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Rossan & Mathias

Livsrum Herlev

A new Cancer Counselling Centre for Herlev Hospital

ad:mt - Aalborg University
Master thesis
Msc 04 - Ark 37
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Mathias Sønderskov Nielsen

PREFACE

This project is a 4th semester master project created by Mathias Sønderskov Nielsen and Herin Rosanthan David at Architecture and Design on Aalborg University. This result of the project is a design proposal for a health centre for cancer sufferers for Herlev and surroundings. The architectural qualities must stimulate and promote the healing process. The project is based on the overall program for counselling centres in the Cancer Society's "Kræftrådgivninger i det 21. århundrede" by Arkitema Health for the Cancer Society in cooperation with Realdania. The themes for the project are evidence based design, indoor climate and aesthetic qualities of light in health counselling buildings.

A special thanks goes to the staff at the visited Maggie Centres and Livsrum Centres, for their willingness to share their knowledge of their centres and open their doors for us.

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ABSTRACT

The project is based on the desire from the Danish Cancer Society to build a centre for Herlev Hospital, as a part of the Livsrum Series. The themes of the project are evidence based design, atmosphere and indoor environment, all with a main focus of daylight and integrating nature. The building type as well the site are analyzed and main parameters were found from both the themes and the analysis to have a point of departure for the process of developing the project. This has resulted in a study trip to Scotland and trough Denmark, where the Maggie Centres and the Livsrum Centres were visited.

The result is a building where cancer patients can seek both counselling and social gatherings, while also being an attractive workplace for employees and volunteers. The form of the building interprets the structure of the surrounding trees, emphasising the tree bands - the root, the trunk and the crown. This creates a relation with the surrounding park, being a contrast to the Hospital - here you are not a number, but a human being. The expression of the building will get people interested to see the life in the building and the barrier between outside and inside has been removed - inviting nature into the house. The project is designed using an integrated design process where technical elements such as indoor air quality and evidence based design is integrated in the process.

Herin Rosanthan David

Mathias Sønderskov Nielsen

PROGRAM

SYNTHESIS

APPENDIX

INTRODUCTION

This project deals with feelings, happiness, hope and sorrow. It is attempted to make a design that can facilitate all those feelings that are related to having cancer or being related to sufferers. It is our most humble task to create hope for everyone who is visiting this centre.

"Architects and doctors are two occupations committed to hope [...] They both construct future worlds of better value [and] are prospective professions oriented to positive outcomes."

(Jencks, 2014, p. 24)

In the present time every third Dane is or has been afflicted by cancer. This means that most of us have a family member or a friend who is afflicted or has been afflicted. Therefore, it is highly important to focus on measures that can help to increase the quality of life and healing for cancer sufferers and their relatives (Cancer.dk, 2015). The goal of this project is to create a new cancer counselling centre for cancer sufferers in Herlev, which could provide a safe space for social interaction and reflection, physical movement, personal change and support in the course of a disease. In this house the person itself is in the centre and therefore the architecture should appeal to both the senses and the soul in contrast to the hospital, which focuses on the medical treatment of the body. The goals is to create a unique architectural expression with an open and welcoming atmosphere with a homely character, while it appeals to the users' natural curiosity and take them around the spatial composition of the building. This new cancer counselling centre is a place where all visitors, both the patient and the relatives can come and find information, support, advice and socializing with others in the same situation. In addition, the architecture should encourage movement and health and accommodate fitness and treatment facilities for rehabilitation and well-being.

The house should be an open and welcoming place, forming a safe environment for confidential conversation and togetherness. The project has its starting point in the contemporary debate and recognition of architecture as healing architecture. Research on healing architecture is fundamentally based on evidence based research within the hospital system. Especially the irrational aspects and the influence of the differentiating light are now considered largely essential to involve in hospital architecture to promote the healing process. This project is based on this philosophy, and focuses on the phenomenological aspect of the architecture, which is inspired by theories by Carlo Volf, Juhani Pallasmaa Peter Zumthor and Christian Norberg-Schulz on various aspects of how to create architecture for the senses and the soul, using primarily the influence of daylight on the architecture itself.

The project is based on the Danish Cancer Society's plan to move more of the major counselling centres to a location in close connection with the new upcoming super hospitals in Denmark (Petersen & Svendler, 2008). The aim is to create more awareness and easier availability from treatment to counselling. The Cancer Society's vision takes inspiration from the philosophy created by the Maggie's Centres in Great Britain, whose goal is to cover the individual and psychological needs and to supplement the medical treatment at the hospital. The Maggie's Centres' philosophy is to a large extent that the architecture is important for the human well-being and consequently also the healing process. With healing architecture and the influence of light and nature as the basis and the Cancer Society's desire to have a location in close connection with Herlev Hospital, it was decided to place the counselling centre in the Hospital Park, west of the hospital. With this location the centre will have a close connection to the hospital and will take advantage of the recreational qualities of the park. At the same time, the public placement will draw more attention to the building itself and its function.

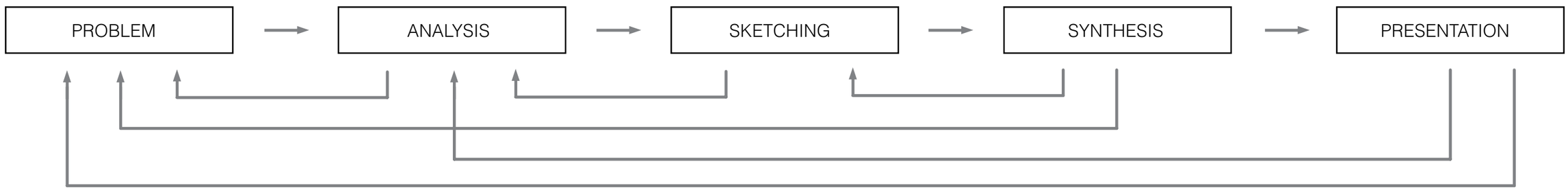


Illustration 1. A principle of the integrated design process (IDP) from Mary-Ann Knudstrup (2005).

METHOD

This master thesis has been developed using The Integrated Design Process, which is also described by Mary-Ann Knudsstrup (2005). In the process the architectural, the functional and the technical parameters will be integrated to create a building of a significant architectural quality. The process consists of several phases, which develop from an initial analysis phase, a sketching phase, a synthesis phase and finally to a presentation phase. The process is iterative, signifying that the process will be made in continuous loops, due to ongoing discoveries. The iterations are part of the work towards the ultimate objective of a building of high architectural quality which functions well, looks good and feels good without using too much energy.

The project is based on an analysis phase where the users of the cancer counselling centres and project site are studied. To analyse the users, a semi-structured interview is used as a tool to gather knowledge about the cancer centres that have been visited. Here the Livsrum Centres in Denmark and the Maggie Centres in Scotland have been visited. When using the interview as a qualitative tool, there can be gathered information about their functional and spatial requirements, as well as the social aspects with regard to the users and employees.

When analysing a project site there is used a combination of *Tracing and Mapping* by James Corner (1999) and *Serial Vision* by Gordon Cullen (1971) and a perceptual awareness of the area, experienced through physical presence in and around the project site. These methods provide an understanding of the project site, its qualities and issues. From the analyses, a set of design parameters is identified, as well as a vision that forms the basis for the sketching phase.

Based on the analysis phase, the sketching phase starts with brainstorms and workshops on how to integrate the parameters from the analysis phase. During this process the ideas needs to be considered for their potential to meet both the architectural, functional, constructive and indoor climatic requirements, thus creating an integrated design process. Each major design decision will be evaluated on aesthetics, function and performance.
The sketching phase is adapted several times to optimize the final solution, which is fully in place in the synthesis phase, in which the building gets its final shape. In this phase, the efforts are on the spatial qualities, light, materials, plan solutions, aesthetics, building envelope and energy framework to work together in order to create good architectural spatial experiences, as well as functional and technical solutions. Finally, the project is presented, focusing on showing all the qualities. This is done through the presentation phase of the project report and during the project examination, where earlier phases and the final design are documented.

“The term ‘Total Architecture’ implies that all relevant design decisions have been considered together and have been integrated into a whole by a well organised team empowered to fix priorities. This is an ideal which can never - or only very rarely - be fully realised in practice, but which is well worth striving for, for artistic wholeness or excellence depends on it “

(Sir Ove Arup, 1970, p. 4)

PROGRAMME

This programme describes the scope of the project. This chapter starts by explaining the foundations of the cancer counselling centre by looking at existing centres in Denmark and Scotland. The Danish Livsrum series is inspired by the Scottish Maggies Centre, which created the foundation for the concept of open counselling. The history of the centres and the thoughts behind them will be described. Both types of centre are using the concept of the Healing Garden. The principles behind these are briefly explained.

To specify the theme, Nordic architecture is explained in its relation to site and how it can be interpreted using tectonic principles. This is something, which is natural to the authors, but might be unknown to people not familiar with the Scandinavian traditions. The cold, Nordic climate, limited global resources and global warming force projects to limit energy consumption on heating and lighting. In order to do this, the building shape has to be optimised in the early phases. The principles of optimisation and focus areas such as daylight are explained in the sustainability section. The effects daylight has on health and happiness is explained in the daylight section.

In order to gain a feeling of the site, different functions are traced in the area to find out how the site is rooted to its context. A serial vision is made on the park of the site to get a spatial presentation and to experience the space as an observer. This serial vision takes its point of view in the arrival to the centre, as this is the spatial atmosphere that visitors will experience. Lastly, the climatic conditions of the site are mentioned and summed up, which will be used to the orientation of the building.

Study trips are made to several counselling centres in Denmark and in Scotland. The learning of these trips is summed up in the case studies section. The section will explain different rooms and feelings that affected the authors on an emotional level and other practical things that did or did not work. This is an experience that has to be delivered to the design of the coming Herlev Cancer Counselling Centre.

The content of the Herlev Cancer Counselling Centre is explained in the room programme and oriented internally and according to the climate and site in the function diagram. This data is based on data from other counselling centres and modified based on visits and reflections on the other centres.

All these examinations are summarized in the design parameters accompanied by our vision for the project. It is important, that there is a clear link between the parameters and the examinations.

Theme
Cancer counselling centres

MAGGIE'S CANCER COUNSELLING CENTRES

The Maggie's Centres are a recurring theme throughout this project. They are the first concept of its kind and the Danish cancer-counselling centres refer to them. The authors have looked upon these centres as a point of departure for the project. They are also visited in Scotland and England and used as case studies later in the report.

The origin of the Maggie's Centres
The Maggie centres are a concept that started in 1996 in the city of Edinburgh in Scotland. The concept is now spread throughout Europe and as well all the way to Asia. The Maggie's Centres are a private organisation, which raises their own money, which means they are not funded by the government. Each Maggie's Centre has its own fundraisers who collect money in the local area, compared to the system here in Denmark where it is the Danish Cancer Society which raises all the money, as a main organisation.

A Maggie's Centre is a place where the public can seek help and support through all the problems related to cancer. The offers are free and apply for all cancer patients; the cancer sufferers and the relatives, family and friends. The centres provides information, advice, psychological support, different courses or just a place to meet others in the same situation. People affected by cancer are all different and therefore the house must address widely and offer the environment they need. It is the professional's job to listen to the patients and relatives and help identify the tools needed so the patients can help themselves through the process.

The concept for Maggie's Centres in Scotland and England was developed by the landscape architect Maggie Keswick Jencks, who herself was diagnosed with cancer in 1993, and her husband, architect, Charles Jencks. Maggie saw through her illness to a high degree, in addition to the medical treatment, the lack of support and advice in dealing with the situation, of having to learn to live a life with cancer. This inspired her and her husband to develop the first Maggie Centre in their hometown of Edinburgh in Scotland, in cooperation with the architect Richard Murphy. Maggie felt that it was important for the cancer sufferers to be an active player in the process of the treatment and to be informed about the course of the treatment and their opportunities, so that they did not become a victim of cancer but actively took part in the treatment.

For many it requires much courage to ask for help, and to take the first step into the centres, and therefore it is important to welcome the patients instantly when they enter the facility. Maggie Keswick Jencks had the conviction that architecture and physical environment can have a major impact on the well being. The objective of Maggie's philosophy is that the patients need to feel valuable as a person and not just as another patient. Maggie's is a place where a community can grove. The buildings should seem uplifting, surprise and renew the soul and therefore all Maggie centres are also different. Because the centres have their own identity, the users get more attached to the buildings, and they therefore feel at home when they enter the building. To amplify this, Charles Jencks expresses his thoughts clearly:

"I discovered that people responded to the building itself. Watching their reaction and the difference in the way people moved, sat and spoke around each other, we began to articulate the important of the 'Maggie's welcome'. Freed from the formality of reporting to a reception desk, people walk into Maggie's as individuals in their own right, rather than patients to be processed. With no signs on the wall, staff and visitors connect in a personable and domestic way; people are not isolated, because they have to engage with other people to ask where the things are, as they would in a friend's house. A conversation by the kettle between a support specialist and a visitor allows an informal start to the relationship. It removes the boundaries of 'care giver' and 'care receiver' and becomes an exchange between equals."
(Jencks, 2014, p. 54)

The kitchen is a central element and the heart of the house. This is where the visitors have the opportunity to make their own coffee and settle down at the dining table, and this is here they gather when there are both large and small events. Therefore, the facilities of the centre are also arranged around the heart of the house, the kitchen. The centres are designed in a flexible manner that encourages conversation in smaller or larger groups, and in both open and closed spaces. The rooms encourage socializing and invite the patients to build personal relationships. It was from the start important for the concept that the Maggie centres are of a size comparable to a traditional house. The small scale makes the centre to appear homely, safe and welcoming. The house must rise to the occasion in the same way as the users has to rise themselves from the most difficult situations in their life.

"If one focuses on the variety of functions, then the typical Maggie's Centre can be seen as a kind of Non-Type. It is like a house which is not a home, a collective hospital which is not an institution, a church which is not religious, and an art gallery which is not a museum."
(Jencks, 2014, p. 28)

Illustration 2. Lots of activity at the Maggie's Dundee

Illustration 3. Maggie's Glasgow by OMA mixing the living room with the Japanese garden.

LIVSRUM SERIES

For more than 25 years, the Danish Cancer Society offered free support and advice to anyone who gets cancer close to their lives. Unfortunately, it is known from several studies that many cancer sufferers' needs are overlooked or under prioritized. Many people with cancer experience a wide range of serious and significant problems or lack of support offers, which means that it is more stressful to get cancer than it needs to be. Studies show, that there should be offered help in two key moments in the cancer patient's progress which is referred to as the *"getting started"* moment, and in the end of the treatment, which is called the *"to continue to move forward"* moment. (Kaldahl & Kruse, 2011)

The studies also show that the counselling services of The Cancer Society are not sufficiently known. The Cancer Society therefore believes that the visibility must be prioritized, and that the availability of counselling services should be made easier, by giving the advice closer to the cancer patients, both during and after treatment. At the same time, the Cancer Society wants to attract new users from the large group of cancer patients who are not currently receiving counselling, for example, people with scarce resources, older people and men in general (Petersen & Svendler, 2008).

To change this, and to get closer to the patients and become more accessible, the Cancer Society has planned along with Realdania to build seven new cancer counselling centres around the country. Six of the planned centres have been built, and Herlev is the only centre, which is still to be designed. This centre is what this Master Thesis is centred around. The new counselling buildings are called *Livsrum* (”Room of Life”), because it is a project in which healing architecture and openness goes hand in hand (Petersen & Svendler, 2008).

More than 30 years of research show that the architecture and the physical environment can help to make patients recover faster and also makes it possible to decrease the amount of pain medication. It's about creating the optimal conditions for the senses through light, sound, colour and aromas. However, the Cancer Society also acknowledges that the medical community nevertheless has been better to admit it than to produce it, when the buildings are built in the health sector. This needs to be changed (Kaldahl & Kruse, 2011).

As a pioneer before the Livsrum series, Frank Gehry designed Hejmdal, which is located in Aarhus. The architecture of the house is unique and allows light and life flow. Visitors in Hejmdal describe that they are astonished when they enter the centre. This is because of the immediate change in atmosphere as everything changes from the exterior brick tiles to the interior mix of a puzzle of huge wooden Douglas columns and patinated concrete and tiles. It is these small surprises that can help pushing the patients in the right direction and make them curious. The house has a glass roof construction, which brings masses of light into the building from all directions. A house, like the life, is full of contrasts, and gives a great contrast to what we often encounter in health care today. The house offers space for tears and smiles, the small meeting or the immersive interview. Here you can be together with others or with yourself - without being alone (Kaldahl & Kruse, 2011).

The new counselling centres must invite and give the individual the opportunity to retake the control over their lives. Therefore, there is a strong emphasis on openness in the new houses. Cancer patients should be able to get counselling with and without an appointment. There should be no waiting time, and the house should be open, whether the desire is to talk with a professional, meet with others or just relax with a cup of coffee. The arrangement should provide the opportunity for conversations to take place in more or less open spaces.

The inspiration for the new consulting concept for Livsrum comes from the Maggie Centres in Scotland, which has existed since 1996. Common to all centres is that they are located close to the local hospital, so cancer sufferers and professionals have a quick and easy access for counselling. They are all designed by famous architects and based on the theory that the overall architectural concept will attract attention and symbolise that the building has a special function and a special content. The people behind the Maggie's Centres say that the architecture is considered to be a key element in their success. They believe that their offer to patients and relatives works well because of the environment they are offered in (Arkitema Health, 2008).

The inspiration for the new counselling concept also comes from the sociologist Ray Oldenburg's thoughts about the "third place". Oldenburg defines a need for "informal public life". The home is our first place - the workplace is the second. The third place is the informal public meeting places "on neutral ground". Oldenburg suggests that these sites are of a paramount importance for a society's social quality. "Homes away from home" Oldenburg calls the importance of cafes, pubs, local small shops, venues, etc. The informal gatherings counteract stress, loneliness, and social inequality and stimulate a sense of community (Arkitema Health, 2008).

This is important, because people with cancer often express that they no longer feel, that they are part of the informal communities, for example, work or sports clubs. They have difficulties recognizing themselves in the social network, which before their illness was a comfortable place. The new cancer counselling centre should therefore help to give the patients the third place, a home away from home, where they always are welcome and can be part of a community. If the counselling takes place in the third place where the patients can feel the life around them, the meeting where people get the opportunity again to take control over their own lives, can be created. Here, the physical framework plays an important role (Arkitema Health, 2008).

The counselling centres are not only the building itself, but also very much the land on which the centre is placed. This should, in addition to being close to public transport and public parking facilities, preferably be a place with enough space for varied and exciting outdoor spaces. The landscape in the form of gardens, paths, trees, flowers etc. offers many activities for cancer patients and counsellors (Arkitema Health, 2008). The building and the landscape should preferably appear as a whole, where the inside has something optimistic and natural to look at, and where the outside has something meaningful and activity characterized to do, despite the serious subject, which they are gathered around. Especially for the sake of talks between the patients and advisers the nature offers a framework in which the usual hierarchies between patient and professional is dissolved and taken over by a more egalitarian and democratic dialogue.

Illustration 4. The Livsrum centre in Aalborg

HEALING GARDENS

The interest for the positive impact on health rehabilitation processes by the influence from nature and gardens has in recent years increased significantly. To consider the more wild nature and the customized healing gardens as an important component of care in different patient groups, is becoming more and more widely. The authors have therefore looked upon the concept for these healing gardens as a point of departure for the design for of the outdoor areas.

Based on research and documented experience from practice, Skov & Landskab has in cooperation with Copenhagen University and Realdania compiled a concept model for healing gardens called Nacadia (Stigsdotter, 2008). The concept model describes how to develop outdoor areas into healing gardens at counselling centres for cancer sufferers in Denmark. The main aspects of the program is how to organize areas so they correspond to cancer sufferers needs, wishes, their treatment and rehabilitation and how to contribute to a healthy workplace for employees and volunteers well being. The concept model can be considered as a research-based model of how to ensure that all elements related to the physical, spatial, content and experiential are integrated into the construction of healing gardens at the cancer counselling in Denmark. The interest in the physical environments impact on human health and well being is increasing worldwide in a wide range of disciplines. This has resulted that the health nowadays often is considered from a holistic perspective that includes the individual's life situation which is the biological, cultural, social and environmental aspects. From a landscape architect's perspective the focus on the health value is therefore found in nature and urban green spaces. Landscape architects today work primarily with planning, design and management in relation to health, based on two perspectives and two types of environments (Stigsdotter, 2008):

1. *Natural and urban green areas - conservation and enhancement of health (health promotion)*
2. *Healing Gardens - relief and treatment of illness (healing)*

The first perspective focuses on the factors that contribute to the individual to preserve and promote the health. More and more research studies, both Danish and international show, that staying in green areas are significantly linked to higher self rated health, lower stress levels and a better well being regardless of gender, age or socioeconomic status (Stigsdotter, 2008). The second perspective focuses on gardens which are deliberately designed for a particular patient group's special needs and requirements, so called healing gardens. Healing Gardens used in Denmark are gardens in which people obtain relief or treatment of their disease through an interaction with garden therapy. Unlike traditional treatments at the hospital, the garden therapy focuses on the development of the individuals own resources rather than solely focusing on the illness (Stigsdotter, 2008).

Research shows that individuals diagnosed with cancer, in many cases are affected by mental fatigue, which among other things, involves memory failure, become more inattentive. They find it difficult to have coherent thoughts and perform demanding activities, have less patience and become more frustrated. In cases of illness, the individual's attention can become overloaded to such an extent that the consequences will be an inability to obtain necessary information about the illness and the treatment, to take decisions related to the treatment and handling losses and interruptions from their normal everyday life. For cancer sufferers the healing process and the recovery process normally take place much of the time in the home. But the healing process is also dependent on social interaction between friends and involvement in social activities that can contribute to mental and emotional well being. Therefore does Skov & Landskab expresses, that it is important that counseling centers have the right framework for social interaction and active development so the experience is optimal (Stigsdotter, 2008). A large part of this framework can be created inside as well as outside, where interaction with nature can be either active or passive. This will ensure not only improved physical surroundings, but also contributing for overall a more positive treatment process where the physical environment supports and improves the general level of health and well being of the individual.

Healing Gardens have trough several research projects shown to be beneficial for patients, relatives and staff because the natural surroundings can seem alleviating, stress reducing and helping to increase user satisfaction by their active or passive participation in the (Stigsdotter, 2008).

To instruct the architects, who are designing a counselling centres, Skov & Landskab has made a list of recommendations for the overall design of the healing garden. They are thought to be an inspiration and help to ensure that all the important elements such as the physical and spatial qualities are integrated into the construction of the healing gardens at counselling centres in Denmark.

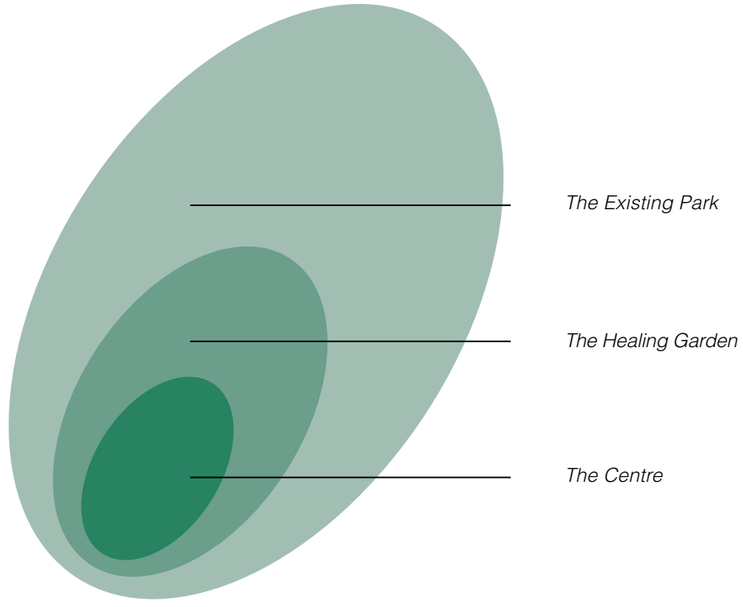


Illustration 5. Relationship between the centre, healing garden and the park. It is important for the garden to be in connection with the park to allow a secondary, larger and more public area.

Nr.	Subject	Recommendation
User Perspective		
1	*Users in the therapy garden*	*It needs to be well defined and their needs and objectives clarified so the therapy garden can be designed optimally for the given user group of:* *- Cancer sufferers* *- Adults relatives of the cancer sufferers* *- Relatives who are children and youngsters* *- Employees and volunteers*
2	*Employees and volunteers*	*- View to the therapy garden provides less stress and more satisfaction* *- Access to a therapy garden and a private garden space for mental rest and recharge is recommended*
3	*The Patient groups needs*	*- Avoid abstract idioms and art* *- Be aware of the targeted audience, so signals with negative associations is avoided* *- The idiom must be easily understandable*
Planning Perspective		
4	*Context*	*- The location must be comfortable and positive.* *- The location of the center should preferably not be in contact with emblematic buildings and negative noises* *- An opportunity for establishing a therapy garden should be a priority* *- A simple building with an easily understandable design language* *- There should be signaled warmth, thoughtfulness, vigor, vitality and security*
	Green Structure	*- Proximity to major natural areas is recommended* *- Utilization of balconies, atria and terraces is recommended* *- Presence in the form of a continuous green structure*
6	*Form and Extent*	*- A closed form which various garden spaces and coherent paths can be incorporated*
7	*The space of the Therapy Garden*	*- More spaces in the therapy garden is important to achieve a variation in levels of requirements, comfort and activity* *- Use the outdoor space for the activities which is held in the building, such as interview rooms, sensory rooms, etc.*
Important Elements		
8	*Water*	*- Water elements are recommended as these can have a positive impact on stress levels, sense impressions and the experience* *- Water Elements can create greater biodiversity and block noise* *- Apply as far as possible the element of water so it is physically accessible*
9	*Greenhouse*	*- A greenhouse is recommended to use for voice communication, sensory, rest or to growing plants (Research shows that a greenhouse in several therapy gardens assessed by patients as a favorite location)*

Illustration 7. Elements for the healing garten. (Stigsdotter, 2008)

Illustration 6. Healing Garden at Maggies Glasgow by OMA

NORDIC ARCHITECTURE

Even though it is possible to characterize typical features to the architectural traditions of the individual countries in the northern regions, there are still common factors, which define and unite these and allow one to discuss them under the collective term 'Nordic Architecture'. To describe the different approaches in the subject of Nordic Architecture, the ambience of the Nordic Light, the identity of the place and the authenticity of the material have been identified and the definition of tectonics has been discusses. One of the significant aspects in the northern architectural tradition is the connection between space and place, and nature, climate and landscape. A theme, which is present in most of Jørn Utzon's works, is the spirit of the place, Genius Loci.

The ambience of Nordic Light

Daylight is the natural light seen during day. It consists of direct light from the sun and diffuse light from the sky. Considering that one can ascribe specific characteristics to the light according to its geographical region, it seems only natural that the specific low and horizontal illumination of the north has had a great impact on the architectural style. Because of the varying seasons, the Nordic light can make buildings appear different throughout the year, for instance during winter when the reflecting surfaces of snow and water combined with the low angle seemingly makes the light enter buildings from below. Light is usually the strongest parameter that describes the atmosphere of the place, and the most comprehensive character of the space and setting. The light emphasises the mind's perception of time and space, emphasising shapes and gives character to surfaces and reveals weight, texture and temperature of the materials (Sørensen and Haug, 2011). Shadows are very long in the winter, but so are the light rays Lights filtered through the façade and far into the building, where it acts as a visual aid and a mood setting and is therefore a strong characteristic in the ambience of place.

"Light can even characterize entire geographic regions, such as the dramatic differences between the burning vertical light of equatorial areas, and the melancholic horizontal light of the northern regions. We could appropriately speak of the 'Geography of light'." (Juhani Pallasma, cited in Sørensen and Haug, 2011, p. 25)

The identity of place

The presence and features of light is not the only determinant of the place, as the interrelation between architecture and landscape is equally important. The understanding of details, context and local conditions are evidently a central aspect in the creation of architecture. Nordic architecture is often characterized by its roots in 'place and space' – in culture and identity (Kjeldsen, et al., 2012). According to the architecture historian Christian Norberg-Schulz, architecture always has its point of departure in the place and in the spirit of the place: "Genius Loci". For Norberg-Schulz the identity of the individual is fundamentally rooted in the spirit of the place. The place has an objective quality, which is revealed. It is therefore the role of the architect to read and to transform the different impressions, which is needed for designing accordingly to the identity of the place (Kjeldsen, et al. 2012).

The authenticity of the material

The authenticity of architecture is not determined only by the resemblance to place and landscape, as the honesty in the use of materials and clarity in the structural composition has become one of the characteristics of the Nordic architectural tradition. Regarding that the architectural style of the Nordic countries is closely related to the sense of place and the local conditions, it seems natural that the materials implemented, equally reflects the context and the local craft traditions (Kjeldsen, et al. 2012). This is for instance seen in the works of Sverre Fehn, Gunnar Asplund and Jørn Utzon, who are renowned for their tectonic expression and authentic narrative.

The Tectonic approach

The emerging writings in the middle of the nineteenth century from Karl Bötticher and Gottfried Semper state that the term *tectonics* not only indicates a structural and a material probity, but also the poetics in the construction, as this may be practised in architecture and the related arts (Frampton, 1990). It is vital that there is a synergy between structure, aesthetics and function. A tectonic design as a poetic of construction signifies that the structural system is a part of the overall expression of the building and its spatial qualities. The structure clarifies the form of the building and expresses its essence. In a tectonic approach, art and technology are equally imperative and the construction is developed together with the aesthetical aspects of the building and as a result of technical solutions. Honesty in use of material should be considered as one of the crucial aspects and the natural properties of the materials should correspond with the way they are utilized, to reach a clear structure. The structure is readable in the design, so it will be comprehendible how the building is built (Frampton, 1990).

"[...] For me good architecture is always tectonic, in the way it narrates the history of its own creation, how it is assembled and how the details relate to the whole. This is what I understand with tectonic language. Not neccesarily a simple geometry, but a narrative about the construction"
(Juhani Pallasmaa as cited in Carter 2012, p.28. Own translation)

The coming Herlev counselling centre therefore needs to relate to, work with, respect and be inspired by its surroundings, but this can only be achieved by an understanding of the context and experiencing the spirit of the place; Genius Loci. This is not only in a physical sense, but also in regards to the social, cultural and climatic aspects. It is important that the building adds value to the site, which means that the building becomes an element within the park and the park becomes an element within the building. It is essential, that the building relates to the atmosphere and the identity of the park, while also emphasising its own important role in the environment. The structural system should be a part of the building expression and its spatial qualities, and be developed simultaneously with the building shape.

Illustration 8. Juvet Landscape Hotel by Jensen og Skodvin has the perfect composition of relating to the landscape in material and scale while creating a sharp contrast in geometry

Illustration 9. Hedmark Museum by Sverre Fehn

Illustration 10. The Utzon Centre by Jørn Utzon

SUSTAINABILITY

Today public emphasis is on minimising energy for building usage. 30 – 40% of the Danish energy usage is used on building heating and ventilation (Energistyrelsen, n.d.). In order to keep the global temperature increase under 2°C and reduce the emission of greenhouse gasses by 20% in 2020 compared to 1990, the Danish Building Regulations (Energistyrelsen, 2015) is stating that buildings built later than, 2010, 2015 and 2020 shall have an energy usage of 25%, 50% and 75%, respectively. According to Henning Larsen Architects, 40-50% of this energy is determined by the design (Kongebro, 2012). This involves wrapping the building envelope in extra insulation, changing windows to a type with a low U-value and probably with a low-e coating to ensure that heat radiation is not transferred from inside and out. This creates a building that is extremely sensitive to the external heat gains both during summer and during winter. In order to control this, the designer has to integrate energy, daylight and thermal simulations in the early phases to get familiar with the building volume and the performance. Getting early feedback on the performance allows the designer to avoid unpleasant surprises by continuously optimising the shape. The quicker the feedback can be generated, the more iterations can be made. Therefore choosing simple simulations and rule of thumbs in the early stages can provide plenteous feedback to have a well-optimised building before initiating the complex simulations.

Why do we rely so heavily upon artificial lighting when we can design buildings that are filled with daylight? And why do we continue to rely upon wasteful air-conditioning systems in locations where we can simply open a window? (Norman Foster, 2003, p. 12)

While Sir Normal Foster makes it sound so easy, it is actually a very complex puzzle to solve as every change in design affects psychological and physical state, energy consumption and price.

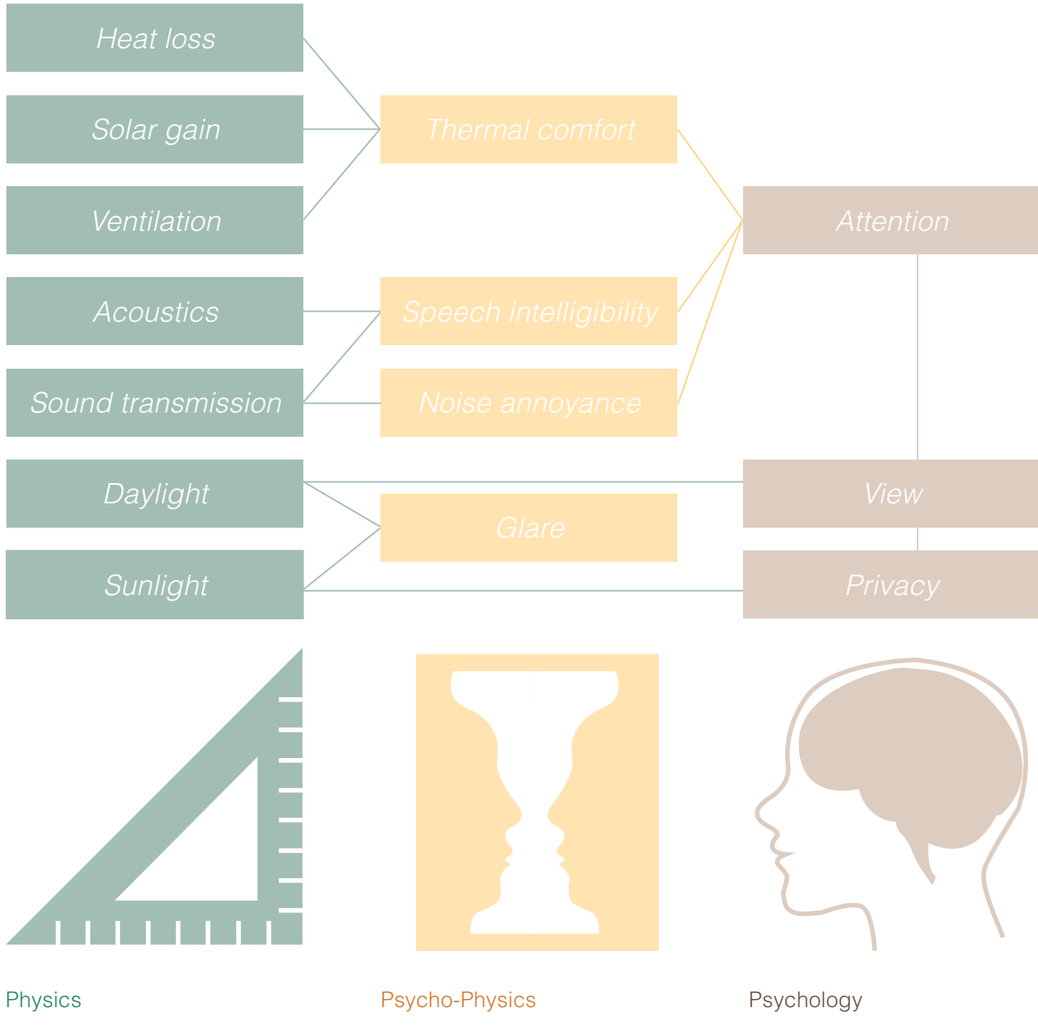


Illustration 11. Relations between physical and psychological attributes (Slides from Camilla Brunsgaard, 2013)

Energy
It is a challenge to create a low energy building without compromising architectonic ideals. However, this is a simpler task when integrated early into the design process. The goal is to create a Danish Low Energy Building Class 2015 building only by using passive solutions without compromising Nordic ideals in architecture. To achieve this class, the building must use less energy annually than 41 + 1000/A [kWh/m²/year] (Energistyrelsen, 2015. §7.2.4.2-1). To do this, there are some few principles that should be applied early:

Gain energy during winter in the early hours to passively preheat the building. This requires access for a low winter sun and cautiousness on over temperatures.
Shade for direct sun during the summer with cautiousness on south and west.
Sketch a principle for natural ventilation for summer scenarios. This can include both thermal buoyancy and wind.
Have a principle for materials and placement of thermal mass.
Allow space for mechanical ventilation with heat recovery during heating season.
Use Be10 to calculate energy usage (Danish Building Research Institute, 2005).
Allow the daylight to penetrate far into the building volume. In summer this should be diffuse light.

Thermal Comfort
The body has a core temperature of around 37 degrees C. In order to keep the temperature, the internal thermostat in the Hypothalamus controls the cooling using sweat and heating by causing heat-producing contractions in muscles.
Our internal temperature is dependent on being able to transfer some heat to the environment. This happens in the following processes (Steen-Thøde et al., 1997):

- Convection to ambient air
- Radiation to ambient surfaces
- Vaporising from the skin
- Convection to ambient surfaces (this is usually minor).

The thermal comfort should comply with BR §6.2.1 and §6.3.1.1 (Energistyrelsen, 2015), which refer to DS 474 and DS 447, respectively. The aim is 10% predicted percentage dissatisfied (PPD). This equals a category II in DS EN15251 (Dansk Standard, 2007). This includes the following parameters found in DS474 based on Clothing values:

Winter:	clo=1	Operative temperature of 20-24 °C
Spring/Fall:	clo=0.7	Operative temperature of 21-25 °C
Summer:	clo=0.5	Operative temperature of 23.5-26.5 °C

In early phases, a 24H-average calculation spread sheet (Steen-Thøde, 2006) will be used to notify if there are any over heating issues with the glazing area or the type of the glass.

Atmospheric Comfort
Atmospheric comfort includes smells and bad air quality. We all know the feeling of too little oxygen in the air on the office, but this is actually due to smells from humans and equipments. As smells are difficult to measure, luckily this is proportional with the CO_2 emission from people, which can be easily measured. According to category I in CR1752 (Comité Européen de Normalisation, 1998) the thresholds are:
CO_2 level of less than 665 [ppm] above outdoors.

Acoustic Comfort
The goal is to create an open space full of indistinct chatter from other people and their activities without the overall sound level getting too noisy. This allows visitors to feel the acoustic atmosphere of the place. Sounds from the outdoor are preferred when possible (during summer) and noise from equipment needs to be muted.

	FEASIBILITY STUDY	CONCEPT DESIGN	SCHEMATIC DESIGN
WINDOW TO FLOOR AREA		✓	
SHADOWS ON SHAPE AND SITE	✓	✓	
SUN DIAGRAMME	✓		
WIND ROSE AND WIND PRINCIPLES	✓	✓	
DAILY AVERAGE		✓	
BE10		✓	✓
BSIM			✓
DAYLIGHT FACTOR		✓	✓

Illustration 12. Timeline for different analytical tools.

Visual Comfort

The idea is that the light should be felt as plentiful and well oriented on areas or surfaces in need of light. A bright environment is generally wished, but darker zones for contemplation are also integrated. Direct sun is preferred to some extent to emphasise atmosphere, as long as the glare and heat provides no issues. It is preferred to deal with these issues with manual blinds and shading rather than high tech automatic solutions. This will be developed using model studies, rule of thumbs and analysed in static calculations in the very commonly used Daylight factor. These will be carried out in the DIVA4Rhino using the RADIANCE rendering core. Radiance is some of the most versatile and validated software when it comes to complex geometries (Iversen et al., 2013). As a minimum requirement, a daylight factor of 2% in working zones and in half of the area of the common rooms and kitchen areas is required. In order to break down the barriers between inside and outside, it is prioritised to have clear uncoated window glazing. This may involve over temperatures but it is prioritised to avoid over temperatures through overhangs and limited window area rather than coated window glass.

DAYLIGHT

Electromagnetic waves are in terms of architecture interesting in the spectrums of ultraviolet, visible light, near infrared and far infrared (Reinhart, 2014). While the ultraviolet light may be blocked out in most float windows, some of this can be avoided with diamond glass, which according to new studies by Carlo Volf (2013) may have just as positive effects on the human body as the common known negative effects, when not over used. More on this in the *Daylight and health section*. The infrared radiation is what we usually refer to as heat radiation, because all objects around us radiate heat based on materials and temperatures. Most everyday objects have temperatures of 0-30 degrees, so they are emitting radiation in the far infrared spectrum. The sun, however, has a surface temperature of 5800 kelvin. On the outside of our atmosphere, this radiation resembles the radiation from a blackbody of 5250K. Some of this radiation is scattered in the sky or absorbed by water and CO_2. The remaining direct sunlight measured at sea level contains 44% of its energy in the visible light spectra, 53% in the near infrared and 3% as ultraviolet. This also means that low-g windows should only block the near infrared and not disturb the visible light. Low-e coatings in a window can keep the far infrared heat from the inside from leaking out. Some of the scattered light in the sky is reflected back on earth and this is what we perceive as diffuse daylight. The skylight has a more bluish colour, which corresponds to the radiation from a blackbody object of 15000K (Reinhart, 2014).

The Danish weather is different during the seasons. In the winter, the overcast weather accounts for 75% of the time, while the summer is overcast 60% of the time. The direct sun varies from 30,000 lux during winter to 100,000 lux during summer. (Volf, 2013)

One strategy is to prioritize good, clear light and use static external shading together with early process analysis to avoid low-g windows in the end of the process, as they can lower the quality of light and view to the outside.

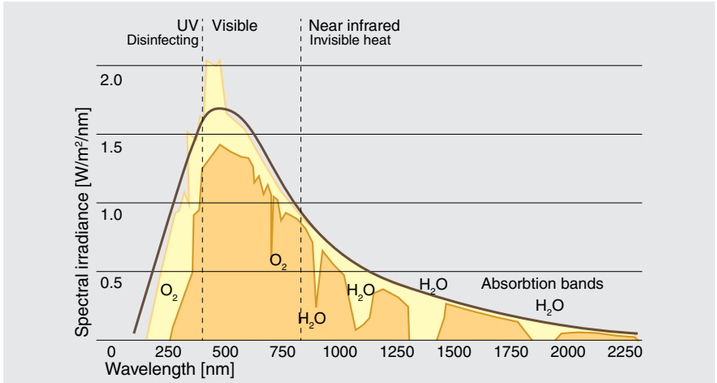


Illustration 13. Approximate diagram of the radiation from the sun outside the atmosphere and at sea level. Notice how some bands are absorbed by our atmosphere.It is also notable that a large portion of the energy in the radiation is within the visible field.

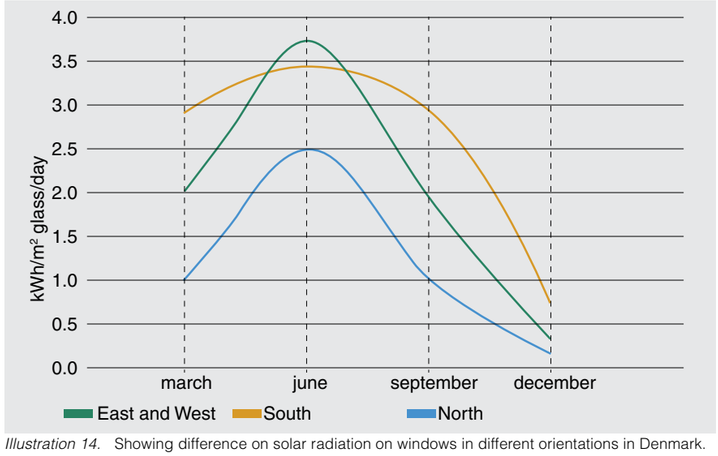


Illustration 14. Showing difference on solar radiation on windows in different orientations in Denmark. Unlike common knowledge, the sun actually radiates more in east and west oriented windows in June than the south oriented windows (Volf, 2013, p. 99).

Daylight and health:
It is no new thought that daylight and beauty can have healing effects on people under treatment. The first Danish public hospital was Frederik's Hospital, which starts the paradigm of The Hospitals of Aesthetics. It was built in 1754 in rococo style with focus on the composition and it looked like a castle. Diseases like plague started the development of the Hygienic Hospitals, which are seen first in England in 1780s but these aren't seen in Denmark until 1910 where the *Rigshospitalet på Blegdammen* was opened. The paradigm of the Hygienic Hospital is a pavilion like, or campus like, approach with smaller units to avoid contagion and lots of daylight from south and east (Volf, 2013; Heslet & Dirckinck-Holmfeld, 2008). Simultaneously, Pasteur discovered the microorganisms in 1875 and this moved the health focus from architecture to medical science. Partly helped by the invention of the elevator, the ideas of a much cheaper hospital with smaller and denser functions immediately became popular for the politicians. Around 100 years later, focus on the link between architecture and health has been more widely accepted (Heslet & Dirckinck-Holmfeld, 2008). With the publication *Healing Architecture* (Frandsen et al., 2011) focus has been re-established on light, art, sound, air and movement. The publication refers to the relationship between daylight or high intensity artificial light and circadian cycle. The more time spent in daylight during day, the better sleep at night (Frandsen et al., 2011, p. 26). This is according to Carlo Volf (2013) emphasized in the blue spectra of the light and on light from above and in front of a person. This is because of the recently discovered Ganglia cells, which are placed in the bottom and back of the periphery retina (Volf, 2013). These cells are directly linked to the production of the sleep hormone *melatonin* and the happiness hormone *serotonin*. A happy day leads to a better sleep, as melatonin is created from serotonin, but there is a more complex balance which is also reverse: A good nights sleep can lead to more serotonin and happiness during the day. It is suggested to emphasize this rhythm through architecture with more light during the morning and mid day and less light in the late afternoon.

Darkness: Serotonin -> Melatonin (less happiness and less activity)
Light: Melatonin -> Serotonin (more happiness and more activity)

The sunlight is seen upon as a double-edged sword. On one side the UV rays have the lethal effects of causing skin cancer and mole cancer. On the other hand, UV radiation is required to produce D vitamin, which is essential for the immune system and can be used to slow the development of breast cancer (Volf, 2013).

To sum up, the daylight should be placed both as an aspect of beauty and as a tool to see clearly, but it also affects both health and mood. To emphasise circadian rhythm, windows should be placed towards east and south and in a lesser degree towards west and north, as long as the thermal comfort is under control. Tall windows rather than horizontal window bands have a higher effect on the ganglia cells in the eye.

Illustration 15. Direct sun in the Serlachius Art Museum Gösta by MX_SI Architectural Studio (mx-si.net)

Site

Introduction

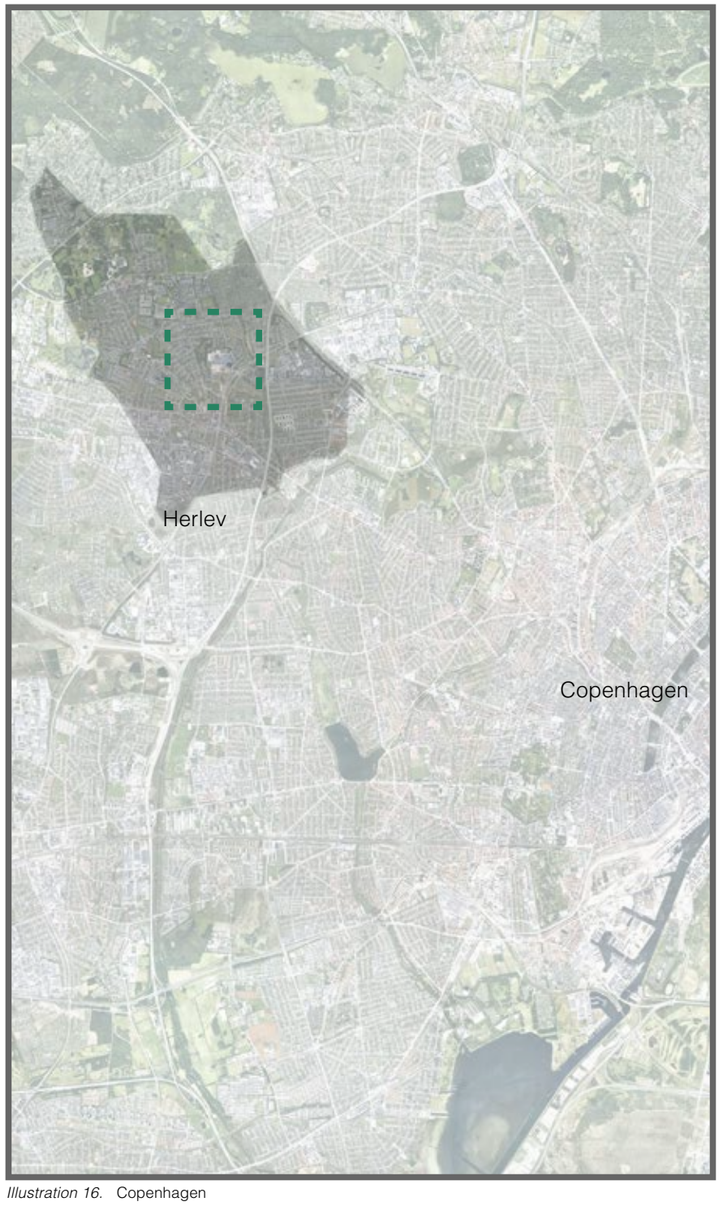


Illustration 16. Copenhagen

Illustration 17. Herlev Hospital and the site

Illustration 18. Photo of The Hospital Park

Illustration 19. Photo of the Herlev Hostpital

Illustration 20. Model of the extension by Henning Larsen Architects

THE HOSPITAL PARK

The Hospital Park is chosen for the Cancer Counselling Centre as it is of near proximity to the Hospital and because it has the ideal environment for an “escape” from the hospital. Placing the Counselling Centre in the park allows for healing gardens and meditation walks without direct views to the hospital. Instead, the views are introvert into the life of the park including children playing and people walking their dogs. This allows visitors of the centre to forget about the hospital and the treatments and focus on the positive things, while still being within walking distance. The short walking distance allows visitors to spend the waiting break at the hospital, on visiting the centre for the first time.

The site furthermore allows curious visitors of the park to get a glimpse of the activities inside the centre without breaking the privacy. On the edge of the park, the centre can draw attention from the street while also being sheltered from the street. The band of trees around the park allows for a more intimate room in the park, while still being connected to the rest of the park. This site allows the perfect balance of private and public, shelter and openness. There is also coherence with opening the facades towards the park and shading and shelter the facades towards the street.

HERLEV HOSPITAL

Herlev Hospital is known as the tallest building in Denmark with a height of 120 meters and a floor area of 30000 m^2. It is one of the largest hospitals with a staff of 4000. The high-rise building has 26 floors, where the wards of the hospitalized patients are located. Each floor has 24 wards - all having access to windows. In the large flat building are outpatients, clinics, laboratories, surgical wards and emergency rooms located. The interior is made up of squares with corridors in-between. The treatment sections are located in each square, which may be used individually or combined. The idea of the grid structure is flexibility - it’s easy to switch the function as required (Essemann-Beck, 2014). The building which is characterized by its brutalist expression is designed by the architects Gehrdt Busch , Max Brüel and Jørgen Selchau.

The opening of Herlev Hospital

In 1976 Herlev hospital opened the doors for its first patients. The time was characterized by a pioneering spirit and new approaches to patients. The old fashioned authority and the passive patient role were gone, and instead entered the ideals of equality, unity and openness and the doctors could now be called with their first name (Essemann-Beck, 2014). Thus, Herlev Hospital was one of the revolutionary hospitals in recent times.

FUTURE ASPECTS

The surroundings of the site are facing many changes. The hospital is expanding almost 60,000m^2 towards the ring road to the west and the central city towards south. The concept of the expansion is rectangles of two stories with rings on top of two or three stories. These new rings create a contrast to the typical orthogonal hospital. They also create several new recreational areas in the courtyards, which the patients at the hospital can utilise. The hospital is then with upcoming new conference facilities connected to the *The Cultural Axis* all the way to Herlev city centre. This axis is a municipal strategy connecting the city centre to the industrial area in the south to the hospital by placing multiple cultural facilities along the axis. This axis is intended to bicyclists and pedestrians.

There will be a light rail stop next to the hospital and there is also a possibility for a new metro stop. The light rail station is expected to open in 2020. This brings more visitors to the area and makes it easier being a volunteer at the coming Cancer Counselling Centre. Also, this light rail makes it easier for elderly to arrive to the site, as there is quite a distance from the current Train Station (Herlev Kommune 2012;2014).

Illustration 21. Infrastructure

Heavily trafficked *Trafficked* *Light traffic* *Paths* *The site*

INFRASTRUCTURE

Arriving to the site will for most users happen via *Hjortespringvej* west of the site. There is a small parking area to the park connected to the road. This is assumed to be sufficient parking for the users of the centre. Hjortespringvej is not seen as heavy trafficked based on registrations in the area, as it seems that primarily the inhabitants in the area use it. Other users will arrive to the centre by walking from the hospital through the park. This allows the authors to build up an atmosphere on the way of arriving to the first meeting from the hospital. Hjortespringvej is connected to the ring road, *Herlev Ringvej* that is connected to the motorway. Compared to Hjortespringvej, is Herlev Ringvej heavily trafficked most of the day.

The park has paths surrounding a pond, which is the central element in the park. This gives the optimal conditions for meditation routes for the future users. All of the paths are connected to the surrounding and are frequently used by pedestrians. There is a bus stop outside the site connecting the park with Herlev Station.

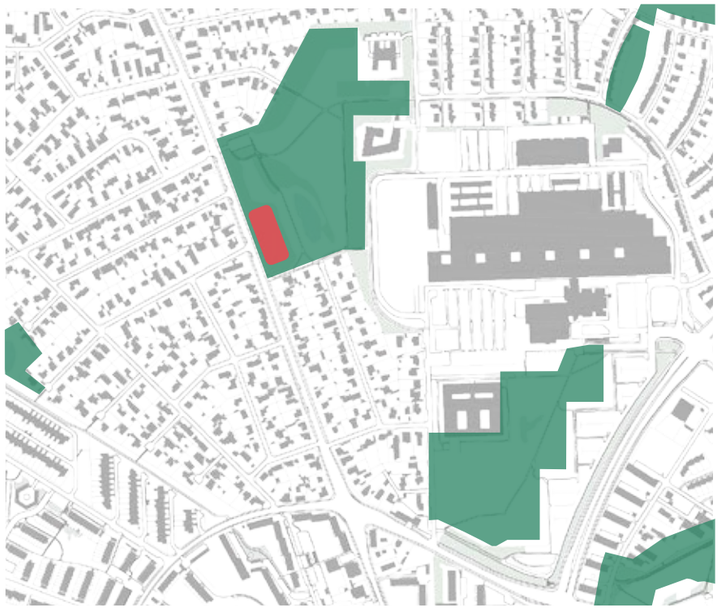


Illustration 22. Private - Public

Public recreational areas *The site*

PRIVATE - PUBLIC

The park emerges like a little hidden oasis in the otherwise bustling Herlev. Looking at the few recreational areas, in distance of Herlev Hospital, the Hospital Park stands out compared to other. This is because the park is surrounded with a band of trees that separate the park from the everyday noise. The park is a public park which mainly is used by dog owners, because the environment gives the dog owner the possibility to release their dogs, compared to the otherwise dense and compact city of Herlev where the recreational areas are few. The Park is surrounded by the Hospital to the east which is a public institution and the central landmark in the area. The rest of the surrounding area includes single-family houses, which is overall a semi-private area. The single-family houses are also characterised with their own private gardens. There are two semi-public institutions Skovgården and Juvelhuset in the north east end of the park, which are residential accommodations that hold respectively physically challenged adults and adults with a mental disorder. The institutions are publicly run, but the atmosphere around them is private.

Illustration 23. Typologies

Single-family houses *Housing blocks* *Public institutions* *The site*

TYPOLOGIES

Herlev consists of several smaller areas, which have different qualities in terms of atmosphere, building typologies and inhabitants. This diversity makes Herlev a complex city structure, which gives the project site various opportunities. The surrounding area is mainly characterized by single-family housing. It is a residential area within the city and accommodates large families and high income couples. This suburban area within the city has qualities such as neighbourhood, own garden and a large amount of private space. The brutalist architecture of the Hospital gives the feeling of an area with industrialisation and gives the hospital its own atmosphere. The hospital tower, which is also the tallest building in Denmark, functions as a landmark in the area. Towards the city, the area primarily consists of dense 3-5 storey housing blocks, which have grocery stores and shopping facilities nearby. These dense apartment blocks are placed as long, straight buildings edging up to the surrounding road, which does not leave much space for public recreational areas. Instead the blocks are provided with green areas in a semi-private courtyard that can be used by their occupants.

PICTURES OF THE AREA AROUND THE SITE

The color of the frames relate to the areas in Illustration 23.

Illustration 24. Single-family houses west for the Site

Illustration 25. Single-family houses north for the Hospital

Illustration 26. Single-family houses north for the Hospital

Illustration 27. Building blocks south for the site

Illustration 28. Building blocks south for the site

Illustration 29. Building blocks south - east for the site

Illustration 30. Herlev Hospital

Illustration 31. The backside of Herlev Hospital

Illustration 32. The Crematory behind the Hospital


Site for the new
Cancer Counselling
Centre

SECTIONS

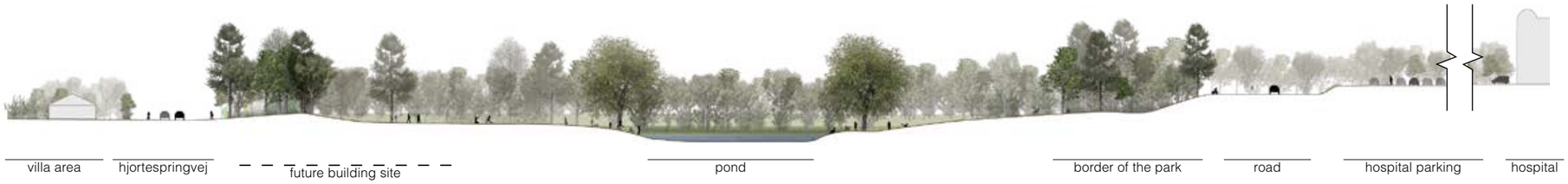


Illustration 33. Section AA 1:1000

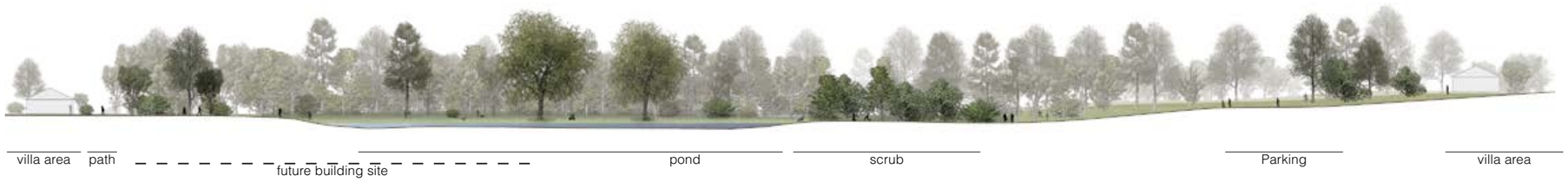
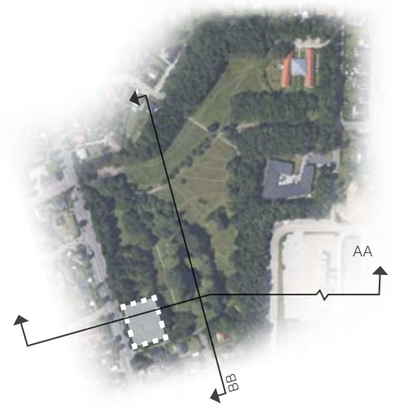


Illustration 34. Section BB 1:1000



SERIAL VISION

The method Serial Vision by Gordon Cullen (Cullen, 1971) has been used to clarify and analyse the two primary arrivals to the project site, with the special reference to the experience of it. The two Serial Visions, which will be described, are the trip from the parking lot at the perimeter of the park and the trip from the hospital. Through this the sensory impressions being created, will be described in a Serial Vision. The phenomenological experiences, that will be made in the area will be held together with the previously described empirical mapped material, thus the hard empirical data will be compared to the soft phenomenological knowledge and approach to the site.

Illustration 35. 1) Leaving the hospital

Coming out from the hospital, a chaotic parking lot is the first view. Going through the parking lot, one can image the challenges in your life, hearing the noise of everyday life. Tall trees from the park are noticed in the horizon.

Illustration 36. 2) The Infinity

Going up the hill it is difficult to see an end of the road. It seems like the road is infinite. Here the park entrance is visible. The view of the Hospital is hidden behind the parking lot, which gives the feeling of leaving the hospital and what it represents behind.

Illustration 37. 3) Entering the park

Seeing the entrance for the park, makes one curious and keen to explore the park which is hidden behind the trees. Walking down the steps and going through the shadows of the trees on the avenue, sounds of the park start to dominate and the noises of everyday life are hidden away.

Illustration 38. 4) The Park

Entering the park, the park opens up, and one instantly feel welcome. In the horizon a couple is walking the dogs, and even though it is a cold winter day, there is life here. The trees whisper because of the wind, and you hear birds singing in the background.

Illustration 39. 5) The Pond

The site opens up and it is possible to hear the everyday noise in the background on Hjortespringsvej. Still the density of the trees on the site filters the sound from the road, which makes you feel protected in the park. Life around the pond is audible from birds and ducks.

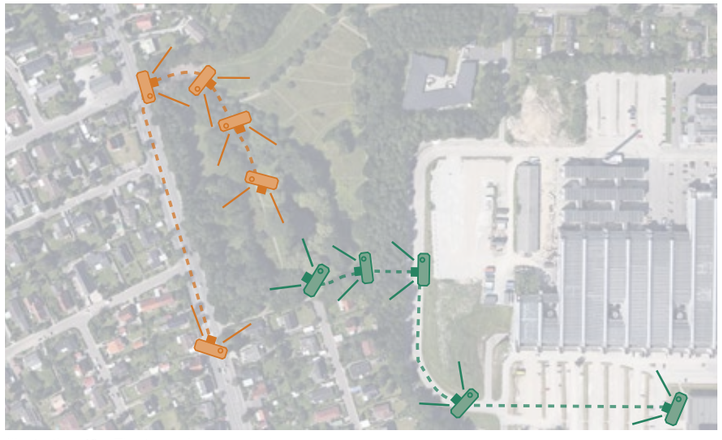


Illustration 40. The two primary arrivals.

The trip from the hospital

The trip from the parking lot

Illustration 41. 1) The perimeter of the site

Arriving from south, will be the common way of arriving by car. Coming through an area with single-family houses, suddenly a band of threes emerge on the side. It seems like a pocket or oasis. At the edge of the site, there is a gate into it. This entrance can in future aspect be used as an entrance for the visitors arriving by bus.

Illustration 42. 2) The parking lot

Entering the parking lot, one feels the change in pavement. The area opens up, and the visitor is welcomed into the park. To the one side the park raises and becomes a quit steep hill, compared to the other side which follows the inclination of the road, it seems more assessable.

Illustration 43. 3) The dense greenery

Going down the path, one is met with an area filled with a dense thicket. Looking in the thicket it is clearly to see the small paths inside of it, indicating children playing in the park. Continuing down the path you are met with enormous trees that embrace you. The trees emphasises the verticality in the park.

Illustration 44. 4) Green area north of the site

Going under the green canopy, one is sheltered from the wind, and slowly you hear birds singing in the background. Going through the shadows of the trees on the avenue, the park suddenly opens up and you see the reflectance of the tall trees in the water.

Illustration 45. 5) Approaching the site with the pond to the left.

Looking at the pond, you notice Herlev Hospital rising in the background. But the site catches your attention. The density of the trees on the site filters the sound of the everyday noises from the road, which makes you feel protected in the park. Instead you can clearly hear the birds singing from the pond, you hear the sound of life.

VEGETATION

The vegetation in the park consists of trees, scrub and open grassy areas. Around the park is a dense band of vegetation and within this band in the southern corner of the park is the site for the future Herlev Cancer Counselling Centre. Inside the band is an opening of a broad mix of conifers, deciduous trees and bushes. This opening is a sheltered space. The forest bed is moist soil, as it has almost the same terrain height as the pond. Acorns, beech nuts, leaves and needles cover the earth in a mix of brown and green tints, revealing on the ground which types trees are above. At visits in February, the beech trees created beautiful red circles under them. The trees and bushes define the space, which has different transparency based on season. This means that in the summer with more outdoor activities, the area is more sheltered. The area has a wild, untouched expression, which can be really beautiful as a contrast to a man made building. In the spring and summer the beech trees add a filtered, very bright greenish light to the area when hit by the sun. This can add to the thought of getting a second chance and thinking more positively. The ivies sprawl in the bottom and on a few of the pines. They are a beautiful, delicate element in the wild area.

For the future aspect the intension is to keep the green band of the trees around the site, having the filtered light entering the building. As the forest bed has a muddy texture it could be an idea in the future aspect to lift the building from the ground, to avoid the watery forest bed, which could introduce a plateau that the building could be placed on.

Illustration 46. The ivy covering the trees

Illustration 47. The muddy forrest bed covered in acorns and needles

Illustration 48. The trees towards the south covered in ivy.

Illustration 49. Inside the band of trees there is an opening of a broad mix of conifers, deciduous trees and bushes.

CLIMATE

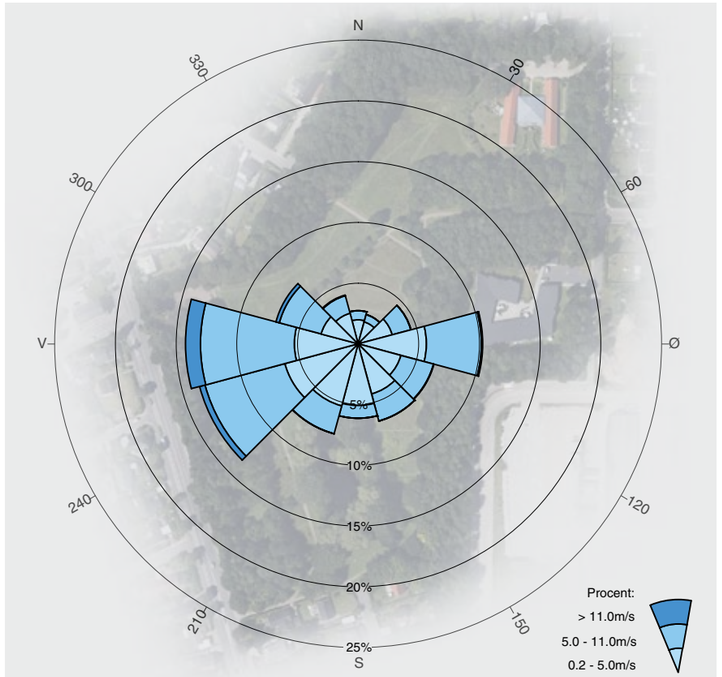


Illustration 50. Wind rose for Værløse in the whole season. Collected in 1989 to 1998. (Cappelen and Jørgensen, 1999)

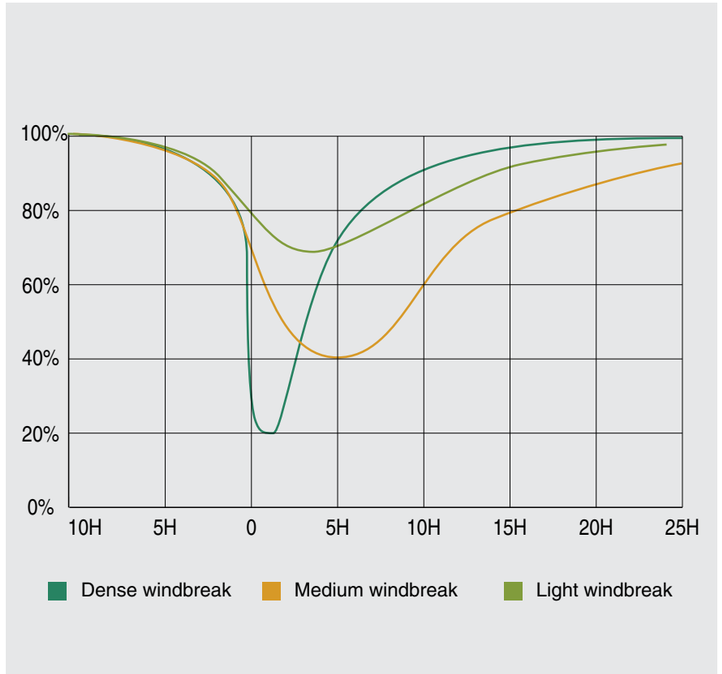


Illustration 51. Effect of windbreaks. Effect is visible in an area up to 5 times the tree height in a band of trees (Lechner, 1991). In the park, the band of 15m tall trees give a wind shelter up to around 50m away.

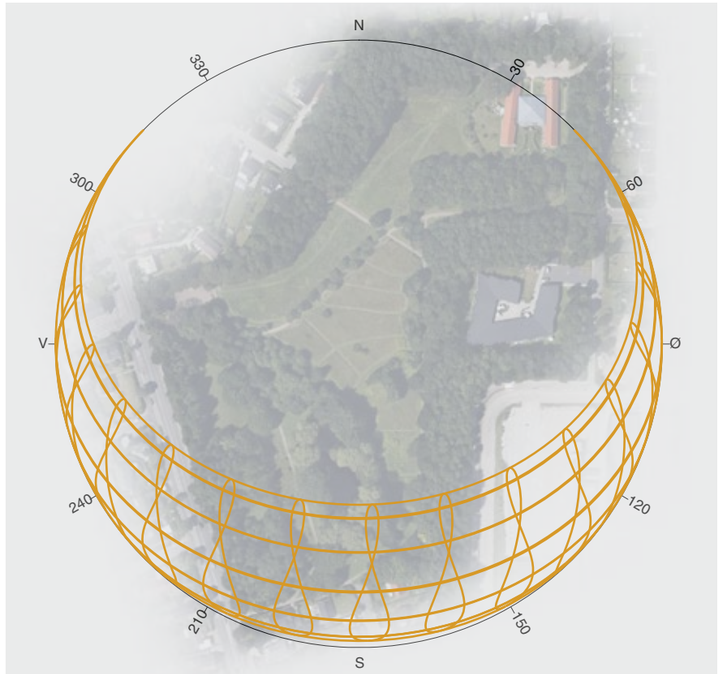


Illustration 52. Sun curves for Danish altitudes.

WIND

The wind on the site is mostly sheltered from the trees around it. At the first site visit, which was on a windy day, the park felt really calm. The bands of trees shelter the park, but this effect diminishes as one moves to a higher altitude. This correlates to theories by Lechner (1991). When crawling in the trees, the authors instantly felt the wind. According to a local weather station (herlev-vejret.dk) and The Danish Meteorological Institute (dmi.dk), the average wind speed is 5m/s and most of the time from west. The velocity is under 5m/s in half of the time and wind speeds are, however rarely, peaking at 15-20m/s from west. This means that the design should provide shelter against the western wind for outdoor areas that are not sheltered by the trees. Also, the western wind can be used to boost ventilation rates during summer. There is wind on the western part of the site, but most of the site is sheltered from the trees, allowing sheltered outdoor areas between the site and the park.

SUN

Building in a band of trees has certain advantages. The trees shade for the direct sun during summer where they are carrying leaves and in winter the naked trunks allow the sun to penetrate. This has great advantages when looking at energy consumption where the heat load from the sun is beneficial during winter. When looking at the outdoor areas, a clearing can be made to allow sun on terraces or gardens within the band of trees in the summer.

Case Studies

Maggie's, Livsrum and Hejmdal

CASE STUDIES

Study trips to the Maggie's centres in Scotland, the Livsrum series and Hejmdal in Denmark have given an enormous amount of information and inspiration for the future design process. In Scotland, six centres were visited for a building analysis and to get to meet the people volunteering, working and using the centres, as this is architecture about feelings. In order to describe several centres in a way that is comprehendible, they are sort into different key elements. Each key element is introduced and described why it is analysed and then it is described for a few selected centres that really impressed or centres where this key element did not work. The key element is summarized in learning at the end of the page. This learning is used as an inspiration for the future design parameters for the project. This is done to create clarity on certain key elements on how they affect the users and if the architects' ideas actually work in the centres with real people visiting and working there.

While it is crucial to have visited the centres in order to comprehend the "real" atmosphere, an attempt is made to explain it alongside with the analysis of the key elements.

The key elements that are analysed are:

- The Arrival
- The Heart of the House
- Flow and Transparency
- Niches and Pockets
- Group and Activities
- Atmosphere

Illustration 53. The visited cancer councelling centres in Denmark and the site in Herlev.

Illustration 54. The cancer councelling centres in Scotland and England.

Denmark

Hejmdal, 2009
Gehry Partners + CUBO
600m²

Aalborg, 2013
POLYFORM arkitekter
700m²

Odense, 2013
Wienberg Architects
620 m²

Herning, 2014
Clauds Pryds
450 m²

United Kingdom

Edinburgh, 1996+2001
Richard Murphy
350m²

Fife, 2006
Zaha Hadid
250m²

Dundee, 2003
Gehry Partners
225m²

Glasgow, 2011
OMA
534m²

Næstved, 2013
EFFEKT
640m²

Vejle, 2013
Arcgency
1046 m²

Roskilde, 2014
ADEPT
620 m²

Newcastle, 2013
Ted Cullinan
300m²

Lanarkshire, 2014
Reiach and Hall Architects
250-300m²

2001 **2003** **2006** **2009** **2011** **2013** **2014**

THE ARRIVAL

Crossing the threshold

After receiving the message from the doctor saying: “You have cancer”, the cancer sufferers are facing the most challenging aspect in their life. It is about convincing them self that they need help, both by getting various treatments at the hospital but also personally by talking to someone who can understand their situation and guide them in the right direction. But taking the next step and admitting, that you need help, is a difficult step for many cancer sufferers. Admitting that you cannot look after yourself, and need help from others puts the life of the cancer sufferers in a new perspective. Therefore is important to welcome the visitors to the centre immediately when they enter the building. This was emphasised by one of the psychologist at Maggie’s Edinburgh.

“[...] it is important to welcome people within 5 to 10 seconds.”

Andy, head of centre at Maggie’s Edinburgh

After Andy mentioned these words he had to leave us, because a person was entering the building, emphasising the words he said before. In the architectural brief it is also mentioned that the entrance has to be obvious, welcoming and not intimidating. One of the volunteers at the Maggie’s Dundee mentioned how difficult it can be to cross the threshold and emphasising how important it is to make a welcoming entrance.

“One day a woman entered the building, and said it was her last treatment and that she was sad she didn’t enter the building earlier. She was just too scared to enter the building.”

Moira, Volunteer at Maggie’s Dundee

This emphasises the role of the entrance, and the role it has for the overall building becoming successful.

Illustration 55. Maggie’s Edinburgh

Illustration 56. Maggie’s Dundee

Illustration 57. The staircase when entering the centre, with small seating areas

Illustration 58. The library when entering the centre whit an astonishing view

Maggie’s Edinburgh

Before entering the centre in Edinburgh the first thing you notice is the outdoor gardening. Looking at the gardening, one has the possibility to look inside the building, and see the life around the kitchen table. This gives the opportunity for the visitors to become curious, but also gives the staff the possibility to see the visitors before they enter the house, and go out and talk with them if needed. Entering the building, you can hear and see what there is going on in the entire house. The domestic scale and the lively colours in the building makes you feel welcomed and gives the building a homely feeling. As some people have difficulties entering the company instantly, there are integrated small seating areas in the staircase where the visitors can sit for themselves or talk with one of the volunteers or staff members.

Maggie’s Dundee

As the centre in Edinburgh have the scale of a domestic house, it is the same for the centre in Dundee. But as well the centre in Edinburgh looks like a domestic house, the centre in Dundee does not. With its curved and shining roof it draws attention to the building and makes newly visitors curious to enter the building. When entering the house, one is welcomed with an immense of light and an astonishing view to the ocean. When taking the first step into the building you feel welcomed and well nourished to enter the rest of the building. You can hear the life in the kitchen which is a separate room, but the view and the warmth from the wooden ceiling is drawing you into the small pocket, which is the library. Here you can sit protected from the rest, and read a book if this is what you want.

Illustration 59. Maggie's Lanarkshire has very much internal transparency but the exterior is very closed. This may be due to a very industrial area (behind the camera).

Illustration 60. Livsrum Odense with its welcoming curves.

Illustration 61. When entering the centre you instantly see the transparency in the house

Illustration 62. Livsrum Odense. An oasis of light and nature

Maggie's Lanarkshire

The arrival to the centre in Lanarkshire is quite opposite compared to the centre in Edinburgh and Dundee. The centre is placed near the hospitals parking lot, which makes the arrival filled with everyday noises. Because the building is placed near the parking lot, the architects wanted to create a barrier between the building and the parking lot, which works perfectly in that regard. But it also creates a barrier for the visitors to the centre. Looking from outside the building looks like a crematory because of the surrounding three meter high walls, and before entering the building you have to go through a gate which emphasises the barrier. When entering the building you are met with an overwhelming contrast, which is welcoming and the transparency in the building makes you hear and see the life going on in the entire building.

Livsrum Odense

Compared to the Maggie Centres, this centre of the Livsrum Series is quiet bigger, which is also seen when approaching the counselling centre in Odense. The centre is made with the concept of three bands, which is a concrete base, a wooden band and the aluminium band which reflects the trees and the sky. As the centre is contrasting the neighbouring building both accordingly to the form and the materials, it creates and curiosity for the house. Entering the building you are met with openness and immense of light, due to the height of the room and the skylight penetrating the ceiling. The various materials used and the use of trees inside the house makes you want to investigate more of the building. The visitors have the feeling, that they can grasp all the challenges in their lives, this is a place for joy and salvation.

Conclusion

The arrival to the centres is the first and main essential element for the centres, because if the visitors to the centres are frightened to enter the building, everything else does not matter. The entrance emphasises the first tone for the mood, you as a visitor experience. It is therefore significant that the experience is inspiring and enhances the friendly and informal gestures coming from the appearance of the building. It is important to create an entrance which can both be welcoming for the visitors, but also give the visitor the curiosity which in the final aspect will attract them to enter the house. When approaching the front door of the house it is imperative that the visitors do not feel observed from either outside or inside. From the entrance the visitors should be able to sense the life in the building before entering. The entrance also needs to be clear and obvious, because as the psychologist at Maggie's Glasgow said:

"The last thing you want after hearing a devastating news, is having difficulties of finding the entrance to the building where you are seeking help."

Joan, psychologist at Maggie's Glasgow

Everybody is different, and therefore can someone be afraid of seeing the life in the house. It is therefore important to create an entrance which can accommodate different individualities, where the visitors to the centre them self can decide if they want to sit down for them self, or join the rest of the company, who mainly will be sitting around the kitchen table, which is the heart of the house. This diversity is not only needed at the entrance, but has to go through the entire building.

Illustration 63. The plan for Maggie's Edinburgh

Illustration 64. The plan for Maggie's Lanarkshire

THE HEART OF THE HOUSE

The domestic feeling

The kitchen is the central element and the heart of the house. This is where the visitors have the opportunity to make their own cup of coffee and settle down at the dining table, and this is where the visitors gather around when there are both large and small events. Therefore, the facilities of the centre are also mainly arranged around the kitchen. The kitchen table is also the place where the spirit of the community feeling evolves. The centre at Edinburgh clearly emphasised the community feeling, where the visitors showed up hours before their classes, so they could talk and connect with the other visitors. Thus the kitchen is not only the place where they gather for various events, but also the place for individuality and place for intimacy. It was here one of the cancer sufferers opened up for us and told us his experiences and what this centre has done for him.

"I was devastated when I entered this building, but when I met Andy, my life changed. This centre saved me. Andy saved me"

Nori, regular visitor at Maggie's Edinburgh

The kitchen area is furthermore at all the centres visited built with an integrated island which gives the possibility for all the visitors at the centre to be a part of the company while cooking in the kitchen. All these aspects gives the kitchen various functionalities to the centre, and provides the domestic feeling to the centre.

Illustration 65. The kitchen in the Maggie's Edinburgh

Maggie's Edinburgh

The kitchen in the centre at Edinburgh is placed near the entrance, so when entering the building, one instantly sees the life around the table. Compared to the other centres, the kitchen was relatively small which made the kitchen quite intimate. The lively colours and various furniture gave the place a personal feeling, which also gave the feeling of staying in one of your relatives homes. Sitting at the table, one can see the garden and the hospital at background trough the big glass doors, which could be opened in the summer times. Sadly the view to the hospital could sometimes recall the thoughts back to their illness and the difficulties they had been going through, which of cause not was their intention.

Illustration 66. The kitchen in the Maggie's Lanarkshire

Maggie's Lanarkshire

Compared to the centre in Edinburgh, the kitchen in the centre of Lanarkshire is placed in the middle of the centre. The kitchen is the main parameter, as the other rooms and facilities is build around it. Sitting in the kitchen, it is possible to see all the activities in the entire house, which gives both the staff and the visitors an overview of the house. The kitchen is surrounded with four light shafts which bring an immense of light into the area, and gives a warm and welcoming atmosphere to the kitchen area. Compared to the kitchen at Edinburgh the kitchen is big and can therefore gather rarely larger events around the table. One of the events is learning how to cook healthy food by a professional chef.

Illustration 67. The plan for Maggie's Newcastle. This is one of the few centres (along with Vejle) with a decentral kitchen. This is clearly a negative thing.

Illustration 68. The plan for Livsrum Roskilde

Illustration 69. The kitchen in the Maggie's Newcastle

Maggie's Newcastle

Compared to the centre in Edinburgh and the centre in Lanarkshire, the kitchen at Newcastle is not placed at the entrance and is as well not the centre of the building. The kitchen is placed in one of the ends of the building, which makes the kitchen seem to be hidden away, which is a shame. When entering the kitchen you are met with a homely and warm atmosphere. The cold concrete can appear cold, but the mix with the wooden cladding and the domestic scale, the room seems welcoming and open. The view out to the garden outside also makes the visitors to relish the silent which can occur in the kitchen, making the place both for serenity and solidarity.

Illustration 70. The kitchen in the Livsrum Roskilde

Livsrum Roskilde

Entering the centre, one is instantly met with the kitchen area, which can seem intimidating for some of the visitors. Therefore the centre has small areas around the room, where the visitors can sit for themselves. This works very well, as one hereby has the possibility to see and hear the life in the kitchen, while simultaneously being separated from the company. The white walls can give the feeling of institutions, but the warmth of the wood used in the kitchen creates a welcoming feeling. The layout of the centre is centralised around the kitchen making the room, the heart of the house. From the kitchen there is direct access out to the garden, which gives the opportunity to open up toward the outdoor, blurring the lines between inside and outside.

Conclusion

As it is clearly shown in the analyses of the centres, the kitchens which are working the best, is where the kitchen is placed in the centre of the building. Here both the visitors and the staff can have an overview, and see the life throughout the centre. Designing the kitchen it is important to create views to the nature, as this is the place, where the visitors will be gathered the most of the time. The other factor is to prevent any views to the hospital, as this can recall the thoughts back to the illness of the cancer sufferers and the difficulties they had been going through.

"One of the main parameters when designing this building, was the emphasis of creating no views towards the hospital. When entering this building you are supposed to put your treatments beside you and forget the time at the hospital."

Ian, psychologist at Maggie's Dundee

Designing the kitchen it is also important to remember the scale of the room. As it is the kitchen which provides the domestic feeling to the centre, is important to create the kitchen in a scale which is comprehendible and has a domestic atmosphere, which both invites for individuality and community. It is important to create a kitchen with various functionalities, so the area can be used for diverse arrangements, emphasising the diversity and flexibility of the house.

NICHES AND POCKETS
Open counselling, socialising

Throughout most of the centres a recurring theme is the massive infill of small pockets and niches everywhere possible. This allows for the open therapy where people can have a conversation in the open space with chattering in the background. The pockets have different functions based on placement, shape and context. For instance, the pockets at the entrances of the Glasgow centre by OMA and the Dundee centre by Frank Gehry both serve as a combination of a waiting room (even though they don't use that word!), an information library and a conversation room. This is where new comers can be picked up or they can sit and read a magazine about cancer. The one in Dundee is more welcoming as it features a window with a great view and it is well lit and it's round, comforting walls makes the visitor relax. The one in Glasgow is darker and is connected to the kitchen, which allows the visitor to sit in the dark and "observe" the activities around the kitchen table without being exposed to the company at the table.

Illustration 71. Maggies Gartnavel in Glasgow by OMA. Pockets are spread throughout the whole building. The pocket in front of the entrance is the one shown on the picture. Here is visual contact to the staff area.

Illustration 72. Maggies Gartnavel in Glasgow by OMA. Pocket A at the entrance. Shows the visual contact to the staff area in the back.

Illustration 73. Maggies Gartnavel in Glasgow by OMA. Pocket B at the entrance is seen in the back and its correlation to the bright kitchen area.

Illustration 74. Maggies Gartnavel in Glasgow by OMA. Pockets E and F and their closeness to the staff area (seen to the left). Having the staff close to the computers allows them to offer help with the websites.

Illustration 75. The more library - living room like pocket at the entrance of the Maggies Dundee centre.

Common for the pockets in these two centres is that the pockets can vary in size and formality. For instance, some pockets are arranged with designer furniture and skin, and others are plastic furniture in different colours. Some are at a hearth, some combined with a bookshelf. Some are right at the entrance for the first chitchat and curiosity and some are more sheltered for deeper conversations. This means that there is a pocket for all kind of situations and all kinds of people.

"We don't tell people where to sit and what to do. We tell them 'sit where you want, do what you want!'"

Andy, Head of Maggie's Edinburgh

Illustration 76. Maggies Dundee first floor. A small pocket with astonishing view.

Maggie's Newcastle

In the centre in Newcastle small single niches are implemented at the stair to provide a reading spot that also has an overview over the library. The function is semi defined by the built in bookshelves, but it is still a flexible sitting spot. They have a gesture that is inviting people to sit in them, try them and enjoy them. Although they are an element in the stair, they become a part of the overall room becoming an element in the library. As the seating areas are places towards the south-west, they are perfectly placed to catch the afternoon sun, so they can also function as an indoor sun chair.

Illustration 77. Maggies in Newcastle. Connection between the stairs and the pockets in the wall.

Livsrum Roskilde

The centre in Roskilde has a niche next to the entrance that works a bit like a cave. There are pockets in the cave in different depths so that each pocket has a different relation to the rest of the space. This cave can be used for different things such as sitting in the back listening to the sounds of the house, sitting in the middle and seeing the living room or sitting in the front as a part of the living room. This allows for different kind of conversations with different requirements to privacy. Also, there is the possibility for a visitor to sit deep in the cave and feel protected while also having a conversation with a therapist who can have a connection to both the cave and the living room.

Illustration 78. Livsrum in Roskilde. Niche C (in the back) and Niche B (to the right).

Illustration 79. Livsrum in Roskilde. Niches D and E.

Conclusion

Generally these pockets serve well for the project and it is important that the new Herlev Cancer Counselling Centre will feature these in a great range of locations, variations and size. There should be the spot for the new comer that is curios and nervous on how the life is on the inside. There should be spots semi connected to the heart of the room that allows for people to be semi connected to this social life. There must be spots that in different ways are connected to the nature and allow for contemplation. They should be avoided in corridors, as these are redundant in the current Livsrum centres, rather they should connected to the different functions of the centre.

Illustration 80. Livsrum in Roskilde. Niches and Pockets. Note that this is not the final plan, so the niches A,B,C and F are changed a little.

GROUPS AND ACTIVITIES

Group therapy, flexible rooms, classes and creative workshops

The activities in the Maggie's and Livsrum centres span from theoretical classes where therapists teach about nutrition, health and feelings to hands on classes where they are cooking food, walking in the forest and having lunch clubs. At a visit in Newcastle, the authors saw an on-going session of *Look Good…Feel Better*. Here, 20 women enjoyed getting their old looks back using make up.

In the Maggie's centres, physical exercise consists of meditation, yoga, relaxation and tai chi whereas the Livsrum series has a more intense 6-week course in relation to chemotherapy, called *Krop og Kræft* (Body and Cancer). Here, the participants are monitored with heart rate monitors and urged to perform their very best. According to Kåre, the head of the Aalborg centre, most of the participants go full out no matter age and shape. This is a difference on the Maggie's centres and the Livsrum series. At Livsrum, the local hospital rents a part of the building to make these exercises. This is done to free the sufferers from doing the exercises in the dull hospital because the Livsrums have a more confident mood and the centre offers a calm atmosphere and the exercise rooms are connected to the outdoor. Kåre in Aalborg claims to have the best rooms for exercise as they are a large volume with lots of fresh air, good outdoor areas connected to them and rough materials, so that people are not afraid of going all in.

Other activity groups include creative sessions with writing, singing, music, painting and handicraft. Hejmdal in Aarhus offers a very tactile, robust basement that function as a painting workshop. Here, the rough, old bricks serve as a good contrast to the very delicate and fine paintings. In some of the centres, the workshop rooms are hidden too much and thereby not used much. It is found ideal that the workshops also serve as a show room for the products made in them. This is seen in Livsrum Næstved and in Vejle.

In Roskilde, the large activity room has a group function in one end and an open space in the other end. These two spaces can be separated by a folding wall, which is well integrated in one of the walls together with racks of shelves. Behind this wall is a storage room full of things for social activities and physical exercise.

The therapy rooms and group rooms function like a domestic room or a small living room. They are generally well lit and have a view to the outside. These views can be large views to a garden or a smaller view to a courtyard. This is seen upstairs in the Maggie's Dundee and in Maggie's Newcastle.

Illustration 81. Work out facilities in Livsrum Aalborg. They feature a perfect correlation with the outdoor, privacy and lots of volume for good air quality.

Illustration 82. Painting facilities in the tactily basement of Hejmdal, Aarhus.

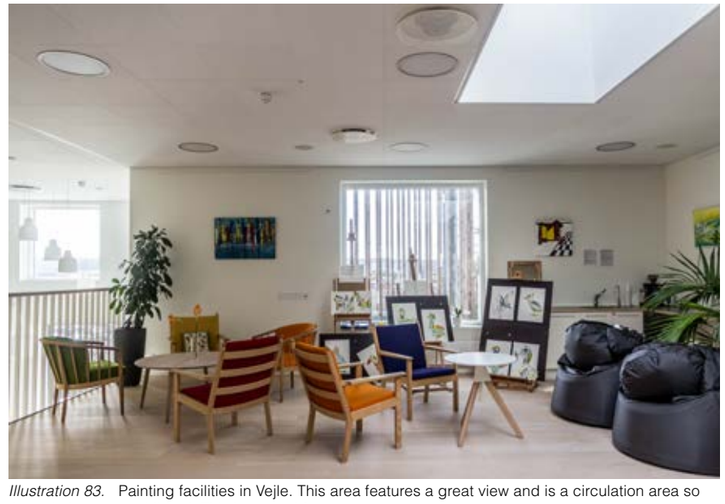


Illustration 83. Painting facilities in Vejle. This area features a great view and is a circulation area so the paintings are exhibited. This is a good feature.

In Maggie's Edinburgh the large group room functions like a large informal living room with vivid colours and soft, comfortable furniture and lots of cushions. Here, some of the furniture is also foldable furniture, which allows changing the room and expanding or contracting the amount of furniture. This is used for relaxation classes, group therapy and creative activities.

At Maggie's Glasgow the group rooms are defined by large sliding walls, which allow them to be open while they are not in use. This way the rooms may seem more inviting. In Glasgow there is the only therapy room without a view to the outside. This space feels soft and the curved wooden walls embrace the users. The room is, however, according to the users, too large. The distance between the two benches is too big. The skylight is not as clear and the connection to the sky is dim. The room is artificially lit from the top by string light LEDs and it is not very soundproof. This makes the room feel less intimate and less ideal for conversations as it looks on the pictures.

Illustration 85. Open group rooms in Maggie's Glasgow. These can be closed with the large sliding doors.

Conclusion

The activity rooms should be flexible rooms in terms of atmosphere and in function. Some of them should be able to be opened up towards the open space or to each other to combine them as a larger group room. While it is generally seen as a useful feature that the rooms can maintain different functions, it has to be cautiously programmed according to the life and the schedules of such a centre. Exercise rooms and workshops should appear robust and raw, so they don't look fragile. This invites people to use the room. It is ideal that the rooms for physical exercise, hard workshops and therapy room can be sound isolated. However soft workshops such as painting and drawing are ideal if they can hear some of the chitchat in the rest of the centre. Rooms for relaxation, yoga and meditation should appear warm and cosy without too many disturbing elements. It is important that storage for all objects for such classes is well integrated or close to these rooms. They benefit of daylight and views to nature, but it is seen as disturbing if people can look in from the outside.

Illustration 84. The therapy room at Maggie's Glasgow without a view to the outside. The room looks intimate and embracing, but the room has a lot of flaws.

Illustration 86. Maggie's Edinburgh. The large activity room full of furniture.

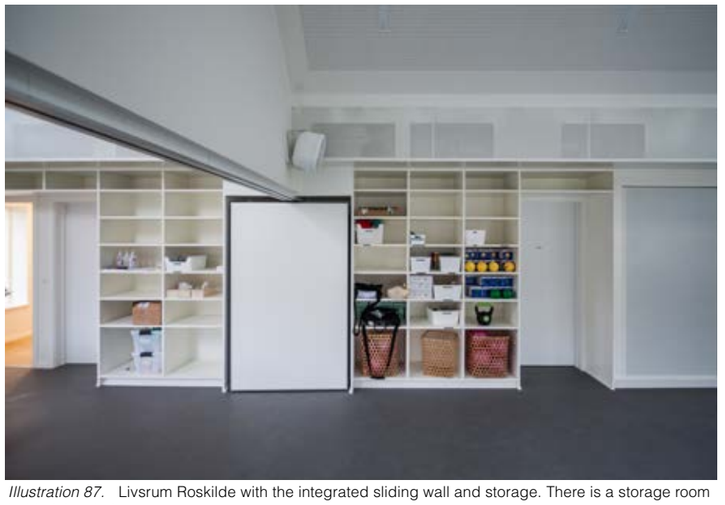


Illustration 87. Livsrum Roskilde with the integrated sliding wall and storage. There is a storage room behind the shelves.

FLOW AND TRANSPARENCY

Overview

The interior layouts of the centres offer a full palette of flows, connections visually and acoustically and degrees of privacy and most of the centres have a great connection to the outside. The entrance in most centres is directly into a cross section of paths, functions or directly into the kitchen.

In Glasgow there is a transparency through most of the open area of the building allowing visitors to view across the courtyard and being in connection with the outdoor. All surfaces are hard so the centre transmits sounds through the whole building. Only the group rooms and therapy rooms are enclosed, and only while they are in use. In order to complete the circular flow in the building without annoying the staff, an extra corridor behind the staff area is established. This corridor features a mirror on one side and a large panorama view to the garden on the other side. There are some issues with this mirror, however. Cancer patients see themselves, maybe in a though situation, not looking well. This is emphasised in the coated greenish glass used on the centre.

The Lanarkshire building is all about flow and transparency. Different niches and functions are weaved together to create a continuous flow through the building. This flow is parallel to the building volume and the building is very open to the two ends - the entrance area to the one side, and the garden to the other side. Varying gradients of privacy through the main room are created through glazed courtyards in the building volume, creating various atmospheres in the centre. The building feels very opaque when looking on the crosswise direction. Group rooms are enclosed from the main room and most rooms have a view to the outside that is parallel to the building. This way it succeeded in hiding the hospital. However it may also seem too enclosed when approached from the hospital. At entry, the staffs notice the visitor, because they are sitting towards the entrance area. But as the staff area is secluded from the entrance the staff area does not become a reception and this creates privacy for the staff and their classified documents.

Illustration 90. Parallel views through the Maggie's Lanarkshire.

Illustration 88. Maggie's Glasgow: The correlation to the outdoor.

Illustration 89. The correlation to the outdoor. This is seen upon entry. A faded view penetrates through the whole building.

Illustration 91. Parallel views through the Maggie's Lanarkshire. Here, the courtyards shade for some of the vision. Also the sky is dragged in using a reflective "crown" on the courtyard.

In Maggie's in Newcastle and in Dundee, the office is placed next to the entrance with a low wall in front of them. This makes the office appear like a reception. Psychologist Sari Harenwall from the Maggie's Newcastle centre mentions that this expression of the office encourages visitors and other members of the staff to interrupt all the time. She says that the staffs need an area to sit quietly and be able to work with classified documents without being interrupted. In Livsrum Aalborg, the office is similarly placed next to the entrance but it has another appearance so visitors don't interrupt in the same way. The staff can still have an eye on the entrance in case that the volunteer host is absent. In Livsrum Herning the administrative staff has, like the Maggie's Glasgow, an office in the back of the centre but it still has a visual contact with the entrance. This can be closed with a curtain when a volunteer host is present and opened when the staff has to monitor entrance.

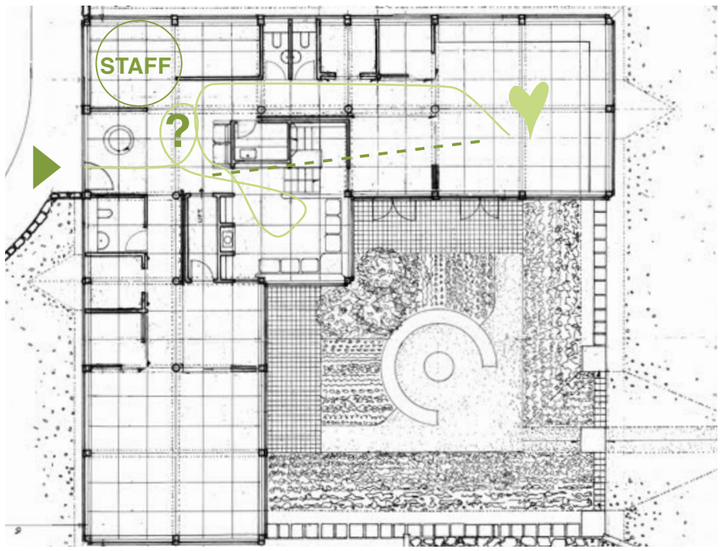


Illustration 92. Confusion upon entry at Maggie's Newcastle. The authors felt that the placement of the kitchen should be more central and connected to the entry.

Illustration 93. The office (upstairs) in Livsrum Roskilde has a view to the rest of the centre without being disturbed.

Conclusion

The Herlev Cancer Counselling Centre should accommodate the need for different transparencies between different functions. This has to be flexible as situations are different from a situation where people in a queue for counselling to large groups preparing for a workout to families using the centre as a living room outside the hospital. Flow should be understandable and people should be lead around in the building. The entrance has to be obvious and the hierarchy between staff area and visitor area should be clear. There should be a hint of a visual connection between as many as the open spaces as possible, allowing visitors to have an overview over different services and volunteers to have an overview over the visitors. It is seen as a positive effect that the chitchat from the activities around the building is audible from the main room while more noisy activities such as the exercise room should be isolated.

Illustration 94. The office area in Livsrum Aalborg is visible but not inviting people to disturb.It looks a bit like the staff is monitoring everyone entering the building.

Atmosphere
The nine points

To create an atmospheric environment it is important to create a homely and inspiring centre. The book “Atmospheres” is written from a lecture held by Peter Zumthor (2003), where he describes nine points, he defines as critical points in creating an atmosphere in his architecture. Zumthor describes these points as very personal and sensitive. It is found important to look at Peter Zumthor, since he is a very sensual and poetic architect, who uses this approach in his design. Studying his approach and method in relation to architecture, it is expected to strengthen these qualities in the design of the Counselling Centre. This section outlines the points with the purpose of taking inspiration in this way of working, looking at architecture and its atmosphere. It is therefore also chosen as an inspiration tool for the future course of the project.

In addition to this, there is from the book Atmospheres, derived some parameters, which the Maggie’s Centres and the Livsrum Series are evaluated upon. The experience of atmosphere is largely subjective, as reflected in this section.

Illustration 96. The transparency of the Maggie’s Glasgow

Material Compatibility
The composition of materials is important for the atmosphere of the room. Each small change in the quantity of material in relation to another can give a very different expression. A single material gives thousand different possibilities to process, proportion and composition.

In the centres, the focus is on creating a homely atmosphere, emphasising the use of materials with a warm appearance. The natural tactile quality that is among stone and wood refers to something homely and recognizable. Therefore are there in the most of the centres also used elements of natural materials. Three of the centres where this is evident are in Maggie’s Dundee, Livsrum Odense and Hejmdal. Here you instantly feel, the proximity and warm atmosphere the wood creates, and you hereby feel welcome in the centres.

Illustration 95. Therme vals by Peter Zumthor, the light becomes a material.

The Body of Architecture
Peter Zumthor looks at the volume of the building as a body, with an anatomy similar to a human body with a heart, a bearing skeleton and a protective skin. Something is hidden, something is implied and other is visible. The building is a body that can touch one and a body that can be touched.

As previously mentioned, it is in the centres visited clear that the kitchen and the dining table is the heart of the house. This is here all life is centred and social interaction emerge. The facade or architectural skin is, however varied in the different centres. Daylight is an important factor in the design of the buildings, emphasising the immense use of glass in the buildings, such as seen at Maggie’s Glasgow, where glass is used as the essential material that creates daylight in all the rooms. Though, the centres vary in transparency, emphasising the diversity of the centres.

Illustration 97. The use of natural materials in Hejmdal.

Illustration 98. One of the window niches in Livsrum Næstved

The sound of space

One's memories are often associated with specific sounds. For example the sound that made you feel at home in your childhood home. Try to find a way into the sound of a room, in its own silence by listening to the material and spatial composure. Each room has a sound of its own.

In many of the centres there have been worked a lot of creating small niches and pockets in continuation of the kitchen area. In this way the visitors can still be a part of the life at the kitchen but they can also sit for themselves and read a book if this is desired. Each pocket represents its own sound of the life in the building, emphasising that the visitors themselves can decide how much they want to be part of the community. Most of the Livsrum centres are arranged so, when closing the door into a therapy room, there will be absolutely quiet. The conversation gets quickly intimate, and the visitors are secluded from the life in the building. Therefore one might work more on creating transparency from the rooms, so they thereby can see the life in the house.

The temperature of space

Every room has its own temperature as it has its own sound. A room can be tempered or balanced through the use of materials. The physical temperature and perceived temperature are closely related. For example, steel can be read as being cold, where wood is read as a warm material.

The distinctive scent of wood stimulates one's sense of smell, which is the case in many of the centres. Simultaneously, the smell of freshly brewed coffee supports the use of the house and appeals to the senses. The wood helps to create a warm ambience and the tactile quality stimulates one's sense of feeling, as the surfaces and level of detail is worked in a way that makes you want to touch and feel the surfaces. The relative small scale and intimate spaces, which in a high degree is experienced at the centres, creates an acoustic environment that seems homely. The open-plan creates an auditory connection between the zones that also can be related to the feeling of home.

Illustration 99. The wooden roof structure gives a warm atmosphere in the Maggie's Dundee.

Illustration 100. The immense use of various furnitures in Maggie's Edinburgh

Surrounding Objects

The people who use the architecture, and the things they are surrounded with, affect the architecture. Things that create a sense of homeliness for the people who use the spaces, there need to be made room for. This creates a common cohesion between the architecture and the use of the architecture.

The involvement of the users in the architecture is evident in all projects, since there is added a various amount of items as furniture, books, pillows and paintings. But mostly the furniture is not directly linked to the architectural expression. In Maggie's Fife, it is clear that the use of the building was not taking into account when designing the building, as there are unfortunate meetings where furniture conflicts with the big swing doors and where room separators are added, to screen for storage, simply because there is not enough space. In general, the furniture is varied in character as they would be in a home where different people use the spaces. In all the centres the user has their own distinctive stamp on the building.

Between composure and seduction
Does the architecture show which way to move. Does it seduce? There should be a sincerity in the way we pass through the house, as a result of the natural curiosity and desire to discover and experience. The building should invite for staying and for experiencing the house. One should not feel forced through the various rooms.

Livsrum Roskilde is entered directly into the Heart of the House. Here is an overview on how the building and the functions emanate out from the kitchen area. The small niches around the room makes one curious and you therefore want to explore the rest of the building. For example, when entering Maggie's Dundee one is greeted by the warm light and the view out into the sea, which comes from the window of the library. But one is also greeted by sounds from the kitchen. This gives the building a distinct possibility that one can either sit alone in the library, or be part of the community inside the kitchen, which hereby gives the arrival room the diversity needed.

Illustration 101. The interaction between the Lounge and the kitchen in LIvsrum Roskilde.

Illustration 102. The outdoor covering of the roof at Maggie's Dundee

Tension between interior and exterior
When creating a box, something is automatically outside and something is inside, and thus transitions, a threshold, a sense of place, something that surrounds and protects us. There's something inside that is hidden from the outside and vice versa. What is seen when staying inside and what is exposed to the outside.

The relationship between inside and outside is underlined in all the projects in which, there is a contact with the outdoor garden or nature views. In Dundee the structure of the ceiling continues out through the facade and forms an outdoor covering, underlining the importance of the relationship between inside and outside. At Livsrum Odense the building shape is continued outside, boundering the outdoor areas, blurring the line between inside and outside. The arrival at Odense also works inviting because it embraces the users with the warmth of the wood, when approaching the entrance. Maggie's Fife, seems on the other hand deterrent, through its pointed shape and black colour.

Levels of Intimacy
The relationship between the building and the size of humans is essential for the experience of architecture. The dimensions of a door make, for example, a significant difference in the experience of entering the building. A very tall slender door may seem elegant and formal opposite to a low wide door, which is normally perceived as informal.

All the centres are relatively small in scale to ensure intimacy and domesticity. However, there are examples of elements which are not related to the human scale. This is evident in Maggie's Fife where the doors are too big to handle and where the built-in shelving continues to the ceiling which is not reachable, making you feel small, which is not appropriate in a centre for cancer patients. Contrary is the case in Edinburgh, where the ceiling height is relatively low over the kitchen and the dining table. Here you clearly feel the domestic scale. However, it may be difficult for some, as the degree of intimacy can be too great when visiting the centre for the first time.

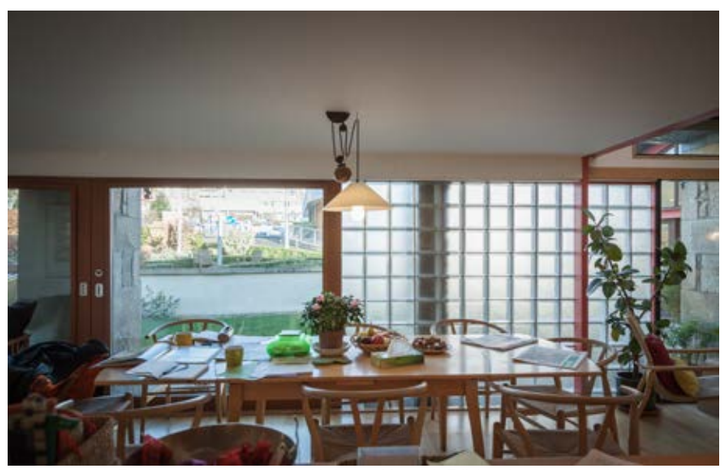


Illustration 103. The low ceiling height in the kitchen at Maggie's Edinburgh makes is an intimate space.

Illustration 104. The lounge at Livsrum Odensen emphasizing the contrast between light and dark.

The light on things

Light is only seen at the moment it hits an object, thus it is important to focus on this object, its form, structure and material which are of great importance for how the light is reflected and how the light is experienced. Daylight rather than artificial light speaks to Zumthor. The different ways it is experienced in different spaces in different times, generates an almost spiritual feeling that there is something greater, beyond what we humans understand.

Overall, there has in the centres been worked with light with a focus on quantity over quality, and in relation to creating contrast. At the centre in Odense, one is greeted by a wall of light that illuminates the kitchen area. But here they have intensively worked with the contrast, making height of the side-lying spaces and the lighting respectively smaller and darker. This gives a feeling of being in a cave, and you get the feeling that you can hide in these little pockets. The house wants to be explored. The skylights, create a diversity during the day, using the underlying trees. This creates different atmospheres in the room relative to the time of day you enter the house.

Conclusion

The nine points from the book "Atmospheres" by Peter Zumthor gives inspiration to the various angles, one can take in creating architecture that has a special soul and poetry, described as atmosphere. Zumthor has certainly a very poetic approach to architecture, materials, spaciousness, light and surfaces, and this is reflected clearly in his architecture in a very specific way, which speaks directly to the soul of most people. These are some of the sensitive qualities which are desired to be implemented in the new Cancer Counselling Centre at Herlev.

The Maggie centres and Livsrum centres manage to create a homely and informal atmosphere where openness and approachability is the focal point. The aesthetic quality varies, but in all the cases except Fife, there is cohesion between aesthetic expression and function as a welcoming counselling centre. The use of space makes its mark on the homely atmosphere, and the added features in the houses takes up a lot of space. It is therefore an important parameter to consider in the design proposal, whether it is okay that many of the elements can be supplied by the users or the architecture must provide many of the features itself.

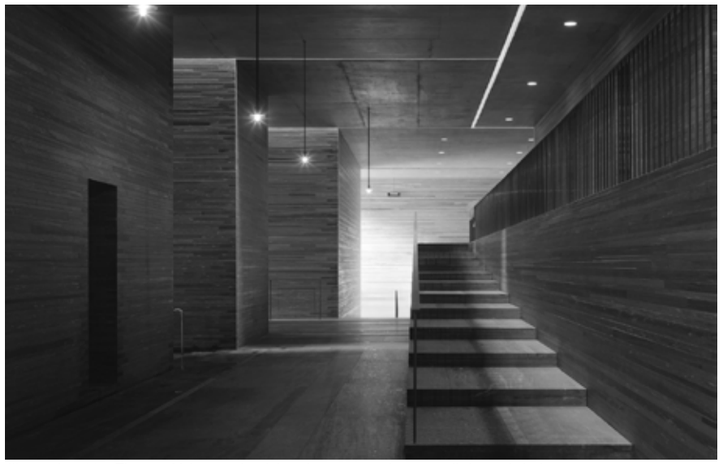


Illustration 105. Therme Vals, emphasizing the contrast between light and dark.

Illustration 106. The therapy room at Maggie's Glasgow without a view to the outside, but light comming from above.

Function Diagram

Intentions before design phase

As seen in many of both the Maggie's and Livsrum centres, it is prioritized that the visitors enter right into the main room, or the heart of the building. From here it is important that they feel safe and protected. This can be done by placing a lot of different pockets, lounge and library in vicinity of the entrance and connected to the main room. Having the administration as one unit, not necessarily connected to the main room, but with a visual connection to the entrance allows them to have an overview on understaffed days.

It is preferred that activities such as exercise, relaxation and counselling are exposed to nature without exposing them to people outside. Placing them in the band of trees can do this. Other activities such as workshop rooms and dining are allowed to be exposed and will be exposed to the park or the road to allow first time visitors to get a glimpse of what is happening on the inside.

The quantities of the rooms are based on a general competition programme for the Livsrum series (Petersen & Svendler, 2008).

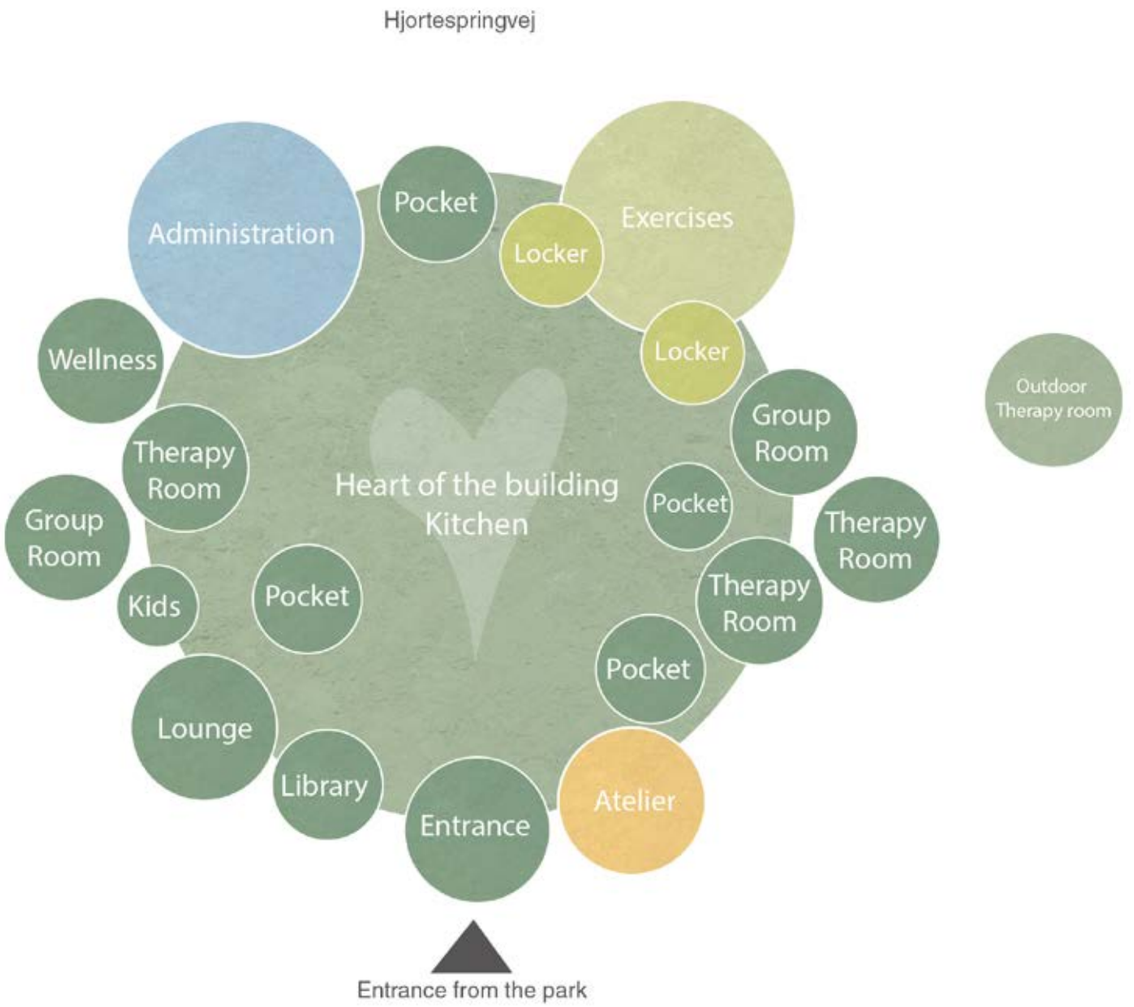


Illustration 107. Preliminary intentions on the functional layout

Room Programme

Intentions before design phase

Function	Number	Size[m2]	Total [m2]	Minimum Ceiling Height [m]	Capacity [pers/room]	Atmosphere	Notes	Area above 2% DF [%]
Common Areas								
Entrance	1	5	5	2,50	6	Welcoming	Towards Hospital	-
Wardrobe	1	10	10	2,50	1		Close to entrance	-
Library/Information	1	15	15	2,50	4	Calm	Close to entrance	50%
Common room/dining	1	180	180	5,00	20	Sense of home		50%
Lounge	1	30	30	2,50	8	Calm	Comforting "cave"	50%
Kids	1	15	15	2,30	4	Informal		50%
Atelier	1	30	30	3,00	6	Robust	Open "showroom"	80%
Depot	1	8	8	2,50	0			-
Lavatories	4	3	12	2,30	1			-
			305					
Therapy								
Wellness	1	15	15	2,50	3	Cosy		-
Group room	2	18	36	2,50	6	Calm	2 together	50%
Therapy room	3	15	45	2,50	3	Calm		50%
			96					
Exercise								
Exercise room	1	70	70	4,00	12	Robust	Large volume (air quality)	50%
Locker room/shower/wc	2	15	30	2,50	6			20%
Ventilation	1	20	20	3,00	0		Away from silent activities	-
Depot	1	10	10	2,50	0			-
			130					
Volunteer/Staff							Zone should not be too inviting	
Open Offices	1	20	20	2,50	4			Working zones
Cell Offices	2	12	24	2,50	2			Working zones
Cell Offices	2	12	24	2,50	1			Working zones
Copy room	1	10	10	2,30	2			-
Staff room / Tea Kitchen	1	30	30	2,50	8	Sense of home		50%
Wardrobe/shower/wc	1	25	25	2,30	1			20%
Cleaning	2	3	6	2,30	0			-
Depot	1	5	5	2,50	0			-
			144					
Heated floor area			**675**	**m2**				

Illustration 108. Preliminary intentions on the room programme

VISION

The Herlev Cancer Counselling Centre will be an inspiring oasis for cancer sufferers. The goal is that it will be a vibrant, inspiring and healing house where cancer patients and caregivers have the best possible framework for conversation and interaction, with counsellors and others in the same situation, emphasising the third place: A hangout place or a second home away from home, job and hospitals. This is where people no matter background can meet with others in the same situation as themselves searching for friends, salvation and answers. Here, the thoughts of hospitals and nurses are replaced with activities, learning and chit chats. This is where you meet people together with your old friends.

It should provide safety and serenity for the visitors as a piece of architecture that is light, understandable and welcoming. The atmosphere should be domestic yet playful as it stimulates the senses using materials, interesting spaces, caves or pockets, and the perception of light. This will signalize a transformation; a new beginning and a chance to put the users lives back together again. Upon entry, visitors should get an overview of the activities without feeling like being in the spotlight, like a stranger. This will help first time visitors who may be in a traumatic situation.

The open spaces and pockets should interact with each other using different transparencies both visually and acoustically, so they can accommodate different moods in different situations and users, where some require more privacy than others. Some of the events can be celebrations while others can be grief. The spaces should invite for exploration so that people on their own can walk around and discover the different zones.

With a point of departure in the Maggie's Centres and the existing Livsrum series, the visual identity of the place should function as an icon showing the purpose of the centre. With its placement at the edge of the Hospital Park in Herlev, the centre should integrate its surroundings and blur the boundaries between inside and outside.

DESIGN PARAMETERS

Perception of the building

Welcoming visitors with an embracing identity which relates to cancer patients and the site
Contrasting the hospital looks
Awareness from the surroundings as an icon
Use the band of trees as middle zone to allow curiousity from future visitors

Interior

Work with transparency to connect areas and create zones of privacy
Breaking down the barrier upon entry
Various rooms with different atmospheres for different occations
Using the light as a material to create atmospheres and zones
Creating room for individuality and community
Break down the barrier between inside and outside

Technical

Optimise shape to maximise benefit from daylight
Preheat building in winter months with direct sun
Avoid over temperatures in summer through shaded geometry
Comply with the Danish Building Class 2015
Comply with thermal and atmospheric comfort class B
Comply with requirements for daylight in the room programme
Integrating room for ventilation and installations

SYNTHESIS

The following pages will introduce the final design of the project. Each of the displayed focus points will be explained in function and aesthetics as well as the intentions behind. The project is displayed from outside in as this gives the reader a good understanding of it and the context. This is not to confuse with the actual process which has been both inside out and outside in, with concurrent technical consideration. Some of the pages have grey boxes and these are symbolising that the content of the box is process and the drawings are work-in-progress drawings, inspiration, etc. When returning to the white background, the reader is back in the presentation flow. The intention behind this is to link the process very close to the actual proposal.

Concept
The main concept

THE MAIN CONCEPT

The main concept is simplified through the following sketches. The building is placed on a plateau, which creates a foundation in the wet forest bed and create a contrast to the park. To break down the volume, the building is split into five “volumes”. Functions like therapy, atelier, lounge, exercise and staff are placed in these volumes, having the heart of the house, as the central and main element in the building. This invites for more public behavior in the large main room and more intimate behavior in the volumes. Creating a gap between the volumes allows views out to the nature, to all directions, erasing the barrier between outside and inside. The roof of the main room becomes an element, which connects all the volumes together with the main room, emphasising that all the functions in the house, are connected with the heart of the house. The building opens up towards the southern terrace, and gives the users and the staff the optimal overview of the entire building. The volumes at the southwestern end of the building are placed so they shelter for the outdoor areas against the wind and the noise from the west, giving the optimal conditions for outdoor events.

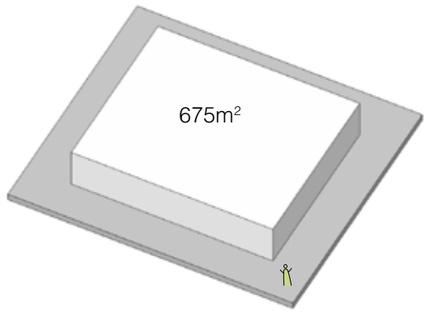


Illustration 109. The building as a volume fulfilling the size in room program

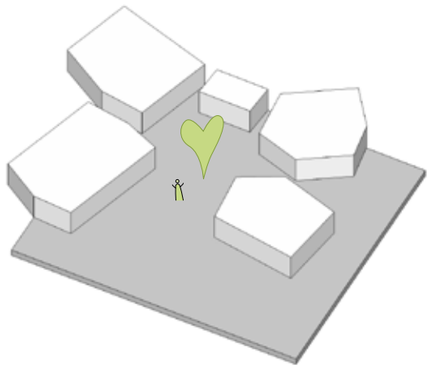


Illustration 110. The building appear as smaller volumes, breaking down the scale, where the heart of the house is the central element in the building.

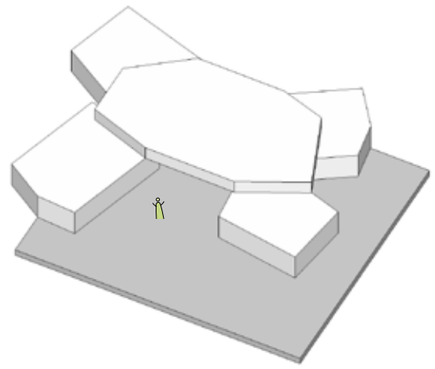


Illustration 111. The roof connects all the volumes together, emphasising that all the functions in the house are connected with the heart of the house.

OVERVIEW

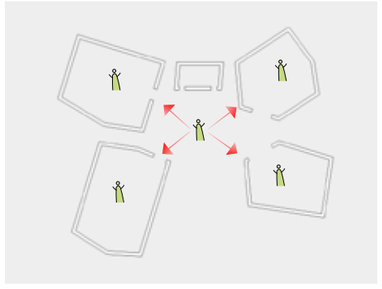


Illustration 112. Standing in the main room the users and the staff have a overview of the entire building

CONTACT WITH NATURE

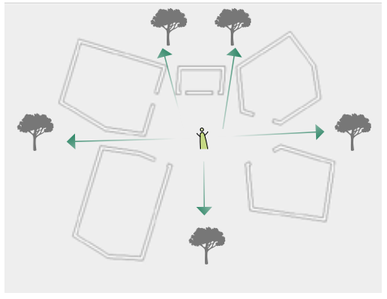


Illustration 113. As the building opens up towards the nature, it blurs the line between outside and inside, inviting the nature into the house.

CLIMATE ADAPTION

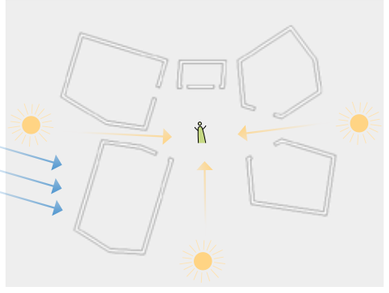


Illustration 114. The building will get passive heating in the morning, while the main roof will cover from the high sun on the midday. The volumes at the western end of the building creates shelter for the outdoor areas, against the wind and the noise from the west.

existing parking

new parking lot

Livsrum Herlev

southern terrace

existing pond

Illustration 115. Overview.

Siteplan

The placement in the park

SITEPLAN

When the visitors arrive from the hospital, they are met with the plateau that lifts the building up from the wet forest bed. The soft shapes of the building appear as a welcoming gesture to new visitors and acts as an inviting element. As seen on the site plan, the building seems like small stones placed in the park, contrasting the sharp and clear lines of the hospital. Hereby, the building is clearly distanced from the idiom of the hospital and becomes more an element that plays along with the park and the surrounding trees. A new small parking area is created north of the building to allow parking for walking-impaired. For larger events in the house, the users can still use the existing parking lot in the northern corner of the park. The shape of the building is reflected on the terrace, forming the different flowerbeds. In order to contrast the green hues of the park, the flower beds are planted with various flowers in varying color schemes and herbs. A barbeque area is placed so that it receives the evening sun. At the southern end of the terrace is the outdoor therapy room placed, which helps to frame the terrace and becomes an element that hides in the forest. The therapy room will have areas for storage and outdoor therapy with a view into the park.

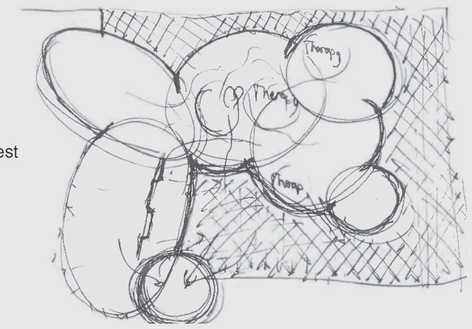
Situated in the forest, the building is distanced from everyday noises, creating the right frames for views out to the nature, and involving the park as a place for healing, gathering and contemplation. To implement the pond as a fixture instead of an element, there has been created a new path around the pond, as it is proved and mentioned in the "Healing Garden" chapter, that water elements has a positive impact on stress levels, sense impressions and the experience. The outdoor areas of the house are hereby connected with the park, giving the users the optimal conditions, for the future healing process.

Illustration 116. The view towards the east from the building.

SITEPLAN PROCESS

Through the process focus has been on creating semi private outdoor areas in association with the cancer-counselling centre. This possibility was given in the south-western corner of the park, allowing the centre to gain its own domain. The feeling of this semi private relationship is emphasised in the plateau. This way the centre respects the forest and is semi hidden in the border of trees. Flowerbeds on the terrace are reflecting the shapes of the building without being a direct copy. When entering the centre, the view to the plateau will be a new interpretation of the forest.
From south it will look like the building is placed on the plateau like on a displayed on a dish. And from west and north, the building exceeds the frame of the plateau and looks more like a border. This way it is open and welcoming towards east as this is the main entrance. The idea also supports the idea of drawing nature into the house, as the same types of forms recur on the terrace. Hereby the terrace gets a calm and understandable layout which plays along with the design of the counselling centre. It is also possible to see how the outside therapy room becomes an extension of one of the volumes, and are thus helping to frame the terrace between the surrounding trees and the centre.

West



East

Illustration 117. The idea of the centre with a two sided facade. Placed on a plateau when looking from east and planted in the ground when looking from west.

Illustration 118. Siteplan

The Building

The life within

A recurring theme in the building is the use of niches; places that open up, that the users can use as a hiding place away from the community without feeling lonely. With a starting point which speaks to the body, which contains contrasts, embracing and is inviting. An architectural expression that through a soft dynamic is pointing forward, trying to tell the story of the life cycle and represents a place in a course; not a terminus. The building is symbolising a new place; a new beginning. Therefore the functions in the house are not hidden away in introverted spaces. This is evidently expressed with the placement of the therapy rooms, which are entered from rooms which are not corridors. This is seen in some of the Livsrum Centres and it sends a negative signal. Furniture is integrated as a part of the architecture allowing niches, seating and storage to be a part of the building.

The volumes in the building are places where users can retreat from the community around the kitchen table, and hide in the small niches and pockets, which are integrated in the building. The small scale of the volumes compared to the more open main room, makes the volumes appear as an embracing element, where the individual is in focus and where the intimate atmosphere is expressed. This is here the more private events take place in the house, and this is where the users can sit with a cup of coffee in a state of contemplation. The lower ceiling height in the volumes in relation to the main room gives the house a homely character, which provides the users with a sense of belonging to the house. The alternating tones of light in the volumes, helps to give the volumes their own identity, creating a varying atmosphere throughout the entire house. The angling forms of the volume create a curiosity that gives the new visitors of the house, an aspiration to explore the rooms within the volumes, to find their proper place in the house.

Illustration 119. The centre is for everyone. Photo by unknown. Found at cancer.dk

Illustration 120. Overview over the functions of the building.

The Structure

Glueing the volumes together

READING THE BUILDING

The building is constructed as five individual volumes with bearing walls that support a floating top, which defines the negative space under it as the main room. The centre of the building is in this way a binding space between functions and volumes, like a plaza is connecting the buildings around it. With a look like rocks that are lying on eachother, the visitor gets the feeling of stability, protection and calmness. The layout of the rocks creates a shelter by opening mostly up towards south and the outdoor terrace. This way, the visitors have their “back” protected, while being oriented towards the outdoor areas and the sun. Here, one is protected like in a cave, without the spaces being too dark. The structural principle is explained further in Appendix 1 on page 106.

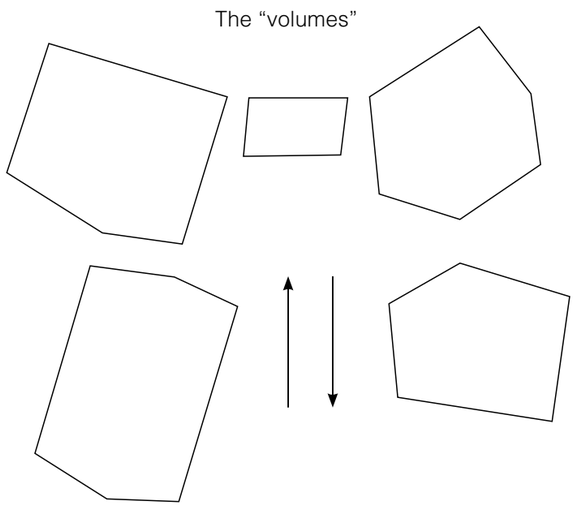


Illustration 122. The volumes protect the users. The negative space between them is oriented towards south.

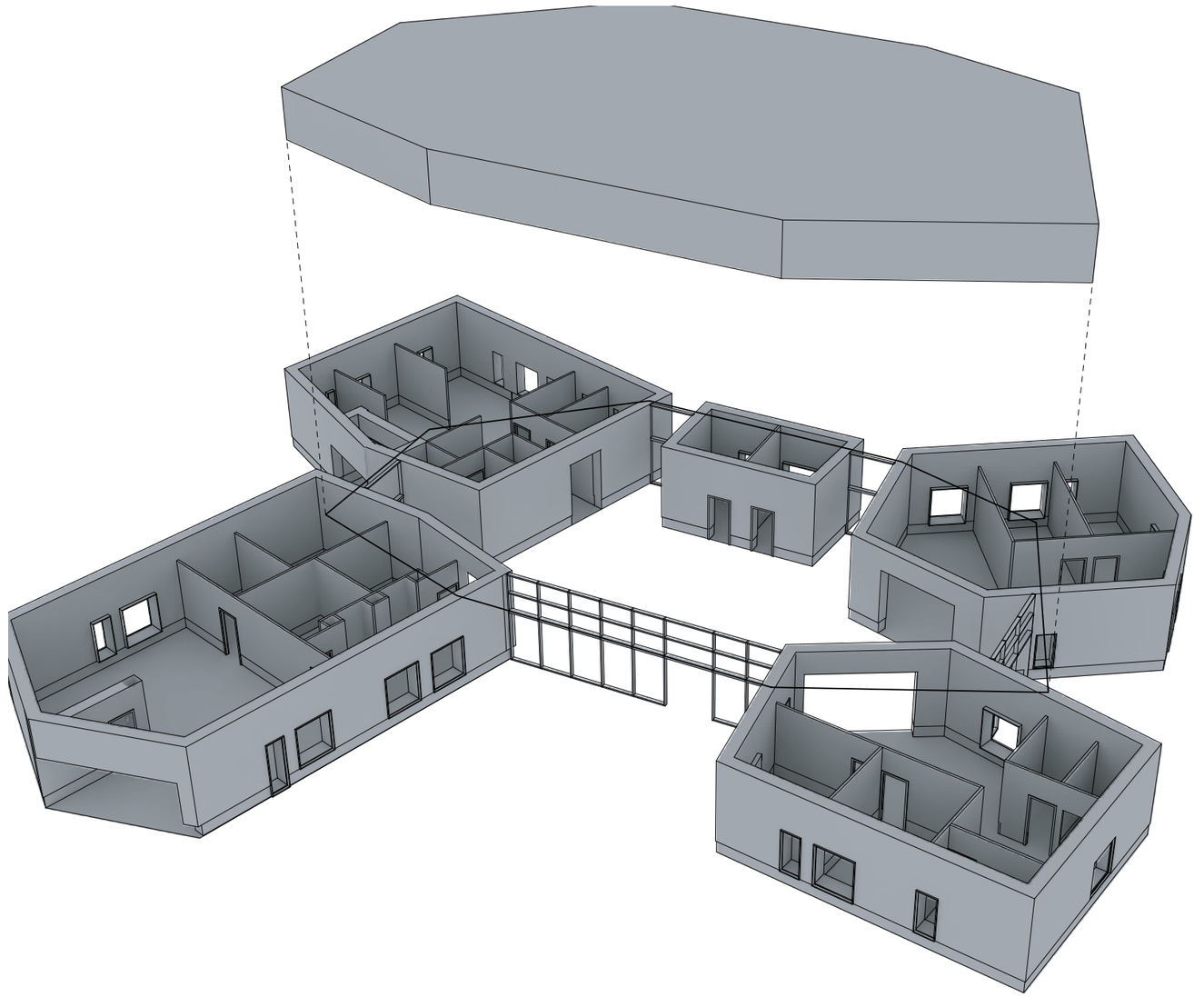


Illustration 123. A principle of how the top is resting on the volumes.

VOLUMES PROCESS

In the early course of the project there were experimented with the concept of the niche and the pocket - integrating small hiding places in the building where the users could retreat into the background. Alongside this, the metaphor of small stones lying on the forest floor was investigated, leading to different shapes, which were analyzed and experimented with. When the "stones" intersected into each other, they created small pockets, which were found interesting and therefore further processed. The amount of intersection of the stones determined the amount and sizes of the pockets inside the building, which resulted in various building forms, which were analyzed. In the end this created a form, where the concept of the niche and the pocket was integrated into various volumes, and thus, the different studies were linked to the final expression.

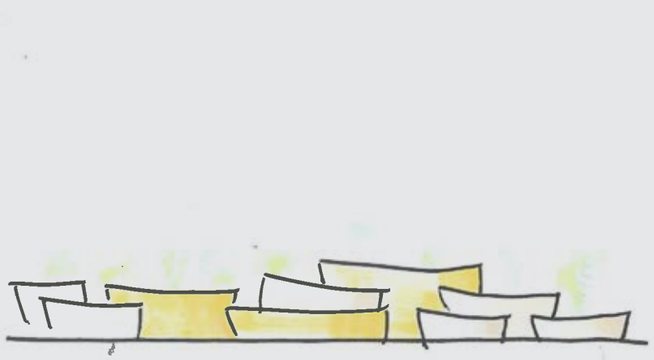


Illustration 125. The idea of the stones laying in the forest bed. This was one of the first sketches on how placement in the forrest should happen.

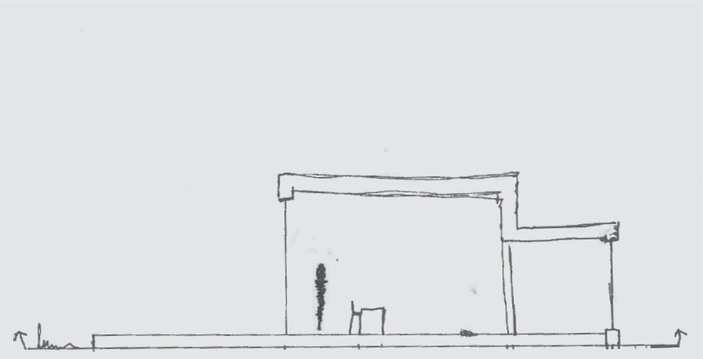


Illustration 127. How a section of the main room and one of the volumes could look like

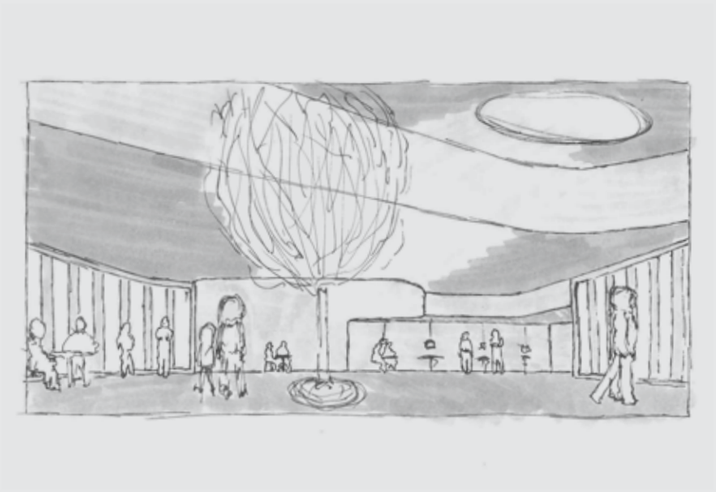


Illustration 124. The pockets which appear when the “stones” is intersecting with each other.

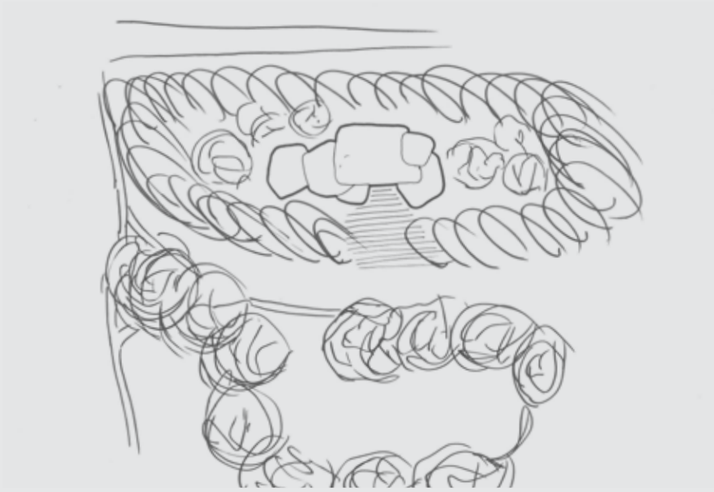


Illustration 126. Here a concept of 6 intersecting “stones”.

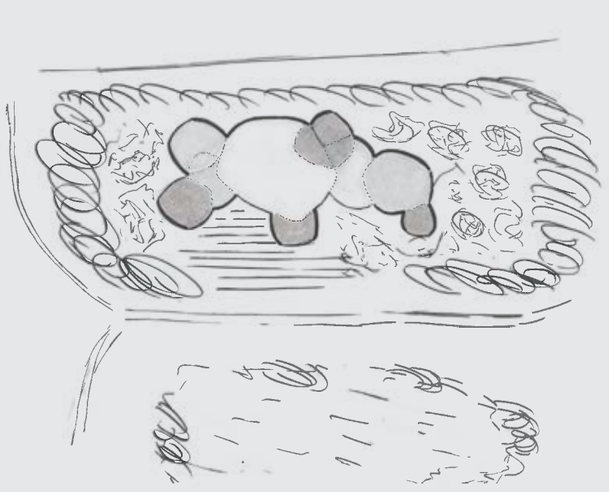


Illustration 128. Here a concept of 9 intersecting “stones”.

The Floor Plan

Transparency

THE PLAN

The kitchen, which is also the heart of the house, is centralized in the plan. This is where the social life is centred around, it is here visitors are welcomed when arriving the first time, and here is where people enjoy a cup of coffee at the dining table before and after participating in an activity in the house. For some, the first meeting, however, can be a difficult meeting, and therefore it is important to have the opportunity to retreat, where it is possible to see the life in the house in a state of contemplation. Therefore is library and lounge located as an extension of the entrance, so the visitors thereby have the ability to “hide” in these little pockets. The functions which are of a private nature is hidden in the back of the building, as exercise and staff, where the functions of a more public nature is in the front of the building, such as library, lounge and the atelier. Standing in the kitchen, the users have an optimal overview of the entire house, which benefits both the individual users and the employees, and when the building opens out onto the south-facing terrace, the users get the experience of being part of the nature. The large glass area helps to extract the nature into the building, thereby erasing the boundary between inside and outside. As the house must seem like a big open house, corridors are minimized in the house. Hereby are the therapy rooms turning towards the social space, giving the feeling that the therapy rooms are part of the house, even when the users are behind closed doors. Around the entire house there are integrated small niches and pockets that have a more intimate and warm atmosphere forming a place for tranquillity and reflection, which provides a diversity to the house. The building is made without a reception as this can help contrasting the hospital feeling. Although staff is located at the back of the house, they have a viewing line to the entrance to help picking up new comers at days where the volunteers are absent.

Illustration 129. Floor plan 1:200

Facades

The connection with nature

WINDOWS

The windows are an element that unites the entire building together. As seen in the elevations and in the plan, the main room has floor to ceiling windows. This is to make the main room as transparent as possible, and helps to give the feeling of being a part of nature, while being inside. The windows, which are placed in the volumes, by contrast, have a variable expression that supports the dynamic forms. The windows are located at a height of half a meter, so the windows have an optimal seating height, which makes them seem like seating-niches for the users. To appear inviting, the window frames are extruded from the wall, giving the window frame the optimal depth for seating. In order to emphasise the horizontal band in the building, all the windows have the same height, thus varying in width, depending on their function within the given space. This gives the building facade a calm expression and emphasises its horizontality. In the therapy rooms, there has been worked with the concept of placing most of the big windows, where privacy allows it. This provides the users an area that they can use if they need time alone during the conversations. For the users can be able to feel at home, they always have the possibility to open the windows and pull the curtain, if this is desired.

The windows are designed with 2-layer low-iron glazing to achieve the best possible rendering of natural skin colours, breaking the barrier between inside and outside and to disinfect the air with UV radiation.

Illustration 130. North facade in 1:200. This is the facade the visitors will see from the close-by parking lot.

Illustration 131. South facade in 1:200

Illustration 132. East facade in 1:200. This facade is seen when arriving from the hospital.

Illustration 133. West facade in 1:200. Seen from Hjortespringsvej.

Facade Workshop

Connecting with nature

FACADE PROCESS

Early in the process, there was worked with the concept that the main room should have a transparent façade, and that it therefore was the volumes that would determine the facade expression. During the facade workshop, there has been worked with various facade solutions, but in this case three facade solutions were examined and analyzed both technically and aesthetically. To have something firm to relate to, there was made a reference building that the investigated facade solutions could be held up against regarding the energy consumption. An energy calculation is made in the program Be10 (Danish Building Research Institute, 2005). In here, a reference building is made after The Danish Building Regulations 2010 (Energistyrelsen, 2015) with a minimum window area of 10% of the floor area. After this, different window setups have been evaluated in terms of energy and daylight and in how they support the building concept the best. To see how much the windows affect the thermal experience in the building, three of the most vulnerable spaces have been analyzed, using the 24h average spreadsheet following calculations found in SBi 202 (Andersen et al., 2002). The spaces that have been analyzed are the southwest-facing office, the south-facing exercise, and the south-facing wellness room. To look at the overall daylight in the building, there has also been made a daylight factor analysis of the various facades solutions.

As seen in the different facade solutions, the energy consumption, the thermal experience and daylight factor are very similar. Therefore the facade expression is chosen from an aesthetic point of view, which supports the concept as much as possible and provide the best experience for the users.

The daylighting analysis method is explained “Appendix 10: Daylight Analysis” on page 130

Some of the 24H spread sheets are found in “Appendix 8: Thermal Comfort” on page 124. The rest are found on attached USB Pen drive.

Nøgletal, kWh/m² år

Energiramme BR 2010

Uden tillæg	Tillæg for særlige betingelser	Samlet energiramme
73,4	0,0	73,4
Samlet energibehov		36,2

Energiramme Lavenergibyggeri 2015

Uden tillæg	Tillæg for særlige betingelser	Samlet energiramme
42,3	0,0	42,3
Samlet energibehov		32,5

Energiramme Byggeri 2020

Uden tillæg	Tillæg for særlige betingelser	Samlet energiramme
25,0	0,0	25,0
Samlet energibehov		23,9

Bidrag til energibehovet

Varme	18,5
El til bygningsdrift	7,1
Overtemp. i rum	0,0

Udvalgte elbehov

Belysning	5,5
Opvarmning af rum	0,0
Opvarmning af vbv	0,0
Varmepumpe	0,0
Ventilatorer	1,6
Pumper	0,0
Køling	0,0
Totalt elforbrug	17,1

Netto behov

Rumopvarmning	18,5
Varmt brugsvand	5,3
Køling	0,0

Varmetab fra installationer

Rumopvarmning	0,0
Varmt brugsvand	0,0

Ydelse fra særlige kilder

Solvarme	0,0
Varmepumpe	0,0
Solceller	0,0
Vindmøller	0,0

Illustration 134. Be10 key figures for the reference building with a window area of 10% of the floor area.

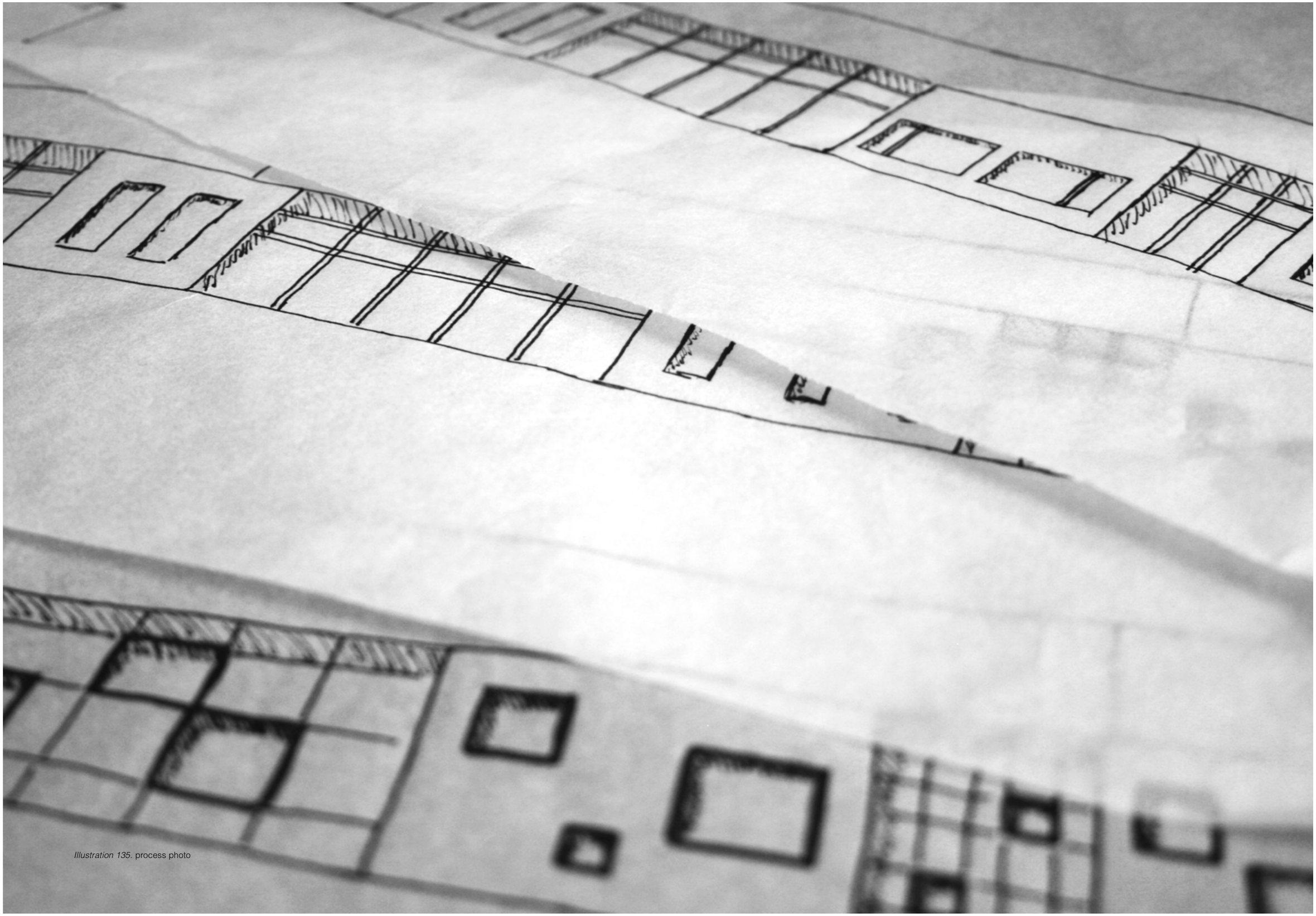


Illustration 135. process photo

FACADE 1: SQUARES

This concept attempts to break down the scale and create a dynamic facade that naturally blends into the forest. Larger windows can be used as furniture and frame certain views. Smaller windows allow for glimpses to the nature and privacy. But when looking at the windows it gives the facade a cluttered expression, which is not wished for. Inside the expression of the windows becomes too expressive, where it is wished to have the windows should create a calm atmosphere inside the rooms.

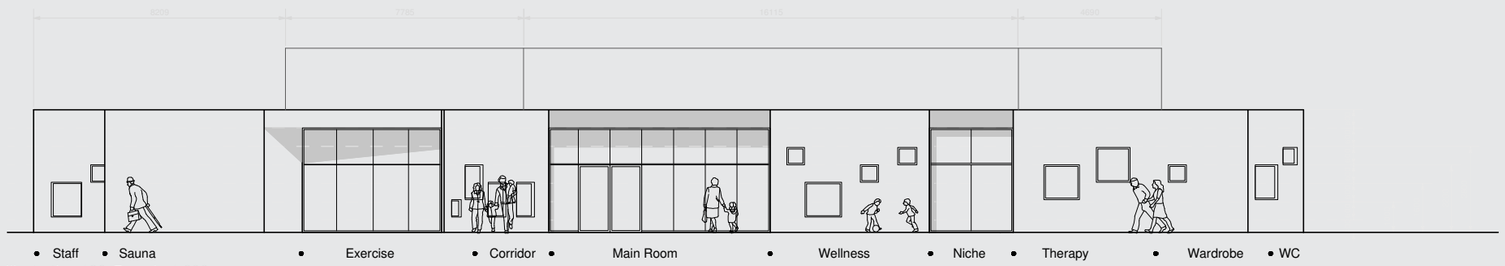
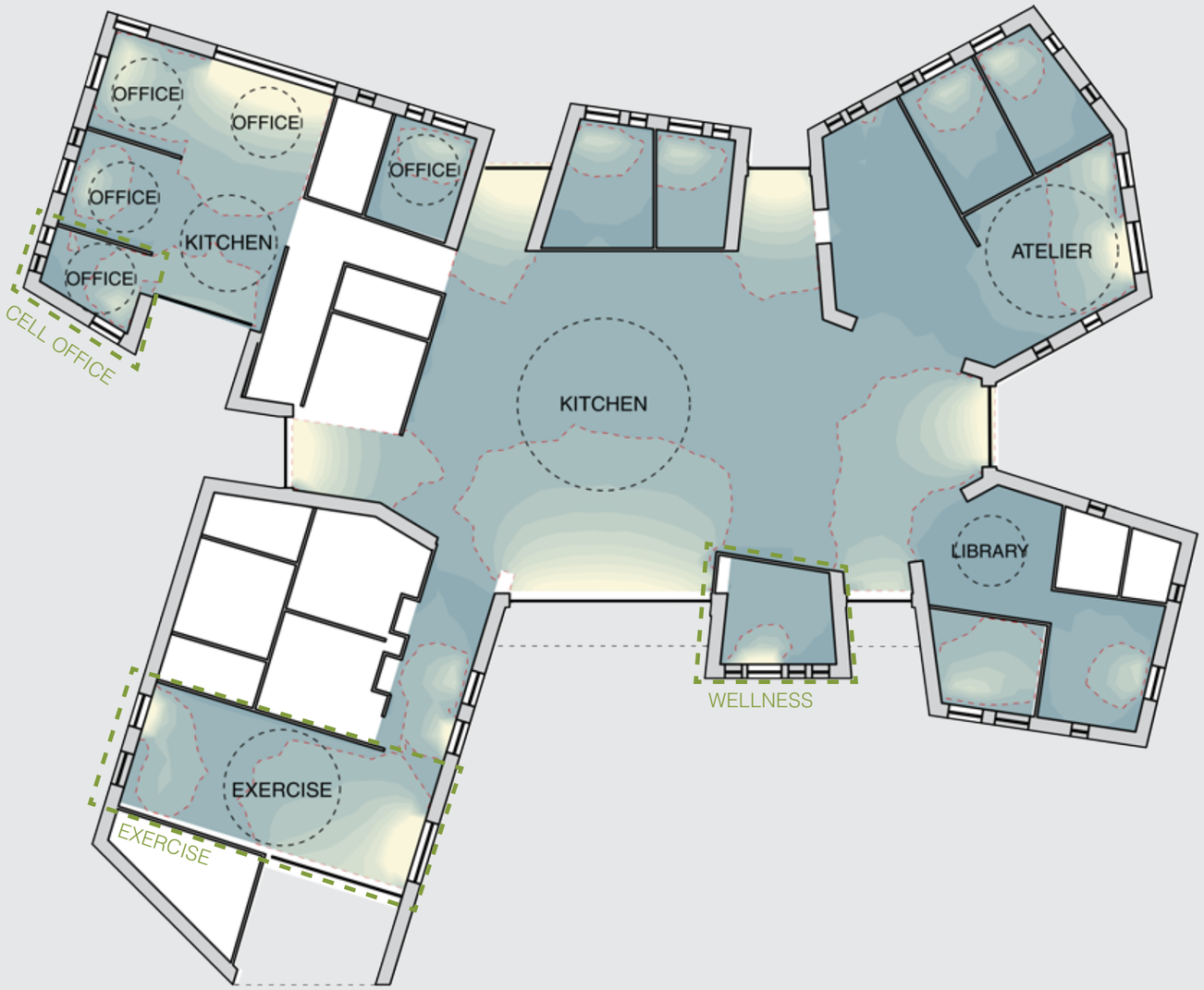


Illustration 136. Facade 1:200

Illustration 137. Exercise

Illustration 138. Wellness

Illustration 139. Cell office



Facade 1 - Plan 1:200
Daylight Factor (DF)
Area above DF2%: 55% of the floor
Window area: 141m²

Illustration 140. Daylight factor

Areas with a daylight requirement

Daylight Factor (% of outdoor illumination on overcast day)
0 1 2 3 4 5 6 7 8 9 10+

Nøgletal, kWh/m² år

Energiramme BR 2010

Uden tillæg	Tillæg for særlige betingelser	Samlet energiramme
73,4	0,0	73,4
Samlet energibehov		45,4

Energiramme Lavenergibyggeri 2015

Uden tillæg	Tillæg for særlige betingelser	Samlet energiramme
42,3	0,0	42,3
Samlet energibehov		39,9

Energiramme Byggeri 2020

Uden tillæg	Tillæg for særlige betingelser	Samlet energiramme
25,0	0,0	25,0
Samlet energibehov		29,4

Bidrag til energibehovet	
Varme	27,6
El til bygningsdrift	7,1
Overtemp. i rum	0,0

Netto behov	
Rumopvarmning	27,6
Varmt brugsvand	5,3
Køling	0,0

Udvalgte elbehov	
Belysning	5,5
Opvarmning af rum	0,0
Opvarmning af vbv	0,0
Varmepumpe	0,0
Ventilatorer	1,6
Pumper	0,0
Køling	0,0
Totalt elforbrug	17,1

Varmetab fra installationer	
Rumopvarmning	0,0
Varmt brugsvand	0,0

Ydelse fra særlige kilder	
Solvarme	0,0
Varmepumpe	0,0
Solceller	0,0
Vindmøller	0,0

Illustration 141. Be10 key figures

Zones with thermal analysis

THERMAL COMFORT: EXERCISE

24 - hour average	t_i	= 23,3 °C
Temp. variation	t	= 9,2 °C
Max temperature	t_{max}	= 27,9 °C

THERMAL COMFORT: WELLNESS

24 - hour average	t_i	= 22,9 °C
Temp. variation	t	= 4,4 °C
Max temperature	t_{max}	= 25,1 °C

THERMAL COMFORT: CELL OFFICE

24 - hour average	t_i	= 23,5 °C
Temp. variation	t	= 4,1 °C
Max temperature	t_{max}	= 25,6 °C

FACADE 2: VERTICALS

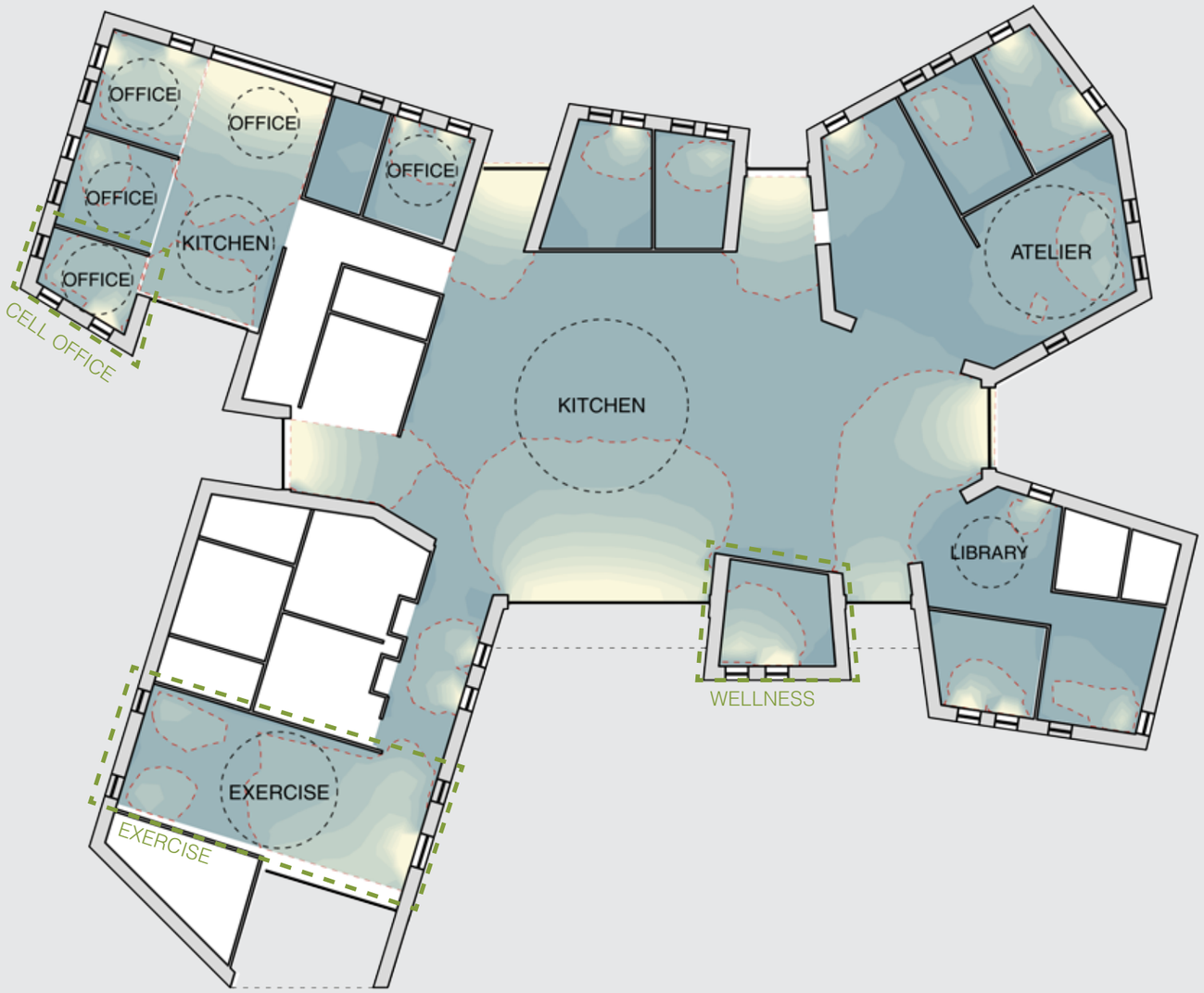
Based on the theory of C. Volf (2013) showing that the vertical window with more of the blue sky light can improve the circadian cycle, there has in this window solution been worked with the vertical expression. Looking at the windows it is contrasting the horizontally in the building, which gives the facade an untidy expression. As there from the start have been working with an idea of creating small seating areas in some of the windows, it has been difficult to implement it in this solution.

Illustration 142. Facade 1:200


Illustration 143. Exercise


Illustration 144. Wellness


Illustration 145. Cell office



Facade 2 - Plan 1:200
Daylight Factor (DF)
Area above DF2%: 44,1% of the floor
Window area: 141m²

Illustration 146. Daylight factor

Areas with a daylight requirement

Daylight Factor (% of outdoor illumination on overcast day)
0 1 2 3 4 5 6 7 8 9 10+

Nøgletal, kWh/m² år

Energiramme BR 2010

Uden tillæg	Tillæg for særlige betingelser	Samlet energiramme
73,4	0,0	73,4
Samlet energibehov		46,5

Energiramme Lavenergibyggeri 2015

Uden tillæg	Tillæg for særlige betingelser	Samlet energiramme
42,3	0,0	42,3
Samlet energibehov		40,8

Energiramme Byggeri 2020

Uden tillæg	Tillæg for særlige betingelser	Samlet energiramme
25,0	0,0	25,0
Samlet energibehov		30,1

Bidrag til energibehovet	
Varme	28,7
El til bygningsdrift	7,1
Overtemp. i rum	0,0

Udvalgte elbehov	
Belysning	5,5
Opvarmning af rum	0,0
Opvarmning af vbv	0,0
Varmepumpe	0,0
Ventilatorer	1,7
Pumper	0,0
Køling	0,0
Totalt elforbrug	17,1

Netto behov	
Rumopvarmning	28,7
Varmt brugsvand	5,3
Køling	0,0

Varmetab fra installationer	
Rumopvarmning	0,0
Varmt brugsvand	0,0

Ydelse fra særlige kilder	
Solvarme	0,0
Varmepumpe	0,0
Solceller	0,0
Vindmøller	0,0

Illustration 147. Be10 key figures

Zones with thermal analysis

THERMAL COMFORT: EXERCISE

24 - hour average	t_i	= 23,2 °C
Temp. variation	t	= 9,1 °C
Max temperature	t_{max}	= 27,8 °C

THERMAL COMFORT: WELLNESS

24 - hour average	t_i	= 23,2 °C
Temp. variation	t	= 4,7 °C
Max temperature	t_{max}	= 25,5 °C

THERMAL COMFORT: CELL OFFICE

24 - hour average	t_i	= 23,7 °C
Temp. variation	t	= 4,4 °C
Max temperature	t_{max}	= 25,8 °C

FACADE 3: HORIZONTALS

This concept relates to the horizontal band of the roof and the placement of the windows also relates well to the lower ceiling heights inside the smaller volumes, creating various seating areas in the entire house. From the outside and inside it gives the facade and the rooms a really calm expression. Therefore the third facade solution is also chosen for further development. Facade three is chosen because of the horizontal expression, and the views and the seating areas it creates for the users of the house. The windows also work well together with the top of the common room as they create bands around the building together emphasising the horizontal expression.

As it is for all the facade solutions, the design requires extra daylight in the main room, exercise, library and workshop. Therefore has there for the further development tried to implement skylight in the house, which is possible to read more about later on in the report.

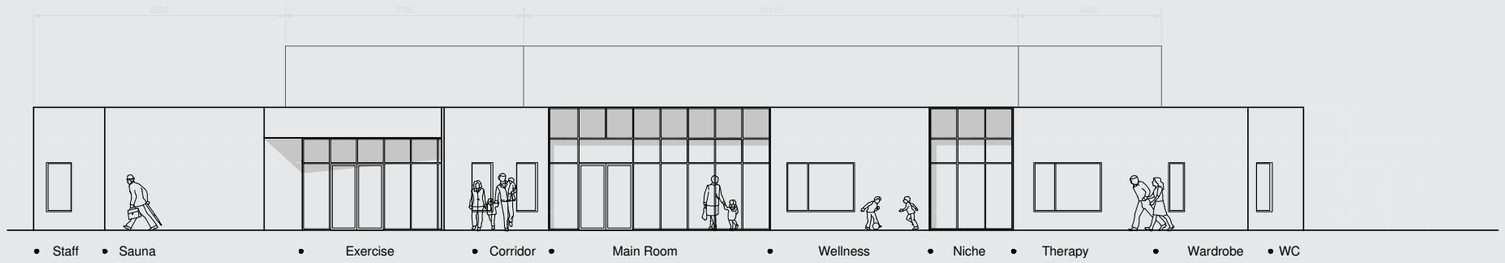
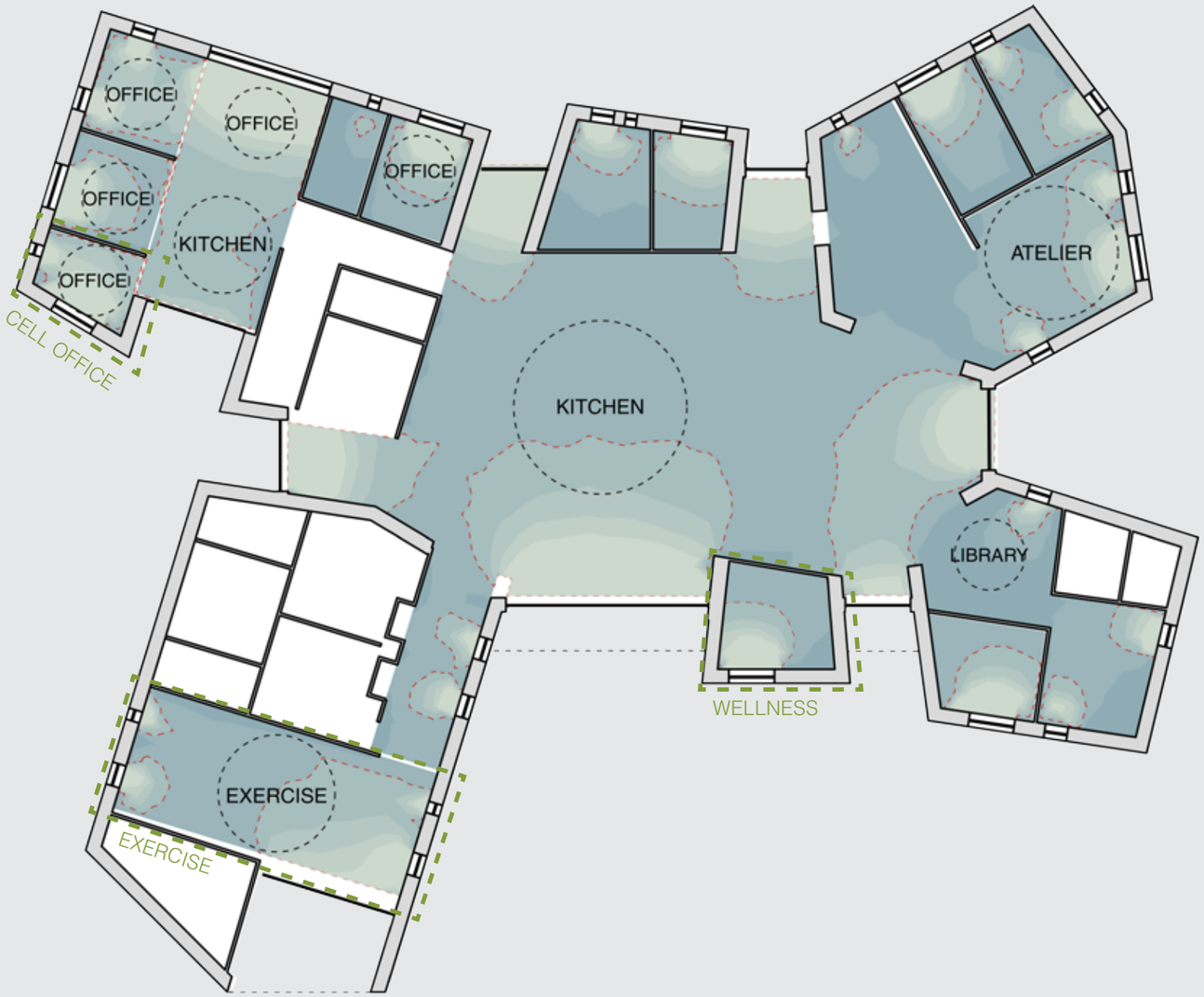


Illustration 148. Facade 1:200


Illustration 149. Exercise


Illustration 150. Wellness


Illustration 151. Cell office



Facade 3 - Plan 1:200
Daylight Factor (DF)
Area above DF2%: 44,6% of the floor
Window area: 141m²

Areas with a daylight requirement

Daylight Factor (% of outdoor illumination on overcast day)
0 1 2 3 4 5 6 7 8 9 10+

Illustration 152. Daylight factor

Nøgletal, kWh/m² år

Energiramme BR 2010

Uden tillæg	Tillæg for særlige betingelser	Samlet energiramme
73,4	0,0	73,4
Samlet energibehov		46,1

Energiramme Lavenergibyggeri 2015

Uden tillæg	Tillæg for særlige betingelser	Samlet energiramme
42,3	0,0	42,3
Samlet energibehov		40,5

Energiramme Byggeri 2020

Uden tillæg	Tillæg for særlige betingelser	Samlet energiramme
25,0	0,0	25,0
Samlet energibehov		29,8

Bidrag til energibehovet

Varme	28,3
El til bygningsdrift	7,1
Overtemp. i rum	0,0

Udvalgte elbehov

Belysning	5,5
Opvarmning af rum	0,0
Opvarmning af vbv	0,0
Varmepumpe	0,0
Ventilatorer	1,7
Pumper	0,0
Køling	0,0
Totalt elforbrug	17,1

Netto behov

Rumopvarmning	28,3
Varmt brugsvand	5,3
Køling	0,0

Varmetab fra installationer

Rumopvarmning	0,0
Varmt brugsvand	0,0

Ydelse fra særlige kilder

Solvarme	0,0
Varmepumpe	0,0
Solceller	0,0
Vindmøller	0,0

Illustration 153. Be10 key figures

Zones with thermal analysis

THERMAL COMFORT: EXERCISE

24 - hour average	t_i	= 23,2 °C
Temp. variation	t	= 8,9 °C
Max temperature	t_{max}	= 27,6 °C

THERMAL COMFORT: WELLNESS

24 - hour average	t_i	= 22,9 °C
Temp. variation	t	= 4,4 °C
Max temperature	t_{max}	= 25,1 °C

THERMAL COMFORT: CELL OFFICE

24 - hour average	t_i	= 24,0 °C
Temp. variation	t	= 4,9 °C
Max temperature	t_{max}	= 26,4 °C

Materials

Connecting the building

THE MATERIALS AND THE THREE BANDS

The house is built on the principle of having three bands framing the entire house. The first band, which adheres to the ground, is made of concrete. The second band, which relates to the human scale and the haptic sense, is constructed of wood, and the third band representing the sky and the rocking tree crowns is wrapped in copper plates. The flowing course of the three bands runs through the entire house, helping the user on the path and tries to break down barriers of psychological and physical nature. The bands running in the house creates small seating areas that are integrated into the walls, and is an element that is seen throughout the entire house. This creates an interaction between the user and the building, enhancing the experience of the house.

The lower concrete communicates the meeting between the house and the terrain and moves pulsating, as an integrated part of the building out on to the terrace where it creates small areas which defines spaces, mark boundaries, opens up and embraces. The middle band of the house, with its warm, soft wood surface, meets the human and the body. This serves as a backrest in the niches, contains pockets for seating and has built in storage and is penetrated with bookcases. The upper band with slightly reflective copper serves as a crown on the building and lifts the mind into a reflective state with images of the treetops and the sky. The red glowing color as seen in the copper, enhances the warm colors, which are seen in the park and in the threes, thereby creating cohesion with the entire park. This crown will serve as an icon from the road when seeing the reflections through the treetops.

The movement of the three horizontal bands connects the house and the outdoor garden together, wherein the park is brought into the house in close connection with the life in the building. Architecture and nature hereby concludes a spatial dialogue which marks and furnishes various degrees of intimacy and relationships between indoor and outdoor spaces and invite for breaks and contemplation, but also for exploring.

Illustration 154. Sustainable horisontal cedar wood siding, seen at tracer.dk. This cedar is provided from FSC certified suppliers.

Illustration 155. Correlation between concrete base and wooden walls, seen in Livsrum Odense. Photo by Helene Høyer.

Illustration 156. Wooden elements together with copper plates seen in Watermans Place, Leeds (C) Dennis Gilbert.

Illustration 157. Correlation between the window frames and the cedar siding. This siding type is called Free-Willy due to its cross section. Found on houtluyten.be

Illustration 158. 1:200 Section A-A. This is the scenario one would see when entering the centre. A detailed section is found in the appendix.

Illustration 159. 1:200 Section B-B.

MATERIALS PROCESS

From the start of the project it has been an important element to contrast the hospital, and its expression. Therefore, there has been through the process worked with the horizontal expression which also meets the human scale. The material selection has taken its origin from the trees which are in the park. The Concrete band is a symbol of how the building adheres to the plateau and how the house is growing up from the forest bed. The wood addresses to the tree trunk, and the copper band addresses to the treetops, creating the sky over the house. To find inspiration for the choice of materials, there has been taking inspiration in some of the centers visited, which has helped to nurture the concept. This has resulted in a further refinement of the middle band. To create an interaction between the users and the wood, the wood has been processed so it appears accommodating, and helps to create seating areas. As the windows are at a height of 500mm, all seating areas are arranged so that all seating heights in the house are also this height. This makes the window band play along with the lower concrete band, and is thus helping to create a framework for users throughout the building. Some of the different elements that have been worked on, as seen on the next page, have been integrated into the house, causing an interaction between users and building.

Illustration 160. The window frames become furniture at Livsrums Aalborg

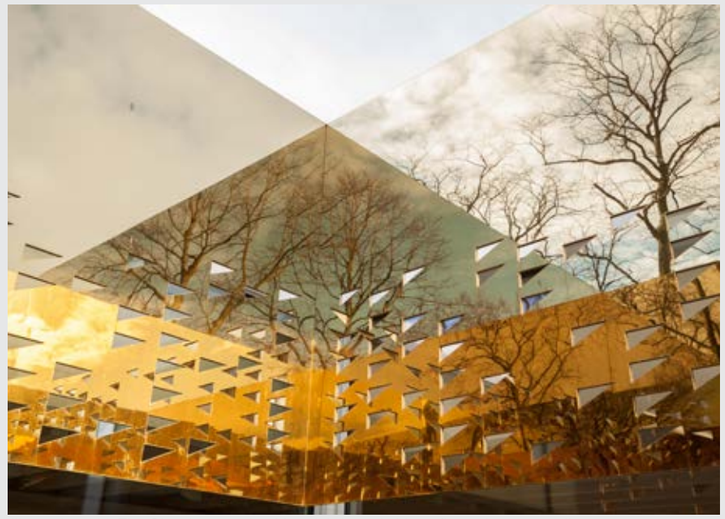


Illustration 162. The Glanzing metal at Maggie's Lanarkshire reflects the surrounding treetops.

Illustration 161. Intergrating the concrete floor and the wooden walls is well expressed at Livsrum Odense.

Illustration 163. At Maggie's Glasgow, is the barrier between outside and inside is almost non existing.

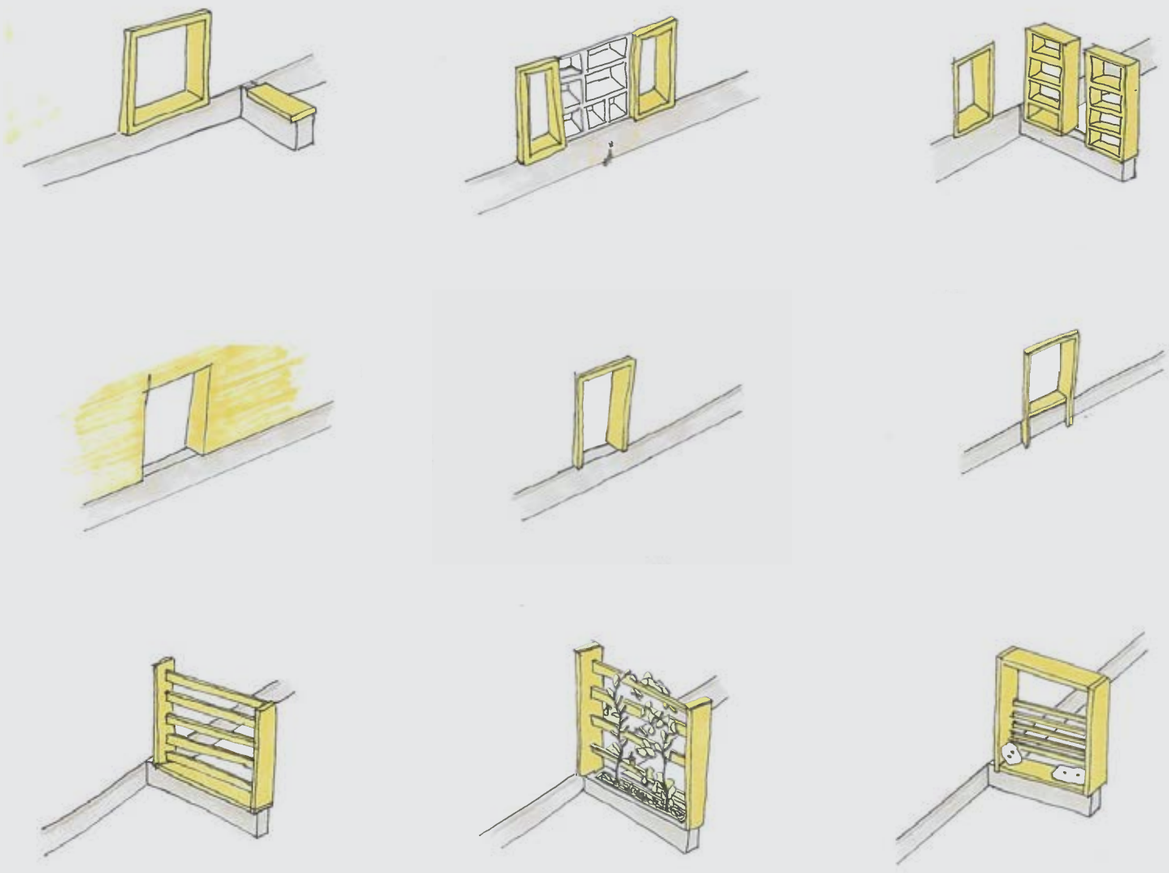


Illustration 164. Exploring the concrete base and the wooden walls

Main Room
Crossing the threshold

THE MAIN ROOM

The arrival
When seeing the building through the treetops, the copper belt catches the attention. The bypassing visitorsin the park want to see and experience the centre. When coming through the entrance the visitors enters the central element of the house, which is the heart of the building, and this is where the kitchen area is located. After walking underneath the band of copper at the entrance, the visitors enters the house where the common space opens up. The visitors will instantly acknowledge the high ceiling heights, and see how the light is penetrating through the southern facade - it feels like the park has become a part of the common room. The wooden ceiling and the varying skylights gives the feeling of standing under a treetop, inviting the park into the house. When entering the house, the visitors enter the common room with a distance to the social activity at the dining table in the kitchen, so the visitors are not involuntarily confronted with a high degree of intimacy. Therefore, there is also located a small seating niche by the fireplace, where the visitors can see the life in the building, in the comfort of the fireplace while hearing the low buzz in the background. The size of the common room gives the room a public nature, still with a friendly and welcoming atmosphere thanks to the warm light, and the warm wood surfaces that surrounds the common room, which speaks to the human scale.

The kitchen
The kitchen is the central element in the entire house, and this is where life takes place - Here the sounds and activities emanates out to the other rooms. The kitchen provides a framework for the social life in the house, here is room for everyone, whether they fancy a cup of coffee or want to cook for a large company. To invite the nature into the house the kitchen is located in front of the terrace area, deconstructing the boundary between inside and outside. In summer, there will be the opportunity to open out to the terrace area, thereby allowing the inside and outside flow together, so the users of the house experiences the feeling of being a part of the park, even when being inside the house. The kitchen is shaped like an island, so the users of the kitchen can cook on both sides of the island and thus creating an interaction among each other. As the kitchen is located in the middle of the house, it is possible to have overview of the entire house, which can benefit both the users and employees. When standing in the kitchen the users will be able to hear the life in the entire building, which can give associations back to the situation where the users are cooking in their own house, and hearing the life in the house. The users are met with variating scenarios in the counselling centre - in one corner there will be painted, and in the other corner children are plying play station. It is a house for everyone.

KEY NUMBERS
Area: 195m^2
Volume: 1065 m^3
People: 20
Air Change: 16 h^{-1}
THERMAL AND ATMOSPHERIC COMFORT:
Amount of time with minimum Class I: 87%
Amount of time with minimum Class II: 97%
Calculations are found in “Appendix 9: Hourly Building Analysis (BSim)” on page 126

Illustration 165. Visualization of the Main room. This is the first view when entering the center. All the niches surround the large southern glass facade (seen in the left part of the image)

NICHES

Between the different volumes and the common room, there are niches furnished with a varying atmosphere, so that it may accommodate the varying needs. Adjacent to the lounge the armchair has been placed in the Readers Corner. This is where one goes if the user needs some rest from the company and a place for reading a book. Sitting in the Newcomers area, the users can see the entire life in house, while the heat from the fireplace, gives a sense of homeliness. The niche next to the staff area is a place the users can go to, if the users need time for themselves. Here the users can hide from the life in the building, and become part of the nature, as the north facing windows from floor to ceiling allows the nature to enter the house. As this niche also is the place where there users can hide from the rest of the company, it is also an area that can be used to have open conversations that are not quite intimate.

As some of the cancer patients also bring children with them to the centre, it is important that there is room for the children, and that they feel welcome in the house. Therefore, in the western corner there has been furnished a niche that is the hang-out place for the children. Here it is possible to play various games, and there will be space for toys for all ages. From most of the house, it will be possible to see the children area so the parents have the opportunity to keep an eye on their children.

INSPIRATION

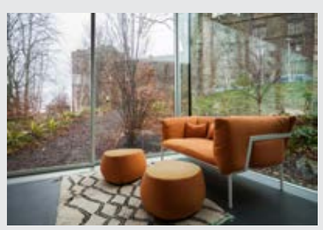


Illustration 166. The niche in Maggies Glasgow becomes part of the nature

Illustration 167. Seating niches in the window at Livsrum Næstved

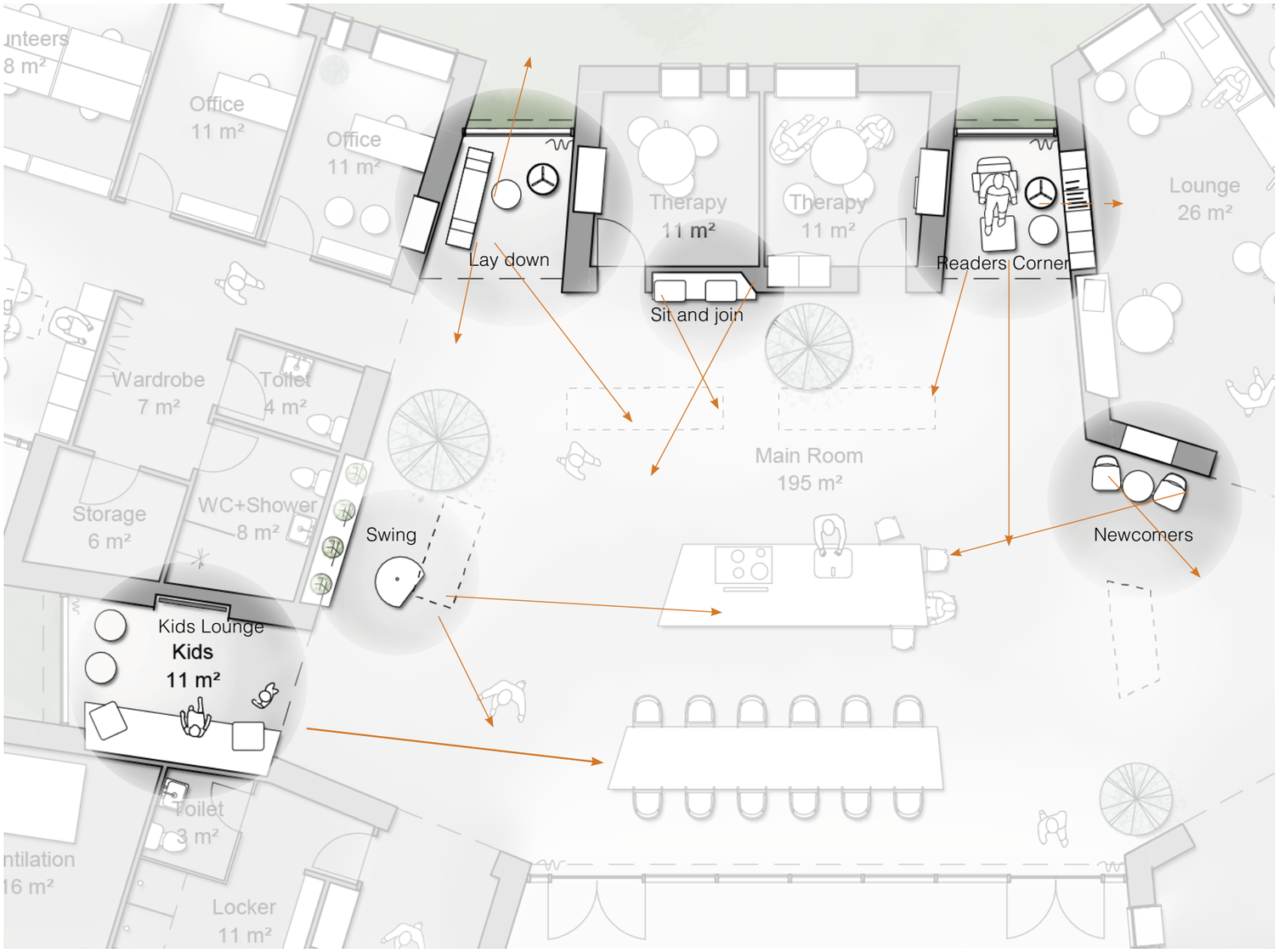


Illustration 168. Plan zoom in 1:100. Arrows show how the vision is oriented. All of the niches can see the kitchen table but their contact to other niches are limited. This emphasises the idea of sitting in a ring with an object in focus in the middle.

Illustration 169. Visualization of one of the niches having the view towards the mainroom and the terrace

THE CEILING PROCESS

As the ceiling in the main room has an area of around 200 square meters it is a dominating element in the scene. It is important to break down the large, heavy surface and create a beautiful light ceiling. The beams that support the roof could be used as an element to break down the scale, but the crosswise direction they created was not desired. Therefore, the lamellas were integrated as part of the process, which helped to make the ceiling lighter, and dissolved the direction, which the beams created. This also provided the possibility of positioning a sound-absorbing material above the lamellas, making it non visible for the users in the house. To pursue the idea of the light ceiling, there has been worked with various tones of the glulam beams and the lamellas, leading to a light tint that made the ceiling appear light. This also helps to support the concept of the light tree crown that protects the users of the house.

Previously in the facade workshop it was concluded that there was a need for skylights. In order to integrate the skylight in the process on designing the ceiling, there were tested different ways the beams could interact with the skylights. This came up with an idea that the skylights could be placed in-between the beams, providing a play to the light which falls into the room. This also highlights the individual beams, which provides an additional lightness to the ceiling structure.

Illustration 170. Ceiling designs

Illustration 171. Ceiling designs

Illustration 172. Ceiling designs

Illustration 173. Ceiling designs

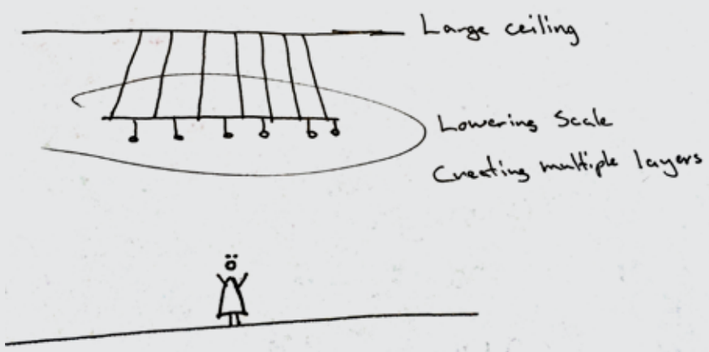


Illustration 174. Adding a floating element to break down the scale and add layers

Illustration 175. Sculptural lighting in Skæring Kirke by EplusN

Illustration 176. The copper pendants are adding an extra layer to the scene.

Illustration 177. The skylights are adding to a well balanced daylit atmosphere

THE MAIN ROOM SKYLIGHT PROCESS

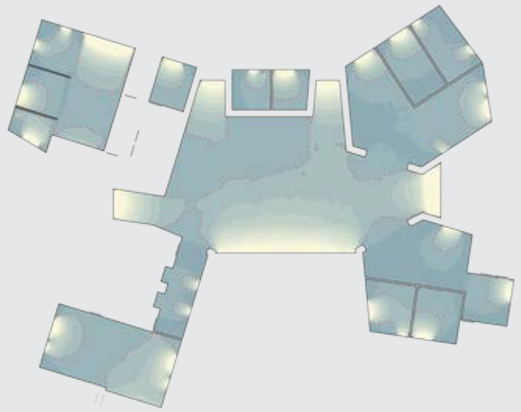
Picking up the process from the façade workshops, it was known that some areas needed extra daylight. This led to a workshop with placing and designing the skylights. First, the main room was examined, and intuitively a large skylight was placed on top of the kitchen table. This created a lot of contrast between the very bright areas in the south of the main room and the rest of the area. In order to even out this contrast, the skylight was moved a bit towards north, and several smaller skylights were added. For each setup, a BSim calculation was done to see how the additional solar gains affected the indoor temperature. Parallel to this, calculations were made to see how much extra natural ventilation could be gained from these windows. They have a great position, as the temperature is highest under the ceiling and the wind drags on skylights. This is combined with thermal buoyancy and is an ideal venting strategy.

The daylight analysis is explained in depth in “Appendix 10: Daylight Analysis” on page 130

The BSim simulations are explained in “Appendix 9: Hourly Building Analysis (BSim)” on page 126

Natural ventilation is explained in depth in “Appendix 7: Possible Natural Ventilation” on page 118.

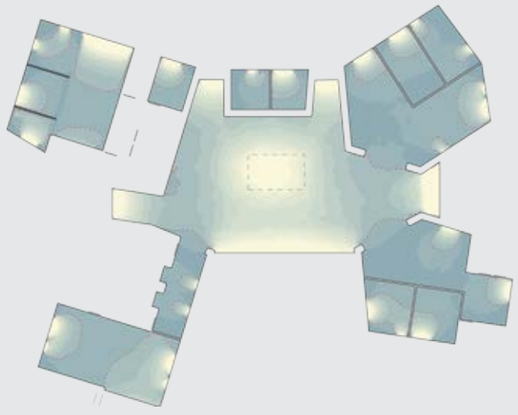
1



Area above DF_2: 46%

Illustration 178. Daylight factor without the skylights

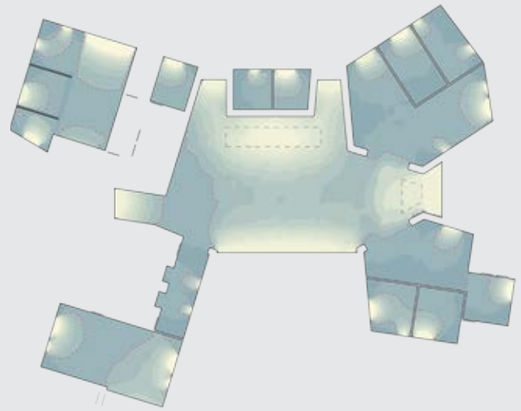
2



Area above DF_2: 60%

Illustration 179. A large skylight is added to the kitchen

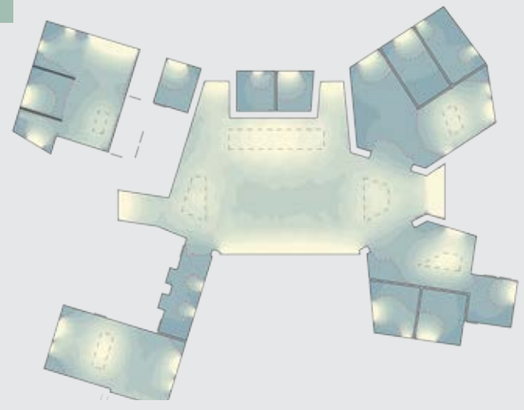
3



Area above DF_2: 53%

Illustration 180. Skylight is moved and an additional is placed at the entrance.

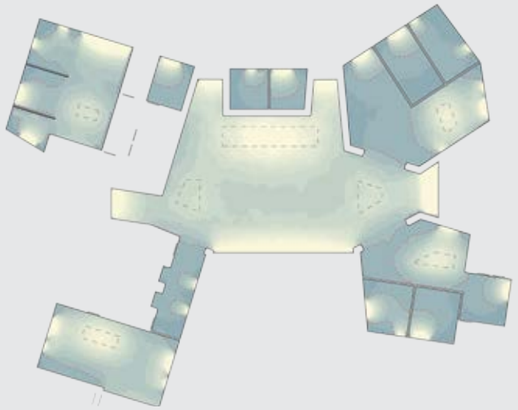
4



Area above DF_2: 75%

Illustration 181. Skylights in all volumes are added and the main room gets an additional skylight to highlight the wall to the west. This wall serves as a background for visitors entering the centre. Even though the skylights were shaded with 500mm vertical wall on their southern edges, sun penetrated too much on those that were oriented north-south. Shading was more efficient on the west-east oriented skylights.

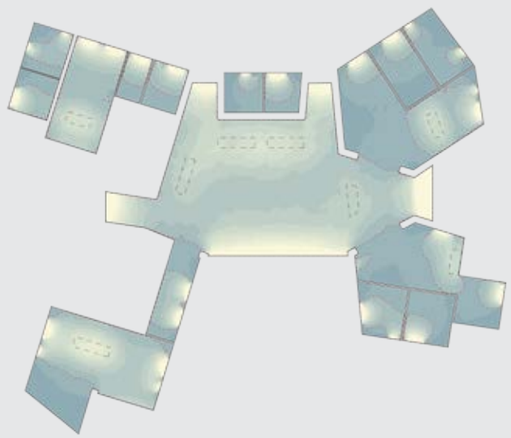
5



Area above DF_2: 73%

Illustration 182. Skylights are rotated to minimise solar gain. With the exception of the one in the gallery, as the building roof shades this window after 11 am.

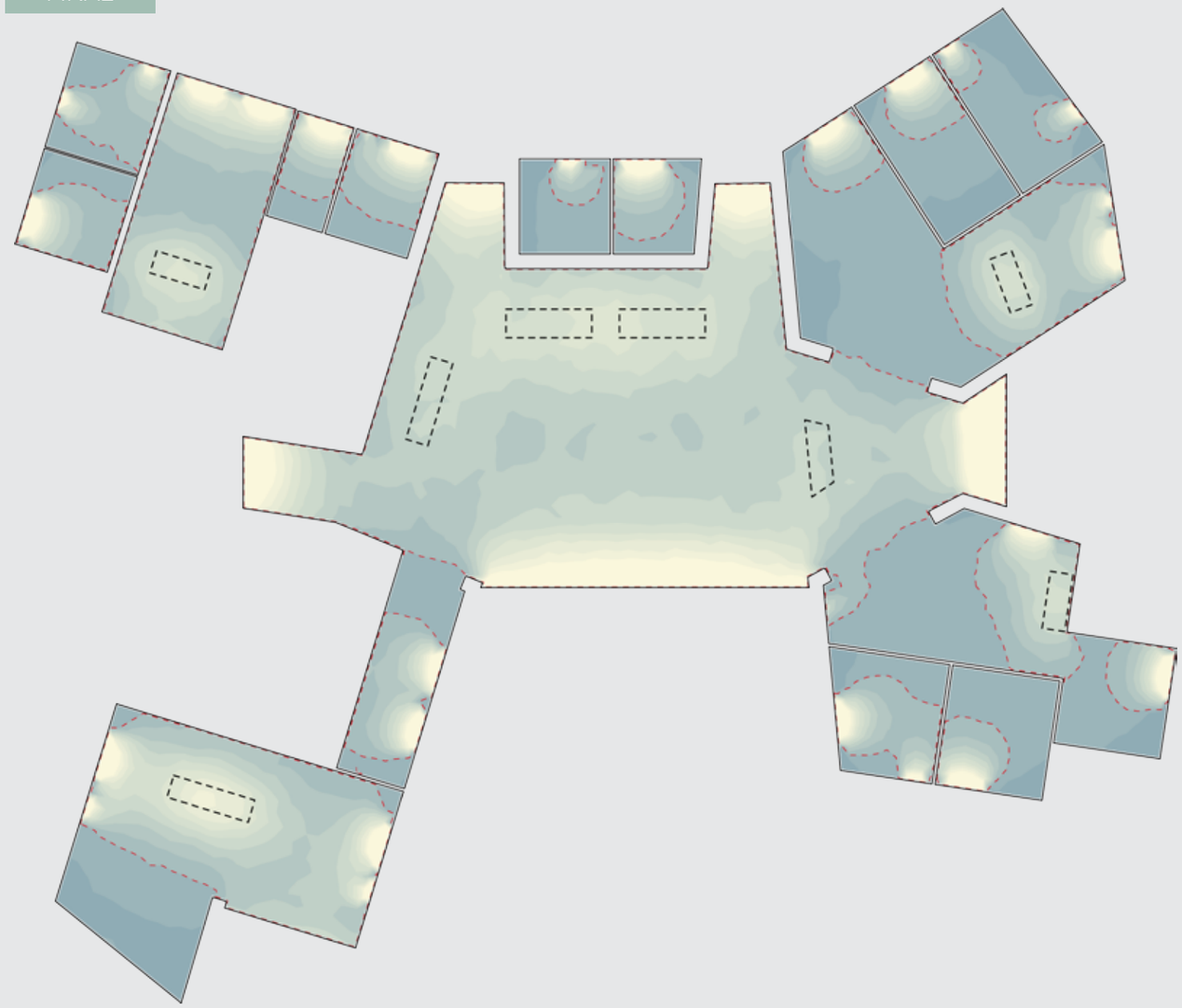
6



Area above DF_2: 70%

Illustration 183. Skylights are streamlined with the same width (800mm) and two different lengths of 2000 and 3000mm. Overall, the building has 70% of the occupied spaces with atleast daylight factor 2.

FINAL



Area above DF_2: 73%

Illustration 184. The final analysis has the same geometry as the 6th analysis. However, the final calculation is more accurate and with addition light bounces, the light is penetrating further into the building. For details on analysis look into “Appendix 10: Daylight Analysis” on page 130.

Lounge

The place for relaxation

LOUNGE

The lounge is an area which is an extension of the common area. This is where you can meet for a coffee and a chat in the slightly secluded surroundings, still in contact with the life in the house, which can make it easier to get started with a conversation, than if sitting in behind closed doors inside the therapy rooms. In the lounge the users can read the newspaper, keeping up with the news on the TV or just read a book in a peace and quiet environment if this is needed. The lounge should feel like a small cave where the users always can go if they need a break from the company in the kitchen. Therefore is the light in the lounge area toned down to strengthen the feeling of the cave, which is also being enhanced by the adjacent fireplace. The lounge is designed so that there are two areas where the users can sit - the fire zone and the window zone. Here-by the lounge accommodates the various needs, giving the lounge place for both large and small companies, and for any mood the users might have. The window in the lounge is also located so that users can look out to the parking lot. The users can hearby sit in the window and wait for a taxi, if this is needed. All this enhances the flexible environment the lounge has, which is an element there goes through the entire building.

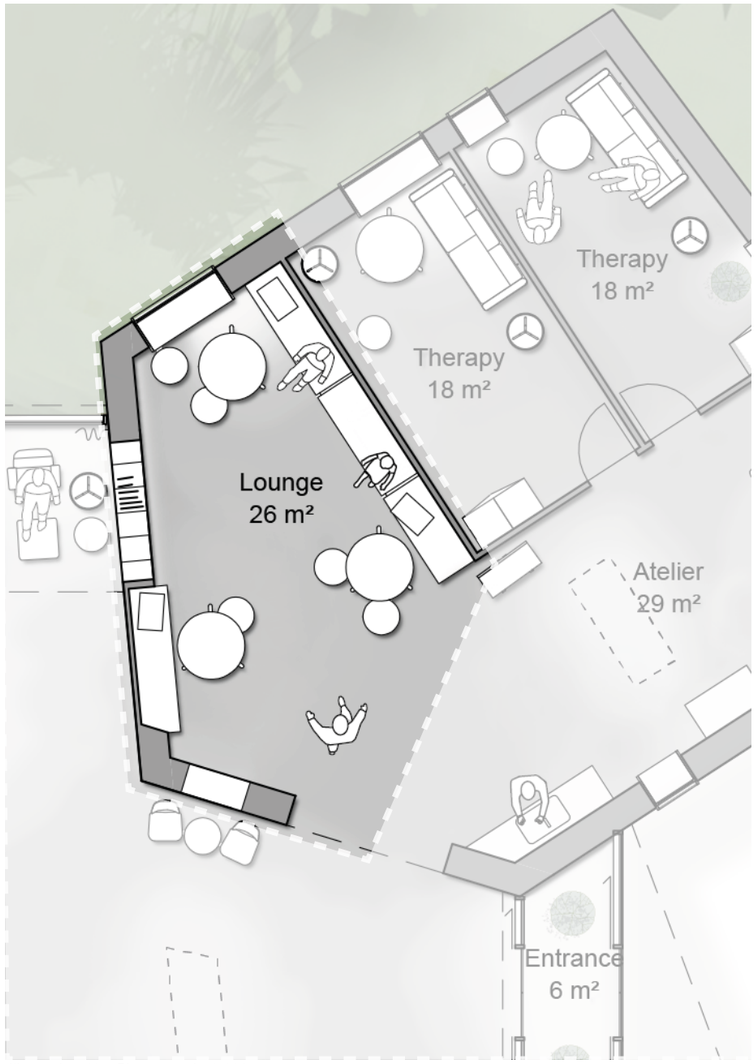


Illustration 185. Plan zoom in 1:100

INSPIRATION

Illustration 186. Seating niches intergrated into the walls at Livsrum Roskilde

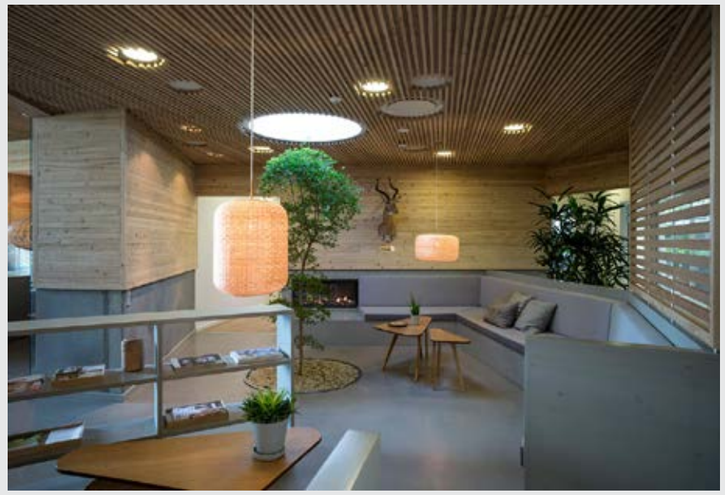


Illustration 187. The feeling of being in a cave in Livsrum Odense (Photo: Helene Høyer)

Illustration 188. Visualization of the Lounge

Library
Information

LIBRARY

Before the first time visitors enter the centre they get the opportunity to look through the window into the library. Hereby they know even before they step into the house, where to find information if this is needed. The library is located to the left of the entrance, which gives the first time visitors the ability to enter into the background, if the life around the kitchen table seems to intimidating. When sitting in the library the visitors will be able to follow the life in the common area. That means, even if you are sitting in the background, you still feel a part of the community. The library is arranged so that the visitors have the ability to interact between each other, and therefore the library can also be used for open conversations. The library will be an area where the visitors can find information about the cancer counselling centre, and therefore there will also be room for a computer if they want to find information on this. As the library has to be a place where the visitors of the centre can have peace and read undisturbed, it is important that there is no transit through this area. Therefore the corridor down to the wardrobe and the library is also separated, so the visitors hereby not will be disturbed in the library area. But as the corridor may not seem as a corridor, there has been worked on creating furniture with an amount of transparency, so the visitors still have a visual contact through the library and the corridor.

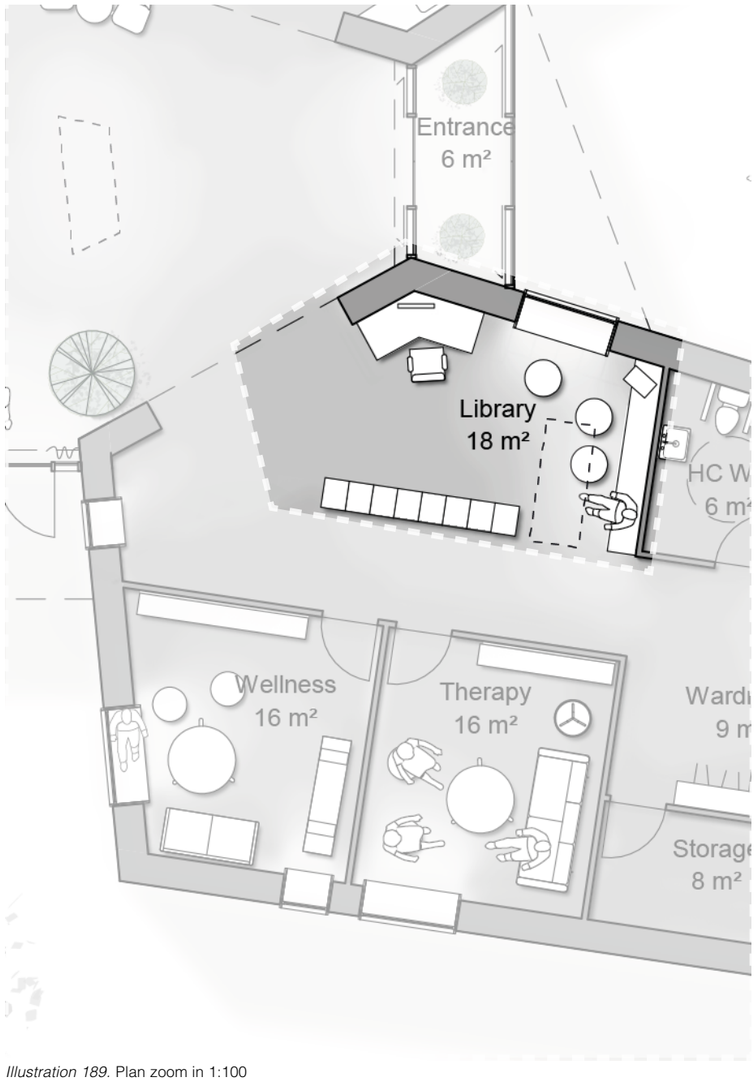


Illustration 189. Plan zoom in 1:100

INSPIRATION

Illustration 190. Different pamflets are for different cancer communities, at Livsum Aalborg

Illustration 191. Library in Livsrum Roskilde

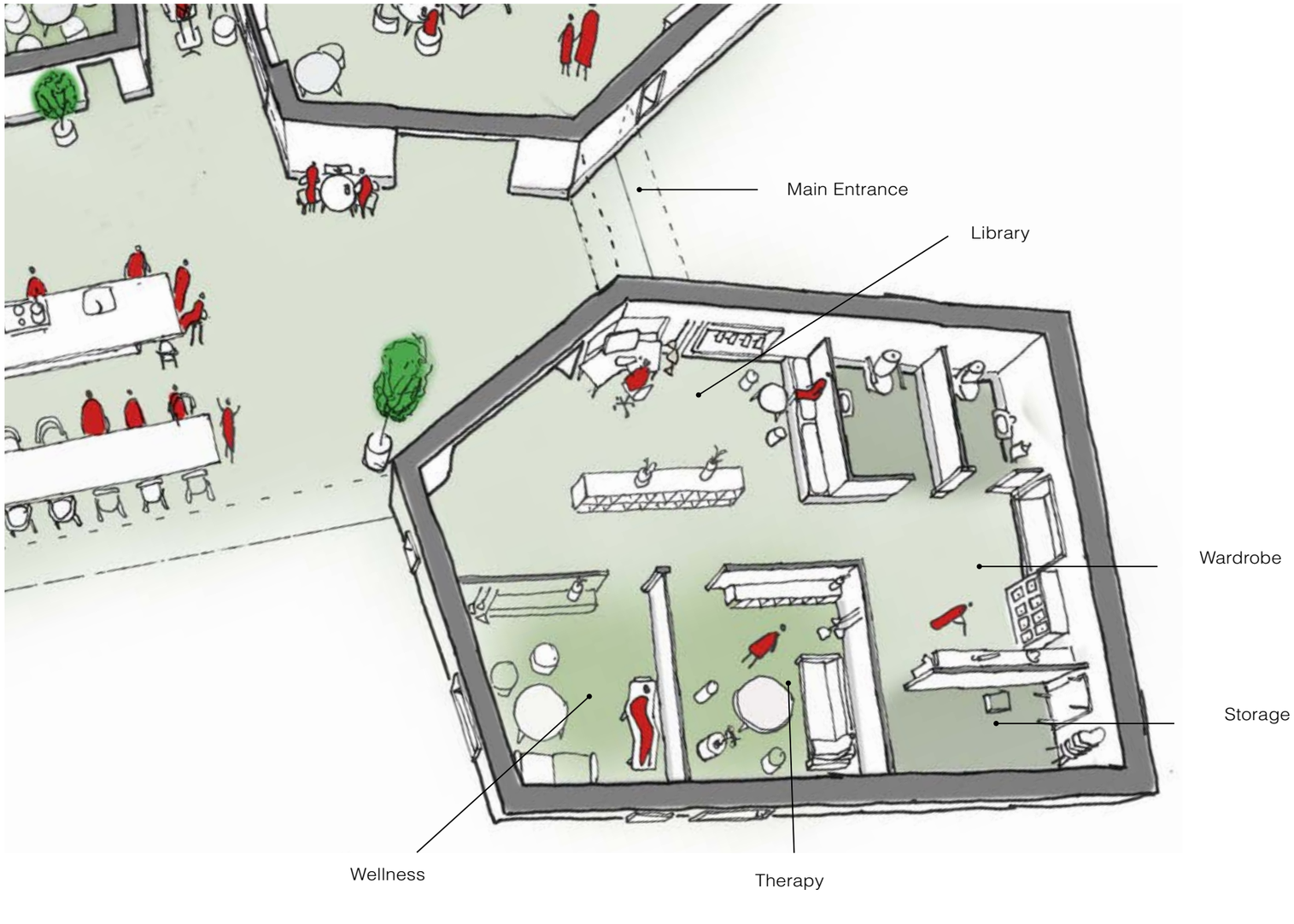


Illustration 192. Library and its surrounding rooms

Atelier

Putting an image on the feelings

ATELIER

The atelier is the recreation area of the house, where the users have the opportunity to come out with their feelings in ways other than to express them through speech, and it is a place where there is room for joy and tears. The atelier is based on the workshops in the other Livsrum centres. Creative group sessions can use the atelier or visitors can use it alone to express their emotions. The atelier has direct views out to the park and the pond, which can provide peace in their soul and the users also hereby get the optimal image for the motive - the green nature. The skylight and the north-easterly facing windows also help to provide the optimal light for painting inside. The atelier is also the place where users exhibit the things they have helped to create, which is not just only paintings. It can be anything from jewellery, colourful bags to small sculptures. The exhibition personalizes the building for the users and gives them an experience of sense of belonging to the place. The exhibition simultaneously provides the users something to contemplate around and something they can show to their family members. This also provides the ability for users to talk about something that does not deal with their disease, and thereby get their thoughts out to other places. The art will act as a positive distraction to the users. In extension of the atelier there are placed two therapy rooms which can also be used if some of the users wants to be behind closed doors. As the atelier is placed close to the park, curious visitors in the park also has the opportunity to see the life in the house, and see what there is being done in the house.

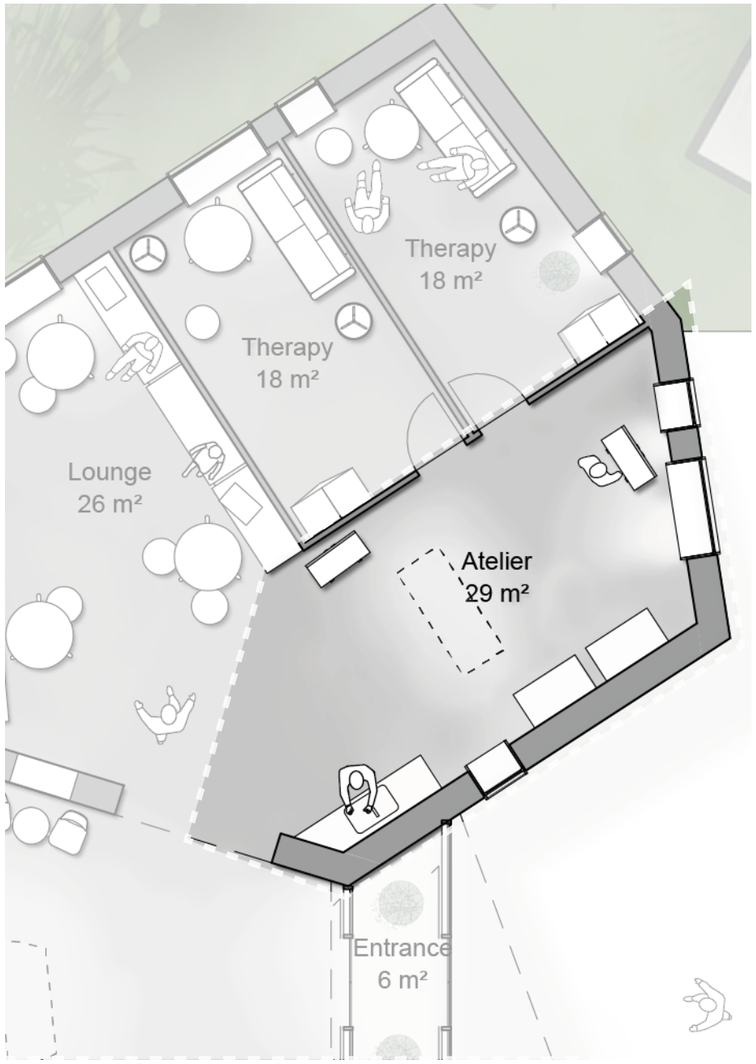


Illustration 193. Plan zoom in 1:100

INSPIRATION

Illustration 194. The open atelier at Livsrum Næstved

Illustration 195. The open atelier at Livsrum Vejle

Illustration 196. Visualization of the Atelier

Therapy

Place for conversations

THERAPY

The Therapy rooms are places in the building where the users can sit by themselves, without any disturbance, because here it is possible to close the doors into the rooms. As the therapy rooms must seem as a part of the entire building, the rooms have been placed with direct access to the open spaces. This avoids an enumeration of closed rooms with a connecting corridor, which can provide users associations to institutions and particularly hospitals. In the house there are three different forms of therapy rooms, which help to provide diversity and flexibility to the various rooms. The small therapy rooms are mainly for smaller conversations, where the conversations are more intimate and have an individual character. The larger therapy rooms can be used for larger group conversations, or family conversations. Here there is room for sofa arrangements and different seating niches, which provides the possibility for zoning spaces in small areas. Wellness is an area where the users have the opportunity to lie down and enjoy the silence in a state of contemplation. As some of the visitors may have trouble sitting up, after a tough treatment of chemo, it is important that they have a place where they can lie down and relax. Therefore, the room is also furnished so it can accommodate place for conversations and relaxation, which also makes the space flexible.

When sitting in the therapy rooms it is important that the users feel at home. Therefore, the rooms are also furnished with furniture with a soft and homely atmosphere that seems inviting, and provides space for tranquility and contemplation. In all the rooms there are views out to the nature and it is possible to sit in the windows - windows that the users can open and close as needed. Since many of the conversations can be very intimate, some of the users can feel exposed by the windows. Therefore there are curtains in all the therapy rooms, which the users can bring down if needed. Giving the users the control of all these elements, gives the users a sense of belonging to the house and makes the house more homely and less institution like.

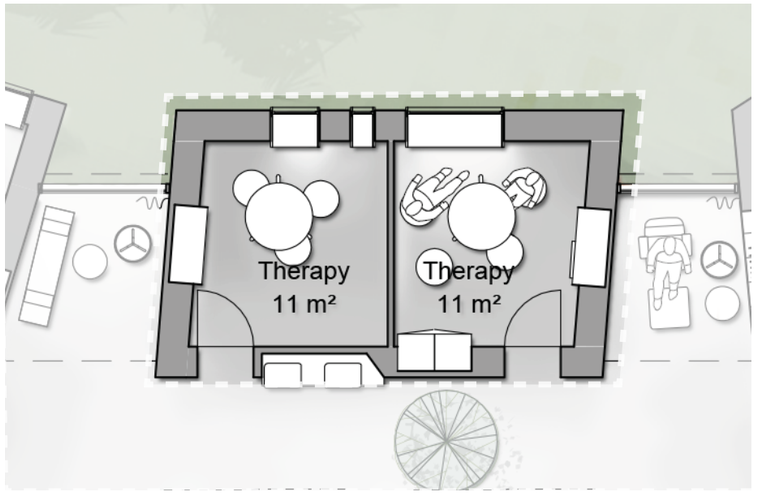


Illustration 197. Plan zoom in 1:100, small therapy rooms

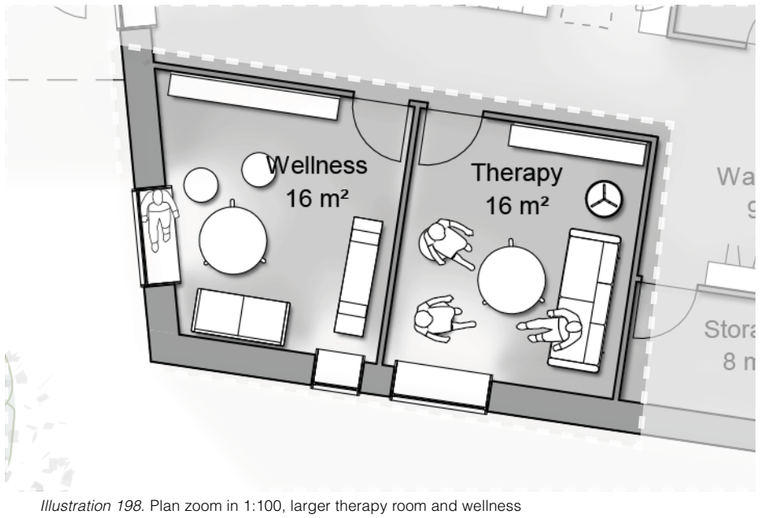


Illustration 198. Plan zoom in 1:100, larger therapy room and wellness

INSPIRATION

Illustration 199. A mix between sofa and chairs in the therapy rooms at Livsum Roskilde

Illustration 200. Furniture with various colours gives a homely feeling in the therapy rooms at Maggies Lanarkshire

Illustration 201. Visualization of the Wellness

Exercise

The place for evolving

EXERCISE

The exercise area is located in the rear end of the house together with the staff area. This means that the room is used only by the users who are signed up to the various exercises which take place in the exercise area. This also ensures that the users who need to exercise moves through the heart of the house, which means that many of the users, meet in the common room before training sessions where they share different stories and experiences over a cup of coffee. On the way down to the training room, the user walks through a corridor which is washed with light from the windows, giving the users a view out to the terrace and the park. This is also where the entrance for the locker rooms is placed. If the users need time for themselves before entering the exercise area, they have the opportunity to sit in the integrated wall - niche where they have the opportunity to read about various training exercises. Sitting there, the users have the opportunity to create an inner peace and enjoy nature view before entering the exercise area, becoming a part of the community. From the exercise area, there are lots of views out to the nature and there is an appurtenant depot space where all the exercise tools can be places after training sessions. If the users want to train outside, the exercise area has its own exercise area on the terrace where the users can work out and breathe out, without feeling watched. The ventilation room is located near the training facilities because it must meet high ventilation demand from the training area, and that it also does not make noise in the rest of the house.

KEY NUMBERS
Area: 73m^2
Volume: 234m^3
People: 10
Air Change: 17 h^{-1}
THERMAL AND ATMOSPHERIC COMFORT:
Amount of time with minimum Class I: 82%
Amount of time with minimum Class II: 97%
Calculations are found in"Appendix 9: Hourly Building Analysis (BSim)" on page 126

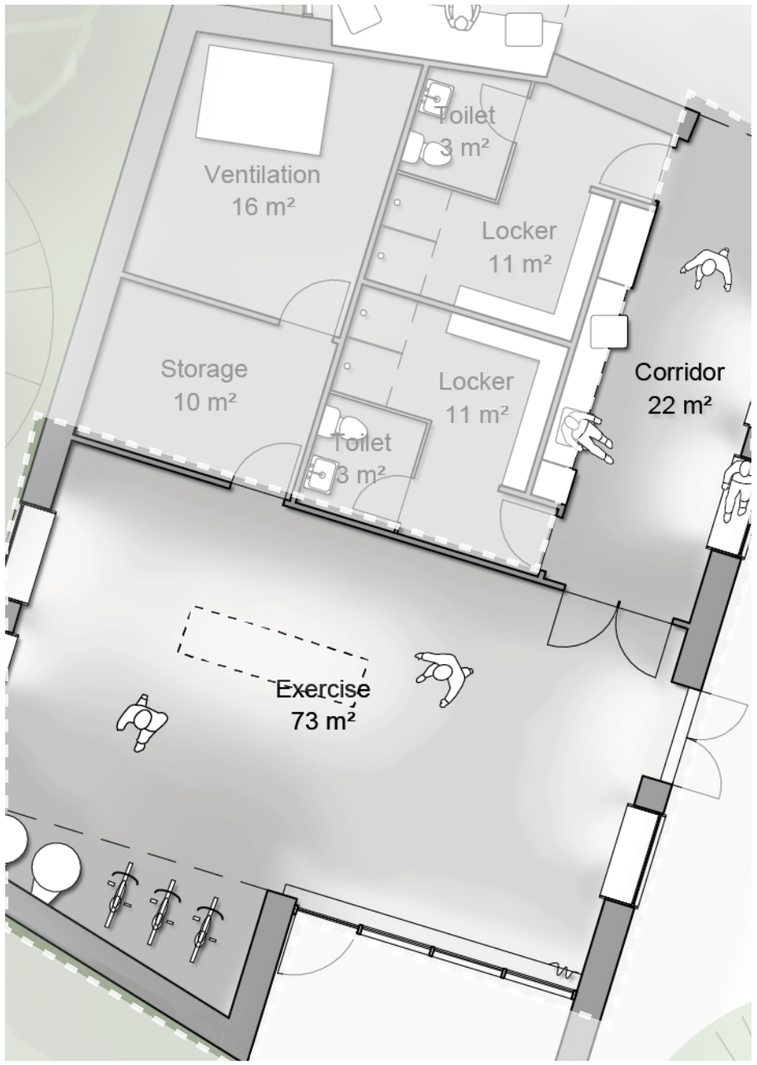


Illustration 202. Plan zoom in 1:100

INSPIRATION

Illustration 203. The exercise room at Livsrum Aalborg

Illustration 204. The corridor before entering exercise at Livsrum Herning

Illustration 205. Visualization of the corridor into exercise

Staff
Backstage

STAFF

The staff area is placed in the back of the building without an inviting gesture. This helps to prevent visitors interrupting the staff and blurs the feeling that visitors may feel monitored. The staff area facilities an open office area where the volunteers have the opportunity to work, and then there are arranged four closed offices where there is room for therapists, the manager and the secretary. The offices are located towards the North West and North which provides an optimum working condition, and ensure that the office area do not become overheated during the workday. The staff also has their own kitchenette, where they have the opportunity to eat and meet - a place where they can be themselves. Although it is important that the staff is visible in the daily time in the house, it is important to give the staff a place where they can have a pause from the tough talks that can occur in the centre.

If there is not a volunteer present, it is important that the staff has the overview of the house. Therefore the staff area is designed so at least one from the staff has the opportunity to look directly through the main room onto the entrance. Hereby the staff can be alert for new fragile visitors who need to be welcomed as fast as possible.

KEY NUMBERS FOR A CELL OFFICE (marked in green)
Area: 12m^2
Volume: 38.4 m^3
People: 2
Max Air Change: 3 h^{-1} (by mechanical ventilation)
24H-Average Max temperature: 26.6 °C
Calculations are found in "Appendix 8: Thermal Comfort" on page 124

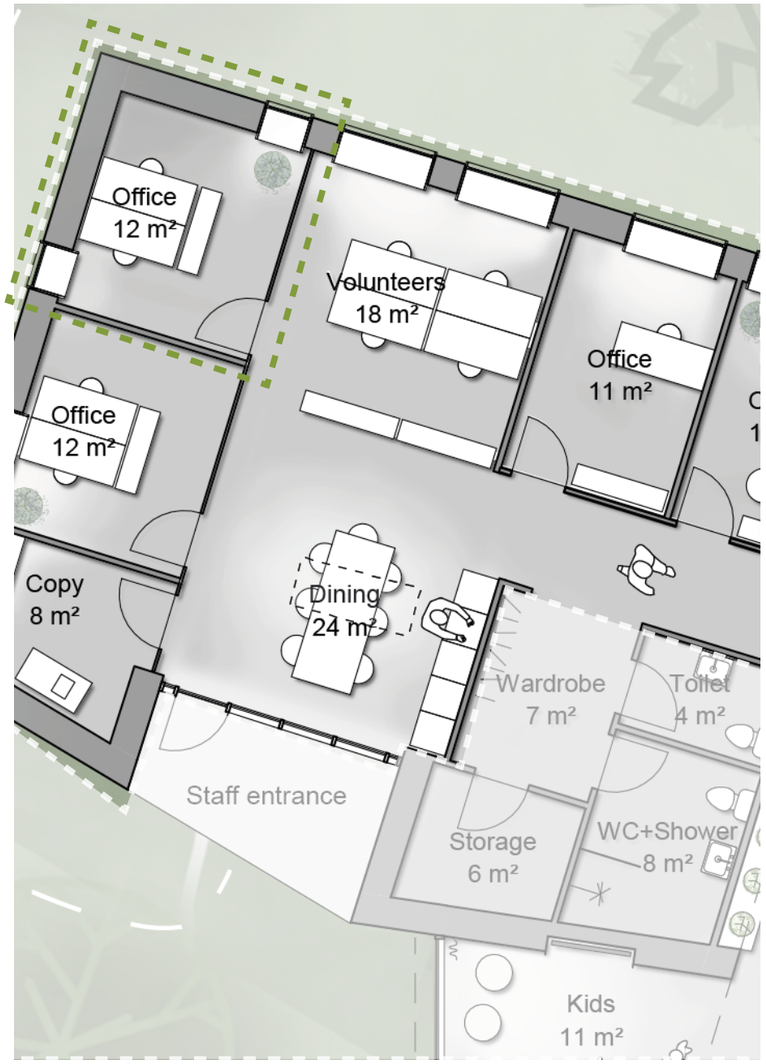


Illustration 206. Plan zoom in 1:100

INSPIRATION


Illustration 207. The Staff kitchen is the central element in the staff area at Livsrum Næstved


Illustration 208. Views in-between the Cell offices at Livsrum Roskilde

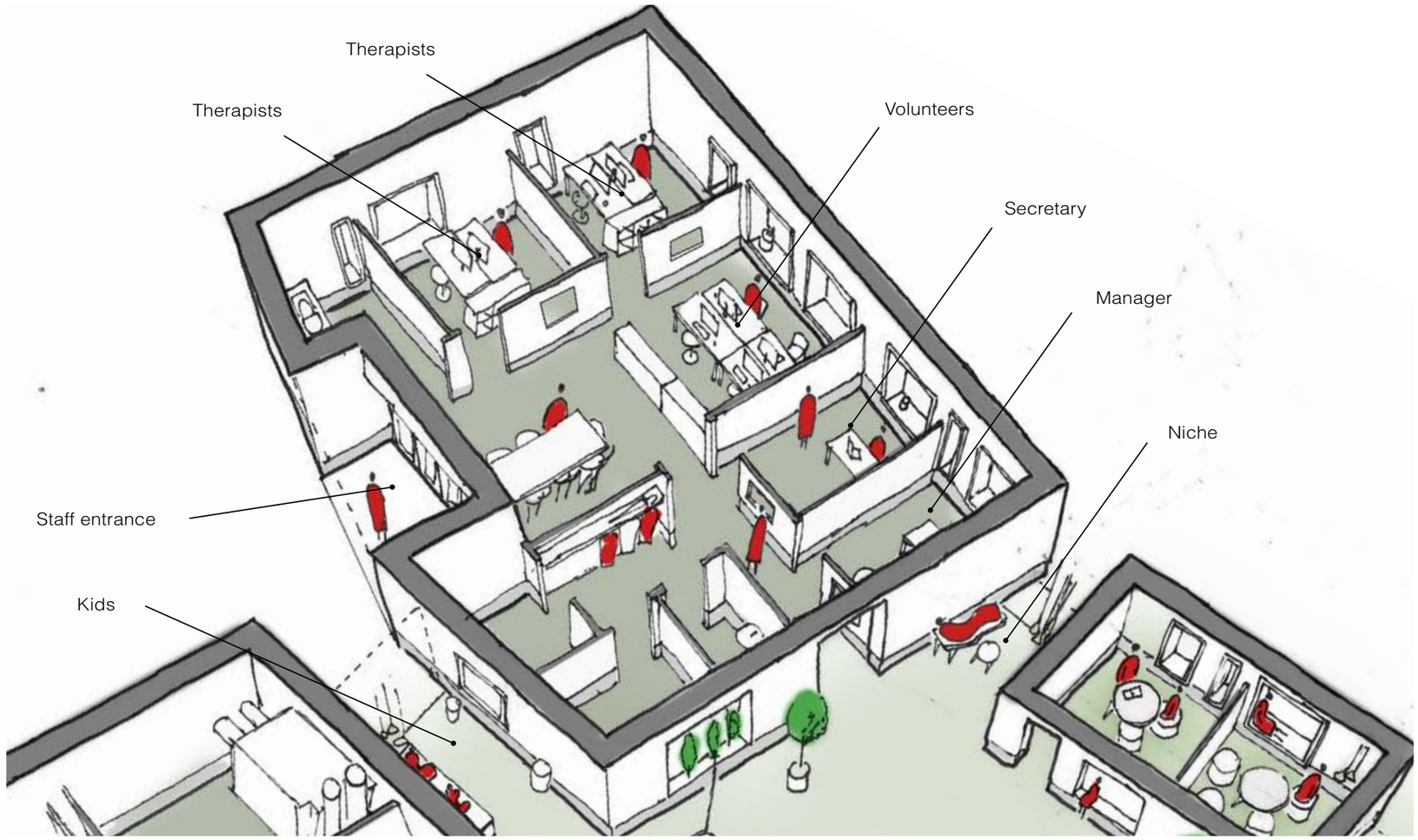


Illustration 209. Axonometry of the Staff

Epilogue

The assessment of the project

CONCLUSION

Based on the Cancer Society's request for seven new Cancer Counselling Centres in Denmark, this project solution is a concrete suggestion for how the future Cancer Counselling Centre for Herlev Hospital can look like. The main themes that have been treated in the project are architectural quality, evidence-based design and a profound knowledge about how these centres work in general. The project has during the process been confronted with a number of considerations relating to a technical, sustainable, functional and aesthetic qualities, which through the integrated design process have led to a number of choices, and thus the project has been formed in the direction of the final solution.

The proposed solution is a building, which with its design and placement signals openness and accessibility while simultaneously invites to confidentiality and privacy. The building relates to its surroundings, but attracts attention because of its distinctive form that indicates that the building contains something "special". Because of the copper roof, the building is easy to identify and the clear entrance works welcoming and inviting. The centre is deliberately kept on a relatively modest scale, distancing the building from the hospital and relating to the human scale. Here, the staffs do not wear a name badge and the visitors are not numbers. The centre is first and foremost a community centre for all cancer patients regardless of age, gender and social background. Users can have many different needs and wishes. Some spend a whole day, others only a few hours. Some for a quiet break from the treatments, others come for a talk with a therapist, join groups or activities. Some days the centre has school classes on visit and some nights they have men's barbeque nights. The centre is designed to accommodate many people and various activities. At the same time the house is characterized with an ambience of tranquillity and contemplation, with a warm atmosphere where the users can feel at home, simultaneously representing an attractive workplace for employees and volunteers.

There is throughout the project drawn much inspiration from the Maggie's Centres, which use the home as reference in the interior designs and where the framework invites for openness and interaction with fellow sufferers. The social hub of the centre is the kitchen that serves as a gathering place for conversations, group events and individual pursuits. Throughout the building small niches and pockets are created with different levels of privacy, so there is both the opportunity to be private and to be social. The visitors, and especially first time visitors, do not have to feel the pressure of having to be social but can seek this when they want to. As it is the entrance that marks the first tone for the atmosphere in the house, the centre is designed so that it is very open and understandable in its layout. From the entrance there is a view to the library, booklets and pamphlets, kitchen and dining area, lounge and the atelier, which gives the first time visitors an overview of the life in the house. This openness and transparency is also highlighted with the visual connection between the main room and the surrounding volumes.

To ensure maximum heat gains during the winter period the southern facade of the building consist of large windows so the direct sun can penetrate deep into the building. In the summer the overhang ensures limited heat gain inside by avoiding direct sunlight on the larger glass panels. The glazed south facade not only ensures winter heat, but also a good amount of daylight and views and contact to the terrace and the surrounding trees, hereby drawing nature into the house. Daylight and relationship to nature have been two important focus areas throughout the project, as this has proven to have a positive influence on people's well-being and wellness. These areas of focus in this project could go hand in hand with the principles for achieving a good indoor climate and low energy consumption. Through working with daylight, solar radiation and air quality it has ensured a good working environment and indoor environment for the users of the centre. The solution with hybrid ventilation also ensures the necessary air change in the building and thus good air quality both summer and winter.

The aesthetical and the technical parameters of the project have interacted in a way, where they in most of the cases have been dependent on each other. With the Centre's architectural quality, homeliness, good daylight and relationship to nature, the architecture is a fellow partner in the foundation to ensure cancer patients and their families the optimal conditions during and after treatments. Besides having a positive effect on the state of mind, the architecture helps the cancer patients and their families to cope with their situation, to give courage and inspiration to explore their own opportunities to move forward. The shape and materials and the large main room in harmony with nature symbolizes a second chance, a new beginning for the visitors that have already gotten bad news. This is the place where one learns the best tools to fight against cancer.

"If one focuses on the variety of functions, then the typical Maggie's Centre can be seen as a kind of Non-Type. It is like a house which is not a home, a collective hospital which is not an institution, a church which is not religious, and an art gallery which is not a museum."

(Jencks, 2014, p. 28)

Illustration 210. The centre seen from south with its terrace in front.

REFLECTION

To understand the theme of the cancer centres, both in Scotland and in Denmark, many of them has been visited. These visits have given the authors a very profound understanding of the atmosphere, not only architecturally but also psychologically. There is a certain “code” of behaviour and mutual emphasis between the volunteers, therapists and the users of the house. After a few of the first visits, we immediately felt at home in the next centres we visited. The users were keen on telling us their quite intimate stories of their fights against cancer and how the people and the centre have helped in this fight. The stories from the centres are many, and the authors would love to have time to tell them all. It has been a challenge to explain what the centres are really about in text and illustrations. There is also much practical knowledge gained from these centres. This can be details that don’t work, things that annoy the staff or rooms with an architectural intention that is not followed through in the built building. This knowledge is well expressed in our final proposal and something the authors will use prospectively in future projects. These can include several new cancer counselling centres, which is to be created in Aalborg, Aarhus and Odense and also Norway has shown interest in the theme.

The first sketches in the process phase were very traditional and rational and were marked by the technical knowledge gained in earlier courses. We have had a difficult time pushing us outside our comfort zones in terms of architecture in order to create this centre. This led to, initially, to explore some very organic stone-looking shapes with an admiration of how these “stones” can intersect each other and how comforting spaces can appear in void. While in this phase, simultaneously, the interior room organisation was developed, and when we came to a point where the shapes needed to be made more rational, a coarse version of the final concept and floor plan emerged. In this process all the learnings from the study trips were used to create comforting spaces with the correct correlations to each other with a very welcoming entrance. That was a very long process with very abstract sketches, but it resulted in a shape that was very straightforward to optimise in terms of energy and indoor climate as some of the passive aspects, such as windows to the south and overhangs were already integrated.

Placing the Counselling centre in the Hospital Park, has created a basis of many considerations throughout the project. On the one hand it seems natural to take advantage of the green space so close to the hospital, creating a public awareness about the Cancer Counselling Centre. On the other hand, a house with a semi-private environment, where users can seek shelter, should not appear like a building where by passers can be spectators to the private events inside the building, for example with therapy and exercise. This dualism has been worked on throughout the process, which resulted in house, where the open functions such as atelier can been seen from the park, and the more private functions as exercise is hidden within the trees. The project site provides breeding ground for multiple users of the house and a greater focus on the functions of the building. However, it has been important through the process, to create a coherence between the house and the site, so the house does not manifest itself in the woods as a foreign object. Therefore, it has been important to create an open house and break the scale of the building. The work with materials, smaller building units, views and openness ensure that the house is working closely with the site, and the openness will ensure more knowledge about the functions of the building, both for potential future users and the general population, without exposing the vulnerable functions in the house.

The technical focus has been on sustainability. With sustainability, the authors have interpret it as the use of tools to integrate indoor climate, daylight and energy usage in order to create a building that can fulfil its role for decades. The main focus while using these tools has been to give the visitors the best possible experience and that the passive solutions should be subtle and well integrated. The clear daylight has been prioritised above energy and therefore the 2015 energy frame is chosen instead of the 2020 energy frame, thus using 2-layer windows instead of 3-layer windows. As a result of the energy requirements, the building gains very thick walls. The main room is created with glazed curtain walls with views to all directions so the visitor does not feel trapped within the thick exterior walls. These walls are continued inside and explored how this thickness can add something to the atmosphere.

A design is never finished until the deadline is due. The authors are proud of the proposal, but there are always things to investigate further. We would have liked a more deep knowledge of the materials used and how the use of them both affects globally and locally in and around the centre. The outdoor areas could have been improved in collaboration with a landscape architect and the structure could have been refined.

The design process has all in all equipped the authors with a skill set that allows them to do a thorough analysis of the theme in order to understand it and be a part of it, in order to create a concrete design proposal to enrich the area - a skill set we can take with us in our future prospect.

"[...] architecture is primarily something built, and that built form becomes an art when it gathers and represents the world to which it belongs. The Nordic art of building thus manifests what it means to 'live poetically' under Nordic conditions, whereby the word 'poetic' acknowledges the qualitative identity of the environment"

Christian Norberg-Schultz (1996, p. ix, preface)

Illustration 211. The centre seen from east with the entrance visible

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Illustrations

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p. 15 Illustration 7. Elements for the healing garten. (Stigsdotter, 2008)
Found at: http://ign.ku.dk/terapihaven-nacadia/forskning/nacadia-konceptmodel.pdf

p. 18 Illustration 11. Relations between physical and psychological attributes (Slides from Camilla Brunsgaard, 2013)

p. 21 Illustration 15. Direct sun in the Serlachius Art Museum Gösta by MX_SI Architectural Studio (mx-si.net)
Found at: http://www.mx-si.net/sin-categoria/serlachius-museum-gosta/ [Accessed February 15th 2015]

p. 35 Illustration 62. Livsrum Odense. An oasis of light and nature
Found at: http://www.frierarchitecture.dk/?portfolio=livsrum-odense-2 <accessed at march 20th 2015>

p. 47 Illustration 104. The lounge at Livsrum Odensen emphasizing the contrast between light and dark.
Found at: http://www.frierarchitecture.dk/?portfolio=livsrum-odense-2 <accessed at march 20th 2015>

p. 58 Illustration 119. The centre is for everyone. Photo by unknown. Found at cancer.dk
Found at: http://www.cancer.dk/hjaelp-viden/raadgivning/radgivninger/region-syddanmark/odense/

p. 74 Illustration 154. Sustainable horisontal cedar wood siding, seen at tracer.dk. This cedar is provided from FSC certified suppliers.
Found at: http://www.tracer.dk/11/showroom#Cedarbeklædning-154 <accessed at march 20th 2015>

p. 74 Illustration 155. Correlation between concrete base and wooden walls, seen in Livsrum Odense. Photo by Helene Høyer.
Found at: http://www.frierarchitecture.dk/?portfolio=livsrum-odense-2 <accessed at march 20th 2015>

p. 74 Illustration 156. Wooden elements together with copper plates seen in Watermans Place, Leeds (C) Dennis Gilbert.
Found at: http://www.czwg.com/works/watermans-place <accessed at march 20th 2015>

p. 74 Illustration 157. Correlation between the window frames and the cedar siding. This siding type is called Free-Willy due to its cross section. Found on houtluyten.be
Found at: http://www.houtluyten.be/volledig-assortiment-gevelbekleding/ <accessed at march 20th 2015>

p. 76 Illustration 161. Intergrating the concrete floor and the wooden walls is well expressed at Livsrum Odense.
Found at: http://www.frierarchitecture.dk/?portfolio=livsrum-odense-2 <accessed at march 20th 2015>

p. 86 Illustration 187. The feeling of being in a cave in Livsrum Odense (Photo: Helene Høyer)
Found at: http://www.frierarchitecture.dk/?portfolio=livsrum-odense-2 <accessed at march 20th 2015>

p. 112 Illustration 214. Window specifications from PRO TEC. Hardwood exterior frames are chosen because of the aesthetics. All PRO TEC windows are with FSC certified wooden suppliers. (protecvinduer.dk)
Found at: http://www.protecvinduer.dk/Forside/Lavenergi/Energidata.aspx [accessed april 10th]

p. 113 Illustration 217. The chosen aggregate for the building. (Exhausto.dk)
Found at: http://www.exhausto.dk/projektering/Beregningsprogrammer [accessed april 10th]

p. 119 Illustration 227. Dimensioning outdoor climate from SBI 202, Table 12.3. (Andersen et al., 2002)

p. 120 Illustration 229. Distance to the neutral plane is important in order to be effecient. (Andersen, et al., 2002)

APPENDIX

THE APPENDIX INCLUDES:

ATTACHED USB PEN DRIVE INCLUDES:

- Full report as a PDF file
- Presentation material as a PDF file

- Be10 files
- BSim files
- Spreadsheets of natural and mechanical ventilation
- Spreadsheets of 24H average
- Spreadsheets of statistics of the BSim results
- Rhino3D file of the geometry used for daylight analysis

Appendix 1: Structural Principles

The roof is supported by battens on glulam beams of 600x200mm in a c/c distance of 1500mm. The gluelam beams are spanning 14 metres across the main room.

The glulam beams are supported on a 800 x 300 reinforced concrete girder surrounding the main room.

It is found well suited to have a 600x200mm in a c/c distance of 1500mm as this size has a good scale to deconstruct the large ceiling, visually.

Inside the volumes, a concrete deck is supporting the roof.

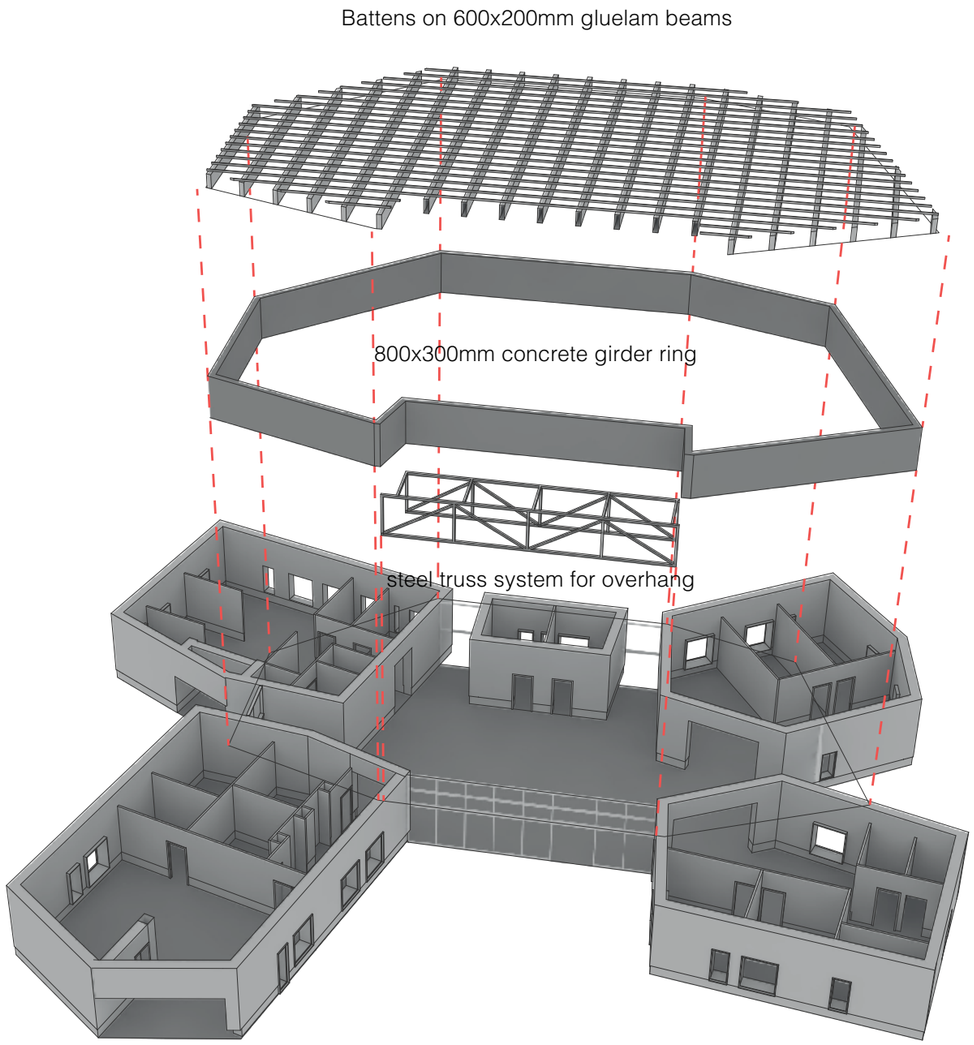


Illustration 212. Structural principle

Appendix 2: Building Components

OVERVIEW

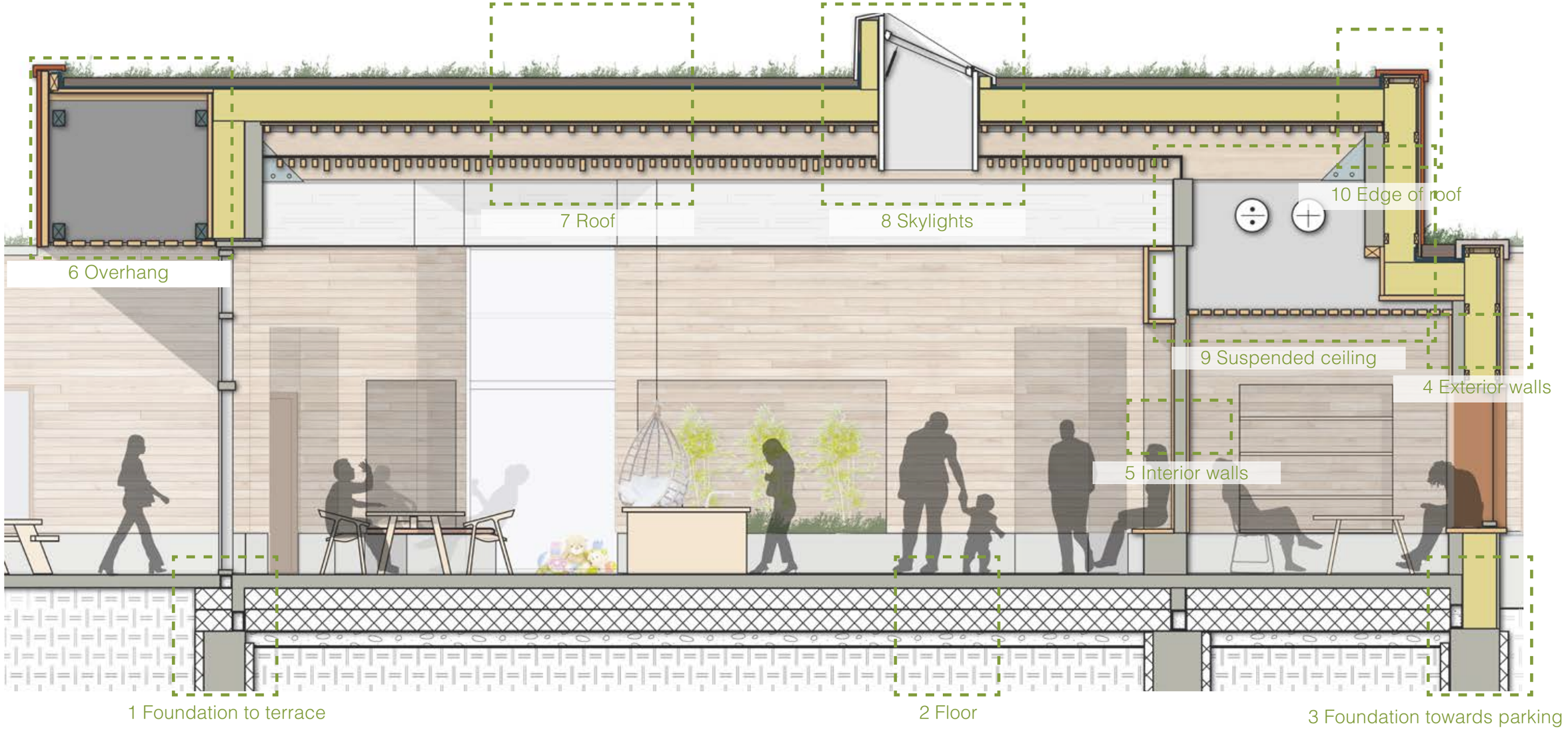
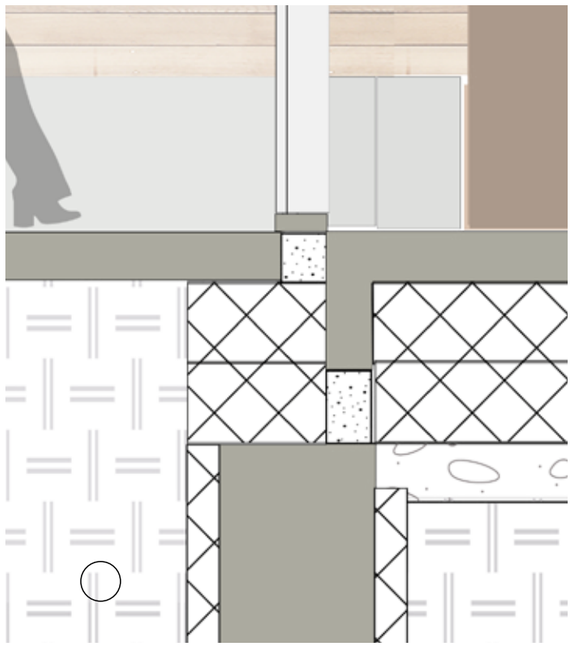


Illustration 213. Detailed section AA 1:50

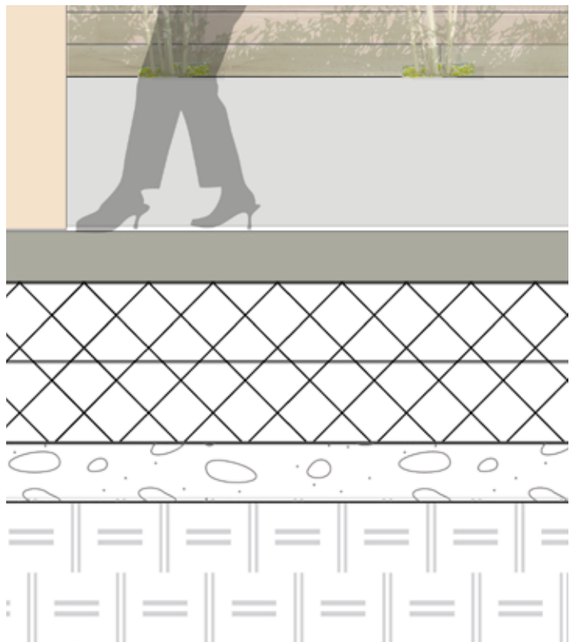


1 FOUNDATION TO TERRACE (1:20)

The floor is supported by a foam glass block on top of a concrete foundation.
The foundation is wrapped in 100mm XPS.

A drainage pipe is advised.

Line loss = 0.0W/mK



2 FLOOR (1:20)

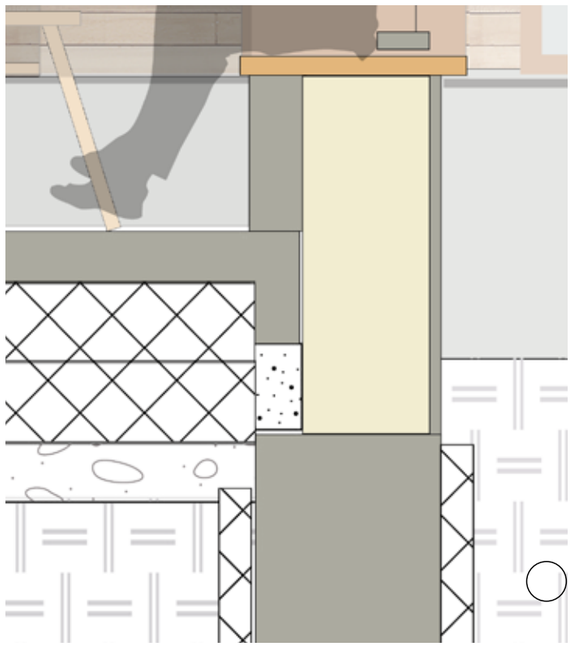
100mm polished concrete cast in-situ

2x400mm XPS, extruded polystyrene foam

100mm sand dune

resting on a capillary breaking layer

U=0.06W/m²K



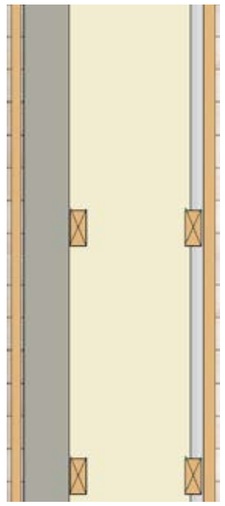
3 FOUNDATION TOWARDS PARKING (1:20)

The walls rest the floor.

The floor is cast in-situ and supported by a foam glass block on top of a concrete foundation. The foundation is wrapped in 100mm XPS.

A drainage pipe is advised.

Line loss = 0.0W/mK



4 EXTERIOR WALLS (1:20)

FROM INSIDE:

30mm cedar wood siding

150mm concrete elements

moist barrier

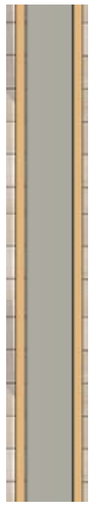
20x40mm wooden battens

inhomogenous layer of vertical wooden elements and mineral wool

moist barrier

ventilated air layer between 20x40mm wooden battens

30mm cedar wood siding



5 INTERIOR WALLS (1:20)

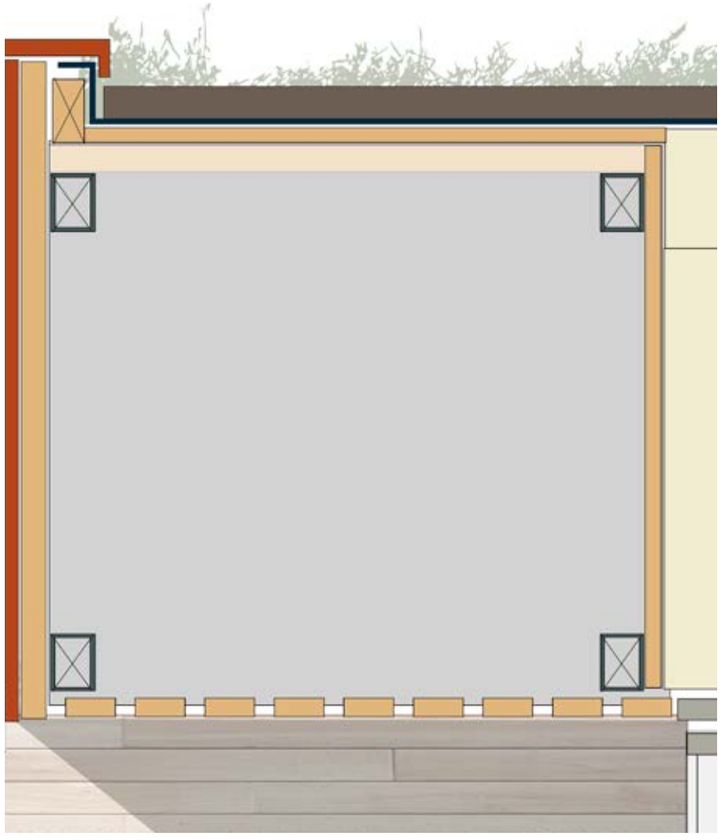
30mm cedar wood siding

moist barrier

150mm concrete cast in-situ

moist barrier

30mm cedar wood siding



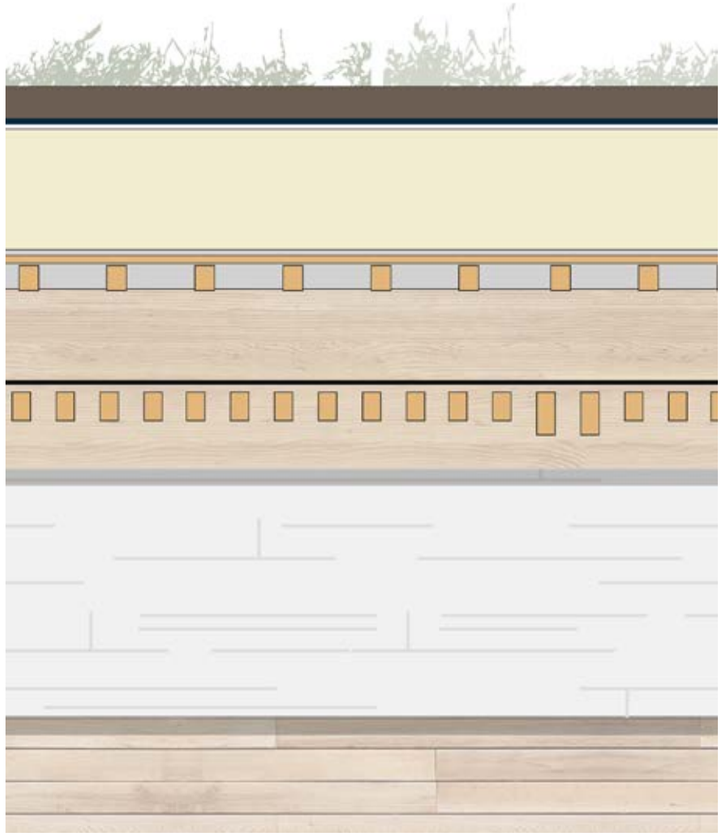
6 OVERHANG (1:20)

The overhang is created to shade the main room from the high summer sun.

It is constructed as a stainless steel warren truss system and hollow.

From the outside, the copper ring embrases this part, so it does not look like an appendix

The truss structure is seen in Appendix 1 on page 106



7 ROOF (1:20)

100mm soil (sedum roof)

2mm water barrier

400mm mineral wool

1mm vapour barrier

20mm OSB board

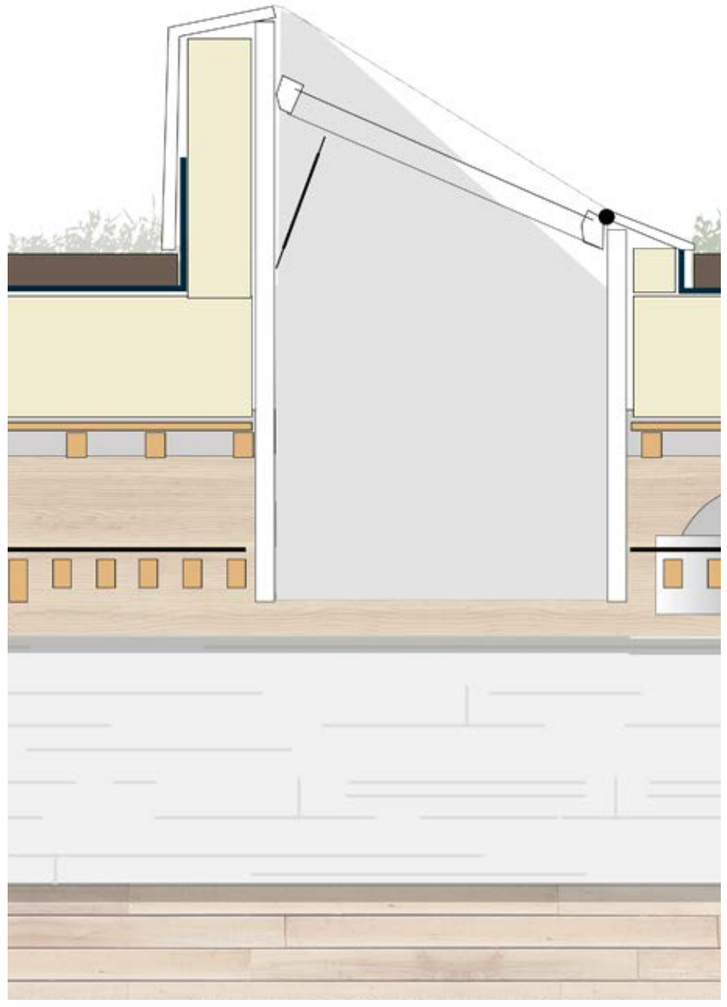
70x40mm c/c=300mm wooden battens

600x200mm c/c=1500mm glulam beams

Between the beams are lamellas under a acoustical absorbtion layer

The gluelam beams are supported by the
800x300mm reinforced concrete bands.

U=0.08W/m^{2}K



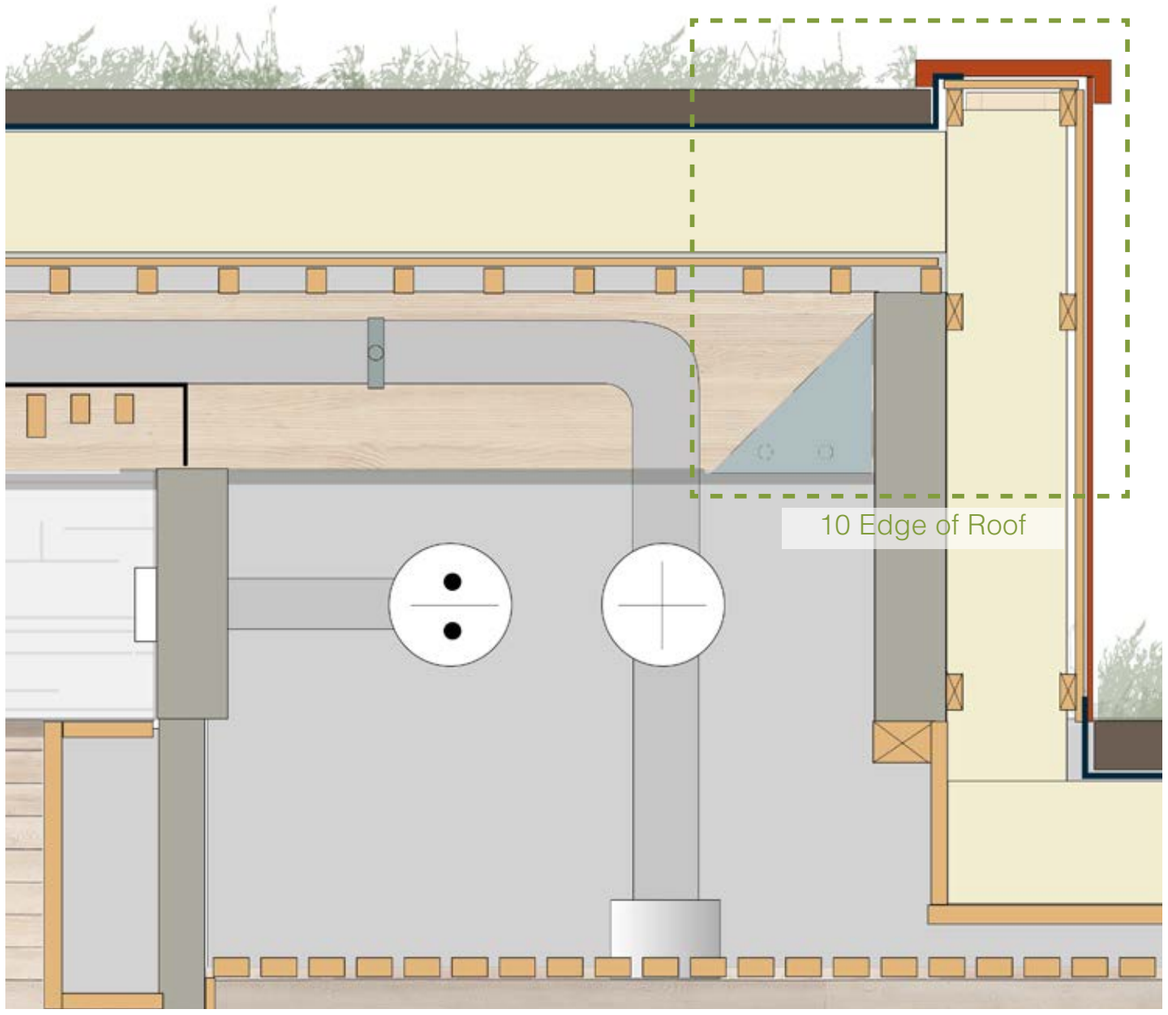
8 SKYLIGHTS (1:20)

Note, this is a principle detail. The actual detail will vary.

800x1300mm skylights placed between the beams
They are elevated above the soil to create shadow from the sun

Daylight and BSim are simulated with skylights in the size above with a “shadow box” 600mm above roof top

Line loss around the skylight = 0.12W/mK

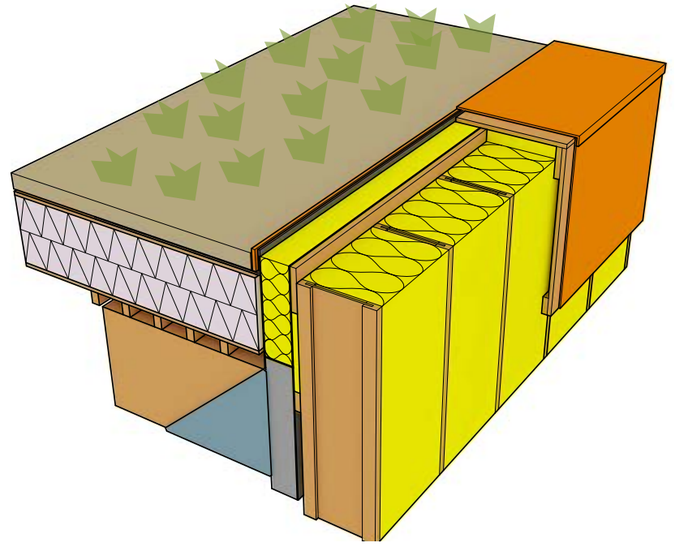


9 SUSPENDED CEILING (1:20)

Note, this is a principle detail. The actual detail will vary.

800x1300mm skylights placed between the beams.
They are elevated above the soil to create shadow from the sun.

Daylight and BSim are simulated with skylights in the size above with a “shadow box” 600mm above roof top



10 EDGE OF ROOF

Note, this is a principle detail. The actual detail will vary.

800x1300mm skylights placed between the beams.
They are elevated above the soil to create shadow from the sun.

Daylight and BSim are simulated with skylights in the size above with a “shadow box” 600mm above roof top

Line loss in the edge: -0.023W/mK
line loss found from similair detail in Komforthusene, Stenaldervænget 43.
(Brunsgaard and Larsen, 2010)

Appendix 3: Energy Calculations

SETUP

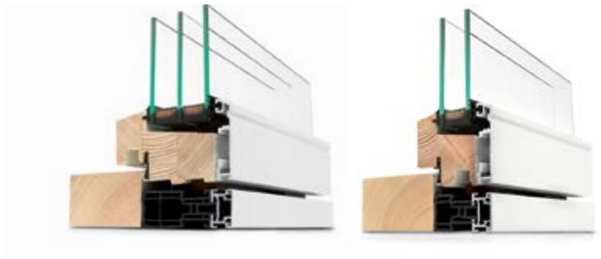
The design uses 2-layers Protec windows in all vertical openings. Low iron glazing in south as this will increase desinfection of air. (Volf, 2013) Passive solutions are applied: shade summer sun, gain winter sun. Heat building early in the day. Gain from natural ventilation. Well daylit environment. Low power, high Ra light sources. heat recovery VAV systems.

Building Envelope:
U_{walls} = 0.08W/m^{2}K
U_{roof} = 0.08W/m^{2}K
U_{floor} = 0.06W/m^{2}K
$U_{windows}$ = 1.44 (0.84 for the 2020 setup)
$G_{windows}$ = 77 (62 for the 2020 setup)
$LT_{windows}$ = 82 (73 for the 2020 setup)

Requirement for mechanical ventilation is calcualted in “Appendix 5: Mechanical Ventilation” on page 116.

Requirement for natural ventilation due to overheating is calculated in “Appendix 8: Thermal Comfort” on page 124 and “Appendix 9: Hourly Building Analysis (BSim)” on page 126.

Possibility for natural ventilation is calculated in “Appendix 7: Possible Natural Ventilation” on page 118.



TEKNISKE DATA	Classic+	Classic+ Energy	Classic	Classic Energy
Standardvindue	1,23 x 1,48 m	1,23 x 1,48 m	1,23 x 1,48 m	1,23 x 1,48 m
Standardrude	48 mm 3-lagsrude m. argon, Ug=0,53	48 mm 3-lagsrude m. argon, Ug=0,64	26 mm 2-lagsrude m. argon, Ug=1,14	26 mm 2-lagsrude m. argon, Ug=1,31
G-værdi (soltransmittans)	49	62	63	77
LT-værdi (lystansmittans)	71	73	80	82
OPLUKKELIGT VINDUE:				
Energi mærkning	A	A	C	B
E-ref for hele vinduet	+ 2,6 KWh/m^2	+ 16 KWh/m^2	- 26,5 KWh/m^2	- 17 KWh/m^2
U-værdi for hele vinduet (Uw)	0,77 W/m^{2}K	0,84 W/m^{2}K	1,32 W/m^{2}K	1,44 W/m^{2}K
Randzonetemperatur	14,1 °C *	14,3 °C	12,2 °C *	12,6 °C
VINDUE MED FAST GLAS:				
Ew for hele vinduet	+ 21,4 KWh/m^2	+ 35 KWh/m2	-7,1 KWh/m^2	+ 5 KWh/m^2
U-værdi for hele vinduet (Uw)	0,69 W/m^{2}K	0,79 W/m^{2}K	1,27 W/m^{2}K	1,4 W/m^{2}K
Randzonetemperatur	14,3 °C	14,3 °C	12,0 °C	12,5 °C
Overholder bygningsreglementet	2020	2020	2010	2015

2020 setup
3 layers

2015 setup
2 layers

Illustration 214. Window specifications from PRO TEC. Hardwood exterior frames are chosen because of the aesthetics. All PRO TEC windows are with FSC certified wooden suppliers. (protecvinduer.dk)

A Be10 calculation (Danish Building Research Institute, 2005) is made to verify the building and to see if the building has reached the demanded 2015 requirements. As seen on the illustration is was possible to reach the requirements, but as the authors were curious to see what initiatives are needed to reach the 2020 requirement, the windows in the entire building were changed from 2-layers windows to 3-layers windows, changing the U-value from 1.44 W/m²K to 0.84 W/m²K. This change made it possible to reach the 2020 requirements, showing the flexibility of the design.

Ventilation rates are defined in “Appendix 5: Mechanical Ventilation” on page 116. A ventilation unit is found, which can accommodate the needed ventilation rates in the building. The unit is found on the website of Exhausto (Exhausto.dk), showing that it has a SFP-value of 1.1 kJ/m³ (See Illustration 217). The size of the unit measures: HxLxD=1800x2050x1525mm. The information from Exhausto has been placed into the Be10 calculations.

All the Be10 calculations are found on the attached USB.

RESULTS WITH 2-LAYER-GLAZING

Nøgletal, kWh/m² år

Energiramme BR 2010

Uden tillæg	Tillæg for særlige betingelser	Samlet energiramme
73,3	0,0	73,3
Samlet energibehov		47,5

Energiramme Lavenergibyggeri 2015

Uden tillæg	Tillæg for særlige betingelser	Samlet energiramme
42,2	0,0	42,2
Samlet energibehov		41,2

Energiramme Byggeri 2020

Uden tillæg	Tillæg for særlige betingelser	Samlet energiramme
25,0	0,0	25,0
Samlet energibehov		30,4

Bidrag til energibehovet		Netto behov	
Varme	31,3	Rumopvarmning	31,3
El til bygningsdrift	6,5	Varmt brugsvand	5,3
Overtemp. i rum	0,0	Køling	0,0

Udvalgte elbehov		Varmetab fra installationer	
Belysning	4,9	Rumopvarmning	0,0
Opvarmning af rum	0,0	Varmt brugsvand	0,0
Opvarmning af vbv	0,0		
Varmepumpe	0,0	Ydelse fra særlige kilder	
Ventilatorer	1,6	Solvarme	0,0
Pumper	0,0	Varmepumpe	0,0
Køling	0,0	Solceller	0,0
Totalt elforbrug	15,6	Vindmøller	0,0

Illustration 215. Be10 calculation for the final design with 2-layers windows.

RESULTS WITH 3-LAYER-GLAZING

Nøgletal, kWh/m² år

Energiramme BR 2010

Uden tillæg	Tillæg for særlige betingelser	Samlet energiramme
73,3	0,0	73,3
Samlet energibehov		37,1

Energiramme Lavenergibyggeri 2015

Uden tillæg	Tillæg for særlige betingelser	Samlet energiramme
42,2	0,0	42,2
Samlet energibehov		32,9

Energiramme Byggeri 2020

Uden tillæg	Tillæg for særlige betingelser	Samlet energiramme
25,0	0,0	25,0
Samlet energibehov		24,2

Bidrag til energibehovet		Netto behov	
Varme	21,0	Rumopvarmning	21,0
El til bygningsdrift	6,4	Varmt brugsvand	5,3
Overtemp. i rum	0,0	Køling	0,0

Udvalgte elbehov		Varmetab fra installationer	
Belysning	4,9	Rumopvarmning	0,0
Opvarmning af rum	0,0	Varmt brugsvand	0,0
Opvarmning af vbv	0,0		
Varmepumpe	0,0	Ydelse fra særlige kilder	
Ventilatorer	1,5	Solvarme	0,0
Pumper	0,0	Varmepumpe	0,0
Køling	0,0	Solceller	0,0
Totalt elforbrug	15,6	Vindmøller	0,0

Illustration 216. Be10 calculation for the final design with 3-layers windows.

Illustration 217. The chosen aggregate for the building. (Exhausto.dk)

Kapacitet:

	For valgt driftpunkt			
	Tilluft	Fraluft	Total	
Luftmængde, qv	2750	2750	-	m³/h
Lækage luftstrøm		211		m³/h
Anlægstryk pt	175	175	-	Pa
Tryktab filter (start)	16	16	-	Pa
Tryktab filter (design)	66	66	-	Pa
Tryktab filter (slut)	116	116	-	Pa
Tryktab veksler	79	104	-	Pa
Tryktab intern	8	8	-	Pa
Kanaltilbehør (spjæld m.v.)	0	0	-	Pa
Total statisk ventilatortryk	328	353	-	Pa
Optaget effekt, P1 ved Design	0,462	0,516	0,977	kW
Specifikt elforbrug, SFP rent filter	517	545	1103	J/m³
Hastighedsklasse EN13053:2011	V1- 0,71 m/s	V1- 0,71 m/s	-	

Varmeveksler - PT-D14 1325

	Tilluft	Fraluft
Nominelt luftmængde	2750 m³/h	2750 m³/h
Tilstand indtag	-12,0 °C / 80 %	22,0 °C / 20 %
Tilstand afkast	19,0 °C / 12 %	-7,1 °C / 95 %
Tryktab veksler	64 Pa	105 Pa
Temperaturvirkningsgrad	91 %	-
Temperatur virkningsgrad med motorvarme	92 %	-
Fugtgenvinding	24 %	59 %

Temperaturvirkningsgrad tør - jævnfør EN308 - 91,5 % ved 2750 m³/h

Appendix 4: Required Ventilation

AVERAGE FOR ENERGY CALCULATIONS:

Building Regulations

Minimum ventilation of 0.35 l/s pr. m^2 heated floor area added to minimum 5l/s pr adult and 3l/s pr child. If a VAV unit is used, a variation is tolerated. A CO_2 concentration of more than 1000ppm is not tolerated. (Energistyrelsen, 2015 §6.3.1.3)

Comfort Classes

Tightening the requirement further by looking at CR1752, it is proposed to follow comfort class I with a maximum of 15% predicted percentage dissatisfied. This involves a CO_2 level of less than 460ppm above outdoors and a decipol of less than 1. The later corresponds to an air flow of 10l/s/olf, where an olf is the population from one standard person. Furthermore the building materials can add 0.1 olf/m^2 (low olf building) (Comité Européen de Normalisation, 1998).

In the cooling seasons, additional ventilation is needed. This is done using natural ventilation.

Two sheets are made; one with a peak scenario to dimension the ventilation unit and to analyze peak scenarios in BSim, and one in an average scenario to get ventilation values for energy calculations in Be10.

The green background is supposed to be taken care of with natural ventilation (combined cross and stack ventilation). Red background is for the mechanical ventilation unit.

BSim simulations are found in “Appendix 9: Hourly Building Analysis (BSim)” on page 126.

Be10 energy calculations are found in “Appendix 3: Energy Calculations” on page 112.

red text is dimensioning per room

Room	no.of rooms [n]	Area pr room [m2]	Volume [m3]	Persons pr. room	Activity[met]	bioeffluents[olf/pers]	Cooling season (Average) Natural venting: airchange$_{overtemp}$ [/h]	q_{olf} [m3/h]	q_{CO2} [m3/h]	$q_{overtemp}$ [m3/h]	$q_{BR\ min(0.3l/s/m2)}$ [m3/h]	$q_{dimensioning}$ [m3/h]	To BE10: $q_{dimensioning}$ [l/s/m2]	Heating season (Average) Mechanical Ventilation: airchange$_{overtemp}$ [/h]	q_{olf} [m3/h]	q_{CO2} [m3/h]	$q_{overtemp}$ [m3/h]	$q_{BR\ min(0.3l/s/m2)}$ [m3/h]	$q_{dimensioning}$ [m3/h]	To BE10: $q_{dimensioning}$ [l/s/m2]
Main Room	1	230	1150	5	1,0	*1*	3,0	*295*	*243*	*3450*	*248*	**3450**	4,2		*295*	*243*		*248*	**295**	0,4
Office large room	1	50	175	2	1,5	*1*	3,0	*74*	*146*	*525*	*54*	**525**	2,9		*74*	*146*		*54*	**146**	0,8
Cell office	4	11	39	2	1,0	*1*	3,0	*27*	*73*	*116*	*27*	**462**	2,9		*27*	*73*		*27*	**291**	1,8
Exercise	1	48	168	3	4,0	*5*	3,0	*182*	*486*	*504*	*52*	**504**	2,9		*182*	*486*		*52*	**486**	2,8
Library	1	20	60	1	1	*1*	3,0	*32*	*49*	*180*	*22*	**180**	2,5		*32*	*49*		*22*	**49**	0,7
Depot	4	10	35	0	1	*1*	0,0	*11*	*0*		*11*	**43**	0,3		*11*	*0*		*11*	**43**	0,3
Lockers	2	13	45,5	1,5	4	*5*	0,0	*93*	*291*		*27*	**583**	6,2		*93*	*291*		*27*	**583**	6,2
Therapy	7	12	42	1	1	*1*	3,0	*23*	*49*	*126*	*18*	**882**	2,9		*23*	*49*		*18*	**340**	1,1
Lounge	1	27	94,5	2	1	*1*	3,0	*49*	*97*	*284*	*36*	**284**	2,9		*49*	*97*		*36*	**97**	1,0
Workshop	1	36	126	1	1,5	*1*	3,0	*48*	*73*	*378*	*39*	**378**	2,9		*48*	*73*		*39*	**73**	0,6
Hallway	1	18	63	0,5	1	*1*	3,0	*24*	*24*	*189*	*19*	**189**	2,9		*24*	*24*		*19*	**24**	0,4
											q_{nat} [m^3/h]:	**7480**						q_{mech} [m^3/h]:	**2427**	

Average numbers of persons in the building: *30*

Mechanical ventilation

Extra	no.of rooms [n]	$q_{function}$ [l/s]	$q_{function}$ [m3/h]	
Toilets	6	*15*	*54*	**324**
Kitchens	2	*20*	*72*	**144**
			$q_{mech,\ functions}$ [m^3/h]	**468**

Additional Mechanical Ventilation

Extra	no.of rooms [n]	$q_{function}$ [l/s]	$q_{function}$ [m3/h]	
Toilets	6	*15*	*54*	**324**
Kitchens included in Mainroom + Office large room				
			$q_{mech,\ functions}$ [m^3/h]	**324**

constants:

building smell [olf/m2]	0,1
outdoor pollution [decipol]	0,05
max pollution [decipol]	1
max cco2 [ppm]:	700
outdoor cco2 [ppm]:	350

Total summer average:	
$q_{summer} = q_{nat}+q_{mech,functions}$ [m^3/h]:	**7948**
n_{summer}[/h]:	**3,2**

Total winter average:	
$q_{winter} = q_{mech}+q_{mech,functions}$ [m^3/h]:	**2751**
n_{winter} [/h]:	**1,1**

Illustration 218. Sheets of peak and average ventilation rates. These mean numbers are used to the Be10 energy calculation. Red numbers are the dimensioning numbers.

PEAK FOR INDOOR CLIMATE SIMULATIONS AND UNIT DIMENSIONING

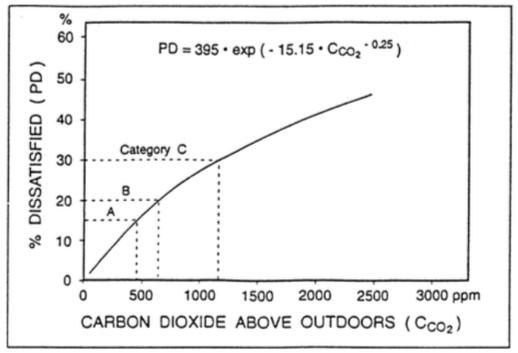


Illustration 219. Comfort classes A,B and C based on CO_2 concentrations in the air. From CR1752 (Comité Européen de Normalisation, 1998 p. 24)

red text is dimensioning per room

Room	no.of rooms [n]	Area pr room [m2]	Volume [m3]	Persons pr. room	Activity[met]	bioeffluents[olf/pers]	**Cooling season (Peak)** Natural venting: airchange$_{overtemp}$ [/h]	q_{olf} [m3/h]	q_{CO2} [m3/h]?	$q_{overtemp}$ [m3/h]	$q_{BR\ min(0,3l/s/m2)}$ [m3/h]	$q_{dimensioning}$ [m3/h]	**Heating season (Peak)** Mechanical Ventilation: airchange$_{overtemp}$ [/h]	q_{olf} [m3/h]	q_{CO2} [m3/h]?	$q_{overtemp}$ [m3/h]	$q_{BR\ min(0,3l/s/m2)}$ [m3/h]	$q_{dimensioning}$ [m3/h]
Main Room	1	230	1150	20	1,0	*1*	3,0	*453*	*971*	*3450*	*360*	**3450**		*453*	*971*		*360*	**971**
Office large room	1	50	175	6	1,5	*1*	6,0	*116*	*437*	*1050*	*108*	**1050**		*116*	*437*		*108*	**437**
Cell office	4	11	39	3	1,0	*1*		*38*	*121*		*45*	**486**		*38*	*121*		*45*	**486**
Exercise	1	48	168	10	4,0	*5*	8,0	*577*	*1943*	*1344*	*180*	**1943**		*577*	*1943*		*180*	**1943**
Library	1	20	60	2	1	*1*		*42*	*97*		*36*	**97**		*42*	*97*		*36*	**97**
Depot	4	10	35	0	1	*1*		*11*	*0*		*11*	**43**		*11*	*0*		*11*	**43**
Lockers	2	13	45,5	5	4	*5*		*277*	*971*		*90*	**1943**		*277*	*971*		*90*	**1943**
Therapy	7	12	42	1,5	1	*1*		*28*	*73*		*27*	**510**		*28*	*73*		*27*	**510**
Lounge	1	27	94,5	5	1	*1*		*81*	*243*		*90*	**243**		*81*	*243*		*90*	**243**
Workshop	1	36	126	4	1,5	*1*		*80*	*291*		*72*	**291**		*80*	*291*		*72*	**291**
Hallway	1	18	63	2	1	*1*		*40*	*97*		*36*	**97**		*40*	*97*		*36*	**97**
											q_{nat} [m^3/h]:	**10153**				q_{mech} [m^3/h]:	**7062**

Maximum amount of people in the building: *79,5*

Mechanical ventilation

Extra	no.of rooms [n]	$q_{function}$[l/s]	$q_{function}$[m3/h]	
Toilets	6	*15*	*54*	**324**
Kitchens	2	*20*	*72*	**144**
			$q_{mech,\ functions}$ [m^3/h]	**468**

Total summer peak:

$q_{summer} = q_{nat}+q_{mech,functions}$ [m^3/h]:	**10621**
n_{summer}[/h]:	**4,2**

Additional Mechanical Ventilation

Extra	no.of rooms [n]	$q_{function}$[l/s]	$q_{function}$[m3/h]	
Toilets	6	*15*	*54*	**324**
Kitchens included in Mainroom + Office large room				
			$q_{mech,\ functions}$ [m^3/h]	**324**

Total winter peak:

$q_{winter} = q_{mech}+q_{mech,functions}$ [m^3/h]:	**7386**
n_{winter} [/h]:	**2,9**

constants:

building smell [olf/m2]	0,1
outdoor pollution [decipol]	0,05
max pollution [decipol]	1
max cco2 [ppm]:	700
outdoor cco2 [ppm]:	350

Illustration 220. Sheets of peak ventilation rates. These peak numbers are used to find the right ventilation unit.
Red numbers are the dimensioning numbers.

Appendix 5: Mechanical Ventilation

VENTILATION LAYOUT:

Building Regulations
Air transport from one room may not happen to another room with less air populated room. (Energistyrelsen, 2015: §6.3.1.1 - 4)

Ducts are placed in the suspended ceiling in the niches and in the volumes.

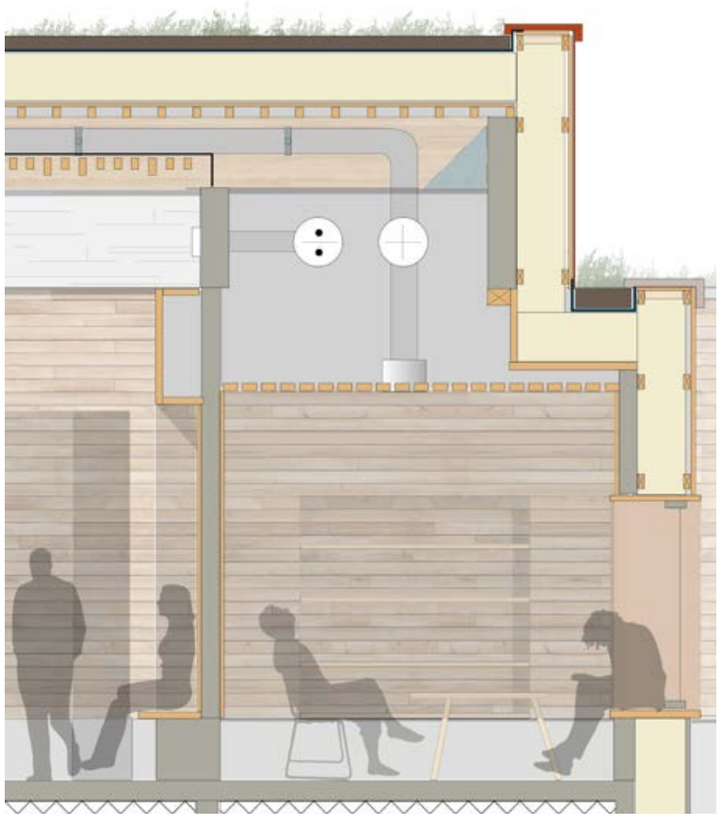


Illustration 221. Section 1:50 showing the ventilation ducts in the suspended ceiling. This setup is very flexible and future installations, changes and maintainance is easy.

Illustration 222. Ventilation ducts (Plan 1:200)

Appendix 6: Thermal Analysis Overview

Different tools are used on different rooms in different phases during this project. 24H Average is used as an early analysis in all of the rooms. Some rooms have gotten more attention than others. These include Main Room and Exercise due to the different usage they have. They are simulated in BSim at the final design to help dimensioning the skylights.

Other rooms which have gotten less attention include Cell office, Staff area and Wellness rooms. These have an updated 24H average sheet of the final design. In the following pages, the highlighted material is displayed. The rest of the calculation sheets are to be found on the attached USB pen drive.

Room	24H Average (thermal)	BSim (thermal+atmospheric)	Possible ventilation
Main Room	In early process	Final Design with skylights	Final Design with and without skylights
Exercise	In early process	Final Design with skylight	Final Design with and without skylights
SW Cell office	In early process *(then moved to NW)*	-	-
NW Cell office	Final Design *(moved from SW)*	-	Final Design
Staff Area	In Early Process and Final Design	-	-
Wellness	In Early Process and Final Design	-	-

Illustration 223. Overview over the status of analysis on the different rooms. Marked ones are shown in appendix, the rest is on USB pen.

Appendix 7: Possible Natural Ventilation

STRATEGY:

The maxmimum possible ventilation is calculated using equations from SBI 202 (Andersen, et al., 2002). They are based on that there is always a mass balance on the wind calculation and on the thermal buoyancy calculation. These calculations are made to see if the thermal buoyancy and the wind pressure are working together or even eachother out. This can be in a situation where the wind wants air in of a very high window, where the thermal buoyancy wants to let the air out.

On the following pages are an overview of the calculated rooms and the calculation sheets for the main room. For the other rooms, please see the attached USB pen drive.

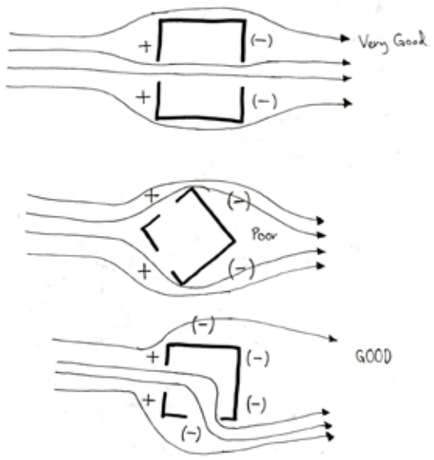


Illustration 224. Ventilation principles after Lechner (1991).

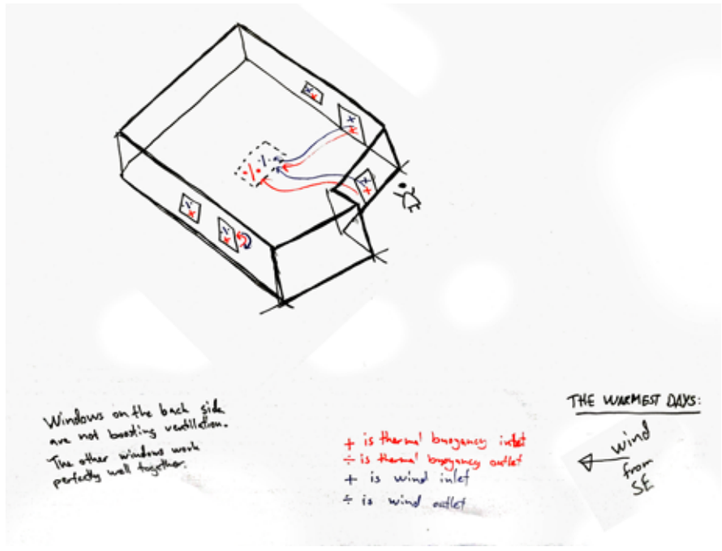


Illustration 225. Shows how important the skylight is for exercise, not only for daylight

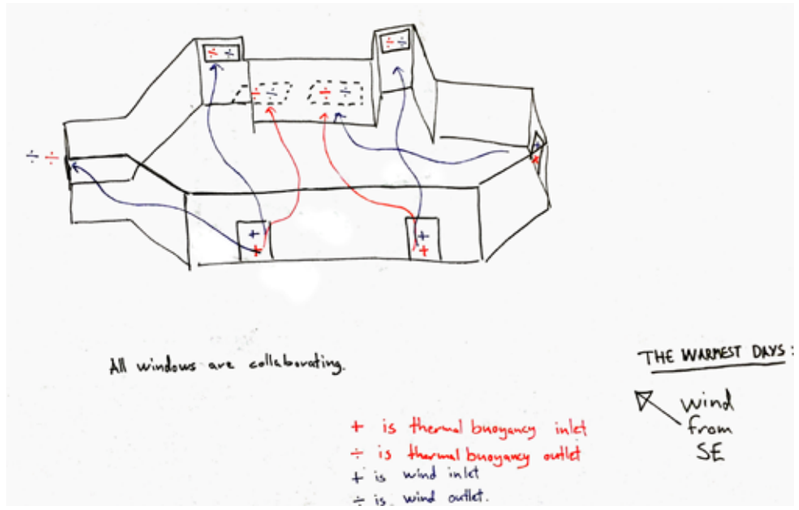


Illustration 226. Shows how the SE wind will work together with thermal buoyancy in the main room.

VENTILATION POSSIBILITIES:

Four rooms are tested for their ventilation possibilities:
Exercise (with and without a skylight)
Cell office SW (which later in the process is now a copy room)
Main Room (with and without skylights)
Staff Dining Area

These rooms are tested in three summer scenarios, all with the 25% percentiles of the wind based on DRY (2015), according to examples in SBI 202 (Andersen et al., 2002):

Summer 24H Mean Average (to=16.1°C, V=1.0m/s)
Summer 24H Mean Max (to=21.0 °C, V=1.3m/s)
Hourly Max (to=27°C, V=4.6m/s, thermal buoyancy neglected)

The interior temperatures are calculated using the 24H Average spreadsheet in Appendix 8 on page 124.

Cell office and therapy rooms are not well suited for cross ventilation. They are calculated using a 1-window equation (found in sbi 202). The authors, however are sceptical for the very high airflow this equation allows, but as only a small part of this is needed, it is judged to be a fair documentation for these rooms. Alternatively, the cell offices and therapy rooms may be ventilation during summer using mechanical ventilation.

A description of the Main Room is found on the following pages. The rest of the rooms are included on the attached USB pen drive.

Tabel 12.3. Dimensionerende udeklimadata anvendt ved beregning af åbningsarealer.

Dimensio-nerings-situation	Ude-temperatur °C [1]		Vindhastighed m/s [2]				Vind-retning
	Døgn-middel	Maksi-mum	Vind-stille	25 % fraktiler for			
				Hele året	Døgn med t_{maks} > 20 °C	Døgn med t_{maks} > 25 °C	Timer med t > 25 °C	
Januar								
Middeldøgn	-1,0		[3]					
Juli								
Middeldøgn	16,1				1,0			SØ
Maks. døgn	21,0					1,3		SØ
Maks. time		27,0					4,6	SØ
Oktober								
Middeldøgn	8,9			2,0				SV
Maks. døgn	13,7			2,0				SV

1) Jf. tabel 6.1.
2) Jf. tabel 6.2.
3) Vindtryk medtages ikke ved beregning af drivtryk.

Illustration 227. Dimensioning outdoor climate from SBI 202, Table 12.3. (Andersen et al., 2002)

Room:	Case:	V_{room} [m3]	$h_{neutralplane}$ [m]	Ti [°C]	To [°C]	Dir_{wind}	V_{10} [m/s]	V_{ref} [m/s]	$Q_{buoyancy}$ [m3/h]	Q_{wind} [m3/h]	Q_{total} [m3/h]	$airchange_{buoyancy}$[/h]	$airchange_{wind}$[/h]	$airchange_{total}$[/h]
Exercise	1: July 24H Mean Avg (Wind+Buoyancy)	168	2,0	21,0	16,1	SE	1,0	0,5	3166	1679	3604	19	10	21
Exercise	2: July 24H Mean Max (Wind+Buoyancy)	168	2,0	23,2	21,0	SE	1,3	0,6	2113	2183	2836	13	13	**17**
Exercise	3: July Hourly Max (Wind)	168	2,0	27,0	27,0	SE	4,6	2,3	0	7725	7725	0	46	46
Exercise +skylight	1: July 24H Mean Avg (Wind+Buoyancy)	168	2,5	21,0	16,1	SE	1,0	0,5	5476	3046	5668	33	18	34
Exercise +skylight	2: July 24H Mean Max (Wind+Buoyancy)	168	2,5	23,2	21,0	SE	1,3	0,6	3656	3960	3678	22	24	**22**
Exercise +skylight	3: July Hourly Max (Wind)	168	2,5	27,0	27,0	SE	4,6	2,3	0	14013	14013	0	83	83
Cell OfficeSW	1: July 24H Mean Avg (Wind+Buoyancy)	48	1,4	21,8	16,1	SE	1,0	0,5	0	2	2	0	0	0
Cell OfficeSW	2: July 24H Mean Max (Wind+Buoyancy)	48	1,4	24,0	21,0	SE	1,3	0,6	0	2	2	0	0	**0**
Cell OfficeSW	3: July Hourly Max (Wind)	48	1,4	27,0	27,0	SE	4,6	2,3	0	0	0	0	0	0
Main Room	1: July 24H Mean Avg (Wind+Buoyancy)	1400	1,4	21,8	16,1	SE	1,0	0,5	6582	3628	7533	5	3	5
Main Room	2: July 24H Mean Max (Wind+Buoyancy)	1400	1,4	24,0	21,0	SE	1,3	0,6	4757	4717	6723	3	3	**5**
Main Room	3: July Hourly Max (Wind)	1400	1,4	27,0	27,0	SE	4,6	2,3	0	16690	16690	0	12	12
Main Room + skylights	1: July 24H Mean Avg (Wind+Buoyancy)	1400	2,6	21,8	16,1	SE	1,0	0,5	27523	8023	27990	20	6	20
Main Room + skylights	2: July 24H Mean Max (Wind+Buoyancy)	1400	2,6	24,0	21,0	SE	1,3	0,6	19893	10430	21930	14	7	**16**
Main Room + skylights	3: July Hourly Max (Wind)	1400	2,6	27,0	27,0	SE	4,6	2,3	0	36907	36907	0	26	26
Staff	1: July 24H Mean Avg (Wind+Buoyancy)	112	2,6	21,8	16,1	SE	1,0	0,5	3897	0	1242	35	0	11
Staff	2: July 24H Mean Max (Wind+Buoyancy)	112	2,6	24,0	21,0	SE	1,3	0,6	2817	0	898	25	0	8
Staff	3: July Hourly Max (Wind)	112	2,6	27,0	27,0	SE	4,6	2,3	0	1	1	0	0	**0**
Staff +sky	1: July 24H Mean Avg (Wind+Buoyancy)	112	2,9	21,8	16,1	SE	1,0	0,5	4193	0	2322	37	0	21
Staff +sky	2: July 24H Mean Max (Wind+Buoyancy)	112	2,9	24,0	21,0	SE	1,3	0,6	3030	0	897	27	0	8
Staff +sky	3: July Hourly Max (Wind)	112	2,8	27,0	27,0	SE	4,6	2,3	0	1	1	0	0	**0**

Illustration 228. Overview over natural ventilation rates

PHYSICS

The airflow through an opening is based on the pressure difference through the opening as described below (Andersen, et al., 2002):

$$q_V = C_d A \left(\frac{2|\Delta p|}{\rho} \right)^{½} \qquad (9.2)$$

q_v = airflow m^3/s
A = geometric opening area, m^2
C_d = Discharge coefficient, 0.7 for windows
ρ = air density kg/m^3
Δp = pressure difference in the opening, Pa

Thermal buoyancy

The air change due to thermal buoyancy is based on the changing density of air based on the temperature. Windows will inlet air if placed under the so called neutral plane and outlet air if placed above. However, the neutral plane changes every time a window is added. The neutral plan is found numerically to fulfill the mass balance using the following equation. This implies volume of inlet air in a room is the same as the volume of the outlet air (Andersen, et al., 2002):

$$\sum_{j=1}^{n} C_{d,j} A_j \left| H_0 - H_j \right|^{½} \frac{H_0 - H_j}{\left| H_0 - H_j \right|} = 0$$

The pressure difference by buoyancy is found based on the height of a window (Andersen, et al., 2002):

$$\Delta p = \rho_u g (H_0 - h) \frac{\Delta T}{T_i} = \rho_i g (H_0 - h) \frac{\Delta T}{T_u} \qquad (9.16)$$

Δp = pressure difference in the opening, Pa
ρ_u = density, outdoor air, kg/m^3
g = gravitation acceleration, $9.82 m/s^2$
H_0 = height of neutral plane, m
h = height of centre of the window, m
T_u = temperature, outdoor, K
T_i = temperature, outdoor, K
$\Delta T = |T_i - T_u|$, K

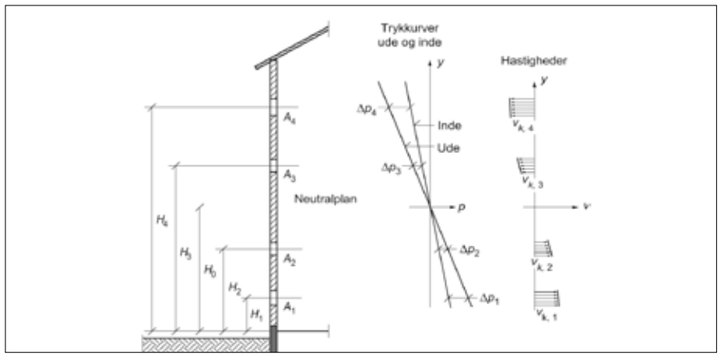


Illustration 229. Distance to the neutral plane is important in order to be effecient. (Andersen, et al., 2002)

Wind pressure

Working side to side with the forces of thermal buoyancy is the wind. The wind is a little less predictable, but in these cases the hot south eastern wind in denmark is used, as the dimensioning is to prevent overtemperatures. As with the buoyancy, the airchange from the wind is based on a mass balance (Andersen, et al., 2002):

$$\sum_{j=1}^{n} C_{d,j} A_j \left(\frac{|2\Delta p_j|}{\rho} \right)^{½} \frac{\Delta p_j}{|\Delta p_j|} = 0 \qquad (9.15)$$

Δp_j = pressure difference in the opening, Pa
ρ = density, air, kg/m^3
A_j = geometric opening area, m^2
$C_{d,j}$ = Discharge coefficient, 0.7 for windows

The wind pressure on an outdoor element is defined as (Andersen, et al., 2002 p. 60):

$$\Delta p_j = p_{v,j} - p_i = ½ C_{p,j} \rho_u v_{ref}^2 - p_i \qquad (9.13)$$

And the internal pressure is defined as:

$$p_i = \frac{1}{2} \rho_u v_{ref}^2 \sum_{j=1}^{n} \frac{C_{p,j} A_j^2}{A_j^2}$$

Rewritten after (9.14b) in Andersen, et al. (2002).

Air change

The pressure differences from thermal buoyancy and wind pressure are combined for each room, whereas both the massbalances for wind and buoyancy are satisfied. This calculation is done in a modified calculation sheet, originally by Per Heiselberg (1999).

This sheet can be balanced to the two massbalances and hereby gives an output of the air flow rates per window. The authors have integrated a macro to integrate the balancing and creating an overview sheet.

It is displayed on the following pages how these calculations are done on the main room.

The other rooms are found on attached USB Pen Drive.

MAIN ROOM: JULY 24H MEAN AVERAGE

The main room is tested with and without skylights. This is done to create thermal BSim simulations of the room, which require an input for ventilation. This way it can be tested if the extra heat gain in a skylight can be countered with extra ventilation heat loss during summer with venting.

Cp values are 0.2 for facades facing the wind and -0.25 for others.

As seen in the example to the right, the wind does not add much to this scenario. It increases the airchange from 4.7/h with buoyancy to 5.4/h with buoyancy and wind. Even though the wind alone can deliver an airchange of 2.6/h.

The skylight boosts the airchange from 5/h without to 20/h with it.

Pressure Coefficient				**Building Height**	4			**Pwind**	0,1 pa		
Windward	0,2			**Windfactor**	0,49			**Pmin**	-0,1 pa		
Leeward	-0,25			**Vmeteo**	1 m/s			**Pmax**	0,0 pa		
roof	-0,38			**Vref**	0,49 m/s						
Location of neutral plan, H_o	1,4 m			**Wind direction**	SE			**Room vol.**	1400 m3		
T_o	16,1 C										
T_i	21,8 C										
C_d	0,7								pa	0,02	0,02
Air density	1,205 kg/m3										
	A m^2	**Eff. Area** m^2	**Height** m	**Thermal Buoyancy** pa	**$AFR_{thermal}$** m^3/s	**C_p**	**Wind pressure** pa	**AFR_{wind}** m^3/s	**Wind pressure** pa	**AFR_{total}** m^3/s	
				Massebalance	0,0000		Massebalance	-0,0001		0,0002	
E: Entrance door	5	3,5	1,3	0,01	**0,49**	0,2	0,01	**0,39**	0,01	**0,62**	
N: Niche high windows	2,6	1,8	2	-0,15	**-0,90**	-0,25	-0,06	**-0,57**	-0,06	**-1,07**	
W: Niche	2	1,4	2,5	-0,26	**-0,92**	-0,25	-0,06	**-0,44**	-0,06	**-1,02**	
S: Terrace doors	8	5,6	1,2	0,03	**1,34**	0,2	0,01	**0,62**	0,01	**1,47**	
					1,83 m3/s total			1,01 m3/s total		2,09 m3/s total	
					6582 m3/h total			3628 m3/h total		7533 m3/h total	
					4,7 /h			2,6 /h		5,4 /h	
					Buoyancy only -->			Wind only -->		Combined -->	

Illustration 230. Without skylights: Natural ventilation in the main room. Sheet based on Heiselberg (1999).

Location of neutral plan, H_o	2,6 m									
	A m^2	**Eff. Area** m^2	**Height** m	**Thermal Buoyancy** pa	**$AFR_{thermal}$** m^3/s	**C_p**	**Wind pressure** pa	**AFR_{wind}** m^3/s	**Wind pressure** pa	**AFR_{total}** m^3/s
				Massebalance	-0,0001		Massebalance	0,0001		-0,0002
E: Entrance door	5	3,5	1,3	0,30	**2,45**	0,2	0,04	**0,86**	0,05	**2,63**
N: Niche high windows	2,6	1,8	2	0,14	**0,86**	-0,25	-0,03	**-0,41**	-0,02	**0,79**
W: Niche	2	1,4	2,5	0,02	**0,26**	-0,25	-0,03	**-0,31**	-0,02	**-0,03**
S: Terrace doors	8	5,6	1,2	0,32	**4,07**	0,2	0,04	**1,37**	0,05	**4,35**
Sk: Skylight west	2,4	1,7	6	-0,78	**-1,91**	-0,25	-0,03	**-0,38**	-0,02	**-1,94**
Sk: Skylight north	4,8	3,4	6	-0,78	**-3,82**	-0,25	-0,03	**-0,75**	-0,02	**-3,87**
Sk: Skylight east	2,4	1,7	6	-0,78	**-1,91**	-0,25	-0,03	**-0,38**	-0,02	**-1,94**
Roof										
					7,65 m3/s total			2,23 m3/s total		7,77 m3/s total
					27523 m3/h total			8023 m3/h total		27990 m3/h total
					19,7 /h			5,7 /h		20,0 /h
					Buoyancy only -->			Wind only -->		Combined -->

Illustration 231. With skylights: Natural ventilation in the main room. Sheet based on Heiselberg (1999).

MAIN ROOM: JULY 24H MEAN MAX

The skylights boost the airchange from 4.8/h without to 15.7/h with it.

				Building Height	4						
Pressure Coefficient				**Windfactor**	0,49			**Pwind**	0,2 pa		
Windward	0,2			**Vmeteo**	1,3 m/s			**Pmin**	-0,1 pa		
Leeward	-0,25			**Vref**	0,64 m/s			**Pmax**	0,0 pa		
roof	-0,38			**Wind direction**	SE						
Location of neutral plan, H_o		1,4 m				**Room vol.**		1400 m3			
T_o		21,0 C									
T_i		24,0 C									
C_d		0,7							pa	0,04	0,04
Air density		1,205 kg/m3									

	A m^2	**Eff. Area** m^2	**Height** m	**Thermal Buoyancy** pa	**$AFR_{thermal}$** m^3/s	**C_p**	**Wind pressure** pa	**AFR_{Wind}** m^3/s	**Wind pressure** pa	**AFR_{total}** m^3/s
				Massebalance	0,0000		Massebalance	-0,0001		0,0008
E: Entrance door	5	3,5	1,3	0,01	**0,35**	0,2	0,01	**0,50**	0,01	**0,61**
N: Niche high windows	2,6	1,8	2	-0,08	**-0,65**	-0,25	-0,10	**-0,74**	-0,10	**-0,99**
W: Niche	2	1,4	2,5	-0,14	**-0,67**	-0,25	-0,10	**-0,57**	-0,10	**-0,88**
S: Terrace doors	8	5,6	1,2	0,02	**0,97**	0,2	0,01	**0,81**	0,01	**1,26**
					1,32 m3/s total			1,31 m3/s total		1,87 m3/s total
					4757 m3/h total			4717 m3/h total		6723 m3/h total
					3,4 /h			3,4 /h		4,8 /h
					Buoyancy only -->			Wind only -->		Combined -->

Illustration 232. Without skylights: Natural ventilation in the main room. Sheet based on Heiselberg (1999).

Location of neutral plan, H_o		2,6 m								
	A m^2	**Eff. Area** m^2	**Height** m	**Thermal Buoyancy** pa	**$AFR_{thermal}$** m^3/s	**C_p**	**Wind pressure** pa	**AFR_{Wind}** m^3/s	**Wind pressure** pa	**AFR_{total}** m^3/s
				Massebalance	-0,0001		Massebalance	0,0000		0,0000
E: Entrance door	5	3,5	1,3	0,15	**1,77**	0,2	0,06	**1,11**	0,07	**2,15**
N: Niche high windows	2,6	1,8	2	0,07	**0,62**	-0,25	-0,05	**-0,53**	-0,04	**0,41**
W: Niche	2	1,4	2,5	0,01	**0,19**	-0,25	-0,05	**-0,41**	-0,04	**-0,30**
S: Terrace doors	8	5,6	1,2	0,17	**2,94**	0,2	0,06	**1,78**	0,07	**3,53**
Sk: Skylight west	2,4	1,7	6	-0,41	**-1,38**	-0,25	-0,05	**-0,49**	-0,04	**-1,45**
Sk: Skylight north	4,8	3,4	6	-0,41	**-2,76**	-0,25	-0,05	**-0,98**	-0,04	**-2,89**
Sk: Skylight east	2,4	1,7	6	-0,41	**-1,38**	-0,25	-0,05	**-0,49**	-0,04	**-1,45**
Roof										
					5,53 m3/s total			2,90 m3/s total		6,09 m3/s total
					19893 m3/h total			10430 m3/h total		21930 m3/h total
					14,2 /h			7,5 /h		15,7 /h
					Buoyancy only -->			Wind only -->		Combined -->

Illustration 233. With skylights: Natural ventilation in the main room. Sheet based on Heiselberg (1999).

MAIN ROOM: JULY HOURLY MAX

In this scenario, the skylight boosts the airchange from 11.9/h without to 26.4/h with it.

Room: Main Room Setup: 3: July Hourly Max (Wind)

				Building Height	4						
Pressure Coefficient				**Windfactor**	0,49			**Pwind**	3,1	pa	
Windward	0,2			**Vmeteo**	4,6	m/s		**Pmin**	-1,2	pa	
Leeward	-0,25			**Vref**	2,28	m/s		**Pmax**	0,6	pa	
roof	-0,38			**Wind direction**	SE						
Location of neutral plan, H_o		1,4	m				**Room vol.**	1400	m3		
T_o		27,0	C								
T_i		27,0	C								
C_d		0,7						pa	0,47		0,47
Air density		1,205	kg/m3								

	A m^2	**Eff. Area** m^2	**Height** m	**Thermal Buoyancy** pa	**$AFR_{thermal}$** m^3/s	**C_p**	**Wind pressure** pa	**AFR_{Wind}** m^3/s	**Wind pressure** pa	**AFR_{total}** m^3/s
				Massebalance	0,0008		Massebalance	-0,0004		-0,0004
E: Entrance door	5	3,5	1,3	0,00	**0,00**	0,2	0,16	**1,78**	0,16	**1,78**
N: Niche high windows	2,6	1,8	2	0,00	**0,00**	-0,25	-1,25	**-2,62**	-1,25	**-2,62**
W: Niche	2	1,4	2,5	0,00	**0,00**	-0,25	-1,25	**-2,02**	-1,25	**-2,02**
S: Terrace doors	8	5,6	1,2	0,00	**0,01**	0,2	0,16	**2,85**	0,16	**2,85**
					0,01	m3/s total		4,64	m3/s total	4,64 m3/s total
					0	m3/h total		16690	m3/h total	16690 m3/h total
					0,0	/h		11,9	/h	11,9 /h
					Buoyancy only -->			Wind only -->		Combined -->

Illustration 234. Without skylights: Natural ventilation in the main room. Sheet based on Heiselberg (1999).

Location of neutral plan, H_o 2,6 m

	A m^2	**Eff. Area** m^2	**Height** m	**Thermal Buoyancy** pa	**$AFR_{thermal}$** m^3/s	**C_p**	**Wind pressure** pa	**AFR_{Wind}** m^3/s	**Wind pressure** pa	**AFR_{total}** m^3/s	**AFR One windo**
				Massebalance	0,0004		Massebalance	0,0000		0,0000	
E: Entrance door	5	3,5	1,3	0,00	**0,01**	0,2	0,76	**3,94**	0,76	**3,94**	
N: Niche high windows	2,6	1,8	2	0,00	**0,00**	-0,25	-0,64	**-1,88**	-0,64	**-1,88**	
W: Niche	2	1,4	2,5	0,00	**0,00**	-0,25	-0,64	**-1,44**	-0,64	**-1,44**	
S: Terrace doors	8	5,6	1,2	0,00	**0,02**	0,2	0,76	**6,31**	0,76	**6,31**	
Sk: Skylight west	2,4	1,7	6	0,00	**-0,01**	-0,25	-0,64	**-1,73**	-0,64	**-1,73**	
Sk: Skylight north	4,8	3,4	6	0,00	**-0,02**	-0,25	-0,64	**-3,47**	-0,64	**-3,47**	
Sk: Skylight east	2,4	1,7	6	0,00	**-0,01**	-0,25	-0,64	**-1,73**	-0,64	**-1,73**	
					0,03	m3/s total		10,25	m3/s total	10,25 m3/s total	
					0	m3/h total		36907	m3/h total	36907 m3/h total	
					0,0	/h		26,4	/h	26,4 /h	
					Buoyancy only -->			Wind only -->		Combined -->	

Illustration 235. With skylights: Natural ventilation in the main room. Sheet based on Heiselberg (1999).

Appendix 8: Thermal Comfort

INTRO

As buildings get more and more heat insulated, it is important to avoid the heat sources rather than spending a lot of energy on cooling. The new Herlev Cancer Counselling Centre is designed without active cooling systems. Over temperatures are avoided only with passive solutions through building geometry.

A draft calculation of these temperatures can be made with the following equation (Andersen et al., 2002 p. 49):

$$t_{i,m} = t_{u,m} + \frac{\Phi_{i,døgn} + \Phi_{sol,døgn}}{24\left(H_T + H_V\right)} \qquad (8.5)$$

$t_{i,m}$ = 24H average of the indoor air temperature, °C
$t_{u,m}$ = 24H average of outdoor temperature, °C
$\Phi_{i,døgn}$ = the heat load over 24 hours from internal sources, Wh/day
$\Phi_{sol,døgn}$ = the total solar gain over 24 hours, Wh/day
H_T = specific heat loss, W/°C
H_V = specific ventilation loss, W/°C

The bounds of the maximum and minimum indoor temperature is found using (Andersen et al., 2002 p. 50):

$$\Delta t_i = t_{i,\max} - t_{i,\min} = \frac{\Delta\Phi_k}{H_T + H_V + H_{akk}} = \frac{\Delta\Phi_{k,i+s} + \Delta\Phi_{k,tu}}{H_T + H_V + H_{akk}} \qquad (8.8)$$

$\Delta\Phi_k$ = difference between the highest and lowest convective heat load (per hour), W

$\Delta\Phi_{k,i+s}$ = difference between highest and lowest convective heat load from internal sources and solar gains (per hour), W.

$\Delta\Phi_{k,tu}$ = variation in the convective heat load from outdoor temperature variation (per hour), W.

H_{akk} = Heat capacity of the room, W/°C

Thermal comfort class II
According to DS/EN15251 (Danish Standard, 2007) , classes are defined in summer and winter. The authors have made a similair assumption for spring and fall with a clothing value of 0.7 clo, where as summer is 0.5 and winter is 1.0.

Opening all windows emphasise the domestic feeling and no windows should be locked. This improves perception of indoor climate (Danish Standard, 1993):

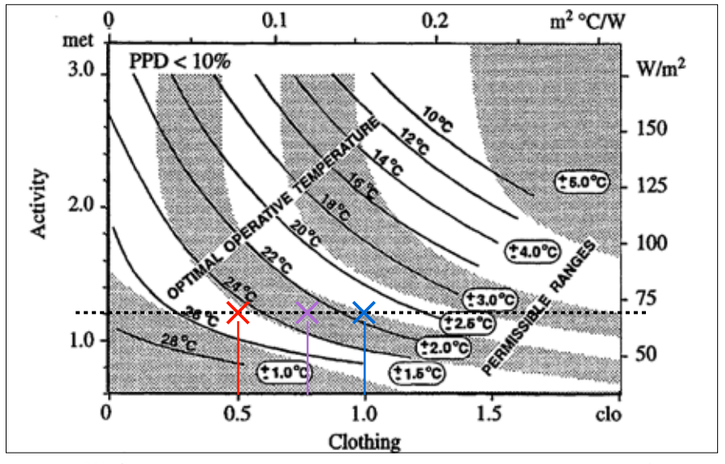


Illustration 236. Optimal operative temperature based on activity and clothing values. This is for a predicted percentage dissatisfied of less than 10%. This equals to comfort class II in DS/EN15251 (Dansk Standard, 2007). Red is a summer scenario, blue is a winter scenario and purple is spring/fall. Graph from DS474 (Danish Standard, 1993).

Wished temperatures:

Season:	Clo	Min temp	Max Temp
Summer	0.5	23.5	26.5
Spring	0.7	21.0	25.0
Winter	1.0	20.0	24.0

The thermal calculations are made in a spreadsheet seen to the right (Steen-Thøde, 2006).

WELLNESS ROOM:

Konstruktioner mod det fri

Nr	Flade	A m²	U W/m²K	Bu W/K	
1	Walls	35,20	0,08	2,82	
2	Roof	16,00	0,08	1,28	
3				0,00	
4				0,00	
5				0,00	
	Sum	51,20		4,10	= Bukon

Vinduer mod det fri

Nr	Flade	Antal stk	A m²	U W/m²K	Bu W/K	Orient grader	Hældning 90/45/0	g-værdi [-]	f(beta) [-]	f(afsk) [-]	f(skyg) [-]	f(glas) [-]	Fsol [-]
0	S wellness 2-ly	1	1,40	1,44	2,02	188	90	0,77	0,90	0,60	0,80	0,80	0,27
1	V wellness 2-ly	1	2,80	1,44	4,03	260	90	0,77	0,90	0,60	0,80	0,80	0,27
2					0,00								0,00
3					0,00								0,00
4					0,00								0,00
5					0,00								0,00
6					0,00								0,00
7					0,00								0,00
8					0,00								0,00
	Sum	2	4,20		6,05	= Buvin							
Samlet specifikt varmetab mod det fri Bt					**10,14**	**= Bt = Bukon+Buvin**							

Konstruktioner mod gulv samt omgivende rum

Nr	Flade	A m²	U W/m²K	Br W/K	tr °C	Br*tr W	
1	walls, 100mm letklinke	28,20	1,30	36,66	22,00	806,52	
2	glasswalls	0,00	3,00	0,00	22,00	0,00	
3				0,00	22,00	0,00	
4				0,00	22,00	0,00	
5	Floor	16,00	0,06	0,96	10,00	9,60	
	Sum	44,2		37,62		**816,12**	**=∑ Br*tr**
Samlet specifikt varmetab mod omgivende rum Br				**37,62**	**= Br**		

Ventilation

	Type	Luftskifte h⁻¹	Rum volum m³	Luftstrøm m³/s	Densitet kg/m³	Varmekap. J/kgK	BL W/K	
1	Ventilation	5,00	51,20	0,071	1,2	1006	85,85	
2	Infiltration	0,01	51,20	0,000	1,2	1006	0,17	
	Sum	5,01		0,071			86,02	
Samlet specifikt varmetab ved ventilation BL							**86,02**	**= BL**

Varmeakkumulering

	Vælg varmeakkumulering	Akk.evne W/K pr m²	Gulvareal m²	Ba W/K	**Beskrivelse af valgt rumopbygning**
1	Middel let	10	16,00	160,00	Rum med indvendige vægge af letbeton og kun uvæsentlige tunge konstruktionsdele
Samlet specifik varmeakkumulering Ba				**160,00**	**= Ba**

Time	Personbelast W	Belysning W	Andet W	Sum W	
1			0	0	
2			0	0	
3			0	0	
4			0	0	
5			0	0	
6			0	0	
7			0	0	
8			0	0	
9	133	128	0	261	
10			0	0	
11	66	128	0	194	
12			0	0	
13	66	128	0	194	
14			0	0	
15	133	128	0	261	
16			0	0	
17			0	0	
18			0	0	
19			0	0	
20			0	0	
21			0	0	
22			0	0	
23			0	0	
24			0	0	
Sum	398	512	0	910	
Middelværdi	17	21	0	**38**	**=Φi**
Max. timeværdi	133	128	0	**261**	**=Φimax**
Min. timeværdi	66	128	0	**0**	**=Φimin**

Pr. m² gulvareal	Personbelast W/m²	Belysning W/m²	Andet W/m²	Sum W/m²
Middelværdi	1,04	1,33	0,00	2,37
Max. timeværdi	8,31	8,00	0,00	16,31
Min. timeværdi	4,13	8,00	0,00	0,00

Vælg måned
Juli

Udetemperatur: døgnm	21	°C	= tu
variation	12	°C	= Δtu

Solindfald vinduer	Areal m³	Orientering grader	Hældning grader	Fsol [-]	Φs W	Φsmax W
0	1,40	188	90	0,27	75	255
1	2,80	260	90	0,27	165	624
2	0,00	0	0	0,00	0	0
3	0,00	0	0	0,00	0	0
4	0,00	0	0	0,00	0	0
5	0,00	0	0	0,00	0	0
6	0,00	0	0	0,00	0	0
7	0,00	0	0	0,00	0	0
8	0,00	0	0	0,00	0	0
Samlet solindfald i rum					**240**	**879**

For valgt måned:	**Juli**	tu =	**21**	°C

Hvis ventilationsluften har samme temperatur som udeluften

Døgnmiddeltemperatur	ti =	**23,3**	°C
Temperaturvariation	∆ti =	**6,3**	°C
Maksimaltemperatur	timax =	**26,4**	°C

Illustration 237. 24H average for the wellness room. Based on (Steen-Thøde, 2006)

Appendix 9: Hourly Building Analysis (BSim)

INTRO

The model is modelled and simulated in BSim (Danish Building Research Institute, 1998). It is used to retrieve information on CO_2 values and Operative Temperatures. The building is simulated for every hour over a design reference year (DRY, 2015) taking into considerations the solar gains, outdoor temperatures, wind, thermal mass and occupancy behavior.

Thermal Comfort

Following temperatures are wished to reach a maximum of 10% predicted percentage dissatisfied:

Season:	Clo	Min temp	Max Temp
Summer	0.5	23.5	26.5
Spring	0.7	21.0	25.0
Winter	1.0	20.0	24.0

Furhtermore it is advised in DS474 (Danish Standard, 1993) to agree with the clients on a certain amount of hours above 26°C and 27°C.

Atmospheric Comfort

The ventilation rates based on occupancy and climate data and possible ventilation rates are entered into the BSim model. Hereby, it is possible to measure the predicted CO_2 levels in the rooms. According to CR1752 (Comité Européen de Normalisation, 1998), CO_2 levels shall be less than 665ppm above outdoor concentration (which is simulated as 350ppm in this BSim model) in order to achieve class B.

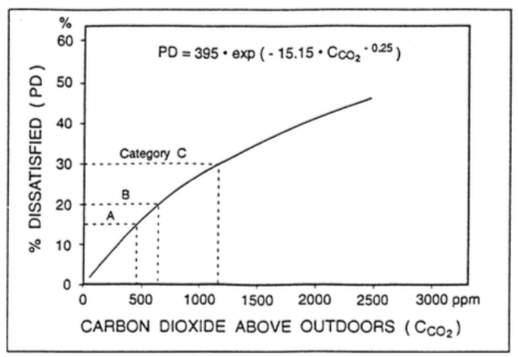


Illustration 238. Comfort classes A,B and C based on CO_2 concentrations in the air. (Comité Européen de Normalisation, 1998 p. 24)

MAIN ROOM

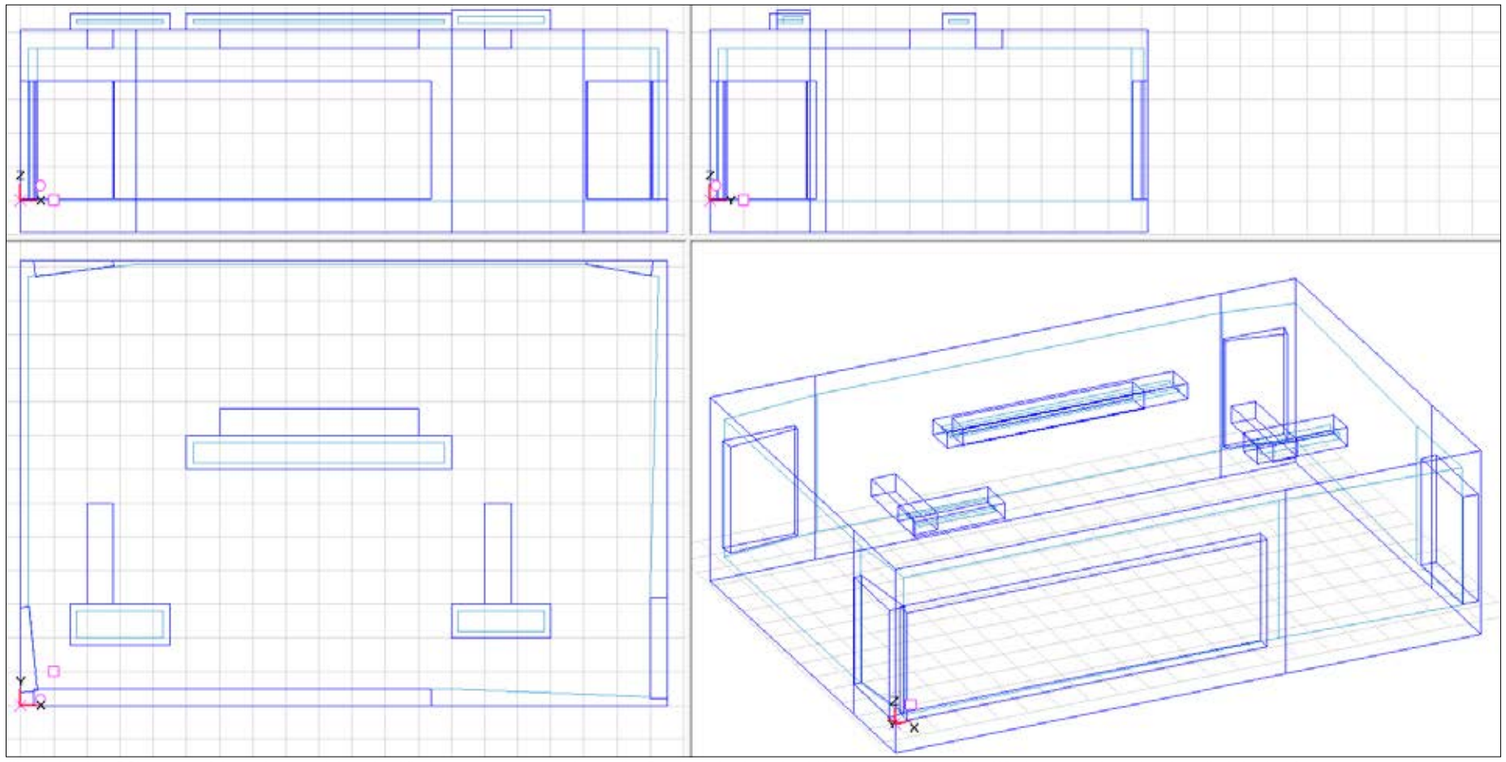


Illustration 239. BSim setup of the main room. It is a simplified geometry compared to reality. But the behaviour should look a lot like the reality. Windows are oriented and applied shadow factors to create fictive overhang and wall depths. Skylights do not have shadow factors, so here boxes are added on top to create shadow. All southern vertical windows are shaded by building geometry in summer season and all skylights are blinded with internal roller blinds and semi shaded by building geometry.

EXERCISE

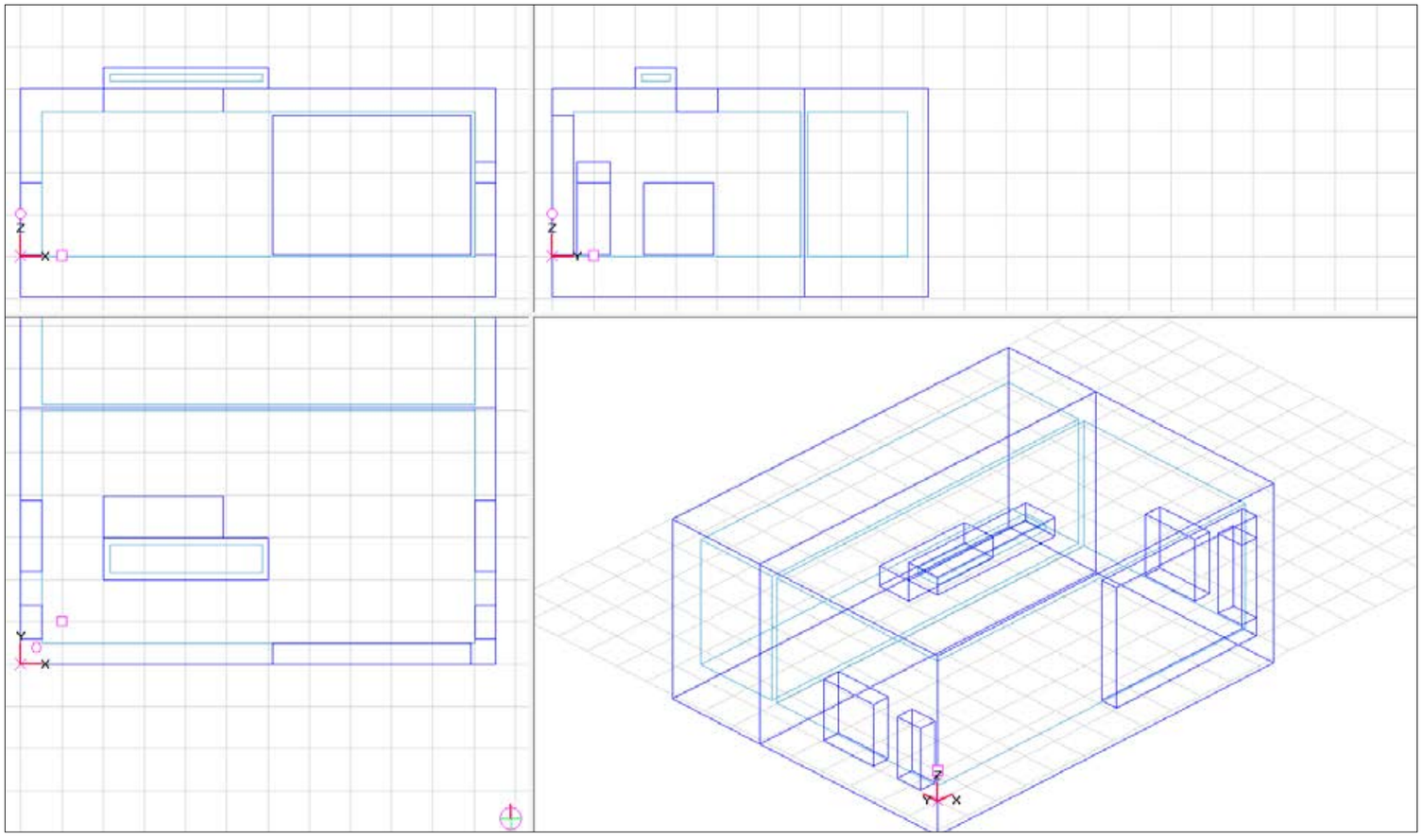


Illustration 240. BSim exercise setup. The room behind is modelled as always 21 degrees and shadow factors are added to all windows.

Illustration 241. showing where the two simulated rooms are placed.

RESULTS

Accumulated outputs can show amount of hours within comfort classes for CO_2 and temperature.

Thermal Comfort

The simulation results show that the Class II in thermal comfort is reached 97% of the time.

Class I is reached 87% and 82% of the time in Main Room and Exercise, respectively.

This means that these two simulated rooms comply with Thermal Comfort Class II, without any active cooling systems needed.

Atmospheric Comfort

Both rooms comply with Class A. This shows that the ventilation dimensioning made in “Appendix 4: Required Ventilation” on page 114 is sufficient.

According to DS/EN15251 Annex G.2, deviations of either 3 or 5% are accepted. (Danish Standard, 2007).

BSim simulations:

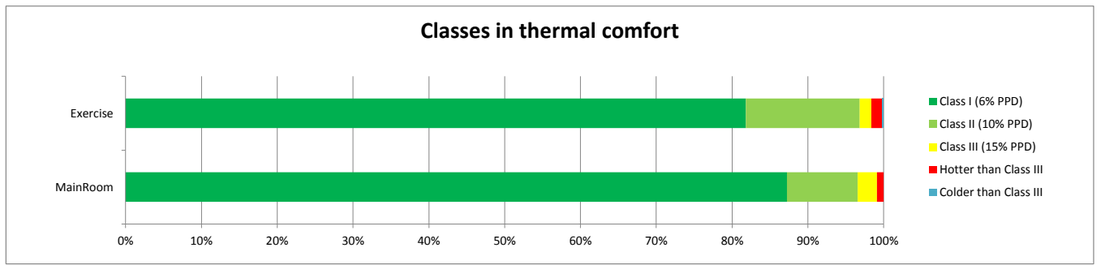
Working hours: 8 18

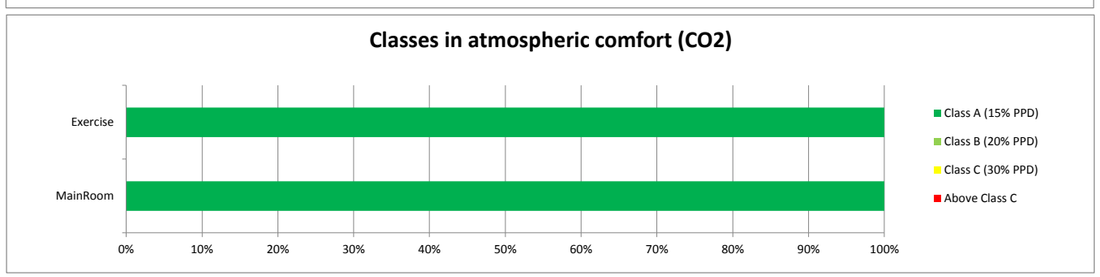
From DS474 on tables A1e

Thermal whole year:	Hours MainRoom	Hours Exercise	MainRoom	Exercise
Class I (6% PPD)	3184	2986	87%	82%
Class II (10% PPD)	**340**	**549**	**97%**	**97%**
Class III (15% PPD)	93	55	99%	98%

Annual hours above 26 and 27 degrees (in hours 8-18)	MainRoom	Exercise
>26	81	168
>27	30	74

CO2 Whole year:		
Class A (15% PPD)	3650	3650
Class B (20% PPD)	0	0
Class C (30% PPD)	0	0
Above Class C	0	0
	3650	**3650**





USING BSIM AS A DESIGN TOOL

Looking at the table to the right shows how statistics on the analysis results can help pinpoint where the actual over temperatures occur. In this case it is visible that the main room gains most of its over temperatures in the spring (Mar-Apr-May). Exercise is getting most over temperature hours in the summer time.

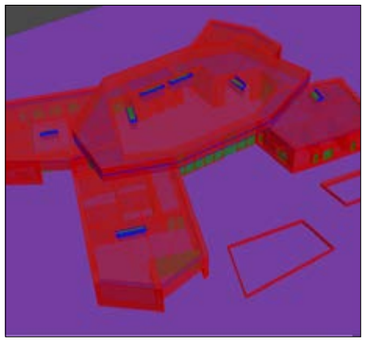
	Too hot for class I	Too cold for class I	Too hot for class I	Too cold for class I	Hours above 26 °C	Hours above 26 °C
Thermal: Jan+Feb	main	main	exer	exer	main>26	exer>26
Class I [21;23]	9	4	2	159	0	0
Class II [20;21[&]23;24]						
Class III [19;20[&]24;25]						
Above Class III [25+]						
Under Class III [19-]						
Thermal: Mar-Apr-May	main	main	exer	exer	main>26	exer>26
Class I [22;24]	235	0	34	141	2	1
Class II [21;22[&]24;25]						
Class III [20,5;21[&]25-25,5]						
Above Class III [25,5+]						
Under Class III [20,5-]						
Thermal: June-July-Aug	main	main	exer	exer	main>26	exer>26
Class I [24,5;25,5]	97	105	130	66	62	94
Class II [23,5;24,5[&]25,5;26,5]						
Class III [23;23,5[&]26,5-27]						
Above Class III [27+]						
Under Class III [23]						
Thermal: Sept-Oct-Nov	main	main	exer	exer	main>26	exer>26
Class I [22;24]	14	0	25	64	2	1
Class II [21;22[&]24;25]						
Class III [20,5;21[&]25-25,5]						
Above Class III [25,5+]						
Under Class III [20,5-]						
Thermal: December	main	main	exer	exer	main>26	exer>26
Class I [21;23]	2	0	4	39	0	0
Class II [20;21[&]23;24]						
Class III [19;20[&]24;25]						
Above Class III [27+]						
Under Class III [19-]						

Illustration 242. Debugging BSim to find when the over temperatures occur. The green circles show where the hours with over temperatures occur.

Appendix 10: Daylight Analysis

The building is analyzed for daylight factor in DIVA4Grasshopper. This gives a quick feedback when changing building geometry. And no file conversion is needed compared to other daylighting simulation options. The aim of the daylight strategy is to have at least DF2%in atleast 50% of the occupied area and to have at least DF2% in all working zones (office tables, gallery, kitchen and exercise).

Geometry



Materials:

#Floor and ground: 0.2
void plastic GenericFloor_20
0
0
5 0.2 0.2 0.2 0 0

#Walls and frames: 0.5
void plastic GenericInteriorWall_50
0
0
5 0.5 0.5 0.5 0 0

#Ceiling and skylights: 0.8
void plastic GenericCeiling_80
0
0
5 0.8 0.8 0.8 0 0

All Glass LT 82%
visual transmission: 82%
visual transmissivity: 89.33%
void glass Window_LT_82
0
0
3 0.8933 0.8933 0.8933

Radiance parameters:

For optimisation (3 bounces)

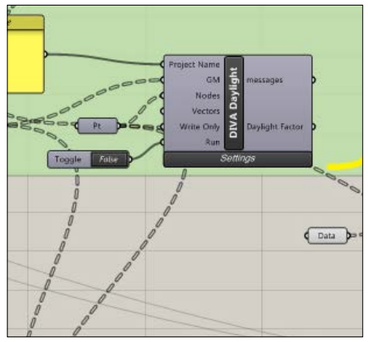
-ab 3 -ad 1000 -as 64 -ar 300 -aa 0.1

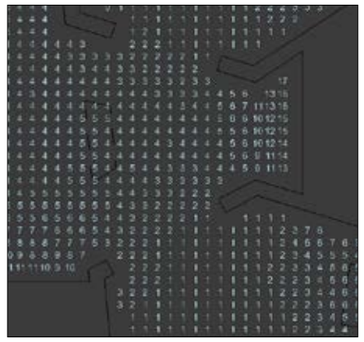
Simulated in a grid 600x600mm 750mm above floor.

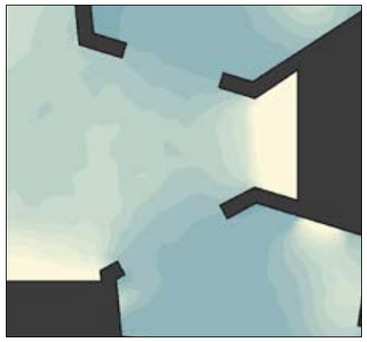
Final calculation (5 bounces)

-ab 5 -ad 1000 -as 64 -ar 300 -aa 0.1

Simulated in a grid 400x400mm 750mm above floor







3D Geometry

Built in Rhino3d with one layer in the windows.

Rhino3D

Materials + Simulation Parameters

Generic materials are chosen except for the glazing. Here a conversion is made from transmission to transmissivity in order to create a custom material. Formula found from

DIVA4Rhino (DIVA4Grasshopper)

Calculation

RADIANCE core integrated into grasshoper via DIVA4Grasshopper

Data treatment

Grasshopper3D

Visual Feedback

Rhino3D

Appendix 11: Fire Escape Routes

IN CASE OF EMERGENCY

As this is a concrete building, all interior seperation walls are REI-60 and all walls to cells are EI-30. The escape strategy allows a large area of rescue openings and emergency exits. As the wooden cladding on the walls may add extra fire, it is ensured that fire does not spread using cells and sections. Each volume is a section with automated doors that close upon fire. Due to the wooden materials and the many users, sprinklers are installed in all rooms.

Fire exits are minimum 1.3m wide and a distance is max 25 meters to the nearest fire exit. Some rooms with fewer users dont have two fire exits, but they do have several rescue openings of atleast Height x Width = 1500mm and with the smallest dimension of minimum 600mm. (Klima, Energi- og Bygningsministeriet, 2012)

R = Rescue opening

Illustration 243. Escape routes 1:200