# Going Beyond Sustainability:

## A Regenerative Housing Block for Oulu Housing Fair 2025

MASTER'S THESIS, AALTO UNIVERSITY SCHOOL OF ARTS, DESIGN AND ARCHITECTURE
ANASTASIA LUZINA

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# Abstract



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**Master of Arts thesis abstract**

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**Abstract**

The construction industry currently follows the linear economy model, where natural resources are used in such a way that they become waste at the end of their life cycle. This traditional model prioritizes profit over ecology and has no concern for the ecological footprint and its consequences.

The circular and linear systems differ from each other in the way the value of a product is created and maintained. With the goal of the circular economy, we try to close the loops of raw materials. The concept promotes sharing, reusing, repairing and recycling materials and products for as long as possible.

Nowadays, sustainability in construction is a measure for current and future architectural design that aims to reduce the damage caused by excessive resource consumption. Rather than reducing environmental damage, we should learn to participate with the environment by using the quality of ecological systems as a basis for design. (Reed, 2007) The premise of regenerative design is that everything we build has the potential to integrate the natural world into architecture as an equal partner. It goes beyond "sustainable" living and aims to re-build the environment.

The project explores regenerative economy solutions in timber construction and aims to utilize them in a design of a housing block for the Oulu Housing Fair 2025 area. The work mainly focuses on architectural solutions that can be applied to the skins and roofs of the building. The aim of the background study is to explore examples of regenerative design solutions and to find out to what extent they can be implemented in contemporary housing and in particular in timber construction.

**Keywords** regenerative architecture, sustainability, timber construction, housing design

# Contents

# Introduction to Regenerative Architecture

I

**In the built environment, sustainability is primarily a matter of efficiency. As a result, environmental rating systems and other mechanisms help to reduce the damage caused by excessive resource consumption. It is more important to learn how to participate with the environment rather than cause less damage. Consumer society can move from fragmented to whole systems thinking by understanding living system interrelationships. With a place-based approach, the designers can create a stable system of mutually beneficial relationships. Hence, ecological design has the potential to not just sustain the environment but also regenerate it.**



## From Sustainability to Regenerative Design

Architects and other representatives of the built environment have been touting sustainable design for the last few decades. At the end of 20s century, due to decreasing amount of fossil deposits and the pollution they caused, as well as the threat of climate change, the quality of the environment has become an important issue for human life. In the field of architecture, climatic and sustainable design have got a significant role starting from the 70s. (E. Postalci, 2018) Energy efficiency and environmental protection were part of the earlier movements. The term sustainability became part of our lexicon in the 1980s when the World Commission on Environment and Development defined sustainability as “meeting the needs of the present without compromising the ability of future generations to meet their own needs”. In the 1990s the term was associated with design and construction approaches that minimize environmental harm.

In modern society, sustainable design in construction means making buildings “less bad”. (Ar. Surabhi Bankhele, Dr. Parag Narkhede, 2019) Currently, a building is called “sustainable” if it considers very little compared to the ecological crisis we’re facing at present. Architects define sustainable architecture as a structure that doesn’t harm the environment by utilizing certain approaches, systems, or materials, such as:

- The tight and compact plan and well-insulated envelope of the building will save energy,
- Pre-cutting materials off-site minimizes job waste,
- Investing in high-efficiency appliances,
- Utilizing non-toxic materials,
- Systematic use of nature’s resources in a mindful manner: rainwater catchment, solar, wind, geothermal, etc.

Rather, regenerative architecture engages the natural world as the medium for and generator of buildings. (Littman, 2009) It tends to utilize the natural systems that exist on a site. An architect who practices regenerative architecture focuses on conservation and performance by reducing a building’s environmental impact by choosing more efficient materials, reducing energy consumption, etc. Architecture based on regenerative design integrates the natural world as an aqual shareholder with every building we construct.

So, what is regenerative? The idea behind regeneration is that we are re-building something when sustainability means low or no negative impacts (net-zero homes, carbon-neutral buildings). And it’s not just the environment, but also society and the economy that we want to rebuild.

Here are a few more ways to consider the difference between sustainable versus regenerative: (Coughlan, 2010)

| | |
|---|---|
| Extractive | Regenerative |
| Hierarchy | Networks |
| Compete in existing markets | Collaborate and create new markets |
| Independence | Interdependence |
| Design of systems | Design of ecosystems |

# Regenerative Architecture

The term architecture, which is commonly defined as the practice of designing and making buildings (Merriam-Webster Dictionary), would be incomplete if we considered architecture as merely a building, which obliterates the possibilities for regeneration and integration. Architecture exists as a part of a site. To design a building that would become a supplementing part of the landscape, designers should not consider them as separate elements. In this way, the term regenerative architecture could be defined as the practice of designing and constructing a place, by integrating the site and building. (Littman, 2009)

The diagram below shows the actual model of treating resources and materials versus the model of a regenerative system.
a. When the site and buildings don't integrate, all kinds of resources have to be constantly added for maintenance, which ultimately turns out in waste. This is a process of degeneration, which has been constantly promoted by our consumer society.
b. In regenerative systems, the integration of architecture and the environment aims to assist the organic processes of nature, where everything that is produced gets recycled.

The built environment is called regenerative when it encompasses more than just buildings. Thus, places, systems, energy, buildings, fauna, and flora are all part of the architecture, which is naturally integrated into the environment. When the ecosystem's health improves, and the architecture is generating more recourses than consumed, the system is regenerative. (Littman, 2009) With this understanding, architecture produces more food, more energy, more and cleaner water, and greater diversity, compared to the current model of recourse treatment.

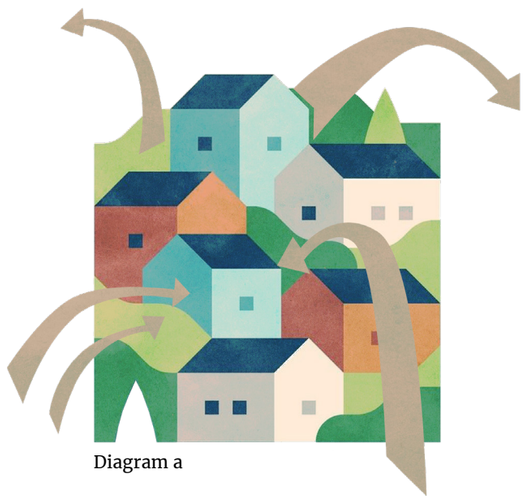


Diagram a

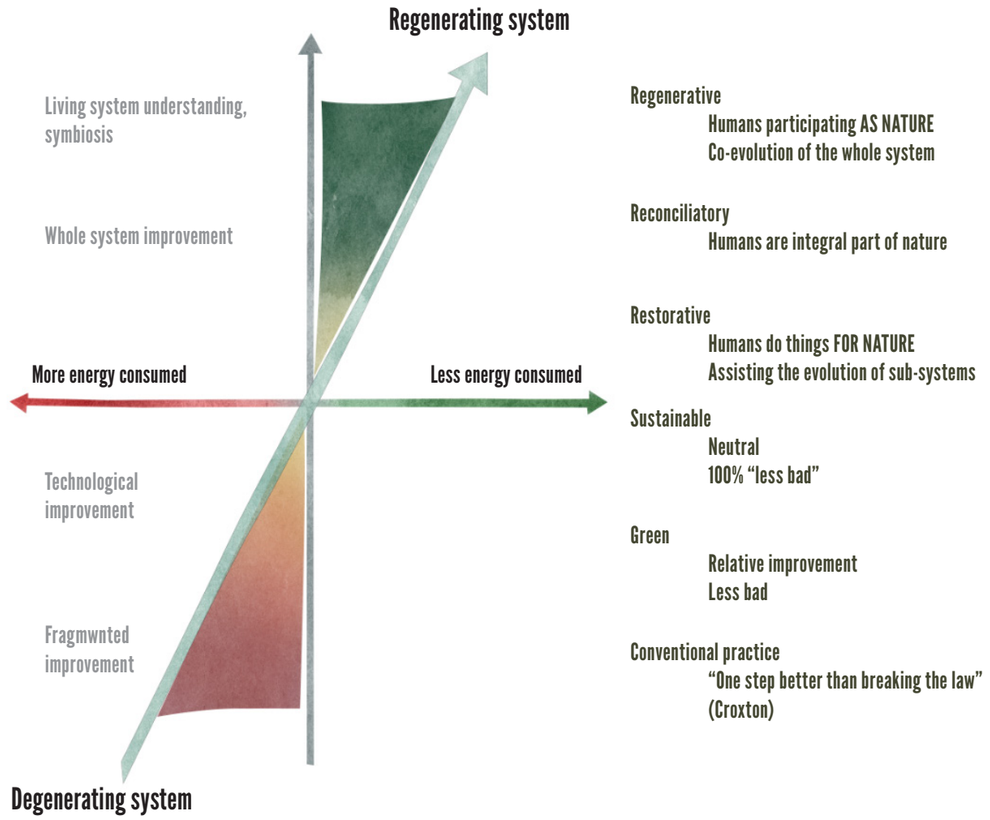
Diagram b

Thus, regenerative design focuses on the development of the whole system we are part of. A design process that involves all the main stakeholders in the place, including humans, earth, and biotic systems, makes it possible to develop a healthy and cyclic relationship through co-evolution. As part of the design process, feedback, reflection, and dialogue are used to foster continuous learning so that all aspects of the system are a part of the place's life.

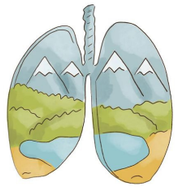
The goal of regeneration is not just to improve a landscape and local habitat; it is to engage all of what makes a place healthy. (Littman, 2009) From a whole systems perspective, any of these entities can be viewed as part of a living system and a key role can be found for any entity within any size physical footprint.

The regenerative approach should completely change our understanding of our relationship with nature. In this way, the term "environment" does not mean a place, but this is the world that is also within us.

The diagram below shows the trajectory of environmental responsibility in design and architecture (Reed, 2007):



# Principles of Regenerative Design



**1. Ecology, health, and society all benefit from regenerative design:**

In order to remediate the harm caused by decades of conventional development, regenerative design projects concentrate on these three areas. (Cowan, Van Der Ryn, 1996) The regenerative design approach stimulates natural ecological systems and actively engages in unique, place-driven social processes.

**2. Design grows from a place:**

Regenerative design starts with the intimate knowledge of a particular place.(Cowan, Van Der Ryn, 1996) The regenerative design promotes the mindset, that everything is connected and is a part of a greater whole. An architect should look beyond the building to define the correct setting and the identity of the building. Regenerative design cannot start with a napkin sketch, it is driven by a deep understanding of the context and the role of the structure as a part of the environment.

**3. Regenerative design can be applied to projects of all types and scales:**

The regenerative design approach can accommodate projects of different sizes, types, and scales. Regenerative project goals are established within its site parameters. To understand the place and climate, design teams use parametric analytic software, geographical maps, federal agencies, and weather data.

**4. Conservation instead of preservation:**

Designers need to understand the difference between conservation and preservation. Regenerative design aims more at conservation due to its focus on natural systems rather than the built environment. Instead, preservation tends to keep the existing ecosystems without allowing them to develop and change naturally. Thus, conservation is another fundamental principle in regenerative design.

**5. Regenerative design relies on existing paradigms of the natural environment: (McDonough, 1992)**

- Energy, waste, and water net-zero
- Decentralization and distribution
- Carbon balance
- Natural materials
- Social equity

**6. Every stakeholder is a designer:**

Stimulating diversity by bringing together different groups of stakeholders each playing an important role in the development of a place brings versatile life to places. Having the community participate in the design process not only brings natural diversity but also makes users feel belonging to the place and develops responsibility for its maintenance.

Such a design approach might change our thinking about building the entire life cycle and its impacts on the local community and ecology. Regenerative design increased the availability of resources and provides opportunities for new suppliers. Also, it changes our perspective on community development, making it important to plan for at-risk populations, promote affordable housing, and incorporate social equity concerns.

# Guiding Regenerative Design Strategies

Regenerative design aims to achieve net-positive development using a whole system approach that reconnects ecology, economy and society. The design takes into account the interaction between the building and the site during the life cycle of the building. (Persson, 2022) The regenerative design requires involvment of project stakeholders during the design process and during the operation period of the building.

In regenerative design, process- and site-oriented management techniques can be applied to decisions that affect material selection and energy consumption. In addition to their impact on the natural environment, these processes should also bring social benefits to the community. Regenerative design aims to create projects that focus on people and the planet and are ecologically restorative.

The architect must have a discussion with the client at the beginning of the project to understand what strategies would they be willing to push forward in terms of regenerative design.

The following are some of the main regenerative design strategies:


Woodcube in Hamburg, Germany. Photo: IBA Hamburg/Martin Kunze

**Use of sustainable materials**

Sustainable materials, that are used to lower the environmental impact, can be recycled or reused at the end of their lifecycle, and are responsibly sourced.

Biesbosch Museum, National Park De Biesbosch, the Netherlands. Photo: Ronald Tilleman

**Biodiversity preservation, Green Roofs & Skins**

Regenerative design prioritizes the preservation of biodiversity and ecosystem health, by promoting the use of vegetation, green roofs, and exterior shells that clean the surrounding air and sequester carbon, and other design strategies that support the local ecology. This can include the use of native plant species, the creation of wildlife habitats, and the incorporation of natural stormwater management systems.

Refugee Housing in Winnenden, Germany by Werner Sobek. Photo: Peter Oppenländer

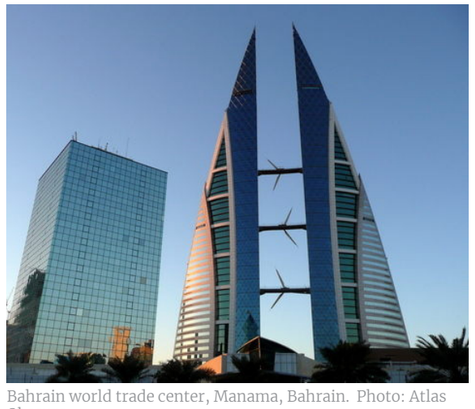
**Waste Reduction and Management**

The regenerative design prioritizes the reduction of waste generated during the building lifecycle: during the construction phase by using prefabrication and modular systems, and in the use phase by the implementation of green waste management practices.

Rio 2016 Olympic Golf Course, Brazil. Photo: Leonardo Finotti

**Water Conservation & Management**

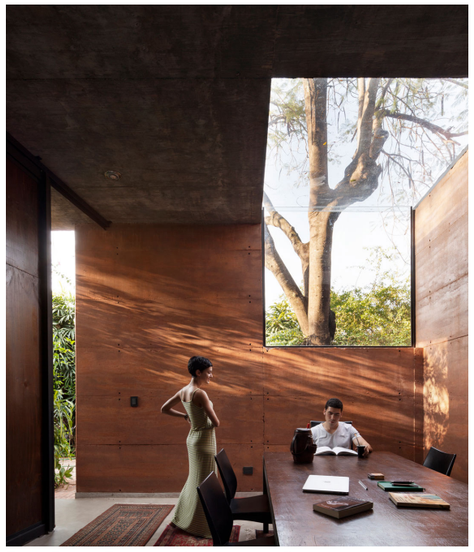
Construction of wetlands that capture and naturally store rainwater is a useful tool for replenishing underground aquifers. Despite the high cost and low return on investment associated with local water treatment, it can result in significant long-term resource savings that easily overshadow short-term financial gains.



Bahrain world trade center, Manama, Bahrain. Photo: Atlas Obscura

**Energy Efficient Design**

Thermally efficient building envelope design reduces the load on mechanical systems. It is also important to design buildings to generate and collect energy resources on-site so that they are less dependent on the utility grid. The stored energy could be used during nighttime hours, for example. Moreover, it could serve as an additional energy source for the surrounding community, reducing their dependence on larger utilities. Renewable technologies such as solar panels and wind turbines are used in many projects today. New technologies are being added every day, such as biodiesel plants that convert solid waste into energy.



Earth Box by Equipo de Arquitectura, Paraguay. Photo: Federico Cairoli, Leonardo Mendez

**Indoor Environmental Quality**

Design of the environment that promotes the health and well-being of users should consider aspects such as natural ventilation, daylighting, and the use of non-toxic materials.

In spite of the fact that some regenerative design strategies have been around for some time, there is still the opportunity to push the boundaries of this field. The building provides us more than just a shelter - it promotes well-being, teaches, and inspires, which are less perceptible, yet still very important, outcomes of regenerative design.

# Designing Regenerative Housing

II

**The majority of the world's population lives in cities, which consume 75% of natural resources and generate 50% of global waste. (Global status report 2017, UNEP) In order for the built environment to be net-positive in the future, regenerative design encourages us to rethink the ways in which the built environment can affect societal resilience, our planet's health, and ecological systems. To move forward toward regenerative design and regenerative systems for our planet, we must understand how to design for all species while respecting planetary boundaries and using science-based goals.**

A home is a place where many of us restore. But what if we could extend its restorative and regenerative properties to the rest of the planet? The chapter takes a closer look at how we can design houses that are better for both the human and the planet.

The regenerative housing project tends to demonstrate that it is possible to create a prototype combining smart and regenerative design and technology solutions with inclusive co-housing principles. Potential residents will be involved from the beginning in the transformation of a brownfield site into an energy-efficient multi-story building with apartments of varying sizes.

The chapter studies the key solutions in housing design, related to both construction technologies and social issues. As part of the project, the study helps to set goals for promoting the circular economy in the design of the housing block and incorporating the circular economy into the planning process from the beginning.

The first part of the chapter will focus on the technological issues. The regenerative approach in the built environment challenges us to construct near-zero energy buildings, use modular structures, and recycled materials, and decrease waste flow and water consumption. Furthermore, a sustainable approach would also help to achieve social justice. For example, investing in energy technologies would consequently reduce energy bills, and therefore the price of our daily life.

Solutions, related to community participation, selection of users, public program, and co-design strategies, will be defined in the second part of the study.

The project aims to form a community of residents who live together in a supportive and collaborative way. In order to encourage and support this process, it is important to involve the future tenants in a co-design process and plan a training program for them. The intent is to develop a strong community with a mixed group of residents in terms of age, social, and cultural background. Special emphasis is placed on self-sufficiency and achieving a degree of independence. The building program specifies the ratios of certain spaces, both personal and public, in terms of functionality.

Having ambitions in both technological and social issues, the trick is to find a good balance. Investing in energy-efficient techniques, for example, might be weighed against the option of building a single or even two more housing units instead. In addition, if the housing units are of higher quality than regular social housing, they will attract some middle-class residents as well. Thus, to allocate housing to the original population, clear and objective criteria are needed.

# Regenerative Economy in Construction

Construction field currently follows the linear economic model in which natural resources are used so that the materials end up as waste at the end of their life cycle. According to official statistics, the European Union currently produces more than 2,5 b. tons of waste in a year. (European Parliament, 2016) To promote more sustainable model and to extend the life cycle of the products the EU Parliament is renewing the legislation on waste management. Thus, the recent proposals include promoting internal market of sustainable products and updating construction products regulation. (European Commission, 2022)

The regenerative economy aims to keep raw materials in circulation. The use of new raw materials is minimized, the reuse of products and their parts is maximized, and at the end of the life cycle, the raw materials of the products are returned to the cycle as new raw materials. Value creation is thus based on preservation and positive contributions for nature and society. (Versnellingshuis Nederland circulair!, 2020.) Regenerative economy operating models include waste minimization, distribution, restoration, repair, reuse, and recycling.

The transition to a regenerative economy brings changes to all parts of the value chain: new ways of transforming waste into recyclable raw materials, innovations in product design, new markets and new models of consumer behavior are required.

Designing the building for demolition and choosing the right material palette helps the most valuable raw materials stay in the loop. During use, the longevity of materials and structural components is ensured through timely maintenance and repair.

**Optimization of elements and materials**

**Material choices: long-lasting structures**

Choosing the right materials is one of the most important requirements for maintainability, disassembly and material circulation. The choice of materials made in the design phase affects the dismantlability of parts of the building and the possibility of sorting the different materials.

A building can be divided into different assemblies based on the expected life cycle of the parts. The site and foundation are usually the most lasting parts of the building and do not need to be changed during use. Similarly, the bearing structure is often a permanent part that is rarely changed. The exterior envelope, on the other hand, is constantly exposed and suffers from weather conditions, and therefore requires regular maintenance and repair. Room layouts are flexible as uses may change within the needs of the users.

**Use local production and materials**

A sustainable building should be built with local materials, that can be produced locally and used without negative impact on the environment, reducing the need for travel.

As for the yard, it is possible to keep materials circulating on site. The earth excavated from the site can be used to build a yard on the same site. In addition, vegetation removed from the building site can be used for the yard or green roof.

**Recycling-based products and structures**

The development and use of recycled materials must take into account the harmlessness and quality of the materials to avoid health problems and environmental damage during use and at the end of their life cycle.

**Maintainability and decomposability: easily separated and reusable structures**

Designing the building to be demolished and choosing the right range of materials will support the circulation of valuable materials. Maintenance and repair will ensure the longevity of materials and structural components. According to the waste hierarchy, the parts that are removed from the building during repairs or at the end of the life cycle should, if possible, be reused for the same purpose as their original function. (Häkkinen & Kuittinen, 2020) The second option would be to separate structures and recycle materials. Only as a last option the materials can be diverted to landfill or energy use.

**Reducing waste**

Reuse, repair, and recycling – these are the primary principles for the use phase and are mostly the responsibility of users, but the design can also provide an appropriate framework for the realization of these imperatives. They can be achieved by encouraging multipurpose use of the space and by designing the space with the goal of extending the life cycle of goods and reducing waste.

**Flexibility**

A multipurpose space can be adapted to a variety of functions in a short period of time without making significant changes to the building's structures or technical systems. A transformable space, on the other hand, is able to respond to significant changes in user needs through structural or technological changes.

**Optimized layouts and structures**

Defining an optimal shape of the building would affect both material and energy efficiency. Prefabrication of building parts, elements, and modules can also help to reduce waste.

**Alternative energy recourses**

Optimization of recourses includes the use of renewable energy sources, energy-efficient solutions, and structural solar shading systems instead of cooling.

**Waste water management**

If wastewater is not properly treated, the environment and human health can be negatively impacted. Alternative residential wastewater treatment systems are designed to treat all of the liquid waste generated within the building. Such systems can clean reusable water so that it can be used for other purposes like watering plants, outdoor cleaning etc. Technical solutions can also reduce energy and water consumption during use. According to researches, households that use consumption-based water billing use about 8% less water than households where consumption-based billing was not used. That method can therefore encourage residents to save water.

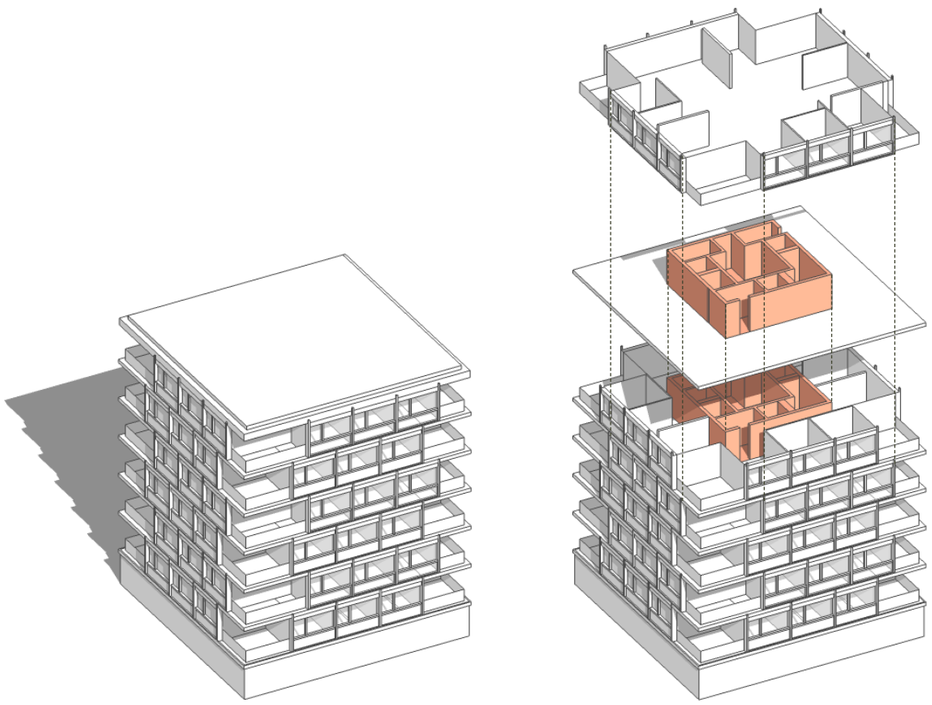
**Promoting and increasing biodiversity**

The goal is not to remove the existing vegetation, soil, and aquatic ecosystems, but to preserve them and use them as part of the design.

**Reduction of earthworks and contact points between the ground surface**

To reduce the earthworks and contact points, it is recommended to select a site with good subsoil conditions to avoid the use of heavy foundation methods such as piling and stabilization.

# Case Study: Bellevue apartments



Living floor plan

**Location: Luzern, LU, Switzerland**
**Architects: alp Architektur Lischer Partner**
**Gross Floor Area: 10,000 sqft - 25,000 sqft**
**Year: 2014**
**Photographs : Roger Frei**

The Bellevue housing with 18 holiday apartments is located near Rigi Kaltbad alpine resort on the old Hotel Bellevue site.

The project is an example of a structural solution, that allows to host different functions during the life cycle of the building. The solid building with a square plan shape consists of two elements: a heavy-weight minimalistic concrete basement and a lightweight 6 floor transparent structure made of wood and glass. The main bearing element is the core structure, that includes all the communications, transportation (stairs, lift) and technical apartment spaces (entrance halls, bathrooms), and enables a column-free living spaces with a high degree of flexibility.

The building is constructed out of modular structural and facade elements, that can be disassembled in the end of the life cycle of the building and recycled.

Photo: Roger Frei

# Use Phase: Design Solutions that Support Regenerative Economy

This subsection explores how planning and design can help achieve the goals of the regenerative economy during the use phase of the building. It includes solutions that extend the life cycle of the building, promotes sharing instead of owning, reduce waste, provide biodiversity and support local producers.

Although the sharing economy is the responsibility of residents themselves, it can still be supported by providing alternatives for users.

Photo: pinterest.com

**Cohousing**

The co-housing concept proposes a lifestyle in which residents tend to live “lighter” on the land and become part of a true community where they have deeper relationships with their neighbours. Co-housing allows a small neighbourhood of 10 to 35 families to share a large community facility and live in individual homes with smaller floor plans around this common space.

Creating diverse, walkable, and socially cohesive neighbourhoods is worthwhile in itself, but has another purpose as part of a regenerative vision for local communities. Cohousing neighbourhoods can serve as a vehicle for innovation in shaping a sustainable future and bringing about more rapid social change.

Photo: flickr.com

**Sharing Economy**

The realization of the sharing economy can be promoted through design by enabling sharing instead of owning. Leasing and renting offer an alternative to buying and owning that is closely linked to the linear economy, increasing the level of use of goods and facilities and reducing their environmental impact and the carbon footprint of their users. In addition to services, sharing can also be based on borrowing or group ownership.

The sharing economy in an apartment building or apartment block can be implemented through shared cars or bicycles.

Common spaces can also include, for example, a “library” managed by residents or an outside entity from which residents can borrow or rent hobby equipment or tools, for example, without having to own them. A well-equipped community kitchen, in turn, can reduce the need to own large dishes or kitchen utensils that are used less frequently - while also making it possible to organize larger parties than in a private apartment. The courtyard, which is versatile and encourages residents to be active, offers the opportunity to try growing food, for example, without having the necessary resources.

Adirondack House by Gray Organschi Architecture . Photo: Matthew Williams

**Multifunctional spaces**

In a sufficiently large and sufficiently high room, it is possible to organize either different functions at the same time or different functions at different times. However, multiple uses can also be supported by furniture. For example, multipurpose furniture that serves different purposes and furniture that is integrated into the structure of the space, easily moved or folded, can serve to change the purpose of the use of the space easily and quickly. Partitions can also be used to divide the space into different functions.

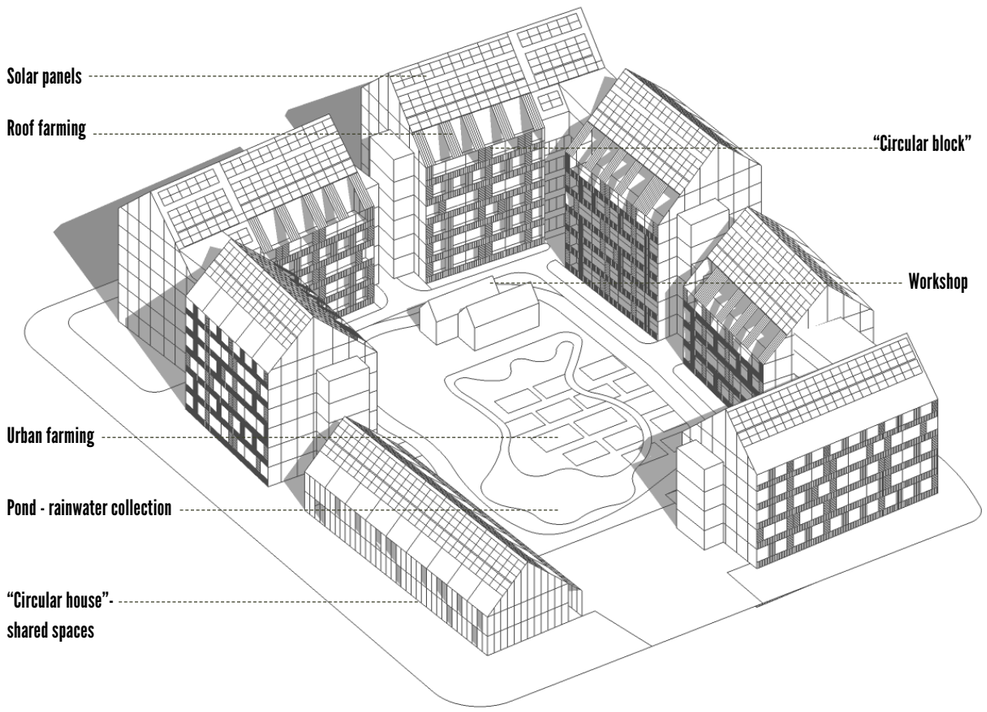

Design and photo: bureau Skyline

**Recycling and waste management**

Reuse, repair, and recycling - are primarily related to the life cycle of goods during use and are therefore mostly the responsibility of users, but design can provide an appropriate framework for the realization of these aims. They can be met by encouraging multipurpose use of spaces and by designing them with the goal of extending the life of goods and reducing waste.

The design of the living environment can support, hinder, or even prevent residents’ sustainable behaviors. For example, waste sorting can be supported by the color of sorting bins, which attracts attention, and the size or number of bins, which serve to estimate the average proportions fractions should be generated if properly sorted. In apartments, adequate space should also be reserved for waste sorting, for example, within the kitchen cabinets. Locating the sorting point at a natural access route in the housing cooperative would also help to make sorting as easy as possible. By designing the building’s irrigation systems to capture rainwater as irrigation water for maintaining the property’s plantings, it is possible to reduce the stormwater load on the surrounding area and reduce water consumption.

# Case Study: TaiSugar Circular Village (TCV)




**Location: Tainan, Taiwan**
**Architects: Bio-architecture Formosana**
**Site area: 4500 m²**
**Gross Floor Area: 28580 m²**
**Year: 2021**
**Photographs: Studio Millspace, Yue-Lun Tsai**

TaiSugar Circular Village is an experimental project, focused on the circular economy concept, which became a part of the Shalun Smart Green Energy Science City grid in Tainan, Taiwan. The master plan of the town was coordinated by the government starting in 2016 and was aiming to create an ecosystem that co-develops with the natural environment, supports a circular economy and contributes to the human-oriented community.

The design represents a housing quarter that contains 3 identical “Circular Blocks”, a “Circular Field” with an “E-House”, “C-House” and “C-Farm”. The last three listed create a group of communal spaces for gardening and producing food, cooking, and gathering.

**Material use**

The concept emphasizes that the cornerstone of any circular economy is “design for disassembly.” Every material has its life cycle and can be reassembled, reused, upcycled, or downcycled to make a new product. Therefore, designers paid attention to joining, fastening, and detailing.

The block was designed to minimize waste during the building’s life cycle. Thus, the architects considered the possibility of assembling and disassembling the buildings with minimal losses. For example, selected pieces of wood from TaiSugar’s old, dilapidated building were used as the main construction material for the E-House, and materials from old railroad tracks were used for the fence around the courtyard. To reduce carbon emissions, CLT elements were used as one of the building materials.

**Construction**

On-site construction usually results in a lot of waste and requires more time for assembly. To minimize this, the architects proposed using prefabricated structures and facade elements. The exterior walls were precast and included balcony elements that were assembled on-site as a curtain wall. In addition, WC elements were used in public spaces and apartments.

**Modularity**

Modularity is another aspect of the regenerative economy, as it provides flexibility and adaptability for future needs. The design includes three identical apartment blocks with a repeating balcony facade system. In addition, a typical custom bathroom unit was used in all apartments. The elements and modules were designed to facilitate maintenance and repair. For example, the walls and ceilings of the common areas are made of wood panels combined with steel wire mesh elements. Here, the panels are fastened with bolts and nuts to facilitate disassembly.

When all the material data of a building is recorded, the materials can be saved for reuse during renovation or demolition. Therefore, the BIM system is an excellent tool to create a library of materials used.

This project aims to increase the use of renewable energy by installing about 2,500 square meters of solar panels on the roof. This energy will be used to make the C-House carbon neutral.

Photo: Studio Millspace, Yue-Lun Tsai

# Site Analysis

III

The project site is located in Oulu in Hartaanselänranta, which is a new residential area at the shore of Oulujoki river delta. The area will host the Oulu Housing Fair in the year 2025, and it is currently being developed into a diverse housing-oriented area that respects nature and sits in the estuary. Eventually, the site will serve all Oulu residents and complement the recreational network while connecting it.



## The Vision of the City of Oulu

The uniqueness of Oulu lies in its northern location, nature, waterways, landscape, the young population, its fair spirit of cooperation, and its competence. (Oulu, Yhdyskunta- ja ympäristöpalvelut, 2017)

Architecture in Oulu means a high-quality built environment, from urban planning to the finest details of individual buildings. (Oulu, Yhdyskunta- ja ympäristöpalvelut, 2017)

Photo: Visit Oulu

The city of Oulu stands out positively from its competitors. It attracts students, new citizens, entrepreneurs, investors and tourists alike. There are countless attractive places in the city for various gatherings and events: marketplaces, pedestrian zones, and parks. In addition, Oulu is known for its diverse business life and excellent services. (Oulu, Yhdyskunta- ja ympäristöpalvelut, 2017) The conditions for the development of various industries are good. Positive job development promotes the well-being of the entire region and diversifies the urban structure. The goal is for Oulu to become an internationally interesting and attractive location for investment in the north. Oulu is also to be developed as a city of tourism and good transport links. The city is located by the sea and has three rivers flowing through it. Therefore, water is an integral part of the city and the landscape. The Oulujoki Delta has always played an important role in the development of the city. The maritime identity of the city of Oulu has its origins in various factors: nature and its appreciation, appreciation of the cultural environment, historical events and merchant shipping. (Oulu, Yhdyskunta- ja ympäristöpalvelut, 2017)

Visualisation: Arkkitehtitoimisto Lahdelma & Mahlamäki, Arkkitehtitoimisto M3

Oulu is the world capital of winter cycling. Despite the long, dark, and snowy winters, residents pedal to work and school all yearround. In this city, 98 percent of the bike path network is maintained throughout the winter, and all paths are lighted. (Oulun kaupunki, 2022) Over the past 40 years, the city has created an extensive network of bikeways separated from vehicular traffic, that covers the city.

Photo: Oulu.com

# Oulu Housing Fair 2025

Visualisation: Muuan Oy

Hartaanselänranta is a new residential area in Oulu in the estuary of Oulujoki river delta, which extends to the beaches of West Tuira and Hietasaari, and is divided into three distinct areas: Hartaanranta in Tuira, Vaakunakylä and Lehtokylä in Hietasaari. Hartaanranta is familiar to many Oulu residents for its characteristic brick depot.

The area will host the Oulu Housing Fair in the year 2025, and the area is currently being developed into a diverse housing-oriented area that respects nature and sits in the estuary. Eventually, the area will serve all Oulu residents and complement the recreational network while connecting it.

Lehtokylä is a green forest-like area that is intended to be preserved as much as possible, as well as the green streets, which are also used to absorb stormwater. Mainly 1-2 story houses are planned for Lehtokylä.

Vaakunakylä will become a semi-urban area of 3-4 story-, terraced and semi-detached houses. In Vaakunakylä, parking is centralized in the parking garage. A service block will house a school and a kindergarten. The ground level of the terraced house complex will contain retail spaces.

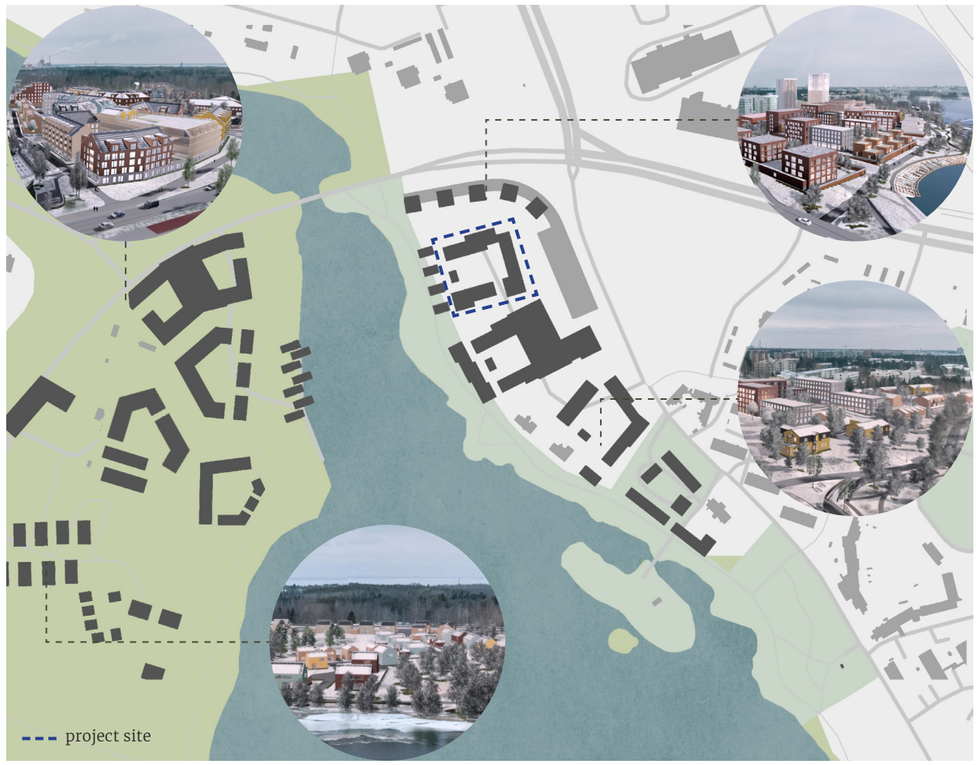
The project site is in Hartaanranta, which is the densest and most urban of these 3. A large part of it is the area of the former city depot. The northern part is dominated by a curved block of 4-story apartment buildings. Blockyards and rooftops will turn into common spaces for residents. Hartanselänranta will have its own parking facility, with retail space and bike parking on the ground floor.


Around a thousand apartments have been proposed for the housing fair arena for more than 1,600 residents.
Visualisation: city archive

project site

## Architectural context


## New master plan for Housing Fair area




## Demolition


## Function diagram

# Design

IV



# Thesis Delimitation

The project aims to apply a regenerative approach in a design of a wooden residential block for Oulu Housing Fair 2025.

The idea behind regenerative architecture is to design buildings that would become a regenerative part of the landscape. It is a very wide and complicated topic that should involve in the creation process all parties, including ecologists, planners, sociologists, engineers, designers, and users. Hence, it is understood, that an architect itself cannot solve all these issues.

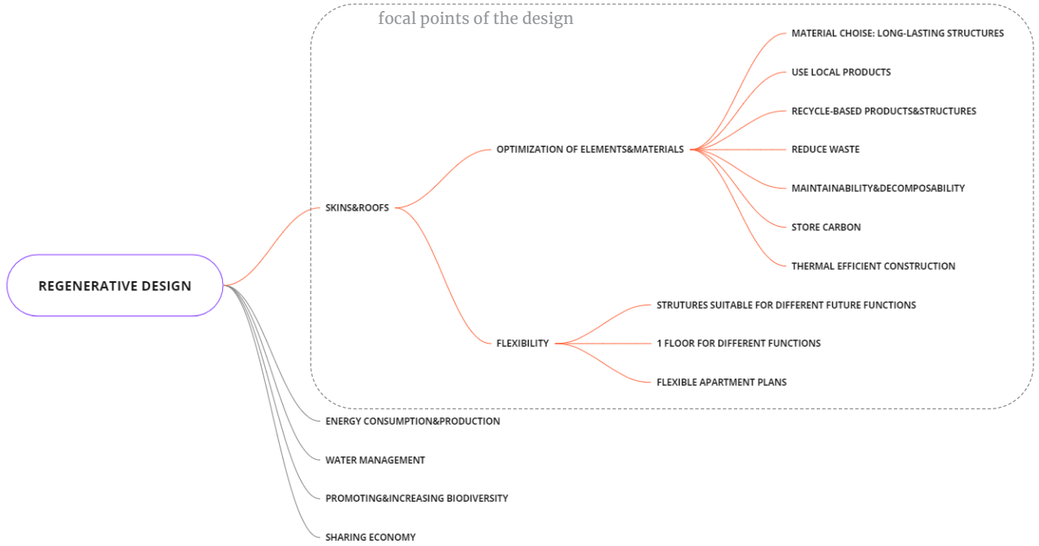
Thus, the work focuses on architectural solutions that can be applied to the skins and roofs of the building. It aims to optimize elements and materials and provide structural and functional flexibility to extend the life cycle of the building.

The project site is located in Oulu in a new residential area Hartaanselänranta, which will be the arena for the Finnish Housing Fair in 2025 and it is currently being developed into a diverse housing-oriented area. The design is following the main guidelines and regulations, provided by the city planners in the new site plan. As an exception, wood was chosen as the main structural and facade material. The choice of wood is therefore explained by the locality of the material and its relation to the traditional architecture of the context.

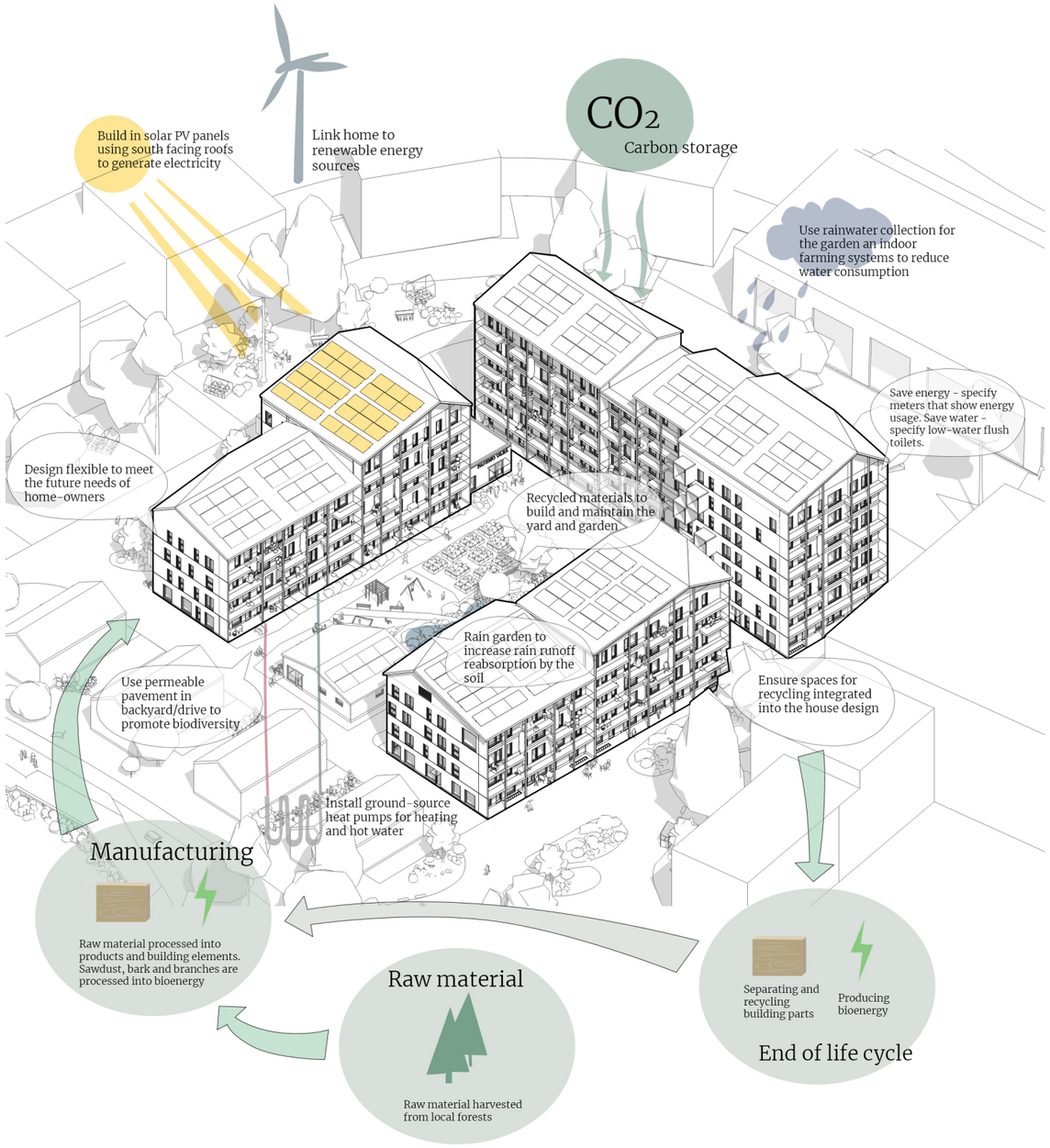
The project promotes such architectural solutions that help to prolong the life cycles of the structures, design for maintenance, repair, and renewal, and provide the building with versatile and adaptable spaces to support and develop community life.

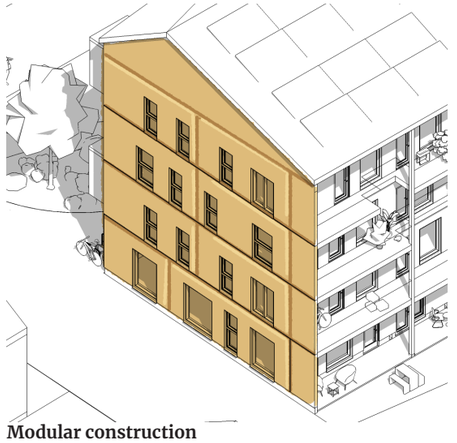
The design aims to free itself from the standards of traditional housing and rethinks the pre-established functions of a home. It brings the natural environment back to the city and promotes new social interactions between its residents.

The project findings might afterward be applied to housing solutions of different scales, situations, and locations.

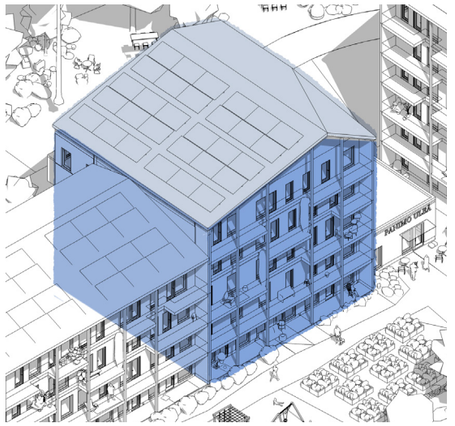


# The Regenerative Vision

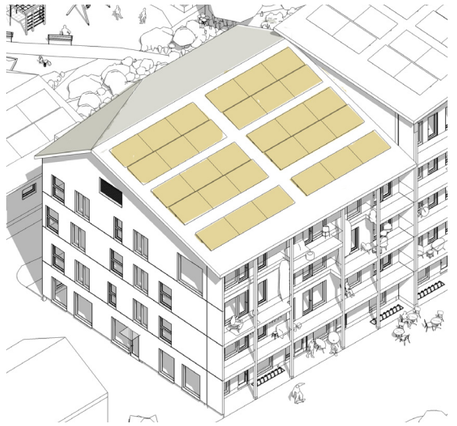


**Modular construction**
To reduce window cutouts waste, outer wall elements are made of well insulated timber frame. Pre-fabricated CLT walls are used for indoor bearing structures.



**Energy-efficient building envelope**
Well insulated outer wall structures and compact layout without volume cutouts provide buildings energy efficiency.



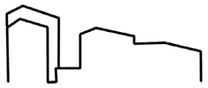
**Roof shape**
The roofs are formed with large surfaces towards south to make profit of solar panels.

**Make use of natural light**
Big windows bring good day light levels and reduce the need for artificial lightning.

**Gardening**
Garden promotes community and well-being. An opportunity for box cultivation in the yard would also help to make use of the users own compost and collected rainwater.

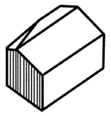

**Local production**
Local food doesn't have to travel, so it helps to reduce gas emissions. It benefits the local economy and supports local producers.

# Architecture



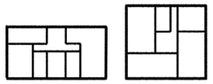
**Urban village**

Buildings of different heights and roof shapes give the block human scale.



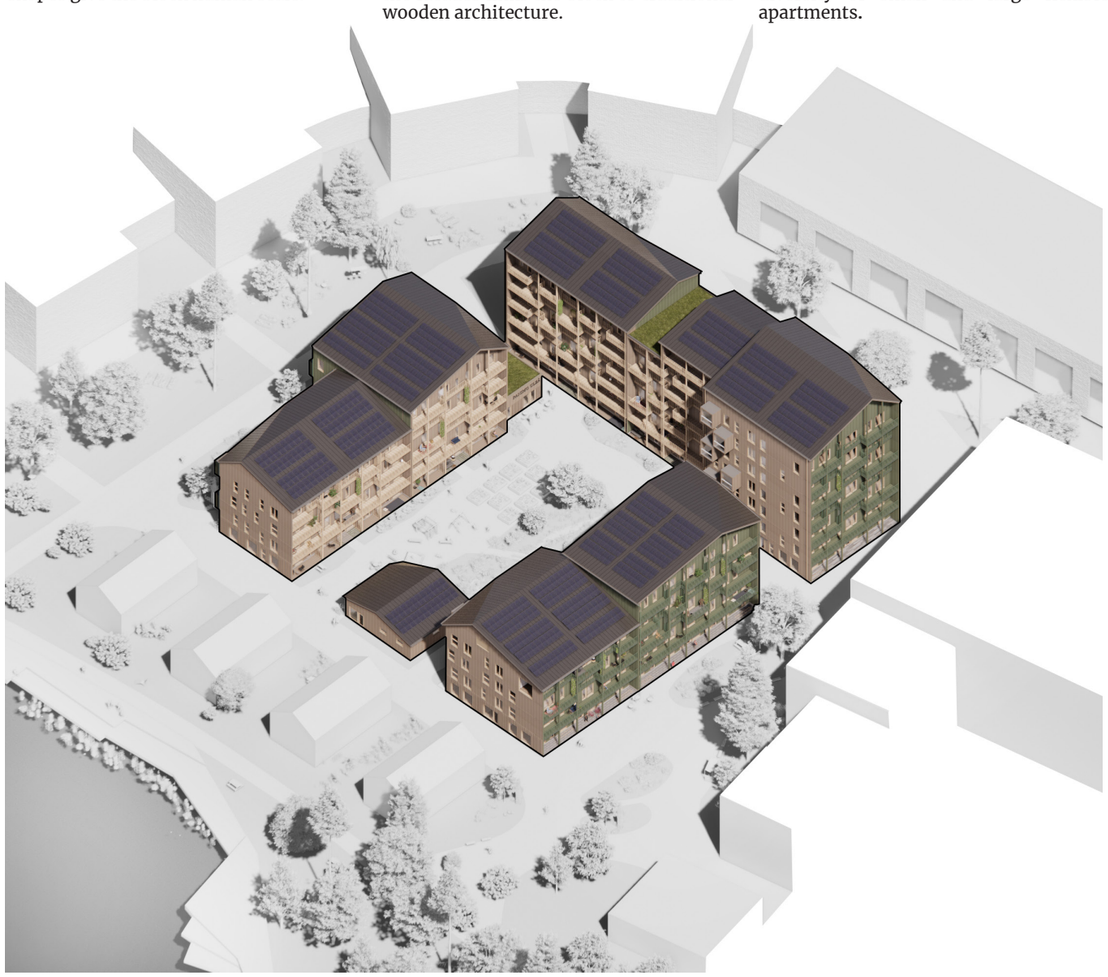
**Shapes and materials**

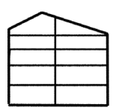
The traditional shapes and use of wood on the facades links the block to traditional wooden architecture.



**Two typologies**

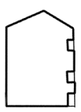
The two building typologies offer a diversity of small and large flexible apartments.





**Pre-fabricated elements**

Pre-fabricated CLT and frame elements enable shorter construction and reduce waste.



**Living facade**

The variative balcony facade creates a semi-private gap and connects the private living spaces with outdoor spaces.

**Make profit of the yard**

Versatile courtyard encourages residents to be active and offers the opportunity to try growing food. The heart of the yard is a common sauna building.

**Material choise**
Long-lasting structural materials and easily reparable covering surfaces let maintain the building for many years.

**Modular partition walls**
Light and easily installable modular partition walls will make the living spaces adaptable to different needs of the future tenants.

**Local food production**
Hydroponics technique of growing plants will become a peacetime application of underground air-raid shelters. In summer season garden beds in the yard are also used for planting.

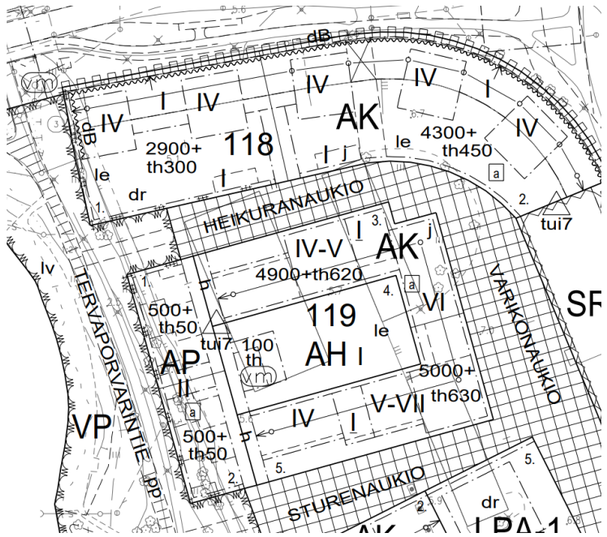
**Welcoming entrances**
Each building has a furnished entrance lobby, where residents can gather, work, play, cook together, and keep and share goods.

**Common spaces for residents**
Common spaces include, for example, a workshop managed by residents, where they can share equipment or tools for repair or craft goods.

**Rental rooms**
Some of the common spaces can be rented by the residents or guests for hobbies or private events.

**Flexible and modular solutions**
Multipurpose furniture that is easily moved, would serve to change the purpose of the space easily and quickly.

# Building Mass Study




New master plan of the area provided by the Oulu City Planning Office

The project area contains 3 sites, 2 of which are assigned by city planning office for housing construction. Each of them contains several buildings of 4-7 floors and the permitted residental areas are 4900 and 5000 sq.m. Additionally, they are allowed to contain 620 and 630 sq.m of common, maintenance and work spaces.

The middle site is the inner yard that can house a small community building with maximum area of 100 sq.m.

As a first step, the original master plan was examined in terms of efficient housing planning, comfortable access, cortyard and apartments natural lightning. As a result, some changes were made to the master plan.

## Option 1 - ORIGINAL

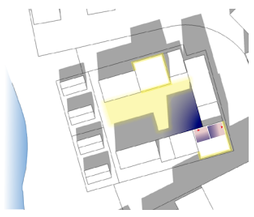
+lots of light in the centre of the yard

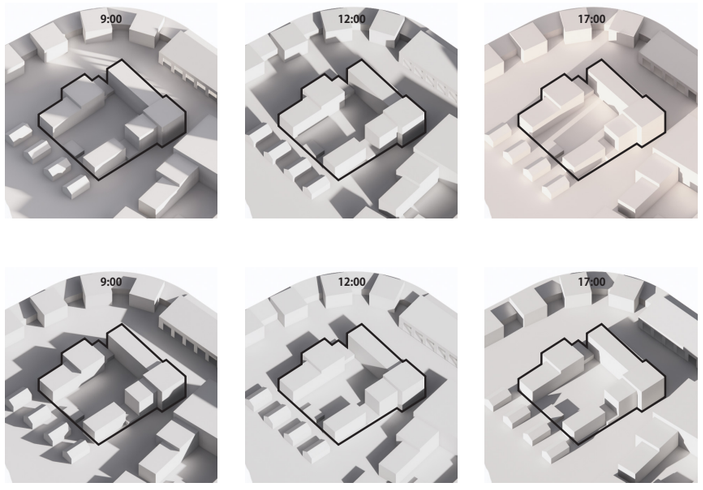
+density decreases towards the waterfront

+volumes, breathing yard

-dark south-east corner

-problematic south tower plan





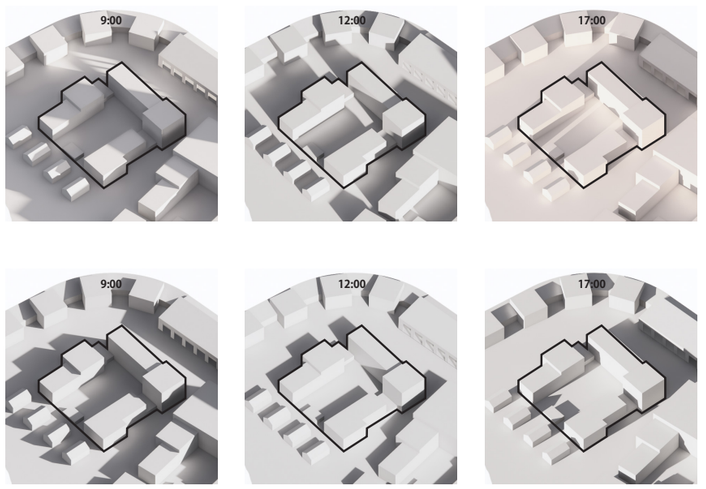

## Option 2 - CHOSEN

+central part of the yard has more natural light

+efficient tower plan

+repeating plans are possible

-less natural light in the




## Option 3

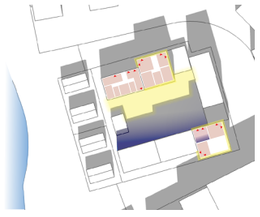
+lots of light in the centre of the yard

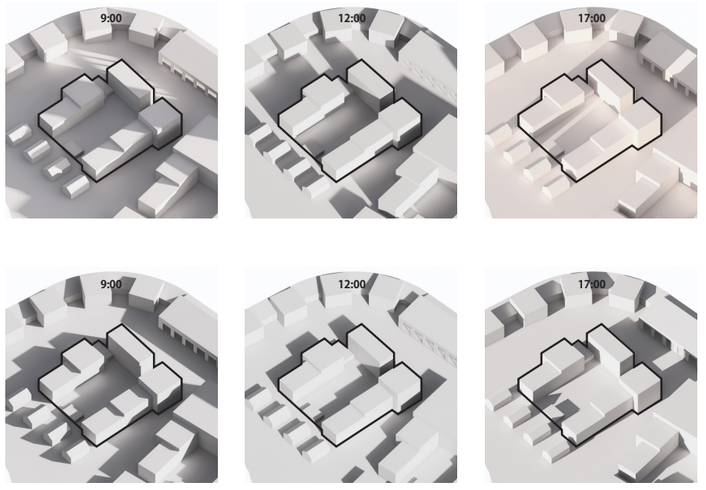
+density decreases towards the waterfront

-dark south-east corner

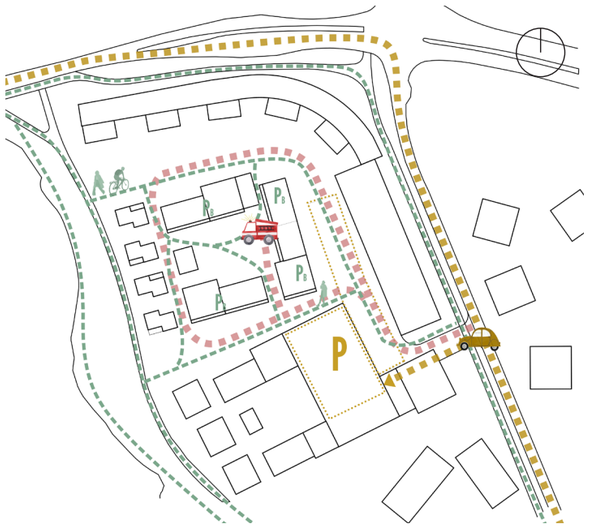
-problematic tower plan

-heavy non-transparent





# Master Plan




## Transportation

- pedestrian
- car
- technical/emergency access
- P bicycle parking
- P car parking

## Public&communal infrastructure

- community space
- retail
- storage
- green infractructure
- open public spaces (square, alley, beach etc.)

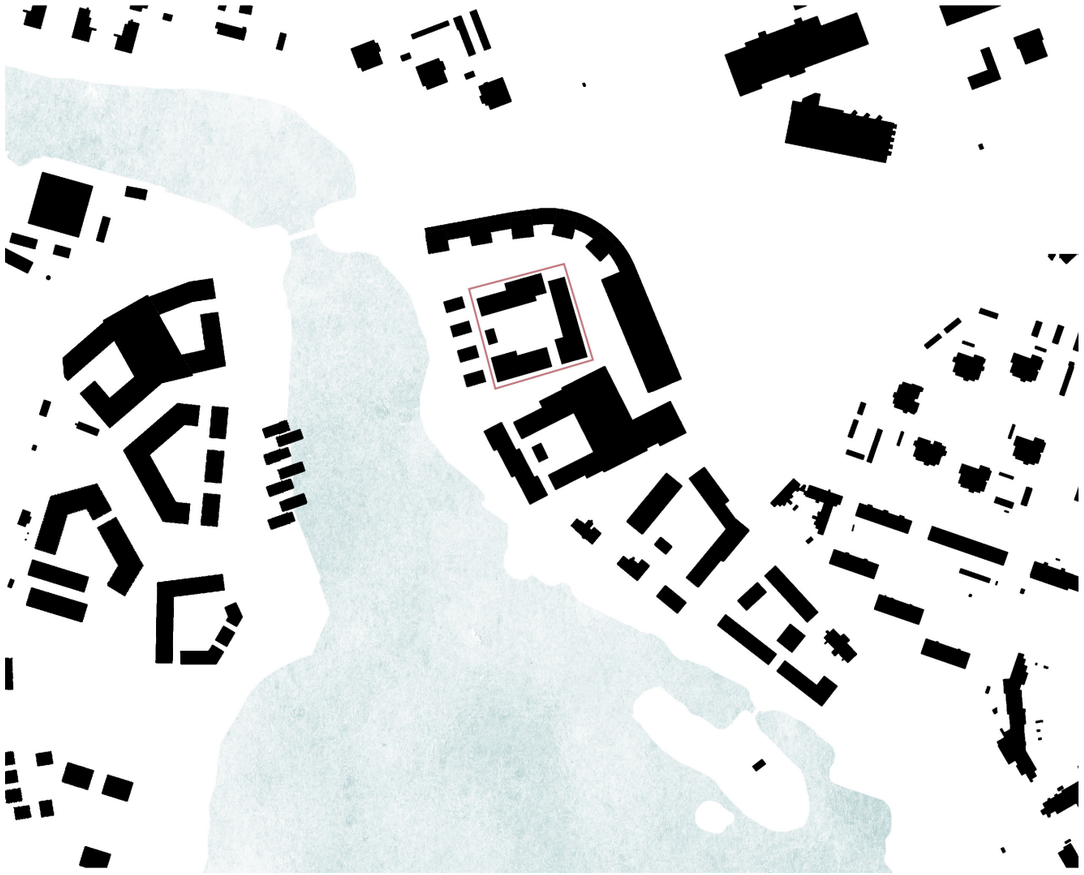
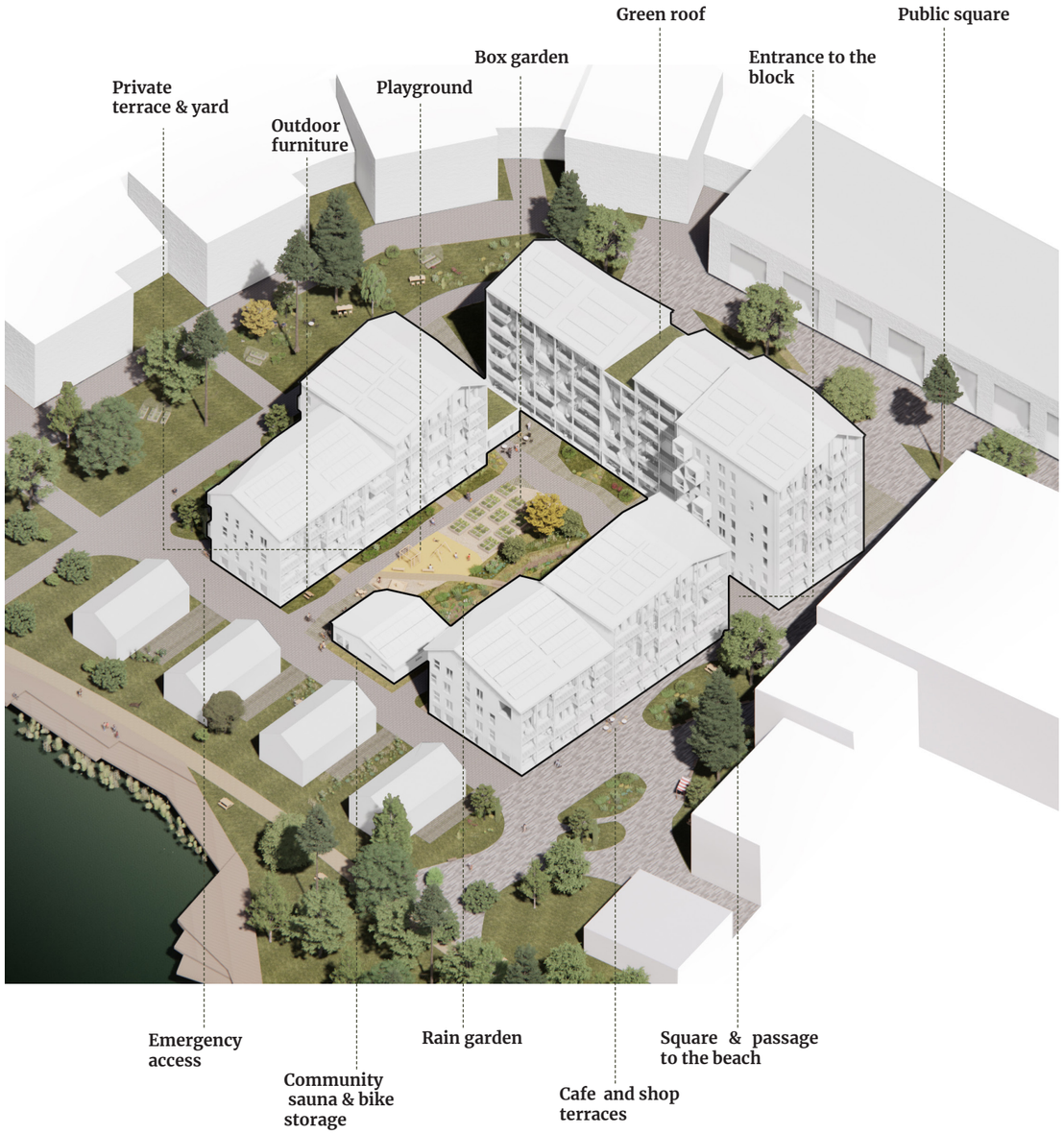
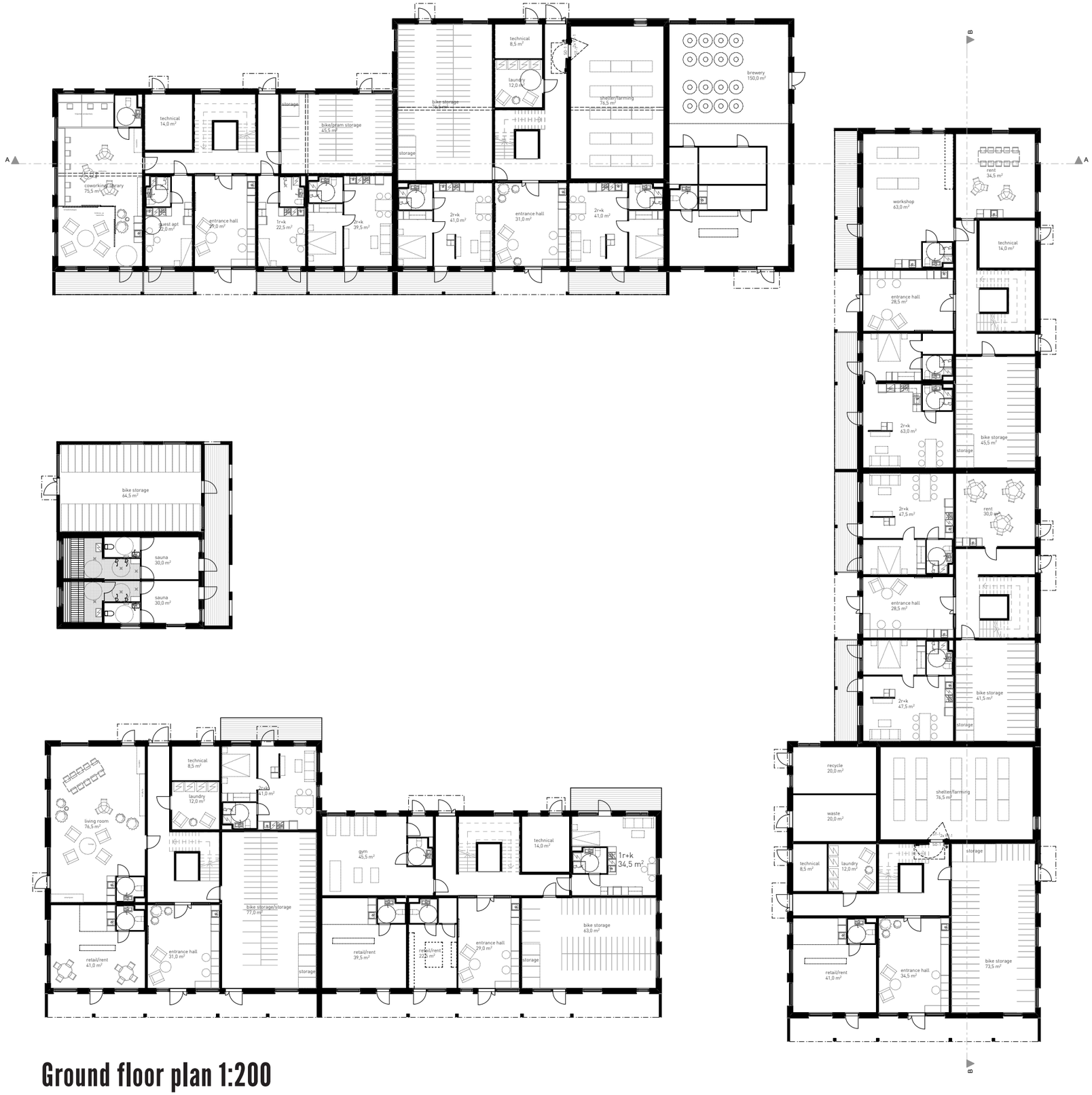


Figure-ground diagram

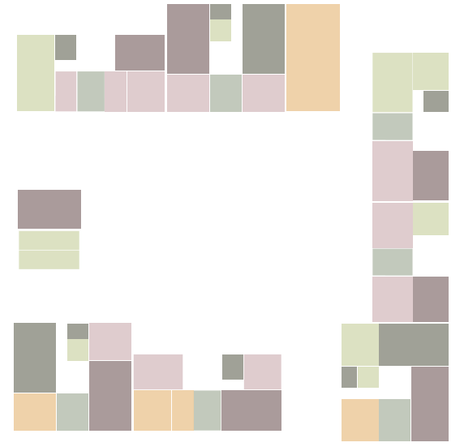
# Green Infrastructure




**Going Beyond Sustainability:** A Regenerative Housing Block for Oulu Housing Fair 2025




## Ground floor plan 1:200



## Ground floor function diagram

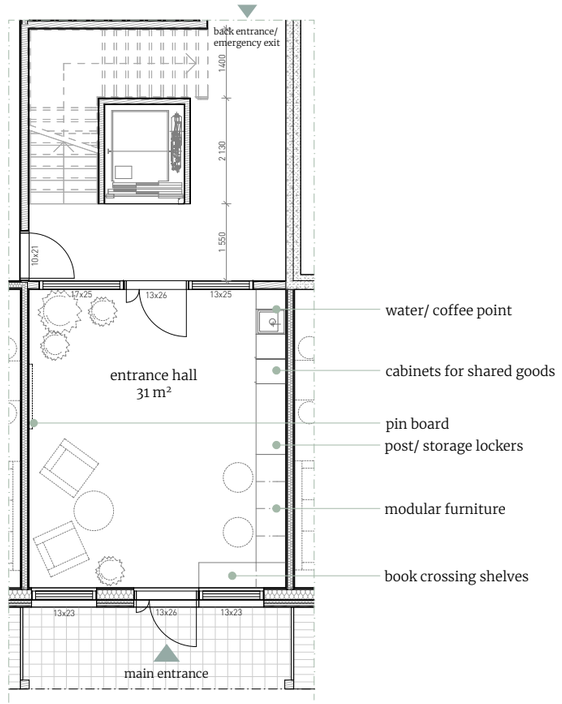
- entrance lobby
- retail/rent
- storage
- community room
- shelter/indoor farming
- apartment

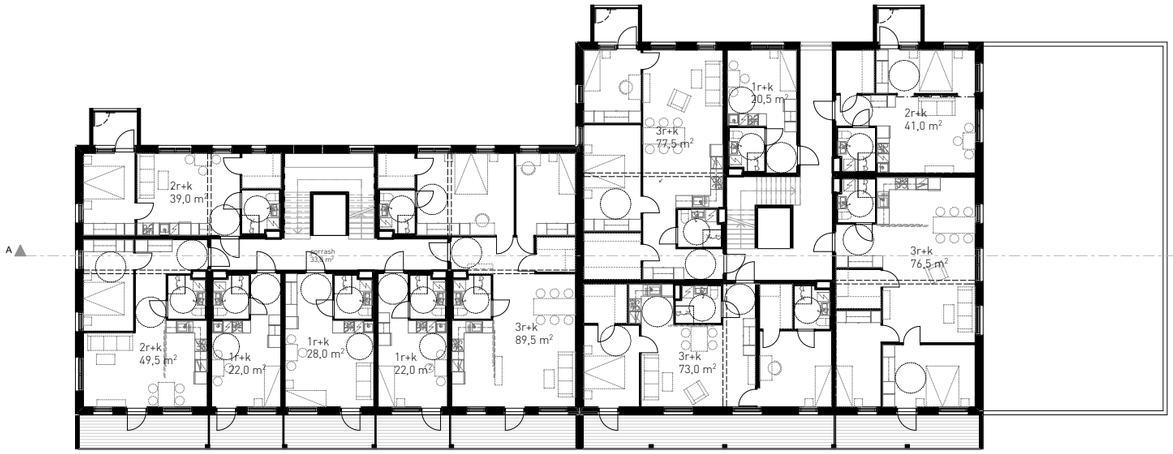
A mixed-use housing block contains various common spaces, such as community rooms and coworking, a gym and a library, storage, and laundry rooms, multifunctional rooms for rent, an indoor farm, and a rooftop terrace.

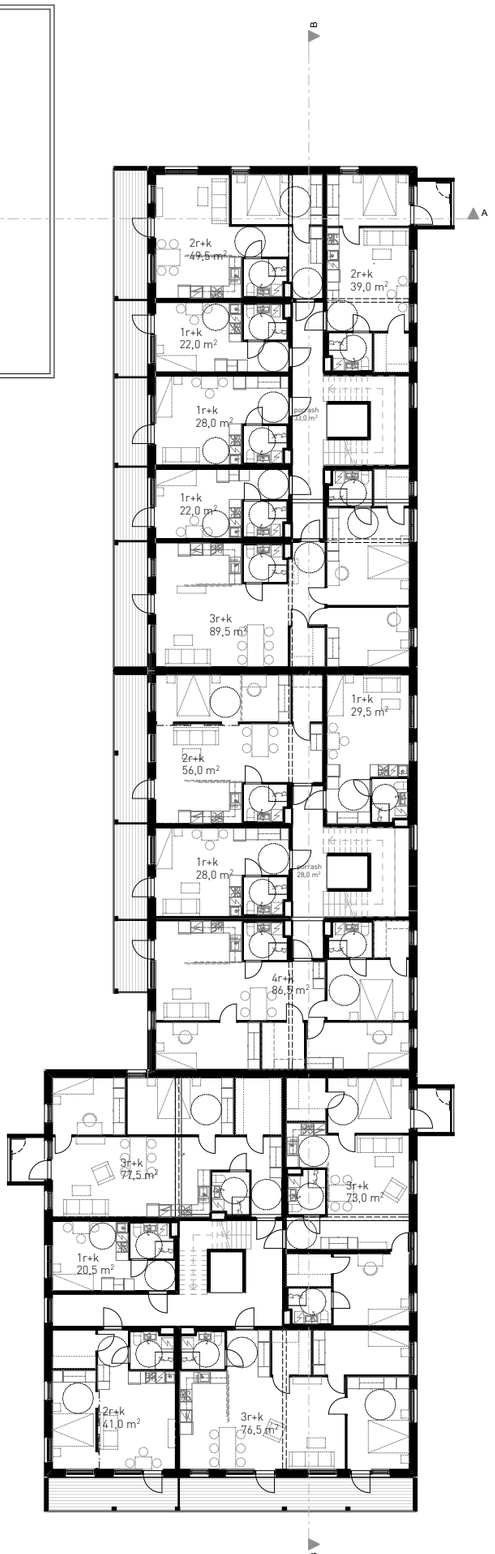
Each house has an entrance lobby, where residents can gather, work, play, cook together, and keep and share goods.

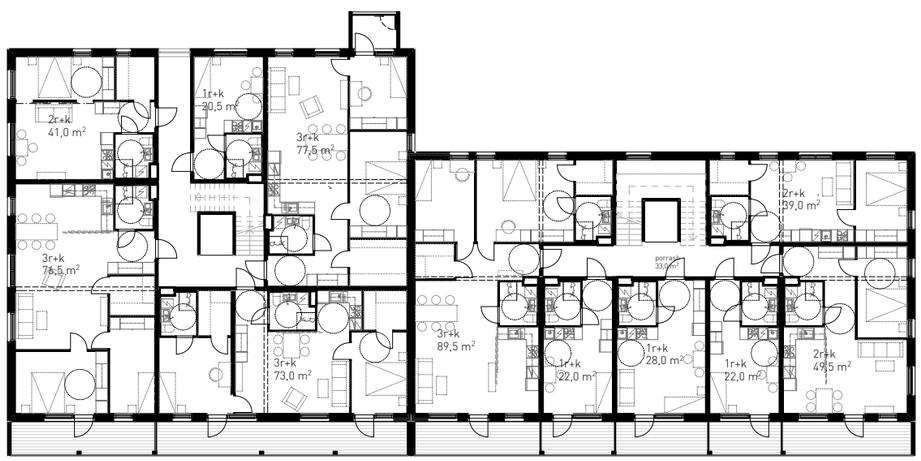
The yard also plays more than just an aesthetic role in the community. It is another collective space, which brings residents together to rest, plant, maintain and share.

Apartment building entrance lobby

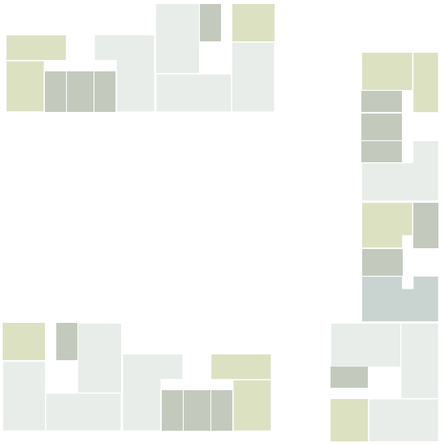





## Typical floor plan 1:200



1 -room apartment
2 -room apartment
3-4 -room apartment
flexible units

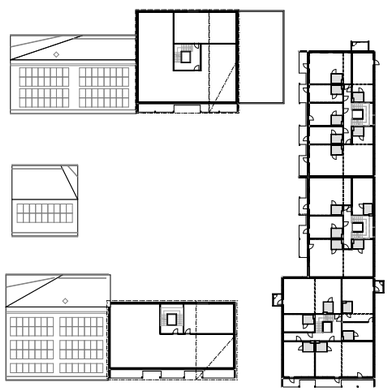
Floor area calculation for each building:

| House ID | Brutto area | Living area (apt., stairc. 15sqm, storage) | Additional area (common spaces, rent, retail) |
|---|---|---|---|
| A | 1300 | 1023 | 133 |
| B | 1970 | 1430 | 240 |
| C | 1952 | 1580 | 163 |
| D | 1820 | 1445 | 68 |
| E | 2510 | 2025 | 175 |
| F | 1620 | 1230 | 215 |
| G | 1430 | 1051 | 247 |
| | 12602 | 9884 | 1245 |

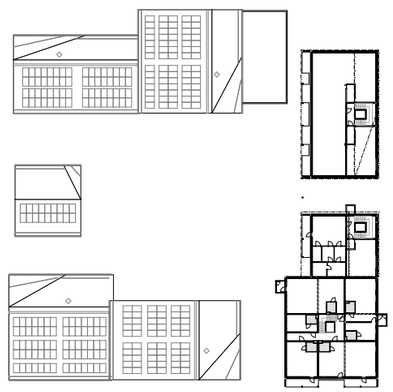
Total amount of apartments of different sizes:

| 1r+k | 2r+k | 3-4r+k | |
|---|---|---|---|
| 62 | 49 | 56 | 167 apts |
| | | | 8040 sq.m |

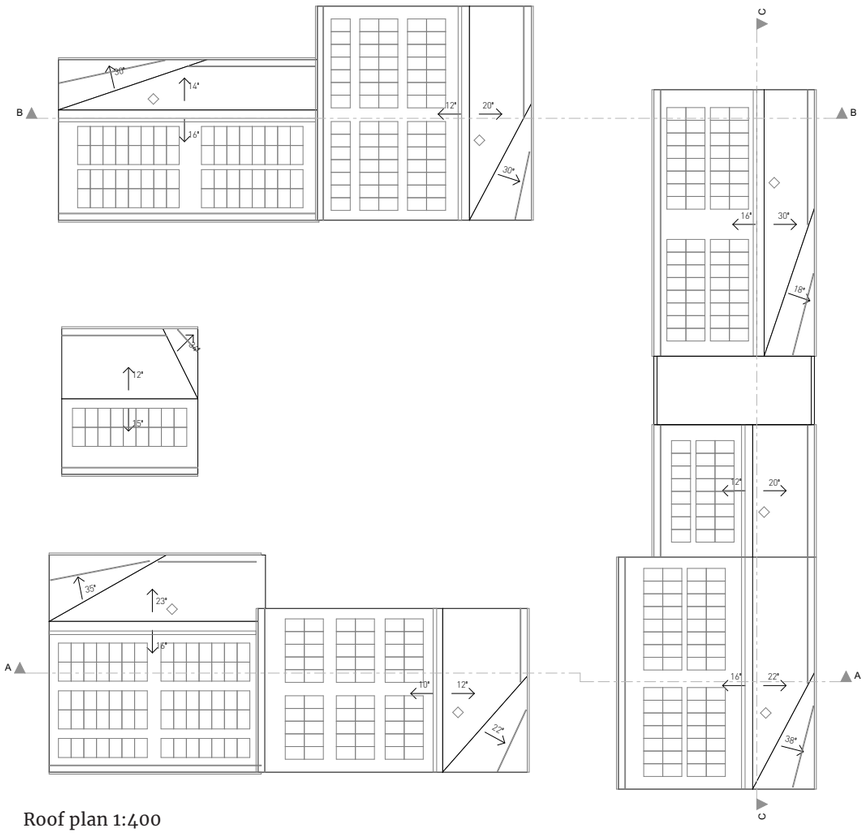
5 floor plan 1:400



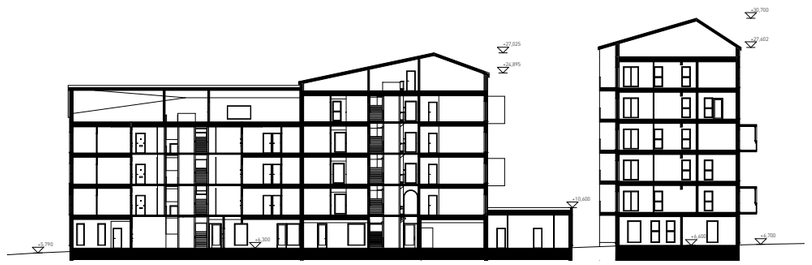
6 floor plan 1:800



7 floor plan 1:800



Roof plan 1:400

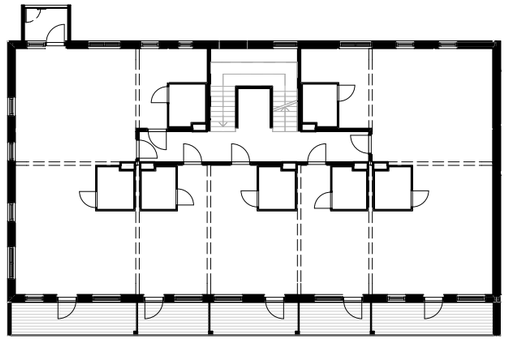


Section A

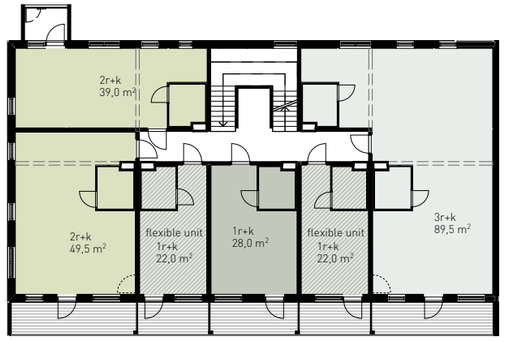
Section B

# Endless Layouts

Typology 1 - Structure



Option of apartment division



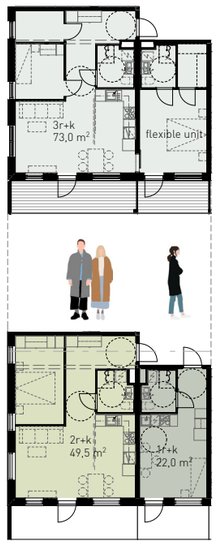

One of the main objectives of regenerative housing is the creation of a collaborative community that is co-created by its future residents. In the group construction project, the residents themselves act as founding partners of the housing cooperative. Here, the participants can decide how much they want to influence the design of the apartment. They can influence the planning and materials of the apartment during the design process.

Because of the open plan of the buildings, it's possible to combine and vary the spaces within apartments, common spaces, and cooperative flexible units.

**Flexible unit**

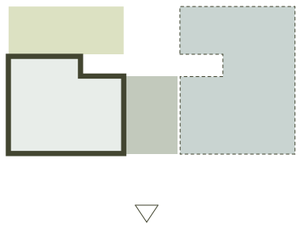
The houses are assembled according to current and future needs. Flexible units, located between other bigger apartments, can serve residents as a studio, a common room, a guest apartment, or, for example, as a way to expand the apartment with an additional room.

Example:
Family A

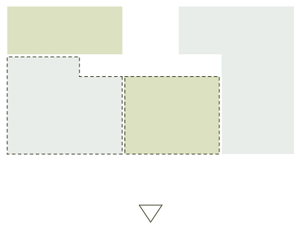



EXAMPLE

Scenario 1

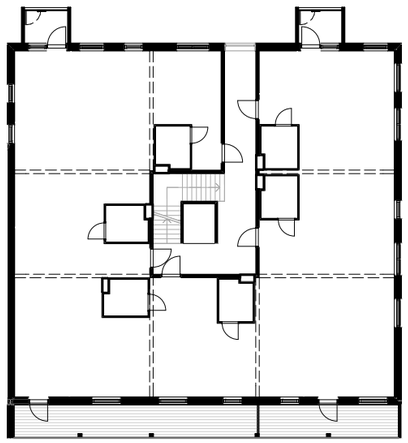


Scenario 2

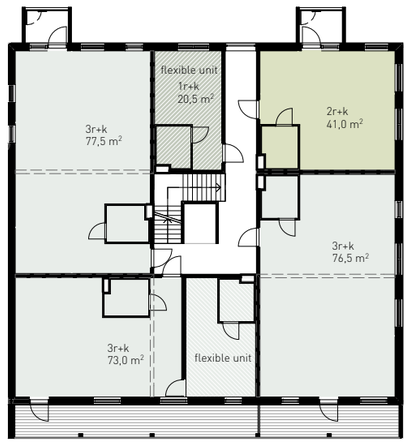


The additional unit can be separated, for example, as a studio apartment for a grown child, or sold out afterwards due to change of users needs

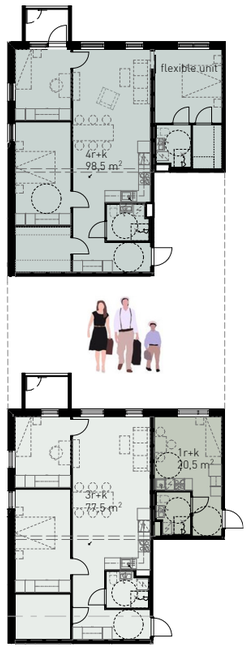
Typology 2 - Structure



Option of apartment division

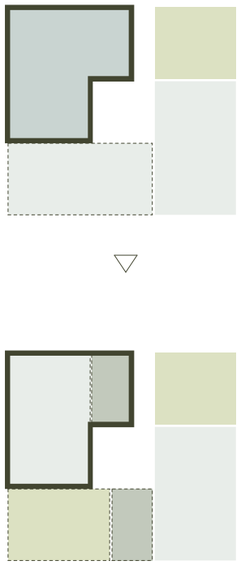



Example:
Family B

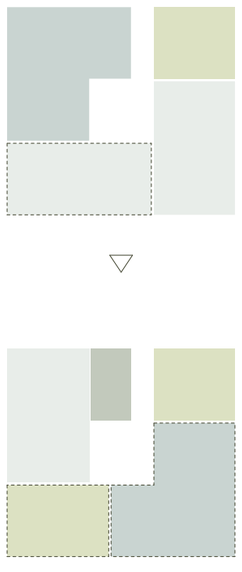



EXAMPLE

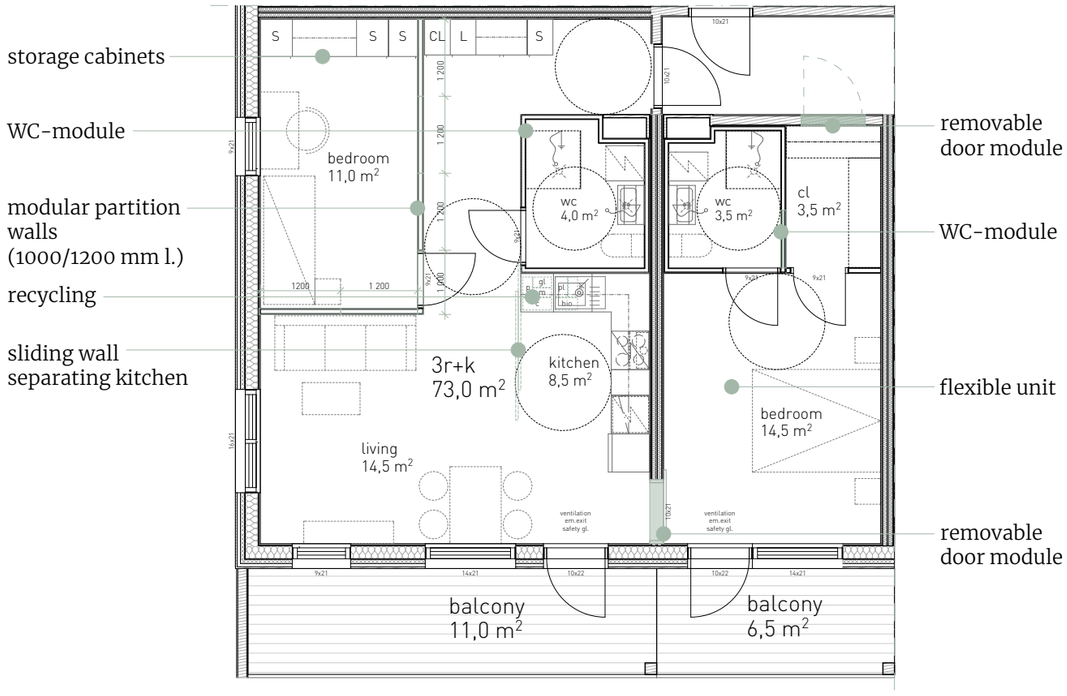
Scenario 1



Scenario 2



# Flexible Apartments




An apartment combined with a flexible module

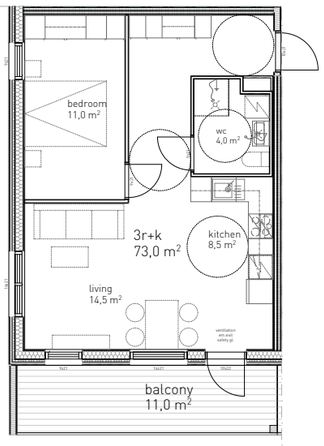
The apartments are flexible inside as well as combinable with neighboring studio units. The example above shows how a 2-room apartment might be combined with a studio into a spacious 3-room apartment. The non-bearing partition walls separating apartments, and the CLT corridor walls have small removable modules, that can be replaced with a door.

The light partition walls dividing the room are constructed of 1000/1200mm width modules, made of two plywood sheets with a 66mm layer of insulation for soundproofing. The wall elements are locked together and fixed to the floor and ceiling with wooden pegs.

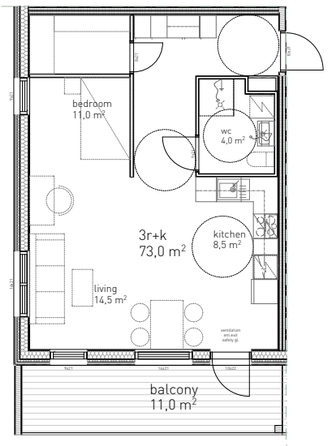
The shape and size of the kitchen allow to separate it from the living room with a light sliding wall.

All apartments have sufficient space for storage and recycling. The kitchen cabinets are designed to fit bins for all waste categories.

Use of modular partition walls in an apartment. Option 1 - two-room apartment




Use of modular partition walls in an apartment. Option 2 - one-room apartment with alcove and wardrobe.



# Facades


Facade A 1:400

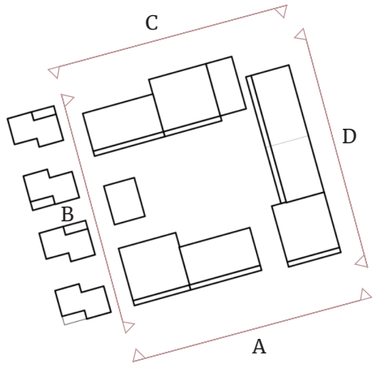

Facade B 1:400


Facade C 1:400


Facade D 1:400

**Facade materials**

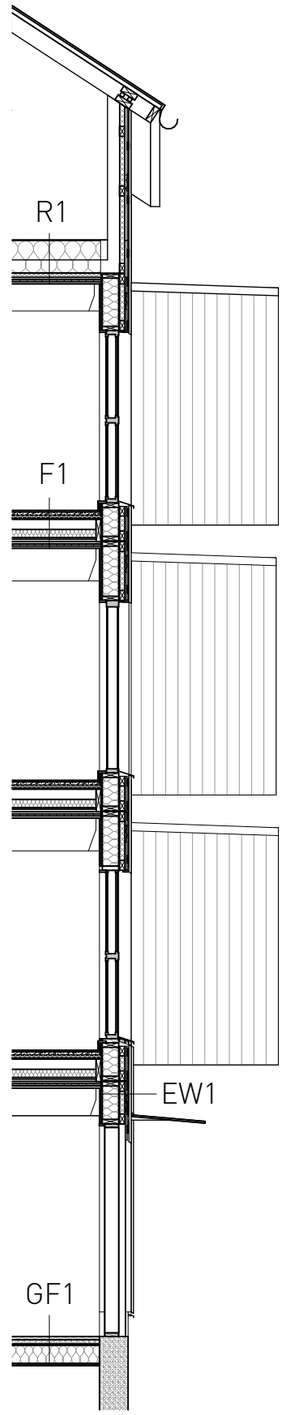
1. Wood cladding 1, green
2. Wood cladding 2, green
3. Wood cladding 1, natural color
4. Steel, beige
5. Steel, dark green
6. Wood bars, dark green
7. Wood bars, natural beige
8. Steel roof sheets, grey



# Sections & details


Section A 1:400

Facade detail




## Constructions

**External wall 1**

| | |
|---|---|
| 28mm | cladding |
| 50mm | wood strapping, screwed through insulation airspace |
| 180mm | insulation Paroc Cortex One |
| 80mm | CLT |
| 18mm | fireproof gypsum board |

**External wall 2, shelter**

| | |
|---|---|
| 28mm | cladding |
| 50mm | wood strapping, screwed through insulation airspace |
| 180mm | insulation Paroc Cortex One |
| 300mm | concrete |

**Partition wall 1, bearing CLT**

| | |
|---|---|
| 30mm | 2x fireproof gypsum board |
| 80mm | CLT |
| 18mm | fireproof gypsum board |

**Partition wall 2, non-bearing**

| | |
|---|---|
| 18mm | fireproof gypsum board |
| 15mm | plywood |
| 66mm | insulated wood frame |
| 20mm | airspace |
| 66mm | insulated wood frame |
| 15mm | plywood |
| 18mm | fireproof gypsum board |

**Partition wall 3, non-bearing, room dividers**

| | |
|---|---|
| 13mm | gypsum board |
| 66mm | wood frame |
| 13mm | gypsum board |

**Ground floor 1**

| | |
|---|---|
| 70mm | concrete |
| 18mm | OSB sheet |
| 225mm | wood beams 45x225, insulation |
| 9mm | wind proof layer |
| 20mm | wood strapping, airspace |
| 100mm | gravel |
| 50mm | EPS120 |
| 300mm | gravel |

**Floor 1, apartments**

| | |
|---|---|
| 40mm | finishing layer |
| 30mm | sound insulation |
| 18mm | OSB sheet |
| 225mm | wood beams 45x225, insulation |
| 20mm | wood strapping |
| 30mm | airspace |
| 80mm | CLT |

**Floor 2, hallways**

| | |
|---|---|
| 15mm | floor gypsum board |
| 120mm | CLT |
| 15mm | fireproof gypsum board |

**Roof 1**

| | |
|---|---|
| | metal sheet roofing |
| 18mm | OSB board |
| | wood strapping, airspace |
| 400mm | insulation layer, stone wool |
| 50mm | mineral wood insulation |
| 80mm | CLT |


PANIMO UUSI

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# Conclusion



Construction field, like many other economic activities, currently follows the linear economic model, which generally follows a standart path: raw materials are collected and processed into products that are used until they are disposed. Hence, value is based on producing and selling as many products as possible and achieving the highest possible sales margin. This leads to avoiding actions that do not add direct value to the company, for example, environmental protection.

Accelerated by the linear economy, the amount of man-made materials has exceeded the amount of living biomass on earth, and by far the largest part of it is accounted for building materials. Hopefully, regenerative approach will provide alternatives to linear use of natural resources and help to prevent waste generation. The regenerative economy aims to keep materials in circulation and add more value to the environment. Value creation is thereby based on conservation and regeneration of natural systems.

The regenerative approach is already gaining awareness in the real estate and construction industries, but its progress on a practical level is still small. In general, construction in Finland is currently being done in the same way as it has been for the past decades, i.e., according to the design, construction, and maintenance practices of the direct economy.

A regenerative approach in architectural design embraces all the commonly known principles of sustainability, but goes beyond technical solutions and looks for higher potentials in the whole system in which the building stands. Regenerative design aims to contribute something sustainably positive to the relationships between people and place.

The design of the apartment block for the Oulu Housing Fair showed how some of the strategies of the regenerative approach can be applied to the building envelopes. It revealed that by optimizing the building materials and elements, we can significantly extend the life cycle of the building and support the relationship between nature and people. Providing spaces with a high degree of flexibility can activate and support the potential of the local community. The project site, which used to be a huge asphalt field, becomes part of the green recreational network and could also attract new species.

Regenerative design is a very broad field that involves professionals from different fields in the process. The project didn’t aim to solve all aspects of regenerative design, but focused only on the issues that fall under the responsibility of an architect. This practice has helped to understand the importance of the regenerative economy as part of any new construction project. In the coming years, the transition from a direct economy that uses fossil materials to a carbon-neutral regenerative economy will hopefully change industry business models, construction processes, and the culture of the entire construction and real estate industry.

Materials and structures

The CLT and wood frame-structured housing block is designed so that the different structures are durable and modifiable and can be easily separated and reused later. The materials used in the design are either renewable (e.g., wood) or recyclable (e.g., steel, brick, timber). The height of the floors allows the buildings to house other future functions, for example, offices or social spaces.

The project doesn´t focus on the underground part of the structure. In the concept design, concrete is used as the main foundation and shelter structure material. Here, the idea was to use a less environmentally damaging form of “eco concrete” produced using industrial or agricultural waste, and sand substitutes like ash from municipal incinerators or sewage sludge, combined with limestone and clay.

Cooperation

Designing and building for the regenerative economy emphasizes the importance of collaboration for a successful outcome. Collaboration and coordination can not only increase the efficiency of project time but also improve the quality of construction.

Comprehensiveness

Regenerative design involves in the process all parties from planners and designers to users - from construction to use and maintenance. Implementing the principles of the regenerative economy requires a very comprehensive view. Focusing on individual recyclable materials does not guarantee a fully successful result. In a holistic approach, the social context and community spaces must be considered as important as the construction material characteristics.

Reflections

The thesis work helped me to explore what regenerative design is and how it relates to the built environment and society. Trying to find the balance between innovative solutions and social context I learned that the biggest challenges here are to promote changes in technologies and legislation, and also to find ways to influence and change individuals’ behavior. Human society can be very resistant to changes, so the role of regenerative design is to activate and support the relationships within the community to grow and develop over time.

As an architect, raised and educated in post-soviet space, I´ve absorbed the idea that architecture has to put emphasis on its artistic attitude and freedom of expression. Instead, a design, run by a regenerative approach, cannot start with a napkin sketch. Applying a place-based approach we learn how natural processes work in every unique place, thus, we can create a system of mutually beneficial relationships.

Another challenge in making a regenerative design for a city is that it’s already part of a very complicated infrastructure that is difficult to influence. Here the challenge is how to adjust our existing cities to a regenerative level. Especially within very small projects, the idea of integrating them into the existing systems of the city is critical. We need to think about how we can adapt existing systems by making small changes. And that’s something we find quite difficult when working in a city center - there’s a limit to which we feel we can influence things.

The regenerative approach in design connotes a very comprehensive understanding of the environment and social processes. I think that to be able to design regenerative architecture, architects and planners definitely need to have somebody in charge of somewhat bigger than the scale of a building. For example, ecologists and other specialists understanding the biodiversity net should be involved in making those fundamental decisions about the site at very early stages.

A regenerative design can never be absolute. Even in a non-perfect setting, success starts when we start doing steps towards a regenerative system. I think that the regenerative approach is all about the way people in communities live. And the role of designers is to build an environment that would contribute to the community and activate and manage its potential.

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**Links:**

Wood constructions and details:
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epuu.fi

Project site info and visuals:
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