Remisen

A new urban addition to Odder rooted in community and context

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Msc04 - arc07

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Title	Remisen A new community-anchored urban addition, where transformation, sustainability and local identity converge into a contemporary architectural narrative.
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“Questions, more than answers, are the pathway to collective wisdom”

Wahl et al. 2016, p. 24

THE READER'S COMPASS
NAVIGATING THIS REPORT WITH EASE

This report is structured to illustrate a dynamic process instead of a linear argumentation. The theme is assemblage which impacts both the content of the report as well as the visual expression. Assemblage is a method and theory that highlights the importance of compositing elements to make a fluid whole. It is reflected both analytically and visually with collage-like illustrations, to accentuate the idea of knowledge as compound and iterative instead of definitive.

A combined methodology

Instead of a traditional segregation of theory, analysis and process, sketches are integrated throughout the report. Sections on theory and analysis are followed by architectural enquiries where keynotes are turned into explorative questions to guide the design process. Every section is further complemented with a collage of sketches to act as a design response to the adjacent analysis or theory.

The analysis

To maintain the abstract assemblage framework and account for the shift in content resulting from this methodology, the analysis is structured into three scales. Firstly, the large scale examines Odder as a city and municipality. Secondly, the medium scale analyzes the immediate context surrounding the site. Finally, the small scale investigates the specific conditions of the building.

How to approach:

Read the report as an ongoing dialogue between theory, analysis, and design.

Use the enquiring questions as reflection and landmarks for architectural thinking.

View the sketches as evolving design ideas, open to further development.

How to read:

Every analytical and theoretical segment is concluded with architectural enquiries, where keynotes are converted into enquiring questions and red text squares present the response.

The enquiries are complemented by sketches, which serve as a visual and conceptual continuation of each section and to bridge specific design strategies.

The illustrations are in a collage style to underline the interconnected understanding of assemblage.

ABSTRACT

This thesis examines how a new settlement in Odder can serve as a catalyst for urban regeneration, while also supporting the ambitions of low emission. Remisen is based on a transformation of the former railway workshop and its surrounding area. By focusing on reusing the existing structure and through the integration of community-minded functions, the project seeks to merge architectural quality with environmental responsibility.

The proposal is based on spatial and programmatic investigations of how architecture improves urban life and identity. It is mediated through green pockets, sequential spaces and typological solutions to create continuity between the existing and the new.

The method combines conceptual thinking, framed through a collage-like process, with technical evaluations conducted through Life Cycle Assessment (LCA). This is used to shape key design decisions. The results emphasize the importance of conserving and rethinking existing structures. As a result, the existing industrial building is retained in its raw state, while the new structures are either superimposed on or embedded within it. This duality creates new spatial experiences that elevate the site's historical identity while introducing a contemporary architectural language.

The thesis concludes by proposing a balanced approach between social, contextual and environmental considerations. Remisen is a sustainable new settlement where architecture supports both community life and cultural continuity.

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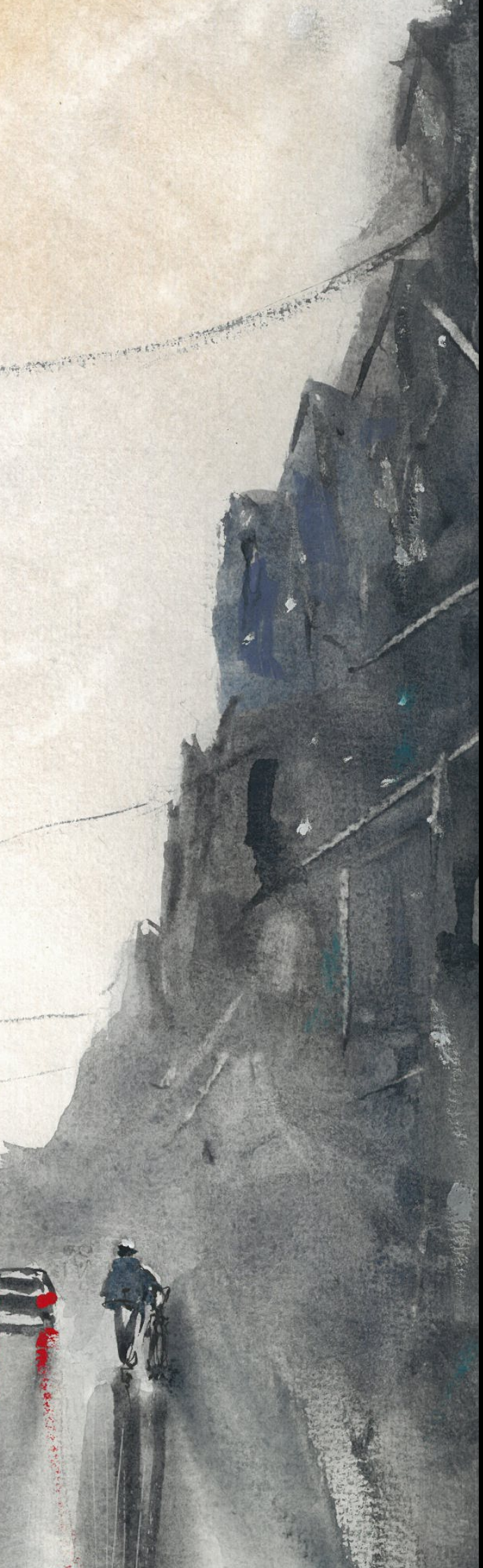
1.. Shopping street, car dominated



Chapter 01: Intro

Motivation

“

We are no longer part of an industrial revolution of materials.
We are at the beginning of Mother Nature's
revolution of materials.
Green 2013

The building sector is today one of the biggest contributors to global carbon emissions and the use of resources in Denmark. According to the Danish Council on Climate Change (Klimarådet 2023) the building sector is responsible for 30% of Denmark's collective carbon emission, especially due to the use of building materials. Traditional materials such as concrete and steel have highly embedded carbon while biobased materials such as wood, hemp, and seaweed not only absorb carbon but also contribute to a circular economy. These materials are renewable, biodegradable and can often be reused or recycled with minimal environmental impact (SBi, 2022).

The design of biobased housing units exhibit the technical, aesthetic, and functional potential in a modern urban context. The units are placed in relation to an existing industrial environment in the interconnection of two main parts of the city. The project demands a connection to both existing structures on site as well as nearby urban functions. This thesis aims to demonstrate how biobased materials can be utilized in a contemporary context without compromising functionality, durability, and aesthetics.

As a continuation of this intention, the new volumes function as a strategic intervention in the city in cooperation with existing structures. These aim to create a new urban environment that strengthens the city's flow and continuity, helping to dissolve the perception of urban barriers. These anchor points should enhance a more integrated and accessible city structure where sustainable materials reduce carbon emissions while creating new social and functional opportunities in the city.

Problem:

How can a settlement serve as a catalyst for urban regeneration through community-centered design that supports climate responsibility?

SUSTAINABILITY - A BIOBASED DESIGN APPROACH

Sustainability in construction incorporates a balance between social, environmental, and economic aspects (Brundtland-kommissionen, 1987). As the building sector is one of the biggest contributors to carbon emissions globally (Klimarådet, 2023), there is an emphasis on alternative materials and building strategies to reduce carbon emissions and support a circular economy.

Biobased materials made from resources such as wood, hemp, straw and grass offer an environmentally friendly approach compared to conventional, often mineral-based, materials. Biobased materials are typically renewable, require less energy to produce and harbour the ability to absorb and store carbon during their growth. However, it's important to recognize that chosing biobased materials does not justify circularity, if the materials end up in a landfill at the end of their life, where the stored carbon is released through natural decomposition processes. The real benefit of using biobased materials comes when they are part of a well-thought-out circular strategy.

With the emphasis on material selection, it is important to integrate passive strategies such as external overhangs, optimized volume placement, and ventilation. These principles become key strategies to ensure material longevity and reduced energy demand (BUILD, 2023). Biobased building materials present moisture capacities that promote moisture regulation of the indoor environment, reducing the need for mechanical intervention and control. (DAC, 2023)

The choice of material is a key parameter when addressing sustainability. Environmental sustainability, particularly as the majority of the environmental footprint of a building comes from its building materials rather than energy consumption. From the perspective of social sustainability, biobased materials impact the indoor environmental performance and the comfort level of residents, including their experience of a space. However, there seem to be issues when addressing economic sustainability as their price points are higher than conventional materials, and biobased solutions require more elaborate planning and engineering, increasing consultancy fees. To ensure a holistic approach to sustainability and successful implementation of biobased solutions requires consideration and integration to all of these aspects, not only to address carbon emissions but also to ensure healthy, flexible. and economic building practices.

REGENERATIVE

If you want to design regenerative
CIRCULATE MATERIALS

Waste is a design flaw. Instead of creating a product with a linear lifespan, one should think in a cycle! Every material can be reused, repurposed, or regenerated. Can YOUR design eliminate waste? Can it be disassembled and introduced in another context? Pose the question if a design can mimic nature's circularity where nothing is ever wasted.

If you want to design regenerative
RESTORE ECOSYSTEMS

A design should not only minimize damages – it should actively repair and regenerate. Consider how your design can restore urban fabrics, communities, or lost spaces. Can your project HEAL a damaged environment? Can it create MORE LIFE? Ask how a design can give more than it takes.

If you want to design regenerative
ADAPT TO CHANGE

Nature thrives through evolution and so should your design. Instead of rigid solutions, create a system that reacts to environmental and social change. Can it be flexible, modular, or resistant? Can it grow and change over time? Pose the question of how to build for a future in constant change.

If you want to design regenerative
BE SELF-SUSTAINING

Dependence on finite resources impairs the system. Instead, draw on local renewable resources. Can your design generate energy? Can it be self-sustainable? How can you design work as an ecosystem that thrives independently while nurturing its surroundings?

If you want to design regenerative
SUPPORT BIODIVERSITY

Life thrives in diversity, and so should your design. Consider how your work can create a habitat that encourages species diversity and integrates with living systems. Can your design be home to wildlife? Can it improve rather than replace nature? Ask if you design can be MORE than just a home for people.

2. Town square

Design scope

Energy demand

- *Dwellings and similar buildings must not have a total demand for supplied energy for heating, ventilation, cooling, and domestic hot water that exceeds 27.0 kWh/m² per year, which corresponds to a low energy class (Bygningsreglementet §473, 2025).*

Air quality

- *In residential buildings, the Danish Building Regulations require a minimum ventilation rate of 0.30 l/s per m² of heated floor area (Bygningsreglementet §441 2025).*

Daylight demand

- *A minimum daylight illuminance of 300 lux in at least 50% of the room for more than half of the occupied hours (European Committee for Standardization 2018)*

Mandatory emission threshold

- *For buildings[...]with a heated floor area[...] exceeding 1,000 m², the climate impact[...] must not exceed 12.0 kg CO_2 equivalents per m² per year (Bygningsreglementet §298, 2025).*

Low emission class

- *The building owner may include information that the construction meets the low emissions class if the climate impact does not exceed 8.0 kg CO_2 equivalents per m² per year (Bygningsreglementet §297, 2025).*

New emission threshold

- *For multi-storey residential buildings, as well as office, retail, warehouse and similar uses: 7.5 kg CO_2-equivalents per m² per year (Retsinformation §28, 2025).*

This thesis investigates how biobased materials can be integrated into a modern architectural context through the development of housing which both function as a physical intervention and an investigation of biobased building methods. The project takes its stance in an existing industrial context and further examines the strategy of combining materials' natural properties with a functional and aesthetical identity. The following presents an extract of some of the technical demands.

AESTHETIC

The transformation of an existing building involves a balance between conservation and renovation. Inspired by the notion of critical regionalism, the project aims to create a dialog between the industrial environment with new biobased additions. This point is thought to be elevated through an aesthetic where the material's tactile identity and natural aging process is a central element.

Biobased materials will not only define the expression but also create an awareness through the contrast with existing structures. The strategy aims to create a symbiosis between new and old by adding and removing elements. It is key that the old structures are still visible while a new relevant function lives inside this existing context.

TECHNICAL

The design is based on the analysis of biobased materials and their technical capabilities regarding construction, indoor environment, and energy efficiency. As biobased materials often have a higher moisture capacity and encourage more vapour-permeable constructions than conventional materials, the integration of passive design strategies is more central.

The structural integrity of the design explores how biobased elements can be applied into a flexible assembly and disassembly. This thesis aims to comply with the low energy class of the building regulations, which minimizes transmission losses and maximizes the use of renewable energy sources.

FUNCTIONAL

The design intervention should provide a new public and flexible urban space that combines social and cultural aspects, with a mix of venues, exhibitions, and areas that accommodate stay. In post-industrial areas, new social anchors are crucial to activate and regenerate the urban environment, preventing isolation and supporting community life.

The design program is created based on several analyses and similar building and urban designs, where multifunctionality are key parameters. The flexibility of materials and construction principles allows the design to adapt to different activities over time and be an integrated part of the city.

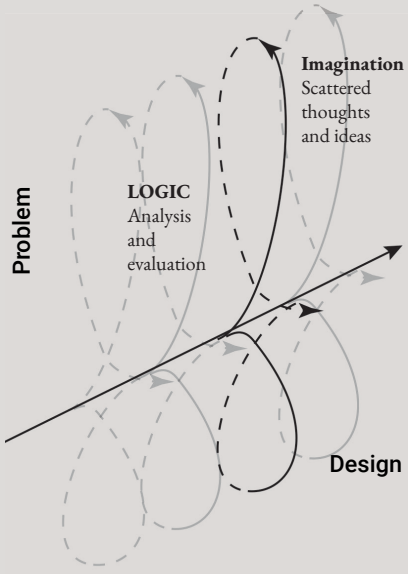
Methodology

SUBSTITUTE BY DESIGN ELEMENT AND JOINTS

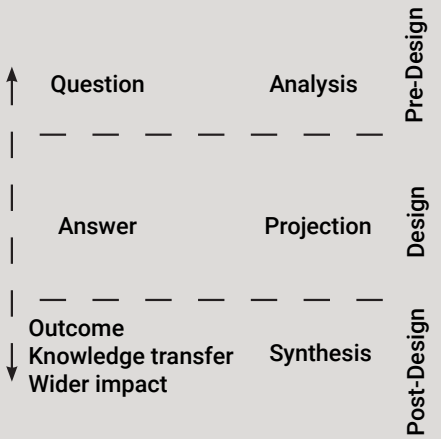
The methodology 'Structural Element and Joints – A Generator for Design Explorations' (Christensen et. al, 2017) aims to integrate structural elements in the early design phase. This methodology suggests a structured approach where creative intuition and technical limitations are balanced. This methodology supports both top-down and bottom-up approaches where both structural concepts and small details are explored simultaneously. This is followed by an iterative cycle where design solutions and challenges are evolving. This underlines the importance of examining structural elements as a factor in architectural design. Another important aspect of the methodology is to separate speculative and logical processes. The initial phase allows for creativity to push new and innovative ideas. Later, the ideas are refined through analytical evaluation based on building performance and architectural quality. The process of evaluation is often controlled through a detailed ranking system. It is especially useful in teaching as it evolves the architectural student's understanding of aesthetics and engineering principles. (Christensen et. al, 2017)

RESEARCH BY DESIGN

Research by Design (RbD) is a methodology commonly used as an academic research tool to generate new knowledge (Roggema, 2016). In contrast to traditional methodologies, which are built upon analytical and empirical data, RbD focuses on being explorative and experimental. This approach is common when assessing architectural practice, city planning, and product design. Here, the design solutions are not only affected by new research but are also active contributors. One of the key elements of Research by Design is its iterative character, where ideas are put to the test through experiments, analysis, and refinement. The question at hand is evolving throughout the process of design. The goal is not simply to create a design solution but to explore new concepts and challenge existing knowledge within a field. RbD combines creative exploration through critical thinking, which ensures that each design proposal informs the problem statement. The results are evaluated by assessing if this solution either challenges or confirms the original hypothesis, which ensures a dynamic approach to knowledge sharing. (Roggema, 2016)



3. Inspired by Design Element and Joints (Christensen, 2017)



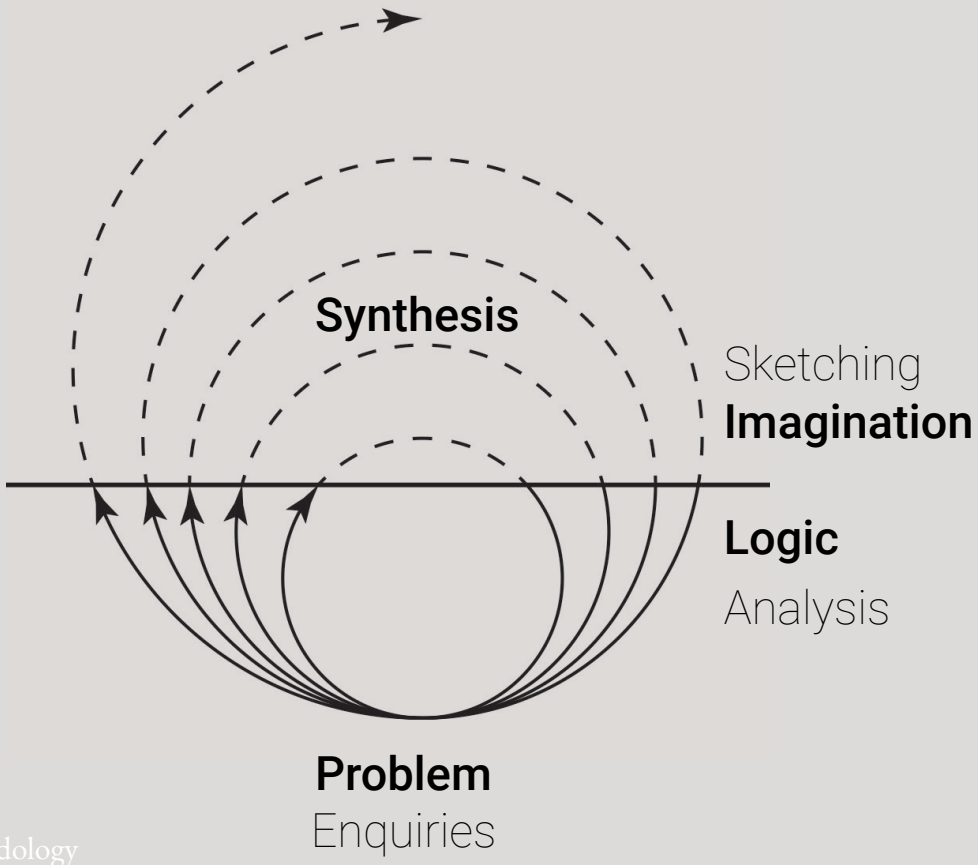
4.Inspired by Research by Design (Roggema, 2016)

A COMBINED METHODOLOGY

By combining the two methodologies, Research by Design and Element and Joints, this thesis aims to create a hybrid approach where a structure design approach is combined with a research-driven experimental approach. This methodology remains iterative as it varies between the problem statement and design development. Instead of using a ranking system to evaluate design results, this methodology aims to challenge or underline the current research question.

In the first part of the process, the definitions of a research question or problem statement are essential. This statement should relate both to architectural design and technical issues. While this statement aims to present a guideline for the project at hand, it is most important to view this as exactly that - a guideline. The research question is not rigid, and it is to be expected to change throughout the design process.

The second phase involves design experiments. Already in the early stages, sketching and modeling are expected to start. These tools are used for testing initial concepts of design. Experiments are expected to break the barrier between analysis and design. Such explorations can affect both architectural and technical performance by comparing research questions and architectural enquiries. If a proposal challenges a hypothesis, the methodology relies on the possibility of changing or refining the research question. This ensures that the process remains open, which aims to encourage creativity and academic clarity. This combined approach ensures that new design thinking inspires research while the result can evolve into new possibilities.



5. Combined methodology

Method

REGENERATIVE DESIGN

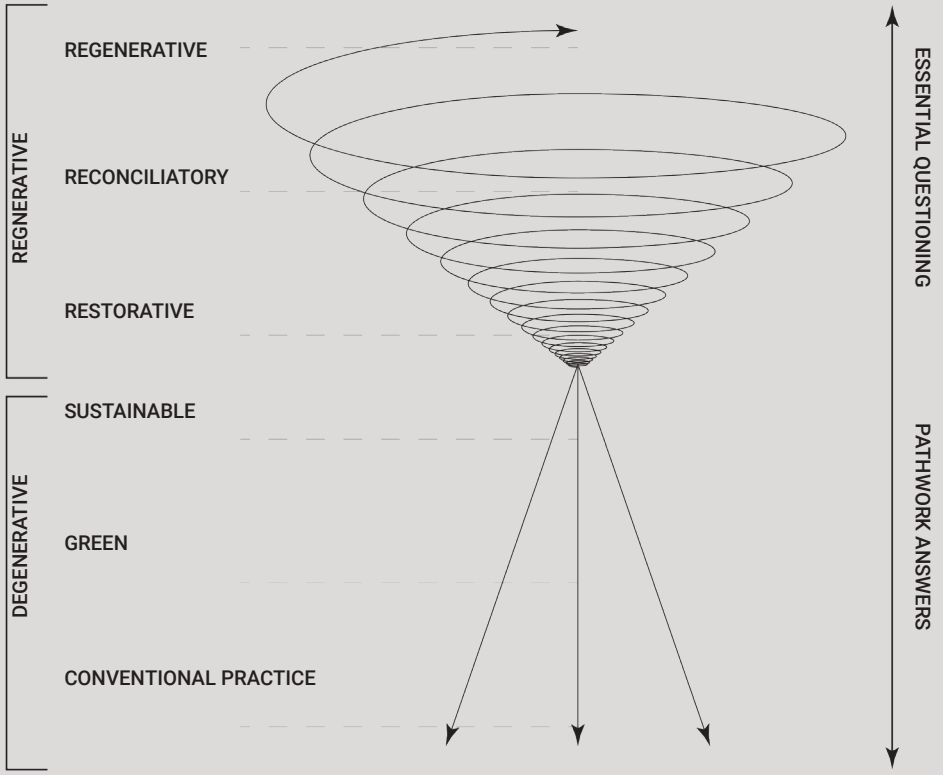
Regenerative design is an approach that seeks to reestablish, renew, and strengthen the lifegiving systems people interact with. In contrast to conventional design methods that often focus on reducing the harm done, regenerative design strives to create conditions that support existing ecosystems and encourage growth. The approach revolves around the acknowledgement that development happens in the interaction between components and the whole. (Wahl et al., 2016)

The approach does not see the built environment as isolated structures, but as dynamic processes that evolve with their surroundings. Change demands the ability to understand new relations that arise between physical, social, and environmental factors. Regenerative design thereby shows its potential in a transformative force, weaving parts to create higher meaning. (Wahl et al., 2016)

The regenerative design framework illustrates how design can move from being degenerative and resource exhaustive to being regenerative and life-vitalizing. The model shows how design can affect the vital force in the dynamic process, where systems either fragments and loses vitality or evolve as an integrated cooperative and coherent state. (Wahl et al., 2016)

This theory model is incorporated into the design process by expressing inquiries. Daniel Wahl states the importance of rediscovering the value of asking questions instead of just seeking "quick-fix solutions and immediate answers" (Wahl et al., 2016, p. 21). Questions open for reflection and cultural discussions that have the capability to change our perspective. Asking questions will thereby be a means to achieving a deeper interaction between design elements. (Wahl et al., 2016)

This approach will be used as a tool to guide the design process of this thesis. The architectural enquiries will be a sequence of questions to help climb the regenerative spiral and create a meaningful design where the components work together in a cohesive system.



6. Regenerative Design, inspiration: Wahl et al., 2016

COLLAGE

In this thesis, collage will be used as a philosophical and architectural method inspired both by Manuel DeLandas assemblage theory and Peter Cooks book '*Drawing The Motive Force of Architecture*'. Cook describes architecture as a dynamic and curious subject driven by experimentation and imagination. In this playful process ,the collage can inspire the unexpected and illuminate new ideas. DeLanda describes assemblage as a structure defined by its components and the relation between them, and not a rigid, definite whole. Collage will then be a tool to visualize connection between components and used to investigate ideas by combining different elements. (Cook 2014; Delanda 2016)

Collage will be used analytically and as a creative tool where drawing will function as a dynamic process rather than a static product. Cook inspires to use collage to create a new understanding of form and space. The method consists in broad terms of four aspects: material collection, composition, examination, and reflection. Material collection is the assembly of visual fragments, sketches and drawings. Composition is the compilation of these fragments, new spacious ideas and relations arise in this stage. The collage will then be examined to find the architectural potential. Lastly the drawing will be reflected upon to reduce the subjective bias by comparing it to theory and analysis. (Cook 2014)

Peter Cook presents collages as an essential and lively aspects of architecture. The drawings ability to stimulate creativity, visualize complex ideas, and act as an experimental tool for innovation and experimentation.

7. Old buildings, new life

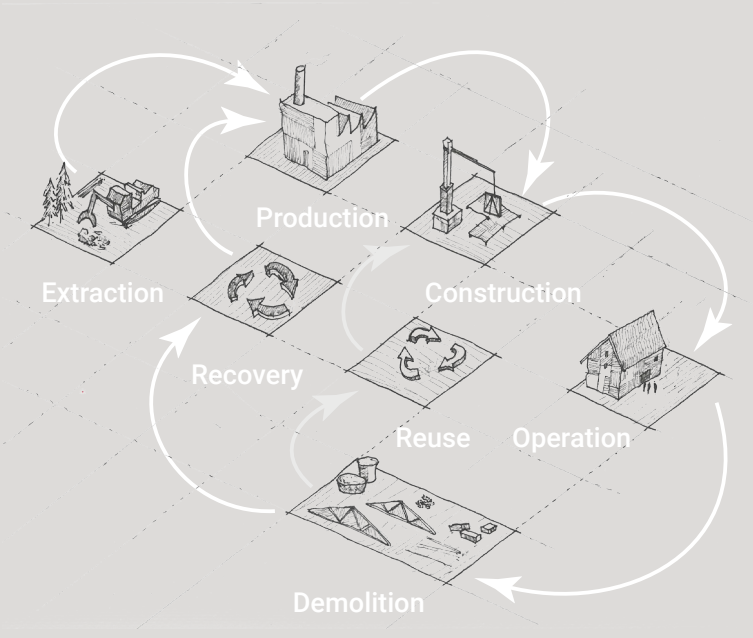
LIFE CYCLE ASSESSMENT

Life Cycle Assessment (LCA) is used as an analytical method for evaluating the environmental impact of selected design proposals. It supports the decision-making process and ensures that decisions are informed and evidence-based.

The LCA method is applied to five overarching phases in the building's life cycle: production, construction, operation, demolition, and reuse or recovery. A central part of this method is the assessment of the environmental impact throughout the entire lifespan of the materials of interest — from resource extraction and production to implementation and possible disposal. Particular attention is given to the material's ability to accumulate CO_2. (Fruergaard Astrup et al., 2022)

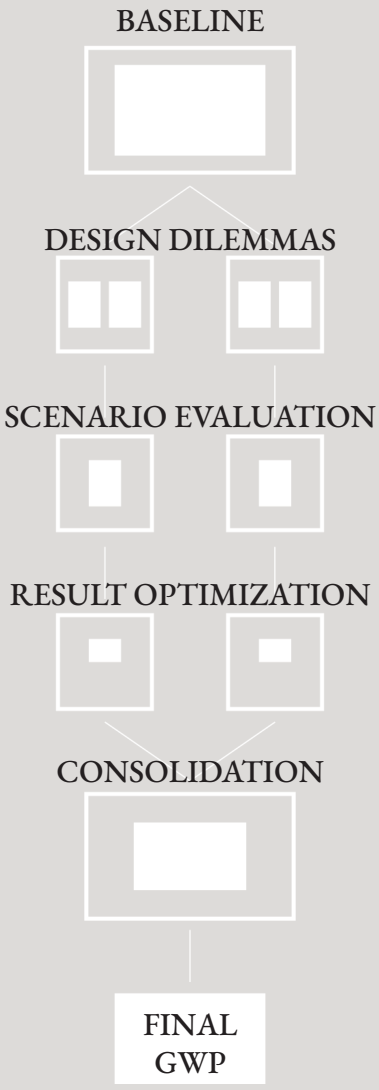
Through this utilization, LCA becomes a strategic tool to support the ambition of making informed decisions regarding the sustainable selection of materials. The evaluation helps to identify not only environmentally friendly choices but also promotes a holistic approach to sustainability. (Fruergaard Astrup et al., 2022)

To achieve low emissions in the final result, the baseline was inspired by the "4-til-1 planet" (CINARK et al., 2023) cases of a low-emission projects. Therefore, some of the primary construction elements, such as walls and roofs, were defined using this baseline. Therefore, the LCA process worked with a highly optimized wall and roof construction, and the goal has been to further refine this baseline to fit the specific requirements of this project.



8. Phases of a building's life cycle

LCA METHOD WORKFLOW



In order to structure the analysis and support the decision-making process, this thesis follows a step-by-step workflow consisting of the following phases:

The process begins by establishing a low-emission **baseline** to form a solid foundation for material choices and design principles. In this thesis, the "4-til-1 planet" cases is used as a reference, particularly its optimized wall and roof construction.

Throughout the design process, various **dilemmas** arise regarding material choices or construction approaches. In such cases, estimate calculations are conducted, informed by the baseline reference, to assess alternative solutions.

The scenario results are then **evaluated**, with focus on material usage, carbon emissions, and architectural quality. The comparison of scenarios ensures that sustainability is balanced with spatial and functional ambitions.

Once a preferred solution is identified, it is further **optimized** to better understand its environmental performance and improve upon material efficiency where possible.

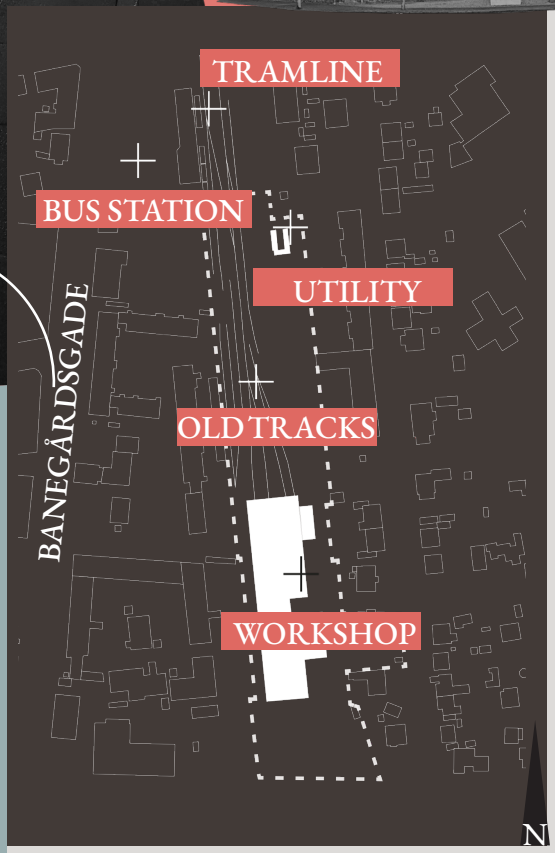
Because the LCA method runs in parallel with multiple design tracks, the selected solutions are **consolidated** into one comprehensive calculation. At this stage, additional construction elements that were not previously considered are also included to provide a more complete picture.

The process concludes with the final Global Warming Potential **(GWP)** result, which is compared to both the current low-emission class limit and the stricter requirements that will be in effect from July 1st, 2025.

9. LCA process method

Odder

BANEGÅRDSGADE



The City of Odder is a smaller city situated in the eastern part of Jutland. It is located roughly 20 kilometers south of Aarhus. The city consists of around 12,000 citizens and functions as a trade and service center for the district around the inner city. Odder is know to be cozy with strong local communities and as a connector between Aarhus and the southern Jutland. (Odder Lokalhistoriske Arkiv, n.d)

10. Location map, 1:1000

Historically, Odder has roots tracing back to the Middle Ages where the area was highly dominated by farming and smaller villages. The development of the city increased significantly in the late 1800s with the establishment of the railroad, which connected Odder to Aarhus. The railway made it possible to easily transport goods as well as people, acting as a catalyst for growth. Today, Odder is still connected to Aarhus by a tramline with Odder being the final station. (Odder Museum n.d)

The center of the city revolves around the bus and tramline station. Even though the old station is no longer in use as a transit hub it is adjacent to the final tramline stop and stands as a historic landmark. The area around the station is today an important centre of infrastructure. Here it is possible to gain access to the rest of the city and catch a connection to Aarhus. This serves as part in making Odder an attractive place to settle down (Midttrafik n.d). The area around the station makes room for bus connections, cycle parking and an attempt at creating the possibility for stay. Besides being a vital part of Odder, it is also close to the shopping street, cultural options and restaurants.

The city of Odder is a place where modern infrastructure and historical roots nurture a city in progression. The combination of an active community, excellent infrastructure, and close vicinity to nature makes Odder an attractive place to visit and live.

11. Collage drawing

Chapter 02: **Theoretical framework**

Assemblage

Quite often architecture is imagined as fixed and unchangeable. In reality, however, it is a dynamic composition formed by people, materials, and its surroundings. Manuel DeLanda's description of assemblage does not directly link to architecture but offers a way to understand architecture as an adaptive system rather than a static whole.

MANY PARTS WORKING TOGETHER

Assemblage is shaped by the past however it is not fully determined by it. It is therefore not like a puzzle where each piece has its place, and if a piece is lost, it creates a hole in the motive. Instead, assemblage is like an army which is not defined by the single soldier but by how its units interact. This can also be viewed in relation to the urban context of a neighborhood. This is not fixed either, as it is a mix of homes, streets, trees, social relationships, and more. Over time, houses will be renovated, new trees planted, residents change, which will all reshape the area. It remains a neighbourhood, even though the place is never truely finished but keeps adapting to ways of living, new needs, and technologies.

"An army, sedentary or nomadic, is an assemblage of assemblages, that is, an entity produced by the recursive application of the part-to-whole relation."

– Delanda, 2016, p. 71

MATERIALS ARE ACTIVE, NOT PASSIVE

Moving down a scale, DeLanda also states that materials themselves have a life of their own. They are not passive things but react to time, weather, and usage. Some materials age beautifully while others break down and require replacement. Buildings designed with materials that naturally adapt to the climate resemble architecture that engages with its surroundings. Materials should be seen as active participants that work with nature rather than against it.

"The whole formed by these three components must possess irreducible properties and dispositions of its own... The concept of a domain was recently introduced into the philosophy of science... many of which are not naturally given but artificially created."

– Delanda, 2016, p. 88

NOTHING EXISTS IN ISOLATION

"All assemblages are unique historical individuals... It is perfectly possible to speak of individual communities, individual organisations, individual cities."

– Delanda, 2016, p. 140

Another important aspect of assemblage is that nothing exists in isolation. Architecture is connected to the ground it is built on, the environment, the people using it, and the materials it is made from. On the contrary, architecture also changes things like how light shines, how shadows are cast, and how people use the spaces. Therefore, good design is not solely about the aesthetic but about how to integrate the surroundings and understand how it impacts the context.

FLEXIBLE, NOT RIGID

"The abstract machine is like the diagram of an assemblage. It draws lines of continuous variation, while the concrete assemblage treats variables and organizes their highly diverse relations."

– Delanda, 2016, p. 108

Delanda suggests that assemblages should be seen not as rigid or fixed, but as an open-ended system that allows for change. He explains that the 'abstract machine' of assemblage allows for continuous variations, rather than imposing a single rigid structure. In architectural terms, this means that embracing flexibility, spaces become responsive to their environment and new needs over time.

Critical Regionalism

Architecture is seen as a static and unchangeable unity, but in reality, it is dynamic and a composition of people, materials, people, and the surrounding in which it is located. Kenneth Frampton presents how critical regionalism offers a way to understand architectural design as an adaptive practice where balancing modern tendencies with site specific characteristics is essential. In Frampton's essay *Towards a Critical Regionalism: Six Points for Architecture Resistance* he argues that architecture should engage and collaborate within the context of the design rather than subjugate to modernist globalised tendencies. (Frampton, 1983)

ARCHITECTURE AS AN ANCHOR

A central aspect of critical regionalism is that architecture should reflect its surroundings. Frampton advises not to let the idea of architecture as a composition of functions be a driver for design – which could be located wherever. Instead, he suggests that a building should be conscious of its surrounding topography, climate and daylight conditions. An example of this is seen in how traditional elements such as shadow, openings, and materials can be used til create a sensory experience. (Frampton, 1983)

MATERIAL PRESENCE

Frampton argues that materials should not only be used as passive element but rather as an active participant of architecture and its interaction with the context. The use of local materials has a tactile quality which instigates a sensuous experience and roots the built environment to its surroundings. Instead of using common and generic materials, the use of materials which are dynamic and present a change in aesthetics enriches architecture and poetics of construction, where the assembly of materials reveals meaning and authenticity. (Frampton, 1983)

FLEXIBILITY RATHER THAN RIGIDITY

Critical regionalism suggest an approach for architecture where flexibility and adaptability trump rigidity and unchangeable. Frampton argues that architecture is not only about form but also about experience and function over time. Building should be made with a sincerity which ensure a strong design. Such an approach creates architecture that is not only timeless but location specific. (Frampton, 1983)

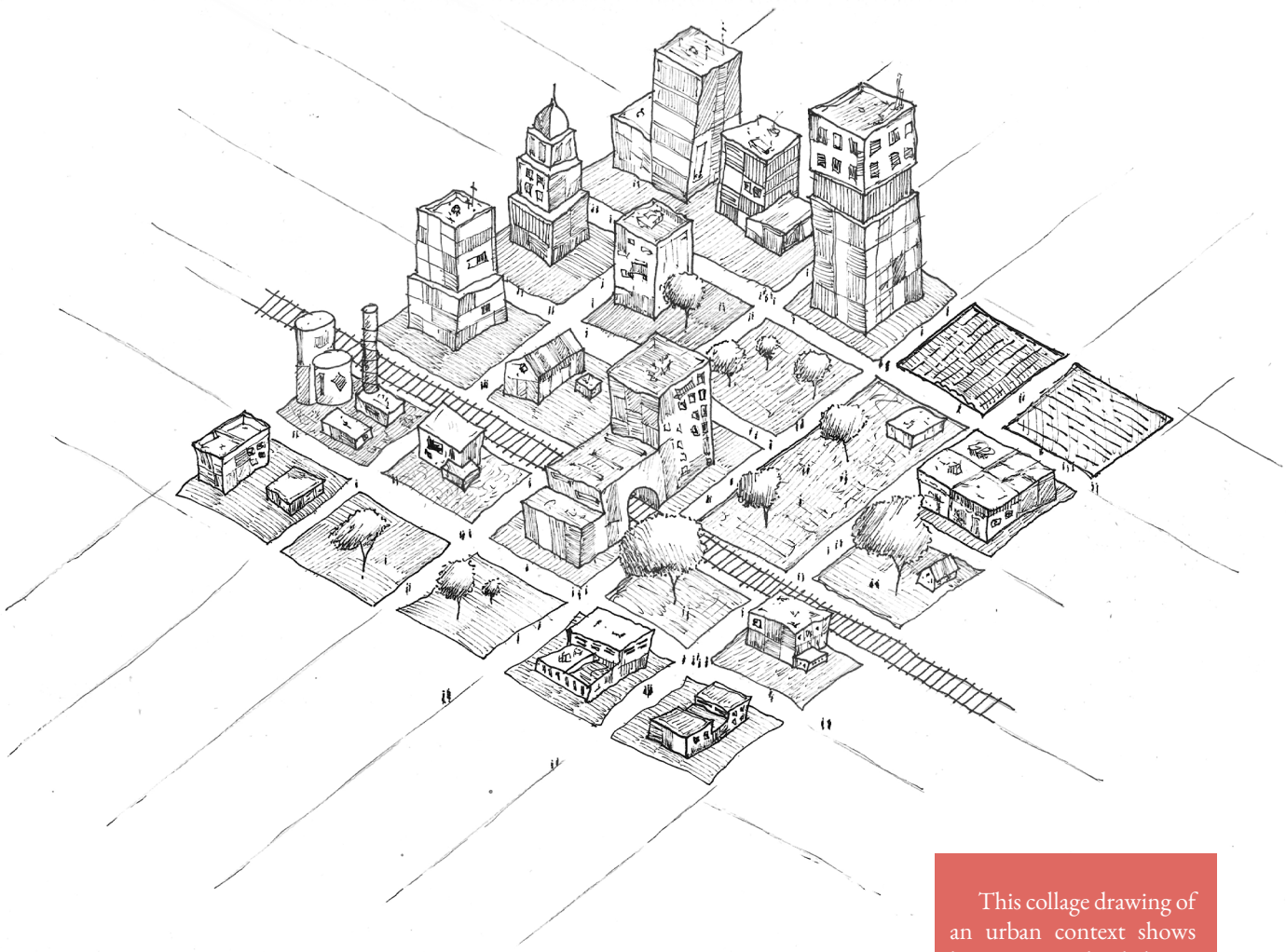
ARCHITECTURE: A COMPONENT OF A WHOLE

Frampton stresses that architecture never exists in isolation but is one component of a bigger whole. It is not about recreating the past or copying local traditions but rather understanding how architecture can influence and be influenced by its surroundings. As a city can evolve through social, economic, and physical factors, architecture should adapt to future change. (Frampton, 1983)

Architectural enquiries

This process evolves from the theoretical foundation, focusing on architecture as a layered and contextual system of relations.

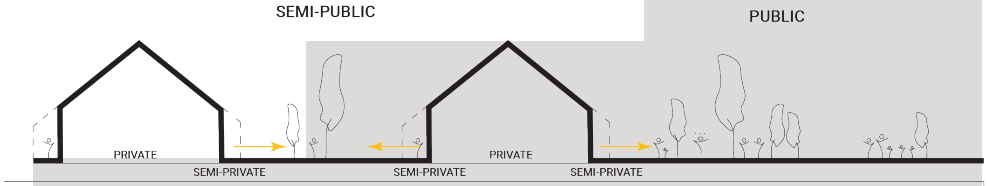
HOW CAN ARCHITECTURE ACT AS A FRAMEWORK THAT CONNECTS PEOPLE, MATERIALS, AND SURROUNDINGS?



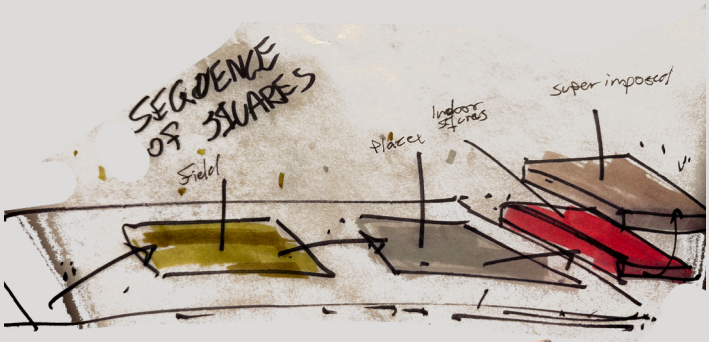
This collage drawing of an urban context shows how a city is divided into seperate functions and yet is brought together by the whole and by the people connecting the spaces.

12. Urban collage drawing

HOW CAN URBAN PROGRAMMING SUPPORT BOTH DIVERSITY AND COHERENCE WITHIN A SHARED PLACE?

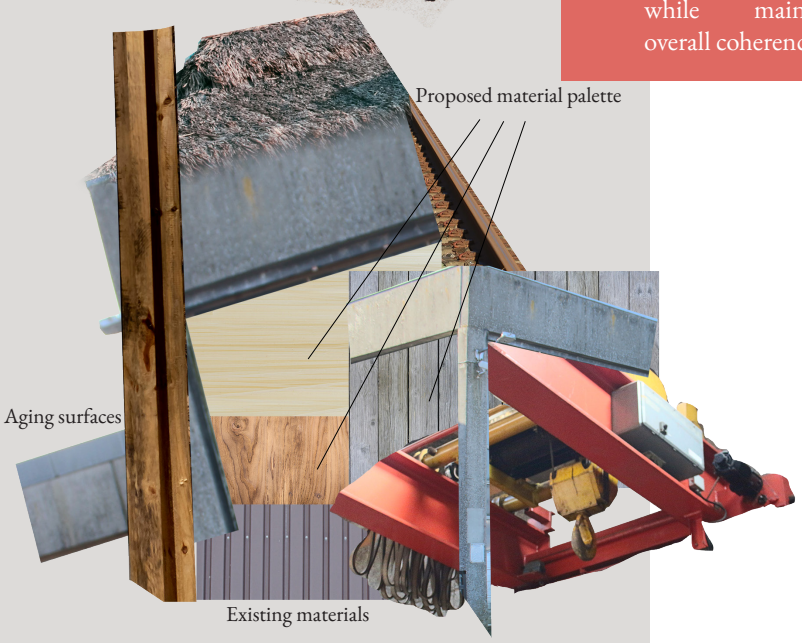


WORKSHOP



To merge residential and community functions, the zoning requires careful attention — respecting privacy while also creating a welcoming atmosphere for the public. This supports functional diversity while maintaining overall coherence.

A sequence of squares highlights the layered nature of urban spaces. Their ability to complement one another creates a multilayered assemblage that operates on multiple scales.



HOW CAN MATERIALS BE USED TO ROOT ARCHITECTURE IN PLACE WHILE BEING ACTIVE COMPONENTS OF TRANSFORMATION?

Through a deliberate weaving of existing and new materials, a story is created that connects the place with its history and anchors the new in its context.

13. Rathlou School

Chapter 03: Registration and analysis

Large scale

MUNICIPAL VISION

Odder Municipal is a dynamic and attractive city located in east Jutland. Odder is known for its nature, strong community, and its location close to other main cities such as Aarhus. In later years the municipality experienced an increase in population and an increased interest in the town from citizens and new businesses (Odder Kommune 2022). However, despite a positive interest in the city, Odder faces new challenges that demand strategic solutions to ensure a sustainable future.

Challenges in Odder

One of the main challenges in Odder is securing a balanced urban development where both growth and safeguarding of nature are prioritized. The municipality experiences an increased need for housing, but there is still a wish to preserve the green breathing spaces while nurturing the connection to surrounding nature (Odder Kommune 2019). Beyond that, it is critical to establish a varied housing composition, ensuring that both young families with children, as well as elderly people, can find a suitable place to live and settle down.

The commercial part of Odder city center also faces some challenges. Like other small-town businesses, the retail in Odder experiences pressure from online shopping and competition from bigger commercial companies. This results in a need for a rebranding of the city center and creates a way to make the shopping streets more attractive for both citizens and visitors from outside Odder (Realdania 2023).

As in many other development strategies, climate change has become a central theme for Odder municipal. Odder is a coastal municipality, exposing it to rising sea levels. Increased rainfall can lead to flooding. Therefore, long-term solutions for climate change adaptation are critical for Odder Municipality to secure a sustainable future. (Odder Kommune 2021)

Strategies

Odder Municipality's ambition is to strengthen the local community and to create a city where the citizens thrive and are engaged in the community. This ambition involves investments in urban spaces, green areas, and cultural offerings aimed at bringing people together to support a vibrant city center. (Odder Kommune 2019)

A key strategy to making the city center more lively and accessible is to create better connections between different parts of the city, along with attractive gathering places and inviting green spaces that encourage people to stay. The municipality is also interested in integrating sustainable solutions such as better biking connections and energy efficiency in the built environment. (Odder Kommune 2021)

14.City map, 1:10000

In the era of climate change, the aim is to reduce carbon emissions extensively and to create solutions that can withstand future climate change. Solutions include managing rainwater, climate adaptation in the city area, and afforestation to strengthen biodiversity (Odder Kommune 2022).

Sustainable Future for Odder

The overall vision of the municipality is to create a sustainable and attractive city where people enjoy living and working. This involves a city where nature, development, and community are united (Odder Kommune 2022). The vision is to secure growth and progress responsibly. The city wishes to attract more companies and entrepreneurs while sustaining its core values as a city with a strong community close to nature (Realdania 2023).

With a clear strategic outline for the future, Odder Municipal is working to create a city where people flourish and where growth is obtained without compromising the respect for the history of the city and future generations.

Rathlousskole

N

CONNECTIONS

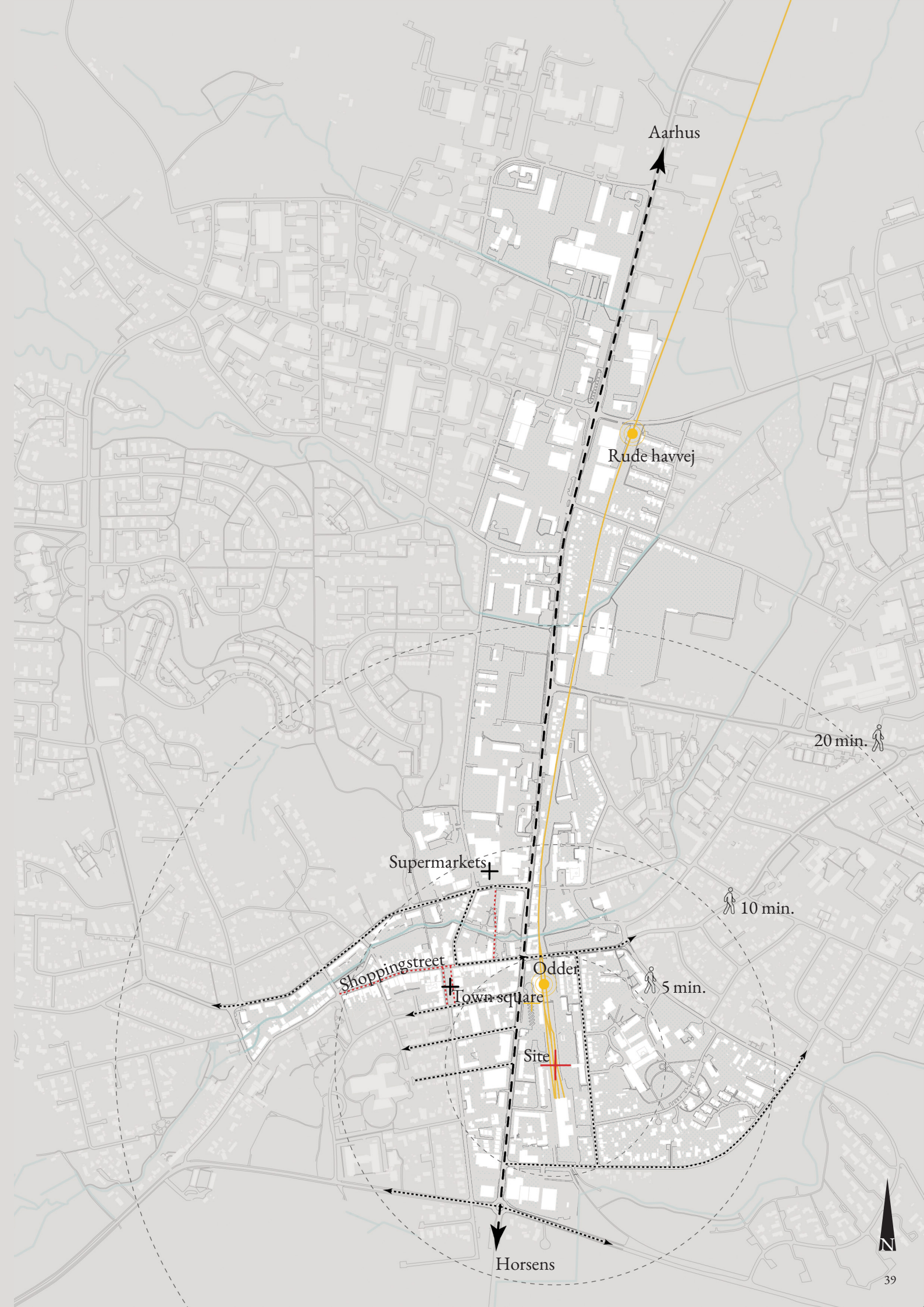
Banegårdsgade serves both as a spine and a challenge - it is the primary road connecting Aarhus and Horsens, cutting straight through the center of Odder. While it increases accessibility by car, it also has a dividing effect on the urban fabric.

Along Banegårdsgade are several important urban anchor points like the bus and tram station, library, supermarket, town square, and shopping street. However, the functions are placed on both sides of the road, meaning that pedestrians must cross this trafficated barrier to move between them. Even though the distances are short and walkable, Banegårdsgade remains experienced as both a physical and psychological barrier, hindering pedestrian flow.

To reduce this barrier effect, it is necessary to strengthen the connections between the city's functions. This involves not only ensuring a clear and safe urban flow, but also creating inviting and eventful routes that help diminish the perception of separation.

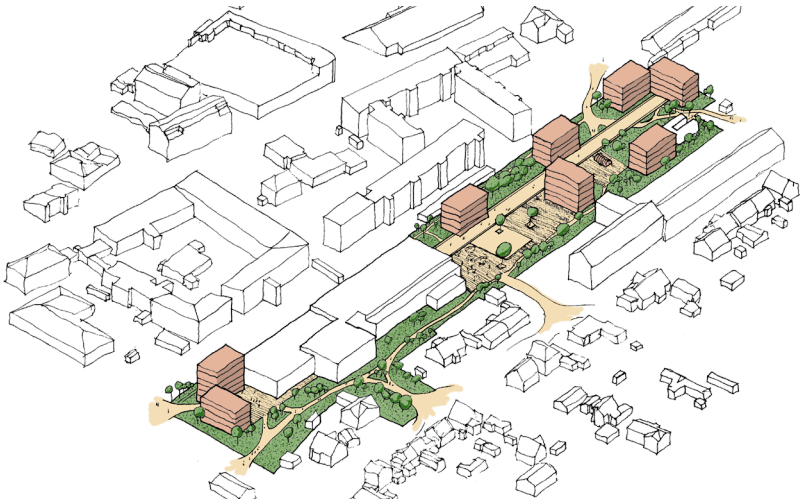
Tramline
Pedestrians
Motor traffic

15. Function map, 1:10000


Aarhus
Rude havvej
20 min.
Supermarkets
10 min.
Shoppingstreet
Odder
Town square
5 min.
Site
Horsens
N

Architectural enquiries
This process spread shows how the site can be occupied by different volumes and functions.

HOW CAN THE CITY CENTER BECOME MORE ATTRACTIVE FOR CITIZENS AND VISITORS?

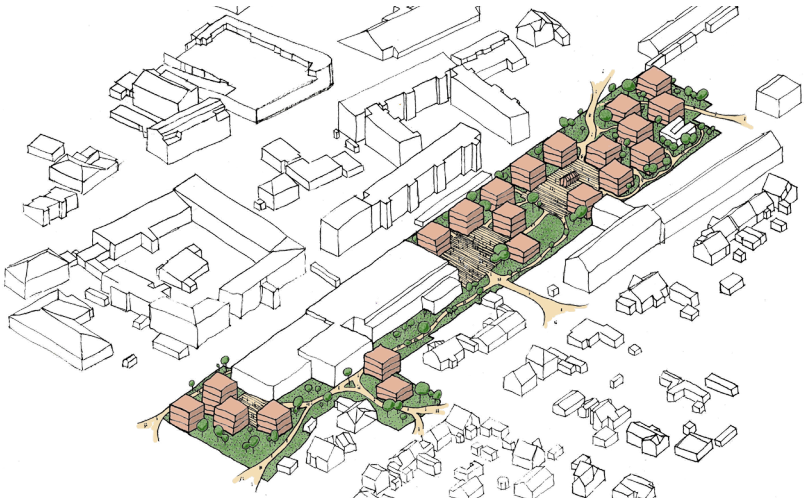


The attached

Fits existing apartment context

Small foot print

Reduces surface area

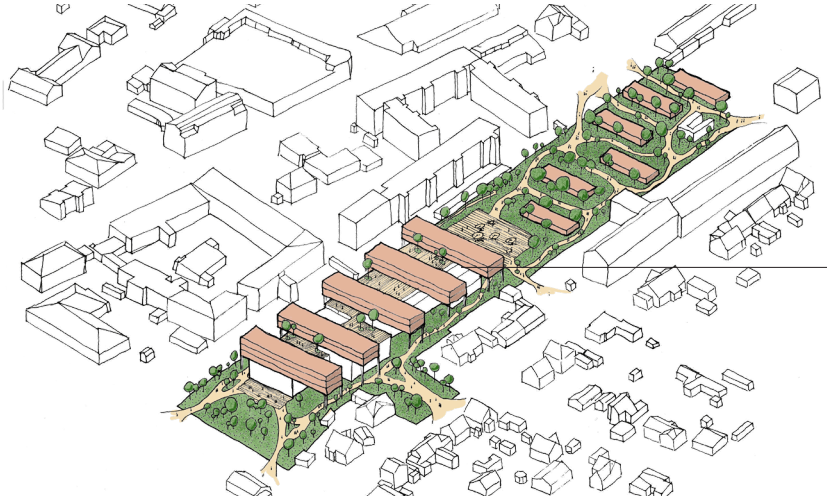


The sprout

Merging context

Expansion

Organic feel



The superimposed

A mix of typologies

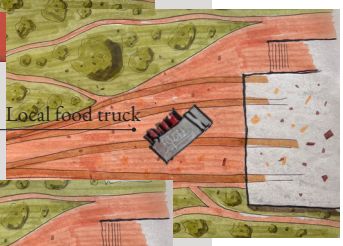
Utilizing roof

prodominated nature

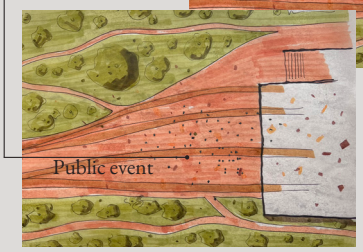
A new typology

Creating superimposed volumes in a modest cityscape like Odder acts as a point of interest with its own identity. It allows full use of the site without compromising the existing workshop building. A new typology is created to support the urban volumes; it also dissolves the southern part of the site and allows for a nature- and people-centered field.

HOW CAN DESIGN STRENGTHEN ODDER'S IDENTITY?



Public plaza events



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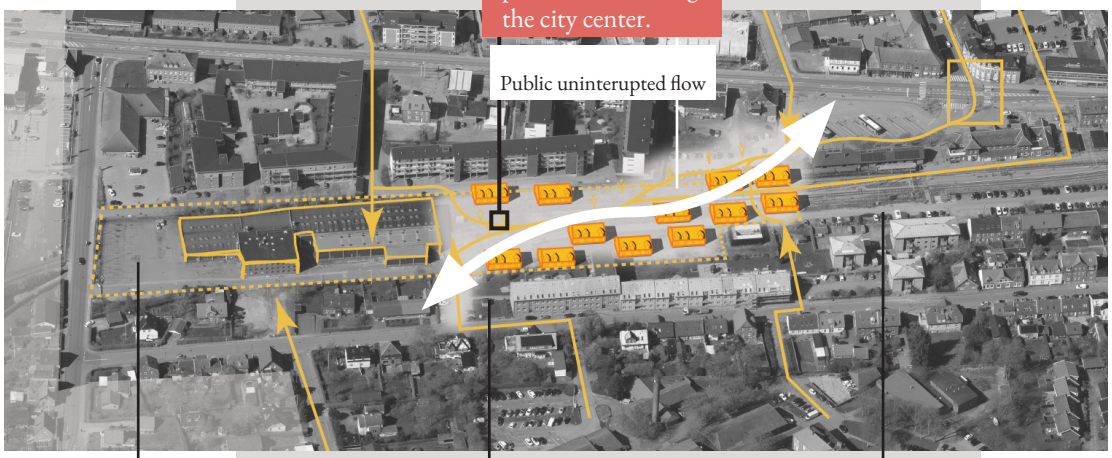
Local produce market

A local produce market will promote local businesses surrounding Odder. Therefore, the site will activate a broader scale within Odder Municipality.

Public events within the urban flow highlight the qualities of the community center.

Uninterrupted flow is important to accommodate the site as an anchor point connecting the city center.

HOW CAN THE SITE BE USED TO OPTIMIZE URBAN FLOW?



Medium scale

FUNCTION MAP

The growth of Odder is based on a distinct relation between functions. Here, industry, residential, and cultural areas each play an important part. While the industrial area dominates the city at first glance, retail, and community take place behind the facades. Here, day-to-day life unfolds.

Industrial area

As one approaches Odder the industrial area is one of the most distinctive structures. Large volumes and production facilities create a significant profile and states the presence of a commercial basis. The industrial part of the city is highly influenced by the functional and rational structure that optimizes production and logistics. Despite its dominating location at the city gates, this area collaborates with the city to create a place of employment to support the city's financial situation.

Residential area

Behind the curtains of the industry, low-rise housing interconnects with a higher density of apartment buildings near the center of the city. The housing environment is created with a balance between functionality and quality of life where connection to retail and green areas contribute. Different typologies ensure a diverse composition of people.

Cultural area

Culture also plays an important part in the city's development and identity. The architecture of the cultural building is in some cases a stand-alone landmark whereas others create a group of functions within a small footprint. The interplay of functions underlines the city's social and historical layers and further development of the city emphasizes the importance of the continuation of a strong cultural community. Therefore, it is crucial to create a space where citizens and visitors can engage with the city spirit. Open squares, places to stay, and public facilities invite the community and diversify the city center as a natural gathering place.

The interplay of industry, housing, and culture ensures a holistic development where each part creates a dynamic identity. As the city flourishes the need for cohesion is vital to ensure an attractiveness for both citizens and corporations.

16. Function map, 1:10000

INDUSTRIAL AREA

RESIDENTIAL AREA

RESIDENTIAL AREA

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ANCHOR POINTS

Hotel

Shopping stret

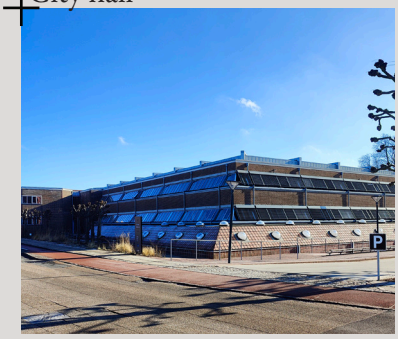
Church

Supermarkets

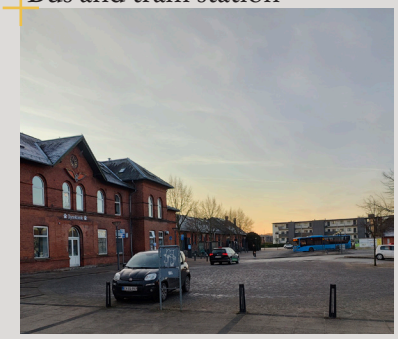
Skovbakke School

Library

City hall



Bus and tram station



Vita park

On the map the city's public and cultural functions are showcased with their placement. Functions such as the library, station, shopping street, and supermarkets create important nodes of attraction within the city. The shopping street creates the opportunity to linger while the school and park areas foster community. Together these functions create a network of public spaces. The site showcases a possibility to stitch and stimulate the connection across the city.

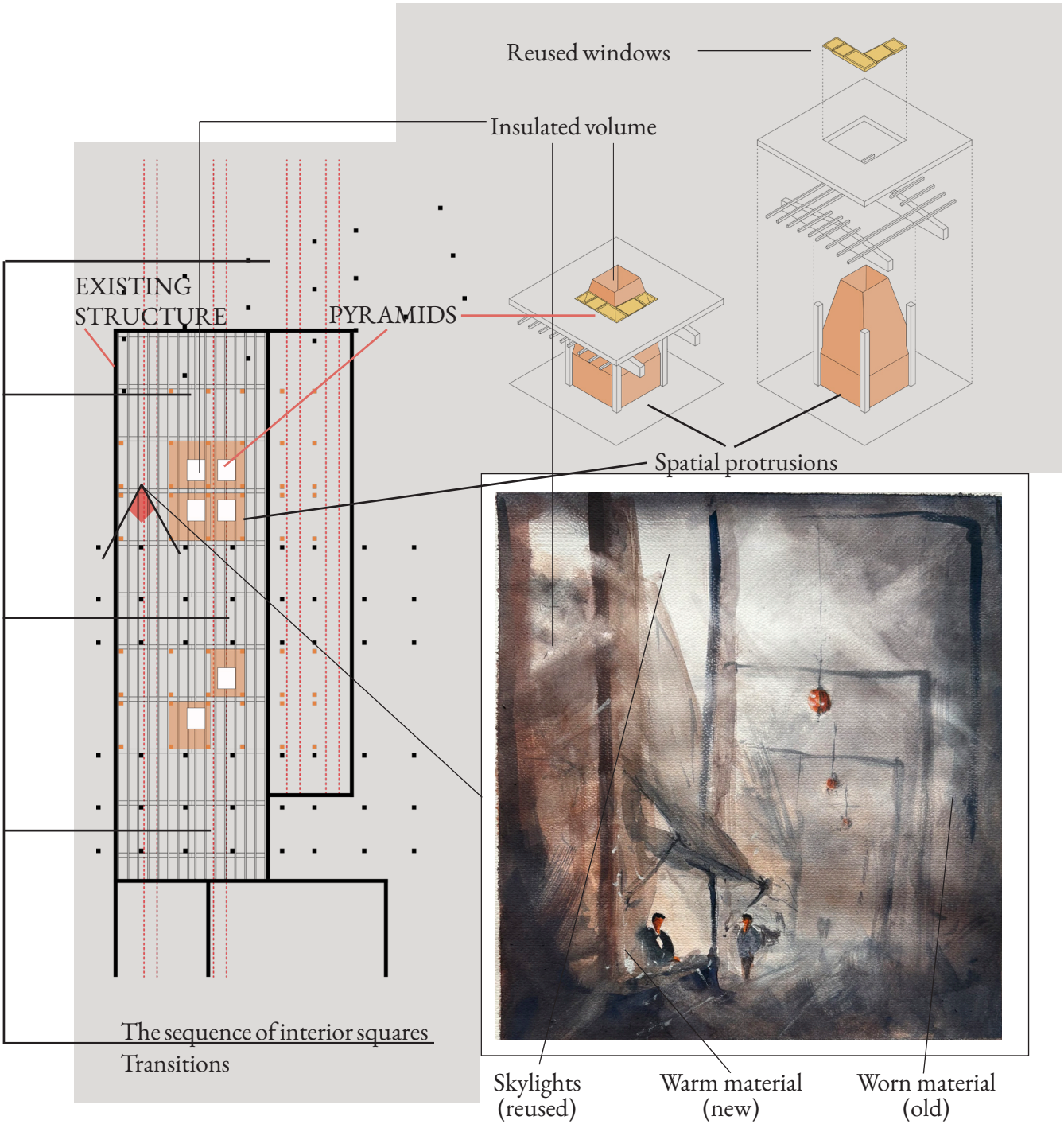
17. Function pictures

18. Function map, 1:5000

Architectural enquiries
This process spread shows the vision of connecting to the city and how it is reflected in the old workshop.

HOW CAN THE SITE BE AN ANCHOR POINT TO DIFFUSE URBAN FLOW INTO THE CITY CENTER?

By connecting the main functions of the city as a sequential flow, a new rhythm emerges in the urban space. This makes it possible to diffuse and anchor the urban movement, allowing the city to be experienced not just as a central point, but as a cohesive sequence of destinations.



HOW CAN SPATIAL TRANSITIONS BE DESIGNED TO ENCOURAGE INTERACTION RATHER THAN SEPARATION?

By working with transitions, a natural rhythm in the movement between spaces arises, rather than perceiving them as separated functions. This strengthens the connection between the new and the existing, and invites people to stay, be present, and engage in community across different functions. This argument applies on multiple levels — both at the building scale, in the relationship between interior spaces, and at the urban scale, where new functions have the potential to complement existing ones.

HOW CAN NEW FACILITIES COMPLEMENT EXISTING ONES?

Architectural enquiries

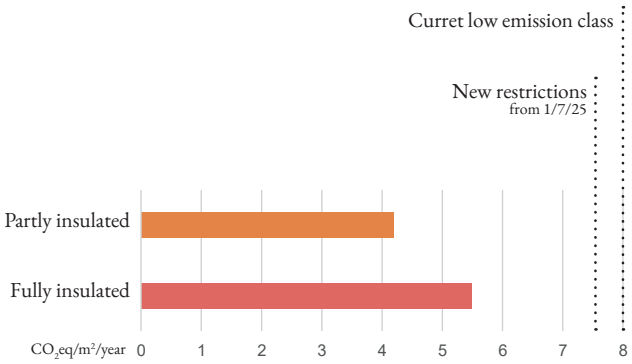
This process spread introduces an LCA study that examines how insulation strategies can reduce the environmental impact of the design.

THE WORKSHOP

This study examines which insulation strategy is most climate-friendly, based on two LCA scenarios: one where the entire workshop is insulated (referred to as 'fully insulated'), and another where only smaller, pyramid-shaped volumes inside the existing structure are insulated (referred to as 'partly insulated').

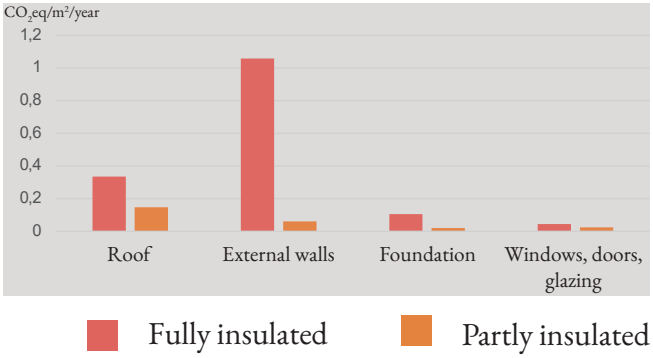
COMPARISON WITH LIMIT VALUES

The pyramid strategy shows a significantly lower GWP than the full insulation scenario, despite the different floor areas. The total floor area for 'workshop' still includes the entire workshop, but with a 50% weighting, as it functions as a passive outer shell for the pyramids.



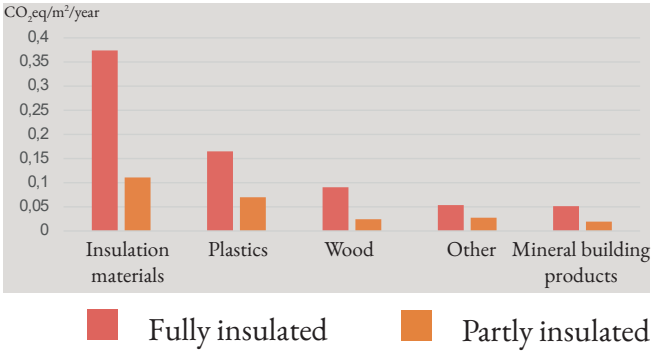
HOTSPOT CONSTRUCTION TYPES

Across all construction categories, the GWP is higher in the full insulation scenario. This is especially true for the external walls, which contribute the most due to a higher wall-to-floor ratio. In contrast, the pyramid volumes have a relatively large roof area compared to their wall-to-floor ratio.



PRIMARY MATERIAL CATEGORIES

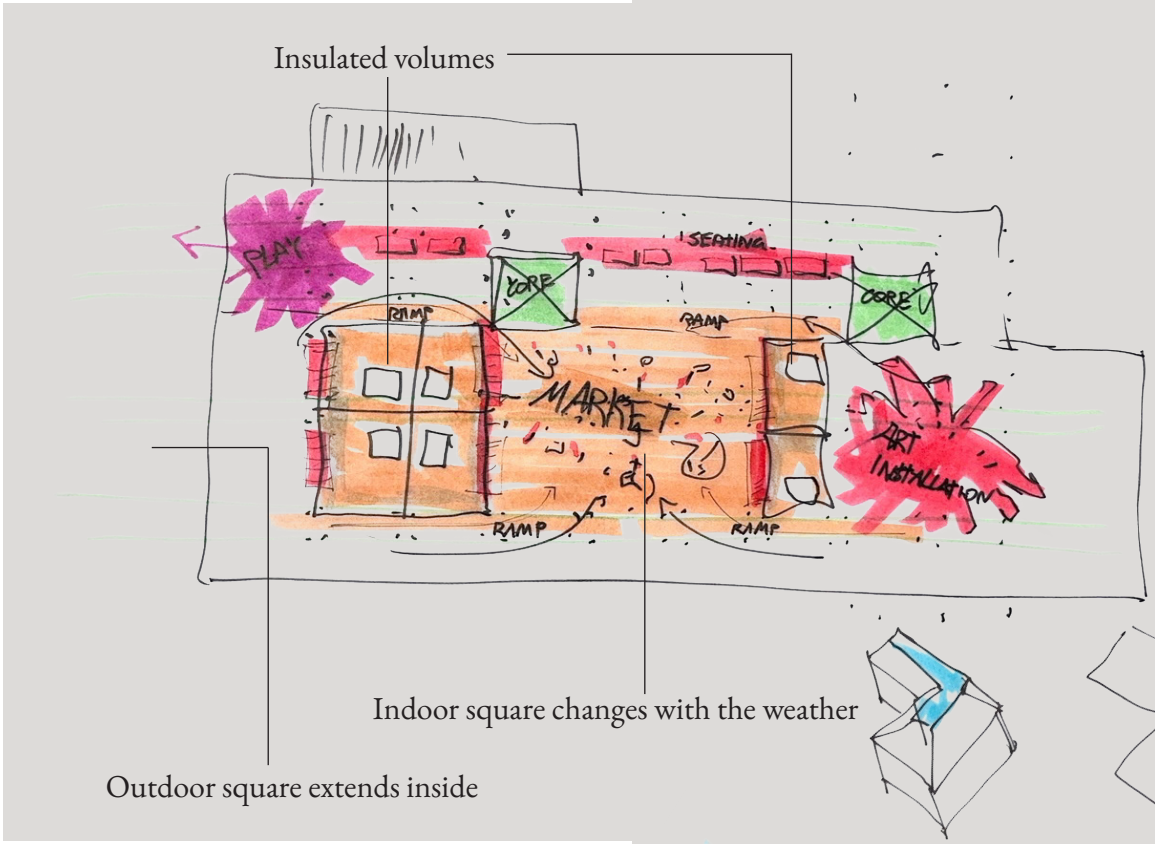
Another important perspective is the material categories. In this comparison, the full insulation strategy results in the highest GWP across all of them. Based on these findings, the pyramid strategy has been selected as the preferred design approach.

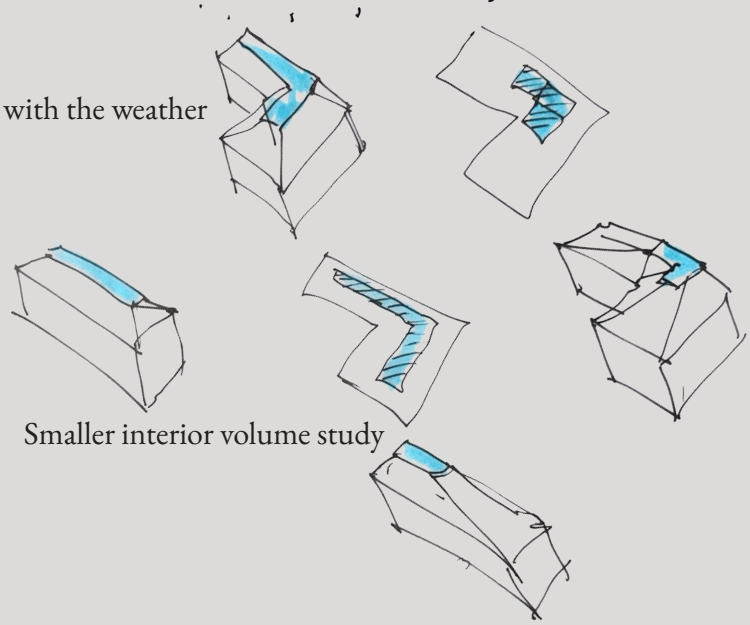


The LCA study shows that a partial insulation strategy—focusing on smaller volumes—is more climate-friendly than fully insulating the entire building. The existing structure is reused as a passive weather screen, preserving its architectural qualities and historical character by minimizing the need for new layers that would otherwise conceal them.

WHEN IS IT MORE SUSTAINABLE TO INSULATE VOLUMES WITHIN SPACE, RATHER THAN THE WHOLE BUILDING ENVELOPE?

By insulating smaller interior volumes instead of the entire building envelope, it is possible to achieve lower CO_2 emissions. The existing structure functions as a passive layer, while the pyramid-shaped interior volumes reduce material consumption and potentially lower energy demand. This approach demonstrates how sustainable solutions can be combined with architectural quality and flexible use.





By placing specific functions in insulated volumes while allowing the open workshop hall to remain a flexible and sensory space, temperature and climate can follow the seasons. This creates atmospheric qualities and allows public outdoor functions to extend inside. It establishes a strong connection between function, experience, and sustainability, while giving the old industrial building a welcoming character.

HOW CAN INDOOR FUNCTIONS MAINTAIN SPATIAL QUALITY WHILE BEING LOCATED IN A NON-INSULATED ENVIRONMENT?

DEMOGRAPHY

Odder Municipal has a clear vision of increasing its population, evidenced by the latest survey which exceeded the prognosis. However, the demographic growth in Odder shows a tendency of an increasing elderly population, while the younger segment is not growing at the same rate. This national challenge, where fewer working citizens are available to support the growing elderly, poses a concern. (Odder Kommune 2023)

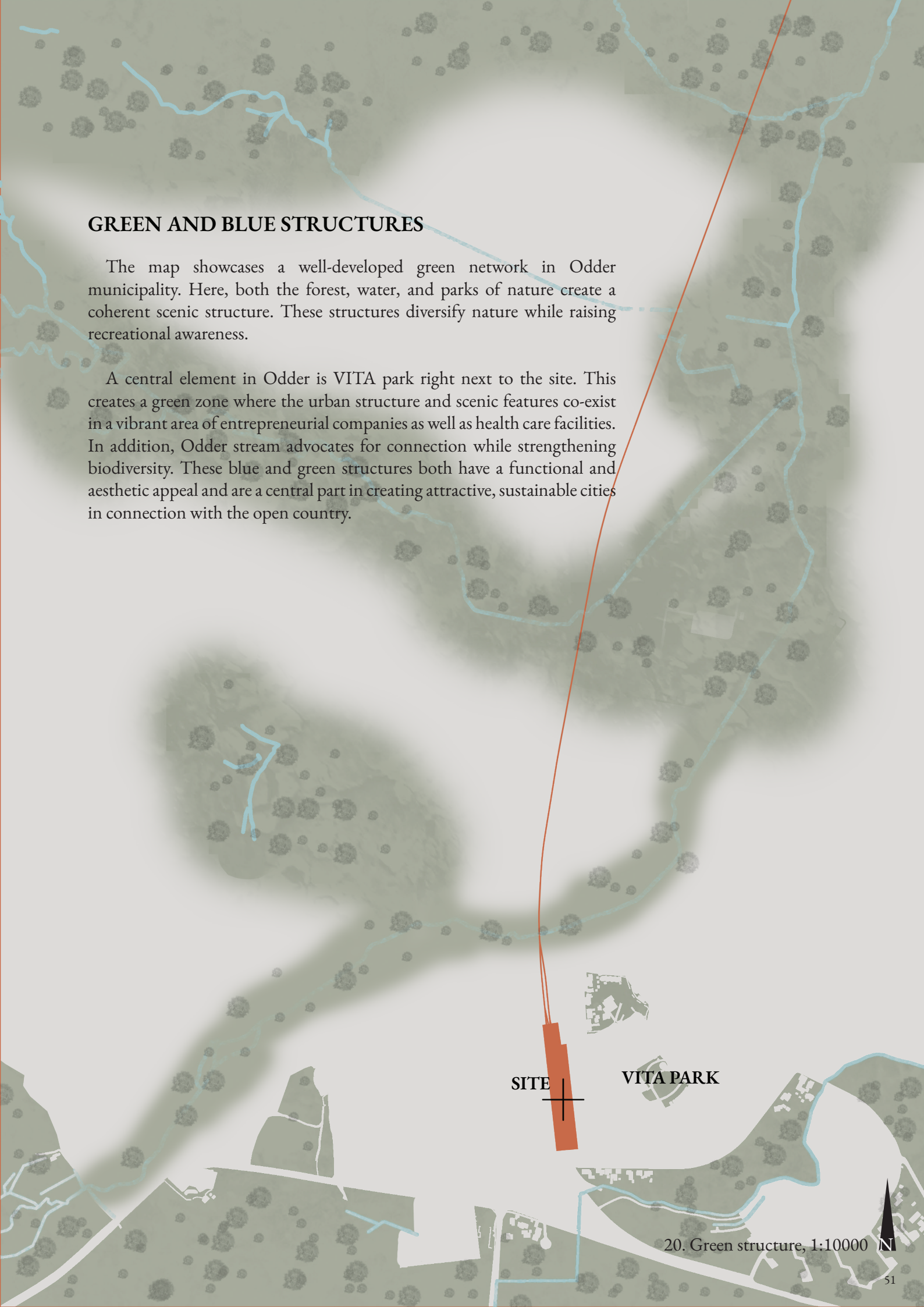
To counter this, Odder municipality works actively to attract more inhabitants through strategic urban development and various housing. The competition of getting new inhabitants with the surrounding municipalities is big, which demands a focus on creating attractive and sustainable residential areas. Odder Municipality therefore directs its attention towards 'liveability' which describes the good, sustainable, and safe life, to attract new citizens and keep existing ones. (Odder Kommune 2023)

19. Demography collage

GREEN AND BLUE STRUCTURES

The map showcases a well-developed green network in Odder municipality. Here, both the forest, water, and parks of nature create a coherent scenic structure. These structures diversify nature while raising recreational awareness.

A central element in Odder is VITA park right next to the site. This creates a green zone where the urban structure and scenic features co-exist in a vibrant area of entrepreneurial companies as well as health care facilities. In addition, Odder stream advocates for connection while strengthening biodiversity. These blue and green structures both have a functional and aesthetic appeal and are a central part in creating attractive, sustainable cities in connection with the open country.



20. Green structure, 1:10000

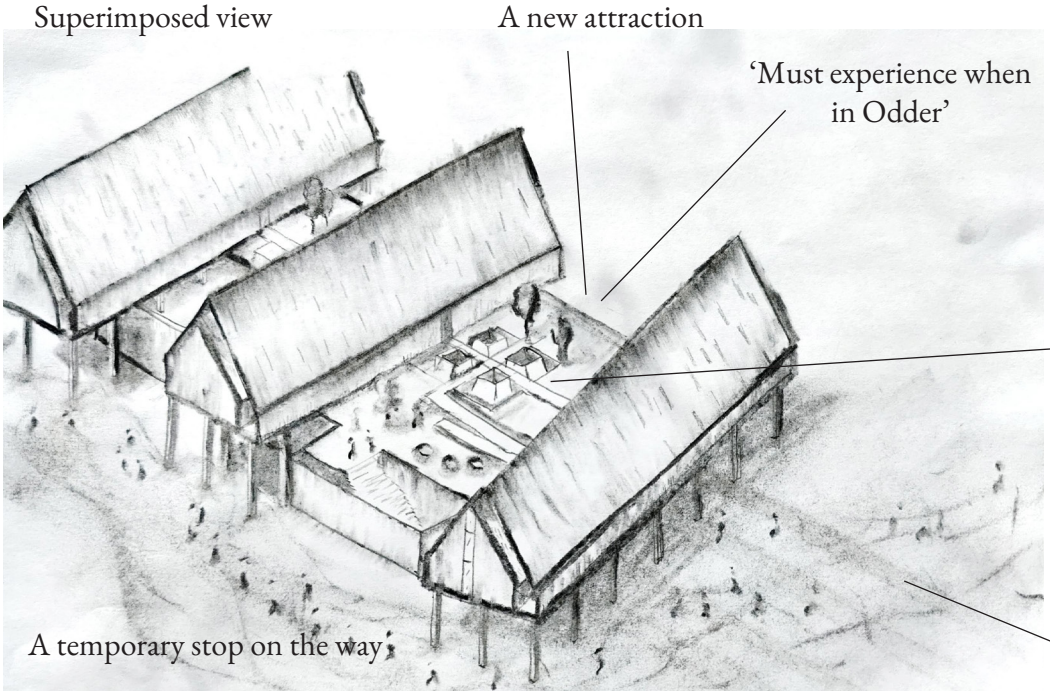
Architectural enquiries

This process spread will show how the design is shaped on behalf of both the city as a whole — striving to be a good city and the individual experience of the people.

Superimposed view

A new attraction

‘Must experience when in Odder’



A temporary stop on the way

HOW CAN ARCHITECTURAL PROGRAMMING CREATE CONTINUITY BETWEEN DAILY ROUTINES AND WELCOME OCCASIONAL VISITORS?

The programming is brought together through a deliberate overlap between everyday facilities and temporary activities. This creates relevance for both residents and visitors. Combined with a new typology in the cityscape, it creates a sense of attraction and destination while connecting locals and newcomers.

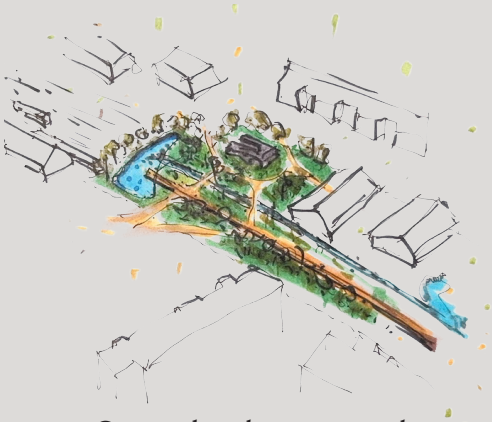
Superimposed with its own identity

Front square

Tracks leading to the interior

Outdoor market

The urban flow seamlessly crosses the plaza

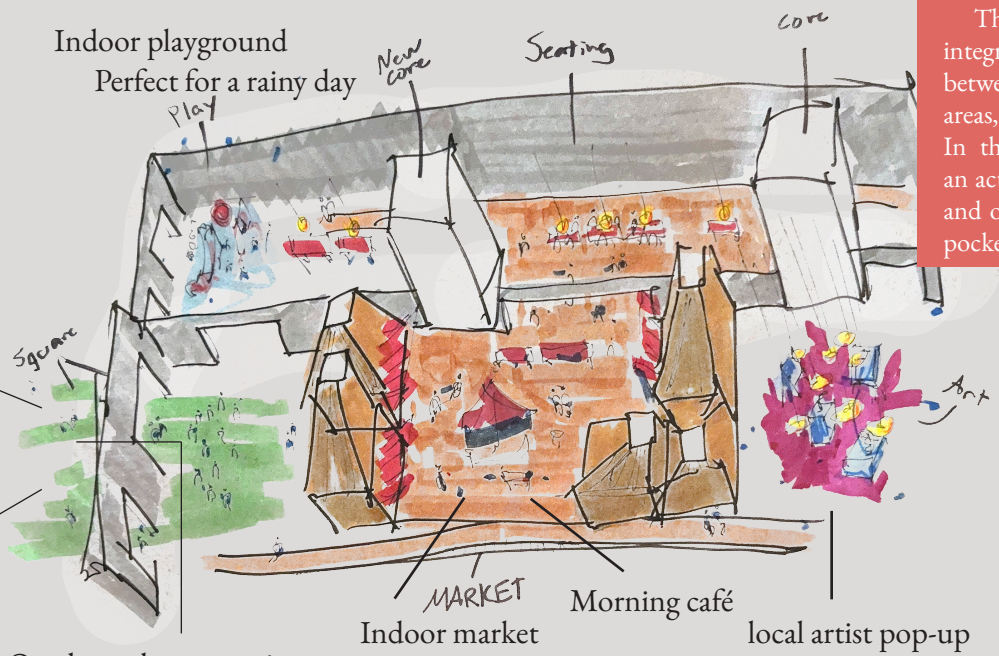


One end with a green park

Superimposed urban space

HOW CAN GREEN SPACES BE INTEGRATED AS ACTIVE AND ACCESSIBLE POCKETS?

The green spaces are integrated into the transitions between residences, urban areas, and public functions. In this way, nature becomes an active agent in everyday life and offers the city small green pockets.

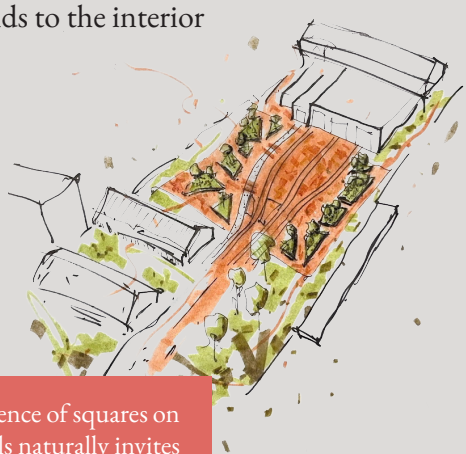


Indoor market

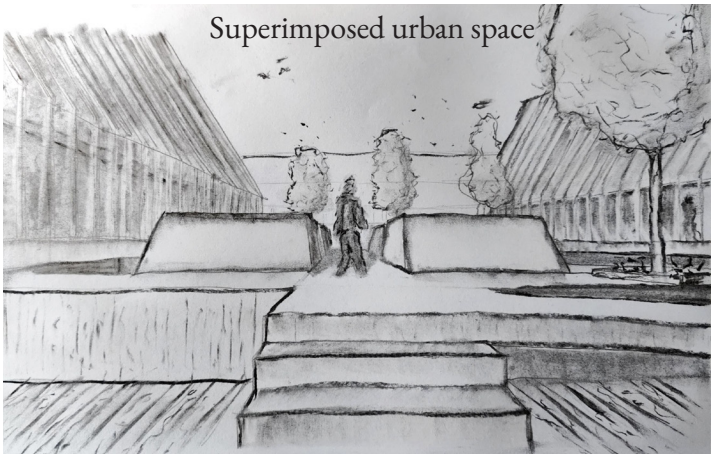
Morning café

local artist pop-up

Outdoor plaza a continuation of the workshop, extends to the interior



Superimposed urban space



This sequence of squares on multiple levels naturally invites people to stay, encourages spontaneous meetings, and softens the barriers between them—activating different types of communities, from everyday encounters to market days and cultural pop-ups.

HOW CAN THE SITE CREATE COMMUNITY AND SOCIAL ACTIVITIES?

Small scale

CONTEXT STUDY

Odder reflects a contrast between new and historic building structures. On the west side of Banegårdsgade, there is more of a tendency to modernize structures characterized by big glass facades, straight lines, and a more open façade. This resembles a newer age of architectural tendencies where light and functionality are prioritized. On the east side of Banegårdsgade, the characteristics are dominated more by a prior architecture where detailed facades, less glazed area, and traditional steep roofing create an intimate atmosphere.

Banegårdsgade is a divider between these parts of town. As the street stitches these neighborhoods together, it also creates a large visual and physical barrier for pedestrians. As a central thoroughfare Banegårdsgade has a central part of connecting infrastructure and can be seen as an indication of the contrast between past and present.

This fusion of architectural periods gives Odder another layer of identity where a balance between growth and preservation is essential to ensure a harmonious city structure.

21. Context collage

SOLAR CONDITIONS

Solar study is an essential tool for design which informs how the sun moves during a specific period. This analysis creates the foundation for making strategic decision on daylight conditions, shadow, thermal load, and energy optimization.

The solar path is mapped on the illustration during key periods as: winter solstice, equinox, and summer solstice. These directions and height of the sun is essential for determining natural daylight and control of shadow, which can affect the design but also the context of the buildings.

Summer solstice

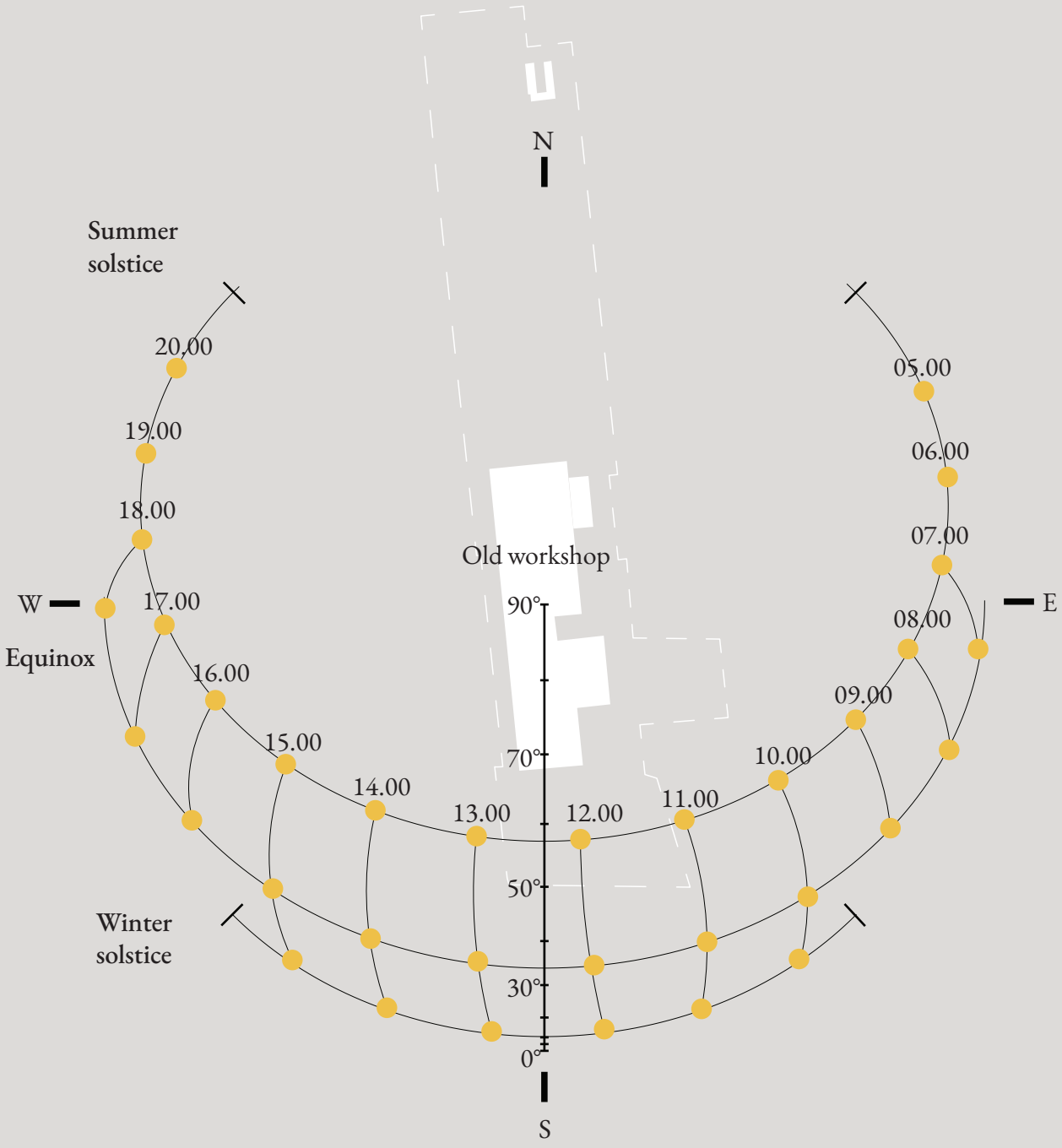
At summer solstice natural daylight stretches from early morning (around 06.00) to late evening (around 19.00). The high angle of the sun has a significant impact on the glazed facade of a design. Southern-facing windows would be impaced by direct heat during most of the day. This heat load could lead to overheating if passive strategies such as overhang and vegetation is not utilized in the design.

Winter solstice

At winter solstice, the path of the sun is much lower than in the summer. This means that the daylight hours are limited as the sun rises at 09.00 and sets before 16.00. These low angles of the sun create a more horizontal direction of the sun, which can be utilized as an advantage to increase thermal impact during colder periods. However, these low sun angles can cause visual discomfort if not addressed properly.

Equinox

At autumn and vernal equinox, the path of the sun is where two extremes meet with around 12 hours of daylight. The light is less sharp than at summer and is more accessible than in the winter. This makes equinox a good reference points to understand the sites average sun conditions throughout the year. It represents a neutral condition where neither sharp shadows nor intense warmth dominates, and thereby creates a balanced reference for spatial planning and comfort.



22. Solar conditions, 1.2000

WIND CONDITIONS

A wind study is an essential part of site-specific assessment regarding architectural and city planning design decisions. On the illustrated wind rose seasonal winds is described through direction and intensity.

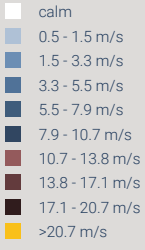
Seasonal wind patterns

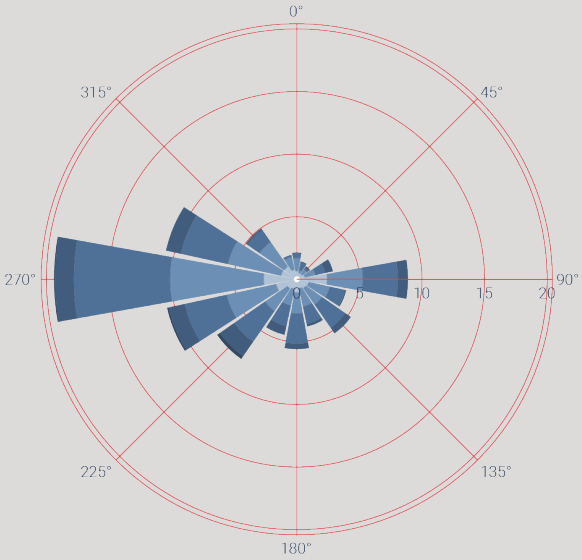
In summer (June-August) the prevailing wind is primarily from the west and north-west with a moderate to strong intensity. This suggests that natural ventilation strategies can be utilized in the design by orienting window opening towards the cooler breeze.

In spring (March-May) the prevailing wind direction stays west yet with an influence from south-west. This transition period illustrates an increased variation in wind speed, which makes decision about exterior conditions in urban areas essential.

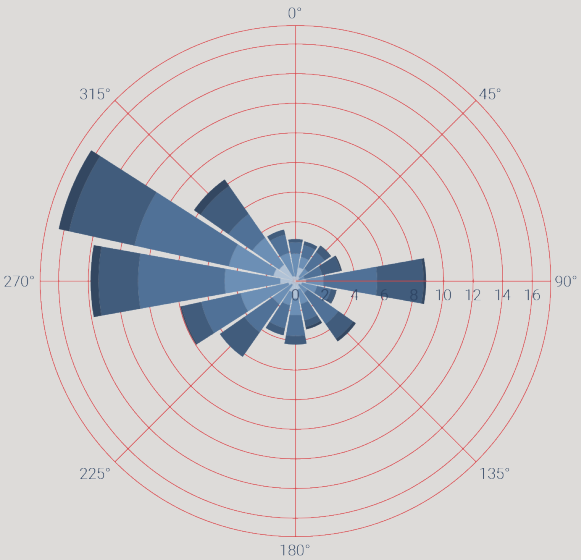
In autumn (September-November) the wind is also mainly from the west. This underlines the need for windbreakers to reduce cooler wind exposure.

In winter (December-February), stronger winds occur, prevailing from the west. This should be minimized through building orientation and landscape elements to mitigate the urban comfort throughout season.

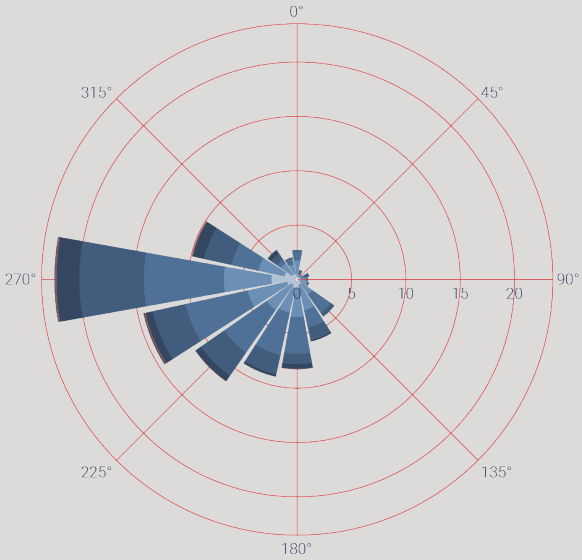




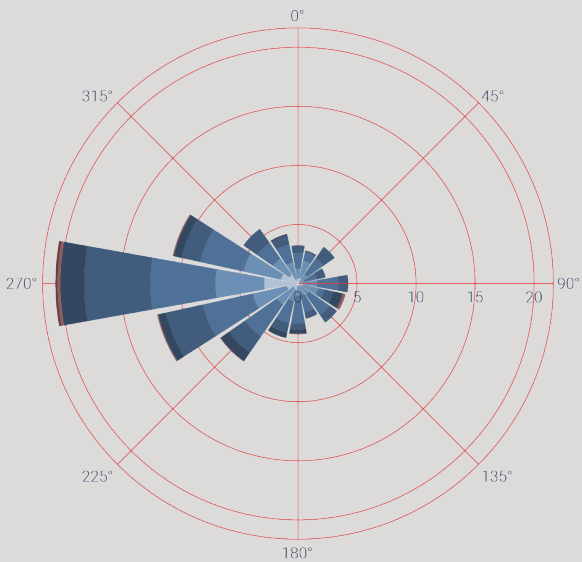
June-August



March-May



September-November



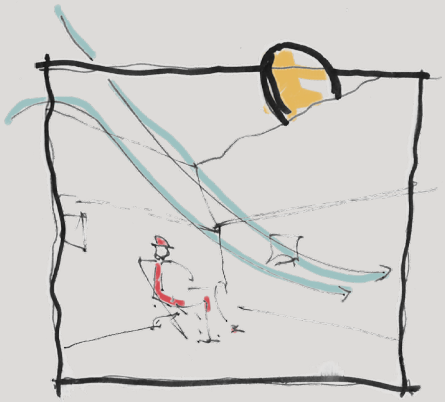
December-February

PASSIVE DESIGN STRATEGIES

Utilizing passive design strategies is a vital element in sustainable buildings. It has the potential to reduce energy demand and increase comfort without the need for excessive mechanical systems by utilizing natural resources like sun, wind, and material properties.

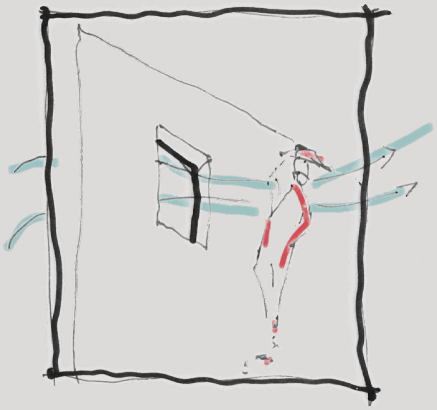
Building orientation and layout

The building's form and layout play a crucial role for energy demand and thermal comfort. Its orientation affects how much sunlight is received and how the wind is utilized. Furthermore, the form also dictates the energy demand, since a compact building optimizes energy efficiency.



Natural ventilation

The placement of openings, windows, and ventilation channels can improve air circulation and reduce the need for mechanical cooling. Cross and stack ventilation are efficient for creating a constant airflow that removes heat and brings fresh air supply. A well thought out solution works with the prevailing wind direction, utilizing it for further efficiency.



Shading control

Effective solar screening can reduce overheating while allowing proper daylight to enter. Overhang, trees, and dynamic shading devices can be used for protection against the high summer sun, while allowing the low winter sun to heat the building.

High performance building envelope

A well-insulated and air-tight building envelope reduces the heat loss between outside and inside. Thermal bridges should be minimized and high performance windows selected. This secures low energy demand by reducing heat losses, reduces moisture-related problems and increases indoor comfort by decreasing temperature asymmetry.

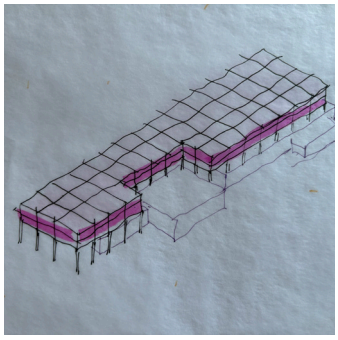
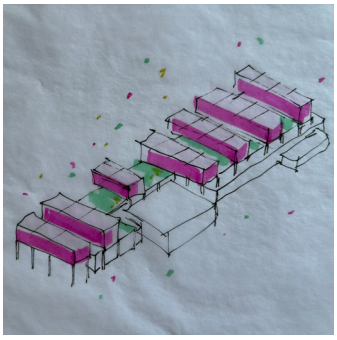
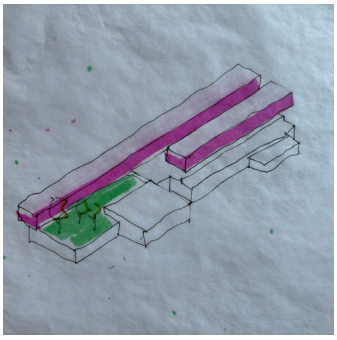
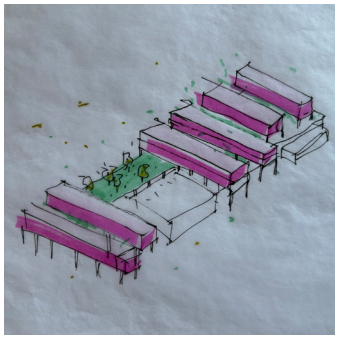
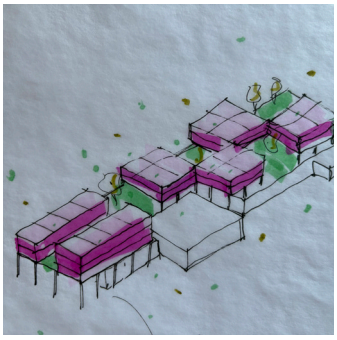
Daylight and windows

Optimal usage of natural daylight reduces artificial lighting needs and improves comfort. Strategic placement of windows and reflective surfaces can lead the light deeper into the building. Northern-facing windows seldom have direct sunlight, providing natural daylight through diffuse sunlight but minimal heat gains, therefore promoting heat losses. South-facing windows are exposed to the direct sunlight, providing heat gains in the winter but at the risk of glare, and a risk of overheating in the summer.

Material properties

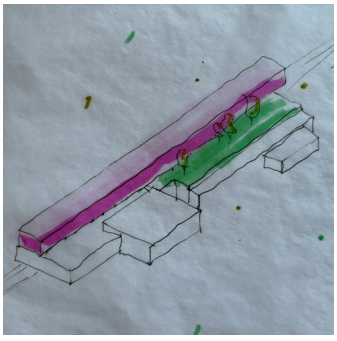
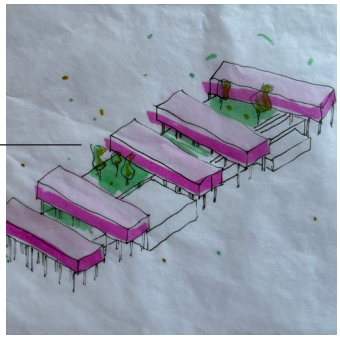
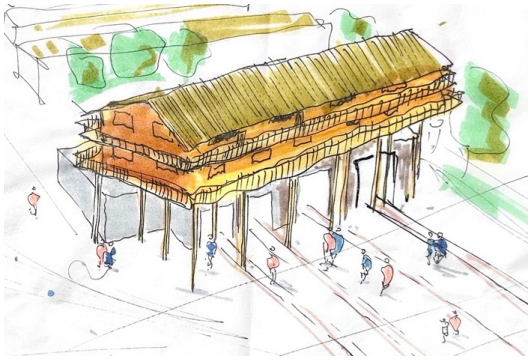
The material choice also plays an important role in regards to the building's passive performance. Besides thermally insulating properties, the materials also have the ability to store and release heat and moisture through their heat and moisture capacities, ensuring a more stabilized indoor climate.

Architectural enquiries
This process spread will justify the overall shape of the volume, while also exploring the detailing of this form and its interior programming.

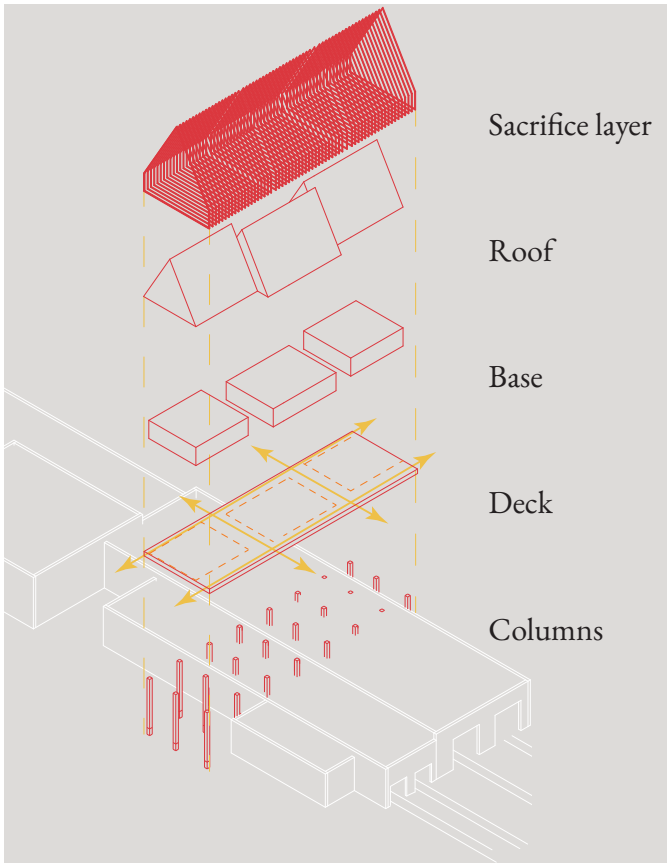






The form is placed across the old workshop form to create a contrast to the existing. This highlights the idea of a new typology without erasing the old workshop's identity. The spaces between create sunny spaces and potential for outdoor quality. However, a challenge lies in the wind conditions from west to east.

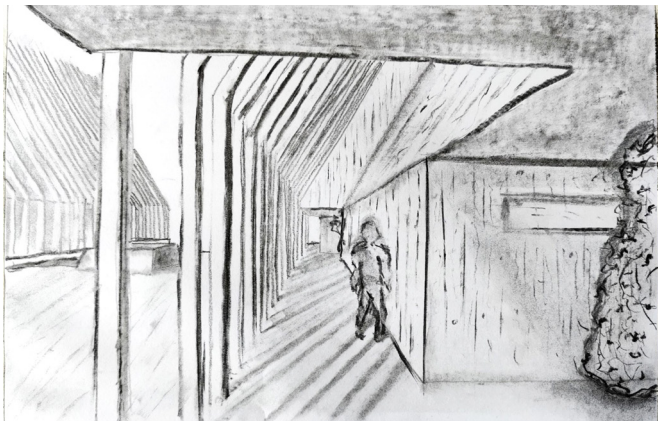
A pitched roof is chosen to create harmony with the context. The roof shape also supports the use of biobased materials and allows for efficient rainwater drainage, making it both technically and aesthetically anchored in place. This form is not final but marks an important step in the design process.

HOW CAN SEASONAL CONDITIONS INFORM SPATIAL LAYOUT AND COMFORT STRATEGIES?



The entrance space



The exterior veranda

At first, the concept of a sacrificial layer was developed to protect bio-based materials, but it instead became more focused on providing weather protection. The columns primarily act as windbreaker and solar shading, while also creating an atmospheric space that forms the superimposed transitions.

CAN WIND BREAKERS AND SHIELDING BE A NATURAL IMPLEMENTATION TO SUPPORT COMFORT?

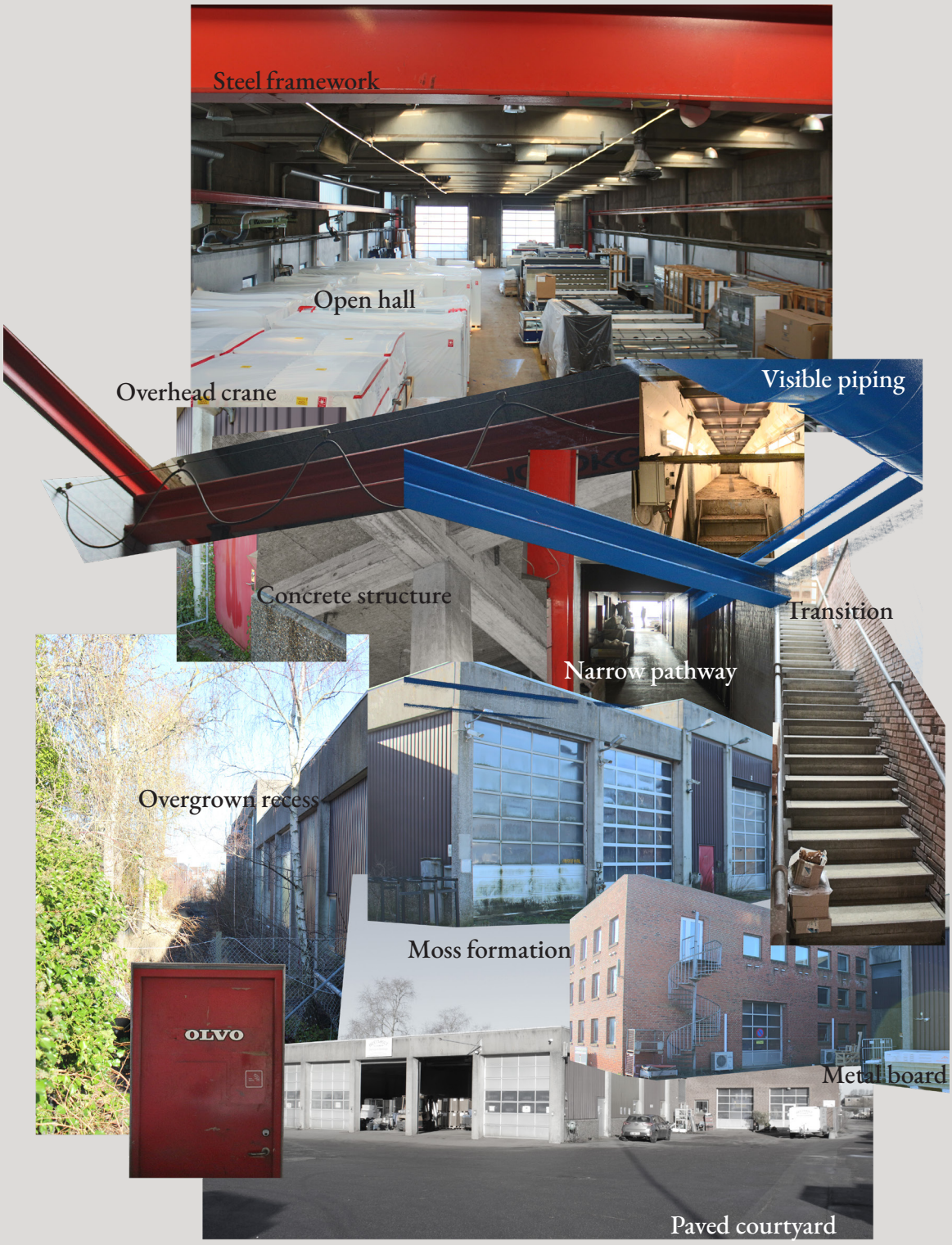
HOW CAN COMPACT DESIGN AND PASSIVE STRATEGIES REDUCE ENERGY DEMAND WHILE ENHANCING INDOOR COMFORT?

BUILDING ANALYSIS

The old workshop is a robust industrial building with a clear trail to its history as a workshop for repair and maintenance of trains. The building consists of a structural concrete frame, where the walls and roofs are made from a combination of concrete, metal panels, and masonry. The loadbearing concrete beams and columns create large open spaces, which gives flexibility in the reuse of the building.

The exterior has an industrial expression with its metal framed large gates. Furthermore, the facades show clear signs of aging, where some sections have moss formation, rust, or flaking of materials. Surrounding areas are partly overgrown, which also indicates that the whole site has not been actively used for a long time.

The interior rooms have varied shapes from tall and open to narrow small pathways, enabling diverse usage of the building. The ceiling has acoustic panels with visible ventilation pipes, old cranes, and crane rails. The floor features built-in rail tracks, which all show the previous use of heavy machinery and railway-related work. The building has a potential in conserving these industrial elements as a part of the building's new identity.



25. Collage of building elements

THE SITE ON FOOT

This analysis illustrates a fictitious route, as the area is currently not publicly accessible. The route is a movement through the site from Vita Park to the shopping street, highlighting the visual and spatial experiences encountered along the way.

(1) The journey starts at road connecting VITA park and the site. It continues toward the old railway workshop, which serves as a landmark at the end of the road.

(2) The next sequence follows the route along the workshop building where the movement flows through a valley-like passage between the apartments on the right and the industrial building on the left. The shifting building structure interacts with the flow of the route, creating a dynamic spatial experience.

(3) Passing the old workshop, the area opens up, revealing the former station functions in the landscape. Masts and wires surround the sky and old rail tracks leave their mark on the ground, accentuating the historical and current infrastructural usage.

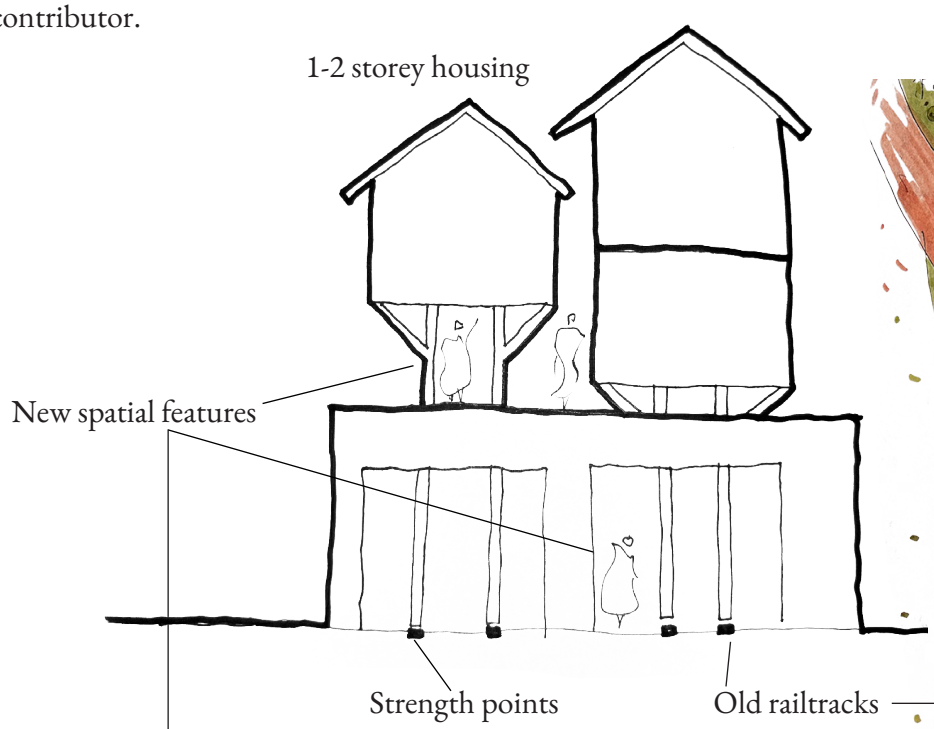
(4) Moving further toward the city center, the Danske Bank building continues to stand out in the cityscape. Its contrasted crown, defined by its black roof and white attic, makes it a noticeable element in the skyline, even when there is a high concentration of busses occupying the sightline.

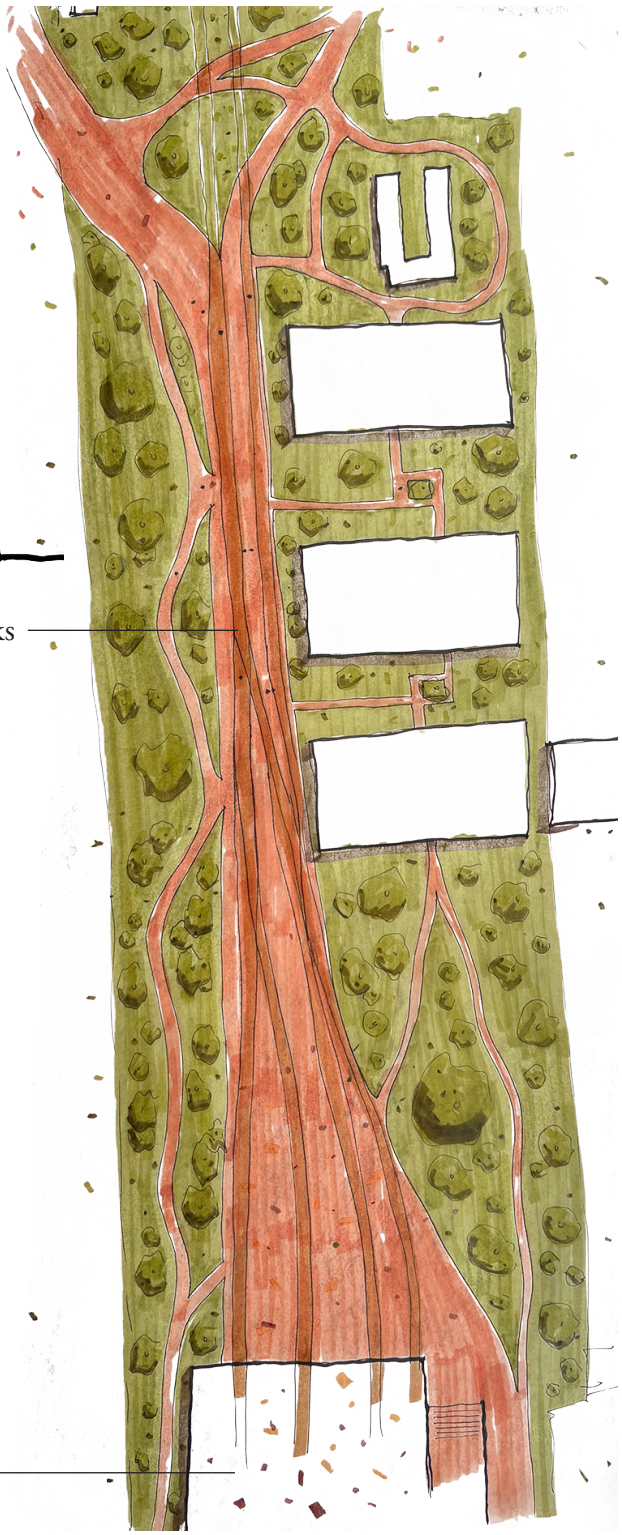
(5) Past the bus station, one must cross Banegårdsgade after which the city center gradually reveals itself. The street leads towards the town sqaure where the distant corner buildings rise above and break the skyline with their spires.

26.Fictive route through the site

Architectural enquiries

This process spread show how existing structures can guide the design with the old rail tracks serving as the primary contributor.





The existing rail tracks form the structural foundation for the new superimposed volumes, serving as natural strength points for the construction. This also creates new spatial features within the old workshop, where new columns intersect with the existing structure and stand in contrast. In the field, the rail tracks continue to guide the design by becoming the main pathway across the site—bridging past and future mobility.

New columns

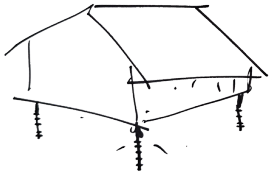
HOW CAN EXISTING STRUCTURES INFORM NEW SPATIAL STRATEGIES AND REDUCE ENVIRONMENTAL IMPACT?

THE SUPERIMPOSED

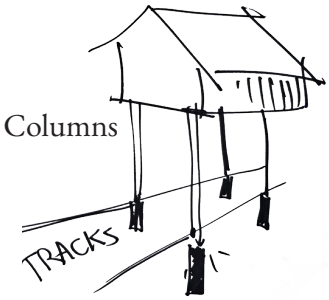
To evaluate the foundation strategy-specifically in relation to building on top of the existing structure - an LCA study was conducted. The aim is to quantify the potential CO_2 savings from utilizing the existing concrete compared to constructing a new foundation.

One scenario involves introducing a new screw pile foundation, while the other focuses on reusing the existing concrete foundation, requiring only a small amount of steel. However, this approach also includes large wooden columns to reach the superimposed height, in contrast to placing buildings directly on the ground using screw foundations.

The study focuses solely on the building's connection to the ground, excluding the floor deck.



Screw pile foundation



Reusing existing concrete

FOUNDATION COMPARISON

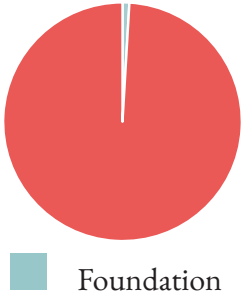
Though the foundation for the superimposed structure would require nearly 15 tons of wood, it still results in a lower environmental impact compared to using a steel screw pile foundation. This ground connection minimizes the use of new, non-biobased materials. However, the strategy cannot be applied throughout the entire site due to the need for densification. Therefore, the final approach will be a mix of utilizing the existing concrete foundation and introducing new screw pile foundations where necessary.

The LCA study shows that reusing the existing concrete foundation significantly reduces CO_2 emissions. By minimizing the need for new materials and utilizing what is already in place, a more sustainable solution is achieved. This demonstrates that building superimposed presents a valuable opportunity to reduce material usage.

UTILIZING EXISTING FOUNDATION

Wood: 14,600 kg
Steel: 300 kg

GWP: 0.07 CO_2 eq / m^2 pr year



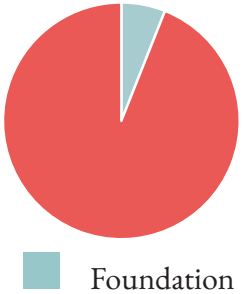
Foundation

0.93% OF THE GWP RESTRICTIONS FROM 1/7/2025

SOLELY SCREW PILE FOUNDATION

Steel: 4,950 kg

GWP: 0.48 CO_2 eq / m^2 pr year

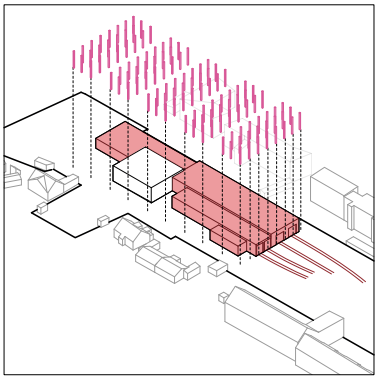


Foundation

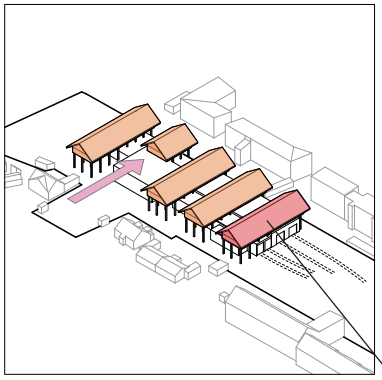
6.40% OF THE GWP RESTRICTIONS FROM 1/7/2025

Architectural enquiries

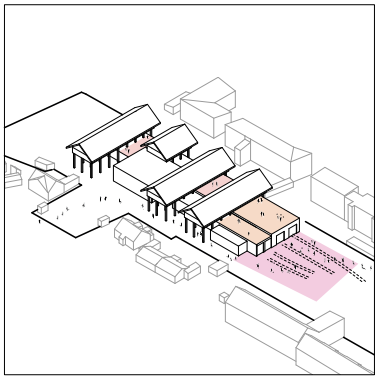
This spread shows how the building volume can strengthen the identity of the place and create new spatial qualities.



A new column storm on rail tracks



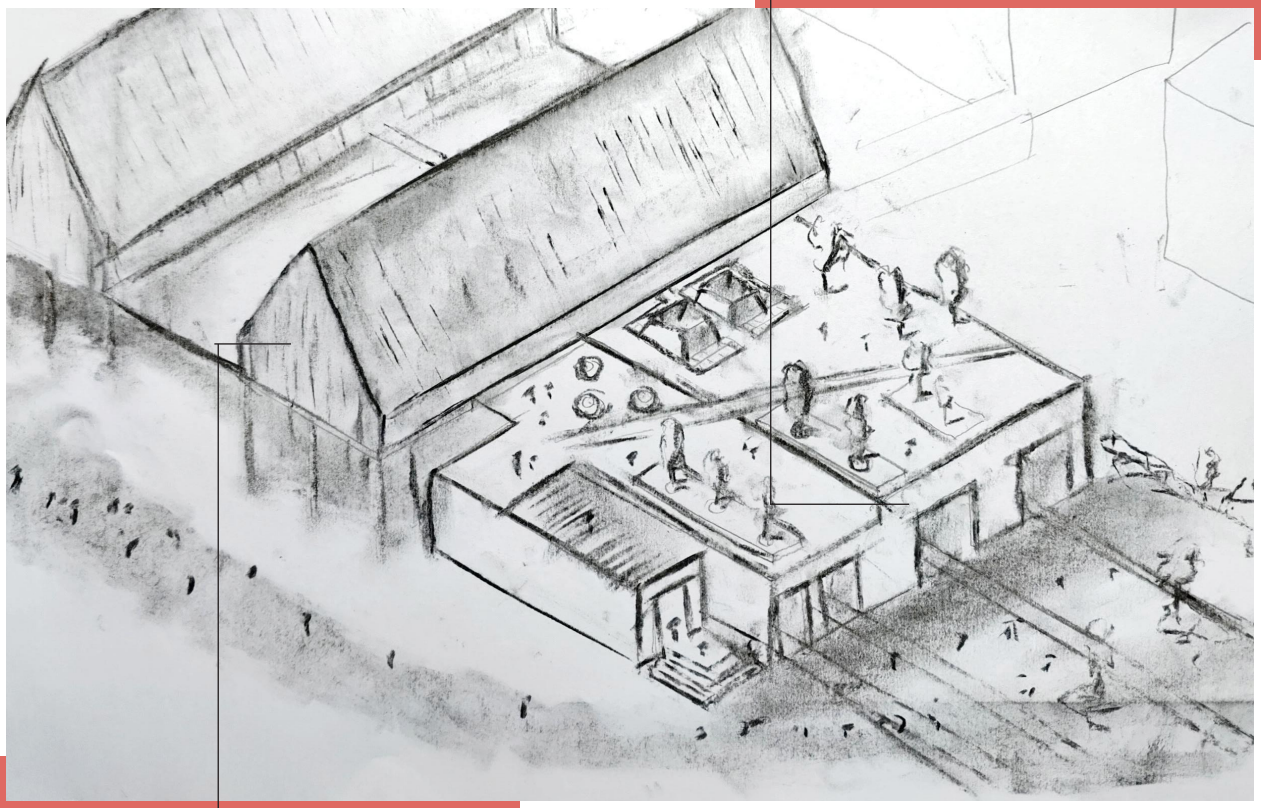
Removed outer volume



Urban life on multiple levels

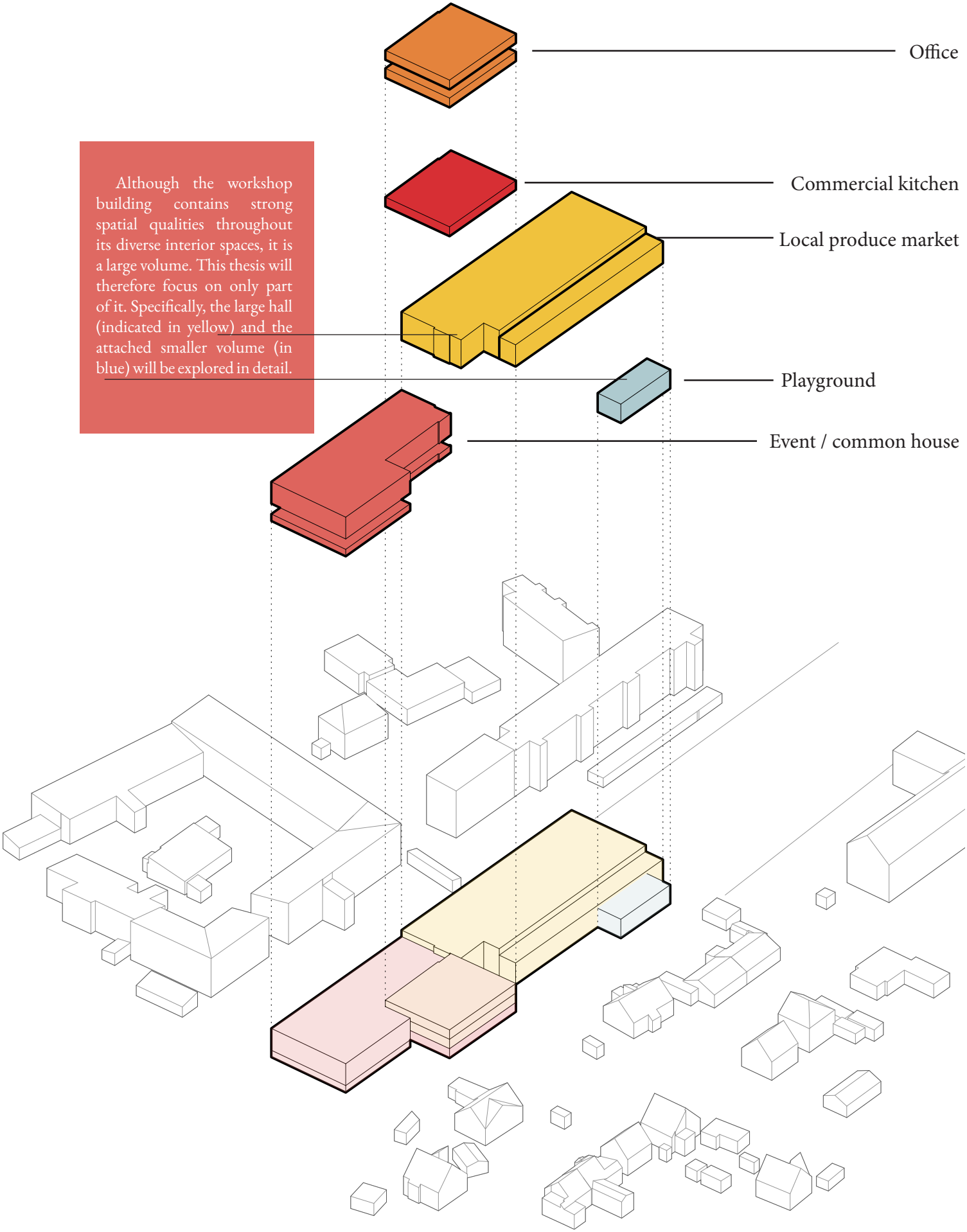
HOW CAN THE APPROACH TO THE SITE ENHANCE THE URBAN EXPERIENCE AND SUPPORT THE IDENTITY OF THE PLACE?

The outer superimposed volume is removed to accentuate the form of the existing building. The workshop now becomes the façade toward the city, an open and inviting structure that connects the outside with the inside, where the rail tracks extend and serve as anchor points for the columns.



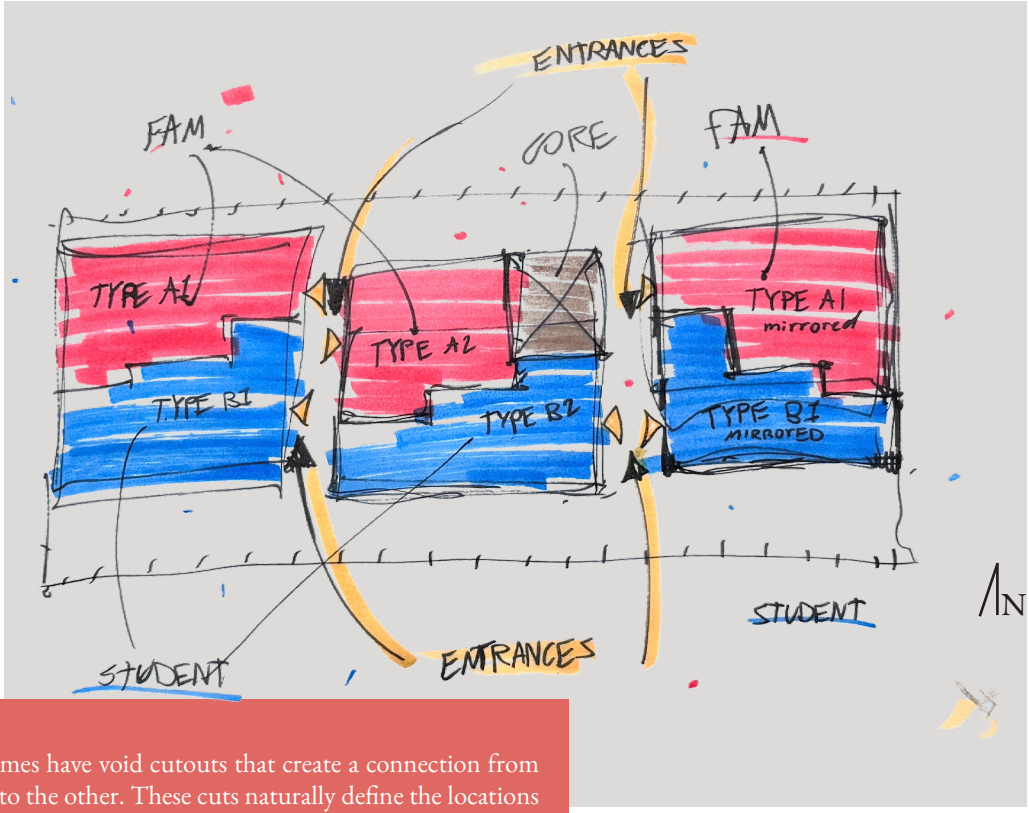
The removed volume improves the view of the city, while the residential volumes create a backrest for the superimposed urban space. Elevating people with a view over the city makes the building feel modest and gives the impression of complementing the city.

HOW CAN VERTICAL SEPARATION IMPROVE SPATIAL QUALITY?

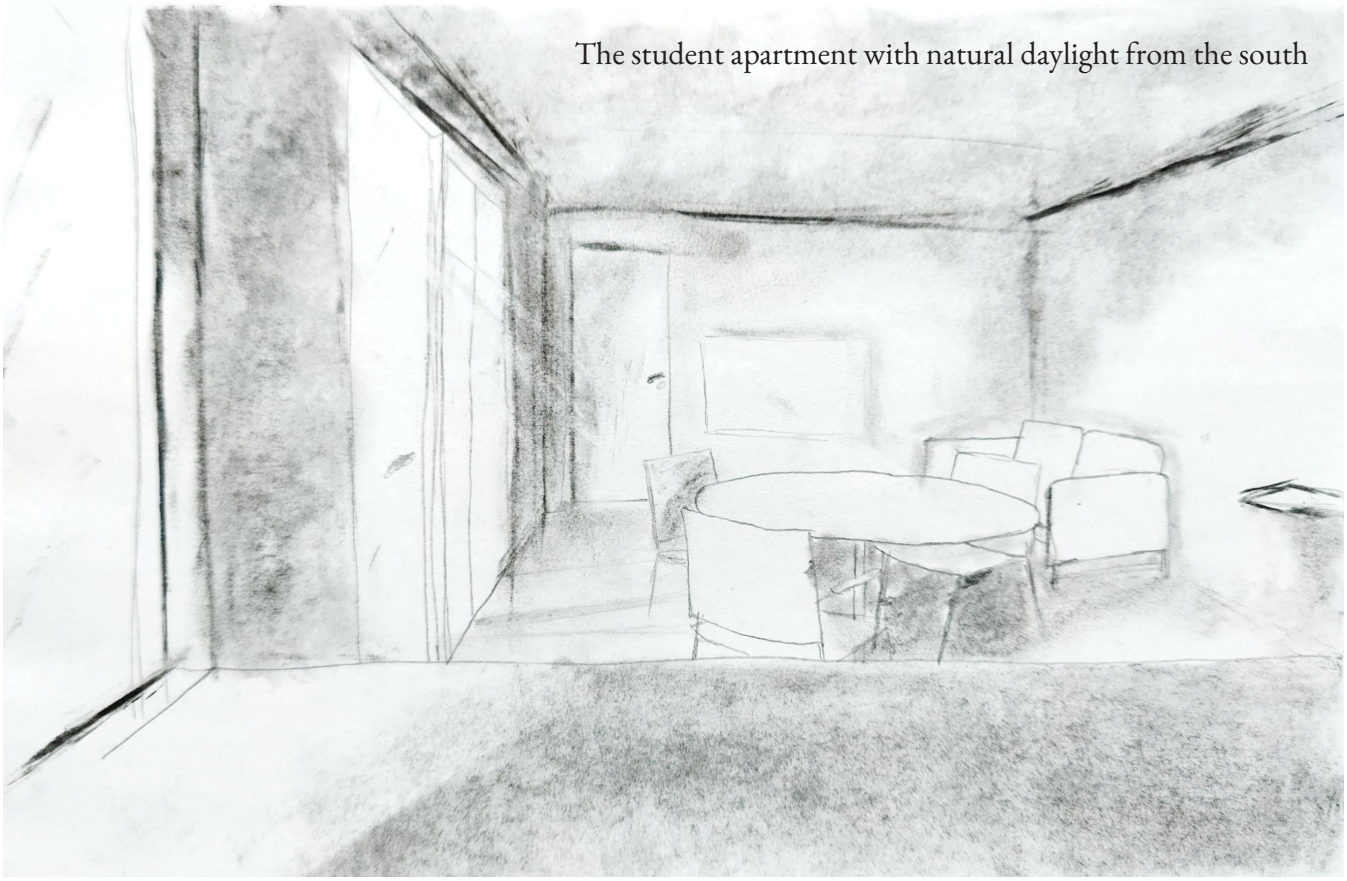


Although the workshop building contains strong spatial qualities throughout its diverse interior spaces, it is a large volume. This thesis will therefore focus on only part of it. Specifically, the large hall (indicated in yellow) and the attached smaller volume (in blue) will be explored in detail.

Architectural enquiries
This spread shows the detailing process of the apartment.

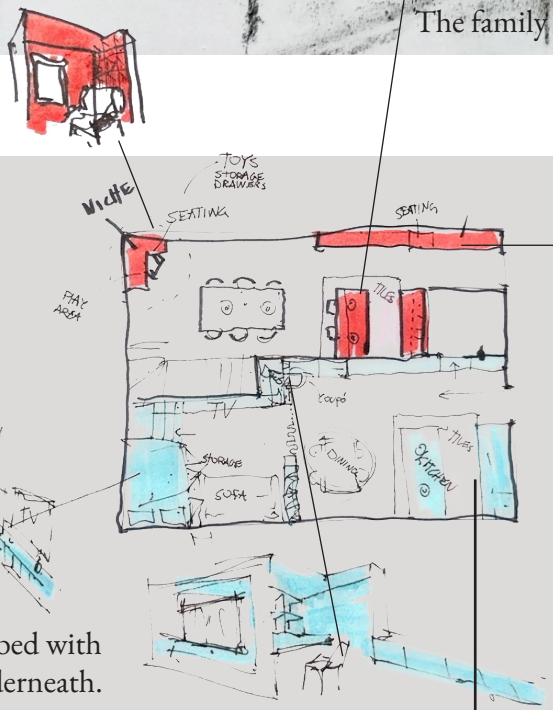


The apartment volumes have void cutouts that create a connection from one side of the volume to the other. These cuts naturally define the locations for the entrances. As a result, the apartments are divided into northern-facing family apartments and southern-facing student apartments. This layout requires the family apartments to have skylight windows on the southern roof in order to receive sufficient daylight. The family apartment therefore features a double-height space to draw in southern light from above.



The student apartment with natural daylight from the south

The family apartment with skylights in the double-height room.



Integrated bed with storage underneath.

Integrated entrance furniture

The interior concept revolves around an integrated furniture element that is present in both apartment types. It explores variations in color and material to create distinct atmospheres, while simultaneously tying the settlement together.

Material exploration in the kitchen.

Case studies

ODDER MILL COTTAGE

Odder mill cottage (1883) stands as an example of traditional building practices and today functions as a local history archive (Odder Museum, n.d.). It showcases how former practice were adapted to both the climate and the use of materials' natural capabilities. This case, however, presents certain challenges that may be relevant for modern building methods.

Building practice and climate adaptaton

One of the more characteristic features of the Mill Cottage is the use of thatched roofing. This type of roofing utilizes overhangs, which reduces the risk of moisture complications (Andersen, 2017). This strategy is an example of climate adaptation where the building design and choice of materials plays a key role in reducing the need for repair and maintenance.

Another important strategy that is not applied in this case, but can be found in similar historical building, is the sacrificial layer. The sacrificial layers, typically applied externally, are allowed to perish to protect larger, functional elements of the design. (Realdania, 2021)

The cottage presents some technical issues, wuch as a low base made of wooden materials. This leads to issues regarding moisture from the ground and splashes from rain. The overhang does decrease the fall velocity of the rain, which minimizes the amount and height of the splash onto the facade. However, the use of capillary breaking layers and elevated foundations used in modern building practice serves as a vital strategy for protecting organic materials and mitigating damage, as illustrated by the example of Odder mill cottage.

Relevance on modern biobased building practice

The techniques used on the mill cottage have some relevance in modern, sustainable buildings. Thatched roofs and wooden cladding are examples of how materials with a small carbon footprint can contribute to durable buildings. There is currently an unrealized potential in the Danish building industry to utilize biobased materials such as straw, clay and wood in modern building practices, all-the-while maintaining aesthetic expressions and long life spans. (Realdania, 2021)

Yet it is crucial to adapt these methods with considerations towards present day climate and regulatory demands. A low foundation, as presented on the mill cottage, can be problematic in a climate with increased precipitation. A solution today could be to elevate the volume onto higher terrain or on a larger base, while using today's insights into the moisture properties of the building materials placed close to the terrain. (Realdania, 2021) It is also important to make use of the possibility of selective replacement (sacrifice) of materials by protecting the remaining surrounding materials.

28. Collage of the old cottage

ROSKILDE FESTIVAL FOLK HIGH SCHOOL / MVRDV + COBE

Roskilde Festival Folk High School is located at Musicon in Roskilde, utilizing an existing structure at a former concrete factory. The project is a great example of modern practicepractice, where investing in recycling, community, and aesthetics is a growing platform centered around sustainability. The high school functions both as an educational institution but also as a platform for social and cultural interactions. These elements demonstrate how a modern building can adapt to the climate crisis while abiding current building requirements.

Building practice and climate adaptaton

A central element of Roskilde Festival Folk High School is the use of recycled materials from the former concrete factory and the festival grounds. The use of these materials reduces the environmental impact significantly. An example is the use of old containers and bricks from the festival, that have been collected and repurposed in the project (ArchDaily, 2019). This choice is both practical and an aesthetic strategy to underline and promote circularity.

While the design does not directly introduce passive strategies such as overhang or a sacrifice materials, the project is influenced by high flexibility and openness, which allows for natural ventilation and well-lit areas. The big common area and transparent surfaces enable a place for social gatherings and thereby support the school philosophy. A possible challenge is that the building is in a former industrial area with sloping terrains and significant ground moisture. Therefore, it is important to design a heightened base and integrate water collection as a part of climate adaptation.

Relevance on modern building practice

This project showcases how modern architecture can incorporate sustainable principles without compromising on aesthetics and functionality. Recycled materials and a flexible plan extend the building's lifespan through future adaptation and renewability. The project is an example of how modern design can build on top of historic volumes without imitating past principles. Instead, the design should draw on principles of material understanding, local adaptation, and maintenance strategies. A focus on robust and changeable elements should be prioritized, as well as the choice of biobased and/or recycled materialssuch as wood and repurposed bricks.

29. Collage of Roskilde Festival Folk High School
Credits: Rasmus Hjortshøj, COAST (appendix 5)

Delimitations

DESIGN DRIVERS

ARCHITECTURE AS AN URBAN CATALYST

The design should complement existing functions and support current activities in Odder, while creating new possibilities for community interaction and social gatherings. By establishing a strong anchor point in the city centre, the project aims to optimize the flow through the city. Subsequently, the new development should strengthen the identity of the city and unite historic elements with future needs.

EVERYDAY LIFE AS A GENERATOR

The design should be based on the people who use the place and the different ways everyday life is lived. It should embrace both the informal and the organized, and accommodate various user groups. Architecture becomes the shared space that grounds the city's daily routines.

ASSEMBLAGE AS DESIGN STRATEGY

The project should revolve around understanding the place as a cohesive whole — where people, materials, and surroundings are interwoven. It should act as a connection between existing structures, new programming, and contextual qualities, while respecting both historical and contemporary needs.

DESIGN GOALS

THE DESIGN MUST

STRENGTHEN PEDESTRIAN CONNECTIONS between the old railway workshop and the city center through a mixed-use program that integrates housing, markets, and cultural heritage.

IMPLEMENT BIOBASED MATERIALS, such as straw and timber, in a contemporary building manner while respecting the industrial heritage of the site.

UTILIZE PASSIVE DESIGN STRATEGIES including solar heat gain, roof overhangs, natural ventilation, and a high-performance building envelope with adaptable building materials.

ADAPT THE OLD RAILWAY WORKSHOP with adaptable biobased interventions and flexible functions to meet Odder's evolving urban needs.

REINFORCE ODDER'S LOCAL IDENTITY by merging the industrial legacy of the railway workshop with contemporary biobased construction.

INCLUDE MODULAR, ADAPTABLE SPACES in terms of functionality, structural systems, and material aesthetics.

CREATE A DIALOGUE BETWEEN CONSERVATION AND INNOVATION by preserving the old railway workshop's identity and integrating contemporary additions.

DEVELOP A SEQUENCE OF SQUARES such as market places, open plazas, and green areas to encourage interaction between users.

CON-

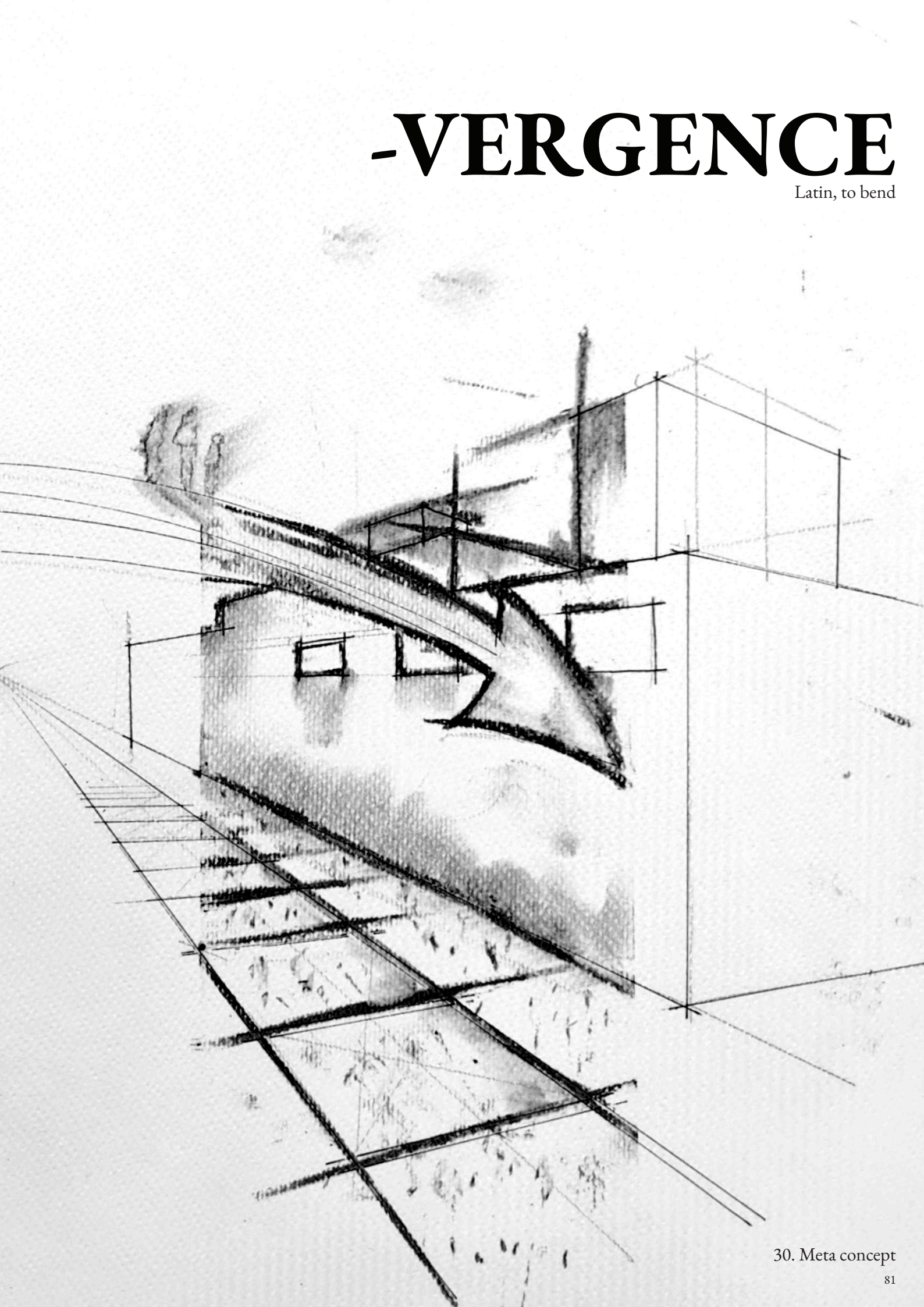
Latin, together

The task of architecture is not only to create something new, but also to heal what already exists - to connect, tie together, and strengthen what has been scattered and forgotten.

The concept of CONVERGENCE is about bridging time and place; the past and the future, the fragmented and the whole, the analog and the digital. This meta concept defines the overall approach of the project — preserving the spirit of the place, by weaving together existing structures, human patterns, and future needs.

-VERGENCE

Latin, to bend



30. Meta concept

Function

The site is divided into three main categories to align with the vision. The first is the field, which will serve as a green urban space. The second is the warehouse, where new functions will be incorporated into the existing structure. Lastly, residential housing will occupy both the superimposed volume as well as the field.

THE FIELD - AN URBAN POCKET

At one end of the site, the project opens up as a green public space, where elements like varied pathways, urban nature, and squares are integrated. Together with the surrounding residential buildings and their courtyards, the field offers easy access to parking.

THE WORKSHOP - A NEW COMMUNITY ANCHOR

The old railway workshop is transformed into both dwellings and new multifunctional spaces. One end of the workshop opens up to the public, while the other is kept semi-public for residents and those with an errand. The primary public function is the local produce market, which includes a sheltered play area and seating for stay. Furthermore, the workshop hosts its own indoor square as a continuation of the outdoor.

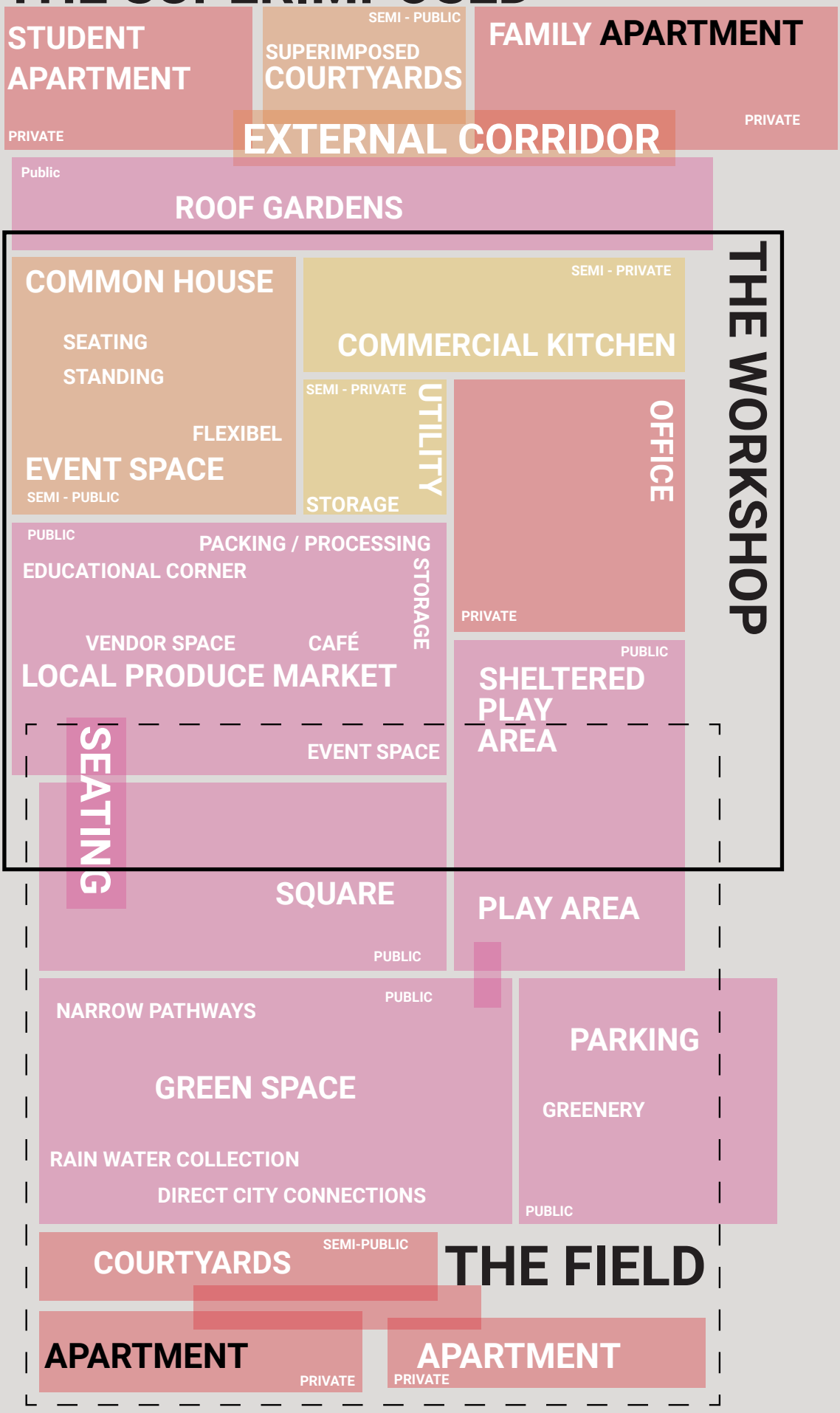
THE SUPERIMPOSED - A NEW TYPOLOGY

A new space on top of the old workshop is created to house residences and new public functions. The residential area is supplemented with semi-public courtyards, and all superimposed functions are connected by external corridors.

A DYNAMIC INTERPLAY

The project deliberately works with programmatic overlaps, where functions merge and create natural transitions between public and private spaces. This mix encourages informal meetings and creates a rhythm between events and daily routines.

THE SUPERIMPOSED



The whole settlement

Function	Construction type	Units [-]	Area pr unit [m²]	Area total [m²]
Event / common house	Transformation	1	900	900
Local produce market	Transformation	1	1460	1460
Office	Transformation	2	475	950
Trust shop	Transformation	1	130	130
Commercial kitchen	Transformation	1	475	475
Utility	Transformation	1	275	275
Student	New construction	24	42	1008
Medium family house	New construction	24	98	2352

Local produce market ≈ 1460 m²

Room	Area [m²]	Thermal requirement	Functional requirements	Atmosphere	
Vendor space	150	Insulated	Selling booths	Lively, dynamic, airy	
Cold storage	30	Insulated	Refrigerated section	Col, sterile, controlled, clean, fresh	
Regular storage	50	Uninsulated	Shelving	Neutral, organized, practical, quiet	
Waste management	30	Uninsulated	Composting, recycling	Functional, controlled,	
Market plateau	315	Uninsulated	Preparation of products	Efficient, clean, productive, comfortable	
Sample station	30	Uninsulated	Try fresh produce	Interactive, welcoming,, sensory rish	
Seating	50	Uninsulated	Food court to enjoy meals	Relaxed, communal, social	
Art installation area	140	Uninsulated	Sustainable information	Engaging, inspiring, informative	
Children's area	50	Uninsulated	Interactive education	Playful, colorful, safe, bright	
Entrance area	215	Uninsulated	Functional, guiding	Playfull, social, leading	
Circulation area	400	Uninsulated	Functional, safe	Leading, functional, controlled	

Room program

The room program is first presented in a general context outlining the primary functions. Afterwards, selected functions are developed further in a more detailed room program. The highlighted functions include the local produce market within the existing structure, as well as family apartment and student apartment placed superimposed on the old workshop.

	Lighting [lux]	Occupancy [no. people]	Acoustics	Air change (cf. BR18) [l/s pr. m²]
	300-700	35	High noise control	0.3
	-	2-5	Low noise control	1.0
	-	5-10	Low noise control	0.3
	150-300	2-5	Moderate noise control	2.0
	300-500	70	Moderate noise control	2.0
	300-500	10	Moderate noise control	0.3
	200-500	25	Moderate noise control	0.3
	300-500	20	Moderate noise control	0.3
	300-500	15	High noise control	0.3
	200-500	50	Moderate noise control	0.3
	300-500	100	Moderate noise control	0.3

Family apartment ≈ 98 m²

Room	Area [m²]	Ceiling height [m]	Functional requirements	Atmosphere	
Dining area	28	3.0	Social space, seating	Warm, inviting, cozy, soft, lively	
Kitchen	9	2.8	Cooking, dining, storage	Bright, airy, fresh	
Living space	26	2.7	Sleeping, closet space	Calm, cozy, restful	
Bedroom 1	11	2.7	Sleeping, study, storage	Adaptable, playful	
Bedroom 2	8	2.7	Sleeping, office, storage	Adaptable, practical	
Office	4.5	2.7	Working, focused	Practical, calm	
Bathroom	10	2.5	Shower, sink, toilet	Refreshing, compact	
Entrance	4	2.5	Transition, storage	Welcoming, practical	

Student apartment ≈ 42 m²

Room	Area [m²]	Ceiling height [m]	Functional requirements	Atmosphere	
Living space	10	3.0	Social space, seating, sleeping	Calm, comforting	
Kitchen	9	2.8	Cooking, dining, storage	Efficient, accessible	
Dining area	18	2.7	Working, dining, storage	Tranquil, relaxed, accessible	
Bathroom	4.5	2.7	Shower, sink, toilet	Refreshing, safe	

	Lighting [lux]	Thermal comfort/max temp. [°C]	Occupancy [no. people]	User profile [time of day]	Air change (cf. BR18) [varies]
	100-300	26 - moderate comfort	2-4	Midday	0.30 l/s pr. m²
	300-500	27 - active use tolerated	2-4	Morning, evening	20 l/s
	100-300	26 - comfortable for rest	2-4	Evening	0.30 l/s pr. m²
	100-300	26 - comfortable for rest	1-2	Evening	0.30 l/s pr. m²
	100-300	26 - comfortable for rest	1	Evening	0.30 l/s pr. m²
	100-300	26 - moderate comfort	1-2	Midday, evening	0.30 l/s pr. m²
	100-250	28 - short and humid use	1-2	Morning, evening	15 l/s
	100-200	26 - moderate comfort	2-4	Sporadic	0.30 l/s pr. m²

	Lighting [lux]	Thermal comfort/max temp. [°C]	Occupancy [no. people]	User profile [time of day]	Air change (cf. BR18) [varies]
	100-300	26 - comfortable for rest	1-2	Evening	0.30 l/s pr. m²
	300-500	27 - active use tolerated	1-2	Morning, evening	20 l/s
	100-300	26 - moderate comfort	1-2	Midday	0.30 l/s pr. m²
	100-250	28 - short and humid use	1-2	Morning, evening	15 l/s

31. Pakhuset

Chapter 04: Presentation

The new anchor point

The connections are now opened, and Remisen becomes a crucial piece in completing the urban puzzle. It makes walking effortless in Odder and closes the circle of urban anchor points in the city. At the same time, it welcomes visitors arriving by car, offering panoramic parking opportunities and establishing itself as an alternative to Aarhus' facilities - a destination for tourists to explore a different atmosphere. The generous street following the old train tracks acts as a stepping stone from one urban function to another. All the while, Remisen maintains its own personality, its own functions, and a unique historical identity.

The proposal has been given the title Remisen as a direct reference to the historical identity of the site as a former railway workshop. The word "remise" traditionally describes a building used for storing and maintaining trains, trams, and other vehicles. In this project, the name reflects the preserved narrative of transformation - from industry to community. Remisen therefore represents not just a physical structure, but a connection between past functions and future opportunities through REuse. It becomes a place where the existing forms the foundation for new life, new connections, and new communities.

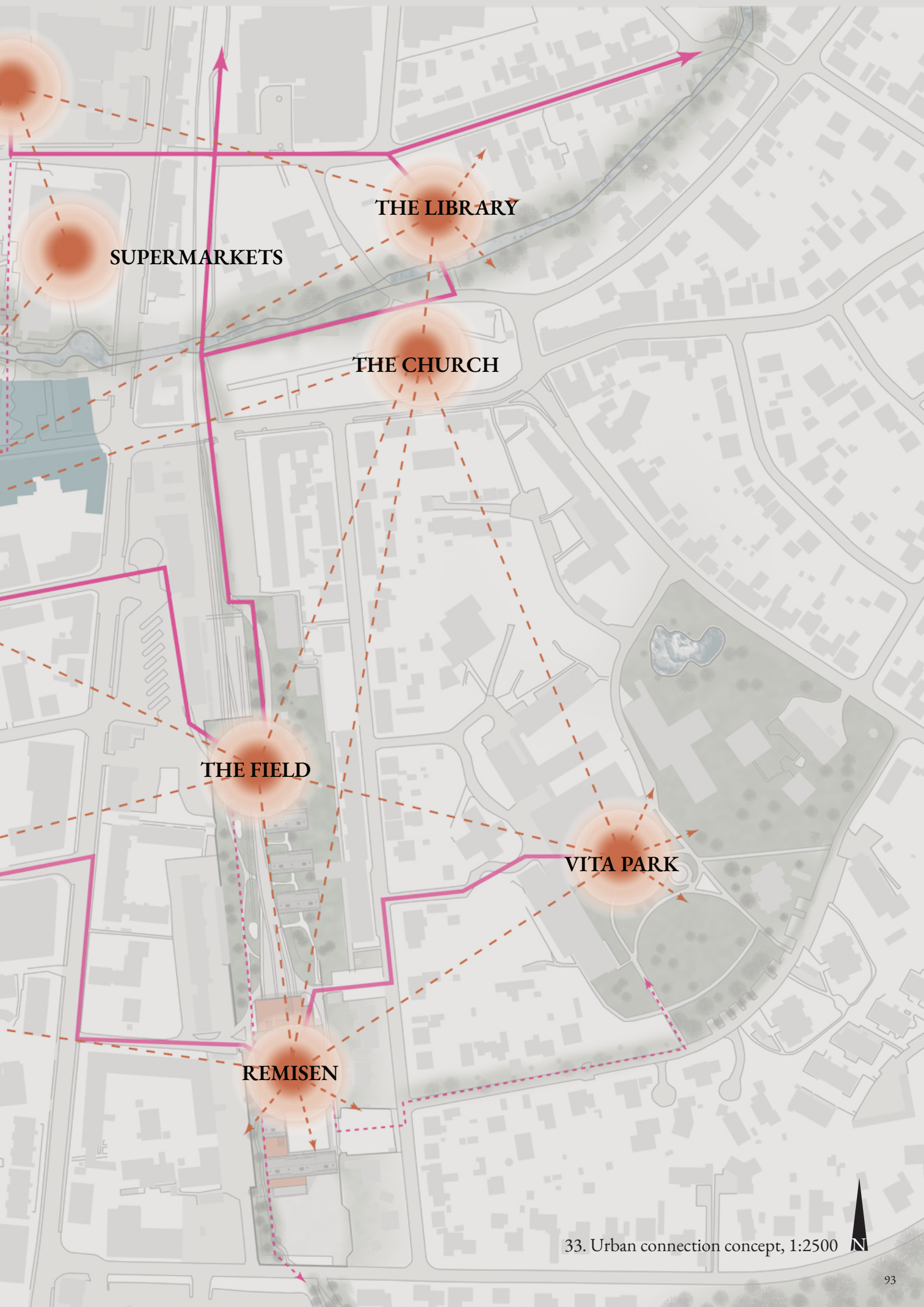
32. The field


REMISEN

LARGE SCALE

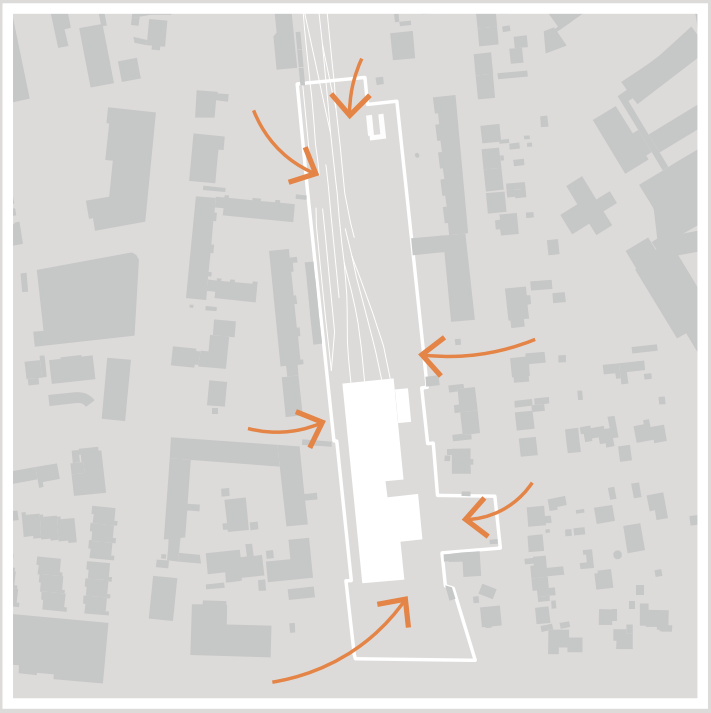
Introducing the large-scale showcases how Remisen becomes a crucial part in connecting the city across Banegårdsgade. The field now becomes a connector between the town square and the historic neighbourhood, enhancing functions such as the Library, VITA park, and the new workshop. It enables a continuous stroll where all aspects of the city can be experienced.

The following section is a presentation of how the design proposal intertwines these connections and the urban fabric while preserving the existing industrial structure. Here, an overall concept - the masterplan - and urban renders are presented as we move towards a more detailed understanding of the project.

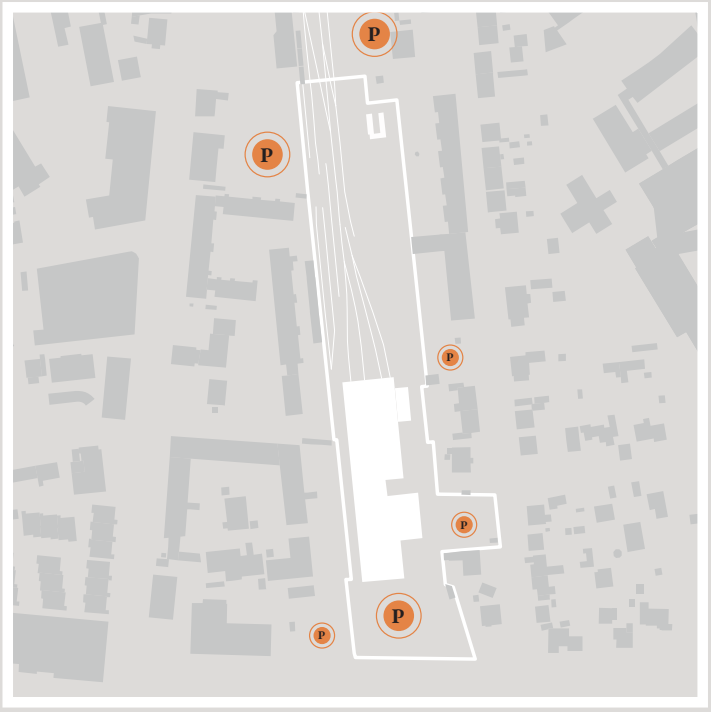


33. Urban connection concept, 1:2500

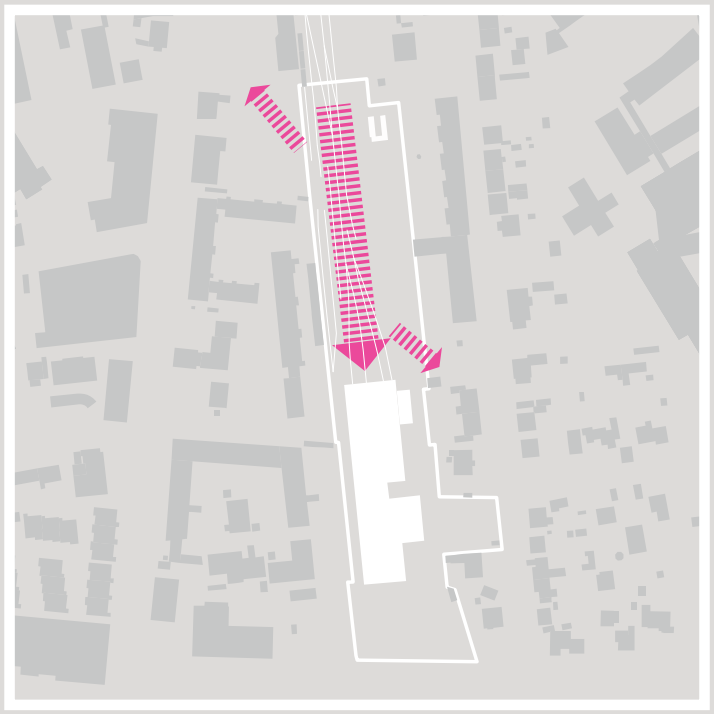
URBAN CONCEPT



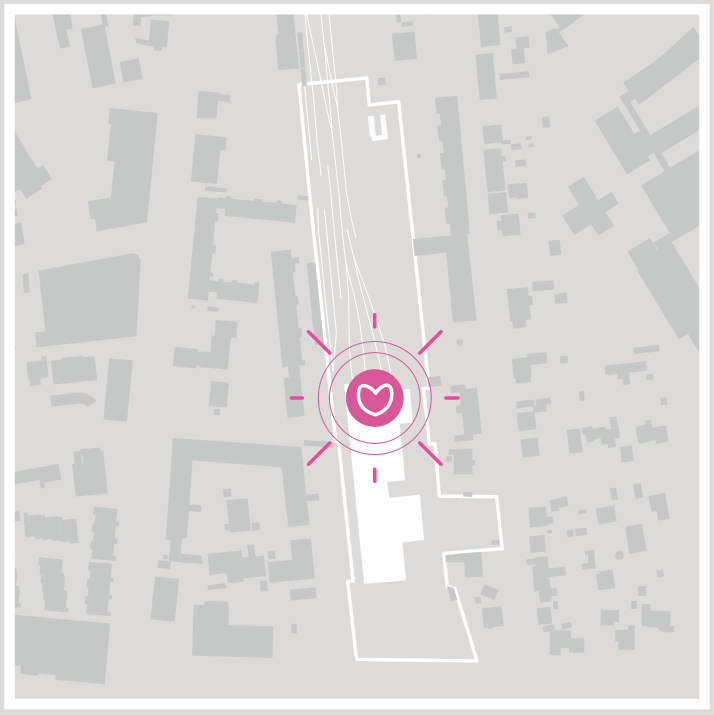
01 Connections to Remisen



02 Surrounding parking areas



03 A new connection with the workshop as a focal point in the city scape



04 A new space is created to meet, stroll, learn, shop, and appreciate the city and community.

CONTEXT MASTERPLAN

The importance lies in creating a landmark without breaking the scale. The superimposed volume must reach upward while remaining connected to the cityscape. Surrounding the site are existing multistory apartment buildings, and further east, a hill with smaller residences. The radical superimposed concept is downscaled in its expression, acting as a mediator between the two typologies and anchoring it within the city of Odder.

35. Context masterplan 1:2500

36. The view from adjacent residential areas.

The project shows its importance within the urban fabric yet maintains a modest presence. The simple form, familiar within the city, rises to a superimposed height, although not detached from the urban scale. Remisen stands as a place of curiosity and storytelling, achieved by carefully utilizing what is already present.

37. The view from Banegårdsgade

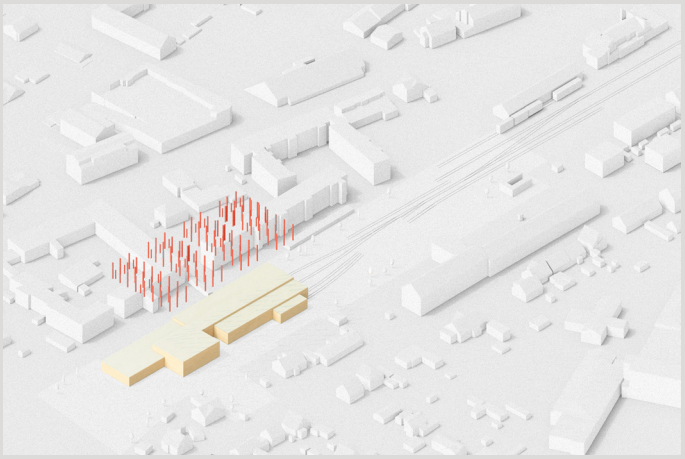
By connecting the urban structure, creating new urban spaces, and transforming the old railway workshop, the project strengthens the city's identity and quality of life. Remisen embraces history while looking towards the future, based on the present conditions.

MEDIUM SCALE

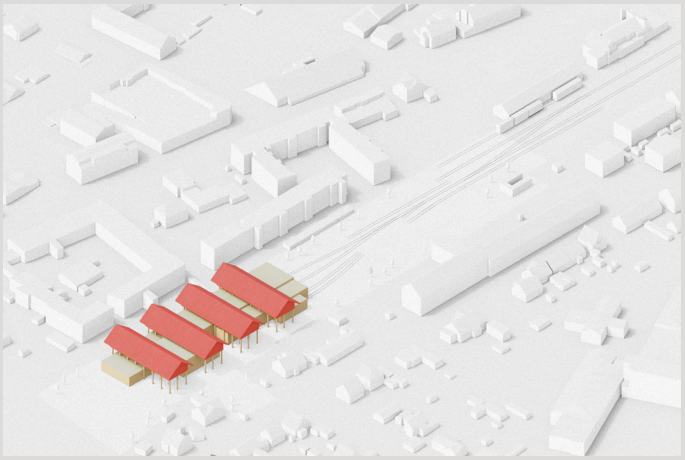
The medium-scale illustrates how Remisen and the surrounding site are woven into the existing context. The area around the old workshop no longer isolates each plot, but instead creates connections across larger spans. This chapter explores how the new design proposal is carefully integrated, the concept behind each design element, and how the superimposed structure becomes both possible and beneficial in this specific location.

38.Siteplan, 1:1000

FORM CONCEPT

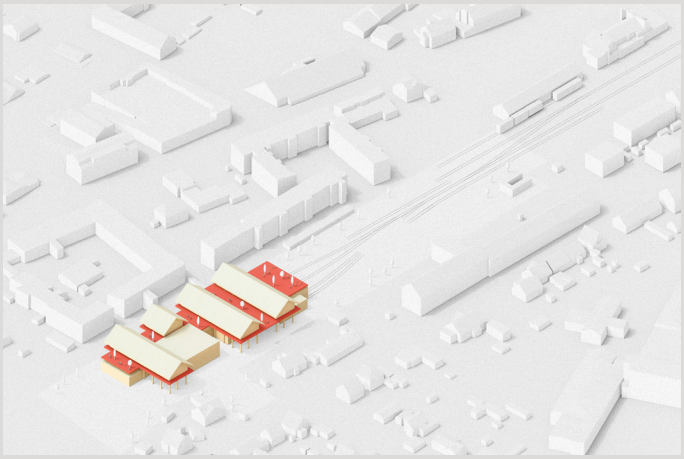


01 Column storm around the old workshop

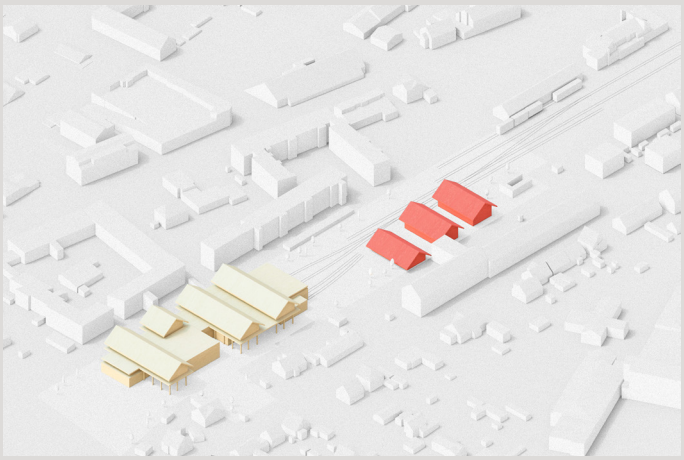


02 Superimposed volumes looking at the context

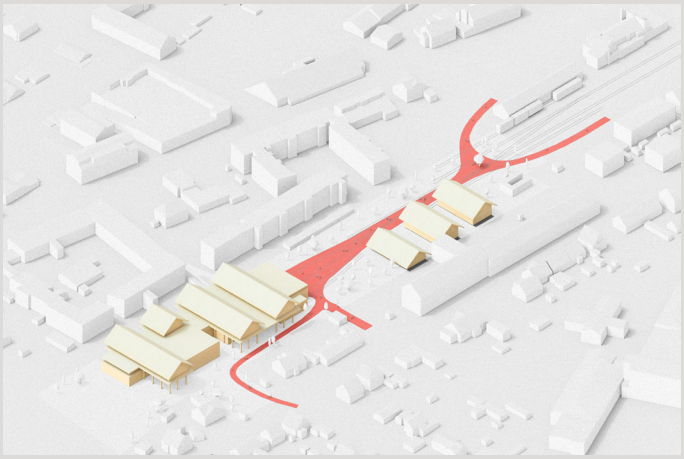
03 Modifying volume to match the rail tracks



04 Connections through volumes in the superimposed urban plateau



05 Densification in the field deviates from the rail tracks



06 Uninterrupted main circulation flow leading to the old workshop

THE SUPERIMPOSED IN CONTEXT

The importance lies in creating a landmark without breaking the scale. The superimposed volume must reach upward while remaining connected to the cityscape. Surrounding the site are existing multistory apartment buildings, and further east, a hill with smaller residences contributes to downscaling the radical superimposed concept, anchoring it within the city of Odder.

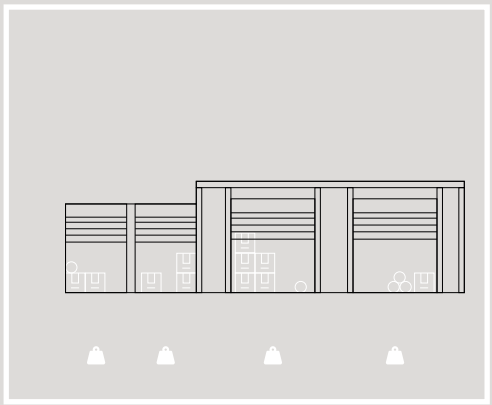
THE EVOLUTION IN FUNCTIONALITY

Previous usage of the workshop

The old railway workshop was dimensioned to withstand the load of moving trains.

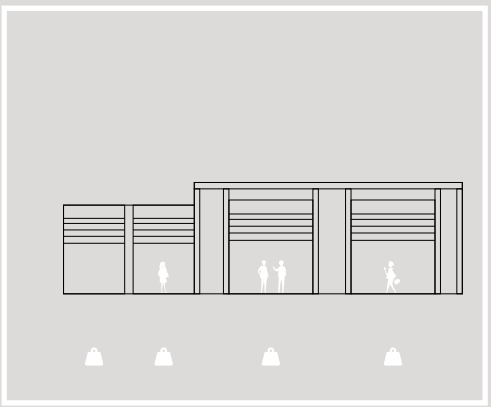
Current use as a warehouse

Subsequently used as storage and a warehouse for smaller utilities.



Future use as a community hub

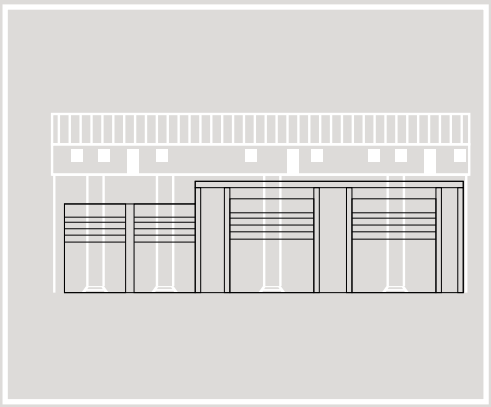
The building will become a house for the people, contributing to the city structure and urban connectivity.



40. Context section, 1:1000

Building superimposed

A multifunctional space will contribute to liveliness throughout the day, mixing public functions and residential housing.



Attached to existing foundation

The new volumes will connect to existing strength points in the foundation, where the train tracks lie.

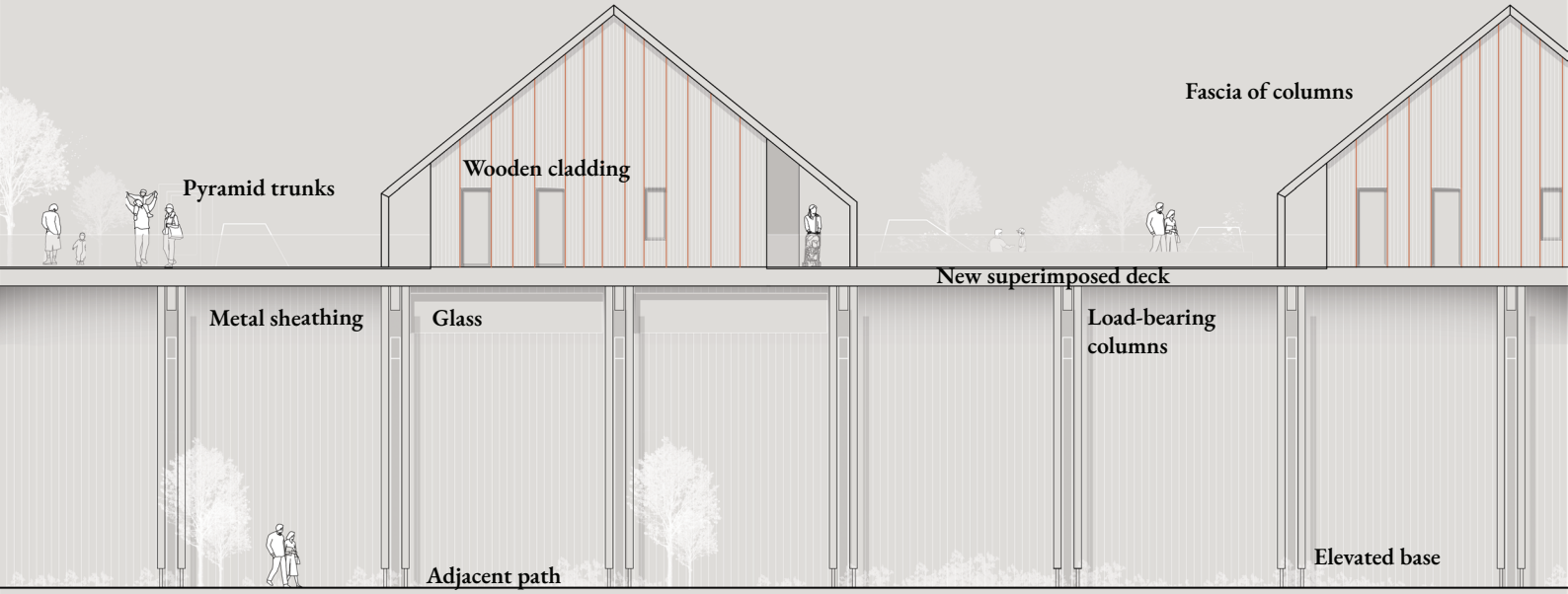
New spatiality on multiple levels

The revitalization of the old workshop and the addition of a new layer on top of the roof secure diverse spatial qualities.

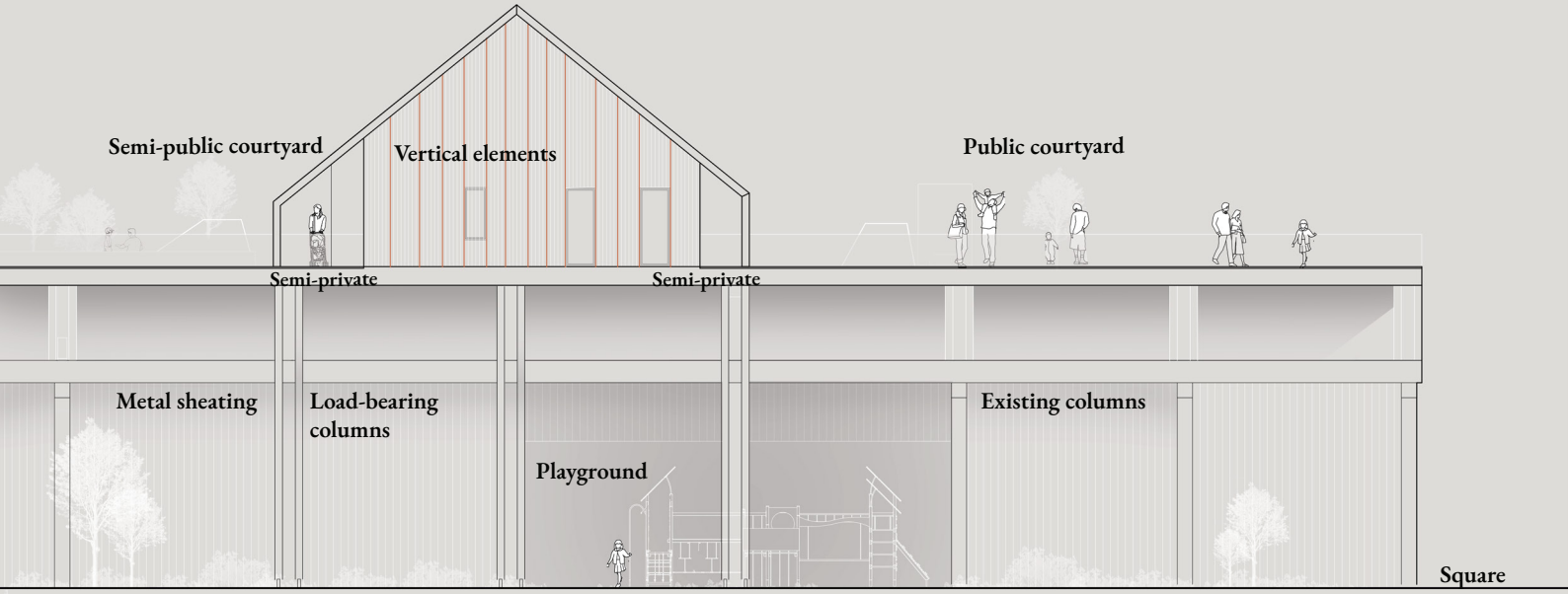
41. Site overview, maquette visualization

42. Visualization from Vita Park

The gables in the new superimposed settlement act as the project's eyes toward the city. The simple pitched roof is chosen for its modest appearance but still maintains a clear identity that fits within the context. The low pitch ensures it does not dominate the urban landscape. Beneath the gables, a series of columns form a rhythmic façade in dialogue with the existing concrete structure behind it. This meeting of new and old becomes a defining gesture in the project's architectural expression.



43. West elevation 1:200



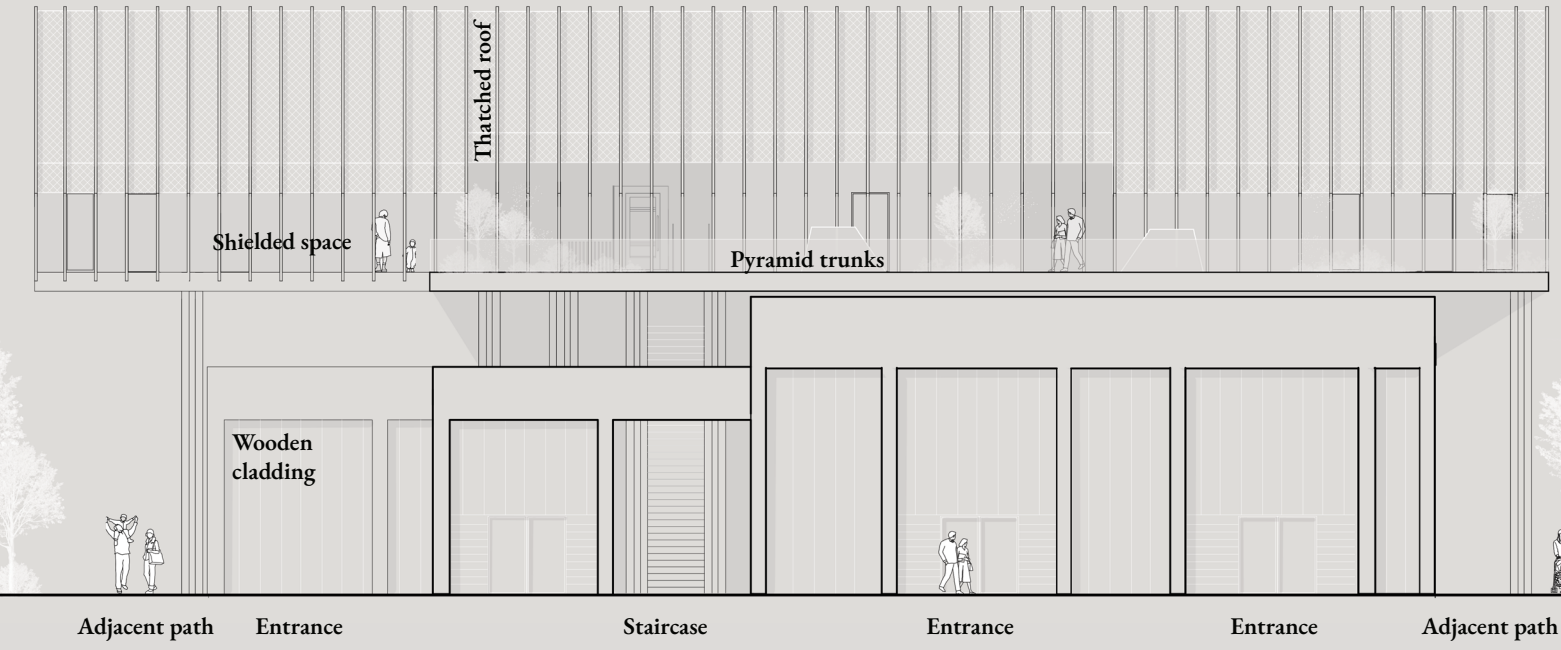
44. East elevation 1:200

45. Visualization of a family apartment

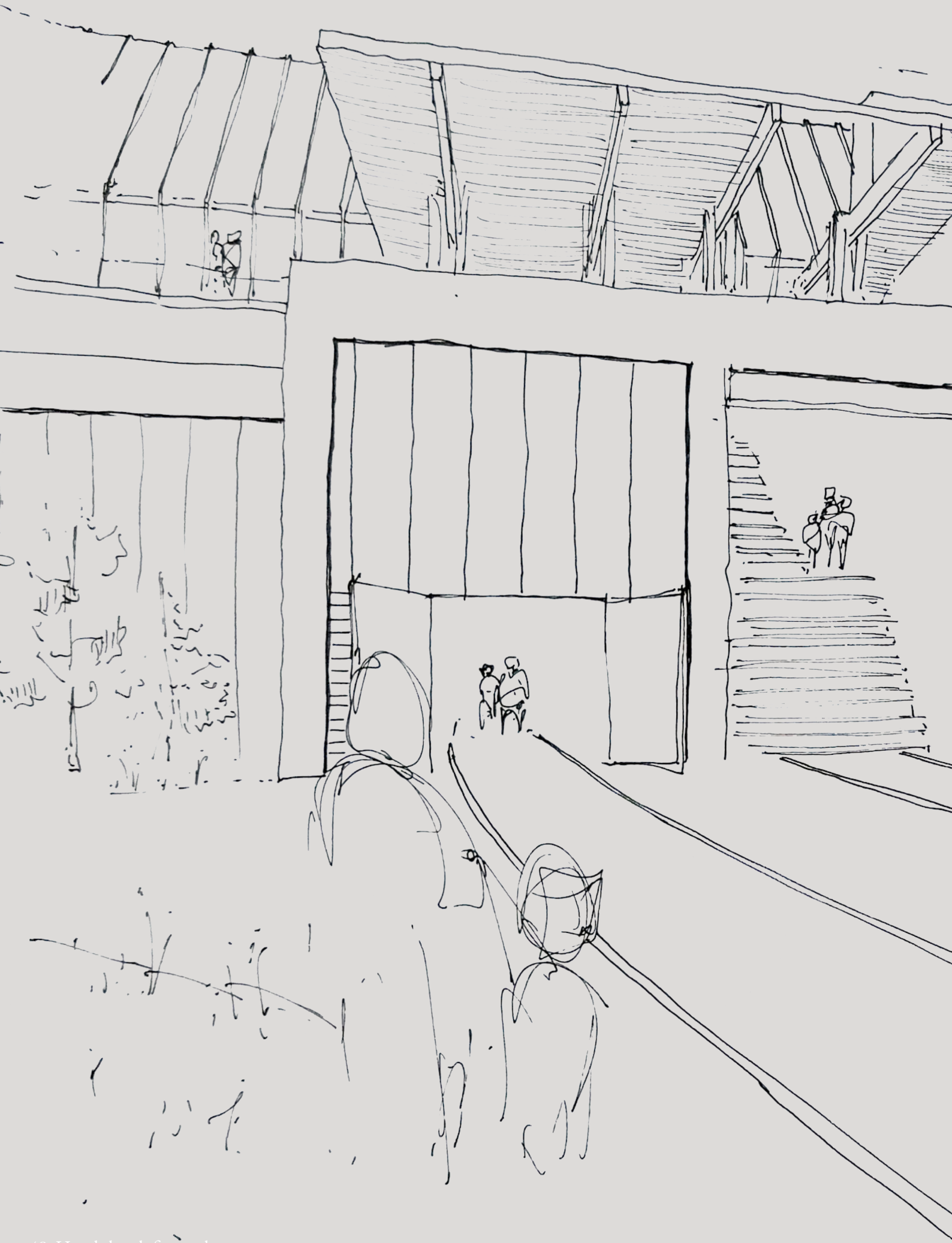
The primary meeting between the city and Remisen occurs at the workshop's northern facade. Here, one steps directly into dialogue between the existing and the new. The old rail tracks still run into the building, marking a strong connection to the site's industrial heritage. A new depth is introduced to the facade through warm wooden cladding, replacing the original metal panels. These vertical timber slats guide the eye upward, toward a newly set-back volume that rises as an architectural layer on top of the existing structure, creating a space for gathering, outlook, and community.

Like the tracks that lead into the building, the vertical slats draw attention inward, forming a rhythmic and contrasting facade that invites people in. The timber retains its warmth over time, especially as the northern facade has minimal exposure to direct sunlight. This transformation preserves the workshop's robust character while introducing new layers of openness and approachability in the urban landscape.

46. South elevation 1:200



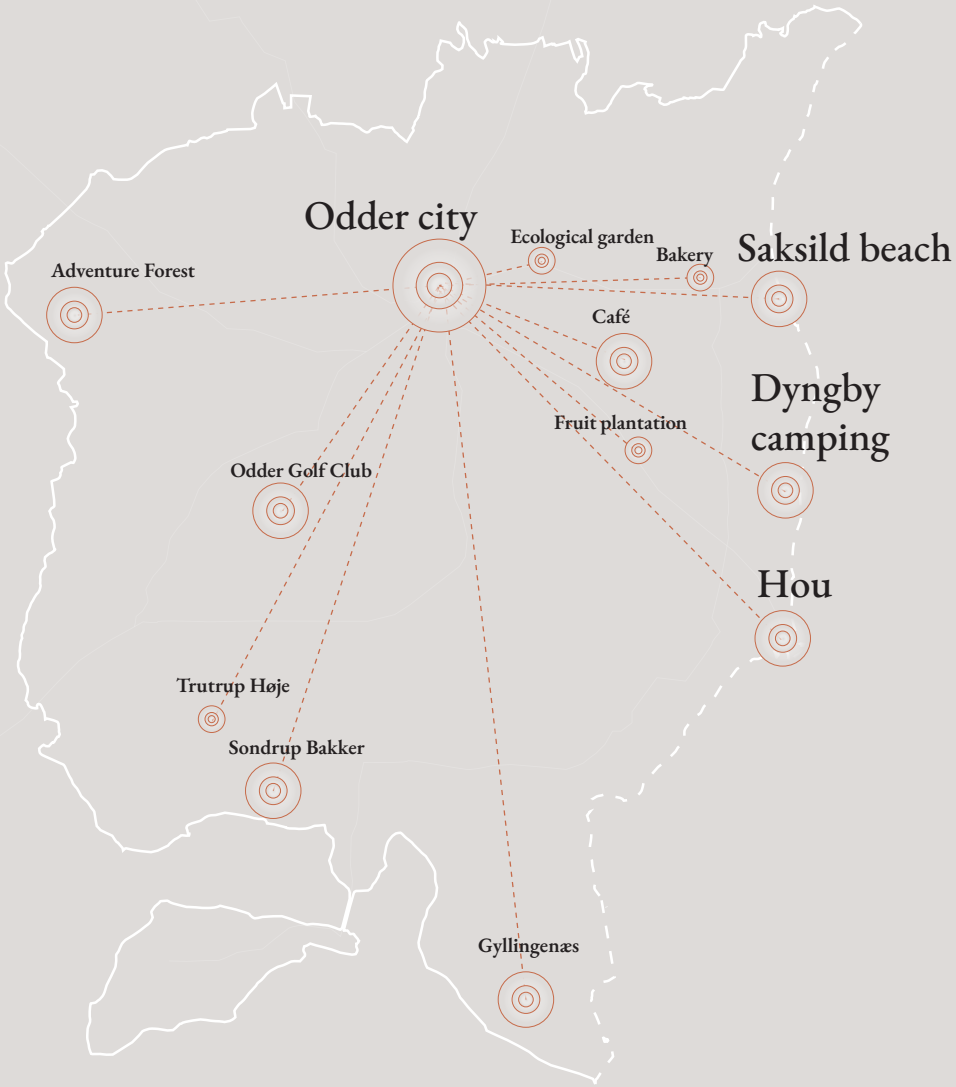
47. North elevation 1:200



48. Hand sketch front plaza

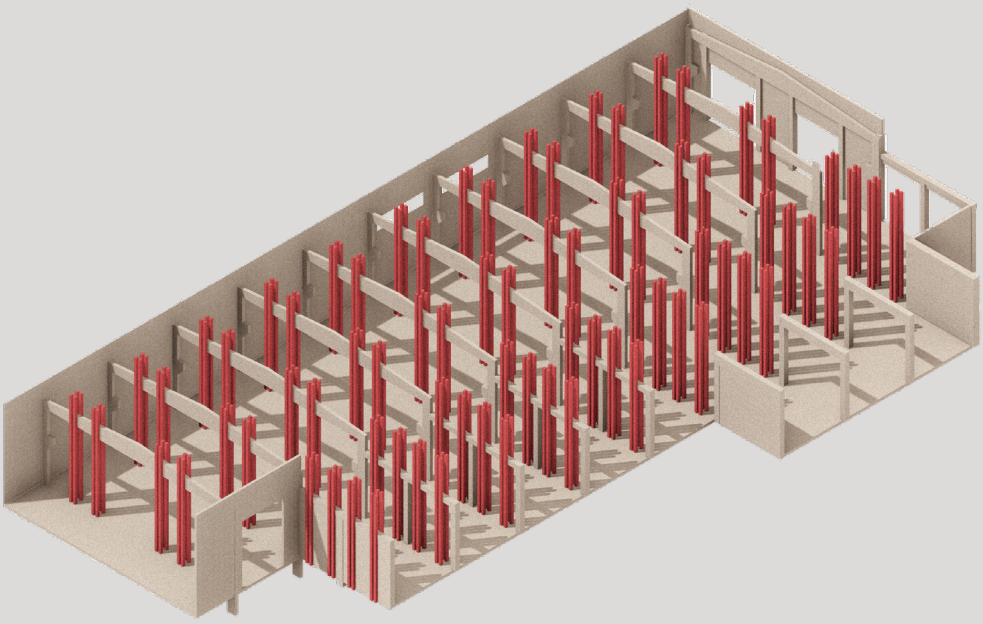
SMALL SCALE

The small scale showcases how Remisen and the surrounding context are intertwined into the design. The workshop now stands as a landmark in the city with local entrepreneurs engaged in the city center. This chapter explores how the interior of the workshop as well as the superimposed residential area is fitted to create space for public activities and private relaxation. Structural components, detailed sections, plan drawings, LCA results and more will underline how a project can fit into current volumes while complying with existing regulatory demands.

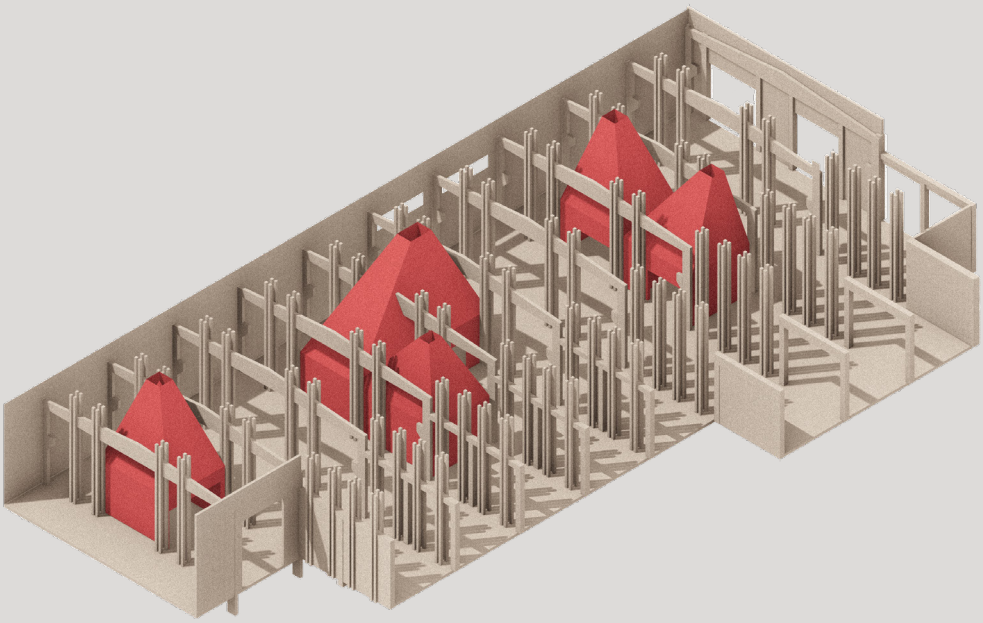


49. Perspective from long section of workshop

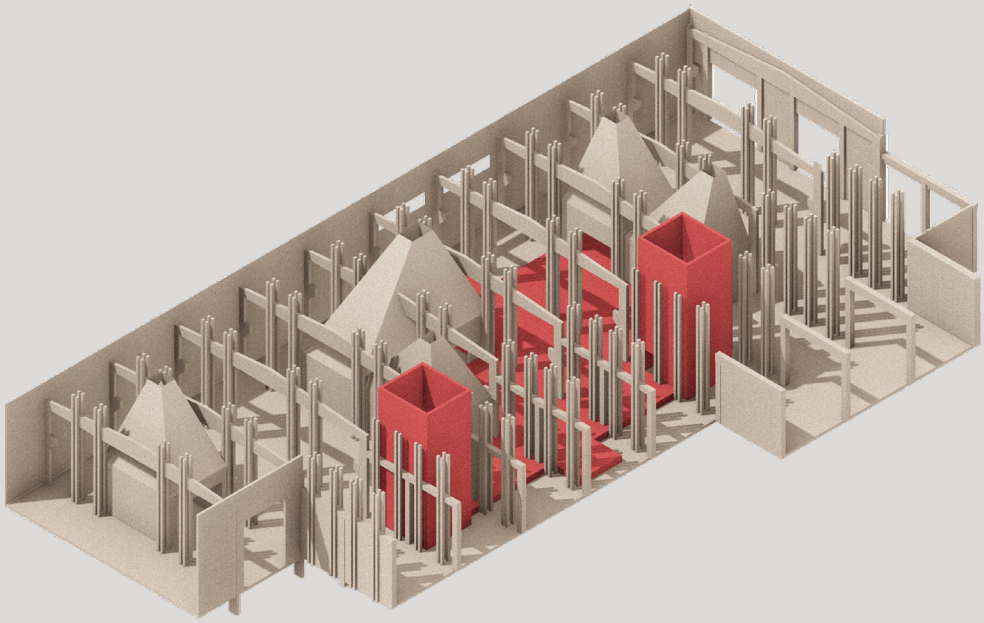
WORKSHOP CONCEPT



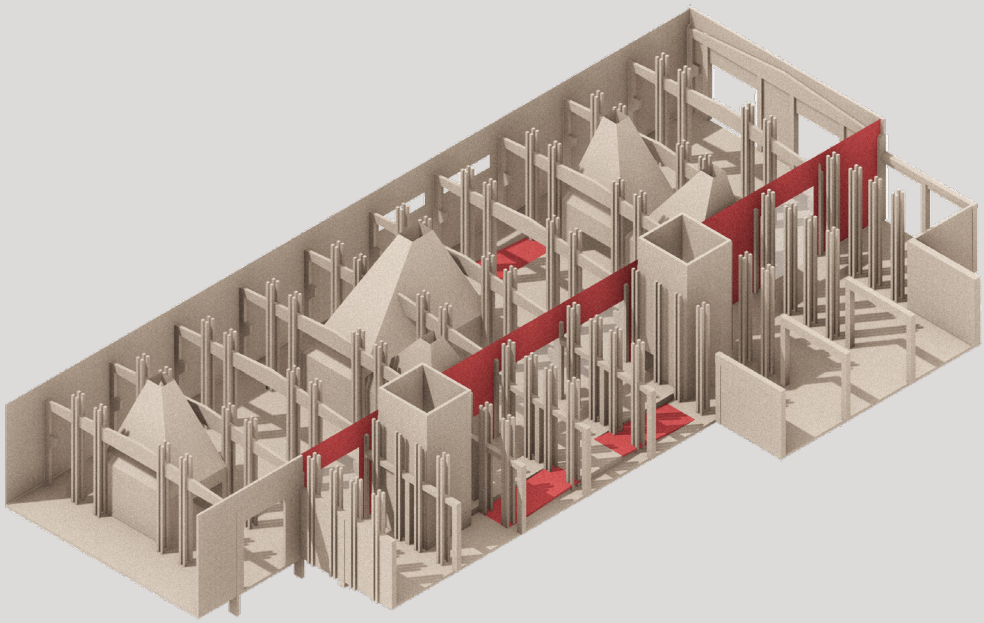
01 New columns breaking up the interior of the hall



02 New volumes create a sequence of interior squares



03 A plateau is created, and staircase cores are placed to accentuate the interior plaza



04 Ramps and holes in the existing walls create open and new circulation

LIFE CYCLE ASSESMENT

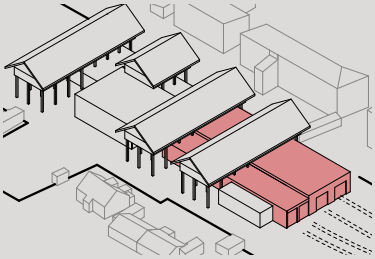
OPTIMIZATION OF BUILDING ELEMENTS

In relation to the project's design process, there has been an ongoing focus on optimizing the construction through the choice of materials. The baseline was a low-emission reference, but it was optimized based on other requirements, and therefore the material choices needed to be adapted to fit the context and the architectural intentions of Remisen.

In the **transformation of the workshop**, the roof materials of the pyramid volumes were changed from thatched roof to wooden shingles, even though it meant a slightly higher GWP. This choice was based on both technical and aesthetic reasons. Using shingles allowed for a lighter roof construction, which reduced the need for heavy loadbearing structures. It also fit better with the interior atmosphere of the local produce market and helped visually downscale the volume in the space while enabling larger net volumes.

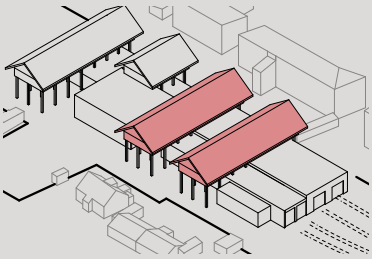
In the **superimposed apartments**, the thatched roof was kept. However, due to its overhang, wooden cladding on the facades became a more suitable choice—both in terms of durability and in supporting the expression of the new architectural layer. Furthermore, the GWP of the apartment foundations has been reduced, as most of the foundation is reused from the existing structure. A further elaboration can be found in appendix 4.

Altogether, the process shows how LCA is not just a tool for final validation, but a tool that should be integrated into the design development. It underlines the connection between environmental performance and architectural decision-making.



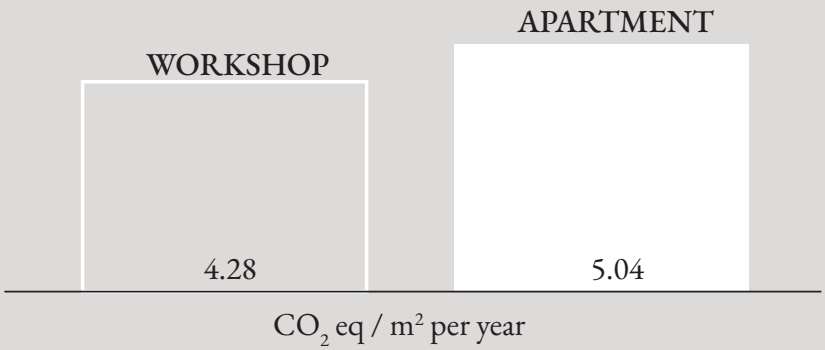
The workshop transformation

Thatched	→	Shingles
EPS	→	Woodfibre
Plastic vapor barrier	→	Biobased vapor break



The superimposed apartments

Screw pile foundation	→	Reusing existing concrete
Facade thatch	→	Wood cladding
Plastic vapor barrier	→	Biobased vapor break



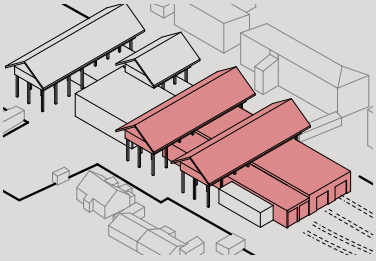
CONSOLIDATED LCA FINDINGS

The LCA calculation was conducted on divisions of the building throughout the process to enable individual studies. A single calculation was done for a section of the workshop transformation as shown on the icon. This includes the local produce market with its pyramid volume, the superimposed urban spaces, and two of the superimposed apartments. The section enables a representative calculation for Remisen as a whole.

It should be noted that the calculations assume a new construction project with the use of recylced materials and building elements. These are primarily found in the old workshop as the exterior shell and the track foundation for the superimposed volume.

This calculation is more detailed than previous. Elements like stairs and ramps, interior walls and such have been included in the GWP. 'External workshop' in the graph presents the creation of the new superimposed deck and the rework of the facade of the workshop.

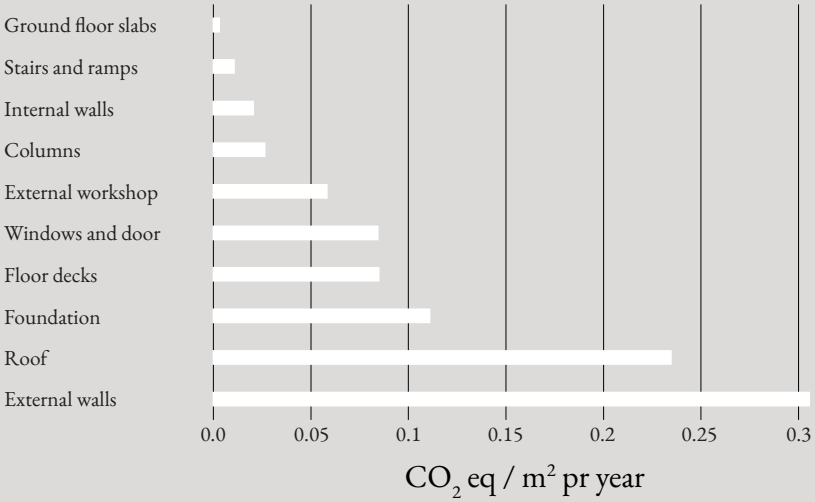
In the calculations there are some areas of uncertainty such as joints between roof and walls, which may effect the result. Therefore, a safety factor of 1.2 is multiplied onto the calculated GWP. The total Global Warming Potential results in an environmental impact of 5.8 CO_2 eq / m^2 per year, which meets the new limit value of 2025.



BUILDING DATA

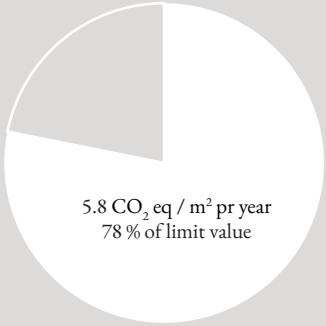
Heated floor area	1332 m^2
Gross floor area	1332 m^2
Integrated garage	1846 m^2
Reference area	2255 m^2
Operational electricity use	-5.3 kWh / m^2 yr
Operational heat use	39.8 kWh / m^2 yr

HOTSPOT OVER BUILDING ELEMENTS



Percentage of the limit value

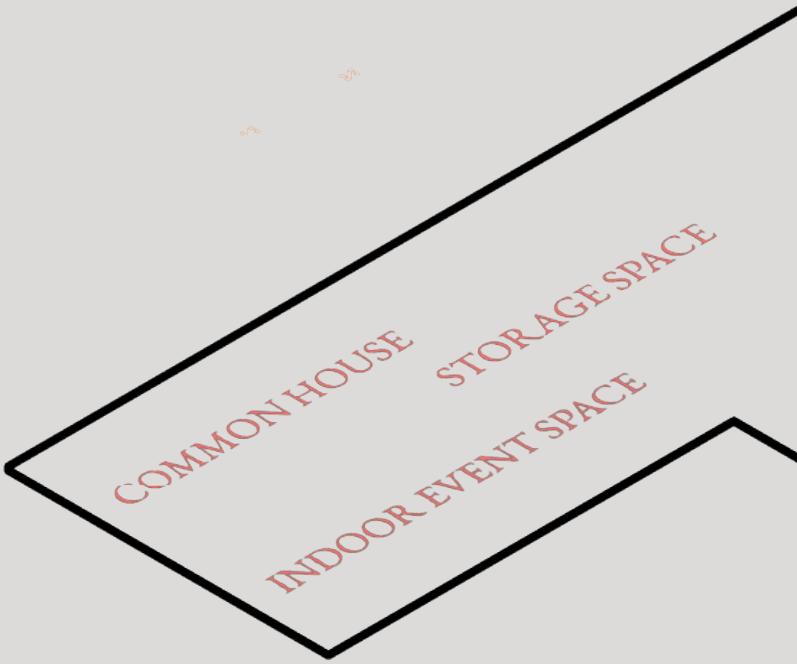
Total: 7.5 CO_2 eq / m^2 pr year

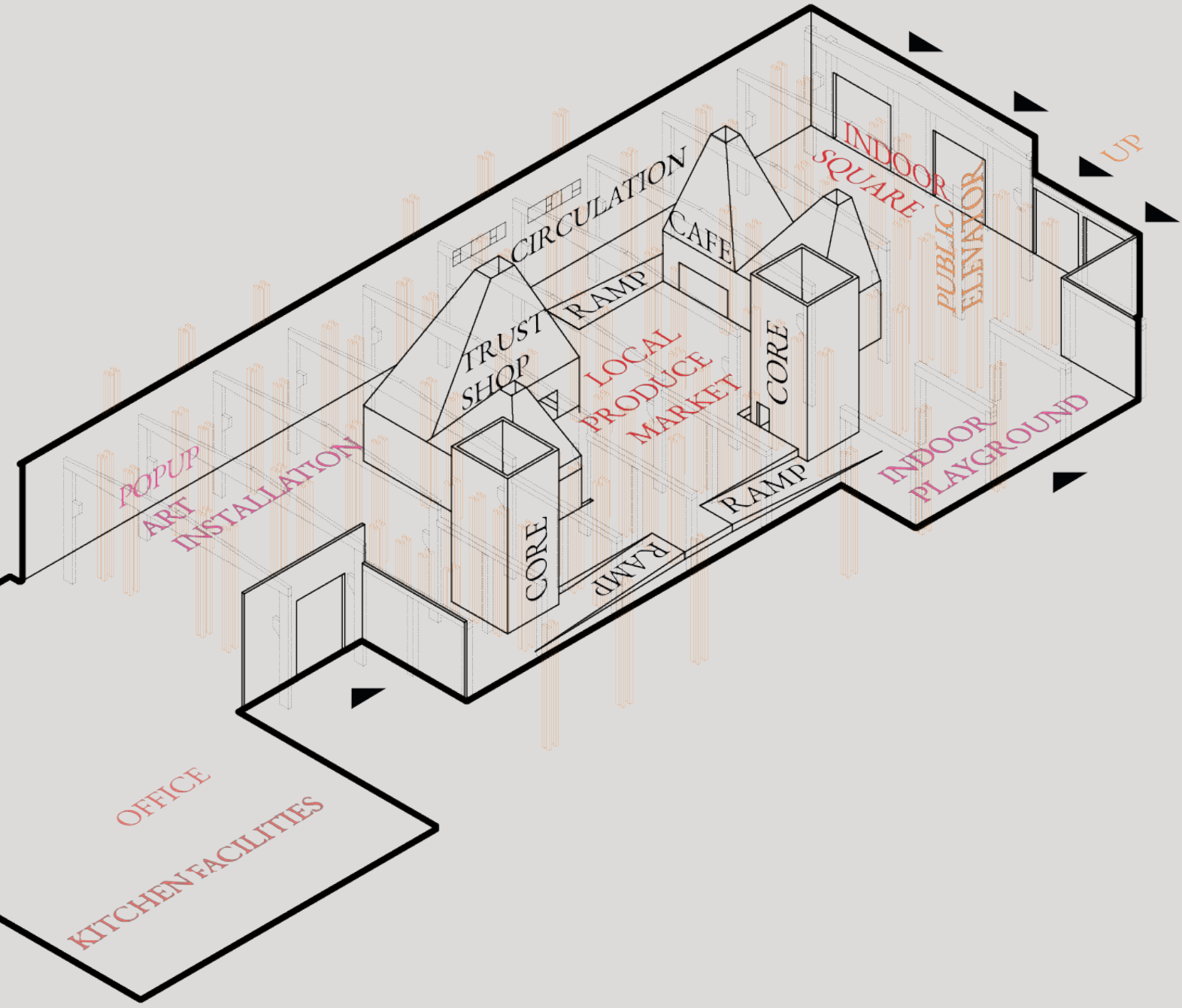


50. Visualization of indoor market

WORKSHOP - LOCAL PRODUCE MARKET

A shared space is created to promote the activities taking place across the entire municipality. The local produce market highlights the smaller production sites that surround the city. It is a place where people are exposed to the many activities happening nearby - from events at Fru Møllers Mølleri, a local café, bakery and butcher, to local artists' ceramics and paintings, the bread from Saksild's bakery, and much more. The space includes a café serving local products, smaller trust-based shops, and exhibitions that tell the story of production and its transportation by old steam trains.





51. Workshop functions diagram

USER GROUPS

52. Visualization of circulation space

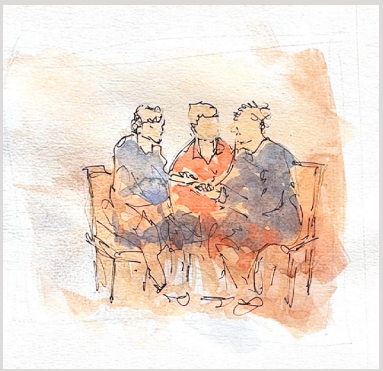
The selected user groups are deliberately broad to embrace diversity and ensure that the project is activated across different age groups, times of day, and purposes. By including locals, passersby, and visitors, a vibrant and flexible urban environment is created. A space that supports a variety of uses throughout the day, from everyday routines and events to spontaneous pauses and recreational breaks.

RESIDENTS

Use the site daily for relaxation, everyday routines, and casual encounters.

DAILY BYPASSERS

Use the site as a shortcut or a break for food, rest, and spontaneous activities.



COMMUNITY GROUPS

Use the site for social gatherings, local markets, and shared meals.

SCHOOL GROUPS AND INSTITUTIONS

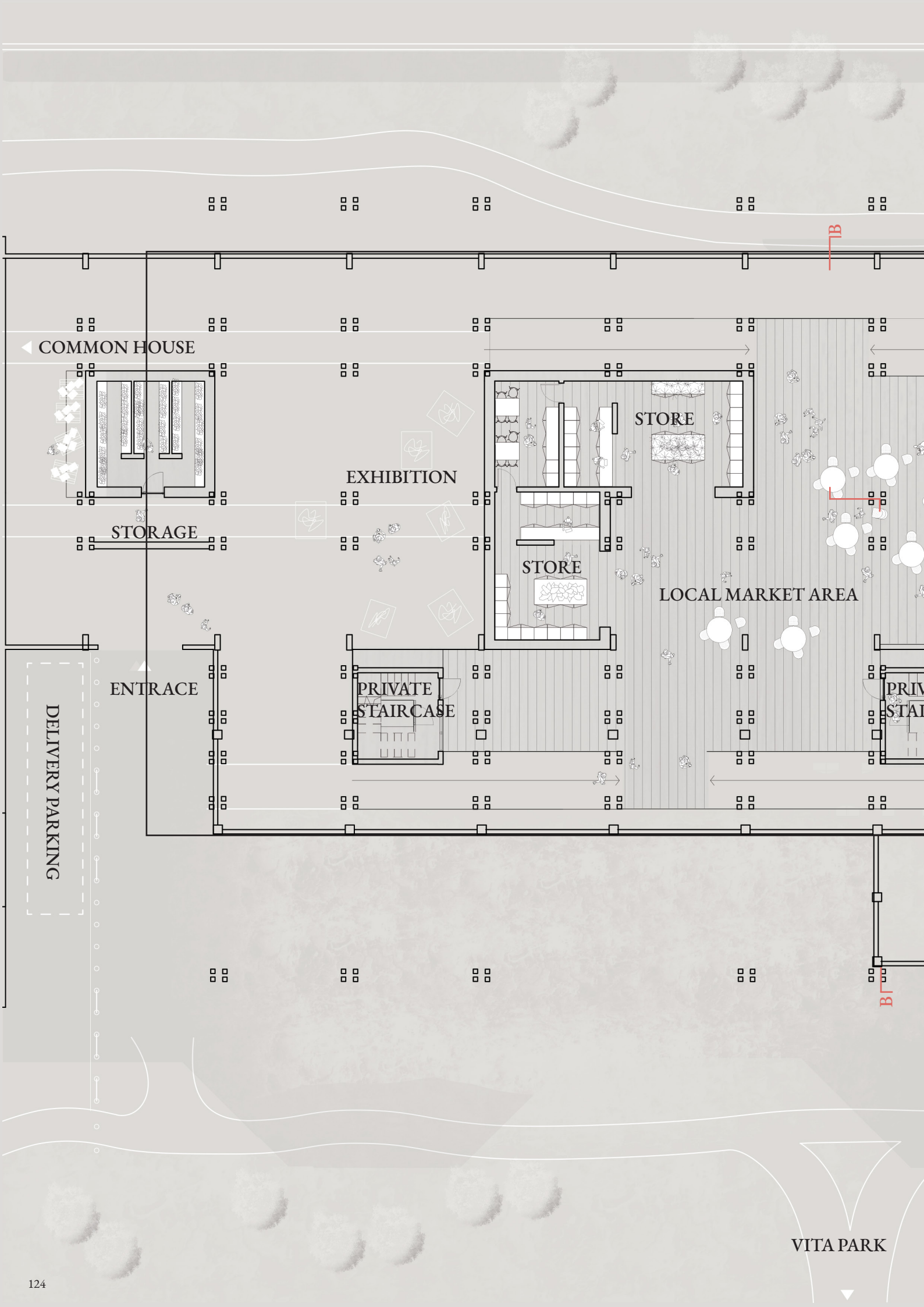
Visit for educational activities, local history, and cultural exploration.

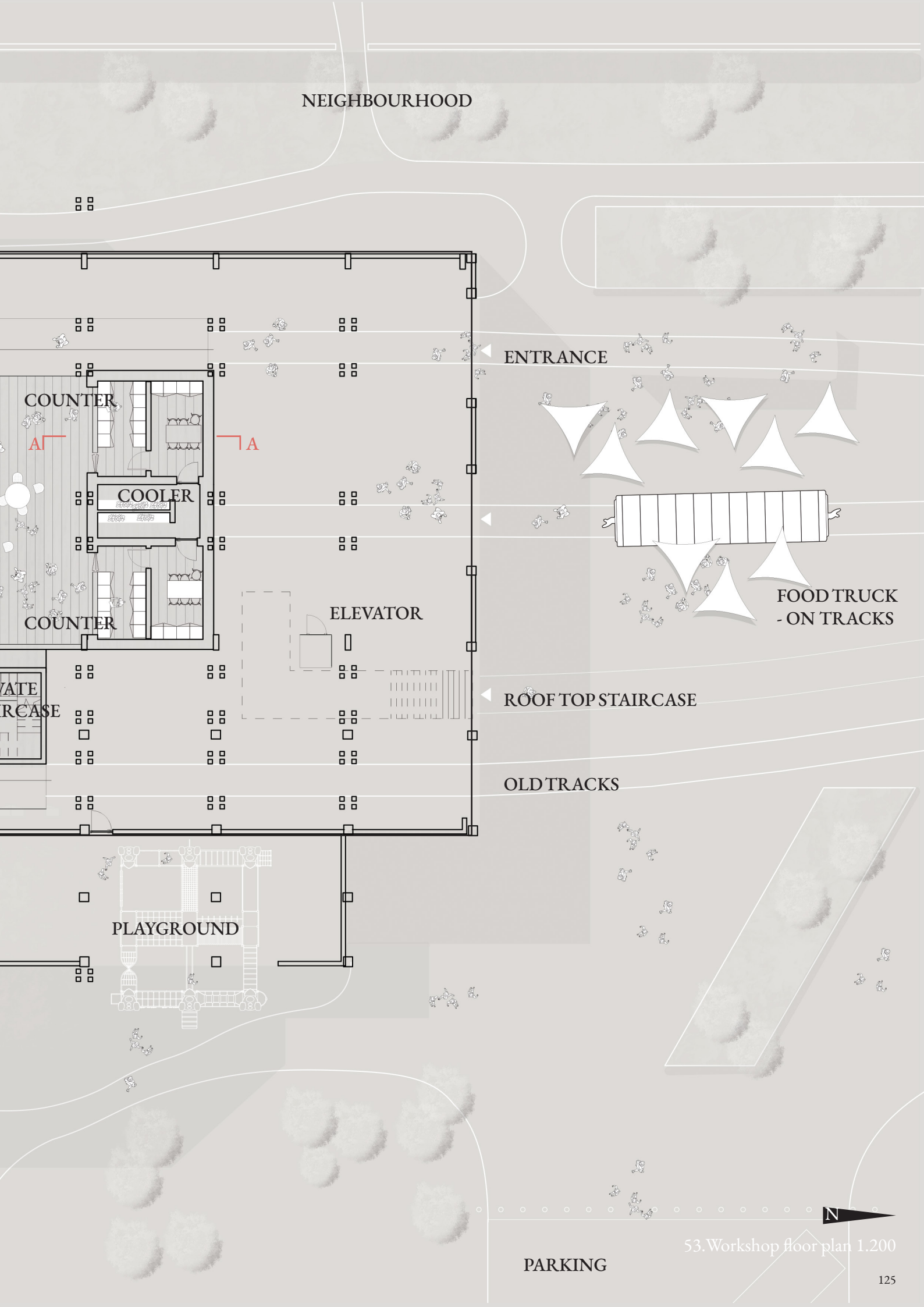
NEIGHBOURING FAMILIES

Visit regularly for the indoor playground, events, and social activities.

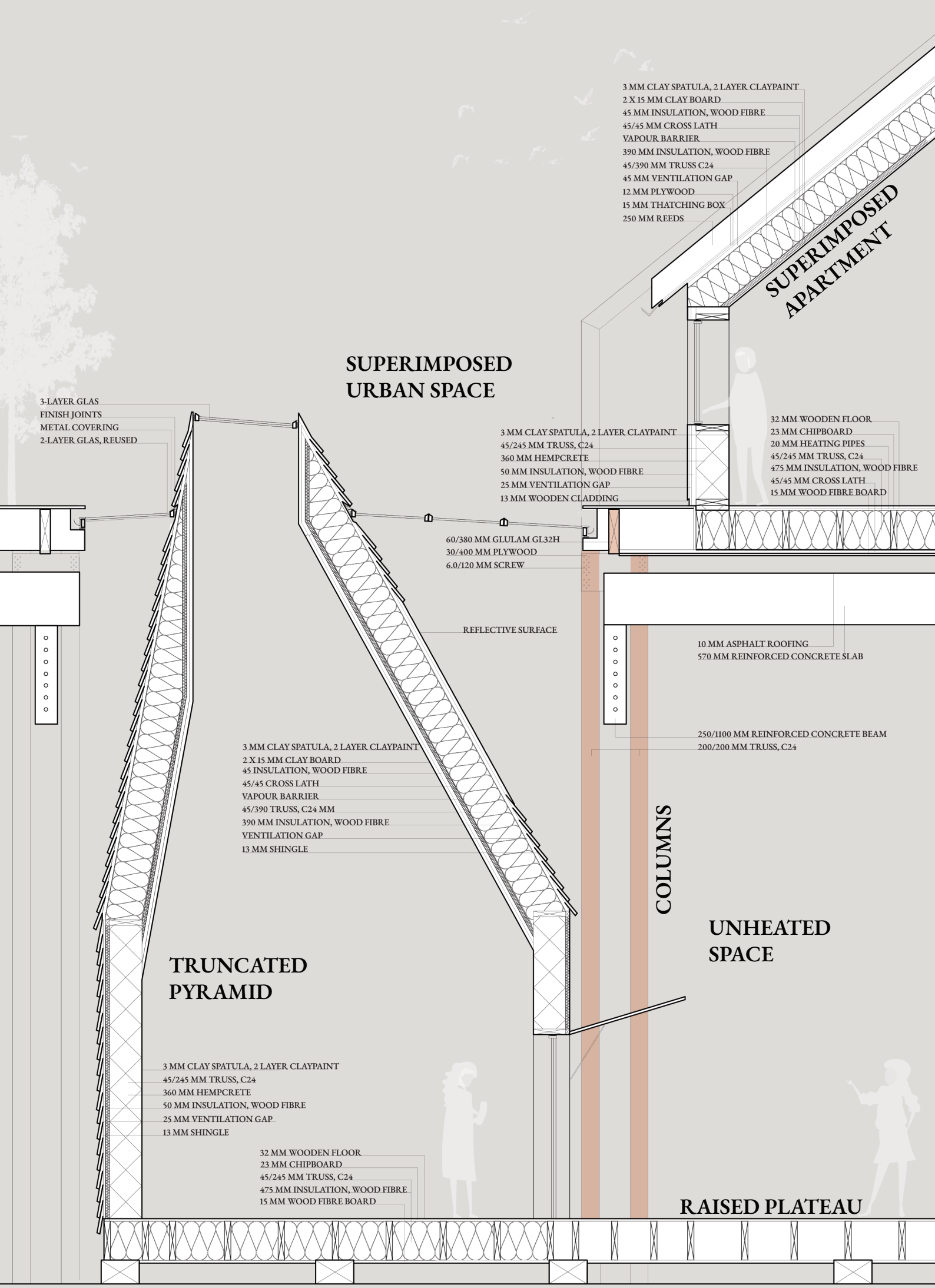
TOURISTS FROM NEARBY AREAS

Visit Odder to experience local culture, markets, and public spaces.


B
COMMON HOUSE
STORE
EXHIBITION
STORAGE
STORE
LOCAL MARKET AREA
ENTRACE
PRIVATE
STAIRCASE
DELIVERY PARKING
B
VITA PARK



53. Workshop floor plan 1.200


3 MM CLAY SPATULA, 2 LAYER CLAYPAINT
2 X 15 MM CLAY BOARD
45 MM INSULATION, WOOD FIBRE
45/45 MM CROSS LATH
VAPOUR BARRIER
390 MM INSULATION, WOOD FIBRE
45/390 MM TRUSS C24
45 MM VENTILATION GAP
12 MM PLYWOOD
15 MM THATCHING BOX
250 MM REEDS
SUPERIMPOSED APARTMENT
SUPERIMPOSED URBAN SPACE
3-LAYER GLAS
FINISH JOINTS
METAL COVERING
2-LAYER GLAS, REUSED
3 MM CLAY SPATULA, 2 LAYER CLAYPAINT
45/245 MM TRUSS, C24
360 MM HEMPCRETE
50 MM INSULATION, WOOD FIBRE
25 MM VENTILATION GAP
13 MM WOODEN CLADDING
32 MM WOODEN FLOOR
23 MM CHIPBOARD
20 MM HEATING PIPES
45/245 MM TRUSS, C24
475 MM INSULATION, WOOD FIBRE
45/45 MM CROSS LATH
15 MM WOOD FIBRE BOARD
60/380 MM GLULAM GL32H
30/400 MM PLYWOOD
6.0/120 MM SCREW
REFLECTIVE SURFACE
10 MM ASPHALT ROOFING
570 MM REINFORCED CONCRETE SLAB
250/1100 MM REINFORCED CONCRETE BEAM
200/200 MM TRUSS, C24
3 MM CLAY SPATULA, 2 LAYER CLAYPAINT
2 X 15 MM CLAY BOARD
45 INSULATION, WOOD FIBRE
45/45 CROSS LATH
VAPOUR BARRIER
45/390 TRUSS, C24 MM
390 MM INSULATION, WOOD FIBRE
VENTILATION GAP
13 MM SHINGLE
COLUMNS
UNHEATED SPACE
TRUNCATED PYRAMID
3 MM CLAY SPATULA, 2 LAYER CLAYPAINT
45/245 MM TRUSS, C24
360 MM HEMPCRETE
50 MM INSULATION, WOOD FIBRE
25 MM VENTILATION GAP
13 MM SHINGLE
32 MM WOODEN FLOOR
23 MM CHIPBOARD
45/245 MM TRUSS, C24
475 MM INSULATION, WOOD FIBRE
15 MM WOOD FIBRE BOARD
RAISED PLATEAU

DETAIL AND ENERGY ASSESSMENT

The detailed section showcases the layers of the truncated pyramids and the connection between the workshop area and the superimposed apartments. The columns create a spacious experience in the workshop while ensuring the structural integrity of the apartments. The connection is strengthened through the pyramids as a sculptural element at the new deck on top.

The apartments and pyramids are designed to meet the low energy class standard which is verified through detailed energy calculations in Be18 (appendix 1). In the design process the volumes were evaluated for energy efficiency and the layout and surface area were adjusted accordingly. The key to reaching the demand was the use of photovoltaics, which are placed on the south-facing apartment roofs with around 20 m² per volume, and 5 m² on the pyramids. Besides introducing renewable energy, the project demonstrates minimal energy usage due to highly insulated volumes and a compact form. The final energy use, which accounts for energy delivered after system efficiencies including transmission losses, is respectively 23.5 kWh/m² pr year for the apartments and 23.8 kWh/m² pr year for the pyramids.

Structural calculations have been carried out to ensure that the proposed system, an important element in the building design, is possible with reasonable material dimensions.

SUPERIMPOSED APARTMENT

TYPE	Floor deck	Wall	Roof	Window
AREA	480 m²	310 m²	512 m²	61 m²
U-VALUE	0.08 W/(m²K)	0.09 W/(m²K)	0.07 W/(m²K)	0.80 W/(m²K)

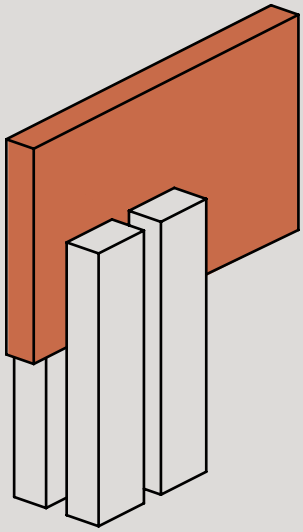
TRUNCATED PYRAMID

TYPE	Floor deck	Wall	Roof	Window
AREA	180 m²	256 m²	400 m²	18 m²
U-VALUE	0.08 W/(m²K)	0.09 W/(m²K)	0.07 W/(m²K)	0.80 W/(m²K)

54. Section AA, Detailed section 1.50

STRUCTURAL BEAM

The beam is presented as a structural evaluation of selected load-bearing beam options. The beam supports the upper deck, redirecting the load to the columns, which then transfers it to the old tracks in the workshop. The selected beam is analyzed through a comparison of utilization coefficients, with a target of 80% utilization for the chosen dimension (appendix 2). The final dimension is presented here, along with the assumed load acting on the beam.



55. Detailed Beam

Load-assumptions

Design load (ULS)

$$q_d = 1.35\, G_k + 1.5\, Q_k$$

G_k = Characteristic dead load (permanent load),
$= 1.9\ kN/m^2$
Q_k = Characteristic live load (variable load)
$= 2.0\ kN/m^2$
1.35 and 1.5 = partial coefficient

(Dansk standard 2002)

$$q_d = 5.57\ kN/m^2$$

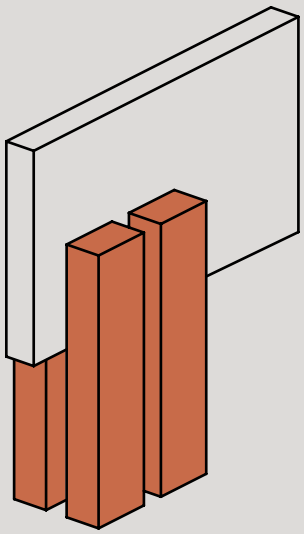
Bending moment

$$M_{Ed} = \frac{q_d \cdot l^2}{8}$$

l = 6 m (span)

$$M_{Ed} = 25.2\ kNm$$

Beam type	Strength $f_{m,k}$ [MPa]	Dimensions [mm]	Moment capacity M_{Rd} [kNm]	Utilization factor
GL32h	32	60 x 380	31,6	78,8%



56. Detailed column

STRUCTURAL COLUMN

The columns under the superimposed are investigated (appendix 2). The study examines how the applied load informs the selection of dimensions incorporated into the project design. The column is evaluated using a utilization factor, which indicates how much of its load-bearing capacity is being used. This ensures that material consumption is minimized by avoiding excessive, unused structural capacity. The target utilization is 80%. For aesthetic reasons, specifically to achieve a sense of lightness, the design presents the column as being divided into four elements that together form a single structural unit. Consequently, the total compressive load at this point is divided by four to assess the utilization of each individual element in the column assembly.

Load-assumptions

Design axial load

$$N_{Ed}=q_d \cdot A$$

q_d = Design load = 5.57 kN/m²
A= area supported by the column = 9.0 m²

(Dansk Standard 2002)

$$N_{Ed}=50.13\ kN/4 = 12.53\ kN$$

As the dimensions of the columns are relatively small, and the utilization is likewise low, it is assumed that the more critical factor is the risk of buckling. Therefore, the utilization investiagted in relation to buckling. For further elaboration see appendix 2.

Buckling capacity

$$N_{b,Rd}=x \cdot A \cdot f_y/\gamma M$$

C24 Truss 70 x 125 mm
x = Reduction factor = 0.095
A= Cross sectional area =8750 mm²
fy = Characteristic compressive strength = 24 MPa
γM= Partial safety factor = 1.3

(DS/EN 2014)

$$N_{b,Rd}=15.35\ kN$$

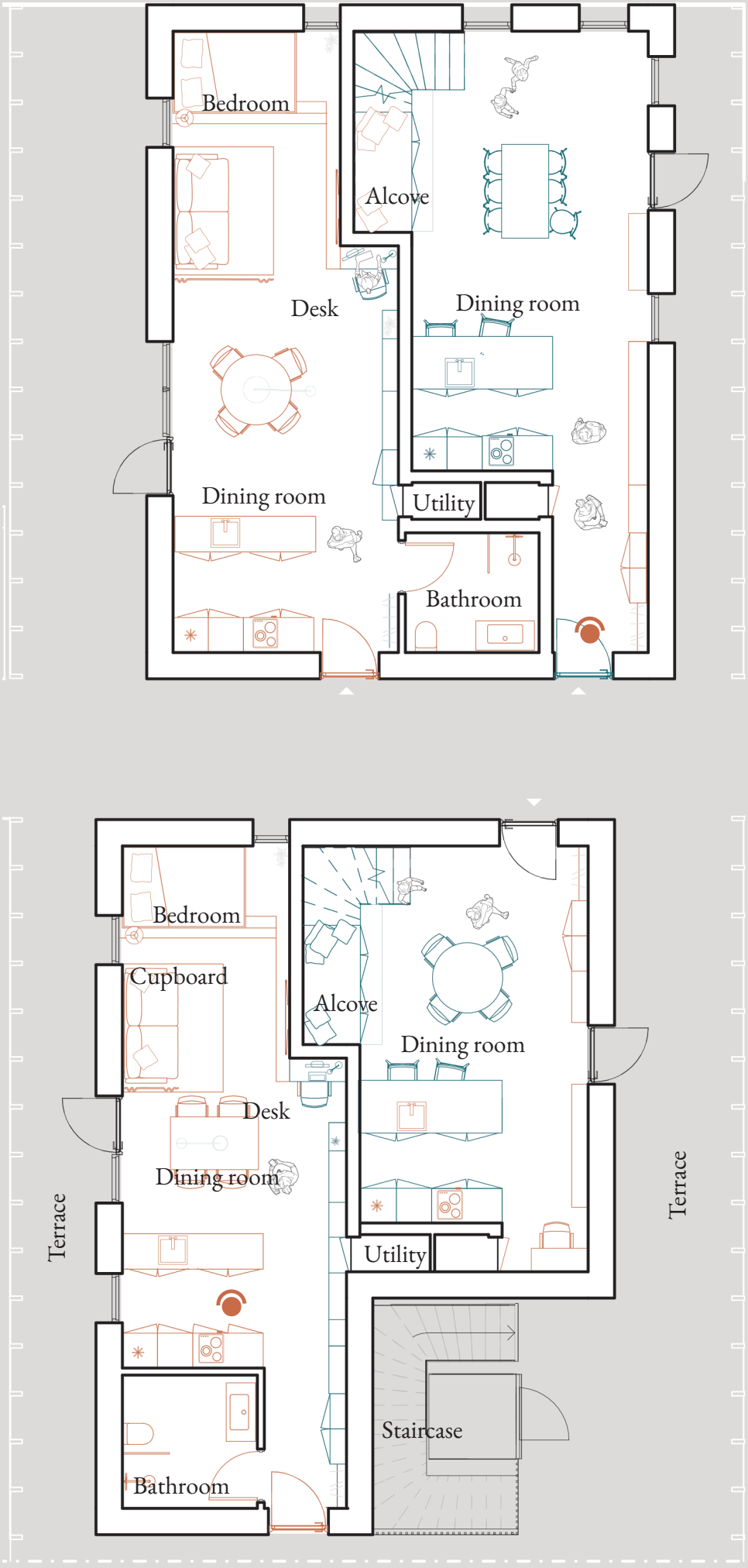
Utilization factor

$$N_{E,d}/ N_{b,Rd} \cdot 100= 93.2\ \%$$

PATH AROUND THE SITE

VITA PARK

57. Superimposed urban floor plan, 1.200



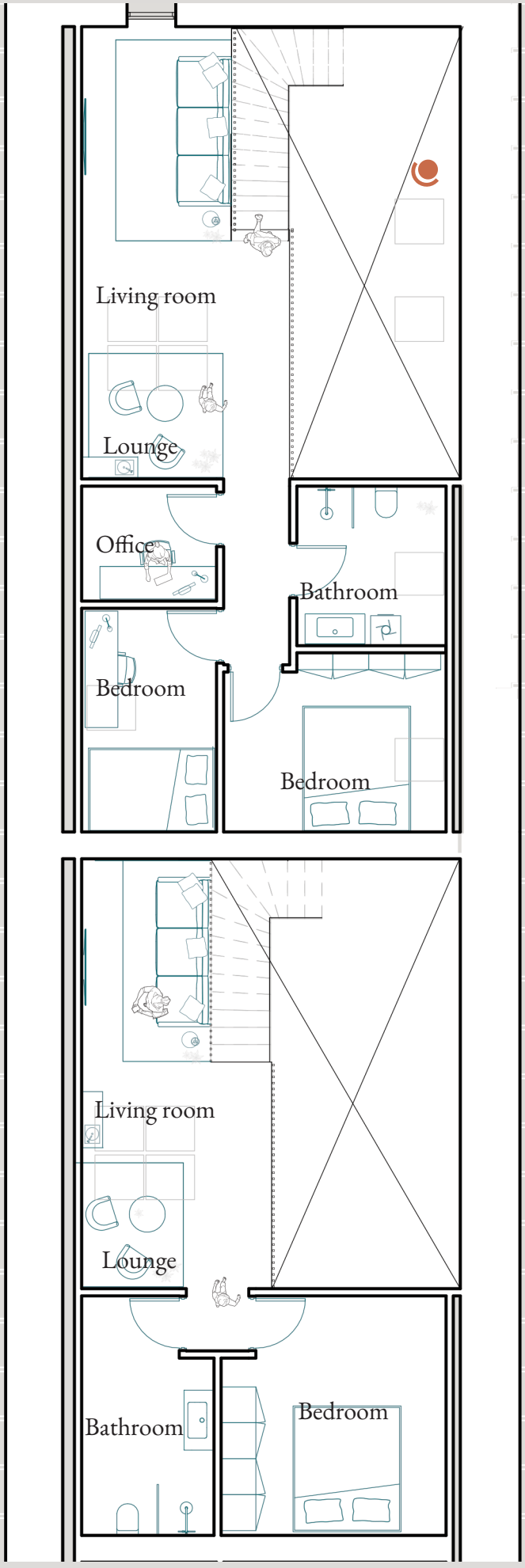
58. Apartment lower level floor plan 1.100

59. Visualization of family apartment entrance

These unique apartments ‘ express their connection to the industrial heritage, with long lines of sight reminiscent of looking along train tracks. Running alongside is the integrated furniture piece, where vertical lines break the sightlines and remind inhabitants that this is a home — a place for personalization.

60. Visualization of student apartment

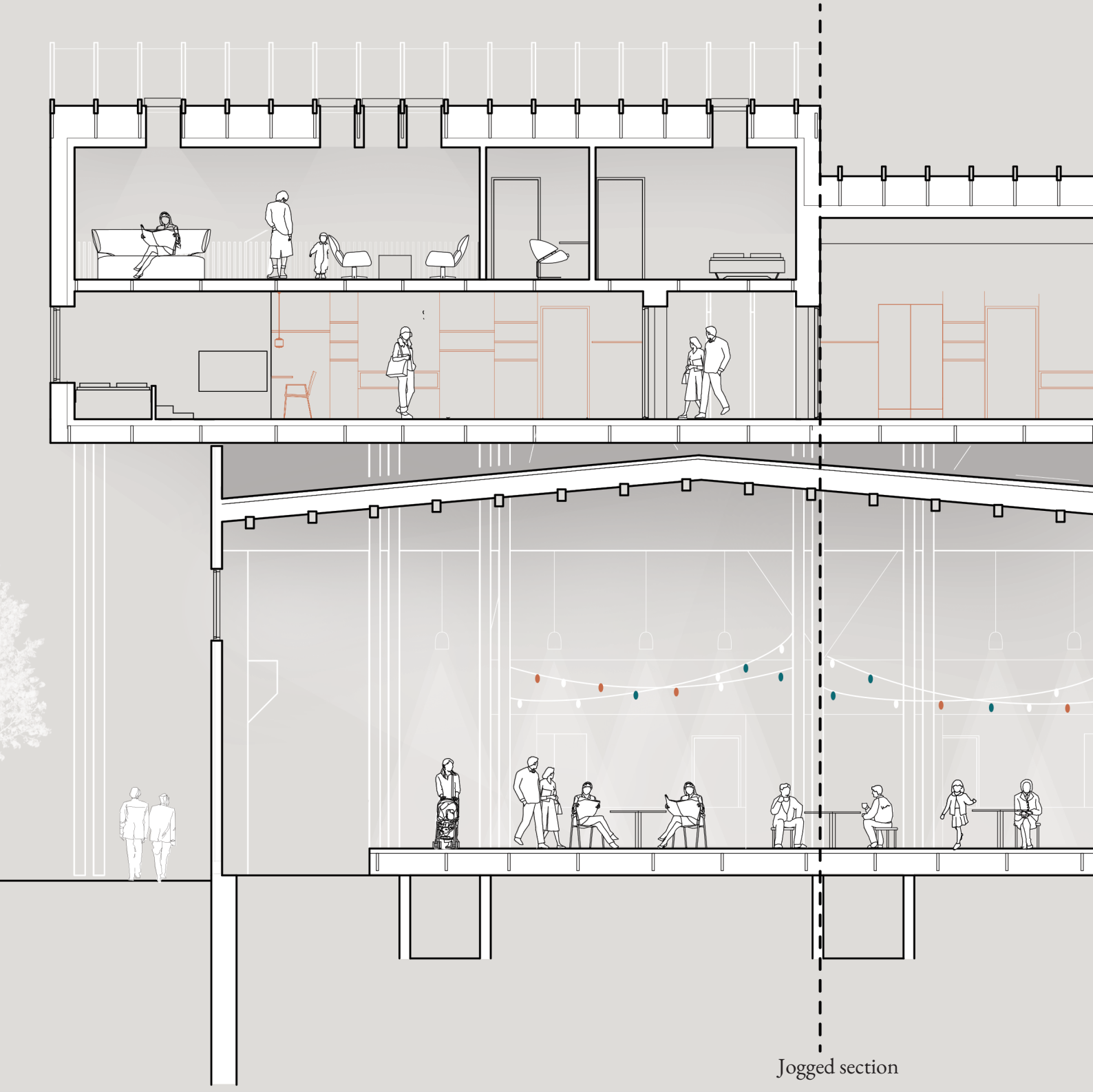
The interior form language reflects an industrial aesthetic, with elevated ceiling heights and shelving running along tracks. The color palette combines bright and dark tones, with an accent of orange, reminiscent of the red crane in the old workshop.



61. Apartment upper level floor plan 1.100

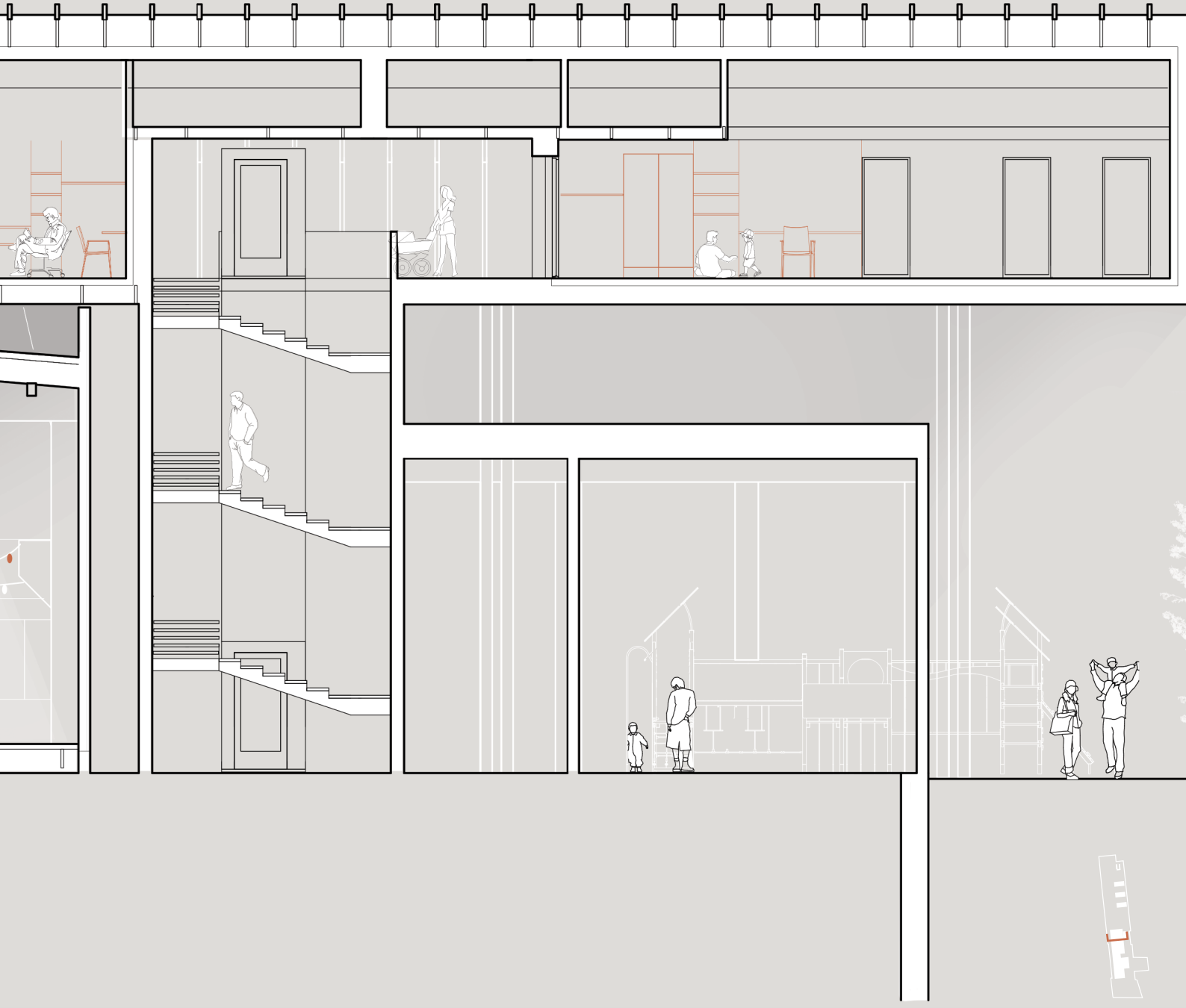
62. Visualization of family apartment dining area

The placement of a northern apartment requires a careful play of light. Therefore, the apartments are intertwined, with the family apartment extending to a first floor above the student apartment, allowing light to flow down through skylights.

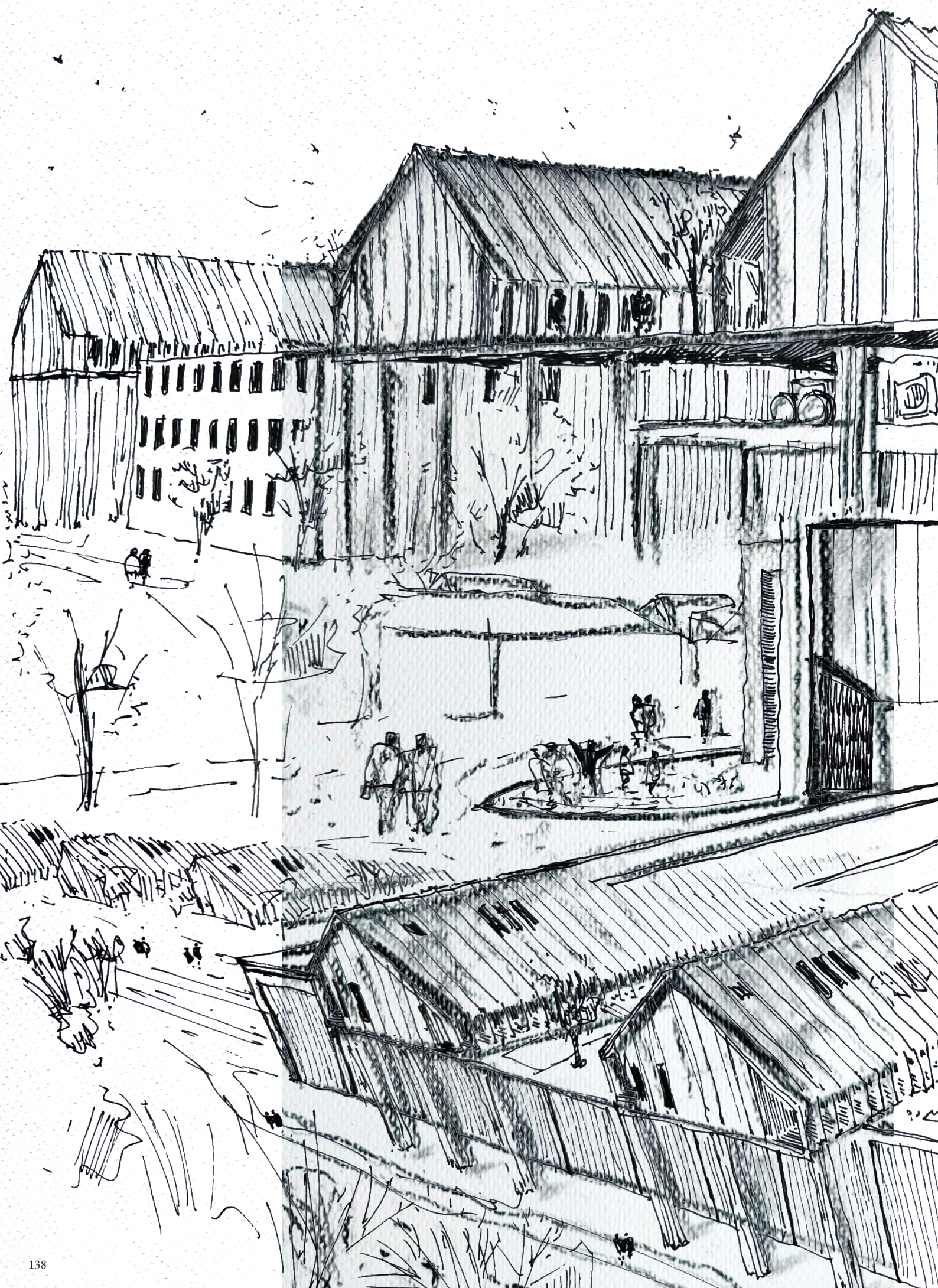


Jogged section

This marks the complete presentation of Remisen, where daily life unfolds visibly in both the residences and the community facilities. The public sphere and the private homes above merge into a cohesive architectural unit. The section illustrates how the superimposed structure not only creates new spaces on top but also connects people and functions. Through this convergence, an architectural balance emerges. The transformation of the existing structure becomes a platform for community life and urban vibrancy.



63. Section BB of apartments, 1.100



65. The municipality

Chapter 05: Outro

Conclusion

In the intersection of the past and the present-day sustainable society, a specific potential of city development is created. In Odder – a city with strong roots and a growing wish to attract citizens as well as visitors – there is an opportunity to reinvent the urban spaces without deleting what already is. This project not only aims to create new volumes but also to sustain and develop connections across the city structure while strengthening existing qualities by making sustainable and aesthetic choices.

Remisen takes its stance in an area with an already assigned identity – the old railway workshop – and allows for that identity to be a new centre of attention in the neighbourhood through a new settlement. Through an architectural and engineering concept that respects and elevates the character of the area, a new layer is developed that stitches existing elements with future use. The new layer of a superimposed volume serves as an umbrella for modern expression, material awareness, and community functions.

The new settlement that is being built on top of past functions is highly attached to existing urban features. The site not only stands as an anchor point to diminish the distance between the city centre, station, and the surrounding green fields, but also as an emphasis of the path systems that are now protruding from the once unreachable site. Remisen is not only a new settlement – it is a city strategy. A strategy that enhances flow, connection, and a sense of community across social and physical boundaries. It is about making Odder a destination that communicates interaction rather than passive sighting. A place for residents and visitors where campers, commuters, and locals get together around a shared experience.

This approach is with a balance between scales; between the private and the public, the old and the new, the temporary and the permanent. The residential spaces are varied and offer different degrees of transparency. Some spaces, e.g., in the workshop, advocate for larger gatherings, while in the residential area, the columns communicate just enough shielding for a calm and reflective stay. Through these principles, both individual and collective needs are accommodated.

The project showcases how city development can set an example for respecting existing and historic structures and emphasizing elements which are already effective. By not tearing down and starting over, but building upon the present narrative, an architecture that anchors an area is created. The old workshop does not stand as a relic but as an active role in a new narrative of Odder as a modern, sustainable, and lively city.

The project is anchored in a process-based design method, where analytical studies and spatial considerations form the foundation for architectural decisions. By using Life Cycle Assessment (LCA) as a process tool, key design solutions have been evaluated to balance environmental performance with architectural ambition. Remisen demonstrates how architectural quality can be united with measurable reductions in environmental impact. This integration of method and material awareness illustrates how sustainable design can be operationalized without compromising contextual sensitivity or spatial quality. Remisen presents an alternative to conventional urban development — a project where resources are preserved, history is carried forward, and new connections emerge across past, present, and future.

This strategy underlines identity while building upon industrial heritage, social communities, and visitors for new authentic experiences. Remisen fills an unexplored area and bridges the gap around Banegårdsgade. Through this settlement, a new connection is created that creates a more accessible and inviting city. The field, the workshop, and the superimposed structure are a catalyst for urban regeneration through community-based design. The project is an example of how sustainable solutions do not have to compromise on functional or aesthetic choices but can be a driver for new values and connections. Finally, the design showcases how architecture and engineering can be both site-specific and forward-looking. By having respect for what is, strategic placement and material awareness open for new city development that not only builds for the future, but also with the past, for the community.

Reflection

The project's approach to transformation and reuse creates a strong narrative that connects the historic layers of the city with its future needs. However, it is essential to reflect on how the proposal could be further strengthened, both concerning the broader urban context and in its spatial detailing. This reflection is therefore structured across three presented scales: large, medium, and small.

Large-scale – City connection and identity

The proposal operates primarily within the boundaries of the former workshop area. A continued design process could have considered a more direct intervention at Banegårdsgade, a major infrastructural barrier in Odder. This intervention could have been illustrated in a statement crosswalk, emphasizing that it is essential to connect the historic neighbourhoods with the city centre. Addressing this would offer the opportunity to support pedestrian connections and enhance urban flow. A more deliberate architectural interface between the site and the road would clarify how the project diffuses into the city and invites people in, not as a dominant landmark, but as a welcoming threshold.

The project raises the question of whether it fully fulfils its role as a landmark. While the idea of a "modest landmark" is conceptually well suited to the context of Odder, the architectural expression might have benefited from a more articulated architectural form language to convey its transformative ambitions. This became apparent during visualizations of the context, suggesting that more studies focusing on human-scale perception and experience could have informed the process further.

Medium scale – The field and the role of nature

The project initially emerged from a focus on developing the park area, but shifted toward transforming the existing structure, resulting in nature becoming a secondary element. Yet, the potential for using nature as an active asset in the site's revitalization remains significant. The field has yet to be explored as a cleansing landscape with self-renewing vegetation, helping to decontaminate the industrial ground and support future buildability. This also aligns with the project's broader narrative of transformation over time - from industry, to nature, to habitation. Here, nature serves as both the city's green lounge and a storytelling element for sustainability.

While the design emphasizes the park's potential on the site, the field has the potential for a more powerful statement as an open public area with transitional spaces. Through a sequence of more defined areas as informal gathering spaces and green public courtyard, the design can enhance social function further and secure the intention of activity and engagement.

Small scale – Spatial comfort and microclimate

The superimposed typology introduces architectural opportunities, but also spatial challenges, especially regarding accessibility and microclimate. Elevating public space can unintentionally create a barrier to entry. Through further development of the entrance, this sequence would minimize the barrier from the elevated spaces onto the public ground. A careful design of the stairs can suggest a particular connection to the surrounding urban fabric.

Inside the superimposed volumes, the apartments unfold. These apartments suggest functionality and state an aesthetic choice. A strong argument for having the columns, which protrude from the workshop and carry these new volumes, as a part of the apartment's structural integrity, but also as an aesthetic element within the living spaces. These columns have the potential for creating a strong bond between the community within the workshop and the private sphere on top. While solar orientation and natural ventilation are implicitly integrated, this could be emphasized. A clear concept of operable facades and strategic vegetation can help modulate the indoor climate while extending outdoor areas.

The urban superimposed space in the present design allows for the prevailing western winds to pass through, which may result in discomfort. Integrating wind shielding - either through vegetation or architectural elements such as the column - could improve the usability and daily comfort of these spaces.

The design proposal showcases how transformation and reuse can create architectural quality with a stance on the historic and future potential of a place. Through a scaled approach to urban areas, landscape, and residential typologies, the narrative of Odder is rephrased. Yet, the reflection points out how this potential can be enhanced when nature is actively involved and the connections across city structures are more clearly communicated. Especially, an interconnection between the existing and the new architecture contains possibilities for a stronger connection both physically, socially, and aesthetically. It is not about replacing but to further enhance what already exists with care.

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List of Figures

Appendix 0: title page

AALBORG UNIVERSITET

THESIS TITLE PAGE

This form must be submitted for all theses written in programs under the Study Board of Architecture and Design, and it should be placed at the beginning of the appendix section of the assignment.

A printed copy of the form must be submitted along with the printed copy of the thesis.

The information given in this form must also be available in PURE.

(All fields must be filled out)

Program: **Architecture** ☒ **Industrial Design** ☐ **Urban Design** ☐
This thesis was written by (full name):
Andreas Schack Fredborg
Frederik Pongpao Holst Walther
Title of the thesis: Remisen
Supervisor´s name: Luis Filipe dos Santos
Submission date/year: 02-06-2025
Is the project confidential? **Yes** ☐ **No** ☒
External collaboration* **Yes** ☐ **No** ☒
External collaboration partner (name of company/organization):
Contact at external collaboration partner (title, name og email):

What is an external collaboration? Read more here.

Appendix 1: Be18

PYRAMIDS RESULTS

Building energy use	37.7 kWh/m²yr
Final energy use	34.5 kWh/m²yr
Primary energy use	23.76 kWh/m²yr

Nøgletal, kWh/m² år

Renoveringsklasse 2

Uden tillæg	Tillæg for særlige betingelser	Samlet energiramme
125,1	2,3	127,4
Samlet energibehov		23,8

Renoveringsklasse 1

Uden tillæg	Tillæg for særlige betingelser	Samlet energiramme
93,9	2,3	96,2
Samlet energibehov		23,8

Energiramme BR 2018

Uden tillæg	Tillæg for særlige betingelser	Samlet energiramme
54,7	2,3	57,0
Samlet energibehov		23,8

Energiramme lavenergi

Uden tillæg	Tillæg for særlige betingelser	Samlet energiramme
33,0	2,3	35,3
Samlet energibehov		23,8

Bidrag til energibehovet

Varme	39,8
El til bygningsdrift	-5,3
Overtemp. i rum	0,0

Netto behov

Rumopvarmning	27,8
Varmt brugsvand	9,9
Køling	0,0

Udvalgte elbehov

Belysning	4,5
Opvarmning af rum	0,0
Opvarmning af vbv	0,0
Varmepumpe	0,0
Ventilatorer	0,6
Pumper	0,0
Køling	0,0
Totalt elforbrug	11,9

Varmetab fra installationer

Rumopvarmning	2,2
Varmt brugsvand	4,7

Ydelse fra særlige kilder

Solvarme	0,0
Varmepumpe	0,0
Solceller	10,4
Vindmøller	0,0

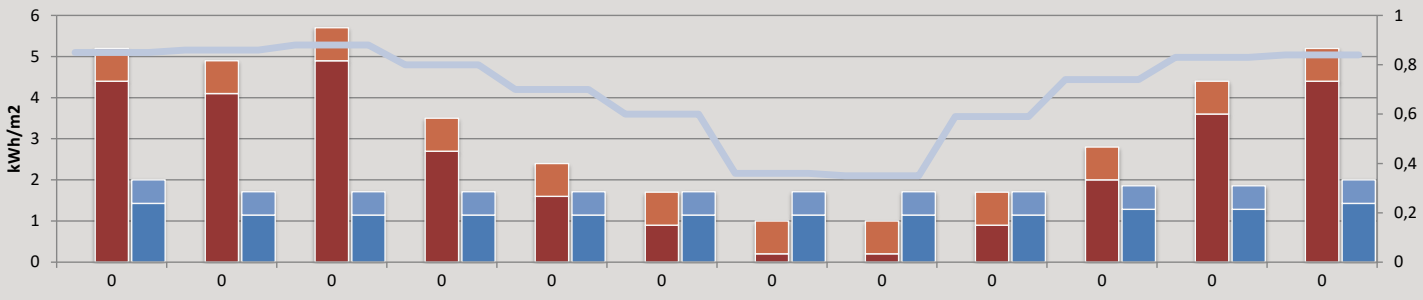
Primary energy use
39.8*0,85 (Primary energy factor, DH)=33.83
-5.3*1.9 (Primary energy factor EI) = -10.07

33.83-10.07 = 23.76

Final energy use

Building energy use

PV panels



- Pipes and DHW
- Internal gains
- Solar gains
- Domestic hot water
- Space heating
- Utilization factor

SUPERIMPOSED RESULTS

Building energy use	44 kWh/m²yr
Final energy use	49.4 kWh/m²yr
Primary energy use	23.49 kWh/m²yr

Nøgletal, kWh/m² år

Renoveringsklasse 2

Uden tillæg	Tillæg for særlige betingelser	Samlet energiramme
75,2	0,0	75,2
Samlet energibehov		23,5

Renoveringsklasse 1

Uden tillæg	Tillæg for særlige betingelser	Samlet energiramme
56,4	0,0	56,4
Samlet energibehov		23,5

Energiramme BR 2018

Uden tillæg	Tillæg for særlige betingelser	Samlet energiramme
32,4	0,0	32,4
Samlet energibehov		23,5

Energiramme lavenergi

Uden tillæg	Tillæg for særlige betingelser	Samlet energiramme
27,0	0,0	27,0
Samlet energibehov		23,5

Primary energy use
(44.4+5)*0,85 (Primary energy factor DH)=41.99
-10.1*1.83 (Primary energy factor EI) = -18.5

41.99-18.5 = 23.49

Bidrag til energibehovet

Varme	44,4
El til bygningsdrift	-10,1
Overtemp. i rum	5,0

Final energy use

Netto behov

Rumopvarmning	26,4
Varmt brugsvand	17,6
Køling	0,0

Building energy use

Udvalgte elbehov

Belysning	0,0
Opvarmning af rum	0,0
Opvarmning af vbv	0,0
Varmepumpe	0,0
Ventilatorer	2,4
Pumper	0,0
Køling	0,0
Totalt elforbrug	43,3

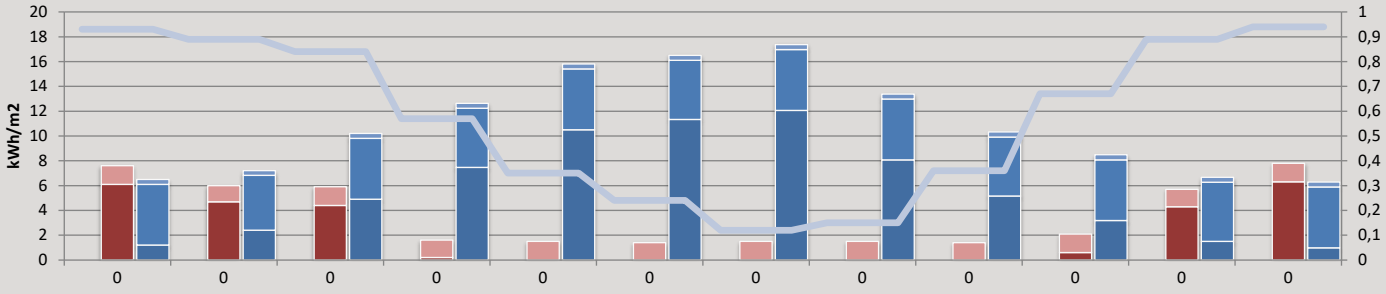
Varmetab fra installationer

Rumopvarmning	0,4
Varmt brugsvand	4,5

Ydelse fra særlige kilder

Solvarme	0,0
Varmepumpe	0,0
Solceller	12,5
Vindmøller	0,0

PV panels



Pipes and DHW
Internal gains
Solar gains
Domestic hot water
Space heating
Utilization factor

Appendix 2: Structural

BEAM ITERATIONS

Load-assumptions

Load type	Load [kN{m²]	Note
Inherent load/deck	0,25	Light wooden construction
Floor	1,00	Wooden floor with subflooring
Ceiling and insulation	0,15	Light roof construction with straw and wood fibre
Light partition	0,50	Light walls of wooden studs and insulation
Live load	2,00	Kategori A , Beboelse jf. DS/EN 1991-1-1 + DK NA

Iteration results

Beam type	Strength $f_{m,k}$ [MPa]	Dimensions [mm]	Moment capacity M_{Rd} [kNm]	Utillization
GL28h	28	60 x 400	31,0	81,3 %
GL32h	32	60 x 380	31,6	78,8%
Kerto-S	50	45 x 400	41,5	60,7 %
Kerto-Q	50	45 x 450	52,6	47,9 %

Moment capacity calculations

GL28h

Dimension: 60×400 mm
Karakteristisk styrke $f_{m,k}$: 28 MPa
Regningsmæssig styrke $f_{m,}d = f_{m,k} \times k_{mo}d / \gamma_m = 28 \times 0.9 / 1.3 = 19.38$ MPa
Tværsnitsmodstand $W = b \times h^2 / 6 = 60 \times 400^2 / 6 = 1600000$ mm^3
Momentkapacitet $M_rd = f_{m,}d \times W = 19.38 \times 1600000 = 31.0$ kNm
Udnyttelsesgrad $\eta = 25,2 / 31.0 = 81.3$ %

GL32h

Dimension: 60×380 mm
Karakteristisk styrke $f_{m,k}$: 32 MPa
Regningsmæssig styrke $f_{m,}d = f_{m,k} \times k_{mo}d / \gamma_m = 32 \times 0.9 / 1.3 = 22.15$ MPa
Tværsnitsmodstand $W = b \times h^2 / 6 = 60 \times 380^2 / 6 = 1444000$ mm^3
Momentkapacitet $M_rd = f_{m,}d \times W = 22.15 \times 1444000 = 32.0$ kNm
Udnyttelsesgrad $\eta = 25,2 / 32.0 = 78.8$ %

Kerto-S

Dimension: 45×400 mm
Karakteristisk styrke $f_{m,k}$: 50 MPa
Regningsmæssig styrke $f_{m,}d = f_{m,k} \times k_{mo}d / \gamma_m = 50 \times 0.9 / 1.3 = 34.62$ MPa
Tværsnitsmodstand $W = b \times h^2 / 6 = 45 \times 400^2 / 6 = 1200000$ mm^3
Momentkapacitet $M_rd = f_{m,}d \times W = 34.62 \times 1200000 = 41.5$ kNm
Udnyttelsesgrad $\eta = 25,2 / 41.5 = 60.7$ %

Kerto-Q

Dimension: 45×450 mm
Karakteristisk styrke $f_{m,k}$: 50 MPa
Regningsmæssig styrke $f_{m,}d = f_{m,k} \times k_{mo}d / \gamma_m = 50 \times 0.9 / 1.3 = 34.62$ MPa
Tværsnitsmodstand $W = b \times h^2 / 6 = 45 \times 450^2 / 6 = 1518750$ mm^3
Momentkapacitet $M_rd = f_{m,}d \times W = 34.62 \times 1518750 = 52.6$ kNm
Udnyttelsesgrad $\eta = 25,2 / 52.6 = 47.9$ %

Design capacity calculations

Column 1 C24

Dimension: 60 ×100 mm
Cross-sectionl area A =60 x 100 = 6000 mm^2
Characteristic compressive strength $f_{c,k}$ = 21 MPa
Partial safety factor γ_M = 1.3
Design strength $f_{c,d} = f_{c,k} / \gamma_M$ = 21 / 1.3 = 16.15 MPa
Design capacity $N_{Rd} = f_{c,d} \times A$ = 16.15 × 6000 / 1000 = 96.9 kN
Utilization = N_{Ed} / N_{Rd} = 12.53 / 96.9 = 12.9 %

Column 2 C24

Dimension: 65 × 95 mm
Cross-sectionl area A =65 × 95 = 6175 mm^2
Characteristic compressive strength $f_{c,k}$ = 21 MPa
Partial safety factor γ_M = 1.3
Design strength $f_{c,d} = f_{c,k} / \gamma_M$ = 21 / 1.3 = 16.15 MPa
Design capacity $N_{Rd} = f_{c,d} \times A$ = 16.15 × 6175 / 1000 = 99.7 kN
Utilization = N_{Ed} / N_{Rd} = 12.53 / 99.7 = 12.5 %

Column 3 C18

Dimension: 70 x 120 mm
Cross-sectionl area A = 70 x 120 = 8400 mm^2
Characteristic compressive strength $f_{c,k}$ = 18 MPa
Partial safety factor γ_M = 1.3
Design strength $f_{c,d} = f_{c,k} / \gamma_M$ = 18 / 1.3 = 13.85 MPa
Design capacity $N_{Rd} = f_{c,d} \times A$ = 13.85 × 8400 / 1000 = 116.3kN
Utilization = N_{Ed} / N_{Rd} = 12.53 / 116.3 = 10.7 %

Column 4 C18

Dimension: 75 x 115 mm
Cross-sectionl area A = 75 x 115 = 8625 mm^2
Characteristic compressive strength $f_{c,k}$ = 18 MPa
Partial safety factor γ_M = 1.3
Design strength $f_{c,d} = f_{c,k} / \gamma_M$ = 18 / 1.3 = 13.85 MPa
Design capacity $N_{Rd} = f_{c,d} \times A$ = 13.85 × 8625 / 1000 =119.4 kN
Utilization = N_{Ed} / N_{Rd} = 12.53 / 119.4 = 10.5 %

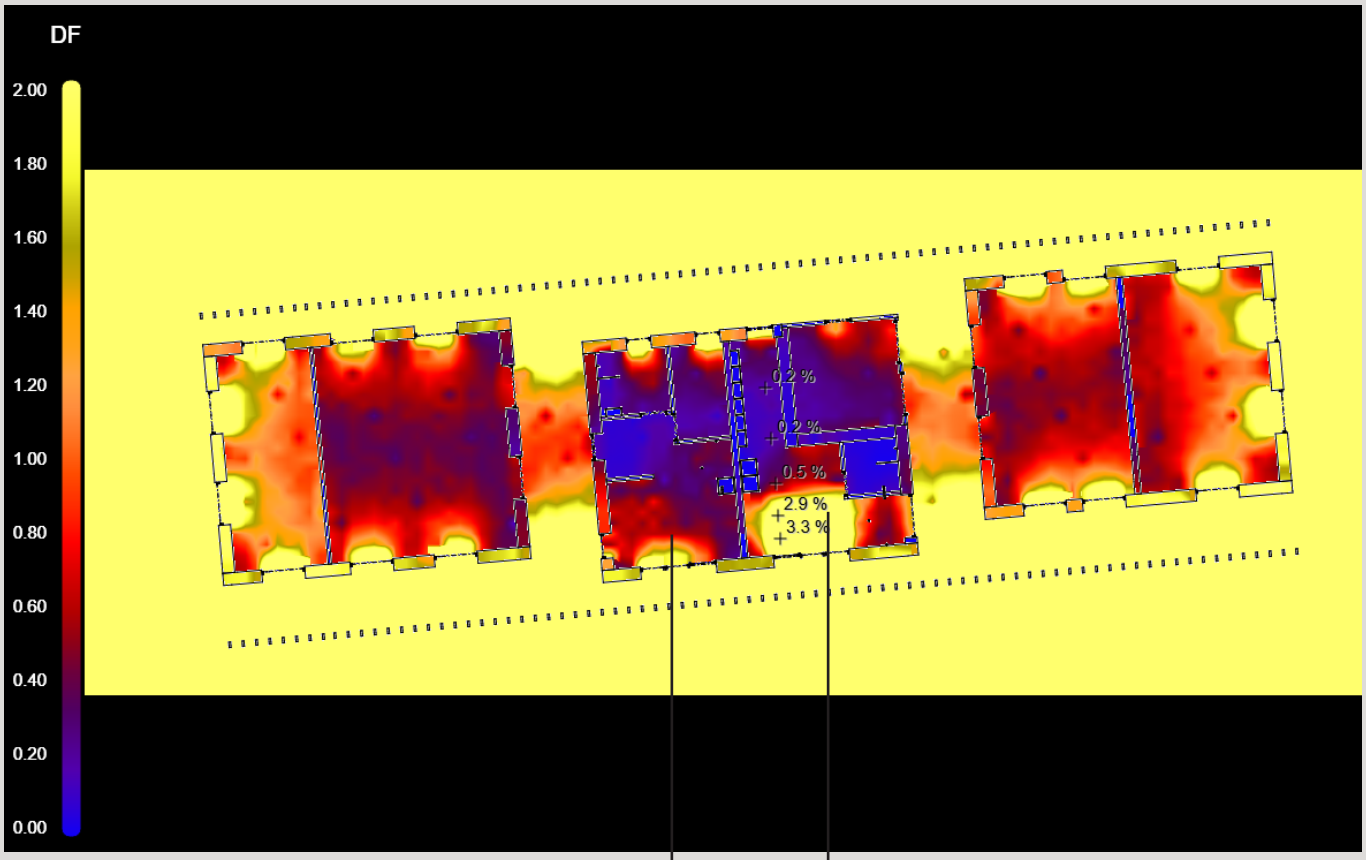
COLUMN DESIGN CAPACITY ITERATIONS

Sowcases a minimal load utilization which is why the beam is calculated for handeling buckling stress

Beam type	Characteristic compressive strength $f_{c,k}$ [MPa]	Dimensions [mm]	Design capacity N_{Rd} [kN]	Utillization
Column 1 C24	21	60 x 100	96.9	12,9 %
Column 2 C24	21	65 x 95	99.7	12.5%
Column 3 C18	18	70 x 120	116.3	10.7 %
Column 4 C18	18	75 x 115	119.4	10.5 %

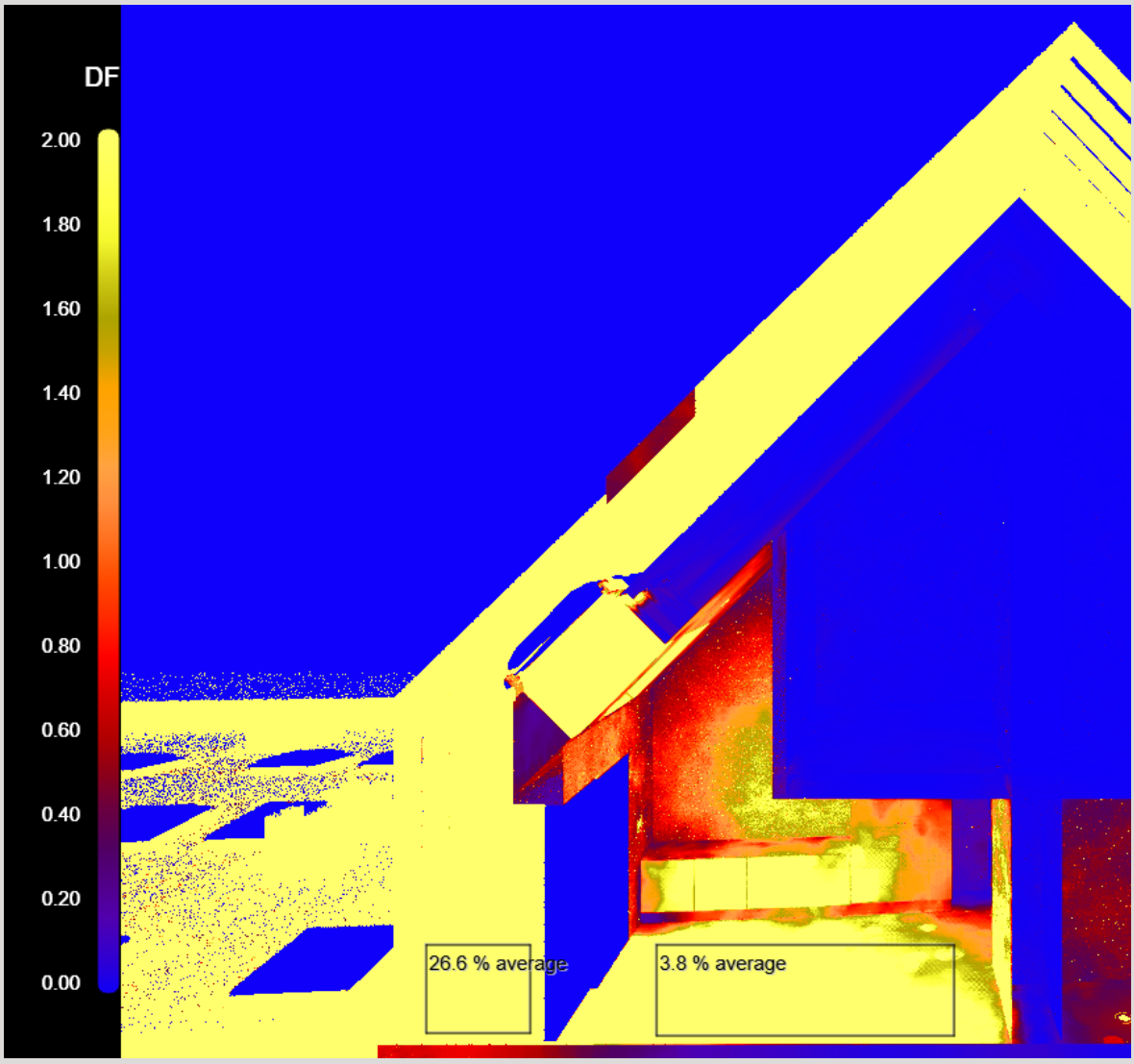
Appendix 3: Daylight analysis

SKYLIGHT IMPACT



FACADE WINDOW +SKYLIGHT

FACADE WINDOW



INCREASES THE DEPTH WHICH NATURAL LIGHT REACHES

Appendix 4: LCA calc.

LCA improvements

This spread shows the improvements made in material choices based on the final design.

THE WORKSHOP TRANSFORMATION

MATERIAL CHOICE

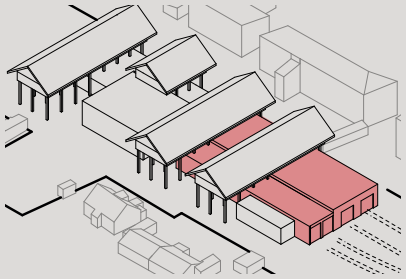
The baseline for the material choices was inspired by the 4til1 Planet project. As a result, the materials were not necessarily selected specifically for this project's context. The following section will contextualize the choices made. Since the baseline was set with a low CO_2 impact, modifying the materials often results in a higher GWP than before.

The primary design change for the pyramids was the replacement of the thatched roof and walls with shingles. Although this results in a slightly higher GWP, it reduces overall material use by enabling a lighter roof structure and reducing the need for heavy load-bearing elements. Additionally, in the interior context, the intention was to visually downscale the volumes by introducing shingles.

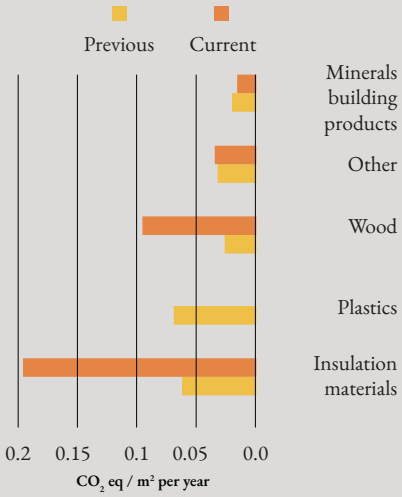
Other improvements include replacing EPS foam with wood fiber insulation to minimize the use of non-biobased materials, and substituting the plastic vapor retarder with a biobased alternative. These changes led to an increased GWP of 4.282 kg CO_2eq/m² per year.

While some material changes slightly increase the GWP, they improve circularity and reduce material quantities.

thatched	→	shingles
EPS	→	Woodfibre
Plastic vapor barrier	→	Biobased vapor break



Heated floor area	*180 m²*
Gross floor area	*180 m²*
Integrated garage	*1530 m²*
Operational electricity use	*32 kWh /m² per year*
Operational heat use	*32 kWh /m² per year*



PREVIOUS

4.15

CO_2 eq / m² per year

CURRENT

4.28

CO_2 eq / m² per year

THE SUPERIMPOSED APARTMENTS

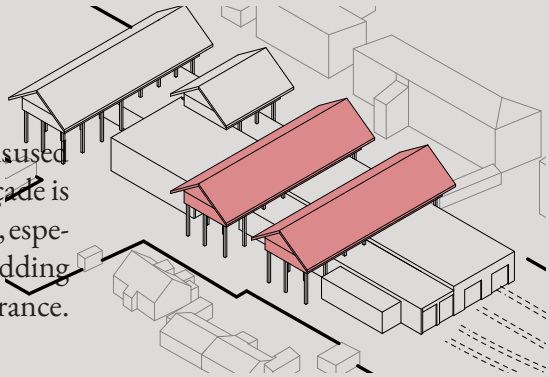
MATERIAL CHOICE

The superimposed apartments align more closely with the materials used in the baseline. Therefore, the thatched roof is retained, but the façade is replaced with wooden cladding. This change was made to add depth, especially along the long facades with overhangs. Similarly, wooden cladding was applied to the gables to provide a warm and welcoming appearance.

This study also includes a comparison between using screw pile foundations and reusing the existing concrete foundation. Some columns remain positioned outside the original workshop volume, which would require new screw pile foundations.

As in the first study, the aim is to minimize the use of non-biobased materials. Plastic has therefore been replaced with bio-based vapor barriers. This also contributes to a more cohesive building envelope, as the hempcrete walls are constructed without a vapor barrier.

Overall, these design decisions result in a lower GWP, primarily due to the reuse of the existing concrete foundation.

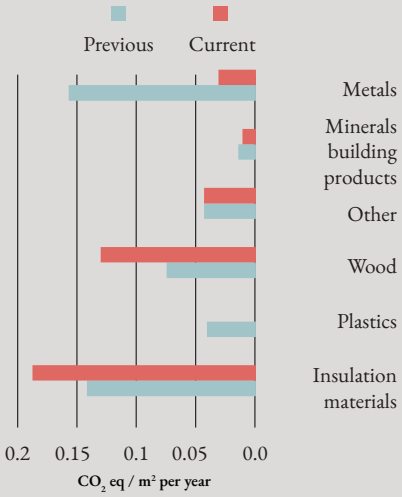


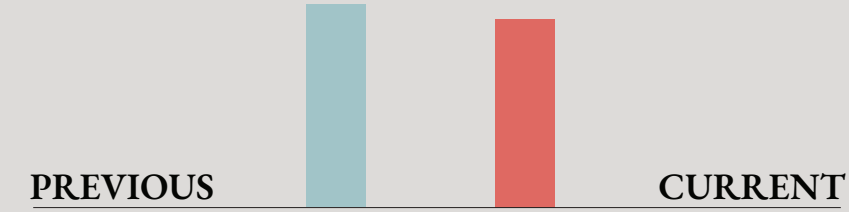
Heated floor area	*576 m²*
Gross floor area	*576 m²*
Integrated garage	*158 m²*
Operational electricity use	*32 kWh /m² per year*
Operational heat use	*32 kWh /m² per year*

Screw pile foundation → Reusing existing concrete

Facade thatch → Wood cladding

Plastic vapor barrier → Biobased vapor break





PREVIOUS

5.43

CO_2 eq / m² per year

CURRENT

5.04

CO_2 eq / m² per year

Appendix 5: copyright agreements

ROSKILE FOLK HIGH SCHOOL PICTURES

CREDITED: RASMUS HJORTSHØJ, COAST STUDIO

Tilladelse til brug af billeder

Indbakke ×

Frederik Holst Walther <fholstw@gmail.com>
til info

man. 19. maj, 11.18 (for 2 dage siden)

Hej Rasmus,

I forbindelse med vores master thesis vil vi gerne spørge om tilladelse til at bruge jeres fotos af Roskilde festival folk highschool (Cobe + MVRDV).

Det er udelukkende for at sikre, at vi overholder ophavsretten, at vi anmoder om tilladelse – Du vil naturligvis stadig blive krediteret i forbindelse med billederne.

Må vi derfor få tilladelse til at bruge dine fotos af projektet i vores akademiske master thesis?

Billederne er fundet her:

https://www.archdaily.com/912035/roskilde-festival-folk-high-school-mvrdv-plus-cobe/5c7003aa284dd1cf9b00007c-roskilde-festival-folk-high-school-mvrdv-plus-cobe-photo?next_project=no

På forhånd tak for hjælpen!

Med venlig hilsen
Andreas Schack Fredborg
Frederik Pongpao Holst Walther

Frederik Holst Walther

13.50 (for 45 minutter siden)

Som aftalt på telefon videresender jeg mailen igen. :) Tak for venligheden! Hilsen Frederik

Rasmus Hjortshøj <rh@rasmushjortshoj.com>
til mig

14.07 (for 28 minutter siden)

hej Frederik
I må gerne bruge billederne.
Rasmus

Master Thesis Project

2025