Architecture is not just shelter - it is care.
Sustainability is not just low emissions - it is designing dignity.
THIS IS HOW WE REIMAGINE THE CHILDREN'S HOSPICE.

HOSPICE HJERTERUMMET

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ABSTRACT

Hospice Hjerterummet is a proposal for a sustainable children's hospice located in Aalborg East, near the new Aalborg University Hospital and adjacent natural landscapes. Addressing the lack of pediatric palliative care facilities in Denmark, the project aims to create a calm, supportive, and homely environment for children with life-limiting illnesses and their families.

The project is developed through a combination of Integrated Design Process (IDP) and Evidence-Based Design (EBD), ensuring that each architectural decision is both user-centered and research-informed. It explores how architecture can promote emotional well-being and physical relief, while integrating sustainability through a healthy indoor climate, and close connections to nature.

The layout consists of six private family units, central communal areas, and treatment rooms organized around the building's heart: the Heartroom - a flexible space for play, rest, and togetherness.

Nature is incorporated through a sensory garden, a memorial pergola, and accessible outdoor spaces that support emotional healing and reflection.

This thesis reimagines the children's hospice not as an institution, but as a temporary home - a place of comfort, connection, and humanity during life's most vulnerable moments.

READING GUIDE

Hospice Hjerterummet is a children's hospice located in Aalborg East, near Aalborg University Hospital and surrounded by nature. Covering a total area of 2.344,3 m², the hospice is intended to accommodate six families at a time, providing a calm, supportive, and home-like environment.

The report is structured into the following sections: prologue, methodological framework, theoretical framework, user and site, problem delimination, design phase, presentation, epilogue, and finally the appendix. A navigation bar at the bottom of each page indicates the reader's position within the overall structure of the report.

TABLE OF CONTENT

DESIGN PHASE

PRESENTATION

EPILOGUE

WHY A CHILDREN HOSPICE?

Every child deserves a space where they feel safe, cared for, and surrounded by warmth - especially those living with life-limiting or life-threatening illnesses. Yet in Denmark, only two children's hospices currently exist, leaving many families without access to specialized palliative care. For these children and their loved ones, the right environment can make all the difference between isolation and connection, fear and peace.

This thesis responds to that gap by proposing a new sustainable children's hospice in connection with the new Aalborg University Hospital - a place that not only provides high-quality care, but also fosters a deep sense of home, comfort, and relief.

We believe that architecture is more than shelter - it is a framework for healing, dignity, and emotional support. Thoughtfully shaped spaces can ease suffering, create moments of joy, and strengthen the bonds between children, families, and caregivers.

By prioritizing a healthy indoor climate - with optimal air quality, thermal comfort, and low-emission materials - the hospice environment supports both physical and emotional well-being. Sustainability here is not only about reducing CO_2 emissions, but about creating with care: ensuring that every material, every detail, and every spatial decision contributes to a setting that honours life, even in its most fragile state.

Beyond the walls, nature plays a vital role in healing. Studies show that access to outdoor environments can reduce stress, ease anxiety, and offer moments of calm and joy. The ability to feel the changing seasons, hear rustling leaves, or simply sit in the open air can offer both emotional grounding and sensory relief. That is why the hospice includes a carefully conceived green landscape - featuring a sensory garden and memorial pergola - where families can reflect, play, or just be together in peace. These outdoor spaces are crafted to be accessible, private, and restorative, expanding the role of the hospice beyond medical care to include memory-making, presence, and life-affirming experiences.

Through this thesis, we aim to reimagine what a children's hospice can be. By combining evidence-based methodology, sustainable thinking, and a human-centered approach, we strive to create more than a building. We hope to offer a place that feels warm, respectful, and dignified - where children are not merely patients, but individuals deserving of beauty, autonomy, and the freedom to experience life, however limited the time may be.

CHAPTER 01

METHODOLOGICAL FRAMEWORK

Chapter 1 outlines the methodological framework of the thesis, detailing the applied methods and sub-methods that have guided the design process. Central to this approach are the principles of Integrated Design Process and Evidence-Based Design, which together ensure a holistic and research-informed foundation for decision-making throughout the project.

INTEGRATED DESIGN PROCESS

In order for a building to meet the many and often conflicting requirements of a modern society – such as energy efficiency, good indoor climate, safety, functionality and sustainability – while also taking into account the needs of users and project-specific requirements, a structured and well-thought-out approach is required. Without a clear method, there is a risk of inefficiency, poor performance and solutions that do not work in practice.

The integrated design process (IDP) is based on five phases that are closely linked and often repeated in an iterative process: problem definition, analysis, sketching, synthesis and presentation (Knudstrup, 2004). The phases are not linear, but continuously adapt to new insights and project development.

In the first phase, the problem definition, the central challenges of the project are defined. Here, a clear problem statement and vision are formulated, which creates a basis for further work.

In the analysis phase, the project is examined in depth through theory, cases, functional requirements, user needs and the character of the place. In a health-related project, this will, for example, involve studies of evidence-based design, legislation and spatial needs.

The sketch phase is about translating knowledge into concrete ideas. This is done through hand drawings, digital models and physical sketches, which are used to investigate and develop solutions in line with the project's goals.

This is followed by the synthesis phase, where ideas are carefully evaluated against the project's vision and overall framework. If something doesn't quite work - maybe because of missing information or unexpected challenges - the process loops back for adjustments. This back-and-forth helps improve and refine the design step by step.

Finally, everything is put together in the presentation phase. Here, the final building is showing by visualizations, diagrams and illustrations that clearly convey the project's background and idea (Knudstrup, 2004).

By creating a constant feedback loop between the design phases, IDP supports a circular process where the design is continuously improved through ongoing iterations (Hansen & Knudstrup, 2005).

EVIDENCE-BASED DESIGN

Evidence-Based Design (EBD) is a design method where decisions are made based on research and experience from previous projects. By using documented knowledge as a basis for design choices, one ensures that the solutions are not only well-founded, but also work in practice. This approach is particularly relevant in a children's hospice, where well-being, care and functionality are crucial.

The process behind EBD typically consists of five phases: organizational preparation, preliminary analysis (pre-design), design, construction and operation. However, in this project – which is academic and not physically built – the focus is exclusively on the first three phases. Furthermore, the practical part of the design phase, which usually involves data collection and hypothesis formation in a real construction process, is omitted.

The first phase, organizational preparation, is about clarifying the overall goals and framework of the project. In the preliminary analysis phase, relevant research, previous examples and user experiences are collected to qualify and inspire the further design. This knowledge is then translated into specific architectural approaches and guidelines in the design phase, ensuring that the project is both based on best practice and takes into account the special needs of the children's hospice (The Center for Health Design, n.d.).

COMBINING IDP AND EBD

Although the Integrated Design Process (IDP) and Evidence-Based Design (EBD) share a structured and iterative nature, their underlying philosophies differ significantly. IDP fosters creativity and encourages exploration, pushing the boundaries of theory and analysis through an iterative, often experimental process. In contrast, EBD is rooted in logic and scientifically validated research, ensuring that each design decision is based on evidence rather than intuition or speculation.

This fundamental difference did not present a conflict when integrating the two methodologies; however, it occasionally extended the sketching and design process. EBD's requirement for rational justification of every design choice contrasts with IDP's more flexible and exploratory approach, necessitating additional steps to align creative experimentation with evidence-based validation.

METHODS

GATHERING KNOWLEDGE

To establish a solid theoretical foundation, literature studies were conducted to collect knowledge on universal design, hospice care, and related architectural theories. This research was particularly relevant during the early analysis phase of IDP, where theoretical insights shaped the project's conceptual direction. Additionally, case studies were undertaken to analyze existing children's hospices, specifically Strandbakkehuset and The Ark, providing valuable insights into functional requirements and user needs. This aligns with the "finding and interpreting" phase in EBD, where design decisions are informed by real-world examples and empirical evidence.

Tools: Literature, academic articles, online resources, documentary

SITE ANALYSIS

Although a physical site visit was initially planned, limited access due to ongoing construction reduced its effectiveness. Instead, alternative mapping methods were employed to examine microclimatic conditions - such as wind patterns and terrain - alongside contextual parameters including infrastructure and proximity to health facilities. This analytical process played a key role in both the IDP's early analysis phase and the "finding" phase of EBD, ensuring a data-informed understanding of the site's constraints and potential.

Tools: Site visit, QGIS, Dataforsyningen, Illustrator

USER ANALYSIS

A comprehensive user analysis was conducted to gain deeper insight into the experiences and needs of hospice users. This included an interview with an employee at Strandbakkehuset, providing firsthand knowledge of hospice operations and user experiences, as well as an analysis of a documentary depicting daily life at a children's hospice. This research was integral to both the IDP analysis phase and the "finding" phase of EBD, ensuring that design decisions were grounded in real-world user needs.

Tools: Documentary, field trip, interview

IDEA GENERATION

To foster creative exploration and test early design ideas, this phase focused on freehand sketching, 2D-form explorations, and 3D spatial studies. Conceptual thinking was translated into spatial form through quick analog sketches and physical or digital form models, which allowed for intuitive and iterative development of design ideas. Sketching and form studies became reflective tools, helping to visualize potential spatial atmospheres and relationships while staying aligned with user needs and project values. This process played a key role in shaping the architectural identity of the children's hospice, especially in relation to play, nature, and emotional comfort.

Tools: Sketching, physical model, Rhino

TECHNICAL METHODS

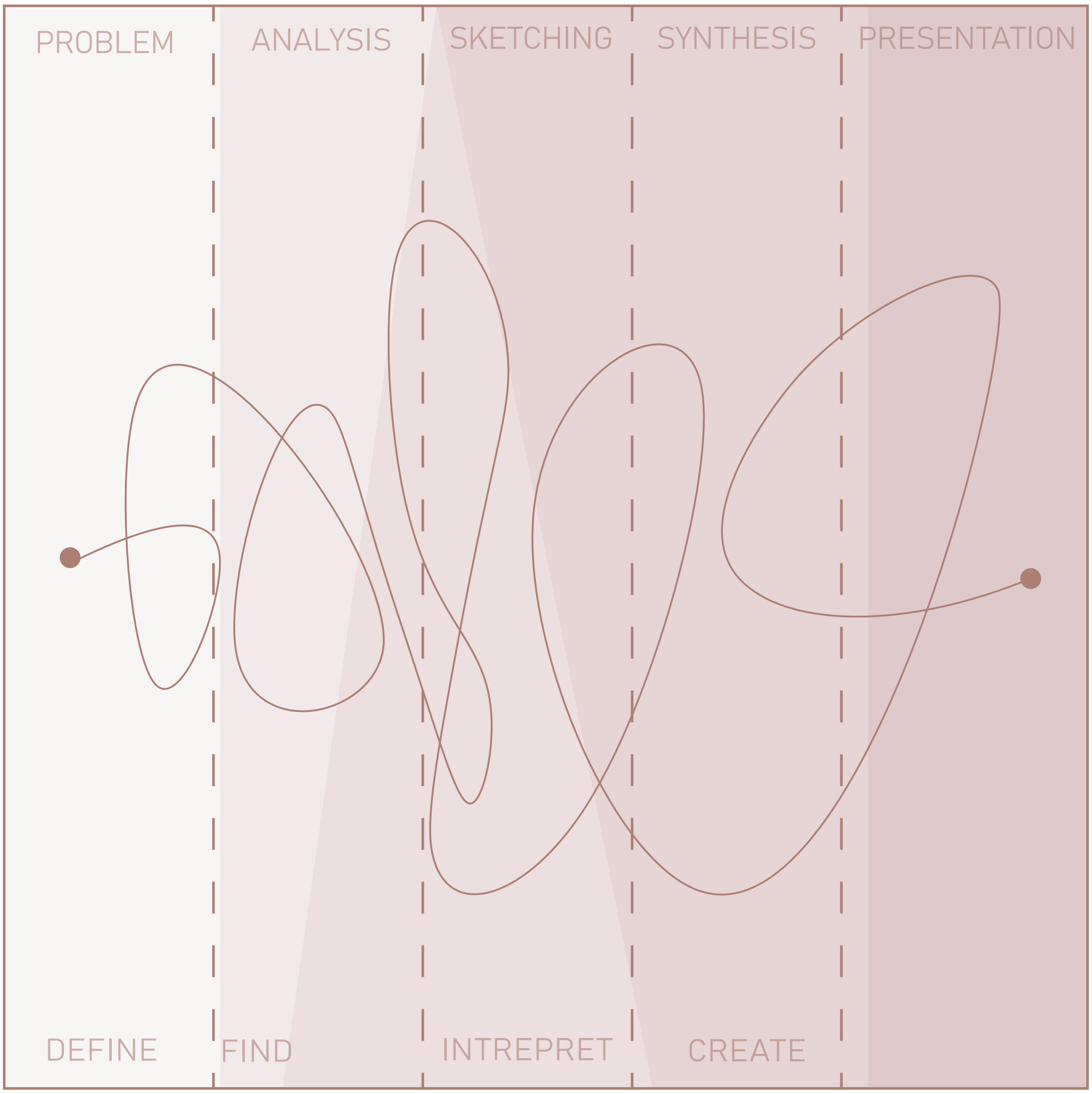
To ensure a healthy indoor climate, energy efficiency, and a low Global Warming Potential (GWP), advanced simulations and calculations were integrated early in the IDP sketching phase, guided by the principles of EBD. These assessments play a crucial role in optimizing building performance, thermal comfort, and overall sustainability.

Tools: BSim, LCA-byg, Be18, Rhino

PRESENTATION

The presentation phase involved compiling and refining visual outputs that effectively communicate the design rationale and process. These include architectural drawings, conceptual diagrams, and atmospheric visualizations developed through both digital and analog media. The visual material was created with the aim of clearly conveying the spatial narrative and emotional intentions behind the design. Additionally, this phase included the preparation of documentation for exhibition and evaluation purposes.

Tools: InDesign, Illustrator, Photoshop, Rhino, Enscape



Ill. 01 – Combining IDP and EBD

CHAPTER 02

THEORETICAL FRAMEWORK

Chapter 2 explores the theoretical framework of the thesis, focusing on key aspects of creating a healthy and homely environment in a children's hospice. This includes sustainability, healthy indoor climate, palliative architecture, the role of nature, and hospice care.

TOWARDS A SUSTAINABLE FUTURE

As the climate crisis deepens, countries around the world are raising the bar in the fight to cut carbon emissions. The construction sector stands at the heart of this challenge, responsible for nearly 40% of the world's energy use and CO_2 emissions (UNEP, 2022). In response, both global and national strategies have been introduced to encourage more sustainable building practices - with a dual focus on energy efficiency and material choices. Denmark is among the front-runners in this transition, implementing some of the strictest environmental regulations for new construction. These efforts reflect a commitment not only to reducing emissions but also to supporting social and economic sustainability.

The 2015 Paris Agreement aims to limit global temperature rise to below 1.5°C, prompting the EU to commit to cutting emissions by 40% by 2030. Denmark, however, has gone further, targeting a 70% reduction by 2030 and full carbon neutrality by 2050. Reaching these goals requires a comprehensive understanding of sustainability, built on three interconnected pillars: environmental, economic, and social. Of these, social sustainability remains the most difficult to define (Pareja-Eastaway, 2012), especially in architecture - where it is critical to ensure that climate policies do more than just cut emissions. They must also foster healthy, inclusive, and livable environments over the long term.

One of Denmark's most impactful regulatory tools is the introduction of stricter limits on a building's Global Warming Potential (GWP). From summer 2025, the current limit of 12 kg $CO_2e/m^2/year$ for buildings over 1,000 m² will drop to 7.1 kg $CO_2e/m^2/year$, and further to 5.8 kg $CO_2e/m^2/year$ by 2029 (rgo.dk).

These thresholds intensify the focus on low-impact material choices, energy supply, and building operation. As a result, Life Cycle Assessment (LCA) has become a key method for evaluating and minimizing environmental impact across the building's entire lifespan - from construction to operation.

On average, new buildings in Denmark still emit just under 10 kg $CO_2e/m^2/year$ (Zimmermann et al., 2020), underscoring the urgency of further reductions. To achieve this, a holistic approach is needed - one that connects environmental and social goals, reduces energy use without compromising indoor quality, and prioritizes long-term resilience. In this context, technologies like energy simulations and passive design play a growing role in reducing carbon footprints throughout the building's life.

In this project, sustainability is understood as both an environmental and social responsibility. The focus lies on promoting physical and mental well-being while reducing the building's carbon impact. This is achieved through thoughtful material choices guided by LCA, smart energy strategies, and careful alignment with current and upcoming regulations.

When it comes to the goal of 7.1 kg $CO_2e/m^2/year$, it will mainly be assessed in the material selection, where LCA is used in a conceptual level to choose the materials. The energy supply for the building will be chosen based on the available options in the area and building operation will be assessed through Be18. As Be18 does not measure GWP but kWh/m²/year, the actual amount it adds to the GWP is unclear. However, the goal is to minimize energy usage, without compromising the indoor climate, as using less energy should have a lower GWP.

LIFE CYCLE ASSESSMENT

Life cycle assessment (LCA) is a comprehensive method for calculating a building's total Global Warming Potential (GWP), offering a data-driven approach to evaluating environmental impact.

When applied early in the project, the method can help to optimise material choices, reduce emissions and ensure that sustainability is not at odds with aesthetic or functional quality. This provides a stronger basis for creating buildings that are both long-lasting and climate-responsible.

To ensure a structured and reliable assessment, LCA is divided into four main phases, each reflecting a part of the building's life cycle. While the method offers a detailed view of material and energy-related emissions, certain factors - like the individual carbon footprint of construction workers - are still difficult to measure precisely. Even so, LCA remains a key tool in sustainable construction, helping guide responsible choices and support more climate-conscious building practices.

PRODUCTION PHASE

This phase covers everything from the extraction of raw materials to production and transport. It has a major impact on the building's overall climate footprint. For example, the impact of wood starts long before construction – trees have to grow for decades before they are felled, processed and transported. This shows how long-term the consequences of material choices can be.

CONSTRUCTION PHASE

This includes the transport of materials to the construction site, the actual construction and the use of, for example, screws, glue, surface treatment and insulation. Smart logistics choices and efficient construction techniques can reduce both waste and CO_2 footprint in this phase.

USE PHASE

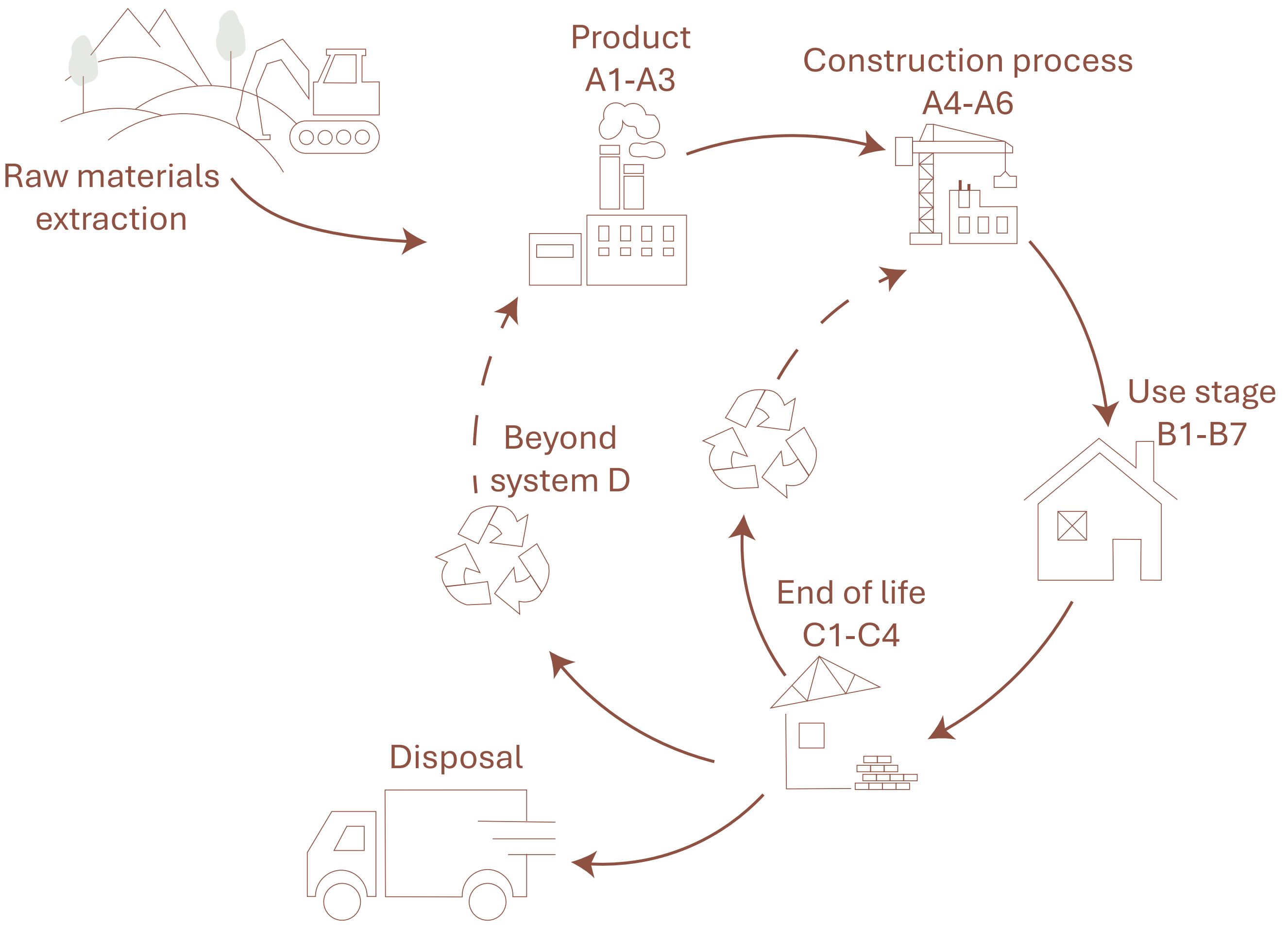
The use phase includes operation, maintenance and energy consumption over the life of the building. Decisions made early in the design phase – such as insulation levels, ventilation solutions and the integration of renewable energy – have a major impact on the building's long-term performance and emissions.

DEMOLITION PHASE

The final phase of the life cycle includes demolition, transport and waste management. Circular principles play an important role here: If materials can be reused or recycled, both waste and climate footprint are reduced. Although recycling itself is not directly included in the GWP calculation, it is included in the LCA tool LCAbyg, which provides a more nuanced assessment of the building's environmental impact (Kanafani, 2024).

By incorporating LCA as a permanent part of the architectural decision-making process, a much more holistic understanding of the building's life cycle and its overall environmental impact is achieved. This makes it possible to choose solutions that both limit resource consumption and CO_2 emissions - while strengthening the building's durability and adaptability.

Ultimately, it is not just about technical calculations, but about a shift in the industry: from seeing sustainability as an extra layer to integrating it as a fundamental design criterion - on an equal footing with function, aesthetics and usability.



Ill. 02 - Life Cycle Assessment Process

ENVIRONMENTAL QUALITY IN A CHILDREN'S HOSPICE

The environment we inhabit has a profound impact on how we experience illness. A child running a fever may feel an unbearable sensitivity to temperature, while a headache can distort their vision and perception of the world around them.

In a healthcare setting, these effects are even more pronounced, where factors like air quality, airflow, and temperature fluctuations can impact both physical health and emotional well-being. For children facing life-limiting conditions in a hospice, the stakes are especially high. A comfortable and healthy indoor climate is not just a luxury; it is essential.

A well-regulated indoor climate becomes a sanctuary - a place where every detail supports the healing process, alleviates distress, and offers a sense of security to both patients and their families in one of the most challenging moments of their lives.

The primary goal of maintaining an ideal indoor climate is to ensure the comfort and safety of both patients and staff. For this reason, a children's hospice demands specific attention to detail when it comes to the indoor environment, as it should support not only the medical and physiological needs but also the emotional and psychological comfort of children and their families during what can be an intensely stressful time.

CRITERIA FOR A HEALTHY INDOOR CLIMATE

The following criteria highlight the fundamental elements for creating a healthy and comfortable indoor environment in a children's hospice:

ACOUSTICS

Some children, especially those with certain conditions, are highly sensitive to sound, while others may develop sensitivity due to their illness. The acoustics of various rooms should be adapted to their function. For example, a hydrotherapy room will require different considerations than a quiet bedroom. The Danish Building Regulations dictate that buildings intended for overnight stays should not be disturbed by noise from adjacent rooms. This doesn't mean complete soundproofing is necessary, but rather that rooms should be designed with the anticipated activities and noise levels in mind. For example, reverberation time in hallways should not exceed 0.9 seconds, and in common areas, the limit is 0.6 seconds (Bygningsreglementet 2018, chapter 17). This is particularly important in a children's hospice, where noise could disturb vulnerable patients' rest or exacerbate symptoms of illness or anxiety.

DAYLIGHT

Natural light should be utilized wherever possible. Exposure to daylight is known to regulate the circadian rhythms of the body, which is crucial in maintaining a healthy sleep-cycle. In a hospice, this can also play a role in improving mood and promoting recovery. According to Energistyrelsen, the glass area should be at least 15% of the relevant floor area (Energistyrelsen, 2015). However, certain medical conditions, including light sensitivity caused by treatments or illnesses like migraines, can cause severe discomfort. Therefore, it is important that rooms be equipped with the ability to block out light when necessary. This flexibility ensures that patients' varying needs are met.

THERMAL COMFORT

Thermal comfort is an essential aspect of maintaining a comfortable environment, particularly in a hospice setting. Children in palliative care often have difficulty regulating their body temperature due to their medical conditions or treatments. Ensuring that a room remains within an appropriate temperature range without fluctuating too drastically is key to providing both physical comfort and support for the healing process.

In Denmark, indoor temperatures must not exceed 26°C for more than 100 hours annually, while the developer determines the treshold for temperatures above 27°C. (Energistyrelsen, 2015). The ability to control thermal comfort is crucial, particularly in areas like patient rooms or playrooms, where patients and their families may spend extended periods.

VENTILATION

Adequate ventilation is necessary for maintaining healthy indoor air quality in any healthcare environment. This is particularly important in a children's hospice, where the air quality can directly affect respiratory health, particularly for patients with compromised immune systems. The Danish regulations state that the minimum air supply should be 0.3 l/s per m^2 of heated floor area, with bathrooms requiring a flow rate of 15 l/s, and kitchens needing 20 l/s (Bygningsreglementet 2018, chapter 22).

Moreover, CO^2 levels, which serve as an indicator of air quality, must be kept below 900 ppm in hospitals and similar settings (Energistyrelsen, 2015). A well-ventilated environment helps to reduce the risk of airborne infections and contributes to the overall comfort of patients and staff alike.

ACOUSTICS
Reverberation time Hallway: <0,9 s Common rooms: < 0,6s (to minimize noise for sensitive patients)

DAYLIGHT
Glass area = 15% room area Adjustable shading in patient rooms (for patients with light sensitivity who need control over daylight exposure)

THERMAL COMFORT
< 100 h above 26°C < 25 h above 27°C Individual temperature regulation in patient rooms (to accommodate patients with fever or cold sensitivity)

VENTILATION
0,3 l/s per heated m^2 < 900 ppm CO_2

ILL. 03 - Indoor climate regulations

USER ADAPTABILITY

In a children's hospice, a degree of flexibility is needed, particularly in terms of ventilation and lighting, to create a homely and comforting atmosphere. Many families may find comfort in being able to adjust the environment themselves - whether by opening a window to allow fresh air or controlling the curtains to adjust the lighting according to the time of day.

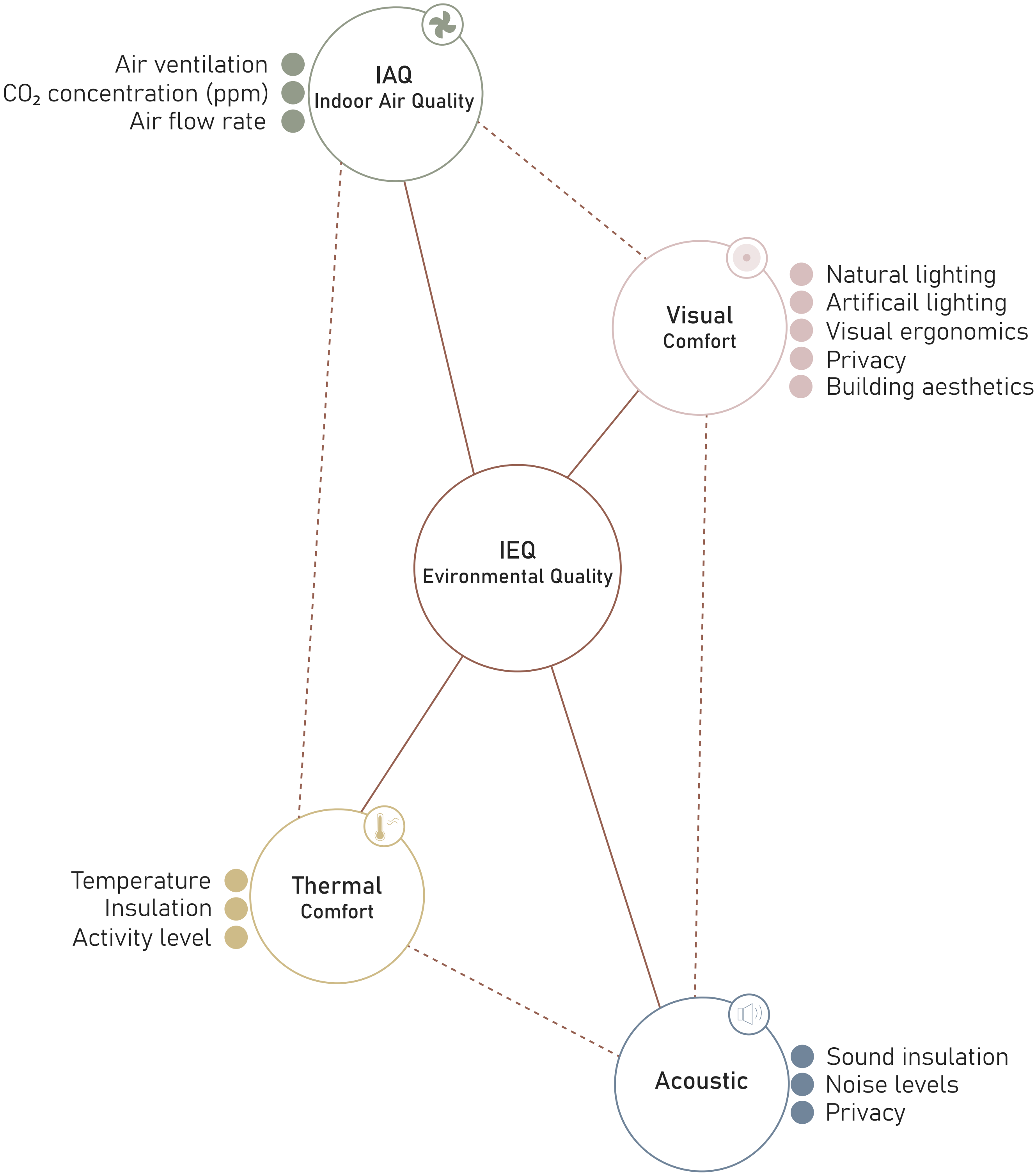
These simple options can have a significant impact on the emotional well-being of families who may spend long periods at the hospice. Such adaptability also allows for a more personal experience, which is essential when providing care in a sensitive environment like a children's hospice (Realdania, 2009).

DILEMMA - SUSTAINABILITY VS INDOOR CLIMATE

Ensuring a stable and comfortable indoor climate is energy-intensive, especially in healthcare environments like children's hospices, where strict minimum standards must be met and additional flexibility is often required for patient care. This creates a key challenge: maintaining a high-quality indoor environment frequently comes at the cost of energy efficiency and environmental sustainability.

Children's hospices require precise control over temperature, and air quality to protect the well-being of vulnerable patients. However, achieving these conditions significantly increases energy consumption, conflicting with sustainability goals such as reducing carbon emissions and minimizing environmental impact. The challenge lies in balancing these competing priorities.

This project must carefully navigate this dilemma to find a compromise that optimizes both sustainability and indoor climate quality. Every design decision must take this balance into account, ensuring that environmental impact is minimized without sacrificing essential patient comfort. Solutions such as, passive design strategies, and smart climate control technologies can help reconcile these conflicting demands while maintaining the high standards required in a hospice.



Ill. 04 - Evironmental quality

THE IMPACT OF NATURE

The impact of nature on mental well-being was first highlighted in 1984 by Edward Owen Wilson, who introduced the concept of biophilia - the innate human tendency to connect with nature (Mazuch 2017). This idea later gave rise to Biophilic Design, emphasizing the importance of integrating natural elements into the built environment to enhance both physical and mental health. In palliative architecture, nature plays a crucial role, whether through direct exposure, such as access to daylight and outdoor spaces, or indirect means, such as the use of natural materials in design.

THE EFFECT OF NATURE IN ARCHITECTURAL DESIGN

Extensive research has examined the effects of natural environments on human health. One of the earliest recognized studies was conducted by Roger Steffen Ulrich between 1972 and 1981. His research focused on post-surgical recovery and compared two groups of patients - one with a view of natural elements like trees and another with a view of a brick wall. The results demonstrated significant differences: patients with a nature view had shorter hospital stays, required less pain medication, reported fewer negative experiences, and experienced fewer post-surgical complications. This study provided early evidence for the positive impact of nature on both physical and mental health (Ulrich 1984).

Further research in 2008 by Peter H. Kahn and his colleagues explored the psychological effects of nature on healthy office workers. The study, conducted over a 16-week period, examined how different types of views influenced stress recovery - comparing a real nature view through a window, a plasma screen simulating nature, and a blank wall. The findings indicated that viewing actual nature through a window had the most restorative effect, significantly reducing heart rate and stress levels. Even simulated nature via screens had a moderate positive effect compared to no exposure at all, reinforcing the idea that even indirect experiences of nature can contribute to psychological well-being (Kahn et al. 2009).

LIGHT, SHADOW, AND SEASONAL INFLUENCE

Natural elements such as light and shadow play a key role in shaping architectural spaces and their atmospheres. Research has shown that daylight dynamics - including changing sunlight patterns, seasonal variations, and reflections - can impact human perception of space and well-being (Browning et al. 2014). Elements like deciduous trees naturally regulate indoor lighting by providing shade in summer and allowing more sunlight in winter, thereby influencing the sense of time and season within a space (Eiler Rasmussen 2012). This interaction between natural light and architecture helps create a comfortable and visually engaging environment.

Architectural orientation and window placement are essential in optimizing daylight, which contributes to a circadian rhythm that aligns with human biological cycles. The transition between indoor and outdoor spaces, combined with strategic lighting design, enhances spatial experience and user comfort. Diffused and reflective light can also improve visual comfort, making spaces more soothing and reducing stress levels (Browning et al. 2014, Eiler Rasmussen 2012).

By incorporating these various biophilic strategies, architectural design can enhance the quality of life for users - particularly in palliative care settings - by fostering a sense of connection with nature and promoting well-being.

PALLIATIVE ARCHITECTURE

Palliative architecture explores how the built environment can support palliative care efforts for individuals with life-threatening diseases, their families, and healthcare staff. The Knowledge Center for Rehabilitation (REHPA) has identified five key design principles for palliative architecture: functionality, light-sound-air-temperature, nature, privacy-relations, and atmosphere. These principles are viewed as an integrated whole, where all aspects are equally important (REHPA 2017).

FUNCTIONALITY

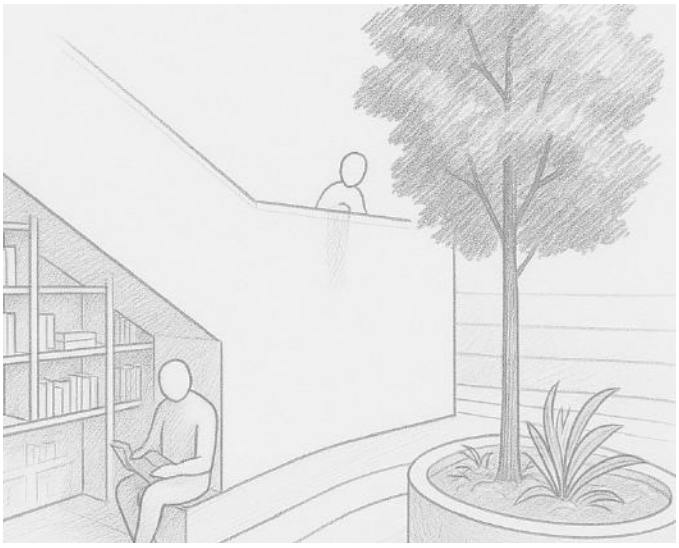
The principle of functionality addresses how the surrounding environment influences staff workflows, workplace conditions, and patient safety. Additionally, it takes into account the ease of orientation and the adaptability of the building design to accommodate various needs (REHPA 2017).

LIGHT-SOUND-AIR-TEMPERATURE

Maintaining a healthy indoor climate is crucial in healthcare facilities. This design principle highlights the role of natural light in improving sleep quality and reducing stress or mental distress. Acoustic conditions are equally important in creating a peaceful and comfortable atmosphere, while air quality, ventilation, and temperature regulation contribute to the overall well-being of users (REHPA 2017).

NATURE

Incorporating natural elements into architectural design can help reduce stress, pain, and depression. Access to outdoor spaces or natural surroundings plays a significant role in supporting the well-being of both patients and relatives. Nature can be integrated into architecture in multiple ways, from gardens and urban green spaces to views of forests, indoor plants, and even visual representations of nature within living areas (REHPA 2017).



Ill. 05 - Sketch of palliative architecture

ATMOSPHERE

The overall atmosphere of a hospice or palliative care facility profoundly shapes the experiences of patients, relatives, and staff. A setting that is calm, home-like, and well-lit fosters emotional well-being and provides a sense of comfort and reassurance for all users of the space. Thoughtfully designed interiors, the use of warm and natural materials, and a balance between openness and intimacy can further enhance the overall experience, helping to create an environment that supports both psychological and physical well-being (REHPA 2017).

PRIVACY AND SOCIAL RELATIONS

Both patients and their families, as well as healthcare staff, have individual needs for privacy and social interaction. The architectural design should provide secluded spaces for moments of solitude and reflection while also facilitating communal areas that encourage social engagement and shared activities among groups of different sizes. Ensuring a seamless transition between private and social spaces can help create a more flexible and accommodating environment that respects individual preferences while fostering a sense of connection and support (REHPA 2017).

MATERIALITY

The building industry currently accounts for 40% of global CO_2 emissions annually, making it one of the most significant contributors to climate change. Given its substantial environmental impact, the industry holds great potential for change. Reducing CO_2 emissions is critical, as failure to do so will result in continued global temperature rise and severe consequences (Architecture 2030 n.d.). Material choices play a crucial role in determining the total CO_2 footprint, but they also influence the mental and emotional well-being of the children and their families, in a children's hospice.

BIOPHILIA AND INDIRECT NATURE THROUGH MATERIALS

Biophilic design suggests that indirect experiences of nature can be introduced into the built environment through materials. Research by Ulrich (1984) and Kahn (2008) highlights the positive effects of nature on human well-being, indicating that even an association with nature - rather than direct exposure - has measurable benefits (Kahn et al. 2009, Ulrich 1984).

Natural materials, especially biogenic materials such as wood, wool, cotton, and stone, contribute to sensory stimulation and enhance the feeling of connection to nature (Kellert & Calabrese 2015). While scientific research on the exact health benefits of biogenic materials remains limited, their psychological impact is evident. Certain natural elements, such as the color green or the texture of wood, can evoke feelings of calmness and warmth, contributing to emotional well-being (Browning et al. 2014). Understanding how materials influence human perception is complex, as their impact is often subjective.

From a psychological perspective, wooden materials are perceived as warmer and more inviting, enhancing the emotional atmosphere within a children's hospice. Additionally, color selection plays a vital role - darker tones are often preferred in therapy rooms to promote introspection, while lighter colors in common areas create a sense of openness and spaciousness, which is beneficial for social interactions within a hospice setting.

In addition to their psychological and aesthetic impact, material choices and colors significantly influence the acoustic environment and lighting conditions within a space. The selection of materials affects sound absorption and reverberation, which can be particularly important in healthcare settings where a calming atmosphere is essential. Likewise, color choices interact with lighting, influencing brightness, perception and visual comfort. In this way, material and color selection can enhance the sensory and functional qualities of a children's hospice, contributing to an environment that supports emotional well-being and social interaction.

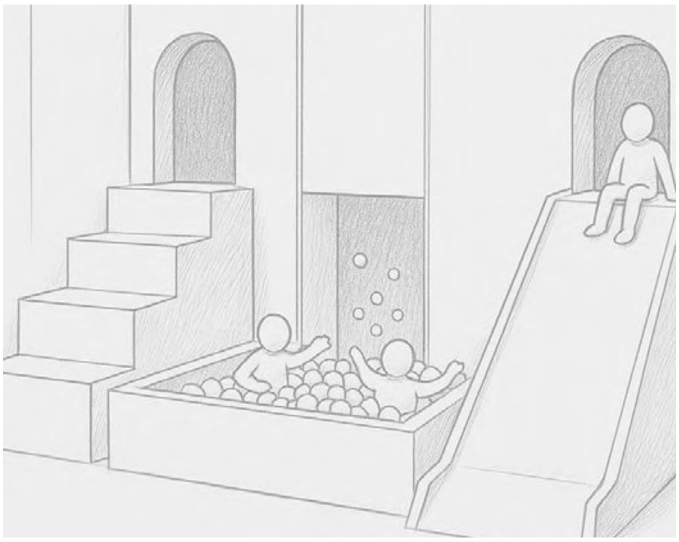
ILL. 06 – Sketch of materialty

ENVIRONMENT FOR CHILDREN

In a children's hospice, play is not only a source of comfort but also a vital means of stimulation and engagement. While younger children depend heavily on play for both emotional and cognitive development, older children interact with their surroundings in more varied ways, necessitating a flexible approach to spatial design. Dutch architects Aldo van Eyck and Herman Hertzberger - both pioneers in child-centered architecture - have explored how built environments can foster interaction, creativity, and a sense of agency. Their work provides valuable insights into designing a hospice that supports children of different ages and needs.

Hertzberger emphasized the experiential nature of architecture, advocating for environments that invite engagement rather than dictating use. He described this as a "come play with me" approach, where architectural elements serve multiple functions. Stairs, for example, do not merely facilitate movement but can also function as informal gathering spots, play areas, or resting spaces (Hertzberger & Swaan, 2009). Similarly, corridors can be transformed into multi-purpose "learning streets," while niches beneath staircases can become intimate reading corners or imaginative play zones. His design philosophy encourages users to "flirt" with the building, exploring and interacting with spaces at their own pace.

Van Eyck, by contrast, is best known for his extensive network of playgrounds across the Netherlands, which seamlessly integrated play into urban life. His playgrounds shared recurring elements such as sandpits, modular concrete structures, and tall steel frames, fostering movement, creativity, and social interaction while blending harmoniously with their surroundings (van Eyck, 2008). His work highlights the importance of providing opportunities for spontaneous and unstructured play within the built environment.



Ill. 07 - Sketch of environment for children

INTEGRATING PLAY IN HOSPICE DESIGN

The principles established by Hertzberger and van Eyck can be effectively integrated into hospice design, ensuring an environment that supports play, exploration, and interaction without feeling excessively childlike. A child-centered approach should incorporate adaptable elements such as window placement at varying heights, enabling better views, increased natural light, and a stronger connection to seasonal changes - features that foster both sensory stimulation and emotional well-being.

By merging Hertzberger's passive approach, which emphasizes spatial awareness and architectural details that subtly invite interaction, with van Eyck's active approach, which introduces objects and structures that encourage direct engagement, hospice design can cater to children of all ages. This balanced strategy ensures that spaces remain both functional and stimulating, accommodating the diverse emotional, social, and developmental needs of children in a hospice setting.

HOMELY ENVIRONMENT

Creating spaces for young patients and their families requires a thoughtful and empathetic approach that acknowledges the profound emotional and psychological challenges associated with illness. Severe illness often disrupts a child's sense of normalcy, stripping them of autonomy and intensifying feelings of anxiety and vulnerability. In a hospice setting, where the focus is on comfort and quality of life, it is essential to create an environment that fosters security, dignity, privacy, and emotional support. Architecture plays a fundamental role in shaping such spaces, not only by minimizing distress but also by establishing a familiar, supportive setting that enables patients and their families to feel at home (Bielak-Zasadzka et al., 2021).

The concept of home extends beyond physical space; it embodies memories, routines, sensory experiences, and a deep sense of belonging. According to Professor Pallasmaa, home is not something that can be instantly created but rather a gradual adaptation shaped by daily life and personal experiences. This highlights the importance of designing hospice environments that promote continuity and familiarity while supporting emotional well-being (Pallasmaa, 1995). A well-designed hospice should not feel clinical or institutional but should instead provide an atmosphere that reflects warmth, comfort, and personal identity.

The built environment in healthcare settings significantly impacts psychological and emotional health. To create a truly hospitable and comforting atmosphere, architectural design must integrate key principles that define the essence of home (Brummett, 1997).

These principles guide the design process and ensure that hospice spaces are not only functional but also deeply supportive of the children and families who inhabit them:

- **IDENTITY**: A home is a space where individuals can express themselves, build relationships, and receive love and support. It fosters social belonging and meaningful connections.

- **ORIENTATION**: A home provides stability and familiarity, offering a space where individuals feel at ease, safe, and free from anxiety. It serves as an anchor for emotional balance and reflection.

- **QUALIFICATION**: A home acts as a sanctuary from external stressors, where individuals have control over their surroundings and can engage in daily activities within a secure and predictable environment.

Furthermore, the perception of home is closely tied to an individual's ability to regulate and adapt their surroundings. A defining characteristic of home is the sense of control it provides - allowing individuals to modify their environment to align with their needs, fostering a feeling of security and autonomy. This extends to indoor climate, where factors such as temperature, lighting, acoustics, and air quality play a fundamental role in overall comfort and well-being. Architectural design that prioritizes adaptability enhances both the perception of home and the practical functionality of the space, ensuring that hospice environments remain flexible, responsive, and deeply supportive for their occupants.

UNIVERSAL DESIGN

The project must prioritize equal opportunities and accessibility, ensuring that spaces accommodate individuals of all abilities and backgrounds. Universal design is a human-centered approach aimed at enhancing usability, health, and social participation. The objective is to create inclusive environments that facilitate everyday life and guarantee equitable access to resources and opportunities for all (Steinfeld et al. 2012). Given the diversity of users in age, height, and physical ability, architectural elements must be arranged to support a broad spectrum of needs. Spaces should ensure safety, accessibility, and adaptability, particularly for children, individuals with mobility challenges, and the elderly (The National Disability Authority's Centre n.d.).

Designing with inclusivity in mind often leads to improvements benefiting all users. Step-free access supports not only wheelchair users but also those with strollers, luggage, or visual impairments. Spacious, accessible restrooms accommodate both wheelchair users and parents with small children. Clear, well-placed signage aids individuals with cognitive or reading difficulties, while multi-height counters enhance usability for a wider range of users. Wheelchair-accessible routes from public spaces to entrances ensure a seamless transition between urban environments.

In addition to regulatory guidelines, universal design can be strengthened by incorporating spatial strategies that promote psychological comfort and emotional well-being. Design elements such as clear access and wayfinding, unobstructed sightlines, access to nature, visual safety and privacy, spatial openness, and natural lighting play key roles in fostering safety and trust (see app. 3). These values are essential when designing for vulnerable populations such as children in palliative care and their families. By aligning architectural decisions with these experiential principles, the design contributes not only to functional accessibility but also to an inclusive, dignified, and nurturing atmosphere.

To enforce inclusivity in architectural design, the Building Regulations (BR18) establish specific guidelines to ensure accessibility across various built environments:

1. Parking spaces designated for wheelchair users must be adequately sized and positioned near entrances to minimize unnecessary barriers (Bygningsreglementet 2018, chapter 20).

2. Entranceways should provide sufficient clearance to accommodate all users, ensuring a minimum passage width while also incorporating level-access zones that facilitate smooth transitions (Bygningsreglementet 2018, chapter 2).

3. Restroom facilities should include adequate clearance in front of fixtures, door widths that accommodate mobility aids, and support elements such as folding armrests to enhance safety and usability (Bygningsreglementet 2018, chapter 3).

4. Circulation routes, including ramps, corridors, and stairways, must incorporate grip-friendly handrails and protective barriers at appropriate heights to provide additional support and security (Bygningsreglementet 2018, chapter 2).

By integrating universal design principles, architects can create built environments that enhance mobility, comfort, and independence for all users. A commitment to accessibility and adaptability ensures that spaces are not only compliant with regulations but also contribute to a more inclusive and equitable society. Thoughtfully designed environments support diverse physical and cognitive needs, ultimately fostering social participation and equal opportunities for all individuals.

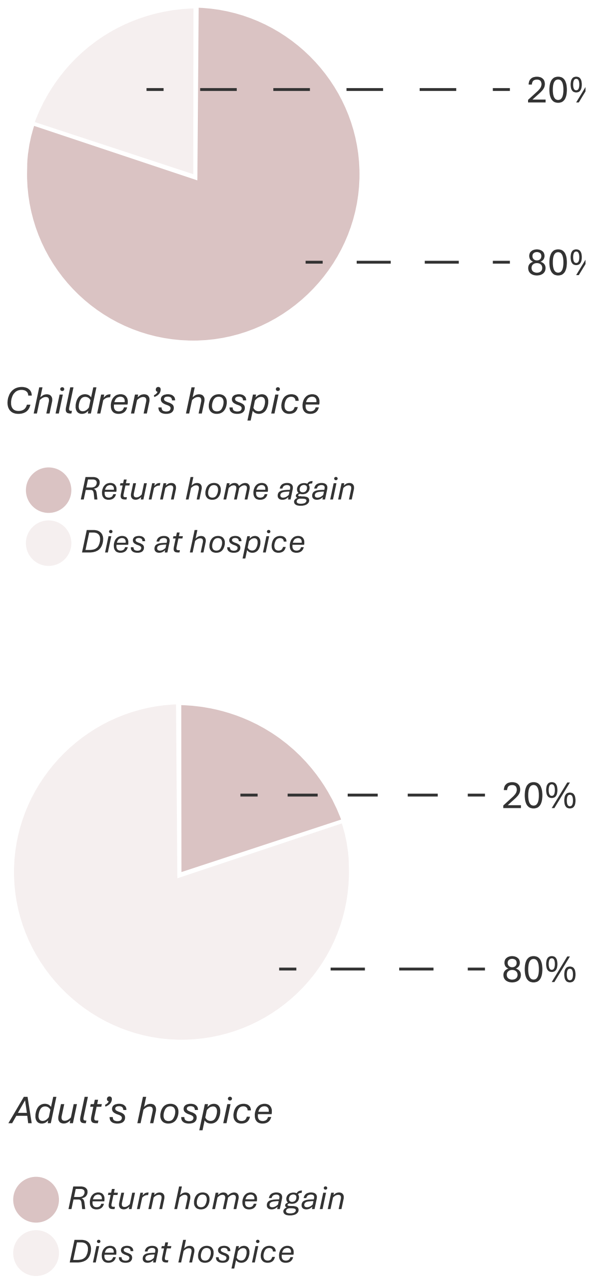
HOSPICE CARE

The general perception of the term 'hospice' is often that of a place where patients go to spend their final days when their illness becomes terminal. However, this understanding oversimplifies the role of hospice care and its broader purpose.

Whether the patient is a child or an adult, hospice care is designed for individuals with incurable - not necessarily terminal-illnesses. The primary goal is to alleviate symptoms, manage pain, and address the emotional and psychological well-being of both the patient and their family (MedicalNewsToday 2020). A hospice stay can be temporary, either because the patient stabilizes and can return home or because the stay serves to provide respite for caregivers (NHS 2022).

In children's hospices, both the sick child and their family are accommodated during the stay. Unlike adult hospices, where patients typically remain until the end of life, approximately 80% of children in hospice care return home (DR 2023). Beyond medical care, staff also provide extensive psychological and emotional support, assisting families both during the child's illness and, if necessary, in organizing funeral arrangements after their passing (Noah's Ark Children's Hospice n.d., Strandbakkehuset n.d.).

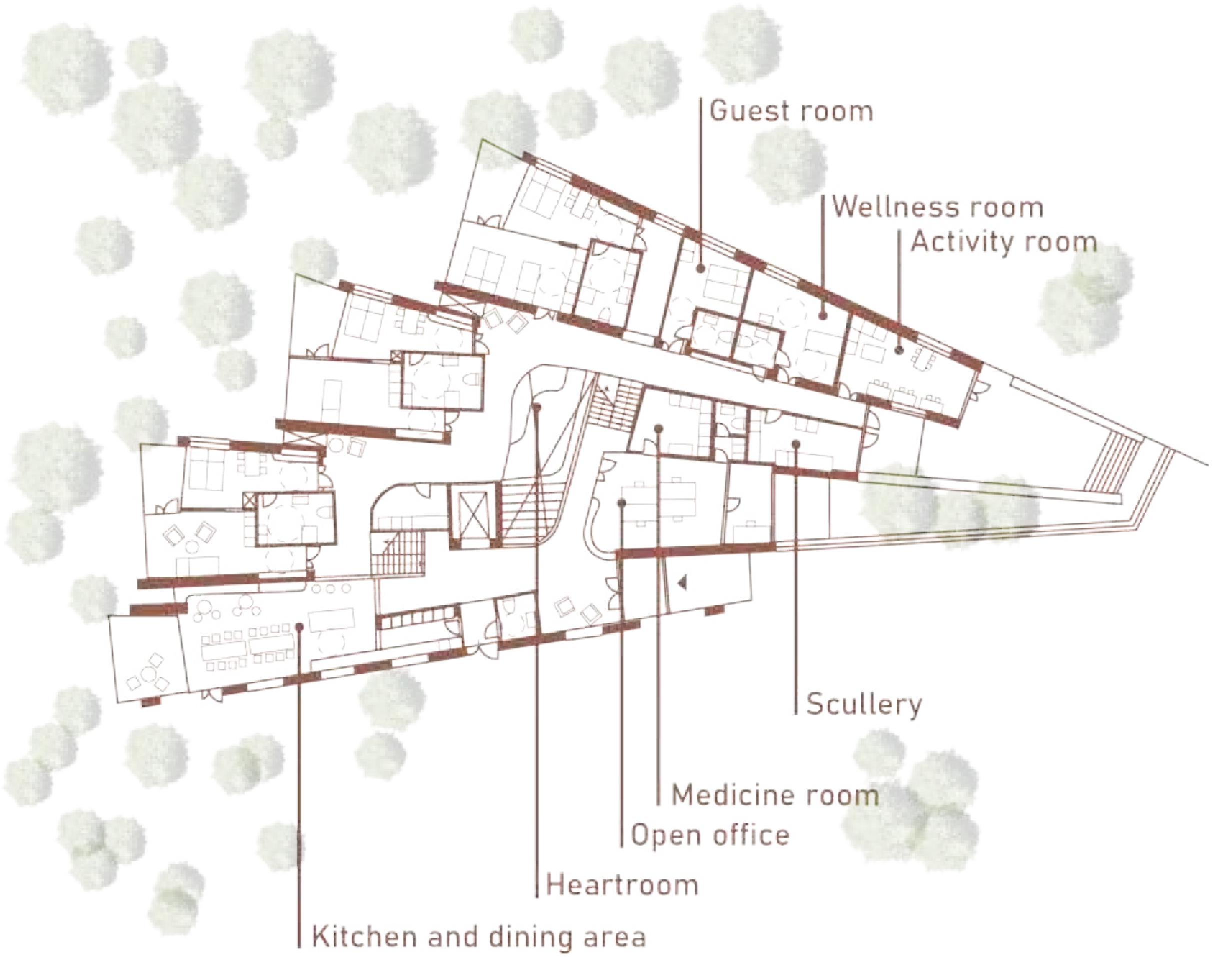
Consequently, pediatric hospice care involves a multidisciplinary team of professionals spanning various fields, including childcare, psychology, pain management, and physical therapy. The overarching aim remains consistent: to ensure the highest possible quality of life for the children and their families, regardless of the prognosis.



Ill. 08 - Numerical data on hospices

STRANDBAKKEHUSET

Location: Rønde, Denmark
Architects: AART Architects
Engineer: Rambøll
Built: 2019-2020



Ill. 09 – Strandbakkehuset floor plan

Strandbakkehuset, Denmark's first purpose built children's hospice, is located in Rønde, next to the adult hospice Djursland. It serves as a key case study in how architecture supports palliative care, family dynamics, and well-being. While sharing some facilities with the neighboring hospice, it is uniquely designed to accommodate children, families, and staff, creating a space that balances privacy, care, and social interaction. (AART Architects n.d.)

SPATIAL ORGANIZATION

The 1,300 m² hospice is structured around four key areas. The family area consists of two-bedroom apartments with kitchenettes and bathrooms, offering a homely atmosphere. A common area with a kitchen, multi-purpose room, and guest facilities fosters social interaction and relaxation.

The treatment area includes therapy and sensory rooms, designed to enhance comfort and reduce stress, while the staff area accommodates offices and support spaces - though a dedicated retreat area has been requested by nurses. (AART Architects n.d.)

A HOMELY AND SUPPORTIVE ATMOSPHERE

To avoid a clinical feel, the design embraces warm materials and intuitive layouts. Wood flooring and furniture promote a "shoes-off" indoor culture, while medical equipment remains discreetly hidden to maintain a comforting environment. Spaces are adaptable to different age groups, ensuring both younger and older children feel at home. (AART Architects n.d.)

CIRCULATION AND SOCIAL INTERACTION

At the heart of the hospice, the Hjerterum (Heartroom) serves as a central gathering space, visually connecting different areas. A tree in the atrium enhances the calming atmosphere, while winding hallways and seating niches provide opportunities for both privacy and spontaneous interaction. The kitchen and living areas further reinforce a sense of home, mirroring the role of a family's living room. (AART Architects n.d.)

APARTMENTS AND CONNECTION TO NATURE

Of the six apartments, four are in use at a time, allowing flexibility for new families. Each unit balances privacy and professional care, with separate family and treatment areas. Private terraces offer views of the forest and lake, where wildlife entertains younger patients. Observations suggest that children engage more with outdoor activities than static views, emphasizing the need for interactive landscapes. (AART Architects n.d.)

BALANCING RELATIONSHIPS BETWEEN PATIENTS, FAMILIES, AND STAFF

The hospice encourages natural interactions in shared spaces, preventing isolation. Informal conversations between staff and families happen throughout the day, facilitated by scattered seating areas and alcoves. While openness is key to the design, staff members have expressed the need for a private retreat to decompress from emotionally demanding work. (AART Architects n.d.)

CONCLUSION

Strandbakkehuset, which we visited during the early phase of the project (see app. 1), exemplifies how architecture can support palliative care by balancing privacy, comfort, and social engagement. Through biophilic principles, warm materials, and flexible spaces, it fosters a calming and inclusive environment. The interplay between private retreats and communal areas ensures that children, families, and caregivers experience both intimacy and support, reinforcing the hospice's role as both a place of care and a home away from home.

Ill. 10 - Strandbakkehuset

NOAH'S ARK CHILDRENS HOSPICE

Location: Barnet, London
Architects: Squire and Partners
Engineer: Rambøll
Built: 2019

ILL. 11 - Noah's Ark Children Hospice floor plan

Located in Barnet, London, within a 10-minute drive of Barnet Hospital, Noah's Ark Children's Hospice - also known as The Ark - was designed by Squire & Partners to provide a peaceful sanctuary where children can truly be children, not just patients, while their families find comfort and connection with others facing similar challenges. Thoughtfully designed to foster both physical and emotional well-being, the hospice creates a nurturing environment that seamlessly integrates medical care with compassionate support. By prioritizing not only the needs of the children but also their loved ones, The Ark ensures that families feel a sense of warmth, security, and belonging throughout their stay. (Squire & Partners n.d.).

SEAMLESS INTEGRATION WITH NATURE

Situated on the edge of town within a nature reserve, the Ark's design maximizes its surroundings, creating a calming atmosphere that fosters well-being. It's butterfly-shaped layout ensures ample natural light and unobstructed views of the outdoors, while external decks to the south accommodate mobility beds and wheelchairs, allowing every child to experience fresh air and nature firsthand. The playground, sensory garden, and nature trails are all wheelchair-accessible, encouraging engagement with the natural world in a safe and inclusive way. (Squire & Partners n.d.).

COMPREHENSIVE FACILITIES FOR HOLISTIC CARE

The Ark provides specialized treatment, activity spaces, and flexible accommodation for children and their families. Patients can stay in private rooms or family suites for up to four people, with distinct spaces tailored for teenagers and younger children. In the event of a child's passing, the Butterfly Room and Suite offer a private, peaceful space for families to grieve and prepare for funeral arrangements. Beyond medical care, the hospice fosters emotional, social, and spiritual well-being. Families and patients gather in multi-faith rooms or communal spaces, while a dedicated treatment zone includes hydrotherapy, music therapy, sensory rooms, soft play, creative spaces, and a games room. These facilities ensure that children can engage in activities that bring joy and comfort, helping to ease the challenges of their conditions. (Eyerevolution London n.d.).

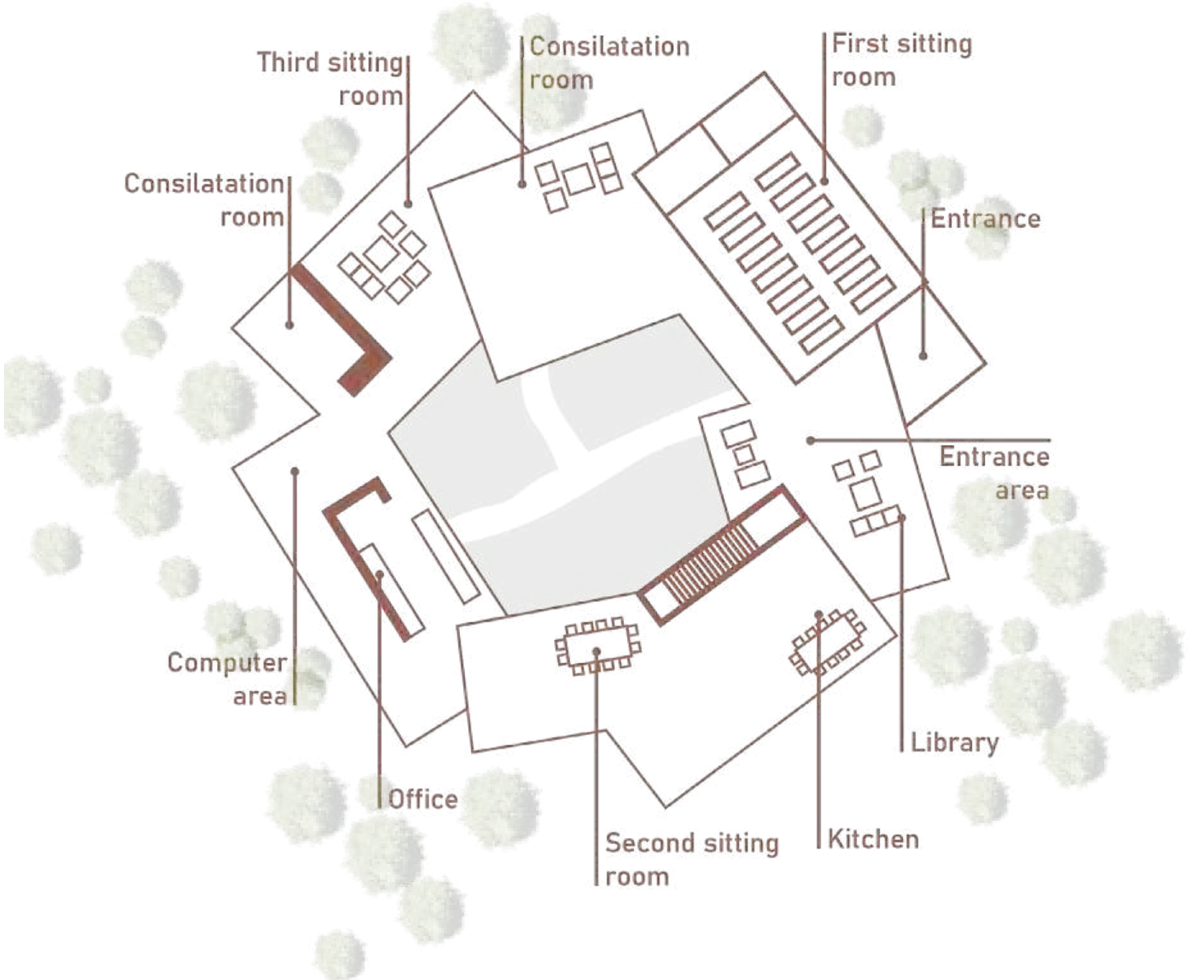
CONCLUSION

Noah's Ark Children's Hospice highlights the diverse functions essential for a pediatric hospice, blending medical, emotional, and spiritual care. By integrating thoughtful architecture with nature and carefully designed spaces, it creates a comforting and inclusive environment for children and their families. The seamless indoor-outdoor connection and diverse activity spaces provide valuable insights for similar projects. However, as the Ark primarily supports short-term stays, additional considerations would be needed to accommodate long-term care requirements, ensuring a more comprehensive approach to pediatric palliative care.

Ill. 12 - Noah's Ark

MAGGIE'S CENTER

Location: United Kingdom
Architects: Richard Murphy Architects
Engineer: David Narro Associates,
Built: 1996



ILL. 13 - Strandbakkehuset floor plan

Maggie's Centres are a series of cancer care facilities designed to provide emotional and psychological support for patients and their families. Located near hospitals but distinct in function, these centres focus on creating a welcoming and uplifting atmosphere that contrasts with clinical healthcare settings. The first centre was established in Edinburgh in 1996 and has since inspired a new approach to cancer care architecture. (Maggie's Centre n.d.)

SPATIAL ORGANIZATION

Maggie's Centres prioritize openness, natural light, and a connection to nature. Each centre features communal areas, quiet spaces, and private consultation rooms. The open-plan kitchens serve as social hubs, encouraging informal interactions. Landscaped gardens and large windows integrate nature into the interior, reinforcing a sense of calm. (Maggie's Centre n.d.)

A NON-CLINICAL ATMOSPHERE

To move away from a hospital-like feel, Maggie's Centres embrace warm materials, soft lighting, and home-like furnishings. Medical equipment is hidden, allowing the space to feel safe and non-intimidating. The layout is intuitive and fluid, designed to accommodate both group activities and moments of solitude. (Maggie's Centre n.d.)

SOCIAL INTERACTION AND CIRCULATION

Central gathering spaces, such as open kitchens and lounges, facilitate connections between visitors, staff, and caregivers.

The absence of reception desks fosters an informal atmosphere, while small seating areas provide opportunities for one-on-one conversations. Meandering pathways through the gardens encourage movement and reflection. (Maggie's Centre n.d.)

CONNECTION TO NATURE

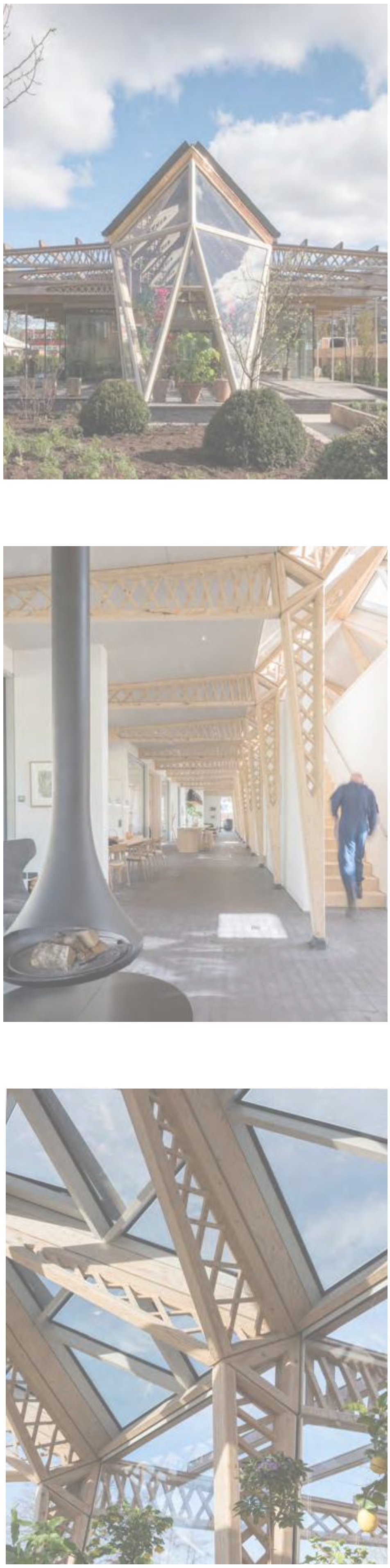
Maggie's Centres are designed to maximize engagement with the natural environment. Floor-to-ceiling windows, outdoor seating areas, and lush gardens create a serene atmosphere. Research suggests that access to nature reduces stress and enhances well-being, making it a core element of the architectural vision. (Maggie's Centre n.d.)

BALANCING PRIVACY AND COMMUNITY

The design encourages interaction while ensuring private spaces for reflection. Patients can engage with others or retreat to secluded corners depending on their needs. This balance supports mental and emotional well-being, fostering a sense of both independence and belonging. (Maggie's Centre n.d.)

CONCLUSION

Maggie's Centres redefine cancer care architecture by seamlessly integrating comfort, nature, and social interaction. Through innovative and human-centered design, they foster an environment that not only supports physical healing but also nurtures emotional resilience and well-being. By bridging the gap between medical treatment and holistic care, these centres set a new standard for compassionate and transformative healthcare spaces



Ill. 14 - Maggie's center

SUBCONCLUSION

The theory presented in this paper can be roughly sorted into three categories: technical, functional and aesthetical. All with a focus on the particular building type of a hospice.

The technical consists of sustainability and indoor climate and defines parameters for the physical environment. These parameters are the minimum requirements for ventilation, temperature, acoustics and daylight according to BR18, and should still be adjustable for the different rooms to ensure the comfort of the user. The GWP is not defined as a number, but rather as a goal for choosing better performing materials.

The functional explores how a children's hospice can meet care and accessibility needs through Universal Design, while still supporting the child's right to play, as emphasized by Hertzberger and van Eyck. The aesthetic is guided by REHPA's principles and Brummett's theory of home, creating a homely, nature-connected environment that supports mental well-being.

Strandbakkehuset is an example of how the aesthetics and functions can be combined through biophilic design, material choices, and flexible spatial arrangements without compromising on the privacy and care needs of patients, family members and staff.

Noah's Ark Children's Hospice helps clarify the required treatment functions of a hospice, as well as some practical rooms when the worst happen and a child dies. Additionally, it gives inspiration to the integration of accessible nature.

Maggie's Centre offers key lessons in designing emotionally supportive care spaces. Though not a hospice, its healing aesthetics, domestic scale, intuitive layout, warm materials, and connection to nature foster calm and dignity. Its sensory richness and informal design provide a strong reference for pediatric palliative architecture.

CHAPTER 03

USER AND SITE

Chapter 3 focuses on the user group and site analysis, offering critical insights into the planning of a children's hospice. It delves into the specific needs of the children, families, and staff, while also examining the physical site and its surrounding environment. A comprehensive understanding of these elements is fundamental in creating a space that is not only functional but also welcoming and supportive for all users.

USER ANALYSIS

HISTORY OF THE CHILDREN'S HOSPICE

The concept of children's hospices was introduced in 1982 in Oxfordshire, England, inspired by the advocacy of the parents of a young girl named Helen, who lived with a life-limiting illness. This pioneering facility, Helen House, marked the beginning of a global movement. The second children's hospice opened in North Yorkshire in 1987, and in 1995, Canada became the first country outside the UK to establish such a facility (Helen & Douglas House, 2022).

EXPANSION INTO THE NORDIC REGION

The development of children's hospices in the Nordic countries occurred significantly later. The first was established in Stockholm, Sweden, in 2010 (Sandberg, 2011). Denmark followed with the opening of its first children's hospice in Hellerup in 2015, and a second in Rønde in 2020 (AART, n.d.; Sankt Lukas Stiftelsen, n.d.; Strandbakkehuset, 2020). Prior to these developments, pediatric patients often received care in adult hospices, which lacked the resources and environments necessary to address children's specific medical and emotional needs.

EVOLUTION OF THE HOSPICE MODEL

The modern hospice model has evolved in tandem with advancements in both palliative care and healthcare architecture. Dame Cicely Saunders, a nurse and medical social worker, founded St. Christopher's Hospice in 1967 in London, initiating a comprehensive approach to care that combined pain management with psychosocial support (St. Christopher's, 2020). Her work laid the foundation for later pediatric adaptations that emphasize holistic care for both the child and their family.

ARCHITECTURAL AND FUNCTIONAL INNOVATIONS

By the 1990s, children's hospice design began to incorporate transitional zones, sensory rooms, and accessible outdoor areas to create a more familiar and comforting environment. One of the most significant innovations was the integration of overnight accommodations for family members. This not only reduced logistical barriers but also ensured that parents could remain physically and emotionally close to their child throughout treatment (Verderber & Refuerzo, 2006).

1982
The world's first children hospice opens, in UK

1987
The world's second children hospice opens, in UK

1995
The first children hospice opens outside of UK, in Canada

2010
The first children hospice opens in the Nordic countries

2015
Lukashuset opens, as the first children hospice in Denmark

2020
Strandbakkehuset opens as the second children hospice in Denmark

2025

Ill. 15 – Timeline of children's hospices

CARE OPTIONS IN DENMARK

CHILDREN'S HOSPICES

For terminally ill children and their families, children's hospices represent a specialized care environment focused on maintaining the best possible quality of life. These facilities offer integrated support, addressing not only the medical but also the emotional and social needs of both the child and their relatives.

Currently, there are two children's hospices operating in Denmark - Strandbakkehuset in Rønde and Lukashuset in Hellerup (Hospice Forum Danmark, n.d.).

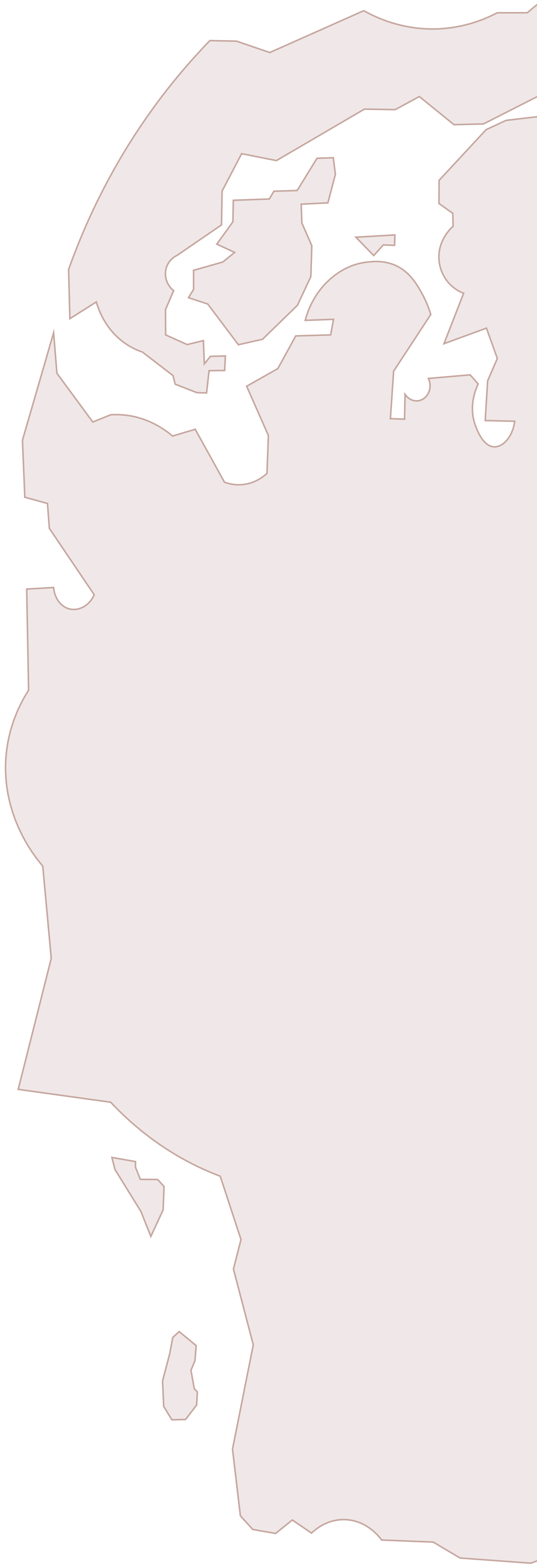
PALLIATIVE CARE TEAMS

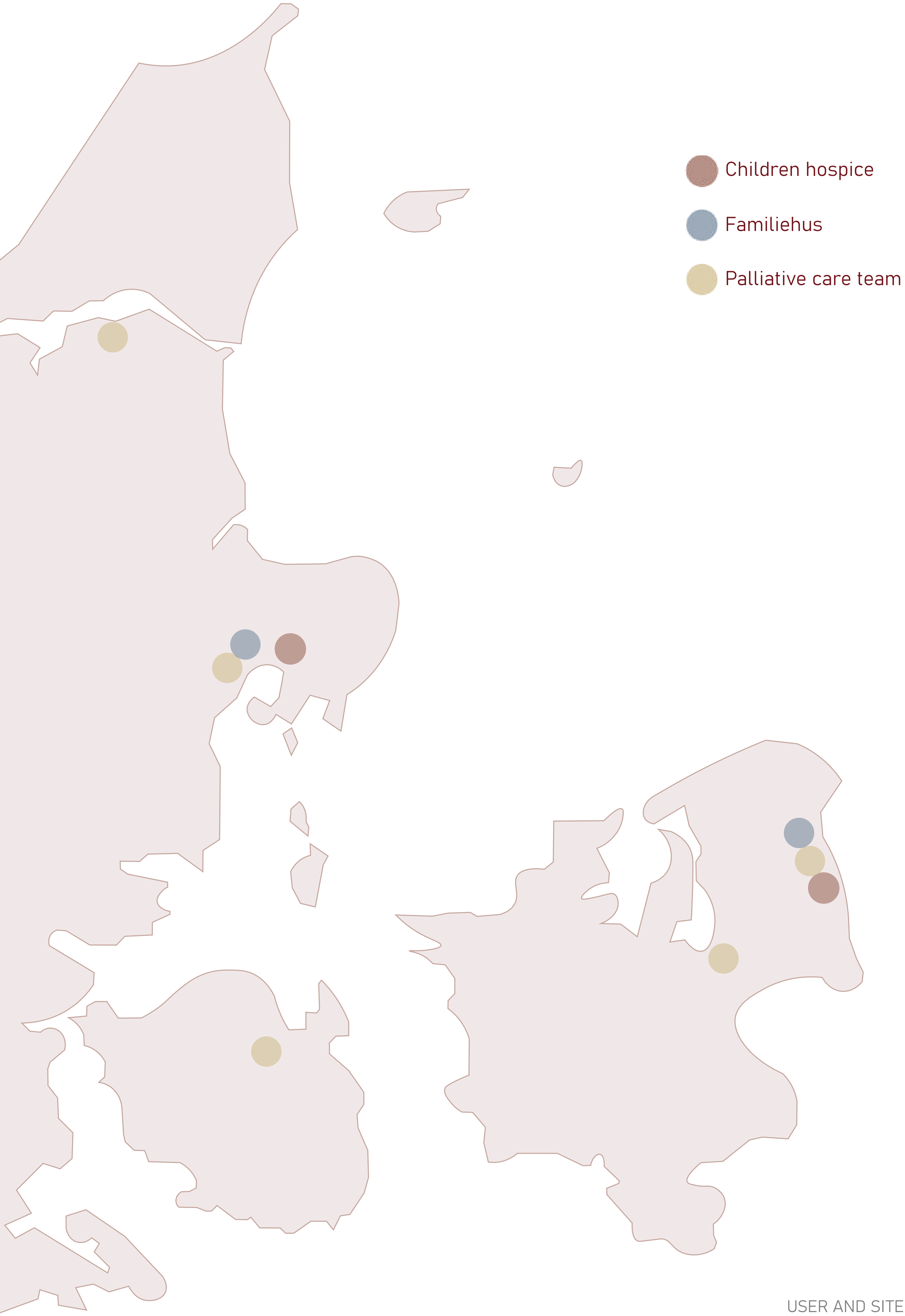
In all Danish regions, specialized Palliative Teams for Children and Youths are established to support families with terminally ill children aged 0–18. These interdisciplinary teams offer holistic care encompassing physical, psychological, and social aspects. Their work is family-oriented and coordinated across hospitals, general practitioners, and municipal services. In Northern Jutland, for example, the team is affiliated with Aalborg University Hospital (Aalborg Universitetshospital, 2024).

FAMILY HOUSES (FAMILIEHUSE)

Family Houses serve as supportive environments for families of children undergoing long-term hospitalization. These facilities allow families to stay close to their child while reducing emotional and logistical stress. The primary aim is to provide a homely atmosphere that promotes togetherness and psychological well-being.

In Denmark, there are two main Family Houses - Trygfondens Familiehus adjacent to Aarhus University Hospital, and Ronald McDonald Hus at Rigshospitalet in Copenhagen (Trygfondens Familiehus, n.d.; Ronald McDonald, n.d.).





ILL. 16 - Care options in Denmark

THE USER GROUP

Children's hospices serve multiple user groups due to their role as specialized palliative care facilities for children with life-limiting or life-threatening conditions. To understand the architectural and functional requirements of such a space, it is essential to distinguish between three core user groups: the patient, the family, and the staff. Each of these groups has unique spatial, emotional, and practical needs that must be considered to create a holistic and supportive environment.

THE PATIENT

As the primary users of the hospice, the needs of the child take precedence. Each patient presents individual requirements based on their diagnosis, condition, and age, which can range from infancy to late adolescence (0–18 years). Despite these variations, all children require an environment that fosters a sense of safety, comfort, and belonging during their stay.

The physical setting must support the delivery of necessary medical interventions while maintaining a non-institutional and child-friendly atmosphere. Privacy is also essential and should be tailored to the developmental stage and autonomy of each child.

THE FAMILY

The family - typically parents and siblings - represents the secondary user group. In most cases, they reside at the hospice alongside the child throughout the duration of care. A key function of the children's hospice is to address the psychosocial needs of the family as a whole, offering therapeutic spaces that facilitate shared experiences, reduce stress, and foster emotional resilience. Although the length of stay is not fixed, it generally ranges from three to four weeks. During this time, family members require spaces to sleep, rest, and engage in meaningful activities beyond their caregiving role. Ensuring comfort for the entire family supports both the child's wellbeing and the family's capacity to cope with the situation.

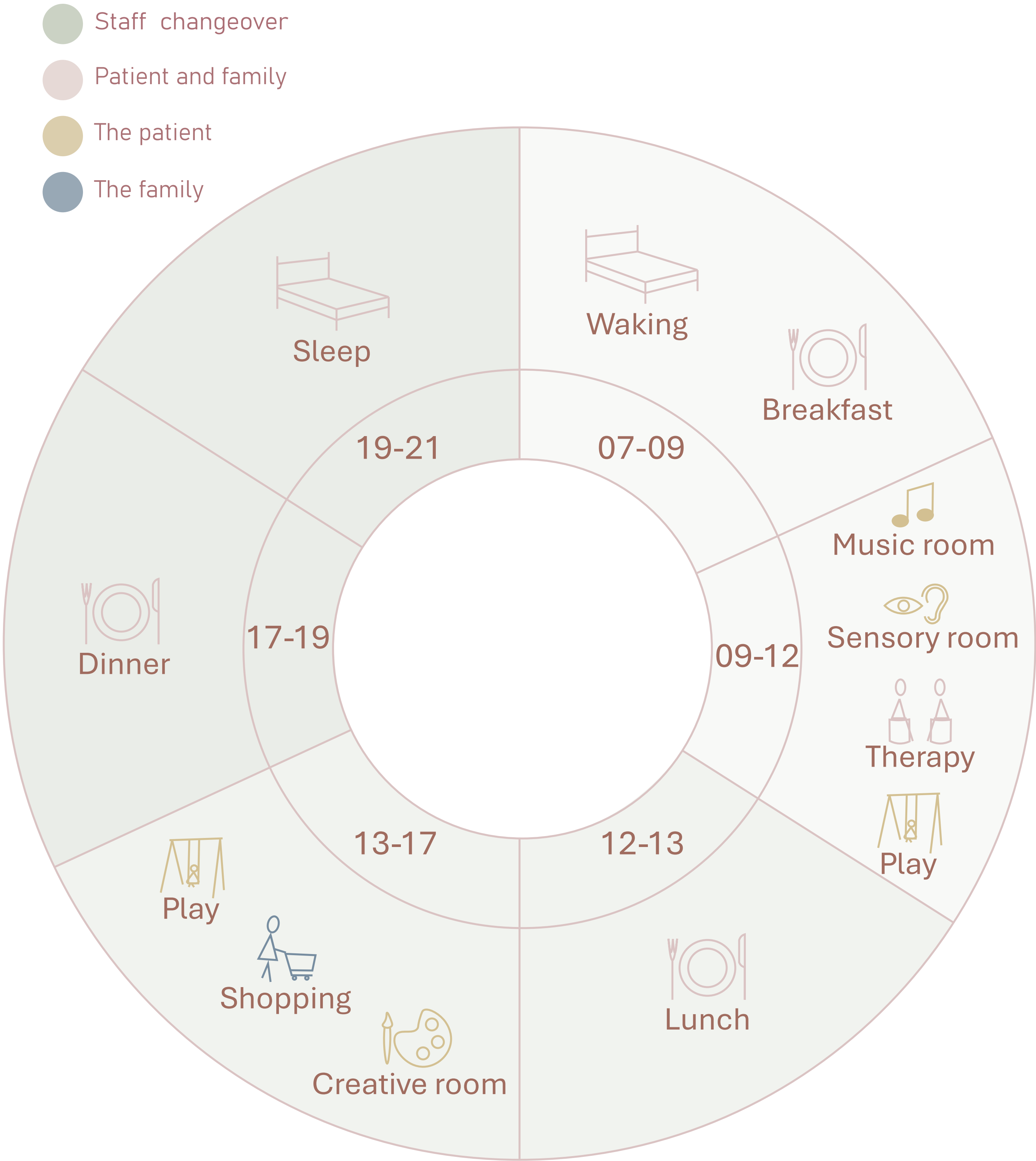
THE STAFF

Staff members constitute the tertiary user group. While they are essential to the day-to-day functioning of the hospice, no single staff member is present continuously, as work is structured into rotating shifts - morning, afternoon, and night.

The morning shift is typically the most active, involving medical procedures, therapy sessions, and shared meals. Fewer staff are present during the afternoon and night shifts, where they primarily perform monitoring duties or remain on standby. To support their roles, staff require dedicated areas for administrative work, private consultations, medication storage, and hygiene-related facilities such as changing rooms.

A DAY IN A CHILDREN HOSPICE

A child's daily experience in the hospice typically follows a gentle rhythm that balances rest, therapy, play, and family interaction. This structured routine is designed to support both physical comfort and emotional stability, and it allows staff and family members to work collaboratively around the child's needs. The daily schedule (see Ill. 17) illustrates how time is divided between key functions such as meals, treatment, creative activities, and sleep, while also indicating the varying presence of user groups throughout the day.



Ill. 17 - Daily schedule of the patients and their family in a hospice

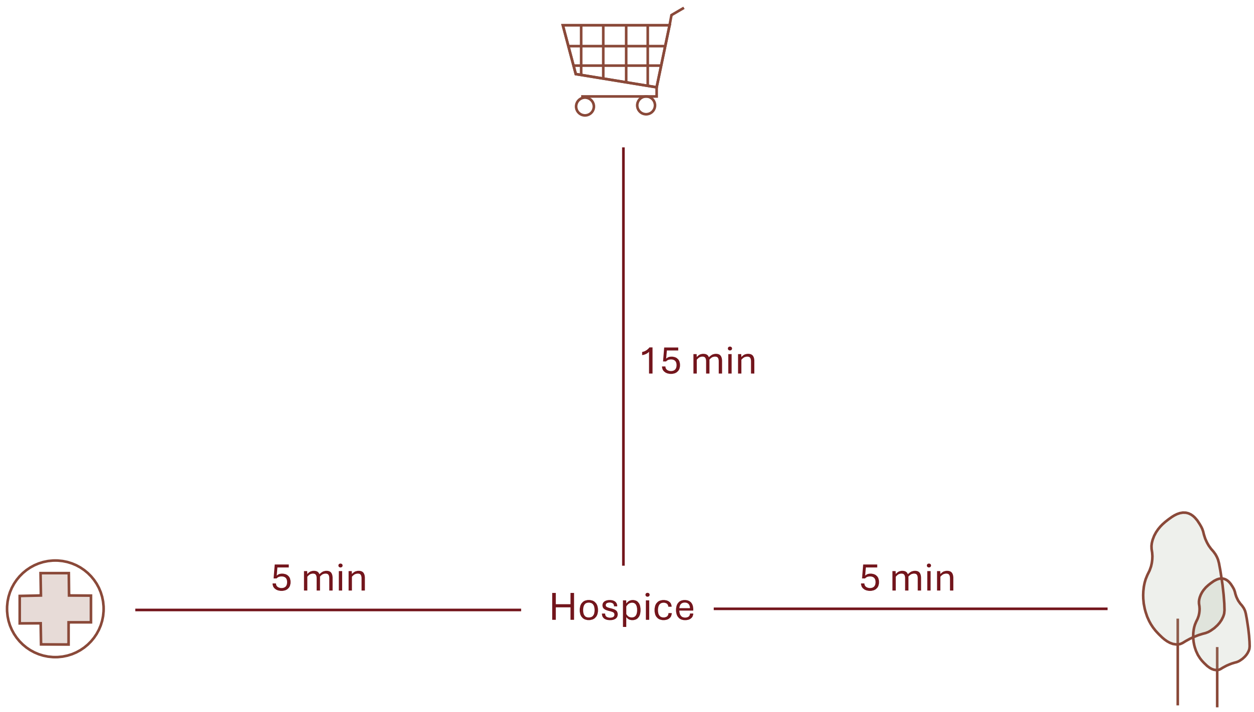
SITE ANALYSIS

As the project focuses on creating a hospice for children, the location plays a crucial role in ensuring accessibility, medical support, and a connection to nature. The site must not be isolated from the city, as it needs to accommodate frequent visits from family members and daily commutes for non-residential staff. Easy access to public transport and well-connected roads is essential to minimize travel burdens, ensuring that families can spend as much time as possible with their children without logistical challenges.

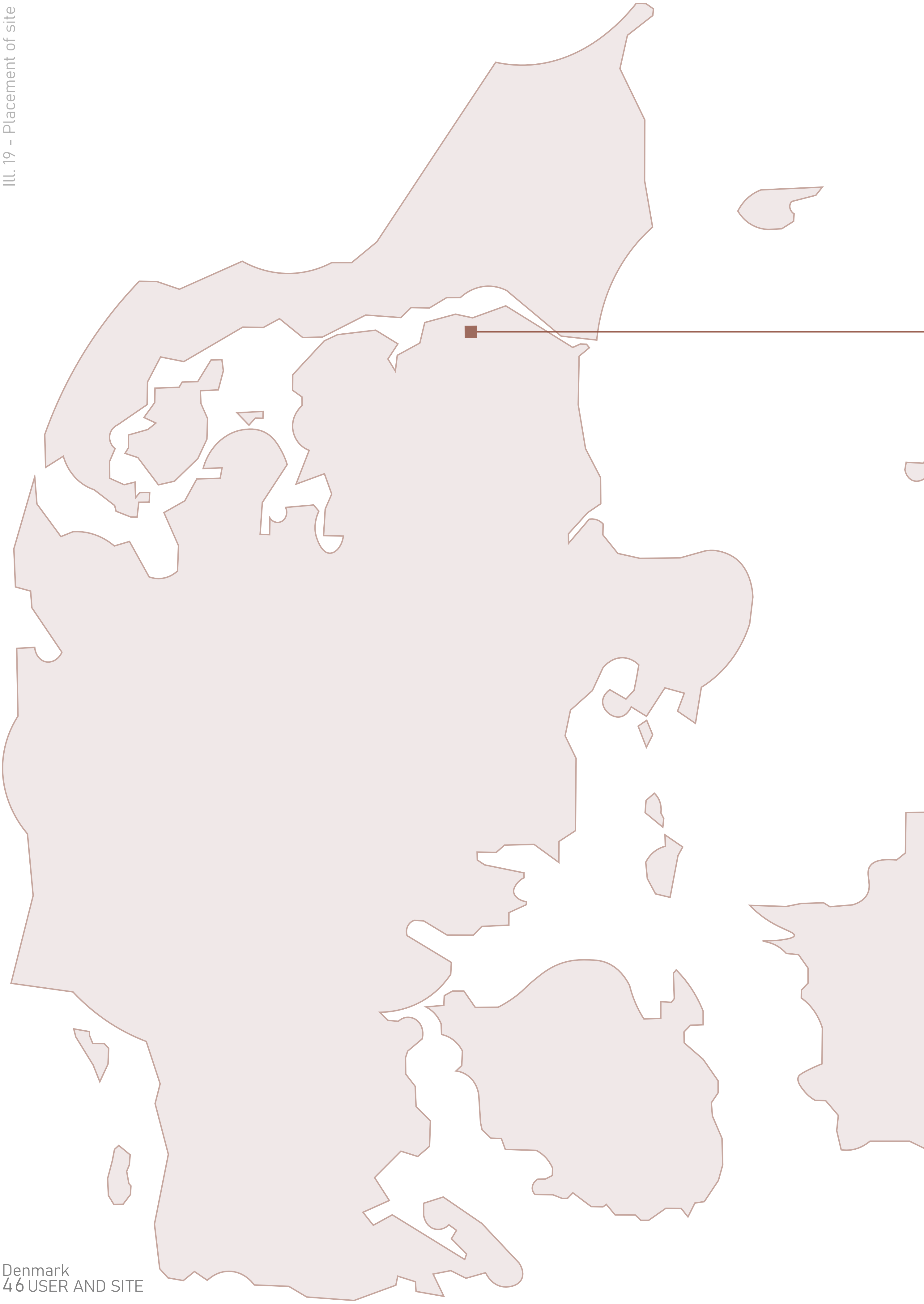
At the same time, proximity to a hospital is vital for handling medical emergencies and complex treatments that cannot be managed in-house. A close relationship with a healthcare facility allows for quick transfers when specialized care is needed, ensuring that patients receive the best possible treatment without unnecessary delays or stress.

Beyond accessibility and medical care, the integration of nature into the site is equally important. Research has shown that natural environments have a profound impact on mental well-being, reducing stress and enhancing emotional resilience. For children with life-limiting or life-threatening illnesses, as well as their families, access to green spaces, fresh air, and natural light can provide a much-needed sense of calm and relief. Carefully designed outdoor areas, such as gardens, sensory paths, or nature trails, can serve as spaces for quiet reflection, play, and social interaction, making the hospice feel less clinical and more like a comforting retreat.

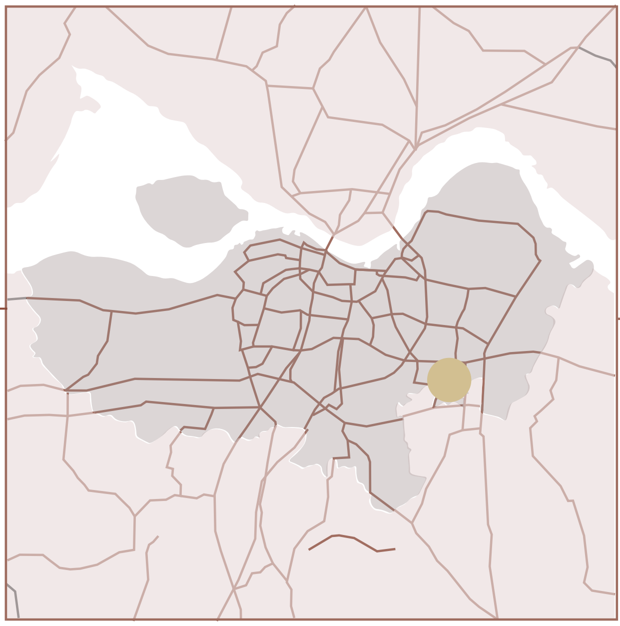
Thus, the site selection must carefully balance urban accessibility, healthcare proximity, and natural surroundings, ensuring that the hospice is not just a medical facility, but a place of comfort, healing, and human connection.



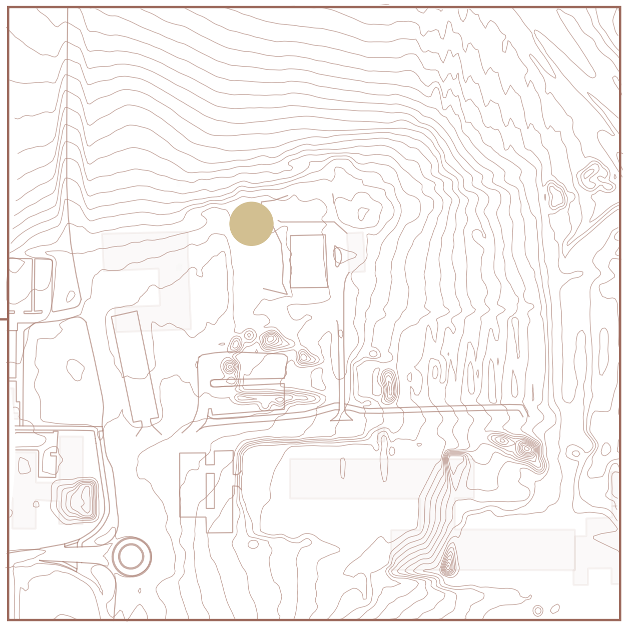
Ill. 18 - Criteria for the site



Ill. 19 - Placement of site



Aalborg, Northern Jutland



Gistrup

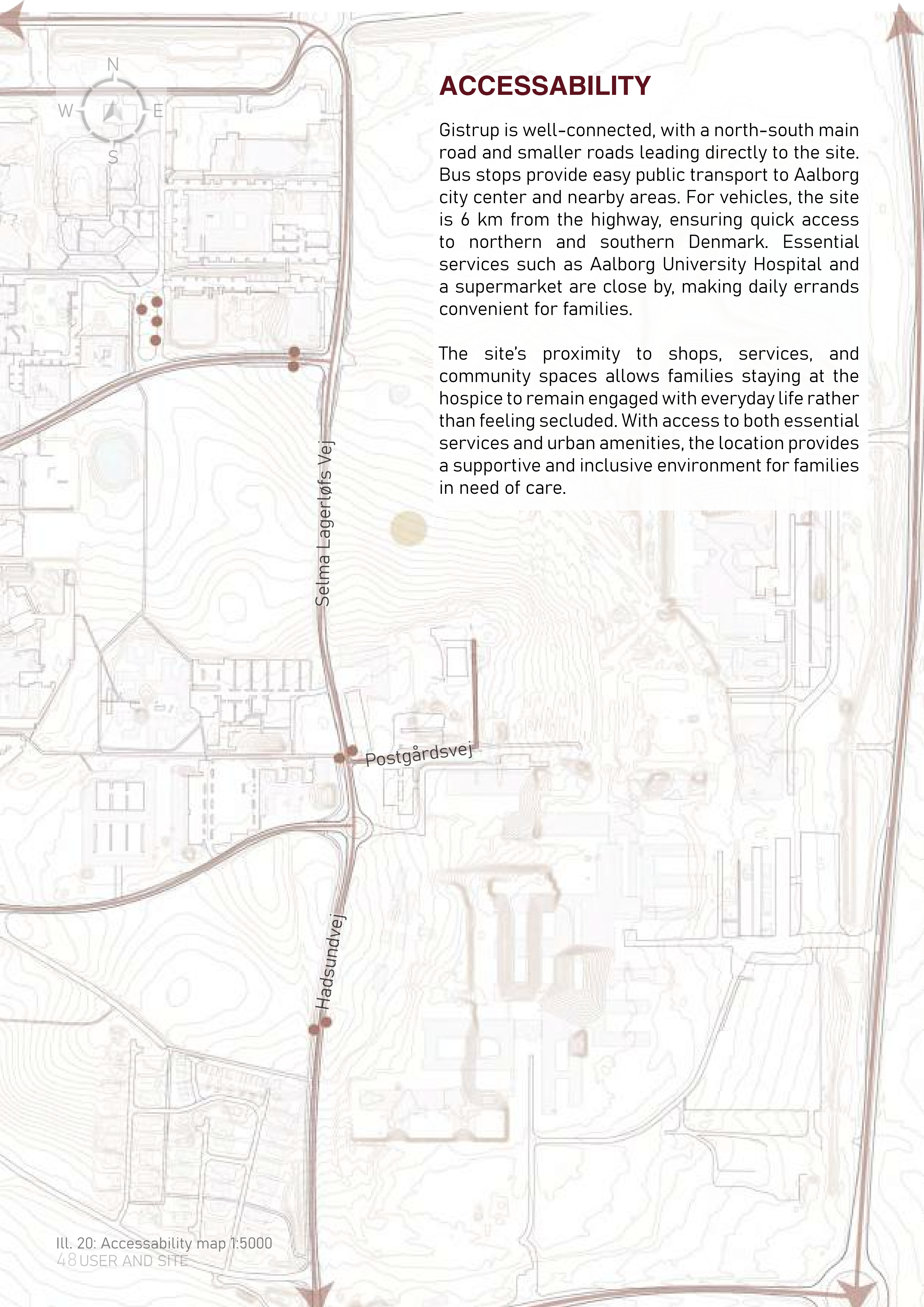
PLACEMENT OF SITE

The chosen site is just north of Aalborg University Hospital. For the staff, this provides easy access to the facilities there and also allows for them to quickly consultation with coworkers. For the patients, it means that medical care not available at the hospice – such as CT and MRI scans – will not require a lot of travel, that can tire or scare the child.
Another important reason for choosing this site is the large amount of nature – in the form of fields and a small, wooded area – and the slightly higher elevation compared to the surroundings.

ACCESSABILITY

Gistrup is well-connected, with a north-south main road and smaller roads leading directly to the site. Bus stops provide easy public transport to Aalborg city center and nearby areas. For vehicles, the site is 6 km from the highway, ensuring quick access to northern and southern Denmark. Essential services such as Aalborg University Hospital and a supermarket are close by, making daily errands convenient for families.

The site's proximity to shops, services, and community spaces allows families staying at the hospice to remain engaged with everyday life rather than feeling secluded. With access to both essential services and urban amenities, the location provides a supportive and inclusive environment for families in need of care.

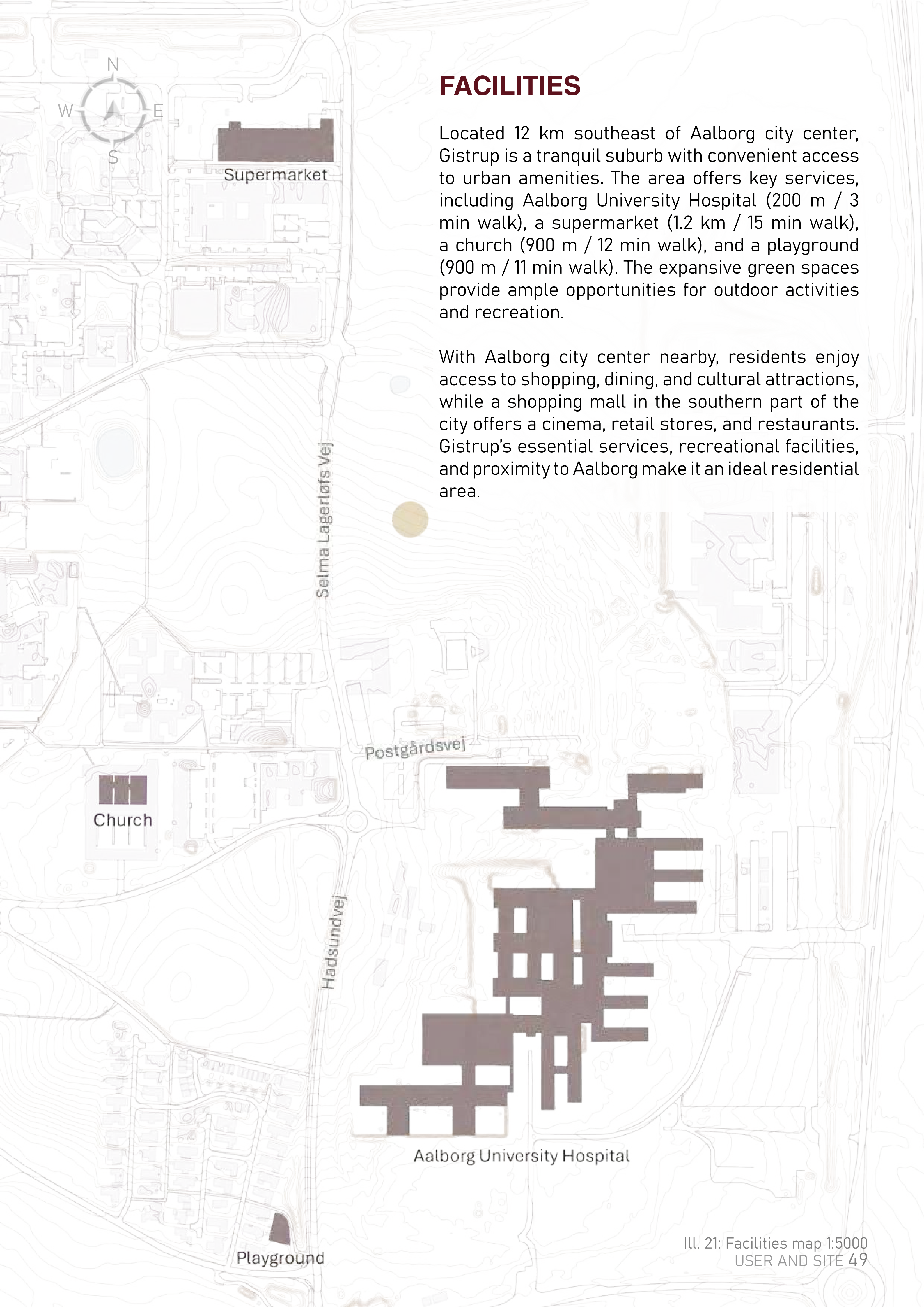


Ill. 20: Accessability map 1:5000

FACILITIES

Located 12 km southeast of Aalborg city center, Gistrup is a tranquil suburb with convenient access to urban amenities. The area offers key services, including Aalborg University Hospital (200 m / 3 min walk), a supermarket (1.2 km / 15 min walk), a church (900 m / 12 min walk), and a playground (900 m / 11 min walk). The expansive green spaces provide ample opportunities for outdoor activities and recreation.

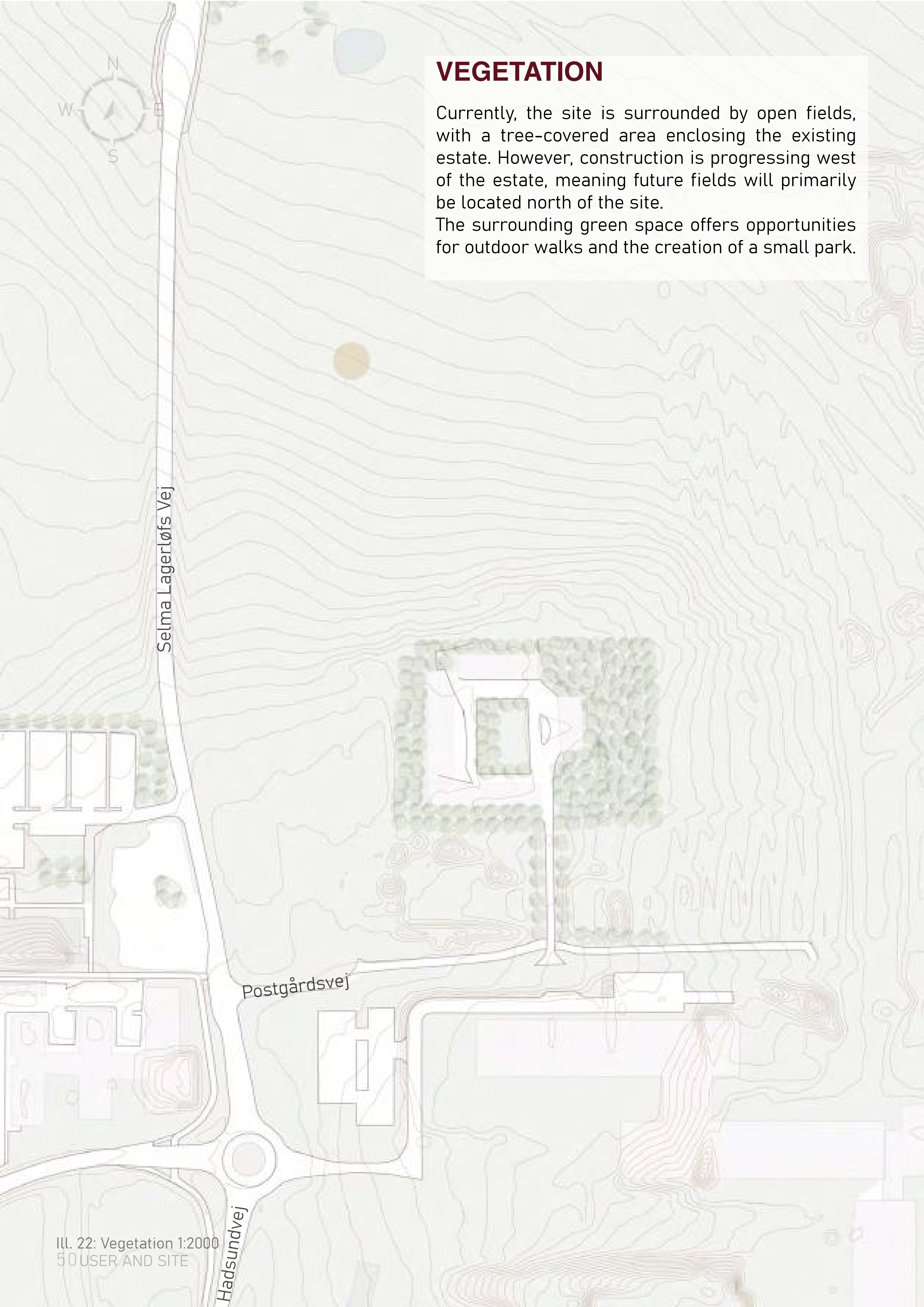
With Aalborg city center nearby, residents enjoy access to shopping, dining, and cultural attractions, while a shopping mall in the southern part of the city offers a cinema, retail stores, and restaurants. Gistrup's essential services, recreational facilities, and proximity to Aalborg make it an ideal residential area.



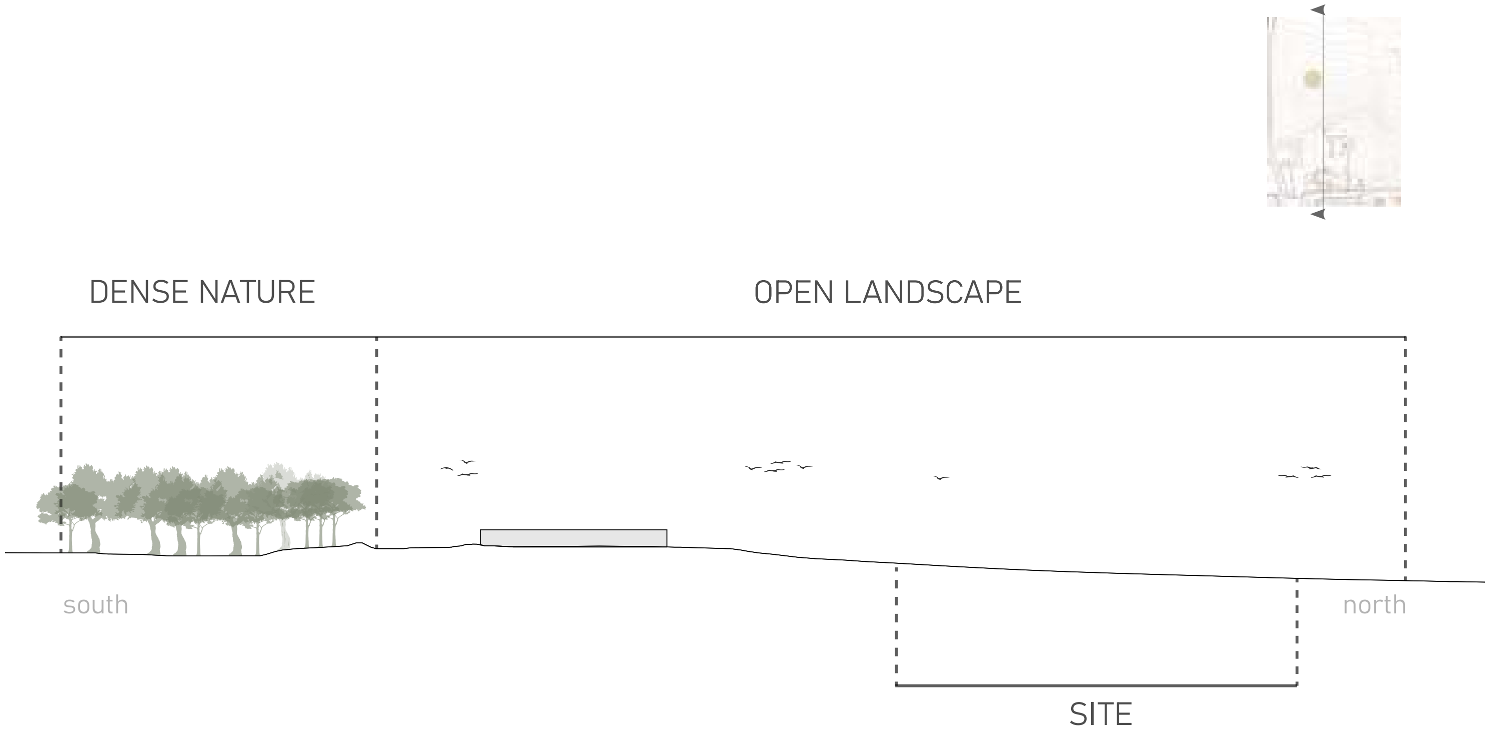
Ill. 21: Facilities map 1:5000

VEGETATION

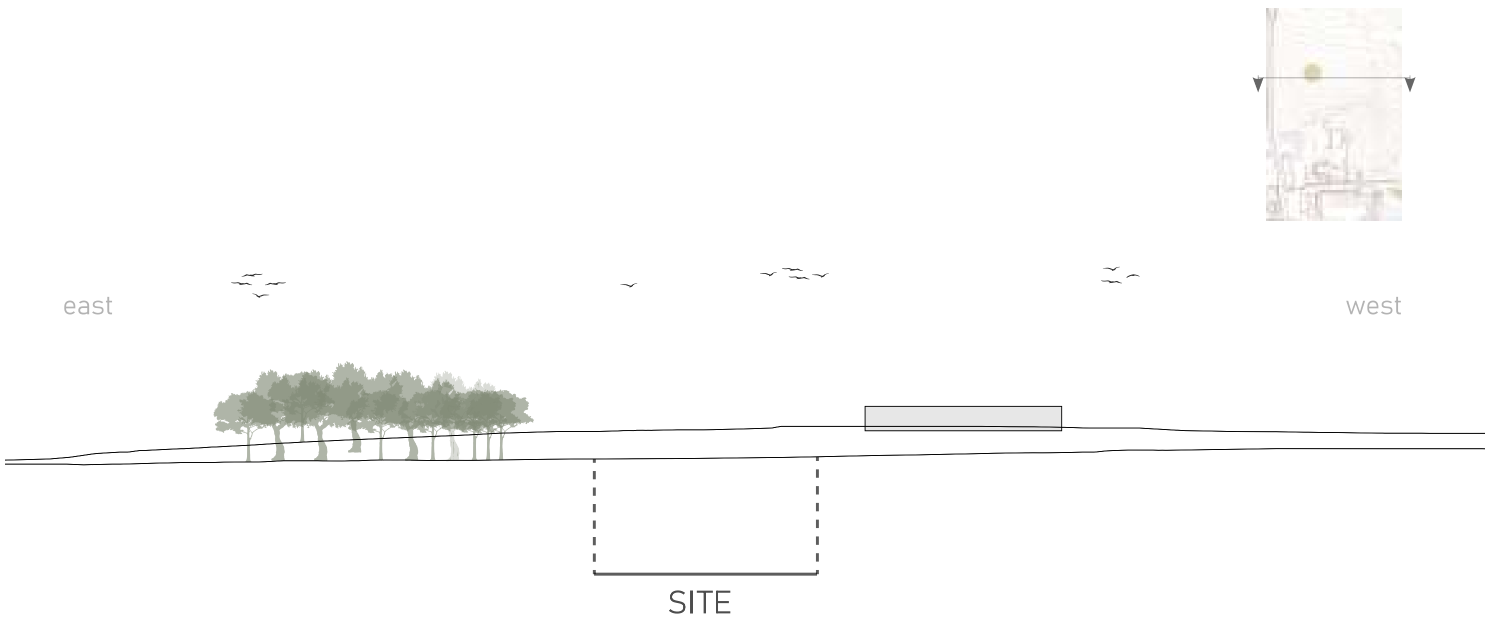
Currently, the site is surrounded by open fields, with a tree-covered area enclosing the existing estate. However, construction is progressing west of the estate, meaning future fields will primarily be located north of the site.
The surrounding green space offers opportunities for outdoor walks and the creation of a small park.



Ill. 22: Vegetation 1:2000



Ill. 23: Site section

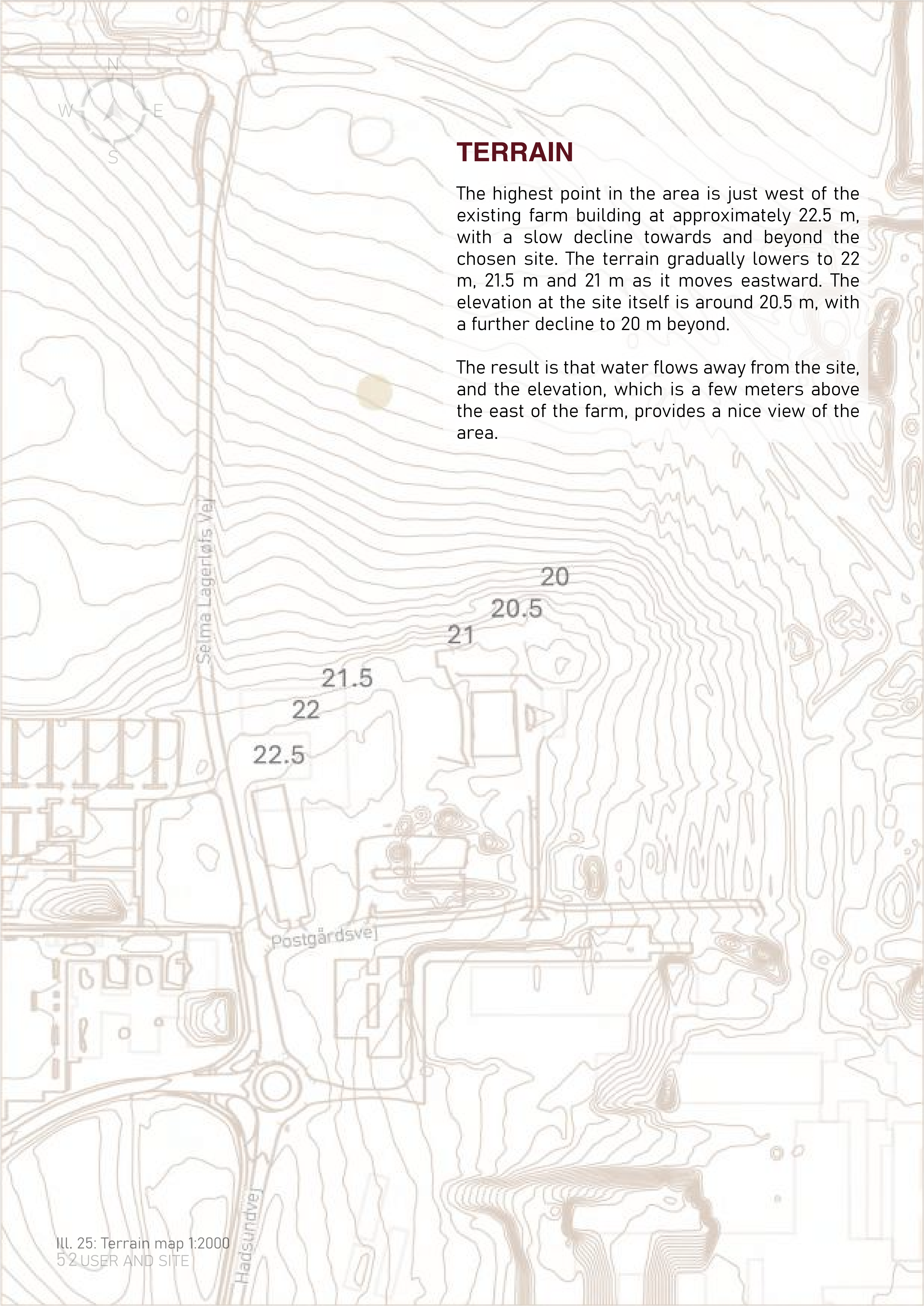


Ill. 24: Site section

TERRAIN

The highest point in the area is just west of the existing farm building at approximately 22.5 m, with a slow decline towards and beyond the chosen site. The terrain gradually lowers to 22 m, 21.5 m and 21 m as it moves eastward. The elevation at the site itself is around 20.5 m, with a further decline to 20 m beyond.

The result is that water flows away from the site, and the elevation, which is a few meters above the east of the farm, provides a nice view of the area.



Ill. 25: Terrain map 1:2000

SOIL CONDITIONS

The geotechnical conditions at the project site – Postgårdsvej, Aalborg – reflect the region's complex geological history, which has significant implications for construction and foundation design. Aalborg's development has been influenced by both glacial and post-glacial processes, resulting in a diverse subsurface composition. Although no direct geotechnical investigations have been conducted at the site, existing reports, such as the COWI geotechnical survey for the nearby Aalborg University Hospital, provide valuable insights into the general soil conditions of the area. These reports indicate that the site is primarily influenced by Quaternary deposits, including moraine clay, sand, and localized organic materials such as peat and gyttja, particularly in the lower-lying sections. These soil types exhibit varying densities and water contents, which influence both load-bearing capacity and settlement behavior. (COWI, 2016)

According to the COWI geotechnical report, the terrain in this part of Aalborg ranges from 6 to 22 meters above sea level. This variability in elevation reflects the historical influence of fluvial and glacial reshaping, leading to an uneven distribution of soil layers. Such variation underscores the potential for differential settlement, highlighting the need for detailed, site-specific assessments when designing foundations for construction. Furthermore, the report indicates that suitable load-bearing soil or chalk formations are generally found at depths ranging from approximately 7 to 20 meters below the existing terrain, depending on the specific location within the site. This depth variation necessitates careful selection of foundation methods to ensure structural stability and mitigate settlement risks. (COWI, 2016)

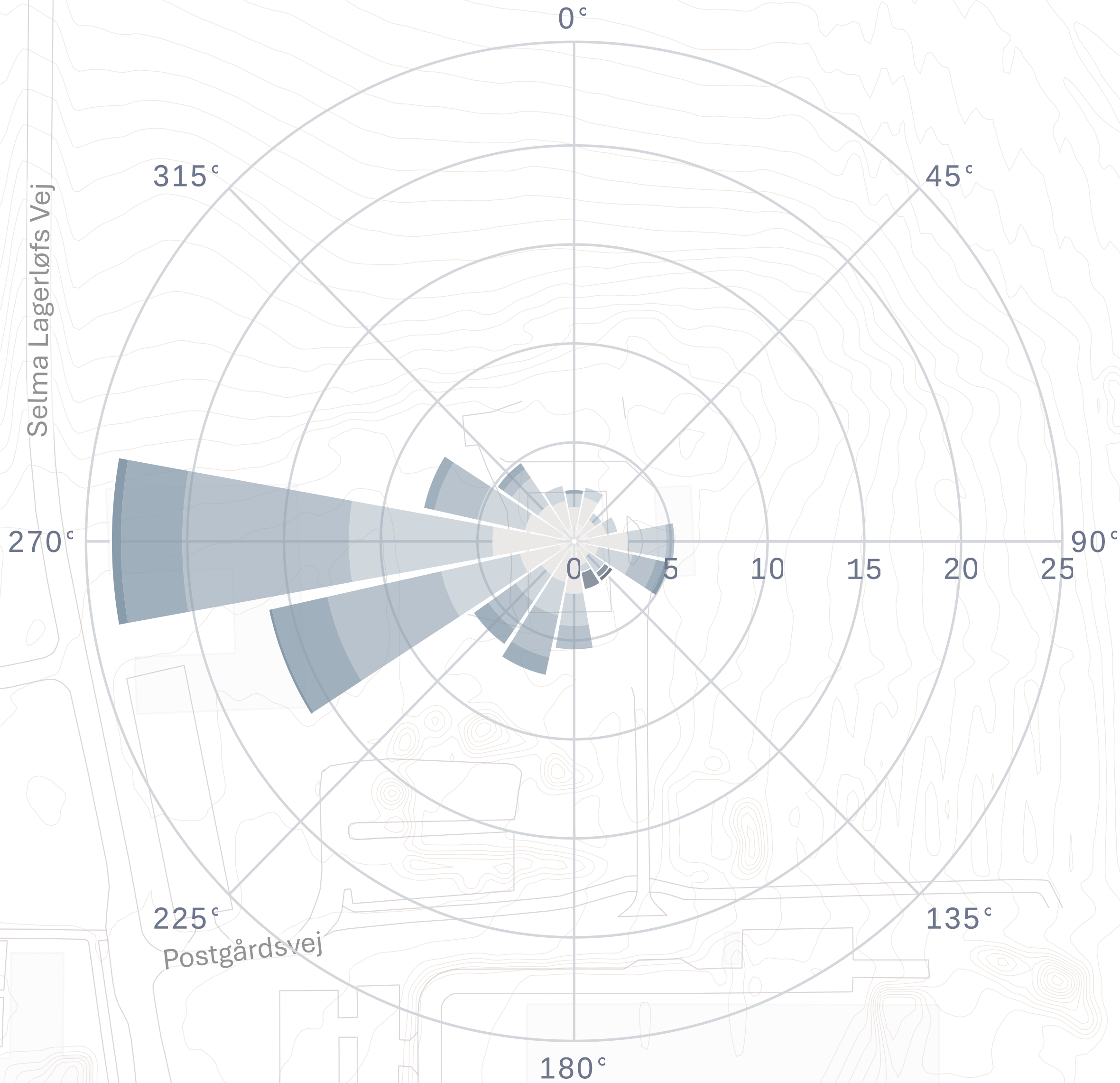
A key challenge in Aalborg's geotechnical profile is the presence of chalk in the subsurface. Chalk, a significant feature of the region's geology, dates back to the Cretaceous period and can serve as a reliable foundation material under certain conditions. However, its depth, hardness, and weathering state vary considerably across the site. In some locations, the chalk is compact and load-bearing, allowing for the potential use of direct foundations. In contrast, in areas where the chalk is soft or fractured, additional foundation measures, such as pile foundations or ground stabilization techniques, may be necessary. (COWI, 2016)

The porous nature of chalk also presents challenges, as it is prone to water infiltration, which can lead to erosion and potentially affect the long-term stability of the foundation. In some areas, karst formations may also be present, creating voids or cavities that could further compromise structural integrity. Given the variability of chalk, the available geotechnical data suggests that site-specific adjustments should be made to account for the underlying soil characteristics.

Although direct soil investigations are not possible for this project, the existing data from COWI's reports and regional geotechnical studies provide a strong foundation for understanding the general soil conditions at Postgårdsvej. These insights can guide the selection of appropriate foundation solutions and contribute to the development of an efficient and sustainable construction plan. Future construction on this site will require careful adaptation of engineering solutions that respond to the geological variability and historical context of Aalborg's soil conditions.

WIND

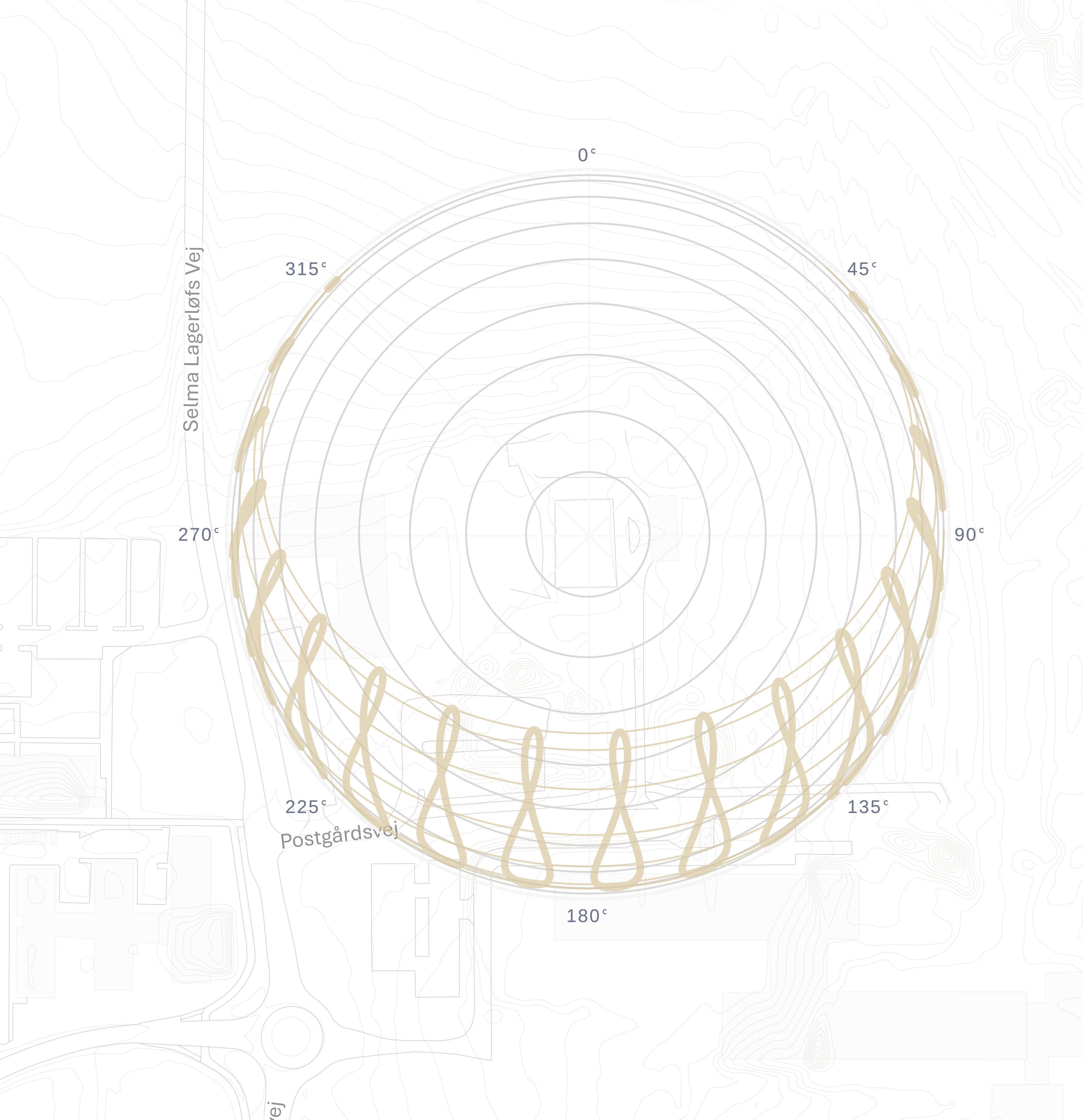
Wind from the west is the most problematic at site, as there is little in the area to create shelter. It is all open fields, except to the south where buildings and trees make for a natural windbreak. The project will therefore have to consider how to shelter the building and outdoor areas from west wind.



Ill. 26: Wind 1:2000

SUN

While the northern half of the site is clear of any shading elements, there is plenty to the south. Tall, deciduous trees and new office buildings called NOVI MEDI PARK border the site, while Aalborg University Hospital rises from a bit further away in slightly lower terrain.



Ill. 27: Sun 1:2000

SUBCONCLUSION

The site is highly accessible by both public transport and car, with well-connected roads that, while sizable, remain free from heavy congestion. Nearby amenities include a supermarket and a hospital, ensuring convenience for daily needs, while City Syd, a major shopping hub, is just a short drive away via the freeway, offering access to a wider range of services.

The southern part of the site is more developed, but the north remains open and unobstructed, consisting of expansive fields with only a few taller shrubs. This provides excellent opportunities to harness natural ventilation and indirect daylight, creating a comfortable and energy-efficient environment. The gently sloping terrain towards the north and east enhances the potential for uninterrupted views of nature, while the relatively level west and south ensure stability for construction and accessibility. The combination of scenic surroundings and strategic placement allows for an optimal balance between urban convenience and a tranquil, nature-oriented setting.

CHAPTER 04

PROBLEM DELIMINATION

Chapter 4 will outline the preservation values, along with the design principles, drawing from the theoretical framework and insights gained from the site and user analysis chapter.

RESEARCH QUESTION

How can architecture create a safe and homely environment, that enhances the quality of life for children with life-limiting or -threatening illnesses and their families while integrating sustainability through healthy indoor climate and material choices that minimize the CO_2 footprint, all while supporting relief through the physical and mental treatments?

THE DESIGN SHOULD...

...integrate nature

The residential rooms should have a direct view to the outdoors, ensuring a strong connection to nature and providing visual relief. Large windows equal to at least 15% of the floor area with minimal obstructions should be used to maximize natural light.

The outdoor areas should be easily accessible from both the residential and common rooms, encouraging residents and visitors to spend time outside. Barrier-free transitions and wide door opnings, at least 1.2 m wide, should be incorporated to make nature a seamless extension of the indoor environment.

All rooms designed for longer stays should have access to natural daylight, ensuring a healthy and comfortable atmosphere. Windows should be positioned to provide even, diffused light throughout the day, achieving a Usefull Daylight Illuminace of at least 50% to minimize reliance on artificial lighting.

...create a nurturing home for the family

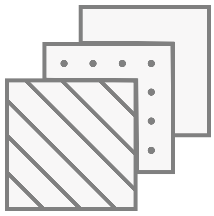
The indoor climate should support flexibility, allowing for different uses and adaptations over time. It should be possible to regulate temperature between 22-26 C° by thermostat or by opening a window and light condition through curtains and mechanical blinds.

Acoustic design should be implemented to create a calm and comfortable environment. This can be achieved by using sound-absorbing materials on walls, ceilings, and floors to minimize noise levels and ensure a reverberation time of maximum 0,6 s.

Medical equipment, such as oxygen, should be discreetly integrated into the design, using built-in storage solutions and carefully planned layouts to minimize the visual impact while keeping essential tools easily accessible for caregivers.

...use materiality as a palliative element

The choice of materials should prioritize low Global Warming Potential and longevity. Natural materials such as wood should be preferred to minimize environmental impact.



The materiality should contribute to a homely environment, counteracting the sterile, white aesthetic of a hospital. Warm, textured materials such as wood and soft fabrics should be used to create a comforting and inviting environment.

... have a comfortable and healthy indoor climate

The hospice should have mechanical ventilation with an air flow rate of a minimum of 0,3 l/s per m^2 and the possibility for natural ventilation in rooms intended for longer stays to ensure a CO_2-concentration of less than 900 ppm.

Thermal comfort should be achieved through heating and cooling systems, using materials with thermal mass equal to a medium light construction with a thermal capacity of 80 Wh/m^2K (IDA Bygningsfysik, 2015). Floor heating, adjustable shading and passive design strategies should help maintain a stable climate year-round.

Ill. 28: Design principles

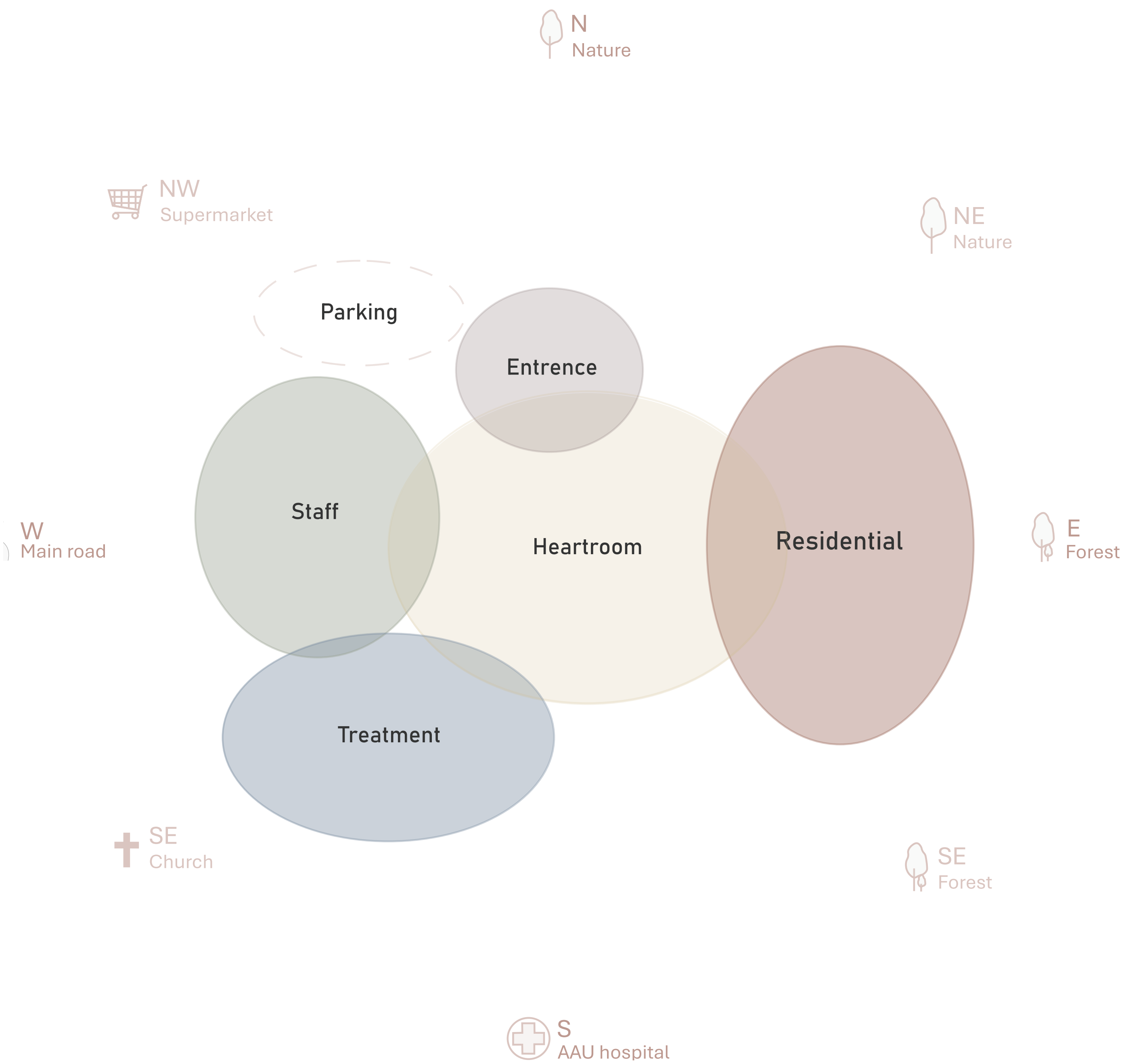
FUNCTIONAL DIAGRAM

A functional diagram was developed to clarify the relationships between rooms and their orientation on-site. The layout is divided into four color-coded categories: staff, treatment, residential, and the Heartroom. The entrance stands apart from these, serving primarily as a transition space for removing shoes and jackets before entering the hospice.

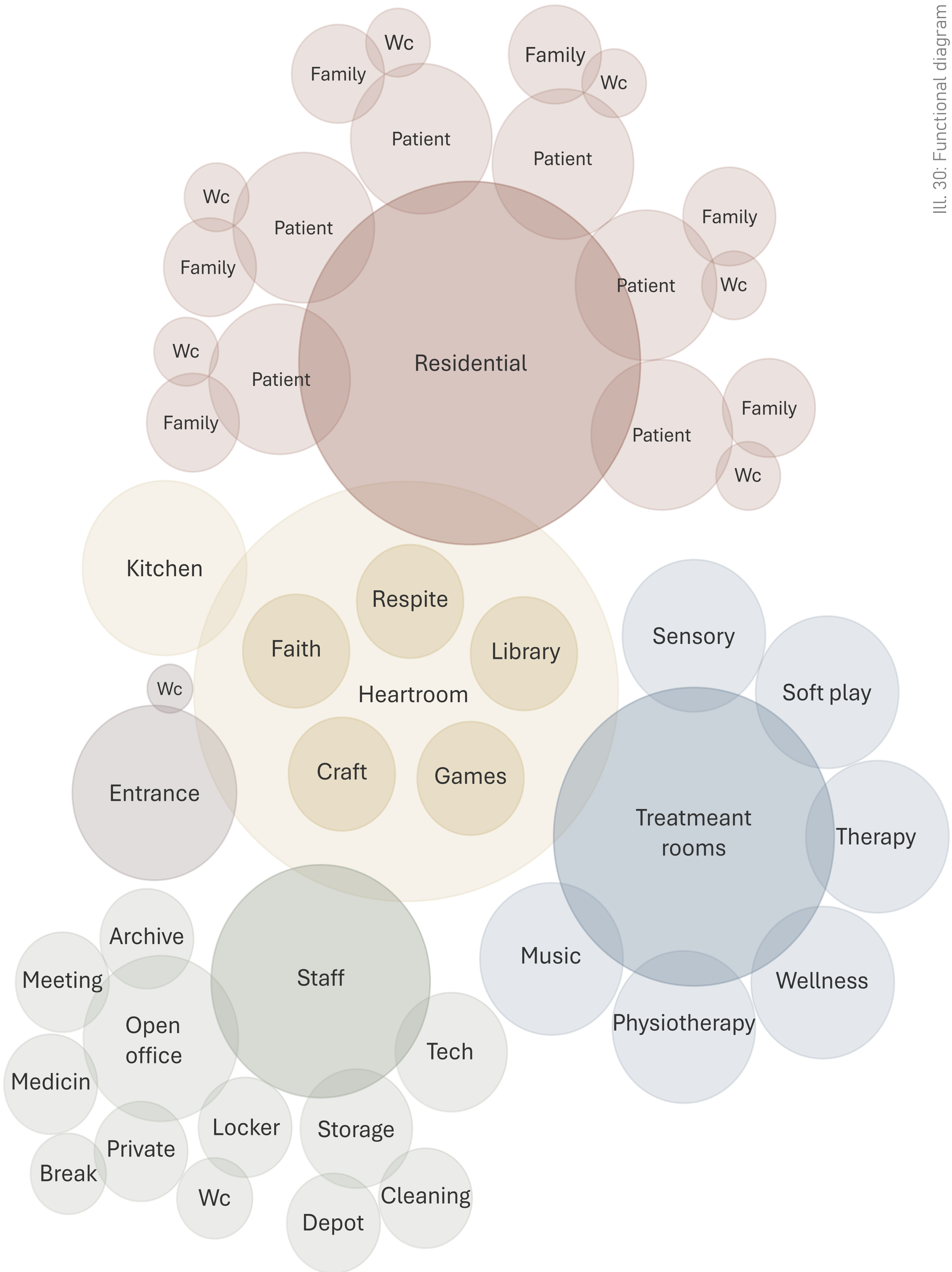
Staff and treatment rooms are positioned to the south for direct access to the hospital, with treatment spaces also bordering the eastern tree line around Postgården.

Residential rooms are placed to the north, ensuring unobstructed views of nature and seamless outdoor access - shielding patients from constant exposure to Aalborg University Hospital. However, this orientation limits sunlight in outdoor areas, making them colder for patients.

At the core, the Heartroom acts as the central hub, connecting all categories and fostering both interaction and movement.



Ill. 29: Functional diagram in relation to cardinal directions



Ill. 30: Functional diagram

ROOM PROGRAM

Room	Quantity	Area	Area total	Max. capacity	Atmosphere	Room height
Common facilities						
Main entrance	1	50 m²	50 m²	10	Homely	5 m
Kitchen and dining	1	200 m²	200 m²	50	Homley, clean	5 m
Strorage room	1	15 m²	15 m²	3	Homely	5 m
Cleaning room	1	10 m²	10 m²	2	Clean	5 m
Heartroom	1	200 m²	200 m²	50	Homely, natural light	5 m
Multifaith room	1	30 m²	30 m²	6	Homely, warm light	5 m
Library	1	24 m²	24 m²	4	Homely	5 m
Respite room	2	15 m²	30 m²	3	Homely, light	2.5 m
Handicap toilet	5	5 m²	25 m²	2	Clean	2.5 m
Laundry room	1	17 m²	17 m²	3	Clean	2.5 m
Residental						
Patient room	6	30 m²	180 m²	6	Homely	2.5 m
Family room	6	35 m²	210 m²	6	Homely	2.5 m
Handicap bathroom	6	20 m²	120 m²	6	Clean	2.5 m
Treatment						
Music therapy room	1	30 m²	30 m²	6	Playfull	2.5 m
Sensory room	1	15 m²	15 m²	3	Playfull	2.5 m
Wellness room	1	20 m²	20 m²	4	Playfull	2.5 m
Physio therapy room	1	15 m²	15 m²	3	Homely	2.5 m
Therapy room	1	15 m²	15 m²	3	Playfull	2.5 m
Soft play room	1	20 m²	20 m²	4	Playfull	2.5 m
Staff						
Open office	1	80 m²	80 m²	8	Homely, light	2.5 m
Private office	1	15 m²	15 m²	3	Homely, light	2.5 m
Archive and copy	1	10 m²	10 m²	2	Clean	2.5 m
Toilet	2	1.5 m²	3 m²	1	Clean	2.5 m
Locker room	1	40 m²	40 m²	5	Clean	2.5 m
Medicine room	1	15 m²	15 m²	2	Clean, light	2.5 m
Meeting room	1	15 m²	15 m²	6	Homely	2.5 m
Break room	1	20 m²	20 m²	5	Homely, warm light	2.5 m
Technical room	1	100 m²	100 m²	5	Clean	2.5 m
Strorage room	1	50 m²	50 m²	4	Clean	2.5 m

Ill. 31: Room program

Room	Noise control	Temperature	Lux	Daylight	Ventilation	Air flow rate
Common facilities						
Main entrance	Moderate	22-26 Cº	300	Yes	Hybrid	0,3 l/s pr m²
Kitchen and dining	High	22-26 Cº	300	Yes	Hybrid	0,37 l/s pr m²
Strorage room	Not applicable	22-26 Cº	300	No	Mechanical	0,3 l/s pr m²
Cleaning room	Not applicable	Not heated	300	No	Mechanical	0,3 l/s pr m²
Heartroom	High	22-26 Cº	300	Yes	Hybrid	0,37 l/s pr m²
Multifaith room	Low	22-26 Cº	300	Yes	Hybrid	0,3 l/s pr m²
Library	Moderate	22-26 Cº	300	Yes	Hybrid	0,3 l/s pr m²
Respite room	High	22-26 Cº	300	Yes	Hybrid	0,3 l/s pr m²
Handicap toilet	Not applicable	22-26 Cº	300	No	Mechanical	3 l/s pr m²
Laundry room	Not applicable	Not heated	300	Yes	Hybrid	0,3 l/s pr m²
Residental						
Patient room	High	15-26 Cº	300	Yes	Natural	0,3 l/s pr m²
Family room	Moderate	22-26 Cº	300	Yes	Natural	0,3 l/s pr m²
Handicap bathroom	Not applicable	22-26 Cº	300	No	Mechanical	0,75 l/s pr m²
Treatment						
Music therapy room	High	22-26 Cº	300	Yes	Hybrid	0,3 l/s pr m²
Sensory room	High	22-26 Cº	Not applicable	No	Mechanical	0,3 l/s pr m²
Wellness room	High	22-26 Cº	Adjustable >300	Yes	Hybrid	0,3 l/s pr m²
Physio therapy room	High	22-26 Cº	300	Yes	Hybrid	0,3 l/s pr m²
Therapy room	High	22-26 Cº	300	Yes	Hybrid	0,3 l/s pr m²
Soft play room	High	22-26 Cº	300	Yes	Hybrid	0,3 l/s pr m²
Staff						
Open office	Moderate	22-26 Cº	300	Yes	Hybrid	0,3 l/s pr m²
Private office	Moderate	22-26 Cº	300	Yes	Hybrid	0,3 l/s pr m²
Archive and copy	Not applicable	22-26 Cº	300	No	Mechanical	0,3 l/s pr m²
Toilet	Not applicable	22-26 Cº	300	No	Mechanical	10 l/s pr m²
Locker room	Low	22-26 Cº	300	Yes	Hybrid	0,3 l/s pr m²
Medicine room	Not applicable	15-25 Cº	300	No	Mechanical	0,3 l/s pr m²
Meeting room	Moderate	22-26 Cº	300	Yes	Hybrid	0,59 l/s pr m²
Break room	Moderate	22-26 Cº	300	Yes	Hybrid	0,37 l/s pr m²
Technical room	Not applicable	Not heated	300	No	Mechanical	0,3 l/s pr m²
Strorage room	Not applicable	Not heated	300	No	Mechanical	0,3 l/s pr m²

Ill. 32: Technical room program

CHAPTER 05

DESIGN PHASE

Chapter 5 outlines the development of the architectural design, guided by emotional sensitivity, environmental responsibility, and spatial clarity. The chapter presents key decisions shaped through iterative studies, material strategies, and performance analysis.

DESIGN PHASE

The design of the children's hospice is built around three core principles: emotional sensitivity, environmental responsibility, and architectural clarity. Every decision – from how the building is placed on the site to the smallest structural details – has been made with the aim of creating a space that feels healing, humane, and thoughtful.

This chapter explains how different elements - such as spatial strategies, simulation tools, material choices, and user needs - have come together to form a cohesive and meaningful architectural proposal.

The design process began in late February, after the theoretical framework and site analysis were mostly in place. Early design work focused on testing structural systems and material options, with special attention to their environmental footprint (GWP) and their ability to support a warm, homelike atmosphere.

The design was developed through an iterative process, where ideas were continuously refined from different angles – aesthetic, functional, and technical. Hand sketches, diagrams, and physical models played an important role early on, later supported by digital tools and environmental simulations that helped sharpen the design with increasing precision.

A key ambition was to understand how architecture can actively support emotional well-being. Through research, case studies, and ongoing reflections, the design gradually took shape as a balanced response to comfort, sustainability, and spatial clarity.

This section offers a brief overview of the most important decisions and how they influenced the final architectural outcome.

LCA MATERIAL RESEARCH

The way users perceive and experience the atmosphere of a space plays a crucial role in shaping its design. In a hospice setting, where patients and their families need comfort and emotional support, the choice of materials becomes essential in creating a calming and soothing environment. The selection of materials should be carefully evaluated to achieve the desired sensory effect, ensuring that they contribute to a relaxing atmosphere while also meeting sustainability goals.

To support this approach, a LCA will be conducted, focusing on two key aspects: The GWP of materials and their impact on the overall atmosphere. The tables presented in this study outline the GWP values of various building materials and structural components, sourced from LCAByg. These analyses serve as a foundation for material selection during the design phase. While the specific materials for the final design have yet to be determined, this preliminary assessment provides a reference framework for making informed decisions.

By integrating LCA from the early stages of the design process, sustainability considerations become an active and influential part of decision-making, rather than a secondary assessment conducted later in the project.

FOUNDATION

	Concrete - Point foundation	*Concrete - Strip foundation*
GWP (kg CO_2 eq./m^2/year) of 1 m^2	0,0068	0,0068
Atmosphere	A light, open feel by elevating the building slightly above the ground.	Provides a stable and heavy feel as the building rests directly on a wide base.
Additional comments	Cost-effective and requires less material but is less stable.	Stronger and more stable, but more expensive and material intensive.

Ill. 33: Table Foundation

TERRAIN DECK STRUCTURE

	Concrete	*Wood*
GWP (kg CO_2 eq./m^2/year) of 1 m^2	0,0068	0,00089
Atmosphere	Not visible	Not visible
Additional comments	If it is at least 10cm thick, it functions as a radon barrier.	Lightweight structure

Ill. 34: Table terrain deck structure

FLOOR CLADDING

	Wood - oak	*Wood - pine*	*Tile*
GWP (kg CO_2 eq./m^2/year) of 1 m^2	0,0027	0,0027	0,0033
Atmosphere	Warm, elegant, and timeless atmosphere	Light, cozy, and natural feel.	Cool, sleek, and modern ambiance.
Additional comments	Strong and durable hardwood.	Lightweight and softwood.	Water-resistant.

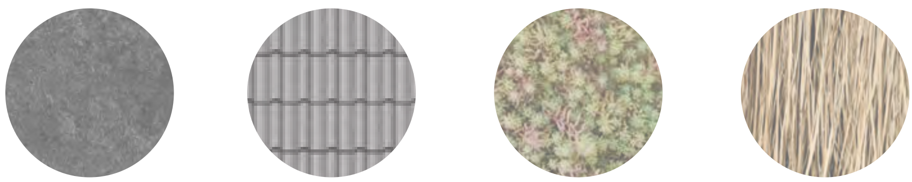
Ill. 35: Table floor cladding

ROOF CONSTRUCTION

	Steel	*Wood - Glue laminated wood*	*Wood - Construction wood*
GWP (kg CO_2 eq./m^2/year) of 1 m^2	0,17	0,011	0,0027
Atmosphere	Sleek, industrial, and modern atmosphere	Gives a warm, elegant, and architectural feel.	Natural, rustic, and traditional ambiance.
Additional comments	Strong, allows large spans with minimal support.	Highly durable, ideal for long-span structures.	Cost-effective may require support for heavy loads.

Ill. 36: Table roof construction

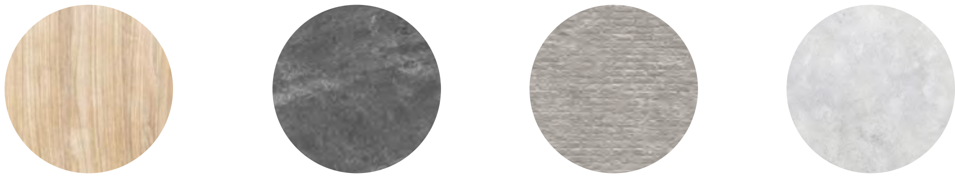
ROOF COVERING



	Steel	*Tile*	*Sedum*	*Straw*
GWP (kg CO_2 eq./m^2/year) of 1 m^2	0,0029	0,0017	0,0055	0,0010
Atmosphere	Sophisticated, natural, and timeless atmosphere	Gives a cool, clean, and modern feel	Adds an organic ambiance	Creates a rustic, earthy, and traditional atmosphere
Additional comments	Highly durable and resistant to moisture and fire.	Easy to clean, ideal for high-moisture areas	Improves indoor air quality	Great thermal insulation properties

Ill. 37: Table roof covering

EXTERIOR WALL CLADDING:



	Wood	*Slate*	*Brick*	*Concrete*
GWP (kg CO_2 eq./m^2/year) of 1 m^2	0,0014	0,0017	0,0057	0,0024
Atmosphere	Creates a warm, natural, and rustic atmosphere	Gives a sleek, elegant look	Provides a timeless, and classic feel	Offers a modern, minimalist, and industrial appearance
Additional comments	Requires regular maintenance	Highly durable and resistant to fire and moisture	Great thermal mass – regulates indoor temperatures	Energy-efficient, and provides good insulation

Ill. 38: Table exterior wall cladding

INTERIOR WALL CLADDING:

	Gypsum	*Wood*	*CLT wood*	*Tile*
GWP (kg CO_2 eq./m^2/year) of 1 m^2	0,00061	0,00061	0,00064	0,00088
Atmosphere	Creates a smooth, neutral, and versatile atmosphere	Adds warmth, texture, and dynamic	Provides a cozy, natural, and solid ambiance	Gives a sleek, clean, and durable look.
Additional comments	Lightweight, easy to install	Enhances acoustics.	Strong, sustainable, and provides natural insulation	Moisture-resistant

Ill. 39: Table interior wall cladding

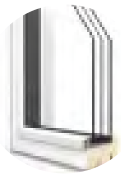
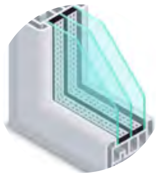
WALL STRUCTURE:

	CLT wood	*Glue laminated wood*	*Construction wood*
GWP (kg CO_2 eq./m^2/year) of 1 m^2	0,0032	0,0020	0,0017
Atmosphere	Not visible	Not visible	Not visible
Additional comments	Allows quick assembly for construction	High strength and flexible	Cost-effective

Ill. 40: Table wall structure

WINDOWS

	Wood, 3-layer glass	*Aluminum, 3 –layer glass*
GWP (kg CO_2 eq./m^2/year) of 1 m^2	0,016	0,023
Atmosphere	Warm and natural	Sleek and modern
Additional comments	Great insulation	Low maintenance

Ill. 41: Table windows

FLOOR PLAN DEVELOPMENT

Initially, each room from the room program was modeled in Rhino as simple squares with the correct dimensions, with proportions carefully estimated to avoid excessively narrow spaces.

The next step involved composing six residential units and arranging them to ensure that both family rooms and patient rooms had direct access to an outdoor area. Simultaneously, smaller wings dedicated to treatment and office spaces were designed and integrated, all converging around a central communal area - the Heartroom - which functioned as a spatial and social connector between the residential and functional zones.

A linear arrangement of the residential units resulted in an inefficient layout with ill-defined spaces and awkward transitions (ill. 42). Conversely, curving the units around the building led to a loss of definition in both the outdoor areas and the arrival sequence, while still presenting challenges in terms of interior spatial organization (ill. 43).

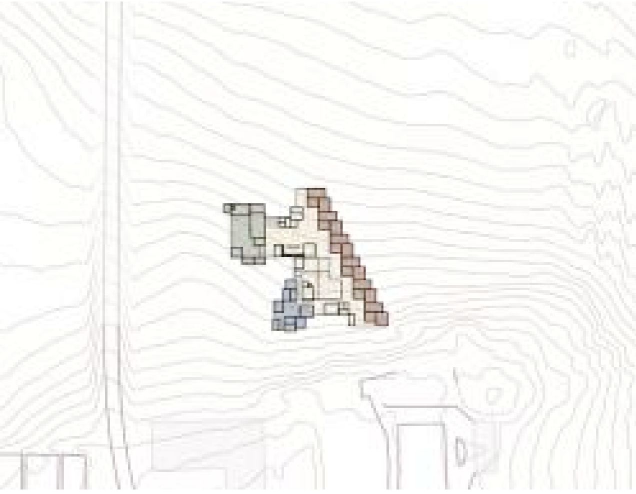
By inverting the curvature of the residential units, a more symmetrical composition was achieved, with the Heartroom and the kitchen forming a central axis. This configuration also introduced smaller, more intimate shared spaces that facilitated a gradual transition between the communal and private areas. The multi-faith space was placed adjacent to the treatment rooms, as its function required a degree of privacy.
However, it remained within the boundaries of the Heartroom's five-meter-high volume, allowing it to benefit from both height and natural light (ill. 44).

Nevertheless, this layout resulted in the residential units facing north, and various storage somewhat randomly scattered throughout.

In the next proposal (ill. 45), the building was rotated 90 degrees, orienting the residential units eastward toward the rising sun. Additionally, the units were separated at the center, allowing direct outdoor access without passing through the living spaces. The Heartroom and communal kitchen were repositioned, placing the kitchen closer to the entrance to evoke a sense of home. In a typical family house, the kitchen is often the first space one steps into, creating an immediate feeling of warmth and familiarity. By replicating this spatial experience, the design aims to foster a welcoming and homely atmosphere. Additionally, the office was placed nearby, as it shares use of the kitchen.
This design required radical adjustments to the existing terrain, if wheelchair users were to have access to both the outdoor areas and the entrance.

A new floor plan was created with a focus on utilizing the natural angles of the terrain for easy access without altering the terrain, while keeping the organizational logic from the previous iteration. As a result, the residential units have a view towards north and east, which lets the morning sun heat up the private terraces and light up the rooms. (Ill. 46). A basement was also introduced beneath the office to accommodate storage and technical facilities (ill. 47).

Staff area Residential area The Heartroom Entrance Treatment area



Ill. 42: Iteration 1 floor plan

Ill. 43: Iteration 2 floor plan

Ill. 44: Iteration 3 floor plan

Ill. 45: Iteration 4 floor plan

Ill. 46: Iteration 5 floor plan

Ill. 47: Basement floor plan for iteration 5

VOLUME STUDY

Alongside the 2D design process, a series of 3D volume studies were conducted to explore spatial relationships and enhance the architectural understanding of the project. These studies were developed in parallel with the function diagram and room program, ensuring that the spatial organization supported the specific needs and intended atmosphere of each area.

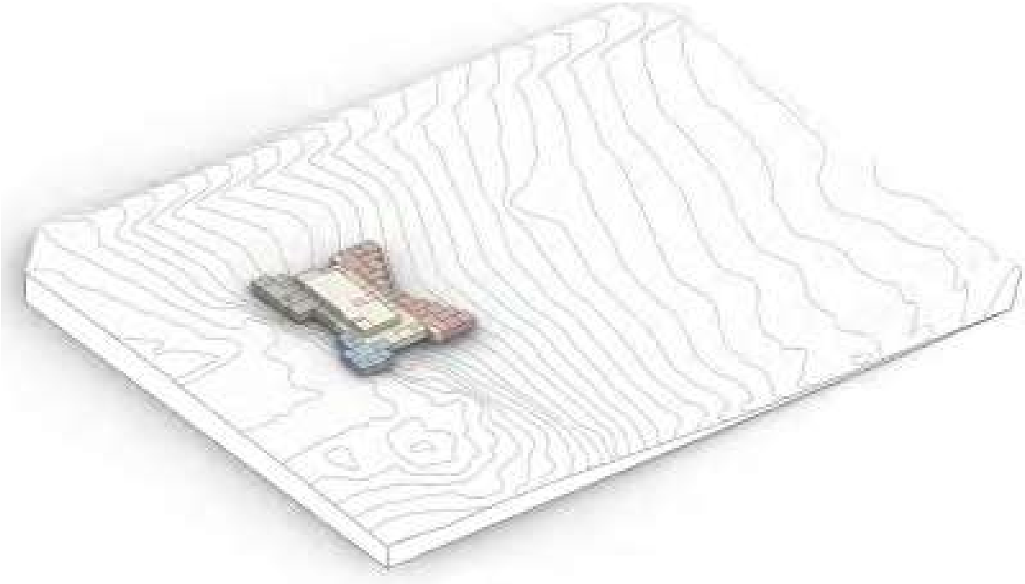
The spatial arrangement was iteratively tested using both physical study models and digital volumetric models. This dual approach facilitated a comprehensive understanding of spatial hierarchies, daylight access, privacy gradients, and flow between zones. The hospice program includes residential units, a staff area, a treatment zone, a large shared kitchen and dining area, and the Heartroom, which acts as the central social and emotional anchor of the design. Each of these functional zones was assigned an independent volume, thereby supporting clarity in wayfinding, functional zoning, and architectural identity.

Illustration 48 presents an early volumetric study where the functional distribution is beginning to emerge. The Heartroom is centrally positioned, with other volumes arranged around it to form a coherent whole. The integration with the terrain is still in an initial phase, and the volumes appear more rigid and compact.

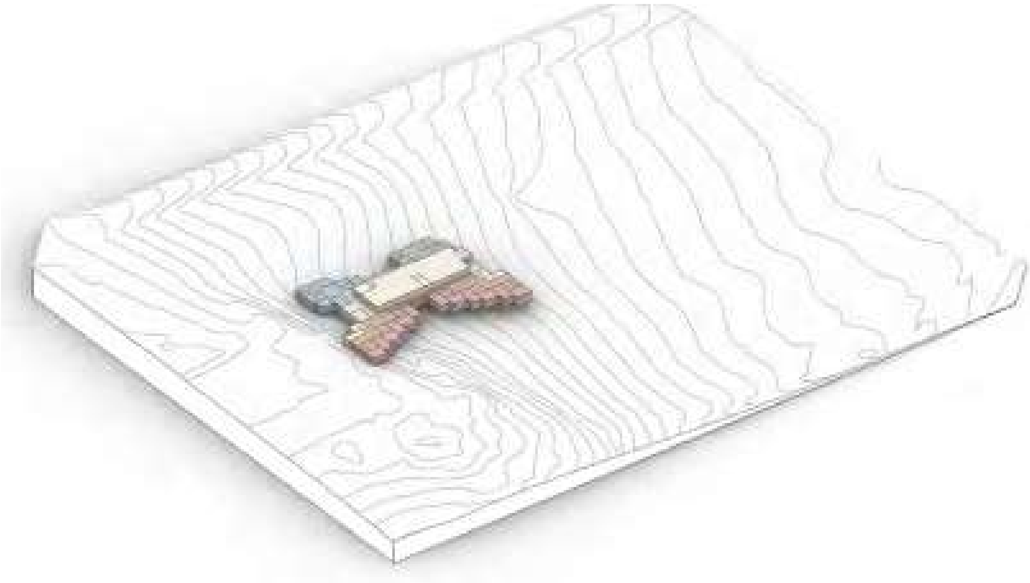
Illustration 49 builds upon this by testing a more articulated volume distribution. Here, the residential units are more visibly pulled apart, creating intimate courtyards and improving visual connections to the landscape. This arrangement allows for greater privacy while preserving proximity to shared functions. The Heartroom's centrality is reinforced, and the differentiation between private and public zones becomes more legible.

In Illustration 50, the volumes have been adapted further in response to topography and orientation. The building now follows the contour lines more closely, minimizing the need for terrain alteration while enhancing the visual and physical relationship with the site. This final iteration demonstrates how the spatial organization was fine-tuned to balance architectural expression, programmatic clarity, and contextual sensitivity.

These volume studies helped shape a design that feels both clear and caring. By separating the different functions into distinct, but connected building volumes, the layout supports the everyday needs of children, families, and staff – while also creating a space that's easy to understand and feels safe to be in.



Ill. 48: Iteration 3 volume



Ill. 49: Iteration 4 volume

Ill. 50: Iteration 5 volume

TOPOGRAPHICAL LEVELING

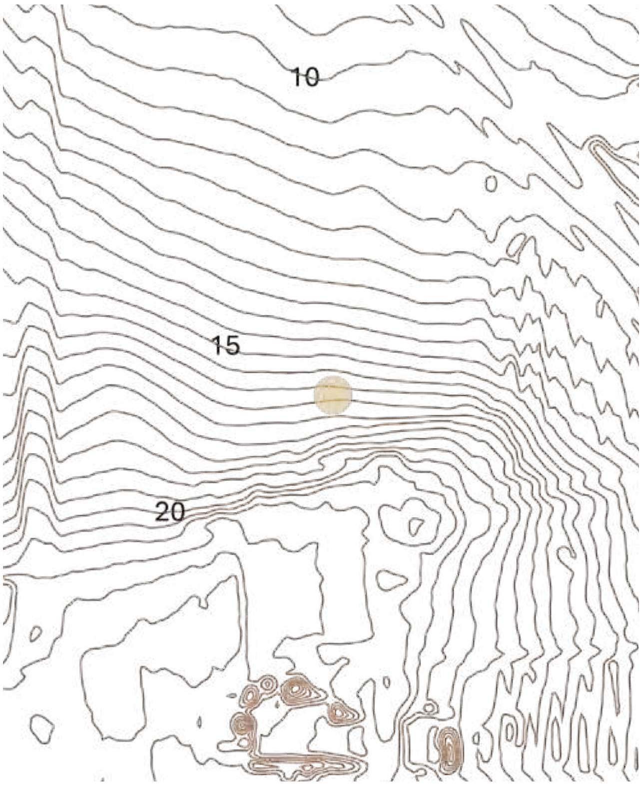
In the early design phases, it became apparent that the site's existing topography would pose a considerable challenge to accessibility (ill. 51). The terrain exhibited a height difference of approximately five meters from one end of the site to the other. Such a steep gradient would compromise both accessibility - particularly for users in wheelchairs - and the potential for integrating the building seamlessly with the surrounding landscape. A re-evaluation of the site's suitability and possible terrain modifications was therefore initiated.

Although the program includes a large park area that could potentially absorb surplus soil through the formation of low hills and landscape features, it was essential to assess the scale of earth movement required. To this end, three initial terrain strategies were tested: (1) adding earth to the lower (north) side of the site, which would raise that edge by nearly three meters, (2) removing earth from the higher (south) side, resulting in a significant excavation, or (3) a hybrid solution where both ends were adjusted by 1.5 meters. The third option was identified as the most sustainable and logistically viable, as it made optimal use of the site's existing resources without necessitating major imports or exports of earth material.

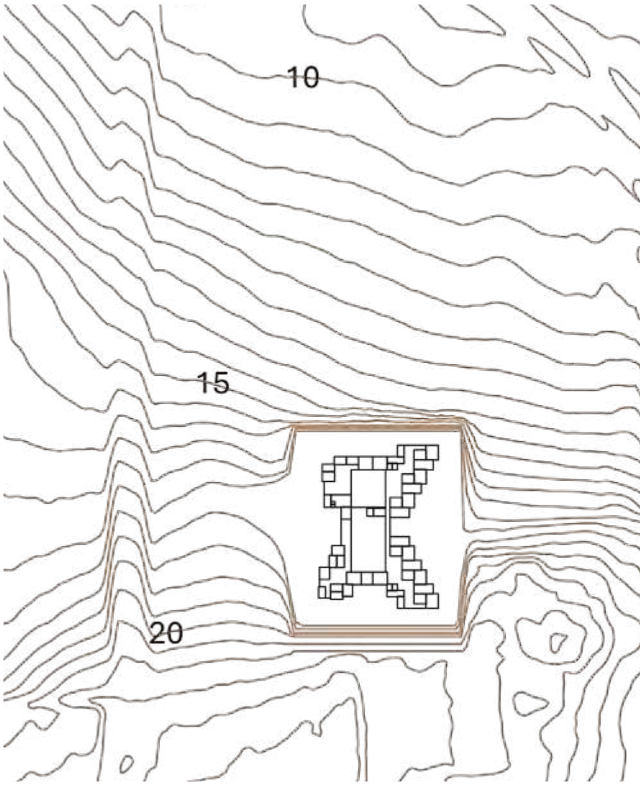
To further quantify these scenarios, two digital terrain models were generated in Rhino: one representing the untouched topography and the other representing a modified terrain where the maximum slope was reduced to 4 cm per meter within a 10-meter buffer surrounding the building (ill. 52). This buffer was intended to accommodate accessible outdoor paths and gathering spaces. Each contour line was translated into a slab with a thickness of 0.5 meters to simplify volume calculations, as a detailed surface mesh would be computationally inefficient at this stage of the design. A volumetric comparison between the two models revealed the extent of earth that would need to be displaced or redistributed.

Despite the feasibility of the hybrid terrain model, the intervention was ultimately deemed too aggressive relative to the project's environmental and architectural ambitions. The children's hospice is deeply rooted in values of sustainability, simplicity, and nature integration. A highly modified terrain would not only increase carbon emissions associated with excavation and soil transport, but also visually and ecologically disconnect the building from its natural surroundings.

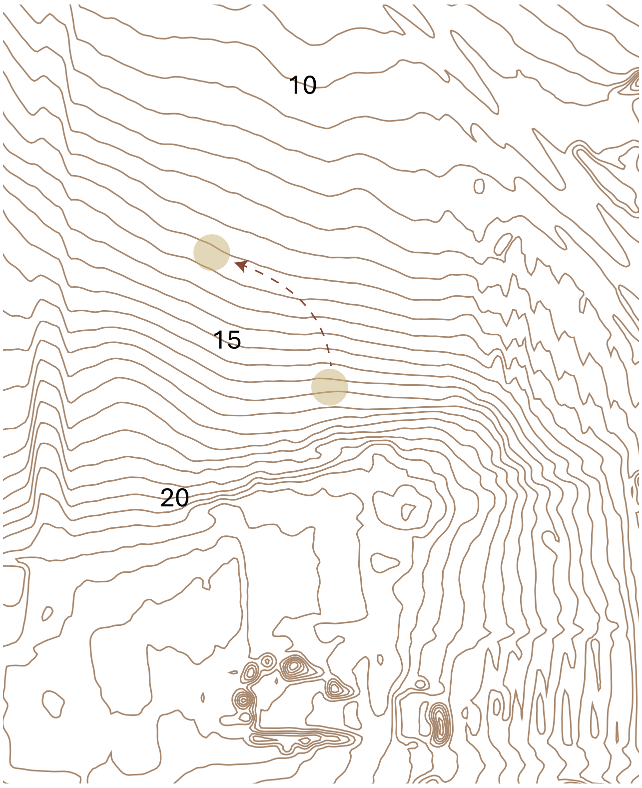
Consequently, the site placement was reassessed, and the building was relocated to a more topographically balanced part of the site (ill. 53). This decision significantly reduced the need for terrain manipulation and allowed for a more natural and gentle integration with the landscape. The updated location ensures that only minor adjustments are required to meet accessibility standards, particularly at the entrance level, thereby preserving the project's connection to the site's natural character (ill. 54).



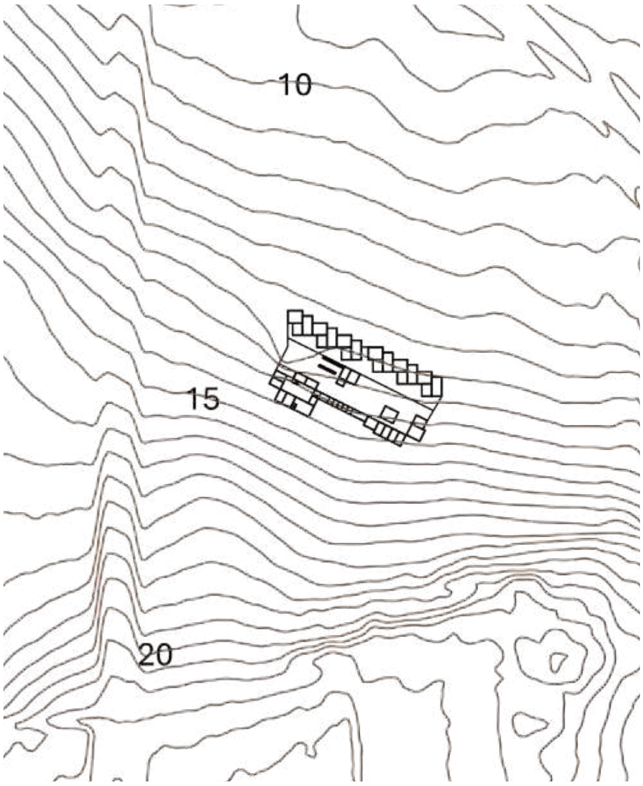
Ill. 51: Original terrain



Ill. 52: Altered terrain



Ill. 53: Moving site



Ill.54: New site

FORM STUDY

To understand the space inside the building, a form study was conducted. This was particularly relevant due to the height difference between the central Heartroom and the surrounding functions. Various roof shapes were explored and evaluated in relation to the site, interior atmosphere, and access to daylight. These spatial studies helped ensure that the architecture not only fulfilled the program but also created a meaningful user experience.

One of the key goals was to establish a strong visual and physical relationship between the building and its natural surroundings. Roof geometry became an important design tool to respond to the sloping terrain, allowing the building to appear grounded and integrated with the landscape. At the same time, roof form played a decisive role in defining ceiling heights, daylight penetration, and the transition between communal and private zones.

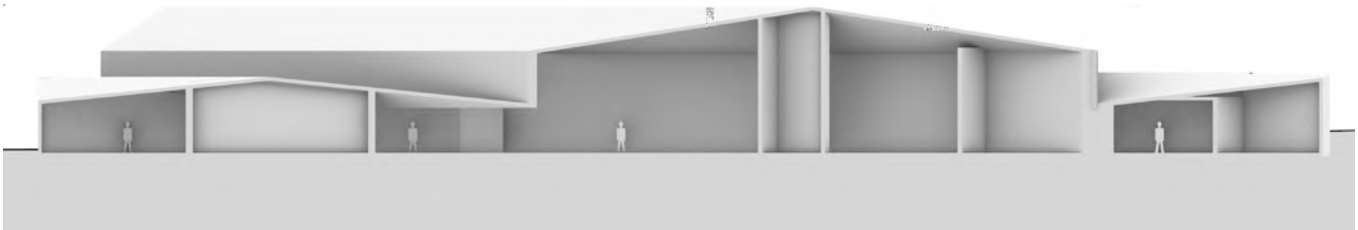
The Heartroom required a roof that could accommodate skylights, support a lush indoor environment with potted plants and trees, and visually connect with the surrounding fields. Some initial concepts, such as in Illustration 55, created a natural directional flow from exterior to interior by following the terrain. However, the flat form limited spatial variation and daylight depth.

Other explorations, such as the inverse triangle in Illustration 57 and 58, proved too complex in terms of construction and performance. They introduced challenges with water drainage, snow loads, and overall spatial clarity. These forms, while sculptural, did not meet the functional and atmospheric demands of the Heartroom.

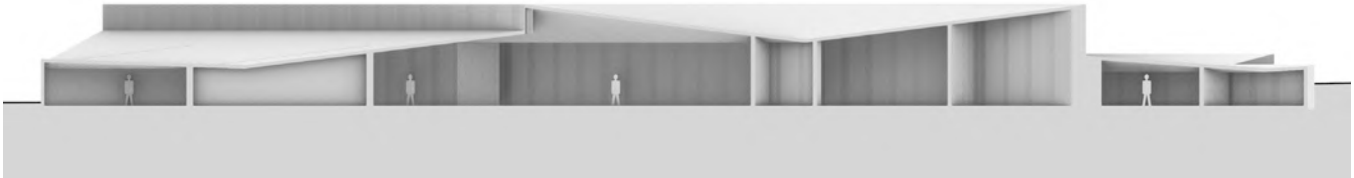
Instead, the gable roof in Illustration 56 emerged as the most suitable solution. Its symmetry and slope optimize daylight from both sides, creating a balanced, calm interior atmosphere. The roof geometry simplifies the overall construction, improves ventilation and lighting strategies, and allows for a natural rhythm across the section. It also enhances the spatial experience by providing a clear and legible form that unites the Heartroom with the rest of the building. This solution successfully combines functionality, sustainability, and architectural identity – making it a defining element in the final design.

Ill. 55: Flat roof

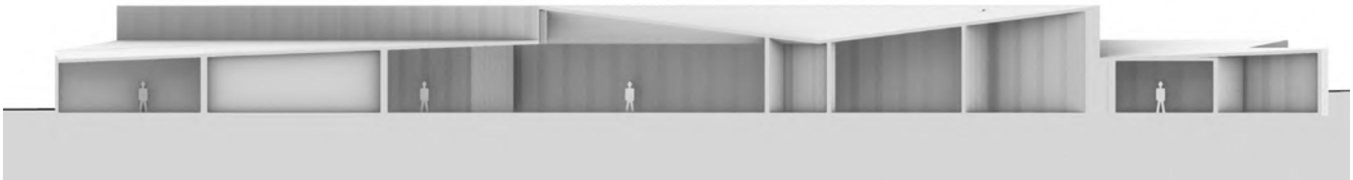
Chosen



Ill. 56: Gable roof



Ill. 57: Inverse triangle roof



Ill. 58: Triangle roof

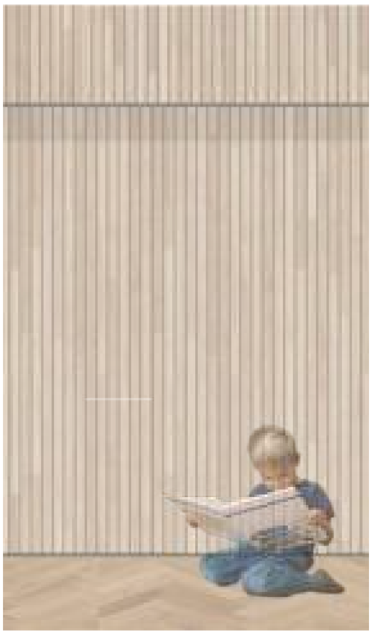
INTERIOR MATERIAL STUDY

This study explores the impact of different material combinations on the spatial experience of children in the hospice. By visualizing various options from a child's perspective, the analysis investigates how wood, textile, and plaster surfaces can shape atmosphere, comfort, and interaction. The goal is to identify materials that support both a sense of safety and opportunities for play, curiosity, and calm.

Each material scenario is evaluated for its sensory qualities - warmth, tactility, acoustic character, and visual calm - as well as its ability to create recognizable, homely settings. In parallel, the selection process considers both environmental and social sustainability. Materials are assessed for their carbon footprint, durability, and recyclability, as well as their ability to contribute to a caring and inclusive environment for vulnerable users.

Through this process, the final interior palette is developed with a focus on supporting children's emotional and physical well-being, while aligning with the project's broader values of responsibility and resilience.

While this study focuses on the interior experience, the following section explores how exterior materials contribute to the hospice's architectural identity and contextual expression.



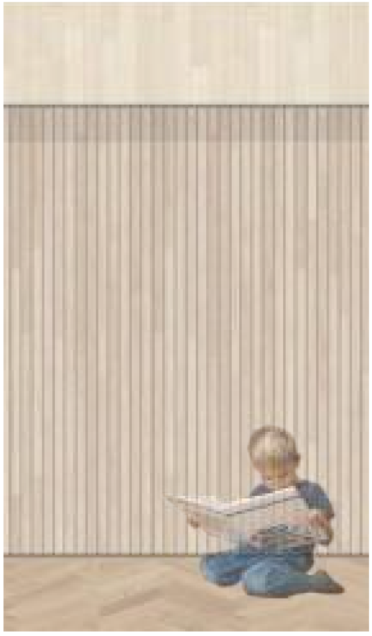
Lamellas ceiling and wall:
A tactile and rhythmic surface that enhances acoustics and warmth – ideal for playful and homely environments.

Lamellas ceiling and plywood wall:
Combines textured ceilings with smooth wall surfaces, creating a warm and grounded interior with subtle variation.

Lamellas ceiling and gypsum wall:
A bright and soft combination that brings visual calm, while the ceiling adds warmth and acoustic comfort.

Plywood ceiling and gypsum wall:
A minimal and airy material palette that reflects light and supports a calm, neutral atmosphere.

Plywood ceiling and wall:
Coherent and warm, this combination offers a natural, homely feel – well-suited for rest and reflection.



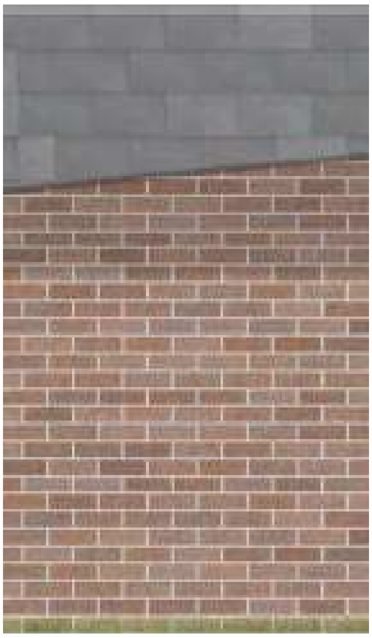
Plywood ceiling and lamellas wall:
A balanced mix of smooth and textured wood, adding richness and tactility without overwhelming the space.

ILL. 59: Interior material study

EXTERIOR MATERIAL STUDY

Steel roof and grey brick: This combination evokes a robust and timeless atmosphere, with a subdued palette that emphasizes material solidity and permanence.

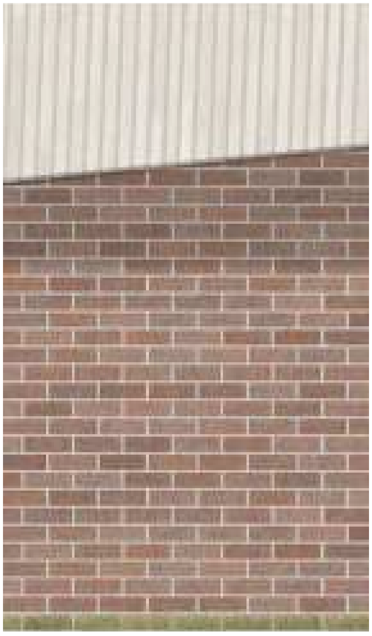
Steel roof and wooden wall: The combination of steel and wood creates a balanced aesthetic, blending natural tactility with architectural refinement.



Steel roof and red brick: A classic and grounded expression, where the warmth of red brick contrasts the cool formality of slate for a traditional appearance.

Wood roof and grey brick: A calm and balanced pairing that merges natural warmth with a restrained, contemporary character.

Wood roof and wooden wall: This creates a cohesive and tactile materiality, evoking simplicity and warmth.

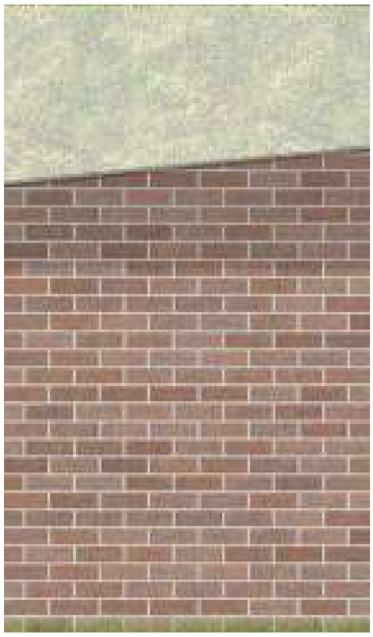


Wood roof and red brick: This combination creates a warm and grounded atmosphere, blending tradition with natural material expression.

Ill. 60: Exterior material study

Sedum roof and grey brick: This pairing fosters a contemporary ecological expression, where the roof softens the industrial undertone of the grey brick.

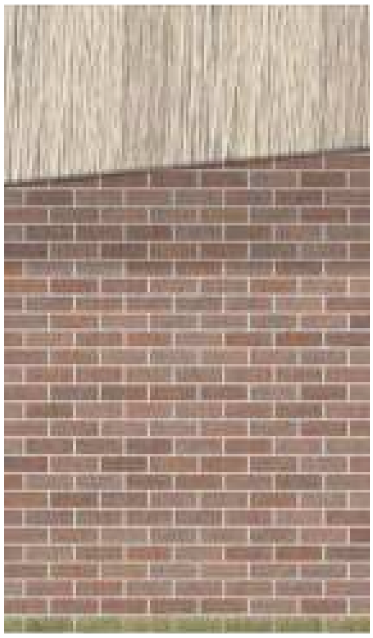
Sedum mat roof and wooden wall: A natural combination that blends seamlessly with the landscape, reinforcing the building's biophilic identity.



Sedum roof and red brick: The earthy tones of red brick harmonize with the organic green roof, resulting in a visually rich and environmentally sensitive aesthetic.

Straw roof and grey brick: The contrast between rustic roofing and contemporary brick introduces a grounded aesthetic, bridging tradition with modernity.

Straw roof and wooden wall: This combination suggests a rustic and rooted atmosphere with clear references to vernacular craft.



Straw roof and red brick: A warm composition that draws on traditional materials and nostalgic character.

DEVELOPMENT OF OUTDOOR AREA

The presence of nature is known to have a profound influence on human wellbeing, particularly in healthcare environments. In the context of a children's hospice, the outdoor spaces acquire a dual role: they must offer therapeutic qualities while also responding to the specific physical, sensory and emotional needs of children and their families. The outdoor landscape is therefore designed not merely as a backdrop to the building, but as an integral part of the overall care environment. The spaces serve both as calming visual extensions of the residential units and as places for play, contemplation, and sensory engagement.

FOREST PARK

To the north of the building, a forest park has been introduced to create a protective buffer against road noise and to enhance the spatial impression of being immersed in nature (ill. 62). This area also plays a significant role in offering varying experiences of movement, exploration, and rest.

Adjacent to the building and immediately accessible from the Heartroom is a playground area. This space has been designed to include inclusive play equipment such as a wheelchair-accessible swing, a carousel and a small climbing structure, thereby ensuring accessibility across a broad spectrum of physical abilities.

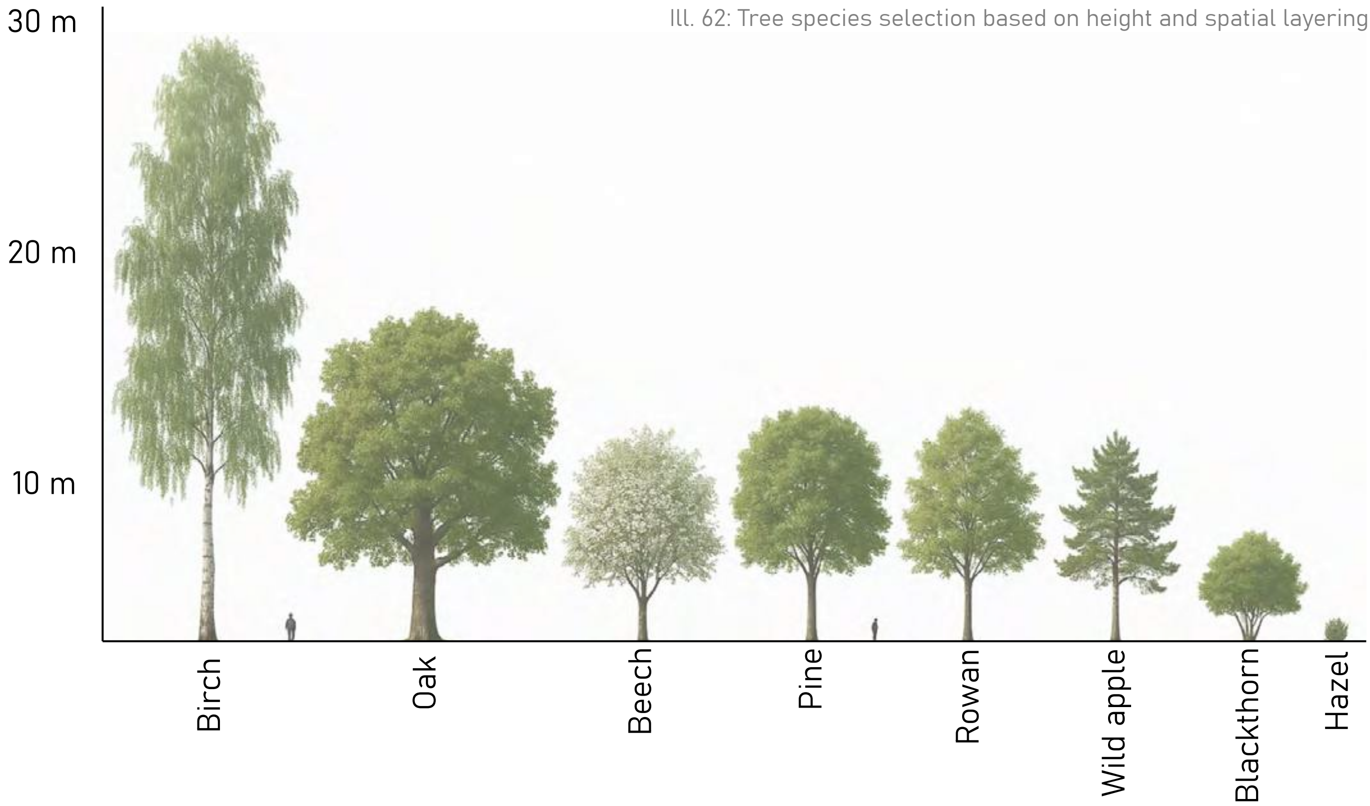
Additional elements such as musical instruments and a low-impact obstacle course extend laterally along the site.

Beyond the playground, the forest park transitions into a series of zones distinguished by the degree of vegetation control rather than topographical change (ill. 61). The inner zone features an orchard with fruit trees and berry bushes that function as a taste garden (ill. 63), – a continuation of the sensory garden concept.

Here, species have been selected to provide edible produce over an extended season with multiple cultivars of apples and pears planted to ensure staggered harvesting times.

The orchard thereby serves not only an educational and sensory purpose but also provides a familiar and comforting landscape motif.

Ill. 61: Axonometric diagram of forest park zones and pathways



Ill. 62: Tree species selection based on height and spatial layering

SENSORY GARDEN

A central element in the landscape strategy is the sensory garden, which is intentionally composed to engage the senses of sight, sound, smell, and touch. The sense of taste is accommodated in a separate area to avoid the risk of accidental ingestion of inedible plants – a safety consideration particularly relevant for younger children. The sensory garden provides a space for relaxation and shared experience, accessible to users of all ages and levels of mobility.

The design process began with the spatial organization of key elements such as a shallow water basin, seating areas, and large flowerbeds. The layout prioritizes both functional accessibility and multisensory stimulation. Particular care was taken to balance the intensity of sensory inputs: for instance, fragrant plants were deliberately distributed throughout the garden to avoid overconcentration in any one area.

A detailed study of appropriate plant species was conducted in accordance with local climate, soil conditions, and seasonal variation (table 63-67). These species were then strategically grouped into zones based on their sensory characteristics.

To support children's sensory development and emotional regulation, plant species were selected with careful consideration of their height, sensory accessibility, and age-appropriate appeal. Low-growing plants that can be seen, touched, or smelled at eye level for young children were prioritized, ensuring that sensory engagement is physically and cognitively accessible. This approach draws on principles from therapeutic landscape theory and child-centred design, where spatial familiarity and safe sensory discovery are known to enhance feelings of autonomy and well-being. (Moore & Cosco, 2010; Marcus & Sachs, 2013).

Sight is naturally stimulated across all beds through dynamic colour palettes and seasonal bloom cycles, which establish a visual rhythm throughout the year. This recurring sensory pattern not only enhances spatial interest but also fosters a sense of familiarity and predictability – qualities that are particularly important in creating a comforting environment for children.

ORCHARD MEADOW - PLANTING

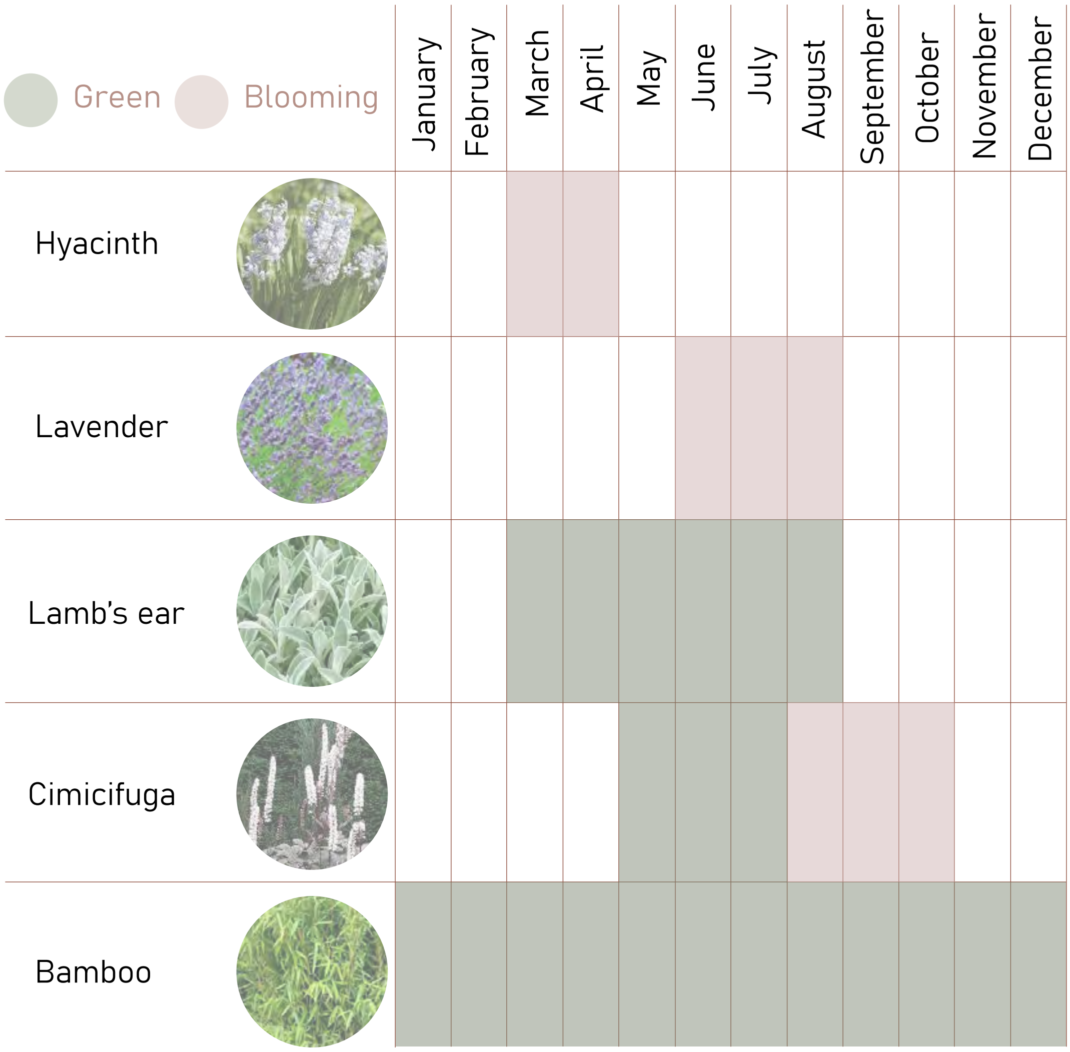
		January	February	March	April	May	June	July	August	September	October	November	December
Rhubarb					■	■	■		■	■	■		
Plum								■	■	■			
Blueberry								■	■	■			
Wild strawberry							■	■	■				
Pear									■	■	■	■	
Apple		■	■	■	■				■	■	■	■	■

ILL. 63: Orchiad medow

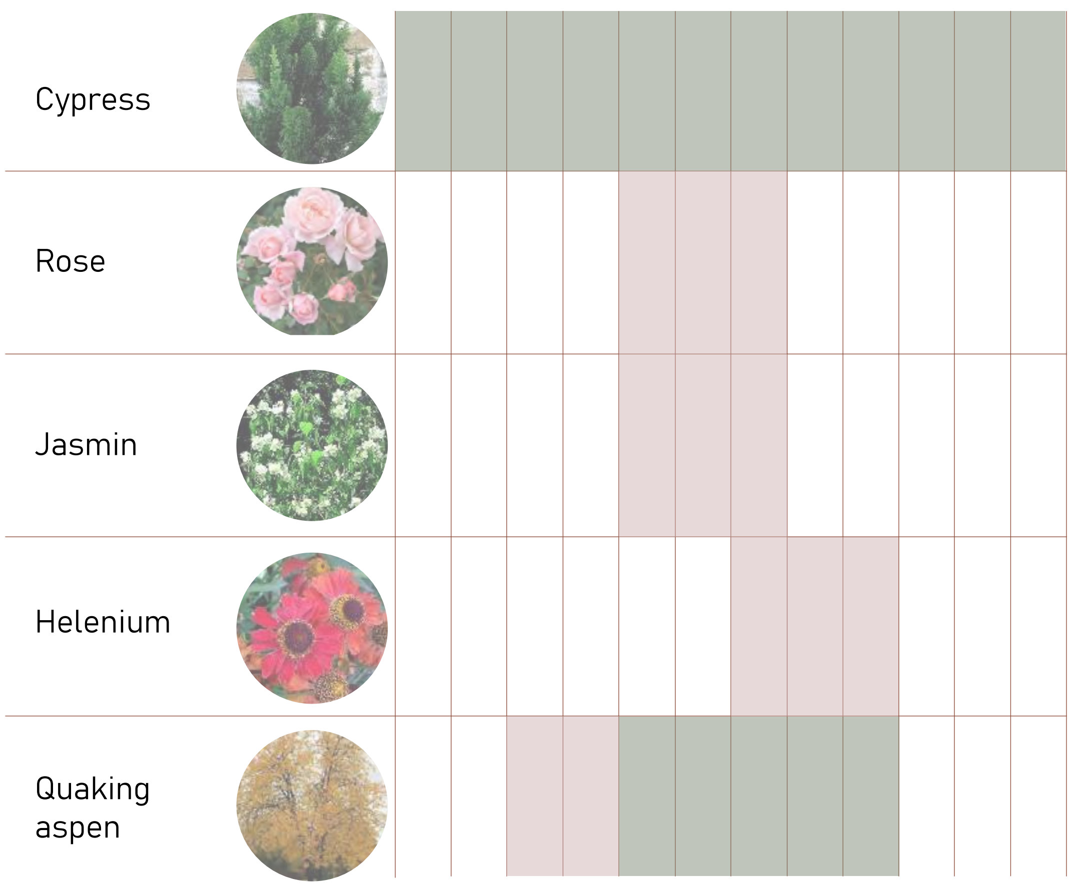
DESIGNING FOR THE SENSES

Scent	Hyacinth, lavender, jasmin, lilac, silk peony, elder, geranium
Touch	Lamb's ear, cypres, thuja
Sound	Bamboo, quaking aspen, hemp agrimony, cimicifuga
Sight	Rose, helenium, tulip, sct. John's wort, crocus, daffodill

SENSORY GARDEN - PLANTING



Ill. 64: Planting – Northwest Bed



Ill. 65: Planting – Northeast Bed

		January	February	March	April	May	June	July	August	September	October	November	December
Thuja													
Lilac													
Tulip													
Silk peony													
Hemp agrimony													

Ill. 66: Planting – East Bed

Elder													
Sct. John’s wort													
Crocus													
Daffodill													
Geranium													

Ill. 67: Planting – South Bed

INTEGRATING PLAY

While the outdoor landscape invites play through nature, movement, and sensory experiences, the interior architecture of the hospice has similarly been designed to nurture playful exploration. In this project, play is not treated as a separate program confined to specific rooms but rather as an integrated spatial principle present throughout the building. Recognising play as vital to children's emotional well-being, cognitive development, and sense of autonomy, the design embeds playful cues and interactive features directly into everyday spaces.

Particular focus was placed on the transitional corridors adjacent to patient rooms. Here, ceiling-mounted perforated panels were used to create shadow play, casting shifting patterns of light onto the floor throughout the day (ill. 68). This dynamic lighting not only enhances the atmosphere but also introduces subtle layers of sensory stimulation. Such visual storytelling invites children to notice, imagine, and move, enriching their experience of circulation spaces that are often overlooked in traditional healthcare architecture.

In more communal zones such as the reception and waiting areas, soft forms and organic motifs were used to establish a comforting yet engaging environment. The reception desk adopts a wavy silhouette and is paired with floating cloud-shaped ceiling elements to create a visually friendly and non-institutional first impression (ill. 69). This setup signals safety, warmth, and welcome to both children and their families, transforming administrative zones into spaces that also carry emotional and spatial meaning.

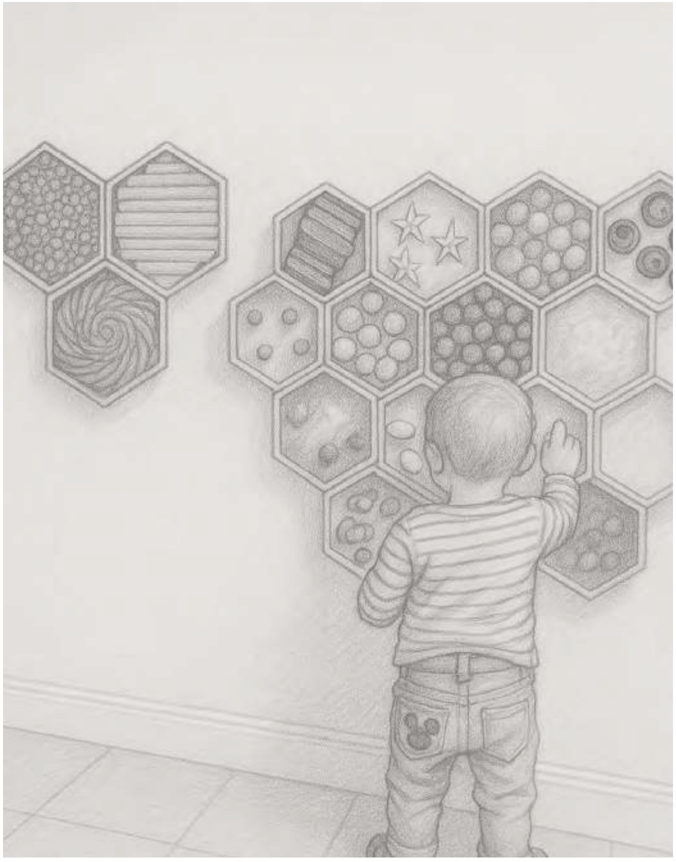
Beyond atmospheric elements, the integration of play extends to interactive wall installations placed along circulation routes and within shared gathering spaces. These wall-mounted panels are composed of natural and artificial textures - such as wood, metal, and fabric - and include tactile elements like spinning discs, movable inserts, and textured surfaces (ill. 70). Installed at child height, these features are designed to stimulate touch, encourage self-directed discovery, and offer moments of sensory engagement even during brief passages through the building.

In addition, play is embedded architecturally through the use of house-shaped wall cutouts and alcoves that invite children to crawl through or pause in imaginative ways (ill. 71). These interactive voids challenge conventional flat wall boundaries and turn static circulation areas into zones of exploration and expression. By incorporating such spatial gestures, the design fosters autonomy, curiosity, and joy in movement, making play an inherent quality of the architectural experience rather than an isolated event.

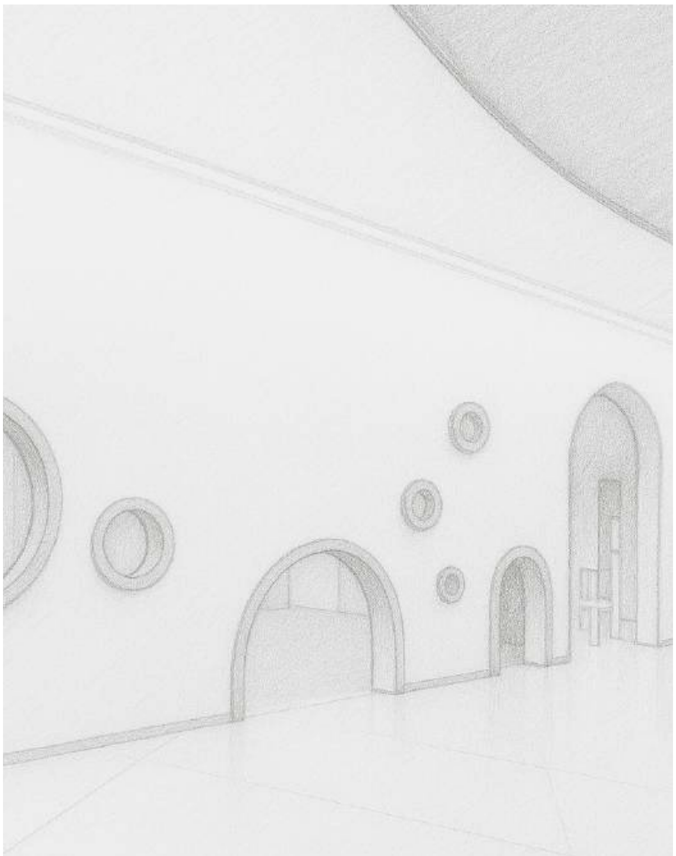
Together, these design strategies reflect a holistic understanding of play not just as entertainment, but as a therapeutic, developmental, and architectural tool that shapes the way children engage with space - particularly in a hospice setting where emotional resilience and everyday joy are central to care.

Ill. 68: Shadow play in corridor. Own conceptual sketch inspired by sensory design approaches in therapeutic architecture. Visual reference: Pinterest A.

Ill. 69: Reception with cloud lighting. Own conceptual sketch referencing atmospheric reception design in pediatric environments. Visual reference: Pinterest B.



Ill. 70: Playful wall panels. Own conceptual sketch inspired by tactile learning tools in therapeutic and educational environments. Visual reference: Pinterest C.



Ill. 71: Interactive wall cut. Own conceptual sketch referencing inclusive spatial play. Circular openings encourage imaginative movement, sensory engagement, and autonomy. Visual reference: Pinterest D.

STRUCTURAL SYSTEM

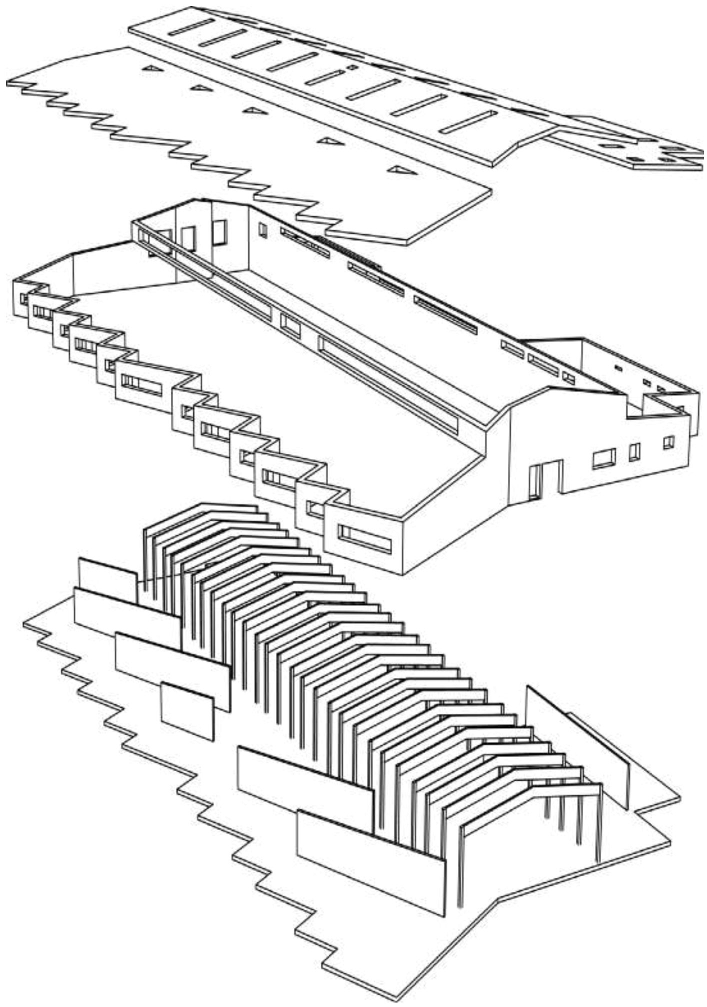
The structural system of Hjerterummet is based on a rhythmic repetition of glulam frames spanning across the width of the building, forming its distinctive gable roof profile. The frames are spaced approximately 2 m apart along the building's longitudinal axis, resulting in a total length of 67 m and a width of 14.5 m. Each frame consists of inclined and vertical columns, sloped roof beams (160×720 mm), and a horizontal ridge beam where the roof elements meet at the top.

The vertical glulam columns are dimensioned 240×240 mm. These dimensions are verified through structural calculations provided in Appendix 2. The 10° roof pitch ensures proper drainage while contributing to a light and balanced architectural expression. This geometry provides both visual calmness and structural clarity, reinforcing the overall identity of the building.

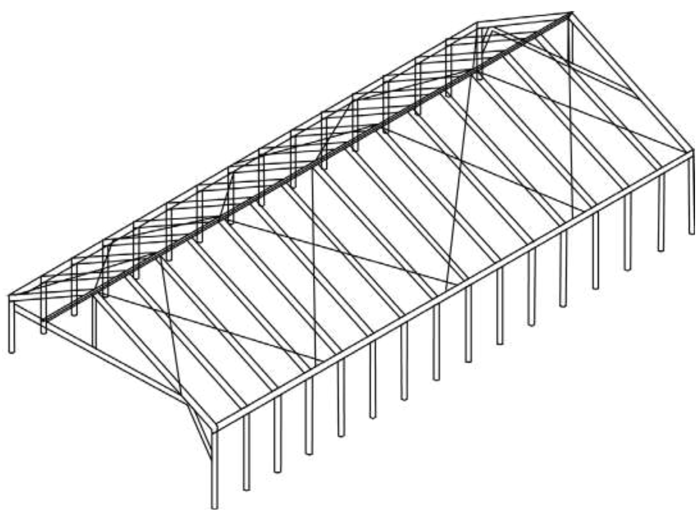
SPATIAL STABILITY AND BRACING

To ensure structural stability, the glulam frames serve not only as load-bearing components but also as bracing elements in the transverse direction. In the longitudinal direction, additional bracing is provided by diagonal steel tension rods (wind braces) placed in both end bays and in one central bay. These are fixed to the roof beams using prefabricated steel connectors, forming diagonal connections that stiffen the roof plane and transfer horizontal loads – mainly from wind – safely down through the structure to the foundation.

Since the roof is constructed with standing seam steel sheets (klikfals 275) and an underlying underlay membrane (Monier), the roof surface itself cannot act as a structural diaphragm. Therefore, the mechanical wind braces play a critical role in resisting lateral forces and maintaining the form and stability of the building over time.



Ill. 72: Structrual system



Ill. 73: Structural system heartroom

STRUCTURAL CONNECTIONS

All connections in the glulam frame system are carefully selected to support both structural logic and architectural expression. The three key joints are described below:

RIDGE CONNECTION

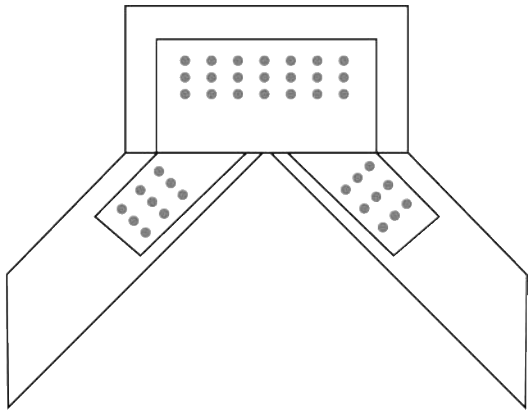
At the ridge, the sloped roof beams are connected to a horizontal ridge beam using a rigid, visible steel plate connection. This moment-resisting joint transfers both tensile and compressive forces, ensuring the stability of the gable roof. The visible detail was intentionally chosen to emphasize structural honesty and provide a clear architectural expression.

BEAM-TO-COLUMN CONNECTION

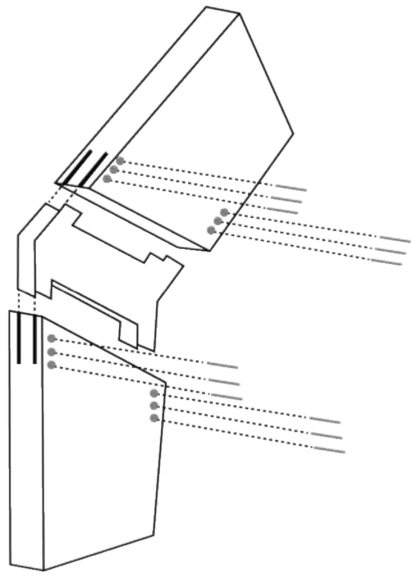
The joint between the sloped roof beam and vertical column is a concealed steel plate connection, recessed into both timber elements and bolted through. It provides a rigid, moment-transferring connection capable of handling both vertical and horizontal loads. Concealing the plate supports the warm, homely aesthetic - particularly important in a children's hospice.

COLUMN-TO-FLOOR CONNECTION

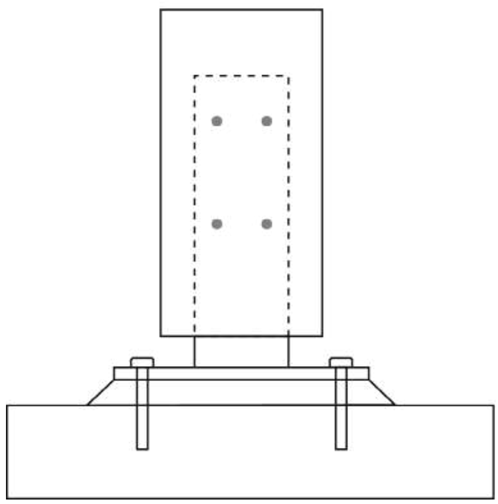
At the base of the columns, a hold-down connector (Rothoblaas WHT500) anchors the glulam posts to the solid beech floor. The connection resists uplift forces caused by wind and movement, while allowing rotation at the base - functioning as a pinned support. Since the subfloor is not concrete, a mechanical anchor ensures secure load transfer into the timber. The maximum uplift force is approx. 34.5 kN, while the WHT500 is rated for up to 70 kN.



Ill. 74: Ridge connection



Ill. 75: Beam-to-column connection



Ill. 76: Column-to-floor connection

BUILDING SAFETY & IMPACT

FIRE SAFETY

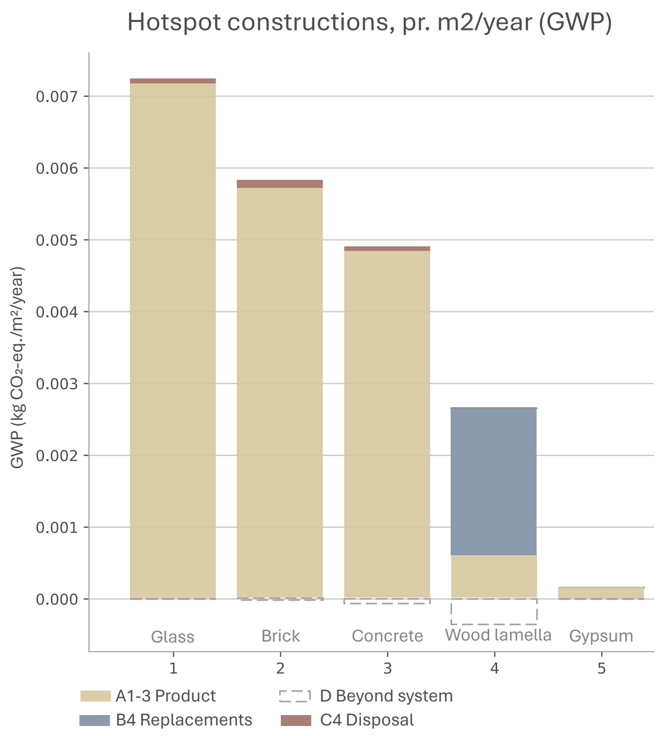
Fire safety was looked at more closely, as a hospice will inevitably have people who are unable to evacuate on their own. This required looking at chapter 5 about fire in BR18.

Depending on whether the building has a floor area of more or less than 1000 m2, how many stories there are and the functions of the rooms, the requirements are different. For instance, a one-story building with less than 1000 m^2 of sleeping area is not required to have emergency light if every living space and room has access to the outdoors. The most important requirement is that all escape routes are:

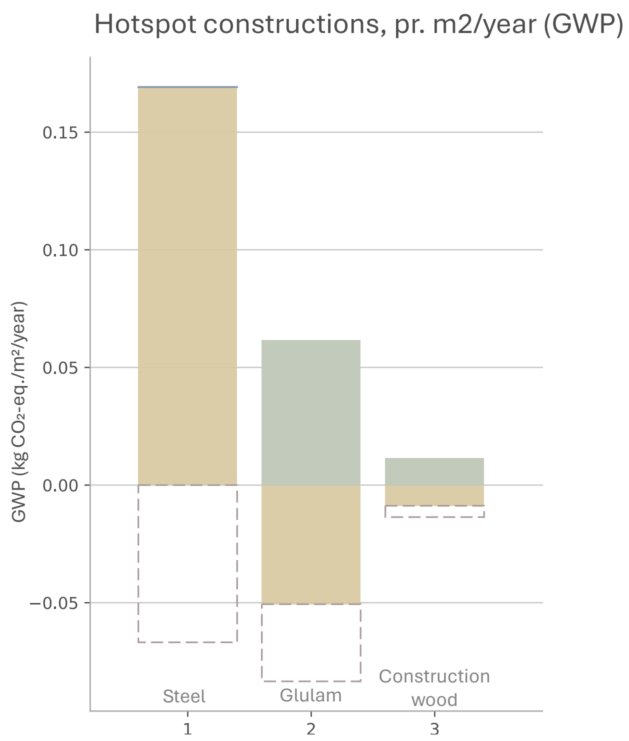
- Clearly marked
- Easy to access and use
- Clear in their entire width
- Leads to a safe outdoor area
- Do not cause any build-up of smoke or heat

(Bygningsreglementet 2018, chapter 5):

A study was conducted to determine the most suitable material for a potential fire break wall, considering options such as fire-retardant wood panels, concrete, and glass (ill 77). The results indicated that wood panels and gypsum board were the most favorable choices in terms of their Global Warming Potential (GWP). Despite the need for wood panels to be replaced every 30 years, they remain a preferable option due to their lower environmental impact compared to alternative materials.



Ill. 77: LCA for fire break wall



Ill. 78: LCA for the structure

FIRE AND MOISTURE PROTECTION

Timber was chosen as the main structural material for its combination of aesthetic qualities and structural performance. Glulam has a well-documented and consistent charring rate of approximately 0.7 mm/min, which allows for predictable behavior in the event of fire. Structural elements can be dimensioned to maintain their load-bearing capacity long enough to ensure safe evacuation and firefighting.

The structure is classified as Service Class 1, as it is located in a heated indoor environment and protected from any long-term moisture exposure. All joints and connectors are either concealed or well-protected from condensation and humidity, and column bases are lifted above floor level with ventilated detailing to ensure long-term durability.

MATERIAL SELECTION AND SUSTAINABILITY

Glulam was selected as the primary structural material due to its sustainable profile and warm visual appearance. As a renewable resource with low embodied energy compared to materials such as steel and concrete, timber significantly reduces the overall environmental footprint of the building.

Having decided, based on the LCA material study and theory, to build primarily with wood, the GWP of several types of wood were compared in LCA (table 78). This comparison did not consider where the wood is sourced from or the suitability – or lack thereof – for a given purpose such as exterior cladding or construction. Beech, for example, is common in Danish forests and is in the lower end for GWP during its lifetime but is not suitable for exterior cladding. Instead, its durability makes for excellent flooring, particularly if the floor is subject to much wear and tear (Vedsted-Jakobsen & Boding, 2023).

Oak, while very good from a GWP point of view, is quite expensive, which makes it less desirable as an exterior cladding due to economy (Vedsted-Jakobsen & Boding, 2023). Using it for the playground equipment, however, would make for a sturdy and long-lived playground.

Sibiran larch is preferable for cladding, despite the greater GWP from transport and production, and is an oft-used exterior in Denmark.

For the construction wood, in the walls at least, pine is chosen for the slightly better GWP and because of the proximity when sourcing it – as it is produced in Norway.

These reflections ensured that each timber type was matched to its most suitable application, balancing environmental, technical, and aesthetic requirements.

BUILDING ENVELOPE

Following the structural and safety evaluations, the construction layers were developed as an integrated part of the design process. Based on earlier LCA material studies, each assembly was tailored to support a low environmental impact while ensuring thermal comfort, fire protection, and structural reliability.

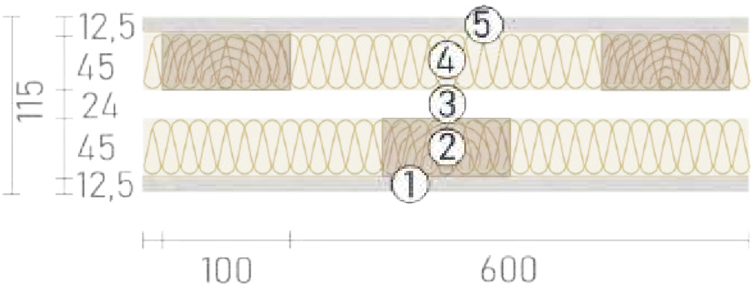
As described in the previous section, timber was selected for its sustainable profile and structural benefits. The initial focus was placed on the exterior wall, as this element plays a key role in both spatial expression and performance. Two alternative wall types – construction wood and CLT – were evaluated, with construction wood ultimately selected for its lower GWP and material honesty.

From here, the remaining constructions were designed to complement the chosen material palette. The roof follows a warm roof principle with mineral wool insulation and natural ventilation. The inner walls rely on lightweight acoustic partitions, while the terrain deck and basement walls combine aerated concrete and stone wool to handle soil contact, thermal requirements, and moisture protection.

By aligning the material build-ups with both structural needs and sustainability goals, the construction system reflects a coherent approach that prioritises climate-conscious choices without compromising on comfort, buildability, or safety.

INNER WALL CONSTRUCTION DETAIL

U-value = 0.46 W/m²K

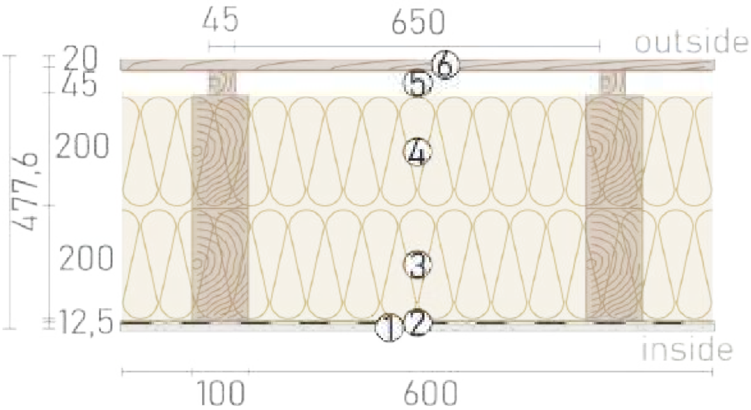


Ill. 79: Inner wall detail

① Gypsum board (12,5 mm)
② Rockwool, stone wool (45 mm)
③ Stationary air (24 mm)
④ Rockwool, stone wool (45 mm)
⑤ Gypsum board (12,5 mm)

OUTER WALL CONSTRUCTION DETAIL

U-value = 0.12 W/m²K

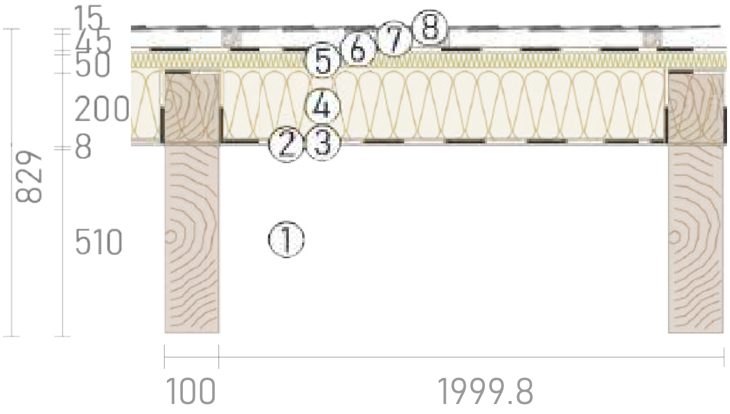


Ill. 80: Outer wall detail

① Gypsum board (12,5 mm)
② Dampfsperre
③ Rockwool, stone wool (200 mm)
④ Rockwool, stone wool (200 mm)
⑤ Stationary air (45 mm)
⑥ Larch (20 mm)

ROOF CONSTRUCTION DETAIL

U-value = 0.18 W/m²K

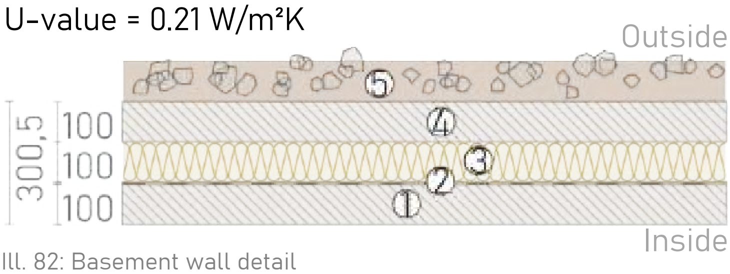


① Inside air (510 mm)
② Funderplan (8 mm)
③ Dampfsperre (0,1 mm)
④ Rockwool, stone wool (200 mm)
⑤ Rockwool, stone wool (50 mm)
⑥ Braas Divoroll Top RU
⑦ Stationary air (45 mm)
⑧ Roof slates (15 mm)

Ill. 81: Roof detail

BASEMENT WALL CONSTRUCTION DETAIL

U-value = 0.21 W/m²K

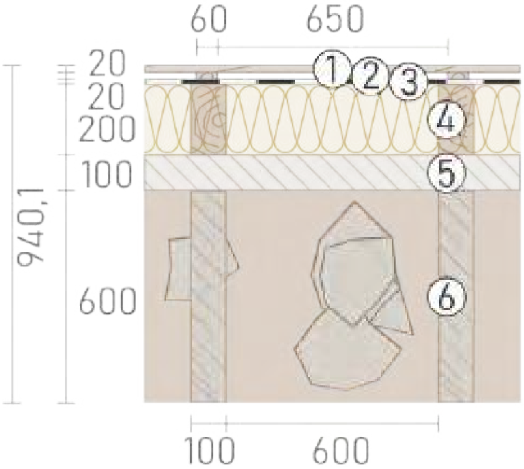


① aerated concrete 350kg/m3 (100 mm)
② Timbertex Dampfbremse
③ Rockwool, stone wool (100 mm)
④ aerated concrete 350kg/m3 (100 mm)
⑤ Soil

Ill. 82: Basement wall detail

TERRAIN DECK CONSTRUCTION DETAIL

U-value = 0.17 W/m²K



① Common beech (20 mm)
② Stationary air (20 mm)
③ Dampfsperre
④ Rockwool, stone wool (200 mm)
⑤ Aerated concrete 350kg/m3 (100 mm)
⑥ Soil

Ill. 83: Terrain deck detail

MATERIAL OVERVIEW - STRATEGY AND SPATIAL CHARACTER

STRUCTURAL FRAME

The load-bearing structure of the building is entirely made of Norwegian pine, a locally sourced and renewable softwood. It was selected for its strength, light color, and warm materiality, all of which support the project's ambition to create a homely and non-institutional atmosphere. In areas where the structure is left visible, the natural qualities of the timber contribute to the spatial identity and help establish a connection between function and form.

FACADE CLADDING

The building's facades are clad in vertical slats of untreated Siberian larch. This material was chosen for its natural durability and weather resistance, allowing it to age gracefully over time without the need for chemical treatments. As the larch gradually silvers, it allows the building to blend gently with the surrounding landscape, reinforcing a sense of humility and place. The cladding design emphasizes verticality and rhythm, and technical details such as gutters are hidden to maintain a clean, uninterrupted surface.

ROOF COMPOSITION

The roof surface consists of black standing seam steel sheets (Stehfalz) combined with a ZinCo sedum mat system. The steel ensures precision and resilience in a northern climate, while the green roof improves insulation, promotes biodiversity, and supports rainwater retention. Visually, the planted layer covers the hard metal surfaces and ties the building into its sloped terrain, making the roof feel like an extension of the landscape rather than a separate element.

INTERIOR FLOORING AND CEILINGS

Across all interior spaces, the floor is covered with beech wood in a herringbone pattern. The consistent use of this warm-toned hardwood creates a welcoming, domestic atmosphere and adds subtle rhythm to circulation paths. Above, the ceilings are clad with beech slats, chosen both for their acoustic properties and their contribution to a calm spatial character. The slatted design mirrors the verticality of the facade and helps guide the eye along the length of the spaces.

INTERIOR WALL FINISHES

The choice of wall materials varies according to function. In spaces requiring calm and sensory regulation - such as the family apartments, wellness room, sensory room, and soft play room - the walls are rendered in white-painted gypsum, providing a neutral backdrop with a soft finish. In more active or communal spaces such as the kitchen, offices, and shared zones, the walls are finished with vertical beech slats, offering texture, depth, and continuity with the flooring and ceilings. This approach allows the interior expression to shift gently between openness and retreat, depending on use and user needs.

Together, the selected materials support the architectural intent of creating a sustainable, tactile, and emotionally supportive environment for children, families, and caregivers.

Ill. 84: Exterior materials

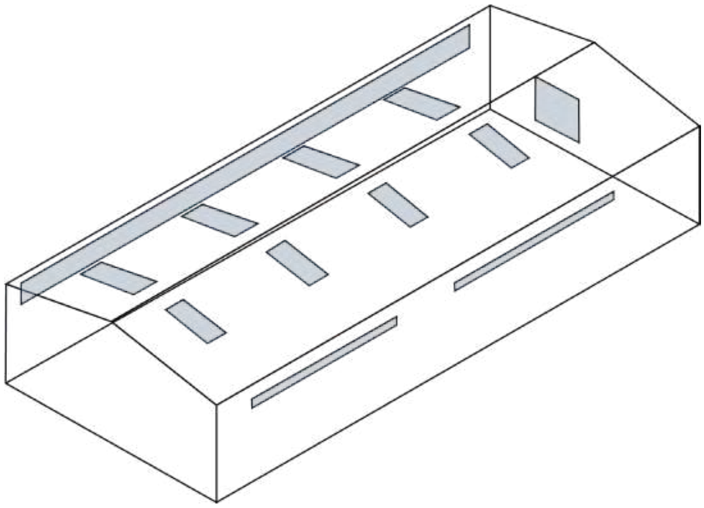
Ill. 85: Interior materials heartroom

Ill. 86: Interior materials family house

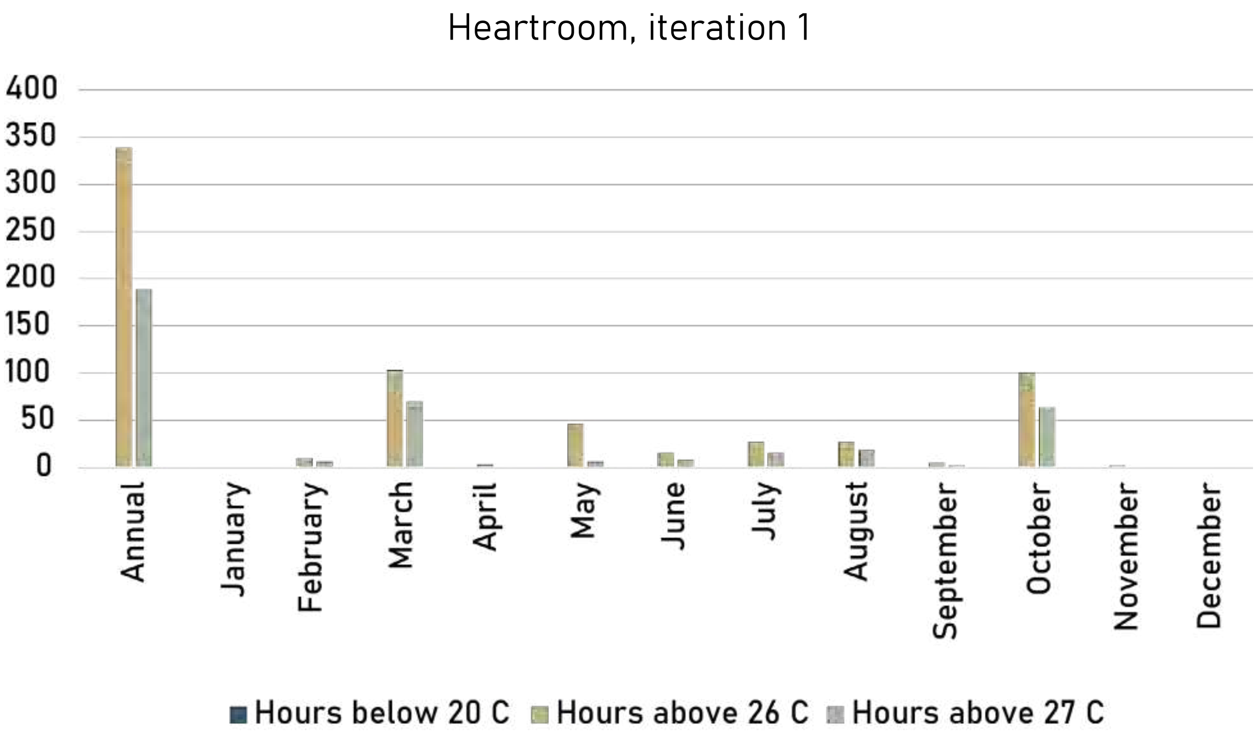
BUILDING PERFORMANCE ANALYSIS

THERMAL SIMULATION (BSIM) - HEARTROOM
As part of the iterative process, BSim simulations were conducted to evaluate and optimize the thermal conditions of the Heartroom. The first iteration had evenly placed skylights and facade windows, where south-facing were shorter and narrrowe than the noth-facing. The results revealed considerable overheating throughout the year, in particularly during the warmer months.

Notably, temperatures in the heartroom exceeded 26°C for over 300 hours annually, with a significant proportion surpassing 27°C, indicating a risk for thermal discomfort and poor passive performance.



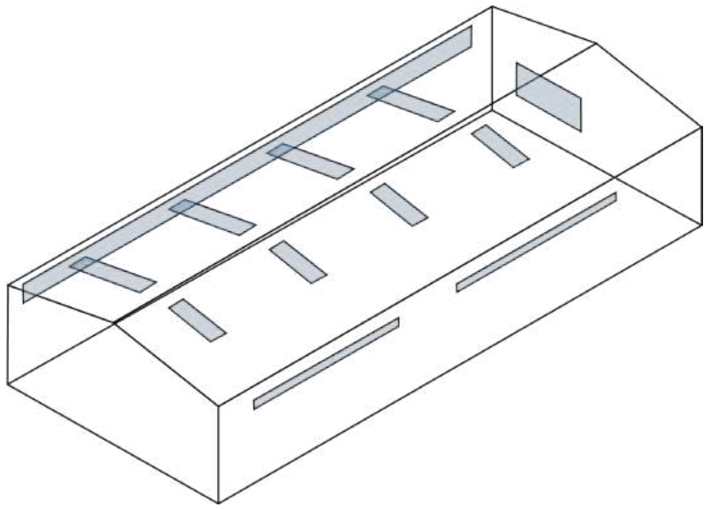
Ill. 87: Heartroom iteration 1



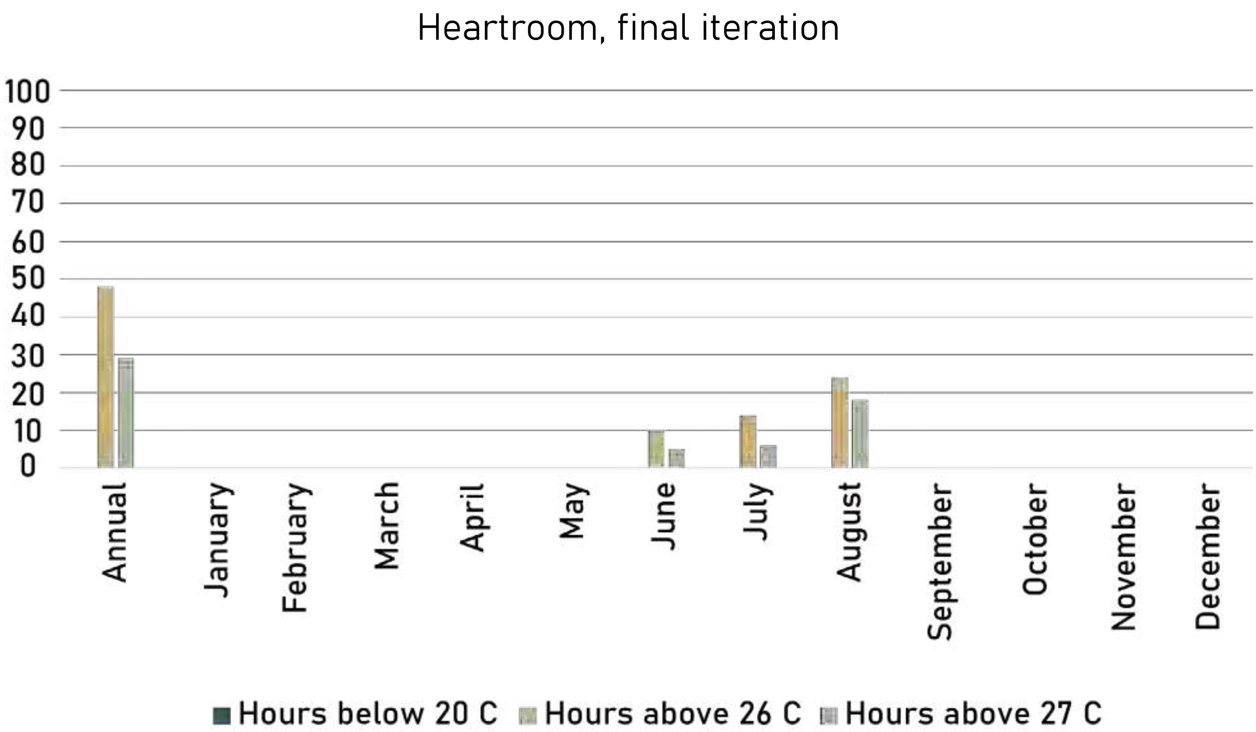
Ill. 88: Heartroom iteration 1 results

In the final iteration, all the skylights were narrowed to 1m with the north-facing lengthend as well. People load was altered to fit the projected conditions instead of having the 50 people constantly hanging round, while natural ventilation at night, light and solar shading were changed during the summer period to make more use of the day light and warm summer wind. This led to the annual overtemperatures dropping dramatically, showing how the implementation of passive means can significantly influence teh building performance and thermal comfort.

The BSim simulations provided a valuable feedback loop in the design phase, supporting evidence-based adjustments toward a more thermally balanced environment. This iterative approach helped align the spatial quality of the heartroom with both thermal performance goals and user comfort.



Ill. 89: Heartroom iteration 2

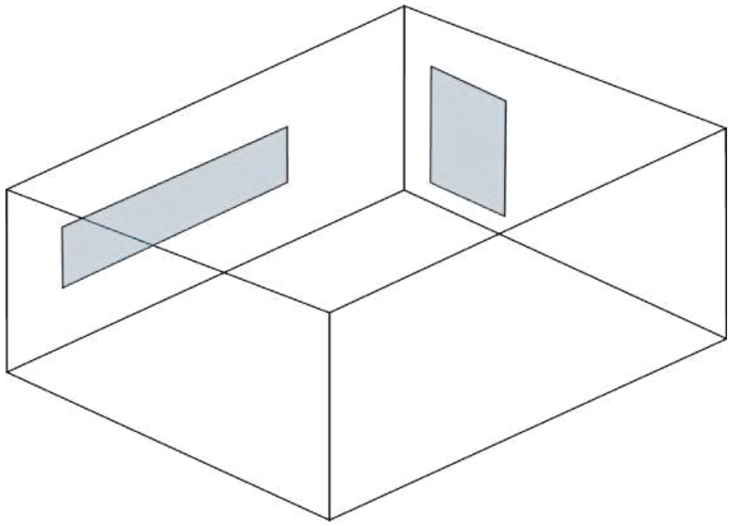


Ill. 90: Heartroom iteration 2 results

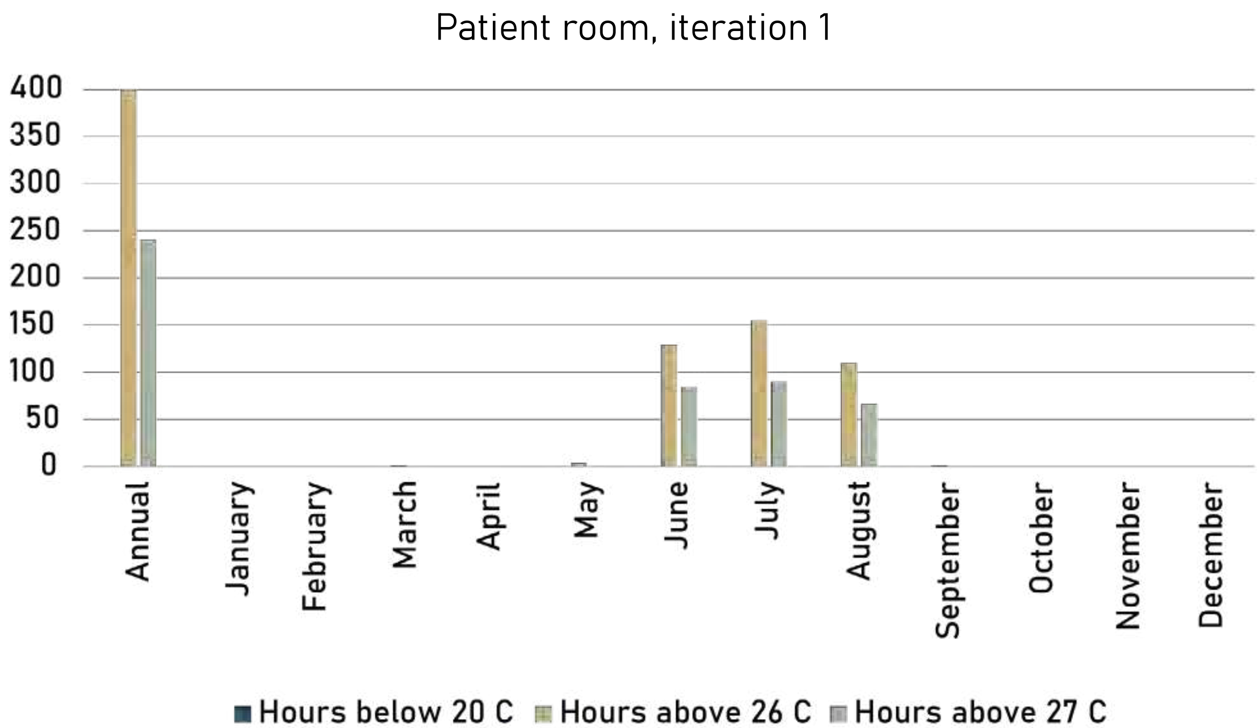
THERMAL SIMULATION (BSIM) - PATIENT ROOM

Several simulation were carried out to assess and iprove te thermal indoor environment of the patient room. In the first iteration, one glass door to the terrasse and a large facade windows was placed on adjacent facades. The simulation resulted in a large amount of time with overheating, particularly during the summer months.

Overall, the indoor temperature exceeded 26°C for nearly 400 hours annually, with over 200 of those hours above 27°C. Such conditions pose a risk to both thermal comfort and patient well-being, especially in a healthcare setting where vulnerable users may be more sensitive to heat stress.



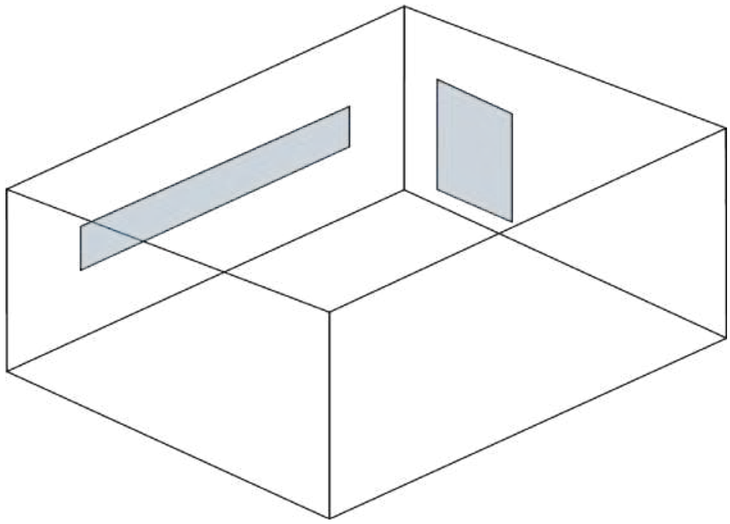
Ill. 91: Patient room iteration 1



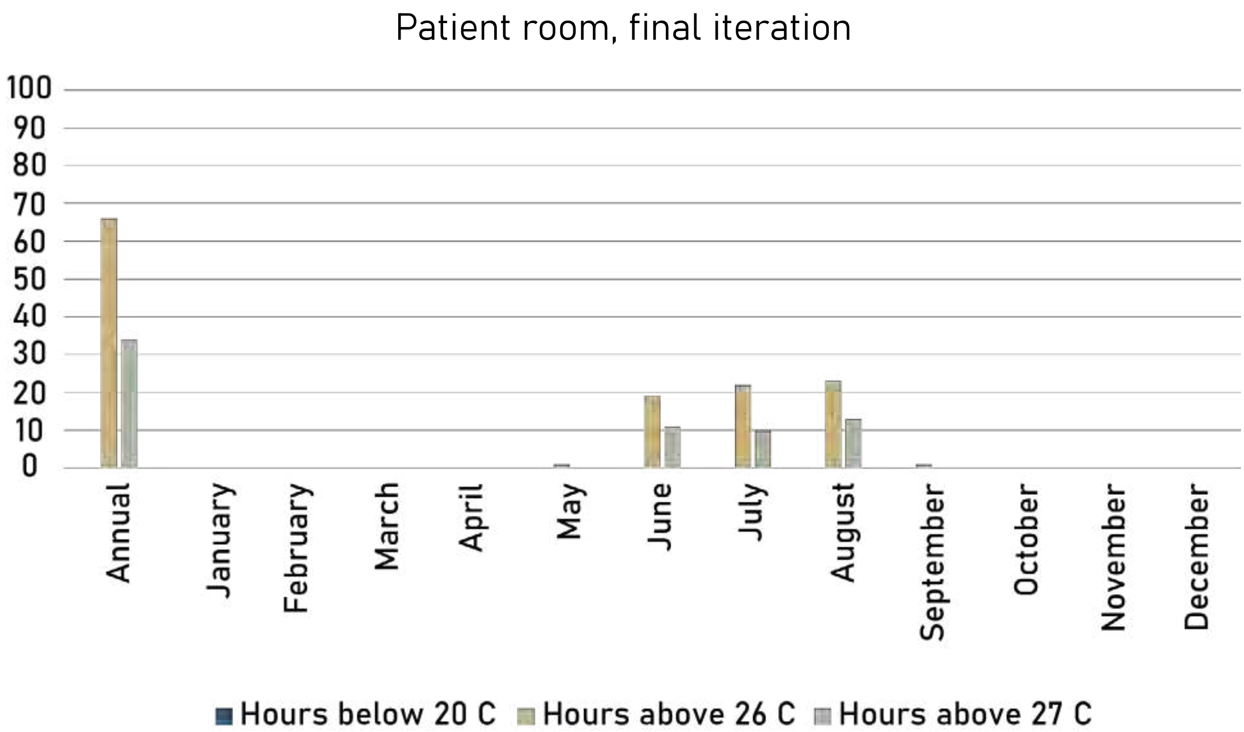
Ill. 92: Patient room iteration 1 results

In the final iteration, the facade window is narrowed, while natural ventilation is made possible during the nigths in summer. Additionally, the people load is changed to better fit the projected schedule and the light schedule is set to match. As a result, the overtemperatures decreased dramatically to 66 h above 26°C and 34 h above 27°C.

This simulation-based feedback confirmed the importance of facade design and glazing strategy in achieving thermal comfort. By optimizing window dimensions and orientation, the design evolution supported a healthier and more stable indoor environment for patients, while aligning with overall performance targets for the building.



Ill. 93: Patient room iteration 2



Ill. 94: Patient room iteration 2 results

DAYLIGHT ANALYSIS

Illustration 95 presents the results of a daylight analysis based on annual simulation data, illustrating the distribution of natural light within the building. The colour gradient reflects varying levels of daylight exposure, ranging from high exposure in areas that receive natural light for more than half the day, to low or no exposure in spaces that remain shaded throughout the day. These variations are directly influenced by the building's geometry, orientation, and facade configuration.

In the context of a children's hospice, access to daylight holds particular importance, as it contributes positively to the psychological well-being, circadian regulation, and overall comfort of both patients and staff. Ensuring that frequently occupied spaces receive sufficient daylight supports the design intent of creating a therapeutic, homely, and dignified environment. Areas with limited daylight availability may require careful integration of artificial lighting to maintain a sense of brightness and spatial quality. The daylight strategy thus plays a key role in supporting both functional performance and the emotional atmosphere of the hospice.

WINDOWS

All windows and glass doors consist of 70% 3-layer-glass and 30% wooden frame. As the focus is on ensuring daylight in rooms intended for longer stays by having at least 15% glass compared to the floor area, the final percentage for relevant rooms is calculated.

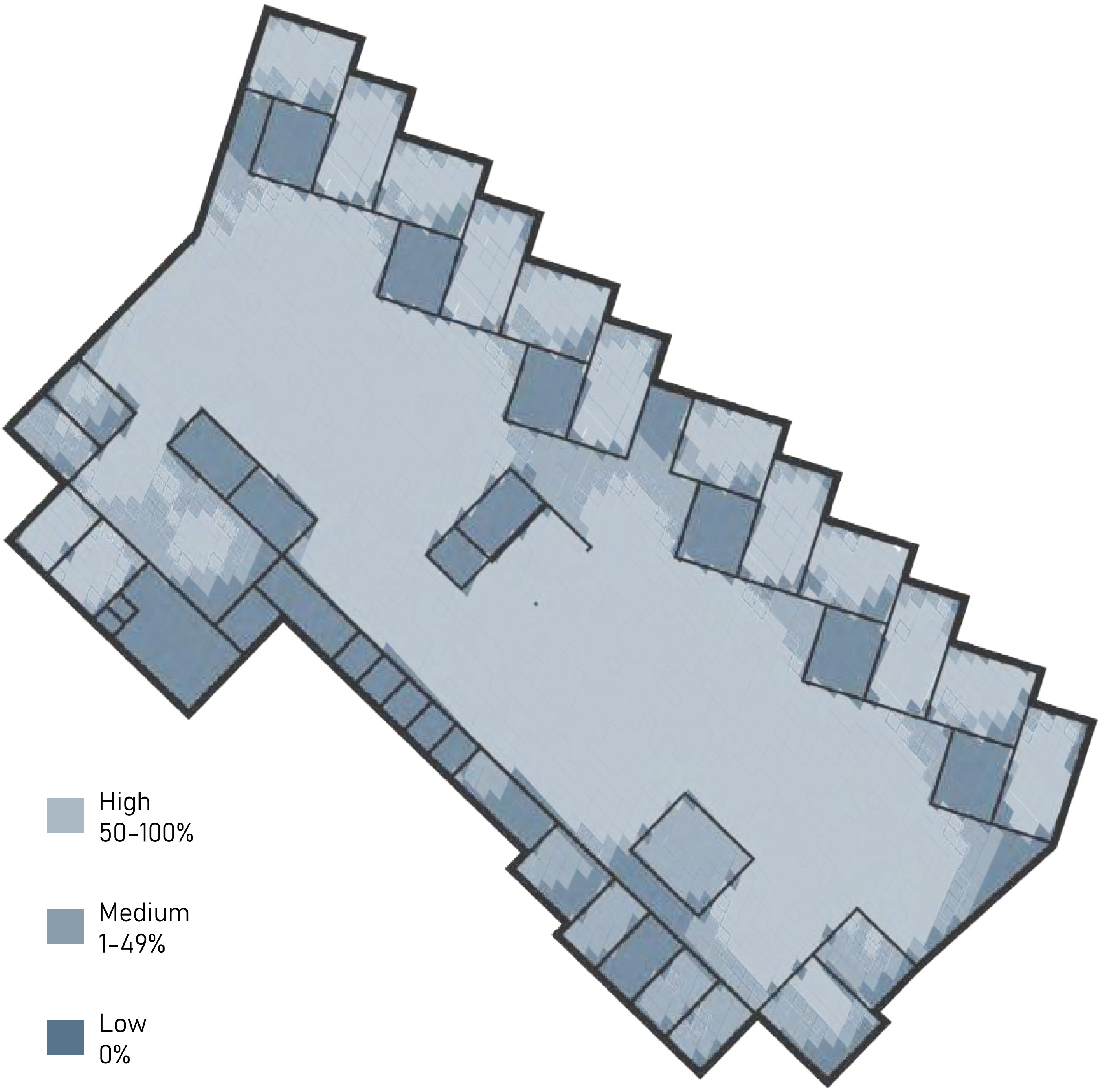
The patient room is thought to be in use most of the day and has an area of 30 m². There is 3,76 m² wall windows and a 2,73 m2 glass door. This means that the final result is 21,63% window to floor area.

The family room is considered less used, as the family is likely to spend more time either with the child or engaged in other activities. It is, however, still used quite a bit. The floor area is 32 m² with an area of 3,49 m² wall window and a 1,4 m² skylight. This makes the window to floor area 15%.

The Heartroom is designed as the main social space of the project with an area of 470 m² and has multiple skylights with a total area of 32,6 m² as well as 47,8 m² wall windows. As a result, the percentage is 17%.

The private offices are in use during work hours, and each have an area of 15 m². Both have a 1 m² skylight and a window of 1,3 m². One of the offices has a second window with an area of 0,7 m². For the private office with the smallest area, this results in 15,3% windows to floor area.

During work hours, it is assumed that there will always be someone in the open office. It has an area of 81 m² with two small windows totaling 0,53 m² and three skylights totaling 7,6 m². Resulting in a window to floor area of 10%.



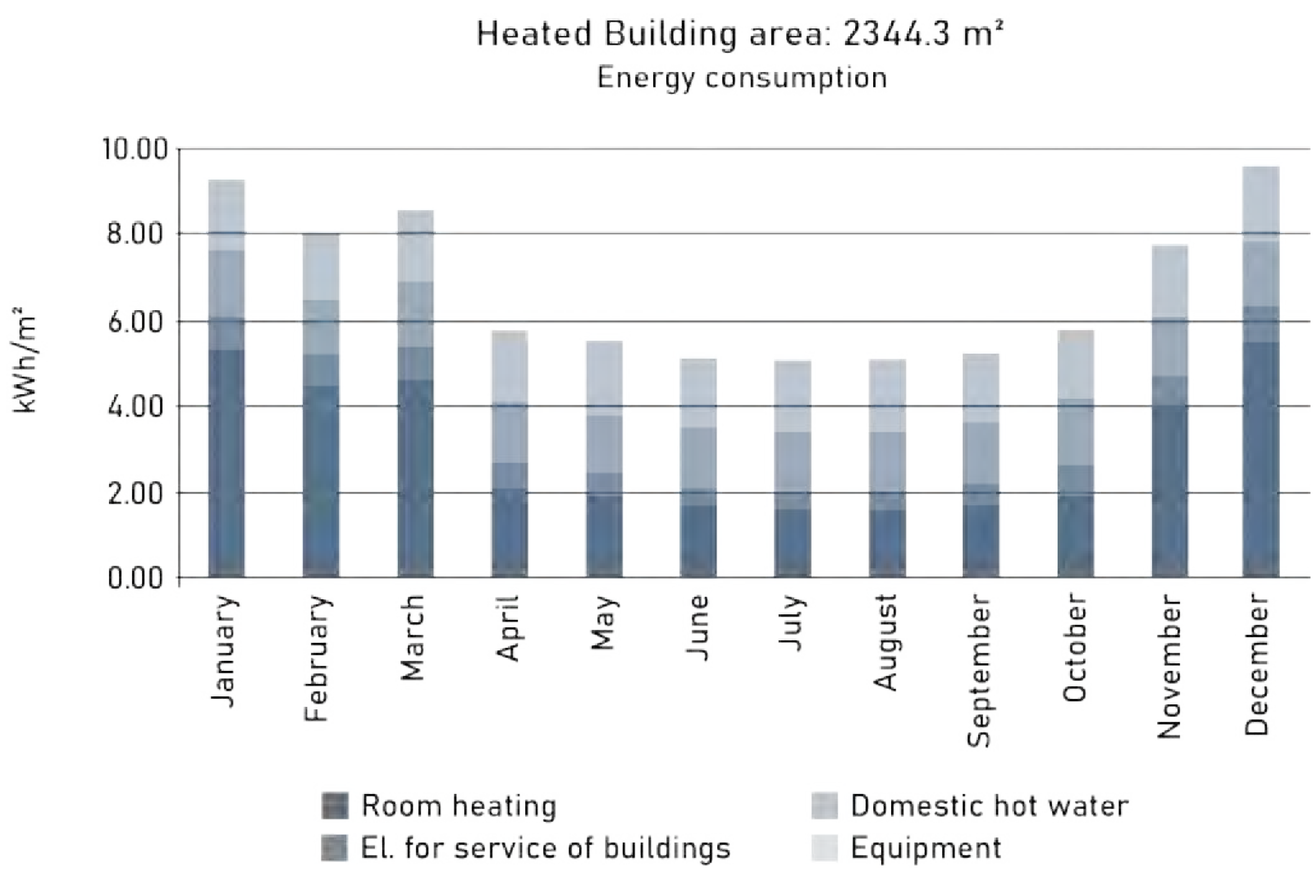
Ill. 95: Dayligt analysis

ENERGY PERFORMANCE (BE18)

To evaluate the energy performance of the children's hospice, Be18 simulations were conducted iteratively to optimize the building's envelope and technical systems. The final calculation shows an annual energy consumption of approximately 7.5-9.5 kWh/m² per month during winter periods, with a significantly lower demand during summer (see ill. 96). The monthly energy use includes contributions from room heating, hot water, equipment, and electricity for building services, calculated relative to the total heated area of 2.344,3 m².

Be18 simulatins were carried out during the design process and are documented in appendix 4. The first iteration had an energy demand of 64,8 kWh/m²/year, which did not meat the requirement for a new building.
To rectify this, the internal heat supply was refined for the zones: Heartroom, residential, therapy and office and the domestic hot water was set to district heating instead of electricity. When that proved insufficient, a heat pump has added to provide heating and hot water, resulting in a final energy demand of 23,3 kWh/m²/year.

The simulation results confirm that the building is designed to deliver a high level of thermal comfort while minimizing energy consumption. Efficient lighting, the absence of mechanical cooling, and careful consideration of heating demand all contribute to a reduced environmental footprint.



ILL. 96: Be18 results

ACOUSTIC PERFORMANCE

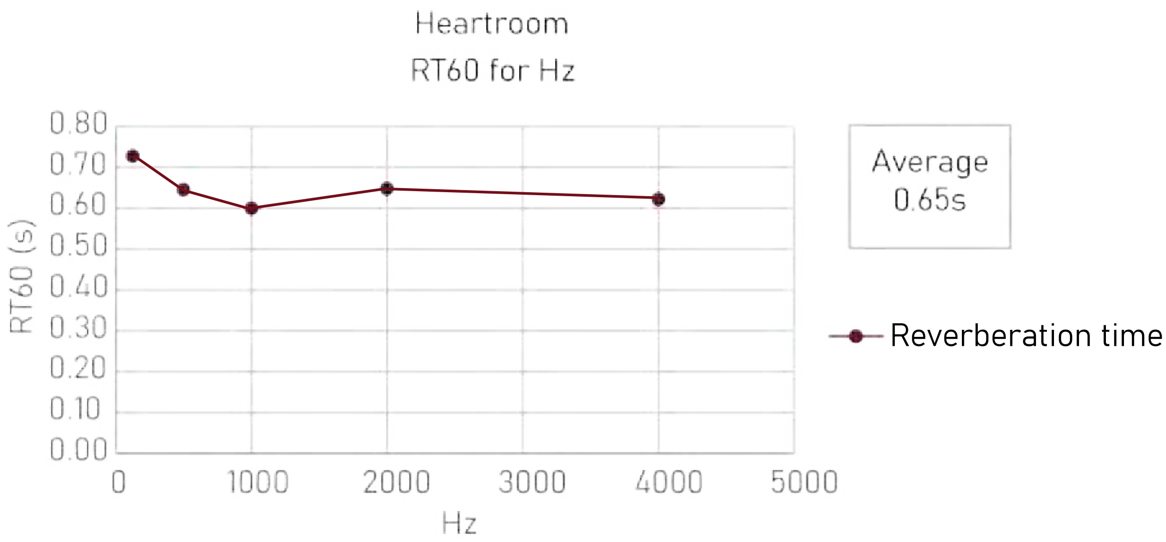
To ensure a comfortable acoustic environment for everyone in Hospice Hjerterummet, the construction of the inner walls includes an airgap between two layers of insulation with separate wood structures (ill. 79). By building it like that, the sound has to travel through several different layers of material to reach the next room, instead of having a more direct connection through the construction wood.

Other than the construction itself, the surface materials were also considered and chosen with care to achieve a reverberation time of no more than 0,6 seconds. To calculate this Sabine's Law $RT60 = 0{,}161 * V/A$ was used on the Heartroom and the residential rooms, as they will see the most frequent use.

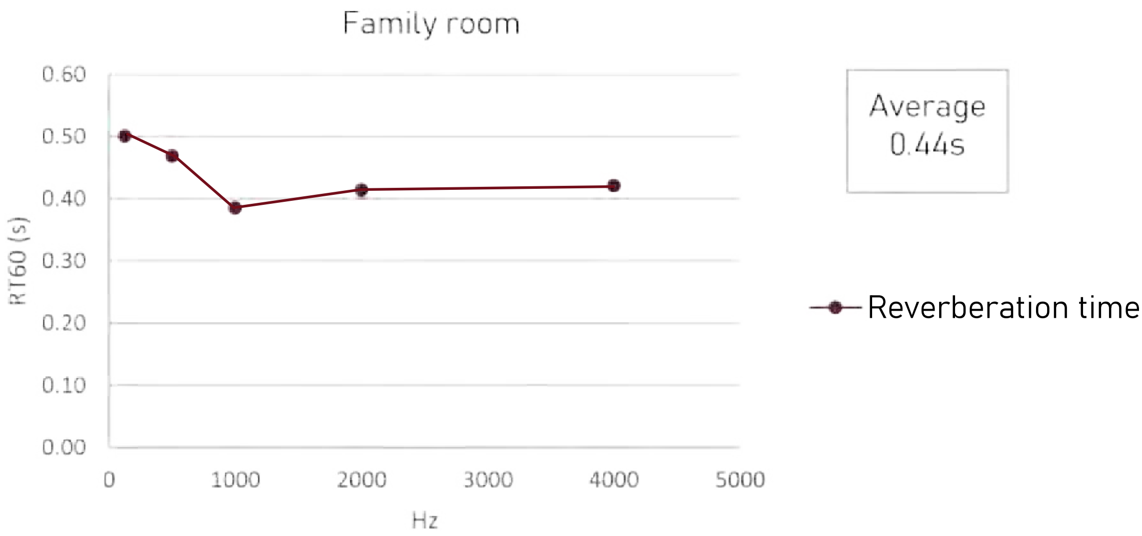
As the desired aesthetic was wood, sound-absorbing wood lamella was the first choice for an interior cladding. Different brands were researched to get an idea of the absorption coefficients for 125 Hz, 500 Hz, 1000 Hz, 2000 Hz and 4000 Hz.

Additionally, the coefficients for wood flooring, glulaminated wood, doors and windows were found. The Rhino model was utilized to find the volume of the rooms and surface areas of the various materials (see app. 6).

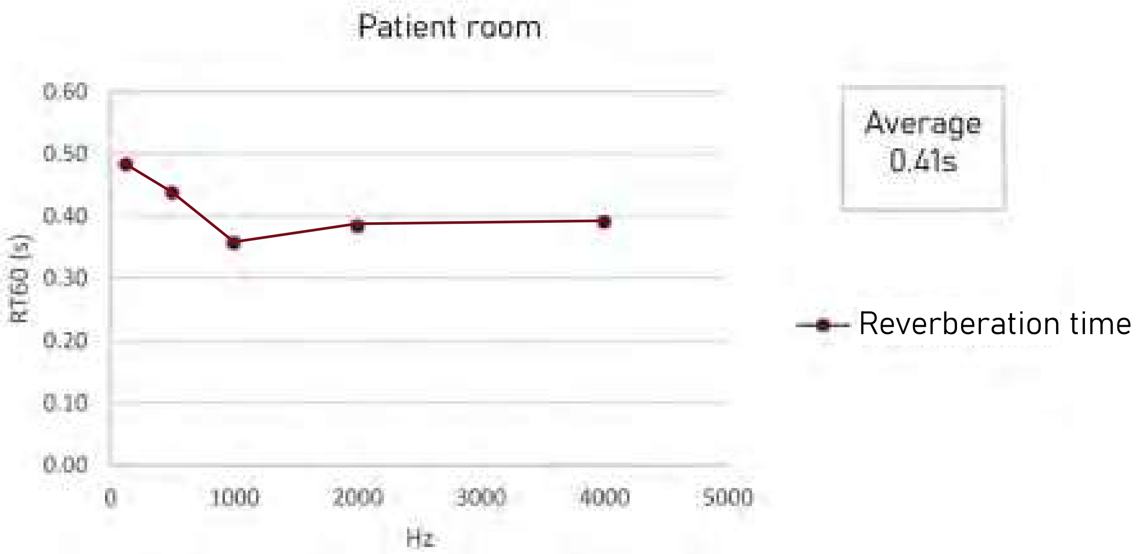
With the volumes being; 2660 m^3 for the Heartroom, 75 m^3 for the patient room and 86.4 m^3 for the family room, the calculated reverberation times are shown in illustration xx-xx. With only the average for the Heartroom being more than 0,6 s. However, as Sabine's Law does not consider furniture, this is still acceptable.



Ill. 97: Reverberation time- Heartroom



Ill. 98: Reverberation time- Family room



Ill. 99: Reverberation time- Patient room

VENTILATION

VENTILATION REQUIREMENTS

The minimum required ventilation according to BR18 is 0,3 l/s per m². By looking at the room program the added CO_2 from people breathing can be calculated as:

$$q_{people} = 0{,}04 \cdot people \cdot \frac{10\frac{l}{min} \cdot 60\frac{min}{h}}{1000\frac{l}{m^3}}$$

The 0,04 represents the percentage of CO_2 in each breath and the 10 l/min are the lung ventilation.

The necessary air flow rate due to pollution can now be calculated as:

$$n = \frac{q_{people}}{V \cdot (900\,ppm - 400\,ppm)}$$

To be able to compare the resulting air flow rate, it is calculated in l/s, for the specific rooms using the formula:

$$q_{v,u,people} = n \cdot V \cdot \frac{1000\,l}{1\,m^3} \cdot \frac{1\,h}{3600\,s}$$

Another option is to consider the heat load in each room and calculate the minimum ventilation to handle that. For this, 10 l/s is removed per person and 0,1 l/s pr watt for lighting – the assumption for lighting is 2 W/m. As a result, the air flow rate is calculated as:

$$q_{heat\ load} = persons \cdot 10\frac{l}{s} per\ person + 2\frac{W}{m} \cdot area \cdot 0{,}1\frac{l}{s}\ pr\ W$$

As seen in diagram xx, the heat load requires a higher air flow rate than the CO_2 pollution form people and will therefore be the air flow rate used for the dimensioning of the ventilation systems.

VENTILATION PRINCIPLE

Mixed ventilation is chosen for most of the building, so that the rooms can be utilized fully rather than having a zone along the walls unsuitable for staying in and to ensure a uniform air quality in the rooms.

Mixed ventilation works by supplying outdoor air with a high velocity, thereby mixing it with the room air. This typically happens near the ceiling and does not take up any floor space, which makes it suitable for smaller rooms and rooms without a high ceiling. As supply and exhaust are both positioned near the ceiling, it is important to carefully plan the distance between them, so the exhausts don't immediately suck out the outdoor air from the supply.

The only room, where this principle is not used in this project, is the Heartroom and consequently the common kitchen and dining space.

DIMENSIONING OF DIFFUSERS

As seen in illustration 100, the air flow rates for rooms with mixed ventilation vary from 14 l/s to 72 l/s, making it necessary to evaluate if one of two units are most suited for each room.

The air throw of the units is calculated based on the formula:

$$0{,}75 \cdot \left(\frac{A}{2} + C\right) \leq l_{02} \leq \frac{A}{2} + C$$

The Danish Building Regulations specify that noise from the ventilation cannot exceed 30 dB in furnished living spaces (Bygningsreglementet 2018, chapter 17).

Based on the two demands, supply and exhaust units can now be found using LindQST.

Room	Volume	Occupant load	Air flow	Air throw	Number of units	Type
Common facilities						
Heartroom	2428.75 m³	50	754.02 l/s	1.5-2.0m	9	Displacement
Kitchen and dining	2428.75 m³	50	754.02 l/s	1.5-2.0m	9	Displacement
Cleaning room	37.5 m³	2	27.75 l/s	1.5-2.0m	2	Displacement
Storage room	45 m³	3	42.39 l/s	1.5-2.0m	2	Displacement
Multifaith room	150 m³	6	84.77 l/s	1.5-2.0m	4	Displacement
Respite room	45 m³	3	42.39 l/s	1.5-2.0m	2	Displacement
Handicap toilet	12.5 m³	2	23 l/s	1.5-2.0m	1	Mixed
Laundry room	51.75 m³	3	37.14 l/s	3.1-4.2m	1	Mixed
Residental						
Patient room	75 m³	6	72 l/s	1.7-2.2m	2	Mixed
Family room	80 m³	6	72.40 l/s	2.0-2.7m	2	Mixed
Handicap bathroom	50 m³	6	70 l/s	1.5-2.0m	2	Mixed
Treatment						
Music therapy room	77.5 m³	6	84.97 l/s	1.5-2.0m	4	Displacement
Sensory room	37.5 m³	3	36 l/s	2.4-3.2m	1	Mixed
Wellness room	52 m³	4	56.68 l/s	1.5-2.0m	2	Displacement
Physio therapy room	37.5 m³	3	36 l/s	2.4-3.2m	1	Mixed
Therapy room	37.5 m³	3	36 l/s	2.4-3.2m	1	Mixed
Soft play room	50 m³	4	48 l/s	1.5-2.0m	2	Mixed
Staff						
Open office	204.6 m³	8	104.37 l/s	3.0-4.0m	2	Mixed
Private office	37.5 m³	3	36 l/s	2.4-3.2m	1	Mixed
Archive and copy	21.8 m³	2	23.75 l/s	1.8-2.5m	1	Mixed
Toilet	8.25 m³	1	11.66 l/s	1.4-1.8m	1	Mixed
Locker room	106 m³	5	63.50 l/s	2.1-5.0m	2	Mixed
Medicine room	37.5 m³	1	14 l/s	2.4-3.2m	1	Mixed
Meeting room	30 m³	6	69 l/s	1.5-2.0m	2	Mixed
Break room	50 m³	5	59 l/s	1.5-2.0m	2	Mixed
Technical room	460 m³	5	91.80 l/s	2.5-3.4m	3	Mixed

Ill. 100: Ventilation table - key values

DIMENSIONING AND PLACEMENT OF DUCTS

Using the nomogram of pressure loss in ducts of galvanized steel and the recommended velocities from the 6th semester mini project on indoor climate (Pomianowski, 2022), the dimensions for the ducts are calculated.

There are two main ducts for mixed ventilation (see ill. 101), both have an air velocity of 4-6 m/s. The main for the residential units has a volume of 4500 m^3/h and the other has a volume of 3000 m^3/h. Making the diameter of the ducts 620 mm and 520 mm.

The duct system for the residential units has three ducts that handle different volumes; one with 260 m^3/h for the first patient room, six with 260 m^3/h that leads to the bathrooms and six with 130 m^3/h for a single unit in the family rooms. All have a velocity of 2-4 m/s. The diameters become 220 mm and 150 mm.

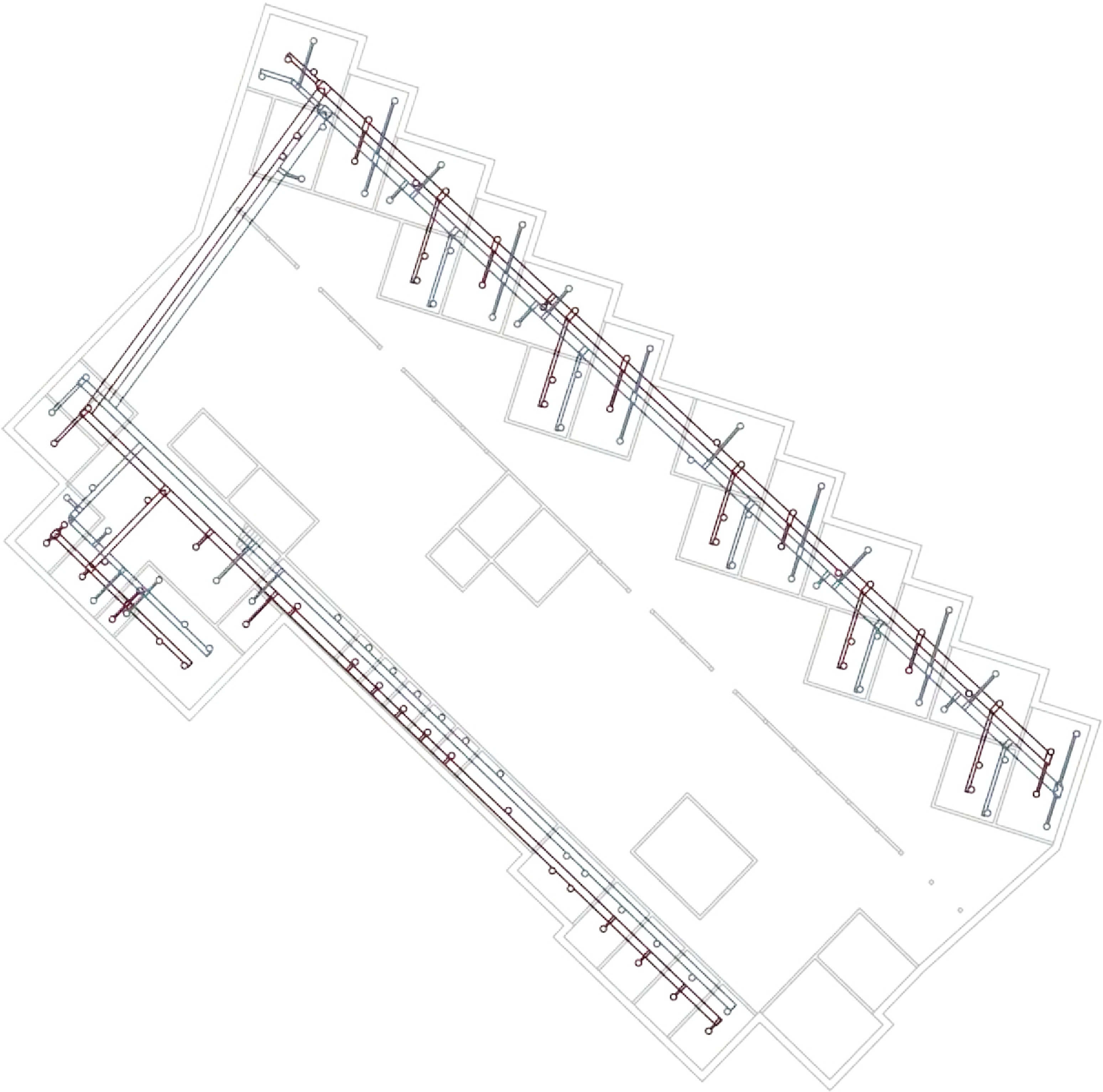
For the office duct, some have the same volume as previously calculated ducts, while others have new volumes. One has a volume of 900 m^3/h and one with 80 m^3/h. The diameter of the ducts are set to 400 mm and 120 mm (see app. 5).

PRINCIPLE FOR THE HEARTROOM

The Heartroom, a large space with a high ceiling for socialization, is the center of the project. The skylights letting daylight in from above and the visible glulam beams create a striking frame for activities and allow several trees to grow indoors, making nature accessible even in the cold winter months for the children. This is the vision for the Heartroom, as such, the ventilation should be without exposed ducts and fans to avoid visual clutter.

Displacement ventilation, which allows for wall diffusers, is therefore chosen. Though it is not suitable for heating the space and supply units cannot be too close to apparatuses like radiators, this is not an issue, as the building was already projected to have floor heating. Additionally, seating and gathering spaces must be planned with a distance from the walls due to the near-zone of the supply units.

This type of ventilation relies on thermal conditions to work, as air colder than the room temperature is supplied with a low speed around floor height. The cooler air is heavier than the room air and will slowly drift towards the warmer areas – such as where humans are congregated – while the heated air is lifted towards the ceiling, where the exhausts remove it. (Lindab, 2021).



Ill. 101: Mixed ventilation - 1:350

DIMENSIONING AND PLACEMENT OF UNITS

In the Heartroom there are twelve supply units along the floor hidden in the walls, six on each long side of the room. The same applies to the kitchen and dining area. While the rest of the high-ceiling rooms have either four or two units depending on their size.

To find the air flow necessary to handle the heat load with displacement ventilation, the method presented in Lindab Air Theory is used. Using the minimum air flow from the heat load calculation results in too great a temperature gradient, as the people are assumed to be sitting most of the time – given an allowable gradient of 2 K, as per the table in Lindab Air Theory – and so the minimum air flow for this gradient is calculated. The calculated results are shown in illustration 99.. The exhaust units are placed in the uppermost parts of the walls above the supply units.

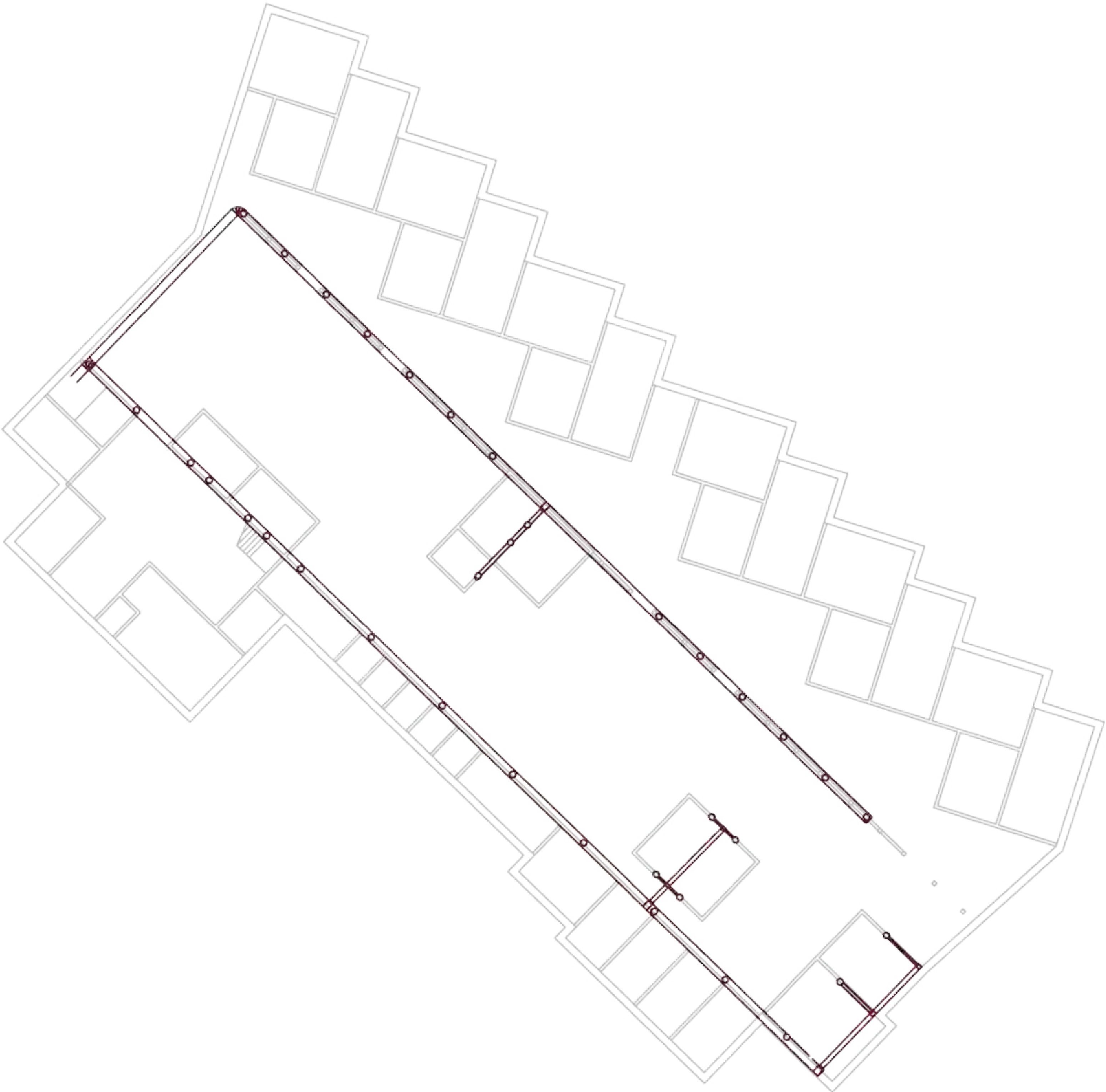
DIMENSIONING AND PLACEMENT OF DUCTS

The total volume of air in the duct systems is 6600 m^3/h dived between two main ducts that run along each side of the Heartroom (see ill. 102). These ducts have a diameter of 560 mm, when using the nomogram.

One side has a smaller duct supplying the Multifaith room and another supplying two high-ceiling treatment rooms. Multifaith has a volume of 300 m^3/h and treatments 500 m^3/h, which results in a diameter of 260 mm and 300 mm.

The Multifaith duct is further split into two, making the volume for each 150 m^3/h, giving a diameter of 165 mm. The treatments duct is likewise split into one with a volume of 100 m^3/h and one with 260 m^3/h. Making the diameters 130 mm and 220 mm.

Lastly, are the ducts connected to the supply units, which have the volumes; 60 m^3/h, 30 m^3/h, 20 m^3/h and 14 m^3/h. Resulting in duct with the diameters of; 105 mm and 80 mm for the rest (as the nomogram does not specify numerical values below that). (see app. 5).



Ill. 102: Displacement ventilation - 1:350

CHAPTER 06

PRESENTATION

Chapter 6 presents the final design proposal for Hospice Hjerterummet, a children's hospice located in Gistrup, Aalborg East.

Ill. 103: Master plan 1:2000

The location of the children's hospice has been carefully selected with a focus on proximity to nature, healthcare facilities and supermarkets. Hospice Hjerterummet is located as a quiet and protected oasis on the edge of the hilly terrain north of Aalborg University Hospital. Here there is distance from the busy hospital environment, but still close if the need arises for quick access to treatment.

The master plan shows how the building fits into the landscape with respect for the natural lines of the terrain and the green surrounding area.

The hospice is located to balance privacy and openness - away from the main roads, but with easy access for both families, staff and visitors. The plan has been designed with both functional connections and the sensory encounter with the place in mind, where children and families can feel safe, seen and surrounded by care.

Ill. 104: Site plan 1:750

Hospice Hjerterrummet is not just a building, but a holistic experience that naturally extends into the landscape. The site plan shows how the hospice opens onto a calm park, which is intended as an integrated part of everyday life. Here, spaces are created for play, contemplation and presence – a landscape counterpoint to the indoor environment, where both body and mind can find peace.

The building's orientation and main entrance create a natural transition between inside and outside. From the residentals and the heartroom, there is direct access to the park via paths that move gently through the landscape. Here, there is space to breathe, find peace and feel nature – something that is absolutely central to the grieving and healing process of children and families.

The park consists of three zones: a sensory garden close to the house, a playground further out, and a memorial in the distance. These spaces offer different experiences and moods – but are connected through a winding path system that allows for both movement and contemplation.

Together, the building and landscape create a whole where care is not only found in the architecture, but also in the surroundings.

Ill. 105: Sensory garden

Ill. 106: Memorial

The sensory garden is a sensory landscape space created to embrace the entire range of emotions – from play and curiosity to silence and reflection. The garden stimulates the senses of hearing, smell, sight and touch through carefully selected plants, textures and sounds that change with the seasons. It is a place where children can explore and be present in the present, and where families can find a breather in nature.

Further inside the park is the memorial – a poetic and meaningful place for remembrance and farewell. Here is an open pergola, where each hospitalized patient is assigned a star upon arrival. The star can be decorated, painted or worked on freely during the stay. If the child passes away, the family can choose to hang the star in the pergola's structure. Over time, the place will become a beautiful and living memorial – a shared sky for the children who have left their mark.

Ill. 107: Floor plan 1:350

Hospice Hjerterummet spans 2,344.3 m² and is organised around a clear division between private, common, and treatment zones. The layout is centred around the Heartroom – the social and symbolic core of the building.

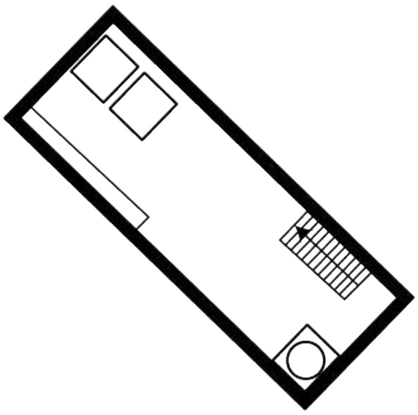
To the northeast, the six residential units provide patients and their families with private rooms, terraces, and views of nature – ensuring daylight, peace, and a sense of home.

Along the southwest, treatment rooms support both body and mind – including sensory, therapy, physiotherapy, soft play, music, and wellness. These are placed in a quieter part of the building to ensure privacy and calm.

The southwest corner contains staff areas such as offices, lockers, and meeting rooms – separated but still closely connected to daily activities.

Common areas are located centrally: the Heartroom, kitchen and dining, and multifaith room. The Heartroom is where the community gathers. The kitchen welcomes guests as the first room of the house, while the multifaith space offers retreat and reflection.

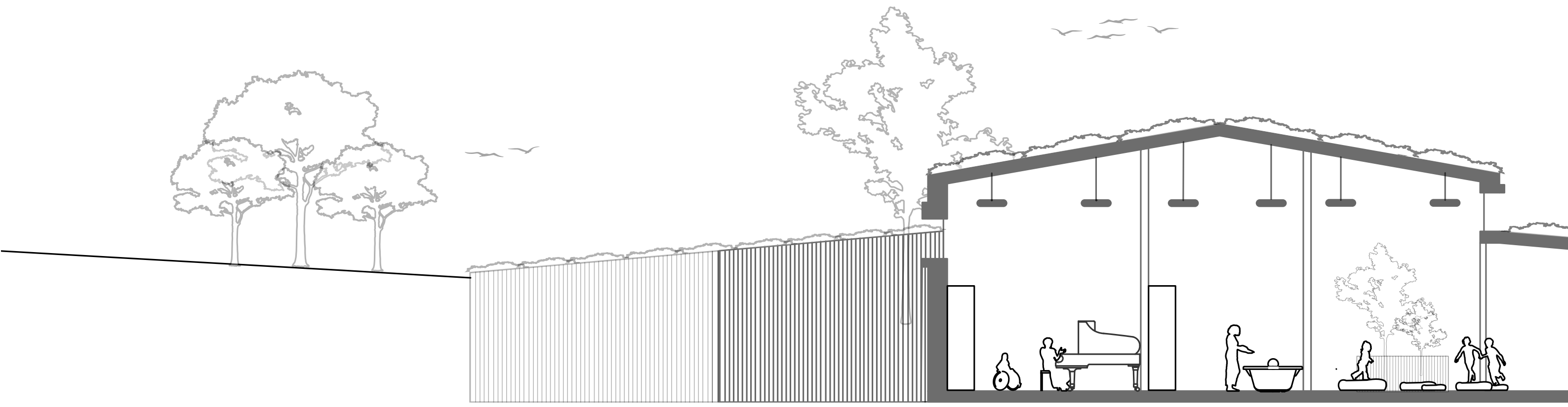
The building balances clarity with care – creating soft transitions between privacy, community, and healing.



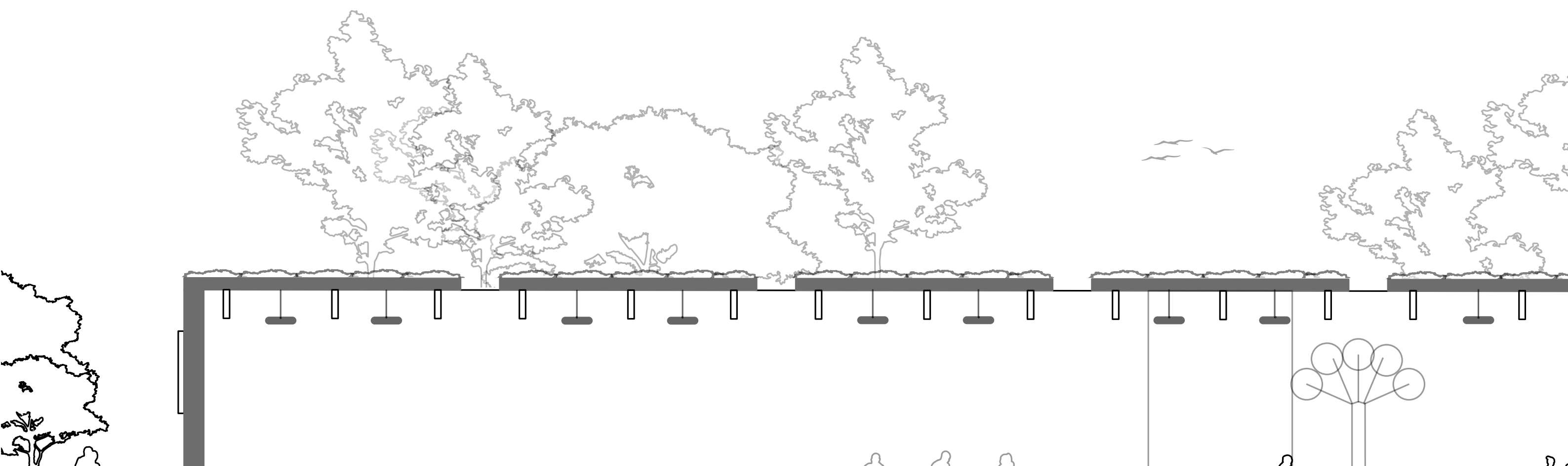
Ill. 108: Basement floor plan 1:350

The basement consists of a single technical room, covering a total area of 100 m². It houses the building's core technical systems, including ventilation units, a heat pump, water piping, and the main electrical distribution.

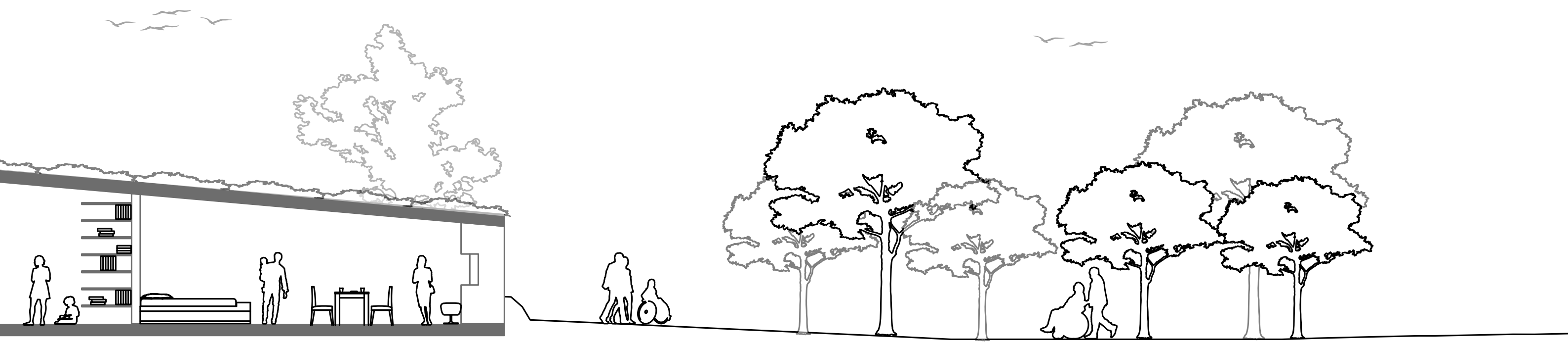
Discreetly placed below ground, this space ensures the efficient operation and maintenance of all building services, while keeping technical infrastructure separate from the daily experience of patients and families.

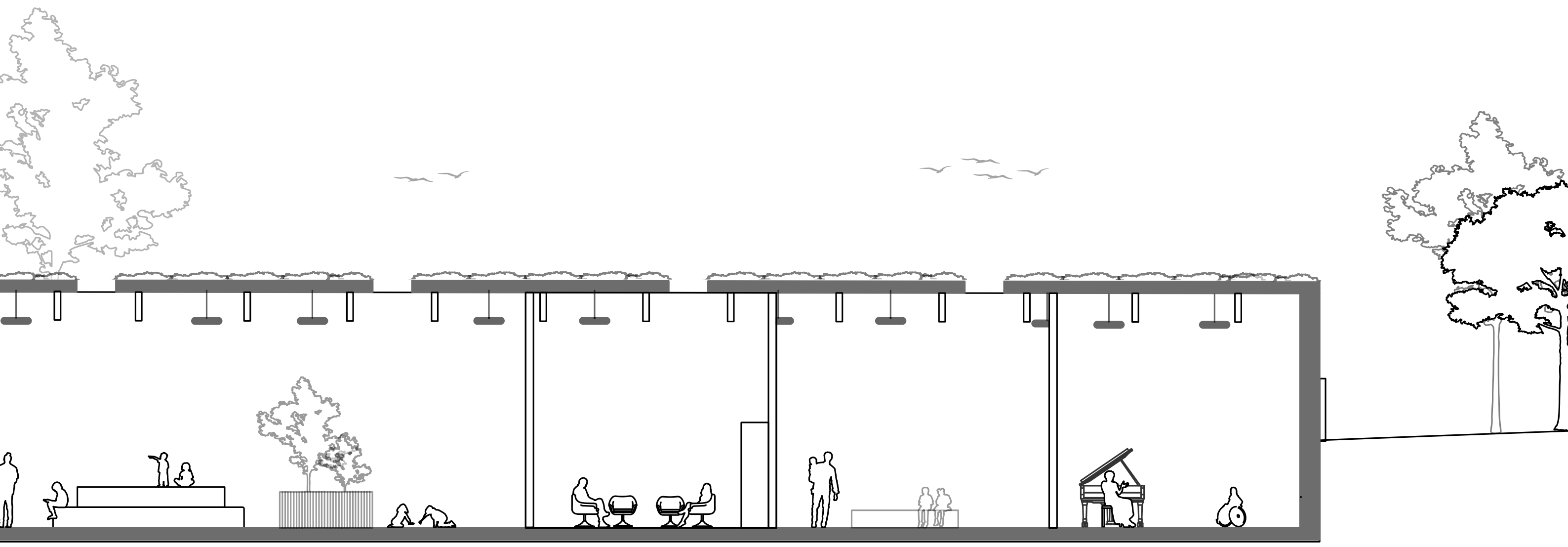


Ill. 109: AA section elevation 1:200



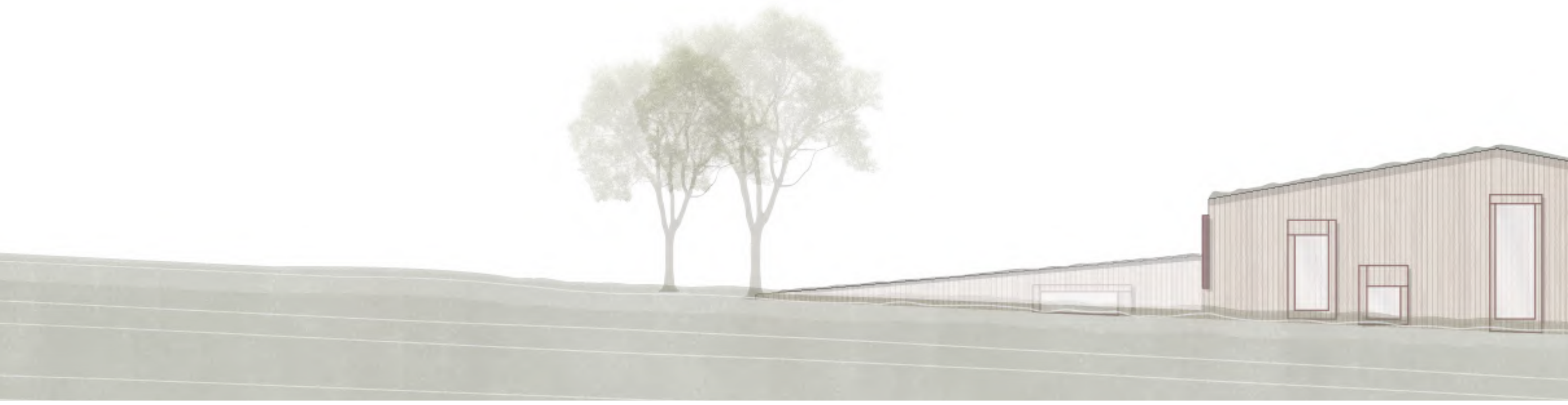
Ill. 110: BB section elevation 1:200



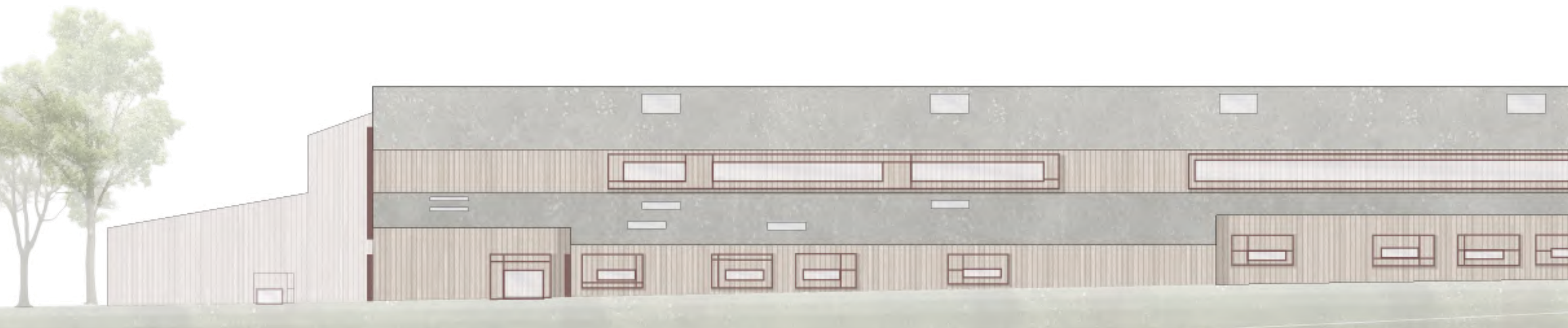


Ill. 111: Northwest facade elevation 1:200

Ill. 112: Northeast facade elevation 1:200



Ill. 113: Southeast facade elevation 1:200



Ill. 114: Southwest facade elevation 1:200

Ill. 115: Hospice Hjerterummet entrance

Ill. 116: Reception

The hospice's main entrance is designed with a focus on security and clarity. The facade is characterized by a rhythmic variation in window sizes and placement, giving the building a playful and informal expression that appeals to both children and adults. The warm shades of the wood cladding, combined with discreet red frames around the windows and doors, contribute to a welcoming and recognizable arrival. The architecture does not seek to impress – but to embrace.

Inside the building, you are greeted by an open and bright reception area, where warm materials and natural light welcome you at eye level. The light wooden walls create a calm and pleasant atmosphere, while the high rooms and narrow windows allow the daylight to softly enter. Soft clouds float above the counter - a playful element that appeals to children's imagination. The reception area signals that this is not a clinical or institutional place, but a homely and safe environment where children can dream, play and feel safe. The space is clear and friendly, so that both children and adults quickly feel seen and welcome.

Ill. 117: Kitchen and dining area

Ill. 118: The heartroom

The communal kitchen is located near the entrance and acts as a warm and recognizable gesture – like the first room you enter in a home. It signals that this place is not an institution, but a place where everyday life can be lived. The kitchen is designed with space for both daily meals, larger communal meals and creative activities. Here, children and adults can gather to cook, celebrate anniversaries or participate in workshops where they draw, paint and share time in each other's company.

The heart room is the building's central and most important space – both physically and symbolically. It is the place around which the entire hospice is built. Here, families and staff gather for shared activities, games, performances and everyday life. The space is open, bright and flexible, and the organic shapes, wooden cladding and built-in seating elements create a warm and lively atmosphere. The tree in the middle forms a gathering point and emphasizes the space's character as both safe and active. The heart room is, as the name suggests, the heart of the building – a place where community pulsates.

Ill. 119: The heartroom - library

Ill. 120: Residential - patient room

Ill. 121: Residential - family room

The patient room is furnished with warm and calm materials that support the feeling of home rather than institution. The wood on the floor and ceiling gives the room a tactile and pleasant atmosphere, while the soft surfaces and muted colors create tranquility. The large, horizontal window acts as a living image of the nature outside and allows the patient to follow the change of seasons – also from the bed. A glass door leads directly out to a private terrace, where fresh air and outdoor life are easily accessible, supporting the experience of freedom and belonging.

The family room is designed as a flexible living and sleeping space for the relatives. Here, parents can work, eat and retreat in a private setting. The room is bright and simple, with furniture and natural materials that support a sense of everyday life in the midst of the extraordinary. The small and varying windows create a playful and vibrant light, and the placement of the furniture allows for both presence and privacy. The room invites the family to be close to the child, while offering a short break when necessary.

CHAPTER 07

EPILOGUE

This chapter concludes the project with a summary of key insights and reflections. It also contains the bibliography and the list of illustrations used throughout the report.

CONCLUSION

Hospice Hjerterummet details a proposal for a children's hospice, aiming to provide a safe place and homely environment where terminally ill children and their families can make lasting memories while receiving the support they need during a difficult time.

Six private apartment units create a private area for the individual families, with a separate room for the patient, so they can retreat into their own space when the need strikes. Here, windows both high and low overlook a park area and a sensory garden, giving a soothing view, while a door provides access to the terrace, even when bedridden.

When not resting, the Heartroom is always open and offers a variety of activities. The energetic kindergarteners can use the soft cushions and large space in the eastern end for a game of tag or explore through the round cutouts in the wall, while the library houses exciting tales for all ages - whether it is the teenager seeking a thrill or a nighttime story for a toddler. In the middle grow two trees among curving ferns - a little bit of nature for everyone to enjoy year-round - and around it is space for visits by therapy dogs, hospital clowns, or anything else. With the double door leading out, the Heartroom connects to the outdoor paths, making it easy to visit the sensory garden for contemplation or go for a walk around the small lake.

Treatment rooms for both the ill child and pressured family are gathered in one corner of the Heartroom - visible but sheltered from the social activity - to embrace the many aspects of life present at the hospice.

The entire building is clad in untreated Siberian larch, which, as it weathers, will contrast more and more with the bordeaux window frames and the green roof, creating a facade that, depending on the direction of approach, either blends with the hill or grows out of it. The interior of the Heartroom is likewise clad in wood, letting it absorb sound and making the large space look warm and inviting.

The residential units have white gypsum walls to allow for easy decorating by child and parent, and to add thermal mass for a more stable temperature.

Hospice Hjerterummet presents a proposal for a children's hospice that is a safe home for both terminally ill children and their families - a place where they can be part of a community with others in a similar situation, supported by knowledgeable staff, and where the facilities aid their emotional and physical health.

REFLECTION

Designing a hospice is a complex task, as a hospice has stricter inherent demands for its indoor climate due to the occupants more delicate constitutions, but the demands for sustainability and energy performance of the building still has to confirm to the current requirements. At the same time, a hospice is both a medical institution – even if the focus is on palliative care rather than more traditional treatment – and a long-term care facility for children in the case of this thesis.

DILEMMA

Increasing demands for sustainability can conflict with the creation or maintenance of a specific indoor climate, especially if passive means are not enough to achieve the desired outcome. However, in a hospice, the temperature has to be stable around the set temperature – whether this is 15°C in the case of death, or 26°C because of an inability to maintain their own body temperature. This can, to some degree, be achieved by utilizing ventilation to remove excess heat during summer and reuse heat during winter. Some heating was inevitable, but installing a heat pump covered most of that need as well as hot domestic water.

Most problematic was the desire to avoid solar panels. As the angle of the roof is at most 10°, their efficiency would be severely reduced, unless they were more angled themselves. Additionally, the roof is very visible when standing on top of the hill and the solar panels would break the aesthetic of the building growing out of the hill. All electricity would therefore be supplied by the existing power network, which made light a more critical factor than expected. A precise definition of how much and where lights were placed, as well as the specific performance of them, might have served the thesis well.

EVIDENCE BASED DESIGN

From the start, the intention was to use both the integrated design process and evidence-based design. But EBD proved more challenging than expected, not so much because of a lack of evidence for any given choice, but because the method was new and, sadly, inexperience meant it took a backseat as time went by. It was loosely utilized throughout rather than seeking decisive evidence for key decisions.

One way EBD could have been used more, was by deepening the collaboration with Strandbakkehuset. If their input had been sought on plan layout or materials, it could have served as further evidence for the final choices.

AESTHETIC

Architecture consists of three main branches: functional, technical and aesthetic. The functional was prioritized in the beginning due to the new type of building - a hospice - and the need to research the required rooms. Technical was gradually used early as well, though some parts like acoustics and ventilation came rather late. Aesthetics, however, did not come into play until far too late, as we both are logical thinkers and lean towards the engineer part of architecture. It was our advisor who encouraged us to address this aspect more actively, which turned out to be a necessary and valuable push. As it was meant to be a children's hospice, the aesthetics had to speak to a child and be more playful than other typologies. Seeing the building from the perspective of a child was difficult and was mainly used when designing the windows. Letting them jump in size, shape and place on the facade and creating the jutting, colored frames is the primary expression of this. The wall in the Heartroom with the round holes is the other major result of trying to engage the child with the architecture. The windows, however, could have been taken further, as the depth and interior side are barely utilized in making a playful building.

LIFE CYCLE ASSESSMENT

The problem statement and some design parameters speak of sustainability in the sense of CO_2, to which LCA is presented as a tool. While LCA was used to cross-check different materials against each other for the sake of finding the best fit with the lowest Global Warming Potential, it was done on a conceptual level.

Diving deeper and looking on the construction and the amount of material needed could have added to the strength of the argument.

SITE

Lastly, the chosen site, though valid for its proximity to the hospital and potential for using nature in the surroundings, was completely inaccessible due to ongoing construction – the open field beyond was the visible part of the site. As such, it was hard to accurately assess it. On top of that, the composition of the ground itself is not ideal – with a depth of 7-20 meters to load-bearing ground, the foundation will use quite a bit of concrete.

BIBLIOGRAPHY

AART Architects, n.d. Børne- og Ungehospice – Strandbakkehuset. Available at: https://aart.dk/projekter/borne-og-ungehospice (Accessed: 07 February 2025).

Aalborg Universitetshospital, n.d. Palliativt Team for Børn og Unge, Region Nordjylland. [Online]. [17 February 2025]. Available at: Palliativt Team for Børn og Unge, Region Nordjylland. Accessed: 17 February 2025.

Architecture 2030, n.d. Why The Building Sector? – Architecture 2030. Available at: https://architecture2030.org/why-the-building-sector/ (Accessed: 04 February 2025).

Bielak-Zasadzka, M. and Dramska, O., 2021. Behavioral needs of the children's hospice facility users – their impact on shaping the space of the facility. Builder Science I Hospicjum Dziecięce, 7(288), pp. 1–4. Available at: https://doi.org/10.5604/01.3001.0014.9169 (Accessed: 06 February 2025).

Browning, W., Ryan, C. & Clancy, J., 2014. 14 Patterns of Biophilic Design.

Brummett, W., 1997. The Essence of Home: Design Solutions for Assisted Living Housing. New York: Van Nostrand Reinhold.

Bygningsreglementet, 2018. (BR18 (Aktuel)). [Online]. Cph.: Social- og Boligstyrelsen. Available at: BR18. Accessed: 06 February 2025.

Dansk Standard, 2018. DS 490:2018. [Online]. [Cph.]: Dansk Standard. [Accessed: 06 February 2025]. Available at: DS 490:2018 : Standard Distribute.

DR, 2023. Indefra med Anders Agger - Børnehospice. [Online]. Available at: Indefra med Anders Agger - Børnehospice | Se online her | DRTV. Accessed: 04 February 2025.

Eiler Rasmussen, S., 2012. Om at opleve arkitektur. Archi Tegn.

Eyerevolution London, n.d. Noah's Ark Children's Hospice. [Online]. [09 February 2025]. Available at: Noahs Ark Hospice 360 Virtual Tour. Accessed: 09 February 2025.

Helen & Douglas House, 2022. The world's first children's hospice. Helen & Douglas House. Available at: https://www.helenanddouglas.org.uk/about-us/our-history/ (Accessed: 17 February 2025).

Hertzberger, H. and de Swaan, A., 2009. The Schools of Herman Hertzberger. Rotterdam: 010 Publishers.

Hospice Forum Danmark, n.d. Hospice – oversigt over hospicer i Danmark. [Online]. [17 February 2025]. Available at: Hospicer - Hospice Forum. Accessed: 17 February 2025.

Kahn, P.H., Severson, R.L. & Ruckert, J.H., 2009. The human relation with nature and technological nature. Peer Rev. J. pp. 37–42.

Kanafani, K., 2024. Environmental assessment of buildings. Lecture in Life Cycle Assessment and Materiality, Aalborg University.

Kellert, S.R. & Calabrese, E.F., 2015. The Practice of Biophilic Design 26.

Knox, M., 2023. Design-Related Impacts on End-of-Life Experience: A Brief Report of Findings from an Exploratory Qualitative Study. American Journal of Hospice and Palliative Medicine. Available at: https://pmc.ncbi.nlm.nih.gov/articles/PMC10248286/ (Accessed: 04 February 2025).

Knudstrup, M.-A., 2004. Integrated Design Process in Problem-Based Learning. [Online]. [10 February 2025]. Available at: Microsoft Word - IDP in PBL 2004 Mary-Ann Knudstrup.doc. Accessed: 10 February 2025.

Marcus, C.C. & Sachs, N.A., 2013. Therapeutic Landscapes: An Evidence-Based Approach to Designing Healing Gardens and Restorative Outdoor Spaces. Hoboken, NJ: John Wiley & Sons.

Mazuch, R., 2017. Salutogenic and Biophilic Design as Therapeutic Approaches to Sustainable Architecture.

MedicalNewsToday, 2020. What is hospice care. [Online]. [04 February 2025]. Available at: What is hospice care? Everything you need to know. Accessed: 04 February 2025.

Moore, R.C. & Cosco, N.G., 2010. Using behaviour mapping to investigate healthy outdoor environments for children and families: conceptual framework, procedures and applications. In: C. Ward Thompson, P. Aspinall & S. Bell, eds. Innovative Approaches to Researching Landscape and Health. London: Taylor & Francis, pp. 33–72.

Noah's Ark Children's Hospice, n.d. Bereavement Support. Available at: https://noahsarkhospice.org.uk/services/bereavement-support/ (Accessed: 04 February 2025).

NHS, 2022. Hospice Care. [Online]. [04 February 2025]. Available at: Hospice care - NHS. Accessed: 04 February 2025.

Pallasmaa, J., 1995. Identity, intimacy and domicile: Notes on the phenomenology of home. Arkkitehti - Finnish Architectural Review, 4, pp. 6–13.

REHPA, 2017. Designprincipper. Available at: https://arkitektur-lindring.dk/designprincipper/ (Accessed: 04 February 2025).

Ronald McDonald, n.d. Om Ronald McDonald Hus, København. [Online]. [17 February 2025]. Available at: Om huset - Ronald McDonald BørneFond. Accessed: 17 February 2025.

Sandberg, A.B., 2011. 'Här får döende barn lindrande vård'. Dagen. Available at: https://web.archive.org/web/20110716111622/http://www.dagen.se/dagen/article.aspx?id=224722 (Accessed: 17 February 2025).

Sankt Lukas Stiftelsen, n.d. Lukashuset. Available at: https://sanktlukas.dk/lukashuset/ (Accessed: 17 February 2025).

Squire and Partners, n.d. The Ark, Noah's Ark Children's Hospice. [Online]. [09 February 2025]. Available at: The Ark, Noah's Ark Children's Hospice — Healthcare — Architecture — Squire & Partners. Accessed: 09 February 2025.

St Christopher's, 2020. Dame Cicely Saunders. Available at: https://www.stchristophers.org.uk/about/damecicelysaunders/ (Accessed: 17 February 2025).

Steinfeld, E., Maisel, J. and Levine, D., 2012. Universal Design: Creating Inclusive Environments. Hoboken, NJ: John Wiley & Sons, Inc.

Strandbakkehuset, n.d. Om Os. [Online]. [04 February 2025]. Available at: Strandbakkehuset - hvem er vi? Accessed: 04 February 2025.

Strandbakkehuset, 2020. Tidslinje for Strandbakkehuset. Available at: https://www.strandbakkehuset.dk/om-os/arkiv/tidslinje-2019-2020 (Accessed: 17 February 2025).

The Center for Health Design, n.d. What is Evidence-Based Design?. [Online]. [11 February 2025]. Available at: About EBD | The Center for Health Design. Accessed: 11 February 2025.

The National Disability Authority's Centre for Excellence in Universal Design, n.d. Building for Everyone: A Universal Design Approach – Planning and Policy. Centre for Excellence in Universal Design. Available at: https://nda.ie (Accessed: 06 February 2025).

Trygfondens Familiehus, n.d. Forside. [Online]. [17 February 2025]. Available at: Trygfondens Familiehus – TrygFondens Familiehus ligger nær Aarhus Universitetshospital i Skejby og er et hus for familier med langtidsindlagte børn. Accessed: 17 February 2025.

Ulrich, R.S., 1984. View through a window may influence recovery from surgery. Science, 224, pp. 420–421.

Van Eyck, A., 2008. Collected Articles and Other Writings 1947–1998. Edited by V. Ligtelijn and F. Strauven. Amsterdam: SUN.

Verderber, S. and Refuerzo, B.J., 2006. Innovations in Hospice Architecture. Taylor & Francis Group.

ILLUSTRATIONS

All illustrations not listed below have either been created or photographed by the members of this project:

Ill. 14 – Maggie's Cancer Centre Manchester (no date) Maggie's Cancer Centre Manchester – Foster + Partners (Image) Available at: https://www.archdaily.com/786370/maggies-cancer-centre-manchester-foster-plus-partners (Accessed: 01 April 2025).

Ill. 12 - Noah's Ark (no date) Noah's Ark Children's Hospice - Noah's Ark (Image) Available at: https://www.noahsarkhospice.org.uk/the-ark/?fbclid=IwAR1XBoUkUU8YxY2vq30k6u8l-juNnl-b-C2oo0U5vrhfiS7U6OGcwKHgfAqY (Accessed: 03 March 2025).

Pinterest A. (n.d.) Corridor with ceiling cut-outs creating shadow play. Available at: https://dk.pinterest.com/pin/402016704257585293/ (Accessed: 21 April 2025).

Pinterest B. (n.d.) Reception design with cloud lighting. Available at: https://dk.pinterest.com/pin/402016704257585290/ (Accessed: 21 April 2025).

Pinterest C. (n.d.) Playful wall panels for children. Available at: https://dk.pinterest.com/pin/402016704257585316/ (Accessed: 21 April 2025).

Pinterest D. (n.d.) Interactive wall cut. Available at: https://in.pinterest.com/pin/402016704257707912/ (Accessed: 21 April 2025).

Ill. 10 - Strandbakkehuset (no date) Strandbakkehuset – Børne- og Ungehospice (Image) Available at: https://aart.dk/projekter/borne-og-ungehospice (Accessed: 03 March 2025).

APPENDIX

APPENDIX 1 – STRANDBAKKEHUSET

Interview:

Hvordan bruger I jeres fællesrum?

- Køkkenalrum spiser alle sammen med pårørende og personale (samlingspunkt) - foregå aktivitet (krearum). Et sted med kontakt med andre. Hjerterummet bruges meget til leg og sange og aktiviteter hvor alle der har lyst kan være med.

Har personalet deres eget privat rum eller sidder I med familierne?

- Ingen personalerum – har dog rum de kan sidde i ved arbejdsro eller diskussioner ved behov. Nærhedsprincippet kan dog være udfordrende når man skal have arbejdsro (kunne godt tænke sig at have lukket kontor fremfor åbne kontor).

Har I nogle udfordringer med en bygning på (tre) etager?

- Har en elevator som er meget nødvendig for at alt kan fungere. Det samler huset mere når det er på flere niveauer fremfor et plan hvor tingene er meget væk fra hinanden – istedet for en lang hospitalsgang. Lyden er også ret koncentreret som er det vi også gerne ønsker. Kalder det niveauer fremfor etager (ingen kælder fornemmelse) man går typisk halve etager op fremfor en hel) børn er gode til at navigere i det.

Er de fleste af jeres patienter sengelagte/kørestolsbrugere eller er der også nogen som kan bevæge sig rundt selv?

- Langt de fleste er hæmmet i deres funktionsniveau - begrænset på en eller anden måde. Har dog begge dele.

Hvordan er transportering af sengelagte/kørestolsbrugere i et hospice med 3 etager?

- Bruger bare elevatoren. Synes ikke der er nogen udfordringer med det – er jo et lille hus. Vigtigt med målene også af hensyn til brandsikkerhed.

Hvornår kommer man til et børnehospice?

- Når man har behov for lindring på et specialiseret niveau - livsbegrænsende eller truende sygdom.

Hvad er forskellen mellem Strandbakkehuset og et familiehus?

- Professionelt tilbud hvor man er indlagt (i vores) - ikke ligesom i et familiehus, der er der bare en masse aktivitet og ingen indlæggelser.
- I et familiehus er der ikke fagligt ansatte, de er drevet af donationer og frivillige. Derfor kan der stadig være ligheder omkring hvordan familien skal kunne være der.

Hvor lang tid er man indlagt?

- Alt fra 14 dage til 6 måneder. Typisk 3-4 uger.

Er der patienter der får behandling i Strandbakkehuset men overnatter derhjemme?

- Nej. Kan dog godt komme på orlov herfra. dækker hele Jylland og Fyn. Man kommer jo for at finde ro i familien. Kan dog godt få behandling på au hospital og komme til hospice et par gange om ugen i en periode.

Kommer man til hospitalet og får behandling, mens man er i Strandbakkehuset?

- Ja. Når hospitalet er for tæt på bliver det hospitalet der styrer på en måde.

Er der mange hospitalsbesøg i løbet af en uges tid?

- Der kan være fra ingen til 3 gange om ugen. Foretrækker at de kommer når de skal besøge sygehuset færre. Bruger meget energi på sygehuset jo. Konceptet er jo at finde ro når de er her. Hvis de skal have behandling ofte kan de jo tage til et familiehus.

Hvad vil du mene, er de mest optimale rammer at placere et hospice i? er det ude i naturen, isoleret og i ro, eller tættere på et hospital eller et helt tredje eksempel?

- Vores placering er helt optimal (midt i naturen) – 30min til hospitalet - med afstand fra en storbys puls. Roen man finder både ude og inde er noget familierne værdsætter ofte.

Hvad er der behov for i lejlighederne til familierne?

- Patientseng med mulighed for at placere en ekstra seng ved siden af hvis de har behov for det. Endnu et værelse til forældrene med en ordentlig seng så de kan sove i fred og ro (ikke en sovesofa). Måske mulighed for et tekøkken men uden at stoppe muligheden for at bruge fællesfaciliteterne for at samles. Et stort handicap venligt badeværelse. Ilt og sug luft ting. Udkig til naturen (føle sig i et med naturen, at man sidder under træerne - nødvendigt for livskvaliteterne) der er mulighed for mørklægningsgardiner hvis man er lysfølsom. De gardiner man har kan man kigge ud af og ikke ind af.

Har I udstyret fremme eller bliver det gemt væk, når det er i brug?

- Med vilje pakket alt væk, da der er forskellige behov for forskellige patiner.

Er alle lejlighederne ens?

- Ja – fleksibiliteten skal være der.

Overnatter ansatte i Strandbakkehuset? Er her nogen i døgndrift?

- Døgnbemanding - dags- aften og nattevagt – sygeplejeske hele døgnet. Resten kommer et par timer om ugen.

Hvordan ift. aldersforskellen på børn, er der nogle forskellige behov, faciliteter eller aktiviteter?

- Ja det er der. Det skal ikke ligne en børnehave hvis der kommer en teenager. Huset tilegner sig børnets behov. Igen er fleksibilitet meget vigtigt

Nu hvor det her børnehospice er relativt nyt, er der nogle ting der ikke fungerer optimalt eller som kunne forbedres?

- Arbejdsmiljøet som nævnt. Personalet er nærmest glemt - tænk på hvordan personalet kan blive udmattet i løbet af dagen (man har også behov for at kunne trække sig tilbage). Familiestuerne kunne godt være lidt større fx til en 5-6 personers familie - må dog ikke blive for stort til en mindre familie.

Er der nogle særlige behov i forhold til lys, lyd og temperatur nogle steder? Særligt i forhold til familieboligerne.

- Temperaturen kan skrues meget ned, når et barn dør så de kan blive liggende i familiestuen. Lamellofter så akustikken kan virke godt i stuerne.

Fra vores Casestudie Noah's Ark, ved vi at nogle hospicer har et såkaldt butterfly room, hvor det døde barn bliver opbevaret et par dage for at få et ordentligt farvel (istedet for at komme i lighuset) og evt. få ordnet alt det praktiske ift. begravelse.

- Det sker i stuen hvor den bliver kølet ned. Familien tager typisk hjem dagen efter barnet er dødt, da de har brug for at komme hjem. Det har man dog i de større hospicer. Jeg synes at det fungerer fint.

Hvordan er dagligdagen for patients familie? Arbejder de eller går i skole? Bliver det så online?

- Startede op unde corona – der fungerede alt online. Men nu hvor alt er tilbage er der ikke mange skoler der kan finde ud af det med at have et barn med online – behovet for at barnet skal i skole er mindre (indtil 7 klasse) derfor er deres fokus typisk familien fremfor skolen. De har dog mulighed for stadig at følge skolen med online. Familier med ældre søskende kan også blive hjemme mens familien er i hospice. Det bedste er hvis forældrene kan få fortabt arbejdsfortjeneste mens de er her, da andet kan blive for besværligt, med transport eller generelt til at få hverdagen til at fungere.

Hvordan er dagligdagen for patienten?

- Står op – nogle gange hjælper personalet med at få dem ud af sengen – det er meget forældrene som står for personlig pleje – spiser morgenmad selv - morgenmøde med oversigt over dagens aktiviteter hvor forældrene kan melde sig – dagene er meget forskellige.
- Nogle gange kan forældrene sige fra da de synes der sker for meget på kort tid, derfor ændres de forskellige aktiviteter, dagene er altså forskellige (eller hvis de ikke har sovet ordentligt hvis barnet ikke har sovet i løbet af natten).
- Vi har også ekstern partner som laver aktivitet i huset (klovne, bål, besøgshund, biograftu-re). Så altså forskellige aktivitet der er sat ind for at give muligheden for at lave gode minder og støtte familien.

Hvordan er dagligdagen for jer (ansatte)?

- Sygplejeske arbejder 8 timer om dagen – fysioterapeut 3 dage om ugen – psykologen 1 dag om ugen. De er fordelt fordi de ikke alle kan snakke med familien på en gang. Vagtskifte om eftermiddagen og igen om aften. Der er altid nogen på arbejde – vigtigt at få de ansatte fordelt over ugen da der ikke er plads til os alle sammen på samme tid.

Udover medicinrum og kontorlokaler (kopirum, mødelokaler) er der så andre relevante rum/funktioner at have i forhold til driften af et børnehospice?

- Stillerum (arbejdsrum) er ret vigtige. Derudover er et konferencerum også vigtigt ift. større møder.

Hvornår bruges musikterapi? Sanserum? Wellness? Fysioterapi? Terapi? Blød-leg-rum?

- Arbejder meget med nervesystemet – krigszone når man er i hospitalet – for man lov til at falde til ro i hospicet. Tager tingene i brug for at berolige deres nervesystemet, så de kan hjælpe familierne bedst muligt. Vigtig at de også for ressourcer/værktøjer med hjem så de kan bruge det til at få det mentalt bedre.

Kan du give os et eksempel på hvilke diagnoser der kan føre til indlæggelse på et børnehospice?
Neurologiske diagnoser (hvor nervesystemet bliver nedbrudt langsomt). (flest af dem)

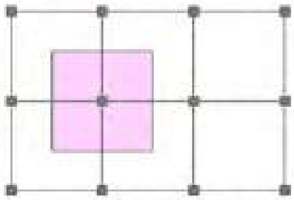
- Serbal pervase
- Alle kræftformer
- MEN her fokuserer vi på livet og ikke på sygdommen. Vi tænker altid på hvordan vi bedst kan støtte livskvaliteten bedst.

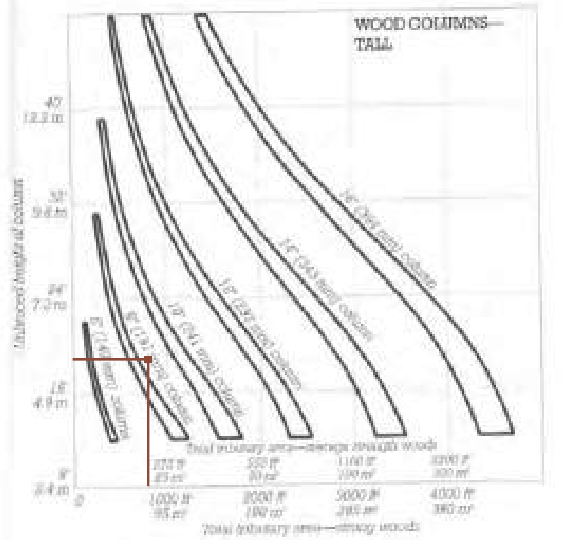
APPENDIX 2 – STRUCTURE

WOOD

Column Sizing

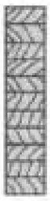
Tributary Area

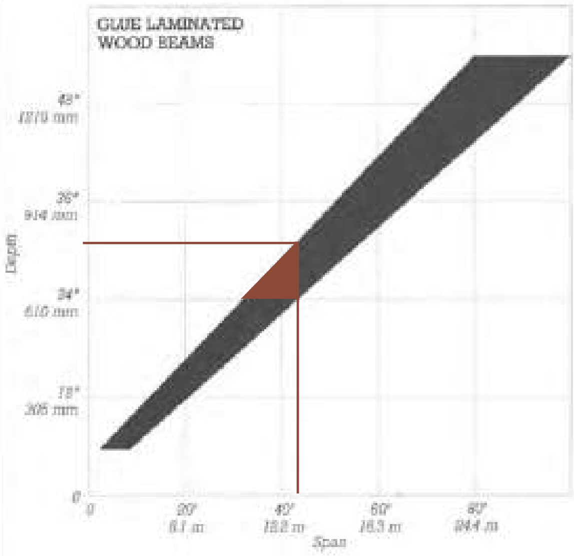




WOOD

Glue Laminated Beam Sizing





Tabel 1.4. Faktoren k_{mod} for forskellige materialer og forbindelser i materialerne. Eurocode 5 giver også værdier for andre pladematerialer. Ikke alle kvaliteter kan anvendes i anvendelsesklasse 2 og 3.

Produkttype	Lastgruppe	Anvendelsesklasse		
		1	2	3
Konstruktionstræ, LVL, limtræ og krydsfiner	P	0,60	0,60	0,50
	L	0,70	0,70	0,55
	M	0,80	0,80	0,65
	K	0,90	0,90	0,70
	Ø	1,10	1,10	0,90

Strength Parameters for Gl30h:

Bending strength: $f_{m,k} = 30$

Tensile strength parallel to the grain (index 0): $f_{t,0,k} = 24{,}0$

Tensile strength perpendicular to the grain (index 90): $f_{t,90,k} = 0{,}5$

Compressive strength parallel to the grain (index 0): $f_{c,0,k} = 30$

Compressive strength perpendicular to the grain (index 90): $f_{c,90,k} = 2{,}5$

Shear: $f_{v,k} = 3{,}5$

Manual hand calculations

Calculation for the glulam beam with skylight:

Parameter	Value
Span (l)	14.5m
Load area	2m
Cross-section	160 x 720 mm
Service class	1 (Indoor)
Vindtryk	0,81 kN/m^2
Form factor (wind)	0,9 (Saddle roof with 10° slope)
γM	1,3
k_{mod} (wind load, AK1)	1,10
Density	480 kg/m^3

Self-weight g (160mm → 0,16m, 720mm → 0,72m):

Original beam self-weight (wood + insulation):

$$g_{normal} = 0{,}16 \cdot 0{,}72 \cdot 480 = 55{,}3 \frac{kg}{m} = \frac{55.3}{9.81} = 5.64 \frac{kN}{m}$$

Self-weight for skylight section (glass):

$$g_{ovenlys} = 0{,}35 \cdot 2 = 0{,}70 \frac{kN}{m}$$

New average self-weight: $\left(\frac{1}{3}\ ovenlys, \frac{2}{3} normalt\ tag\right)$

$$g = \frac{2}{3} \cdot 5{,}64 + \frac{1}{3} \cdot 0{,}70 = 3{,}76 + 0{,}23 = 3{,}99 \frac{kN}{m}$$

Wind load (standard factors; wind pressure × shape factor for saddle roof × load area):

$$q_W = 0{,}81 \cdot 0{,}9 \cdot 2 = 1.458 \frac{kN}{m}$$

Total line load p:

$$p = g + q_W = 3{,}99 + 1.458 = 5.448\frac{kN}{m}$$

Moment at the center of beam M_{Ed}:

$$M_{Ed} = \frac{1}{8} \cdot p \cdot l^2 = \frac{1}{8} \cdot 5{,}448 \cdot 14.5^2 = \frac{1}{8} \cdot 5{,}448 \cdot 210.25 = 142{,}92\ kNm$$

Section modulus W:

$$W = \frac{1}{6} \cdot b \cdot h^2 = \frac{1}{6} \cdot 160 \cdot 720^2 = 13.824.000\ mm^3 = 0{,}01382\ m^3$$

Load-bearing capacity M_{Rd}:

$$M_{Rd} = f_{m,d} = \frac{k_{mod} \cdot f_{m,k}}{\gamma M} = \frac{1.10 \cdot 30}{1.3} = 25.38\ MPa$$

$$M_{Rd} = f_{m,d} \cdot W = 25.38 \cdot 10^6 \cdot 0.01382 = 350.9\ kNm$$

Safety check:

$$\frac{M_{Ed}}{M_{Rd}} = \frac{142{,}92}{350.9} = 0.41 \leq 1$$

A glulam beam of 160×720 mm is therefore sufficient to carry the load.

Calculation for the glulam column with skylight:

Parameter	Value
Free height	5.1m
Cross-section	240 x 240mm
Tributary area	$20m^2$ (søjlen bærer 2m x 10m tag)
$f_{c.0,k}$ (Characteristic compressive strength)	30 MPa
γM (partial coefficient)	1.3
k_{mod}	0.60
E-modulus	$11.000\ MPa = 11.000.000\ N/m^2$

Self-weight (beam):

$$g = 0.16 \cdot 0.72 \cdot 480 = 55.3\frac{kg}{m}$$

Converted to kN: $\frac{55.3}{9.81} = 5.64\frac{kN}{m}$

Wind load:

$$q_W = 0.81 \cdot 0.9 \cdot 2 = 1.458\frac{kN}{m}$$

Total line load:

$$p_{total} = 5.64 + 1.458 = 7.098\frac{kN}{m}$$

Converted to area load (since the column supports an area):

$$q = \frac{7.098}{2} = 3.549 \frac{kN}{m^2}$$

Vertical load on the column:

$$N_{Ed} = 3.549 \cdot 20 = 70.98\ kN$$

Cross-sectional area:

$$A = 0.24 \cdot 0.24 = 0.0576\ m^2$$

Minimum second moment of area (I):

$$I = \frac{b \cdot h^3}{12} = \frac{0.24 \cdot 0.24^3}{12} = \frac{0.24 \cdot 0.013824}{12} = 0.0002765\ m^4$$

Radius of gyration i:

$$i = \sqrt{\frac{I}{A}} = \sqrt{\frac{0.0002765}{0.0576}} = 0.069m$$

Slenderness ratio:

$$\lambda = \frac{l_0}{i} = \frac{5.1}{0.069} = 73.91$$

(Since it is above 70 there is risk of buckling – therefore buckling reduction is used $\chi = 0.30$)

Dimensioning compressive strength:

$$f_{c,d} = \frac{k_{mod} \cdot f_{c,0,k}}{\gamma M} = \frac{0.60 \cdot 30}{1.3} = 13.85\ MPa$$

Load-bearing capacity N_{Rd}:

$$N_{Rd} = \chi \cdot A \cdot f_{c,d} = 0.3 \cdot 0.0576 \cdot 13.85 \cdot 10^6 = 239.5\ kN$$

Safety check:

$$\frac{N_{Ed}}{N_{Rd}} = \frac{70.98}{239.5} = 0.30 \leq 1$$

A glulam column of 240×240 mm is therefore sufficient to carry the load of 135.5 kN over a free height of 5.1 m.

Calculation of uplift force at the column base:

Load on roof beam: 6,774 kN/m^2

Span between columns: (14,5 m)

(Line) Load per beam = area load × tributary width (2 m)

$$q = 6{,}774 \times 2 = 13{,}548 \frac{kN}{m}$$

Total force on the beam:

$$F = q \times L = 13{,}548 \times 14{,}5 \approx 196{,}4\,kN$$

Calculation of Moment at the Ridge:

$$M = F \times \left(\frac{h}{2}\right)$$

$$= 196{,}4\,kN \times \left(\frac{5{,}1}{2}\right) = 500.82\,kNm$$

Calculation of Uplift Force in the Column:

The moment must be resisted by a force in each column, forming a moment couple:

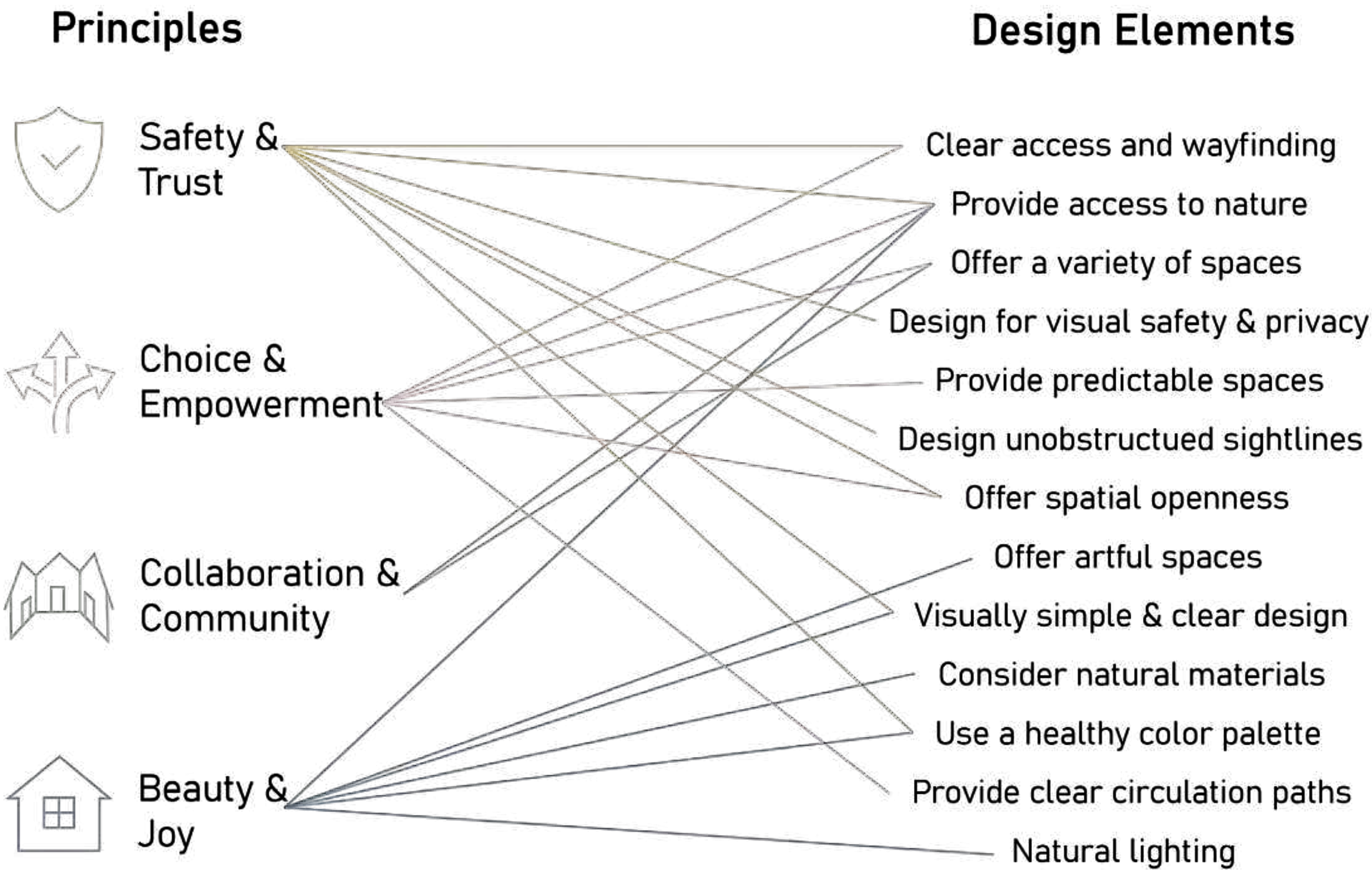
$$T = \frac{M}{b}$$

Where b is the distance between columns = 14,5 m

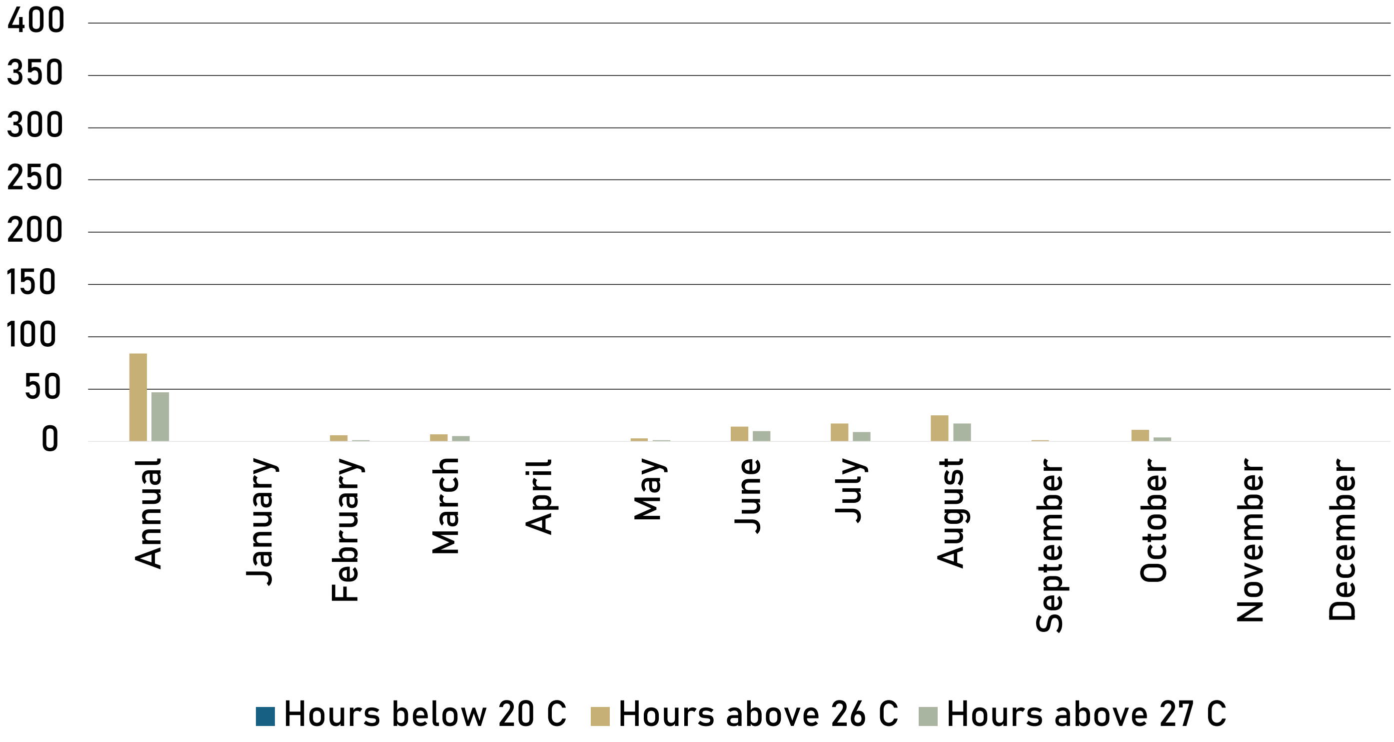
$$T = \frac{500{,}82}{14{,}5} \approx 34{,}54\,kN$$

The uplift force at the column base is 34.54 kN. Since WHT500 can withstand uplift forces up to 70 kN this is acceptable.

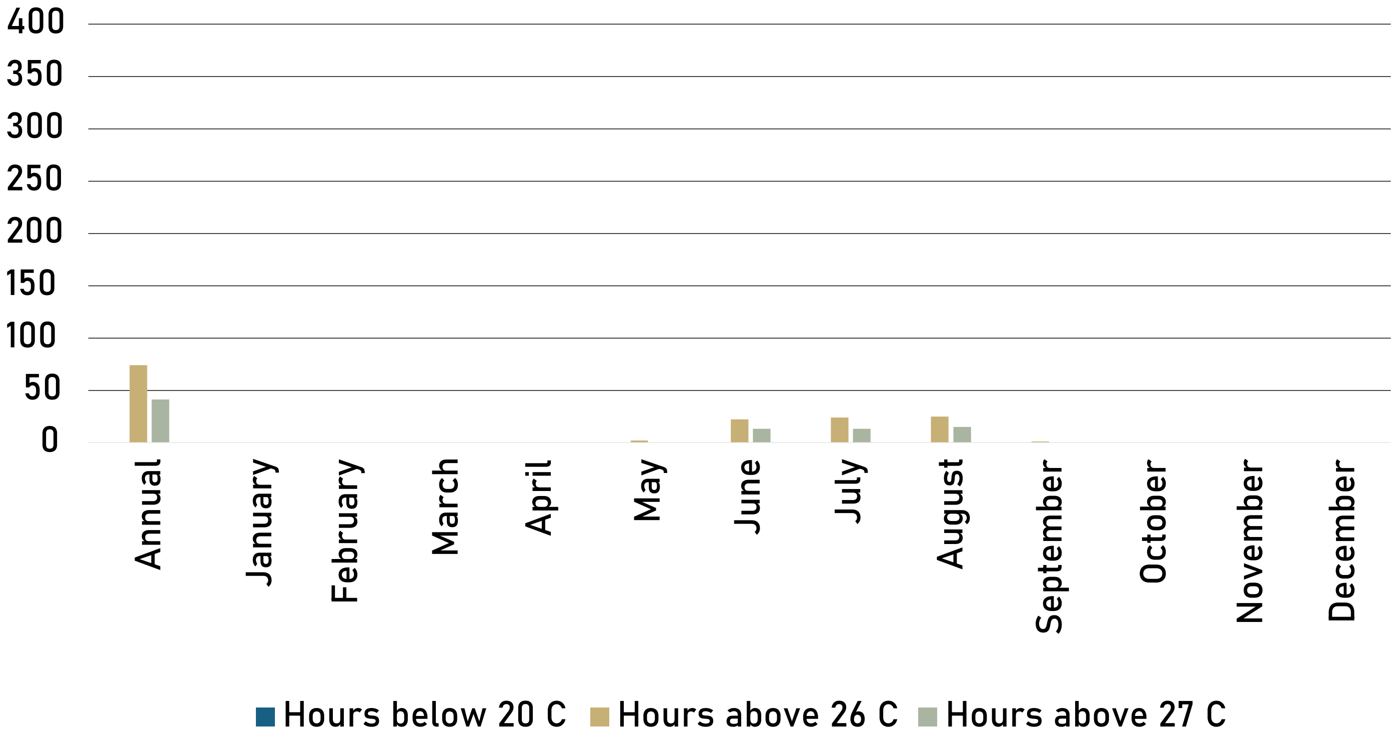
APPENDIX 3 – UNIVERSEL DESIGN



BSim - heartroom, iteration 2



BSim - patient room, iteration 2



Be18 – iteration 1

Nøgletal, kWh/m² år

Renoveringsklasse 2

Uden tillæg	Tillæg for særlige betingelser	Samlet energiramme
70,9	0,0	70,9
Samlet energibehov		64,8

Renoveringsklasse 1

Uden tillæg	Tillæg for særlige betingelser	Samlet energiramme
53,2	0,0	53,2
Samlet energibehov		64,8

Energiramme BR 2018

Uden tillæg	Tillæg for særlige betingelser	Samlet energiramme
30,4	0,0	30,4
Samlet energibehov		64,8

Energiramme lavenergi

Uden tillæg	Tillæg for særlige betingelser	Samlet energiramme
27,0	0,0	27,0
Samlet energibehov		64,8

Bidrag til energibehovet

Varme	42,2
El til bygningsdrift	15,2
Overtemp. i rum	0,0

Netto behov

Rumopvarmning	20,4
Varmt brugsvand	14,8
Køling	0,0

Udvalgte elbehov

Belysning	27,8
Opvarmning af rum	0,0
Opvarmning af vbv	15,0
Varmepumpe	0,0
Ventilatorer	0,0
Pumper	0,4
Køling	0,0
Totalt elforbrug	24,0

Varmetab fra installationer

Rumopvarmning	21,8
Varmt brugsvand	1,7

Ydelse fra særlige kilder

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

Be18 – iteration 2

Nøgletal, kWh/m² år

Renoveringsklasse 2

Uden tillæg	Tillæg for særlige betingelser	Samlet energiramme
70,9	0,0	70,9
Samlet energibehov		46,7

Renoveringsklasse 1

Uden tillæg	Tillæg for særlige betingelser	Samlet energiramme
53,2	0,0	53,2
Samlet energibehov		46,7

Energiramme BR 2018

Uden tillæg	Tillæg for særlige betingelser	Samlet energiramme
30,4	0,0	30,4
Samlet energibehov		46,7

Energiramme lavenergi

Uden tillæg	Tillæg for særlige betingelser	Samlet energiramme
27,0	0,0	27,0
Samlet energibehov		46,7

Bidrag til energibehovet

Varme	54,0
El til bygningsdrift	0,4
Overtemp. i rum	0,0

Netto behov

Rumopvarmning	15,1
Varmt brugsvand	17,2
Køling	0,0

Udvalgte elbehov

Belysning	27,8
Opvarmning af rum	0,0
Opvarmning af vbv	0,2
Varmepumpe	0,0
Ventilatorer	0,0
Pumper	0,4
Køling	0,0
Totalt elforbrug	20,5

Varmetab fra installationer

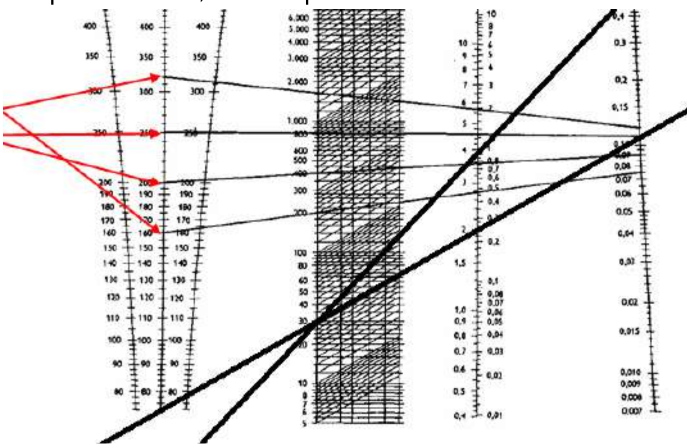
Rumopvarmning	21,8
Varmt brugsvand	4,0

Ydelse fra særlige kilder

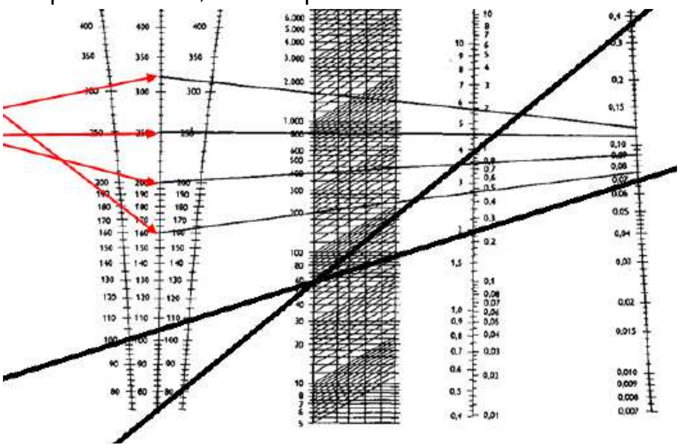
Solvarme	0,0
Varmepumpe	0,0
Solceller	0,0
Vindmøller	0,0

APPENDIX 5 – VENTILATION

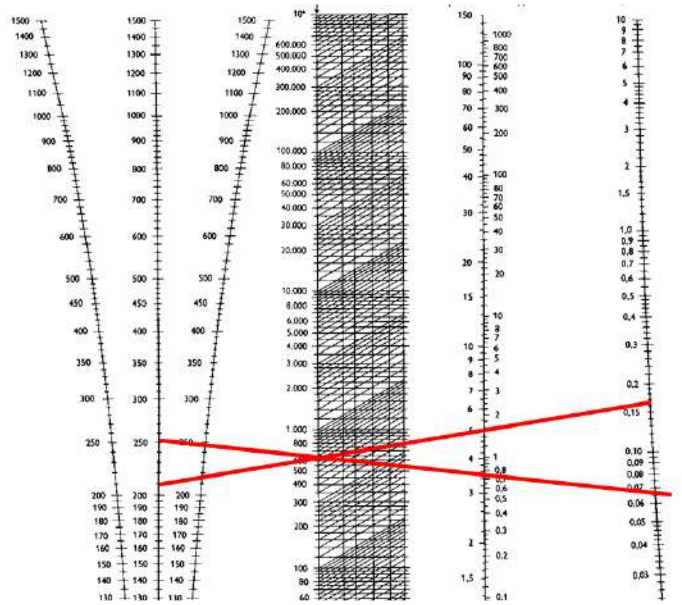
Displacement, 30 m³ per h



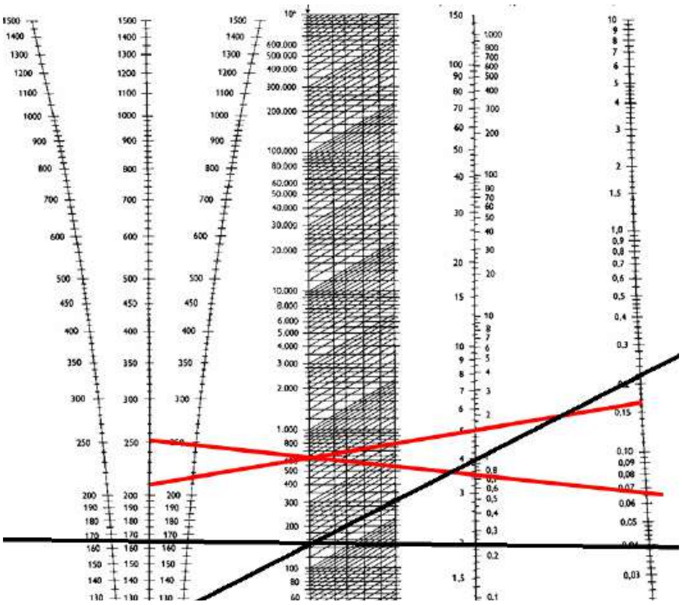
Displacement, 60 m³ per h



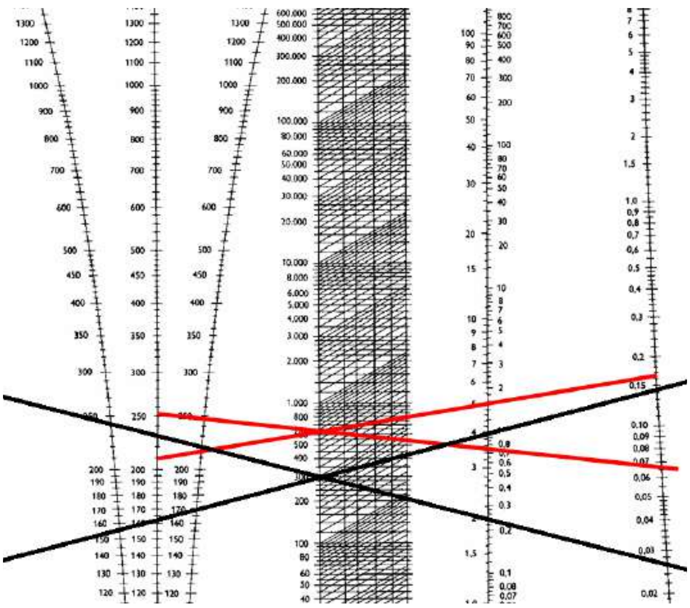
Displacement, 100 m³ per h



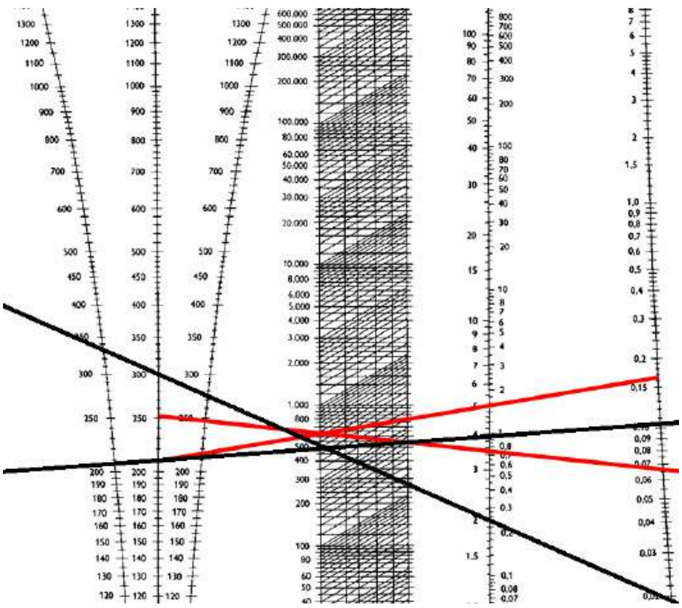
Displacement, 150 m³ per h



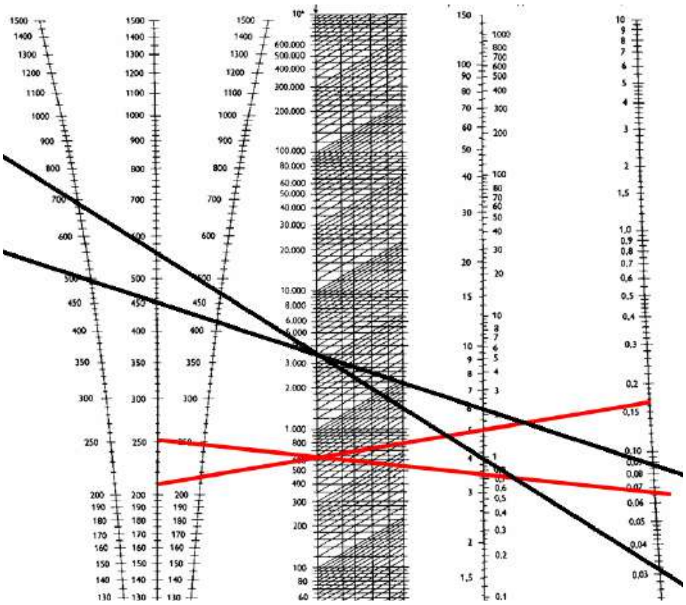
Displacement, 300 m³ per h



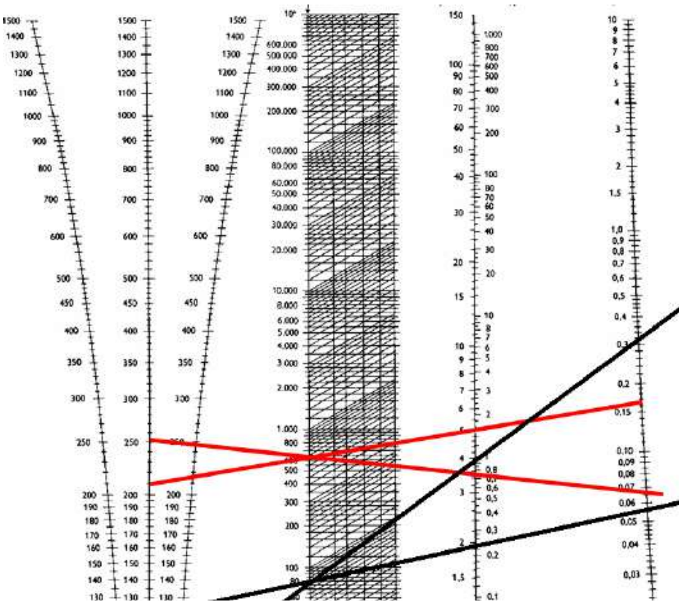
Displacement, 500 m³ per h



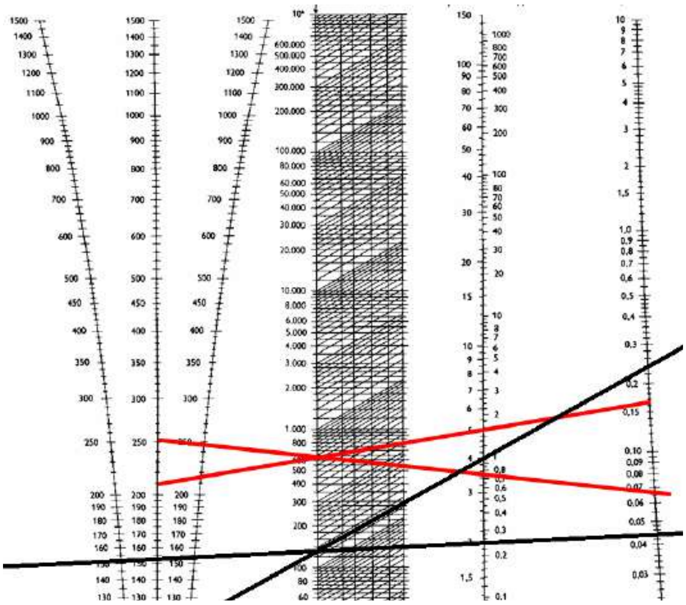
Displacement, 3500 m³ per h



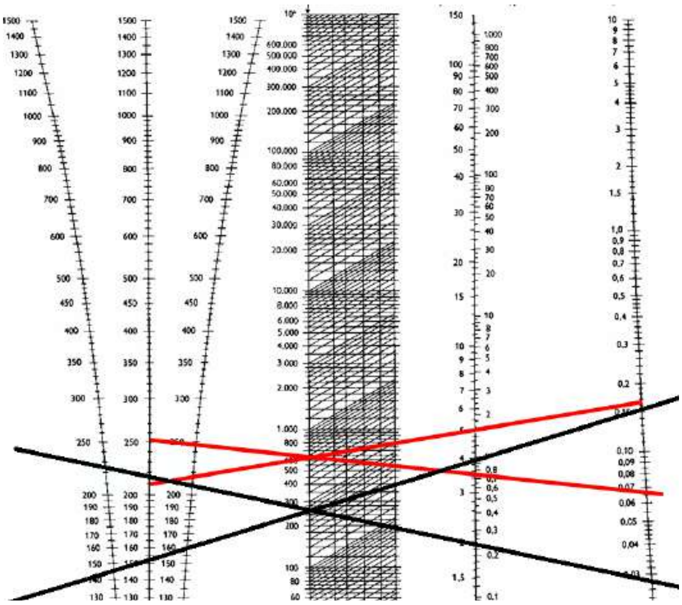
Mixed, 80 m³ per h



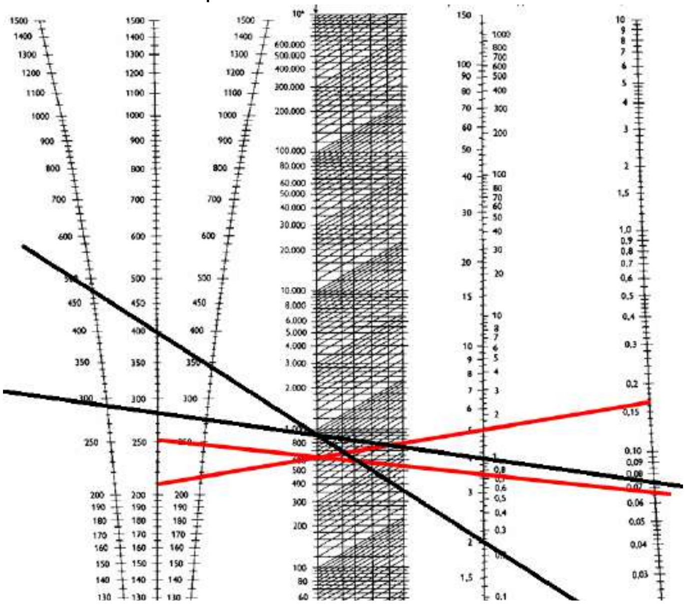
Mixed, 130 m³ per h



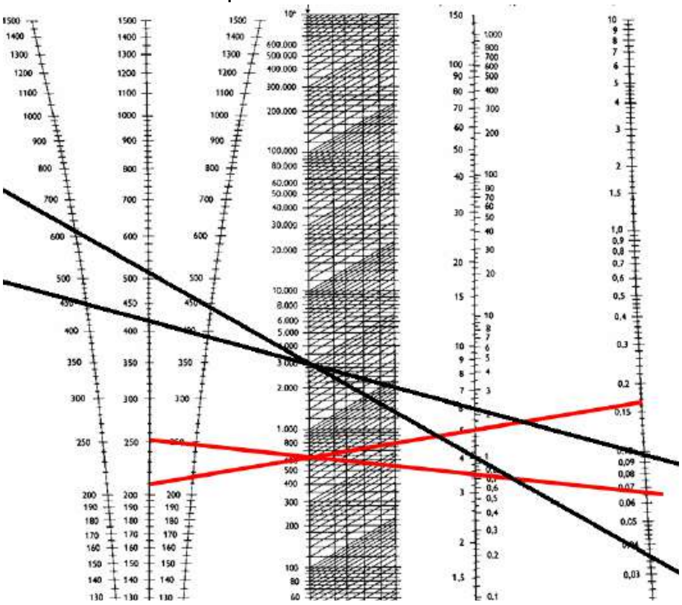
Mixed, 260 m³ per h



Mixed, 900 m³ per h



Mixed, 3000 m³ per h



APPENDIX 6 – ACOUSTIC PERFORMANCE

Hz	Lamella	Floor	Glulam	Gypsum	Door	Window	Acoustic
125	0,5	0,15	0,4	0,15	0,2	0,35	0,6
500	0,65	0,1	0,11	0,06	0,06	0,18	1
1000	0,94	0,07	0,1	0,04	0,08	0,12	0,95
2000	0,88	0,06	0,07	0,04	0,1	0,07	0,9
4000	0,86	0,07	0,05	0,04	0,1	0,04	1

	Lamella	Floor	Glulam	Gypsum	Door	Window	Acoustic
Heart	308,3 m2	460 m2	272 m2		27,3 m2	75,7 m2	401,5
Patient	30 m2	30 m2		52,7 m2	5,46 m2	6,7 m2	
Family	32 m2	32 m2		70 m2	2,73 m2	67 m2	

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Title Page for Thesis

This title page is ***mandatory*** for theses in all programs under the Study Board of Architecture and Design. The title page should be placed in the assignment after the front page.

(All fields must be filled out)

Education: Master of Science in Civil Engineering (Cand.Polyt.), Architecture	**Semester:** MSc04
Prepared by (full name):	
Marwa Al-Asadi	
Renée Weigelt Rasmussen	
Title of the thesis: Hospice Hjerterummet	
Supervisor´s name: Michael Lauring Per Kvols Heiselberg	
Submission date: 02.06.2025	
Is the project confidential? (yes/no): No	
External collaboration* (yes/no): No	
External collaboration partner (name of company/organization): None	
External collaboration contact person (title, name og email): None	

What is an external collaboration? Read more here

HOSPICE HJERTERUMMET

A place for life - even when time is limited. This children's hospice is meant to offer a safe and homely environment for children with life-limiting illnesses and their families. The project explores how architecture can support comfort, dignity, and sustainability in times of emotional and physical vulnerability. Through spatial empathy, natural materials, and calming surroundings, Hospice Hjerterummet reimagines how palliative care environments can feel more like home.

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