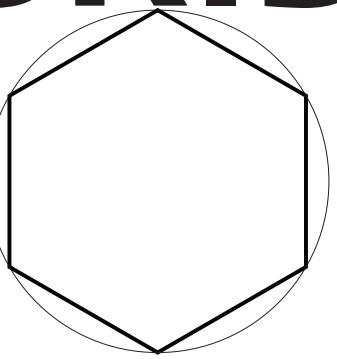
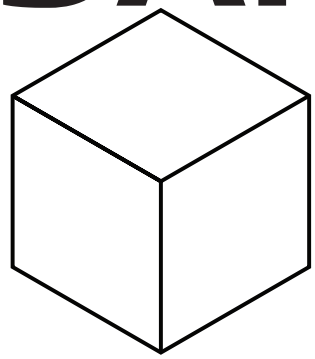
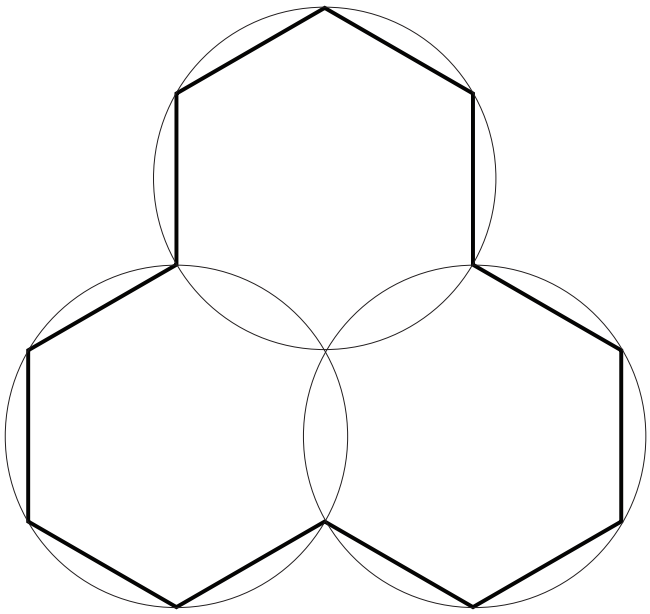
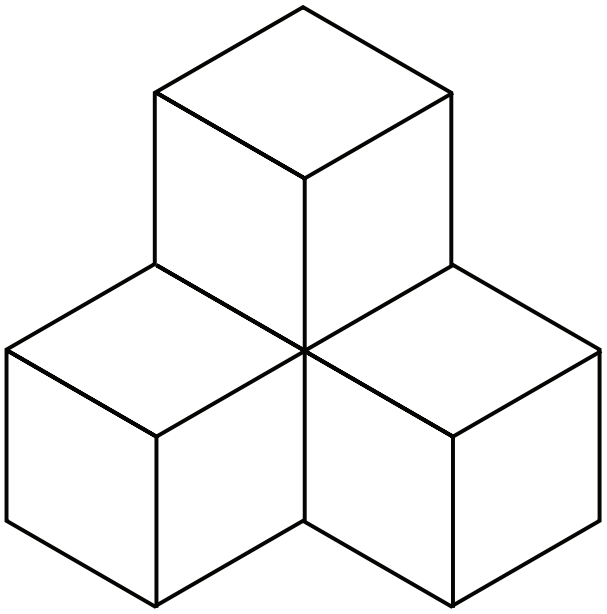
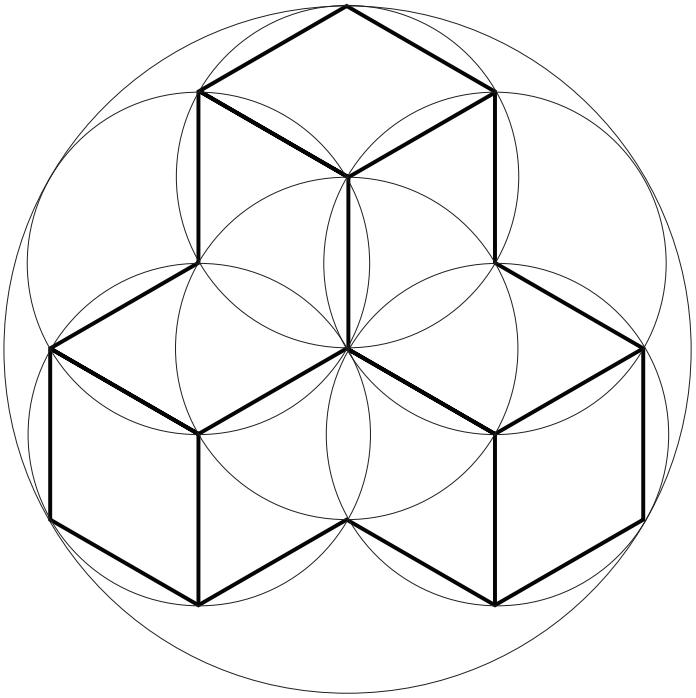
HYBRID URBAN-ISM

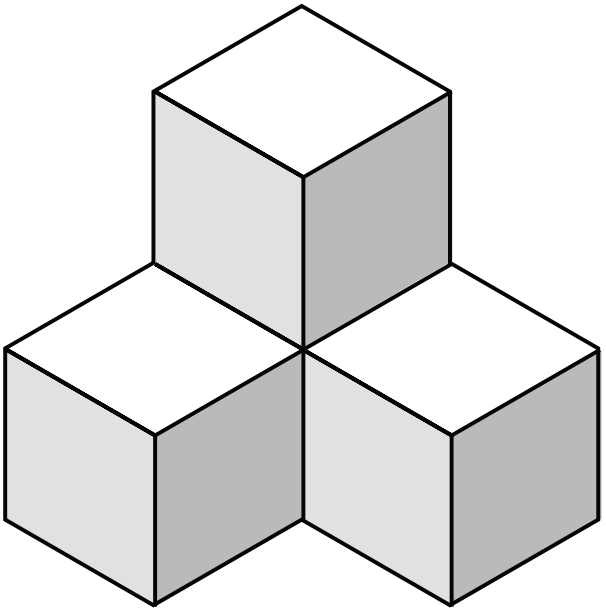












Towards adaptive densities

Title Sheet

Aalborg University
Faculty of Engineering and Science
Departure of Architecture, Design & Media Technology
Master of Science in Urban Design, Urban Architecture

Title
Hybrid Urbanism - Towards adaptive densities

Theme
Densification of Copenhagen

Keywords
Hybrid, Urbanism, Density, Resilience, Sustainability, Compact City, Social Condenser

Thesis Period
01.02.2016- 25.05.2016

Supervisors
Professor, PhD MSc M.Arch Hans Kiib
Associate Professor, MSc Civ. Eng. Niels Agerholm

Aleksander Borg Pedersen
20142909
URB MSC04

AALBORG UNIVERSITY
DENMARK

Preface

This thesis was written in 2016 in Copenhagen. As it gradually revealed its challenging nature, it simultaneously exposed facinating litterature from a wide variety of researchers, writers and publishers as A+T Research Group, Winy Maas, Jan Gehl, Rem Koolhaas, Poul Bæk Pedersen and many others. The litterature was examined with great interest and sparked numerous ideas that could not be included in this thesis.

I would like to thank my supervisor Hans Kiib for his honest feedback, since "ærlighed er kærlighed uden 'k'" and my technical supervisor Niels Agerholm who reminded me that trees doesn't grow into heaven. I would like to thank my mother, father and family for their irreplaceable support. Also James for the mellow wisdom, numerous house dj's for keeping the tempo at night and my fellow students, who looked out for me. Finally, my friends for their calm insights to the entire process and their support at the most dire times.

Reading Guide

This thesis is divided into four chapters and accompanied by a drawing folder.

The first chapter contain the abstract, introduction, vision and concept. This outline the main problem this thesis aim to solve and the context in which the discourse takes place.

Subsequently, the second chapter contain the analysis, theoretical reflection, methodology and case study. This chapter dissect the potentials and problematics that are directly related to the strategy and design proposal.

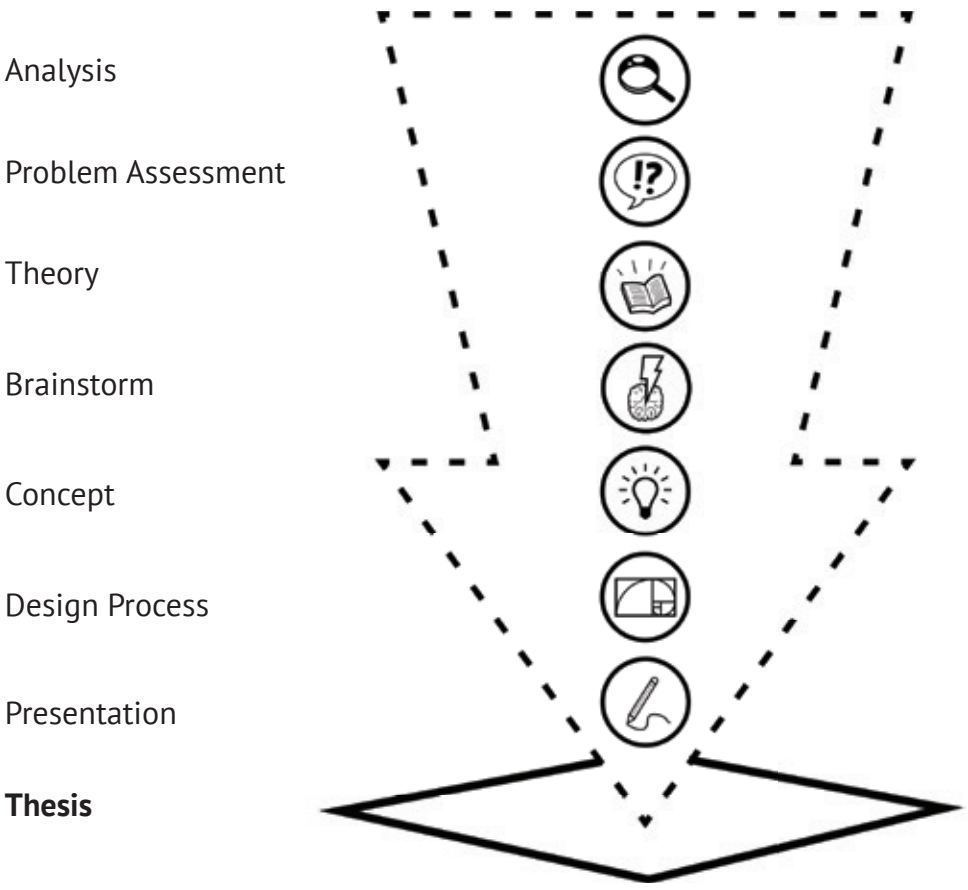
The third chapter contain the design process, principles, urban strategy, architectural concept as well as the drawings, visualizations and technical solutions. In this chapter, the design proposal and strategic tools for future development are presented with the main body of graphic material.

Finally, the fourth and last chapter contain the conclusion and reflection, which conclude the thesis and reflect upon possibilities, had the thesis continued.

Table of content

Chapter I - Introduction and Vision

Thesis Development



Ill. 1 Thesis development: Illustration of the thesis' processual development

Abstract

The primary aim of this thesis was to uncover the optimal method for designing a desirable human habitat with a relatively high urban density. The challenge was to design quality housing that could provide its inhabitants with sufficient daylight, comfortable microclimate, abundant green spaces, safe and efficient infrastructure and plenty of social and public amenities.

The research questions took point of departure in accomodating the increasing urban immigration to Copenhagen and the requirements of a this diverse demographic.

- What are the requirements of a growing contemporary urban population and how can an increasingly denser city meet these?
- How do you design for densification with quality?

With emphasis on the design proposal, this thesis provide a methodology for development of a large scale urban neighborhood, with an urban design strategy and architectural concept along with principles for development. With focus on dense urban living, the design proposal provide-apartments for 15.000 inhabitants including public amenities and an infrastructural solution for the increased traffic flow. Furthermore, the methodology and design process provided a method to design with iterative quality assessments, to systematically ensure the best possible living conditions for future inhabitants.

Denmark

Copenhagen

Refshale Island

Project Site

12 Ill. 2 Location: From Global, to national and finally local scale. Location of the project area and site restriction.

Introduction

On a planetary scale, our civilization experience an unprecedented urbanization. Currently, 54% of the worlds population live in urban regions and by 2050 the urban population will reach 66% globally (United Nations, 2014).

On a national scale Copenhagen is the fastest growing city in Denmark and it is densifying with approximately 1000 migrants every month and by 2025 the city's population will have increased with 100.000 inhabitants (Københavns Kommune, 2015). From 2015 to 2025, the municipality has planned to build 45.000 dwellings and 6000 student apartments, while the following areas are planned for development; Nordhavn, Sydhavn, Carlsberg City, CPH Science City, North East Amager and Ørestad (Center for Byudvikling, 2015). The surplus from sales of lots in these areas, finance the metro development and is under administration of the Port & City Development company. The Port & City Development facilitates much of the public development processes within Copenhagen and is owned by the municipality of Copenhagen and the Ministry of Transport (Center for Byudvikling, 2015; CPH City & Port Development, 2016).

When current housing development plans are finished, new areas must be taken into consideration as the urban population is expected to increase. Between 2025 and 2030, the population in Copenhagen will increase with approximately 30.000 inhabitants (Center for Byudvikling, 2015; Københavns Kommune, 2015), so to accomodate the urban immigrants, the last undeveloped area within the municipality must be included in development of the city; the Refshale Island. An important requirement for development is that infrastructural conditions must improve, which has lead to planning of a harbour tunnel from Nordhavn through Refshale Island and further on to Amager (Rambøll, 2012).

The increasing population growth combined with Copenhagen Municipality's plan to create a 'city for people' (Københavns Kommune, 2015) creates a series of challenges which leads to the question: What are the contemporary requirements for a growing urban population and how can an increasingly denser city meet these? How do you design for densification with quality?

As a hybrid, this thesis will span between a pragmatic design based upon parametric principles and an academic design method. The purpose of this thesis is to design an urban habitat that envelops all aspects of living: Intrigues and jealousy; love and infatuation; desire and apathy; ecstacy and relief. As such, the design will both participate in and witness the fractal evolution urban living.

Vision and Concept

Potato Rows **Radisson Blu Royal Hotel** **The Mountain**

The vision of this thesis is to accomodate an increasing urban population on decreasing available land and envelop integral parts of the municipality's vision for Copenhagen and Refshale Island (Center for Byudvikling, 2015; Københavns Kommune, 2015; Thiemann et. al., 2015). This will be based upon research and theory in urban design. This thesis will propose a new urban neighborhood with an urban strategy for the entire Refshale Island and a detailed example of how to start and continue development from the 'anchor point' on a limited area within the site. Furthermore the solution will integrate mobilities in the urban fabric as part of the urban strategy and accommodate the mobilites peformance, that a new urban development requires. The thesis will be a feasible answer, but an experiment and thereby a foundation for debate on how to design for dense living. It will challenge the current building tradition by accomodating emerging tendencies in contemporary living and provide a tangible option based upon the research and theories of Winy Maas, Jan Gehl, Rem Koolhaas and Poul Bæk Pedersen.

The design proposal will consist of an urban strategy and an architectural concept, both with a series of design parameters; a design of the anchor point, which represents the first phase of development, and a set of urban and architectural principles for future planning and development of the Refshale Island. Thereby the thesis will provide a methodology for solving urban planning and design problems in relation to dense human habitats, while it accomodates the needs in Copenhagen for housing demand and a possible direction for future urban development.

The concept envelops a hybrid between three different typologies that contribute to Copenhagen with three very different and individual set of values. These represent pinnacles of their time with qualities applicable to this thesis. They are inherent landmarks in the context of Copenhagen, but have an important role in each respective time of construction. This is highly relevant to the Refshale Island as it has undergone an adaptive transformation through each of the three industrial revolutions from the 1st industrial revolution in the 18th century untill today with the beginning of the 4th industrial revolution in the 21st century (Bjarnesen et. al. 2014; Lauring, 2006; Schwab, 2016). The historic context and relation to Refshale Island is further explained on page 20.

 Ill. 3 Concept diagram: Concept with the typologies: Potato Row Houses, Radisson Blu Royal Hotel, The Mountain which combined leads to the hybrid urbanism design.

Hybrid Urbanism

The Potato Row dwellings show an example of the intrinsic values the concept aims for, with its urban and architectural qualities of livability, its 'human scale' (Gehl, 2010) and its tactility. This was an important typology in the 1st industrial revolution and has become a symbol of the danish values of solidarity from strong worker unions and a sprouting welfare state.

These values are intertwined with the contrasting Radisson Blu Royal hotel with its more extrinsic values of density performance, historic value and icon of *gesamtkunstwerk* in Copenhagen. It is a symbol of what you could call a danish architectural renaissance started by Arne Jacobsen (Sheridan, 2011). The building marked Copenhagen's entrance to the 2nd industrial revolution with modernistic - almost elitist - characteristics in a very democratic urban context, but most importantly it set a standard for an extreme attention to detailing and how danish culture could interpret the concept of a complete and ideal *gesamtkunstwerk* (Sheridan, 2011).

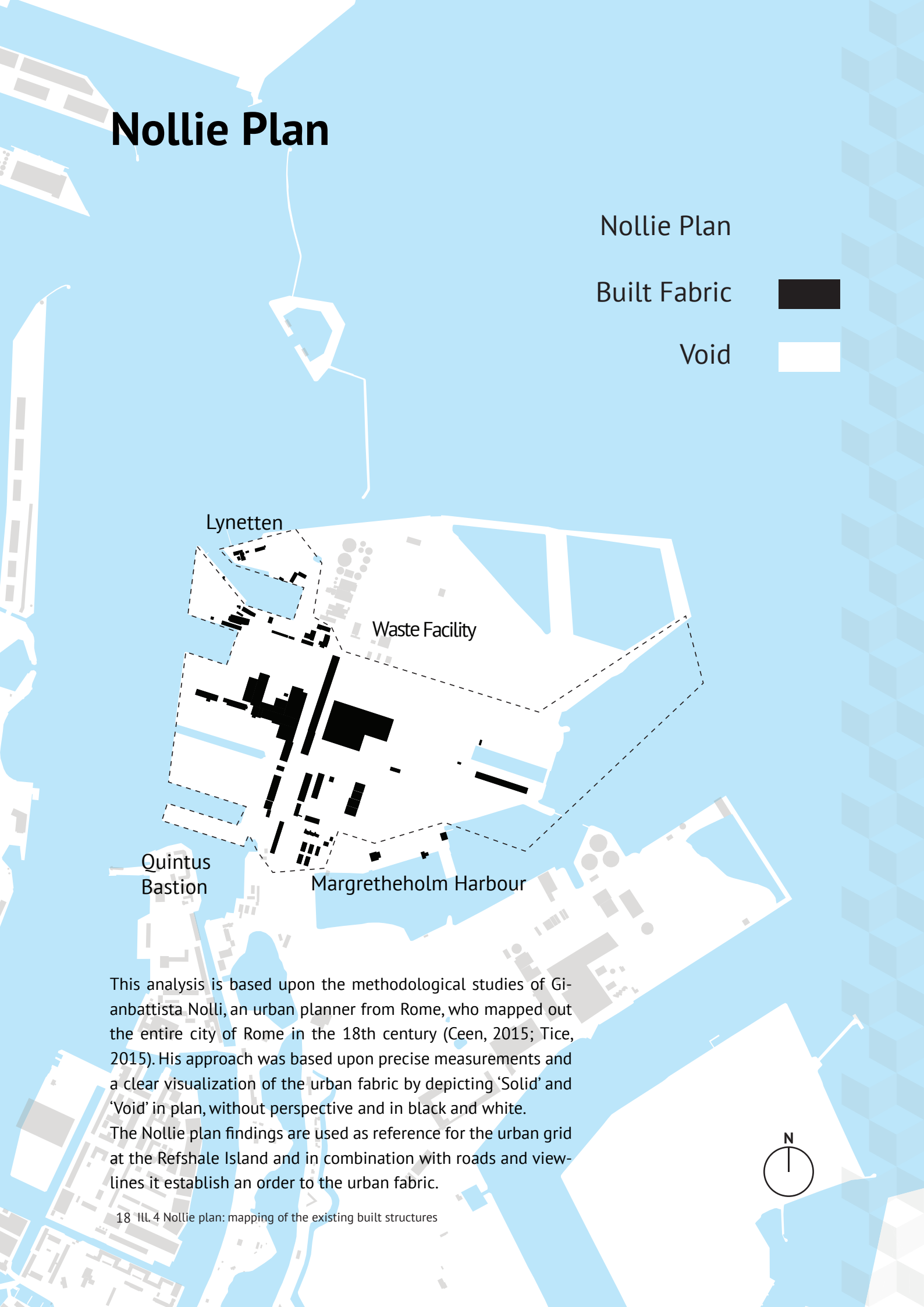
Finally The Mountain dwellings by PLOT (former JDS and BIG architects) envelop an answer to what the contemporary hybrid habitat should provide its inhabitants. It redefines the conventional typological separation in a hybrid with social cohabitation and amenities which are usually exclusive for suburban living, in close vicinity to the city center (Ingels, 2010). To a certain extent it synthesize the values of livability in the 3rd industrial revolution, which has branded Copenhagen as a prime example of an urban sustainable human habitat (Københavns Kommune, 2015)

Each typology contribute with both intrinsic an extrinsic, values to the urban and architectural principles as well as design and development of the anchor point. Thus the three typologies provide not only with cultural and social value but also with urban performative and architectural value, as three examples that have become a part of the cultural history of Copenhagen. The merge of these typologies provide an aim and a set of qualities for how new urban development should perform while adhering to the building traditions of Copenhagen. As the 4th industrial revolution is approaching, this concept takes a step towards an increasingly adaptive hybrid typology, which is scalable, modular and quite anonymous to the point of being an adaptive method - more so than a fixed typology. Thereby it can adapt its morphology to local and contextural requirements while providing its inhabitants with optimal conditions for contemporary livability.

Chapter II - Analysis and Discussion

Context Analyses
Historical Analysis
Site Analyses
Theoretical Discussion
Methodology
Case Study

Nollie Plan



This analysis is based upon the methodological studies of Gianbattista Nolli, an urban planner from Rome, who mapped out the entire city of Rome in the 18th century (Ceen, 2015; Tice, 2015). His approach was based upon precise measurements and a clear visualization of the urban fabric by depicting 'Solid' and 'Void' in plan, without perspective and in black and white.
The Nollie plan findings are used as reference for the urban grid at the Refshale Island and in combination with roads and viewlines it establish an order to the urban fabric.

 Ill. 4 Nollie plan: mapping of the existing built structures

Analytic Discourse

The following section contain a series of conducted analyses, which have been directly or indirectly translated to the design, either through the individual design parameters or by providing essential information for the urban and architectural principles as well as the urban strategy and architectural concept.

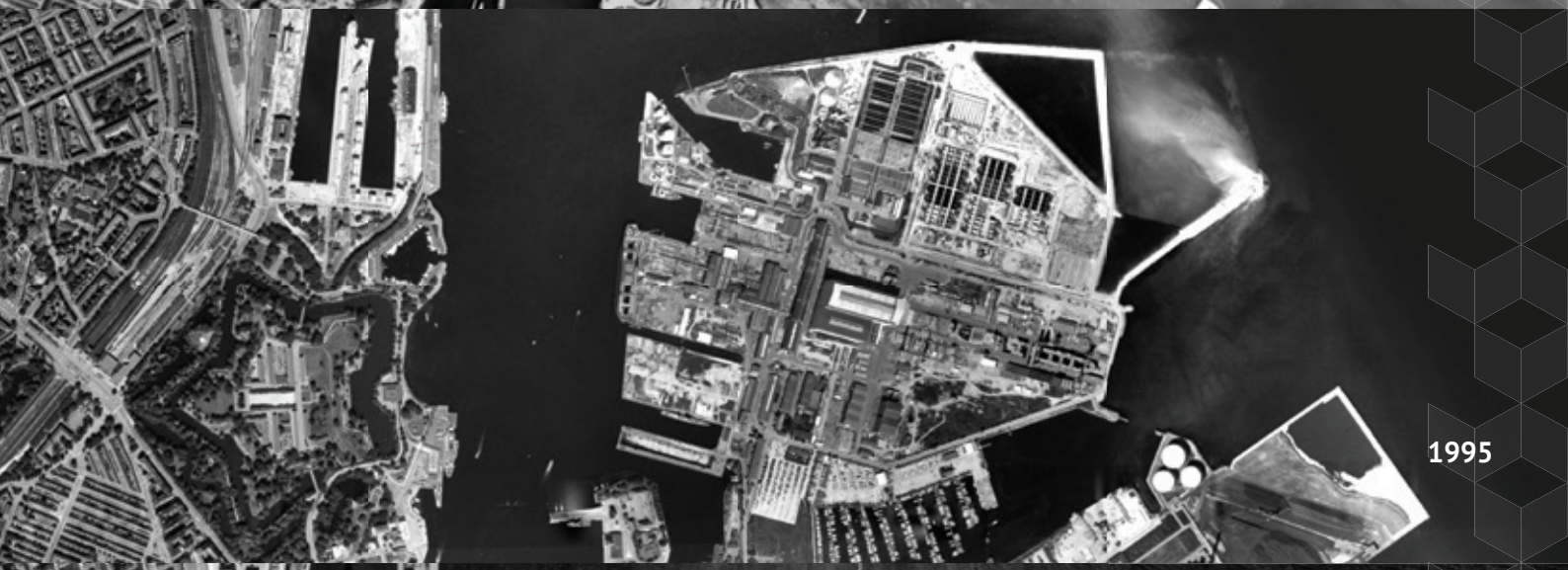
The conducted analyses consist of a Nollie plan and mobilities analysis, which gives an overview of the island with its existing built structures, the surrounding context and future planning for the Refshale island and Copenhagen. Subsequently, the historical analysis reflects upon the island's adaptive development through three industrial revolutions. The section continues with analyses of programs on the island, building heights, current infrastructure, green spaces, smell pollution, wind conditions, views and viewlines, as well as structures for preservation found with the SAVE method (Guaralda et. al., 2012; Bjarnesen et. al., 2014; Ceen, 2015; Tice, 2015). Finally the mapping of land ownership and the local plan give insight to the power balance between the actors, which is important to accomodate the economic and political forces which already are established (Bjarnesen et. al. 2014; Thiemann et. al. 2015). But also to avoid neglect of less powerful but equally important actors; the few existing users and future inhabitants just as well (Thiemann, 2015). These can provide qualitative long-term qualities of social, cultural and recreative and counteract unwanted gentrification. In this case it is evident that the few current and many potential users have little to say in the process and require a representation through the designer to avoid a top-down developed environment. Since there are almost no inhabitants on the island, even if there was a focus group, no one would show up (Bjarnesen et. al. 2014).

The local plan was developed with three actors: the municipality of Copenhagen, Refshaleøens Ejendomsselskab A/S and the City & Port Development I/S which . It propose houseboats to the west, a 30.000m2 solar panel park, a large event space east to the B&W halls and generally to use the existing industrial buildings for creative entrepeneurship, which is highly prevalent. The municipality doesn't allow any changes in the local plan, thereby no development, until 2023 and requires a significant improvement to the infrastructural facilities to and from the island (Bjarnesen et. al. 2014; Thiemann et. al. 2015), which will be described in the section 'Mobilities Analysis' on page 40.

The analyses reveal several potentials in both the history, landscape and urban structure of the site. As the site contains many potentials, it is currently utilized by temporary programs as creative and recreational business and cultural events. The municipality and Refshaleøens Ejendomsselskab afford these activites to direct attention to the island and attract investors as well as public interest in the area: To catalyze public life as a foundation for future development (Bjarnesen et. al. 2014; Thiemann et. al. 2015).

1899

1954



1995

2015

Historical Analysis

In 1170 King Absalon built his castle at Strandholmen, which marked the beginning of Copenhagen Harbour. With its central placement in Øresund, close to Sweden and Helsingør, the Copenhagen harbour became an economic and diplomatic keypoint in strategic urbanisation. King Christian IV utilized this strategic potential and expanded development of the harbour along with urbanisation of Copenhagen, to mark the city as a metropol (Bjarnesen et. al., 2014).

The late 18th century, brought the 1st industrial revolution and with it came water and steam-powered mechanical production (Schwab,). In Copenhagen, the Copenhagen Harbour Company established Refshale Island in 1868, to accomodate the commercial activity following mechanical production. Refshale Island was initially used for storage of navy material and commercial activity, and the excess excavation soil was used to expand areas as the Refshale Island.

In the late 19th century the 2nd industrial revolution brought electricity along with divison of labour and mass production (Schwab, 2016). Thus, Refshale Island changed purpose to accomodate not only increased commercial but also industrial activity and production. In 1872 the island was acquired by Burmeister & Wain (B&W) for industrial ship production, while gradually transitioning from commercial goods transport and completely abandoning storage for the navy (Bjarnesen et. al. 2014). In 1918 the island's connection to Holmen to the south was improved to accomodate increased traffic for the industrial production of ships. After World War II, the 2nd industrial revolution had matured to significantly increase mass production. Industry in Copenhagen Harbour expanded during the 1950's along with the Refshale island, and the B&W factory occupied 10.000 workers at its maximum - including the author's grandfather. At this point the island was used for industrial ship production primarily. B&W expanded with the large shipping dock to the east, which was established to prepare ships before delivery and connected to the new 'B&W halls' for ship assembly (Bjarnesen et. al., 2014) and in 1960 the shipyard was fully developed for industrial production and goods transport (Lauring, 2006).

The 3rd industrial revolution, in the late 1960's, introduced electronics, Information Technology and automated mass production (Schwab, 2016) and Refshale Island expanded to the size it occupies today, during the 1970's. During the 80's and 90's industrial ship production moved to developing countries in Asia and as a result, B&W declared bankrupt in 1996. The four pension funds; Sampension, PKA, PFA Pension and Lønmodtagernes Dyrtidsfond established Refshaleøens Ejendomsselskab A/S to acquire the island with plans of future urban development (Bjarnesen et. al. 2014).

The island is currently occupied by various creative businesses and cultural institutions, while many of the former industrial buildings are used for temporary events and festivals as Distortion, Copenhell and Eurovision. These initiatives attract investors and attention to the island to afford public life before developing on the island. The owners plan to make the island a Co2 neutral neighborhood and cooperated on a new local plan with the municipality of Copenhagen, which contains a 30.000m2 solar panel park (Bjarnesen et. al. 2014; Thiemann, 2015) The question remains: How will Refshale Island adapt to the future and arrival of the 4th industrial revolution? (Schwab, 2016)

Ill. 5,6,7,8 History: the development of Refshale Island through 4 industrial revolutions


Hellerup
Nordhavn Tunnel
Nordhavn
Planned Tunnel
Road
Bicycle Highway
Critical Points of Contact
Østerbro
Nørrebro
Critical Points of Contact
Amager Resource Center
Copenhagen Skiresort
Copenhagen K
Copenhagen Cable Park
Christianshavn
Amager
Sydhavn
Islands Brygge
N
Connection to Ring Road

Mobilities Analysis

Copenhagen is undergoing significant changes as the public metro is expanded and residential development is vastly increasing along with increasingly liberal building codes for high-rise development. The municipality attracts strong human capital and provides the inhabitants with social capital in form of recreational facilities and highly praised 'livability' in the urban environment (Center for Byudvikling, 2015; Københavns Kommune 2015; Saaby, 2016).

The mobilities analysis is based upon the theoretical concepts of 'Mobilities and the Network City' and 'Critical Points of Contact' by Ole B. Jensen (Jensen et. al. 2011; 2012; Jensen, 2013; 2014) which defines the analysis perspective of mobilities development in Copenhagen. Mobilities (in plural) is thereby used as defined by Jensen and simplified as such; all infrastructural networks whether virtual, physical, social or otherwise transportational structures of the information society.
This analysis shows the current state of bicycle and automobile mobilities as well as the planned Nordhavn tunnel (Rambøll, 2012), which will establish a peripheral ringroad east of the city center. The Critical Points of Contact are the most important infrastructural nodes as these will be the key points of traffic intersection as soon as the tunnel is finished.

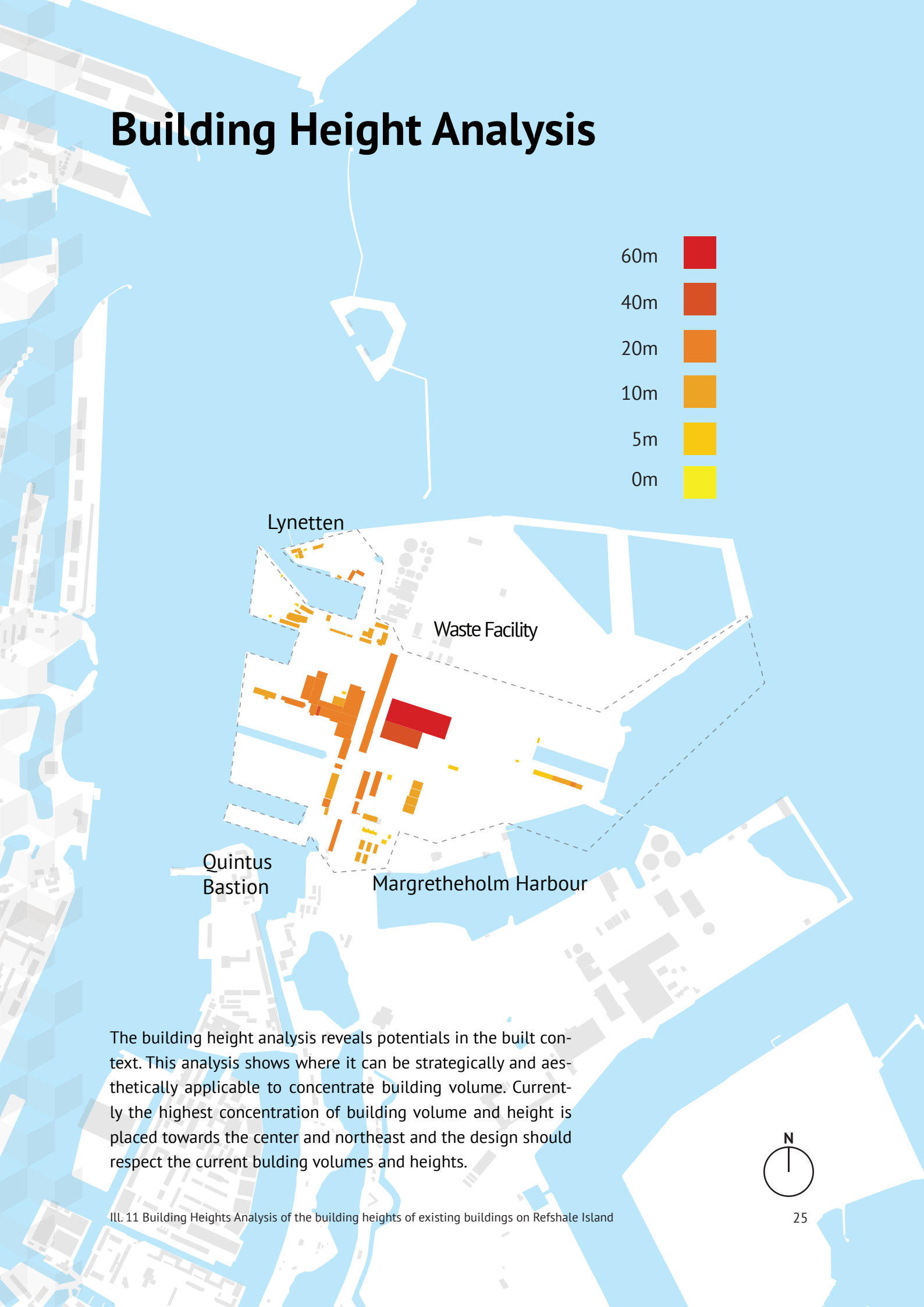
As introduction to future complications, the analysis serves to prioritize the most important planning problems and point of departure for the technical solution. As it is necessary for the design in general to calculate parking and traffic capacity for the entire island. Subsequently the parking must be integrated in the design and ensured sufficient space to accomodate the traffic from the tunnel in addition to the increased traffic as result of development.

Infrastructure Mapping

To identify problems and potentials of infrastructural character, the mapping serves as a powerful tool. It is clear from the mapping that cars are prioritized over pedestrians and bicycles. There are no dedicated pathwalks for pedestrians an only a few hundred meters of bicycle lanes, which insufficient for a housing area, which this will become. The public and private roads provide a well connected infrastructure and can be utilized for more recreational activities, suited for a housing neigbourhood.

 Ill. 10 Infrastructure: Analysis of the infrastructural grid on Refshale Island

Building Height Analysis



The building height analysis reveals potentials in the built context. This analysis shows where it can be strategically and aesthetically applicable to concentrate building volume. Currently the highest concentration of building volume and height is placed towards the center and northeast and the design should respect the current bulding volumes and heights.

Ill. 11 Building Heights Analysis of the building heights of existing buildings on Refshale Island

Green Space Mapping

The island provides plenty of green spaces, despite them being of poor ecological quality (i.e. low biodiversity). A majority of the green spaces are grass lawns with occasional bushes and almost no trees. These could potentially be connected to form a continuation on the island.

 Ill. 12 Green Space: Analysis of the green spaces on Refshale Island

Viewlines Analysis

Within the existing urban fabric are a series of viewlines and views. Since the old industrial buildings are placed in an orthogonal order, the streets and spaces within create east/west oriented corridors with views toward some of the most prominent landmarks in Copenhagen. The viewline analysis provides qualitative data to establish a grid with respect to these views and the existing urban fabric.

Ill. 13 Viewlines: Analysis of the viewlines on Refshale Island

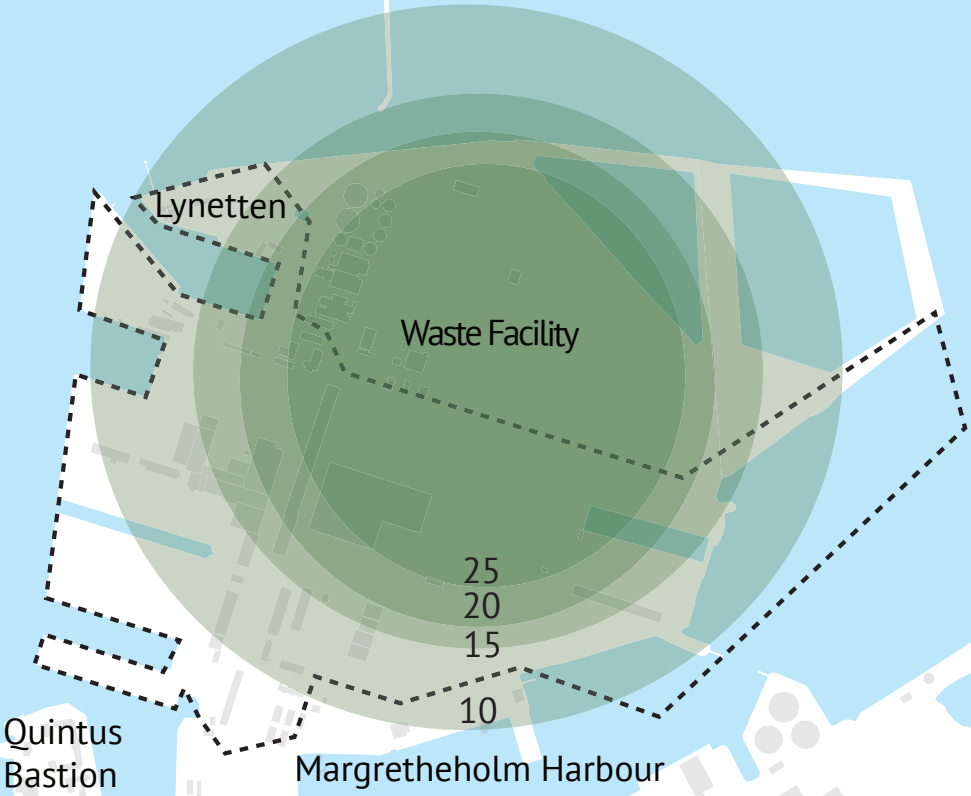
Smell Pollution Analysis

Smell pollution measured in LE units

Dwellings: 10LE max

Recreation: 15LE max

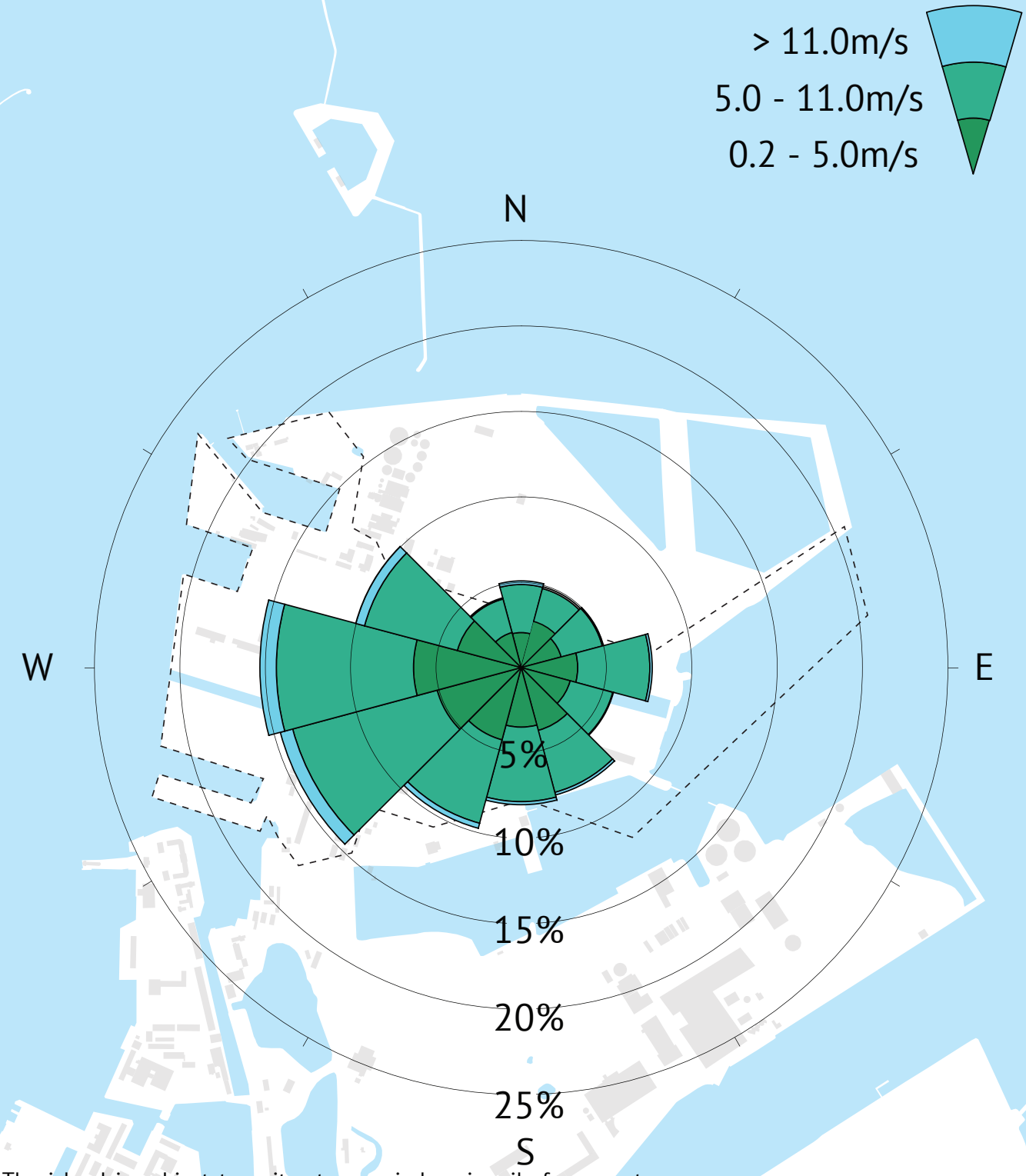
Business: 20LE max



A waste water facility is placed in the northeast corner on Refshale Island which eminates some smell pollution. According to the local plan the problem is significant and needs a solution (Thiemann et. al. 2015). The problem is luckily solvable with chemical treatment of the wastewater to avoid smell directly from the wastewater tanks. Furthermore, the tanks should be covered to encapsule the smell more effectively. This is a quite simple and costeffective solution (Bjarnesen et. al. 2014). Fortunately the wind blows towards east and away from the center of the island.

 Ill. 14 Smell Pollution: Analysis of the smell pollution on Refshale Island

Wind Rose Analysis



The island is subject to quite strong winds, primarily from west and south-west which requires significant attention to avoid inhabitable urban spaces. The wind must be disrupted, dispersed and deflected to decellerate the wind velocity (Thiemann et. al. 2015).

Ill. 15 Wind Conditions: Analysis of the wind conditions on Refshale Island

Programmatic Mapping

A majority of the occupants are creative business or cultural and recreational programs. The business program consist primarily of small companies with various creative products or services, while the cultural programs are mainly public or governmental. The few residents are placed in approximately ten houseboats, three rowhouses and a temporary immigrant housing village.
The various existing programs could easily be complimented with a housing neighbourhood with less varied programs, as the two contrasts would create a programmatic diversity together.

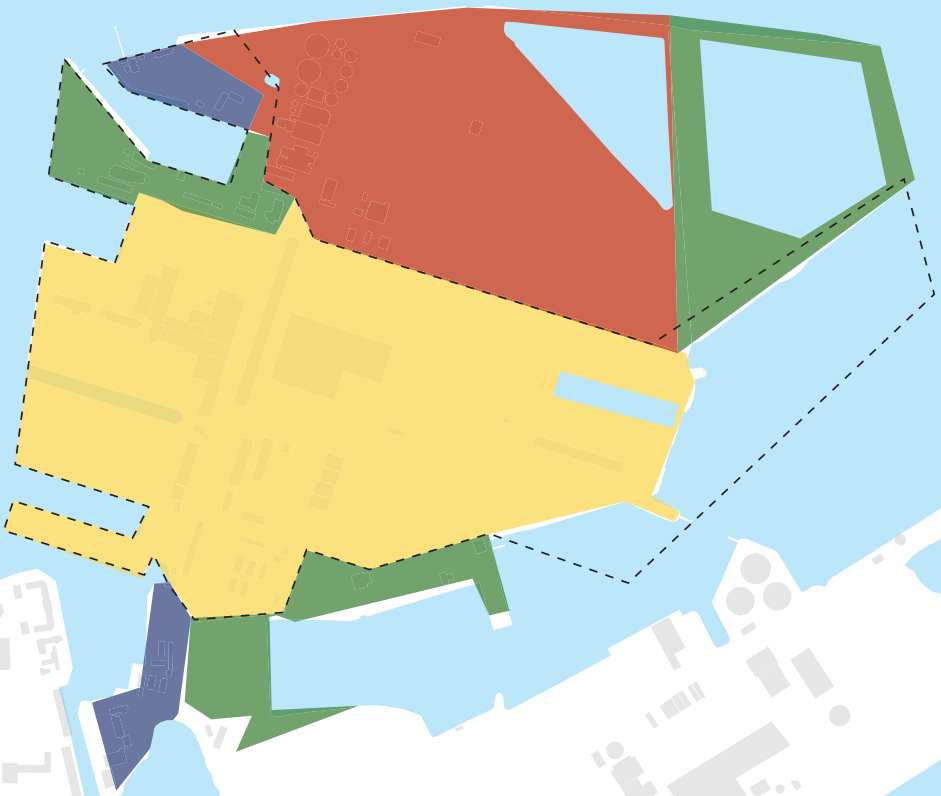
 Ill. 16 Programs: Analysis of the programs on Refshale Island

Preservation Analysis

This preservation analysis is based upon a SAVE analysis (Bjarnesen et. al. 2014) and a best-practice to ensure sufficient area for housing development and that the historical qualities is preserved. The most important historical buildings are kept along with the buildings that currently holds active business programs and have been restored for this purpose. Thereby the preserved buildings have an active role in reviving the island.

Ill. 17 Preservation analysis: Analysis of the buildings to preserve on Refshale Island

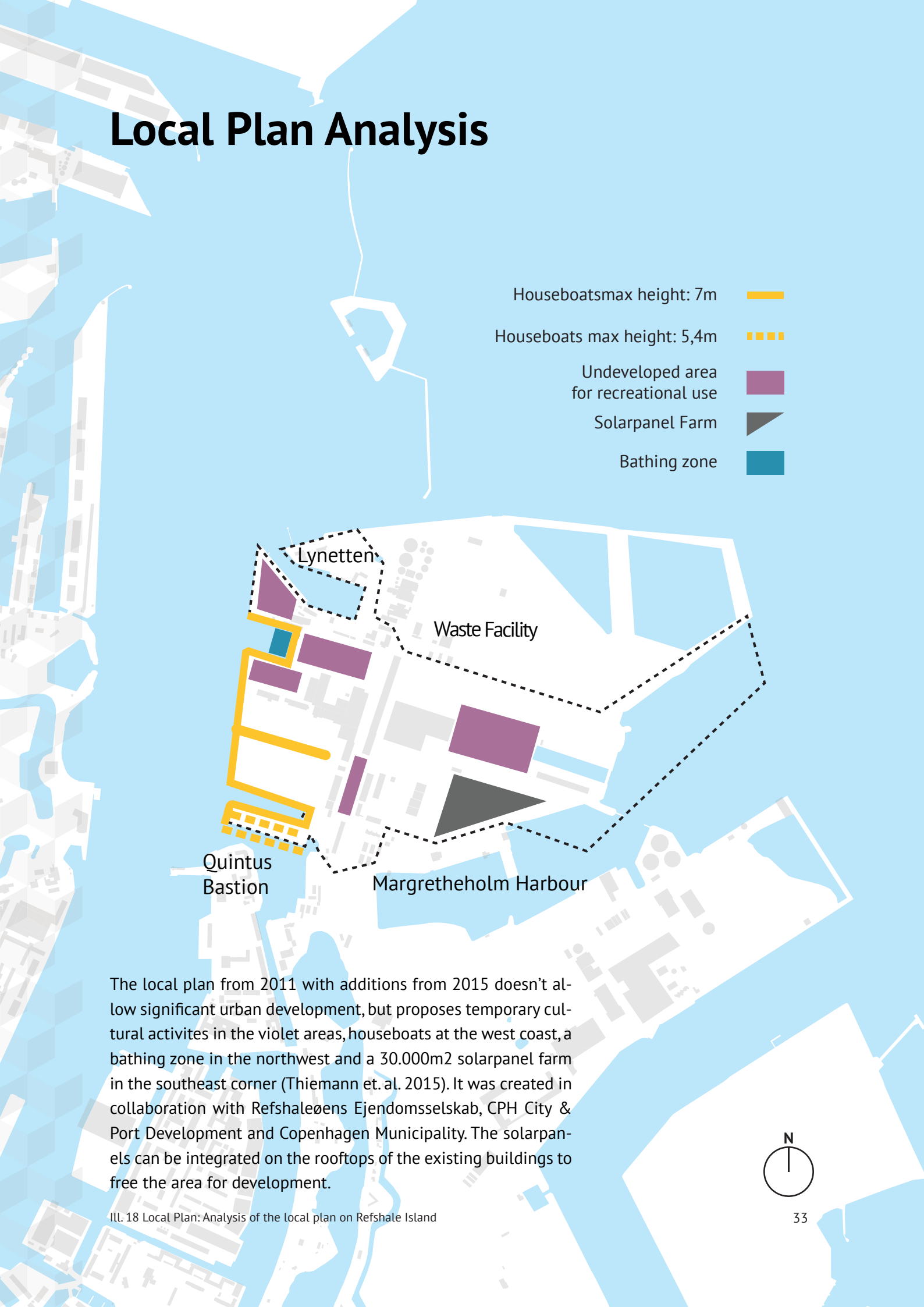
Ownership Mapping



The major owner is the Refshaleøens ejendomsselskab, which was established and bought the property from bankrupt B&W in 1996 (Lauring, 2006; Bjarnesen et. al. 2014). Therefore it is important to facilitate a collaboration between the owners to ensure a well functioning plan for the island and that this is executed to benefit the future inhabitants and users.

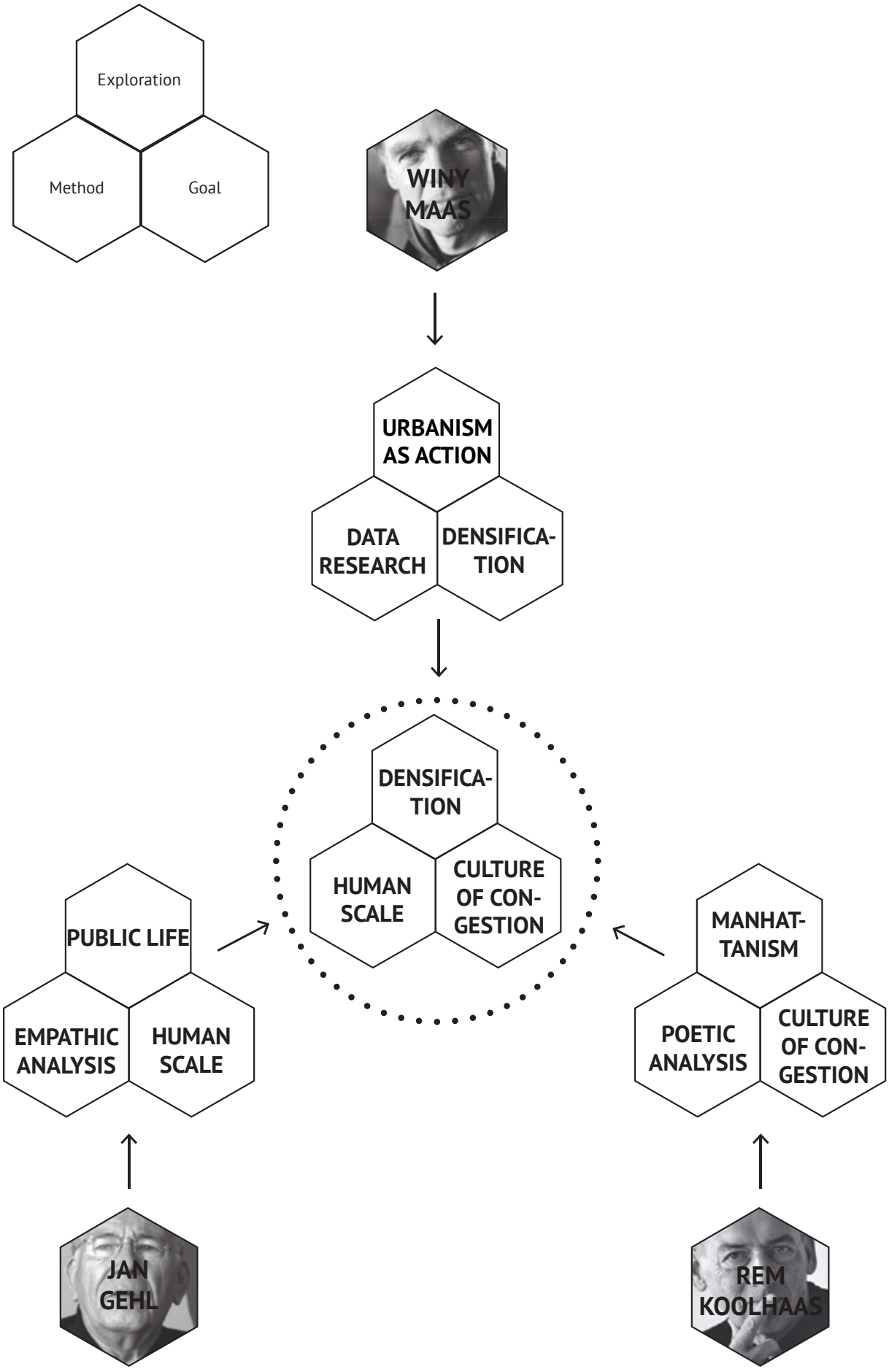
 Ill. 17 Ownership: Analysis of the ownership rights on Refshale Island

Local Plan Analysis



The local plan from 2011 with additions from 2015 doesn't allow significant urban development, but proposes temporary cultural activites in the violet areas, houseboats at the west coast, a bathing zone in the northwest and a 30.000m2 solarpanel farm in the southeast corner (Thiemann et. al. 2015). It was created in collaboration with Refshaleøens Ejendomsselskab, CPH City & Port Development and Copenhagen Municipality. The solarpanels can be integrated on the rooftops of the existing buildings to free the area for development.

Ill. 18 Local Plan: Analysis of the local plan on Refshale Island



34 Ill. 19 Theoretical Framework: Diagram of the theoretical framework

Theoretical Discourse

The former analysis section showed a series of problems and potentials addressed in each analysis, but in particular there was great potential in the history and viewlines towards the entire Copenhagen area. Furthermore, several buildings have preservational qualities and contain a diverse mixture of programs, which could contribute to a strong identity and public life together with the green spaces. The wind could show to be a problem, which should be solved in the design. This leads to the question of what tools that are necessary to solve these problems and how it can be done, which will be answered in this section.

This section is a study of the theoretical work by three architects, with the common field of exploration: what is necessary to design dense cities of high quality? As illustration 19 shows, each theory provided perspectives to the design parameters and for each theory; a field of exploration, a method and a goal for the theoretical findings. The theoretical framework (see illustration 19) describes the field of exploration, the method and aim for each theory. These have been combined to three subjects: 'densification' (Maas, 1998) as the area for exploration, then the 'Human Scale' (Gehl, 2010) as a quality assessment tool for urbanisation and finally the 'culture of congestion' (Koolhaas, 1994) as the goal - despite Koolhaas' somewhat ephemeral findings.

Winy Maas propose research based design as an experiment, which suggests a methodological approach to experiment with extreme urban densities. This approach is systematically tested in Poul Bæk Pedersen's (2011) research and implemented for this thesis in the methodology section on page 42. Jan Gehl approach problems in the obsolete aftermath of modernistic urbanism, in which he argues for a phenomenological approach to accomodate the psychological and tactile stimuli of experiencing cities as human habitats. This approach and the complimentary principles are implemented in the Sensory Syntax tool, where it is merged with the Space Syntax theory by Bill Hillier and Julienne Hanson (1984), which is ellaborated in the cities for people and methodolgy sections. Rem Koolhaas dissect planning and development of the world's capitol by writing a 'retroactive manifesto' for Manhattan. His search has defined global urbanism through the 20th century and seek an ephemeral ingredient to a seemingly chaotic and almost alchemic urbanisation eminating from Manhattan. His answer is the 'culture of congestion' which is an approximate prediction of what will happen by merging Maas' methodology and Gehl's theory.

The conclusion of each theory share close similarities in the sense that they all focus on density and strategic planning (i.e. planning for the city to adapt and evolve strategically) and acknowledge these findings as elementary building blocks for optimal design of cities. The sections that follow is first 'Densification as Action' outlining the work of Winy Maas (1998) in comparison to the research by Poul Bæk Pedersen (2011). Secondly, the section 'Cities for People' with the work of Jan Gehl (2007; 2010) is related to Space Syntax by Bill Hillier and Julienne Hanson. Finally, 'Culture of Congestion' outlines the work of Rem Koolhaas (1994) and reflect upon its relevance in contemporary urbanism, which is followed by a summary of the theoretical section.

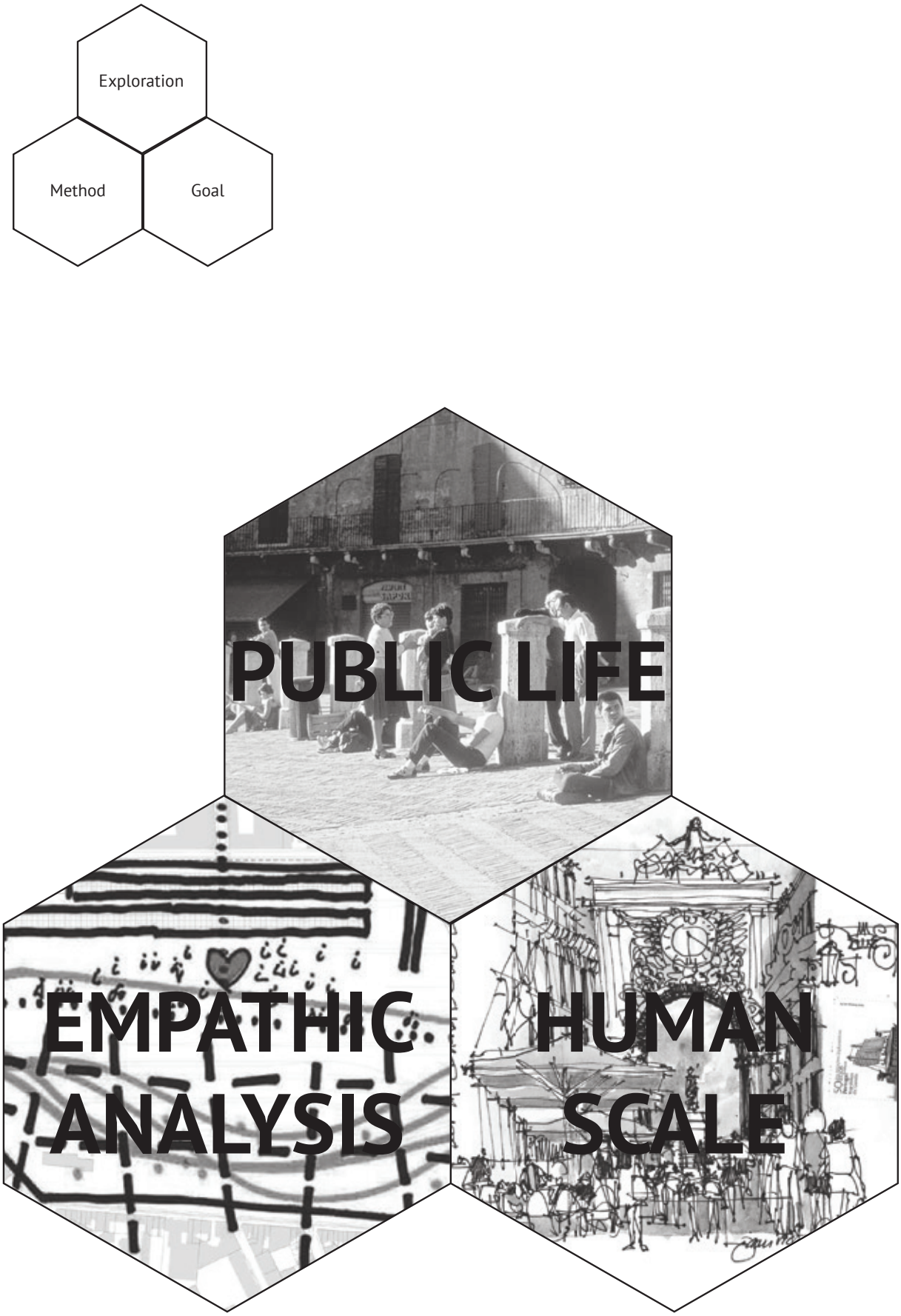
36 Ill. 20 Maas' elements: Diagram of the theoretical elements in Winy Maas' theories

Densification as Action

Winy Maas is one of three founders of MVRDV; a dutch architectural office with trailblazing research and design of architecture and urbanism. Maas is a former employee of OMA and Rem Koolhaas and has interpreted dutch postmodernistic architecture in his own way. He works with data research but tests the research in design solutions in a seemingly endless iterative methodology. In particular Maas has worked on research and experimentation with a 'research by design' approach (Maas et. al. 1998). His research provide conceptual design proposals that manifest the research findings, which display quite radical solutions and many of these research projects become part of the office's realised projects (Maas et. al., 1998a; 2012).

In Costa Iberica he argues for a densification of the programs apparent on the coast of Spain. By concentrating landscape in one area and vice versa with urban fabric the ecological and urban qualities increase; biodiversity increase and so does urban proximity. This is what Maas argues for; high densities and compact cities provide the necessities for an urban habitat and does so with high regards for the environment (Maas et. al., 1998a; 1998b). With a vast record of data research in sociology and economy Maas provides a solution to the problematics of monoprogrammatic urbanisation of the spanish coast. Costa Iberica concentrates the general norm for Maas' work, which is a broad spectrum of multidisciplinary research, problem assesment, an open minded approach to problems and change with pragmatic visions. Maas embrace the potentials that exist in change and visualize the change in large diagrams which also provides a problem assesment. This problem assesment is a strong foundation for his research as these strengthen the argument for each design decision, but it also provides possibilities that would not otherwise have revealed themselves. What differentiate Maas from many others is that he interprets the problems quite literally and this provides him with quite radical design solutions that he manages to realize not only in his research but also by answering clients' requirements. Thus his research serves as groundbreaking platform for designs that cannot survive the obstructions of reality, but deserve an experiment - an iteration if you will - with the purpose of revealing problem solving design that has not been seen before (Maas et. al., 1998a; 1998b; 2005; 2012). Through iterative experimentation, Maas provides a methodology and technique to non judgmental design process. This empowers the designer to fearless experimentation to achieve a solution, albeit radical, to the problems that society faces, ergo 'urbanism as action' (Maas et. al. 2012)

With close relation to Maas, Poul Bæk Pedersen conduct similar research in his book 'Sustainable Compact Cities' (2011) but contrary to Maas, he consider a series of pragmatic parameters that ensure comfortable living conditions and quality housing in his design proposals. With various methods, Pedersen continue some of Maas' ideas but with a much more pragmatic approach, and a closer connection to the users of the design. In that regard, his research is closer to that of Jan Gehl (2007; 2010) and perhaps a hybrid between Jan Gehl and Winy Maas, who propose quite opposite solutions to the same theme of how to design dense cities with quality. This leads us to the following section, which outline Jan Gehl's theories and body of research.



38 Ill. 21 Gehl's elements: Diagram of the theoretical elements in Jan Gehl's theories

Cities for People

Jan Gehl is an urbanist and architect with a career in studies of urban spaces, which propagates from his offices in Copenhagen, Melbourne, San Fransisco and New York. His work is based upon more than 5 decades of studies with his wife (a psychologist), with the purpose of finding the necessary parameters to create and maintain a high quality social and public life. In collaboration with his wife they studied the phenomenology, sociology and psychology of urban inhabitants in relation to the urban space (Gehl, 2007; TEDx Talks, 2016)

Gehl writes about and provides tools and principles for 'cities for people' (Gehl, 2010) based upon research of successful and appealing mediterrainean renaissance cities. His studies show that our sensory apparatus have been the limitation to urbanism and planning before modernism, which by default ensured that urban habitats related to our senses and phenomenological perception of our physical surroundings. As the second industrial revolution roared after the second world war, cars and mass production dominated the discourse of urbanisation and urban planning (TEDx Talks, 2016). His studies started in Siena in Tuscany, Italy and with reference to one of the greatest urban spaces: Piazza del Campo di Siena (Gehl 2007; 2010). With quantitative and qualitative data, he continues the work of Jane Jacobs and William H. Whyte who both opposed the modernistic discourse in urbanism and argued for a spontaneous city, that affords social activity and is based upon a people-oriented premise. Gehl argues how cities are for people and illustrates how scale and speed of travel are connected; the detailing of a building facade should reflect the pace of which the spectator travels. This means that a pedestrian enjoys a highly detailed stimulus compared to a person traveling by car, since the travel speed determines the ability to percieve the physical environment (Gehl, 2007; 2010). Furthermore, the difference in travel speed between cars and pedestrians create a hazardous conflict in practical mobility by prioritizing the physical presence of a traveler by default: Cars are faster and heavier than pedestrians, which makes them more powerful in a traffic situation. To avoid this, Gehl argues for a much more diverse and detailed urban space, which prioritizes pedestrians and bicyclists over cars - contrary to modernistic planning (Corbusier, 1946; Gehl, 2007; 2010).

By ethnographic analysis, observing and quantifying urban inhabitants behaviour, Gehl's research has developed an understanding of cities with impact on the discourse of urban planning and design. He analyses mediterrainean cities and provide pragmatic tools to reverse-engineer 'cities for people' and apply these principles to new urban development (Gehl, 2007; 2010).

Gehl concludes his findings to what he calls 'The Human Scale'; that planning and urban design focuses on spaces that are detailed and designed to stimulate pedestrians moving at 5km/h. He argues for architects and planners to empathize with the users and thereby provoke a bottom-up design approach. He provides various tools and principles which are used and interpreted for this thesis in the methodoloy section (Gehl, 2007; 2010; TEDxTalks, 2016).

40 Ill. 22 Koolhaas' Elements: Diagram of the theoretical elements in Rem Koolhaas' theories

Culture of Congestion

Rem Koolhaas started as a journalist but followed his grandfathers footprints and became an architect. His work has been essential to the discourse of contemporary architecture and his research continue to reinterpret architectural innovation albeit with roots in old masters Mies Van De Rohe (Koolhaas, 1994).

'Delirious New York' is a so-called retroactive manifesto for Manhattan, which Koolhaas writes as a poetic analysis. The book outlines the story and development of Manhattan as a city centre with an unprecedented influx of people, but also a rare ambition from city planners and architects. Even the great Le Corbusier attempted to force his modernistic principles upon the otherwise organically grown urban fabric. Koolhaas depict the bitter loss of Le Corbusiers attempt at rebuilding the city with vast free space and indistinct vertical typologies. Koolhaas describe the development of building codes and zoning laws with emphasis on the contributors to the collective image of Manhattan as the earliest form of a 'crowdsourced' city (Koolhaas, 1994).

Despite an abstract poetic approach, Koolhaas' analyses provides three characteristics of the architecture and urbanisation of Manhattan. First he introduces 'Vertical Schism' which is a division of horizontal layers in the city, to create horizontal layers of urban habitats, comparable to stacked suburban housing. Secondly he observes a general tendency to distinguish and differentiate a detailed and 'soft' interior with a 'hard' and insensitive exterior - with what he calls the 'Great Lobotomy'. Finally he argues for the main ingredient that catalyzes Manhattan and has its roots in history; the 'Culture of Congestion'. This is quite comparable to what both Maas and Gehl argues for: an urban density that provides a critical mass of people and renders the urban habitat to the brink of chaos. The chaotic element of spontaneity and uncontrollable creativity is what drives a city and makes it attractive. He argues that the 'Manhattan Grid' is a polar opposite to the chaos that eminates from the rare density that exist in Manhattan (Koolhaas, 1994). Could the tension between these opposites be Manhattan's law of attraction?

The findings of Koolhaas relate closely to one particular design parameter based upon the research findings by Poul Bæk Pedersen; the urban environment. Both Pedersen (2011) and Koolhaas (1994) focus on the importance of a dense city but complimented with public and active programs. In fact high density is common for all theories, but the importance of an active program is shared between Gehl (2007, 2010), Koolhaas (1994) and Pedersen (2011) which shows a relation between a well functioning city and its ground floor program.

In conclusion, these three theoretical stand points serve as a direction for the thesis and are essential to ensure a set of quality requirements that can steer the project and assure a coherence and relevance in the design and that it appropriately address the problems it is created to solve.

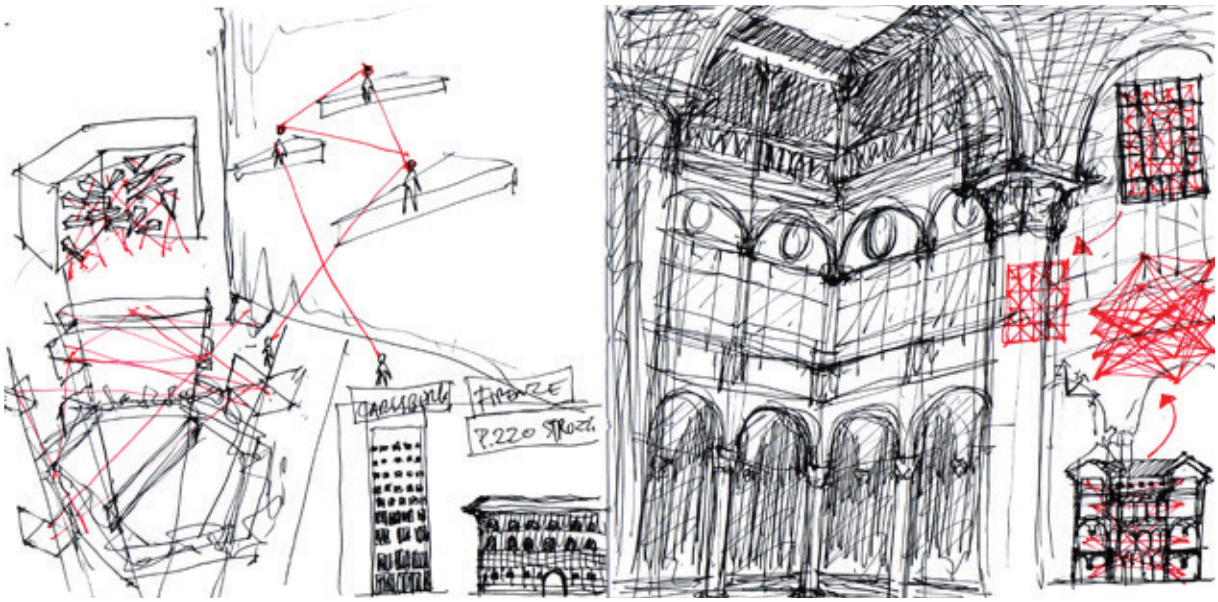
The following section on methodology describe how this is done and implemented in the design. with further explanation of how Pedersens (2011) provide methodology to these theories.

Sensory Syntax

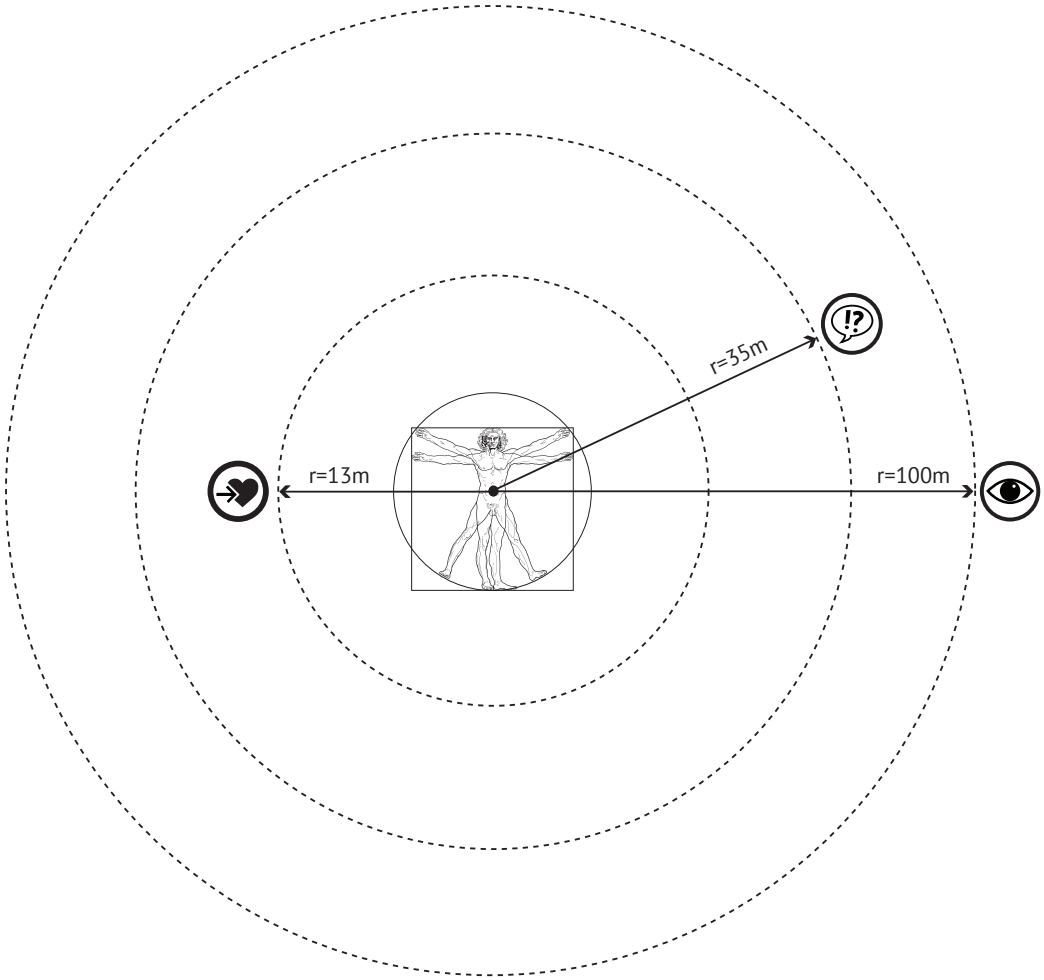
From the theoretical reflection and studies emerged an apparent need for a pragmatic tool to implement the theoretical findings. This section is an extension of the theoretical analysis, and serve to establish a bridge between the theory and methodology with a practical use in the design. As a simplified and practical representation of Gehl's research (2010) of sensory navigation in the urban space, the tool illustrates limitations to the sensory apparatus with a sphere surrounding the subject's body (see ill. 25). The tool is a practical hybrid between Gehl's (2010) findings and the Space Syntax methodology by Bill Hillier and Julienne Hanson (1984). Space Syntax is an urban planning tool that gives insight to the plausibility of a design's social affordance and performance. It maps out the urban fabric in colors according to the social potential the urban spaces affords (Billier et. al., 1984). Thereby it can assist in integration of open spaces in a building, as Poul Bæk Pedersen suggests (Pedersen, 2011).

The Sensory Syntax was directly implemented in the design on plan and section drawings and in 3D CAD models, utilized as a quality assurance tool based upon Gehl's research (2010) and Pedersen's Open Space parameter (Pedersen, 2011). Thereby Sensory Syntax tool can be used preliminarily in the design process, but also subsequently in quality assessment of a building, in coherence with the principles of the Human Scale (Gehl, 2007; 2010).

Case studies where conducted to examine the relevance and possible use of the tool. Among the cases where Palazzo Strozzi in Florence, VM Houses in Copenhagen among others (see illustration 23 and 24). The Sensory Syntax tool's simplicity made it easy to implement in the design, it sets a series of requirements to urban spaces and social performances of the urban fabric. The tool can was used as a practical integration of The Human Scale (Gehl, 2010) in order to rethink public and private spaces and to ensure social interaction and relation to the tactile environment, in a dense urban environment.



42 Ill. 23,24 Case Sketches of the case studies that laid foundation for the Sensory Syntax tool. VM Houses in Copenhagen, Park Royal Tower in Singapore, Palazzo Strozzi in Florence. Both plan, section and 3D is examined for use of Sensory Syntax.



The tool works a such: A subject is placed in the center with sensory perceptive limitations illustrated as spheres surrounding the subjects body. The outer sphere (100m radius) illustrates visual perception limitation, which sets the maximum distance from the subject to a public space with people, for instance pedestrian sidewalks or a public square. The second sphere (35m radius) illustrates the limit to aduitive perception, which allows the subject to perceive loud noises and intense physical expressions, a full conversation is challenging (Gehl, 2010). Semi-public spaces and peripheral social interaction should be kept within this distance as for instance courtyards or public terraces. The inner circle (13m radius) allows conversations and more detailed interaction, this could be between neighbours and would be a good maximum distance between private balconies and terraces (Gehl, 2010).

This practical tool examplifies how the theoretical reflection was used as a methodological tool in the design process (see p. 62) and leads us from the theory to the methodology in the following section.

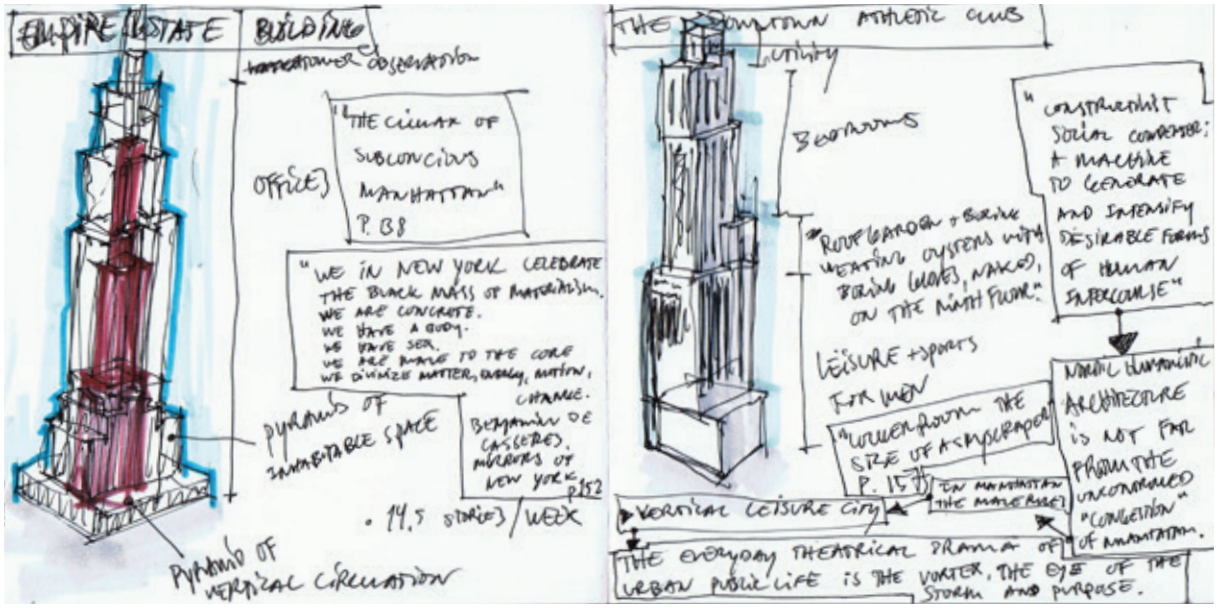
Ill. 25 Sensory Syntax Tool: Diagram of the Sensory Syntax tool

Methodology

This section outlines the methodological approach to the thesis, which consist of various tools derived from the theory and analyses. At first the section convey the analytical methodology with the following tools: negative space mapping (Guaralda et. al. 2012), sketching as phenomenological analysis (Jenkins, 2013; Müller, 2013) and research by design (Pedersen, 2011). Subsequently follows a section about how Pedersen's (2011) concept of 'design by research' was used and interpreted as a parametric design methodology with Pedersen's research findings as design parameters. This section also outline how the design parameters were used to steer the iterative design process and finally the Sensory Syntax tool, which is based upon one of Gehl's (2010) findings.

Negative space mapping

To accomodate the ambitions described in the local plan (Thiemann et. al., 2015) and prepare Refshale Island for climate change and constantly changing demand for urban quality of life, it was necessary to focus on urban resilience and the city as an ecosystem with appropriate methods. The academic article *Negative space and positive environment: mapping opportunities for urban resilience* (Guaralda et. al., 2012) proposes a framework to map positive development opportunities. The mapping creates a foundation for a network of layers in the urban fabric, relatable to Jensen's (2013; 2015) theories of the Network City, with focus on social, ecological, walkable and sustainable networks, proposed as what could be termed an urban 'nervous system'. The network would provide resilience for all its individual parts and thereby the city as a whole (Guaralda et. al. 2012). This served as the primary methodological approach for analysis and problem assessment of the site and surrounding context.



44 Ill. 26 Zoning Sketch: Sketches analyzing the Empire State Building and Downtown Athletic Club for the theoretical reflection and analysis of programming as well as zoning laws decribed in Delirious New York (Koolhaas, 1994).

Sketching as phenomenological analysis

Hand sketching was used as a tool for phenomenological analysis of architectural and urban case studies, with close reference to the problematics and method examined in this thesis. Sketching is a well established tool among architects and has been used for studies of anatomy, architecture, proportion and aesthetic dissections by artists and architects as Michelangelo Buonarotti, Filippo Brunelleschi, Sandro Botticelli, Leonardo Da Vinci, Le Corbusier (Corbusier, 1954; Jenkins, 2013; Müller, 2013).

Iterative Methodology

This thesis utilize design parameters as performance requirements and thereby force the design to undergo iterations that are informed and dictated by these research based design parameters. To describe the process in more illustrative terms, the design process and each consecutive step of iteration follows as such:

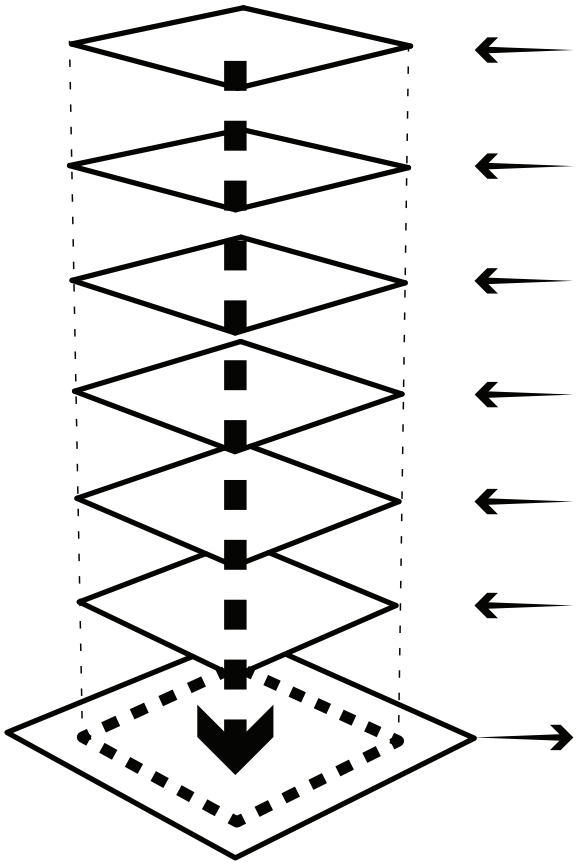
1. Mapping defines the optimal area (and its volumetric and contextual limitations) for the anchor point and first phase of construction; the 'anchor point'. This is defined in the analysis section and illustrated in the analysis diagram on the following page.
2. A maximum possible volume is extruded from the anchor point to the local height restriction.
3. Quantitative design parameters with physical influence (i.e. daylight conditions, wind conditions, and open spaces) 'carve out' the volume; this refines the volumetric architectural capacities.
4. Qualitative design paramaters with metaphysical influence (i.e. urban environment, program, and Sensory Syntax) refine the volume by establishing networks of public spaces and socially relating spacial qualities.

Each consecutive step impact the design as a layer of calculated disintegration that is forced down upon the design; a research based obstruction. This requires the design to be reconstructed in iterative steps according to each design parameter, which are described in further detail on the next page.

Research by Design

The research conducted by Poul Bæk Pedersen in his book *Sustainable Compact City (2011)* was used as a framework for both analysis and design. It was also part of the theoretical reflection in relation to the three theoretical standpoints. The book's results were found through 'Research by Design', which in this thesis was used for preliminary analysis in the case studies, but in the design process it was reversed to 'Design by Research'. The case studies where chosen for their inherent qualities and analyzed with Pedersen's (2011) findings and Research by Design as method.

ANALYSIS



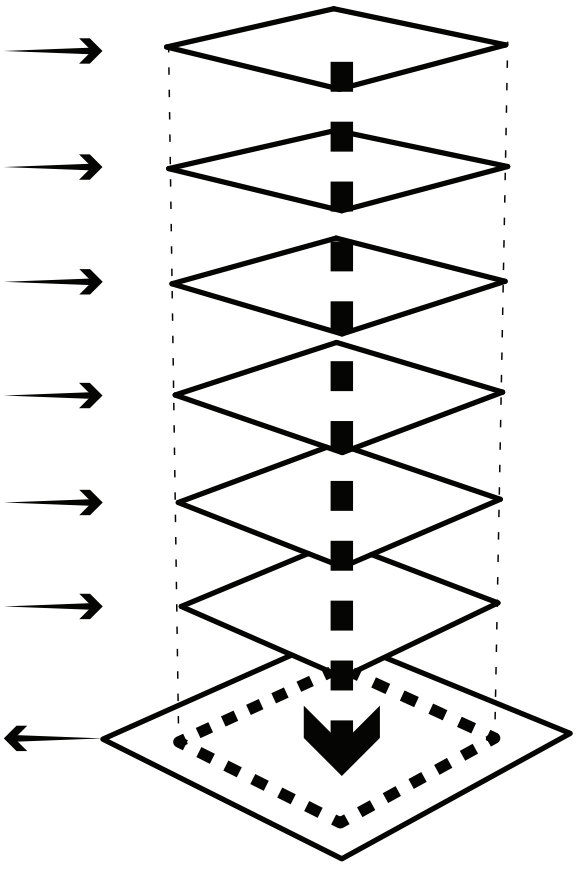
1. History, Nollie Plan and Preservation analysis
2. Building Heights
3. Viewlines, Mobilities Analysis, Infrastructure
4. Green Space Mapping
5. Wind Rose, Smell Pollution
6. Program, Ownership, Local PLan

Design Parameters

DESIGN PROCESS

1. Land Use
2. Daylight Conditions
3. Mobilities
4. Open Spaces
5. Wind Conditions
6. Urban Environment

Design



 Ill. 27 Analysis process: Diagram describing the analysis process and how it defined the design parameters
Ill. 28 Design Process: Dagram describing how the design parameters where implemented and used in the design process

Methodology

Design by Research

For the design process, the analysis method was reversed from Pedersen's (2011) Research by Design, to 'Design by Research'. This method introduce performative quality assessments as design parameters and establish a research based and parametric design process. 'Design by Research' is the parametric design method that utilize Pedersen's (2011) research results in the following design parameters, which serves to shape, evaluate and define the design:

- Land Use: Compact cities decrease resource consumption and is ideal for areas with scarce buildable area. A high FAR (floor area ratio) ensures affordable dwellings by providing a large net internal area (NIA) with a low gross floor area(GIA) - more squaremeters in a smaller footprint. In this design, the land use should aim for an approximate FAR of 200% to ensure the sufficient Net Internal Area to house the 15.000 inhabitants as outlined in the scenario study.
- Daylight Conditions: Tall and slim building typologies provide extraordinarily good daylight conditions, therefore building depth should aim to be approximately 12-16m and the daylight factor should aim to be more than 2.0 which is equivalent to 200lux inside.
- Open Spaces: In high density urban developments, design of open spaces must take wind conditions into close consideration and could integrate open spaces in the building volume itself that would provide shelter and vegetation to decellerate the wind. The quantative requirements for open spaces are described in detail in the urban principles on page 65.
- Wind Conditions: High density buildings can provide good wind conditions, with consideration to the specific site conditions. Tall buildings with a small diameter often cause turbulence at ground level, which increase the requirements for performative open spaces, but should also be addressed in the volumetric design. Wind speeds should not exceed 8m/s.
- Urban Environment: High density and mixed use buildings can catalyze public life, but needs an active plinth in order to utilize the first 3 floors and integrate these in the public realm. The design should aim to provide programs on the ground floor area that catalyze social activity and these programs should occupy approximately 30% of the site.
- Mobilites: This parameter is added, as it is an inherent part of the design and the technical solution. It defines the building plots, some urban spaces and the 'urban grid', which is determined by existing infrastructure, viewlines and buildings.

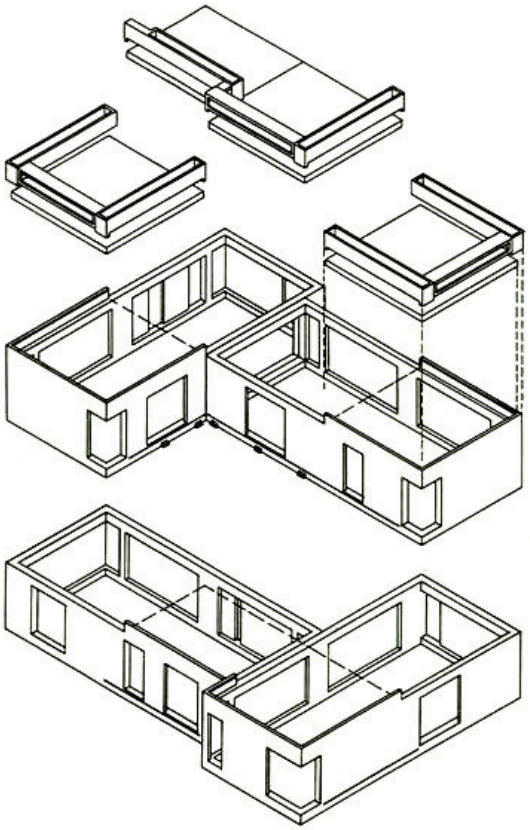
The design parameters are illustrated on page 46, and based upon the research by Pedersen (2011) both described in the theoretical and methodology section and further detailed in the urban and architectural principles on page 65 and page 75.

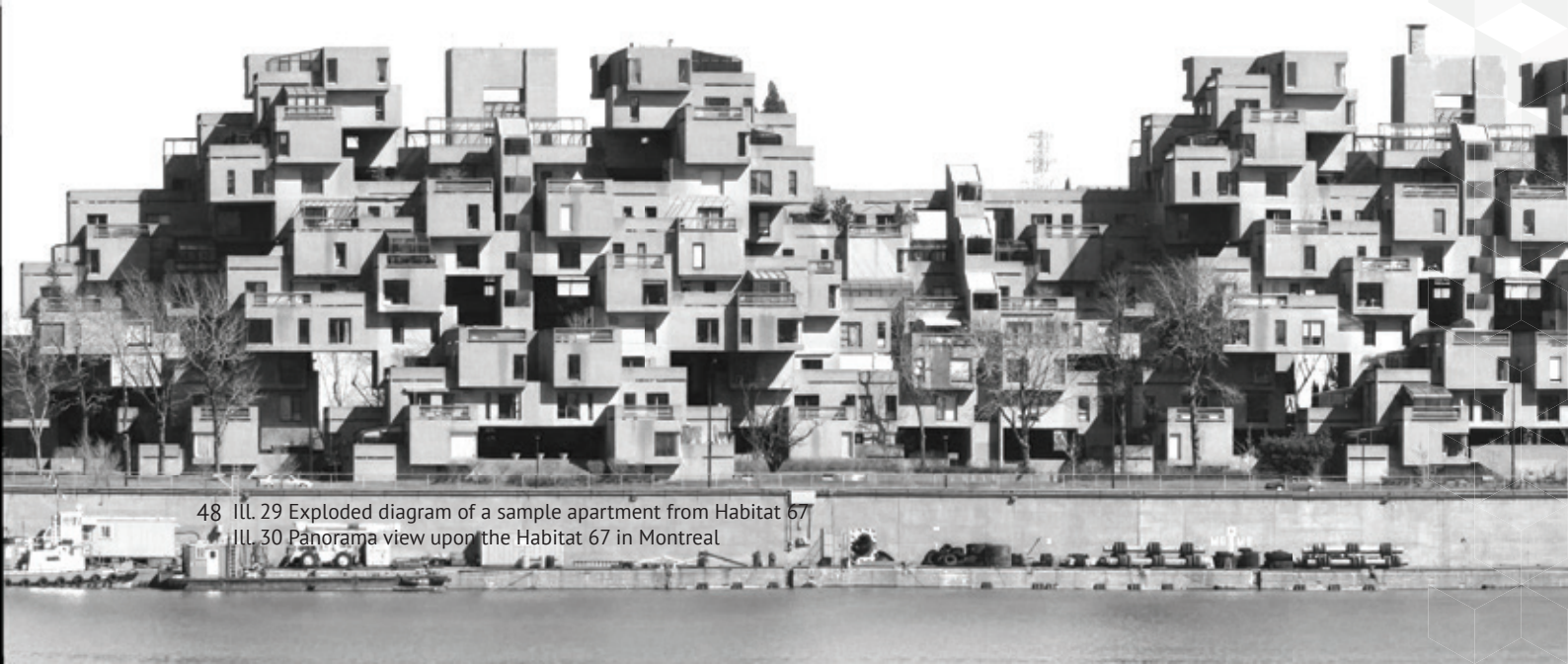
To summarize and conclude, the methodology outlines and illustrates a direct implementation of the theoretical reflection with a practical point of departure in Pedersen's (2011) research. This research provide requirements for the design, which is translated into a set of design parameters. The following section illustrate a series of examples that have implemented a similar design method in both newly constructed and long existing buildings.

Case Study

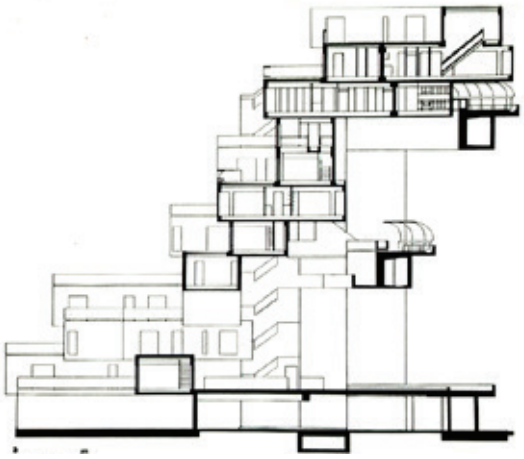
Habitat 67 by Safdie Architects - finished 1967 in Montreal

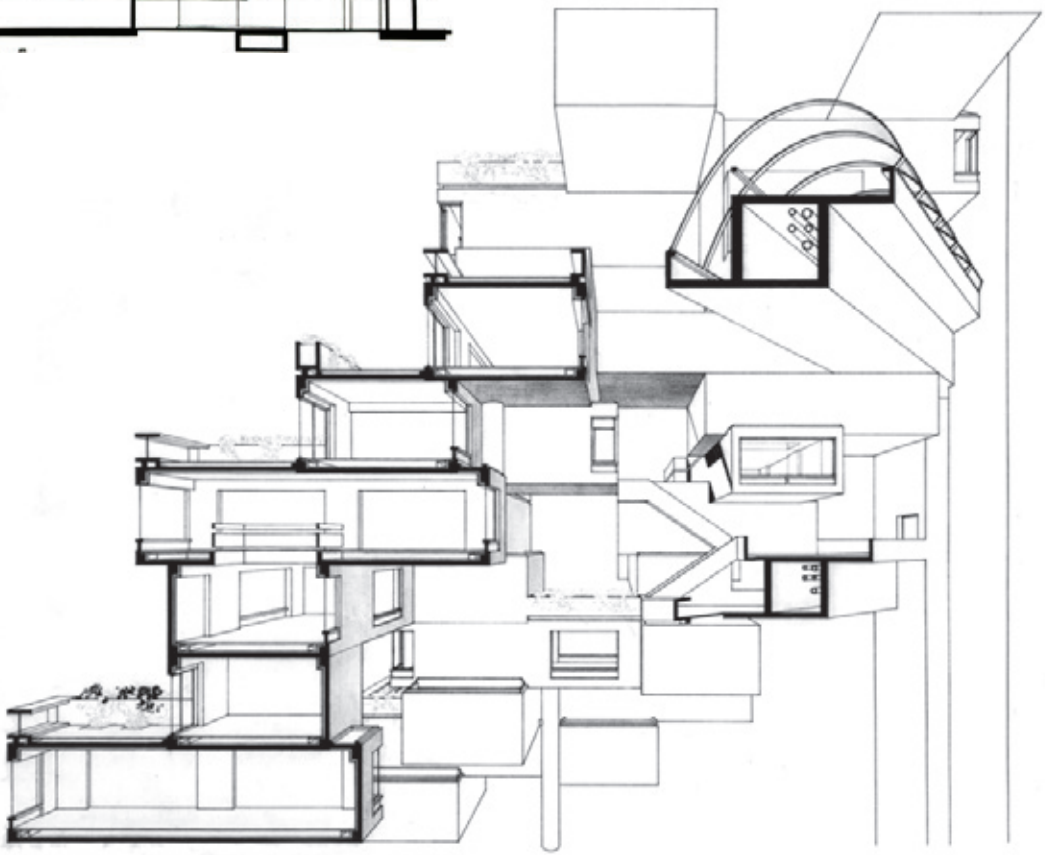
The Habitat 67 was designed by Moshe Safdie. His thesis at the McGill University, was exhibited at the Expo 1967 and subsequently built in Montreal, Canada. The thesis is a housing project, designed as 'universal housing' for various demographics and with the optimal conditions for social living, daylight conditions, wind conditions and accessibility to the most common ammenities originally only available in the suburbs: private gardens and terraces, community living, and high daylight exposure but with the privacy of a suburbian dwelling. He developed a catalog with appartment solutions and in coherence with the modernist tendency, the appartments where based upon prefabricated and modular construction methods (Merin, 2013; TED, 2014). Contrary to his modernist colleagues, he managed to integrate empathic values in a monoprogrammatic and large scale urban thesis.





Ill. 29 Exploded diagram of a sample apartment from Habitat 67
Ill. 30 Panorama view upon the Habitat 67 in Montreal



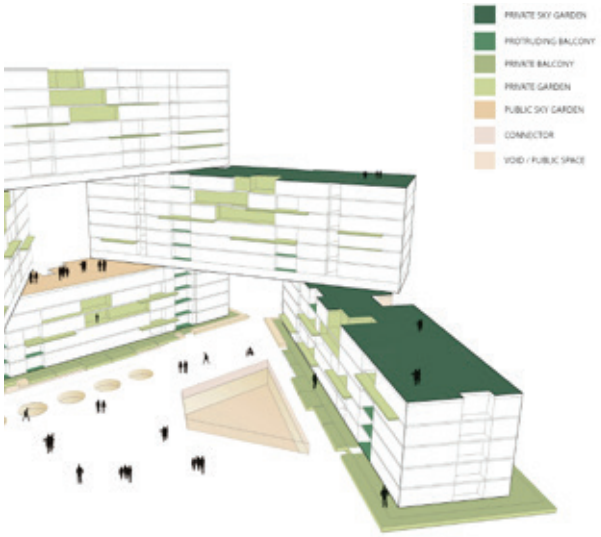


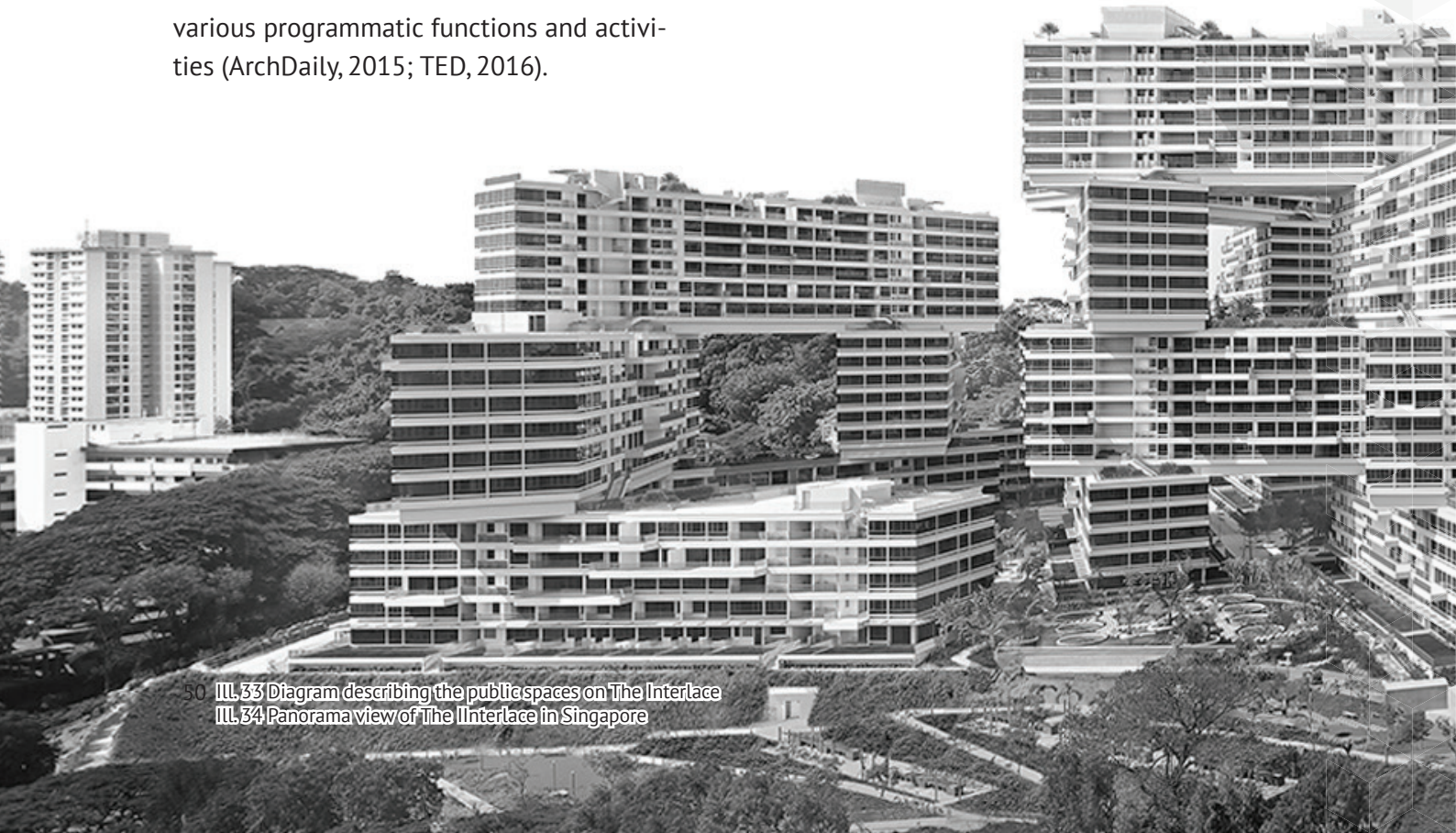
Ill. 31 Section of the Habitat 67
Ill. 32 Perspective section of the Habitat 67

Case Study

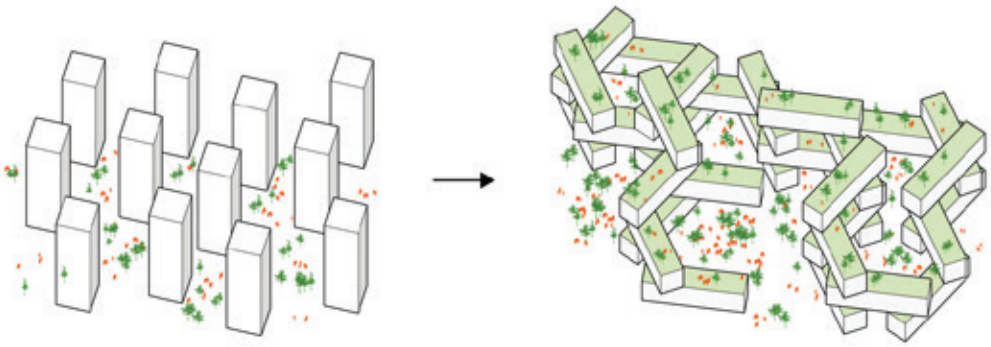
The Interlace by OMA - finished 2013 in Singapore

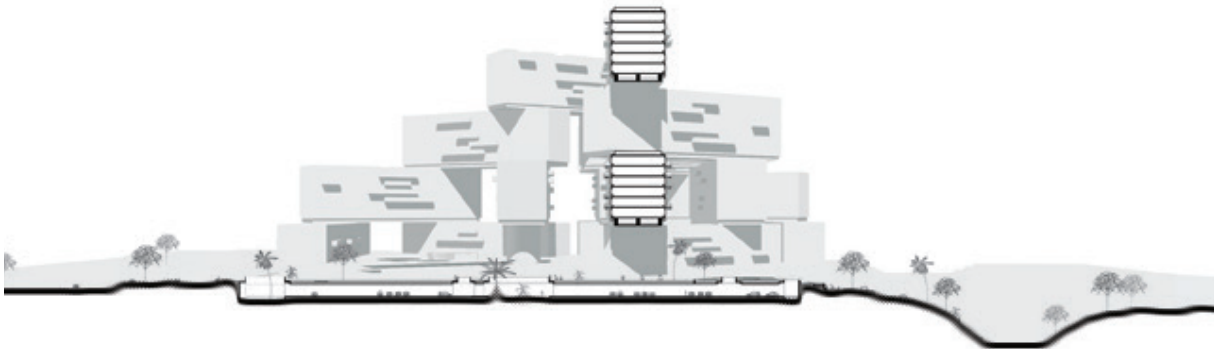
The Interlace is a housing project designed by OMA with founder Rem Koolhaas but as history repeats itself, his employee - in this case Ole Scheeren - was project leader and claimed credit for the project as his own. He later founded Buro Ole Scheeren with strong roots in Asia where his career has blossomed. The Interlace is placed in Singapore and proposes a new housing typology an adherance to what one might call suburban living in a dense urban city. The thesis proposes a unique proximity to social interaction, nature, public and private areas with premium daylight conditions and recreational facilities. True to tradition, the OMA thesis provides a simple but strong narration as it destructs the modernistic high rise plan and rebuilds it to a 'human ant-hill' with intertwined routes for various programmatic functions and activities (ArchDaily, 2015; TED, 2016).





Ill. 33 Diagram describing the public spaces on The Interlace
Ill. 34 Panorama view of The IInterlace in Singapore



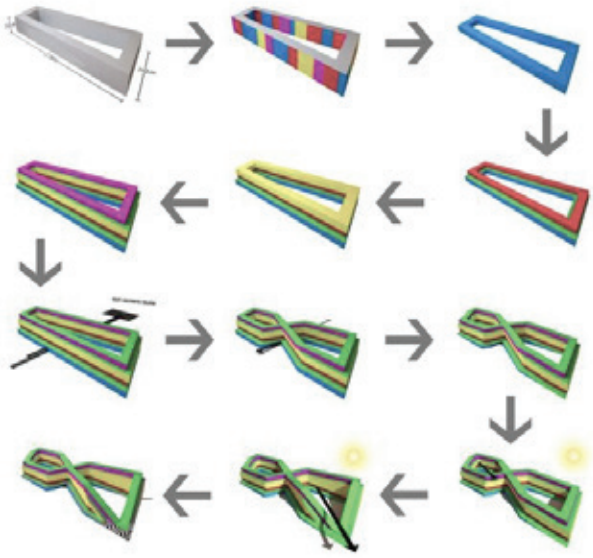


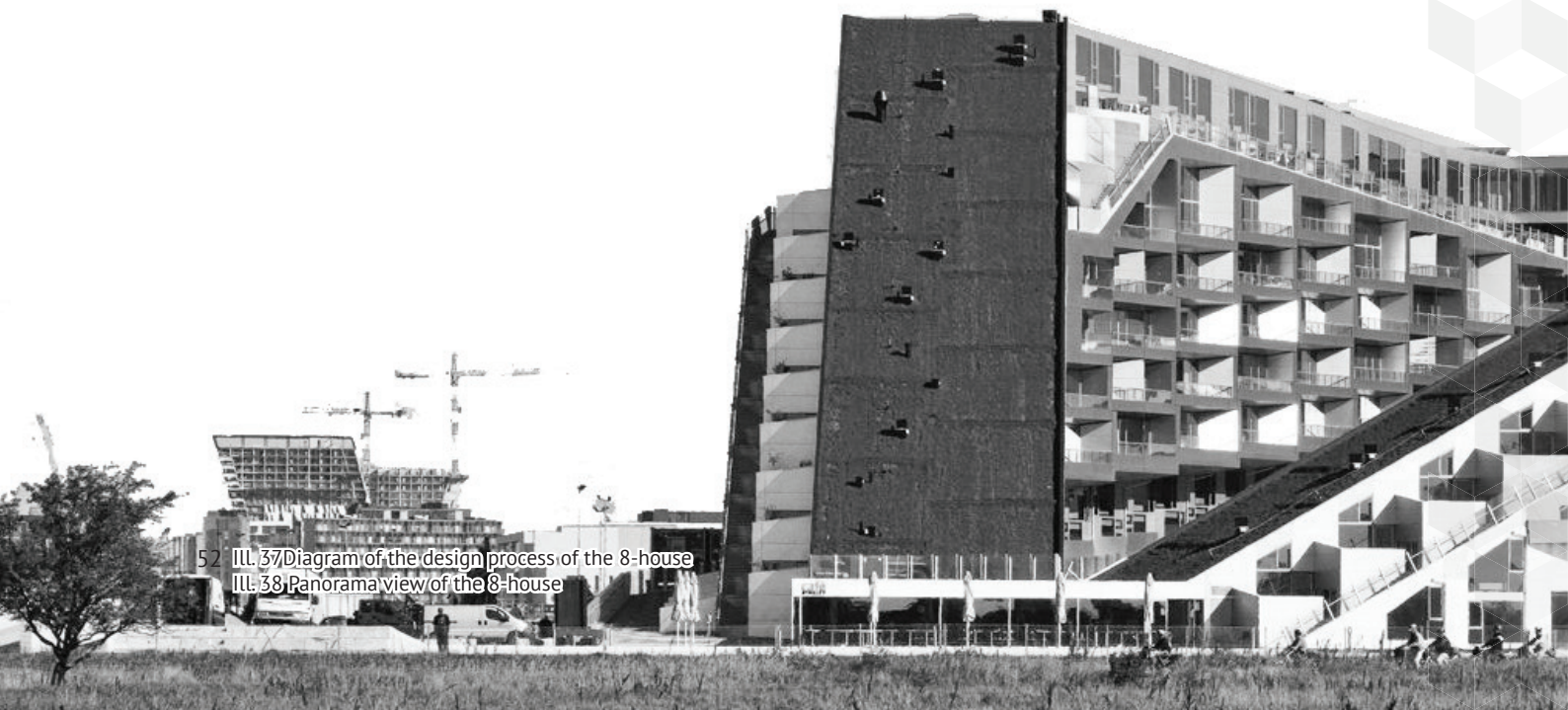
Ill. 35 Concept Diagram of the Interlace
Ill. 36 Section of the Interlace

Case Study

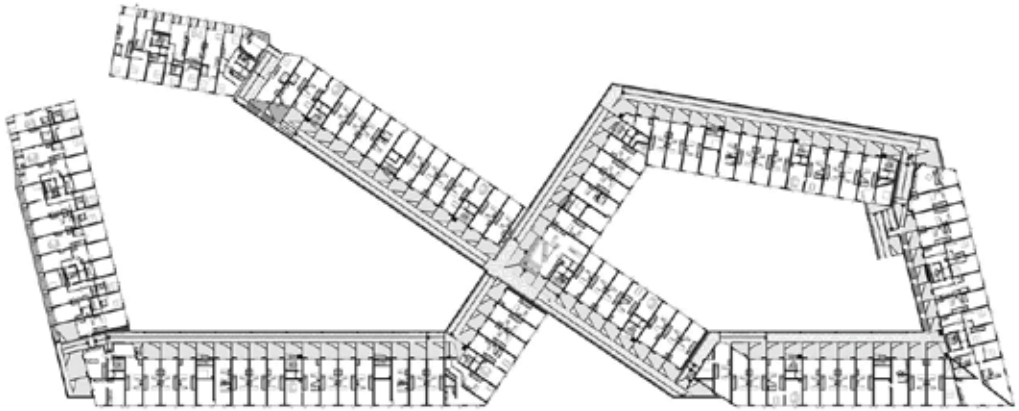
The 8-House by BIG - finished 2009 in Copenhagen

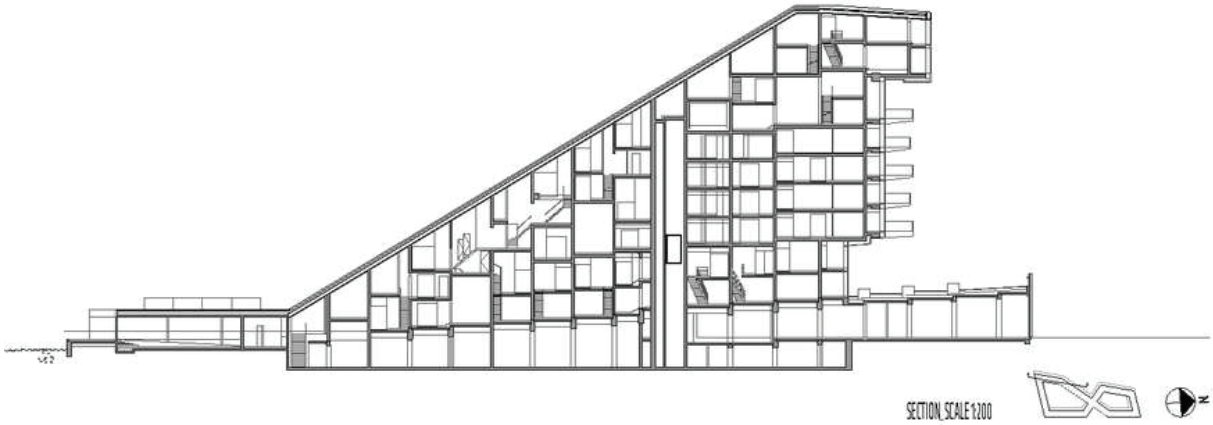
The 8-house was designed by Bjarke Ingels as one of his first projects with BIG - founded in 2008 as an independent office from former PLOT. The housing thesis propose a new typology to envelop the traditional danish row-house in a higher density than ever. Bjarke's discourse is a hybrid between the storytelling from OMA and social democratic values of solidarity and community of the traditional Danish welfare state (Ingels, 2010). The building provides a continuoys loop of circulation from the ground floor to the tenth floor with direct connection to a tiny frontyard for each apartment facing the elevated 'suburban street'. The traditional danish carré typology has been morfed into a horizontal double helix and provides a communal structure - albeit introvert - in contrast to what the surrounding Orestad has failed to do. (Minner, 2010)





Ill. 37 Diagram of the design process of the 8-house
Ill. 38 Panorama view of the 8-house



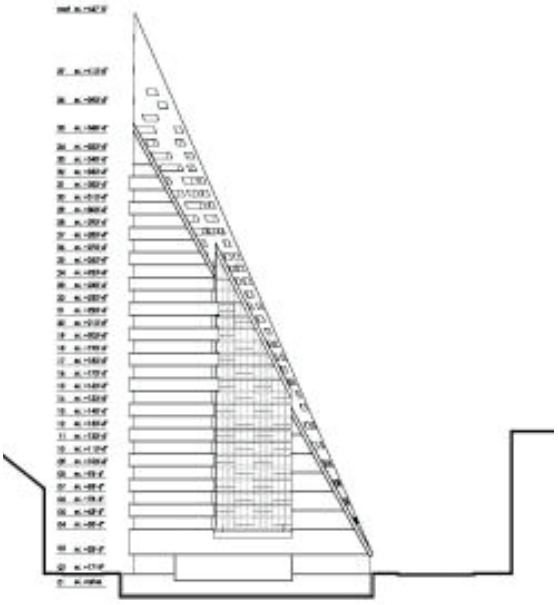


Ill. 39 Site plan of the 8-house
Ill. 40 Section of the 8-house

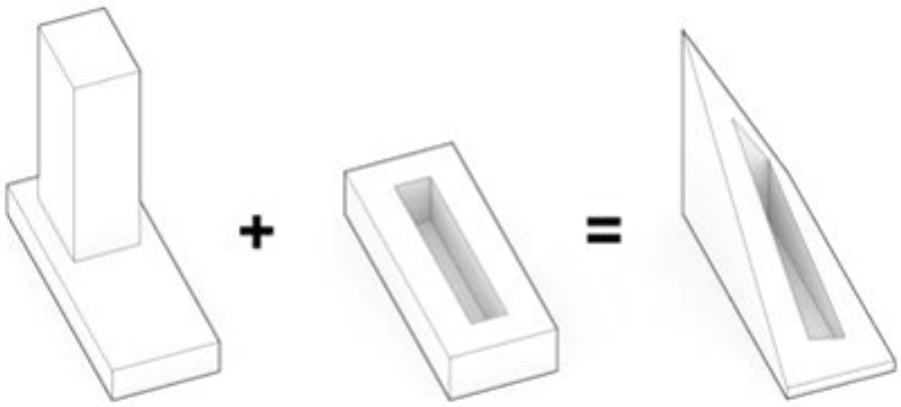
Case Study

VIA West 57th by BIG - finished 2016 in New York

As many other immigrants, Bjarke brought an inherent part of his cultural identity to the land of opportunity. The design is a hybrid between the Danish carré typology and an american skyscraper; a socalled courtscraper (Ingels, 2015). The building provides a traditional danish courtyard with public and recreational amenities while enveloping a high density and even private balconies to accomodate the developers economic demands. To avoid blocking the view from the neighboor building, the northeastern corner is stretched upwards and opposite is the southeastern corner. In addition, this provides views towards Hudson River and daylight to balconies and the courtyard, while adding an iconic silhouette to the famous New York skyline. As usual the pragmatic nature of Ingel's design overrules traditional architectural norms as materials, finishes and detailing remain without regard for the context (perhaps intentionally?). His succes disregard that residential development in New York conventionally utilize bricks while glass and steel materials are for business development. (Minner, 2010; Ingels, 2015)



Ill. 41 Section of the VIA West 57th
Ill. 42 Panorama view of the VIA West 57th



Ill. 43 Concept diagram of the VIA West 57th
Ill. 44 Design process diagrams of teh VIA West 57th

Case Discussion

The case studies where conducted to analyse existing projects, which could answer questions and problems of how to build dense human habitats with qualities that meet contemporary living (described in the design process on p. 62). The cases are all built, while Habitat 67 by Safdie Architects has been used for more than 50 years, the Interlace by OMA and the 8-House are only a few years old while the VIA west 57th is finished in 2016. These cases were chosen for their evident functionality, as opposed to similar designs which have never been built. The cases where chosen for their similarities; as mentioned they provide solutions to common problems of habitation, but most importantly the design process and study of the concept showed to benefit this thesis' methodology. By 'reverse engineering' and tracing the conceptual design approach for each design and analyse the thoughts behind them, it was possible to organize the methodology for this thesis.

Common to the cases are the design parameters which are generally similar to the design parameters chosen for this thesis: land use, daylight, open space, wind and urban environment. The cumulation of these design parameters are designed to catalyze social interaction and comfortable living, both in private and public spaces. One could speculate that they all meet an inherent social desire for belonging, as the social aspects of living in a dense urban environment are almost orchestrated in the building masses. The Interlace create podiums, that stage the public spaces at the plinth of each consecutive building block. The VIA West 57th and 8-House create an amphi-teatre with courtyards as the pivot point for social interaction. The habitat 67 differentiates itself as it provides minor stages in the elevated pathwalks between building structures, these provide opportunities to socialize as one encounter a neighboor on the way to one's apartment.

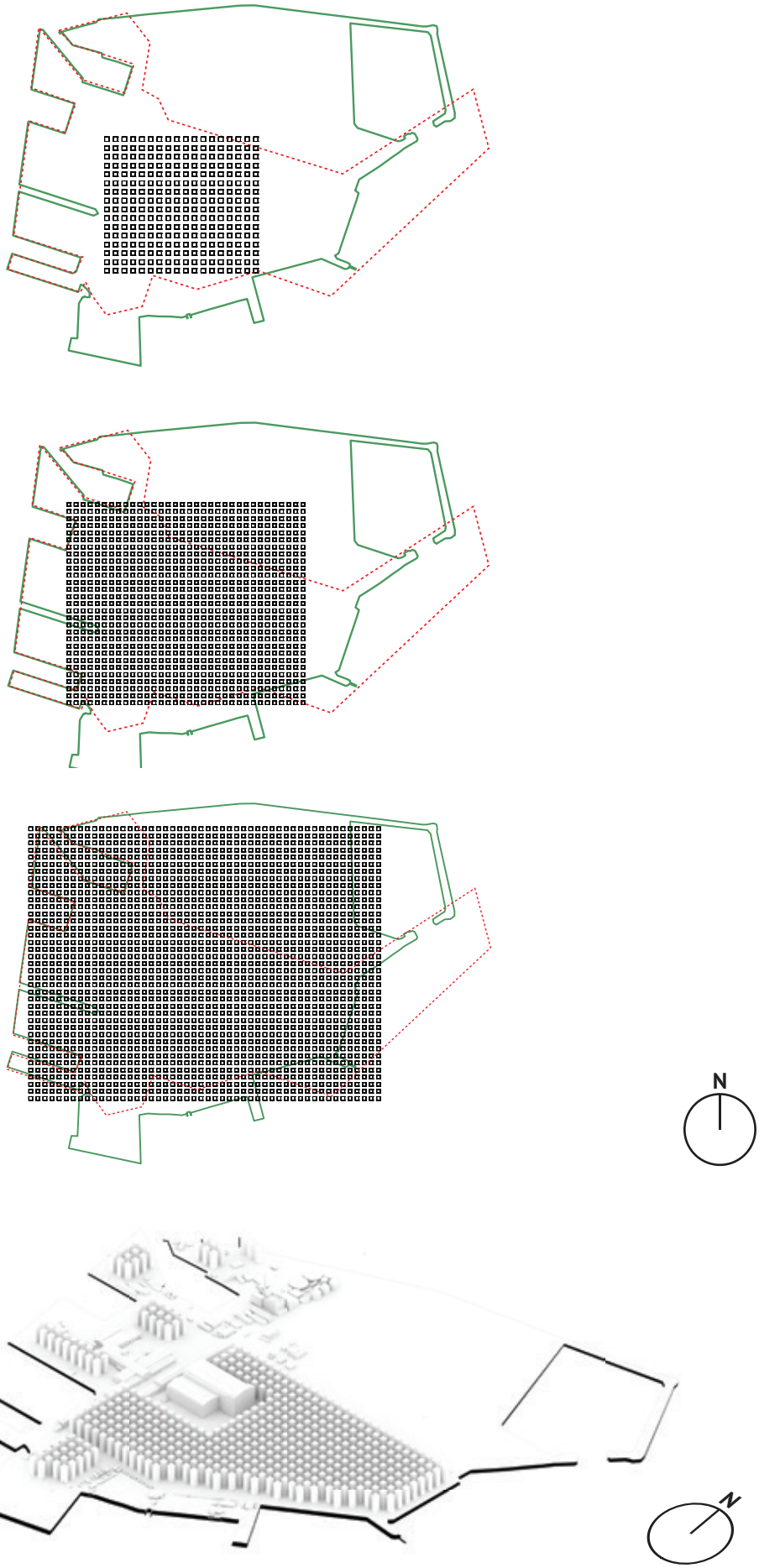
A common lack in the design of all cases is a sensitivity to tactile aesthetics, which shows in the choice of materials. The VIA West 57th and 8-House are both covered in aluminum plates except for the glass openings to each apartment (Ingels, 2010; Minner, 2010; Ingels, 2015). This is a well performing material in terms of both cost of maintenance and acquisition, but it does render the facades quite 'cold' in the sense that it is not a pleasant material to touch and does not associate with warmth or comfort in contrast to wood, plaster or some forms of refined concrete. The Habitat 67 and Interlace are mainly built in white and traditional reinforced concrete (Merin, 2013; ArchDaily, 2015), which is equally uncomfortable albeit being practical and economic. In contrast the generation of architects before Ingels carry a strong tradition with respect to the choice of materials and thereby a tactile approach to architecture, much of which Gehl call for (see section on theoretical reflection). Among this generation are two good examples as Lundgaard & Tranberg and Dorte Mandrup with female leaders who manage to implement a very detail oriented and empathic relation to the users with thorough implementation of tactile materials and adherence to the human scale. Examplary projects are the Tietgen student housing and National Theater by Lundgaard & Tranberg or the Seaplane Hangar by Dorte Mandrup. Each design is an example of an aesthetic sensitivity to the details that have an important to the everyday life of a building's users. This is an important parameter to adhere to in order to design a successful project for everyday users and ensure their wellbeing.

The four cases relate closely to the design parameters and research by Poul Bæk Pedersen. They show various examples of how to ensure optimal daylight conditions, provide abundant open spaces integrated in the architecture, utilize plot ratio with density and shelter the open spaces from wind with dense vegetation or the architectural structures themselves. This can be seen especially in the diagrams for each project, that describe how the building take shape after the design parameters and how these are integrated between the architecture and urban dresign.

The reason why the above case studies where not used for the concept is that these cases provide insight to existing and well functioning buildings that are results of similar concepts. These cases are hybrids and provide urban qualities that this thesis aim for, whereas the three typologies in the concept represent undiluted qualities of each individual typology that together can meet the complex requirements for a hybrid urban habitat. The case studies are analysed to dissect how similar designs work and what is lacking that this design should avoid, in contrary to the references in the concept, which suggest what the design proposal should aim for and how to relate to the specific urban context of Copenhagen. In particular, the cases studies were used for their common methodology, which is based upon a set of parameters similar to the design parameters in this thesis.

In conclusion, the case studies examplify, and provide solutions to the design parameters and show how these can be used to solve a series of problems with dense urban living. They provide the necessary physical environment to afford a high quality of living. Furthermore, they lack a close relation to the phenomenological and tactile needs of the users, which is hard to apply to a parametric design, as it is usually based upon best practice and craftsmanship. Nevertheless, these qualities are important as they relate directly to the users' everyday life and experience of their physical surroundings. Finally the case studies could point towards other cases that would be important to the project, three examples are the typologies mentioned in the concept on page 14. The Potato Rows provide the missing tactility and phenomenology related to 'Gehl's Human Scale' (Gehl, 2010) while the Radisson Blu Royal hotel, provide a higher regard for detailing and consider the construction as part of the design, finally The Mountain provide a different hybrid use of building program with suburban amenities.

Ill. 45,46 Close up of the facade from the VIA West 57th besides a close up of the Potato Rows facade, the images are in approximately same scale.



58 Ill. 47 a serie of diagrams showing the building capacity on Refshale Island

Scenario Study

This section introduce the next chapter by summarizing the thesis' problem assesment and analysis in an overview of the three possible scenarios. Three different scenarios with the same building density (FAR: 130%) and thereby gives insight to the capacity of the site and island in general. This is necessary to illustrate approximately how many inhabitants the island can contain, but also to illustrate the relative scale in which this thesis is designed. The study shows a balance between the capacity and the housing need respectively. The medium scenario was chosen for design, due to its challenging scale and sufficient capacity. Thereby an increased influx of inhabitants would be possible but the plan envelop a minimum amount of inhabitants just as well. Each square signifies a building of 12x12m in 5 floors and each road is approximately 15m wide; these measurements are based upon a standard density in central Copenhagen.

Minimum scenario: 4400 inhabitants (Rambøll 2012).
Site area: 300.000m2
Footprint:: 150.000m2
Floor area: 250.000m2
Floor height: 5
FAR: 130%

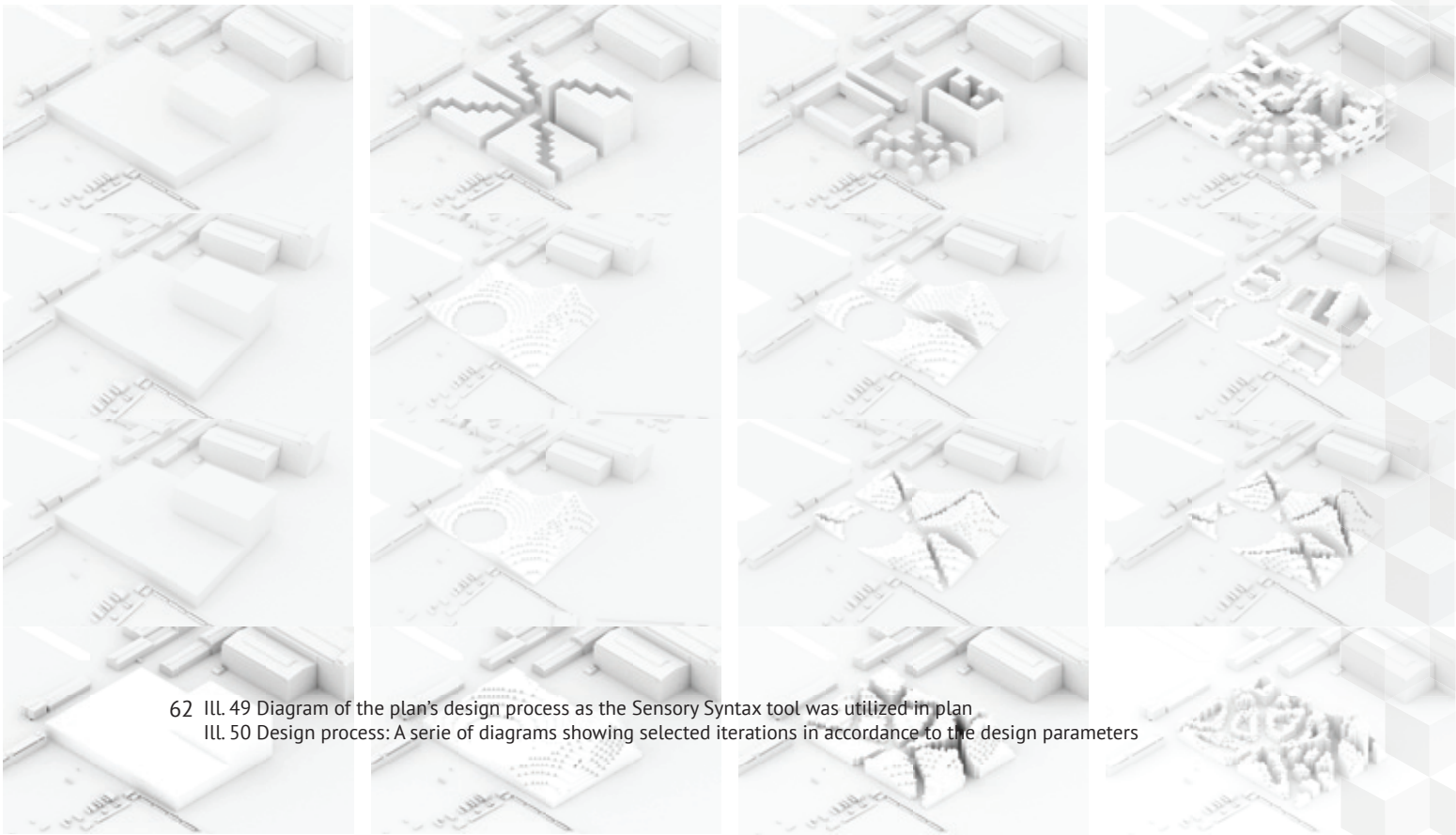
Medium scenario: 15.000 inhabitants based upon an estimate
Site area: 300.000m2
Footprint: 550.000m2
Floor area: 700.000m2
Floor height: 5
FAR: 130%

Maximum scenario: 30.000 inhabitants (Københavns Kommune, 2015)
Site area: 300.000m2
Footprint: 1.100.000m2
Floor area: 1.400.000m2
Floor height: 5
FAR: 130%

In general the study shows a clear example of the densification capacity on Refshale Island. A medium scenario of 15.000 inhabitants would be possible, but the design must leave extra undeveloped space to ensure that future planning is possible, this could be a potential metro extension, different road sizes, programmatic changes or an increase or decrease in population capacity. The recommended building percentage is approximately 200% with an average floor height of 7,5 floors. As illustrated (see ill. 47 bottom), the following section on the design process will outline how this data was implemented in the design process and design proposal, based upon the analysis, the theoretical reflection and the methodology section.

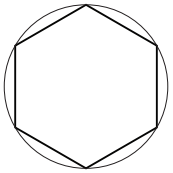
Chapter III - Design and Strategy

Design Process
Urban Principles and Strategy
Master Plan
Architectural Principles and Concept
Site Plan
Sections
Visualizations
Technical Solutions

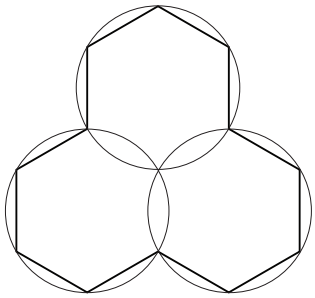


62 Ill. 49 Diagram of the plan's design process as the Sensory Syntax tool was utilized in plan
Ill. 50 Design process: A serie of diagrams showing selected iterations in accordance to the design parameters

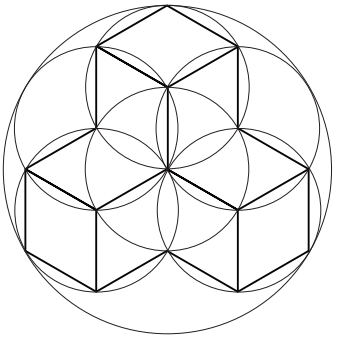
Design Process



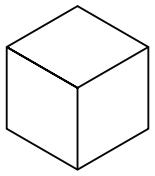
This section explains how the design was conducted and is followed by the urban strategy and architectural concept, with their respective set of principles.

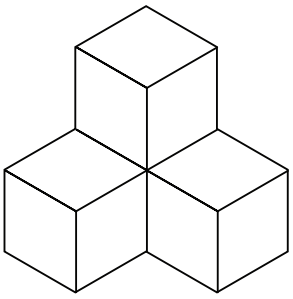


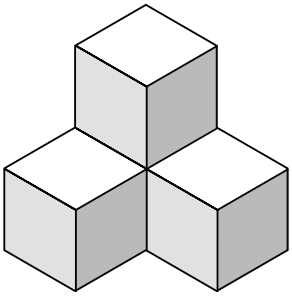
The design process was divided into an urban strategy on a large scale, covering the entire Refshale island, and an architectural concept; covering the anchor point. This would ensure that problems on the large scale would be handled strategically and provide a strategic framework. Subsequently the architectural scale had to be taken into closer consideration to ensure that the Human Scale (Gehl, 2010) and design parameters where accomodated on a smaller scale - thereby ensuring a well functioning architectural concept by nurturing phenomenological needs of the individual users to create a livable city. For this process, the Sensory Syntax tool was utilized (see illustration 49). As described in the methodology section the design process and design parameters was founded upon findings from Poul Bæk Pedersen's (2009) research, but the design process itself was a reverse engineering of BIG's design process, with basis in the case studies (Ingels, 2010; 2015).



The design process, the urban strategy, and the architectural concept are closely related; the design process is illustrated as layers of design parameters that force individual iterations and refine the design one obstruction at a time and both the urban strategy and architectural concept is illustrated in series of diagrams. Both processes are steered by the design parameters but the parameters have been modified and interpreted to accomodate the different scales. As such, the design process spans between and connects the methodology, the urban strategy and the architectural concept and it explain the design in a series of diagrams. To clarify each process, the urban strategy and the architectural concept is further described on the following pages with thorough definition of each design parameter and graphic material of the design proposal.







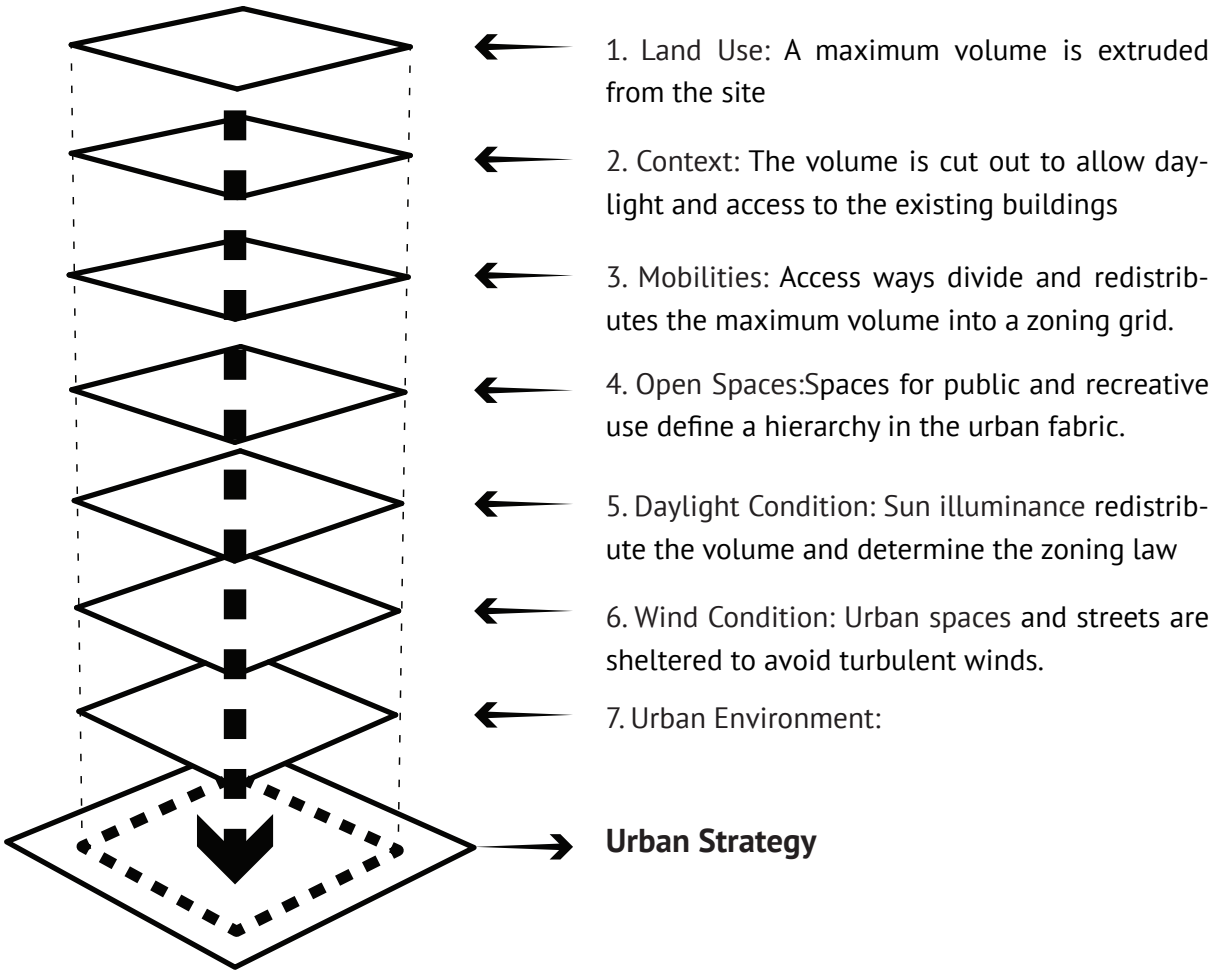
Ill. 48 Diagram illustrating the design process as it develops and utilize the Sensory Syntax tool

Urban Design Process

This section outline the specific design process for the urban strategy and its respective principles.

As described in the methodology section, the urban design process develop through the design parameters in iterations. As the design evolves, the site undergoes studies on capacities and densities. Each step reveals the inherent qualities to Refshale Island and where it is rational to plan development.Two parameters were added to the process; mobilities (Jensen, 2010) and context. Mobilites is simply the defining factor in establishment of an urban grid, since mobilities are the fundamental structure that enables the thesis to function the term itself is described in the mobilities analysis on page 19. In this case mobilities is established as a grid structure with point of departure in the existing built structure, with extended capacity for the increased infrastructural requirements. Context is the relative open space needed to allow light and access to the buildings that have preservational value (Bjarnesen et. al., 2014).

The illustration below shows how the urban strategy has evolved, which is further illustrated and explained on the following pages. In short the process adhere to the design parameters as such:



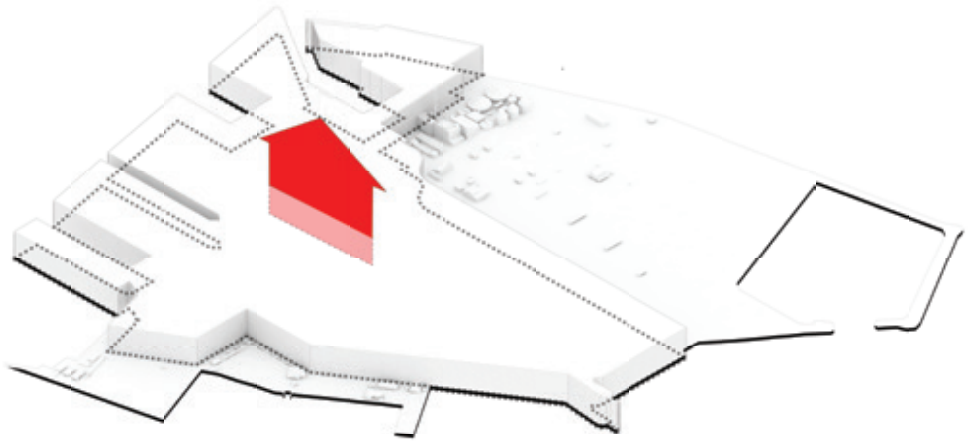
64 Ill. 51 Diagram illustrating the urban design process and how design parameters become the urban strategy

Urban Principles

The urban principles define a set of rules and incentives for development at Refshale Island on an urban scale. This ensures quality urban spaces and the best premise for a high quality of urban life in order to meet the vision of Copenhagen municipality (Center for Byudvikling, 2015). The principles envelop interests of all actors at Refshale Island (Municipality of Copenhagen, CPH City & Port Development, Refshale Ejendomsselskab) including the future inhabitants which are represented through interviews (Bjarnesen et. al., 2014) and conducting problem assesment in other development projects as Carlsberg City and Nordhavn (Saaby, 2016; Keis, 2016).

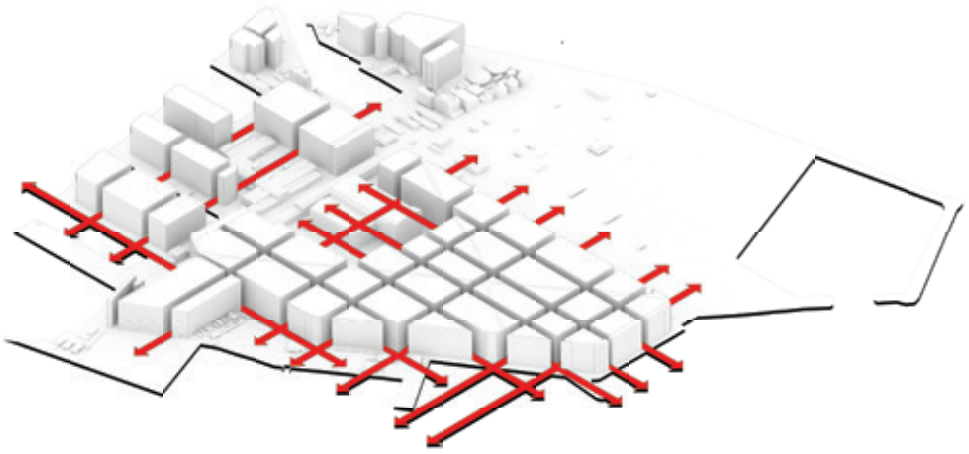
- **Land use** on each plot should reach an average of approximately 200% FAR, to ensure that the dwelling capacity is reached of approximately 7000 apartments for 15.000 inhabitants.
- As part of the **context,** the buildings that have preservational status (see preservation analysis p. 31) should be kept for their historic value and can be renovated for new purposes. It is proposed to continue and expand the rental agreements for small creative business.
- **Mobilities** planning is prioritized towards comfort and efficiency for pedestrians and bicycles, while cars are prioritized lowest in the mobilities 'hierarchy' after public transport. Maximum speed on the entire island is 50km/h.
- Elevated **open spaces** (e.g. placed on the building) can be included in calculation of the total open space area, but these must be accessible to the public in order to do so. The various open spaces are categorized and further explained in the architectural principles on p. 72.
- A **daylight factor** of 2.0 (200lux) must be achieved, which on a strategic scale is met by concentrating the maxiumum building height of 15floors to the north and north-eastern part of the site, where high-rise buildings will cast the least possible shadow on surrounding buildings. In general the average floor height should be 7.5 floors to reach the necessary capacity and daylight requirements. Business and parking is placed mainly in this area, as these programs require less daylight.
- **Wind conditions** in the urban spaces should be comfortable, which means that wind speeds cannot exceed 8m/s. Trees and dense vegetation must be placed strategically on roads and and in urban spaces to decellerate the wind and buildings can provide shelter just as well.
- To contribute to the **urban environment** and public life, detail and retail programs must be placed at ground floor. These must have one facade towards the street, to avoid dead urban spaces and mainly be concentrated around the main street, crossing through the urban fabric. This will concentrate commercial activity and public life to the main street and the squares that appear along the street.
- All construction must contribute to the goal of making Refshale Island Co2 negative. Thereby producing more renewable energy than the island consumes. This can be done by either integrating renewable energy production in the new building itself or otherwise contributing to the production of renewable energy elsewhere on the island. This thesis propose to place 30.000m2 on the rooftops of the existing buildings to contribute to this goal, which is written in the local plan.
- To acquire residential property, the buyer must be resident in the apartment. This is to avoid real estate speculation by foreign investment, that will cause unbalanced gentrification and a possible real estate bubble.

Urban Strategy



01_LAND USE

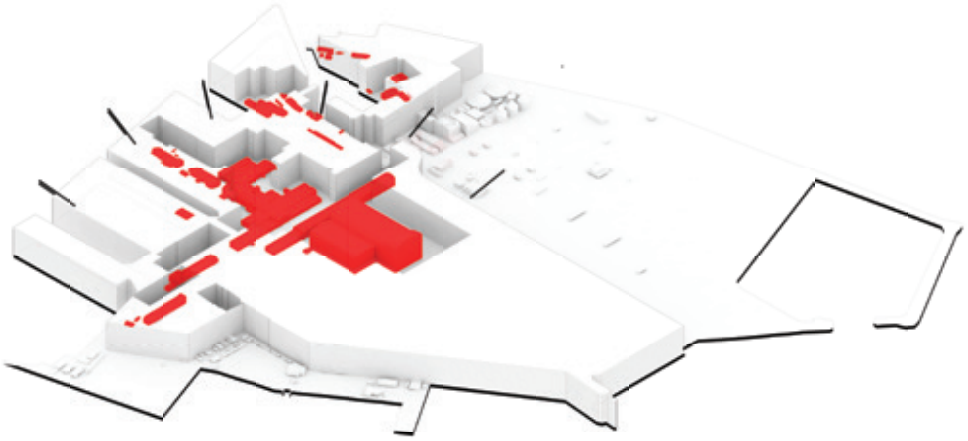
The maximum possible volume is extruded from the site



03_MOBILITIES

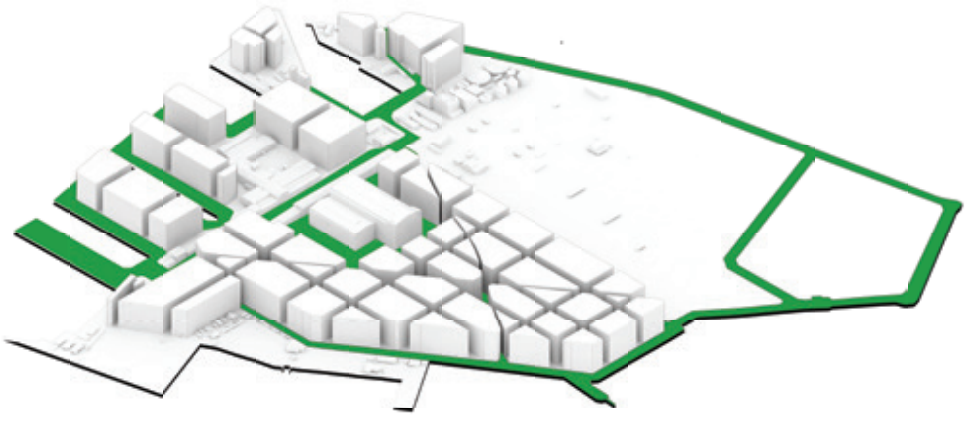
The mobilites network establish an urban grid and define the urban fabric

Ill. 52 Diagram illustrating the first design parameter
Ill. 53 Diagram illustrating the third design parameter



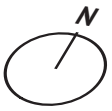
02_CONTEXT

Historical buildings carve out the volume and dictate materials for future development



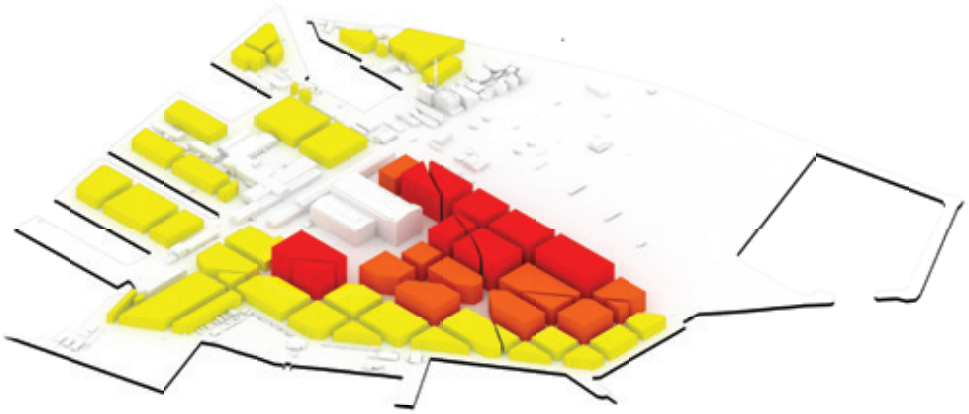
04_OPEN SPACE

Public spaces are connected and provide a continuous green promenade



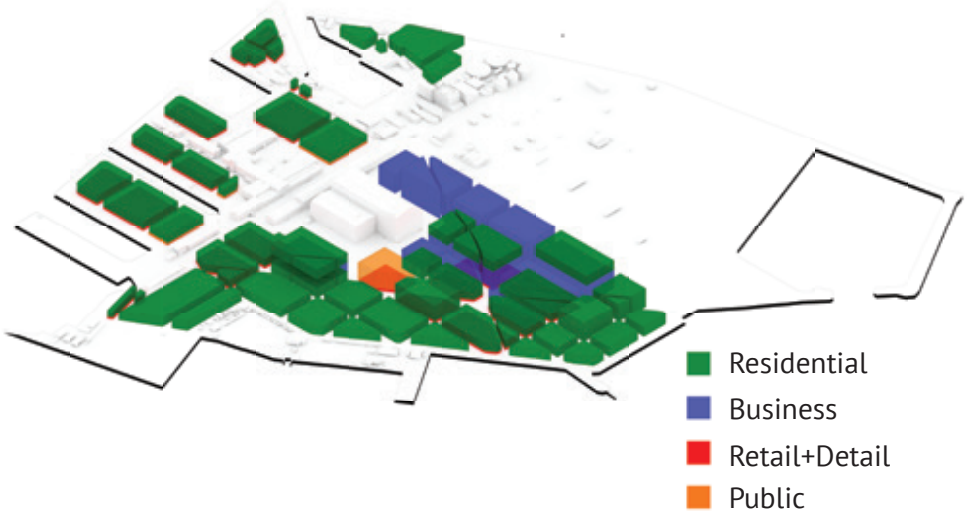
Ill. 54 Diagram illustrating the second design parameter
Ill. 55 Diagram illustrating the fourth design parameter

Urban Strategy



05_DAYLIGHT

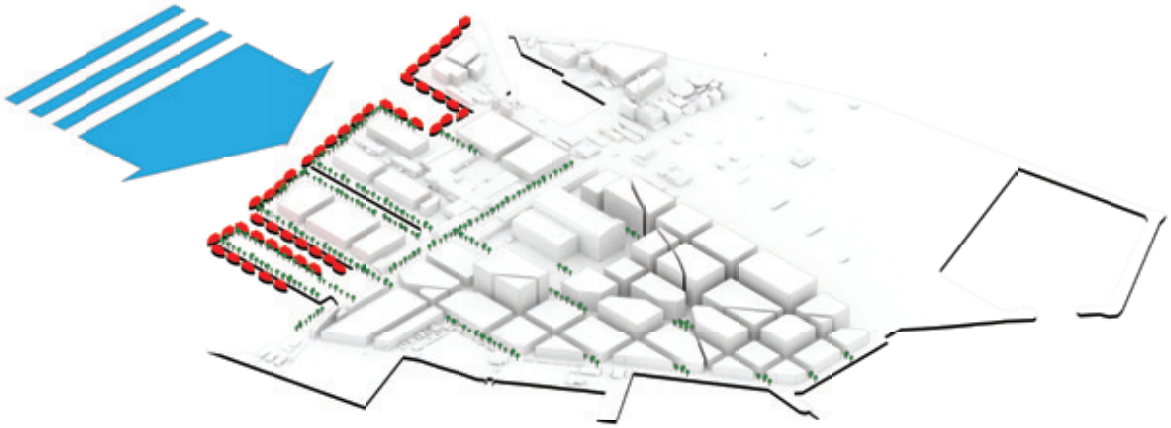
Zoning law and building heights are determined by daylight conditions



07_URBAN ENVIRONMENT

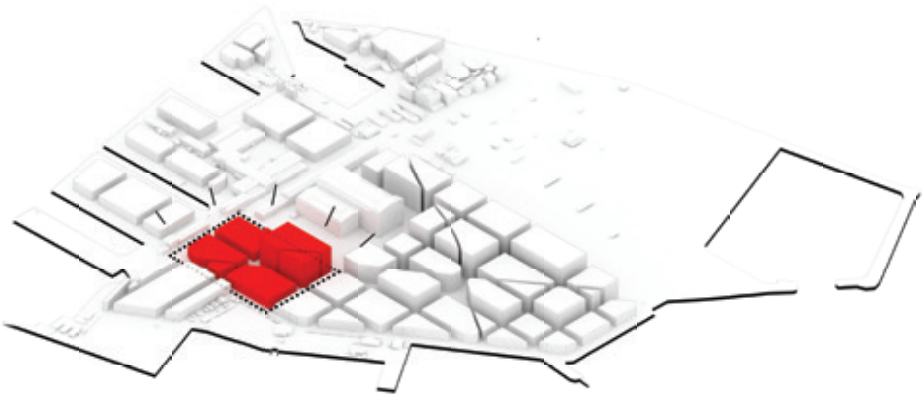
The programmatic hierarchy ensures an active plinth and a vibrant public life

 Ill. 56 Diagram illustrating the fifth design parameter
Ill. 57 Diagram illustrating the seventh design parameter



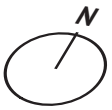
06_WIND

By breaking down the wind from west, microclimate is improved to nurture public spaces



ANCHOR POINT

The anchor point is selected as first phase and catalyst for development



Ill. 58 Diagram illustrating the sixth design parameter
Ill. 59 Diagram illustrating the anchor point

Architectural Design Process

This section outline the design process for the architectural concept and its respective principles. As described in the methodology section, the architectural design process develop through the design parameters in iterations. Each step alters the architectural morphology, which adapts to the design parameters. The urban design process established a strategy and set of overall principles, while the architectural design process address a level of detail that is more directly relateable to the users. Throughout the design process, it became evident that the strictly parametric methodology was insufficient in creating a comfortable and appealing design, as described in the case reflection on page 56. As the design process moved to an increasingly smaller scale, the need increased for tactile aesthetics and a phenomenological sensitivity to detail.

In the architectural design process, the open spaces are divided into public, semi-public and public spaces. The public spaces are available and easily accessible, clear entrances makes them 'inviting' to the public. The semi-public spaces are available to the public but less inviting as they are primarily for the residents, as for instance some of the courtyards. The private spaces are only accessible for private residents.
The illustration below shows how the urban strategy has evolved, which is further illustrated and explained on the following pages.

1. Land Use: A maximum volume is extruded from the site to the required floor area.

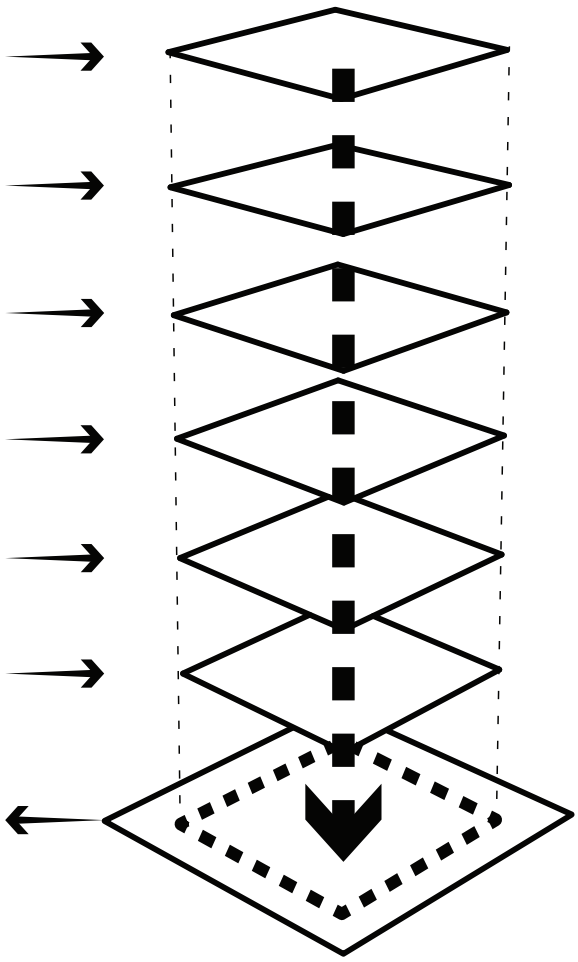
2. Mobilities: Alleys for pedestrians, bicyclists and residents' cars carve out irregular shared spaces that reduce speeds and provide various spatial experiences through the urban fabric.

3. Daylight Conditions: The volume is redistributed to ensure daylight in the apartments, at the lower floors and urban spaces.

4. Open Spaces: The courtyards and rooftop terraces are dedicated to open space, creating an abundance of spaces for recreational use.

5. Wind Conditions: To diffuse and decellerate the wind, the volume is further refined and tree are placed strategically throughout the urban fabric.

6. Urban Environment: Active programs are placed at ground floor and close to the central square to concentrate public life and catalyze social interaction



Architectural Concept

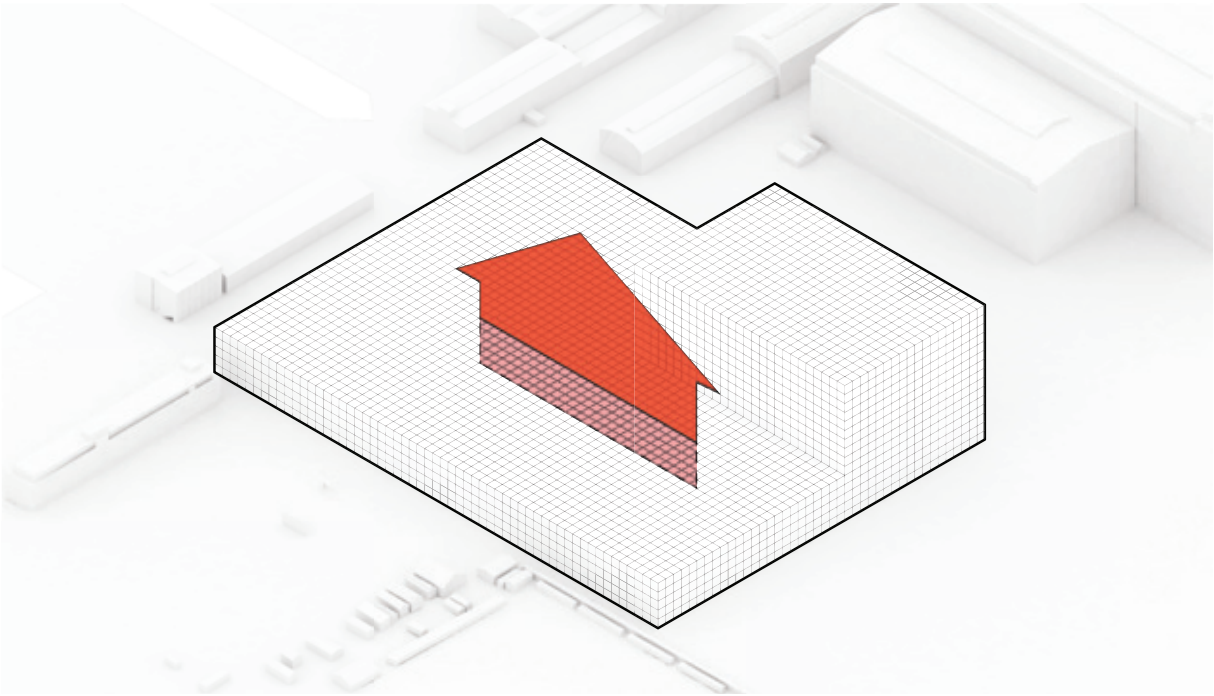
72 Ill. 61 Diagram illustrating how the design parameters inform the architectural concept

Architectural Principles

The architectural principles defines a set of rules and incentives for development on an architectural scale at Refshale Island. This ensures quality housing and the best premise for a high quality of urban life in order to meet the vision of Copenhagen municipality (Center for Byudvikling, 2015).

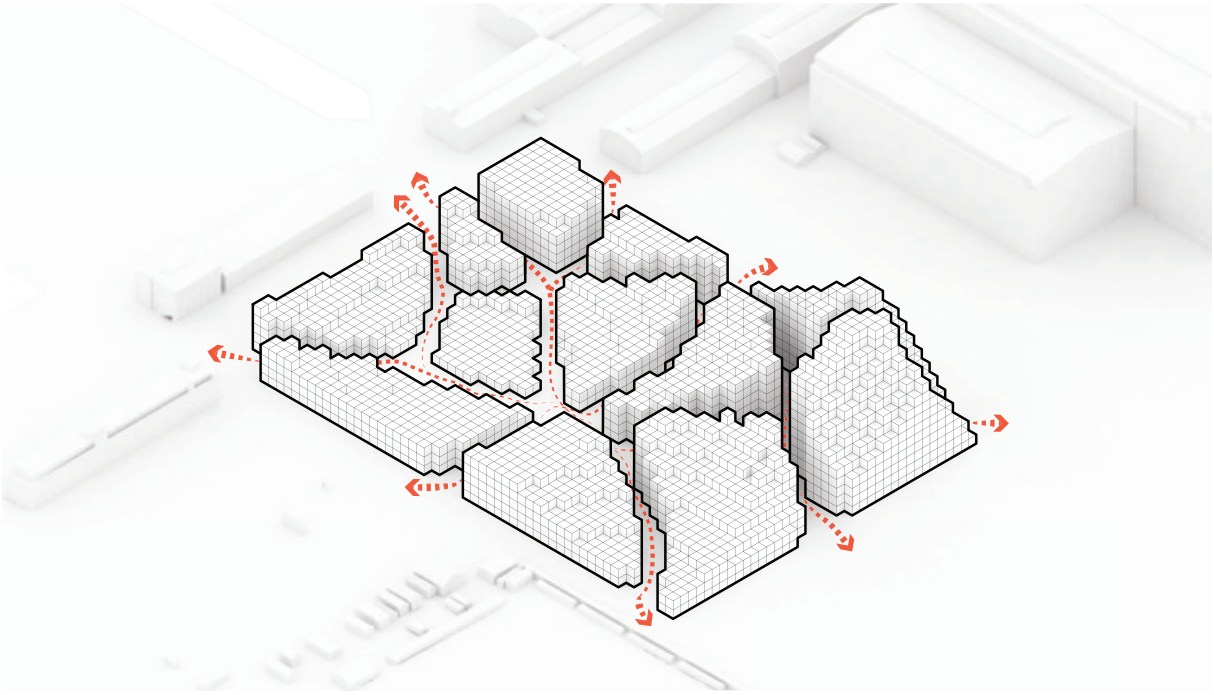
- The FAR should be approximately 200% to ensure the required dwelling capacity requirement.
- Only residents can drive by car through the alleys with a maximum of 25km/h, since this is a shared space. The alleys provide occasional parallel parking for residents and guests in addition to the parking house at the north-east corner of the anchor point.
- A daylight factor of 2.0 is required in every apartment, which equals to 200lux.
- All apartments must have views to vegetation within a 100m radius and a private or public terrace within a 35m radius.
- All apartments must have a daylight factor of 2.0, (200lux)
- Wind speeds cannot exceed 8m/s and all terraces should have a windshield towards west, wether this is from vegetation or artificial material is irrelevant as long as it is effective.
- Active programs must be placed at ground floor and all buildings with a facade towards the main street or a square, must place commercial programs toward these urban spaces to concentrate and catalyze public life.
- If the developer builds a percentage of public housing (Y), the maximum allowed building height (X) is doubled in percentage. The current maximum building height is 30m, which is approximately 8 stories (Thiemann, 2015). As an example, the developer builds 25% public housing and is thereby allowed to build 50% higher than the current maximum building height, in this case that would be 45m. If the developer chooses to build 100% public housing, the maximum building height would increase to 60m, which still is less than the B&W halls - approximately 17 stories but the maximum for the entire site. Thereby X=Yx2.
- Occasional exceptions can be made to the building heights, if the building shows relative significant improvement to the design parameters: daylight, wind conditions, open space, urban environment, land use or mobilities. Otherwise if the building provides significant positive impact to the surrounding urban spaces by catalyzing public life or providing public amenities.
- The average apartment size (X) must be 100m2 in each building, but the percentage of apartments below 50m2 (Y) can double the average apartment size. Thereby X=Yx2. This incentivizes microapartments and apartments for lower income tenants.
- The interior planning must be designed to allow sharing of the apartment, that is two individuals sharing the rental or ownership contract. The average size difference between living room and bed room cannot exceed 50%, which means that one room cannot be more than double the size of the other to ensure that the social and economic demographics becomes as diverse as possible.
- All apartments must have residence obligation, which prohibits real estate speculation.
- It is recommended for future development to consider innovative sustainable technology as timber structures and prefabricated strawbale walls in order to reach Co2 neutrality and innovate in housing development. Examples are done by C.F. Møller and Salto Architects.

Architectural Concept



01_FARMAX

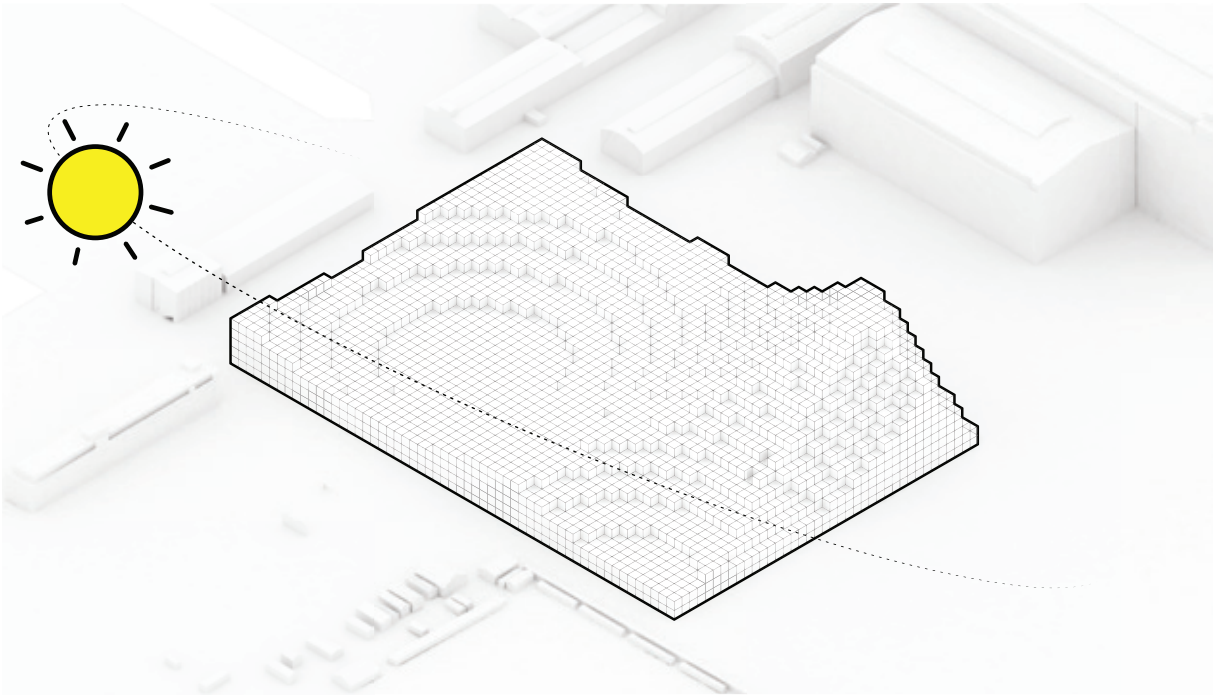
The maximum volume is extruded from the site, according to the new zoning law



03_MOBILITIES

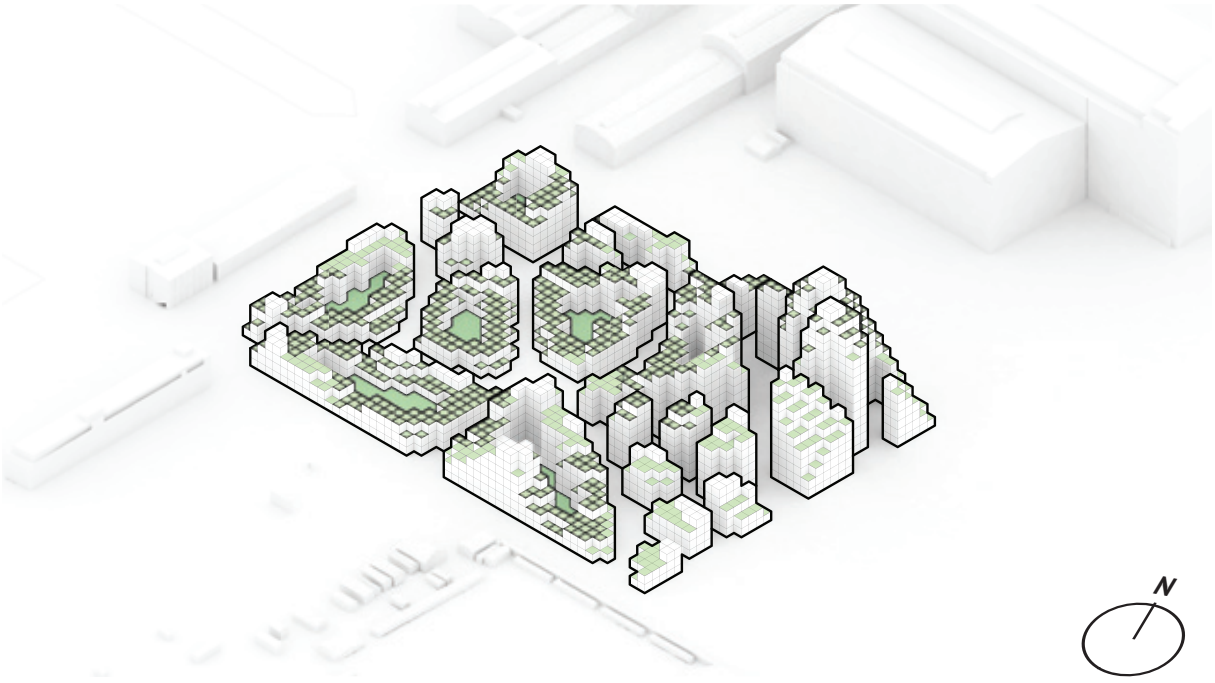
The organic mobilities network decellerates traffic and prioritize pedestrians and their spatial experience of the urban fabric on foot

Ill. 62 Diagram of the first design parameter
Ill. 63 Diagram of the third design parameter



02_DAYLIGHT

The volume is dispersed to allow maximum daylight exposure and minimum energy consumption

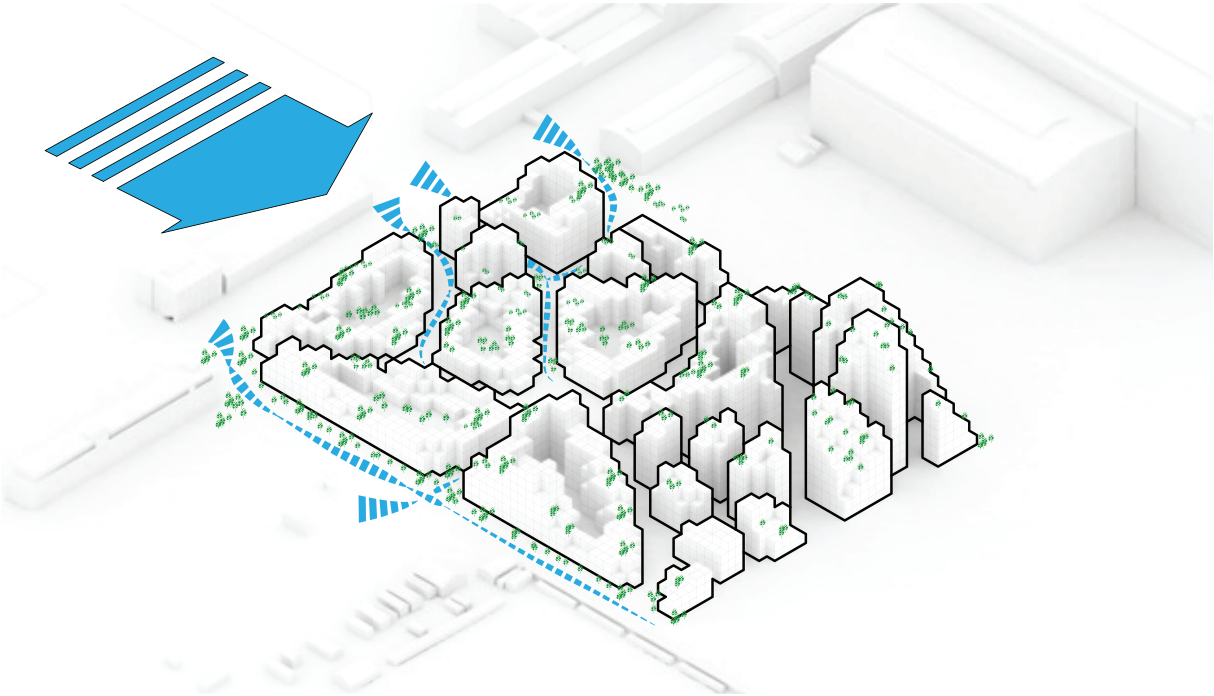


04_OPEN SPACE

Public, semi-public and private spaces are strategically placed to afford communities

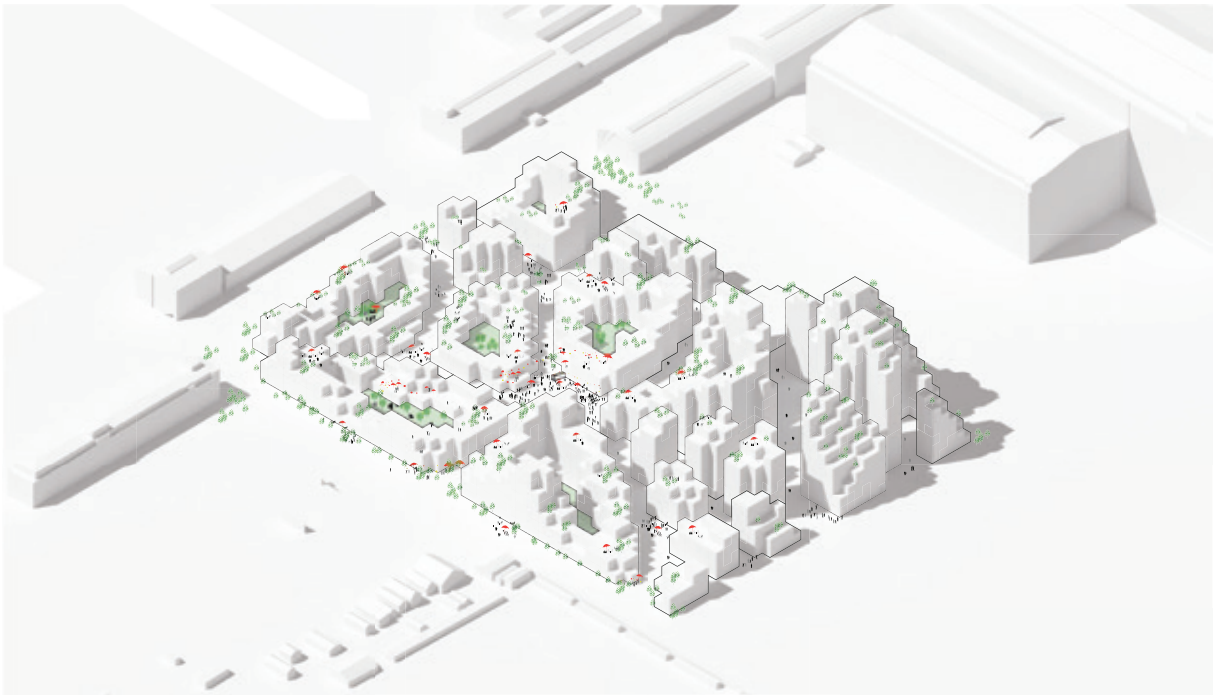
Ill. 64 Diagram of the second design parameter
Ill. 65 Diagram of the fourth design parameter

Architectural Concept



05_WIND

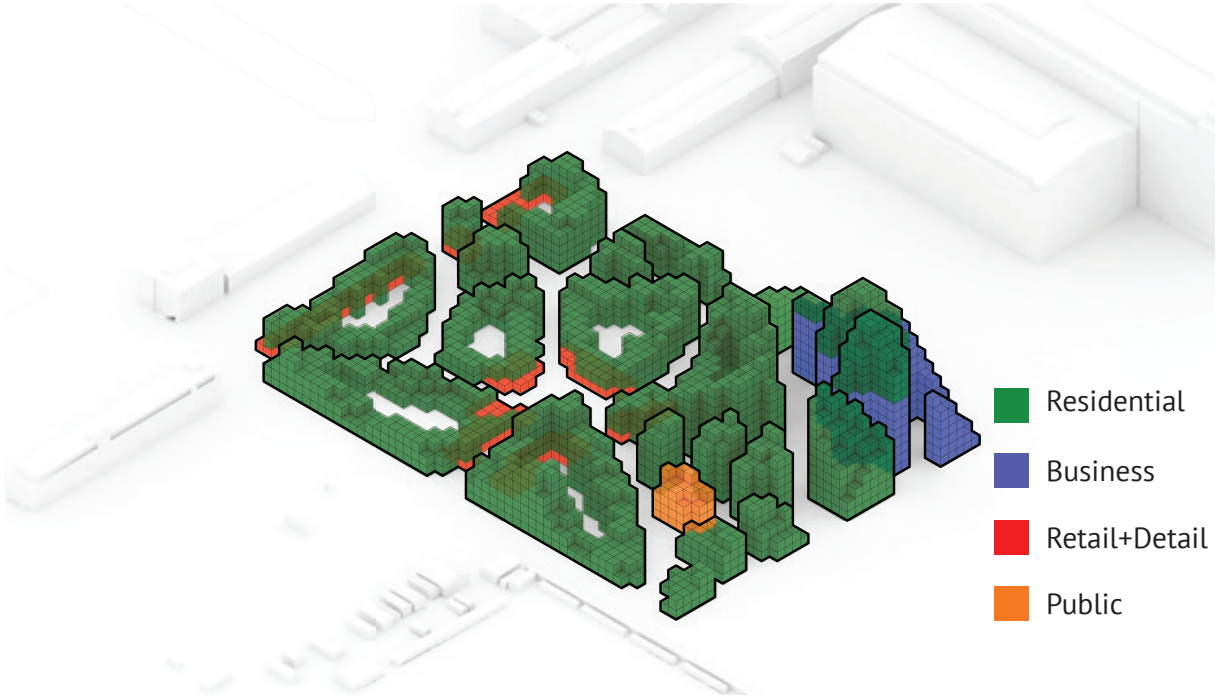
The refined volume and vegetation disperse and decellerate the wind to improve local microclimate



PERFORMATIVE GREEN SPACE

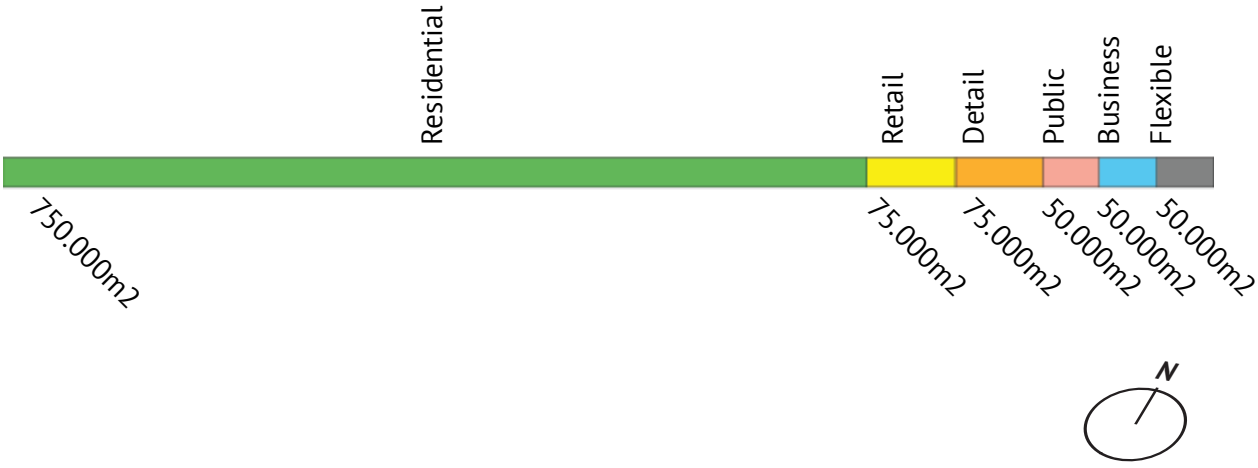
Semi-public green spaces on rooftop terraces and courtyards can be used for urban farming

 Ill. 66 Diagram of the fifth design parameter
Ill. 67 Diagram of the performative green spaces



07_URBAN ENVIRONMENT

Strategic programming ensure daylight and accessibility to each program's requirements. The programs are expected to merge and change over time, which is accounted for.



TOTAL PROGRAM

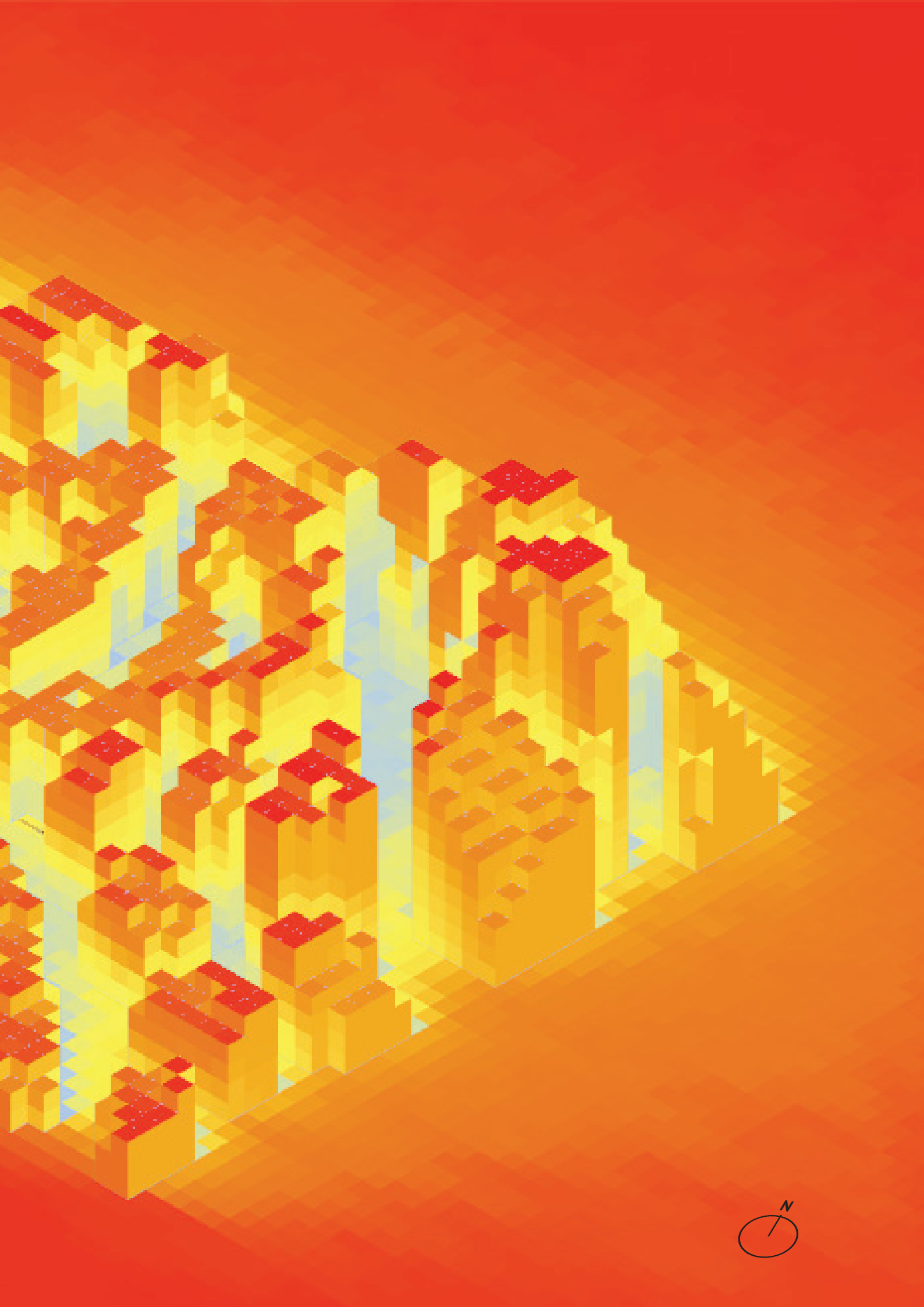
The anchor point is used for programming of the entire island, with 50.000m2 of flexible program to take precautions for change in demographics and dwelling demand.

Ill. 68 Diagram of the sixth design parameter
Ill. 69 Diagram of the programs

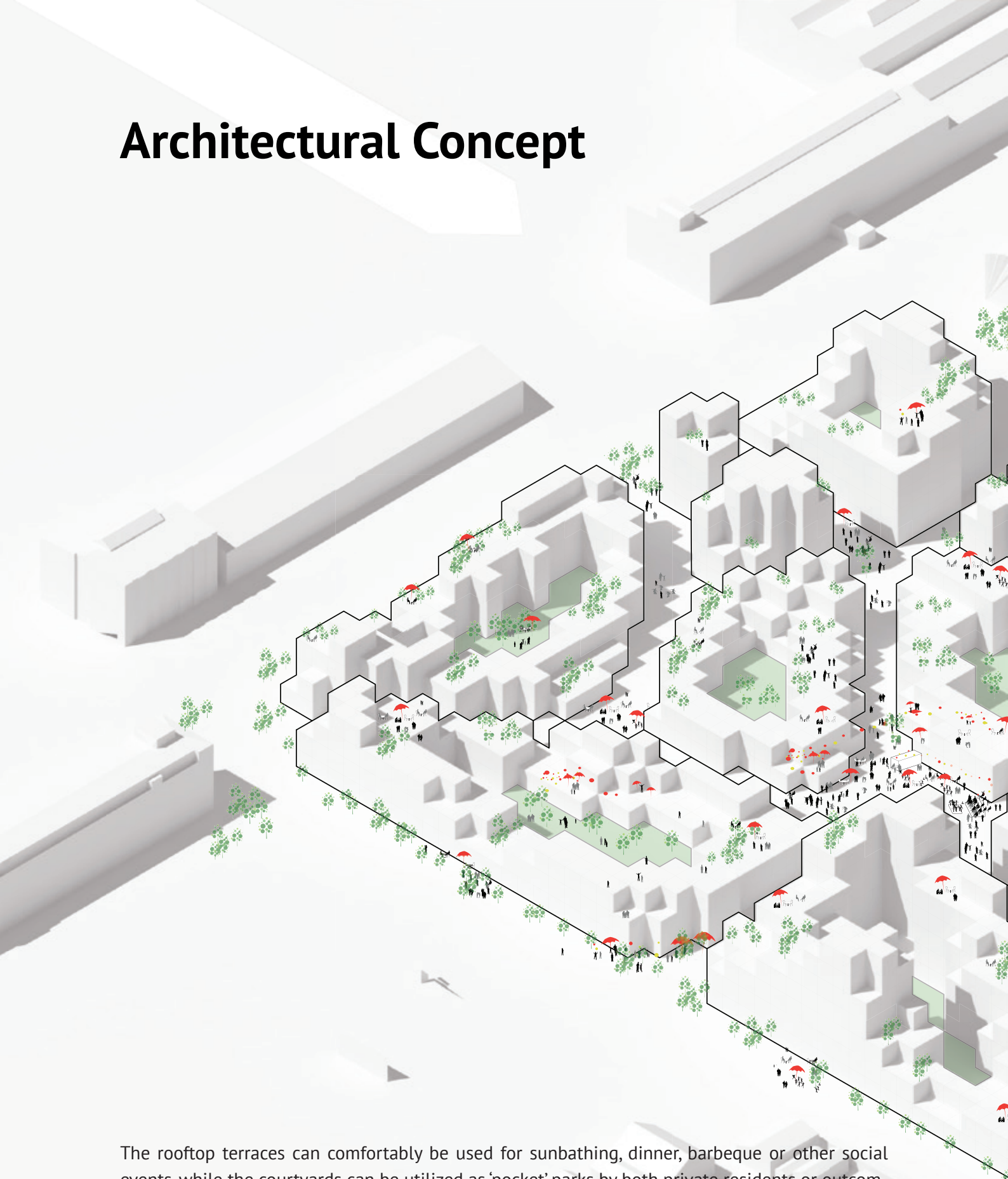
Sun Hour Analysis of Volumes

This analysis illustrates the average of direct sunlight illuminance, measured in average hours per year. Here illustrated throughout the building volumes, facades and into the urban fabric. It is clear that the rooftops and southern facades recieve most sunlight, but that the analysis model has been used in the design process to ensure daylight at the lower floors and ground level. The model does not calculate indirect sunlight or reflections and is therefore a conservative estimate of the expected sunlight conditions.

Ill. 70 Sun hour analysis made in Grasshopper with Ladybug plugin

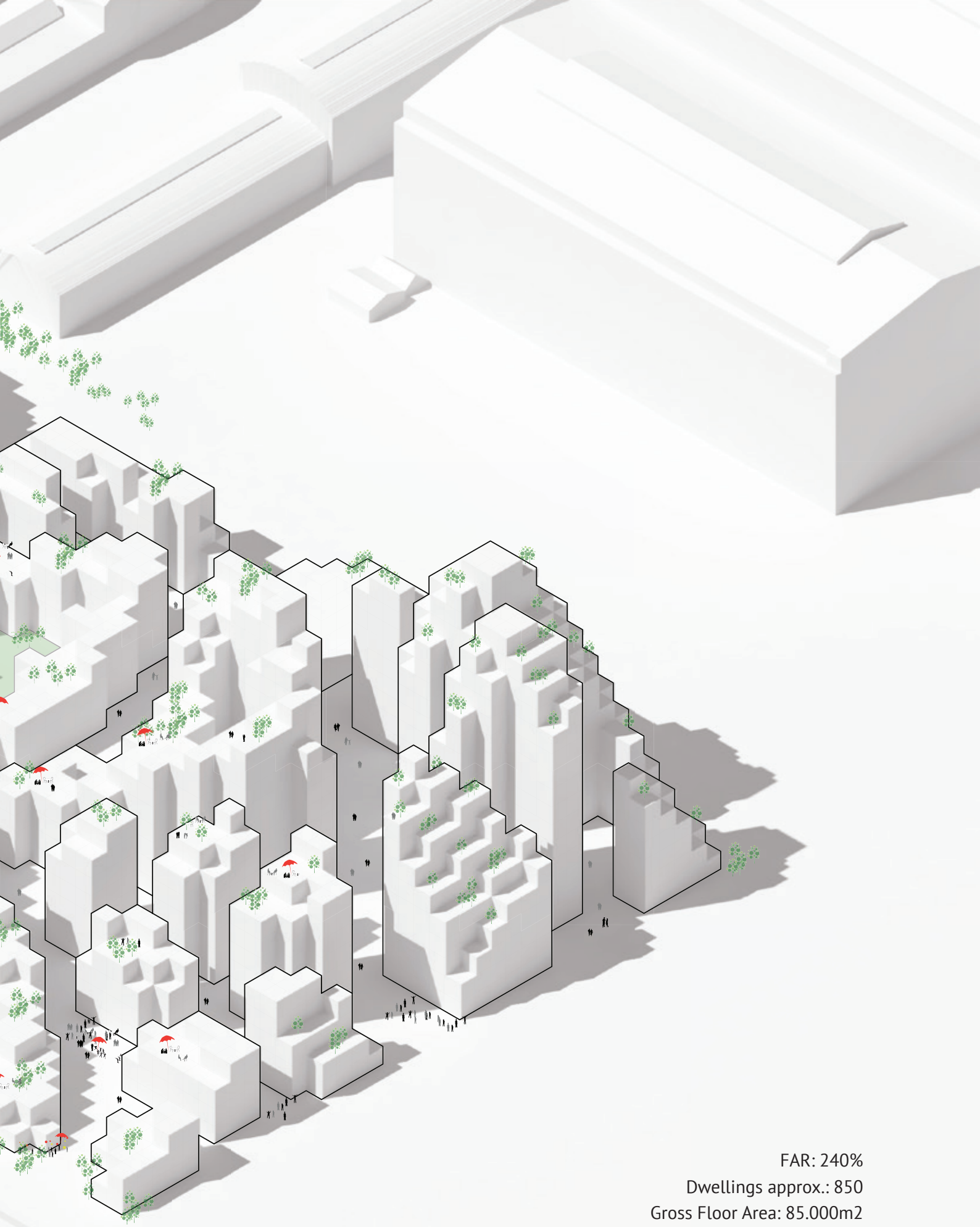

N

Architectural Concept



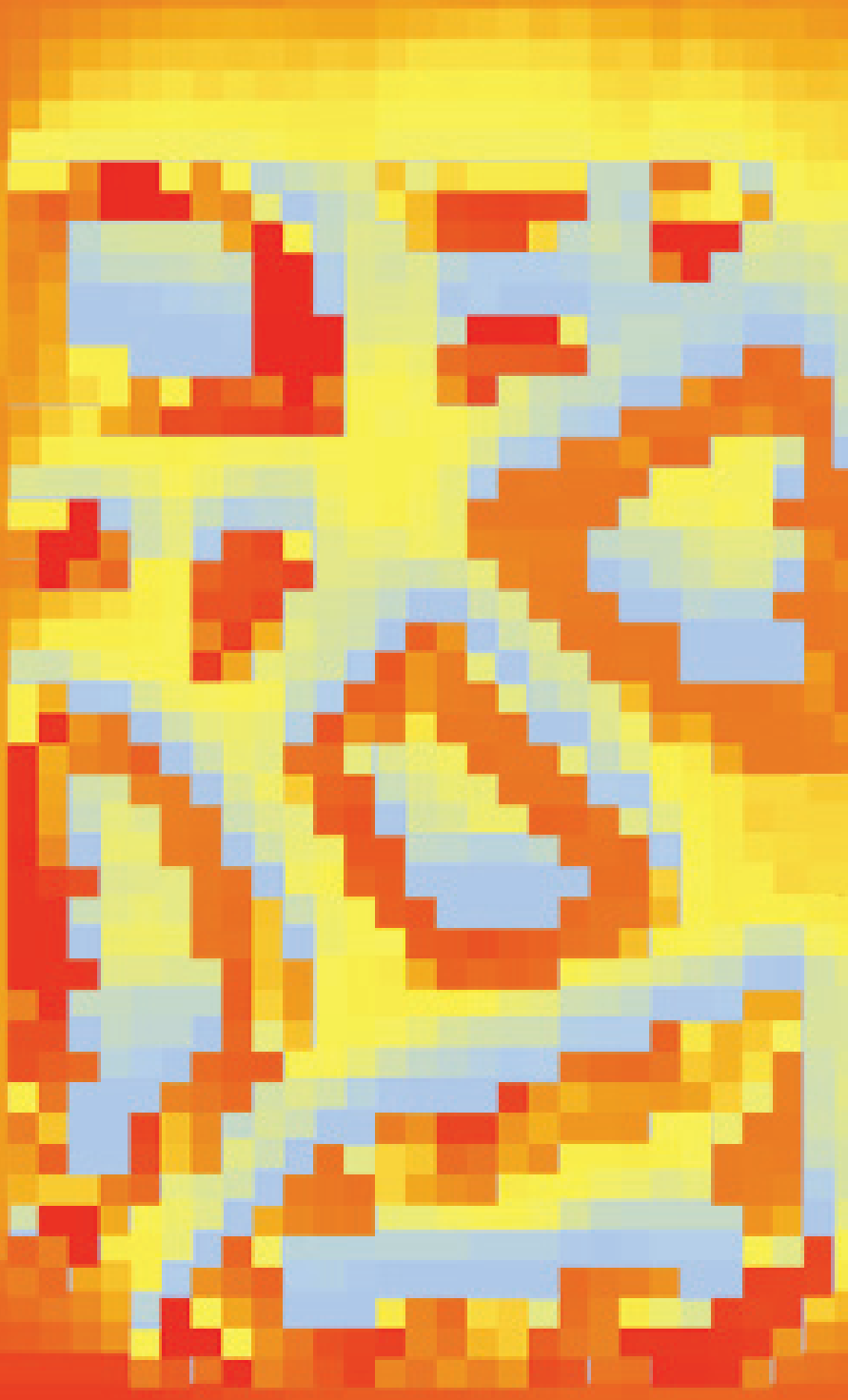
The rooftop terraces can comfortably be used for sunbathing, dinner, barbeque or other social events, while the courtyards can be utilized as 'pocket' parks by both private residents or outcomers. By design, the central square is the core of public life, with the highest concentration of active programs and optimal sun exposure, as well as its central placement on the Main Street. By utilizing the green spaces for urban farming and even egg production, the entire Refshale Island could be an example of local sustainability, turning the former industrial wasteland into its opposite.

Ill. 71 Diagram of the architectural concept



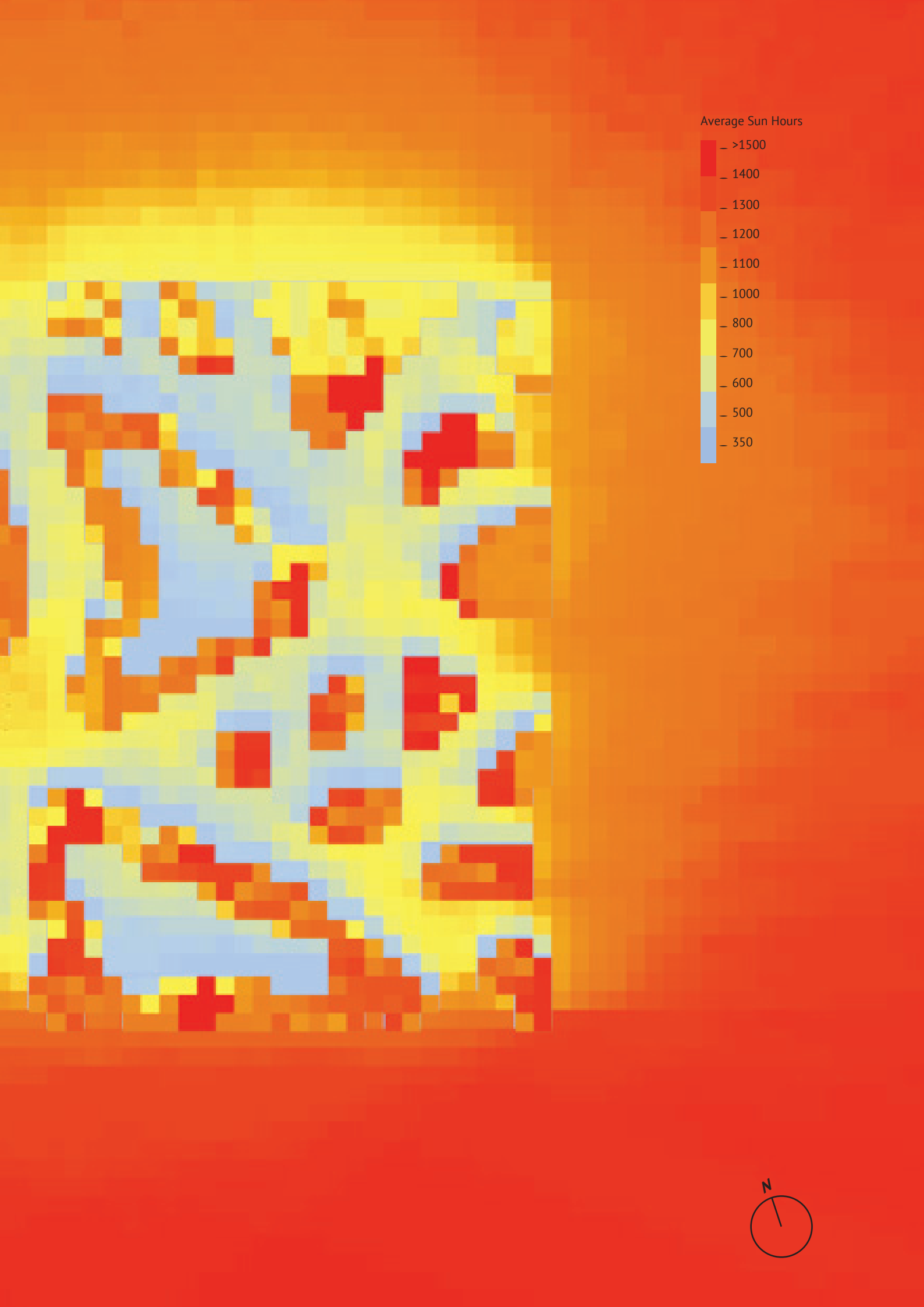
FAR: 240%
Dwellings approx.: 850
Gross Floor Area: 85.000m2
Plot Area: 35.000m2

Sun Hour Analysis of Urban Spaces



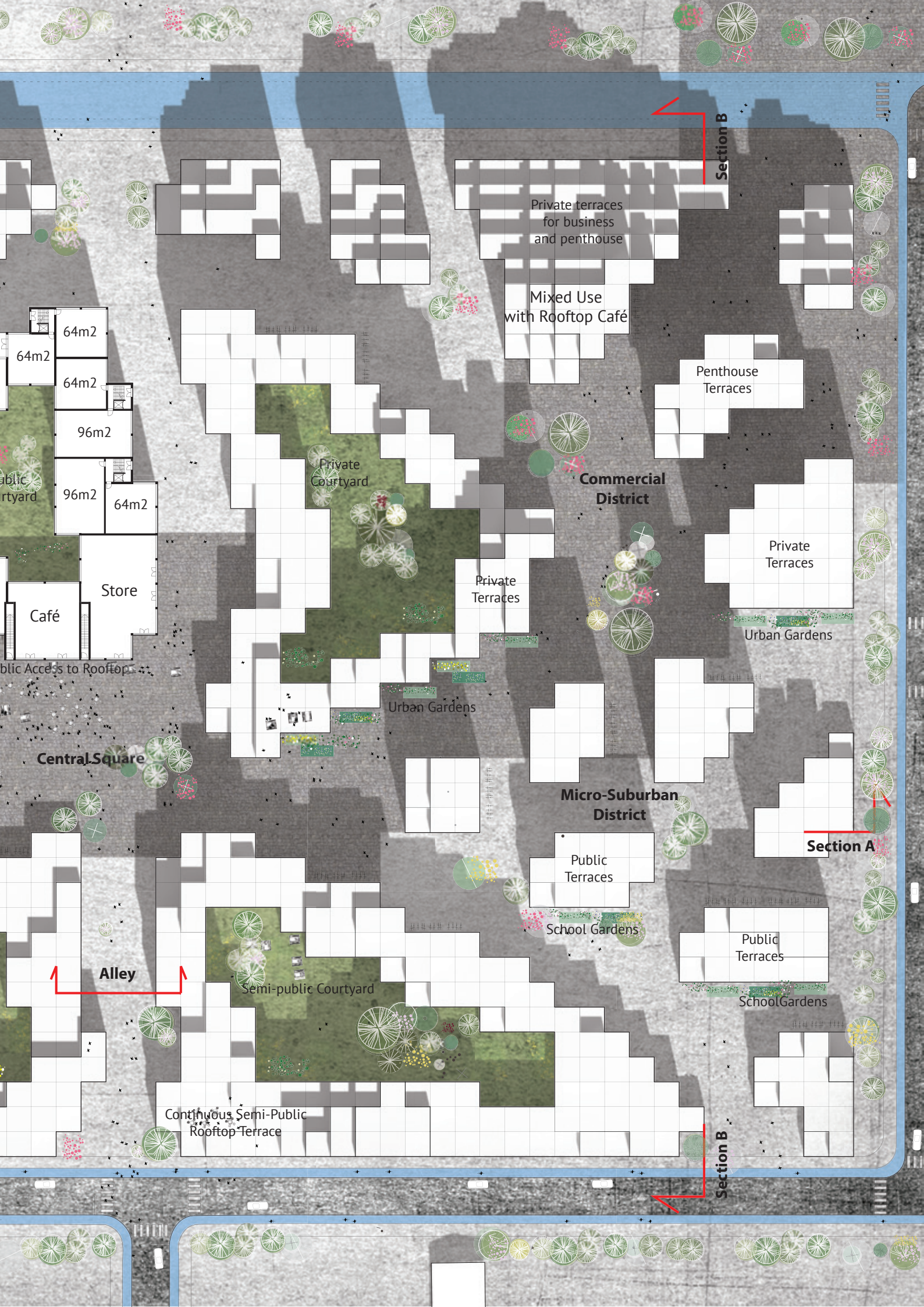
This analysis illustrates the average og direct sunlight illuminance, measured in average hours per year. This illustration shows how sunlight is dispersed on rooftop terraces and the urban spaces between building volumes. Volumes around the central urban square are designed to allow as much daylight as possible onto the urban square. To calculate daylight conditions in the interior would require further analysis, while this analysis provides the foundation.

Ill. 72 Sun hour analysis in plan


Average Sun Hours
>1500
1400
1300
1200
1100
1000
800
700
600
500
350
N

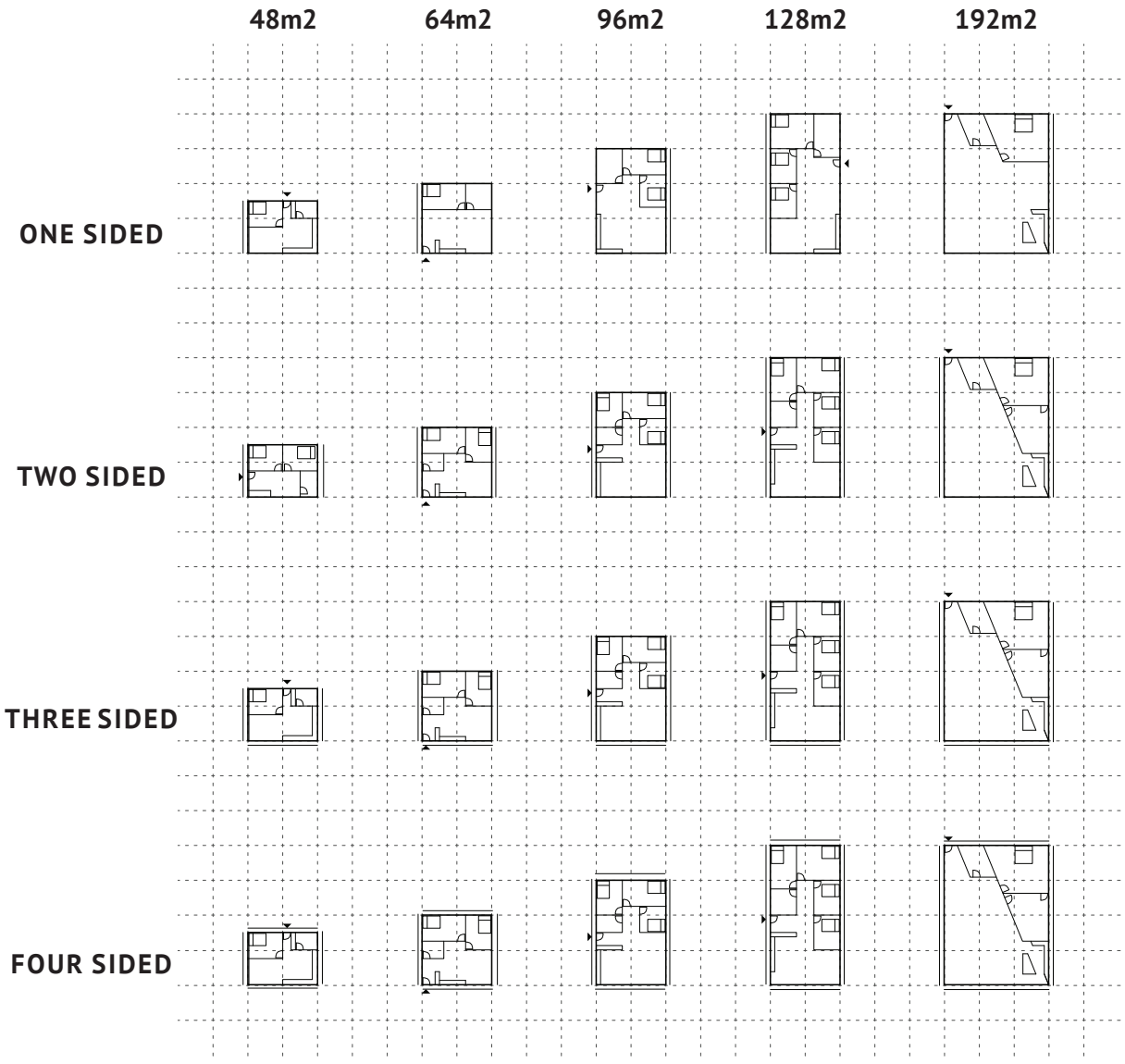
Anchor Point Site Plan

Ill. 73 Site plan of the anchor point


Section B
Private terraces
for business
and penthouse
Mixed Use
with Rooftop Café
Penthouse
Terraces
64m2
64m2
64m2
96m2
96m2
64m2
Private
Courtyard
Commercial
District
Private
Terraces
Private
Terraces
Urban Gardens
Store
Café
blic Access to Rooftop
Urban Gardens
Central Square
Micro-Suburban
District
Section A
Public
Terraces
School Gardens
Public
Terraces
SchoolGardens
Alley
Semi-public Courtyard
Continuous Semi-Public
Rooftop Terrace
Section B

Apartment Catalog

In the architectural design, it as important to ensure maximum flexibility for apartment designs and optimal adherence to the design parameters, with particular emphasis on daylight. A grid based upon 4x4x4 meter standard size would meet these requirements and ensure that even small apartments would get sufficient daylight due to tall ceiling heights, which also would allow space for high basements and reinforced structure for the rooftop gardens. The building volumes are dimensioned for apartments with depth from 6 to a maximum of 16 meters which ensures good daylight conditions and flexible plan solutions. The 4x4x4 grid would simplify the construction process significantly as both surveys and machinery can adopt the modular system with ease. The apartments illustrated below consist of several typologies depending on the daylight orientation but provide daylight for all living rooms. Some typologies suggest single residents or multiple students, some allow couples and families with up to three children. Penthouse apartments are also included as these can be used to attract foreign investment.



86 Ill. 74 Diagram of suggested apartment types compatible with the grid and plan

Material Catalog

The material catalog illustrates a series of materials that serve as principles for material use in development of Refshale Island. It takes references from the existing industrial structures that carry a strong history and use the materials for facades, pavement on streets and urban spaces as well as urban inventory as benches, light poles, trash cans, manhole covers etc.

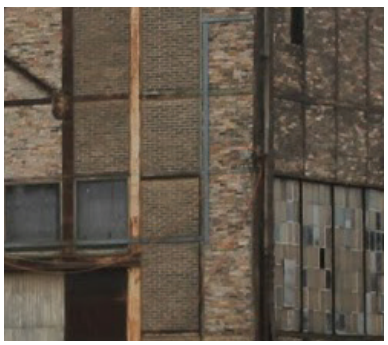
Cobblestone, railroads and urban vegetation for pavement and landscape



Worn industrial steel for urban inventory



Brick and concrete building facades


Contrasts as a general principle



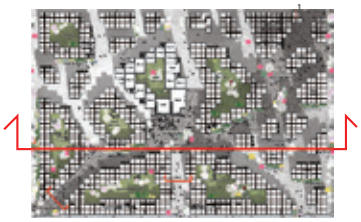
Ill. 75, 76, 77, 78, 79, 80, 81, 82, 83, 84, 85, 86, Photographs of materials on Refshale Island

Longitudinal Section A-A

Central Square

Ill. 87 Longitudinal section AA of the anchor point

Business District

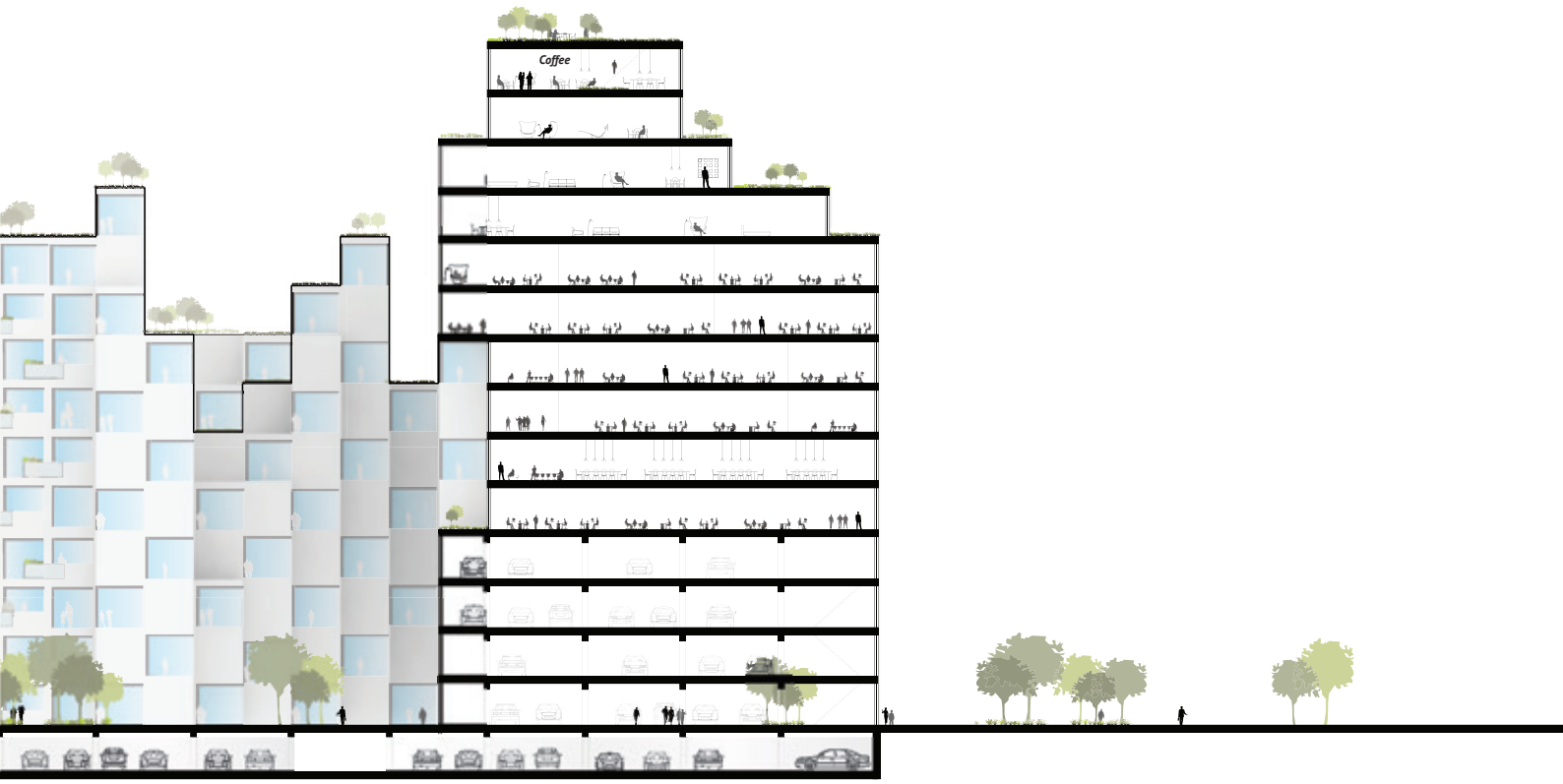


Ill. 88 Site plan with section arrow to indicate placement of the section

Cross Section B-B

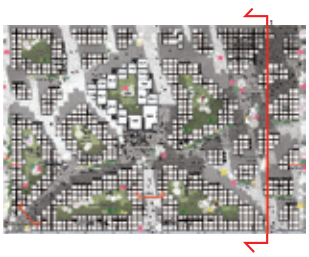
Education and Public Amenities

Ill. 89 Cross section BB of the anchor point



Underground Parking

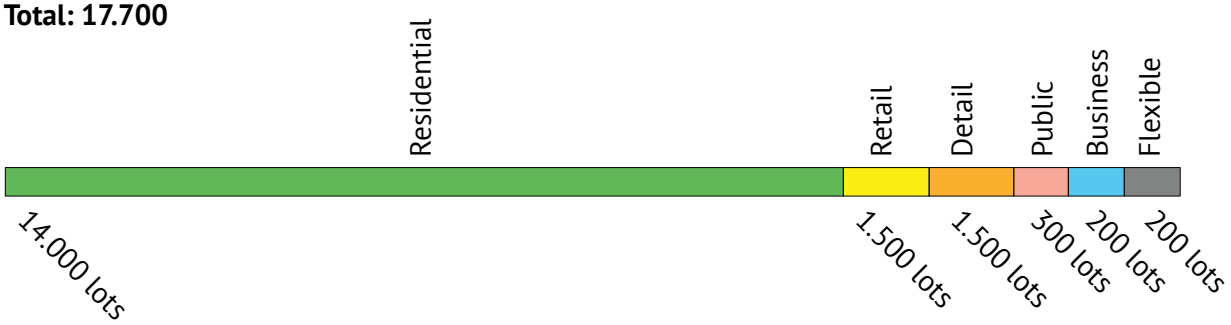
Hybrid Office building with Public Terrace and Parking



Ill. 90 Site plan with section arrow to indicate placement of the section

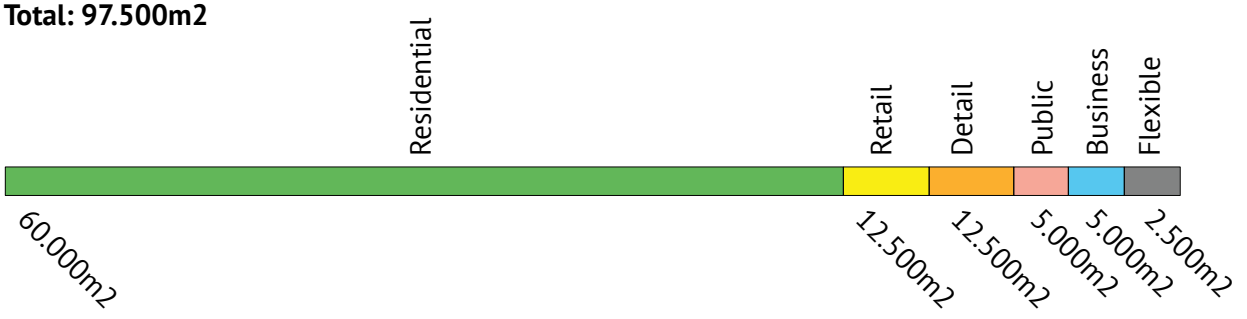
Program

Required bicycle parking
Total: 17.700



Required car parking
Total: 4000

Required car parking space
Total: 97.500m2



Sources: Grønvad et. al. 2016, TU-Data, 2016; Vejdirektoratet, 2016; Via Trafik, 2014

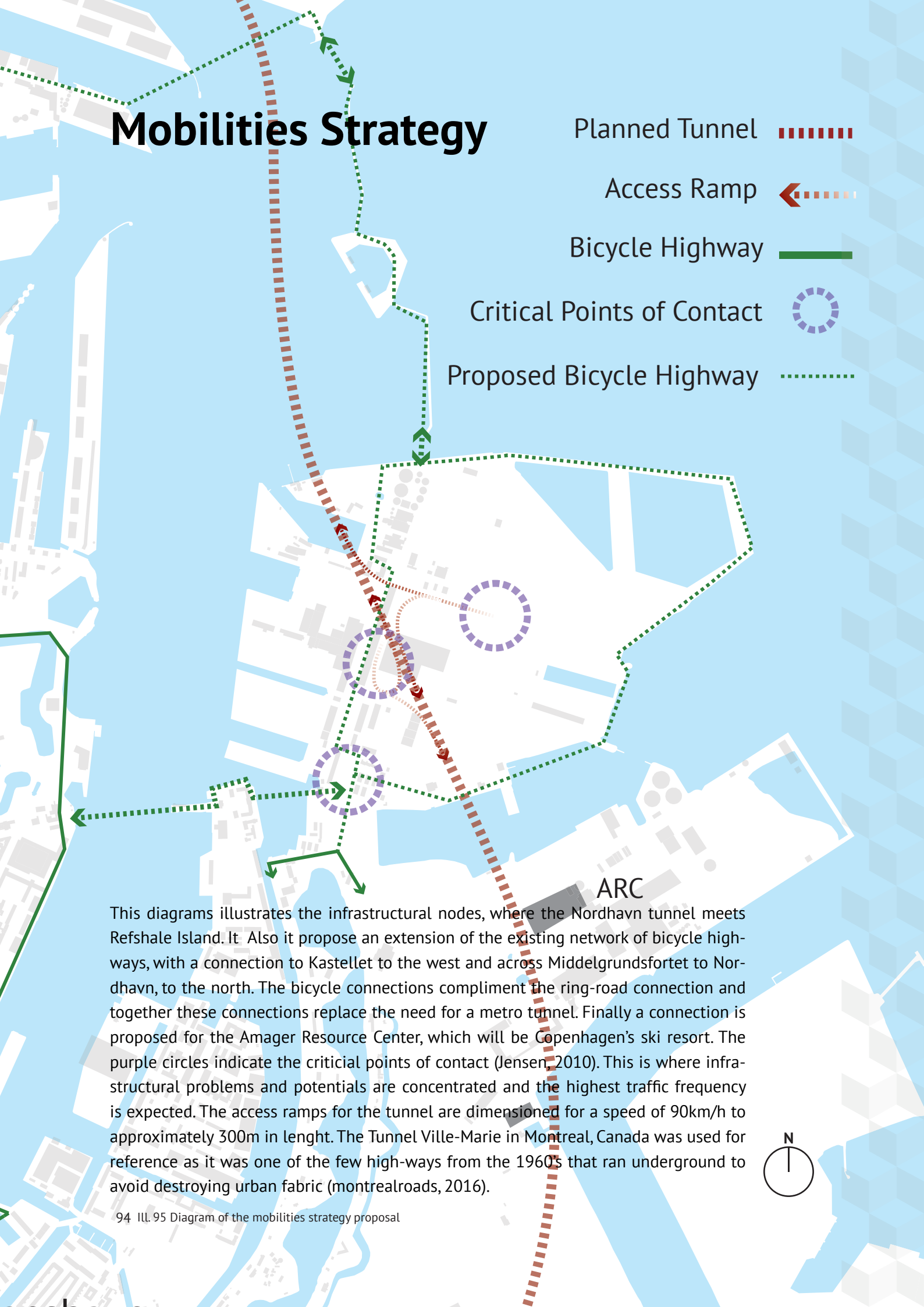
92 Ill. 91 Diagram of the program distribution
Ill. 92 Diagram of the required bicycle parking lots
Ill. 93 Diagram of the required car parking lots
Ill. 94 Diagram of the required car parking space including space for circulation

Infrastructural Solution

The following section covers the requirements and solutions for traffic and parking capacity on Refshale Island, which is followed by an infrastructural integration of Refshale Island in the overall traffic planning of Copenhagen municipality. Subsequently, the island's mobilities network is illustrated and explained with its principles and finally complimented with recommended integration of parking solutions and four street typologies. These four typologies demonstrate how the streets are used for different urban environments and mobilities solutions, which is further ellaborated on p. 100-102. The section will also cover the amount of trips taken, which have informed the design of road-capacity for pedestrians, bicyclists and cars. To simplify, the amount of users and their trips dictate the parking needs and road capacity, with the parking norms and road dimensions from the Danish Cyclist Society, Danish Road Directorate and the Ministry of Transport and Construction (Bølling-Ladegaard et. al., 2007; Danish Road Directorate, 2016).

According to numbers by municipality of Copenhagen, the norm is 2,2 residents per 100m2 (Danmarks Statistik, 2016; Københavns Kommune, 2015), which shows that the plan reaches a capacity of 15.000 inhabitants on the 700.000m2 net internal area (NIA), which is approximately 7500 dwellings. In addition, 50.000m2 is allocated for circulation, fire escapes, lobbies, storage and technical amenities, which cover a total of 750.000m2 gross floor area. Business program equal approximately 50.000m2 gross floor area (GFA), while retail and detail program equal approximately 150.000m2 GFA. Public amenities equal approximately 50.000m2 GFA, this includes schools and kindergardens as well as cultural institutions. The remaining 50.000m2 are allocated as 'buffer' to ensure a programmatic flexibility in case of change in the demographic tendencies. This space could also be used for multi-storey parking garages for the residents and businesses. As the numbers show a significant need for parking area, 25.000m2 of the flexible program must be used for parking, but this can be used for a double utilization of 100%. This means that the parking for residents and business can be shared as these programs require parking in two different timespans throughout the day. Underground parking is considered economically viable, since the real estate prices in the area will be quite high, equivalent to Nordhavn of approximately 30-40.000 per m2. A majority of the parking must be underground which will probably be limited to one floor below ground level, since the island is artificial. This is to utilize the area above ground for more beneficial purposes in both an architectural, social and economic sense. It would be unwise to estimate a larger area for parking than what is suggested here, as the advancement in disruptive technologies i.e. self-driving cars accellerate exponentially and will render current parking norms completely obsolete.

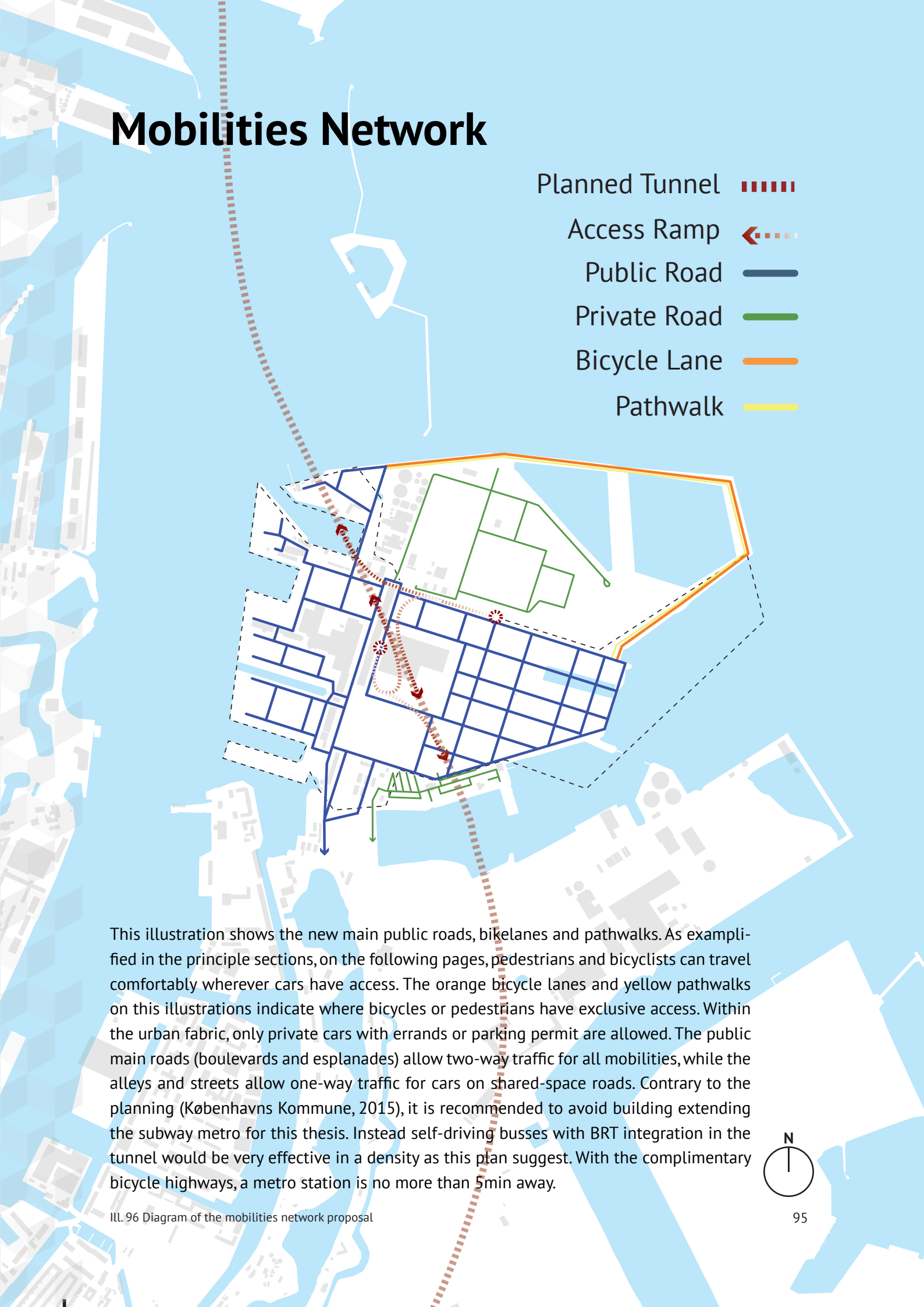
Transportation	**Trips**	**Parking Lots**	**Parking Space NIA**
On foot	7.560	0	0
Bicycle	7.140	17.700	21.240
Public transport	2.520	0	0
Car passenger	4.620	0	0
Car	18.900	8.250	97.500
Other	1.260	0	0
Total	42.000	25.950	118.740m2



This diagrams illustrates the infrastructural nodes, where the Nordhavn tunnel meets Refshale Island. It Also it propose an extension of the existing network of bicycle high-ways, with a connection to Kastellet to the west and across Middelgrundsfortet to Nor-dhavn, to the north. The bicycle connections compliment the ring-road connection and together these connections replace the need for a metro tunnel. Finally a connection is proposed for the Amager Resource Center, which will be Copenhagen's ski resort. The purple circles indicate the criticial points of contact (Jensen, 2010). This is where infra-structural problems and potentials are concentrated and the highest traffic frequency is expected. The access ramps for the tunnel are dimensioned for a speed of 90km/h to approximately 300m in lenght. The Tunnel Ville-Marie in Montreal, Canada was used for reference as it was one of the few high-ways from the 1960's that ran underground to avoid destroying urban fabric (montrealroads, 2016).

 Ill. 95 Diagram of the mobilities strategy proposal

Mobilities Network

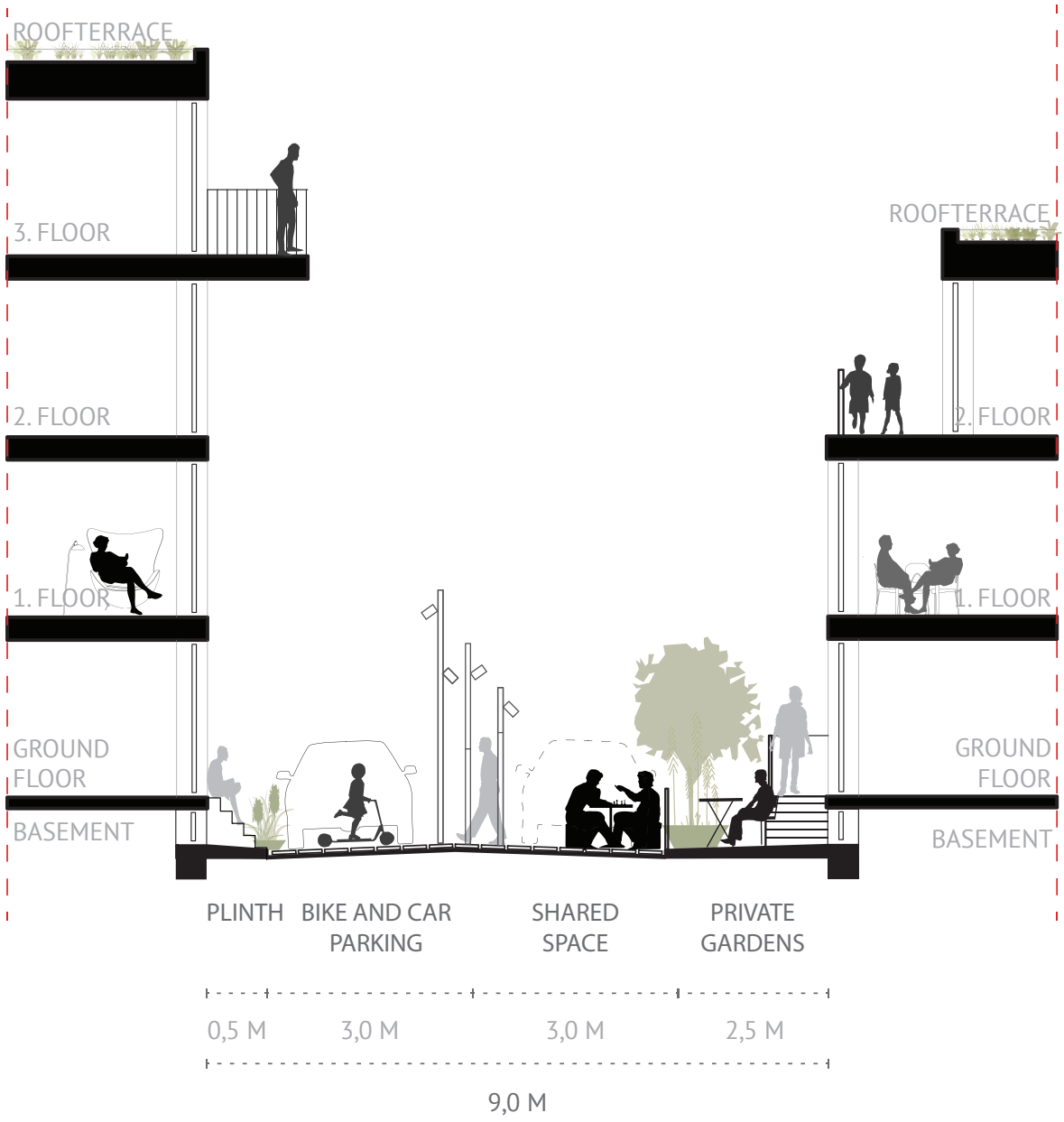


This illustration shows the new main public roads, bikelanes and pathwalks. As exampli-fied in the principle sections, on the following pages, pedestrians and bicyclists can travel comfortably wherever cars have access. The orange bicycle lanes and yellow pathwalks on this illustrations indicate where bicycles or pedestrians have exclusive access. Within the urban fabric, only private cars with errands or parking permit are allowed. The public main roads (boulevards and esplanades) allow two-way traffic for all mobilities, while the alleys and streets allow one-way traffic for cars on shared-space roads. Contrary to the planning (Københavns Kommune, 2015), it is recommended to avoid building extending the subway metro for this thesis. Instead self-driving busses with BRT integration in the tunnel would be very effective in a density as this plan suggest. With the complimentary bicycle highways, a metro station is no more than 5min away.

Ill. 96 Diagram of the mobilities network proposal

Principle Sections

ALLEY

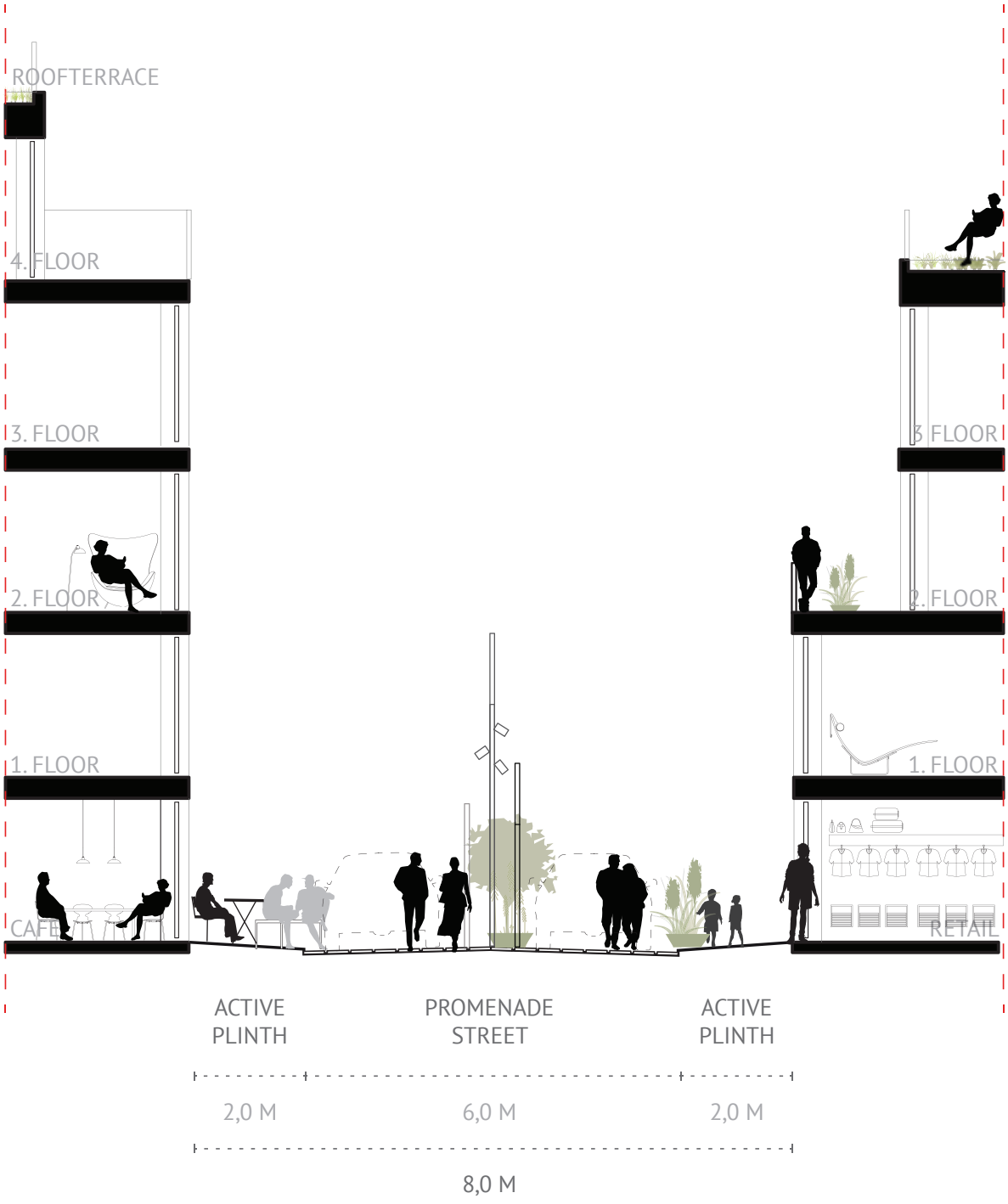


The following principle sections show four typologies of urban mobilities, which represent four different urban spaces and infrastructural solutions to the mobilities network. They afford different modes of transport but prioritize pedestrians first, then bicycles, public transport and at last cars. The streets and mobilities strategy is oriented towards public and private transport by car, since the planning of Nordhavn tunnel is for cars and due to the technological advances in self-driving cars, examplified with the planned self-driving busses in Aalborg from 2018 (Ingeniøren, 2016).

They 'Alleys' are narrow streets, meanding in between the building volumes. These are dimensioned to allow cars with special errands as well as parking for residents on the southern half

 Ill. 97 Principle Section of the Alley

MAIN STREET



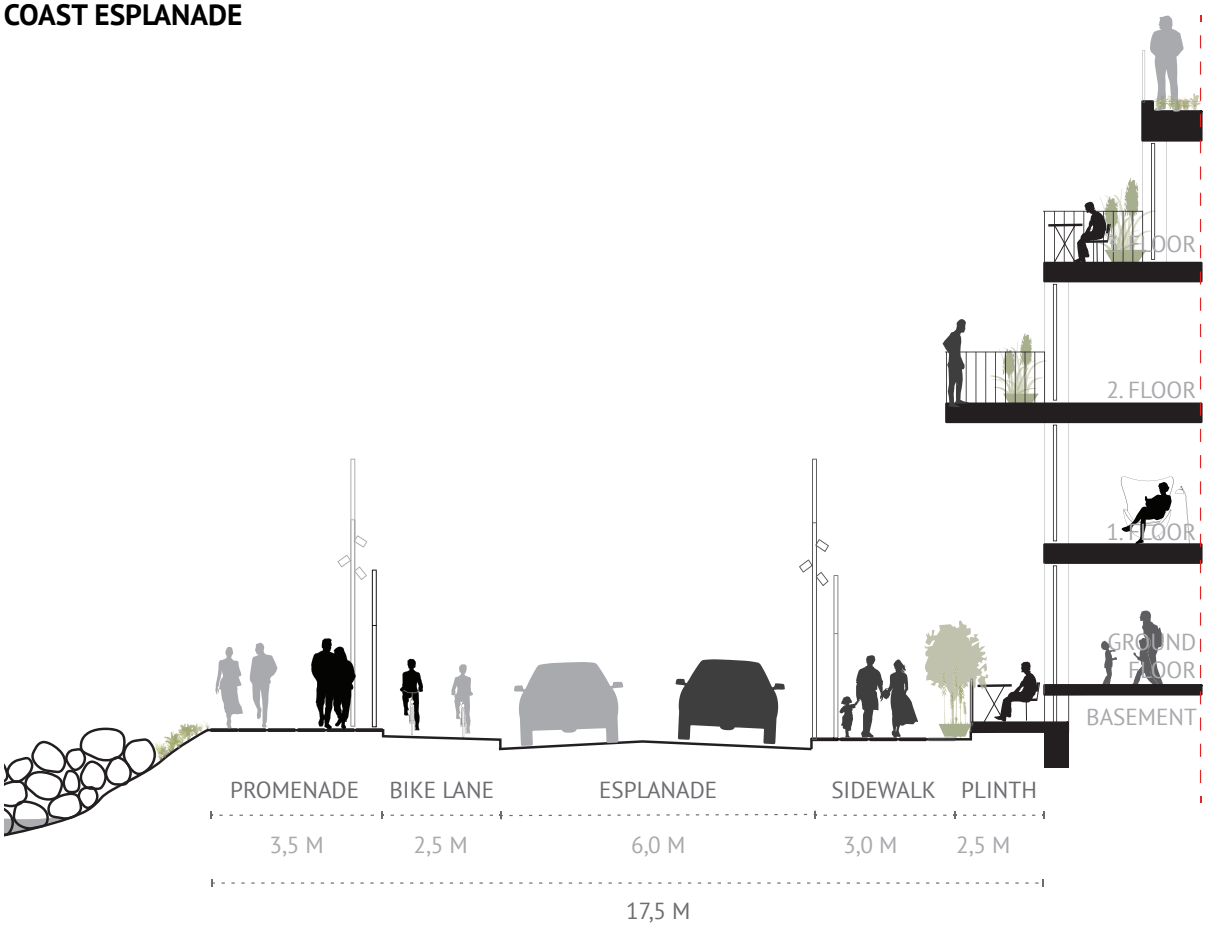
of the road, shaded by the apartment buildings. The alleys are designed as shared space with a maximum speed of 30km/h, with consideration for families and social gatherings.

The 'Main Street' is a long slightly curving promenade, stretching from the south-western corner at the entrance to Refshale Island, past the B&W Halls, connecting to the 'Coastline Esplanade' ocean promenade at the north-eastern corner. This is a shopping and promenade street that continue through various densities and urban squares which provide various spacial experiences and views through the new urban neighborhood. A majority of the detail and retail programs are concentrated around this street and so are the urban squares.

Ill. 98 Principle Section of the Main Street

Principle Sections

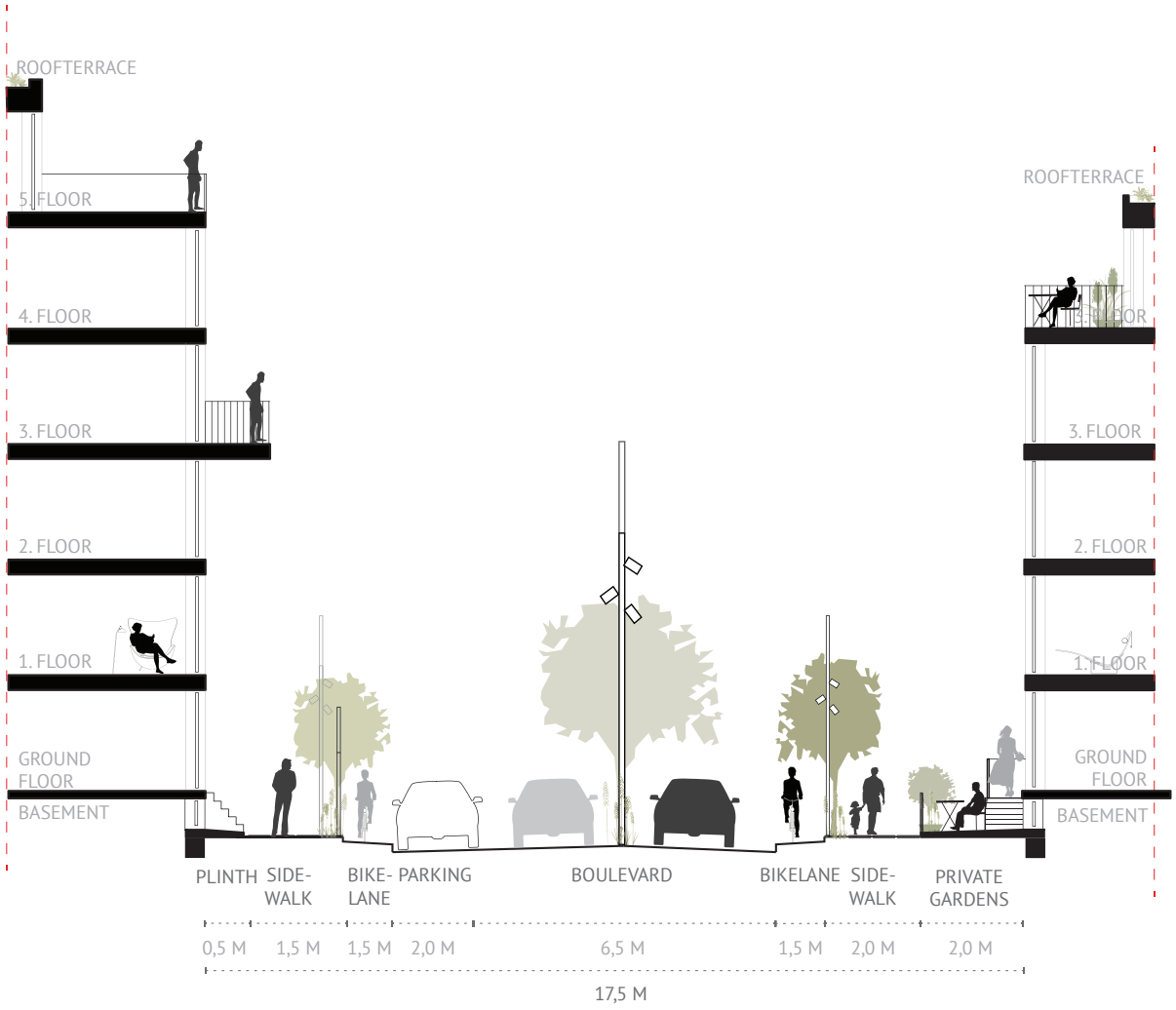
COAST ESPLANADE



The Coastline Esplanade starts at the southern part of Refshale Island, stretches along the coast to the easternpart of the island and splits; cars towards east and the Nordhavn Tunnel, while bicyclists and pedestrians can continue the ocean promenade to the north and along to the west coast until they return to the island's southern entrance. Along the coast is a wide promenade sidewalk for pedestrians, this is dimensioned so two couples can pass eachother without separating. Next to the promenade is a two-way bikelane and a two-way road with a maximum speed of 40 km/h. Towards the buildings are a wide sidewalk and a private plinth with space for a small garden or terrace with a view towards Øresund and Sweden across the ocean.

 Ill. 99 Principle Section of the Coast Esplanade

BOULEVARD



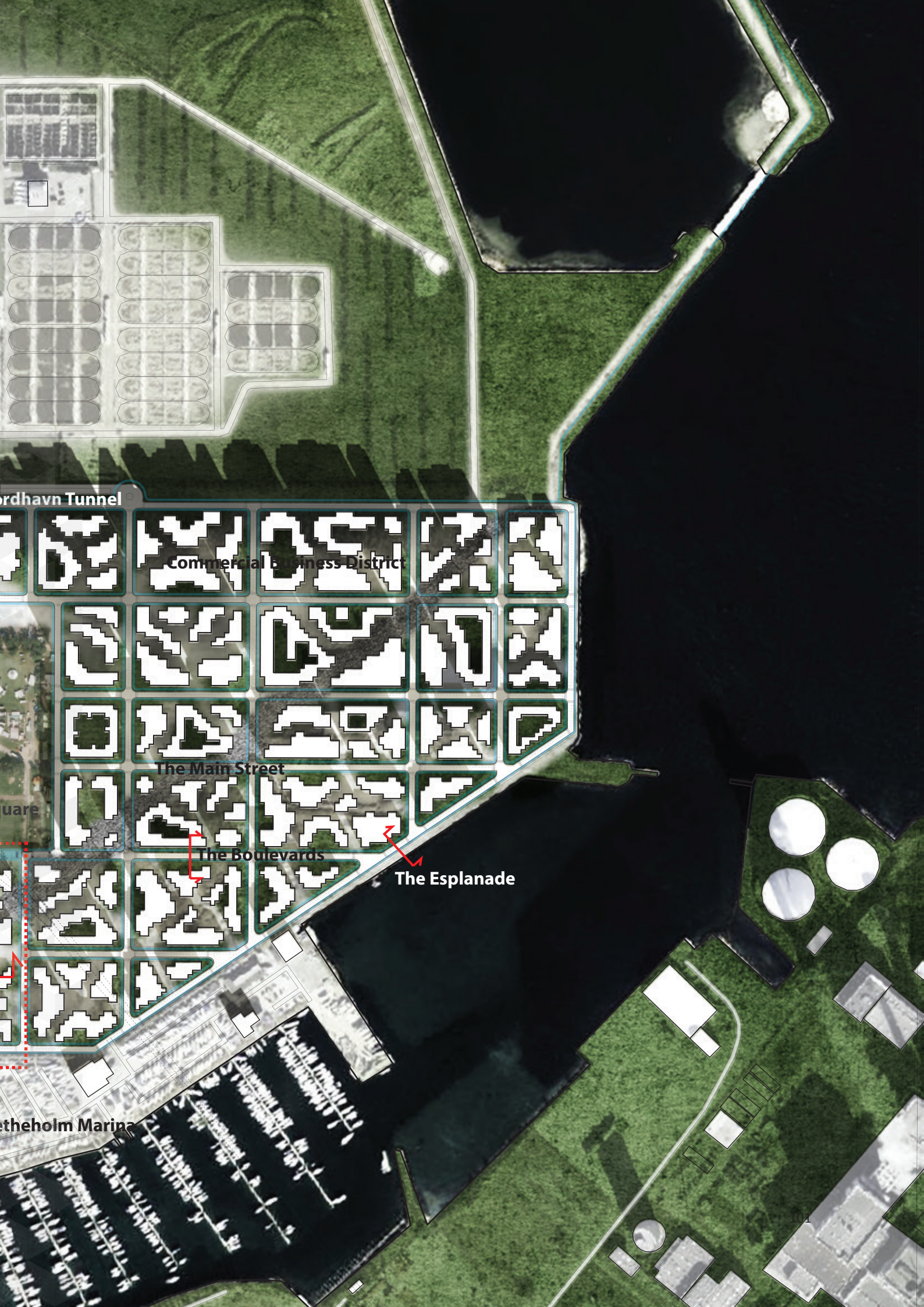
Throughout the plan, the Boulevards define a grid structure to organize the otherwise organic shaped urban fabric. The boulevards span from north to south and cross from east to west, with connections to the Nordhavn Tunnel north and east from the B&W Halls (see illustration on page 97). These main connections provide the capacity for a majority of the traffic for automobiles and public transport.

This section has demonstrated the urban spaces, infrastructural connections and parking capacity required for a well functioning infrastructure for the new neighborhood. The following chapter contains the thesis' conclusion and reflection.

Ill. 100 Principle Section of the Boulevards

Master Plan


Waste Facility
Beach Club
Harbour Bath
Access to No
Bike
Highway
B&W Student Housing
B&W Garden
Creative Business
District
Access to
Nordhavn Tunnel
Event Sq
Metasite
Harbour Bath
Margre
Esplanaden
Bridge
10 30 50 100 200
Bikelane


rdhavn Tunnel
Commercial Business District
The Main Street
The Boulevards
The Esplanade
etheholm Marina

Ill. 102 Visualization of the Central Square at the anchor point

Chapter IV - Conclusion and Reflection

Conclusion

This thesis set out to discover the optimal method for the design of a dense, functional and comfortable human habitat with the following research questions:

- What are the requirements of growing contemporary urban population and how can an increasingly densified city meet these?
- How do you design for densification with quality?

The aim was to design quality housing and urban spaces that would provide its inhabitants with sufficient daylight, comfortable microclimate, abundant green spaces, safe and efficient infrastructure and plenty of social and public amenities. This thesis established the necessary knowledge for a method to design a dense urban neighborhood with high quality dwellings. The design proposal resulted in approximately 7000 flexible quality apartments with an average size of 100m2 and provided an abundance of green spaces and recreational amenities for a vibrant and healthy private and public life.

The process took departure in the urban plannning discourse in Copenhagen, site analysis and historical context, which lead to the a theoretical analysis. The parametric design method evolved from this process and started to shape the strategy, design and mobilities solution. Finally this was assembled in a design proposal with a capacity of 15.000 inhabitants including public amenities and other necessities, but as the design progressed, the scale became increasingly smaller and this revealed unforeseen challenges. The parametric design methodology, with basis in Pedersen's (2011) and Maas' (1998) theories, was quite effective at the urban scale, but it couldn't properly account for qualitative parameters at or below the architectural scale, which required utilizing theories from Koolhaas (1994) and Gehl (2010). When the design process had reached the buildings' interior, the initial parameters where no longer relevant and the method could not account for tactillity, traditions of material use, cultural color preferences, light settings, historical identity and other parameters that have a significant impact on the user's everyday life. Gradually through the process, it became clear, that the design had to relate closer to the user. The design process had to be more empathic and this parameter was not quantifiable. By returning to Gehl's theories (2007; 2010), it became obvious to empathize with the hypothetical users, by visualizing the inhabitants' lives unfolding in the urban spaces and buildings. This was the necessary parameter of empathy that would turn the design from diagrams and large plan drawings, to homes and backyards for people's lives to flourish.

The process of writing this thesis unveiled how important it is to avoid designing architecture for architects or urbanism for urbanists, but instead to empathize with people that inhabit and use the spaces or in other words; to design cities for people.

Reflection

This thesis aimed to produce the design material equivalent to a master plan competition proposal, but with the methodological, analytic and theoretical foundation of an academic thesis. The work included a vision and concept, accompanied by analysis and case study, then followed by a design proposal with strategy and development principles. The parametric design method was an effective tool to organize public and private spaces even though it showed to have its limits in terms of tactility and attention to detail.

Paradoxically, the process included numerous challenges in limiting the thesis, as many ideas and elements where interesting to include, and all seemed important. Prioritizing these ideas was increasingly challenging, as I wrote by myself and received only minmal feedback from fellow students. In contrast, a group project would have undergone much more critique on an everyday basis. Fortunately my supervisor provided constructive feedback and more so than my own, but discussions where limited, as there were few to discuss with. On the other hand, this made decision processes faster and the main idea could be explored in a more uncompromising manner, in the design proposal. Some elements as the theoretical analysis could have been ellaborated more thorough in a more comparative and critical analysis with focus on the benefits and disadvantages of each theory.

Had the thesis been less limited in time and focus, it would have been interesting to continue down in scale and design interior plans, materials and landscaping, now knowing the importance of these elements. The tactility, that was inevitably lacking in the largest plans and diagrams, would be interesting to explore and carry through in the design, and even more so than in the material catalog. The history of Refshale Island should be evident by utilizing the industrial materials in new construction, as described in the material catalog (see page 93). It would emphasize the historical background for the island and provide an identity to the new development, that otherswise might not relate to its users. If this had been a real project, the next step would have been to design and detail interior drawings and prepare these for the construction. It would have been interesting to choose materials, windows, doors, furniture and fixture. Furthermore, the development strategy could have benefited from a timeline, to map out the development process in detail. It would divide the process into development phases and provide more tangible solutions future problematics and it could provide strategic alternatives to planning in case of socioeconomic changes or changes in the demographic that would render the original problem statement obsolete. As mentioned, the timeline could also contain alternatives to the design at the anchorpoint, to which in a hypothetical case could be chosen by user involvement or focus group. The B&W Halls have a strong historical significance at the island, which deserve a section for itself, but in the design proposal it was described as B&W Student Housing (see masterplan p. 100). This proposal could have been detailed as a design proposal itself, by placing student dorms as modular blocks inside the large steel structure of the halls, in fact a similar proposal has been done by BCVA Architects. Inside the smallest of the two halls could have been a covered garden similar to the Jardin Des Fonderies in France, which is a beautiful garden designed within the structure of two old industrial halls (see illustration 103 on page 109).

As society changes rapidly, especially with disruptive innovation in Information Technology, it would be interesting to explore innovative solutions that relate to the profile of Denmark and as a sustainable country and city. Among these technologies, the timber structured 'Wooden Skyscraper' by C.F. Møller architects is interesting, as the structure could be implementable in the modular design of this plan. It would be a sustainable way to innovate in architectural construction and provide to the plans of making Refshale Island Co2 neutral (Thiemann et. al. 2015). Accompanied by prefabricated strawbale walls, as provided by the Modcell Straw Technology company it could create an entirely new way of constructing houses that would significantly decrease Co2 emissions from construction. With robotic and fully automated production processes, this would be an ideal alternative to conventional construction techniques. Furthermore, the design could have implemented sustainability with DGNB standards or even systems to make the entire island self-sustainable. By utilizing the existing windmills and integrate internal water recycling systems, the island would become self-sufficient with electricity and water. By utilizing the green spaces for urban farming and even egg production, the entire Refshale Island could be an example of local sustainability, turning the former industrial wasteland into its opposite.

With specific regards to the design, the anchor point could have merged better with the context by established roots in the urban fabric to avoid over sized open spaces. The anchor point could have related more to the B&W Halls, perhaps lean into the halls and create a large hybrid structure together. The large square north of the anchor point between the B&W Halls could have been programmed better and utilized for development or an extension of the B&W park. The next step would be to make a series of principle plans in 1:100 with details of the urban spaces, the material and the synergy between ground floor and urban spaces. It is of upmost importance for this urban development to function as an urban habitat, that retail and detail is sufficient for the inhabitants needs and provide a vibrant citylife with diverse commercial interests that differentiate and outperform large retail interests as shopping malls and their equivalents.

The rapid changes of society, increase the necessity for cities to be resilient and adaptive. A way for future cities to accomodate this change is for urban designers to look into the pioneering professions in disruptive innovations and adapt the mindset that will provide strategic planning and adaptivity into the design of cities

Ill. 103 Photograph of the Jardin Des Fonderies in France
Ill. 104 Photograph inside the Jardin Des Fonderies in France

Illustration Index

Illustration no.	Title	Source and Page
Illustration 35	Concept diagram interlace	Belong to Dezeen.com, p. 49
Illustration 36	Section Interlace	Belong to Dezeen.com, p. 49
Illustration 37	Concept diagram 8-house	Belong to Dezeen.com, p. 50
Illustration 38	Panorama view 8-house	Belong to Archdaily.com, p. 50
Illustration 39	Plan 8-house	Belong to Dezeen.com, p. 51
Illustration 40	Section 8-house	Belong to Dezeen.com, p. 51
Illustration 41	Section Via West 57th	Belong to Dezeen.com, p. 52
Illustration 42	Pamorama view Via West 57th	Belong to Dezeen.com, p. 52
Illustration 43	Concept VIA West 57th	Belong to Dezeen.com, p. 53
Illustration 44	Design process VIA West 57th	Belong to Dezeen.com, p. 53
Illustration 45	Facade VIA West 57th	Belong to Dezeen.com, p. 55
Illustration 46	Facade Kartoffelrækkerne	Belong to kartoffelrækkerne.dk, p. 55
Illustration 47	Scenario Study	Author's creation, p. 57
Illustration 48	Design process	Author's creation, p. 60
Illustration 49	Plan design process	Author's creation, p. 61
Illustration 50	Iterative design process	Author's creation, p. 61
Illustration 51	Urban design process	Author's creation, p. 62
Illustration 52	Land Use	Author's creation, p. 63
Illustration 53	Mobilites	Author's creation, p. 63
Illustration 54	Context	Author's creation, p. 64
Illustration 55	Open Space	Author's creation, p. 64
Illustration 56	Daylight	Author's creation, p. 66
Illustration 57	Urban Environment	Author's creation, p. 66
Illustration 58	Wind	Author's creation, p. 67
Illustration 59	Anchor Point	Author's creation, p. 67
Illustration 60	Master Plan	Author's creation, p. 68
Illustration 61	Architectural Design Process	Author's creation, p. 70
Illustration 62	Farmax	Author's creation, p. 72
Illustration 63	Mobilities	Author's creation, p. 72
Illustration 64	Daylight	Author's creation, p. 73
Illustration 65	Open Space	Author's creation, p. 73
Illustration 66	Wind	Author's creation, p. 74
Illustration 67	Performative Green Space	Author's creation, p. 74
Illustration 68	Urban Environment	Author's creation, p. 75
Illustration 69	Program Distribution	Author's creation, p. 75

Illustration Index

Bibliography

Bibliography

- Azrieli, D. (2013) (Semi)Urbanism: Creating new housing typology through slippage. Canada: Carleton University
- Bjarnesen, V. S., Dolleris, M. S., Kristensen, D. B., Kristensen, K. E. F., Petersen, M. B., Vestergaard, N. Z. (2014) *Bæredygtig Byudvikling på Refshaleøen*. Copenhagen: Aalborg University
- Bølling-Ladegaard, E., Celis, P. (2007) *Cykelparkeringshåndbog*. Copenhagen: Dansk Cyklist Forbund
- Center for Byudvikling (2015) *Kommuneplan 2015: Forslag til Københavns kommune*. Copenhagen: KKDesign
- Corbusier, L. (1946). *Towards an Architecture*. London: Architectural Press.
- Corbusier, L. (1954). *The Modulor – A Harmonious Measure to the Human Scale Universally applicable to Architecture and Mechanics*. Germany.
- Gabel, J. (2016) CTBUH Year in Review: Tall Trends of 2015, and Forecasts for 2016. Chicago: Council on Tall Buildings and Urban Habitat
- Gehl, J. (2007) Livet mellem husene: Udeaktiviteter og udemiljøer. Copenhagen: Arkitektens Forlag
- Gehl, J. (2010) Cities for People. Washington: Island Press
- Glaser, M., Hoff, M., Karssenberg, H., Laven, J., Teeffelen, J. V., (2012) *The City at Eye Level: Lessons for the Street Plinth*. Delft: Eburon Academic Publishers
- Guaralda, Mirko & Kowalik, Magdalena (2012) *Negative space and positive environment : mapping opportunities for urban resilience*. In Schrenk, Manfred, Popovich, Vasily V., Zeile, Peter, & Elisei, Pietro (Eds.) Proceedings REAL CORP 2012 Tagungsband, REAL CORP, Schwechat
- Hillier B. and Hanson J. (1984) *The Social Logic of Space*. Cambridge: Cambridge University Press.
- Hwang, I. Y. S. (2006) Leapfrogging From Vertical Sprawl to Volumetric City: A Study of Compact, Viable 3D Future Model Using Hong Kong. Hong Kong: University of Hong Kong
- Ingels, B. (2010) BIG: Yes is More. Hohenzollernring: Taschen.
- Ingels, B. (2015) Hot to Cold: An Odyssey of Architectural Adaptation. Koln: TASCHEN
- Jacobs, J. (1964) The Death and Life of Great American Cities: The Failure of Town Planning. Modern Library, London.
- Jensen, O. B. (2013) Staging Mobilities, London: Routledge
- Jensen, O. B. (2014) Designing Mobilities, Aalborg: Aalborg University Press
- Jensen, O. B. & N. Morelli (2011) Critical points of Contact: Exploring networked relations in urban mobility and service design, Danish Journal on Geoinformatics and Land Management, vol. 46, no. 1, pp. 36-49
- Jensen, O. B., S. Wind & D. B. Lanng (2012) Critical points of Contact - between urban networks and flows, Aalborg:
- Aalborg University Press
- Kielgast, L. V., (2014) Nordic Cities in Transition. Malmo: Holmbergs
- Kiib, H., Marling, G. (2015) *Catalyst Architecture - Rio de Janeira New York Tokyo Copenhagen*. Aalborg: Aalborg University Press
- Koolhaas, R. (1994) *Delirious New York: A Retroactive Manifesto for Manhattan*. 2nd ed. Italy: Monacelli Press

- Københavns Kommune (2015) *Status på København, Nøgletal for København 2015*. Copenhagen: Københavns Kommune
- Lauring, K. 2006, Københavns Havn 1840-1940 - som fotograferne så den, Nordisk Forlag
- A/S, København.
- Lauring, M., Silva, V., Jensen, O. B., & Heiselberg, P. (2010). The Density of Sustainable Settlements. Aalborg: Aalborg University Press.
- Lefebvre, H. (1974/91) The Production of Space, Oxford: Blackwell.
- Lynch, K (1960). The Image of the City. The MIT Press: Massachusetts.
- Lynch, K. (1981) Good City Form. The MIT Press: Massachusetts.
- Modernismen [Modernismen] 2001. Den Store Danske Encyclopædi. Vol. 19. Haslev: Gyldendal
- Miyamoto, R. (1997) Kowloon Walled City. Tokyo: Hiroshi Shimonaka.
- Maas, W., Hardel, M., Ouwerkerk, P., (1998a) Costa Iberica: Upbeat to the leisure city. Spain: ACTAR
- Maas, W., Van Rijs, J., Koek, R., Ed, (1998b) FARMAX: Excursions on Density. Rotterdam: 010 Publishers.
- Maas, W., Van Rijs, J., (2005) KM3: Excursions on Capacities. Rotterdam, Actar-D.
- Maas, W., Van Rijs, J., De Vries, N., Knikker, J., Zuidgeest, J., Hofman, K. (2012) MVRDV: Agendas on Urbanism. Korea: Equal Books
- Maas, W., Van Rijs, J., De Vries, N., The Why Factory (2012) The Vertical Village: Individual, Informal, Intense. Rotterdam: NAi Uitgevers
- Müller, A. (2013) *Drawn to Design: Analysing Architecture Through Freehand Drawing* Basel: Birkhauser Verlag GmbH
- Neufert, E. and P. (2000): Neufert Architects' Data. 3rd Edition, Oxford: Blackwell Publishing
- Pedersen, P. B., Bundgaard, C., Christiansen, J., Justesen, R. Andersen, M. L. (2011) *Sustainable Compact City*. 3rd edition. Denmark: Arkitektens Forlag
- Per, F. A., Mozas, J., Arpa, J. (2014) This is Hybrid: An Analysis of mixed-use buildings. Spain: a+t architecture publishers
- Rambøll (2012) *Østlig Ringvej Sammenfatning af linjeføringsanalyse*. Copenhagen: Transportministeriet
- Thiemann, D. M., Nielsen, P. J. (2015) *Lokalplan nr. 209 med tillæg nr. 1*. Copenhagen: Teknik- og Miljøforvaltningen, Københavns Kommune
- Sheridan, M. (2011) *The SAS House: Jacobsen's Lost Gesamtkunstwerk*. New York: Phaidon
- United Nations, Department of Economic and Social Affairs, Population Division (2014).
- *World Urbanization Prospects: The 2014 Revision, Highlights.* New York: United Nations
- Via Trafik (2014) Glostrup Kommune Parkeringsstrategi - Parkeringsnormer. Glostrup: Glostrup Kommune
- Wong, Grace K. M. (2003) The Only Way to Build is Upwards: The Tallest Public Housing Development Thesis in Singapore. Singapore: National University of Singapore.

Internet Sources

- Arkitema, (2016) Faste Batteri. [ONLINE] Available from: http://arkitema.com/da/projekter/bolig/faste-batteri [Accessed 13 February 2016]
- Arkitema, (2016) Uptown Nørrebro. [ONLINE] Available from: http://arkitema.com/da/projekter/bolig/

Bibliography

- uptown-nørrebro [Accessed 13 February 2016]
- CPH City & Port Development (2016) *Om Selskabet*. [ONLINE] Available from: http://www.byoghavn.dk/ombyoghavn/om+selskabet.aspx [Accessed 01 March 2016]
- Børsen, (2016) Byggefesten raser i København og det bliver endnu vildere. [ONLINE] Available from: http://www.business.dk/ejendomme/byggefesten-raser-i-koebenhavn-og-det-bliver-endnu-vildere [Accessed 12 February 2016]
- Ceen, A. (2015) *Nuova Pianta di Roma Data in Luce da Giambattista Nolli l'Anno MDCCXLVIII* [ONLINE] Available from: http://nolli.uoregon.edu/nuovaPianta.html [Accessed 01 March 2016]
- Entasis, (2016) Carlsberg Byen. [ONLINE] Available from: http://entasis.dk/1138 [Accessed 15 February 2016]
- Grønvad, V. F., Petersen, S. S. (2016) *Parkerings- og færdselsarealer – Arealbehov parkering, færdelsarealer mv.* [ONLINE] Available from: http://www.hfb.dk/fileadmin/templates/hfb/dokumenter/rum-pdf/14_Parkeringsarealer.pdf [Accessed 07 May 2016]
- Montrealroads.com (2016) *Ville Marie Autoroute - Historic Overview*. [ONLINE] Available from: http://www.montrealroads.com/roads/A-720/. [Accessed 07 May 2016]
- Schwab, K. (2016) *The Fourth Industrial Revolution: what it means, how to respond*. [ONLINE] Available from: https://www.weforum.org/agenda/2016/01/the-fourth-industrial-revolution-what-it-means-and-how-to-respond/ [Accessed 30 May 2016]
- Tice, J. (2015) *The Nolli Map and Urban Theory*. [ONLINE] Available from: http://nolli.uoregon.edu/urbanTheory.html [Accessed 01 March 2016]
- Trummer, P. (2016) M.S. Design of Cities [ONLINE] Available from: https://sciarc.edu/academics/postgraduate/design-of-cities/ [Accessed 22 April 2016]
- TU-Data (2016) Transportvaneundersøgelsen - Hovedresultater. [ONLINE] Available from: http://www.modelcenter.transport.dtu.dk/Transportvaneundersoegelsen/Hovedresultater [Accessed 07 May 2016]
- Danish Road Directorate (2016) Nøgletal om vejtransport. [ONLINE] Available from: http://Danish Road Directorate.dk/DA/viden_og_data/statistik/trafikken%20i%20tal/Noegletal_om_vejtransport/Sider/default.aspx#.VMom_cZ7zIU [Accessed 07 May 2016]

Lectures

- Jensen, O. B. (2015) Theories of the Network City and its Technologies, [Lecture to MSc Urban Design] Aalborg: Aalborg University, 16 March 2015
- Keis, D. (2016) High in the Sky [Lecture to Network for Young Planners] Nørrebro, 5 February 2016
- Maci, G. (2016) High in the Sky [Lecture to Network for Young Planners] Nørrebro, 5 February 2016
- Saaby, T. (2016) High in the Sky [Lecture to Network for Young Planners] Nørrebro, 5 February 2016
- Smith, S. 2015. Exploring section as a design method [Lecture to MSc Urban Design] Aalborg University, 25 March 2015.

Video

- Harvard GSD, 2012. *What Was Metabolism? Reflections on the Life of Kiyonori Kikutake - Toyo Ito*. [video online] Available from: https://www.youtube.com/watch?v=20rYUAeiL10 [Accessed 25 February 2016]

- JUT Foundation, 2014. *The Vertical Village Documentary.* [video online] Available from: https://www.youtube.com/watch?v=bb3EYq-NTmo [Accessed 13 February 2016]
- TED, 2014. *Moshe Safdie: How to reinvent the apartment building.* [video online] Available from: https://www.youtube.com/watch?v=c-KnaYZJg48 [Accessed 10 March 2016]
- TED, 2016. *Why great architecture should tell a story | Ole Scheeren* [video online] Available from: https://www.youtube.com/watch?v=iQsnObyii4Q [Accessed 17 February 2016]
- TED, 2016. *Alejandro Aravena: My architectural philosophy? Bring the community into the process* [video online] Available from: https://www.youtube.com/watch?v=o0I0Poe3qlg [Accessed 17 February 2016]
- TEDx Talks, 2016. *In Search of the Human Scale | Jan Gehl | TEDxKEA*[video online] Available from: https://www.youtube.com/watch?v=Cgw9oHDfJ4k [Accessed 23 April 2016]

Journalism

- ArchDaily (2015) *The Interlace / OMA / Ole Scheeren* ArchDaily. [online] 6 May. Available at: <http://www.archdaily.com/627887/the-interlace-oma-2/> [Accessed 10 March 2016]
- Bjerregaard, M., 2016. *Spektakulært højhus skyder op i Aarhus*. DR Nyheder, [online] 15 February. Available at: http://www.dr.dk/nyheder/indland/spektakulaert-hoejhus-skyder-op-i-aarhus [Accessed 17 February 2016]
- Faber, K., 2013. *Op, op, op: København får stribevis af nye højhuse*. Politiken [online] 14 February. Available at: http://politiken.dk/kultur/ECE1897837/op-op-op-koebenhavn-faar-stribevis-af-nye-hoejhuse/ [Accessed 17 February 2016]
- Heggland, N. O., 2015. Byggefesten raser i København og det bliver endnu vildere. Berlingske Business [online] 11 March. Available from: http://www.business.dk/ejendomme/byggefesten-raser-i-koebenhavn-og-det-bliver-endnu-vildere [Accessed 17 February 2016]
- Hoyer, S. B., Ng, N., 2016. *De bor i slum - oven på Hong Kongs højhuse*. Politiken, [online] 12 February. Available at: http://politiken.dk/magasinet/feature/ECE2480003/de-bor-i-slum---oven-paa-hongkongs-hoejhuse/ [Accessed 17 February 2016]
- Ifversen, K. R. S., 2015. *Anmeldelser: Syv nye højhuse*. Politiken [online] 30 July. Available at: http://politiken.dk/kultur/arkitektur/ECE2774943/anmeldelser-syv-nye-hoejhuse/ [Accessed 17 February 2016]
- Ingeniøren (2016) *Aalborg får fransk førerløs elbus i 2018*. [ONLINE] Available at: https://ing.dk/artikel/aalborg-faar-fransk-foererloes-elbus-i-2018-182722 [Accessed 07 May 2016]
- Minner, K. (2010) *8 House / BIG*. ArchDaily [online] 20 Oct. Available at: <http://www.archdaily.com/83307/8-house-big/> [Accessed 10 Mar 2016]
- Merin, G. (2013). AD Classics: Habitat 67 / Moshe Safdie. ArchDaily. [online] 10 March 2016. Available at: <http://www.archdaily.com/404803/ad-classics-habitat-67-moshe-safdie/> [Accessed 10 March 2016]
- Thorsen, N., 2016. *Arkitekt om højuse: "Der er også et liv i den højde"*. Politiken [online] 30 July. Available at: http://politiken.dk/kultur/arkitektur/ECE2774905/arkitekt-om-hoejhuse-der-er-ogsaa-et-liv-i-den-hoejde/ [Accessed 17 February 2016]