PROGRAM

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Abstract

This program establishes the framework for the problem and solution for this master thesis. In a context which is highly contextually based the investigations and mappings underlines the social standpoints from the physical- and mental context. Furthermore it seeks to establish an understanding of user profiles and the typologies of the present Nordic city.

Methodology

This project will be carried out through the method of the *Integrated design process* (IDP) and will be contained in two volumes; the program and the report. This volume will cover the problem- and analysis stage, where the problem will be established and analyzed based on a hermeneutic and phenomenological approach to the field of architecture, whilst creating the foundation for this thesis within the realm of sustainable architecture in a Nordic context.

The second volume covers the sketching, synthesis and presentation stage where the project will begin to take shape and ultimately conclude in a presentation of the finished design. This will also be done through a hermeneutic and phenomenological approach but also based on empirical rationale and interdisciplinary knowledge to create equilibrium between the technical and aesthetical aspects.
The synergy in the process will be maintained through the iterations created stages of the IDP and the informed design solutions derived thereof.

Prologue

Brief
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Breif

The purpose is to look into the contemporary Nordic city structure to create the opportunity for the city to develop the inner district instead of pushing the development out in the suburban areas. The design is to concern dwellings with innovative housing qualities by integrating a new Nordic sustainable high-rise building in the western part of Aalborg. The site is a piece of an existing city block that is demarcated by Vesterbro, Holbergsgade Urbansgade and Korsgade, located on Korsgade between two existing buildings. Because of the downtown location, all necessary daily functions as institutions of ordinary and higher education, kindergartens, shops, supermarkets and day nurseries are all located within walking distance. The infrastructure around the site has good accessibility to streets, bicycle lanes, bus routes and a train station.

Sustainability is an important focal point to the project, and covers three aspects; Environmental, Social and Economic, whereas the energy performance of the building is important. But the question surrounding the high-dense city and infrastructure is closely related to achieving a high level of sustainability. It is well documented that the urbanization is putting constant pressure on the structure and density of the city, and that a high population density along with multifunctional city structures takes part in a more sustainable city be decreasing the use of private cars and thereby the consumption of energy to transportation. The sustainable city should therefore be based on a dense community to which the main population would be situated close to day-to-day functions. The Nordic lifestyle suggests an open and green way of living that is most suitable in the suburbs, located in driving distance from the daily functions. The dilemmas concerning sustainability and housing qualities must be solved in the project as criteria for a *Nordic high-rise* to be successful.

The new Nordic and sustainable high-rise building is to solve the issues, and integrate qualities that take into account the Nordic lifestyle, the local context and the need for activities and outdoor spaces. The project will primarily focus on dwellings, but has to take the existing functions of the site into the design and thereby open the possibility to be programmed with public functions.

Preliminary questions

How to redevelop the Nordic city to accommodate the increasing need for dwellings in the future and to rethink the present lifestyle to design architecture that generates the future prospects for a high sustainable city and way of living?

The main idea behind this thesis is to explore the Nordic city as it is today and compare it to the challenges that it is facing, and how the city is to handle it by redeveloping the city by its existing context.

The thesis aims to focus on and discuss the increasing urbanization and the architectural problems surrounding the use of undeveloped sites and the lack of development of the city with a perspective on *Urban infill* as a tendency. In addition the thesis will seek to explore the possibilities of integrating the high-rise in a dense Nordic city to meet the challenges of the city today, and to challenge the lifestyle of the Nordic citizen.

Ill. 1; World population growth

Ill. 1; Urban Infill

The city of today, tomorrow and the future

The city is and has always been in transformation, a transformation that reflects society and its cultural and economic development. Danish cities is covering a cultural heritage that can be traced 1000 years back to the Viking age which puts the development of the city in a perspective that covers several historical periods (Thomsen, 2009). With each historic period the city structure has changed according to the preferences and logic of the generation and a constant need to accommodate for more people (Thomsen, 2009). Today we are moving towards new challenges facing a still increasing urbanization, less space and demands within sustainability.

How does the New Nordic city look like, what are the challenges and how do we meet the domestic demands, and also the global need for sustainable solutions? The development of the New Nordic City is to reach technical sustainability but also to solve and take into consideration the social movement.

There are different tendencies to the development of the city in a global perspective and all tendencies expect an expansion of the city. One tendency is for the cities to develop horizontally, another is the Climate and Energy city development, which doesn't only develop the outskirts of the city but take into account the undeveloped sites within the city core to establish a higher density (Realdania, 2010).

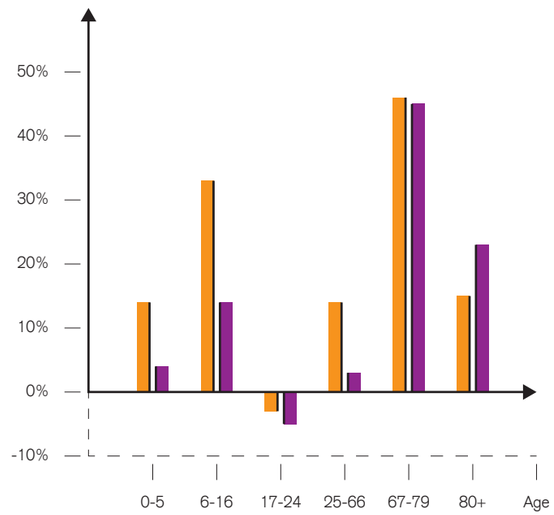
The Climate and Energy city focuses on creating a sustainable city that uses undeveloped areas and infill methods to create a positive development. In a Nordic context one of the dominating typologies is the city block, which creates many values to the high-density lifestyle since it takes into account the values and problems of living in the city.

The city has to develop and one approach is by *Urban infill* which is an upcoming tendency that uses undeveloped sites within the city to create a sustainable development by, among others, rethinking an area and to raise the density (SCI, 2013).

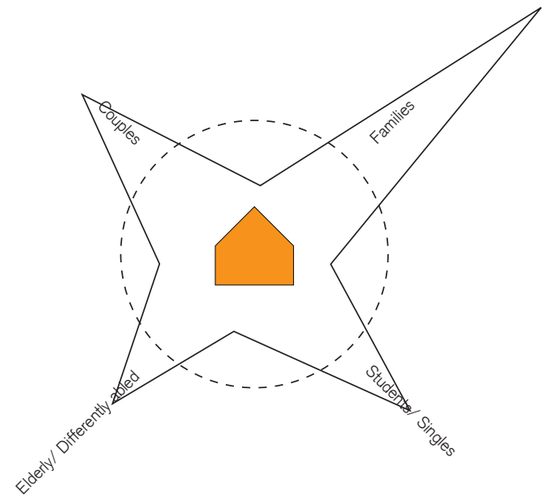
Urban infill

One of the upcoming tendencies in the building industry when developing urban areas is *Urban infill* which to some extend is the counterpart to urban sprawl. *Urban sprawl* is a course of the increasing urbanization, but instead of a development of the urban core, *Urban sprawl* develops the city horizontally in a low-rise building development at the suburban areas. To avoid an unnecessary use of rural land and support a sustainable urban development, more are looking into the principles of *Urban infill*, explained through the utilization of underdeveloped land in existing communities. By using *Urban infill* as a strategy the new development is added to the existing energy, transportation and cultural infrastructure and can thereby diminish the overall negative sustainable footprint. The definition is wide, ranging from building sites which hasn't been built to the demolition of existing buildings that is of such a low standard that they have become eyesores.

Because of the cultural heritage and proud building traditions in Nordic countries, the approach to *Urban infill* will be conducted through the utilization of spaces in the city core that hasn't been built. To further institute a distance from traditional development and acknowledge that the building will be positioned in a context and will be contextually based, the choice of the site will be weighed upon its contemporary and future relation to the context.



III. 1; Population growth



III. 2; Userprofile

Dwellings

The population of Aalborg is expected to grow with 8,9% from 2014 – 2026 where the demographic growth primarily will be within the ages of 25-66 years (COWI, 2014). This predicts a large growth of families and a need for dwellings suitable for families need. Today Aalborg is dominated by housing units oriented to user groups consisting of one or two persons, and is primarily situated in old workers neighborhood in city blocks that rarely reach the lowest demands for living comfort or new modular building complexes with more or less the same architectural expression and experience. There is little space for the family in the city due to small apartments and lack of individualization.

There is a desire to live in the city, but the architectural quality of the present city apartments and those being built recently is often limited to characterless structures with the same type of module and with similar expressions. This fosters that people chooses to live in the old city block apartments which does not reach the standards for energy or indoor environment but succeeds in atmosphere (HLA, 2013).

Approach to dwellings

A focal point to our approach to dwellings will be based on a social standpoint. We are already able to build economic buildings that reach a high level of environmental sustainability. Most of these buildings are uniform and designed for one user profile which leaves the city active during only a part of the day.

To feel safe in the city and around our home there is a need for the feeling of safety and community. To accommodate this we need activity on the street, we need ‘eyes on the street’ (Jacobs, 1961) and to ensure this the building needs to be programmed for a larger span in user diversity and the meeting between them. Citizens need to see different user profiles in and around their local environment and get a feeling of a varied and stable community.

The goal is to create a residential building that not only focuses on high-densities, but also the development of user behavior and integration of the users in a community. This is done by creating diversity in experience, gathering places and incorporation of different user preferences.

Demography

Singles, couples and larger families, dominates Aalborg and over one half of all dwellings consist of two rooms, whereas nearly half of all residential buildings are city blocks. Aalborg is divided into several areas, which each are dominated by a user group. The site is located in Vestbyen and is, in relation to the other districts, dominated by singles and small families within the age of 20-29 years. In Vestbyen the city block stands for over 90% of dwellings within an apartment footprint of 40-79 m2 whereas nearly no one owns a car (AK, 2012).

The increase in population in Aalborg and more specific in Vestbyen, estimates that the amount of small families will increase and that the couples, small- and large families will do as well (AK, 2012).

User profile

The design will be based on a building system that adapts to the social need and the city’s future transformation. The building system therefore has to be able to suit different user profiles; students, couples, a variety of family sizes and differently abled – all user profiles which creates activity at different times a day and use the building in different ways. The building has to create the boundaries for all user profiles to make sure that segregation will not happen.

The population growth of Aalborg is expected to grow with 8,9% from 2014 – 2026 (COWI, 2014) which will result in a need for 806 housing units a year. The balance between the groups of age is mainly orientated around 25 – 66 year with around 50 % and 6 – 16, 17 – 24 and 67 – 79 years more or less shares a second place with around 12 % each (COWI, 2014).

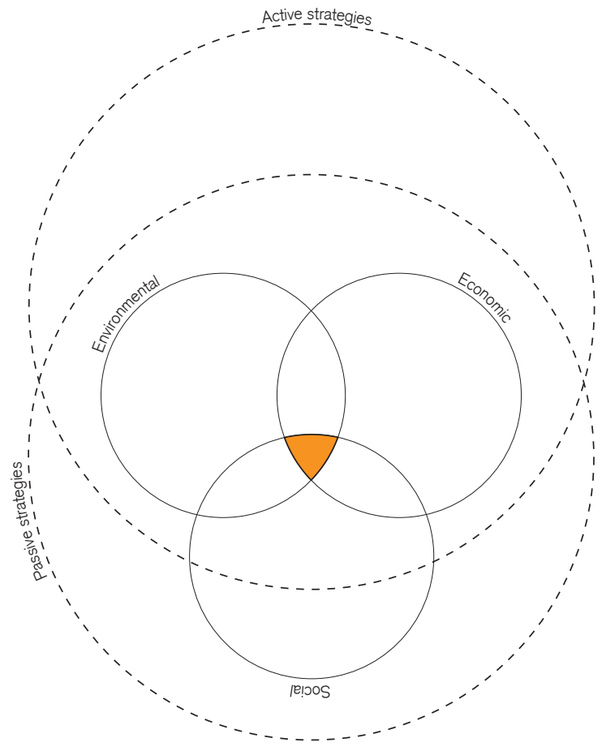
This can be used to predict and shape the program for a residential building, but one also has to take into account that user profiles are not a static measure but that they are developing and that citizens change their homes according to the direction their lives progresses.

Sustainability

Sustainability is a term that covers a wide area and is used in daily conversations in the debate about society and our future on earth. Sustainability can be seen in two overall perspectives; a politically determined and the perceived, which in itself are two different approaches. Sustainability as a topic can be divided into three; *Environmental, Social* and *Economic* and are important aspects to take into consideration when designing a building (Larsen, 2013).
The Danish understanding of sustainability is attached to the Brundtland report 'Our Common Future' which was published in 1987 and the certification system DGNB certification system. The Brundtland report surrounds the topic of sustainability within the scope of our living conditions and the conditions for living for the next generations (Larsen, 2013). The DGNB certification system is on the other hand a system that is based on 63 criterions within six areas, and is based on the current European situation.

Two elements that in the last years have had a great influence, that to some degree has resulted in the user often has been forgotten in the search for low-energy buildings. We have now reached a sufficient environmental sustainable level and the need has therefore arisen to take a look at the perspective of the user. Buildings are more than technical solutions, energy and materials, it is also about the activity taking place inside the building and the relation between the users and the ability to feel safe and home (HLA, 2013).
People are moving to the city and the population is increasing, and if we don't carefully reflect on how to develop the city, the development will stagnate and we will, in a few years, have cities that have not solved any of the environmental, social or economic problems. We need to develop the inner circles of the contemporary city so that it is suitable for the future instead of preserving the past. Within an architectural approach there are two ways of doing so; renovation and *Urban infill*. We are going to invest in the possibility of *Urban Infill* in a Nordic context, which often is an open spaces situated in the enclosure of a city block.

Urban infill creates the opportunity to give an area an architectural lift and add value to the city. It is a choice based on research of the sustainable city and the opportunities that stand within high-density sustainable architecture. The day-to-day life has many steps that are unwanted and unnecessary due to a home situated far from work, public institutions and other daily functions. This can be solved by a higher density, where the citizen is placed at the center of their lives.



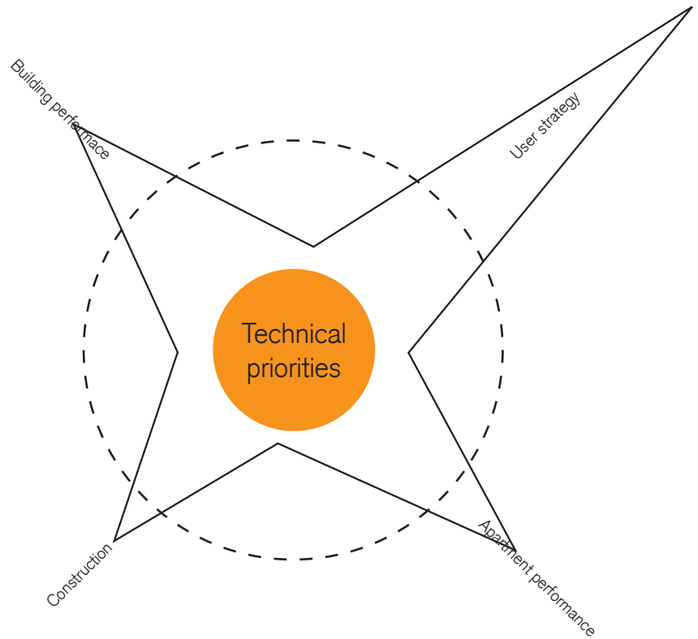
Approach to Sustaianability

People are the heart of sustainability, if you do not design for the people and their desire for the function they will always find a way to compromise; people shape architecture. We believe that sustainability should be approached from a social point of view, to use and have the people who are going to live there in our minds. We need to make the user conscious and aware of the environmental issues existing today to make them care and change. We do not directly wish to integrate the user to see the large perspective of sustainability, but to understand the aspects which has a direct influence on their daily life.

Even though the intention is to approach the project from a social point of view, it is directly connected to the environmental and economic, and as the project is to develop the three themes is to follow hand-in-hand.

To shape the boundaries for the families to live in the city the building has to take into consideration and ask the question of; how would the vertical city look like in a Nordic city? Within the boundaries of the site and the high-rise building the intention is to create a diversity and awareness around the fellow citizen and to enhance the quality and take part of the cultural layers.

Ill. 1; Sustainable approach



Technical perspective

The aim for the project proposal is to reach the Danish standard for low-energy buildings. The ambitions is to use both passive and active strategies, but the demand to reach a zero-energy standard is not to be set since we will have a social focus due to our believe in the larger perspective to be more efficient. The aim for the project will be to reach the best sustainable result, and the 2020 standard as a minimum.

The focus will be to integrate all technical aspects from the start. Research and studies has shown that 80% of important decisions are made in the first part of the project, and that 40 – 50% of the energy performance from buildings are locked in the design (Kongebro, 2012).

The technical prospects will be divided into three topics; Building performance, Indoor environment and Strategies.

Building performance
The building performance is relying on passive parameters and the building design therefore has to be designed for the site, its context and the location. The structural system and technical solutions is to be designed to reach a low heat transmission to reduce the need for energy, and it is important to consider the materials since it accounts for a large part of the total energy used for the building and because it does not directly take part in the Danish standards.

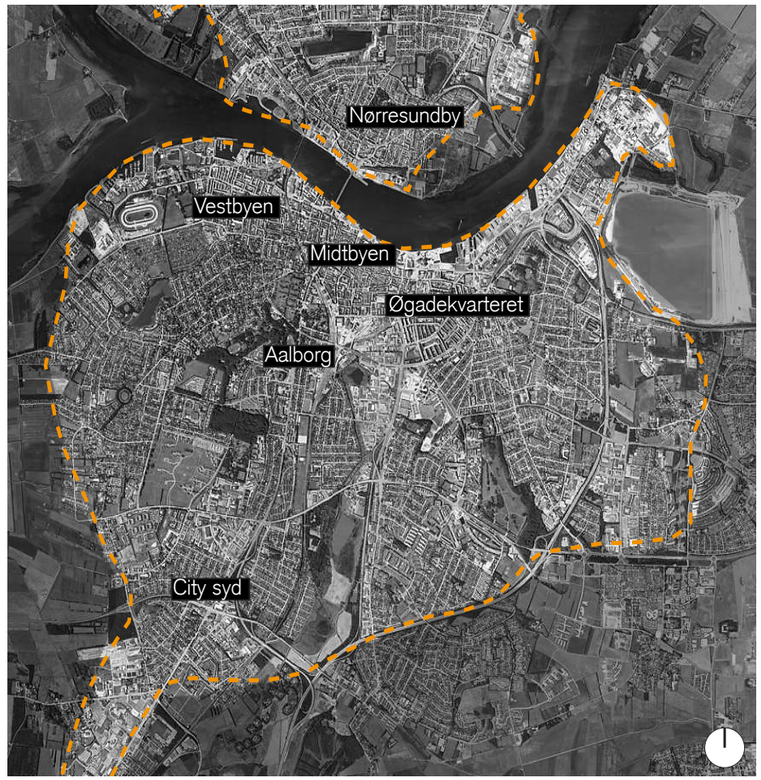
Indoor environment
The comfort level has to reach the category II for dwellings to fulfill the regulations, and therefore has to take into account the comfort and the indoor performance due to temperatures, pollution, noise etc. Daylight and ventilation will be the two main topics to reach the requirements as well as designing the systems to be user specific and adjustable.

Strategies
To reach the highest possible level of building performance and indoor environment both active- and passive strategies is to be integrated.
Considerations about orientation, vegetation, surroundings, shading, materials, sun, wind and noise is important to both strategies. The passive strategies have to create the boundaries for a high performing building in a performance and comfort perspective. The active strategies are to be integrated in the building, design and orientation is therefore important to create the boundaries to harvest energy.

	Dwellings II		**Public** II		**Building requirements** DK
	Summer	*Winter*	*Summer*	*Winter*	*BR 2015*
Temperature	20,0 - 25,0	23,0 - 26,0	20,0 - 24,0	23,5 - 25,5	30,2 *kWh/m2 year*
Daylight	200 Lux		500 Lux		
Sound	25 - 40 dB		30 - 45 dB		*BR 2020*
	PPD (percentage diss.		*PPD (percentage diss.*		20 *kWh/m2 year*
Pollution	20%		20%		
	Airflow per person		*Airflow per person*		
	7 l/s/pers		7 l/s/pers		
	Outdoor		*Outdoor*		
CO2	350 PPM		350 PPM		
	Allowed above		*Allowed above*		
	500 PPM		500 PPM		

Place

Aalborg
Aalborg as a high dense city
Development strategy
Blue and green structures
Landmarks
Infill sites in Aalborg
Possible sites
The site
Local plan
Site registration



Aalborg

Aalborg has a long and proud history due to its importance as a driver for the Danish trading market. The city was established as a trading point in the 900's since its location in the northern part of Denmark and the relation to the fjord. Aalborg was the second larges city around the 1600's and experienced its first downturn in start of the 1800's due to the loss of Norway. Thereafter the city developed to an industrial city and was in the years up to the 1990's dominated as a workers city where industries as the C.W. Obels factory, the Danish Spritfabrikker and Aalborg Portland had a great influence on the development. Not long after the city ended up with a vernacularly slogan as "the city of smoking chimneys" "Byen med de rygende skorstene" (Byhistorie, 2016).

In the 1990's Aalborg had changed from being the industrial workers city to become a service and student minded city whereas areas along the harbor and Eternitten arose with new architecture bringing a new era in architectural identity and left the city with few marks reminding of a proud industrial history (Byhistorie, 2016).

Ill. 1; Boundaries of Aalborg

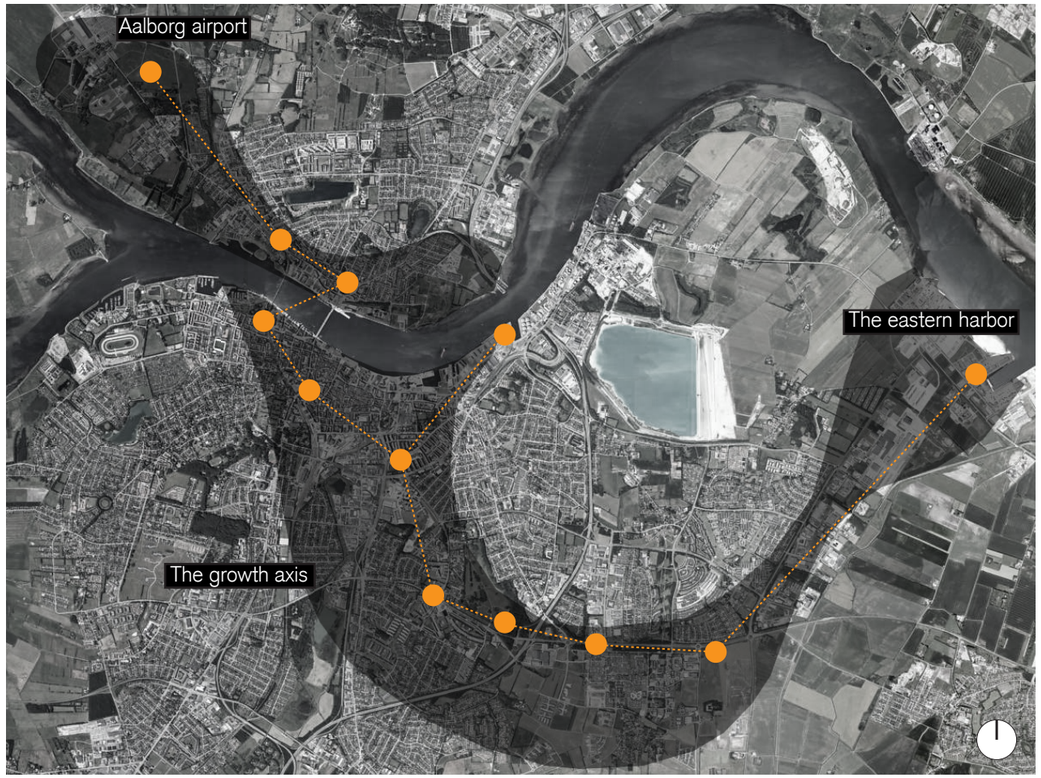
Aalborg as a high-dense city

Aalborg is at the moment one of the cities in Denmark that experience the larges urban development. Large parts of the city are under development to meet the need for dwellings and an efficient infrastructure. Aalborg municipality has in that perspective opened the debate about the high-rise building in Aalborg (TM, 2007).

Aalborg might not have a high-density profile but has never the less, in many years, been characterized by large buildings due to the industrialization where Nordkraft, Aalborg Portland, Hedegaard etc. has been dominating landmarks and used as branding to the public (TM, 2007). Due to a development of the industry moving out of the city, many buildings has been left and demolished. This has left Aalborg with the opportunity to develop the city in a new direction where the high-rise building will be an alternative strategy to consider (TM, 2007).

The analysis and debate about high-rise buildings in Aalborg has great value, however, the debate has been stretched over a number of years and in a city as Aalborg, which is developing in such a high pace, we already see high-rise buildings being established along the waterfront. High-density buildings are a reality in Aalborg and are overtaking old industrial areas. These are valuable sites and the development can be questioned, however, this is not a topic which will be covered in this thesis, but the integration of a high-rise building in the city, characterized as the high-dense city.

Pic. 1; Aalborg cityscape



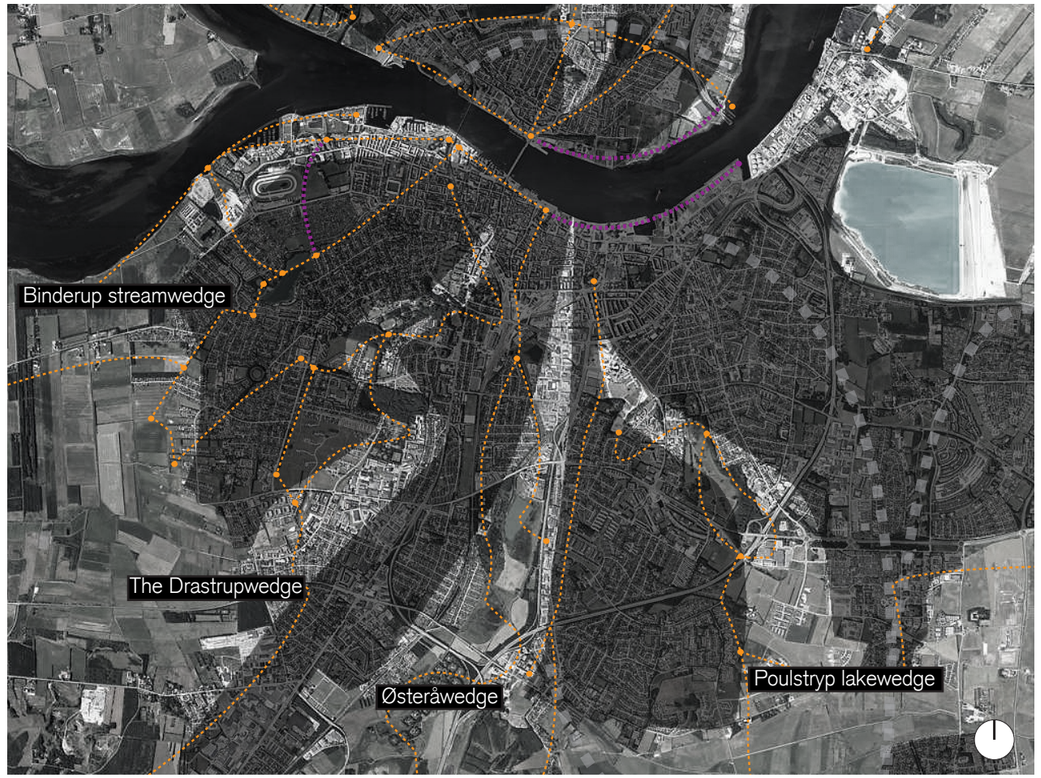
Development strategy

The city development of Aalborg is primarily focused on increasing the density and converting the existing buildings along, what is referred to as the growth axis (TM, 2013). The intention is to have anchors along the axis to sustain the development in these areas in the form of recreational spaces, infrastructure, business and other social and economic focus points while infilling the undeveloped sites throughout the city with contemporary buildings.

As a part of DK 2050, Aalborg has agreed to achieve independence of fossil fuels by 2050, and is well underway by transforming the outdated buildings in Aalborg east, where after the focus will be directed towards transforming Vestbyen (TM, 2013).

Focal points

Ill. 1; Aalborg development strategy



Blue and green structures

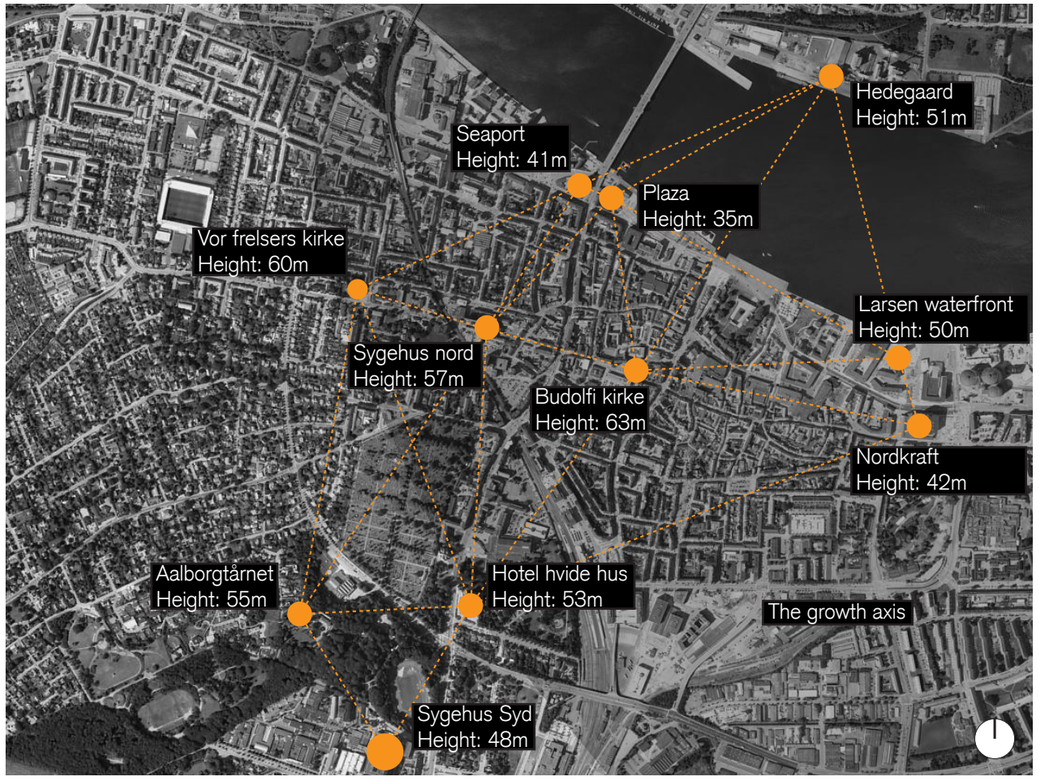
Aalborg municipality also sees it as an important part of the city's wellbeing and identity to preserve the existing and integrate new green structures in the city. The overall plan is to maintain the qualities of the fjord and the surrounding landscapes by utilizing blue and green wedges to penetrate the urban structure and connect them through recreational passages. Some of the areas of focus are accessibility to the green spaces, greens effect on health and identity and the socioeconomic benefits (AK, 2010).

Recreative connections

New recreative connections

Ecological connections

Ill 1; Blue and green structures



Landmarks

Aalborg has always been dominated by higher buildings than the ordinary cityscape. Because of its industrial significance Aalborg became known as “the city of smoking chimneys” where the high-rise mainly consisted of the factories slim chimneys and the few church towers. Later on buildings such as Aalborg Portland and Hedegaard became dominant at the harbor front, both in height but also in mass. In more present time tall buildings has become a more familiar sight in all parts of Aalborg and is no more solely industrial but also hosts residential and cultural purposes.

Landmarks

Ill. 1; Aalborg landmarks

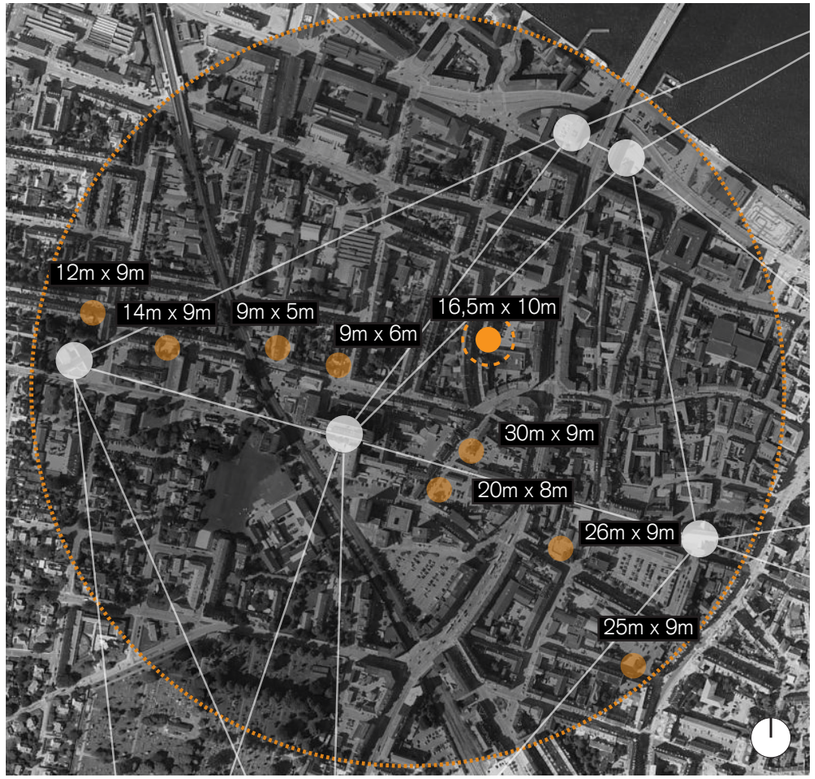
Infill sites in Aalborg

Within the boundaries of Aalborg several potential sites has been considered. The potential sites were to take into consideration the impact a high-rise would have, its density and relation to the context and landmarks placed within the nearest proximity. As a result of *Urban infill* the density and infrastructural relations was an important to the decision of site.

Since Aalborg is a city with a relatively low density concentrated around development areas, the site had to be oriented towards finding a possible scenario in the dense part of the city with suitable density and infrastructural possibilities. The dotted circle indicates the area to which the potential sites were narrowed down.

Infill sites
Less potential sites
Landmarks

Ill 1; Urban infill sites



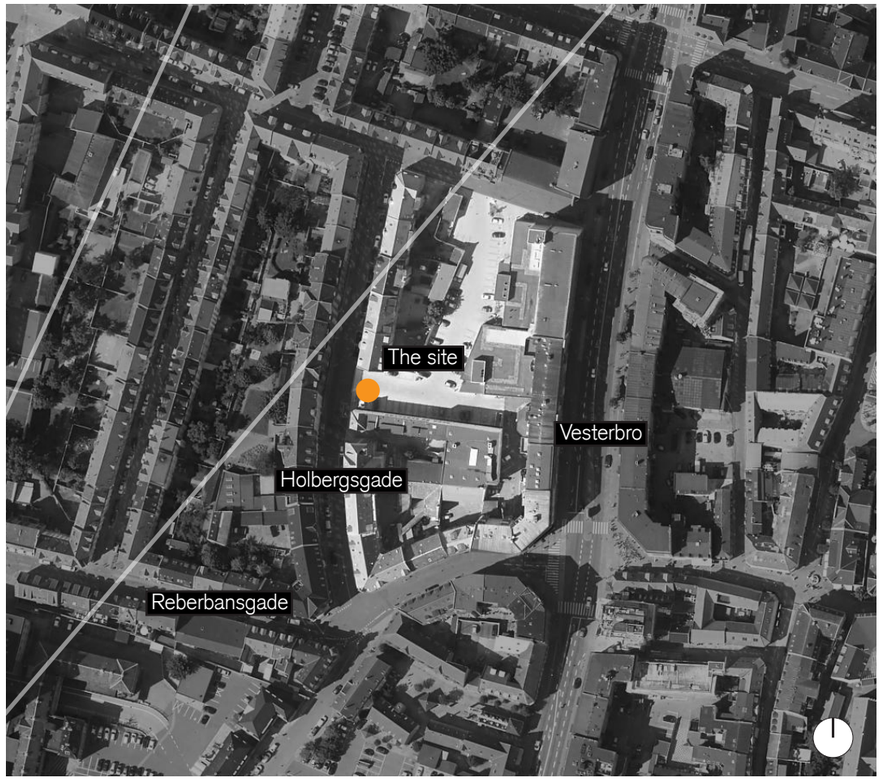
Possible sites

Within the inner circle nine potential infill sites can be found. The sites relate to open spaces in the cityscape and are often part of the city block. As a result to the approach of *Urban infill* all sites have limited boundaries in most orientations and the footprint is relatively small.

Within the nine sites one distanced itself as it was situated close to the main artery Vesterbro, within a cluster of landmarks and high density.

Potential sites
Less potential sites
Landmarks

Ill. 1; Sites



The site

The site is part of the city block demarcated by Vesterbro, Urbangade, Holbergsgade and Korgade. The site has two footprints, one that relates to the city block that is 17,5x 10,5m and one that takes part in the courtyard, limited by the functions of the courtyard.

The site is situated in the dense city and has less than five minutes to all primary functions, and within the city block shops, retail and businesses are located.

Today the site functions as passageway between Vestbyen and the city center and the people utilizing the public institution within and around the city block, as well as supporting the need for deliveries to the retail stores.

The site is placed in the western part of the city block and has two existing buildings situated on both sides.

Ill 1; The site

Local plan

Vestebro is one of the most significant areas in Aalborg and also share the function as the main traffic artery within the dense city and is the primary connection to Nørresundby.

The buildings along Vesterbro were reconsidered in the mid 1900s in relation to the establishment of the Limfjords Bridge. Back then the smaller houses of 1-2 floors was demolished to create the boundaries for 5-7 floors and growth.

The area along Vesterbro is dominated by architecture related to the Funkis movement in Denmark in the 1930s and the horizontal band in the façade enhances the movement along the road.

The buildings surrounding the city block are listed within the middle category 4-6.

The local plan can be separated into two subcategories; buildings facing Vesterbro and buildings facing Vestbyen – the site lies within the buildings facing Vestbyen and has less strict demands for architectural appearance.

Ill. 1; Local plan

Site registration

Function
The site functions as a passage for the movement from Vestbyen to the harbor front, to the city center and the functions integrated within and around the city block. The movement within the city block serves the retail and parking lots and the site is a secondary opening where the primary opening is situated in the northern end of the city block.

Materials
The general context has a front and backside, where the front is dominated by red brick and the back with yellow brick and the roofs are covered with red tiles and canopies.

The courtyard is primary covered with asphalt and has minor buildings defining the outdoor spaces associated to each block unit. In the northern part of the courtyard there has been integrated parking lots and the retail shops has associated services nearby. Small buildings and associated structures dominate the southern part.

Pic 1-6; The site

Context

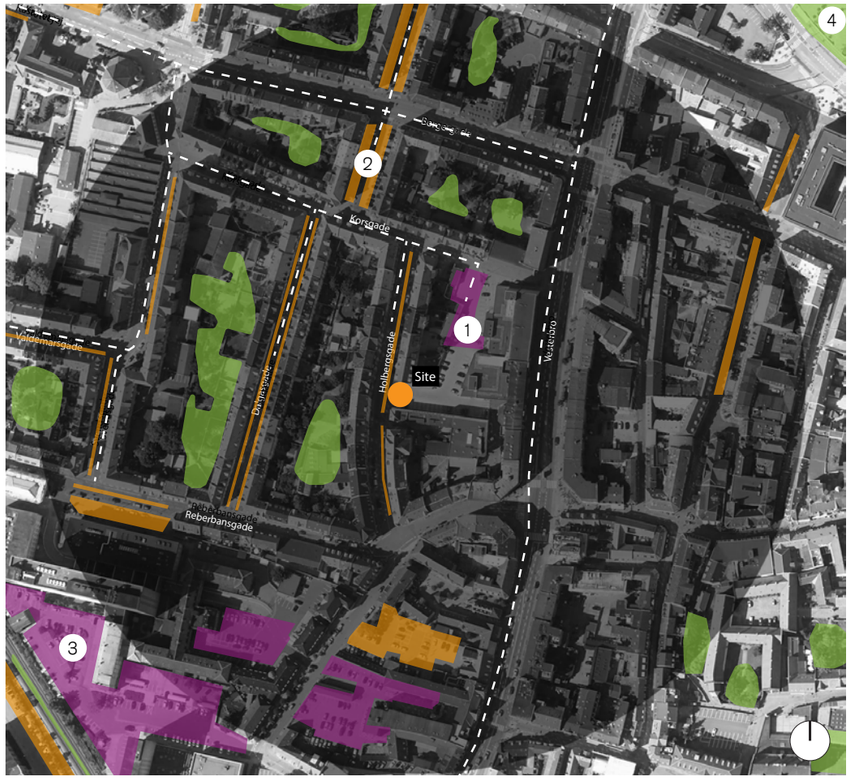
Accessibility
Parking, squares and vegetation
Public services
Noise
Climate, sun, wind and rain

Accessibility

The site is situated within the dense city and has therefore easy access to public transportations, car paths, bicycle lanes and pedestrian paths. Within a radius of 500m it will be possible to reach stations for public transportation and it is possible to walk or ride directly from the site and onto the larger infrastructural systems of Aalborg.

- Car path
- Bus lane
- Pedestrian path
- Bicycle path

III. 1; Accessibility



Parking, squares and vegetation

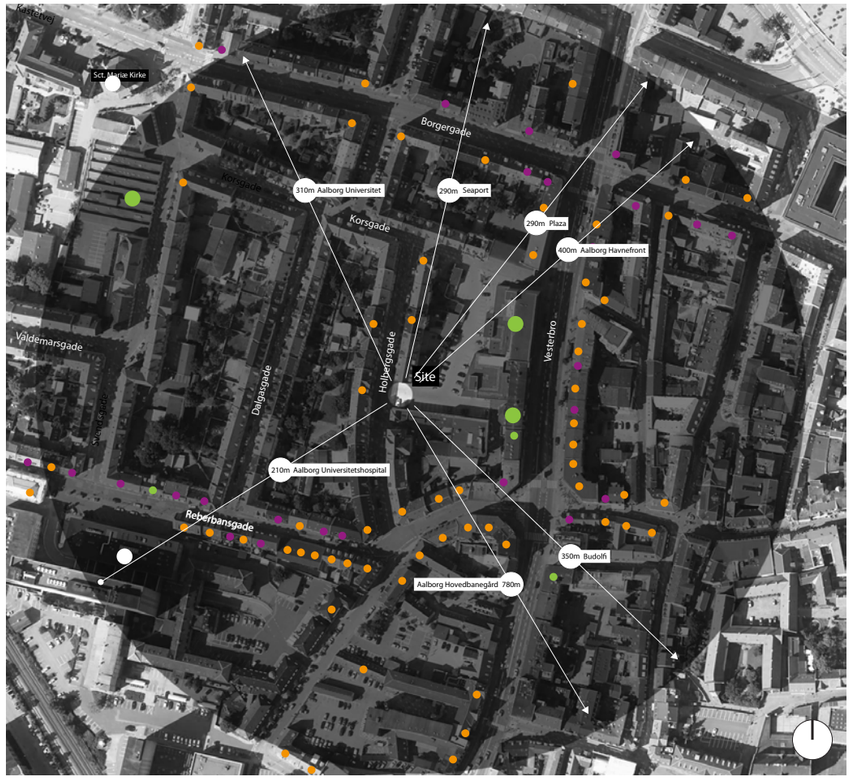
Vestbyen has around 4500 spaces for parking, and from the site there is a radius of 500 m to public parking houses and on the adjacent streets it is possible to find street side spaces for parking (AK, 2012).

The population of Vestbyen is around 12.500 persons in 8.700 households and is, with the city center, the most populated area. 68% of the citizens of Vestbyen does not have a car and only 29% has one.

The squares are lacking and it can be difficult to find nearby squares and public recreational areas, and because of the social value of recreational areas this has to be taken into consideration in the design proposal.

- Private
- Public
- Vegetation

III. 1; Mapping

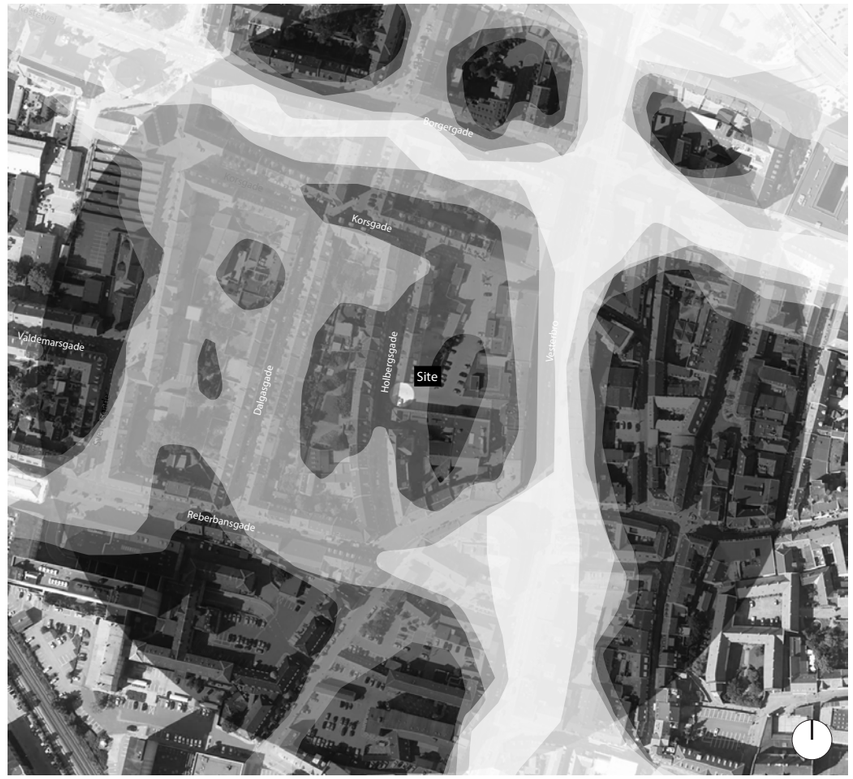


Public services

The site is close to Reberbansgade which is dominated by trading, food stores, cafés and minor businesses, and is on the other side close to Borgergade/ Kastetvej, that is one of the main roads in Aalborg. Within walking distance it is possible to reach public institutions, food stores, shops and public transportation that connect to north Jutland and the south.

Restaurants / cafés
Supermarkets
Business / stores
Public institutions

III. 1; Services



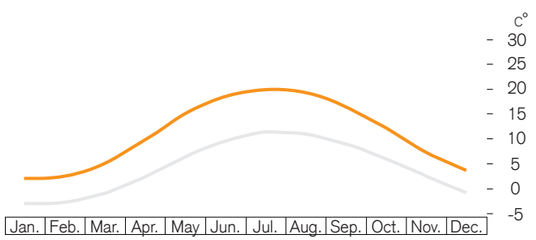
Noise

In the area there are various convenience and retail stores and restaurants, while Aalborg northern hospital and the main infrastructural artery Vesterbro are located close by. This result in relatively high, discontinuous noise levels surrounding the site because of the adjacent roads are used as access routes for ambulance and delivery of goods to the different stores.

Because of the sites distant location from Reberbanesgade and the fact that the city block shelters the noise from Vesterbro, the issue of noise will not have a big impact on the design.

Above 75 db
55-60 db

III. 1; Noise map



III. 1; Temperature

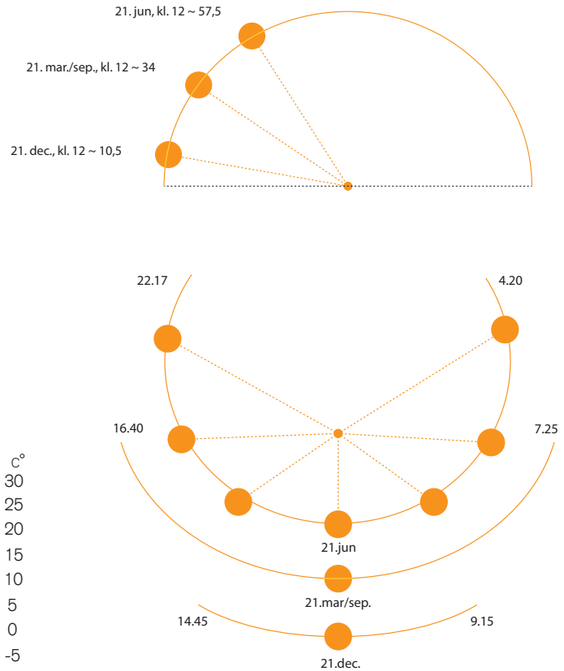
Climate

Due to Aalborg's location in the northern part of Denmark the city is characterized by windy conditions, large amount of rain and changing daylight conditions. Aspects that shape the city and the use of the city, and therefore topics that have a great importance to the design. Northern people have a tendency to use there home more which can be related to the climate in the cold month.

The climate is creating the atmosphere and according to Norberg-Schulz, "Light manifest that space which things and life inhabit, and Nordic light thus creates a space of moods, of shifting nuances, of never-resting forces" (Norberg-Schulz, 1997).

Light is one of the Nordic most precious elements, it does not only give things their presence, but brings life and id entity to it.

Daylight and wind conditions will be focal points due to its importance and to the topic of higher buildings, which can create and negatively effect if not integrated proper.

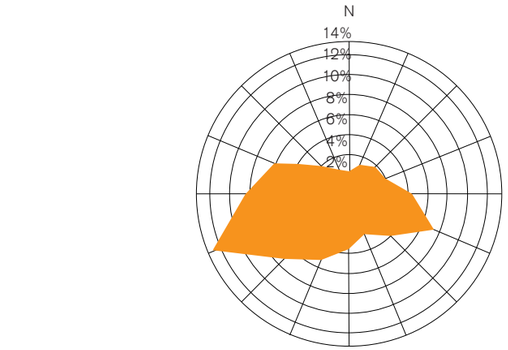


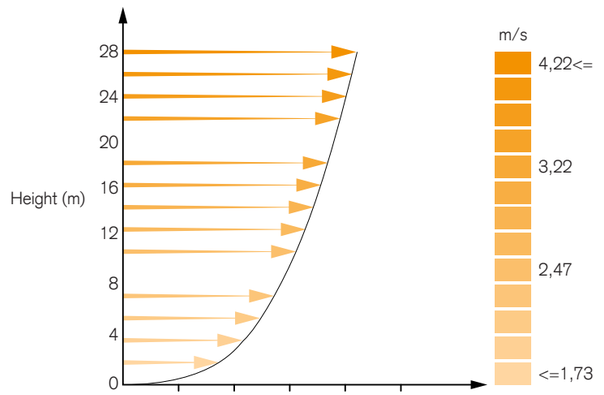
III. 2; Sun path

Sun

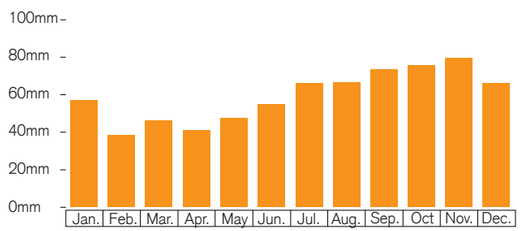
An important aspect in a Nordic context, where the availability of light can be scarce, is the quality and presence of light, both in the perspective of energy and perception. Given the position of the site the impact on the neighborhood and the recreational areas has to be assessed along with the possibilities of utilizing passive strategies to optimize the use of the sun while minimizing overheating.

As the site is located in a Scandinavian context, the amount of light and presence of shadows varies much throughout the seasons. At June the sun reaches its highest point in the sky and the amount of daylight hours is also peaking, the amount in which it changes is relatively extreme when reaching December and each situation needs to be exploited for their possibilities. In an urban context the amount of light each space receives is valuable and the design therefore has to be accordingly optimized without compromising the qualities of the existing buildings.





III. 1; Wind speed Wind speed (m/s)



III. 2; Rain

Wind and rain

Orientation, shape and size of buildings are all important parameters when designing towards utilizing the positive wind properties as well as shelter against the negatives. The site is on one side exposed to the wind but as an excerpt of a city block it is a part of a sheltering structure protecting the internal recreational space. Therefore it would be ideal to utilize the wind pressure for natural ventilation while preserving the function as a sheltering structure and take the dimensions of the building into consideration.

The Nordic climate is a relative humid and cool climate, this needs to be considered in the passive and active strategies to compliment the interior and exterior spaces dependent on the seasons, whether it being passive solar heating, shelter or sunny outdoor spaces.

Casestudies

The Nordic high-rise
The Nordic citizen
From house to home
Turning torso
Hornbækhus

The Nordic high-rise

In a society with increasing sustainable values and demands, the traditional Nordic city is challenged in relation to their expansion and preservation of the core values of the dense urban areas. To build high develops the traditional city and adds sustainable value in a future perspective, but has to be seen in a historical and societal perspective before functioning and challenge how Nordic people perceive high-rise buildings.

The stereotypic high-rise building is the tall and slim structure, known from the Manhattan skyline, which has come to represent a capitalistic thought, rather than quality of space and liveability and is often seen with implications concerning energy consumption. This contradicts with traditional Nordic building traditions and self-perception where the urban space surrounding the building is weighed equally to the interior and contextual identity is preserved through the new buildings adaptation of the context.

The Nordic tradition of building tall buildings has prior almost been limited to the modernist apartment buildings, such as Høje Gladsaxe and Bellahøj seen in the outskirts of the cities, which even though they were created by contemporary society ideals has been associated with ghetto formation, social stigma and poor architecture and living conditions.

In more modern times there has been an adaptation of a more modern style in high-rises, seen in e.g. Santiago Calatravas, Turning Torso or in the general development in the debate about high rises in Nordic cities that has set about changes to the tradition of not building high.

Still the idea of building high is challenged by the prejudice towards the negligence of the urban space and the proximity to the green area for the citizens. While the Nordic citizens appreciate the connection to the green areas, globalized cities, that are already building high, face the same issue of proximity to green spaces, while having problems with handling the climatic changes and waste management (Despommier, 2011). Dr. Dickson Despommier sees it as a necessity that the dense cities adapt to the rising sustainable issues by implementing green in the planning of high-rise areas, to solve some of the social and ecological issues (Despommier, 2011).

The *Nordic high-rise* building must therefore be built according to the context to ensure that the existing urban structure is developed and not dissolved and that the building contributes to the improvement of the context and the values that are appreciated in the human scale and the public space (Arkitema, 2005). Also, the building has to incorporate contextual identity so that it is integrated in the Nordic context but, in a way, so that it still helps transforming the current city situation and challenge how it is perceived and face the future sustainable issues (Arkitema, 2005).

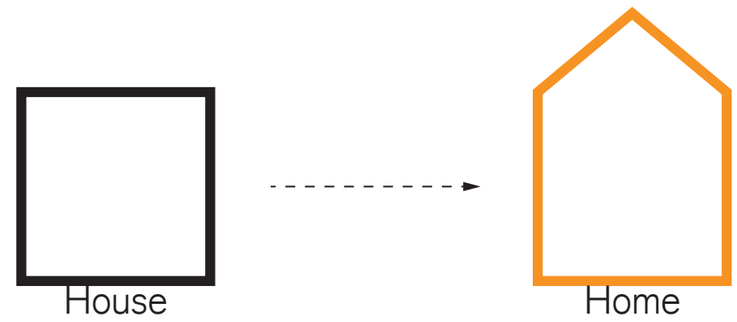
The Nordic citizen

Because of a long historical lineage, the Nordic identity is deeply attached to the cultural roots that have created the current society, and the historical remnants have therefore become a contemporary reflection of the Nordic people. Along with a proud tradition for urban planning, that always has taken scale and perception of the city into account, the Nordic countries has fostered a strong affection for their historical artifacts and has come to think of the city as a structure that has always been well-functioning, and still is (Arkitema, 2005).

Seen from a planning perspective, the modern cities are structured around a historic center, which in time has been subsequently expanded with several layers of outgoing urban structure, where the historical value is decreasing the further one retracts from the center (Arkitema, 2005). The preservation of the historic center has maintained a relationship between man and building that has created cities in the human scale.

The human scale has always been present and the contemporary Nordic city has therefore become an elaborate amplification of the relationship between man and space and a reflection of the Nordic people. Parameters as changeability, interaction, mobility and sustainability, in all its aspects, are key design drivers to the Nordic urban space, and recreation, materiality, infrastructure and outdoor activity is their materialization (Realdania, 2010).

Pic. 1; The street



From house to home

There is no principal way of creating a home and there is a different understanding of what a home is depending on the user, but it's the architects' task to understand the psychological mindset of the user in order to create the optimum frames where the home can develop.

Mentioned by Marie Frier in *Interiority* – a critical theory of domestic architecture, one of the major issues of residential architecture is that it does not unite home and construction system and the spatial detailing is lost before the technical and economical aspects (Hvejsel, 2011). She raises the claim that a home is created through a static measure referred to as *interiority* which can be briefly explained as the personal detailing of a space at the scale of furniture, such as an integrated stair or a sky lit bathroom (Hvejsel, 2011).

With *Interiority* as the point of departure the physical dimensions of the space has to be challenged with spatial detailing creating relation to the space and its function. It needs a level of detailing at the scale of furniture which dissolves the perception of standardization and evokes human emotions and relations. As mentioned by Frier the spatial experience and relation is often left before the technical aspects (Hvejsel, 2011) but instead of making a mere transfer of focus it would be preferable to propose a double adaptation, or integration, where neither the constructive or aesthetical parameters are neglected but that a synergy is established that creates a relation and understanding of not only the rooms but the entire building. The theories and thoughts thereof will be investigated throughout the project to substantiate the role of creating a home in residential architecture.

Ill. 1; house-home

Pic. 1; Inspiration

Pic. 2; Concept

Pic. 3; Plan

Pic. 4; Silhouette

Pic. 5; Construction

Pic. 6; Cityscape

Turning Torso

Architect: Santiago Calatrava
Associated Architect: SAMARK Arkitektur & Design AB
Construction manager: NCC Sweden

Completion 2005
Height: 190 m, 54 floors
Apartment area: 13.500 m^2
Commercial area: 4.000 m^2

The tallest building in Scandinavia is the Santiago Calatrava 'Turning Torso' in Sweden, Malmö by its height of 190 m. The Turning Torso is the only skyscraper in Scandinavia and the first twisting skyscraper in the world, it is by many means an incredible building that is a good example on how a building can create value to an area while being a singularity (archdaily, 2015).

"The Twisting Torso is one of those superb examples that went beyond the creation of a signature tower and helped shape an entirely new and invigorating urban fabric," Timothy Johnson, Vice Chairman, CTBUH board of Trustees and Partner, NBBJ.

The building in itself is made with thoughts to the environment and materials have therefore been chosen carefully to its task and recycled materials has been used when possible (inhabitat, 2011). Furthermore the building is completely powered by renewable energy produced off-site and has integrated monitors so residents are able to follow their energy and heat consumption to save energy end money, as well as having integrated a organic grinding system that convert waste into bio-energy (inhabitat, 2011).

The structure is inspired by the human body and has a concrete core that takes the main loads, supplied by the concrete spine which perimeter takes vertical loads and an exoskeleton which makes the building resistant to wind load (arcspace, 2005).

As a case study the Turning Torso is studied as an example on how the Nordic skyscraper looks like today, and in which degree it is possible to develop an area and to create the boundaries for a new lifestyle, a sustainable lifestyle. Furthermore the building is based on a modular system of 9 boxes that adapt to the movement and loads but still has a vertical that supply the building more efficient than many other lower buildings.

1

2

3

4

Hornbækhus

Architect: Kay Otto Fisker
Completed: 1923
Architectural style: Neoclassicism

5 levels, 290 apartments
Lenght: 200m Wide: 80m

The city block was the first Danish generalized residential building during the need for dwellings in the aftermath of World War 1. in the 1920's. The Hornbækhus city block is one of the best Danish examples, from this time, that defined and inspired a long tradition in Danish residential development (abhornbækhus, 2015).

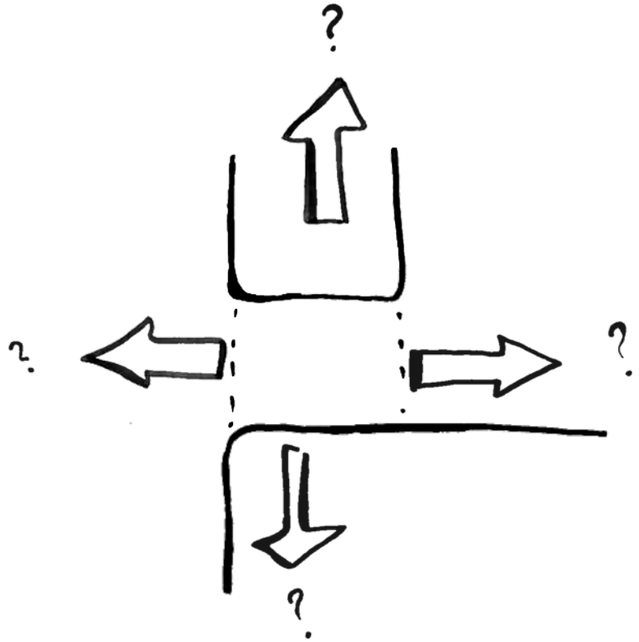
Hornbækhus was a project developed in collaboration with a landscape architect which resulted in the open and bright well planned courtyard that was placed in protection from the life on the streets (abhornbækhus, 2015).

The block in general was seen as responsible architecture due to economic, use of materials and rational expression, and was related to the suburbs and the situation around World war 1. where the first intense urbanization had a great influence.
Hornbækhus and the city block is studied due to its influence on the development of Danish residential buildings in relation to the city block becoming the dominant city structure today. It is also done to understand the time it was made and under what circumstances and how to approach buildings alike with greater understanding. Furthermore the case study is to enlighten the Danish tradition for generalized residential buildings.

Pic; 1-4; Hornbækhus

Epilogue

Site conclusion
Program
Initial room program
Vision
Reference list
Illustrations



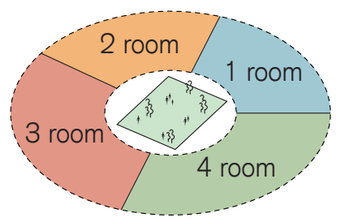
Site conclusion

With a limited footprint and three orientations locked, due to existing buildings and the cityscape, questions opens around the possible development of the site and how to approach a site with a small footprint while achieving high densities.

With respect to the existing context and horizontal functions the site would be able to take part in the courtyard based on the building being able to give something back to the local community. Even though the site is limited in the ground plane, the building has the possibility to develop freely when exceeding the present cityscape.

Ill; 1; The Nordic high-rise

Total units	%	m^2		Unit form
1 room	20	x		
2 room	20	x		
3 room	30	x		
4 room	30	x		
Public space	x	x		

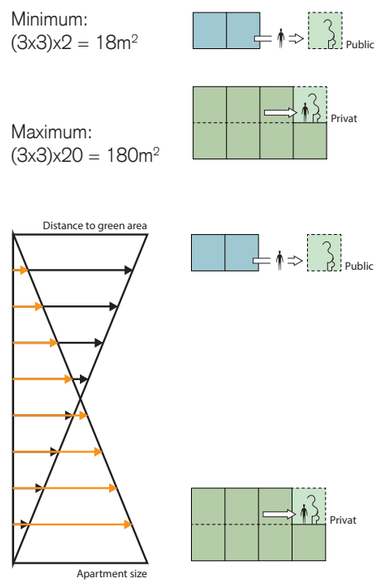


Program

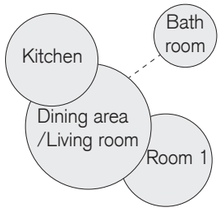
The building will be separated vertically into two overall parts; a lower level and a higher level. The lowest part of the building has to relate to the existing context and its functions where the top is to create its own environment as a vertical city.

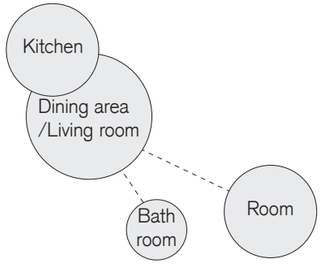
The site is already a part of the city generator by function and the lower level of the building therefore has to become an equal part of the city generator, and as a new element to its surroundings it has to enhance or create the opportunity to develop an area within the dense city. The program for the lower levels therefore has to accommodate for businesses, squares, paths or community functions where the higher level, on the other hand, has to create its own environment. The challenge for the program will be to create a user diversity where the preferences of each profile is met and support each other and create an awareness and connection to the local community on- and around the building. Furthermore it is important to integrate spaces for activities, recreational spaces and green gardens.

The program for a high-rise building should therefore face the issues of being a part of the existing city generator as well as creating its own vertical generator to ensure housing and lifestyle qualities.



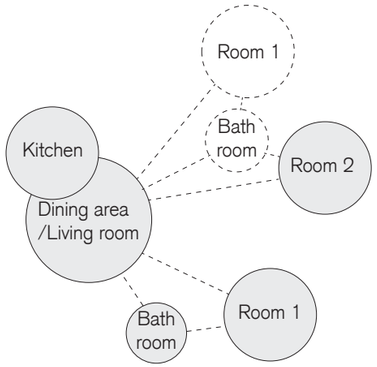
Ill; 1; Programming

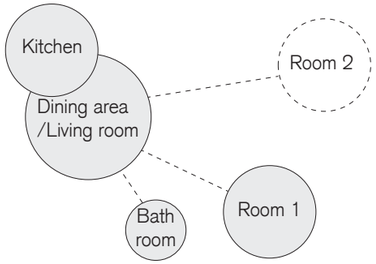




Ill; 1; Students

Ill; 2; Singles / couples



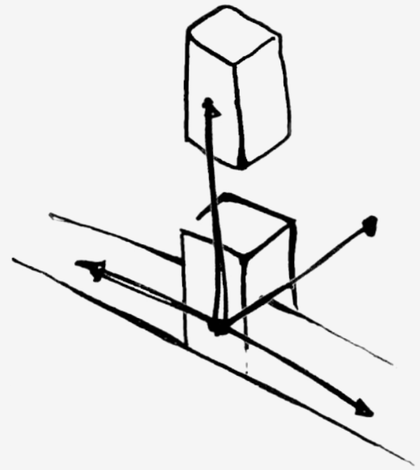


Pic; 3; Large families

Pic; 4; Diasbled

Initial Room program

The design has to accommodate for five different user profiles; students, singles, couples, families and disabled – five types with different preferences. Based on statistical data and empirical knowledge, several of the user profiles can be divided into subcategories or linked to other types and their choice of dwelling size, but the preference of each type's concluding apartment choice is inescapably linked to the present development of their lives and economical situation. Besides the preferable apartment choice each type have their own personal preferences according to space layout and context.



Vision

The high-rise is to create a connection between the horizontal- and vertical city by taking the fabric of the city into account. In addition it has to achieve a high social sustainable value, which integrates user diversity and recreational areas in height. The appearance of the high-rise is to create a relation to its surroundings and respect the context and society of Aalborg.

Ill; 1; Vision

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Illustrations

PRESENTATION

VOLUME II

N110
Frederik Stensgaard Diget & Peter Flaccus Poulsen
MA-Thesis 2016
May 2016

Abstract

The master thesis outlines a design proposal for integrating a high-rise in the dense city of Aalborg in Denmark. As a residential *high-rise* the aim is to facilitate the qualities of the horizontal city in the vertical and take part in the *city generator* and establish the boundaries for *future dwellings* within the city, integrating living qualities suitable for a *Nordic lifestyle*. The proposals *sustainable* approach seeks to integrate features that relates to the user as the primary source for a higher sustainable level within residential buildings.

Essentials

Title
N110
Volume II - Presentation

Theme
Sustainable Architecture

Authors
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Peter Flaccus Poulsen

Project module
MA-Thesis 2016

Project period
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Group
18

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Claus Kristensen
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Aalborg University, 2016
Department of Architecture, Design and Media Technology
Architecture & Design

Table of contents

Introduction

The master thesis is a sustainable architectural design proposal developed at the Department of Architecture and Design at Aalborg University. The proposal has been made in accordance with the study guide of M.Sc.04, and is created with an *Integrated Design Process*. The proposal represents our final architectural project that deal with the topic of integrating a high-rise in a dense Nordic city.

As the urbanization increases, the cities are continuously challenged and have to take into consideration how the future of the city will be. Furthermore it is of great importance to see the city not only as it is today, and to what demands it has today, but to look at the large perspective to design the city to be able to accommodate the needs in the nearest future. To create the frames for a healthy city and its citizens the development plan has to be carefully developed and the buildings sheltering the citizens has to create the frames for growth and health for many generations.

Urban sprawl is a tendency which affects cities all over the world and has in a development perspective negative influence on the city due to the result of situating people in a larger distance form their daily doings and the increasing footprint on the environment and its biodiversity (Ng, 2010). As a counter measure to *Urban sprawl* many larger cities has started to look at *Urban infill* as a strategy to utilize undeveloped sites or buildings to create new boundaries for growth.

Aalborg is a city in rapid development and has in the past years opened the discussion and opportunity about integrating the high-rise in the cityscape (TM, 2007). The primary cityscape of Aalborg exists of buildings between 4-6 stories and has a comparative homogenous appearance with city blocks made of bricks. The new buildings, rising at the harbor front, stands as a contrast to the city and its history by their iconic principle of individual projects relating more to individual landmarks than the city.

The proposal investigates the opportunity of integrating the high-rise as an *Urban infill* project in the dense city, and therefore has to both integrate the horizontal city as well as creating the vertical. The proposal deals with a small footprint and is situated as a part of an existing city block, which in the first six floors defines the enclosure.

Methodology

The overall methodological framework of the project is structured around Marie-Ann Knudstrup; The *Integrated Design Process* in Problem-based Learning (IDP), which represents an academic approach on how to address complex, holistic, sustainable architecture, where aesthetical and technical aspects are equally weighed and integrated (Knudstrup, 2004). The main technical focus will be based on sustainability through three main topics (Larsen, pp. 14), the secondary focus will be oriented on structural composition and materials. The *IDP* is the overall framework of the project and it consists of five non-linear phases: Problem-, analysis-, sketch-, synthesis and the presentation phase and their iterative interrelations (Knudstrup, 2004).

The problem phase
The problem phase takes a hermeneutic approach towards texts, documents, programs and the disciplinary field of architecture in order to establish a relevant contemporary issue and create the foundation of this master thesis. The problem is represented in the complication of the increasing urbanization that cities around the globe meet every year, and is sustained by articles, papers and first-hand experience. Furthermore this phase creates an initial stand on how the problem should be approached in the realm of sustainable architecture within a Nordic context.

The analysis phase
Following comes the analysis which sheds light upon the questions obtained in the previous stage regarding the subject, sustainability and also parameters such as context and relevant cases. It is characterized by both a hermeneutic and phenomenological approach towards domestic architecture, performance-based results, material characteristics and structure, and creates an understanding of how to initiate the sketching phase.

The sketching phase
Through the obtained knowledge from the previous phases the sketching phase seeks to incorporate the results with empirical rationale, by means of numerous iterations, to ensure informed design solutions. Various analogue and digital tools, such as hand-sketches, model making and building simulations are shaping the design by iterations within the sketching phase and as the design progresses it forces the process to leap backwards generating iterations with the previous phases. To ensure a better understanding of the spatial development, representation methods including plans, sections, perspectives and diagrams are conveying the essentials of the project. Therefore the sketching phase will be a phenomenological approach based on intuition and prior results that would create equilibrium between the technical and aesthetical aspects and establish a coherent concept from many possible solution**s.**

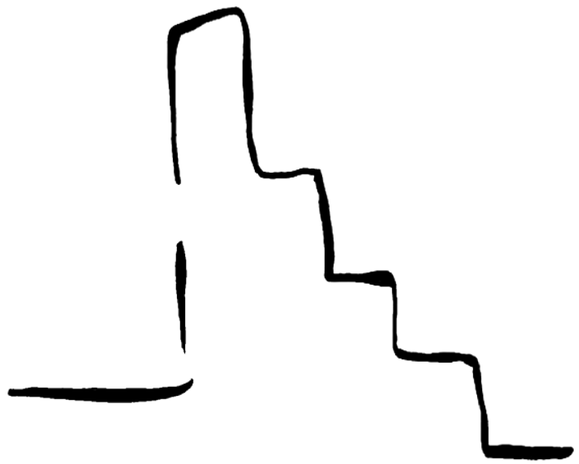
The synthesis phase
As the sketching phase, the synthesis is dominated by several iterations. Here the architectural and functional solutions are combined into the design that best covers the vision and intentions initially stated and further narrows down the possible solutions, closer to a complete design. Since the aesthetical and technical parameters often are representing each separate field, this phase requires and creates numerous iterations specifically to ensure that the project obtains integrated qualities and functions as holistic architecture.

The presentation phase
In this phase the final proposal is presented through the presentation methods that communicate the projects sustainable character in the best possible way and conveys a structured, informed process that answers the thesis.

Presentation

Concepts
Siteplan
Visualizations
Programming
Plans
Daylight
Section
Structural system
Details
Sustainability
Fireproctection & escape
Elevations

Ill.1. Night view over Aalborg



Concept for design

The concept is based on offsets that create a relation to the context by scaling and density, and emphasizes its relation to the context by respecting the sun path and letting sunlight pass through to nearby buildings and the courtyard. Additionally the offsets create roof terraces that accommodate the vertical need for recreational areas and underline the structural principle as the loads decreases in height.

Its appearance is based on form follows function as the façade indicates the structural system and interior experience as the apartments have been based on a grid system.

Concept for sustainability

The concept for sustainability has been based on the users' daily patterns and needs and the goal to reach the 2020 standard. The overall idea, which lies outside the demands for transmission loss and heat demand, is to integrate the user and focus on the economic benefits by awareness and to focus on daily functions.

Site plan

The traditional Nordic city block has in the last decades had a negative development where the qualities of the interior courtyards have been neglected with poor infill projects (HLA, 2013). N110 seeks not only to eliminate the negative development by establishing vertical *Urban infill* instead of compromising the cityscape but also favors high architectural quality with apartments that has panoramic views over the city. The municipality has long been having plans for developing the area with more apartments and parking and by leaving the backyard untouched and establishing underground parking the backyard has been transformed to a courtyard filled with recreation for the surrounding city block while keeping its original function. Even though its magnitude would suggest a compromise with the context the high-rise is gently down-scaling into an unused area and defining the recreational area and creating a relation to the existing city block.

Ill.1. Site plan

Ill.1. Top of the building

Silhouette

What seemed as a quiet jutlandic city has in the last decade gone from an industrialized city to a renowned international city both in education and the uprising of new architecture in old industrialized areas and along the waterfront, and the new iconic high-rise building on Holbergsgade is an excellent example on the city's will to increase its reputation. Its sleek and iconic posture is an addition to the rising Aalborg skyline and identity yet, measuring 110m, few existing Danish residential building matches its magnitude. While the building could rest on its 36 steories and 9 different unit credentials it expresses a strict elegance with its relation between its aesthetic form, function and contextual awareness.

Ill. 1. Vertical courtyard

Vertical courtyard

The horizontal living is rethought in the vertical semi-public courtyards established in the down-scaling of the form, where the building respectfully acknowledge the space occupied for erection and facilitates green spaces for the residents and underlining the green structures of the city.

The distance to recreational areas is now established at the very center of the residents' lives and can now enjoy the sunset's warm rays in sheltered conditions in their vertical courtyard. It is bringing the traditional suburban qualities into the heart of cities, undermining the high-rise stereotype as an introvert dominant structure and introducing elegance with a seamless convenience.

Ill. 1. Perspective over Aalborg

Cityscape

With the old industrialized areas cleansed of former identity, Hedegaard and Sygehus Nord stands as some of the only dominating buildings left from Aalborg's concrete era but the new high-rise on Holdbergsgade brings a renaissance to the language in a new translation. While the building may stand as a dimensional contrast to its existing neighborhood, it brings a refreshing change of pace as a new addition to the Aalborg skyline and perception of the traditional Nordic city. In the city space the building gently respects the existing boundaries but exceeds the traditional city vertically, becoming an exposed landmark for the old industrial city in contrast to the development areas along the harbor. From the apartments the curves of the fjord can be followed far along the plane countryside and on the vertical courtyard and terraces one can watch the sun go down in the horizon and the traditional city below.

Ill.1. Arrival

Arrival

While accepting its singularity the building respects the existing boundaries of the cityscape strictly continuing the present facade lines so that one barely notices its magnitude. On a gentle way the structural columns touches the ground, facilitating its solidity while the ground floor raises double-height, greeting the passers and residents and opening up the building. The integrated semi-public functions and workshop area, where the individual can fix their broken furniture or wash their bike, is a fresh contribution, in eye-height, to a district which has become an area that lies in slumber most part of the day.

Ill.1. Entrance

Ill.1. Kitchen

Entrance

The expression of the building would seem to be pure and pragmatic but entering the apartments the intentions of the relation between expression and experience becomes unveiled at first sight when met by an incredible framed view over the city. The journey to the apartment, by the private elevator, and the amazing view instantly underlines the exquisiteness in the detailing and elaborate spatial journey throughout the apartment. Coming home from a busy day at work or arriving as a visitor, the unparalleled view over the city is an exquisite detail which puts the city in perspective and highlights the quality of vertical living.

Kitchen-dining room

The kitchen has become a large part of the everyday life, and along with the growing trend in fitness and wellbeing, the kitchen has become a place for bodily worship and a workspace for complex recipes. In combination with the living room the kitchen seeks to combine the qualities of architectural details and contemporary living as a workspace but also a place for conversation. The hardwood flooring is creating a pleasant atmosphere while facilitating the base for optimum working environment during longer periods. When cooking one could easily reach for fresh herbs or vegetables grown in the private greenhouse in the window alcoves or plant a combination of flowers to enhance the room character. All these details are a contribution that underlines the fact that horizontal living can be translated vertically.

Ill.1. Livingroom

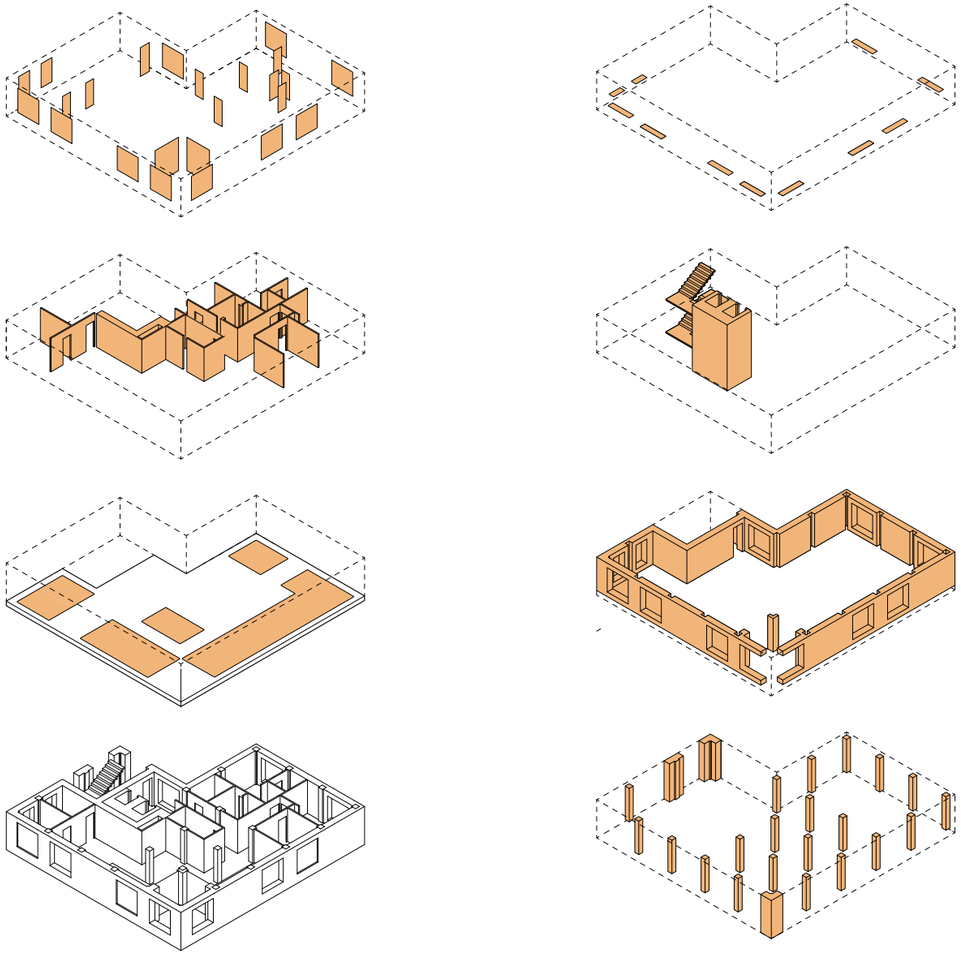
Ill.1. Bathroom

Living room

The often limited view, when living in the city space, is completely removed because of its height and further enhanced by the 2,1m x 2,1m windows framing different breathtaking views of the city. Along with the remarkable windows the extra room height makes the floating room seem even more spacious and lets in light in the deepest corners of the apartments and illuminates the details in the floor and ceiling. Besides the elaborate relation between exterior and interior the living quarters has been united to one single free flowing room where the functions come together and the residents can take pleasure in each other inseparable. The bold interior is only divided by the structural columns and sections of hardwood floor which has a duality in its aesthetical warm, Scandinavian appearance and the practicality of the individual workspaces. The living room is a culmination of elaborate, contemporary design mixed with an elegant practicality where the residents can rejoice in all its qualities and become the center of their lives.

Bathroom

Even though the building expresses elegance in uniformity and strictness, the building favors details as highly as function and highlights the function of each room with details. Residents in the top quarter of the building have the luxury of an unspoiled view over the city of Aalborg, in their 2,8m bathtub which is molded from the massive wall into an exquisite concrete detail. In the morning the residents can prepare themselves for the coming active day with a perfect city view and the morning sun shaping the textures of the minimalistic room while taking a shower, or rejoicing over the beginning of a weekend with relaxation by having a cup of coffee in the bathtub. On the other hand the bathroom is also designed for being a room for retreat and wellness, where the polished concrete is only lit up by the night lights from the city and candles lit for intimacy.



III.1. Materiality layers

III. 1-12; Materiality and detailing

Materiality

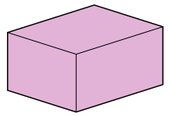
Composition, details and materials in a combination are the framework for the experience and atmosphere of the building as a whole and within. It creates the boundaries for a home that the inhabitants can relate to and by its simplicity personalize after needs, without compromising the essential of the design.

The design creates an awareness of the structural system and by the use of solid materials a sense of safety supports the comfort level. The exposed structural system has been of great importance to create an honest building and by the use of concrete it both relate to the Northern mentality and the history of Aalborg.

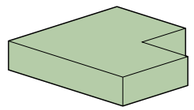
The solid materials improve the indoor climate due to heat accumulation, which support and stabilizes indoor temperature to counteract excessive heat and the demand for heating in late hours.

Concrete and timber are the two primary materials used as simple and honest elements that with their tactility and identity creates a spatiality that helps zoning each apartment. Concrete function as the strong and solid element with a semi-polished surface and integrated heating are the primary floor material. Timber is used for zoning by function as the softer more comfortable element and is therefore used for workstations.

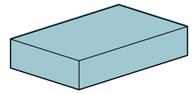
A great deal has been put on the simple elements and their function so that the materials and details support the experience of the room and the view that comes with the high-rise. The details are simple and support the functions of each element to create larger sense of home – the windowsill has a thickness that comes with a need for insulation and a strong construction. The thickness creates the opportunity to create an experience of *Interiority* as seats, greeneries and an integrated bath.



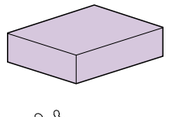
A210$_2$
210m^2
Large family



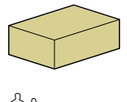
A200$_2$
200m^2
Large family



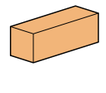
A140$_2$
140m^2
Medium family



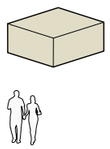
A110
110m^2
Small family



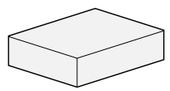
A66
66m^2
Couple



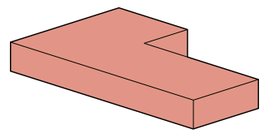
A26
26m^2
Single/ Student



T52
52m^2
Student/ Couple

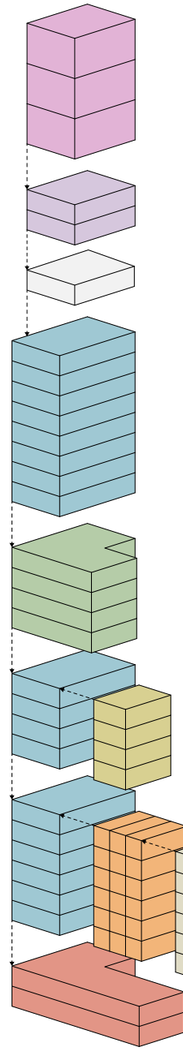


T110
110m^2
Cenference

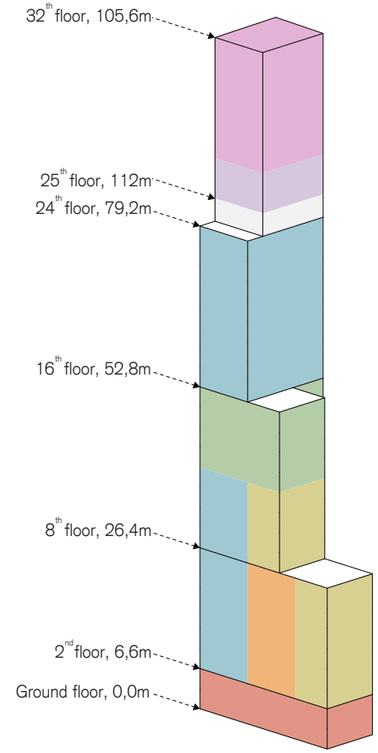


T330
330m^2
Public/ Service

III.1. Apartment types



III.1. Programming



III.2. Vertical programming

Programming

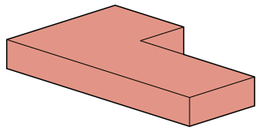
The program is designed to accommodate the needs serving the horizontal city as well as creating the boundaries for the vertical city to flourish. The building is separated into four primary parts of eight-nine floors.

The first part is programmed to relate to the horizontal city by scale and function. The two lowest floors are programmed with public and private services and the top six floors are apartments that relates to all user groups, with a main part for students. A52 and A26 is both placed near the horizontal city since they are within a user spectrum that uses the city most.

The second part has been programmed with a larger diversity in families, which has space for both large and small families. The small family apartments has little or no outdoor space, but is close to the largest vertical courtyard that can be shared by all users.
The third and second highest part has only one apartment typology A140 and servers as a more exclusive apartment since it is raised over the city and has an extraordinary view. A140 has private terraces but is also close to the semi-public recreational areas.

The fourth and highest part of the building is programmed with a conference room connected to an exterior terrace and penthouse apartments within two sizes to accommodate the need for high and medium demand for area.

The program is a interpretation of the horisontal city to create the boundaries for the Nordic high-rise.



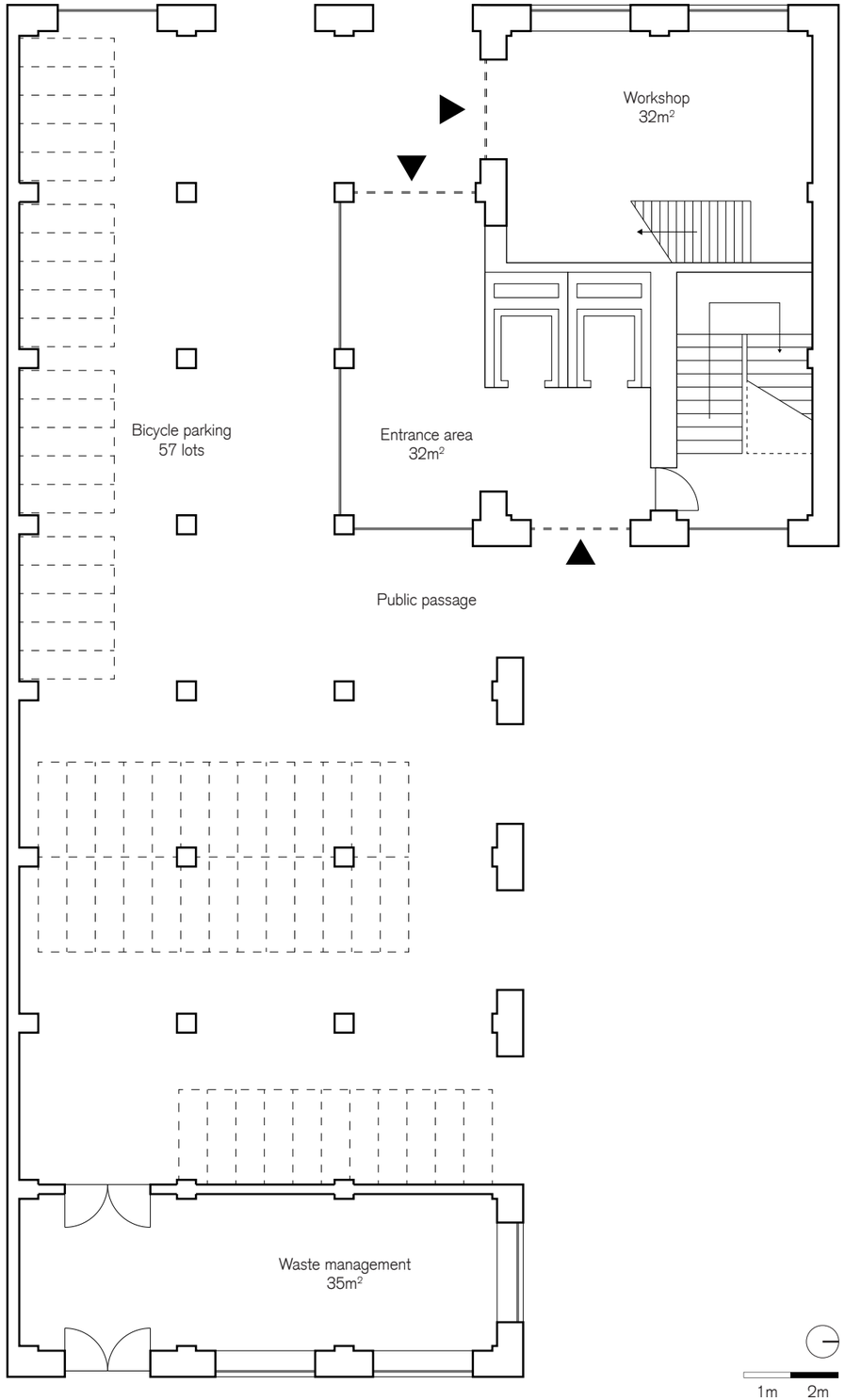
Ground floor

The ground floor welcomes the residents and the citizen of Aalborg by an integration of both public and private services.

The vertical movement functions as a focal point in the plan as it is the most valued function due to its high activity, transporting people to and from the apartments as well as serving the business at the 1st floor and the conference at 24th floor.

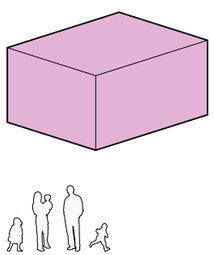
In relation to the vertical core a workshop area has been integrated that both serves the public and the residents. The workshop is designed in two plans where the plan at the ground floor is accessibly for the public, and function as a workstation where it will be possible to clean and repair bikes. The 1st floor serves only the residents as a minor workshop area the can be used for furniture and smaller objects.
The workshop also works as a vertical connection between the basement, ground floor and the 1st floor to allow access to storage rooms.

The ground floor has been designed to meet the city as an open space and the entrance area has therefore been made open and double high. The main part of the ground floor serves bicycle parking and waste management.



III.1. Ground floor

III.1. Ground floor



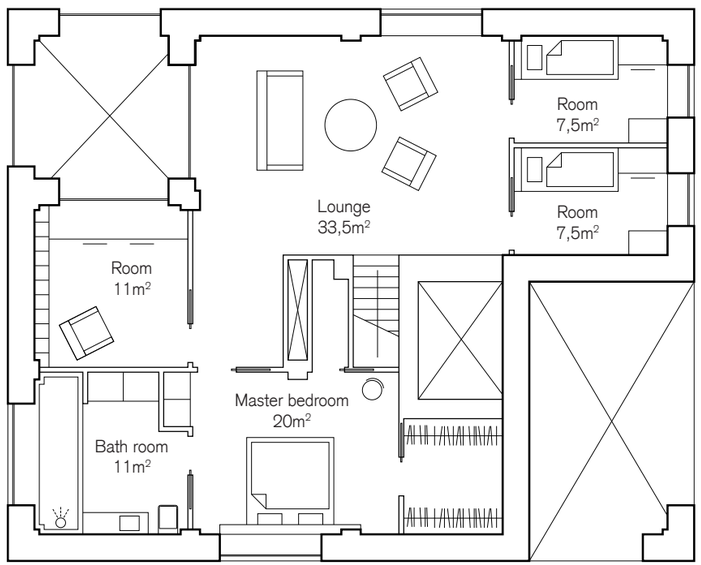
A210

The two-story, 210 square meter apartment is situated at the top fourth of the building, and is defined as the penthouse apartment. The A210 is a duplex apartment that creates a flow between daily functions and the experience and exclusiveness of living above 75 meters, which gives majestic experience from the very step into the apartment. When one takes the step into the apartment it will be directly into the entrance that is designed to have a view directly to Aalborg city and the fjord.
A210 is designed with an open and welcoming 1st floor with a minimum of doors and closed areas to bind functions and the daily life together. Due to a new Nordic lifestyle that has to take into consideration the high-paced lifestyle where family quality time often happens in the free time between other activities.
The kitchen is placed close to the dining table and the two terraces, and has a direct access to a little kitchen garden that is combined with the little terrace. The dining-area is separated from the living room and the lounge by a spatial separation created by the structural system of the columns, the core and shifting materiality.
The living room is orientated to the west with a view over the fjord and the sunset. The room is separated by a freestanding wall giving the room two functions of a traditional living room and a more enclosed area that is open to its surroundings and the nature that creates an awareness and contemplation.

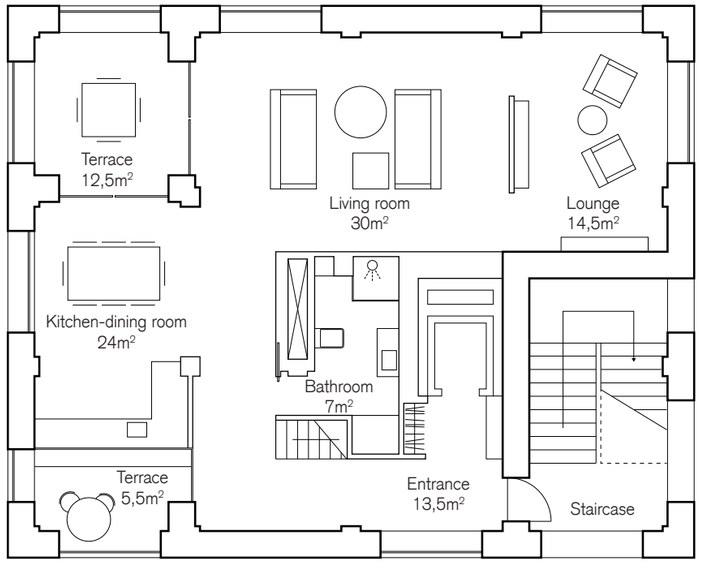
A210 has two terraces at the 1st floor, one is orientated against the sunrise and the early hours of the day and is with direct relation to the kitchen, and the other related to the afternoon and evening hours which is the largest terrace made for dinging and sun chairs.

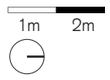
The access to the 2nd floor is located in the core, around the 1st floor toilet and bath and uses the space left free from the reduced amount of elevators. The floor is entered in an open second living room that binds home office and bedrooms together. There are two smaller bedrooms and a master bedroom that has an integrated walk-in closet and the master bathroom that has a bath, which is integrated in the windowsill with a view over Aalborg.

III.1. Apartment: A210

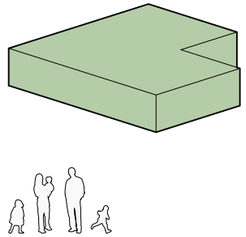


III.1. A210 2nd floor plan





III.2. A210 1st floor plan



A200

With 200 square meters the apartment represents the needs of a large family. The apartment is in one plan and is orientated around the kitchen that serves as the heart of the apartment connecting the dining room with the living room.

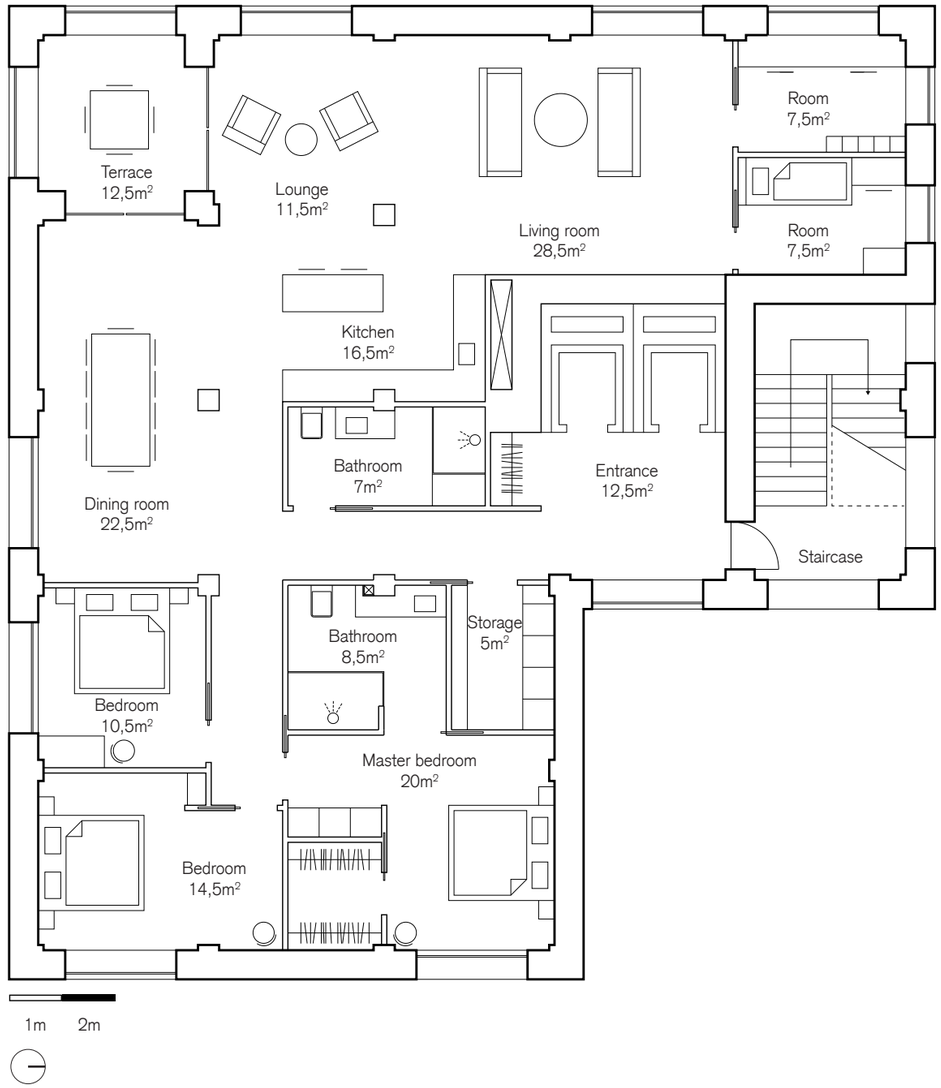
The apartment can be accessed by two elevators and one staircase, which all has direct access to the entrance that has a window that gives a view and allowing light to enter the space. The entrance has an integrated wardrobe and the apartments' storage room is placed close to this area.

A hallway will guide one pass the small toilet and bath and into the dining area that is directly connected to the kitchen, living room, lounge and the terrace. Each function is related to the structural system that creates a grid and a spatial experience and diversity to each zone. The awareness and division of each zone is further enhanced by the shifting materiality in the flooring.

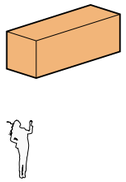
The large area creates a connection between the primary functions of the home and allows the family to attend different doings while still being presence as a family.

To each side of the primary room the secondary functions as the master bedroom, bedrooms, guest room and a home office are situated. The master bedroom is the largest room and has associated bathroom and walk-in closet. The rooms are based on the structural system and how it allows openings in the envelope as well as the technical necessities to toilets and kitchen. All partition walls are a light construction and it would therefore be possible to refurbish the plan layout according to future needs.

III.1. Apartment: A200



III.2. Vertical programming



A26

With a limited area of 26 square meters the A26 is the absolute smallest apartment. The apartment has been designed to use every square meter to its full potential. In front of each apartment is a semi-private gallery that gives each apartment a setback. When entering the apartment the plan has been designed with a minimum entrance area that is partly separated from the kitchen. The apartment is in one plan with no room separation as the toilet core functions as a spatial separation.

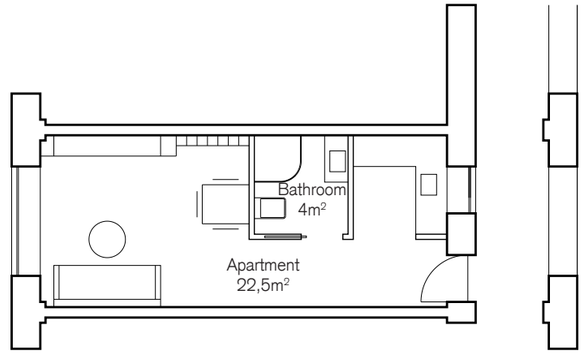
The kitchen is designed with five elements and has been limited to a free space of 1,2m, but has an opening to the gallery to create a larger openness and give better daylight conditions.

The living room is a multi-functional room that both serves as dining room, lounge, bedroom and home office. The room is designed with foldable display functions, which allows the space to change function depending on use.

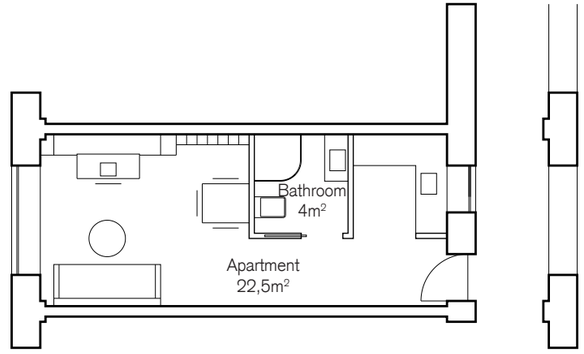
To use the boundaries to its full potential the windowsill also has been designed to function as an extra couch or reading place.

The three plans show the different display solutions.

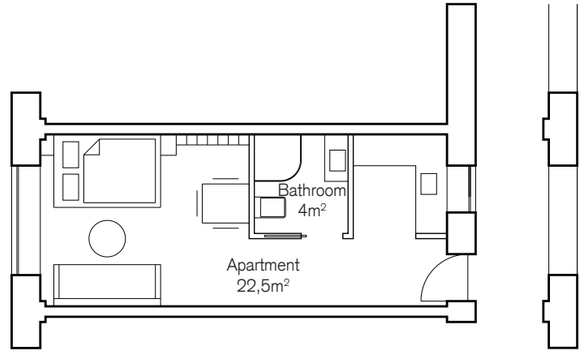
Ill.1. Apartment: A26

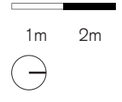


Ill.1. Foldable display 1

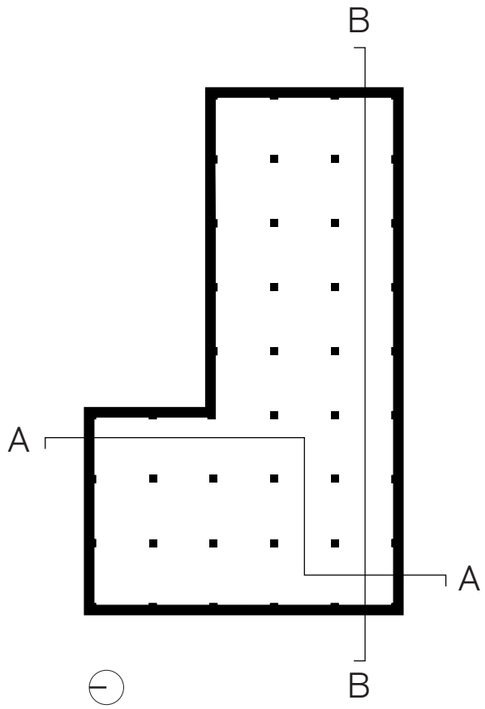


Ill.2. Foldable display 2





Ill.3. Foldable display 3

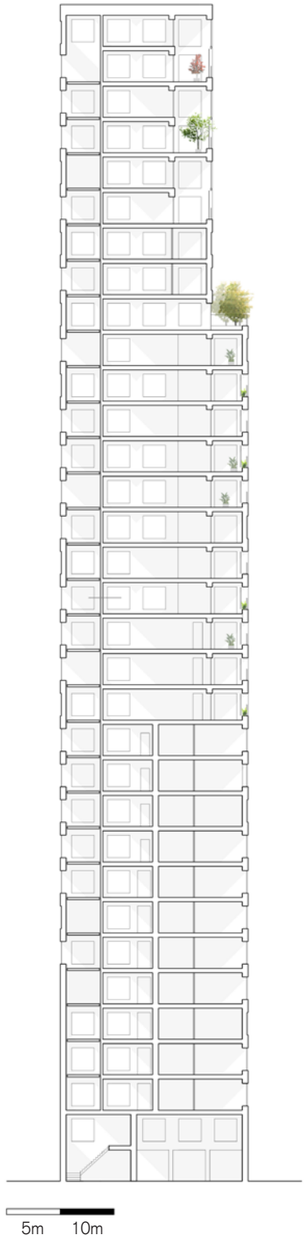


III.1. Section indicator

Sections

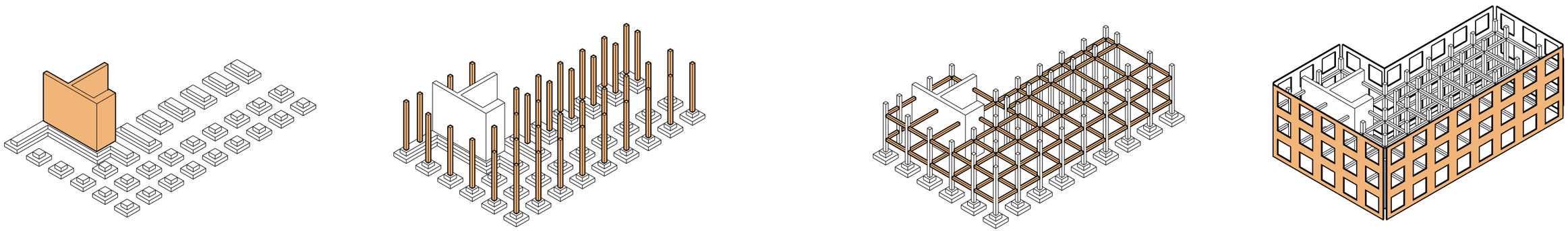
Section A-A highlights the placement of the vertical movement, its relation to the apartments and the journey it creates by its exposure in the façade. Furthermore it highlights the apartment's relation to their private terraces and the spatial experience of the entrance and workshop.

Section B-B expresses the complexity in the combination of the different apartment types and how the building scales down towards the cityscape and facilitates semi-public and private sheltered places for recreation.



III.1. Section A-A

III.2. Section B-B



Structural system

The high-rise is a complex and difficult building to construct due to extreme vertical and horizontal loads and to a high safety classification as the building has a large impact on people and surroundings if it should collapse.

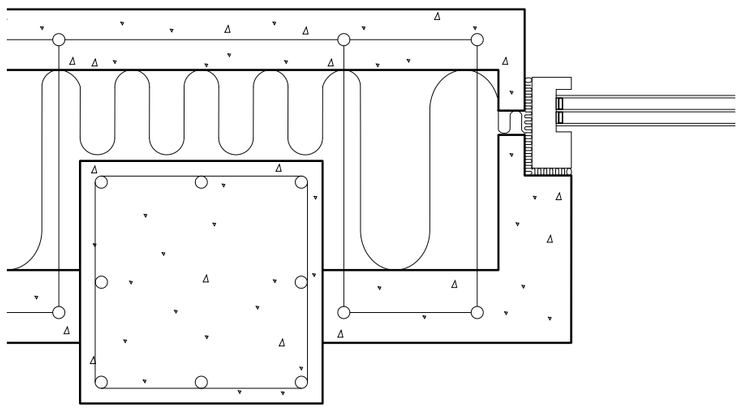
The structural principle is of great importance in a high-rise. If the structure is designed according to the function and needs it is possible to save expensive square meters and create the boundaries for plans that collaborate with the structure.

The structural system does not only work as the frames for the loads but also as an element that creates the appearance of the building and the frames for the spatial experience and indoor environment in each apartment.

Related to sustainability the structural system has been designed to use as little material as possible by the combination of concrete and steel. The combination of concrete and steel uses the best properties from both materials to create a building that is both resistant to vertical and horizontal loads and still works as a flexible building to avoid splits and collapse.

The structural system is based on a four-step construction principle that uses columns and beams and is called the *Super Structure*, which has been used for high-rise construction since the 1800s when steel construction was developed (Science, 2016). As an improvement to the *Super Structure* there has been integrated a bearing core and the construction decks has been created as a composite floor to stiffen the whole construction.

Ill. 1. Shows the construction principle as steps, but would be constructed and elevated in situ. From the left to the right is first added the foundation as a grillage construction where after the vertical movement is placed and the vertical core constructed. The third step is the construction of the columns, then the beams and final the façade.



External concrete layer,100mm

Energy/ solar window
U-value; 0,7W/m^2 *k

Insulation, 40mm

Window joint, 12mm

Insulation, 330mm

Reinforcement

Internal concrete layer
120mm

Concrete column, reinforced
400x400mm

External wall 1:10

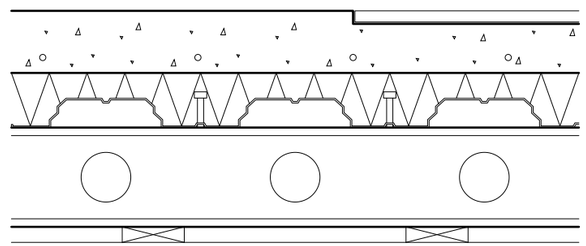
The detail of the meeting between the column and the external wall has been designed to create a spatial separation between the grid and functions of each plan by a displacement of 100mm. The displacement also creates an extra gap between the external concrete wall where insulation has been placed to avoid a thermal bridge.

The window is designed as an integrated part of the external wall and has been placed nearest the exterior to create an opportunity to use the windowsill as furniture.

The outer and inner concrete wall is reinforced and connected to the column to help stiffen the construction.

The total dimension of the wall is 550mm with the column and has a u-value at 0,12W/m^2K.

Ill.1. Detail: External wall



Timber floor w. foam mat 20mm

Concrete floor w. heating, 100mm

Rigid insulation, 88mm

Corrugated sheet

HE..B profile
160x160mm

Spacer, 25x100mm

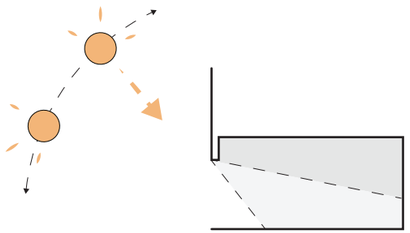
Plasterboard, 12,5mm

Composite Floor 1:10

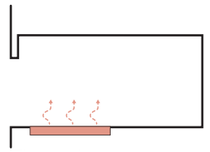
The floor construction is based on a perforated HE..B profile with a overlaying corrugated metal sheet. The floor construction function as an element that helps stiffen the building. On top of the corrugated sheet is rigid insulation and on top of that concrete with integrated heating.

The ceiling is created with an integrated cooling system and a simple finish with plasterboard.

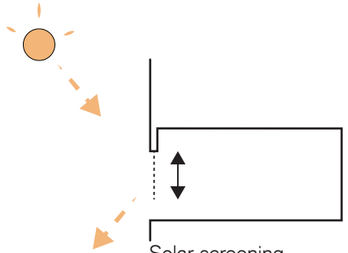
Ill.2. Detail: Composite floor



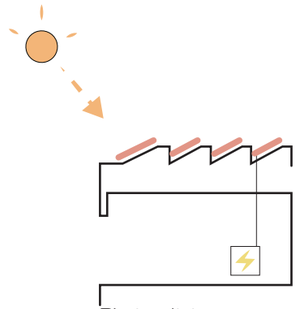
Sun path and angle



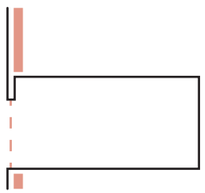
Thermal mass



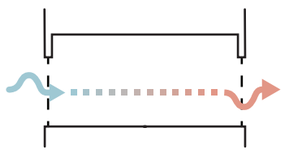
Solar screening



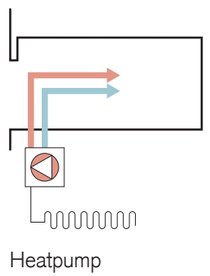
Photovoltaic



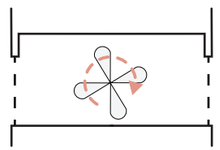
Insulation



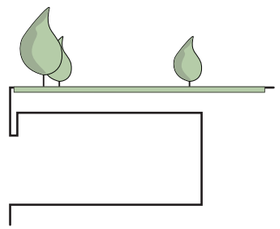
Natural ventilation



Heatpump



Mechanical ventilation



Biodiversity/
Recreational areas

Sustainability

Sustainability has been approached from a users perspective, but focuses on three main topics; Environmental, Economic and Social. The user is the primary focus due to the conviction of the user as the main resource to create a sustainable environment. The strategy will be based on information that relates to the apartment units economical situation, but the building as a whole has been designed with integrated passive and active strategies from start to end.

Building
As the building is situated at a narrow site in the dense city some features has been difficult to change or use to its full potential. The design has been made with thoughts to the context and features that follow the idea of a vertical city.

By the use of offsets it has been possible to optimize the sun- and daylight conditions for the context and courtyard as it has been designed according to the sun path to let light through. The offsets also opens the opportunity to create recreational areas within the vertical city to serve the residents situated higher than eight floors, and creates a dynamic appearance with integrated green areas as well as enhancing the building as an elegant and light structure as it narrows down as it increases.

As the building narrows down the amount of apartments also decreases which allows the removal of one of the elevators at the two top parts of the building. This result in fever expenses and material usage for elevators, electricity for use and more m^2.

The structural system has been designed and dimensioned to reach as little as possible material use and there have been used materials with a long lifetime and that easily can be reused.

The building has integrated rain- and grey water that will support watering of green areas and the water used for toilets.
The primary heating system is based on geothermal heating pumps that will be integrated in the courtyard and as vertical pipes into the earth if necessary.

Apartments
The plan has been designed to optimize the indoor environment as it takes into account the sun path and the sun position in different seasons. The floor height has been increased to improve the daylight conditions and to create better air conditions.

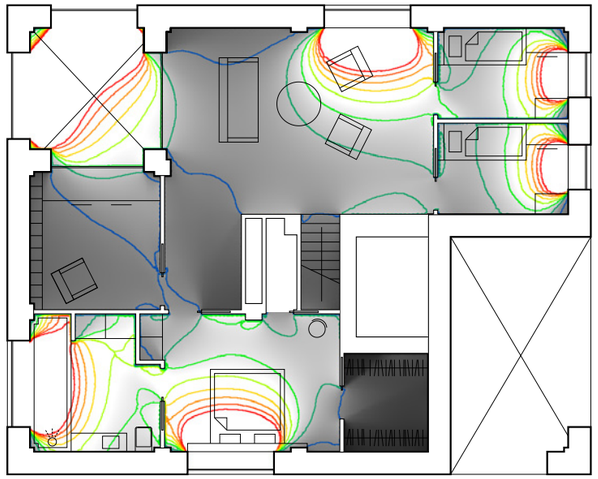
All apartments have integrated decentralized ventilation systems with effective heat recovery, but rely on a hybrid strategy to use both natural and mechanical ventilation. Due to the height of the building all ventilation system has to be controlled mechanical to handle excessive wind conditions.

To avoid excessive heating in the apartments the glass of the windows has been chosen in relation to the g- and f-value to let the desired daylight and heat into the apartment. This is not enough to avoid the excessive heating and there has therefore been integrated solar shading between the sheets of glass in the windows.

To take advantage of biomass, all apartments is connected to a biomass system that gathers food waste and excrement's from the toilets to create energy.

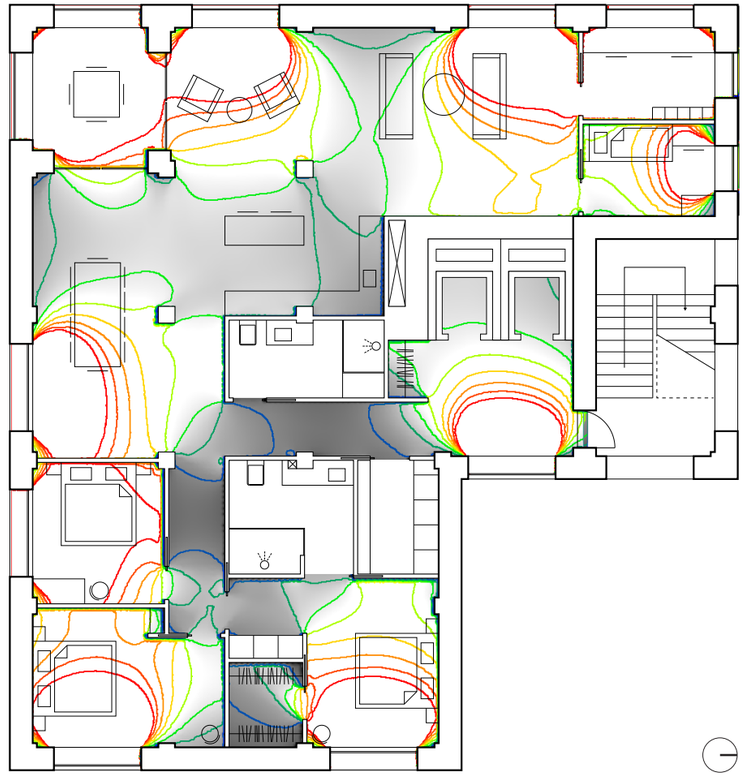
All features related to the apartments can be controlled by a monitor in each apartment to which the residents will be able to see where and how much energy they are using, as well as the financial consequence is. In that way it will be up to the user to improve the system to save money on a short and long perspective, which in the end will result in a building that uses less energy.

III.1. Sustainability diagrams

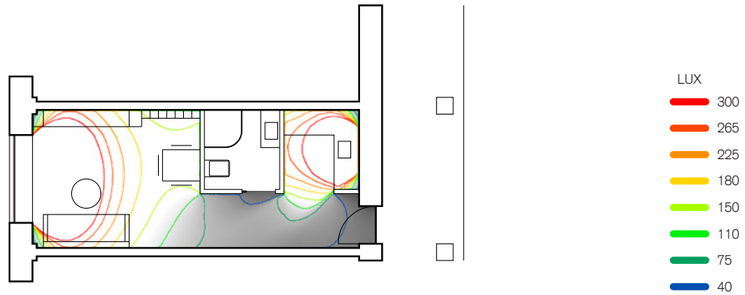


Ill.1. Daylight simulation A210 2nd floor

Ill.2. Daylight simulation A210 1st floor



Ill.1. Daylight simulation A200



Ill.2. Daylight simulation A26

Performance

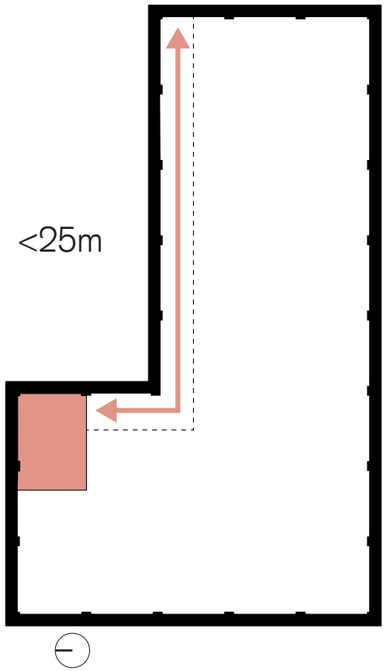
The building performance has been important to create an environment and a building that suit todays and to-be requirements. The importance of a well performing building and apartments doesn't direct relate to the need of reaching requirements, but has been used as a design element to ensure a indoor environment that support the design and experience.

The building does reach the requirements for 2020 and the indoor environment perform satisfying. The indoor environment is based on integrated decentral ventilation system, heating- and cooling system and integrated sun screening in the windows that all can be controlled by the user.

As a result to combination of the integration of all parameters resulted in the sizing and dimensioning of the building as it stand.

The final simulations can be found in appendix; Be15, BSim, Daylight, ventilation and Construction.

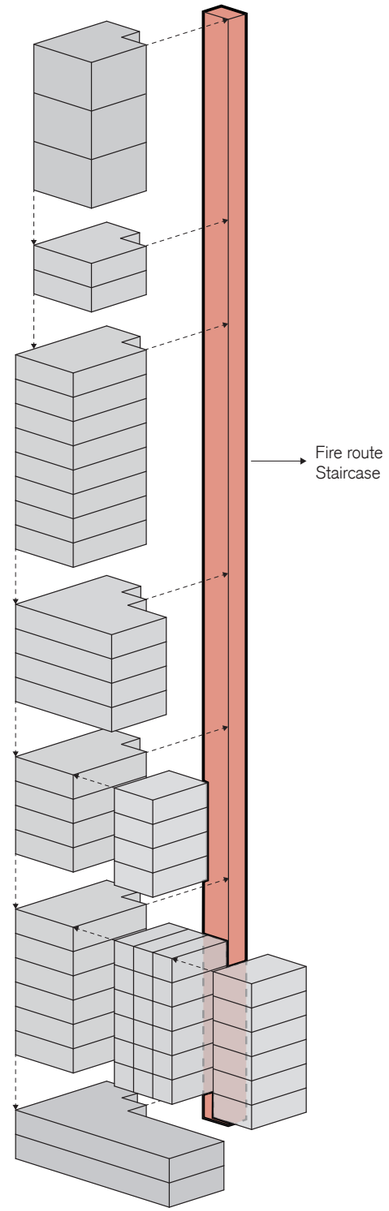
As a result of the openness and organization of the plans the daylight simulations turn out as satisfying results. The gradient gives an indication of dark and bright areas where it is possible to see how closed areas in the external wall creates darker areas within the plan where they are needed.



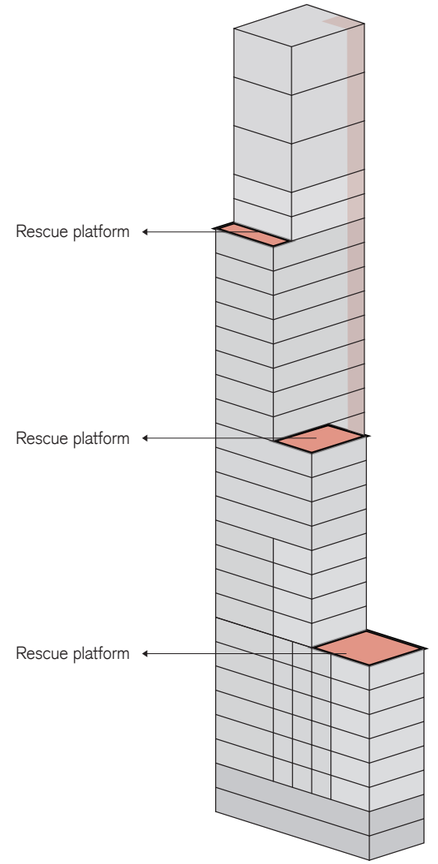
Fireprotection and escape

To sustain satisfactory conditions during an emergency the building has been designed to fulfill the requirements for usage category 4 for residential purposes (TB, 2015). The staircase is established as an unheated, naturally ventilated space to ensure that eventual smoke can be ventilated from the space and secure a fast descend to the open. In some cases the descend can be prevented, then the residents can either seek refuge in their apartment which functions as a fire cell or seek towards one of the courtyards which functions as a rescue platform. To further increase the residents safety the fire safety installations counts, smoke alarms, hose reels and an improved fire proofing of the steel construction to avoid that the members elongate. Furthermore the choice of decentralized ventilation units supports the fire proofing strategy when preventing spread of smoke and toxins via connected air ducts.

Ill.1. Escape route



Ill.1. Vertical escape route



Ill.2. Rescue platforms

Ill.1. West elevation

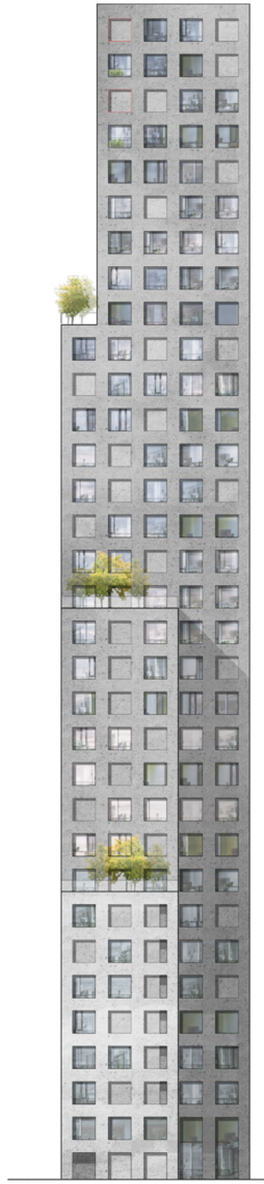
West

The West elevation shows the synergy in the building, how the structural system functions and the varying window grid. The bottom and top has a different expression through double grid elements where the bottom supports the horizontal movement and the top enhances the verticality.

Ill.2. North elevation

North

The north elevation scales down the façade by the use of two window types supported by a functional and aesthetic purpose and reveals the staircase as an integrated element in the facade.



Ill.1. East elevation

East

The east elevation shows the buildings slender form and strict facade and how dynamism is created by closing some of the façade openings while avoiding overheating.

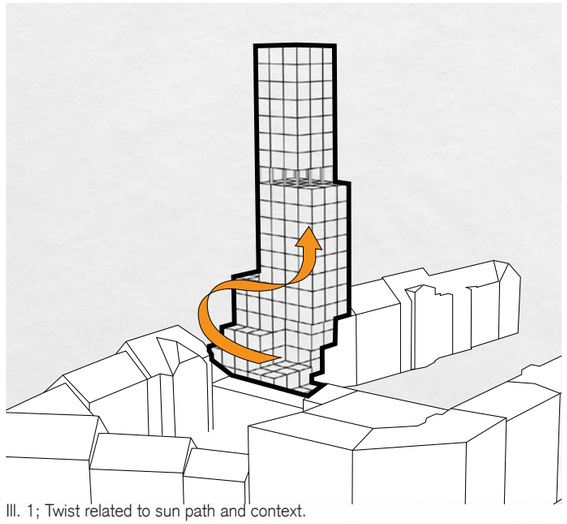
Ill.2. South elevation

South

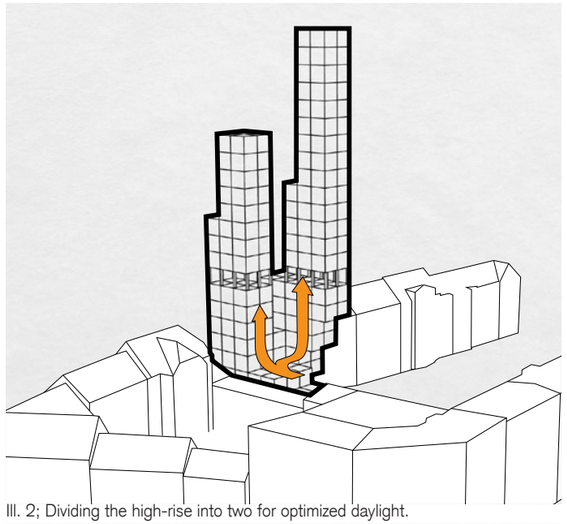
The south elevation shows the relation between the apartments and their private terraces and the downscaling of the overall shape where the vertical courtyards are located.

Design Process

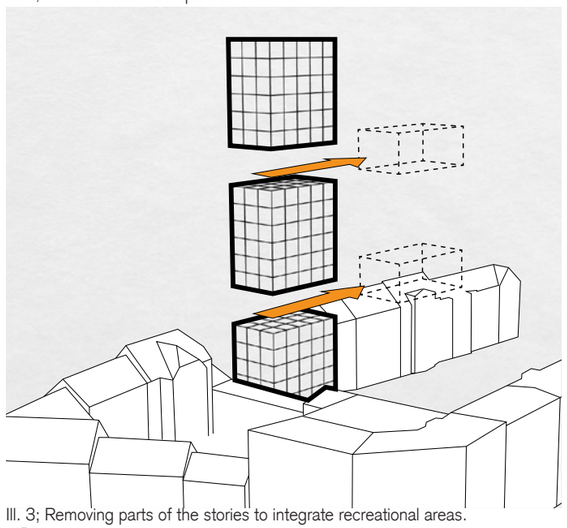
Concept
Form
Vertical
Structural system
Facade
Apartments
Materiality
Daylight
Technical aspects
Be15



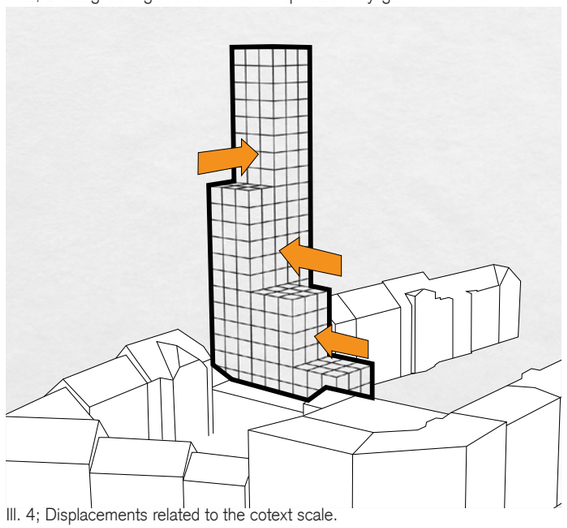
Ill. 1; Twist related to sun path and context.



Ill. 2; Dividing the high-rise into two for optimized daylight.



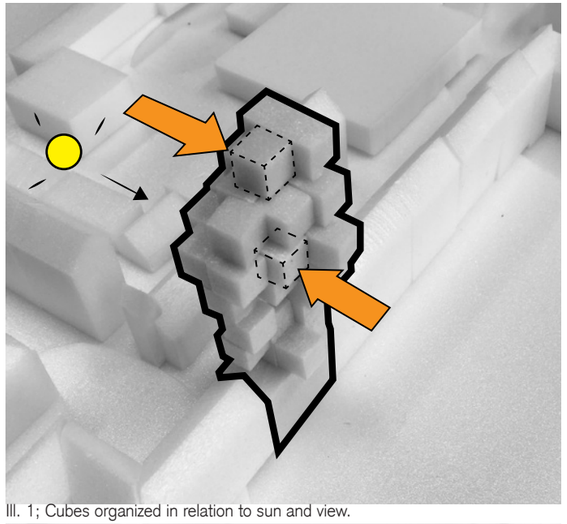
Ill. 3; Removing parts of the stories to integrate recreational areas.



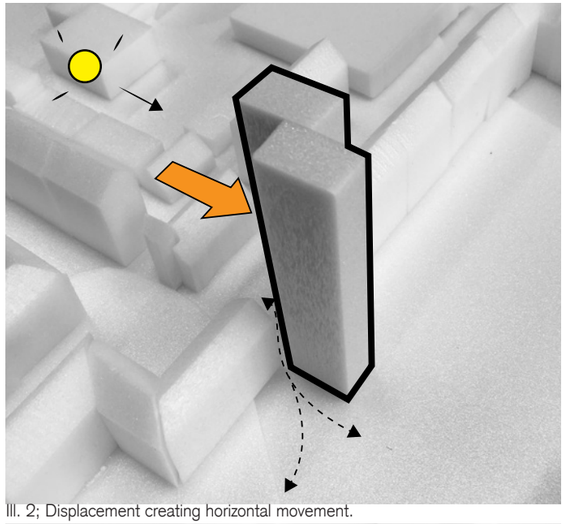
Ill. 4; Displacements related to the cotext scale.

Concept

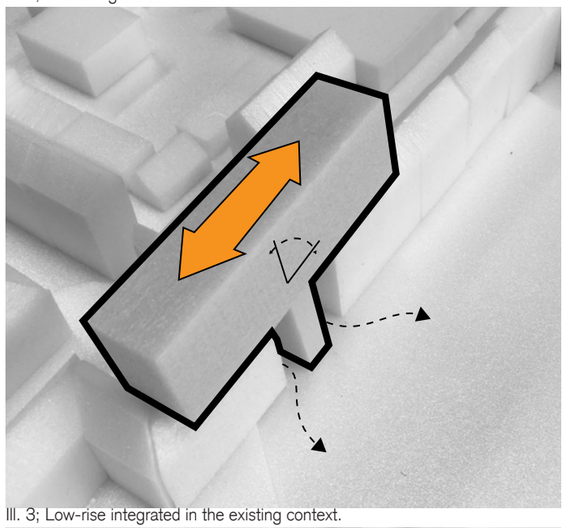
Studies of the concepts derived from a Nordic approach, which focused on climate, the city and thoughts of a high-rise as a humble structure that by its simplicity, diversity or relief should create the boundaries for development and growth.
The studies investigated opportunities of how a high building would be able to be integrated in the city block and the dense city. A focal point and a point of departure were to relate to the horizontal city and to create the vertical city.
Concepts concerning the horizontal city focused on scale, flow and the sun path. Where as the vertical concepts studied the ideas of having a vertical city and what means was necessary.
As the concepts developed and floor plans were tested it came clear that by creating a high-rise on a small footprint the shape, structure and the vertical movement would be crucial to the final result of the high-rise as a whole.
Concepts therefore also studied the opportunity to create a give-and-take relationship with the courtyard by allowing part of the footprint to take a part of the shared space if it in return gave something back to the community.
As the project developed and the idea of a high-rise began to take shape it was clear how a high structure would influence the surroundings not only in the nearest context, but also in all off Aalborg. The building would stand as a landmark and represent the entrance to North Jutland, and the project therefore begun to have another importance, where simplicity and humility became important to represent the citizen's personality and strength.



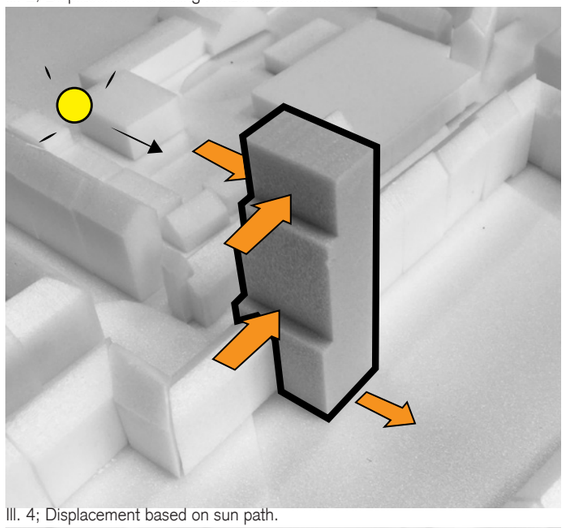
Ill. 1; Cubes organized in relation to sun and view.



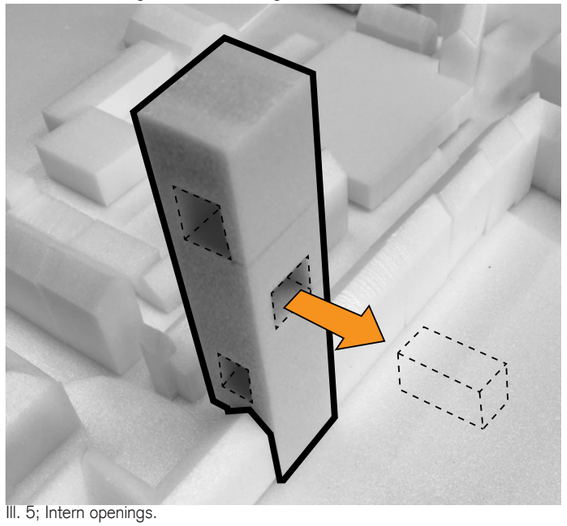
Ill. 2; Displacement creating horizontal movement.



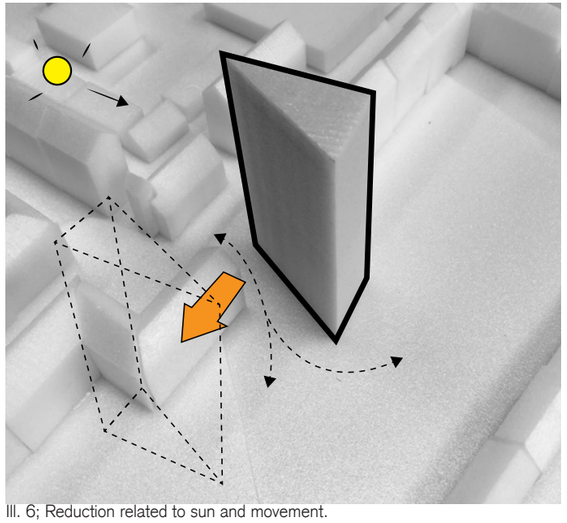
Ill. 3; Low-rise integrated in the existing context.



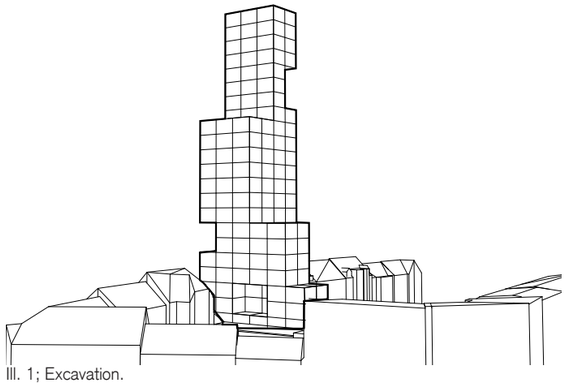
Ill. 4; Displacement based on sun path.



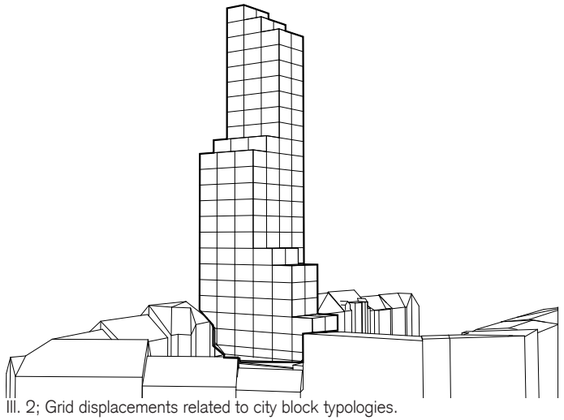
Ill. 5; Intern openings.



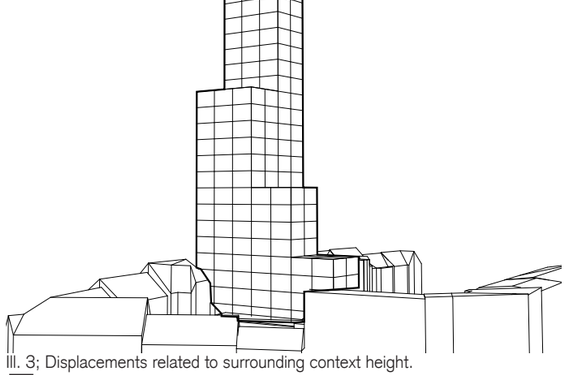
Ill. 6; Reduction related to sun and movement.



Ill. 1; Excavation.



Ill. 2; Grid displacements related to city block typologies.



Ill. 3; Displacements related to surrounding context height.

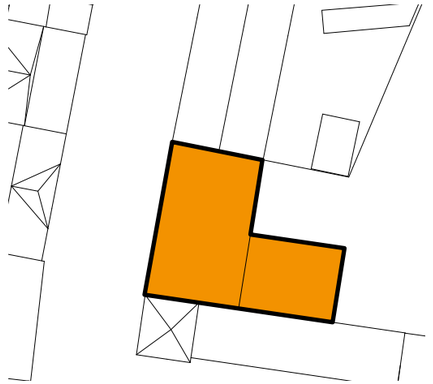
Ill. 4; Recreational stories.

Form

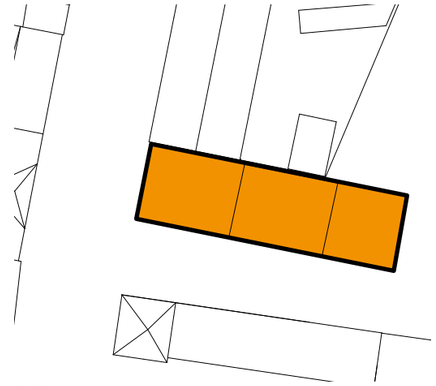
The investigations on how to develop the general concept was directed by increasing the qualities of living both for the inhabitants in the building but also for the surrounding context by a search for a suitable down-scaling without compromising the general form concept. Besides the general form the process sought to establish outdoor areas, both in form of semi-public roof gardens and also in the form of private terraces or cantilevered spaces.

The strict form concept should be highlighted through iterations of the up-scaling and outdoors areas while seeking to gesture the surrounding context by investigations on the infliction of the buildings height and mass.

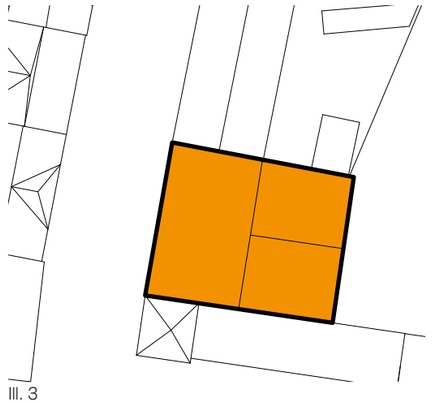
Another important aspect was to acknowledge the context by ensuring proper relation both in terms of geometry but also maintaining a realistic amount of openness and daylight. The footprint had to maximize the potential of the site and handle the weather conditions without compromising the adjacent buildings and functions of the retail stores.



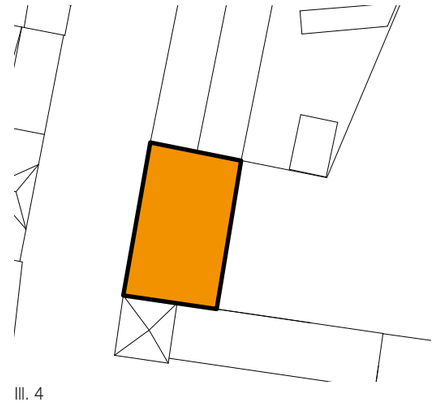
Ill. 1



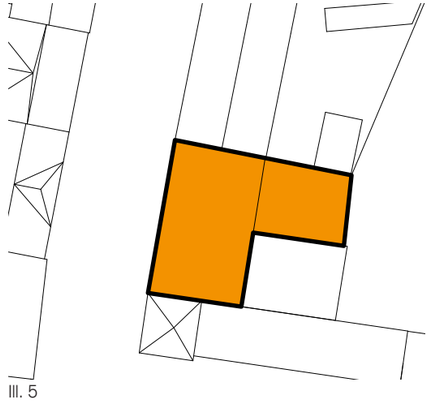
Ill. 2



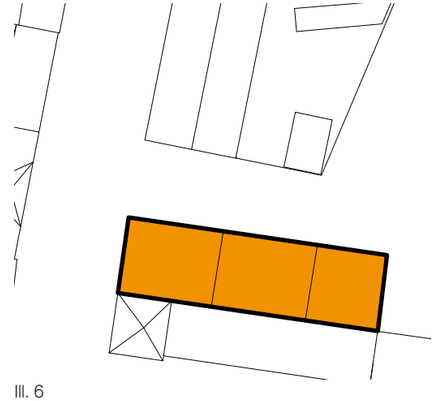
Ill. 3



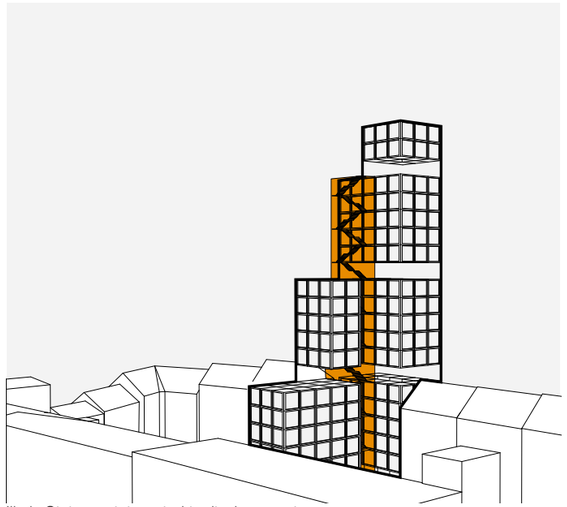
Ill. 4



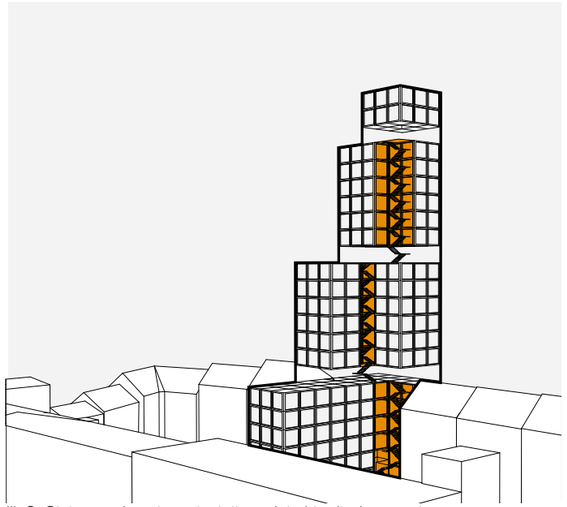
Ill. 5



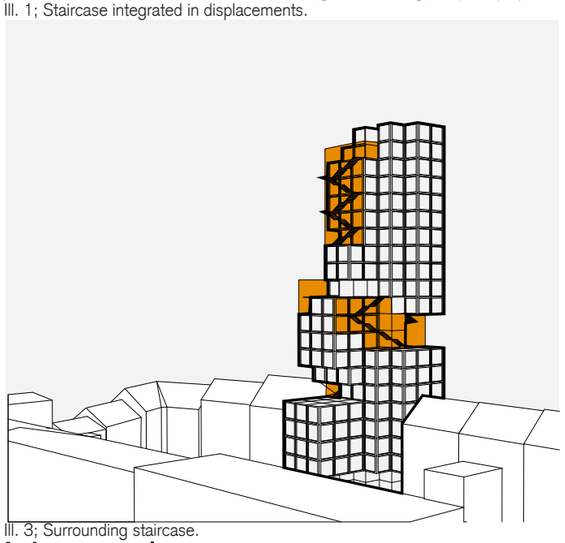
Ill. 6



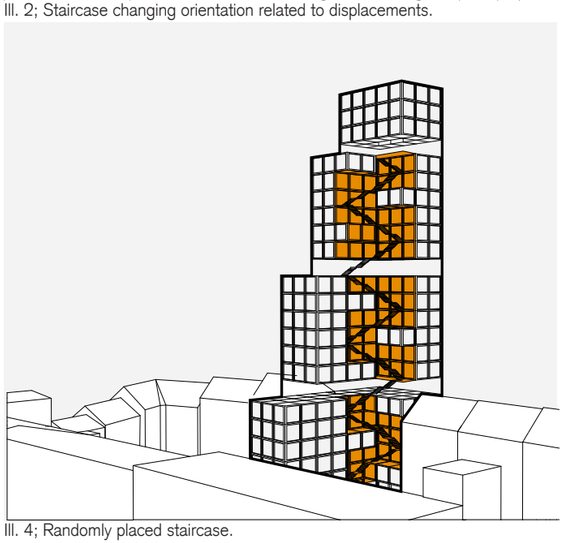
Ill. 1; Staircase integrated in displacements.



Ill. 2; Staircase changing orientation related to displacements.



Ill. 3; Surrounding staircase.

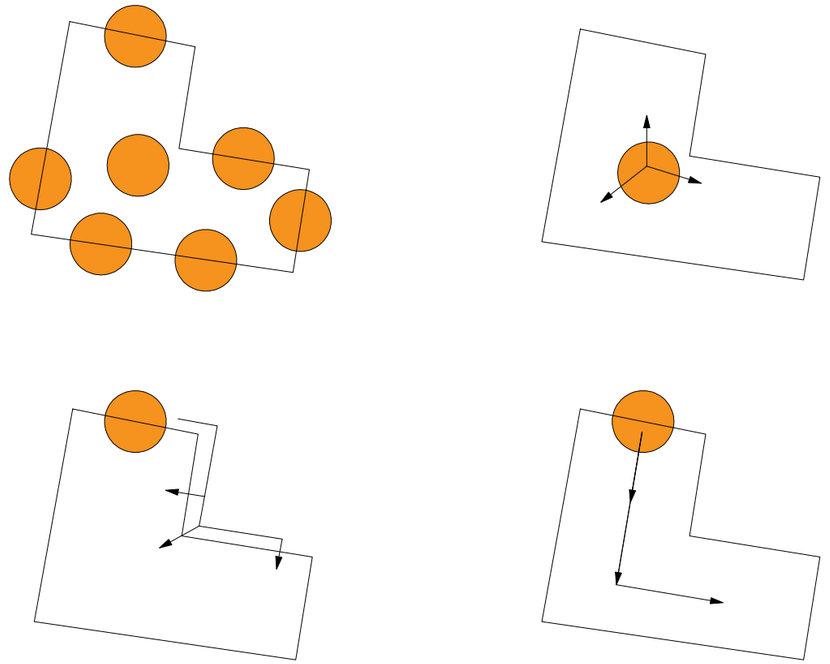


Ill. 4; Randomly placed staircase.

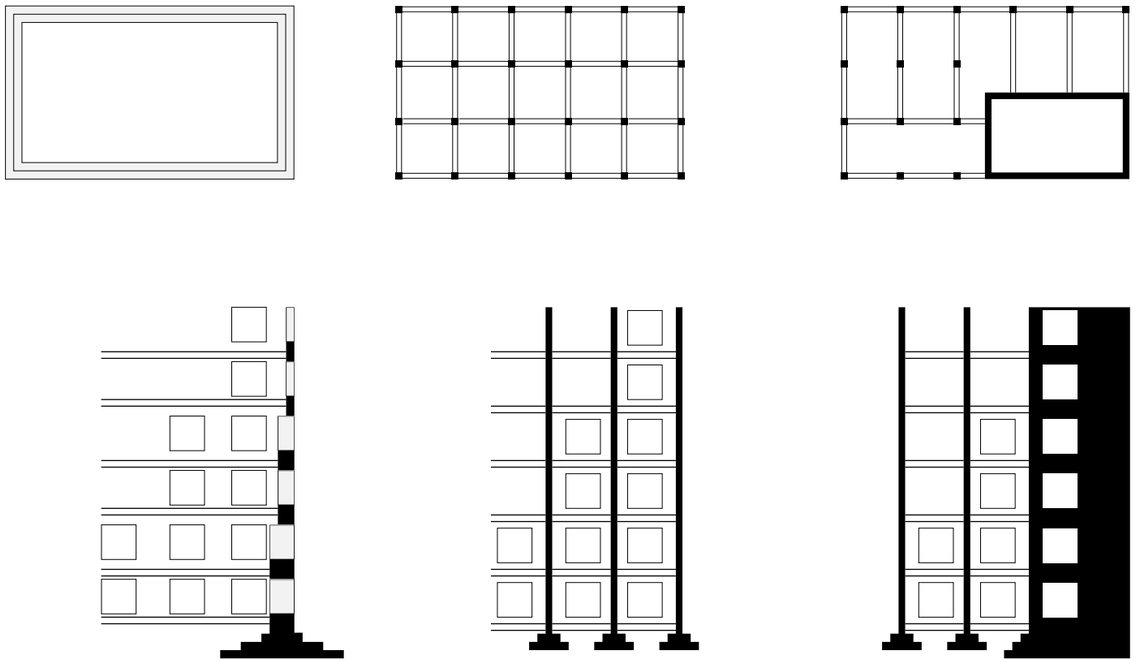
Vertical

Because of the small footprint and the diversity in the apartments, the position and quality of the vertical movement had to be considered as one of the first iterations. The design criteria was to make the access exceed the mere logistical value of a traditional access and make the way to your apartment a journey with quality and experience and encourage the use of the stair rather than the elevator.

The general function of the access could not be neglected so the stairs had to become a synergy between function and experience. Whether it was a dynamic or more static investigation, the investigations into the expression of the access were done according to that the access should become a contributing element to the façade and utilize the height of the building as an experience. Whether it was a dynamic or more static solution



Ill. 1; Organization of staircase.



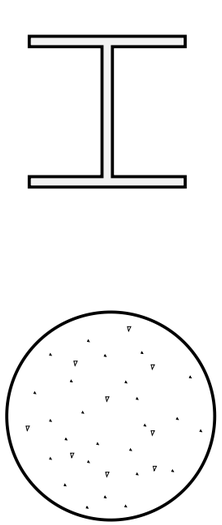
Ill. 1, Structural principles

The structural principles was studied to find the proper solution for a high-rise building situated in the dense city with a limited footprint while still creating a building with a flexibility in plan and façade.

Structural system

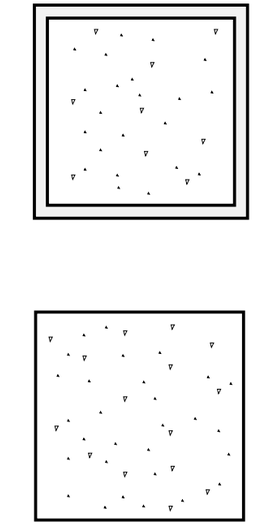
A building of + 100 meters isn't difficult to construct, and the structural system and its principles was therefore studied to design a structure that would accommodate a limited footprint, reduction of materials and spatiality.
The structural systems studied the opportunity of using bearing exterior walls, columns and a hybrid with a bearing core. The bearing exterior wall had a pyramid-effect that resulted in a loss of a large area and the columns locked the plans at too many places due to the amount of needed columns related to the desired dimensions. The result ended up in a system that combined both principles by the use of columns as the main principle and a bearing core that supported the system. The column/ core principle gave the opportunity to work with a grid that would be suitable for the site and still be flexible around the core. As the structural system has been a design parameter it would also be a part of the expression and relation between outside and inside.
The columns was studied and designed to support the spatial quality and understanding of the construction. The materiality therefore also had to correspond to its function and was tested with different materials and shapes. The studies resulted in a squared concrete column since it corresponded to the grid and structural system of the building. To optimize room height, integrate technical features, the stiffness of the building and the material weight, the floor structure became of great importance to the project. It was desired to integrate floor heating and the ventilation system. The structure ended up in a composite floor deck with profiled corrugated sheets and a HE..B steel profile with integrated ventilation pipes.

Structural calculations of beams and columns can be found in apendix.



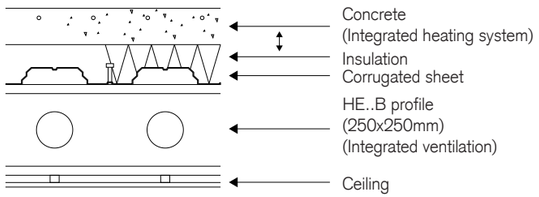
Ill. 1, Columns

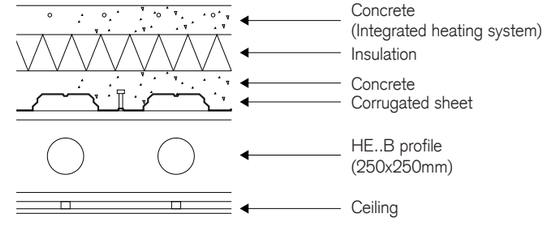
Four profiles were studied in relation to structural and material properties as well as the spatiality and zoning in the apartments. The column had to support the overall expression of the building.

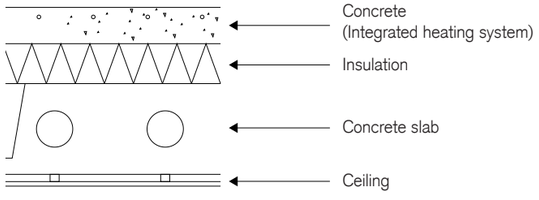


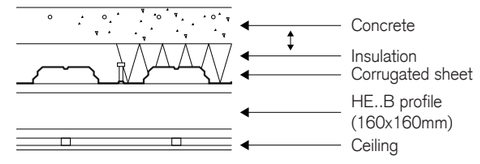
Ill. 2, Floor structure

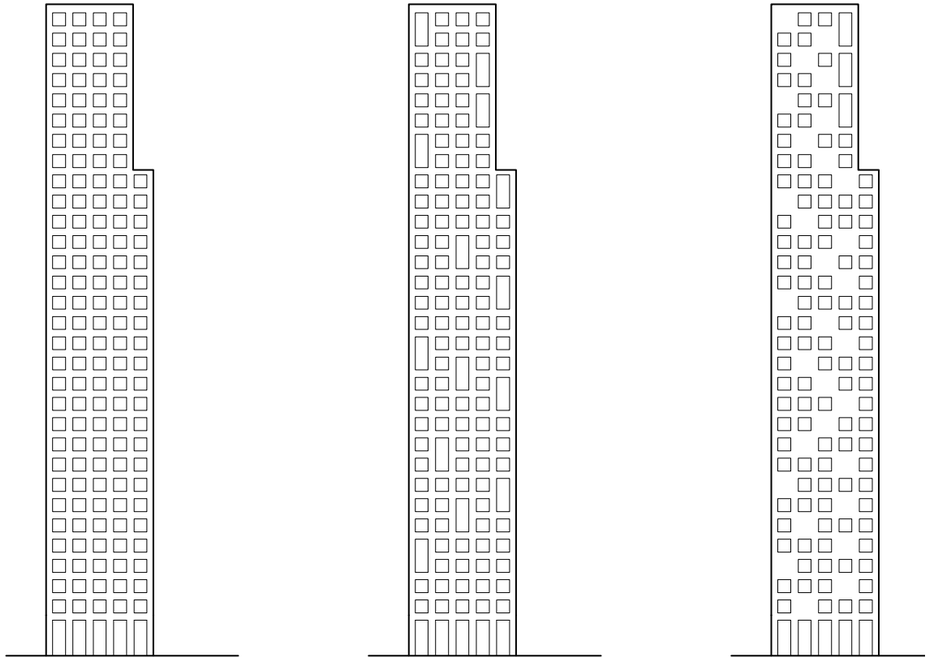
The floor structure had to be limited to a minimum within weight, thickness while still supporting the structure against horizontal loads. A combination of steel beams, corrugated sheets and concrete was studied.











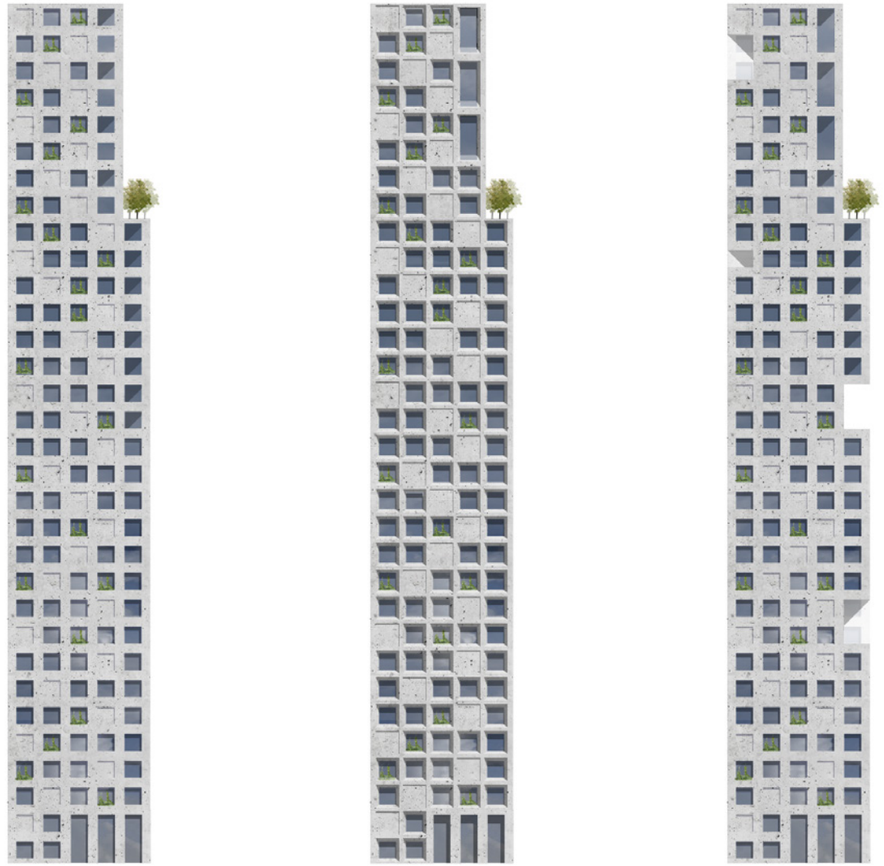
III. 1; Facade composition.

The minimalistic facade is sought further developed according to dynamism, interior expericene and overall aesthetic entirety.

Facade

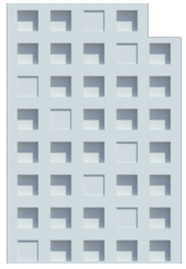
Once the conceptual form of the building had been established, the process of developing the façades began. The relation between the exterior and interior had since the beginning been an important aspect where an honest commitment to the structural system and form follows function should secure an honest, understandable building.

The general idea was to keep the building as a strict, solid geometry made primarily of concrete and glass with patches of green and even though the building would transcend the present scale the building had to meet the context with an inviting gesture. Furthermore the building would become dominant in the cityscape so the approach was to aim for a subtle expression which expressed Nordic building traditions with relation to the context and have the dynamism and detailing expressed through its regularity rather than irregularity.



The combination of concrete, glass and green patches is tested alongside the fall of shadows on the facade to test the overall experience of the building.

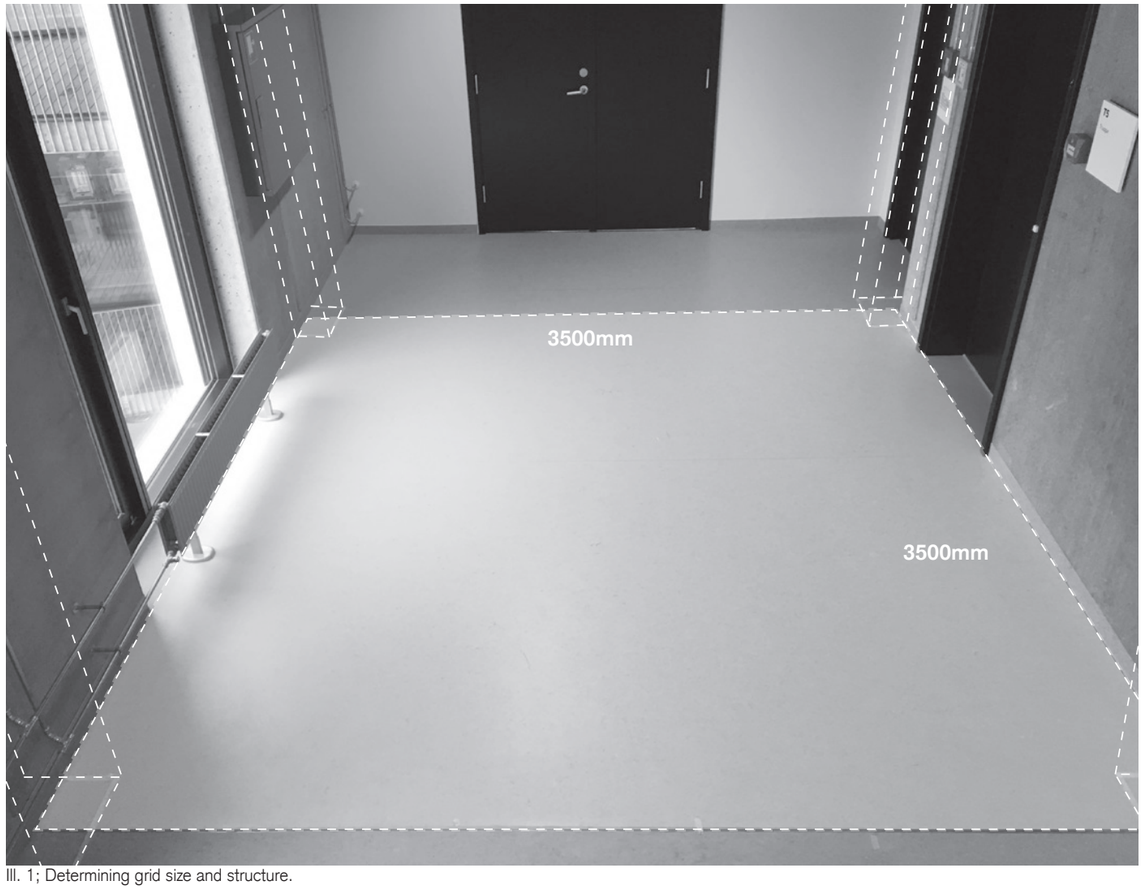
The facade achieves and ekstra depth with hipped windowsills and expresses the overall building concept.



The strich form concept is reflected in a minimalistic facade where the dynamism is created by the plays of shadows.

Dynamism is created through the application of canopees which creates a regular yet depthfull facade.

III. 1; Facade detailing.



Ill. 1; Determining grid size and structure.

Apartments

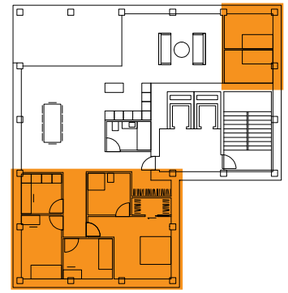
The apartments had to reflect contemporary living and meet the demands for a variety of users including the user types currently living in the city and the ones which the present city, to some extend doesn't accommodate for.

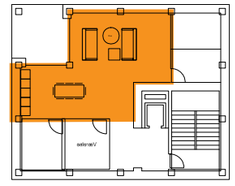
Because of the intentions of an honest commitment to the buildings structural system, a realistic approach to technical routings and restrictions from the footprint and access, the process became an integrated process between the experienced environment and technical aspects.

The intentions were to establish core design parameters which would shape the plan solutions. One of them was to create apartments with a hierarchical programming between the living and sleeping quarters, both in terms of view and privacy but also because of the sun path during the day. Another one was to form free flowing spaces without restrictions such as doors or partition walls but to keep the division of co-existing spaces limited to the structural columns and the detailing. Because of the structural systems importance to the overall expression the size of the module was continuously assessed with regards to functionality, structure and atmosphere.

Ill. 1; Night functions.

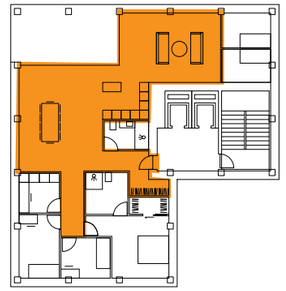
An important aspect was to acknowledge the day pattern that the user had and the different functions of the apartment. Therefore the apartments should reflect a programmatic user division of spaces so each space would function as a unit and enhance the function of each space.





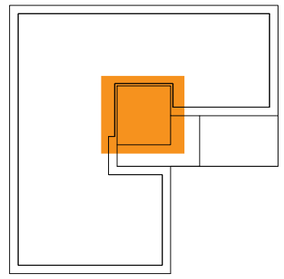
Ill. 2; Day functions.

One of the contemporary ideals of the modern dwelling is the kitchen-dining area. The apartment would reflect a free flowing living area where all the functions of the family would be united.



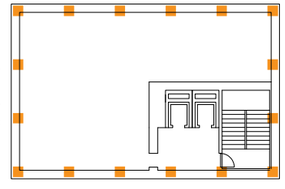
Ill. 3; Layout

Besides the strict overall shape, the access was a key design driver to the functionality of the entire building, the structural system and the plan layouts.



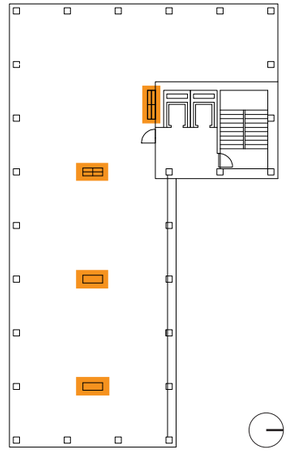
Ill. 4; Columns

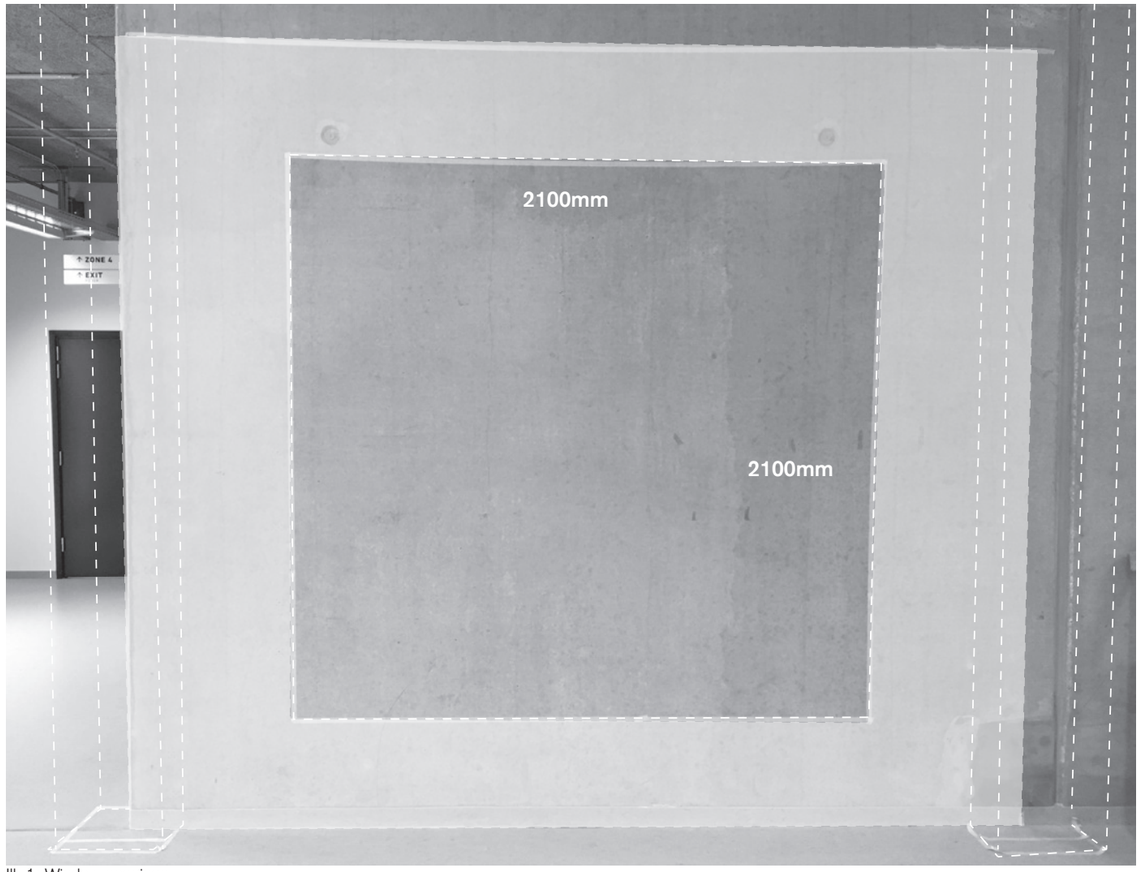
Because of the columns determined the grid size the it became a continously iterative process between interior size and functionality of the grid and facade.



Ill. 5; Routings

The technical routings highly determined the different layouts because of the varieaty of the different types of plans.





Ill. 1; Window openings.

Materiality

One of the most important aspects of the project was to create a materiality and level of detailing that corresponded to the context and user and would sustain the notion of feeling at home. The initial thoughts on materiality, context and the transition from house to home are represented in the programme.

In general the building had to reflect the raw identity of the context and therefore the most dominant material is concrete. The investigations were then done to amplify the general concept and function each room had and how to make a room with a raw character warm and livable.

A room entirely of concrete seemed to become too hard both when perceived but also when considering work- and living areas and the acoustical indoor climate. At the same time the idea was to keep switching materiality to a minimum, to ensure calm rooms. As a result the floor of the rooms was investigated on how to programmatic highlight their functions and give the rooms a level of detailing and personality. To further enhance the personality and detailing of each space another aspect was to investigate the possibilities for built-in features that would become a part of the architectural and spatial concept.

Also when using rough materials the tactility was an equally important aspect to consider since the concrete should represent massiveness but also elegance and processing with residential qualities.


Ill. 1; Concrete/ Timber.

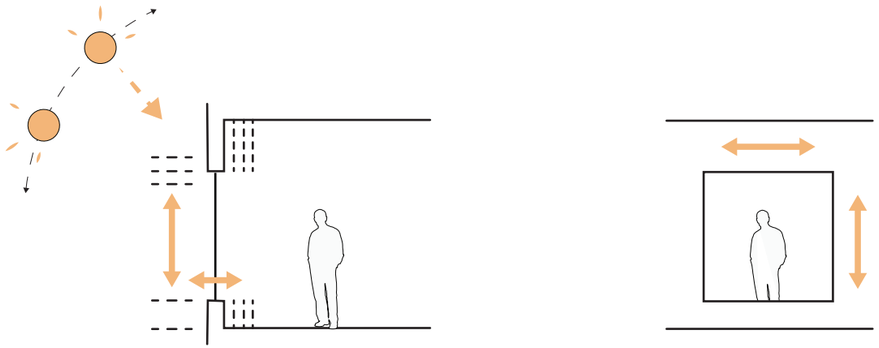

Ill. 2; Concrete/ Concrete.


Ill. 3; Timber/ White.


Ill. 4; Parquet/ Concrete.


Ill. 5; Floor detail.


Ill. 6; Wall detail.



III. 1; Daylight process, window

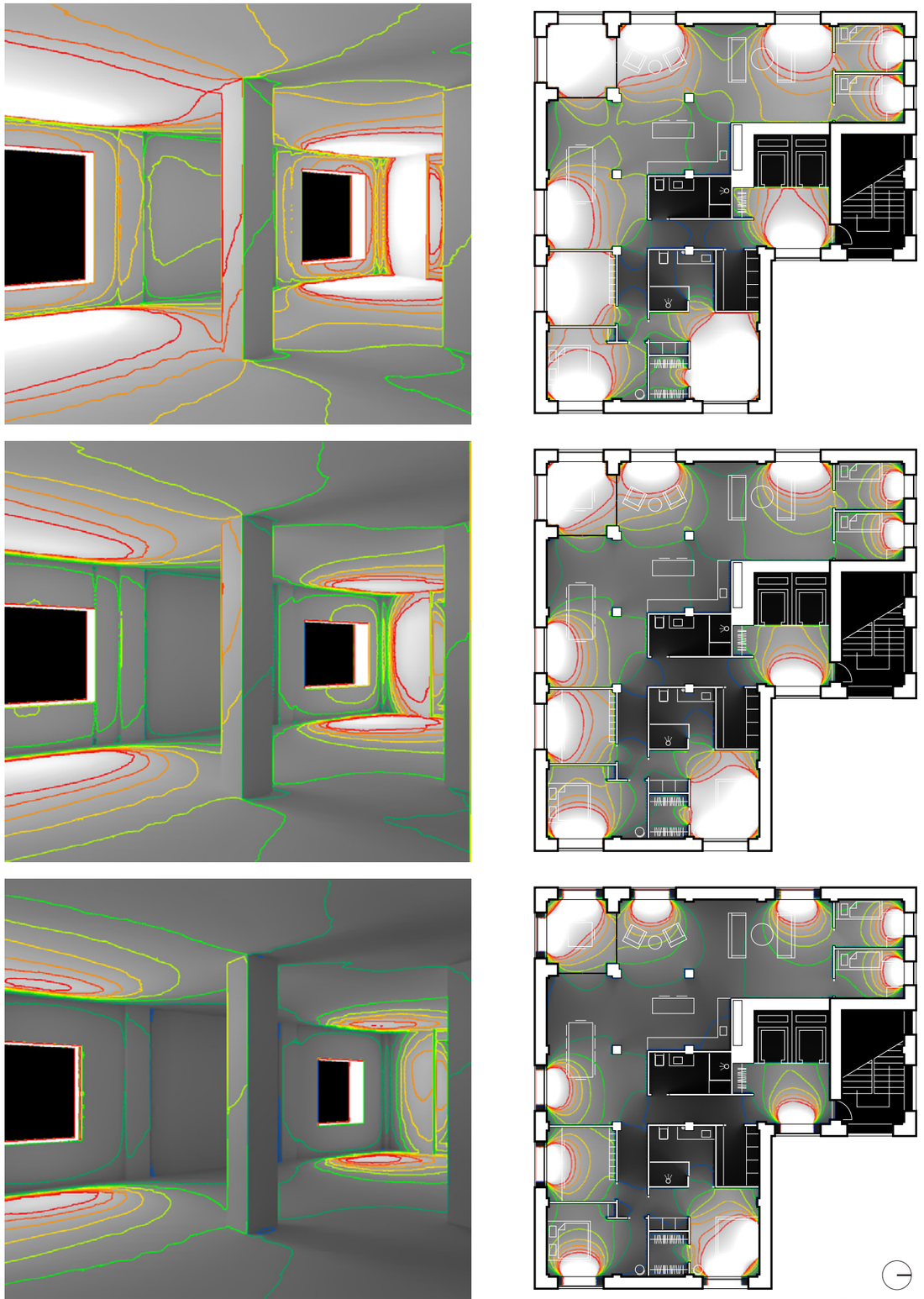
Daylight

Studies of the indoor daylight conditions served as a design tool to investigate both the indoor environment, the spatial experience and to optimize the envelope.

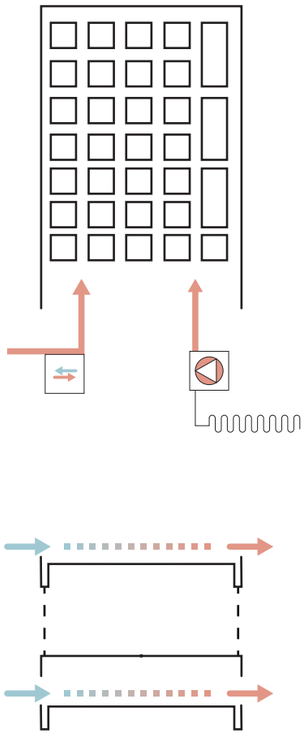
The primary studies focused on the placement and size of the windows, and to estimate and design the apartments in relation to room height, materials and the construction.

The studies were made in three different seasons, mid-summer, equinox and mid-winter to ensure a satisfying indoor environment.

The simulations show the result on how the window size impact the space.



III. 1; Daylight simulations



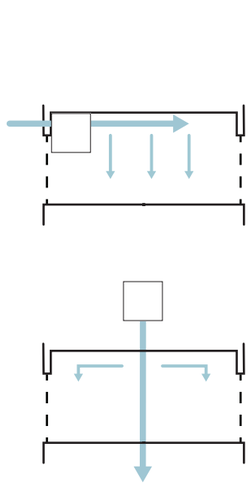
III.1. Heating/ Cooling process

Heating/ cooling

As a part of the sustainable strategy heating and cooling has been part of the design process related to structural principles, details and thoughts to user involvement.

The heating strategy was studied to use a system that could be integrated in the floor structure and that would be effective in an economic and environmental sustainable perspective. District (direct / return), geothermal and solar heating was considered in the process.

The cooling strategy was based on the need for cooling doing summer and extreme weather conditions. Different solutions were considered concerning groundwater and integrated airshafts.

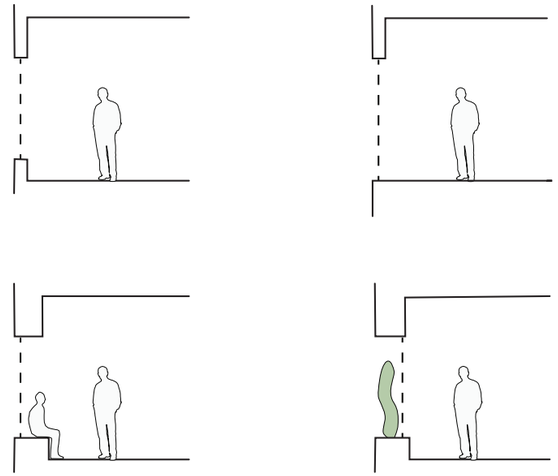


III.2. Ventilation

Ventilation

The two main ventilation principles considered was a centralized and decentralized system. The two systems both influence the architectural expression and the spatial experience due to the grid and mechanical installations.
The central system was considered to be able to take clean air in from the top floor, but would use as lot space for technical installations around the core and in each floor structure. Furthermore would the system be difficult to design for user involvement in relation to economic.

The decentralized system would be installed in each apartment as several units or as one aggregate that would distribute the air to the different rooms. The decentralized system would opposed the centralized system have a larger influence on the façade, but would be user controlled.

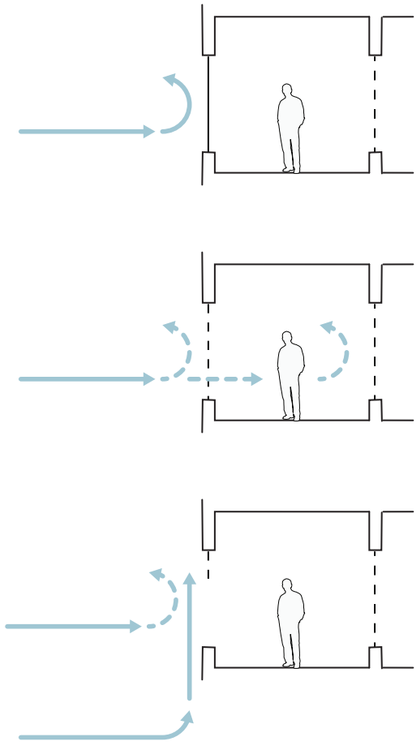


III.1. Windowsill

Windowsill

The windowsill influences the overall architectural expression, the spatial experience and has the opportunity to function as furnitecture, solar screening and greenery.

The sizing of windows and windowsill has been part of a process that has been studying the opportunity to create qualities within architectural elements to give larger value to the apartment as a home.



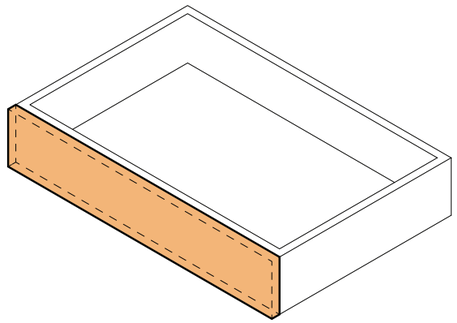
III.2. Wind screening

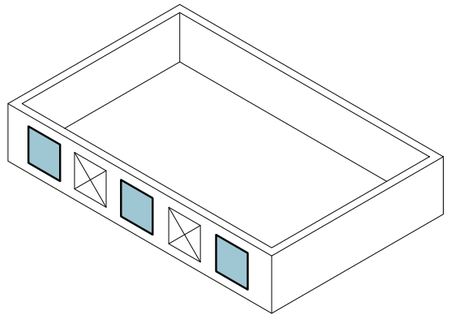
Wind screening

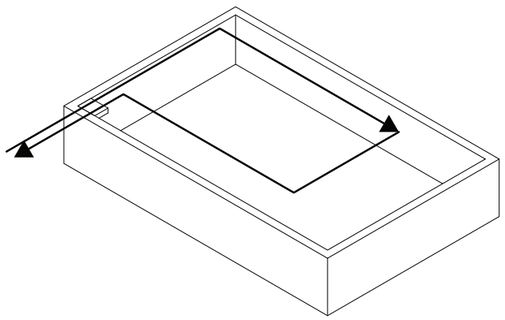
Terraces and recreational areas are part of the overall idea of the vertical city but face a problem due to the gains of wind speeds according to height, and the design of the terraces has therefore been considered as an integrated function in the building.

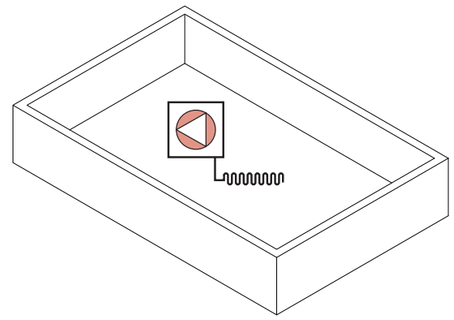
To prevent excessive wind conditions design solutions were studied as a functional unit and architectural value. Considerations dealt with closed glass structures, penetrated sheets, partly integrated wind screenings and techniques used on boats where the wind would be used to prevent wind.

As a result of the studies this topic would still need a test before the actual decision of the strategy could be chosen.









External wall:

U-value:	0,22kW/m^2
2015	37,1kWh/m^2 year
2020	27,3kWh/m^2 year
U-value:	0,15kW/m^2
2015	34,0kWh/m^2 year
2020	24,9kWh/m^2 year
U-value:	0,12kW/m^2
2015	31,6kWh/m^2 year
2020	23,1kWh/m^2 year

Window/ Glass:

U-value:	0,77 kW/m2
G-Value:	0,38
U-value:	0,70 kW/m2
G-Value:	0,52
U-value:	0,62 kW/m2
G-Value:	0,64
Procentage:	
Window:	50%
Window:	35%

Performance

The performance of the building and the apartments has been design generators and therefore used as parameters to shape the building and experience. The different strategies has been simulated in both Be15 and BSim to ensure the performance for both building and apartment. Final results for BSim and Be15 can be found in Apendix along with the process for BSim.

External wall

The external wall was designed to both expose and support the structural principle as well as creating a envelope that is suitable for a low heat transmission. Due to design decisions the final external wall perform with a U-value at 0,12 kW/m^2, which is a bit higher than could have been possible with a construction that primary would be designed for performing and not the spatial experience of the room.

Window/ Glass

The window sizing and performance was carefully chosen in relation to its G- and F-value to accommodate the need for letting light and heating into the building. Windows and glass was both designed and organized in relation to the sun path in summer and winter and openings/ closed areas placed in relation to indoor functions.

Ventilation

The ventilation system was tested within a central and decentralized system. Both system has different pros and cons but with the small footprint and the focus on user oriented sustainability the decentralized ventilations system was chosen. The decentralized system is integrated in each apartment and takes air in/ out in the façade.

Heating

District- and geothermal heating was considered as possible strategies to heat the building. Geothermal heating was chosen as it would be possible to integrate it in the courtyard and drill vertical as a supplement. The district heating was considered as a supplement to geothermal heating or as using return water from the city to the heating plant.

III.1. Be15 design parameters and simulations

Epilogue

Conclusion
Reflection
References
Illustrations

Conclusion

A high-rise influences its near and far within many aspects due to its height and vertical gathering of numerous people at a small footprint. N110 is a high-rise integrated in the dense city that uses undeveloped spaces with a minimum impact on the local society.

The high-rise is erected on an undeveloped space between two buildings in a city block in the dense part of Aalborg. As it is today the site functions as an open transit area to retail stores between the western part of Aalborg and the highly trafficked Vesterbro. The high-rise maintains the existing function in the lowest two floors by having a more open appearance and letting people pass through at the ground floor. N110 is further integrated in the context by adding the quality of a public workshop area, which is a space where the local environment can clean or fix their bicycles, furniture etc. and meet the inhabitants of the building.

Due to a small footprint and the gathering of a large amount of people the site will need a redeveloping. The municipality has already suggested a development plan for the existing city block and its courtyard with integrated parking areas. N110 propose a new strategy with an integrated, underground parking and the implementation of green areas in the courtyard as a part of the transit area where people move through and trucks unloads cargo for the retail stores. The high-rise has integrated its own semi-public courtyards on the offsets of the building which can be used as recreational areas by the residents. The recreational areas serve as a part of the translation of the qualities from the horizontal city and suburbs to the vertical city and facilitate places for meeting and establish a relation to the people one is living next to. The size of the courtyards relates to the density of the building and therefore they diminish the further the distance to the ground and have been detailed to handle the wind conditions. The courtyards both serve as areas where people can relax and enjoy a green retreat from the dense city, but also as an open opportunity for shared greeneries to grow vegetables.

As a public service a conference room has been programmed into the building on the 25th floor that can be rented by the residents and public for events or business, allowing everyone to experience the unparalleled view. On the 1st floor is integrated a rental space for business to add to the user diversity and ensure a lively building in all hours of the day.

The design of N110 is related to the context and the history of Aalborg by the use of materials and in relation to its overall form concept. The high-rise is divided into four primary parts of eight-nine floors, which relate to the existing context and does gradually reduce in height as it faces the courtyard and the people using it. The construction is made of solid materials primary of concrete to relate to the history of Aalborg and to stand as a reference to the industrial buildings and chimneys that the city used to have and now has in Aalborg Portland which stands as a silhouette along the fjord. N110 has an honest expression that relates to its structural system and functions and the design has been build on honesty and the principles of form follow function.

Each apartment has been designed with focus on materials, the structural system, details, indoor environment and the advantages of building high to create spatiality and extraordinary experiences in each apartment and room. The apartments are based on a division between the living- and sleeping quarters and the idea of free flowing rooms only separated by columns and the use of materials in order to accommodate a contemporary Nordic lifestyle. In addition the access ways has been integrated into the journey to- and concepts of the apartments to enhance the spatial experience and layout and achieve more than a practical value.

N110 has an integrated sustainable strategy that in its appearance isn't visible. The strategy is based on user patterns and relates to each apartment as units to inform the residents of their use and possibilities of improvements to reduce energy consumption and their economic frames. All energy consuming features are related to a smart-monitor tracking the use of electricity, heat, ventilation, water and waste and relate it to the indoor environment to enlighten the user of their consumption and to which areas it will be possible to improve and how much money they will be able to save. N110 features biomass energy, waste water reuse, rainwater harvesting, photovoltaic systems, waste management, heat recovery ventilation systems, heat-pump system related to geothermal heating or district return water, integrated geothermal cooling system and a design based on as little material consumption as possible. The sustainable strategy is based on social, environmental and economic sustainability, and focus on the user and their patterns to enlighten and create awareness to reach better results.

N110 will stand as a landmark and a symbol of the honesty and solidity of Aalborg and North Jutland and will represent a new perspective to the Nordic way of life, and will be a example on how it is possible to create great living qualities within the dense city that both accommodate the horizontal and vertical city and by its design and strategy will be one of Denmark's most green and environmentally correct buildings.

Reflection

The city of today, tomorrow and the future

The topic of a high-rise in a city like Aalborg provides not only a reflection upon the essentials of building vertically but also the future development and role of the Nordic city structure and infliction on the city, contemporary users and user development. If the high-rise generally would be accepted it would become a milestone in Danish architecture which could set about changes to how they perceive and limit the fabric of the cities.

The question of how to approach the contemporary Nordic city to secure a sustainable development was one of the ground pillars to this thesis and still is a subject of reflection without a singular answer. The Nordic city is as much a physical manifestation of the Nordic citizens' contemporary self and is therefore a size, which is hard to approach without compromising ideals but simultaneously has to lay the foundation for the development of the Nordic citizen and overall demography. Consequently the Nordic city has to be seen as a topic of a structure that has to develop and is therefore up to interpretation of the individual.

History and tradition is hard to consider when speaking about development, which leads to the duality of the actual approach in this thesis. As a considerate approach, *Urban Infill* respects the existing structure by filling out the underdeveloped areas in the city but as a bold angle to the issue the manifestation of it as a high-rise raises complexities and reflections to the discussion on Aalborg as a future Nordic city.

Aalborg is a city without any real skyline but has, alongside other Nordic cities, an ongoing high-rise debate on the reality of it, the appearance and location. The exclusion of the high-rise in the historic city could increase the distance to accept from the Nordic citizen when high-rises have become a symbol of capitalism and iconic architecture but could also be seen as a preservation of the city's history and a method to focus the high-rises to certain areas and ensure their integration in that manner.

Sustainability

The overall strategy within sustainability has been evolving around the social and economic aspect due to the interest of establishing sustainable user awareness on their daily patterns and routines. Environmental sustainability is today a natural part of the design of buildings and has reached high performances due to the technical knowledge within details, insulation, ventilation and heating strategies. The environmental approach has therefore been a naturally integrated process from the early design stages, but with thoughts on sustainable development and architecture designed for the user the main focus has evolved around the user as a point of departure.

Because of the context and its acceptance of the high-rise as a present singularity, the process has been a constant weighing between the parameters which integrates the high-rise and those which underlines the singularity. In a context that values its identity, the contextual values has been weighed higher than the idea of an iconic or utopian architecture, also because of the fact that the building will become an icon for the city regardless and the iconic expression the stereotypical high-rises has contradicts the expression in the historical Nordic cities.

The choice of the external material has likewise been weighed between the practicality and identity but could be reconsidered within an environmental perspective as the facades are facing the sun and are untroubled by other buildings. It could therefore had been a possibility to integrate photovoltaic systems as an external finish, but due to desired appearance, the relation to the city and its history it was given a lower priority and only integrated at the roof to create enough energy to support the active sustainable features.

As a further development it would have been interesting to investigate the possibilities that lies within a more environmental approach and what opportunities that lies within new technologies such as photovoltaic systems that could be integrated without disturbing its appearance.

Ill.1. The top of N110

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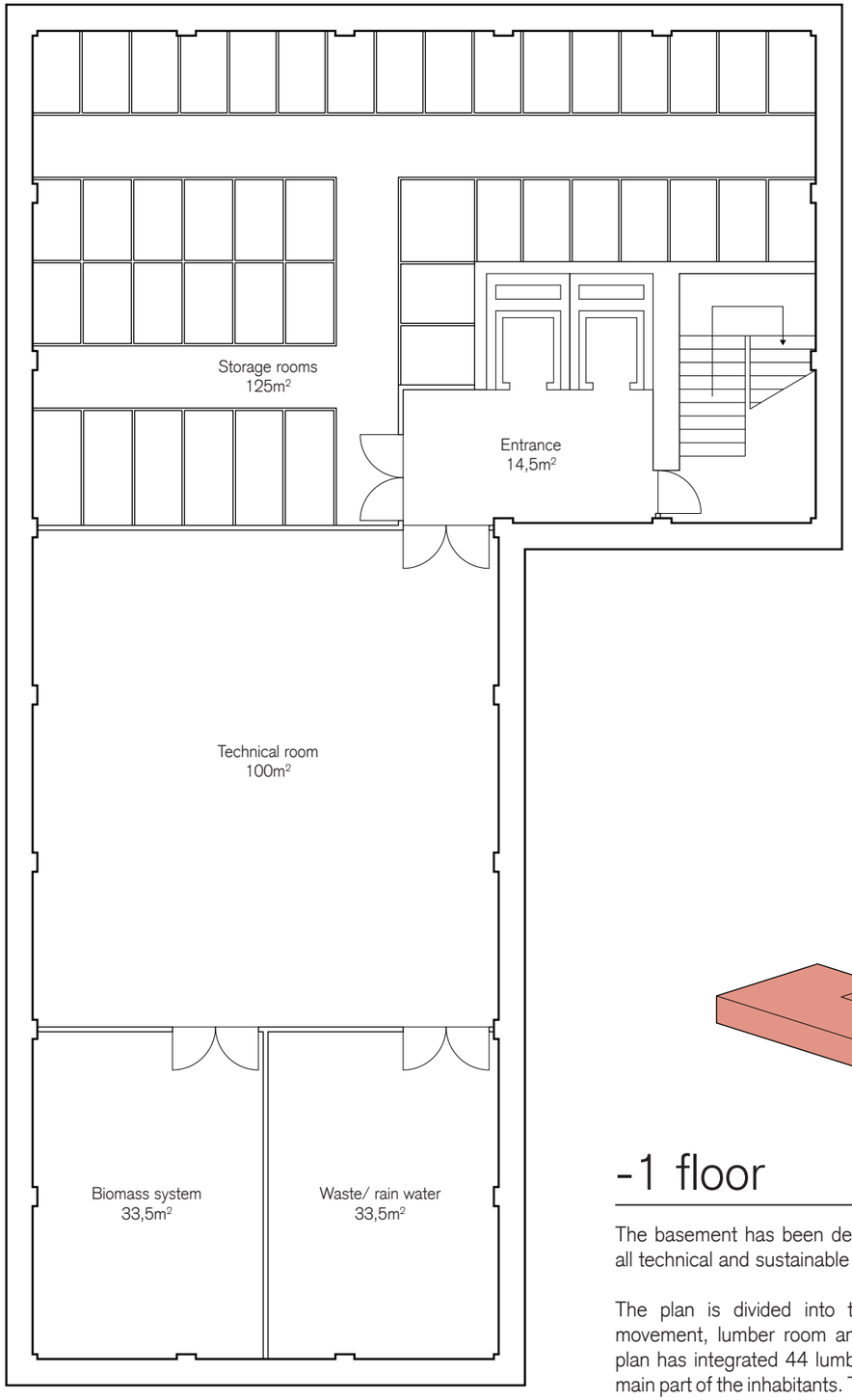
Appendix

Plans
Be15
BSim
Ventilation
Construction



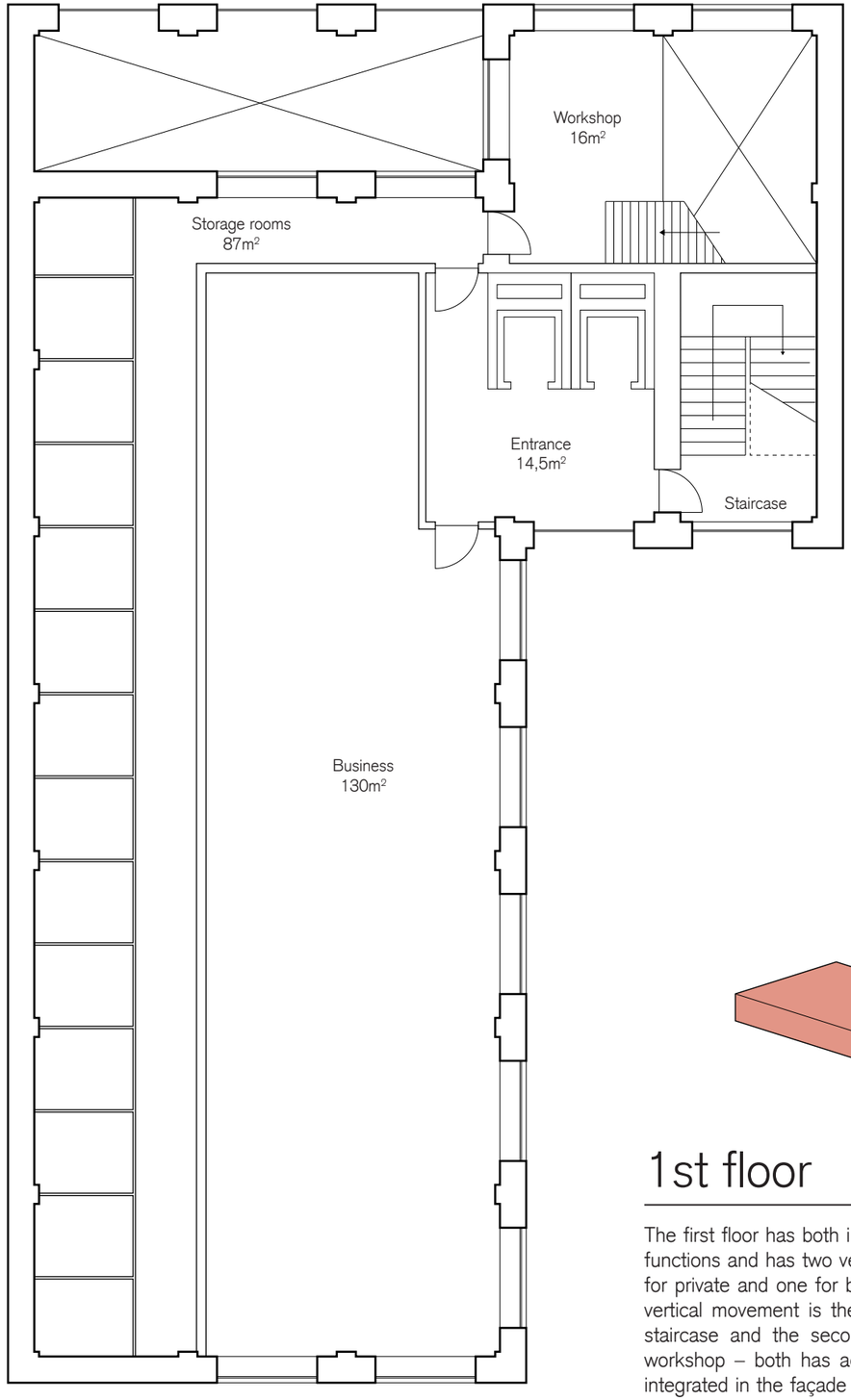
1m 2m

III.1. Basement plan

-1 floor

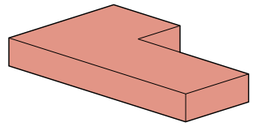
The basement has been designed to accommodate all technical and sustainable requirements.

The plan is divided into three functions; vertical movement, lumber room and technical rooms. The plan has integrated 44 lumber-rooms that serve the main part of the inhabitants. The technical rooms have three functions as it both serves common features for heating and electricity and the sustainable features as food grinder and waster/ rain water collection.



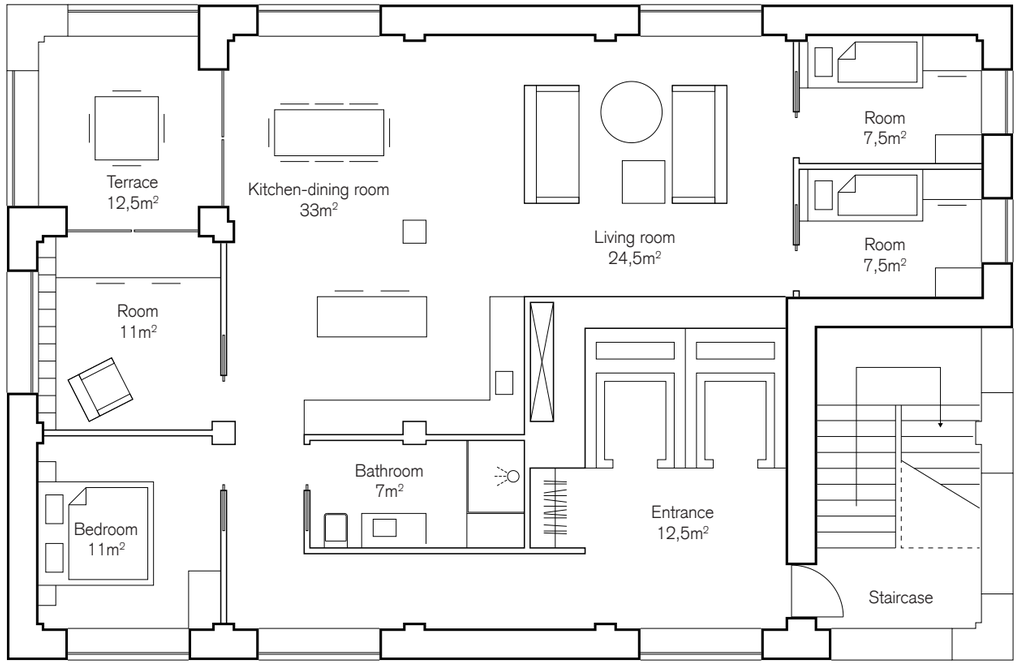
1m 2m

III.1. 1st floor plan



1st floor

The first floor has both integrated public and private functions and has two vertical movements; one only for private and one for both private and public. The vertical movement is the primary with elevator and staircase and the secondary is connected to the workshop – both has access to the lumber-rooms integrated in the façade orientated to the south that is closed due to existing buildings.

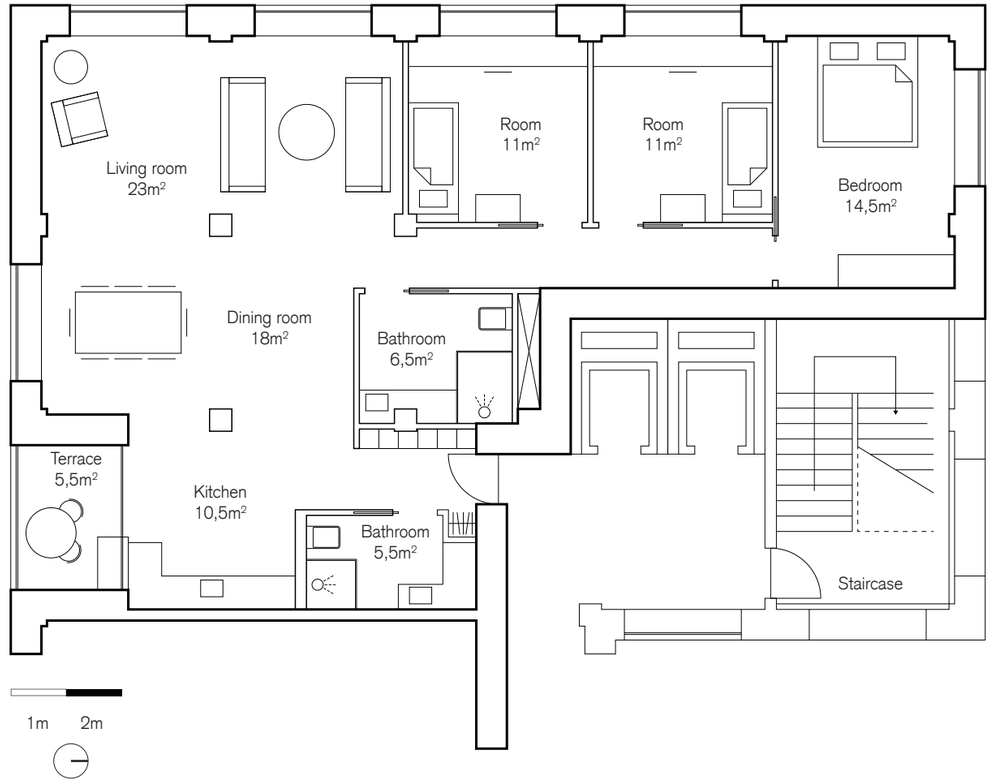


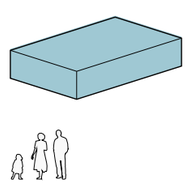
A135

The 135 square meter apartment covers the need for a small to a large family. The apartment has integrated a master bedroom, the opportunity to two small bedrooms and a large office.

The daily functions are designed as one large plan with the kitchen as its heart, and have a one-module terrace.

Ill.1. Plan solution: Apartment A135

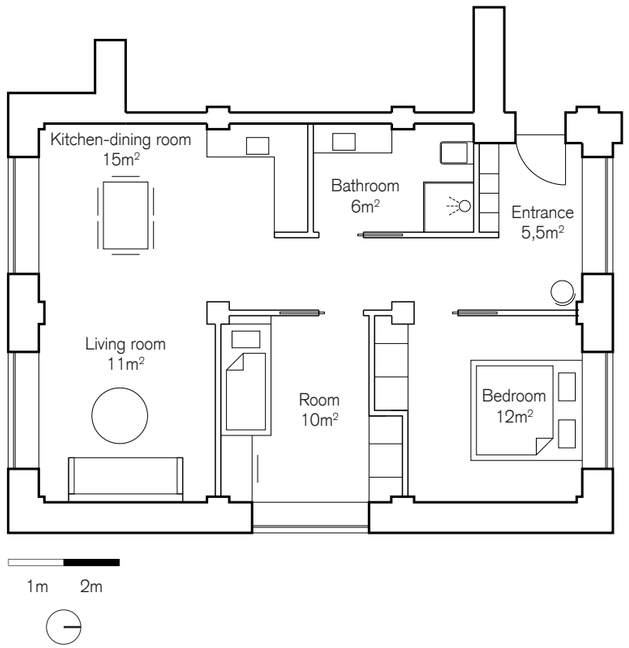


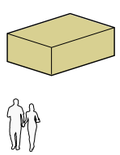


A120

The 120 square meter apartment covers the need for a small to a medium/ large family. The apartment has a master bedroom, two medium bedrooms, two toilets, a half-module terrace and the daily functions are designed as one room. The plan shares the entrance with the small apartments A26 and A52.

Ill.1. Plan solution: Apartment A120



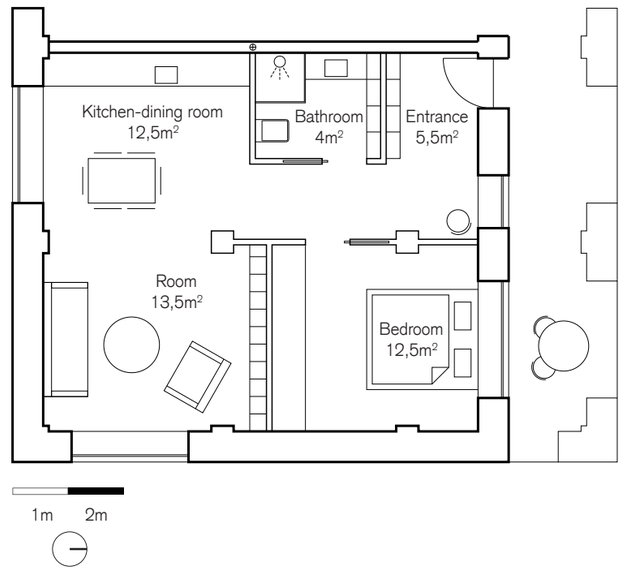


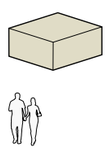
A66

The 66 square meters apartments suit a small family or couples with its two bedrooms and a kitchen-dining room that shares the space with the living room. The apartment has on bathroom and the interior walls have been designed to accommodate the need for storage.

To use all square meters all windowsills has been designed as a place to sit which especially creates an extra dimension to the entrance area.

Ill.1. Plan solution: Apartment A66





A52

The 52 square meter apartment is designed to couples or singles as it is designed with two rooms. The apartment share the entrance are with the A120 and A26 and has therefore has an open are in front of the apartment.

All the A52 apartments has three facades to the N/ E/ S.

Ill.1. Plan solution: Apartment A52

Nøgletal, kWh/m² år

Renoveringsklasse 2

Uden tillæg	Tillæg for særlige betingelser	Samlet energiramme
110,6	0,0	110,6
Samlet energibehov		27,9

Renoveringsklasse 1

Uden tillæg	Tillæg for særlige betingelser	Samlet energiramme
52,8	0,0	52,8
Samlet energibehov		27,9

Energiramme BR 2015

Uden tillæg	Tillæg for særlige betingelser	Samlet energiramme
30,2	0,0	30,2
Samlet energibehov		25,2

Energiramme Byggeri 2020

Uden tillæg	Tillæg for særlige betingelser	Samlet energiramme
20,0	0,0	20,0
Samlet energibehov		18,5

Bidrag til energibehovet

Varme	13,4
El til bygningsdrift	5,8
Overtemp. i rum	0,0

Netto behov

Rumopvarmning	20,4
Varmt brugsvand	0,0
Køling	0,0

Udvalgte elbehov

Belysning	0,0
Opvarmning af rum	0,0
Opvarmning af vbv	0,0
Varmepumpe	2,3
Ventilatorer	3,5
Pumper	0,1
Køling	0,0
Totalt elforbrug	27,7

Varmetab fra installationer

Rumopvarmning	0,0
Varmt brugsvand	0,0

Ydelse fra særlige kilder

Solvarme	0,0
Varmepumpe	7,0
Solceller	0,0
Vindmøller	0,0

Nøgletal, kWh/m² år

Renoveringsklasse 2

Uden tillæg	Tillæg for særlige betingelser	Samlet energiramme
110,7	0,0	110,7
Samlet energibehov		9,7

Renoveringsklasse 1

Uden tillæg	Tillæg for særlige betingelser	Samlet energiramme
52,8	0,0	52,8
Samlet energibehov		9,7

Energiramme BR 2015

Uden tillæg	Tillæg for særlige betingelser	Samlet energiramme
30,2	0,0	30,2
Samlet energibehov		6,6

Energiramme Byggeri 2020

Uden tillæg	Tillæg for særlige betingelser	Samlet energiramme
20,0	0,0	20,0
Samlet energibehov		-1,9

Bidrag til energibehovet

Varme	15,7
El til bygningsdrift	-2,4
Overtemp. i rum	0,0

Netto behov

Rumopvarmning	29,9
Varmt brugsvand	0,0
Køling	0,0

Udvalgte elbehov

Belysning	0,0
Opvarmning af rum	1,1
Opvarmning af vbv	0,0
Varmepumpe	2,6
Ventilatorer	3,8
Pumper	0,1
Køling	0,0
Totalt elforbrug	29,5

Varmetab fra installationer

Rumopvarmning	0,0
Varmt brugsvand	0,0

Ydelse fra særlige kilder

Solvarme	0,0
Varmepumpe	14,2
Solceller	16,1
Vindmøller	0,0

Be15 - Final result

The final Be15 simulation has been separated into two simulations to see how the building is performing with and without active features. The simulation shows that the building perform satisfactory according to the requirements and the personal goals.

Even though the external wall has a higher transmission loss than desired the building perform satisfying due to the chosen windows, heating- and ventilation strategy. Furthermore is a high-rise in theory well performing due to reduced external area and in our case a simple geometry.

III.1. Be15 iteration

BSim - Final result

The final simulation for the A200 shows how the apartment accommodates the requirements for excessive heating and how it in general performs.

The BSim simulation model has been designed as tool to study the indoor environment to determine ventilation, window strategies and sun screening.

The buildings transmission loss is to be seen as a guideline – to see the buildings energy performance see Be15 – Final result.

Final simulation	
Area	200
Entire apartment	Sum/Mean
qHeating	6595,4
qCooling	0
qInfiltration	-2706,4
qVenting	-3168,15
qSunRad	6115,73
qPeople	3168
qEquipment	3128,4
qLighting	0
qTransmission	-7220,86
qMixing	0
qVentilation	-1302,21
Sum	2,8
tOutdoor mean(°C)	8,1
tOp mean(°C)	23,1
AirChange(/h)	2,2
Rel. Moisture(%)	35,9
Co2(ppm)	453,1
PAQ(-)	0,4
Hours > 21	99,30%
Hours > 26	0,70%
Hours > 27	0%
Hours < 20	0%
FanPow	2740,63
HtRec	21762,42
ClRec	0
HtCoil	929,92
ClCoil	0
Humidif	0
FloorHeat	0
FloorCool	0
CentHeatPumpPow	0
CentCoolingPow	0
CentHeatPump	0
CentCooling	0

Data sheet			
Internal wall	Light structure	Plasterboard	100mm
External wall	Heavy structure	Concrete	550mm
Floor	Floor	Composite	400mm
Roof	Ceiling	Composite	400mm
Window	Krone, Coto 62	3 layers	95%

qLighting	0
qTransmission	-9543,54
qMixing	0
qVentilation	-1346,85
Sum	3,46
tOutdoor mean(°C)	8,1
tOp mean(°C)	23,1
AirChange(/h)	2,3
Rel. Moisture(%)	35,8
Co2(ppm)	451,9
PAQ(-)	0,4
Hours > 21	96,40%
Hours > 26	4,60%
Hours > 27	0%
Hours < 20	0%
FanPow	2740,63
HtRec	21778,94

Data sheet			
Internal wall	Light structure	Plasterboard	100mm
External wall	Heavy structure	Concrete	550mm
Floor	Floor	Composite	400mm
Roof	Ceiling	Composite	400mm
Window	Krone C Krone Fyr	2 layer	95%

BSim - Process

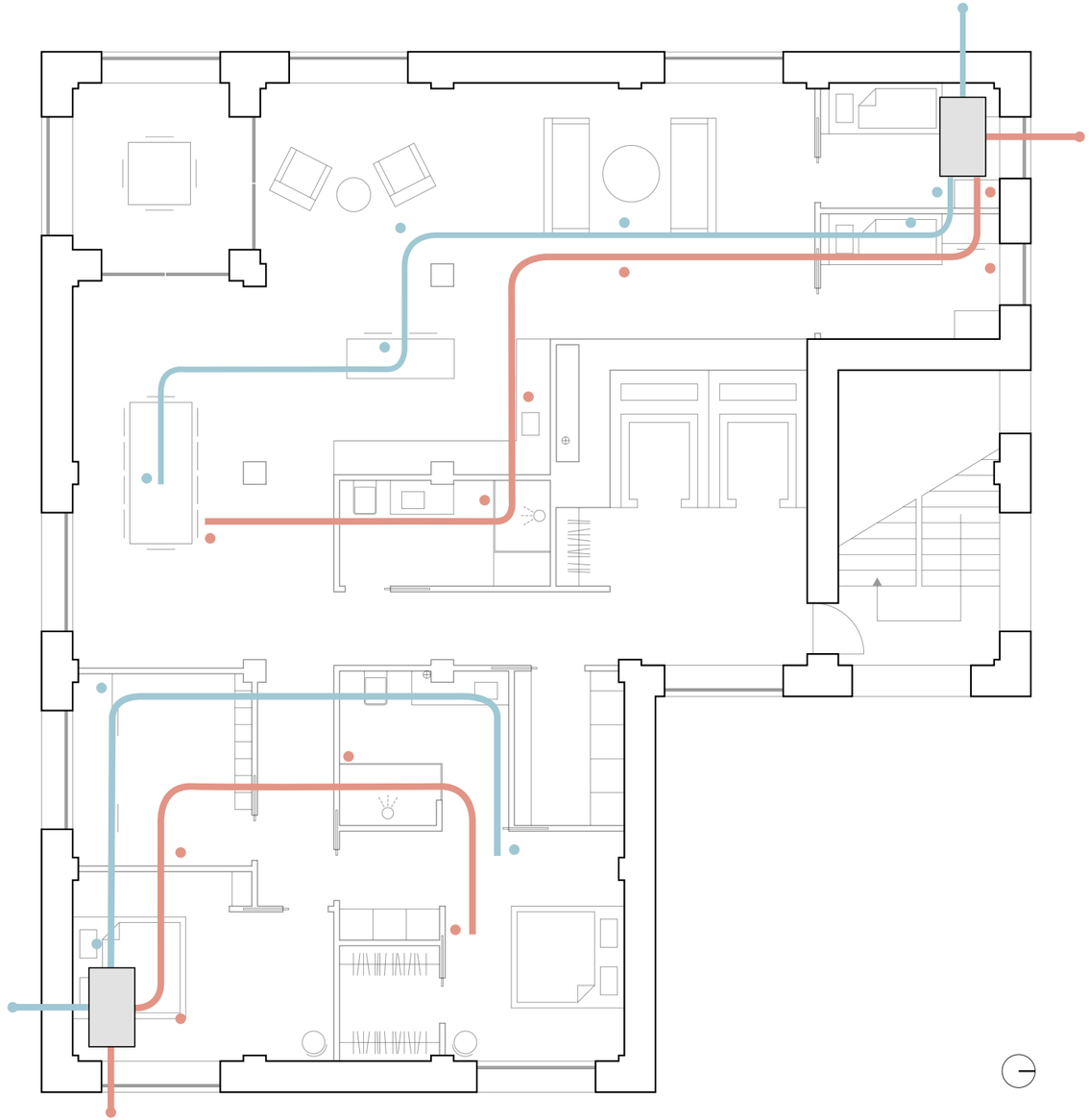
BSim has been used as an integrated tool to secure well performing apartments by helping to chose the proper elements within construction and strategies. As a point of departure knowledge from previous projects has been used as a generator.

qLighting	0
qTransmission	-11024,12
qMixing	0
qVentilation	-1352,82
Sum	3,57
tOutdoor mean(°C)	8,1
tOp mean(°C)	23,1
AirChange(/h)	2,1
Rel. Moisture(%)	35,8
Co2(ppm)	451,7
PAQ(-)	0,4
Hours > 21	94,60%
Hours > 26	5,40%
Hours > 27	0%
Hours < 20	0%
FanPow	2740,63
HtRec	21786,18

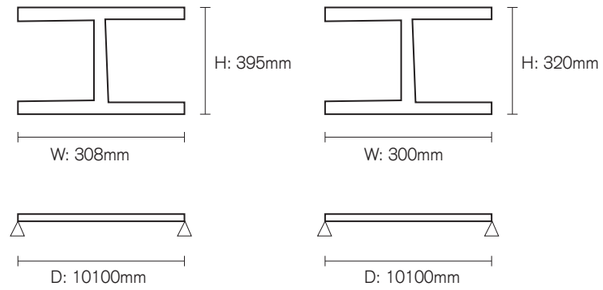
Data sheet			
Internal wall	Light structure	Plasterboard	100mm
External wall	Heavy structure	Concrete	350mm
Floor	Floor	Composite	400mm
Roof	Ceiling	Composite	400mm
Window	C Krone Fyr	2 layer	95%

Ventilation

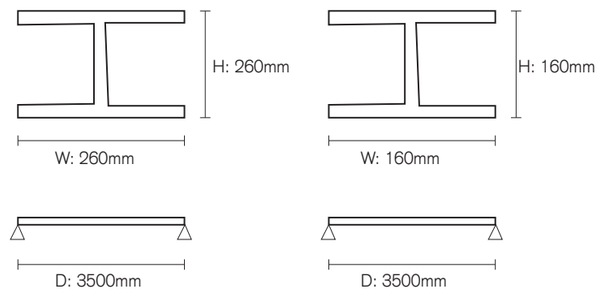
The ventilation is carried out as hybrid ventilation where natural ventilation is the primary source of ventilation during summer but is not sufficient during winter when temperature differences become too extensive. The natural ventilation is based on cross- and single-sided ventilation and due to the height of the building, dampers has been established to control the inlet and handle wind impacts on the frame itself but also on the indoor environment in the form of draught and noise. In order to avoid practical problems with a central unit, regarding the number of square meters that will be lost and the risk of spread via ducts, there has been installed respectively one to two decentralized units, in each apartment, depending on the apartment size and the intake of fresh air is guaranteed by having the intake and exhaust at various orientations. The decentralized units are also supported by the idea of giving the users a sustainable awareness and user-driven control over their own energy consumption.



Ill.1. Ventilation principle



AGT_{MAX}: 25,25mm



AGT_{MAX}: 8,75mm

Construction

The structural principle has been designed to accommodate the need for a light construction with integrated technical features.

Different dimensions were tested to evaluate span, material use and room height. All calculations were made in accordance to 'teknisk ståbi' to test AVG and BGT to ensure a realistic dimensioning.

As a result of different tests we found it optimally to shorten the span between the columns to lower the dimension of the beams and the columns.

The calculations show an example of the calculation of one beam. The calculation is related to the dimension of the column and the floor construction.
The external wall has been designed to be self bearing.

HE . . B Profil

h :	320	(mm) Højde	s. 240
l :	300	(mm) Længde	-
d :	11,5	(mm) Krop tykkelse	-
t :	20,5	(mm) Flange tykkelse	-
A :	16100	(mm2) Tværsnitsarea	-
g :	127	(kg/ m) Vægt pr. længdeenhed baseret på densitet	-
I.y :	308200000	(mm4) Inertimoment	-
i.y :	138	(mm) Inertiradius	-
f.y :	225	(Mpa) Karakteristisk styrke	s. 229
q.k :	1,5	(kN/ m2) Nyttelast	s. 167
g.k.d :	2,4	(kN/ m2) Karakteristisk egenlast af dæk	

Beregning:

Karakteristisk egenlast af bjælke (g.k.b)
Beregning af den permanente egenlast af bjælken på baggrund af vægten pr. længdeenhed, baseret på densiteten (g):

g.k,b = g * g'

g = Vægt pr. længdeenhed baseret på densitet (kg/ m)

g' :	9,81	(m/ s2) Tyngdeacceleration	
g.k.b =	~~1245,87~~	N/ m	1,24587 kN/ m

Karakteristisk total egenlast (g.k)

g.k = g.k,b + g.k,d*d.s

d.s :	10,1	(m)	10100 (mm) Dækkets spænd
g.k =	25,48587	kN/ m	

Bestemmelse af anvendelsesgrænsetilstand (AGT)
Der foretages en stivhedsanalyse ved at beregne AGT i lastkombinationerne. Ved AGT anvendes karakteristiske laster.

AGT overholdes hvis : u.til > u.max

AGT = G.kj,sup + Q.k,1

G.kj,sup : 25,48587 (kN/m) Karakteristisk egenlast

Q.1 = q.k * d.s

Q.1 = 15,15

AGT = 40,63587 kN/m

Bjælkens maksimale nedbøjning, øjeblikkelig nedbøjning (u.max)
Beregnes udfra Statik og Styrkelære s. 292

u.max = (5*AGT*L^4) / (384*E.0*I)

E.0 : 210000 (MPa) Elasticitetmodul for stål S355 s. 229

u.max = ~~2,1143E+18~~ ~~2,4853E+16~~ 85,0710725 mm

Tilladt nedbøjning (u.til)
u.til = l/400

u.til = 25,25 mm

AGT overholdes?

AGT kontrol = 25,25 > 85,0710725