”GROW UP”

How Urban Farming can be incorporated into a residential building?

CHALMERS

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Content

Abstract

There are many factors that indicates that the future cities are facing a major structural change in its urban design. The changing climate, increased urbanization and lacking resources are some elements that demands more of our future urban cities. An increasing global population and a worldwide growing urbanization has raised the question about the future food security in cities all over the world. This growing trend is putting us in a vulnerable situation were we do rely on global imports and rural resources. In order to reduce the vulnerability and increase the resilience we need to diversify patterns of food resources and encouraging alternative activities and lifestyles.

The thesis investigating the field of resilient architecture, trying to see how a residential building formation can promote urban farming and increase the food security. The project attempt to add a housing topology into an urban context that incorporate the activity of urban farming to strengthen the dwellers cohesion and ecological value.

The thesis is carried out as a research by design project. Investigating the opportunities to secure parts of the food supply within a residential project in Gothenburg city.
The research consists of literature studies, interviews, site visits and digital and physical model analysis in order to create a relationship between the analysis and proposal.

The thesis present a design proposal carried out as a housing typology with the possibility to harvest the recommended consumption of vegetables per person over a year through different farming methods.

Keywords:
Urban farming, Housing, Food Security, Urban Resilience, Sustainability

1.0
Introduction

The biology do focus on diversity and multiplicity in order to survive. Our bodies have two kidneys, two loungs, two brain half, where one of them are able to work if the other one are damaged or collapse. An ecosystem built of diversity were things can change or damage without the whole system breaking.

I think there is a necessity to apply this diversity within our field as well, an elastic way of thinking. If the food chain get disturbed, a resilience design approach might be crucial for our future cities. During my first semester on Chalmers I studied the course, "Sustainable Development and Design Professions" I got interested of working further on this approach. Food is not only a central part of our health but also a crucial part of the field within sustainability which became the starting point in this discourse.

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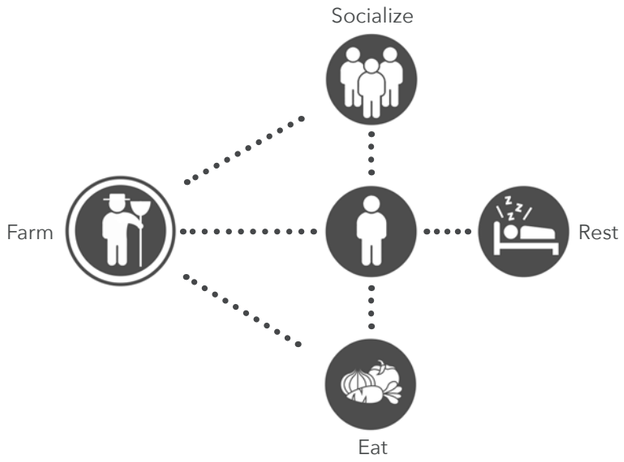
Purpose

By a practice based project I will look into the field of resilient architecture and try to see how the residential building formation can promote potenital urban farming and increase the food security. The project attempt to add a new housing topology into an urban context that incorporate the activity of urban farming to strengthen the dwellers cohesion and ecological value.

Question

#1 How can urban farming activate an ecological sustainable consciousness of the residents and citizens?

#2 How can you use urban farming as an activity to promote social sustainability within the building?



Method

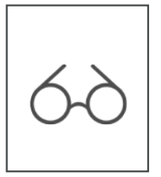
This thesis will be a research by design project investigating the opportunities of incorporating housing with the activity of urban farming. The research will consist of literature studies, site visits, digital and physical model studies.

Delimitations

The framework of this thesis will be directed to a mixed target group with an urban lifestyle interested in gardening and growing their own food. The purpose with the farming is not primary made for economical reasons but rather to enhance the social and ecological situation. The aim is therefore not to produce in a big scale but instead to cover the recommended intake of vegetables and crops for the dwellers.


Litterature study


Digital models


Case studies


Iterations


Physical models


Interviews

2.0
Background

Resilience

Resilience addresses the dynamic transformation and adaptability of highly complex social and ecological systems. The concept of resilience thinking stresses the importance of adaptability, transformability and development. It represent the capacity of continuous adjustments and changes over time, and it crosses thresholds of the unexpected such as natural disaster or economical crashes, (Biggs, Folke, Norström, Reyers, & Rockström, 2016)

The increased urbanization and human development are stressing the natural resources and growing climate change. Our society have been crossing the natural threshold and are now on the tipping point of the planet's boundary. This have been observed by natural scientist since many years back but now also by the wider audience thanks to evidents as forest fires, flooding, increased temperates and raised sea level to mention a few. The human activity have in different scales been stressing the ecosystem and are triggering the tipping point to an extreme level. (Lenton, 2019)

The humanity have emerged as the single operator of the biosphere but needs urgently to shift the development in relation to the biosphere. This raising alarm and growing threats of abrupt natural disaster are putting the human kind in a vulnerable situation. The humanity need to cope with unexpected social, economical and natural changes and are therefore in need of a resilience concept in order to adapt, (Folke, 2010)
A static state of mind can expose cities to vulnerable situation in global changes. A change in the very complex urban landscape works as a chain reaction and can have a dramatic influence in many directions. But by spreading the risk and work with diversity many situation can absorb the the disturbance and reorganize and still function properly, (Biggs et al,. 2016)

Urban agriculture in the past

People might think that urban farming is something contemporary in the increasing urbanization. Futuristic vision of high technology food production in the core of cities have been highly discussed in the last decades along architects, engineers and social scientists as one solution of urban sustainability. This concept of Swedish urban agriculture traces back before the industrial era, and it was one of many provisions in Swedish towns during 16th-19th century. (Björklund, 2010) The state did donate agricultural land to the Swedish towns in order to achieve extra income. The inhabitants could then trade and commerce which was an economic sideline. Urban agriculture was in many ways the economic industry up until 1830 and was therefore an important factor in the economical chain (Björklund 2010)
This led later to a development of "garden cities" which is a city planning system with small scale buildings with associated gardens. These communities was original planned outside the city center and was characterzied by the landscape itself, stronger vegetation was left for recreation and the streets was customized after the terrain usely with a softer appearance.
In contrast to the garden cities during the same period in the beginning of 20th century did the allotment appear with roots from Germany. The cities was usely dense and it was common with housing shortage in the crowded city center. The supply of fruit and vegetables was poor which led to the appearance of allotments with the possibilites to grow your own vegetables. This was a growing phenomenon in Sweden and speciellay during the world wars when it resulted lower costs and an increased potential food supply. This was another way to give the city dwellers a potential own garden for recreation and growing food in contrast of the garden cities (Schimanski 2008).

One important factor to urban farming in the pre-industry era was to keep a short distance to the customer since the transportation was slow and expensive. The industrialization and introduction of the railway changed this perception, the food production was not as dependent of urban location as before since the products now could travel further and quicker. During the 20th century the transportation technique developed rapidly in relation with the increased food production and commercial activity. (Björklund, 2010). This urban development in Sweden and other high income countries have decentralized the food production and concentrated the food chain into a globalized mass production with complex producing chains and long transportation distances. When Sweden joined European Union, the restriction of emergency food stocks abolished in order to favor the free market within Europe. The self sufficient food production in Sweden have decreased in the light of globalization since then. In Gothenburg the municipality have action plans for emergencies such as flooding, energy collapse and evacuation routes but no emergency plan for food production in a disruption of the import. (Olsson, 2016)

The discussion of climate change, peaking oil and unsustainable transportation distances have identified a bigger interest of local produced food. Even though the local products usually means higher prices, people are more conscious of the environmental impact. Despite the complex food chain and a jungle of different products an urge for healthier and nutritious food can be seen which is usually something that locally produced food offer.

Fig:1 A family in Flora-Linnea allotments outside Uppsala established 1932. Photo by Axel Sagerholm.

Urban farming today

The concept of Urban farming has the last decade had a new breakthrough as a result from earlier city planning. The modernism planning was in many decades trying to distinguish urban and rural, to separate the functions in housing, working, transport and leisure in order to achieve efficiency. The interest of urban farming is growing bigger in Sweden in order to search for another approach to shorten the food chain and to implement a greener cityscape. Urban farmers are being noticed of a phenomena as old as the city itself. Integrating agriculture between the physical formation as it used to be centuries before (Delshammar 2012). There are different ways of understanding urban farming, allotments for example have been used the last century and is a well known concept, but today have new ideas of urban farming developed. There are no exactly definition of how urban farming might take place, but according to the scientist of system ecology at Stockholms University, Kristin Schaffer 2014, you can categorize urban farming in different categories such as:

"Kitchen gardening"- A very small scale private gardening i form of allotments, balconies and private backyards.

"Forest gardening" - A urban farming method were you are trying to mimic the nature itself in a small scale basic approach.

"Innovative farming" - Might be seen as the combination of the technology and innovative approach such as aquaponic and vertical farming.

"Commercial farming" - Can be a version of innovative farming, it is a category of farming for commercial activity, a business model is implied and are adressed to urban residents or companies. This is usually applied of left over urban spaces in cities and might be in collaboration with the municipality. Stadsbruk is a good example of an organization using commercial farming in cities, they are the link between farmers and land owners promoting farming for commercial standards.

Fig:2 Robert Shaw and Marco Clausen, the grounder of Prinzessinnergarten. Photo by Ute Langkafel

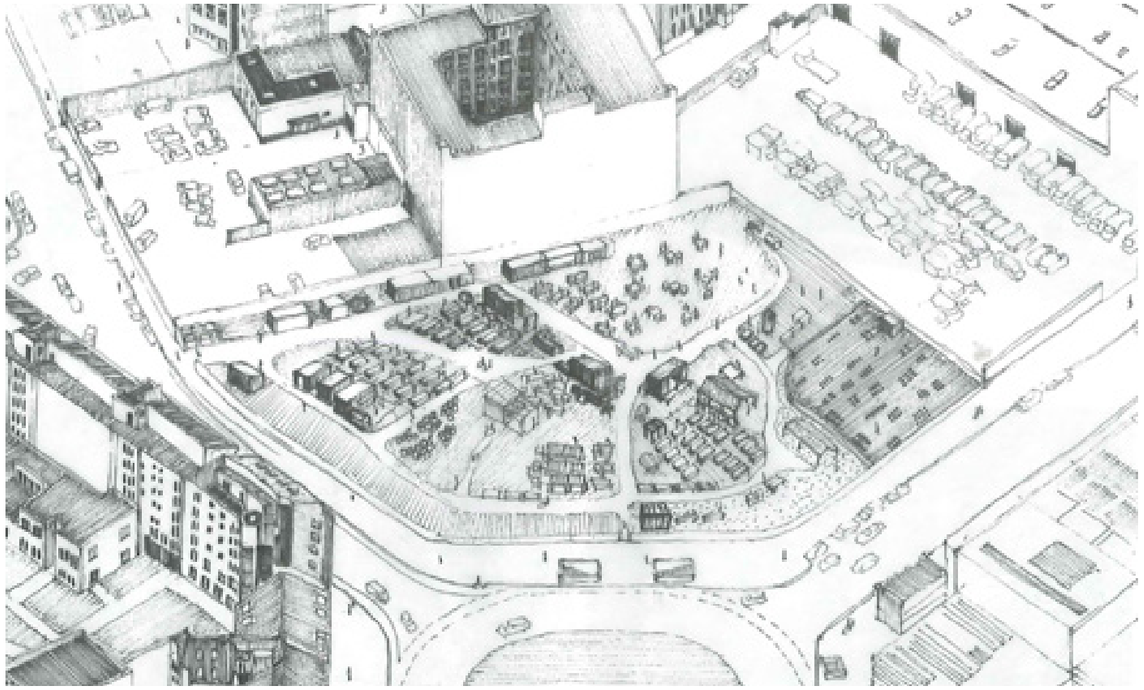


Fig:3 Sketch of Princess gardens in Moritzplatz in Berlin Kreuzberg graphic by Natalia Hosie

"Guerrilla gardening" - it is the act of people farming on land without formal permission, it might take shape as a non-violence statement or political protest but the reasons can of course be widely spread, the main idea is usually to provoke a change initiated by a group of people or organizations by occupying land.

"Community gardens" - Is another category having a focus point of social activity instead of commercial. This type is about meeting people and might be seen as a method of solving social problems. It promotes safety, health and social activity. One example is the "princess gardens" in Moritzplatz in Berlin Kreuzberg. A group of people started to grow organic food on a wasteland in central parts of Berlin and it became a place for learning, socialize and experiment with farming.

The idea of this project is not to focus on one category of farming. The methods have different purposes and the idea in this project is to combine a proposal of housing with focus on a small scale food production including social activity and ecological value more than the economical gain. If the aim was only to maximize the outcome of crops without focus on social value, the commercial or innovative farming would maybe be a good method. High technology solution would produce more crops than a community garden for example since the method is more efficient per capita and the technology can help to produce day and night during longer seasons.
But in this case there are more factors that I want to focus on. I want to adress the social activity and see how that can be increased. My idea is to investigate how to use urban farming as a tool to gain other important criteria in a housing project instead of just combining these two ideas. The different farming methods mentioned before can therefore be used in different parts of the project in order to achieve maximal outcome in many criteria.

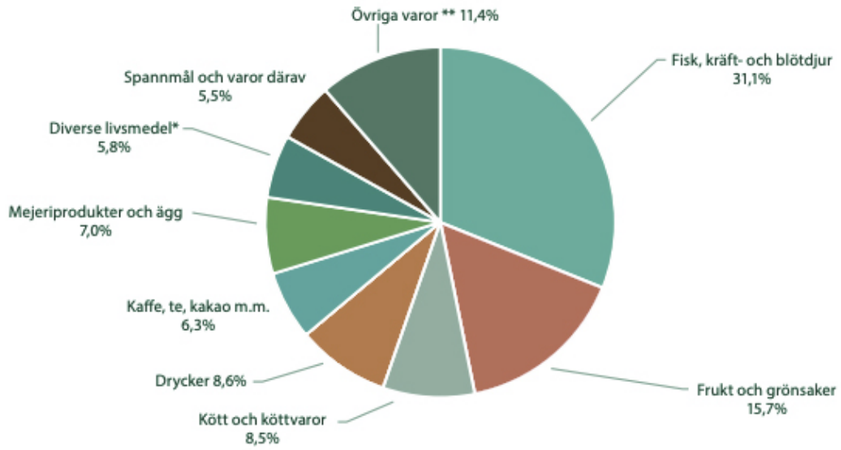


Fig4. Shows the import of agricultural products and food in different categories of products. Jordbruksverket (2019).

Food import

Sweden import more or less the double amount of agricultural products and food than we export. (Livsmedelsverket 2019) The food industry in Sweden have been increasing both when it comes to import and export between 2017-2018 which is natural yearly process in the Swedish trading market. But there is a huge imbalance of the amount that we import versus export when looking at the statistics from the yearly rapport of Swedish trading market in agricultural and food products made by Jordbruksverket 2019. The main countries Sweden import from is Norway, Denmark, Netherlands and Germany, and consist mainly of fish, fruit, vegetables, beverages, meat, diary products and coffee etc. However you should bear in mind that the statistics of import countries can in reality be different since the trade flow reported as import from EU country can originate from other countries.
This means that the data is received from the transit country instead of the originate country that might be outside EU and therefore even longer imports distances of food and agricultural products than it shows in the reports. (Jordbruksverket 2019). One example is the fruit imported from South America which is a big supplier of certain fruit to Sweden, the food chain from South America are delivered to the harbor in the Netherlands and then distributed to Sweden but are registered as an EU-import from the Netherlands.

The import consist of products that have difficulties to be produced in Sweden such as bananas, soya and coffee beans for example. But there are also a significant amount of products that are competing with Swedish produced products. Different kinds of vegetables, fruits and cereals compete with imported products mainly from our neighboring countries. The result of this according to the rapport from Lantbrukarnas riksförbund, 2018 is showing that 48% of what the Swedish inhabitants was consuming during 2017 are imported from other countries.

Food security

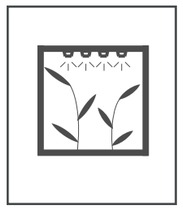
The last decade have the phenomena of urban farming been an increasing topic in the discussion of the sustainable city. There are no official definition of the means of a sustainable city, but terms as transport, energy supply, waste systems, architecture, green areas, health, recreation and climate response are often mentioned. The food supply is often taken for granted in the definition of a sustainable city and it is also absence in the discussion of national security. This is astonishing since the development of food production is today more or less totally integrated in the global economy market. (Sage 2013)

Since Sweden joined EU and abolished the requirements of security food stockings 1995, the self sufficiency have decreased and the import of food and agricultural products have increased, (Olsson & Olsson 2016). The flow of goods between the European countries have created a complex global chain of mass production within the food industry. Today are 48% of the food we are consuming imported from other countries which makes us non self sufficient and dependent of the import, (Lantbrukarnas riksförbund, 2018) This might put us in vulnerable situations and can have direct impacts of the national food supply.
Food security are according to FAO (2008) usually mentioned in relation to developing countries but can regardless developing stage be identified in four categories, availability, access, utilization and stability. The food security are in direct relation to the food system supply in order of planning, processing and distribution. The global food industry are more or less in control of the food system and are reducing the local impact of food balance. The food security can therefore be affected whether it is a developed country or developing country, (Olsson & Olsson 2016). A majority of globalized food supply, and a reduced diversity, might create an exposing situation if the global food chain is interrupted. Climate changes, political conflicts and lacking resources are examples of situations that are highly probable of today. Olsson (2016) refers to Moberg (2015) that Sweden and many other high income countries are taking the food supply for granted which are putting Sweden in a vulnerable situation and might be considered as a question of national security. The global market are allowed to control undisturbed and the Swedish food supply are only a very small scale production on compromised rural areas nowadays. This have also an indirect impact of the polarization between the urban and rural landscape.

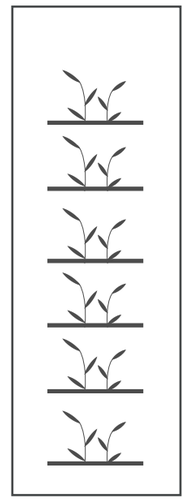
3.0
Design Parameters

Soil based farming

Green roof cultivation

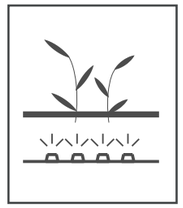


CEA-Farming

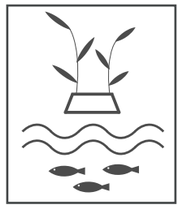


Vertical farming

Hydroponic



Aeroponic



Aquaponics

Farming methods

The way of growing your own vegetables within an urban context could take shape in many different methods. The background led me into the research of farming methods in order to understand what parameters that are necessary to implement in the project and how to organize the building to work in the favor of urban farming. The different agricultural methods do have different characters and bring different qualities into the project. During the process the focus turned more into three kinds of methods with different qualities that wanted to investigate further.

Soil based farming

The crop yield differ depending on the crop and method of production. It might also vary over the years because of climate and other circumstances which makes it problematic to calculate. But in order to estimate the potential return and required footprint of soiled based farming, it is needed to collect data of the amount of consumption in Gothenburg and collect information of potential return in different crops. These numbers are received from the report, Matproduction och urban hållbarhet by Olsson (2016) and is in this thesis used as a supporting ground in order to understand the approximate footprint and the potential return of this farming practce.
According to Livsmedelsverket (2019) is a daily consumption of 250g vegetables recomended and with the numbers received by Olsson (2016) is it possible to estimate the average footprint per person and year to match the recomended consumption. The return from the vegetables and crops below do have an average result of 34 tons/hectare of soil based farming, which means a potential return of 3,4kg/m².
The result of these numbers are showing that the footprint required to cover the recomended consumption of vegetables for one person is 26m². of this agructultural method.

Different agricultural method gives different yield. According to Olsson (2016) is well known that intensive cross combined agricultural methods inclusive eco-agricultural methods are giving higher return than conventional methods. Bio-intensive agriculture is an organic system achieving maximum yield from minimum land area. It means you are densifying the different crops, using compost and raised beds for intense planting growing in soil. It is increasing the biodiversity, the soil sustains fertile, it is inexpensive in comparison to other methods and are easy implemented by people who lack the resources to use commercial chemical and fossil fuel based forms of agriculture. This method is therefore more common in Urban and peri-urban agricultural since the lacking amount of surface is usually a problem in Urban areasm Olsson (2016)

In the study by McClintocks (2013) the bio-intensive ecological farming have different levels of yields. McClintocks have characterized this methods in three levels. Low, medium and high intensity. The high intensity-levels is very demanding and time consuming which in this project is unreasonable since it doesn't meet the expectations of the dwellers and are therefore not included in the comparison.

In this project is it reasonable to conclude that the dwellers will use the ecological farming of low and medium bio-intensive method instead of the conventional method. This housing project will therefore produce a variety of products instead of a single product and not only provide vegetables for the dwellers but also in increase the biological diversity. The aim is to create housing units included in the organic system of production as a part of the puzzle. The natural resources as sun and water is providing vegetables, the vegetables is providing food for the dwellers and the dwellers is providing nutrion by their waste and the cycle is closed.

Potential yield in ton/hectare

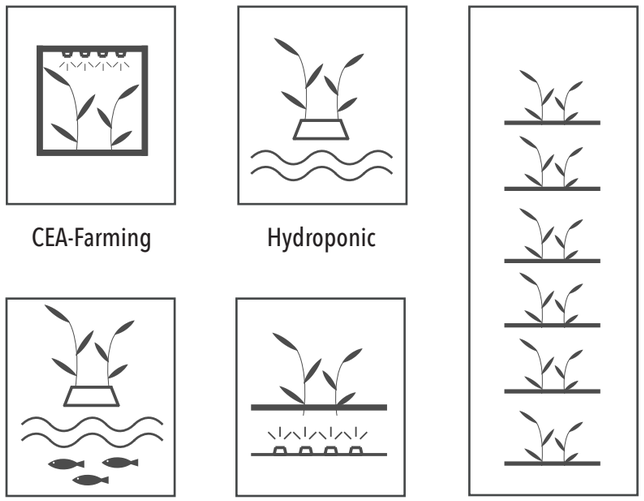
Carrot	Onion	Lettuce	cauliflower	Leek	other kitchen plants	other brassiacs	other root crops
6,3ton/ha	46,3 ton/ha	19,7 ton/ha	17,3 ton/ha	30,2 ton/ha	33,7ton/ha	27,4 ton/ha	34,1ton/ha

Fig:5 Vertical farming of salat indoor using ACE-technology.

Controlled-environment agriculture (CEA)

CEA is a term covering different ways of producing food indoors. It is a technology based approach to maintain a food production with the aim to maintain optimal growing conditions throughout the development of the crops. This food production is most often taking place in structures such as buildings or green houses with technology controlling the conditions in order to maximize the yield. The technical implementation can have a wide range of variables but are usually taking care of: light, temperature, humidity, nutrition, carbon dioxide and pests, Horvath (2018).

The CEA-method have the possibility to produce more or less any crop and can therefore be used to grow food, algae for biofuels, pharmaceutical and nutraceutical applications.
The indoor farming have the recent years grabbed the headlines in the mainstream media of agricultural future scenarios over the globe. It has been pronounced as one possible solution to increase the food security in vulnerable places since the method controls the surrounding condition and deletes the unexpected adversities that affects the yield. The production can therefore eliminate the seasonality and create a stable food supply all year round.
The CEA technology can take shape in different ways and includes a wide range of solutions such as hydroponics, aeroponics, and aquaponics and vertical farming for example.



Hydroponics

Hydroponic is a growth system based in water instead of soil. The plant roots are growing in reservoirs that are pumped with mineral nutrient solution which can come from plenty of different sources.
The hydroponic method offer many advantages and are often used in vertical farming since the system can be composed in a vertical solution with a water flow pumped from top to bottom. The method are decreasing the water usage and makes the plants grow quicker than in original soil since the crops doesn't need to use same amount of energy to create a strong root system to find water in the soil.

Aeroponics

Aeroponics is the method of growing plants without using soil or an aggregate medium in an air or mist environment. Water and nutrient solution is sprayed directly on the plants, the unabsorbed mist is condensed and return to tanks to be used again.

Vertical Farming

Vertical farming is a type of ACE-method where crops are stacked on vertical levels in a building. Predominantly this is taking shape without natural light or soil and are often combined with hydroponic system solutions in a vertical direction.
Vertical farming is often used in locations where lacking surfaces for agriculture is a problem but also can also be found in abandoned buildings reused for urban farming, Horvath (2018)

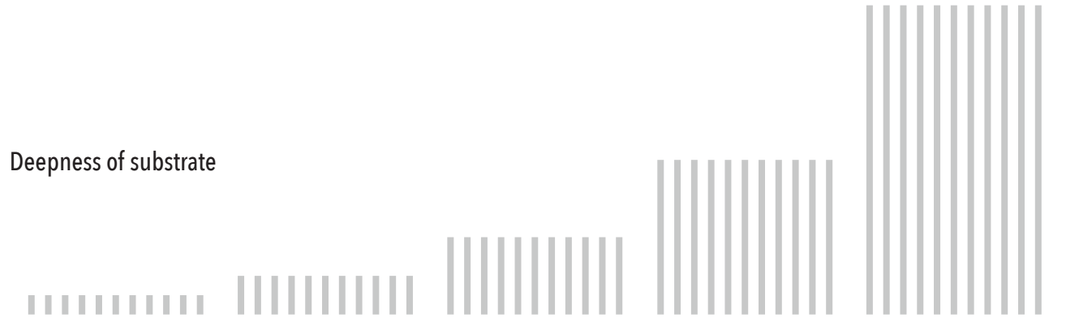
Aquaponics

Aquaponics is a combination of hydroponics and aquaculture. The plants are growing in an aquatic environment with nutrients that are coming from fish tanks. A pump moves the nutrient-rich water from the fish tank to a hydroponic system that are providing the water and nutrients to the plants, the water then get cleansed and goes back to the fish tank.

Green roof cultivation

The vision of the city today is to densify and exploit land for people in attractive metropolitan areas in order to increase the efficiencies of infrastructure and create close connections between work, dwelling and recreations. This is explained in the guideline book of green roofs by Capener, Emilsson, Jägerhök, Malmberg and Pettersson-Skog, (2017) and they mean that the usage of land have therefore the negative aspect of decreasing important green areas for recreation, filtering the air and delay for stormwater. To compensate the loss of land have therefore resulted an increase usage of green roof in development of bigger cities. The definition of green roof can have a wide variation but are in fundamentals the overlay of vegetation above the waterproofing elements of the floor joists or roof structure. The variations of green roofs can be characterized into extensive, semi-intensive and intensive depending on the usage and maintenance. Extensive green roofs require in general low maintenance with an appearance that differ from intensive green roof that require a higher maintenance. Their character should therefore not be mistaken by the depth of plant bed but instead of their area of use (Capener, et al., 2017).

The aim in this case is to explore the possibility to cultivate vegetables and herbs in a housing project where the construction such as roof or balconies can be a possible design parameter in the future work. That means that a plant bed of 150-300mm applied on the roof structure could be a possible scenario for growing a wide range of vegetables and herbs, which is shown in the next-coming schemes made by the author based on information of Capener et al,. (2017)



30-150mm	150-300mm	300-600mm	600-1500mm	1500mm or more
Sedum, moss, house leak, herbs, grass and meadow of flowers.	Herbs, vegetables, perennials	Bushes, woody-perennials	Larger bushes, smaller trees,	Bigger trees

Components of green roof

Layer of vegation

Substrate

Filter fabric

Drainage

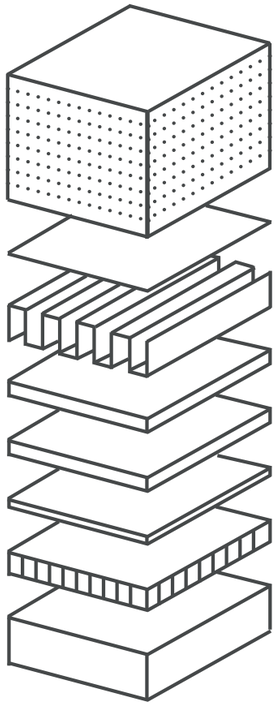
Protection course

Root barrier

Waterproof membrane

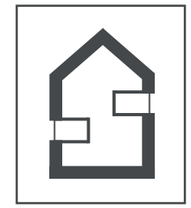
Insulation

Structural roof



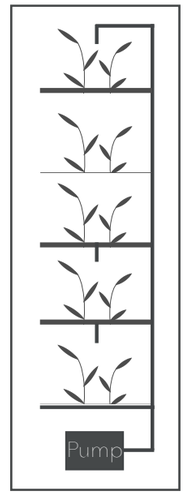
Substrate depth for examples of herbs and vegetables

100mm	150mm	200mm	250mm	300mm
Chive	Cabbage	Haricoverts	Beetroot	Rhubarb
Arugula	Peas	Aubergine	Broccoli	Potatoes
Salat	Garlic	Chili	Zucchini	Currant
Welsh onion	Onions	Leek	Cauliflower	Corn
Chervil	Mint	Persley	Dill	Gooseberry
	Thyme	Rosemary	Fennel	
	Strawberries	Kale	Lemongrass	
		Lavender	Tarragon	
		Parsnip		
		Carrots		
		Cucumber		



Balcony lots

Soil based farming



Vertical hydroponic farming

Focus of growing

The way of growing your own vegetables within an urban context could take shape in many different methods. During the process the focus turned more into three kinds of methods with different qualities that wanted to investigate further. The idea is to see how these farming methods can be incorporated into a housing project and what qualities they supply when it comes to social and ecological dwelling. The reason why it became these three methods was more or less the diversity of outcome and the possible result of use. The soil based farming is the more traditional way of urban farming and can implemented as an organic procedure of farming, Organic waste and grey water from residents can be composted and used as fertilizer to the soil. This season based method require organization and collaboration and have a great possibilities as a common activity in order to learn to know your neighbors.

The hydroponics method is an innovative growth system based in water instead of soil that comes with many advantages. It has a very high yield outcome since it can grow vertically and save a lot of surface. The system is connected to a pump that provide reservoirs with water from the top to the bottom which results a very efficient water saving in comparison to other methods. This system requires a curtain infrastructure of its built environment which I found interesting to investigate further and how that could be implemented into the project.

The third approach is the kitchen gardening which can be seen as the smallest scale of methods in shape of window or balcony growing.
This method might not provide the same amount of yield but do have an interesting relation to the dwelling itself. It has the possibility to penetrate the identity of farming all the way to the inside of your dwelling.

4.0
References

Fig:6 Naturhus by Bengt Warne. Photo by Karl-Dietrich Bühler

Naturhus

The concept of Naturhus was born by the Swedish architect Bengt Warne during the 1970s in Stockholm. Its holistic idea is based on three parts, greenhouse, dwelling/function and natural cycle. The greenhouse is a weather protection that enables a closed cycle with plants and gardening, using waste and grey-water as nutrition for fruits and vegetables. The energy use is lowered and the seasons for gardening is extended, the conservatory can then also be an extension of the living room for social gatherings and activities.

The temperature inside the greenhouse are varied during the year depending on the season but are in general higher. The greenhouse climate is more dependent on the amount of sun than the outdoor temperature and are therefore having a bigger difference in temperature in the middle of the day when the sun is stronger.

Mull earth can be produced from kitchen and garden compost. Rainwater is collected, used for dishes, washing and laundry. The water from the sewer is providing nutrition for the plants, the water is then filtered and can be used again. It can go either back to the house, watering the plants if needed or be collected in a pond preventing from dry air. (Olsson,F. meeting 12th February 2020)

In the first Naturhus by Bengt Warne the idea was that the greenhouse should be a sun collector to live in. The sun drives the air around and the heat was stored in a bedrock below the house but was also using a high efficiency stove to keep the house warm. Today many Naturhus is instead combined with technology in order to be more efficient in heating and energy saving.

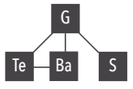
Fig:7 Naturhus by Bengt Warne. Photo by Karl-Dietrich Bühler

Naturhus Saltsjöbaden

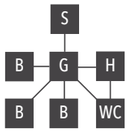
Built: 1974-76
Located: Stockholm
Architect: Bengt Warne

The concept Nature House was born by the Architect Bengt Warne in Saltsjöbaden 1974-76. The building was a private Villa for his family with a living area as a core surrounded by a green house. It was also a research center and a expirement project för further investigation if a single family house could utilize natural resources. After Naturhus in Saltsjöbaden, many other project have been inspired and followed the concept of Naturhus in Sweden and Germany.

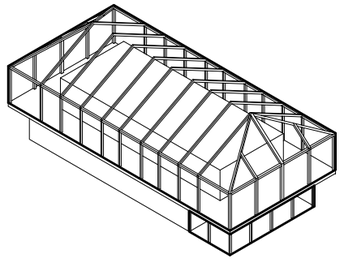
Room Connections:



Entrance level.



Level 1



Room Index

E:	Entrance	Ch:	Changing-Room
H:	Hallway	L:	Lounge
G:	Green House	C:	Conference
L:	Livingroom	R:	Relax
B:	Bedroom	Ba:	Basement
T:	Toilet	Te	Technical room

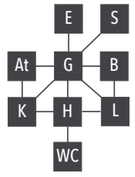
Fig:8 The green house in Sundby naturhus by Tailormade arkitekter.

Sundby Naturhus

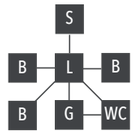
Built: Ongoing
Located: Vallentuna
Architects: Fredrik Olson, Tailor made architects

Sundby nathurhus is a private Villa for a family in Vallentuna outside Stockholm. The core consist of two levels surrounded by a green house with possibilites for growing organic food and extending the warmer seasons. Most of the rooms are connected to the green house and are easily approached from the inside.

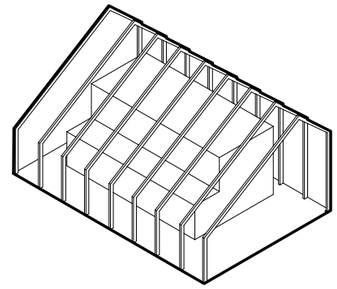
Room connections:



Entrance level.



Level 1



Room Index

E:	Entrance	Ch:	Changing-Room
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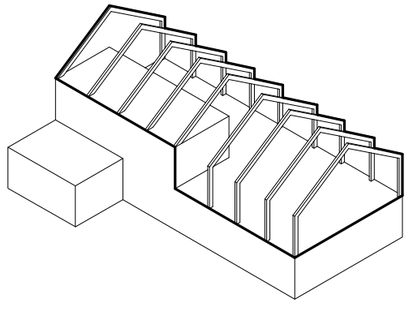
G:	Green House	C:	Conference
L:	Livingroom	R:	Relax
B:	Bedroom	Ba:	Basement
T:	Toilet	Te	Technical room

Fig: 9 Uppgränna naturhus by Tailormade arkitekter. Photo from Tailormade arkitekter.

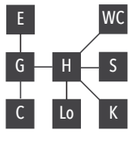
Uppgränna Nathushus

Built: 2015
Located: Gränna
Architects: Fredrik Olsson, Tailor made architects

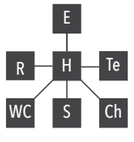
Uppgränna Naturhus is an Eco Café just next to Vättern in Gränna. A building for activities such as, conferences, café, and recreations with an green house atmosphere same as the north Italy according to the architect himself.
The indoor functions is located in the base with a green house on top the building with possibilities for gardening and social activity.



Room connections:



Entrance level.



Level -1

Room Index

E:	Entrance	Ch:	Changing-Room
H:	Hallway	L:	Lounge
G:	Green House	C:	Conference
L:	Livingroom	R:	Relax
B:	Bedroom	Ba:	Basement
T:	Toilet	Te	Technical room

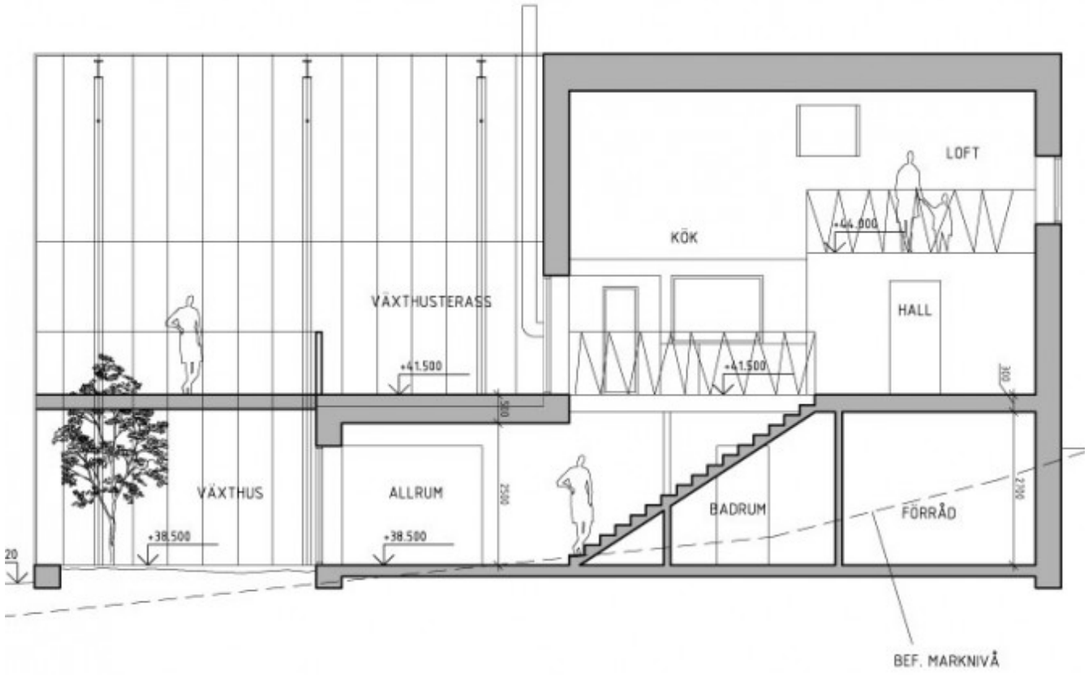
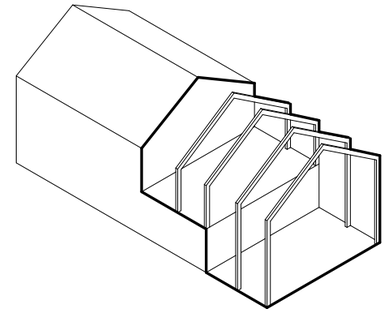


Fig:10 Section of Lindbackens naturhus by Tailormade arkitekter.

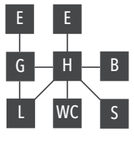
Lindbacken Naturhus

Built: 2017
Located: Uppsala
Architects: Fredrik Olson, Tailor made architects

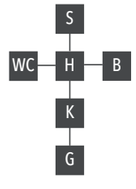
Lindbacken Naturhus is a private villa in Uppsala with a green house in two levels. First level have possibilities for farming and the second level is a terrace for social activity. The greenery are cleaning the air and water and transform the grey water to nutrition for the plants.



Room connections:



Entrance level.



Level 1

Room Index

E:	Entrance	Ch:	Changing-Room
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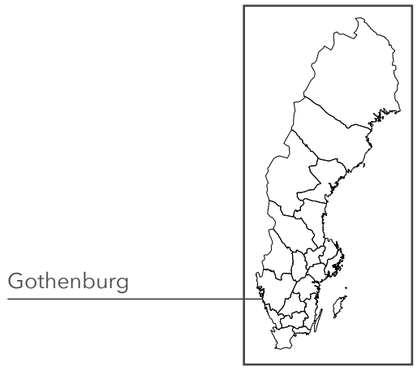
Green house principals

Green house around | Green house on top | Green house extension | Green house levels extension

Analysis of references

The different houses do have different possibilities and principals. The concept of a house inside a green house have varied looks and can be inspirational in many ways. The greenhouse principals can be fragmented into the fundamental basic volume that consist of; A house completely inside a green house. A house with a green house attached on top. A house with a green house extension on one level. A house with a green house extension in all levels. The different approaches gain variation of qualities and needs to be customized to the area in order to work properly.
All the projects do have the concept of Naturhus as common ground, but three of the projects are private villas and you can find common qualities from the dwelling-function in relation to green house in these projects. The fourth project is a public building that doesn't really treat dwelling-functions in the same manner, but do still have interesting qualities that could be used as inspiration further on.
All the projects have the possibility to enter through the "green house garden" which can be a gentle and appreciated first impression of the house.
Both Naturhus Saltsjöbaden and Sundby are totally enveloped by the green house and have therefore possibilities to approach the greenhouse from all rooms regardless their function. Gränna and Lindbacken do have connection to the green house from rooms with more social functions such as living room, kitchen and conference/meeting room.
The use of the green house do more or less serve similar purposes in all cases. The green house stresses the barrier of outdoor/indoor and can be used in a wider range of season than an ordinary house. This quality of a microclimate is then utilized as an extension of the social functions such as dinners and social gathering.
It is used to farm vegetables and fruits in a small scale for private use. And it is also used as an extra space for relaxation and tranquil activities.

5.0
Site



Lindholmen

The plot have earlier been used as slipways for the period of "Lindholmens Varv" between 1840-1970. It was during the 19th century the greatest shipyard of Gothenburg and was the biggest workplace in the city. The land are since 1978 owned by the municipality project group "Älvstranden Utveckling AB and are today working in collaboration between the state, municipality, enterprise in order to develop the area of the former shipyard.

The site of today consist of parking and a temporary building permit for a kindergarten constructed in two story barracks. The area flourish of younger people during day-time since the area is surrounded by many educational institutions nearby including the new built Lindholmens tekniska gymnasium. The topographic of the specific plot is flat in contrast to beginning of Slottsberget just nearby which gives the site an interesting character.

Fig:11 Air-photo over Lindholmen

Lindholmen do still have many traces from the history of the shipyard. Many of the surrounding buildings are 15-20 meter high industry buildings from the 50s-60s and characterized by brick works and a larger scale of industrial footprint.

But within a visual distance to the site there is wide variation of scale and material. Wood and brick is the the strongest character from the shift of last century to contemporary buildings of today. The structure of the surrounding quarter are following a grid pattern with stone pavement and open spaces in between the buildings. The program of the quarters consist mainly of education, offices and a smaller amount of services and dwellings.

Fig:12 The newly built Lindholmens tekniska gymnasium just behind the plot. Photo by author

Sun simulations

Different typologies were tested at the site. The volumes are based on similar surrounding typologies from the area. The volumes were analysed with a sun hour-simulation in an early stage in order to see the farming possibilities for further development.

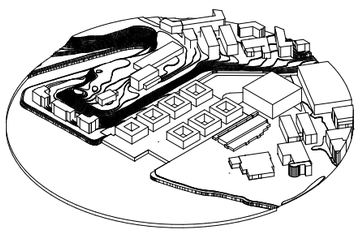
The simulations are showing approximately the amount of hours the surfaces are sun- exposed during a day. The different typologies were tested in each season but the shown example below are taken from the summer season in the first week in June in order to understand the farming possibilities of different shapes and typologies.

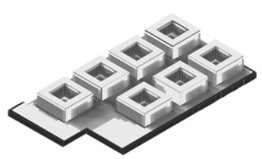
In this stage was the idea to occupy the whole area but was later changed into a smaller footprint, leaving the southern part of the plot untouched.
The simulations was just a guideline in order to understand the approximation of sun movement and amount of sun hours in the area. The simulations are made with the software plug-in for SketchUp called "sun-hours".

The last shown example with south orientated facades and closed courtyards was having most sun exposed surfaces that could be utilized for different farming methods. The high amount surface of solar exposure opens up for green house possibilities integrated into the building. Two big courtyards between the buildings are sun exposed most parts of the day and could be used as soil based agriculture of a community character.

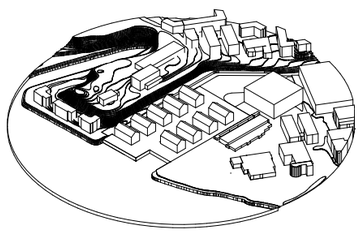
I decided to investigate this composition further, but was changing the size of footprint later in the development into a smaller version.

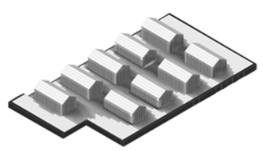
Closed Courtyards



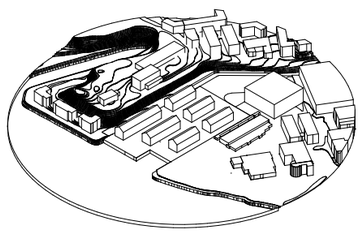


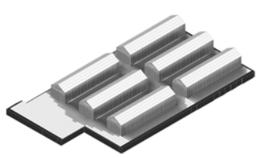
Short south oriented lamella



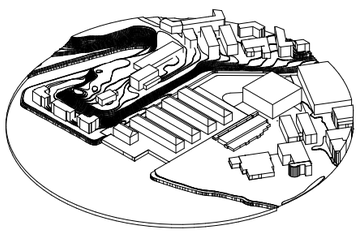


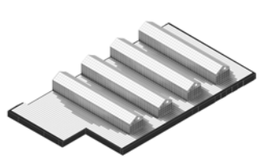
East-West oriented Lamella



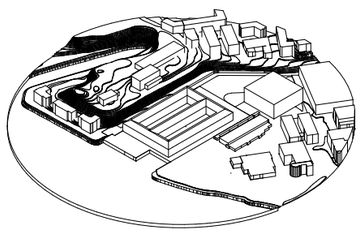


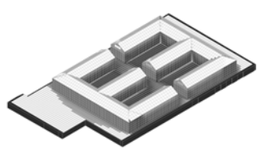
South orientated long lamella



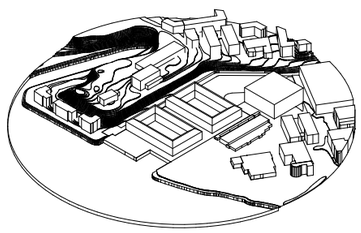


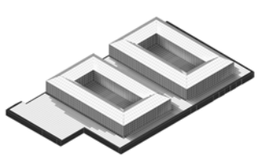
East-west orientated closed courtyard



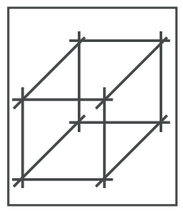


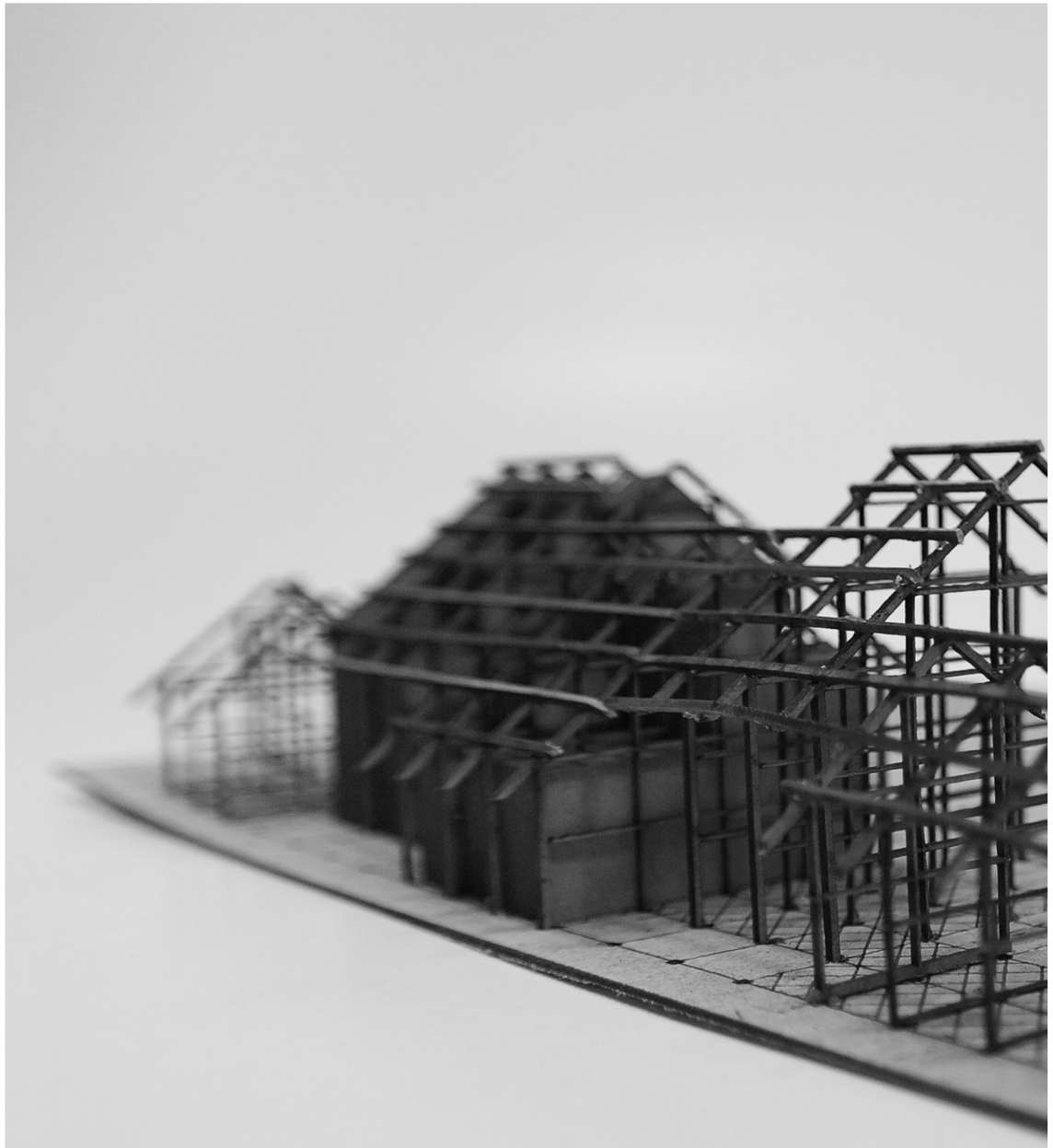
South orientated closed courtyards





6.0
Process





Structural iteration

The iterations of a building footprint was based on a structural logic. The idea was to find a fundamental construction that could be applied to the plot, serving the functions of dwellings with farming possibilities. It was also helpful in order to understand the scale of the site and get an understanding of potential surface for dwellings and farming. This was made in an early stage in combination with model and volume studies as a method for creative process in order to get ideas of function and aestethics appearance.

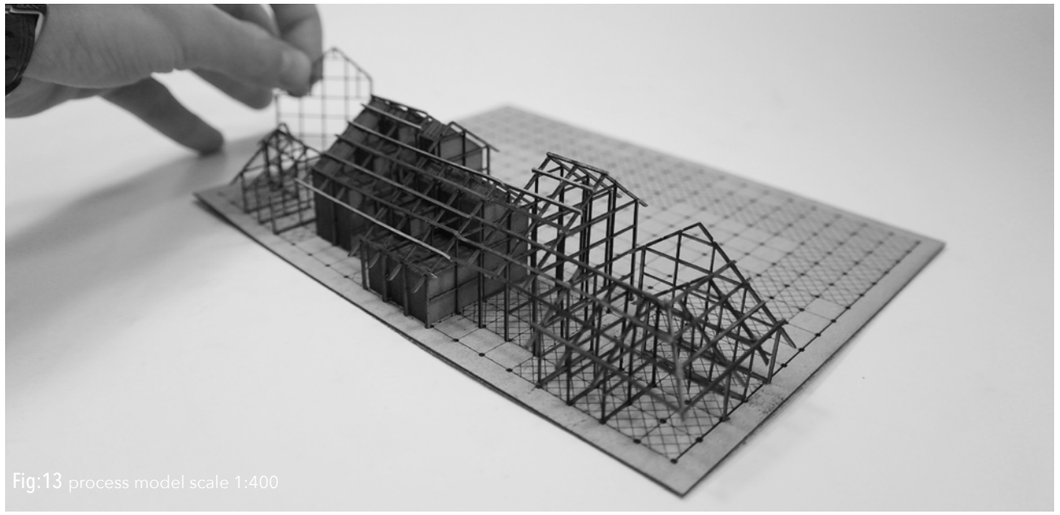
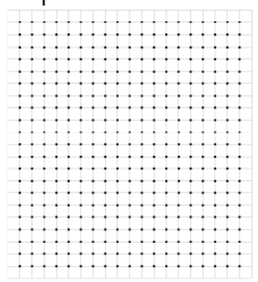
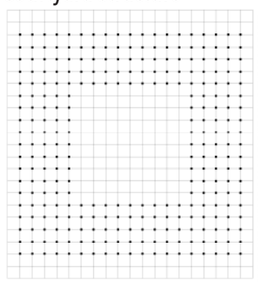


Fig:13 process model scale 1:400

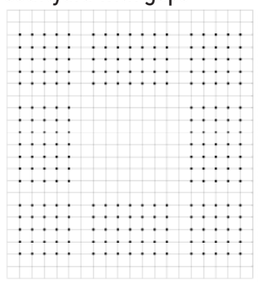
Full potential structure



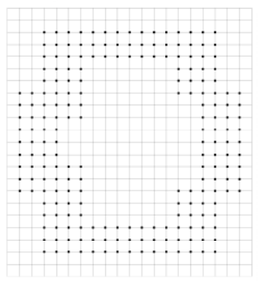
Courtyard structure



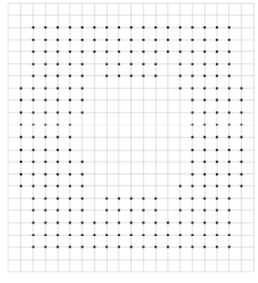
Courtyard with gaps



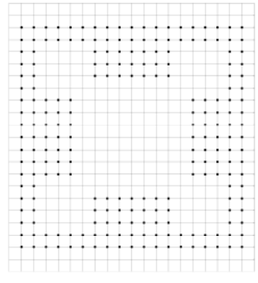
Courtyard deformed



Mini courtyards



Courtyard with indentations



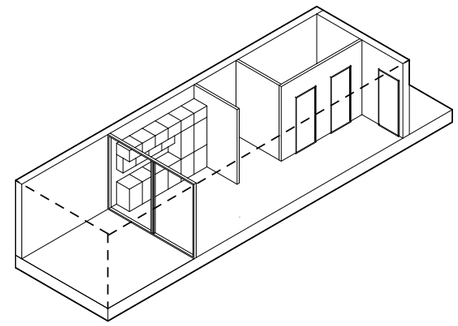
Structural iteration

The 4x4 m grid was based on the "functional dimensions" from earlier proportions of the modernism and their working class dwellings according to Ola Nylander (1998). They did usually have approximately an format av 4x4 meters with few deviations in their dimensions of regular room types. In general, a half room was 7m2, a small bed room was 10m2, a bigger bed room was 12m2 and the bigger social rooms as living room was 18-20.

This helped to understand the building structure in the early stage of the project but was not decided to be a specific rule in general. But it was a good strategy in order to calculate possible surface for different functions included in the project and to see possibilities of a logic construction and appearance.

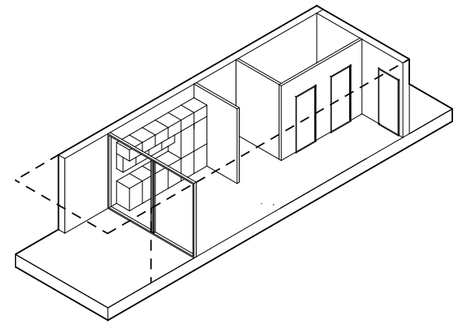
Amount of sun hours with full overhang

The roof and side walls have full overhang



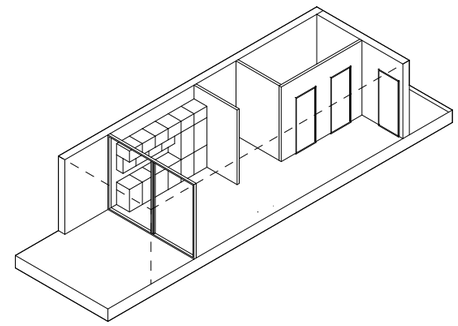
Amount of sun hours with medium overhang

The roof have full overhang while the side walls stand out only half.



Small overhang

Both the roof and walls have half overhang



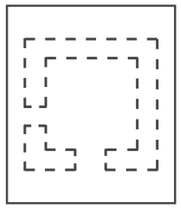
Light studies

In order to create the balcony gardens with the possibilities of growing, I needed to see the qualities of light depending on the depth of the balcony and overhang of the surrounding apartments. The diagrams are examples of some tests with different overhang in a south direction. The simulations is based on the same software used earlier in the project.

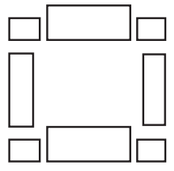
The simulation is showing the last week in June when the sun stands as highest in a northern context, and shows an approximately index of how many hours the surface is sun-exposed. Next page shows the surface of the balcony in plan in different directions in order to understand the light quality depending on their location.

7.0

Iterations

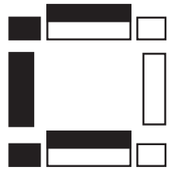


Footprint



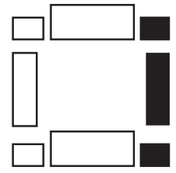
The building footprint.

Apartments



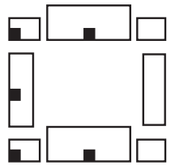
The apartments are located on south, east and west side, surrounding the inner courtyard.

Kindergarten



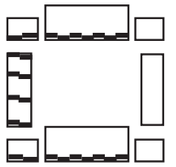
The site has an existing temporary kindergarten which is included in the program but not further investigated.

Staircases



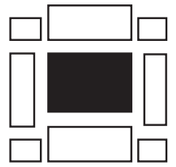
Closed staircases are distributing people to their apartments, each staircase is distributing to 2-4 apartments/level and are located in each apartment-building.

Private garden balconies



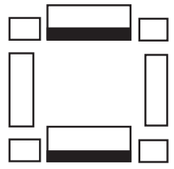
Private balconies for kitchen gardening are placed towards south in order to gain enough amount of sun hours for growing.

Shared comunity garden



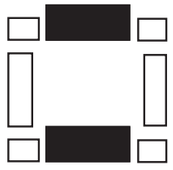
The courtyard is used as a community garden for shared soil based farming.

Green house



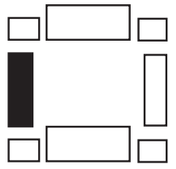
The two southern facades of the bigger building volumes are green house structures applied.

Green roof cultivation



Farming possibilities are applied on two of the roof surfaces.

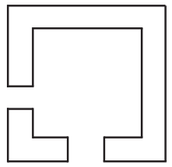
Farming equiptment



Storage for farming equipment and technical room is placed in the south west part of the building.

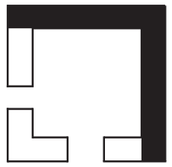
Iteration 2

Footprint



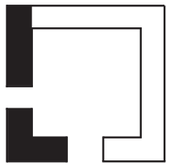
A more continoues building footprint.

Apartments



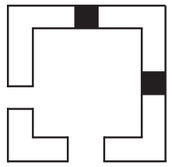
Due to the light conditions are the left wing of apartments changing side to the east side.

Kindergarten



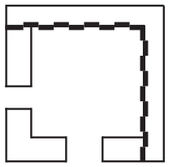
The kindergarten are changing side. The stone wall next to the street are throwing shadows in late afternoon on the west facade which was

Staircases & green house



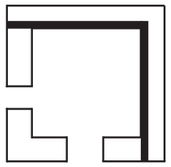
The green house are integrated into the building structure and are working as staircases.

Private garden balconies



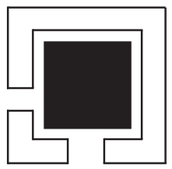
The balcony entries are also working in the manner for private growing possibilites.

Balcony entry



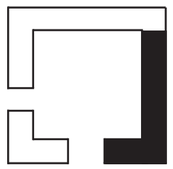
The apartments are approached through balcony entries in south direction with growing possibilities.

Shared comunity farming



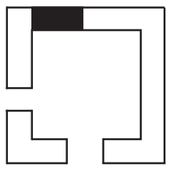
The building volume creates a courtyard for community soil based farming.

Green roof cultivation



Farming possibilities are applied on the roof of the western part of the building.

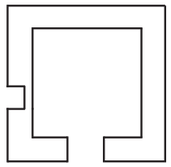
Farming equipment



Farming equipment is placed in the north part part of the building working as a barrier between the kindergarten and the residents.

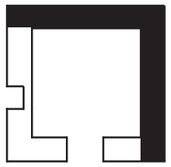
Iteration 3

Footprint



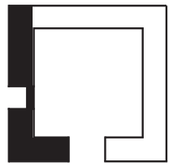
The building footprint stayed relatively unchanged.

Apartments



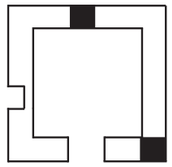
The apartments are located north-east in order to gain sun to the private balconies.

Kindergarten



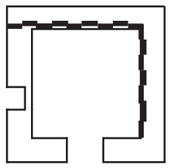
The kindergarten is still placed on the west side.

Staircases & green house



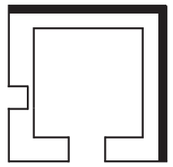
The project has two green house staircases with vertical hydroponic system that distributes the residents to their apartments.

Private garden balconies



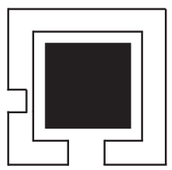
The private balcony gardening or "kitchen gardening" is located in south-west based on the amount of sun hours.

Balcony entry



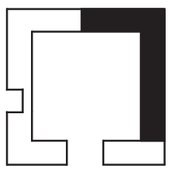
The balcony entries are seperated and are approached from the back instead.

Shared comunity farming



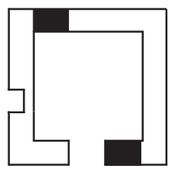
The surrounding buildings are creating a courtyard which is used as a community garden for soil based farming used by the residents.

Green roof cultivation



Possibilities for cultivation are applied on two of the roof surfaces.

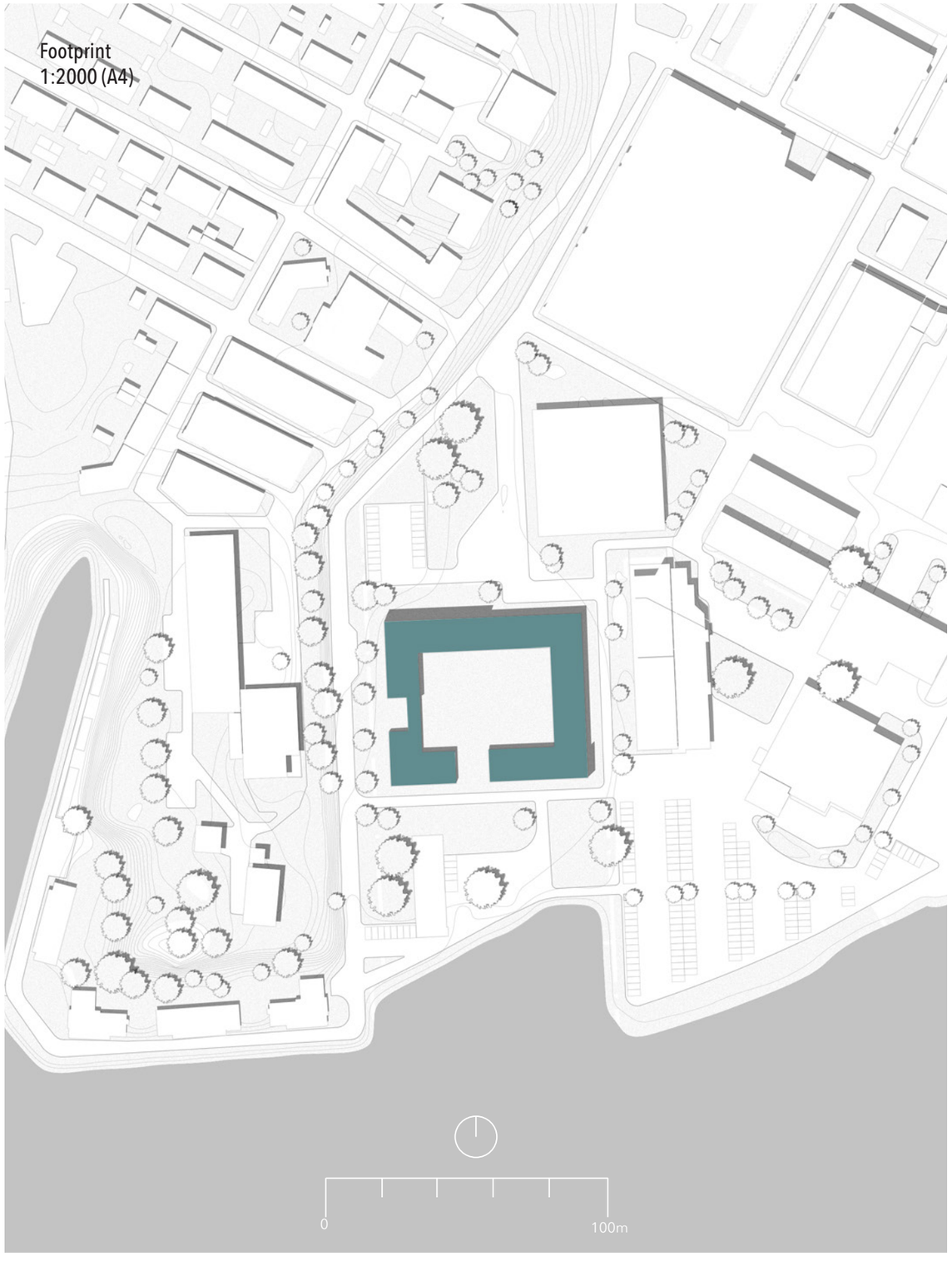
Farming equiptment



Farming equipment and technical room is placed in north and food processing is placed in the south part of the building, highly visible for people passing by in order to atract and create curiosity by its farming activity.

8.0
Proposal

Site plan



Axonometric

Axonometric

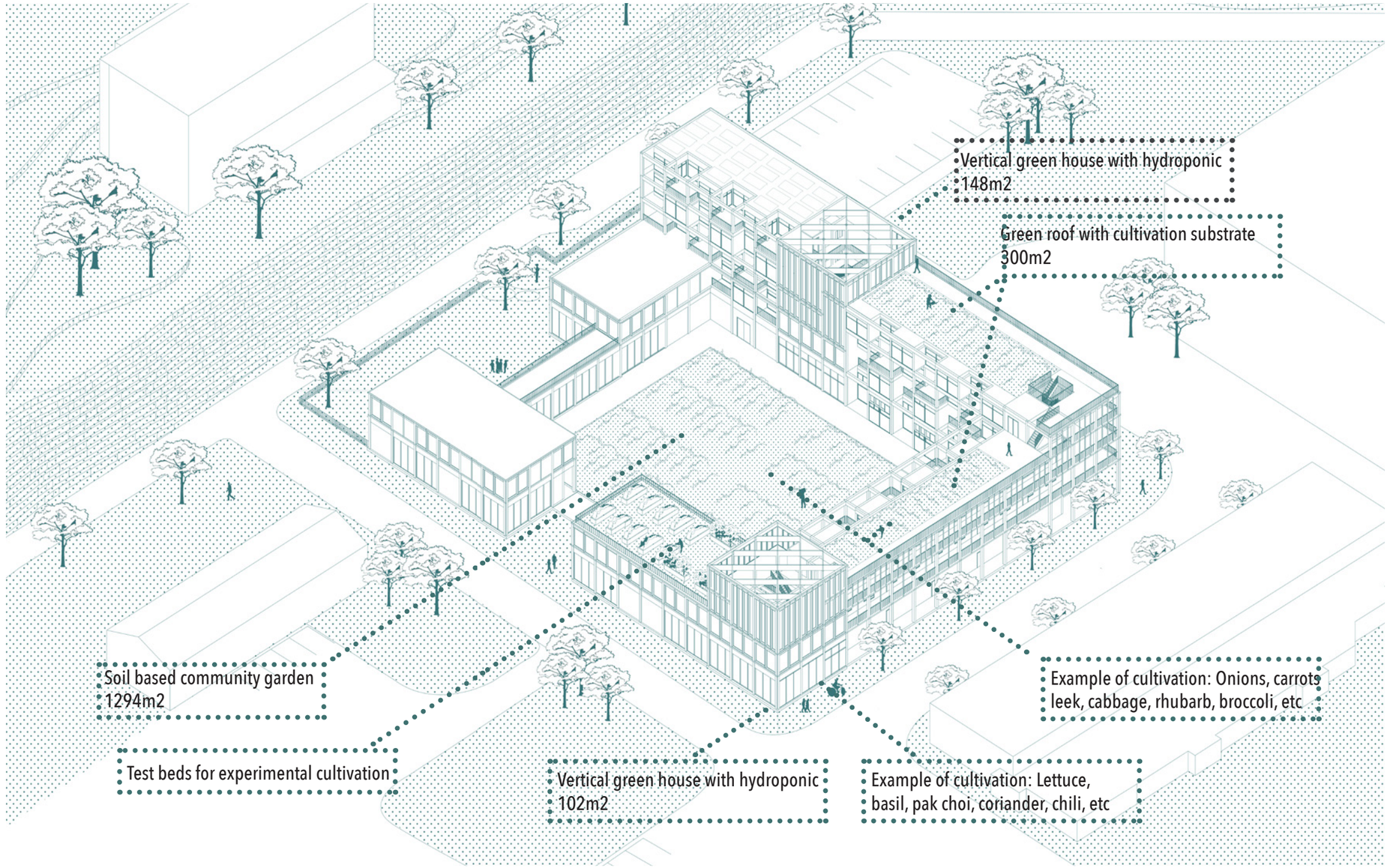
100 residents approximately

Soiled based community garden 1294m2
Soil based roofgarden 300 m2
Vertical hydroponics 252 m2

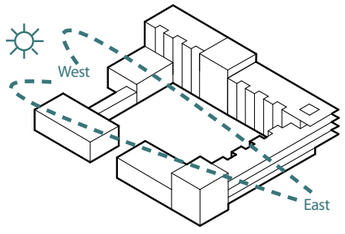
42 Apartments
Area for dwelling 2675 m2

Relation between dwelling and farming:
Dwellings occupies 52% of total area
Farming occupies 48% of total area
(Kindergarten not included)

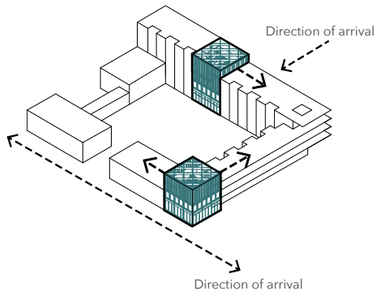
An axonometric overview of the building strategy including the three types of farming incorporated into a residential housing. All housing units are facing towards the soil based comunity garden for seasonbased cultivation in the middle of the project. The building is sun orientated in order to maximize the sun exposure for all types of agriculture. A higher level in north protecting from northern winds and lower in south letting sun in to the community garden. The vertical hydroponic system is combined with the two staircases that leads you to the apartments through balcony entries. The vertical farming staircases are placed in south direction and in location of arrival. The kindergarten is located on the west side. In relation to one of the staircases you find the harvest treatment where you can process the harvest. The roof of the building are taking care of the sun and water treatment, solarpanels are gaining energy to the hydroponic system and the water is led to water harvest tanks that are treated and used by the pumps to the vertical farming.



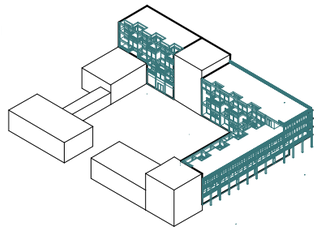
Sun orientation



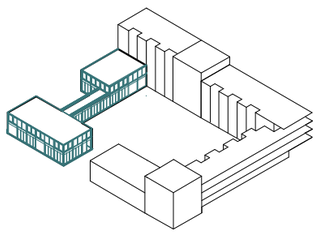
Green house staircases



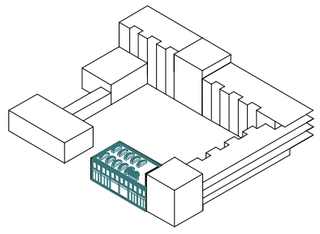
Apartments



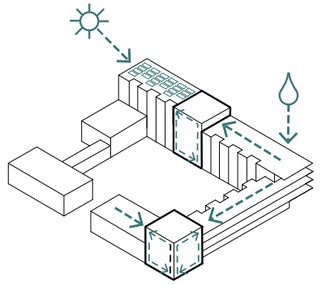
Kindergarten



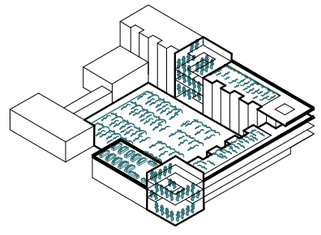
Harvest market & workshop



Sun & water treatment



Farming oppurtunities



Exploded vertical green house staircase

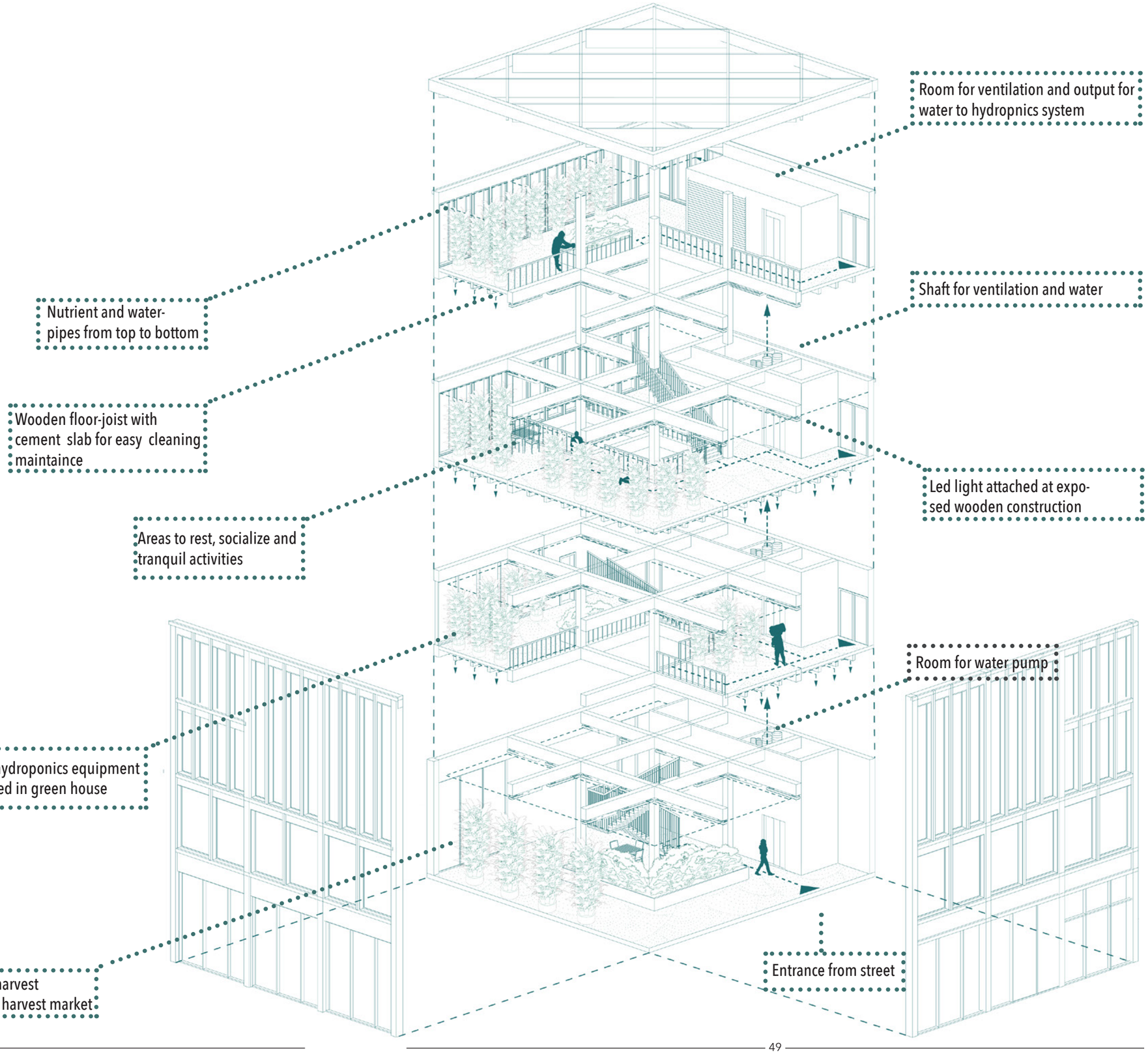
Used by approximately 30-50 people

Example of potential cultivation
Lettuce, Basil, Pak Choi, Coriander, parsley, tomatoes, chili

m2

110m2 potential hydropnic growing

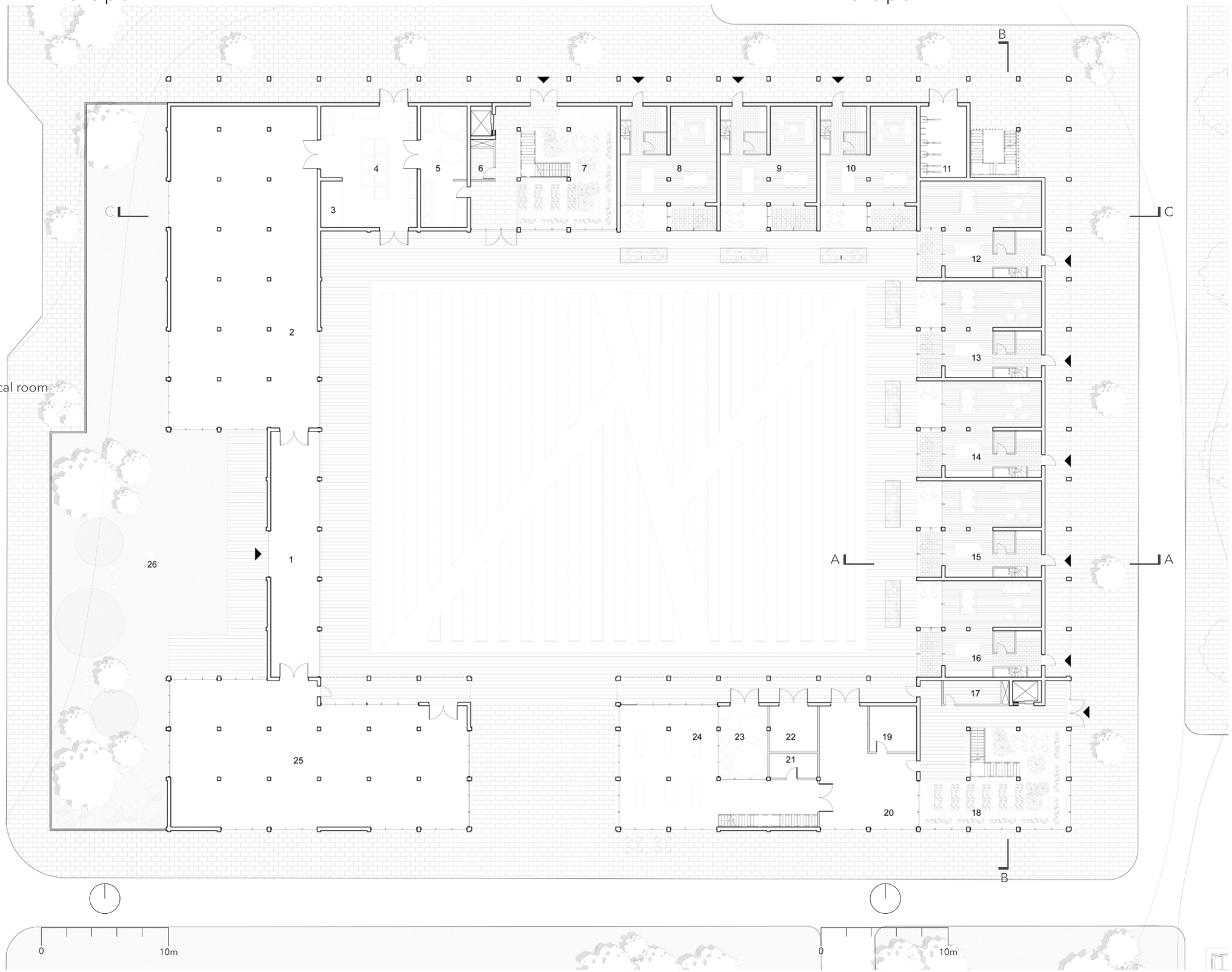
The farming as an activity creates situations of spontaneous interactions, shared spaces and shared tools that can entail a further communication between the dwellers and increase the social richness in the project. The idea to turn the staircase into a vertical green house was an aim to create a threshold between the dwelling and life outside where the residents could interact not only for the activity of farming in itself but also for spontaneous meetings on their way. The green house do extend the farming seasons in comparison to other methods, since it is whether protected and since it is a controled environment. This can be utilized by the residents as an unique space decreasing the barrier between outside and inside as a comfortable entrance to their home. This idea of a vertical green house became also one reason to approach the project with balcony entrances. That solutions made it possible to use the staircase as a funnel to distribute people within the project and increase the possibilities for social interactions and conversations between the residents.
The vertical farming needs a higher maintenance in comparison to many other farming methods since its a technical controled environment. This became also one of the reasons to integrate the hydroponics farming in the staircase, since the flow of people can help running the daily care of this activity. Residents passing by can check the routine of the farming activity on their way home or when leaving the apartment. It might help to detect if something is not working or needs to be regulated in a nice daily flow of a everyday life. This is then increased by not having a central stair in the same position but instead changing direction in order to make the circulation go around the green house.



Site plan

Ground floor
1:300

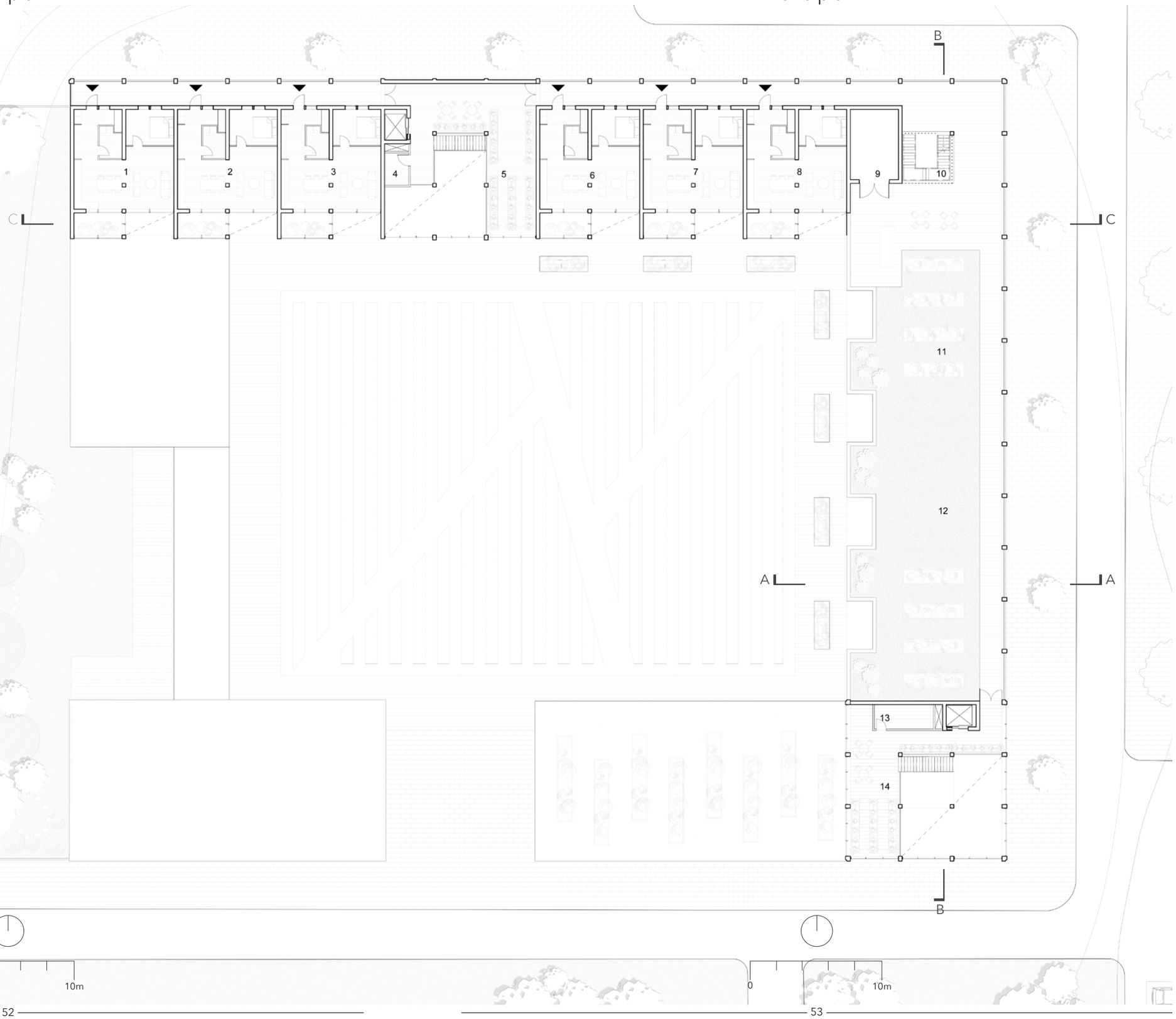
1 Entrance to kindergarten
2 Kindergarten section 1
3 Composte machine
4 Recycling
5 Water treatment and technical room
6 Pump for hydroponic system
7 Vertical Green House staircase
8-10 Maisonette apartments
11 Bike storage
12-16 Maisonette apartments
17 Pump for hydroponic system
18 Vertical Green House staircase
19 Cooling room for vegetable storage
20 Farming processing room
21 Restroom
22 Equipment-room for farming
23 Exposed water treatment and technical room
24 Harvest market
25 Kindergarten section 2
26 Kindergarten playground



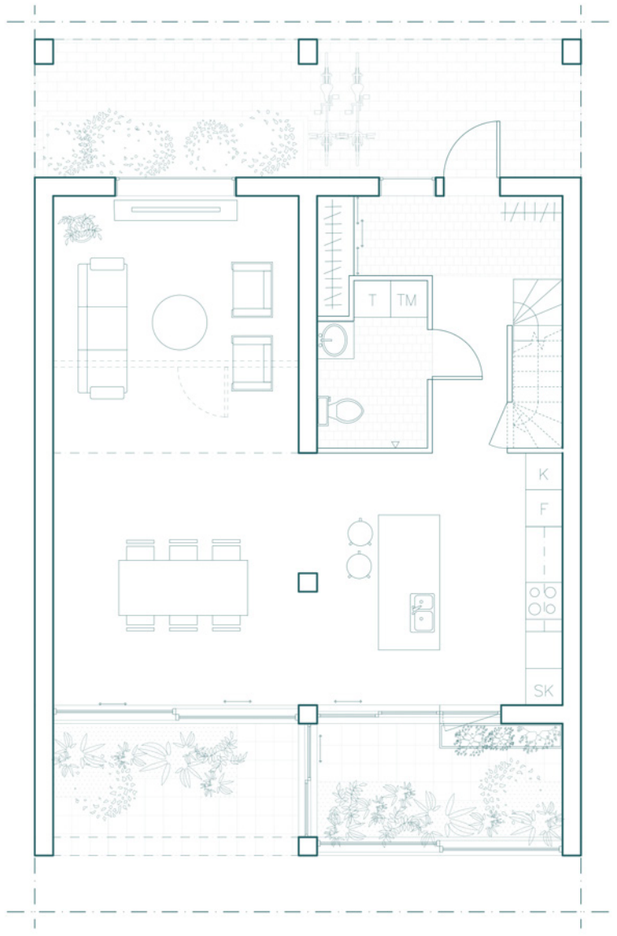
Site plan

Level 4
1:300

1-3 Apartments
4 Storage for hydroponics farming
5 Vertical Green house staircase for hydroponic system
6-8 Apartments
9 Equipment room for roof garden and water harvesting
10 Emergency stairs
11 Raised plant beds for deeper root system plants
12 Soiled based cultivation for smaller plants
13 Storage and ventilation for hydroponic system
14 Vertical Green House staircase for hydroponic system



Apartment A
1:100



Size

Apartment 103 m2
Conservatory 7,4 m2
Outdoor gardening 7,4m2

Amount of people

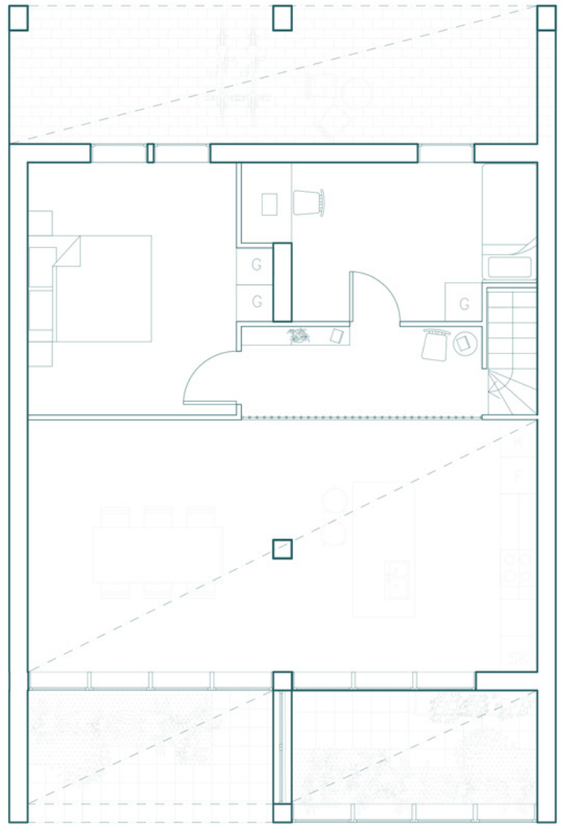
3-4 Person

Cultivation

Example of possible cultivation:
Tomatoes, cucumber, beans, chili peppers, basil, herbs, salat etc.

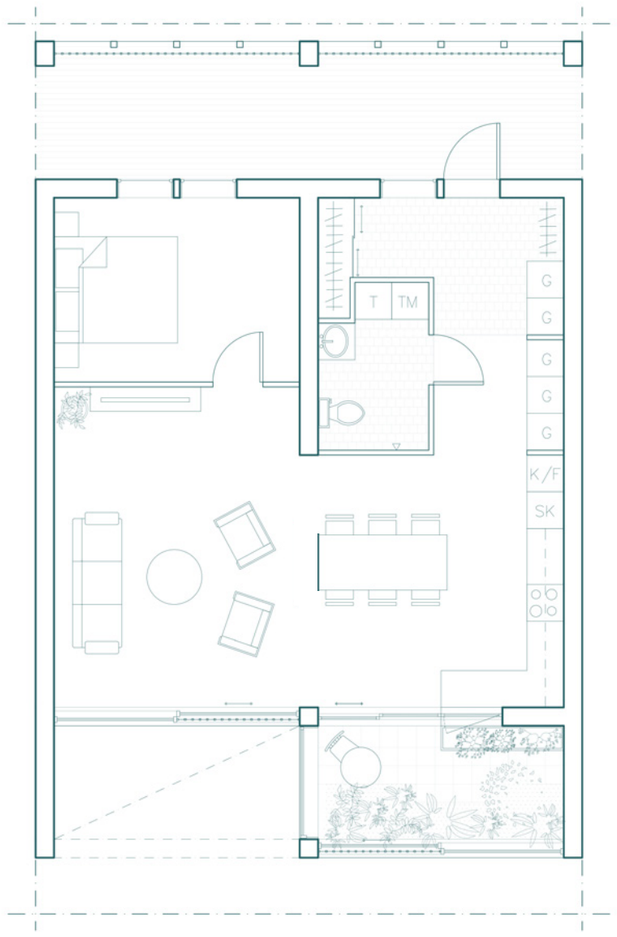
0 5m

Apartment A Loft
1:100



0 5m

Apartment type B
1:100



Size

Apartment 62m2
Conservatory 7,4 m2

Amount of people

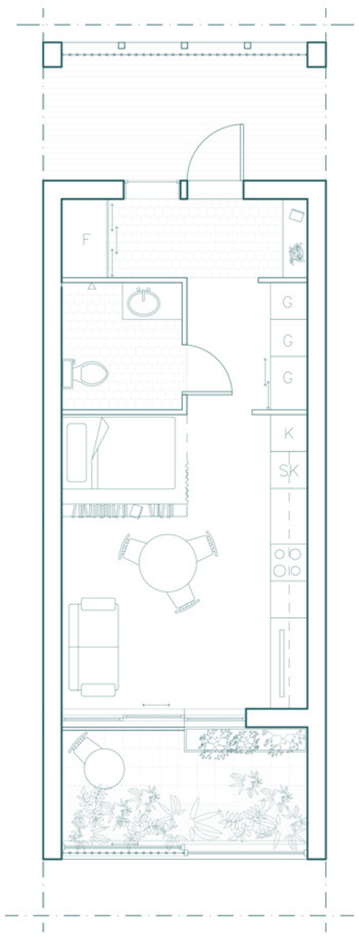
1-2 Person

Cultivation

Example of possible cultivation:
Tomatoes, cucumber, beans, chili peppers, basil, herbs, salat etc.

0 5m

Apartment type C
1:100



Size

Apartment 33m2
Conservatory 7,4 m2

Amount of people

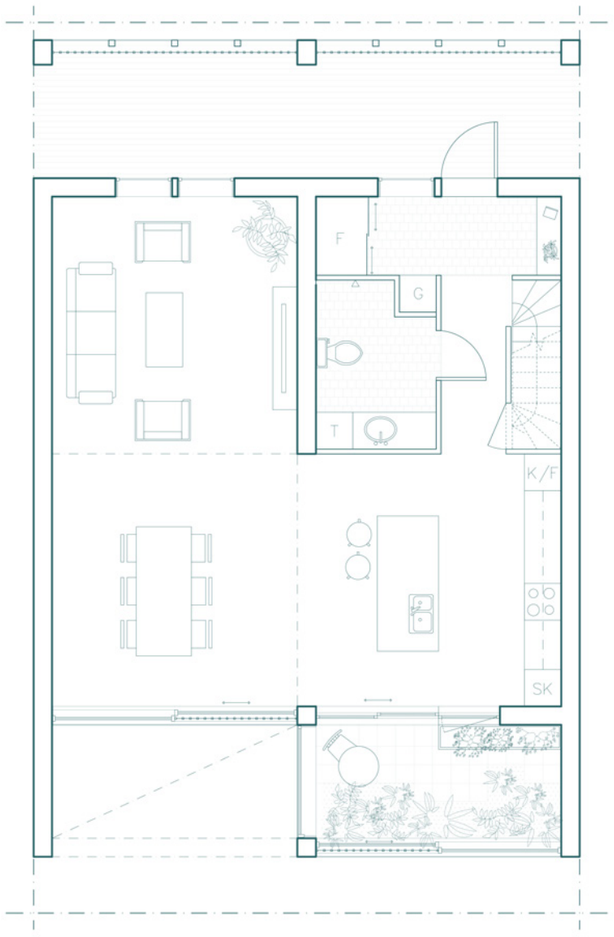
1 person

Cultivation

Tomatoes, cucumber, beans, chili peppers, basil, herbs, salat etc.

0 5m

Apartment type D
1:100



Size

Apartment 128m2
Conservatory 7,4 m2
Outdoor terrace14,8m2

Amount of people

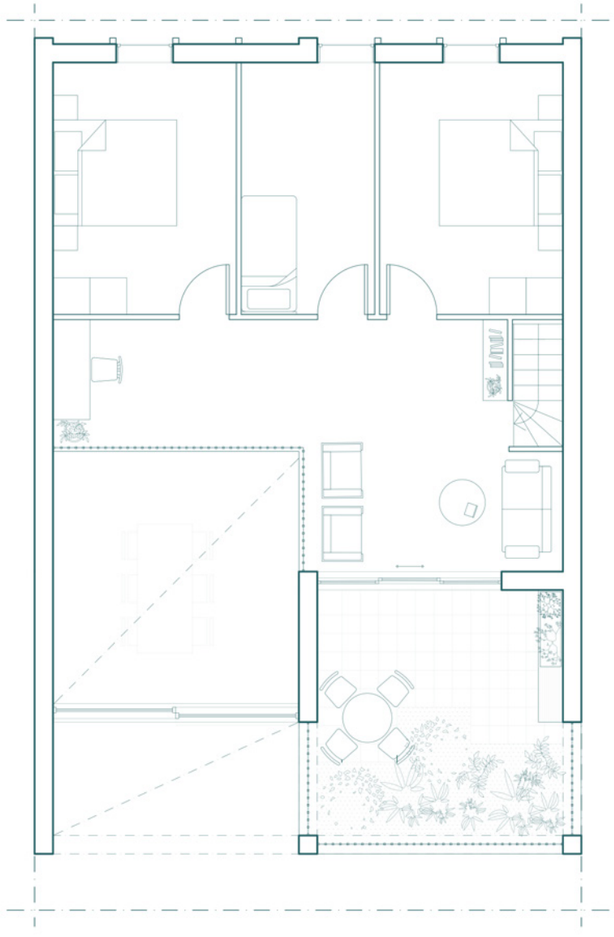
3-4 Person

Cultivation

Example of possible cultivation:
Tomatoes, cucumber, beans, chili peppers, basil, herbs, salat etc.

0 5m

Apartment type D second floor
1:100



0 5m

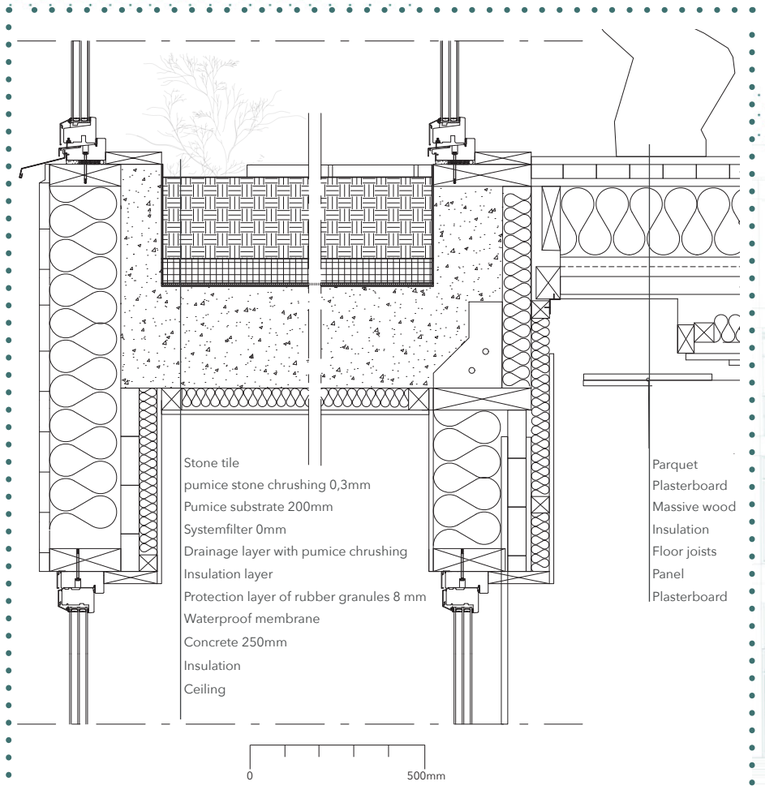
Apartment type B towards courtyard

The apartments are based with similar approach. The entrance are located in north and east. You enter from the ”back” of the apartment with sightlines from the entrance to the conservatory into the courtyard. The apartment opens up towards the courtyard with larger openings where you have the terrace and conservatory for growing. The facade have an offset inwards in order to protect the insight. The conservatory do follow the facade level in order to gain more sun hours and also working as a buffer-zone between the outside and inside, preventing the transparency to be too big with this large openings.

Conservatory

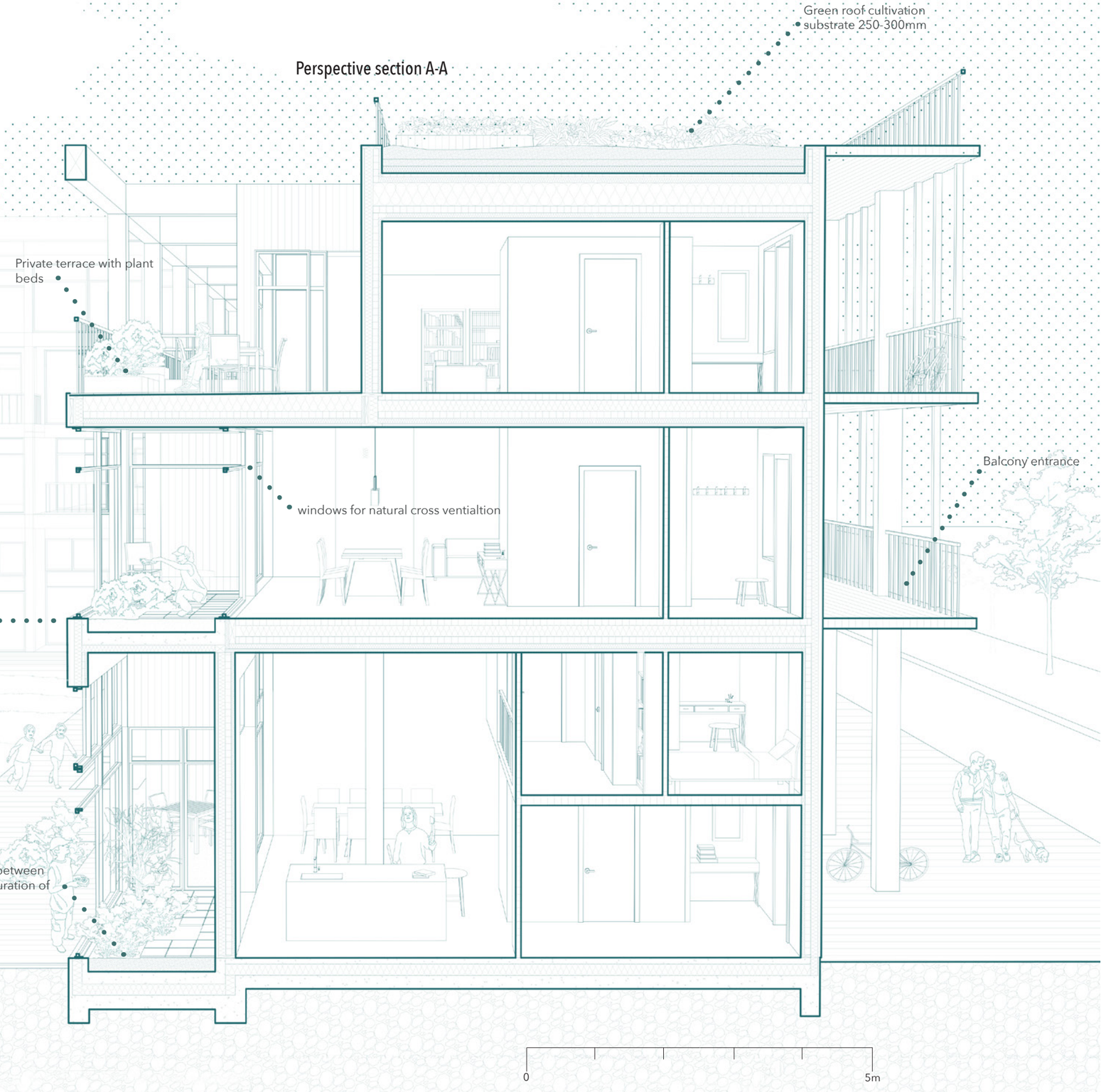
The kitchen is located in relation to the conservatory for easy maintenance of the crops. The conservatory is based on a concrete slab that rests on the wooden construction, filled with pumice stone as substrat deep enough to grow herbs and smaller vegetation. In the substrate do you have metal panels holding stone tiles as floor that can be removed in order to keep a flexibility in your growing.
That means that the residents can put their on touch in their growing balcony and decide the amount of surface that should be for growing depending on the season.
Between the conservatory and kitchen do you have a built-in plant bed for bigger garden plants with deeper root-system that can climb on the East wall. This kithen garden can penetrate the farming character all the way into the home of the residents and built a stronger identity that might affect the residents to a more sustainable lifestyle.

Balcony garden detail



Section

Perspective section A-A



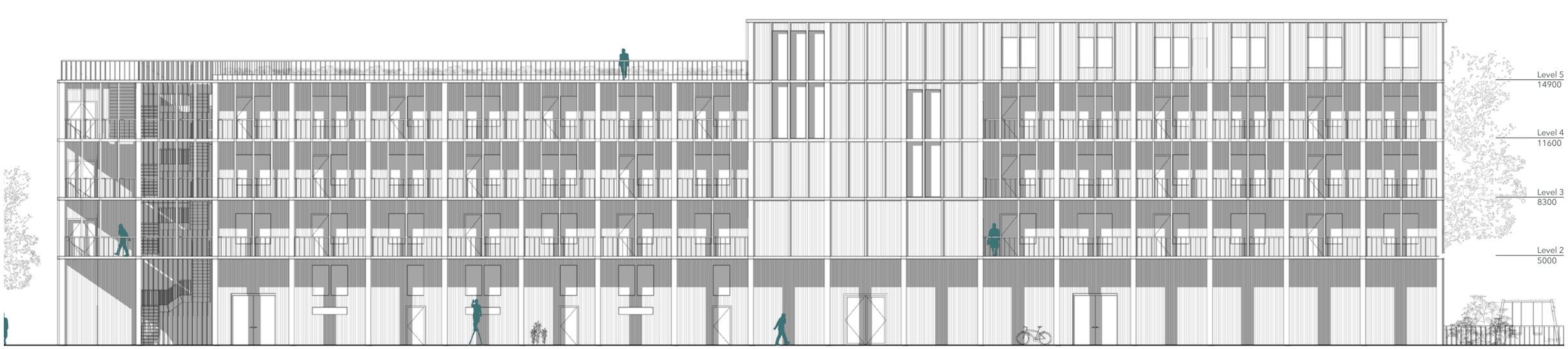
South Facade
1:200

0 10m

Elevation

0 10m

North Facade
1:200



0 10m

Elevation

0 10m

East Facade
1:200

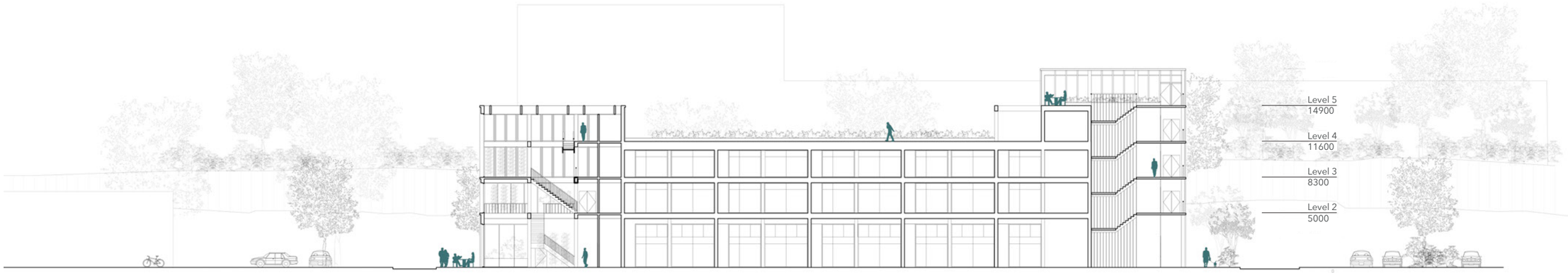
0 10m

Elevation

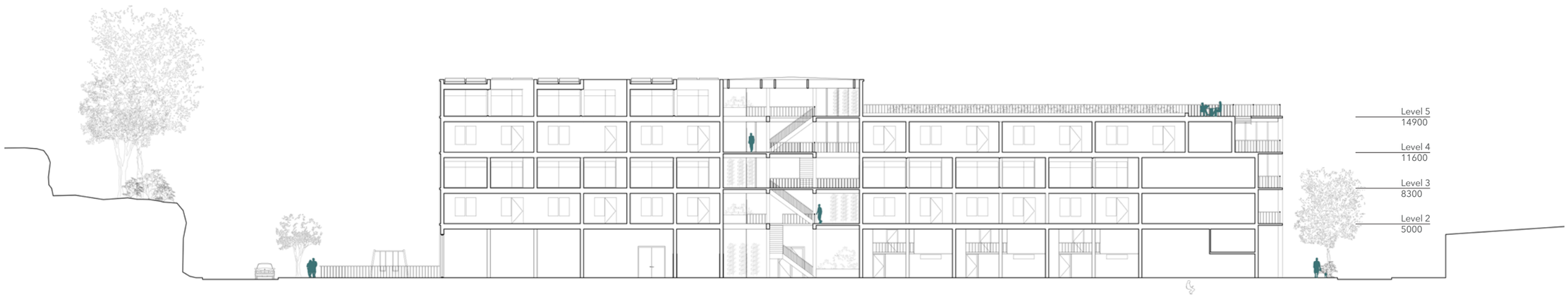
0 10m

Section

Section B
1:400



Section C
1:400



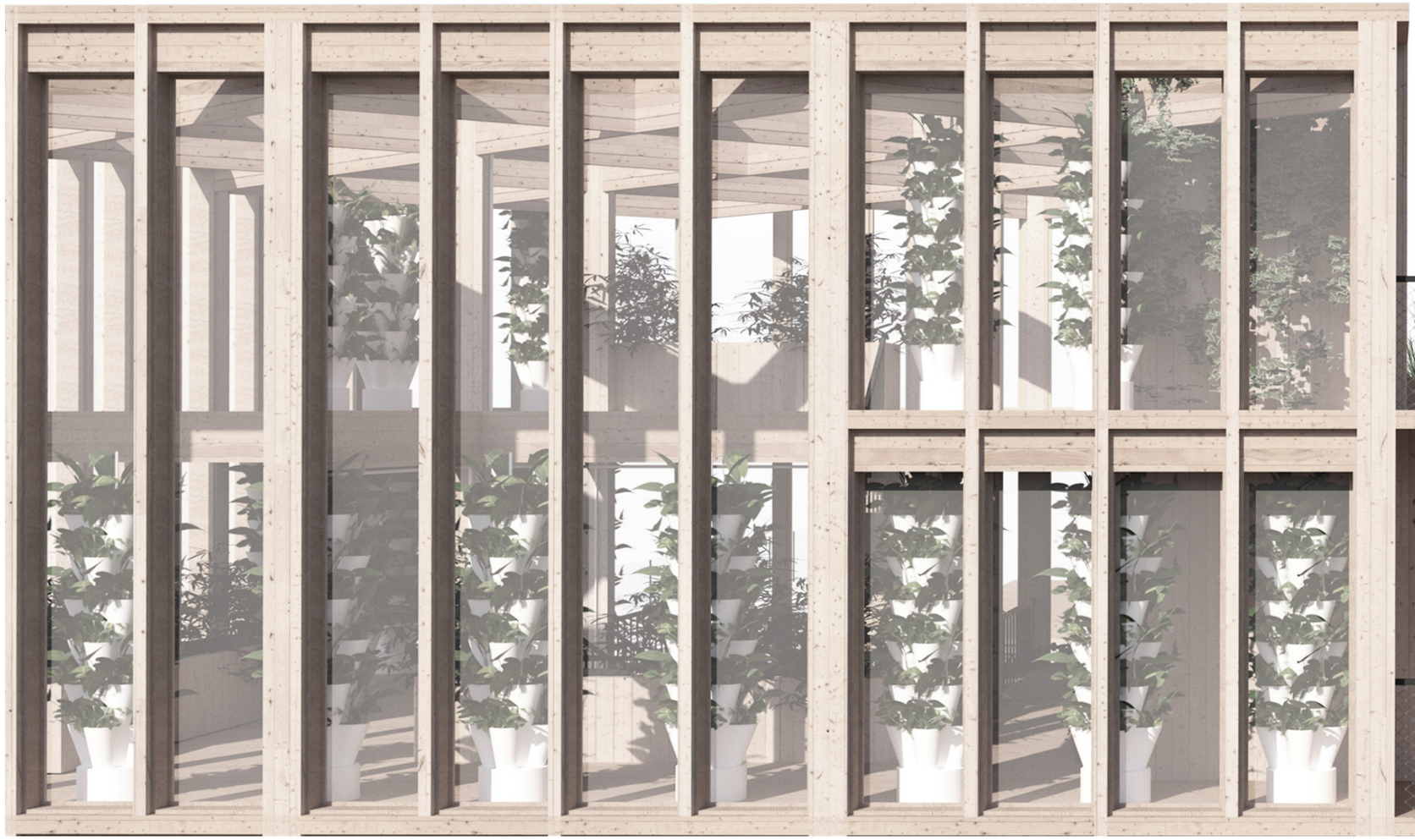
0 20m

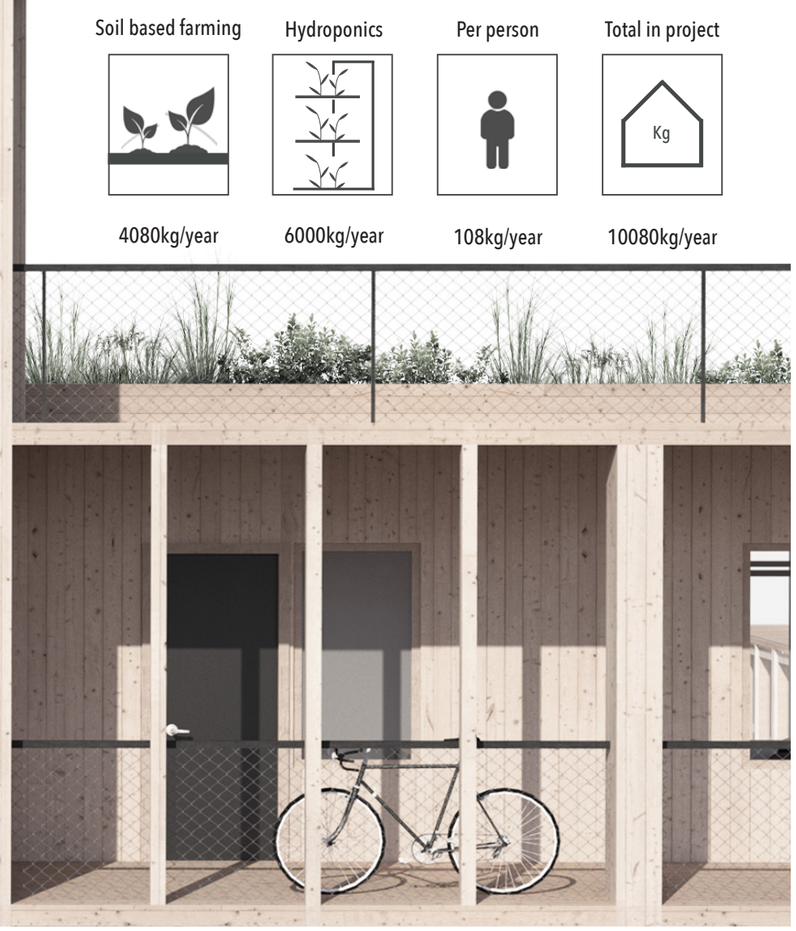
70

0 20m

71

Perspective





Hydroponics yield

The yield from the hydroponic can have a high variation of output depending on crops and surrounding circumstances. In the research it was problematic to find relevant numbers that was consistent to this project and its qualifications. But in order to get a rough approximation of potential output I was looking closer to a case study presenting a comparison between different farming methods including vertical hydroponics system. The production was lettuce and the yield was presented in kg/m2/year. The study was based on a medium scale farming production in Lyon with controlled climate and added artificial light when needed during darker periods. The cultivation cycle was achieved 5 times during a year which means the production was not continuous during all months but was stopped during the coldest season. Which could be a relevant scenario in this case as well.

The presented yield was 44,7 kg/m2/year. In order to control this number I was looking at different sources as well, finding a rule of thumb that lettuce grow approximately 200g/m2 /day using a hydroponic system. Translated to a year with 5 cultivation cycles results approximately 30kg/m2/year.
Since the potential yield from the sources doesn't present deeper information about maintenance and material/equipment, I decided to go for the lower number of 30kg/m2/year with production losses of 20%.
All the area in the staircases cant be used for hydroponic growing since people also need to circulate and a few spots do have parts of shadows during the day. But an estimation of total area 250m2 can be used for cultivation. The result will thereby reach 6000kg of lettuce per year in total.

Soil based farming yield

When looking into the result of farming yield there are many parameters having importance in the calculations. For example what methods you are using, sort of vegetables you are farming, which zone of location etc. But in order to get an estimation I was using the information of potential return from the report by Olsson (2016) that have been mentioned earlier in this report. The average amount of vegetables in soil based farming was 3,4kg/m², this can give a rough estimation of potential return in this project.
In order to be a bit more realistic in the calulations you might need to add potential of losses in the production as well. It was difficult to find relevant numbers of estimated production losses caused by weather and storage, since different sources presented different numbers. But 15%-25% of loss did occured in different calculation which made go for an average of 20%.

The project consist of 1500m2 potential area for soil based farming that could be used for a wide range of vegetables. Knowing that the average return is 3,4kg/m² and production losses about 20% gives the total amount of 4080kg vegetables per year with this farming method.
So by adding these farming methods over a year it gives the result of 10 350kg vegetables.
If we consume that this project household 100 people sharing equal of this amount, that gives a number of 103,5kg of vegetables each year.
The recommended consumption of vegetables stated by livsmedelsverket (2019) was 250g vegetables each day. They recommend 112kg/year for an average man, and 91kg/year for an average woman.
Which means that that the activity of urban farming in this case could have an yearly production that matches the recommended intake.

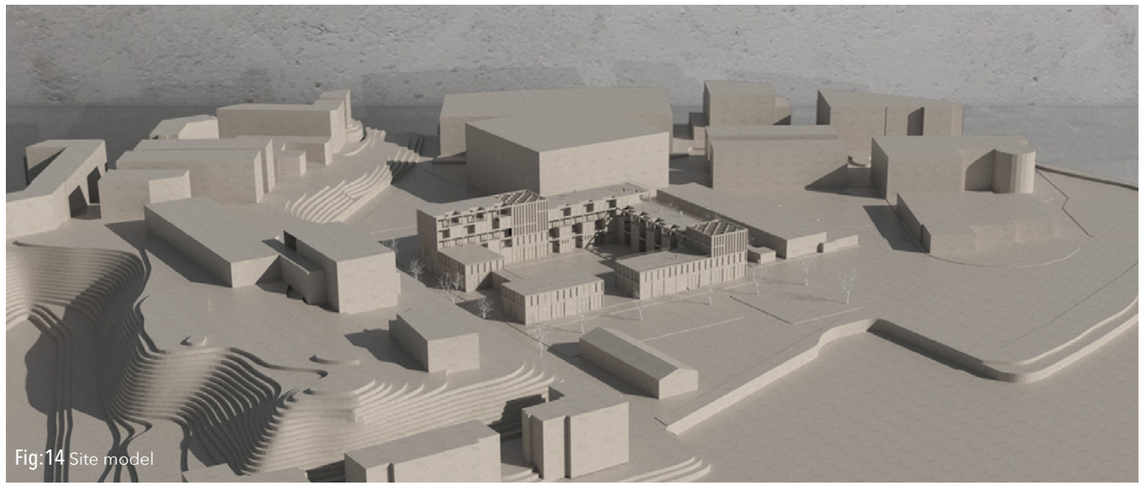


Fig:14 Site model

Outcome and reason of decisions

The content of this project was to provide the possibility for urban farmers to grow their own crops in order to supply the daily intake of vegetables and to see how this could be incorporated in a residential project. My aim was to activate an ecological consciousness of the residents and investigate how to use urban farming to promote social sustainability.
The research consist of different agricultural methods but was during the process focusing on three different farming-characters. Soil based community farming on ground and on the roof. Kitchen gardening. And innovative farming based on vertical hydroponics in a green house. With the idea that these method would cooperate in order to compensate their lacking properties depending on method.
The hydroponic method is an environmental controlled agricultural method that require a curtain infrastructure that needs more energy and resources in comparison to free land farming for example. This means a higher cost and maintenance that can be a skeptical move for a small scale production in an economical point of view. But my attempt was to include this system in order to exchange the positive properties of each method. The hydroponic method is space efficient and can be well controlled and therefore less dependent of other surrounding factors such as climate and insects etc. The hydroponics system have the possibilities to produce over a longer time and is not based on seasons in the same manner as soil based outdoor farming which is having a shorter and limited growing period. The hydroponic can therefore be a supplement to the other farming methods in this project. Crops can be sowed earlier in the season and moved to the outside farming when the roots have grown bigger and therefore streamline the production of vegetables. This strategy of pre-cultivation is something that is used in many homes today, plants that requires a longer period of growing are pre planted in kitchen windows or green houses and then moved outside when the season starts.

The economical aspect of including vertical hydroponics was one critical scenario that wasn't studied further but should be mentioned. The cost for this system is higher than other farming method since it require more equipment and energy to control the green house environment. But there was some decisions that was made in order to try decrease the cost. Many examples of hydroponics system are based indoors with less solar exposure which requires led lights and a higher energy cost. My decision of turning the staircase into a solar exposed space for vertical farming was made in order to be less dependent on added light during the growing seasons when the sun condition is good. The staircases are therefore placed in sun exposed location in order to gain higher amount of sun hours and decrease the cost added lights.
The vertical farming is not an added building construction but instead integrated in the building structure as the staircase. It is of course an over dimensioned space for stairs which requires a higher cost but at the same time a cross-purpose that integrates two services and uses the space for more than taking the residents from point A to B.
According to the study made by Cleantech högdalen (2018), the highest cost is not the energy consumption, it stands for about12-25% of the operating-cost depending on size and configuration of the ACE-method. The highest cost overall is for the staff. In this project are

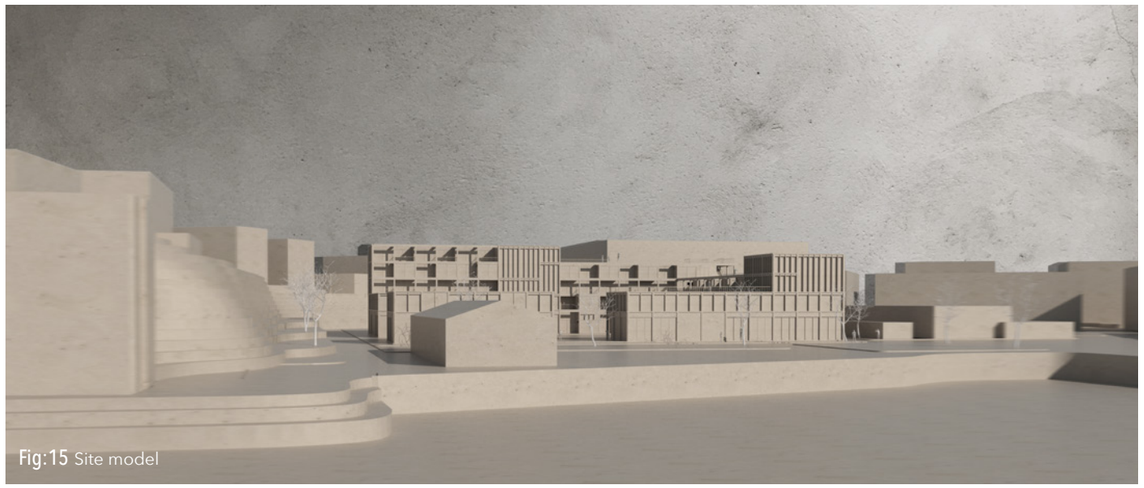


Fig:15 Site model

the residents running the farming activity and do not need extra operators for the vertical farming. They do therefore stand for the highest cost. The energy can then be produced by solar-panels on the roof for a long term solution of decreasing the operating cost in this project. This was also one aspect I was having mind developing my project. The ACE-method of vertical farming needs a higher maintenance than many other farming methods. By integrating the hydroponics farming in the staircase the flow of people can help running the daily care of this activity. Residents passing by can check the routine of the farming activity on their way home or when leaving the apartment. It might help to detect if something is not working or needs to be regulated in a nice daily flow.

During the research I understood that urban farming involves complex factors that stands in relation to each-other. Many interdisciplinary perspectives creates a wide and complex understanding of the impact that urban farming might have on us humans, the area, the city and the society. This entails a more complicated task to deal with in a residential project but do at the same time have potential of qualities.

The social network, integration and community feeling was something I saw as potential within this project. The farming as an activity creates situations of spontaneous interactions, shared spaces and shared tools that can entail a further communication between the dwellers and increase the social richness in the project. The idea to turn the staircase into a vertical green house was an aim to create a threshold between the dwelling and life outside where the residents could interact not only for the activity of farming in itself but also for spontaneous meetings on their way. The green house do extend the farming seasons in comparison to original methods thanks to its controlled environment and that could also be positive utilized by the residents as an unique space within a housing project. This idea of a vertical green house became also one reason to approach the project with balcony entrances. The balcony entrance made it possible to use the staircase as a funnel to distribute people within the project and increase the possibilities for social interactions and conversations between the residents.
 Some decision was taken in order to attempt an a proliferation for surrounding local engagement. My idea was that a housing project can be a catalyst of sustainable encouragement and the aesthetic and physical formation can create an identity of a sustainable lifestyle that might have an impact in a wider perspective. For example the placement of functions and visual relation can send out signals that might influence the opinions of the project in general. The appearance and placement of the green house staircases was one decision that attempted to expose the character of the project. For example the placement in the corner towards the street is highly visible for people passing by with transparent activity that aims to attract and create curiosity.
 In combination with the farming as an activity it can also reinforce the identity for the residents and strengthen the cohesion between the people and the building.
The material of a wooden construction was also one decision in this direction. To send out a message of a sustainable awareness and to understand the logic of structure that are trying to create a body as one entity.

Litterature

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Figures

Fig.1.Axel Sagerholm. A family in front of allotment (Photograph) Retrieved 2020-03-10 from https://digitaltmuseum.se/011013948550/kvinna-flicka-och-man-flora-koloniforening-falhagen-uppsala

Fig.2. Ute Langkafel / MAIFOTO. Grounder of Prinzessinnengarten. (photography) Retrieved 2020-02-26 from https://prinzessinnengarten.net/about/

Fig.3 Natalia Hosie. (Sketch) Prinzessinnengarten. Retrieved 2020-02-26 from https://prinzessinnengarten.net/about/

Fig.4 LMF (2018) (Graph) Food import. Retrieved from: www.fao.org/docrep/013/al936e/al936e00.pdf

Fig.5. Sky Green. (Photograph) Vertical farming station. Retrieved 2020-04-04 from http://www.skygreens.com/

Fig.6. Karl-Dietrich Bühler. (Photograph) Nature house in Saltsjöbaden. Retrieved 2020-02-15 from http://bengtwarne.malwa.nu/gallery.html

Fig.7. Karl-Dietrich Bühler. (Photograph) Nature house in Saltsjöbaden. Retrieved 2020-02-15 from http://bengtwarne.malwa.nu/gallery.html

Fig.8. Tailormade arkitekter (Photograph) Sundby naturhus. (Photograph) Retrieved 2020-02-20 from: https://tailor-made.se/

Fig.9 Tailormade arkitekter. (Photograph) Gränna naturhus. Retrieved 2020-02-20 from https://tailor-made.se/

Fig.10. Tailormade arkitekter (Photograph) Lindbackens naturhus Retrieved 2020-02-20 from: https://tailor-made.se/

Fig 11. Lantmäteriet 2020 (Map) Lindholmen

Fig.12 By Author 2020 (Photograph) Site visit

Fig.13 By Author 2020 (Photograph) Process Model

Fig.14 By Author 2020 (Photograph & digital model) Site model

Fig.15 By Author 2020 (Photograph & digital model) Site model