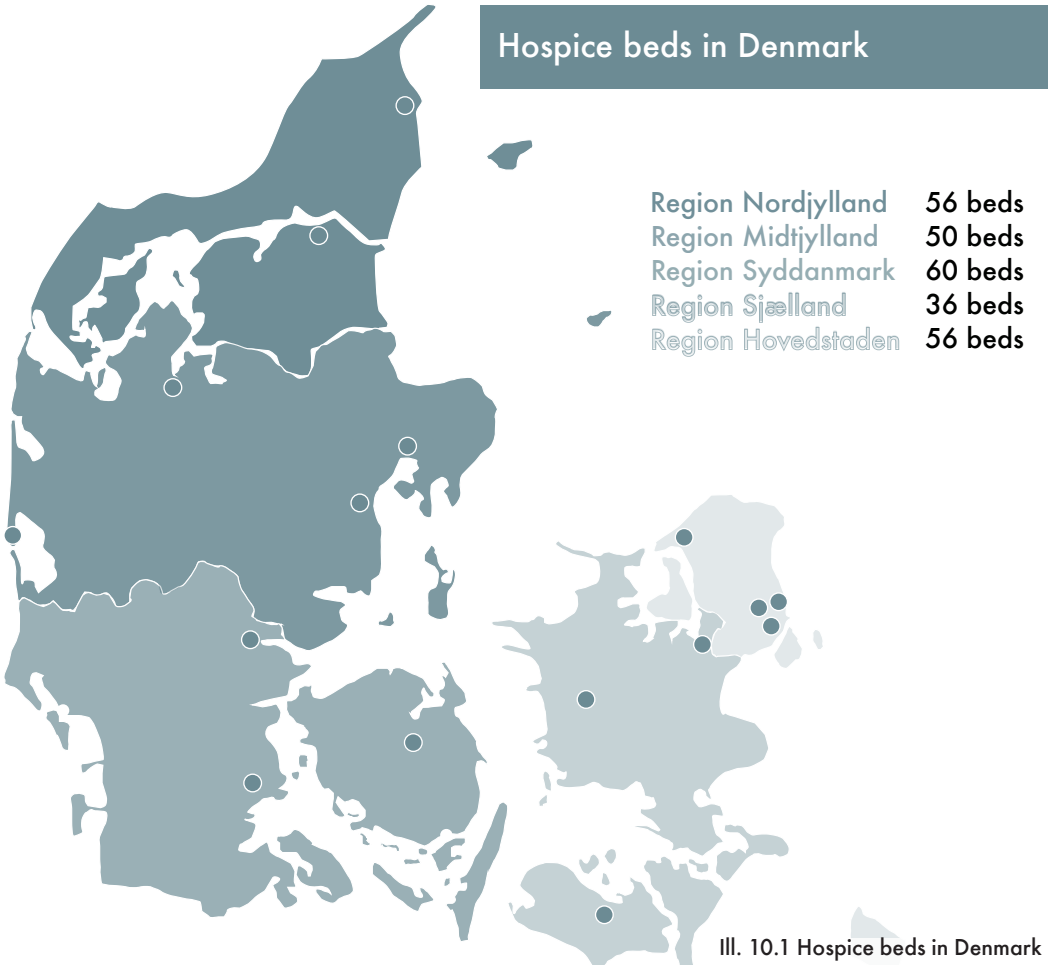
In order to give the patients of the hospice optimum conditions, it has been seen as a great advantage to gain an understanding of the concept of the palliative care and the patient profile.

"*Palliative care is an approach that improves the quality of life of patients and their families facing the problem associated with life-threatening illness, through the prevention and relief of suffering by means of early identification and impeccable assessment and treatment of pain and other problems, physical, psychosocial and spirituall*".

- WHO [WHO, 1998]

Palliative care intends neither to hasten nor postpone death, but instead it provides relief from pain and offers a support system that helps the patients through the last phase of their lives. The care will enhance quality of life and may have a positive effect on the course of illness.

In addition to providing the patient help, the support system will also provide support to the relatives and give them tools to cope with the illness of the patients and eventually death. The system therefore consists of a multidisciplinary team that integrates the psychological and spiritual aspects of care, with the intentions to address the needs of patients and their families. [Pavi 1, 2012]



Ill. 10.1 Hospice beds in Denmark

HOSPICE IN DENMARK

In the 1990's the question of hospice and palliative care was placed on the politicicans agenda and 6 years later an accession was made to the aims of the above mentioned WHO for palliative care. This treatment was to be offered to all terminally ill and dying patients, no matter location – home, hospital or hospice. From 1996 – 2001 patients had to pay for the treatment at a hospice, but due to hospice legislation the treatment became free of charge.

Multidisciplinary palliative teams were established with the purpose of assisting the patient, their relatives and professionals. The palliative team can be linked to a hospice, a palliative care unit or a hospital. From there the palliative team is available around the clock for referrals and advice. Thereby their primary assignment is a supportive and coordinating function [Realdania, 2009].

Quote from Hospice Limfjorden

"The motive for staying at a hospice is not to die, but to live until you die"

[HospiceLimfjorden, 2011]

Ill. 11.1 Family love

PATIENT PROFILE

In order to be referred for admission the patient must be suffering from a progressive life threatening disease with a short rated remaining lifetime. With 97%, cancer is one of the most common diseases seen at a hospice, because of the predictable remaining lifetime. As predictable as it might sound, it occurs in 10-20% of all patients, that the patient health improves and stabilizes, which results in discharging the patient either at home or to a nursing home. This improvement of the health is caused by the peaceful atmosphere, the sense of security and pain relief.

The majority of Danes wish to pass away in their own home, this is why most hospices are affiliated with a homecare hospice function, this with the purpose of having a collaboration between a visiting team from the hospice or hospital. But despite the wish of a homely atmosphere while passing away, around 50% die at hospitals, 25% at home and 25% at care home or institutions. The average age of the patients is around 65 and differs between 19 – 90 years. [Hospice Forum, 2012]

From this analysis there has been obtained an understanding of the treatments at hospices - how it differs from a hospital and finally there has been given insight into the patient profile. These aspects will be taken into consideration when designing, in order to support the palliative philosophy.

1.7 //

DAY CARE CENTRE

Great advantages have been experienced in day-care centers in England, which is why it is found relevant to investigate this subject.

NEW WAYS OF UTILIZING THE HOSPICE

In the future the patients will have longer courses of diseases due to the new methods of treatments. Therefore they will seek for both basic and specialized palliative care, meaning new pre-admission assessment demands, offering flexible outgoing treatments, covering most of the hours. This offer will indicate more varied patient courses, which will demand a palliative team compressive hospice, hospitals, other institutions and home care.
[Realdania, 2009]

The concept of Day Care Centre does not exist in Denmark – yet, but is widely known in England as a positive solution. Day Care Centres have primarily been founded to give patients, who are diagnosed with incurable diseases and are too well to stay at a hospice, social and therapeutic care to avoid social isolation and in the long term relieving the relatives from the burden of care. Both patients and relatives will be offered treatments much earlier in the course of the illness with an initial social approach and a development of treatment in the direction of various palliative interventions.

This change of patient base and the broader palliative care over time, will pave the way for new ways of utilizing hospices.

THE NEED OF DAY CARE CENTERS

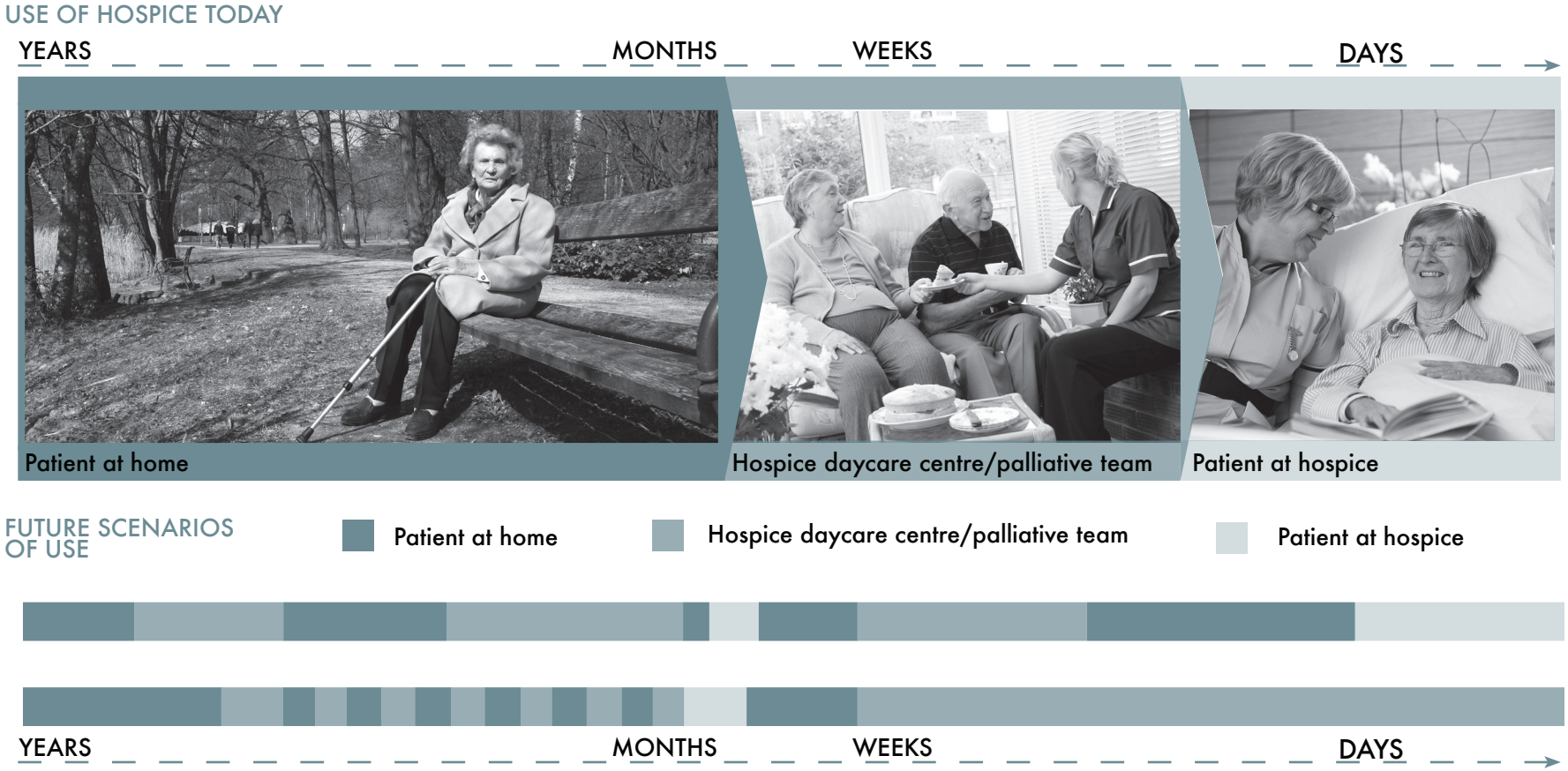
Following quote is from a nurse at an English day-care center.

"Among our participants, there was, quite often, either an inability or an unwillingness to talk to family and friends about their illness"
[Palliative Nursing, 2008]

This quote testifies that there is a need for palliative Day Care Centers. The patient does not always feel comfortable by involving relatives in their illness, and for that reason the Day Care Centers give the patient the offer of receiving treatment or just get together with people who are in the same situation and thereby creating social relations.

Furthermore, according to Programme for the Good Hospice in Denmark an estimation show that the Day Care Centers in European countries are lacking, which is why a demand for palliative care services has recommended, for every 150.000 inhabitants one Day Care Centers should be a must.
[Realdania, 2009]

Based on these arguments it is evident that there is a need of Day Care Centers in Denmark. Day Care Centers accommodating the need of the future by being more flexible, in extension to the assumed longer courses of illnesses. This may result in more flexible treatments and gathering points that will cherish the social relation between patients.



Ill. 13.1 Course of treatment now and in the future (Realdania, 2009)

1.8 //

"PROGRAMME FOR THE GOOD HOSPICE IN DENMARK"

In order to gain use of already existing studies, which have turned out positively within the field of hospice buildings, inspiration has been taken from Realdanias Programme for the Good Hospice in Denmark as the initiative source of the evidens based design approach .

The fund of Realdania initiated the project The Good Hospice in Denmark in 2005. The aim of the project was to gather the experiences gained within the hospices in Denmark, while considering new aspects of the hospice looking into the future.

The intention of the Programme for The Good Hospice in Denmark is to serve as an inspiration and a manual, ensuring that sufficient thought is being given to the intention, function and expression to the physical framework when designing or upgrading a hospice. Thereby the overriding aim of the programme is to create optimal conditions for the terminally ill, the relatives and a well functioning workplace for the staff at the hospice.

While staying at a hospice, it is obviously the initiatives in form of care, pain relief and pastoral care that is the most essential, but it is also important that the physical environment can play along and support the humane care in a difficult time. [Realdania, 2009]

When designing a hospice, most common facilities is to be designed according to the relatives needs. This became evident during an interview with Dorit Simonsen, the manager at Djursland Hospice. Most patients spend the majority of the day at the ward (ill.14.1), while the relatives often are in need of social relation and to interact with other relatives who are in the same situation. The patients are often resolved with the death, while the relatives find it harder. This is the reason for designing common areas that encourage social relation.

DESIGN PRINCIPLES

According to the Programme of The Good Hospice the physical framework has to work as an active element, contributing to an improved life quality, which is the foundation for drawing up some design principles (ill. 15.1) that gives a direction of the physical framework. The principles deals with the functional demands, the relations of different parts of the building and the varying ambience and expressions that some of the main spaces should promote.[Realdania, 2009]

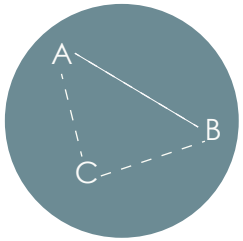
The design principle on the opposite page is chosen due to the focus on the individual user, which is seen as the pivotal focal point. Using the suggestions pointed out from the Programme for the Good Hospice in Denmark, is as an effort to establish an evidence-based design approach, which is often used in the planning, design and construction of healthcare facilities. The designer makes decisions according to healthcare professionals and information available research from project evaluations.

Ill. 14.1 Distribution of hours (Realdania, 2009)

This should result in improvements and utilization of resources. [McCullough, C., 2009]

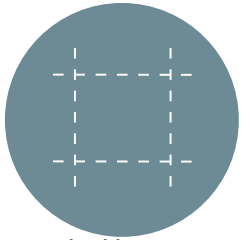
To summarize the essence of this chapter, the functions of the hospice is not only in the favour of the patient, but the relatives as well. In order to create optimal condition for the patients and relatives, there will be taken inspiration in some design principles that is being presented in the Programme of the Good Hospice in Denmark. These will be further elaborated later in the programme in order create more specific parameters dedicated to the chosen themes and theories.

The building as a whole and the relations between individual parts



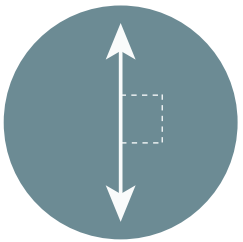
Create easy connections between A and B

Include access or incorporate green areas



Flexible areas

Avoid the feeling of being watched



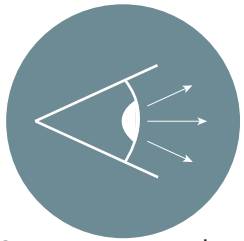
Extensions of common rooms, in the shape of intimate spaces

Common areas should encourage social relations

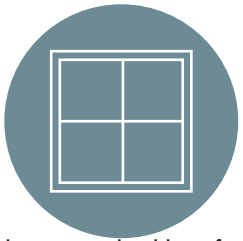
The arrangement of the ward section

Divide the wards into smaller clusters

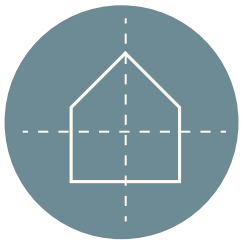
Create suitable sizes of wards – not too big



Create an opportunity to keep an eye on the life outside



The patient should not feel trapped in bed



Wards of varying sizes

Create possibility for relatives to spend the night in the ward

Staff areas

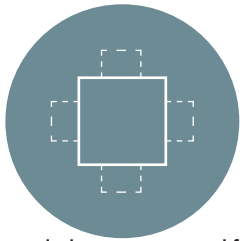
Staff in close connection to the different functions

Team based work areas

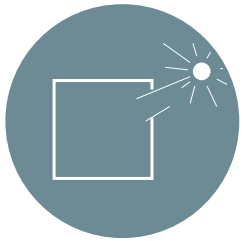
Create opportunities for dynamic meetings

Common rooms

Create a natural common function



Divide big rooms into different zones



Create a spiritual atmosphere in the room of reflection

Ill. 15.1 Selected design parameters from the Programme for the Good Hospice in Denmark (Realdania, 2009)

1.9 //

CASES

Following two case studies have been chosen to investigate due to the fact that they seemingly represents each others contradiction, both in relation to the surroundings and construction. Both of them consist of 12 patient wards, but the layout of the hospices are very different.

KamillianerGardens Hospice is placed in the dense city of Aalborg in close connection to the busy street Kastetvej. The building was not originally designed for this purpose, which is why the hospice is divided into three floors. Due to the placement in the city, there is only a limited green area in connection to the hospice, which gives only few recreational views.

Hospice Djursland is unlike KamillianerGardens Hospice placed on relatively open land, with views that are breath taking. There is a clear orientation towards the view throughout the entire layout. In relation to this, the layout is very open, which gives the functions of the hospice a certain accessibility.

The reason for choosing two hospices this diverse, is to draw similarities and contradictions and thereby gaining a broader knowledge of what it entails to design a hospice, by analyzing what is solved successfully and what is less successful. In relation to this, it is chosen to use a phenomenological approach, meaning in this case, to experience the hospices in person and interviewing the staff. Hopefully, by having experienced the atmosphere and the daily life it will create a good foundation for designing a hospice.

In order to maintain a comparable approach and making it possible to evaluate the cases on the same basis, they have been analyzed by the method "Scale as a Method". This method derives from a Ph.D. thesis made by Marie Frier Hvejsel at Aalborg University concerning how a gesture of interior can be analyzed in order to understand an architectural form as a whole. The method consists of five aspects:

- Function (explains the functional qualities of the analyzed 'gesture' in relation to the architectural whole)

- Emotion (explains the emotional qualities of the analyzed 'gesture' in relation to the architectural whole)

- Realm (explains the contextual implications of the analyzed 'geesture' in relation to the architectural whole)

- Construct (explains the constructive implications of the analyzed 'gesture' in relation to the architectural whole)

- Principle (Considers wether it is possible to extract a constructive 'principle' explaining how the analyzed 'gesture' is practically revealed)

[Hvejsel, 2011]

The method is developed with the interior as a point of reference, however, in relation to this project this method is seen as a suitable and adaptable method that can be applied on a larger scale as well. The first four aspects will then provide a profound understanding of the four topics in relation to the architectural whole, whereas the principle will be a critical extraction of the knowledge gained as a common conclusion and a manner to capture the essence of the concept.

Ill. 17.1 Winter morning at the lake

KAMILLIANERGAARDEN

REALM

Hospice Kamillianergaarden, a newly restored Danish hospice, is located in an old building of the catholic Kamillianer Order in the centre of Aalborg. Originally the building was established as an eye clinic dated back to the early 19th century since then the building has been undergoing different functions. The final alteration for what is today Kamillianergaardens Hospice, began in 1999.

FUNCTION

The institution of Kamillianergaarden is independent with its own interdisciplinary palliative team. Therefore the physical frame of the hospice has to contain a lot of functions.
The home visiting service is organizationally separated from the rest of the hospice. The home visiting department as well as the examination facilities are handled by the palliative team, which is attached to Aalborg hospital. The different competences gathered closely together gives an optimal treatment and it gives the patients and relatives a secure feeling by seeing familiar faces.

CONSTRUCTION

The hospice is restricted by the physical size of the L-shaped building from the 1900 century. That is why it has been necessary to prioritize and utilize the limited space. First of all it has been prioritized to give the 12 patient wards a reasonable size with windows towards the garden. This was followed by locations of communal rooms and support services in the remaining space. This has induced fairly big patient wards while meeting rooms and offices have limited space.

EMOTION

Entering the hospice, the first emotion coming to your mind is confusion. There is no reception and no clear direction or hierarchy of the building, therefore the building seems rather unwelcoming. You are met with closed doors from the palliative team and finally at the second floor, you find an open door. The lack of a reception is clearly in effort of avoiding an institutional feeling, but it is not successful.

The hospice is divided into three floors which minimizes the length of the hallways. Despite the division and the built-in niches, a 35 meter hallway seems rather monotonous and institutional. Furthermore, the division of the floors is seen as a disadvantages in correlation with the nurses work flow and the immobility of the patients. One advantage of the division is, that the patient wards are divided into smaller units which create a fellow-feeling.

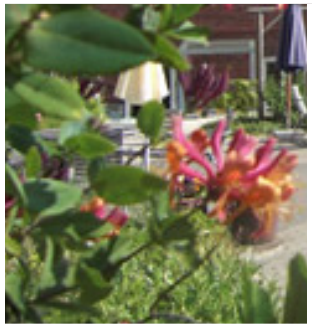
The atmosphere of the hospice is more or less melancholy without any stimulus. The garden is to be watched from the 12 wards facing the courtyard - to be watched and not to be entered. There is a lack of facilities that support the philosophy of a hospice, given a spiritual atmosphere - reflection room, a room which stimulates your senses and views which give you peace of mind.

The colors of the wards are very successful, with the light and warm colors giving a homely feeling, in relation to white institutional walls. Furthermore the built-in niches along the passageways, give the patients and their relatives the opportunity for more intimate semi-privat spaces for conversation and reading.

PRINCIPLE

Hospice KamillianerGaardens provides, with the division into three floors and the lack of a reception, a rather incoherent building, which is not in favour of the user. However, this division into floors promote a stronger fellow-feeling. There is a constant awareness of being at an institution due to the evident lack of stimuli and hierarchy.

Ill. 19.2 Patient rooms



Ill. 19.1 Kamillianergaarden, facade towards the garden

Ill. 19.3 Common area

Ill. 19.4 Play room

Ill. 19.5 Spa

Ill. 19.6 Hallways

Ill. 19.7 Dining area

Ill. 19.8 Library

1.09 // CASE

HOSPICE DJURSLAND

REALM

Hospice Djursland is situated in Rønde on the border between the urban area and the open spaces of the surrounding landscape and becomes a building within the landscape. The hospice was built as a result of a competition won by C. F. Møller in 2006, and was based upon the Programme for the Good Hospice in Denmark by Realdania.

FUNCTION

Today the hospice is a well-functioning and appealing place for the terminally ill patients as well as their relatives. Furthermore one of the most important aspects of palliative care is the notion of knowledge sharing, which is why Hospice Djursland has an incorporated multi hall used for seminars, lectures, entertainment and services from the local priest there the immovable patients can follow the services from their television. The staff is organized into teams and divided on the number of patients to reassure a continuously flow and stability through common routines and thereby comfort for the patients and relatives.

CONSTRUCTION

The building is a single story building divided into three layers consisting of an administrative layer towards north, a layer of nurses, service functions and atriums functioning as gardens of senses, and the third layer placed towards south consists of the patient wards and common areas. The layers are divided by two curved corridors and are illuminated by natural light, which minimizes the sense of long institutional hallways. Likewise, the patient room is lightened up by natural light penetrating from two sides of the room established by the utilization of skylight. The materials used are copper, glass and oak that patinate beautifully and interact with the landscape.

Ill. 20.1 Plan solution, Hospice Djursland

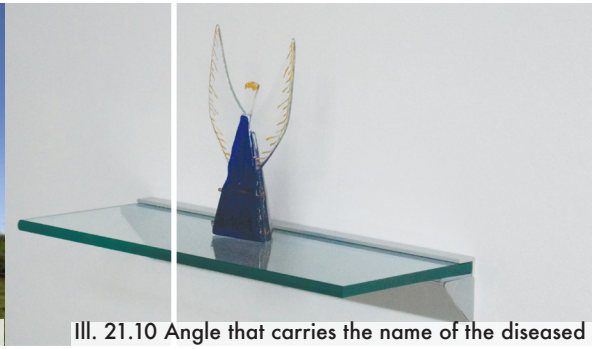
EMOTION

The strong visual contact that exists between the surrounding landscape and the inside, and the close connection and contact between the layers provides a comprehensive and clear layout that creates a whole. The framed view from the patient wards with view upon the bay and a lonely tree gives the place a sense of spirituality and belonging, while the common kitchen and the atriums appeal to the well being of the patients both psychical and physical in terms of light, smells and sounds to stimulate and activate the senses. There exists a strong community feeling between the patients, staff, relatives and volunteers, who all together create the sought atmosphere of relieve.

PRINCIPLE

Hospice Djursland provides the best possible conditions to promote the quality of life, respect and dignity, which all create the psychical and physical frames to “live until you die”. The overall experience of Hospice Djursland is that it is an embodiment of a humane building, which tries to lower the demarcation between a home and an institution and gathers both under one roof.

Ill. 21.1 Hospice Djursland



Ill. 21.10 Angle that carries the name of the diseased

Ill. 21.2 Patient room

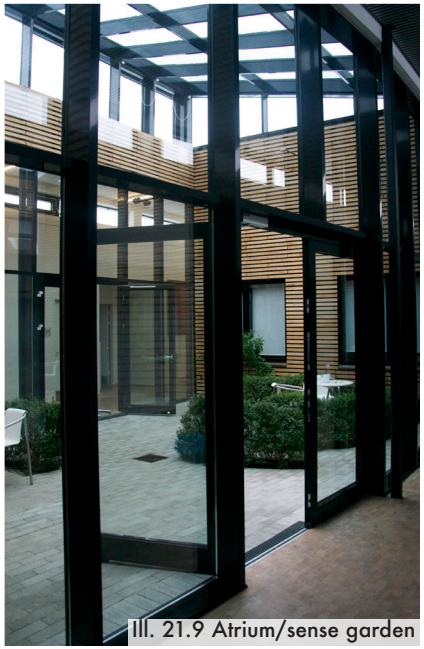
Ill. 21.3 Dining area

Ill. 21.4 Sense garden

Ill. 21.5 Spa aroma

Ill. 21.6 Spring flowers

Ill. 21.8 Hallways



Ill. 21.9 Atrium/sense garden

Ill. 21.7 Spa

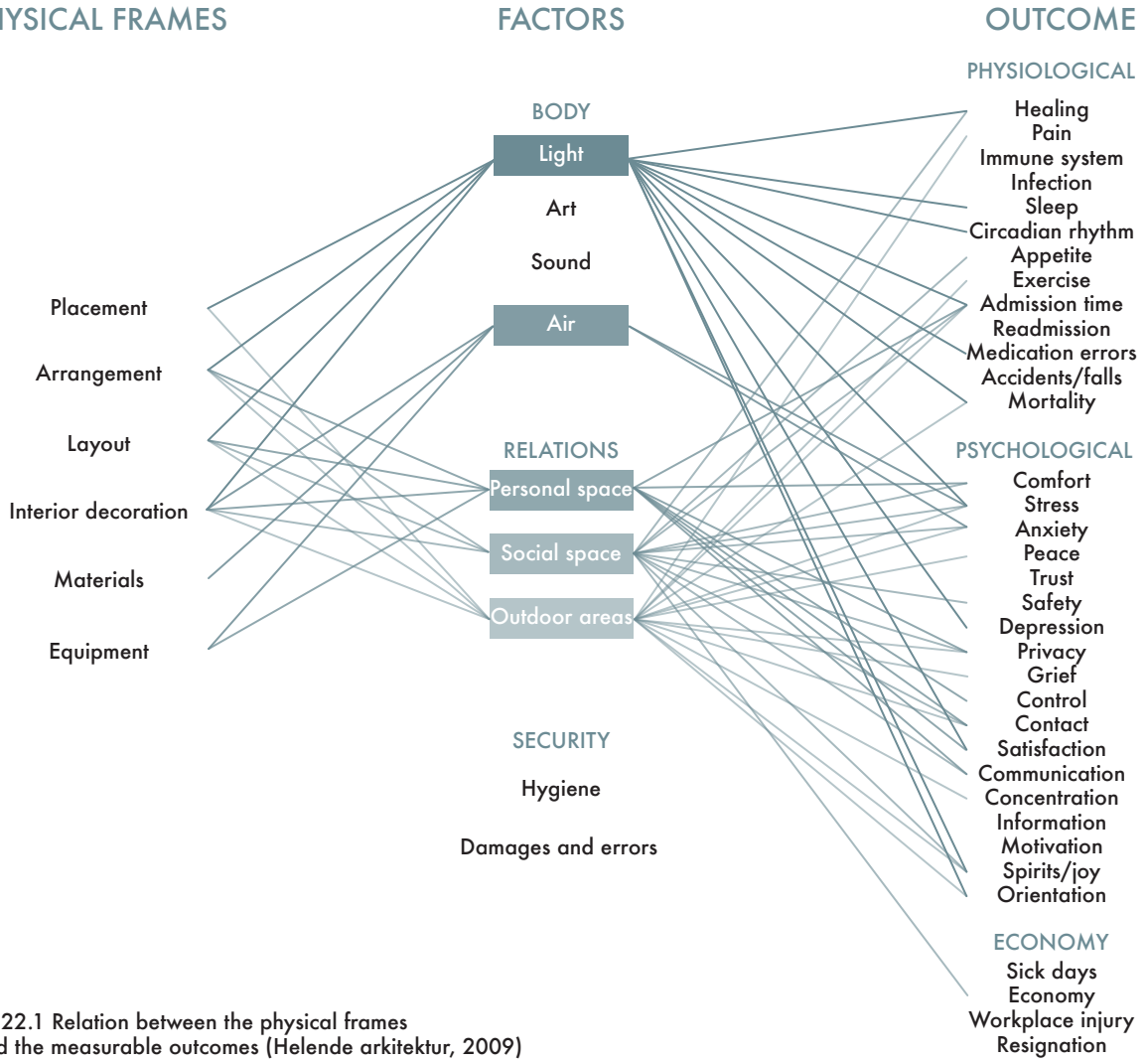
1.10 //

HEALING ARCHITECTURE

As an effort to design a well-functioning hospice it is vital to recognize the important aspects of research within the field of healing architecture in order to create an evidence-based design proposal.

The phrase healing architecture can seem rather misguiding when referring to a Hospice. However, it is becoming commonly known that the physical framework has a huge effect on the well-being of humans within, which is why Palliativt Videncenter has developed a platform for knowledge sharing on their homepage focusing on how to create evidence-based architecture [Pavi 3, 2012].

Research has shown that the physical framework forms the basis of several factors that concern body, relations and security, and outcomes can be measured both physiological, psychological and economical. By adjusting and optimizing the demands to the factors, it is possible to affect the physical framework and thereby the outcome in the end, which means that the building has to meet the demands [Frandsen, A. K., et al, 2009] .



Ill. 22.1 Relation between the physical frames and the measurable outcomes (Helende arkitektur, 2009)

It is evident that the actual building can relieve several outcomes by creating the right environment. And some of the essential factors to consider while designing are:

Light, since it is dependent on both placement, disposition, plan solution and arrangement and can affect numerous outcome such as circadian rhythm, pain, stress, depression and spirits.

Air, since the indoor climate has a considerable influence on our wellbeing. It is a factor that has not been investigated as much in the terms of healing architecture, however, it does have a noticeable affect on our comfort [Frandsen, A. K., et al, 2009] .

Personal space, since it gives the opportunity of cherishing the close relations in the final hours in private and intimate environment taking both patient and relatives into account. This has a positive effect on outcomes such as comfort, content and communication.

Social space, since it creates a common ground of informal and casual interaction between patients and the opportunity for confidential conversations between patients to minimize the feeling of anxiousness, stress and nervousness amongst others, and to give the feeling of not being alone in the final hours [Realdania, 2009].

Outdoor space, since the access to green surroundings and the opportunity to retract to nature or have a visual contact has a positive effect on our physical and psychical well-being and outcomes such as exercise, stress, spirits and concentration. [McCullough, C. F, 2009]

Common for all these considerations is that the physical frames, the substance and needs has to fuse into one unit, which both humanly, professionally and architectonic support the users of the hospice. However, it is important to accentuate that architecture alone cannot heal a terminally ill patient, but that the overall architectonic layout considering the quality of daylight, the atmosphere in a room and the created spaces can have a relieving effect in the patients precious final hours.

In the design the outlined aspects will become utilized and enhanced in order to achieve an evidence-based design that has a positive and relieving influence on the users.

Ill. 23.1 Forest floor

1.11 //

WELL-BEING AND HOMELINESS

Homeliness is a crucial aspect for the well-being of the patients on a hospice in order to minimize the feeling of being in an institution and enhance the feeling of respect, dignity and independence. The patient rooms will become the additional home of the patients and ought to be perceived like this as well [Realdania, 2009].

With this statement as a point of reference, parallels can be drawn between the well-being of old people living in assisted living facilities and patients living in hospices. Both user groups are unable to attend to themselves in a proper manner and have special needs in order to obtain well-being. A research project from Denmark, "Trivsel og Boligform" deals with the concept of well-being and how it can be achieved [Møller & Knudstrup, 2008].

The notion of well-being is basically the individual person and its characteristics and competencies (habitus) combined with the surrounding context. The well-being model (Ill.24.1) enhances the factors that have an influence on the comfort and well-being of elderly, which strongly is consistent with the observations and wishes in the Programme for the Good Hospice in Denmark. [Møller & Knudstrup, 2008] . However, it is important to see each factor in relation to the others, since an optimisation on only one can bring it out of balance and cause more harm than good. The factors of well-being can be seen as qualities through which one can reach the goal, while the impact depends on the habitus of individual person.

Through this research superior aspects concerning well-being are identified as both knowingly and unknowingly needs, expectations and goals:

Physical and psychical health: care, nursing and comfort

Security and safety: safe and accessible environment

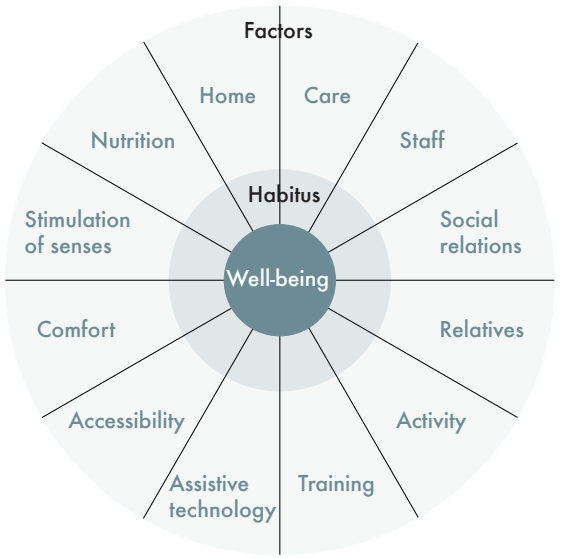
Independence: taking care of ones own needs

Self-dependence: control over the activities of the day, surroundings and choices

Social relations and contact: relatives, friends and staff

Meaningful activities: everyday activities, recreational activities, and hobbies

Self-understanding: identity, status and life history



Ill. 24.1 The Well-being Model (Møller & Knudsen, 2007)

Ill. 25.1 Expression of well-being

Evidently it will not be possible for the patients at a hospice to achieve all these aspects on their own in their last days, but in their good periods they can be rather mobile by which the mentioned aspects is of great importance for the patient to maintain dignity and feel alive. However, then the day comes where the patient is rapidly weakened the palliative team will relieve the patient and help in the best manner to keep reaching these aspects of well-being.

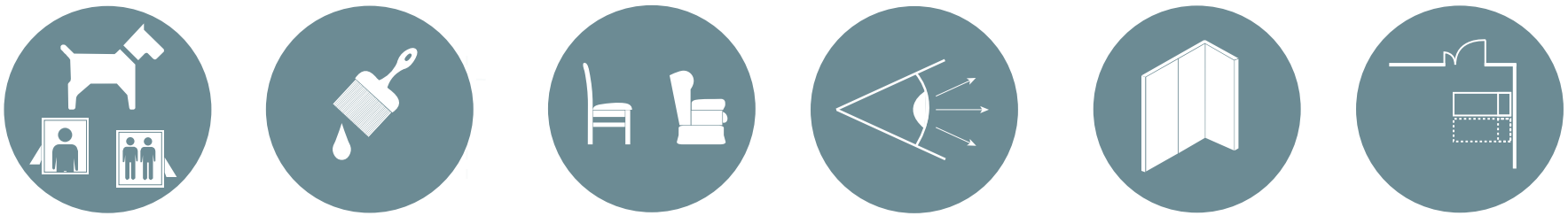
"*When we wake up in the morning, we do not need to start all over by defining ourselves, instead we can take a look around where the surroundings will confirm who we are. ... The home is a mirror. It is me.*" [Mechlenborg, M., 2011]

The home is a self-representation and the memory of a good life, identity and self-understanding, which is crucial to recognize and be among for a terminally ill patient.

As an effort to achieve homeliness and thereby well-being of the patients several parameters concerning the private patient homes can be established (ill. 25.2).

Moreover it is important to create a differentiation between the patient homes and the common areas as a graduation of privacy. This will promote the community feeling and distinguish the patient home as being private and individual.

The research emphasises that the superior aspects can be boiled down to the notion of homeliness and thereby privacy as having crucial meaning when talking about well-being [Møller & Knudstrup, 2008] . The concept of homeliness is thereby an important parameter to consider when designing a hospice, since it is the firm standpoint from which we can orientate in chaos.



Ill. 25.2 Parameters concerning private patient homes

1.12 //

IN A SILENT HOUR

The purpose of this section is to enlighten some of the personal and emotional issues a terminally ill patient faces through the course of illness and the ensuring needs of the relatives.

Following poem is written by a young girl who was hospitalized. The poem was found after she passed away:

"*Help me, care about what happens to me,*
I am so tired, so lonely, and so very afraid.
Talk to me – reach out to me – take my hand.
Let what happens to me matter to you.
Please, nurse, listen"
(Hee et al., 2012, p. 9)

As written in the poem above, the terminally ill are perfectly aware that it is not possible to remove the fear, loneliness and tiredness, but what helps is a presence of another listening human being. Human beings are normally occupied by doing something, why it is difficult to accept when you are reduced to just a being. And it is in these situations that another listening being is needed.
However, sometimes the patient prefers a volunteer or impartial to discuss the pressing existential questions: Why me? Is this the end? What is the purpose? What happens next? Even though there does not exist a direct answer, it is a relieve for the patients to be able to communicate their feelings and thoughts of the pending death (Hee et al., 2012). This can be a difficult process both for the patient and the relatives, why both parties are in need of a place for personal contemplation. In the last phase of the course of illness, the patient will be severely weakened and perhaps wants some time alone whereas the relatives often are in need of a secluded space, where it is allowed to withdraw.

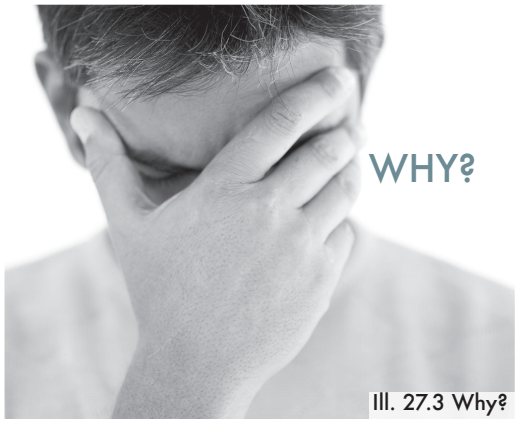
Because of this, and as Dorit Simonsen, the manager of Hospice Djursland, established, it is of the outmost importance to incorporate spaces for the relatives to make personal reconciliation with the situation in privacy or if they have the need to talk personally with the priest, psychologist etc. Likewise it is important for the relatives to gain some social relations in a hospice, thus they can find relive in talking to others in the same situation.

This is an essential point and the difference between treatments at a hospital and treatments in a hospice. At the hospital, their primary goal is to keep one alive, but there is no room for human care. At the hospice, the primary aim is to give people a peaceful passing and there is plenty of care and offers for the patients and their relatives.

In relation to this it is seen as an important factor to implicate the needs of the relatives when designing a hospice by incorporating small and more private spaces as well as making the common areas attractive and minimizing the feeling of being in an institution.

Ill. 27.1 Goodbye

Ill. 27.2 Love



Ill. 27.3 Why?

Ill. 27.4 Sorrow

1.13 //

THE FAREWELL

This chapter deals with the notion of the farewell of a cherished family member or friend and following what can be done in order to reassure the optimum conditions.

To lose a dear relative is often a personal and intimate process that requires the necessary space for contemplation, serenity and to say a tearful farewell in private and undisturbed surroundings that allows the bereaved to focus entirely on their grief.

When death occurs the conflicting feelings of grief and relief often meet the relatives, which is why it is decisive that the immediate processing of the death is according to the pace of the relatives [Hee et al., 2012] .

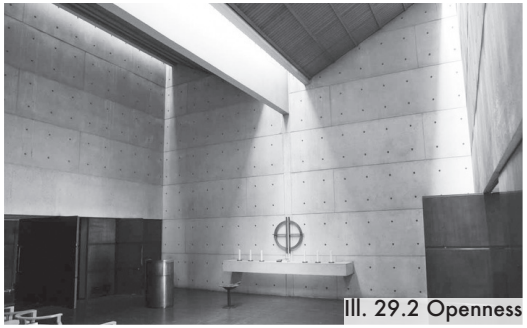
With the before mentioned as a point of reference notice were made during the visits at Kamillianergaarden in Aalborg and Hospice Djursland in Rønde. In both cases the deceased stays in the patient room in case relatives want to say their goodbye until the funeral director comes. However, when leaving the Hospice, the deceased has to come out through the entrance, which has to be coordinated with the rest of the hospice in case visitors or new patients should arrive.

This project will strive to emphasize the notion of the farewell on a symbolic and poetic level as well, since the sacred ritual ought to be seen as a straight and determined course, which will be reflected in the physical course of the hospice. The relatives will have the opportunity to follow the deceased to the hearse and say their goodbye in their own pace and give them a dignified and undisturbed parting.

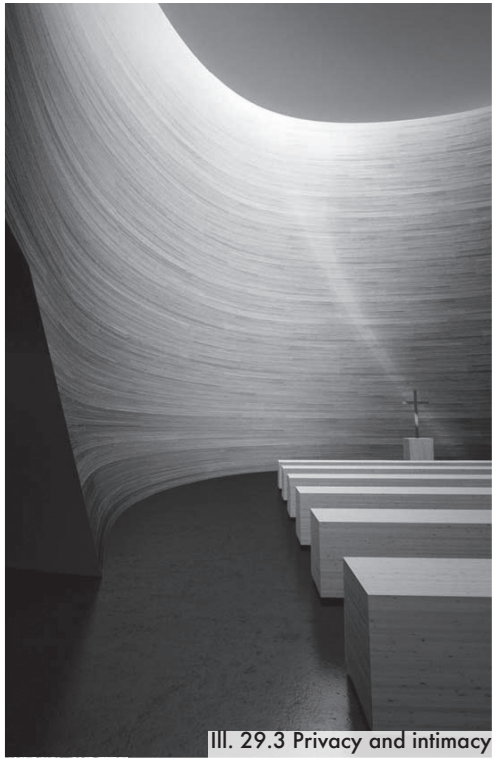
In relation to these thoughts focal points have been established in the light of chapels and their common qualities of creating the necessary physical frames that promote the sought atmosphere. This has shown to be commonly achieved by modest means. A careful attention on the materials provide a simplicity, calmness and serenity that gives the relatives time and space to focus on their sorrow.

During the design process focus will be made on creating a separate an symbolic exit for the deceased to generate the most respectful departure.

Ill. 29.1 Emotions

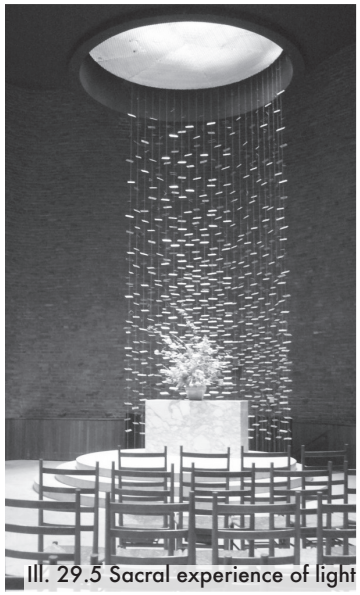


Ill. 29.2 Openness

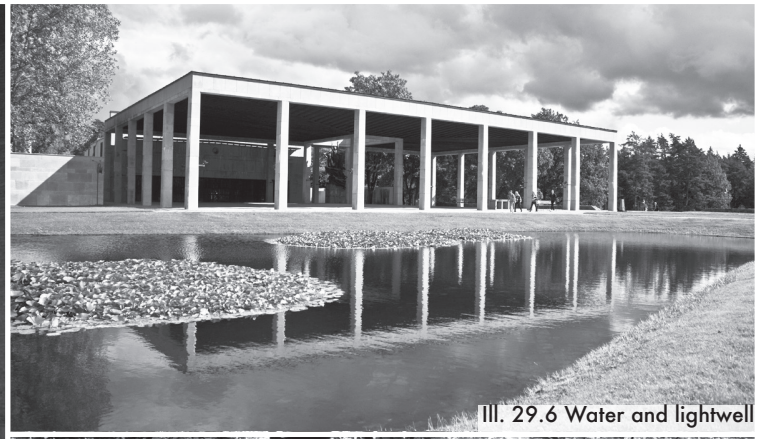


Ill. 29.3 Privacy and intimacy

Ill. 29.4 Light and simplicity

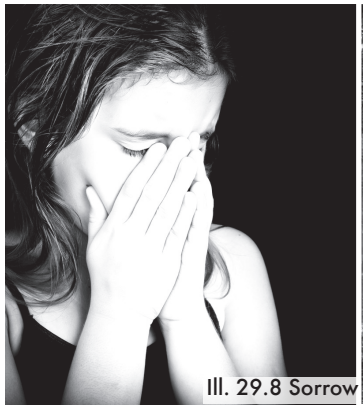


Ill. 29.5 Sacral experience of light



Ill. 29.6 Water and lightwell

Ill.29.7 Love



Ill. 29.8 Sorrow

Ill. 29.9 Nature and view

Ill. 29.10 Poetics and calmness

1.14 // CONTEXT ANALYSIS

THE BUILDING SITE

In order to find a specific building site, contact was made with the chairman of Palliativt Videncenter – Arkitektur og Lindring, Helle Timm, who was interested in the project and mentioned the possibility of an actual site in Skanderborg municipality.

In Skanderborg there is an active "Friends of Hospice Eastern Jutland" with the aim of getting a hospice to Skanderborg. The architect, and active member of the group, Eric Pettersson, had worked on a rough concept proposal and was very kind and offered his help regarding a building site and the future development of the area. They had been given a site in the outskirts of Skanderborg donated by a private land owner, but the final decision is still to be made by the local authorities on whether it can become a reality with a hospice in Skanderborg.

Skanderborg municipality is part of Region Mid Jutland and has about 58.000 inhabitants. The municipality lies in beautiful natural surroundings that include some of the highest natural terrains in Denmark.

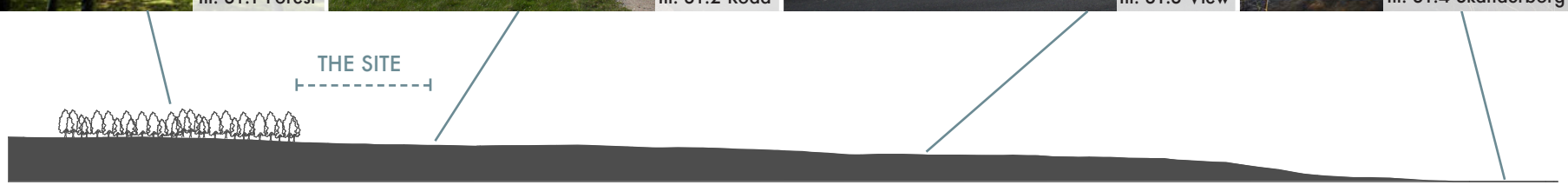
Ill. 30.1 Skanderborg kommune

Ill. 31.1 Forest

Ill. 31.2 Road

Ill. 31.3 View

Ill. 31.4 Skanderborg lake



Ill. 31.5 Section through the building site 1:10.000

The building site is, as mentioned above, a donated ground of 10.000m2 placed in the outskirts of Skanderborg in the Anebjerg district by a protected forest east of the Skanderborg lake. The surrounding context is characterised by a hilly open landscape, why the building site does not have a view to the lake.

Ill. 31.6 Building site

ACCESSIBILITY

Due to the placement in the outskirts of Skanderborg the accessibility of the site has been investigated.

ROADS

There is one main road passing by the site, Fruering-vej, which is a wide road with an established separate two-lane cycle path. This road provides an easy access to the site and is connected to a functioning infrastructure both to highway E45 and to the city centre of Skanderborg. In the neighbouring city Fruering the speed level is minimised by the use of traffic islands, but outside the Fruering city borders the roads are wider and straight, which can enhance the speed level rapidly.

PEDESTRIANS

As a result of the new builds in the area west of the site a net of paths for the pedestrians and cyclists has been established almost all the way to the city centre. Moreover there exists an off road path on the outskirts of the protected forest by the site.

PUBLIC TRANSPORTATION

The site is placed both close to city busses and regional buses. In the new build area to the west the city bus has its last stop in a reachable distance from the site, which is the same for the regional bus that drives through Fruering. Furthermore, the train station is included in the Copenhagen-Aalborg line and is a transfer station for the trains to Skjern, and the station is placed in the heart of Skanderborg within a distance of 5km from the site.

The site is placed within a acceptable distance from public buses and thereby connection to the national train at the train station. Furthermore the site is close to the highway E45, which makes it easily accessible and easy to reach by car.

Ill. 32.1 Accessibility


Ill. 32.2 Cycle Path

Ill. 32.3 Fruering main road


Ill. 32.5 Fruering bus stop


Ill. 32.6 Closed bus stop


Ill. 32.4 Off road path

SENSE OF THE PLACE

In order to obtain the atmosphere of the district, a phenomenological approach has been done with a walk through the area.

The sloping landscape of the district Anebjerg, is surrounded by low residential buildings, which is of different characters with new residential villas that reflect modern materials and characteristic, and middle-aged residential houses with thatched roofs – a charming district with a local church.

Anebjerg is a district on the outskirts of Skanderborg, far enough away from the crowded city, to create a calm atmosphere, silent enough to appreciate the chirping of birds and the trickling stream, which gives the district a sense of belonging.

Nature plays the leading role in the district with the hilly landscape, open spaces and the forest, a forest that reflect the four different seasons of the year.

It is obvious that nature, the sloping landscape and the silence of the district are the dominating factors, which will be strived to respect in order to maintain the existing atmosphere.


Ill. 33.1 Artificial landscape


Ill. 33.2 Dog walking


Ill. 33.3 Fruering Church


Ill. 33.4 Revonations


Ill. 33.6 Stream


Ill. 33.5 Forest

MATERIALS & VEGETATION

Ill. 34.1 View from site

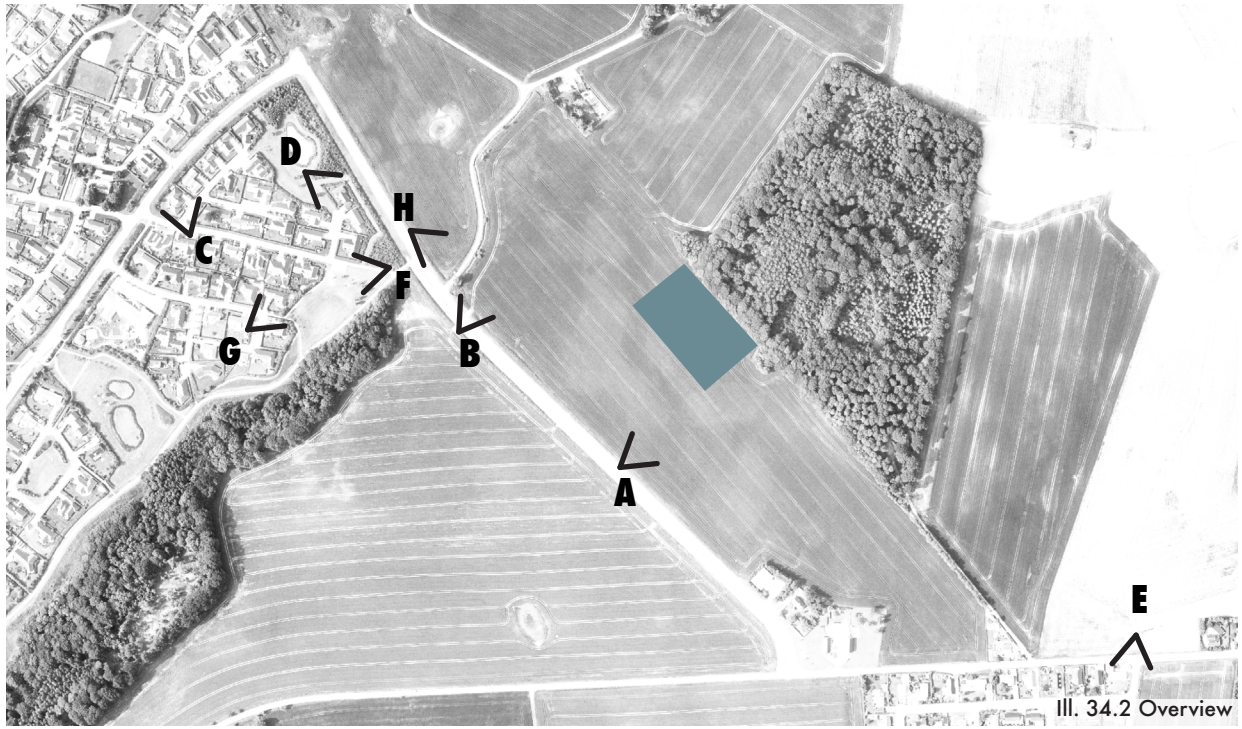
In order to design a Hospice that adapts to its context, the surrounding vegetation and materials in the area have been studied.

The building site is placed in an open landscape and the vegetation on the actual site is rather limited due to the fact that it is presently a field. However, the site is located next to a protected forest, which is an indicator of both time of year and place.

The open landscape has a hilly character in the nearby context and is gradually sloping all the way down towards Skanderborg lake west of the building site. This character of a hilly landscape is incorporated in the nearby new build area and enhanced by artificial small hilltops.

The area is characterised by different typologies with the new build single-family houses all build in the local material brick, and in Fruering the renovation of old houses and even old thatched houses. However, the entire area is dominated by domestic homes in a dense-low placement.

The building site is thereby located in a borderland between several contrasts; a newly build housing area and an old village, open landscape and dense forest and residential area, wild and untamed nature versus the traditional tamed residential gardens and artificial hilltops.



Ill. 34.2 Overview

With the site as a physical link between the contrasts the area provides a wide range of possibilities and is not locked to a single expression. The quietness of the area and the open sloping landscape emphasises the presence of the sky and view towards vest, which all together gives the opportunity of integrating and incorporating the design within the landscape.

B

Ill. 35.1 Small stream going down to Skanderborg lake

C

Ill. 35.2 New build in brick

D

Ill. 35.3 Garden vegetation

E

Ill. 35.5 Old thatched houses

F

Ill. 35.6 Newly build artificial landscape

G

Ill. 35.7 Dominating privet hedge within residential area

H

Ill. 35.8 Old tree

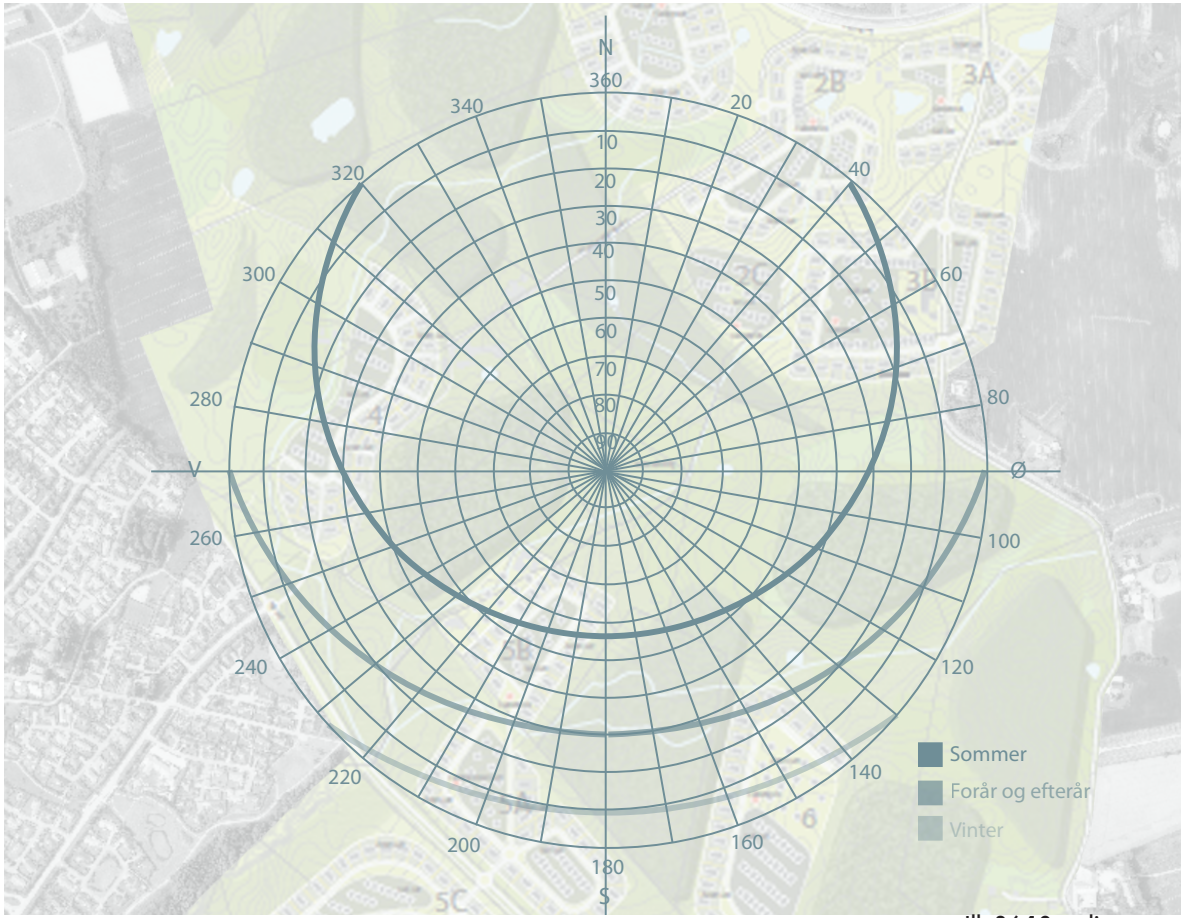
MICRO CLIMATE

The utilization of the sites microclimate is an important factor when designing an energy optimized building. Considerations concerning sun and wind should be made in order to create passive heating and cooling, in the shape of inlet of sun and natural ventilation. With this as an argument following analysis has been elaborated.

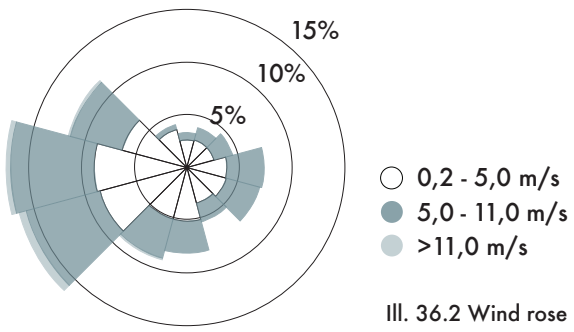
As evident from the wind roses the distribution of wind direction and speed is most frequently from west and southwest (ill. 36.2). The westerly wind from the sea will typically bring relatively homogeneous weather, both during summer and winter – mild weather during the winter and cool during the summer. The wind direction is the key factor when describing the weather [DMI, 1999 Technical] and is as well the key factor when designing a natural ventilation layout. In order to design the optimal conditions for natural ventilation, it is necessary to utilize the dominating wind – the westerly wind. This will have a great importance of the orientation of the building and the layout of functions at the hospice.

From the sun diagram it is evident that the sun rises in the East and sets in the West. During the analysis of healing architecture it occurred that especially the sun rise, in the East, is important for the patients in order to obtain the right circadian rhythm. This is a contradiction to the site, where a forest rises in the east and will in worst case cast shadows on the site and worst in the winter, where the angle of the sun is lower than in the summer. Disregarding the forest, the site is not to be disturbed by any other factors casting shadows, due to the open landscape.

From this investigation it is obvious that the layout of the building will gain great benefits from a orientation towards west – southwest in order to allow natural ventilation and the shading, in the morning hour, will crave attention, when designing the patient wards.



Ill. 36.1Sun diagram



Ill. 36.2 Wind rose

FUTURE DEVELOPMENT

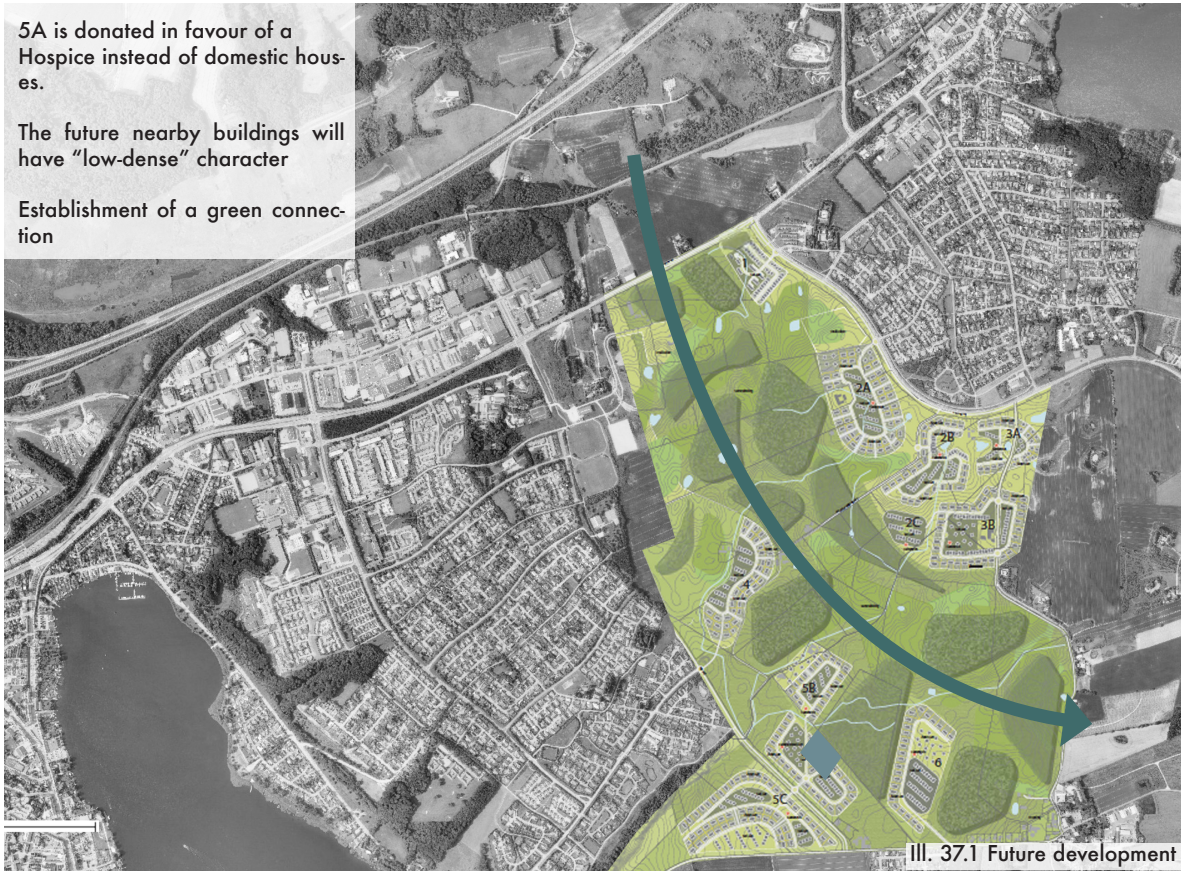
Following research of the future development of the area of Anebjerg, is seen as an important aspect when having the aim of designing a context relevant building in relation to Nordic Architecture.

THE FUTURE

The area of Anebjerg is seen to contain approximately 900 new residents. These are to be developed in close connection to the great new forest and natural area of Anebjerg. Anebjerg Forest will furthermore in addition to the recreational environment contribute to more natural areas, connections between two existing natural areas. In relation to this, Anebjerg is described as a sustainable up-and-coming city, in the shape of Low energy residential buildings and incorporations of green recreational areas. Therefore it is seen as a must to make the building site fit into the beautiful rolling countryside.

The aim of the residential area is a varied course of experiences with close connection to the landscape and the new forest. In order to ensure that the existing residential areas, in close connection to Anebjerg, will also enjoy the landscape, the housing areas will be positioned as open islands on the outskirts of the landscape, while the buildingsin the center will perceive more intimate.

The plan for the area is expected to be developed during the upcoming 15-20 years, which is why the plan of the area is created very flexible, and in relation to placing a hospice on the donated area in Anebjerg, which has been obliged positively by the city council.



Ill. 37.1 Future development

SUSTAINABILITY

In order to achieve a high level of sustainability in the district, the density of the buildings will vary and may in some areas be higher than in ordinary single-family areas. The orientation of these will be according to the sun and wind, in order to take advantage of the passive solutions. Within the district selected areas will be reserved for zero energy buildings. The reopening of drains and waterways and construction of new ponds will contribute to experiences of both forest area and the new district. In order to create a greater interaction between residential areas and recreational facilities, running and exercise route will be applied.

From this chapter it is evident that the nature lishighly cherished, both in a visual manner, being present in nature and protecting it in relation to sustainability. This stresses the need of a sustainable approach when creating architecture in this district – designing a low energy building that respects the nature.

1.15 //

NORDIC ARCHITECTURE

The term Nordic architecture is investigated to acknowledge a common focal point to healing architecture and to establish an aesthetical expression.

During the last ten to twenty years we have witnessed a revival of the old Nordic traditions concerning architecture interpreted in new ways with new technologies and stances in effort to discover the New Nordic [Kjeldsen, K. et al., 2012] . This Nordic identity is a notion of numerous aspects since there exists no definite correct answer due to the fact that it can be considered as a living essence.

The identity is both inner personal and individual, but is also considered to be the social relation to others as well as being present at a certain time and place. All these aspects make the identity of New Nordic a sum of personal experiences of traditions, history, geography and the human reflection upon this [Kjeldsen, K. et al., 2012] .

Still it is possible to identify the essential focal points back to the original masters of the 20th century like the importance of light, materials and their tactility, the relation and correlation between human and nature, the poetry and the narrative.

The New Nordic is thereby not a complete recurrence to the former practice, but to have a strong emphasis on the fundamental focal points and further use the geographical dictated qualities in new traditions.

LIGHT

Ill. 38.1vBagsværd church

LIGHT

Light is the basic phenomenon that permits us to define our natural and physical surroundings, thus light can transform these in each season, each day, each hour and each moment. In that matter light and architecture is inseparable and interdependent.

"Architecture is the masterly, correct and magnificient play of masses brought together in light"

– Le Corbusier

The usage of light is a notion of refinement, which is utilized by several great architects throughout history. It is not merely seen as a tool to light up the room that encloses us, but it has the ability of becoming much more and giving a sense of spirituality. Utzon managed to emphasize this in several of his buildings and capturing light in its most pure and aesthetic form.

MATERIALS

Ill. 38.2 Reindeer Centre Pavilion

MATERIALS

In the term of materials the rediscovery of the traditions has brought awareness of the natural resources and a profound understanding of these. An example of this is the Wild Reindeer Centre Pavilion by Snøhetta, Norway, where the quality and durability of the materials is capable of withstanding the harsh climate and refers to local building traditions.

The natural appearance of the materials makes the pavilion blend in and become a natural extension of the surrounding rich landscape. The pavilion becomes a tale of how it is possible to understand the architecture in relation to the landscape and the honest use of local materials.

RELATION BETWEEN HUMAN AND NATURE

Ill. 39.1 Nordic Pavilion, Venice

POETICS

Ill. 39.2 Woodland Cemetery

TECTONICS

Ill. 39.3 Steilneset Memorial

RELATION BETWEEN HUMAN AND NATURE

The Norwegian architect Sverre Fehn has a strong emphasis on the natural elements and considerations in his way of designing, whether it is in the city or further out in the country.

His comprehensive approach to nature is characterized by a sense of humility and servility to enhance the beautiful interaction between nature and civilisation. He evokes a sensation of belonging between these two aspects and tries to erase the boundaries by his use of materials and implementing natural elements.

The Nordic Pavilion is a beautiful example of this since it embodies all the elements of "the North" as light, scale, material, structure, space, atmosphere, nature and the relation and correlation to human.

POETICS

As highlighted one of the focal points is to create a certain atmosphere where lights, materials, space, structure and relations reach a higher level where architecture will become poetry.

In Erik Gunnar Asplund's Woodland Cemetery the whole atmosphere is carefully planned and achieved by modest means, which shows his humility to the function of his task. The beautiful landscape and the integration of buildings submerge the visitor in quiet contemplation.

"*Anytime you write a poem, you need to find the balance between your thoughts and your language. Nothing should disturb the essence of the idea. It is the same with architecture*"

– Sverre Fehn

TECTONICS

The mentioned Nordic traditions are seen and practised by architects from other parts of the world, and one of those is Peter Zumthor. He possesses the same characteristics and his designs are based on conditions much like those of the Nordic tradition, where he is taking the cultural conditions, atmosphere, climate and landscape into account, its genius loci.

The Steilneset Memorial to the victims of the witch trials in Norway is a beautiful example of how Zumthor addresses the senses in this tectonic creation, which strongly emphasizes an awareness of the materials and an evident reference to local structures found nearby [architectureau, 2012] .

To reassure an evidence-based design with a strong aesthetical expression that refers to the Nordic tradition the focal points of light, materials, the poetics and relation to nature will be emphasized.

1.16 //

INDOOR ENVIRONMENT

This chapter concerns considerations regarding the sustainable demands to the design of the hospice followed by the focal points within the notion of indoor environment.

The term sustainability has become a global and well-known topic, which cannot be ignored by the construction industry and thereby the architects anymore, since buildings account for 40% of the total energy consumption of Europe. In Denmark the energy consumption gradually decreases in 2010, 2015 and 2020 respectively [Climate minds, 2012]. This means that the total energy consumption in 2010 is a 25% reduction of the 2006 standards, while in 2015 it will become 50% and further a whole 75% reduction in the 2020. In this project it is the aim to reach the goals of 2020 and the low energy frame from the Danish Building Regulation on 20 kWh/m2.

However, the term sustainability goes beyond these energy frames. To achieve the holistic approach to sustainability the basic factors Social, Environmental and Economical has to be combined in order to present the well-being of humans [Hansen, 2012] . And it is this emphasis on the users that makes the sustainable approach compatible with the concept of healing architecture. With the notion of the well-being of the users as a point of departure, they both seek a comfortable indoor climate.

The indoor climate is inevitable of outmost importance when designing a hospice, since its philosophy is to relieve and create a comfortable atmosphere for the patients in their last living days. While dealing with these rather fragile users it is important to consider the four main aspects of indoor climate; indoor air quality, thermal quality, acoustics and lighting conditions, which all has an influence on our senses either physical and psychical.

THE ATMOSPHERIC INDOOR ENVIRONMENT

The atmospheric indoor environment concerns the CO2 concentration and pollution produced by equipment and people and is thereby a matter of health and comfort. To avoid pollution and to reassure healthy surroundings the air ought to be observed as fresh, whereas the right amount of ventilation during all year is essential. In this report the aim concerning the patient room is to fulfil the category A, which according CR1752 corresponds to a high level of expectations and minimum dissatisfied, why it is necessary to calculate the air change rate and take use of the simulation program BSim in the design process, so that the CO2 concentration does not exceed the outdoor level with more than 460 ppm [CR1752, 1998] .

THE THERMAL ENVIRONMENT

The thermal indoor environment concerns the parameters that have an influence on the heat balance of the users. It is important that these parameters are perceived as acceptable in order to achieve a satisfactory thermal comfort. The experienced thermal indoor environment is thereby determined by the individual users personal heat balance, which depends on the activity level and clothing. Due to the fact that the users are terminally ill and thereby their activity level are low, the temperatures ought to differentiate between the patient rooms and the staff areas, since they most likely will not find the same temperature range ideal. In the design point of reference will be taken in the patient rooms in order to meet their demands of well-being, which results in a temperature around 24,5oC +- 1oC in the summer and 22oC +- 1oC in the winter in order to obtain a category A level [CR1752, 1998]. As an effort to reach the optimum thermal environment both during the winter and summer and avoiding overheating, it is important to make investigations during the design process and optimize the design according to the rough spread sheets Daily- and Month Average and for later detailing and verification take use of the dynamic simulation program BSim.

THE ACOUSTIC ENVIRONMENT

In relation to the acoustic environment the main aspect is protecting and reducing undesirable noises. This is inevitable to consider in effort to create private patient rooms where the patients can retract themselves to seek refuge and prospect during their sensitive hours. To reassure a comfortable acoustic environment the aspects of Airborne Sound Insulation, Impact Noise Level, Reverberation time and contextual noises from traffic and installations all

Ill. 41.1Indoor environment

have an influence on how the indoor environment is perceived.

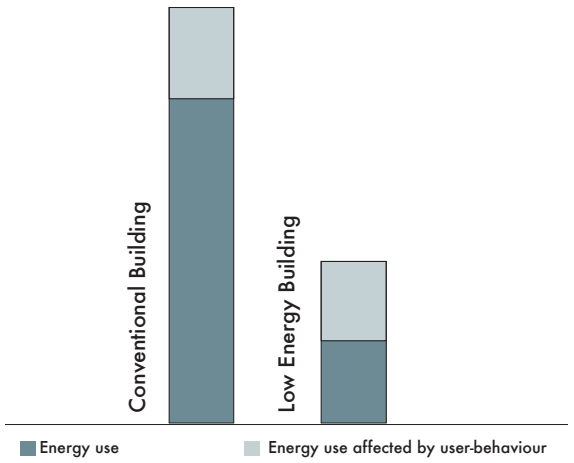
THE LIGHTING CONDITIONS

As mentioned before light and a visual and strong connection to nature is of the outmost importance while discussing healing architecture and Nordic architecture. It is important to create and achieve comfortable lighting conditions, which means a daylight factor of minimum 2%, minimizing flickering light, contrasts and blinds, why shading devices have to be considered. Furthermore it should be possible for both visitors and patients, whether they are bedbound, standing or sitting, to obtain a straight view to nature in order to relieve the patient. This will have to be considered and investigated while designing the patient rooms through form studies and placement of windows and documented by simulations to achieve the most optimum lighting conditions for the patients and the rest of the hospice.

USER BEHAVIOUR

While designing a hospice with a optimum and healthy indoor environment it is important to incorporate the user behaviour as a result of the different types of users, patients, relatives and staff, who all have different needs, wishes and demands to the indoor environment. It has been proven that user behaviour has a huge impact on the total energy consumption in low energy buildings, based on the users limited knowledge [Brunsgaard, C., 2011] . As a result to this, it is the building that has to be significantly energy optimized to reach the standards of 2020, which will be verified by using Be10

This chapter gives an indication of how and why to reassure a comfortable indoor environment in the design of a hospice, which will be utilized and integrated in the design process.



Ill. 41.2 The effect of user behaviour

1.17 //

OPTIMIZED ENERGY DESIGN

The aim of reaching the goal of low energy class 2020 from the Danish Building Regulation is attemped by working with passive solutions as an integrated part of the design concept, considering the important parameters of an energy efficient building design. Therefore parameter concerning heating, cooling, lighting and technical installations will be considered in proportion of the passive solution.

The approach of working with passive solutions, as an integrated part of the design concept, is intended to reduce the energy consumption to a minimum.

The key to design according to passive solutions is to take advantage of the local climate, taking point of reference in the sun path, vegetation, wind flow and thermal mass. These techniques are most easily applied to new buildings compared to existing buildings.

The different passive approaches should all be considered from the initiated design process, in order to integrate these in the design concept. Following passive approaches, which are described, is being considered in this project.

SOLAR HEAT GAIN

The sun is one of the only natural sources of energy speaking of heat gain. Therefore, when designing a low energy building, it is important to consider the orientation of the building and the windows. Windows facing south will allow a big amount of solar radiation, while windows facing north will provide heat loss. During the cold winter months the solar radiation is more than welcome, in order to reduce the heating, while in contrast to the summer months, the south and west facing windows will be cause of overheating issues. Therefore to reduce the temperatures it is important to investigate different sizes of windows and integrate some shading device.

LAYOUT OF FUNCTIONS

In extension to the solar heat gain it is important to organize the functions according to the path of the sun. By doing this, it will be possible to create different temperature zones, which will be very beneficial speaking of a hospice.

NATURAL DAYLIGHT

In order to minimize the electricity consumption it will be beneficial to utilize the natural daylight in the daytime. In correlation with the hour of the day it will be necessary to supply artificial light or block the light in order to maintain a certain temperature.

INTERNAL HEAT GAIN

Due to the function of the building the level of internal heat gain is limited. The level of activity is relatively low, why the majority of the heat gain will occur in the shape of technical installations.

THERMAL MASS

Designing with a passive approach, windows, walls and floors can be placed to collect, store and distribute solar energy. Buildings made with a heavy structure like concrete and brick, consists of a large thermal mass, these elements are able to maintain a relatively stable indoor temperature. In the winter period heat will be distributed during the day, while in the summer time heat will be released during night time, when the temperature is lower, this will be elaborated on page 84. [Sol-hjem, 2012]

NATURAL VENTILATION

In order to reduce the energy consumption in relation to the cooling demands, it will be beneficial to

Ill. 43.1 Home for life

utilize natural ventilation. During the summer time, this approach will be most beneficial, while in winter period the natural ventilation can cause a large amount of heat loss, why mechanical ventilation, including heat recovery, will be most suitable. This strategy consisting of both natural and mechanical ventilation is called hybrid ventilation, which will be elaborated on page 116.

SURFACE TO FLOOR RATIO

When designing low energy buildings it is important to find the optimal relation between surface and floor area. That is why positive results are achieved when designing compact. In this situation, designing a hospice, the building can however be perceived too compact. The patient rooms are in need of a large amount of natural daylight and beautiful views. Designing a compact building with large amount window areas is paradoxical, and will therefore be one of the great challenges of this project.

THERMAL BRIDGES

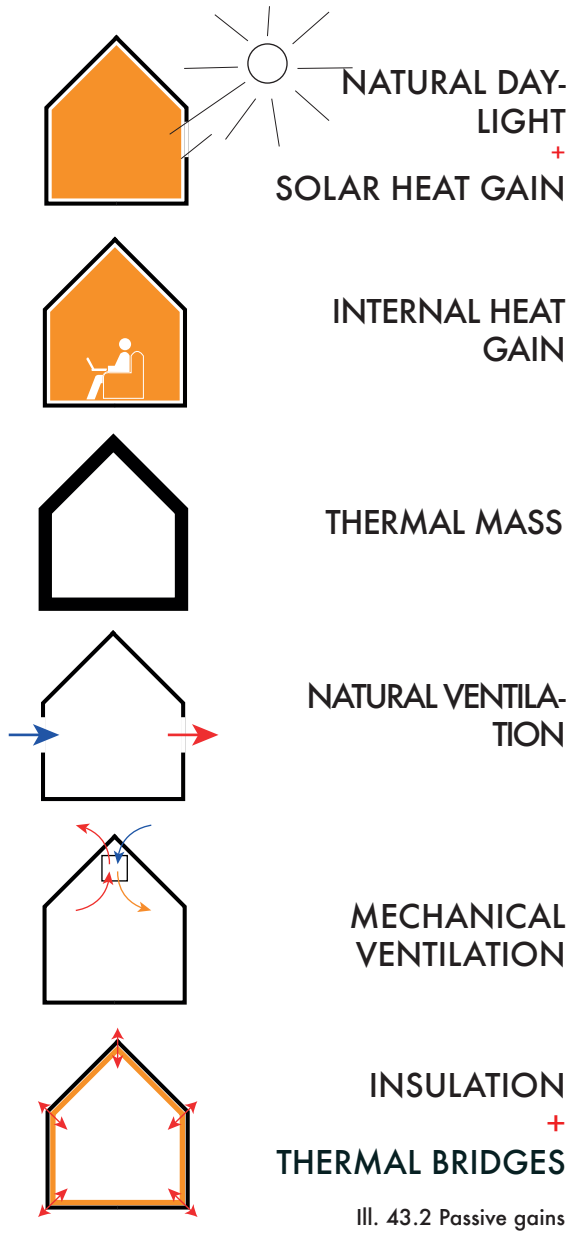
In order to minimize heat losses, it is important to avoid thermal bridges. Thermal bridges are often perceived in constructions and construction elements for example window frames, window itself and leaking corners of the building. By optimizing construction methods and choosing other products for example windows with lower U-values, it will be possible to reduce the thermal bridges.

INSULATION

In order to minimize the heat loss, a very important step when designing, is to choose the right amount of insulation. In relation to the increasing energy demands it is evident, that the thickness of the walls increases proportionally. But when more insulation keeps being added to the wall, excess insulation will be added. There is a thin line between improving the wall and just adding, at some point there will not be a significant difference of the U-value, and adding on more will not underpin the sustainable approach.

From this chapter it is evident that there are plenty passive solutions that will be beneficial to incorporate in the initial stage of the design process in order to reduce the energy consumption before optimizing (ill.5.1). By taking advantage of these, a reduced energy consumption will be achieved.

PASSIVE GAINS



Ill. 43.2 Passive gains

1.18 //

ROOM CLASSIFICATION

It is chosen to investigate the five sensuous space characters from "Sanserne Hospital" in order to incorporate more soft parameters in the evidence based design approach. These characters will help defining the different functions of the hospice sensuous characters.

In the foregoing chapter, Healing architecture, it has been mentioned, that there is evidence that a number of positive physical and environmental factors have a healing effect. It is even possible to set some models of explanation for this, based on knowledge of interaction between the brains mental state and how the body is functioning.

Evidence based design is a method attributed to Professor Roger S. Ulrich and plays a major part in health care architecture, since it is difficult to argue how architecture influence human performance and well-being. Therefore Ulrich, among others, have been detected the effects of individual components in architecture trough experiments, which have led to evidence as well as guidelines for when designing.

Any room will automatically consciously or unconsciously create a sensory experience based on the human 5 senses. A space will always result in feeling response and in order to incorporate another sensuous aspects in the evidence based design approach, there have been taken inspiration in the five space characters made in correlation with the investigation of "Sansernes hospital" and its characterizations of the subjective space perception, each character with its own qualities with countless variations. [Heslet, L., et al, 2008]

The sublime space

A conscious or artistically motivated design includes content beyond the descriptive. Furthermore a space that has a specific positive attributes that go beyond the measurable and experienced emotionally.
A sublime space is defined as a space with the potentials to cause a positive, perhaps breathtaking subjective sense experience, which is intentional. Thus, a sublime space can be beautiful (sense), create safety (feeling) and can have a ceremonious dimension.

The qualified space

The qualified space supports the activity and function of a space positively and does furthermore deliver welcoming signals and provide safety.

The indifferent space

An indifferent space contains standardized features and refrains from individual shaping of spaces and colors. The space creates, at best, fairly neutral feelings- emptiness and boredom, but on the other hand, they evoke neither fear nor discomfort. There is nothing to consider. The indifferent space expresses indifference, why it is not suitable as a room in close relation to patients.

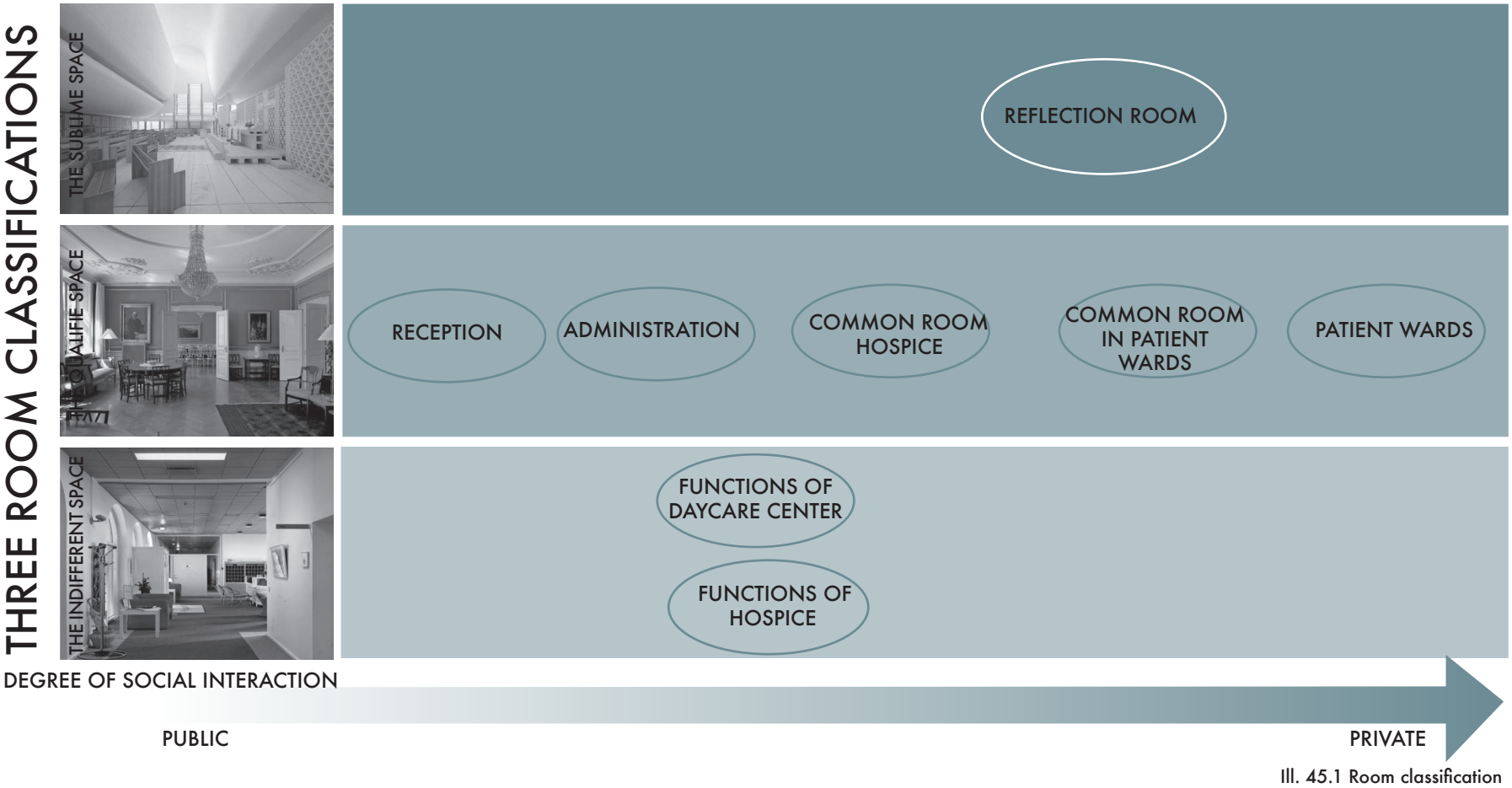
The suppressive space

This type of space is experienced as oppressive, where you feel insecure and alienated. They often cause discomfort due to its hardness, in the shape of hard materials and poor lighting conditions. The atmosphere of this type of room has sometimes been used in connection with interrogation rooms and courtrooms.

The unhealthy space

The unhealthy space is decidedly harmful. It may have an unpleasant indoor environment affecting the comfort and health. [Heslet, L., et al, 2008]

The suppressive and unhealthy spaces are spaces which have no positive features when designing a hospice, why they will not be considered when choosing atmospheres of the hospices different functions. The different characters will be assigned the various functions in the Spatial Program.



Ill. 45.1 Room classification

1.19 //

SPATIAL PROGRAM

The following spreads represent the spatial program, which is developed based on the requirements listed in the Programme for the Good Hospice in Denmark [Realdania, 2009] combined with additional conclusions established in the analysis.

ROOM SPECIFICATION	UNITS	AREA	FUNCTIONAL DEMANDS	SITUATED CLOSE TO	VIEW
Private facilities					
Patient room	12	30 m^2 pr. unit	-Own toilet and bath -Light control -Handicap friendly -Opportunity of accessing the bed from two sides -Level free access	- Common rooms - Green areas - Staff areas	-Nature -East -Forest
Common facilities					
Living and dining room	1	79 m^2	-Meeting place for patients, relatives and staff -Handicap friendly -Opportunity for bedbound patients -Flexibility according to activities	-Patient rooms -Arrangement and relative kitchen	-Nature -Forest
Arrangement and relative kitchen	1	Included in the living room	-Arrangement of the food coming from the kitchen -Lighter cooking for the relatives -Dining area for the patients, relatives, volunteers and staff	-Patient rooms - Living room	-Nature -Forest
Library	1	53 m^2	-Meeting place for patients, relatives and staff -Handicap friendly -Opportunity for bedbound patients -Flexibility according to activities	-Patient rooms -Living and dining room	-Nature -Forest
Hobby room	1	53 m^2	-Meeting place for patients, relatives and staff -Handicap friendly -Opportunity for bedbound patients -Flexibility according to activities	-Patient rooms -Living and dining room	-Nature -Forest
Reflection room	2	15 m^2	-Spiritual non-religious room -Opportunity for bedbound patients	-Patient rooms	-Nature
Guest room	4	20 m^2 pr. unit	-Room for relatives -Own toilet and bath	-Patient rooms	-Nature

ROOM CLASSIFICATION	STIMULI	DAYLIGHT	OPERATIV TEMP. SUMMER	OPERATIV TEMP. WINTER	CATEGORY	VENTILATION RATE
Qualified space	-Sense of sight -Hearing -Sense of smell	HIGH	24,5°C +- 1°C	22°C +- 1°C	A	≤ 1,7 h^{-1}
Qualified space	-Sense of sight -Hearing -Sense of smell	HIGH	24,5°C +- 1°C	22°C +- 1°C	A	≥ 0.5 h^{-1}
Qualified space	-Sense of sight -Sense of smell	HIGH	24,5°C +- 2°C	22°C +- 2,5°C	B	≥ 0.5 h-1
Qualified space	-Sense of sight -Hearing -Sense of smell	HIGH	24,5°C +- 1°C	22°C +- 1°C	A	≥ 0.5 h-1
Qualified space	-Sense of sight -Hearing -Sense of smell	HIGH	24,5°C +- 1°C	22°C +- 1°C	A	≥ 0.5 h-1
Sublime space	-Sense of sight -Hearing	HIGH	24,5°C +- 2°C	22°C +- 2,5°C	B	≥ 0.5 h-1
Qualified space	-Sense of sight	MEDIUM	24,5°C +- 2°C	22°C +- 2,5°C	B	≥ 0.5 h-1

ROOM SPECIFICATION	UNITS	AREA	FUNCTIONAL DEMANDS	SITUATED CLOSE TO	VIEW
Rehabilitation and therapy room	1	18 m²	-Room for massage -Opportunity of lifts	- Spa room	No direct insight
Spa room	1	20 m²	-Spa und pain therapy -The bath has to be operative from both sides -Opportunity of lifts	- Rehabilitation and therapy room	No direct insight
Children room	1	min. 20 m²	-Activities and entertainment for children	-Common rooms - Guest rooms	-Nature
Conversation room	2	10 m²	-For private and undistrubed conversations -Primarily for staff and relatives -Limited insight	-Patient rooms - Staff areas	No direct insight
Multi functional hall	1	42 m²	-Lectures -External conferences -Concerts	- Staff areas	
Staff facilities					
Open working area	1	70 m²	-Open working environment	- Reception/entrance	-Nature
Work station	2	15 m²	-Team based and open working environment -Visual connection to the wards	- Patient wards	-Nature
Meeting room	1	21 m²		- Reception	-Nature
Coffee room	1	31 m²		- Staff area	-Nature
Print/copy room	1	15 m²		- Open working area	No need of view
Conversation room	1	10 m² pr. unit	-Small breaks and conversation between colleagues	- Staff area	No direct insight
Archive	1	10 m²		- Staff area	No need of view
Practical facilities					
Arrival	1		-Welcome area -Open and informative	-Staff area/ Day-care center - Multi hall	-Nature
The Farewell	1		-Separate exit	-Patient rooms	-Nature
Kitchen	1	95 m²		-Staff area	No need of view
Toilets	10	5 m² pr. unit		- Staff area	No need of view
Medicine room	1	15 m²	-Locked and undisturbed	-Staff area	No need of view

ATMOSPHERE	STIMULI	DAYLIGHT	OPERATIV TEMP. SUMMER	OPERATIV TEMP. WINTER	CATEGORY	VENTILATION RATE
Qualified space	-Hearing -Sense of smell	MEDIUM	24,5°C +- 2°C	22°C +- 2,5°C	B	≤ 3.24 h^{-1}
Qualified space	-Hearing -Sense of smell	MEDIUM	24,5°C +- 2°C	22°C +- 2,5°C	B	≤ 3.24 h-1
Qualified space	-Sense of sight	MEDIUM	24,5°C +- 2°C	22°C +- 2,5°C	B	≥ 0.5 h-1
Qualified space	-No specific stimuli	MEDIUM	24,5°C +- 2°C	22°C +- 2,5°C		≤ 3.24 h-1
Qualified space	-No specific stimuli	MEDIUM	24,5°C +- 2°C	22°C +- 2,5°C	B	≤ 6.04 h-1
Qualified space	-Sense of sight	MEDIUM	24,5°C +- 2°C	22°C +- 2,5°C	B	≤ 6.07 h-1
Qualified space	-Sense of sight	MEDIUM	24,5°C +- 2°C	22°C +- 2,5°C	B	≥ 0.5 h-1
Qualified space	-Sense of sight	MEDIUM	24,5°C +- 2°C	22°C +- 2,5°C	B	≤ 6.07 h-1
Qualified space	-Sense of sight	MEDIUM	24,5°C +- 2°C	22°C +- 2,5°C	B	≤ 6.07 h-1
Indifferent space	-No specific stimuli	LOW				≤ 6.07 h-1
Qualified space	-No specific stimuli	MEDIUM	24,5°C +- 2°C	22°C +- 2,5°C	B	≤ 3.24 h-1
Indifferent space	-No specific stimuli	LOW	24,5°C +- 2°C	22°C +- 2,5°C	B	≤ 3.24 h-1
Qualified space	-Sense of sight -Hearing	MEDIUM	24,5°C +- 2°C	22°C +- 2,5°C	B	≥ 0.5 h-1
Sublime space	-Sense of sight	MEDIUM	24,5°C +- 2°C	22°C +- 2,5°C	B	≥ 0.5 h-1
Qualified space	-No specific stimuli	MEDIUM	24,5°C +- 2°C	22°C +- 2,5°C	B	≤ 6.07 h-1
Indifferent space	-No specific stimuli	LOW	24,5°C +- 2°C	22°C +- 2,5°C	B	≤ 3.24 h-1
Indifferent space	-No specific stimuli	LOW	24,5°C +- 2°C	22°C +- 2,5°C	B	≤ 3.24 h-1

ROOM SPECIFICATION	UNITS	AREA	FUNCTIONAL DEMANDS	SITUATED CLOSE TO	VIEW
Sluice room	1	15 m²	-Zink	-Patient wards - Daycare Center	No need of view
Laundry room	1	10 m²	- Tumble dryer and washing machine - Storage	-Patient wards - Daycare Center	No need of view
Linen room	1	15 m²		-Patient wards - Daycare Center	No need of view
Remote storage	1	35 m²	- Storage	-Staff area - Outdoor	No need of view
Near storage	1	45 m²	- Storage	-Staff area - Patient wards	No need of view
Locker room, women	1	23 m²	-Toilet, bath and lockable lockers	-Staff area	No need of view
Locker room, men	1	20 m²	-Toilet, bath and lockable lockers	-Staff area	No need of view
Caretaker room	1	10 m²	-Office and workshop for small repairments	- Remote storage - Staff area	No need of view
Garbage room etc.	1	Included in remote storage	-Separate unit containing garbage, dirty linen, garden instruments etc.	- Remote storage - Outdoor	No need of view
Technique room	2	32 m²	-Technique for ventilation.	- Remote storage - Outdoor	No need of view
Day Care Center					
Consultation room	1	15 m²	-Massage couch operative from both sides -Zink	Daycare Center	-Nature
Coffee room	1	24 m²	-Social activities -Handicap friendly but not for bedbound patients	- Daycare Center	-Nature
Nap room	2	6 m² pr. unit	-Couch for patients who get uneasy	- Daycare Center	No need of view
Sluice room	1	15 m²	-Zink	- Daycare Center	No need of view
Doctors office	1	25 m²	-Zink - Desk	- Daycare Center	-Nature
Fitness	1	60 m²	-Fitness equiptment	- Daycare Center	-Nature
Outdoor area					
Outdoor area	Vary			- Patient wards - Common facilities	South
Sense garden	1			- Patient rooms - Common facilities	
Parking bikes				- Entrance	
Parking, cars	min. 20			- Entrance	

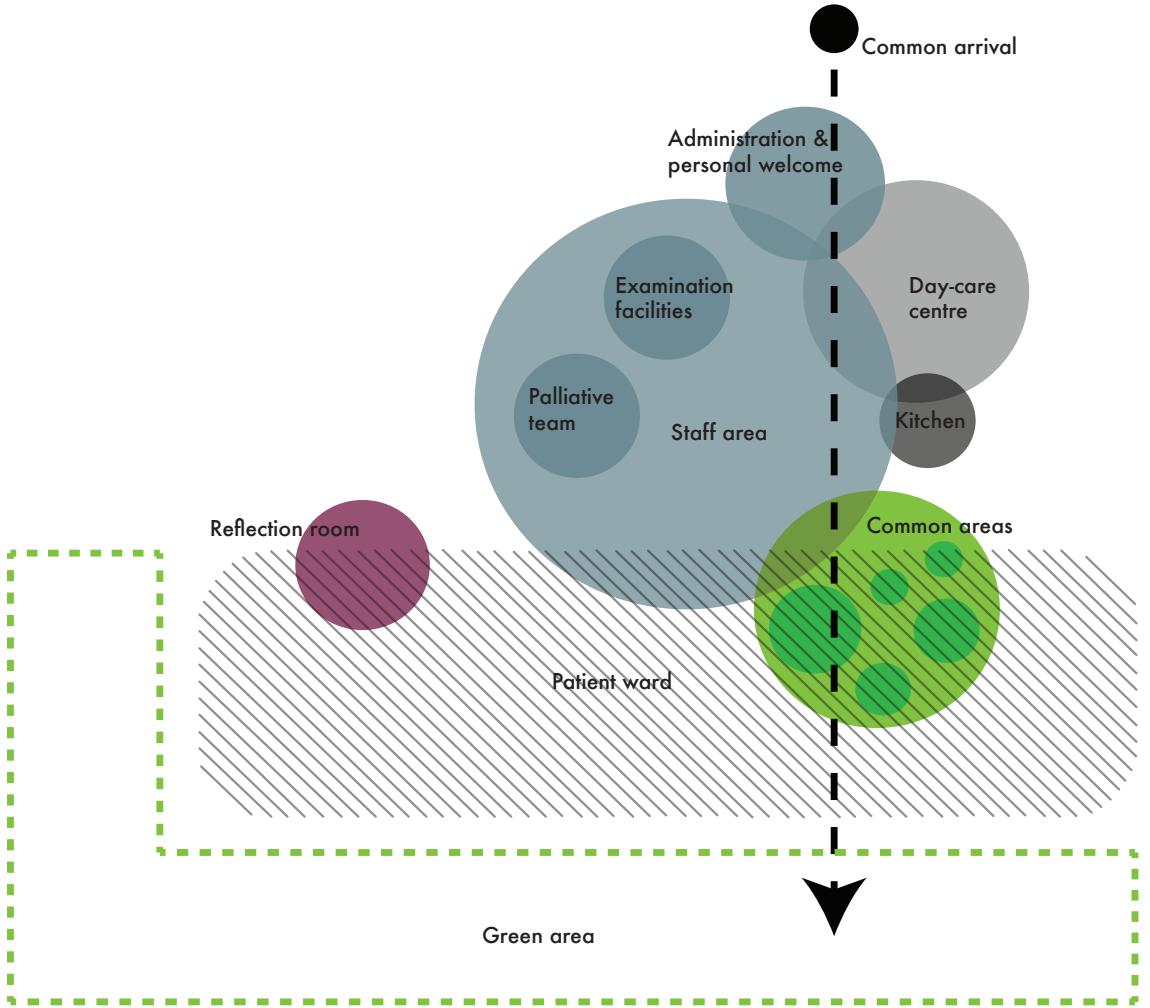
ATMOSPHERE	STIMULI	DAYLIGHT	OPERATIV TEMP. SUMMER	WINTER	CATEGORY	VENTILATION RATE
Indifferent space	-No specific stimuli	LOW	24,5°C +- 2°C	22°C +- 2,5°C	B	≤ 3.24 h^{-1}
Indifferent space	-No specific stimuli	LOW	24,5°C +- 2°C	22°C +- 2,5°C	B	≤ 3.24 h^{-1}
Indifferent space	-No specific stimuli	LOW	24,5°C +- 2°C	22°C +- 2,5°C	B	≤ 3.24 h^{-1}
Indifferent space	-No specific stimuli	LOW	24,5°C +- 2°C	22°C +- 2,5°C	B	≤ 3.24 h^{-1}
Indifferent space	-No specific stimuli	LOW	24,5°C +- 2°C	22°C +- 2,5°C	B	≤ 3.24 h^{-1}
Indifferent space	-No specific stimuli	LOW	24,5°C +- 2°C	22°C +- 2,5°C	B	≤ 3.24 h^{-1}
Indifferent space	-No specific stimuli	LOW	24,5°C +- 2°C	22°C +- 2,5°C	B	≤ 3.24 h^{-1}
Indifferent space	-No specific stimuli	MEDIUM	24,5°C +- 2°C	22°C +- 2,5°C	B	≤ 3.24 h^{-1}
Indifferent space	-No specific stimuli	LOW	24,5°C +- 2°C	22°C +- 2,5°C	B	≤ 3.24 h^{-1}
Indifferent space	-No specific stimuli	LOW	24,5°C +- 2°C	22°C +- 2,5°C	B	≤ 3.24 h^{-1}
Qualified space	-Sense of sight	MEDIUM	24,5°C +- 2°C	22°C +- 2,5°C	B	≤ 2.85 h^{-1}
Qualified space	-Sense of sight	HIGH	24,5°C +- 2°C	22°C +- 2,5°C	B	≤ 2.85 h^{-1}
Qualified space	-No specific stimuli	MEDIUM	24,5°C +- 2°C	22°C +- 2,5°C	B	≤ 3.24 h^{-1}
Qualified space	-No specific stimuli	LOW	24,5°C +- 2°C	22°C +- 2,5°C	B	≤ 3.24 h^{-1}
Qualified space	-Sense of sight	MEDIUM	24,5°C +- 2°C	22°C +- 2,5°C	B	≤ 2.85 h^{-1}
Qualified space	-Sense of sight	MEDIUM	24,5°C +- 2°C	22°C +- 2,5°C	B	≤ 2.85 h^{-1}

1.20 //

DIAGRAM OF FUNCTIONS & DESIGN PARAMETERS

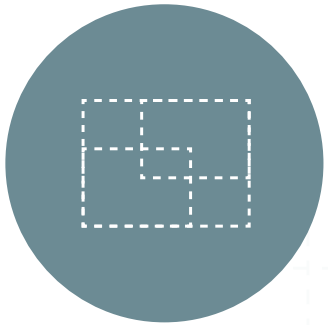
This chapter is a short recapitulation of the analysed design principles and a proposal for a diagram of function to illustrate the different relations between the functions.

When designing a hospice it is important to recall that it exists of several functions beside the patient wards. The hospice is a platform of knowledge sharing and a base from which the palliative care will be assessable. In relation to this a diagram of functions template from Programme for the Good Hospice in Denmark has been utilized in order to obtain a figurative understanding of the design as a whole and the internal connections between the functions.



Ill. 52.1 Diagram of functions (Realdania, 2009)

REALM



FUNCTION

CONSTRUCTION

EMOTION

Ill. 53.1 Design parameters

As an extension of this and based on the several design parameters derived throughout the analysis, primary design principles will be established in order to create a clear hierarchy.

Realm

The hospice should relate to the context and provide a view and a direct access from each of the patient wards to the outdoor. The layout and orientation of the hospice should moreover reassure good lighting conditions that will have a healing and comforting affect on the patients both in the patient rooms and common areas.

Function

The hospice should posses a certain flexibility in the layout of the building to reassure maximum utilisation of the rooms. Moreover it is important to create an coherent course through the building to decrease the feeling of an institution. Lastly there should exist a graduation between private and common areas and functions, so that the patients will not be unnecessary bothered.

Construction

The patient ward should be divided into smaller clusters in order to reflect the overall work organisation of the staff and their team-based workflow so that each team takes care of one cluster, which will result in a stronger community feeling, intimacy and a sense of security between both co-workers, patients and relatives.

Emotion

The hospice should enhance the possibilities for social interaction and social relations between patients, staff and relatives by the means of attractive and comfortable common areas. Larger common rooms as well as smaller can express these informal meeting points, which will have a relieving and reassuring affect. Moreover the hospice should have a separate exit for the patients passing away in the hospice so that the relatives can say their farewell in undisturbed surroundings and without exhibiting the deceased for the entire hospice.

These design parameters will become the primary focal points in the design process in order to extract a conceptual principle in manner of capturing the essence of the architectural whole.

1.21 //

VISION

The vision of this project is to design a hospice, with an integrated Day Care Center, that will embrace the patients and relatives need for comfort and well-being. The architecture should encourage a relieving process, while enhancing the life quality of the patients and make the last part of their life's journey enjoyable. The physical frame of the hospice should work as the mediator between the principles of Nordic and Healing Architecture and the well-being of the patients.

It is the aim to design a context related building, that will respect the unique nature and atmosphere on the site by taking advantages of the methodology of Nordic architecture.

Since the hospice is located in future sustainable district development, it is the aim to fulfill the standards of Low energy class 2020 by primarily using passive solutions. This stresses the need of focusing on the indoor climate and the comfort of the patients by fulfilling the standards of category A in the patient wards. The final design should be based on an Evidence Based Design approach and an interaction between functional, aesthetical and technical aspects, which should result in an integrated design solution.

In the following chapter, the Design process, which leads to the final design proposal, will be described.

The Design process aims to justify the different decisions that have been made during the process. The decisions have been made on the base of the program and the chosen methods. The methods being used in the development of the design proposal is the Integrated Design Process and Evidence Based Design. The methods are being reflected in the consideration regarding the well-being of the patients, functionality of the building, architectural expression and the desire of reaching the Danish Energy Frame of Building regulation 2020. The process may occur rather pragmatic, but every step has been evaluated according to already mentioned considerations.

During the process there have been made a large number of iterations, therefore it has been chosen not to involve the reader in all steps of the process, since it will create a confusing and a rather large process. Therefore it is chosen to display the initiatives that are being justified by experimentation and evaluation in relation to above mentioned considerations. This is done by illustrations and explanatory text, which will give an overview of the course of development.

PROCESS 2.0

2.01 //

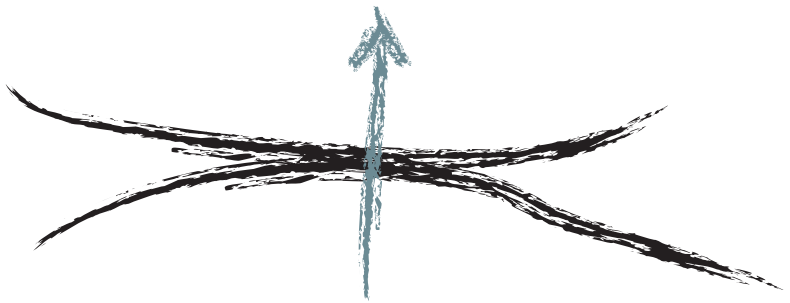
CONCEPT

The architectural concept is a result of a composition of elements from the program, the four design principles and the vision.

- Light and nature should be allowed into the hospice, with the attempt of creating a spacious atmosphere and the appreciation of the green elements, in relation to Healing and Nordic architecture.
- The placement of functions should create a flow and natural meeting points, meeting points that will create social interaction.
- The flow of the building should control the degree of privacy, with the attempt of creating a graduation from public and to private.

Integrate a course of nature within the building

Create natural meeting points



Create a graduation from public and to private

Ill. 59.1 Concept

2.02 //

INVESTIGATION OF TYPOLOGIES

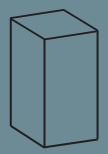
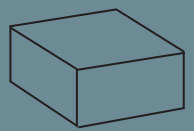
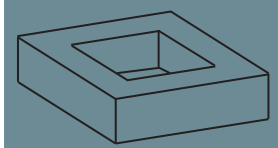
In order to build an energy optimized building, it seen important to investigate different building typologies evaluated on the base of Energy Consumption, light and functionality

Throughout the analysis it has been expressed how crucial light within the hospice is, this is in conflict with a compact building shape in correlation to Low Energy building. Therefore there have been made an initiating investigation of different building typologies.

The typologies are assessed against the potential of:
- creating good lighting conditions
- creating a reasonable energy consumption
- creating good work conditions, based on organizing function and flow.

It is evident that the tall building shape is by far the best, when speaking of energy consumption and even lighting conditions, but it will interfere negatively with the nurse's work flow and will create a less functional layout, which is not wanted. So, when looking at building shapes with only one floor, it is evident, though you increase the surface area, the energy consumption will only vary with 0,62%. This will give the ability to create staggered facades that will allow light from multiple orientations, or the opportunity to give the façade a changing expression.

When choosing a one plan building, the deterioration of the buildings Energy Consumption is not significant, therefore there has been seen great freedom when designing.

MULTIPLE TYPOLOGIES compared on the basis of a ground area of 500m²	LIGHTING compared on the basis of intuition	ENERGY CONSUMPTION compared on the basis of Be10 calculations	FUNCTIONALITY compared on the basis of intuition
	+ Create light from different directions + possibility of making light penetrate deep into the building	Optimal shape	- Stairs will interfere negatively with the work flow - Does not provide the necessary overview - Seems fragmented
	- Difficult to make the light penetrate deep into the building	72,27 % variation from the optimal shape	+ Provides the building with an overview - When placing functions in the middle, long hall ways will be created
	+ Light will easily penetrate the building	72,41 % variation from the optimal shape	+ Provides the building with an overview - May create rather long courses of hall ways
	+ Light will easily penetrate into the building + Possibility to have light from different directions	72,70 % variation from the optimal shape	- Does not provide the necessary overview + Create a natural protected outdoor area
	+ Light will easily penetrate into the building + Possibility to have light from different directions	72,89 % variation from the optimal shape	- Does not provide the necessary overview + Create a larger area towards the outdoor

2.03 //

SUMMER- AND WINTER SOLSTICE

The site is located in close connection to a common forest of approximately 24 meters hight. The forest will natural cast some shadows on the site, why it has been found relevant to examine the shade conditions.

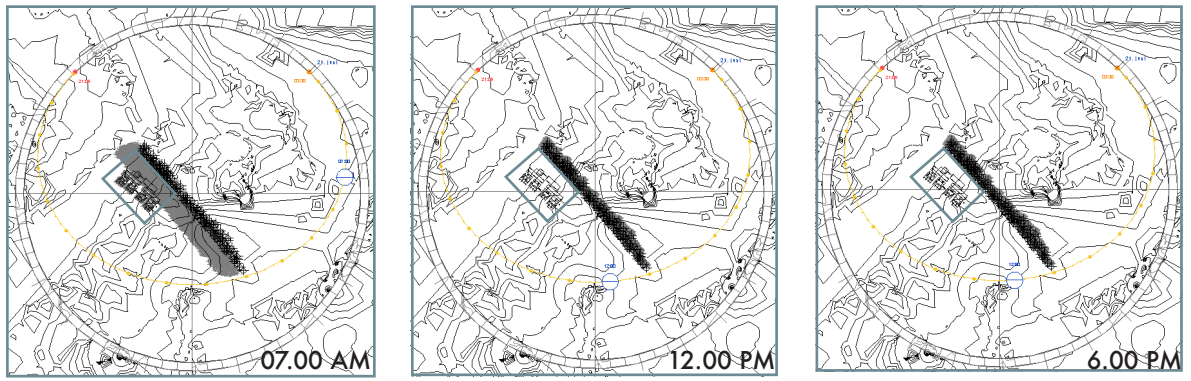
The shade conditions of the site are being examined in relation to the solstice, which is either the longest day of the year (June 21) and the shortest day of the year (December 22) (ill. 61.1).

From these illustrations it is evident, that the forest does not cast any significant shadows on the site. It should though be noticed that if it is a wish to take advantage of the sunrise, in relation to its effect on the patients (healing architecture), the hospice should be placed with a distance to the forest, in order to avoid shadows in the summer.

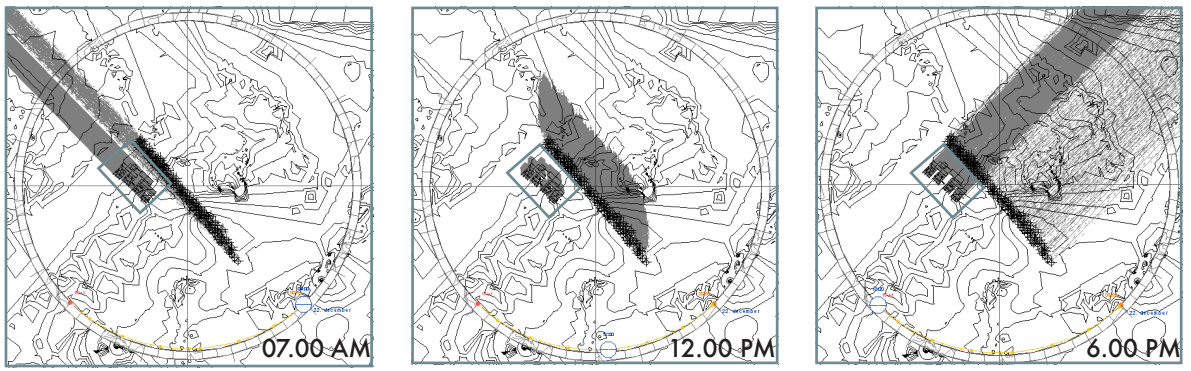
In relation to the context, it is worth mentioning that the proposed low and dense residential area will not have an influence on the shade conditions on the site.

This investigation verifies a relatively great freedom when placing the hospice on the site.

SUMMER SOLSTICE, June 21



WINTER SOLSTICE, December 22



Ill. 61.1Summer- and winter solstice

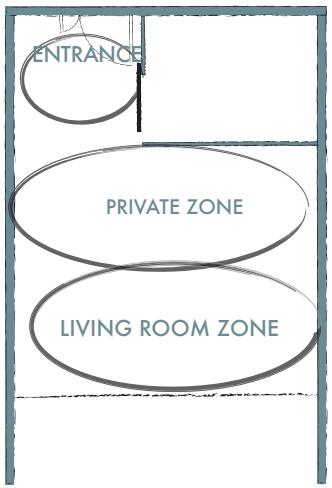
PATIENT WARDS

In order to create the optimum conditions for the patients living in the patient wards it is important to keep their physical statement in mind when creating, what in most cases is the last home of the patients.

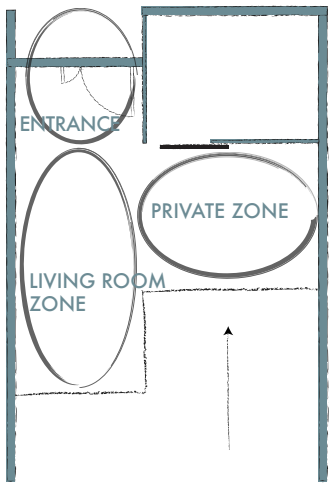
With this notion as a point of reference the concept of zoning occurred. By the means of different zones corresponding to the different stages of illness of the patients, which differs a lot on a short amount of time. Hospice Djursland manager, Dorit Simonsen, emphasizes that the patients at arrival are mostly mobile and can walk around with reservations and maintain a high amount of self-dependence. However, this independence is quickly reduced to a minimum and the patient becomes so weakened that "every inch of the body hurts and works against the patient", as Dorit Simonsen explains it. When this stage occurs the patient will be bound to the bed. Because of this it is the desire to create a more private and intimate area within the room where the patients can be at their very last stage of their illness where they are rapidly weakened. Additionally the desire is to create a direct view to the green areas outside immediately when entering the room by the means of a more open zone.

The iterations in ill. 62.1 illustrate how investigations have been made in order to achieve the different zones. With a rectangular room as a point of departure it is difficult to obtain a intimate and private area, why half the façade will be dragged in, in order to create a more defined and private zone. With the definition of a private zone, the entrance to the toilet is likewise placed in connection with the private sphere. The entrance to the patient ward will have a semi-private character, which starts already outside the ward and thereby creating a small transition zone and a graduation.

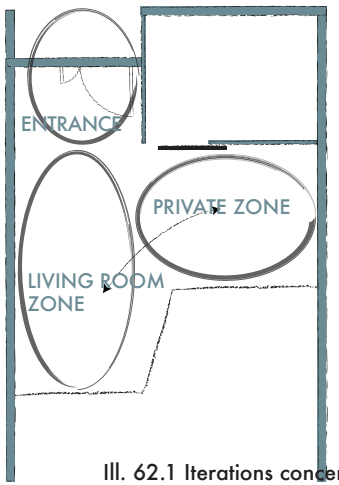
Iteration 1



Iteration 2



Iteration 3

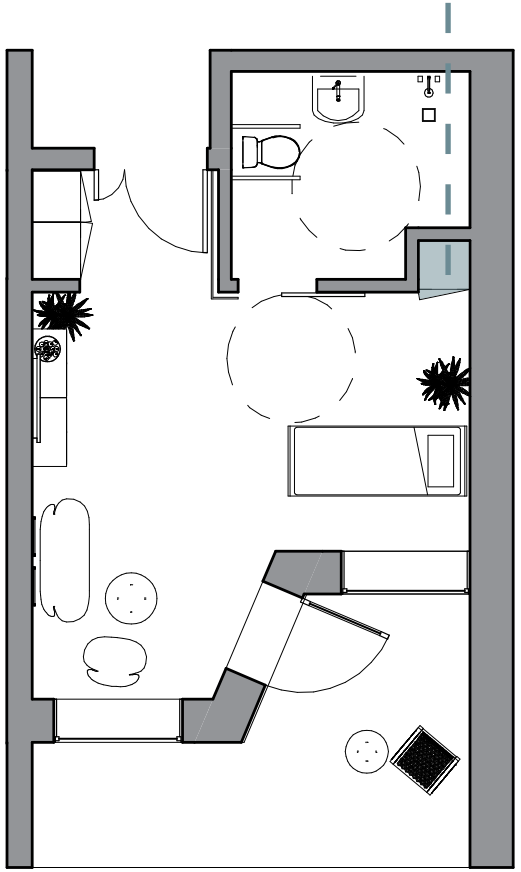


Ill. 62.1 Iterations concerning zones

In order to regain certain cohesion between the zones and to create a more useable space the notable corner is removed, which breaks down the spatial barrier. By doing this the patio gains the same qualities of the different zones that is seen within the plan solution of the patient ward, where one part will become more secluded and protected. Additionally the walls will continue out on the terrace emphasizing the direct view to the natural elements and support the concept of a more sheltered outdoor space as well.

Regarding the décor the plan is designed so that it is possible to have an overnight guest sleeping in a spare bed beside the patient in the private zone if wanted. The bathroom is designed according to standards in order to accommodate patients in wheelchairs and making the bath accessible by a bathing stretch. Moreover a lift is incorporated in a fixed cabinet in the private zone in order to maintain the necessary and prescribed equipment when the patient is bedbound and fully dependent on others in a discreet and tasteful manner.

INCORPORATED CABINAT WITH INTEGRATED LIFT



Ill. 63.1 Patient wards

PATIENT WARDS

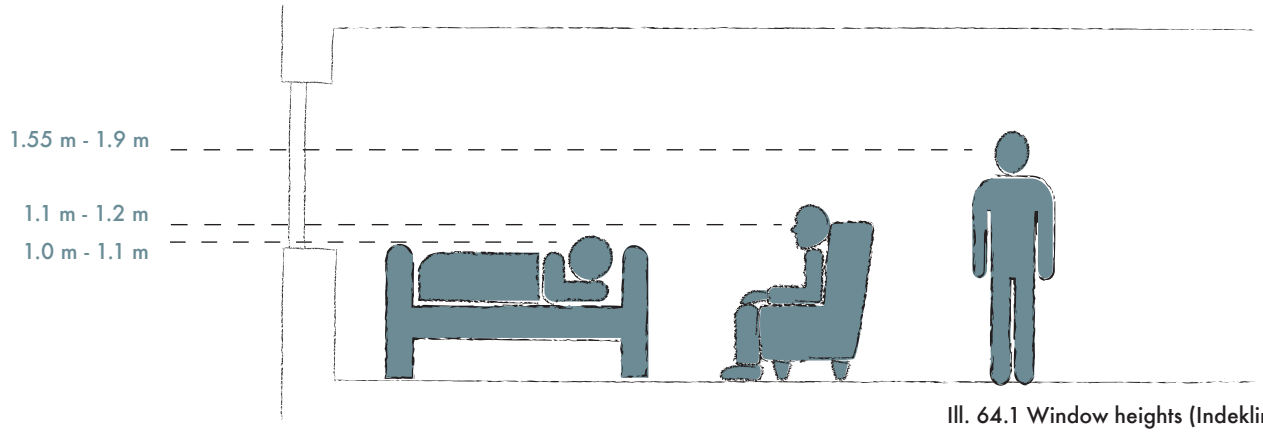
With the division of the plan into zones according to the different stages of the course of illness of a terminal patient as a point of reference different concepts concerning the window placement are investigated and evaluated on a aesthetical, functional and an energy optimized basis.

In order to create a more private and intimate zone within a room of limited square metres it has been the purpose to emphasize this zone and differentiate it by the means of light as well. The zone where the patients are bedbound in the last period of their lives has to have a more private character where they do not feel displayed. However, it is still important that they maintain an undisturbed view towards natural elements in accordance to the principles of healing architecture. The optimum placement of a window suitable for a person on bed rest and a relative sitting beside is found and placed in the private zone (ill. 64.1). The window is horizontal to ensure a wider range of view. This way the view is secured while it has become more difficult to look into the room due to the relatively low height of the window.

It is evident from the different iterations (ill. 65.1), especially iteration 1, that the relatively high average daylight factor is reached because of large amount of light near the windows. In the following iterations it is tried to let light penetrate deeper into the room by placing a window up high combined with a sloping roof.

The final choosing of iteration 4 is based upon a combination of several aspects even though it possesses the highest transmission loss. It allows light deep into the room and divides the patient dwelling into different zones both in the placement and sizes of the windows and the amount of light, which is readable in the façade aesthetics.

It is evident from the investigation that it is not possible to obtain a high daylight factor in the back of the room due to a limited amount of free façade and the demand of a private and intimate zone. This is why it is necessary to incorporate another initiative during the design process in order to reassure a higher daylight factor in the private zone, since it still ought to be considered as a workplace for the nurses.

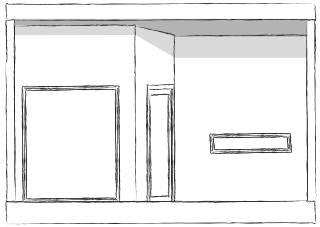


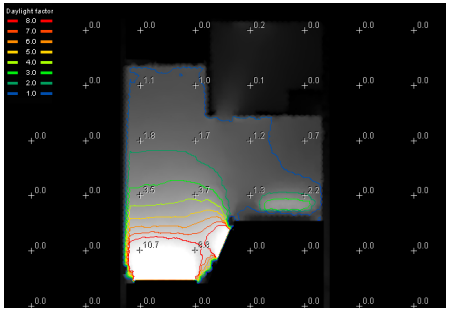
Ill. 64.1 Window heights (Indeklimahåndbogen, p. 304, 2000)

Iteration 1

Transmissionloss: 528,17 W

Average daylight factor: 3,14%

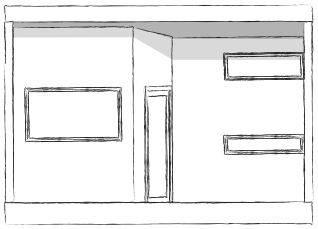


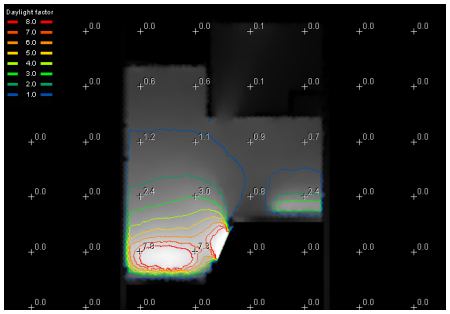


Iteration 2

Transmissionloss: 508,41 W

Average daylight factor: 2,4%

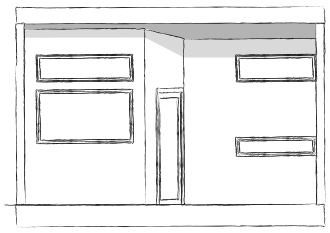


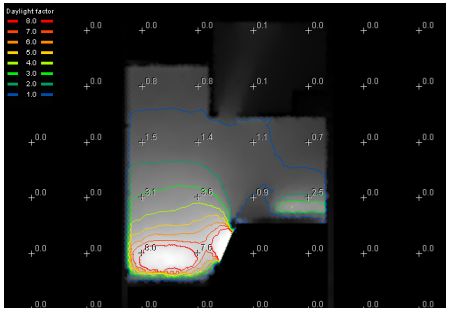


Iteration 3

Transmissionloss: 592,65 W

Average daylight factor: 2,67%

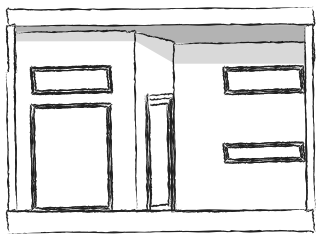


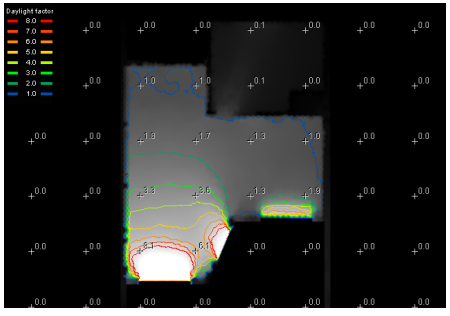


Iteration 4

Transmissionloss: 668,57 W

Average daylight factor: 2,68%





PATIENT WARDS

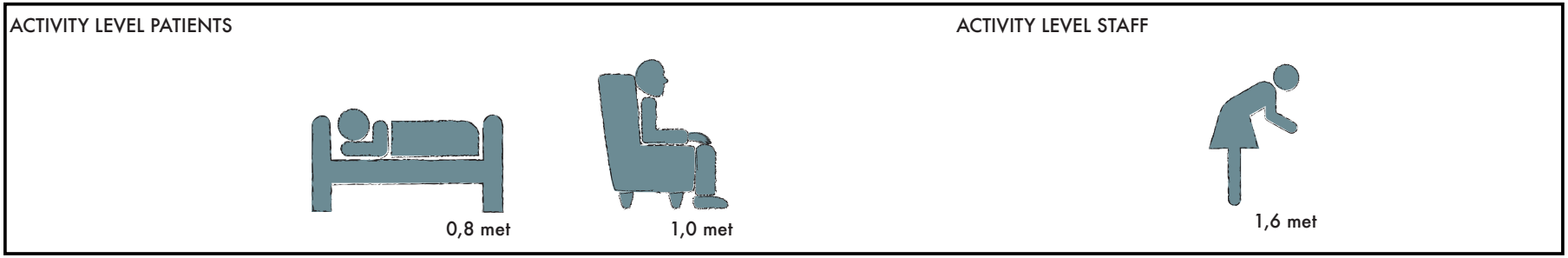
In relation to previous investigations and in order to find the optimum orientation of the patient wards the 24-hour average spread sheet has been utilized as a rough indication in order to evaluate the thermal indoor environment. The four chosen directions are based upon the layout of the site and thereby orthogonal. The final exact orientation will be investigated and adjusted according to Be10.

The investigation is made based on the previously chosen window layout and from the warmest month. Since the thermal indoor environment is of great importance in the patient wards and since the activity level of the patients is rather low, reduced to 0.8 – 1.0 met, it is essential that the indoor temperature is relatively high in order to create a comfortable thermal environment (ill.66.1). The activity level of the staff will be considerably higher, but they will not be present in the patient wards all day. However, the internal heat load will be affected by it and in the case of visits from relatives and friends. This is calculated within the spread sheets, but it is still a rather rough indication of the optimum orientation.

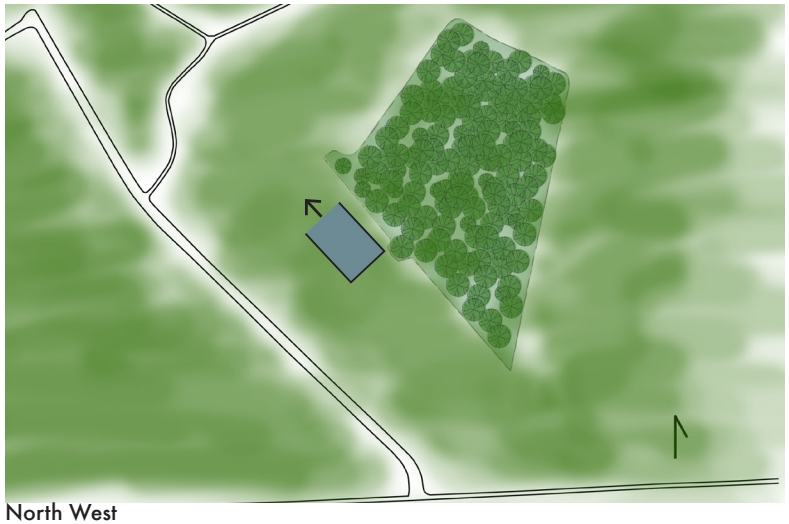
It is evident from the investigation that the most optimum orientation is NW where the patient wards are being protected from the most critical sun.(ill. 67.1). However, due to the layout of the site it is not possible to place 12 patient wards all facing NW without placing them in layers, which is against the initial design principles and the concept.

According to the future development of the area there will be placed dense low buildings in the nearby areas, which gives another reason for not choosing a NW orientation. In stead it is chosen to look "inwards" and thereby seclude the patients and orientate the patient wards towards the forest and away from the public main road and the future buildings, which is furthermore consistent with the concept of a graduation from public to private. With this orientation the sun can penetrate the wards in the morning from the east, which has proven to have a positive effect on the patients and their circadian rhythm.

The chosen NE orientation is not the optimum orientation according to the spread sheets, however, it is the one that answers best to the layout of the site, the design principles and the concept. The final exact orientation and smaller deviation from NE will be based on investigations in Be10, which gives a more precise result due to the several variable parameters.

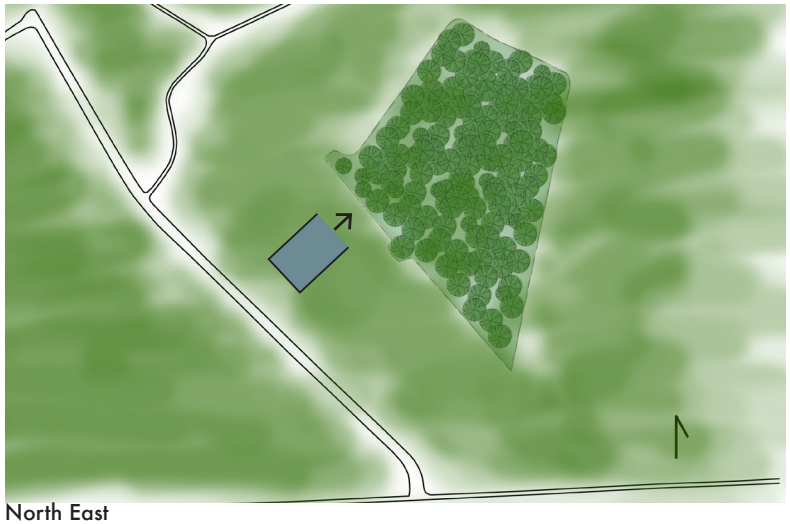


Ill. 66.1 Activity level (CR1752)



North West

The optimal orientation of the patient wards



North East

A deterioration of the optimal orientationwith 0,82%

South West

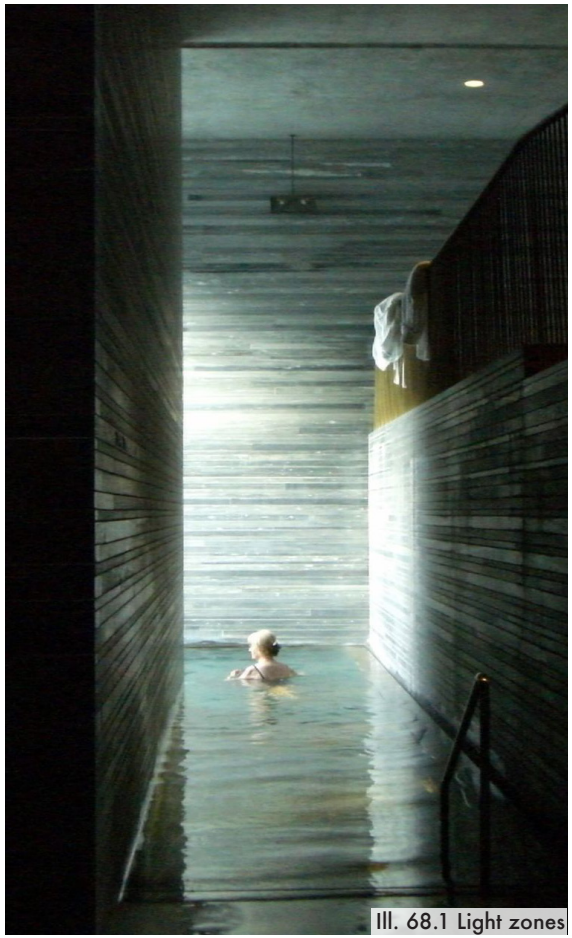
A deterioration of the optimal orientation with 5,8 %

South East

A deterioration of the optimal orientation with 6,35 %

Ill. 67.1 Orientation of patient wards

PATIENT WARDS



Ill. 68.1 Light zones

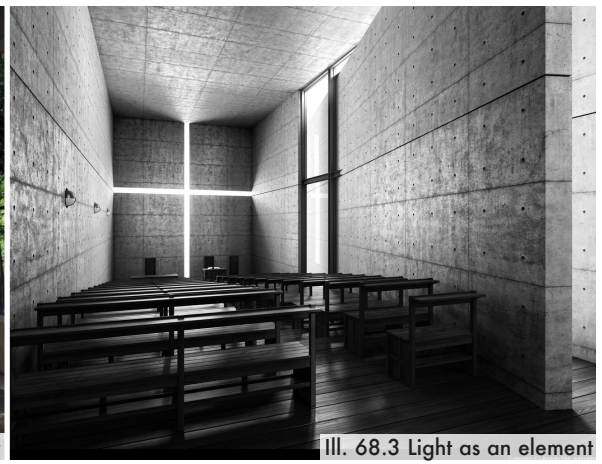
As an extension of previous investigations, concerning the placement of windows, it is necessary to consider how to obtain more daylight in the patient wards in order to reach a higher daylight factor.

The idea is to create a comfortable and reliving indoor environment according to daylight, why potentials are seen in considering the different types of light and how they affects the perception of space. Basically three iterations are chosen to emphasize the different ideas and the effects they create (ill.68.1-3).

Iteration 2 is chosen due to the fact that it provides a high daylight factor but more importantly it creates a soft, continuously and pleasant diffuse light. With the incorporation of light in the back of the room, the risk of a blinding effect towards the windows is reduced rapidly. By choosing iteration 2 the diffuse light will become a constant lighting element reflecting the qualities of the Nordic soft light and avoiding the critical direct sun from SE.

By implementing a second source of natural daylight, the average daylight factor is increased rapidly which corresponds positively to the theories of Healing Architecture. Moreover it is still possible to recognize the different zones in the distribution of light. The usage and potentials of artificial light as well will be detailed during the process.

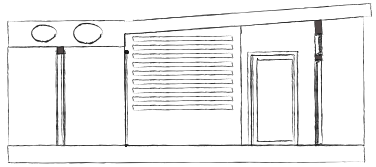
Ill. 68.2 Diffuse light

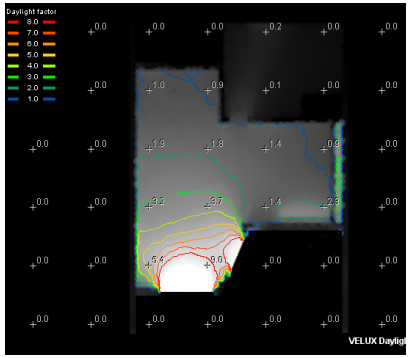


Ill. 68.3 Light as an element

Iteration 1: Creating a light well by utilizing an entire wall with a skylight placed above.

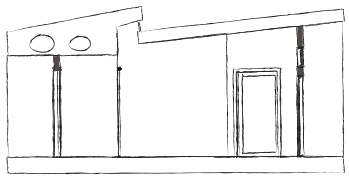
+ Can add a warm colour to the back wall that will reflect and emphasize a warm at mosphere
+ Creates an element in the patient wards and minimizes the feeling of a traditional institution
- Demands a rather big area of the limited square meters of the patient ward
- Provides only a daylight factor of 0.9% in the private zone

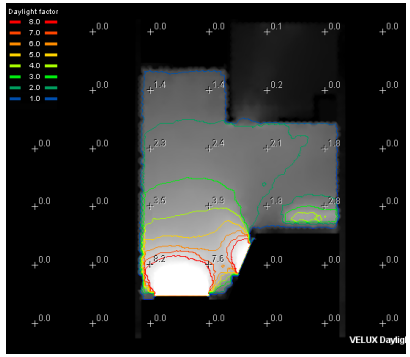




Iteration 2: Creating a horizontal stripe of windows by the means of dividing the roof into two facing southeast.

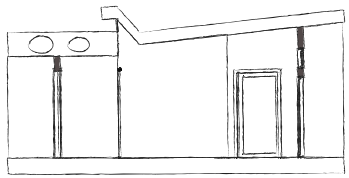
+ Provides a high daylight factor
+ Achieves a diffuse soft light
+ Avoids the most critical solar radiation

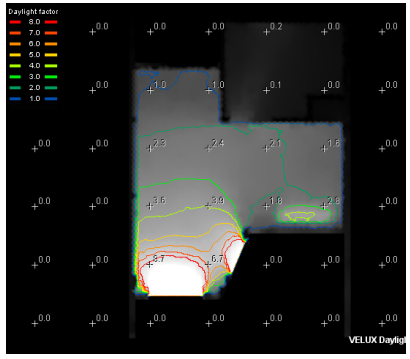




Iteration 3: Is an inverse example of iteration 2 and faces southwest

+ Provides a high daylight factor
- Faces the critical solar radiation from southwest
- Direct sunlight





PATIENT WARDS

With the establishment of the patient wards it is obvious to investigate the indoor environment in order to reassure comfortable and healthy surrounding for the inhabitants.

The chosen ventilation strategy of the patient wards is mainly mechanical due to the desire for a stabile indoor environment since the users are rapidly weakened and in a vulnerable situation where the activity level is limited. However, it should be possible for the patients to obtain a certain amount of user control, why it is possible to supplement with natural ventilation if wanted.

In order to establish the dimensioning factor for the air change, calculations have been done for the basic minimum demands from the Danish Building Regulation, the CO_2 concentration and the operative temperature respectively (Appendix 6.01). According to the calculations it is the temperature that has the biggest influence on the indoor environment; hence it will determine the air change rate necessary to lower the indoor air satisfactorily according to category A. The calculated air change according to the operative temperature in the patient ward is 1,7 h^{-1} based on the internal heat load, solar radiation and transmission loss.

As a more reliable investigation the dynamic simulation programme BSim has been utilized in order to verify the level of CO2 concentration and overheating on an hourly basis due to the more detailed amount of parameters. The model is simplified as much as possible but will still contain the actual volume of the patient ward and the windows are placed in an average situation in order to achieve a more exact result.

The amount of inlet air provided by the mechanical fans corresponds to the calculated air change, however, it is still possible for the inhabitants to influence the indoor environment, why venting is applied in the summer period May-September and activating at 25 degrees. Additionally it can only be activated from noon 12 a.m. to 5 p.m.

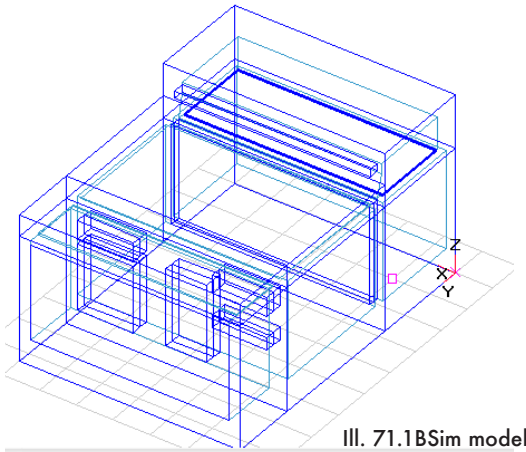
The results from BSim can be seen in illustration 71.2, which shows the overheat hours that evidently do not exceed the maximum limits from the Building Regulations. The result can be categorized as being highly acceptable due to the relatively few hours above the acceptable.

Illustration 71.4 presents the key values during a year. It shows how the air change rises during the summer as a result of the increasing temperatures. As a response to this the CO2 level decreases drastically. All the illustrations emphasize how the thermal indoor environment is within Category A. The limited hours above 26 and 27 degrees respectively, are thereby fairly acceptable.

As an additional investigation there has been chosen a scenario where the patient has three guests in the patient wards and how this will affect the indoor environment. The graph (ILL. 71.5) shows the result of this scenario. It is evident that the enlargement of the internal heat load and the CO2-level have an influence on the air change, however, it is not the CO2-level that causes this, but instead it is the higher amount of internal heat load that activates and increases the air change, which corresponds to the fact that temperature has been the dimensioning factor for the air change.

Hospice	Sum/mean	January	February	March	April	May	June	July	August	September	October	November	December
Top mean temp.	24	23.1	23.1	23.2	23.6	24.9	25.0	25.1	25.1	24.9	24.0	23.3	23.1
Air change	1.0	0.6	0.6	0.6	0.6	1.1	1.5	1.7	1.7	1.0	0.6	0.6	0.6
CO_2 (ppm)	570.3	616.9	617.0	616.9	615.4	532.8	491.3	477.4	465.5	540.9	615.7	616.5	616.9
Hours >26	69	0	0	0	0	0	18	24	27	0	0	0	0
Hours >27	7	0	0	0	0	0	0	0	7	0	0	0	0

Ill. 71.2 Key figures



Ill. 71.1BSim model

INPUTS

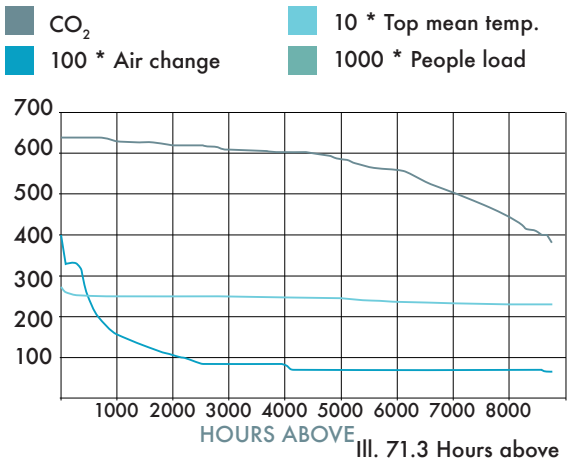
Ventilation
- The minimum supply is calculated according to the Danish Building Regulations that requires 0.5h^{-1}, which sets the inlet and outlet supply to 0,017 m3/s.
- VAV-ventilation (variable air volume) with the VAV max factor on 5, which makes it possible to obtain a supply 5 times higher than the 0.5 h^{-1}, by which it easily can reach the calculated demand.
- Setpoint indoor air: 23 degree
- Setpoint cooling: 25 degree
- Schedule: all year

Venting
-The natural ventilation will only be applied in the summer period going from May-Sep in the interval 12 a.m. to 5 p.m.
- Setpoint 26 degree

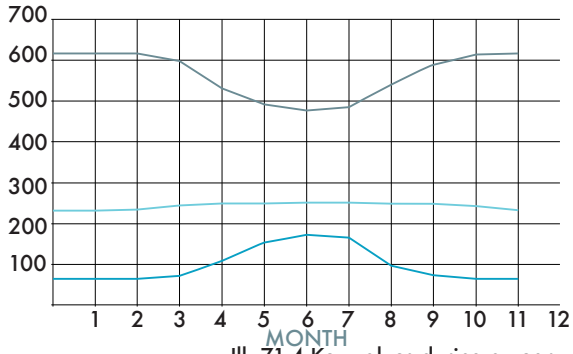
People load
- The people load is set to 1,2 persons of 0,8 kW due to the low activity level
- Day profile varies between 80-100% during the day due to the frequent visits from nurses etc. (5 times pr. Day for an hour, which is probably a long span of time)
- Schedule: all year

Equipment
- Heat load: 0,16 kW
- Schedule: all year
- Day profile: 100% 9-22

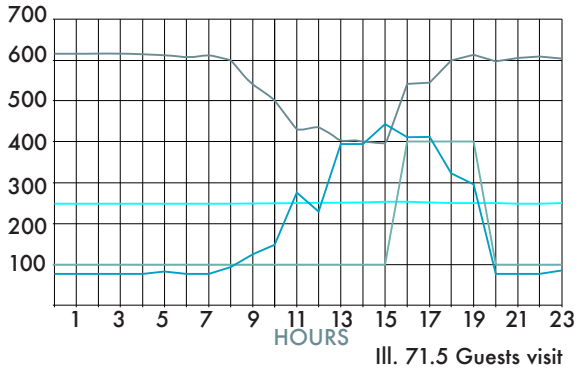
Lighting
- Standard values
- Schedules: will be divided into summer-, winter- and night light (the night light with the factor 0.1, which is due to the limited amount of light turned on by the nurses during the night – work light).



Ill. 71.3 Hours above



Ill. 71.4 Key values during a year



Ill. 71.5 Guests visit

2.09 //

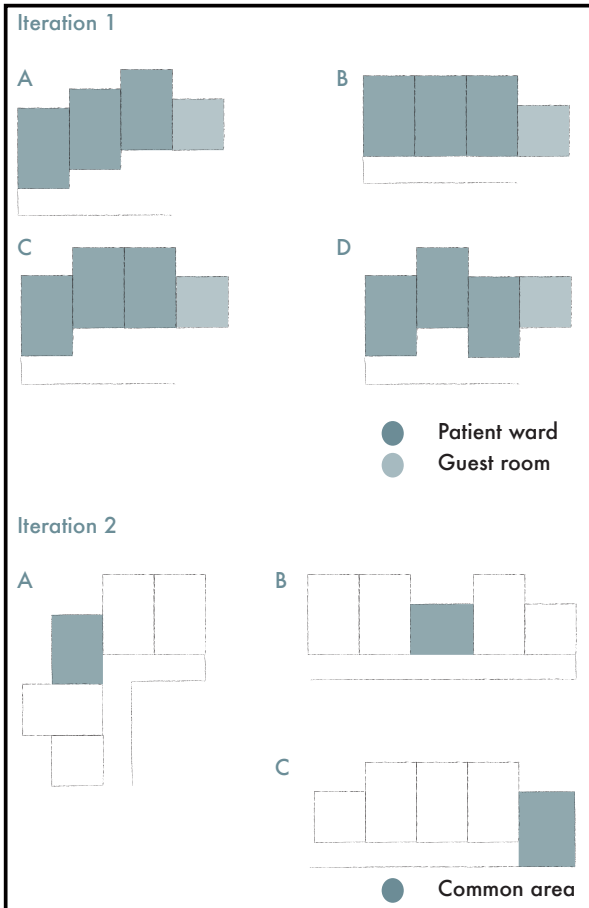
CLUSTERS

Since the concept of clusters is a focal point it is important to establish how they ought to be composed and function.

The idea of clusters derives from the possibility of creating a greater community feeling and to promote strong relations between both patients and relatives in this hard and critical time. Moreover will the division into clusters reflect the overall work organization of the staff and thereby their team-based workflow, meaning that each cluster has their own team. This will likewise obtain a grater intimacy feeling and a sense of security between patients, relatives and co-workers.

Each cluster will be defined by three patient wards, which is the amount suitable professionally according to Hospice manager of Djursland Hospice, Dorit Simonsen. In order to further enhance the sense of belonging each cluster will have their own guest dwelling at the disposal of the relatives, who does not feel comfortable sleeping in the patient wards. Finally the last addition to each cluster is a common area in which the patients and even more their relatives can come and create new and beneficial relations.

Example A from iteration 2 gives the best flow by placing the common area in a corner defined by two rooms giving it a more central and dominant character, breaking the physical barrier and thereby creating a visual contact between the nature in front of



Ill. 72.1 Iterations concerning the clusters

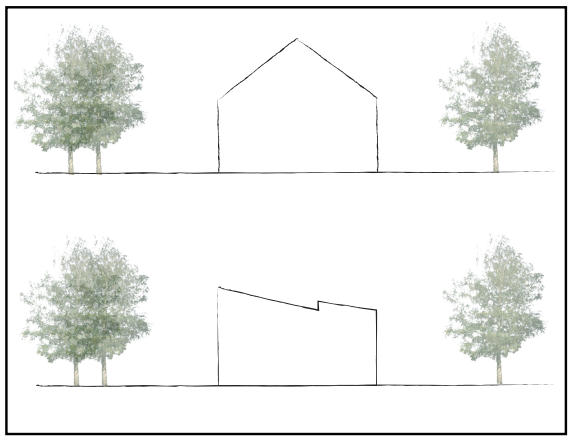
- Difficult to create a useable common area without interfering with the semi-private entrances of the patient wards
- The common area will become a waste of space rather than having the character of being a defined room
- Compromises the functionality of being a hospice where bed fares occurs frequently

As a conclusion it is decided that the common area has to be defined as an actual room and keep the hallway a hallway in order to achieve the wanted qualities and hierarchy without compromising the functionality.

- It will become rather long layout of the clusters
- or it will be difficult to create a useable layout without patient wards facing each other, which is against the concept and the chosen orientation.

the patient wards and the rest of the hospice.

Potentials are seen in making it a parameter in the further development of the composition of the clusters that they will interpret the traditional monastery, which were the first to consider the physical frames of having a influence of the well-being of the patients (Region Hovedstaden, 2010). In this project potentials are therefor seen in giving each patient ward an open front yard and a more secluded and private backyard, which will be visually connected by the common area.



Ill. 73.1 Principle of a front- and backyard

Ill. 73.2 Traditional protected monastery courtyard

Ill. 73.3 Interpretation of a protected courtyard

2.10 //

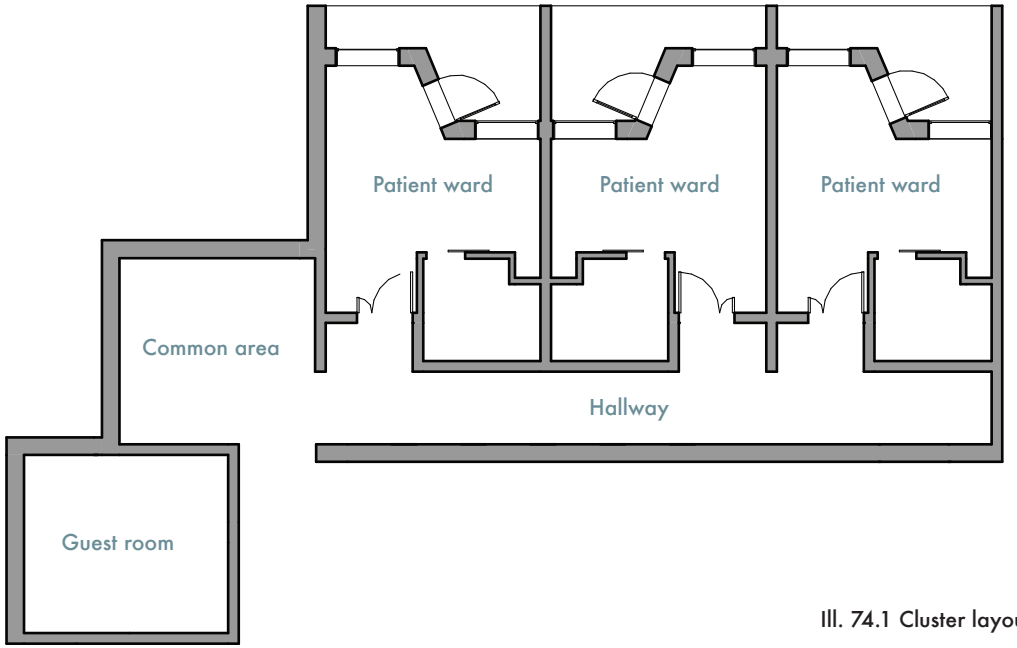
COMBINATION OF CLUSTERS

With the previous considerations concerning the clusters as a point of departure, the further development and combination will be determined with an emphasis on the notion of a front- and back yard and creating a defined common area.

Due to earlier investigations each patient ward ought to obtain an unblocked view towards NE, which is why the guest room is utilized in order to create the defined common area placed in the corner of the cluster (ill.74.1). Based on this common principles the clusters are combined in order to achieve a basic layout.

The combination of the clusters will provide a central common living room, which create a significant axis that contribute to an easy and intuitive orientation and guidance throughout the composition of the clusters in accordance to the theory of Healing Architecture [Region Hovedstaden, 2010] .

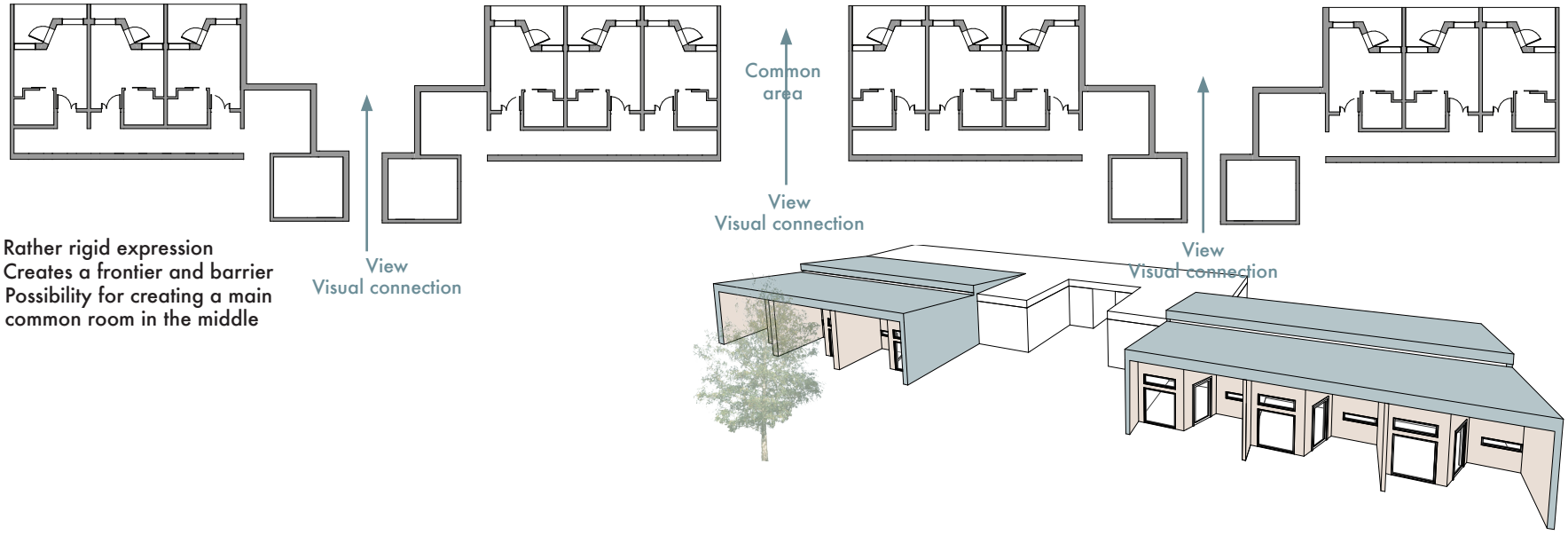
The second iteration is chosen and shows how the entire cluster is being placed under one roof that encloses and defines each cluster. With the small displacement in plan from the first iteration to the second, the common room will thereby follow the existing lines both in plan and section.



Ill. 74.1 Cluster layout

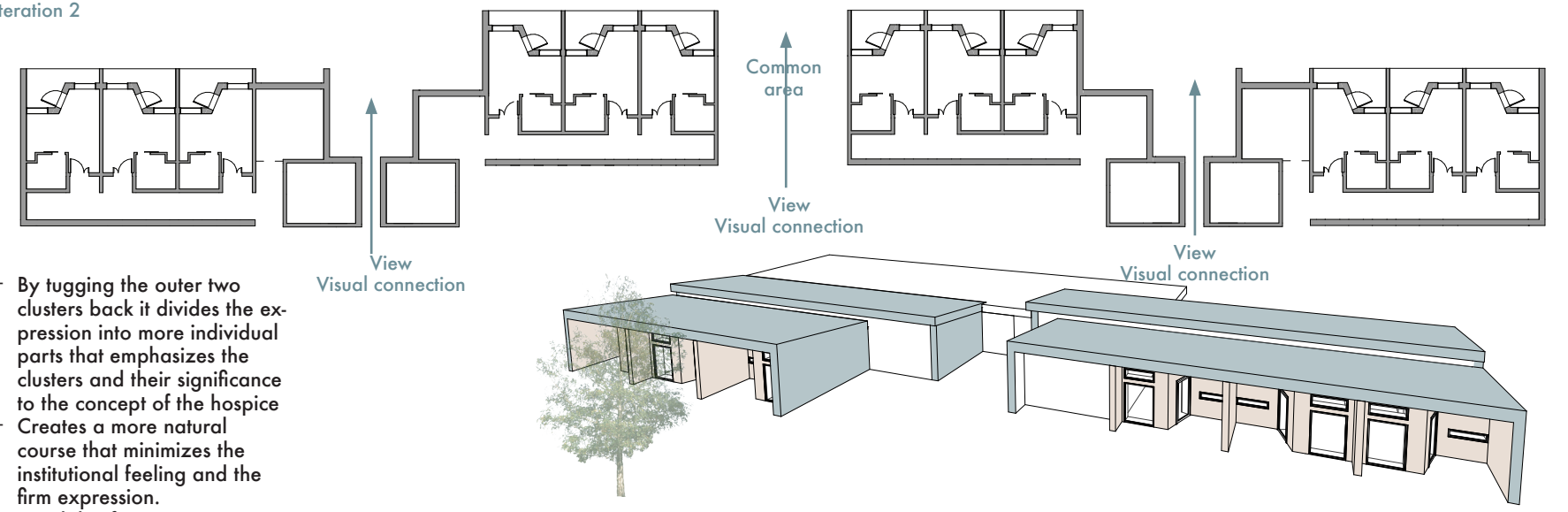
With the combination of the clusters it is possible to gain a visual contact to the natural elements outside and thereby break down the rather rigid barrier, without compromising the optimum view and orientation of the patient wards. Moreover, the clusters emphasize and illustrate the principle of a front- and back yard with different characters seen in monasteries.

Iteration 1



- Rather rigid expression
- Creates a frontier and barrier
+ Possibility for creating a main common room in the middle

Iteration 2



+ By tugging the outer two clusters back it divides the expression into more individual parts that emphasizes the clusters and their significance to the concept of the hospice
+ Creates a more natural course that minimizes the institutional feeling and the firm expression.
+ Possibility for creating a main common room in the middle.

Ill. 75.1 Iterations concerning the combination of clusters

2.11 //

REFLECTION ROOM

With the establishment of the clusters and their combination it is obvious to investigate how to utilize the rather inconvenient space formed in between the gathering of two clusters.

The concept of the reflection room is to create a safe and secluded zone with a spiritual and non-religious atmosphere that emphasizes and encourages quiet contemplation for patients and especially the relatives. With this notion as a point of departure the crucial space between the clusters can be utilized and turned into a beautiful advantage.

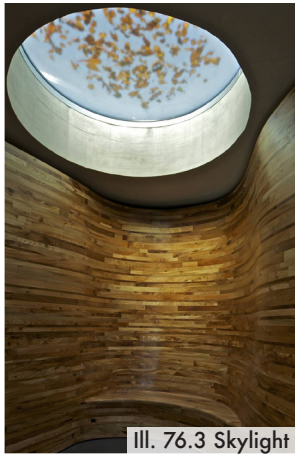
The idea is to utilize the narrow passage, keep the facing walls of the guest rooms massive in order to create an undisturbed view towards the forest and the natural elements as an effort to create a sublime space with positive features beyond the measureable, which appeal to the experienced emotions.

General focal points have been established throughout several iterations. It is an important factor to achieve an undisturbed view to the natural elements outside and capturing the whole spectrum going from ground, to the horizon and lastly the sky (ill. 77.1).

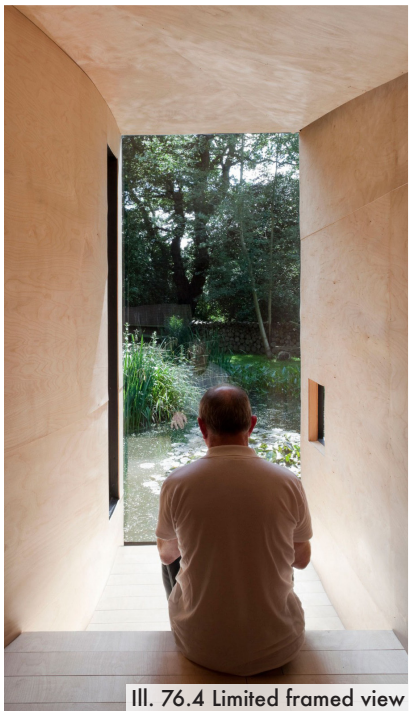
Iteration 3 illustrates the final solution where both the water element and the external wall are incorporated in the room. This is in order to maintain the entire spectrum but also to create a second character within the room. Now there exists a gradu-

Ill. 76.1 Secluded space with light as main stimuli

Ill. 76.2 Natural elements



Ill. 76.3 Skylight



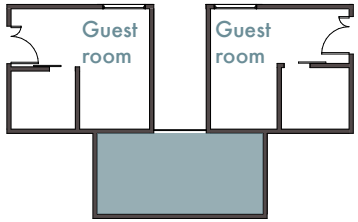
Ill. 76.4 Limited framed view

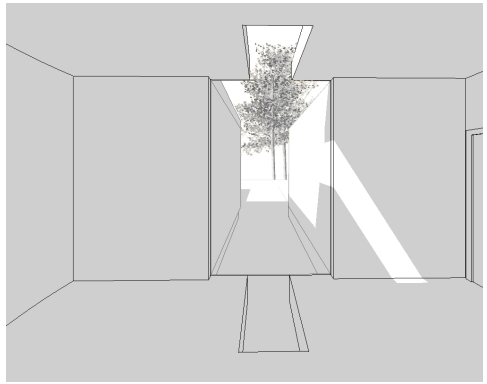
Ill. 76.5 Framed view with an incorporated water element

ation of the level of retraction and the amount of stimuli, whereas the corner without the direct view has a more secluded character and fewer stimuli. Moreover the room will have en internal wooden cladding with the intention of creating the entire scene into a simple element of its own neglecting all unnecessarily disturbing factors. Finally the room is not enclosed by a physical door but screened and shielded by the geometry, which makes it relate the rest of the hospice and appear as a welcoming and accessible function.

Iteration 1

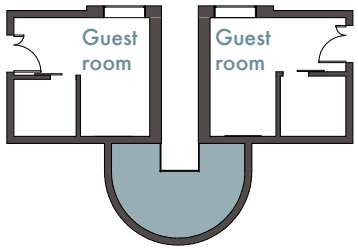
- The spectrum going from ground to sky is divided
+ Incorporates a water element that is thought to continue from the outside and to the interior
- Only one character

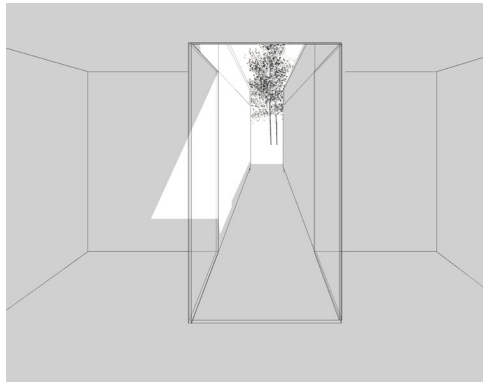




Iteration 2

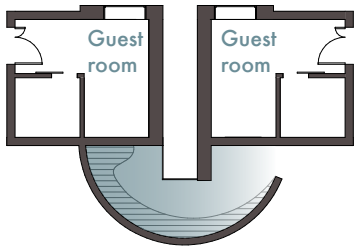
+ Incorporating the outside further into the room
+ Maintains the entire spectrum
+ The round form contributes with qualities both to the spatial experience inside the reflection room and outside by the means of allowing natural light to bounce softly to the areas behind the reflections room
- Only one character

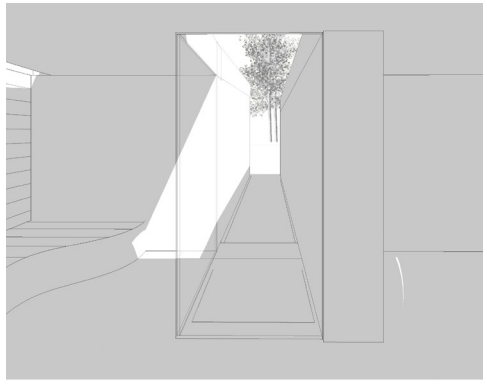




Iteration 3

+ Maintains the entire spectrum
+ Creates more than one character
+ Relates to the rest of the hospice
+ Round form





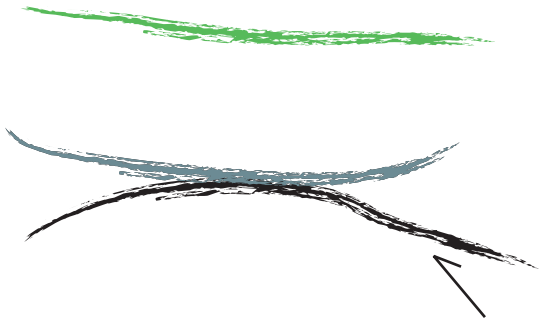
Ill. 77.1 Iterations concerning the reflection room

2.12 //

HIERARCHY AND LANDSCAPE

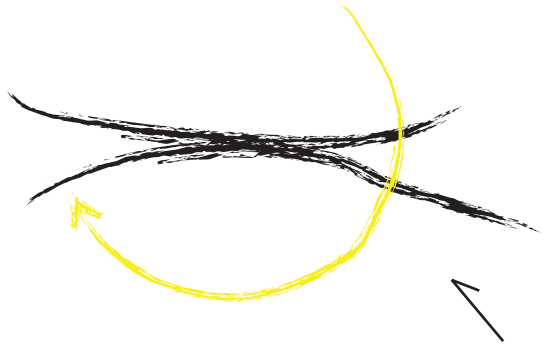
Following section presents the overall principles concerning the general hierarchy of the building and its placement in the landscape. This is done by illustrations referring to the architectural concept.

THE PATIENT WARDS AND THE FOREST



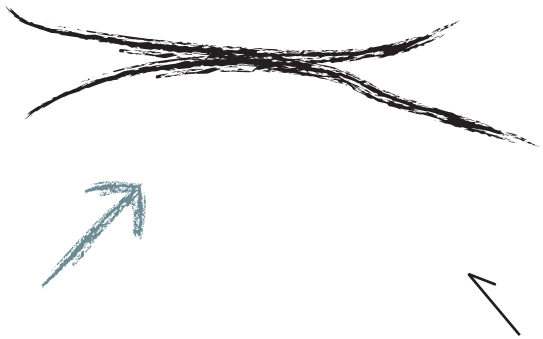
Due to the relatively small size of the site it is chosen to placing the building parallel with the forest. By facing the patient wards towards the forest, these will have a secluded and protected character away from the public main road.

THE BUILDING AND THE SUN



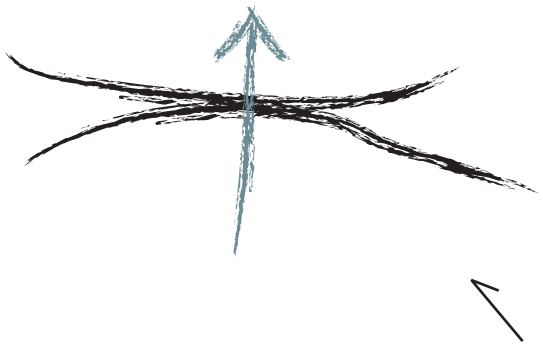
By placing the patient wards parallel to the forest it will give the opportunity of taking advantages of the sunrise within the patient wards. The patients will gain great benefit from this, in the shape of maintenance of the circadian rhythm. The patient wards will only be exposed of the morning light, which will not cause overheating within the wards, thus it easier to stabilize the indoor climate.However it is important to integrate solar shadings in the facades in the opposite side of the hospice, due to the fact of the critical sun during the afternoon.

THE BUILDING AND THE WIND



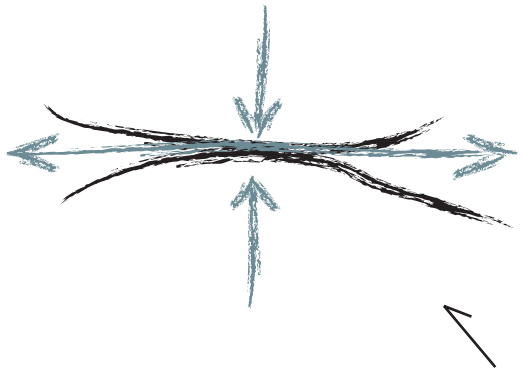
The patient wards are placed on the opposite side from where the dominating west wind strikes the building, this is done with deliberation. Due to the weak patients within the patient wards it is the aim only using mechanical ventilation. This makes it possible to utilize the wind in the shape of natural cross ventilation in the remaining building, which is also in need of a larger air change, due to the exposed facades with a southeast direction.

A GRADUATION FROM PUBLIC AND TO PRIVATE



The building will be placed on the ground in accordance to the concept of a graduation from public to private meaning that the front of the building by the entrance will consist of only public functions like administration, Day Care Centre, parking and access for logistic purposes. By doing this the remaining site behind the building will be dedicated to the patients and their visiting relatives and thereby giving it a more private character. This differentiation and concept of turning focus inwards ought to be visible in the façade expression as well.

AXES CREATING A FLOW WITHIN THE HOSPICE



When designing a hospice with different functionalities, it is found important to create a graduation from public and to private, this in order to protect the privacy of the patients. This graduation is tried defined by two axes within the building. The entrance axis will emphasize a centre within the building, while the main flow axis is defined by the adjacent functions.

Ill. 79.1 Principle of the hierarchy and landscape

2.13 //

THE SPINE

A Hospice requires several institutional and practical functions in order to perform and provide the optimum treatment to the patients and to a greater extend the relatives. This section concerns the notion of these functions and how they can be elaborated.

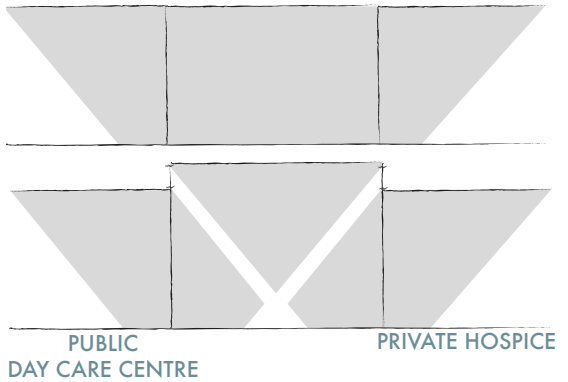
In relation to the concept, turning focus inwards and the notion of a graduation going from the public Day Care Centre to the private patient wards potentials were seen in creating a consistent element that will function as an embodiment of the boundary between public and private as a Spine through the building. This element will have a strong character that will be visible in the facades as well and provide a certain amount of readability to the building and the functions within the element.

Another primary reason for investigating the principle of a consistent element is because of the Day Care Centre, which evidently has several functions similar to the ones present in the hospice. In order to avoid a double establishment of these similar functions potentials are seen in the opportunity of making them shareable and accessible to both the Day Care Centre and the patients living at the hospice. However, this is an inconsistency with the concept of a graduation, which is why it is necessary to make the shared functions within the consistent element reachable from each side (ill. 80.1).

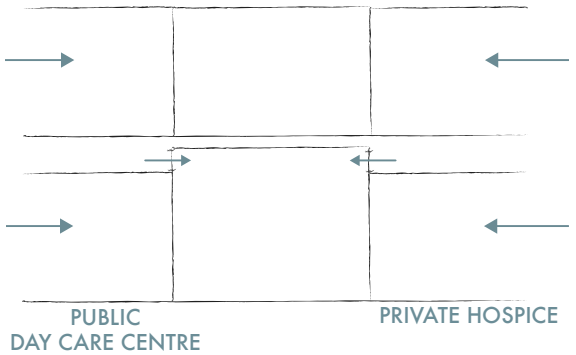
With the establishment of the desire for an element containing most of the secondary functions that should be available from each side rise some critical questions concerning daylight, fresh air and view. However, raising the roof of the Spine enough to place a small window, which can provide both daylight and natural ventilation, solves this (ill. 80.1-2). By doing this the Spine is being further emphasized as a separate element within a building mass. Moreover it is only functions without the demand of a view that is placed within the Spine such as sluice room, laundry room, technical room, spa, archive, toilets etc. The functions are lastly placed by the main function that they are supporting whether it is the Day Care Centre, the administration or the general private hospice. Iterations concerning the general layout of the Spine will be described in illustration 81.3.

The Spine will be a distinguished element both in the façade, in plan and in the interior, why possibilities are seen in keeping the Spine in a consistent material with a high heat accumulation as a passive solution in order to contribute to the energy consumption of the building. This heavy material will only be interrupted by doors, which will be retracted into the wall, so that it appears as a through rock intersected by small holes. In order to further emphasize the Spine as a consistent element windows will be placed right beside the Spine in the surrounding building mass and likewise skylights to allow natural light to reveal the tactility of the material.

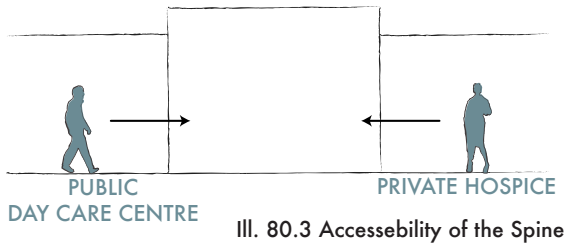
According to the principles of Healing Architecture it is important that the institution is relatively easy to survey in order to gain a quick orientation of the building [Region Hovedstaden, 2010] , which the concept of the Spine contributes positively to by being a recognisable element and soften up institutional feeling.



Ill. 80.1 Allowing natural light in the Spine



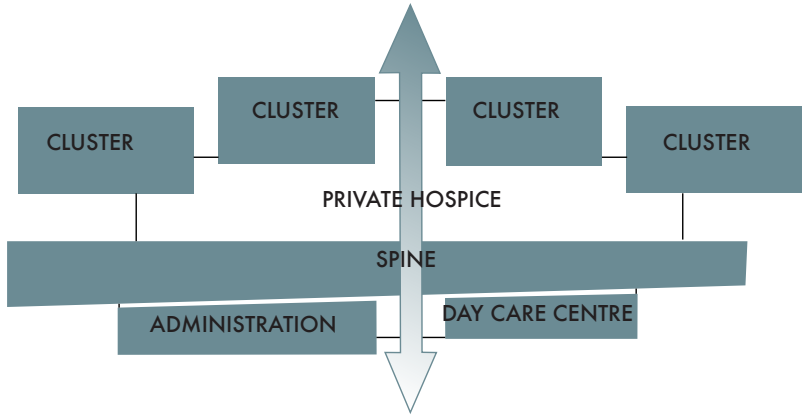
Ill. 80.2 Allowing natural ventilation in the Spine



Ill. 80.3 Accessebility of the Spine

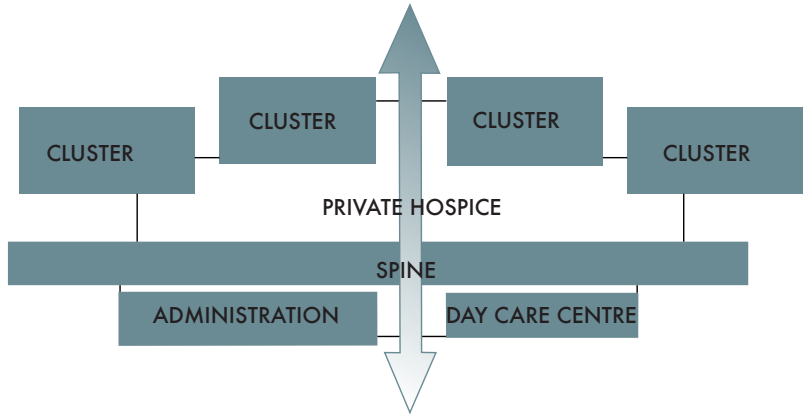
Iteration 1

Due to the differentiation of the square meters of functions supporting respectively the administration and the Day Care Centre, the Spine gained an oblique form. However, the form had difficulties relating to other than itself.



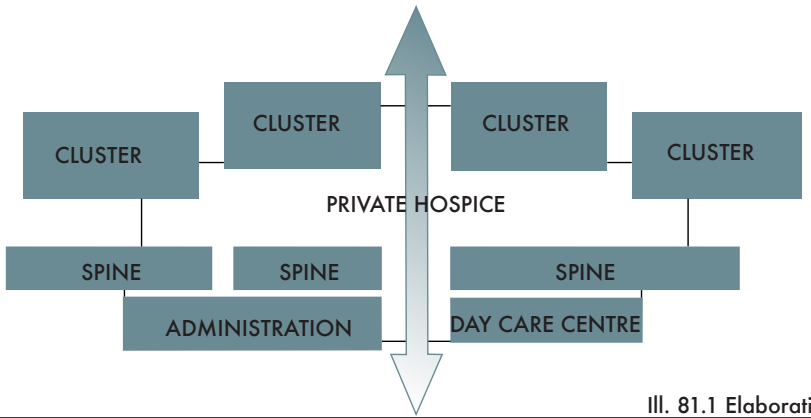
Iteration 2

The oblique form was replaced with a rectangular one in order to keep the same geometries, however, in this case the rectangular form became a static barrier with little connection between the different layers of the hospice.



Iteration 3

The rectangular form is divided into smaller parts in order to create a greater cohesion between the layers so that the building becomes an entirety. The Spine is divided on the middle, which creates a natural axis and entrance to the hospice, and a smaller division by the administration, which provides a second connection addressed to the staff to maximize their interface. This second connection is deliberately not inserted by the Day Care Centre since it is a separate public function.



Ill. 81.1 Elaboration of the Spine

2.14 //

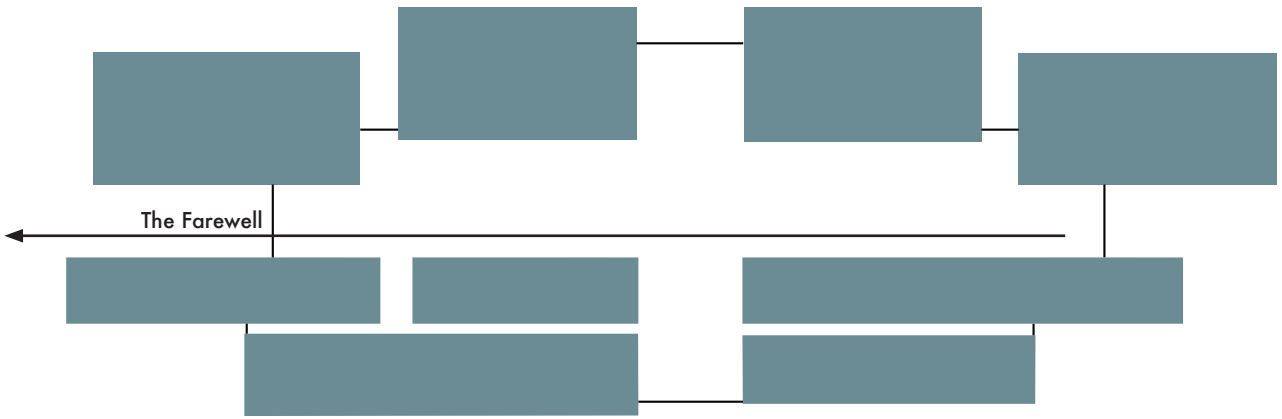
THE FAREWELL

This section is the result of the initiative thoughts outlined in the program concerning the notion of creating the spatial experience suitable for a dignified farewell.

It is an important factor not to hide away this function of the hospice, since it is an inevitable part of life and is more an appreciation of that our loved ones after a tough course of illness have found peace. Because of this the Farewell will have a visually evident placement at the end of the characteristic axis created by the Spine as a symbolic reference to the last journey. There will in plan arise a small niche in order to give the Farewell the character of a space and a continuous presence.

With the placement of the Farewell the Spine (ill. 82.1) is utilized to create a forward and characteristic framed view together with an additional wall, which furthermore secures a certain level of privacy to this emotional ritual. The overall scene of the Farewell has a rather narrow character that, when the hearse comes, will provide an intimate and embracing framing of the entire ceremony. The hearse, the coffin, the love to the deceased will all be captured in an intense moment out under the porch roof that allows a single beam of light to wander across the wall of the Spine revealing its tactility (ill. 83.4).

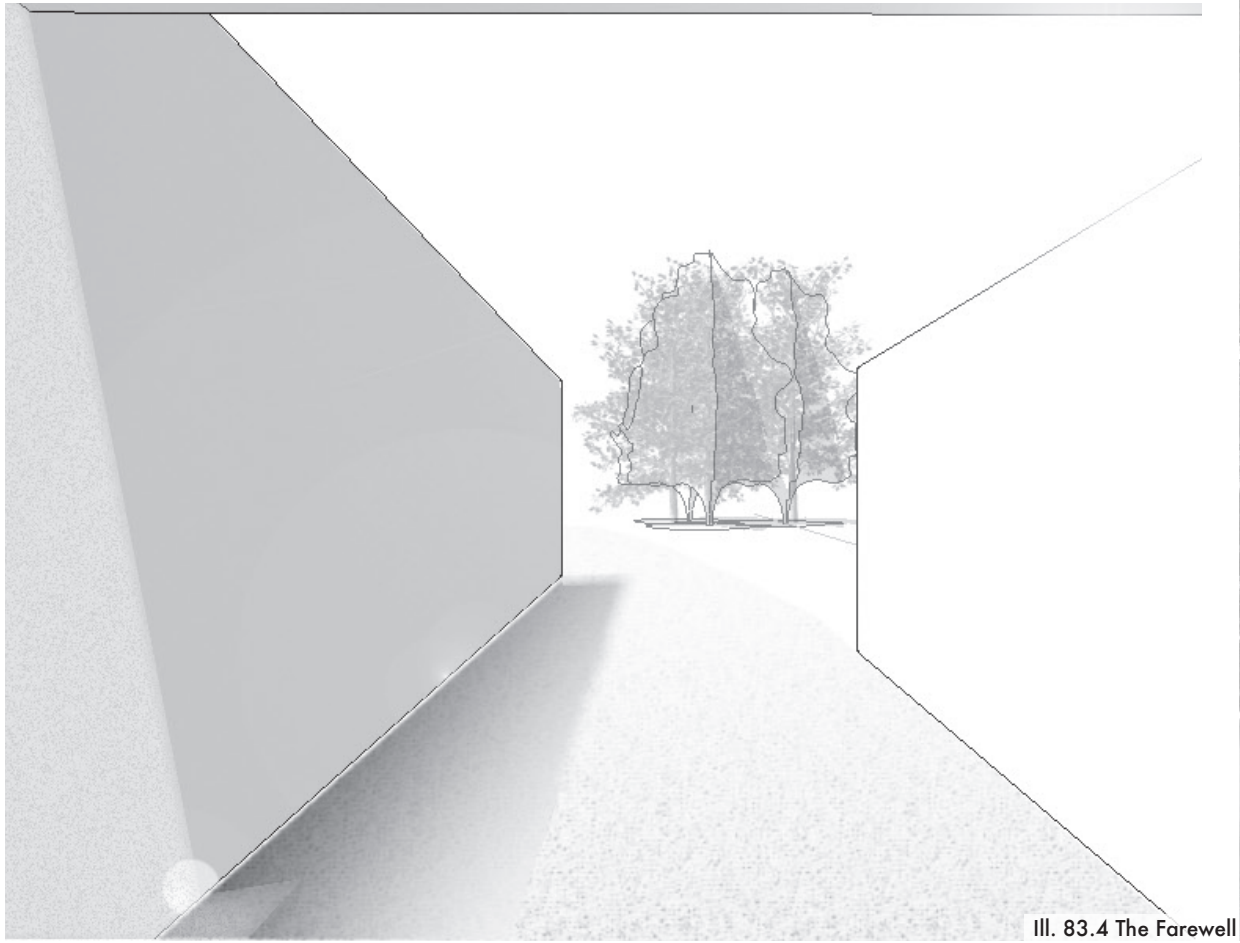
When time comes the hearse will drive down a small gravel road and disappear behind the geometry of the Spine. The simplicity of the entire scene is its strength and it is reached by modest means; nature, materials, light, intimacy and lastly the discrete sounds of gravel road.



Ill. 82.1 Placement of the Farewell

Ill. 83.1 Natural elements

Ill. 83.2 Space for private intimacy



Ill. 83.4 The Farewell

Ill. 83.3 Subdued gravel road

Ill. 83.5 Framed view

2.15 //

ADMINISTRATION

This section presents the administration and the positive influence of high thermal mass within the building.

The administration is characterized by an open plan office with an associated meeting room, coffee room and printing room. The exposed southeast facing windows, are equipped with louvers in order to protect against the sun. When the louvers are open, the light will penetrate into the administration and provide the spaces with minimum 200 lux and when the temperature is rising within the building, the slates are able to close. This will create a massive expression of the facade, which is found positive, because this will strengthen the entrance of the hospice.

The administration is placed in connection to the Spine that contains the majority of the secondary functions, with the aim of providing the administration with a relatively open plan.

The Spine have another function, as already mentioned in the chapter The Spine, one of the efforts of achieving the Energy Frame of Building Regulation 2020, is the passive solution of the consistent element of The Spine. The walls of the Spine, consisting of heavy materials, have a high thermal mass. The high storage capacity of the walls absorbs and store warmth and coolness until it is needed within the building. In the winter the thermal mass will absorb solar gain, while at night the process is reversed which leads to heating of the adjacent room. In that manner, the thermal mass prevent large indoor temperature changes even though the outdoor temperatures rise or fall. [energy.org, 2012]

It was chosen to verify this theory by testing the effect of the Spine on an adjacent room, in the dynamic program of BSim. The aim was to test the effect on the temperature in a room having a heavy wall compared with a light wall. The room being chosen was the most critical room, in relation to temperature – the open office landscape within the administration. The office of 70 m2 contains 8 office workers and with the southeast facing facade, there is a great need of ventilation in certain periods.

There is made a BSim simulation over a day, in relation to the light and heavy wall. As visualized in the two graphs it has been demonstrated that the heavy wall will reduce the temperature of the office with 0,12 degrees, which is not a significant reduction. However, what is worth noticing is the reduction of air change in relation to the test of the heavy wall. The chosen ventilation system is an intelligent system, VAV, meaning that when the temperature within the office reaches 25 degrees the air change will increase in order to maintain a temperature on 22 degrees. So, when looking at the graph it is evident that the ventilation system works harder to reduce the temperature in relation to the light wall, therefore the actual difference of temperatures is considerable large.

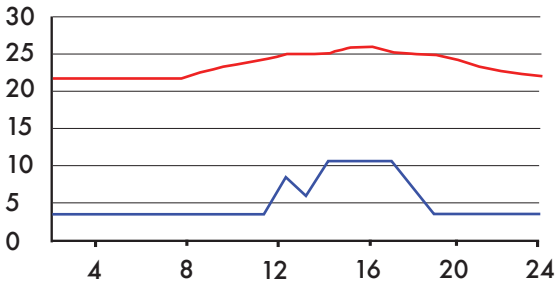
In conclusion it is evident that the theory of thermal mass is valid. In relation to the Energy Consumption the thermal mass indicate, that due to the more stable temperature within the rooms in adjacent to the Spine, the air change will be equivalent lower, which will have a positive impact on the Energy Consumption.

BSim investigation of thermal mass within the office
- made over 24 hour

Temperature during the day, C°

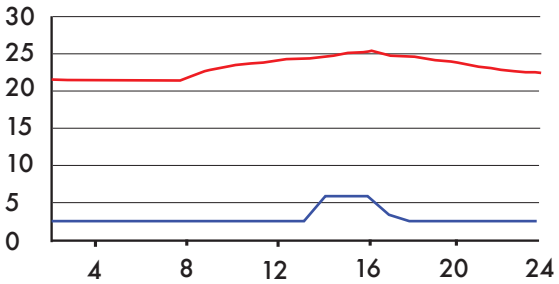
Air Change, h^{-1}

Light wall



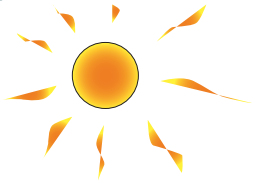
Ill. 85.1 Light wall

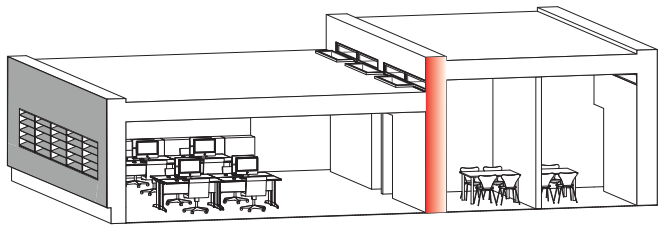
High thermal mass



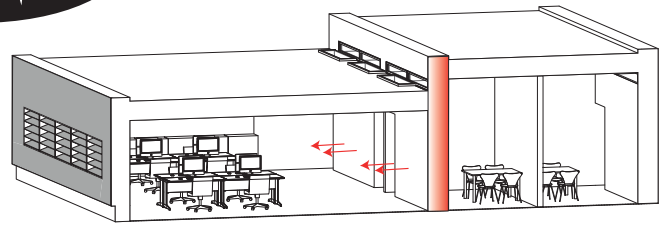
Ill. 85.2 Heavy wall

The principle of heat accumulation





The heavy wall of the Spine absorb and store the warm from the sun.



At night, the wall of the Spine release heat to the adjacent room.

Ill. 85.3 Heat accumulation of the Spine

2.16 //

DAY CARE CENTRE

This section presents the intension of establishing a daycare offer at the hospice in favor of the terminally ill that is too well to stay at the hospice and might have several years left.

In that manner it is an expansion of the palliative care, that will ensure earlier efforts regarding the concerns and issues that life-threatening diseases gives rise to. The regular visits at the daycare center with the systematic assessment will furthermore prevent the terminal ill in having unnecessary visits and admissions at the hospital.

The daycare center is furthermore an offer to the patient that should otherwise be spending the majority of the day home alone. In that manner, the daycare center will be a place where the patient can create a social network. The coffee room will be the place to create informal contact to other patients. There will furthermore be organized group conversations and cultural arrangements like presentations of different subjects, these arrangements will be located in the Multi hall of the Hospice.

Doctor

The Daycare center will offer patients medical consultations, where the patient can be examined and treated for troublesome physical symptoms such as pain and nausea. After having received treatment, the patient will at times feel unwell, therefore the daycare center has been equiped with a nap room, where the patient can lie down.

Nurse

It will be possible for the patient to get support and guidance relating to physical and mental problems. In addition, the nurse can guide the patient in relation to diet, since the patient often will have poor appetite and nausea.

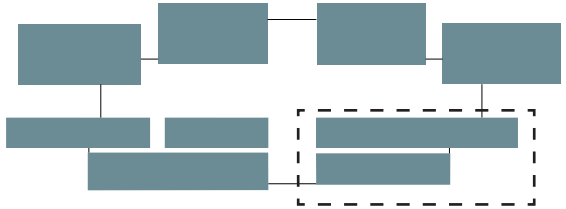
Physiotherapy

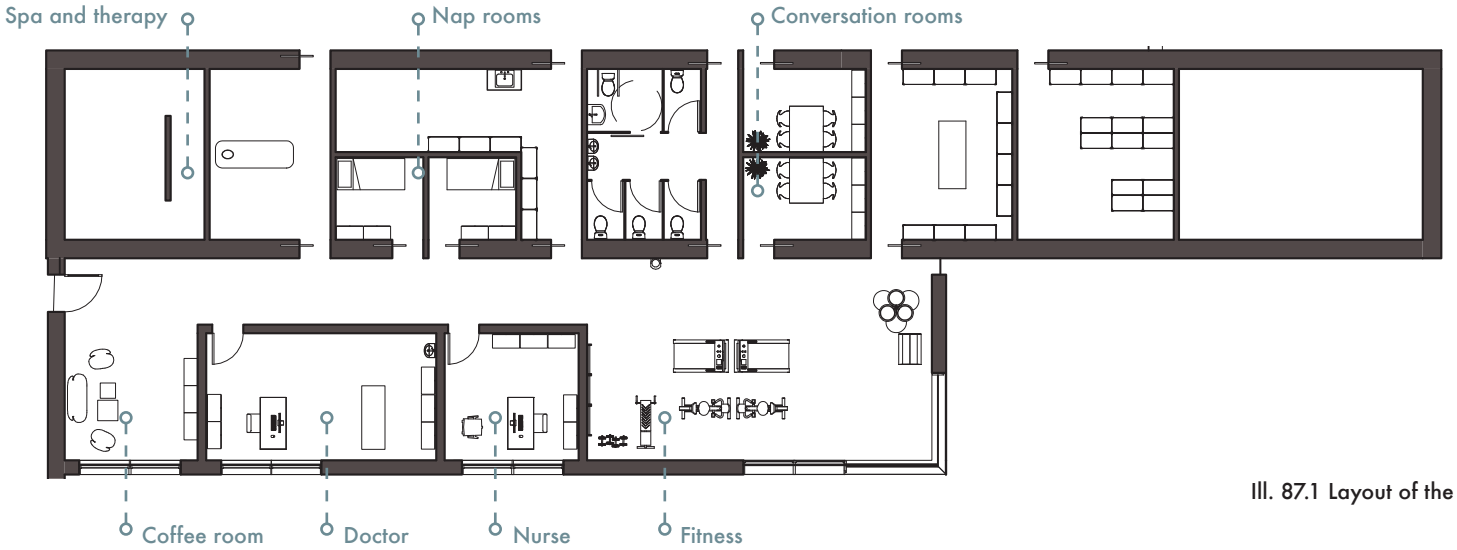
The physiotherapist will support and help for maintenance of the physical abilities of the patients through guidance and training, therefore the Daycare center has been assigned with a fitness room with various equipment. In case of holding a yoga class for several patients, the event will be located in the hospice Multi Hall. There will furthermore be access to the spa and therapy rooms, which are shared with the hospice. Within these spaces it will be possible for the patient to get a massage, spa and aromatherapy.

Psychologist and priest

Speaking with a psychologist or a priest will help to deal with for instance anxiety, sadness, isolation and sorrow, all topics that can be difficult to talk with relatives about.

The size and shape of the Day Care Centre has been dictated by the functions of the Day Care Centre and the location within the hospice.





Ill. 87.1 Layout of the Day Care Centre

Ill. 87.2 Fitness work out

Ill. 87.3 Social interaction

Ill. 87.4 Nurse consultation

2.17 //

INVESTIGATION OF ATRIUMS

An atrium will have an impact on the energy consumption and the indoor environment. Therefore this is tried investigated in Be10 with the aim of gaining knowledge of the consequences of a potential atrium.

The site is currently an open landscape, but eventually the surroundings will become densely populated, why it is seen as a potential to turn the sight inwards, towards an integrated atrium. So even if the hospice is located in a future dense populated area, it will be secluded.

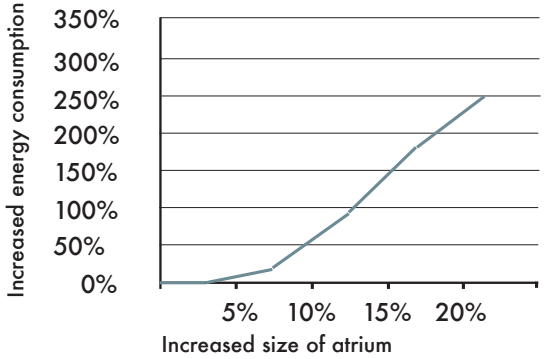
However, atriums are not in favour of the buildings compactness, this in relation to achieving the energy frame of the building regulation 2020, but an atrium is considered to be important in relation to the indoor environment and the architectonic quality.

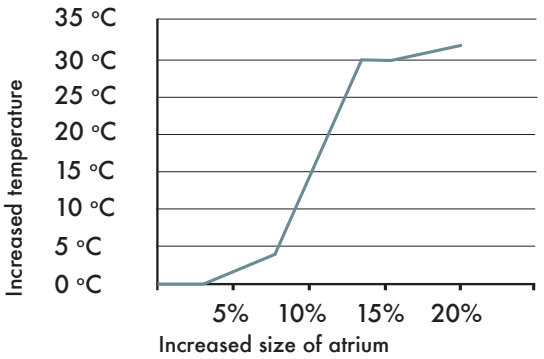
The study shows a progressive deterioration of both the energy consumption and the temperature, whether it is a quadratic or oblong shape. It is worth noticing that there is a drastically degradation from an atrium equivalent to 15 percent of the ground area and upwards. The oblong shape do however show a more even rising graph of temperature compared to the quadratic.

When designing the atrium it will be important to justify the size and orientation of the atrium according to the spatial qualities that an atrium will contribute to.

QUADRATIC ATRIUM

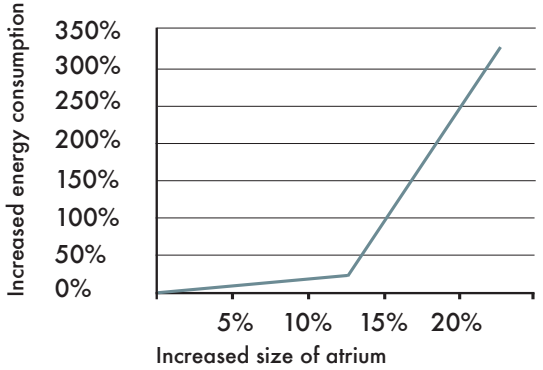
The quadratic atrium is designed with an equal area towards north, south, east and west.

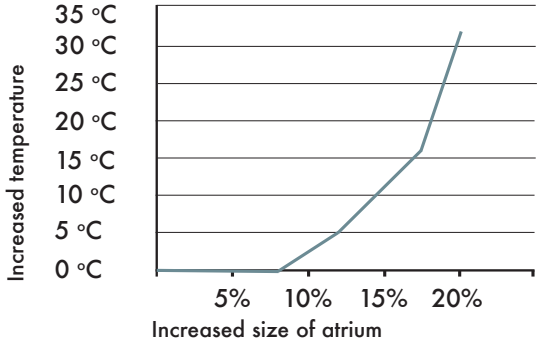




OBLONG ATRIUM

The oblong atrium is designed with an equal area towards north and south, and an equal area towards east and west.





2.18 //

SHAPING THE ATRIUMS

When shaping the atriums it will be considered how they contribute to an indoor and outdoor course and how they create light and spaces. The sizes will be evaluated on the base on previous survey.

In relation to the architectural concept it is the aim to create a green consistent course throughout the hospice, with the purpose of promoting one of the theories of Healing architecture with green elements that will reduce the patients stress level. On the base of this, it is chosen to integrate two atriums, one for each cluster placed in the middle of the building, thereby creating a secluded garden as a reference to the principle of a front- and backyard.

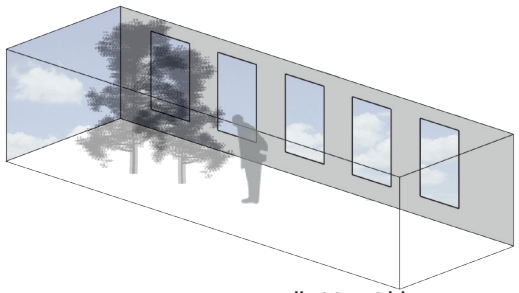
Having two atriums in the middle of the hospice will create a certain internal transparency that will contribute to a higher level of overview and cohesion between the various functions.

In order to create different identities of atriums it has been chosen to make a differentiation of their sizes. The largest atrium will not be closed by a roof, but will extrude itself into the entrance axis creating a roofed veranda. The smallest atrium will be roofed by a transparent roof, which will give the possibility of being used in the different seasons.

To receive more information about the consequences of having two atriums in relation to the Energy Consumption, references is made to the chapter, Energy optimization.

CRITERIAS FOR SHAPING THE ATRIUMS:

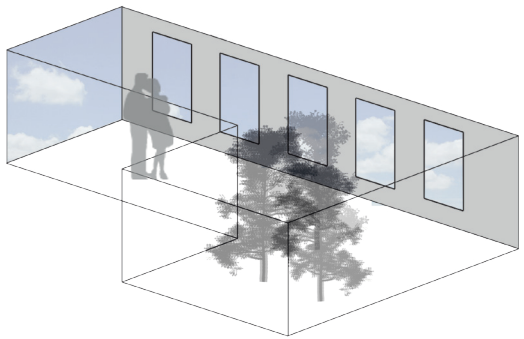
- Take advantages of the positive elements from the oblong shape: an even raising graph of temperature and a shape that will provide the horizontal building with a large amount of light.
- The size of the atriums should at maximum reach 15 % of the hospice ground area, which is 380 m2.
- It is the aim to create a zoning of the atriums, with the purpose of meeting different spatial experiences.
- It is the aim to create two different identities of atriums.
- The atriums should promote spaces within the hospice.



Ill. 89.1 Oblong atrium

- The oblong shape does not necessary contribute to a spatial course.

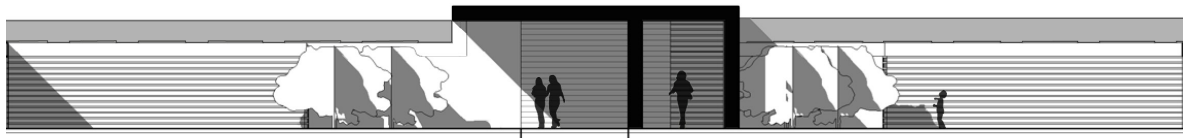
\+ Will contribute positive to the indoor environment by creating light and air.



Ill. 89.2 L-haped atrium

\+ The L-shape will create a natural zoning of the outdoor spaces, while forming a regular space within the hospice, a space which can be utilized for common areas.

\+ Will contribute positive to the indoor environment by creating light and air.



Ill. 89.3 Section through the atriums

LANDSCAPED COURTYARD

The atriums have been assigned with different facilities and qualities whereas the landscaped courtyard on 120 m^2 will possess the character of an untamed natural landscape with natural paths. From the roofed veranda it will be possible to observe and cherish the secluded nature captured in the atrium.

Maggie's Centre for cancer care placed in Glasgow, is designed by OMA Founding Partner Rem Koolhaas and OMA Partner-in-charge of the project, Ellen van Loon.

The building comprises a sequence of L-shaped masses, in the form of a ring of interlocking rooms surrounding an internal landscaped courtyard. The uninterrupted glazed walls create a great cohesion between inside and outside, which is often cherished when designing in Scandinavia. The open courtyard will furthermore make it possible to follow the seasons in a framed view.

Ill. 90.1 Landscaped courtyard inspiration






Ill. 91.1 Garden of Senses inspiration

GARDEN OF SENSES

The roofed atirum will posses a different character of a accessible "outdoor" area protected from the at times harsh climate.

The multifarious raised beds with different herbs and plants and an installed water basin with running water will provide aromas and stimuli that can awake the senses of the patients. The raised beds will be available to even those in wheelchairs, given them the opportunity to get their hands in the soil.

2.19 //

MULTI HALL

In proportion of the hospice is having different functions and users, it is assessed that the hospice will benefit from a Multi Hall.

Administration

Within the field of the health sector there is a great focus on knowledge sharing, which is with no exceptions when speaking of hospices. The knowledge sharing is often done by conferences, where the different hospice will host the arrangement. This claims the need of a rather big space with the opportunity to set up chairs and tables.

Day Care Centre

The Day Care Centre has been founded to offer patients, who are too well to stay at hospices, social and therapeutic care. So, when patients are visiting the hospice it is most likely with the purpose of having social interaction. With a multi hall it will be possible for the Day Care Centre to offer greater gatherings.

Hospice

It is found important that the hospice should be able to provide large-scale event such as: Exhibitions, concerts, theater and services by the church. Furthermore it is seen as equal important to give the patients the opportunity to invite relatives for celebrating the festive seasons.

Having a multi hall being capable of containing these different events will demand a certain flexibility of the space.


Ill. 92.1 Services

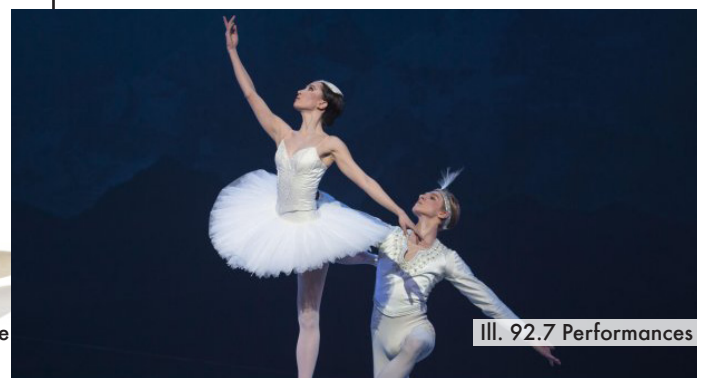

Ill. 92.2 Concerts


Ill. 92.3 Events


Ill. 92.4 Shrovetide


Ill. 92.5 Exercise


Ill. 92.6 Saint Lucy's day


Ill. 92.7 Performances

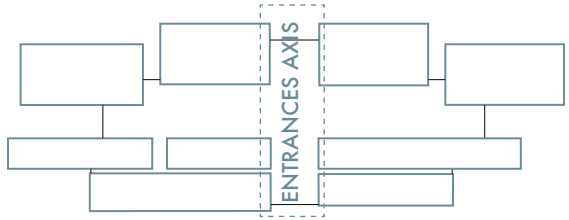
2.20 //

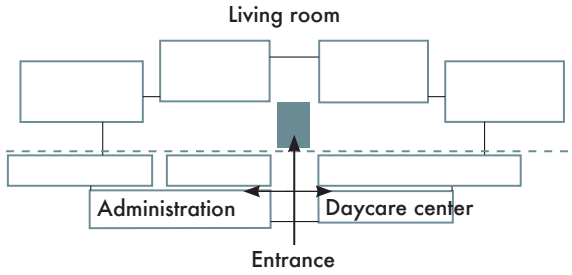
PLACEMENT OF MULTI HALL

The intention of the Multi hall is to create a centered common function, which should be accessible for the hospice, Day Care Centre and administration.

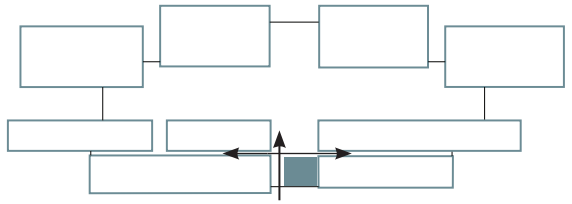
It is the aim to place the multi hall within the entrance axis, due to the central placement. This axis is the heart of the hospice – the natural gathering point. Within the axis the multi hall should be placed in order to uphold the wish of a graduation from public and to private, which will provide the clusters and the common areas of the hospice with a certain privacy. So, when external visitors are entering the hospice, it should not disturb the daily life of the hospice.

As already mentioned, the multi hall should contain a large number of events, why it is important that the multi hall is flexible to a certain extent. In this case there have been seen potentials in a regular airy space and if necessary with the possibility of using sliding doors to enlarge the space, which depends on the final location.

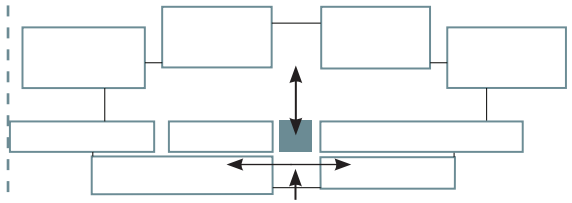




Centered between the atriums
- Creates two unnecessary hallways to a one direction living room
- One will have to transgress the borderline between the daycare center and the hospice itself, which is seen as a contradiction to the graduation.
- Walls should be massive in order to create privacy within the hospice.



In the corner
- Placing the multi hall in the corner of the entrance looks more like an attribute
- Create a rather unusual and unwelcoming entrance.
+ Create a direct access to the outdoor, which gives the opportunity of natural daylight.



Placed in the center of the two axis
+ Placed in the actual heart of the hospice where the two axis meet.
+ Create a welcoming entrance where the reception will distribute guest.
+ It is placed before the borderline, which allows the walls to be semi–transparent.
+ By placing sliding doors in the wall towards the hospice, this in the effort of opening up and create square and thereby involving the hospice when event is suited.

Ill. 93.1 Placement of Multi Hall

2.21 //

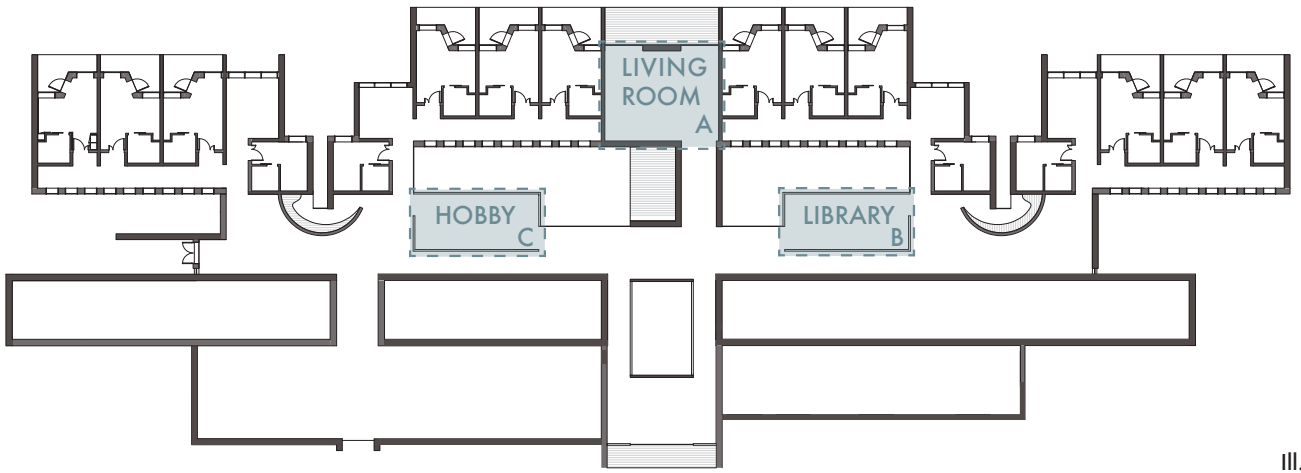
COMMON AREAS

This section presents an elaboration of the common areas, and their function, within the hospice.

With the overall layout of the building in place it is in order to turn focus on the actual common functions within the building. While shaping the atriums two common areas came as a response to this. The two common areas by the atriums will have an open character and only separated from the hallway by a lamella partition wall, which allows the light to penetrate deep into the hallway as well while still creating a defined room for the common areas. The two common areas in connection with the atirums will have the functions of a small library and hobby room respectively accessible to both patient and relatives as well.

By creating these two relatively open common areas in connection with the main flow axis of the hospice the atmospheres will spread out and affect the rest of the hospice and making them relatable, reachable and manageable. They will encourage to social interaction between patients and relatives and small pauses by the green lungs of the hospice.

The main common room is a combined living room and dining room for all the patients at the hospice. It has a central placement between the clusters with direct access to the green and natural elements of the outside. It is important to keep this common room as a defined space and a destination rather than a transit area. Because of this all access will remain on the two main flow axis giving all the inhabitants the same narrative transition and experience of the hospice beautified by the encircling presence of the atriums as green lungs combined with a direct view to the natural elements outside. This course of movement and its several stimuli impacts is envisioned to have a relieving effect on the patient and the relatives as well.



Ill. 94.1 Common areas

Ill. 95.1 Inspiration

2.22 //

THE ROOF

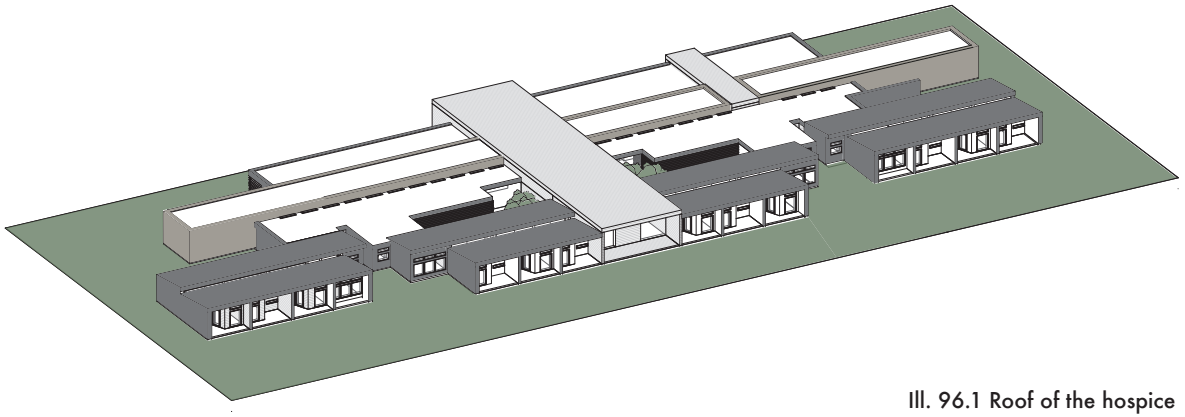
In order to find a suitable design of the roof, there have been made several iterations as the ground floor took shape. The design of the roof where designed with the intention of creating a hierarchy in the building facade to provide a differentiation of spatial experiences, in the shape of different ceiling heights.

The roof has been seen as an important element with the purpose of emphasizing the division of functions within the building. The different functions have been extruded up to different heights with the intention of creating a hierarchy in the building facades. While extruding the heights, considerations regarding the functionality and spatial potentials have been made. The majority of the roof constructions have been kept flat, with the intention of emphasizing the horizontality of the building.

The minimum ceiling height has been set to 2,6 meters, which is seen as a decent height where one will not feel weighed down by the ceiling and at the same time will not feel small and insignificant. This ceiling height will create the basis from where other masses will extrude from, either to mark a transition or purely by functional reasons.

Patient wards

The design of the patient ward roofs has already been stated, why it will not be further explained other than the slope of the roofs has been designed with the intention of creating a bright and friendly indoor environment with different zones, where nature is admitted as a visual treat. In this regard, the slope of the roof has been important in terms of the location of the windows and the spacious qualities. The sloping roofs can only be seen in the composition of the clusters, which gives them its own character and stand out from the remaining building. To emphasize the unified expression the roof and walls will be enclosed by a single material.



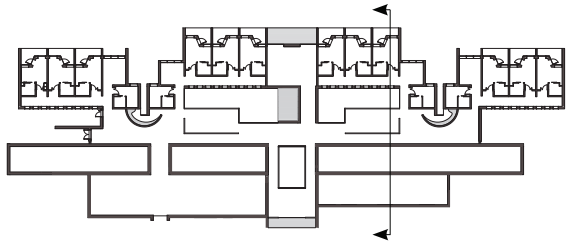
Ill. 96.1 Roof of the hospice

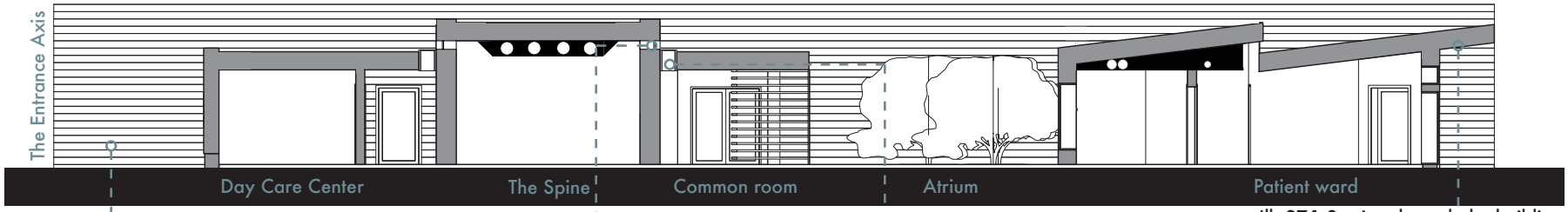
The Spine

The recurring element of the Spine of functions has been centralized in the building and will not necessarily allow natural light in. This is with perfect deliberation while the functions is not meant for longer stay, why it is only secondary functions placed within the Spine. But in order to ventilate the spaces there have been seen potentials in extruding the spine upwards and placing narrow windows in the facades. Theses windows will allow cross ventilation and the natural light will have access to the spaces.

The entrance axis

The entrance axis is marked by the dominating height. It was important that the axis should stand out from the remaining building, not only in terms of materials, but in height as well. With a height of 4,5 meters the axis is the tallest element. This is assessed as having a welcoming effect and the functions located within the axis. Entrance, multi hall and common room, is found to be suited with such ceiling height and will be able to benefit from the spatiality.





Ill. 97.1 Section through the building

Ill. 97.2 Minimizing the transition between exterior and interior

Ill. 97.3 Windows placed up high

Ill. 97.4 Skylight

Ill. 97.5 Large windows

2.23 //

MATERIALS

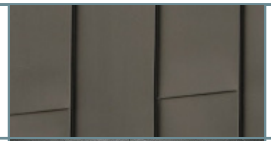
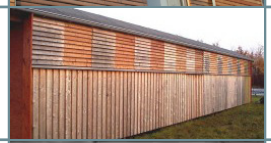
This easy living resident, placed with a view to the ocean in the Mosman neighborhood of Sydney, is designed by Fox Johnston Architects. The concept of the design is to create private living spaces away from the street and instead create a focus on the outdoor areas of the garden and the great view towards the ocean. External walls and screens open and close, providing the rooms with both privacy and shading. The approach regarding the materials is practical in the shape of robustness, durability and tactility. Bluestone, Anthra-Zinc, wood and glass are combined both in the façade expression and internally. [Artrss, 2013]

The combination of materials that emphasizes the horizontality of the building, while having matching screens that, when closed, create a massive and monotonous facade. This is seen as having great potentials in relation to the hospice horizontal building mass, which occasionally is being split by vertical elements.

The gray scaled colors combined with the warm wooden cladding create a contrast that enhances the different functions and scale, which is found essential in order to create an easy readable facade.

Ill. 98.1 Inspiration

Following materials that will be presented are the materials, which have been intended to respectively facade cladding and interior. These have been chosen in relation to creating contrasts and an easy readable facade. Furthermore these have been chosen because of their durability suited for the Nordic climate. It has been chosen to showcase two materials per function with the purpose of arguing for the selected materials.

	MATERIAL AND USE	PICTURE REFERENCE	APPEREANCE	SURFACE TREATMENT	PATINATE	DURABILITY	AESTHETICS
ADMINISTRATION AND DAY CARE	Anthra Zinc - facade cladding		matt homogeneous dark gray color	no treatment is needed environment-friendly	remains stable over time	45 years	The homogeneous surface with the rhythmic sessions will emphasize the horizontality
	Slate - facade cladding		gray rustic tactility	no treatment	remains stable over time	45 years	2 heavy facades - slate and tile (spine) will not create a great contrast. The short elements will appear cluttered.
ENTRANCE AXIS AND PATIENT WARDS	Larch - facade cladding		warm brown appereance	it is not necessary to treat it, but in terms of durability and expression it could be an option	grey brown appereance	10-15 years without treatment >25 years impregnated in Class AB and B	Whether the tree is being treated or not, the tree will be a contrast to the other materials - a soft element.
	European Thuja - facade cladding		warm red/brown appereance	to preserve the brown / red color, a lightly pigmented wood oil coat will do it	grey appereance	10-15 years without treatment >25 years impregnated in Class AB and B	Whether the tree is being treated or not, the tree will be a contrast to the other materials - a soft element.
THE SPINE	Kolumba brick - spine with high thermal mass		the oblong standard format 528 x 108 x 37 mm gives a horizontal appereance	no treatment	remains stable over time	60 years	Kolumba brick supports horizontality of the building and gives an elegant expression.
	Brick standard format - spine with high thermal mass		a standard arrangement of tiles in the gray scale	no treatment	remains stable over time	60 years	The heavy facade will clearly reflect the passive theory of high thermal mass in the interior

Ill. 99.1 Material proporties

2.24 //

FACADES

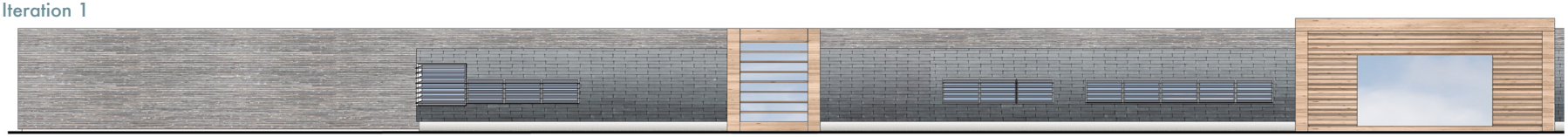
As an extension of previous section this section concerns the further development of the facades in relation to the chosen materials.

It is determined that the Spine will consist of a heavy material with a high heat accumulation, the entrance axis in wood cladding should have a warm, welcoming and distinguished material, while the administration and Day Care will have a horizontal expression that emphasizes the horizontality of the building.

The illustrations below presents some examples of how the different types of materials can be combined and how these combinations are perceived together. Potentials are seen in the Kolumbian brick since it provides a slender and less rigid expression due to its rather randomly appearance. Moreover will the textually and tactility give an honest quality to the interior of the building, which the concrete will not be able to.

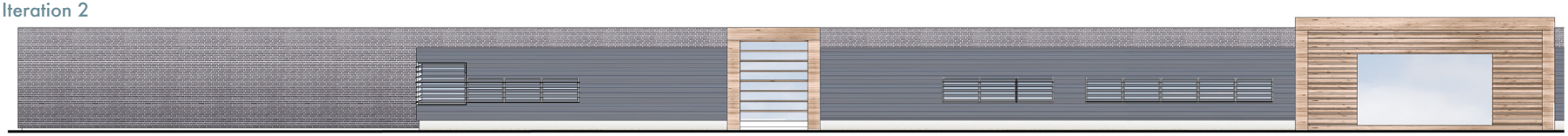
In relation to the remaining facades, it is important to emphasize the horizontal expression in order achieve a calm, harmonious and consistency that creates an entirety. To reach this, zinc is chosen since it can provide a continuous horizontal appearance and on the same time appear lighter than slate and thereby give a more honest expression. Moreover zinc will have the opportunity of creating depth and life in the façade due to the visible joints and their different characters.

Iteration 1



Ill. 100.1 South west facade in Kolumba brick, slate and larch

Iteration 2



Ill.100.2 South west facade in Regular brick, zinc and larch

Iteration 3

Ill. 100.3 South west facade in Concrete, zinc and larch

Larch is chosen as the wooden cladding, and in an untreated version, due to its qualities and course of patina that leaves it with a silvery grey brown expression still possessing the warmth of the material.

Due to the heaviness and size of the southwest façade, the foundation of the building will be raised above floor level in order to give the expression lighter and delicate character as a contrast to the through going Spine.

The Building as a Whole

As an addition to this the internal cohesion between the different layers of the building is investigated. Since the concept of clusters is a focal point of the building, it is investigated whether they ought to be distinguished in the facades as well. The illustrations represent different combination with the before chosen materials.

The final aesthetical expression is the concept of the perception of an entirety being extracted by two through going notable axis in their own characteristic material. With the establishment of the aesthetical concept the facades are kept in horizontal zinc, and kept on the roofs on the patient wards as well in order to maintain the characteristic clear form and wrap the clusters together by the means of the roofs.

Iteration 1

Ill. 101.1 North west facade with Larch on the clusters

Iteration 2

Ill. 101.2 North west facade with Horizontal zinc on the clusters

Iteration 3

Ill. 101.3 North west faacade with Kolumba brick on the clusters

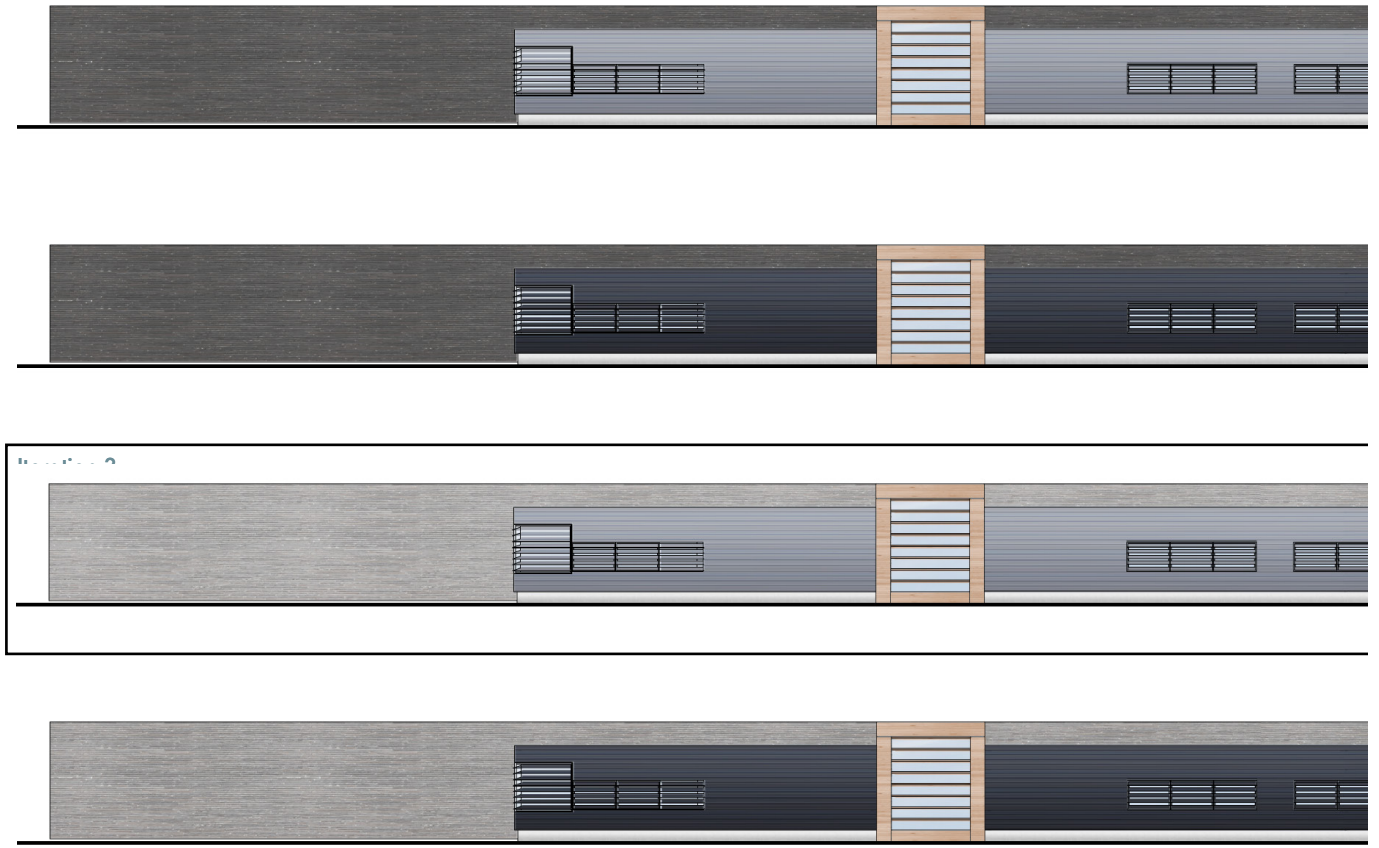
Iteration 4

Ill. 101.4 North west facade with Vertical zinc on the clusters

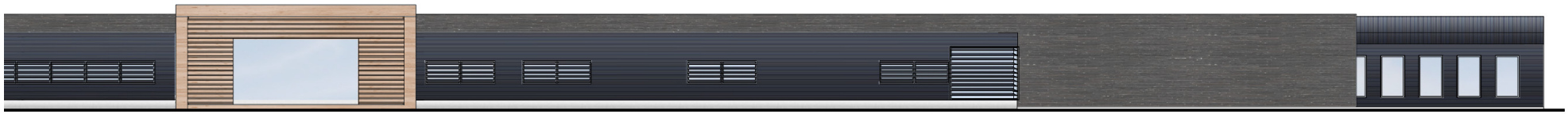
Appearance of the materials

Lastly it is obvious to investigate how the materials of the building collaborate in the search for the desired architectural expression. The illustration 103.1 represents how studies are made within the nuances of the different materials, which evidently have a huge influence.

In order to accentuate the aesthetical concept it is important to enhance the hierarchy of the building, which is reached by the means of contrasts. However, the contrasts are already provided by the characteristics of the materials. Iteration 3 is thereby chosen as the final principle of the facades even though it differs quite a lot from the given inspirational case study. It provides a harmonious and light expression despite the massive and heavy appearance of the volumes. Moreover it corresponds well to the focal point of Nordic Architecture where light has a great influence, which in this case can be reflected and play on the faces of the zinc material. The overall expression will be dominated by a building perceived as en entirety with a strong hierarchy, where the materials provide a cohesive appearance that will patinate beautifully together.



Ill. 103.1 South west facade Contrasts in the nuances



Ill. 103.2 South west facade in Dark nuances

Ill. 103.3 South west facade in Light nuances

Ill. 103.4 South west facade in Inverse contrasts in the nuances

The following sections are a further elaboration of the materials and their properties, the construction and ventilation principles of the hospice together with additional decisions concerning the fireproofing and drainage of the building. Moreover the iterations made during the process according to energy optimization will be described and an exposition of the potentials of artificial lighting in relation to a hospice.

3.0 DETAILING

3.01 //

MATERIALS

This section, containing the following three pages represents the further detailing of the chosen materials.

Ill. 107.1 VMZ QUARTZ-ZINC STRAT by vmzinc

Zinc

The chosen zinc is VMZ QUARTZ-ZINC STRAT by vmzinc in a light grey nuance with a height on 470mm, which is a standard coil height. It is pre-patinated and the relevant finish maintains the natural textures (vm.dk).

Further it is obvious to consider the actual joints of the zinc in order to achieve the desired aesthetical façade expression. Illustration 107.2 represents the different possibilities. Dexter is the chosen principle for the final façade system due to the fact that it has the qualities of being both a façade and roof system respectively, which is the desire for the patient wards. It has a strong and recognizable structure that creates depth in the façade by the means of the different climatic conditions.

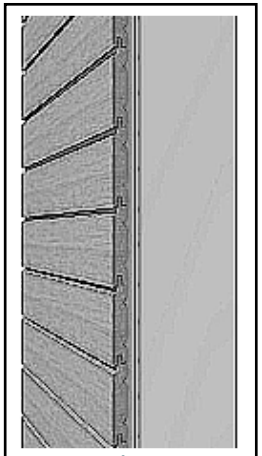
VMZ QUARTZ-ZINC STRAT is as mentioned a pre-patinated product, which means that the process has given the zinc approximately the actual nuance that it keeps throughout the further patinate process. In case of a further patinating the zinc can appear a slight lighter.

Ill. 107.2 Joint principles

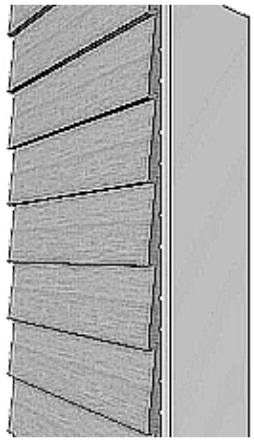
Larch cladding

Larchwood is often used as façade cladding due to the qualities of the material. In order to establish a cladding principle four different principles have been investigated and evaluated on their aesthetical appearance and architectural contributions.

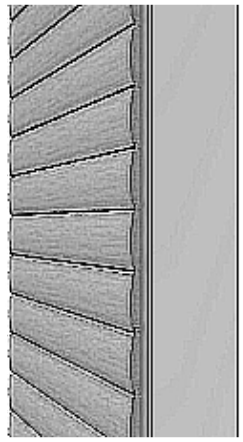
The determined larch wood cladding principle is laths attached according to the Tongue and Groove principle. The cladding represents and emphasizes a horizontal appearance that corresponds to the aesthetical concept. The surface appears smooth, is easy to montage and can be utilized both interior and exterior, which will give a cohesive expression. The cladding will be applied to the entrance axis, the box at the administration and by the patios in the patient wards. By choosing the Tongue and Groove principle the façade will gain a certain depth and thereby a convincing directional shadow effect that creates the horizontal expression.



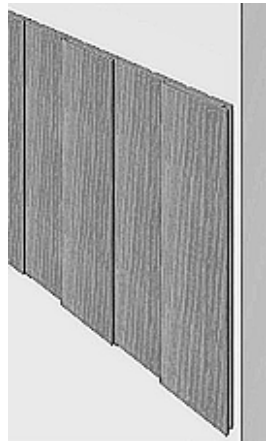
Tongue and Groove



Weatherboarding



Log House Board



One on two

Tongue and Groove with drip edge

Ill. 108.1 Wooden cladding principles

Sun shading

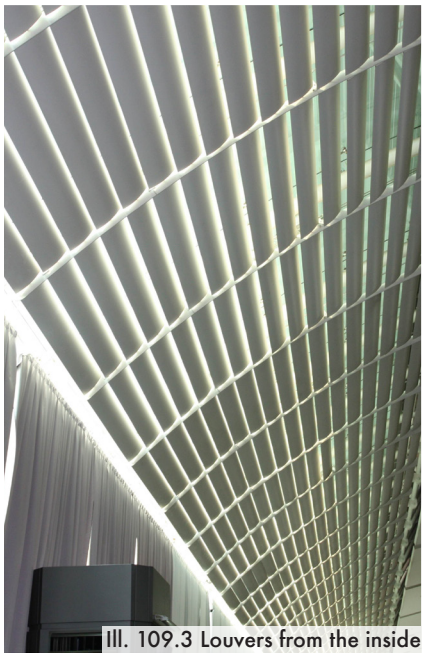
The southwest façade by the administration and Day Care Centre is rather exposed to the sun due to the fact that no overhang is utilized in order to emphasize the concept of a cohesion mass being split by two through going elements. Because of this the idea is sought to be further enhanced and combined with the need for solar shading.

With this idea as a point of departure the windows will be extracted deep into the facades in order to make room for sun shading louvers. The principle is to carry on and emphasize the horizontal expression in the facades by the means of the louvers. With a height of 470 mm in the zinc material, the louvers will have the half height in order to have the ability to close the window entirely while retaining the horizontal lines. The louvers will be perforated steel plates in order to maintain the opportunity for a view to the outside while still blocking some of the sun heat.

This principle will moreover contribute to the architectural concept for the facades by giving it a massive look when the louvers are shut, while still allowing view to the outside and natural light from the repeatedly skylights near the Spine, giving a living character to the façade with an open and a closed expression.

Ill. 109.1 Perforated sun louvers

Ill. 109.2 Differentiation between an open and closed facade

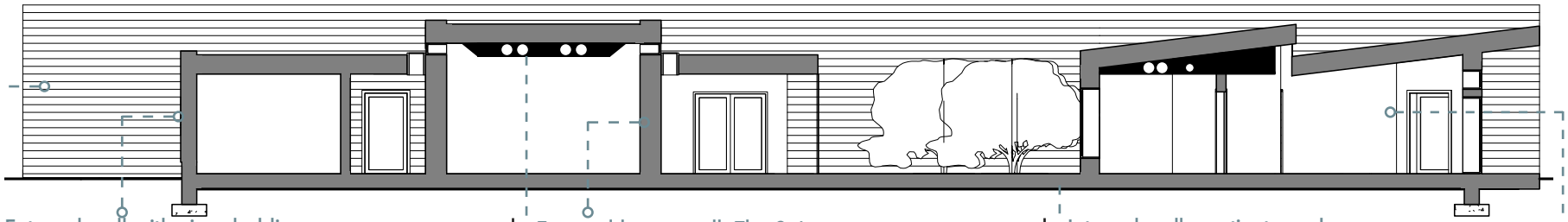


Ill. 109.3 Louvers from the inside

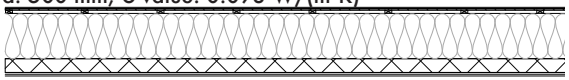
Ill. 109.4 Differentiation between an open and closed facade

CONSTRUCTION

This section presents an elaboration of the composition of the constructions present in the building.

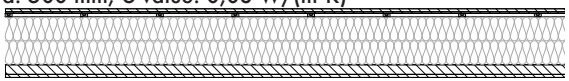


External wall with zinc cladding
d. 500 mm, U-value: 0.093 W/(m²K)



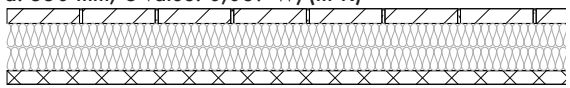
Materials	λ [W/(mK)]	[mm]
Zinc Cladding	0,116	8
Plywood	0,11	12
Batten 25x50, ventilated air gap	0,1	25
Rockwool Venti-Batts	0,032	329
Concrete	0,35	100
Plaster 2x13	0,2	26

External wall with wood cladding
d. 500 mm, U-value: 0,08 W/(m²K)



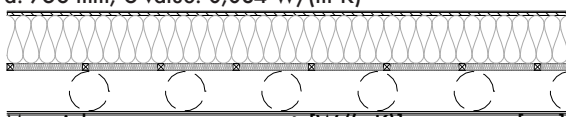
Materials	λ [W/(mK)]	[mm]
Wood Cladding	0,13	22
Plywood	0,13	22
Batten 25x50, ventilated air gap	0,1	25
Insulation	0,032	349
Massiv wood construction	0,12	70
Wood Cladding	0,13	22

External heavy wall, The Spine
d. 550 mm, U-value: 0,089 W/(m²K)



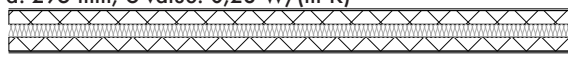
Materials	λ [W/(mK)]	[mm]
Kolumba Brick, 528x108x37	0,48	108
Insulation	0,032	342
Concrete	0,35	100

Roof with suspended ceiling
d. 756 mm, U-value: 0,084 W/(m²K)



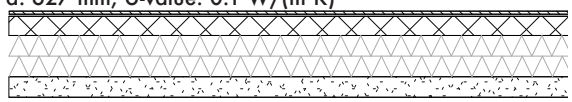
Materials	λ [W/(mK)]	[mm]
2x Roof coating (Asphalt)		10
Coverboard	0,13	22
Insulation	0,032	300
Moist barrier	-	-
Insulation/batten 48x48	0,034	48
Suspended ceiling	-	300
2x13 Plaster board	0,88	26

Internal walls, patient wards
d. 295 mm, U-value: 0,28 W/(m²K)



Materials	λ [W/(mK)]	[mm]
Plaster	0,88	13
Concrete	0,35	100
Insulation	0,032	95
Concrete	0,35	100
Plaster	0,88	13

Ground deck
d. 627 mm, U-value: 0.1 W/(m²K)



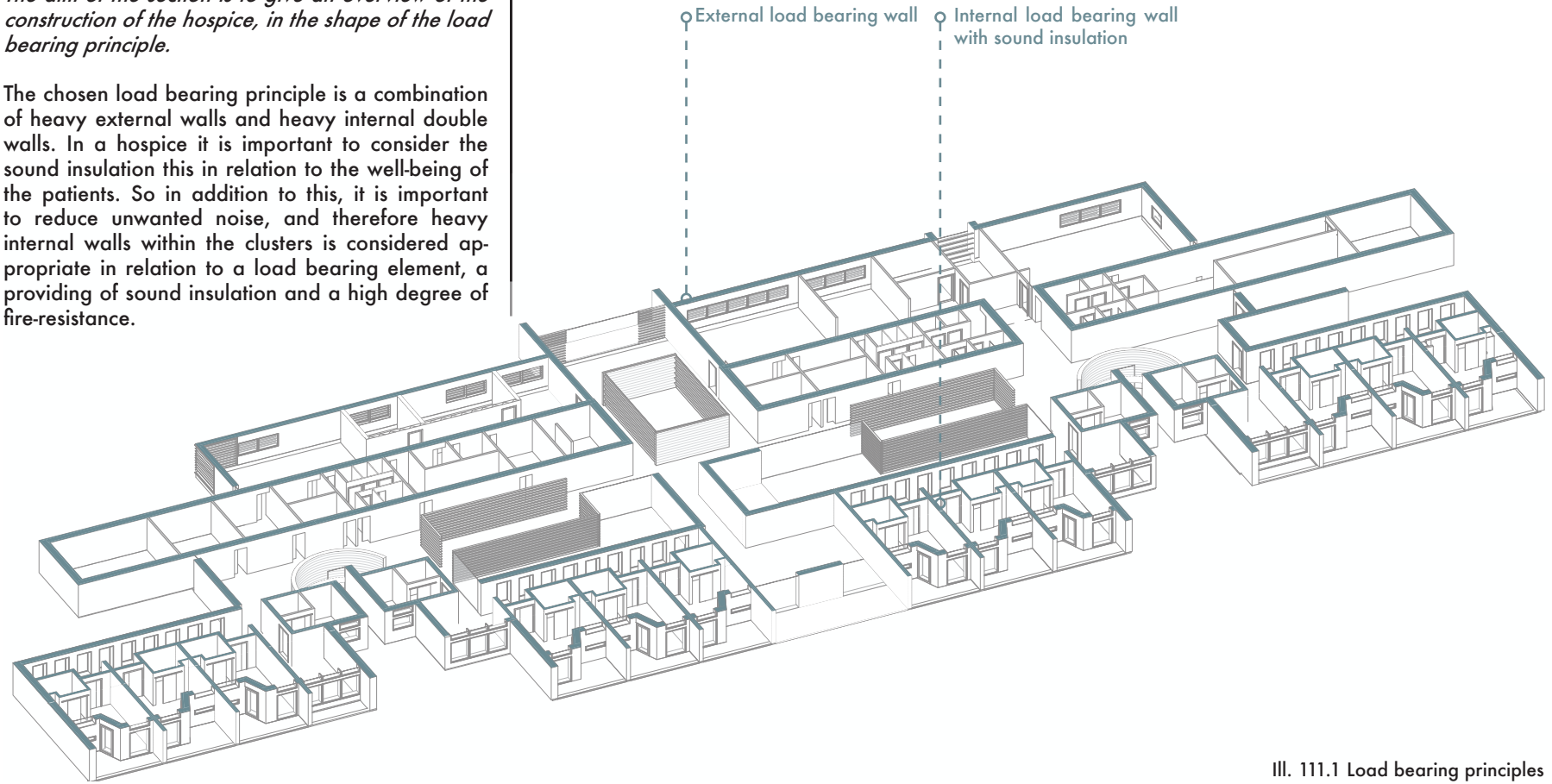
Materials	λ [W/(mK)]	[mm]
Flooring	0,13	22
Sound Insulation	0,04	15
Floor heat plate	-	-
Concrete	0,35	140
Polystyren 2x150	0,032	300
Granular Capillary Break	-	150

3.03 //

LOAD BEARING PRINCIPLE

The aim of the section is to give an overview of the construction of the hospice, in the shape of the load bearing principle.

The chosen load bearing principle is a combination of heavy external walls and heavy internal double walls. In a hospice it is important to consider the sound insulation this in relation to the well-being of the patients. So in addition to this, it is important to reduce unwanted noise, and therefore heavy internal walls within the clusters is considered appropriate in relation to a load bearing element, a providing of sound insulation and a high degree of fire-resistance.



Ill. 111.1 Load bearing principles

3.04 //

ENERGY OPTIMIZATION

This chapter aims to clarify the different energy considerations that has been incorporated during the design process, this in order to achieve a building design that will fulfill the Danish Energy Frame of low Energy Buildings 2020.

Since the oil crisis in the 1970's it has been seen as a focal point, to reduce the energy consumption of buildings. In 1977 the building regulation demanded a better insulation of the building envelope while decreasing the window areas, with the goal of reducing the transmission loss. In the 1990's this approach where changed into an even better insulation and in correlation to the windows, low energy glass made larger windows reaccepted, and a new focus was taken on the benefit of passive solar heat, this in order to reduce the heating demand. In 2006 the building regulation stressed a more holistic regulation of how the buildings perform. Besides focusing on reducing the heating demand, when calculating on the energy consumption, cooling, domestic hot water, technical equipment and lighting also where taken in to account. [Marsh, 2011]

It is the aim to achieve the Danish Energy Frame of low Energy Buildings 2020, which demands a total energy reduction on 50 % compared with the standards of 2010. Building within this class demands that the energy supply for heating, ventilation, cooling and domestic hot water per. m^2 heated floor area not to exceed 20 KWh on an annual base. [BR, 2011]

In order to achieve the 2020 target, it has been seen as an important aspect to integrate the passive solutions in the initiating stages of the design process. In relation to passive solutions there are several parameters to adjust in order to affect the energy consumption in a positive direction.

- Orientation of the hospice and patient wards
- U- and G-values that varies according to the specific window.
- Heat accumulation, which smoothens out the variation in temperature.
- Hybrid ventilation, mechanical and natural ventilation.
- Shading devices that prevent direct sunlight in the summer period and thereby reduces the cooling demands.
- Placement of the windows for passive solar gain.

The overall building shape and the enclosed functions are primarily designed according to the parameters of orientation, heat accumulation, shading devices and ventilation strategies, which created the base of the energy consumption which reached an energy consumption of 24,8 kWh/m2 year. So in order to reach the goal of 20 kWh/m2 on an annual base there has been made a couple of iterations, with the aim of improving the building as whole and making energy optimizations.

Iteration 1 (ill. 113.1)
There were seen potentials in reducing the window areas with an SW orientation. With an reduction of 20 m2 windows, in respectively Daycare Center and administration, improved the energy consumption with 4,2%. The reduction of window areas did furthermore reduce the overheating within the administration in advantages of the indoor environment. The iteration was though not sufficient.

Iteration 2 (ill. 113.1)
The already entered u- and g-values were not specific values according to the individual windows. So in order to find the specific u- and g-value for each and every window Velfac's energy calculator were used [Velfac, 2013].This initiative had a crucial effect on the energy consumption, which were reduced with 32%.

These iterations made it possible to reach the Danish Energy Frame of low Energy Buildings 2020, by taking advantage of passive solutions. It is though not all initiatives who have been made in the favor of the energy consumption. Some initiatives have been made in the effort of creating good indoor environment, though they were conflicting with an energy optimization.

Atrium
As already demonstrated in the chapter - Investigation of atriums, an atrium will have a negative influence on the energy consumption (ill. 113.2). When

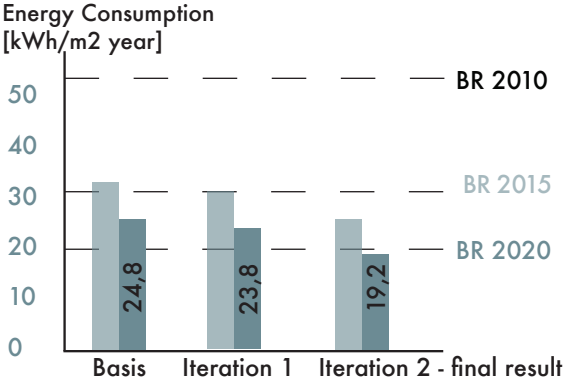
looking at the key numbers of the energy consumption it is evident that there is a need for heating and by removing the atriums the heating requirements will be reduce with 11,5 percent. It is evident that the atriums have a negative effect on the technical aspects, but will definitely be compensated by the contributions of a light and welcoming indoor environment.

Mechanical ventilation in the patients wards

Energy would have been saved by utilizing natural ventilation during the summer, but when dealing with weak patients it is found important to have a stable indoor environment, which mechanical ventilation can provide. Therefore mechanical ventilation is in use on an annual base within the patient wards.

From the initial stage of the project it was the aim to reach the Low Energy Frame of Building Regulation 2020 of 20 kWh/ m² on an annual base. With a calculated energy consumption of 19,2 kWh/ m² the goal is reached by taking advantages of passive solutions. As mentioned, there have been made some initiatives which were not in the favor of the energy consumption, but these are assessed as a contribution to the notion of Healing Architecture. In order to reduce the Energy consumption, active elements can be added, which is the final initiative according to the pyramid of sustainable design approach presented by Henning Larsen architects (Ill.5,1). Adding on active solutions has however not been necessary in order to achieve the goal, therefore these solutions has not been elaborated.

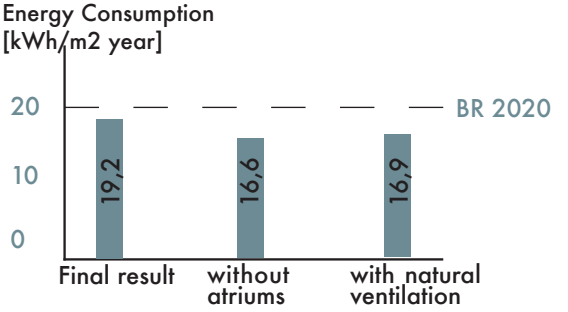
Energy optimization by iterations



Ill. 113.1 Second round of iterations

Deterioration of energy consumption

- Final result minus atriums and mechanical ventilation within the patient wards.



Ill. 113.2 Detoration of Energy Consumption

Key numbers of the energy consumption [kWh/m2 year]

ENERGY FRAME BR 2015			
Without supplemt 30,4	Supplement from special conditions 0,0	Total energy frame 30,4	
Total energy requirement			26,2

ENERGY FRAME BR 2020			
Without supplemt 20,0	Supplement from special conditions 0,0	Total energy frame 20,0	
Total energy requirement			19,2

Contribution to energy requirement		Net requirement	
Heat	13,2	Room heating	5,0
El. for operation of building	6,2	Domestic hot water	8,2
Excessive in rooms	0,0	Cooling	0,0
Selected electricity requirements		**Heat loss from installations**	
Lighting	0,0	Room heating	0,0
Heating from rooms	0,0	Domestic hot water	0,3
Heating of DHW	0,0	**Output from special sources**	
Heat pump	0,0	Solar heat	0,0
Ventilators	6,1	Heat pump	0,0
Pumps	0,2	Solar cells	0,0
Cooling	0,0	Wind mills	0,0
Total el. consumption	60,5		

3.05 //

LIGHTING

The natural light has a healing affect on the patients, which is why the layout and orientation of the patient wards has been designed in relation to this. When the natural light is not sufficient the artificial light work as a substitute. So in order to accomplish suitable lighting conditions throughout the whole day, artificial lighting has been investigated.

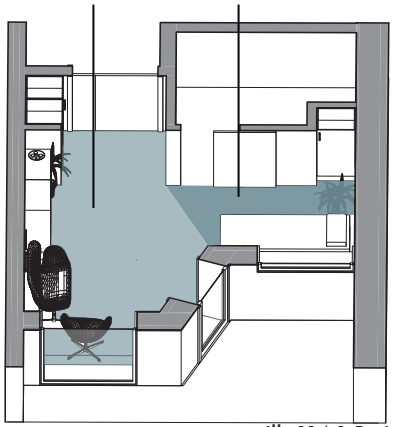
One will often find big differences in how the light is perceived and what mood it brings, this compared to ones origin. Lone Stidsen, Ph.D student at Allborg University, refers to McClugan, C. L. B who claims that the physical environment, the organizational culture and the lighting condition can have an influencing affect. The lighting conditions in the shape of illumiance and the color of the lighting have shown to have a positive effect on the user in relation to mood and behavior.

What is now clear is that the lights strength, color and quantity have different effects on people depending on their origin. With a hospice open to a multicultural society, it is important not to favor a particular audience, but rather to make light flexible to some extent, and otherwise take into account how light affects the body on an evidence based level.

Zoning

With patient wards already divided into two zones in terms of volume and natural light, it has been seen as a golden opportunity to support this division of zones in terms of artificial light as well. The patient

Flexible zone Enclosed space



Ill. 114.1 Patient ward

wards have different range of functions to facilitate, caused by the different users with different needs, in relation to lighting.

The wards is the patients home. At the same time it is a work station, where the nurses do the ward rounds.
The wards is a place where the patient spends most of the day's 24 hours, while nurses only spend few hours, but the different needs of the users should be balanced.

Flexible zone

This zone is seen as the flexible part of the patient ward, whereas the artificial light should emphasize:

- Dynamic lighting as an installation can be seen as a positive initiative in relation to achieve a pleasurable light atmosphere dictated by the user – this might though cause a large amount of internal heat gain that can cause an unhealthy indoor climate.
- Another opportunity is to have multiple light sources that can be turned on when suited.

Looking at the overall picture it is found most flexible to have light sources of different characters and size, instead of one dominating the space.

The enclosed space

The enclosed space is intended for the bedridden patient and the nurses, why the space should accommodate good lighting conditions in both favor.

Patient

- The transition between night and day can be made less stressful for the patient when experiencing a natural sunrise. The sunrise will suppress melatonin production before the actual waking occurs. The north/east oriented windows support this theory and during the winter, artificial lighting can supplement the natural lighting.
- It is contrary necessary not to suppress melatonin production when the patient is going to sleep, this by having a low blue

content and a low light level.

- When nurses stop by the patient wards during the night, switching on the general ward lighting may interfere with the circadian rhythm.

Staff

- The nurses must have adequate lighting in order to perform visually demanding work according to standards, the lighting installations should comply no less than 200 lux, which in day hours is being provided by the natural light without glare.
- During the night it is necessary to reach the same level of light, which is done by using artificial light.

It is evident, that the light of the patient wards has to accommodate different needs, at different times, which cannot be fulfilled only by natural lighting, why the artificial light should work as a substitute for the natural daylight especially in the winter.

In order to meet the dual purpose from a lighting point of view, there have been seen advantages in an installation in the shape of a lighting panel that will allow light in different directions. The walls will be illuminated, which will give the observer a bright and open spatial impression.

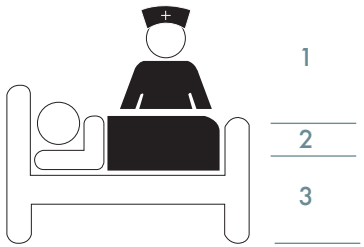
1 - Light above the panel:
In the effort of avoiding a sterile and clinical experience of light, the surfaces of the enclosed space can be giving a warm color. The surface and its color have an influence on the perception of space, and the light being reflected on the warm colored surfaces will create a warm and inviting atmosphere.

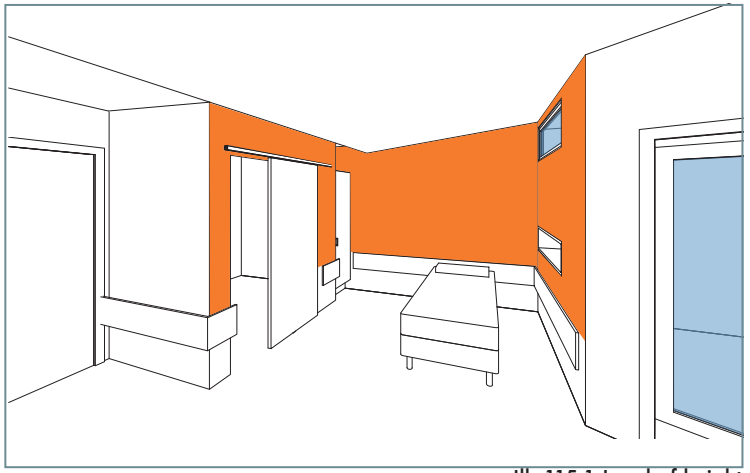
It should be possible to vary the level of light, in correlation to the varying age of the user – in proportion of older patients there will be a great requirement of a higher light level.

2 - In the middle:
The lighting should enable the patient to read, write and eat their meals. At the same time the light must provide good visibility to enable the staff to function correctly. This is tried solved by having a separately wall mounted or an integrated horizontal lighting source in the panel.

3 - From the panel and down:
This light will be casted downwards illuminating the floor, which will enable the nurses to move around safely during the ward rounds at night. The downward light will furthermore not disturb the sleeping patients as much as a lighting source illuminating the entire room.

Distribution of light





Ill. 115.1 Level of height

3.06 //

VENTILATION STRATEGY

The ventilation strategy of the hospice is based on hybrid ventilation in the shape of using mechanical ventilation on an annual base, which will be supplemented by natural ventilation during the summer. This is with the intention of reducing the energy consumption in a period, where there is an enlarged need of ventilation, due to the greater amount of solar gain. The purpose of using mechanical ventilation is to ensure good indoor air quality while taking advantages of the heat loss from ventilation in the shape of heat recovery.

Mechanical ventilation

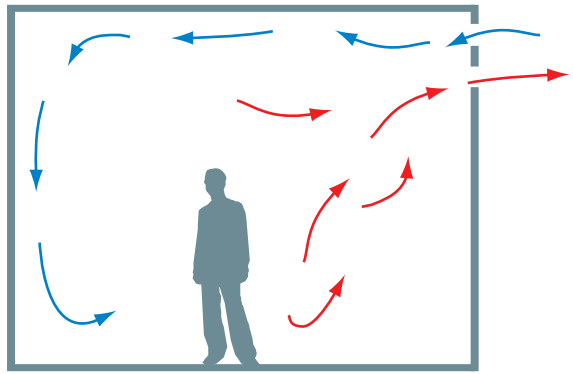
It is chosen to take advantage of Mixing ventilation, where the fresh air is supplied at a high velocity outside the occupied zone. This form of ventilation will not cause the patients discomfort, which Displacement ventilation may, due to the cold supplied air. The high air velocity of the Mixing ventilation creates a low internal pressure that leads to a mixing of the polluted and fresh air. At first, the air flow velocity will be high, but as the polluted air mixes with the injected air, the air velocity decrease.

Air quality

The air quality has a great influence on how spaces are experienced, so when designing a hospice it is important to consider the desired air quality. In order to define the quality of air there has been taken point of references in CR1752's three categories of air qualities. The three categories A, B and C correspond to how air is perceived with respectively 15, 20 and 30 percent dissatisfied. In relation to the patient wards, where patients spend the majority of the day, it is the aim to fulfill the category A. It is seen as a different scenario in the remaining areas of the hospice, where people are acting in a higher pace, why the air quality is not perceived in the same way, as in the patient wards. Therefore category B is seen as acceptable.

Ventilation aggregate

In correlation to the required air change, as shown in the schedule, there is a minimum requirement of 735.46 l/s in order to ventilate the entire building, this according to Danish Building Regulation. The use of the building and the amount of occupants



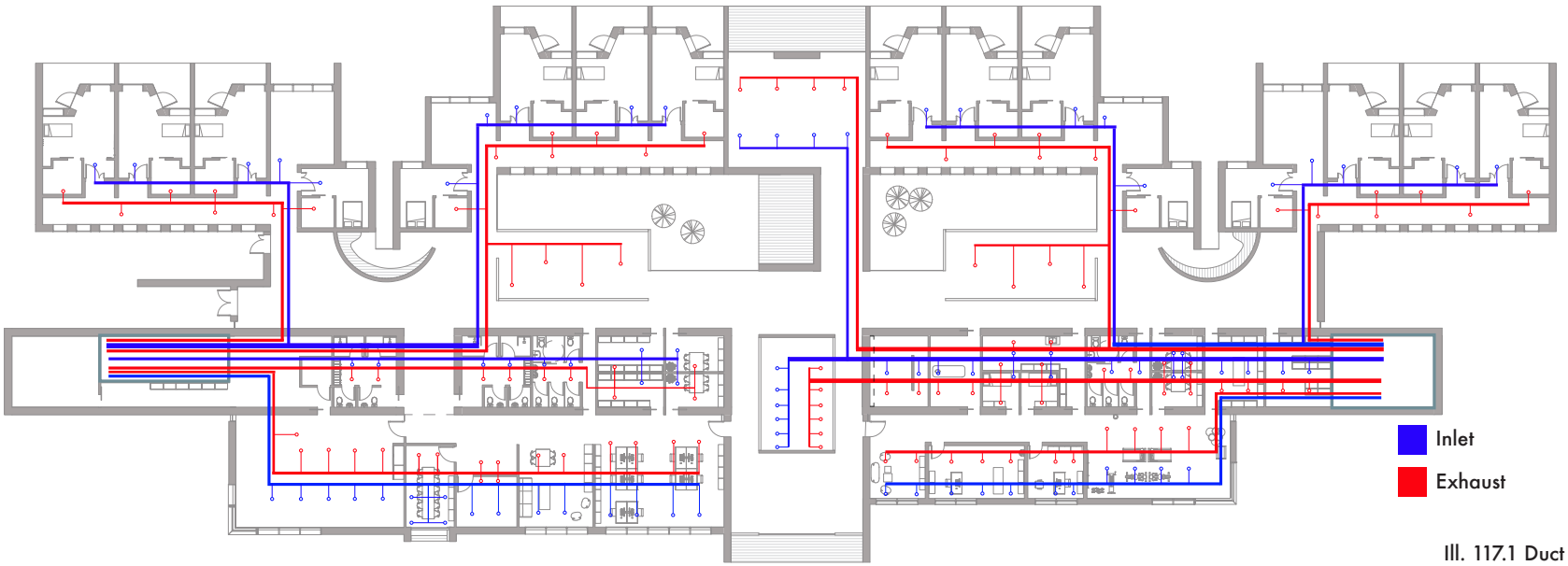
Ill. 116.1 Mixing ventilation

Unit	Category	Area	Volumen	Numbers of occupants	Air change rate h^{-1}	Air change rate l/s
Patient ward	A	30 m^2	85 m^3	1.2		
- CO_2 level					0.486	11.475
- Operative temperature					1.7	40.14
- Danish Building Regulation (minimum requirement)					0.5	9
Additional building	B	2091,54 m^2	5922 m^3	approx. 30	average 3.4	3833.19
- Calculated maximum requirement						
TOTAL (absolut minimum, danish building requirement)		2451.54 m^2	6942 m^3		0.5	735.46
TOTAL (maximum)		2451.54 m^2	6942 m^3			4314.87

will though vary according to time of day, year and season. Therefore the two ventilation aggregates, placed in separate rooms, should be able to provide a considerable higher air change rate. Therefore the maximum air change rate has been calculated to 4314 l/s, this in relation to temperature and CO2. On the base of this calculation, it was possible to find two suitable aggregates, Exhausto's compact VEX 170H, which are able to provide the building with 1200 – 8600 m3/h. [Exhausto, 2013]

Duct layout

From the two aggregates located in each end of the hospice, there will be lead ducts of respectively inlet (blue) and outlet (red) to the entire building, this with the aim of providing the building with the necessary air change. The sizes of ducts has not been further investigated, why it is estimated that a suspended ceiling containing ducts with a diameter of 300 mm will be sufficient, when speaking of the main ducts within the Spine. In order to maintain this thickness and in order to reduce the pressure loss, the ducts will not cross each other. The duct layout has furthermore been designed with the aim of reaching short ducting, also with the aim of reducing pressure loss.



Ill. 117.1 Duct layout

3.07 //

NATURAL VENTILATION

Natural ventilation supply spaces with fresh air from the outside, through for example windows, doors and valves. It derives from natural forces in the shape of temperature differences and wind pressure. In order to utilize natural ventilation to a maximum the building should be designed in relation to the context to create an efficient and more stable result. [Indeklimaportalen, 2013]

Initial considerations

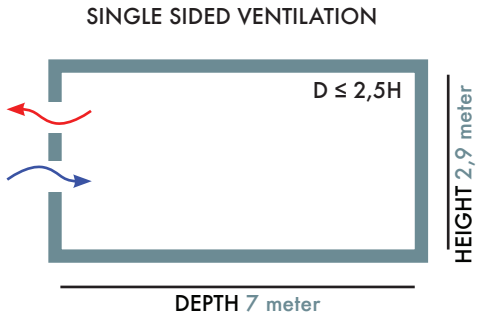
From the initial stage of the design process, considerations regarding the ventilation strategy were made. It was the aim to use mechanical ventilation in the patient wards on an annual base, in the effort of creating a stable indoor environment. Therefore the twelve patient wards were placed in the opposite direction from the dominating western wind. This is with the intention to allow other functions to take advantages of the dominating wind and thus utilizing natural ventilation.

Principles

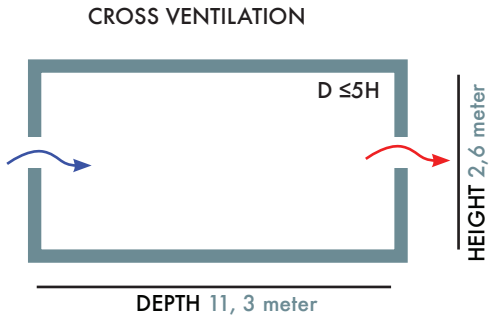
When speaking of natural ventilation a distinction is made between three different principles of natural ventilation: Single sided, cross and stack ventilation. From these three principles it is chosen to take advantage of single sided and cross ventilation.

Single sided ventilation:

This principle of ventilation is to be used within the patient wards, with openings placed in only one wall. There will be openings in the shape of windows and one terrace door. [Indeklimaportalen, 2013)



Ill. 118.1 Single sided ventilation

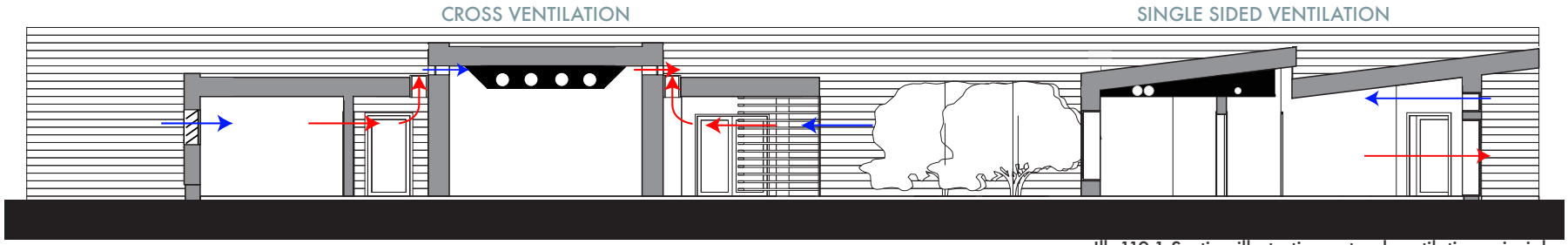


Ill. 118.2 Cross ventilation

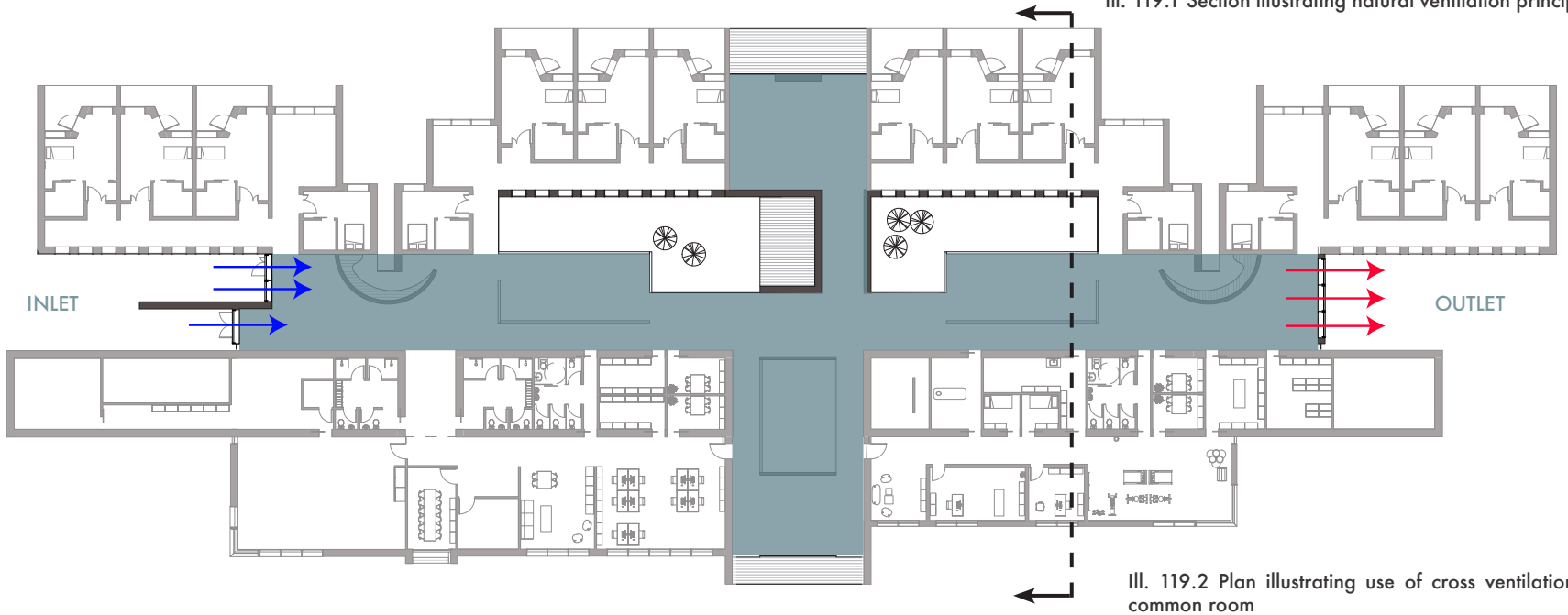
Cross ventilation:

Cross ventilation is used in most parts of the hospice. The principle of cross ventilation is based on wind pressure differences where the fresh air operates trough openings on the wind warded side (over pressure) and out through openings on the lee warded side (under pressure). It is possible to establish cross ventilation with openings in multiple surfaces – walls and ceilings. The hospice openings are placed in both walls and ceilings.
[Indeklimaportalen, 2013]

The inlets and outlets have been placed in respectively southeast and northwest facades (Ill.119.2). By placing three windows (1100mm x300 mm) in each facade, being open with 30 percent, it is possible to ventilate the common area with the absolutely necessary air flow rate (appendix 6.03). This corresponds to the minimum requirement stated by the Building Regulations and replacing the air every half hour. During the summer it is conceivable that there will be a greater need for ventilation, in order to reduce the temperature of the building. In this case it will be possible to open more windows. The three windows on each facade is just a small sampling of windows placed in the common area. The two atriums and the skylights, placed along The Spine, will also be able to provide with respectively inlets and outlets.



Ill. 119.1 Section illustrating natural ventilation principles



Ill. 119.2 Plan illustrating use of cross ventilation in common room

3.08 //

FIREPROOFING

This section presents the necessary considerations concerning fireproofing of the hospice and securing the inhabitants.

Application Category

According to the Danish Building Regulations it is firstly important to define the application category of a building, where it is being distinguished between 6 categories. A building like a Hospice is categorized as category 6 as it includes: "Building sections for daily and/or nightly stay, where the occupants present are not capable of bringing themselves to safety." (BR 2010, kap. 5.1.1). Hereby including nursing homes, rehabilitation- and bed wards on hospitals, institutions for physical or psychical disabled, senior housing etc. Each category consists of specific regulations concerning several features of the fireproofing strategy, however, this project will only focus on the crucial aspects concerning the layout of the building.

Fire sectioning

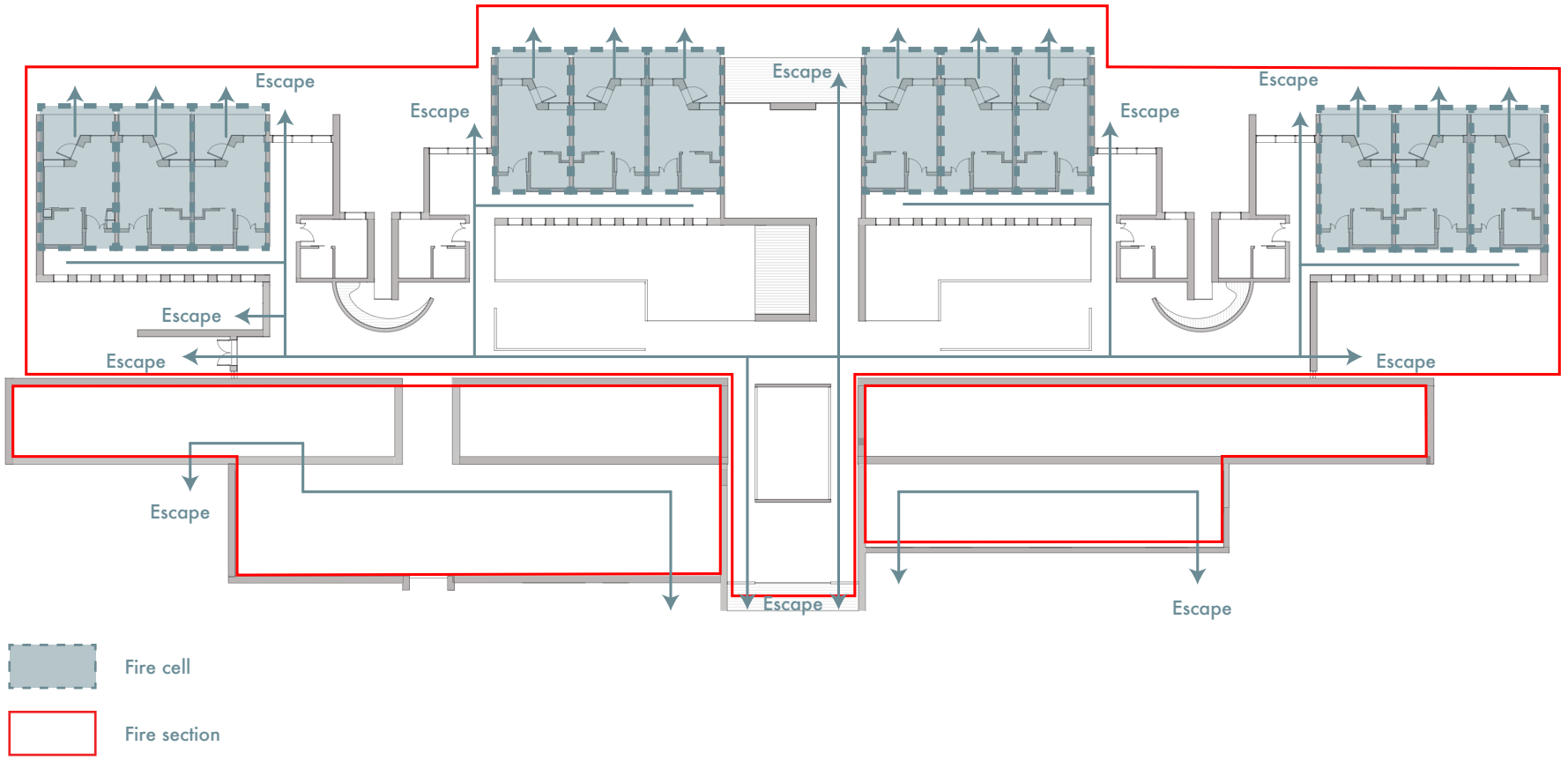
The building will be divided into fire cells and fire sections in order to secure the fire from spreading to the surrounding rooms within the time for an evacuation. To accommodate this the construction materials will be coated with fire restraining finish.

Due to the size of the building and the fact that it belongs to application category 6, it is necessary to divide the building into two fire sections since the building area exceeds the maximum limit of 2000m2 (sbi-anvisning 230). In order to meet this demand, the hospice will be divided into three fire sections; the administration, the Day Care Centre and the remaining hospice provided with automatic sprinkler system. With this division it is possible to escape out to the open. The fire sections will be physical divided by a fire restraining door. Additionally each patient ward will form a fire cell where it is possible for the patients to remain in the cell until they can become rescued.

Fire escapes

The fire escape strategy of the hospice is presented in illustration 121.1. It emphasizes how each patient wards forms a fire cell from which it has two separate exits; one directly to the open and one to an escape route. The distances to the nearest fire escape will not exceed 25 meters. Due to the fact that the hospice is a single storied building, it will be possible to obtain a direct access to the open through a fire opening.

The escape route conditions will not compromise with the minimum width on 1.3 meters of the corridors since they are dimensioned so that two patients bed are able to pass each other. Moreover can the principles of artificial lighting elaborated in a previous section be utilized in order to create a panic lighting placed in a lower level, hence creating a strong focus on the floor and the identification of the safe escape routes.



Ill. 121.1 Fireproofing principles

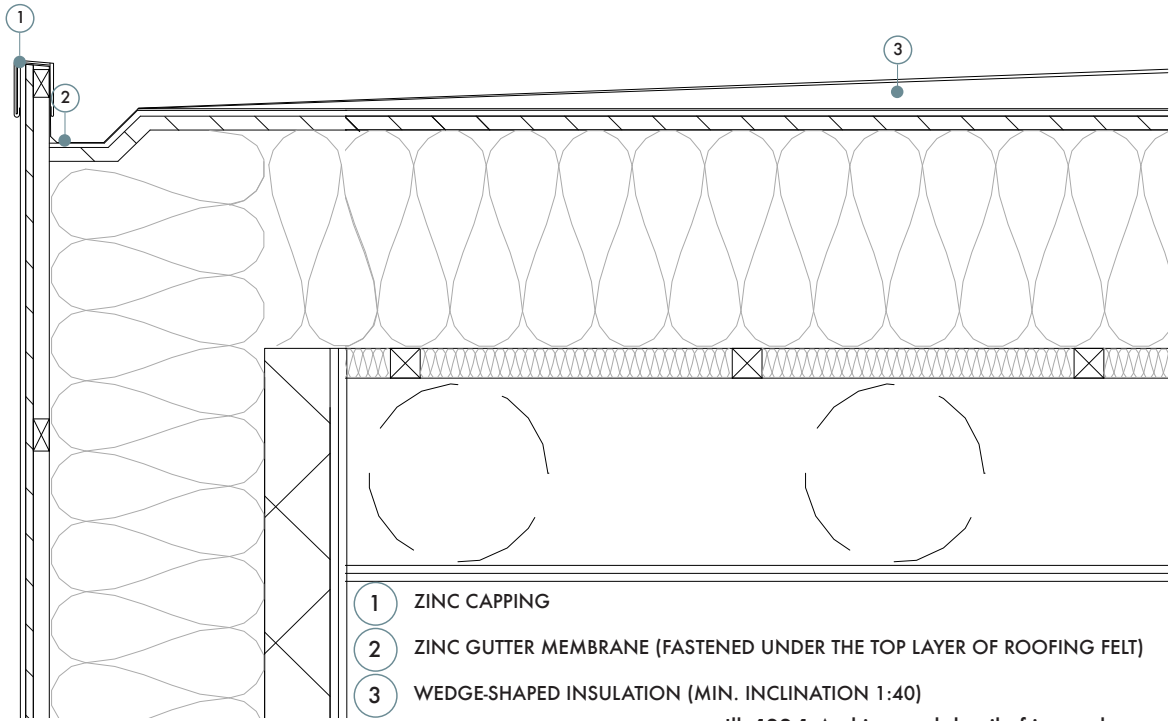
3.09 //

DRAINAGE

This section concerns the further reflections regarding the detailing of the overall drainage principle of the building

Due to the desire and development of the plane roofs it is obvious to consider how the rainwater ought to be led away and down from the roofs. Illustration 123.1 presents the drainage principle of how the roofs will have a small inclination that will be hidden behind the MURKRONE of the walls. Because of this it is chosen to have internal gutters in order to strengthen and emphasize the aesthetical expression of the building being a mass of clear cut off geometries.

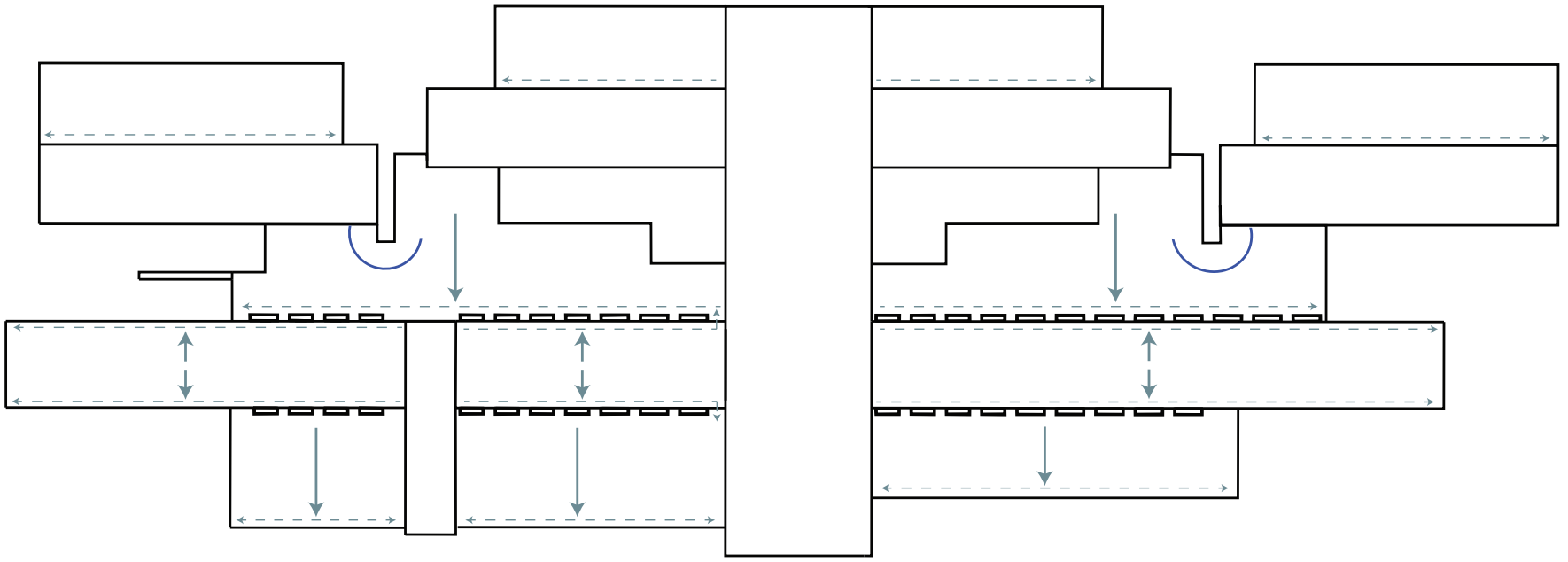
The Spine will have a two sided inclination that led to the internal gutter and further to the internal outlet hidden in the exterior walls. However, the part of the Spine that do not have a direct connection to the outside will leed the water down to the roofs below from where the water will run down the gutter and out. This is chosen rather than letting the rainwater being led down the heavy walls of the Spine in the middle of the interior of the building in case of a restoration or repairment, which will be easier and cause less damage on an exterior wall with a light



Ill. 122.1 Architectural detail of internal gutter

finishing cladding. Illustration 122.1 presents a detail of the principle of the internal gutters.

Zink is, as earlier mentioned, utilized on the roofs of the clusters, where it is led across the roofs in another internal gutter and out on the sides on the building. In this case it is possible to utilize only a hole at the end of the gutter and thereby allowing the rainwater to run down the side of the wall. However the actual further detailing of the drainage is beyond the span of this project and will thereby not be specified further than these overall considerations concerning the principles of how the roofs will be drained.



Small inclination (min. ratio 1:40)

Drainage

Ill. 123.1 Inclination and drainage principle

4.0 EPILOGUE

2.02 //

CONCLUSION

The aim of the project was to design a hospice situated on a donated site in the outskirts of Skanderborg with beautiful natural surroundings. The vision was to accomplish physical frames of a hospice that should support the palliative theories, enhancing the life quality of the patients by implementing the theories of Healing and Nordic Architecture, while reducing the energy consumption of the building to the Low Energy Class of 2020 by taking advantages of only passive solutions. This has been accomplished by balancing the approaches of the Integrated Design process and the Evidence Based Design

In order to achieve well-being among the patients, there have been giving great attention to the need of the patients and the different stages that a terminally ill goes trough. This is for instance evident within the layout of the patient wards where consideration regarding zoning of the plan, the placement of the windows and the focus on creating a view and access towards the surrounding nature, has all been in the effort of creating the frames of the patients last home, that will evoke comfort and support in a difficult time.

The Palliative care, which the patients as well as the relatives receive at the hospice, is not only being reflected in the assigned functions of the hospice. It is also evident from the division of patient wards into Clusters, this as an answer to the team based workflow of the staff.

The cluster is furthermore an attempt to reach a certain graduation from public to private within the building, due to the fact of having different functions beneath one roof. Besides being a hospice, the hospice is assigned with a Day Care Centre and the knowledge sharing within the field of Palliative care call for conferences within the hospice. So in order not to expose the patient staying at the hospice, a graduation is found necessary, in order to respect the patients need for silence, calmness and privacy. The graduation is not being expressed by a barrier, but by an intuition enhanced by the axes and the decreased sizes of spaces. The different levels of privacy will furthermore be enhanced by the variety of common rooms and informal meeting points, where social interaction between patients and relatives will occur. The different common rooms have a great range of use and are able to handle quiet contemplation, celebrations, events and social interaction.

When visiting Hospice Djursland it became clear, that the common rooms were more or less in the effort of creating social interaction between the relatives or to create spaces where the relatives can withdraw themselves. An example of such space is one of the hospice most private and intimate spaces - the reflection room. This has been designed on the base of taking advantages of elements within the field of Nordic Architecture. This is being expressed by modest means, where nature has been captured by a poetic framed view. From here the patients and relatives can enjoy quiet contemplation and get lost in time.

In relation to Healing Architecture it was the aim to provide the building with a certain overview, in order to reduce the stress level of the user. This is accomplished by dividing the different functionalities of the hospice into zones and is furthermore enhanced by the two consistent axes within the building. The axis of the Spine is being emphasized by the green course throughout the building, in the shape of two atriums. The atriums contribute to an enhancement of the indoor environment and the notion of Healing and Nordic architecture. The atriums will create secluded and protected outdoor spaces, which the patients and relatives will gain great benefit from.
When the day comes and a patient passes away, it is found important not to treat death as a taboo and hiding the death of a fellow patient from the other patients. This may cause uncertainty between the patients. Instead is it seen important to leave the hospice with dignity where the axis will contribute to the last poetic journey. This will be the last Farewell.

4.01 //

DISCUSSION

When designing a hospice it is obvious that it is a rather complex matter due to the several crucial aspects and factors within the concept of a hospice. It is not possible to boil the project down to just the well-being of the patients. Even though it is of the outmost importance to enhance their quality of life through the relieving initiatives of palliative care, it is also important to remember that it is a place and a haven for the relatives as well, while still being a professional workplace for the staff. However, the design aimed to fulfil the needs of the patients in order to design spaces worth living in.

One of the main parameters established in the section concerning well-being is the notion of homeliness and creating a home for the patients and not just a hospital room. This is obtained to a certain degree in the flexible area of the patient ward where it is possible to bring personal furniture etc. However, the flexibility within the room by the means of smaller physical divisions as emphasized in the Programme for the Good Hospice in Denmark is not achieved. In relation to this the idea of 12 different patient wards, varying in size, degree of privacy and decoration, occurred in order to promote a greater flexibility. However, persuasive disadvantages overruled this idea in favour of the notion of flexibility within a general patient ward, in stead of risking to end up in a custom patient wards that does not fit the actual patient.

Another factor to consider within the building is the distances created by the oblong geometry. This is a critical point in relation to the weakened patients and the staff, to whom it is a place of work. However, the long course is in no comparison to the traditional institutional hallway due to the constant impact of natural elements and spatial deviations that soften up the rigid course of movement. Additionally will the Spine contribute as a recognisable through-going element that enhances the flow of the building and the overall orientation as well as minimizing the clinical expression by its materiality and tactility. Even though long distances are present in the building it is seen as a more important factor to incorporate a green wedge through the building in response to the principles of Healing Architecture and the concept. Therefore it is envisioned that the present course of movement and flow within the hospice will provide the patients with several relieving stimuli, which is prioritized higher. Moreover will the distances be shortened rapidly in relation to the working nurses since it has been chosen to organize the hospice according to the principle of clusters, which emphasizes the team-based workflow enhanced by the smaller workstations. This will additionally create a stronger community feeling, intimacy and a sense of security as a result of the more personal relation between patients, relatives and the staff.

During the programme it became obvious that the site is placed in beautiful surroundings that was the desire to utilize. However, the site has a regular rectangular shape that does not provide noticeable lines or characters to benefit from in the elaboration of the design of the hospice. This allows the final hospice to be a distinguished orthogonal geometry relating to the single presence factor – the forest. Due to the future development of the district of Anebjerg the hospice will therefor have the risk of becoming less contextual related if the district would be developed according to another layout concept. However, this has not had an influence of the project since it is a fictive project to a certain level. If it is decided to situate a hospice in the outskirts of Skanderborg, the present local plan of the area will be revised, why the actual layout of the future development is not considered in the project but only the definition and fact that the nearby areas will be utilized. This determination of this only assisted to the developing of the concept and strengthened the principle of turning focus inwards.

In relation to this it was the initial desire to empha-

size both the topography of the site and the theory of Nordic Architecture by incorporating the hospice within the landscape. However, during the design process it soon became a contradiction to the functionality of the hospice, where it is chosen in favour of the hospice being able to function on the terms of the patients and the staff by having a plane building with direct connection to the outdoors all way around the building providing the level free access. This results in a more untamed and natural backyard of the hospice that emphasizes the concept.

During the design process less focus has been giving the administration and Day Care Centre of the hospice due to the fact that the main focus has been on the patients and their relatives. Because of this, the geometries of the administration and the Day Care Centre are reached by a rather pragmatic approach dictated by the functions available within the Spine. However, the results form a building perceived as an entirety with a dominating architectural and aesthetical expression. This, and the rest of the process, bears the mark of being a process of conscious choices both concerning the energy consumption, functionality and aesthetics.

Living and feeling life until the end

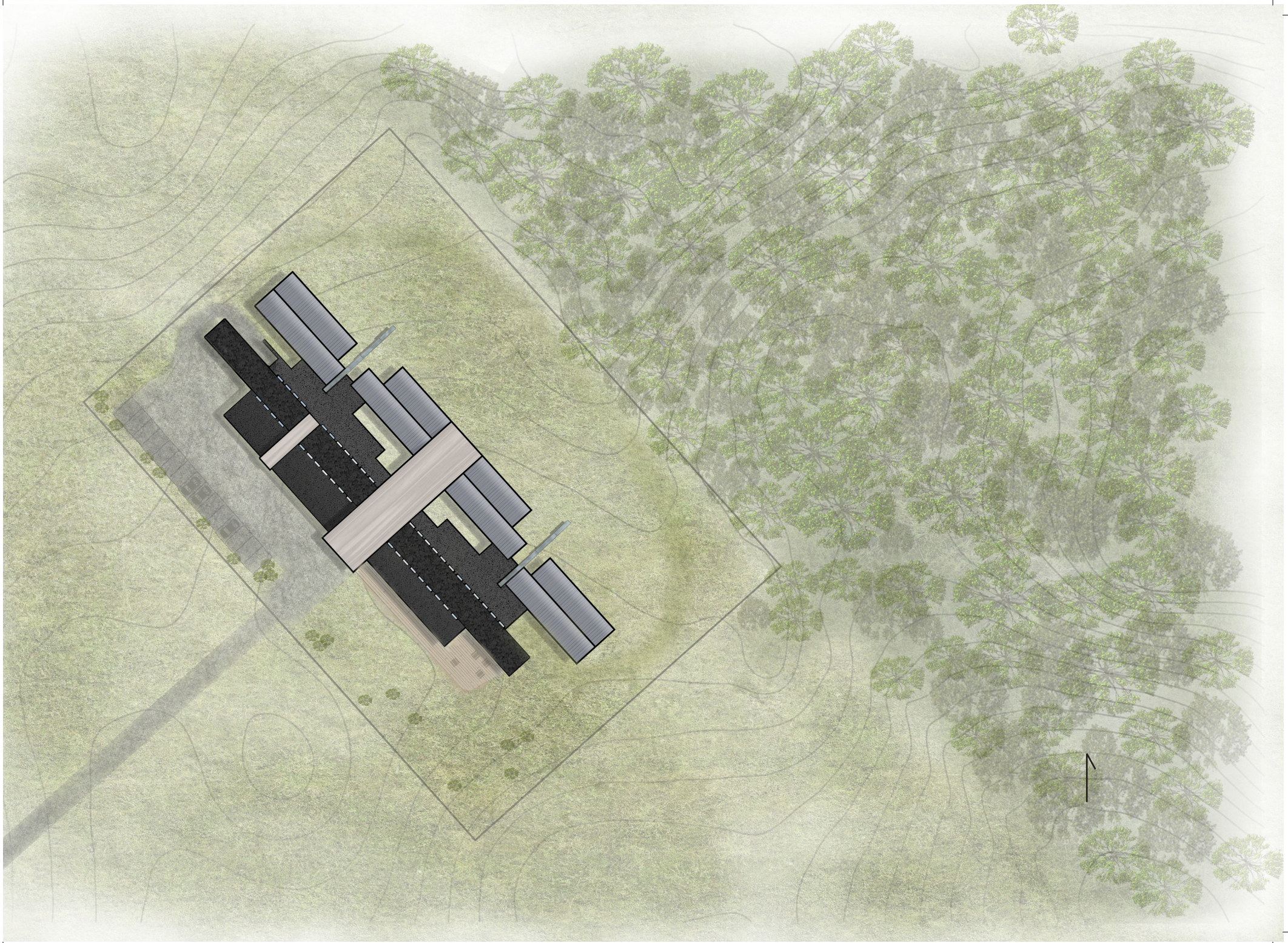
The following section is a presentation of the final design proposal that will be visualized through plans, sections, facades and visualizations respectively. To scale drawings is enclosed within the drawing folder.

PRESENTATION 5.0

5.01 //

MASTERPLAN

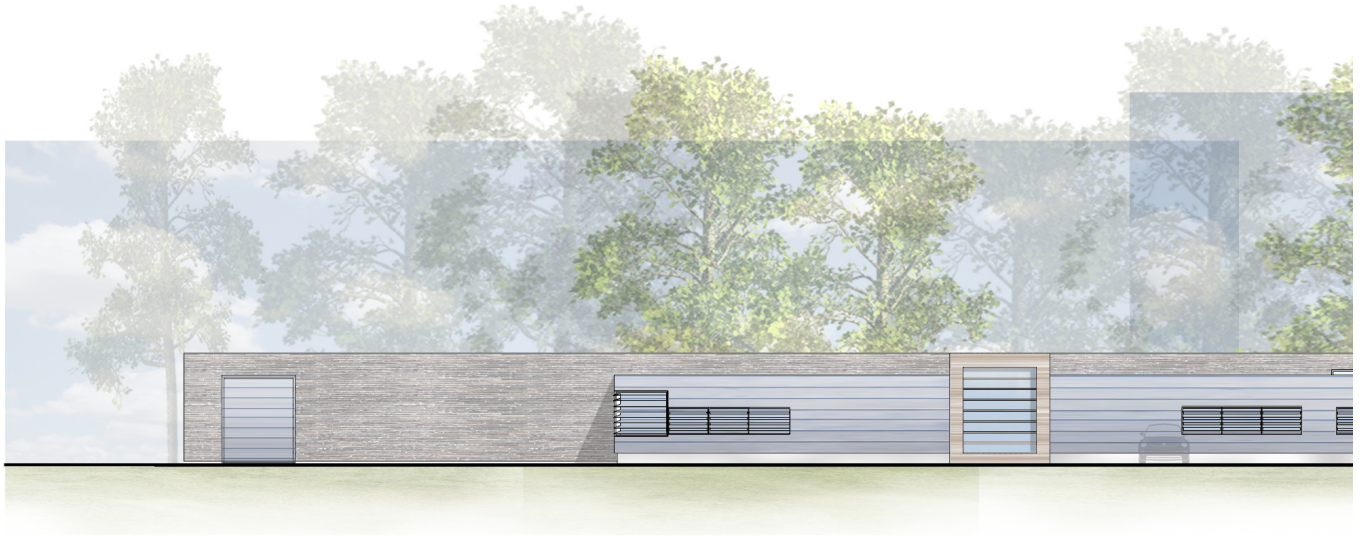
The masterplan of the site emphasizes the simplicity of the building lying undisturbed and secluded in the landscape. Focus is turned towards the forest, which emphasizes the concept of creating a more secluded and protected space for the inhabitants of the hospice. The strong axial attention within the building is visible in the masterplan as well with the straight arrival to the site, which stresses the narrative of the building.

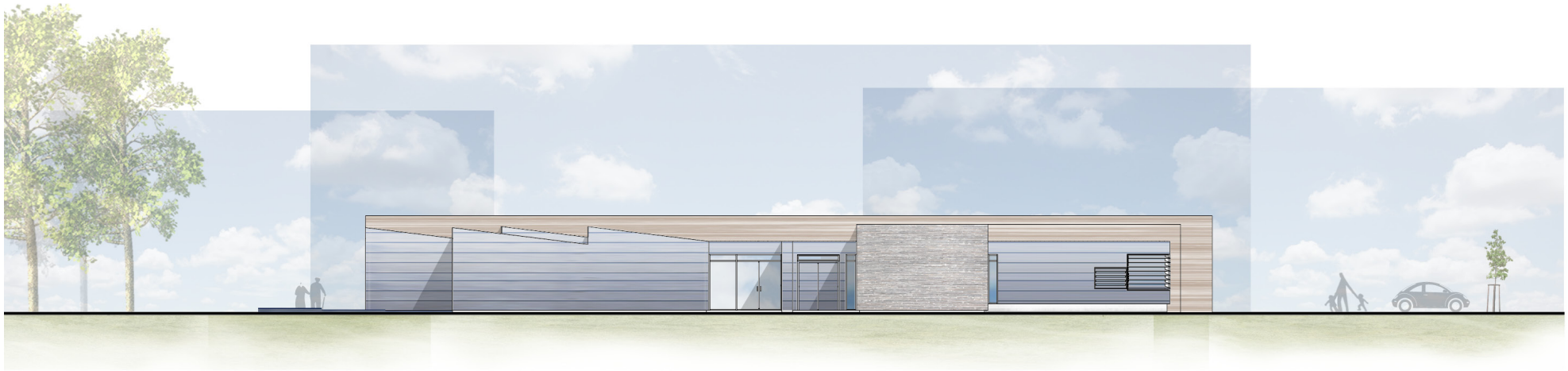


5.02 //

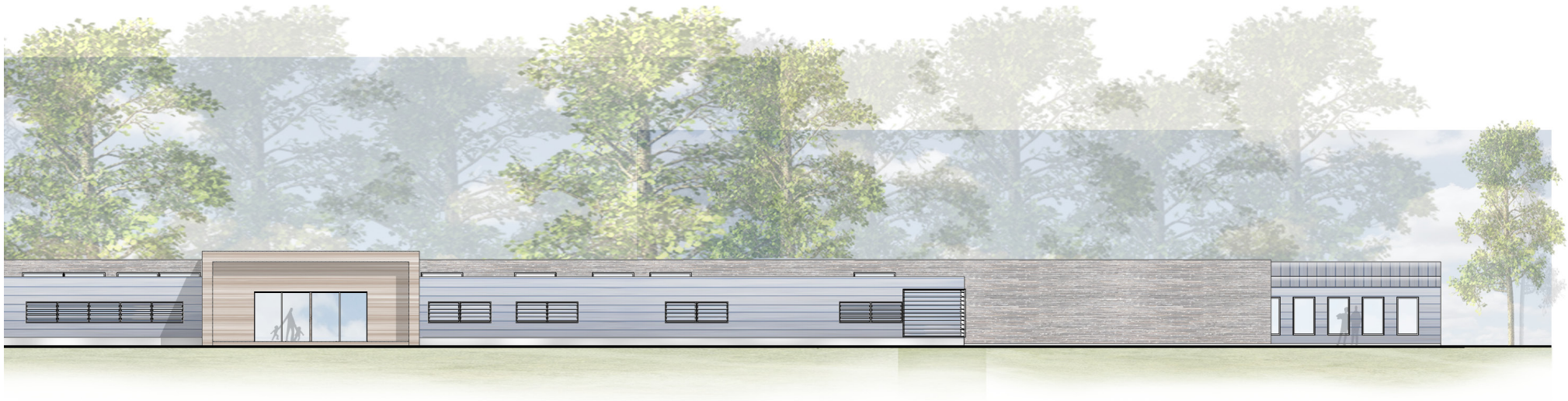
FACADES

The facades are strongly characterised by the two through-going axes that creates the architectural expression of being an entirety divided by the axes. The southwest façade presents the entrance of the hospice and is harmoniously interacting with the picturesque forest in the background emphasizing the serenity and calm atmosphere created both within and outside the hospice. The horizontality of the building and the materials generate a strong appearance, which is beautifully balanced by the forest.





Northwest facade

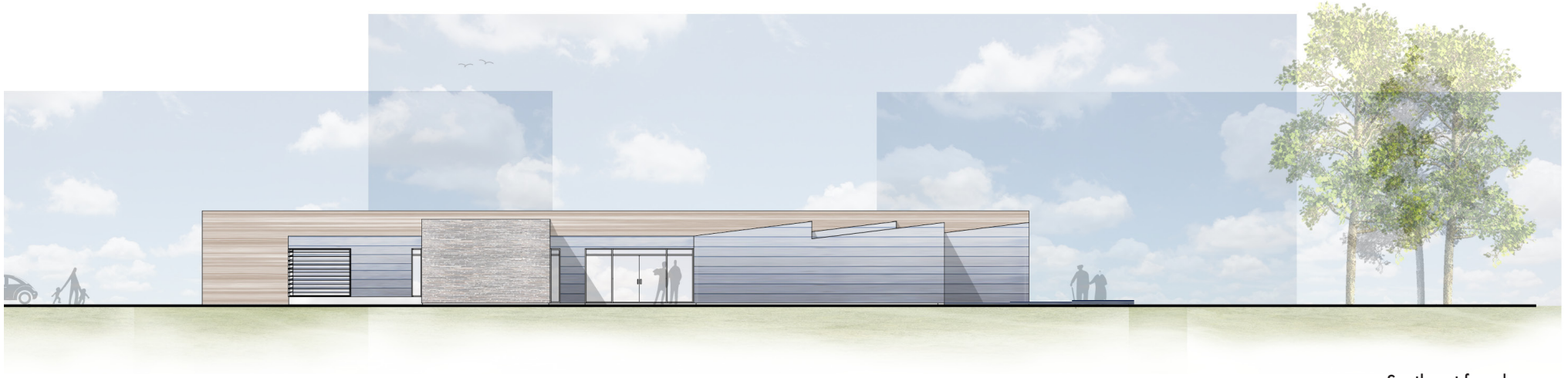


Southwest facade, entrance

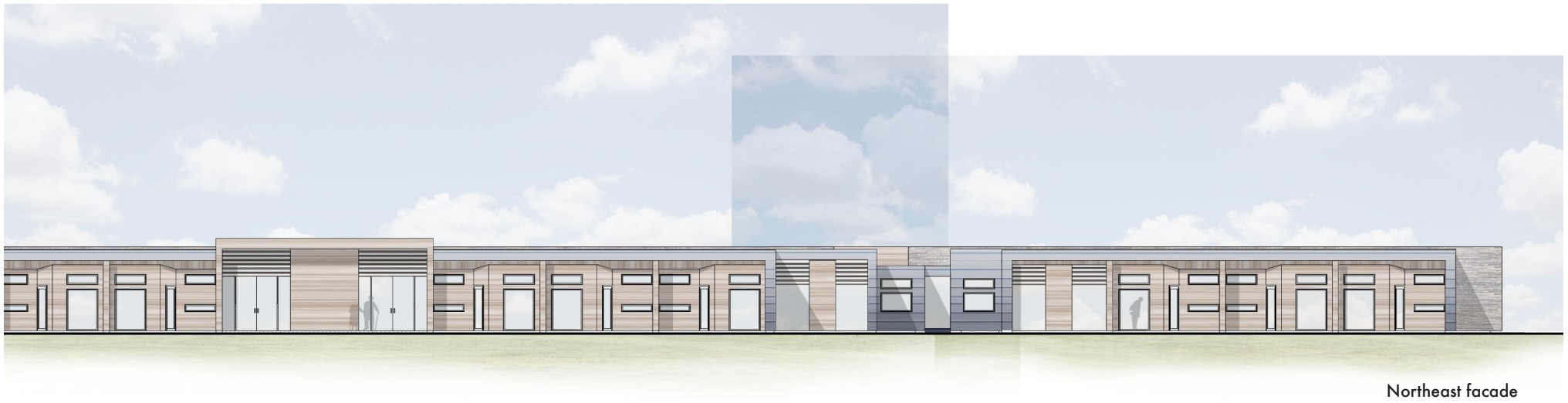
5.03 //

FACADES

The northeast façade represents a rather different expression that is softened up by the dynamics in the façade and the materials. Moreover it creates a readable façade from which it is obvious to establish and recognize the building as a hospice, where close attention has been made to the quality within the patient wards. While reading the facades it is evident from the southeast that the hospice consists of several layers going from the entrance before reaching the patient wards.



Southeast facade



Northeast facade

5.04 //

PLAN OF THE HOSPICE

HOSPICE

1.01 - 1.12	Patient wards, 30 m²
1.13 . 1.16	Guest room, 20 m²
1.17 - 1.20	Common room, cluster, 15 m²
1.21 - 1.22	Reflection room, 15 m²
1.23	Library, 53 m²
1.24	Hobby room, 53 m²
1.25	Landscaped atrium, 120 m²
1.26	Garden of senses, 80 m²
1.27	Living room, 79 m²
1.28 - 1.29	Nurses work station, 15 m²
1.30	Multi hall, 42 m²

THE SPINE

2.01 - 2.02	Technique room, 32 m²
2.03	Remote storage, 80 m²
2.04	Locker room, men, 20 m²
2.05	Locker room, women, 23 m²
2.06 - 2.07	Toilets, 36 m²
2.08	Medicine room, 15 m²
2.09	Archive, 15 m²
2.10 - 2.13	Conversation room, 10 m²
2.14	Spa room, 20 m²
2.15	Rehabilitation and theraphy, 18 m²
2.16 - 2.17	Nap room, 6 m²
2.18	Sluice room, 15 m²
2.19	Laundry and linen room, 25 m²
2.20	Near storage, 45 m²

ADMINISTRATION

3.01	Kitchen, 95 m²
3.02	Meeting room, 21 m²
3.03	Printing room, 15 m²
3.04	Coffee room, 31 m²
3.05	Open working area, 70 m²

DAY CARE CENTRE

4.01	Coffee room, 24 m²
4.02	Doctor office, 25 m²
4.03	Consultation room, 15 m²
4.04	Fitness, 60 m²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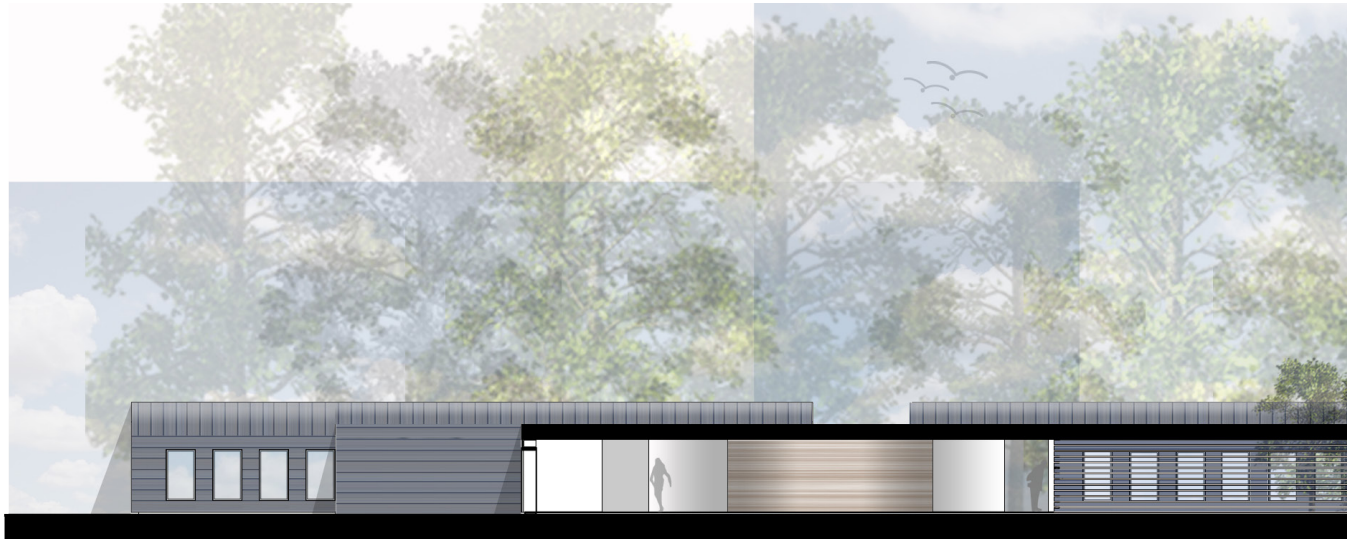
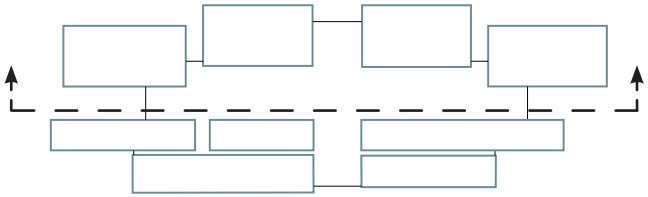
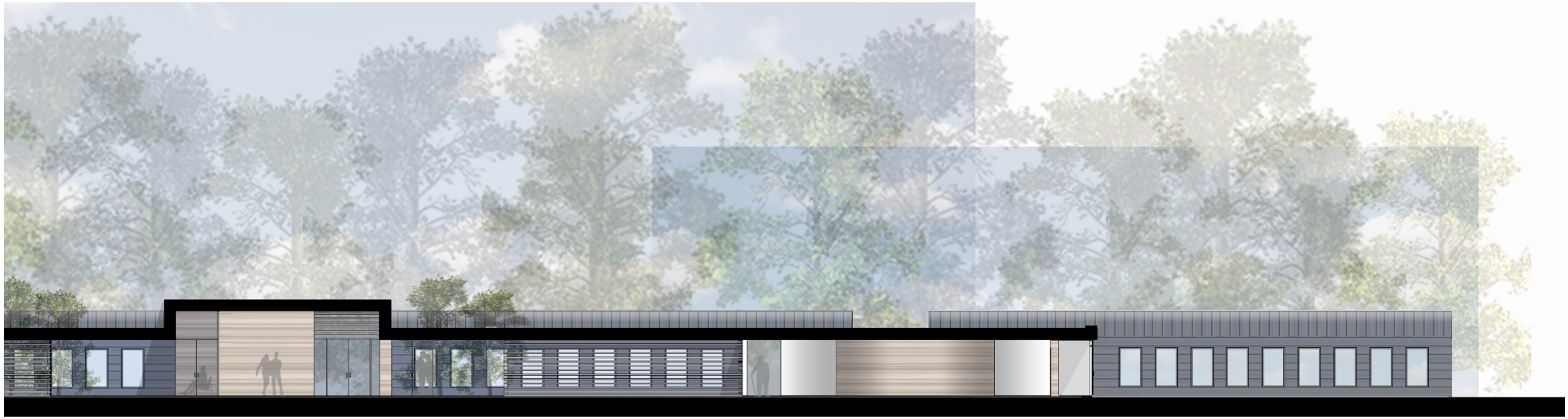
5.05 //

SECTION

This section presents the entire length of one of the main flow axes and illustrates how it is not possible to associate the long course of movement with traditional institutional hallways due to the several deviations in terms of natural light, air, green areas, materials and open spaces that encourage to social relations.





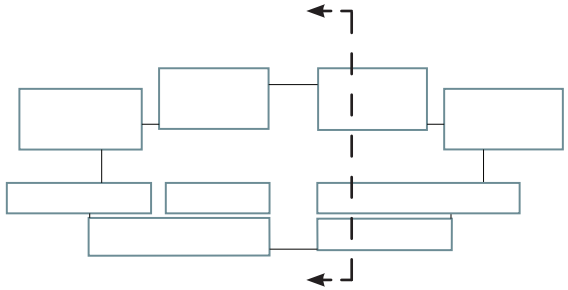


Section through the main axis

5.06 //

SECTION

The different layers and the hierarchy of the hospice are beautifully presented in this section. It is evident to trace the straight course and development of the functions within the rooms, which are enriched by the placed atriums that allow natural and relieving elements to penetrate into the building. The composition of the hospice is thereby enhanced both in plan, section and facades.



Section through the different layers of the hospice

5.07 //

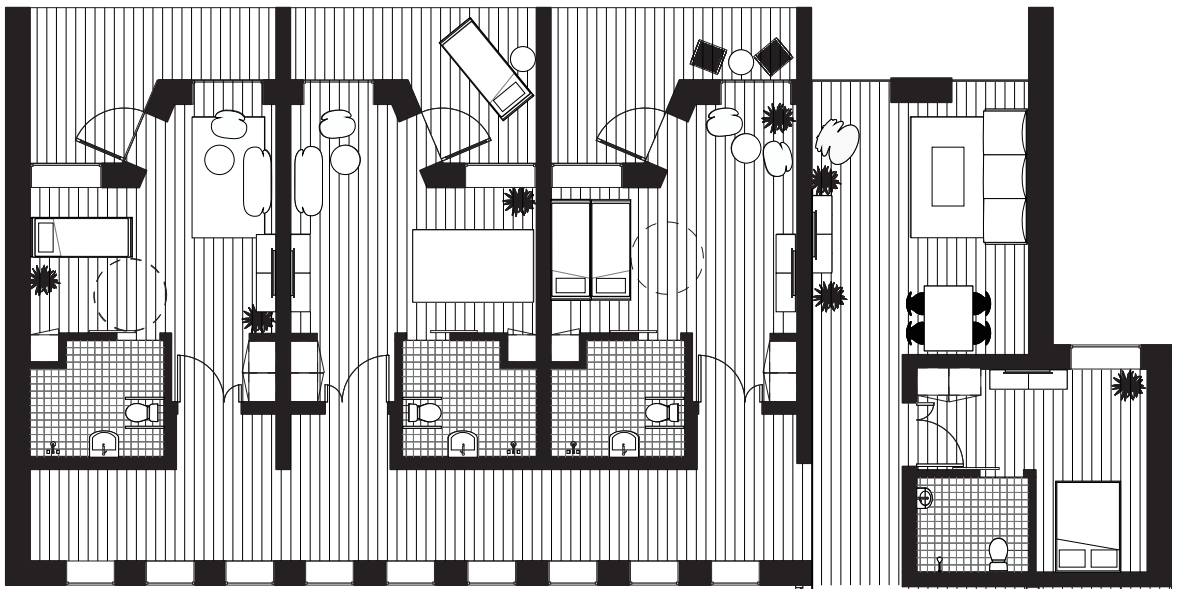
VISUALIZATION OF THE HIERARCHY

This visualization presents the complete view of the hospice. The hospice lies peacefully in the landscape and reveals the overall hierarchy, the aesthetical expression and architectural concept. It is an embodiment of the vision of creating a hospice based on the principles of Nordic and Healing architecture.

5.08 //

CLUSTERS

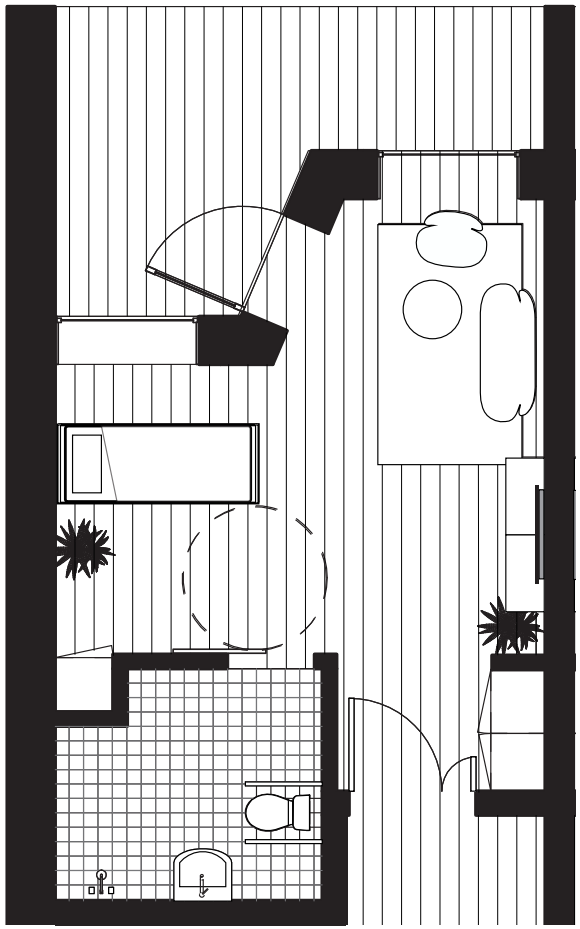
The plan of the clusters encourages and upholds close relationships both between patients, relatives and their interaction with the staff. The principle of a closer and more intimate connection is evident in the exterior as well. The clusters will be embraced and shielded under one roof, which emphasizes the functions within.



5.09 //

PATIENT WARDS

The patient wards are elaborated with a strong focus on the notion of zoning, both by the means of natural light, insight and view, which is evident in the plan and the visualization. The differentiation of spatial perception is balanced to the different needs of the patient within the different stages of illness. The patient wards will have a breath-taking view to the forest immediately when entering the room and thereby achieving a high level of stimuli.



5.10 //

REFLECTION ROOM

This room is a place for quiet contemplation for both patients and relatives. The room possesses several immeasurable qualities of light, serenity, spirituality, calmness and thoughts and having the possibility of neglecting all unnecessary disturbing factors. The different characters within the room make it possible utilize the graduation of the level of retraction.

5.11 //

MULTI HALL

The visualization presents one of the functions that can be assigned to the multi hall – Shrovetide. With the placement of the multi hall in the intersection of the two axes of the hospice gives the opportunity of utilizing it to such arrangements. It is envisioned how the multi hall can open up to the hospice and creating a gathering point. It will be possible for the patients to enjoy festive traditions with their families while still receiving the relieving care from the palliative team. Moreover can such arrangements be instrumental in breaking the unmentionable barrier of passing away.

5.12 //

ATRIUM

The atrium visualization presents the landscaped courtyard and how the concept of turning focus inwards is achieved. Due to the different characters of this atrium it is possible to stay within the more shielded roofed patio while observing and enjoying the calmness of the green lung in front of the wood stove on the long summer night. It is most certainly a hospice where you are still living and feeling life.

APPENDIX 6.0

6.01 //

VENTILATION IN PATIENT WARDS

This appendix presents the calculated air change rates for the patient wards.

In this project three different scenarios concerning the air change rate within the patient wards have been investigated in order to establish the most critical one. The different parameters are Temperature, CO_2 – concentration and the standards from the Danish Building Regulation respectively. During these calculations it will be possible to determine the dimensioning parameter according to air change in the patient wards.

CO_2 - concentration

The air change rate is found by using the rarefaction equation

$$c = \frac{q}{n * V} + c_i$$

Terms:
c = CO_2 concentration
q = pollution from people
n = air change
V = volumen
c_i = pollution in the inlet air

This expression is rewritten in order to isolate the air change when the acceptable amount of pollution in the patient ward is set according to category A and 810 ppm.

$$n = \frac{\frac{q}{V}}{c - c_i}$$

The air change then becomes

$$n = \frac{\left(\frac{0{,}019\,\frac{m^3}{h} * 1}{85\ m^3}\right)}{810\ ppm - 350\ ppm} * 1000000 = \underline{0{,}486\ h^{-1}}$$

As a further investigation and as a stress test for the BSim model, the air change rate is found for a scenario where the patient has a visit from three guests.

$$n = \frac{\left(\frac{0{,}019\,\frac{m^3}{h} * 4}{85\ m^3}\right)}{810\ ppm - 350\ ppm} * 1000000 = 1{,}944\ h^{-1}$$

Danish Building Regulation

$$n = \frac{0{,}3\,\frac{l}{s} * 30m^2 * 0{,}001 * 3600}{85\ m^3} = \underline{0{,}38\ h^{-1}}$$

Temperature

The air change is calculated for August, the most critical month according to temperature

$$n = \frac{\left(\frac{\emptyset_{i,døgn} + \emptyset_{sol,døgn}}{24\left(t_{i,m} - t_{u,m}\right)}\right) - H_T}{H_{v1}}$$

Terms:
n = air change
$\emptyset_{i,døgn}$ = internal heat gain
$\emptyset_{sol,døgn}$ = heat gain by sun radiation
$t_{i,m}$ = internal mean temperature
$t_{u,m}$ = outside mean temperature
H_T = Heat transmission
H_{v1} = Specific heat loss by ventilation

Temperatures:

$t_{i,m} = 24\ °C$

$t_{u,m} = 15{,}9\ °C$

Internal heat load

1,2 persons of 100W in 100%	= 120 W
Equipment (3,5W/m²)	= 105 W
Light (8W/m²) in 35%	= 84 W
SUM	= 309 W

Internal heat load for 24 hours:

$$\phi i, døgn = \left((1{,}2 * 100\ W) + \left(\left(8 \frac{Wh}{m^2} * 30\ m^2 \right) * 35\ \% \right) + \left(3{,}5 \frac{Wh}{m^2} * 30\ m^2 \right) \right) * 24 = 7416\ Wh$$

Solar radiation (24-hour average)

$$\phi sol = g * f_\beta * f_{shade} * f_{shadow} * f_{glass} * A_{win} * I_s$$

$$\phi sol, døgn = 0{,}5 * 0{,}9 * 0{,}9 * 0{,}6 * 0{,}9 * 9{,}05 * 1968$$

Total sum for 24-hours 11311,13 Wh

Heat transmission for windows and walls

$$Ht = At * U * (1 - b)$$

$$Ht, windows = \left(9{,}05\ m^2 * 1 * (1 - 0)\right) = 9{,}05 \frac{W}{°C}$$

$$Ht, walls = \left(10{,}09\ m^2 * 0{,}08 * (1 - 0)\right) = 0{,}81 \frac{W}{°C}$$

$$Ht, total = 9{,}05 \frac{W}{°C} + 0{,}81 \frac{W}{°C} = 9{,}86 \frac{W}{°C}$$

Specific heat loss by ventilation

$$H_{v1} = \delta * Cp * V * n$$

Terms:
δ = density of air
C_p = Specific heat capacity of air
V = volumen
n = air change

$$H_{v1} = 1{,}2 \frac{\text{kg}}{\text{m}^3} * 1005 \frac{\text{J}}{\text{kg°C}} * (85\ m^3) * 1\ h^{-1} = 102510 \frac{\text{J}}{\text{h°C}}$$

$$H_{v1} = \frac{102510 \frac{J}{h°C}}{3600} = 28{,}48\ \text{W/C}$$

The air change rate can now be calculated

$$n = \frac{\frac{7416 + 3895{,}13}{24 * (24 - 15{,}9)} - 9{,}86}{28{,}48} = 1{,}7\ h^{-1}$$

Based on these three calculations it is obvious that temperature is the most critical parameter and will thereby dimensioning the ventilation in the patient wards.

6.02 //

VENTILATION IN THE ADMINISTRATION

This appendix presents the calculated air change rates for the administration.

The previous calculations concerning the dimensioning parameters are repeated with the aim of establishing it for the administration as well. The administration is in this calculation defined as the same geometry as the previously reviewed BSim model, meaning the open office with 8 people working.

CO_2 - concentration

The air change rate is found by using the rarefaction equation

$$c = \frac{q}{n * V} + c_i$$

Terms:
c = CO_2 concentration
q = pollution from people
n = air change
V = volumen
c_i = pollution in the inlet air

This expression is rewritten in order to isolate the air change when the acceptable amount of pollution in the administration is set according to category B and 900 ppm.

$$n = \frac{\frac{q}{V}}{c - c_i}$$

The air change then becomes

$$n = \frac{\left(\frac{0{,}019\,\frac{m^3}{h} * 8}{236{,}6\ m^3}\right)}{900\ ppm - 350\ ppm} * 1000000 = \underline{1{,}17\ h^{-1}}$$

Danish Building Regulation

$$n = \frac{0{,}3\frac{l}{s} * 91 m^2 * 0{,}001 * 3600}{236{,}6\ m^3} = \underline{0{,}42\ h^{-1}}$$

Temperature

The air change is calculated for August, the most critical month according to temperature

$$n = \frac{\left(\frac{\emptyset_{i,døgn} + \emptyset_{sol,døgn}}{24\left(t_{i,m} - t_{u,m}\right)}\right) - H_T}{H_{v1}}$$

Terms:
n = air change
$\emptyset_{i,døgn}$ = internal heat gain
$\emptyset_{sol,døgn}$ = heat gain by sun radiation
$t_{i,m}$ = internal mean temperature
$t_{u,m}$ = outside mean temperature
H_T = Heat transmission
H_{v1} = Specific heat loss by ventilation

Temperatures:

$t_{i,m} = 24\ °C$

$t_{u,m} = 15{,}9\ °C$

Internal heat load

8 persons of 100W	= 800 W
Equipment (3,5W/m²)	= 318,5 W
Light (8W/m²) in 35%	= 364 W
SUM	= 1482,5 W

Internal heat load for 24 hours:

$$\phi i, døgn = \left((8 * 100\ W) + \left(\left(8 \frac{Wh}{m^2} * 91\ m^2 \right) * 35\ \% \right) + \left(\left(3{,}5 \frac{Wh}{m^2} * 91\ m^2 \right) * 50\% \right) \right) * 24 = 35580\ Wh$$

Solar radiation (24-hour average)

$$\phi sol = g * f_\beta * f_{shade} * f_{shadow} * f_{glass} * A_{win} * I_s$$

$$\phi sol, døgn = 0{,}5 * 0{,}9 * 0{,}2 * 0{,}8 * 0{,}8 * 7{,}6 * 2940$$

= 1287,0144Wh

$$\phi sol, døgn = 0{,}5 * 0{,}1 * 0{,}2 * 1 * 0{,}8 * 4 * 2940$$

= 94,08 Wh

Total sum for 24-hours =36961,0944 Wh

Heat transmission for windows and walls

$$Ht = At * U * (1 - b)$$

$$Ht, windows = (7{,}6\ m^2 * 0{,}8 * (1 - 0)) + (4m2 * 0{,}8 * (1 - 0)) \quad = 9{,}28\ \frac{W}{°C}$$

$$Ht, walls = \left(16{,}2744\ m^2 * 0{,}08 * (1 - 0)\right) \quad = 1{,}30 \frac{W}{°C}$$

$$Ht, total = 9{,}28\ \frac{W}{°C} + 1{,}30\ \frac{W}{°C} \quad = 10{,}582\ \frac{W}{°C}$$

Specific heat loss by ventilation

$$H_{v1} = \delta * Cp * V * n$$

Terms:
δ = density of air
C_p = Specific heat capacity of air
V = volumen
n = air change

$$H_{v1} = 1{,}2\ \frac{\text{kg}}{\text{m}^3} * 1005 \frac{\text{J}}{\text{kg°C}} * (236{,}6\ m^3) * 1\ h^{-1}$$

$$= 285339{,}6 \frac{\text{J}}{\text{h°C}}$$

$$H_{v1} = \frac{285339{,}6 \frac{J}{h°C}}{3600} \quad = 79{,}361\ \text{W/C}$$

The air change rate can now be calculated

$$n = \frac{\frac{35580 + 1381{,}0944}{24 * (24 - 15{,}9)} - 10{,}582}{79{,}361} = 3{,}05\ h^{-1}$$

Based on these three calculations it is obvious that temperature is the most critical parameter and will thereby dimensioning the ventilation in the administration.

6.03 //

INLET AND OUTLET

Following calculation aims to prove, that the big common area of the hospice, can be provided with the necessary air flow rate of 1773,432 m3/h by having openings for inlet and outlet on each 0,198 m2.

The equations being used has been introduced in 8. Semester attended course AZEC, conducted by Anna Joanna Marszal, assistant professor at Byggeri og Anlæg Aalborg University.

TERMS

P_w:wind pressure

C_p:wind pressure coefeccient,depend on the buildings orientation

ρ_u:density of air

k:wind speed profile according to type of terrain - open flat country

h: height of ceiling

a: wind speed profile according to type of terrain

P_i: internal pressure

A: area

C_d: discharge coefficient

Q: air flow rate

First and foremost the wind pressure on the facades, where the openings are being placed, is calculated:

$$P_w = C_p * \frac{1}{2} * \rho_u * v_{ref}^2$$

$$v_{ref} = v_{meteo,10} * k * h^a$$

$$v_{ref} = 6\frac{m}{s} * 0{,}68 * 2{,}6\, m^{0{,}17} = 4{,}799\, m/s$$

$$P_{w1} = 0{,}2 * \frac{1}{2} * 1{,}2\frac{kg}{m^3} * \left(4{,}799\frac{m}{s}\right)^2 = 2{,}76\, pa$$

$$P_{w2} = (-0{,}6) * \frac{1}{2} * 1{,}2\frac{kg}{m^3} * \left(4{,}799\frac{m}{s}\right)^2 = -8{,}29\, pa$$

From this calculation it is evident, that there is a pressure difference, which corresponds to the drive of natural cross ventilation. The inlet will be placed on the wind warded facade, while the outlet will be placed on the lee warded facade. The following step is to calculate the pressure difference across the openings, in order to allow wind in and out of the building.

$$\Delta P = P_w - P_i$$

The internal pressure in the building is:

$$P_i = \frac{1}{2} * \rho_u * v_{ref}^2 \left(\frac{A_1^2 C_{p1} + A_2^2 C_{p2}}{A_1^2 + A_2^2}\right)$$

$$P_i = \frac{1}{2} * 1{,}2\frac{kg}{m^3} * \left(4{,}799\frac{m}{s}\right)^2 * \left(\frac{(0{,}198\, m^2)^2 * 0{,}2 + (0{,}198\, m^2)^2 * (-0{,}6)}{(0{,}198\, m^2)^2 + (0{,}198\, m^2)^2}\right) = -2{,}76\, pa$$

$$\Delta P_1 = 2{,}76\, pa - (-2{,}76)\, pa = 5{,}52\, pa$$

$$\Delta P_2 = (-8{,}29\, pa) - (-2{,}76)\, pa = -5{,}53\, pa$$

The air flow rate can now be calculated:

$$Q = C_d * A * \sqrt{\frac{C_p * \rho_u * v_{ref}^2 - 2P_i}{\rho_u}} = \frac{m^3}{s}$$

$$Q_1 = 0{,}65 * 0{,}251\, m^2 * \sqrt{\frac{|0{,}2 * 1{,}2\frac{kg}{m^3} * \left(4{,}799\frac{m}{s}\right)^2 - 2 * (-2{,}76)\, pa|}{1{,}2\frac{kg}{m^3}}} = 0{,}494\frac{m^3}{s} = 1773{,}432\frac{m^3}{h}$$

$$Q_2 = 0{,}65 * 0{,}251\, m^2 * \sqrt{\frac{|(-0{,}6) * 1{,}2\frac{kg}{m^3} * \left(4{,}799\frac{m}{s}\right)^2 - 2 * (-2{,}76)pa|}{1{,}2\frac{kg}{m^3}}} = 0{,}494\frac{m^3}{s} = 1773{,}43\frac{m^3}{h}$$

The calculation proofs that the amount of air being let into the building are able to pass at the outlets.

6.04 //

BSIM ADMINISTRATION

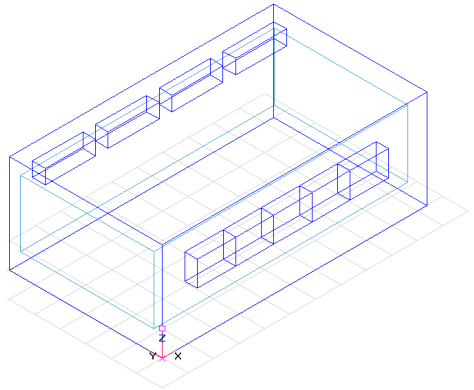
This section presents and clarifies the use of BSim in the administration.

Ventilation
- VAV-ventilation (variable air volumen) set to a supply of 0,036m3/s as a response to the minimum demand of 0,5h^{-1}, whereas the VAV max factor is set to 8, in order to make it possible to obtain a supply 8 times the amount if critical days.
- Setpoint indoor air: 22
- Setpoint cooling: 25
- Setpoint CO2: 850 ppm
- Schedule: all year

Person load
- 8 persons of 0,1 kW due to the higher activity level than the patient wards
- Day profile: 20% 1-7, 90% 8-16, 20% 17-24
- Schedule: all year

Equipment
- Heat load 0,4 kW
- Schedule: all year
- Day profile: 40% 1-8, 100% 8-16, 40% 17-24

Venting
- Basic air change 2 h^{-1}
- Max 7h^{-1}
- Set point 26
- Summer period maj-sep



Ill. 167.1 BSim model

Average air change →
CO_2 concentration →
Over heat →

ThermalZon	Sum/Mean	1 (31 days)	2 (28 days)	3 (31 days)	4 (30 days)	5 (31 days)	6 (30 days)	7 (31 days)	8 (31 days)	9 (30 days)	10 (31 days)	11 (30 days)	12 (31 days)
qHeating	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
qCooling	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
qInfiltration	-2591,32	-168,03	-155,84	-153,77	-124,83	-415,80	-295,23	-264,72	-274,29	-357,06	-102,52	-125,78	-153,45
qVenting	-105,48	0,00	0,00	0,00	0,00	-27,64	-20,18	-16,12	-15,87	-25,67	0,00	0,00	0,00
qSunRad	1314,08	42,33	85,40	119,48	163,13	160,12	147,65	149,11	143,91	125,61	90,50	50,89	35,95
qPeople	3241,20	275,28	248,64	275,28	266,40	275,28	266,40	275,28	275,28	266,40	275,28	266,40	275,28
qEquipment	2190,00	186,00	168,00	186,00	180,00	186,00	180,00	186,00	186,00	180,00	186,00	180,00	186,00
qLighting	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
qTransmissic	-3183,71	-428,29	-394,93	-382,32	-310,70	-176,71	-128,91	-117,64	-113,29	-167,89	-259,14	-313,13	-390,76
qMixing	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
qVentilation	-864,77	92,71	48,73	-44,68	-173,99	-1,24	-149,73	-211,91	-201,73	-21,39	-190,12	-58,39	46,97
Sum	-0,00	0,00	-0,00	-0,00	-0,00	-0,00	0,00	-0,00	-0,00	0,00	0,00	0,00	-0,00
tOutdoor me	7,7	-0,5	-1,0	1,7	5,6	11,3	15,0	16,4	16,2	12,5	9,1	4,8	1,5
tOp mean	22,8	22,2	22,3	22,6	23,2	22,7	23,4	23,7	23,7	22,6	23,1	22,5	22,2
AirChange/h	1,8	1,2	1,2	1,2	1,3	2,2	2,7	3,1	3,0	2,1	1,2	1,2	1,2
Rel. Moistur	40,9	33,2	30,6	32,3	34,4	39,1	49,3	53,6	50,6	50,4	42,2	40,7	33,9
Co2(ppm)	710,1	819,4	810,8	814,4	778,4	589,8	568,0	557,3	554,6	592,6	797,7	818,4	819,1
PAQ	0,3	0,5	0,5	0,5	0,4	0,4	0,2	0,1	0,1	0,2	0,3	0,3	0,4
Hours > 21	8760	744	672	744	720	744	720	744	744	720	744	720	744
Hours > 26	59	0	0	0	0	1	16	19	23	0	0	0	0
Hours > 27	23	0	0	0	0	0	5	7	11	0	0	0	0
Hours < 20	0	0	0	0	0	0	0	0	0	0	0	0	0
FanPow	791,29	55,86	51,82	56,37	59,51	60,07	84,60	101,63	97,27	55,72	58,50	54,06	55,88
HtRec	3930,38	602,23	559,79	523,20	379,62	227,87	106,81	63,58	68,52	183,75	264,43	410,10	540,50
ClRec	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
HtCoil	1085,24	224,56	183,38	107,51	25,57	135,73	30,12	3,43	13,85	103,65	3,51	78,03	175,92
ClCoil	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Humidif	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
FloorHeat	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
FloorCool	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
HeatPump	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
HeatPumpE	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00

Ill. 167.2 Key values

1.21 //

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