Nangijala

A Children´s Hospice

MA4-ARK19, June 2014 Ingunn Cecilie Hvidsten

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Summary

This project will address the design and function of a children's hospice located in Oslo, Norway. The focus will be on creating a facility that allows the patients and their families to spend their last time together in a homely and caring environment while still receiving care from qualified staff. To get a better understand the demands of such a facility, an investigation with references to healing architecture with focus on universal design will be executed. Alongside this investigation, analysis of the real true meaning of such a facility and what the best design for children are, will also be performed. As the hospice is located in Oslo, studies of Nordic architecture is required. The technical focus will be on creating a sustainable and energy efficient building.

A special thanks to:
Mary-Ann Knudstrup
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INTRODUCTION
Problem/Idea

During the past 30 years, developments occurring in the field of medical technology have been tremendous, with improvements and innovations prolonging the life of children suffering life limiting illnesses and conditions in many cases. (Grundevig, A., Pedersen, N., 2012) The extended lifetime given through health care improvements has highlighted the need for quality palliative care for children, especially in the last phase of their life.

A sick child requires constant care and nurturing, which normally takes place at a hospital. For the children and their families, the sterile environment of the hospital can cause distress, and for this reason, the need for spending the last time at home has increased. (regjeringen.no)

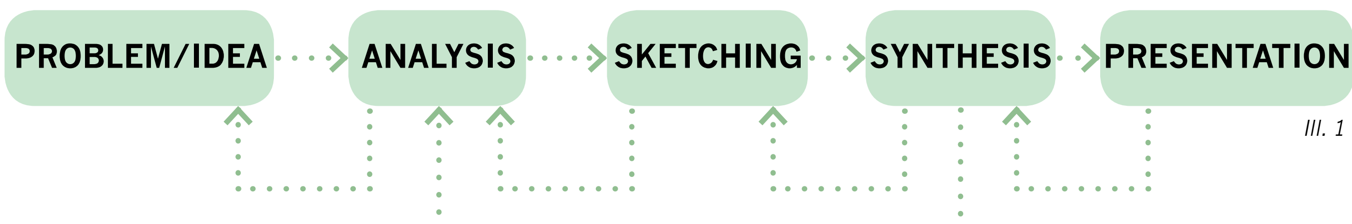
This increasing need for home-style care requires sufficient resources from the local health care centres, which in too many cases they are unable to provide. A solution to this problem is a hospice for children capable of offering qualified staff and equipment in a homely atmosphere. The children will receive good care, while the families will be provided with a support system, both during the child's illness and after. (barnepalliasjon.no)

The experience of children's hospices in other countries such as Germany and Great Britain has been positive. In spite of this, the development in the Nordic countries has been slow with only one children's hospice located in Scandinavia.

Lille Erstagården lies in Stockholm, Sweden. (erstadiakoni.se) The centre has been a success and an expansion is currently being planned although there is still a need for similar facilities in both Denmark and Norway. This project will therefore address the design of a children´s hospice in Oslo, Norway.

INTEGRATED DESIGN PROCESS

This project will follow the Integrated Design Process that has been taught at the Architecture and Design program at Aalborg University. This method combines the learning components from the fields of architecture and engineering. The process allows both fields to be present from the beginning of a project until the final design. This process has five stages, the *problem/idea, analyzing, sketching, synthesis* and *presentation stage*. The design process of the children hospice will follow these five stages, and the results of each step will be presented in the report. Since a design process is an unpredictable development, it will be necessary to continuously return to earlier stages, like the illustration demonstrates. (Knudstrup, M-A., 2004)



Ill. 1

ANALYSIS

Ill. 2

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CHILDREN´S HOSPICE

What is palliative care and a children´s hospice?

Ill. 3: Care from helth personel gives comfort

Ill. 4: Palliative care is for the whole family

Ill. 5: A children´s hospice gives joy to the childs last days

Palliative care is a part of the medical service provided to persons with life-threatening or life-limiting conditions. The service includes the physical, emotional, social and spiritual aspects of the illness, and the goal is to control the symptoms and to increase life quality. Adult´s and children's palliative care have many similarities, but there are certain key aspects that divide them. In this case, children refers to the age group 0-18 years old. For instance, a child's illness affects the entire family. The parents become the main caregiver, which in turn affects the siblings. Therefore, palliative care is introduced at the point of the diagnosis and is directed towards the whole family. (ill 3, 4, 5) (togetherforshortlives.org.uk). When a child reaches the point in the disease where the conditions goes from life-threatening to life-limiting, and it becomes clear that full recovery is not possible, the palliative care team begins to prepare the child and family on the forthcoming time. Information and support is provided to the families to help them to have a good and worthy end of the child's life. In most cases, the child will pass away in the hospital, although it is often desired by both the child and the family to spend their last days together at home. This wish is often difficult to fulfill for the hospitals, due to low capacity, and in most cases, parents cannot be home with their child without professional healthcare. (DH/CNO-D-CF&M, 2008). As mentioned, the solution to this issue is a children's hospice, which are created entirely for end-of-life care specialized for children. The purpose of such a hospice is to provide the children and their families with 24-hour health care and support from qualified staff in a homely environment. The families get the option to move in with the child, and the parents will also get assistance by the staff and the siblings are welcome to play in the common rooms. The aim of the hospice is to treat death as a natural part of life and give life to the child's last days. (Craft, Sir A., Killen, S., 2007)

CASE STUDY

Lille Erstagården
Sweden


Ill 6: Every room has their own outdoor space.

As mentioned in the introduction, Lilla Erstagården is the first and only children´s hospice in Scandinavia. The facility was finished in 2012, and is situated in Stockholm, Sweden. The purpose of this building is to offer children; mainly from 0 -18 years old with life-limiting conditions, and their families, a place to be together with a 24-hour care system for the final phase of the child's life. The staff mainly consists of pediatricians, primary nurses, nurturing nurses, physiotherapists, councilors, music therapists, a deacon and a clown. At Lilla Erstagården there are five rooms where the families can spend time together, but the center also provides relief for severely handicapped children. (erstadiakoni.se) The hospice has been well received, and the upcoming expansion is to be designed by Reflex architects. The new hospice is to be located in Nacka, surrounded by nature, which can be accessed by wheelchairs and sickbeds. It contains seven two-room units with individual bathrooms. The units are separately and playfully arranged, with the goal of creating an intimate atmosphere. The design use wooden cladding and colors to create a sense of homeliness, as showed in ill. 5. (reflexark.se)

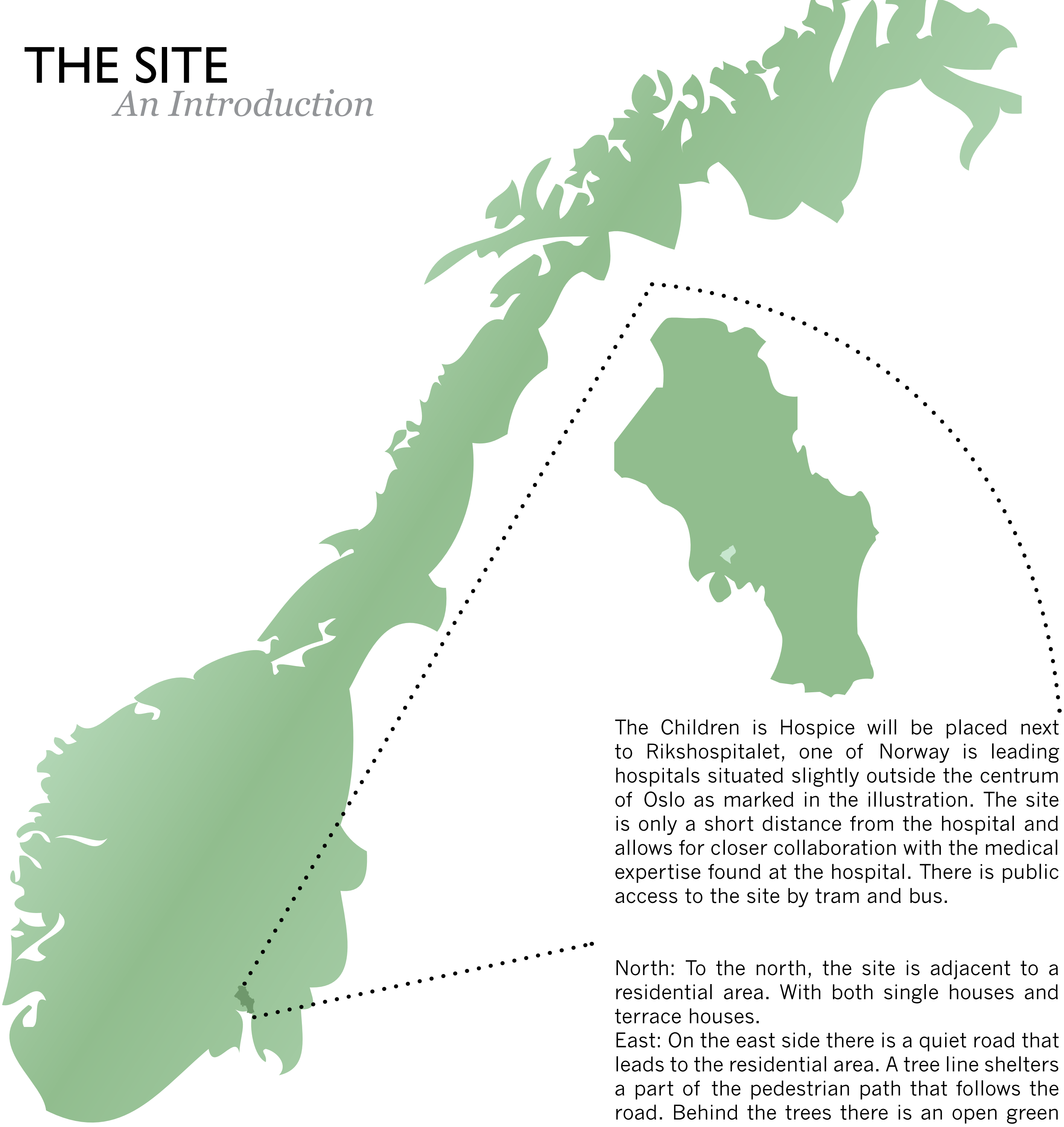
Robin House
Scotland

The Robin House is the second children´s hospice built in Scotland, after the Rachel house, and it opened in 2005. The design is created by Gareth Hoskin Architects, and it was especially built for its purpose. (garethhoskinsarchitects.co.uk) The house accommodates eight families, who have their own rooms, and a variety of common facilities; a library, different play areas (ill. 6), hydrotherapy pool and a quiet room. There is also a common kitchen and a dining area. The house is located outside of Glasgow, and the house utilizes the surrounding nature by having large glass windows and a courtyard, displayed in ill. 7. The bedroom units are situated in two wings facing the south to maximize the daylight and the view. A ribbon roof over the foyer and day spaces defines the architecture. (chas.org.uk)


Ill 7: The play area.


Ill 8: Open outdoor space.

THE SITE
An Introduction



Ill 9

The Children is Hospice will be placed next to Rikshospitalet, one of Norway is leading hospitals situated slightly outside the centrum of Oslo as marked in the illustration. The site is only a short distance from the hospital and allows for closer collaboration with the medical expertise found at the hospital. There is public access to the site by tram and bus.

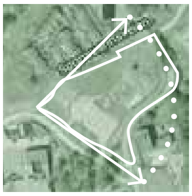
North: To the north, the site is adjacent to a residential area. With both single houses and terrace houses.
East: On the east side there is a quiet road that leads to the residential area. A tree line shelters a part of the pedestrian path that follows the road. Behind the trees there is an open green area that leads to a residential zone.
South: South of the site are the hospitals Rikshospitalet and Gaustad hospital. There is also a kindergarten for the local children, which is sheltered from the site by a building associated with Gaustad hospital.
West: The west side opens up to a green area with many threes and walking trails.

Ill 10. The site.

The most common access to the site is from the highway and up beside Rikshospitale. The residence at the hospice will access the building site from the north, which lets them drive around the site and examine the building before they enter.

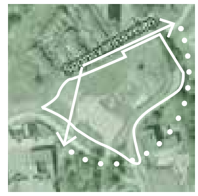
THE SITE

Contextu al Surrounding



Ill 11

Ill 12



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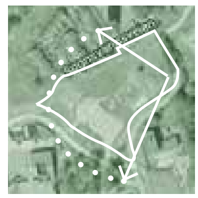


Ill 14

Ill 15

Rikshospitalet has a lighter color bricks, and the white wooden shutters help create a lighter look. The building is located behind a small hill, seen form the site, which prevents the building from being dominant in the landscape. The older brickwork in the Gaustad hospital has a darker tone. The red color combined with the dark wooden shutters, along with the angular shape, gives the building a heavy appearance.

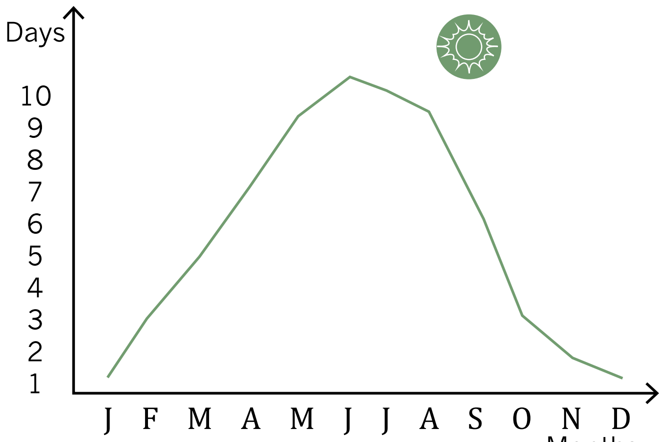
Ill 16

The residential area consists of detached houses, and terrace houses. The main cladding material is wood, painted in different colors.

Ill 17

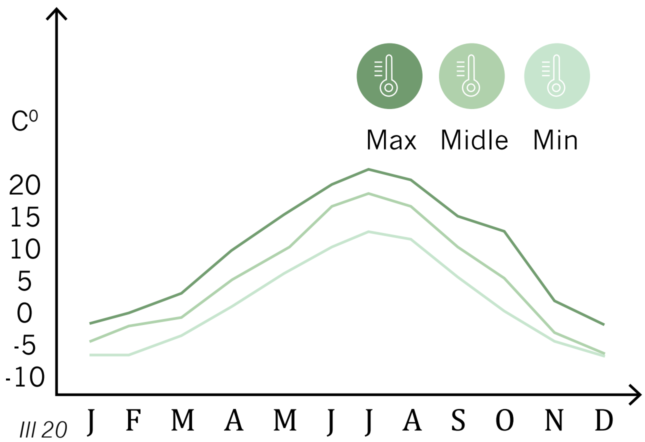
The few trees on the site are deciduous trees. The pedestrian pathway that goes alongside the road up to the residential area situates them. The threes in the park area consist of a combination of conifers and deciduous trees.

THE SITE
Climate



Ill 18

Ill 19



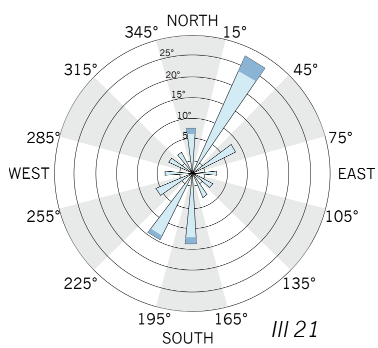
Ill 20

Sun

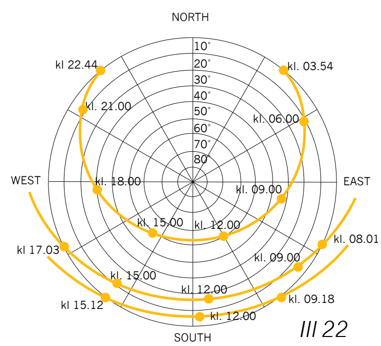
There is little around or on the site that can shield the hospice from the sun. The building therefore has good opportunities to utilize the sun for passive heat gains. The low altitude of the sunrays in the wintertime allows the sun to penetrate far into the building, see ill. 20. In the summer, there is a risk for overheating, and blinds can be necessary to create shelter from the sun. PV cells can be a means to exploit the solar energy.

Wind

The dominant wind direction on the site is from the north in the winter months and from the south in the summer months, sees ill. 19 and 21. Being able to utilize the wind is an important factor in sustainable design, in order to create natural ventilation. The placement of the windows is important, considering a risk for low buoyance in the summer. The windows must therefore be placed to. It is important to remember that the building can function to shelter the outdoor areas.



Ill 21



Ill 22

Monthly normals in the period 1961-1990

Direction	NNE	NNE	NNE	NNE	SSE	SSE	NE	NNE	NNE	NNE	NNE	NNE
Month	J	F	M	A	M	J	J	A	S	O	N	D

Monthly normals in the period 2004-2013

Ill 23

HOME
What is a home?

“A home is created while you live in it”
Mark Vanchers, anthropologist, (Vancher, M. 2010, p. 13)

Although the term “home” is often used, it is a complex word with many facets. People refer to their home country, their hometown or their childhood home. The common association is that the word often has a positive connotation. When talking about a home, in the sense of a building, the building itself serves as a frame around everyday life and contains the objects the inhabitants use during their day. The building and the persons live in a symbiosis where there is a mutual influence. When the person changes the building, the building also changes the person. The person begins to associate the house and its objects with emotions and memories. The house is transforming into a home. (Coolen, H. 2009) In today´s society the home is left in the morning when the family goes to work or school, only to be returned to after a days work. The home is perceived as a retreat from the outside world. Here the families are not employees or students, but they are allowed to be individuals. This in combination with a familiar surrounding creates a stress-relieving environment. (Coolen, H. 2009) When a family goes through something so distressing as a life-limiting sickness among their children, the importance of being in a familiar and non-stressful environment where they are allowed to cope in their own way is extremely important. When the end of the sick child´s life is approaching, the family can feel the need for professional support. Therefore, it is important that the family is allowed to bring objects that they connect with home, like the child´s toys, ill. 26. This will be a way of creating a sensation of being home.

Ill 24: Example of object filled with emotion.

NORDIC ARCHITECTURE

Ill 25: Tautra Mariakloster by Jensen & Skodvin Arkitekter

Ill 26 Ill 23: Art instalation by Grafton Architects.

Ill 27: Nordic pavilion by Sverre Fehn.

Ill 28 Ill 25: Naust på Aure by TYIN Architects.

The harsh climate in the Nordic countries generally causes the inhabitants to spend a majority of their time indoors. This is reflected in the architecture. The ordinary home has been treated as an important piece of architecture and been given considerations in line with major public institutions. (Lund, N. 2008)

Nature has always been rooted in the Norwegian identity, which can explain the sensitivity toward the context in which the building lies, as seen in ill. 24. The architecture is described as natural and authentic, with a focus on honesty in the use of material and structure as in the building by Tyin architects, ill. 25. The design has a tectonic approach with a focus on the poetry of the detail, as seen in the roof construction in ill 22, where wood is the most common building material, especially when it comes to private housing. (Lund, N. 2008)

In the northern parts of the world, illumination changes astoundingly during the seasons. The long summer days offer a low slant of sunlight that casts long shadows and lasts long into the night. In the short winter days, however, the sun barley glimpses over the horizon. The ever-changing weather filters the sun through clouds and creates a subdued light. These dramatically different daylight conditions have made light a focal point in the Nordic architecture, ill. 23. (Plummer, H. 2012)

HEALING ARCHITECTURE
Universal Design

"Universal design is the design of all products and environments to be usable by all people, to the greatest extent possible, without the need for adaption" *Ron Mace, architect (Ryhl, C. 2012, p. 14)*

This investigation of healing architecture has taken the publication "Helende Arkitektur" by Frandsen, A. Et al., as its point of departure, which discusses the influence of architecture in a healing environment. The publication does not state that architecture itself have the power to heal, but that the building´s design can promote and improve a healing environment, through the atmosphere and quality of the building. In order to provide a healing environment that can be accessed by all, the building must be universally designed. This examination will therefore inspect how the elements of healing architecture can be utilized in order to make the building available for different kinds of disabilities.

Light

Light is the source of life, and a means of healing. Studies documented in the report "Helende Arkitektur" show that exposure to light helps, and prevents depression and can shorten recovery. The solar energy can lead to fewer mistakes among health care staff. Children in health care facilities often have problems sleeping, and a sufficient exposure to daylight during the day can help create a healthy circadian rhythm. A good daylight factor is advantageous for people with visual impairments, which large windows can provide, as seen in the kindergarten illustrated below, where colors have been added to the window frames, ill. 27. It is, however, also important to consider glare and overheating when positioning the windows. The possibility to control one´s environment is important for the self-esteem and the perception of the room. There should therefore be possible to control the light exposure from the sick bed.

Art

Arriving at a health facility can be frightening and distressing for the children, as well as for the rest of the family. Apart from creating a homely and friendly atmosphere, art and art installations can help create distractions and promote fascination among the children. The possibility to display art in the hospice should be incorporated from the beginning of the design process, in order to get the best result. A play with color and materials could not only lighten up the facility, but also serve as an easy way to navigate through the building. Bright colors can make it easier for sight impaired, but can also seem overwhelming for people with normal vision. (Frandsen, A. Et al., 2009)

Sound

The sense feeling of privacy and safety often derives from sounds, or the absence of sounds. When a patient can overhear or be overheard by others, it is difficult to have a confidential conversation, and the person may feel unsafe. Sound disturbances during the night can be interruptive and cause sleep deprivation. A high sound level in the facility may affect the staff´s consentration and routines. Acoustic deliberations must be integrated in the design from the beginning of the design process. But sound can also have a positive effect. Music can be calming and distract the children from pain. It is therefore a good idea to involve music during therapy. Long reverberation time can cause problems for hearing impaired. It is beneficial to take this into consideration when determining the material. (Frandsen, A. Et al., 2009)

Ill 29: Kindergarden in Spain by LosdelDesierto Architects.


Ill 30: Example of acessible playground.

Air
The air affects us through temperature and smell. Terminally ill children have an impaired health, and drafts and low temperatures can worsen their condition. One of the characteristics of a hospital is the smell. A hospice should as far as possible avoid resemblance to an institution, and it is therefore essential to have a good ventilation system to prevent bad odors. The choice of materials should reflect this. Materials should be easy to clean and not obtain scents. (Frandsen, A. Et al., 2009)

Movability
It can be difficult to orientate in an unknown building and this creates an uneasy feeling. When the aim of the building is to create a homely and friendly atmosphere, it is then necessary that the navigation is easy in he building. Studies show that it is easier to navigate a simple floor plan than a complex one. It is also easier to navigate through signs, but this can create problems for people with impaired vision. Here different use of material can be used, which can also be a means to create texture and atmosphere in the house. Movability is made easier if the building is built in one level, without stairs or levels. Customized features, like custom made toilets for children and a reception desk in two different heights can improve the usability of the house, both for adults and children (Frandsen, A. Et al., 2009)

Common Space
In a medical facility, especially a Children´s Hospice, different types of socialization demand´s different types of space. There is a necessity for open social spaces where people in similar situations can meet and support each other. However, the family also requires private time. The time spent in a hospice is often difficult and many, also the staff, need a place where they can reflect in solitude. The children, both the sick child and the siblings, should be offered their own playrooms rooms. Here the ill children should be able to play with their siblings, if their conditions allow it. (Frandsen, A. Et al., 2009)

Recreational Areas
Gardens have proved to decrease stress and improve the well-being for patients, families and staff in medical facilities. Garden stimulate all the human senses and are a place where people can come together on equal terms. Different types of vegetation will ensure that there is always something beautiful to look upon, and spruce trees covered in snow create interesting sculptures. Surrounding the hospice by a garden, which is easy to view and access, will motivate the inhabitants to use it. This will improve their social environment. Different zones should encourage different activities. To be accessible, the pathways must be level and wide enough to fit wheelchairs and sickbeds. Heating and lighting along the path will make the garden possible to use during the year. Benches and overhang will encourage quiet reflections, while a playground will appeal to the children. The playground should contain swings and slides that can be used by less mobile children, see ill.28. The playground could also be used by the neighboring children and create an entertaining view from the inside. A fireplace is a way to create a social outdoor meeting place where the family can meet while barbecuing. (Frandsen, A. Et al., 2009)

DESIGNING FOR CHILDREN

Ill 31:Children playing on the floor.

Ill 32: Niches to hide in.

When a building is to be designed with special attention to children and young adults, it is important to understand how children perceive their surroundings. Children see the world from a lower angle than adults, and they spend large portions of their time playing on the floor as illustrated above, ill. 29. This makes it natural to heat the house with floor heating, to make sure the children are warm and comfortable. As the children are on the floor it leads to over 50 % of the room are over their head and are empty. Sound can therefore uninterrupted travel across the room and create noise. There are three types of noise: air borne noise, impact noise and flanking noise. To avoid a noise level that can lead to headache and agitated children, the buildings must be formed to create beneficial acoustics.

The sense of touch is especially vital to children, particularly for children with disabilities, where other senses may not be so prominent. Different use of materials can create a tactile experience for the children. The use of color can also affect the experience of the room, ill. 31. Younger kids tend to prefer bright colors, while older kids and teenagers like a more somber color pallet. Apart from setting the mood, the colors can be a guide to different zones in the house. Natural light is important for children as well as adults. The children would benefit from having the windows placed low on the wall, to be able to see out, or be able to climb up to the windowsill, ill. 30. A sitting place in the window creates a good outlook for the child.


Ill 33: Windows in childrens height.


Ill 34: Colorfull interior.

It is important that the children feel included in all parts of the house, not only in the assigned areas. Small private spaces can be created, so especially shy children can withdraw and have an opportunity to reflect on their feelings and their inner turmoil, holes in the wall can be a good hiding place as seen in ill.32. The kitchen is often considered the heart of the house. Ramps alongside the kitchen tables can be a means to involve the children when the food is prepared.

The house needs to build to suit small children, but at the same time it is important not to overlook the older children and teenagers. The teenagers should be given their own space, where they can watch TV, play music or video games. It is important to create an inclusive environment for this age group as well. If the whole house has a particularly childish look, it can make them feel like they are not respected as the young grown ups that they are. (Dudek, M., 1996), (Rui Olds, A., 2001)

THE LAST STEPS

This text is based on article “Den døende Pasient” in the magazine Tidsskrift for den Norske Legeforening and the master thesis “Stemningsrummet, om det at dø” by Stine Maria Louving Niessen.

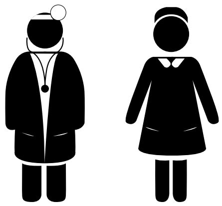
When the end of life is approaching, there are certain recognizable stages that a person goes through. After a long-lasting illness a person´s general condition is impaired. The need for sleep increases and the physical ability is weakened, which makes the patient stay in bed the majority of the time. The environment seems less important and the consciousness veils and the family will get less response from their child. The child slowly pulls away from life and the ability to orientate is reduced which can lead to occasional confusion. In the end the interest for nutrition is impaired.

The last stage, as described in the above, can be short or last over several days or weeks. During the process, the patient can experience anxiety, agitation, vomiting, depending on the disease and the medication.

To be in this situation is a great stress for the family. To take care of the child around the clock will wear the parents out, and it is therefore important that they can withdraw for shorter periods of time, either with the healthy siblings or by themselves.

For the family, the sorrow can, after a while, change their perception of life add additional depth to our existence or in other cases the sorrow lingers and can manifest and turn into prolong illness. It is therefore important that the family is looked after, is prepared and is given the necessary information during the process. After the child has passed away, there must be room to support the family and provide the help they need. (Nielsen, S.M.L 2013)
(Hofacker von, S., Paulsen, Ø., Kosland, J. H., 2006)

THE USER GROUP



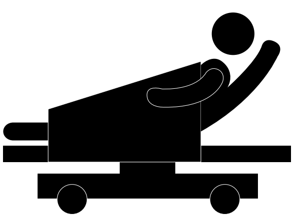
Ill 35

Staff
The work environment of the staff is team based and divided into four teams. The caregivers always consists of at least one nurse per child on duty. The palliative team consists of a pediatrician, a psychologist and a physiotherapist. This group visits the house during the day and has appointments with the child or the family. Beyond this there is a team of volunteers and an administrative leader. The closeness to Rikshospitalet, one of the major hospitals in Norway, creates an opportunity to chair knowledge and exploit the expertise that exists here. The proximity to the hospital will ensure that regular and familiar personnel treat the child.

The facility has to offer a good working environment for the staff. A focus must therefore lie in creating sufficient office spaces with meeting rooms and social areas where the staff can come together. Quiet zones must also be designed, so the staff can get some rest and have an opportunity to reflect over a possibly difficult day. (Based on interview of institution leader Sonja Wiencke Welde at Stabekk Hospice for adults).

Ill 36

Family
A conversation with a couple who lost their son to cancer when he was two years old provides an insight to how the last phase is experienced by those involved. They were provided with their own room at the hospital, which they could use when they wanted to and they appreciated the safety that the close by staff provided. Predictability was created when they were told how the last phase would be. The couple had contact with the same staff through the process, and was able to establish a personal relationship with them. The common facilities in the hospital were a means to get in contact with other families in the same situation. (Interview of Rasmus T. Gjestland and Sissel Thorud)



Ill 37

Children/Youth
The children that will be received at this hospice are 0-18 years old. To be a relevant candidate they must belong to one of the four categories establiched by A Guide to the Development of Children´s Palliative Care Services, by ACT, an organization working for children´s palliative care in The UK (Chambers, L., 2009)

- Life-threatening conditions, where the child is going through treatment, but where the treatment may fail.
- Conditions where an early death is inevitable, but where the child can have undergone long periods of treatment in order to prolong life.
- Progressive conditions where there is no available treatment, except palliative treatment that can be given over a number of years.
- Irreversible, but not progressive illnesses that are complex but where there is no healing treatment. This group often has an excessive need for health professionals, since complications and an early death are expected. (Chambers, L., 2009)

ROOM PROGRAM

The hospice will be a place for terminally ill children and their families to stay during the last part of the child´s life. The facility is to offer apartments, both for larger and smaller families. The staff has their own office space, and there are rooms dedicated for therapy. Patients, families and staff can meet in the social spaces. The room program, with its functions and square meters is to be seen as an initial room program to be used in the sketching phase.

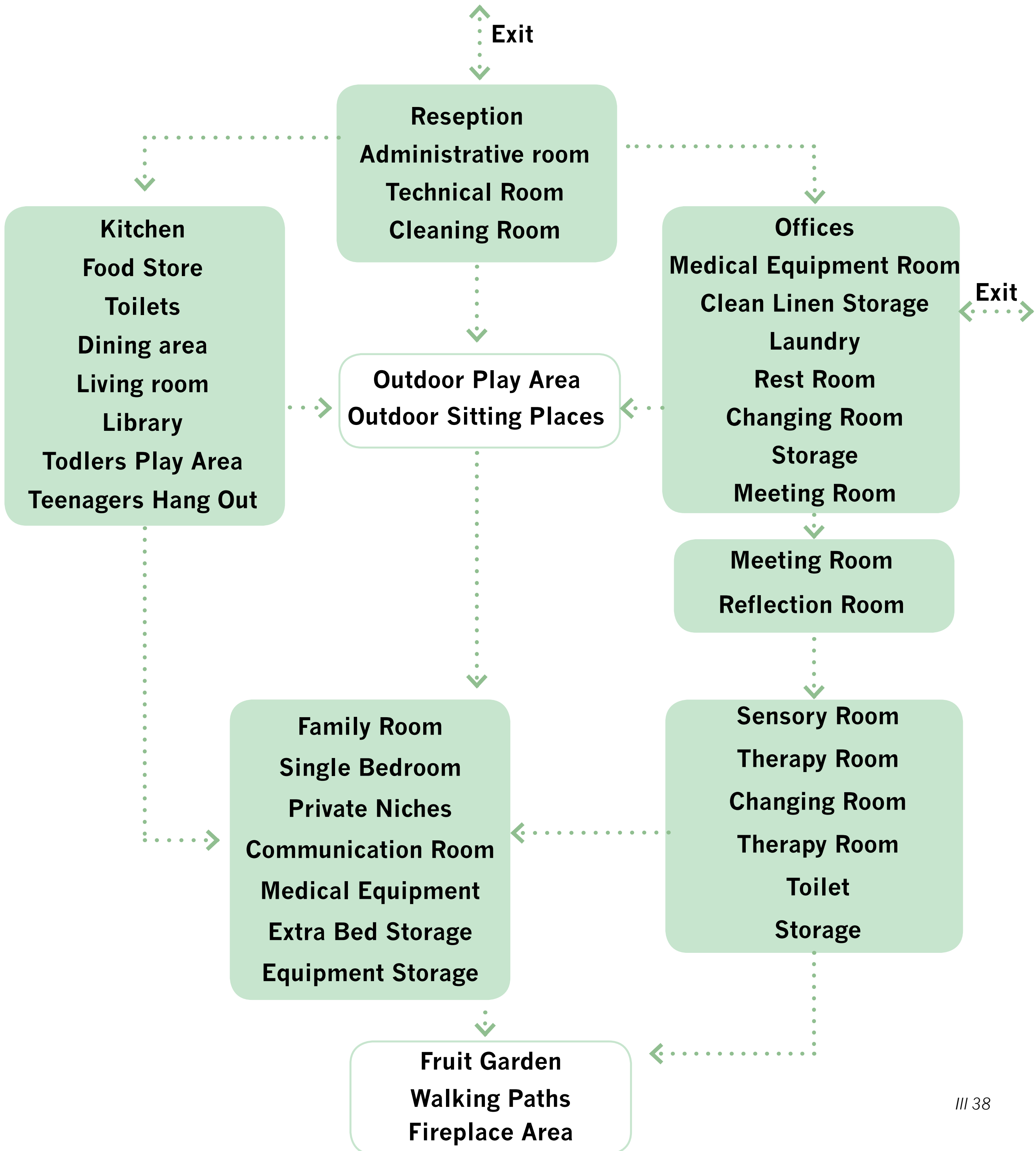
The program is based on information and help from Ja til lindrende enhet og omsorg for barn og International Children's Palliative Care Network (www.barnepalliasjon.no)* and Realdanias Program for det gode hospice. (www.realdania.dk)

Name	Nr.	SQM	Description	Atmosphere	Outdoor Access	Day light	Privacy	View
Reseption	1	10m²	Reseption desk	Welcoming	√	■■■		■■■
Administrative Room	1	15m²	Store records, office for administrative leader	Comfortable		■■	■■■	■■
Cleaning Room	1	5m²	Storage of cleaning equipment	-			■■■	
Technical Room	1	30m²	Easy access	-			■■■	
Meeting Room	1	15m²	Staff/parent meting, sofa, table, screen	Unformal, homely, safe	√	■■	■■■	■■
Reflection Room	1	25m²	Spiritual room, roof for reflection, viewing room	Sacred, quiet, calm, safe	√	■■	■■■	■
Kitchen	1	12m²	Kitchen fasility, equiped for children and disabled	Homely, organised		■■■		■■
Food Storage	1	5m²	Fridge, Freezer	-			■	
Dining Area	1	25m²	Place for stafe and families, parties	Energetic, social	√	■■■		■■■
Living Room	1	40m²	Sofas, tables, toys, fireplace	Homely, friendly	√	■■■		■■■
Library	1	15m²	Place to read and relax	Homely, quiet		■■	■	■
Toilets	4	15m²	Disabled toilets	Homely			■■■	
Toddlers Play Room	1	15m²	Toys, cuddle areas	Homely, energetic	√	■■■	■	■■■
Teenage Hang Out	1	15m²	TV, music, games	Modern, homely	√	■■■	■	■■■

*The information comes from a non published document.

Name	Nr	SQM	Description	Atmosphere	Outdoor Access	Day light	Privacy	View
Sensory Room	1	12m²	Stimulates the senses	Comfortable, relaxing, calm		■	■ ■	■
Therapy Pool	1	40m²	For children and family	Calming, relaxing		■	■	■
Changing Rooms	1	15m²	Suited for disable	Calm			■ ■ ■	
Toilets	1	8m²	Disabled toilets	Homely			■ ■ ■	
Therapy Room	1	15m²	Music therapy, physiotherapy	Relaxing, calm		■	■ ■ ■	■
Offices	11	40m²	For nurses, doctors and therapists, open office space	Organised, comfortable		■ ■ ■	■ ■	■ ■
Storage	1	5m²	For therapist equipment	-			■ ■ ■	
Meeting Room	1	15m²	Staff meetings or parents meeting	Unformal, homely, safe		■ ■	■ ■ ■	■ ■
Rest Room	1	10m²	Bed, chair, sofa			■ ■	■ ■ ■	■ ■
Changing Rooms	1	8m²	Lockers, toilet, showers				■ ■ ■	
Laundry	1	15m²	Washing machines, dryers				■ ■ ■	
Clean Linen Storage	1	5m²	For clean linen				■ ■ ■	
Medical Equipment Storage	1	10m²	For medicine and medical eqipment, extraction for antibiotics, keet cool				■ ■ ■	
Family Room	4	35m²	2 rooms, bathroom, sickbed, 3-4 beds, sofa, tv, storage for medicine	Homely, relaxing, unformal. safe	✓	■ ■ ■	■ ■ ■	■ ■ ■
Single bedroom	4	20m²	Sick bed, 1-2 bed, sofa, tv, storage for medisine	Homely, relaxing, unformal. safe	✓	■ ■ ■ ■ ■	■ ■ ■ ■ ■	■ ■ ■ ■
Private Niches	2	5m²	Unformal meetings, sitting place	Safe, cheltered		■ ■	■ ■ ■	■ ■
Communi-cation Room	1	10m²	Sofa, tables, screen	Unformal, homely, safe			■ ■ ■	
Extra Bed Storage	1	10m²	Extra bed or furniture				■ ■ ■	
Equipment Storage	1	10m²	Weelchairs, lifts					

ROOM RELATION DIAGRAM



III 38

ENERGY DEMANDS

The technical aim for the hospice building is to be a low energy house with sufficient indoor climate and good acoustics. The building will follow the Danish building regulations for a residential building, because of the continuous occupancy of the house. The Norwegian building requirements are lower than the Danish, and there will therefore be a greater challenge to meet the Danish standards.

Energy class
The building will follow the energy demands of building class 2020, which states that the total energy consumption for heating, ventilation, cooling and warm water cannot exceed 20 kwh/m^2 pr. Year. (bygningsreglementet.dk)

Indoor Environment
The term indoor climate include the thermal conditions, the lighting conditions, the air quality and the indoor acoustics.

Thermal Conditions
The thermal conditions consider the temperature inside the building, and how the use of materials, window area, sun shading, cooling and orientation of the building affects the indoor temperature, and ensures there is no overheating in the summertime. The thermal conditions will be constructed to comfort class I, which refers to a high level of expectations from the users and is recommended for disabled and sick persons and children. The comfort class relies on a temperature of 21-25 C0 in the wintertime and 23,5-25,5 C0 in the summertime according to DS/EN 15251. (bygningsreglementet.dk)

Lighting Conditions
The size of the windows and their placement must be adapted to the room´s size and use. Luminance in the different rooms is following the standard from DSEN 15251, but aims to have minimum 200 lux. (bygningsreglementet.dk)

Air Quality
The air quality is affected by the ventilation systems (CO2) and the inside pollution (smell, Olf) and the temperature. Both natural and mechanical ventilation along with the material use will be used to create a good indoor air quality. The air quality will follow the standards from DSEN 15251. (bygningsreglementet.dk)

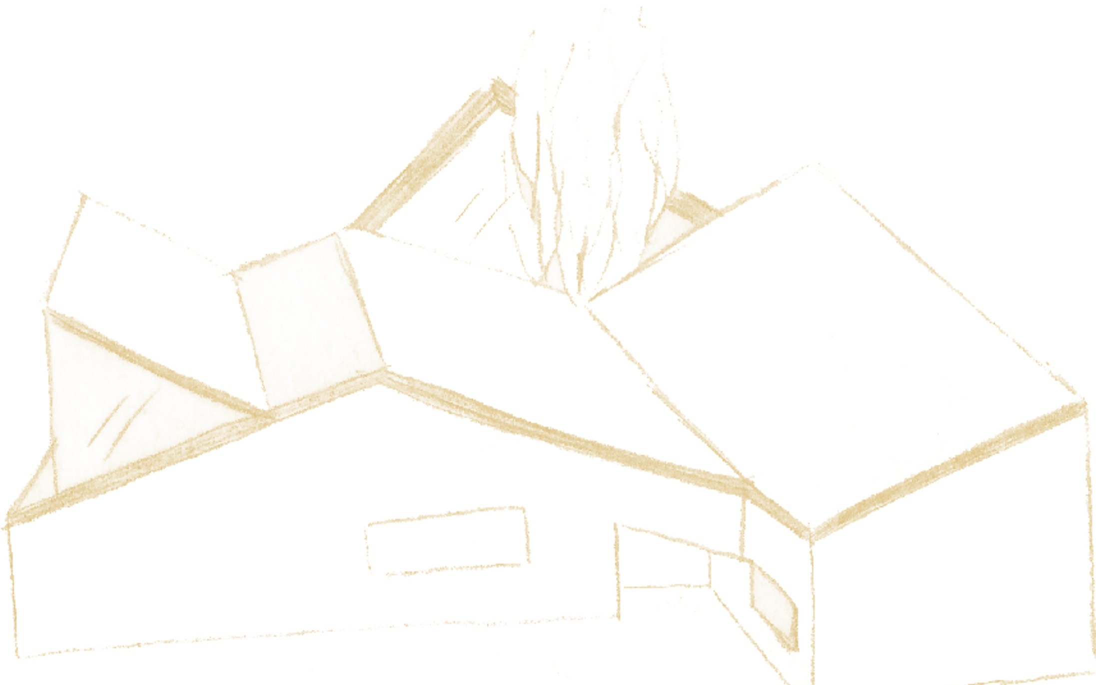
Acoustic Conditions
The hospice contains many rooms that are meant for relaxation and a calm atmosphere. The shape of the building interior and the use of materials will therefore have a decisive effect on the indoor acoustic conditions. With regards to acoustic quality, the standards in DSEN 15251 will be used as a point of departure. (bygningsreglementet.dk)

DESIGN PARAMETERS

• Create functional and flexible living units, where the family can feel at home.
• Create private/public, open/closed spaces throughout the building.
• Facilitate spaces and functions that can promote life add joy to the children´s life.
• Utilize the natural daylight and the materials to create a safe and homely atmosphere.
• Create a building that is accessible for professional staff, terminally ill children and their families.
• Create a sustainable low energy building according to the demands of the Danish building regulations 2020.
• Exploit the natural forces on the site in order to create natural ventilation and passive heat gain.
• Create a building on one level in order to ease the accessibility for the disabled.
• Create a roof that holds an interest for the children when they lie in their beds or are pushed in their wheelchairs.
• Create a building with a light and comprehensible appearance.

VISION

To design a children´s hospice, situated in Oslo, Norway, that is able to offer palliative care and comfort for terminally ill children and their family in a safe and homely environment.



SKETCHES

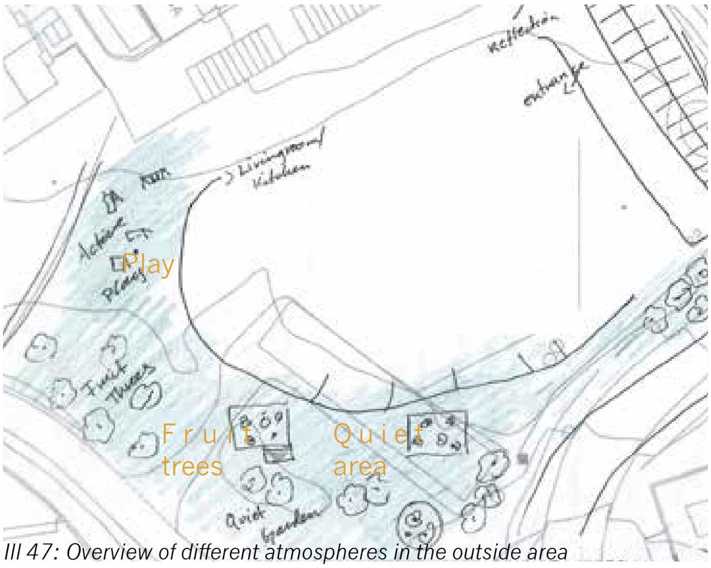
This part of the report displayes the sketching phase. Here the functions listed in the function diagrame are placed on the site according to the requirement of the different rooms. The plans and form of the building are developed together with a focuse on the living units.

SKETCHES

Green areas and functions on the site

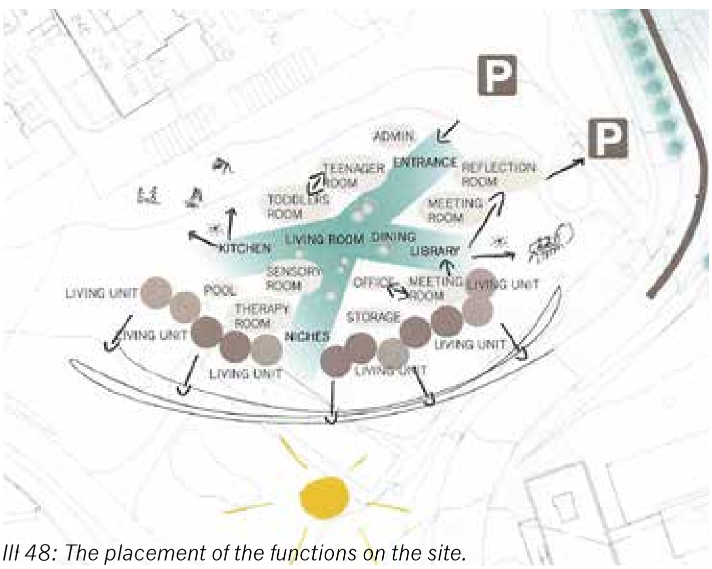
The sketches and models displayed over the following pages are a selection from the result of the sketching phase. The comments are not a description of the finished result, but of the thoughts and ideas that went along with the sketches and resulted in the main concept.

Different compositions of the functions were tested, where their placement on the site and their connection to each other were based on the room relation program seen in the analysis phase.



Ill 47: Overview of different atmospheres in the outside area

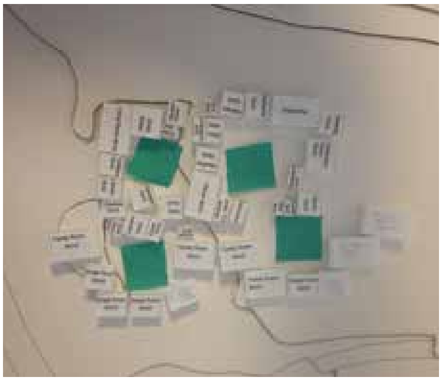
The study of healing architecture shows that a garden has a calming effect on people in a medical facility. A garden with different growths is created around the house, ill 47. The playground is the active area and situated close to the neighboring residential area to include the children who used to play here. The best view is to the south and a more quiet, reflective garden is placed in front of the apartments.



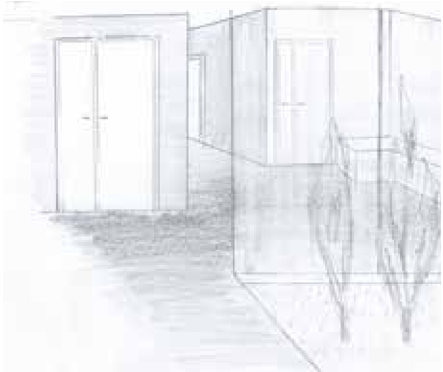
Ill 48: The placement of the functions on the site.

The apartments are facing the south to utilize the view and the passive heating from the sun, ill 48. However, this will lead to overheating, and solar shading must be incorporated into the design. The kitchen and dining area is in close connection with the playground, so the parents can cook and keep an eye on their children at the same time. The entrance to the house and the entrance to the reflection room are facing the north and the parking area. The road goes up to the house and the entrance area has an overhang to prevent the family getting wet when they are unloading their vehicle. The reflection room has its own entrance for the visitors and the hearse. The exit is marked with a small garden of its own, to signalize that the coffin is not carried out the back of the building, but given a dignified farewell.

SKETCHES
Plans

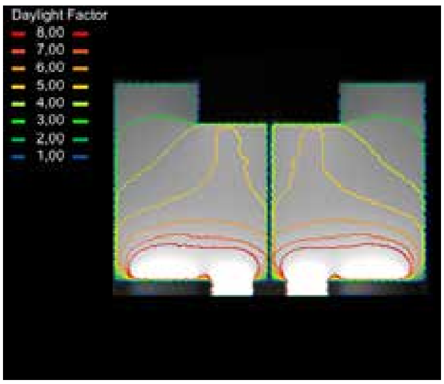


Ill 42: Green areas are introdused to the building.

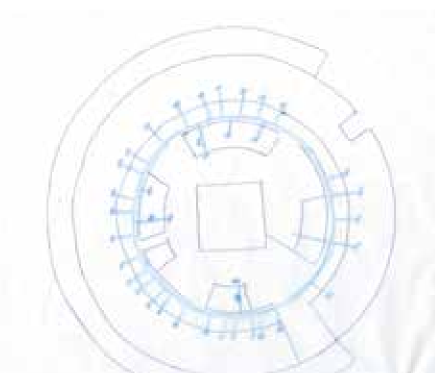


Ill 49: The green areas can have different caracters.

The garden that surrounds the house is drawn into the house by creating internal courtyards. The green areas create views inside the building that alters the atmosphere. Trees and bushes can create a quiet reflective atmosphere, while swings and sandpits can provides a more active and energetic atmosphere. The green area opens up the building and brings inn natural light.



It is strived towards a sufficient daylight inside the apartments of at least 200 lux. Diffident tests with different roofs and window openings were tried out to get a sense of how the light spreads in the room.



Ill 45: Test of ventilation system.

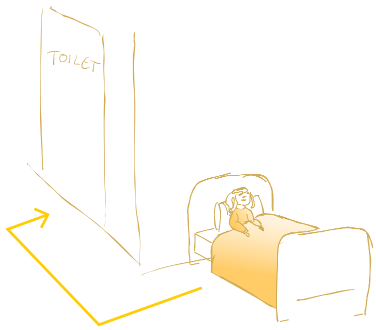
Ill 46: Circular plan.

During the alterations of the floor plan and the design, technical demands arose. It was important to have the ventilation incorporated and thought into the design. In the circular floor design, the ventilation channels follow the circulation, ill 45.

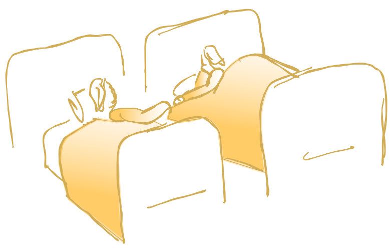
The floor plan in ill 46, gives the inhabitants the possibility to observe life in the social areas before joining into it.

Living Units

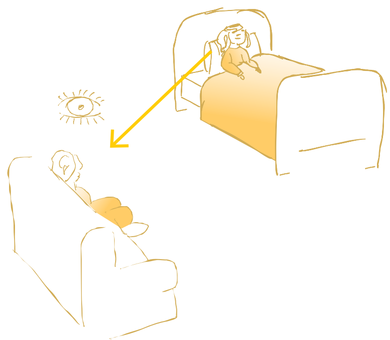
The following illustrations demonstrate important features concerning the placement of the child´s bed. The features will be incorporated into the design of the living units. (Christophersen, J., 1998)



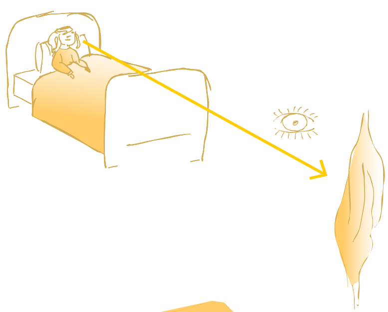
When using the lavatory, there is often a need for assistance. The person must therefore have a clear path to the bathroom.



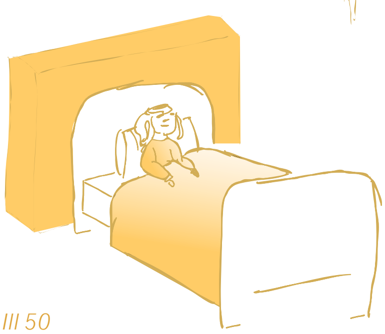
To allow rearrangement in the room, the beds are on wheels. There must be enough space next to the child´s bed in order for the parent to sleep next to their child.



In the text The last steps in the analysis, it is stated that the child will spend the majority of their time in the bed, and it is important that the bed in an incorporated part of the sitting arrangement, so the child feels included in social gatherings in the room.



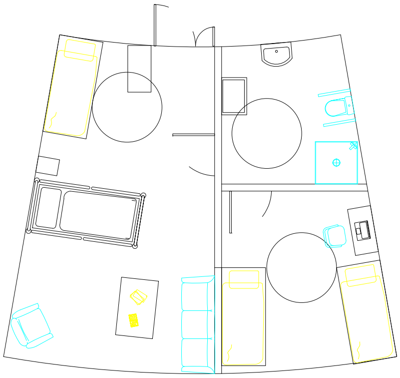
From the bed, the child must have a good view to the outside, to be able to enjoy the calmness that nature brings and have easy access to the terrace, so the bed can be rolled outside.



Ill 50

It is important that there is something behind the bed, so that the child does not get the feeling that someone is coming in from behind them.

Living Units



Ill 51: Sketche of design for the family rom.

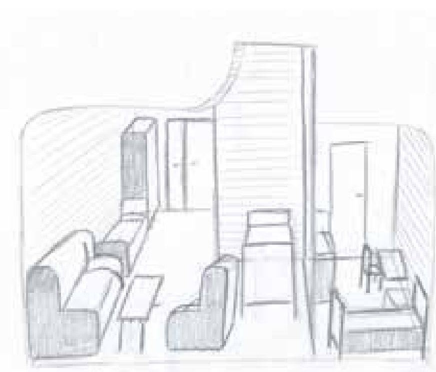
Ill 52: Sketche of design for the single rom.

There are two different types of apartments in the children´s hospice, defined in the room program. The family apartment consists of two rooms so the other family members are not awaken in the night if the child is restless. The extra bedroom is aligned with the main room with a sliding door, to create a larger living room during the day, ill 51.

Ill 53: Sitting place in the window.

Ill 54: Different zones in the room.

In order to reach the energy goals, the insulation layer will make the walls quite thick. The thick walls can be utilized as sitting places in the windows. To prevent fire spreading or noise between the apartments, the inner walls are insulated. This makes them ticker and they can work as bearing constructions. By arranging the furniture, different zones can be created in the room, like an entrance area where cloaks and shoes can be placed. A medicine closet can for example divide this area. (Christophersen, J., 1998)



Ill 55: Skylight over the bed.

Ill 56: Community feeling infromt of the rooms.

The sick children will spend large portions of their time in their bed, and a skylight situated over them can allow them to see the clouds drifting during the day and the stars during the night. The skylight will also allow for cross ventilation, which can be used on summer days. The bed is pulled into the room so the draft from the facade window will not affect the child.

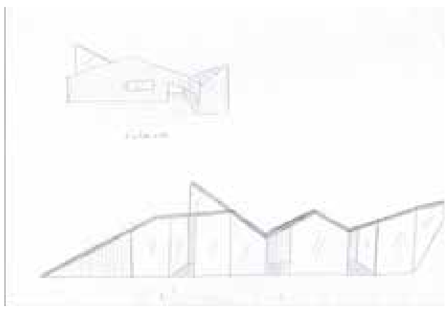
Form Studies

Ill 57: *The traditional Norwegian home.*

Ill 58: The buildings clear cut gives an almost caricated expression of a piched roofed house, the symbole of home.

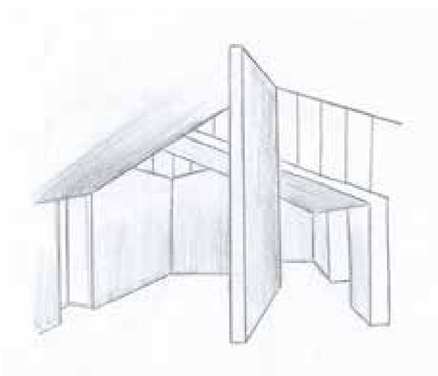
The building is to become the home for the child and his or her family. In Norway as described in the text Nordic Architecture, wood is the most common constructing material, especially in residential homes, see ill 57 and 58. Wood is therefore used as both the constructing material and the cladding of the hospice, to create a link to the family home the child leaves behind.

Ill 59: Sketches of angeled roofs

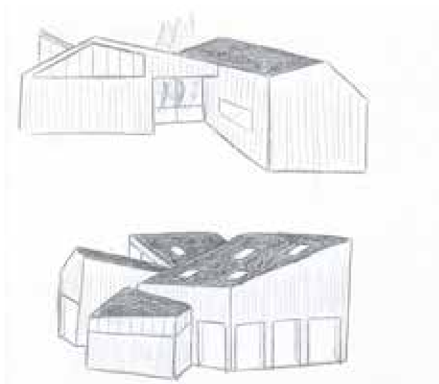


Ill 60: Sketches of angeled roofs

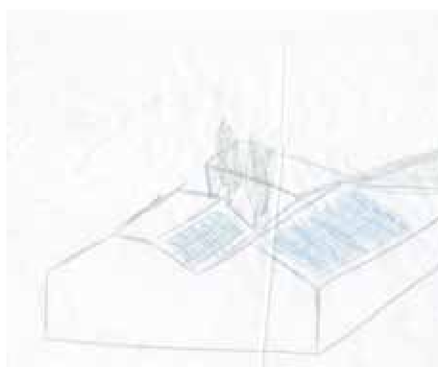
The weather conditions, described in the analysis part, suggests that an angled or pitched roof will suit the harsh climate. To create a light and comprehensive form, as wished for in the design parameters, the building is divided into several smaller building volumes with pitched roofs. When they are placed next to each other, a cluster of small houses is created.



Ill 61: Interior sketch of the bearing construction.

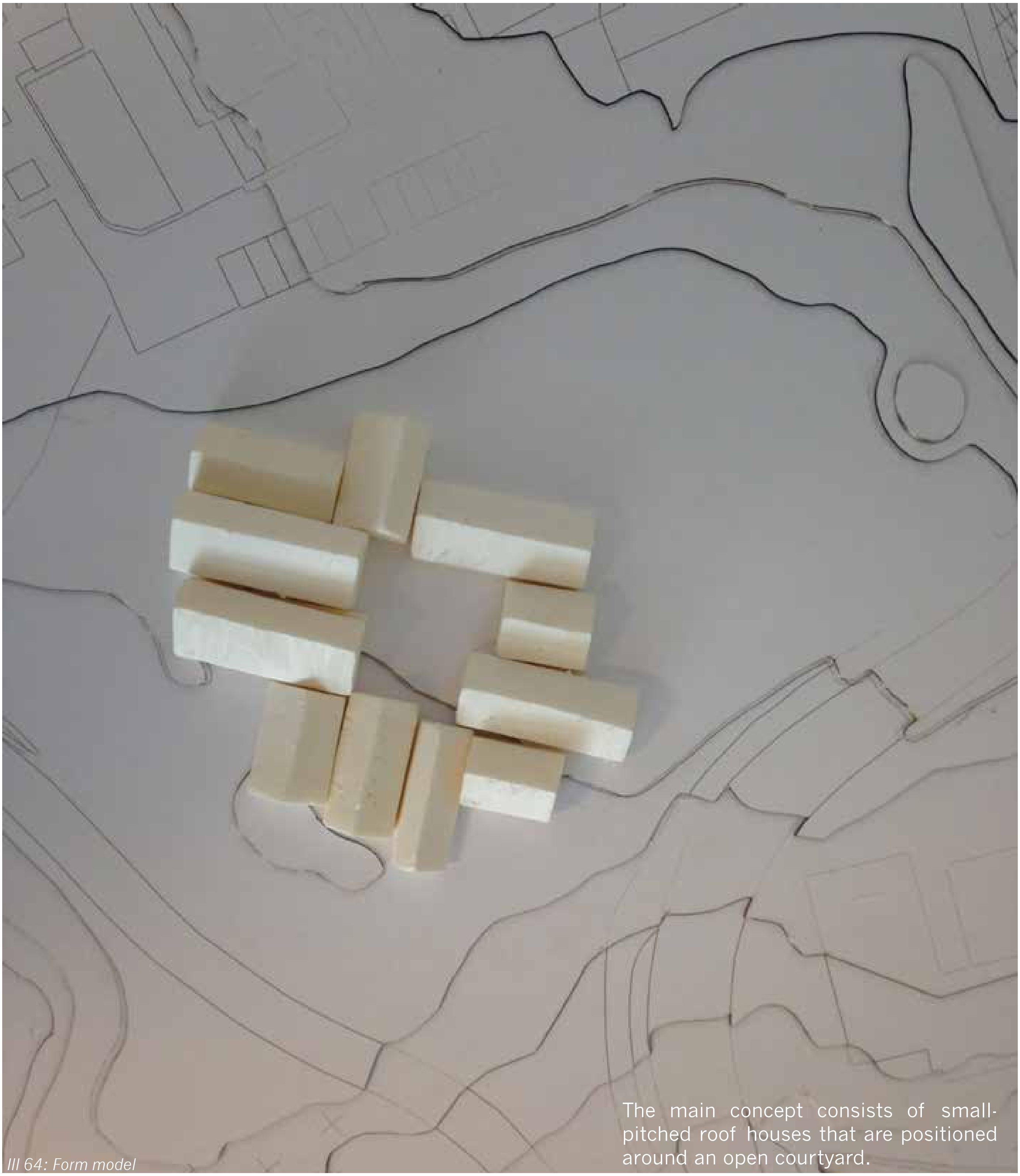


Ill 62: Exterior sketch



Ill 63: Exterior sketch

Main Concept



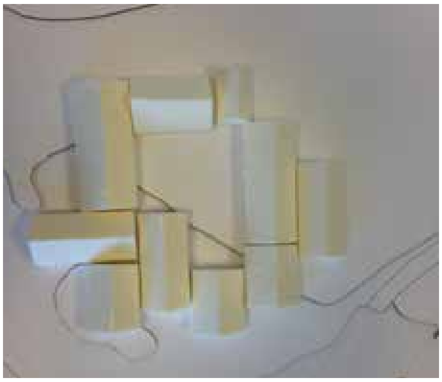
Ill 64: Form model

The main concept consists of small-pitched roof houses that are positioned around an open courtyard.

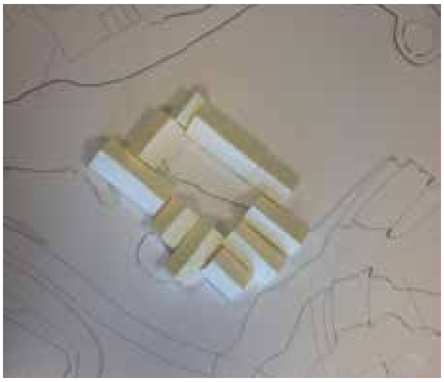
SYNTHESIS

In this section of the report, the main concept is developed and specified and culminates in the final design.

Form Development



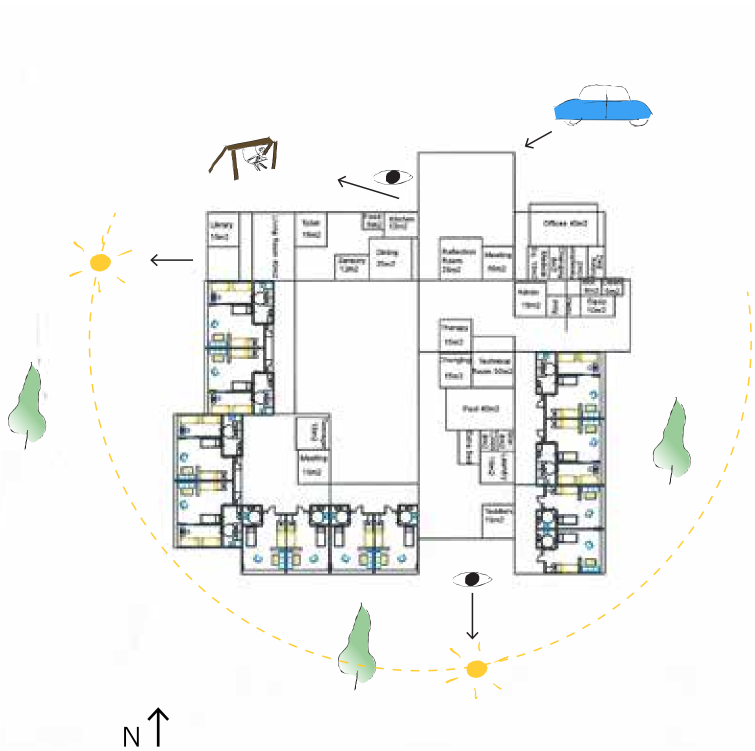
Ill 66



Ill 67

Ill 68

The models show different ways in which the small building parts can be connected. The small building volumes are positioned around an open courtyard. The courtyard provides natural light and link nature to the building. It also provides a sheltered place for the children to play.

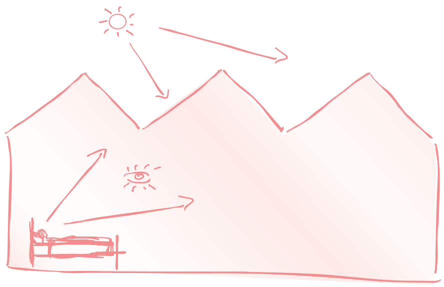


Ill 69

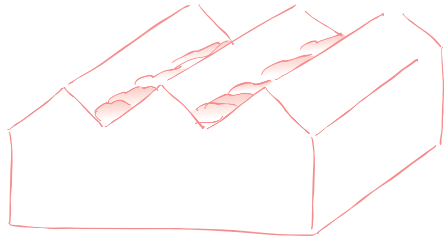
The living units are placed towards east, south and west. They are placed so that the nature surrounding the site can be seen from the living units. The social common rooms face south and west, so both the midday sun and the evening sun can be enjoyed. The reflection room and the offices are held to the north, close to the entrance of the building, ill 65.

Foof Development

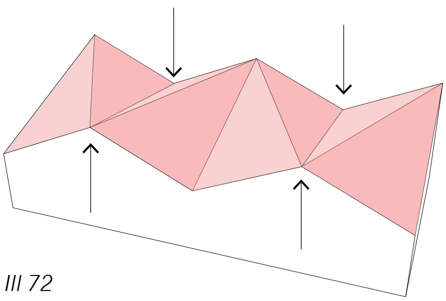
As stated in the text The last steps in the analysis, the children´s condition makes them spend a large part of their day in bed or in a wheelchair. This means that when they move through the house their gaze is free to wander around the room. The roof becomes a more prominent surface that should be interesting to look at. The roof is worked with to see if it can be altered into a more interesting shape that can provide a play of light and movement.



Ill 70

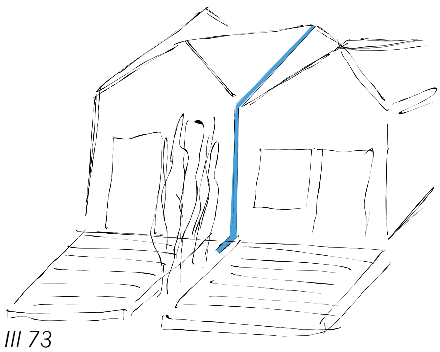


Ill 71
Snow and rainwater can pool up in the gorge between the pitched roofs.



Ill 72

The roof is divided into triangles and the edges of the triangles is pushed up and down.

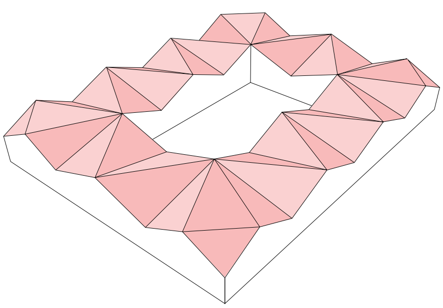


Ill 73

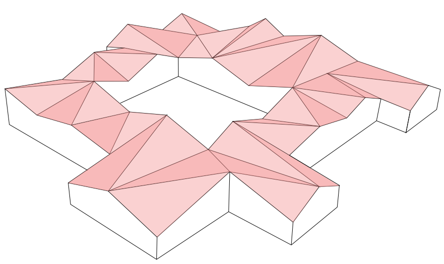
The slope of the roof will make the snow and water slide off the roof. The water collected can be used to water plants.

Ill 74

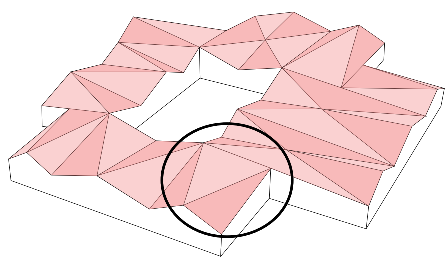
In order to lead the ventilation ducts through the building, the ceiling must be lowered some places to be able to hind the ducts. The ducts are hidden to keep the focus on the angled roof. The lowered ceiling can then be used for creating semi-private zones, for example in front of the apartments.



Ill 75
An investigation of different ways in which the end of the buildings join.



Ill 76



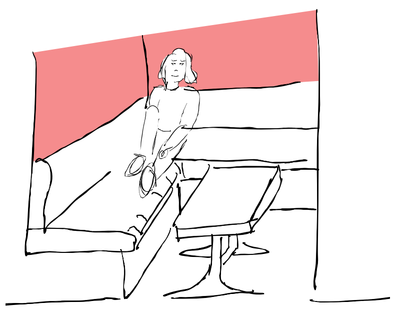
Ill 77 This courner joining is choosen.

Zoning of the building

A children is hospice holds many feelings at both ends of the spectrum, which makes the needs of the resident vary as described in the text The last steps. Sometime they seek the comfort of others and other time they need require solitude. The building is therefore divided into active public zones and private zones. The inhabitants should be able to choose for themselves how active they want to be in the public life of the house and how withdrawn they want to be from it. Semi-public and semi-private areas are therefore introduced to act as buffer zones between the active and private areas.

The semi-private areas are marked by a colored wall that helps define the area, while the semi-public areas have color on the floor. This enhances the understanding that the zones have a different character than the main room.

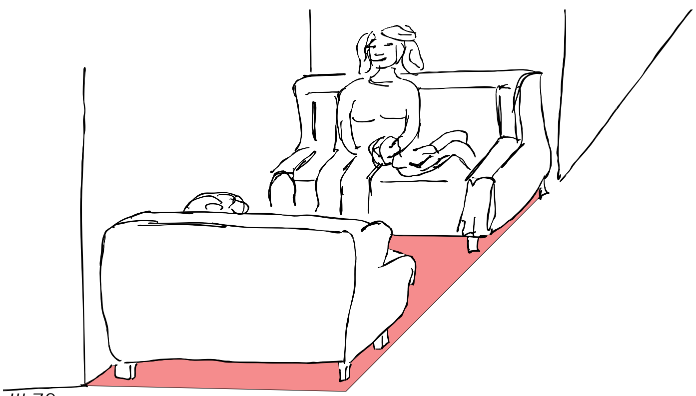
Semi-Private



Ill 78

It can be challenging to take care of a sick child, and sometimes one needs a small break to reflect in solitude. Private niches in connection to the private apartments provide quiet areas for conversation or reflection.

Semi-Public



Ill 79

When the family arrives to the public areas, they may rest in the semi-public areas before they enter the main area. Here they can maintain a visual contact before they have to take an active part in it.

Materials

Exterior Cladding
The exterior is clad in Kebony pine cladding. The timber is treated so it can last up to 30 years without treatment. The impregnation is environmentally friendly and hardens the wood so it is adhere to rot and resistant to abrasion. When exposed to the weather, the wood will gain a gray patina as showed in ill 81.


Ill 80


Ill 81

Roof
To maintain the clean cut of the building, the roof is clad in roofing felt and kept in a dark color to better bled in with additional solar cells.


Ill 82

Interior Cladding
The interior cladding is held in light timber, pine, which gives a light and airy atmosphere. The light color is a good contrast to the splashes of color that marks the entrances to the apartments or the niches.


Ill 83


Ill 84

Floor
The floor is held in the same color shade as the walls and is in timber parquet. Parquet is chosen since this is a material it is easy to clean and it is often used in residential buildings. By having the walls and floor in timber, a distance is created to the white and sterile walls at the hospital.

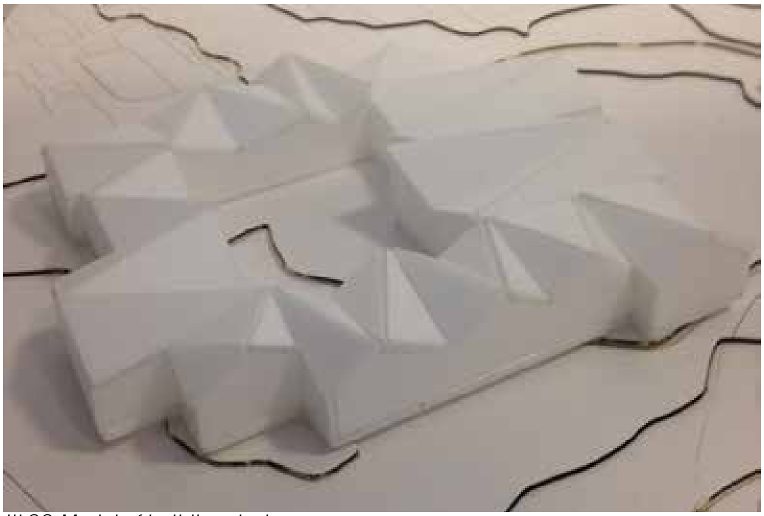

Ill 85


Ill 86

Ceiling
The ceiling is held in white plasterboards. In the big social areas, like the dining room and the common room, the plasterboards are replaced with an acoustic ceiling; based on the investigations of the acoustics that is displayed in the following section of interior environment.


Ill 87

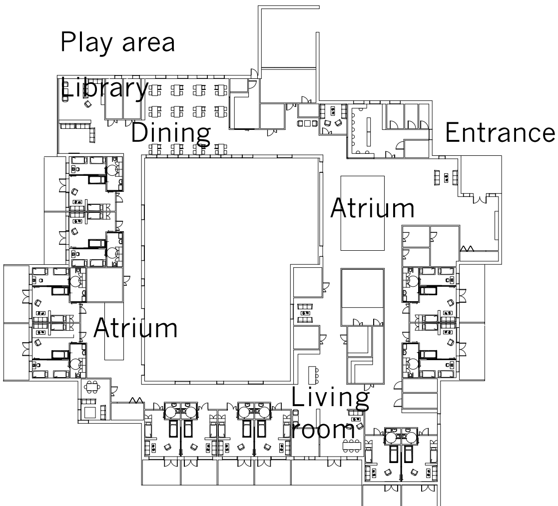
First result, energy calculation



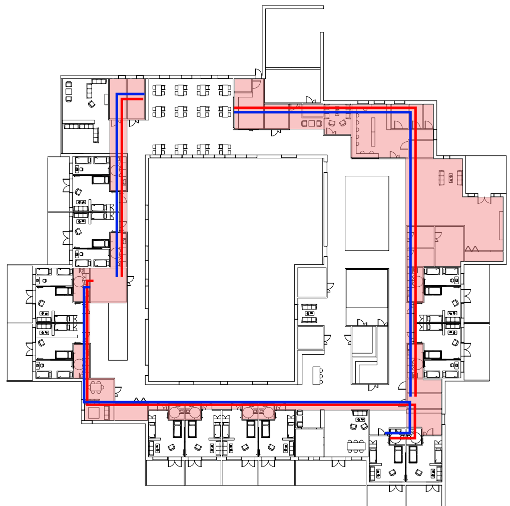
Ill 88 Model of building design.

The model shows the building at this stage in the process. Ill 89 displays the plan of the spatial organization. The social areas are divided two: the dining area and the living room. The living room is facing the south and enjoys the energetic daylight. The calmer atmosphere of the evening sun marks the dining and library room.

Ill 90 shows the ventilation ducts and the colored area shows where the ceiling is lowered to hide the ducts.



Ill 89 Floor plan.



Ill 90 Illustration of the ventilation ducts.

A Be10 calculation of the building is done to investigate the energy consumption of the building during a whole year. The calculation shows that the building uses 26 kWh/m2 a year. As stated in the energy demands in the analyze part of the report, the goal is to reach 20 kWh/m2 a year.

To reduce the consumption, the building envelope can be reduced. By limiting the protruding building parts and thereby creating fewer corners. The building outline will be reduced and hence the line loss. This would also lead to a smaller building envelope. It is however important that the design is not reduced to a square. The protruding parts of the building create the visual image of smaller and less compact building. A middle-way is therefore strived towards, where the building envelope is reduced and the protruding parts of the building are reduced, but not extinct.

Nøgletal, kWh/m² år

Energiramme BR 2010

Uden tillæg	Tillæg for særlige betingelser	Samlet energiramme
53,3	0,0	53,3
Samlet energibehov		39,2

Energiramme Lavenergibyggeri 2015

Uden tillæg	Tillæg for særlige betingelser	Samlet energiramme
30,5	0,0	30,5
Samlet energibehov		35,5

Energiramme Byggeri 2020

Uden tillæg	Tillæg for særlige betingelser	Samlet energiramme
20,0	0,0	20,0
Samlet energibehov		26,0

Bidrag til energibehovet		Netto behov	
Varme	18,8	Rumopvarmning	8,7
El til bygningsdrift	8,2	Varmt brugsvand	9,2
Overtemp. i rum	0,0	Køling	0,0

Udvalgte elbehov		Varmetab fra installationer	
Belysning	0,0	Rumopvarmning	0,9
Opvarmning af rum	0,0	Varmt brugsvand	0,1
Opvarmning af vbv	0,0		
Varmepumpe	0,0	Ydelse fra særlige kilder	
Ventilatorer	8,0	Solvarme	0,0
Pumper	0,2	Varmepumpe	0,0
Køling	0,0	Solceller	0,0
Totalt elforbrug	65,4	Vindmøller	0,0

Ill 91 Be10 result

Light Study, Single Apartment


Ill 92 Test 1.

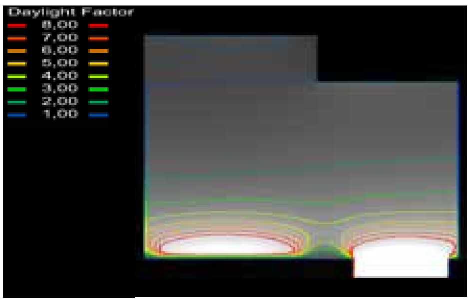

Ill 93 Test 2.


Ill 94 Test 3.

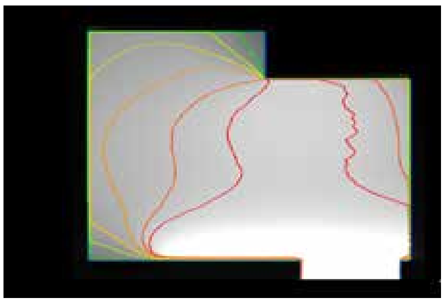

Ill 95 Test 1.

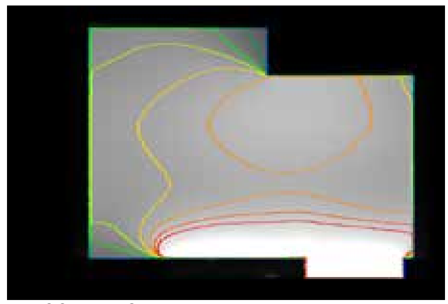

Ill 96 Test 2.


Ill 97 Test 3.



Ill 98 Test 1.


Ill 99 Test 2.


Ill 100 Test 3.

For valgt måned:	Juli	tu =	21	YC
Hvis ventilationsluften har samme temperatur som udeluften				
Døgnmiddeltemperatur		ti =	24,6	YC
Temperaturvariation		Δti =	3,4	YC
Maksimaltemperatur		timax =	26,3	YC

Ill 101 Test 1.

For valgt måned:	Juli	tu =	21	YC
Hvis ventilationsluften har samme temperatur som udeluften				
Døgnmiddeltemperatur		ti =	24,6	YC
Temperaturvariation		Δti =	3,5	YC
Maksimaltemperatur		timax =	26,3	YC

Ill 102 Test 2.

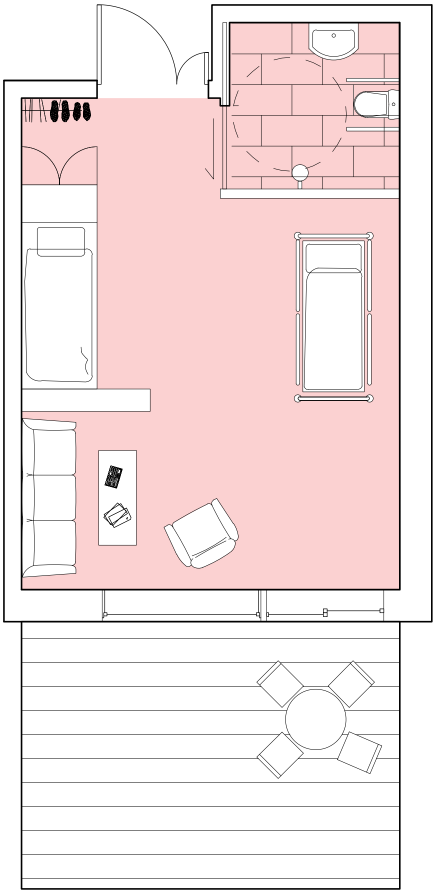
For valgt måned:	Juli	tu =	21	YC
Hvis ventilationsluften har samme temperatur som udeluften				
Døgnmiddeltemperatur		ti =	24,5	YC
Temperaturvariation		Δti =	3,5	YC
Maksimaltemperatur		timax =	26,3	YC

Ill 103 Test 3.

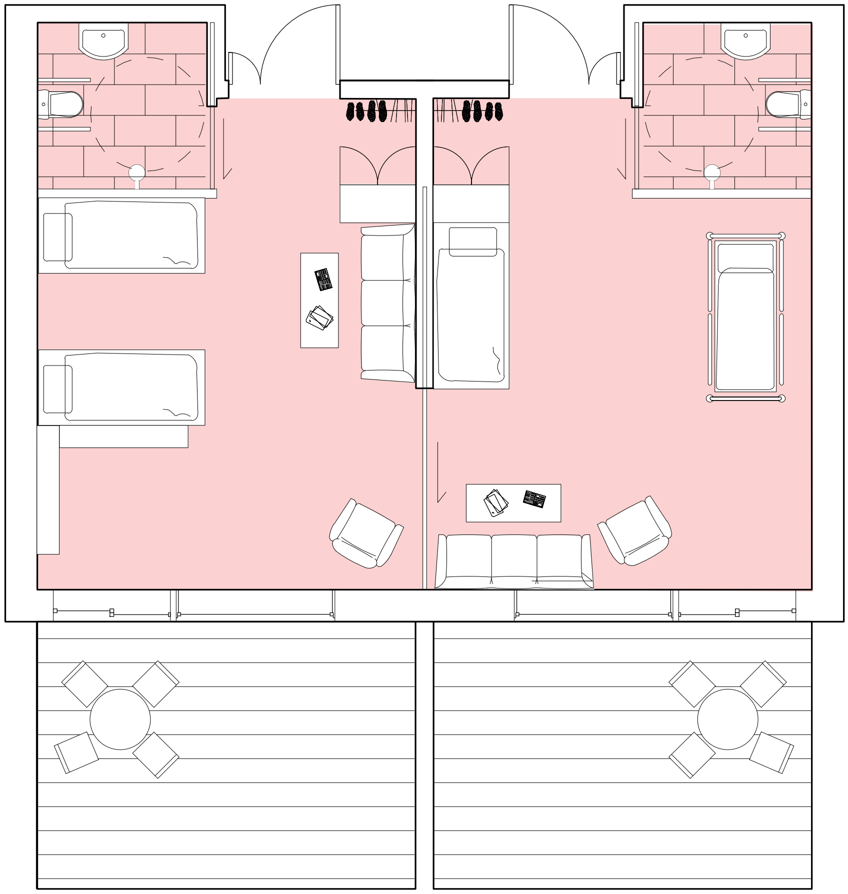
The light study of a single apartment to the south shows that the roof window is important to light the back of the room. Both test 2 and 3 brings sufficient daylight to the apartment, but alternative 3 is chosen for the final design because the windows goes to the floor. They will allow the children that plays of the floor a view out to the garden.

Since the apartment faced the south, a daily average calculation is executed to investigate the overheating in the room. The temperature for all the three tests shows a range from 24,5 to 26,3. This is too high, according to the energy demands stated in the analysis part of the report. Shading is therefore necessary for the windows.

APARTMENTS
Single Apartment



Ill 104 Single apartment
1:100

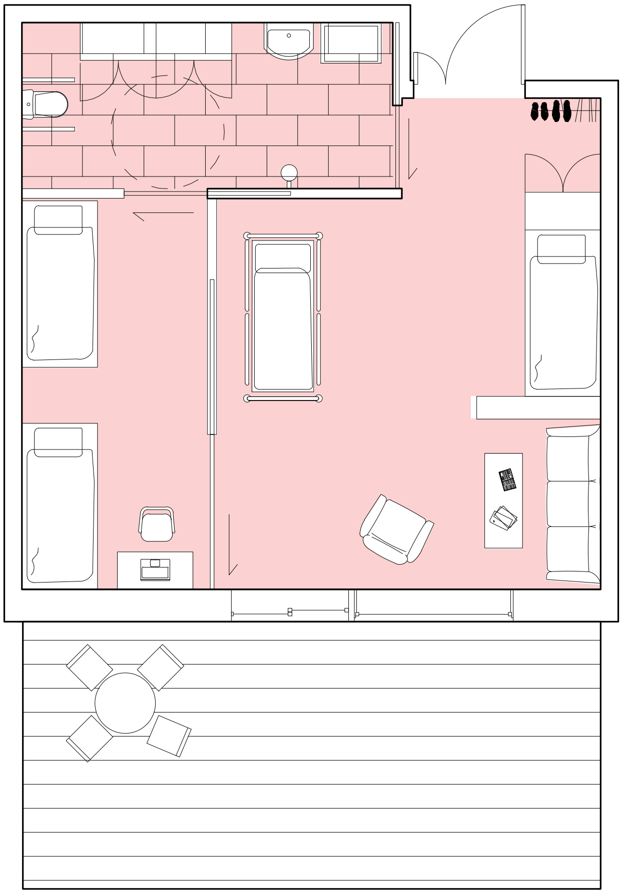


Ill 105 Combined apartments
1:100

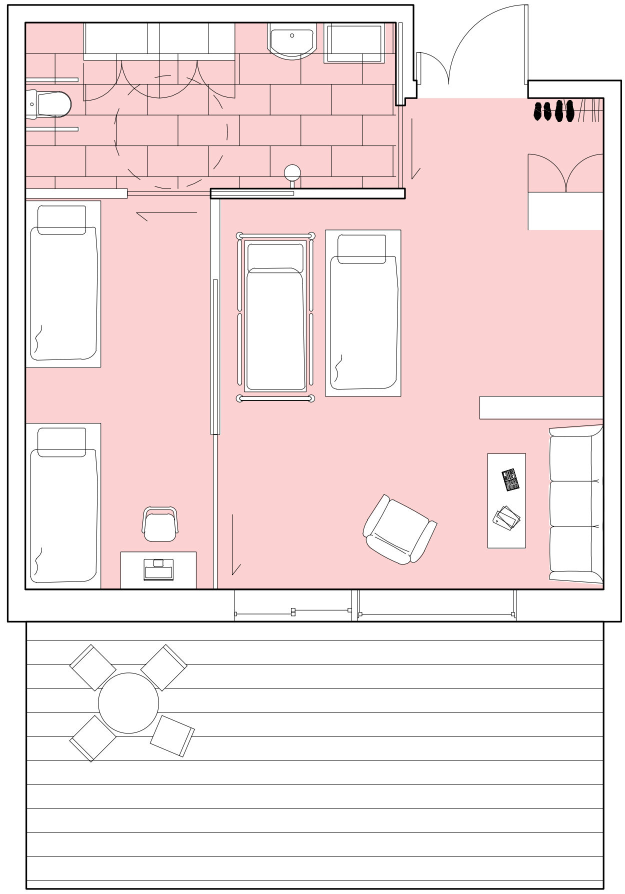
The single apartment is designed for older children who only need one parent with them at all time. The access to the bathroom is made easy by placing the bed up against the bathroom wall. The wall protects the sick bed, so the child can feel that his or her back is protected when someone enters the apartment. The bed has easy visual connection to the sitting group by the window, and the child will be a natural part of the conversation. The terrace door is placed in front of the bed, so the child can look out and be easily transported out to the terrace. The bed is on wheels, so the bed can be pushed out form the wall if the nurses needs to assist the child or the child wants to be transported to other parts of the house. The parent's bed is placed in a niche created by the medicine cabinets and the shelf in front of the sofa. During the night the bed is pushed out from the wall, so the parent can lie and hold hands with their child.

Depending on the number of families in the hospice, the single apartment can be opened up by a sliding door and extend into the neighboring apartment, creating a home for a family of four or five if the sleeping sofa is used. The interior is on wheels, so the apartment can easily be rearranged.

APARTMENTS
Family Apartment



Ill 106 Family apartment
1:100



Ill 107 Nightly arangement
1:100

The layout of the family apartment is similar to the single apartment, but here the sliding door leads into an additional bedroom. The text Healing Architecture stated that sick children can have a disturbed sleeping rhythm. The additional bedroom has therefore its own access to the bathroom, so the child is not disturbed during the night.

FINALISED DESIGN
Be10 result

Ill 108 Final design

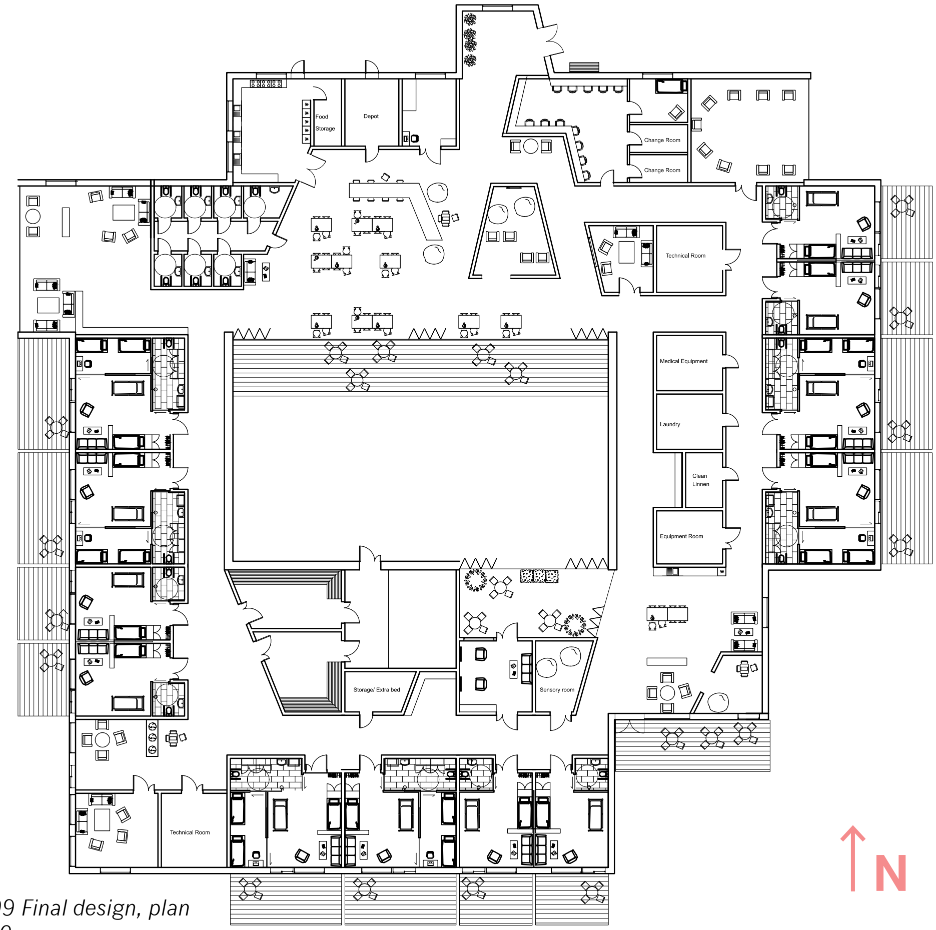
The illustration above represents the final design of the children´s hospice. The small houses are joined together protectively around a green inner court, where large glass wall allows the daylight to enter the building. The effect is enlarged by the variations in the facades. Each of the apartments are joined two and two together in one little house. Every apartment has their own terrace with a view to the surrounding nature.

To be able to calculate the yearly energy consumption of the building, a BE10 calculation is done of the building.

The result shows that the building consumes 24,4 kWh/m2 per year. This is 4,4 kWh/m2 per year over the recommended consumption of 20 kWh/m2 per year that is stated by the Building regulation 2020. To be able to reach the 2020 standard, the building need to add active means. 110m2 of solar cells are added to the rood and brings the yearly energy consumption down to 19,8 kWh/m2 per year, which means that the building fulfills the Building regulations of 2020.

FINALISED DESIGN

Be10 result



Ill 109 Final design, plan 1:500

etal, kWh/m² år

ergiramme BR 2010

iden tillæg	Tillæg for særlige betingelser	Samlet energiramme
53,2	0,0	53,2
amlet energibehov		36,9

ergiramme Lavenergibyggeri 2015

iden tillæg	Tillæg for særlige betingelser	Samlet energiramme
30,4	0,0	30,4
amlet energibehov		33,3

ergiramme Bygger 2020

iden tillæg	Tillæg for særlige betingelser	Samlet energiramme
20,0	0,0	20,0
amlet energibehov		24,4

idrag til energibehovet		Netto behov	
arme	18,1	Rumopvarmning	8,1
l til bygningsdrift	7,5	Varmt brugsvand	9,2
Overtemp. i rum	0,0	Køling	0,0

dvalgte elbehov		Varmetab fra installationer	
elysning	0,0	Rumopvarmning	0,9
Opvarmning af rum	0,0	Varmt brugsvand	0,1
Opvarmning af vbv	0,0		
armepumpe	0,0	Ydelse fra særlige kilder	
entilatorer	7,4	Solvarme	0,0
umper	0,1	Varmepumpe	0,0
øling	0,0	Solceller	0,0
otalt elforbrug	60,1	Vindmøller	0,0

Ill 110 Be10 result

Energiramme BR 2010

Uden tillæg	Tillæg for særlige betingelser	Samlet energiramme
53,2	0,0	53,2
Samlet energibehov		30,6

Energiramme Lavenergibyggeri 2015

Uden tillæg	Tillæg for særlige betingelser	Samlet energiramme
30,4	0,0	30,4
Samlet energibehov		26,9

Energiramme Bygger 2020

Uden tillæg	Tillæg for særlige betingelser	Samlet energiramme
20,0	0,0	20,0
Samlet energibehov		19,8

Bidrag til energibehovet		Netto behov	
Varme	18,1	Rumopvarmning	8,1
El til bygningsdrift	7,5	Varmt brugsvand	9,2
Overtemp. i rum	0,0	Køling	0,0

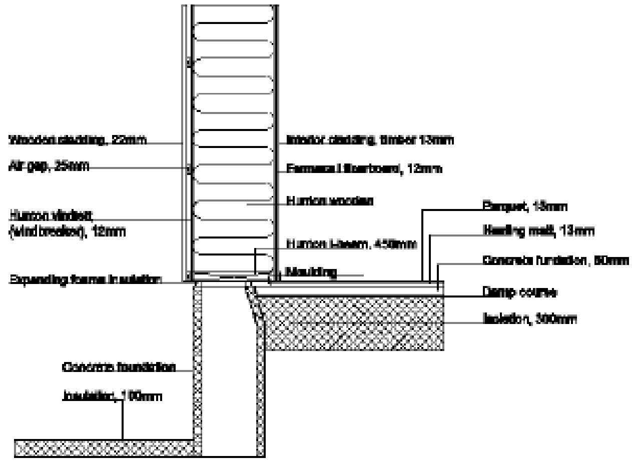
Udvalgte elbehov		Varmetab fra installationer	
Belysning	0,0	Rumopvarmning	0,9
Opvarmning af rum	0,0	Varmt brugsvand	0,1
Opvarmning af vbv	0,0		
Varmepumpe	0,0	Ydelse fra særlige kilder	
Ventilatorer	7,4	Solvarme	0,0
Pumper	0,1	Varmepumpe	0,0
Køling	0,0	Solceller	2,5
Totalt elforbrug	60,1	Vindmøller	0,0

Ill 111 Be10 result with solar cells

CONSTRUCTION
Details

The exterior wall is constructed based on the Hunton I-beam system (hunton.no). Here the stands are replaced with Hunton I-beams. With regular stands the timber percentage is 12%, but by using the I-beam the percentage decreases with 30%.

The wall is insulated with Hunton wooden fiber insulation. This insulation, compared to Rockwools Flexi Batt, has a higher thermal resistance, which requires a thicker layer of insulation. The wooden fiber insulation requires a thickness of 0,45m to get a U-value of 0,09, while the Flexi Batt only needs 0,4m. The reason for choosing the wooden fiber is that the environmental concern is valued higher than the wall thickness. The creation of stone wool insulation requires a lot of energy, while the wooden insulation is 100% recyclable and it is made from vast materials from the timber production. The material have a good heat store capacity and are able to store and transport moist through the wall. (www.hunton.no)

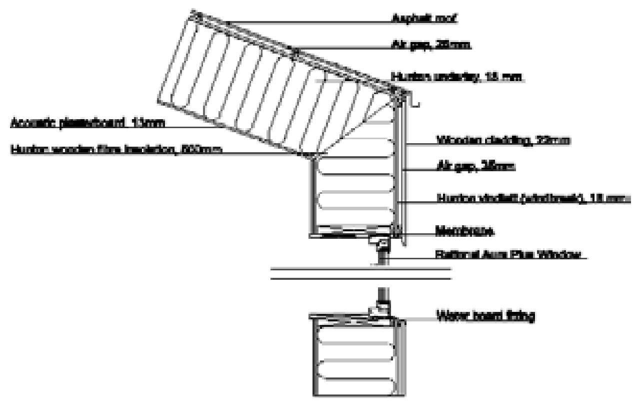


Ill 112 Foundation and wall detail

The floor heating consists of heating mats situated under the parquet. It is assumed that in the future more efficient floor heating will be possible. The heating mats are easy to remove without destroying the floor construction, and the floor heating will therefore be able to be replaced with a more efficient system in the future. (elby.no)

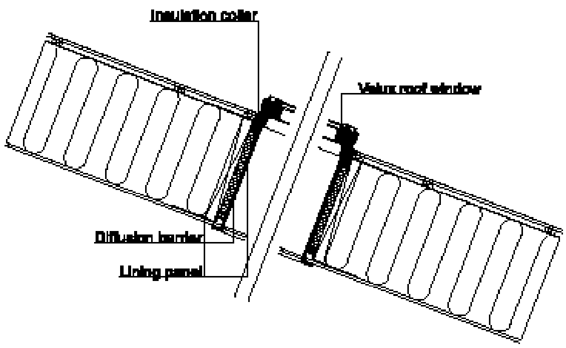
The roof is clad with asphalt to maintain the clean-cut visual expression to the building. The asphalt material is grainy, to prevent friction, so the snow will stay on the roof. To be on the safe side, additional snow catchers will be installed, to make sure the snow doesn't fall down on the terraces.

To be able to maintain a low u-value in the roof, and thereby maintain the heat in the house, the roof in insulated by 500mm insulation. This creates a thick roof, which would look heavy and dominant on top of the walls. The exterior wooden cladding is therefore pulled up, to hide a part of the roof thickness. Visually this turns the roof into a contour line that frames the angles of the small house.



Ill 113 Window and roof detail

CONSTRUCTION
Details



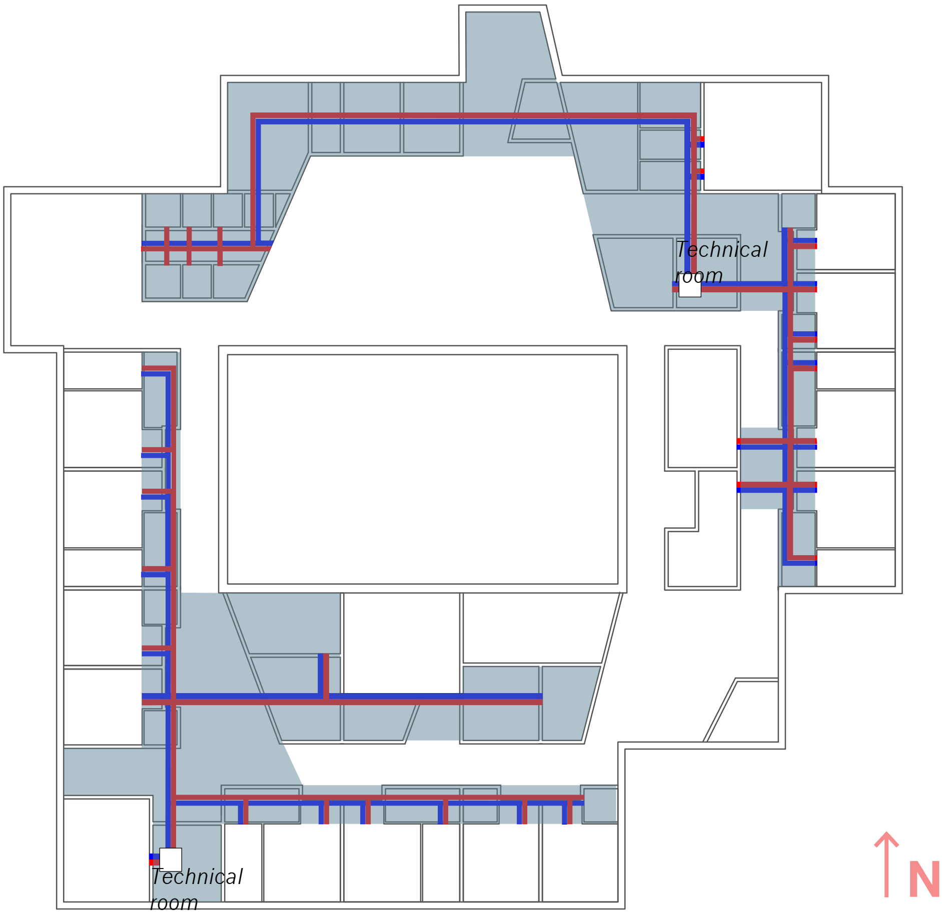
Ill 114 Skylight detail

Velux Windows are chosen for the skylight. The skylights are mechanical, so that the family can open the window if they require natural ventilation or they can close the blinds during the night.

Ill 115 Example of steel column and steel beams

The building is constructed with the aim of being a sustainable building. The construction material is therefore held in timber. However, to be able to construct the roof spans, the glue lam beams would have to increase the height of the roof dramatically. It would also take a considerable amount of timber in comparison to the amount of material that would be needed to create a steel beam. Steel beams resting on steel columns that are placed in the walls therefore construct the roof.

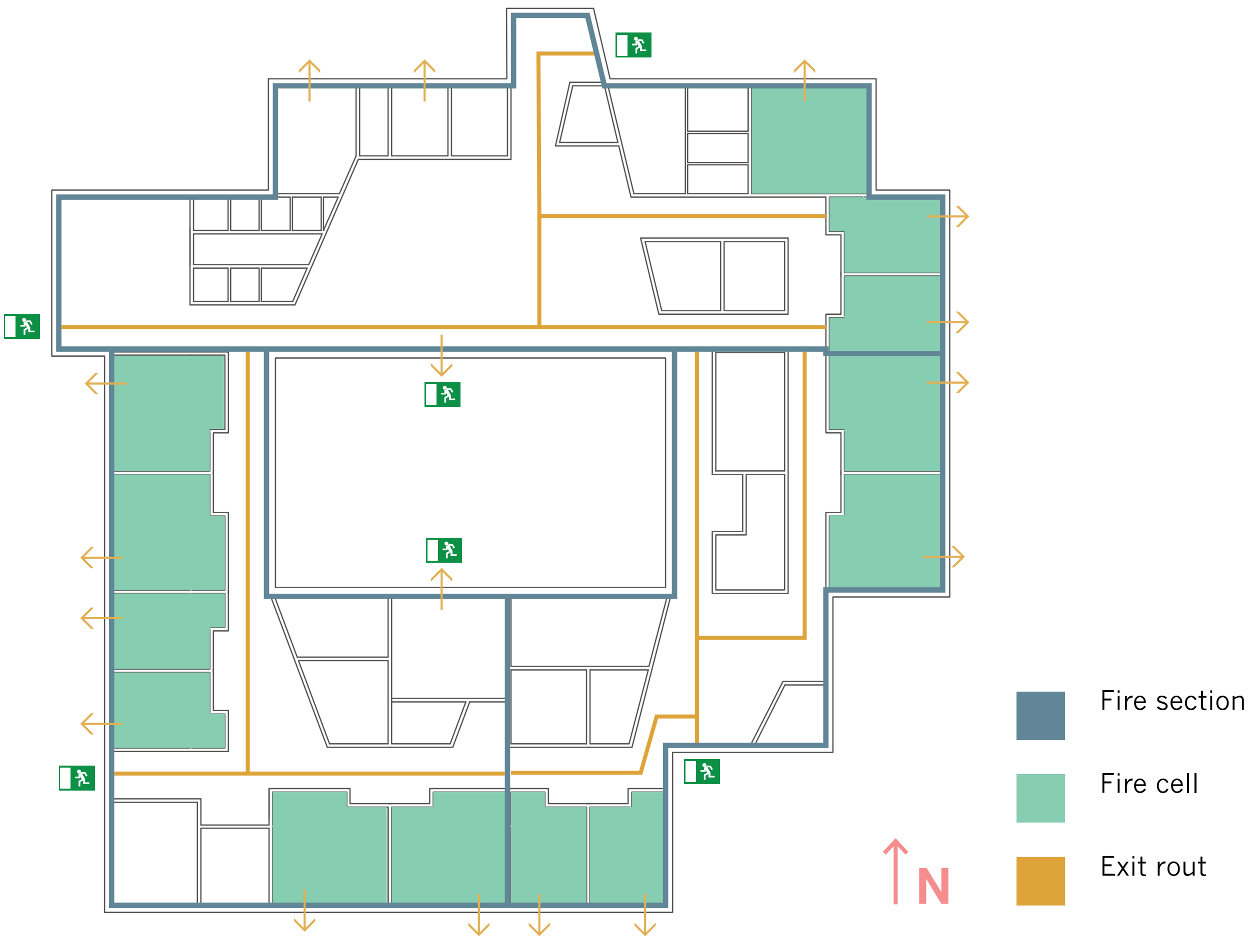
VENTILATION



Ill 116 Illustration of the ventilation ducts and the lowered ceilings

The building has two technical rooms of which the ventilation ducts are extracted from as seen in the illustration. The ventilation is hidden from view, to prevent dust gathering on top of the ducts and in order to maintain the clean lines of the building. The ducts are hidden with lowered ceilings, displayed with blue marking on the illustration. The lowered ceiling becomes a mean to create different zones in the house. The area in front of the apartments and the niches in the hallway becomes a semi-private space by lowering the ceiling. It also creates a contrast between rooms, for example when moving from the changing room and into the pool.

BRANN



Ill 117 Illustration of the fire section, fire cells and exit routs

The hospice is following the application category 6 applicable to buildings where the inhabitants are not able to evacuate the building without assistance. This category is typically used for elderly apartments or hospitals.

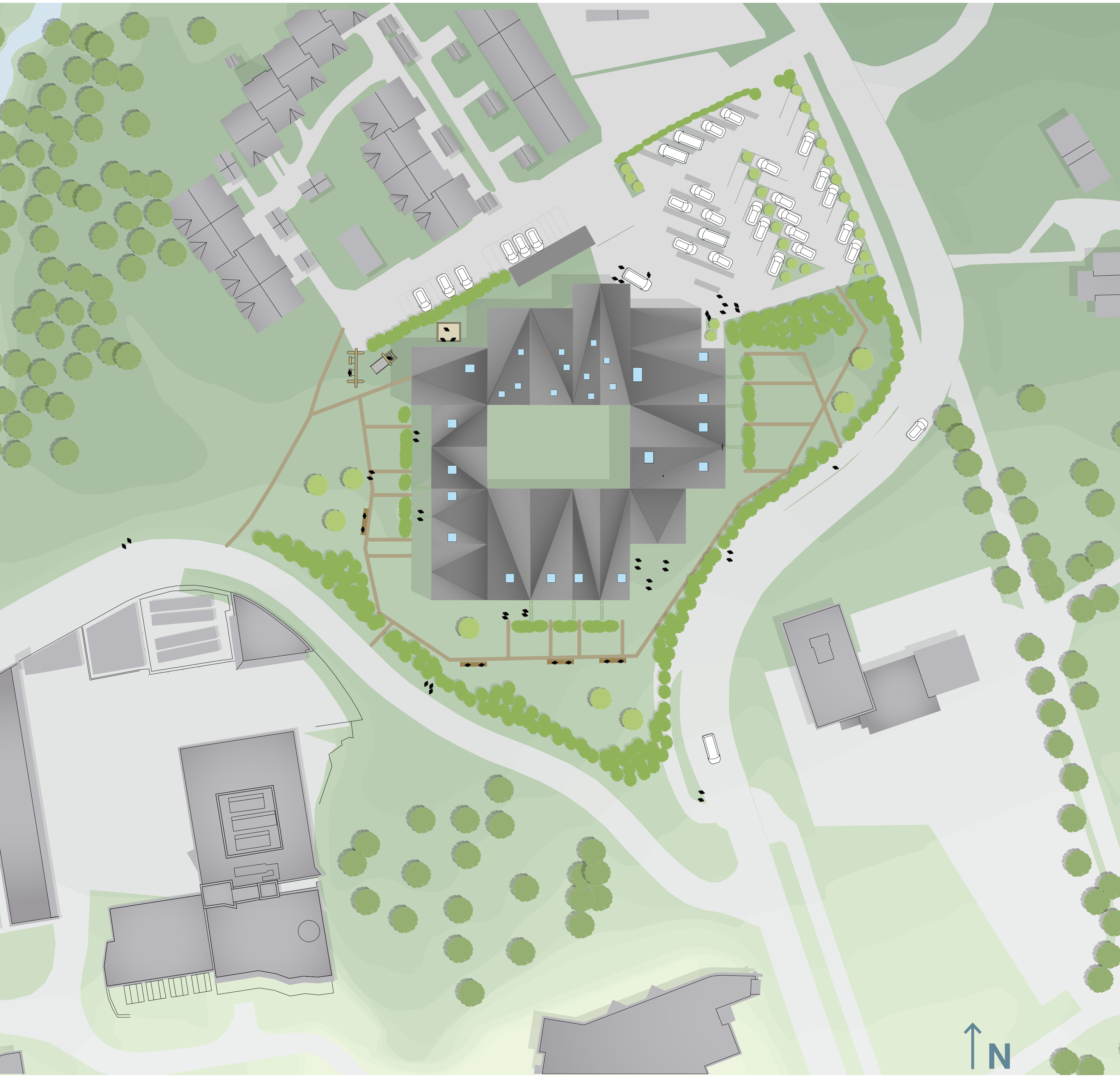
A fire-section is a part of the building that prevents the fire from spreading to the rest of the building during the evacuation time and the time it takes for the rescue team to rescue the inhabitants. The building consists of three sections separated by fire-resistant doors hidden in the walls.

A fire-cell is a room that prevents the fire from spreading to other fire-cells during the time it takes to evacuate and rescue the inhabitants. Each of the apartments and the reflection room is a fire-cell. The inner walls are constructed as double wooden walls with fire-resistant plasterboard and cladding. The walls have a minimum fire resistance of 30 min. (SINTEf Byggforsk, 2010)

PRESENTATION

The final design and technical calculations are presented.

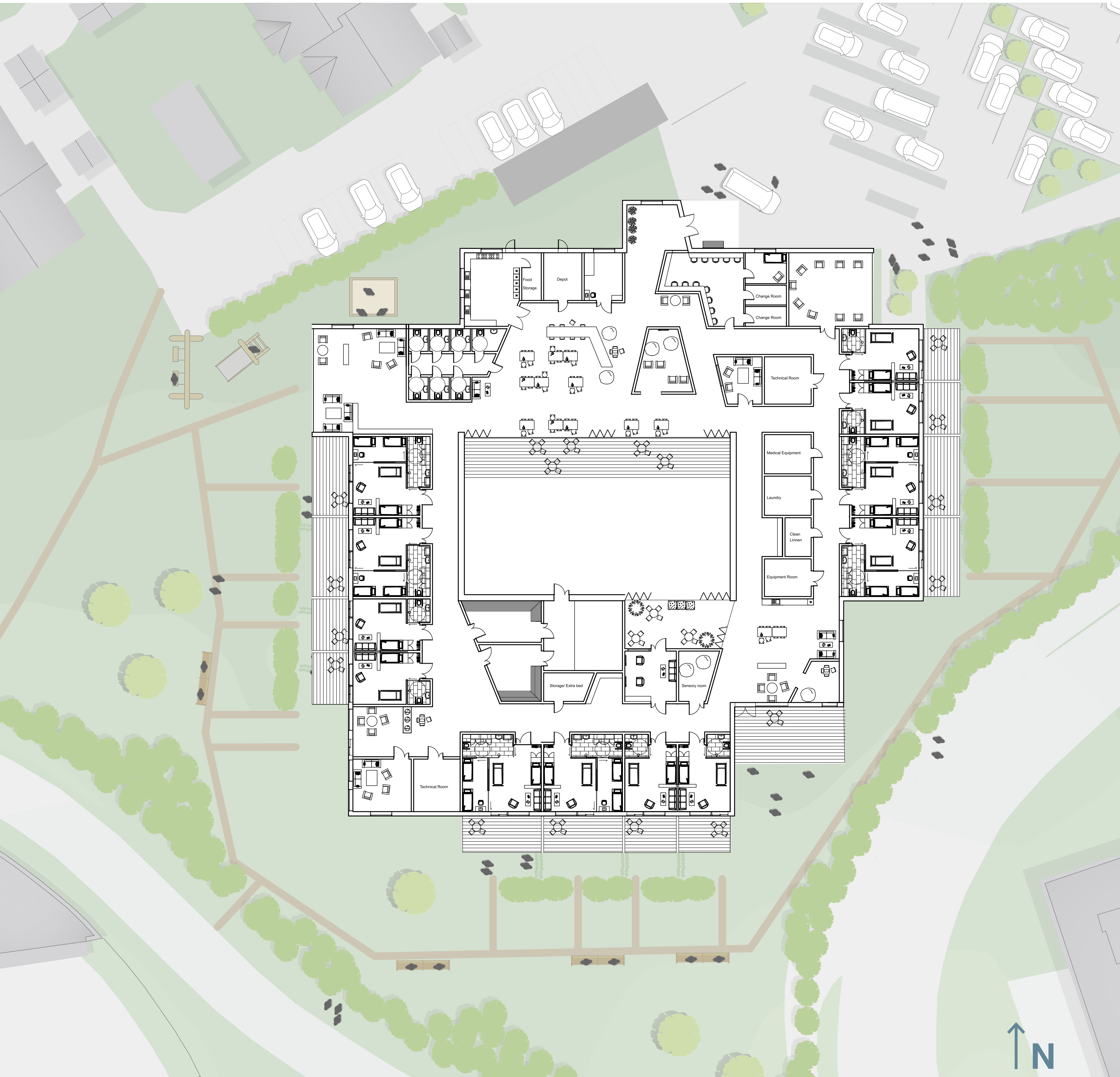
SITE
1:1000



Ill 119 The site plan

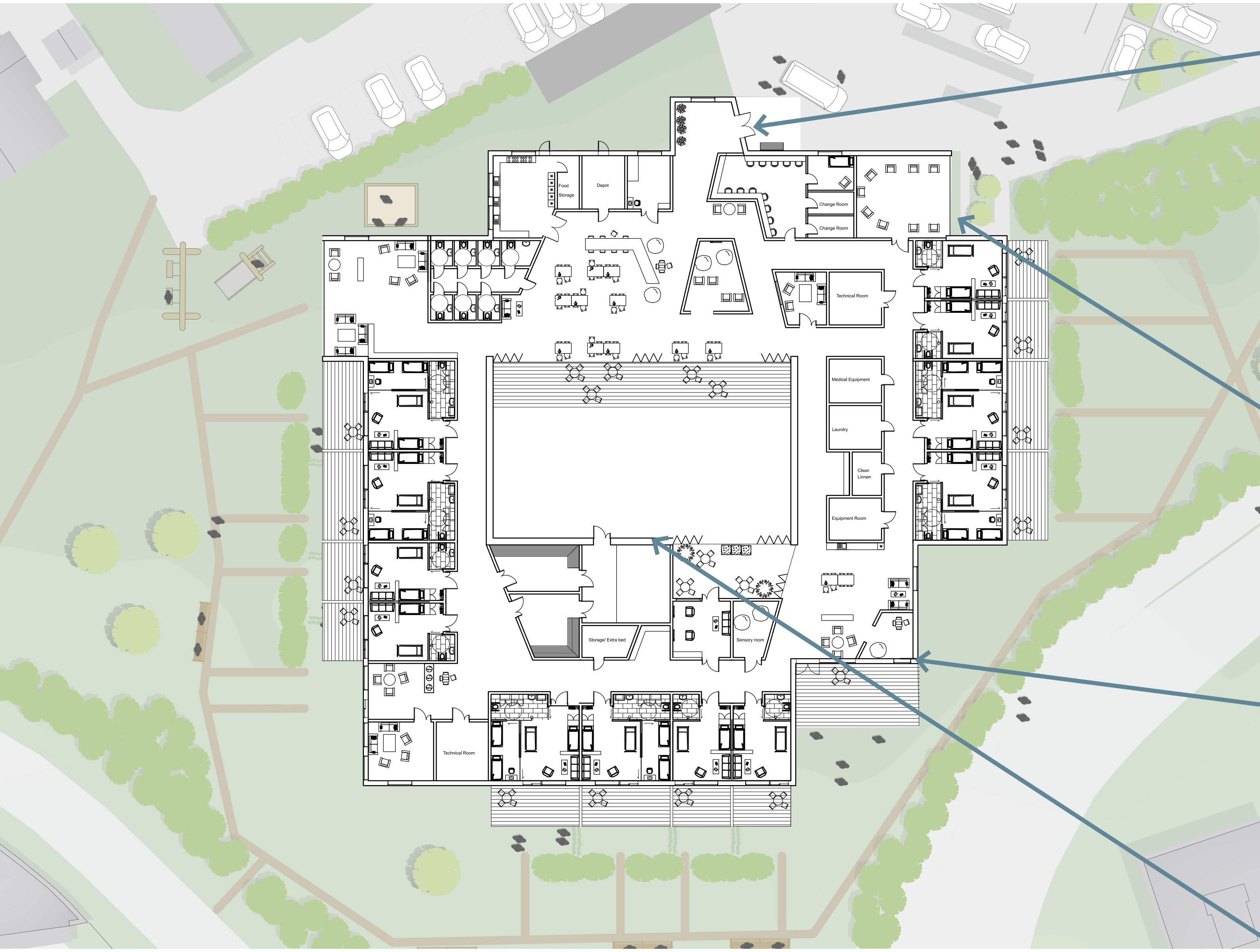
PLAN

1:500



Ill 120 The floor plan

Presentation of the plan



Garden

The garden that surrounds the hospice is divided into differed zones connected by a pathway. In front of the kitchen and library a playground is placed. A tool shed creates a border to the neighbouring car parking. Here equipment for maintaining the garden is places. A separate room is for vast and garbage.

When following the pathway around the house, the atmosphere grows less active and more calm and reflective as the pathway leads around the house. Benches are placed alongside the pathway, and creates pause sites, where the vies can be watcvvv$hed, while the children are playing on the grass.

Entrance

The entrance to the hospice is marked by a secluded wall that creates an overhang that shelters the family when they are unloading the car. While the father is parking the car, the family can rest on the bench outside or enter the building. Inside they have a clear visual contact to the courtyard, which can serve as a distraction for the children who may feel uneasy by the situation. The family are meet by an information board on the wall opposite the entrance that informs of the upcoming activities in the house. The reception is a part of the office and can assure the parent of the professional care they will receive.

A few steps further and the family are on the edge of the dining room. Here a small communication niche serves as a pausing place, where the family can observe the activity in the dining room. From here they can see the kitchen and through the glass doors of the kitchen they can gimps the playground. In the end of the dining room the library lies with a west facing view of the forest. In the evening the families can gather here and sit in front of the fire and read a book or play a board game.

Reflection Room

Behind the office lies the reflection room. This is a multifunctional space, where meetings, concerts and theatre performances can take place, but the main purpose of the room is to be a place where family and friends of the child can meet and have a last farewell after the child have passed away. A glass end wall brings light into the room and gives the coffin an easy access out to the hearts. The exit leads out to a sheltered garden that gives a peaceful atmosphere to the room.

Living Room

On the family's path towards their apartment, they are lead past the living room. Here a small kitchen provides the opportunity to heat baby formula or make a coup of coffee. The toddlers have been given their own space where they can play while the parents can sit and talk. A winter garden provides additional light into the room, and creates a buffer area between inside and outside. On warm days the winter garden can open up towards the courtyard. The sensory room divides the living room and the teenagers hang out, here the child´s senses get stimulated through sound, light and texture. The sensory pool provides an activity for the whole family and the warm water can be a mean of pain relief for the child.

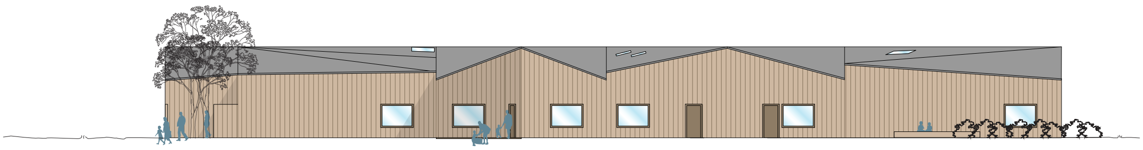
Courtyard

The courtyard is in many ways the heart of the building where the families can sit on the terrace and enjoy the sun and the children play. The plants create a calm atmosphere and bring nature into the building. The hallways cradling the courtyard have deep windows that can serve as private niches where the view of the courtyard can be enjoyed.

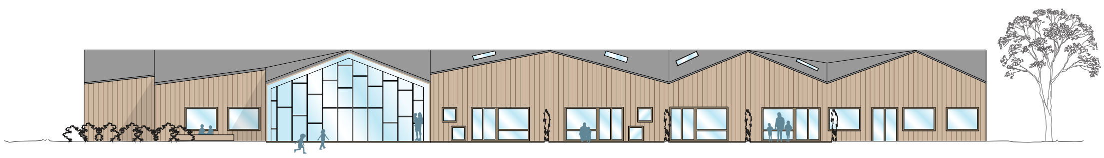
In the end of the hallway the family reaches their apartment, where they can retreat. The way to their new home has given them a preview of what the house has to offer, which will make it easier for them to navigate the building.

FACADES

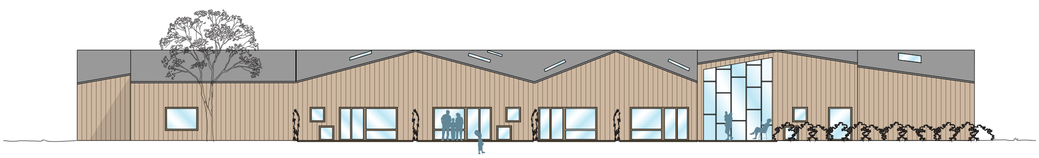
1:500



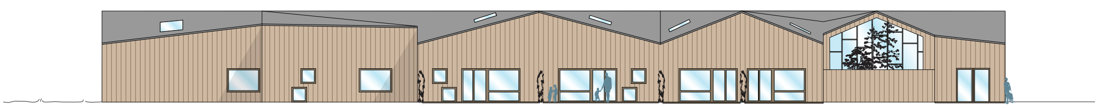
North



West



South

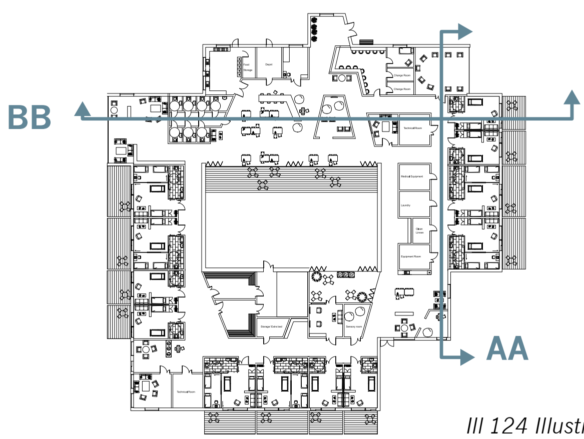


East

Ill 122 Facades

SECTION

Ill 123 Sections



Ill 124 Illustration of the section

EXTERIOR

Ill 125 The exterior of the building

FAMILY APARTMENT

Ill 126 interior of the family apartment

DINING ROOM

Ill 127 Dining room

HALLWAY

Ill 128 Hallway

INDOOR ENVIRONMENT

Air Change Rate

In the Children´s Hospice the fragile health of the sick children will in many cases prevent them from going outside. This means that the majority of the time the family spends at the hospice is spend inside. The stress and exhaustion that affects the family and the fragile health of the child suggests that the inhabitants are especially sensitive to the indoor climate, as stated in the analysis. The Danish Standard DS/EN 15251, have divided indoor quality into different category. The Children´s Hospice strives towards category 1, which is for people with a high expectation to the indoor climate.(www.ds.dk)

The investigation of the indoor climate is done where the occupants spends the most of their time, in their apartments. The survey is executed on the single apartment toward south and two family sized apartments towards west and east. The calculations presented here are done for the finished design.

The first step of the indoor climate investigation finds out which of the three factors that affects the indoor air quality has the determining factor. The factors are the pollution in the air from people and the building (olf), the CO_2 level in the room and the temperature in the room. To find which of these have the biggest affect on the air quality, the air change rate is calculated for the different factors.

The air change rate for olf and CO_2, single apartment:

Single room

Air change rate

Air change rate in therms of CO2: **0,7** h-1

c=q/nVr+ci

n=q/Vr(c-ci)

People: 2

Symbol	Units	Value	
c	ppm	750	The indoor consentration of CO2 above the outdoor consentration, (DS/EN 15251)
ci	ppm	400	The average CO2 consentration in Norway (NTNU og SINTEF)
qperson	m3/h	0,034	Polution from the people in the room, ***qperson=17M/1000*** (Aalborg Unviersitet, p 46)
Vroom	m3	138,3	Room volume
Vl	m3/h	97,1	Air flow rate
n	h-1	0,7	Air change rate

Air change rate in therms of pollution (olf): **1,4** h-1

c=10*q/Vl+ci

Vl=(10*(qperson+qroom))/(c-ci)

n=Vl/Vr

People: 2

Symbol	Units	Value		
c	decipol	1		Indoor air quality, (CR1752 p 23)
ci	deciplo	0,1		Outdoor air quality, (Aalborg Unviersitet, p 41)
qperson	olf	2	0,9	The people are producing 1M (Aalborg Unviersitet, p 46)
qroom	olf	3,0	1,8	Materials and ventilation in the room, a lov-olf building 0,1olf/m2, (Aalborg Unviersitey, p 4
Afloor	m2	29,9		Floor area
Vroom	m3	138,3		Room volume
Vl	L/s	55,4		Air flow rate
n	h-1	1,4		Air change change

INDOOR ENVIRONMENT
Air Change Rate

The air change rate for olf and CO_2, family apartment:

Family room
Air change rate

Air change rate in therms of CO2: **1,0** h-1

c=q/nVr+ci
n=q/Vr(c-ci)

People: 4

Symbol	Units	Value	
c	ppm	750	The indoor consentration of CO2 above the outdoor consentration, (DS/EN 15251)
ci	ppm	400	The average CO2 consentration in Norway (NTNU og SINTEF)
q_{person}	m3/h	0,068	Polution from the people in the room, ***q_{person}=17M/1000*** (Aalborg Unviersitet, p 46)
V_{room}	m3	197,6	Room volume
V_l	m3/h	194,3	Air flow rate
n	h-1	1,0	Air change rate

Air change rate in therms of pollution (olf): **1,3** h-1

c=10*q/Vl+ci
Vl=(10*(q_{person}+q_{room}))/(c-ci)
n=Vl/Vr

People: 4

Symbol	Units	Value	
c	decipol	1	Indoor air quality, (CR1752 p 23)
ci	deciplo	0,1	Outdoor air quality, (Aalborg Unviersitet, p 41)
q_{person}	olf	2	The people are producing 1M (Aalborg Unviersitet, p 46)
q_{room}	olf	4,4	Materials and ventilation in the room, a lov-olf building 0,1olf/m2, (Aalborg Unviersitey, p 40)
A_{floor}	m2	43,5	Floor area
V_{room}	m3	197,6	Room volume
V_l	L/s	70,6	Air flow rate
n	h-1	1,3	Air change change

40)

Of the two factors, the pollution in the air was the determining factor.

The next step is to check if the air change rate is enough to avoid overheating in the rooms. The spreadsheet Døgnmiddelberegning, provided by Aalborg University, is used for this task. According to category 1, the acceptable temperature rage is 21-25 C° in the summer time and 23,5-25,5 C° in the wintertime.

INDOOR ENVIRONMENT
Daily Average Calculation

The area of the building envelope and the volume are inserted into the spreadsheet and the calculations are done for a day in July. The air change rate given for the pollution in the previous calculation is used.

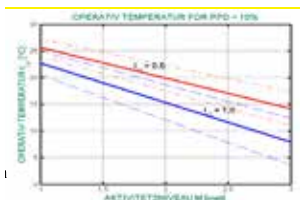
Loads for the single apartment

Load	Value	Schedule
People Load	2 persones	Always
Activity Level	1 Met = 100W (Sitting position)	Always
Equipment	1PC and 1TV= 30W	20W (PC) = 10am-17pm 30W(PC+TV)= 17pm-22am
Lighting	200 lux	8am-22pm

Loads for the family apartment

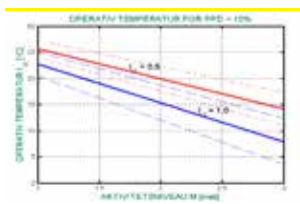
Load	Value	Schedule
People Load	4 persones	Always
Activity Level	1 Met = 100W (Sitting position)	Always
Equipment	2PC and 1TV= 50W	20W (1PC) = 10am-17pm 50W(2PC+TV)= 17pm-22am
Lighting	200 lux	8am-22pm

Projekt:			
Single room			
For valgt måned:	Juli	tu =	21 YC
Hvis ventilationsluften har samme temperatur som udeluften			
Døgnmiddeltemperatur	ti =	23,6	YC
Temperaturvariation	Δti =	7,3	YC
Maksimaltemperatur	timax =	27,2	YC



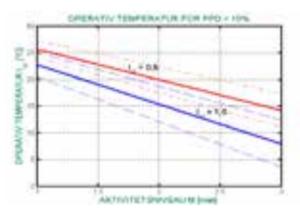
Result for the single apartment

Projekt:			
Family room			
For valgt måned:	Juli	tu =	21 YC
Hvis ventilationsluften har samme temperatur som udeluften			
Døgnmiddeltemperatur	ti =	23,2	YC
Temperaturvariation	Δti =	7,9	YC
Maksimaltemperatur	timax =	27,2	YC



Result for the west facing family apartment

Projekt:			
Family room			
For valgt måned:	Juli	tu =	21 YC
Hvis ventilationsluften har samme temperatur som udeluften			
Døgnmiddeltemperatur	ti =	23,5	YC
Temperaturvariation	Δti =	7,5	YC
Maksimaltemperatur	timax =	27,3	YC



Result for the east facing family apartment

The result shows that the air change rate must be increased to 4,5 h^{-1} for the single and the east facing apartment. Because of the low setting sun, the west facing family apartment must have an air change rate of 5 h^{-1}. With thin ventilation rate, the middle temperature in all the rooms are around 23C°. the highest maximum temperature is in the east facing apartment, where the temperature can get up to 27,7C°.

This means that the apartments have a acceptable indoor temperature.

INDOOR ENVIRONMENT
Natural Ventilation

The mechanical ventilation is active all year around, but when the temperature goes above 25,5C° it is assumed that they open the windows and uses natural ventilation. It is therefore investigated what the necessary area of the windows must be to be able to ventilate properly. The rooms have cross ventilation, where the air comes inn from the east, south or west faced windows and goes out through the skylight. The calculation is done for the worst-case scenario, a summer day with no wind, so the ventilation is only through thermal buoyancy. To simulate this the outdoor temperature is 20C° and the indoor temperature is 22C°. It is assumed that the natural ventilation happens through the 1,434 x 2,1m window in the façade and through the skylight 1,5 x 1,5m. These two windows have the same size and placement in both the single apartments and the family apartment.

Pressure Coefficient				**Windfactor**	
Windward	0,25			**Vmeteo**	
Leeward	-0,8			**Vref**	
roof	-0,65				
Location of neutral plan, Ho		2,7 m			
Outdoor temperature		20 C			
Zone temperature		22 C			
Discharge coefficient		0,7			
Air density		1,25 kg/m3			
	Area m2	**Eff. Area m2**	**Height m**	**Thermal Buoyancy pa**	**AFR (thermal) m3/s**
Inlet	3	2,100	1,417	0,109	0,88
Outlet	2,25	1,500	5,3	-0,214	-0,88
				Massebalance	0,00

Årsmiddel for gjennomsnittlig vindhastihet i Oslo 2,7 m/s

Air change rate for thermal buoyancy, in the single apartment

Air Flow Rate	3160,174	m^3/h
Volume of apartment	138,270	m^3
Air change rate	22,86	h^-1

Air change rate for the thermal buoyancy, in the family apartment

Air Flow Rate	3160,17	m^3/h
Volume of apartment	197,6	m^3
Air change rate	15,99	h^-1

The result shows that the inlet is below the neutral plane and the outlet is above the neutral plane, so the buoyancy is working, but the speed of the wind is too high, which means that the draft in the room is intolerable. A test is therefore done to see what area of the window opening is required to ventilate the air.

Pressure Coefficient				**Windfactor**	
Windward	0,25			**Vmeteo**	
Leeward	-0,8			**Vref**	
roof	-0,65				
Location of neutral plan, Ho		4,8 m			
Outdoor temperature		20 C			
Zone temperature		22 C			
Discharge coefficient		0,7			
Air density		1,25 kg/m3			
	Area m2	**Eff. Area m2**	**Height m**	**Thermal Buoyancy pa**	**AFR (thermal) m3/s**
Inlet	0,8	0,560	1,417	0,284	0,38
Outlet	0,5	1,500	5,3	-0,040	-0,38
				Massebalance	0,00

Årsmiddel for gjennomsnittlig vindhastihet i Oslo 2,7 m/s

Air change rate for thermal buoyancy, in the single apartment

Air Flow Rate	1358,032	m^3/h
Volume of apartment	138,270	m^3
Air change rate	9,82	h^-1

Air change rate for the thermal buoyancy, in the family apartment

Air Flow Rate	1358,03	m^3/h
Volume of apartment	197,6	m^3
Air change rate	6,87	h^-1

The result shows that an inlet opening of 0,8 m^2 and an outlet of 0,5 m^2 is enough for the thermal buoyancy to ventilate the apartment. This means that satisfactory ventilation will be created by opening the window ajar. The air change rate is still a bit high, and can create a draft, but that would be in the area close to the window and will decrease quickly and not affect the child in the bed.

INDOOR ENVIRONMENT
BSim Calculations

For a more accurate calculation over a whole year the program BSim is used. In BSim both the east and the west faced family apartment is calculated together with the south facing single apartment and situated in Oslo. The models are simplified to a rectangle with the correct areas of the openings to the windows and the doors.

Loads for the single apartment

Load	Value	Schedule
People Load	2 persones	Always
Activity Level	1 Met = 100W (Sitting position)	Always
Equipment	1PC and 1TV= 0,03 kW	20W (PC) = 10am-17pm 30W(PC+TV)= 17pm-22am
Lighting	200 lux	8am-22pm

Loads for the family apartment

Load	Value	Schedule
People Load	4 persones	Always
Activity Level	1 Met = 100W (Sitting position)	Always
Equipment	2PC and 1TV= 0,05 kW	20W (1PC) = 10am-17pm 50W(2PC+TV)= 17pm-22am
Lighting	200 lux	8am-22pm

Loads appied for both apartments

Load	Set Point	Max Temp.	Min Temp.	Schedule	Comments
Heating	24C			Always	The whole building is heated by floor heating, which give a good distribution of the heat and makes it comfortable for the kids to play on the floor. The main temperature is 24C°, but when the outside temperature is 21C°, the floor heating ceases. In BSim the floor heating and the radiator heat is calculated as one.
Infiltration				Always	
Ventilation		22C	19C	Always	The Max Temp and Min Temp values indicates the extremes of the mechanical ventilation. When the outdoor temperature is >-12 then the air is ventilated with 22C° and when the outdoor temperature is <10 the air supply temperature is 19C°.
Venting	25,5C or 700ppm				When the indoor temperature over 25,5C° or the CO^2 concentration is above 700ppm, it is assumed that the inhabitants opens the windows.

INDOOR ENVIRONMENT

BSim Result

According to DS474 (www.bygningsreglementet.dk) the temperature in the rooms, during time of occupancy, should not exceed 26C^{p} for more than 100 hours and should not exceed 27C^{p} for more than 25hours. The results shows that all of the apartments are within this range, although in the west faced family apartment, the ventilation supply must increase from 0,6 m3/2 to 0,065 m3/s to be able to bring the temperature down to 25h<27C^{p}. The west facing apartment is just inside the limit, and in reality it would probably be good to increase the air supply to be on the safe side. The CO2 levels are below 700ppm, which is the accepted limit.

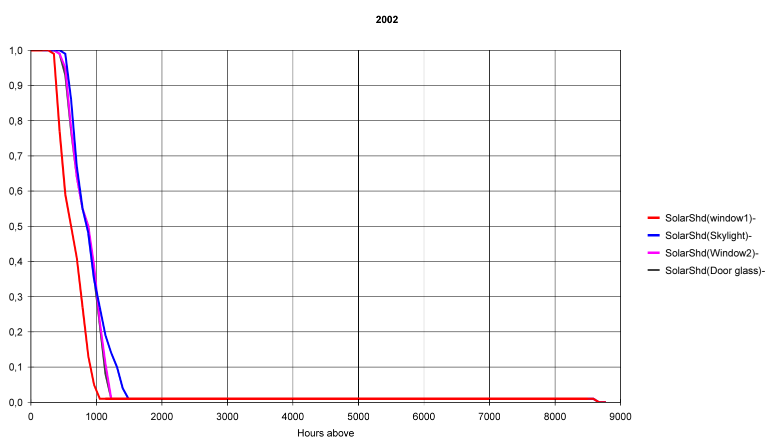
In the simulation it is assumed that all the windows and the glass door is shaded with blinds. The shading is activated when the indoor temperature is 24C^{p} and over. The sun limit is set to 0,3kW and when the blinds are shut the sunlight factor is 0,05 kW. The to diagrams below displays when the shades are used, this test is done to make sure the blinds are not drawn all the times.

Single Apartment facing south

Year 2002, tstep=90, RadModel=Petersen, Options: optimized

Month	Sum/Mean	1	2	3	4	5	6	7	8	9	10	11	12
qHeating	3794,54	523,54	430,54	412,61	346,32	224,89	147,49	97,59	118,12	231,47	337,40	409,18	515,37
qCooling	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
qInfiltration	-4237,18	-582,90	-479,51	-482,65	-402,10	-241,51	-175,30	-122,72	-135,47	-248,42	-355,73	-431,58	-579,30
qVenting	-17,22	0,00	0,00	0,00	0,00	0,00	-2,71	-9,27	-5,23	0,00	0,00	0,00	0,00
qSunRad	1024,75	26,28	50,61	95,17	121,57	141,57	141,39	131,75	116,83	95,09	66,34	28,66	9,49
qPeople	1261,44	107,14	96,77	107,14	103,68	107,14	103,68	107,14	107,14	103,68	107,14	103,68	107,14
qEquipment	155,13	13,18	11,90	13,18	12,75	13,18	12,75	13,18	13,18	12,75	13,18	12,75	13,18
qLighting	571,32	75,51	57,15	50,40	34,83	24,84	20,34	22,68	27,99	40,68	60,93	73,53	82,44
qTransmission	-845,25	-91,23	-92,38	-108,83	-83,53	-66,30	-44,81	-45,86	-36,04	-43,25	-73,42	-85,91	-73,70
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	-1707,52	-71,50	-75,07	-87,02	-133,52	-203,81	-202,82	-194,48	-206,52	-192,00	-155,83	-110,32	-74,62
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 mean(°C)	6,4	-3,5	-0,7	0,8	4,2	11,5	14,3	17,0	16,1	10,6	6,3	1,7	-1,5
tOp mean(°C)	23,1	22,0	22,3	22,1	22,9	24,0	24,2	24,4	24,2	23,7	23,0	22,6	21,7
AirChange(/h)	1,9	1,9	1,9	1,9	1,9	1,8	1,8	1,9	1,8	1,8	1,9	1,9	2,0
Rel. Moisture(%)	28,4	19,3	19,5	19,8	20,8	28,8	35,7	45,4	45,4	32,8	29,2	24,5	19,5
Co2(ppm)	459,8	457,8	457,7	457,9	457,9	463,5	462,2	462,4	464,5	461,2	458,4	459,5	453,9
PAQ(-)	0,5	0,7	0,7	0,7	0,6	0,4	0,3	0,1	0,1	0,4	0,5	0,6	0,7
Hours > 21	7600	575	524	560	593	733	720	744	744	678	621	575	533
Hours > 26	34	0	0	0	0	0	14	16	4	0	0	0	0
Hours > 27	11	0	0	0	0	0	3	8	0	0	0	0	0
Hours < 20	1064	160	138	171	117	8	0	0	0	30	107	135	198

The diagram shows that the skylight needs the most shading, and the blinds are closed around 500 hours a year, while the south facing windows are closed 300 hours during the year. The south facing windows are 50% shut during 500 hours over a year.

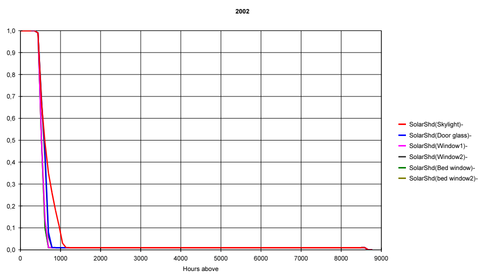


BSim Result

Family Apartment facing east

Year 2002, tstep=90, RadModel=Petersen, Options: optimized

Month	Sum/Mean	1	2	3	4	5	6	7	8	9	10	11	12
qHeating	4241,77	625,70	498,23	535,28	423,88	198,99	112,90	62,83	79,21	234,69	387,36	469,62	613,07
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	-6158,95	-845,13	-681,25	-716,41	-591,89	-339,19	-253,28	-180,66	-198,58	-364,14	-528,06	-624,03	-836,33
qVenting	-135,32	0,00	0,00	0,00	-0,50	-12,90	-21,25	-62,26	-38,12	-0,29	0,00	0,00	0,00
qSunRad	822,21	10,18	25,23	61,49	91,55	131,42	134,38	133,53	104,29	72,77	38,36	13,20	5,81
qPeople	2522,88	214,27	193,54	214,27	207,36	214,27	207,36	214,27	214,27	207,36	214,27	207,36	214,27
qEquipment	1241,00	105,40	95,20	105,40	102,00	105,40	102,00	105,40	105,40	102,00	105,40	102,00	105,40
qLighting	641,43	83,61	68,94	57,96	40,23	28,89	23,58	27,36	33,12	44,28	69,48	80,28	83,70
qTransmission	-1252,68	-95,64	-117,72	-131,37	-111,07	-123,05	-94,92	-94,65	-82,31	-88,67	-100,67	-121,58	-91,02
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	-1922,34	-98,39	-82,17	-126,63	-161,57	-203,83	-210,77	-205,84	-217,27	-208,00	-186,13	-126,85	-94,90
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 mean(°C)	6,4	-3,5	-0,7	0,8	4,2	11,5	14,3	17,0	16,1	10,6	6,3	1,7	-1,5
tOp mean(°C)	23,5	22,7	22,4	23,0	23,5	23,9	24,3	24,6	24,5	24,1	23,6	23,0	22,2
AirChange(/h)	1,6	1,6	1,6	1,6	1,5	1,5	1,6	1,7	1,6	1,5	1,5	1,5	1,6
Rel. Moisture(%)	28,7	19,5	20,8	19,5	21,0	29,9	36,4	45,5	45,8	33,2	28,6	24,8	19,5
Co2(ppm)	539,6	538,2	538,8	537,9	538,3	546,5	542,4	531,2	542,5	546,5	539,7	542,5	530,3
PAQ(-)	0,4	0,6	0,6	0,6	0,6	0,4	0,3	0,1	0,1	0,3	0,4	0,5	0,7
Hours > 21	7966	630	535	631	657	715	720	744	744	720	688	608	574
Hours > 26	62	0	0	0	0	0	17	35	10	0	0	0	0
Hours > 27	23	0	0	0	0	0	10	13	0	0	0	0	0
Hours < 20	673	107	129	91	46	24	0	0	0	0	24	97	155

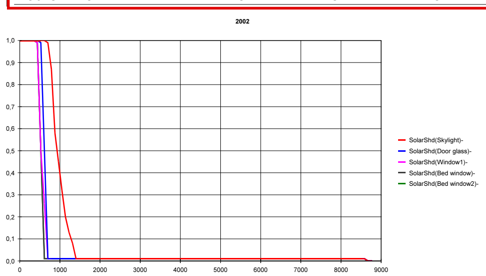


The diagram shows that the needs for shading is similar for all the windows, including the skylight. And that the blinds are shut approximately 1000 hours during a year.

Family Apartment facing west

Year 2002, tstep=90, RadModel=Petersen, Options: optimized

Month	Sum/Mean	1	2	3	4	5	6	7	8	9	10	11	12
qHeating	4685,47	693,32	548,46	558,87	419,13	257,50	148,80	94,92	111,77	260,53	420,72	483,39	688,07
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	-6104,43	-825,47	-689,08	-707,26	-577,74	-347,06	-251,00	-177,03	-195,40	-357,00	-525,56	-618,23	-833,61
qVenting	-109,64	0,00	0,00	0,00	-1,07	-12,53	-16,39	-48,84	-30,62	-0,19	0,00	0,00	0,00
qSunRad	892,30	11,77	29,48	69,68	109,94	136,89	139,85	133,15	111,61	81,67	46,81	14,82	6,64
qPeople	2522,88	214,27	193,54	214,27	207,36	214,27	207,36	214,27	214,27	207,36	214,27	207,36	214,27
qEquipment	1241,00	105,40	95,20	105,40	102,00	105,40	102,00	105,40	105,40	102,00	105,40	102,00	105,40
qLighting	523,71	77,76	60,75	50,67	27,27	15,39	12,24	11,70	20,70	35,01	59,22	74,88	78,12
qTransmission	-989,93	-63,60	-97,30	-108,25	-99,94	-94,44	-72,97	-73,03	-61,38	-70,93	-82,88	-105,55	-59,65
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	-2661,37	-213,45	-141,05	-183,38	-186,94	-275,42	-269,89	-260,54	-276,35	-258,45	-237,98	-158,67	-199,24
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 mean(°C)	6,4	-3,5	-0,7	0,8	4,2	11,5	14,3	17,0	16,1	10,6	6,3	1,7	-1,5
tOp mean(°C)	23,4	22,2	22,6	22,8	23,1	24,1	24,3	24,5	24,4	23,8	23,6	22,8	22,2
AirChange(/h)	1,8	1,8	1,8	1,8	1,8	1,8	1,8	1,9	1,8	1,7	1,8	1,8	1,9
Rel. Moisture(%)	28,6	19,8	20,5	19,5	21,3	29,2	36,2	45,6	45,7	33,3	28,3	24,5	19,7
Co2(ppm)	511,7	511,1	510,6	510,2	510,6	516,0	514,4	507,9	514,7	516,3	511,1	513,5	504,4
PAQ(-)	0,5	0,7	0,6	0,6	0,6	0,4	0,3	0,1	0,1	0,4	0,5	0,6	0,7
Hours > 21	7882	600	537	612	623	744	720	744	744	698	693	589	578
Hours > 26	71	0	0	0	0	0	18	40	13	0	0	0	0
Hours > 27	25	0	0	0	0	0	11	13	1	0	0	0	0
Hours < 20	797	137	125	124	92	0	0	0	0	13	41	109	156

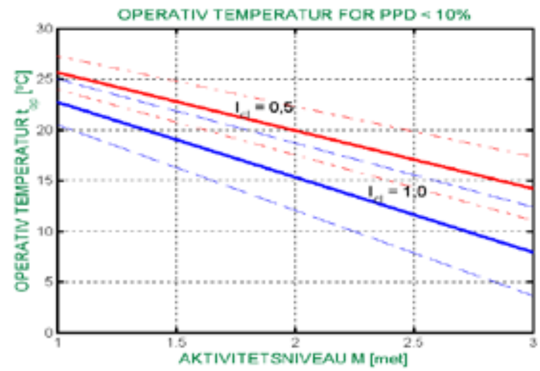


The diagram shows that the skylight needs the most shading, the blinds are closed approximately 600 hours during the year. While the west facing windows are shut around 500 hours during the year.

INDOOR ENVIRONMENT
Dining Area

Floor-to-ceiling windows along the whole south wall characterize the dining area. Although blinds will shade the windows, it is still reasonable to believe that the room is in danger of over heating. A daily average calculation is therefore calculated to see what the temperature is during the critical moth of July. The air change rate for the family apartment is used as a point of departure. It is assumed that the room holds a people load of t40 persons. (This corresponds to all the families and additional visitors or staff.) It is assumed a full people load during dining hours and a people load of 10 persons from 8am-22pm. There is no fixed equipment in the room, but in case someone brings their computer, it is assumed 5 computers during the period 10am-18pm.

For valgt måned:	**Juli**	tu =	**21**	ϒC
Hvis ventilationsluften har samme temperatur som udeluften				
Døgnmiddeltemperatur		ti =	**23,2**	ϒC
Temperaturvariation		Δti =	**7,9**	ϒC
Maksimaltemperatur		timax =	**27,1**	ϒC



The result shows that the air change rate must be increased to 4,5 h-1 to be able to ventilate sufficiently. The buildings surrounding the courtyard shade the building, this leads to a shading factor of 0,4, which leads to sufficient natural light inside the room. The average room temperature is 23,2 Co with a maximum temperature of 27,1Co. Since there is a tolerance of 25 hours above 27Co the temperature in the dining room is acceptable.

INDOOR ENVIRONMENT
Acoustics

The acoustic challenges in a building can be divided into two parts, the building acoustics and the room acoustics. The building acoustic is the sound that travels in the building. The transmission path goes from room to room and from floor to floor. In the hospice building, it is important that the sound does not travel from one room to another. According to Trehusboka will the walls be sufficient sound proof if the thickness is 232mm. (SINTEF Byggforsk, 2010). This includes a layer of fibreboard under the interior timber cladding on both sides.

The room acoustics concerns the sound that affects the room when the sound emitter is in the room. The reverberation time, the time it takes for the sound signal to decrease with 60dB in sound intensity, can affect a persons well being in the room. The reverberation time decreases when furniture or the building materials absorb the sound. Since the apartments are furnished and quite small, the reverberation time is not calculated for this room. The acoustics are calculated for the worst-case scenario, the dining room, which is the biggest room in the house and holds the most people. According to BR95 (P. H. Kirkegaard) the acceptable reverberation time in a day-care centre, which it is natural to associate the building with, is Tmidle < 0,6 s in 120-2000 Hz. The reverberation time is calculated by the Sabine formula:

Tsab = 55,3 x (V(cA))

V=room volume
c= the speed of sound (340 m/s)
A= equivalent absorption area, which depends of the different materials absorptions coefficient (www.sae.edu)

T=(0,16*V)/((Sa*s)+(Sn*A)+(4*m*V))

Ækvivalent absorpsionsareal	(Sa*s)
Absorptionskoefficient	α
Overfladeareal	S
Absorption fra personer	(Sn*A)
Antal personer	n
Absorptionskoefficient for en person	A
Absorption i luft	*(4*m*V)
Luftabsorption	m
Rumfang	V

*Kun beregningsmæssig betydning hvis V > 1000 m3

The spread sheet shows that the reverberation time for a sound of 125 Hz is 1,38sm which is 1,38s-0,6 s= 0,78s over the recommended value. A way to solve this can be to use acoustic plasterboards in the ceiling or introduce sound absorbent boards on the walls. The room is now calculated for the minimum of furnishing, but will in reality also have shelves and more sitting areas.

Ækvivalent absorpsionsareal	**Materiale**	**Areal**	**125 Hz**		**250 Hz**		**500Hz**		**1000Hz**		**2000Hz**	
		S (m^2)	α	Sα	α	Sα	α	Sα	α	Sα	α	Sα
Gulv	Parket på beton gulv	275,4	0,04	11,02	0,04	11	0,07	19,3	0,06	16,52	0,06	16,52
Loft	Gipsplater	244,8	0,15	36,72	0,11	26,9	0,04	9,79	0,04	9,792	0,07	17,14
Vegger	Trepanel	242,6	0,25	60,65	0,22	53,4	0,17	41,2	0,09	21,83	0,1	24,26
Vinduer	Glass	122,9	0,18	22,12	0,06	7,37	0,04	0,03	0,08	9,832	0,02	2,458
Stoler	Tre (2/3 okkupert)	10	0,37	3,7	0,4	4	0,47	4,7	0,53	5,3	0,56	5,6
Bord	Træ	20	0,1	2	0,09	1,8	0,08	1,6	0,08	1,6	0,08	1,6
Dør	Træ	18	0,1	1,8	0,07	1,26	0,05	0,9	0,04	0,72	0,04	0,72
Absorption fra personer		**Antal**	Sα/stk	Sα	Sα/stk	Sα	Sα/stk	Sα	Sα/stk	Sα	Sα/stk	Sα
Personer		40	0,25	10	0,35	14	0,42	16,8	0,46	18,4	0,5	20
Absorption i luft												
v/ 50% RF	**Volumen**		**125 Hz**		**250 Hz**		**500Hz**		**1000Hz**		**2000Hz**	
			m	mV	m	mV	m	mV	m	mV	m	mV
	m^3	1276,4					4E-04	0,51	0,001	1,276	0,002	3,063
Total absorption			1,4	148,0	1,3	119,8	1,3	94,3	1,4	84,0	1,4	88,3
Efterklangstid				1,38		1,71		2,16		2,431		2,313

Kilde: http://www.sae.edu/reference_material/pages/Coefficient%20Chart.htm

Be10 CALCULATION

The energy requirement that was stated in the research part of the report was to reach the BR2020 demand of an energy consumption of 20kWh/m² a year. To be able to calculate this the program Be10 is used. The Be10 program works like a spreadsheet where the different values of the building must be added before the program is able to calculate the energy consumption. The building has distant heating and is calculated as a residential building.

The areal and the values of the building envelope are inserted into the program. The value of the different influences that characterizes the building is added. The building has mechanical ventilation that is active throughout the year. The mechanical air-flow is set to 0,6 l/s m² in both the summer and winter time, with a temperature of 18C°.

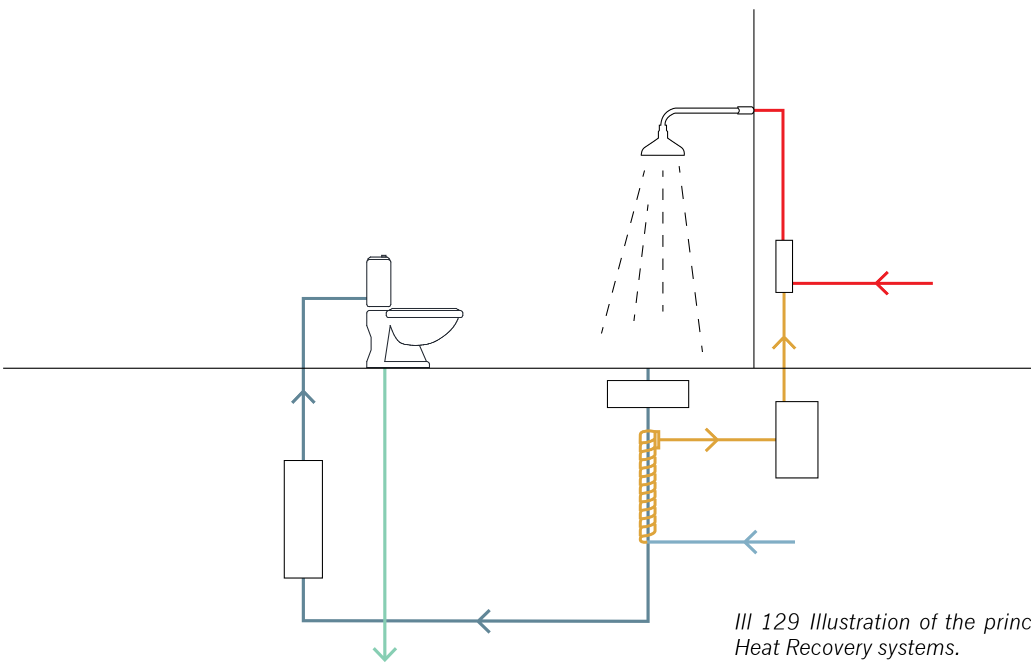
The internal heat gain from the inhabitant is set for a residential building, but the equipment load is increased. The hospice includes an office area with several computers, printers etc. The equipment load is therefore equivalent to the load given for a non-residential building.

The building receives cold water with a temperature of 10C° that is heated up to 55C°. Using a drain water heat recovery system can reduce the energy used for heating the warm water. The DWHR-system reuses the heat from the grey water that is produced by the shower and uses it to heat up the cold water that comes into the building. The now cold grey water is then used to flush the toilet. The heated water is then stored in a tank until someone needs warm water again.

According to renewability.com their Power-Pipe-system can, by utilize the heat from the gray water, heat water from a temperature of 10C up to 24C° under equal flow conditions. The water is then stored in a water tank in room temperature.

This means that the distant heating only needs to heat the water by:

55C- 14C= 41C°.



Ill 129 Illustration of the principles behind Drain Water Heat Recovery systems.

Be10 CALCULATION
Result

The result shows that the building has an energy consumption of 24,4 kWh/m² per year. Which is 4,4kWh/m² per year over the building regulations 2020 demand of 20 kWh/m² per year. The building uses 9,1 kWh/m² per year on warm water and to compensate for the losses in the systems used in the building. Room heating takes 8,1 kWh/ m² a year.

Energiramme BR 2010

Uden tillæg	Tillæg for særlige betingelser	Samlet energiramme
53,2	0,0	53,2
Samlet energibehov		36,9

Energiramme Lavenergibyggeri 2015

Uden tillæg	Tillæg for særlige betingelser	Samlet energiramme
30,4	0,0	30,4
Samlet energibehov		33,3

Energiramme Byggeri 2020

Uden tillæg	Tillæg for særlige betingelser	Samlet energiramme
20,0	0,0	20,0
Samlet energibehov		24,4

Bidrag til energibehovet		Netto behov	
Varme	18,1	Rumopvarmning	8,1
El til bygningsdrift	7,5	Varmt brugsvand	9,2
Overtemp. i rum	0,0	Køling	0,0

Udvalgte elbehov		Varmetab fra installationer	
Belysning	0,0	Rumopvarmning	0,9
Opvarmning af rum	0,0	Varmt brugsvand	0,1
Opvarmning af vbv	0,0		
Varmepumpe	0,0	**Ydelse fra særlige kilder**	
Ventilatorer	7,4	Solvarme	0,0
Pumper	0,1	Varmepumpe	0,0
Køling	0,0	Solceller	0,0
Totalt elforbrug	60,1	Vindmøller	0,0

Ill 130 Be 10 result without active means

Active means is therefore necessary to be able to reach the 2020 demands. 110m² of solar cells are installed on the roof. The solar cells follow the shape of the roof, which gives them an average angle of 21°. This brings the building energy down to 19,8 kWh/m² per year, which means that the building fulfils the 2020 demands.

Nøgletal, kWh/m² år

Energiramme BR 2010

Uden tillæg	Tillæg for særlige betingelser	Samlet energiramme
53,2	0,0	53,2
Samlet energibehov		30,6

Energiramme Lavenergibyggeri 2015

Uden tillæg	Tillæg for særlige betingelser	Samlet energiramme
30,4	0,0	30,4
Samlet energibehov		26,9

Energiramme Byggeri 2020

Uden tillæg	Tillæg for særlige betingelser	Samlet energiramme
20,0	0,0	20,0
Samlet energibehov		19,8

Bidrag til energibehovet		Netto behov	
Varme	18,1	Rumopvarmning	8,1
El til bygningsdrift	7,5	Varmt brugsvand	9,2
Overtemp. i rum	0,0	Køling	0,0

Udvalgte elbehov		Varmetab fra installationer	
Belysning	0,0	Rumopvarmning	0,9
Opvarmning af rum	0,0	Varmt brugsvand	0,1
Opvarmning af vbv	0,0		
Varmepumpe	0,0	**Ydelse fra særlige kilder**	
Ventilatorer	7,4	Solvarme	0,0
Pumper	0,1	Varmepumpe	0,0
Køling	0,0	Solceller	2,5
Totalt elforbrug	60,1	Vindmøller	0,0

Ill 13 Be 10 result with active means

CONCLUSION

When the family enters the building the family is presented with the essence of the building. The staff in the reception greets the arriving family to the hospice. From here the family is able to see the residence enjoying the each other's company in the dining area where they eat, play or relax. Through the glass façade, they can see the threes in the inner courtyard and people resting on the terrace. This view can distract the child and ease some of the uneasiness of the new surrounding. Behind the reception they can see the nurse station where the nurses and doctors work. The first impression of the building holds the essence of what the building is about. A place where the family can enjoy each other company or meet others in a similar situation, under the care of professional staff. The house offers the families a way to continue with their daily routine and be able to focus on each other and enjoy their time together.

The arriving family is able to have a visual contact with the life in the dining area, but is able to choose if they want to take part of it or follow the path to the apartments. The circulation in the building is easy to navigate, and moved around the courtyard, which applies the house with daylight. Through the house, there are small niches with sitting arrangements. The severity of the situation calls fore the possibility to hide away and be alone with ones thoughts. Or have a quiet conversation with the staff or other residences.

The aim of the house is to offer life to the final days of the child. The family can find different activities in the house of which they can enjoy together. The pool offers an activity where the whole family can join, and the movie room has large pillows, where the family can gather to watch movies or children´s TV. Activities like concerts or theatre can be hold in the reflection room, and be a way to mark holidays or events. During the day the parents can watch the children can play in the toddlers play room in the living room area or the teenagers can hang out in the teenager room, while they have a chat over a cup of coffee. In the evening the family can gather in front of the fireplace and read a good book.

When the family arrives the hospice, they have a difficult road behind them and an even harder one in front of them. The hospice cannot prevent the sorrow they are going through but they can ease the stress and make the way more comfortable. The house allows the family to know their child will get the best care all the way to the end, and provides them with the possibility to focus on what's most important, the family and the joy they have together.

REFLECTION

The challenge of this project was to design a building that contained the extremes of the human emotional specter. A building that balances sorrow and joy but with room for both. The approach was to allow death to be a natural part of the building, but not the main focus. The focus is of the child and his or her family and the life and joy they share together. The child is to be treated as a child and not as a terminally ill patient.

The result of the challenge is a building that facilitates for the family, where the family is allowed to be themselves in homely surroundings and decide for themselves in what way they want to deal with the situation. The building utilizes the materials and the building form to create zones with different characteristics that meets the individual needs of the family. The buildings closeness with nature is a redeeming factor for the stress the family is under and a source of fascination and joy for the children. The buildings focus on life can be seen in the social gathering places where the family can meet others in similar situations and enjoy each other's company. The closeness of the staff creates a safety for the family and a break, so they only have to focus on each other.

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Illustration 112 Detail inspirated by Hunton wall systen, www.hunton.no
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