THE PULSE

... A PLACE TO UNFOLD

PROJECT TITLE //

The Pulse - A Place To
Unfold

ABOUT //

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ANNEX //

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7

PAGES //

169

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“ *What is architecture if we cannot see it?* ”

ABSTRACT

This master's thesis presents an architectural design proposal that responds to the lack of a place for all aspects of the rehabilitation of the blind and visually impaired people in Denmark today. Designing for this specific user group yields an awareness and understanding of general concerns within the field of architecture and society as a whole. This calls for an approach based on reinforcing the importance of multisensory spaces to evoke the potential power of architecture. This thesis approaches sustainability, sensory architecture and tectonics through the perspective of a blind person, highlighting the potential of multisensory architecture.as a generator for the experienced quality of spaces.

The design proposal provides a variety of facilities to address the rehabilitation of the individual as a whole, with a special emphasis on physical activity. Since the benefits of physical activity are not limited to the target group, but are equally important and beneficial for everyone, the building will be an open and active part of the community, thereby supporting social sustainability. The perspective of sustainability is further investigated in relation to the environmental aspects, such as the use of our natural resources and the building's energy consumption.

The final proposal departs from the idea of a directing, single flow line that forms the main connection between all functions throughout the building. This supports legibility and wayfinding through the architecture itself, and guides the visitor through a series of different experiences based on the gestures of the space provided by materiality, acoustics, temperatures and light.

The pivot of the architecture is to inspire people to move and increase the heart rate and pulse, thereby supporting an ecology of movement and providing a place to unfold.

- CONTENT -

- CONTENT -

05 PRESENTATION
THE PULSE

06 PROCESS
DESIGN PROCESS

07 EPILOGUE
CONCLUSIONS AND REFLECTIONS

08 APPENDIX
DESIGN PROCESS MATERIAL

READER'S GUIDE

The following report is the documentation of the master's thesis *The Pulse - A Place to Unfold* created in the spring 2019 at Aalborg University. The representation of this project will throughout the following pages be divided into eight different chapters, documenting all phases of the design process. Firstly, the motivation for this thesis and an introduction to the theme of blindness acquaint the reader with the background knowledge of the theme and the state of the art within the field of blindness in Denmark. Subsequently, the thematic studies of sustainability, sensory architecture and tectonics are introduced with the methodology and strategy for approaching these themes. Afterwards, the final design proposal is presented followed by a supplementary design process. Finally, the epilogue concludes and reflects upon project and process, after which the appendix rounds off the report.

INTRODUCTION

This thesis will through the perspective of a blind or visually impaired put forward a design proposal that seeks to enlighten the potential of multi-sensory architecture as a part of sustainability. The correlation between these two subjects are explored through the implementation of tectonics as a method to enhance the gesture of a space, such as a multisensory detail, and the gesture of the overall place to the surrounding community, which endeavours to emphasize the social sustainability and support inclusion.

When designing within the field of blindness, it is crucial to consider the rehabilitation of the whole individual. Both functional, emotional and physical rehabilitation are pivotal for a succesful, independent life for the blind and visually impaired, however, a place that holds such rehabilitation forms under one roof does not exist in Denmark today.

Therefore, this master's thesis strives to design a place to unfold - a place, which allows for all rehabilitation forms to take place. In addition to this we endeavor to enlighten the importance of physical activity as a fundamental aspect for not only the health and welfare of the specific user group but for all individuals. Developing such building typology calls for investigating the benefits of physical activity and their potential as a main driving force for supporting social sustainability and a prosperous well-being.

Living a healthy and active life as a blind or visually impaired person can be particularly challenging as it requires the space to support multisensory legibility and wayfinding. Therefore, from an arcitectural point of view this will be a main focal point in the following project.

This new building typology seeks to accommodate both the visually impaired and their relatives for shorter stays. Courses and activities based on either a few hours, days or weeks will be offered, allowing for a range of possibilities and a variety of needs to be met. Additionally, the place will be open for other, external, user groups, as movement and sensory experiences are not exclusively beneficial for the blind and visually impaired, aiming to stimulate social sustainability in a larger perspective. The project site is situated in an attractive area of Hobro, where health and well-being characterise the neighbouring context. This allows for an interactive and inclusive relationship with the surrounding community and supports the idea of enhancing the importance of movement.

“ *Can designing for the blind enrich the experience and understanding of architecture and promote a multisensory approach in future projects?* ”

MOTIVATION

The built environment surrounds us and not only affects our physical world, but also our social and emotional world. Architecture has an immense power and influence, and holds the potential to enrich our lives and perspectives. Carefully designed spaces can disclose a narrative that deeply moves the perceiver, despite any sensory deficits. Even so, we all too often witness a neglectance of experienced quality in architecture, seemingly due to economic pressure, global trends and misplaced priorities. The potential of architecture is commonly repressed, and standardised utilitarian buildings have become the norm. This development needs to be challenged by reinforcing the importance of multisensory spaces and evoking the potential power of architecture.

With our educational background, we position ourselves on the threshold between architecture and engineering. The role of the architect is becoming increasingly ambiguous, calling for increased interdisciplinary knowledge. The building industry is dynamic and constantly challenged by both social, environmental and economic aspects. In the book Towards an Ecology of Tectonics, Anne Beim states that architects need to create the framework for architecture that supports societal prosperity without compromising the environment. Environmental and ecological approaches where the built environment is in harmony with the natural systems of our world are often neglected (Beim, 2014). We argue that existing regulations force the direction of the industry towards reducing operational energy consumption, rather than towards an approach where a prudent use of natural resources takes precedence.

The increasing complexity of our discipline should be celebrated through an integrated and interdisciplinary approach, with an emphasis on inclusive architecture that increases the quality of life for all, disabled or not. More specifically, this project focuses on the blind and visually impaired. According to rehabilitation leader at Dansk Blindesamfund Birgitte Lilletvedt, a loss of vision can be a traumatic experience and requires an extensive rehabilitation process. The rehabilitation should concern the individual as a whole (Lilletvedt, 2019), and aim to encourage and strengthen independence and nurture the indulgence of existence. The rehabilitation should have a special emphasis on mobility and physical activity, and the project aims to explore the ecology of movement. Pallasmaa states that it is within the power of architecture to "initiate, direct and organise behaviour and movement" (Pallasmaa, 2005, 63). This is a notion we seek to elaborate through the design.

Architecture that actively engages our senses and encourages movement is not only of importance to the blind and visually impaired, but, in our opinion, to all individuals. These aspects are explored with the blind as a target group, but the knowledge and principles are doubtlessly applicable and beneficial in a larger perspective. With this approach we seek to counteract the current development of the building industry and aspire to challenge the lack of experienced quality.

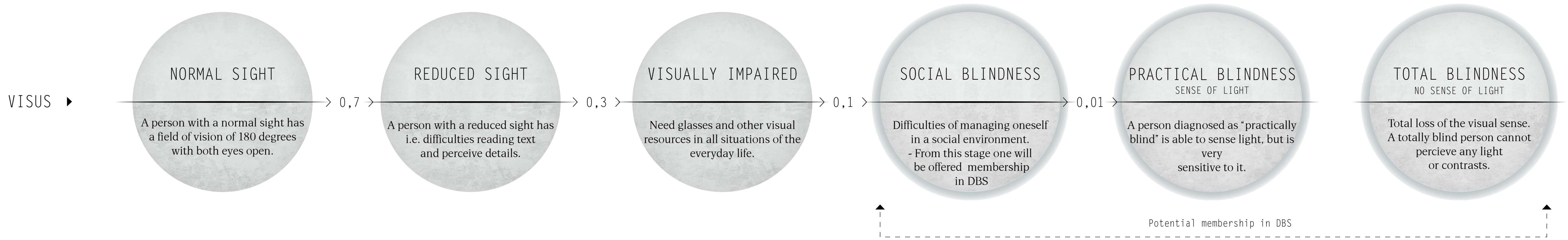
01

INTRODUCTION TO THE THEME

Ill. 1 - blindness theme

Ill. 2 - Categories of vision in relation to the level of visus

Ill. 3 - Blindness



BLIND AND VISUALLY IMPAIRED PEOPLE

/ BEING BLIND IN DENMARK TODAY

Today many people live with some form of disability that requires different resources to cope with various situations in their everyday life. Globally, it is estimated that approximately 1.3 billion people live with a visual impairment, and among these 36 million people are totally blind (Bourne et al., 2017). In a contemporary society, where the needs of disabled people are not always considered and integrated in the design of public spaces and buildings, challenges for visually impaired or blind people can be found regarding navigation and managing themselves.

Visus. The definition of a person, who has a certain degree of visual impairment or is defined as blind is based upon the visus of the best sighted eye. If a person has a visus of 0.1 and is watching something from a distance of 6 meters, this is equal to what a person with a normal vision could see from a distance of 60 meters. A visus of 0.7 and higher on the best sighted eye indicates normal vision, whereas a visus of 0.01 or less on the best sighted eye, and still with a sense of light, points to a person, who is practically blind. Only when a person cannot perceive or sense any light,, he or she is indicated as totally blind (Bek, Øgaard, Kjeldsen, 2018).

Blind and Visually Impaired People in Denmark. In Denmark people with a disability are not registered in a system, as handicapped people should be seen as individuals on an equal basis as non-disabled people, and not as a certain group of people with a handicap. As a result, the exact number of people who are blind or live with a visual impairment in Denmark cannot be stated. However, Dansk Blindesamfund (The Danish Society for the Blind also known as DBS) is an independent, private organization that has members from all over Denmark. The number of members in DBS contributes to an estimation of how many people, that are blind or visually impaired in Denmark, however, this number does not count in every person with a visual handicap as a membership is voluntary. Today DBS has approximately 8000 members, and it requires a visus of maximum 0.1 on the best eye to be qualified for a membership, which means that a person should be socially blind as a minimum. In case of a visus above 0.1 but with complications, such as a narrowed visual field, a membership can be established (Rydning and Jespersen, 2014).

On a national basis different rehabilitation options are available. In addition to Dansk Blindesamfund, there are municipality based Service Centres for People with Vision Loss, Instituttet for Blinde og Svagsynede and Synscenter Refsnæs. The work of the municipality based Service Centers is to diagnose the individual according to their level of visual handicap and allocate the appropriate government subsidy and resources necessary to facilitate their everyday life. Instituttet for Blinde og Svagsynede (IBOS) is a national competence- and rehabilitation center, focused on furthering the educational and occupational future for the individual (Rydning and Jespersen, 2014). Synscenter Refsnæs is a national center for blind and visually impaired children below the age of 18 that offers educational courses and schooling for the children and their parents (Synref.dk, 2019).

Dansk Blindesamfund. The work of Dansk Blindesamfund is focused on helping the blind and visually impaired in all aspects of their life. They help their members in gaining an education and finding a suitable job, and are working towards increasing independence, improving health related aspects and reducing loneliness. They offer rehabilitation, counseling, courses, network and support, and fight for better terms for the blind and visually impaired (Dansk Blindesamfund, n.d.). Dansk Blindesamfund is based in their own building called Fuglsangcentret in Fredericia. It was designed especially for them and opened in 1989, and is used as a hotel, course- and conference center. The building encompasses facilities such as hotel rooms, restaurant, meeting rooms, swimming pool, courtyards, social areas and offices for the staff (Dansk Blindesamfund, 2018). The center is open for everybody, but around 60% of the time it is used by blind and visually impaired people that participate in various courses offered by DBS (Lilletvedt, 2019).


always up to
60%
less

Ill. 4 - Photos from Fuglsangcenteret

Ill. 5 - Fuglsangcenteret in Fredericia

- Sunroom -

- Node -

- Corridor -

THE STATE OF THE ART IN DENMARK

/ FUGLSANGCENTRET IN FREDERICIA, DK

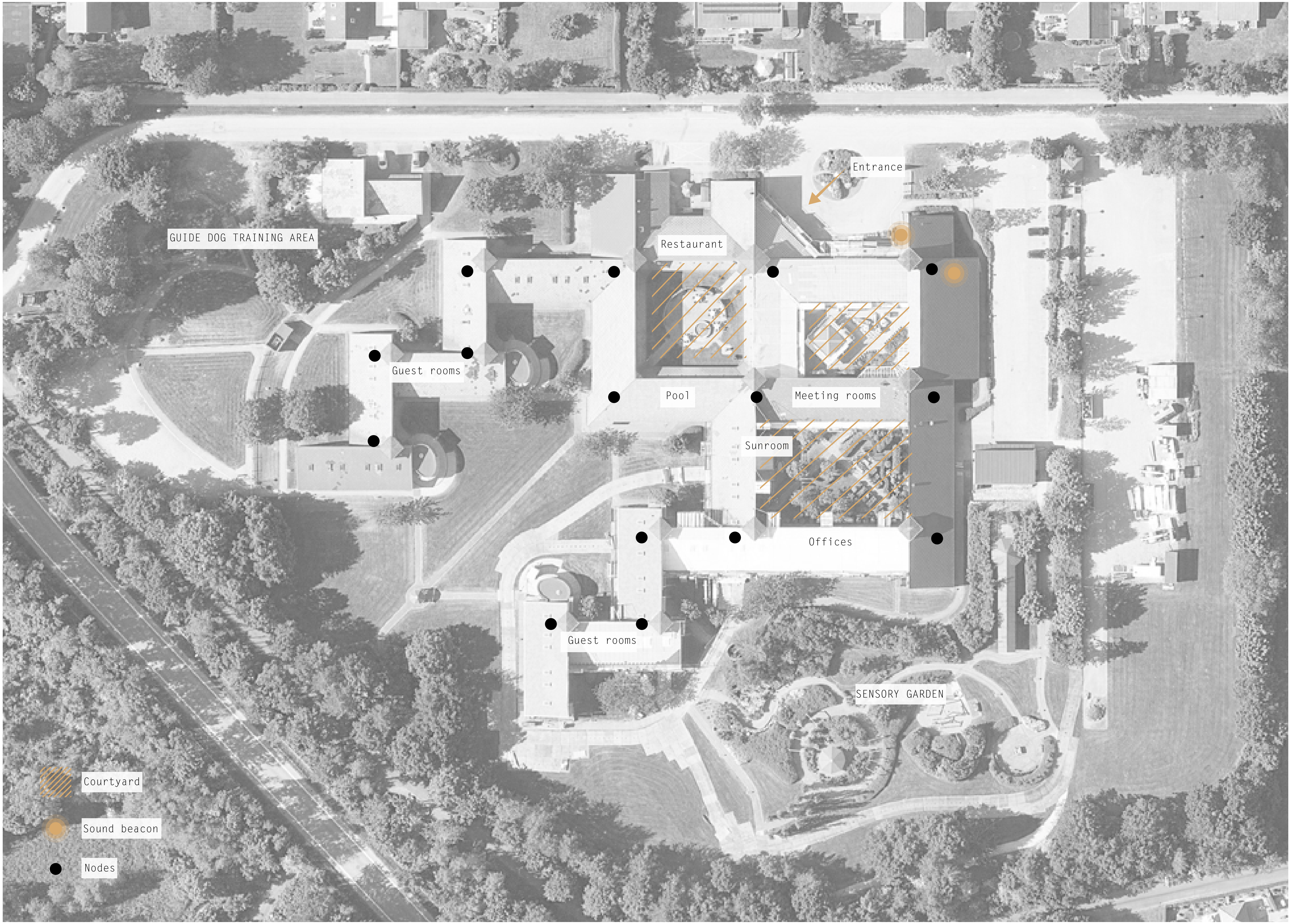
The building is designed to be accessible, both in terms of the building itself and the furnishings. Wide corridors with systematic bends constitute the flow of the building. At the "bends", or rather nodes, tall spaces with skylights emerge and create contrasting acoustic properties. Furthermore, two sound beacons, a water fountain and a birdcage, are placed along the corridors to provide the blind or visually impaired with information about their location within the building (Dansk Blindesamfund, 2018).

A study trip to Fuglsangcentret revealed the qualities of the design, or in some aspects, the lack thereof. The layout of the corridors with the clearly defined nodes seems easily legible at first, but the excessive amount of bends and the identicality of them becomes confusing. In each node two or three hallways converge, and in some, a door leading to the exterior spaces is added. When walking around in the center we were asked by a staff member if we were lost, which he revealed during our conversation was not unusual at all. The sound beacons are effective, but they are placed in the same part of the building, leaving the rest unattended and the many corridors difficult to distinguish from each other.

The floor in the hallways is decorated using two contrasting tiles with slightly different tactile qualities to indicate the nodes. The hallways are equipped with handrails that at first glance all seem identical, but after a closer look it is revealed that there is a slight difference between the handrails adjacent to the guestrooms and the rest of the center. This is practical, but the handrails are, in our opinion, not very well integrated.

The sensory garden was rather discouraging and did not provide noticeable stimulation, but the sunroom in one of the courtyards displayed distinctive sensory qualities. There was a clear contrast in temperature and materials compared to the vicinal hallway, producing another atmosphere clearly distinguishable from the rest of the building.

Fuglsangcentret provides accessibility and a space designated for the blind and visually impaired, but it severely lacks in legibility. The composition of the spaces cause confusion and the sensory experiences are limited. The center does not have adequate facilities for movement. Consequently, the rehabilitation offered by Dansk Blindesamfund at Fuglsangcentret does not encompass the individual as a whole. The physical rehabilitation is deficient and the target group is largely limited to motionless activities during their stay.


Entrance
GUIDE DOG TRAINING AREA
Restaurant
Guest rooms
Pool
Meeting rooms
Sunroom
Offices
Guest rooms
SENSORY GARDEN
Courtyard
Sound beacon
Nodes

Ill. 6 - The visual field illustrated with different visual diseases

VISUAL FIELD
/ DISEASES CAUSING A VISUAL IMPAIRMENT

The visual field refers to the area in which objects can be seen by the eye. A normal binocular visual field spans almost 200 degrees horizontally and almost 130 degrees vertically (Carroll and Johnson, 2013). A person with vision loss either experiences a blurred or a reduced visual field, usually caused by various diseases, but occasionally also injuries. The most common conditions and causes are further explained below and conceptually illustrated.

Cataract. When the lens of the eye becomes opaque it causes a blurred or cloudy vision also known as cataract. This is most commonly associated with aging, but can also be a birth defect (Vision Loss Resources, 2018). This condition is experienced in various degrees, clarified by the system of visus, ranging from reduced sight to total blindness.

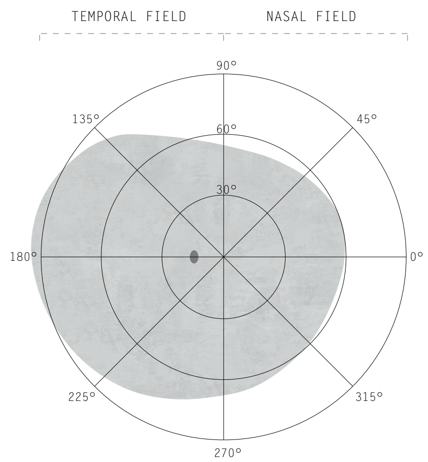
Macular degeneration. Macular degeneration, or age-related macular degeneration, is the leading cause of visual impairment for people above the age of 55. This disease is portrayed as a blurred or dark area in the center of the visual field, while the peripheral vision can remain intact (Vision Loss Resources, 2018).

Scotoma. Scotoma is the term for a blind spot in an otherwise normal visual field. This can be caused by several diseases, including glaucoma and retinitis pigmentosa, and can have any size, shape and position in the visual field (Carroll and Johnson, 2013).

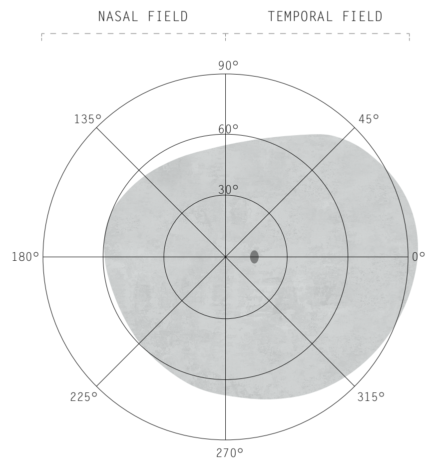
Hermianopsia. Hemianopsia is the loss of vision on one side of the visual field, usually delimited by the vertical midline. Stroke, brain tumor, infection or surgery complications are common causes, but the condition can also be congenital (Vision Loss Resources, 2018).

When designing a place for the blind and visually impaired, it is essential to understand what it actually means to have a vision loss and how it is portrayed. The majority of the target group are not blind, but rather visually impaired. The substantial variety of visual defects means an extensive range of individual situations that are crucial to recognise when creating the physical framework for the rehabilitation process. The place needs to accommodate all types of visual impairment and provide sensory experiences for all.

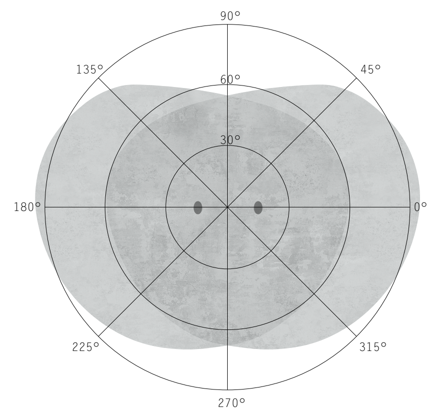
VISUAL FIELD



Normal visual field of left eye



Normal visual field of right eye



Normal binocular visual field

VISUAL FIELD WITH DIFFERENT DISEASES

Normal visual field

Cataract

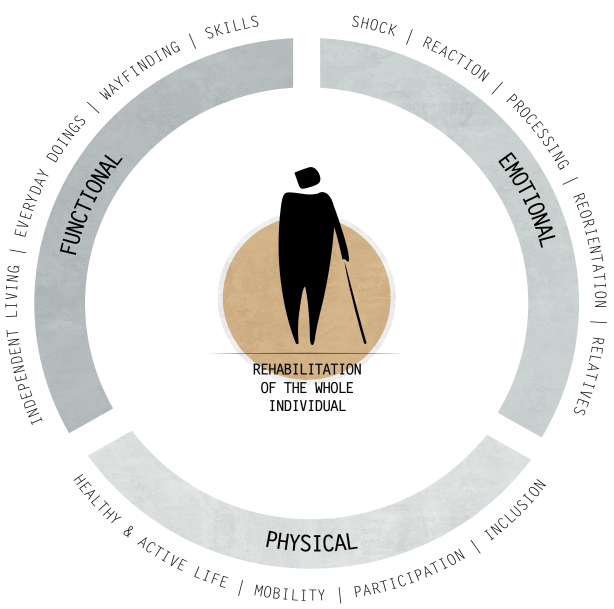
Light sense

Macular degeneration

Scotoma

Hemianopsia

Ill. 7 - Rehabilitation of the whole individual
Ill. 8 - Functional Rehabilitation
Ill. 9 - Emotional Rehabilitation



REHABILITATION OF BLIND AND VISUALLY IMPAIRED
/ EMOTIONAL, FUNCTIONAL AND PHYSICAL

Losing the sight can be a traumatic experience and adjusting to a life with limited or no vision is a challenge. According to rehabilitation leader at Dansk Blindesamfund Birgitte Lilletvedt, rehabilitation of a blind or visually impaired person has to consider the individual as a whole, including the emotional, functional and physical aspects of their life (Lilletvedt, 2019).

Emotional Rehabilitation. A person that suddenly, or rapidly, loses the sight usually experiences a crisis, or more specifically a traumatic crisis, defined as a situation where a person feels a threat towards their physical existence, social identity, safety and/or fundamental living conditions (Rørth, 2015). A traumatic crisis can be divided into four different phases that are experienced throughout the emotional rehabilitation process. These phases; shock, reaction, processing and reorientation, varies according to the individual, and the length, content and extensiveness of them are dependent on the person and their emotional responses to their condition (Haarh, 2013). There is a stigma associated with being blind or visually impaired, resulting in a widespread isolation and loneliness among the affected. Gathering and encountering other people in a similar situation is very beneficial when processing the loss, as well as learning coping strategies for life without vision (Lilletvedt, 2019).

Functional Rehabilitation. The functional rehabilitation is focused on managing and overcoming the obstacles related to everyday life. After a loss of sight, learning to orient yourself and getting from one location to the next is crucial. This encompasses using the mobility cane, and learning to recognize the tactile sensation of different materials and obstructions, along with possibly getting a guide dog and adapting to a new way of utilizing GPS devices. Communication devices with voice or tactile control are helpful, as they enable a more independent approach in everyday life situations, both within the home and in unfamiliar locations. Within the home, other tasks such as cooking or cleaning require a different manner of working that has to be mastered through time (Lilletvedt, 2019).

Physical Rehabilitation. Adapting to life without vision also requires physical rehabilitation. Loss of vision affects the balance negatively, which in turn affects the mobility and independence. A significant amount of blind or visually impaired people become overweight, as they lack the courage and body awareness imperative to being physically active (Lilletvedt, 2019). Overweight and immobility have both physical and emotional consequences, suggesting that physical rehabilitation is vital for the blind and visually impaired. Physical activity should be focused on gaining confidence to overcome obstacles and limitations, allowing for freedom of movement and increased independence.

Rehabilitation of the blind and visually impaired is a process that requires a lot of new skills, but also new perspectives. Rehabilitation is achieved through both experiences and learning. As an example, learning to read and write, and experiencing a zip-line or a musical performance can be equally contributing to the rehabilitation process. Learning and gaining experiences do not exclude each other, on the contrary, a combination of them is highly preferable (Lilletvedt, 2019).

FUNCTIONAL REHABILITATION

Wayfinding

Orientation | Navigation
Use of mobility cane
GPS devices | Guide dogs

Communication

Voice controlled devices
Braille writing system
Tactile Communication

Everyday tasks

Cleaning | Cooking

EMOTIONAL REHABILITATION
/ Phases of a traumatic crisis

Shock

Depressive despair | Desperate anger
Indifference | Sorrow

Reaction

Blaming someone or something
Anosognosia | Repression
Why me?

Processing

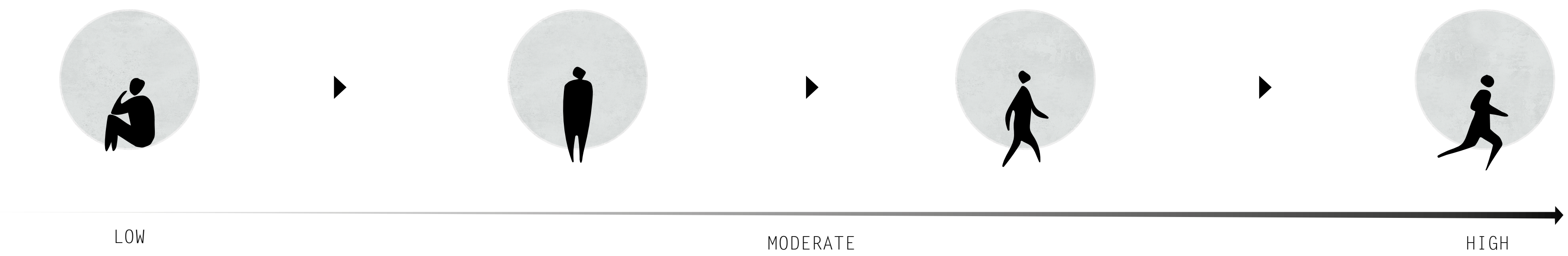
Acceptance

Reorientation

Active use of assistive devices
Discovering opportunities
Willing to learn | Motivated

Ill. 10 - Physical rehabilitation

Ill. 11 - Materiality inviting for physical activity



PHYSICAL ACTIVITY

/ WHY IS PHYSICAL ACTIVITY SO IMPORTANT?

Physical activity encompasses every kind of movement where the energy consumption increases. It is recommended to be physically active for a minimum of 30 minutes every day, with a moderate or high intensity (Aagaard, 2014). A moderate intensity is defined as an activity that raises your pulse, but you are still able to hold a conversation without difficulties. High intensity is defined by a higher pulse, and difficulties holding a conversation (Christiansen, 2017).

Physical activity is much more than just staying healthy and fit. The benefits of being active covers both physical and mental aspects and leaves a highly valuable imprint on the individual. By being active, the acquirement of a range of diseases and the development of many lifestyle diseases can be prevented (Aagaard, 2014). Physical activity can also play another major role regarding the development of motor skills and the maintenance of the functional capacity. Furthermore, it can entail and encourage social gatherings which in itself is life-affirming and enriching, and moreover generate positivity and provide surplus energy. Any kind of activity where the body is in movement can contribute to mental health, greater well-being and greater quality of life (Christiansen, 2017). These aforementioned aspects are clearly not limited to the blind and visually impaired, but are equally important and beneficial for everyone.

The Disability and Health Journal presents a study that investigates the perceived barriers that prevent the blind and visually impaired from being physically active. The results are based on answers from 160 blind or visually impaired people, forming 8 general categories (see graph in appendix p. 157). The results show that the category called environmental factors had the greatest impact. This category includes the physical accessibility to exercise facilities, lack of adapted exercise equipment and lack of a place to exercise with individuals with similar disabilities. Psychological aspects, such as lack of motivation, self-consciousness and lack of enjoyment, were the second most frequent answer among the participants. Knowledge, or the lack thereof, covers activities, skills and equipment. Health related factors are comprised of poor health and discouragement. Social influence encompasses aspects such as lack of family support and people's misconception about their physical condition or abilities. Personal matters are not specific for the target group, but includes lack of time and cost of participating in activities. The category called visual impairment concerns unexpected obstacles, a hesitation to move faster and fear of getting lost. The smallest perceived barrier was safety, which includes fear of accidents or injuries (Lee et al., 2014).

The study provides an insight into the reason why many blind and visually impaired people refrain from physical activity, but the accuracy of the results can be questioned. The answers are grouped into general categories, but many of the answers could easily be placed under two or more categories. This makes the final result partly inaccurate as it is partly based on the personal judgement of the researchers. However, the answers provided by the blind or visually impaired can be used to guide the design process.

The answers presented by the study contributes to our motivation for this project, further arguing for the need for a place that encompasses adequate facilities for the rehabilitation of the individual as a whole, with a special emphasis on physical rehabilitation. Physical rehabilitation is a deficient dimension in the opportunities available in Denmark today for the blind and visually impaired. This is a notion we find important to change, aiming to create a building that not only benefits the blind, but breaks down barriers and becomes a part of the community as well. Movement and physical activities of all pulse intensities will set the frame for an active stay where a variety of both indoor and outdoor activities are offered.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02

METHOD AND THEMATIC ANALYSIS

Ill. 12 - sensory experiences

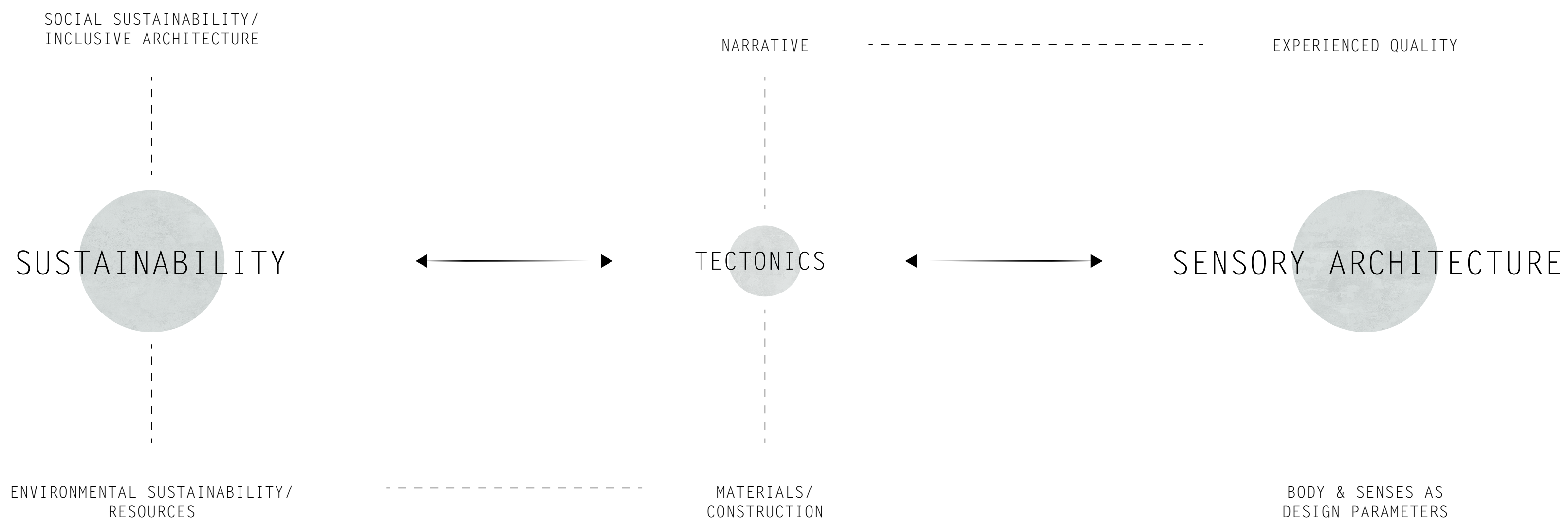
SUSTAINABLE AND SENSORY ARCHITECTURE

/ METHODOLOHY

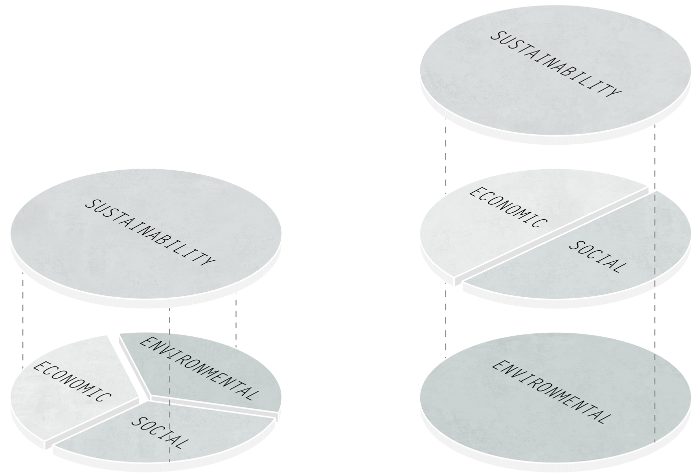
Our position on the threshold between architecture and engineering obliges us to consider the integration of interdisciplinary processes and approaches in order to strive towards a holistic design. The ambitions of our project, the site, the target group and the current development of the building industry comprise an intricate composition of subjects that need to come together and become parts of an architectural project understood as a whole.

Sustainability is inevitably linked to architecture and the building industry. Social sustainability, approached through an investigation of accessibility and legibility, is expressed in our project as inclusive architecture. Inclusion of all people in society, despite disabilities, provides increased possibilities of participation and contribution, thereby supporting growth in the community. Environmental sustainability is an undeniable element of not only the project, but the future of our planet. We accuse the building industry of neglecting holistic environmental and ecological approaches, especially concerning the use of natural resources. Mindful use of building materials is not only an environmentally sustainable approach, but crucial to the creation of a space in synergy with its construction. Tectonic theory provides an approach that can challenge our accusation of contemporary architecture as lacking in experienced quality. It holds the power to reveal the full potential of a space, and can provide the foundation for creating a narrative of the built environment based on a sensory experience. Using the body and senses as design parameters can incite an intimate interaction with our surroundings, imparting an extended perception of space and contributing to an exploration of the potential power of architecture.

In our project tectonics is seen as a link between sustainability and sensory architecture; an approach used to connect these key aspects in order to attempt to achieve a holistic design. In light of the importance of and correlation between sustainability, tectonics and sensory architecture within our project, we introduce a combination of methods to guide the design. We employ ongoing Life Cycle Assessment and energy consumption calculations to strive towards an environmentally friendly design. Moreover, DGNB will serve as an inspirational design tool towards a sustainable final proposal. Along with principles of inclusive architecture, the certification system will also provide guidance in the attempt to achieve an accessible, inclusive design. We combine these methods within an integrated design process, allowing the methods to be directing from the very beginning of the project.



▲ *Ill. 13 - Exploring tectonics as a method to merge sustainability and sensory architecture*



Equality between the three pillars of sustainability

Environmental as fundamental for all other parts of sustainability

SUSTAINABILITY

/ HOW DO WE GRASP THIS THEME?

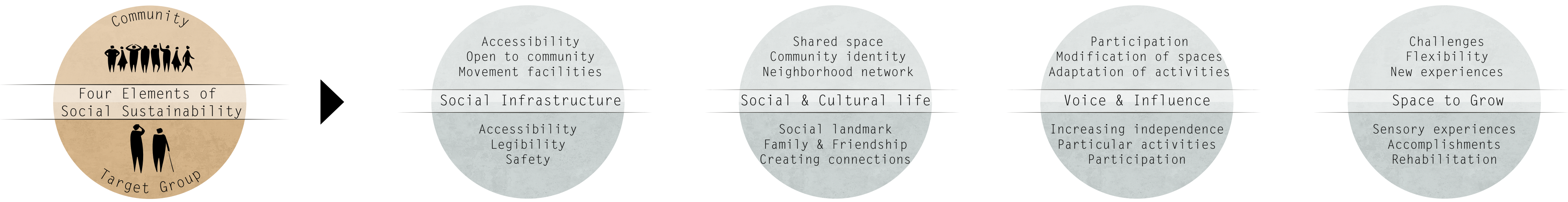
Architecture is under constant development, adapting to cultural, political, technical and environmental changes. In today's society there is an increasing focus on sustainability, which is inevitably conjoined with architecture and the building industry. Sustainable development is commonly referred to as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs." (Brundtland, 1987, p. 16). The term sustainability can be further elaborated through the three pillars of sustainability, where environmental, social and economic sustainability are to be considered concurrently (Sassi, 2006). In our thesis, it is imperative to emphasise the social sustainability through an inclusive architecture, acknowledging the social vulnerability of the target group. Furthermore, the environmental aspect is an inescapable constituent of not only the project, but the future of our planet, and this project aims to take a small, modest, step in the right direction.

The three pillars of sustainability are commonly considered as equally important (Sassi, 2006), but we argue that they should, in fact, not be considered equally important. A habitable environment is the foundation that social and economic sustainability are built upon. Without a habitable environment, the other two would become irrelevant. The consequences of our general environmental neglect are becoming more and more evident, with menacingly severe repercussions awaiting in the future if we do not succeed in counteracting the current development.

The extent of the effort put into these counteractions can also be discussed. Achieving a significant change requires us, generally referring to the population in developed countries, to consider the environmental consequences of our way of life. Our current luxury living standards and consumption rates do not match the regeneration of natural resources. We wish to achieve and design for environmental sustainability, without compromising or redefining our idea of quality of life.
Social sustainability merges issues such as equity and health, with the notions of happiness, wellbeing and quality of life. Social sustainability is traditionally regarded on a community or society scale, and the parameters are considered in a large perspective. Amenities and social infrastructure, social and cultural life, voice and influence, and space to grow are four elements that are vital when building new, successful communities (Woodcraft, Hackett and Caistor-Arendar, 2011). We have translated and adapted these four elements as to function as goals and guidelines in this thesis as shown in the illustration. The building will become an active part of an existing community, and it is important to consider the potential enrichments our project can bring to the area, as well as the influence of the community on the design of the building. We see a potential in designing an inclusive architecture, that forms the basis for the application of the four elements in our project. Contributing to social inclusion and equity through the architecture will support the participation from a wider user group, and give rise to an intensification in growth.
In this project, the deficiencies in the available rehabilitation of the target group places great importance on physical activity. The effects of physical activity on us and our surroundings, and our opportunity within this

◂ Ill. 14 - The three pillars of sustainability

▸ Ill. 15 - The four elements of social sustainability



project to construct surroundings that shape the possibilities and limitations of physical activity, provide us with the concept of an ecology of movement. We argue that movement is a cornerstone within the theme of sustainability, as both the physical and mental health benefits have great implications for both social and economic sustainability.

We argue that environmental sustainability exceeds social and economic sustainability in importance in a long term perspective, but the value of social sustainability in an everyday life perspective is not to be depreciated. Architecture holds the power to shape social behaviours and change the narrative of people's everyday lives. A building can be exceptionally environmentally sustainable, but if nobody wants to use it, it becomes worthless and a waste of resources. This substantiates their dependency on each other within the field of architecture and the necessity of regarding them simultaneously.

As mentioned earlier, this project aims to provide a small contribution towards environmental sustainability. Issues such as global warming, scarcity of resources, deforestation, soil degradation, waste management, extinction of flora and fauna and overpopulation, render the situation endlessly complex (Sassi, 2006). Our project can not possibly attempt to provide answers to the many problems associated with environmental sustainability, and even though our contribution seems insignificant and isolated, it can perhaps inspire or add to the increasing focus on the subject and thereby promote a positive development.

This thesis will focus on encouraging a prudent use of natural resources by considering consumption, waste and reuse. This includes using tools such as the certification system DGNB and conducting material investigations using life cycle assessment (LCA), as well as calculating the operational energy consumption.

INCLUSIVE ARCHITECTURE
/ DESIGNING FOR THE BLIND

The implementation of inclusive architecture as an approach towards accessible, inclusive design calls for innovative thinking in an interdisciplinary field, and does not describe a process of compliance, but a continuous process of improvement. Professor Edward Steinfeld of the University of Buffalo states that inclusive architecture is "a process that enables and empowers a diverse population by improving human performance, health and wellness, and social participation" (Trommald, 2013). Increasing health contributes to a prevention of disabilities, enhances social participation and can from a sustainability perspective be seen as a key factor to support both economic and social sustainability. Even though cultural, economical and social situations vary a lot within different countries, common trends in inclusive architecture have emerged (Trommald, 2013). These trends are presented in the text that follows.

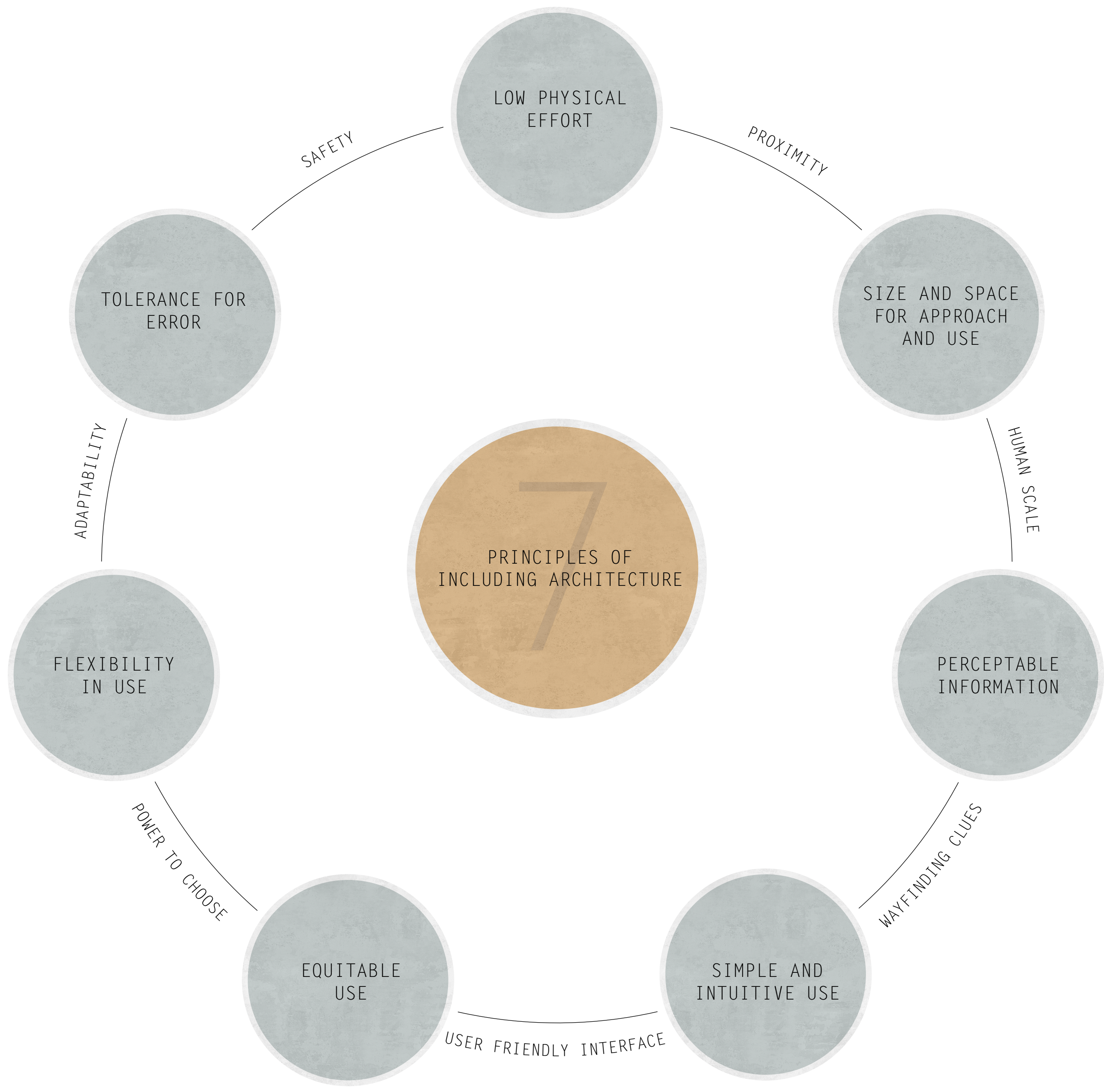
From Regulation to Innovation. Firstly, going from regulation to innovation defines how architects and designers have always, and still are, conforming to legislations, rules and standardizations, which is important in a national and international plan-developing perspective. However, focusing exclusively on these standards may result in solutions based on the minimum qualities given through minimum solutions (Trommald, 2013). Thus, innovation and the act of rethinking designs of environments and buildings to reach an architectural quality beyond legislations and rules is an increasing focus.

From Accessibility to Inclusion. Beforehand, the focus towards accessibility took a starting point in the physical elements and implementations in building environments, such as ramps and lifts for people in wheelchairs as well as tactile guidance paths for the people with a visual impairment. However, the trend of going from accessibility to inclusion brings a more holistic perspective on the social inclusion of the disabled people (Trommald, 2013). Thus, the total service or activity becomes universal, letting the disabled people experience on an equal basis as everyone else.

From Barriers to Sustainability. Accessibility is sometimes regarded as a part of the design that entails economical and social implications where initiatives for a minority in the community can be an expensive cost (Trommald, 2013). However, in the design towards a sustainable society, it should be possible for all individuals to participate and contribute, calling for the initiatives to be integrated early in the design process instead of becoming costly add-ons.

Equality and Social Inclusion. Designing for everyone should accommodate the needs of different users resulting in social inclusion and involvement. It should facilitate all users' autonomy, independence and spontaneity, and provide options and possibilities rather than limitations (Trommald, 2013). The neglect of certain user groups, such as visually impaired and blind people, can cause them to feel loneliness and exclusion. However, an architectural design that enhances the diversity of use, creating opportunities and flexibility will contribute to a sense of purpose, involvement and social participation for the individual. These possibilities, provided by an inclusive architecture, afford all users equal standing, enhancing all people as individuals and not as certain groups divided by their status, such as physically or mentally disabled people. Thus, it contributes to the sense of equality among individuals.

In our project, we will consider the seven principles of inclusive architecture as guidelines directing us towards achieving a final design that approaches the aforementioned trends.



▲ *Ill. 16 - The seven principles of including architecture*

Ill. 17 - Certification systems and their primary values
Ill. 18 - Chosen parameters to act as guidelines

DESIGNING TOWARDS SUSTAINABILITY

/ SUSTAINABILITY CERTIFICATION SYSTEMS

The prevalence of certified buildings derives from the increasing awareness and interest in the urgency for a more sustainable building- and construction industry (Dk-gbc.dk, 2019b). Certification or rating systems are technical instruments helping to assess and clarify what impact buildings and construction projects have on society, economics and the environment (Bernadi, et. al., 2017).

With a wide range of certification or rating systems worldwide the four leading systems are the Building Research Establishment Environmental Assessment Method (BREEAM) from the UK, the Haute Qualité Environnementale (HQE) from France, the Leadership in Energy and Environmental Design (LEED) from the U.S. and the Deutsche Gesellschaft für Nachhaltiges Bauen (DGNB) from Germany.

The aims of these four systems are in general similar yet their focuses and way of rating differs based on the different contexts they operate within. BREEAM has existed since 1990 and is the oldest of these four mentioned systems. BREEAM evaluates sustainable values on the basis of ten categories; energy, health and wellbeing, innovation, land use, materials, management, pollution, transport, waste and water (BREEAM, 2019). LEED´s rating system is similar but consist of nine categories (New.usgbc.org, 2019). HQE rates based on three overall topics which are energy efficiency, respect for the environment and health, and comfort for the occupiers (Behqe.com, 2019). Finally, DGNB evaluates on environmental, economic, social, technical, process and site qualities. DGNB applies a holistic approach to sustainability (Dk-gbc.dk, 2019c), rather than a narrower approach focused mainly on environmental sustainability as seen in the other three systems. Due to this notion, DGNB has been further developed and adjusted to danish standards and regulations and is now commonly used in Denmark.

Today, DGNB-certified building- and construction projects appear throughout the country, despite the voluntary basis. In this project DGNB is used as a guideline and inspiration at an early stage and during the design process, allowing the final result to approach a sustainable performance. DGNB is a positive constituent of the development of the building industry, but the system has its flaws. A part of the system is based on subjective observations, and the ratings therefore become dependent on personal opinions. This means that the rating of the subjective qualities can fluctuate and the final result can differ depending on the people responsible. Furthermore, DGNB has defined a maximum amount of points to be attained in each category, and thereby also a maximum level of sustainability. This is where we ask ourselves, who is to determine the limits of sustainability? The certification honours provided by DGNB set the framework for different levels of sustainability, but how can we determine when a building is sustainable enough and deserves to be rewarded the highest certification honour? Despite these questions, DGNB is an important step in the right direction, and contributes to the furthering of a holistic sustainable approach in building projects.

We, as soon to be recent architecture/engineering graduates, have the opportunity to influence the architectural offices and promote the voluntary use of the DGNB certification system. Using the integrated design process and thus integrating sustainable aspects at an early stage produces projects where sustainability is a high priority. In the years to come, this influence ought to drive the building industry towards a greater sustainable approach.

SELECTED DGNB GUIDELINES FOR THE DESIGN PROCESS

PROCESS

PRO1.2 Integrated design
PRO1.3 Design concept (complexity)

ENVIRONMENTAL

ENV1.1 Life cycle impact assessment
ENV1.2 Local environmental impact
ENV2.1 Life cycle assessment primary energy
ENV2.3 Land use

ECONOMIC

ECO2.1 Flexibility and adaptability
ECO2.2 Commercial viability

SOCIOCULTURAL

SOC1.1 Thermal comfort
SOC1.2 Indoor air quality
SOC1.3 Acoustic comfort
SOC1.4 Visual comfort
SOC1.5 User control
SOC1.6 Quality of outdoor spaces
SOC2.1 Design for all
SOC2.2 Public access
SOC3.1 Architectural quality
SOC3.3 Layout quality

TECHNICAL

TEC1.2 Sound insulation
TEC1.3 Quality of the building envelope
TEC1.4 Adaptability of technical systems

SITE

SITE1.1 Local environment
SITE1.2 Public image and social conditions
SITE1.3 Transport access
SITE1.4 Access to amenities

LIFE CYCLE ASSESMENT - LCA

/ A SUSTAINABLE APPROACH

With an increased focus on climate change, resource scarcity and the consequences we face if we do not act to oppose and solve this crisis, environmental sustainability is an important and inevitable aspect to consider and integrate in building designs today. Life Cycle Assessment or LCA, is a method which can be applied in a design process to evaluate a material, product or process in relation to its environmental impacts (Bernadi, et. al., 2017). The method is based on quantitative data, measuring the potential environmental impacts and resource consumption during a whole or partial life cycle of a building.

The LCA method distinguishes between three types of approaches: cradle-to-grave, cradle-to-gate and gate-to-gate. Firstly, cradle-to-grave includes all phases of the life cycle. From extraction of raw materials through production, transportation, construction, operation, end of life and potentially reuse of materials. Thereby it gives the most holistic perspective on the environmental impact and resource consumption of the building and is also the most commonly used. Cradle-to-gate is the assessment of a material or product within the first phases of the life cycle before the operation phase, while gate-to-gate assessment concerns only a single phase within the production chain (Bernadi, et. al., 2017). Results inferred from the life cycle analysis can be measured and assessed in relation to different categories. Among these are the global warming impact (GWP) and the primary energy consumption (PEtot) measured in respectively CO2 and kWh (Rasmussen and Birgisdottir, 2015).

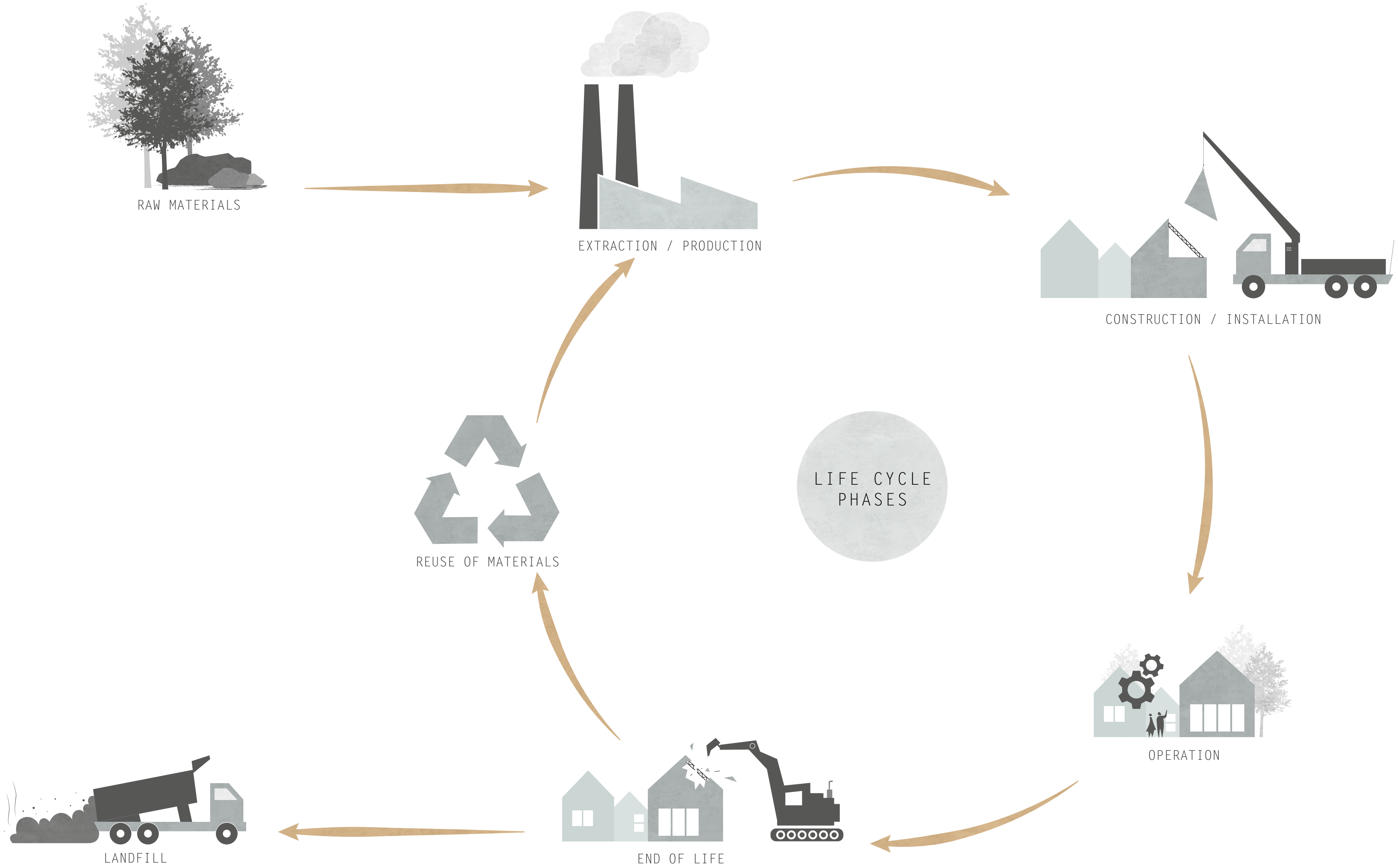
To shed light upon building construction and its global warming potential (GWP) and primary energy consumption (PEtot), SBI has made a number of analyses upon different construction parts with a number of variations within each category (Rasmussen and Birgisdottir, 2015).
For instance, 120 variations of exterior walls and 30 variations of roof constructions generated results showing median and dispersion values for both GWP and PEtot (see appendix p. 158). The results identified windows and roof constructions as construction parts with high values, indicating that their environmental impact were higher than other comparable construction parts. However, these results are exclusively based upon one square meter of each construction part and does not take the actual area or amount into account. Thus, it is of great importance to consider the size and square metres of each part when comparing them, which can vary from one building to another.

The results can be guiding in relation to what construction parts we can work with in terms of lowering the values for GWP and PEtot. The roof is a construction part that has a high value, and a considerable dispersion, making it suitable for us to investigate in our endeavor to achieve a low environmental impact.

LCA regarding GWP and PEtot will be applied as a background knowledge in this project to enhance our understanding and examination of the environmental impact our design carries and induces as well as the primary energy consumption of the building. A sustainable design proposal entails complexity in terms of how to approach it, as sustainable design not only concerns one aspect but many. As argued before, we find the environmental part of sustainability decisive and crucial to the design process. LCA will act as a tool to compare specific materials or set of constructions, which can inform our decision-making during the design process and ensure that environmentally sustainable initiatives and solutions will be implemented in the final building design.

◂ *Ill. 19 - Life cycle assessment phases*

▸ *Ill. 20 - Results from LCA analysis made by SBI*



> *“Without consciously looking at them, we breathe in our surroundings with all our senses.”*
>
> *- Christopher Day (Day, 2004, 5)*

SENSORY ARCHITECTURE
/ DESIGNING FOR A SENSORY EXPERIENCE

In contemporary architecture the experienced quality of created spaces is often overlooked as a repercussion of the common neglect of the body and the senses as design parameters. Our perception of a place, a form or piece of architecture is communicated by the senses. It can be hard to predefine, as it is situational, contextual and personal, meaning that the outcome of the architectural intentions is contingent on the specific circumstances. Consequently, the experienced quality we wish to achieve becomes subjective, emphasising the immense complexity related to our approach. However, the contextual circumstances, meaning the target group, site, composition and character of spaces are possible for us to affect, allowing us to direct the perception through the design towards a defined experience.

The visual sense is in architecture often considered exclusively, leaving the other senses unattended. Vision, historically regarded as the most dominant sense, reflects, surveys and investigates, but can also create a feeling of isolation, distance and separation where the other senses tend to enhance our interaction and unite us with our surroundings (Pallasmaa, 2005).

We argue that architecture should not define any sense as the dominant, but rather engage all the senses respectfully. We aim to create a multi-sensory architecture where an interaction of multiple sense modalities occurs, forming the foundation for our exploration of an experienced quality. Architecture that manages to incorporate multiple senses within its design and composition, not only has a greater opportunity to provide beneficial and serviceably distinguishing marks for people who are blind or visually impaired, but also a greater opportunity to encourage a deeper and more intimate interaction with the building for all of us. Sensory architecture holds the power to provide an extended notion of space.

Hearing, touch, thermoception, proprioception, vision and smell are all to be investigated and incorporated in this thesis. The omni-directional auditory sense is informative, offers direction and warnings about potential dangers (Brodey, 1965). The particular properties of different materials, combination of materials and disposition of surfaces within an acoustic space provide the perceiver with key information about their location and the character of the surroundings. Our tactile sense offers information in a close perimeter to the body, signalling nearness, intimacy and affection, and has the power to provide us with a deep connection with our surroundings (Pallasmaa, 2005). The perception of temperature, thermoception, will also play a big role in the design process, both in terms of room and surface temperature. The proprioception sense, the ability to perceive position and movement of our body, limbs and muscles (Gandevia, 2016), is a crucial component in the physical rehabilitation of the blind and visually impaired. The visual sense is not to be depreciated as only a small portion of the target group are totally blind. Light and shadows significantly impact the perception of a space for a visually impaired person.

The olfactory sense plays an important role when considering the memory of a place. Memories are rooted in sensory experiences and the isolated visual experience of a place can easily be forgotten, but the smell, taste, touch or sound of a certain place will be rooted deeper within us. The smell is often the most persistent memory of a space, and an easily recognisable aromatic experience characterises the environment (Pallasmaa, 2005). The memory of a space, established through the experienced quality, is an important notion regarding both the orientation and sense of safety for a blind or visually impaired person. Incorporating sensory landmarks that spark the memory can be used to navigate within a building, supporting wayfinding and cognitive mapping.

WARMTH | SMOOTHNESS | SOUNDS | DIFFUSE LIGHT | SHADOWS | SOFTNESS | MOVEMENT | OPENNESS | PERCEIVED SAFETY| CONTRASTS | HARDNESS | TEMPERATURE | INTERACTION | EMBRACE | SCENTS

▲ *Ill. 21 - Sensory architectural photos*

"*The sighted individual will pay little attention to a small ramp leading into a space; or to the transition from a soft floor to a hard one; or from a brilliant room with hard surfaces to a mellow one with soft wall coverings; or from a warm room to another slightly cooler. And he will pay little attention to these details because that is all they are to him: details. But these clues are not details to a blind individual. These clues are the space itself. They provide the only way blind persons can perceive space and become orientated to it.*" (Bernardo, 1970, 264)

Without continuous provocation, the sensitivity of our sensory system fades, and a poor level of sensory stimulation dulls our existence (Day, 2004). Experienced contrasts yield sensory stimulation, and thus, the incorporation of sensory contrasts in the design is essential. Striving to create architecture that incorporates and engages all the senses, is crucial in achieving the appropriate framework for a successful rehabilitation of the blind and visually impaired. Exploring the blind perception of a space can add another perspective and understanding of how to approach architectural design, where qualities of multisensory spaces and the potential power of architecture is revealed.

Our sensory perception of a space is inevitably linked with the indoor climate. The building regulations and define a set of requirements regarding the indoor climate which are established to ensure a satisfying thermal, atmospheric, visual and acoustic indoor climate. These are obligatory, but we also see further possibilities of using parameters within the indoor climate to enhance a specific atmosphere and sensory experience. We wish to explore the sensory potential of the indoor climate, without compromising requirements and energy consumption levels.

The acoustic properties of the space are crucial to consider. The reverberation time and noise level requirements are dependent on the use of the room. Acoustic properties can be used to, for example, identify and emphasise activity in certain areas. The positioning in the range between a lively or dead space can contribute to defining the character of the room, indicating intimacy or monumentality, activity or calmness, invitation or rejection.

The requirements for the thermal indoor climate are dependent on the activity level, clothing and season. This allows us to create thermal zones and differentiate between areas. A temperature difference can provide clues as to the intended use of the space.

The atmospheric indoor climate includes requirements regarding the maximum pollution level, dependent on the use of the room. In our building where movement is an essential cornerstone, the activity level will affect the air quality and the ventilation rates.

The visual indoor climate needs to address the daylight factor, but in our project it is of greater importance to achieve adequate lighting without creating glare, as it can be harmful for the visually impaired with increased light sensitivity. The indoor climate needs to be carefully considered, not to contradict but work in symbiosis with the sensory experiences we aim to achieve.

TECTONICS AS A METHOD

/ AN APPROACH TO LINK SUSTAINABILITY AND SENSORY ARCHITECTURE

In the subject of tectonics many definitions have emerged through time and contributed to our understanding of the relation between the design of a space, its poetics, and the construction that forms and realises the space. Our interpretation of architecture and space through tectonic theory and the implementation of tectonics as an approach and method to a design process will contribute to an architectural project understood as a whole, uniting the intangible space and poetics of tectonics with the tangible principles and construction of it.

Tectonics was from its etymological origin in the greek word "tekton" related to the craft of a carpenter or builder, however, the definition of the word evolved over time and became linked with the art of making and constructing (Schwartz, 2017).

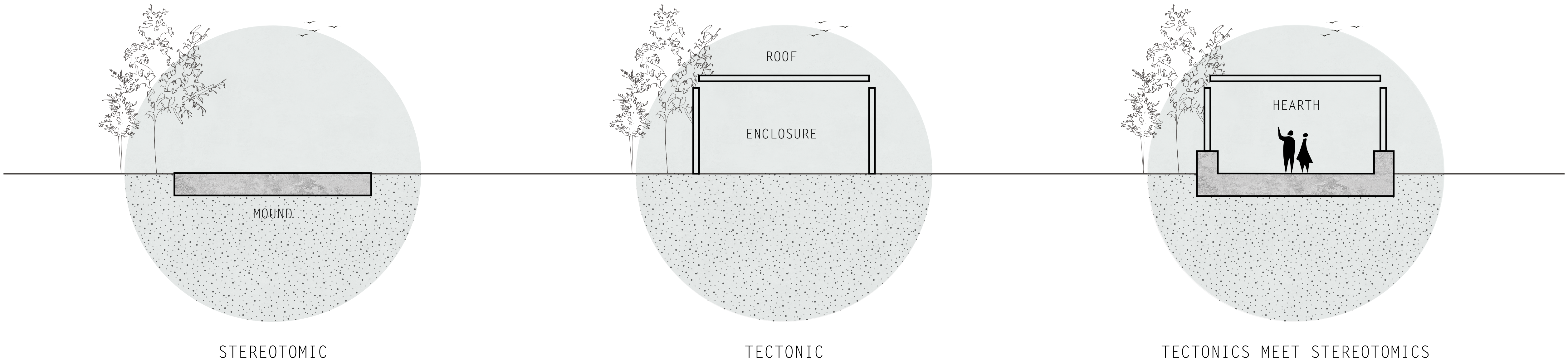
The german architect Gottfried Semper defined the four elements of architecture as being the hearth, the mound, the roof and the enclosure (Semper, 1989). The mound, or sometimes referred to as earthwork, represents the foundation that meets and receives the building and connects the man-made with place and nature. The mound, along with the enclosure and roof, acts as a protecting element of the hearth. The hearth covers the moral element, which serves as the pivot for the built environment and creates the essence and reason for the three other elements. In addition to these elements, Semper separates the construction into two typologies: stereotomics and tectonics (Schwarts, 2017). Semper argues that the stereotomic construction method embodies the heavy mass building elements and makes the hearth and mound rooted to the place. The tectonics in this context defines the assembling of lightweight structures, and is often related to the construction of the enclosure and the roof. The division into two construction typologies incorporating respectively the hearth and mound in one and the enclosure and roof in another can be translated into the the idea of the hearth and mound as bound to the place, providing the essence and reason for gathering, and the enclosure and roof creating the framework to do so.

The finnish architect Juhani Pallasmaa states that "The authenticity of architectural experience is grounded in the tectonic language of building and the comprehensibility of the act of construction to the senses. We behold, touch, listen and measure the world with our entire bodily existence, and the experiential world becomes organised and articulated around the center of the body." (Pallasmaa, 2005 p. 64). Thereby his perspective upon construction is not only the construction as a physical existence, but also the constructing as a practice that embodies and gives a tangible form to a quality or feeling experienced through our bodies, uniting them with the material world. The british architect Kenneth Frampton acknowledges tectonics as "poetics of constructions", considering tectonics as the synthesis between the aesthetical aspect and the construction (Frampton, 1995).

In a contemporary perspective the construction must be devised or reconsidered to address the situation we face today regarding climate change and resource deficiencies (Beim and Madsen, 2014). On an environmentally sustainable basis the construction must relate to the existing crisis in our present-day society, however, it must not compromise the sustainability that lies within societal prosperity and our well-being.

In the light of the previous assertions, tectonics must from our perspective be seen as an approach to create a space in synergy with its construction, while simultaneously addressing environmental sustainability. Furthermore, it should create an architectural narrative and experience built upon the senses to reveal its full potential. A tectonic building today should narrate the sustainability through the use of materials or resources and create a space that supports the growth of social sustainability. Our perspective on tectonics positions it as a link between sustainability and sensory architecture.

There is a substantial amount of theory written on the subject of tectonics, but actual methods viable in a design process are not prevalent. "Gestures and principles" composed by Marie Frier Hvejsel attempts to translate abstract theory into an applicable method. To enlighten the narrative of the architecture it is necessary to understand the relation between the gesticulation and quality of a space and by which means this is realised. "Gestures and principles" sheds light upon the qualities of a space and the principles to reveal it, and will form a basis for a final design, where the notions of gestures and principles will be fused into construction (Hvejsel, 2018). As an initial method of our design process, this application will guide our design towards what we understand as a tectonic project seen as a whole.



▲ *Ill. 22 - Stereotomic, Tectonic and Hybrid*

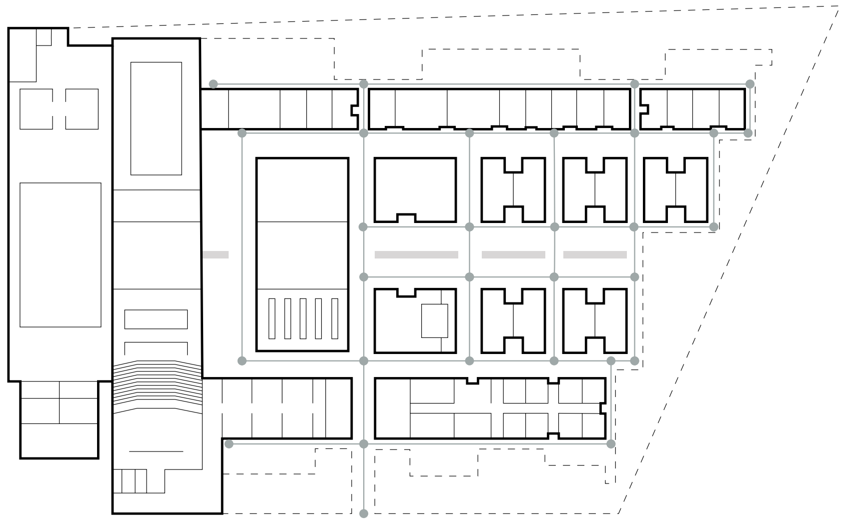
◄ *Ill. 23 - The theme of blindness*

Representing the Theme Through Case Studies

This thesis aims to approach sustainability, sensory architecture and tectonics through the perspective of a blind or visually impaired person. We wish to explore if this perspective can enrich the experience and understanding of architecture, and promote a multisensory approach in other projects that do not necessarily involve the same target group.

We aim to explore the use of sensory contrasts and landmarks in our project, to support legibility and wayfinding. Striving towards a holistic design, we wish to create an architectural narrative based on the senses and approach sustainability through considerations regarding inclusive architecture and the use of materials and natural resources.

To gain an understanding of existing architecture within the chosen field, four case studies have been conducted. The first two are buildings for blind and visually impaired of different character, and the investigations aim to identify key principles that can inform our design process. The third case study focuses on the building typology and functions, aiming to inform our room program. The last case study pivots environmental sustainability and provides information about the use of natural resources and inspiration towards possibly incorporating alternative materials.



WAYFINDING

/ INTRODUCING THE ICD METHOD

The Center for the Blind and Visually Impaired in Mexico City and the Lighthouse for the Blind and Visually Impaired have been selected and are analysed to identify specific principles and elements incorporated in the design that can inform our design process. The case studies will be analysed based on their use of sensory architecture, materials and considerations regarding wayfinding.

According to assistant professor at the University of Wisconsin-Madison Michael J. O'Neill, ease of wayfinding is reliant on architectural features that support legibility and help people to create an accurate cognitive map of the spatial relations within the building (O'Neill, 1991). To objectively analyse the legibility of a building it is possible to measure the complexity of the floor plan through the use of ICD. ICD, or InterConnection Density is based on the connections between decision points along paths leading through the building. By counting the amount of connections at each decision point and calculating the average, a number is found that indicates the complexity and legibility of the floor plan. This number is typically between 2 and 3. Empirical studies show that a lower average ICD indicated a more accurate cognitive map and improved wayfinding performances.

ARCHITECTURE FOR THE BLIND

/ CENTER FOR THE BLIND AND VISUALLY IMPAIRED IN MEXICO CITY

Center for the Blind and Visually Impaired in Mexico City offers a range of services for the specific target group. By implementing sensory design features in the architecture, the intention of the place is to improve spatial perception by letting the architecture activate the five senses, making the embodied experience the source of information (Archdaily.com, 2001). The complex lies as a composition of fragmented volumes, within a heavy and dark stone wall surrounding the volumes. These are constructed of concrete frames, and vary in size, weight and composition of materials.

Guidelines. Exterior paths construct the flow between functions within the complex. In certain locations the path slopes slightly, activating the proprioception sense and serving as a landmark. Changes in the type of pavement and the horizontal and vertical lines cast in hand level in the concrete walls identifies each building. A groove in the pavement is both a visible and a tactile element that indicates a change of direction of the path.

ICD. The exterior paths are numerous, and the amount of connections between the decision points is high. The calculations present an average ICD of 2,87 which is towards the higher part of the typical spectrum.

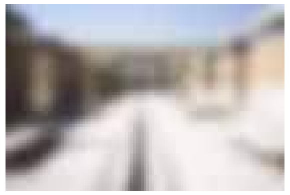
Contrasts. The use of materials with contrasting visual and tactile properties recurs throughout the whole complex where cold, smooth paving stones meet the warm and rough tepetate bricks of the walls. The complex is surrounded by a dark, uneven stone wall. The composition of building volumes create shadow- and light areas that are used to guide the visitor. For instance, the entrances are retracted and covered to create a darker area that is visually distinguishable for a person with cataract or light sense, but also protected from the heat coming from the sun. This activates the thermoception sense and creates a transition between the interior and exterior.

Landmarks. In addition to the slopes along the paths, there are several other landmarks incorporated in the design that addresses other senses. There is a small water runnel in the main courtyard of the complex. The sound of the water is easily identifiable for all and visually distinguishable for a person with cataract or light sense, resulting in a distinct landmark. Furthermore, various plants are placed within the complex, activating the sense of smell.

◀ *Ill. 24 - Plan of the center in Mexico with ICD applied*

▶ *Ill. 25 - Photos from the center in Mexico seen with diseases*


- Normal -


- Cataract -


- Light Sense -

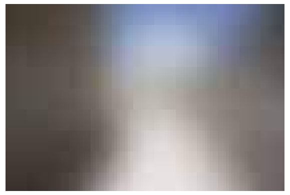

- Macular Degeneration -


- Scotoma -


- Hermianopsia -


- Normal -


- Cataract -


- Light Sense -


- Macular Degeneration -


- Scotoma -


- Hermianopsia -


- Normal -


- Cataract -


- Light Sense -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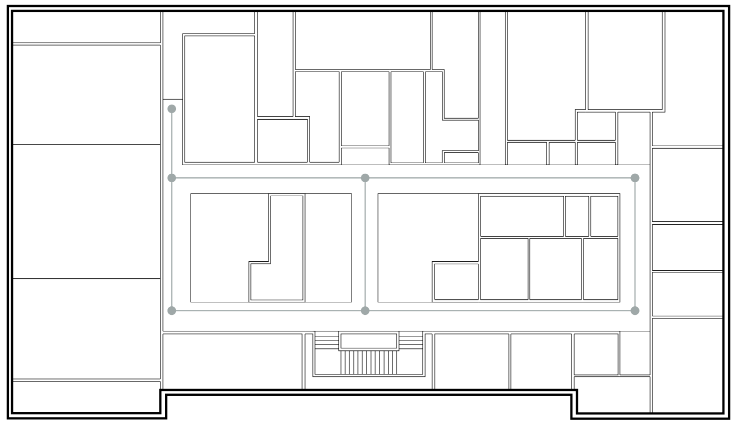
- Hermianopsia -



ARCHITECTURE FOR THE BLIND

/ LIGHTHOUSE IN SAN FRANSISCO

LightHouse for the Blind and Visually Impaired in San Francisco is a section of a highrise designed for people with a visual handicap by the blind architect Chris Downey in cooperation with architect Mark Cavagnero associates. The LightHouse is located in downtown San Francisco and provides a wide range of services and programs such as training and education for blind and visually impaired (lighthouse-sf.org, 2019a). The LightHouse attempts to set new standards of accessibility and functionality for people with a visual impairment by using contemporary lighting and innovative architectural design features in the design of the building (lighthouse-sf.org, 2019b).

Guidelines. A path of polished concrete forms the main flow of each floor. The open areas connected to the path are covered by carpet flooring, and a separation between concrete and carpet is highlighted by a metal transition strip to emphasise and define the demarcation between these areas.

ICD. The main flow is kept simple and a low number of connections results in an average ICD of 2,29. This number is significantly lower than the ICD of the Center for the Blind and Visually Impaired in Mexico City.

Contrasts. Throughout the building the use of materials have been carefully considered in accordance to their acoustic properties. The sound of footsteps on the concrete path provides information about the space as a transit area, whereas the carpet absorbs the sound and indicates a calm space to stay. Furthermore, the areas are arranged with different light intensities to emphasise the contrast between them, and make them clearly distinguishable for a person with cataract or light sense. The open carpeted areas have a lower light intensity to indicate a lower level of activity and the areas for transit have a higher light intensity. In addition to this, contrasting colours on specific elements or within selected rooms are seen throughout the building. Rich and saturated colours can be distinguished by many with low vision, and pieces of furniture are more noticeable within a space when they have with a colour that stands out. The windows are equipped with dark window frames to make the glazed areas more detectable and prevent possible accidents.

Landmarks. The three floors of the LightHouse are connected by a large staircase. The dark wood of the stairs contrasts all the other materials used throughout the building and the staircase becomes a distinct landmark.

CONCLUSION

/ RECAPITULATION OF THE TWO CASE STUDIES

Conclusion. The case studies have given an insight into how design features that support the abilities of the blind and visually impaired can be integrated in the architecture, without giving the expression of a place for a specific disabled community or labelled group of people. These buildings implement subtle design features that unconsciously speak to the senses and improve the legibility of the space.

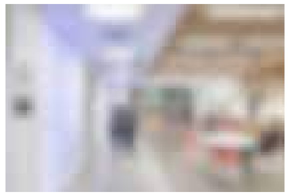
Both projects indicate that the use of materials is crucial, both to create contrasts and signal the character of the space, but also to function as guidelines along the flow of the building. Landmarks implemented in the design can provide information about the specific location and improve wayfinding performances. Though empirical studies have confirmed the use of the ICD measurement, the results should not be seen as conclusive and indisputable. The ICD is based solely on the floor plan and does not take the architectural design of the space into account. The decision points are all seen as identical, but in reality the character of these locations can vary enormously. In our design process, ICD is seen as a tool that provides background knowledge in the early stages of the project, but does not dictate the design.

The gained knowledge and principles identified in this analysis directs the design process towards integrating subtle but effective design features that activate the senses and promote a comprehensive spatial understanding.

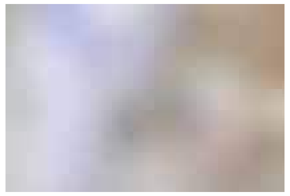
◀ *Ill. 26 - Plan of the Light House with ICD applied*

▶ *Ill. 27 - Photos from the Light House seen with diseases*

- Normal -



- Cataract -



- Light Sense -

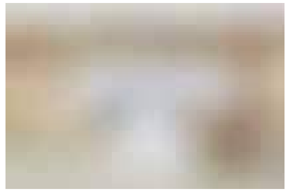
- Macular Degeneration -

- Scotoma -

- Hermianopsia -

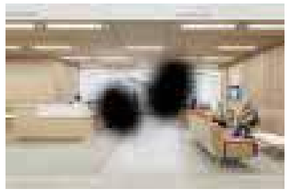
- Normal -

- Cataract -



- Light Sense -

- Macular Degeneration -



- Scotoma -

- Hermianopsia -

- Normal -

- Cataract -

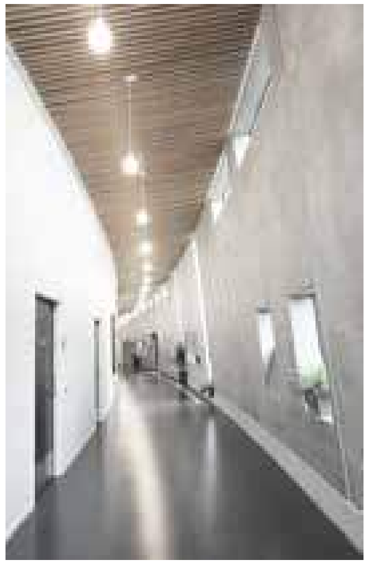
- Light Sense -

- Macular Degeneration -

- Scotoma -

- Hermianopsia -



BUILDING TYPOLOGY

/ A HOLIDAY, CONFERENCE AND SPORT CENTER FOR DISABLED PEOPLE

A study trip to Musholm, in Korsør, expanded our horizons regarding accessible architecture. Musholm facilitates holidays, conferences, a variety of sports and physical activities. Originally, it was designed for people with muscular dystrophy and the building received a bronze medal from the International Olympic Committee for the integrated accessibility (Musholm, 2019). The use of Musholm can be divided into three main categories: holiday, conference and sport, and the facilities allow for these categories to be connected and mixed during a stay.

Holiday. Musholm offers a variety of accommodation options for individuals, families or larger groups. All the guestrooms and apartments are designed for the disabled and feature handicap-friendly equipment such as lifts and adjustable furniture. The building encourages people with a disability to meet and enjoy social gatherings. Facilities such as restaurant and fireplace lounge give Musholm a character of being a relaxed vacation centre.

Conference. The building provides possibilities for both small and large conferences or events. The meeting rooms are flexible and can be opened up to become bigger, or divided to become smaller. Musholm provides a unique opportunity to combine the conferences held at Musholm with recreational activities.

Sport. The large multifunctional gym, encircled by a red sloping ramp, is the main attraction regarding the sports facilities. It enables enables all visitors to get to the top of the two stories high gym and encompasses a wide range of activities and room for movement, whether it is trying the zip line, playing basketball, doing gymnastics or competing in electrical hockey. The gym also contains a stage that allows for larger events to be arranged. The structure of the ceiling in the gym is designed to provide appropriate acoustic performances for shows on the stage, physical activities and conferences so they each can function successfully.

A stay at Musholm also invites for different outdoor experiences and activities. Among these are walks and hiking tours through the landscape along the coast, outdoor chess, swings, football goals, teepees and a campfire.

Architectural quality. The multifunctional gym becomes a gathering point within the building. It encompasses a variety of functions and qualities within the same space and holds a wide range of experiences. The ramp provides access to both open and closed spaces, as well as smaller niches, and along the ramp there is an open glass facade that creates a continuous connection with the exterior. The larger rooms are equipped with skylights that emphasise the size of the spaces and flood them with light. The hallways in the other parts of the building are clearly distinguishable from the other spaces. The tilted concrete wall is a distinct feature, noticeable throughout the building.

Conclusion. When designing a place with activities and accommodations for people with a certain disability, it is of prime importance that the construction and the composition of the building is designed to make the integration of sufficient accessibility possible. By doing so, one does not only set a satisfying frame for the target group but also for a place that invites for a broad user group to stay at the place and utilise the facilities. Incorporating a large range of activities of different character, both internal and external, inspires the users to explore and through movement utilise the facilities. This case study will inform our design process by giving an insight into a building typology, which encompasses qualities and functions that can inspire the room program of our project.

◂ *Ill. 28 - Photos from Musholm holiday, conference and sport center*

▸ *Ill. 29 - Photos from The Biological House in Middelfart*

SUSTAINABLE ARCHITECTURE

/ THE BIOLOGICAL HOUSE IN MIDDELFART

The Biological House in Middelfart is designed and developed by EEN til EEN architects in cooperation with GXN and NCC. The house is a part of a newly developed concept for building houses, rooted in the idea of using leftover materials and by-products from the agriculture industry as new building materials. In Denmark the production of wheat creates leftover straws or stubbles of approximately 2.8 mio. tons each year (Miljøstyrelsen, 2017). These leftovers can with the technology of today be used for building materials, such as plates and insulation, instead of being burnt or exported. Furthermore, materials from the production of grass, seaweed, eelgrass and tomato plants are used in The Biological House.

Straw construction plates and eelgrass insulation. The architects and engineers behind The Biological House put their focus on a circular network of the materials, where materials that were previously regarded as waste will now be reused and a part of a complete circulation. This is done e.g. through their use of straws for construction plates made by Novofibre (Miljøstyrelsen, 2017). Using straw is beneficial due to the extensive availability, the strength and the high level of the binding material lignin. As the plates are open to diffusion, the architect and engineer argue that this benefits the indoor climate, and that the breathable construction is especially suitable in the summer period when the moisture is vented out through the interior ventilation system. Furthermore, straw is a hygroscopic material that can absorb or release the moisture. However, this system requires that the whole construction and strategies for ventilation account for a diffusion-open building envelope which may be complex in larger building typologies than residential houses. Furthermore, the knowledge of the straw-material is not yet extensive and the production of the constructive plates is limited to few sizes.

The insulation properties of eelgrass are similar to what can be found in Rockwool and the natural content of minerals and salts makes it resistant to fire, animals, mould and rot (Zostera, 2019) This makes the eelgrass a sustainable alternative to Rockwool, as the natural production of eelgrass will absorb the CO2 instead of releasing it into the atmosphere. What can be questioned about the eelgrass used in The Biological House is the use of eelgrass produced in the Mediterranean Sea and not in Denmark. Using the insulation produced from eelgrass from Denmark the transportation would be limited, and the environmental sustainability improved.

Architectural expression. The Biological House is a proposal of future, sustainable architecture, that can be built easily due to its modular system and prefabricated elements. The foundation of the building is raised upon small pillars, giving the house a distance to the terrain and place. The house is adaptable to the needs of the users through its modular system, and the users can add or detach modular systems as it fits them. However, the system also generates many limitations to the architecture as it forces the building to be constructed in a certain way. The system does not fit all building typologies or locations, and may result in architecture that does not relate to its site.

The vertical, nordic scotch pine cladding on the facade gives the house a warmth and the singularity of each wooden panel gives the expression of the facade a uniqueness to an otherwise prefabricated, modular systemised building. The recess in the gable and integrated bench creates an enclosed, embracing niche, where one can linger in the sun. The simplicity of the overall form of the house enhances the expression of a modular, constructive system, while the facades narrates the use of natural, nordic materials.

03

SITE ANALYSIS

Ill. 30 - Forest at the project site

Ill. 31 - Location of Hobro ◄
Ill. 32 - Project site and the surroundings ►

LOCATION
/ HOBRO - A SCENIC AREA

Mariagerfjord municipality lies in the North of Jutland and with its population of more than 42.000 people, it is also the home of several major companies (Mariagerfjord,dk, 2019b). The municipality is a fusion of four former municipalities and encompasses smaller village communities along the fjord as well (Cittaslow.org, 2019). With its excellent and unusual nature, including the fjord, Mariagerfjord offers a variety of landscapes from small creeks and lakes to sloping hillsides and forests. These scenic surroundings, mixed with history, culture and a range of atmospheres, make Mariagerfjord a unique place for everyone to experience (Visitmariagerfjord.dk, 2019a).

Mariager Fjord cuts and bends its way into the northern Jutland from Kattegat Sea. At the very end of the Fjord and in a hilly terrain lies the city of Hobro, the biggest city in the municipality with a population of nearly 12.000 people (Mariagerfjord,dk, 2019a). The great infrastructural connections, either by car on the E45 highway or by train, both crossing the municipality, makes the city interact with the rest of the country (Mariagerfjord,dk, 2019b). The city is known for its Viking fortress Fyrkat established plenty years ago. Besides the Fyrkat, it is possible to experience a reconstruction of a real viking town, this is why the city of Hobro is called "Homestead of the Vikings" (Visitmariagerfjord, 2019b).


The City Center
of Hobro
Project
Site

SITE MAPPINGS
/ CARTOGRAPHIC ANALYSIS

A series of mappings were performed to uncover the different layers of the project area, aiming to reach an understanding of the surrounding areas, functions and infrastructure.

In the area southeast of Hobro and south of Mariager Fjord the forest called Østerskov is located. Østerskov is an old forest in the outskirts of Hobro city and with its tall and majestic trees, undulating terrain with wide and easily accessible pathways and lively bird life, it is an area that invites for nature experiences and relaxing walks. Furthermore, with its close proximity to the Fjord it is possible to get a panoramic view over Mariager Fjord (Visitmariagerfjord, 2019c).

Along Amerikavej south of Østerskov is the location of Hotel Amerika and Julemærkehjemmet. Julemærkehjemmet is a place for children at the age of 7 to 14 years with wellbeing problems. These children who are all in the same situation, learn how to live a healthy life with plenty of exercise and friendships (Julemaerket.dk, 2019). Hotel Amerika next door, has gone from being a home for people who are blind to being a regular hotel for everyone. Back in the day Hotel Amerika was the first "home" for blind people in Denmark, established by Dansk Blindesamfund in 1937. The purpose of the place was to provide a holiday- and recreational- "home" for people with a visual handicap and to later on offer courses with the focus on living a life of independence. Dansk Blindesamfund left the property in favor of a more modern and accessible building in 1987, causing the conversion from a "home" for the blind to a regular hotel (Historien bag Hotel Amerika - Fra blindehjem til hotel, 2018).

A short walk to the south, passing Julemærkehjemmet and Hotel Amerika, a connection between Østerskov and Ormeskov is revealed. Ormeskov is a small forest leading to the location of the site. The site oozes of a delicate balance between scenic nature and lively spirit because of its surroundings of both forest, open landscape and institutional buildings.

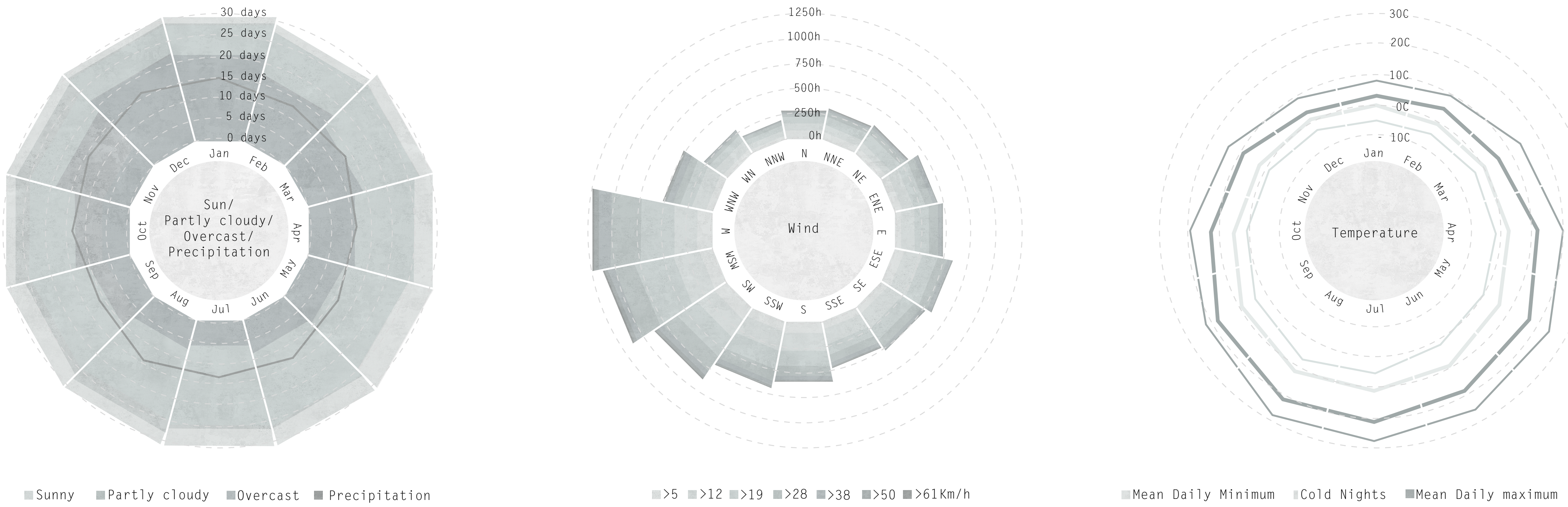
▲ *Ill. 33 - Areas surrounding the Project Site.*

▲ *Ill. 34 - Functions in the Area*

▲ *Ill. 35 - Infrastructure - Roads and Pathways*

Ill. 36 - Climatic Conditions of Hobro City ◄

Ill. 37 - Photo from Project Site ►



CLIMATE

/ MACRO AND MICRO CLIMATE AT THE PROJECT SITE

Investigations concerning the macroclimate of Hobro provided knowledge regarding the amount of sunny and cloudy days, precipitation, wind conditions and temperatures. These studies are of particular importance when designing sensory architecture where the entire human body acts as the source of information by an activation of the senses, and is also important for technical considerations regarding indoor climate and energy consumption.

Solar conditions. The results generated from studies of the solar conditions have provided information on when to take advantage of the solar radiation reaching the site and that active and passive strategies can be implemented in the building design. As the site is formed as an open field to the south, and not obstructed by trees or other shading elements during most of the day, it enhances the possibility to implement these strategies in our project. Additionally, the weather conditions affect the light intensity, and working with design features that incorporate different levels of daylight into the building is crucial for people with a visual impairment.

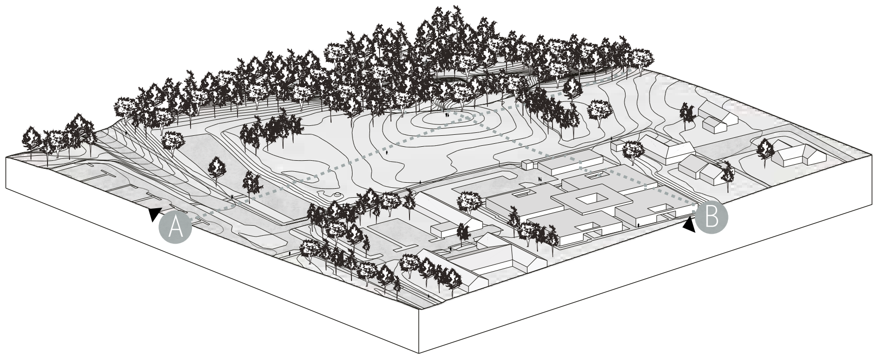
Precipiation. The precipitation throughout a year does not show remarkable fluctuation. With May being the month with the least precipitation of 11,7 days and December with the most precipitation of 15,7 days, it discloses a site that nearly half of the days during a month experiences rainy drops from the sky. This allows for the opportunity to create areas where the individual is being guided by the rain through the auditory sense. It can not only be a guiding feature, but also visually appealing, contributing to the experienced quality of the space.

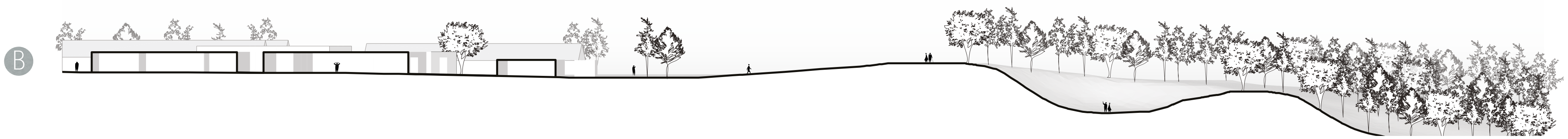
Wind. Studies regarding the wind reveals that the dominating wind is blowing from west and southwest and the strongest wind blows primarily from November to March. The implication of this is a broader knowledge of the wind directions and where to situate the building within the site to achieve and incorporate natural ventilation strategies based on the aims of a sustainable architectural outcome.

Temperatures. During July and August, the absolute warmest months with the highest temperatures and only six and seven days of overcast weather, it is crucial to consider indoor climate in terms of overheating as well as energy consumption. Furthermore, during these months natural ventilation is of increased importance, as the temperatures allow for natural ventilation during the whole day.

Ill. 38 - 1:1000 Sections of the site

Ill. 39 - Photo from project site





Ill. 40 - Photo from project site ▶

THE SENSE OF PLACE
/ A PHENOMENOLOGICAL EXPERIENCE

In a node between city, institutions and forest the site lies as an untouched place with a wildly growing vegetation narrating a transition between city and nature. The place communicates this transition through a naturally made path, which directly connects the area of institutions with the forest. Here one can sense the enclosure of nature through bird song, the whistle of the leaves in the trees and the soft forest ground.
The density and enclosure of the forest is contrasted by the open field of the site, which stretches towards the southeast and flows into vast open fields. This along with the position on a hilltop allows for the warm sun to penetrate the whole project site.

Along both the south and west oriented edge of the site, roads separate the place from the built environment, leaving the site more directly connected to the forest area rather than the city. The edge to the west is emphasized by a mound of soil and vegetation, which physically makes a barrier between road and project site, and contributes to a sense of safety when staying in the area.

To the north and east, the woods create an enclosure, which can be perceived as the visual background and edge of the project site, but the forest reaches deeper than what the eye can see. The sounds from children at play, activities and life within the forest reaches the site and bear witness of the vastness and extensiveness of the area within the woods. Thus, the visual barrier is blurred by the multisensory experience of the place.

To grasp an understanding of the spatial experience as a blind person, the site was phenomenologically sensed through the application of dark glasses and exclusion of the visual sense. Arriving to the site from southwest creates a sensation of leaving the city behind with a movement through a slightly rising terrain towards the sounds of the forest, giving the area a direction through the auditory and proprioceptive sense. Furthermore, through the dark glasses it is possible to sense the periphery of the woods through the low intensity of light and dark tinge and the brightness of the open field, which contributes to the experience of direction and navigation at the site. The abundance of sounds from birds, people and life in the woods, the wind across the open field, buzzing traffic and sounds from the built environment supports the liveliness and vitality of the place, and provides a sense of being in a place of opportunities. Through the varying ground, both materiality wise and in terms of the rugged, non-uniform terrain one experiences the existence of the underlay and get a sensory connection with the ground, as opposed to the experience of a totally uniform and homogeneous, underlying surface. This forces one to engage with the place through the ground and in correlation to that get an awareness of one's body and movement.

Ill. 41 - Materiality found on site ▶

THE DIFFERENT NUANCES OF THE PLACE

/ MATERIALITY FOUND WITHIN THE AREA

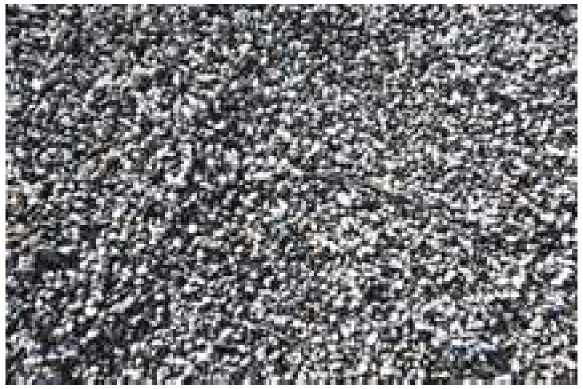
The experiential qualities derived from the blindfolded analysis of the site depend largely on the materiality sensed on the body. The site and area in Hobro brings a great variation in materiality and different sensory experiences as a result.

A tactile experience. Walking to, through and away from the site brings different experiences of the ground coverings and focuses the attention to the tactile experience of the surface underneath. The gravel on the parking lot expresses a functional transition area with a slower pace than the asphalt of the roads. The trimmed, even grass contributes to a feeling of safety and provides a comfortable material for slow walking, while the uneven field of wild, tall grass indicates an untouched, natural area. Within the forest, the walking path of hard soil, tamped nearly to an even layer, narrates a place visited regularly. The softness and moisture of the sand close to the water marks the transition between land and water. The transition creates an awareness of each step forward, as the next could possibly be a step into the water.

The high tree trunks rising from the forest ground narrates different identities through their different tactilities. The old oak trees have a rough surface with soft moss growing in between the bark on the trunk. The high beeches have a more even surface with rough areas stretching horizontally, marking the seriality in the pattern. These tactile properties contribute to the experience and understanding of the complex diversity of the forest.

The auditory sense. When arriving at the parking lot, the gravel reflects the sound of both pedestrians, cars and bicycles. The sounds creates a feeling of safety, as the different movements are clearly distinguishable in this transitional area between the site and the city. Walking through the forest, the crackling sounds of the dry leaves on the forest ground create an awareness of the size and scale of the tree crowns in the summer, and the many leaves that have fallen onto the ground constitute a carpet of the forest. When reaching the bay of the fjord, the calmness of the rippling water and the enclosing forest behind, draw the attention towards the openness of the fjord.

The sense of season - the scent of place. As the early spring emerges, the scents of the site, the city, the forest and the fjord characterise the area as a place that holds a variation of different sensory experiences. The nature is an extensive part of the area, and the different seasons are expressed through the aromas of the materials found in nature. In winter the cold and dry air causes less intense smells, than in the warmer seasons (Puiu, 2019). Thus, the scent of the winter is modest and mild, and the cool air feels fresh and crisp. The spring is the season of blooming vegetation and a moist, soft forest floor. The aromatic flora of the site brings a variation of different scents, that enhance the season of spring. Summer brings a vastness of aromas from the colorful vegetation in blossom, and the high temperatures enhance the scent of place to its fullest (Puiu, 2019). When fall arrives, the leaves dry out and cover the forest floor as a carpet. They fall onto the moist ground, watered by the rain, and the smell of the damp forest and the humid air reveal the character of the fall season.





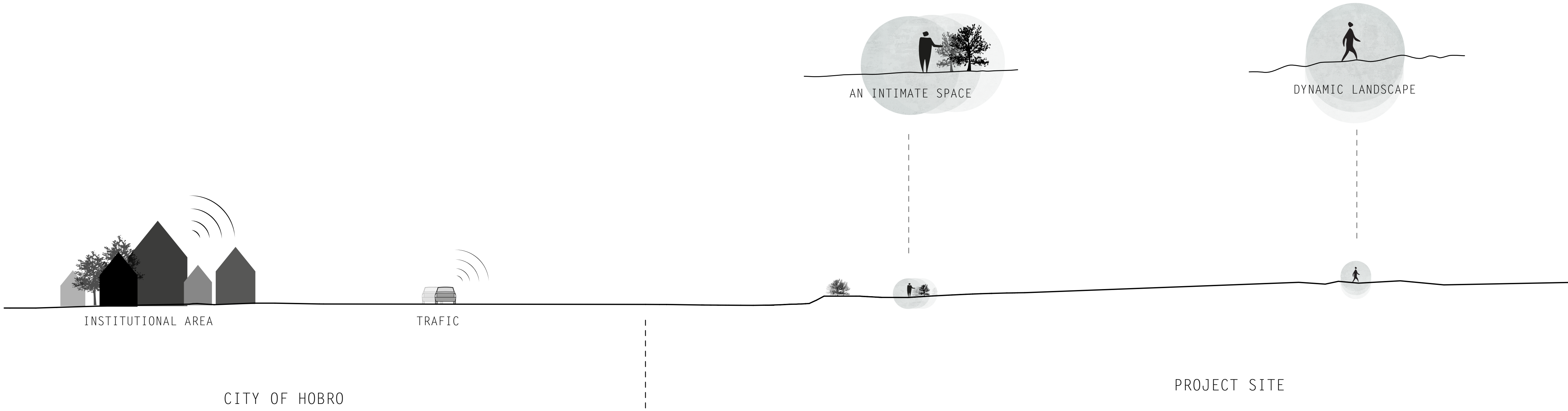










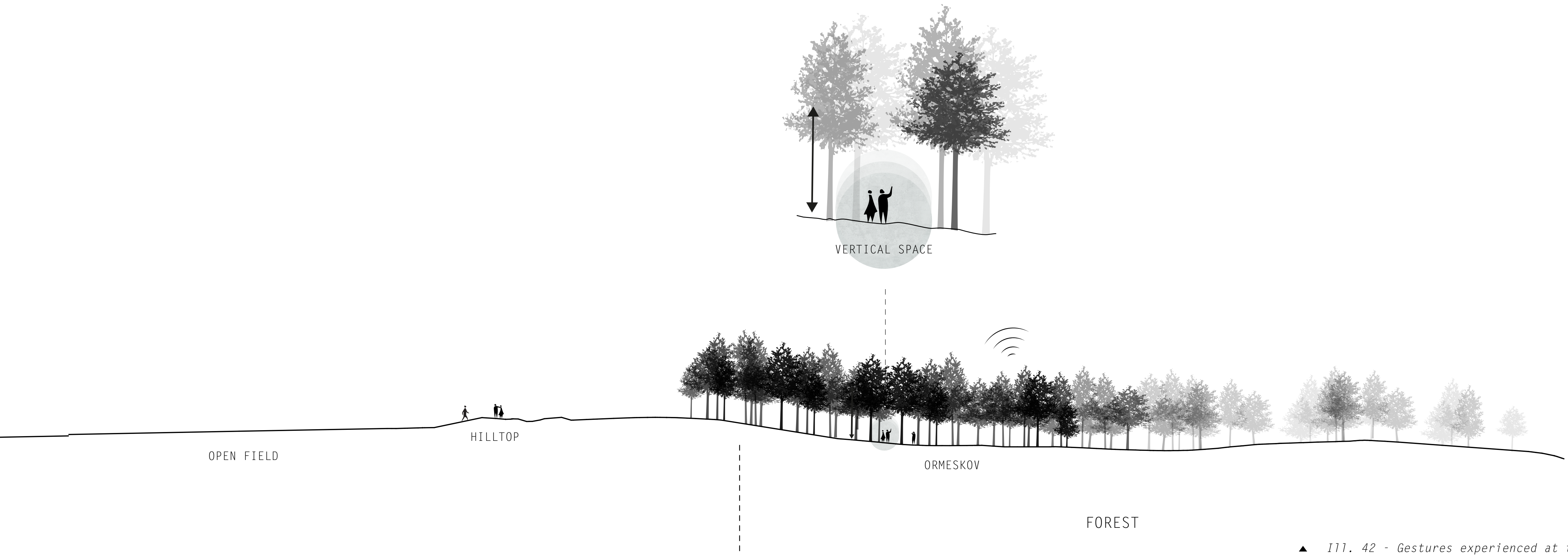
GESTURES AND PRINCIPLES
/ A TECTONIC METHOD

Through the application of the tectonic perspective and theory "Gestures and Principles" (Hvejsel, 2018) we strive to grasp the spatial gestures given by the principles, and the relation between architecture and place. This to create a tectonic project in synergy with its environment and place, where architecture and place are inseparable and harmoniously linked, and the structure and construction supports the narrative of the building. Furthermore, the application of the theory illuminates the potentials of the place through the recognition and understanding of gestures. These describe what the space does through the principles, that comprise the technical understanding of the construction and thereby how the architecture and place reveal their gestures.

The spatial qualities found within the project site will act as leading parametres for the ongoing design process, letting the theory of "Gestures and Principles" become a directing design tool. The creation of a building that projects these gestures and spatial qualities onto the exterior and interior of the building will contribute to a tectonic design and architecture, that narrates and reflects the sense of place. To grasp the phenomenological experience of the space as a blind or visually impaired person the application of dark glasses enhances the gestures perceived without the sense of vision, letting the other human senses come forward and become dominating. From this perspective different gestures and spatial qualities have been acknowledged.

The Spatial Quality of an Open and Intimate Space. The contrasting open field and dense forest found on the project site bring a variation in the spatial experience. Being positioned in the centre of an open field can seem distant from the human scale and the vastness of the area can feel even more limitless when the sense of vision is excluded and one cannot perceive any edges in the horizon. The fresh wind represents the breath of the open field and along with the sounds from far off they make one aware of the large scale of the place. However, in the centre of this openness the appearance of vegetation, such as small trees and bushes allows for direct interaction with the nature at the site, stimulating the sense of touch through the tactility of leaves and other vegetation, bringing the scale down to a more human related proportion.

The Spatial Quality of a Vertical Space. On the other hand, the forest brings another scale and direction to the space through the verticality in the tree trunks that reach upwards, emphasised through the bird song and whistling sound from leaves above. The ascending direction of the trees impacts the experience of the space, and one might feel the urge to bend one's head backwards, face the sky and listen to the sounds of the forest. Furthermore, the light penetrating the density of the tree crowns can be perceived by the partially sighted and illuminates the verticality of the trunks. It highlights the trees as spatial compartmentalising elements in the forest.



Ill. 42 - Gestures experienced at the project site

The Spatial Quality of a Dynamic Landscape. The gesture and spatial quality of a dynamic space is perceived through the naturally curvy and uneven terrain, which forces the perceiver to interact with the landscape as well as one's own body through the movement up- and downwards. The variation in an ascending and sloping terrain and the constant awareness of the correlation between body and place make the experience a journey towards the hilltop. The differentiation in heights and spaces created at the site narrates the layering of the earthwork and the dynamics of the landscape.

The Spatial Quality of an Auditory Direction. As the project site is situated at the edge of the forest and in close proximity to built environment, the site appears as an oasis of calmness surrounded by a variation of sounds that express a periphery of liveliness and energy. The perception of the sounds differs from each other, letting the auditory sense navigate the body through the terrain towards either forest, an open field or the city. The contrasting sounds contribute to an audible direction of the space, where the activities surrounding the project site acts as leading and guiding parametres. All together these sounds also create a sense of enclosure, enhancing the location of the project site within a node of different activities and engaging the space with its surroundings.

The Constructive Principles. The vastness of the open space is communicated through an open structure, articulated by the omitting of barriers, while the tactility of the material and interaction with the environment through the sense of touch, constructs our perspective on an intimate space. This interaction happens not only through the ground beneath us, but also through the tactility within the reach of the hand. The verticality and open, upward-going space arises from the slenderness and repetitive alignment of the tree trunks, whereas the light and sounds from above emphasises the height. The dynamic landscape and different spaces occurring as a result of the layering is rooted in the non-uniform terrain and foundation, which contributes to motions and movement. Finally, the spatial quality of an auditory direction is realised through the openness of the project site, letting the sounds travel at the site.

04

DELIMITATION

Ill. 43 - Sensory experiences

- VISUALLY IMPAIRED -

- TOTALLY BLIND -

- RELATIVES -

- STAFF -

- EXTERNAL USERS -

USER GROUP

/ DESIGNING FOR THE USER GROUP

The building will accommodate five different user groups; visually impaired, totally blind, relatives, staff and external users. These users will utilise the facilities on either an hourly or daily basis as daily visitors, or on a weekly basis as overnight stays.

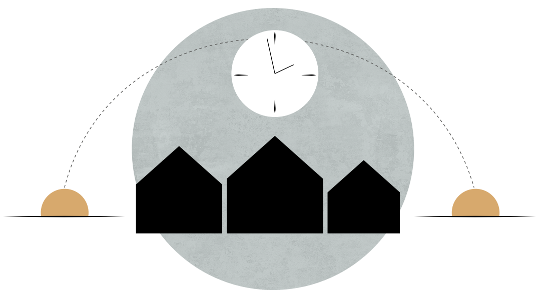
Visually impaired and Totally blind. The building will first and foremost accommodate rehabilitation facilities for blind and visually impaired people of all ages. They will have very different needs based on their visual condition, rehabilitation process, and personal ambitions, and the building should provide the framework for a meaningful stay for all.

Relatives. A family member becoming visually handicapped can also be traumatic and life changing for the relatives. The needs of the blind person is usually prioritised, while the needs of relatives are overlooked. (Dansk Blindesamfund, 2019) The building will also meet the needs of the relatives, encompassing the emotional rehabilitation as well as functional rehabilitation, as the everyday life with a blind family member can be challenging and demanding. The facilities should provide a positive experience for the relatives, giving them a feeling of being equally important and prioritised, as they also play an important role in the rehabilitation of the blind and visually impaired.

Staff. In order to provide adequate rehabilitation for the target group, the building will also be designed to accommodate rehabilitation staff such as psychologists, physiotherapists, and teachers, as well as practical staff to handle the everyday tasks. Thus, the staff should be included as a part of the target group in the design process.

External users. The building will invite external users, users that have no relation to blindness, to utilise the building on an equal basis with the target group. This allows for a broader and more comprehensive use of the facilities, and supports growth and social sustainability within the community.

◂ *Ill. 44 - User group*
▸ *Ill. 45 - Duration of stays*



- DAILY VISITORS -
hourly basis

- OVERNIGHT STAYS -
days or weeks

DURATION OF STAYS
/ THE BUILDING'S OPERATING TIME

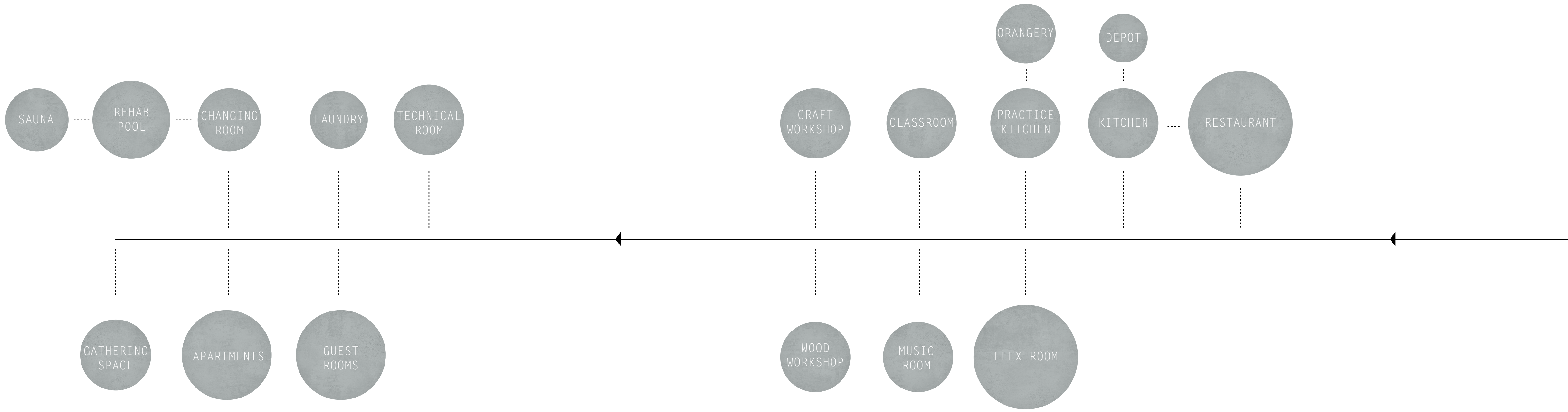
Daily visitors. The building allows all users to utilise the facilities on an hourly and daily basis. The inclusion of daily visitors will contribute to the involvement of the local community by collaboration with the surrounding context such as the children's institution, neurological institute and the residential area.

Overnight stays. Overnight stays will render weekly use possible for both international, national, regional and local users. Thereby, the building can accommodate longer rehabilitation courses and become a vacation destination for families.

- DELIMITATION -
ROOM PROGRAM

Functions	Quantity Amount of rooms	Capacity Amount of people	Unit area m2	Height m	Total area m2	Pulse intensity Low / Moderate / High	Spatial Perception
Foyer	1	-	140	3,5	140	Moderate	Inviting, welcoming, open, green
Staff office	2	5	15	3,5	30	Moderate	Designated for Staff
Restroom	2	1	5	3,5	10	-	-
Main artery	1	-	-	-	-	All	Guiding, transit, safety, varied
Transition Space	2	5	15	-	30	-	Clearing, resetting, varied, contrasting
Multi Gym	1	150	450	6	450	High	Center of attention, movement identity, inspiring
Rhytm and dance	1	20	60	5	60	High	Spacious, centralised
Crossfit	1	5	60	5	60	High	Connected to multigym, playful, open
Balance room	1	15	120	5	120	High	Connected to multigym, inspiring, open
Changing room/Restroom	4	1	5	3	20	-	-
Depot	1	-	40	6	40	-	-
Technical room	1	-	20	3	20	-	-
Rehab pool	1	10	60	3,5	60	Low	Embracing, calm, warm materiality
Sauna	1	5	5	2,5	5	Low	Wooden materials, warm materiality
Lounge	1	5	15	3	15	Low	Social, cosy, relaxing
Changing room/Restroom	3	1	5	3	15	-	-
Laundry room	1	-	15	3	15	-	-
Technical room	1	-	15	3	15	-	-
Kitchen	1	5	50	3	50	Moderate	Functional
Restaurant	1	80	120	4,5	120	Moderate	Social, inviting, cosy
Depot	1	-	20	3	20	-	-
Practice kitchen	1	8	40	3	40	Moderate	Functional, social
Dining	1	8	20	4,5	20	Moderate	Social, cosy, flexible, open
Classroom	2	10	25	4,5	50	Moderate	Functional, social, flexible
Craft workshop	1	8	25	4,5	25	Moderate	Creative, social, open
Wood workshop	1	10	40	4,5	40	Moderate	Creative, social, closed room
Music room	1	10	50	5	50	Moderate	Lively space, rhytmically, closed room
Childrens room	1	15	20	4,5	20	Moderate	Playful, inviting, open
Flex room	1	40	80	5	80	Moderate	Grand, directional, flexible
Orangery	1	5	50	3,5	50	Moderate	Green, social, closed transparent room, smell
Restroom	4	1	5	3	20	-	-
Technical	1	-	20	3	20	-	-
Fireplace lounge	1	20	50	3,5	50	Low	Intimate, warm materiality, relaxing, social
Meditation room	1	5	25	2,3	25	Low	Spiritual, intimate, relaxing, silent
Restroom	3	1	5	3	15	-	-
Laundry room	1	2	10	3	10	-	-
Technical room	1	-	15	3	15	-	-
Guest room	12	2	20	3	240	Low	Private, calm
Apartment 1	6	5	55	3	330	Low	Private, calm, homely
Total m2			1770		2375		

Light artificial / natural	Acoustics	Temperature degrees celcius	Ventilation	Notes
Natural	RT60: 0,9 s	22-24	Natural - cross ventilation	Direct access to the outdoor center
Natural	RT60: 0,6 s	22-24	Natural - Single sided	One staff open, one staff closed
Artificial	-	-	Mechanical	-
All	All	All	-	-
Natural	-	-	-	Transparent area, connection to the outdoors
Natural	RT60: 1,2 s,	18-20	Natural - Stack + cross ventilation	Goalball (9x18m), climbing wall (5m), gymnastics, etc.
Natural	RT60: 1,5 s	18-20	Natural - cross ventilation	Dance, Rhythm, flow yoga
Natural	RT60: 0,9 s	18-20	Natural - cross ventilation	Individual challenges, body strength
Natural	RT60: 1,2 s,	18-20	Natural - cross ventilation	Balance training, trampolin
Artificial	-	-	Mechanical	-
Artificial	-	-	Mechanical	-
Artificial	-	-	Mechanical	-
Natural	RT60: 0,9 s	26	Mechanical + natural - single sided	Possibility to open up to outdoors
Artificial	RT60: 0,6 s	Adjustable	-	View to the outdoor through pool area
Natural	RT60: 0,9 s	22-24	Natural - single-sided	View to the forrest
Artificial	-	-	Mechanical	-
Artificial	-	-	Mechanical	-
Artificial	-	-	Mechanical	-
Natural	RT60: 0,9 s	20-22	Mechanical + Natural - single sided	Open kitchen towards restaurant
Natural	RT60: 0,6 s	22-24	Natural - Single sided	Direct view and access to the outdoors
Artificial	-	-	Mechanical	-
Natural	RT60: 0,9 s, Def > 50	20-22	Mechanical + Natural - single sided	Connected to restaurant kitchen through depot
Natural	RT60: 0,9 s, Def > 50	22-24	Mechanical	Flexible area
Natural	RT60: 0,9 s, Def > 50	22-24	Natural - single sided	Possibility to divide into smaller areas
Natural	RT60: 0,6 s, Def > 50	22-24	Natural - single sided	Craft
Natural	RT60: 0,6 s	20-22	Mechanical + Natural - single sided	Wood craft
Natural	RT60: 1,2 s	22-24	Natual - single sided	Extra sound insulated
Natural	RT60: 0,6 s	20-22	Natural - single sided	Playroom for children, direct access to outdoors
Natural	RT60: 1,5 s, Clarity -1 to 3	22-24	Natural - Stack ventilation	Possibility to divide into smaller areas
Natural	RT: 0,6 s	-	Natural - single sided	Planting, cosy, relaxing, access to three rooms
Artificial	-	-	Mechanical	-
Artificial	-	-	Mechanical	-
Natural	RT60: 0,6 s	24-26	Natural - single sided	Direct view and access to outdoors
Natural	RT60: 0,4 s	24-26	Natural - single sided	Direct view and access to outdoors
Artificial	-	-	Mechanical	-
Artificial	-	-	Natural - single sided	-
Artificial	-	-	Mechanical	-
Natural	RT60: 0,6 s	22-27	Natural - single sided	Possibility to connect two guestrooms
Natural	RT60: 0,6 s	22-24	Natural - single sided	Possibility to connect two apartments



FLOW AND FUNCTIONS

/ FLOW RELATION BETWEEN THE DIFFERENT FUNCTIONS

A simple and intuitive flow within a building is crucial for the blind or visually impaired. The flow is of great importance as the room program offers a large variety of rooms and spaces. Thus, the idea of one main flow line that connects all the rooms forms the basis for a high level of legibility and an intuitive wayfinding.

Moreover, the rooms are placed in sections containing functions of the same category, meaning each sections will get it's own identity. This will allow for the design to express different atmospheres and experiences along the flow through the building.

▲ *Ill. 46 - Flow and function diagram*

DESIGN PRINCIPLES

CITY VS. NATURE

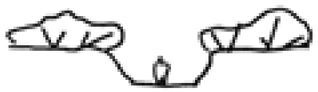
/ THE DESIGN SHOULD RELATE TO THE CONSTRASTING CITY AND NATURE

CENTERED AROUND MOVEMENT

/ THE OVERALL DESIGN SHOULD CENTER AROUND MOVEMENT AND PHYSICAL ACTIVITY

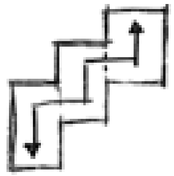
BUILDING FOLLOWS TERRAIN

/ THE SLOPING TERRAIN SHOULD BE AN INTEGRATED PART OF THE DESIGN



ARRIVAL THROUGH MOUND

/ THE MOUND SHOULD FORM AN OPENING FOR ARRIVAL

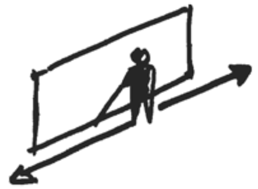


DIFFERENTIATING VOLUMES

/ THE BUILDING VOLUME SHOULD FORM VARIOUS SPACES AND STILL BE A CONNECTED WHOLE

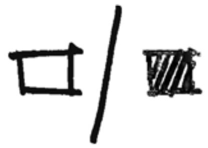
TRANSITION SPACES

/ BETWEEN CONTRASTING ATMOSPHERES TRANSI-TION SPACES SHOULD BE IMPLEMENTED



NATURAL GUIDELINES

/ THE ARCHITECTURE SHOULD BE A GUIDING SPACE



CONTRASTS

/ CONTRASTS IN THE PERCEPTION OF A SPACE OR MATERIAL WILL CONTRIBUTE TO WAYFINDING

CONVEX-CONCAVE WALL SHAPE

/ THE CONTRASTING CONVEX-CONCAVE WILL ACT AS GUIDING IN RELATION TO THE

INTERCONNECTION DENSITY (ICD)

/ THE DESIGN SHOULD AIM FOR A LOW SCORE IN THE ICD METHOD

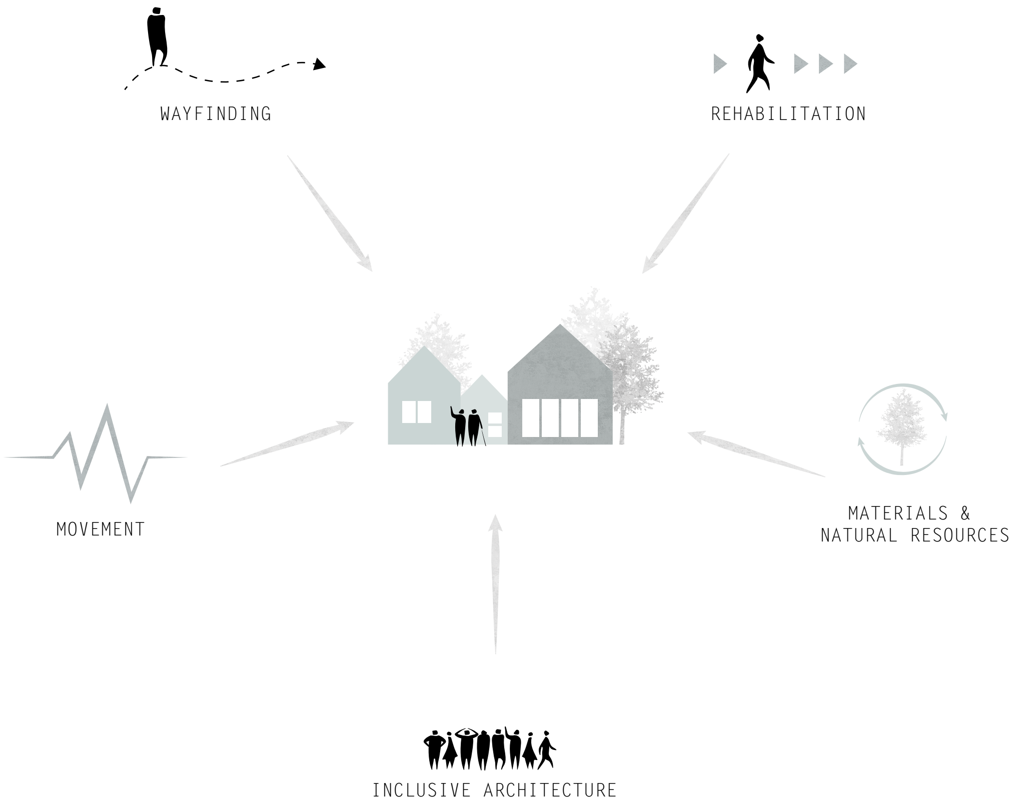
ACOUSTICS

/ THE DIFFERENT SPACES SHOULD CREATE VARIOUS ACOUSTICAL EXPERIENCES

LANDMARKS

/ THE DESIGN SHOULD INCORPORATE DIFFERENT LANDMARKS ON THE INTERIOR AND EXTERIOR

▲ *Ill. 47 - Design principles*



▲ *Ill. 48 - Vision*

VISION - A PLACE TO UNFOLD

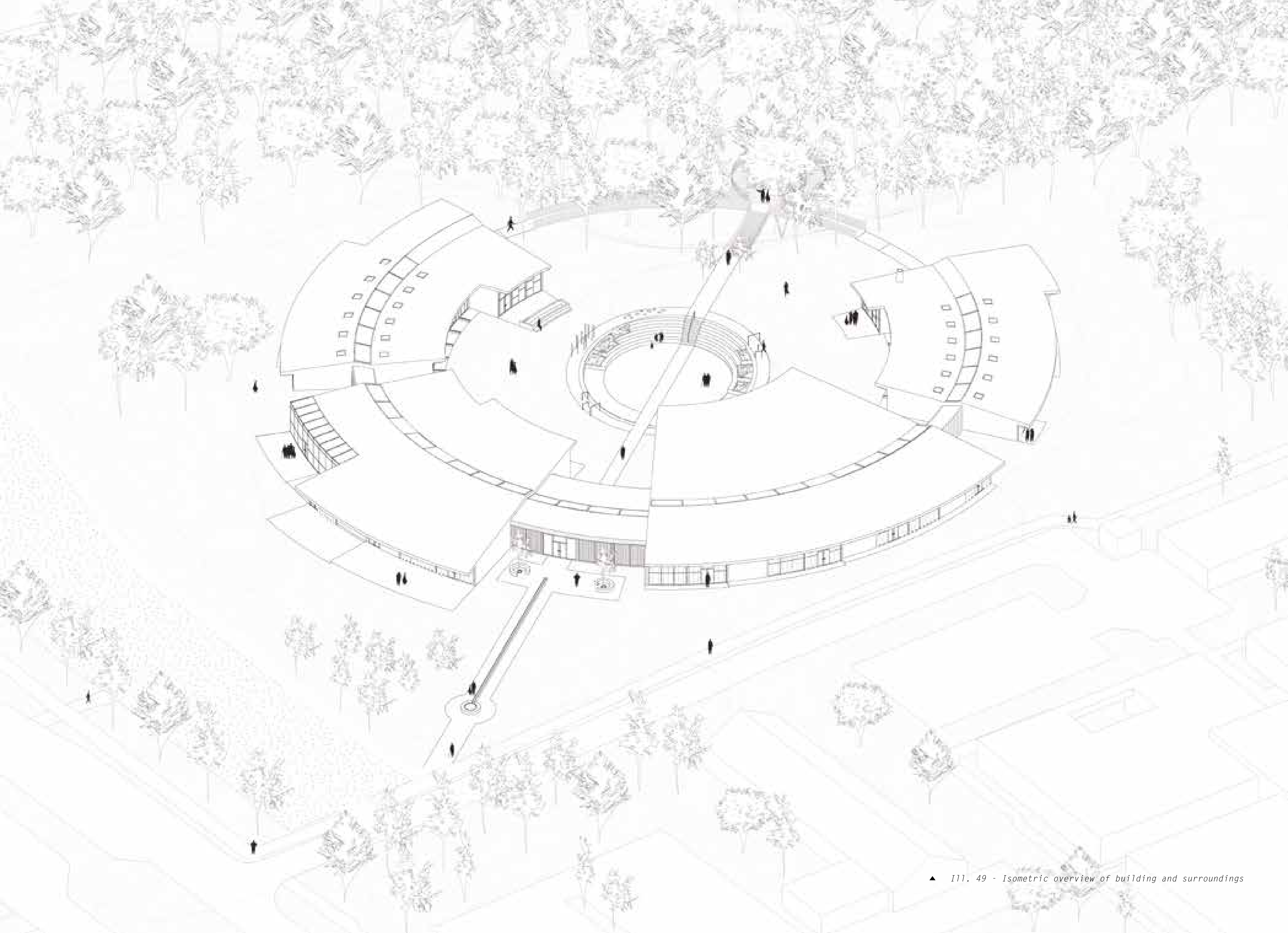
Through designing for the blind and visually impaired, we endeavor to highlight the potential of multisensory architecture and enhance the experienced quality of a space. We aim to create an architectural narrative based on sensory experiences, and explore sustainability through an inclusive architecture and the use of materials and natural resources.

The building should accommodate all aspects of the emotional, functional and physical rehabilitation of the blind, visually impaired and their relatives. The pivot of the architecture is to inspire people to move and increase the heart rate and pulse, as well as encourage social gatherings between the different users.

The architectural design should support legibility and wayfinding through the use of sensory contrasts and landmarks. We strive to design architecture that challenges and motivates the individual to participate in physical activity, thereby supporting an ecology of movement and providing a place to unfold.

05

THE PULSE



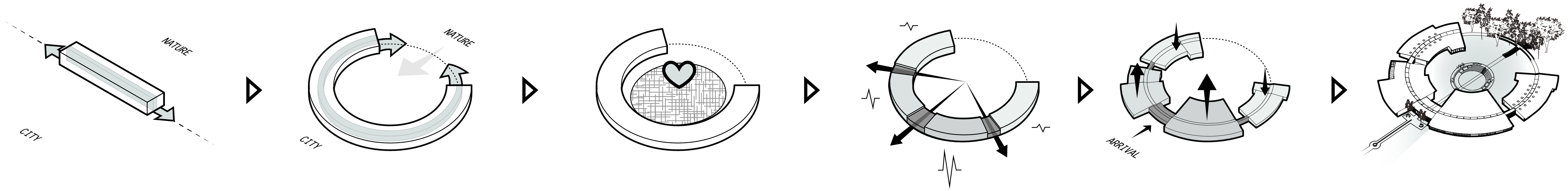
▲ *Ill. 49 - Isometric overview of building and surroundings*

The diagonal axis departs from the parking lot as an arrival path that passes through the mound, where the building is visually revealed. The pleasant sound of conversation from the restaurant's terrace and the muffled music from the rhythm room provide you with a direction towards the building. The sound of footsteps through the gravel can be noticed further ahead, and as you walk along the path, you encounter the arrival point - a water bassin, from where the sound of running water accompanies you all the way to the entrance.

Ill. 50 - Arrival Path ▶

Ill. 51 - Conceptual development of building ◄

Ill. 52 - 1:500 Masterplan ►



NATURE VS. CITY | EMBRACING THE NATURE | CREATING A CENTERED SPACE | PULSE ZONES AND TRANSITION SPACES | VOLUME DEVELOPMENT | ACTIVATING THE LANDSCAPE

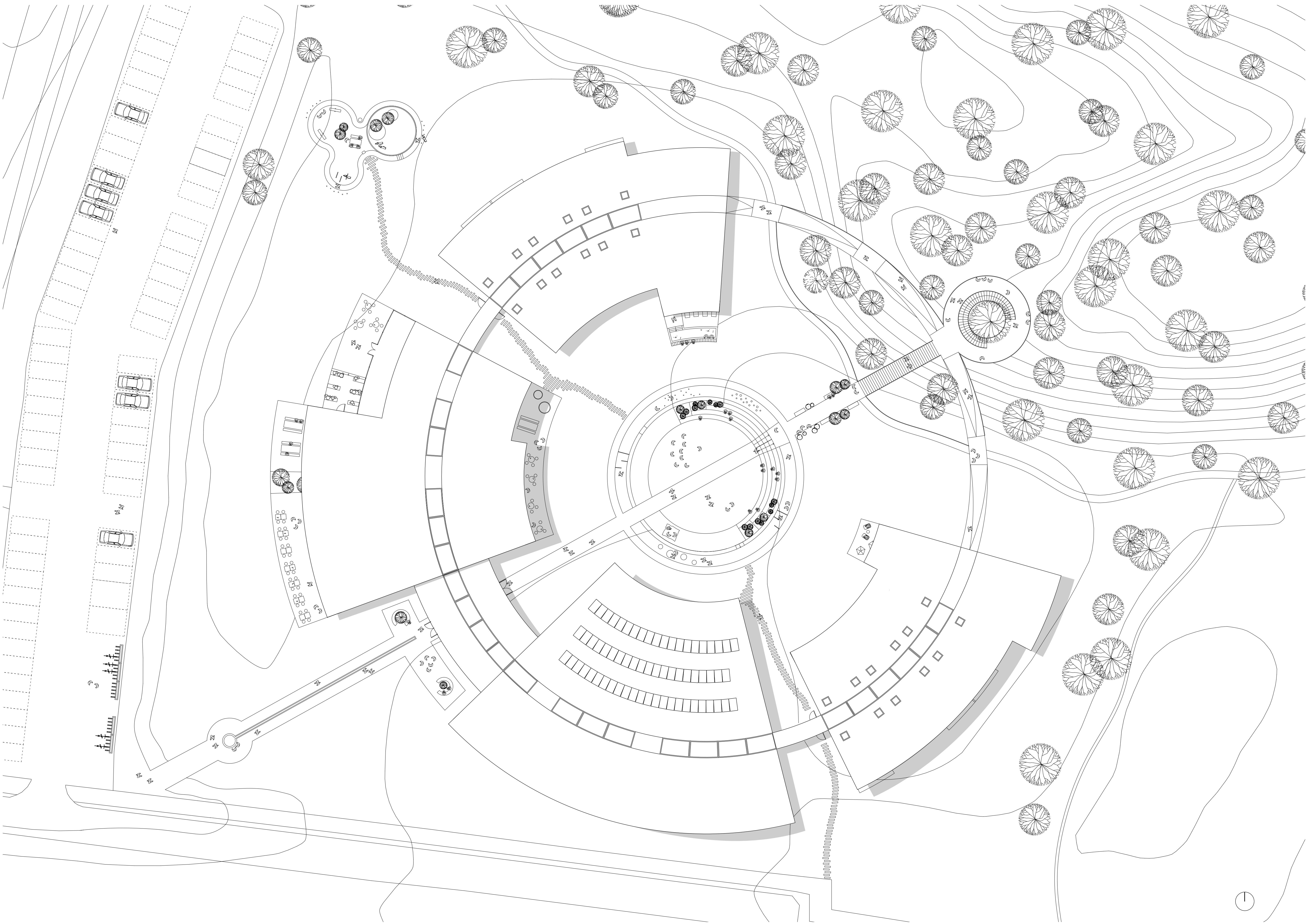
CONCEPT

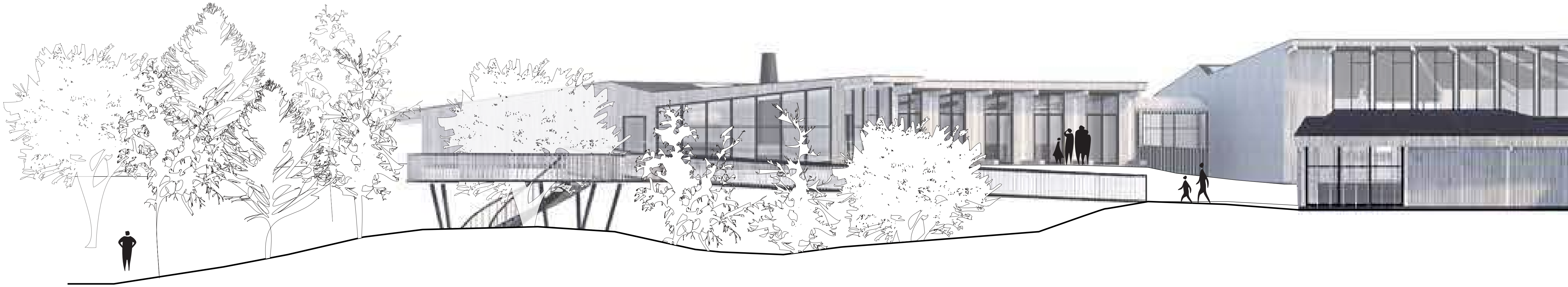
/ THE MAIN ARTERY OF THE BUILDING

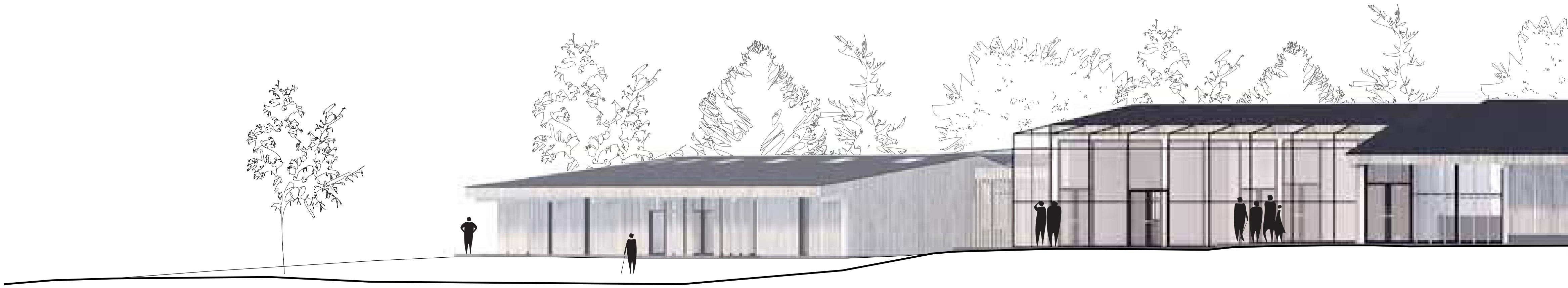
The presence of both city and nature at the site and the contradicting sensory experiences they impart dictate the building as a barrier between them. The building embraces the nature to enhance the connection to the forest and create a centered space that is sheltered from the city and provides a space the blind and visually impaired can explore safely. The volume also creates an inward direction, promoting social gatherings and interaction.

The building is divided into zones defined by different pulse intensities that identify the functions and describe the experience of the spaces. The flow between the pulse zones is constituted by a main artery that runs through the whole building. When moving along the main artery, the visitor becomes a part of each specific experience while continuously encountering sensory contrasts and landmarks. Transition spaces mark the shift in pulse and provide an opportunity for clearing the mind before entering the next zone.

The volumes are adjusted to suit the interior functions and intended experience, and to create smaller adjacent outdoor areas. The landscape is activated through a completion of the circle through the forest and a diagonal axis that moves through the dynamic landscape and connects city, building and nature.

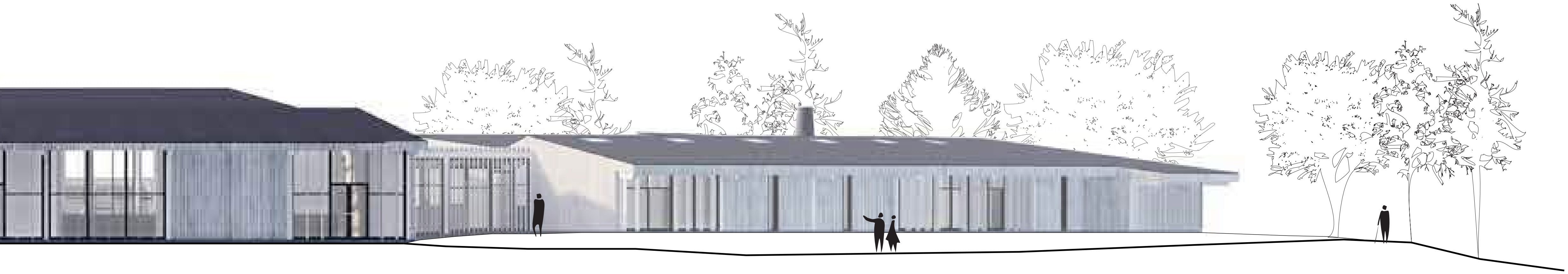




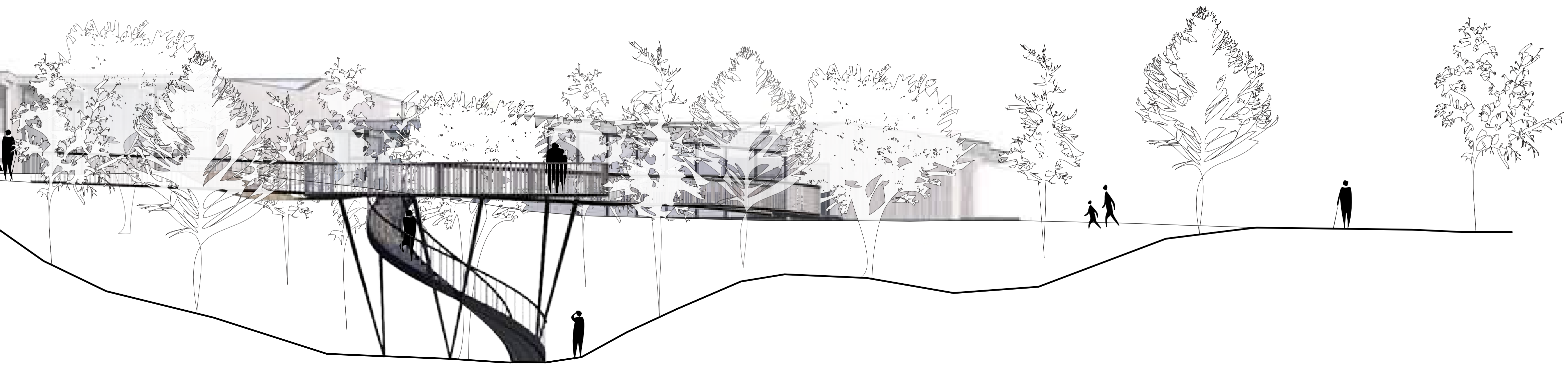


▲ Ill. 53 - 1:200 Facade North

▲ Ill. 54 - 1:200 Facade West



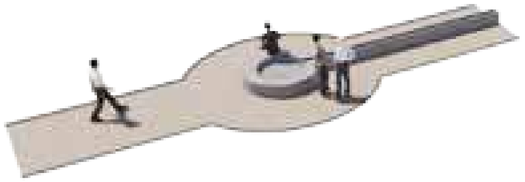
▲ *Ill. 55 - 1:200 Facade South*



▲ *Ill. 56 - 1:200 Facade East*

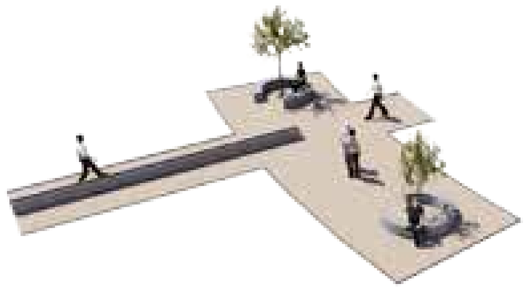
Ill. 57 - The embracing building

As you step out from the foyer and continue along the diagonal axis you find yourself back on the auditory and recognisable gravel. This materiality provides you with an audible and tactile memory, narrating the pathway you are taking and revealing your surroundings. In the center of everything, you sense the embracing atmosphere - the encircling building and the surrounding amphi creates an enclosed and safe space, while sounds from the different corners of the building narrates a place of opportunities, and you get a feeling of inclusion and being a part of a community. The catching enthusiasm sensed through sounds from the activities that take play at the obstacle course around you affects your motivation and inclination for joining and unfolding.



ARRIVAL POINT

Water fountain as landmark and guideline at the arrival path.



ARRIVAL SQUARE

A square in front of the foyer allows for meetings and lingering in the sun before entering the building.

CENTRAL AMPHI

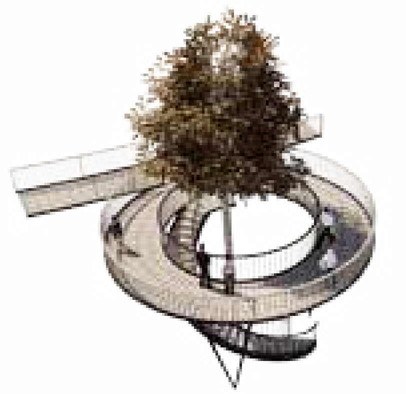
Placed in the center of the site and utilising the slope of the landscape, the central amphi invites for a variety of activities, while the obstacle course surrounding it provides a fun alternate path.

SENSORY GARDEN

The sensory garden is filled with aromatic flowers and fruit trees, and allows for a sensory interaction with the enclosing vegetation.

HANGING BRIDGE

Stepping onto the hanging bridge, your balance is activated and you become aware of the open space underneath you, while the sounds from the forest increase in intensity.



FOREST PLATEAU

When walking around at the plateau you can touch the tree crowns and smell the forest while the sound of your footsteps, the birds and the rustling of leaves are reflected in the deep hollow underneath you.

▲ *Ill. 58 - Serial vision of outdoor diagonal path*

▶ *Ill. 59 - The path through the forest*

Ill. 60 - Pulse intensity zones

Ill. 61 - Plan 1:500

DIFFERENT PULSE INTENSITIES

/ DIVISION BETWEEN ATMOSPHERIC ZONES BASED ON PULSE

The main artery constitutes the flow between the four pulse zones and forms a distinct guideline that through sensory contrasts and landmarks supports legibility and wayfinding for the blind and visually impaired. The pulse intensities form the basis for an architectural narrative generated by sensory experiences along the main artery. These experiences dictate the location of the functions.

1 Foyer
2 Information
3 Staff Office

High Pulse Zone

4 Multi Gym - Goalball Area
5 Rhythm Room
6 Balance Room
7 Cross Fit Area
8 Depot
9 Depot
10 Technical Room

11 Transition Space

Low Pulse Zone

12 Apartments
13 Guest Rooms
14 Fireplace Lounge
15 Laundry
16 Technical Room
17 Meditation Room

Moderate Pulse Zone

18 Restaurant
19 Kitchen
20 Cold Store
21 Depot
22 Technical Room
23 Practice Kitchen
24 Common Area
25 Flex Room
26 Music Room
27 Wood Workshop
28 Children's Room
29 Class Rooms
30 Craft Workshop
31 Orangery

32 Transition Space

Low Pulse Zone

33 Apartments
34 Guest Rooms
35 Technical Room
36 Laundry
37 Common Area
38 Sauna
39 Kneipp Hydrotheraphy
40 Rehab Pool

41 Parking
42 Arrival Square
43 Central Amphi Area
44 Obstacle Course
45 Sensory Garden
46 Hanging Bridge
47 Forest Plateau
48 Raised Path
49 Jacuzzi
50 Trampolines
51 Guide Dog Training Area
52 Campfire Area

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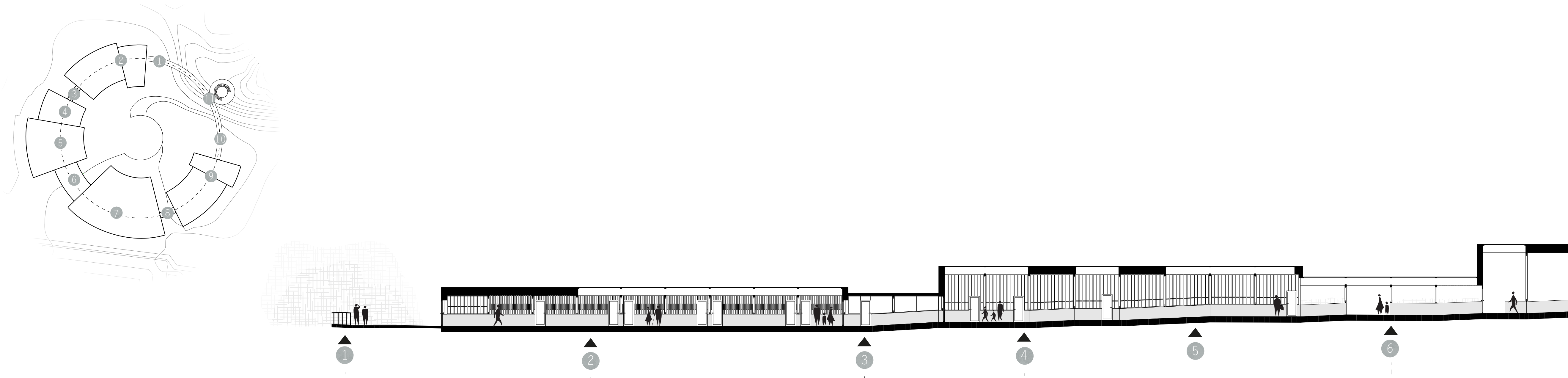
Ill. 62 - Foyer

As you step into the interior arrival space of the building different contrasts reach your sensory sphere. The sound-reflecting concrete reveals the gait of people around you, and the clearly expressed contrast between the concrete and warm wooden flooring marks the pathway towards the main artery, which will guide you around the building. From a distance you can hear the differentiation in activities on your left and right, which gives you an idea of what happens in the following spaces. As you lean on the concrete wall and your hand glides along it's polished surface, you brush something on the way. The exposed joint between the stereotomic concrete and the tectonic wooden structure meets in height with your hands, and the gesture of an intimate space that interacts with your sense of touch reveals the narrative of the structure.



OUTDOOR - FOREST

When standing by the edge of the forest, you are sheltered by the tree crowns and the sounds of the forest surround you. The fresh smell of the forest ground and vegetation makes you feel a close connection with the nature.

APARTMENTS - POOL - SAUNA

When you enter the low pulse zone, the warm temperature calms you down and makes you feel relaxed. The smell of the rehabilitation pool reaches your nose and the warm sound of conversation from the lounge reaches your ears.

TRANSITION

From a warm, comfortable space you step into the unheated transition area. Suddenly, the only sounds you can hear are those of your own footsteps and movement. The path begins to slope, activating your proprioception sense and making you aware of your movement and body. The space makes you notice yourself and your own position within the building. Your mind is cleared, and you begin to focus on what comes next.

CLASSROOMS - WORKSHOPS

When entering the moderate pulse zone, you notice the presence of people engaged in social interaction as friendly conversa-tions and chatting fills the space with sound. The smell of wood from the wood workshop pervades the air, and the skylights infuse the space with light from above.

RESTAURANT - KITCHEN - FLEXROOM

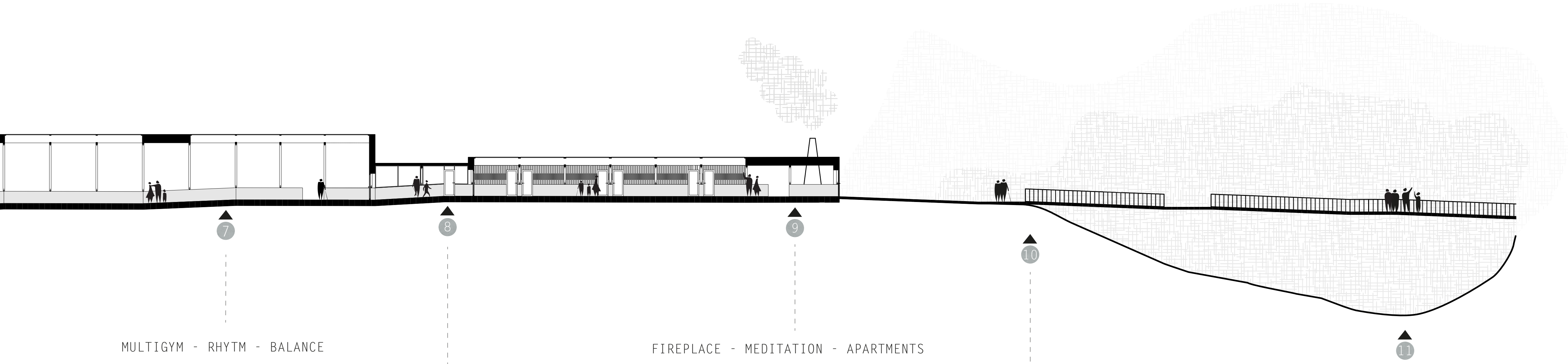
The smell of food and cooking from the open kitchen attracts you as you walk through the restaurant. Softly audible music from an event in the flexroom mixes with the sound of cutlery and cooking in the restaurant. The space oozes of social interaction and a friendly conversation.

TRANSITION - FOYER - STAFF

When you arrived at this place, this was the first space you stepped into where the sounds from two directions reached you, and you first encountered the main artery. Now you have been a guest for a few days, and your experience of the foyer is as a transition between the moderate and high pulse zones. The space is marked by an interruption of the concrete guideline and plants your hand comes into contact with when you move along.

10 m

Ill. 63 - Circular Section of Main Artery ▸



MULTIGYM - RHYTM - BALANCE

Before entering the space, you were prepared for the high pulse intensity through the sounds that reached you in the foyer. When you enter, a lower temperature touches your skin, and you can hear people moving and playing. The lively acoustics make you understand the space as large with profuse possibilities and opportunities. You feel inspired to challenge yourself and participate in the activities surrounding you.

TRANSITION

Between the high and low pulse areas you enter a transition space, marking a strong spatial contrast. The small transition space clears the mind and body from the previous space and prepares you for the next. It makes you focus on the exact space you are moving through and forget about the past.

FIREPLACE - MEDITATION - APARTMENTS

As you step into the second low pulse zone the warmth reaches you once again. You notice the absence of ramps and the sound of low conversation and crackling fire from the fireplace lounge. The cosy space invites you to unwind and relax on the soft furniture as the smell of the firewood reaches your nose.

OUTDOOR - HILLTOP - HIGHEST POINT

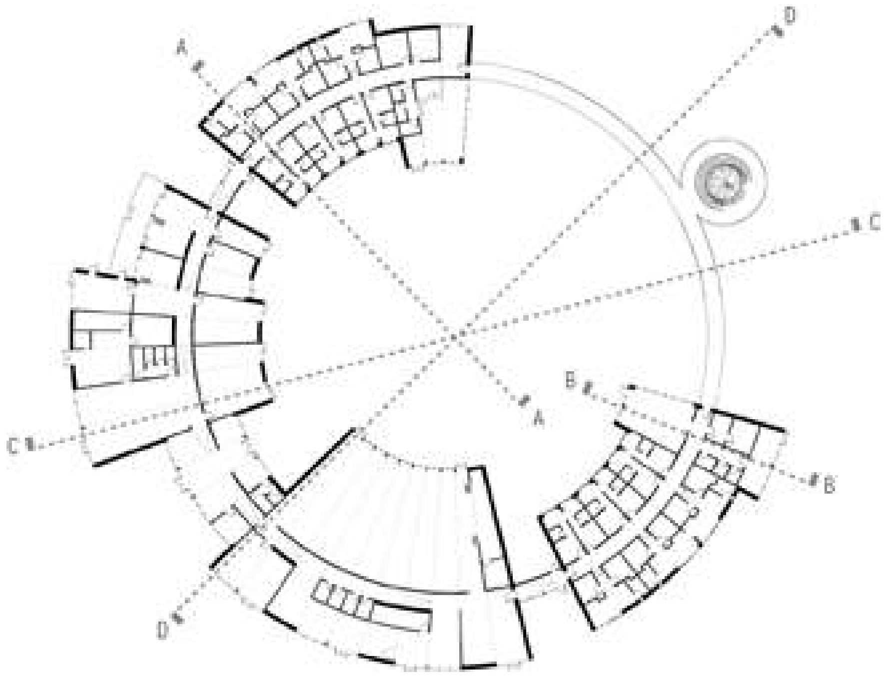
When you step outside the openness of the space becomes evident. At the hilltop the wind catches your hair and you can hear distant sounds of both buzzing traffic from the city below you and the bird song and rustling leaves in the trees of the forest.

FOREST PATH - PLATEAU

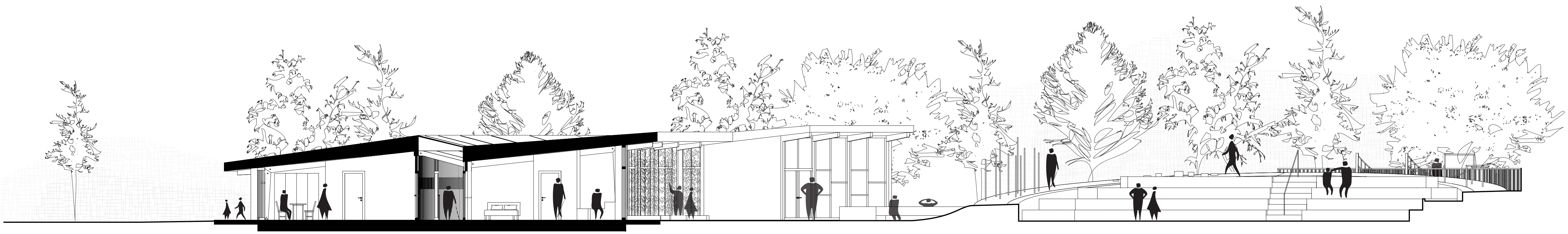
The path takes you into the forest, and as you move along the sound of your footsteps starts to reverberate underneath you. You can sense the hollow beneath you, and you understand that the path you are walking upon is high above the ground, and as you touch the leaves around you, you understand, that these are a part of the tree crowns. You once again notice the fresh smell of the forest ground and vegetation.

Ill. 64 - Multi Gym

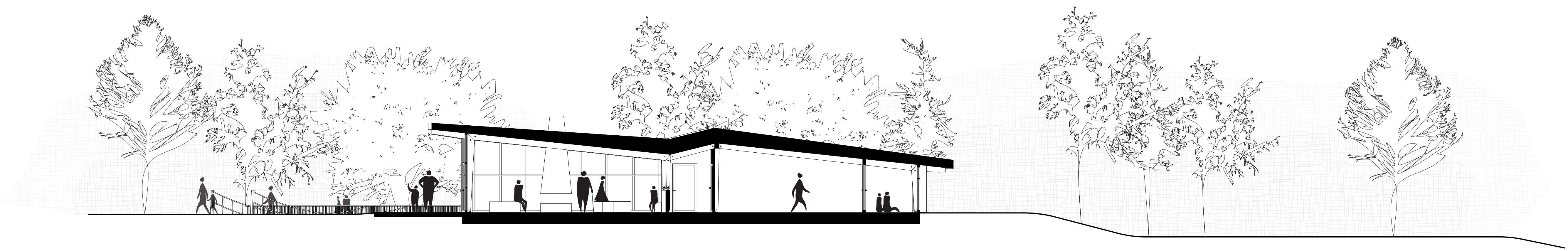
Along your way at the main artery of the building you step into what can be sensed as a large, open space where the atmosphere reverberates a high pulse intensity. The ongoing goalball game, the people cheering at the person on the climbing wall and laughter from people practicing their balance to your left makes you feel the joyfulness of physical activity on your body - even before you take part in it.



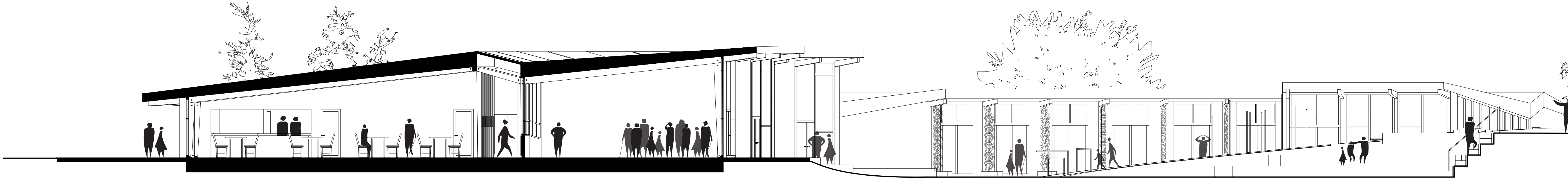
▲ *Ill. 65 - Section overview*

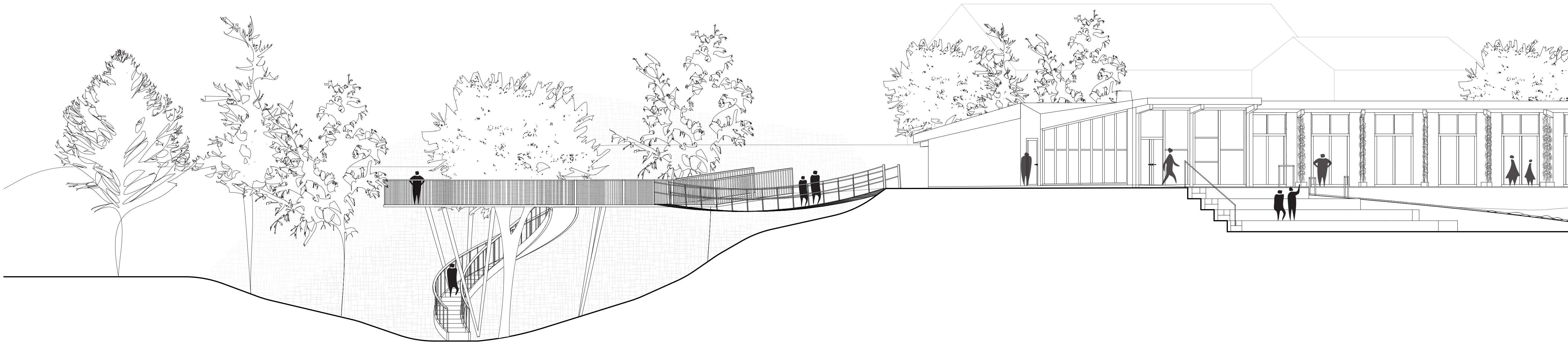


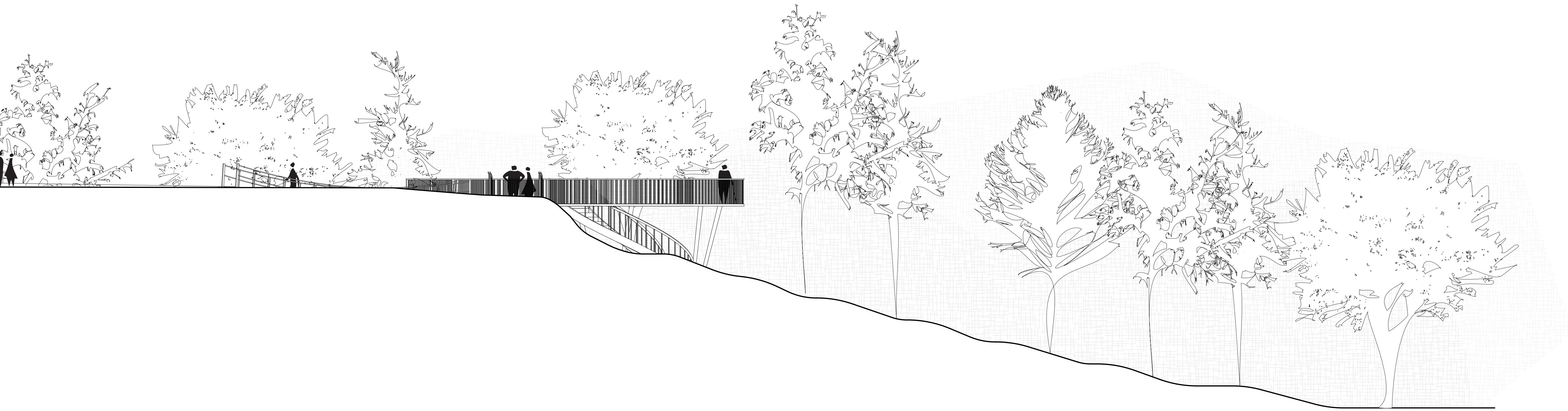
▲ *Ill. 66 - 1:200 Section AA*



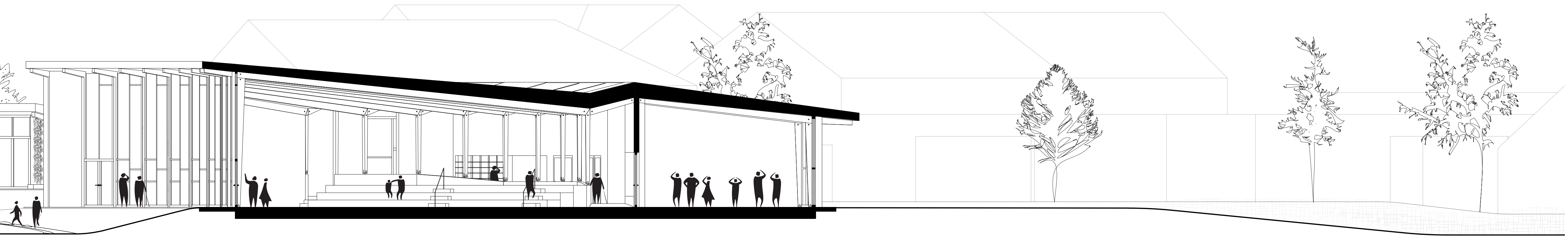
▲ *Ill. 67 - 1:200 Section BB*







▲ *Ill. 68 - 1:200 Section CC*

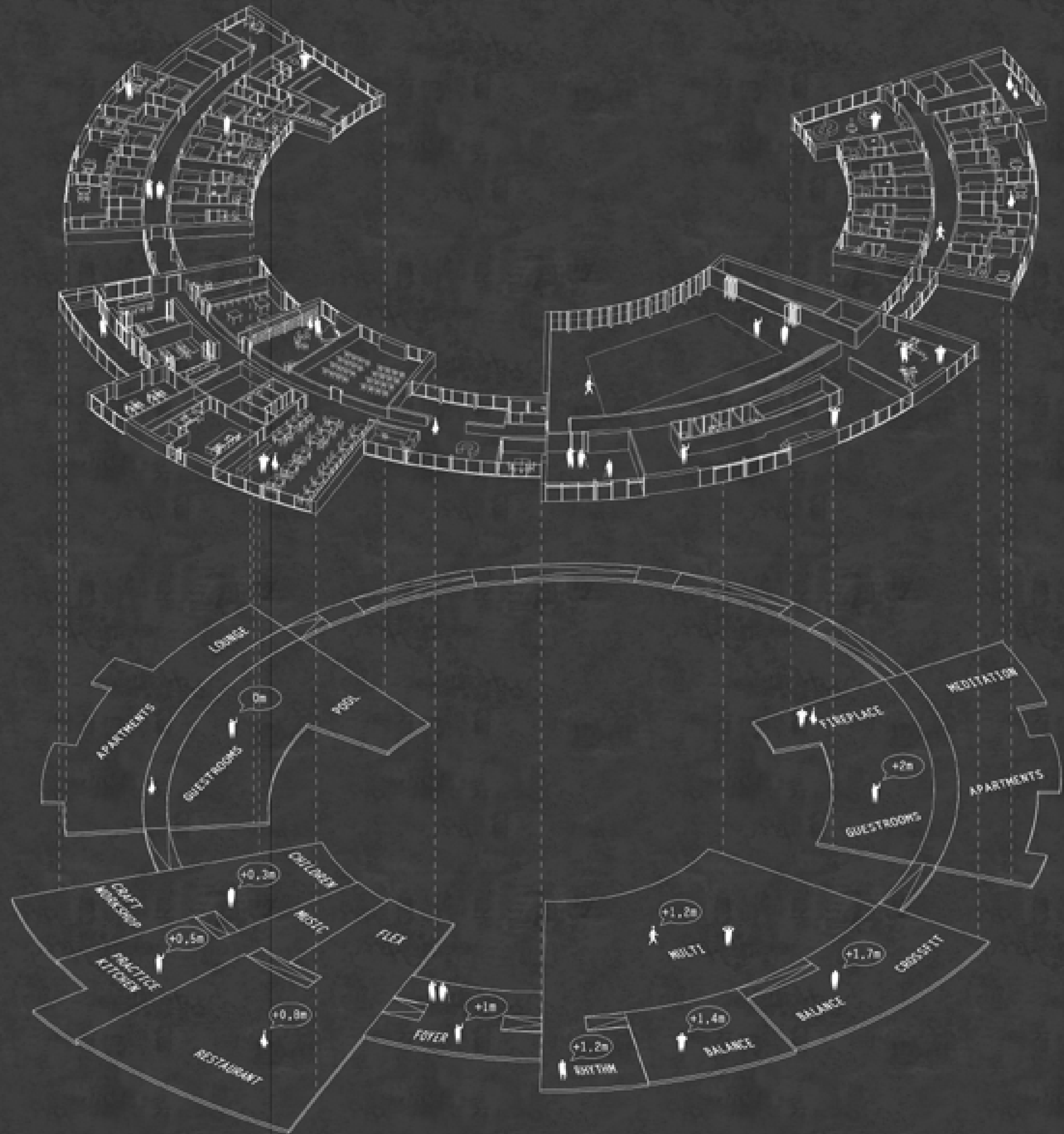


▲ *Ill. 69 - 1:200 Section DD*

Ill. 70 - Levels along the main artery ▶

SLOPING WITH THE LANDSCAPE

The levels of the building are designed to fit the terrain at the site. This will enhance the sense of place and communicate it's gesture of a dynamic terrain, while also providing guidance and legibility due to the contrasting ramps and plateaus of the main artery. This contrast contributes to wayfinding for the blind and visually impaired as it indicates when it is possible to divert from the main artery and enter the surrounding spaces. The ramps also activate the proprioception sense, aiming to improve balance and bodily awareness, which is imperative to the physical rehabilitation of the blind and visually impaired.



LOUNGE
APARTMENTS
0m
GUESTROOMS
POOL
FIREPLACE
MEDITATION
+2m
APARTMENTS
GUESTROOMS
CRAFT WORKSHOP
+0.3m
CHILDREN
MUSIC
FLEX
+0.5m
PRACTICE KITCHEN
+0.8m
RESTAURANT
+1m
FOYER
+1.2m
MULTI
+1.7m
CROSSFIT
BALANCE
+1.4m
BALANCE
+1.2m
RHYTHM

- INTERIOR -

OPEN SPACE

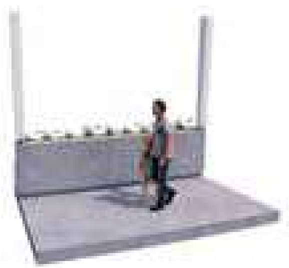
Upon the continuous concrete guideline there are only the constructive columns that frame the main artery while keeping a connection with the surrounding functions through the openness of the structure.

SEMI-OPEN SPACE

Between the constructive columns, a semi-transparent structure separates the spaces. The visual connection allows for contact between the main artery and the adjacent spaces, narrating them as open for everyone.

PRIVATE SPACE

In the low pulse areas the guiding wall clearly marks a division between the private rooms and the more public main artery. The composition of wooden lamellas provides a clear guideline at eye level, while also contributing to appropriate acoustics.



THE LANDMARK OF PLANTS

While the structure of the guideline is the same as in the open space, the plants in hand level provide both a tactile and olfactory experience that functions as a landmark and gives the guideline a distinctive character.

AN EMBRACING CORNER

Along the main artery, embracing corners are integrated to provide the opportunity for pauses and taking breaks. The concave wall encloses the seating area and gives the person a sense of being embraced.

STORAGE

Within the walls along the main artery, storage is integrated to allow people to leave their belongings or functional tools, such as a mobility cane or protective glasses, while participating in an activity.

Ill. 71 - Serial vision of interior main artery ▲

Ill. 72 - Main artery through low pulse areas ▶

Ill. 73 - Design initiatives for the user group ◂
Ill. 74 - Mirrored plans for guestroom and apartments ▸

MULLIONS IN EYE HEIGHT

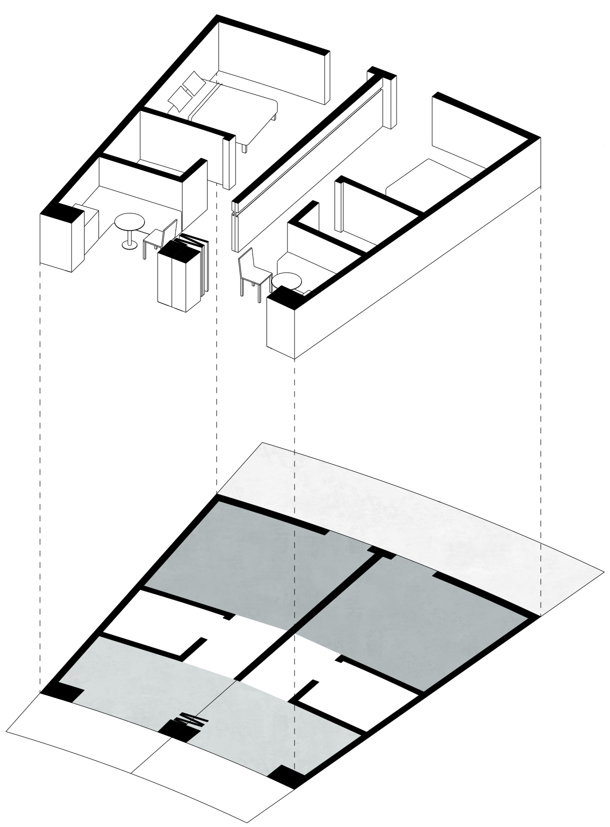
A RECESSED HANDRAIL IN THE INTERIOR WALL

A STRIP OF ARTIFICIAL LIGHT MARKS THE TRANSITION BETWEEN WALL AND FLOOR

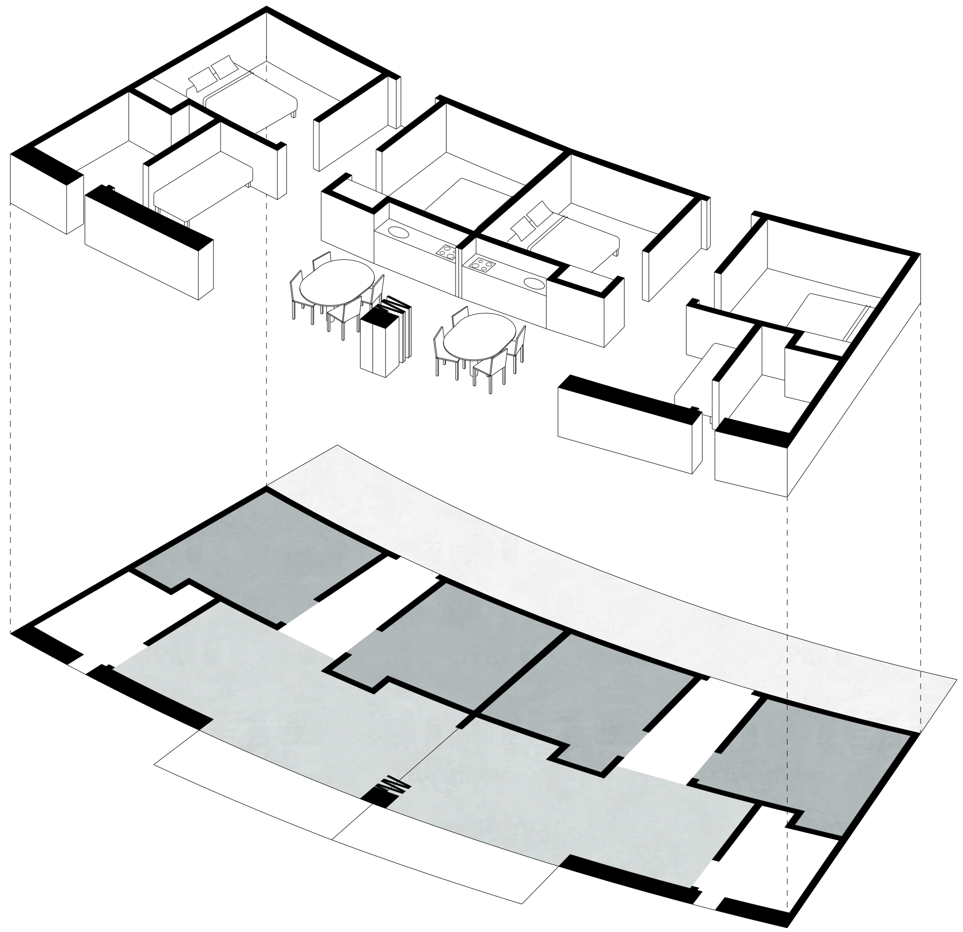
DETAILING

/ DESIGN INITIATIVES FOR THE BLIND AND VISUALLY IMPAIRED

As windows can be difficult for visually impaired people to distinguish, black wooden frames are used to mark them and create a contrast. Additional mullions are placed at average eye level for an adult, and a child, as many visually impaired people have restricted visual fields. Furthermore, the guestrooms are designed with a guideline as an integrated part of the plywood wall. The warm material provides a contrasting tactility compared to the main artery and guides the visitor through the room.
Finally, a strip of light is placed underneath the edge of the concrete wall in the main artery. It functions as a visual separation between the floor and the wall for the visually impaired, as well as a guiding element.



GUESTROOMS



APARTMENTS

LIVING SPACES
/ GUESTROOMS

When entering the guestroom from the main artery in the low pulse zones, the first wall you encounter is hollowed out in hand height, creating a guideline in the warm plywood material. The soft carpet on the floor slows down your pace and makes you feel at home. The skylight in the sleeping area lets a dimmed light enter the space, and you can hear the calming sound of the rain falling on the glass. From this private area, the guideline brings you towards the social zone where sliding doors allow you to step out onto a small terrace and the sound of the ongoing activities in the outdoor space reaches you. On the terrace you meet your neighbor, and as you fall into conversation, you decide to open the folding wall between your separate guestrooms to continue your dialogue inside.

LIVING SPACES
/ APARTMENTS

When entering the apartment from the main artery, you find yourself in a narrowed space with natural guidelines on both sides, directing you further into the space. Retracted from the social areas are the bedrooms, which occur as private zones. Continuing forward makes you experience a spatial change - the room opens up towards a social area, which extends into the mirrored apartment through the open folding door. Furthermore, the social gathering space opens up to the exterior through the sliding door and lets in the sounds from the surrounding context.

Ill. 75 - Fireplace lounge

The warmth of the flames fills the space and the pleasant crackling sound makes you want to linger around the fireplace with friends and family. The warmth of the materiality and the softness of the furniture provides an aura of relaxation and an opportunity to unwind. The panoramic view of the forest makes you aware of the proximity to nature and the calmness of the forest. As someone opens the door to the exterior, the sounds from forest are let in, giving the space the character of a fireplace in the woods.

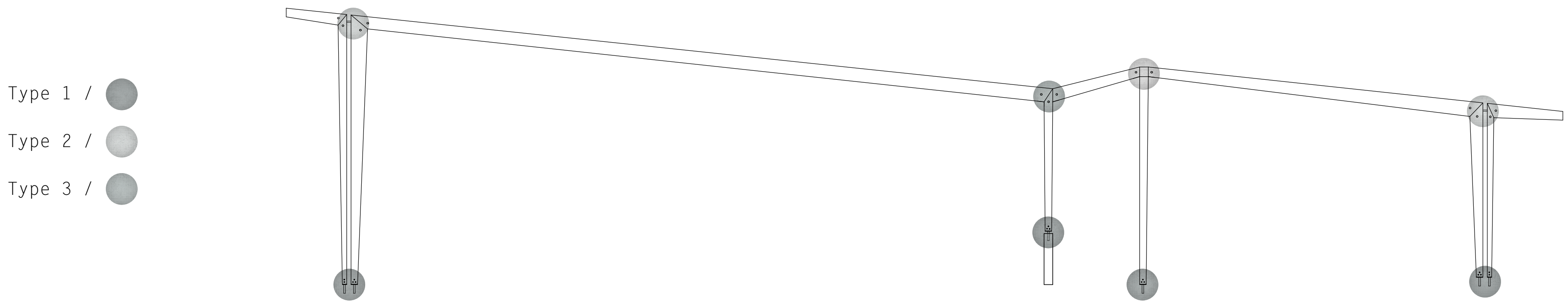
Ill. 76 - Structural system of the building

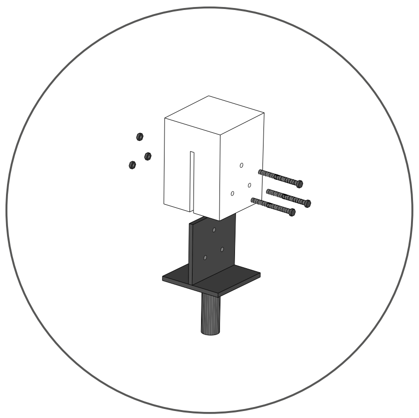
Ill. 77 - Frame structure and joint details

A FRAME STRUCTURE

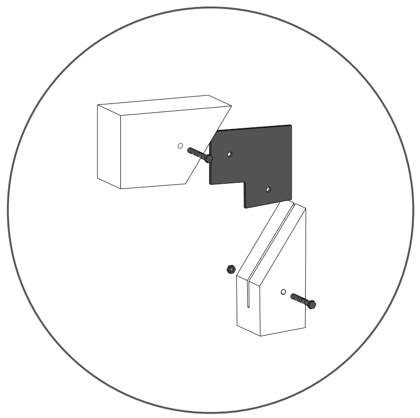
The structural system is composed of glulam columns and beams that are assembled using steel joints. The joints make the structure prudent as it can be easily disassembled and the columns and beams can be reused or replaced if necessary.

BEAMS	COLUMNS	JOINTS
GLT - Spruce	GLT - Spruce	Steel

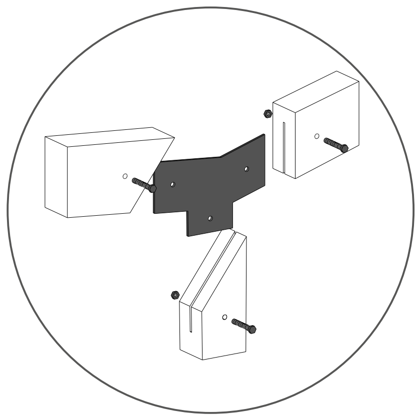




Type 1
/ Column base support



Type 2
/ Column-beam joint



Type 3
/ Column-beam joint

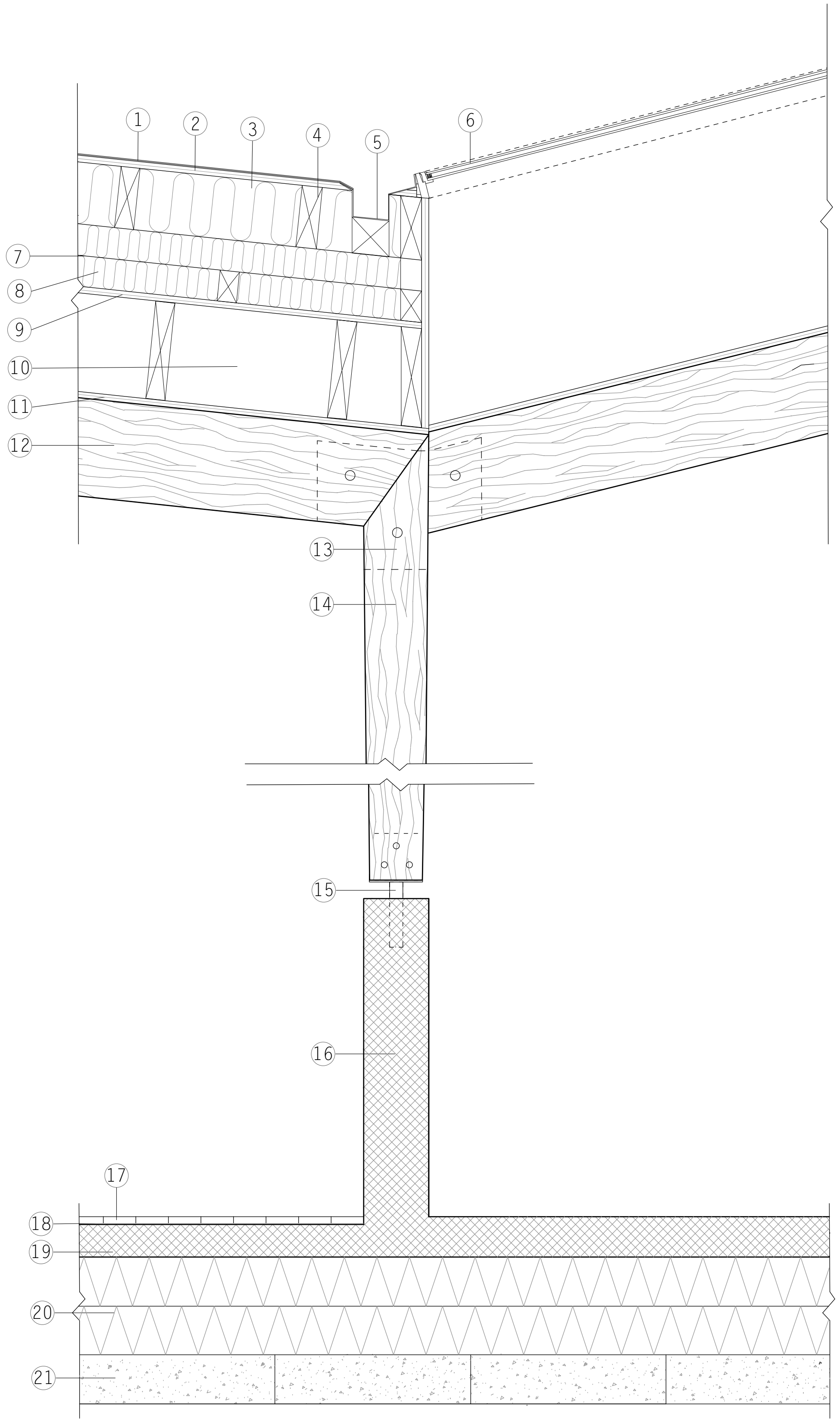
Ill. 77 - 1:20 Detail drawing ◀

Ill. 78 - Materiality specifications ▶

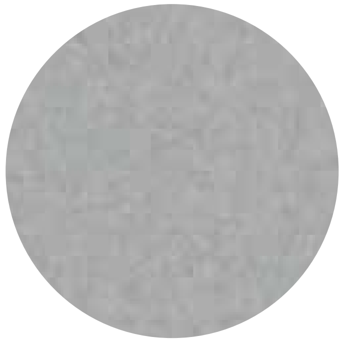
DETAIL

/ SECTION THROUGH MAIN ARTERY CONCRETE WALL

1. Roofing felt
2. Roof construction
3. 285 mm eelgrass insulation
4. Battens
5. Gutter
6. Skylight in main artery
7. Membrane
8. 95 mm eelgrass insulation
9. Plywood
10. Space for ventilation pipes
11. Plywood
12. Glulam beam
13. Steel joinery
14. Glulam column
15. Steel support for column
16. Concrete wall
17. Wooden floor
18. Floor foam
19. Concrete slab
20. 300 mm insulation
21. Lightweight concrete



FLOORING

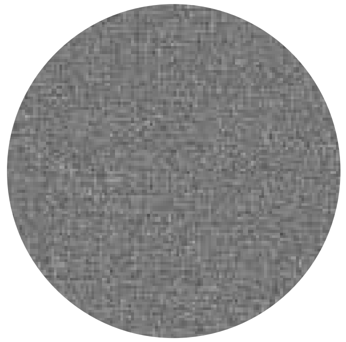


POLISHED CONCRETE

Main artery floor and guideline.

HARDWOOD FLOOR

Used in common spaces in all pulse intensities.



CARPET

Flooring in apartments and guestrooms.
Indicates privacy within low pulse areas.

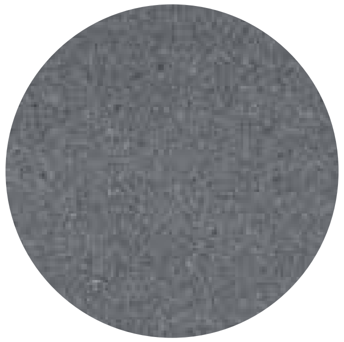
DYNAMIC FLOORING

Zones within the balance room.
Flexible floor tiles, memory foam flooring,and trampoline.

INTERIOR

PLYWOOD

Interior walls in entire building



ACOUSTIC FELT

Back wall of embracing corners in main artery.
Upcycled end-of life textile from Really (Reallycph.dk, 2019)

SOLID TEXTILE BOARD & LAMELLAS

Wall of main artery in low pulse.
Upcycled end-of life textile from Really (Reallycph.dk, 2019)

TROLDTEKT & LAMELLAS

Ceiling in entire building.
Spacing increased or decreased to support acoustic intentions.

EXTERIOR

WOODEN FRAME

Black wooden frame on all windows.

GLASS

Clear glass in windows
Tinted glass marks doors to exterior

TIMBER CLADDING

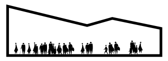
External facades and roof on foyer and transitions.
Character cladding from Kebony (Kebony.com, 2019)

ROOFING FELT SHINGLES

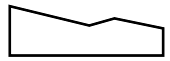
Roof on all pulse intensities.
Roofing felt from Derbigum (Derbigum.dk, 2019)

Ill. 79 - Scheme of acoustics

Ill. 80 - Exploded drawing for acoustic



OCCUPIED



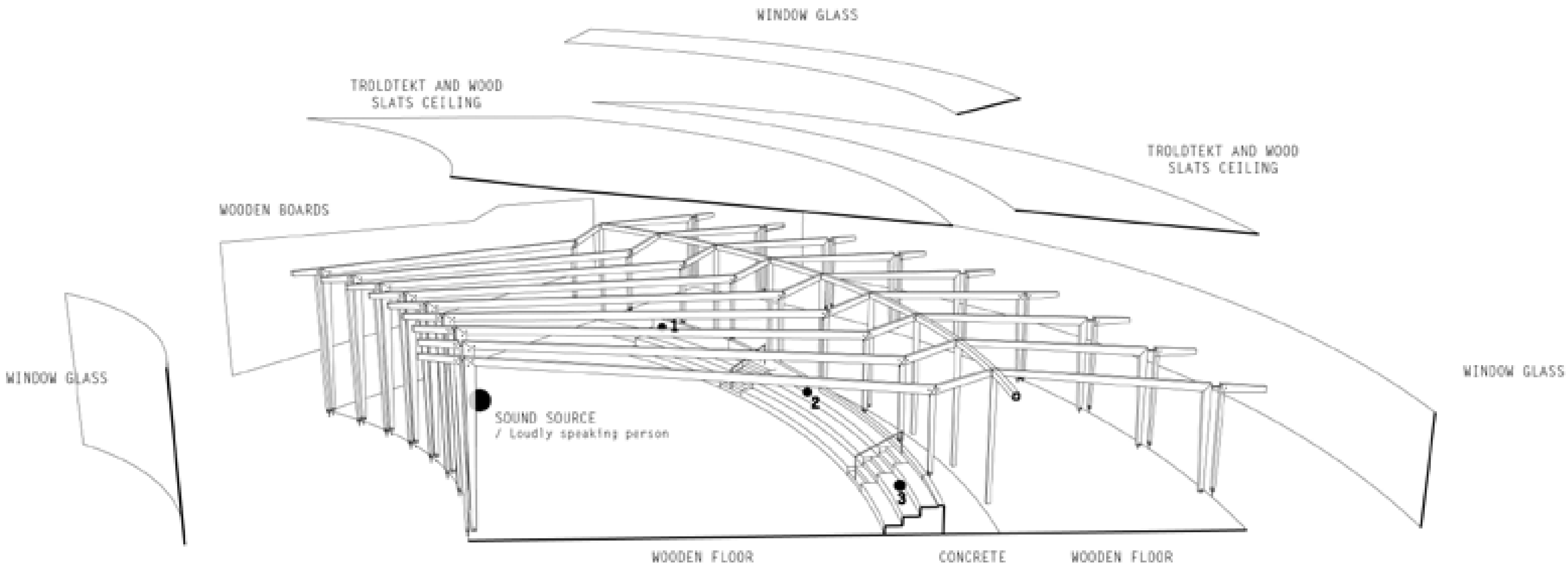
UNOCCUPIED

	OCCUPIED 0-8000 Hz			OCCUPIED 500 Hz			OCCUPIED 1000 Hz			UNOCCUPIED 0-8000 Hz			UNOCCUPIED 500 Hz			UNOCCUPIED 1000 Hz		
RECEIVER	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
REVERBERATION TIME (RT60)	1.1	0.9	1.2	1.4	1.1	1.5	1,3	1.1	1.5	1.3	1.4	1.4	1.3	1.5	1.5	1.4	1.6	1.5
1-1.5 s	●	○	●	●	●	●	●	●	●	●	●	●	●	●	●	●	○	●
DEFINITION (D50)	83.1	89.7	85.2	89.1	92.4	83.7	83.1	92.6	84.4	79.1	85.1	78.3	80.1	87.3	78.7	82.3	88.3	78.8
>50 %	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
CLARITY (C50)	7.0	11.5	8.1	6.1	10.9	7.1	5.6	11.0	7.3	5.9	7.8	5.7	5.8	8.4	5.7	5.3	8.8	5.7
8-12 dB	○	●	●	○	●	○	○	●	○	○	○	○	○	●	○	○	●	○

ACOUSTIC EXPERIENCE

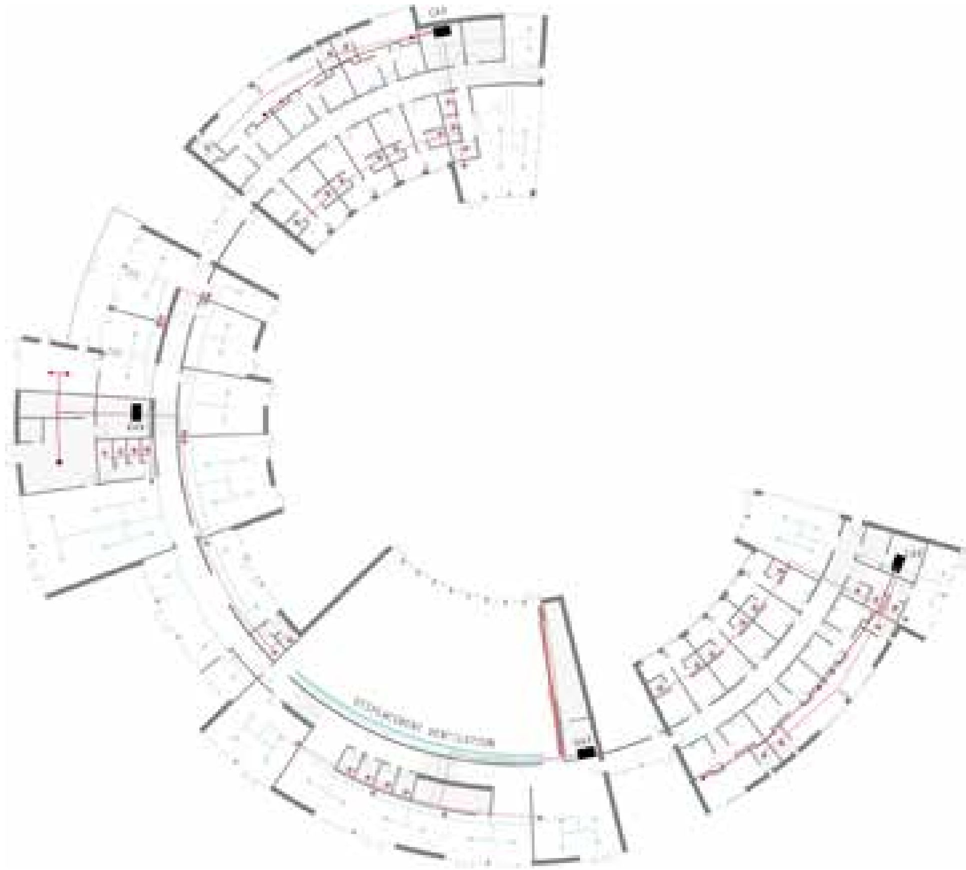
/ THE MULTI SPACE

The acoustic experience of the multi space within the high pulse zone should service different activities such as goalball games, talks, presentations and other events. First and foremost, it should enhance the experience of an open, large space, which invites for physical unfolding, through it's reverberation time. This in play with a high definition and clarity values, that ensure clearness in both what kind of sound is heard and from where it travels through the space. Thus, an absorptive ceiling of troldtekt and lamellas ensures a high definition and clarity, while the open, large volume with reflective surfaces such as the window glass provides an appropriate reverberation time.


WINDOW GLASS
TROLDTEKT AND WOOD
SLATS CEILING
TROLDTEKT AND WOOD
SLATS CEILING
WOODEN BOARDS
WINDOW GLASS
WINDOW GLASS
1
2
3
SOUND SOURCE
/ Loudly speaking person
WOODEN FLOOR
CONCRETE
WOODEN FLOOR

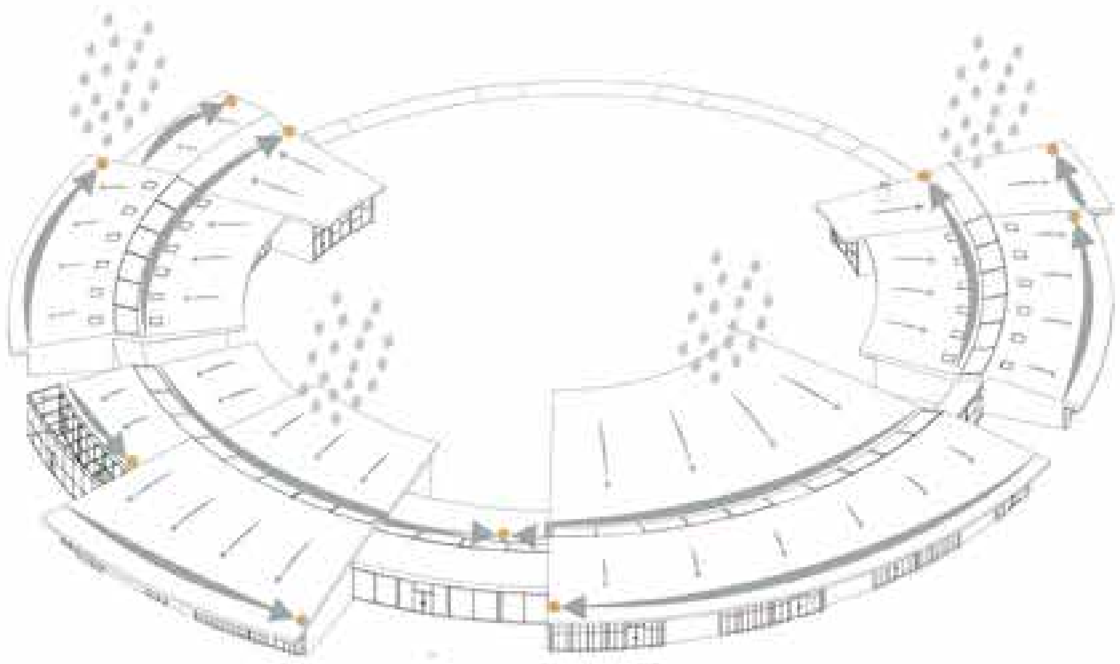
Ill. 81 - Mechanical Ventilation - Duct system ◄

Ill. 82 - Rainwater strategy ►



MECHANICAL VENTILATION
/ STRATEGY OF DUCT SYSTEM

The mechanical ventilation system is composed of four decentralised ventilation units, each serving a separate pulse zone. In the moderate and high pulse zones, the pipes cross the main artery above the embracing corners. The absence of skylights results in a darker section, creating a contrast in the visual experience of the main artery and marking the possibility for taking a break. In the low pulse zones, the covered sections of the main artery indicate gathering spaces of similar character to the embracing corners.



RAIN WATER
/ STRATEGY FOR HANDLING RAIN WATER

As rain falls on the building, the shape of the roof causes some of the water to gather above the main artery. The roof of the low pulse areas are slightly tilted to allow the rain water to be directed towards the forest. The rain that falls on the moderate and high pulse zones is directed towards the foyer, where the water is collected and descends through a transparent pipe in the middle of the room. This creates a visible and audible architectural feature that functions as an extension of the external water feature placed at the arrival point. The slope of the site causes the rain that falls on the ground in the central space to run towards the building. The water is collected in grates placed along the terraces and used to supply the external water feature.

Ill. 83 - Overview of building and rooms for Be18 and BSim

Ill. 84 - Numbers from Be18 and BSim

Total Energy Consumption
Residential part
28,7 kWh/m^2 year
Energy frame BR18
30,9 kWh/m^2 year

Total Energy Consumption
Other part
31,9 kWh/m^2 year
Energy frame low energy
33,0 kWh/m^2 year

Total Energy Consumption
Other part w. solar cells
6,9 kWh/m^2 year
Energy frame low energy
33,0 kWh/m^2 year

RHYTHM ROOM

TEMPERATURES

52 hours > 26 °C
23 hours > 27 °C

Top Mean (Monthly)
18,70 - 20,36 °C

Maximum Temperature
August / 30,35 °C

Minimum Temperature
Nov-Mar / 20,00 °C

AIR QUALITY

Max CO_2 Level (Monthly)
555,0 - 562,9 PPM

Mean CO_2 Level (Monthly)
395,0 - 409,2 PPM

HEAT BALANCE

Heating
+ 817,03 kWh

Sun Radiation
+ 4874,84 kWh

People Load
+ 7665 kWh

Equipment
+ 255,5 kWh

Infiltration
- 3146,31 kWh

Natural Ventilation
- 2159,40 kWh

Transmission
- 3573,42 kWh

Mechanical Ventilation
- 4733,23 kWh

GUEST ROOM

TEMPERATURES

0 hours > 27 °C
0 hours > 28 °C

Top Mean (Monthly)
21,48 °C - 22,85 °C

Maximum Temperature
June / 25,98 °C

Minimum Temperature
January / 20,27 °C

AIR QUALITY

Max CO_2 Level (Monthly)
448,0 - 450,6 PPM

Mean CO_2 Level (Monthly)
426,2 - 428,2 PPM

HEAT BALANCE

Heating
+ 518,85 kWh

Sun Radiation
+ 1589,97 kWh

People Load
+ 499,32 kWh

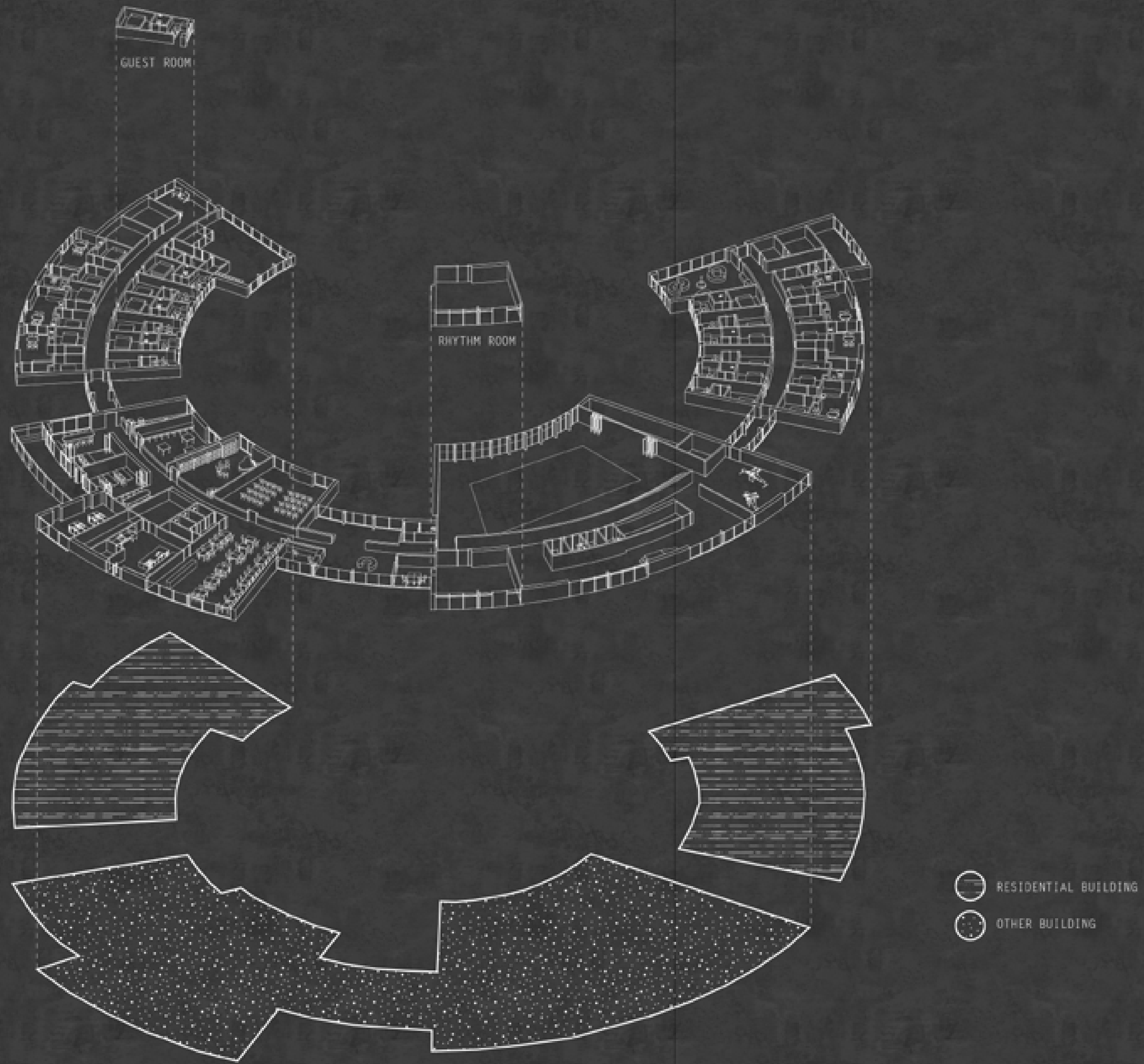
Equipment
+ 693,5 kWh

Infiltration
- 233,99 kWh

Natural Ventilation
- 127,35 kWh

Transmission
- 2919,93 kWh

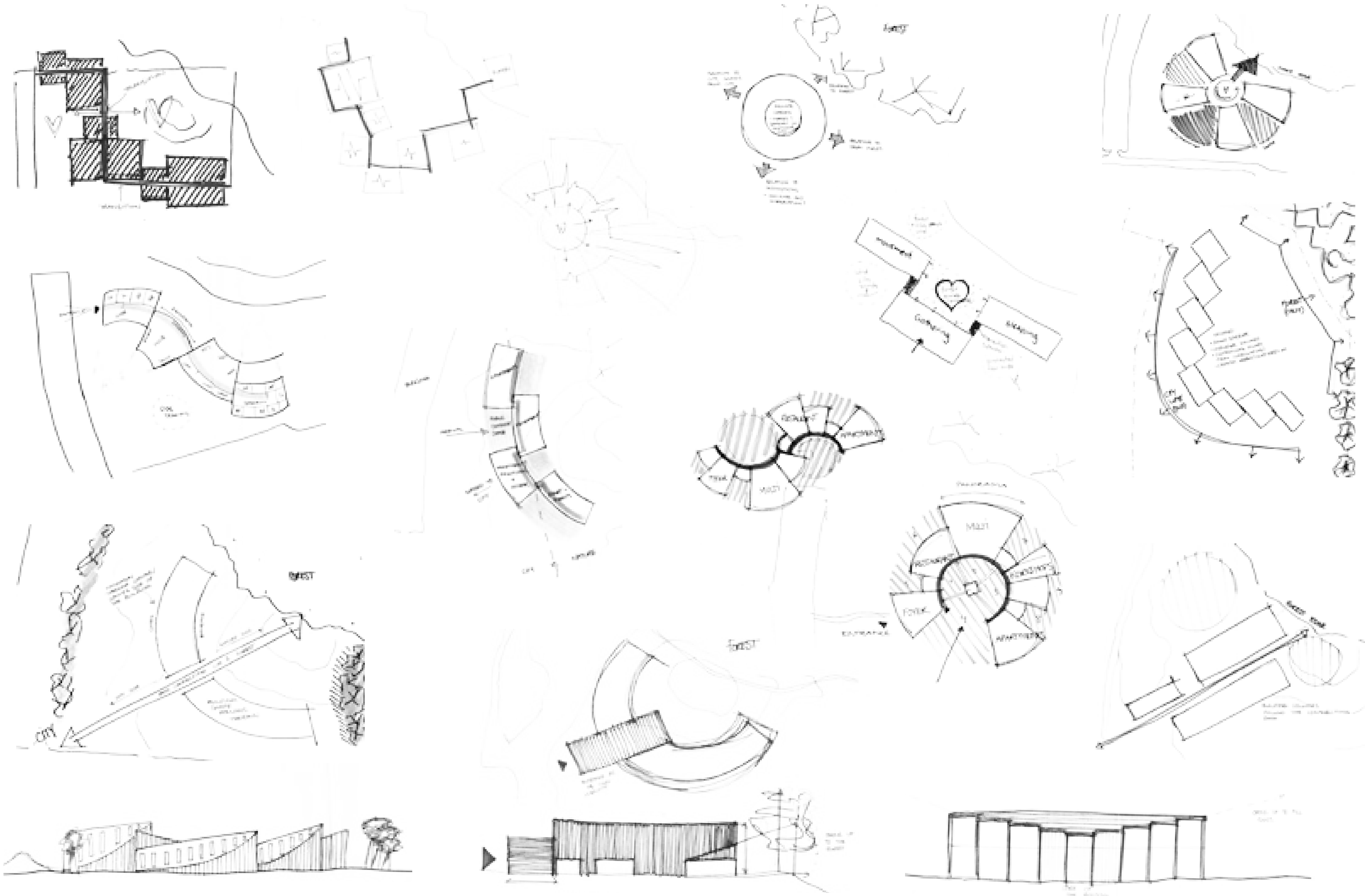
Mechanical Ventilation
- 20,36 kWh


GUEST ROOM
RHYTHM ROOM
RESIDENTIAL BUILDING
OTHER BUILDING

06

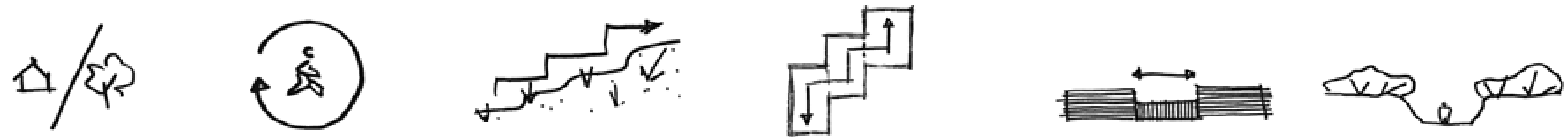
DESIGN PROCESS

Ill. 85 - Process


CITY
FOREST
MULTI

Ill. 86 - Sketches of volumes in plan and section

Ill. 87 - Design principles



CITY VS. NATURE

CENTERED AROUND MOVEMENT

BUILDING FOLLOWS TERRAIN

SMALLER VOLUMES INDICATE DIFFERENT SPACES, BUT FORM A “WHOLE” BUILDING

CONTRASTING SPACES TO MARK A TRANSITION

ARRIVAL THROUGH MOUND

SKETCHING WORKSHOP - PART 1

/ SITE AND VOLUMES 1:200 AND 1:500

The initial sketching workshop focused on diagrammatic sketches in plan and section, respectively in 1:200 and 1:500, aiming to explore the relationship between the site and different volumes. These sketches informed the design The initial sketching workshop focused on diagrammatic sketches in plan and section, respectively in 1:200 and 1:500, aiming to explore the relationship between the site and different volumes. These sketches informed the design process through the identification of a set of principles.

The thematic analyses determined the emphasis on physical activity, resulting in a discussion of ideas regarding movement as the pivot of architecture. The distinction between city and nature is based on the phenomenological analysis of the site, where the contrasts between the sensory experiences produced by the two areas became evident. The dynamic landscape that characterises the site provided an intention of creating a building that follows the terrain. The size of the building lead to the idea of generating smaller volumes to be combined into a whole using contrasting transition spaces. The mound separating the existing parking lot from the site was investigated and creating an arrival through the mound was identified as a quality.
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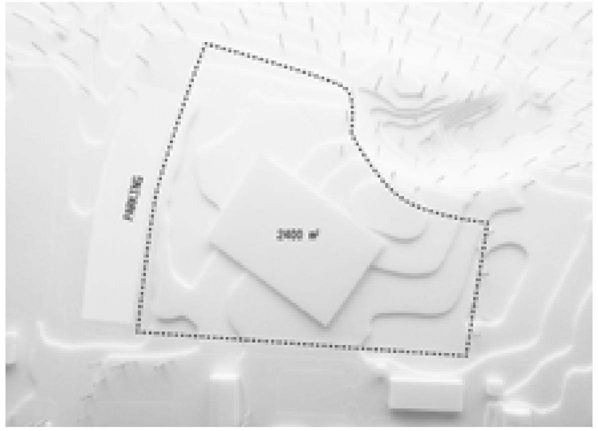
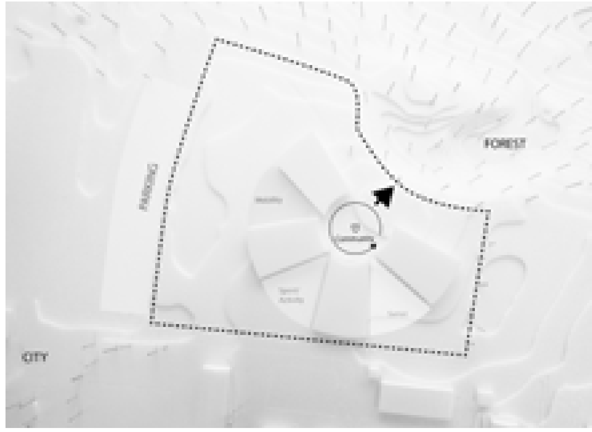
Ill. 88 - Construction models

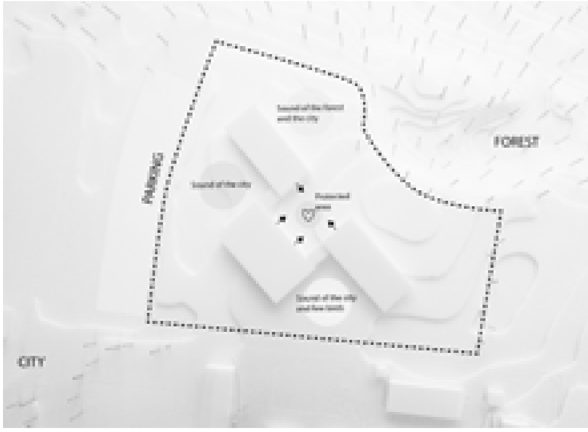
Ill. 89 - Volumes models



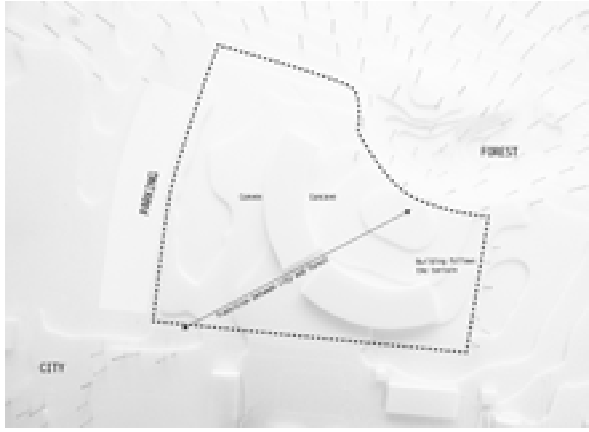
SQM FROM ROOM PROGRAM



CONCEPT 1



CONCEPT 2

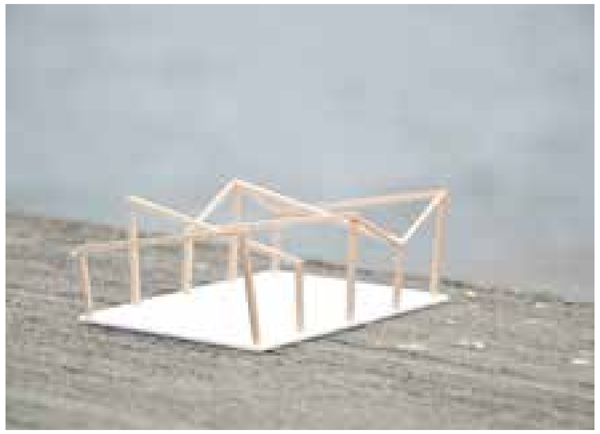


CONCEPT 3

VOLUME STUDY

/ PHYSICAL MODELLING IN 1:500

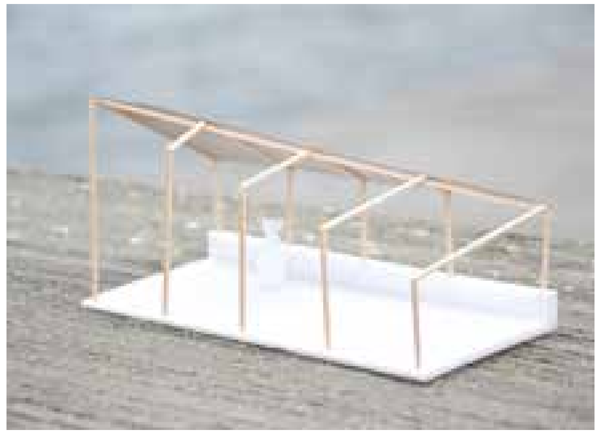
The initial sketching workshop produced several proposals that were chosen to be further investigated in a volume study. A physical 1 to 500 model provided an extended understanding of the terrain at the site and surrounding context, as well as the size of the building volume. Firstly, the total sqm collected from the room program where placed as a single volume at the site to understand the proportions of site and building. The different volumes on the site model were discussed and conceptual ideas identified, resulting in three initial concepts. The first concept was based on a centered outdoor space relating to the forest and creating a sense of community. The volumes distributed in a fan shape created three separate sheltered outdoor spaces. The second concept emerged from the surrounding sounds and the idea of three volumes connected through transition spaces. The third concept introduced a transition as well as a distinction between the city and forest, portrayed through a concave-convex shape that follows the terrain.



A DYNAMIC ROOF

A MODULAR SYSTEM

GRID SYSTEM

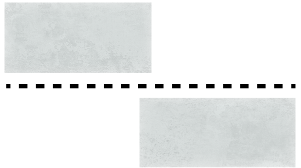


STEREOTOMIC MEETS TECTONIC

CONSTRUCTION
/ INITIATING PHYSICAL MODEL WORKSHOP

An initial construction workshop functioned as a kickstarter for the structural considerations, aiming to provide different structural systems for further explorations. The investigation of the structural system using physical models allowed us to understand the meeting between the different structural elements and become aware of potential challenges. The use of different materials and techniques resulted in a diverse collection of models that investigated the correlation and interplay between spaces, shapes and structures. This workshop generated the idea of emphasising the meeting between stereotomics and tectonics, as well as the idea of allowing a physical guideline to be controlling for both the spaces and the structure.

SINGLE FLOW PATH

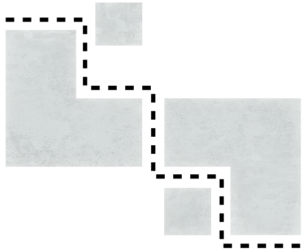


STRAIGHT LINE
/ ICD: 1

Simple flow with only two directions - however, the simplicity leaves no clues about direction and navigation through the flow itself.

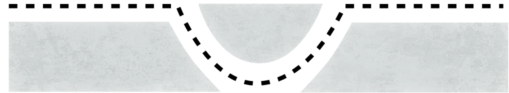
CONCAVE-CONVEX
/ ICD: 1

The simplicity of the flow in the concave-convex shape is beneficial for the ICD rate, and the contrast between convex and concave can be used as guidance in a certain direction through sensing the shape on either your left or right.



THE STAIR-SHAPE
/ ICD: 1,75

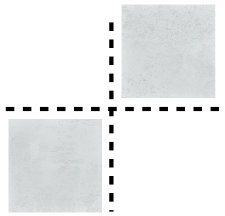
The stair-shaped flow creates breaks along it's way, but gives a seriality in the flow, which can be confusing if no landmarks are implemented.



BOWED DOWN
/ ICD: 1,5

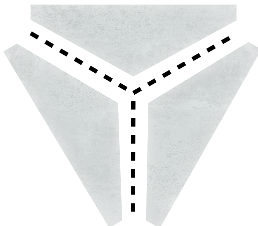
This single flow path has a simplicity in its form, yet provides a contrast in linear and convex-concave flows. This contrast can be beneficial as a wayfinding clue.

PLURAL AXIS



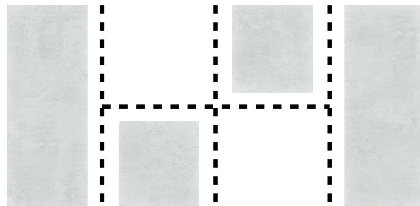
THE CROSS
/ ICD: 1,6

With a center in the cross the flow divides into four wings. This allows for a decision point in the center, from which all directions can be accessed.



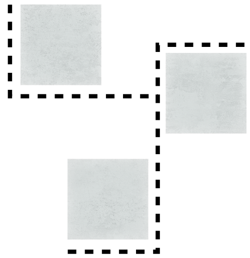
120 DEGREES
/ ICD: 1,5

The 120 degrees flow has the same properties as the cross, but with af lower ICD value. Thus, flow types with a centered point becomes more complex the more wings it has, and the less wings the more intuitive and simple.



THE GRID
/ ICD: 1,77

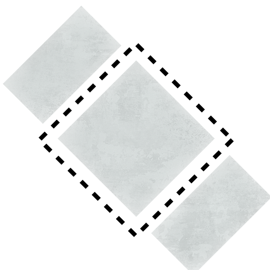
The grid flow has an opportunity of creating various spaces, but has a high value in ICD, which contributes to a confusing wayfinding for a blind or visually impaired.



THE HOOK
/ ICD: 1,7

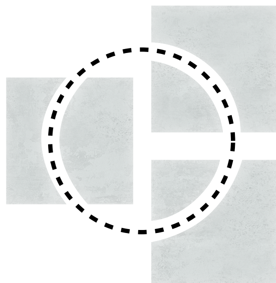
This flow shape can signify different spaces by bendings - however, each bending is of the same character and the high ICD makes navigating in this flow complicated for a blind or visually impaired.

A CLOSED LOOP



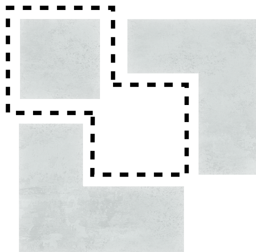
THE SQUARE
/ ICD: 2

The closed loop of the square has four corners which causes a change in direction, however, nothing in the flow signifies a start or end point, but continues in the squared shape.



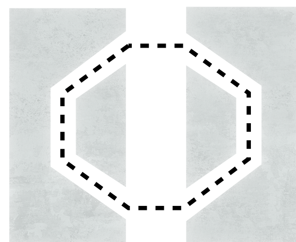
CIRCULAR FLOW
/ ICD: 0

The circular flow is the flow with the lowest ICD, but as no decision points are made the circular flow will act as an infinity loop for a blind or visually impaired



THE ANGULAR 8
/ ICD: 2

Even though the angular 8 flow centers around two different spaces, the flow has the same ICD rate as the simple square. This brings a differentiation in the spatial opportunities with no change in ICD.

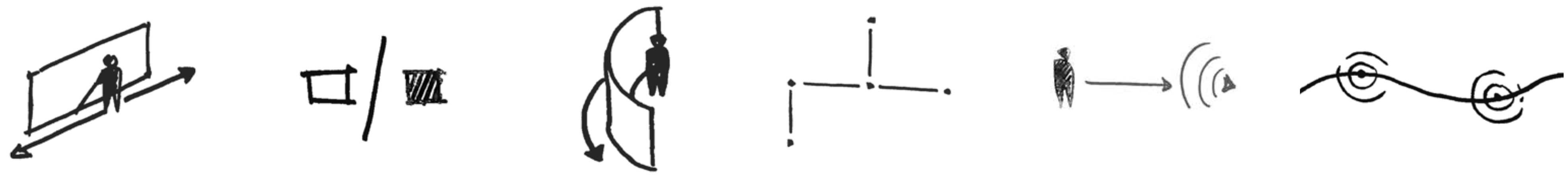


THE OCTAGON
/ ICD: 2

The octagon shape is as the other closed loop flows more complex due to the missing start or end decision points, however, the slightly bending corners might be less interupting in the flow than a 90 degree corner.

◂ *Ill. 90 - Sketches of flow with and ICD notion*

▸ *Ill. 91 - Wayfinding principles*



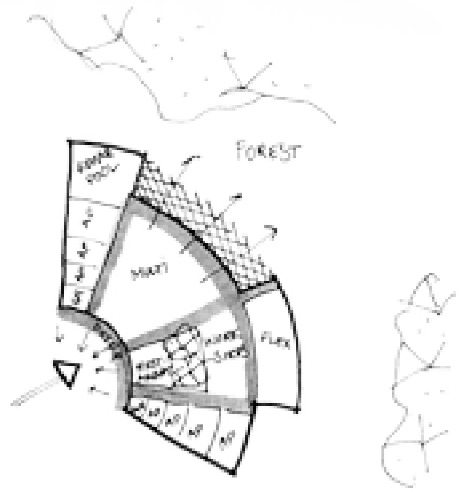
FLOW AND WAYFINDING

/ WAYFINDING PRINCIPLES AND FLOW BETWEEN FUNCTIONS

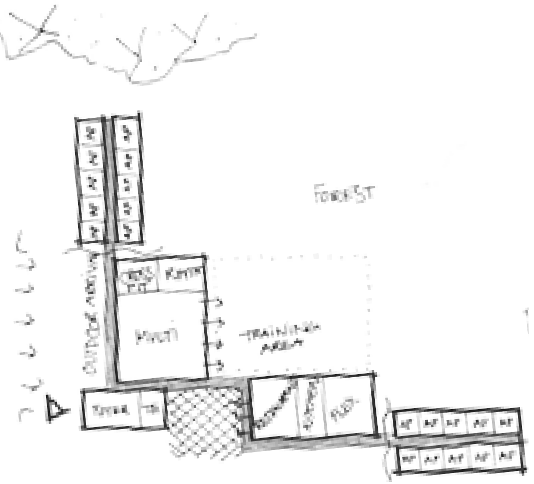
Illustrations of conceptual flow lines through building volumes were created to investigate the qualities of different layouts and compare the conceptual flows with each other in relation to the ICD value. These were divided into three categories, allowing us to identify potential patterns in the ICD results. The closed loop flow lines generally have a higher IDP value, except the circular flow due to its non existing edges. The illustrations in combination with earlier sketches and workshops resulted in a set of flow and wayfinding principles that include the implementation of a natural guideline, different wall shapes, contrasts and landmarks, as well as using acoustic properties to provide clues about direction and the character of the space. These principles acted as guidelines for the further design process to ensure an integration of wayfinding principles early in the project development.

Ill. 92 - Sections introducing level diffirences ▶

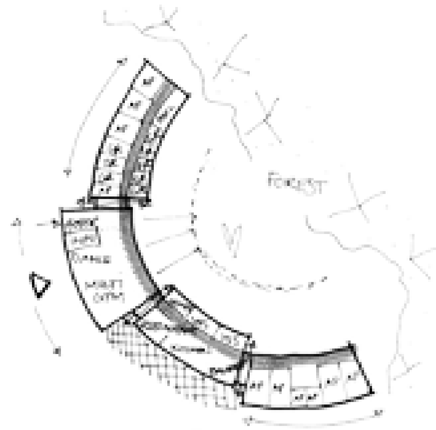
Ill. 93 - Plan layouts of six different forms ◀



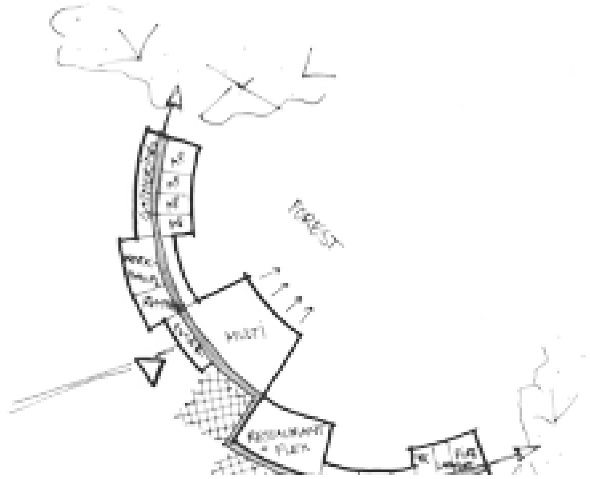
THE FAN



L-SHAPE

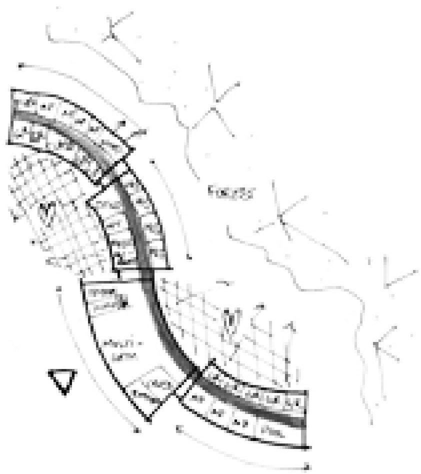


HALF CIRCLE

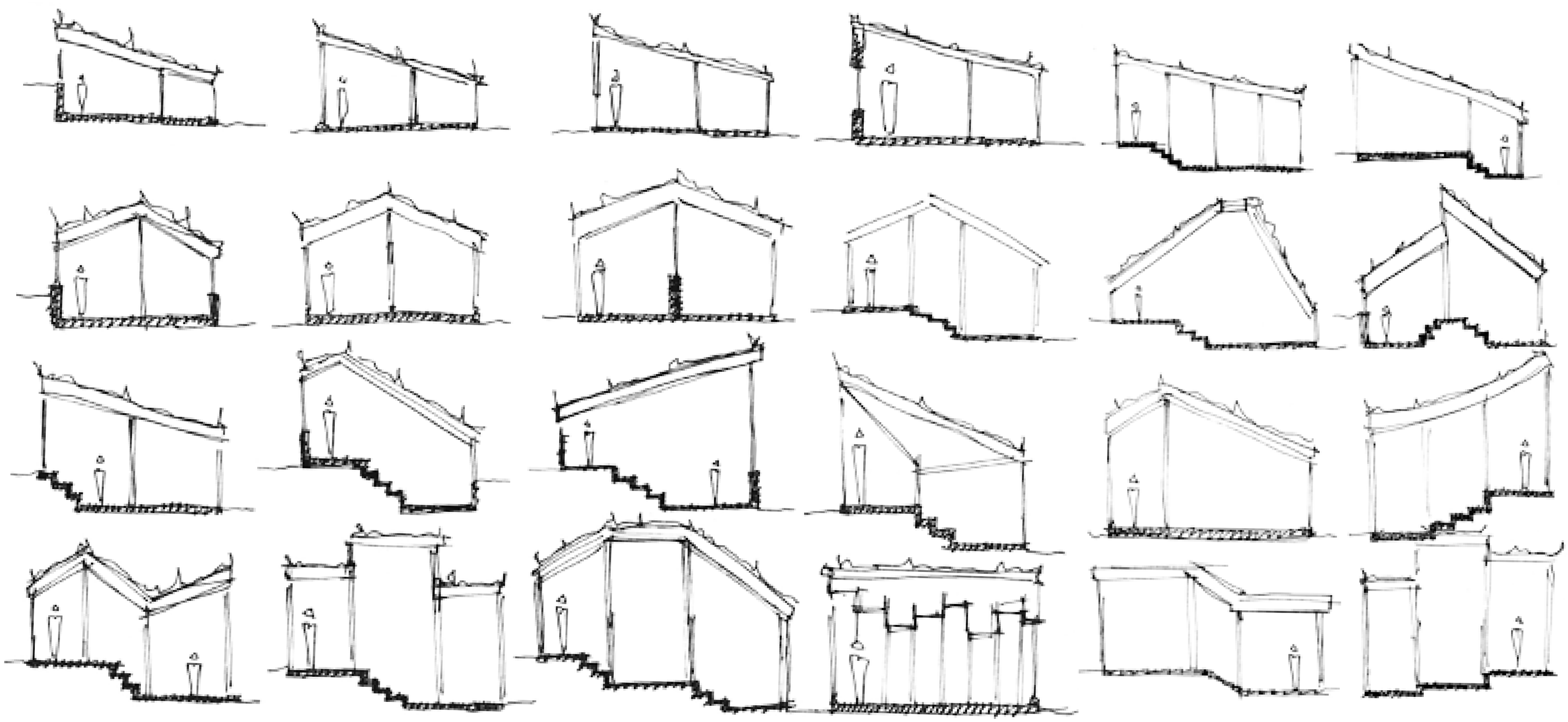


FRAGMENTED HALF CIRCLE

CIRCLE



S-SHAPE



SKETCHING WORKSHOP - PART 2

/ FUNCTIONS AND PLAN LAYOUT

The second sketching workshop focused on the layout of the plan and implementation of a clearly distinguishable main flow line throughout the building. The intention was to merge ideas from the first sketching workshop with the principles identified through the wayfinding and flow workshop. The result of this workshop was the development of six different plan layouts with various flow shapes that were chosen to be evaluated further as seen on the following pages. These plans all illustrate a separation and variation in volumes to create contrasting experiences within the spaces. The majority of the sketches also include a centered outdoor area, which is preferable when considering the sense of safety and defined outdoor areas. When placed as an extension of the multigym, the outdoor area can also inspire social gatherings through physical activity. Additionally, conceptual sketches in section were made to investigate the potential qualities of level differences within a space in combination with different roof shapes.

L-SHAPE

CIRCLE

THE FAN

	L-SHAPE	CIRCLE	THE FAN
CONCEPTUEL NOTIONS	Two different cores and axes: movement and social gathering. Overall building divides city and nature, but lies close to the city and creates large, undefined outdoor area towards the forest.	Correlation between indoor and outdoor - completed whole. Main artery as directing for the building volumes.	Opportunity to chose what direction to go in. Arrival in heart of the building.
ORIENTATION	Multigym exposed to the city and with connection to the forest, yet shaded by foyer/arrival.	360 degrees. Circular/circle gives opportunities of orienting in exact direction.	Large surface to northeast. The depth of the spaces makes natural light hard to reach within the volume.
WAYFINDING	One decision point, 3 nodes. Bends or corners not acoustical beneficial.	Concave vs. convex as guiding, no bends/breaks, complete circle and complete path - easily understandable. Guiding both exterior and interior.	Relatively easy/simple wayfinding but forces one to choose before entering the spaces, and does not follow one through the whole building.
RELATION TO LANDSCAPE	Avoids hilltop. Along contour lines. Lies in the bottom of the sloping terrain.	Need level differences in the building layout and therefore an interplay with the landscape and site.	Forced level differences in the whole building.
OUTDOOR AREAS	Small defined areas, however, not many defined outdoor areas towards nature and forest with sun during the whole day.	Clearly defined circular, centered space. Fewer spaces towards the city. Sun reaches outdoor areas, which also have a connection to the forest, during the whole day.	Few outdoor areas, embracing arrival.
CITY VS. NATURE	Clear division between city and nature.	Clear division between city and nature.	Too compact to really separate city and nature but does divide nature and city from arrival.
SURFACE RATIO	Floor: 2190 m2 Wall + Roof: 4198 m2 Ratio: 1.9	Floor: 2788 m2 Wall + Roof: 4720 m2 Ratio: 1.7	Floor: 2360 m2 Wall + Roof: 3624 m2 Ratio: 1.54

- SKETCHING PHASE -

HALF CIRCLE

Concave/convex. Four seperated volumes with transitions in between. Volumes do not vary a lot and therefore do not create various experiences in itself.

All south orientated rooms are out towards the city. Multigym to the southwest and exposed to the city. All volumes faces the forest and nature.

Simple and clear wayfinding because of the concave/convex shapes and no larger bendings.

Follows the contour lines. Does not challenge the landscape but adapts to it. From the hilltop the building "disapears". The building embraces a hill.

A "safe zone" towards the forest is defined but is of large scale. All spaces towards southwest is facing the city. These spaces are not clearly defined.

Clearly divides city and nature through its longistudinal direction.

Floor: 2280 m2
Wall + Roof: 4219 m2
Ratio: 1.85

S-SHAPE

Embraces city and forest. A simple, yet differentiating flow in the building.

High pulse area and foyer located far to the south. Building divided in two directions. Northeast and southwest spaces.

Simple and clear wayfinding, however, the contrast in concave/convex cannot be as guiding as in e.g. the half circle because it mirrors itself.

The shape both respects and challenges the landscape.

Outdoor areas to the south and north. Two large and open areas.

Clear division between city and nature.

Floor: 2328 m2
Wall + Roof: 4498 m2
Ratio: 1.93

FRAGMENTED HALF CIRCLE

Improvement of the half circle and improvement of the experiences along the main artery.

Multigym extends towards the north. All outdoor areas to the south is towards the city. Social/restaurant to the southwest but also towards the forest.

Simple but with a bend: two decision points makes the building seperated in two. Bends has no acoustical benefits.

Half circle follows contourlines, but fragmentation blurres the correlation between building and landscape.

Small and intimate spaces. All areas to the southwest is towards the city and all areas to the northeast is towards the forest.

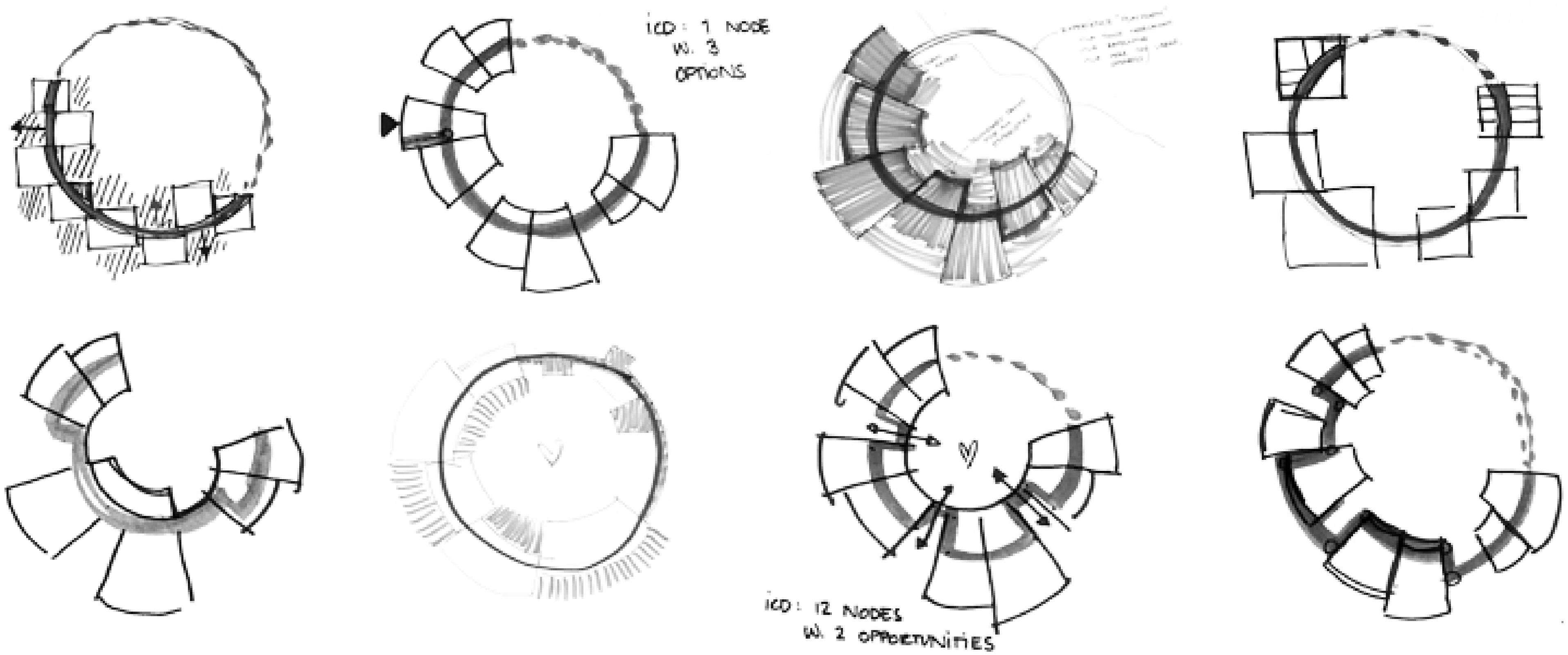
Clear division of the city and nature.

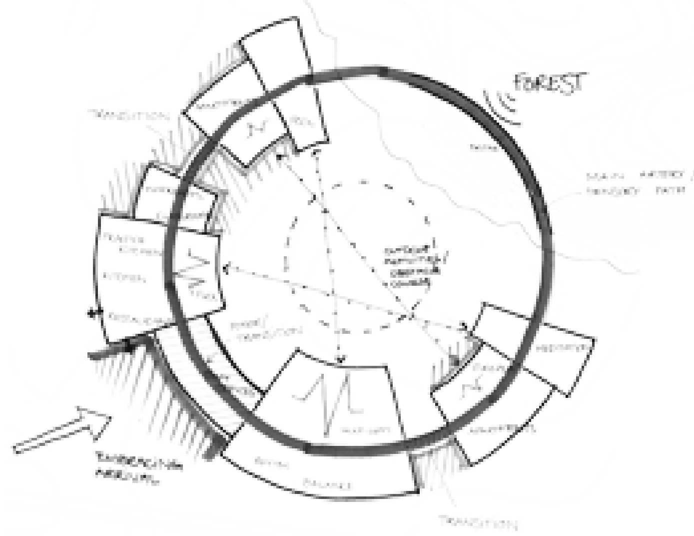
Floor: 2349 m2
Wall + Roof: 4113 m2
Ratio: 1.75

▲ *Ill. 94 - Evaluation scheme*

Ill. 95 - Detailed plans of the circle

Ill. 96 - Initial sketches of the circle



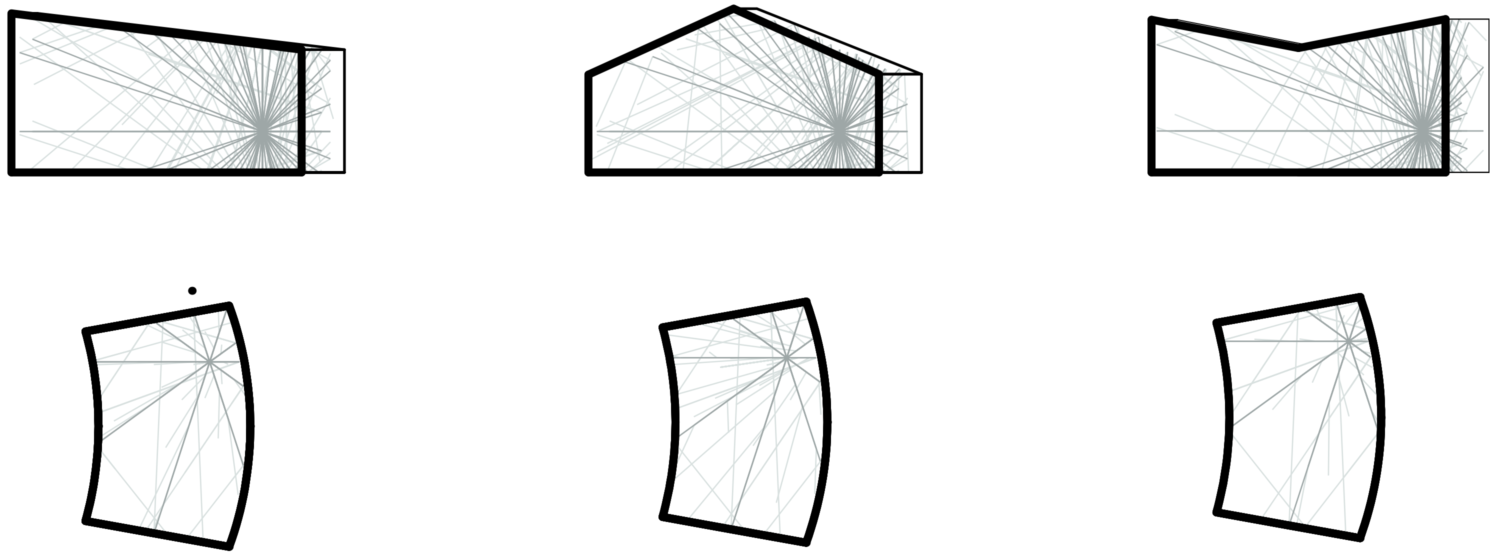


DEVELOPING THE CIRCLE

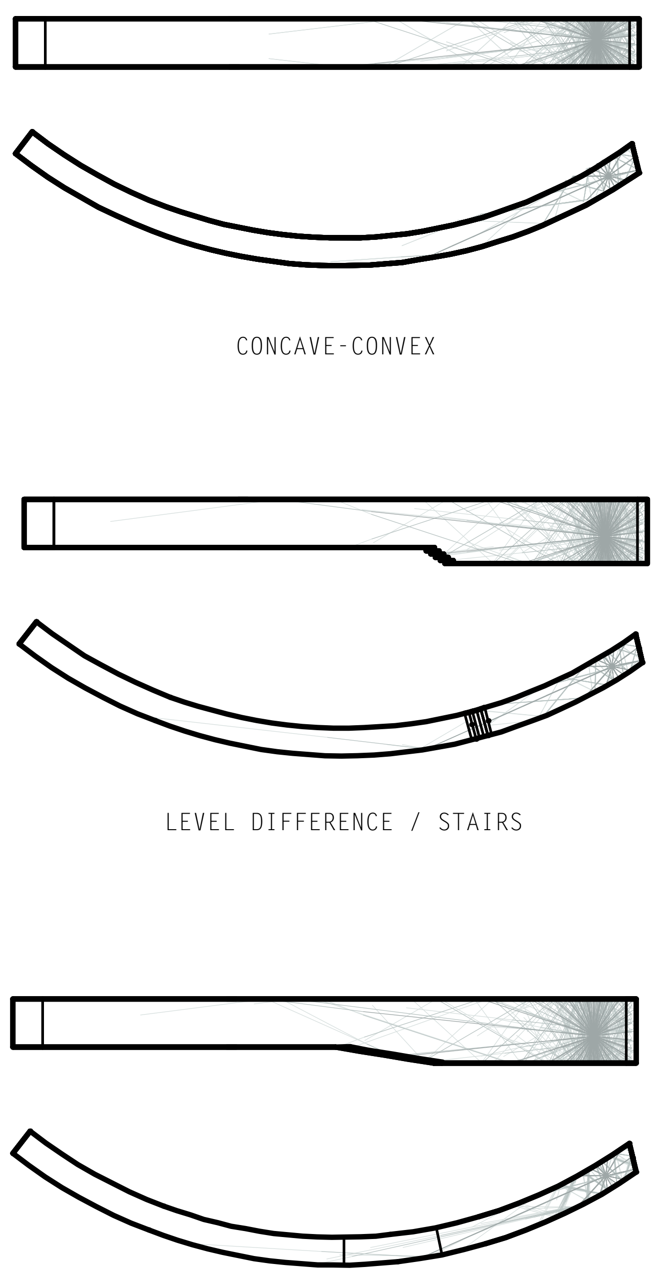
/ VOLUMES AND FUNCTIONS

On the basis of the evaluation of the six shapes, the circular form was chosen for further detailing. The shape and composition of volumes, as well as the layout of the main flow line, were investigated through sketching. The development of the main flow line, combined with considerations regarding the achievement of an experienced quality through sensory contrasts and using movement as the pivot of the architecture, resulted in the initial definition of the concept. The volumes were adjusted to encompass different pulse intensities, narrating their different, atmospheric character, while the main flow line became the main artery, serving to connect the whole building and support guidance. The intended experience within each pulse intensity was defined and became the point of departure for the further development of the design.

RAYTRACING / VOLUME STUDY



RAYTRACING / MAIN ARTERY STUDY



ACOUSTICS

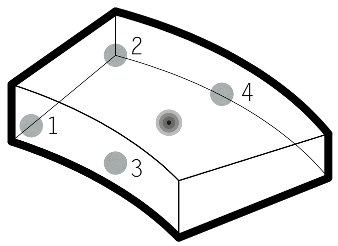
/ VOLUMES AND MAIN ARTERY STUDIES

To inform the design process different acoustic studies have been completed. Firstly, ray tracing on concave-convex volumes with different ceiling layouts illustrated how the sound is distributed in a space. The sound travels in the whole room with the sloped and pitched roof, whereas the negatively pitched roof captures most of the sound in the defined space where the source is located. These acoustic differences was taken into account in relation to wayfinding clues and sensory experiences in the further design process. Studies of the main artery have been made on the concave-convex shape to ensure that sound travels far enough to reach the different spaces and provide acoustic wayfinding clues. As the site introduces level differences, the implementation of stairs or ramps affect the acoustic properties. As the illustrations show, the sound travels furthest with the implementation of ramps. In addition to this, ramps was also chosen on the basis of it's activation of the balance of the body and the proprioception sense. Furthermore, studies on acoustic values in relation to reverberation time RT60, definition D50 and clarity C50 have been made. This was done to see the acoustic properties of the basic shape matching the size of the multi gym, and compare these results with the same shape applied with a differentiation in materiality and an absorptive ceiling. The results show a clear improvement in definition and clarity by applying another material, while the reverberation time only differ a few decimals. However, the implementation of integrated furnishing, structure, inner walls and a more detailed design will affect the acoustics of the space and decrease the reverberation time concurrently with an increased surface area.

◀ *Ill. 97 - Raytracing studies*

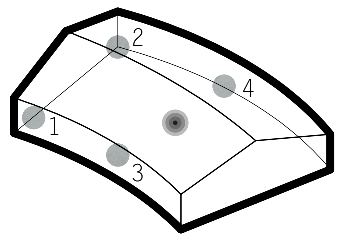
▶ *Ill. 98 - Acoustic properties studies*

ACOUSTIC VOLUME STUDY



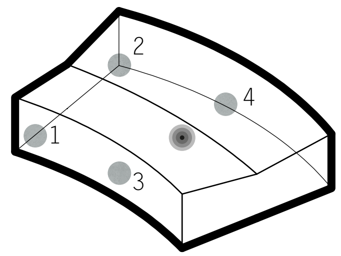
SLOPED ROOF

RECEIVER	REVERBERATION 62,5 - 8000 Hz	DEFINITION 0 - 100 %	CLARITY
1	1,6 - 2,2 s	27 - 67 %	-4,4 - 3,0
2	1,5 - 2,3 s	22 - 59 %	-5,6 - 1,5
3	1,5 - 2,1 s	33 - 74 %	-3,1 - 4,4
4	1,4 - 2,4 s	30 - 69 %	-3,6 - 3,4



PITCHED ROOF

RECEIVER	REVERBERATION 62,5 - 8000 Hz	DEFINITION 0 - 100 %	CLARITY
1	1,5 - 2,3 s	26 - 63 %	-4,6 - 2,4
2	1,5 - 2,2 s	25 - 63 %	-4,8 - 2,4
3	1,5 - 2,5 s	33 - 72 %	-3,2 - 4,1
4	1,3 - 2,2 s	22 - 62 %	-5,5 - 2,0

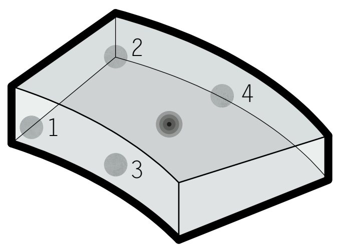


NEGATIVE PITCHED ROOF

RECEIVER	REVERBERATION 62,5 - 8000 Hz	DEFINITION 0 - 100 %	CLARITY
1	1,3 - 2,2 s	26 - 64 %	-4,7 - 2,4
2	1,6 - 2,1 s	29 - 67 %	-3,9 - 3,1
3	1,4 - 2,3 s	27 - 64 %	-4,3 - 2,6
4	1,5 - 2,2 s	34 - 76 %	-2,7 - 4,9

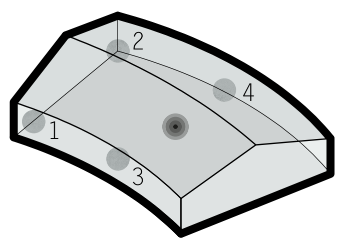
APPLICATION OF MATERIALS

FLOOR / WOOD **WALLS** / WOOD **CEILING** / TROLDTEKT AND WOOD SLATS



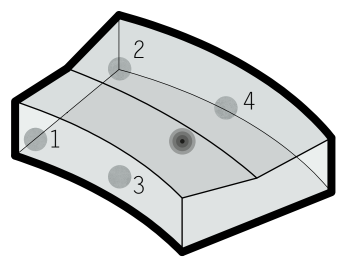
SLOPED ROOF

RECEIVER	REVERBERATION 62,5 - 8000 Hz	DEFINITION 0 - 100 %	CLARITY
1	1,3 - 2,3 s	55 - 73 %	0,8 - 4,2
2	1,4 - 2,3 s	49 - 65 %	-0,2 - 2,5
3	1,5 - 2,4 s	65 - 80 %	2,6 - 5,9
4	1,3 - 2,5 s	65 - 78 %	2,6 - 5,4



PITCHED ROOF

RECEIVER	REVERBERATION 62,5 - 8000 Hz	DEFINITION 0 - 100 %	CLARITY
1	1,3 - 2,5 s	49 - 67 %	-0,2 - 3,1
2	1,4 - 2,8 s	48 - 66 %	-0,3 - 2,9
3	1,5 - 2,1 s	65 - 80 %	2,7 - 6,1
4	1,4 - 2,9 s	56 - 72 %	1,1 - 4,0

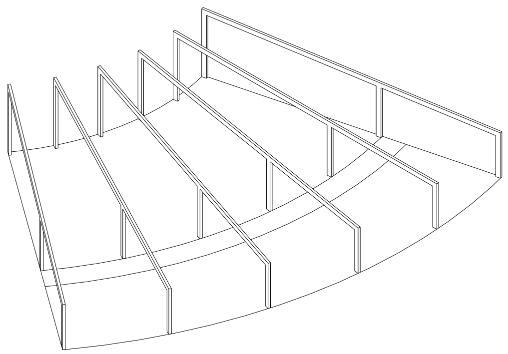


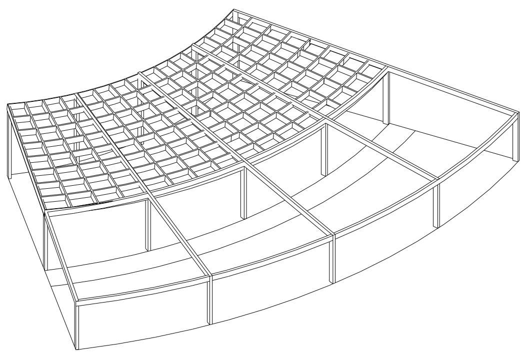
NEGATIVE PITCHED ROOF

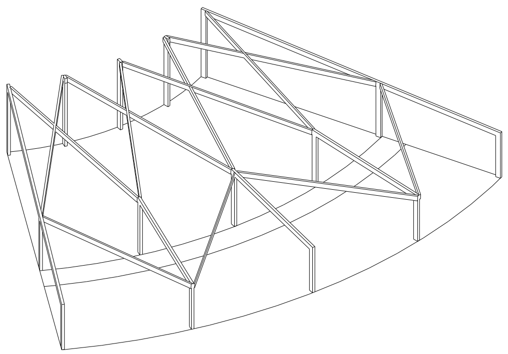
RECEIVER	REVERBERATION 62,5 - 8000 Hz	DEFINITION 0 - 100 %	CLARITY
1	1,4 - 3,1 s	50 - 66 %	0,1 - 2,9
2	1,5 - 2,5 s	53 - 70 %	0,5 - 3,8
3	1,5 - 2,6 s	65 - 80 %	2,7 - 6,0
4	1,4 - 2,6 s	56 - 72 %	1,2 - 4,0

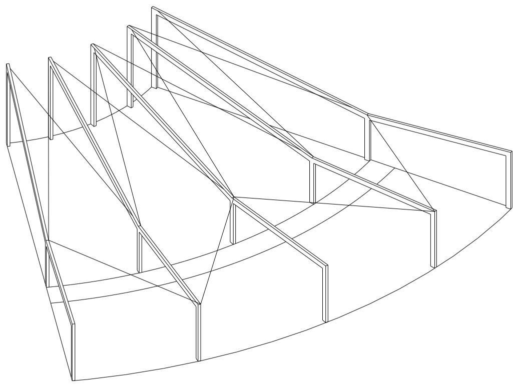
Ill. 99 - Structural concepts and daylight ►

Ill. 100 - Structural concepts ◄


BASE STRUCTURE


ACOUSTIC GRID

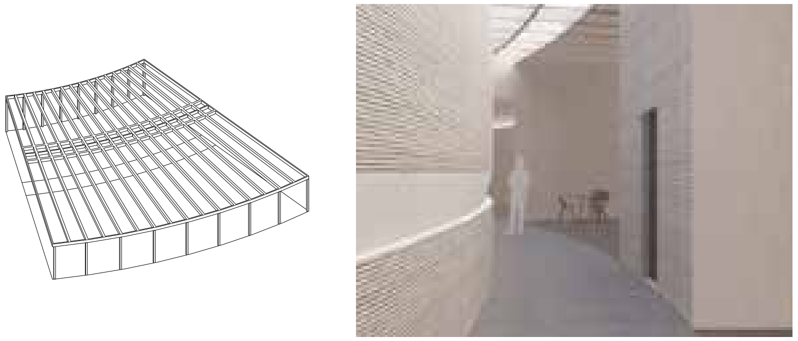

INTERSECTING STRUCTURE


INTERSECTING WIRES

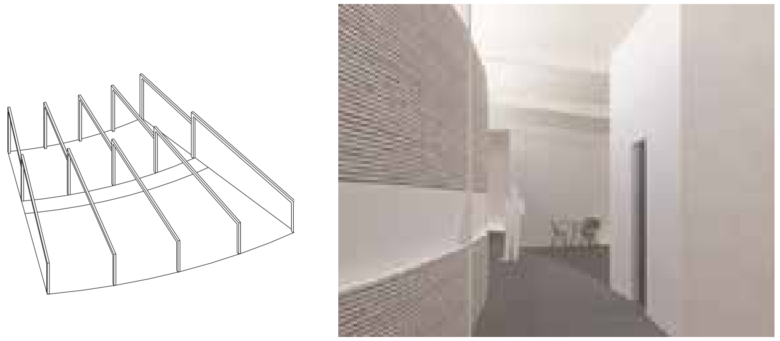
CONSTRUCTION AND DAYLIGHT

/ STRUCTURAL SYSTEM AND THE IMPLEMENTATION OF WINWODS

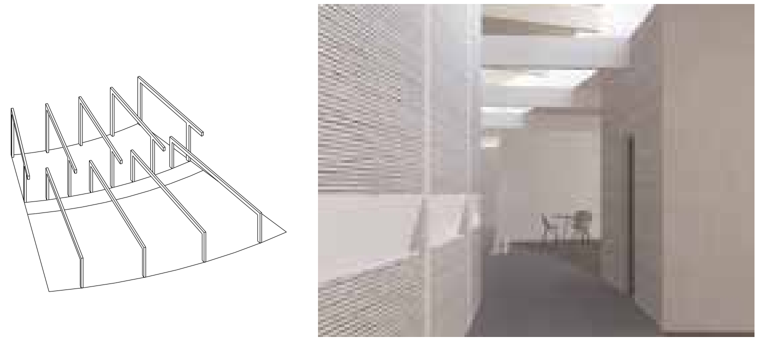
The structural system of the building was developed through the creation of a number of iterations. These iterations were evaluated based on their overall shape, spatial impact and daylight qualities. The angled beam structure was chosen as it clearly marks the main artery as an individual space through both the light and the structure itself. Furthermore, the combination of a short spacing between columns as a result of the narrowing volume shape towards the inner circle created a verticality, relating to the gesture of a vertical space found in the tree trunks of the forest. The opposite located columns are spaced further apart, relating to the horizontal openness found on the project site and exposing the facade towards the city of Hobro.



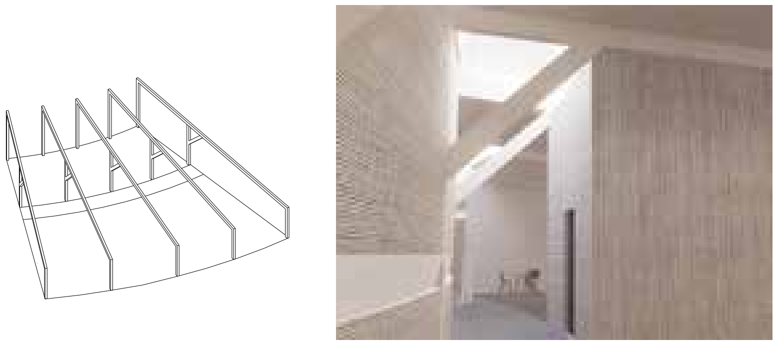
GRID



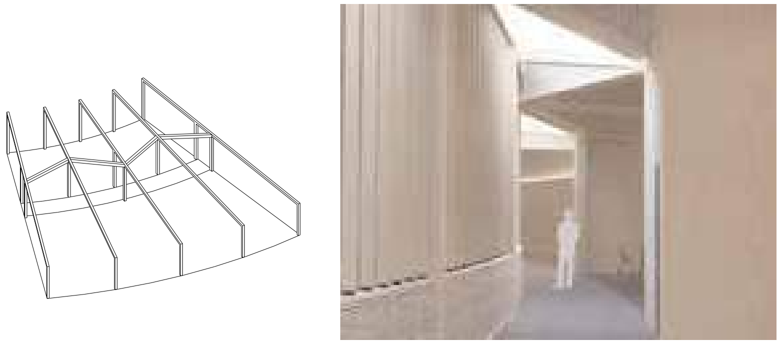
TWO LEVEL BEAM



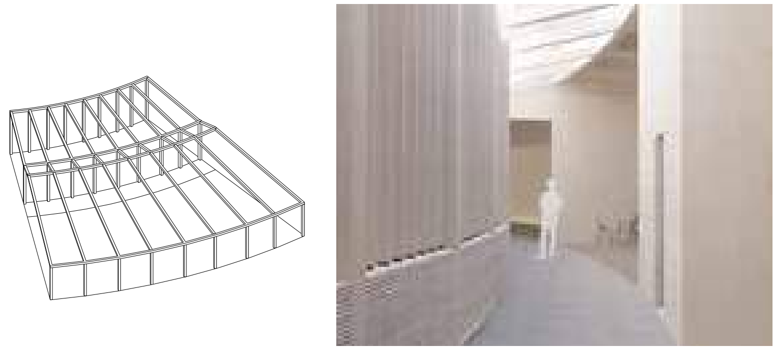
DOUBLE BEAM



Y-SHAPE



ZIGZAG



ANGLED BEAM

Ill. 101 - Materiality in Main Artery / Moderate pulse zone

Ill. 102 - Materiality in Main Artery / Low pulse zone

Ill. 103 - Joints variation in Main Artery

HORIZONTAL SLATS WITH INTEGRATED GUIDELINE

HORIZONTAL SLATS AND HOLLOWED OUT GUIDELINE

HALF WALL WITH HORIZONTAL SLATS AND GUIDELINE

HORIZONTAL SLATS AND VERTICAL LAMELLAS

CONCRETE WITH TIMBER COLUMNS

CONCRETE WITH VERTICAL LAMELLAS

PERFORATED PLATES

WOODEN SLATS

SHIFTED TOP-BOTTOM WOODEN SLATS

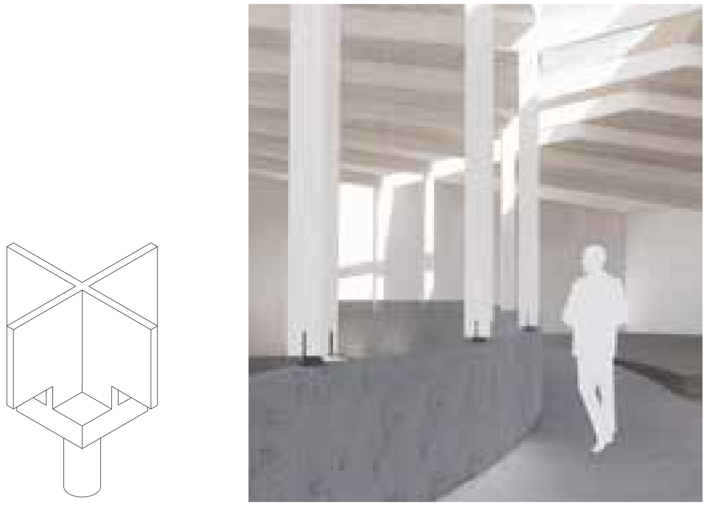
DETAILING THE MAIN ARTERY

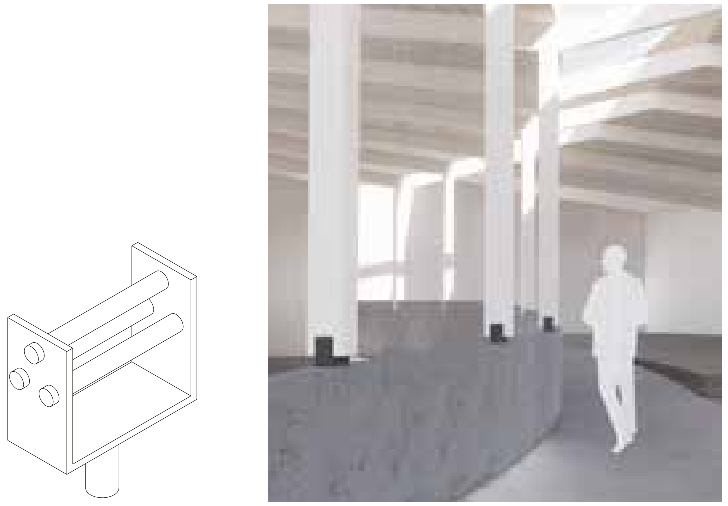
/ MATERIALITY AND JOINTS

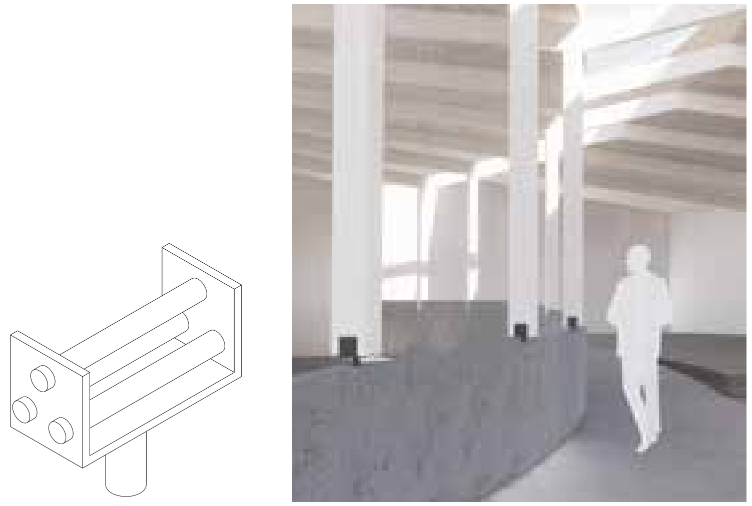
The main artery was further detailed, aiming to make it a clearly distinguishable architectural element that supports wayfinding and legibility through tactile, visual and acoustic qualities. Investigations of materials and composition of materials resulted in the decision to use a one meter high concrete wall as a natural guideline throughout the building. The concrete is used to imply a transit space through the hard surface underneath the feet and in hand level. The concrete also reflects the sound of footsteps, further emphasising its identity as a main flow line.

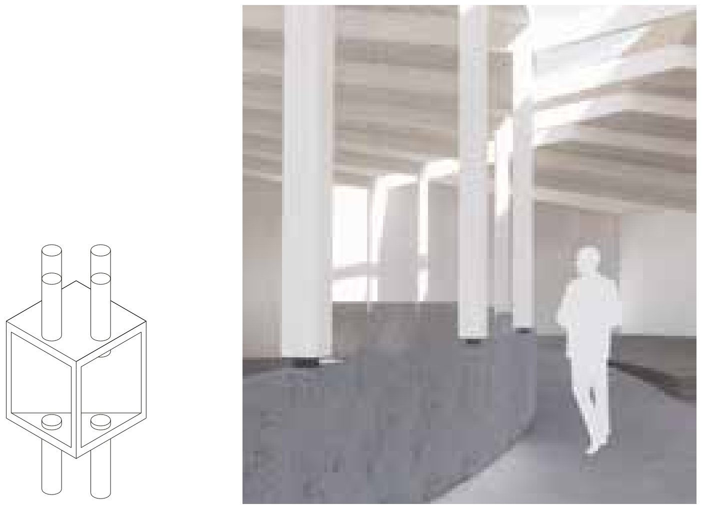
In the low pulse areas the configuration of the adjacent spaces required a wall of full height on both sides. The concrete guideline was maintained, and several iterations were made to investigate the interplay between the two walls and determine the effect of the light in the enclosed space.

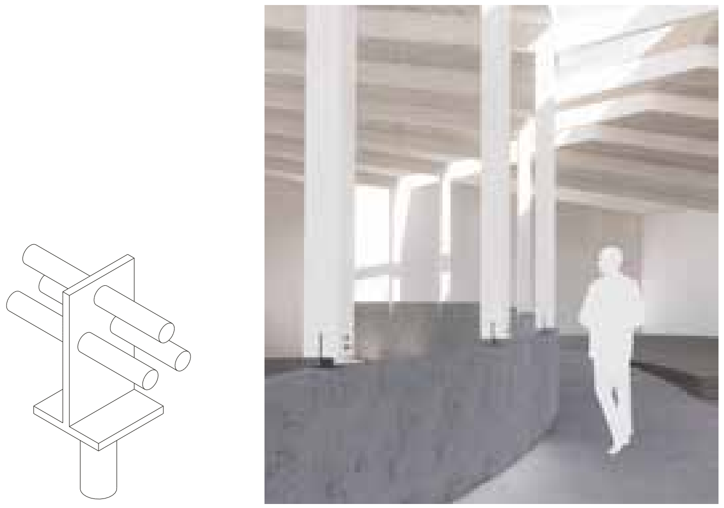
The columns are elevated and positioned on top of the concrete wall, allowing the joint between stereotomic and tectonic to become a tactile element, thereby providing the blind and visually impaired with clues about the structure of the building. The design of the joint was specified to explore and emphasise the meeting and contrast between the concrete wall and the column. Subsequently, the elevated three bolt-joint was chosen for further detailing.

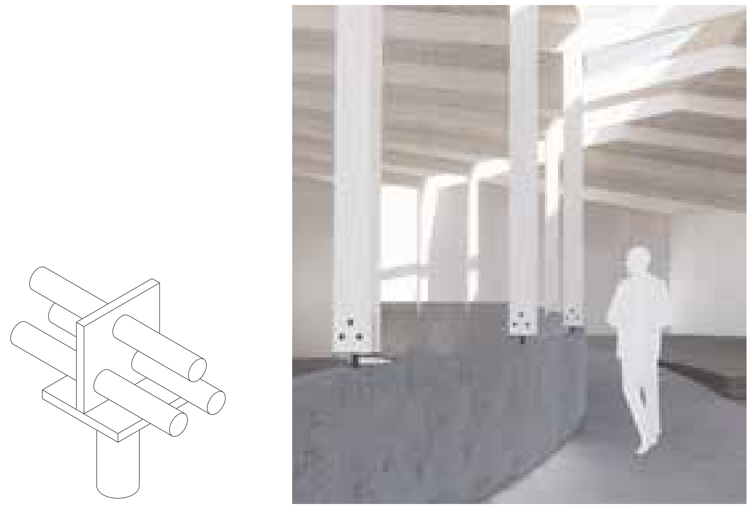

CROSS JOINT


U-JOINT


ELEVATED U-JOINT

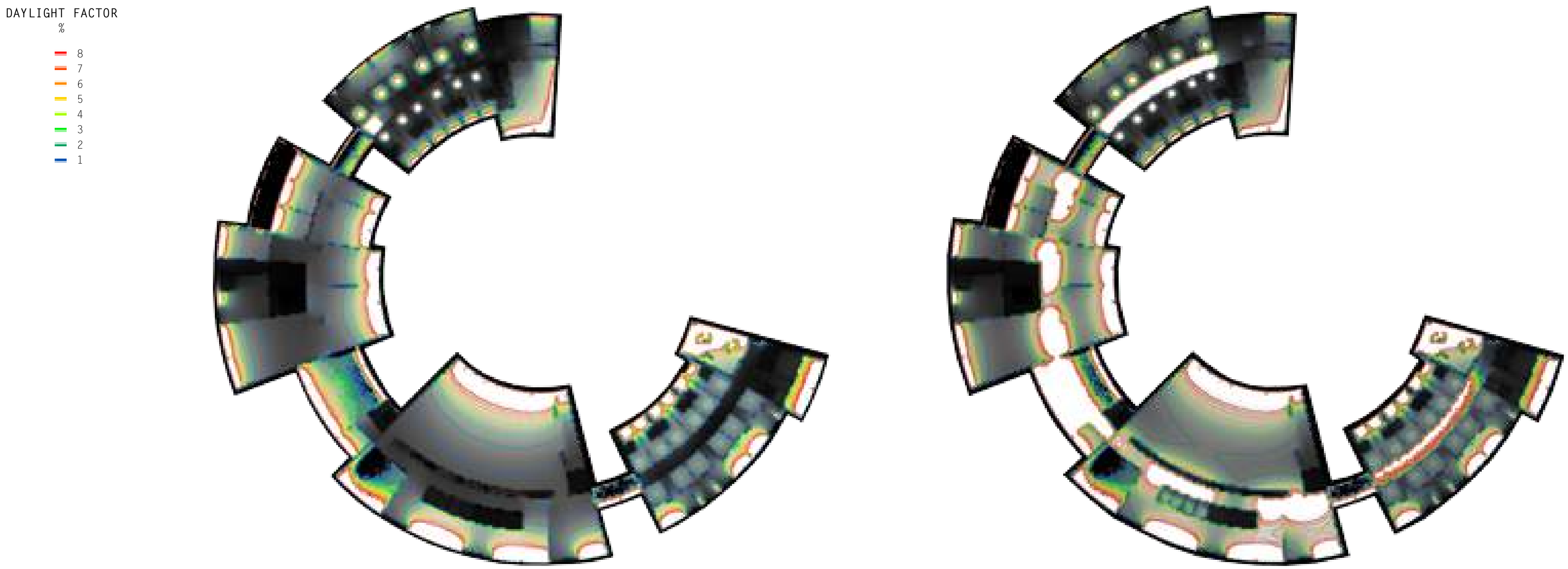

CUBE-JOINT


RAISED THREE BOLT-JOINT


ELEVATED THREE BOLT-JOINT

Ill. 104 - Daylight investigations of the whole plan

Ill. 105 - Three variations of mechanical ventilation



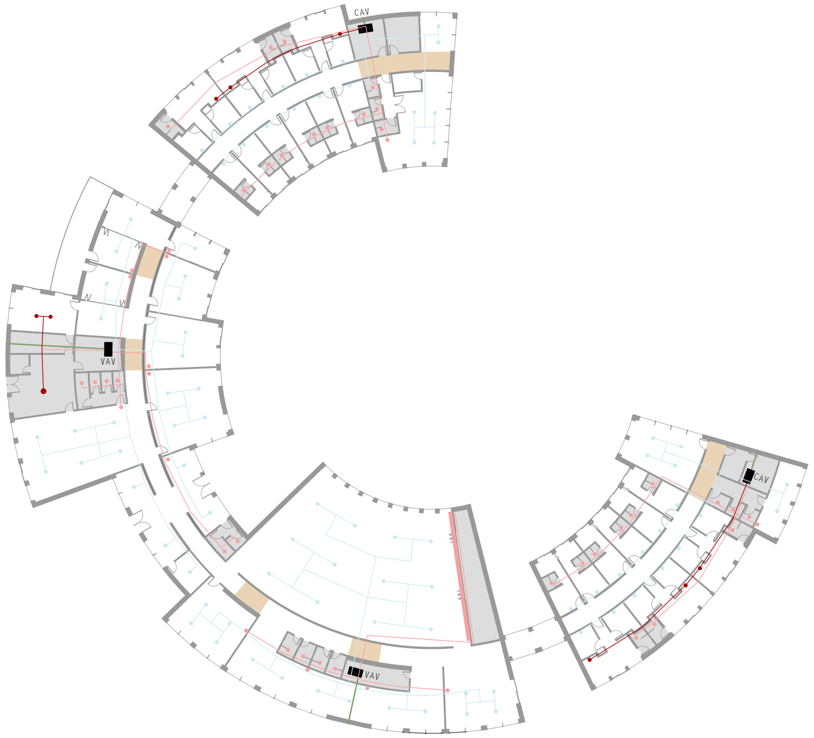
WITHOUT SKYLIGHT IN MAIN ARTERY

WITH SKYLIGHT IN MAIN ARTERY

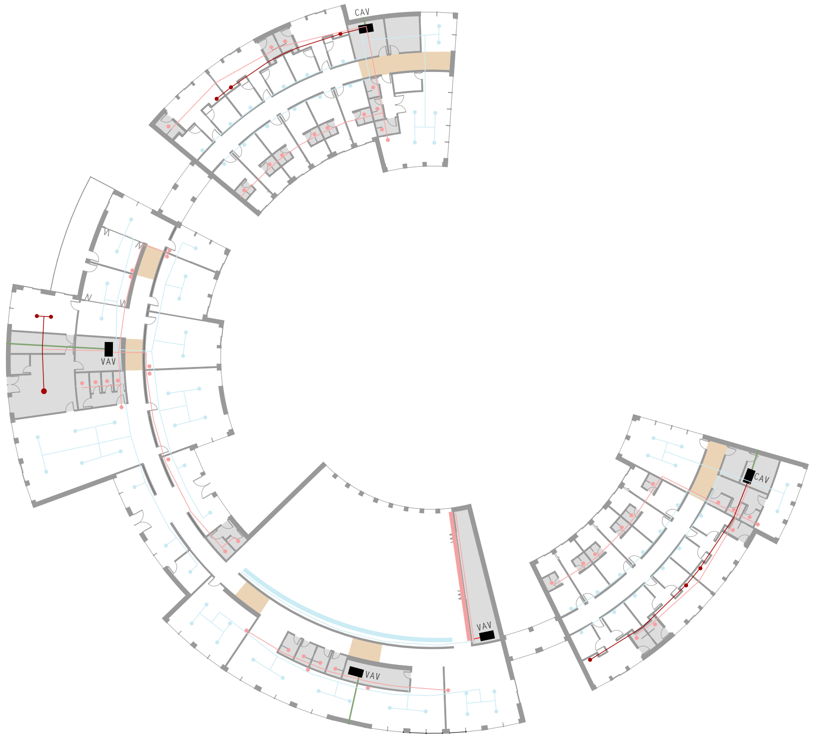
DAYLIGHT ON THE WHOLE BUILDING

/ BUILDING WITH AND WITHOUT SKYLIGHT IN MAI ARTERY

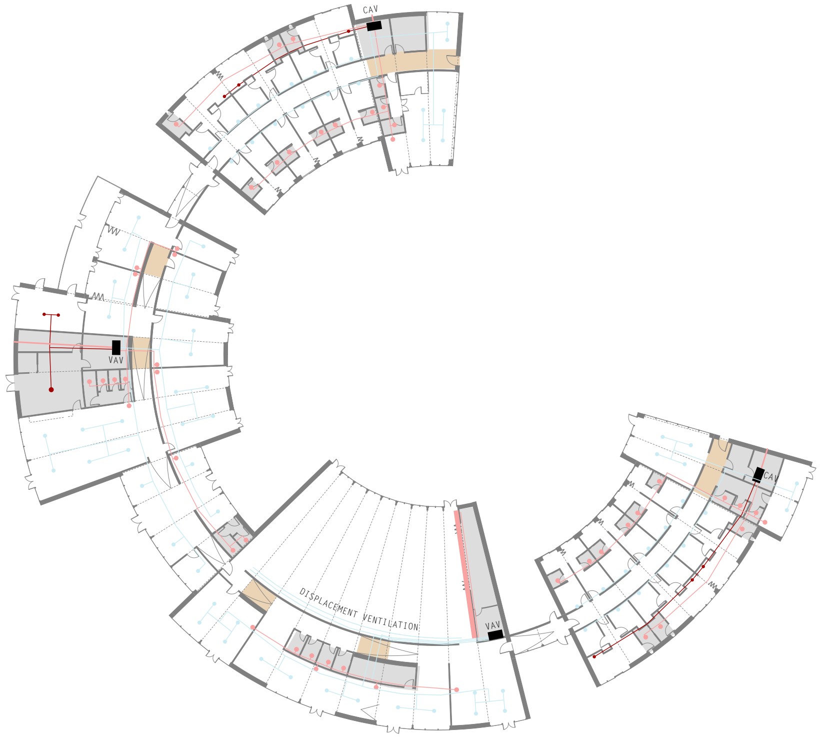
The daylight factor throughout the building was simulated with and without skylights in the main artery. The results clearly show that incorporating skylights enhances the distinction of the main artery and ensures adequate daylight conditions in the surrounding functions.The simulations also show that the absence of skylights above the embracing corners creates a clearly noticeable contrast, giving the break areas a darker and cozier character. The absence of skylights in certain sections also allows for the mechanical ventilation ducts to cross the main artery.



OPTION WITH FOUR VENTILATION UNITS
AND MIXING VENTILATION



OPTION WITH AN EXTRA UNIT AND DIS-
PLACEMENT VENTILATION



FINAL OPTION WITH FOUR UNITS AND
DISPLACEMENT VENTILATION

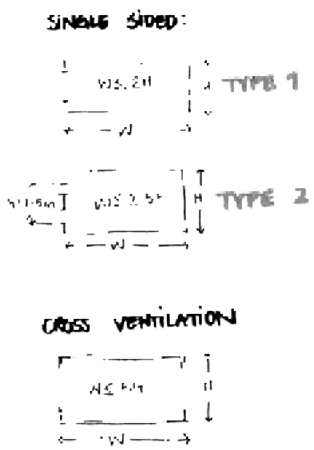
MECHANICAL VENTILATION

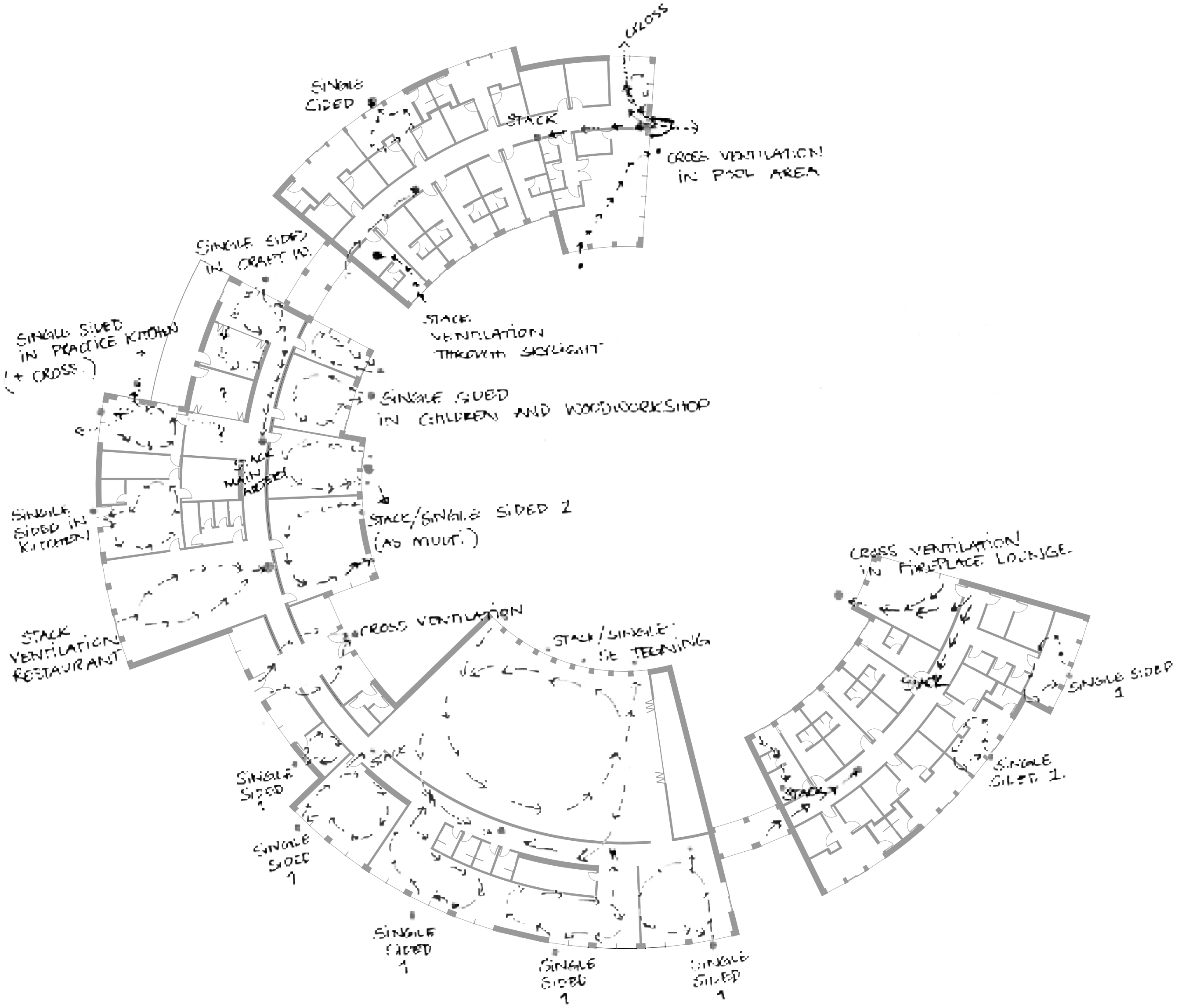
/ THREE VARIATIONS

The development of the strategy for mechanical ventilation departed as an initial thought to implement a separate ventilation unit for each pulse intensity. When using only mixing ventilation, the high pulse zone with the multigym needed a minimum of 12 supply air diffusers to be able to maintain an acceptable CO2 level during times with a high people load and activity level. To decrease the amount of ducts, and thereby the material usage and pressure loss, other options were investigated using displacement ventilation placed underneath the spectator seating. Finally, the placement of the ventilation unit in the high pulse area was altered, resulting in a reduced amount of ducts and a reduced distance to the facade where the intake is located.

Ill. 106 - Natural ventilation of multigym and guestrooms ▸

Ill. 107 - Natural ventilation of the of building ◂





NATURAL VENTILATION

/ THE WHOLE BUILDING

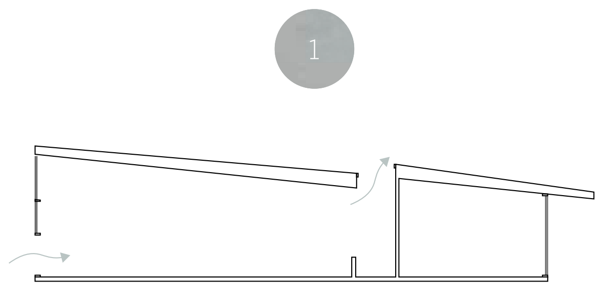
A conceptual strategy for the natural ventilation in the whole building was developed, determining the type of ventilation as either single sided, cross or stack ventilation. The multigym and guestroom were chosen to be further investigated using two different configurations of openings and three different climatic scenarios for each. The scenarios were established to investigate the robustness of the natural ventilation strategy in the two spaces. The calculations show the required size of the opening in the guestroom to maintain an atmospheric comfort, and how much of the mechanical ventilation that can potentially be replaced by natural ventilation in the multigym

MULTI GYM AND GUESTROOM

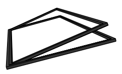
SCENARIO 1
No wind,
1 degree temperature difference

SCENARIO 2
Only wind,
1m/s from north

SCENARIO 3
Wind 1m/s from north,
1 degree temperature difference



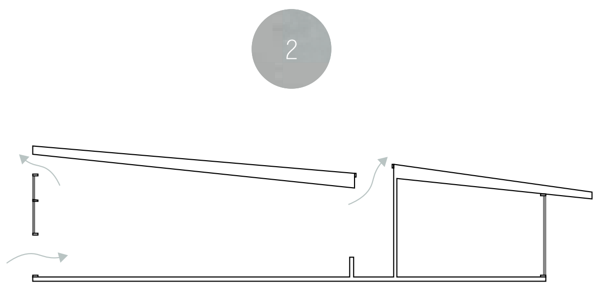
MULTI GYM
Stack ventilation
Driving force: thermal buoyancy and wind pressure



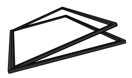
7 skylights:
25cm opening

2 double doors:
Wide open, 90

Scenario 1: 2,056 m^3/s
Scenario 2: 2,009 m^3/s
Scenario 3: 2,874 m^3/s



MULTI GYM
Stack ventilation
Driving force: thermal buoyancy and wind pressure



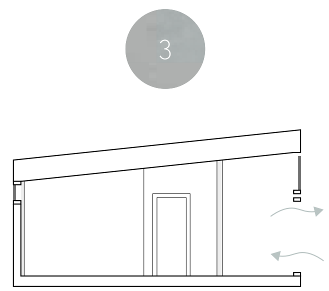
7 skylight:
25cm opening

2 double doors:
Wide open, 90

9 top windows:
25cm opening

Scenario 1: 2,261 m^3/s
Scenario 2: 2,361 m^3/s
Scenario 3: 2,908 m^3/s

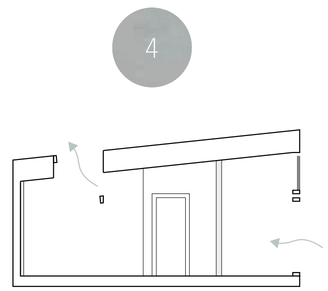
Needed air flow rate: 4,05 m^3/s



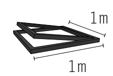
GUESTROOM
Single sided ventilation
Driving force: thermal buoyancy

Sliding door:
22cm opening

Scenario 1: 0,032 m^3/s
Scenario 2: 0,000 m^3/s
Scenario 3: 0,032 m^3/s



GUESTROOM
Stack ventilation
Driving force: thermal buoyancy and wind pressure



Skylight:
10cm opening

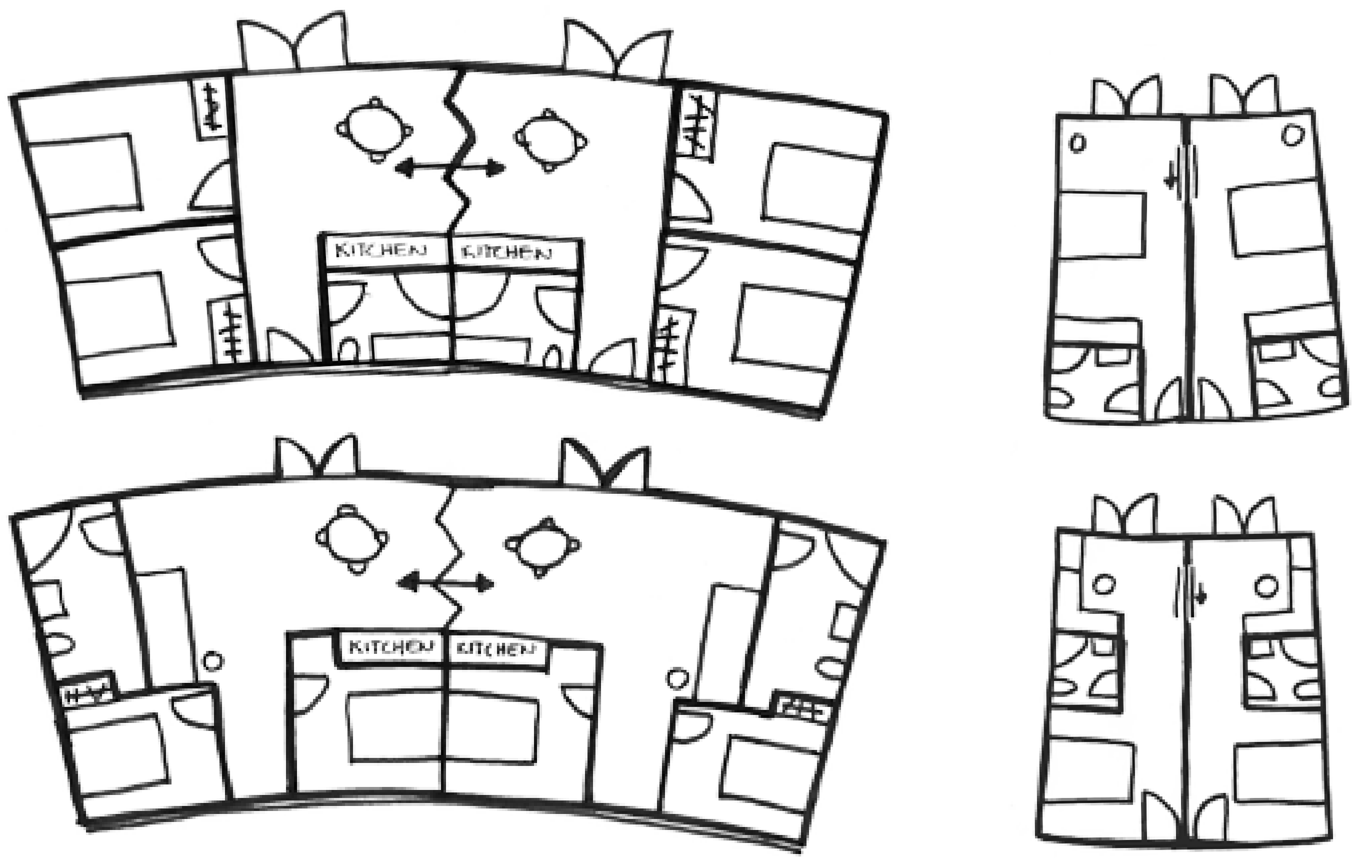
Sliding door:
15cm opening

Scenario 1: 0,032 m^3/s
Scenario 2: 0,050 m^3/s
Scenario 3: 0,060 m^3/s

Needed air flow rate: 0,032 m^3/s

Ill. 108 - Daylight guestrooms ▸

Ill. 109 - Detailed plans of apartments and guestrooms ◂



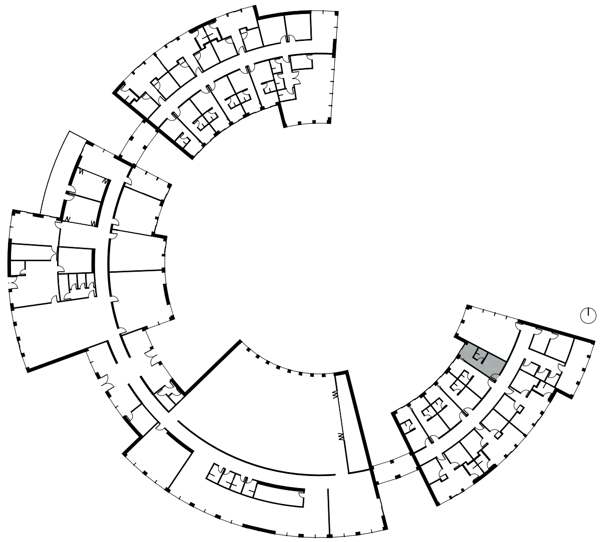
APARTMENTS AND GUESTROOMS

/ DETAILING

In the design process of guestrooms and apartments the experience of privacy and relaxation has been a key focus, as well as the flexibility in size of the spaces. With the idea of implementing an optional opening between the spaces to make them suitable for groups, disabled people with their assistant or larger families, the point of departure for the design was a mirrored layout. Additionally, the experience of private and less private zones within the guestrooms or apartments has been prioritised, as the guestroom or apartment itself should provide a variation in the spatial understanding. The privacy has been enhanced by placing rooms in retracted areas of the guestrooms or apartments, while the living areas are facing outdoors and the more public areas.

Within the guestrooms the idea of a continuous, straight flow along the interior wall that acts as natural guideline was directing for the plan layout. The location of the restroom either creates one open space, or a division between two zones: one, which is oriented towards the outdoor and one retracted from the facade to keep it more private. This allows for a differentiation in the experience and gesture of the space.

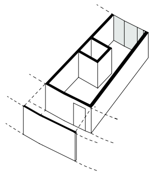
As the placement of the restroom in the guestroom has been located in the center of the space, the daylight factor had to be considered. An analysis of the guestroom with different iterations in relation to window areas was conducted. The interplay between the spatial gesture, daylight conditions and natural ventilation led to the choice of iteration 5. This iteration implements a skylight, which ensures appropriate daylight and natural stack ventilation, while the multisensory experience of the small space extends towards the exterior.



GUESTROOM

SIZE	WALLS	CEILING	FLOOR	WINDOWS
20 m²	Pine Wood Reflectance: 0,66	Pine Wood Reflectance: 0,66	Carpet Reflectance 0,75	78% Transmittance Reflectance: 0,77

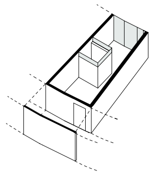
1



ITERATION 1

Windows external wall

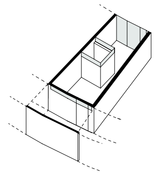
2



ITERATION 2

+ Windows top wall restroom

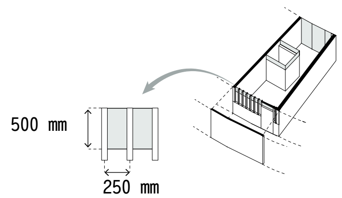
3



ITERATION 3

+ Windows top wall
main artery

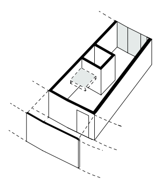
4



ITERATION 4

+ Lamellas (Depth: 100 mm)

5



ITERATION 5

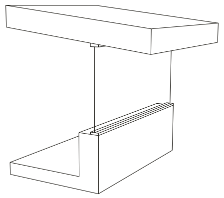
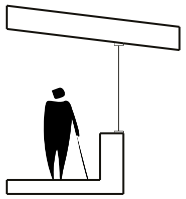
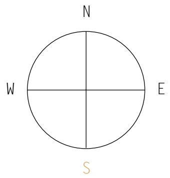
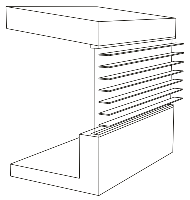
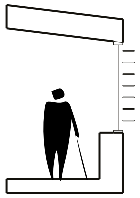
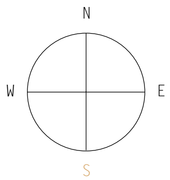
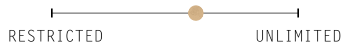
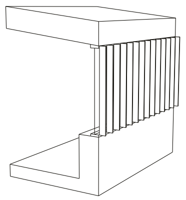
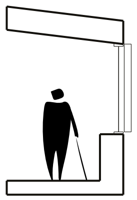
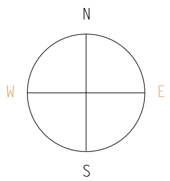
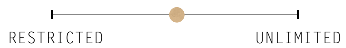
Windows external wall
+ Skylight

DAYLIGHT FACTOR
%

8
7
6
5
4
3
2
1

Ill. 108 - Evaluation scheme / Passive strategy ◂

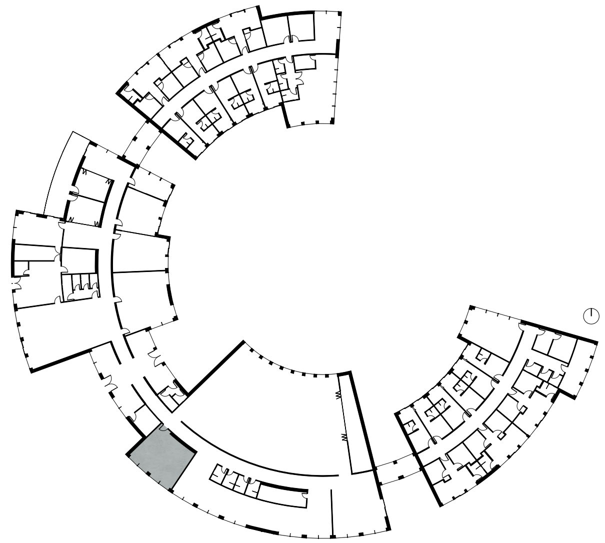
Ill. 109 - Indoor Climate / BSim ▸

TYPE	SECTION	IDEAL ORIENTATION	VIEW RESTRICTION	PROS	CONS
				Effective as shading during the middle of the day in summer, and allows for the passive heat to enter in the winter. Minimal view restriction.	Not effective as shading in the morning or after noon. Direct sunlight can enter easily, which can potentially harmful for the visually impaired.
				More effective as shading than overhang seen over a whole daytime. Allows for passive heat to enter in the winter.	View is more restricted than overhang. Depending on the material, reflec tions from the lamellas can potentially cause glare. Could be compli cated to apply on a circular building.
				Effective towards west and east, and in the morning and afternoon towards south. Potential aestethic qualities.	Not effective when the sun is positioned in directly in front of the window. Restricts view towards the sides.

PASSIVE STRATEGY - FACADES

/ EVALUATION SCHEME AND INDOOR CLIMATE

The implementation of permanent shading types and passive strategies to avoid overheating was initially investigated through a manual evaluation scheme, made on the basis on a few variables. The vertical lamellas and the overhang were investigated further in BSim with a calculation on the Rhythm Room. The choice of this room for simulations was based on its location and orientation with large glazing areas towards the south and a risk of overheating problems. The different iterations through BSim gave an understanding of the impact of each step in relation to the interior temperatures and indoor climate. These investigations contributed to the development of the facades and an integrated design solution, where energy consumption were reduced, indoor climate improved and architectural expression recessed from visual illustrations.



RHYTHM ROOM

SIZE / 59 m²

PEOPLE LOAD / 20 PEOPLE

ITERATION 1
/ No shading

26 °C < 138 hours
27 °C < 82 hours

ITERATION 2
/ 2 m overhang

26 °C < 108 hours
27 °C < 64 hours

ITERATION 3
/ Windows offset from ground: 1 m
+ 2 m overhang

26 °C < 57 hours
27 °C < 28 hours

ITERATION 4
Lamellas depth: 300 mm dist: 600 mm
+ 2 m overhang

26 °C < 52 hours
27 °C < 23 hours

Ill. 110 - LCA Evaluation svheme

Ill. 111 - Materiality investigations

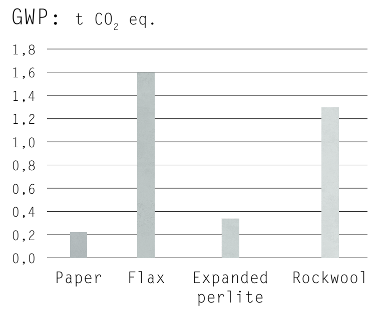
INTERIOR WALLS

MATERIAL (1 m^2 x 10mm) Type	WEIGHT kg/m2	TOTAL GWP kg CO_2 eq.	PRODUCTION kg CO_2 eq.	REPLACING kg CO_2 eq.	WASTE TREATMENT kg CO_2 eq.	TACTILE QUALITIES	VISUAL QUALITIES	REFLECTANCE
Gypsum board	10kg	6,65	3,3	3,32	0,027	No direction, smooth, cold	Plain	0,85
Birch veneer	4,6kg	9,74	-3,51	4,88	8,37	Directional, smooth, warm	Light, natural, inhomogeneous	0,66
MDF	7,8kg	8,28	-6,76	4,14	10,9	No direction, rough, warm	Homogeneous, darker	0,45
Cellulose fiberboard	1kg	2,77	-0,056	1,38	1,44	No direction, rough, cold	Homogeneous, darker	0,45
Wooden board (5 layers)	4,6kg	3,37	-6,42	1,68	8,11	Directional, smooth, warm	Light, natural, inhomogeneous	0,66

ROOF

MATERIAL (1 m^2) Type	TOTAL GWP kg CO_2 eq.	PRODUCTION kg CO_2 eq.	REPLACING kg CO_2 eq.	WASTE TREATMENT kg CO_2 eq.
Slate	14,0	13,92	0	0,08
Roofing felt	107	5,65	85,2	15,7
Zink	24,0	12,0	12,0	0,004
Steel, trapeze profile	36,8	12,3	24,5	0,008

INSULATION



Materiality

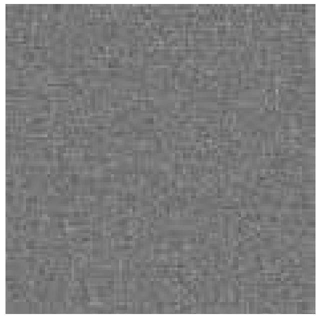
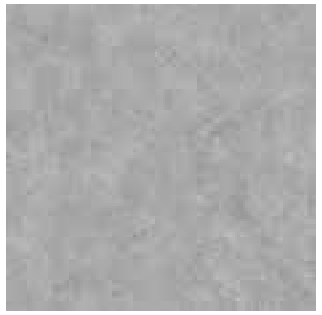
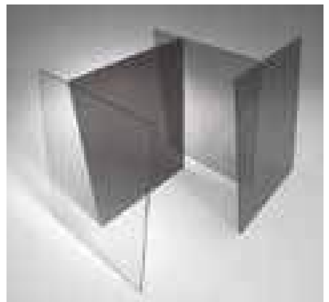
/ MATERIALS INVESTIGATION AND LCA

A study of SBI's construction examples in LCAbyg identified the insulation as a building material that could be investigated in terms of using an alternative material. When considering the global warming impact, the paper insulation seemed as the most promising option, but further investigations raised the issue of constructability, as the paper insulation has to be blown into a sealed space within the walls and ceiling. This lead to further explorations, resulting in a choice of eelgrass insulation from Zostera. It is available in batts, has received a Cradle to Cradle-certification on a gold level, is produced in Denmark and has a thermal conductivity similar to rockwool (Zostera, 2019).

The outer layer of the interior walls was also investigated through LCAbyg. The values are based on the same dimensions and indicate that using a cellulose fiberboard would result in the lowest environmental impact regarding global warming. However, when considering the tactile and visual qualities, the wooden board emerged as the preferable choice. The study does not take the rest of the structure of the interior walls into account, and does therefore not provide any applicable values but can be considered as background knowledge.

Furthermore, the environmental impact of different types of cladding on the roof was explored. The dimensions used for the study are the dimensions suggested by LCAbyg. Neither of the materials available in the program were considered sufficiently sustainable. As a result, wooden shingles were selected instead, but further detailing revealed the angle of the roof to be too small for a successful application of the shingles. Finally, shingles of roofing felt from Derbigum were chosen because of the increased lifespan and decreased environmental impact compared to regular roofing felt (Derbigum.dk, 2019).

The collection of materials on the following page illustrate some of the options considered throughout the design process.

FLOORING	CEILING	ROOF	INTERIOR WALLS	EXTERIOR WALLS	OUTDOOR PAVEMENT	BUILDING ENVELOPE
 CARPET	 TROLDTEKT AND LAMELLAS	 ROOFING FELT	BIRCH	 VERTICAL WOOD CLADDING	 FINE GRAVEL	 PAPERWOOL INSULATION
 CONCRETE	 WOOD SLATS	 WOODEN SHINGLES	 PERFORATED PLATE	 DARK WOOD CLADDING	 ROUGH GRAVEL	 EELGRASS INSULATION
 WOOD FLOORING	BIRCH	 WOODEN LAMELLAS	 WOODEN LAMELLAS	 HORISONTAL WOOD CLADDING	 GRASS	 A VARIATION OF TINTED GLASS

07

CONCLUSION AND REFLECTION

◂ Ill. 112 - Reflecting material

CONCLUSION

Through designing for the blind and visually impaired and allowing sensory experiences to direct the design, the project presents an architectural narrative that provides an extended perception of the space. The experienced quality throughout the building highlights the potential of multisensory architecture and promotes an intimate interaction with the surroundings.

The pivot of the architecture is to inspire people to move and increase their heart rate and pulse. The building is divided into four zones, each corresponding to either a high, moderate or low pulse intensity, indicating the nature of the functions within each zone. The main artery flows through the entire building and connects the functions throughout with a sensory legibility, making it inviting and attractive for the blind and visually impaired.

The project site and surrounding context provide a range of sensory experiences that inform the volumes of the building. The contrasts between the city and nature form a node that positions the building on the site, while a diagonal axis creates a transition that connects city, building and nature. The building embraces the site and adapts to the dynamic landscape through the implementation of ramps along the main artery. The ramps speak to the notion of social sustainability through an inclusive architecture, and function as local landmarks. Furthermore, they trigger the proprioception sense and balance, aiming to encourage movement within the moderate and high pulse zones.

The concept of the main artery revolves around the idea of one simple and intuitive flow, which provides the space with a gesture of guidance throughout the whole building. By following the visitor through the different spatial experiences, the architecture allows for the user to decide whether to participate and engage with the surroundings or not based on the current experienced situation.

The main artery itself is not intended as an isolated experience, but rather a part of the experience within the different pulse zones. It has its own distinct identity, but the pulse intensity defines the experience, rather than the configuration of the guideline. The guideline along the main artery exists in different variations depending on the pulse zone and surrounding functions. It varies between open, semi-open and closed, and incorporates local landmarks, storage and embracing corners that function as pause spaces from the surroundings. The embracing corners are marked by an interruption in the skylights above the main artery, giving them an easily distinguishable character while also allowing for the mechanical ventilation pipes to cross the main artery.

As a crucial part of the experienced sensory atmosphere, the acoustics are considered as a spatial narrator, informing the visitor about scale and function. The gesture of the open space found in the multi gym invites for physical activities, gathering and unfolding, while the contrasting intimate spaces of the low pulse areas provide a warm space for relaxation and privacy. These gestures are enhanced by the acoustics, narrating the open space through a large volume and high reverberation time, as well as the intimate space through the use of absorptive materials in the smaller volume, providing a lower reverberation time.

The materiality throughout the building creates multisensory contrasting atmospheres, which supports wayfinding and enhances the desired experience of the space. Contrasting concrete and wood marks the shift between the transitional area of the main artery and the adjacent common spaces. Furthermore, contrasts in nuances, surface temperatures, tactility and directionality of the materials contributes to the holistic understanding of the space.

The use of recyclable materials as an alternative to the traditional materials, such as rockwool insulation and gypsum boards, with a higher environmental impact ensures the implementation of initiatives aiming to approach environmental sustainability.

The main artery and concrete guideline also form the basis for the structural system. The stereotomic concrete guideline meets the tectonic timber structure, composing an overall hybrid structural system. The joint that merges the concrete and timber columns emphasises the meeting and contrast between them. The position of the joint on top of the guideline invites for a tactile exploration, and provide the blind and visually impaired with a notion of the structural composition and scale of the building.

The low pulse zones encompass living accommodations in the form of guestrooms and apartments. Both spaces are based on the same principle; retracting the bedroom from the facade to indicate a more private space through dimmed light and enclosed areas, and placing the social space towards the exposed facades. The design of the guestrooms and apartments allow for them to be combined with the adjacent guestroom or apartment, thereby extending the social space and promoting gatherings and interaction.

With an architecture that intensifies the ecology of movement through the sensory gestures of a space, the sustainability and sensory architecture become inseparable constituents for this project to be understood as a whole.

REFLECTION

The chosen subject for this master's thesis required a rethinking of traditional approaches. Applying another perspective, completely new to us, proved to be a challenge. Getting an insight into the many variables and obstacles a blind person is confronted with every day, called for an exploration of unconventional methods. During the design process we applied darkened glasses when analysing the site and image filters to mimic the varying visual fields of the visually impaired. Considering our surroundings from the perspective of a blind or visually impaired person also led to physical experiments regarding tactility, composition of shapes, level differences and guidelines. These experiments increased our awareness of the sensory qualities affiliated with certain materials or architectural elements and could have been used to a further extent. The challenge of validating these methods was raised during the design process. We cannot possibly gain a complete physical understanding of experienced qualities from the perspective of a blind person, without actually being blind.

Considerations regarding the intricate interconnectivity between sustainability, sensory architecture and tectonics opened up a substantial amount of topics relevant to our approach. Attempting to grasp these subjects proved to be both time consuming and complex as our previously defined approach demands a wide perspective and a wide range of subjects. Establishing a limitation of the range of subjects covered could have favored going in depth with a few selected topics, such as LCA, but maintaining the wide perspective and exploring the potential application of our approach took precedence.

During the design process we encountered the issue of establishing a balance between creating a design that assists the blind and visually impaired in their everyday lives, and a design that challenges and motivates them. The main artery is an element that demands such considerations. The ramps challenge their balance and spark the proprioception sense, while the adjacent guiding wall becomes the helping hand.

To support wayfinding, interior landmarks were incorporated along the main artery. These landmarks are in our project mainly based on experiential contrasts, and not in the shape of specific elements continuously producing, for instance, a certain sound. Some of the experiential contrasts are based on the use of the space and require ongoing activities that provide the visitor with an extended notion of the space, but the incorporation of more permanent landmarks might prove to be a more reliant approach when wayfinding is considered exclusively. Though in our project, wayfinding and experienced quality need to be considered simultaneously in order to achieve a coherent architectural narrative.

The desired experiences within the different pulse zones have been dictating for the indoor climate throughout the design process, aiming to achieve sensory contrasts and experiences rather than comfort. This intention raises concerns regarding the balance between adhering to the comfort requirements and creating contrasts. For instance, in the apartments and guestrooms a temperature of 24 degrees during the daytime is intended to support the experience of the low pulse zone, but on certain occasions, this might cause an inordinately high level of discomfort. In this case, the natural ventilation could provide the solution.

The building encompasses 12 guestrooms and 6 apartments, providing the opportunity for weekly stays. Economically, a greater number of guestrooms and apartments might have been preferable, but the small number of overnight visitors allow for more intimate social gatherings and provide a greater sense of ownership and belonging.

The use of materials has been an important subject throughout the design process. The chosen materials are intended to support the experience of the space through tactile, acoustic and visual qualities. In certain compositions, the level of contrast between the materials could be questioned, implying that a greater number of different materials could prove to be necessary.

The relevance of the chosen topic for this master's thesis has throughout the progression of the project expanded our horizons in relation to the potential application of our approach in future architectural projects, not necessarily concerning the blind and visually impaired. Sensory architecture holds the power to influence our behaviour, and the implementation of the body and senses as design parameters can be applied in any architectural project.

Books:
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- ILLUSTRATION LIST -

08

APPENDIX

INTERVIEW WITH BIRGITTE LILLETVEDT

An interview with Birgitte Lilletvedt, the head of rehabilitation and counseling at DBS, was conducted to establish an insight into the practices of DBS, and gain information regarding the facilities at Fuglsangcentret in Fredericia.

Birgitte Lilletvedt:
Vi laver rehabilitering for blinde og svagsynede, og det handler om at rehabilitere hele mennesket. I den forstand, at når man mister synet må man lære at orientere sig, man må lære at gå fra A til B, man må lære at benytte den hvide stok, benytte GPS, finde vejen til butikken og finde vejen til arbejde. Det har en funktionel side med at man skal lære at bruge kommunikationsmidler, en Ipad, eller en Iphone, eller en computer, eller en Mac, hvad det nu må være. Oftest er Apple teknologi meget tilgængeligt for blinde og svagsynede, men det ved man jo ikke. Man tænker jo at telefonen ikke er meget tilgængelig fordi den har næsten ikke nogen knapper, men den har Siri, og den har stemmestyring, så blinde benytter telefonen på en lidt anden måde, men det skal man jo have oplæring i og det tilbyder vi.

Så vi har den fysiske side med at bevæge sig, og så har vi den funktionelle side som handler om alt om hjælpemidler. Det funktionelle handler også om at lære at benytte sit køkken, at lære at lave mad. Hvordan gør man det, og hvordan finder man ting i sit køleskab, hvordan laver man ernæringsrig mad som synshandicappet? Vi har et øvekøkken her (på Fuglsangcentret), hvor de lærer at lave mad.

Det med synstabet har også en følelsesmæssig side. Det er ikke særlig sjovt at miste synet, mange bliver nedstemte, deprimeret og har store udfordringer. Man tror at man er alene, og der er stadig et stigma knyttet til det at være blind. Man snakker ikke så meget om det, så det at komme her (Fuglsangcentret) og møde andre der er i samme situation, det hjælper meget. At få snakket og bearbejdet sorg og krise, og lære nogle mestringsstrategier for hvordan man kommer videre.

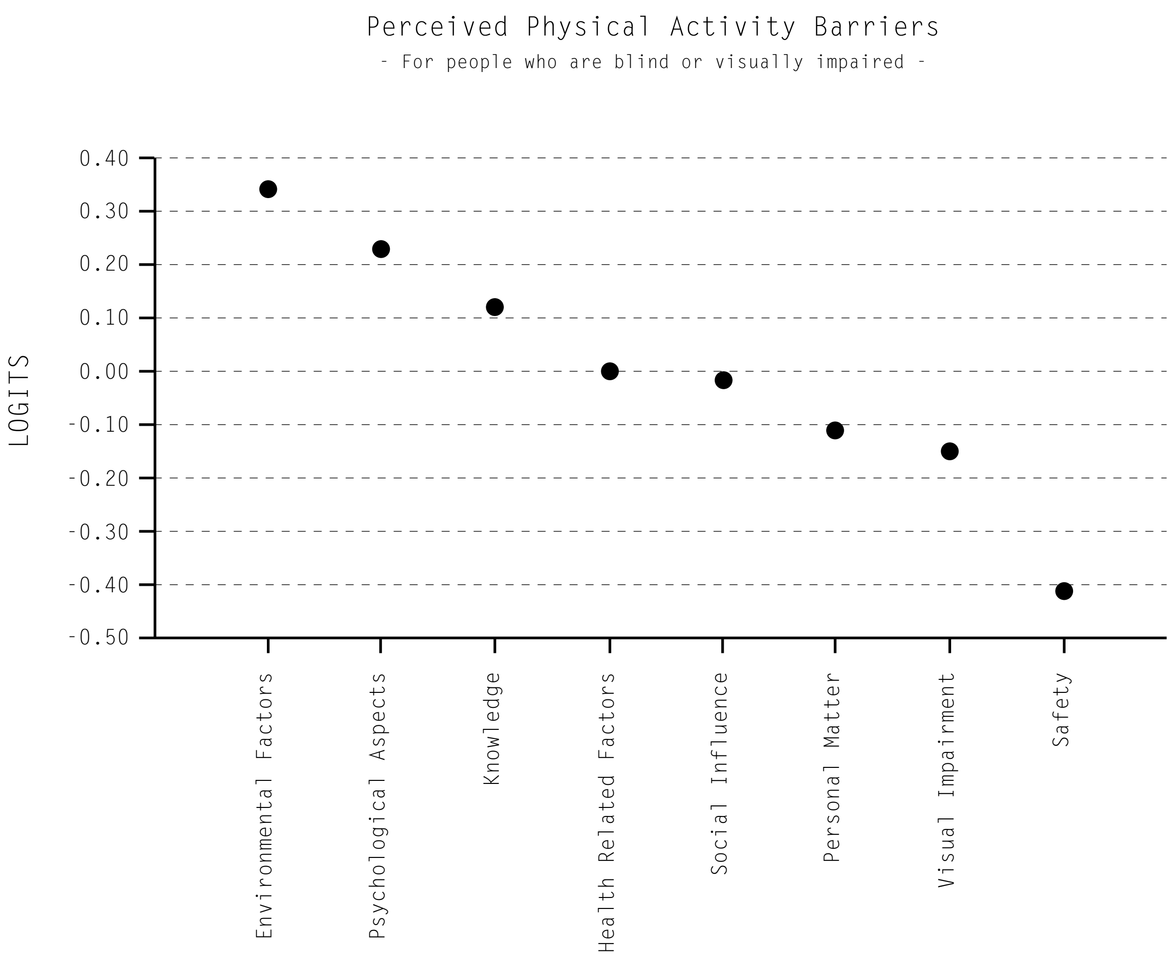
Det er sådan essensen i det vi laver her, og så kan i læse om alle vores rehabiliteringskurser. Vi ønsker, at når vi siger at vi rehabiliterer hele mennesket, så ønsker vi at gøre mere i forhold til fysisk aktivitet. Motion, bevægelse og det at være udendørs. I Norge så snakker man om ude-rehabilitering, fordi det har en egen effekt det at være udendørs og få frisk luft og stimulere sanserne, end det man gør indendørs.

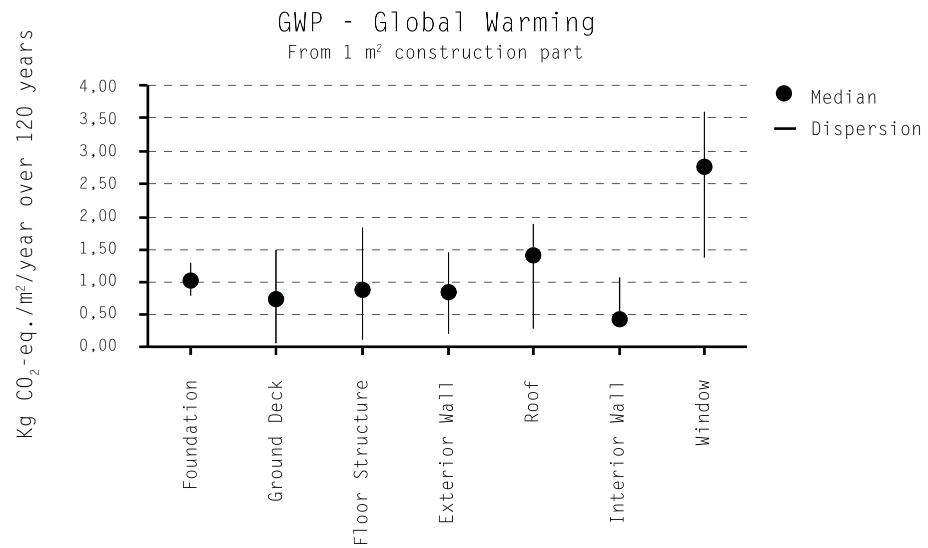
Vi siger også at fysisk aktivitet det skal være fast i vores rehabilitering. På samme måde som man lærer kommunikationsmidler, så lærer man også at være fysisk aktiv. Mange blinde bliver overvægtige, de går ikke tur og de er ikke fysisk aktive fordi der er så mange barrierer. Det skal vi stimulere og motivere til.

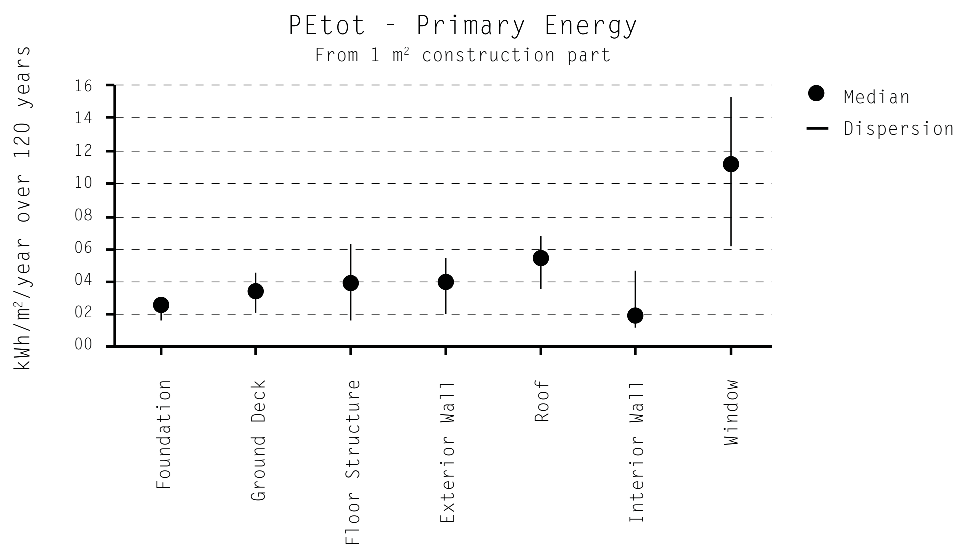
Jeg skulle meget gerne set at dette center låg ved vandet, og at vi havde en nærhed til vandet. Men det vi har her er nærhed til skoven og der er en tilgængelig sti, som ligger lige bagved centret. Det er der mange muligheder i.

Min rehabiliterings tilnærming er at man skal have oplevelser i kombination med læring. Der er så meget læring i andre aktiviteter, og mestring og bryde barrierer. Når i ser videoer fra de norske centre ser i at de har zip-line(go high bane) og klatrevæg. Det er også lige så meget rehabilitering som at sidde og skrive, eller lære punktskrift for eksempel. Det handler jo om at få mod på livet, overskud, kontrol på egen krop og blive kropsbevidst og din egen identitet.

Jeg mener at vi har meget stort behov for en multihal som har det hele, hvor der er fitness, alt under idræt og mestring og balancetræning. Balancetræning er så vigtigt for blinde, fordi når man mister synet får man rigtig dårlig balance.


Perceived Physical Activity Barriers
- For people who are blind or visually impaired -
LOGITS
0.40
0.30
0.20
0.10
0.00
-0.10
-0.20
-0.30
-0.40
-0.50
Environmental Factors
Psychological Aspects
Knowledge
Health Related Factors
Social Influence
Personal Matter
Visual Impairment
Safety


GWP - Global Warming
From 1 m² construction part
Kg CO_2-eq./m²/year over 120 years
4,00
3,50
3,00
2,50
2,00
1,50
1,00
0,50
0,00
Foundation
Ground Deck
Floor Structure
Exterior Wall
Roof
Interior Wall
Window
Median
Dispersion


PEtot - Primary Energy
From 1 m² construction part
kWh/m²/year over 120 years
16
14
12
10
08
06
04
02
00
Foundation
Ground Deck
Floor Structure
Exterior Wall
Roof
Interior Wall
Window
Median
Dispersion

RESIDENTIAL BUILDING

Key numbers, kWh/m² year

	Without supplement	Supplement for special conditions	Total energy frame	Total energy requirement
Renovation class 2	72,0	0,0	72,0	28,7
Renovation class 1	54,0	0,0	54,0	28,7
Energy frame BR 2018	30,9	0,0	30,9	28,7
Energy frame low energy	27,0	0,0	27,0	28,7

Contribution to energy requirement	
Heat	27,9
El. for operation of bulding	2,7
Excessive in rooms	0,0

Net requirement	
Room heating	14,8
Domestic hot water	13,1
Cooling	0,0

Selected electricity requirements	
Lighting	0,0
Heating of rooms	0,0
Heating of DHW	0,0
Heat pump	0,0
Ventilators	2,6
Pumps	0,0
Cooling	0,0
Total el. consumption	32,4

Heat loss from installations	
Room heating	0,0
Domestic hot water	0,0

Output from special sources	
Solar heat	0,0
Heat pump	0,0
Solar cells	0,0
Wind mills	0,0

RESIDENTIAL BUILDING

OTHER BUILDING

Key numbers, kWh/m² year

	Without supplement	Supplement for special conditions	Total energy frame	Total energy requirement
Renovation class 2	96,3	0,0	96,3	31,9
Renovation class 1	72,3	0,0	72,3	31,9
Energy frame BR 2018	41,6	0,0	41,6	31,9
Energy frame low energy	33,0	0,0	33,0	31,9

Contribution to energy requirement	
Heat	29,8
EL for operation of bulding	3,4
Excessive in rooms	0,0

Net requirement	
Room heating	24,6
Domestic hot water	5,3
Cooling	0,0

Selected electricity requirements	
Lighting	0,0
Heating of rooms	0,0
Heating of DHW	0,0
Heat pump	0,0
Ventilators	3,4
Pumps	0,0
Cooling	0,0
Total el. consumption	17,8

Heat loss from installations	
Room heating	0,0
Domestic hot water	0,0

Output from special sources	
Solar heat	0,0
Heat pump	0,0
Solar cells	0,0
Wind mills	0,0

OTHER BUILDING

OTHER BUILDING WITH SOLAR CELLS

Key numbers, kWh/m² year

	Without supplement	Supplement for special conditions	Total energy frame	Total energy requirement
Renovation class 2	96,3	0,0	96,3	6,9
Renovation class 1	72,3	0,0	72,3	6,9
Energy frame BR 2018	41,6	0,0	41,6	6,9
Energy frame low energy	33,0	0,0	33,0	6,9

Contribution to energy requirement	
Heat	29,8
El. for operation of bulding	-9,7
Excessive in rooms	0,0

Net requirement	
Room heating	24,6
Domestic hot water	5,3
Cooling	0,0

Selected electricity requirements	
Lighting	0,0
Heating of rooms	0,0
Heating of DHW	0,0
Heat pump	0,0
Ventilators	3,4
Pumps	0,0
Cooling	0,0
Total el. consumption	17,8

Heat loss from installations	
Room heating	0,0
Domestic hot water	0,0

Output from special sources	
Solar heat	0,0
Heat pump	0,0
Solar cells	14,6
Wind mills	0,0

OTHER BUILDING WITH SOLAR CELLS

- LIGHT AND SHADOW STUDIES -

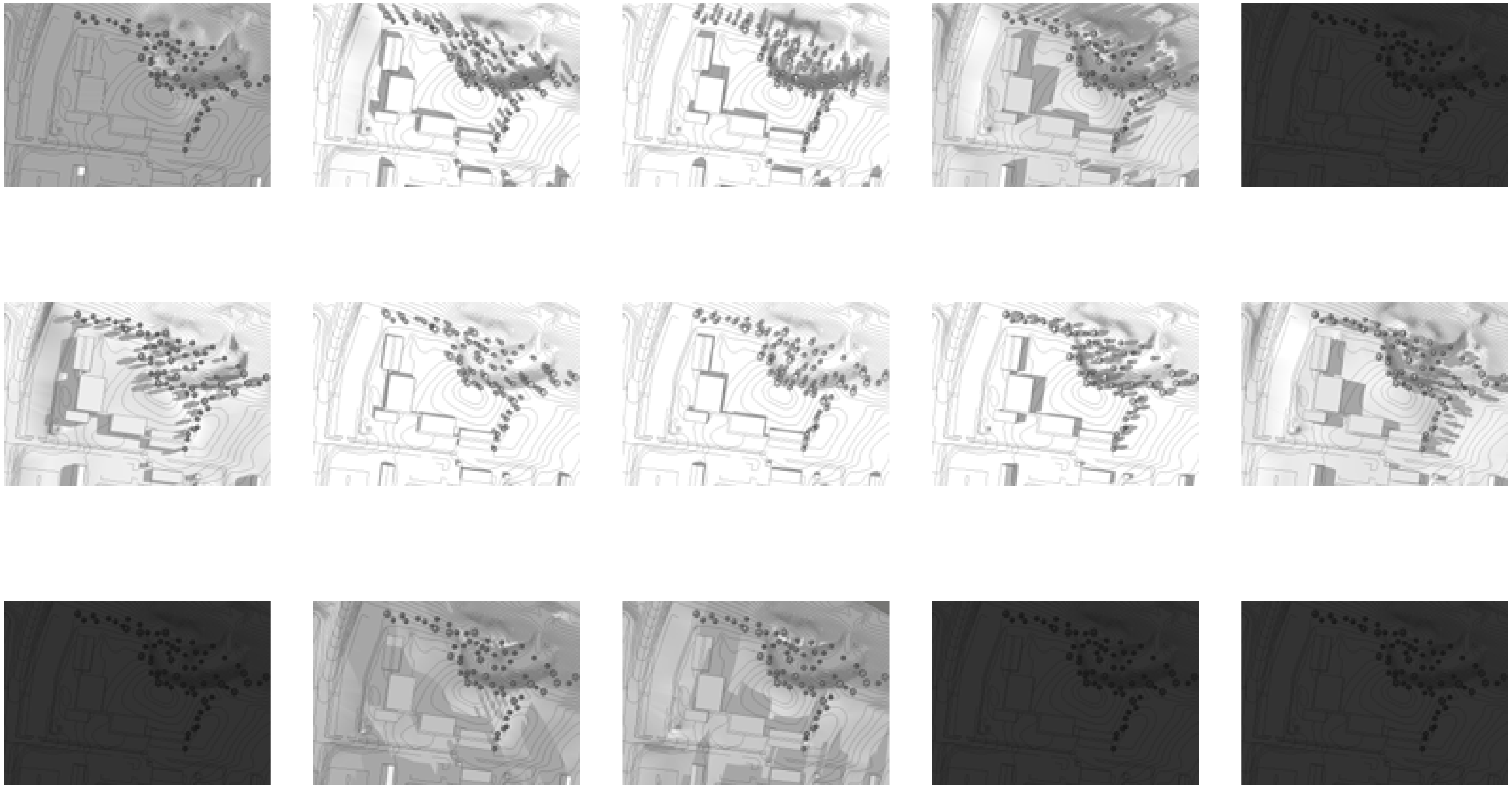
L-SHAPE

08.00 12.00 15.00 18.00 20.00

21.03

21.06

21.12



- LIGHT AND SHADOW STUDIES -

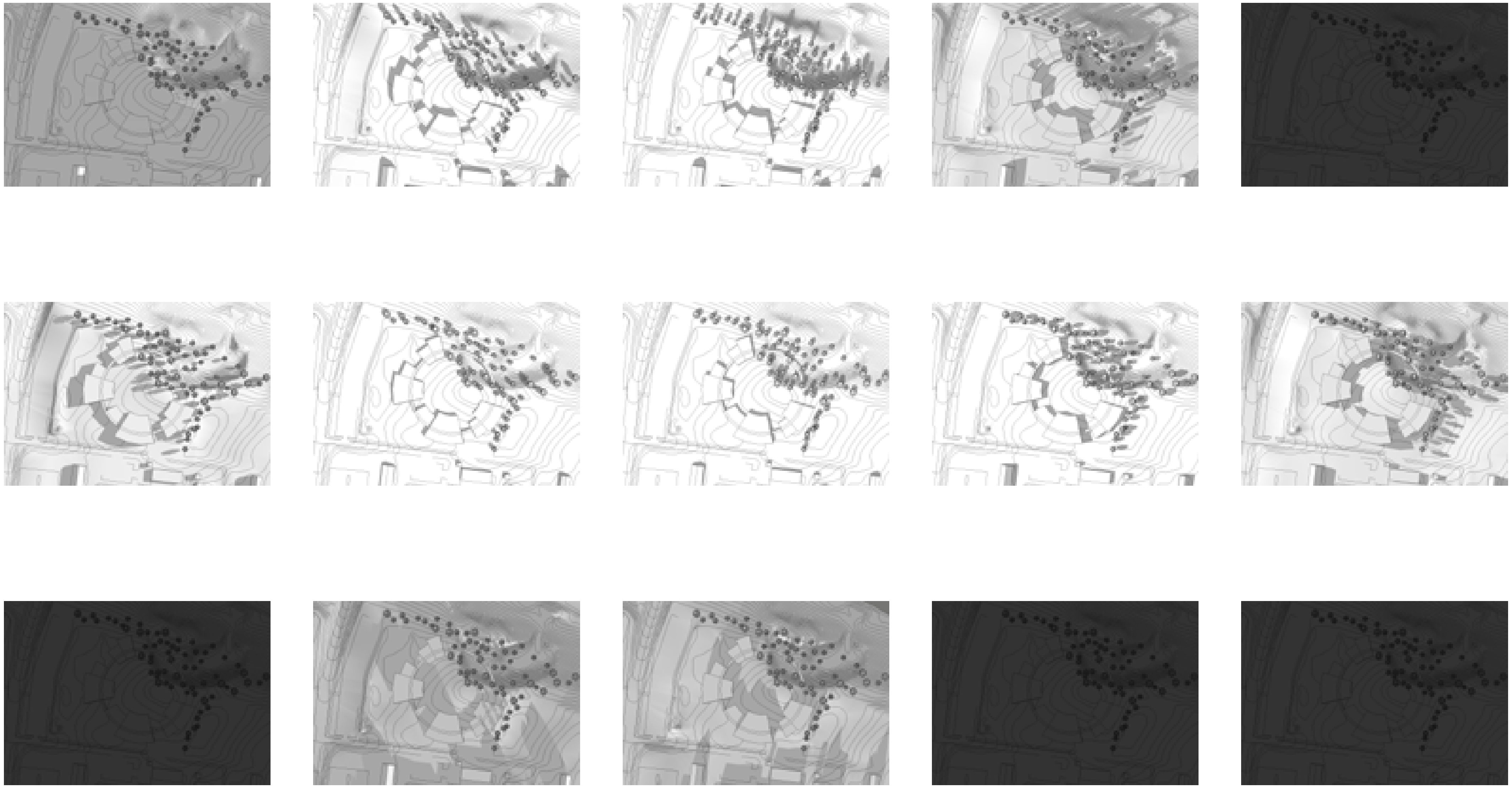
CIRCLE

08.00 | 12.00 | 15.00 | 18.00 | 20.00

21.03

21.06

21.12



- LIGHT AND SHADOW STUDIES -

THE FAN

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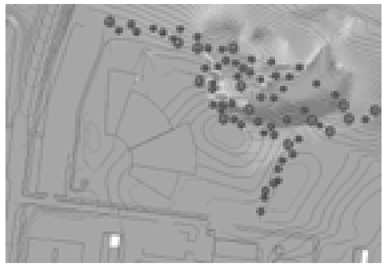
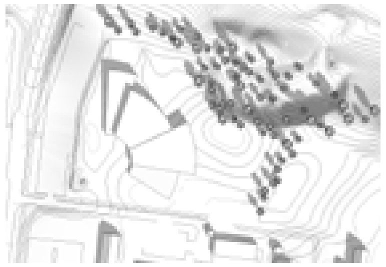
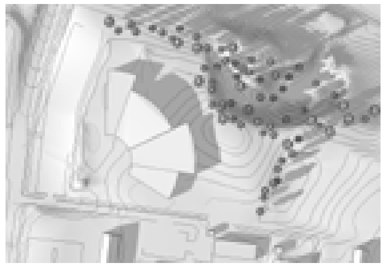
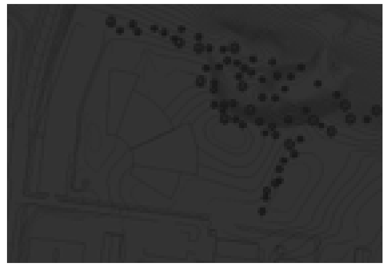
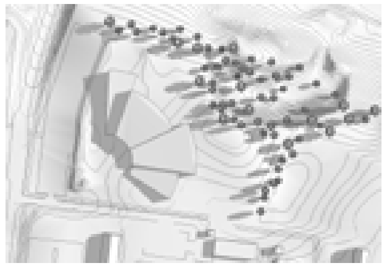
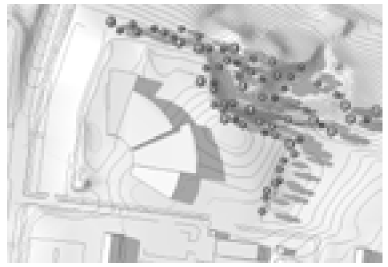
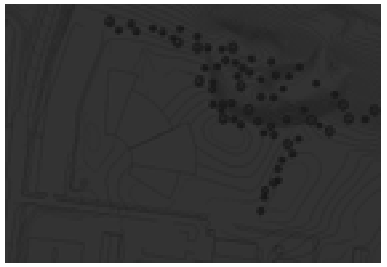
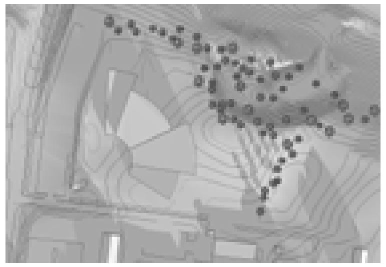
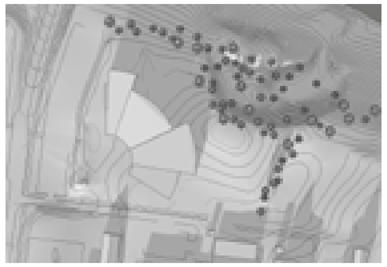
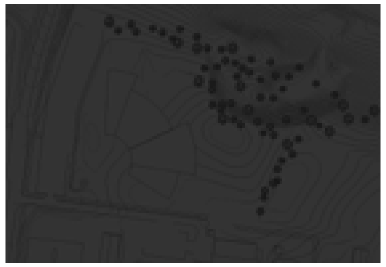
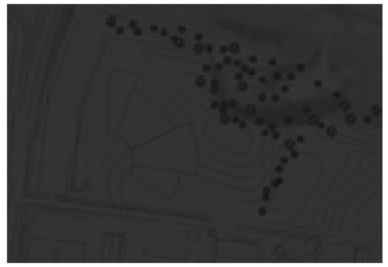
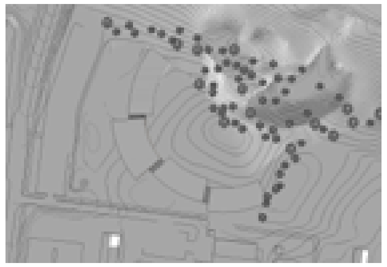
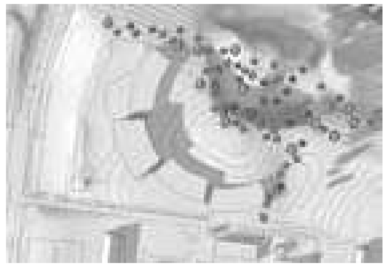
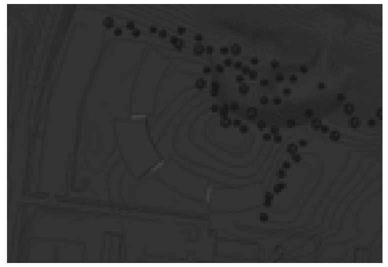
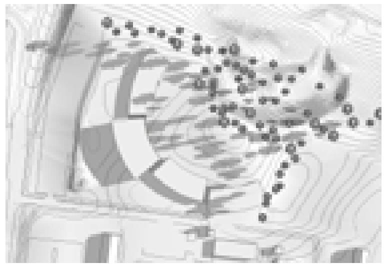
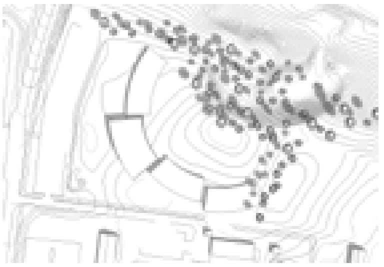
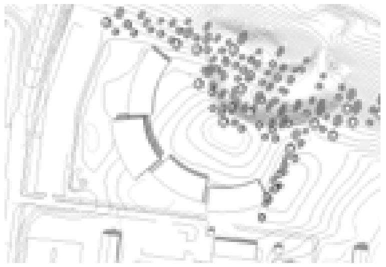
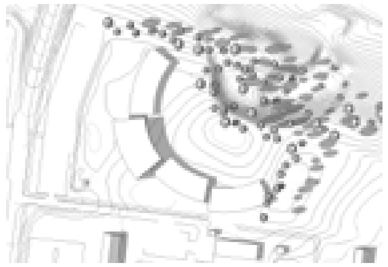
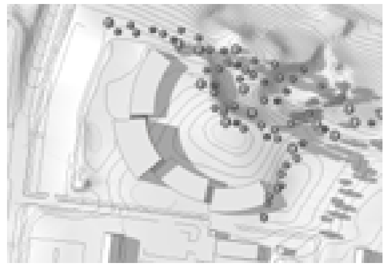
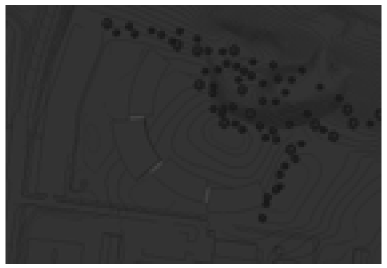
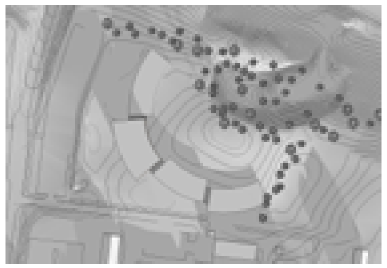
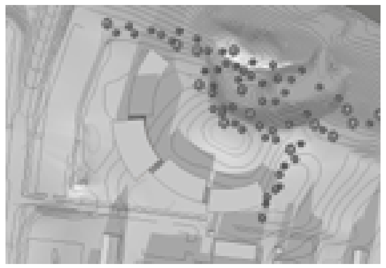
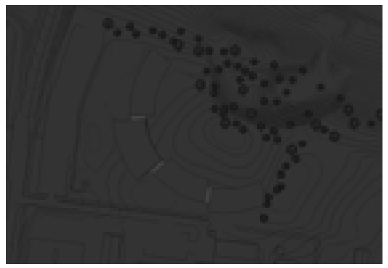
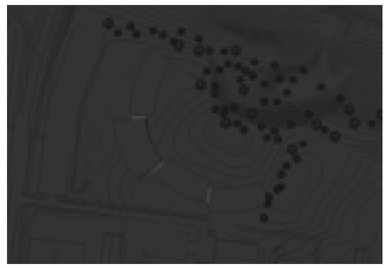
21.03					
21.06					
21.12					

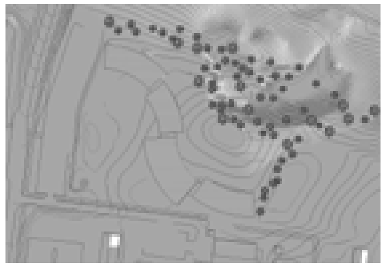
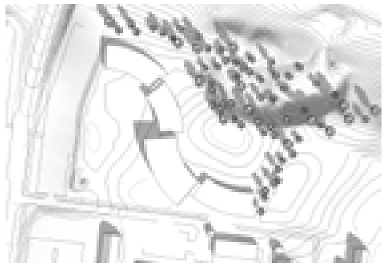
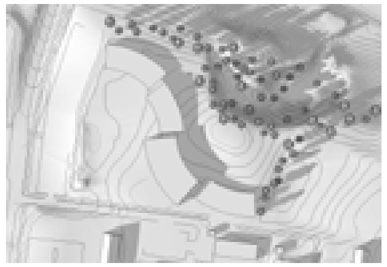
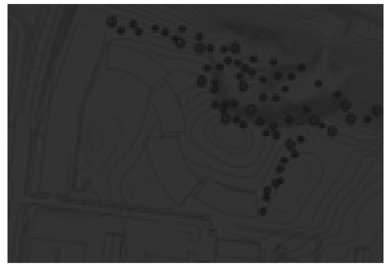
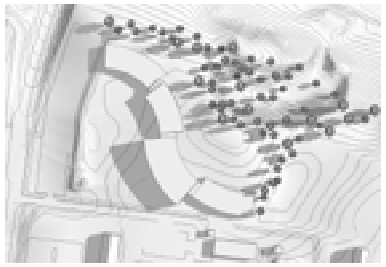
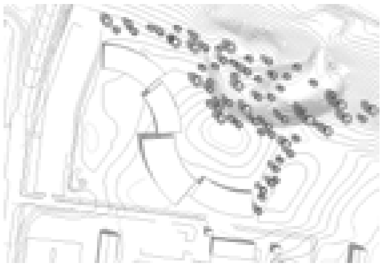
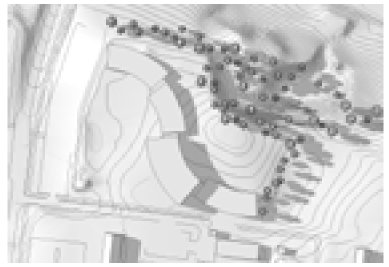
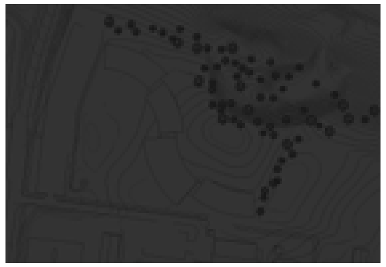
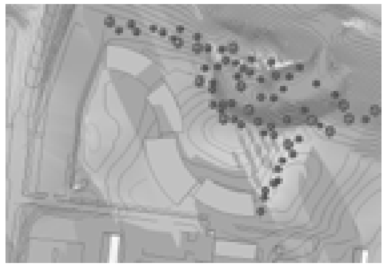
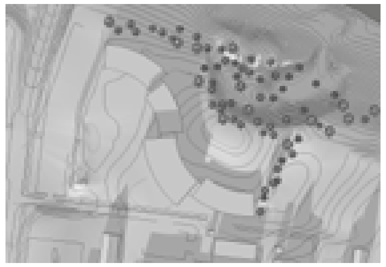
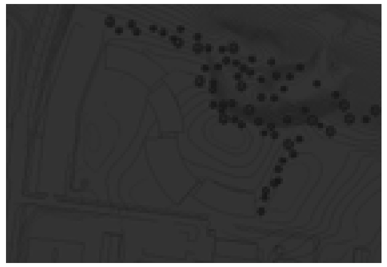
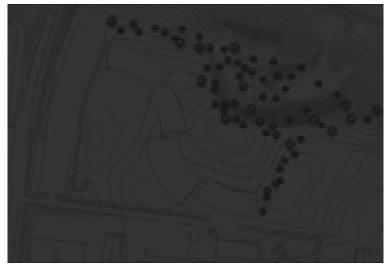
- LIGHT AND SHADOW STUDIES -

HALF CIRCLE

	08.00	12.00	15.00	18.00	20.00
21.03					
21.06					
21.12					

- LIGHT AND SHADOW STUDIES -

S-SHAPE

	08.00	12.00	15.00	18.00	20.00
21.03					
21.06					
21.12					

- LIGHT AND SHADOW STUDIES -

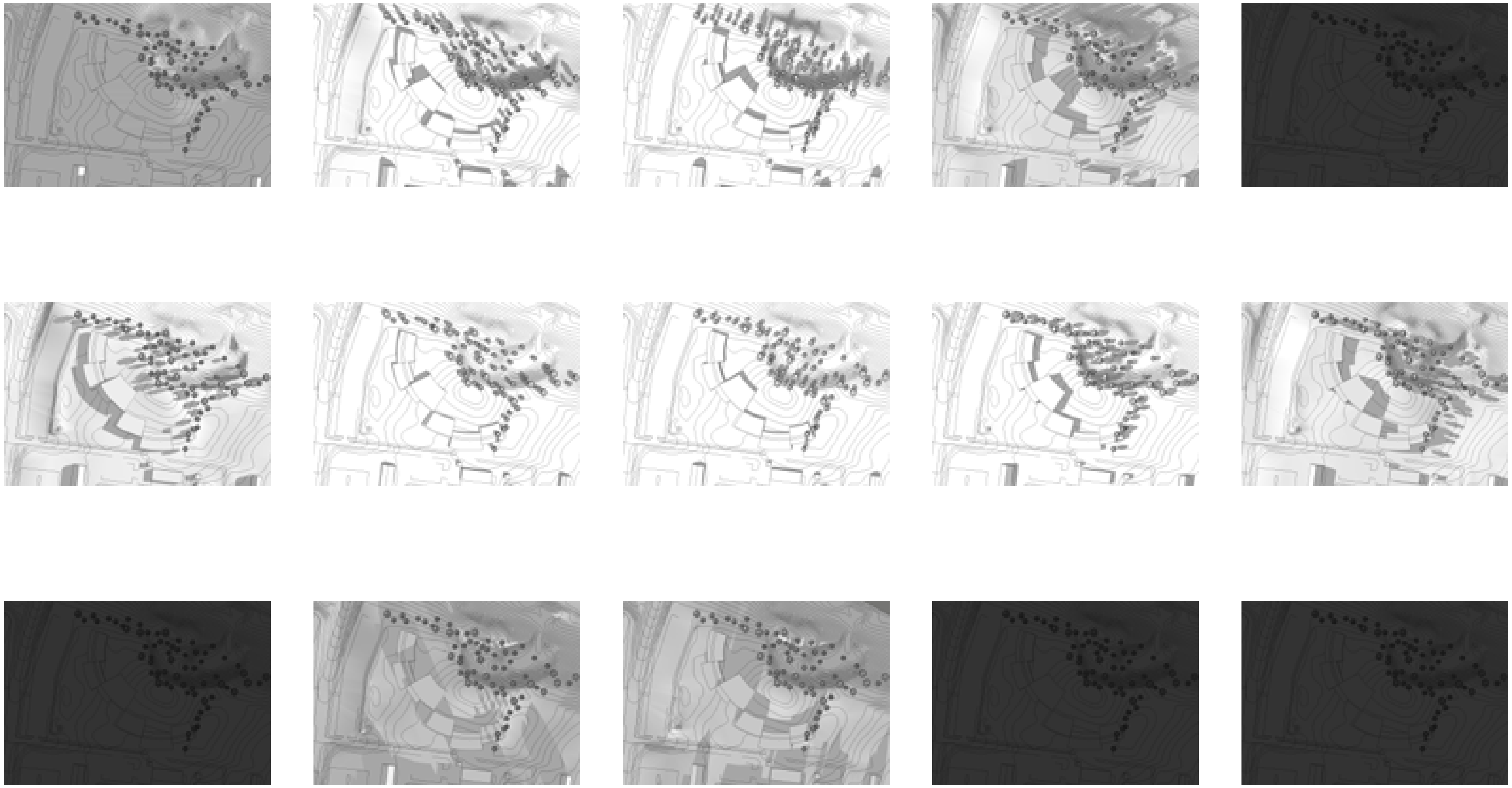
FRAGMENTED HALF CIRCLE

08.00 12.00 15.00 18.00 20.00

21.03

21.06

21.12



DATA

A / AREA OF MODULES

B / MODULE EFFICIANCY

MONOCRYSTALINE HIGH EFFICIANCY: 18%

C / PEAK POWER

D / System Factor

W. HIGH EFFICIANCY INVERTER: 0,85

E / Solar Radiation

SOUTH ORIENTED, 15 DEGREES INCLINATION: 1100 kWh/m^2

ENERGY DEMAND
/ RESIDENTIAL PART
28,7 kWh/m^2 year

TOTAL EL. CONSUMPTION
/ RESIDENTIAL PART
32,4 kWh/m^2 year

ENERGY DEMAND
/ OTHER PART
31,9 kWh/m^2 year

TOTAL EL. CONSUMPTION
/ OTHER PART
17,8 kWh/m^2 year

SOLAR PHOTOVOLTAICS
/ DIMENSIONING

(32,4 kWh/m2 year + 28,7 kWh/m2 year/1,8) + (17,8 kWh/m2 year + 31,0 kWh/m2 year/1,8) = 83,36 kWh/m2 year

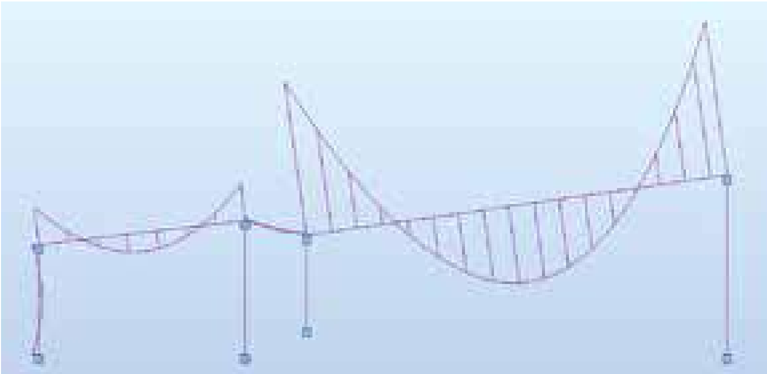
Domestic Appliances — *Energy conversion into electricity by primary energy factor* — *Domestic Appliances* — *Energy conversion into electricity by primary energy factor*

83,36 kWh/m2 year x (1097 m2 + 1723 m2) = 235075 kWh/year

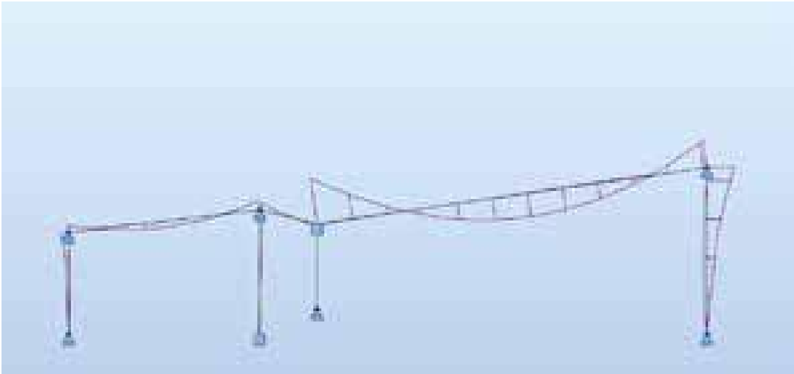
Energy need / m2 — *Total m2 of the building*

235075 kWh/year = C x D x E => C = 235075 kWh/year/(0,85 x 1100 kWh/m2) => C = 251 kWpeak

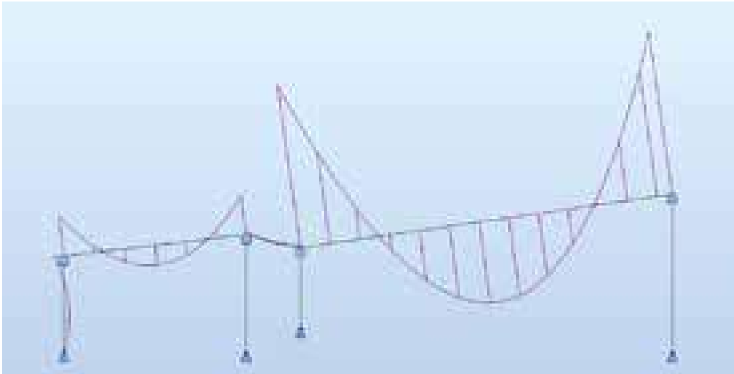
A = (C x 100)/B => A = (251 kWpeak x 100)/18 => A = 1394 m2



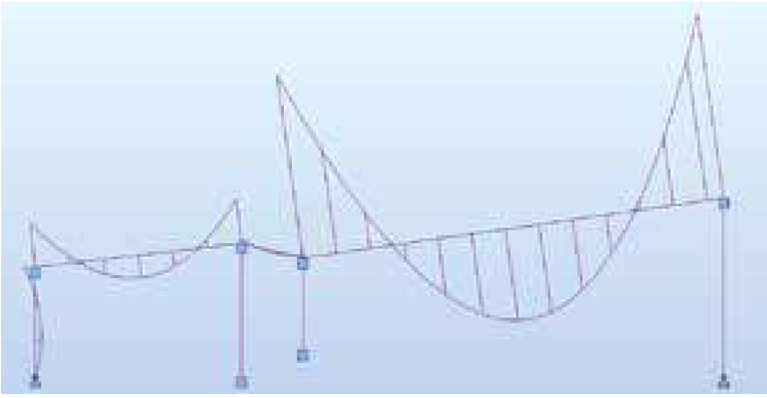
ALL FIXED



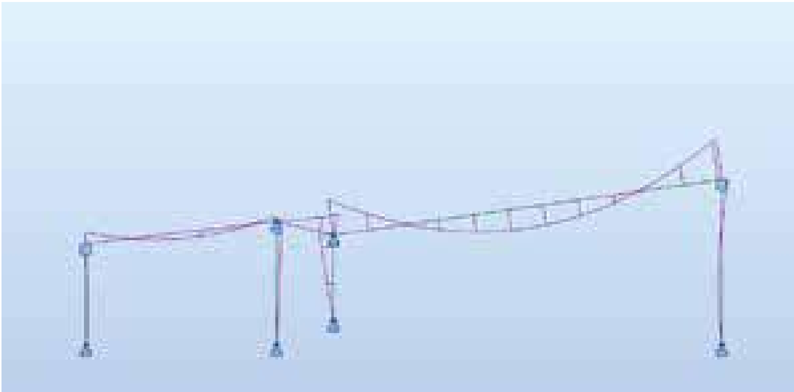
MIXED FIXED/HINGE VERSION 1



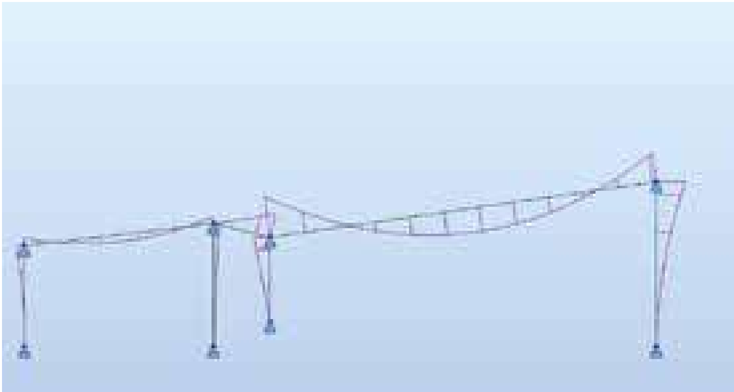
MIXED FIXED/HINGE VERSION 2



MIXED FIXED/HINGE VERSION 3



MIXED FIXED/HINGE VERSION 4



ALL HINGE

- NATURAL VENTILATION -

VENTILATION RATE CALCULATION
/ GUEST ROOM

Area	20 m^2
Room height	3 m
Room Volume (Vr)	60 m^3

IN RELATION TO CO_2

CO_2 concentration: max 500 + 350 ppm (EN 15251)

C	700 ppm
C_i	350 ppm
Ventilation Efficiency, eop	1
C_u = eop * (C-C_i) + C_i	700 ppm
Air pollution source, q	17 l/h / person
Capacity	2 people
Activity level	1,5 Met
q	51 l/h
Ventilation need for CO_2	
Vl = q/(C_u-C_i)	0,051 m^3/h
	0,04 m^3/s
Air Change Rate	
N=Vl/Vr	2,43 h^{-1}

IN RELATION TO OLFACTION

Air quality (olfaction): values from EN 15251)

C	1,4 dp
C_i	0 dp
Ventilation efficiency, e_{op}	1
Cu = e_{op}*(C-C_i)+C_i	1,4 dp
Air pollution source, q	
Capacity	2 people
Activity Level	1,6 olf
	3,2 olf
Low-olf building (0,1*area)	2 olf
q	5,2 olf
Ventilation need for olfaction	
Vl =10*q/(Cu-Ci)	37,1 l/s
	133,7 m^3/s
Air Change Rate	
N = Vl/Vr	8,3 h^{-1}

VENTILATION RATE VALUE
/ MULTI GYM

Area	350 m^2
Room height	5 m
Room Volume (Vr)	1750 m^3
CO_2	OLF.
9,61 h^{-1}	7,2 h^{-1}

VENTILATION RATE VALUE
/ FLEX ROOM

Area	90 m^2
Room height	4,5 m
Room Volume (Vr)	405 m^3
CO_2	OLF.
5,76 h^{-1}	3,1 h^{-1}

VENTILATION RATE VALUE
/ RHYTHM ROOM

Area	59 m^2
Room height	4,5 m
Room Volume (Vr)	265,5 m^3
CO_2	OLF.
10,98 h^{-1}	8,3 h^{-1}

NATURAL VENTILATION CALCULATION
/ GUEST ROOM - STACK VENTILATION

Pressure Coefficient		**Windfactor**	0,65	**Pwind**	0,3 pa
Windward	0,18	**Vmeteo**	1 m/s	**Pmin**	0,0 pa
Leeward	-0,2	**Vref**	0,65 m/s	**Pmax**	0,0 pa

Location of neutral plan, Ho	1,4 m	**Buildingvol.**	m3	
Outdoor temperature	21 C	**Volume**	m3/section/floor	
Zone temperature	22 C			
Discharge coefficient	0,7	**Internal pressure, Pi**	pa 0,016814811	0,02
Air density	1,25 kg/m3			

	Area	Eff. Area	Height	Thermal Buoyancy	AFR (thermal)	Pres Coefficient	Wind pressure	AFR Wind)	Wind pressure	AFR total
	m2	m2	m	pa	m3/s		pa	m3/s	pa	m3/s
North sliding door	0,323	0,226	1,1	0,013	0,033	0,18	0,031	0,050	0,031	0,060
Skylight	0,161	0,113	2,7	-0,054	-0,033	-0,41	-0,125	-0,050	-0,125	-0,060

Massebalance 0,00 | Massebalance 0,00 | 0,00

AFR FROM NATURAL VENTILATION: 0,060 m^3/s

/ GUEST ROOM - SINGLE SIDED

NEED: 0,04 m^3/s

AFR FROM NATURAL VENTILATION: 0,032 m^3/s

/ MULTI - STACK VENTILATION

NEED: 4,67 m^3/s

AFR FROM NATURAL VENTILATION: 2,056 m^3/s

/ MULTI - STACK VENTILATION (MORE OPENINGS)

NEED: 4,67 m^3/s

AFR FROM NATURAL VENTILATION: 2,26 m^3/s