The Vertical Archipelago

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Abstract

The Vertical Archipelago

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This thesis began with an interest in responding to the urgent need for housing in cities that are growing at unprecedented rates. An in-depth exploration of two architectural responses to similar housing shortages served as an excellent case study of how people perceived the future of living. The Million Homes Program and the Metabolist Movement were focused on solving housing crises that were in a constant state of flux due to the movement of people, resources, geographic boundaries, ideas, and social understandings.

Through design explorations influenced by my personal experiences while on an exchange program in Stockholm I was able to develop methods that metabolize energy from the city and express it through operations such as anchoring, growing, inhabiting, and bridging. These operations allow for a high density housing project in the city center without imposing a heavy footprint on the existing urban infrastructure.

The Vertical Archipelago is a high density housing proposal that responds to rapid urbanization and climate change in Stockholm, Sweden. Rather than providing a static use structure, this thesis proposes a frame as a medium which organically grows as necessary in order to provide spatial connections between individuals and their community.

Although speculative, this proposal could reflect a new reality based on factors that will significantly impact how we live in the 21st century.

ACKNOWLEDGMENTS

To Peter, Jim and Jen: I am grateful for the supervision, and invaluable help throughout this thesis.

To The Valle Exchange Program, Meike, and Erik: Thank you for the great hospitality and guidance while researching in Stockholm

To my family and friends: Thank you for the encouragement and support.

The Vertical Archipelago

Figure 1: Stockholm context collage

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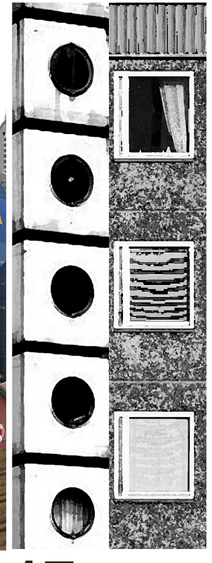


PROLOGUE

The year is 2100 and as Stockholm's seasonal rains continue to intensify, torrential downpours overflow channels creating floods in the Tunnelbana (figure 2). Stockholm inhabitants first experienced the consequences of climate change in 2000, when fields and meadows in the islands of Lake Mälaren were underwater and Gamla Stan's underground station was close to being flooded. The immediate need to provide a viable solution has become a critical concern. However, past solutions have been shortsighted and have been known to raise the social consequences that marginalize groups of people by excluding them from Swedish society. Despite all of this, Stockholm is growing rapidly, and many people are attracted to the city for the opportunity it provides. This has led to high demand for housing. Urbanization and climate change have been woven together by the uncertain futures they propose. Although Stockholm may not be able to prevent flooding from occurring, this thesis begins by accepting climate change and its effects and uses architecture as a catalyst to move away from rigid short-term thinking by designing high-density housing proposal that adapts to these issues.

Figure 2: The Future Of Stockholm Collage

CH.1
INTRODUCTION

Sweden is growing and has surpassed a population of 10 million. With more than 935,000 residents, Stockholm will soon surpass a population of 1 million. The fact that Stockholm is one of the fastest growing regions in Europe is positive for all of us.

– STOCKHOLMS STADSHUS AB

Figure 3: Stockholm City Center

Stockholm has become one of the fastest growing cities in Europe due to its booming economy. High paying job opportunities have created an influx of people coming into the city every day. The Stockholm City Plan predicts that by 2040, the City of Stockholm will have an estimated population of 1.3 million people as opposed to the 960,031 they have today.[1] Despite this growth, Stockholm shares a responsibility to the people who live there today as well as to future generations. Climate change continues to show its daunting effects globally. Sweden is experiencing a postglacial rebound which means the land is rising faster than the sea at about ⅔ of its coast. Although central areas such as Stockholm are not as affected by sea levels rising at this time, a major threat presents itself throughout the Lake Mälaren region due to the increase of heavy rains and snowmelt.[2] Figure 2 shows the worst case scenario for how climate change could make Stockholm uninhabitable in the event of Lake Mälaren flooding and subsequently overflowing and mixing with the Baltic Sea. Without any systematic increase in the flow capacity of drainage systems, the extra water filling channels and Lake Malaren will threaten those who live in low-lying areas.

In an age characterized by climate change and urbanization, cities need to be resilient in order to adapt to these factors without allowing the built environment, transportation systems and other critical urban infrastructure to collapse. Stockholm has begun responding to these two concerns by setting the goal of being fossil fuel free by 2040 and by using only sustainable building materials that have a low environmental impact. In 2016, 54 percent of the energy used in Sweden came from renewable sources, the highest percentage in the European Union.[3] Although this is a great start, eliminating fossil fuels and using environmentally friendly materials is only part of the solution. These solutions have limited flexibility and don't account for how the built environment might adapt to meet the demands that climate change will pose.

Figure 4: Housing construction in Stockholm

Stockholm's housing shortage is not unprecedented. Similar housing shortages in the past have led to a number of comprehensive and visionary responses. Two of the most prominent are the Japanese Metabolist Movement and Sweden's Million Homes Program. They both designed housing systems based on functional and relational needs. They re-thought how big cities should be designed during periods of rapid urbanization. Both architectural movements were primarily urban design responses to post world-war issues in countries that found themselves with the drastic need for housing. However, Metabolism and The Million Home Program tried to impose extremely idealistic approaches on a very real city. Both the Metabolist utopian and Million Home pragmatic approaches resulted in functional, social, demographic, and technological challenges. This thesis will examine the Metabolist Movement and the Million Homes Program to understand how these two architectural responses to housing confronted the issues of density, organic growth, and sustainability.

As a way to provide cultural context for the project this thesis will also attempt to provide an understanding of Swedish culture. No place is better for immersing oneself in Swedish culture than among the 30,000 islands that make up the Stockholm archipelago. Each has a unique topographic and environmental character composed of a mix of rocky cliffs, lush forests, and sandy beaches. Here, various ecologies and their architectural counterparts continually adapt to the seasons. Exploring the uninhabited islets as well as islands that are scattered with new communities and ancient villages, where large houses and small cottages stand side by side, provided a deep understanding of how Swedish people live.

The place where the Baltic Sea meets Lake Malaren at Hammarbyslussen was chosen as a site to explore responses to the undeniable changes in the city's future that will be brought on by increased urbanization in the face of climate change. This thesis proposes an incremental approach to the need for high-density housing by adapting to the constantly changing climate. An understanding of the successes and failures of Metabolist Movement and the Million Homes Program, along with cultural lessons learned from the archipelago will serve as background for developing an appropriate response to the new housing challenges confronting Stockholm. This response will organically grow with the needs of the community as necessary. The ability to adapt to a new framework for solutions to the increasing problems caused by the rapid growth of population and climate change will offer an unlimited number of new possibilities.

Figure 5: Proposal view from the Lake Mälaren

CH.2

PARALLEL TRENDS OF 21ST CENTURY

Figure 6: Urbanization + Climate Change Collage

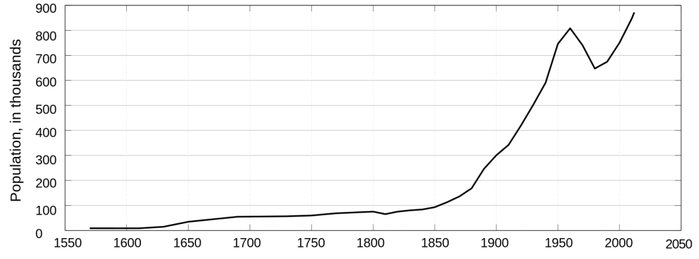


Figure 7: Population Growth In Stockholm

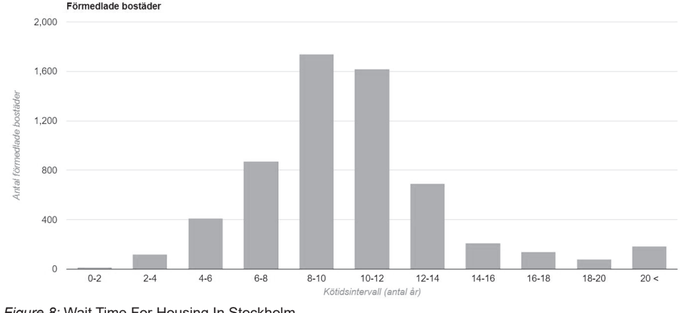


Figure 8: Wait Time For Housing In Stockholm

URBANIZATION

The promise of jobs and other opportunities, pulls people to cities. Today, 55% of the world's population live in urban areas, a proportion that is expected to increase to 68% by 2050.[4] Urbanization has the potential to promote resource efficiency and economic growth. Data from Bostadsförmedlingen, the Stockholm Housing Agency shows the increase in population since the 1500's (figure 7), and the available homes compared to average wait time in years (figure 8).

URBANIZATION:

EVOLUTION OF HOUSING TYPOLOGIES

Stockholm is no stranger to large scale master planning. An evolution of housing typologies (figures 9 and 10) has occurred throughout the previous decades. Growing cities such as Stockholm have faced many challenges in meeting the needs of their growing urban populations. Aside from housing, additional challenges have included transportation, infrastructure, employment, education, and health care. Understanding these growing challenges caused by urbanization is crucial for future development in order to allow cities to continue to provide a healthy environment in increasingly densified cities. However cities also contribute to one of the biggest problems facing the world today, environmental degradation.

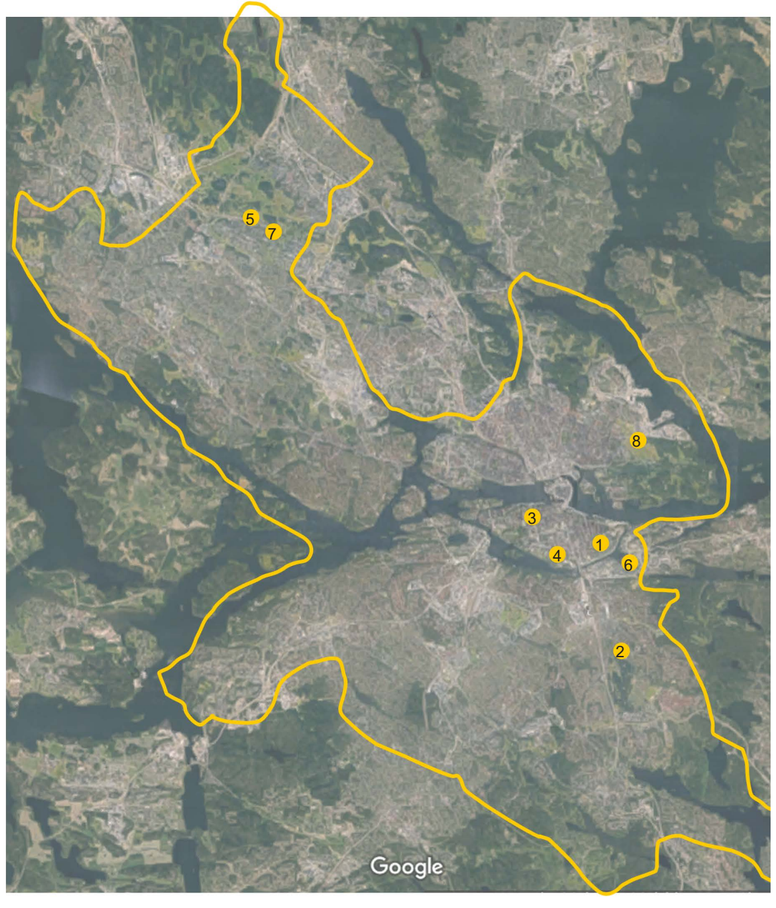


Figure 9: Evolution of housing typology location

Figure 10: Evolution of housing typologies

CLIMATE CHANGE

Climate poses an immense potential liability for civilizations throughout the world. The way cities make use of natural resources has a global long-term impact on the ecosystem of our planet. Stockholm has set clear and effective measures to reduce the use of fossil fuels and continues to improve as a green city. In 2010 this hard work paid off when it was the first city awarded the European Green Capital title.[5] These types of initiatives show how Sweden is open to creating opportunities for adaptable sustainable developments and has taken a leadership role in developing innovative design solutions. However unprecedented circumstances still remain that cannot be controlled due to the permanent global damage that has already been done. Postglacial rebound, flooding, and erosion are all inevitable threats that need to be better understood in order to properly address them. With ice caps melting and heavier seasonal rains comes increased flooding. Figure 11 is a watershed map of rivers that drain into Lake Mälaren. As previously mentioned, during the winter of 2000, more water flowed into the lake than could be let out through the locks, causing flooding which nearly reached Stockholm's central underground subway station.[6] Floods can be instantaneous or occur gradually over time. They can be fluvial, when the capacity of the stream is not sufficient to hold water; flooding caused by high sea levels; and pluvial, when heavy short term rains create surface and sewer flooding. Heavy precipitation also has a negative impact on a city's infrastructure and agriculture.

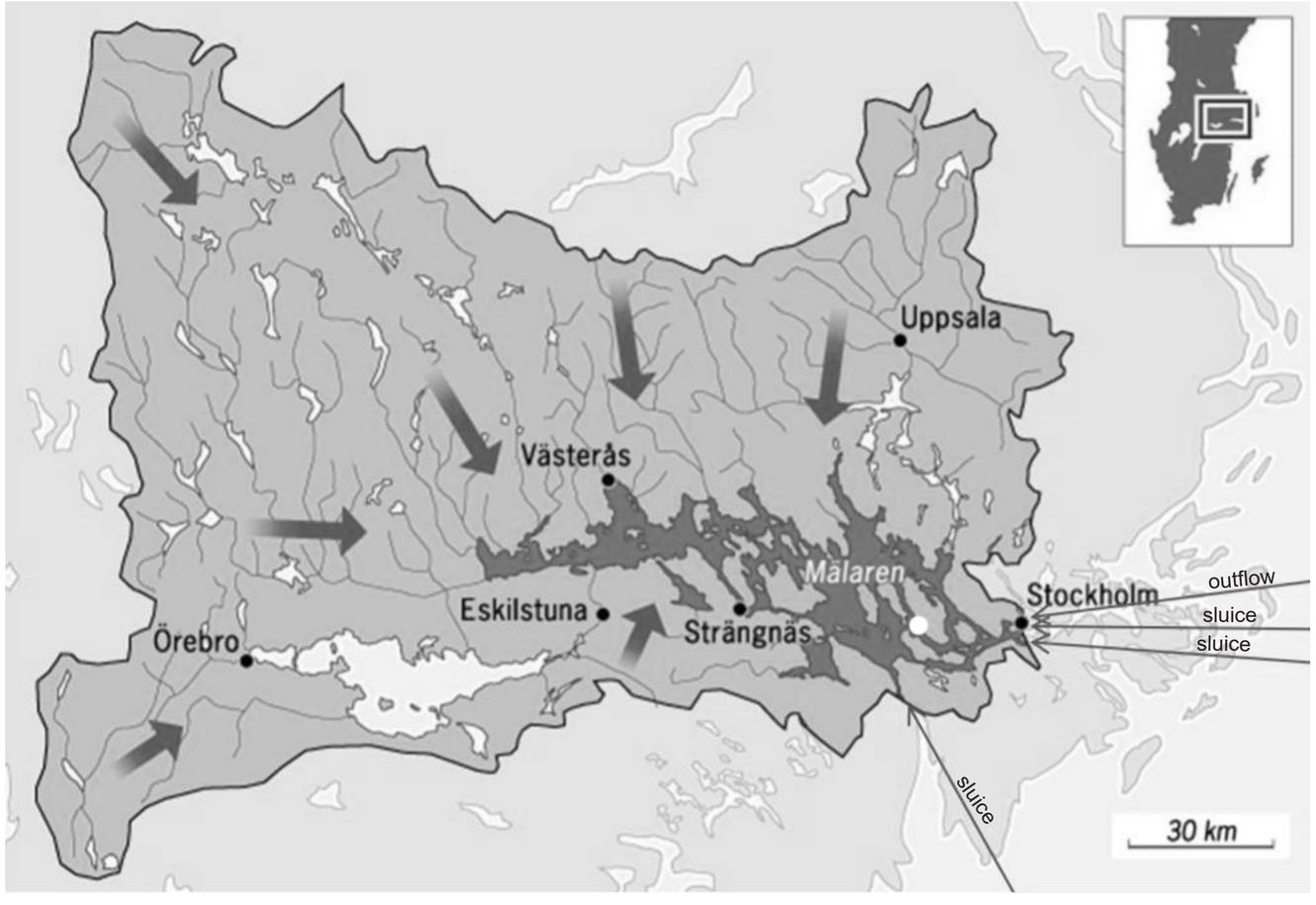


Figure 11: Watershed

EVOLUTION OF THE BALTIC SEA

The geographical region of Sweden used to be covered in ice. Throughout time the ice melted and became a freshwater lake and eventually, through erosion, it has become the Baltic Sea that exists today. Due to post glacial rebound, Stockholm has experienced a slight uplift over the centuries, but according to Swedish Meteorological and Hydrological Institute by 2050 postglacial rebound will decrease and the sea will start to rise faster than the land, ultimately displacing about 10 percent of Sweden's population. Figures 12 and 13 shows the evolution of the Baltic Sea and how not addressing these threats could make Stockholm uninhabitable. These consequences due to climate change pose a threat to the city, but rather than providing a short-term solution, this thesis accepts these changes and proposes a systematic design solution that produces a new form of vertical living as the ground plane become uninhabitable.

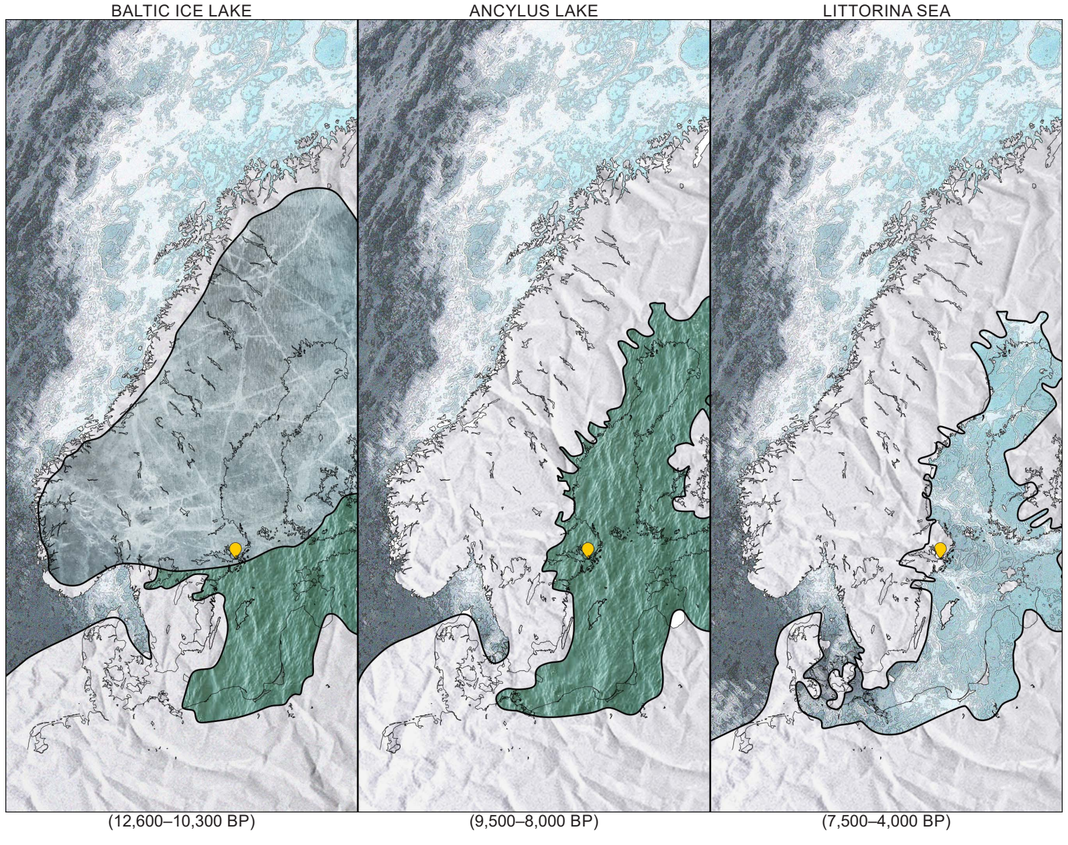


Figure 12: Evolution of the Baltic sea.

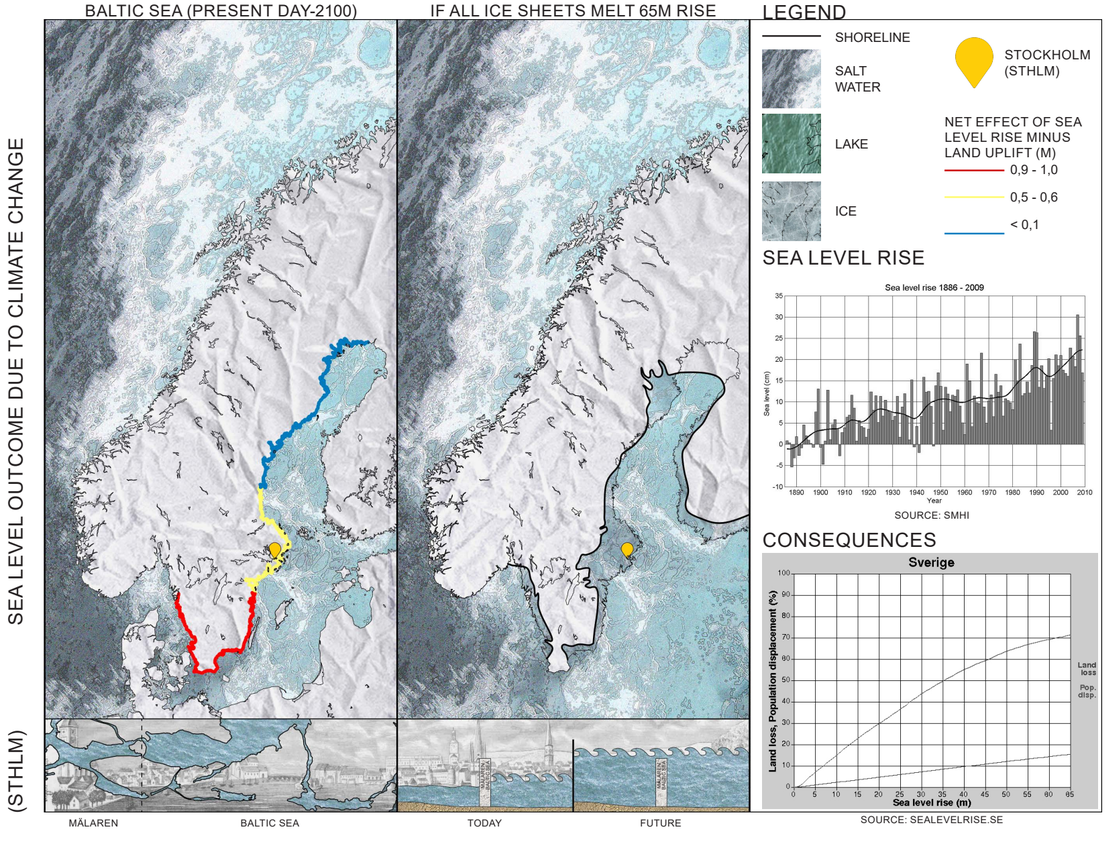


Figure 13: Sea level outcome due to climate change.

CH.3

METABOLISM + MILLION HOME PROGRAM

Although Stockholm has faced housing shortages in the past, they are about go through another major cycle of increased housing pressures. In order to understand how these challenges have been handled in the past, the Metabolist Movement and the Million Home Program were investigated.

Architecture has been influential in addressing housing shortages in the past. After WWII numerous cities needed to be reconstructed due to wartime destruction or an increase in population. However, most of the high-density housing that was built has acquired a bad reputation. Pruitt-Igoe set an infamous precedent as a dysfunctional urban abyss that was later demolished due to overcrowding and criminal activity.[7] Since then, high-density housing projects have been perceived as a threat to safety, health and property values. These perceptions have caused high-density housing to be considered undesirable and has caused it to become institutionally and systematically discriminatory. If approached correctly, high-density housing can reduce the necessity for land, create community, and encourage mass transit. Various strategies have been implemented within the past decades to improve efficiency and reduce the cost of construction for developments in urban areas including technological adaptations, prefabricated elements to speed the building process, and new ideas about how the buildings can function.

Studies of the Metabolist Movement and the Million Home Program allow for a better understanding of how housing shortages have been approached in the past. Although the Metabolist Movement and the Million Home projects vary in scale, they share the principles of mobility and renewal, technology, and flexibility. However, the technical, political, and cultural means to support their utopian proposals did not exist. Observations of these two movements will serve as a critique of both their visionary work and their built projects. The thesis aims to use a critique of the visionary design process of Metabolism and the pragmatic approach of The Million Home Program in order to develops a strategy to address the urgent housing needs of Stockholm.

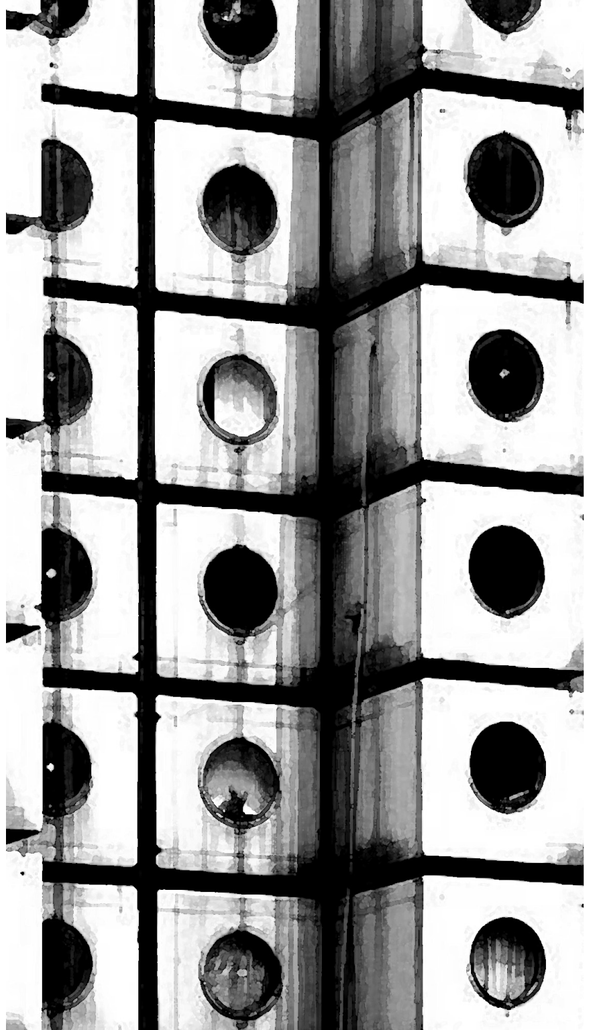


Figure 14: Nakagin Capsule Tower & Tensta

METABOLISM

“Metabolism was primarily a response to the catastrophe that followed the atomic bombing of Japan and vulnerability to natural disasters such as earthquakes, with architecture envisioning the complete transformation of Japan as a system of political, social, and physical structures into resilient spatial and organizational patterns adaptable to change.”

- Meilke Schalk
The Architecture of Metabolism.
Inventing a Culture of Resilience

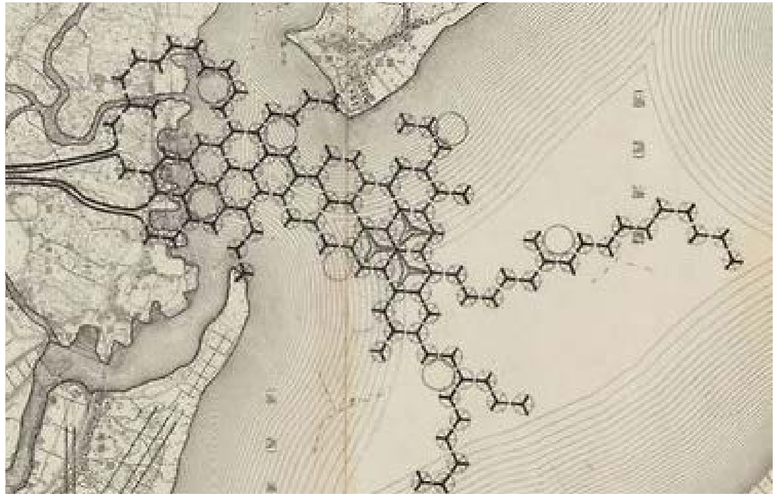
Metabolism, a Japanese architectural movement from the 1960s, approached Japan’s housing shortage with radical and visionary urban concepts that proposed various adaptations of dwelling units. *“The movement was primarily a response to the catastrophe that followed the atomic bombing of Japan and vulnerability to natural disasters such as earthquakes, with architecture envisioning the complete transformation of Japan as a system of political, social, and physical structures into resilient spatial and organizational patterns adaptable to change”*.[8] Soon after World War II, many cities in Japan were wiped out and faced a drastic need to produce a redevelopment of their social structure. From this emerged a series of powerful architectural metaphors that set out to make a statement rather than solve the devastation in a more pragmatic manner. This included metabolic processes that were driven by forces of political or environmental changes, world conflicts, policy shifts, and generational changes in interaction through technology. It consisted of themes of impermanence and regeneration, systematic infrastructures and megastructures, mass production, and individualistic domesticity.

Figure 15: Metabolism Collage

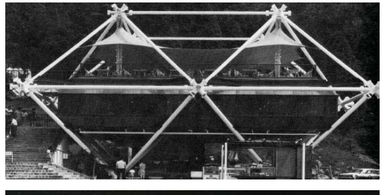
METABOLISM:

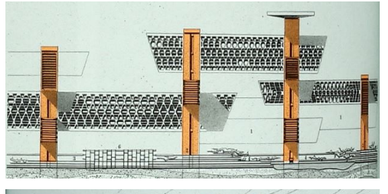
MANIFESTO

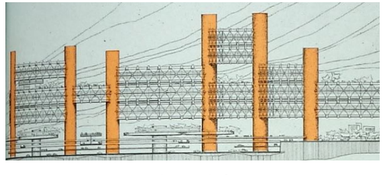
Among the visionary Japanese architects who dreamed and produced these exciting ideas for future utopias were Kisho Kurokawa, Kiyonori Kikutake, and Fumihiko Maki. The visions of these architects were all influenced by Kenzo Tange, the pioneer of the postwar architectural movement, who at the time was already exploring modular post-war reconstruction methods. However, it was not until the 1960's at the Tokyo World Design Conference that the design team consisting of Kurokawa, Kikutake, and Maki created what would be a manifesto for this new architectural movement. Metabolism: The Proposals for A New Urbanism, included the introduction of sites not considered before, such as Kikutake's Ocean City and Kurokawa's Space City. The proposals from The World Design Conference exemplified the Metabolists humanistic approach towards new physical forms. Visions for utopian architectural solutions typically included structures with a permanent core and short-term module attachments that embraced emerging technologies. Arata Isozaki, disciple of Kenzo Tange, writes,"The image Metabolism deployed comprised a permanent core supplemented by a shorter-term growth module. The former was a mega-structure that may be likened to a tree trunk or spinal cord; the latter resembled the branches of a tree or organs of the body, constantly renewing its cellular metabolism. Especially remarkable was a mass-produced, interchangeable capsule unit for living".[9] The vision was that architecture could be recreated infinitely and that it could bring order to cities in a time of chaos.



ON THE SEA







ON THE LAND

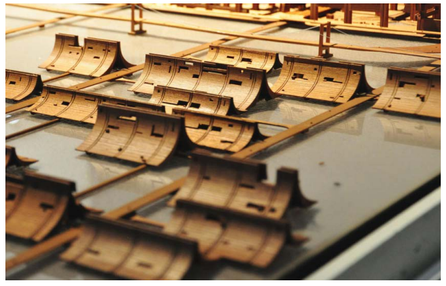
IN THE AIR

Figure 16: Metabolism Manifesto

METABOLISM:
SEQUENTIAL GROWTH

PLAN FOR TOKYO
KENZO TANGE
TOKYO BAY
1960

Population in Japan grew at an unprecedented rate soon after the war. Proper infrastructure lagged far behind causing a dysfunctional urban environment. A coherent structure of the city was lost to urban sprawl due to the fast-changing society. The increase in population drove Tokyo's land prices to an monumental level. This caused land ownership to become difficult to afford. The limited accessibility to land due and increasing population caused a spark for the proposal to create a new order for modern cities and motivated the debut of Tange's 1960 plan for Tokyo. In his proposal Tange states, "Tokyo has formed as a result of totally planless spontaneous growth on the basis of self-assertion of the inhabitants. [There has been an] irritating ... lack of leadership on the part of governments in enforcing a rational plan for Tokyo".[10] TTange's proposal aimed to revolutionize the existing social structure by designing a plan for Tokyo that would accommodate the city's continuous expansion. He proposed to create a series of adaptable decentralized satellite cities as the solution to Tokyo's rapid population boom. The scheme involved an eleven-mile-long spine spanning across Tokyo Bay and featured a linear series of interlocking loops meant to liberate the human environment. This new linear spatial order incorporated urban concepts for mobility and growth as the needs of the population dictated. Tange compared the growth of the proposed city to the evolution of an amoeba: "The amoeba and the asteroid have radial centripetal forms, but vertebrates have linear bone structures with parallel radiations. When the living functions of organisms differentiate and perform the composite function of life, the centripetal pattern evolves into a system of parallel lines grouped around an axis formed of a spine and arteries. The process whereby a vertebrate body hatches from an egg illustrates the possibility of gradual development on the part of a linear system".[11] His vision for a utopian ideal was that as a city matures, it requires different functions, transforming from its original form to one which is able to perform more complex functions. This process would continue to be a continuous development during the Metabolist era.



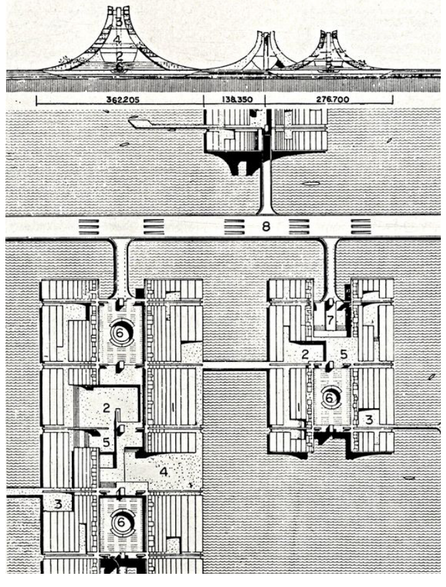


Figure 17: Tange Kenzo, Plan for Tokyo 1960

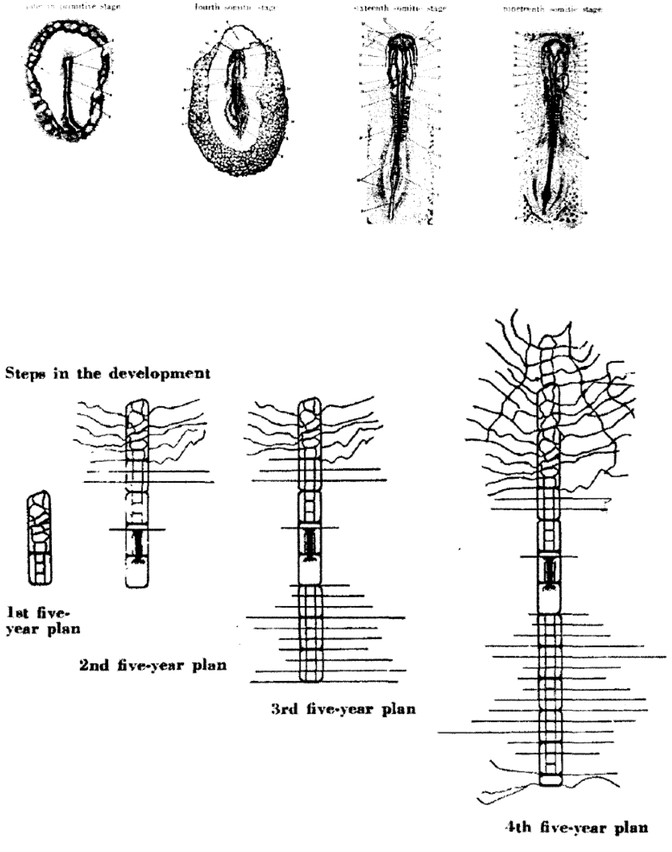


Figure 18: Tange Kenzo, Phasing Plan, Plan for Tokyo 1960

METABOLISM:

GROUP FORM

SHINJUKU SUBCENTER PROJECT

FUMIHIKO MAKI AND OTAKA MASATO

TOKYO, JAPAN

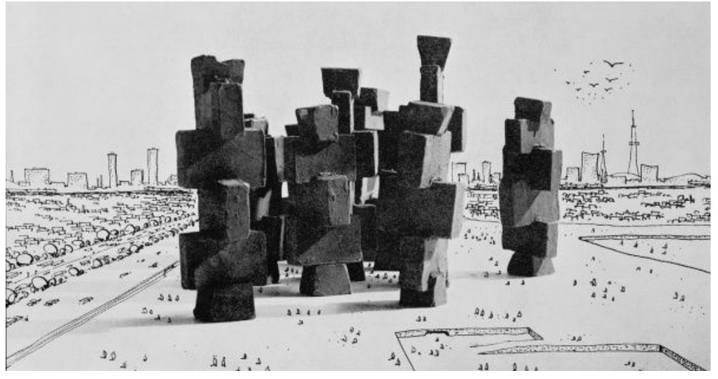
1960/1964

Visions to re-structure the rapidly expanding cities and seek an alternative social order for the world was an enthusiasm shared by most of the Japanese Metabolist architects. Concerns centered upon the spatial design of future urban plans and one of those concerns was that cities were composed of static elements that lacked visual and physical character. Cities require flexibility and elasticity as social and economic uses change. Going beyond the static elements inspired Fumihiko Maki and Otaka Masato's investigation of defining space through grouped buildings that are formed through composition, structure, and evolution. This research was put into practice during their collaborative projects proposed in Maki's 1964 study entitled, Investigations in Collective Form. Group Form is defined as a group of buildings that share strong physical relationships. It is based on four factors: the basic materials and construction methods; the intelligent and dramatic use of geography and topography; human scale and the sequence of development.[12] The Group Form concept distanced itself from the isolated Metabolist megastructural utopias. In fact, the term megastructure was coined by Maki. He defined three prototypes of collective form - compositional form, the megastructure, and group form. According to Maki, a megastructure referred to a strategy in urban design that tended to include the program of a whole city in a single structure. These architects reexamined the approach of various new physical forms through the lens of Maki's study of the collective form.[13] One of those projects was the Shinjuku Subcenter Project. Known as one of the most significant transit systems, with more than a million people using it every day, it had land values that were among the highest in Japan. Masato's and Maki's proposal consisted of artificial ground planes that provided parks for gathering and socializing. The parks were also used for linking to other physical forms around the project. Multi-level shopping centers would have vertical shafts as their only permanent structural elements, allowing for floors and walls to be adjusted as needed. Cantilevers in high rise towers would create vistas and provide spaces for social gatherings. The collective form anticipated that, although incredible technology was emerging, it should not dictate our choices, but instead provide possibilities for elasticity among our cities.

COMPOSITIONAL FORM

COMPOSITIONAL FORM

GROUP FORM



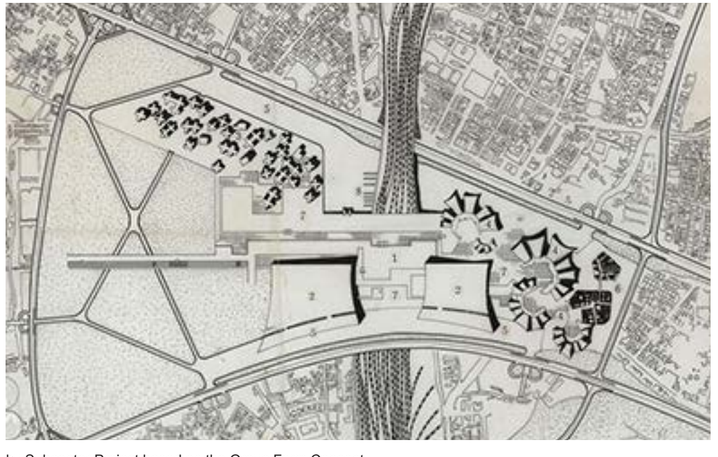


Figure 19: Shinjuku Subcenter Project based on the Group Form Concept

METABOLISM:
DISCONNECTIONS

Today, only traces of the Metabolist movement remain in Japan, many of its built projects were temporary or have since been demolished. The few that remain are in extreme disrepair, beyond rehabilitation, and have become unsuitable for living. An example of this would be the Nakagin Capsule Tower. The minimal space used in the plug-in capsule concept was meant to guarantee fundamental living conditions and individual freedom within society. Today a net covers the building due to debris falling off, leaks are common where the joints of the units have eroded, and the capsules have not been updated since they were first installed. The only circular window that provides light for each of the capsules is fixed to prevent accidents but impedes natural ventilation in the room, resulting in extreme temperatures. Approximately forty capsules out of the hundred and forty remain in use as apartments, while the others are used for storage, office space, or have just been abandoned and allowed to deteriorate.[14] Challenges like these have created uncertainty for The Nakagin Capsule Tower and projects similar to it.

The World Expo ‘70, Harmony For Mankind, was one of the final opportunities for Metabolist architects to build a series of physical forms and test their radical ideas. This included iconic design concepts of megastructures and capsule living. However, these visionary proposals also stirred skepticism among other design professionals. J. M. Richards, the editor of Architectural Review, saw in this exposition “the ambiguity of purpose between trade promotion and cultural exposition, the ambiguity of design-objective between the serious contribution to architecture and display technique and the attention-catching gimmick”.[15] To him, the expo was a collection of buildings that contradict one another. The schemes were a romantic idea that did not demonstrate how they would be realized. Their fixation on the technology of the future led to a severe dissolution of utopian ideas for future cities, which resulted in most of the buildings and facilities being torn down soon after the expo.

Figure 20: Net covering Nakagin Capsule Tower used to catch falling debris.

MILLION HOME PROGRAM

The Million Home Program in Sweden was intended to be a creative solution to address the post-war housing shortage. Sweden's ambitious plan for a utopian society proposed to provide its citizens with over one million homes within ten years. Sweden was a neutral country in World War II and thus did not require reconstruction of war-damaged areas like many other countries at the time. Not being damaged by the war meant that Sweden could produce goods for the rest of Europe. However this economic boom led to an extreme housing shortage as its citizens moved to the city to find work. The increasing demand for housing required traditional construction methods to be completely reimagined. It was a period of an almost complete utopian alignment of political interest, policy making, production models, planning ideals, and implementation of architectural research and education.[16] This led to government incentives that encourage experimentation between research and professional practice. It included a comprehensive analysis of the standards of a postwar nuclear family of 2.7 kids, prefabricated elements, and mass production.

The Million Home Program was influenced by scientific studies on the standards of living. These studies were meant to rationalize the planning of residential spaces and provide well-built and efficient dwellings for all residents. An example of this was the Home Research Institute. Its research began with two sisters, Brita Åkerman and Carin Boalt, who played a pioneering role by studying how to improve the design of kitchens, household appliances and the working conditions for homemakers. Not only did the research institute affect the daily conditions of millions of families, but it also had an essential influence on the Swedish building industry and producers of household appliances. Its mission was formulated as follows: "The mission of the Home Research Institute is to work towards systematic rationalisation of working conditions in the Swedish home through research into the technical and economic issues associated with work tasks in the home as consumption centres and workplaces, taking into consideration the psychological, hygienic and social issues associated with general work tasks in the home".[17] The physiological studies were meant to develop methods, tools and working environments that would reduce stress and strain on homemakers. These findings were then incorporated into the construction standards of the Million Home Program in order to improve sub-standard living conditions.

"All over Europe massive numbers of people live in these post-WWII large-scale housing estates. The estates were carefully planned, but now often manifest a multitude of problems. They house large numbers of low-income households, the unemployment rates are above average and in some countries they have become concentration areas for ethnic minorities."

-Roger Andersson

Large Housing Estates in Sweden

Figure 21: Million Home Program collage

MHP:

SITES VISITED

The Valle Exchange Scholarship provided the opportunity to further study the Million Home Program to understand its design processes, the technical and functional advancements of its history, and the challenges that the dwellings built during the program pose for the present. The methodology for this research proposal included case studies, on-site field work investigation, and interviews with architects, planners and other stakeholders involved in current adaptive retrofit strategies.

This research examined the adaptations of an architectural movement that confronted matters of density, organic growth, and sustainability by designing a system that was able to produce over one million homes in the span of ten years. Figure 22 illustrates the housing settlements that were visited and documented. These housing settlements were selected based on adaptations made chronologically programmatically, technologically, socially, and demographically over the past decades. This documentation analyzed how the settlements have adapted, and their current condition. Understanding the successes and failures of the adaptations made to these housing settlements, provided valuable information with regard to determining a process for an adaptable high density housing proposal.

The Million Home Program has had a noticeable impact on the way many people live today. However, these built projects are now reaching an age requiring thorough maintenance that was not anticipated when the housing projects were built. These requirements have provided an opportunity to adapt the construction methods of the era to develop useful adaptations and sustainable solutions to the inherent problems of the Million Homes Projects, both socially and physically.

A portion of this thesis focused on analyzing the various pragmatic adaptations that have been done to the Million Homes Projects. This will help to determine what has been successful and could be implemented into future developments. The following case studies exemplify the housing adaptations needed to meet the standards of the 21st century.

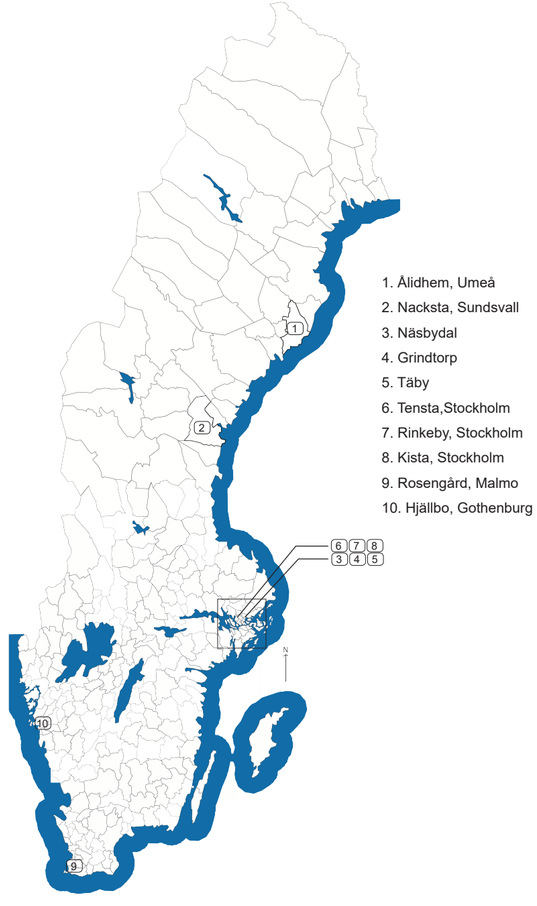


Figure 22: Stockholm map

MHP:

CHRONOLOGICAL ADAPTATIONS

Figure 23 through 26 shows chronological adaptations that occurred throughout the decade of The Million Home Program. The building process was greatly improved with the prefabrication of constructional elements. It began with the residential community of Grindtorp. The ambitious circular plan consists of four semi-circular buildings, two of which are 11 stories tall and the other two 6 stories tall. Grindorp is perhaps the best known example of precast monumentality. Later developments include the podium tower, the slab house, and finally a more vernacular approach. An example of this vernacular approach is Hovsjo. This Project is the only one of the few that used wood framing and a pitched roof, similar to a stuga. The project is no taller than two stories high, and although it uses similar room types, Hovsjo's rooms provide more spacious layouts in the kitchen, living room, bedrooms, and storage. The buildings were designed according to the technical and architectural ideas of this period, ideas partly based on the style of the early Modern Movement. Most building forms are strictly geometrical, with plain, undecorated façades.[18] By the end of the era this housing project removed itself from the aesthetic of the grand and industrialized style of living by rejecting the standardized norms from the previous projects of the Million Home era.

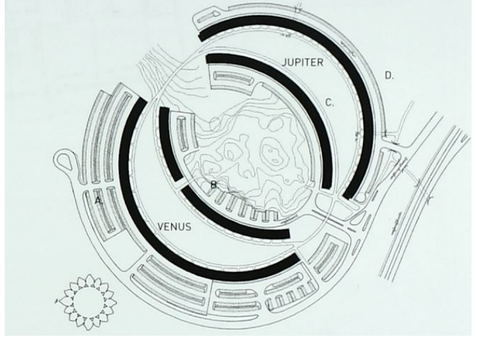


Figure 23: Grindorp: Avant-garde

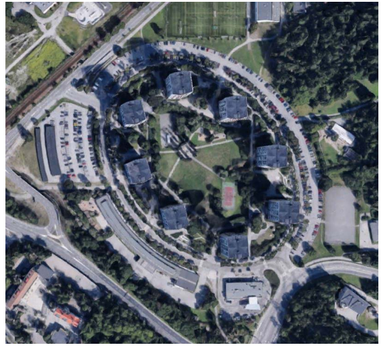


Figure 24: Näsbydal: Podium

Figure 25: Tensta: Slab house

Figure 26: Hovsjö: verncaular

MHP:

EXISTING UNIT TYPES

The original building stock was designed for a nuclear family with 2.7 kids. Figures 27 through 29 show the layout of the original plans, which were focused on providing efficiency in minimal spaces. However, the future performance of these post-war buildings for much larger families was not thoroughly considered. Evaluations are now measured and performed before and after renovations. These evaluations include a concern for energy use, health, and the social environment.

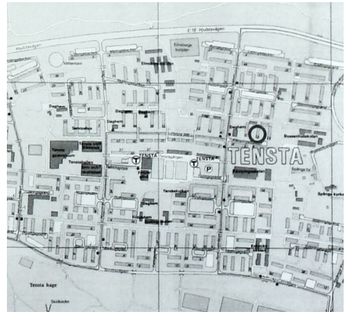


Figure 27: Site plan

Figure 28: Typical floor plan

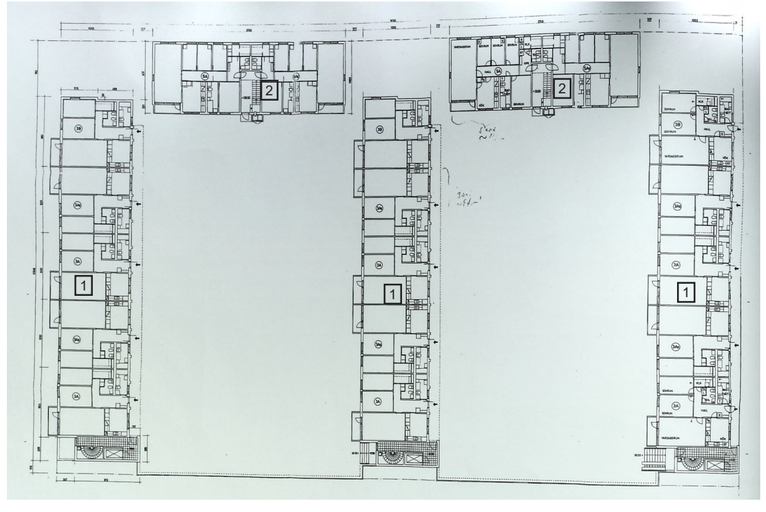


Figure 29: 1.Vertical infrastructure is grouped at the end of the housing block which links to a shared balcony.
2.Vertical infrastructure is grouped at the middle of the housing block which links to a shared balcony.

Figure 30: "An opening was made in the load-bearing wall separating two apartments to enable two bedrooms from one apartment to be incorporated into the other. The large apartment is 122 square meter and the smaller studio apartment is 56 square meters".

Figure 31: "Uppingegrand 30, The Duplex - explore the potential to link apartments vertically. An opening large enough for a standard stair was cut into the floor slab enough where a large closet had been".

MHP:

UNIT ADAPTATIONS

In the past decades, waves of immigrants, changing family structures and lifestyles have overstressed and aged the buildings that have led to requiring renovations. The design standards intended for Swedish families in many cases now have to provide for larger families of immigrants. Fortunately, the interior non-load bearing conditions in most of the housing projects provide opportunities for interior spaces to be easily altered, expanded and divided to create additional spaces. Erik Stenberg, teacher, architect and former resident of Tensta, has been deeply involved in renovations of Million Program apartment units. The logic of the prefabricated elements of the original construction has provided flexibility in re-arranging the interiors of the buildings with ease. Updates are possible because of the modular strictness of the original system. Units can be easily rearranged without major structural modification. The Million Program has demonstrated great potential for changing the interior floor plans in order to address contemporary issues of identification, individualization, and overcrowding.[19]

DISCONNECTIONS

The failures of Metabolism and The Million Homes Program have created a belief by some in our discipline that architecture is not capable of solving social problems. However, these two movements developed their forms by engaging architecture in political, social, and environmental issues. Similar issues such as land scarcity, inadequate infrastructure, socioeconomic inequality, and environmental disasters continue to exist today. However Metabolism and the Million Homes Program have shown that there needs to be a re-evaluation of traditional approaches to planning and design. Thus, this thesis will propose an idea of incremental growth, as opposed to developing a comprehensive master plan, in solving future housing shortages.

The research of chronological and programmatic adaptations to the Million Homes Program buildings has revealed a pattern of disconnections with regard to addressing changing social conditions. These disconnections have resulted in unfit living environments. Metabolism and the Million Home Program were so drawn to the efficiency of large-scale systems that they led to a disconnection between the individual, their community, and the city. Three major social disconnections emerged during my research and personal experience of living in a Million Home Program housing project. These include disconnections between communities, the ground plane, and the city.

Figure 32: Understanding the human scale collage.

DISCONNECTIONS:

COMMUNITY

Through my experience of living in Tensta Tower (figure 33) it became clear to me that these housing settlements lacked public or social gathering spaces, which isolated individuals living there because they were not connected to their neighbors. The Tensta Tower also included bleak narrow corridors (figure 34) which lack character. Built out in the suburbs of Stockholm, construction was based on efficiency and how quickly these new developments could be built.

The original proposal for Tensta was that Swedish-born people would live there, but since its development, the housing settlement has been in a constant ethnic flux. The Somali population now constitutes as one of largest refugee groups in Tensta.[20] The increase in the refugee population has led to difficulties in integrating these groups into Swedish society and culture. Surveys done by the Swedish Board for Health and Social Affairs indicate that immigrants are poorly integrated and that a large proportion of them live in isolation.[21] It is important to realize these new immigrants to Sweden have left their country of origin and lack a social network. This thesis proposes to provide spaces for various communities to connect to another.

Figure 33: Tensta Corridor

Figure 34: Somali women in Rinkeby

Figure 35: Tensta Tower

Figure 36: Täby

DISCONNECTIONS:

GROUND

While most traditional housing blocks in Stockholm are four to five stories tall and have a strong connection to the street level, the Million Home Program buildings do not. These high rise estates that are up twenty-two stories tall (figure 35-36) create a disconnection of residents from one another and from the outdoors. Architect Jan Gehl describes the importance of human scale, “Meaningful contact with ground level events is possible only from the first few floors in a multi-story building. Between the third and fourth floor, a marked decrease in the ability to have contact with the ground level can be observed. Another threshold exists between the fifth and sixth floors. Anything and anyone above the fifth floor is definitely out of touch with ground level events”.[22] These vertical housing settlements have led to social isolation. This thesis explores the possibility of elevating the ground plane up to many different levels as one builds vertically.

DISCONNECTIONS:

CITY

The master planning goal for the Million Home Program, including Tensta, was to form concentrated housing settlements around a center with services and a subway connection to the city. These housing settlements are scattered over large green fields outside of Stockholm (figure 38-39), typically organized with high-rise houses placed along the passing highway and low rise houses placed closer to the center. This spatial organization was meant to provide a new urban lifestyle outside of the city. However it actually led to a disconnection from the city (figure 37). This disconnection was exacerbated by the slow expansion of vital services such as the subway system, which was not in operation until four years after Tensta was completed. A newspaper journalist describes the situation in Tensta, "...this is of poor consolation for those tens of thousands of settlers that have to live in a scary world, face discomfort and substandard service, experience accidents and live in a constant phycological and physical stress".[23] This isolating aspect of the Million Homes projects clearly demonstrates the value of building within or close to an existing urban environment, which this thesis project proposes to do.

Figure 37: Stockholm. Source: Google Earth

Figure 38: Tensta + Rinkeby

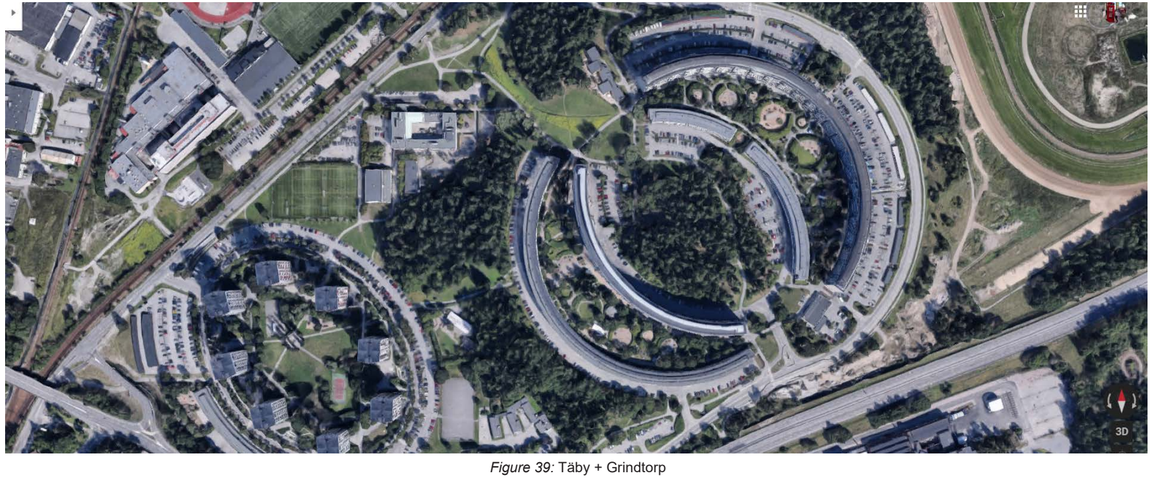


Figure 39: Täby + Grindtorp

CH.4

SWEDISH IDENTITY & OPERATIONS

This thesis proposes a high-density approach to housing that responds to rapid urbanization and climate change in Stockholm.

With a rising population of nearly one million people in Stockholm, individuals are increasingly living in denser environments. Stockholm also faces new issues pertaining to climate change that will require a new way of thinking about how to address this housing shortage. My Valle research examined the Million Homes Program, which confronted issues of density, organic growth, and sustainability by designing a system that was able to produce over one million homes in ten years. In documenting the disconnections produced by this housing program, it was considered essential to provide a high-density housing approach that maintains connections between the community, ground plane, and the city.

Figure 40: Stockholm's site context collage

“The harsh climate turned the Swedish Vikings into tough hunters who preferred to use their spare time for resting rather than socializing with their neighbors. The result is a nation of introverts who still treasure their independence and crave a large amount of elbow room.”

- PETER BERLIN
Xenophobe’s Guide to the Swedes

COMMUNITY:

USE OF PUBLIC SPACES

Though Sweden is known as a nation of introverts, Stockholm’ is known for the extensive use of its public spaces. These includes outdoor clubs, theatres, and markets (figure 41-43). This thesis recognizes the importance of public spaces in Swedish culture.

Figure 41: Vitabergsparkens Amfiteater

Figure 42: Tensta farmer’s market

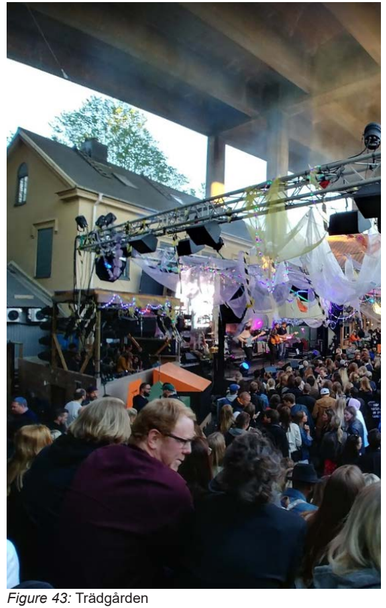


Figure 43: Trädgården

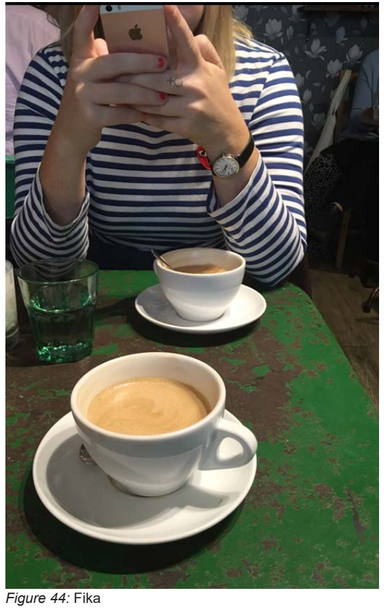


Figure 44: Fika

Figure 45: Outdoor lunch

Figure 46: Kräftskiva

COMMUNITY:

USE OF COMMUNAL SPACES

Swedish hospitality is genuine. They love to invite someone over for coffee or a meal. These generous experiences (figure 44-46) of socializing with friends and colleagues include summer lunches, fika, and kräftskiva. Opportunities for communal activities and social spaces should be an important consideration in the design of new housing.

COMMUNITY:

USE OF INDIVIDUAL SPACES

The Swedish Viking culture has been known to be reserved and independent due to Sweden's sparse population, short summers, and long, dark, cold winters. Compact and closely knit living units include spaces that allow time for resting rather than socializing (figure 47-48). This includes the outhouses, which often include such stylish amenities as wood chips, padded toilet seats and at times even comedic portraits of Swedish royal family (figure 49). Although the introverted reputation of the Swedish culture has changed over time, it is important for this thesis to provide spaces that provide the opportunity to be on one's own.

Figure 47: Tensta living unit

Figure 48: Stuga dining room

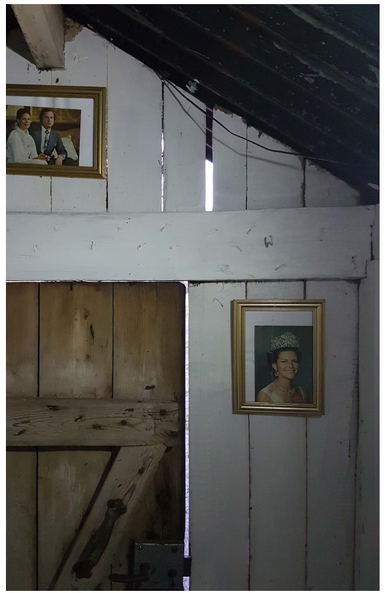


Figure 49: Outhouse interior

"The swedes have a dream: to save Nature from Man. It's as close to a passion as the Swedes ever get."

- PETER BERLIN
Xenophobe's Guide to the Swedes

GROUND:

NATURE LIGHT FOOTPRINT

The Stockholm Archipelago includes about 30,000 islands in the Baltic southeast of the city. These islands are a place where many Swedes go to find solace year around. There they are able to participate in many outdoor traditions such as midsummer celebrations, mushroom and berry picking, kayaking, sailing, and hiking. While traveling through the archipelago, one quickly notices the minimal presence of the buildings and other civilizing elements (figure 50). The Swedish people are known for their conservation efforts, which may, in part, be due to allemansrätten (freedom to roam), where people can wander freely without the fear of prosecution, as long as nothing is destroyed or nobody is disturbed.[24] In order to address the continuously adapting environment due to climate change and urbanization, this thesis proposes an approach that will have a minimal impact to its site to allow the natural features of the site to remain untouched.

Figure 50: Anchoring types

CITY:

SITE

Cities are energetic and diverse. There are numerous advantages to be gained from living in the city. Examples include easy access to local services, culture, and employment opportunities. Jane Jacobs states, “Cities have the capability of providing something for everybody, only because, and only when, they are created by everybody”.[25] In the case of The Million Home Program, most of the dwellings were built in new suburbs outside of the city. These new neighborhoods often required local services, many of which were completed long after the completion of the housing settlements. This disconnection from the city shows the importance of building in an existing urban environment and tying into existing services and social spaces.

Stockholm began as a port between Lake Mälären and the Baltic Sea that, as an important trading center, steadily grew into the city that we see today. This urbanization, along with post-glacial uplift, caused the original water lines to slowly disappear (figure 52). With continuing rapid urbanization and impending climate change, including as heavier seasonal rains and rising sea levels, the preexisting water levels are expected to return, displacing those residents who live along the shoreline This thesis aims to locate the Vertical Archipelago within Stockholm’s city center which would allow for natural growth of the proposed high-density housing structure without needing to try to mitigate the changing shoreline.

Figure 51: City center region in Stockholm

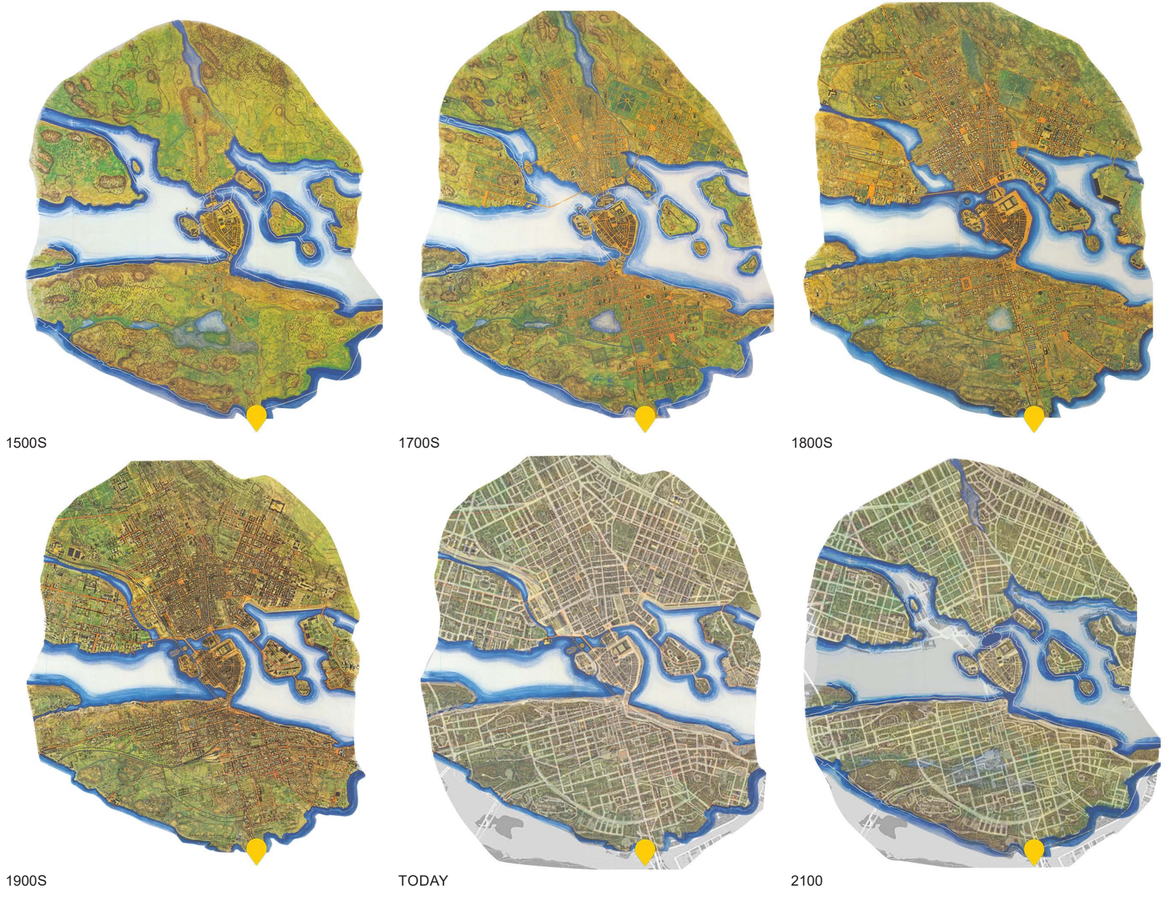


Figure 52: Timeline of the locks

CITY:

SITE ANALYSIS

The site was chosen on order to accommodate high-density housing that is adaptable in Stockholm's rapid urbanization. It is centered on the locks of Hammarbyslussen, where sweet and saltwater mix. This connection between the Baltic and Lake Mälaren is essential to the city and serves various purposes. First, the locks are used for raising and lowering boats, ships and other watercraft between stretches of water. Second, the locks acknowledge and respond to the flow of Lake Mälaren, releasing water as necessary. Figure 53-55 shows the lock development throughout time. Understanding the response of this diverse site allows for similar applications on similar sites.

The west side of the site is primarily known for its nature reserves and community gardens. The east side contains residential housing blocks, city parks, and an industrial district. These two different conditions have resulted in a plan for high-density housing that grows by responding to the city's rapid urbanization and climate factors without significantly altering the existing context. Figure 56 illustrates the initial approach. The nodes represent points of grounding the project in the water, on the land, or even on existing buildings. The proposed nodes allow the growth of the high-density housing structure to occur in specific spots that won't interfere with existing views, for residents in the existing housing blocks on the east side of the site for example. Bridging the points of entry will allow for additional connections to neighboring structures as the existing ground plane becomes inaccessible due to rising water levels.

Figure 53: Historical Hammarby Sjostad Aerial

Figure 54: Current Hammarby Sjostad Aerial

Figure 55: Current Hammarby Sjostad Aerial

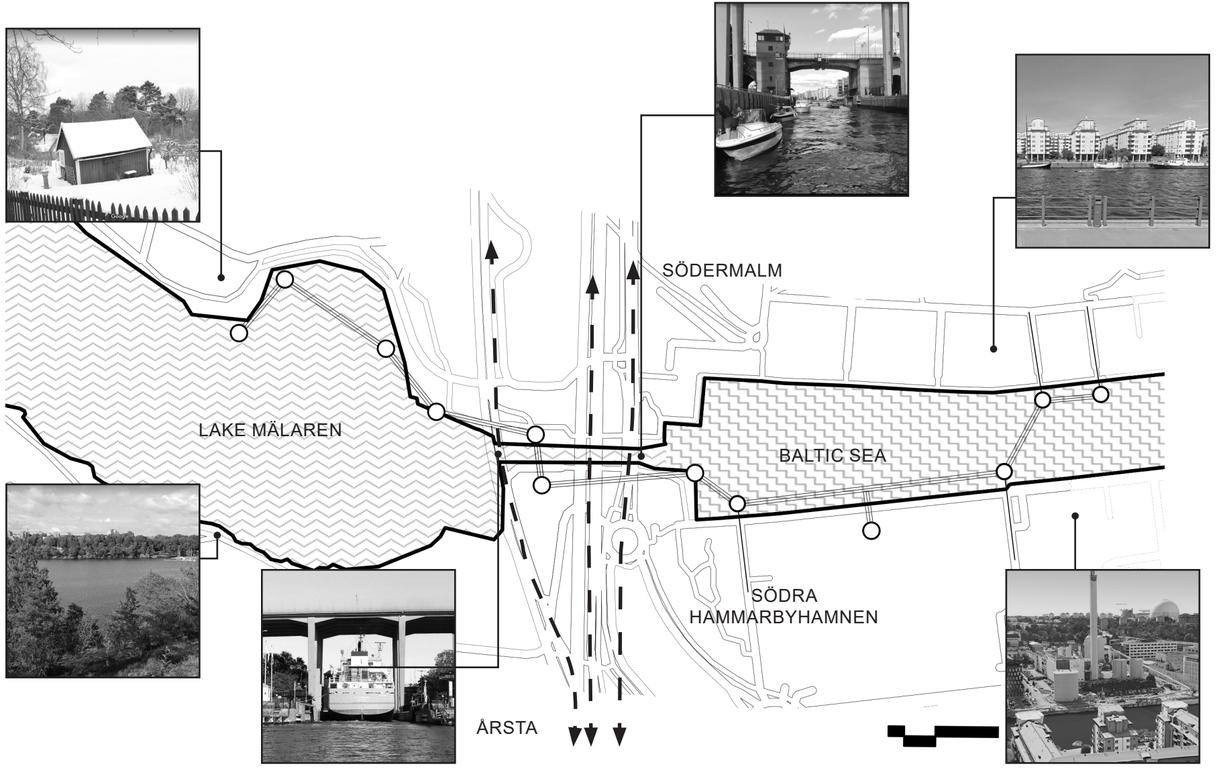


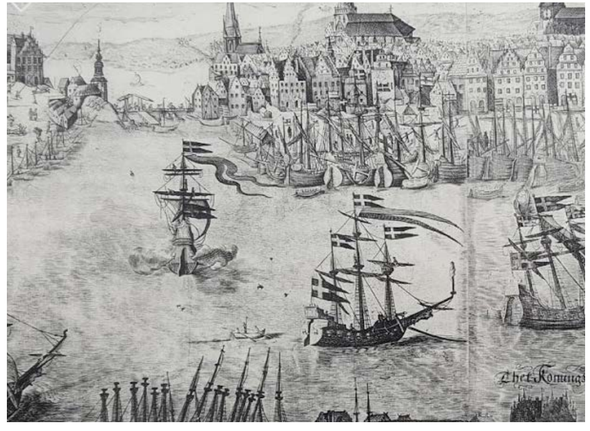
Figure 56: Site analysis

CITY:

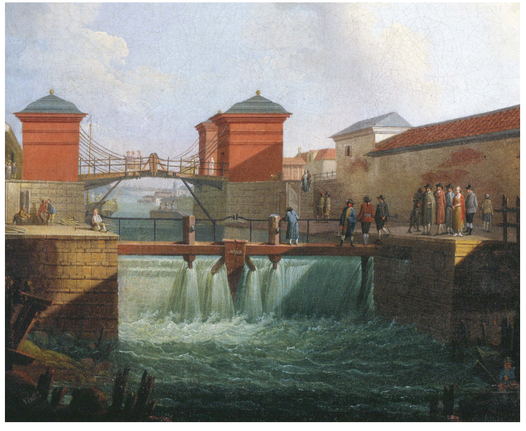
SITE ANALYSIS

Stockholm's locks have been rebuilt every century since the 1600s (figure 57).[26] The Queen Christina Lock, was the first lock to open in 1642, and served Stockholm's 30,000 residents. In 1755, the Christopher Polhem Lock accommodated 70,000 residents, the Nils Ericson Lock built in 1850 accommodated for 93,000 residents, and the Karl Johan Lock in 1935 was built for a population of 420,000 residents. Today, resources are being used to improve Stockholm's northern locks, however, the locks at Hammarbyslussen were last updated in the 1930s, which means that they are approaching their century mark and will soon need to be rebuilt.

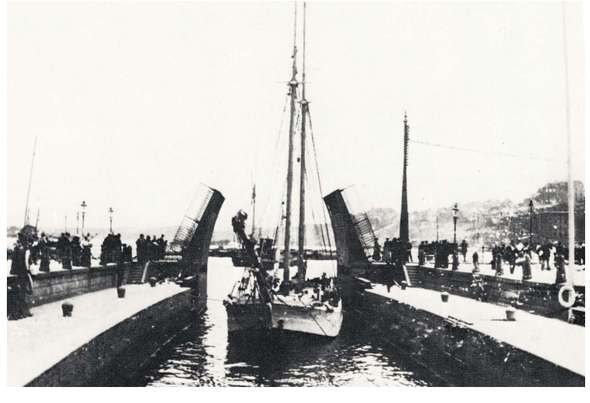
In the past few decades, climate change has caused Stockholm to experience heavier rainfalls thus increasing the risk for flooding. Since 2000 the city's overall weather has been unseasonably wet. In some cases extensive local surface water flooding has nearly reached the central underground station tunnel of Stockholm.[27] Although the renovations of the locks have happened every century, considering climate change future renovations may need to become more frequent. Rather than providing a short term solution, this thesis proposes to accept these new conditions caused by climatic factors and take a vertical approach that will allow the ground plane to elevate to many different levels as the existing ground plane becomes uninhabitable.



1642: QUEEN KRISTINA LOCK



1755: CHRISTOPHER POLHEM LOCK



1850: NILS ERICSON LOCK

1935: KARL JOHAN LOCK

Figure 57: Timeline of the locks

OPERATIONS

Based on the framework, case studies, understanding of the Swedish culture, and site analysis previously mentioned, this thesis aims to provide a high-density housing model that connects the individual to their community, and to the city. In order to accomplish this four sets of operations were developed. Anchoring, growing, inhabiting, and connecting are used to metabolize energy from the city and allow for healthy expansion of Stockholm without interfering with the existing context or being overwhelmed by changing climate conditions.

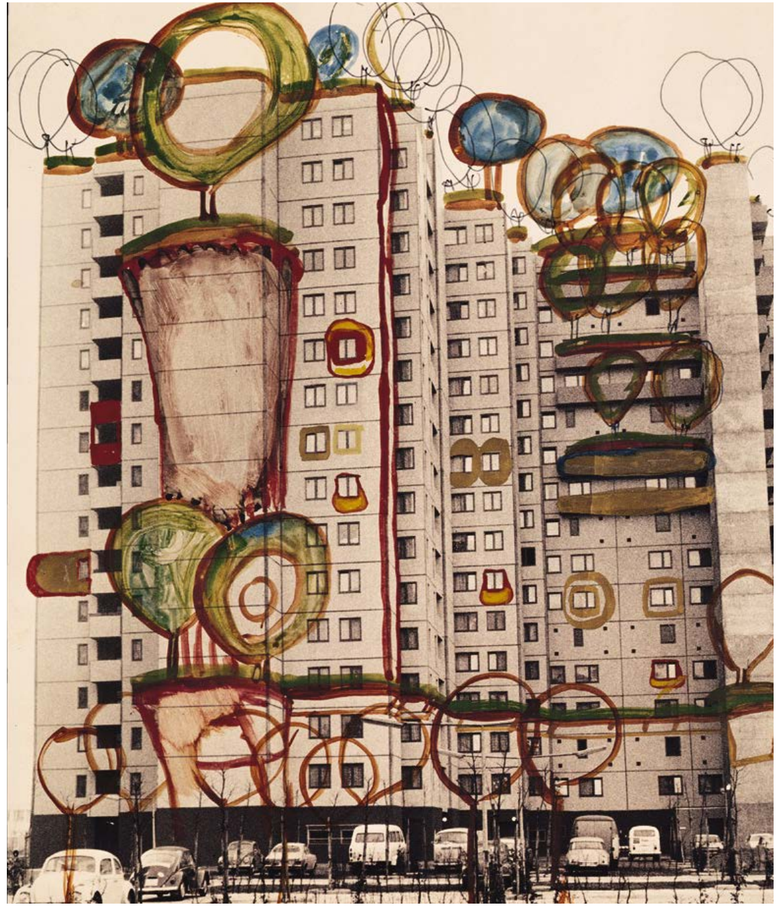


Figure 58: Suggestion for healing architecture by Friedensreich Hundertwasser: “a stronghold against the false order of the straight line, a bastion against the grid system and the chaos of nonsense.”

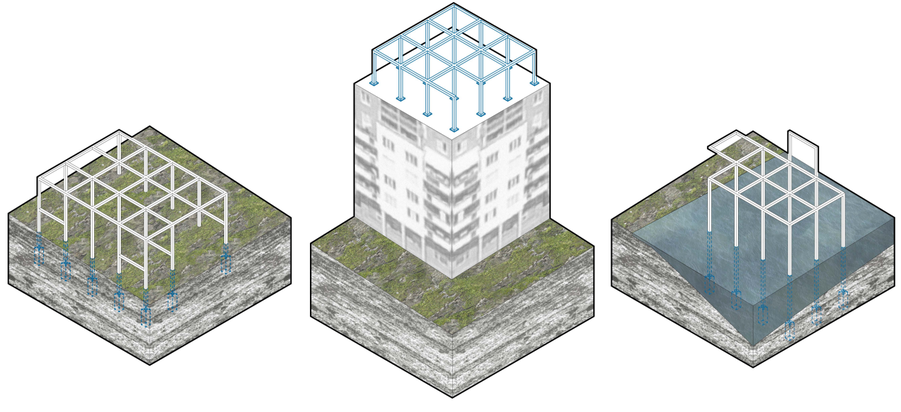


Figure 59: Anchoring diagrams

ANCHORING

Anchoring activates the area at designated places such as on land, on existing buildings, and in the water. The landscape one sees throughout Sweden is a mosaic of shapes originating from different periods, some of which are still being formed. Common rocks are gneiss, granite, granodiorite, sandstone, and marble.[28] Similar to barnacles on a ship, most buildings attach to the existing topography, built independently from their host. This thesis uses the topographic character of Stockholm’s islands in understanding how the built environment should respond to its site (figure 59).

GROWING

The cell frame structure (figure 60) is light, allowing for an effortless assembly that will grow systematically over time. Although rigid, the frame is characterized by transparency and a flexible geometry. The frame is constantly adapting to the housing needs of the inhabitants. This cell growth does not dictate static uses, but rather creates a dialogue for an unlimited amount of ways it can be inhabited in the future.

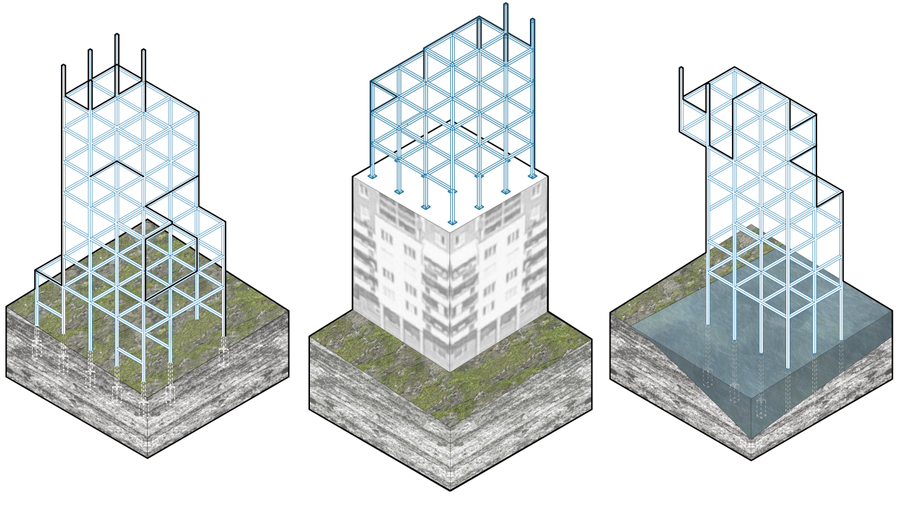


Figure 60: Growing diagrams

INHABITING

Collective forms begin to inhabit the cell frame (figure 61) including public, communal, and individual spaces. American urbanist William H. Whyte states, “ideally, sitting should be physically comfortable... It’s more important, however, that it is socially comfortable. This means choice... Choice should be built into the basic design”.[29] Acknowledging the concerns of the residents, their cultural history and distinctive typologies will lead to the creation of a wide variety of habitations. These varying forms will provide a rich and comfortable living environment.

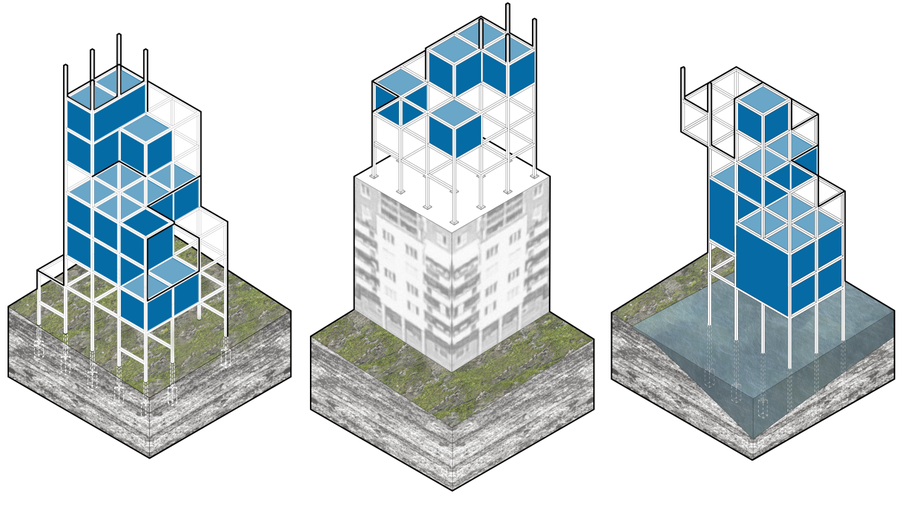


Figure 61: Inhabiting diagrams

CONNECTING

Figure 62 show how the links between the cell frame structures will create new elevated ground planes as the existing ground plane becomes uninhabitable.

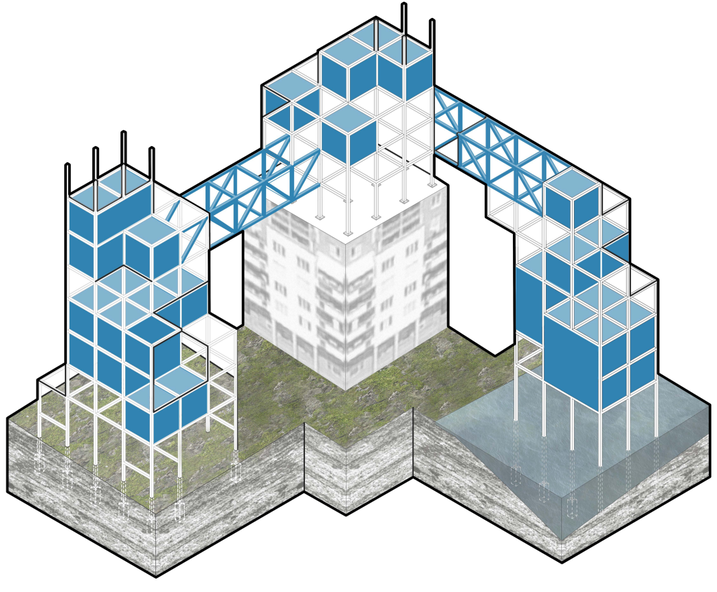


Figure 62: Connecting diagram

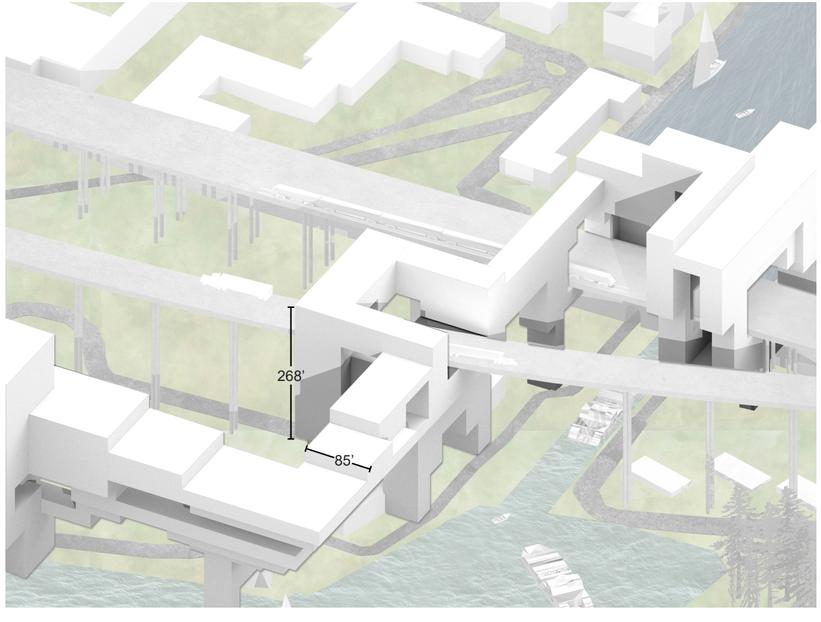


Figure 63: Massing diagram

MASSING DIAGRAM

The massing diagram (figure 63) shows the how the high-density housing community could spread across the site, stretching over and under the existing bridges that connect Södermalm to Årsta and expanding into Lake Mälären and the Baltic.

CONCLUSION

The premise for the Vertical Archipelago was based on a study of the successes and failures of Metabolism and The Million Home Program, as well as an understanding of the Swedish culture. Through personal experiences and research of The Million Home Program, this thesis discovered that successful high-density housing should connect the individual to their community, the ground plane, and the city. An understanding the Swedish culture influenced the uses of spaces and the connections to the ground plane. From this analysis a site was chosen at the Hammarbyslussen locks.

Based on the operations of anchoring, growing, inhabiting, and bridging, The Vertical Archipelago can integrate with the site without interrupting its existing context. These operations are then able to respond to rapid urbanization and climatic change in order to create a high-density housing project in the city. However, rather than providing a static solution, this thesis proposes a frame as a medium which can grow organically as needed in order to provide spatial connections between the individual, community, and city.

"CITIES HAVE THE CAPABILITY OF PROVIDING SOMETHING FOR EVERYBODY, ONLY BECAUSE, AND ONLY WHEN, THEY ARE CREATED BY EVERYBODY."

- JANE JACOBS

The Death and Life of Great American Cities

Figure 64: Slussen project: current lock construction in the northern side of Stockholm

CH.5
PROPOSAL

Anchoring, growing, inhabiting, and connecting are methods used to properly integrate with the site and provide a healthy expansion as Stockholm grows and densifies. The initial concept was inspired through a collaging method that derives inspiration from the the case studies (figure 65).

Because of the importance of maintaining a meaningful connection to human scale relative to the outdoors and other people, the ground plane should be on many levels. This provides a healthy environment regardless of how high the building rises. Rather than producing a static use or individual units, the frame structure provides an open dialogue for how people can inhabit it. The Vertical Archipelago grows in an ad hoc manner as needed by the community.

This high-density housing proposal is designed to respond dynamically to different climatic conditions such as summer, a storm surge or a snowstorm. It provides a framework for people to adapt to changing conditions caused by rapid urbanization and climate change

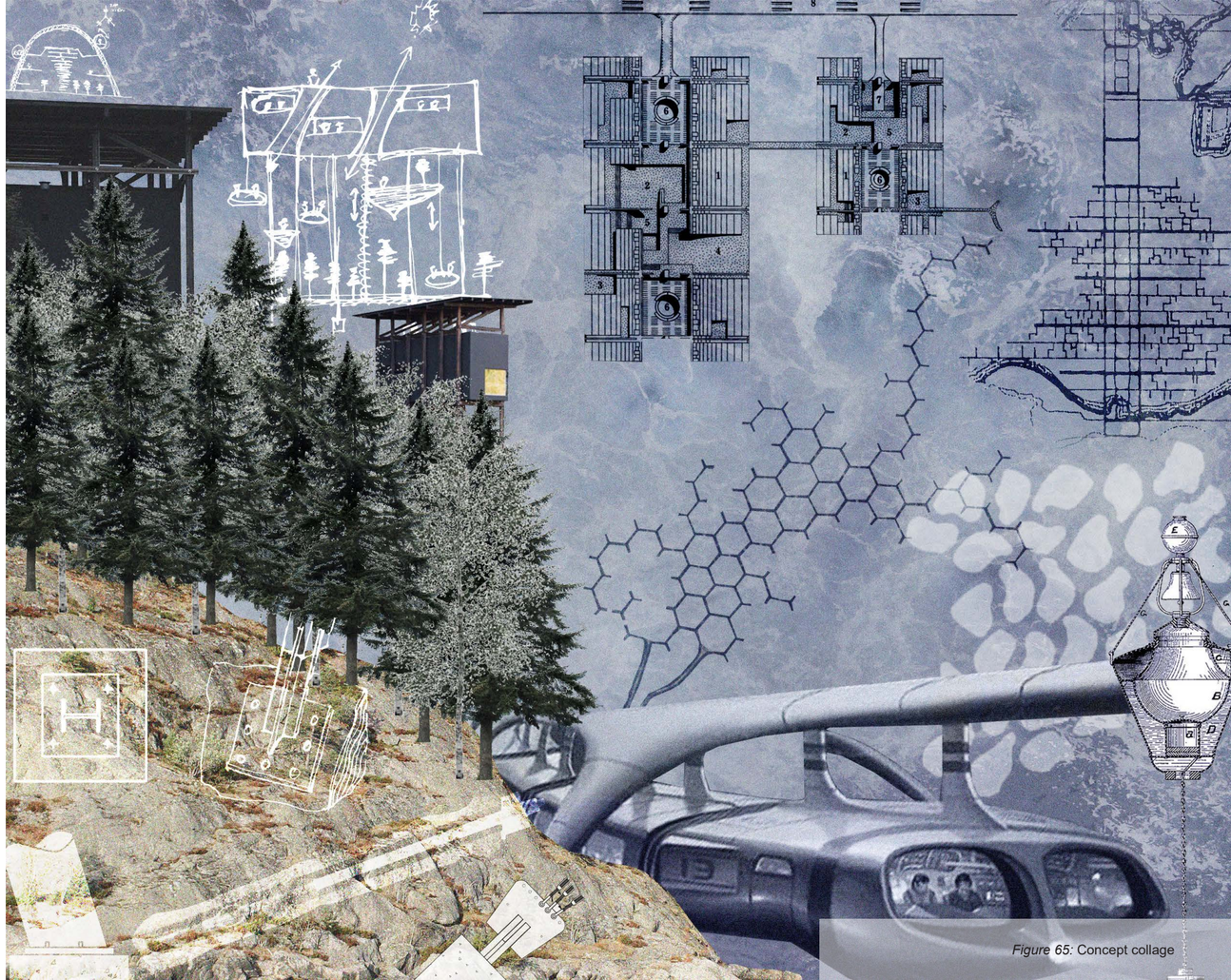


Figure 65: Concept collage

LAKE - STORM SURGE - 2030

Figure 66 show the cells frame structure after eleven years since construction first began, on the west side of the locks. Access to the structure is through the vertical shafts that have been anchored on land, water, or existing infrastructure. During a storm surge seasonal rains have grown stronger and water levels have risen about ten feet. Inhabitants of the structure are not at risk of having their property flooded due to this climatic event. As the water rises certain ground level activities including the community gardens relocate to the new structure. During this time period, foliage begins to grow and cover the frame structure.

Figure 66: Lake perspective: storm surge

LAKE - MIDSUMMER - 2070

Figure 67 shows how the structure has grown and has been densely inhabited over several decades. Designated areas remain open to the public and ensure a healthy balance between individual, communal, and public space. Although, the structure is a rigid cell frame, a colorful range of living units and other functions are built in it, providing a strong a sense of ownership and individuality for the residents.

Figure 67: Lake perspective: summer

BALTIC - FALL - 2025

Across the locks on the east side, the Baltic Sea has also risen. This side of the locks is characterized by housing settlements and industrial district. Through systematic planning, and anchoring the structure at designated points, existing views of the surrounding context have been maintained (figure 68).

Figure 68: Baltic perspective: storm surge

BALTIC - SNOW STORM - 2100

Figure 69 shows how life in the Vertical Archipelago has become normalized by the year 2100. The winter holidays are approaching. As pedestrians cross the bridge, one can how see the warmth of the cozy interior spaces built within the cell frame stand in stark contrast to winter storm ravaging outside.

Figure 69: Baltic perspective: snow storm

PUBLIC SPACE

As the ground becomes uninhabitable and people have to relocate there will be a demand for new public spaces to allow new and existing communities to flourish. Figure 70 illustrates the potential character of the generous public spaces. Although, they are located high up in the structure, they show how different cultures traditions will continue to thrive in these spaces.

Figure 70: Public space view

PUBLIC SPACE

Figure 71 shows how a mixture of habitations can coexist with one another. Each unit is personalized and unique, establishing emotional ownership. The connection of the individual to its community and city has been brought up vertically, with the dwellings connecting to the outdoors and to other spaces.

Figure 71: Public space view

CH.6
CONCLUSIONS

Stockholm is growing quickly, and. as a result there is a high demand for housing. Although Stockholm is no stranger to large-scale housing projects, climate change presents new factors that will require adaptation to new environmental and social conditions. A study of Metabolism and the Million Home Program, along with an understanding of Swedish culture have greatly influenced this proposal to provide housing that is drastically needed in Stockholm.

The design project is based upon the idea of using a frame that can continuously adapt to changing conditions without creating significant impact on the surrounding environment. Through the operations of anchoring, growing, inhabiting, and connecting, this thesis brings the individual closer to its community by elevating the ground plane to many levels. After being deployed, the frame system will respond to its specific site condition. There is no correct configuration, and it will allow for multiple interpretations of experience. Not only do these four operations respect the identities of the different cultures that it could accommodate, but the process of prefabrication, mass production, and linkage to mass transit will also increase the building's affordability and adaptability. As this incremental growth process produces the homes needed, a new city will emerge, weaving itself into the existing city fabric.

The Vertical Archipelago is a speculative project that describes how high-density housing might address the ever-changing environmental and social conditions of the 21st century.

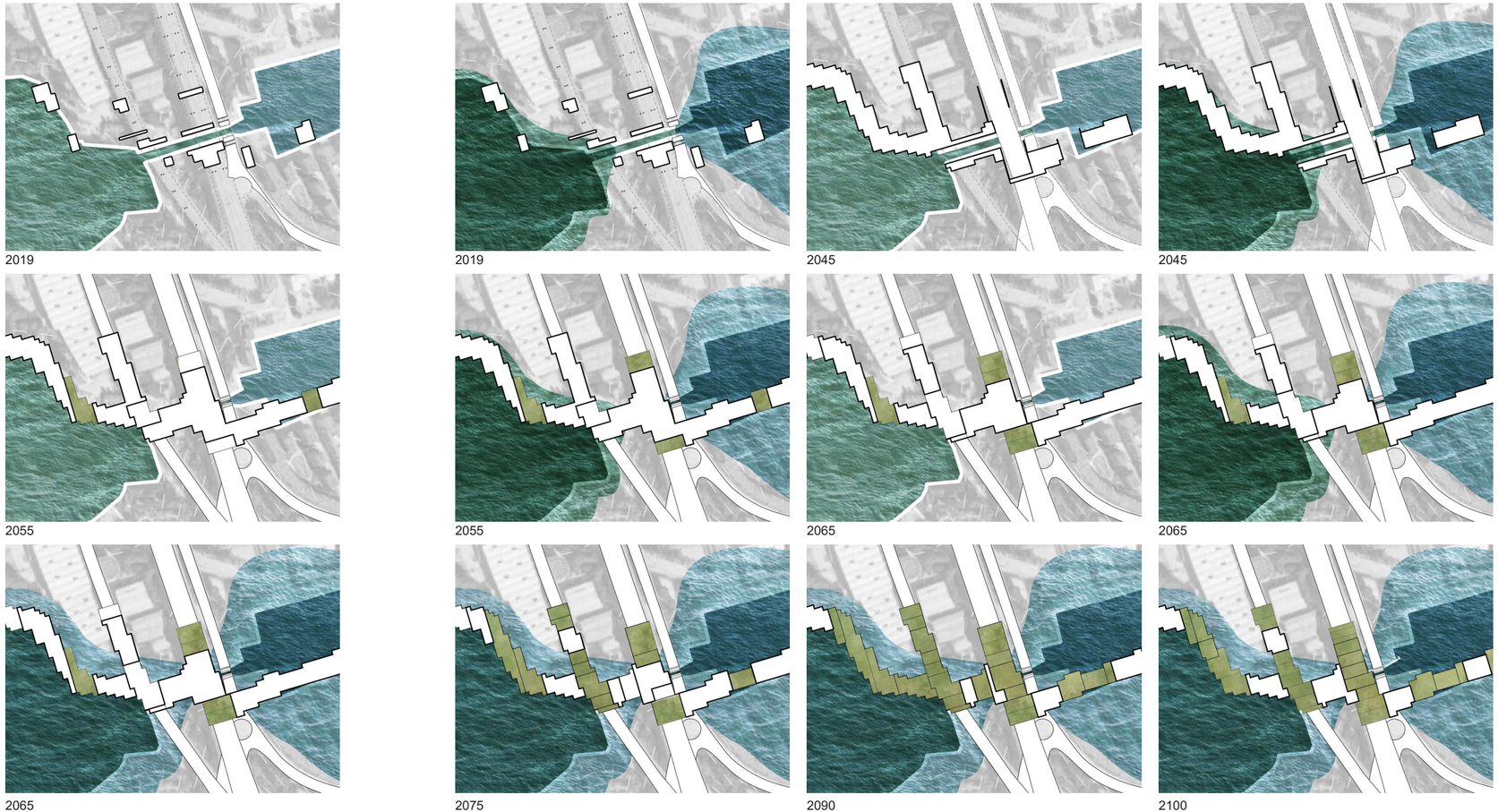


Figure 72: Flux of water levels timeline

List Of Figures

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