TAMPERE UNIVERSITY OF TECHNOLOGY

TOWARDS A SUSTAINABLE SKANSSI

SUSTAINABLE DESIGN STUDIO
2013

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SUSTAINABLE DESIGN STUDIO
2013

Tampere University of Technology

School of Architecture

Department of Civil Engineering

Faculty of Business and Industry

Tampere 2014

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Juan Del Barrio Batista (ed.)

Towards a sustainable Skanssi

Sustainable Design Studio 2013

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Mikko Laak

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TAMPERE UNIVERSITY OF TECHNOLOGY

TURKU

Contents

Towards a sustainable Skanssi - Preface

The new city district of Skanssi is a real opportunity for Turku. The new development reaching from the Helsinki-Turku motorway towards the University campus of Kupittaa will fix a void in the urban fabric of Turku. Developments on lots of the size of Skanssi in close proximity to the city centre are quite rare. Especially the plans to develop a new residential district with the means of sustainable design offers a great opporunity.

The Sustainable Design Studio held at Tampere Universtiy of Technology took the chance to be part of developing the new Skanssi and the students started working on the case in autumn 2013. Twenty students started the process with a thorow anaylis on site realised during a workshop in cooperation with the city of Turku. One major question consisted in the scale of the new development: How can a dense and high-quality urban structure foster the sustainability and vitality of the city?

As a result of the design studio the students produced many interesting proposals. The work was realised in two stages: First students worked in groups to conduct the analysis and design masterplans for the whole Skanssi-area. Later, each student chose an individual topic from the group plans to examine and design the topic of individual interest. Central aspects during the group work were the possibility to develop a sustainable district with a human scale respecting the closeness of nature. Many of the masterplans proposed could be even densified or the efficiency of the buildings provided could be increased without having to make cuts in qualitative factors. The outcomes of the second, individual phase provide for example new models for schools or urban farming. An interesting addition to the course works was provided by the green roof and storm water management analysis, which shows very effectively the impact of built structures as buildings and roofs and sealed surfaces on the ground on the local stormwater managament.

I would like to thank the city of Turku and the City of Turku´s *Turku Urban Research Programme* for the rich cooperation in which the University of Turku and its chinese guests took a big share. I hope that the results of this course and this collaboration will give the City of Turku and its partners new insights and ideas for developing a sustainable Skanssi!

Tampere, 10.02.2014
Harry Edelman
Professor, architect
Tampere University of Technology, School of Architecture, Department of Civil Engineering

A major goal of developing the new Skanssi district consists in the objectives of smart and sustainable (sub)urban development. Designing a coherent and sustainable district is a challenging task. The process has so far involved research and cooperation with different partners and new models of operating have been developed. At the same time new influences and ideas have been gathered in order to guide the development of Turku as a whole. This publication compiled by TUT is one part of this interdisciplinary and holistic process, and it will surely influence the future plans and processes.

It has been an interesting journey to follow the progress of the works from the first ideas until the final publication. The students´ impressions and viewpoints have already in their working process influenced the actual development process of the area and parts of these will be utilised in the future planning process. I would like to thank Prof. Harry Edelman´s team for their activity and the students for their open-mindedness and their excitement in this work.

Turku, 16.02.2014
Oscu Uurasmaa
city planner
City of Turku, Environmental Division, Urban Planning

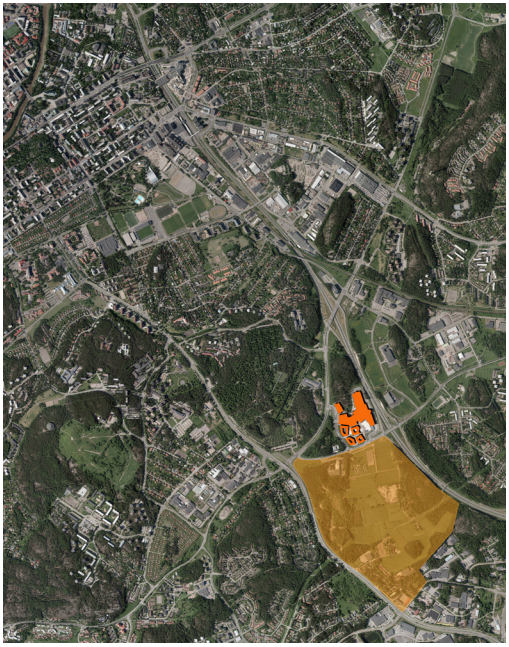
Introduction

The publication at hand is the result of the Sustainable Design Studio organised during autumn 2013 at the School of Architecture at Tampere University of Technology. This publication focuses on the design and development of the new Skanssi area from the perspective of sustainable design. The student works selected for this publication were submitted as final submissions of the Sustainable Design Studio which was organised for the first time at TUT. The majority of the course´s students were fifth year students who complete their studies in the international Master´s programme in Architecture. In total 20 students started the working process with an analysis of the planning area on site which was conducted during a workshop and an excursion realised in cooperation with the City of Turku at the beginning of the course. In Turku the students explored the planning site itself, the neighbouring city districts and Turku in a broader context. In the workshop in Turku first impressions were catalysed and the intensive project work began. The final critique of the course and the submission of the final course works took place in December 2013. In addition to Prof. Harry Edelman the teaching team consisted of TUT´s researchers Malgorzata Joachimiak, Mikko Laak and Nathan Siter.

For this publication six *analyses* and *structure & master plan* suggestions, which were realised as group works, have been gathered. Furthermore the individual works of 12 students are visible in this publication. The works of the *analysis* and *structure & masterplan* –phase are divided thematically as follows: *Nature & green spaces*, *Infrastructure* and *Human-centric & community-based design*. The individual works focus on the following aspects in a broader sense: *Ecological solutions*, *Community-based & interactive design*, *Urban & public space* and *Flexible typologies*. In addition to that, Steven Collins, student at the University of Helsinki, conducted a study on *Greenroof storm water management* which utilized some of the groups´ master plan suggestions. Finally Kaisa Härkönen's diploma thesis *Lyhtyniittu* (lantern meadow) examines the environmental and landscape management and the spaces between the buildings for future Skanssi.

We would like to thank the students for their course works and the City of Turku for the good cooperation, for the support of the course and its implementation.

Towards a sustainable Skanssi!



The planning area in the urban fabric of Turku

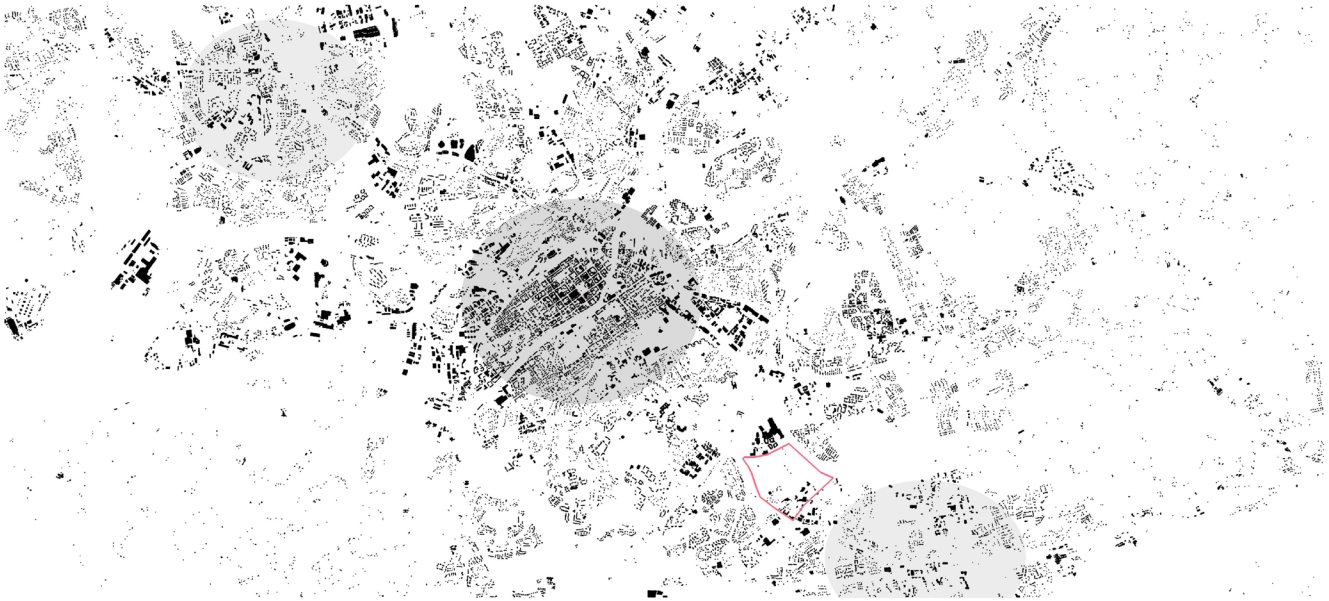
Analysis

SILMU

Gao Xianghe
Szymon Galecki
Kaisa Härkönen

Skanssi is an area 3 kilometers away from Turku city center, located between two roads, road 110 and highway. Skanssi is a fringe between urban and rural zones. There is currently a mall with services and extensive variation of landscape zones.

The current Skanssi is a space which is overrun by nature with several detached dwellings. The landscape is diverse and consists of forested hills which embrace meadow and wetland areas. To the north there is a large shopping mall, and the other edges are surrounded by low density residential pockets.



granulation of central Turku

planning area

planning area

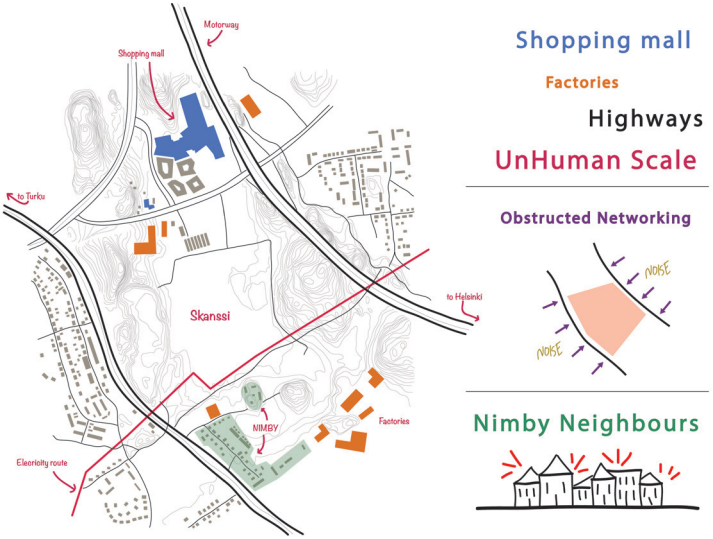
surface / soil types in the planning area

GREEN FINGERS

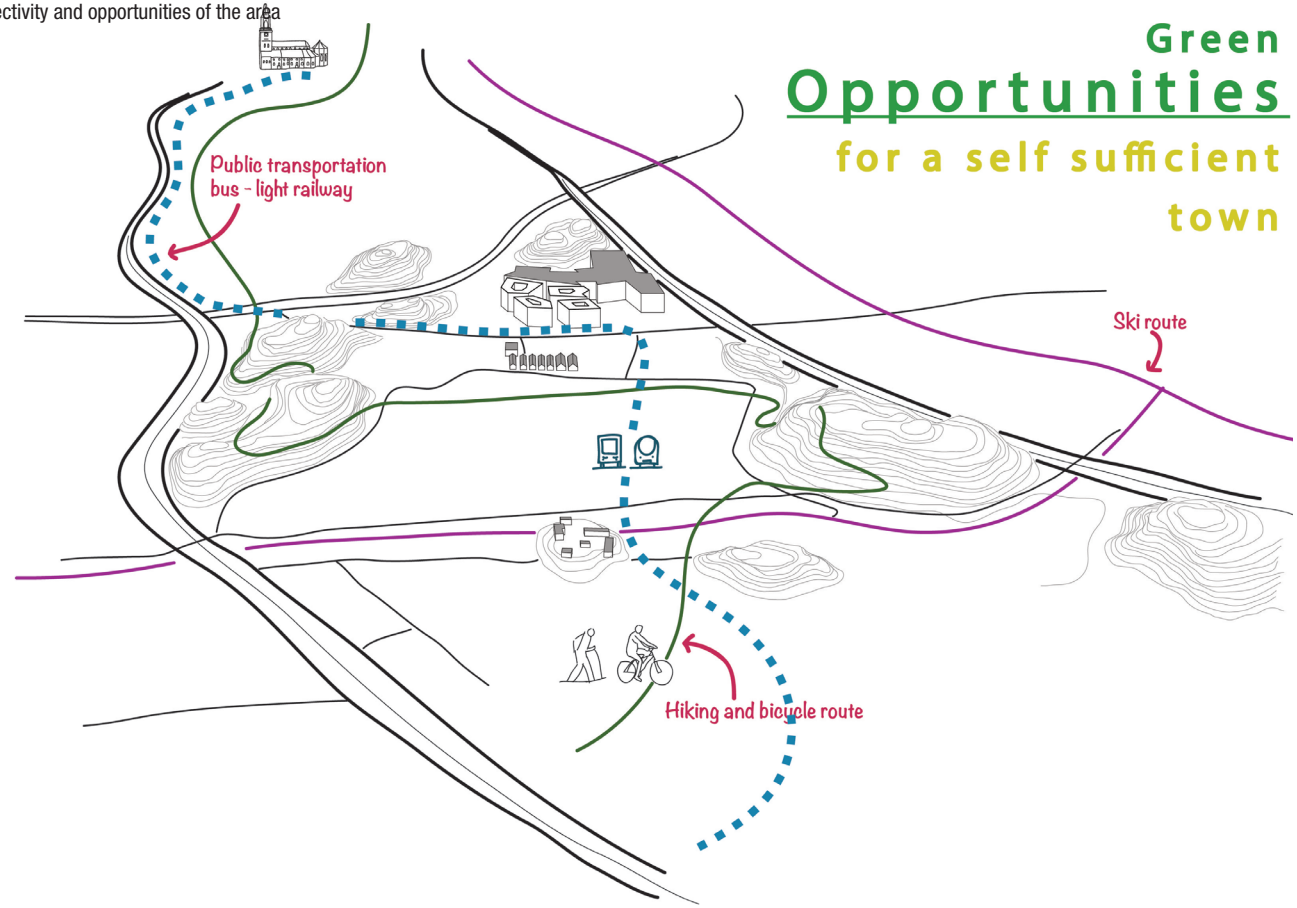
Mattia Di Bennardo
Raul Reunanen
Sung-Bok Song

regional analysis

analysis of the planning area



connectivity and opportunities of the area

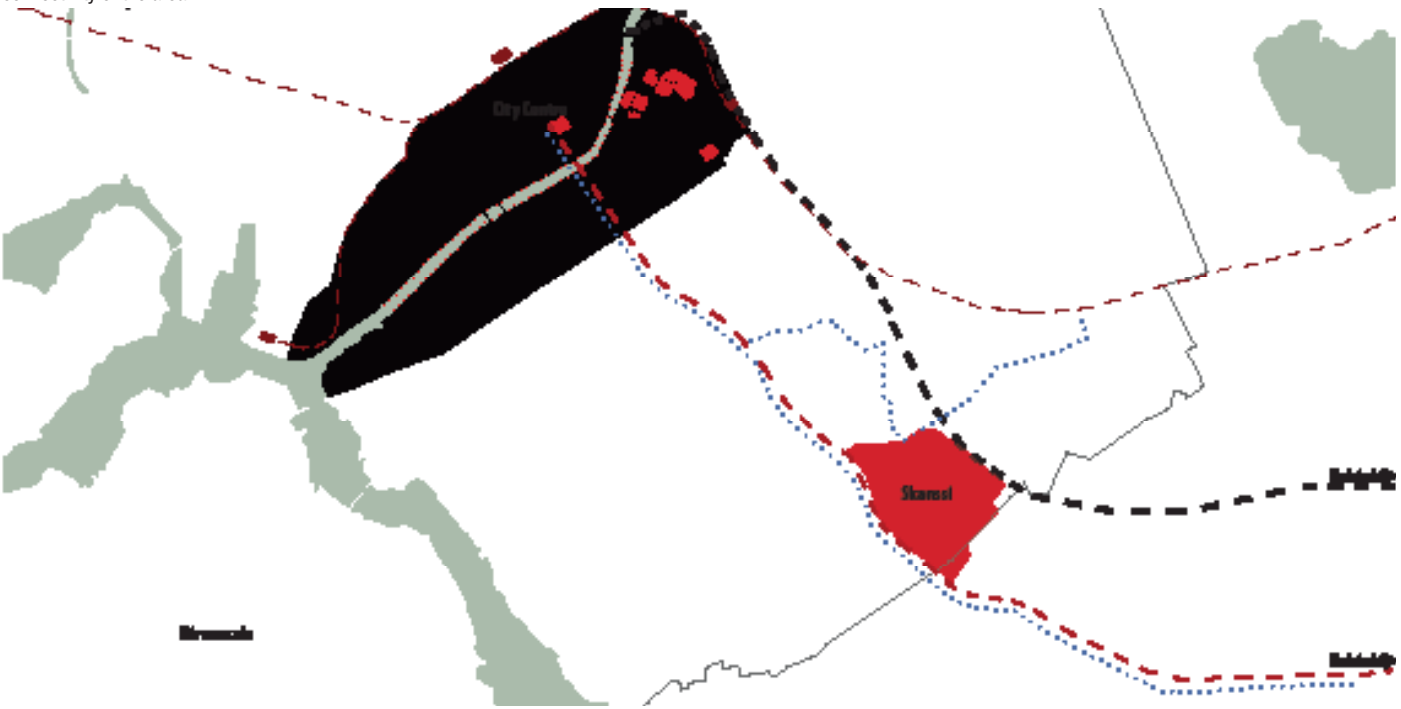


SOCIAL HUBS

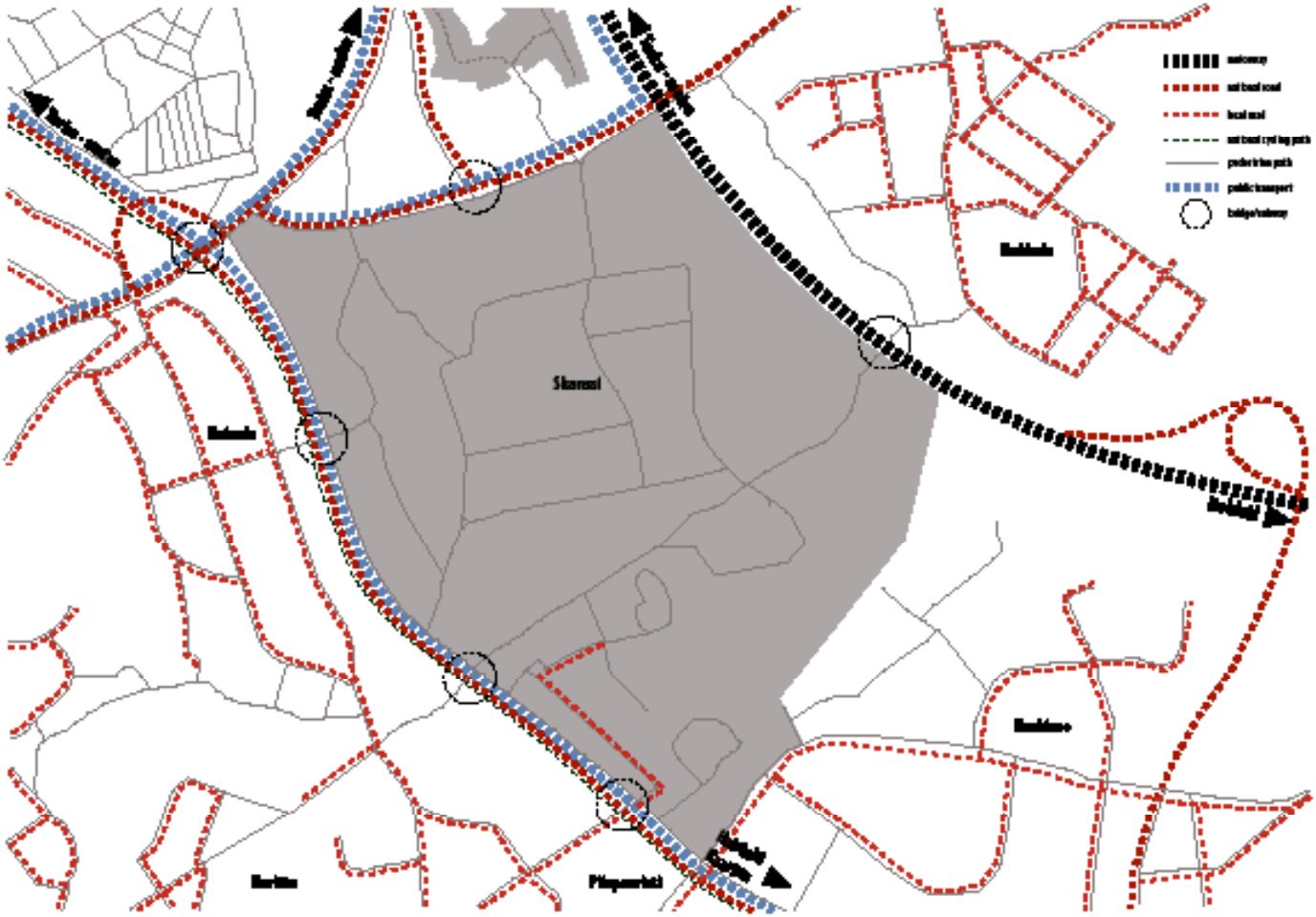
Aleksandra Zarek
Mariana Costa
Nguyen Minh Chau

Skanssi is a void in the urban fabric of Turku. The area is constrained by rigid borders (highway, national roads) but at the same time the connectivity of the zone is of high quality. The area is mainly an open field with occasional forests and minor topographic changes. The Skanssi shopping mall with a number of interconnected public spaces is an important functional feature of the site.

connectivity of the area



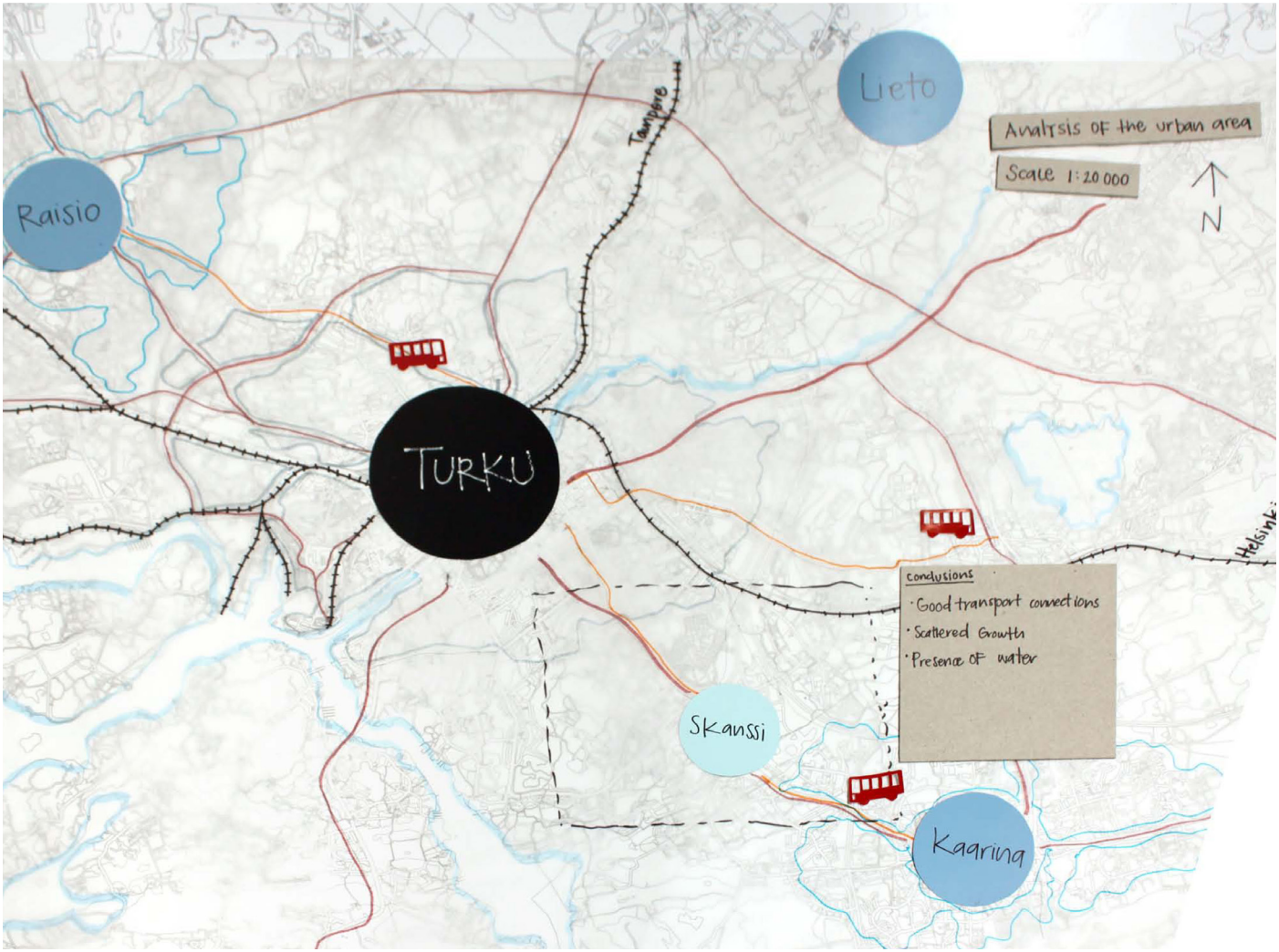
connectivity of the planning area



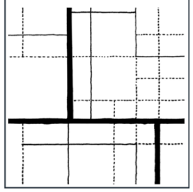
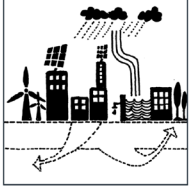
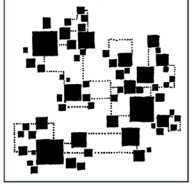
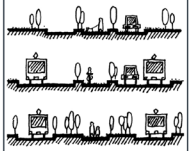
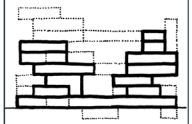
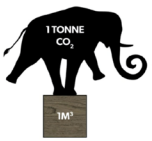
LEGO SKANSSI

Nao Iwasaki
Amanda Reyes
Natalia Rincón
Zihan Zhao

regional connectivity of the area



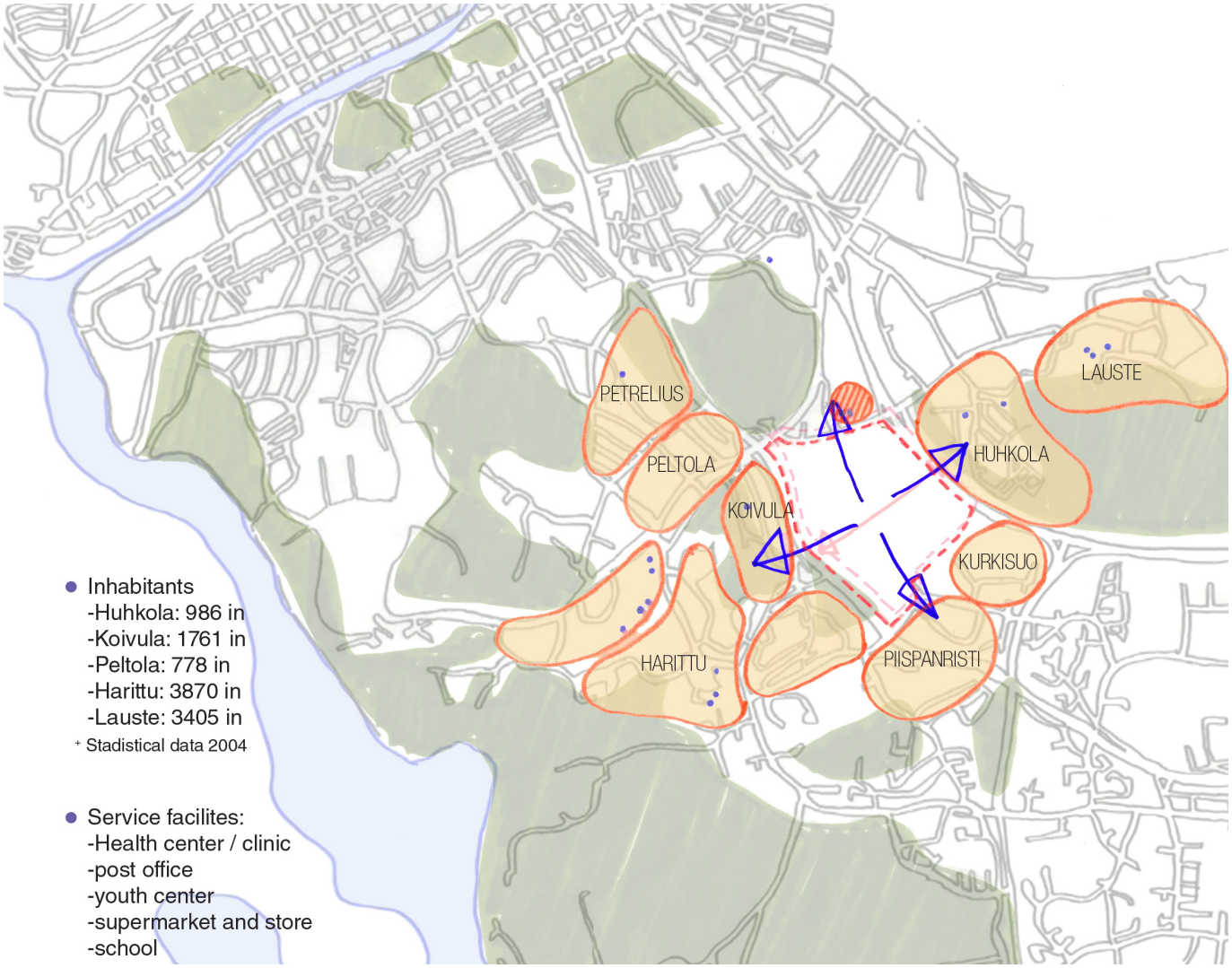
Smart city -operations model, analysis

	GOVERNANCE	ENVIRONMENT	SMART ECONOMY	MOBILITY	LIVING + WORK	PEOPLE + IT
						
INDICATORS	Enabling supply and demand model ICT oriented	Green Buildings Green Energy Green Urban Planning Limit Gas Emissions	Productivity Local and global connections Entrepeneurship	Mixed-modal access Prioritized clean and non-motorized options	Culturally vibrant and happy Safe Healthy	Inclusive society Embrace creativity 21st Century Education
FACTS	Skanssi area has had several proposals for urban projects that haven't been realized. A project to control water usage has been done in the area, however it hasn't been used as planned. It's difficult to populate an area with 8,000 people and still have a crossgenerational approach.	Trucks and Bins use 100kWh/waste ton Heating generates more CO2 than cooling Floods, lowering ground-water level, soil consolidation, erosion, collapsing slopes, harm for recreational use	**CO_2 EMISSIONS** **47% BUILDINGS** **33% TRANSPORTATION** **19% INDUSTRY**		Housing is getting more expensive. Work is shifting to the home place.	In 1960 45% of the population in Finland was living in nuclear families. In 2011 41% of the population was living alone. No sense of community. Technology is changing life patterns.
			Material waste Non environment friendly materials	Car has more hierarchy than a pedestrian A car remains parked 90% of the time in average "Big Box" effect in cities The city looses its scale	**URBANIZATION** **75% 2040** **50% TODAY**	
SOLUTIONS	Building in stages follows the supply-demand model and thus, allows diversity of people.	Automatic Solid Waste Collection Smart Grid Two way electricity network Supporting ICT functionality (Measurement, Control) Storm Water control	Choose standard measurements that will cut down construction waste Choosing wood industry allows local suppliers to grow economically, generating more jobs.	Transformable streets that would allow different kinds of technologies to take place.	Mixed uses Basic module system provides flexibility and produces low impact	Crossgenerational approach

SYNERGETIC SKANSSI

Juan Del Barrio Batista
Lisa Voigtländer
Shiu Yu Yeung

surrounding city districts of Skanssi

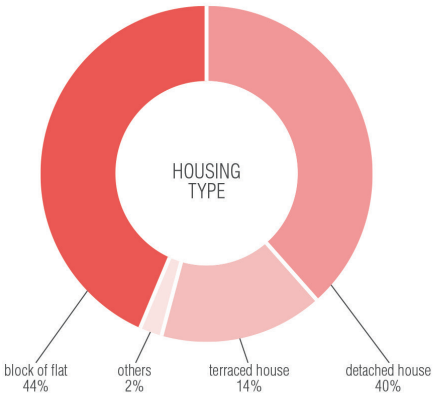


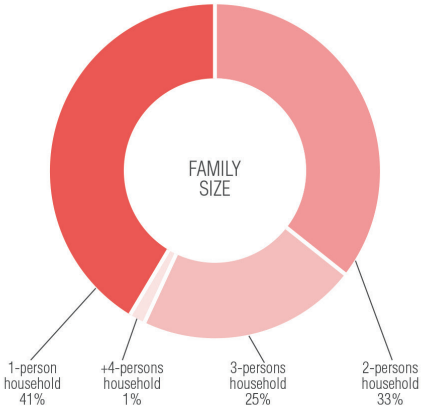
- Inhabitants
  -Huhkola: 986 in
  -Koivula: 1761 in
  -Peltola: 778 in
  -Harittu: 3870 in
  -Lauste: 3405 in

  + Stadistical data 2004

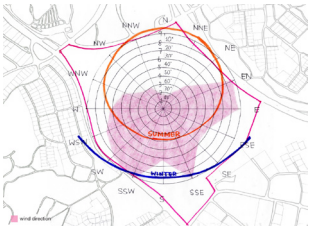
- Service facilites:
  -Health center / clinic
  -post office
  -youth center
  -supermarket and store
  -school

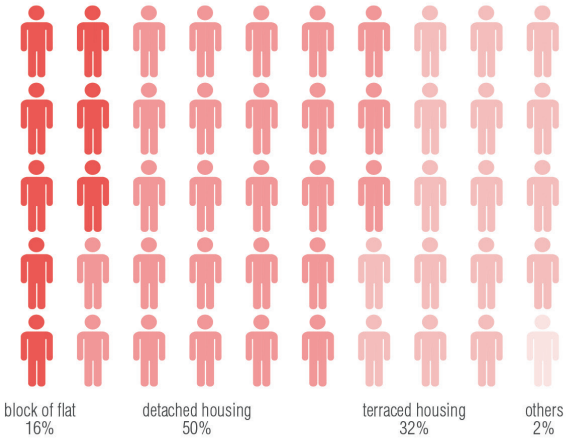
inhabitant-profiles - floor areas





role of Skanssi in the Turku context
environmental analysis

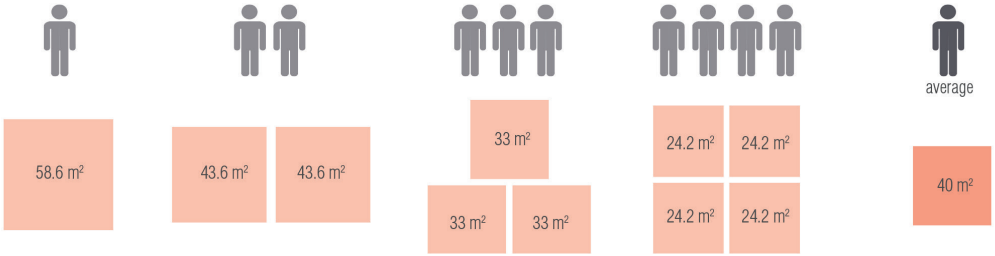




1 or 2-persons household
⇢ blocks of flats / terraced houses

3-persons household or more
⇢ detached houses

FLOOR AREA PER PERSON BY SIZE OF HOUSEHOLD
in Finland in 2010



Structure & Masterplan

SILMU

Gao Xianghe
Szymon Galecki
Kaisa Härkönen

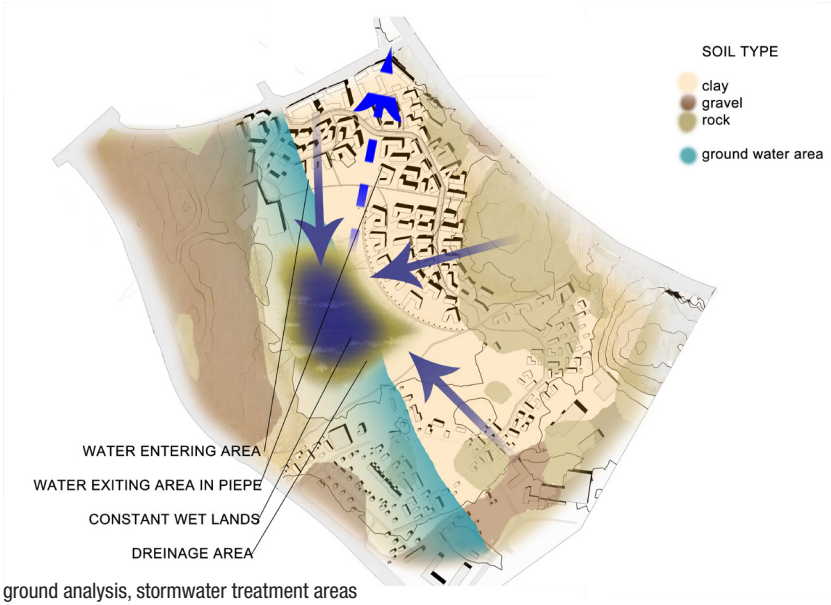
Good quality soil is needed as a solid foundation for constructing the residential buildings. In addition to that, the building sites have to provide sufficient sunshine. These qualities are located along the northern zone to the east, ending in the south. The existing residential buildings are to be retained and knitted into the new structure. A conclusion reached through extensive analysis is that the factory in the north-west corner should be demolished as it will not be sustainable.

A residential area of a network of blocks with the full range of social services will be built. These include a community kindergarten, a school, small shops, home offices and outdoor activities. The structure of the area represents a gradient between urban and rural character. Heights of the buildings are optimal according to their placement on the site. The tallest buildings are located to the edge so as not to overshadow others. Through the tools a holistic building solution which is sensitive to the landscape and surrounding nature is developed.

Skanssi is designed as a self-sustaining residential area, inclusive of work, free time and dwellings. This reduces the need for travel and results in a stronger sense of community. Three primary entries to Skanssi are accessible via tram, vehicle and bikes. Another two entries are accessible via foot. A tram stop in the center of the residential area connects Skanssi with the greater Turku area. Traditional streets with vehicle access are kept to a minimum. Pedestrians are placed in the highest priority.

The storm water management system will incorporate reuse of collected water within the self-sustaining area of Skanssi. Currently circulatory pumping is needed in parts of the catchment area. The design allows for release of the pumped water to the central waterway, the pond. This will ensure enough water in the pond throughout the year. The quality of storm water is maintained through the small infiltration areas in proximity of the vehicular streets, which will is an efficient filtration management technique.

community-life in Skanssi



ground analysis, stormwater treatment areas

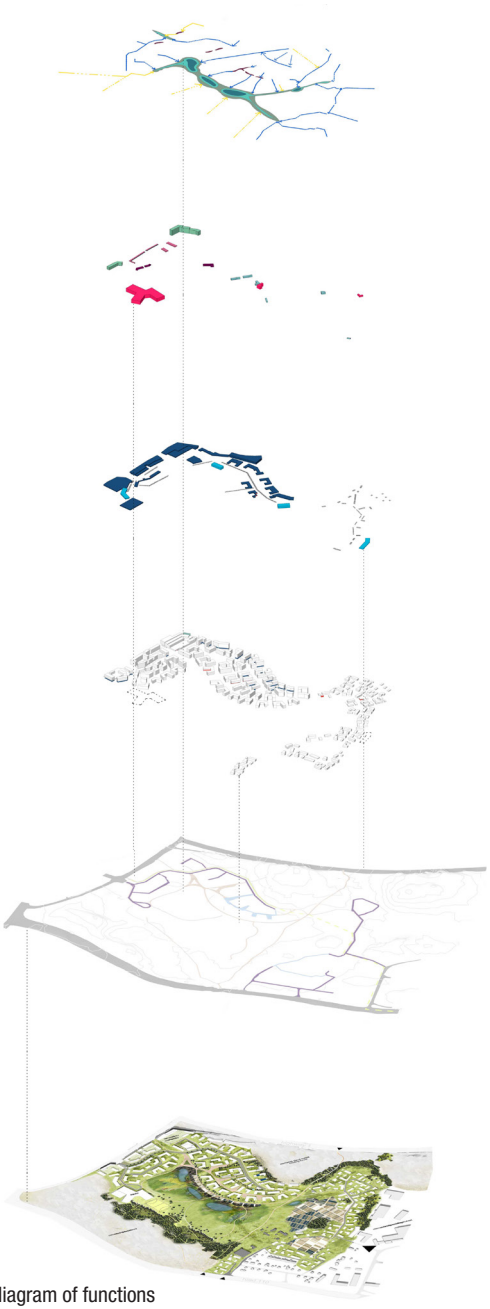
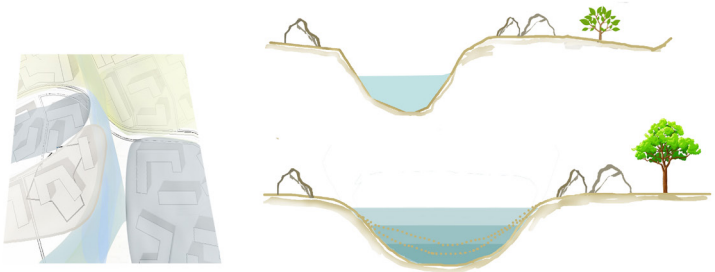
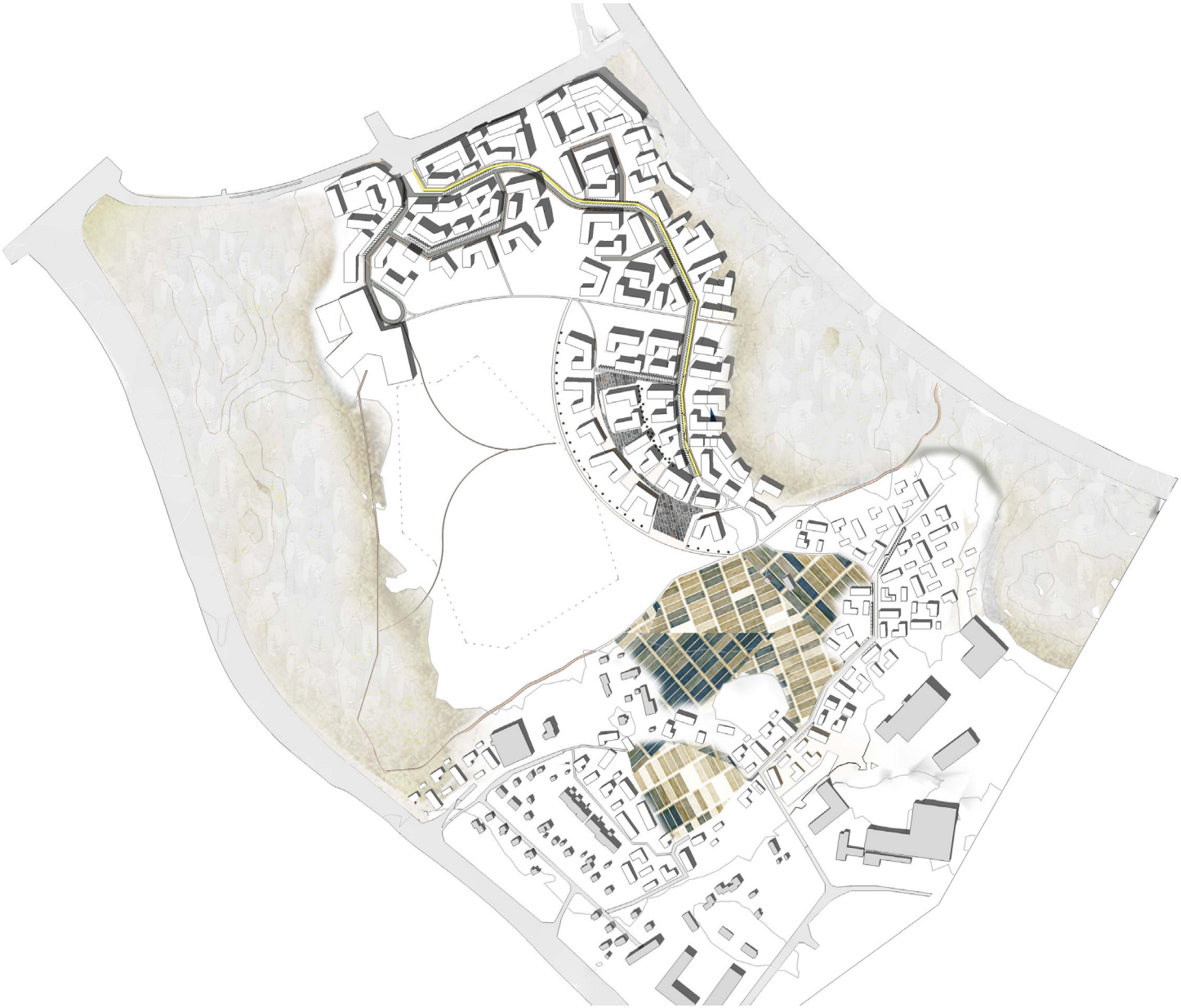


diagram of functions

public outdoor spaces



collection of stormwater



masterplan

GREEN FINGERS

Mattia Di Bennardo
Raul Johannes Reunanen
Sung-Bok Song

The block plan provided in this project is derived from the human desire to be surrounded by nature. Rather than providing artificial and privatised green areas, this proposal seeks to facilitate the inhabitants´ access to real nature. In order to bridge the gap between nature and productivity-oriented agricultural spaces this project aims to combine the values of living in an natural environment with engaging into the production of agricultural goods. Food to supply the inhabitants can be partly produced in the Skanssi area. Enaging the local society in production or at least rising awareness for locally produced food on site will provide a step towards sustainability. In addition to that a local sense of community among the inhabitants will be created.

The design concept focuses on environmental management. The existing nature is preserved as much as possible. The building typologies created will include different modes of farming and facilitate the incorporation of farming in the urban environment. The community farm and garden, the roof gardens, private gardens and green houses will be accesible for every inhabitant. The farming facilities will be coordinated and operated by volunteers and the central farming and community organisation *Green Generator*.

concept chart

masterplan

granulation

athmosphere

masterplan

GREEN HEART

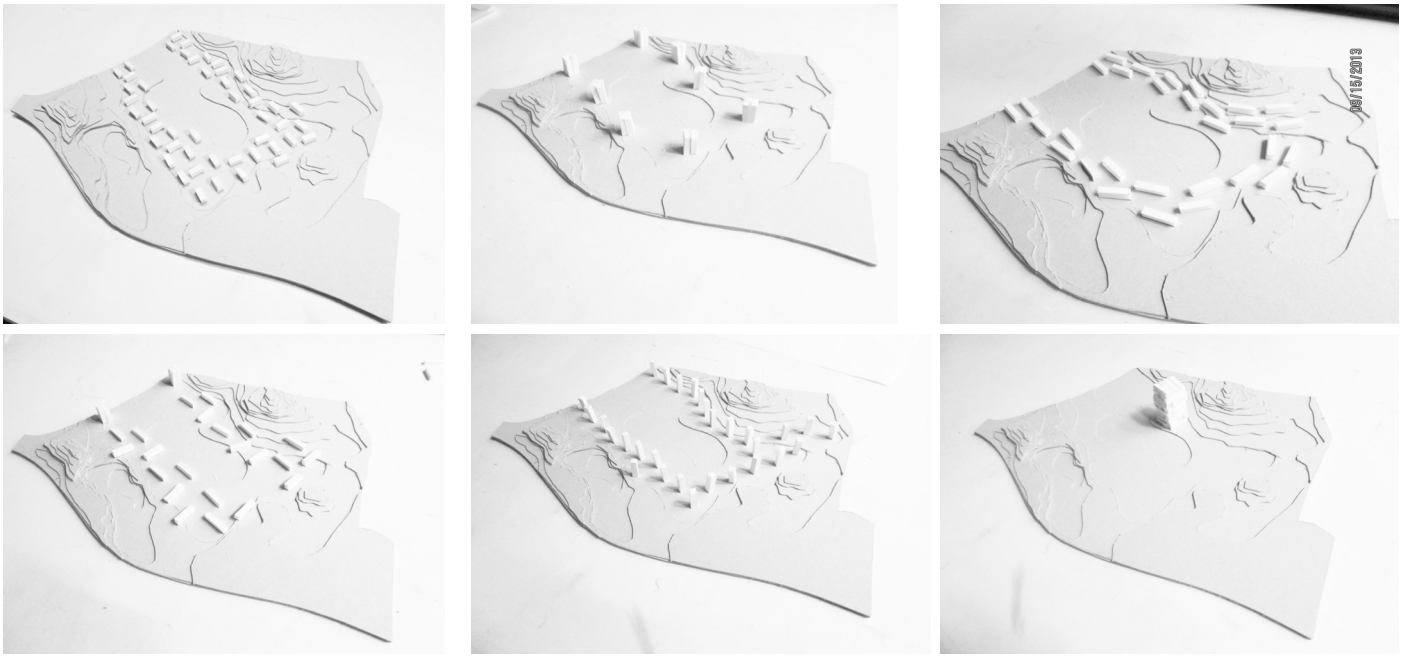
Franz Remigius Nescher
María Teresa Bustamante Morales
Zimo Zhao

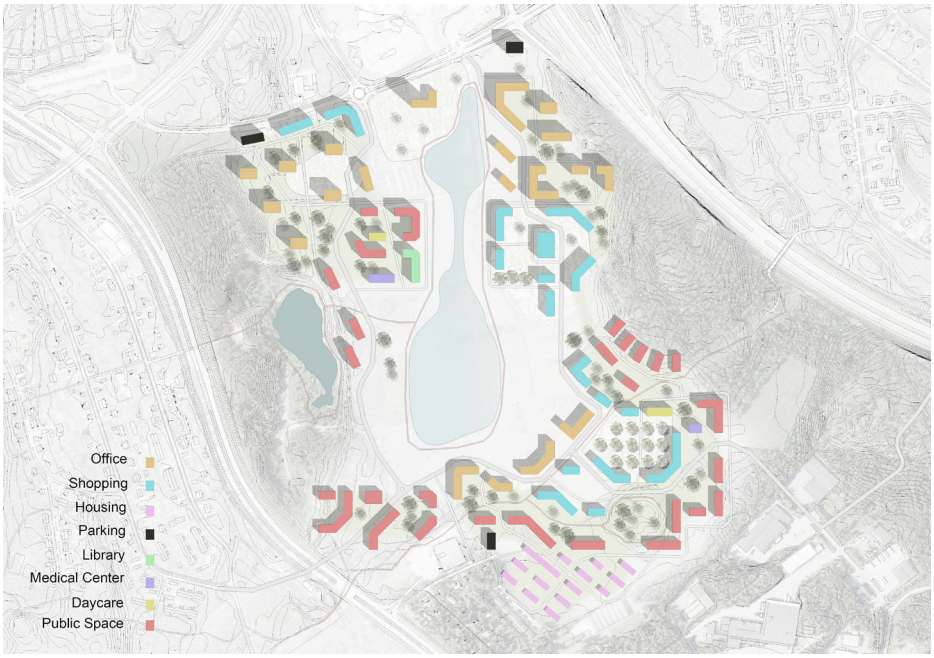
The design concept proposed in this project is derived from the idea, to create a loop along the forest areas on both sides of the site. The central landscape formed by the loop and the new developments is called green heart and is the main focus of the site. The buildings face two directions allowing every resident two views, one to the central landscape and the other to the existing forests.

The loop is the main access, for public and private transportation. A diverse network of pedestrian and cycling paths connect all important facilities on site and also the surrounding neighborhoods. The new tram line connects Skanssi with the city center and in the future Kaarina Center. The main goal for traffic control is the reduction of private transportation methods such as the cars. Hence the use of alternative methods or public transportation is encouraged. Cars are permitted to drive on the loop and certain roads. Further the parking spaces were reduced to a minimum and were created on the entry points of the site. The *Kiss and Ride* system allows the residents to leave their car at a safe place and use public transportation instead.

The *Green Heart* is the center and main attraction of the site. It contains all outdoor activities and activates and attracts the residents but also people from all around Turku to enjoy the proximity to nature. The green heart does not just serve as a place for leisure and nature but has an important function in the fabric of the infrastructure of the site. It serves as a storm water detention basin and is the main part of the storm water management. In addition to that the lake serves as a place to relax and enjoy the landscape.

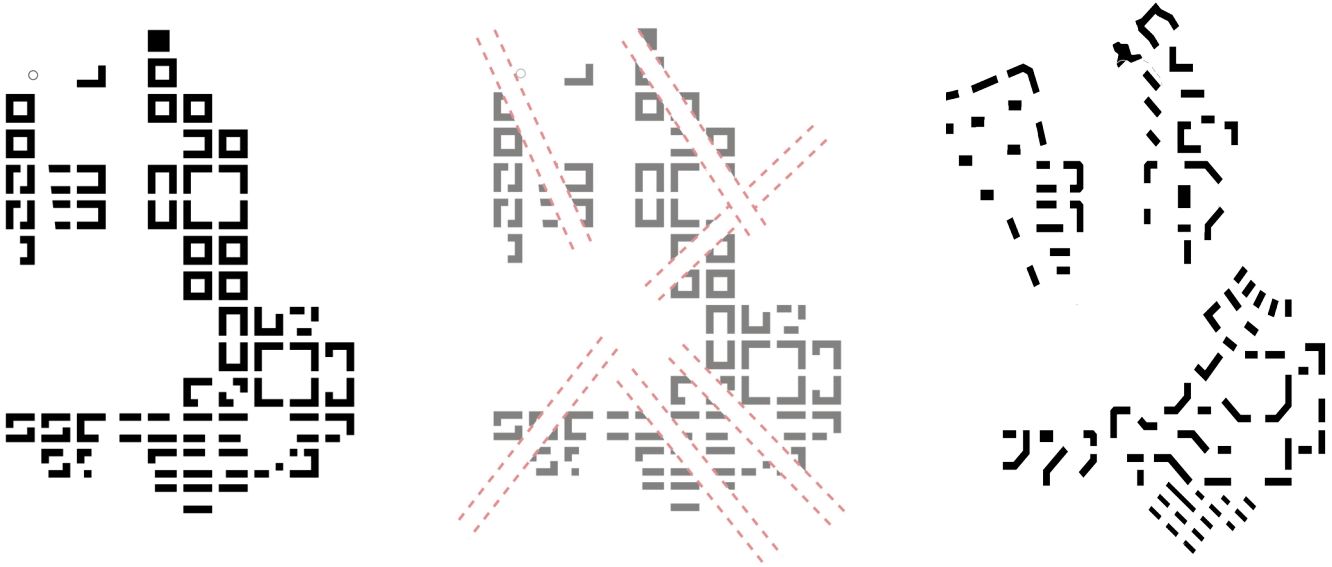
The structures are diverse and integrate into the individual locations they are set. The buildings are focused to the main loop. A higher density is in the south closer to the *Kiss and Ride* system and the existing infrastructure of the shopping center.





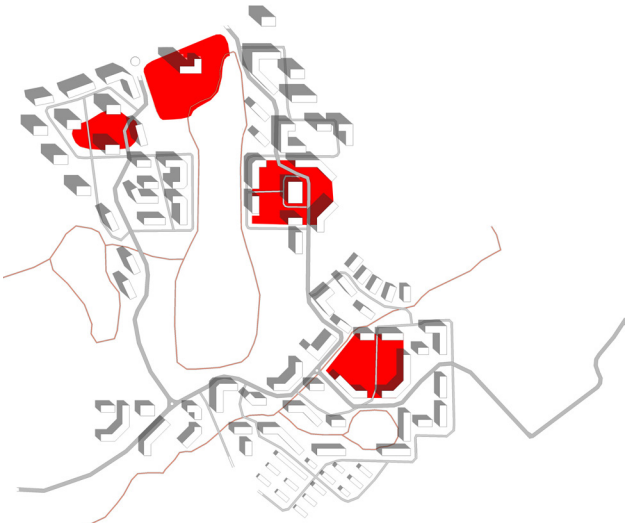
granulation analysis
functions

masterplan



fomation of final block structures

green areas

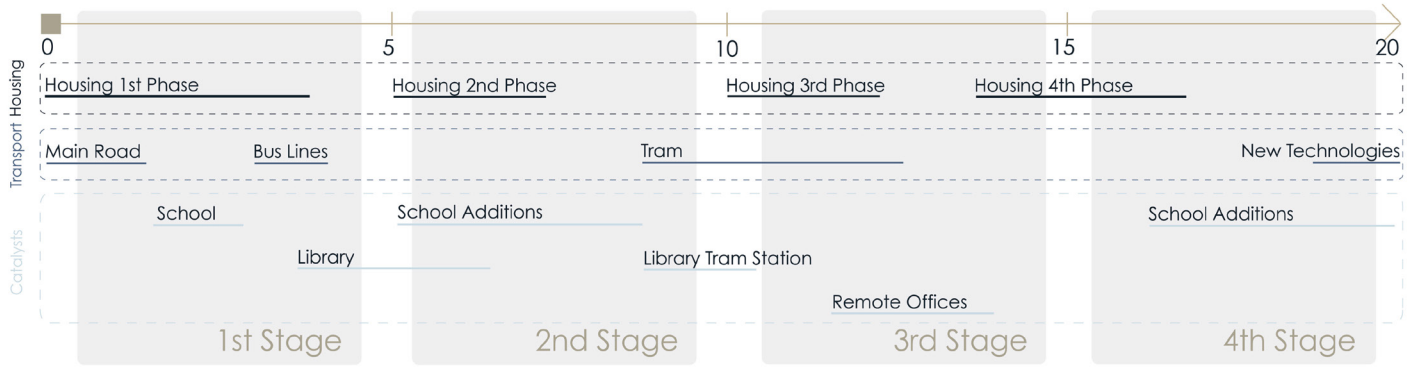


squares and plazas

LEGO SKANSSI

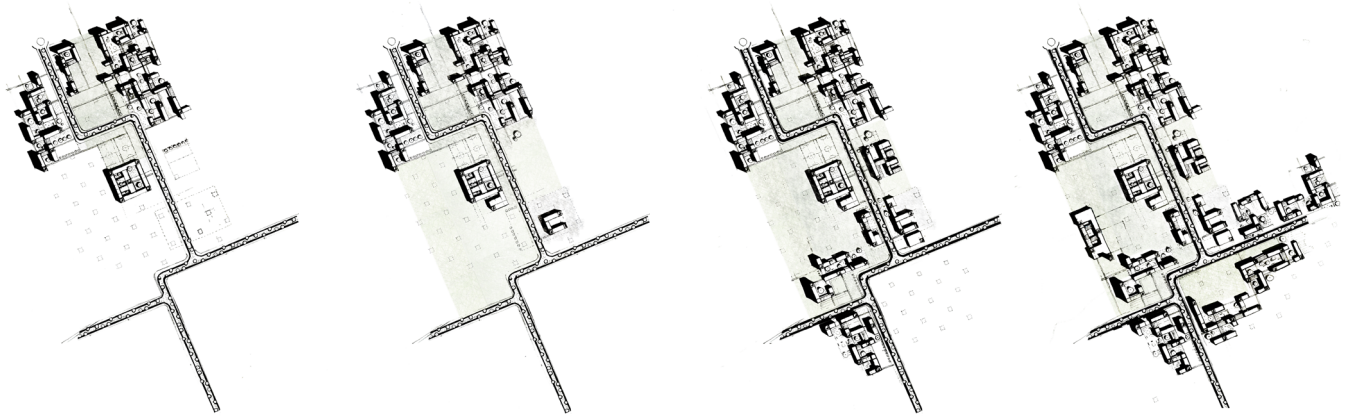
Nao Iwasaki
Amanda Reyes
Natalia Rincón
Zihan Zhao

The proposal seeks to provide a keen approach to the city's needs and the latest urban planning theories such as the smart city concept. This concept allows the urban area to grow in the different aspects that constitute a city such as: economy, design, people, technology and sustainability. The proposal includes a multi-agent cooperation to facilitate Skanssi´s growth as a smart city in the future. *The Lego Skanssi* –project offers a proactive solution to the changing needs to the built environment: Flexible modular buildings are presented easily adaptable to and a smart grid enables adaptable infrastructure.



different phases of development

phases of construction



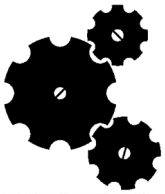
Main Road
Secondary Road
Tram Line
Hiking Route
Cycling Route

Housing + Commercial
Housing + Office
Housing
School Area
Portable Architecture
Cultivation Area

Electricity
Trash System
Storm Water

infrastructure and functions

land use



SYNERGETIC SKANSSI

Juan Del Barrio Batista
Lisa Voigtländer
Shiu Yu Yeung

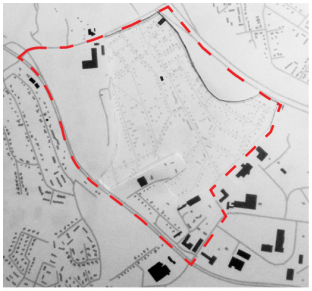
The sustainable urban development described in this project can be transported with the image of the gearwheel. This system symbolizes the interlocking and part taking of all different environmental levels as well as the aspects of sustainability. After carefully analysing the site to understand its character, values and difficulties, we formulated and organized our goals with the three main topics of sustainability: Quality of natural and build environment, social cohesion and economic vitality, which we want to achieve with our design.

Key aspects of the concept proposed in this project are

- quality of nature and built environment
- social cohesion
- economic vitality

This project aims to create a city district- own identification as part of whole Turku. Skanssi should complement Turku´s growth in the direction of Kaarina. Furthermore Skanssi can act as a nearby recreational area, where locals can enjoy the nature, agricultural landscape and the services provided.

Different housing typologies and solutions constructed out of local and renewable materials will provide an attractive living environment. A range of public, semi-public, semi-private and private spaces will create different spaces for the inhabitants needs. Local communities will be developed on different levels (levels-district-cluster-block-building) and spaces for participation will be created. Economic vitality will be ensured through mixed structures in the built environment.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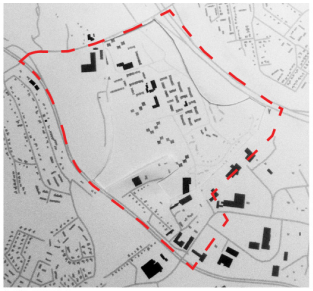
LAUSTE


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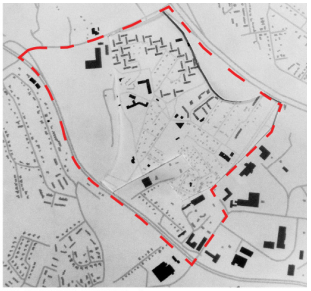
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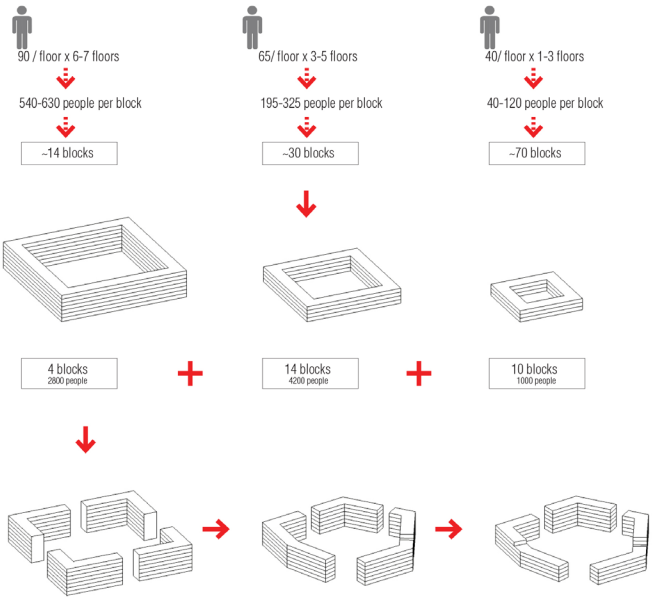
CENTER SOUTH


CENTER


TALLINN

granulation analysis



densification of the building blocks

1# FOREIGN FAMILY

→ NOW living in suburb
→ in the future, they will live in skanssi,,,,,,,
-near city center
-low-density housing
-their kebab shop on 1st floor
-they can combine the working and living spaces

2# STUDENT

→ NOW living in suburb with parents
→ in the future, he will live in skanssi,,,,,,,
-live alone in a 7-storeys height high-rise building
-live closer to his parents and university
-live closer to the shopping mall and the activities area

3# FINNISH FAMILY

→ NOW living in countryside
→ in the future, they will live in skanssi,,,,,,,
-live in 5-storeys heights mixed use housing
-live near to the bus stop
-live in a community

4# PATCHWORK FAMILY

→ NOW living in city center
→ in the future, they will live in skanssi,,,,,,,
-live in a mid-density housing
-live closer to the school
-live closer to the green and forest

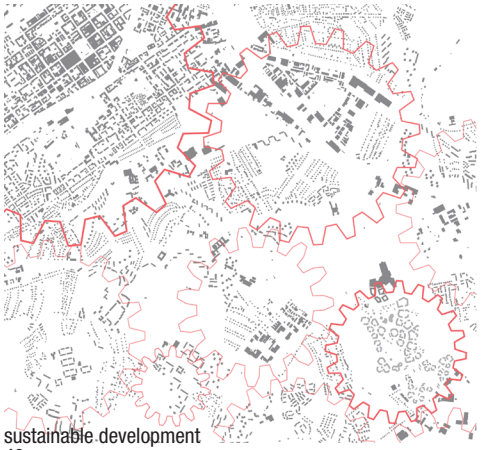
5# ELDERLY LADY

→ NOW living in city center
→ in the future, they will live in skanssi,,,,,,,
-live in a social housing
-live near the social facilities
-live in a community to meet more friends

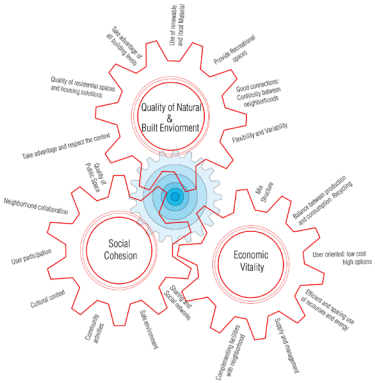
6# ECO-COUPLE

→ NOW living in suburb
→ in the future, they will live in skanssi,,,,,,,
-meet some people who have the same ideology
-build a eco-village with friends
-do farming

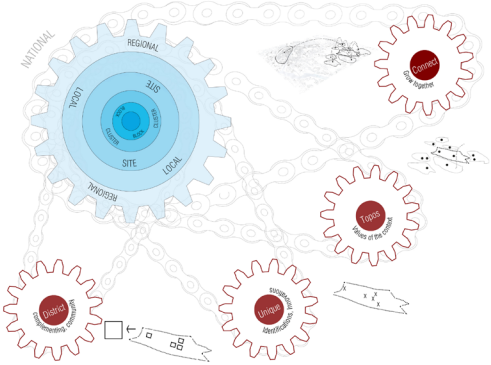
family profiles



sustainable development



assessment of sustainability



environmental zoom in - main goals and activators


RESIDENT ENTRANCE
CAR MAIN ENTRANCE
cultural facility
RESIDENT ENTRANCE
HIKING PATH
RESIDENT ENTRANCE
educational facilitis
agriculture field
CAR SECONDARY ENTRANCE
sport facilities
CAR MAIN ENTRANCE
gym
CAR SECONDARY ENTRANCE

masterplan

SOCIAL HUBS

Aleksandra Zarek
Mariana Costa
Nguyen Minh Chau

The area is constrained by rigid borders (highway, national roads) but at the same time the connectivity of the zone is of high quality. The area is mainly an open field with occasional forests and minor topographic changes. The Skanssi shopping mall with a number of interconnected public spaces is an important functional feature of the site.

The strategy for the next planning stages is to use the idea of physical and perceptive TRANSITION in terms of typology, scale, appearance, so that the area relates closely to its immediate neighbouring areas. In order to increase the level of social and environmental sustainability, a diverse network of pedestrian paths should also be included to increase the level of permeability across the site. Introducing vehicle traffic should also be considered to connect the existing bus facilities to connect the borders of the site in a logical manner.

The main concept for the *Social Hubs* master plan for Skanssi encapsulates the juxtposition of housing units and public or semi-private community facilities in a form of mainly low-scale housing clusters. The proposal is based on the idea of inclusion of the diversity of users who will be integrated in the common activities in the social 'hubs' - the community spaces serving as the 'living rooms' for each cluster containing a variety of functions. The main purpose is to stimulate human interactions between all age groups among the residents in a number of activities. Therefore, Skanssi will be regarded as a unique composition of socially vibrant clusters.

The scheme proposes a variety of different cluster typologies, in which blocks of flats are juxtaposed with row houses and interlinked community spaces. In order to strenghten the idea of social street life, most of the entrances to the buildings are placed from the inside of each cluster, so that the residents have to cross the interior of their area to reach their own homes. At the same time, the buildings with the entrances opening up onto public streets still retain the sense of belonging to a specific cluster. The general height of each cluster is kept relatively low with the articulation of a public function with a higher structure. By means of adjusting the edges of each cluster to create more dynamic street rhythm and introducing the new spatial nodes, the concept of permeability is even more enhanced. Calculations helped us understand how many people will occupy each cluster. The total number of residents in a new scheme will constitute 7570.

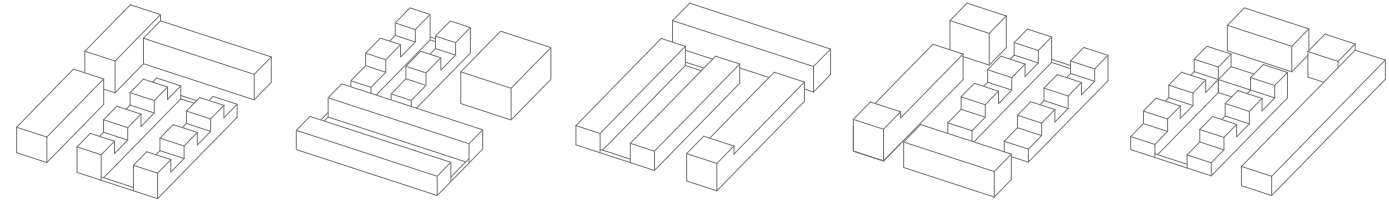
The new main pedestrian promenade will run through the middle of Skanssi. The main vehicle road will also be proposed with two new bus stops in the vicinity of a school and new mixed-use public facilities. In case of emergency vehicles have the possibility to enter the clusters. Three new collective parking areas (26 000 sqm) distributed evenly across the site to will be included to decrease the level of car usage. Public facilities of the clusters located along the two main roads open up onto the street. The majority of higher buildings face the main roads. The position of higher and lower buildings respects the daylight exposure at all seasons of the year.

The four main services zones of different character (mixed-use services - northern part, recreational zone - western part, cultural zone - central part and mixed-use services - southern part) will be proposed to create more significant social nodes. At the same time, all the clusters contain their own community 'living room' with shared facilities that are also public in some parts of the area, i.e. pharmacy or hairdresser's salon.

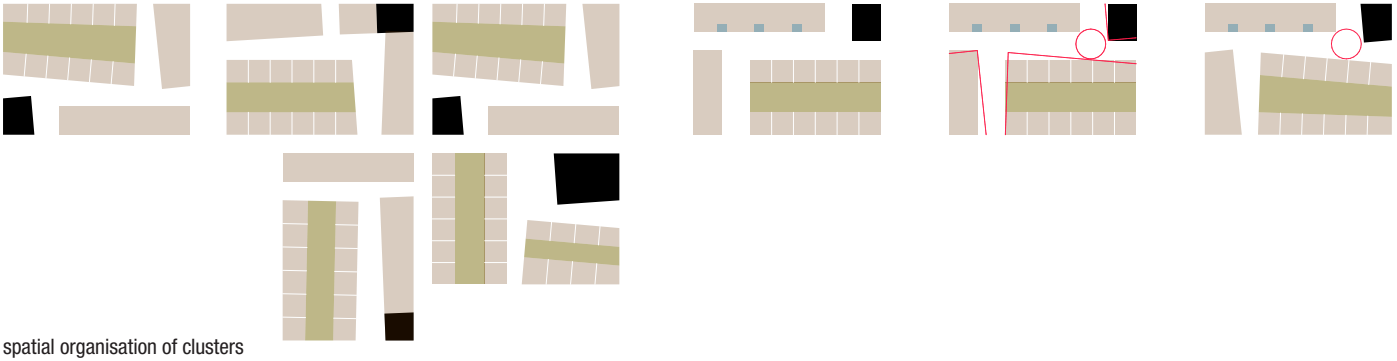
Ref. images. Donnybrook Quarter. Peter Barber Architects

Accordia. Maccreanor Lavington

Accordia. Maccreanor Lavington

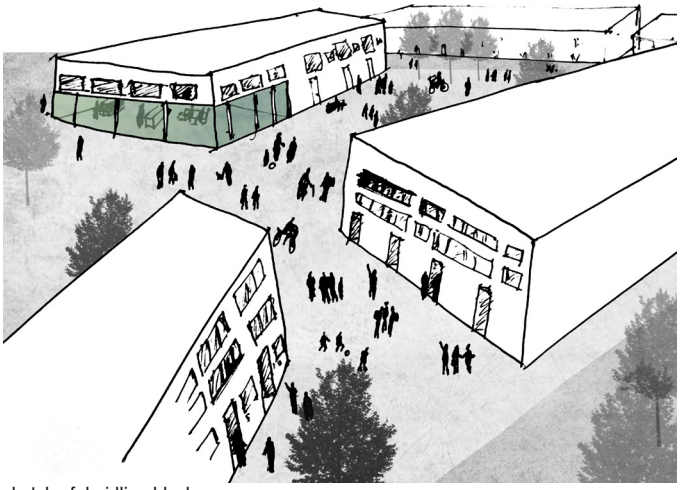


cluster typologies

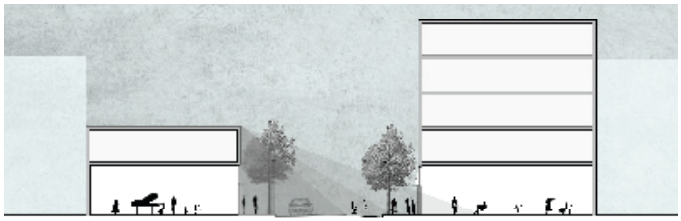


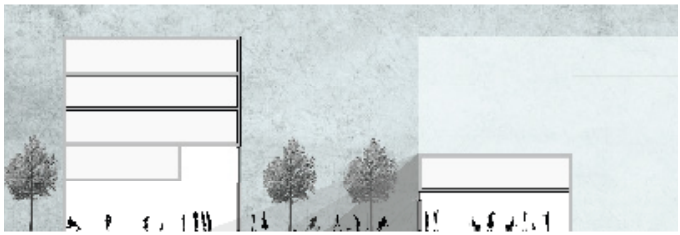
spatial organisation of clusters

masterplan



sketch of buidling block

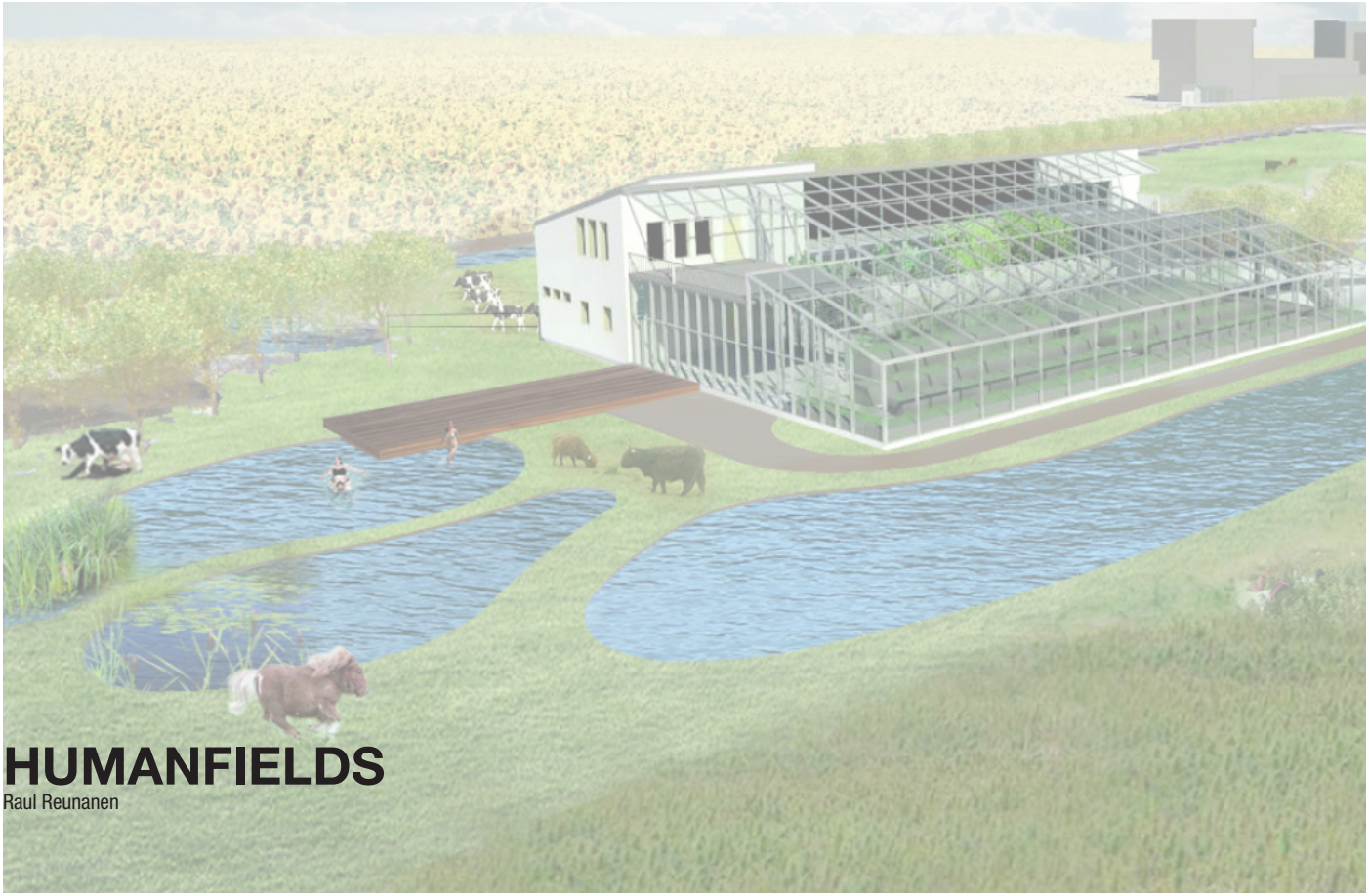




sections

permeability of the proposed structures


Selected individual works



HUMANFIELDS

Raul Reunanen

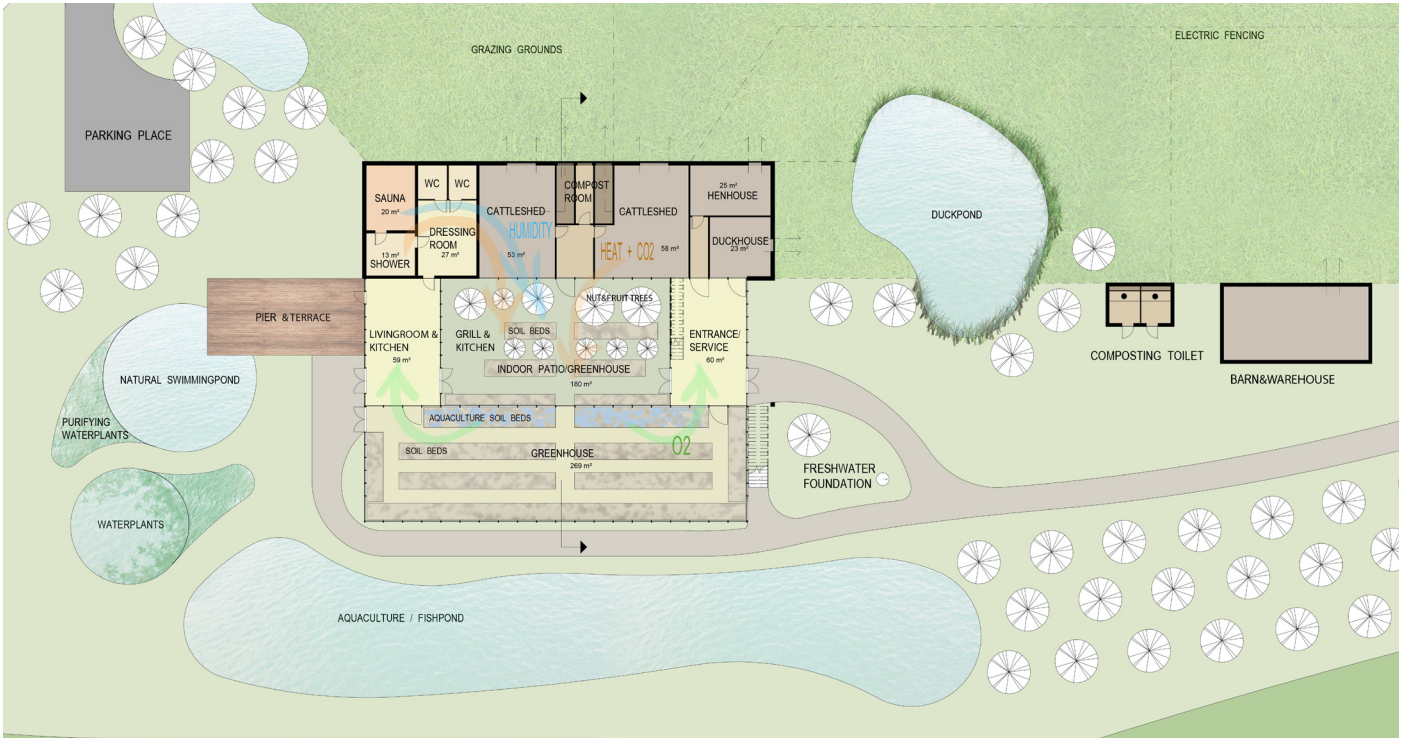
This project focuses on the relation between humans and their living environment and the surrounding nature. The proposal does not only value the nature and landscape in the Skanssi area in terms of landscape, but also seeks to provide an immediate interaction between the inhabitant and the nature. The project shows many different forms of urban gardening and rural farming: bigger scale farmlands, rentable smaller farming fields, apple and berry gardens, yard gardens, rooftop terraces and balconies.

The environmental and ecological education centre *Bioshelter* provides several possibilities for interaction and natural activities. The *Bioshelter* functions as a public living room where a greenhouse, an animal stable, a sauna and a communal kitchen are combined. The *Bioshelter* offers several innovative and sustainable solutions: its heating is mainly based on the waste heat emitted by the sauna, showers, the animals in the stable and the kitchen. Overheat can be exhausted by using the roof windows which create a natural pressure-based ventilation. Furthermore, moist air can be used to water the plants in the greenhouse. Kitchen-waste will be used to nurture the farm animals in the stable or the fields nearby.

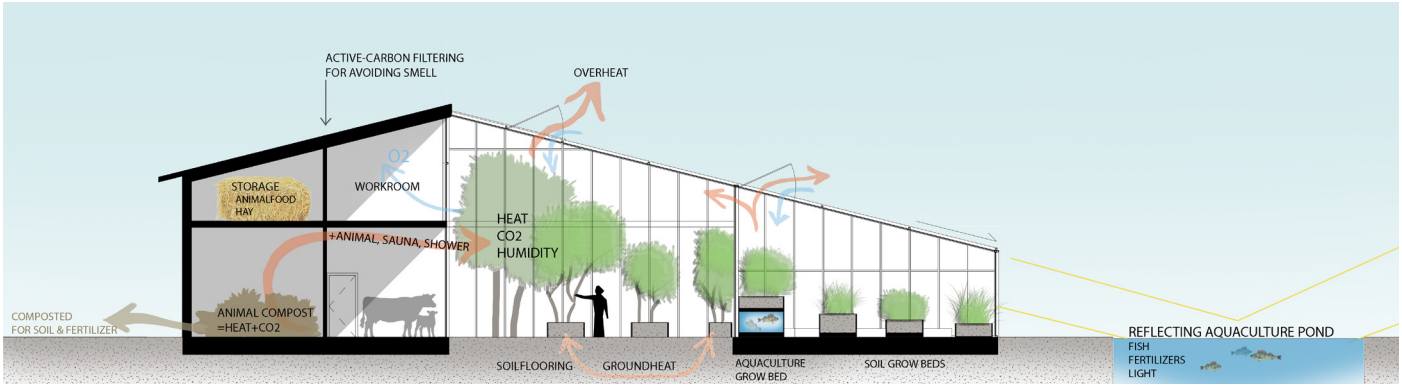
The housing typologies proposed consist of combined multi-storey and row houses. The curvy walled hempcrete-wood storeybuilding prvides energy-saving solutions of both building and living. In the building phase a massive amount of carbon oxide is locked to the lime-rendered hemp-limewalls, which is a highly potential, non-flammable and healthy natural building method. Combined with timber structures, the buildings become a huge storage of carbon locked into the lime-binded walls, ceilings and floors. The ventilation and cooling is working naturally with breathing walls and a greenhouse corridor. The yards, terraces, balconies and the garden house give the habitants many possibilities to work, experience and produce with the local soil & solar energy.

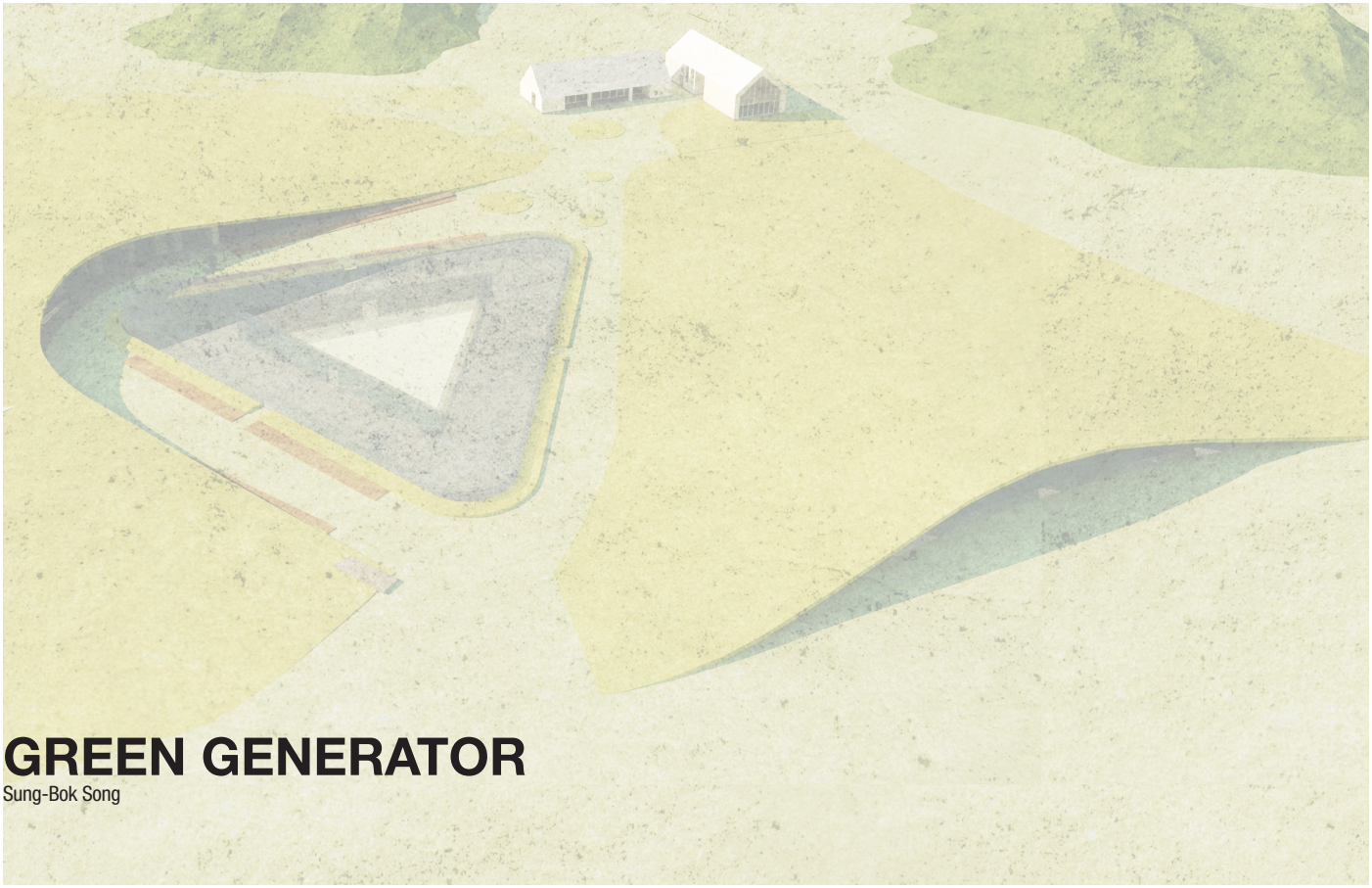

FARM FIELDS
COMPOST
GRAZING GROUNDS
APPLE GARDENS
TOILET & BARN
BERRY GARDEN
FARMLAND
YARD GARDENS
YARDPLAN EXAMPLE

site layout



Bioshelter-farm, floor plan and section





GREEN GENERATOR

Sung-Bok Song

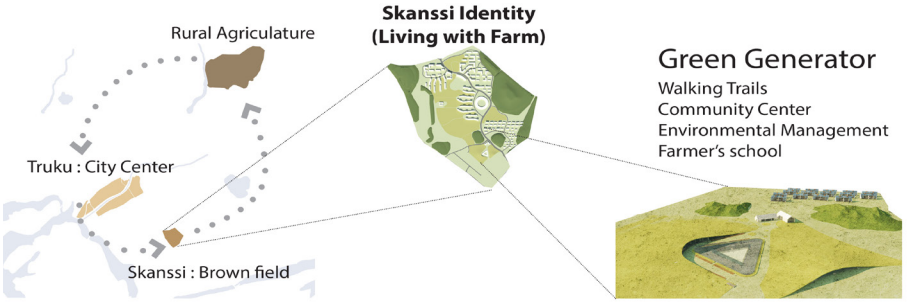
The proposed identity for Skanssi can be summarized as ”Living with Farm”. The *Green Generator* will support the identity of the area effectively by supplying walking trails, a community center, environmental management and a farmer’s school.

The inhabitants of Skanssi and whole Turku will benefit from the interactions taking place in the *Green Generator* plan. The project focuses on town ecology, social impacts, health and economic advantages. In order to share the benefits, the *Green Generator* is operating learning and experiencing programs such as teaching practical farming skills, soil testing and greenhouse propagation, feeding and breeding farm animals and lastly the institution supplies small amounts of quality foods.

In the case of Turku citizens can join the institution´s programs by participating a weekend-farm or spend a longer period and live in local rental housing. Also students can take part in fieldwork and participate in summer camps. Local farmers can exchange their knowhow by supplying local food to the Skanssi residents, which is a lucrative market for them. In addition to that a tourism program can be offered to showcase the different modes of farming in the area.

The design concept consists of three different areas: the visiting center, a green house and the rental housing area. The areas are naturally connected by walking trails. The inhabitants of Skanssi and the visitors can experience the atmosphere of living in a farm environment by walking the trails through the area. People can buy seasonal foods and study farming at the visiting center. Theses facilities can also be used as a community center. Some of the row houses are utilized as rental housing to host non-locals during the workshops. These buildings are planned according to an energy efficiency plan. The buildings are facing south, so that the house can get enough solar energy. The integrated green houses and a heat recovery system help to save energy.

Green generator



concept

athmosphere

site layout

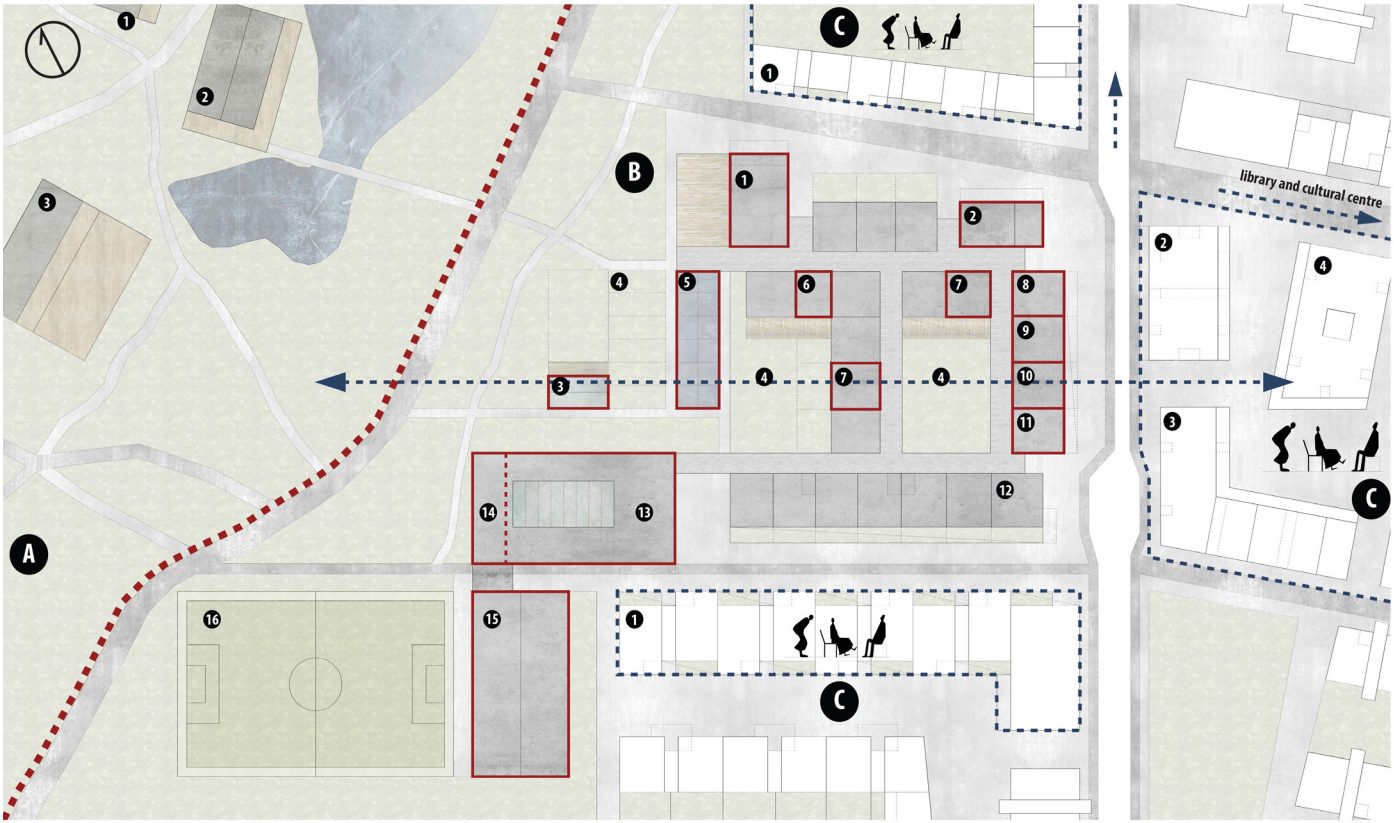
SCHOOL OF INTERACTIONS

Aleksandra Zarek

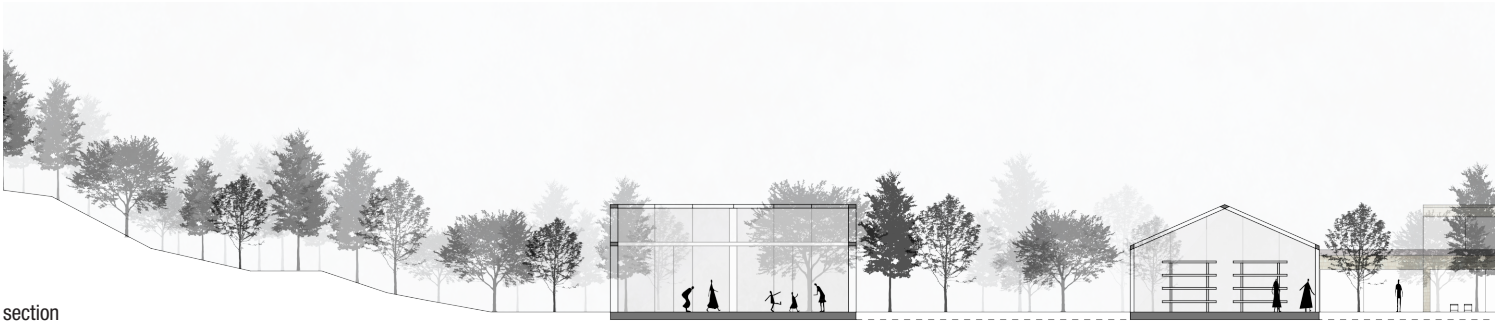
The new educational complex located in the heart of Skanssi comprises a crucial part of the network of community services laid out in the proposed '*Social Hubs*' master plan. It is located directly next to the recreational and cultural centres - it interacts with the library and multimedia spaces to the east and with the sauna, playground, restaurant and other sports facilities to the west. It is also placed relatively close to the other two mixed services zones at the main entrances to the area. The school can be easily reached by foot, bicycle or public transport from any point in Skanssi.

The new complex encapsulates the concept of a traditional teaching centre combined with a possibility of renting out the usable space to various professionals, who could offer educational services (workshops in music, art, photography, language teaching etc.) both to the school as well as to the community of Skanssi, with a particular focus on the elderly residents from the nearby clusters. The main front of the building will be thus used as a flexible multifunctional and interlinked zone for diverse activities, which can open up onto the street enhanced with landscape and seating facilities. Due to its convenient central location as well as its internal layout with the multifunctional zones interacting with the outward areas, the building can be easily reached by the elderly residents from the nearby housing complexes as well as by other residents of Skanssi.

The building's internal functional layout - the gradual transition between the activity classrooms, multifunctional corridor, internal courtyards, the greenhouse and the picnic area strictly interacts with the neighbouring zones - the main vehicle and pedestrian avenue, housing complexes for the elderly and the recreational zone on the hill. The main role of the centre is thus to stimulate interactions between the residents of Skanssi by involving them in a variety of interconnected activities. Besides the flexible activity rooms, kindergarten and primary school teaching classrooms, internal courtyards with cultivation possibilities, the greenhouse and a barbecue/picnic site, the centre also includes a swimming pool with a cafe, directly linked both to the primary school and to the gym/fitness area on the first storey level. The adjacent football pitch can be used by the pupils of the school as well as other residents. The building makes use of some of the passive energy strategies such as natural cross-ventilation, which can be achieved by means of multiple roof and wall openings within one classroom. Multiple openings also offer plenty of natural light, which enhances the learning environment. The building's structure and cladding is executed from locally sourced timber.



site layout



section

Activity zones within and around the school complex

A | RECREATIONAL ZONE

1. Restaurant
2. Community sauna
3. Playground

B | EDUCATIONAL COMPLEX

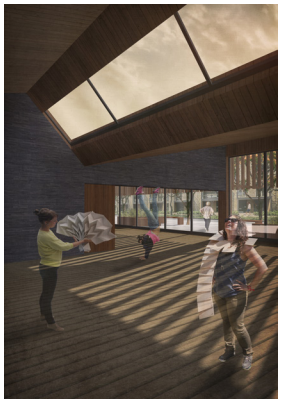
1. Performance space
2. Web designer's studio | Computer classroom
3. Barbecue pavilion
4. Cultivation gardens
5. Greenhouse
6. Cooking school
7. Multifunctional space
8. Musician's studio| Workshop | Multifunctional space
9. Graphic designer's studio | Multifunctional space
10. Artist's studio | Workshop | Multifunctional space
11. Sculptor's studio | Workshop | Multifunctional space
12. Language school
13. Swimming pool
14. Cafe with an outdoor terrace
15. Fitness centre | Gym
16. Football pitch

C | ZONES FOR THE ELDERLY

1. Housing for the elderly
2. Housing with a community space
3. Health centre
4. Chapel | Contemplation space

entrance view

courtyard perspective



sample classroom

SYNERGETIC SKANSSI

Juan Del Barrio Batista

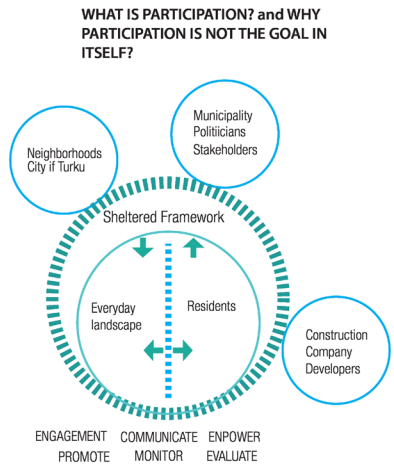
From the first beginning the idea of this projects was to provide different frameworks. Particularly the ones that consider the human dimension in the architectural discourse have been stressed in this proposal.

The project´s sustainable strategies have three dimensions: social cohesion, quality of the built environment and economy. Particularly in its system, the project took into account as much as possible the social cohesion and the quality of built environment. Some inputs for the economic dimension are addressed through the eyes of flexibility and resilient scenarios.

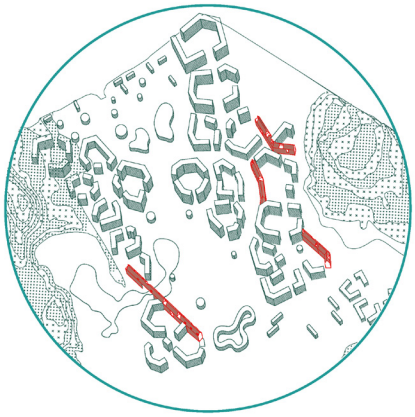
Participation takes an important part in the project, nevertheless the goal of the project can be reached through other means as well. A scenario for no participation at all is also proposed to offer a realistic approach.

The presented project has two parts. The first part is related to a flexible social housing system that can have different situations depending on the landscape or its users. This system uses the horizontal densification as an approach for an innovative way of giving form to the local landscape.

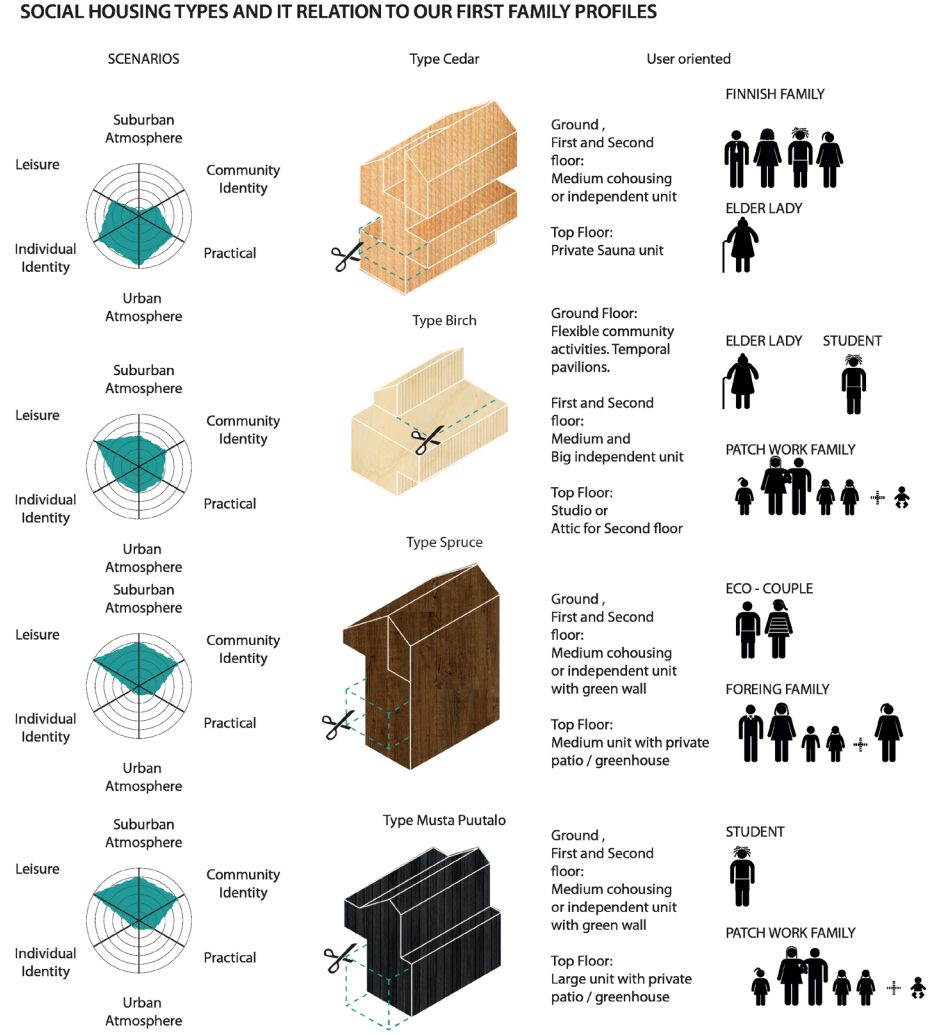
The second part developed attempts to make the participation of local residents more significant and resilient and add value to the whole Skanssi area.



concept

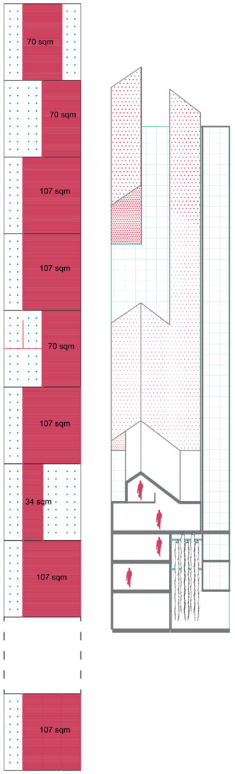


densification of the blocks



housing typologies for different dwellers

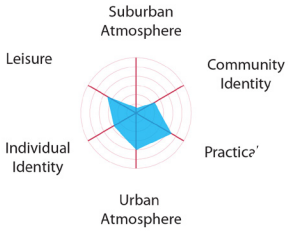
WHAT ARE THE LIMITS OF GROWING?



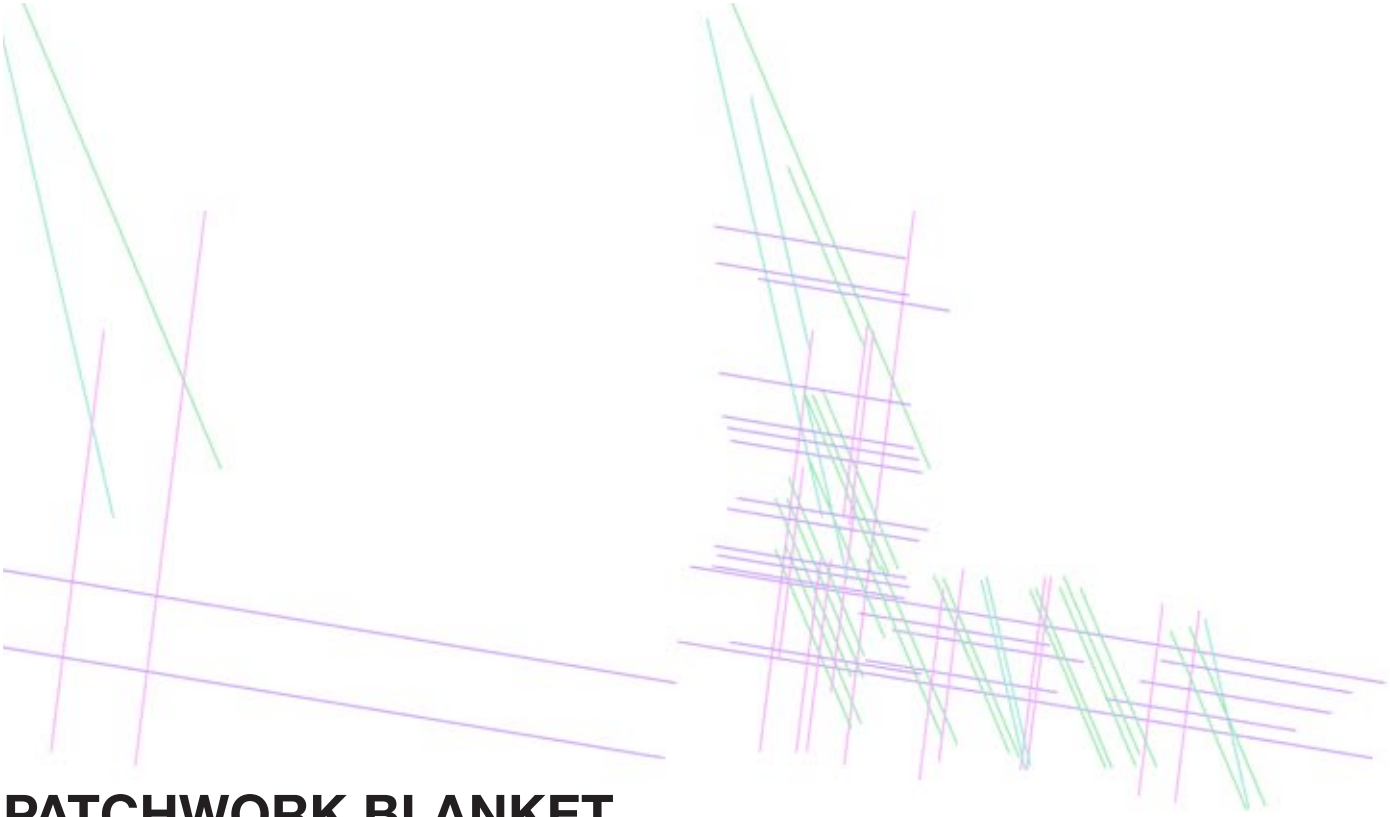
horizontal densification between the blocks

participatory coutyard

PARTICIPATORY LANDSCAPE AND RESILIENT SCENARIOS



local hardwood landscape



PATCHWORK BLANKET

Szymon Galecki

The main concept behind the project is to connect the green area of the hill in the eastern part of Skanssi with the shopping mall in the north. The shape of green patches is derived from existing axes and drives people through the mall to the subject site. The connection is graduated by an increasing volume of greenery when leaving the more urban area surrounding the mall.

The ground floor plan of the buildings surrounding the plaza is destined for commercial use. The area is defined by the character and time of activation. It is important to mention that all services must be diverse from those offered in the mall, so they do not compete. Most of these will concentrate around small, family like companies that provide services for Skanssi residents and guests visiting.

The market place can also be used for hosting events. Multi-use will help to keep it alive and keep people interested in it. The playground is separated from the main flow of people, to create a less bustling space. The amphitheatre functions as view point to the wetlands.

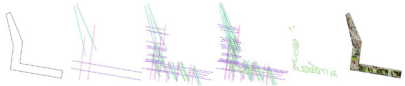
The main flow of people in Skanssi will be created through the mall in the northern part and city centre of Turku in the same direction. The quality of transit zone is improved and traffic directed to the mall. The main path through the plaza collects pedestrians from the surrounding areas. The main transportation hub is located in the centre of the plaza, including the tram stop that improves the connection to the city.

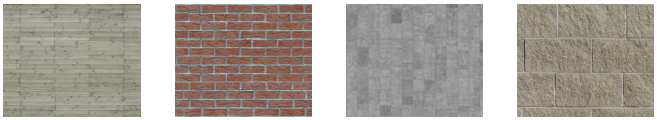
Materials used for the pedestrian zone were carefully selected in terms of sustainability and their future potential reuse in other purposes or as already re-used materials, taking into consideration the cradle to cradle -approach to material usage.

streetscapes

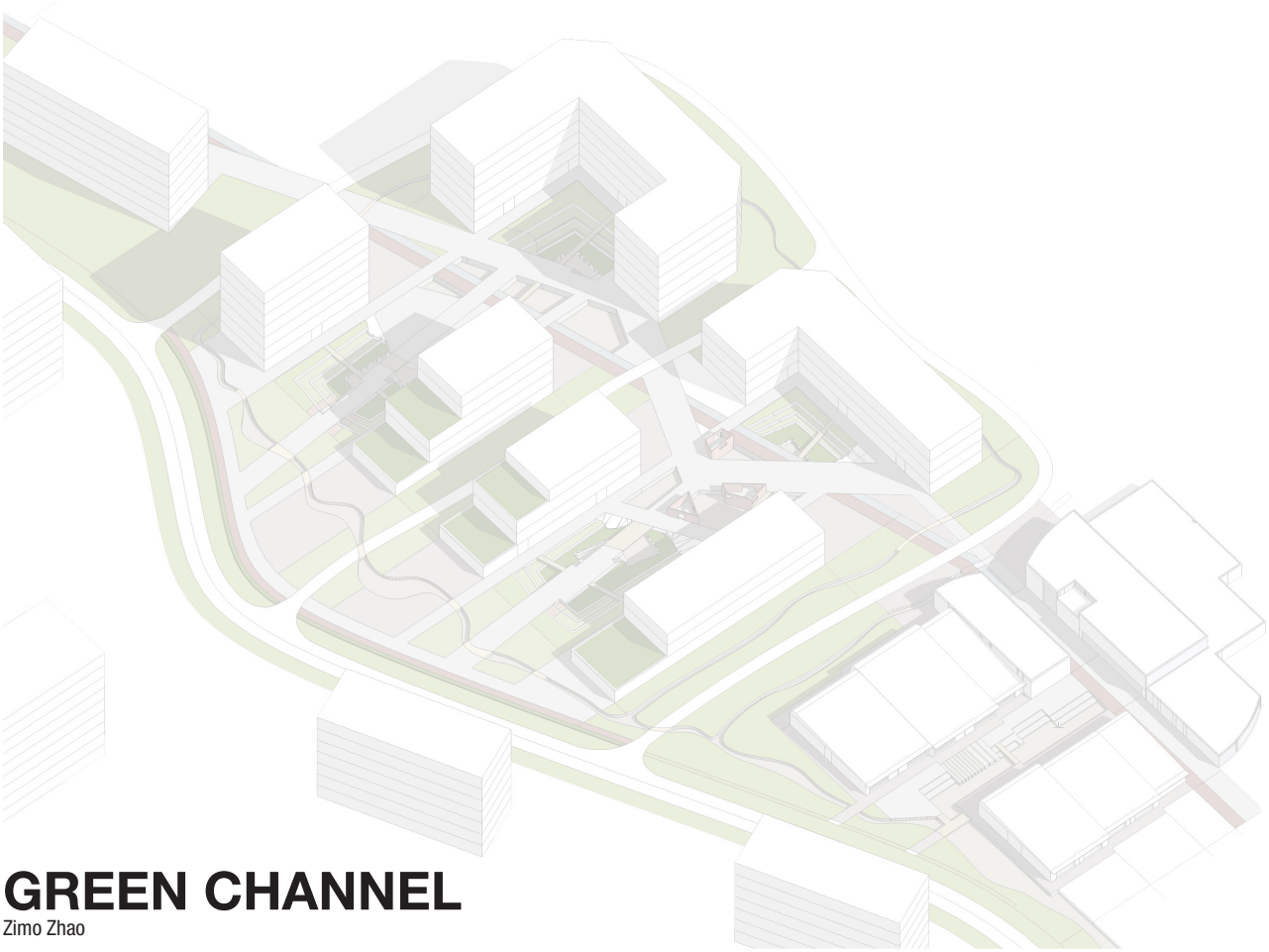
map of functions

spatial layout of the pedestrian street





details & materials



GREEN CHANNEL

Zimo Zhao

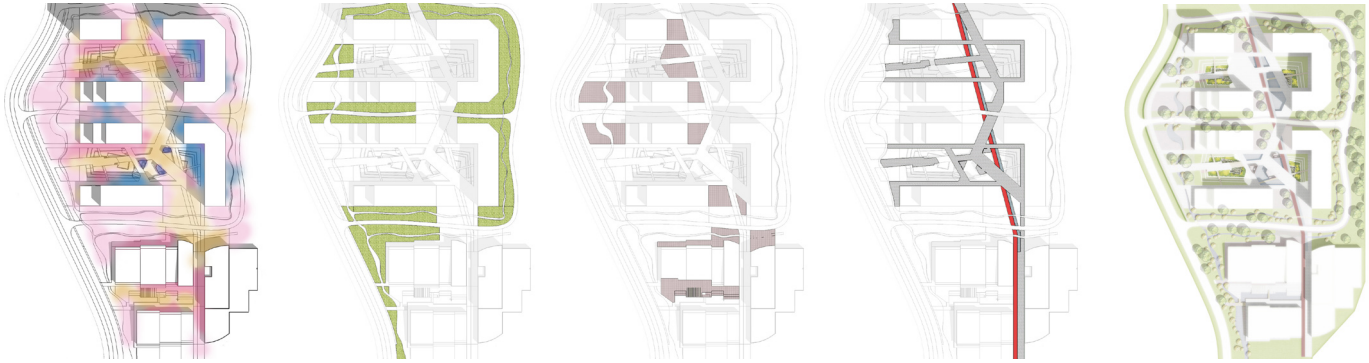
In the future Skanssi area needs a school for the rising population. The school locates in the center of the site. It has the best location, view, and connection to both the residential area and the nature. The strength above is to define the school as a community center which shared by all the Skanssi residents.

The connection between residential building and the school will be realized by the *Green Channel*, a corridor-like public space which integrates pedestrian walkways, bike routes and wetlands for waste- and rainwater treatment. The *Green Channel* functions as a key opening towards the important public buildings and the central lake of Skanssi.

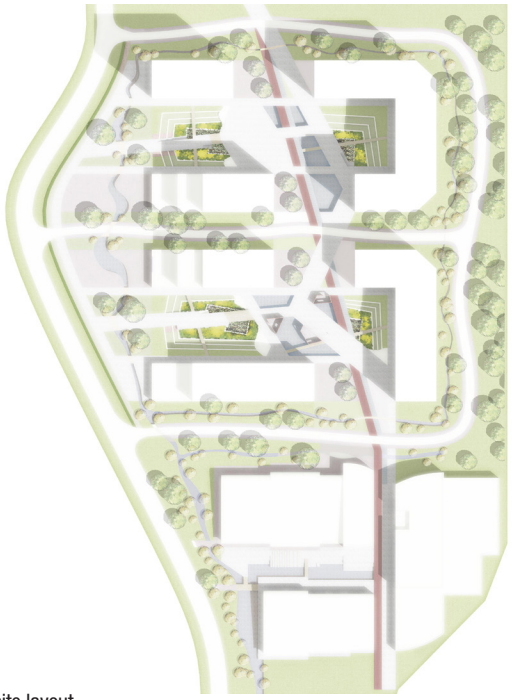
The school and community center in the south of the axis attract people to come from the whole Skanssi and lagrer Turku area. The *Green Channel* works as a shortcut specially designed for pedestrians and bikers, encouraging people choose the low carbon way of travel. People can enjoy the different functional landscapes and get educated while traveling on the *Green Channel*.

The functional landscape plays an important role in the design. Every building has its own waste water and rain water treatment system, which is realized by constructed wetlands. These wetlands filter the dirty water from the kitchen and bathroom. The filtered water could be re-used to flush the toilet for example.

Green Corridor light traffic route



feeling of the space, green areas, open spaces, pedestrian walkways and cycling paths



site layout

local school
public space

CULTURE NODE

Mariana Costa

The *Culture node* is concentrated in the central area at the crossing of the main pedestrian streets. The *Culture Node* is functionally divided into five different buildings in the central area of Skanssi. Therefore the *Culture Node* spreads outside the physical walls of each single building and functionally and spatially combines different uses: a library, a café, an auditorium with studios, a gallery and a playground. Each building is built out of recycled wood from regional sources and the position of each building was thought according to the social sustainability and sunlight exposition.

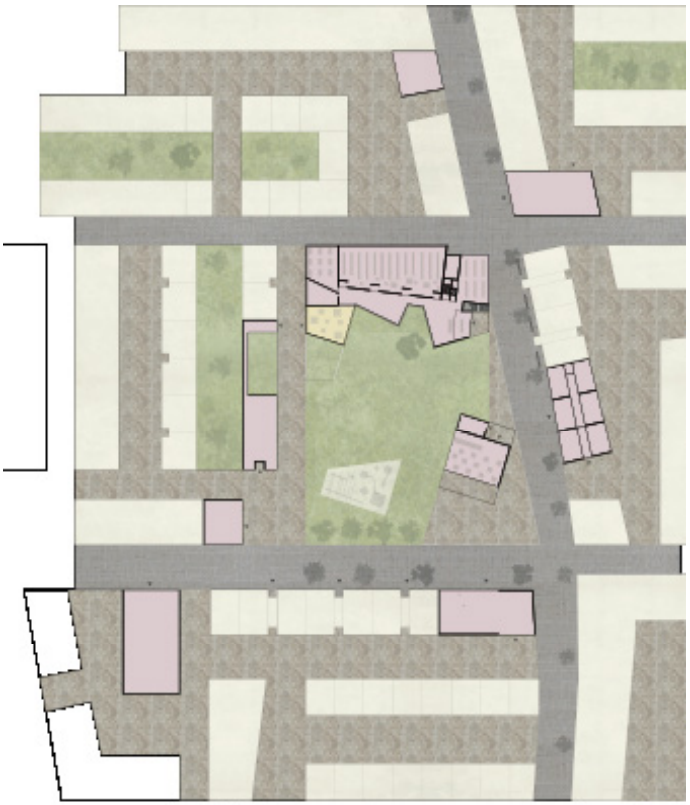
Skanssi Library´s content will be donated by Skanssi's inhabitants. Everybody can donate his or her books, cd's, movies, audio books, games, etc., which are not used anymore. The library´s rooftop is part of the *Culture Node´s* public space as well. It has some slopes and benches to encourage people to find different positions to read and study, especially during the summer season. It can also be used as an outdoor auditorium.

Next to the node the biggest of Skanssi's playgrounds is located.The playground offers the children differend wooden structures to play with. This spot also has some space reserved for workshops organized by the day care centre, the library community and the gallery.

The house-studios next to the gallery are a different housing typology designed for artists or students who wish to live near to the library and the galleries and enjoy an artistic dynamic lifestyle.

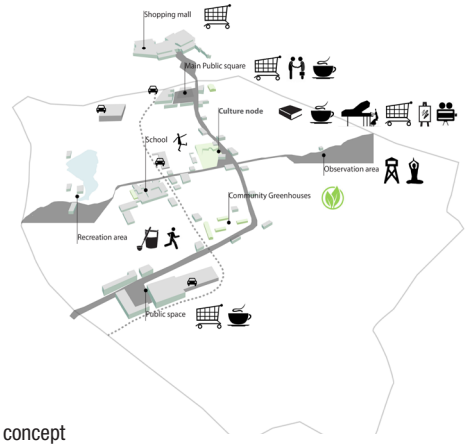
The cafe opened to the node and exposed to the southern sunlight can be used as restaurant and bar. During the summertime the exterior space can be protected from the sun´s heat by a temporary wooden structure.

The gallery has an important role in Skanssi´s urban fabric. It serves as a space and platform for art venues and happenings and therefore has an importance that reaches outside Skanssi´s borders. Visitors can enjoy art exhibitions and participate in the gallery's activities (as the workshops of ceramic, painting on canvas, multimedia, sculpture, etc.). During the summer time the exhibitions can be organised outdoors next to the esplanade café.



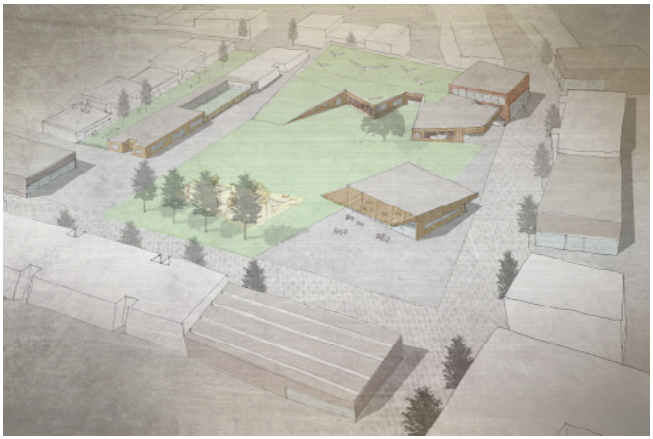
site layout

roof surafaces



concept

athmosphere of the public space



public space

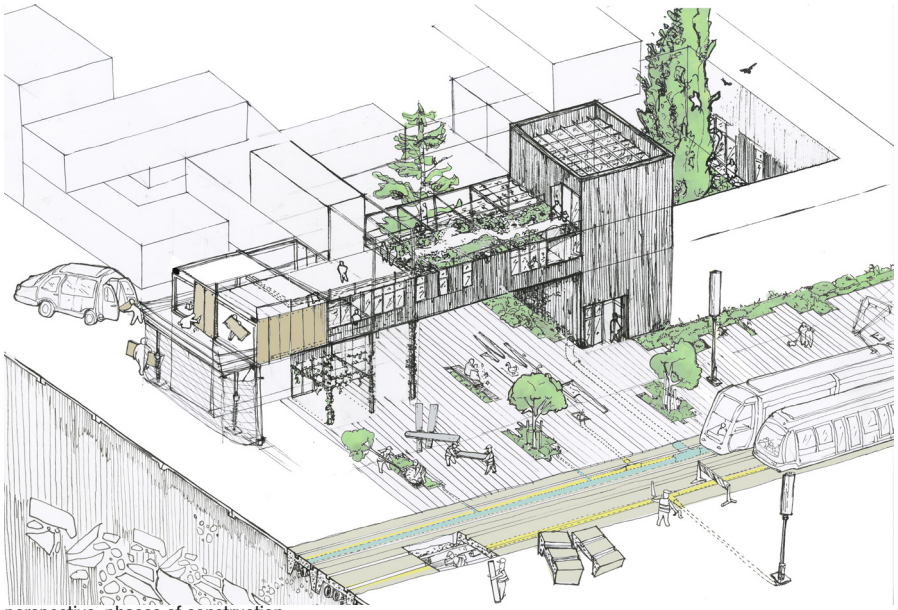
rooftop terrace of the library

rooftop and greenspace of the library

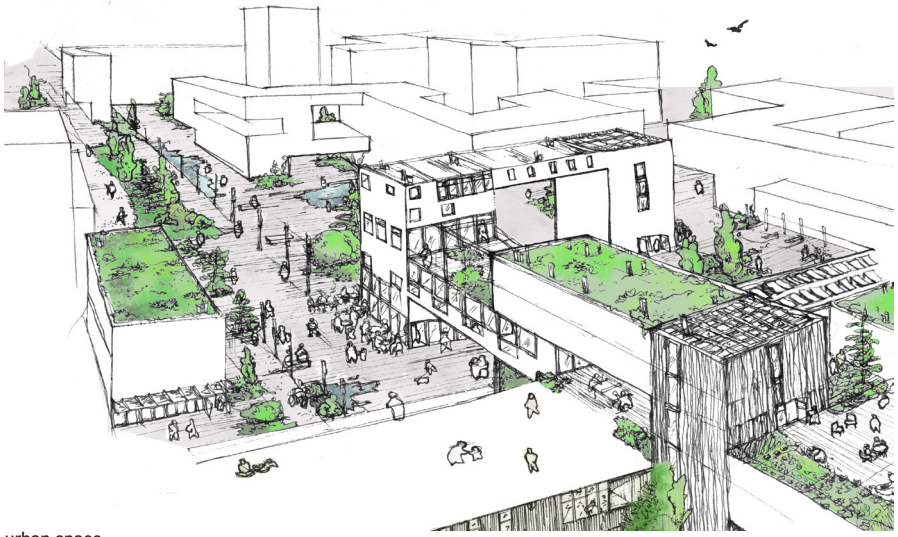
LEGO SKANSSI

Amanda Reyes
Natalia Rincón

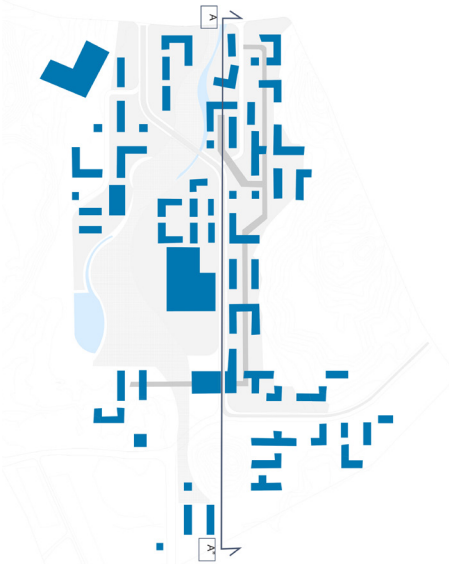
The proposal seeks to provide a keen approach to the city's needs and the latest urban planning theories such as the smart city concept. This concept allows the urban area to grow in the different aspects that constitute a city such as: economy, design, people, technology and sustainability. The proposal includes a multi-agent cooperation to facilitate Skanssi´s growth as a smart city in the future. The *Lego Skanssi* –project offers a proactive solution to the changing needs to the built environment: Flexible modular buildings are presented easily adaptable to and a smart grid enables adaptable infrastructure.



perspective, phases of construction

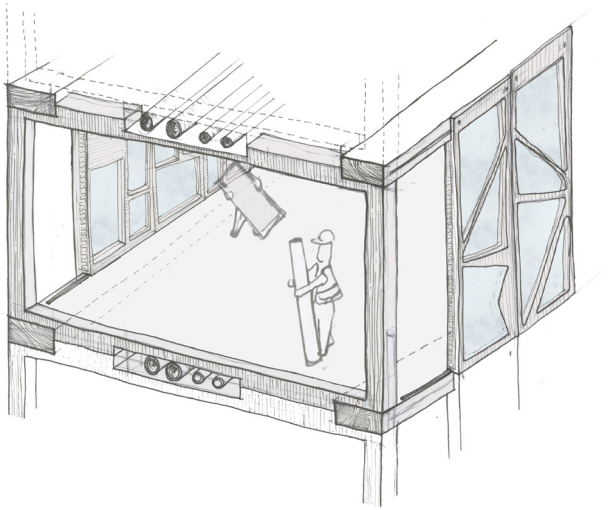


urban space



granulation

modular construction according to *Lego Skanssi*



SMART GOVERNANCE

With the cities growing at a fast pace and techonologies taking over our daily activities it is necessary that urban planners, architects and municipal leaders offer the residents a place that is healthy, secure, that offers the space to host such technologies and that is able to cope with the only certain thing: change.

The concept of a Smart City has now been a motive of study in many parts over the world and it is so complex that requieres specialized knowledge in every area. Nonetheless, researches agree that there are some key areas that define an urban area like this: Smart Governance, Smart Environment, Smart Economy, Smart Mobility, Smart Living and Work and Smart People and Technologies. In the next panels it is shown how to cope with each one based on simple considerations while planning.

The first characteristic that we decided to approach was the Smart Governance. This means the city is focused on enabling the supply demand model and that is oriented to information and communications technologies. Making room for a demand supply imply that a Smart City builds only when there is a need to, contraire to what has happened in our last decades where the the cities have been constructing non stop.

When we building only when its needed we allow the stakeholders to invest more wisely. In the other hand, the projects tend to be cheaper and with more down to earth approaches. Our project hopes to cope with this by building in four different stages.

The stages are divided on four and are oriented specifically to each generation. Acknowledging that each generation has different values and that each one is a reliable depiction of its era provides us with the ability to make a more educated planning.

Below each stage shows the different things that are happening along a spam of 20 years. The site plans above show the growth of the area in these 4 different stages and provide a general sections of how the volumes grow.

Having a master plan that is divided into real years and sets realistic goals grants architects and designers to add their personal signature to the area making it diverse and interesting.

In the other hand, a city that is focused in information and communication technologies plans for the future. As it is conscious that the different ways of communicating nowadays is changing conduct patterns and with it architecture. It can be said that perhaps nowadays public and private spaces are merging and that all that is needed is a comfortable space with a wide screen.

STAGE 1

- Transport
  - Area destinated mostly for cars
  - Main Road across the whole area
  - 2 secondary roads that connect the buildings
  - 4 parking spaces ready with foundations
- Residential
  - Total count of residential buildings is 12
- Public
  - 2 main floors of 3 buildings destined for retail and pub lic services
- Semi public
  - 1 floor of 3 buildings is destined for office space
- Landscape
  - Main pedestrian street
  - Landscape design across the whole area
  - Storm water control

STAGE 2

- Transport
  - Area destinated mostly for cars and buses
  - Main Road across the whole area remains the same
  - 2 secondary roads that connect the buildings
  - 2 parking spaces are modified and two remain
- Residential
  - Total count of residential buildings is 29
- Public
  - 2 main floors of 13 buildings destined for retail and public services
- Semi public
  - 1 floor of 7 buildings is destined for office space
- Landscape
  - Vegetation around the area has grown and new plants have been added to the landscape
- Other Services
  - A day care and elementary school start in the center of the area
  - A public library starts with the construction

STAGE 3

- Transport
  - Area destinated mostly for tram and two lanes of low traffic
  - Main Road across the whole area changes to rails and tram stops
  - 1 secondary roads is shortened, the other one has change its pavement and its kept for low speed traffic
  - All the parking spaces have been modified by now
- Residential
  - Total count of residential buildings is 40
- Public
  - 2 main floors of 13 buildings destined for retail and public services
- Semi public
  - Office space is mixed with the residential areas
- Landscape
  - New urban elements are incorporated into the landscape such as urban furniture, playgrounds and portable archi tecture
  - The treking and cross country road have now a turistic stop
- Other Services
  - The day care has evolved to a primary school
  - The library has expanded through the area incorporating coffee shops, exhibitions and other public services

STAGE 4

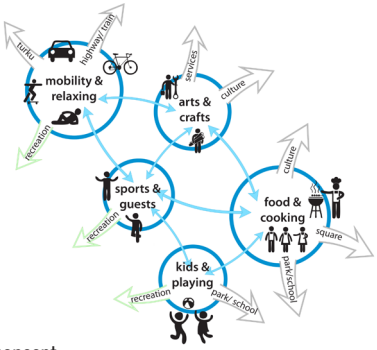
- Transport
  - Area destinated mostly for tram and two lanes of low traffic
  - Main Road remains with the tram service
  - Electric cars are incorporated in the area and the smart grid is modified to support the new techonology
  - The 2 secondary roads are kept for low speed traffic
- Residential
  - Total count of residential buildings is 49
- Public
  - 2 main floors of 15 buildings destined for retail and public services
- Semi public
  - Office space is mixed with the residential areas
- Landscape
  - New urban elements are incorporated into the land scape that allow exhibitions and cultural events to occur
  - Screens and other technologies incorporated into the urban space
- Other Services
  - The school now hostes different grades starting from day care to highschool
  - The library continues its growth with mobile initiatives
  - New technologies are incorporated into the smart grid and into the private and public spaces

different phases of the development

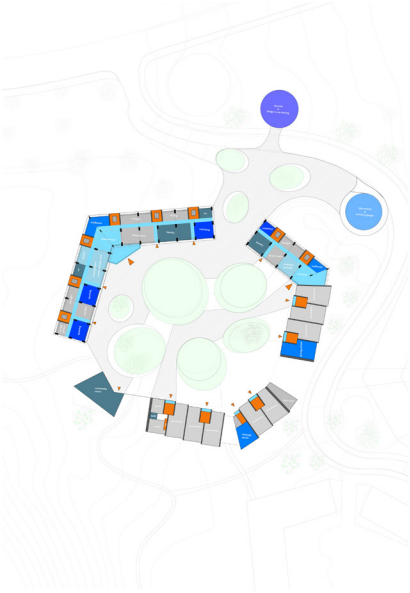
SYNERGETIC SKANSSI

Lisa Voigtländer

There is a lot of potential for more sharing options in our households and every day life, especially in the semi sectors or medium size community. Either the things are private or public/ commercial but very less in between. The proposal sets a topic and belonging for every housing block in the cluster to create a specialty of identification in the close-by neighborhood. The ground floor of the bigger buildings is opened for shared, community and meeting spaces. The feeling of community and togetherness is taken into account already in the planning phase and enforced by the built structures. This project facilitates a strong sense of community combined with flexible multi-story wooden buildings.



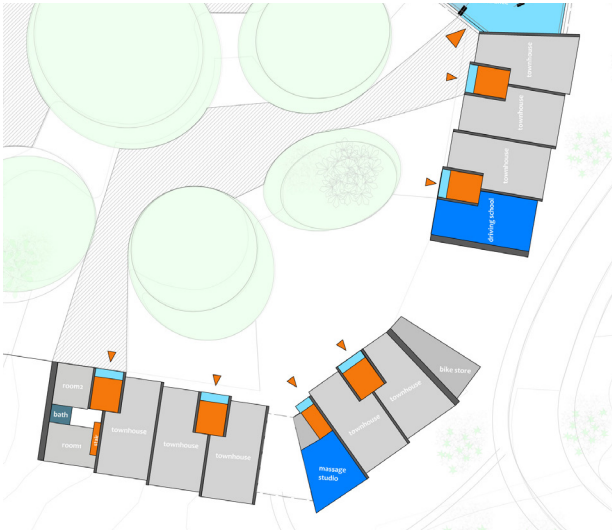
concept



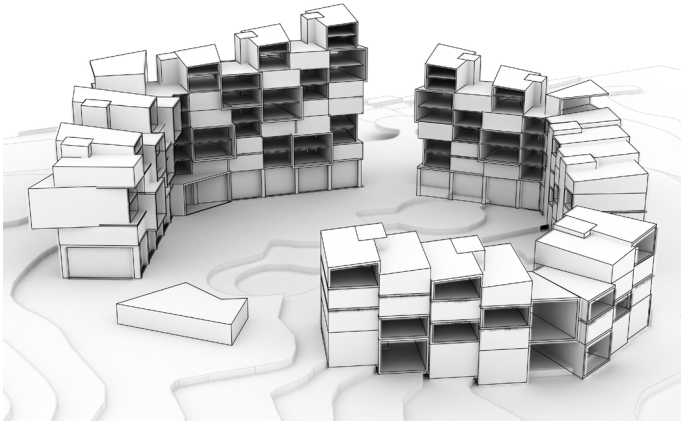
floor plan

site layout

use of local resources and recycling



ground floor



apartment cluster

sections

LYHTYNIITTU

Kaisa Härkönen

The master´s thesis examines design solutions which support sustainable development, create privacy and a sense of community in the residential areas. The aim is that these solutions could be used not only in the Skanssi area, but also in other residential areas in the future.

The theoretical part focuses on the directions which Finland´s Ministry of Environment has given for sustainable development. The theoretical part deals with a research about environmental psychology in order to find solutions for designing privacy and a sense of community in a residential area.

The main part of this thesis describes the actual urban planning for the Skanssi area. The third part combines the theory and the practice. The planning area is located in Skanssi area in Turku. The city of Turku has started Skanssi´s planning process in the beginning of the year 2000. The objective of this thesis is to be part of the bigger process and to provide ideas for the town planning and land use in the area.

The master´s thesis proves that sustainable design is a very complex matter. It is possible to find concrete design solutions which are sustainable in different aspects of sustainability. By investing in privacy and community in the residential areas developers can accomplish a sustainable and user-friendly environment.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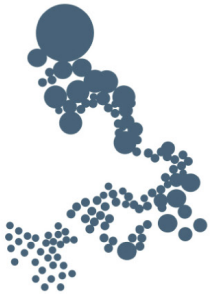
masterplan

Tarttumapinnat

luontoyhteys



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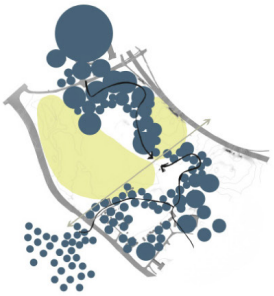


pääyhteydet

streetscapes and sections. Mixed-use street

The aim of the mixed-use street is to replace huge parking spaces between the residential areas and to provide an active streetscape. Street furniture and greenery ensure a quality streetscape around the year.

traffic / connection street

“The streetscape is the urban dweller´s yard” – Jan Gehl. Even though the nature of the streetscape is urban and vibrant, different hierarchies between the means of transportation and levels of privacy remain perceivable.

green-street

streets and connections

Jalankulkuväylä

Ajoneuvoliikenne

Raitiovaunuliikenne

Pyörätie

Esteetön kuntorata (1,5 km)

Kuntorata (3 km)

streetscapes and sections. Park-street

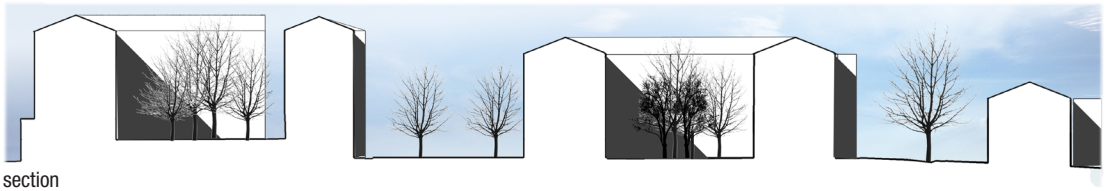
forest trail

In order to fit the new residential areas into the existing urban structures, three different block structures are proposed. *Urban block 1* (see example below) is closely connected to the area around the shopping centre. The block provides urban structures and clearly framed streetscapes.

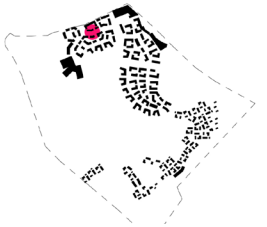
Block type 2 proposes an intermediate solution between single-family houses and urban blocks.

Block type 3 consists of dense single-family houses which connect the existing residential areas to the shopping centre.

block structure, *Urban block 1*

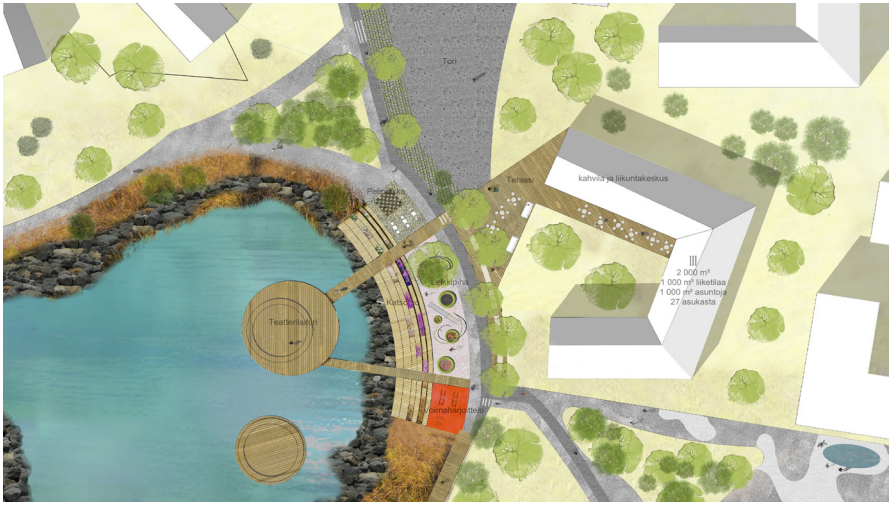


section

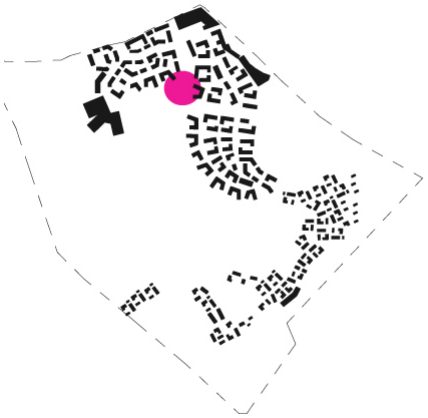


panorama of the recreational area

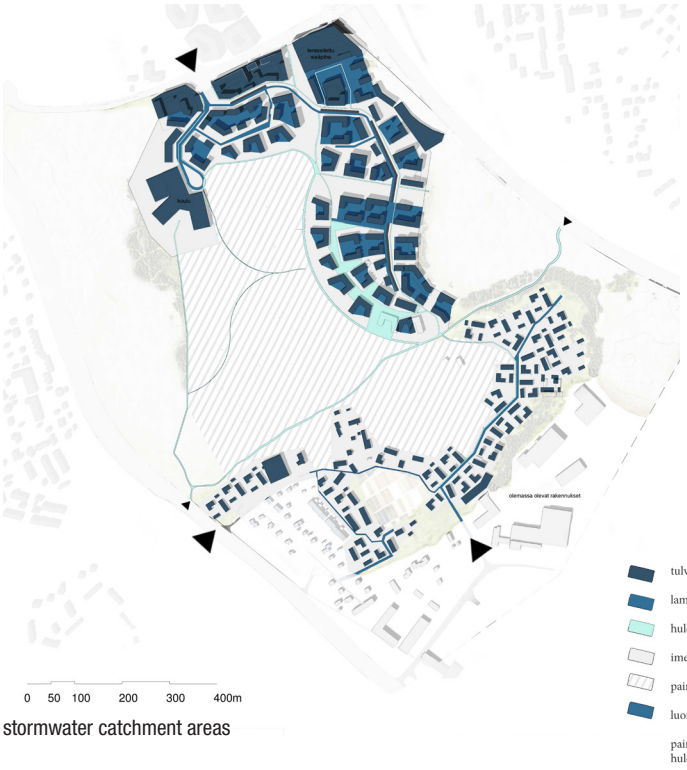
The activity area is sited between the residential area and the recreational area. Due to multiple possibilities for activities the area is suitable for residents of all ages.



site layout of the activity area



location of the activity area



stormwater catchment areas

The observation towers are located in the south-west and provide a view over the stormwater bassins.

observation towers

Forest-huts activate the residents of whole Skanssi.

forest-huts

panorama of the activity area

GREEN ROOF STORMWATER MANAGEMENT

Steven Collins

Urban Development & Conventional Issues

Urban developments consits of large areas of impervious streets, driveways, sidewalks, paths, roofs, and courtyards. These conditions intensify stormwater runoff rates and volumes, cause erosion, and increase the amount of pollutants arriving downstream - All of which cause harm to the local ecosystem. Intensified post-development runoff rates along with intensified rainstorm projections into the future, also result in urban areas that are prone to flooding.

There are several engineering techniques that can be used to mitigate these issues and transform the post-development hydrographs and peak flows to resemble the pre-development conditions. However, it is likely that the most sustainable way of doing so is by increasing the green infatructure at the ground level and by covering the impervious rooftops vegetated porous surfaces - Green Roofs.

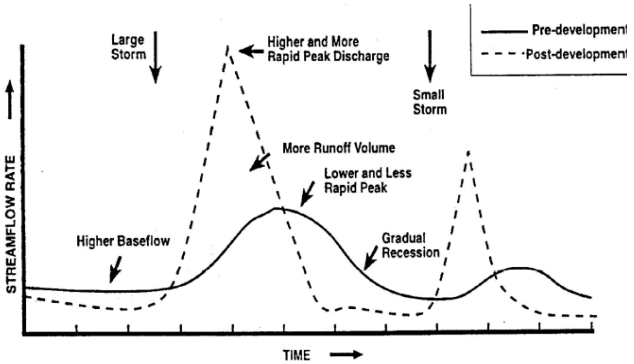


Figure 1: Water runoff from an area before any development occurs shows lower more moderate flow rates. When development displaces green areas with hard impervious surface the water runoff volumes and rates are intensified creating the curve more like the one shown by the dotted line.

Green roofs

Detain rain water in its structure reducing runoff volumes

Slow down the movement of surface waters

Reduce runoff flow rates

Improve the water quality at the effluent of the site

Reduced loads on stormwater management facilities

Reduce the risk of flooding

Question:
How well do green roofs reduce peak runoff rates under different design scenarios?

Rational method

$$Q_p = CiA$$

Where;

Q_p= Peak flow rate
$C = C_{weightedAvg.}$
i = Rainfall intensity derived from t_c
A = Catchment area under consideration

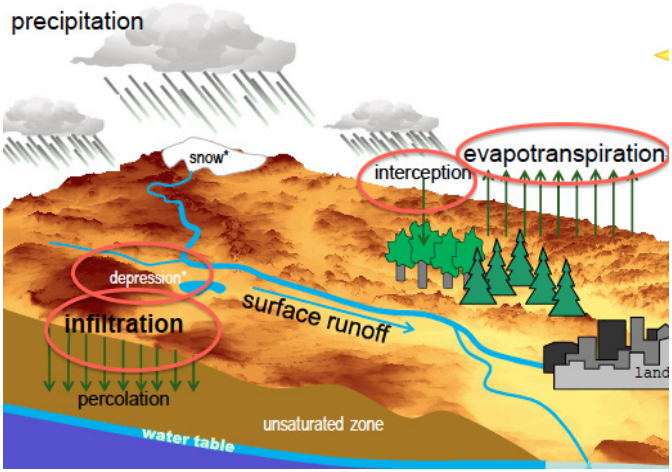


Figure 2: A runoff coefficient (C) is equal to the depth of runoff divided by the depth of rainfall. It accounts for all initial abstractions (infiltration, depression storage, interception, and evapotranspiration) as well as soil permeability. A weighted average over the the catchment area gives the total amout of water to runoff.

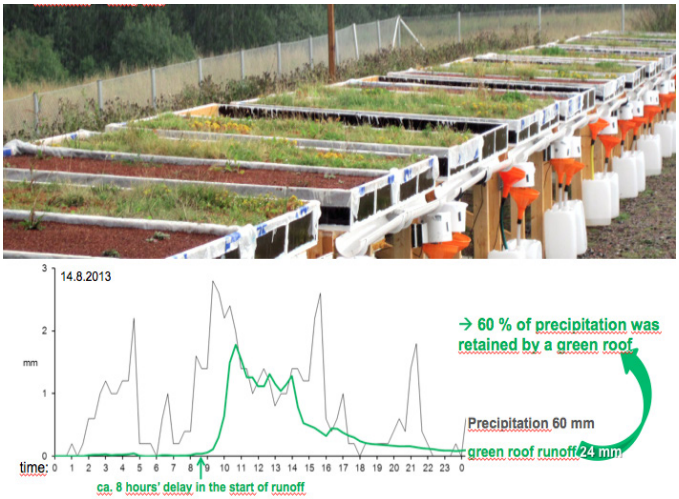


Figure 3: An experiment in Lahti, Finland in 2013 compared the runoff from a green roof and a conventional impervious roof. The results varied for different rainstorm intensity, however on average the green roofs were able to retain runoff by 8 hours and detain 60% of the total volume. This research, backed by other literature, was used to estimate the amount of water theoretically detained on site in the Skanssi context.

Green Roofs in Practice & Literature

Normal impervious roofs covered with asphalt or bitumen materials as well roofs with membranes covered with gravel have high, 85% to 95%, runoff values, incresing with storm intensity. These numbers are drastically reduced for the green roof scenario, ranging from 40% to 60% with increasing intensity.

In practice

Ramboll Oy - Green roofs are assumed to absorb approx 50% of total rainfall.

In Literature

Miller (1998) and Scholz-Barth (2001) - Peak flow rate reductions approx. 50%.

DeNardo et al. (2005) - green roofs retained 100% of smaller rains and 25% of larger rain.

Jarrett et al. (2006) 45-55% of the annual rainfall volume can be retained on the green roof.

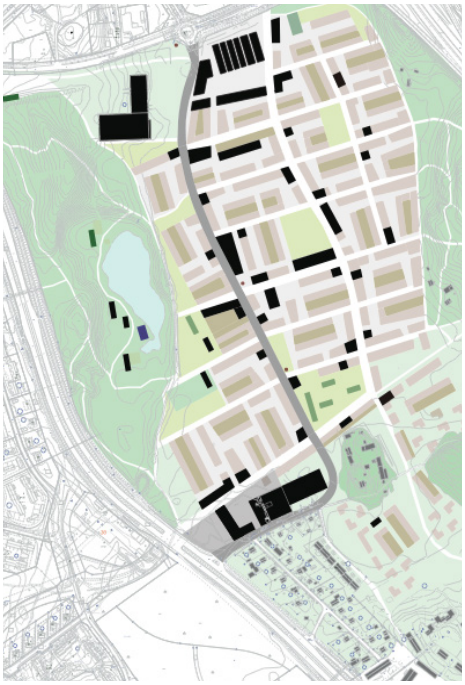
Conventional & Green Roof Runoff Coefficient

Conventional Roof C = 0.85 - 0.95

Green Roof C = 0.40 - 0.60

Design Scenarios Considered

SILMU



SOCIAL HUBS

GREEN HEART

Design scenarios considered: *Silmu, Social Hubs* ja *Green Heart (Skanssi 5)*

Assumptions:

A rooftop can only fit a green roof on 50-95% of its total area, depending on the building type. (Single family housing=90%, multiple attached housing=85% School/community centre/health centre=70%, small business =90%)

Roofs facing north (315-45 deg.) with a slope > 5% will not be suitable for green roofs in Finland and that other areas highly shaded from other building structures will also be unsuitable.

A uniform green roof structure will be used throughout with the following structural components:

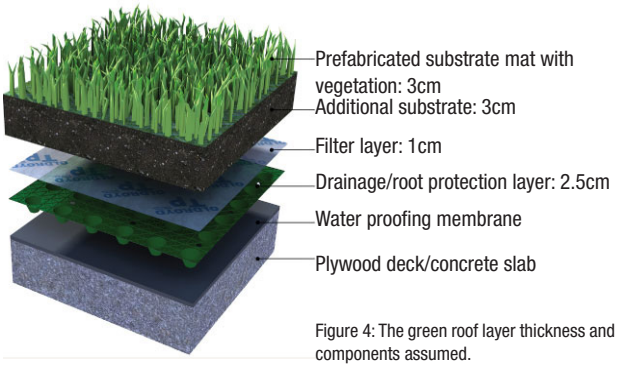


Figure 4: The green roof layer thickness and components assumed.

Time of Concentration

The time of concentration is the time it takes for water to travel from the hydraulic most distant point to the outlet increases with the application of green roofs. It is calculated using the assumption that there are three types of flows that occur as water flows further down the hydraulic path - sheet flow, shallow concentrated flow, and open channel flow. Sheet flow is derived from the kinematic wave equation and applies to the first 40 meters of flow where individual water droplets flow almost idependently or in small collective groups in the same direction over the entire surface area. Shallow concentrated flows are flows in isolated rills and gullies or increasing proportions. It is based on Manning's equation and assumes a roughness coefficient for a paved surface and an unpaved surface allowing deviations within these limits to be extrapolated. Finally, open channel flow, is the flow in streams, rivers, or pipes. It follows Manning's formula for surface roughness along the wetted perimeter and assumes a flow resistance coefficient based on the specific features and characteristics of the open channel. The time of concentration is the sum of each flow segment. The process and equations are elaborated below:

time of concentration $t_c = t_f + (t_{sc1} + t_{sc2} + \cdots + t_{scn}) + (t_{oc1} + t_{0c2} + \cdots + t_{ocn})$

$$t_f = 0.00288 \frac{(nL)^{0.8}}{\sqrt{P_2} * S_o^{0.4}}$$

Where;

n= Mannings roughness coefficiant
L= Length along hydraulic path
p_2= Precipitation with 2 yr, 24 hr intensity
S_o= Slope

$$t_{sc} = \frac{L_{sc}}{V_{sc}}$$

$$V_{sc} = 16.1345(s)0.5 - unpaved$$

$$V_{sc} = 20.3282(s)0.5 - paved$$

Where;

L_{sc}= Length along hydrualic path
V_{sc}= Flow velocity

$$t_{oc} = \frac{L_{oc}}{V_{oc}}$$

$$V_{oc} = \frac{1}{n} R^{2/3} s_o^{1/2}$$

Where;

n= Manning's roughness coefficient (open channel flow)
R= Hydraulic radius = A/WP
A= Cross sectional flow area
WP= wetted perimeter
S_o= Slope of the hyraulic grade line

Results & Discussion

The time of concentration was determined from constructing a theoretical - longest hydraulic path, based on the contours of the Skanssi site. The catchment area for both the complete Skanssi site and a subcatchment of the most densely built up area was analysed. The lessor of the two times of concentrations governed for peak flow determination. The time of concentration results for each design scenario are presented in table 1:

	Silmu	Social Hubs	Skanssi 5
Time of conc. bare roofs	39 min	32 min	35 min
Time of conc. green roofs	42 min	36 min	38 min

Table 1: Time for concentration for each design scenario

The peak flows were calculated from historical precipitation data obtained from the Finnish Meteorological Institute. Information regarding rainfall intensity, duration, and frequency of storm events are numbers averaged for southern Finland. The return period defines a storm duration and intensity that is likely to occur or be exceeded once in that time period. The 5 year, 10 year, and 100 year storm return periods relate to increasing storm intensity while the storm duration remains constant. For each design scenario the time of concentration is equal to the duration of the storm. This is consistent with the rational method of peak flow determination because at this time all of the catchment area is contributing to the volume of water at the effluent of the catchment area. The peak flows were calculated using the rational method and the results are presented in table 2:

The results show that for each design scenario, the time of concentration is increased for the case where green roofs are applied. In *Silmu*, the green roof case showed a time delay of 7% compared to the bare roof case. *Social Hubs* showed a time delay of 11% and *Green Heart* (*Skanssi 5)* a delay of 8% for the green roof case over the bare roof case. However it should be noticed that the building structure for *Silmu* had given the greatest time of concentration for both cases. In the design of *Social Hubs*, a large portion of the catchment area was covered by rooftops resulting in the largest runoff retention time. However, the remaining urban area is covered by streets, pedestrian walkways, and courtyards - all of which transport water quickly downstream.

	Silmu			Social Hubs			Skanssi 5		
Return period	5yr	10yr	100yr	5yr	10yr	100yr	5yr	10yr	100yr
Qp bare roofs (m^3/min)	67.0	83.5	138	134	168	295	113	142	228
Qp green roofs (m^3/min)	42.0	58.4	110	109	143	234	99.1	125	211
Qp % reduction	37	30	20	19	15	20	12	12	8

Table 2: Peak flows at catchment outlet.

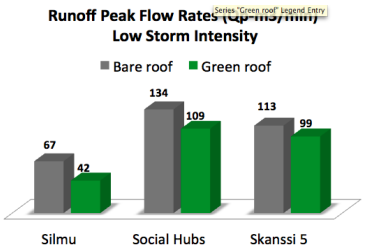


Figure 6: Runoff peak flows for each design scenario. A comparison of the bare roof and the green roof cases whith a storm intensity equl to a 5 year return period.

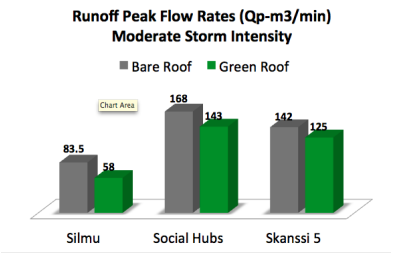


Figure 7: Runoff peak flows for each design scenario. A comparison of the bare roof and the green roof cases whith a storm intensity equl to a 10 year return period.

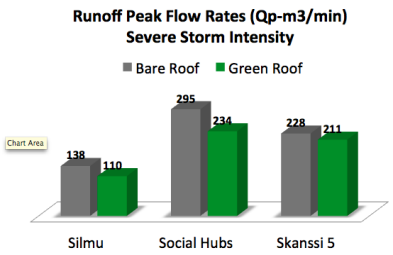


Figure 8: Runoff peak flows for each design scenario. A comparison of the bare roof and the green roof cases whith a storm intensity equl to a 100 year return period.

The reduced flow rate with green roofs also decreases the amount of pollutants (heavy metals, PAH's, suspended solids, nitrogen, phosphorous, etc.) that are picked up and carried downstream. The results from a study conducted by the University of Pittsburgh in 2006 reveal the extent to which reduced runoff decreases pollutants contained in stormwater runoff. The pollutant mass was calculated relative to the expected runoff reduction for the alternative roof types. The results are presented in Table 3.

Skanssi and the City of Turku want to conserve the fresh water and groundwater reserves in the area. Urbanization and polluted waters conventionally go hand in hand but regulations to reduce flow rates and detain a minimum amount of stormwater on site mitigates the effects of runoff contamination and provides groundwater recharge. This is important for sensitive groundwater areas like Skanssi. The use of green roofs along with other stormwater best management practices would help in keeping the local waters clean.

Downstream from the Skanssi catchment are sewer pipes that transport the runoff from the site, under the adjacent street, and further down stream. The sewer diagram in Figure 9 shows the pipe network and sizes. A 1200mm pipe governs the maximum flow rate capacity. Table 4 shows the minimum pipe diameter needed to transfer the runoff from each site at different rainfall intensities. The results show green roof effect the demand on the sewer network. Note that in *Green Heart* (*Skannsi 5*), a 5-year rainfall intensity requires the 1200mm pipe to be upgraded in the bare roof case but not in the green roof case.

Roof option (quality[a])	Control roof	Extensive green roof
Run-off reduction	33%	60%
Lead (g)	15	9
Zinc (g)	25	15
Cadmium (g)	0.15	0.08
Copper (g)	100	60

[a]Mass of pollutant in roof run-off per year based on an average annual rainfall of 0.94 meters.

Table 3: Green roof runoff reductions and its relationship to water quality.

Kuva 9: Skanssin jätevesiputket

	Silmu			Social Hubs			Skanssi 5		
Return period	5yr	10yr	100yr	5yr	10yr	100yr	5yr	10yr	100yr
Pipe diam. bare roofs (mm)	1060	1090	1350	1400	1520	1830	1220	1350	1570
Pipe diam. green roofs (mm)	930	1050	1280	1300	1450	1750	1150	1280	1530

Table 4: Sewer pipe minimum diameter required at catchment outlet.

Figure 5: Green roof assumed to be suitable for 3/4 of the total roof area.

Feasibility & Sustainability

Ecosystem services are the services provided by nature that humans rely on for their own well-being. Globally many of these services are being degraded rapidly or being used unsustainably and fresh water is no exception. The full cost of losing these services or the financial gains received from maintaining healthy services is difficult to measure. The traditional ways of urban development focus on the primary, easy to measure, benefits associated with economics and social needs, and utilizing nature only to further enhance theses two types of benefits. However, with increased knowledge on the state of the environment, came a need to change the way we live and develop. The health of the local and global environment needs to be considered in modern building methods and taken into equal considerations with economics and social needs.

Economically, green roofs have a higher cost tied to them with increased materials, longer installation labour time, higher structural loading from increased roof weight, and in some cases increased maintenance. The initial cost along with incomplete or unreliable engineering information, and general scepticism about incorporating living ecosystems onto a building, resists the implementation of green roofs. Nonetheless, studies continue to show the advantages of green roofs and how they can be a smart and feasible choice for a progressive neighbourhood.

At the 2012 Nordic Green Building Council's Conference in Helsinki, Philip Buttery the CEO from the International Sustainability Alliance explained that certified provides immediate returns on investments and on average certification provides higher rental rates by 2-5% and more stable occupancy, higher effective rents by 6-7% and higher selling price by 11-13% when compared to traditional office buildings. Furthermore, when examining the financial benefits of a green building it has been show that people working in a green office building are more productive, they experience less absenteeism, and have a general increase in health, well being, and satisfaction towards indoor environmental quality.

Certification

Certification is an effective tool for driving the sustainable building markets forward. Green roofs provide reduced energy use, heat island mitigation, increased biodiversity, as well as natural storm water management. All of these features are rewarded with certification points under many of the major certification programs. The demand for green buildings and green neighbourhoods is rising as the public become more knowledgeable of the benefits and interested in being more environmentally friendly. The rising cost of fuels and energy is also a major influence on the demand for greater efficiency and conservation. These demand produce the market and customers who want an environmentally friendly product. Hence the creation of over 50 major certification programs worldwide including certification programs for neighbourhood development.

Certificaton Advantages	People
Office buildings	More productive employees
2-5% higher rental rates	37% reduced sick leave
6-7% higher effective rents	
11-13% higher selling price	

Buttery 2013, CEO of ISA

Measuring the Benefits

When measuring the worth or value of a green roof it is important to create valuation methods for the social, health, and environmental benefits that are otherwise left out and to consider all the externalities involved with their inclusion in the neighbourhood. These include: Improved air quality, decreased sewer piping infrastructure, aesthetically pleasing environment, reduced heat island effect, noise level reduction, carbon sequestration, and wildlife habitat and biodiversity enhancement.

In an effort to measure the benefits associated with reduced energy demand, stormwater management, and air quality improvement a study from the University of Michigan produced the graph shown in figure 10. The net present value is compared for a conventional roof and a green roof under different valuation methods. Although the most important factor came from the fact that green roofs have a life span of twice that of a conventional roof, when the other benefits were measured as well, it is seen (from the lower left corner of the black dotted box) that the NPV of a green roof is less than the NPV of the conventional roof after only 10 years.

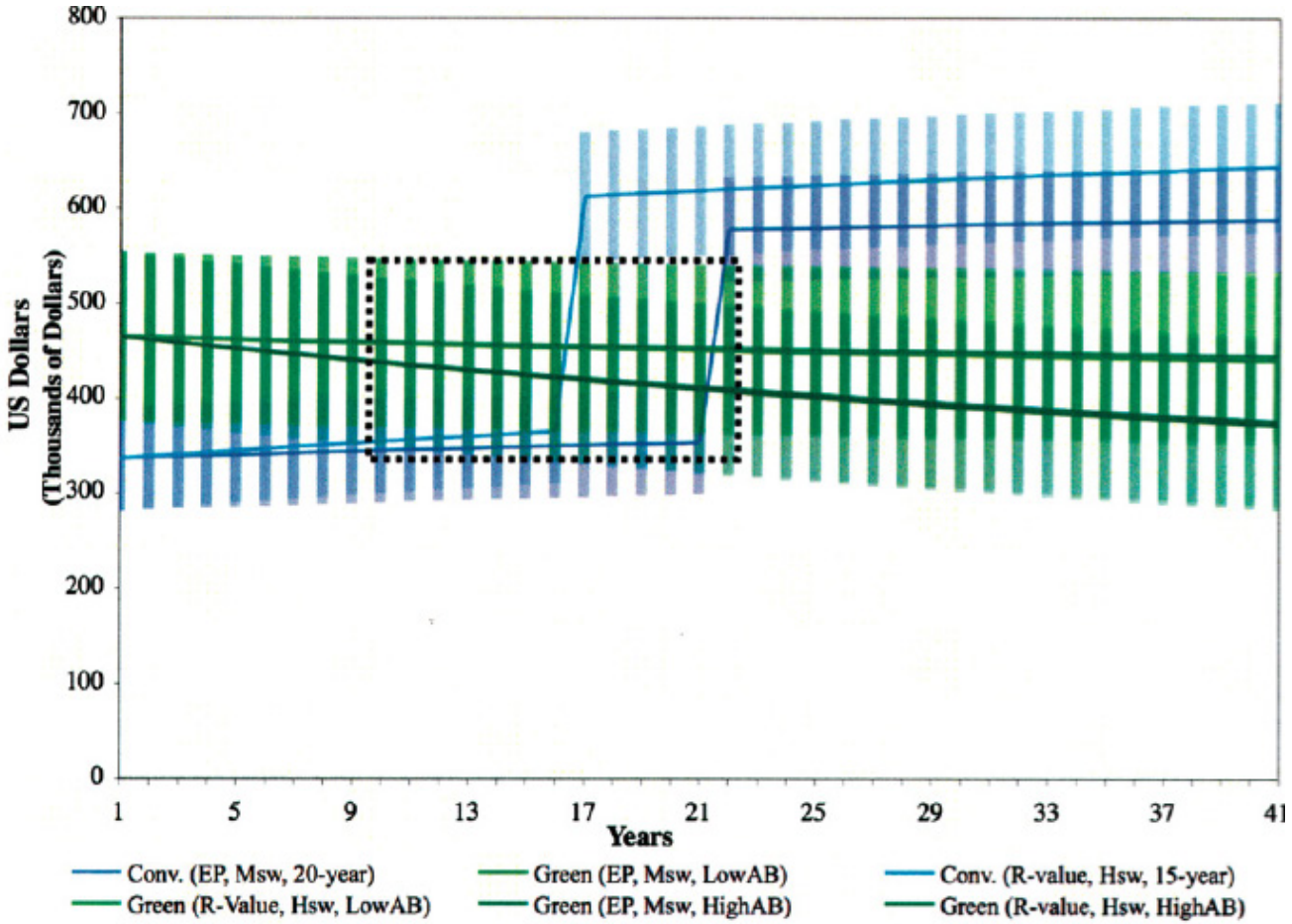


Figure 10: Net present value of a green roof and conventional roof considering novel valuation methods.

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