SPROUT LIVING

Greenhouse Co-living for Start-up Entrepreneurs

CHALMERS

Jonas Berg
Master thesis at Chalmers Architecture
2016-06-01

Program: MPARC
Examiner: Ola Nylander
Tutor: Björn Gross

Jag vill tacka...

...min handledare Björn Gross och min examinator Ola Nylander för bra kritik och handledning...

... TailorMade arkitekter och Greenhouse Living för bra rådgivning...

... Tech Farm som bidragit med kärnproblematiken och sakkunskap inom området...

...och min familj som gjort examensarbetet praktiskt genomförbart!

Kram!

CONTENT

SPROUT LIVING

Greenhouse Co-living for Start-up Entrepreneurs

The lack of housing in Sweden also includes co-housing for start-up entrepreneurs, a phenomenon that has evolved in recent years internationally and is also facing a great demand nationally. This form of housing, also called co-living, focuses on community and sharing economy to create social and professional synergies.

The Naturehouse concept, founded in Sweden by Bengt Warne in the 1970s, basically means housing within a greenhouse structure. Besides a warmer surrounding climate, a typical feature is to produce energy locally in terms of recycling of sewage, food production and electricity. This concept is still in strong development and so far it has mostly been applied on single-family housing.

Sprout Living is combining the Naturehouse and co-living concepts in order to create a new sustainable housing typology. It is based on the program of a current application to Vinnova regarding financing a commercial project with similar ambitions, called Tech Farm. Sprout Living is based on parallel design and literature studies, as well as current research and knowledge that is not yet published, generated by experts from the application of Tech Farm.

The result is a building in the coming urban development of Frihamnen, Göteborg. A lamella shaped volume, fitted into a residential block, consists of two elevated dense housing units wrapped in a greenhouse structure. Open greenhouse areas between and on top of the housing volumes create spaces for communication, social activity and cultivation.

The project examines the intricate relations between private and public, movements and meeting places which a concept such as co-living demands. It also examines and discusses degrees regarding off-grid housing, and other aspects of the Naturehouse concept applied on an apartment building situated in an urban setting.

THESIS INTRODUCTION

Naturehouse Concept

The starting point for the project has been my interest in the relation of outdoors and in indoors and the potential of what could happen inbetween. A thermal space could be created by a separation of the weather protective surface and the insulated part of the wall which would prolong the outdoor living and result in a more dynamic social life that expands or retracts according to season.

These thoughts led me further to the Naturehouse. A concept of similar spatial character which also inhabits solutions of local energy production in terms of cultivation, energy and recycling of waste, something that for me instinctively responds to the idea of an ecological, social and economic way of building. What if housing in cities could view waste more as a resource which could produce a significant amount of food, instead of sending it to costly disposal at the local sewage treatment plant. So far the Naturehouse concept primarily has been adapted on single family housing in sparsely populated residential areas, which are less sustainable when considering resource-efficient use of land, environmentally friendly service and travel according to distances.

- **How can the Naturehouse concept be applied on apartment housing in an urban structure where transport systems and service networks are more sustainable?**
- **What levels of local waste recycling and energy production is reasonable in an urban context?**

Co-living

These questions led to contact with the project team writing and designing an application to the organization Vinnova, regarding financing, among others, the development of the Naturehouse concept combined with co-living for entrepreneurs in an urban context.

This project is called Tech Farm and is basically a co-living concept with great focus on sustainability for young start-up entrepreneurs with tech talent. Tech Farm is initiated by residents from the so far only co-living for entrepreneurs in Sweden, House 24 in Stockholm.

The idea of working and living together with other like-minded people has become increasingly attractive to the target group, and this co-housing form is called co-living. The purpose of Tech Farm is to create an accommodation with a strong community that offers good opportunities to work from home, which create synergies and contacts on a professional level as well. These factors are of great importance for young entrepreneurs trying to enter a specific market and in this respect the single household is, by the target group, in many cases experienced as obstructive.

- **My project, Sprout Living, uses the room program and the target group analysis from Tech Farm as a starting point, as well as the basic question ”–how combine a co-living with all its social aspects with the Naturehouse concept”.**
- **What synergies can be found between the two concepts?**

Göteborg

In contrast to the Tech Farm project wich is situated in Stockholm, Sprout Living is using a site in Göteborg, where like in most dense populated parts of Sweden, a serious lack of housing is prevailing. According to the survey ”Bostadsbristens pris ” (2014, WSP Analys och Strategi, on behalf of HSB and Västsvenska handelskammaren) the housing production in Göteborg must increase by 50% to keep pace with the local growth of population.

This housing shortage affects most significantly young people when trying to enter the housing market, and the target group for the co-living typology is primarily young entrepreneurs. House 24 in Stockholm has existed about four years and the que for getting accomodation is long and includes entrepreneurs from all around the world. Many issues are related to the accessibility of reasonable housing, including the development of businesses.

- **Establishing a co-living for entrepreneurs in Göteborg could be a direct way to inject new ideas to the business climate, and at the same time ease the lack of housing.**

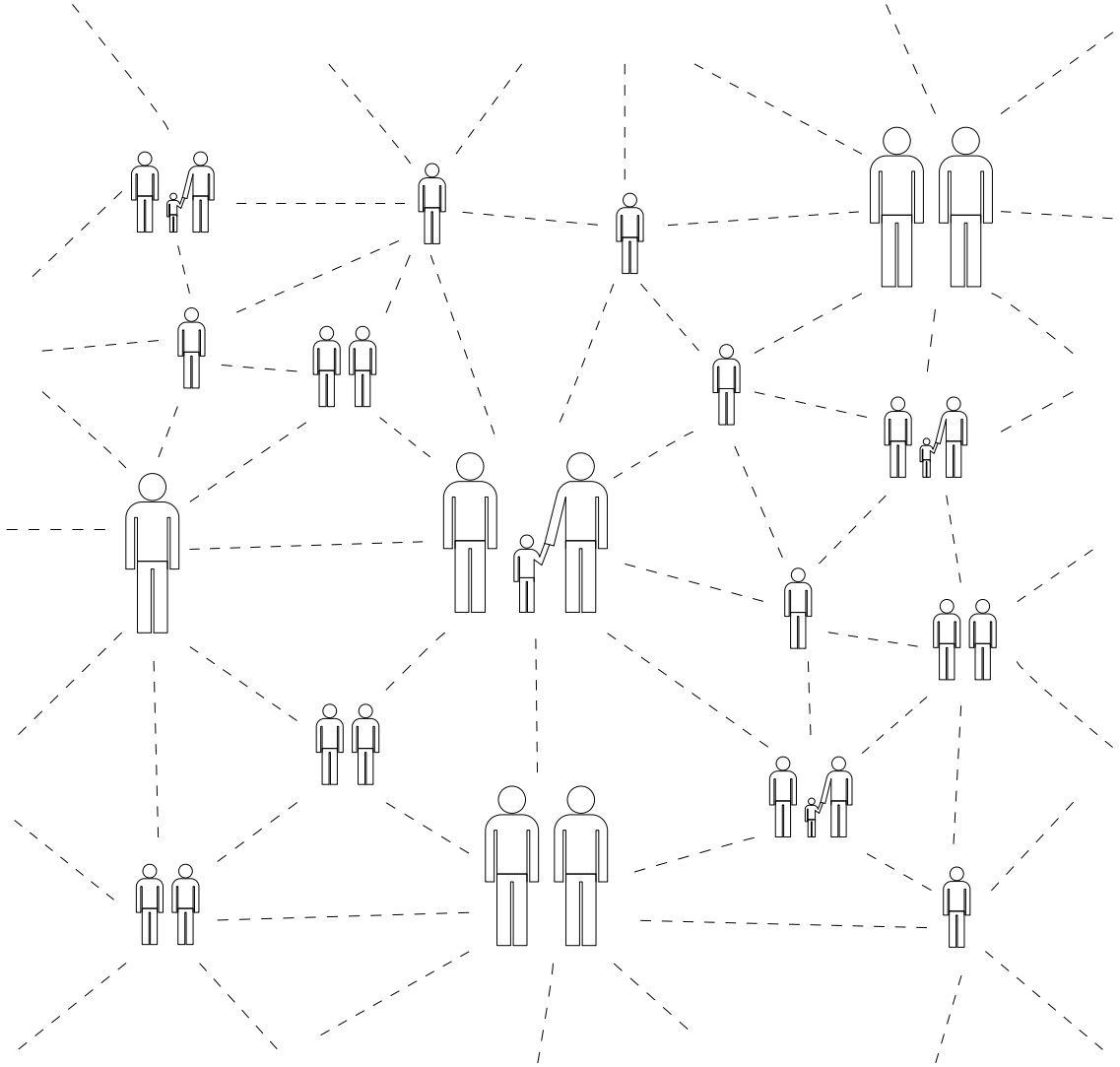
Property Concept

Tech Farm is basically a co-living concept with great focus on sustainability for young start-up entrepreneurs with tech talent. Tech Farm is initiated by entrepreneurs from the so far only co-living for entrepreneurs in Sweden, House 24 in Stockholm.

The goal is to create a global community of around 100 properties worldwide. In each Tech Farm live 20-100 start-up entrepreneurs. As a resident of Tech Farm one is also a member of a global community and can move between the buildings around the world. A criterion for every Tech Farm is that each property should be situated within an hour to an international airport.

The accommodation consists of micro-apartments between 10-40 sqm that share social/work- areas, cleaning service, gym, sauna and more. Major focus is on digital solutions and the idea is that all the services in the house can be ordered through an ”on- demand” service on the Internet, including short-term rental contracts which run from month to month to facilitate members’ mobility.

The idea is that you as a member temporarily should be able to move to another Tech Farm and easily rent out your apartment to another during this period. Therefor smart storage is of importance to facilitate quick changes of tenants.



Interview

The target group consists of young start-up entrepreneurs between 20-40 years. They are singles or couples and if they get a child/children they want to be able to stay in their housing for a period and not be forced to move straight away. Through an interview-based survey conducted on 20 people from the identified target group, made by the working group in the Tech Farm project, has the following description of the target group emerged (summarized by me), see right:

- Global/Digital nomad
- Internet
- Social
- Community
- Healthy
- Food

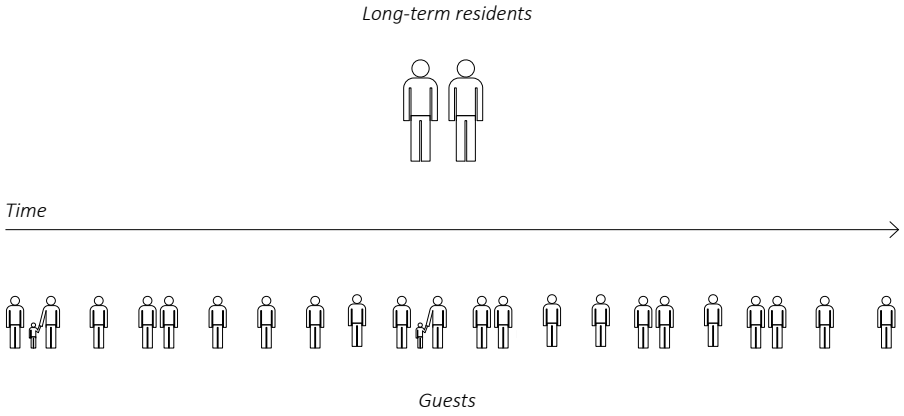
Potential target group?

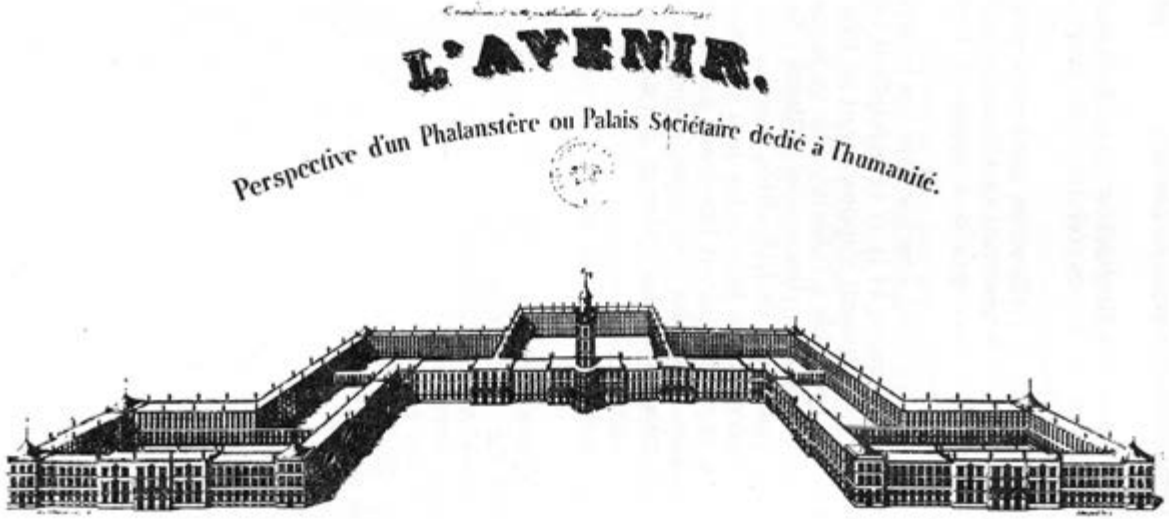
Two Groups of Residents

The residents of Tech Farm are divided into two groups:

Long-term residents
They stay longer and are culture carriers for their specific Tech Farm. You can become a l-t resident if you show commitment to the local house community. Their average stay is 3-4 years.

Guests
Guests are more temporary and does not have the same commitment in their specific Tech Farm. Their average stay is 3-4 months .





Charles Fourier´s Phalanstères.

Various Forms

Collective housing, or co-housing, has a long history both as a response to practical solutions like service, but also larger social issues like equality and to be part of a community. According to the Swedish organization "Kollektivhus NU" the term cohousing includes fully fledged collectives, eco-villages and collective houses with fully equipped private apartments with common living spaces.

Early Predecessors

As criticism of the prevailing feudal conditions, the Renaissance humanist Thomas More described an ideal social structure of a fictitious people in his book "Utopia", published in 1506. In addition to freedom of religion and equal education for women and men, the inhabitants of Utopia was organized in neighborhoods with common areas for dining and recreation.

About 400 years later the industrialization and the poor conditions for workers evoked questioning. The utopian French socialist Charles Fourier (1772-1837) formulated a vision in which the workers would live collectively in large joint social palaces, called "phalanstères". These would among others include caterers, communal dining rooms, schools, theater, fencing arena (!) and more. The collective organization of this vision was not appreciated by the current French power elite and the idea was forbidden to be practiced in the country. However, a project was realized in Guise in northern France inspired by the "phalanstère" called "Familistère" in 1856-1859. It was developed and built by the iron stove manufacturer Jean Godin. It was a complex consisting of a factory and workers-housing arranged in blocks with glazed yards. Eventually the workers was given ownership of the factory and

Glazed yard well suited for events, Familistère in Guise by Jean Godin.

the heads of other public spaces. Today it is listed as a historically important building. During approximately the same period, the "family hotels" in the US with shared kitchens was a result of the economic issues for a growing working class living in cities.

In the 1900s, co-housing was started to be seen as a broader response to the housing and the equality issue and not just a solution for certain categories of people. This approach to public housing occurred in the Soviet Union in the 1920s and was followed by Sweden a few years later. These two countries are also considered as the two most important countries of the development of the collective house during the 1900s[1].

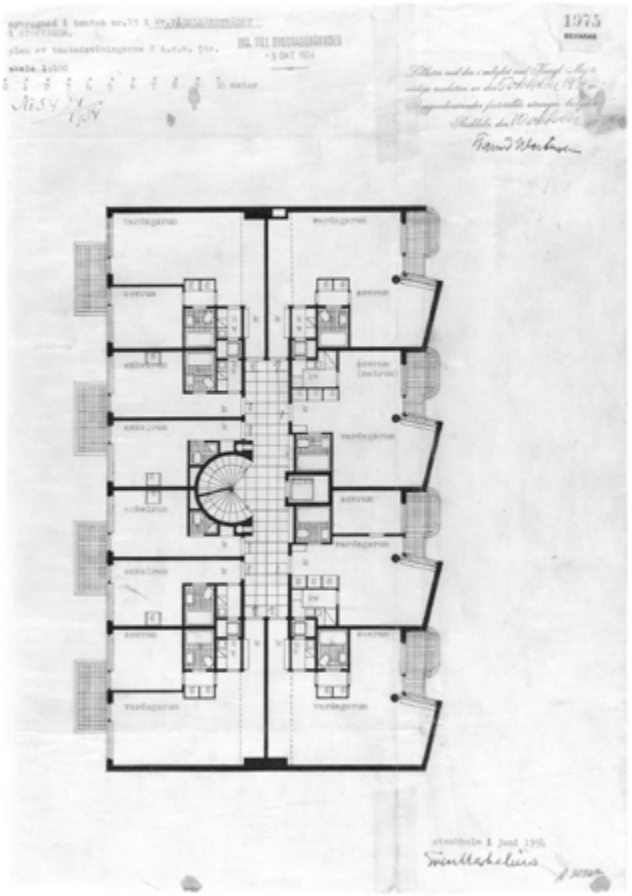
20th Century

The concept of co-housing arose at a time when the poor housing situation seriously attracted attention as a social problem. Within architecture, co-housing became an expression for the rationalization and service thinking that characterized society during this time. The labor market required more workers, meanwhile married women demanded the same right to work and spare time as men. This resulted in a need of simplification of the housework to make the everyday life of families to function. Therefore, the architects began to examine how the efficiency of the workplace also could be applied to the home and life of people. A rational society would engage as many as possible in the production. During leisure time, residents would participate in training, political meetings or recreation to form a democratically conscious population. This meant that the home did not have to be particularly large, but cover the most basic needs and provide storage for a few possessions. Another factor was the increasing costs for housekeepers which made the middle class interested in optional solutions. In Sweden, the authors of the book "Acceptera" which was released in conjunction with the Stockholm Exhibition in 1930, predicted that a large part of the population would be living in collective houses in the future.

Despite an analyzed need, co-housing was never adopted as a general solution of the housing situation in the Soviet Union, nor in Sweden. One factor was the expensive costs of the staff replacing the housewives. The configuration and function of the collective houses at this time did not focus so much on the social community, but rather on rational aspects. For cost reasons, the working class could not afford this typology and therefor the concept did not get any broad political support from the labor movement, except within the women's association.

1. Caldenby, C, Walldén, Å, Kollektivhus –Sovjet och Sverige omkring 1930, Byggnadsforskningsrådet, Stockholm, 1979, s 218-219

John Ericssongatan 6, by Sven Markelius. (Image: Wikipedia)



John Ericssongatan 6

The architect Sven Markelius realized through private contacts and in partnership with, among others, the radical social democratic politician Alva Myrdal, the first co-housing in Sweden situated at John Ericssonsgatan 6 in Stockholm in 1935. The goal was simplified housework through central organization of cooking and day care rather than togetherness and cooperation. The house contained 54 small apartments, a small store, restaurant and day care center in the ground floor. There was a dumbwaiter for ordering food to the apartment and a laundry chute leading to a laundry in the basement. On the roof terrace was a sandbox, wading pool and shower. In 1938, 21 employees worked in the house. Sven Markelius lived himself in the house for a long time together with other radical intellectuals. Because of the small apartments (and lack of common spaces?) no families moved in. The service in the house was actively working until the 1960s when it was discontinued.

Bo i gemenskap (BiG)

With inspiration from the student movement in Europe in 1968, and the cohousing community movement that developed within it as a questioning of the bourgeois nuclear family (ex. Kommune II in Berlin), the working group “Bo i gemenskap” (BiG) was formed in Sweden in the 1970s. When the lack of housing, housing standards and housing hygiene in Sweden at this time to a large extend was resolved, social and community aspects of the dwelling regained focus and interest[2]. In the early 1980s, almost all the 15 former collective houses were based on service from employees, had been decollectivized. This meant a boost for the new role of collective houses which meant a social community where

2. Gromark, Sten, Boendegemenskap: en kritisk granskning av boendegemenskap som samhällsangelägenhet, av dess värden, Göteborg : Avd. för byggnadsplanering, Chalmers tekn. högsk., 1983, s 17

common features and activities were shared. Instead of service from employees and its high costs, it was now the residents who together organized household chores and often had common meals as focus.

To finance the common areas in the BiG-model, each apartment refrains about 10% square meters, which means a given relationship between the number of apartments and the number of joint surfaces. The first example of a co-housing following the BiG-model was ”Stacken” in Göteborg which adapted a sparsely populated existing million programme housing unit according to its new needs. The common areas where placed on the entrance-floor and on storey 5. Stacken is active still today.

In the 1980s and early 1990s about 50 collective houses were created in Sweden, most of them were built by municipal companies and the majority followed the BiG model. The most common form of occupation today is private tenancy, but cooperative tenancy and cooperative ownership exists as well. During the 1990s, cohousing accommodations for people with grown-up children were developed where residents could support each other in a long period of aging, a type of senior housing as it is called today.

Stacken, Bergsjön in Göteborg.

Co-Living – New Phenomenon

Co-living is a form of co-housing that has emerged in recent years. The concept started in the US and has now spread to several parts of the world. So far, all the co-livings are incorporated in an existing property, but several companies are planning new constructions for this purpose. The concept is a development and combination of co-working (where entrepreneurs share work space with others to create synergies and contacts) and co-housing. Co-living is a collective accommodation that (often) has a similar target group (young entrepreneurs); people who live a mobile life with much travel, where the fixed point in everyday life often is the internet rather than the dwelling. To quickly access a social and professional network in their new community collectivist ideas have become a solution.

The way the housing market looks today sharing accommodation is also one of few options for this target group being able to live in attractive and expensive areas and cities. Compressed apartments share common areas like a large kitchen and living room. A big difference compared to previous examples of co-housing, is that the large scale co-living concepts are often created by companies that owns, manages, and provides service to multiple objects of similar content, where leases run from month to month. Large co-living companies markets and sells accommodation as a finished product rather than that the residents create the content themselves. In many ways this is a sort of hybrid between the classic co-housing and the hotel industry.

WeLive

The American company WeWork, which provides start-up office spaces, has recently launched WeLive which focuses on co-living for the same target group. This year they opened a co-living at 110 Wall Street, New York, in a building where there already is a WeWork situated in underlying floors. The accommodation provides 200 apartments, mostly with one or two bedrooms, but there are also apartments with several bedrooms. All apartments are equipped with kitchen and bathroom and have access to the common parts such as living room and kitchen. The rent for the contract, which runs from month to month also includes internet, exercise classes, yoga room, monthly cleaning, free coffee, tea and beer. Involvement in community is done via a custom application. The average area of an apartment is 40 square meters.

Common area, WeLive in 110 Wallstreet, New York. (Image: WeLive)

Apartment unit, WeLive in 110 Wallstreet, New York. (Image: WeLive)

Hus 24

There are also examples of similar concepts but in smaller scale. Hus 24 in the Gamla stan in Stockholm is the only counterpart in Sweden and has existed four years. Here live young tech entrepreneurs from all around the world. Hus 24 was created with inspiration from similar co-livings in Silicon Valley, US where entrepreneurs live together in small housing, 10-20 people rather than in large complexes. In Hus 24, about ten people are sharing the 240 sqm in 5 floors. There are 6 bedrooms, one with six beds in the form of bunkbeds, the others are single/couple rooms. Toilets, large kitchen, living room and brainstorming sauna belongs to the common areas. In the living room with a fireplace, small workplaces are set along the walls and a large meeting table in the middle.

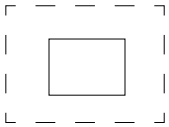
Common livingroom, Hus 24, Stockholm. (Image: Arte)

Bengt Warne

The Naturehouse concept was developed in the 1970s by architect Bengt Warne. He describes what the concept means in his book ”På akacians villkor, (1993)”. Although the book is at times a bit too simplistic in its argumentation, it gives a good insight into passive energy management and human ecological building. In the introduction, he describes the following basic rules that form the core of his approach to both the Naturehouse concept and ideas of building in general (my translation):

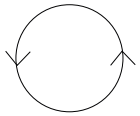
1. Look to the actual needs and not to the artificial. The technology should be subordinated biological functions. In our lifestyle, construction and living, we need to learn from nature.
2. Let our homes cooperate with nature. Organisms live and are dependent from energies like sun, wind, rain, soil and plants. We can shape our houses based on the same principles .
3. Give the residents the possibility to control the energies themselves. Let us light a fire, ventilate, water, cultivate and change these flows according to our own likings and demands.
4. Use sofisticated and environmentally friendly technique when energies of nature is not enough.

Principles illustrated to the right are extracted from the book ”På akacians villkor”.



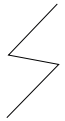
Separation of Climate Shell

The greenhouse structure constitutes a third climate zone between outside and inside, creating a dynamic social space that expands or retracts according to season.



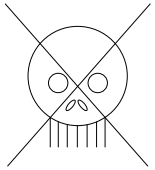
Cycles

The concept consists of several cycles: recycling of rainwater and greywater. Human waste as fertilizer in gardens. Plants that purify the circulating air etc.



Energy

Heating of water and air through greenhouse effect. Food production in cultivations. Natural ventilation. Solar cells. Rainwater harvesting.



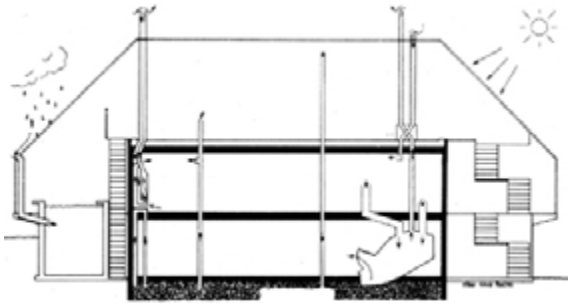
No Poison

All materials should be environmentally friendly in all aspects.

Well Being

A central part of the Naturehouse concept is focusing on human well-being achieved in harmony with nature. Much exposure to sunlight, physical contact with greenery and nontoxic materials are some contributing factors that the concept offers.

Naturhuset, Saltsjöbaden by Bengt Warne



Technical section.

Naturhuset, Bengt Warne

In 1974-80, Bengt Warne designed and built a house in Saltsjöbaden outside Stockholm, Naturhuset, with the same thoughts as he later formulated in his book ”På akacians villkor”. The house consists of a heated insulated compact core in wood with kitchen, living room and bedrooms, which are enclosed in a greenhouse structure, creating areas around and on top of the core. One of the principles is that this extra greenhouse space creates great opportunities for additional qualitative social space and area for effective cultivation, for a relatively low cost per square meter (about a third of the price of an isolated equivalent area).

Another purpose of the house was to create synergies between the energies of the living core and the greenhouse to increase self-sufficiency and reduce the environmental footprint. Examples of these are the use of a composting toilet that both creates air pressure which together with the greenhouse effect create a natural ventilation, and also produce fertilizer for cultivations in greenhouse area. The passive ventilation leads the air through masses stored under the house which buffers the temperature and evens out the climate all through the day. During the implementation period the house was used for research, development and demonstration of human ecological technology.

Sewage is filtered and cleaned in cultivation beds. (Image: Anders Solvarm)

Sikhall, Anders Solvarm

Anders Solvarm has built a house inspired by Bengt Warne's principles. His house was initiated about 15 years ago located in Sikhall, Dalsland. It is a log house enveloped by a greenhouse structure. One of the differences with the Naturehouse in Saltsjö-baden is that instead of a composting toilet, Anders Solvarm uses and develops a system where all sewage is purified in cultivation beds placed in geenhouse area, meaning that the house does not need to be connected to the municipal sewer system. Nutrients from black/gray water also produces rich harvests of vegetables consumed by the residents of the house. The house is like an ongoing experiment in which alternative, environmentally friendly technologies and solutions being tested in scale 1:1.

Interior Uppgrenna naturhus. (Image: Greenhouse Living)

Uppgrenna naturhus. (Image: Greenhouse Living)

Uppgrenna naturhus, TailorMade Architects/Greenhouse Living

TailorMade architects and the consult group Greenhouse Living, where Anders Solvarm is one of four consultants, have together created Uppgrenna naturhus in Gränna. It is a building for conferences, café and accommodation which utilizes the Naturehouse principles. Uppgrenna naturhus produces food instead of waste by purifying sewage in cultivation beds placed in a greenhouse areas. The greenhouse also extends the summer season and create a climate equivalent the Mediterranean.

1.

2.

3.

3.

Lacaton & Vassal

The architects Lacaton & Vassal have continuously worked with temperated zones created of simple materials such as corrugated plastic and standard modules in steel, which is one way to create cheap square meters with high social qualities.

1. Latapie House
2. Transformation of Housing Block - Paris 17°, Tour Bois le Prêtre
3. Mulhouse, Social Housing
(Images: Lacaton & Vassal)

KasCo (CC-Studio) in Amsterdam North in collaboration with Dill Architecten. (Image: CC-Studio)

KasCo, CC Studio

The dutch architects CC STUDIO has developed the concept KasCo, a narrow 3-4 storey townhouse with a greenhouse structure creating glass-enclosed patios and roof terraces as well as providing shelter from rain and wind.

Generally

When designing an ecologically sustainable building, there are many parameters to take into account in the process. I have tried to sort out those that affect the early stages in the design process, since those are most relevant for my project. Then there are of course other important parameters, such as social and economical, but these are not stated in this chapter.

Greywater Purification

To purify all sewage (black- and greywater) through cultivation beds, specific sqm are required to get desired effect. I have studied the report ”Utvärdering av system för BDT-vattenrening med avseende på resurseffektiva städer och hållbar urban livsstil inom EVAA-projektet och H+ området, Helsingborg (2012)”, as well as contineously conversed with the author of the article, Dan Eric Archer (civil engineer), and Anders Solvarm (builder and owner of the Naturehouse in Sikhall and expert on purification of sewage through cultivation beds). They are also members of the consult group Greenhouse Living (part of Vinnova application). The most updated information says that:

- To purify all sewage (black- and greywater); 9 sqm/person is required. Á 130 l/day and person
- To purify only greywater; 5 sqm/person is required. Á 100 l/day and person

I realized quite early in the process that purifying all sewage would require too large surface of cultivation beds and therefor be economically difficult to motivate. In regard of this I decided to focus on the greywater alone.

Greywater consist of similar amount nutrients as is used in conventional farming, apart from a considerable larger amount of sulfur which is a rest from daily use of soap. Pipes distributing the greywater is placed 150mm below surface to prevent the sulfur to spread odour in greenhouse. The depth of the cultivation bed should be at least 1100mm and it should preferably be divided in at least two steps to distribute the degradation process making sure that harmful bacterias are eliminated. The idea is that the greywater contributes with majority of irrigation of the plantations, as well as supplying nutrients needed.

The greywater is accumulated in a tank in the basement. It is pumped up and distributed in cultivation beds in roof where light conditions are best in a city. Nutrients from greywater are absorbed by crops which eventually are harvested and consumed by residents. The purified greywater can be released directly into nature.

Purification of greywater in cultivation beds, that produce food for residents and others, sets requirements of the substances added into the system. It entails that the accommodation in this building ecourage the residents to make environmentally friendly choises when consuming since all added substances from their daily lives will in a very direct way affect this cycle.

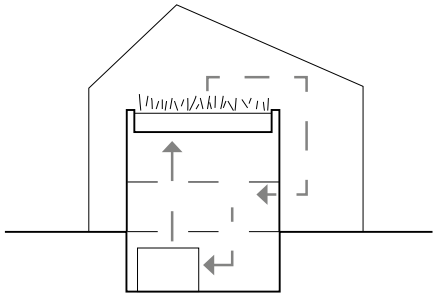


Illustration of greywater cycle.

Greenhouse Standard

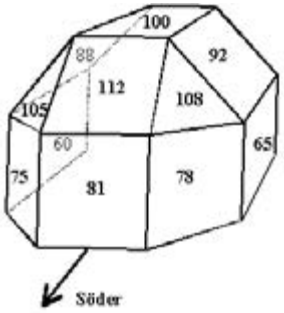
Sprout Living uses the standard meassurement of the greenhouse manufacturer Drivadan. They have delivered greenhouse structures to greenhouse housing before, i.e the Uppgrenna naturhus by Greenhouse Living and TailorMade architects.

- 3060mm C-C, load bearing structure.
- 612mm C-C, glass panes.

Greenhouse structure from Drivadan as a component in a greenhouse villa in Hillerö, Denmark. (Image: Drivadan)

Solar Cells

The idea is to maximize the amount of solar cells to make the building as self-sufficient in electricity as possible. In order to integrate them into the design, and to make as much economic benefit as possible, I will use the BIPV (Building Incorporated Photo Voltaics) principle. It means replacing actual building material such as facade paneling etc. with solar cell panels instead of adding solar panels as an additional material on the outside. To calculate the electricity production and to get an idea of how it influences the design I use a calculation method recommended by the national development program SolEl (funded by, among others, Energimyndigheten).



The illustration shows how angle and direction affect production from solar cells. This calculation model is accessable on the website of SolEl-programmet.

Massive Wood

The insulated part of the building will consist of massive wood since it is a renewable source and stores carbon dioxide instead of producing it. It is also comparatively low in weight, which provides structural benefits since the foundation can be less extensive and the drying time is much shorter compared to concrete.

Apartment buildings in massive wood result in thicker dimensions in apartment separating walls and floors because of noise issues.

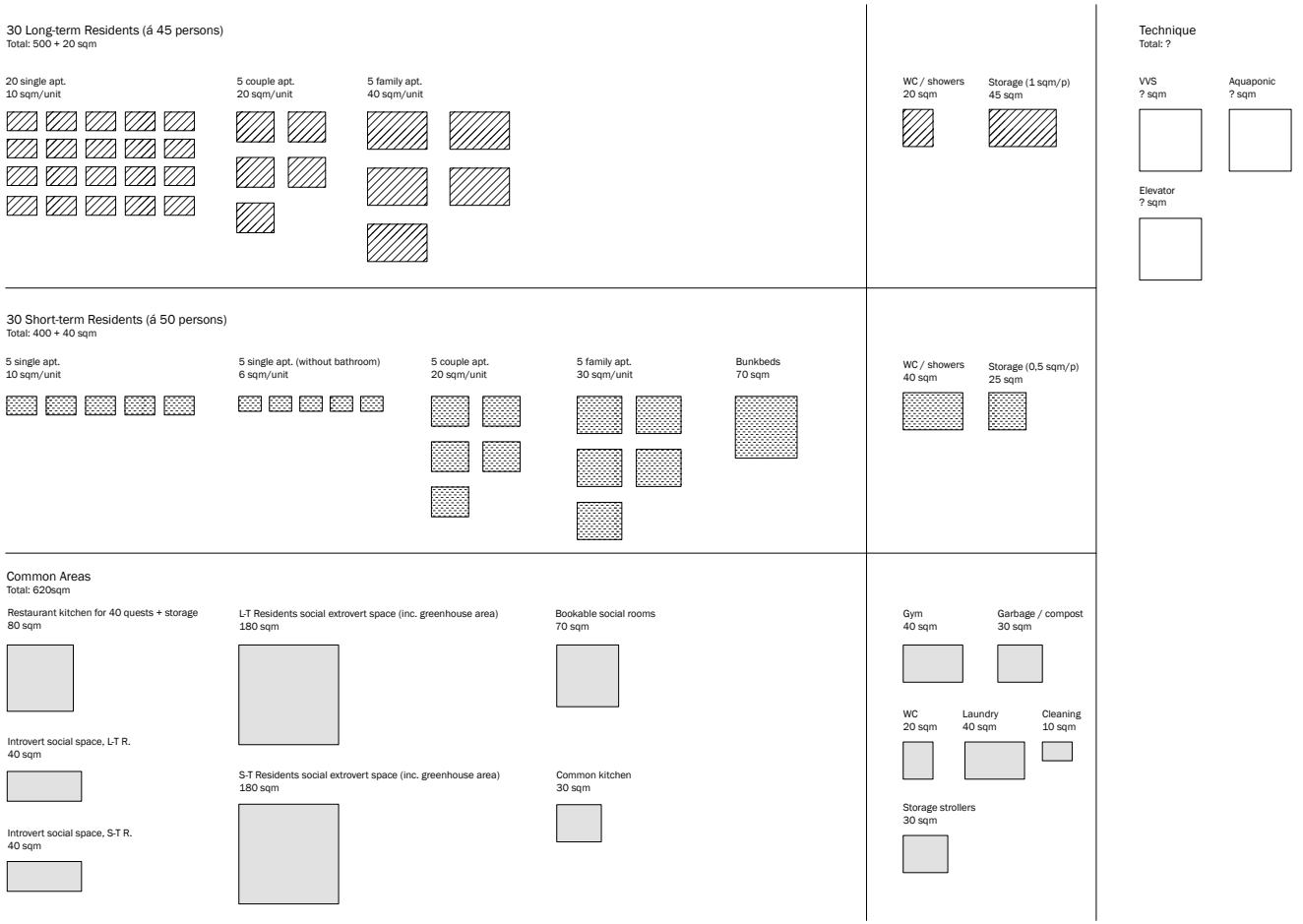
Massive wood construction consisting of glulam elements. (Image from: www.ekobyggportalen.se)

Using Tech Farm Program as Starting Point

According to Tech Farm, long-term residents and guests should be separated sharing greenhouse and other social and working areas. Long-term residents shall have their own common kitchen and living room. The first program layout by Tech Farm is illustrated to the right.

Since this program is a work in progress one aim with Sprout Living has been to question and develop it.

Some early questions were:
- How organize an effective building with 6-10 sqm apartments regarding entrance situations, accessability, toilets etc?
- How organize separation of l-t residents and guests regarding access to common/private areas and still create a building whith natural meeting places between the two groups?



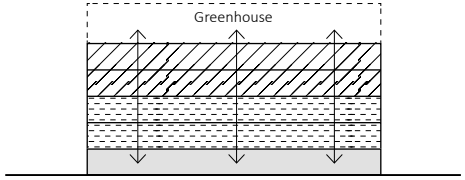
Common

Long-term residents

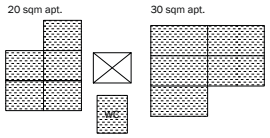
Guests

Program Distributed in Requested (by Tech Farm) Levels

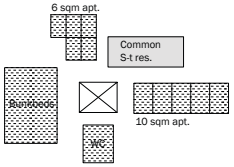
The distribution of properties on each level was an early sketch from the Tech Farm project where one can question access to the rooftop, regarding equality between the two groups of residents. In this sense the layout illustrates a problematic hierarchy. Allt-hough the most important question to me is how to permeate the whole building with the Naturehouse character.



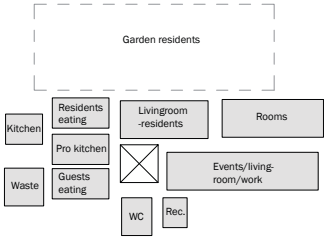
3. Short-term residents



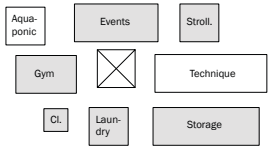
2. Short-term residents



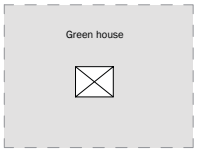
1. Groundfloor



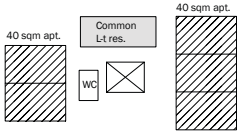
0. Basement



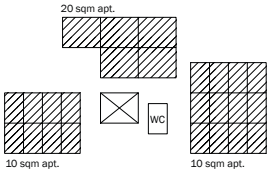
6. Roof terrass

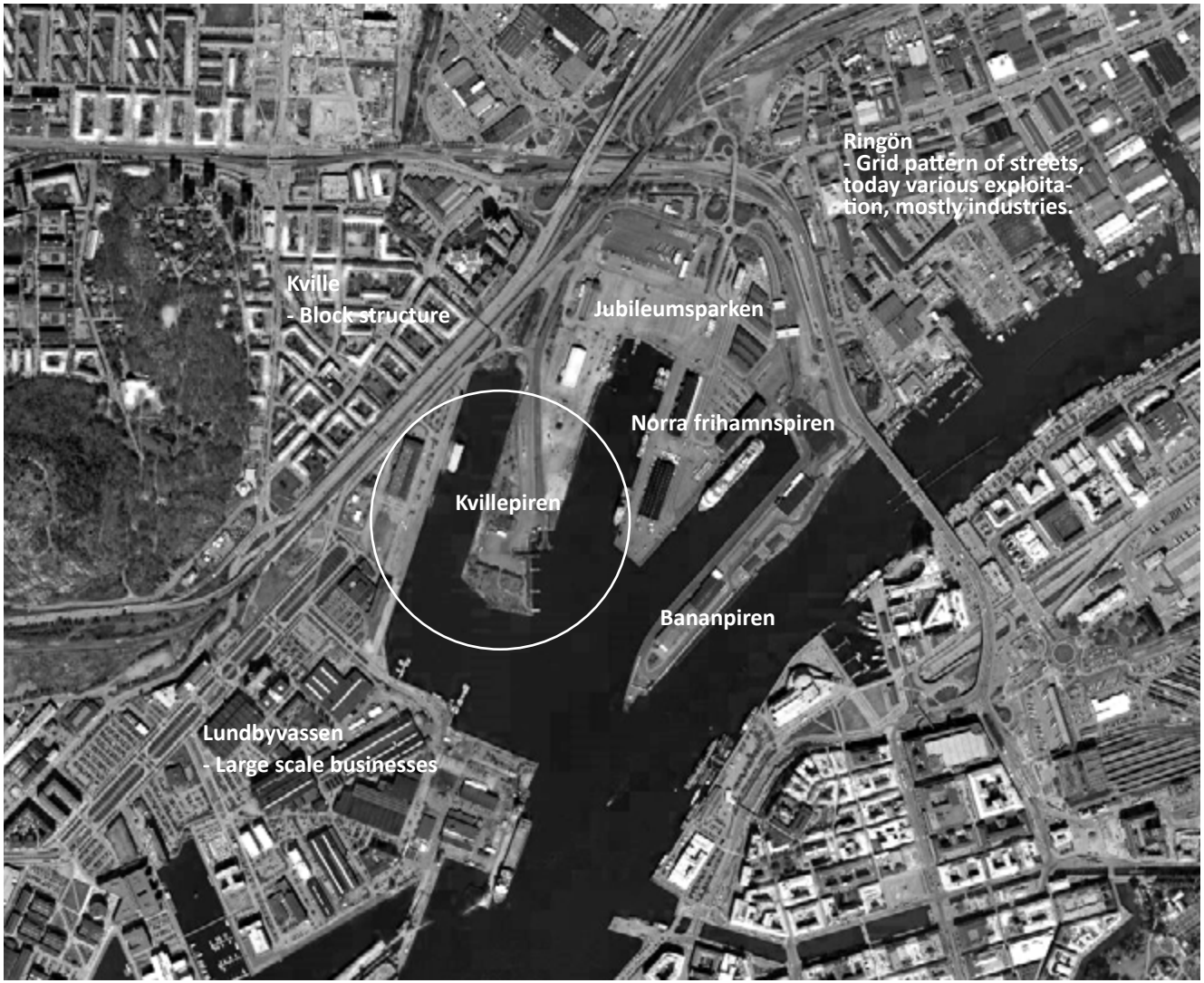


5. Long-term residents



4. Long-term residents





Frihamnen, Göteborg

Frihamnen is a district in central Göteborg, consisting of three piers, Bananpiren, Norra Frihamnspiren and Kvillepiren, which is facing a future extensive urban exploitation. Eventually the city center will be connected to the area and it will be characterized by mixed urban development according to Ävstranden utveckling AB. The idea for parts of the area is that it should grow and be filled with content gradually by the Göteborg inhabitants. The Jubileumsparken could be seen as an example of this. Today it includes a public sauna, private and professional cultivations which supplies crops to some of the restaurants in the city.

Top: Urban farming in Frihamnen
Bottom: Public sauna by RaumlaborBerlin in Frihamnen

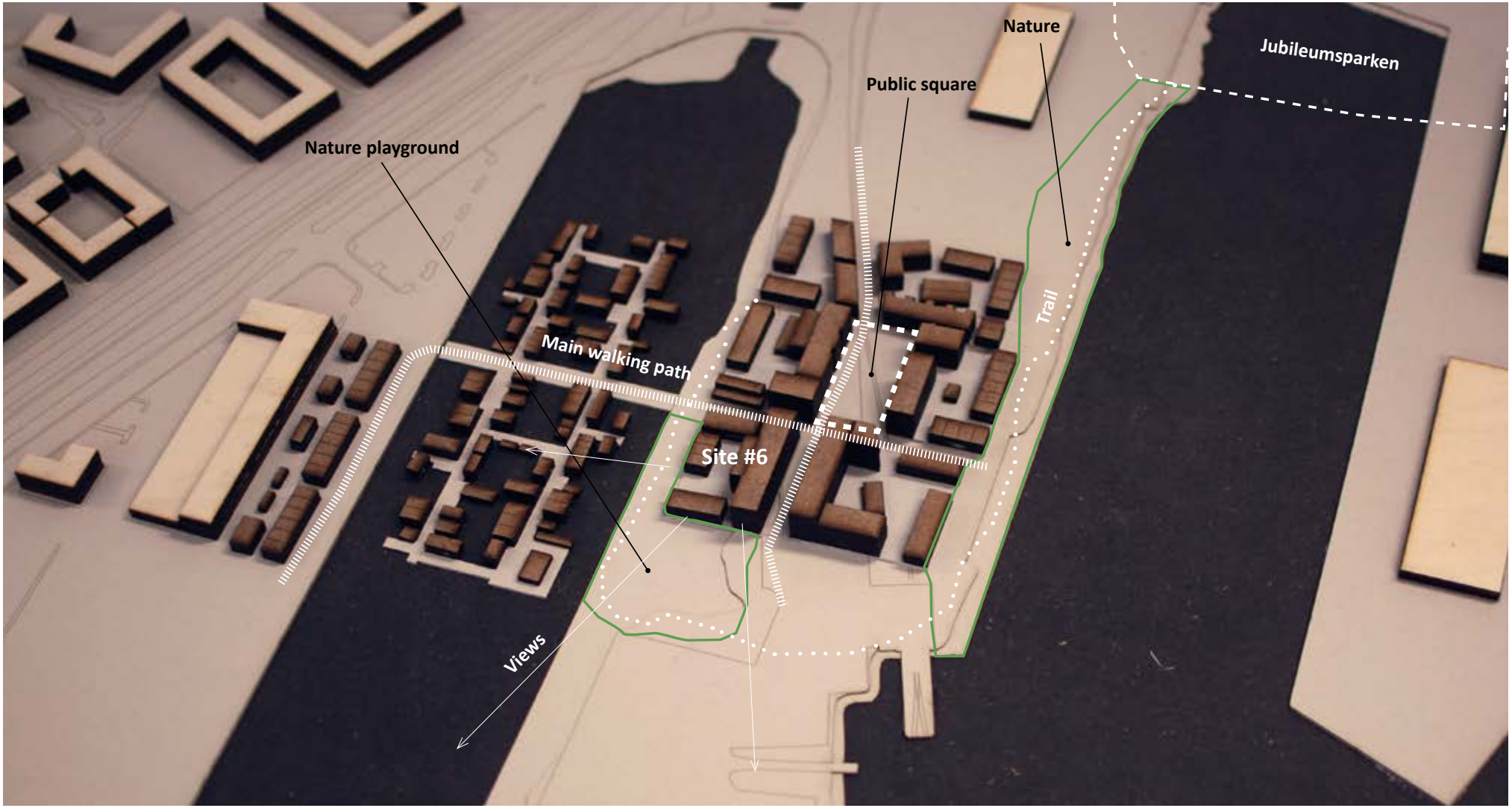
Competition Masterplan as Context

This spring (2016) a competition for temporary housing for refugees, students and company housing in Frihamnen was organized by Älvstranden utveckling AB. The Berlin-based office Raumlaborberlin developed basis for masterplan.

The new temporary residential area replaces two existing warehouses on Kvillepiren. Piers and floating homes will connect Kvillepiren with Lundbyvassen. RaumlaborBerlin'S illustration (see below) shows a broken block structure expressing the spontaneity and small-scale character Älvstranden utveckling AB demands in competition program.

Sprout living is using the masterplan from the competition as geographical context, though the project assumes a permanent built area. The area is divided in nine sites. The height of the buildings are regulated for load reasons. Sprout Living is situated in site 6.

Top: Illustration by RaumlaborBerlin
Left: Masterplan for competition scale 1:4000


Nature
Jubileumsparken
Public square
Nature playground
Trail
Main walking path
Site #6
Views

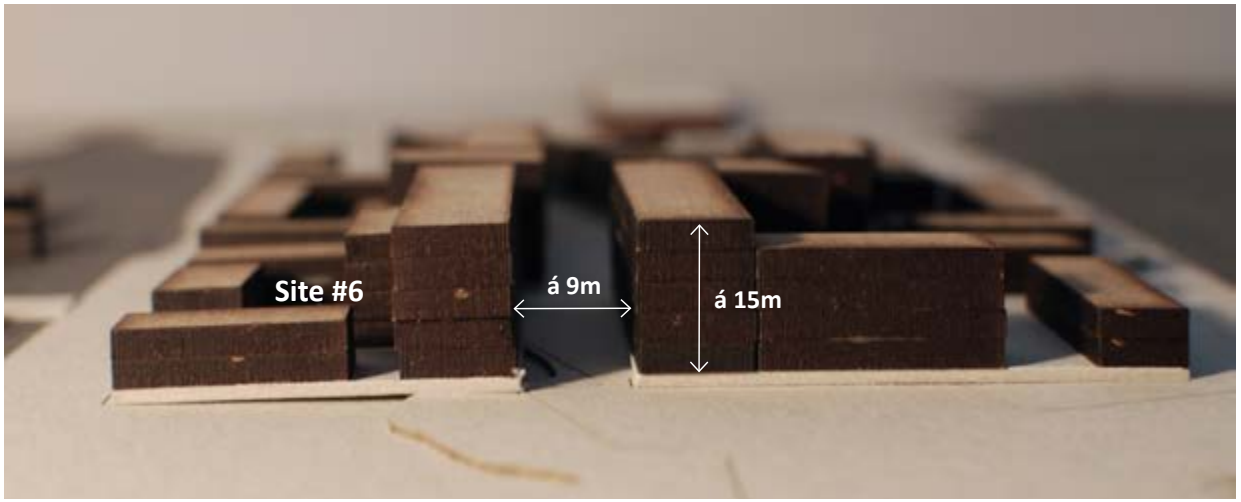
Kvillepiren

The area on Kvillepiren is characterized by blocks consisting of lamellas that face the more public streets, and small scale broken structure towards water. The blocks gather around a central square that most likely will become a natural meeting and event place in the neihgborhood.

Site 6

The site has good views and South-West orientation which is favourable for farming and solar energy production. It is linked and exposed to the public square and also adjacent to a small green area with playground and a trail for exercise opportunities.

The qualities correspond well to wishes from target group:
- Central, close to culture etc
- Close to nature, a small nature site and the river.



The streets are quite narrow and buildings relatively high which give two differentiating characters on each side regarding private and light conditions.

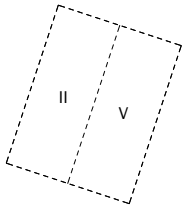
To left: Model study based on current masterplan for competition. All volumes in this model are based on illustration by RaumlaborBerlin and not a design proposal for Sprout Living.

Maximum exploitation of site. The closed block is not communicateng formally with surrounding.

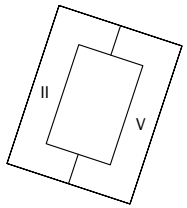
Sprout Living is the two parallel structures to East. Entrance balconies towards narrow yard. The structure appears as a colossal (with greenhouse covering). Not relating to townhouses in West.

Lamella facing street and broken structure towards the water, similar to rest of area. Room for a yard and smaller townhouses with different target group, creating social mix.

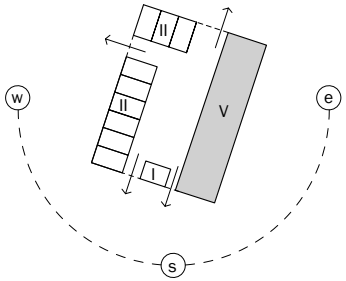
Village concept creating various interesting social spaces. No rational place for cultivation. Unique structure from surrounding creating its own isolated block.



1. Site restrictions



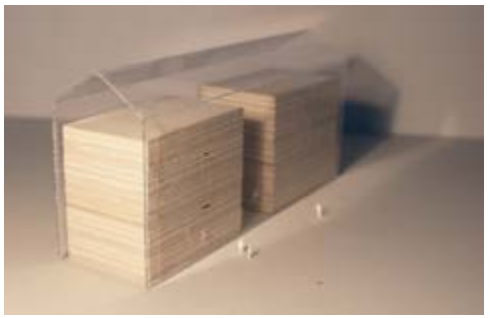
2. Max exploitation



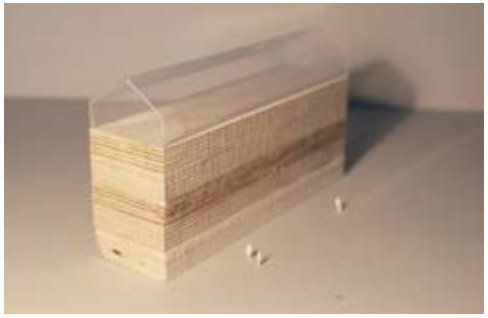
3. Volume in North-South for best light conditions. Openings in block create paths and correspond to surrounding area

Volume Principles

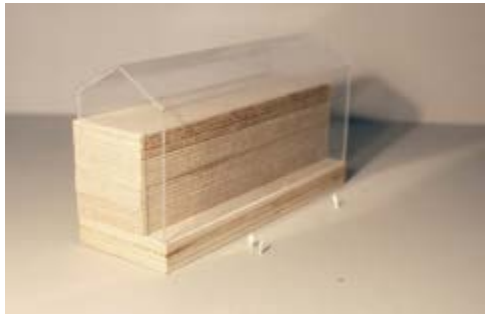
In simple models the relation between greenhouse and insulated living volumes were studied. The earlier adressed question of incorporating the greenhouse character through the whole buildning was in focus.



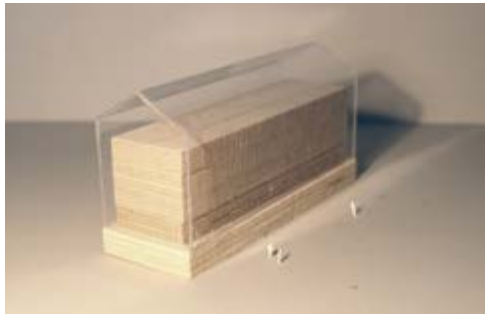
Dividing core creating social space in between leading to greenhouse on top. Greenhousecharacter in entrance floor! + dividing the structure into smaller scale -relating to surrounding.



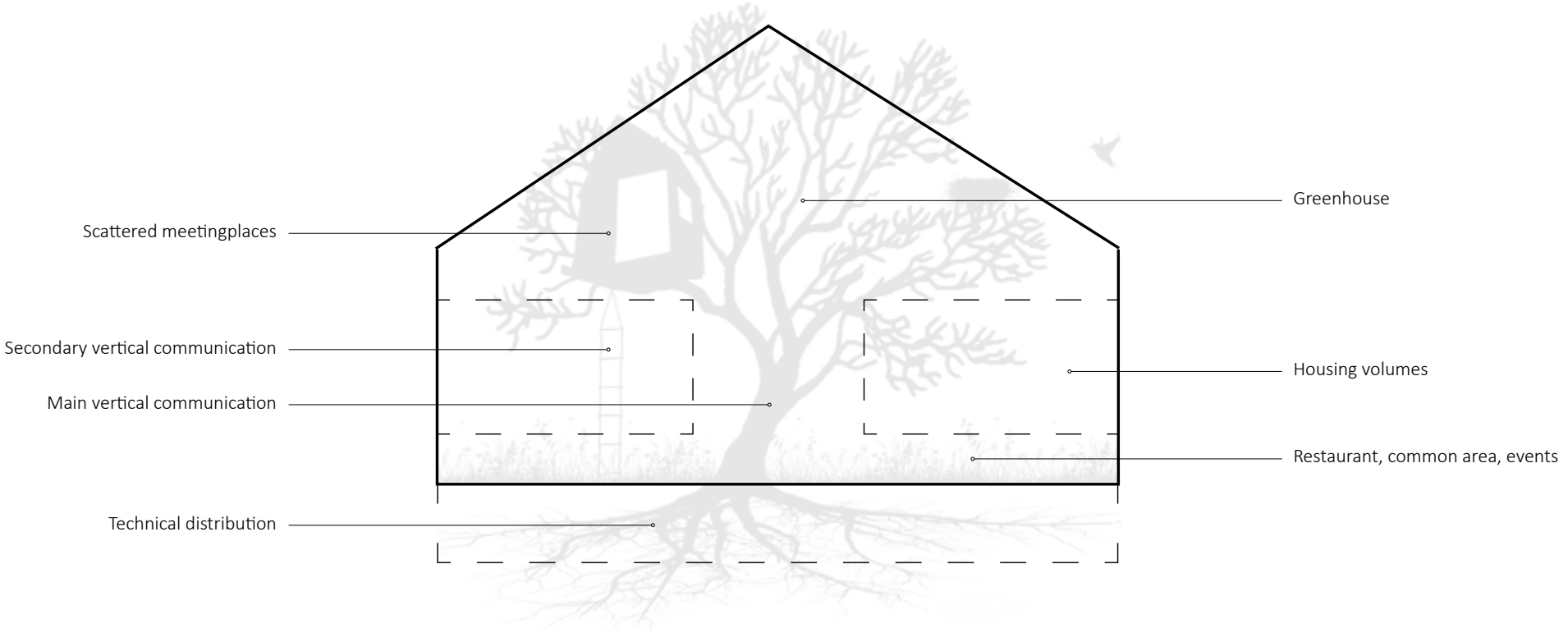
Appears, and is, more like a normal house. Greenhouse living?



Entrance balcony in greenhouse. Most likely apartments on just on side of corridor/entrance balcony, otherwise too different qualities of living. Therefor becomes to long and ineffective.



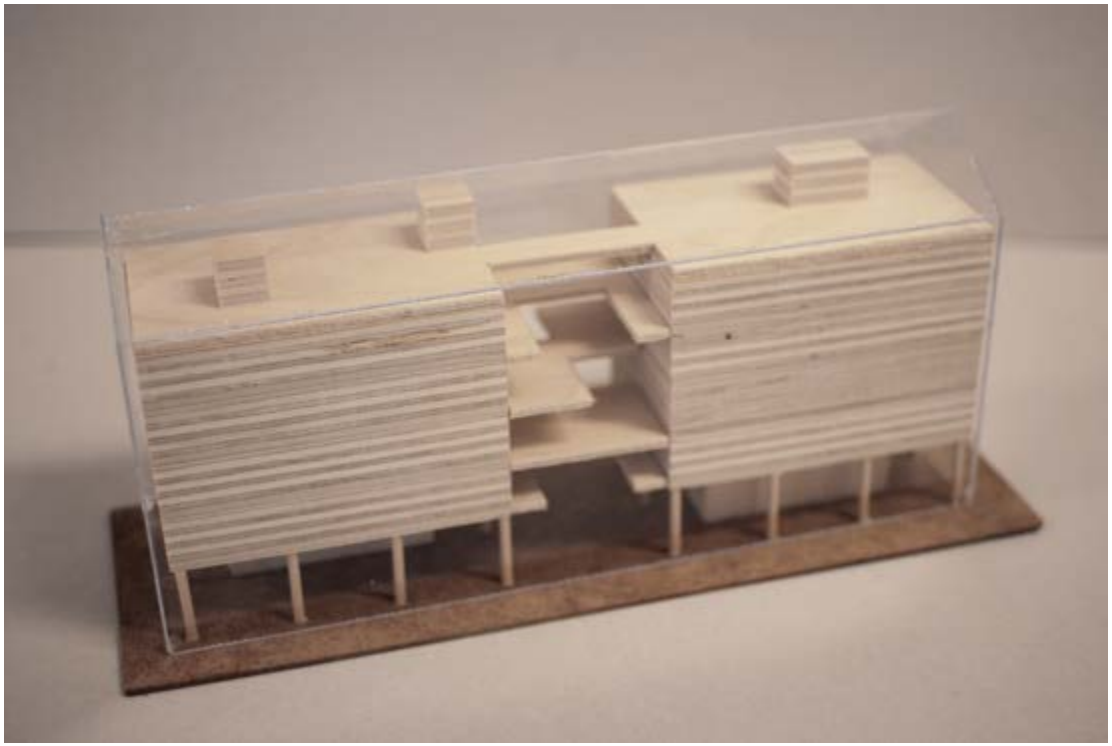
Due to fire regulations of housing this alternative is difficult. One needs to be able to evacuate through window into the free.



Tree Concept

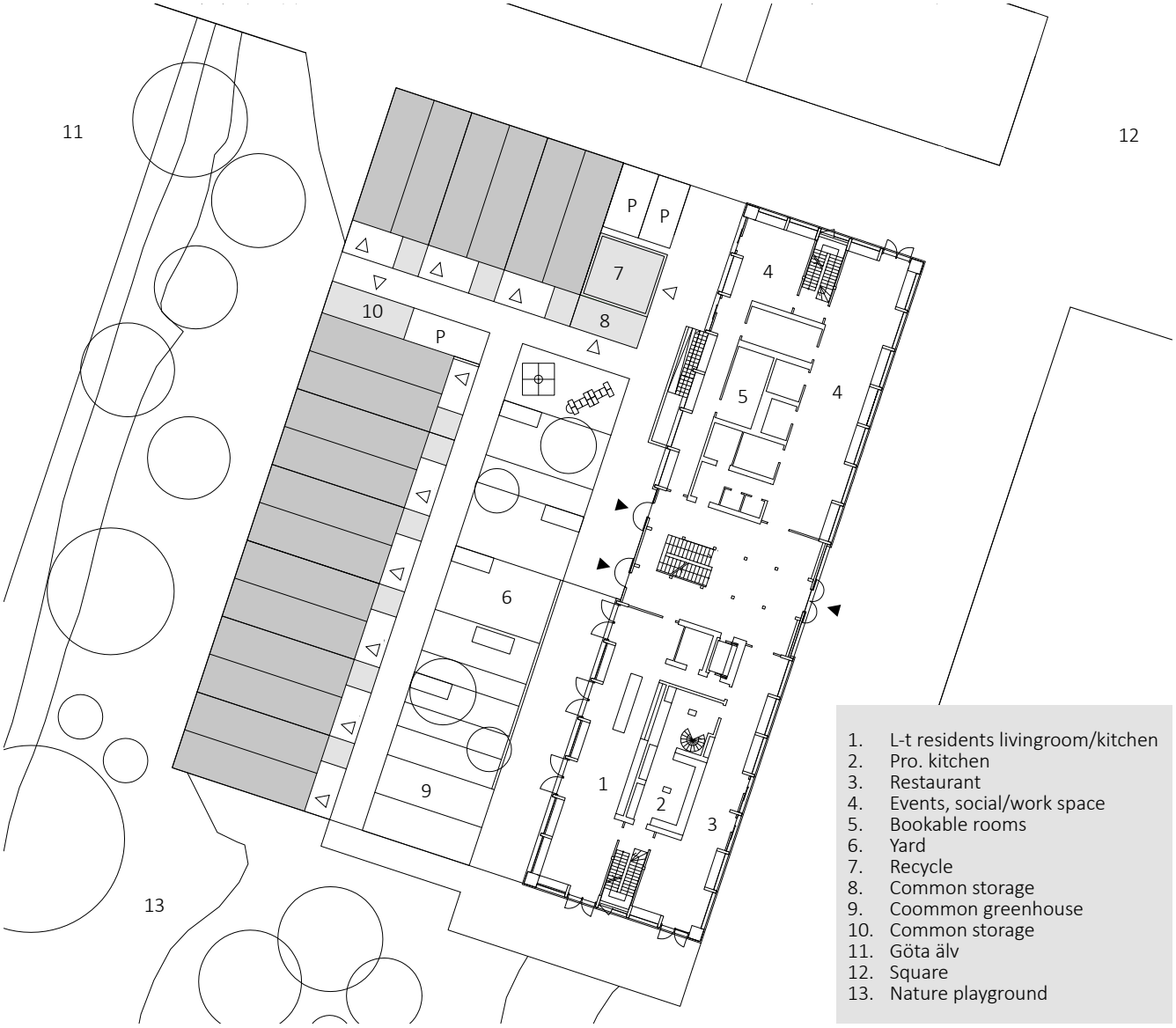
The concept of a tree is evolving. The ”Stem” in the center is the main vertical communication between the ground and the greenhouse, or “Crown”. Functions and social spaces are distributed along the Stem to encourage residents to use the stairs and meet spontaneuosly. Branches or corridors enable access to small apartments within housing units. The greenery is flourishing in the Crown, and the leaves or solar cells provide cooling shadow and energy for the house.

A tree is also the result of a sprout, which could be used as an allegory for starting a business.



Concept model

This model is an application of the tree concept on a potential building. Two massive wooden housing units elevate in a greenhouse structure enabling common social activities, work and cultivation to take place around them.



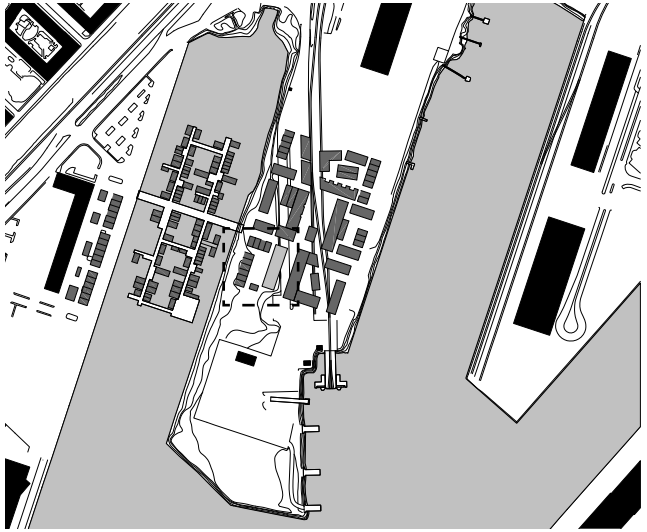
1. L-t residents livingroom/kitchen
2. Pro. kitchen
3. Restaurant
4. Events, social/work space
5. Bookable rooms
6. Yard
7. Recycle
8. Common storage
9. Coommon greenhouse
10. Common storage
11. Göta älv
12. Square
13. Nature playground

0 5 20

Scale 1:500

Social mix

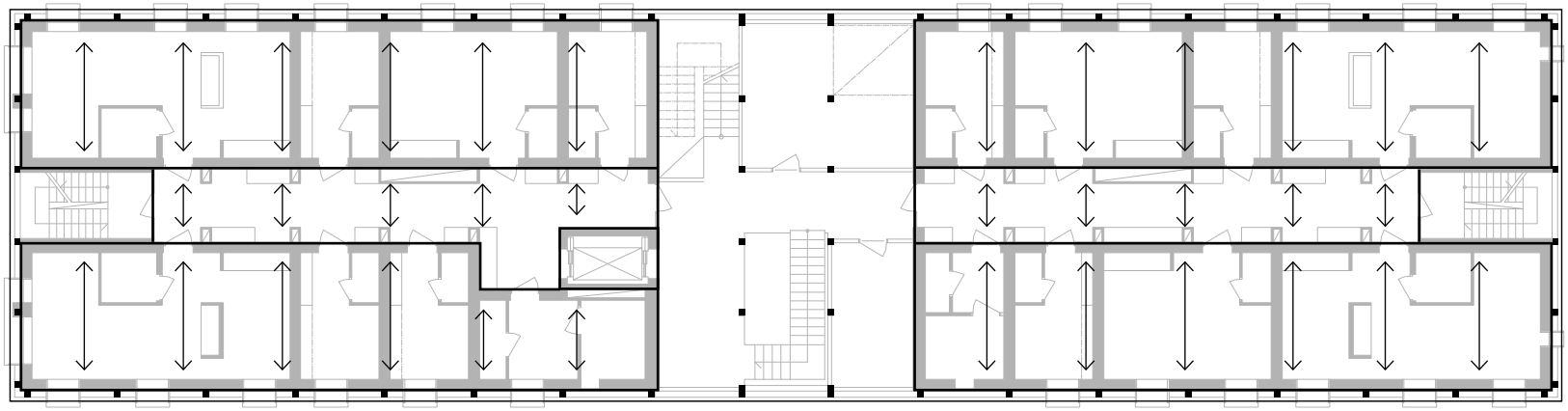
The block consists of Sprout Living and rowhouses that share common resources in the yard. In this way the residents of Sprout Living also get a natural connection with people outside the community. The more public common part in the North faces the street and is in visible contact with square. The professional restaurant open for residents and visitors is situated in the South towards the street side. The more private long-term resident part of entrance floor faces the the yard and the small grove.



0 80 400

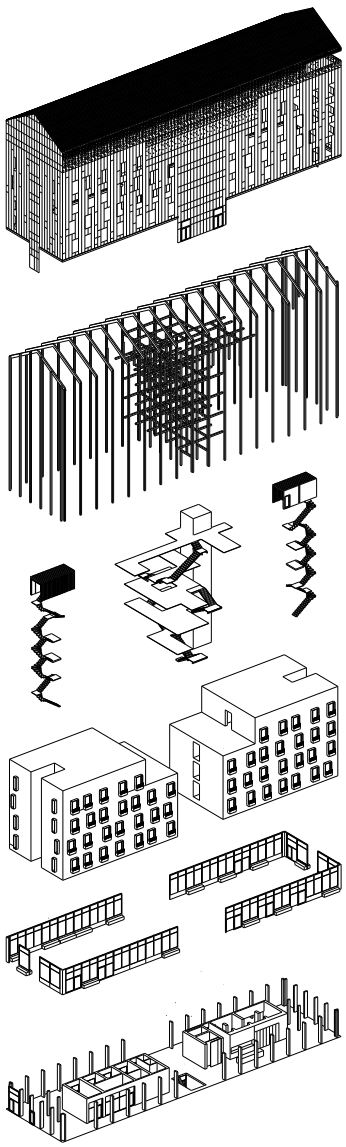
Scale 1:8000

Sprout Living frames the yard which creates an interacting space for the residents of the block.



Wooden Boxes Wrapped in Greenhouse

The structure is divided into a grid according to Drivadans standard meassurement. 3060mm between pillars on long side and 2448 on gables. Shafts and storage create nisches in entrance halls. All vertical communications are placed in greenhouse except from elevator. The facade and walls towards entrance halls in housing units are load carrying. The housing units stabilize the greenhouse structure.



Facade System
Transperent glass/semitransperent solar cells in greenhouse areas. When infront of housing units, panes are either laminated with solar cells (South and West) or wooden grey boards (North and East), due to bad light conditions. Meassurement according to greenhouse manufacturer Drivadan (cc 612mm).

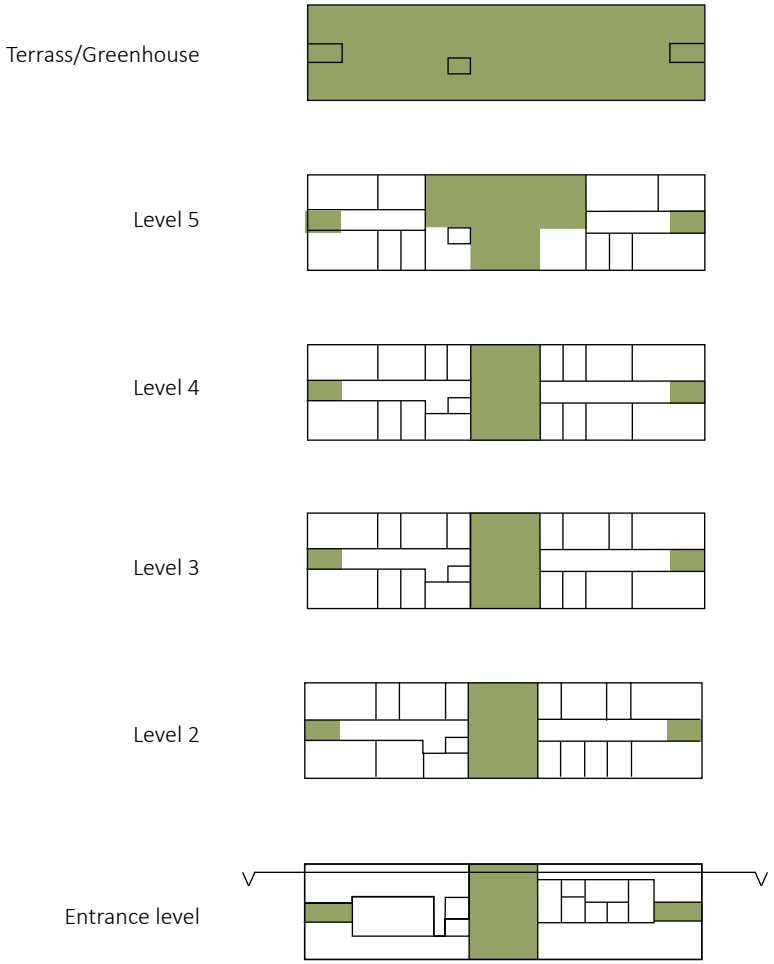
Greenhouse Structure
Pillars and beams in glulam create the body of greenhouse and facade system.

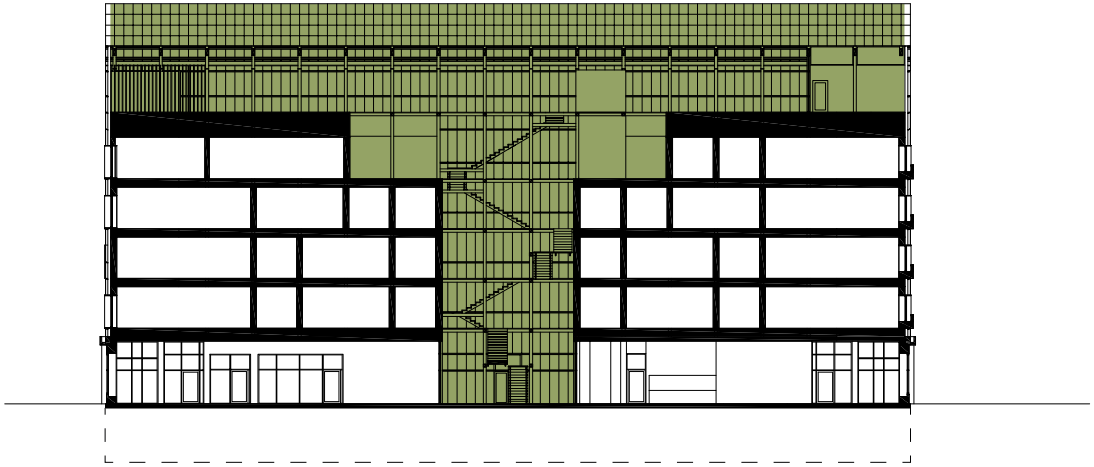
Vertical Communication
Main organic stair and elevator shaft in massive wood in center and slender straight stairs on gables.

Housing Units
Two efficient housing units in massive wood mirror each other, contrasting slender greenhouse structure.

Insulated Glass
Insulated glass with incorporated benches and cultivation boxes cover the heated parts of entrance floor

Cores
Two cores in massive wood on each side contain functions, restaurant and bookable rooms. They are surrounded by open social and work areas.

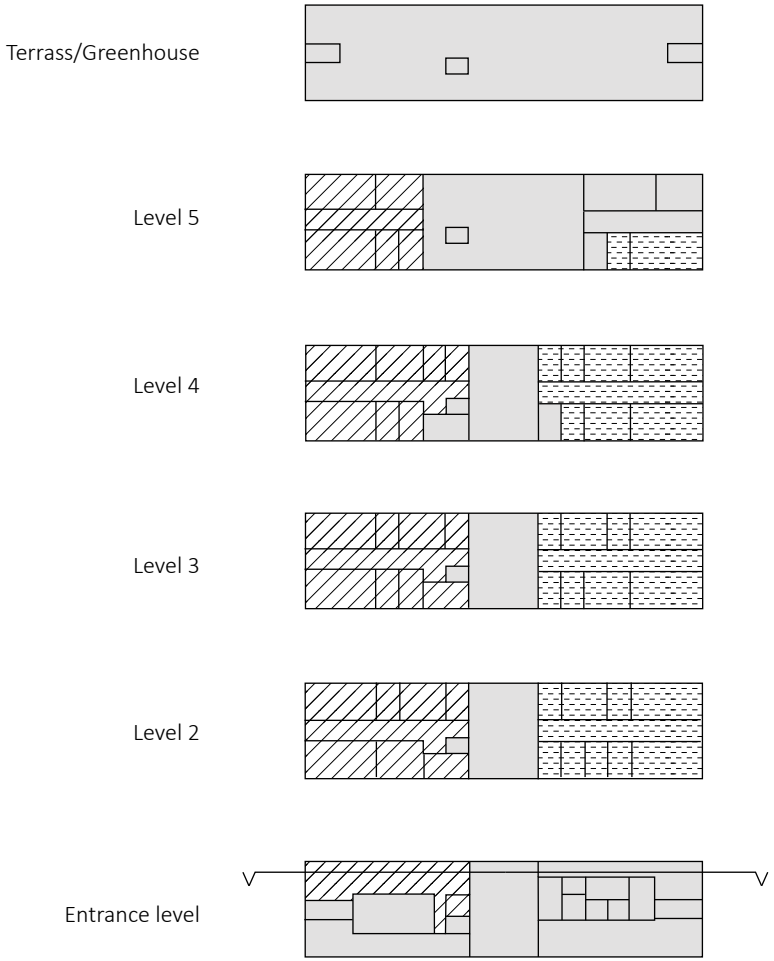


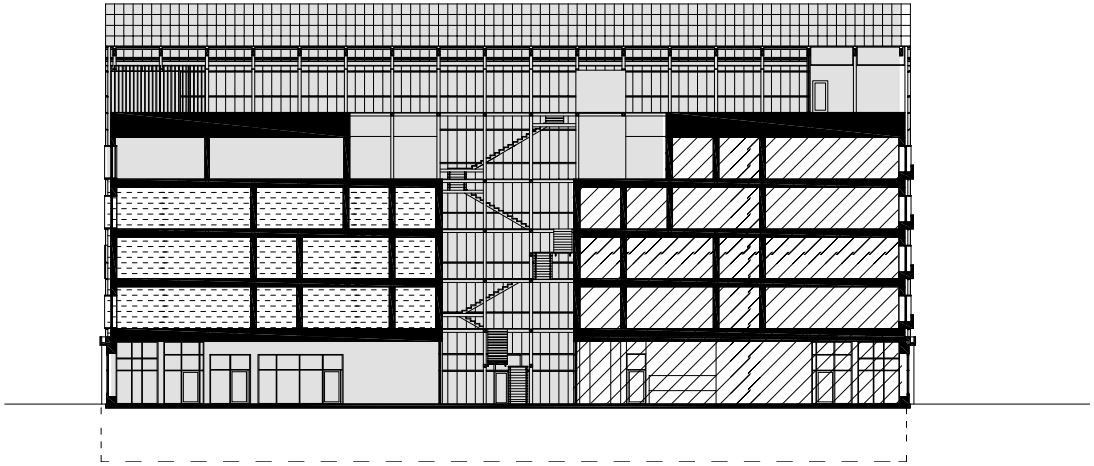


Greenhouse

Tree

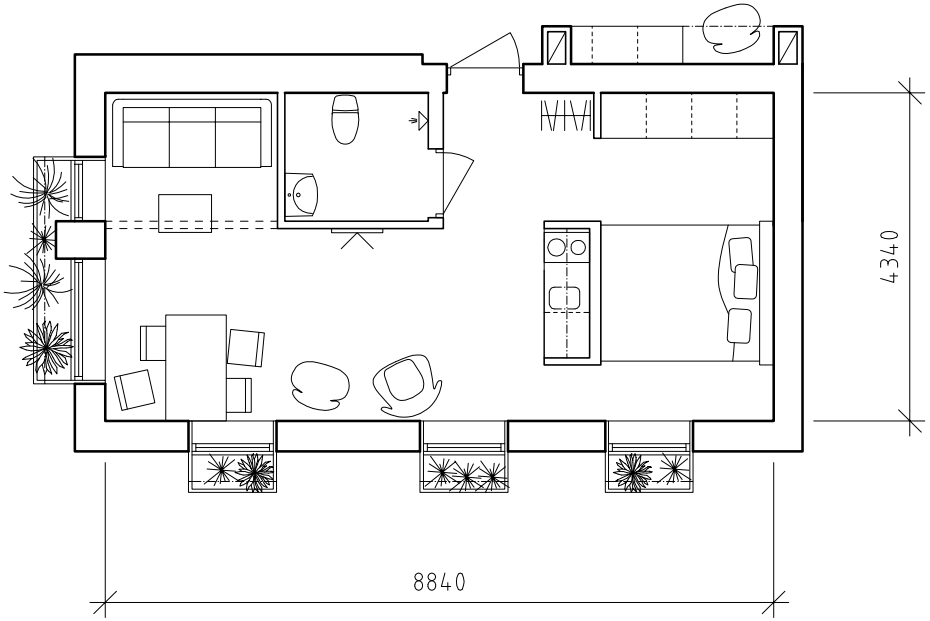
The plan and section are shaped like a tree letting down light into the strcture. The greenhouse offers places for leisure and work as well as cultivation.



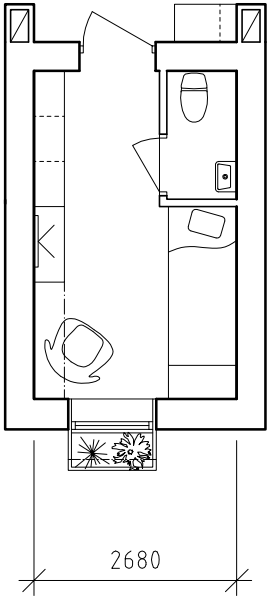


Division

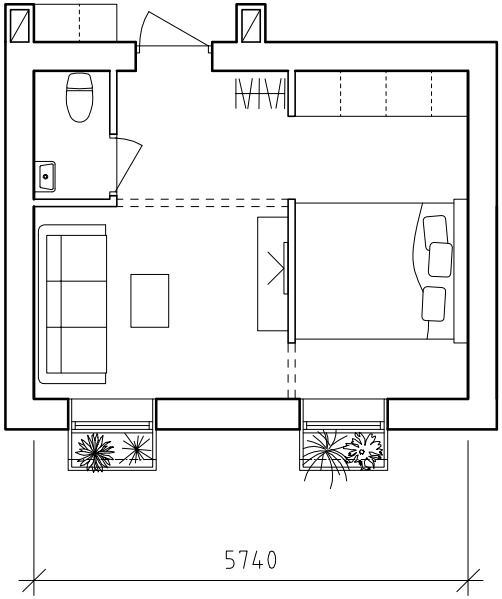
The two groups of residents, long-term and guests, are organized in one housing block each. Both have equal access to greenhouse areas. The long-term block is situated in the South with great views towards the river. The block for guests is inte the North towards the square and central part of the neighborhood.



38 kvm



11,5 kvm

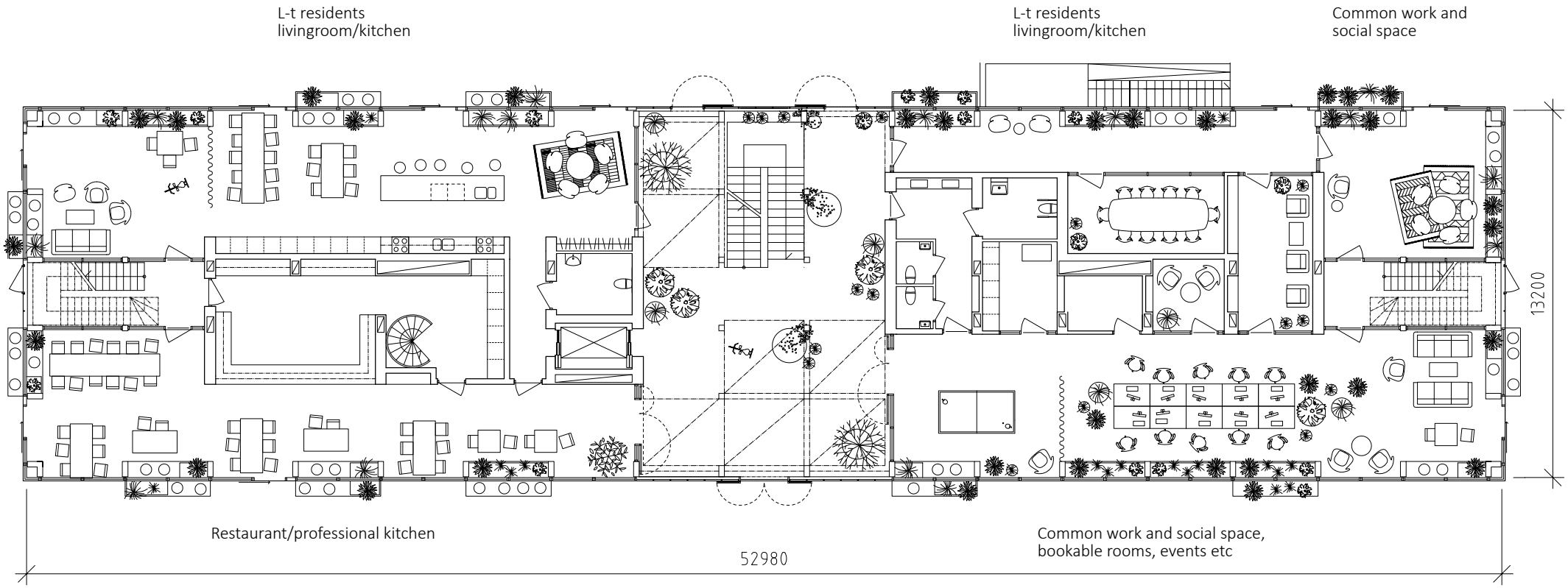


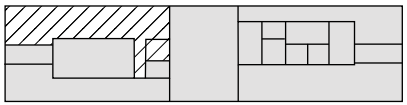
25 kvm

Scale 1:100

Apartments

The apartments all have accessable beds. Entrance corridors provide effective storage per sqm. There is an accessable bathroom and shower in each entrance hall. The 38 sqm apartment has a nisch to use as small room for potential baby, as well as an accessable bathroom. Larger social areas and kitchen/restaurant is distributed in building compensating for smaller apartments.



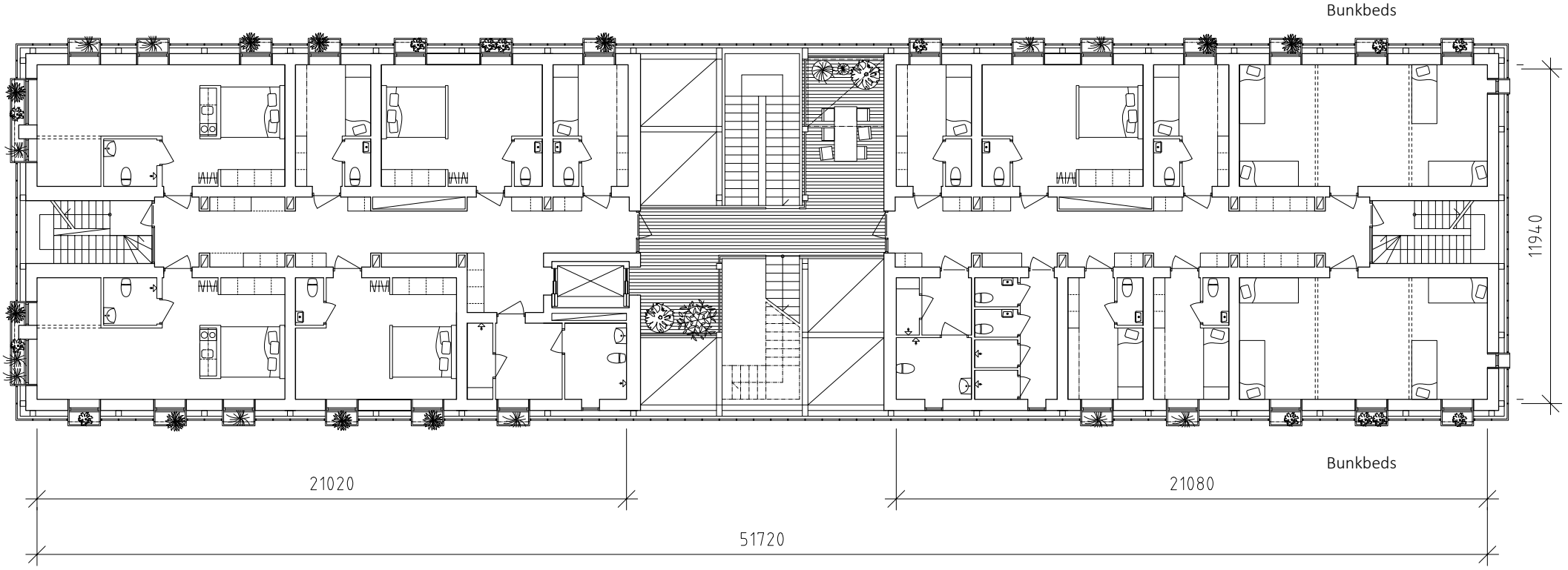


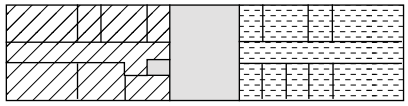
0 5 10

Scale 1:200

Entrance level

Functions, shafts and smaller bookable rooms are gathered in two cores surrounded by open areas for socializing, dining, events etc. Long term residents can access their livingroom and kitchen directly through elevator or seperate staircase. The professional kitchen has internal staircase to second kitchen area in basement.



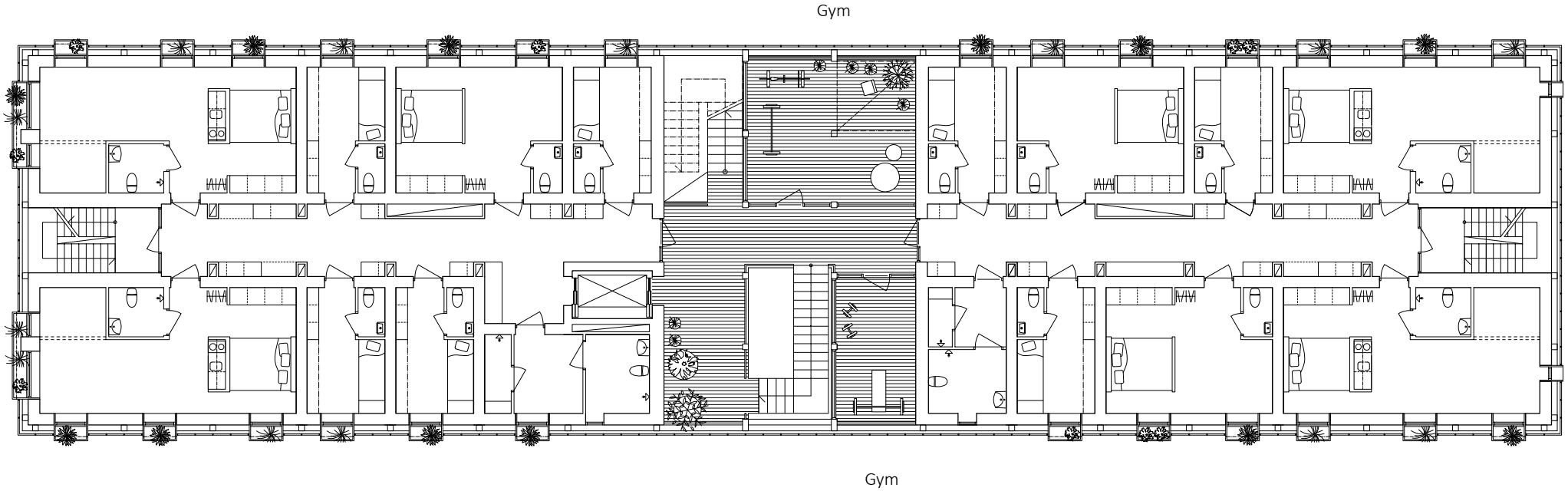


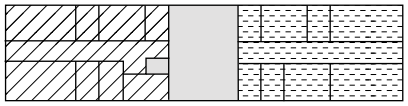
0 5 10

Scale 1:200

Level 2

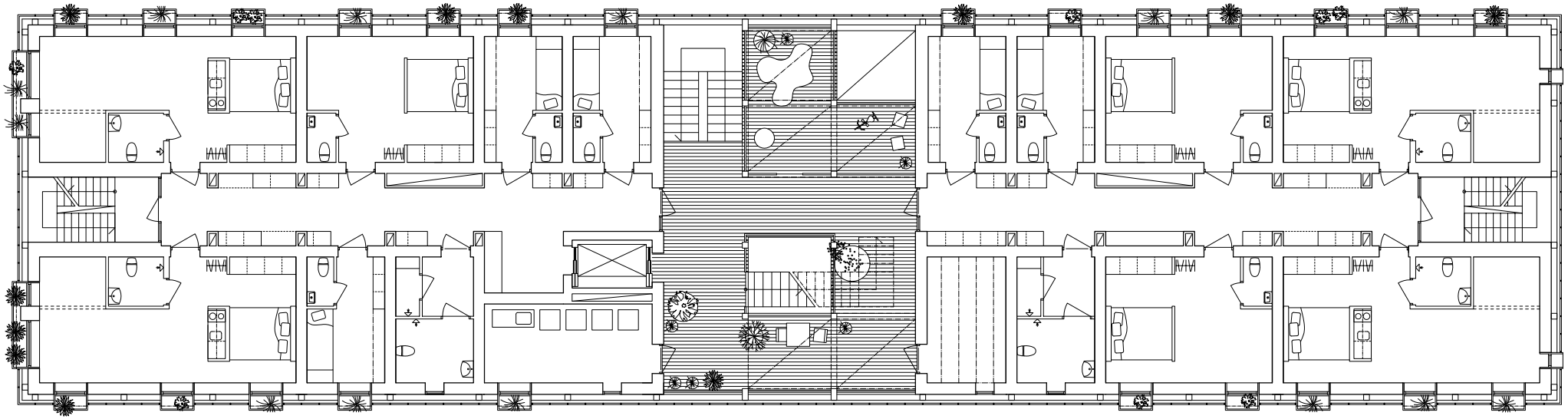
The entrance halls all have a common bench. The long term residents can access elevator straight from their entrance hall. Shafts are placed according to grid enabling different configuration of apartments on each floor. Two rooms with bunkbeds in guest unit is compensated with extra toilet/shower module.





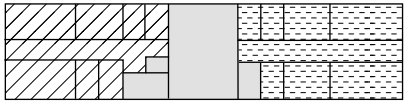
Level 3

A common gym is placed in level 3. The stair in the centre (the Stem) is organically shaped offering different views and impressions on each floor.



Laundrey

Drying room



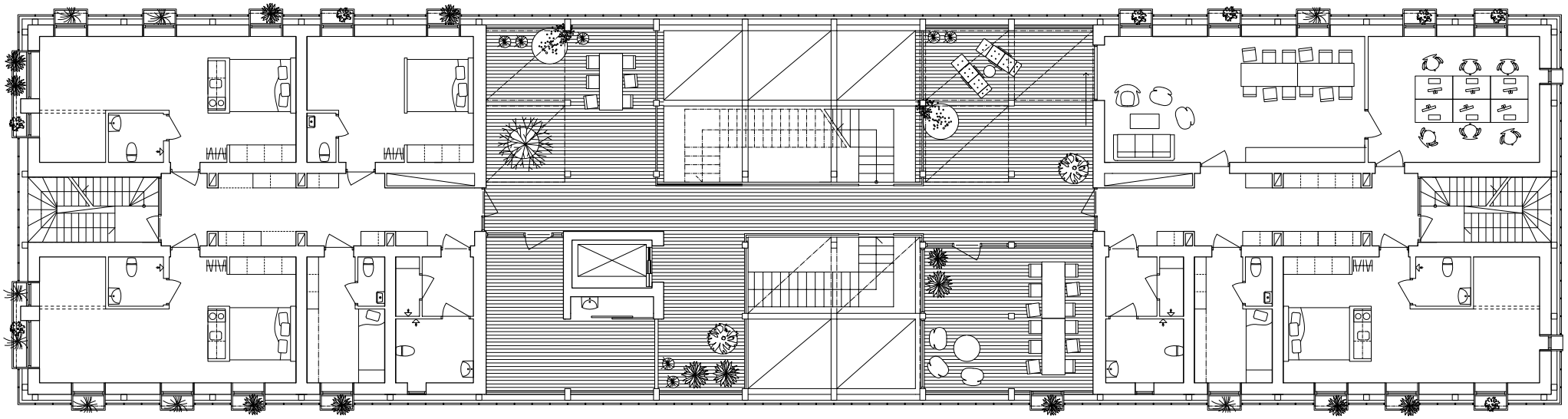
Level 4

The common laundrey is combined with play area facilitating housework combined with child/children.

0 5 10

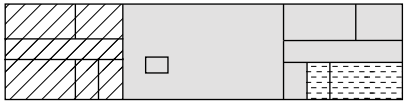
Scale 1:200

Common social and work area



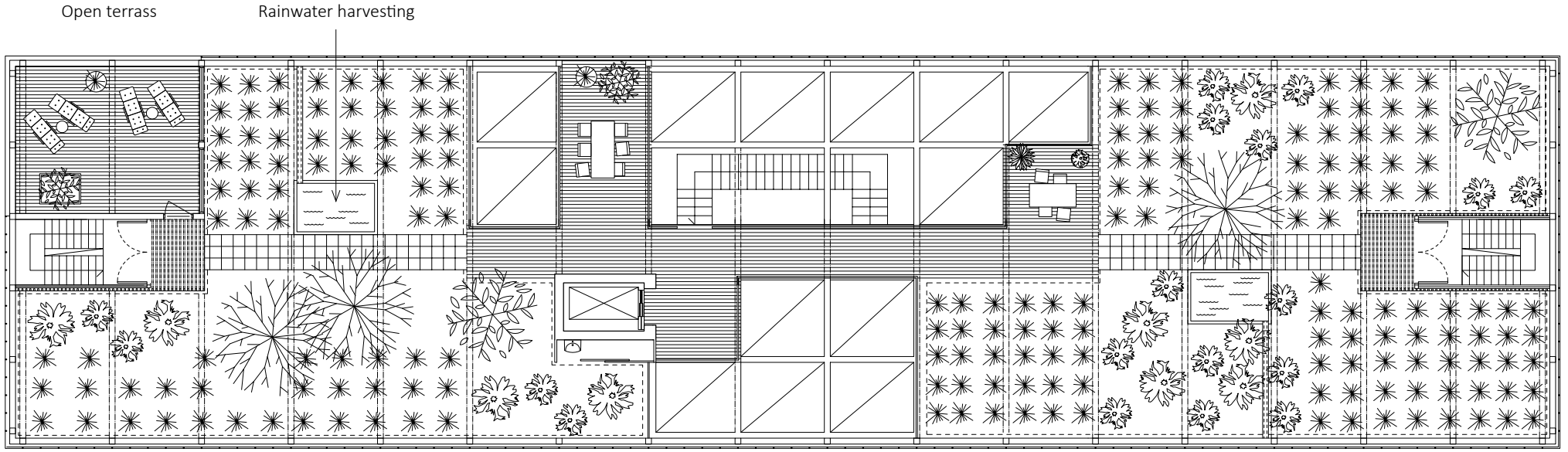
Str. gardening

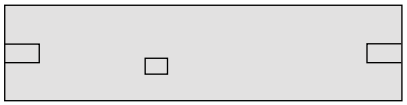
Bookable room



Level 5

The greenhouse area expands on level five letting down light further in building. Common living- and working room for everybody in North-West with direct access to greenhouse area.



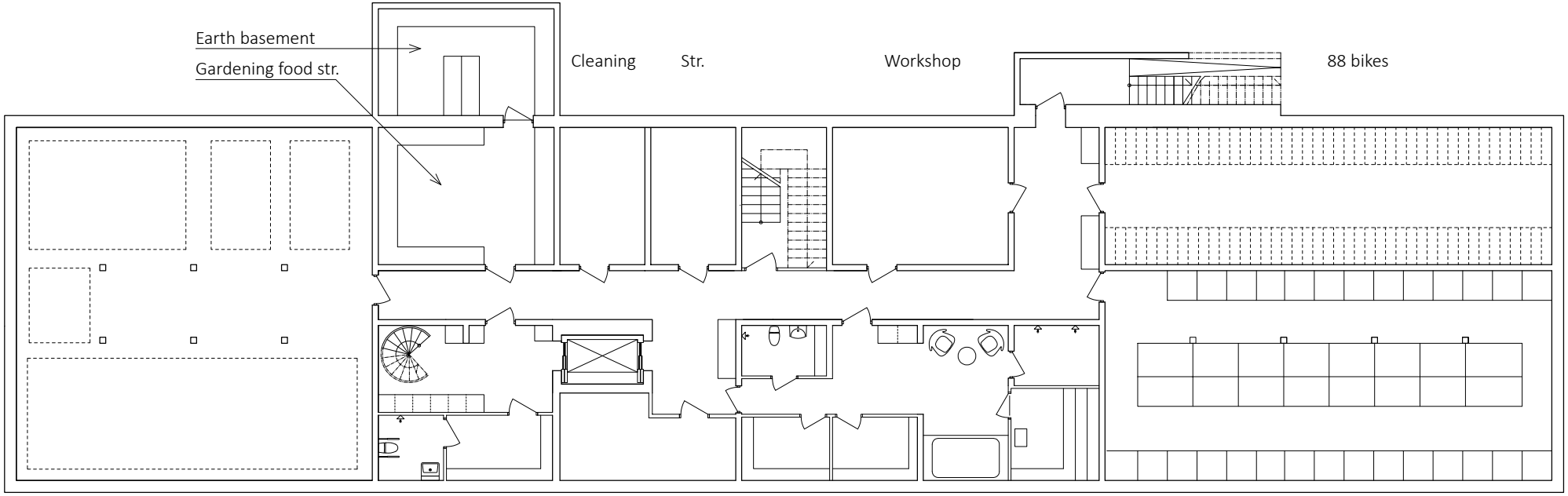


Terrass/Greenhouse

The greenhouse level has focus on cultivation, but offers scattered areas for socializing or work, including the outdoor terrass in South-West.

0 5 10

Scale 1:200



Basement

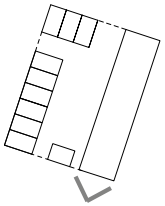
The chef of the pro-kitchen is also hired as gardener. The kitchen has an internal stair leading to direct access to large elevator and terrass for easy logistics. On the opposite side there is room for food and gardening storage as well as an earth-basement. In the thechnique room there is room for an accumulation tank for greywater. A spa is situated close to elevater and main stair.

Facades

Opaque dark grey wooden boards replace solar cells randomly creating a lively impression. Cultivation boxes outside all windows in South, West and East softens the potentially harsch impression of the black/dark grey greenhouse facade. They also give an opportunity for each resident to contribute with their personal expression.

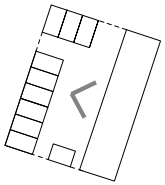
South Facade

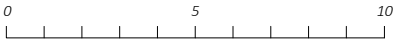
Larger windows towards South to maximize views, though thick nisches protect from heating sun in summer.



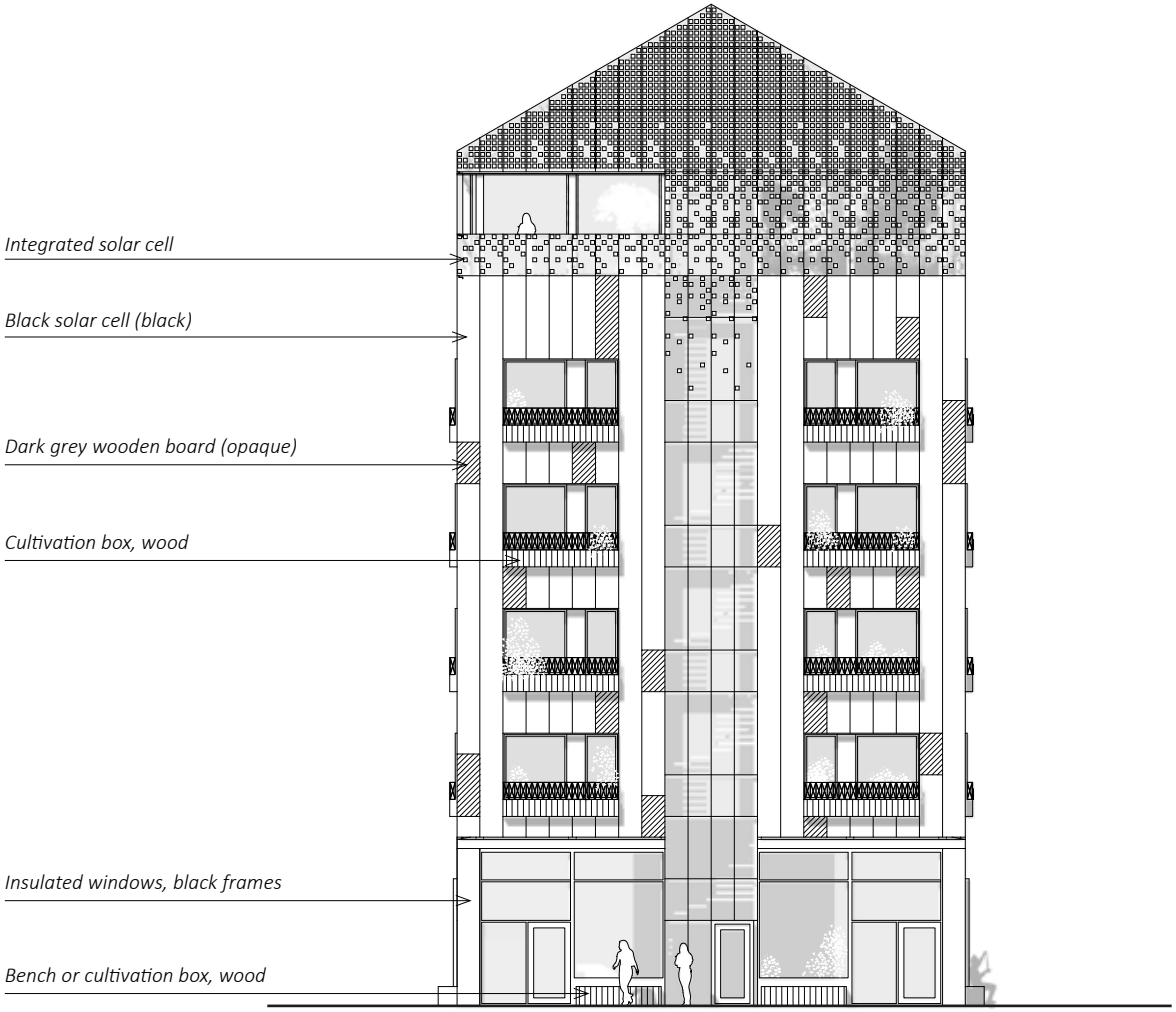
West Facade

The tree concept is most visible from West facing the yard. Integrated solar cells in transparent glass-panes simulate leaves of the tree-crown and provide cooling shadow for plants and residents.





Scale 1:200



South

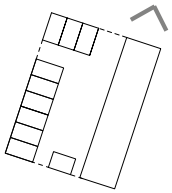
West

Inverted

Due to less sun exposure the relation of glossy solar cells and opaque wooden boards is shifted on the North and East facades.

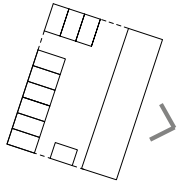
North Facade

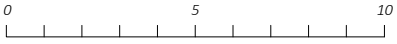
Smaller windows towards North to minimize heat loss.



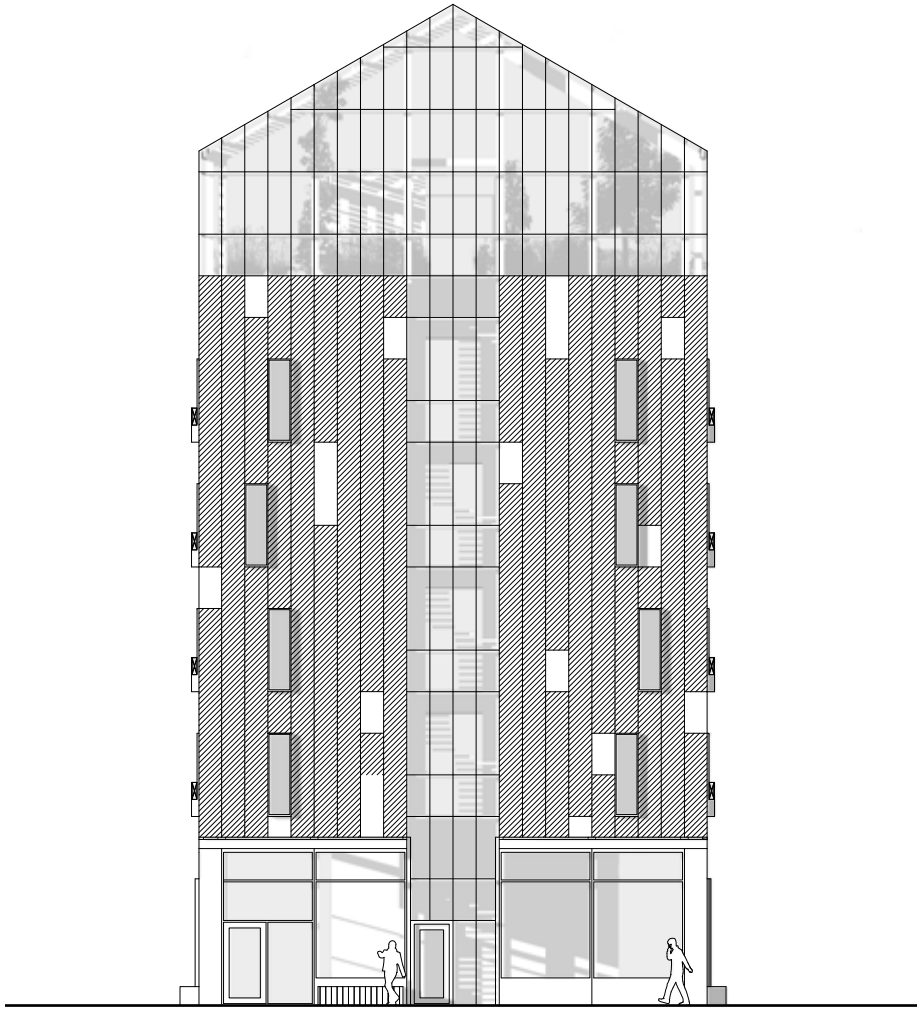
East Facade

This side is facing the street and is therefor more closed to create privacy. White glass panes provide light for functional rooms and bathrooms behind.

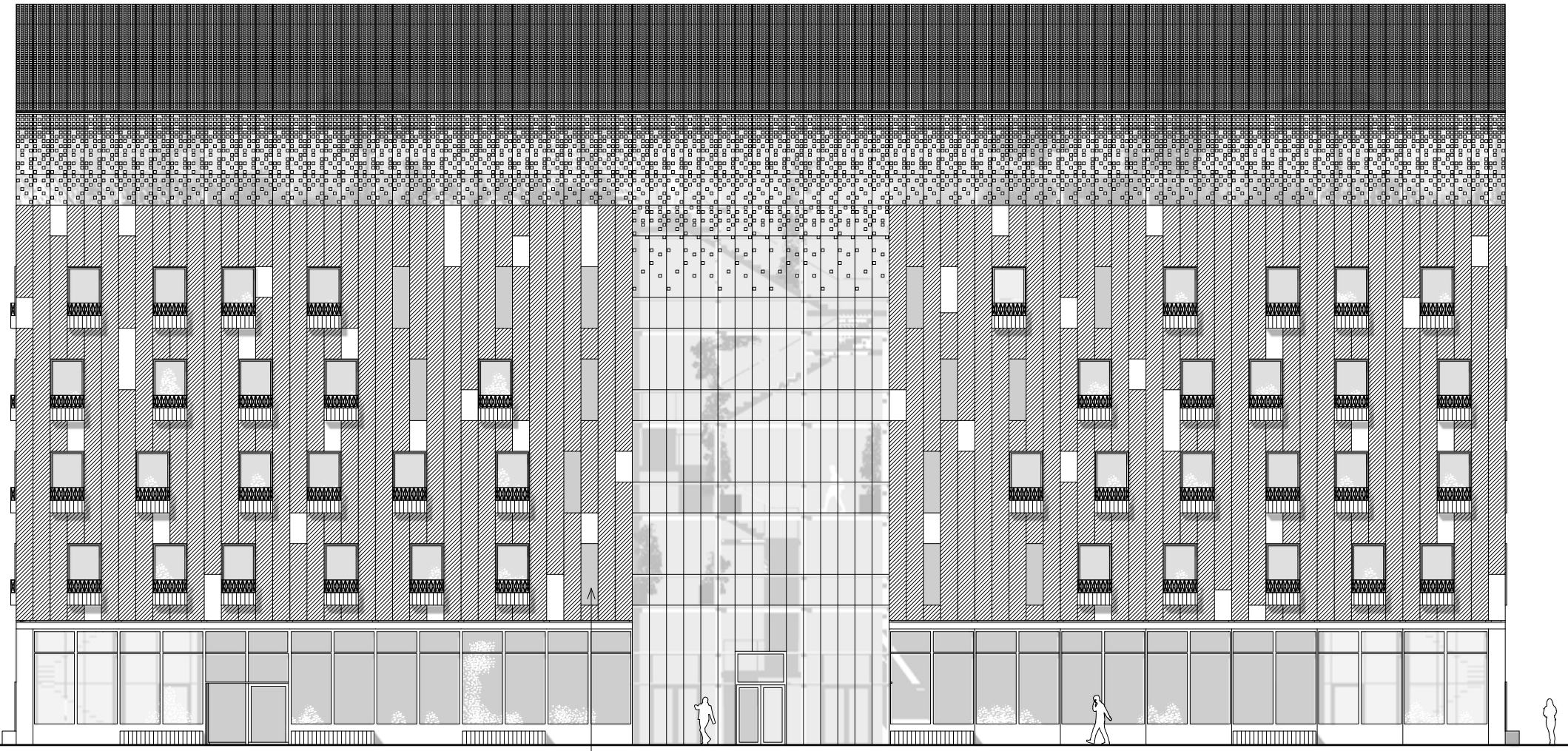




Scale 1:200

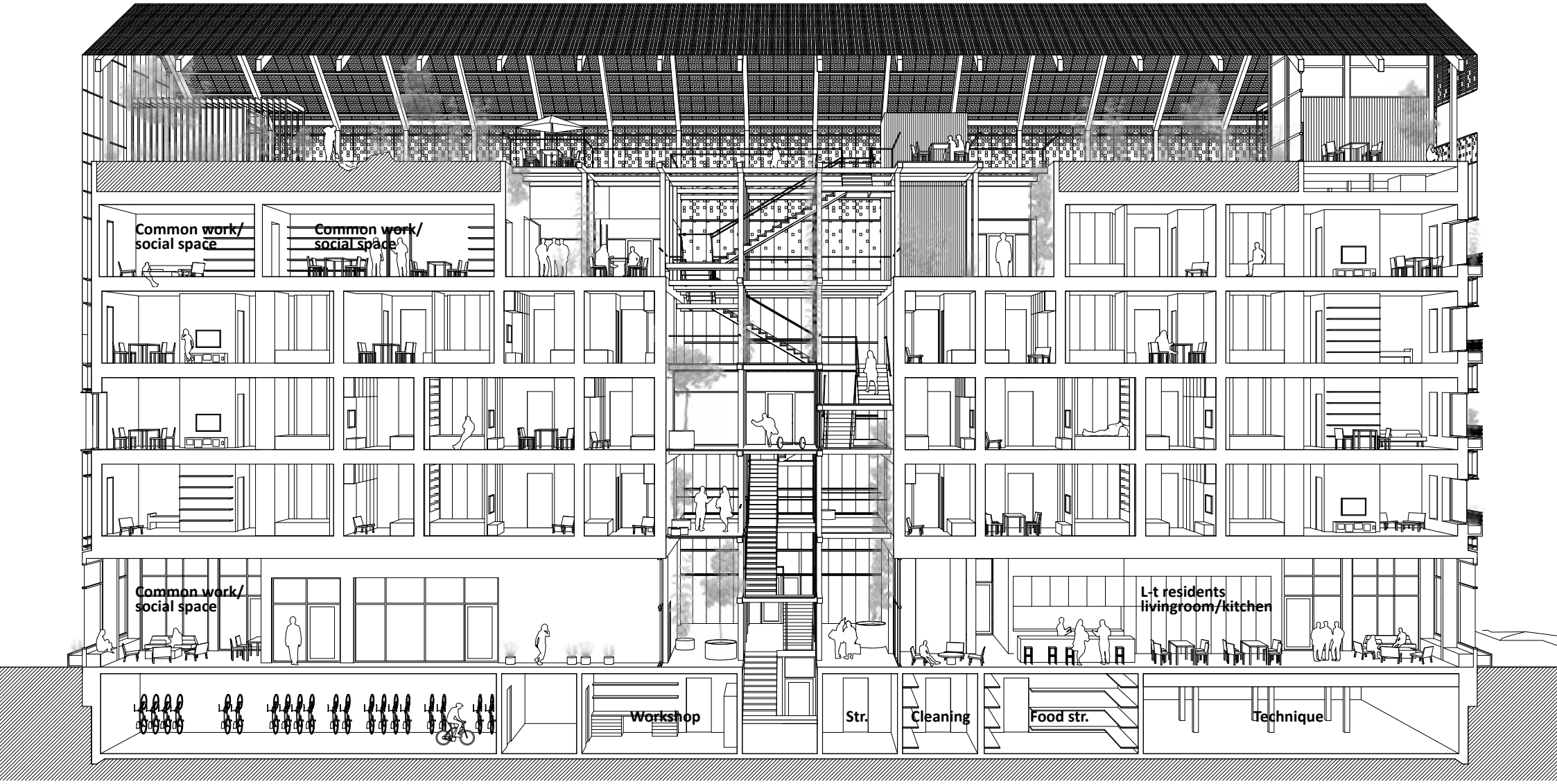


North



East

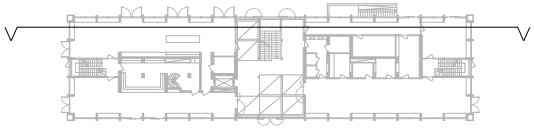
White transperent glass pane


Common work/
social space
Common work/
social space
Common work/
social space
L-t residents
livingroom/kitchen
Workshop
Str.
Cleaning
Food str.
Technique

SECTION A-A

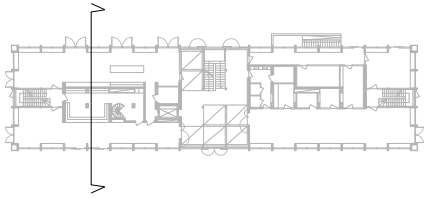
Section A-A

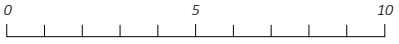
The section illustrates how the small housing units are contrasted with generous common areas within the greenhouse structure and around cores in entrance level.



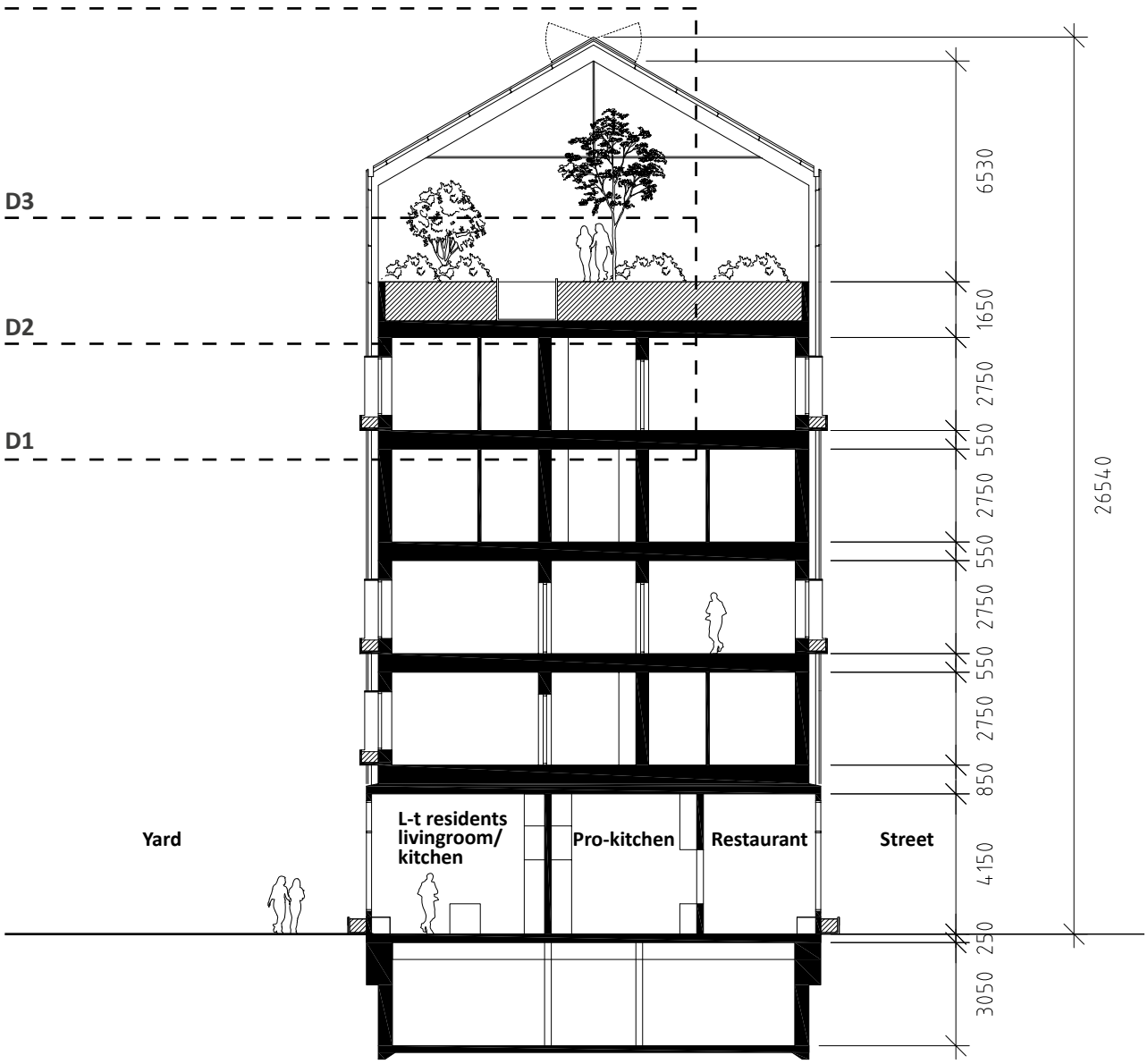
Section B-B

The generous roof height in greenhouse permits vegetation to grow high. During the warm season hot air (can reach over 40 c°) accumulates in the top above human height before let out through hatches. 2750 in height in apartments permit businesses as tenants as well to ensure future flexibility.

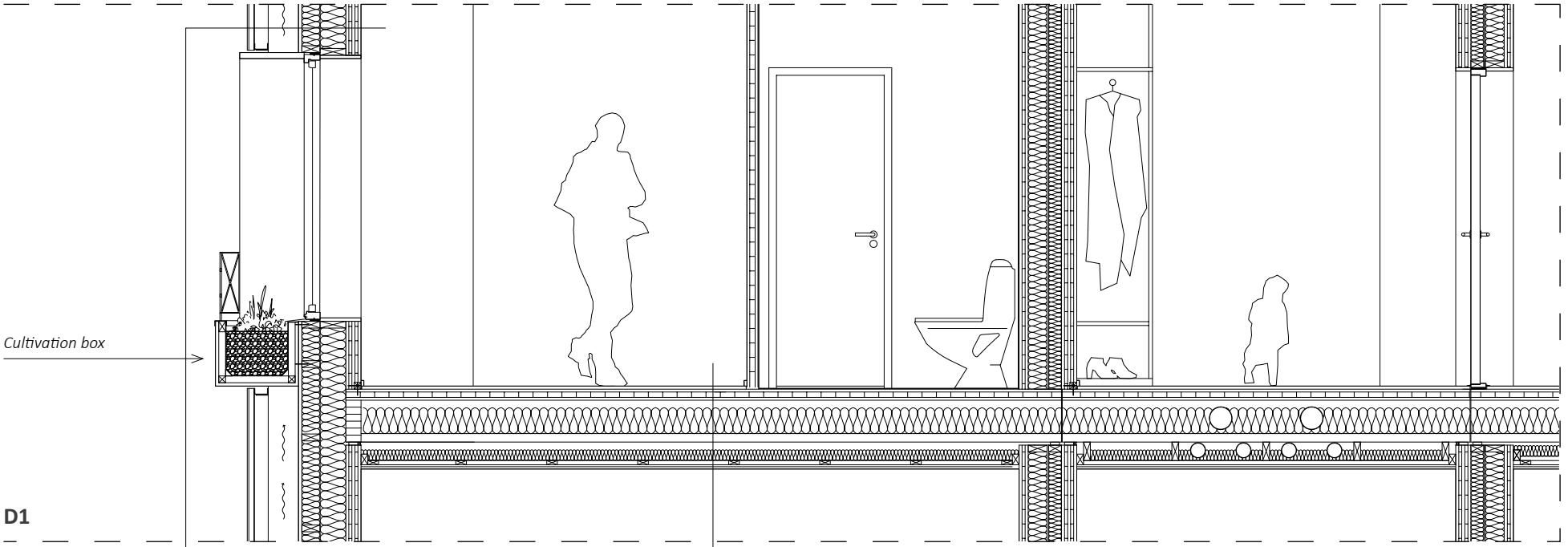




Scale 1:200



SECTION B-B

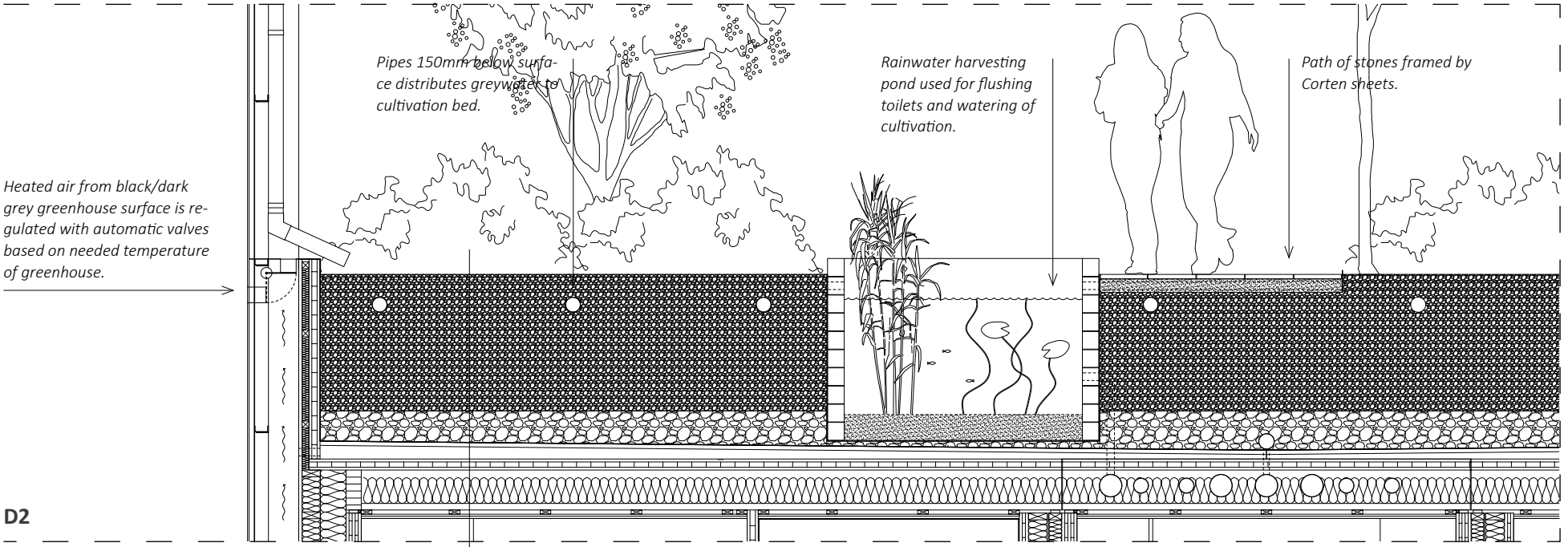


100 Massive wood structural panel
170x45 Wood beam (170 cellulosa insulation)
120x45 Wood beam (120 cellulosa insulation)
120x22 Wooden panel c-c 600
200x200 Massive wood pillar
91x45 Aluminium profile
47x40 Aluminium profile
4 Solar cells, black (glossy)/wooden outdoor board, grey (opaque)

20 Wooden flooring
73 Massive wood structural panel
276 Massive wood beam (T) (170 cellulosa insulation)
120x45 Wood beam (120 cellulosa insulation)
28x70 Spline
13 Gypsum
15 Wooden board

0 *1* *2*

Scale 1:40

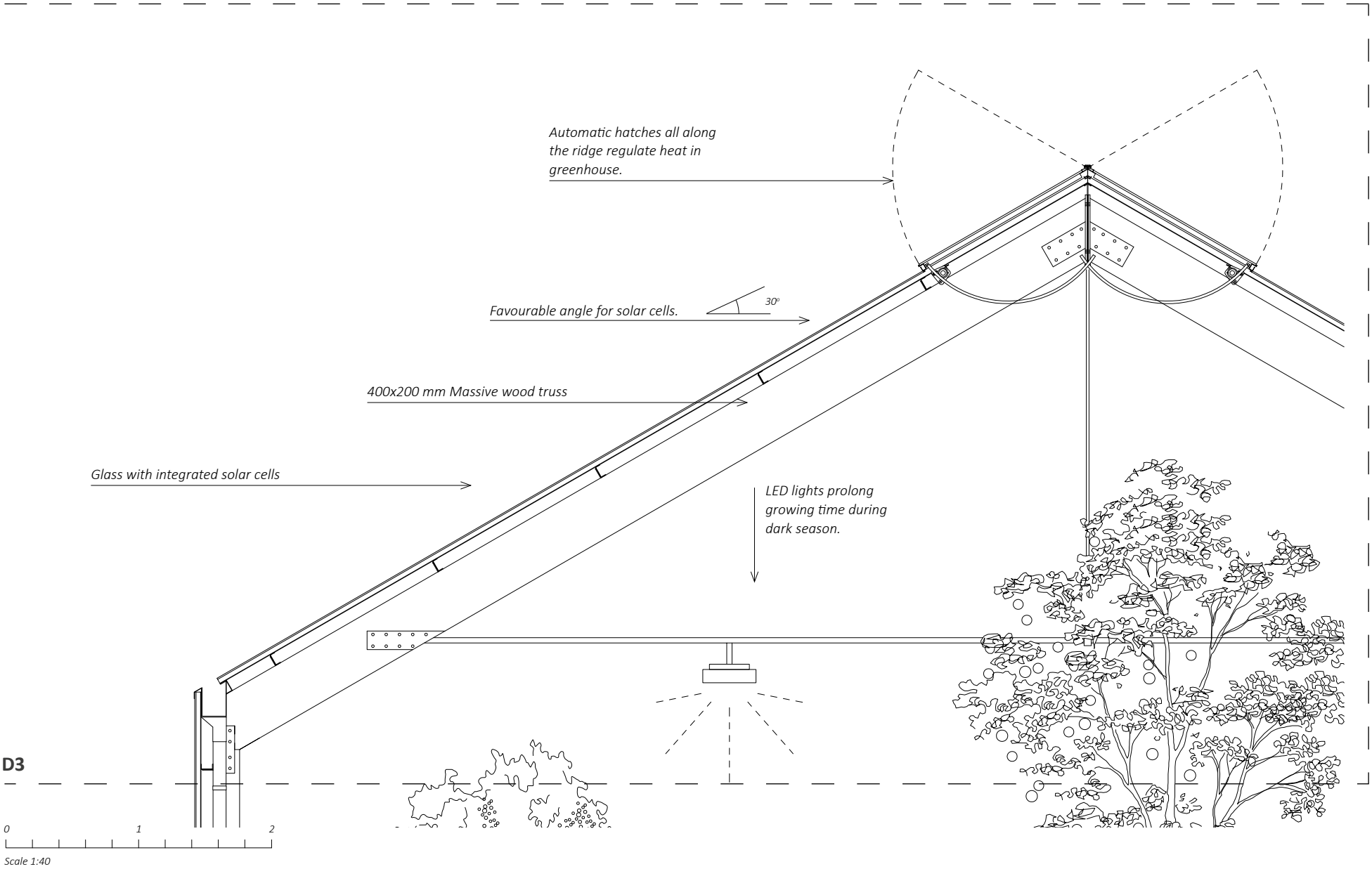


900 Peat/charcoal/hydrograins ∅0-16mm
200 Drainage, hydrograins ∅16-32mm
1,5 Rubber waterproofing (EPDM)
28 Wooden boarding with inclination
90 Air ventilation
73 Massive wood structural panel
276 Massive wood beam (T) (170 cellulosa insulation)
28x70 Spline
13 Gypsum
15 Wooden board

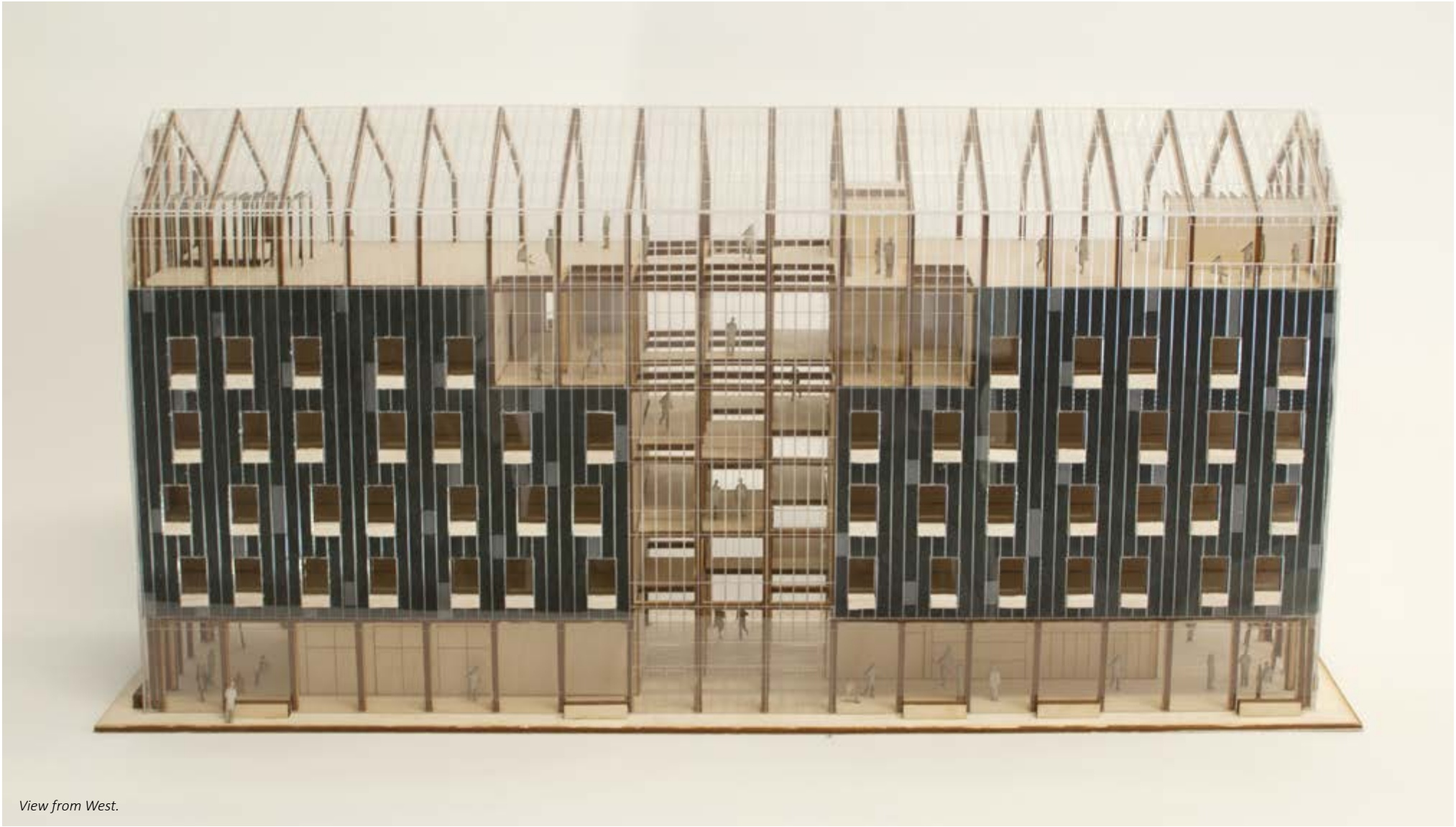
Cultivation Bed

The cultivation bed needs to be 1100mm to ensure elimination of harmful bacterias (Pathogens). The pipes distributing greywater is placed 150mm below surface to make sure that the potentially large amount of sulfur (mostly from soap), does not raise to surface and release odour. Inclination towards drainage pipe transports purified water for further release in nature*.

** Information from interview with cultivation bed expert Anders Solvarm.*

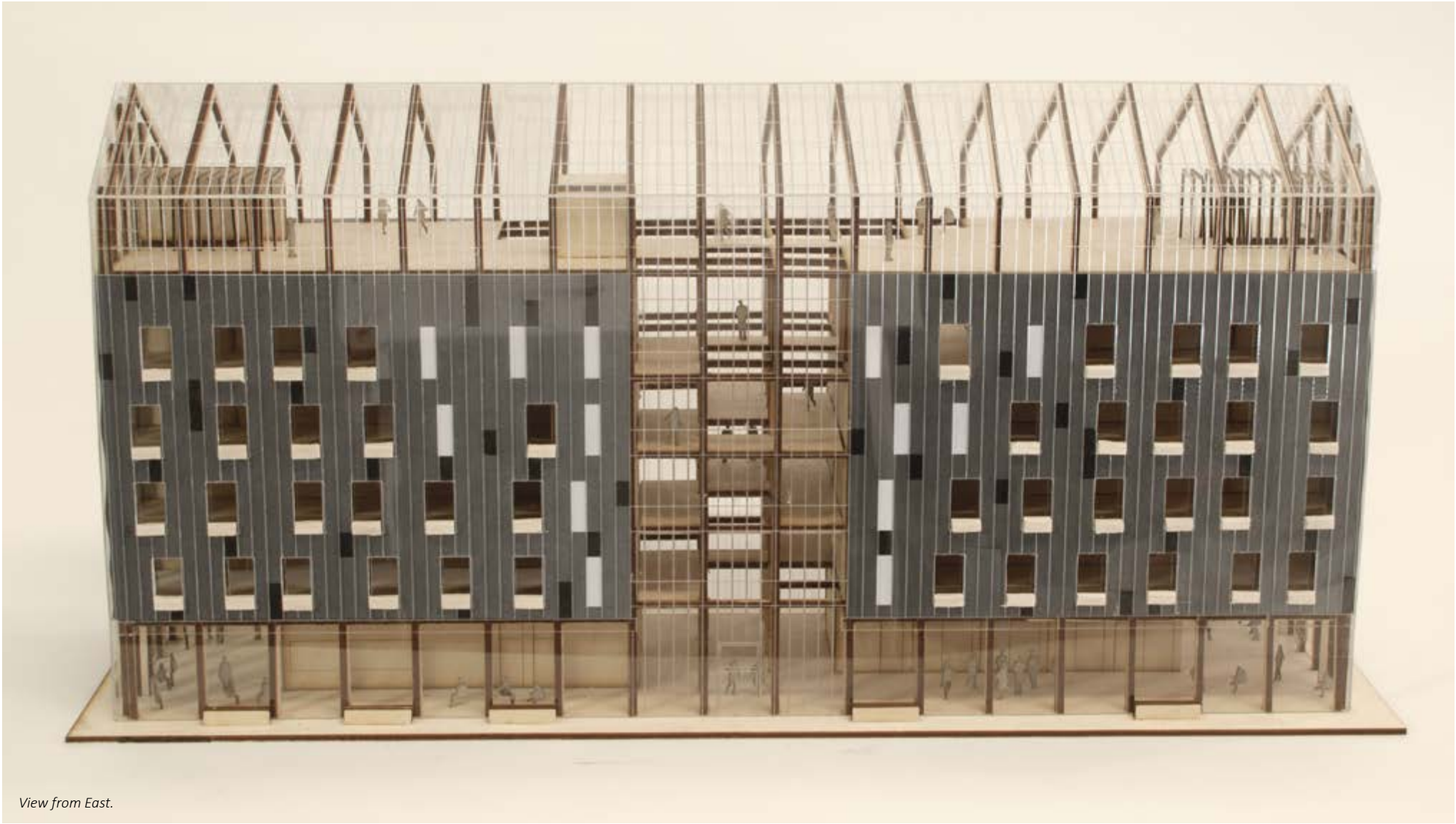

Automatic hatches all along the ridge regulate heat in greenhouse.
Favourable angle for solar cells.
30°
400x200 mm Massive wood truss
Glass with integrated solar cells
LED lights prolong growing time during dark season.
D3
0
1
2
Scale 1:40

Perspective of roof terrass.



View from West.

View from South-West.



View from East.

Sprout Living

BTA excluding basement and terrass: á 3483 sqm
BTA including basement and terrass: á 4830 sqm
BTA including basement: á 4193 sqm
BTA warm: á 3416 sqm (of which basement 710sqm)
BTA cold: á 1414 sqm

Á 76 residents
15 apartments 38 sqm (of which 2 bunkbeds)
10 apartments 25 sqm
19 apartments 11 sqm

Comparison with Average Apartment Building

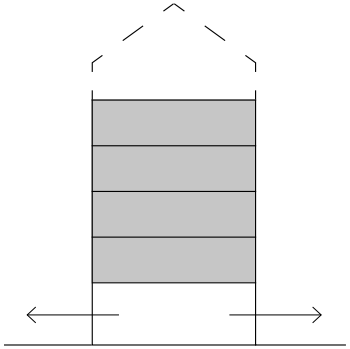
In a comparison with an average apartment building I do not include the greenhouse area of the roof, only the underlying floors because the building permit allows only five floors. (In Sprout Living, I have assumed that the greenhouse on the roof could be granted thanks to the sustainable aspect of it, which I think would be a reasonable opinion from the municipality if they strive to encourage local food and energy production, as well as new methods for relieving the treatment plants of the city.)

I assume that the BTA (including cold greenhouse, though not terrace level). I calculate 4193 x 0.75 = 3145 to count off the vertical communication and function spaces to get the living area.

The average number of persons per apartment is around 2, and the average apartment size is about 92 sqm according to Statistiska centralbyrån (2012). This means that the BTA in this particular example of an average apartment building would result in about 68 tenants.

More Social Space

Apart from the qualitative rooftop with social and cultivation areas, Sprout Living does not only create housing for 8 people more (though very much tighter apartments), but it also creates a vital ground floor of 715 sqm with common rooms and a restaurant where the public is invited. The generous staircase as well as the basement also offers common functions and social space like gym of 45 sqm and a spa of 63 sqm.

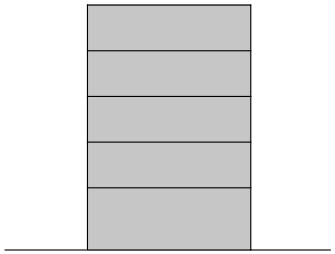


Sprout Living

- BTA (excl. terrass): Á 4193 sqm
- 15 apartments 38 sqm (of which 2 bunkbeds)
- 10 apartments 25 sqm
- 19 apartments 11 sqm
- Á 76 residents
- + social space in staircase
- + 715 social space/resaurant in entrance floor

Less Area to Heat

One also has to take into account the economcial and environmentally benefit that Sprout Living has all vertical communication and social space in greenhouse areas (1414 sqm), which saves á 2/3 of investment in building costs and maintainance costs regarding heating.



Average Ordinary Housing

- BTA (excl. terrass): Á 4193 sqm
- 4193 x 0,75 = 3145 sqm living area
- Á 34 apartments (92 sqm each)
- Á 68 residents (2 persons/apt.)
- 0 sqm common social space
- No vital entrance floor

Design Decision

One idea I had before the start of the project was that the solar cells should be placed in a certain angle to the south to do some good. It turned out that it is true to a degree since they are most effective in that position, but other angles and directions can be sufficiently productive as well. By using a calculation illustration (to the left) as a reference point in the design process, I realized that there would be no great loss, or any loss at all, if the ceiling was placed with the angles to the east and west instead of south, as the latter option looses a large part of the area of the volume facing the north where power efficiency is considerably lower. Since the site conditions and the dwelling qualities was got better by placing the lamella with the gables to the north and south, those where the factors that determined the choice of location.

Calculation of Effect from Solar Cells

- Facade east-west: Thin film-solar cells (Sharp), total area 537sqm, effect 8-9%, = 23 415 kWh/year
- Facade south: Crystalline solar cells (HIT Panasonic), total area 104 sqm, effect 19%, = 13 685 kWh/year
- Roof east-west: Crystalline solar cells (HIT Panasonic), total area 365 sqm, effect 19% = 53 365 kWh/year
- Totally: 90 465kWh/year

Estimated Total Electricity Consumtion of Sprout Living

A very rough estimate of electricity consumption that was made early in the Tech Farm project was:

1. 1700kWh electricity plus district heating 1000kWh per person/year.

or

2. Alternatively 2000 kWh (based on the use of heat pump) per person per year on.

This calculation included among others following parameters : energy efficient lifestyle , common cooking, 100 % LED lighting, energy efficient electronics, water efficient showers, FTX system, water circulation pump, passive house standard.

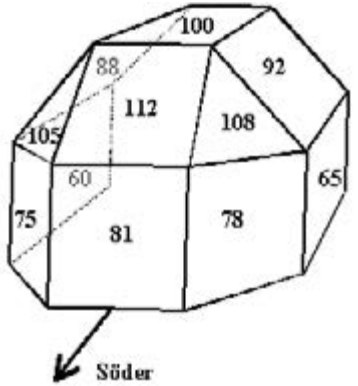
Percent Electricity Production from Sola Cells

If elcetricity consumption is alt. 1: 76 persons x 2700 = 205 200 kWh/year, á 44% from solar cells

If elcetricity consumption is alt. 2: 76 personer x 2000 = 152 000 kWh/year, á 60% from solar cells

BIPV

Since Sprout Living uses BIPV (Building Incorporated Photography Voltaics), the installation of solar cells as well as the settlement time becomes financially advantageous as they not only generate electricity but also fulfills a second function (such as weather protection) for the building that would otherwise cost money.



Purifies all Greywater from Residents

Sprout Living has about 76 tenants. If the starting point is that 5 sqm cultivation bed is needed to purify all greywater from one person, then, the total area needed to purify the greywater of all residents is 380 sqm.

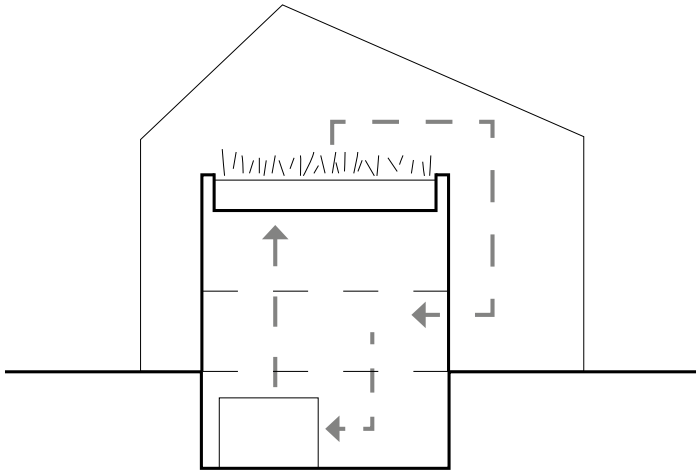
–Sprout Living has around 380 sqm of cultivation beds which means that it purifies 100% greywater from residents.

Food Production

It is difficult to estimate the production of food which the cultivation results in due to the effect of several parameters such as, what kind of crops are grown, how tightly planted etc. An attempt for an extremely rough estimate could be something like this:

In the book ”Rätt ur jorden-Handbok i självhushållning” (2014) by Bella Linde and Lena Granefelt, they conclude that 500 sqm of cultivation on land is enough for a family of two adults and two children to become self-sufficient of vegetables for one year. If crops are grown in a greenhouse instead, the production could be multiplied with four. 500 sqm divided by 3.5 persons (two children represents about 1.5 people according to my own estimate based on figures from Livsmedelsverket) will be approximately 143 sqm of cultivated land/person.

–This means that the growth surface of Sprout Living (380 sqm) can produce an annual consumption of vegetables for about 11 people , which is about 14.5% of the tenants.



Ventilation

Sprout Living uses passive cooling and heating from a culvert that uses the temperature from the ground as energy source. This air flow is connected to the FTX system and reduces energy loss when heating or cooling the building. The residual heat from the FTX-system is used for heating greenhouse during cold seasons.

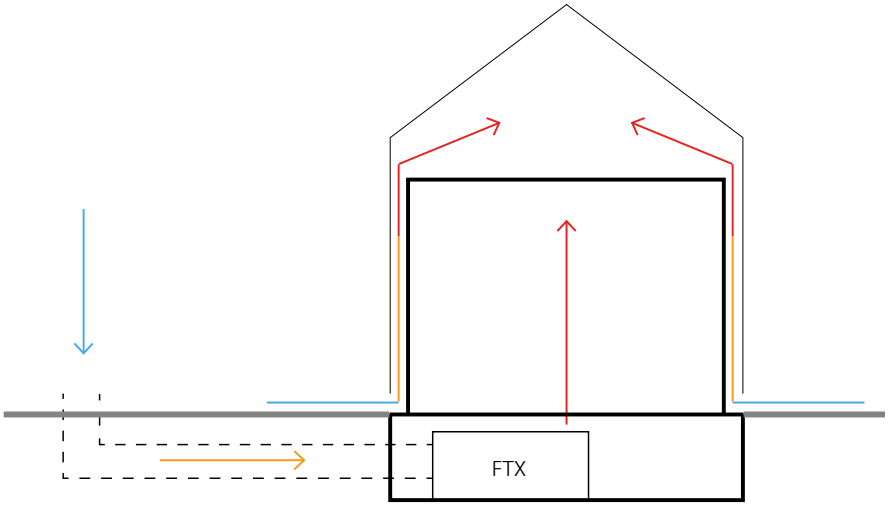
The greenhouse shell generates heat on backside of solar cells and dark grey boards which elevates to the terrass and heats it during cold seasons.

Energy

According to the master thesis study ”Ett mikroklimats påverkan på en byggnads energianvändning” (KTH 2012) by Térčse Kuldkepp where the climate is simulated through digital models, a greenhouse effectively reduces the energy for heating, up to 30%, but it also increases the need for cooling. In her report the total energy reduction is á 10% for a newly built house.

In a similar digital study based on Sundby naturhus (Energimodellering av naturhus,-en studie av Sundby naturhus), by Olof Persson and Patrick Wennerstål, the result shows that the house saves 32,9% of energy for heating. They stress the importance of sufficient ventilation to prevent over-heating, but does not present how or if that affects the final energy balance.

Both reports show on a 30% reduction of energy for heating which is promising. These reports are based on digital models of smaller houses which makes it hard to say what the effects on a larger building, like Spout Living, would be. Still they help to give a hint of how the energy consumption is affected.



Naturehouse as Apartment Building

A Naturehouse requires commitment from its residents. Bengt Warne says in his book ”På akacians villkor” that he saw the Naturehouse as a child who needed care during the time he lived there. Compared to ordinary housing there are more components to take care of in a Naturehouse considering all passive and automatic cycles that shall be functioning. In this aspect, it can become a problem when the Naturehouse concept is applied on an apartment building with groups of people. It is important that the residents can agree and cooperate to some degree. Can you trust that your neighbor does not pour chemicals into the toilet or wash toxic clothing which later end up in your own food harvested from common cultivation beds? Who actually take care of all gardening work?

From an economic perspective there are also som questions comming into mind but the most critical might be; what developer would prioritize reducing salable livingarea in favour for cultivation beds that purify greywater.

Co-Living

A co-living means in this case that the residents belong to a specific target group where many basic values regarding accommodation will be shared. It facilitates the management and administration of the housing and I think that a collective form of housing is almost a prerequisite for operating an apartment building as a Naturehouse.

According to the target group analysis, the residents will probably not be so interested in cleaning and carry out everyday activities in general, apart from cooking. If this concerns growing crops has not been mentioned in the report. My belief is that most people like gardening and nature in general and are most likely willing to sacrifice a little lap-top time to make an effort once in a while in the greenhose. In this case the cultivations also contributes to the social life in the building since it offers a natural way of meeting other people. However, the chef, also employed as a coordinator and chief gardener, is the one in charge for organizing the gardening work.

Economical Benefits

I think combining the Naturehouse concept with a co-living answers to several questions both in terms of management, but also regarding economy. Except for farming, the cheaper square meters created by the greenhouse structure are also advantageous to use as social- and work spaces, which enables a rich social life for reasonable costs. The greenhouse square meters are available all year around but the purpose may shift depending on season. For example, the gym is perfect using in autumn and spring, probably even parts of winter, but during hot summers it probably becomes too hot for physical activities. Instead it might be suitable for cultivating tomatoes instead and the residents could go to an outdoor gym nearby instead?

In this regard and context, the greenhouse area could be seen as an economical benefit rather than left out salable livingarea. It depends of course on who built the housing and who owns it. If the project would be realized the Sprout Living residents would probably have great involvement in both design and building process. When finnished they would either buy or rent the building, which means that the builder would be ensured that he/she would get payed when the housing is completed, even though not as much as if the greenhouse was replaced by insulated area? Still it might be an attractive project for a builder since it would be great marketing and therefor easier to get land from the municipality.

Though, I think that the best option for this type of housing concept to be implemented is that the residents build it themselves (byggemenskap). Then the economical benefits from building less insulated area in favour for greenhouse area would be obvious.

Division

The split in the program between ”Long- term residents” and ”Guests”, which is requested in the program from Tech Farm, has affected the composition of the building in my project, Sprout Living, and has during and after the project raised some questions. Both in terms of social and professional exchanges between the groups and what effects it might have on the atmosphere in the building, but also the impact it might have on the flexibility of the building if the demand from one group increases (i.e l-t residents) and the other group decreases in demand (i.e. guests), or vice versa. How does the layout of the house cope with these changes?

The choice I made to both emphasize the division through a free space in the shape of the ”Stem” between the two resident groups, has partly been a result of the design decision to incorporate greenhouse charachter to all levels, but also an active choice to separate the two groups since I can relate and sympathize with the desire to have a smaller and safer part, within the larger whole, for those who are permanently living in Sprout Living (l-t residents).

The disadvantage of this division is that the concept possibly gets weakened if, for example, the demand for l-t residents goes down and it simultaneously goes up for guests, and one is forced

to house guests in the l-t residents part to fill vacancys. A solution to this is that if such a situation occurs, there is a possibility to rent out floors to businesses instead. The floor height (2750mm) allows it and there are accessible toilets in each entrance hall. There is already a large-neutral entrance situation in the centre and a lunch restaurant in the entrance floor. In this scenario the division between the residents is maintained and the new businesses and activities could actually contribute with valuable contacts and input to the community.

Sustainability

The social and economical parameters, as discussed above, together with the ecologically sustainable parameters which is implemented, such as local and ecological food production, electricity production, a renewable material like wood as main construction and building material, reuse and purification of all grey water from residents etc, I think Sprout Living is a sustainable building in all aspects.

Sprout Living shows an example of how cities and housing can become more resilient in the future by reducing the need for transportation and outsourced energy production. This housing form would also work as an inspiration and educator of a sustainable living for its residents. It sets demands of their every day habits, and demonstrates various precious natural cycles, that can otherwise be mystified and forgotten in an urban context.

Revival of Early 20th Century Collective Housing?

Sprout Living is a development of the co-living concept, which in turn is a variation of the co-housing form that has existed in theory and practice for a very long time. The wishes of the target group has resulted in a building that is a kind of a hybrid between:

1. Swedish co-housing from the first part of the 20th century. For example, John Ericssonsgatan 6, where the actual housing form was primarily a solution to coordinate and streamline the house work from an economic perspective.
2. The latter ”Bo i gemneskap” (BiG) based co-housing that arrived in the 1970s and had more focus on the community and social aspects.

I think that the return to the earlier part of the collective housing of the 20th century, is based on the fact that the target group, –young entrepreneurs, is relatively new to this form of housing and comes from a different background where household services are more accepted? The residents culture of the BiG-model form of co-housing is partially grown out of the political climate of 1968, which probably has characterized those collectives in design and content. It is clear how the co-housing form now attracts other people, such as young entrepreneurs, and also mixed elderly people into senior housing for instance, which is another relating housing form. Could it be the longing for a community in reaction to a more and more individualized society, due to among others, the digitalization of social networks and increasing single housing, that is the cause of the raising interest in co-housing?

Grip, E, Sillén, I, Gemenskap och samarbete: att bygga och bo i kollektivhus, Stockholm: Sabo, 2007

Gromark, Sten, Boendegemenskap: en kritisk granskning av boendegemenskap som samhällsangelägenhet, av dess värden, Göteborg: Avd. för byggnadsplanering, Chalmers tekn. högsk., 1983

Caldenby, C, Walldén, Å, Kollektivhuset Stacken, Göteborg: Bokförlaget Korpen, 1984

Caldenby, C, Walldén, Å, Kollektivhus –Sovjet och Sverige omkring 1930, Byggnadsforskningsrådet, Stockholm, 1979

Warne, B, Fredriksson, M, På akacians villkor –Att bygga och bo i samklang med naturen, Warne, Partille, 1993

Bainbridge, D, Passive Solar Architecture – heating, cooling, ventilation, daylighting, and more using natural flows, Green Publishing, Chelsea, 2011

Arild, H, Tillväxthus, Arkitektur, 2, 2016, p. 42-49

Archer, D-E, Sol-el, Åter –forum för självförsörjning och alternativt boende på landsbygden, 2016, 1, p. 8-11

Archer, D-E, Utvärdering av system för BDT-vattenrening med avseende på resurseffektiva städer och hållbar urban livsstil inom EVAA-projektet och H+ området -Helsingborg, 2012

Linde, B, Granefelt, L, Rätt ur jorden –handbok i självhushållning, Ordfron Förlag, 2014

Ålund, H, Naturhus –bostad med mellanrum, LTH, Lund, 2015

Persson, O, Wennerstål, P, Energimodellering av naturhus,-en studie av Sundby naturhus, LTH, Lund, 2015

Kuldkepp, T, Ett mikroklimats påverkan på en byggnads energianvändning, KTH, Stockholm, 2012

The Guardian, Co-living – the companies reinventing the idea of roommates, (2016-03-20).
http://www.theguardian.com/business/2016/mar/20/co-living-companies-reinventing-roommates-open-door-common-

The Time, Inside the NYC Building That Offers Nirvana for Millennials, (2016-04-04).
http://time.com/4280233/welive-new-york-city/

Dagens Nyheter, De bor på arbetsplatsen, (2013-01-17).
http://www.dn.se/ekonomi/jobb-karriar/de-bor-pa-arbetsplatsen/