TITLE PAGE

Title
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Course
Sustainable-Tectonic Architecture:
Integrating Social Sustainability
and Climate Impact

Institution
Aalborg University

Department
Architecture, Design and
Media Technology

Main Supervisor
Luis Filipe dos Santos

Techinical Supervisor
Thomas Juul

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Appendix
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Emil Vinther Schmidt

Julie Damgaard Holst

Malthe Jokumsen Kjær

Nikoline Rueskov Timmerby

Oliver Schüsler Nielsen

Périne Christiane Michèle Lehé

ABSTRACT

This report presents a design for an urban operation of social housing in Vilsundvej in Nørretranders located in Aalborg Øst. The project aims to implant a sustainable complex, with a stronger attention to social sustainability, creating a place where residents are the main concern. Different methods and steps have been used to arrive at this goal. An analysis phase, studying the statistics of the area, looking at the climate information but also going on site, experimenting it and talking to the people living there, questioning their way of living in this area, their needs and wants. Workshops took place to start the implantation on the site and the design of indoor spaces and layouts. The project has an urban dimension, including not only the buildings but also shared spaces, a common house, the road and paths through the site, leisure activities and green areas. Technical mediums, such as Climate Studio, BSim and BE18, were used during the whole process, helping especially during the volumetric work and indoor climate. The project is centered on social sustainability but also on tectonic construction, net zero building, adaptability, biodiversity, community and wellbeing. The design results in a complex of different buildings, for each profile, a sustainable construction, aiming for net zero building using passive and active strategies, diverse shared spaces, encouraging meeting between everyone and by all seasons, and an attention to nature, allowing biodiversity to fulfill.

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PROLOGUE

PROJECT DESCRIPTION

The project site is located on Vilsundvej in Nørre Tranders, close to a residential area of social housing. This opportunity-rich space gives potential to expand the existing housings, while providing a cohesive and secure urban district. This proximity allows us to use the strengths of the area around and work on its weaknesses to offer a new neighbourhood centered on safety, community engagement and social cohesion.

The design strategy is based on an analysis of the site and its surroundings, using both the qualities and challenges. The proposal reaches an urban density between 70 and 100% and includes details of selected typologies. The project contains two of the three typologies: typology A: dwelling for one or two people with a gross area of maximum 75 m2. B: a shared accommodation for five families, where three families consist of a single parent with one child, and two families consisting of a single parent with two children of maximum gross area of 450 m2 overall. And C: a housing unit that is accessible for one or two elderly people with a maximum gross area of 85 m2. The social approach cares about every user, offering them all safety, community interaction, sense of belonging and celebrating diversity. The technical approach prioritizes a sustainable settlement, net-zero housing and the use of organic materials.

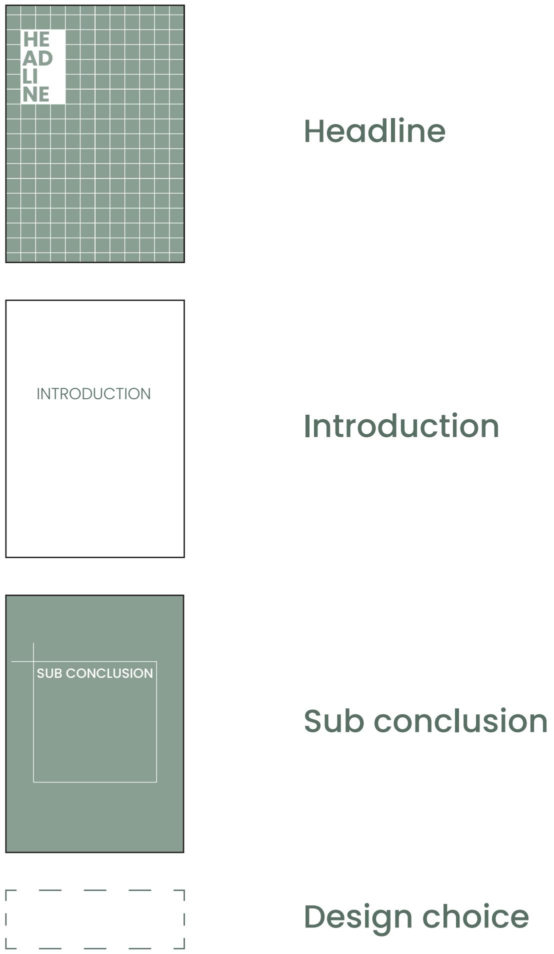
The project also integrates all necessary infrastructure such as parking for one per two residents, bike parking for each inhabitant and shared outdoor leisure areas that will cover a minimum of 3000 m2. This report unfolds all the phases of the project, from the analysis to the final iteration and through the design process, sketches and conclusions taken.

READING GUIDE

This project report introduces the task of designing sustainable-tectonic architecture with a focus on integrating social sustainability and climate impact. This is followed by a paragraph of analysis that provides a deeper understanding of the project site's location and relation to the surroundings, as well as a study of how people who already live in the area experience it and want the area to remain or be changed. These analysis helps form the foundation for the further work on a concept.

This is followed by an introduction to the design process, where various design studies have helped to form the final design proposal. As a continuation of this, the final design proposal is presented in the presentation paragraph. Here, the design's functions, materials, construction and connections to the surrounding areas are visualized. Finally, there is a reflection on the entire project and a conclusion that collects and summarizes the most important points that have been made throughout the report. At the back of the report is an appendix.

The report includes the following pages. Below is a description of what they describe:



ill. 1: Reading guide

METHODE

The project utilizes the Integrated Design Process (IDP), developed by Mary-Ann Knudstrup. The method works to unite architectural and engineering disciplines into a cohesive whole throughout the design process, optimizing aesthetics, functionality, indoor climate, and sustainability through an iterative approach. The Integrated Design Process consists of five stages: problem identification, analysis, sketching, synthesis, and presentation (Knudstrup, 2004).

01 Problem Identification: This stage involves identifying a challenge related to the project brief that the work can address and attempt to solve.

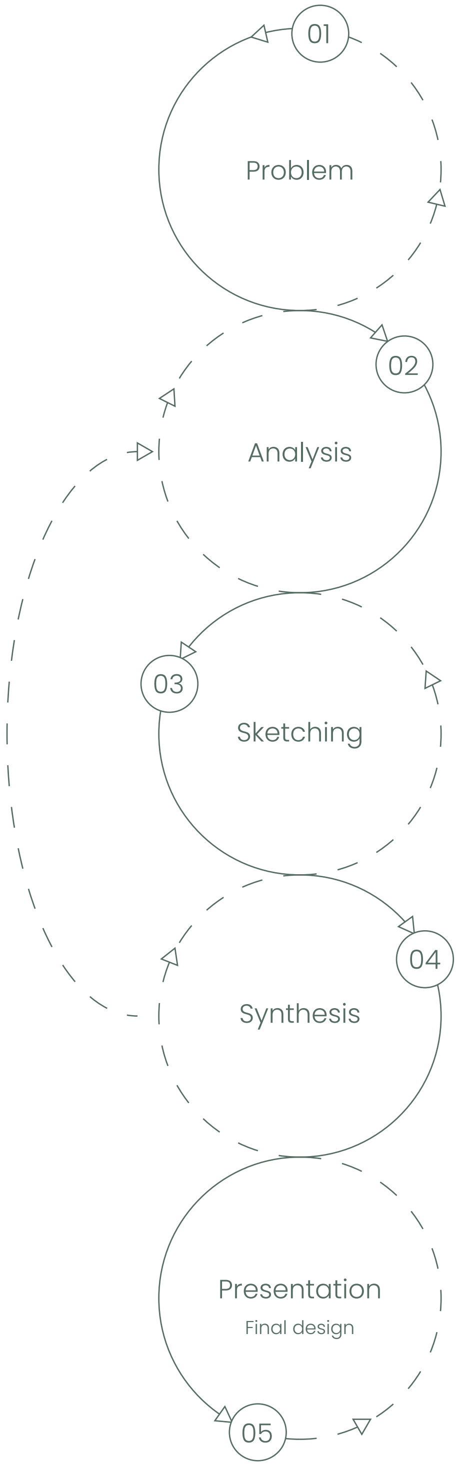
02 Analysis: Here, all information influencing the site is gathered, including factors such as solar studies, wind patterns, vegetation, and similar conditions. Regulatory requirements, local plans, and municipal plans are also examined during this phase, alongside the use of both analog and digital sketching tools.

03 Sketching: Here the project's architectural and engineering work begins through sketching, model-making, and design development to create a design proposal that satisfies requirements and ambitions regarding both technical aspirations and aesthetic considerations. This phase in particular is repeated multiple times until a satisfactory design emerges.

04 Synthesis: All details, qualities, and aesthetic choices of prior phases are brought together into a holistic design proposal.

05 Presentation: Lastly, the project's process and qualities are communicated through a report, model, or other medium. This includes documentation of the methodology behind various calculations and design decisions (Knudstrup, 2004).

AI tools were used as a proofreading tool to correct grammatical errors and improve readability. All design work and content are authored by our group.



ill. 2: Methode

THEORY

Social housing

Social housing appeared in Denmark after the first World War, where the population number in the cities increased and the apartments were too small and dense, which resulted in diseases and epidemic (Dansk Arkitektur Center, 2019). The goal was to create housing with a thought on creating more light, bigger apartments, spaces between the buildings and also reduce the rent. In the 1920s and the 1930s the architects focus was on creating apartments with only the most necessary space for each room to get a proper apartment. The idea of these apartments was mass production and social equality. In the 1970s the focus changed to more flexibility and personality for social housing, and in this time it changed to more decentralized communities, where the common house and thoughts on the green environment became a part of the values (Dansk Arkitektur Center, 2019).

Sustainability

Sustainability is the combination of economic, social and environment. The environmental aspect relies on biodiversity, climate stability, reducing pollution and waste. The economic one talks about a fair distribution of resources, avoiding destruction of environmental systems and avoiding systems based on exploitation. Social sustainability is about equity, social justice, inclusion, diversity, democracy and quality of life. The goal of sustainability is to combine all three aspects, on the same level (Peters, T. 2016).

Social sustainability

In Bo-miljø, written by Ingrid Gehl, in 1971, the environmental psychologist makes a list of 8 needs she considers essential for a sustainable architecture (Peters, T. 2016). The project follows these needs and integrates them in the design.

Human contact: people should be able to meet and interact with each other. To do so, opportunities to meet must be given like benches, courtyards and play areas. Social studies shows that human contact improves the well-being of inhabitants.

Privacy: a balance between private and public must exist. Calm areas have to be provided, isolating from noise and crowds. Both private and public areas with these qualities will be appreciated.

Varied experiences: in the buildings' sizes, materials used, width of outdoor spaces. The experiences also varies following the months, as the inhabitants use the space during the whole year it's important to take season changes in consideration.

Purposefulness: having a sense of community and a feeling of belonging in the area lived in. Providing spaces to be active, such as gardens, shared rooms, or volunteer groups maintains this feeling.

Play: Gehl argues that play is not reserved to children but is needed by people of all ages. It doesn't have to be in the form of a playground but must be expressed with spatial and sensory experimentation.

Structure and orientation: simple wayfinding and visual cues helps developing a safe feeling around the area. A clear spatial organization is also good for people with dementia, handicapped and elderly people.

Ownership and identification: being able to personalise its living environment, giving control over the place. Spaces must be easily customizable, letting freedom for furniture, colors and adaptive way of living.

Aesthetics and beauty: working on the indoor environment with parameters such as light, view, form and materials impact the feeling inside of the buildings.

Environmental sustainability

One of the components of environmental sustainability is biodiversity. Biodiversity describes the relation between living organisms and the environment they live in (Habitats & Molio, 2024). It focuses on every species and every ecosystem. It is described by the interconnection of three levels: the variety of genes inside a single species, the variety of species (plants, animals and microorganisms) in a given area and the variety of ecosystems (forests, oceans, wetlands, grasslands etc.). In all three levels an important factor is the interaction between all species.

With the urbanization and the growth of human activities, this relation and balance changed. The occupation of lands by construction, urban spaces and the resource consumption of primary resources leads to biodiversity loss. As all species are interconnected, the loss of one will impact all the other ones, including human life. If too many species of the same ecosystem were to disappear, the ecosystem itself would collapse. This could have impacts such as pollination, water purification or fertility, having direct repercussions on food production for humans (Habitats & Molio, 2024). The birds, insects and microorganisms are relevant for agriculture and must be preserved. The consequences also concern human health, economic and social life aspects. It is essential to protect the biodiversity of a site when planning to work on it.

Based on "BIODIVERSITET I BYGGERI OG BYUDVIKLING" (Habitats & Molio, 2024) there are five keys justification to work and integrate biodiversity in a construction and urban project:

The biological justification: the ecosystems need to be protected to ensure a balance and to prevent from the risks mentioned earlier. It is important to consult each species and their role (pollination, seed dispersal, decomposition, soil formation etc.) to know which aspect is in danger and which species are to worry about. The goal is to have a diverse profile of species, not only by number but especially by functions. To do so, an analysis of the existing ecosystem must be conducted.

The economic justification: a good biodiversity reduces natural risks (flood damage, water treatment, heat stress etc.) and will avoid future issues. It can be seen as an investment in the ecosystem to ensure stability and resilience.

The practical justification: vegetation and nature in general have many great benefits over construction and can be used in many ways. The proximity of vegetation or water can help naturally cool down a building without using energy. In a steep environment, the use of vegetation helps slow down the erosion of the site. In general, biodiversity supports climate adaptation.

The social and education justification: when comparing a biodiversity-rich area and an urban space, the first one benefits mental and physical health, inviting for more movement, helping reduce stress and improving the sensory experiences. The variety of ecosystems and species is a great support for education and awareness about environmental issues.

The moral justification: the idea that human life is no better than any other species. The extinction caused by humans is irreversible and stopped millions years of evolution to get to the diversity present today. Humans should not have a negative impact on their surroundings and must protect it.

Net Zero Building

A net zero building (net ZEB) is a building with a low energy demand, balanced by an equivalent amount of renewable energy (Aalborg University, 2025). It should not be confused with an autonomous building, as a net ZEB is connected to energy networks. The balance is calculated on an annual basis.

Multiple challenges and parameters need to be considered: unit of balance, type of energy used, balancing period, renewable supply options, indoor climate and energy efficiency requirements (Aalborg University, 2025).

The unit of balance talks about the measurement of energy balance. It includes primary energy (the energy coming from the natural ressources), final energy (the energy delivered to the building after the losses), useful energy (the energy actually used for lighting, heating, equipment etc.) and the CO2 emissions from the whole operation. The primary energy differs depending on the use and its factor. For electricity the primary energy factor in Denmark is 1.95 while it’s 0.85 for district heating due to heat losses.

The type of energy used is identified in three categories. The first one being the building-related energy for heating, cooling, hot water, lighting, ventilation etc. The second category relies on the users: appliances, cooking and equipment. The last is related to construction via the materials, the construction period, maintenance and renovation.

The balance period is usually annual but could also be monthly, seasonal or even multi-yearly. The annual is the most common as it covers every season and meteorological changes through the year.

Renewable energy must be used to balance the energy demand. Multiple options exist to do so: solar panels, solar thermal, bio mass, wind and wave energy. The best choice is using energy produced on site or as close as possible, to minimize the losses in transport. The systems can be put on the building itself (solar panels) or on buildings nearby.

Indoor climate is an important aspect in a design, especially in a dwelling used all year long. Indoor climate is defined by thermal comfort, air quality, lighting and noise control via acoustics. A good indoor climate must not require more energy use by the inhabitants, or the building could no longer be called net zero if additional heating, cooling and lighting have to be used. It should be thought about during the design phase and measured once the design is done.

The energy efficiency strategy is to lower the energy need as much as possible, using materials and passive strategies. A building with a high energy demand could be balanced with a large amount of energy supply and be considered net zero but would be unsustainable (Aalborg University, 2025). The main goal is to have an efficient building and balance the demand with renewable energy.

Net zero buildings are regulated by a European directive on Energy Performance of Buildings (EPBD) defining the zero energy buildings as the standard for new constructions from 31. December 2020.

VISION

The vision is to generate an area bringing people together. No matter their profile: families, single people, students, young adults, elderly residents, should live next to each other with opportunities to meet. These places should be developed as outdoor spaces, green areas and shared rooms welcoming various activities, for every profile, all year round. New ways of living should be offered, studying the needs of every group user and offering adaptive spaces for everyone. The settlement must combine architecture, nature and the people living there, creating a harmonious residential environment. The buildings' masses and architectural expression should incorporate warmth, simplicity and thoughtfulness, using materials, form and textures to do so.

The area should combine functional needs, quality of spaces and life, sense of community within the inhabitants, sustainable construction and an attention for nature and biodiversity.

PROBLEM FORMULATION

How can a sustainable, tectonic housing design, based on a visible grid structure cultivate an inclusive and socially cohesive residential community in Aalborg Øst by integrating human-scale spaces, shared greenery and leisure activities while also responding to climatic strategies that connect the site to its surrounding context?

ANALYSIS

The analysis aims to create a comprehensive understanding of the site and its surroundings as a foundation for a further design process. The chapter examines the analysis of the site's physical and social conditions in order to identify key potentials and challenges at the project site, thus it can be translated into a final design proposal, that is based on the existing conditions. The analysis looks at site analysis, user analysis, case studies and finally an overview of the design strategies and design criteria that is used to create the final design proposal.

SITE ANALYSIS

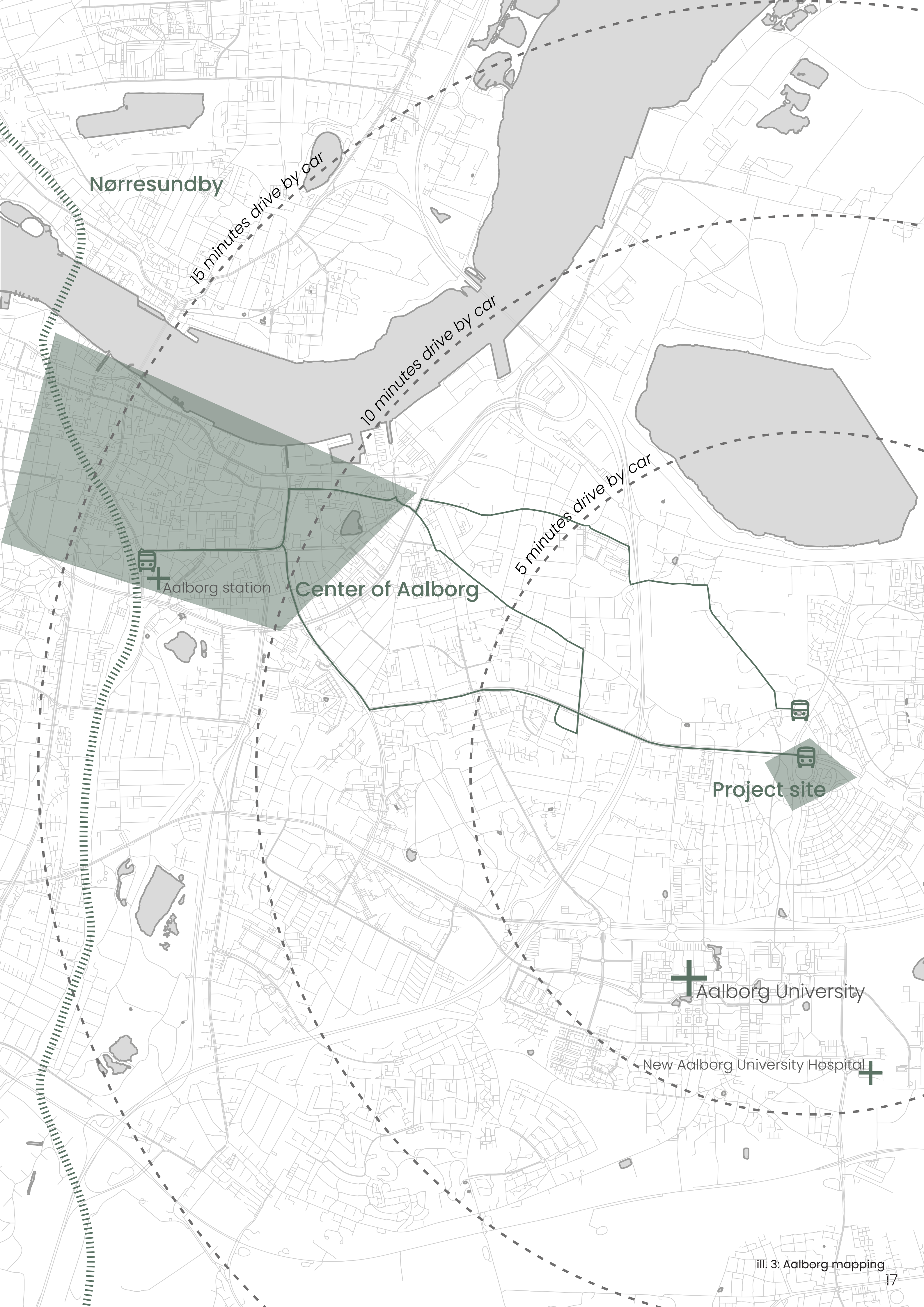
This section starts the site analysis, from a large view of Aalborg to the site scale. The site is shown in plans, pictures and sections. The analysis focuses on the whole area, studying the demographic, materials and biodiversity of the housing around. This section also goes through a climate analysis for both sun and wind impact. Finally, a SWOT of the area concludes this part.

AALBORG MAPPING

The Aalborg mapping provides an overview of the relation between the project site and the main connections around it such as the center of Aalborg, Aalborg University east, and the new Aalborg University Hospital. The mapping also shows how the city is linked to the station through bus routes, whereas driving times are defined as 5, 10 and 15 minutes. This situates the project both close to the city and the other surrounding landmarks. This relatively short travelling distance enhances the site's potential to become a residential area, as it makes it easy for the occupants to access workplaces, education and other cultural facilities, while also maintaining a green and flourishing environment.

This combination of well-connected roads and public transport highlights that the site is easily accessible which makes it suitable for daily commuting. The map also provides a clear understanding of how the position of the site is adequate in correspondence to the rest of Aalborg and its surroundings, making the area more attractive and functional for residential areas

Rail road
Bus route
Areas



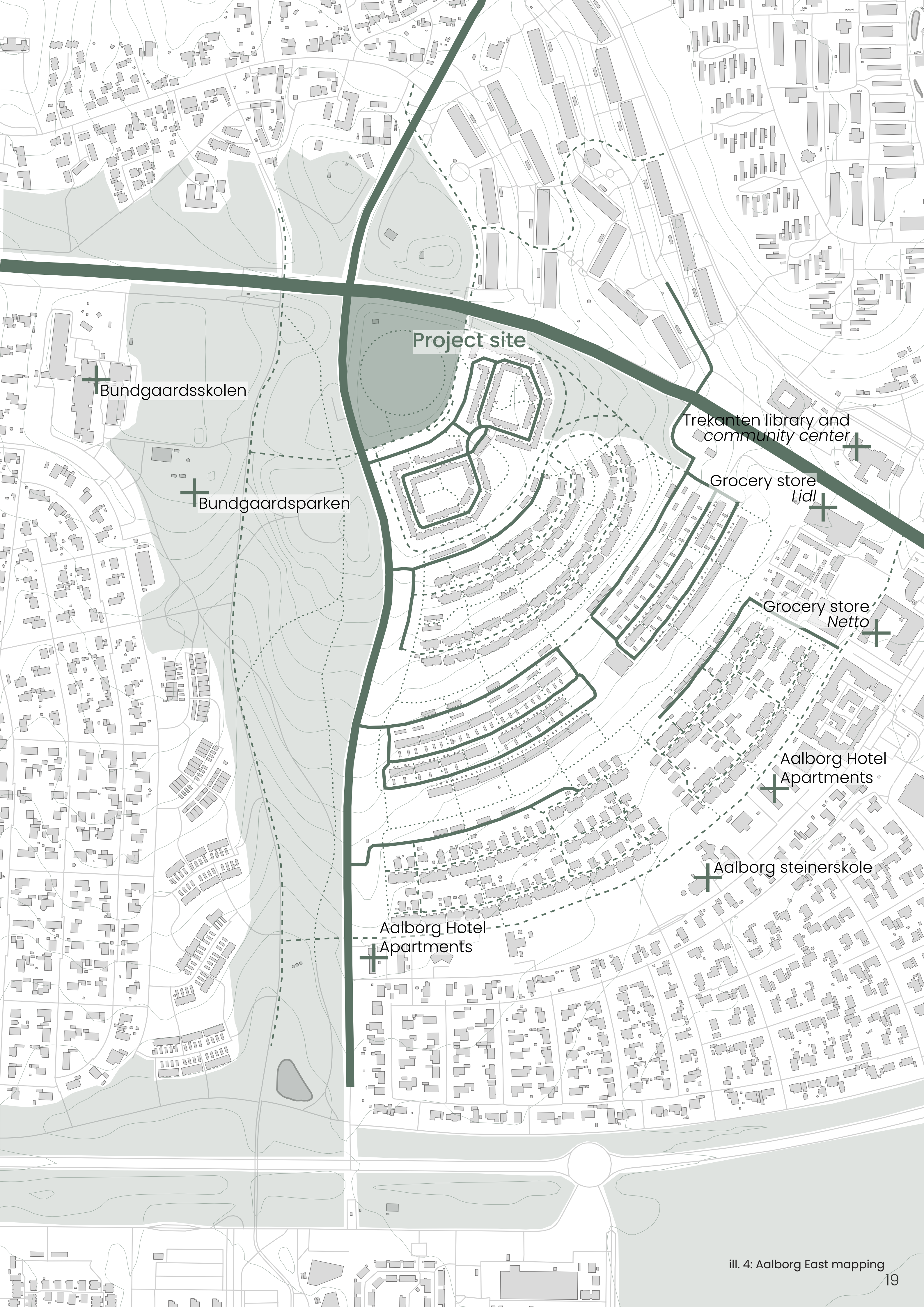
ill. 3: Aalborg mapping

AALBORG EAST MAPPING

This mapping illustrates the existing context of the project site, displaying the different infrastructure, pathways, nearby landmarks and green connections. The site is placed centrally between other residential areas with access to main roads, pedestrian paths and recreational landscapes. Within reach of the site there are grocery stores, a school and hotel apartments as well as communal spaces creating a diverse urban environment combining residential, educational, social and service functions.

The green paths provide strong connections for non-motorized movement, linking the area to surrounding parks and neighborhoods. The relationship between the built structures such as buildings, infrastructure and natural elements, creates a well-connected area with clear landmarks and fairly short distances between day-to-day conveniences, making the area fitting for a compact and accessible resident.

Landmarks
Roads
Edge - Terrain
Paths
Green areas



ill. 4: Aalborg East mapping

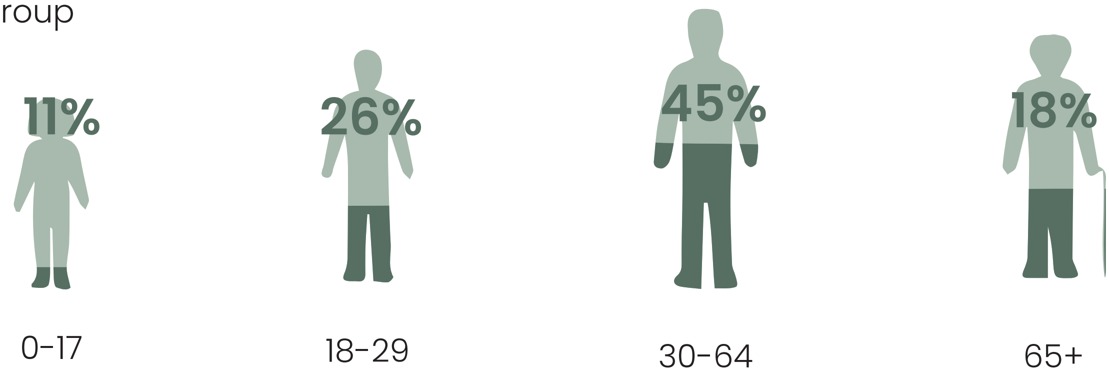
DEMOGRAPHIC

The majority of the residents live alone or without children, leading to a low person per household of only 1,4. A large diversity of group age is present, even if only a few children and teenagers live there (Boligforening, 2023).

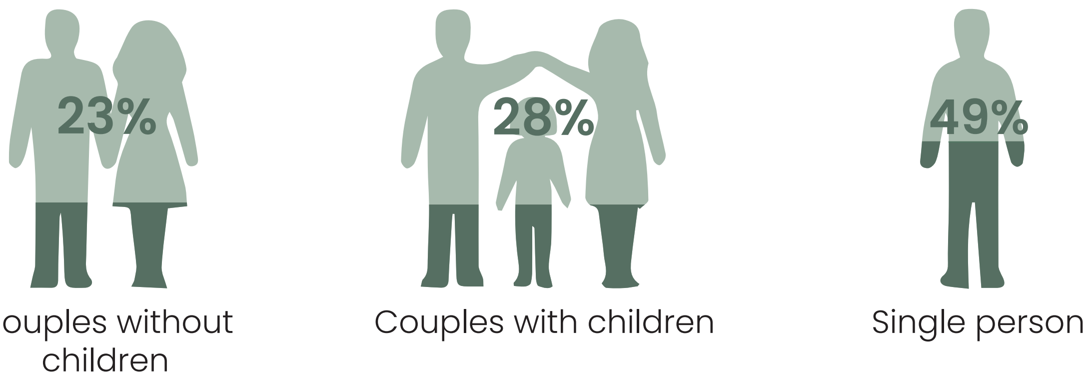
The level of education is much lower than the rest of Denmark with only 23% of residents pursuing higher education.

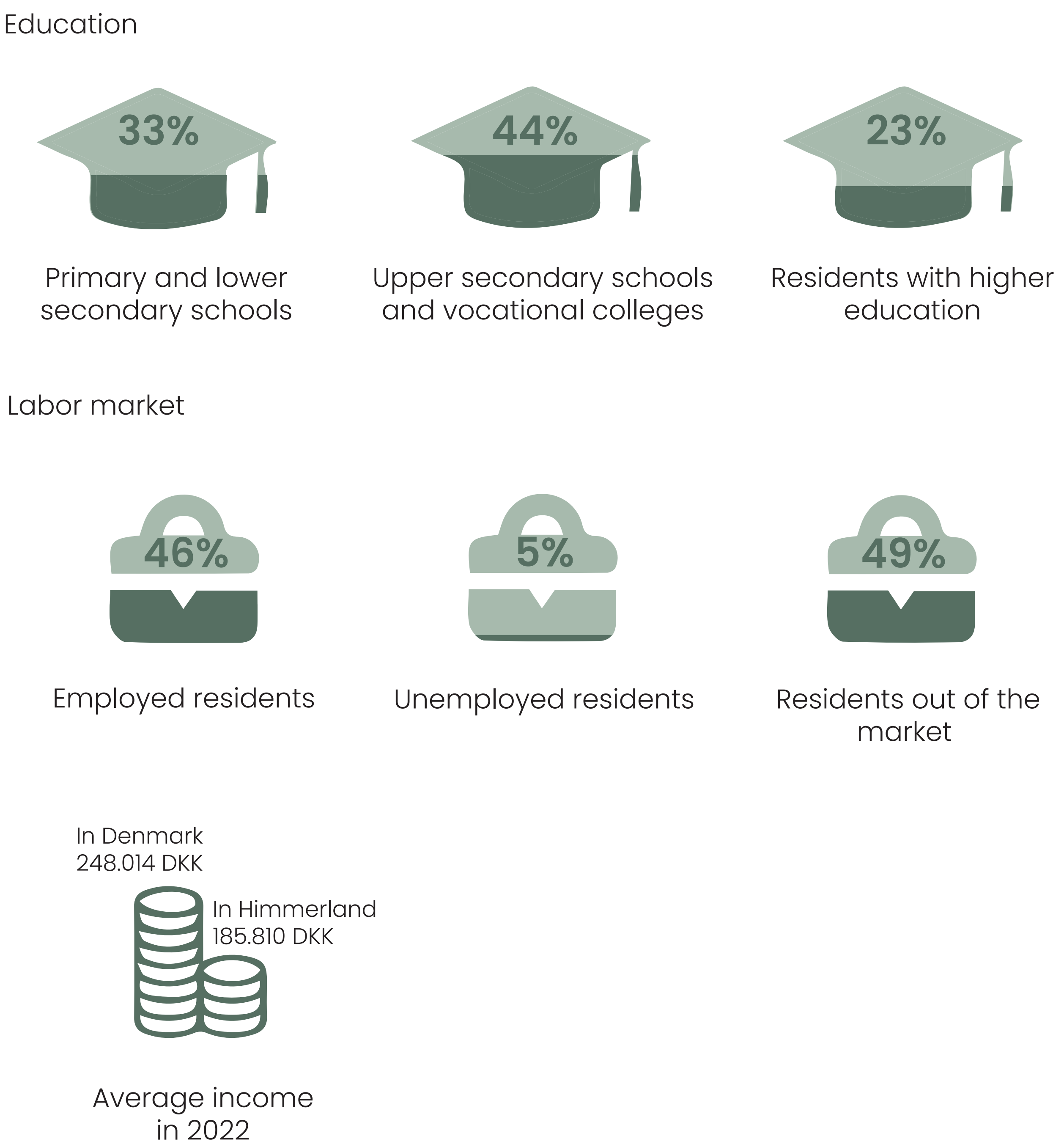
Half of the residents are off the labor market: students, retirees and others not available to work, leading to an average income 30% lower than the national one (BUILD, n.y.).

Age group



Family situation





ill. 5: Demographic

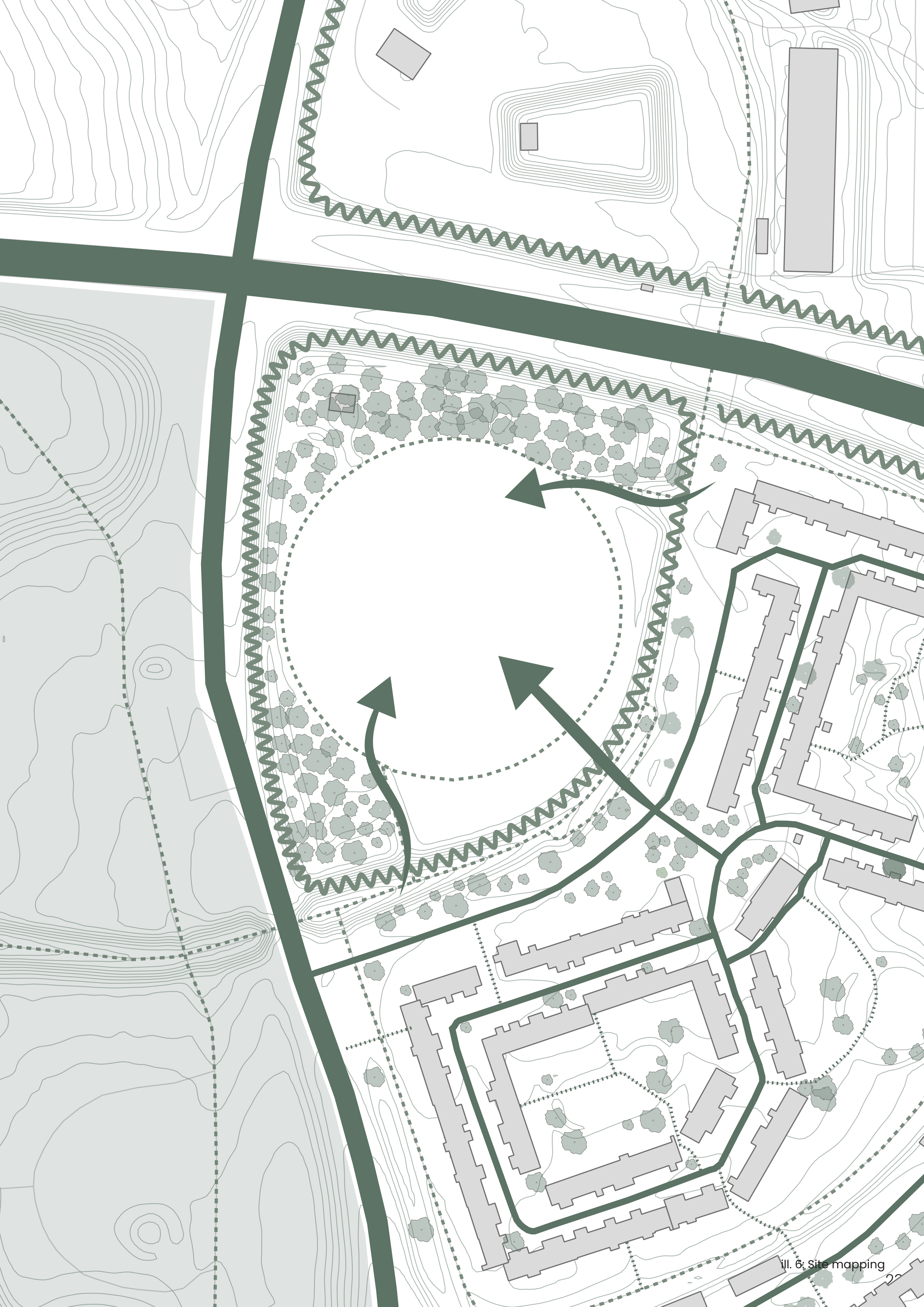
SITE MAPPING

The site mapping is a tool for understanding how the closest surroundings relate to the site. It illustrates how the existing landscape, edges, pathways, roads and buildings interact with and frame the site. The nearest neighborhood consists of 2-3 floor row-houses, with internal streets that provide parking for cars while also providing shared spaces for leisure in the middle.

The circulation onto the site occurs primarily through paths extending from the neighborhood and the surrounding walkways. A centrally placed path forms the main point of entry, directing movement directly onto the site. Access for vehicles arrives from the west offering possibilities to integrate car parking near the residents on the site, while also ensuring a convenient connection to the main road. There is also a bike and pedestrian path running along the site's edge, making it even more accessible for all kinds of transport.

The topography of the site is defined by steep surrounding terrain, giving the site an elevated character within the area. The edges are lined with dense forestry vegetation, contributing to a green and more biodiverse area. All these conditions will guide the upcoming design phases.

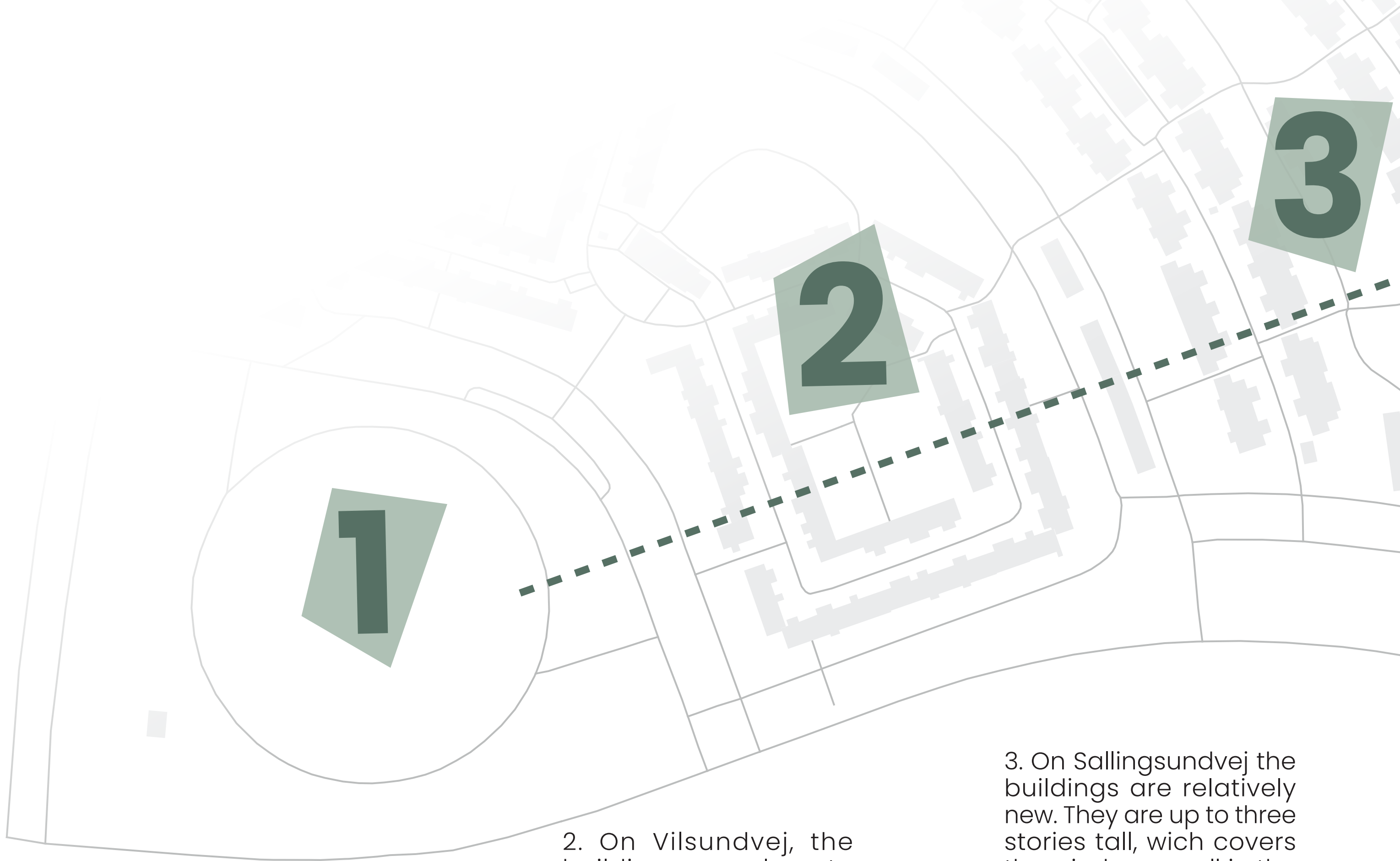
Roads
Edge - Terrain
Paths



ill. 6: Site mapping

PHENOMENOLOGICAL

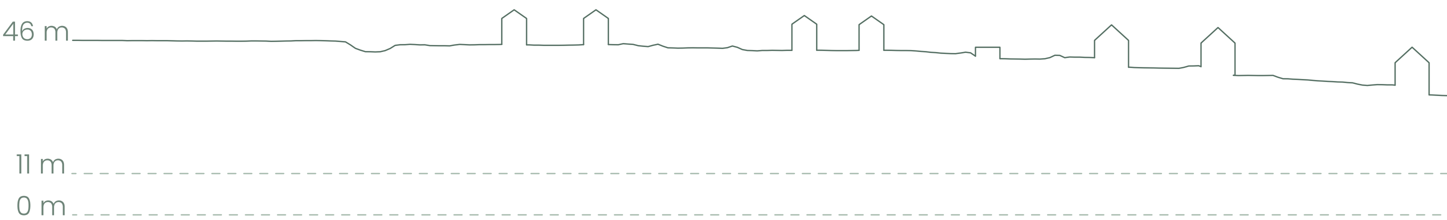
In order to gain a deeper understanding of the sensory impressions experienced by being on the site, a phenomenological analysis of both the site and the surrounding area has been prepared. The locations for which phenomenological analyses have been prepared are based on the different typologies that are found in the area. The areas each have different qualities and disadvantages, each of which provides an insight into what can be implemented on the site and what should be avoided.



1. The site is a flat and open surface with trees to the west, that covers the site from the wind. On the site there is a football pitch, with birds on it.

2. On Vilsundvej, the buildings are close to each other, and the street is very curvy. The sightlines are therefore relatively short, and the area can be a bit hard to navigate in.

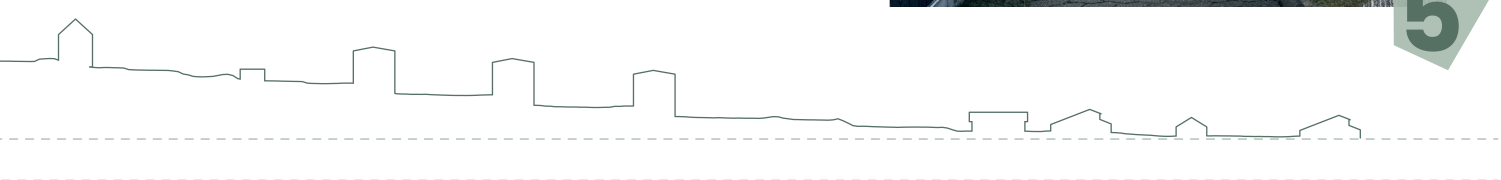
3. On Sallingsundvej the buildings are relatively new. They are up to three stories tall, wich covers the wind very well in the voids. However the sun-conditions is not optimal in the voids.



ill. 7: Phenomenological

4. On Næssundvej they have a lot of opportunities for the kids to play on the playgrounds, and on the green areas. The buildings are close to each other, and there are some terrain differences.

5. On Hvalpsundvej the buildings are very close to each other, which makes the area very compact. There are multible green areas, and human scale feels good due to the relatively short buildings.



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MATERIALITY

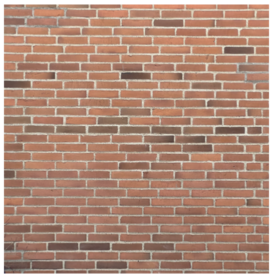
In the analysis phase, the materials on the project site and the residential areas around have been researched. The residential areas near the project site consist of bricks, tiles, wood, bricks and a lot of surrounding vegetation. The project site itself consists of paving tiles, large grass areas and a lot of surrounding vegetation. Since the surrounding residential areas are very different from each other in materiality and typology, it allows for the freedom to design a project with its own materiality and identity.

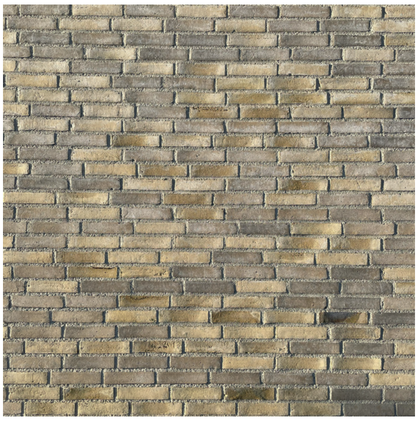
Hvalpsundvej

Project site

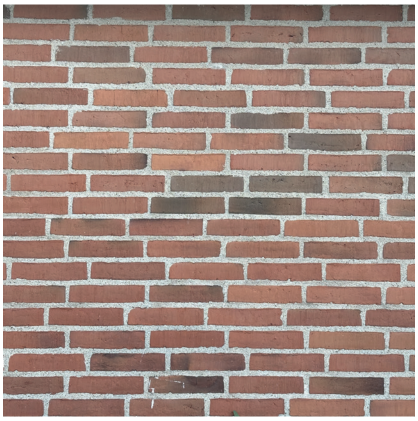
Næsundvej

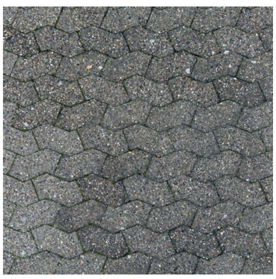
Sallingsundvej





Vildsundvej





ill. 8: Materiality analysis

SERIAL VISION

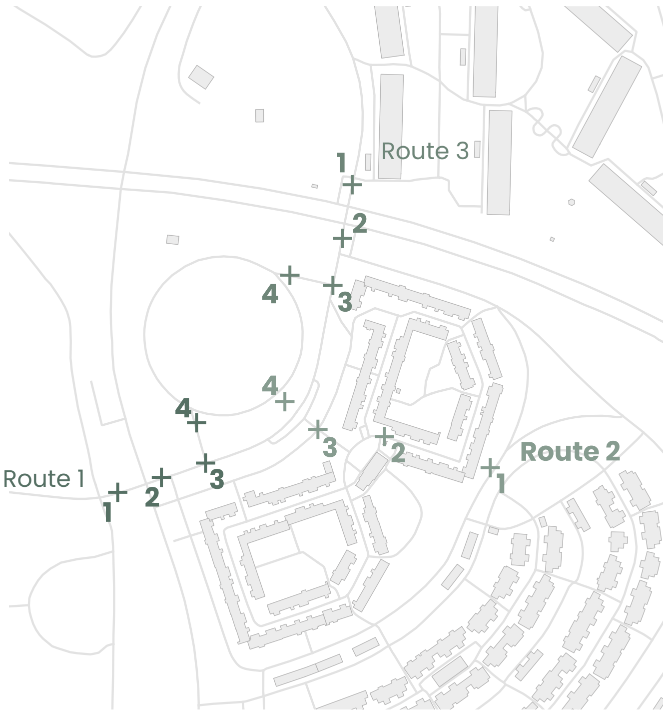
The Serial Vision shows three different routes leading up to the site. The focal points for the Serial Vision is how intuitive, accessible and inviting the three entrances to the site are.

Route 1 is the entrance from south/west of the site. This route feels enclosed because of the steep slopes on both sides of the path and the tunnel and surrounding vegetation. The stairs to the site are difficult to spot because of the dense vegetation and that makes the entrance to the site enclosed and not inviting.

Route 2 is the entrance from south/east of the site. This route passes through the residential area. This road leads through a narrow passage and three different stairs before reaching the site, and it feels like you have to know the neighborhood to know this route. Thus the route is not that intuitive, it feels more open and inviting when you meet the entrance to the site.

Route 3 is the entrance north/east of the site. This route crosses a bridge and moves through relatively flat terrain without stairs, which makes it easily accessible. The entrance to the site is visible and inviting, as the tall vegetation on one side continues along the site's edge while the other side opens up to the site.

This Serial Vision is used to explore how the building's placement and orientation makes the entrances more visible, inviting, and intuitive.



ROUTE 1

1

2

3

4

ROUTE 2

1

2

3

4

ROUTE 3

1

2

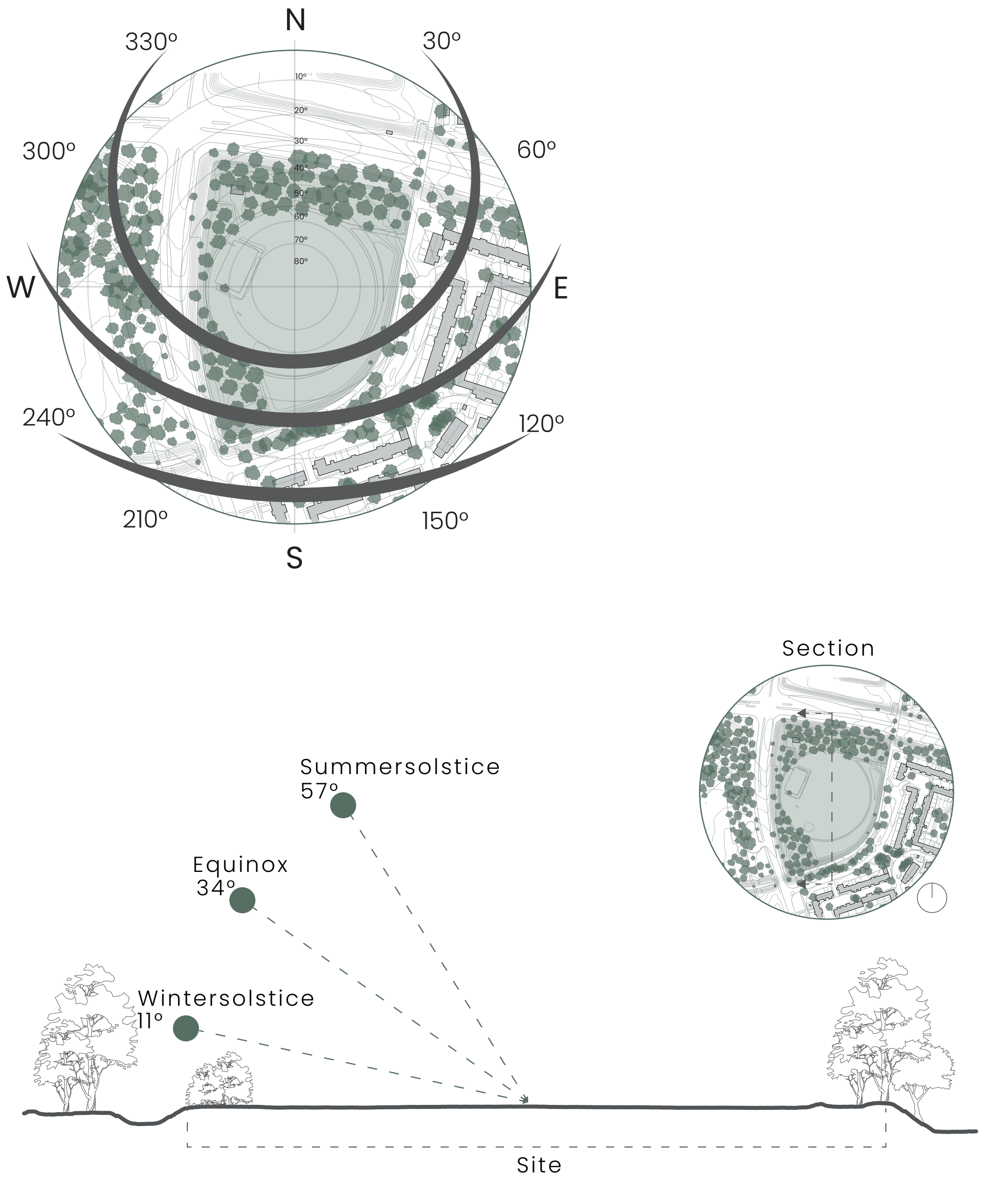
3

4

ill. 9: Serial Vision

SUN ANALYSIS

The sundiagram illustrates the sun's path during winter, equinox and summer. It shows how the sun's position varies through the course of a year, which contributes to a qualified assessment of how the sun affects the project site. Right under the sundiagram, the analysis is supplied by a section through the site, from which the sun's height is compared to the profile of the terrain and the obstructions on site. This makes it possible to identify the potential elements that might cast shadow onto the site, where the sun is highest during summer, winter and equinox. It's possible to see that during winter, the trees might have an influence on the conditions on site, since the sun is low on the sky during the day.

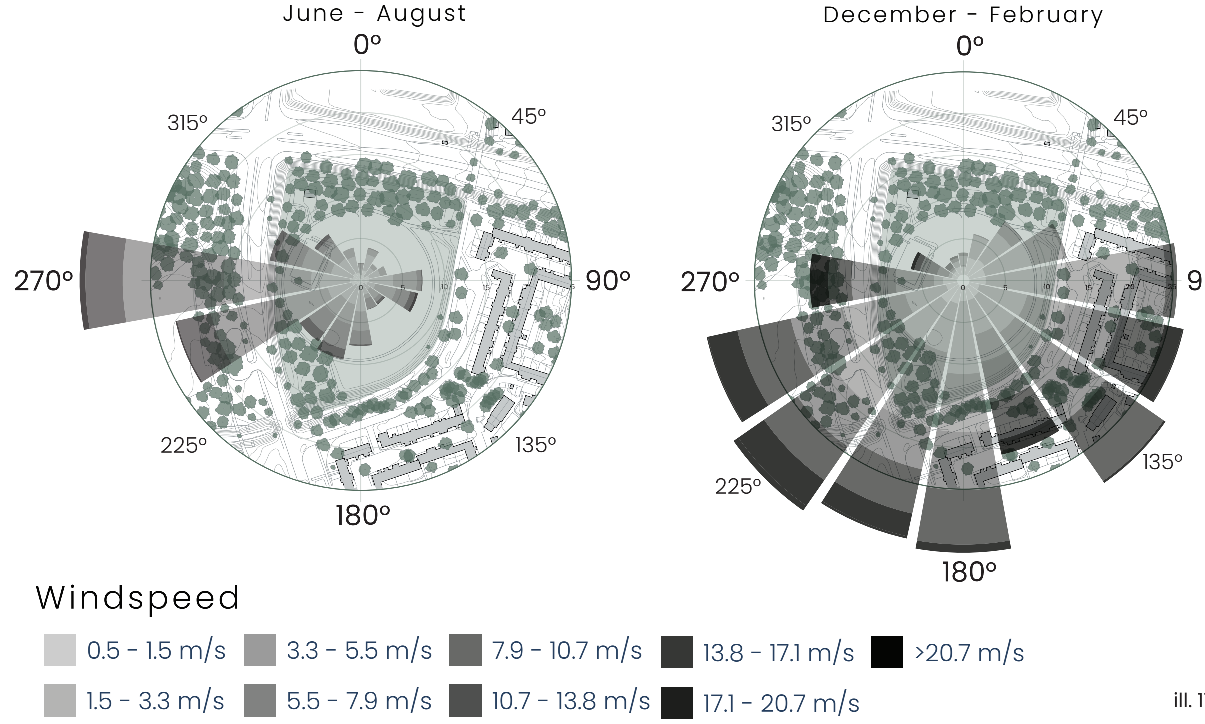


ill. 10: Sun analysis

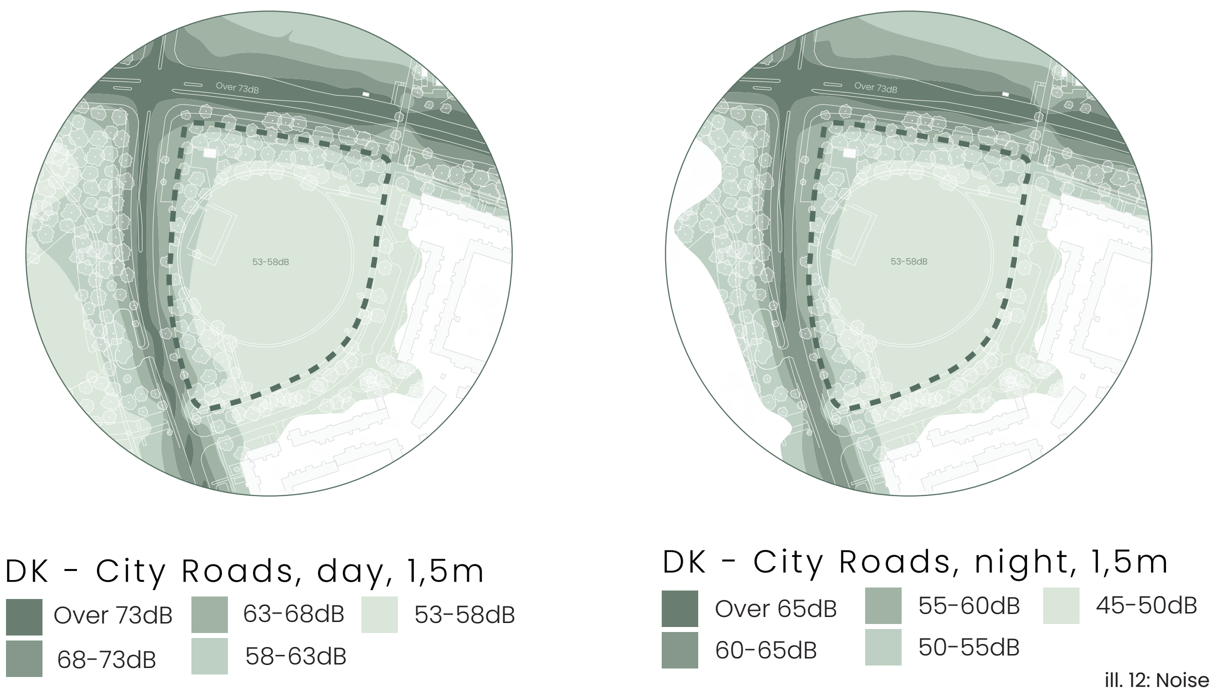
WIND AND NOISE ANALYSIS

The windmaps show the variations that occur from the wind during the winter season and the summer season. The windroses show the wind's direction as well as its speed. They are placed over the project site, since the wind is going to affect the orientation and placement of the later design in the design process. During the winter months from December to February, the wind varies a lot coming from the western, southern and eastern front. During the summer months from June to August the wind primarily comes from the western front, making it vary less than during winter.

In the bottom the noise around and on the site is shown to be very loud on the surrounding roads, but becoming silenced by the treelines. This will be assesed in the upcoming design phases.



ill. 11: Wind analysis



ill. 12: Noise analysis

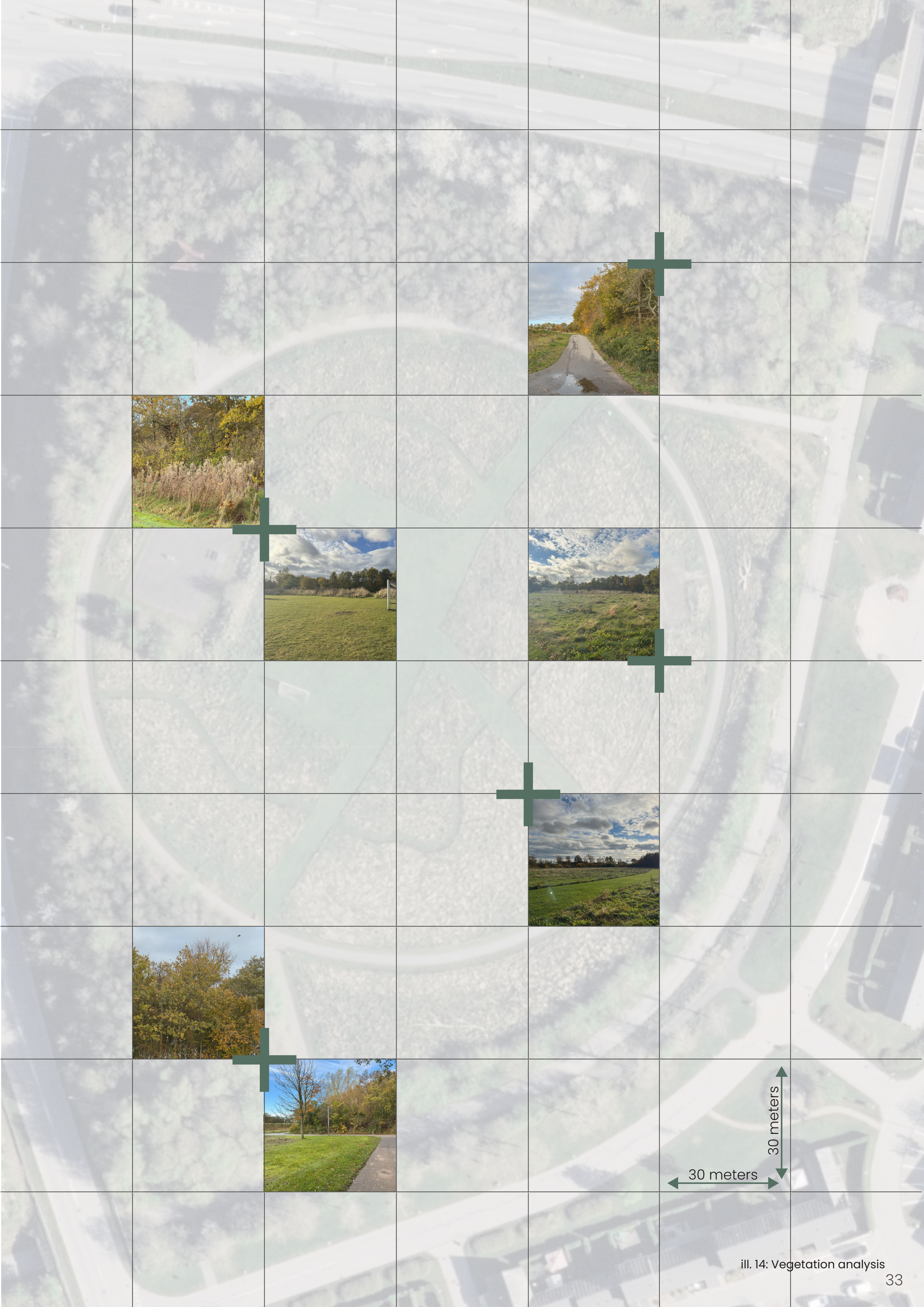
BIODIVERSITY

Biodiversity is a measure of the variety of life in an ecosystem that strengthens the stability and ecological value of an area. The habitat matrix (Strandberg, 2017) examines the area's biodiversity by comparing the indicator and ambassador species that Aalborg Kommune have put out, with the existing plant species and habitats that the area already includes (COWI, 2017). By identifying which species the current environment can support, we gain knowledge about the habitat's quality and that way determine what improvements can be made to enhance overall biodiversity.

The other page shows how the different habitats and nature types change within the site's perimeters. The area shows an edge with a diverse forestry character, where the middle consists of a lot of wild grass, and cut grass for leisure activity.

ill. 13: Biodiversity matrix analysis

Known species (site) / Indicator species	Hawthorn	Field maple trees	Oak trees	Plane trees	Meadow weeds	Goldenrods	Birch trees	European hazel	Red dogwood	Stinging nettle	Waxcaps	Wood decaying fungi	Dead trees	Grey alder
Rabbit	+				+					+				
Hedgehog	+		+		+		+	+		+		+	+	
Squirrel	+	+	+	+			+	+	+			+	+	+
Northern lapwing					+						+			
Skylark					+						+			
Bumblebees	+	+	+		+	+	+	+		+	+			+
Blue butterfly	+	+	+		+		+	+	+	+				+
Great spottet woodpecker		+	+	+			+	+				+	+	+
Orchids					+						+			
Globe flower					+									
Sticky catchfly	+				+	+				+				
Ambassador species														
Chequred skipper	+				+						+			
Clustered bellflower					+						+			
Purple orchid			+		+						+			
Red-backed shrike					+									



ill. 14: Vegetation analysis

SWOT

The SWOT analysis is a tool that contributes an overview of the key characteristics of the site, recognizing its strengths, weaknesses, opportunities and threats. It shows what things are good in the area, showing its limitations, as well as showing other external factors that could either support or threaten future developments. The SWOT helps advise future decisions, ensuring that the design process takes these potentials and restraints into consideration.

Strengths

- Site is well-sheltered from traffic hazards and noise pollution by trees and elevation differences.
- Elevation and low-rise surrounding structures ensure excellent sunlight availability while preserving southeastern views.
- Highly walkable location with shopping and daily necessities within close proximity.

Weaknesses

- The enclosed nature of the site creates a risk of isolation from surrounding neighborhoods.
- Unfavorable demographic/economic statistics for the project area.
- Limited direct site access due to insufficient infrastructure.

Opportunities

- Incorporation of green building technologies and sustainable design principles.
- Potential to create community gathering spaces and foster social interaction.
- Ability to attract diverse demographics to the area.
- Activation of underutilized land.

Threats

- Limited site size restricting development potential and viable typologies.
- Oversupply of similar developments in the area.
- Unforeseen site conditions.

ill. 15: SWOT analysis

SUB CONCLUSION

Through these site analysis, an understanding of the site and its location and character has been achieved. It has been shown that the site has potential for residential development based on the easy accessibility, close relation to the green areas around the site and the location in relation to the centre of Aalborg. The area is characterised by a human scale, low-rise buildings, which can be taken into consideration further in the process in order to create safe surroundings for the occupants. At the same time, the analysis provides the opportunity to create clearer access conditions for users, and create an experience when the occupants arrive at the site. In the following designprocess there can be worked on the connection to the other areas, the arrival and the orientation of the buildings.

Since the site is located on a hilltop, the solar analysis shows that the existing solar conditions are good and that there is effective shielding from noise from the surrounding roads, using the dense planted edges towards the roads. This must be taken into consideration to ensure good residential and outdoor living qualities. Overall, this forms a solid foundation on interaction, accessibility, biodiversity and social communities.

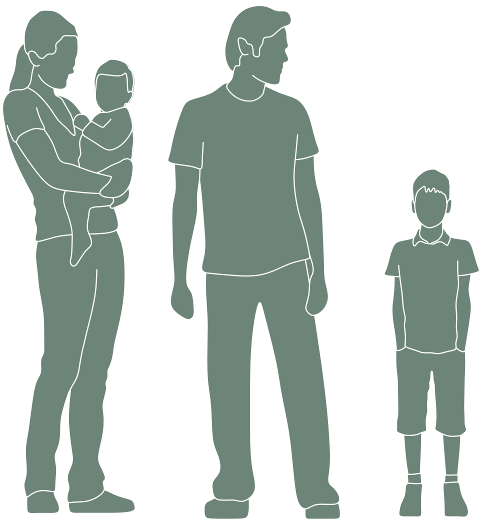
USER ANALYSIS

This section is based on the demographic analysis done in the first part and focuses on the inhabitants and the way they live in the area. User groups are determined, their needs and schedules are analysed. The analysis is based on statistics but also on an interview conducted on site. The last part is the room program and functional diagram, giving direction for the project.

USER PROFILE

The different user profiles are developed based on the analyses, focusing specifically on housing typologies A and C. The profiles create user-based expectations that guide how the final design should respond to the specific needs and behaviours of one or two person housing units and elderly residents, including others like students and families. By understanding the different ways people interact with the area and its environment, the profiles help to ensure that the design will address functional, social and perceptual aspects effectively.

Families

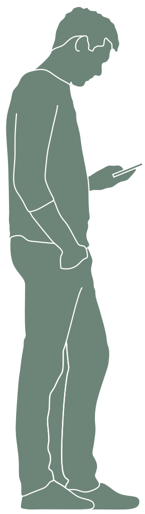


Families usually value safe and active surroundings, where children can play freely. They need flexible homes that can adapt to changing family dynamics as well as daily routines. Some of the things they look for when finding houses is access to schools, green spaces and facilities that encourage public use. The outdoor areas should encourage social interactions among neighbors, and the design should support both privacy and sociality (Broker, 2024).

Key points:

- Safe and active environment
- Flexible homes
- Proximity to schools, green spaces and public facilities
- Outdoor areas
- Private and social connections

Students

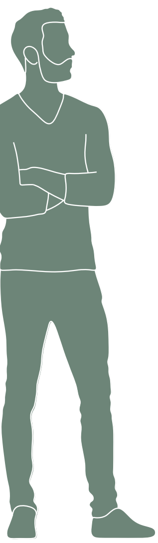


Students often look for a balance between privacy and participation. Compact apartments with access to shared conveniences, such as gardens, lounges, kitchens and other socially encouraging places to create a balance that is enjoyable for them, that changes from independence to social contact. Affordability and access to local conveniences are key factors, whereas a welcoming and inclusive atmosphere helps encourage informal connections and a sense of home beyond the privateness (Mechlenborg, 2024).

Key points:

- Balance between privacy and participation
- Compact apartments
- Access to shared spaces
- A welcoming, inclusive atmosphere that fosters informal connections
- A sense of home beyond the private space

Young adults



Young adults look for flexible and affordable homes. that is within close proximity to education, workplaces and vibrant urban life. Compact well-designed spaces that can adapt to changing needs are attractive, especially when they are paired up with shared facilities and spaces, such as common kitchens, lounges or co-working areas. A sustainable design with easy access to cycling routes and public transport, strengthens their sense of being in a dynamic and connected community (Mechlenborg, 2024).

Key points:

- Flexible and affordable homes
- Proximity to education, workplaces and urban life
- Shared facilities
- Sustainable design
- Close to public transport and cycle routes
- Dynamic and connected community

Elderly people

ill. 16: User profile

The elderly people seek a place with calm and accessible living environments. Within close proximity of public transport and services. Social spaces such as gardens or common rooms help prevent isolation, and enhance their social life. A sense of belonging and familiarity strengthens their quality of life (Rikke, 2009).

Key points:

- Calm and accessible living environments
- Close to public transport and essential services
- Social spaces to enhance social life
- Sense of belonging and familiarity

SCHEDULE

The site mixes a large diversity of resident profiles who all live in the same area with different life styles and rhythms. It can be hard to co-exist next to neighbors that you barely meet during the week.

A study of every inhabitant's profile's schedule helps understand the relations between all of them, when they can interact with each other and why these meetings are not happening now. Based on these analysis, new solutions and opportunities can be offered to include everyone based on their schedules and life habits.

Hour by hour :

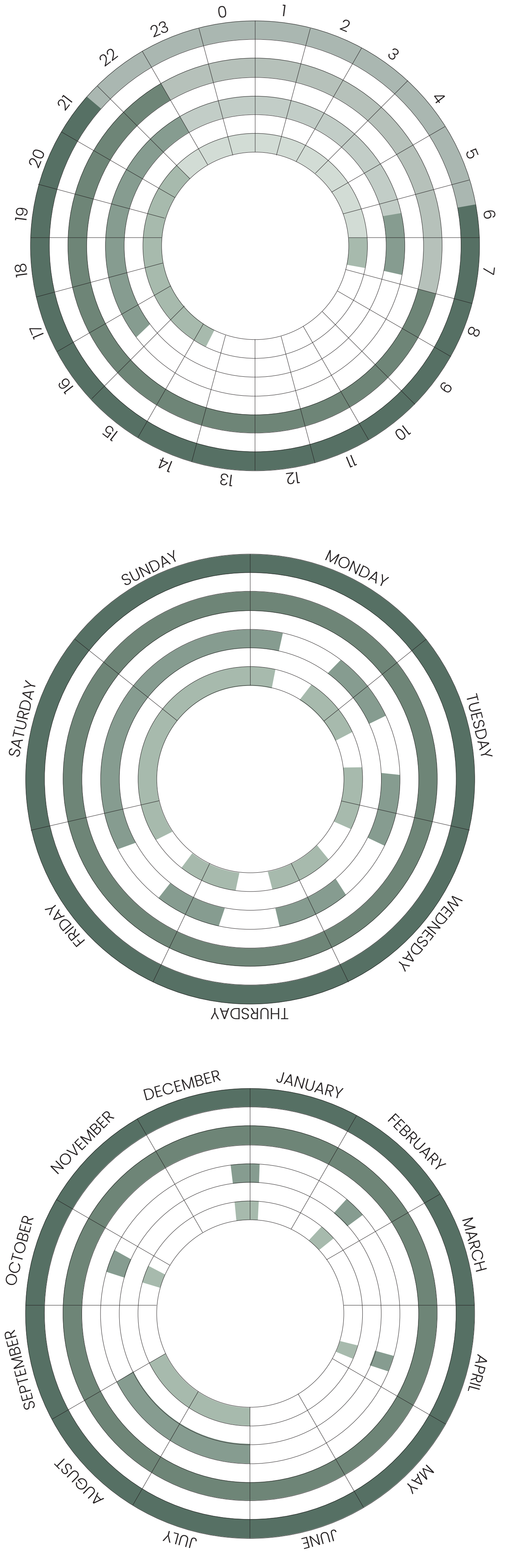
Half of the residents are not working: retirees, students or adults that can't work, it means that a lot of inhabitants are home during the day and could interact with each other if the opportunity is offered. Evening activities could gather every profile together.

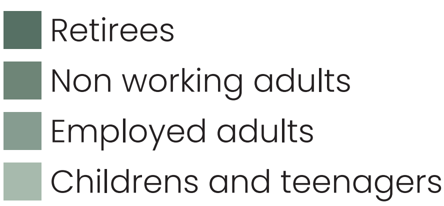
Day by day :

Weekdays are mostly occupied by school and work and committing to something after a full day can be hard for some. On the other hand weekends are a good time to come together and meet with your neighbors and friends. Here again half of the residents are home all week and offering them opportunities to fill their days is also essential for them.

Month by month :

The holidays' periods are spread throughout the year and seasons, meaning that all weathers will be experienced during those meetings. It's not possible to only rely on outdoor activities and meeting areas. An indoor space is crucial to ensure a comfortable environment all year long.





ill. 17: User schedule

INTERVIEW

This interview provides a better understanding of the experiences of a long term occupant of Aalborg øst, and more specifically Sundbyparken. Through her reflections, we gain insights on the neighborhoods strengths, challenges and everyday social life. It highlights both the community's strong connections and the area's changing character. The interview helps identify what should be preserved, improved and considered in the future design process for a new residential development.

"I'm a volunteer — involved in everything out here, the triangle, the activity house, organizing parties and so on."

"People are generally very happy to live here."

"We have something out here, some people call it a gossip bench, we're a little group that sits out here drinking coffee and eating cake."
"And then sometimes people walk by and say, 'Oh, this looks so cozy, can we join?'"

Strong sense of community

"We've got a little town out here now."

"If I ever move again, it has to be Aalborg East... and we've been here ever since."

Attachment to the Area

"I really like Aalborg East... the first place we looked at when I was 16 was a concrete building, and she said, 'I want to live here.'"

"I'm happy to live out here."

Occupant of Næssundvej
Woman
65+ years old

"It should be a bit park-like, where you can sit and relax on some benches."

Need for Better Green Spaces

"We're missing our green areas again."

"It feels more intimate when the cars aren't on the street but outside the area."

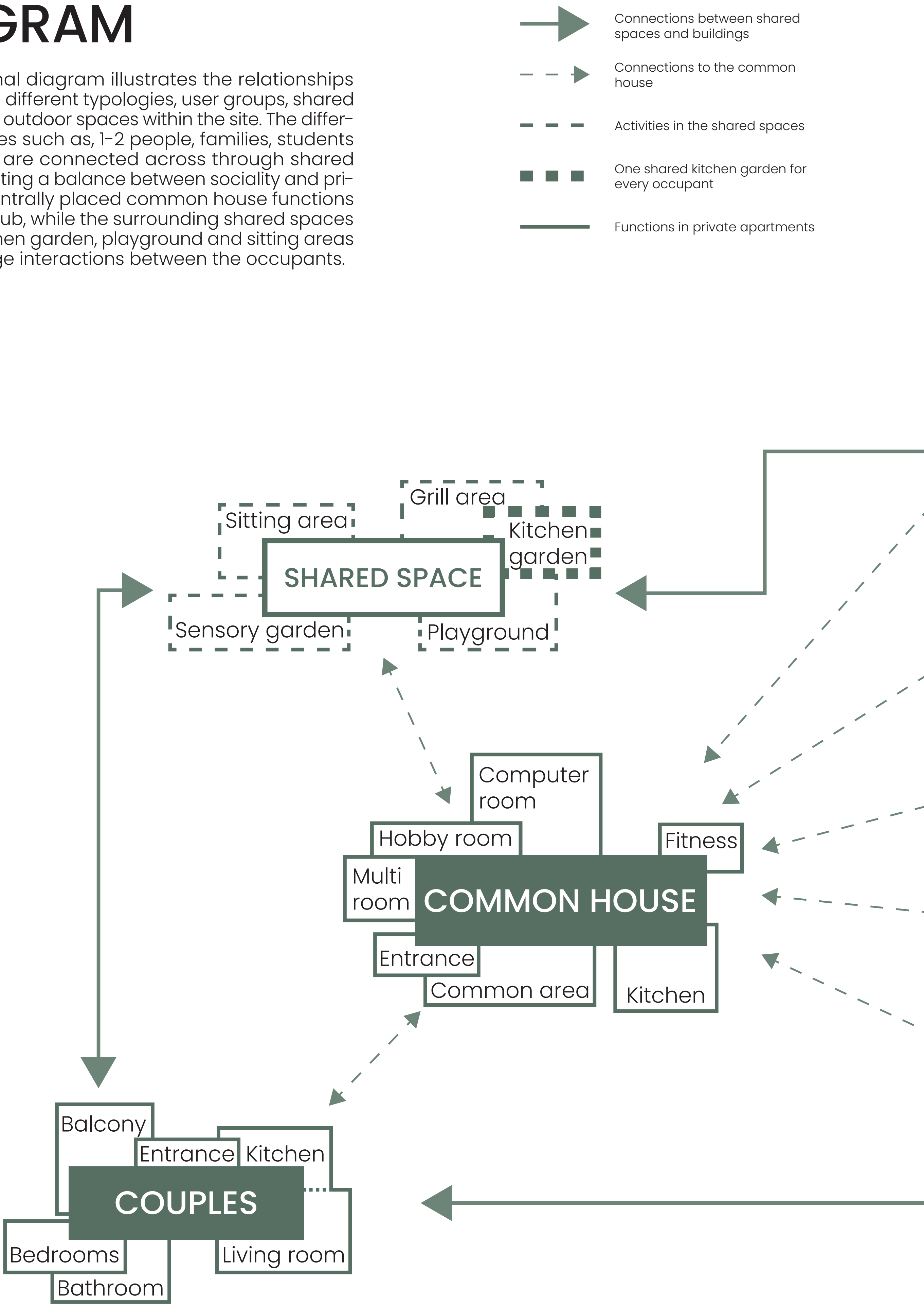
Car-Free Environment

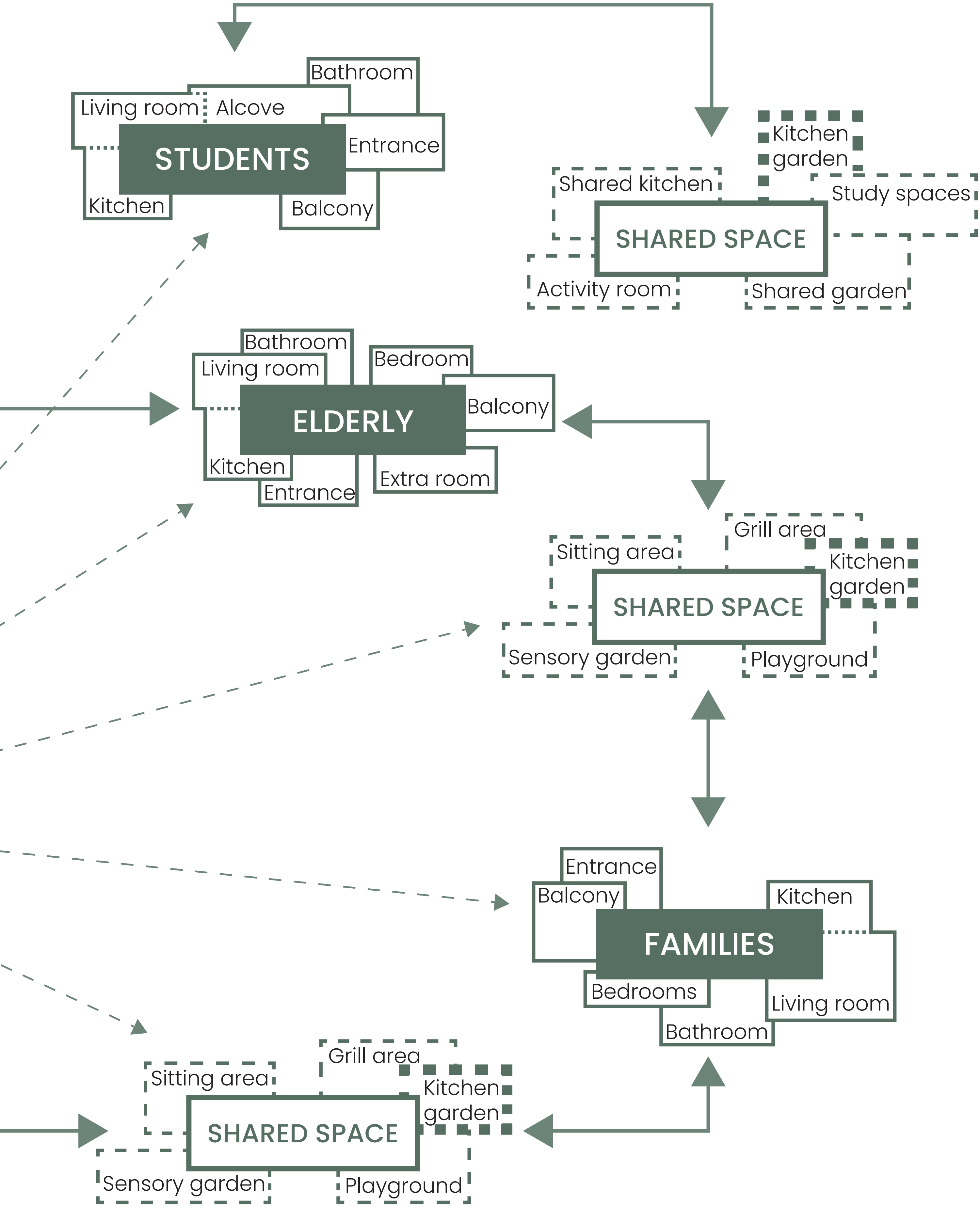
"I don't have a car, and it's nice that they aren't in the area."

ill. 18: Interview

FUNCTIONAL DIAGRAM

The functional diagram illustrates the relationships between the different typologies, user groups, shared facilities and outdoor spaces within the site. The different typologies such as, 1-2 people, families, students and elderly, are connected across through shared spaces, creating a balance between sociality and privacy. The centrally placed common house functions as a social hub, while the surrounding shared spaces such as kitchen garden, playground and sitting areas all encourage interactions between the occupants.





ill. 19: Functional diagram

ROOM PROGRAM

The room program presents a residential concept, consisting of a diverse mix of occupants, which in this case is elderly, families and 1-2 person households. These three types of residents are connected through a common house. Since there are no existing structures on site, the program draws reference to projects addressing similar user groups and spatial needs.

The different housing types are created based on residents' routines and preferences, whereas the common house should function as the social core, providing different opportunities for social connectivity for the residents.

Together, these elements create inclusivity, sustainability and an environment that balances individual comfort with a shared life.

STUDENT 1 bedroom	Quantity	Gross area	Floor	Atmosphere	Outside view
Entrance + office	1	7 m²	1st - 7th	Spacious, functional	Exterior corridor
Kitchen Living room	1	15,5 m²	1st - 7th	Spacious, aesthetic	Nature/shared spaces
Alcove	1	4,5 m²	1st - 7th	Calm, cozy	
Bathroom	1	3,5 m²	1st - 7th	Private	
Total indoor		**39 m²**			
Balcony	1	6,5 m²	1st - 7th	Calm, cozy, sunlit	Nature/shared spaces

FAMILY 4 bedroom	Quantity	Gross area	Floor	Atmosphere	Outside view
Entrance	1	5 m²	Ground floor-2nd	Spacious, functional	Nature/shared spaces
Kitchen Living room	1	42 m²	Ground floor-2nd	Spacious, aesthetic	Nature/shared spaces
Bedroom	1	10,5 m²	Ground floor-2nd	Calm, cozy	Nature/shared spaces
Bathroom Toilet	2	6 m² 2 m²	Ground floor-2nd	Private	
Children's rooms	2	11 m²	Ground floor-2nd	Calm, cozy, flexible	Nature/shared spaces
Total indoor		**115,5 m²**			
Terrace	1	19,5 m²	Ground floor-2nd	Calm, cozy, sunlit	Nature/shared spaces

ill. 20: Room program

COMMON HOUSE	Quantity	Gross area	Floor	Atmosphere	Outside view
MULTI ROOM					
Entrance	2	6,5 m²	Groundfloor	Functional	Nature/shared spaces
Kitchen	1	33 m²	Groundfloor	Spacious, aesthetic	
Toilet	2	8 m²	Groundfloor	Calm, cozy	
Multi room	1	132 m²	Groundfloor	Private	
Storage	1	15,5 m²	Groundfloor	Private	
FITNESS					
Entrance	1	5,5 m²	Groundfloor	Functional	Nature/shared spaces
Toilet	1	9 m²	Groundfloor	Spacious, aesthetic	
Fitness	1	65,5 m²	Groundfloor	Calm, cozy	
Storage	1	15 m²	Groundfloor	Private	
HOBBY ROOM					
Entrance	1	6,5 m²	Groundfloor	Functional	Nature/shared spaces
Toilet	1	8 m²	Groundfloor	Spacious, aesthetic	
Hobby room	1	63 m²	Groundfloor	Calm, cozy	
Storage	1	15 m²	Groundfloor	Private	
Total indoor		**382,5 m²**			

COUPLES/ ELDERLY	2 bedroom 2 different apartments	Quantity	Gross area	Floor	Atmosphere	Outside view
Entrance		1	8,5 m² 6,5 m²	Ground-4th	Functional	Exterior corridor
Kitchen Living room		1	34,5 m² 32 m²	Ground-4th	Spacious, aesthetic	Nature/shared spaces
Bedroom		1	13,5 m² 14,5	Ground-4th	Calm, cozy	Nature/shared spaces
Bathroom		1	8 m² 9,5 m²	Ground-4th	Private	
Total indoor			**77,5 m²**			
Balcony		1	8,5 m²	Ground-4th	Calm, cozy, sunlit	Nature/shared spaces

COUPLES/ ELDERLY	3 bedroom	Quantity	Gross area	Floor	Atmosphere	Outside view
Entrance		1	6 m²	Ground-4th	Functional	Exterior corridor
Kitchen Living room		1	25,5 m²	Ground-4th	Spacious, aesthetic	Nature/shared spaces
Bedroom		1	14,5 m²	Ground-4th	Calm, cozy	Nature/shared spaces
Bathroom		1	7,5 m²	Ground-4th	Private	
Ekstra room/office		1	10 m²	Ground-4th	Flexible, light	Nature/shared spaces
Total indoor			**77,5 m²**			
Balcony/terrace		1	8,5 m²	Ground-4th	Calm, cozy, sunlit	Nature/shared spaces

SUB CONCLUSION

The user analysis shows that the surrounding areas contain a variation in the occupant composition, with different needs, everyday lives and expectations. Across the different user groups, families, students, young adults and the elderly, a common need for a safe environment, flexible housing and access to shared activities emerges and should be incorporated through the designprocess. At the same time, the analysis of the daily and seasonal schedules shows that there is potential for strengthening social interaction between occupants, especially if the activities are offered at different times and across the different age groups.

The interview supports the importance of the area achieving a strong local community, green outdoor spaces and car-free environments, in relation to creating a sense of safety and social interaction. This shows the importance of preserving and further developing the areas social qualities, while at the same time introducing new shared activities. Overall, the user analysis forms the basis for further developing the design of building typologies, thus opportunities for common areas are created and where the balance between privacy and community becomes a central design approach for the further design.

CASE STUDIES

This section focuses on three projects, each on a different topic. They allowed us to take inspiration for construction, net zero building and social housing. This section ends with the design strategies and criterias established for the project. These design choices were influenced by all the analyses done, the site understanding and the user needs.

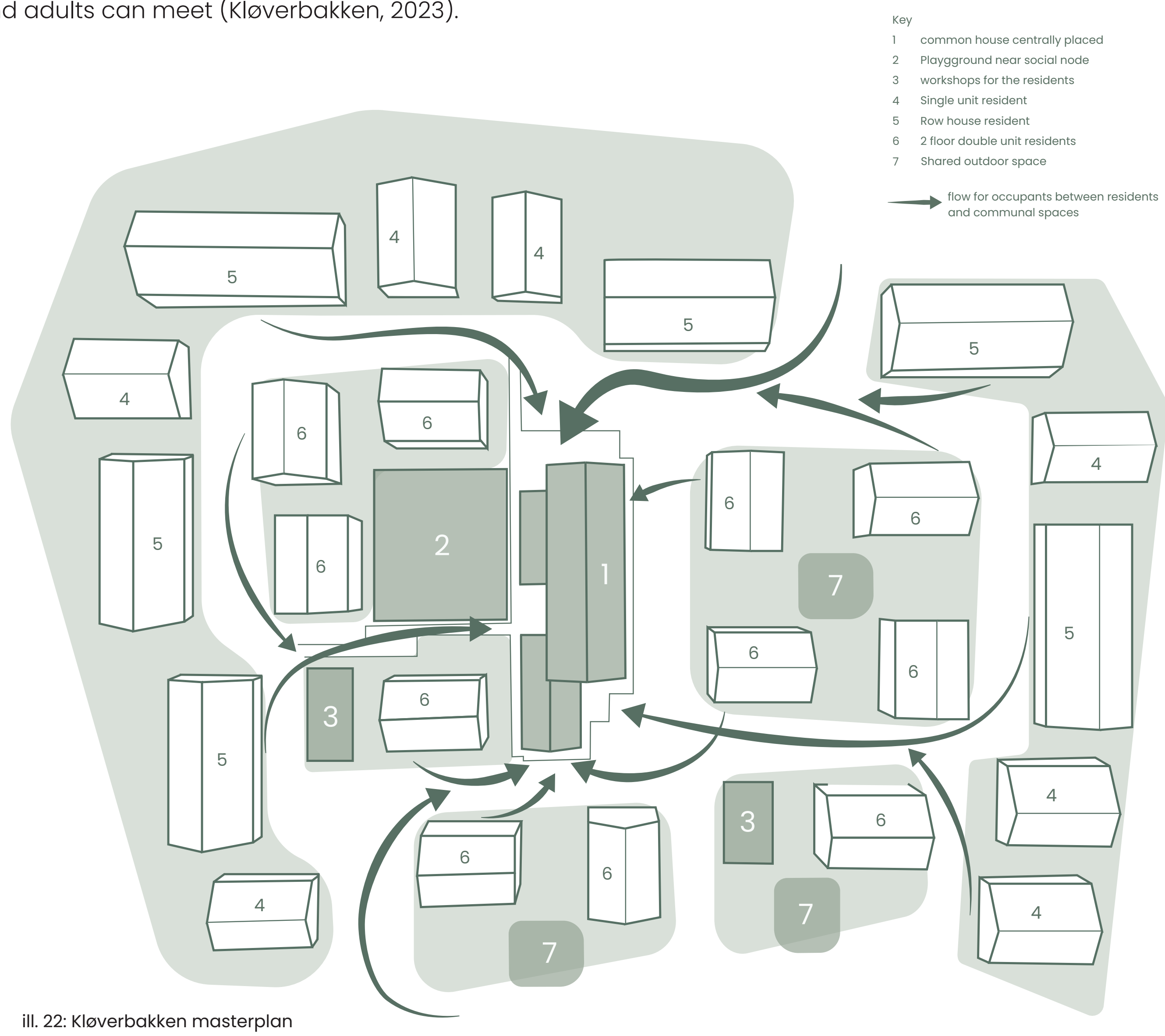
KLØVERBAKKEN

Kløverbakken is a housing community situated right outside of Odder. It is designed to cherish connectivity between multiple generations. The heart of this project is the centrally placed common house, which functions as the main communal area, where residents can unite for cooking, meeting up and other social activities. By placing it in the middle of the site, it ensures that it is the natural point for movement on the site, becoming the pillar for social life in the community (Kløverbakken, 2023).

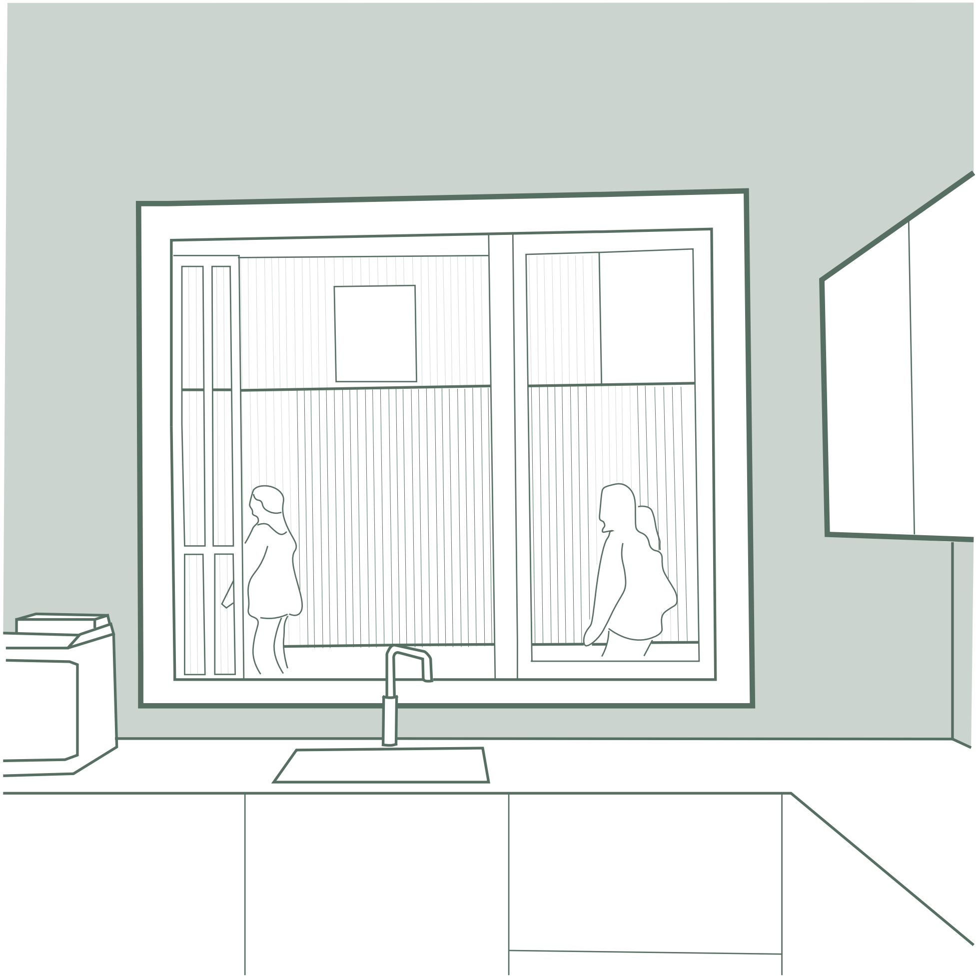
Around the site there are strategically placed workshops, creating various different social nodes. They function as areas encouraging occupants to collaborate and meet each other in another way than what the common house offers.

On the site there are multiple different typologies, these consist of single units, row houses and two floor double units. By doing this, the area allows for a broad spectrum of user groups, allowing young families, couples and elderly to live beside each other, making it a place where all kinds of age groups connect naturally. The paths and shared outdoor spaces add even more of these encounters, making the whole site one big social space. By placing the cars on the outside of the site as well, it allows the area to become even more intimate, where kids can play on the street and adults can meet (Kløverbakken, 2023).

ill. 21: Kløverbakken picture



ill. 22: Kløverbakken masterplan



ill. 23: Kløverbakken kitchen

Connections between privacy and public

The interiors of the apartments are also strategically planned, to make them integrated in the social life on site, while still having their private areas. An example of this is the kitchen window. By placing the kitchen window with direct contact to the pedestrian paths right outside, it becomes another active point of contact with the community. Daily tasks such as using the sink or preparing food suddenly become open for the people walking by. This leads to conversations, greetings or just eye contact between the residents, which then becomes a part of their daily life (Arken, 2023).

By doing this, the architecture once again functions as a social activator, strengthening the social environment of Kløverbakken. It creates a soft boundary between the private feeling and the shared space, assuring even more casual interactions between the occupants. In a community relying on building connections between residents, the act of doing daily tasks becomes an extra opportunity to encounter neighbors, creating a more welcoming and living environment (Arken, 2023).

VANDKUNSTEN

Housing on Lisbjerg Bakke (2014–2018) offers a compelling challenge to Denmark's concrete-dominated approach to multistorey housing. Designed by Vandkunsten Architects in Aarhus, the 40-unit development is organized like a small village with shared courtyards, with units ranging from 50 to 115 m². The project uses the WoodStock system, a column-beam structure in laminated wood that Vandkunsten developed alongside MOE engineers specifically for this purpose (Vandkunsten, n.d.) (Divisare, 2021).


ill. 24: Vandkunsten picture 1

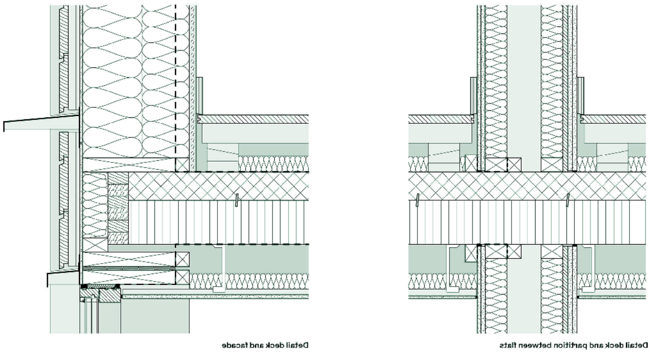
The project is driven with a pragmatic structural system where each material does what it does best. The main column-beam framework is of laminated wood, but the 23 cm CLT decks are topped with a 9 cm of concrete to meet Denmark's strict acoustic requirements for multi-story housing. Additionally the elevator and stair cores are surrounded with reinforced concrete to improve sound dampening, and steel beams are used where structural loads require them (Vandkunsten, n.d). The exterior uses untreated spruce cladding that weathers naturally, and an oversized roof overhangs and drip edges protect the wood while becoming part of the building's visual identity (Vandkunsten, n.d) (Divisare, 2021).

The facades aren't structural, because the columns placed within the walls carry all the loads. This affords the residents freedom to customize their interior layouts without compromising the building's structural integrity - It also means the building can be disassembled or reconfigured later, supporting material reuse in the future (Vandkunsten, n.d.).


ill. 25: Vandkunsten picture 2

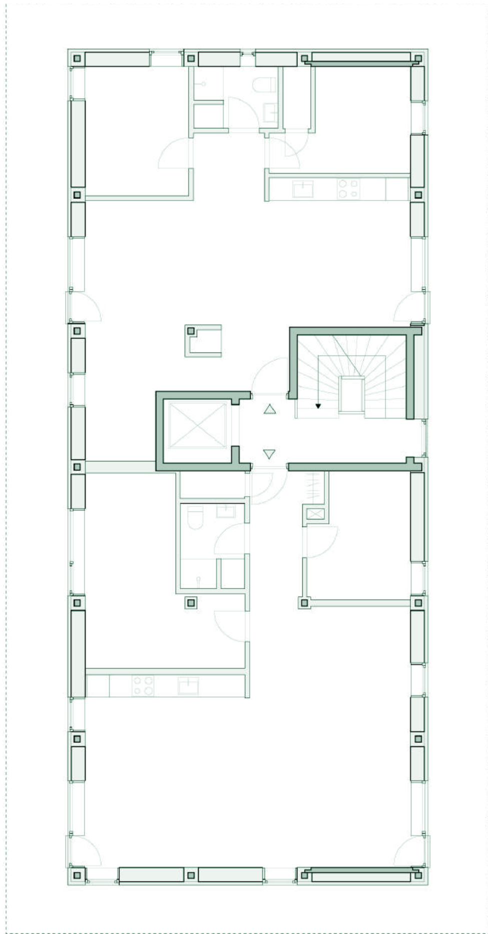

ill. 26: Vandkunsten picture 3

Another major achievement is the economics and sustainability of the project - here construction costs came in at just 11,000 DKK/m² excluding VAT, while life-cycle assessments show the building's total embodied carbon is half that of comparable concrete construction, due to timber's carbon storage capacity (Vandkunsten, 2018). Lisbjerg Bakke demonstrates that hybrid timber construction could work as a practical model for social housing (Vandkunsten, n.d.) (Divisare, 2021).



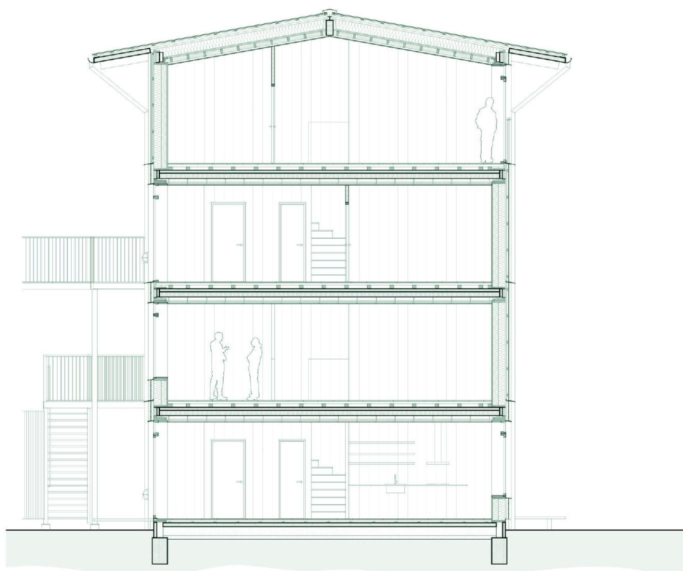
ill. 27: Vandkunsten construction

ill. 28: Vandkunsten Masterplan



ill. 29: Vandkunsten Floor plan

Facade



Section

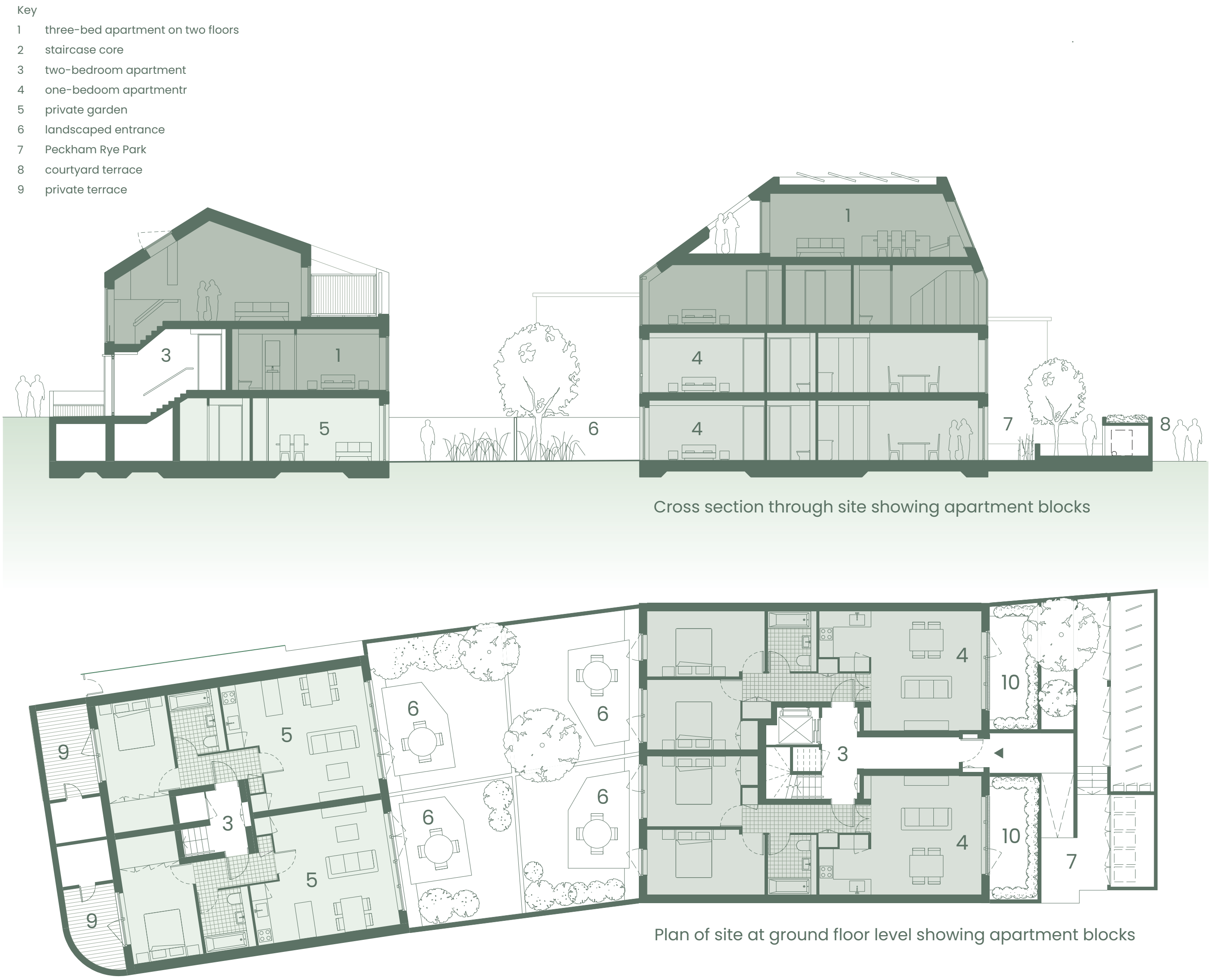
ill. 30: Vandkunsten Sections

THE RYE APARTMENT

The Rye Apartments in Peckham, London, designed by Tikari Works and completed in 2020, takes a different structural approach than Lisbjerg Bakke's hybrid system. Here, CLT fulfills two functions: the same panels serve as both load-bearing structure and finished interior walls (TDUK, 2022). This economically astute strategy eliminates separate interior finishes while creating warm, tactile spaces throughout the apartments.

The structural logic inverts typical timber construction. By positioning CLT on the interior and wrapping the entire envelope around the building it greatly helps with airtightness without major thermal bridging, (TDUK, 2022). The lightweight CLT slabs and panels, enables reduced foundations, and can be manufactured off-site and assembled in just two weeks per block (TDUK, 2022). Combined with photovoltaic panels and heat recovery ventilation, the project achieves a near-Passive House certification while significantly reducing carbon emissions (TDUK, 2022).

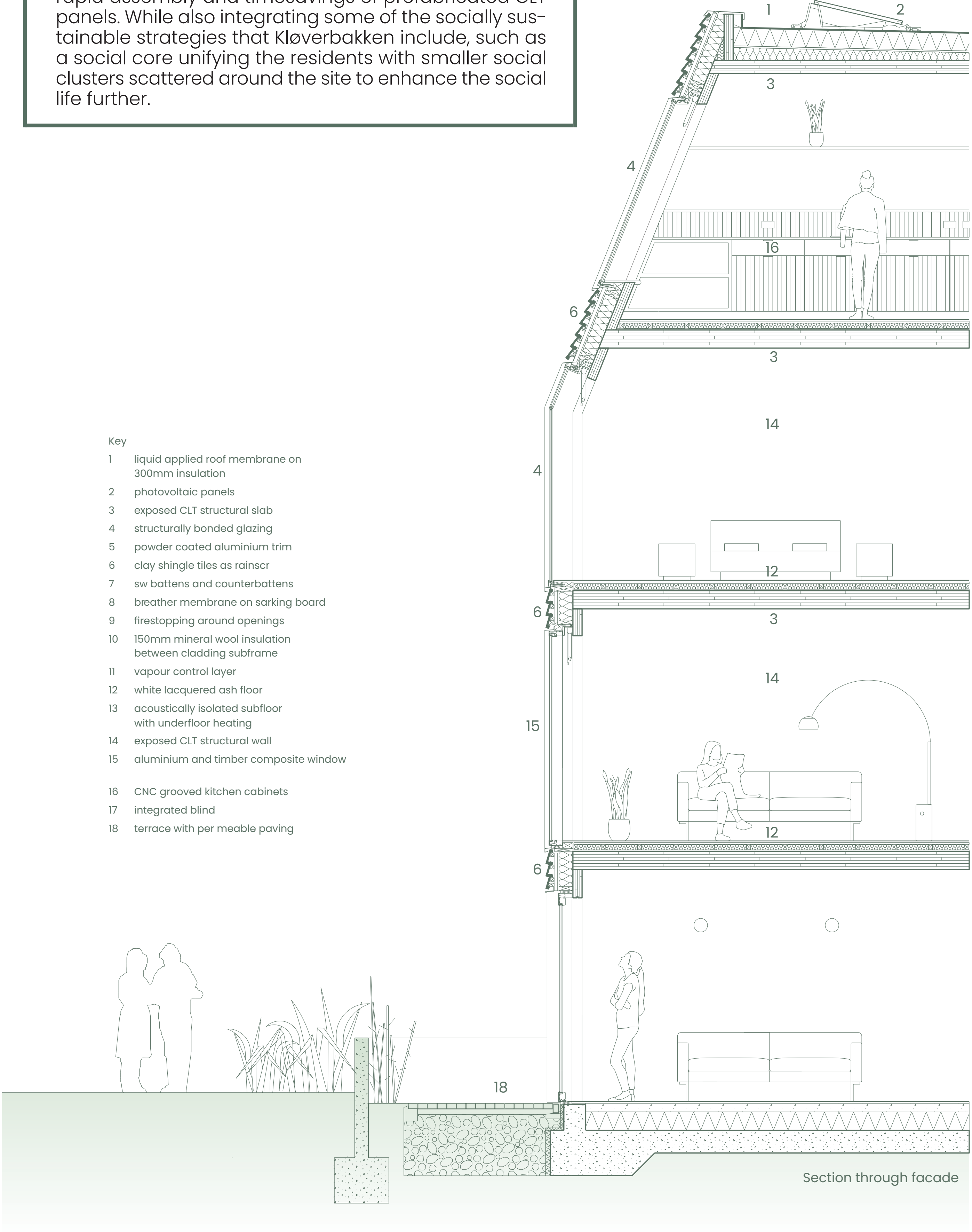
ill. 31: The Rye Apartment picture



ill. 32: The Rye Apartment plan and section

SUB CONCLUSION

Drawing from these precedents, this project seeks to synthesize all three approaches: adopting Lisbjerg Bakke's flexible column-beam structural system. Incorporating Rye's prefabricated CLT components, with the intention of harnessing the planning flexibility and material efficiency of a timber frame with the rapid assembly and timesavings of prefabricated CLT panels. While also integrating some of the socially sustainable strategies that Kløverbakken include, such as a social core unifying the residents with smaller social clusters scattered around the site to enhance the social life further.



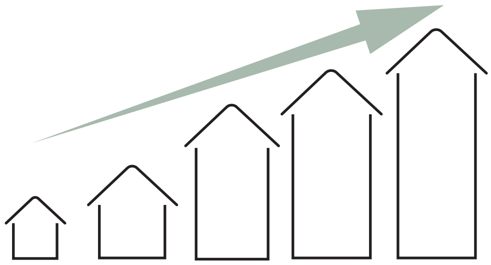
Key

1 liquid applied roof membrane on 300mm insulation
2 photovoltaic panels
3 exposed CLT structural slab
4 structurally bonded glazing
5 powder coated aluminium trim
6 clay shingle tiles as rainscr
7 sw battens and counterbattens
8 breather membrane on sarking board
9 firestopping around openings
10 150mm mineral wool insulation between cladding subframe
11 vapour control layer
12 white lacquered ash floor
13 acoustically isolated subfloor with underfloor heating
14 exposed CLT structural wall
15 aluminium and timber composite window
16 CNC grooved kitchen cabinets
17 integrated blind
18 terrace with per meable paving

ill. 33: The Rye Apartment construction section

DESIGN CRITERIAS

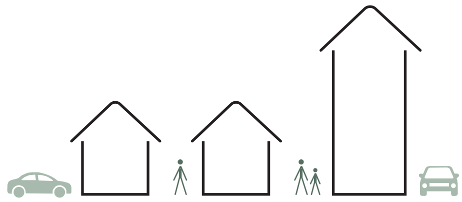
Increasing density



The density is increasing towards the north, leaving lower buildings on the south and a lot of outdoor spaces.

Criteria: 70 % density of 12 000 m2

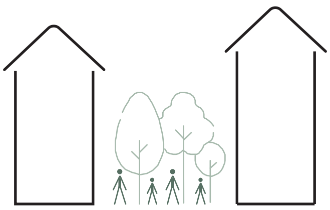
Protecting the pedestrians



No cars are allowed on the site, parking spots will be placed outside, leaving the paths to the pedestrians and bikes.

Criteria: Zero parking between the buildings

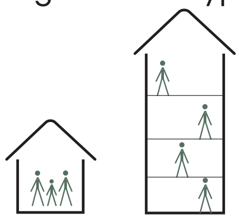
Creating leisure activities



The outdoor spaces between the building will be used as leisure areas, allowing inhabitants to meet.

Criteria: 3000 m2 for leisure activities

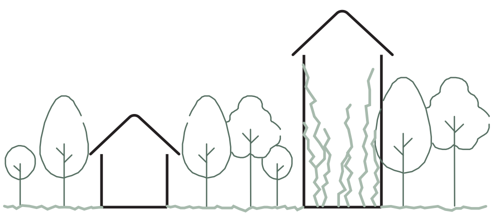
Developing different typologies



The different user groups will be placed in the buildings on the site, according to everyone's needs.

Criteria: Design typologies for students, elderly, families and couples

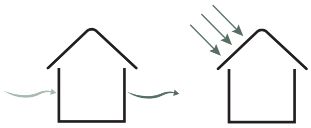
Offering green areas



The ground must stay as natural as possible and vegetation will be implanted on buildings and in the shared spaces

Criteria: Maintening the same biofactor as the actual one

Net zero energy building

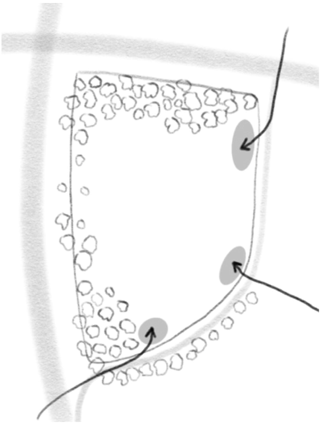


The design will include passive strategies and will be made regarding the sun and wind impact on site.

Criteria: Net Zero energy building
Low carbon emission materials

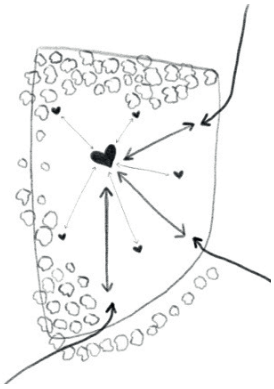
ill. 34: Design critirias

DESIGN STRATEGIES



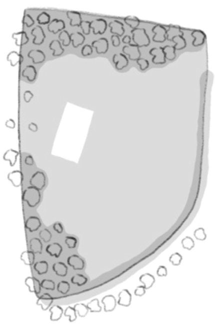
Access

After experiencing the site three pathways to access the site were highlighted. These three areas will remain clear to ensure an easy and effective entrance to the site.



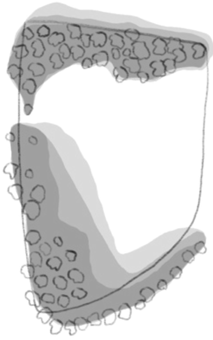
Connection

The three access leads to a central point in the middle of the site, creating a natural meeting point to place the common house and shared spaces. This space becomes the heart of the site, bringing everyone together.



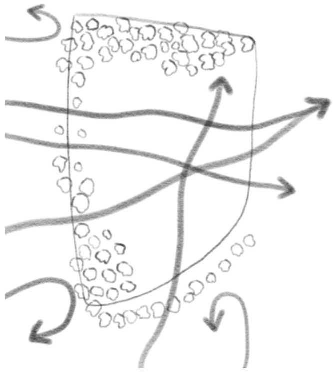
Vegetation

The site is mostly covered by grass. The north, west and south borders are trees and the east is smaller bushes. It is important to keep as much as possible to preserve this biodiversity as it is.



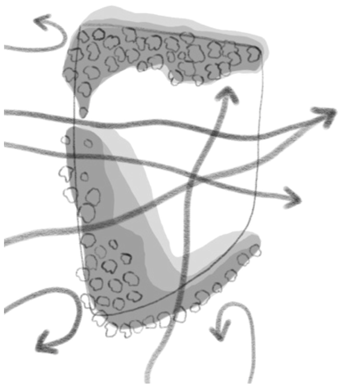
Sun

Most of the site is exposed to sun, as the vegetation is mostly on the edges. Buildings placement will play the biggest role in the shading of areas.



Wind

The wind comes mostly from the west and thanks to the trees an important portion of it is stopped before even reaching the site. The goal is to be protected from the wind, especially when the speed increases.



Sun and wind

Combining both analysis highlights different areas on the site for their strengths and weaknesses. All parts of the site can be used at different time periods all year long, depending on the conditions.

ill. 35: Design Strategies

PROCESS

This chapter presents the design development through initial models and sketches. The design process unfolded across three parallel and interconnected scales.The masterplan began with a model workshop that established the building placement on site. This initial layout was then refined through the integration of outdoor spaces, circulation routes, parking areas, and leisure areas, which ultimately shaped the overall site organization. In parallel, the architectural character developed through explorations of circulation systems, roof forms, and facade design. Finally, the indoor layouts were developed, testing different floor plan configurations for each building typology to meet the different user requirements. While presented sequentially here, these three scales were explored simultaneously, each informing and responding to the others throughout the design process.

INITIATING DESIGN PROCESS

This section includes the first initiating thoughts and ideas about what social housing is and the first design ideas for a design concept. The section goes through a brainstorm on social housing, the initiating sketches, model studies, light studies and ends up concluding with the preliminary design concept.

Brainstorm Social Housing

The initiating design process started out with a brainstorm for social housing. In this brainstorm thoughts were shared about what social housing means and implies. The main focus was on diversity and community which was associated with the word "Social housing". This brainstorm led to a common idea about what social housing is and how the further process could be designed to fulfill the properties of social housing like shared spaces, social nodes and co-living.

ill. 36: Brainstorm, social housing

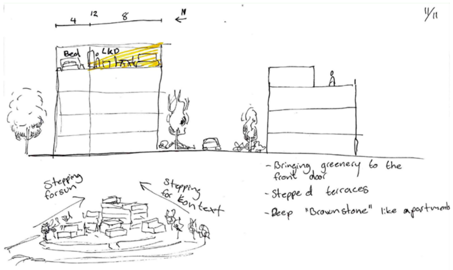
INITIATING SKETCHING

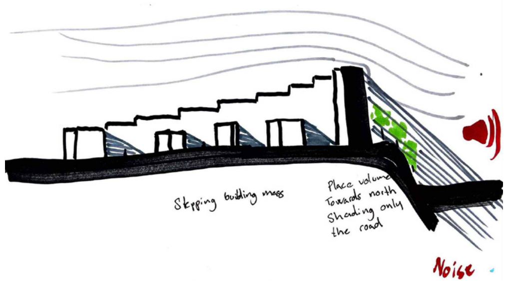
In the initiating design process sketches were made on the basis of the initiating site analysis. These sketches should start the idea generation and start the design process. In this phase the focus was especially on edges, privacy vs. public, entrances to the site and the placement of a common house.

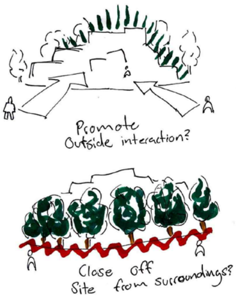
This process made it clear that the design should have a demarcation towards the road in the northern part of the site. Other than that, the site should have a good distribution of private, semi-public and public spaces. It also clarified that the design should have three entrances where the middle one should be the main path that leads into the heart of the site where the common house should be placed.

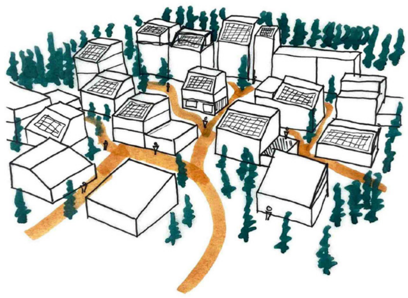
Edges

The sketches focus on how to make an edge to the roads in north and west to cover the noise from the roads. The sketches show how to close off the roads by increasing the building heights towards north and keep the trees and greenery towards north and west.





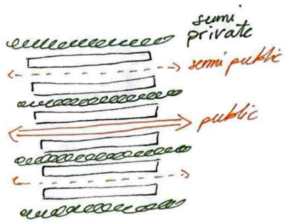


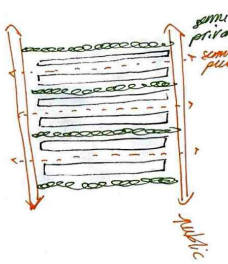


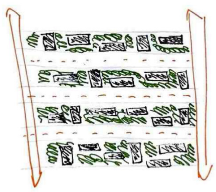
ill. 37: Initiating sketches, edges

Private vs. public

This focus point was researching on how to create spaces between the buildings that allowed public, semipublic and semiprivate outdoor spaces. In this phase it gets clear that by placing the buildings staggered from each other it will create outdoor spaces which feels more semipublic.



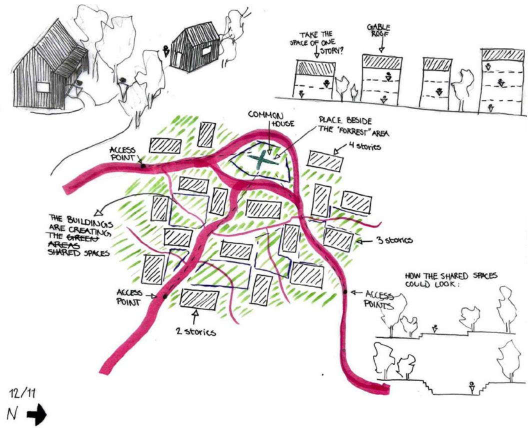


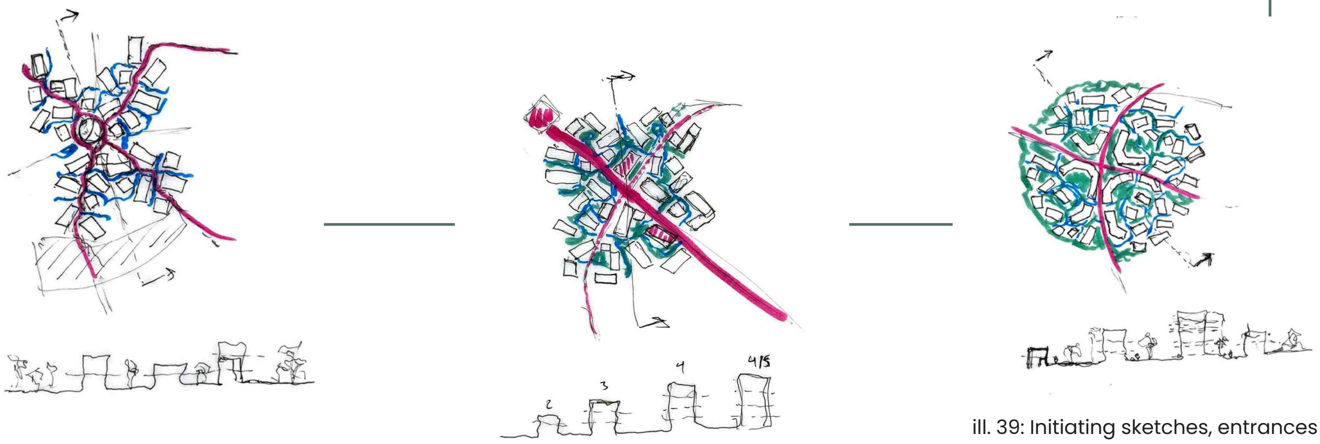


ill. 38: Initiating sketches, private vs. public

Entrances

These sketches focused on the three entrances which are at the site today and how to implement them in the design. Some of the sketches show variation in the building heights by increasing towards the center or towards the edges and some sketches show how the paths could vary whether it's a main path or a secondary path.

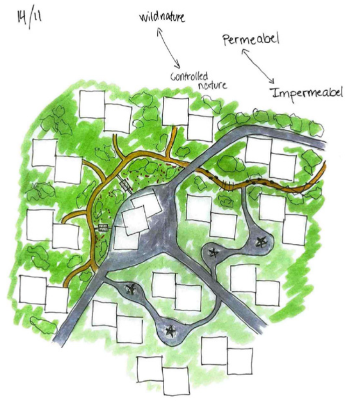


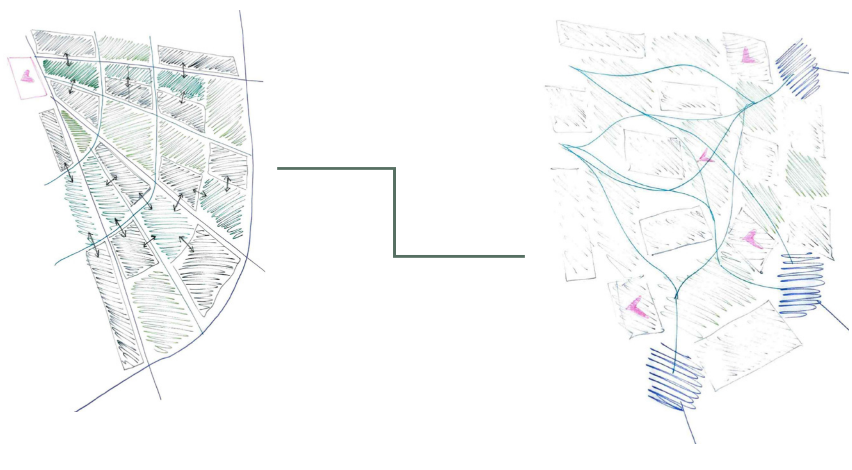


ill. 39: Initiating sketches, entrances

Common house

These sketches focused on where to place the common house on the site. There are iterations on the common house placed in the middle of the site as a heart of the site, on the common house placed in the corner (north/west) of the site with sight-lines leading to the common house and where the common house is divided along the three entrances.





ill. 40: Initiating sketches, common house

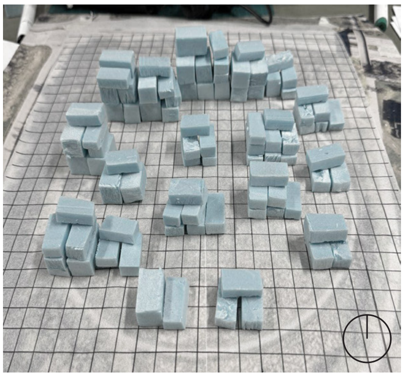
MODEL STUDIES

The model studies focused on the placement of the buildings and the urban density. By doing the model studies it makes it easier to module the masterplan and research the scale of the buildings and the space between the buildings. These models were created with the thoughts from the initiating sketches about creating an edge towards north, and having the common house in the center of the site. The studies result in working with a grid where the buildings are placed directly north/south because it is the optimal orientation when it comes to the indoor environment. When placing the buildings on a grid and offset the building volumes from each other it creates smaller rooms, that feels more semiprivate for the residents.

1. This model was created to research the circular form that the site has today. It was an idea of having a center in the middle as a meeting point and make roads around this center which become more semipublic where the residentials can meet each other and live side by side. This model is more like a whole unit and doesn't have a clear hierarchy.

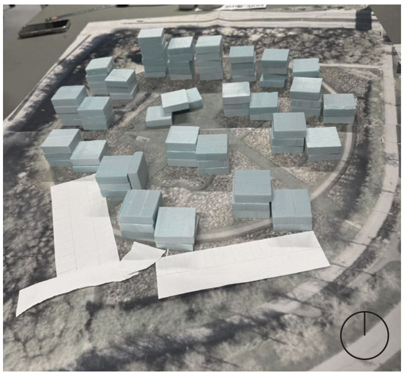
2. This model focused on creating a hierarchy on the site where the tallest buildings create an edge to the north and west part of the site and the lower buildings are towards the existing surrounding residential area. This creates a connection to the surroundings and when you enter the site you will meet the buildings in human scale by the two story houses.

3. In this model the grid was introduced for the first time. The grid was placed directly north/south to create as much sunlight as possible in the buildings and in the urban areas. The focus was now to increase the building heights towards north to create the best circumstances for the sunlight.



This was the initiating concept that was further developed in the design process because it makes some good circumstances for the sunlight, creates a hierarchy at the site and a center with smaller courtyards between the buildings.

4. In this iteration the buildings become more modular units and the idea of doing the buildings as prefabricated constructions made the buildings more uniformly. The focus point was to create clear sightlines from the paths to the common house in the center of the site. In this iteration the symmetric structure destroyed the smaller courtyards a bit and made the site more public between the buildings.

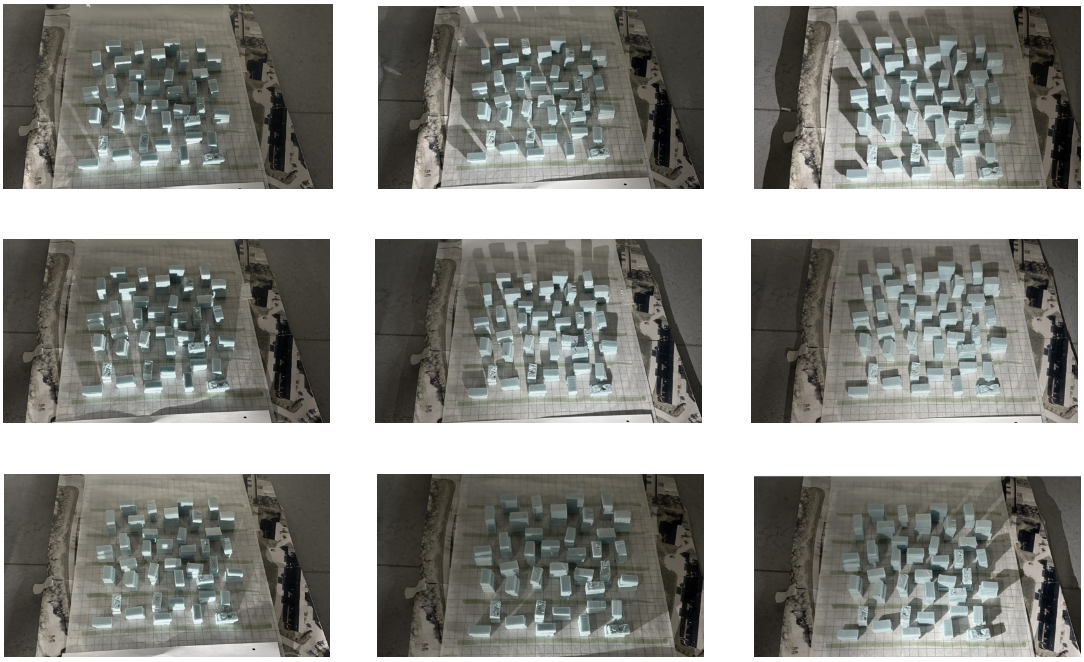


ill. 41: Model studies

LIGHT STUDIES

In the initiating design phase a workshop with light studies researches how the building volumes affect the shadows on the site. In this workshop there was focus on how to make outdoor areas which are exposed by light. From these light studies it was decided to work with a masterplan which creates small courtyards where the light can get in and leisure activities can be placed.

Winter Solstice December 21. | **Equinox** September 21. | **Summer Solstice** June 21.



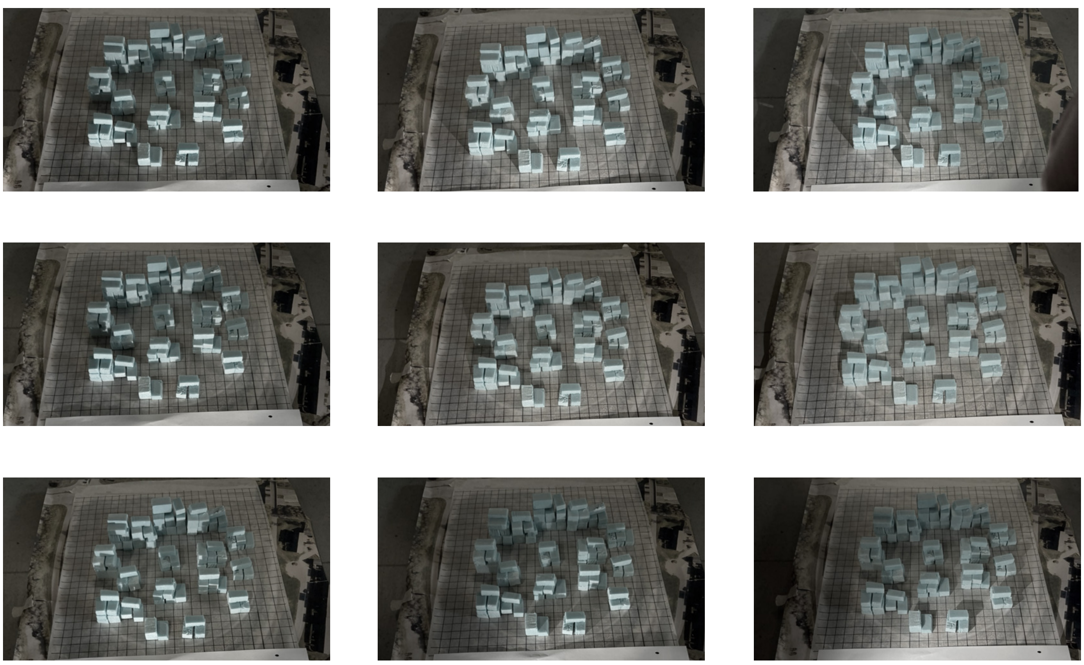
9:00 (10:00 Winter)

12:00

17:00 (15:00 Winter)

ill. 42: Light studies, iteration 1

Winter Solstice December 21. | **Equinox** September 21. | **Summer Solstice** June 21.



9:00 (10:00 Winter)

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17:00 (15:00 Winter)

ill. 43: Light studies, iteration 2

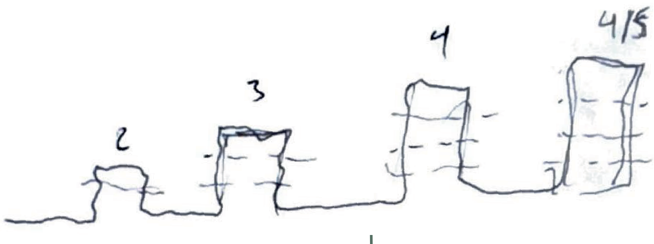
INITIATING DESIGN CONCEPT

The initial design is based on a grid dictating the buildings' placement. This design sums up a lot of criterias and ideas that were to be applied on the site.

The density is higher on the north part, with the height of the buildings increasing as long as their proximity.

The alternation of masses and voids creates spaces between the buildings, welcoming vegetation and activities for the users.

The paths are free to evolve in an organic way, leading from the entrances to the center and heart of the site, going around each building and areas.



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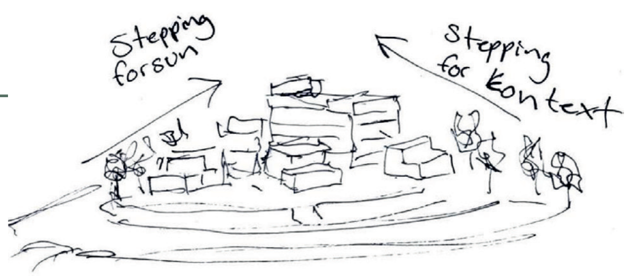
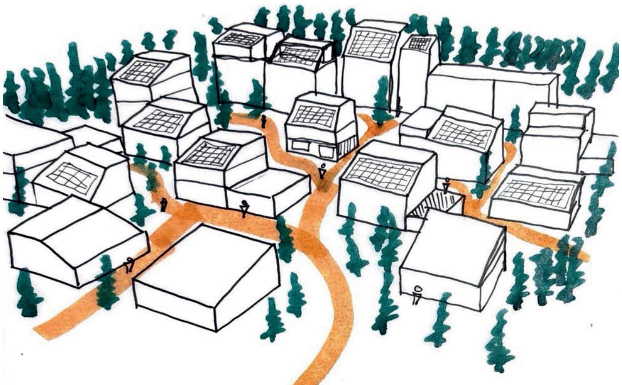
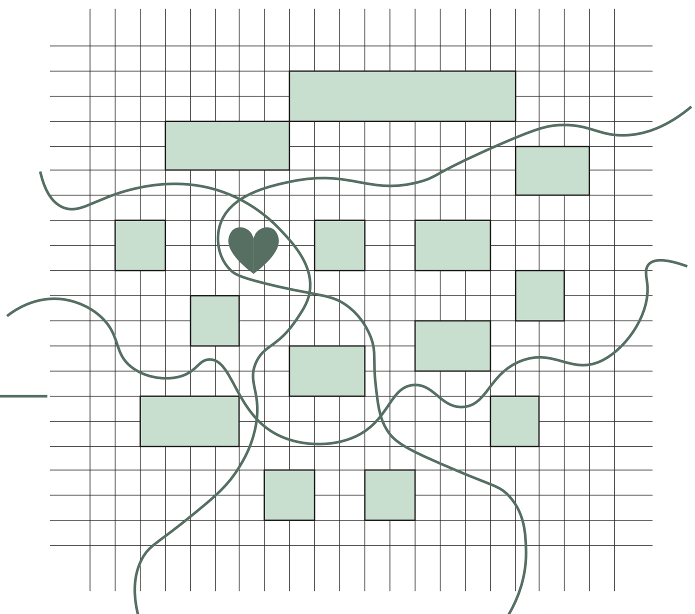






ill. 44: Initiating design concept

MASTERPLAN DEVELOPMENT

This section includes the development in a large scale on the masterplan. The development includes the large connections such as the relationship between the building volumes and the room between them as well as paths and roads along the site. The section goes through the development of the placement of the buildings, paths and parking, which in the large scale have been conclusive for the final design.

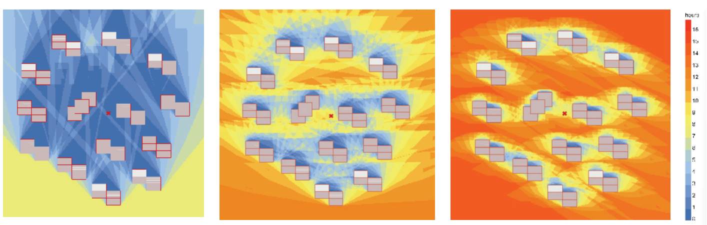
PLACEMENT OF BUILDINGS

Iteration 1

The first iteration introduced the idea of using a grid to place the buildings. With the idea of increasing the density towards the north, most of the units are placed there, reaching a height of 6 even 7 floors. This creates a linear building, almost as a wall, visible from outside of the site and establishing a limit. The rest of the buildings are placed following the grid, more randomly but with the idea of putting a building every time a void is created: not letting a line or column free of construction, blocking open views.

Iteration 2

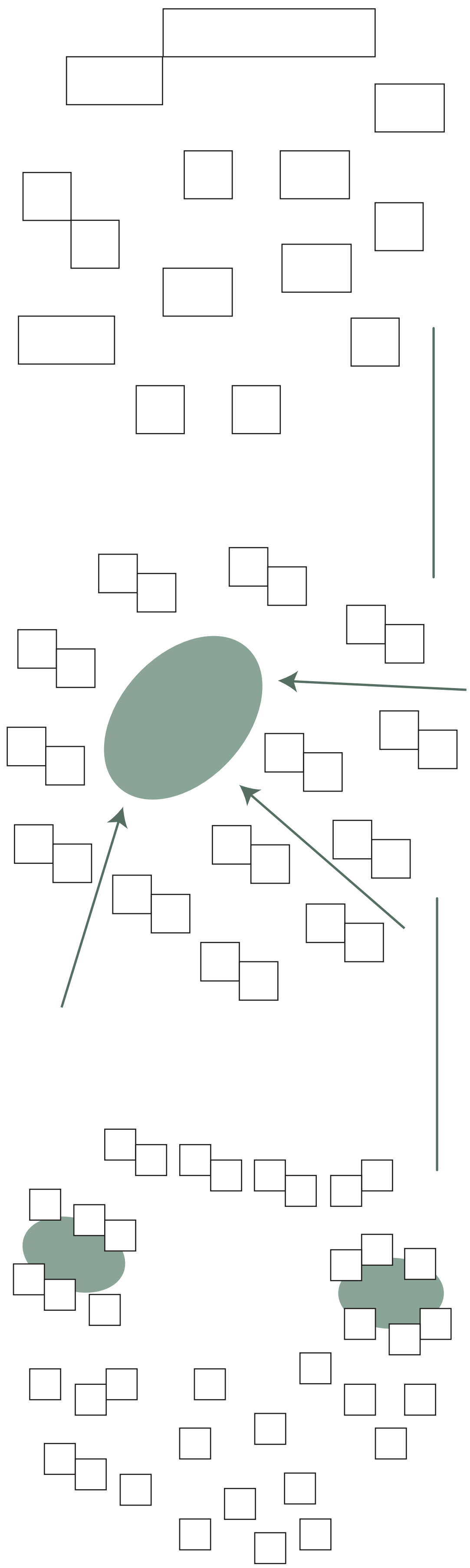
This iteration sees the apparition of a clear middle space, meeting point of the three site access. The middle access, coming from the rest of the area, stayed the main one and the most important path during the whole process, keeping an access from this entrance to the middle of the site was important in all the iterations made. The buildings became more modular and looked all the same. The idea of doing different typologies and being able to distinguish them by the building masses didn't work due to the repetetive building structure.



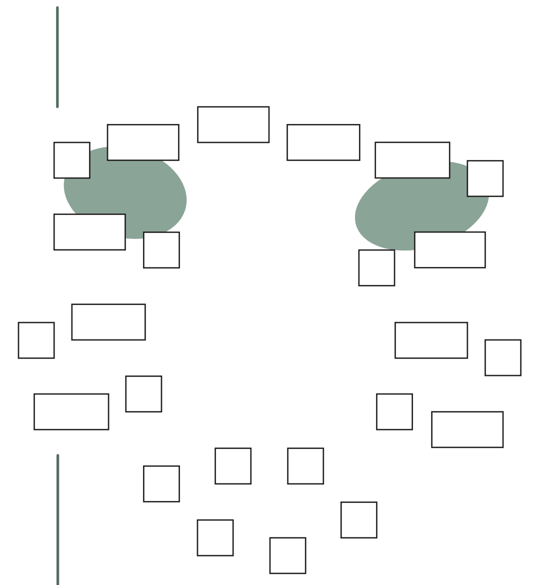
Winter Equinox Summer

Iteration 3

The grid became smaller, allowing units to combine and create bigger ones or letting some smaller buildings, allowing more diversity for the shapes. The idea of aligning them on the north showed again but this time the buildings are being off-set, to break the idea of doing one big wall. On the rest of the site the placement start to create areas between the buildings, bringing some units closer together and generating smaller communities inside the site.

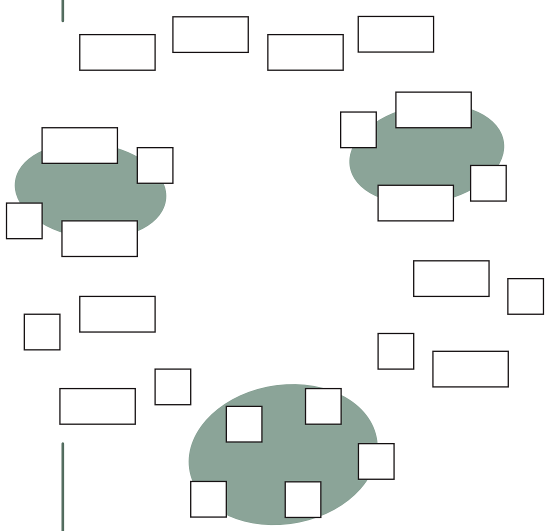


ill. 45: Placement of the buildings iterations



Iteration 4

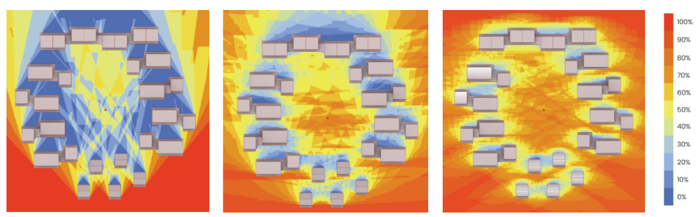
The idea of creating courtyards was extending on the whole area, placing all the buildings around a circle shape. The typologies start to be more visible. On the north, the highest buildings will welcome the students, they are still placed along the same line, being off set and separated to create rhythm. In the south the families' houses are kept as single units, placed following their own pattern. The last typology is the one organised around the courtyards. After doing sun analysis, the north part was too shaded to be used and needed to be changed.



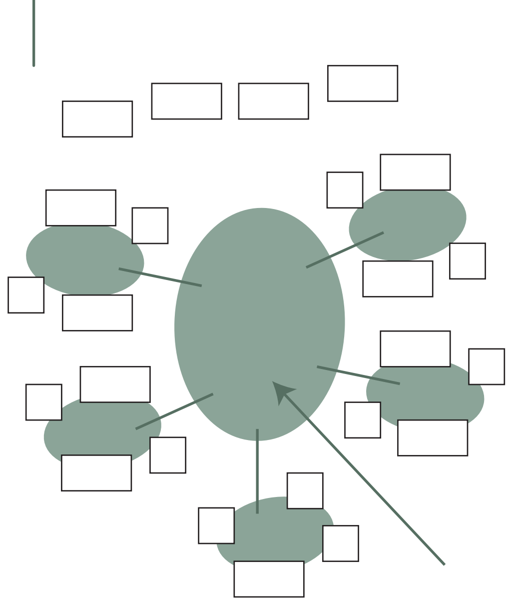
Iteration 5

The northern buildings were moved to be less impacted by shading and only the one in the middle were kept. The space created allowed us to implant more buildings in the courtyard's shape. A new sun analysis of these spaces showed that the daylight on the buildings is sufficient but the shading on the courtyards is too important, especially for the two on the north, where the buildings are the highest.

The families' layout was thought with the idea of creating a courtyard but looked too random compared to the other ones, a lot of propositions for this space were suggested.



Winter Equinox Summer



Iteration 6

After all these changes, came to the final iteration of the buildings' placement. The three typologies are organised by their own layout. The students' buildings on the north are almost aligned, being off-set and separated to break the image of a linear unit. The second typology is arranged around the courtyards, the two northern ones having a wider gap to allow sun in these spaces. Finally, the families' houses are placed in the same layout, in a circular shape, around a courtyard. But compared to the others, one unit is missing, opening the courtyard to the rest of the site, especially to the common house and the leisure activities that will be placed there. The path from the entrance to the center of the site is still present and the big middle area will welcome the common house, outdoor spaces and leisure activities.

PATHS

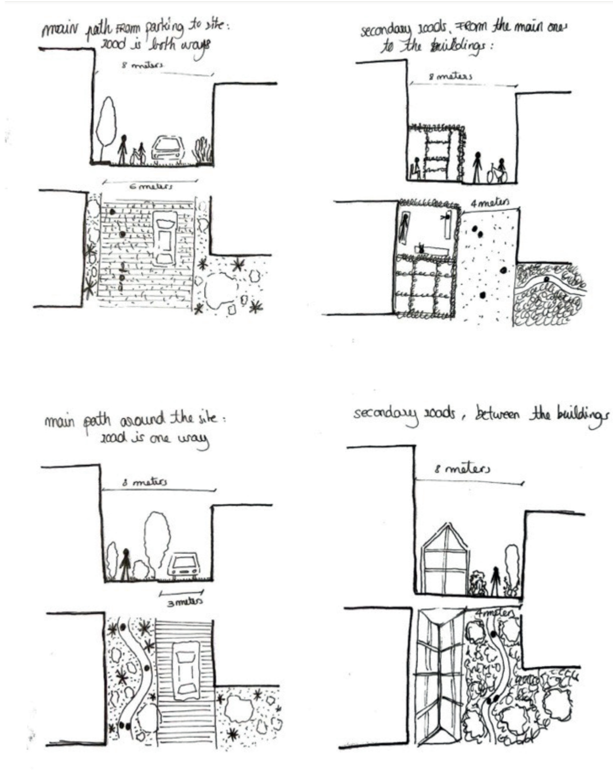
When thinking about the paths along the site, we determined multiple types, each having their own purposes and dimensions.

The road leading to the parking should be large enough for a two way drive, while still being welcoming to the pedestrians and the bikes, which stay the main users of this area, especially because cars are restricted to the outside of the site.

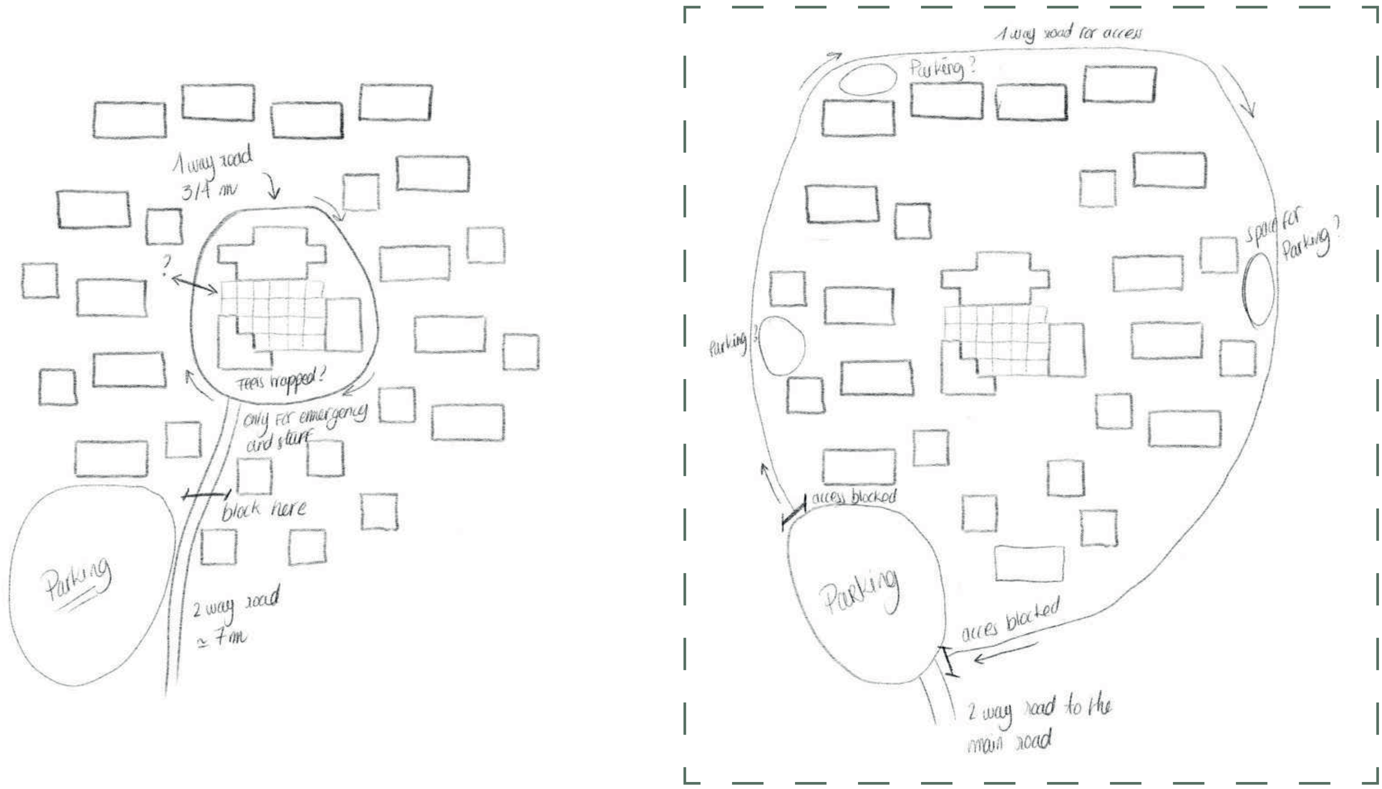
The access road, along the site, is only for emergency cars, occasional drive or picking up the trash. It still needs to be large enough but won't be used a lot so it is mostly for bikers and pedestrians.

The main paths in the site connect the site entrances to the common house and the common house to the buildings. It is not accessible to cars but will be used a lot, it needs to be accessible easily, for everyone and by every conditions.

The final paths are used for walking through the site, while enjoying the green areas. They are more organic and kept wilder, to fit with the nature around it.



ill. 46: Sections between buildings process



ill. 47: acess road process

Acces roads

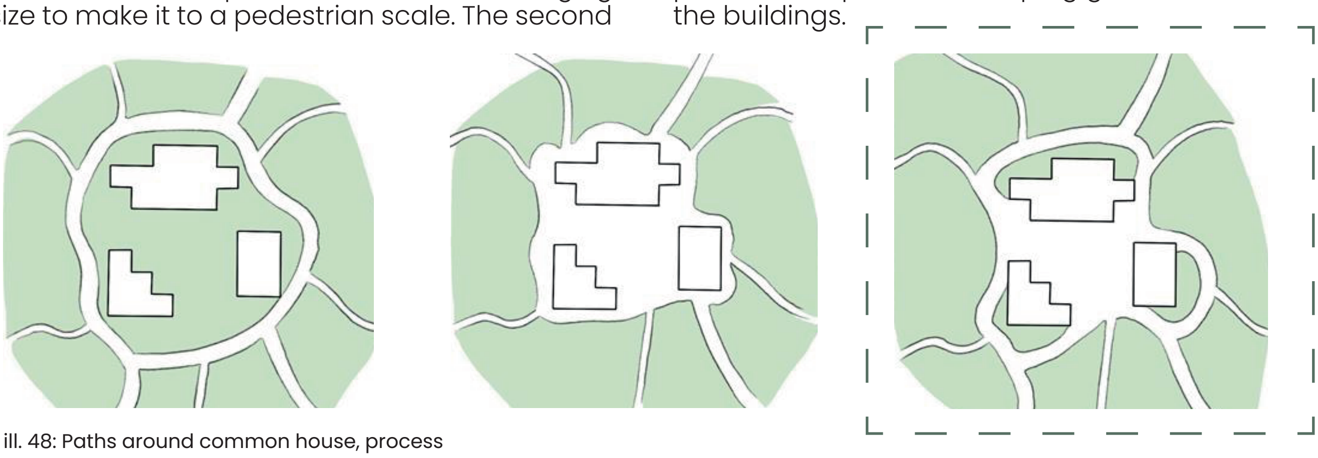
The access road for cars is located on the south-east part of the site. For safety reasons and fire reglementations, the cars need to be able to access the whole site even if it's not what is wanted for a daily basis. It means that at least one road needs to be large enough for cars throughout the site.

The first idea was to put this road around the common house, allowing deliveries for this space when it's needed, and reaching all the buildings within a short distance. It quickly felt like this was isolating the common house from the rest of the site, trapping it inside this road.

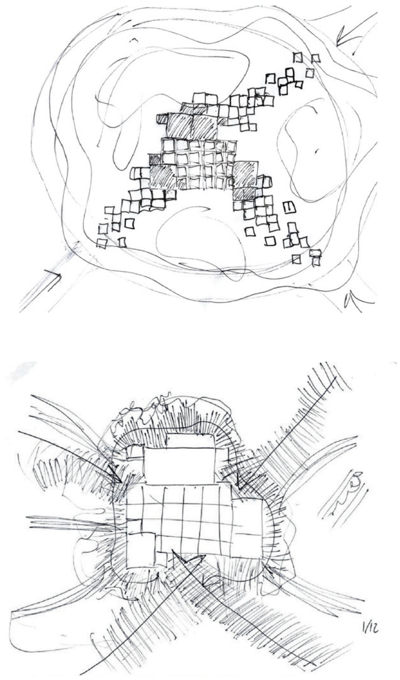
After a few iterations, the road that goes around the site was settled. It still allows cars to come close to the buildings when it's needed but it keeps the whole site free from this size of pavement.

Paths connected to common house

A path around the common house is still needed as it represents the center point of the site. It needs to be accessible from the entrances of the site and from all the buildings around. The first idea was to use the same road as the one planned for the cars, changing the size to make it to a pedestrian scale. The second idea was to pave all the area around the common house, the paths spreading from it to the buildings. The final iteration is a mix of both, creating an organic path all around the common house, connecting all paths in one place, still keeping green areas around the buildings.



ill. 48: Paths around common house, process



ill. 49: Pixel paths iterations, process

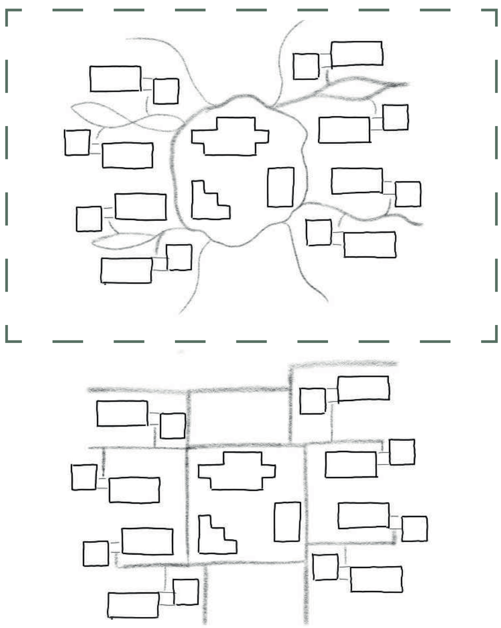
Paths around the common house

The paths leaving the common house area become smaller as they reach the entrance of the buildings. As said earlier, they are made for pedestrians but still need to be accessible for everyone, including parents with strollers or wheelchair users. That's why they are still large enough to welcome people walking next to each other or to allow them to pass by without having to step in the grass around.

The pavement of the roads and the paths was also discussed when planning the hierarchy of the different paths, to get as much permeable ground as possible around the whole site.

The first idea was to make them different so the typologies would be visibly their own. The main road would be stones, bricks or tiles: easy to drive or bike on, non-slip during the rainy days and clean of dirt. Then as the paths become for pedestrians only they are changed for wood, giving a more natural look in the middle of the vegetation they pass by. The smallest paths would be kept as earth or dirt, being almost untouched.

At the end it was decided to make them all the same materials, to ensure continuity between the different areas and for a cleaner look of the site. The choice landed on paved bricks, being a permeable pavement while still being accessible for every user: cars, pedestrians, wheelchair users and bikes.



ill. 50: Strict vs. organic paths iterations

PARKING

One of the criterias for the site was to establish a free car zone. This means giving parking opportunities outside of the site.

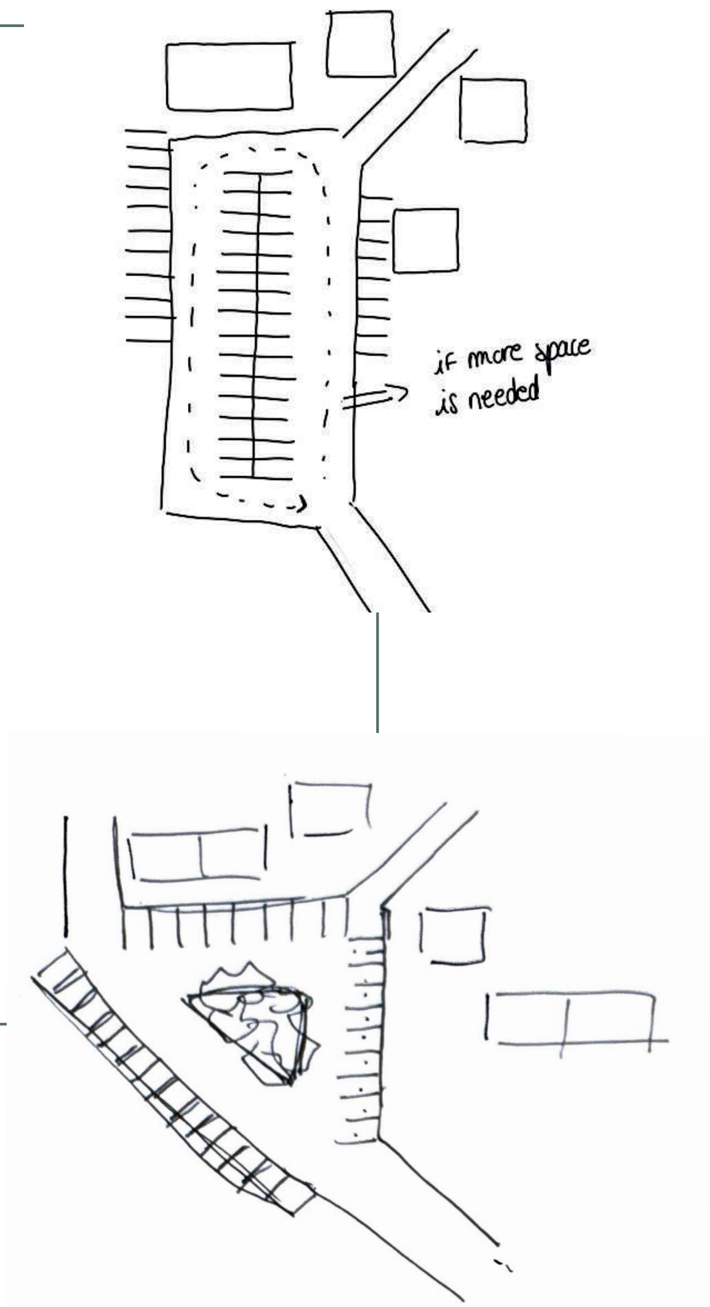
The access road is placed on the south-east of the site. The main parking is placed there, keeping the cars at the entrance of the site.

The ground is a permeable pavement, letting grass grow and allowing water to infiltrate the ground.

To meet the municipality requirements of one spot for every two housing units and one for every eight students' units, 44 parking spots across the site, and an additional 8 handicapped spots.

The bike parking placed it on the closed off ground level in the students' buildings, and additional bike parking placed along the acces road.

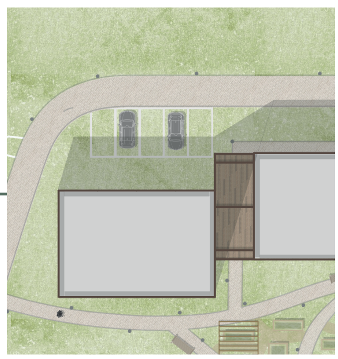
Different iterations of organic and structured parking layouts were experimented with, before settling for a triangular shape with a green area in the middle.



	Amount	Parking Rate	Parking Total	PPL	
Students	72	0,125	9	1	72
Couples	25	0,5	12,5	2	50
Elders	25	0,5	12,5	2	50
Families	19	0,5	9,5	4	76
	141		43,5		248

ill. 51: Parking space iterations

As the design of the site evolved, the choice was made to put the accessible road all around the site, and no longer across the site. This gave the opportunity to put parking spots closer to the northern buildings while keeping the cars out. Some spots are put next to the students' buildings and some handicapped ones are placed next to the buildings for the elderly, shortening the distance between the parking and the entrance of their building.



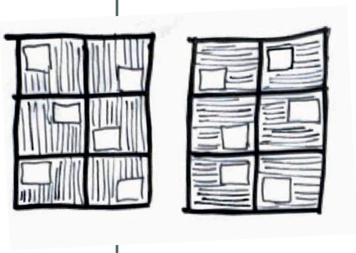
ill. 52: Parking decisions, process

BUILDINGS DEVELOPMENT

This section includes the development of the buildings design, expression and detailing of how the buildings separate from eachother. The focus has been to create a coherent site and at the same time create different building typologies with their own identity. This section goes through the development of the facades, the roofs and the circulation in the buildings.

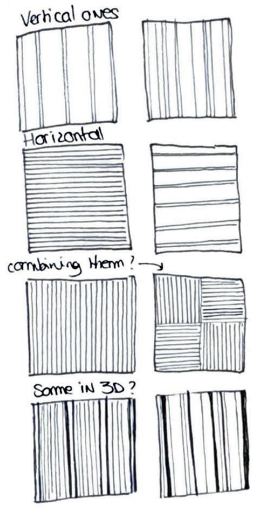
FACADES

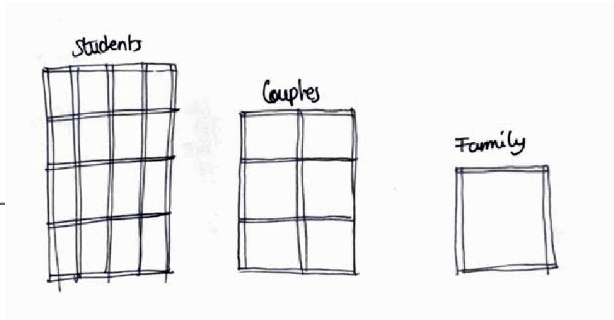
General



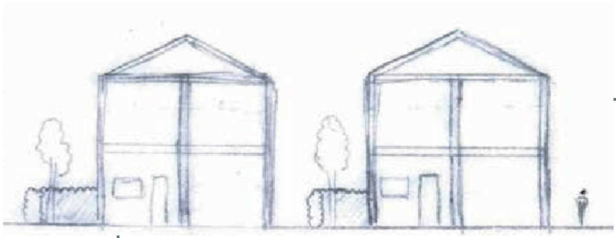
The buildings are managed based on a grid that goes through the beams and columns. The goal for the facades was to be able to see this grid in a vertical way and not just in the horizontal plans, using it as an exo-skeleton.

The grid being used in all the buildings created a lack of uniqueness for each typology. Thus, different facade designs were iterated on to give each typology its own identity; either by playing with the balconies or offsetting the grid by half every floor. The idea was to be able to recognize the typology and the people living in it by looking at the facades. The cladding on the facades is also changing to adapt to every typology





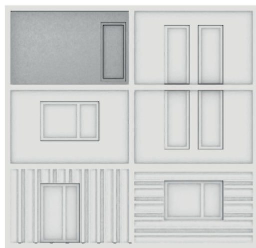
ill. 53: Facade iterations, general

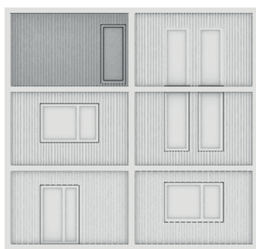


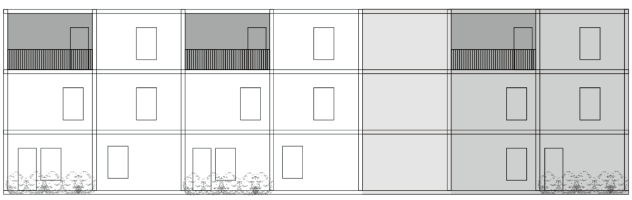
Families

The first iterations for the family units were almost single houses, being seen as their own units. The grid is less obvious on them as they don't have balconies and no external structure. The beams and columns are still visible but placed on the walls and not out.

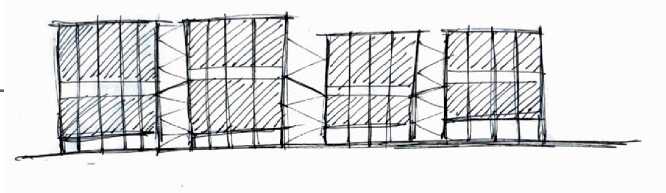
For the families placed on top of the couple's unit one idea was to change the cladding between the typologies to be able to tell them apart. It was decided to put the same on every wall to guarantee a cleaner look of the buildings.







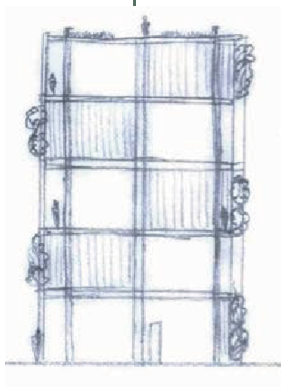
ill. 54: Facade iterations, families

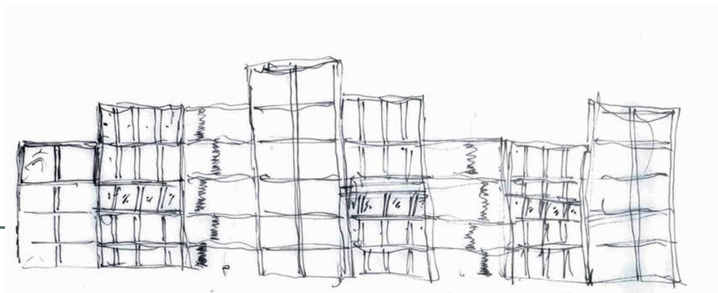


Students

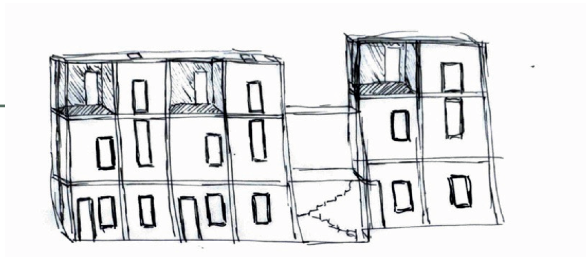
The student units are half the size of the apartments. They each have a balcony, put next to eachother they almost create an exterior corridor all along the facade. The exo-skeleton is shown by beams and columns, where vegetation could grow, creating a green facade.

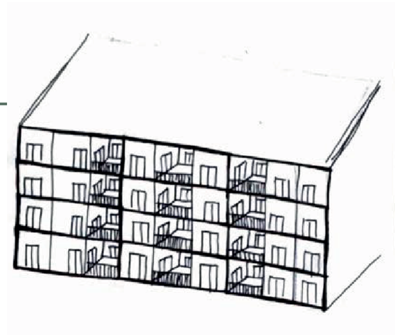
On each block, one floor will be a shared space. The thought was to connect them visually by either; making them glass, taking off the balconies, putting them all on the same level or connecting them by external walkways.





ill. 55: Facade iterations, students





Couples/ Elderly

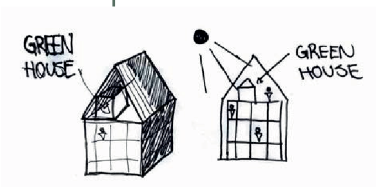
For the couple's and elderly's buildings it was mostly a game with the placement of the balconies. Initially it started by having them as loggia, inside the facades. Later on the exo-skeleton was presented and applied to this typology, meaning that the loggias became external balconies. In order to achieve a different look from the student units, the balconies are not on the whole wall but only on half of it. After trying multiple placement, the preferred one was placing them diagonally, creating rhythm in the facade. The grid is still visible thanks to all the beams and columns around the balconies.

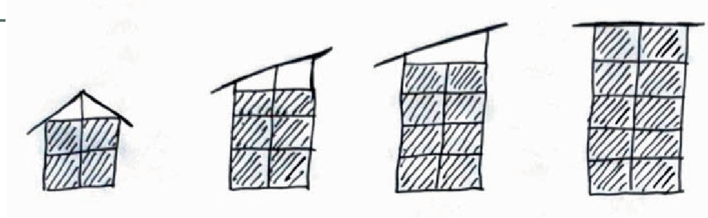
ill. 56: Facade iterations, couples/elderly

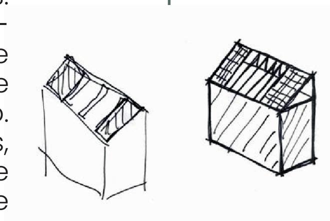
ROOFS

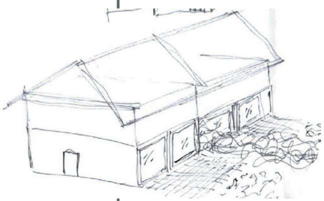
ill. 57: Roof iterations, differentation

Differentiation

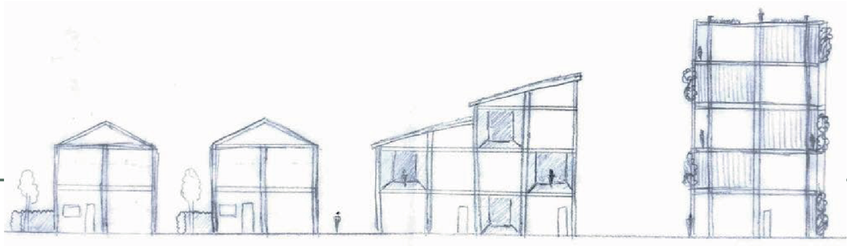




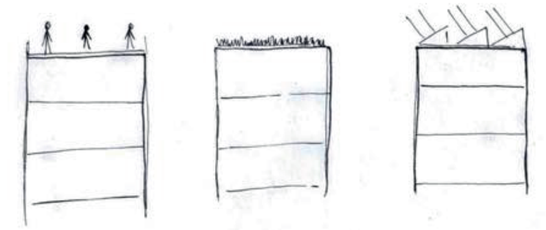


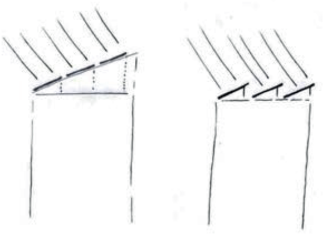


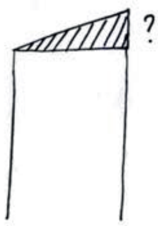
Just like the facades, the first thought was to create three types of roofs to distinguish the three typologies. It was combined with the idea of increasing the density towards the north and doing a transition from the buildings around. The family houses on the south have gabled roofs, as the houses on the rest of the area do. The highest buildings on the north, the students' ones, have flat roofs to fit a high rise building aesthetic. The typology in between gets a single pitch roof, to ensure a transition between the three different types.



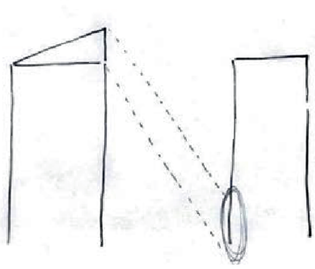
Shadows







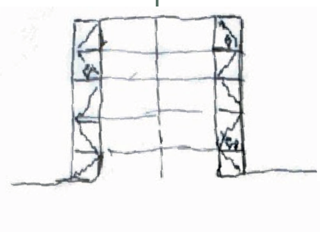
Once the design process began using these three types, a limitation quickly emerged. The single-pitch roof added an additional floor and created significant shading for the buildings located to the north. This required a reconsideration of the roof strategy and a choice between maintaining different slopes or adopting flat roofs across the entire site. The shading impact was the primary argument in favor of flat roofs, but several additional advantages were identified. Flat roofs require fewer materials, making them more cost-effective, faster, and easier to construct. They also allow for multiple uses on the roof surface and can accommodate as many solar panels as a pitched roof. In fact, flat roofs offer greater flexibility, as the angle of solar panels can be adjusted if needed. Finally, the pitched roof created an extra floor without a clear function, resulting in a large, unused area.

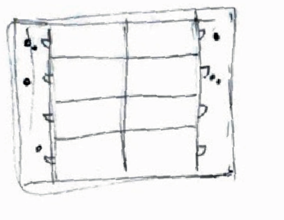


ill. 58: Roof iterations, shadows

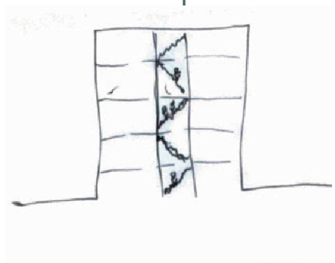
CIRCULATION

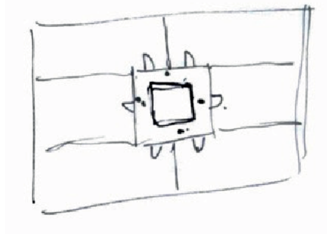
Circulation in the buildings



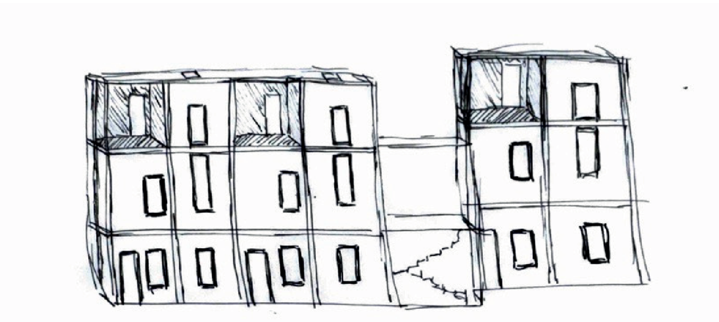


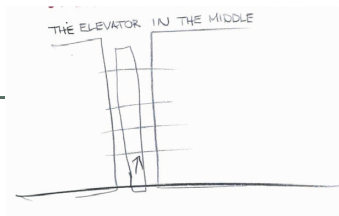
As the building masses were drawn, circulation across the buildings and floors was considered. All housing units were intended to benefit from both south and north façades, allowing cross ventilation through the rooms. This required the units to be placed side by side rather than organized around a central circulation. The idea of an outdoor corridor leading to the entrances was quickly introduced. It would be placed on the north façade, leaving the south façade free for larger windows. This space can also be used by all inhabitants as an outdoor extension of their living space.

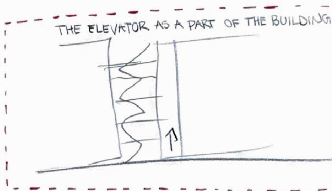




ill. 59: Circulation in the building, process

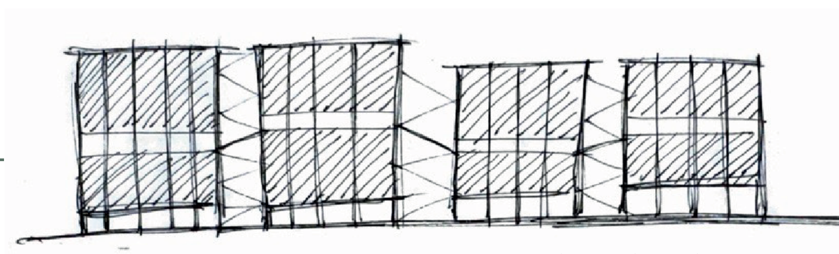






Circulation between the buildings

Once the horizontal circulation was settled, the vertical circulation was addressed: where and how to access the outdoor corridors. After examining the placement of the buildings next to each other, the idea emerged to connect some of them through shared staircases, with one staircase serving two blocks. The blocks are not aligned, reflecting the intention to offset them, and the staircase reinforces this line between them. After a few iterations, the staircase was enclosed in a glass box, creating a vertical void within the building mass.



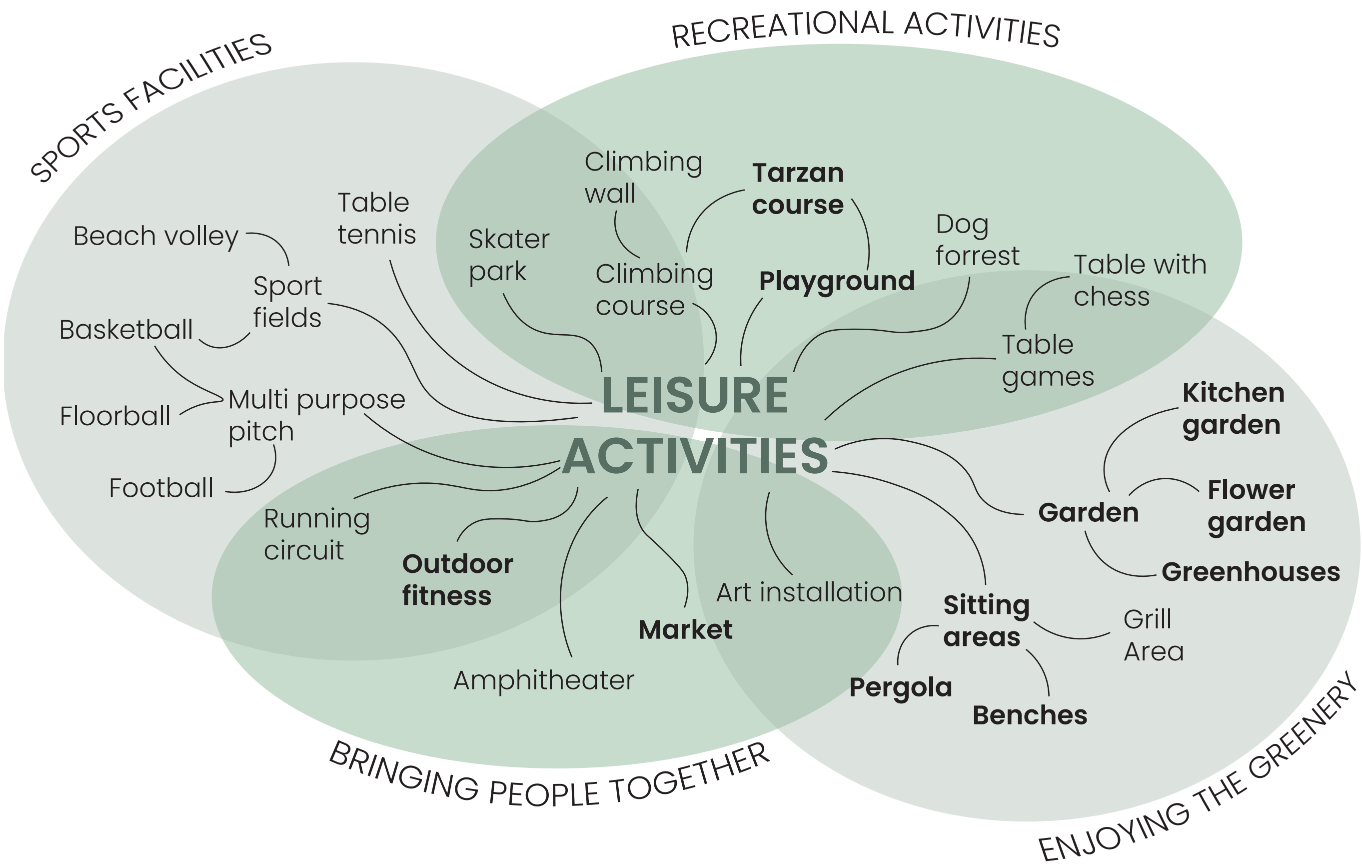
ill. 60: Circulation between the building, process

LEISURE ACTIVITIES DEVELOPMENT

This section includes ideas for leisure activities as well as the placement and design of these. The project's brief says that 3000m² should go to leisure activities around the site. They need to be designed, placed and organised regarding the building's placement and the user groups. They are thought of in relation to the common house with the same goals: bringing people together, offering new activities, being able to be used during the whole year. The large leisure requires a variety of activities, both in their purposes and the people they are related to. This section goes through a brainstorm of leisure activities, the placement of the leisure activities in relation to the building masses and the common house.

BRAINSTORM

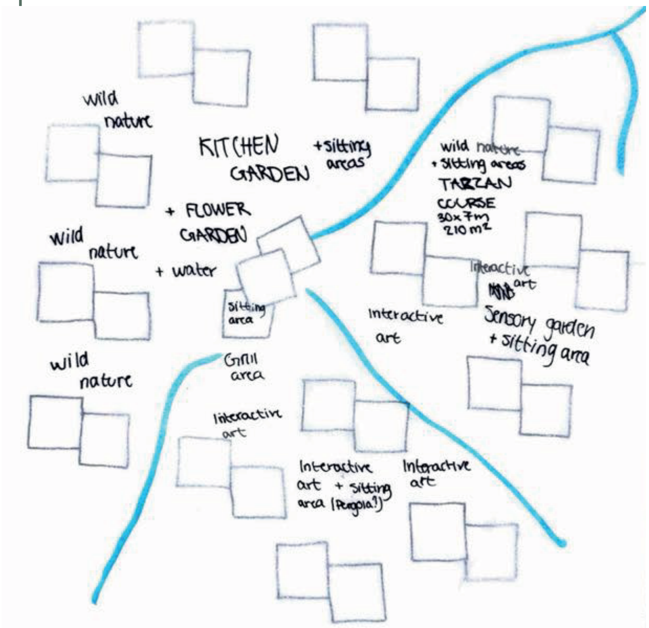
The activities chosen to incorporate are marked in bold. They are mostly aimed to place more greenery on the site and to be able to enjoy it. Few sports facilities were chosen as there are already some present in the other areas around. The concern was put on activities that will benefit all the users groups.

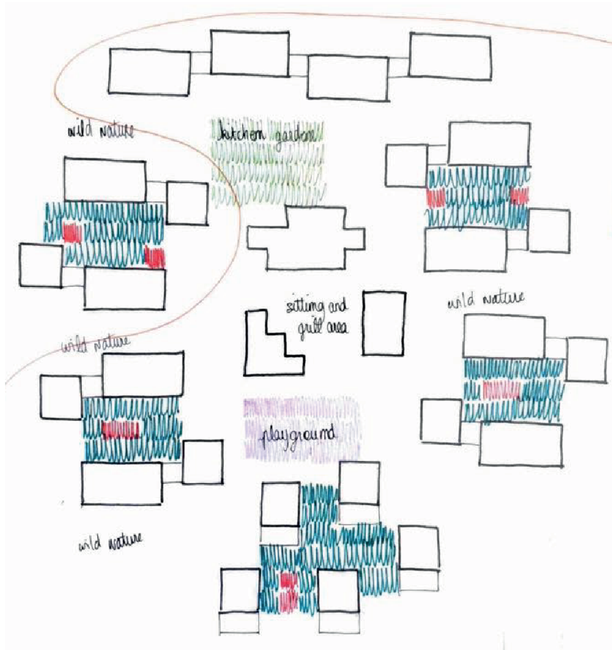


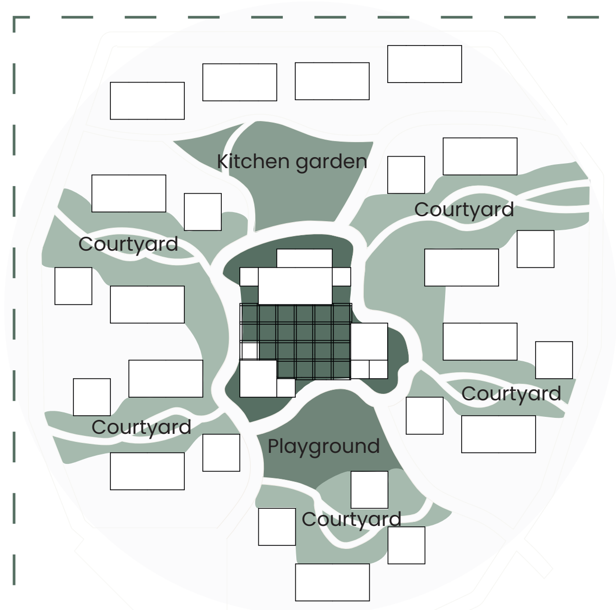
ill. 61: Leisure activities, brainstorm

PLACEMENT OF ACTIVITIES

ill. 62: Placement of activities process



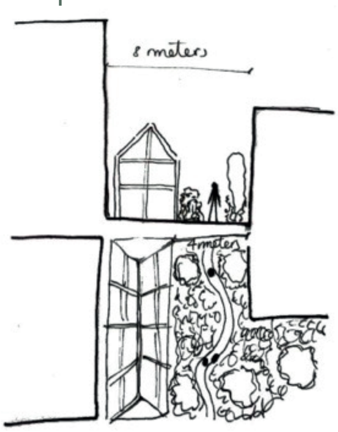


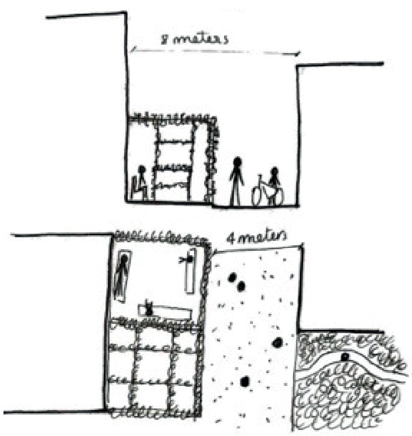


The placement of the leisure activities evolved with the masterplan and the building's placement but the main ideas stayed the same. There is the center of the site which welcomes the common house and the main outdoor shared space. The kitchen garden is placed in the sunniest area while the playground and recreational spaces are placed around the families units. Between the buildings the areas are kept natural, landscaped as sensory gardens, or as wild nature. In both cases these spaces are good for biodiversity and the species living there.

In the final placement there is a sitting area between the buildings of the common house, a kitchen garden on its north and the playground is on its south, near the family's houses. The spaces between the buildings become green courtyards.

Different organisations of the courtyards were experienced, creating a hierarchy, from public to private. The common house is the most public part of the site, being accessible for everyone. The courtyards are semi private as they are mostly used by the inhabitants of the buildings around them. This gradation is shown by a change in the nature, becoming wilder and wilder as the areas become more private. The paths are also becoming narrower and more organic.

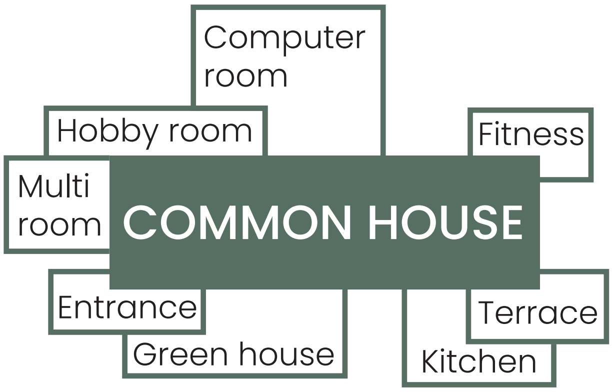




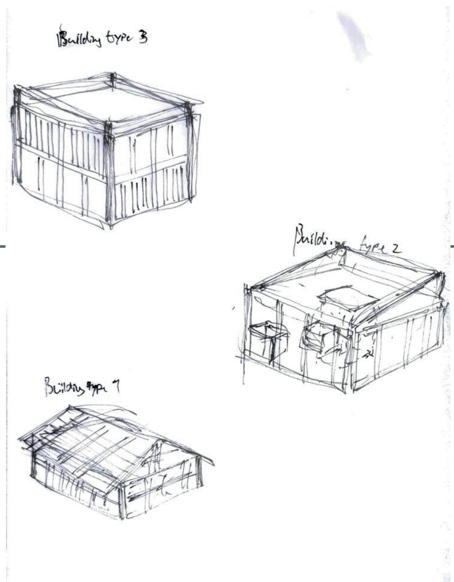
COMMON HOUSE

Brainstorm

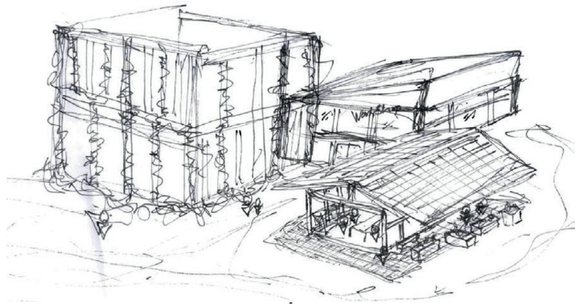
The initial functional diagram for the common house suggested multiple spaces. Some are placed outdoors: the terrace and greenhouse, some could be put together: the kitchen with the multi-room, the hobby room with the computer one. Three units naturally occur and the idea of doing separate buildings appears. As designed in the masterplan the idea is to have only one common house, with everything happening in the same area. The stake is to design a single space that creates different areas.

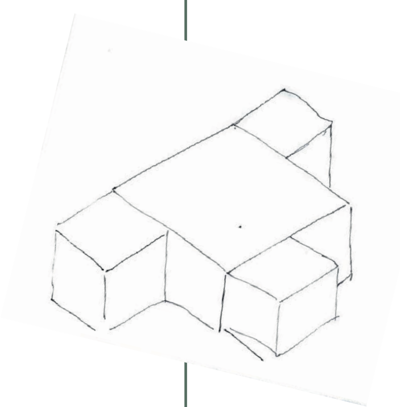


ill. 63: Common house, brainstorm

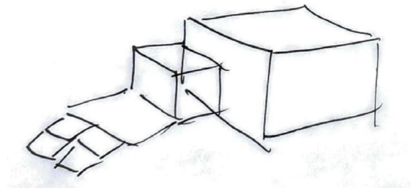


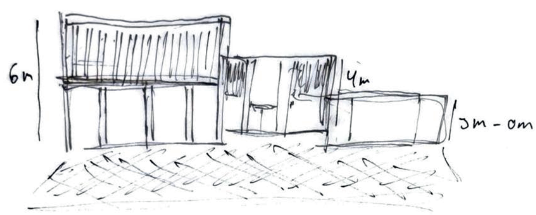
Shapes



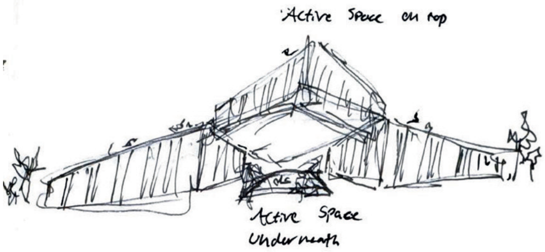


Three buildings compose the common house, and the housing is divided into three typologies. One of the earliest sketches aimed to identify the characteristics of the three typologies within the units of the common house. After multiple shapings, a system of voxels appeared: a cube that can be repeated as needed. It is based on the same grid as the rest of the site. The larger rooms have a double height, while the additional rooms on the side are smaller, creating a gradient.

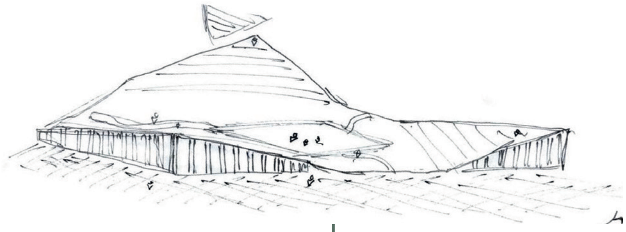




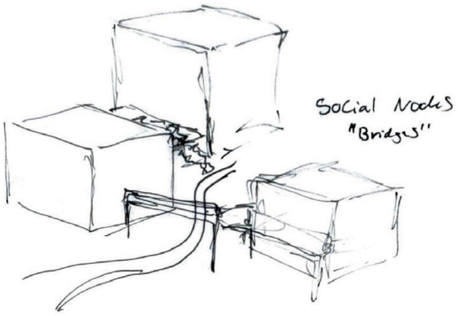
ill. 64: Common house, shape iterations

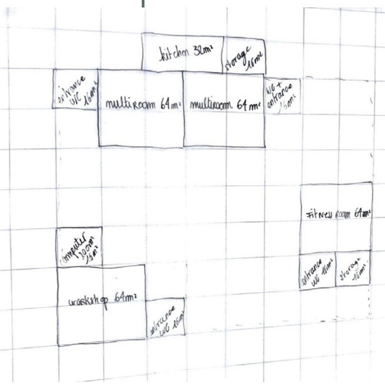


Outdoor areas

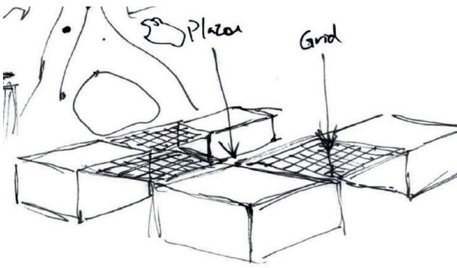


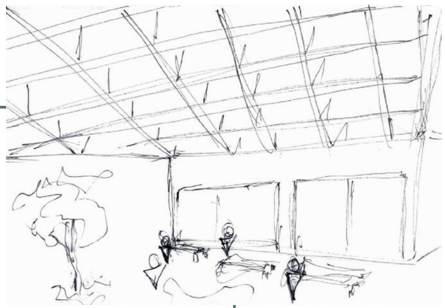
One of the ideas was to create an outdoor space linked to the common house, its placement remained to be decided. Multiple ideas were suggested: on top of the roof, under an elevated building or between the units. For accessible reasons the choice was made to place the building in a square shape and to use the void in the center as the outdoor space. The indoor rooms are then placed in the different buildings, regarding their functions and needs.





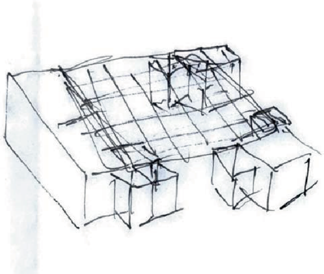
ill. 65: Common house, outdoor iterations

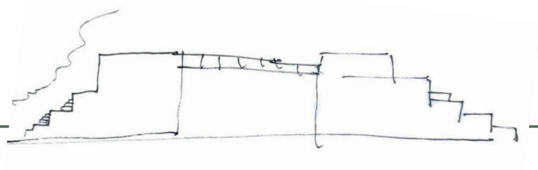


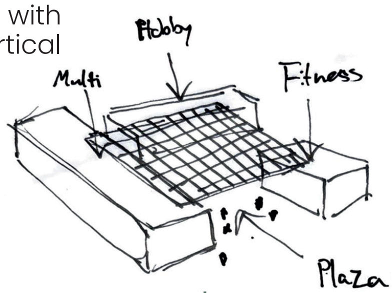


The courtyard

The space created between the buildings serves as the outdoor area for the common house. It's a flat area, kept free so it can be flexible and welcome multiple activities if needed. The goal is also to be able to extend the rooms outside, for a bigger reception, an outdoor fitness class or the need for more space in the workshop. A grid is placed on top, aligned with the roofs of the buildings, serving as a vertical limit.







ill. 66: Common house, courtyard iterations

THE INDOOR DEVELOPMENT

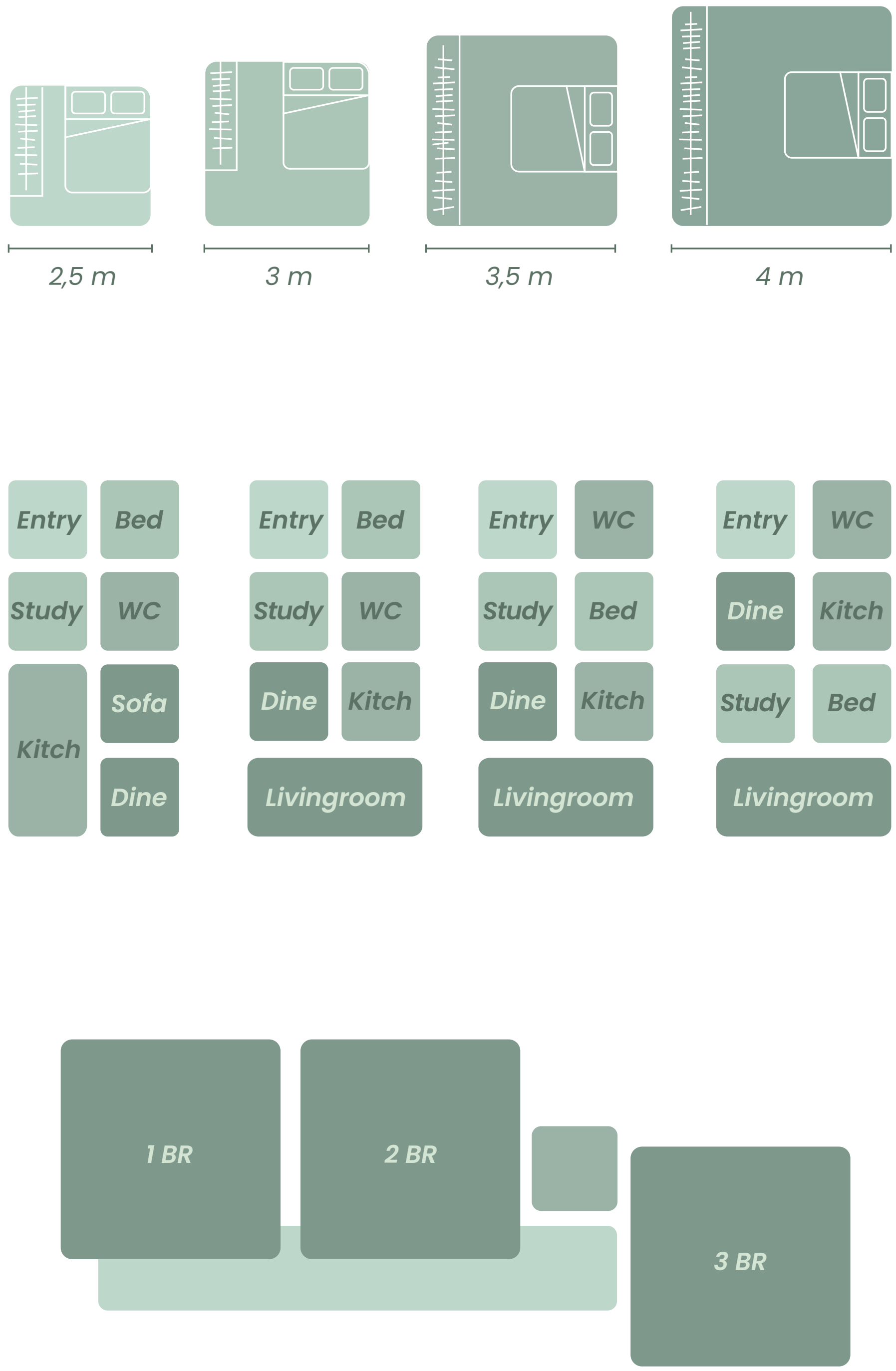
This section includes the development of floor plans and the indoor environment in the most critical rooms in the different typologies. The focus has been on creating apartments with a good room distribution and the possibility for making chances and flexibility within the units. This section goes through floorplans for families, couples/elderly and students and afterwards looking at the Bsim process for the indoor environment.

Floor plans

The floor plans evolved through three distinct phases: first optimizing the structural grid itself, then refining layouts to meet user needs, and finally coordinating how different units work together within the complete building blocks.

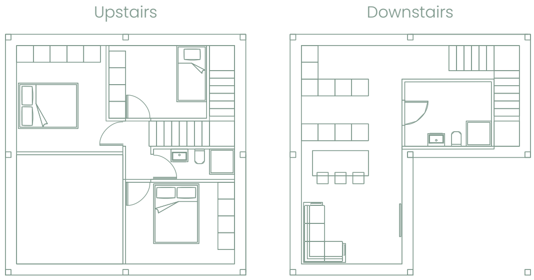
Early iterations started with grid dimensions based on educated guesses, then tested these through multiple iterations. This trial-and-error process quickly exposed problems. Sometimes the grid created spatial conflicts - a bed and closet placed too close together would block circulation paths. Other times rooms ended up disproportionately large or small, creating awkward imbalances across the plan. The real breakthrough in solving the plans was disconnecting rigid alignment between walls, furniture, and the structural grid. This added flexibility which made the design process easier and produced far better results: more compact plans, smoother circulation, and a more equitable distribution of space across different rooms.

The design criteria imposed strict size limits that added another layer of complexity, with units at 75 m² for one or two people, 85 m² for elderly couples, and 115 m² for families with regards to Danish social housing regulations. These constraints meant figuring out how to serve very different users; singles, couples, elderly residents, families, within the same structural framework. The family units presented the toughest puzzle: fitting three bedrooms plus all essential amenities into just 115 m² required creative problem-solving. Ultimately, these limitations didn't just restrict the design - they shaped it, pushing the project toward solutions flexible enough to accommodate multiple demographics while staying within tight regulatory boundaries. Furthermore the many possible floor plans reinforce the conceptual idea behind the structural system, allowing for great adaptability to suit a variety of building sites, typologies and users.

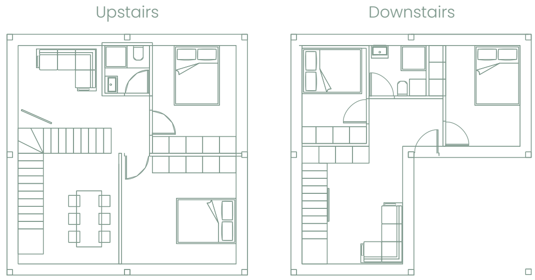


ill. 67: Room sizes, process

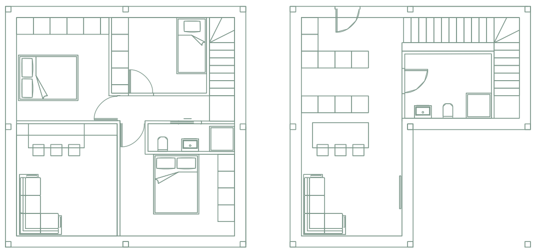
Families



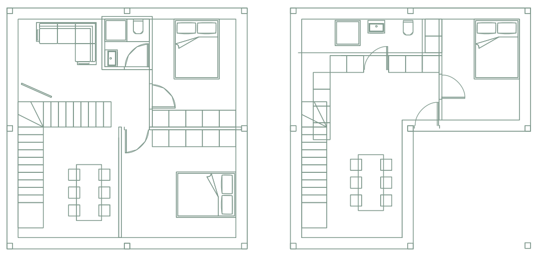
Keeping bedrooms same floor



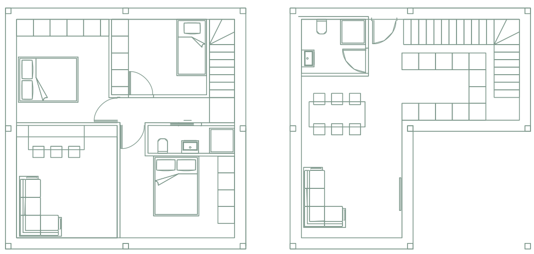
Variations of stairs placement



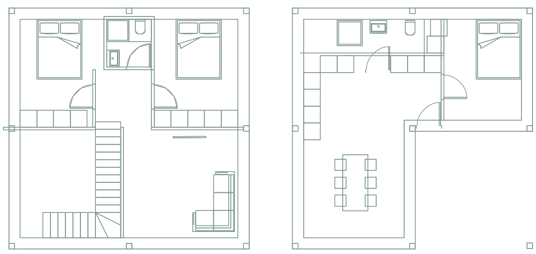
Toilet accesibility on sleeping floor



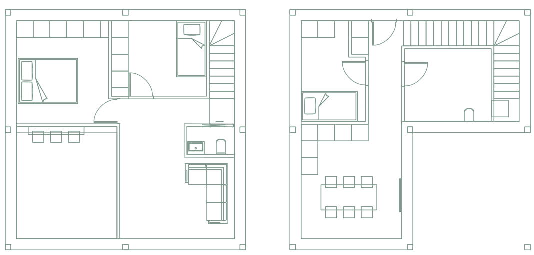
Toilet accessibility on sleeping floor



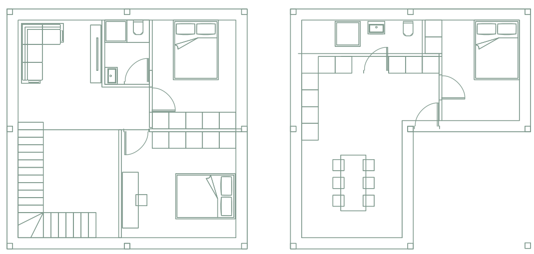
Rearrangement of living, kitchen, dining



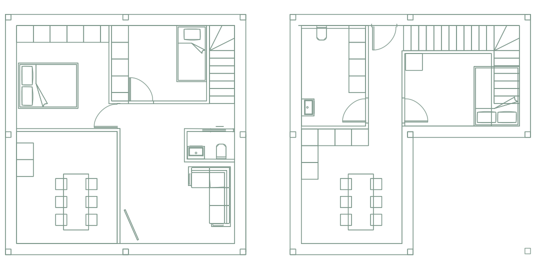
Variation of stairs placement



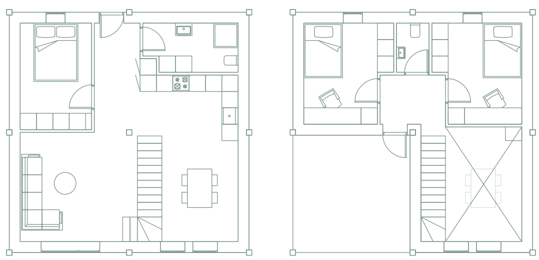
Placing living room upstairs



Variation of stairs placement



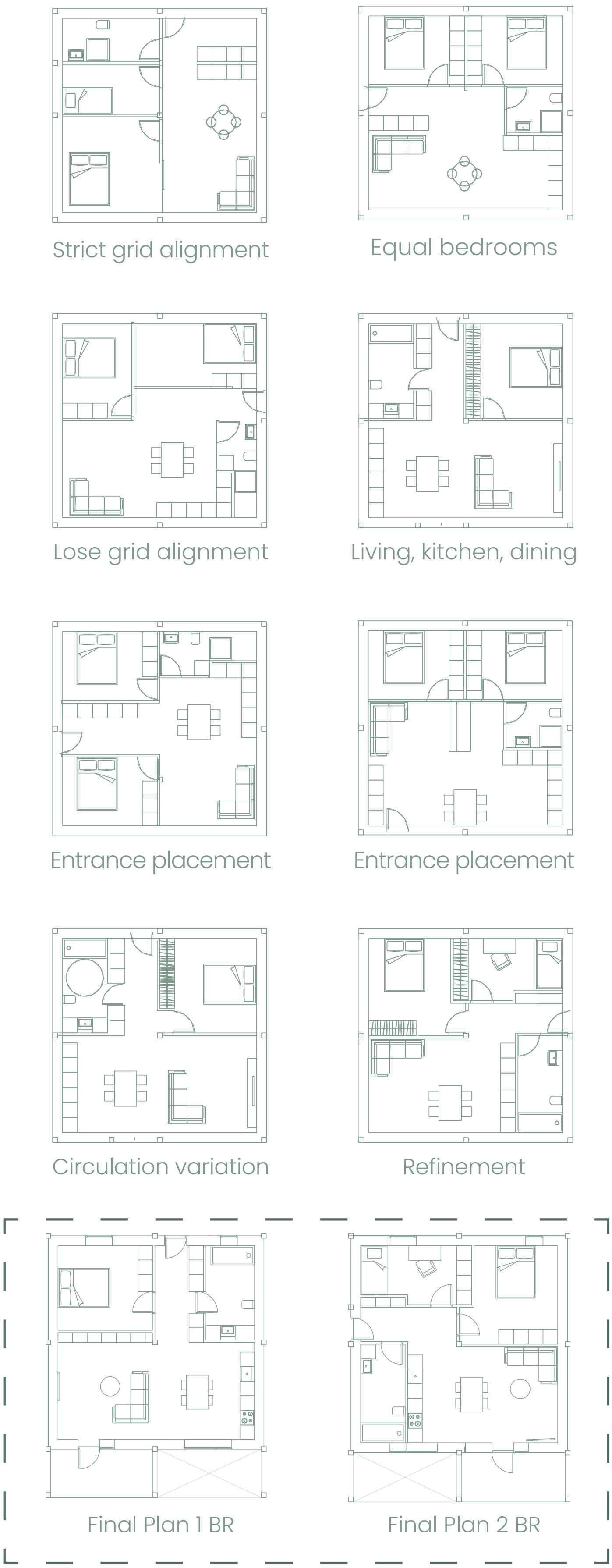
Testing downstairs bedroom layouts



Final plan family unit

ill. 68: Floor plan iterations, Families

Couples/Elderly



ill. 69: Floor plan iterations, Couples/Elderly

Students

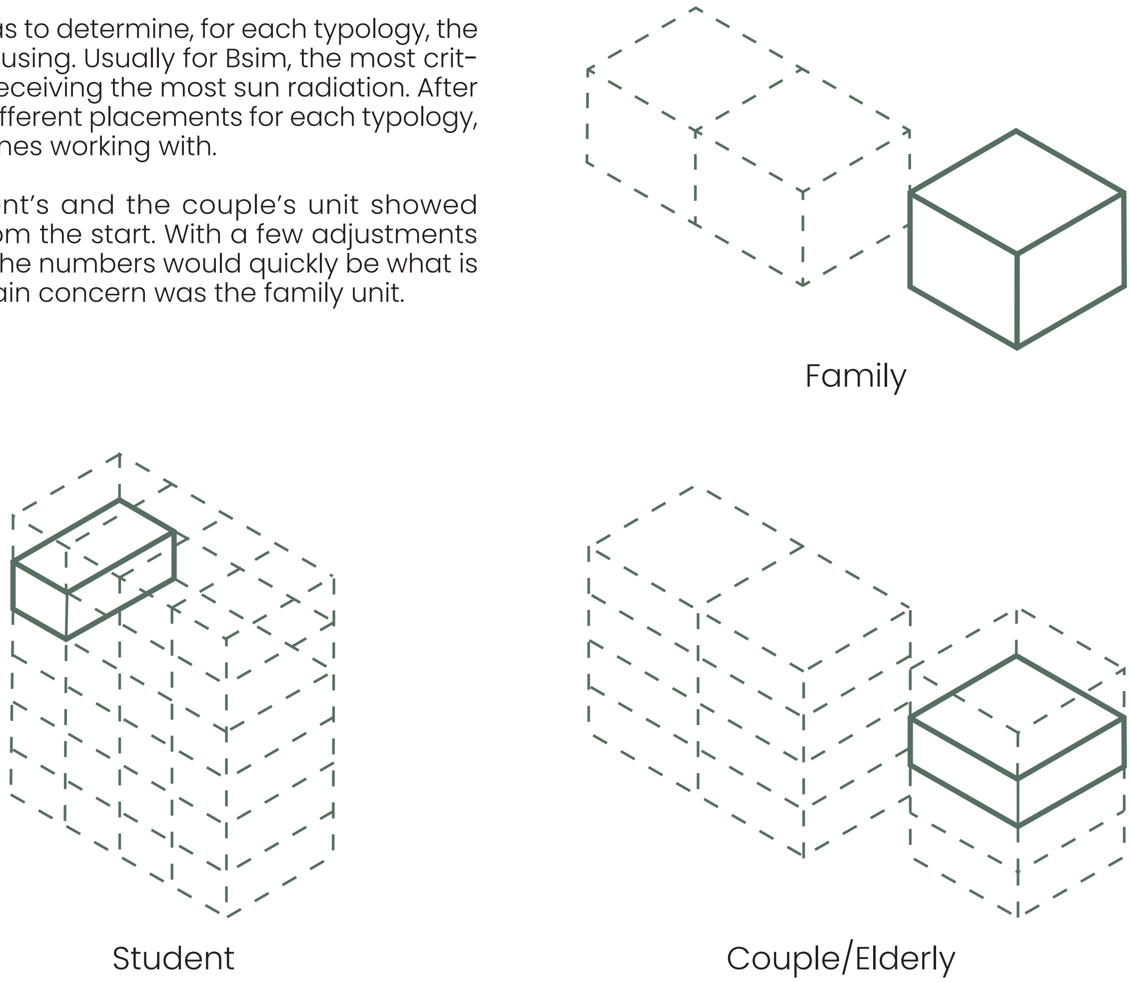
ill. 70: Floor plan iterations, Students

BSIM PROCESS

ill. 71: Bsim, working models

The first step was to determine, for each typology, the most critical housing. Usually for Bsim, the most critical is the one receiving the most sun radiation. After testing all the different placements for each typology, those are the ones working with.

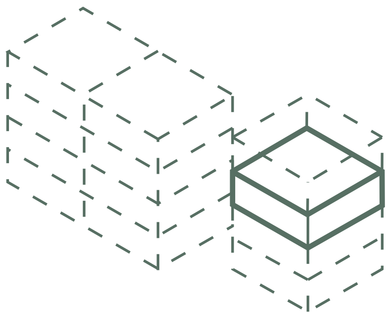
Both the student's and the couple's unit showed good results from the start. With a few adjustments in the systems the numbers would quickly be what is needed. The main concern was the family unit.



Couples/Elderly

The couples were challenged by a lack of ventilation. Adding bigger windows and a mechanical ventilation to support the natural air flow resolved this issue, while still maintaining a reasonable air change.

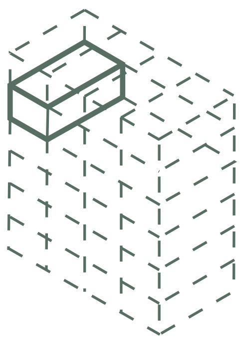
Temperature: 21,1º
Hours >26º: 0
Hours <19º: 0
Air change: 1,1/h
Moisture: 31,5% - 63,4%
CO2: 379,3 ppm



Students

The biggest challenge for the student's unit was to control over-heating, because it's a small area boxed by other heated housing. Adjusting the window's size and using the balcony as shading solved this problem.

Temperature: 20,7º
Hours >26º: 0
Hours <19º: 0
Air change: 1,1/h
Moisture: 32,8% - 64,3%
CO2: 385,4 ppm



ill. 72: Bsim process, Couples/Elderly and Students

Families

The family unit is on two floors, with the dining room having a double height

Initial

The initial stage is the building with the windows but without the systems, to see what are the actual strengths and weaknesses of the housing, with a special interest in the temperature.

Temperature: 10,6°
Hours >26°: 0
Hours <19°: 6 788
Air change: 0/h
Moisture: 19,9% - 77,5%
CO2: 350,0 ppm

Adding systems

Once the first systems are added, the indoor temperature became better, without over or under-heating. The problem for now is the air quality.

The CO2 level is pretty high, the air change is low and the air humidity is too low during the winter, leaving a dry air inside. All these are showing a lack of ventilation.

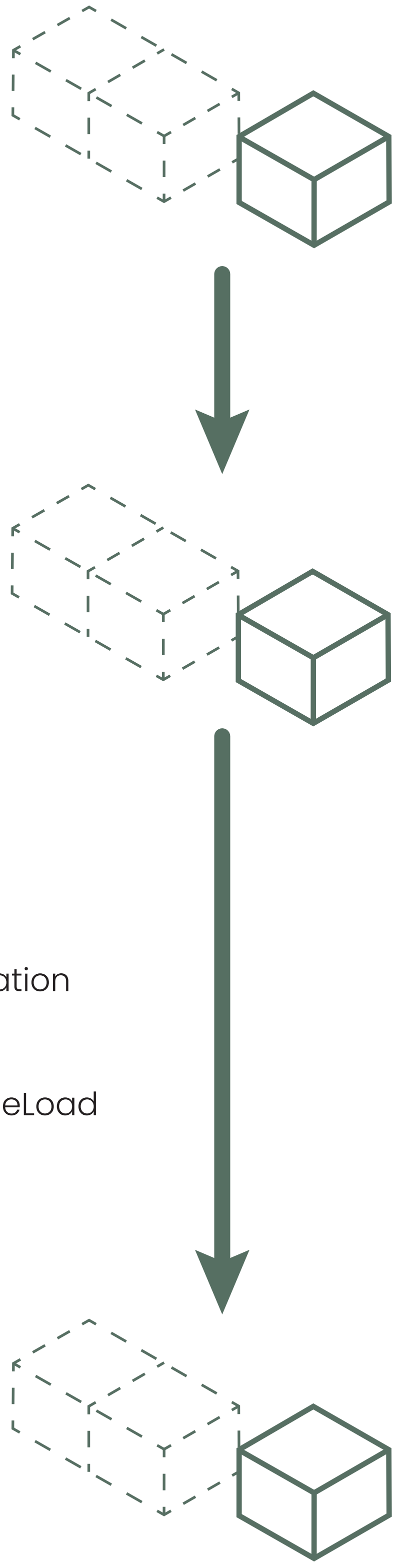
Temperature: 20,4°
Hours >26°: 0
Hours <19°: 0
Air change: 0,6/h
Moisture: 24,5% - 61,6%
CO2: 466,0 ppm

Natural ventilation
Heating
Infiltration
Lightning
Equipment
PeopleLoad

Final

Adding mechanical ventilation, working all year round and adjusting the MoistureLoad, gave more ventilation to the building, and the air change doubled. The CO2 level really dropped and the moisture level is now between the right numbers.

Temperature: 20,8°
Hours >26°: 0
Hours <19°: 0
Air change: 1,2/h
Moisture: 32,5% - 62,9%
CO2: 311,4 ppm



MoistureLoad
Mechanical ventilation

ill. 73: Bsim process, Families

PR ES EN TA TI ON

Introduction

This chapter presents the project's final design proposal and illustrates how previous analyses and conclusions throughout the process have been translated into a concrete design approach. Through various diagrams and visualizations, the spatial structure of the project and the connection between buildings, common activities and outdoor areas are communicated. The purpose of this chapter is to provide an overall overview of the project's final idea, scale and functions, as well as how social and sustainable considerations are addressed in the project.

STAK

STAK is more than just another new residential area on the outskirts of Aalborg. STAK is an inclusive and inspiring mini-community where generations meet and the community thrives. Through a number of outdoor areas and shared activities, meetings between the elderly, families, couples and students are invited.

STAK is located in Aalborg East, and is only a few minutes from Aalborg University, which makes the area very attractive for students. At the same time, the project is also close to shopping, schools and leisure activities for people of all ages.

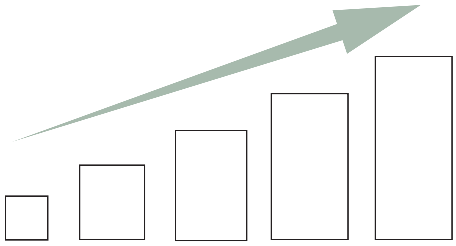
Whether the top priority is to create a good social environment, or the focus is more on the green transaction, STAK is the right place to be. Through being a Net-Zero site construction, STAK demonstrates how the construction of the future can be both environmentally responsible and architecturally ambitious.

STAK embraces diversity and creates an environment where there is room for everything from rainbow families, singles and the elderly, to newlywed families and young couples, all of whom are looking for a sustainable lifestyle with community in focus.

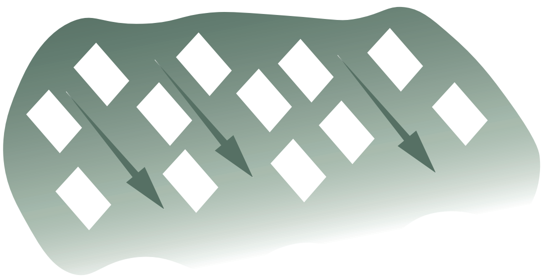
A place that combines social, environmental and economic sustainability, for today's needs and future generations.

CONCEPT DIAGRAMS

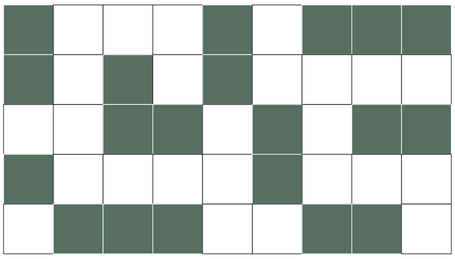
Increasing the density and the heights of the buildings towards the north



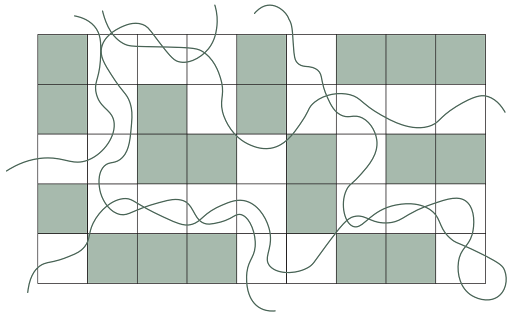
Extending the vegetation towards the south



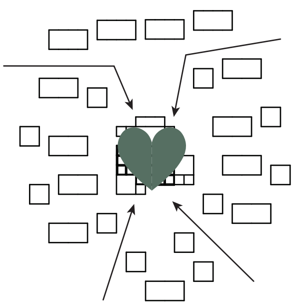
Grid system in the buildings and for the placement of the buildings



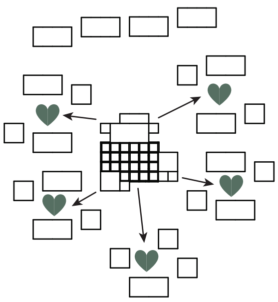
Organic paths and outdoor spaces between the grid



Bringing people from the site and from outside together



Semi-public meeting places for the residentials



ill. 74: Concept diagrams

ill. 75: Common house render

MASTERPLAN

The masterplan shows the finalized result of how the site has been composed and organized, which comes with an urban density of around 73%. The residential buildings are arranged in small clusters, creating shared spaces between the buildings that engage social interaction between the inhabitants while also allowing plenty of daylight into the dwellings and sunlight into the courtyards. In total, the development provides 141 residential units distributed to 248 occupants.

By prioritizing the pedestrians, the vehicles have limited access within the site, with a circular road with parking placed alongside the edges as well as a bigger parking space in the entrance of the site, ensuring that the spaces within are slow paths that are safe, calm and free from traffic. The parking equals to around 47 standard parking spots plus 8 handicap parking spots, with close proximity to the elderly units, enhancing inclusivity.

The overall layout of the environment is a balanced relationship between built areas and green spaces, integrating nature as a defining element throughout the site. At the center of the site is the common house, which is deemed the social and functional heart of the project, creating an environment that encourages social interaction between all types of user groups.

To the north of the common house, a big communal kitchen garden is provided and made accessible for all user groups, allowing even more social interaction. South of the common house is a playground that offers possibilities for the families to gather and let their kids play together. All the courtyards on the site are characterized by extensive greenery and different activities, adding to the social landscapes throughout the residential areas.

The majority of the bike parking is located in the ground level of the two student housing buildings situated to the west and east, creating approximately 240 spaces. An additional 28 spots are placed around the common house, making a total of 268 biking spots.

Energy performance and sustainability is a big aspect of the project and are also integrated on the masterplan. Photovoltaics are placed on the roofs of the tallest buildings and with the largest roofs averaging around 55% of the roofs covered. This has been calculated to create the amount of energy demanded of the development, to achieve a zero-energy site.

Overall, the masterplan displays a well-connected environment that responds to human scale while integrating nature, sustainability and architecture. The balance between communal life and privacy mixed with a variety of shared leisure activities and green spaces becomes the base that supports inclusivity, resilience and creates an inviting residential community.

ill. 76: Facts about the site

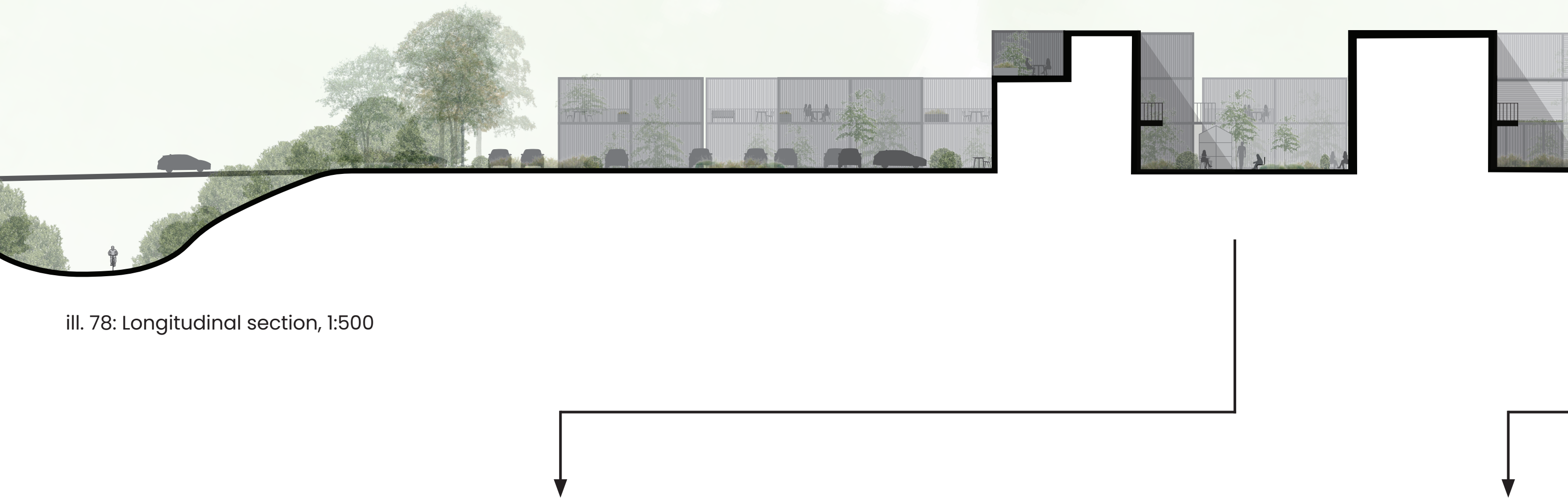
Urban density	73%
Amount of residential units	141
Amount of occupants	248
Parking spots	55
Bike parking	268
Photovoltaic coverage	55%

ill. 77: Masterplan, 1:1000

LONGITUDINAL SECTION

This section shows the site in a large scale where the building heights and the courtyards between the buildings are shown. The section in 1:500 is supplemented with some zoom-in sections that show the courtyards and spaces between the buildings in 1:200.

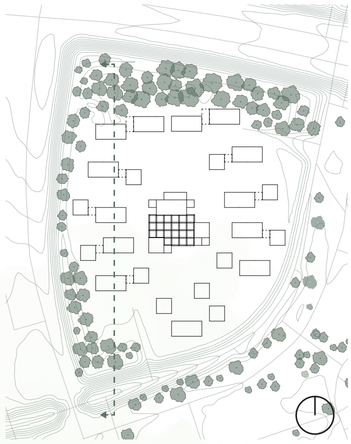
Section 1:500



ill. 78: Longitudinal section, 1:500

Sections of courtyards 1:200

ill. 79: Sections of courtyards, 1:200



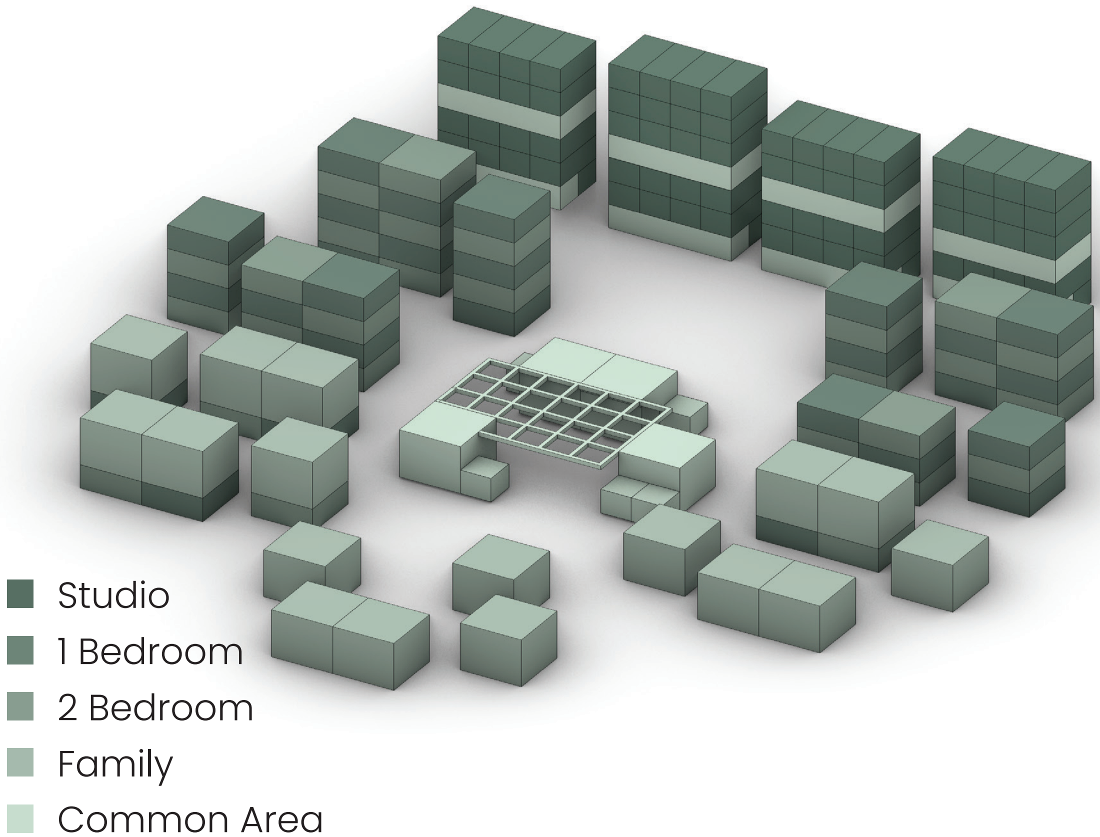
PLACEMENT OF USERS

The placement of apartment typologies follows a few key design decisions. The design criteria to match surrounding building heights naturally creates gradual change in building mass that concentrates toward the north and west, tapering down toward the south. This tapering also facilitates better solar conditions on the site, by reducing the self shading by surrounding buildings.

Students and studio apartments are placed toward the north where the buildings are tallest and most densely packed. Family units, by contrast, are placed in the sunnier southern edge where lower two-storey buildings create the kind of atmosphere and outdoor spaces that are well suited for households with children. One- and two-bedroom apartments for couples and elders fill the middle ground, bridging these two areas of low-rise and high-rise, with a medium-rise in between.

Beyond this spatial logic, the design deliberately mixes certain typologies to encourage intergenerational living. One-, two-, and three-bedroom apartments are mixed throughout the development, bringing together couples, families, and elders in the clustering of buildings. The intention behind this decision is to create mutually beneficial relationships between the unit occupants. Older residents often face social isolation, while children benefit from exposure to different generations - mixing these groups creates opportunities for interaction that address both needs.

With regards to the Student housing, it was decided to keep them separate from other typologies. Their schedules are irregular, they socialize at odd hours, and noise levels tend to be higher. Mixing students with families or elderly residents would likely create friction around these lifestyle differences. Keeping student housing separate lets students form their own community while maintaining the quieter environment other residents need. To support this decision, extra common spaces for eating, socializing (partying), studying, and leisure have been placed in the four student buildings, to support the kind of peer interactions central to student life.



ill. 80: Placement of users

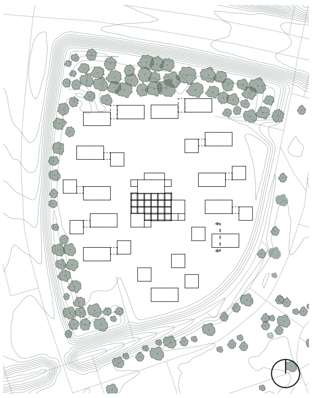
FAMILIES

Floor plan 1:200

All family apartments are 116 m2 and are distributed over two floors. The dining room is the most central room in the apartment and is designed as a double-height room, which helps to create a greater sense of space and creates visual contact between the two floors. There are two bedrooms and a toilet on the upper floor and when you get up on the upper floor you have direct access to a private terrace. The stairs is centrally located in the apartment and functions as a room divider between the living room and the dining room, while from the stairs you get a look down to the dining room and this gives the experience of life across the two different floors.

ill. 81: Floor plan 1:200, Families

Section 1:200

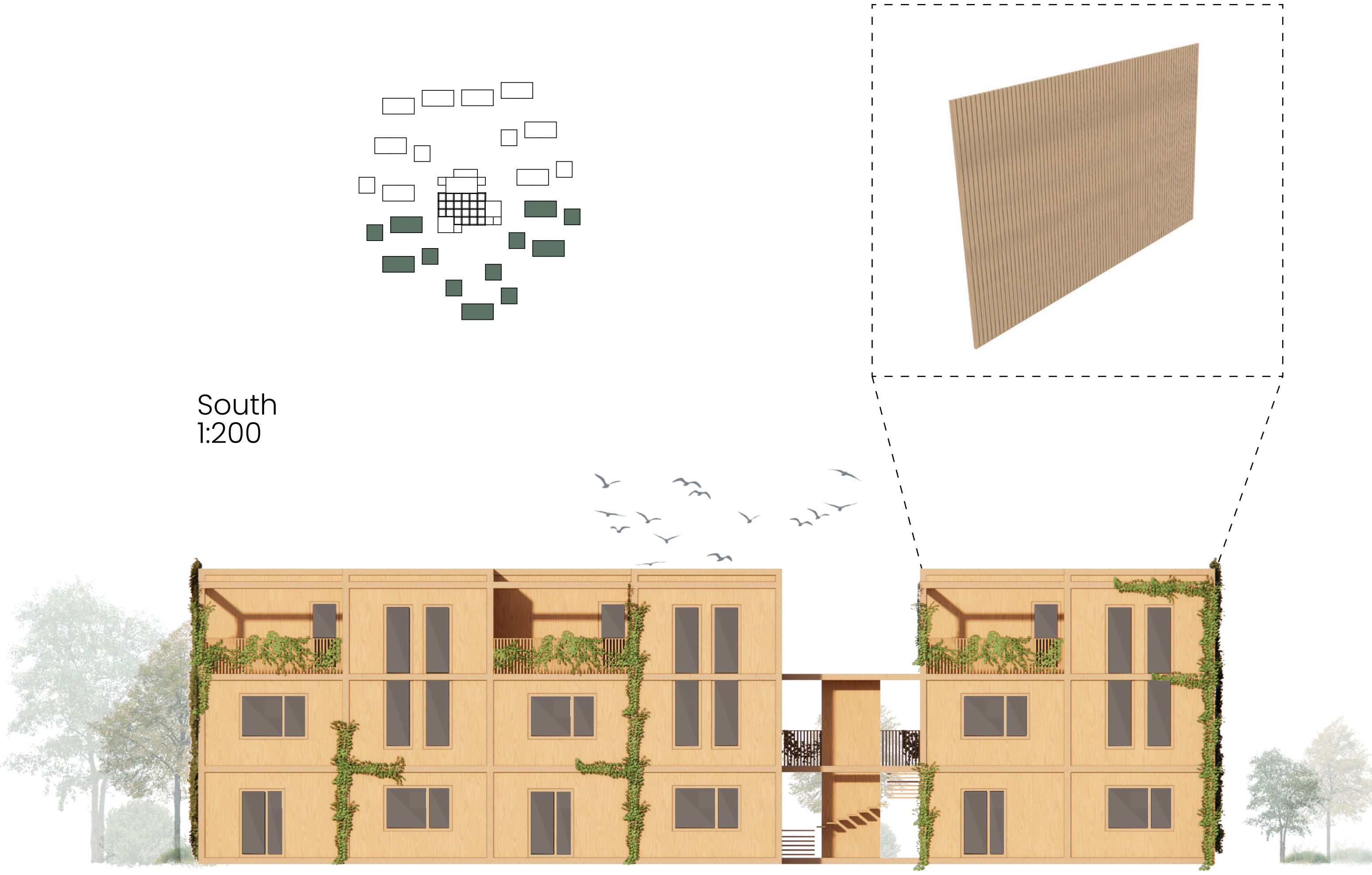


ill. 82: Section 1:200, Families

Elevations 1:200

In the most southern part of the site the family units are placed. The settlements create variation in the appearance of the buildings on the site. In this example of the typology, the top floors is the family units, as they are double floored, wheras the bottom floor is meant for elderly or couples. Some of the units are only two storys. The facades are made up of singular elements placed close together, making it appear very clean.

ill. 83: Elevation 1:500, Families



ill. 84: Elevation 1:200, Families

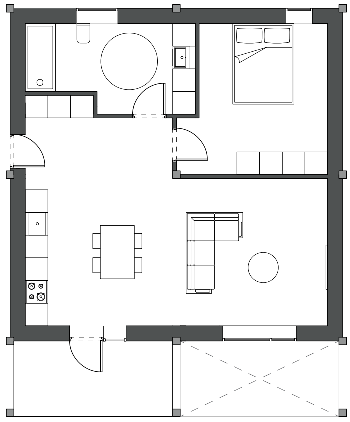
ill. 85: Familiy apartment render

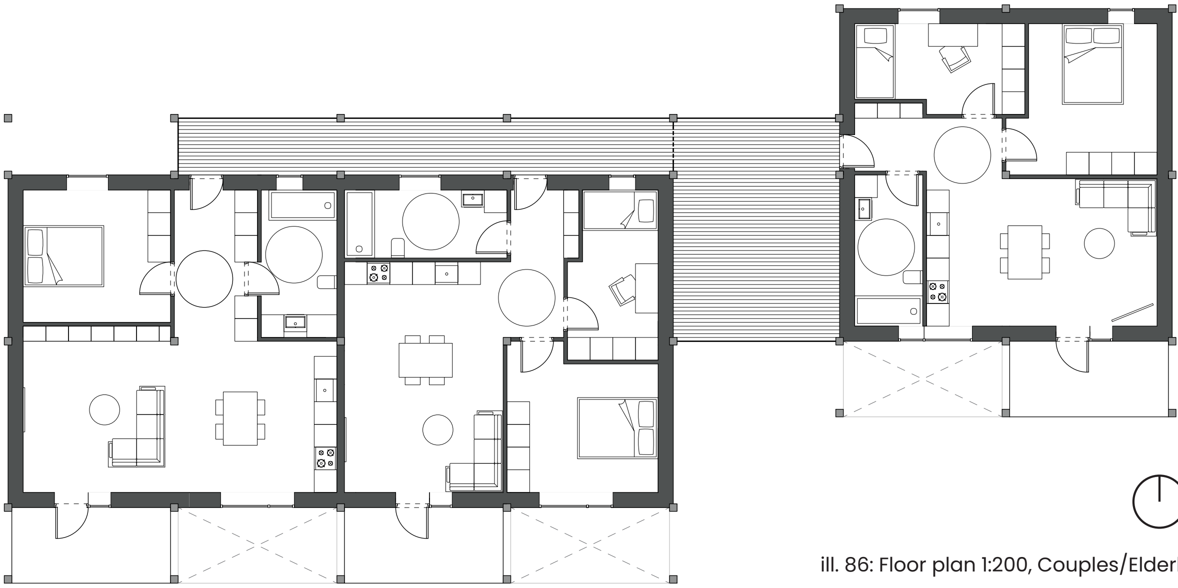
COUPLES AND ELDERLY

Floorplan 1:200

These floorplans show four different layout options for couples and elderly, providing flexibility for different needs. All apartments are 77 m2 and are designed with accessibility in mind, so that people with disabilities also can live in the apartments. There are both one- and two bedroom apartments, which form the different layout of the inside. There is one of each apartment type with an entrance from the exterior corridor on the northern side of the building and one of each apartment with an entrance at the western side.

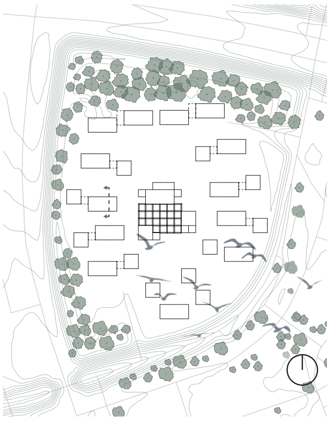
Variation





ill. 86: Floor plan 1:200, Couples/Elderly

Section



ill. 87: Section 1:200, Couples/Elderly

Elevations 1:200

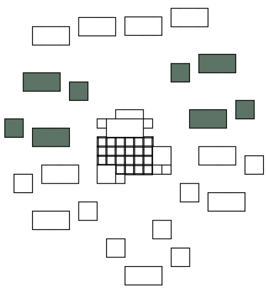
In the middle of the site, the second biggest buildings appear. These buildings are built on the principles of an exo-skeleton imitating the grid structure. The balconies change place for every second floor, making the facade vary having greenery on the facades aswell. The facade of the buildings are built on a lamella system, and change direction for every second grid-square.

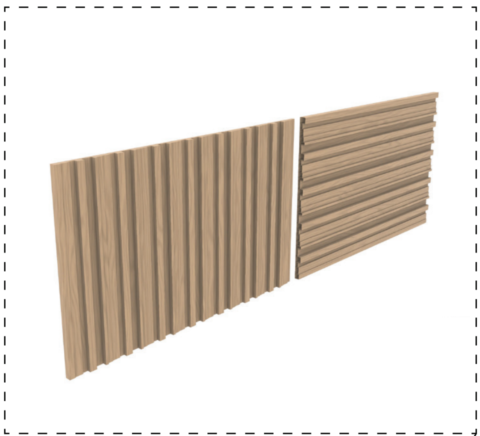
East
1:500

West
1:500

North
1:500

ill. 88: Elevation 1:500, Couples/Elderly



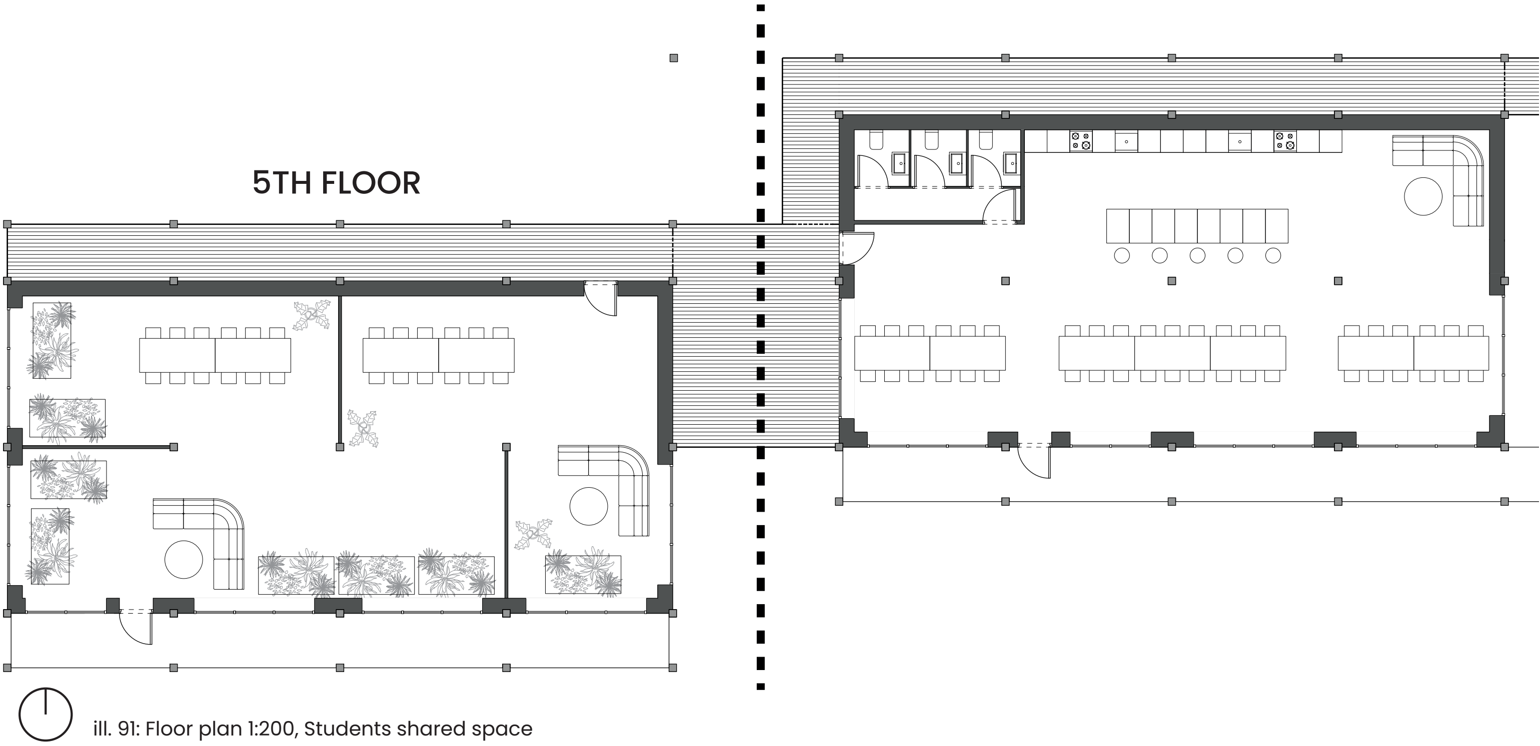


South
1:200

ill. 89: Elevation 1:200, Couples/Elderly

ill. 90: Courtyard render

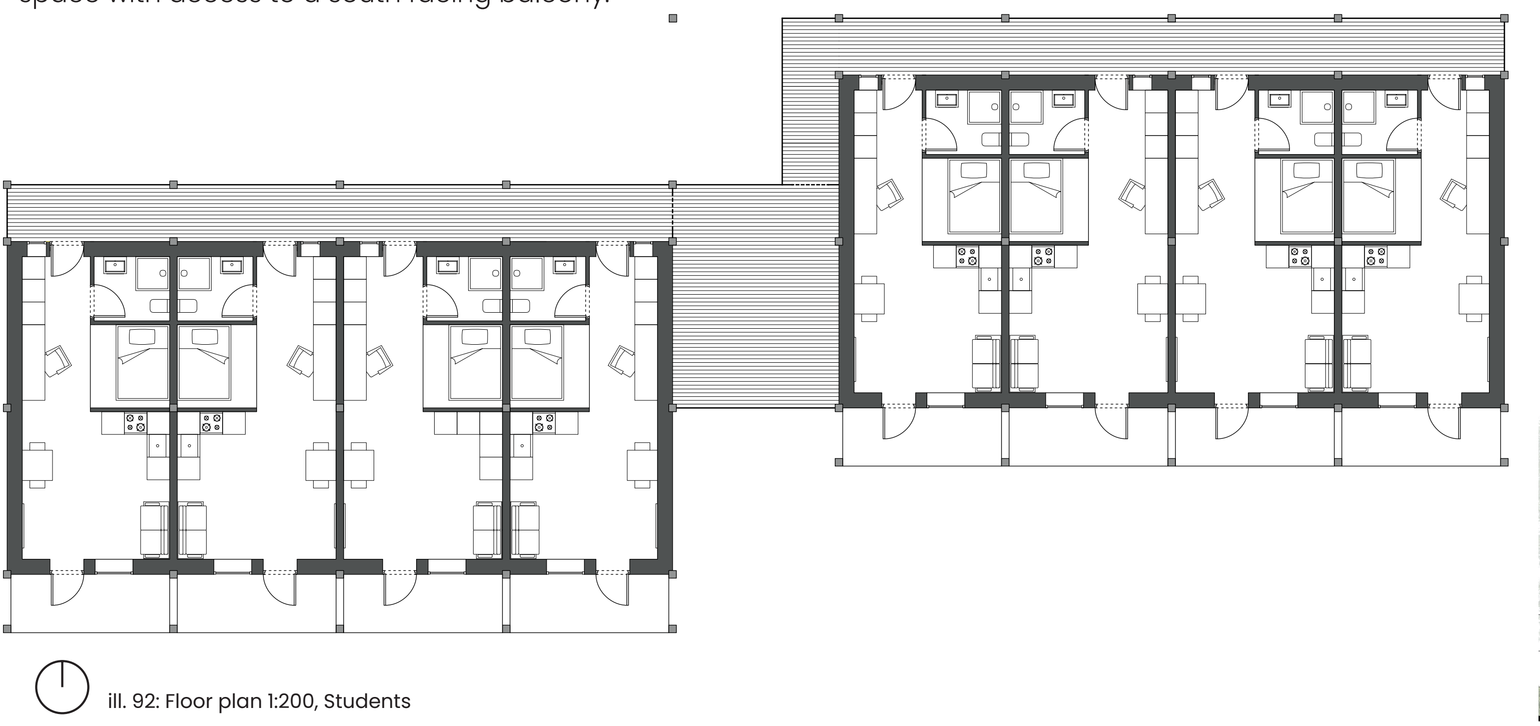
STUDENTS



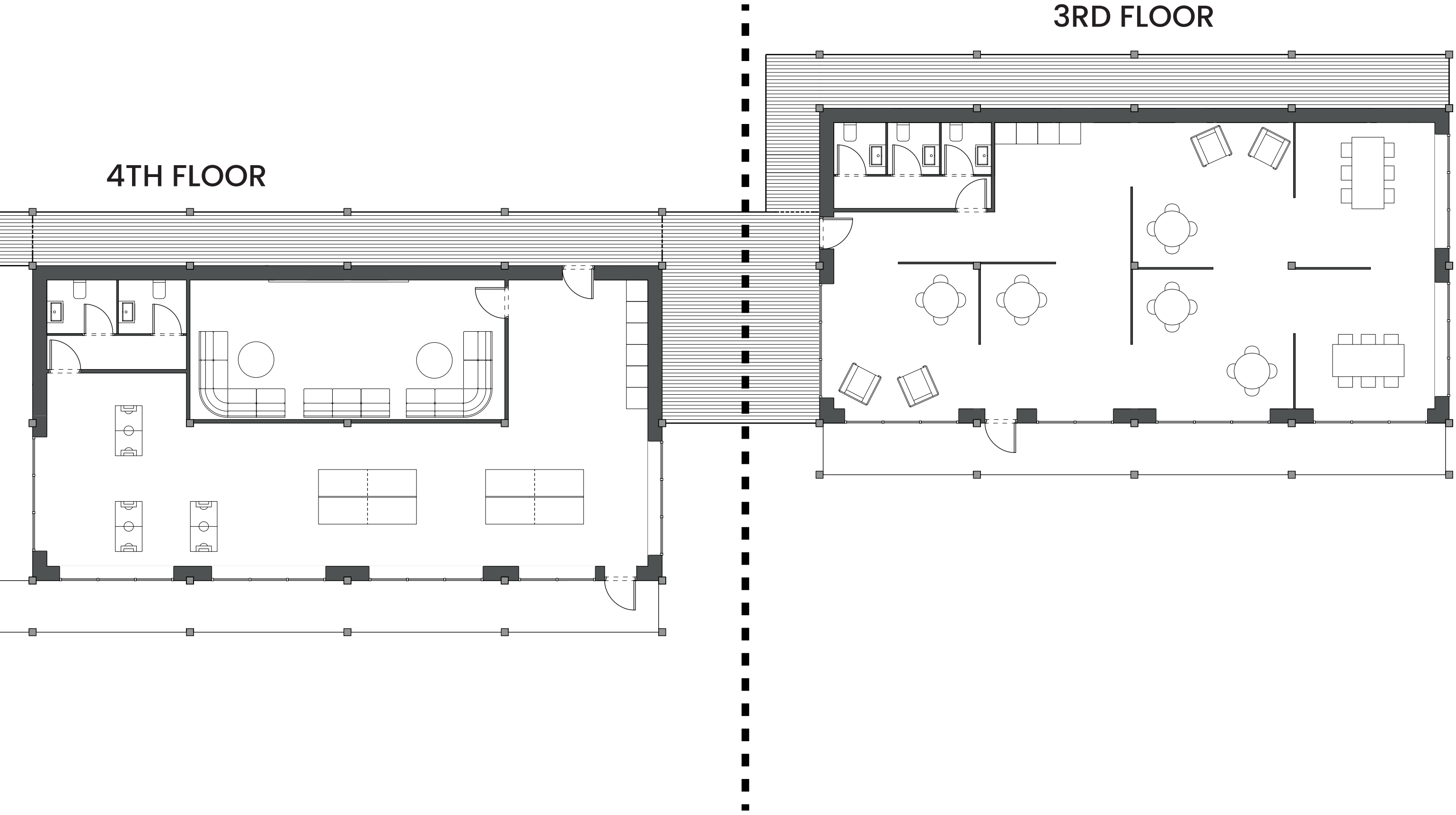
ill. 91: Floor plan 1:200, Students shared space

Floorplans 1:200

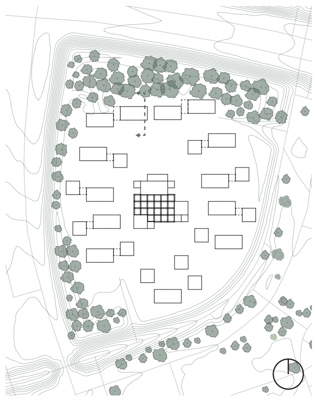
The floorplan for the students shows an overview of the shared spaces for all the students living in the apartments. These are divided into different functions including a garden, a shared kitchen for communal dining, a games and cinema area and the last one is a study space. These areas support both socializing and interaction across the circulation core. The next floorplan shows the 38 m2 student apartment where the living room is located to the south to get a bright space with access to a south facing balcony.



ill. 92: Floor plan 1:200, Students



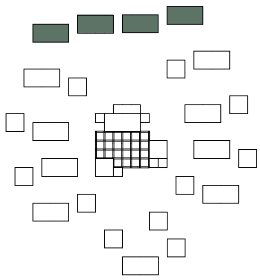
Section 1:200

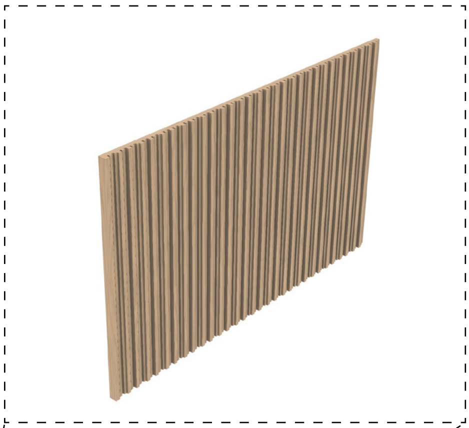


ill. 93: Section 1:200, Students

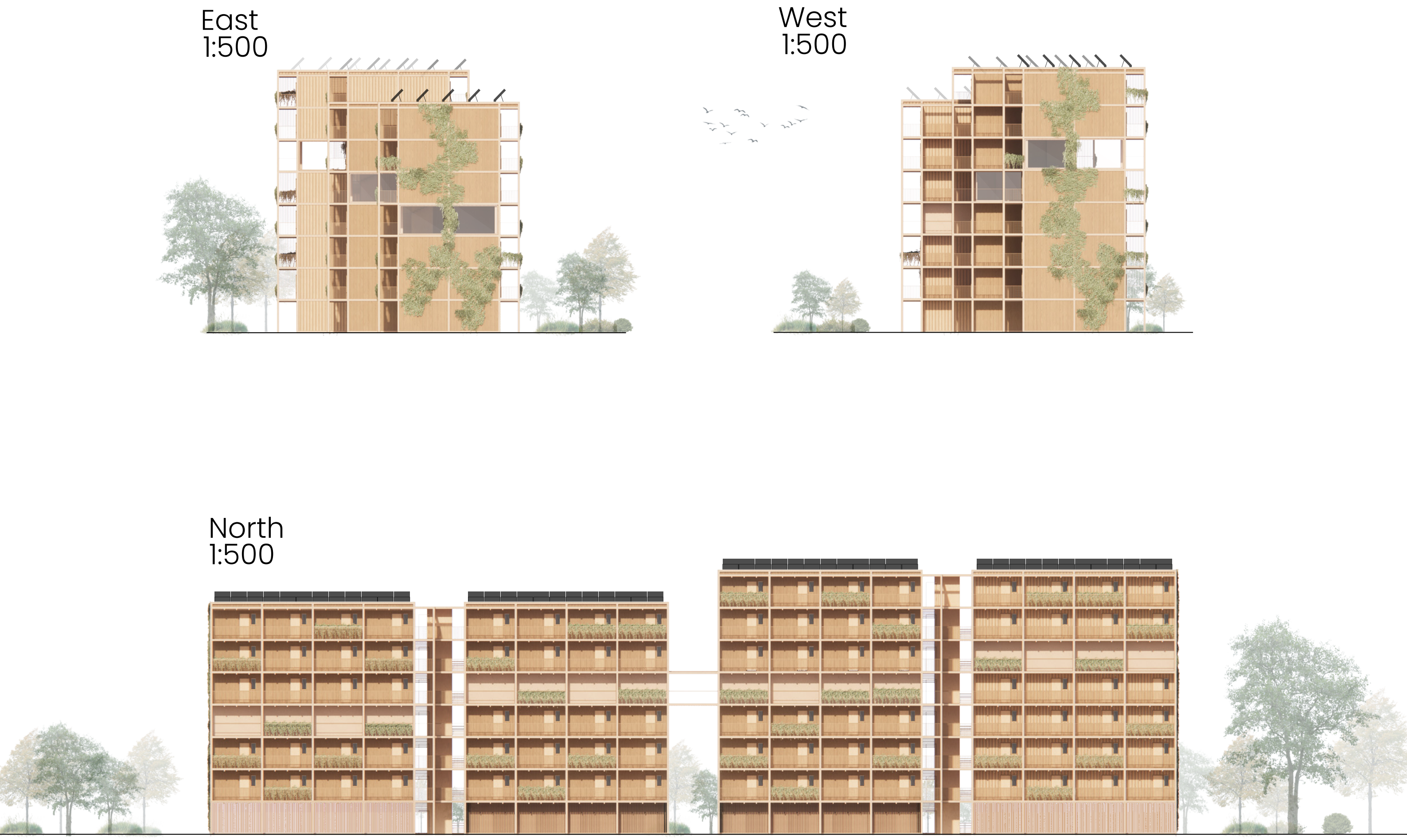
Elevations 1:200

On the most northern part of the site is the student apartments, which are also the tallest buildings on the site. The buildings are structured with an exoskeleton, making the facade interesting and transparent, whereas every unit has their own balcony attached. In the middle of the buildings, the shared spaces creates a feeling of the building floating in some places, while also offering the occupants to socialize within the building itself. The staircase and elevator have been placed between the buildings and with a transparency making the facades vary. On the northern part, there is exterior corridors, elevating the concept of having an exoskeleton on the building facades. In the two middle buildings, a washing room as well as storage rooms for the residents have been placed, also to create a more lively facade in the bottom floor. The two buildings on the edges have bike parking, so all space have been utilized. The facade of the buildings is a lamella system with changing sizes and offsets, making it stand out even more.





South
1:200



ill. 94: Elevations 1:500, Students

ill. 95: Elevation 1:200, Students

ill. 96: Kitchen garden and student units, render

COMMON HOUSE

Floorplan 1:200

The common house is intended as a meeting place for the occupants, with a focus on community and interaction across different age groups. The building is created as three building volumes, each containing its own activity. The first building contains a multi-purpose room, which can be used flexibly and transformed depending on the activity, whether it is communal dining, lectures or other joint activities. The second building contains a hobby room, where occupants can pursue their various hobbies and learn from each other, while the last building contains a fitness room.

The three buildings are positioned so they form a common outdoor center on the site. The multi-purpose room can be opened out towards the outdoor space, which helps to strengthen the activation of the indoor and outdoor space in extension of each other and thus enables the creation of the different activities that suit all age groups.

ill. 97: Floorplan 1:200, Common house

Different scenarios

The common house is divided in three parts, creating an outdoor area between them. Above this area a wooden grid serves as a roof to create a vertical limit. This courtyard should bring inhabitants together, no matter the user group they are part of, the time of the day or the season. It has to be accessible for everyone, all the time.

The neutral setting is made to wander around and meet the neighbors. A water fountain is installed on a flat surface, allowing this space to be dry and used for other purposes.

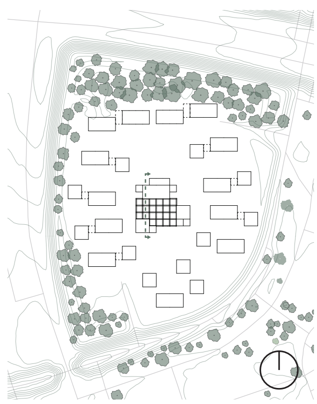
The proximity to the indoor common space gives the opportunity to extend these rooms outside. The large area can welcome an outdoor reception and the fitness room can organize outdoor classes when the weather allows it.

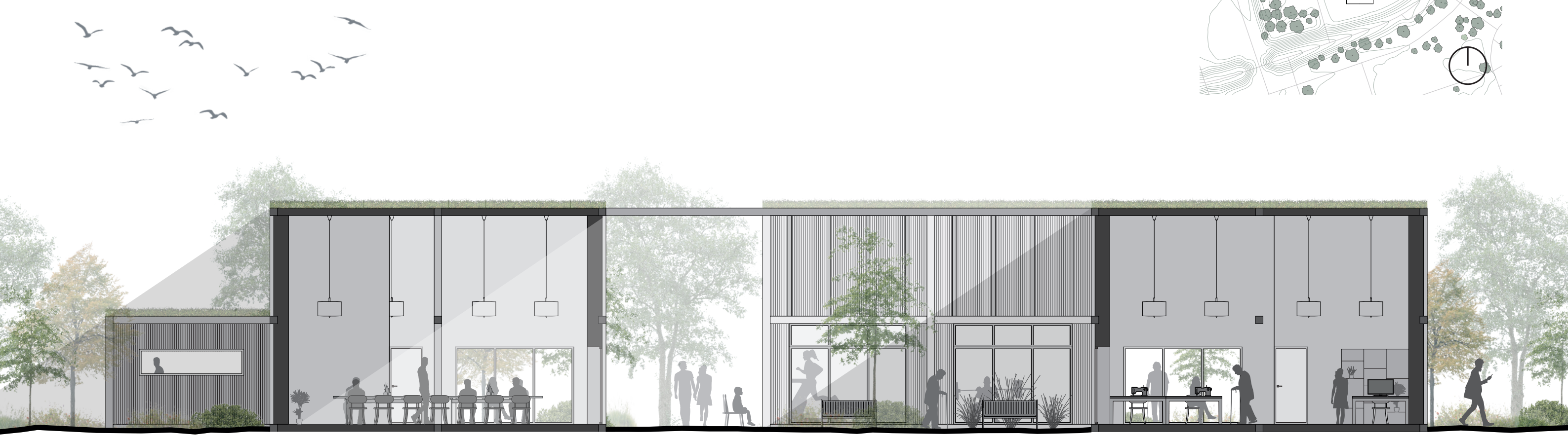
Other occasional activities, such as a market or an open air cinema, can take place and bring people from outside of the area.

The aim is to be able to use it all year round, with different weather through the seasons. The ground is paved bricks, meaning it is gonna stay dry and clean, being usable even when the weather is not the nicest.

ill. 98: Different scenarios, Common house

Section 1:200





ill. 99: Section 1:200, Common house

INTERIOR MATERIALS

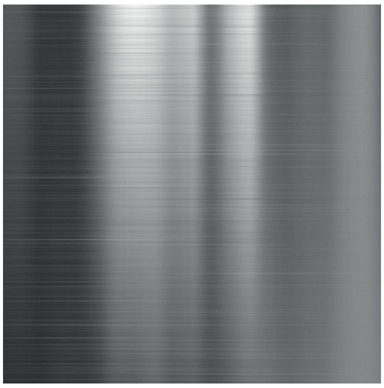
The indoor materiality is designed to give a light and warm expression with light wood and white colours. The floor inside the housing is oak basketweave floor and the walls and ceiling are plaster, which makes a nice balance between the warm coloured wood and clean white walls. The beams and columns in the construction are made of CLT pine wood and are visible from the inside of the building which creates depth and warmth to the ceiling and the walls.

Interior cladding

Oak basketweave floor

Plaster walls and ceiling
Pine beams and columns

Construction



Steel for joints

CLT douglas

ill. 100: Interior materials

EXTERIOR MATERIALS

The exterior materiality is designed with focus on organic materials with a natural expression, which changes over time. The facades are thermalwood pine which over time gets patina and becomes more gray and cold in the colour. On the facades and balconies greenery is growing which compliments the wooden facades. The pavement on the site is primarily brick pavement in warm colours which is placed in organic lines around the site. On the playground the pavement is wood chips which is an organic and soft substrate. The parking spots are made of a permeable pavement which make the parking area green in the expression.

Exterior cladding

Thermowood pine (different patinas)

Triple-glazed windows

Greenery on the facade

Pavement

Brick pavement for paths

Wood chips for playground

Permeable pavement for parking

ill. 101: Exterior materials

BIODIVERSITY

For the final proposal, the vegetation in the matrix has been extended to ensure that the biodiversity is improved throughout the site. This is achieved by creating more habitats for the ambassador species, which will cause the area to become ecologically improved. The remaining vegetation will be extended onto the site, to accomplish a diverse and lush environment.

Known species (site) / Indicator species	Hawthorn	Field maple trees	Oak trees	Plane trees	Meadow weeds	Goldenrods	Birch trees	European hazel	Red dogwood	Stinging nettle	Waxcaps	Wood decaying fungi	Dead trees	Grey alder
Rabbit	+				+					+				
Hedgehog	+		+		+		+	+		+		+	+	
Squirrel	+	+	+	+			+	+	+			+	+	+
Northern lapwing					+						+			
Skylark					+						+			
Bumblebees	+	+	+		+	+	+	+		+	+			+
Blue butterfly	+	+	+		+		+	+	+	+				+
Great spottet woodpecker		+	+	+			+	+				+	+	+
Orchids					+						+			
Globe flower					+									
Sticky catchfly	+				+	+				+				
Ambassador species														
Chequred skipper	+				+						+			
Clustered bellflower					+						+			
Purple orchid			+		+						+			
Red-backed shrike					+									

ill. 102: Biodiversity, final

	Added species (site) / Indicator species	Thyme	Birds-foot trefoil	Blackthorn	Oregano	Foxglove	Yellow rattle	Wild carrot	Thistles	Apple trees	Cherry trees
				+						+	+
										+	+
		+	+	+	+	+		+	+	+	+
		+	+		+			+		+	+
										+	+
							+				
		+	+		+		+	+			
						+	+				
						+	+			+	+
				+					+	+	+

This information is based on general European biodiverse knowledge organized with assistance from an AI tool using recognized environmental management sources

BIOFACTOR

			Factor	Analysis area (m²)	New area (m²)
Paved or partially paved areas	Solid paving	Impermeable paving; no vegetative cover. Roof areas without greenery, concrete, asphalt, tiles.	0	350	2 768
	Partially paved areas	Permeable paving and paving with vegetation. Tiles used as grass reinforcement, wooden decks, gravel areas for traffic.	0,1	0	4 977
Green areas	Planted areas, low diversity	Monocultural green areas. Lawn, dense ground cover, beech hedge.	0,2	3 480	562
	Planted areas, low/medium diversity	Semi-species-poor areas. Extensive/unmown lawn.	0,4	8 270	2 617
	Planted areas, medium/high diversity	Semi-species-rich areas, areas with native species.	0,7	932	2 425
	Planted areas, high diversity	Species-rich green areas. Areas with high-quality forest character. Or habitats for endangered animal species.	1	10 704	10 387
Aditionnal areas	Vertical facade planting	Facade planting with climbing plants	0,4	0	5 040

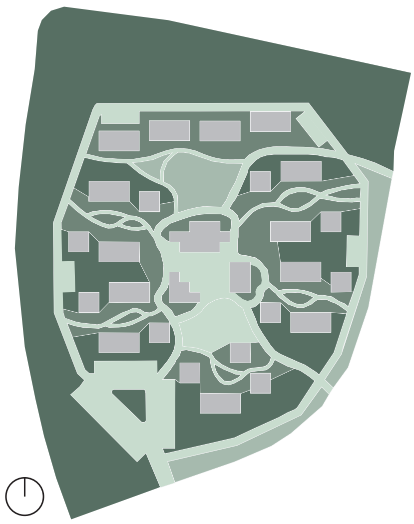
The biofactor helps analyse the biodiversity of a site ground. Based on different parameters and categories, each area of the site is rated with a factor. A very paved and impermeable ground has the lowest factor: 0, while a very diverse and rich green area has a factor of 1. Each area is multiplied by its factor, giving an average biofactor of the whole site, between 0 and 1.

The initial biofactor is 0,647, thanks to a large forest area and a very small paved area, leaving most of the site as unmown lawn.

The goal is to keep a high biofactor through the site. To do so a lot of the areas are planted with medium and high diversity species. The roads and paths are made of a permeable pavement of bricks, allowing water to infiltrate. Most of the facades have vegetation along them, allowing us to implant a lot of greeneries on the whole site.

The final biofactor is 0,664, being even better than the original one thanks to a low paved area and an important implantation of wild gardens.

Total area	23 736	23 736
Biofactor	**0,647**	**0,664**



ill. 103: Biofactor

VEGETATION

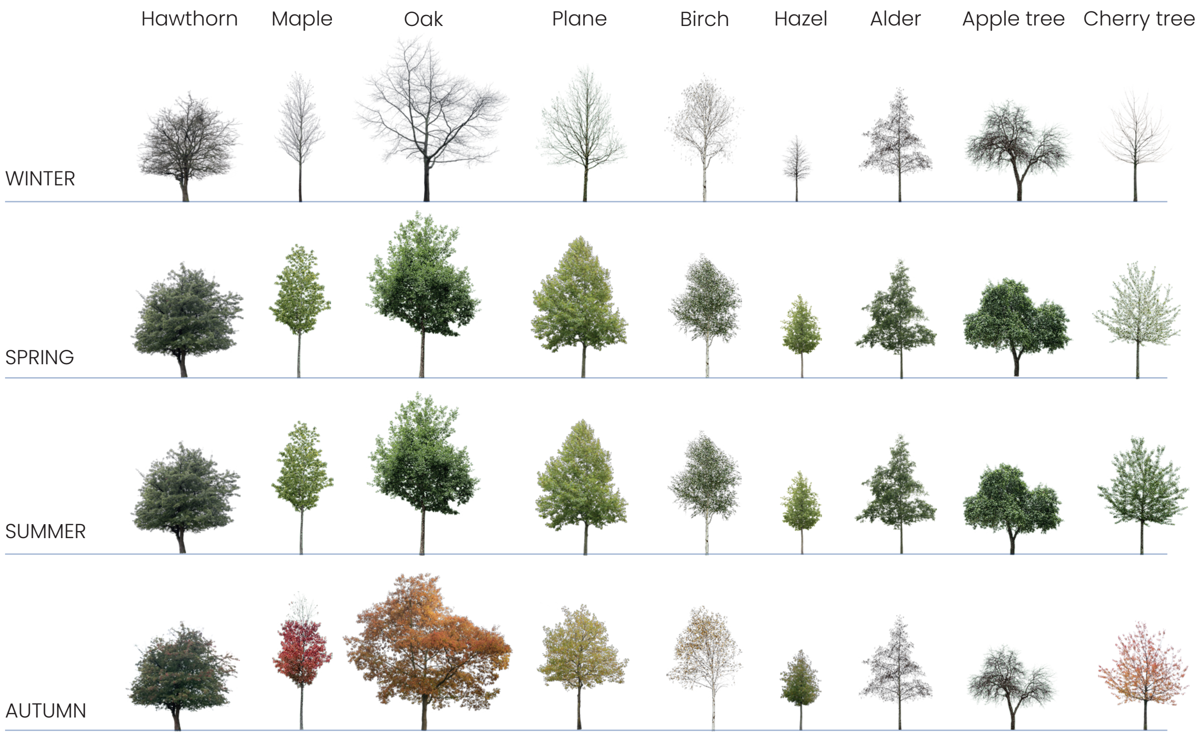
Flowers

Most of the flowers already on site bloom between May and September (birdsfoot trefoil, foxglove, yellow rattle and wild carrots). Planting flowers which bloom during the fall and winter (winter jasmin, chrysanthemums and christmas rose) will benefit species during this time as well as providing an esthectic surroundings all year long.

ill. 104: Flowers along the year

Trees

The trees on site are deciduous trees meaning they lose their leaves during the winter, having then a low impact on the shading for their surroundings. The various heights and leaves' colors offer a diverse look of these areas. The addition of fruit trees such as apple trees and cherry trees is good to ensure biodiversity through species diversity.



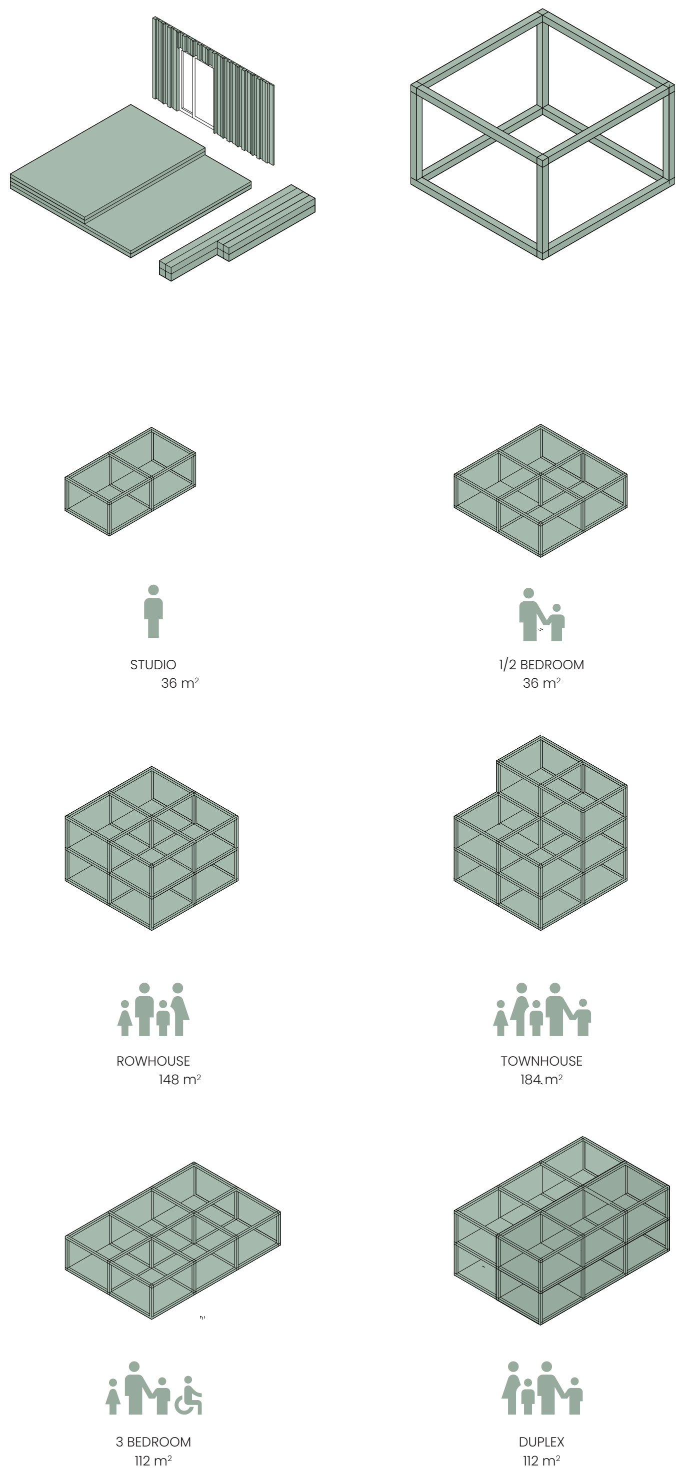
ill. 105: Trees along the year

TECHNICAL

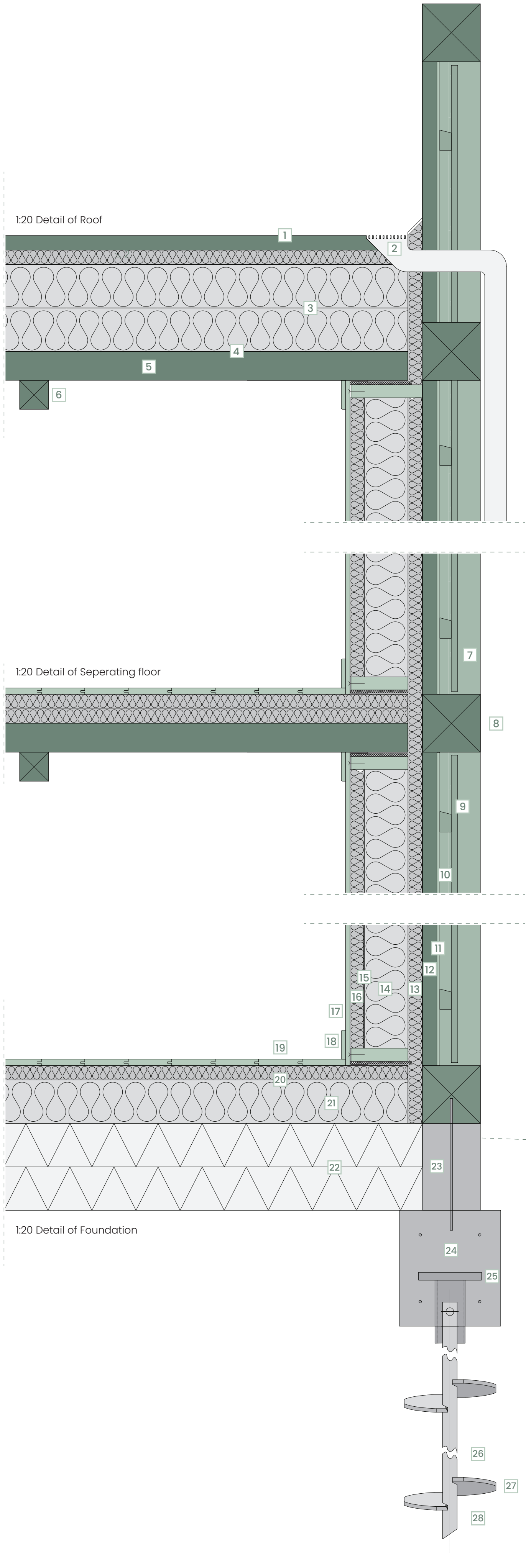
CONSTRUCTION

The construction of the project follows a design strategy that prioritizes ease of construction through modularity and standardized blocks and components that interlock during assembly, coupled with a focus on sustainable construction in both material selection and construction techniques. The standardized components of glulam beams and columns that constitute the structural skeleton of the buildings, along with the CLT slabs that span between them, can be manufactured off-site and assembled rapidly on-site. Furthermore, the choice to employ helical screw piles that penetrate the ground to a depth of 20 metres at the tallest buildings reduces the quantity of concrete required without compromising structural integrity, while simultaneously enabling accelerated construction timelines. The use of metal brackets and the fully timber-based construction also facilitate future disassembly and material reuse.

The nature of this design and structural system allows for a wide range of application possibilities, which supports the diversity of apartments, houses, and other residential typologies that can inhabit the system. This flexibility means the design can be modified and adapted to suit a variety of sites and demographics, spanning from low-rise to high-rise developments, limited only by the structural capabilities of timber construction.



ill. 106: Construction concept

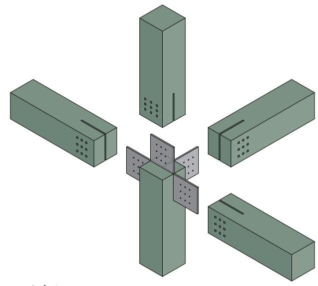


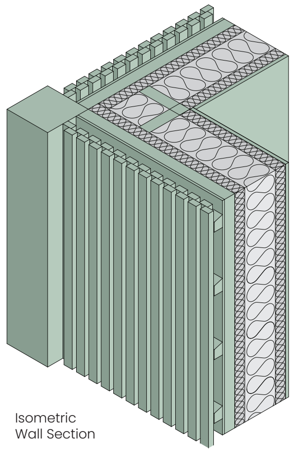
1 Wood
2 Gutter
3 350mm Thermal insulation
4 Vapour barrier
5 CLT slab
6 Timber beam

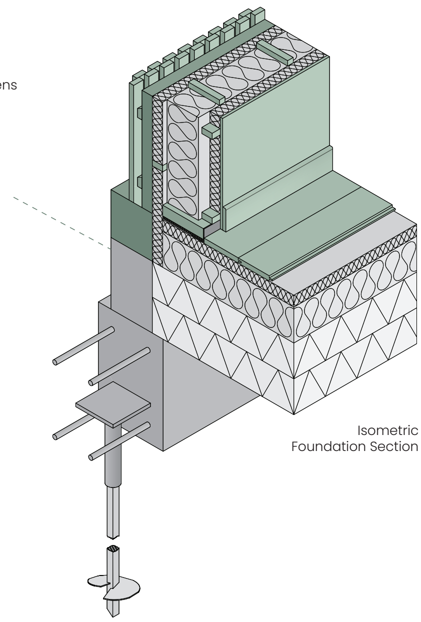
7 200 mm Timber Column
8 200 mm Timber Beam
9 20 mm slatted cladding
10 40 mm rear ventilated cavity

11 External wind barrier
12 50 mm CLT slab
13 50 mm Thermal insulation / Horizontal battens
14 150 mm Thermal insulation / Studs
15 Vapour barrier
16 Service layer
17 Wood panel
18 Skirting board
19 Wood flooring

20 Vapour barrier
21 200 mm Thermal insulation
22 300 mm XPS isulation
23 Concrete stem wall
24 Cast reinforced Concrete footing
25 Pile Cap
26 Pile Shaft
27 Helical bearing plate
28 Pilot point


Joints


Isometric
Wall Section

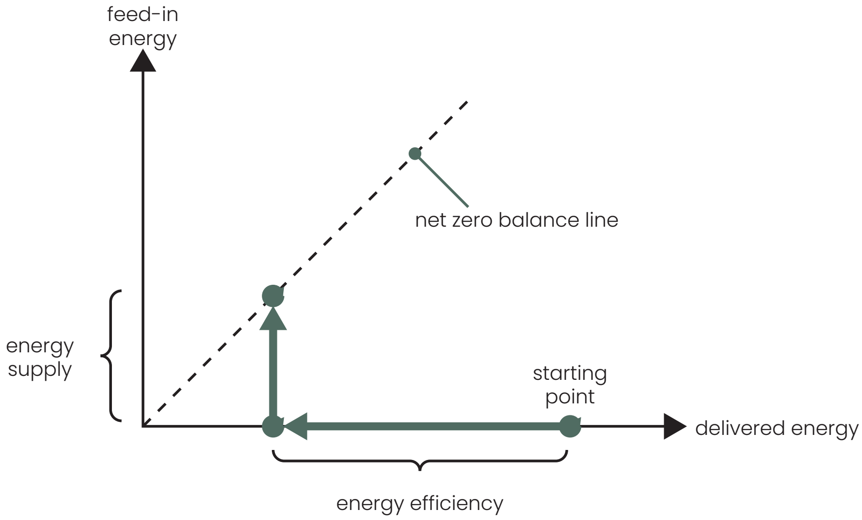

Isometric
Foundation Section

ill. 107: Construction details

Net-Zero Energy

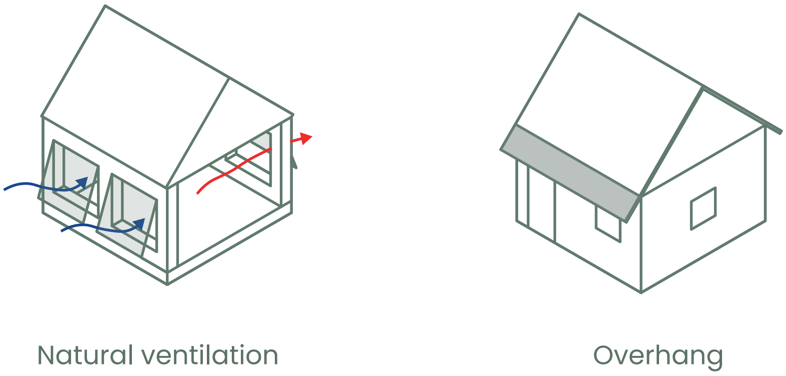
Definition

Zero energy construction can mean several things. This project is working with net-zero energy for the entire site, which means that the site produces as much energy as it consumes over the course of an entire year. To achieve net-zero energy, work has been done with several different active and passive strategies, which, in conjunction with good U-values on both the foundation, roof, windows and external walls, help to reduce the energy framework for each individual building.



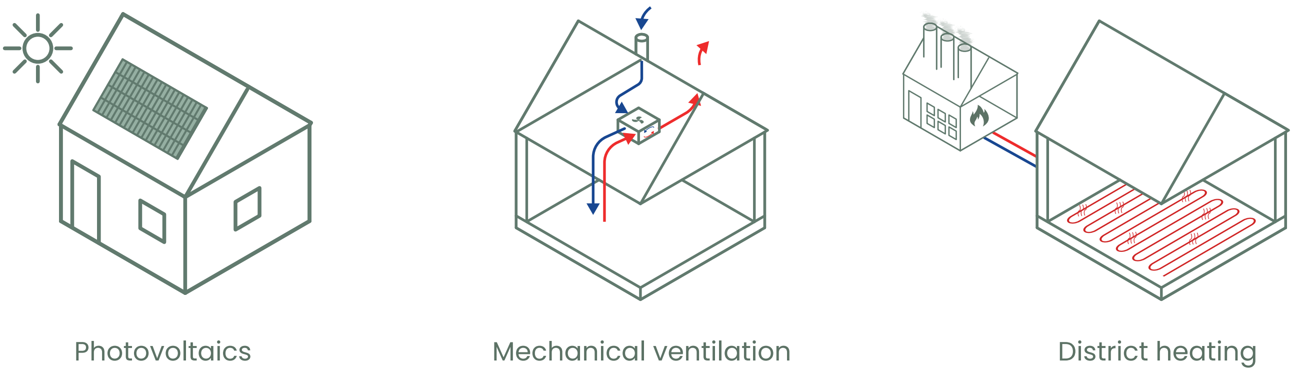
ill. 108: Net-zero energy

Passive design strategies



ill. 109: Passive design strategies

Active design strategies



ill. 110: Active design strategies

BE18

Results

The three be18 simulations show the energy frame for the three types of housing located on the site, namely student housing, couples/elderly apartments and family units. The simulations is based on the three homes that receive the least sun on the site, as the large overhangs in the form of balconies presumably create so much shade that the homes with the worst energy frames come from a greater consumption of space heating, rather than the need of cooling due to excessive heat.

Since district heating is very cheap and efficient in Aalborg, this is used to heat the homes. This means that the solar panels must cover the power consumption from electrical appliances, lights, etc. The solar panels play an important role in making the site net-zero energy, as they must produce at least as much energy as the buildings consume.

Students

Key numbers, kWh/m2 year

	Without supplement	Supplement for special conditions	Total energy frame	Total energy requirement
Renovation class 2	72,3	0,0	72,3	28,0
Renovation class 1	67,7	0,0	54,3	28,0
Energy frame BR 2018	39,2	0,0	31,1	28,0
Energy frame low energy	27,0	0,0	27,0	28,0

Contribution to energy requirement	
Heat	28,0
El. for operation of building	2,2
Excessive in rooms	0,0

Net requirements	
Room heating	8,9
Domestic hot water	17,6
Cooling	0,0

Selected electricity requirements	
Lighting	9,7
Heating of rooms	0,0
Heating of DHW	0,0
Heat pump	0,0
Ventilators	2,1
Pumps	0,0
Cooling	0,0
Total el. consumption	32,8

Heat loss from installations	
Room heating	1,6
Domestic hot water	4,4

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

ill. 111: Be18, Students

Couples/Elderly

Key numbers, kWh/m2 year

	Without supplement	Supplement for special conditions	Total energy frame	Total energy requirement
Renovation class 2	75,5	0,0	75,5	29,9
Renovation class 1	56,6	0,0	56,6	29,9
Energy frame BR 2018	32,5	0,0	32,5	29,9
Energy frame low energy	27,0	0,0	27,0	29,9

Contribution to energy requirement	
Heat	29,5
El. for operation of building	2,5
Excessive in rooms	0,0

Net requirements	
Room heating	12,5
Domestic hot water	15,1
Cooling	0,0

Selected electricity requirements	
Lighting	0,0
Heating of rooms	0,0
Heating of DHW	0,0
Heat pump	0,0
Ventilators	2,4
Pumps	0,0
Cooling	0,0
Total el. consumption	33,2

Heat loss from installations	
Room heating	1,9
Domestic hot water	2,0

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

ill. 112: Be18, Couples/Elderly

Families

Key numbers, kWh/m2 year

	Without supplement	Supplement for special conditions	Total energy frame	Total energy requirement
Renovation class 2	90,4	0,0	90,4	39,2
Renovation class 1	67,8	0,0	67,8	39,2
Energy frame BR 2018	39,3	0,0	39,3	39,2
Energy frame low energy	27,0	0,0	27,0	39,2

Contribution to energy requirement	
Heat	39,8
El. for operation of building	2,8
Excessive in rooms	0,0

Net requirements	
Room heating	12,8
Domestic hot water	19,8
Cooling	0,0

Selected electricity requirements	
Lighting	0,0
Heating of rooms	0,0
Heating of DHW	0,0
Heat pump	0,0
Ventilators	2,4
Pumps	0,0
Cooling	0,0
Total el. consumption	33,5

Heat loss from installations	
Room heating	7,2
Domestic hot water	6,7

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

ill. 113: Be18, Families

BSIM

BSim was used to study every typology, using the most critical placement each time. BSim is used to look at indoor climate, air quality and temperature.

Concerning temperature the regulations give a maximum of 100 hours/year above 27° and there shouldn't be a time when the temperature is under 19°. In all three buildings both these regulations are respected, with no hours under 19° and none above 26°.

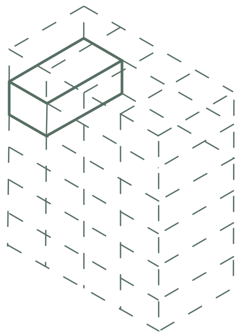
The air quality is based on different parameters such as: CO2 level and the relative humidity in the air. The recommended CO2 level in a well ventilated housing is between 300 and 400 ppm. All the housing fits in these standards. The optimum relative humidity range is between 40 and 60%, but it can be as low as 30% without being a health threat. The excessive humidity in these dwellings happen during the summer, a period when the inhabitants can ventilate more if needed.

System used

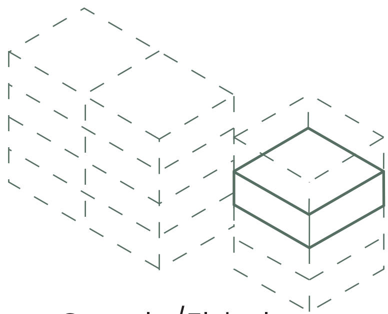
- Natural ventilation
- Lightning
- Heating
- Equipment
- Infiltration
- PeopleLoad
- MoistureLoad
- Mechanical ventilation

Results

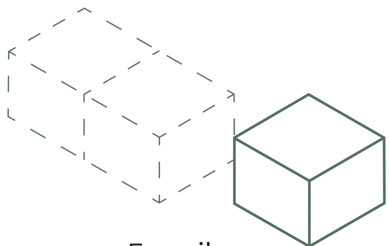
Temperature: 20,7°
Hours >26°: 0
Hours <19°: 0
Air change: 1,1/h
Moisture: 32,8% - 64,3%
CO2: 385,4 ppm


Student

Temperature: 21,1°
Hours >26°: 0
Hours <19°: 0
Air change: 1,1/h
Moisture: 31,5% - 63,4%
CO2: 379,3 ppm


Couple/Elderly

Temperature: 20,8°
Hours >26°: 0
Hours <19°: 0
Air change: 1,2/h
Moisture: 32,5% - 62,9%
CO2: 311,4 ppm


Family

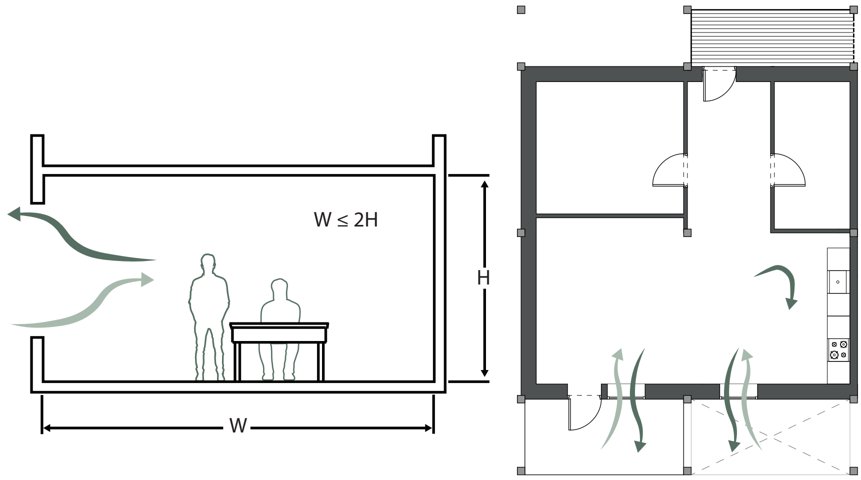
ill. 114: Bsim results

NATURAL VENTILATION

Single-sided ventilation

The couple's and elderly's unit

Single-sided ventilation occurs when the openings are all on the same facade of the building. It's the case for the couple's and elderly's living room, with two openings on the same wall, the south one. This facade gets the most wind, assuring a big air entry in the building, allowing enough air movement.



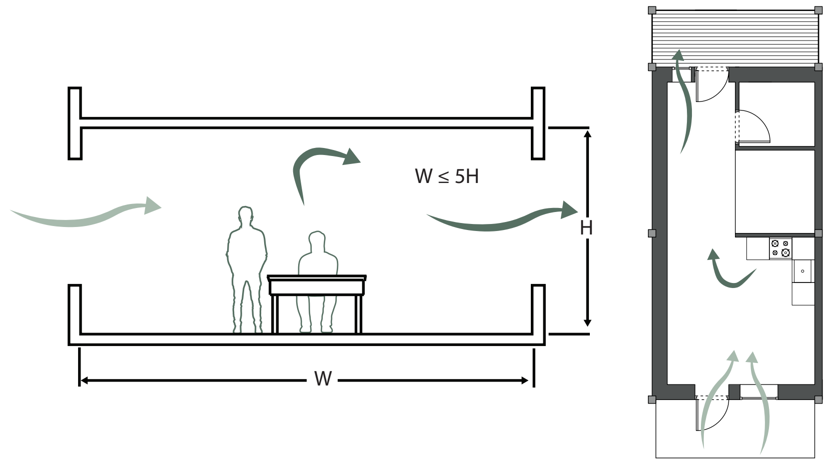
ill. 115: Single-sided ventilation

The first parameter to look at is the rule of thumb. For an effective single-sided ventilation, the width of the room can't be more than twice of its height. The height of the room is 2,8m meaning the width has to be under 2x2,8=5,6 meters. In this typology the living room has a depth of 4,4m. The single-sided ventilation is efficient in this building, allowing the air to flow and to ventilate the room.

Cross ventilation

The student units

Cross ventilation happens when there is an opening in more than one wall, either two walls on different facades, or one opening in a wall and one in the roof. In the student's unit there are two openings on opposite sides of the housing: a big window and a glass door on the south wall, a smaller window on the north facade.



ill. 116: Cross ventilation

Like the single-sided ventilation, the cross ventilation also needs to respect a rule of thumb to be effective. The width of the room has to be less than 5 times its height. The height of the room is still 2,8m meaning the depth of the room can be as much as 5x2,8=14 meters. The student's apartment is one big room with the full width of the building: 8,8 meters. The cross ventilation is effective in this apartment. The wind comes mostly from the south, meaning that the air will flow from the living room to the entrance, passing by the kitchen and bedroom.

Stack ventilation

The family units

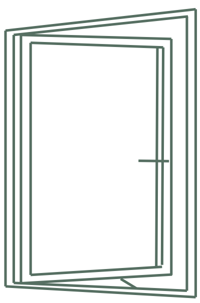
Stack ventilation is characterized by multiple openings on different heights. The hot air naturally rises and will escape by the high opening while the cold air will enter through the lower one. The dining room of the family's unit has a double height with windows on both levels. Another window is in the living room and provides a single-sided ventilation, as shown in the couple's and elderly's unit.

ill. 117: Stack ventilation

The natural air pressure difference between cold and hot air, making the warm air rise and flow from the bottom to the top. The escaping air at the top will create a negative pressure in the low part of the wall, allowing air to enter by the windows placed there. It's a great system to use in the summer when the room starts to heat too much. But it's mostly efficient during winter when there is a big difference between the indoor and outdoor temperature. Stack ventilation provides a good air flow all year round and is good when combined with mechanical ventilation

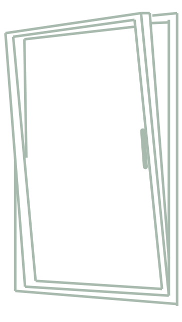
Window openenings

Two different openings are used in the buildings. Both provide advantages for different seasons. That's why in some windows they are combined.



Side-hung outward opening

The first one is a side-hung outward opening. This window can fully open, allowing a big air flow to enter the room. They will mostly be used during summer or to ventilate a lot when needed. They open outward to let the frame free to use. In the student's unit the window is low enough to be able to sit on it, with the outdoor opening both sitting and ventilation can happen at the same time.



Bottom-hung inward opening

The second one is a bottom-hung inward opening, allowing only the top part to open, creating a 20cm opening. This system will mostly be used in winter, to allow ventilation to happen without chasing all the hot air out. The opening is towards the inside to prevent potential rain from coming in. This way they can also be opened during a rainy day if ventilation is needed.

ill. 118: Window openings

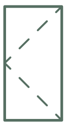
Effective opening area

The effective opening area shows the area available for air to enter and exit the room. Each window has a different one based on its height and opening width.

The calculation depends on the type of opening.
For a side-hung window it's the area multiplied by a factor of 0,6.
A = H x W   Av = A x 0,6
For a bottom-hung window it's half the area with a factor of 0,45.
A = 0,5 x H x W Av = A x 0,45

Typology 1 : student
Typology 2 : couple and elderly
Typology 3 : family

North window in typology 1

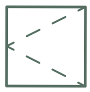


A = height x opening width
A = 1 x 0,5 = 0,5 m^2
Av = A x C = 0,5 x 0,6 = 0,300 m^2

North window in typology 2

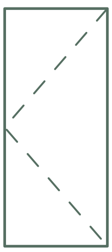
A = height x opening width
A = 0,7 x 1 = 0,7 m^2
Av = A x C = 0,7 x 0,6 = 0,420 m^2

North window in typology 2 and 3



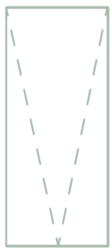
A = height x opening width
A = 0,7 x 0,7 = 0,49 m^2
Av = A x C = 0,49 x 0,6 = 0,294 m^2

South glass door in typology 1, 2 and 3



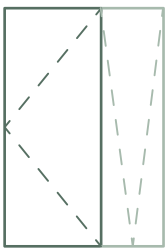
A = height x opening width
A = 2,1 x 0,9 = 1,89 m^2
Av = A x C = 1,89 x 0,6 = 1,134 m^2

South high window in typology 3



A = height x opening width x 0,5
A = 2,1 x 0,2 x 0,5 = 0,21 m^2
Av = A x C = 0,21 x 0,45 = 0,095 m^2

South balcony door in typology 2



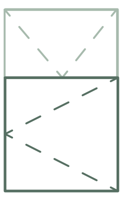
Biggest part

A = height x opening width
A = 2,1 x 0,85 = 1,785 m^2
Av = A x C = 1,785 x 0,6 = 1,071 m^2

Smallest part

A = height x opening width x 0,5
A = 2,1 x 0,2 x 0,5 = 0,21 m^2
Av = A x C = 0,21 x 0,45 = 0,095 m^2

South window in typology 1



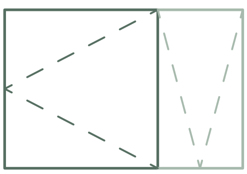
Biggest part

A = height x opening width
A = 1 x 1 = 1 m^2
Av = A x C = 1 x 0,6 = 0,600 m^2

Smallest part

A = height x opening width x 0,5
A = 0,6 x 0,2 x 0,5 = 0,06 m^2
Av = A x C = 0,06 x 0,45 = 0,027 m^2

South window in typology 2 and 3



Biggest part

A = height x opening width
A = 1,4 x 1,35 = 1,89 m^2
Av = A x C = 1,89 x 0,6 = 1,134 m^2

Smallest part

A = height x opening width x 0,5
A = 1,4 x 0,2 x 0,5 = 0,14 m^2
Av = A x C = 0,14 x 0,45 = 0,063 m^2

ill. 119: Effective opening area

DAYLIGHT

On site

A solar analysis of the site boundary has been carried out to investigate how the sun affects the outdoor areas throughout the year. The analysis provides an overview of which parts of the site receive the most and least sun, and thus provides insight into where the best locations for leisure activities are.

The illustrations down below show how the site and the building facades are affected by the sun during sun hours in summer, equinox and winter.

In buildings

In order to assess the daylight conditions in the apartments there has been made some daylight analysis in climate studio. The analysis includes primarily Spatial Daylight Autonomy (sDA) and the distribution of daylight in selected rooms. This ensures a pleasant amount of daylight in the rooms and that the apartments live up to the Danish BR18 standards.

The climate studio results down below, are based on the apartment with the least amount of daylight from each apartment type.

Summer

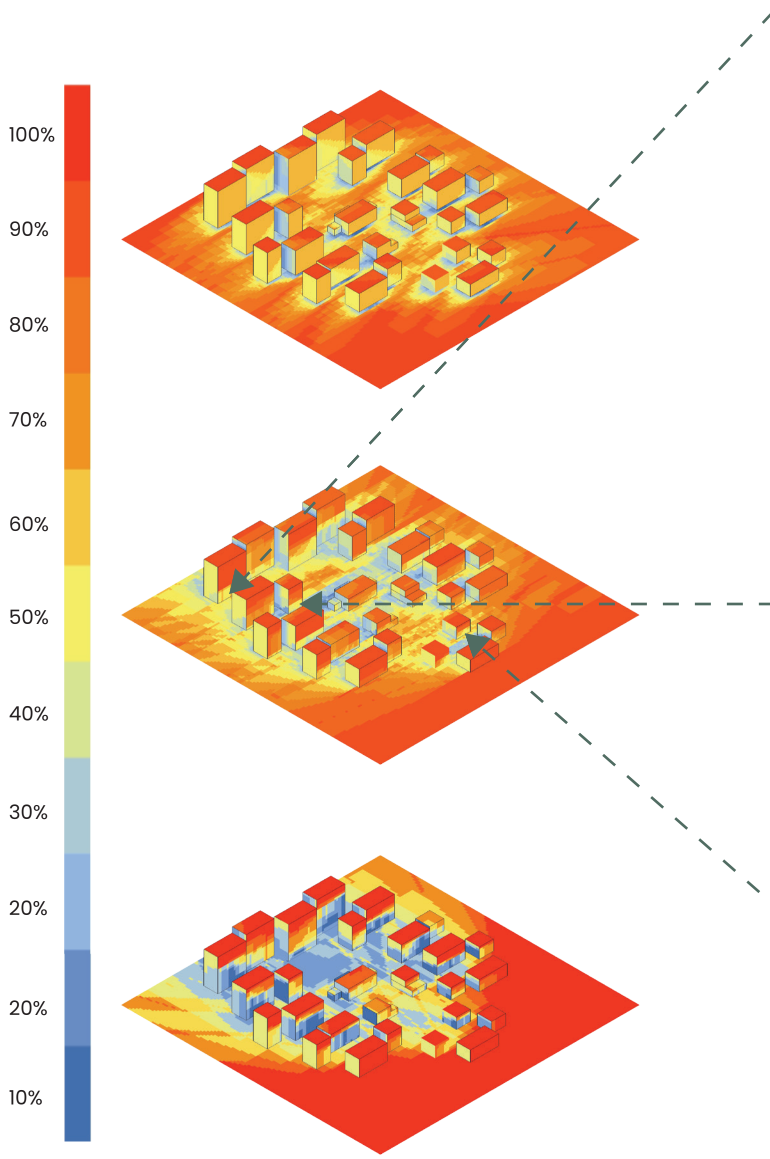
On the longest day of the year, both the site and buildings are hit by plenty of sun. This creates both good outdoor spaces and bright apartments.

Equinox

On the equinox, both buildings and outdoor spaces are hit by more shade than on the longest day. However, there are still many good outdoor spaces and bright apartments.

Winter

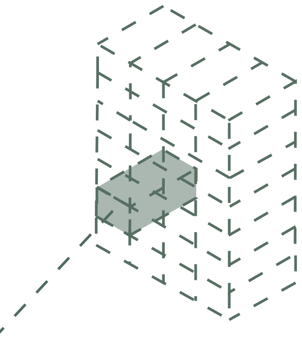
On the shortest day of the year, the sun is low, and therefore long shadows are cast. This can be expected to result in some darker apartments and outdoor spaces, which can be difficult to completely avoid. However, the upper apartments and some outdoor spaces are still well lit.

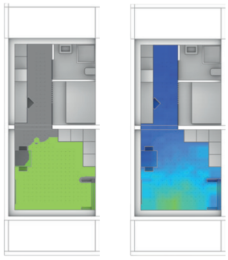


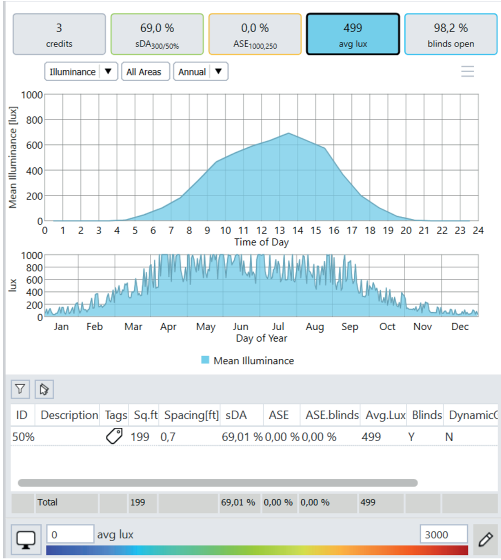
ill. 120: Solar analysis, showing pct. of daylight from sunrise to sunset at summer, equinox and winter

Student apartments

For the studio apartment, the combined kitchen/living room, as well as the hallway has been analysed. Here you can see that the living room and kitchen are well lit, but that the hallway is a bit darker.



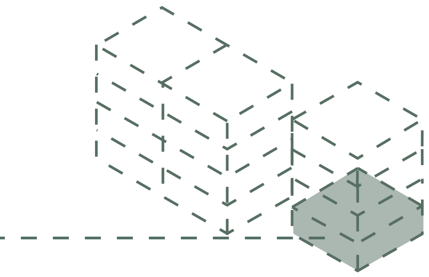


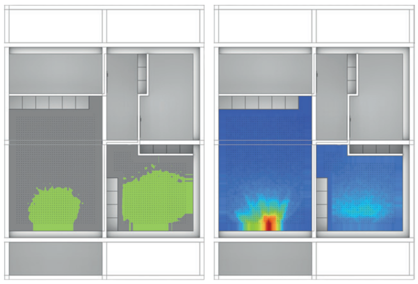


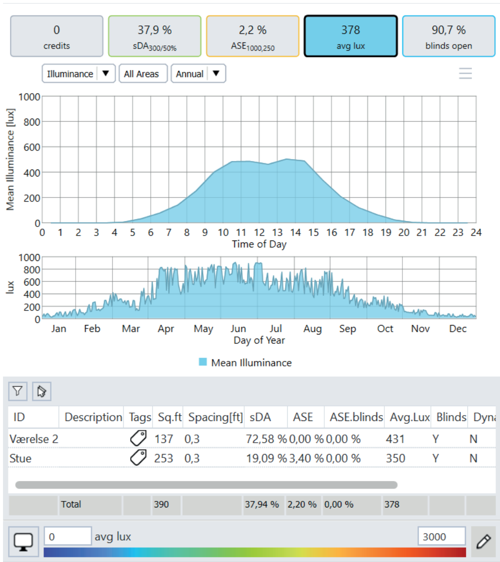
ill. 121: Daylight, Students

Couples/Elderly apartments

In apartments for couples and the elderly, the analyses are based on the living room/kitchen area and the master bedroom, as these are the rooms that are likely to be used the most.



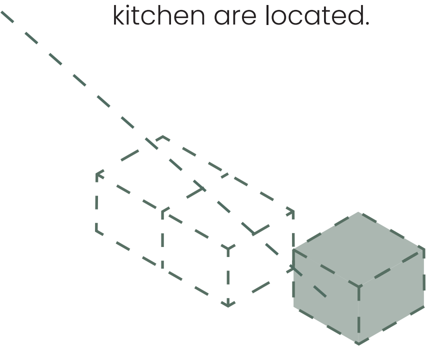


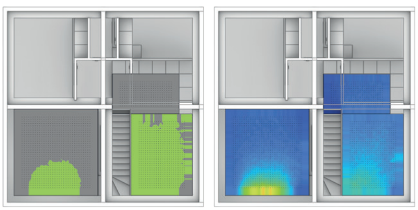


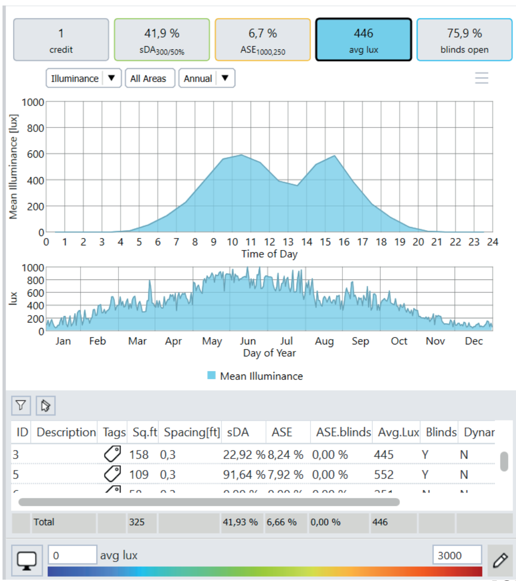
ill. 122: Daylight, Couples/Elderly

Family units

The family units consists of two floors, with a particular focus on creating optimal daylight conditions on the lower level, as this is where the living room and kitchen are located.







ill. 123: Daylight, Families

SOLAR PANELS

To achieve a Net Zero Site, the site must produce at least the same amount of energy as it consumes. In this case the building is a part of the electricity network, which means that during the summer periods the solar panels produce more electricity than the site consumes. When solar panels on the other hand doesn't produce enough energy, the site will have to consume energy from the electricity network. If the energy balance on an annual basis is zero, the site is a net zero site.

In this project the focus has been on calculating the overall energy consumption from the buildings, while the energy use from the rest of the site hasn't been calculated. It is however estimated that the solar panels produce a sufficient amount of energy to cover the whole site including streetlights etc., as the buildings only consume 55% of the produced energy from the solar panels.

Energy pr solar panel sqm:
q * y * z

Solar rediation:
1200 kWh/m2 (q)

Photovoltaic efficiency:
Monocrystalline 20 % , 0,2 (y)

System efficiency:
80 % , 0,8 (z)

Energy pr solar panel sqm:
1200 kWh/m2 * 0,2 * 0,8 =
192 kWh/m2

Calculated solarpanel area

Students
Gross area: 3.520m2
Energy frame 28 kWh/m2 yr.

Total energy consumption (kWh/yr):
3.520m2 * 28kWh/mr yr = **98.560 kWh/yr**

Total m2 of solarpanels:
$\frac{98.560 \text{ kWh/yr}}{192 \text{ kWh/m2}} \approx$ 514 m2

Couples/elderly
Gross area: 4.337m2
Energy frame 29,9 kWh/m2 yr.

Total energy consumption (kWh/yr):
4.337m2 * 29,9kWh/mr yr = **129.676 kWh/yr**

Total m2 of solarpanels:
$\frac{129.676 \text{ kWh/yr}}{192 \text{ kWh/m2}} \approx$ 676 m2

Families
Gross area: 1.973,7 m2
Energy frame 39,2 kWh/m2 yr.

Total energy consumption (kWh/yr):
1.973,7m2 * 39,2kWh/mr yr = **77.369 kWh/yr**

Total m2 of solarpanels:
$\frac{77.369 \text{ kWh/yr}}{192 \text{ kWh/m2}} \approx$ 403 m2

Solar panels
Total roof area: 2890 m2

Needed m2 of solarpanels
514m2 + 403m2 + 676m2 = 1593 m2

CONCLUSION

This project has aimed to develop a proposal for sustainable, social housing architecture, where social, environmental, and technical considerations are integrated into a unified whole. Based on a building site on Vilsundvej in Nørre Tranders, work has been undertaken to create a new residential area that both relates to the existing surroundings and contributes new qualities in the form of community, security, and sustainable solutions.

The project has been developed through the Integrated Design Process (IDP), where architectural and engineering disciplines have been processed in parallel and iteratively. This approach has made it possible to work with spatial, structural, and energy-related aspects simultaneously, but has also highlighted the challenges that arise when complex decisions must be coordinated across disciplines. In particular, the work with the structural grid system has functioned as a central design tool, which has helped to create order and throughout the design, but has also demanded continuous adjustments and compromises when spatial and social qualities needed to be prioritized.

The preliminary analyses of site, users, and context helped form a solid foundation for the projects following design phases. Flexible residences and access to shared facilities was identified as a common need of students, young adults, families and elderly residents. These needs have been translated into a residential area where different housing typologies are gathered around a common focal point in the form of a common house, which functions as a social center. Here, interaction between residents is supported through both indoor and outdoor leisure activities, while attempting to balance the need for privacy and community through private balconies, semi-private courtyards and larger public common areas.

The project's technical solutions support the ambition of sustainability, among other things through work with daylight conditions, energy frameworks, district heating, and photovoltaics to meet the residences own energy needs. The calculations show that the buildings collectively can achieve a net-zero energy balance on an annual basis, which contributes to reduced environmental impact for the lifespan of the building. At the same time, work has been done with material choices and spatial arrangements that take into account both carbon-conscious material use, indoor climate, flexibility, in hopes of securing a long lifespan.

Overall, the project demonstrates how complex architectural issues can be handled through an integrated and iterative approach, where compromises are not seen as weaknesses, but as conscious negotiations between competing considerations. The project shows that sustainable housing architecture is not solely about technical solutions, but to a large extent about creating frameworks for social interaction and the sense of belonging that is needed in everyday life. The experiences from the process simultaneously point to the importance of early coordination, shared conceptual understanding, and a technical rigor to ensure coherence between vision and realization.

REFLECTION

The Necessity of Parallel Development

Collaborative design operates under a fundamental challenge: how to pursue technical depth across multiple specialised domains while ensuring these parallel efforts converge into a coherent whole. This project required an enormously broad interdisciplinary spectrum to be developed concurrently rather than sequentially. The reality of architectural practice is that timelines necessitate distributed work; structural systems, energy calculations, and functional plans cannot wait for each other but must advance in deliberate parallel.

This parallel development proved both productive and challenging. It enabled each specialised domain to achieve meaningful depth while creating moments of friction where design decisions in one domain demanded significant recalibration in others, as the central pillar of iterative design. The question is not whether to work in parallel, time constraints make this inevitable, but how to orchestrate these parallel streams into a holistic design.

The Grid System: Order and Constraint

The structural grid system emerged as the project's most revealing case study in managing parallel development. Initially conceived to rationalise building placement and create spatial coherence, the grid represented an attempt to establish order within complexity. It functioned as a productive design tool that forced precision, clarity, and structural rationality.

However, the grid's introduction revealed challenges inherent in asynchronous decision-making. As access balconies and resident balconies were developed, they encroached on space originally allocated for courtyards between buildings. The grid was confronted with spatial realities it hadn't been organised to anticipate, forcing the design to either break the system to preserve spatial qualities or abandon certain ambitions to maintain systemic coherence.

The grid was simultaneously enabling and constraining. The challenge was not in avoiding tensions but in recognising when the system should guide decisions and when it should yield to more compelling solutions.

The Cost of Ambiguity

Perhaps the most instructive challenge arose from what seemed trivial: the meaning of "4-metre grid." Did this refer to centre-to-centre measurements or edge-to-edge? Internal or external dimensions? This ambiguity created unforeseen errors throughout structural details, spatial dimensions, and drawing coordination, ultimately requiring time-consuming rework.

This experience highlights that parallel processes demand more than organisational charts: they require precise, shared language. The more distributed the work, the more critical ongoing coordination becomes. Regular knowledge sharing is not merely beneficial but essential to avoid preventable setbacks. In retrospect, earlier and more frequent knowledge sharing would have created shared reference points to prevent such misalignments.

The Gap Between Vision and Execution

The project did not achieve all its initial ambitions due to time constraints. Integration of parallel development tracks required compromises. Design choices bent to accommodate structural considerations; others simplified to coordinate with technical limitations or functional requirements.

The question is whether this gap between ambition and result stems primarily from insufficient time or reveals a fundamental condition of architectural complexity. The answer is both. An earlier, more integrated approach might have reduced necessary compromises. Conversely, parallel development was precisely what enabled pursuit of the project's full complexity and breadth. Notably, the challenge differed from projects plagued by indecision and rushed final detailing. A clear conceptual framework was established early; time pressure stemmed not from hesitation but from the sheer complexity of synthesising numerous design decisions into a coherent whole.

Moving Forward: Balancing System and Freedom

The project's central lesson concerns balance: between structuring systems and design freedom, between locking down decisions and maintaining flexibility, between ambitions and feasibility.

Three major lessons emerge for future practice:

First, establish common language and conventions earlier. Precision in terminology and measurement standards prevents compounding errors that ripple throughout the project.

Second, avoid obstacles of your own making. Not all design decisions need locking down simultaneously - decide consciously which systems should be fixed early to guide other work, and which should remain flexible longer.

Third, accept that complex architectural projects inherently involve navigating tension between timelines, ambition, and realisability. This is not a problem to be completely solved but a condition to be managed with skill and awareness.

The parallel processes that challenged the group were also what made depth possible. The grid that constrained also provided order. The compromises made were not failures but negotiations between competing values. Complex architectural projects inherently involve managing these tensions, and the skill lies not in eliminating them but in navigating them with awareness and turning them into meaningful design decisions.

LITTERATURE

Aalborg University (2025). n.d. *Working definition of a Net Zero Energy Building (NetZEB) approach*. Available from: https://www.teknologisk.dk/_/media/69864_Working%20Definition%20of%20a%20Net%20Zero%20Energy%20Building%20%28NetZEB%29%20approach.pdf [Located 10. December]

Arken, Tegnestuen (2023). *Bofællesskabet Kløverbakken.* Available from: https://www.tegnestuenarken.dk/projekter/kloverbakken [Located 25. November]

Boligforening, Himmerland (2023). B*eboerdata 2023*. Available from: https://www.moodle.aau.dk/course/view.php?id=55581, Lecture 1 [Located 4. November]

Broker, Josh Austin (2024). *What to Look for in a Home When You Have Young Children*. Available from: https://hunterofhomes.com/real-estate-blog/what-to-look-for-in-a-home-when-you-have-young-children/ [Located 5. November]

BUILD – Institut for Byggeri, By og Miljø (n.y.). *NabolagsAtlas*. Available from: https://www.nabolagsatlas.dk/dk/population/#pos=5.99/56.052/9.5 [Located 4. November]

COWI (2017). *RIG NATUR I AALBORG KOMMUNE – en strategi for biodiversitet*. Available from: https://naturkommunen.dk/wp-content/uploads/2020/10/Aalborg-rig-natur-endelig-version-10-05-17.pdf [Located 5. December]

Dansk Arkitektur Center (2019). *Socialhistorie*: *Boligbyggeri som politisk og socialt værktøj*. Available at: https://dac.dk/magazine/socialhistorie-boligbyggeri-som-politisk-og-socialt-vaerktoj [Accessed: 15. December]

Divisare (2021). Vandkunsten Architects, Helene Høyer Mikkelsen · *Housing on Lisbjerg Bakke*. Available at: https://divisare.com/projects/439470-vandkunsten-architects-helene-hoyer-mikkelsen-housing-on-lisbjerg-bakke [Located 15. December]

Habitats & Molio (2024). *BIODIVERSITET I BYGGERI OG BYUDVIKLING*: *Et katalog med regler, rammer og relevant inspiration*. Available at: https://realdania.dk/publikationer/faglige-publikationer/biodiversitet-i-byggeri-og-byudvikling [Located 10. December]

Kløverbakken (2023). *Kløverbakken i Odder*. Available from: https://kloeverbakken-odder.dk/fakta-om-kloverbakken/ [Located 25. November]

Knudstrup, M.-A. (2004). *Integrated Design Process in Problem-Based Learning*. I: Kolmos, A., Fink, F.K., & Krogh, L. (red.), The Aalborg PBL Model: Progress, Diversity and Challenges. Aalborg: Aalborg Universitetsforlag, s. 221–234. Available from: https://vbn.aau.dk/ws/portalfiles/portal/1624830/The_Integrated_Design_Process__IDP____A_more_holistic_approach_to_sustainable_architecture [Located 29. September]

Mechlenborg, Mette & Jensen, Jesper Ole (2024). *New "small living" concepts in Denmark*: *A way towards sustainable cities?* Available from: https://vbn.aau.dk/en/publications/new-small-living-concepts-in-denmark-a-way-towards-sustainable-ci/ [Located 5. November]

Peters, T. (2016). *Social sustainability in context*: *Rediscovering Ingrid Gehl's Bo-miljø. arq*: *Architectural Research Quarterly, 20(4), 371–380*. Available from: https://www.cambridge.org/core/journals/arq-architectural-research-quarterly/article/social-sustainability-in-context-rediscovering-ingrid-gehls-bomiljo/0D20F12D52FB1F886C6C1586B90D4AA9 [Located 10. December]

Rikke, Stinne, Erik & Simon Bo (2009). *Ageing in communal place*: *Ethnographic studies of social interaction in senior housing communities*. Available from: https://pure.au.dk/ws/portalfiles/portal/18842325/Ageing_in_Communal_Place_Aarhus_et_al.pdf [Located 5. November]

Strandberg, Beate & Rasmussen, Kristine (2024). *REGISTRERING AF INDIKATORER FOR BIODIVERSITET I BYER*. Available from: http://dce.au.dk/fileadmin/dce.au.dk/Udgivelser/Tekniske_rapporter_300-349/TR312.pdf [Located 5. December]

Timber Development UK (2022). *The Rye, Peckham – Tikari Works.* Available at: https://timberdevelopment.uk/index.php?pda_v3_pf=/_pda/2022/09/TCS128.pdf [Located 4. November].

Vandkunsten.com (n.d.). *Sustainable wood architecture designed for transformation by Vandkunsten Architects.* Available at: https://vandkunsten.com/en/projects/lisbjerg-wood [Located 4. November].

Illustration list

All illustrations except for the green ones is created by the group members or pictures taken by the group members.

AP
PE
ND
IX

Interview

Interviewer: So I've set it to record. Yes, just to explain a bit more about what we're out here for. It's because up on top of the hill there's this football field or pitch. So our task has been to try to design some more social housing out here. To practice for our architecture studies. And then we've been around looking at some of the other social housing that's located out here. And then we've distributed these questionnaires, which I also gave you. And then one of the tasks is also that we should try to see if we can get an interview with some of those who live out here. So we're really happy that you want to participate.

Resident: Well, of course.

Interviewer: You mentioned briefly at the window that you've both lived here before, then been in private housing and then moved back here again.

Resident: Yes.

Interviewer: Could you tell a bit about, is it because you've been happy living here that you moved back again?

Resident: Yes, it is. I really like Aalborg and Aalborg Øst. Because we moved out here the very first time when we were 16 years old together with my boyfriend. And the first apartment I went to look at, it was concrete. So I said to my boyfriend that I'd like to live here. And exactly that apartment we went to look at with concrete and such, that was the one we got.

Interviewer: Was it exactly the same area here?

Resident: It was up in the other street, the top street here on Næstsundvej. And when we moved in, those rows were here, so I had a view all the way up. Then at some point we wanted to have children. Then we agreed we wanted to try to build a house there in the 90s. We actually moved out here in '83 and moved from here in '90. To Gjøtrupvej, and that was also here in Aalborg Øst. And then after we moved over there, we lived there for 3-4 years. And then my husband says to me kind of jokingly, shouldn't we try to put the house up for sale? Well, we could do that. Then the real estate agent comes and says, when can you move? – the papers are signed. So we moved home to my mother-in-law and lived there temporarily. Then we also buy a house out in Visse.

Interviewer: Yes, a bit from Aalborg?

Resident: A bit from Aalborg, it's just below us. Yes, it's out towards Sønder Tranders. So we move out there. I have my first child of course over on Gjøtrupvej in '93. And then we move to Visse and live there until '97. Then I become ill and become an early retiree. So my husband says, where should we move? So I say, if I'm going to move again, it's Aalborg Øst. And I want to be on Næssundvej again. And we've lived here ever since. And now we're writing 2025.

Interviewer: So how many years have you been here in total? Now for example '83 to '95. And then from... Seven years. Yes, and then from '97 until now.

Interviewer: So you're happy with it out here?

Resident: I'm happy with it out here.

Interviewer: What about the neighborhood etc., do people know each other back and forth?

Resident: We have something... There are some who say out here, we have a gossip bench. Which we have right out here in front. We're such a group that sits out here and drinks coffee. And then some bake cake and have fun with us. And then there are some who come by and say, how nice it looks. May we join? Or we say, don't you want to join? And then they sit down too.

Interviewer: That was also one of the things I noticed. It looks a bit like you have some semi-private outdoor areas out here. I don't know if you can do it yourselves... Can you control what you have out there?

Resident: We have to apply for it. Okay. Now for example, I just had that terrace made out there. You have to apply to have that made.

Interviewer: But it's okay that you can make it a bit personal?

Resident: We're not allowed to do anything ourselves out here without having applied for it. We're not allowed to.

Interviewer: Now you have small children etc. Now I can see there's a playground right there. Are there sufficient playgrounds and green areas?

Resident: We're missing our green areas again. Now for example up on Vildsundvej, we had huge green areas when I moved in. It was just a field with trees and such. All of that is disappearing out here, I think. It is.

Interviewer: How would you like such a green area to be? Is it wild nature, or should it be a bit more...

Resident: It can be a bit more park-like. Where you can come up and sit and relax up there with grandchildren. With some benches and such. We do have over in Bundegårdsparken, on the other side of Humlebakken. But I'd rather be over here. Because this is where I belong. Down there, we also often go down there. There's something called Frøstien, for example. And I walk that too. Just to get out and get some exercise. Otherwise I just end up sitting. I don't want too much to happen out here. Now I've lived here so many years, and I've been able to follow where they build. Now I think there are too many hotels out here, for example. There are 3-4 hotels down here on Venesundvej. I think that's too much. But we've also gotten the big hospital out here. So there has to be somewhere they can live. Those out here, the doctors.

Interviewer: Is it because there are too many people running around here? Or does it not feel private enough?

Resident: Sometimes I don't think it feels private enough out here. But well, they also have to be here. When we get that hospital out there. They can't just travel home from Copenhagen, or wherever they come from. London, England. Well, so it's probably fine enough. But I just think there's too much hotel-like out here.

Interviewer: Do you think there have been predominantly positive or negative changes here since you moved out?

Resident: It just happens too fast. We can't keep up. Now for example there's Valpesundvej and Oddersundvej. They're also going to rebuild all week. You can't keep up out here, because then new shops have come. Now for example we've gotten Lidl over here, and Netto, and we've gotten a Pizzeria. We've gotten a small town out here, but it just happens way too fast.

Interviewer: But is it nice that Lidl and such have come, so you don't have to go far?

Resident: Yes, it's lovely to have it right in the backyard. I think it's great. If you're just missing something. Then you don't have to go into town.

Interviewer: Did you have to before?

Resident: We had to go into town, because even though we have Førtex over here, it takes almost half an hour before we're home again. Not everyone has cars. Not everyone has such a bicycle – I can cycle over there. I can't. It's a bit annoying, and that you have to go into town, that also takes 20 minutes. So it's lovely that we've gotten it out here.

Interviewer: If you don't have a car, are you happy that the cars are kept away from the area? Now they all park down at the end.

Resident: I think it's lovely - Because it's a fire road. There are also many who have asked why we can't get a one-way street. But we can't because it's a fire road. So I think it's lovely that we don't have to park in the street, like they do down on Statensundvej. I think we're the only street over here on this side. As we say, the right side of Humlebakken. We've always said that. So I think it's lovely that you don't park down in the street. People don't get hurt from going up to get their car at the parking lot. I don't think so. Because then there would just be cars parked everywhere.

Interviewer: Yes, but that's also what we noticed. Now we've walked in different places. That's also something we notice. It's a bit more intimate here. There are two cars that delimit the entire area. What about the rent over time?

Resident: It hasn't increased very much. No, it hasn't. When we moved in, it cost 5,000. Now we pay 7,000. Because we also have a garage. And that with electricity and water and heat and all that. So it's really not. I don't think so.

Interviewer: How big is it?

Resident: It's 98 square meters here.

Interviewer: How many rooms is that?

Resident: It's four rooms. We have bathrooms, three rooms up here and kitchen. And then we have a living room downstairs.

Interviewer: So there's a staircase somewhere?

Resident: Yes, there is. And there are some of them that are reversed. Where you go up to the living room instead. And there are three floors too.

Interviewer: What about the neighbors here? Is it your impression that people stay here for a long time? Or is there a lot of turnover?

Resident: Right now there's a lot of turnover. We've lost five. We live right around here, who have moved. But they've also lived here for some years. So they've also been young people who have said, "well, we'll take this as a stepping stone here. And then we'll move out to a house." But there are some who have lived here for 20 and 25 years.

Interviewer: Are people generally happy to live here?

Resident: Very happy. Now for example the activities committee and such out here. I'm a volunteer. I'm involved in everything out here. Trekanten and the activity houses on Sallingsundsvej. And I arrange Christmas tree parties and all such things. And I'm a volunteer photographer out here. I go around taking pictures.

Interviewer: That sounds nice. But there's also something to spend time doing out here.

Resident: Yes, there is. And now for example they've also started organizing a trip. Where you can go on a trip to Germany. Those of us who are at home. So you can just get out and get to know each other. The other neighbors on the other streets.

Interviewer: Yes. Exciting, exciting. Uh, I don't know. We've run out of questions. When I look at the form, we're basically through it all. Shouldn't we just say a thousand thanks because you wanted to help us.

Be18

Families

Building

Name: Families - Baseline

Detache
Detached house (detached single-family house)
Semi-detached and nondetached houses
Multi-storey house, Store etc or Other (non-residential)

1	Number of residential units	0	Rotation, deg.
108	Heated floor area, m²	108	Gross area, m²
0	Heated basement, m²	0	Other, m²
81	Developed area, m²		
35	Heat capacity, Wh/K m²	Start at	End at (time)
168	Normal usage time, hours/week	0	24

Calculation rules

BR: Actual co — See calculation guide

Supplement to energy frame for special conditions, kWh/m² year: 0

Only possible for other than residential buildings and calculation rules: BR: Actual conditions.

Warning: New reference for lightning in BR15: 300 lux.

Heat supply

District h — Basis: Boiler, District heating, Block heating or Electricity

Mechanical cooling

0 — Share of floor area, -

	External walls, roofs and floors	Area (m²)	U (W/m²K)	b	Ht (W/K)	Dim.Inside (C)	Dim.Outside (C)	Loss (W)
		370		CtrlClick	37			1184
+1	North	52	0,1	1,00	5,2	20	-12	166,4
2	East	52	0,1	1,00	5,2	20	-12	166,4
3	South	52	0,1	1,00	5,2	20	-12	166,4
4	West	52	0,1	1,00	5,2	20	-12	166,4
5	Roof	81	0,1	1,00	8,1	20	-12	259,2
6	Floor	81	0,1	1,00	8,1	20	-12	259,2

	Foundations and joints at windows	l (m)	Loss (W/mK)	b	Ht (W/K)	Dim.Inside (C)	Dim.Outside (C)	Loss (W)
		87		CtrlClick	4,02			128,64
+1	Foundation	35	0,1	1,00	3,5	20	-12	112
2	Windows	52	0,01	1,00	0,52	20	-12	16,64

	Windows and outer doors	Number	Orient	Inclination	Area (m²)	U (W/m²K)	b	Ht (W/K)	Ff (-)	g (-)	Shading	Fc (-)	Dim.Inside (C	Dim.Outside (	Loss (W)	Ext
		15			15,33		CtrlClick	10,731			CtrlClick				343,392	0/1
+1	North Windows	4	0	90	0,5	0,7	1,00	1,4	0,9	0,85	North	1	20	-12	44,8	0
2	North Doors	0	0	90	0	0,7	1,00	0	0,9	0,85	North	1	20	-12	0	0
3	South windows - big	10	180	90	1,2	0,7	1,00	8,4	0,9	0,85	South big	1	20	-12	268,8	0
4	South windows - small	0	180	90	0	0,7	0,00	0	0,9	0,85	South small	1	20	-12	0	0
5	South Doors	1	180	90	1,33	0,7	1,00	0,931	0,9	0,85	South small	1	20	-12	29,792	0

	Ventilation	Area (m²)	Fo, -	qm (l/s m²)	n vgv (-)	ti (°C)	El-HC	qn (l/s m²)	qi,n (l/s m²)	SEL (kJ/m³)	qm,s (l/s m²)	qn,s (l/s m²)	qm,n (l/s m²)	qn,n (l/s m²)
	Zone	108		Winter			0/1	Winter	Winter		Summer	Summer	Night	Night
+1	Apartments	108	0,8	0,3	0,85	0	0	0,1	0	1	0,3	3	0	0
2	Apartments, reduced	108	0,18	0,15	0,85	0	0	0,1	0	0,8	0,15	3	0	0
3	Apartments, forced	108	0,02	0,6	0,85	0	0	0,1	0	1,2	0,6	3	0	0

	Internal heat supply	Area (m²)	Persons (W/m²)	App. (W/m²)	App.night (W/m²)
	Zone	108,0	162,0 W	378,0 W	0,0 W
+1	Apartments	108	1,5	3,5	0

Heat distribution plant

Composition and temperature

Description	Dimensioning	
	65	Supply pipe temperature, °C (at outdoor temp. of -12 °C)
	45	Return pipe temperature, °C
Anlægstype	2	Type of plant: 1: unified or 2: dual

	Pipe lengths in supply and return	l (m)	Loss (W/mK)	b	Outdoor comp (J/N)	Unused summer (J/N)
		20				
+1	Begge veje	20	0,12	1	N	N

Description: Varmt brugsvand

Hot-water consumption (water 55 °C, cold water 10 °C)

250 — Average for the building, litre/year per m² of floor area

Domestic hot water system

55 — Domestic hot water temp., °C

Add an hot-water tank by right-click on Domestic hot water at the left

Hot-water tank

Description: Ny varmtvandsbeholder

1 — Number of tanks | 1 — Part of hot-water consumption, -

0 — Tank volume, litre (For solar heating containers, state total volume)

55 — Supply temperature from central heating, °C

Nej — El. heating of DHW (If 'No' the boiler operates in summer)

☐ Solar heat tank with back-up power (Correction for temp.layering)

0,74 — Heat loss from hot-water tank, W/K

0 — Temp. factor, b for setup room, - (Heated zone: b = 0, Outdoor: b = 1)

Charging pump

	Effect, W		Charge effect, kW
For combi-pump, state effect as 0 W	0	☐ Controlled	0

	Pipe lengths in supply and return	l (m)	Loss (W/mK)	b
		25		
1	1	25	0,12	1

Key numbers, kWh/m² year

Renovation class 2

Without supplement	Supplement for special conditions	Total energy frame
90,4	0,0	90,4
Total energy requirement		39,2

Renovation class 1

Without supplement	Supplement for special conditions	Total energy frame
67,8	0,0	67,8
Total energy requirement		39,2

Energy frame BR 2018

Without supplement	Supplement for special conditions	Total energy frame
39,3	0,0	39,3
Total energy requirement		39,2

Energy frame low energy

Without supplement	Supplement for special conditions	Total energy frame
27,0	0,0	27,0
Total energy requirement		39,2

Contribution to energy requirement

Heat	39,8
El. for operation of bulding	2,8
Excessive in rooms	0,0

Net requirement

Room heating	12,8
Domestic hot water	19,8
Cooling	0,0

Selected electricity requirements

Lighting	0,0
Heating of rooms	0,0
Heating of DHW	0,0
Heat pump	0,0
Ventilators	2,4
Pumps	0,0
Cooling	0,0
Total el. consumption	33,5

Heat loss from installations

Room heating	7,2
Domestic hot water	6,7

Output from special sources

Solar heat	0,0
Heat pump	0,0
Solar cells	0,0
Wind mills	0,0

Couples/Elderly

Building

Name: Elderly and couple apartments

Multi-sto

Detached house (detached single-family house)
Semi-detached and nondetached houses
Multi-storey house, Store etc or Other (non-residential)

1	Number of residential units	0	Rotation, deg.
402	Heated floor area, m²	402	Gross area, m²
0	Heated basement, m²	0	Other, m²
81	Developed area, m²		
35	Heat capacity, Wh/K m²	Start at	End at (time)
168	Normal usage time, hours/week	0	24

Calculation rules

BR: Actual co — See calculation guide

Supplement to energy frame for special conditions, kWh/m² year: 0

Only possible for other than residential buildings and calculation rules: BR: Actual conditions.

Warning: New reference for lightning in BR15: 300 lux.

Heat supply

District h — Basis: Boiler, District heating, Block heating or Electricity

Mechanical cooling

0 — Share of floor area, -

	External walls, roofs and floors	Area (m²)	U (W/m²K)	b	Ht (W/K)	Dim.Inside (C)	Dim.Outside (C)	Loss (W)
		770		CtrlClick	87,58			2802,56
+1	North	153	0,123	1,00	18,819	20	-12	602,208
2	East	77	0,123	1,00	9,471	20	-12	303,072
3	South	153	0,123	1,00	18,819	20	-12	602,208
4	West	77	0,123	1,00	9,471	20	-12	303,072
5	Roof	155	0,1	1,00	15,5	20	-12	496
6	Floor	155	0,1	1,00	15,5	20	-12	496

	Foundations and joints at windows	l (m)	Loss (W/mK)	b	Ht (W/K)	Dim.Inside (C)	Dim.Outside (C)	Loss (W)
		196,8		CtrlClick	6,72			215,04
+1	Foundation	52,8	0,1	1,00	5,28	20	-12	168,96
2	Windows	144	0,01	1,00	1,44	20	-12	46,08

	Ventilation	Area (m²)	Fo, -	qm (l/s m²)	n vgv (-)	ti (°C)	El-HC	qn (l/s m²)	qi,n (l/s m²)	SEL (kJ/m³)	qm,s (l/s m²)	qn,s (l/s m²)	qm,n (l/s m²)	qn,n (l/s m²)
	Zone	402		Winter			0/1	Winter	Winter		Summer	Summer	Night	Night
+1	Apartments	402	0,8	0,3	0,85	0	0	0,1	0	1	0,3	1,8	0	0
2	Apartments, reduced	402	0,18	0,15	0,85	0	0	0,1	0	0,8	0,15	1,8	0	0
3	Apartments, forced	402	0,02	0,6	0,85	0	0	0,1	0	1,2	0,6	1,8	0	0

	Internal heat supply	Area (m²)	Persons (W/m²)	App. (W/m²)	App.night (W/m²)
	Zone	402,0	603,0 W	1407,0 W	0,0 W
+1	Apartments	402	1,5	3,5	0

	Pipe lengths in supply and return	l (m)	Loss (W/mK)	b	Outdoor comp (J/N)	Unused summer (J/N)
		20				
+1	Begge veje	20	0,12	1	N	N

Heat distribution plant

Composition and temperature

Description	Dimensioning	
	65	Supply pipe temperature, °C (at outdoor temp. of -12 °C)
	45	Return pipe temperature, °C
Anlægstype	2	Type of plant: 1: unified or 2: dual

Description: Varmt brugsvand

Hot-water consumption (water 55 °C, cold water 10 °C)

250 Average for the building, litre/year per m² of floor area

Domestic hot water system

55 Domestic hot water temp., °C

Add an hot-water tank by right-click on Domestic hot water at the left

	Pipe lengths in supply and return	l (m)	Loss (W/mK)	b	Outdoor comp (J/N)	Unused summer (J/N)
		20				
+1	Begge veje	20	0,12	1	N	N

Hot-water tank

Description: Ny varmtvandsbeholder

1 Number of tanks 1 Part of hot-water consumption, -

0 Tank volume, litre (For solar heating containers, state total volume)

55 Supply temperature from central heating, °C

Nej El. heating of DHW (If 'No' the boiler operates in summer)

☐ Solar heat tank with back-up power (Correction for temp.layering)

0,74 Heat loss from hot-water tank, W/K

0 Temp. factor, b for setup room, - (Heated zone: b = 0, Outdoor: b = 1)

Charging pump

	Effect, W		Charge effect, kW
For combi-pump, state effect as 0 W	0	☐ Controlled	0

	Pipe lengths in supply and return	l (m)	Loss (W/mK)	b
		25		
1	1	25	0,12	1

Key numbers, kWh/m² year

Renovation class 2

Without supplement	Supplement for special conditions	Total energy frame
75,5	0,0	75,5
Total energy requirement		30,3

Renovation class 1

Without supplement	Supplement for special conditions	Total energy frame
56,6	0,0	56,6
Total energy requirement		30,3

Energy frame BR 2018

Without supplement	Supplement for special conditions	Total energy frame
32,5	0,0	32,5
Total energy requirement		30,3

Energy frame low energy

Without supplement	Supplement for special conditions	Total energy frame
27,0	0,0	27,0
Total energy requirement		30,3

Contribution to energy requirement

Heat	30,0
El. for operation of bulding	2,5
Excessive in rooms	0,0

Net requirement

Room heating	12,5
Domestic hot water	16,5
Cooling	0,0

Selected electricity requirements

Lighting	0,0
Heating of rooms	0,0
Heating of DHW	0,0
Heat pump	0,0
Ventilators	2,4
Pumps	0,0
Cooling	0,0
Total el. consumption	33,2

Heat loss from installations

Room heating	1,0
Domestic hot water	3,4

Output from special sources

Solar heat	0,0
Heat pump	0,0
Solar cells	0,0
Wind mills	0,0

Students

Building

Name: Student apartment - baseline

Multi-sto: Detached house (detached single-family house) / Semi-detached and nondetached houses / Multi-storey house, Store etc or Other (non-residential)

1	Number of residential units	0	Rotation, deg.
941	Heated floor area, m²	941	Gross area, m²
0	Heated basement, m²	0	Other, m²
156	Developed area, m²		
35	Heat capacity, Wh/K m²	Start at	End at (time)
168	Normal usage time, hours/week	0	24

Calculation rules

BR: Actual co — See calculation guide

Supplement to energy frame for special conditions, kWh/m² year: 0

Only possible for other than residential buildings and calculation rules: BR: Actual conditions.

Warning: New reference for lightning in BR15: 300 lux.

Heat supply

District h — Basis: Boiler, District heating, Block heating or Electricity

Mechanical cooling

0 — Share of floor area, -

	External walls, roofs and floors	Area (m²)	U (W/m²K)	b	Ht (W/K)	Dim.Inside (C)	Dim.Outside (C)	Loss (W)
		1498		CtrlClick	173,56			5553,92
+1	North	396	0,12	1,00	47,52	20	-12	1520,64
2	East	198	0,12	1,00	23,76	20	-12	760,32
3	South	396	0,12	1,00	47,52	20	-12	1520,64
4	West	198	0,12	1,00	23,76	20	-12	760,32
5	Roof	155	0,1	1,00	15,5	20	-12	496
6	Floor	155	0,1	1,00	15,5	20	-12	496

	Foundations and joints at windows	l (m)	Loss (W/mK)	b	Ht (W/K)	Dim.Inside (C)	Dim.Outside (C)	Loss (W)
		495,8		CtrlClick	9,71			310,72
+1	Foundation	52,8	0,1	1,00	5,28	20	-12	168,96
2	Windows	443	0,01	1,00	4,43	20	-12	141,76

	Windows and outer doors	Number	Orient	Inclination	Area (m²)	U (W/m²K)	b	Ht (W/K)	Ff (-)	g (-)	Shading	Fc (-)	Dim.Inside (C	Dim.Outside (	Loss (W)	Ext
		66			120,6		CtrlClick	84,42			CtrlClick				2701,44	0/1
+1	North Windows - small	0	0	90	0	0,7	1,00	0	0,9	0,55	North	1	20	-12	0	0
2	North Doors	20	0	90	1	0,7	1,00	14	0,9	0,55	North	1	20	-12	448	0
3	South windows - small	20	180	90	1,68	0,7	1,00	23,52	0,9	0,55	South	1	20	-12	752,64	0
4	South windows - big	4	180	90	9,6	0,7	1,00	26,88	0,9	0,55	South	1	20	-12	860,16	0
5	South Doors	22	180	90	1,3	0,7	1,00	20,02	0,9	0,55	South	1	20	-12	640,64	0

	Ventilation	Area (m²)	Fo, -	qm (l/s m²)	n vgv (-)	ti (°C)	El-HC	qn (l/s m²)	qi,n (l/s m²)	SEL (kJ/m³)	qm,s (l/s m²)	qn,s (l/s m²)	qm,n (l/s m²)	qn,n (l/s m²)
	Zone	820,4		Winter			0/1	Winter	Winter		Summer	Summer	Night	Night
+1	Apartments	807	0,8	0,3	0,85	18	0	0,1	0	1	0,3	1,8	0	0
2	Common area	134	0,1	0,3	0,85	18	0	0,1	0	1,5	0,3	1,8	0	0
3	Apartments, reduced	807	0,18	0,15	0,85	18	0	0,1	0	0,8	0,15	1,8	0	0
4	Apartments, forced	807	0,02	0,6	0,85	18	0	0,1	0	1,2	0,6	1,8	0	0

	Internal heat supply	Area (m²)	Persons (W/m²)	App. (W/m²)	App,night (W/m²)
	Zone	941,0	1411,5 W	3293,5 W	0,0 W
+1	Apartments	673	1,5	3,5	0
2	Commonarea	134	1,5	3,5	0
3	Washing room	134	1,5	3,5	0

	Lighting	Area (m²)	General (W/m²)	General (W/m²)	Lighting (lux)	DF (%)	Control (U, M, A, K)	Fo (-)	Work (W/m²)	Other (W/m²)	Stand-by (W/m²	Night (W/m²)
	Lighting zone	268	Min.	Inst.			U,M,A,K					
+1	Common area	134	2	5	300	3	M	0,8	0	0	0	0
2	Washing room	134	2	5	300	3	M	0,8	0	0	0	0

Heat distribution plant

Composition and temperature

Description	Dimensioning	
	65	Supply pipe temperature, °C (at outdoor temp. of -12 °C)
	45	Return pipe temperature, °C
Anlægstype	2	Type of plant: 1: unified or 2: dual

	Pipe lengths in supply and return	l (m)	Loss (W/mK)	b	Outdoor comp (J/N)	Unused summer (J/N)
		30				
+1	Begge veje	30	0,12	1	N	N

Description: Varmt brugsvand

Hot-water consumption (water 55 °C, cold water 10 °C)

250 Average for the building, litre/year per m² of floor area

Domestic hot water system

55 Domestic hot water temp., °C

Add an hot-water tank by right-click on Domestic hot water at the left

Hot-water tank

Description: Ny varmtvandsbeholder

1 Number of tanks 1 Part of hot-water consumption, -

0 Tank volume, litre (For solar heating containers, state total volume)

55 Supply temperature from central heating, °C

Nej El. heating of DHW (If 'No' the boiler operates in summer)

☐ Solar heat tank with back-up power (Correction for temp.layering)

0,74 Heat loss from hot-water tank, W/K

0 Temp. factor, b for setup room, - (Heated zone: b = 0, Outdoor: b = 1)

Charging pump

	Effect, W		Charge effect, kW
For combi-pump, state effect as 0 W	0	☐ Controlled	0

	Pipe lengths in supply and return	l (m)	Loss (W/mK)	b
		80		
+1	1	80	0,12	1

Key numbers, kWh/m² year

Renovation class 2

Without supplement	Supplement for special conditions	Total energy frame
72,3	0,0	72,3
Total energy requirement		28,0

Renovation class 1

Without supplement	Supplement for special conditions	Total energy frame
54,3	0,0	54,3
Total energy requirement		28,0

Energy frame BR 2018

Without supplement	Supplement for special conditions	Total energy frame
31,1	0,0	31,1
Total energy requirement		28,0

Energy frame low energy

Without supplement	Supplement for special conditions	Total energy frame
27,0	0,0	27,0
Total energy requirement		28,0

Contribution to energy requirement

Heat	28,0
El. for operation of bulding	2,2
Excessive in rooms	0,0

Net requirement

Room heating	8,9
Domestic hot water	17,6
Cooling	0,0

Selected electricity requirements

Lighting	9,7
Heating of rooms	0,0
Heating of DHW	0,0
Heat pump	0,0
Ventilators	2,1
Pumps	0,0
Cooling	0,0
Total el. consumption	32,8

Heat loss from installations

Room heating	1,6
Domestic hot water	4,4

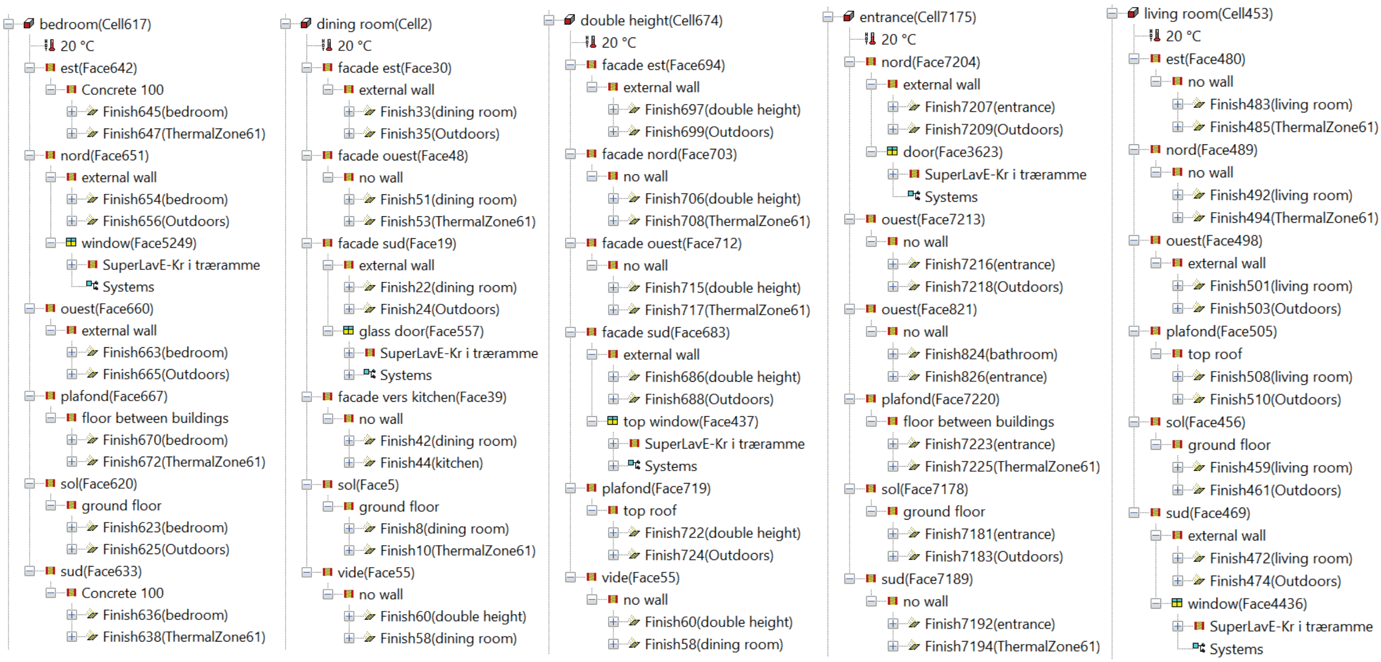
Output from special sources

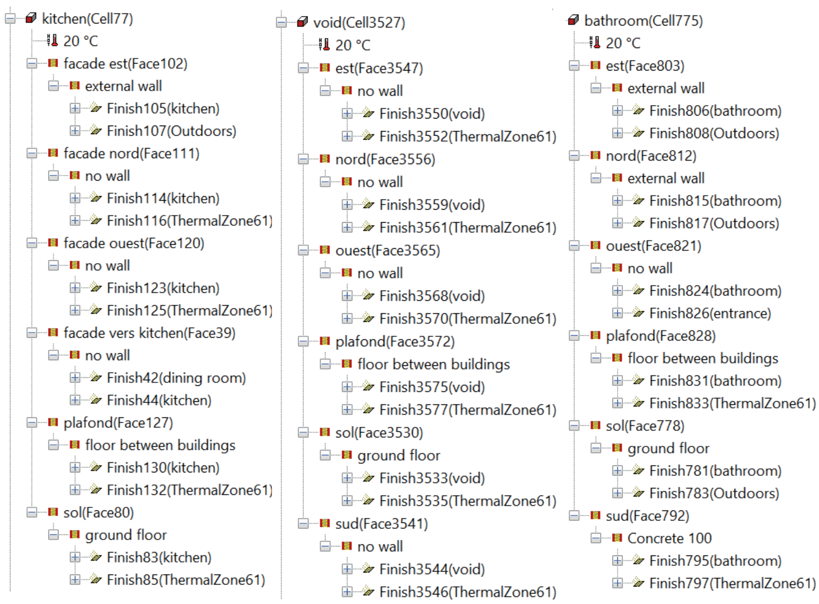
Solar heat	0,0
Heat pump	0,0
Solar cells	0,0
Wind mills	0,0

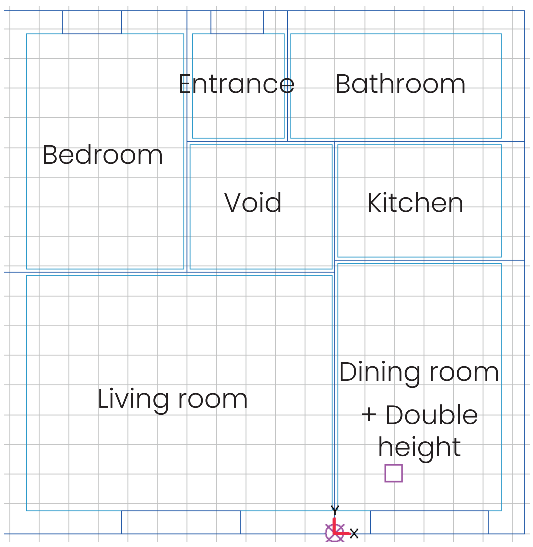
Bsim final model

Family

The most critical unit is a single unit, on the south part on the site, with no neighbors on the sides.







Couples/Elderly

The most critical unit is a unit with no neighbors on the sides but one above and one under.

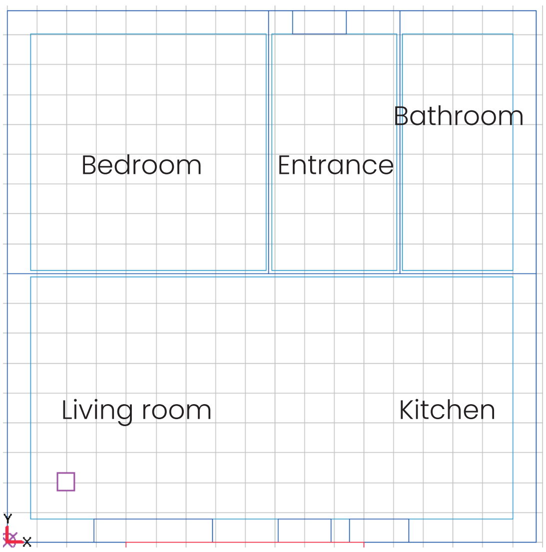
- bedroom(Cell1112)
  - 20 °C
  - est(Face1139)
    - Concrete 100
      - Finish1142(bedroom)
      - Finish1144(entrance)
  - nord(Face1148)
    - external wall
      - Finish1151(bedroom)
      - Finish1153(Outdoors)
  - ouest(Face1155)
    - external wall
      - Finish1158(bedroom)
      - Finish1160(Outdoors)
  - plafond(Face1162)
    - floor between buildings
      - Finish1165(bedroom)
      - Finish1167(ThermalZone61)
  - sol(Face1115)
    - floor between buildings
      - Finish1118(bedroom)
      - Finish1120(ThermalZone61)
  - sud(Face1128)
    - Concrete 100
      - Finish1131(bedroom)
      - Finish1133(ThermalZone61)

- entrance(Cell687)
  - 20 °C
  - est(Face1139)
    - Concrete 100
      - Finish1142(bedroom)
      - Finish1144(entrance)
  - nord(Face708)
    - external wall
      - Finish711(entrance)
      - Finish713(Outdoors)
    - door(Face768)
      - SuperLavE-Kr i træramme
      - Systems
  - ouest(Face686)
    - Concrete 100
      - Finish689(bathroom)
      - Finish691(entrance)
  - plafond(Face720)
    - floor between buildings
      - Finish723(entrance)
      - Finish725(ThermalZone61)
  - sol(Face690)
    - floor between buildings
      - Finish693(entrance)
      - Finish695(ThermalZone61)
  - sud(Face696)
    - no wall
      - Finish699(entrance)
      - Finish701(ThermalZone61)

With the balcony as a shading

- bathroom(Cell648)
  - 20 °C
  - est(Face366)
    - external wall
      - Finish371(bathroom)
      - Finish369(Outdoors)
  - nord(Face677)
    - external wall
      - Finish680(bathroom)
      - Finish682(Outdoors)
  - ouest(Face686)
    - Concrete 100
      - Finish689(bathroom)
      - Finish691(entrance)
  - plafond(Face693)
    - floor between buildings
      - Finish696(bathroom)
      - Finish698(ThermalZone61)
  - sol(Face651)
    - floor between buildings
      - Finish654(bathroom)
      - Finish656(ThermalZone61)
  - sud(Face662)
    - Concrete 100
      - Finish665(bathroom)
      - Finish667(ThermalZone61)

- living room(Cell2)
  - 20 °C
  - facade est(Face30)
    - external wall
      - Finish33(living room)
      - Finish35(Outdoors)
  - facade nord(Face39)
    - no wall
      - Finish42(living room)
      - Finish44(ThermalZone61)
  - facade ouest(Face48)
    - external wall
      - Finish51(living room)
      - Finish53(Outdoors)
  - facade sud(Face19)
    - external wall
      - Finish22(living room)
      - Finish24(Outdoors)
    - WinDoor514(Face512)
      - SuperLavE-Kr i træramme
      - Systems
    - living room window(Face527)
      - SuperLavE-Kr i træramme
      - Systems
    - kitchen window(Face542)
      - SuperLavE-Kr i træramme
      - Systems
  - sol(Face5)
    - floor between buildings
      - Finish8(living room)
      - Finish10(ThermalZone61)
  - toit(Face55)
    - floor between buildings
      - Finish58(living room)
      - Finish60(ThermalZone61)



Student

The most critical unit is a unit with only a neighbor on one side, one above and one under.

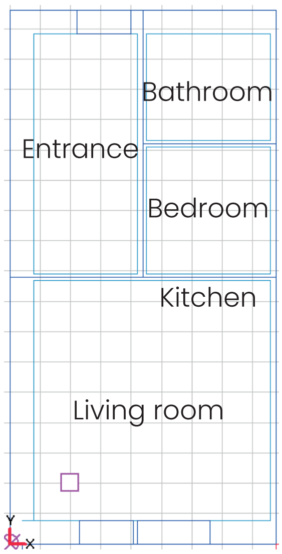
- bathroom(Cell472)
  - 20 °C
  - est(Face499)
    - wall to other unit
      - Finish502(bathroom)
      - Finish504(ThermalZone242)
  - nord(Face508)
    - external wall
      - Finish511(bathroom)
      - Finish513(Outdoors)
  - ouest(Face517)
    - Concrete 100
      - Finish520(bathroom)
      - Finish522(ThermalZone242)
  - plafond(Face524)
    - floor between buildings
      - Finish527(bathroom)
      - Finish529(ThermalZone242)
  - sol(Face475)
    - floor between buildings
      - Finish478(bathroom)
      - Finish480(ThermalZone242)
  - sud(Face488)
    - Concrete 100
      - Finish491(bathroom)
      - Finish493(bedroom)

- bedroom(Cell3164)
  - 20 °C
  - est(Face3180)
    - wall to other unit
      - Finish3183(bedroom)
      - Finish3185(ThermalZone24
  - ouest(Face3193)
    - no wall
      - Finish3196(bedroom)
      - Finish3198(ThermalZone24
  - plafond(Face3199)
    - floor between buildings
      - Finish3202(bedroom)
      - Finish3204(ThermalZone24
  - sol(Face3167)
    - floor between buildings
      - Finish3170(bedroom)
      - Finish3172(ThermalZone24
  - sud(Face3174)
    - Concrete 100
      - Finish3177(bedroom)
      - Finish3179(ThermalZone24
  - sud(Face488)
    - Concrete 100
      - Finish491(bathroom)
      - Finish493(bedroom)

With the balcony as a shading

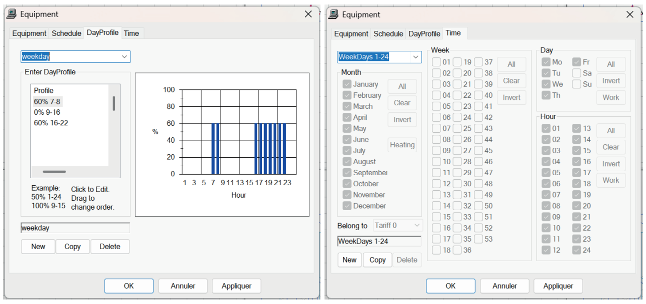
- entrance(Cell417)
  - 20 °C
  - est(Face440)
    - no wall
      - Finish443(entrance)
      - Finish445(Outdoors)
  - nord(Face449)
    - external wall
      - Finish452(entrance)
      - Finish454(Outdoors)
    - door(Face3613)
      - SuperLavE-Kr i træramme
      - Systems
  - ouest(Face456)
    - external wall
      - Finish459(entrance)
      - Finish461(Outdoors)
  - plafond(Face462)
    - floor between buildings
      - Finish465(entrance)
      - Finish467(Outdoors)
  - sol(Face420)
    - floor between buildings
      - Finish423(entrance)
      - Finish425(ThermalZone242)
  - sud(Face431)
    - no wall
      - Finish434(entrance)
      - Finish436(ThermalZone242)

- living room(Cell2)
  - 20 °C
  - facade est(Face30)
    - wall to other unit
      - Finish33(living room)
      - Finish35(ThermalZone242)
  - facade nord(Face39)
    - no wall
      - Finish42(living room)
      - Finish44(ThermalZone242)
  - facade ouest(Face48)
    - external wall
      - Finish51(living room)
      - Finish53(Outdoors)
  - facade sud(Face19)
    - external wall
      - Finish22(living room)
      - Finish24(Outdoors)
    - glass door(Face253)
      - SuperLavE-Kr i træramme
      - Systems
    - window(Face380)
      - SuperLavE-Kr i træramme
      - Systems
  - plafond(Face55)
    - top roof
      - Finish58(living room)
      - Finish60(Outdoors)
  - sol(Face5)
    - floor between buildings
      - Finish8(living room)
      - Finish10(ThermalZone242)

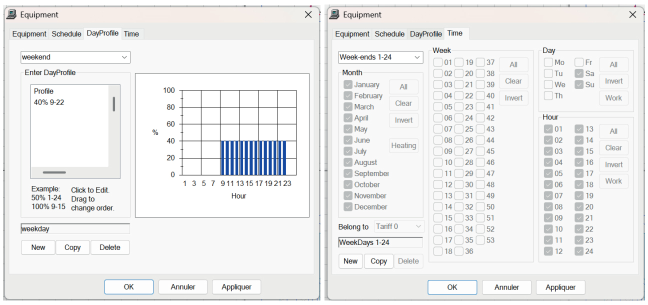


The internal walls are called "Concrete 100", but as shown in the construction page, they are made of wood and not concrete, it's only a typing mistake.

Schedules

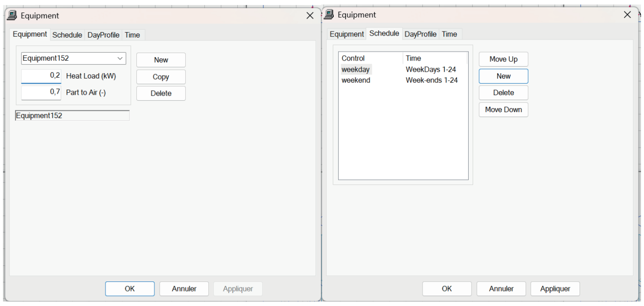


Weekdays

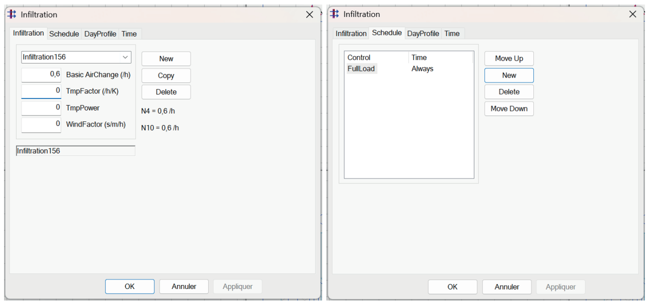


Weekend

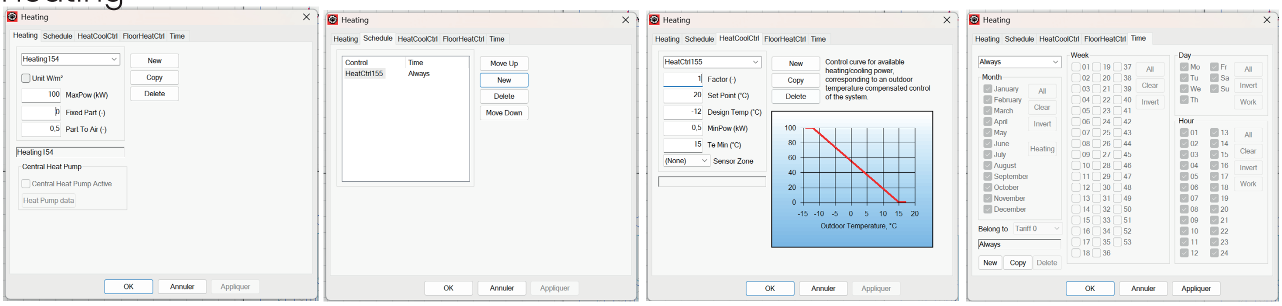
Equipment



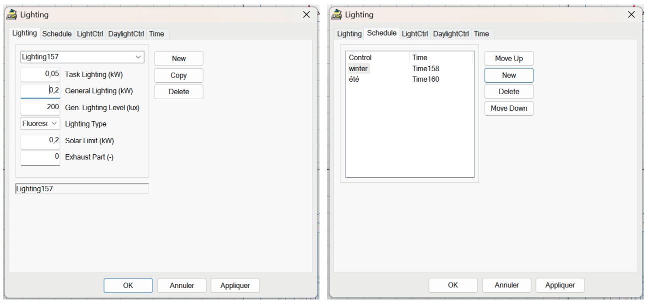
Infiltration

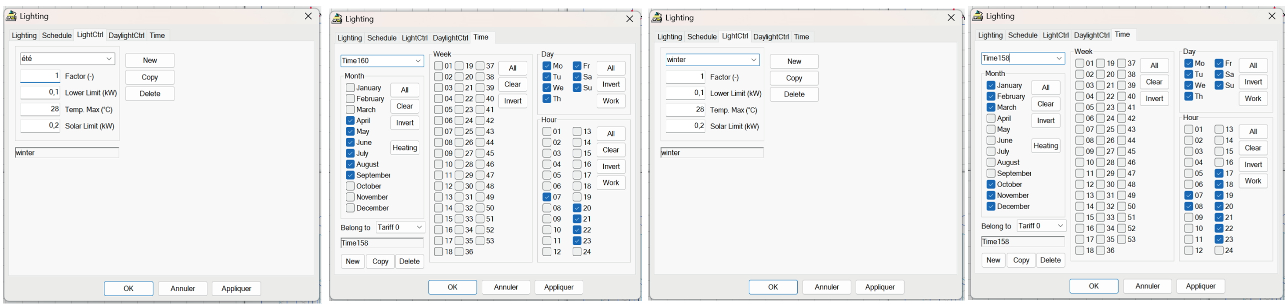


Heating

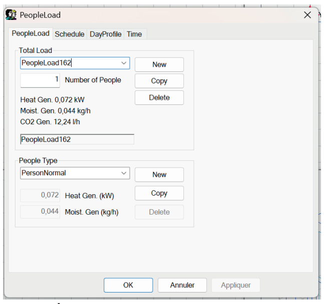


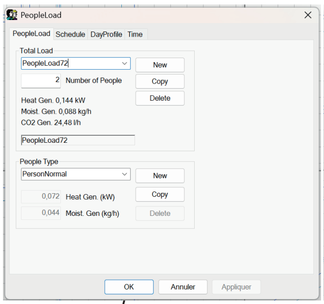
Lightning

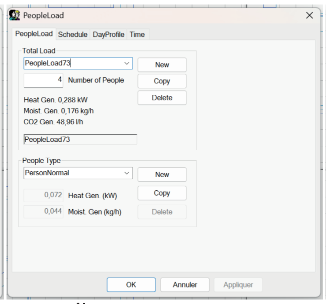


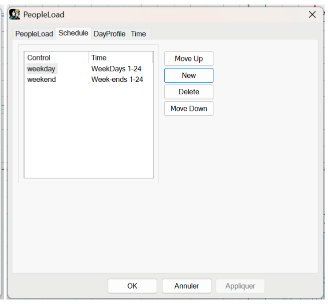


PeopleLoad

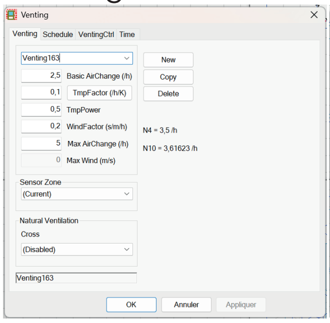

Students

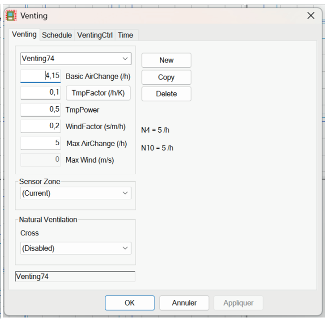

Couples/Elderly

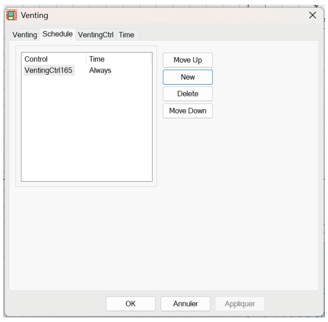

Family

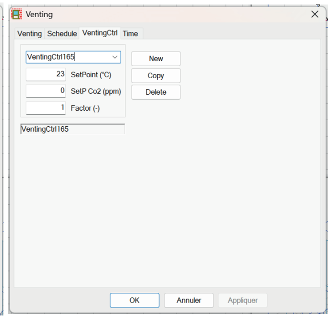


Venting

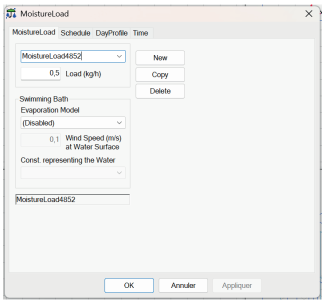

Students and couples

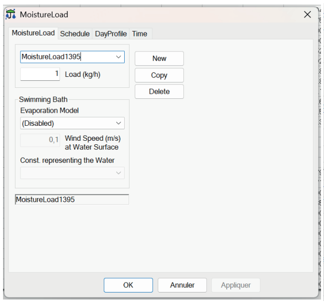

Family

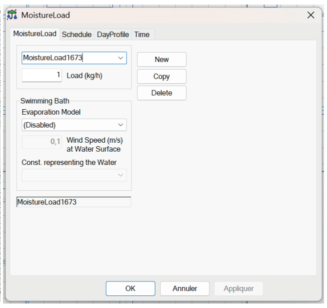


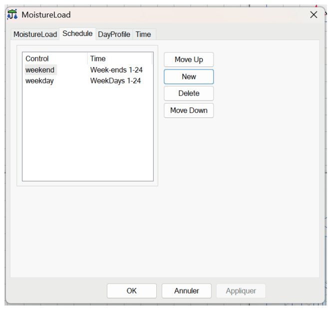


MoistureLoad

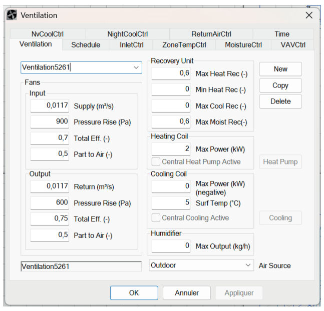

Students

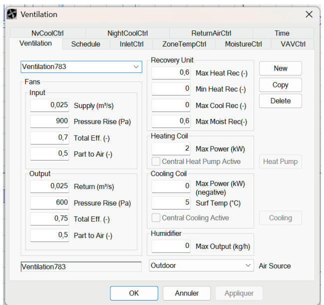

Couples/Elderly

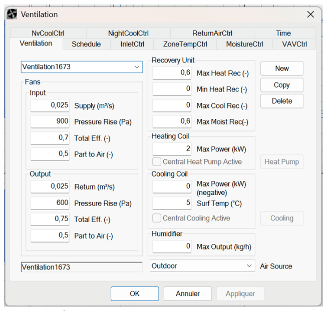

Family

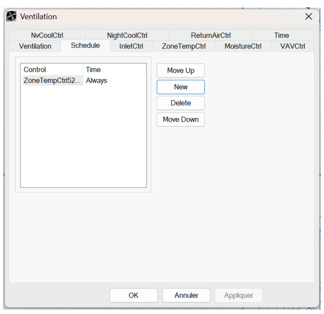


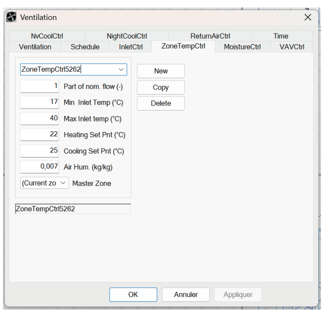
Ventilation

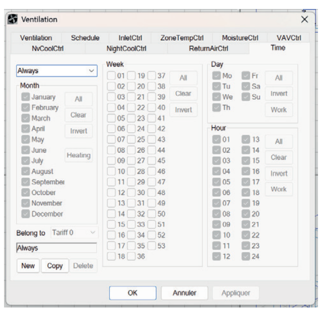

Students


Couples/Elderly


Family







Internal and external walls

- Concrete 100
  - MaterialLayers
    - i091 - Gypsum Fibreboard
    - TotalThickness=0,1
    - R=0,3125 m²K/W

Concrete 100
ConstructionMaterial
Gypsum Fibreboard
Sfb
i091 | 0,1 | 0

Drag to change order

Material	Thicknes...	Resistan...
Gypsum Fibreb...	0,1	0

- wall to other unit
  - Unit=m2
  - Lifetime=1
  - MaterialLayers
    - f70 - Plasterboard
    - m09 - Wood fiber insulation batt (sorption min)
    - f70 - Plasterboard
    - TotalThickness=0,2
    - R=3,17778 m²K/W

wall to other unit
ConstructionMaterial
Plasterboard
Sfb
f70 | 0,05 | 0

Drag to change order

Material	Thicknes...	Resistan...
Plasterboard	0,05	0
Wood fiber insul...	0,1	0
Plasterboard	0,05	0

- external wall
  - Unit=m2
  - Lifetime=1
  - MaterialLayers
    - f70 - Plasterboard
    - m09 - Wood fiber insulation batt (sorption min)
    - i0 - Wood fiber board, hard
    - v00 - Ventilated air gap
    - i11 - Plywood 22 mm WBP P-30
    - TotalThickness=0,39
    - R=8,08886 m²K/W

external wall
ConstructionMaterial
Plasterboard
Sfb
f70 | 0,015 | 0

Drag to change order

Material	Thicknes...	Resistan...
Plasterboard	0,015	0
Wood fiber insul...	0,25	0
Wood fiber boar...	0,05	0
Ventilated air gap	0,05	0
Plywood 22 mm ...	0,025	0

Floor, ceiling and roof

- ground floor
  - Unit=m2
  - Lifetime=1
  - MaterialLayers
    - i1 - Plywood 12 mm Malaysian Morranti WBP
    - m09 - Wood fiber insulation batt (sorption min)
    - m010 - Expanded Polystyrene (selfdefined)
    - TotalThickness=0,52
    - R=13,2094 m²K/W

ground floor
ConstructionMaterial
Plywood 12 mm Malaysian Morranti WBP
Sfb
i1 | 0,02 | 0

Drag to change order

Material	Thicknes...	Resistan...
Plywood 12 mm ...	0,02	0
Wood fiber insul...	0,2	0
Expanded Polys...	0,3	0

- floor between buildings
  - Unit=m2
  - Lifetime=1
  - MaterialLayers
    - i11 - Plywood 22 mm WBP P-30
    - m09 - Wood fiber insulation batt (sorption min)
    - i0 - Wood fiber board, hard
    - TotalThickness=0,222
    - R=3,69206 m²K/W

floor between buildings
ConstructionMaterial
Plywood 22 mm WBP P-30
Sfb
i11 | 0,022 | 0

Drag to change order

Material	Thicknes...	Resistan...
Plywood 22 mm ...	0,022	0
Wood fiber insul...	0,1	0
Wood fiber boar...	0,1	0

- top roof
  - Unit=m2
  - Lifetime=1
  - MaterialLayers
    - i0 - Wood fiber board, hard
    - m09 - Wood fiber insulation batt (sorption min)
    - i0 - Wood fiber board, hard
    - TotalThickness=0,505
    - R=10,8294 m²K/W

top roof
ConstructionMaterial
Wood fiber board, hard
Sfb
i0 | 0,1 | 0

Drag to change order

Material	Thicknes...	Resistan...
Wood fiber boar...	0,1	0
Wood fiber insul...	0,35	0
Wood fiber boar...	0,055	0

The floors, roofs and ceilings have cold bridges of 0,4 W/mK in the edges

Windows and glass doors

The U-Value is 0,7

- SuperLavE-Kr i træramme
  - MaterialLayers
    - a42 - Climastop N Diamant
    - b3 - Wood, pine/fir 600

SuperLavE-Kr i træramme
ConstructionMaterial
Climastop N Diamant
Sfb
a42 | 0,05 | 0

Drag to change order

Material	LinTrCoeff/Width/Pct
Climastop N Dia...	0,05
Wood, pine/fir 6...	0,2

Windoor
Windoor Property | Natural Ventilation | Cold Bridges
Opening
Cd 0,65
Cnt 0,5
Afrac 1
Convective Heat Transfer Model
Ka 5

Edit Material
Material | Glazing | Additional | UserDefined
Climastop N Diamant
Heat Transmittance: Normal 0,3; Diffuse 0
Uvalue (W/m² K): Center 0,6
Light Transmittance: Normal 1
User Defined Curve
Clear Transmittance

Edit Material
Material | Frame
Wood, pine/fir 600
UValue (W/m² K) 0,6

The windows and glass doors have cold bridges of 0,1 W/mK in the edges

Student

ThermalZon	Sum/Mean	1 (31 days)	2 (28 days)	3 (31 days)	4 (30 days)	5 (31 days)	6 (30 days)	7 (31 days)	8 (31 days)	9 (30 days)	10 (31 days)	11 (30 days)	12 (31 days)
qHeating	2585,16	476,22	427,61	506,09	200,59	52,24	14,12	0,00	0,00	2,65	85,79	342,24	477,61
qCooling	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
qInfiltration	-1846,46	-242,68	-221,39	-259,75	-158,10	-113,22	-85,23	-54,71	-53,62	-85,22	-131,08	-200,32	-241,14
qVenting	-16,24	0,00	0,00	0,00	0,00	0,00	-1,22	-7,50	-7,03	-0,48	0,00	0,00	0,00
qSunRad	326,06	10,74	18,14	32,85	33,98	35,10	38,99	35,69	34,15	35,06	30,05	13,22	8,09
qPeople	143,41	12,17	11,00	12,20	11,78	12,17	11,81	12,17	12,18	11,79	12,17	11,79	12,18
qEquipment	408,80	34,72	31,36	34,72	33,60	34,72	33,60	34,72	34,72	33,60	34,72	33,60	34,72
qLighting	638,25	69,75	63,00	69,75	37,50	38,75	37,50	38,75	38,75	37,50	69,75	67,50	69,75
qTransmissi	-4263,24	-570,40	-518,59	-604,83	-362,23	-250,90	-191,96	-114,14	-115,17	-189,57	-306,82	-469,01	-569,60
qMixing	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
qVentilation	2024,40	209,51	188,89	209,01	202,89	191,14	142,40	55,03	56,03	154,65	205,43	200,99	208,42
Sum	0,14	0,03	0,03	0,03	0,00	-0,00	0,01	0,01	0,01	-0,01	0,00	0,02	0,03
tOutdoor me	8,1	0,7	0,4	-0,7	7,1	11,5	14,2	17,8	17,9	14,5	9,8	3,4	0,7
tOp mean(°C	20,7	20,1	20,1	20,1	20,1	20,6	21,3	22,2	22,2	21,6	20,3	20,0	20,1
AirChange(/l	1,1	1,1	1,1	1,1	1,1	1,1	1,1	1,2	1,2	1,1	1,1	1,1	1,1
Rel. Moistur	48,0	35,2	35,3	32,8	43,0	51,3	59,7	64,3	62,2	58,9	55,2	41,7	36,8
Co2(ppm)	385,4	386,2	386,1	386,1	386,3	386,0	385,3	382,3	382,8	385,9	385,9	385,9	386,0
PAQ(-)	0,4	0,6	0,6	0,6	0,5	0,3	0,2	0,0	0,1	0,2	0,3	0,5	0,6
Hours > 21	2804	0	0	0	13	183	448	741	740	607	72	0	0
Hours > 26	0	0	0	0	0	0	0	0	0	0	0	0	0
Hours > 28	0	0	0	0	0	0	0	0	0	0	0	0	0
Hours < 19	0	0	0	0	0	0	0	0	0	0	0	0	0

Couples/Elderly

ThermalZon	Sum/Mean	1 (31 days)	2 (28 days)	3 (31 days)	4 (30 days)	5 (31 days)	6 (30 days)	7 (31 days)	8 (31 days)	9 (30 days)	10 (31 days)	11 (30 days)	12 (31 days)
qHeating	1179,58	256,46	222,46	273,59	20,28	0,00	0,00	0,00	0,00	0,00	2,44	142,08	262,26
qCooling	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
qInfiltration	-4398,19	-559,29	-510,57	-600,35	-382,55	-297,53	-216,94	-128,58	-126,08	-208,17	-341,52	-470,45	-556,15
qVenting	-22,27	0,00	0,00	0,00	0,00	0,00	-1,83	-10,60	-9,17	-0,68	0,00	0,00	0,00
qSunRad	576,23	20,05	33,99	58,85	57,44	60,79	67,92	62,25	57,90	61,44	55,72	24,82	15,05
qPeople	264,27	22,35	20,28	22,58	21,66	22,35	21,89	22,35	22,46	21,77	22,35	21,77	22,46
qEquipment	367,04	31,04	28,16	31,36	30,08	31,04	30,40	31,04	31,20	30,24	31,04	30,24	31,20
qLighting	638,25	69,75	63,00	69,75	37,50	38,75	37,50	38,75	38,75	37,50	69,75	67,50	69,75
qTransmissi	-2137,01	-288,67	-261,20	-301,58	-188,67	-132,06	-93,22	-43,88	-45,18	-92,78	-161,24	-238,35	-290,19
qMixing	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
qVentilation	3532,17	448,32	403,89	445,82	404,26	276,65	154,28	28,70	30,13	150,68	321,43	422,38	445,62
Sum	0,06	0,00	0,01	0,01	0,01	-0,01	0,00	0,03	0,02	-0,00	-0,02	0,01	0,01
tOutdoor me	8,1	0,7	0,4	-0,7	7,1	11,5	14,2	17,8	17,9	14,5	9,8	3,4	0,7
tOp mean(°C	21,1	20,0	20,0	20,1	20,8	21,9	22,1	22,3	22,3	22,0	21,7	20,3	20,0
AirChange(/l	1,1	1,1	1,1	1,1	1,1	1,1	1,1	1,2	1,2	1,1	1,1	1,1	1,1
Rel. Moistur	45,6	34,1	34,2	31,5	40,0	46,0	56,1	63,4	61,2	56,3	49,6	39,6	35,6
Co2(ppm)	379,3	379,8	379,9	380,0	379,9	379,6	379,3	376,9	377,5	379,7	379,5	379,7	379,8
PAQ(-)	0,4	0,6	0,6	0,6	0,5	0,3	0,2	0,0	0,1	0,2	0,3	0,5	0,6
Hours > 21	4710	0	0	2	244	744	720	744	744	720	685	107	0
Hours > 26	0	0	0	0	0	0	0	0	0	0	0	0	0
Hours > 28	0	0	0	0	0	0	0	0	0	0	0	0	0
Hours < 19	0	0	0	0	0	0	0	0	0	0	0	0	0

Family

ThermalZon	Sum/Mean	1 (31 days)	2 (28 days)	3 (31 days)	4 (30 days)	5 (31 days)	6 (30 days)	7 (31 days)	8 (31 days)	9 (30 days)	10 (31 days)	11 (30 days)	12 (31 days)
qHeating	4893,19	940,86	826,43	944,07	317,62	72,77	13,59	0,00	0,00	1,61	149,65	675,54	951,05
qCooling	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
qInfiltration	-3836,88	-500,10	-456,21	-535,15	-329,08	-238,57	-181,93	-116,52	-115,53	-180,00	-273,99	-412,87	-496,95
qVenting	-63,52	0,00	0,00	0,00	0,00	0,00	-6,25	-25,15	-29,17	-2,95	0,00	0,00	0,00
qSunRad	1409,29	42,08	73,21	138,67	154,62	158,08	160,81	151,23	163,46	158,14	125,01	52,49	31,47
qPeople	528,54	44,70	40,55	45,16	43,32	44,70	43,78	44,70	44,93	43,55	44,70	43,55	44,93
qEquipment	367,04	31,04	28,16	31,36	30,08	31,04	30,40	31,04	31,20	30,24	31,04	30,24	31,20
qLighting	629,05	69,75	62,70	66,55	37,50	37,45	35,50	38,35	37,35	37,50	69,15	67,50	69,75
qTransmissi	-8059,13	-1077,05	-979,40	-1138,51	-684,17	-479,65	-366,75	-215,77	-216,60	-358,78	-577,94	-886,71	-1077,80
qMixing	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
qVentilation	4132,54	448,73	404,58	447,87	430,11	374,18	270,86	92,14	84,37	270,69	432,38	430,27	446,37
Sum	0,10	0,02	0,02	0,02	0,00	-0,00	0,01	0,01	0,01	-0,01	0,00	0,01	0,02
tOutdoor me	8,1	0,7	0,4	-0,7	7,1	11,5	14,2	17,8	17,9	14,5	9,8	3,4	0,7
tOp mean(°C	20,8	20,1	20,1	20,1	20,2	20,8	21,6	22,4	22,4	21,8	20,5	20,1	20,1
AirChange(/l	1,2	1,1	1,1	1,1	1,1	1,1	1,2	1,5	1,5	1,2	1,1	1,1	1,1
Rel. Moistur	47,1	34,8	35,0	32,5	42,1	49,9	58,0	62,9	60,6	57,6	54,2	41,3	36,4
Co2(ppm)	411,1	413,3	413,5	413,8	413,6	413,0	409,9	402,3	402,5	411,9	412,9	413,2	413,3
PAQ(-)	0,4	0,6	0,6	0,6	0,5	0,3	0,2	0,0	0,1	0,2	0,3	0,5	0,6
Hours > 21	3102	0	0	0	48	248	534	744	744	644	140	0	0
Hours > 26	0	0	0	0	0	0	0	0	0	0	0	0	0
Hours > 28	0	0	0	0	0	0	0	0	0	0	0	0	0
Hours < 19	0	0	0	0	0	0	0	0	0	0	0	0	0