Abstract

English
The project objective was to create a sustainable housing complex consisting of 40 subsidized apartments, which was based on the open competition “Fremtidens Bæredygtige Almene Boliger” arranged by the ministry of By, Bolig og Landdistrikter.

The certification system DGNB figures as the sustainable approach to the project, as it includes the three branches of sustainability - environmental, economic and social. The goal was to create sustainable homes by implementing DGNB criteria in the Integrated Design Process, as utilised at Aalborg University, and thereby secure good quality and good sustainable homes.

The process of developing a DGNB implementation evolved simultaneously with the design process. The design process should reflect the DGNB application and therefore the competition was used to test the DGNB application. A ‘Gesture’ was applied in the design process to add value to the home and remember the human scale.

The focus in the project is the human scale and the human needs and comfort by using DGNB to secure environmental sustainability, using a ‘Gesture’ to create a home and using both to secure social sustainability and comfort.

Danish
Projektets mål er at skabe et bæredygtige boligkompleks bestående af 40 almene boliger, hvilket er baseret på den åbne konkurrence “Fremtidens Bæredygtige Almene Boliger” udskrevet af Ministeriet for By, Bolig og Landdistrikter.

Certificeringsordningen DGNB anvendes som den bæredygtige tilgang til projektet, da den omfatter tre retninger inden for bæredygtighed - miljømæssig, økonomisk og social. Målet er at skabe bæredygtige hjem ved at implementere DGNB kriterier i den Integrerede Design Proces, som anvendes på Aalborg Universitet, og dermed sikre god kvalitet og gode bæredygtige hjem.

Processen for DGNB anvendelsen udviklede sig samtidig med design processen. Design processen skal reflektere DGNB anvendelsen og derfor bruges den åbne konkurrence til at afprøve DGNB anvendelsen. En ‘Gesture’ bruges i design processen til at skabe merværdi i hjemmet og huske den menneskelige skala.

Fokus i projektet ligger på den menneskelige skala, menneskelig behov og komfort ved at anvende DGNB til at sikre miljømæssig bæredygtighed, bruge en ‘Gesture’ til at skabe et hjem og anvende begge til at sikre social bæredygtighed og komfort.

Aalborg University
Architecture and Design

Project title:
Sustainable Subsidized Homes

Project period:
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Supervisors:
Mads Dines Petersen
Rasmus Lund Jensen

Number of reports:
6

Number of pages:
130

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Contents

Future scenario

There is a need for good examples of affordable sustainable housing with a high architectural quality. The broadest possible part of the population should find it attractive to create their home in this housing. They must feel safe and take an active part in the new community's development by creating a sense of belonging.

This project was based on the open competition "The future of sustainable subsidized housing" arranged by the Ministry of City, Housing and Rural districts. Many of the goals were based on their demands and desires and the site was chosen from the competition.

The housing development is to live up to the 2020 building regulations and energy requirements and apply sustainability in the broad understanding as defined in the Brundtland report: social sustainability, environmental sustainability and economic sustainability. (Christiansen, 2013) The building should add to sustainability awareness in the society and, through a DGNB certification, show occupants as well as others that the building's sustainabilty is measurable.

Some aspects of the DGNB rating system were included in the design process and integrated as a natural part of design and planning of the building complex.

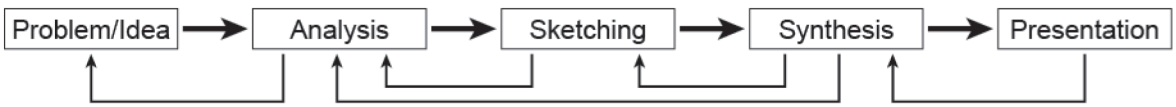
The DGNB rating system was used as a tool to integrate sustainability into the design process. This guaranteed the early consideration of the DGNB qualities, just as building technical knowledge and other sustainable initiatives were implemented from the start.

Subsidized housing has very specific guidelines and legislation. The residences were therefore optimised according to functionality and space. The homes were to be as functional as possible, while still perceived as open, light and spacious. To achieve this, a tectonic approach was integrated into the design process as an equal method to the DGNB qualities to assure a good home environment for the residents.

To accommodate a broad spectrum of the population, the housing complex was ideally to include a variety of housing types and sizes for different groups of inhabitants, age groups and family situations. Since all residents in Denmark have a right to subsidized housing, in theory, the housing should accommodate all people and lifestyle situations. This was a significant parameter in the design process and decision-making.

The goal in this project was to work with the chosen site and design subsidized housing of a high architectural quality for a diverse population. The architectural quality emerges from the method of combining DGNB and a tectonic design approach under the common subject of sustainability. The method has been explored through the competition "The future of sustainable subsidized housing" and can ideally be used as a paradigm for other projects in the future.

Method



(Knudstrup, 2004)

INTEGRATED DESIGN PROCESS

The Integrated Design Process is a method, which combines knowledge from several disciplines, such as architecture and engineering, within a design process. The disciplines interact throughout the process to solve problems and create new solutions while designing a building.

The process is iterative and not, as the time schedule would suggest, linear. The back and forth re-evalution between the different phases of the design occurs regularly in this process.

The Integrated Design Process was used as a method to integrate the technical and sustainability aspects of the design with aesthetic and tectonic goals in a holistic manner.

The 5 phases:

1 ***Problem identification and idea development*** – a description of the initial project concept. ‘

2 ***Analysis*** – an analysis of all information relating to the project and the site.

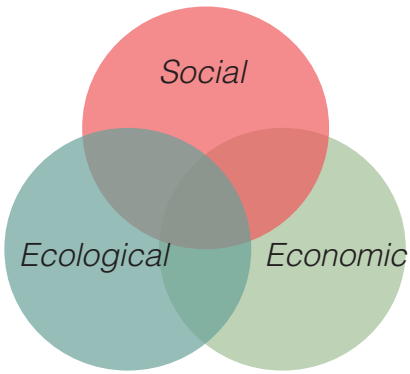
3 ***Sketching*** – the combination of knowledge from all specialities to investigate in sketch form possibilities for the desired product.

4 ***Synthesis*** – the final form is reached integrating the three previous phases.

5 ***Presentation*** – the design solution is documented and explained.

(Knudstrup, 2004)

SUSTAINABILITY

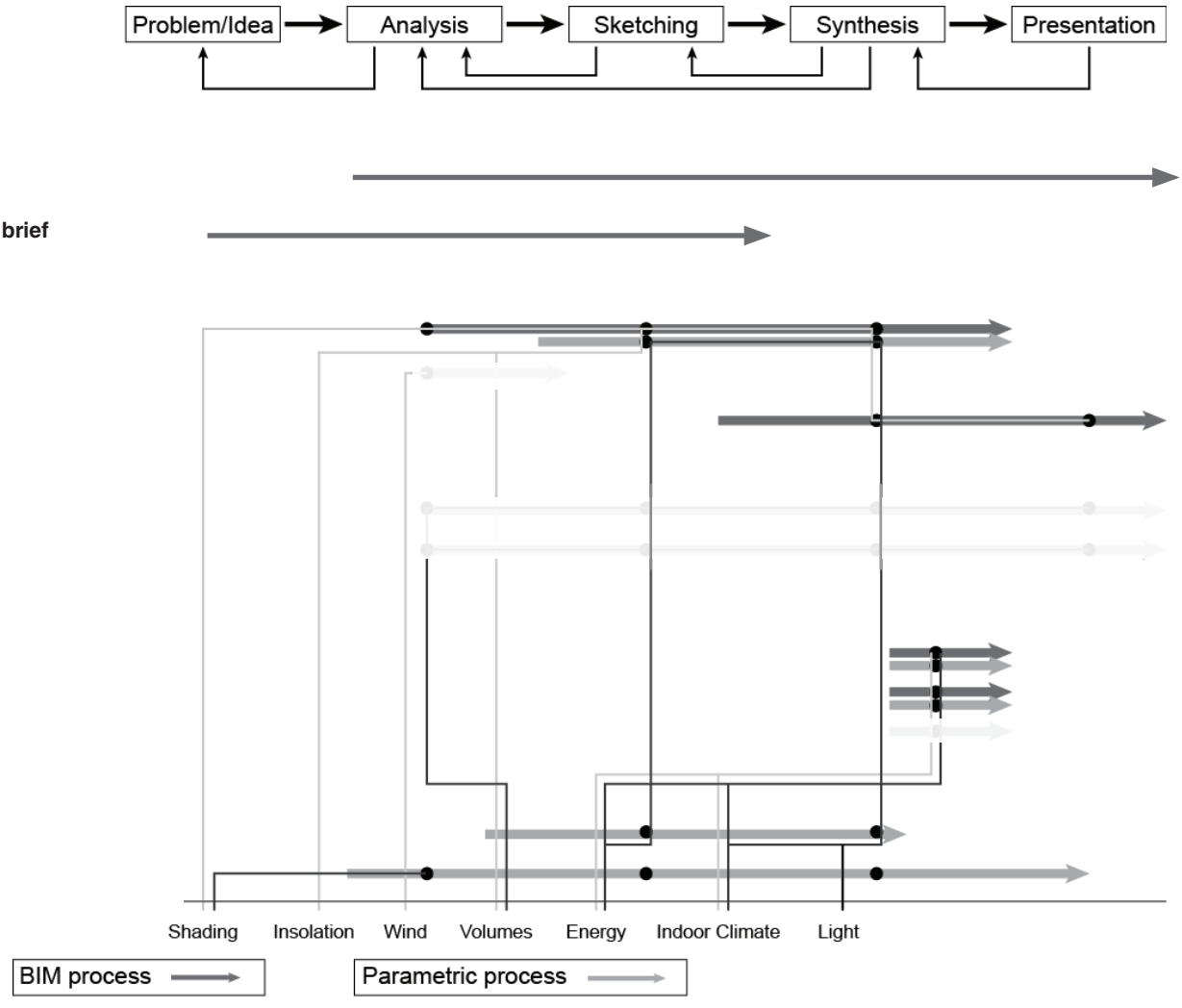


SUSTAINABILITY

The overall focus of the project was sustainability and the definition of sustainability was used to set the design parameters and goals for the final design. By using the broad definition of sustainability, especially in regards to social sustainability, and not just low energy design, the concept was to create better homes and better surroundings for the inhabitants.

By combining the Integrated Design Process with a holistic approach to sustainability, it allows all disciplines to take part in the process as early as possible, involving all disciplines and strengthening the decisions made in the process. It allows the design to reach its potential and should create a building of the highest quality. The theory claims that the result will be good architecture that would benefit both present and future users. This presents a difficult task and requires many interdisciplinary participants (Hvidbog om bæredygtighed i byggeriet, 2013, p. 6). In this project the architectural and engineering disciplines have been integrated, which allows for the inclusion of many aspects of sustainability. It should be noted that an all inclusive design process would require an expanded project team beyond the confines of this assignment.

Under the headline sustainability the subtopics have been DGNB, including most of the sustainability goals, and tectonics, which provided for the aesthetic and functional aspects of the design. To maintain focus on all aspects housing design simultaneously is a very comprehensive task. DSNB and tectonic design were used as the tools to help organize and simplify the complexities of this task.



(Educating for a Carbon Neutral Future : A Danish perspective in a Global World, Mads Dines, 2014)

Tools

Different software will be used in the design process to ensure a holistic design.

Mads Dines' paper "Educating for a carbon neutral future" from 2014 addresses the learning goals of Architecture and Design at Aalborg University. The integration of different computer software programs in the design process is discussed through the analysis of three student projects. (Educating for a Carbon Neutral Future : A Danish perspective in a Global World, Mads Dines, 2014)
The diagram on the left displays where in the design process the different software were used. This project has mainly worked with the following software:

Sketchup
Sketchup is used in the earlier phases for sketching ideas. Sketchup has the ability to quickly and intuitively create 3D models that can be tested in different scenarios.

Revit
Using BIM-software early in the design phases, it was intended to avoid problems that typically occur when working in a team when developing architectural and technical drawings. Individual drawings can potentially be out of date requiring time consuming drawing corrections. Revit was used to design a single model where it was possible to extract integrated information to make all the necessary drawings of the design.

Be10
Be10 was used to calculate energy usage of the design. It was used simultaneously with Bsim.

BSim
Bsim was used to calculate the indoor climate of the design. It was used to optimise the design by testing design alternatives.

Velux Daylight Simulator
The Velux Daylight Simulator was used to make quick daylight factor simulations, so as to understand the amount of daylight penetrating each apartment.

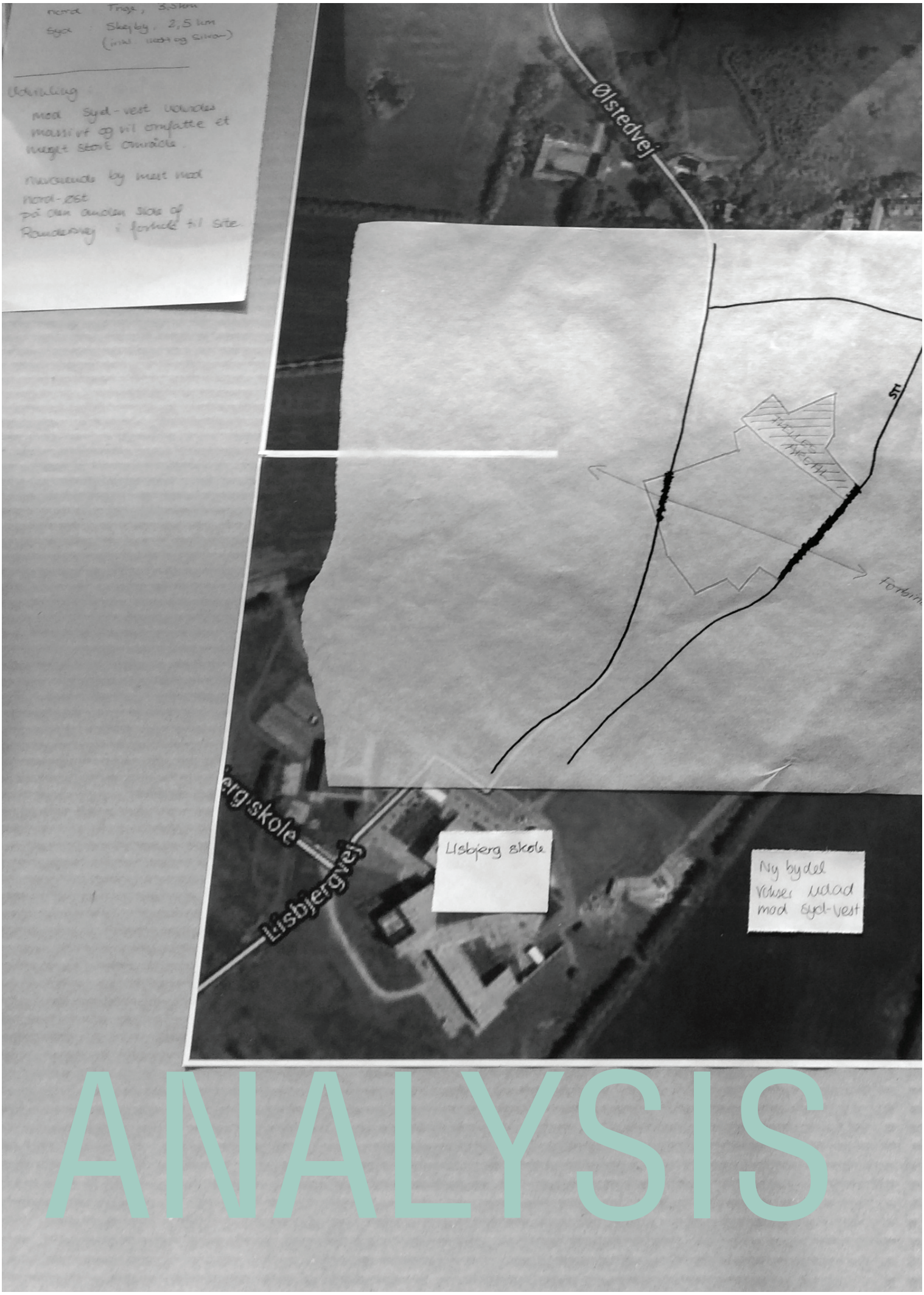
DGNB
DGNB was used to measure how sustainable a building is. This project will investigated the use of DGNB in a design process. The intent iwas to develop a method oas ton how DGNB couldan be implemented in the integrated design process taught at Architecture and Design at Aalborg University. As DGNB in Denmark has currently has nnot been developed for residential buildings, the project will used the criteria developed for office buildings and translated them for residential development.

Scope

The available material related to DGNB created a natural limitation for the project. Only a limited selection of information is accessible to the public due to the confidentiality DK-GBC (Green Building Council Denmark) subjects their consultants to. The material used for this project were the DGNB mini guide, an introduction to DGNB and guidance from the technical supervisor.

Knowledge acquired through the course of studies at Aalborg University determined the qualities and criteria used in the selection process. DGNB states that a team of at least five professional competencies are required to achieve the holistic approach of sustainability as defined by DGNB. The target was, therefore, to emphasise a reduced selection of criteria based on subjects stressed in the project program for creating subsidized housing in Lisbjerg.

The goal was to satisfy the demands of the competition, as far as possible, while maintaining a critical view of the brief. The comprehensive calculations for the economy of municipally subsidized housing are not, for example, included in this project. However, an overall consideration of maintaining the affordability of subsidized housing through the building design were considered during the design process.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Ny bydel
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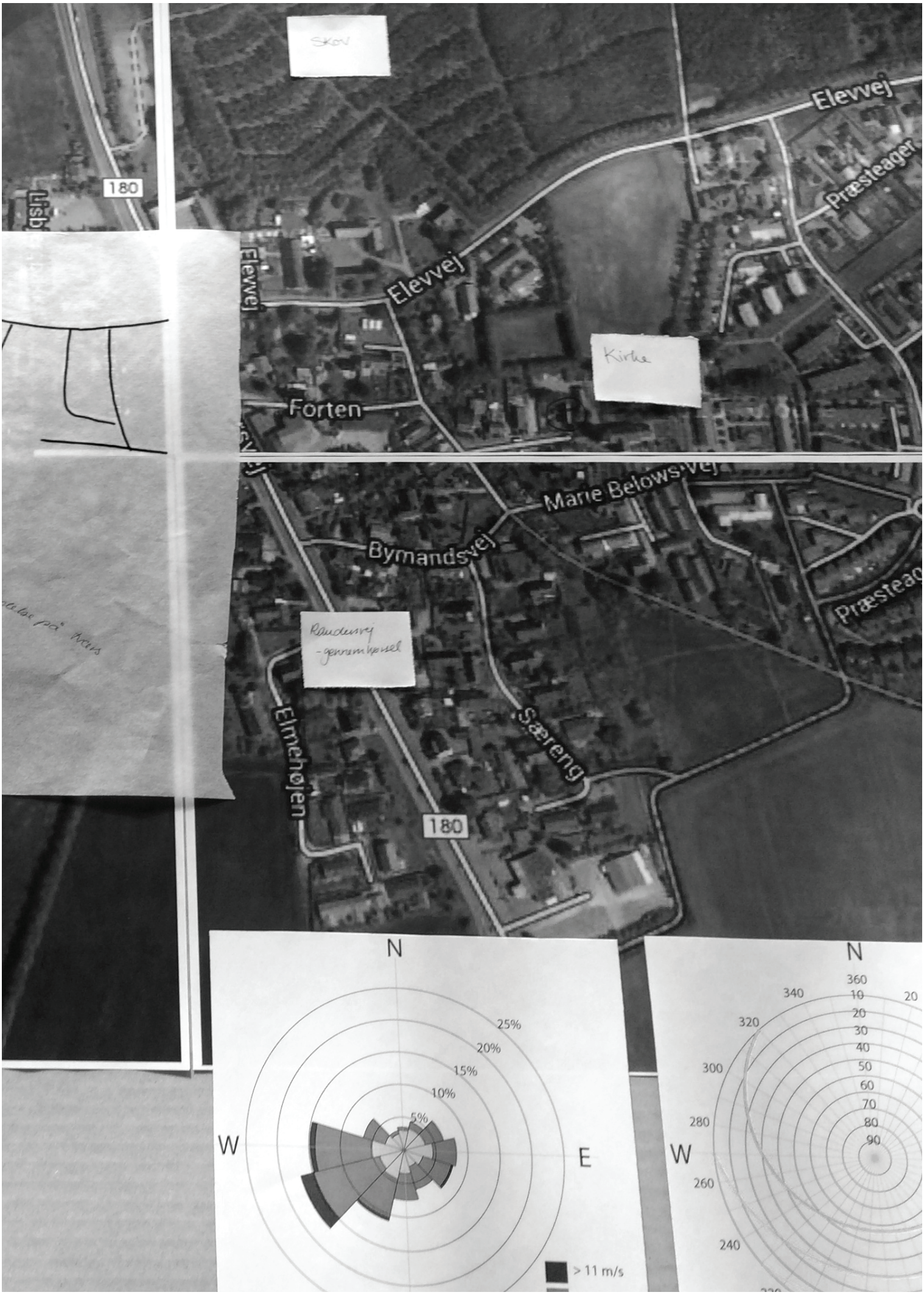
mod Syd-vest

ANALYSIS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MINISTERIET FOR
BY, BOLIG OG
LANDDISTRIKTER

FREMTIDENS
BÆREDYGTIGE
ALMENE
BOLIG

ÅBEN KONKURRENCE PROJEKT

2013-2014

DEMONSTRATIONS BYGGERIER

SEEST/LISBJERG

PROGRAM

AUGUST 2013

Introduction to the competition

"Fremtidens Bæredygtige Almene Boliger" is a competition organized by the "Ministeriet for By, Bolig og Landdistrikter" in collaboration with two housing associations, Lejerbo and Al2bolig. It is an ongoing open architectural competition that had its final submission in November 2013 but whose winner is as yet undecided. By choosing a competition which will potentially be built, it was possible to investigate the chosen design process against a realistic building program.

The two housing associations each provided a potential building site, the first in Lisbjerg, Denmark and the second in Seest, Denmark. Each site demanded working with different typologies, which depended on the characteristics of the context. The Lisbjerg site is close to the centre of the city with need for multi-story housing to accommodate the municipality's desire to increase the population. The Seest site is surrounded by 1-2 story residential villa housing and therefore required high density low-rise housing.

The purpose of the competition was to rethink subsidized housing in Denmark in terms of sustainability, while retaining the high standard of the Danish design culture for subsidized housing. It was proposed to use DGNB as a stepping stone when considerig sustainability. This was also to ensure that the project followed a holistic approach by implementing the social, economic and environmental aspects early into the design process.

The social aspect of rethinking subsidized housing was one of the main focus points of the competition, which was emphasized in the elaborate listing of 'soft values' regarding human comfort and health.
(Fremtidens Bæredygtige Almene Boliger – Åben konkurrence, 2013-2014)

Competition brief

GENERAL EXPECTATIONS
The competition brief stated a long list of demands, many related generally to the expectations, regardless of which site the project entry chose. A numbr of statements referred to soft values regarding the future inhabitants and their comfort, while others concerned more the building and construction demands.

THE SUSTAINABLE FOCUS
The practical and technical expectations can be summarized under the headline “sustainability”, since these encompass all aspects of obtaining a sustainable building design.

- Sustainability in the broadest definition - economically, socially and environmentally.
- Common demands to quality, as defined in BR10.
- Technical solutions and architectural quality were to be incorporated equally.
- The housing development must be certified by the DGNB certification system to a silver or gold honours level, as formulated by DK-GBC, Green Building Council Denmark.
- DGNB must not be limiting.
- Inclusion of energy optimization in the design solution and achievement of a 2015 low energy class as a minimum.
- Use of renewable and sustainable materials which are durable.
- Ensure a comfortable and healthy indoor environment in regards to temperature, air quality, daylight and sound insulation.
- A general project focus on energy consumption, water consumption, waste management, materials and spatial use.

THE HUMAN FOCUS
The competition expectations regarding human comfort, the so-called soft values, can be summarized as following:

- Create a good home environment
- Create homes for different life phases, life situations and family configurations.
- Support neighbourliness.
- Support quality in everyday life.
- Create an attractive community.
- Create attractive common areas, both for individual use and social gathering.
- Create a sense of security.
- Support diversity.

(Fremtidens Bæredygtige Almene Boliger – Åben konkurrence, 2013-2014)

From these multiple demands, of which there are many more in the competition brief, it can be concluded that the focus should be on creating good homes for a broad demographic. The human should be the central concern and the design should ensure a high level of comfort, health and living quality. The architectural quality to be equally a focal point in addition to sustainability for low energy buildings and DGNB certification.

The proposal for incorporating technical solutions with architectural quality has been interpreted as a desire to incorporate an Integrated Design Process.

MAIN FOCUS

Of the two proposed sites, Lisbjerg was chosen as the site for this project. The idea was to use the project at Lisbjerg to extract and demonstrate a holistic approach that would use the DGNB early in the design phase and incorporates DGNB into an Integrated Design Process. The approach helped establish the parameters that defined the final design. The competition set the frame for the project, wherein the design and the DGNB work method were developed.

SITE SPECIFIC DEMANDS

The competition required:
40 housing units
4000m^2 (including common areas)

5x Youth housing, total brutto 250m^2
10x Family housing, 2-3 rooms, total brutto 850m^2
25x Family housing, 4+ rooms, total brutto 2725m^2

Every apartment was also to be provided with a separate 2m^2 storage space.

- The building height could vary from three to five storeys, rising from the northeast to the southwest.
- The site should accommodate a future of 4500-6000m2 which should be a critical parameter in locating the first phase of the site development.
- Green areas should be a minimum of 40% of the building floor area – in this case 1600m2
- Rain and storm concerns should be considered in the design of the outdoor spaces.

Parking:

- One underground automobile parking space is to be provided per family apartment and one quarter parking space per youth housing. This is equivalent to 30 parking spaces. In addition seven ground levle parking spaces are to be provided, of which three are to be reserved as for handicap spaces.
- Two bicycle parking spaces are to be provided per housing unit, of which a minimum of 50 must be covered or closed off.

(Fremtidens Bæredygtige Almene Boliger – Åben konkurrence, 2013-2014)

The competition requirements have been incorporated into the project and accommodated as far as possible.

Subsidized housing

Subsidized housing is publicly supported housing of various types. In recent times, ghettoization has become a primary concern of this type of housing and a mixed demography, which includes both socioeconomically advantaged and disadvantaged people is considered of the greatest importance in combatting this tendency. It is therefore imperative that subsidized homes appeal to all segments of the society. The 'Danish model' of subsidized housing is based on cooperation, social responsibility and solidarity and the principle that everyone has equal rights to a subsidized home.

"Good, healthy and cheap homes for ordinary people." (Engell, 2012, p. 25)

This statement is a simplified description of subsidized housing by Hans Engell in his book "Danmarks Almene Boliger", but it contains the three main goals when creating subsidized homes i.e. high quality homes with a healthy environment at a low cost. The focus on quality and costs during both during the design and construction phases provides an attractive environment with low maintenance costs and therefore low rental rates. Most importantly the homes should be for everyone. (Engell, 2012)

High quality healthy homes appeal to all people. It is when trying to attract a diverse demographic, which is generally believed to lessen the many social problems associated with subsidized housing areas. This factor is a high priority with the politicians and is richly reflected in the legislation and funding for both new developments and the renovation of older housing developments developments. (Den almene bolig – i korte træk, 2013)

Subsidized housing consists of three types [Link 6-8]:

- Family housing
- Housing for the elderly
- Youth housing

Subsidized housing is generally built as either low density developments such as row houses or as apartment buildings. The three types of housing are often mixed together and rarely constructed as stand alone developments, Again, this is an initiative to encourage a diverse demographic. A primary challenge, however, in the creation of the mixed socio-ecomomic demographic in subsidized housing is the state's social responsibility to citizens requiring financial assistance. Subsidized housing makes up only 20% of the overall housing market but undertakes 100% of the social responsibility regarding the provision of housing. (Engell, 2012)

Originally subsidized housing stood for a mixture of both renewal and tradition and socio-economic boundaries were challenged. Historically, this housing type provided a central role in the development of high quality Danish architecture with projects from such architects as Steen Eiler Rasmussen and Hoff & Windiinge. The housing demands of the 1960's, in combination with the rapid industrialization of the building industry, led to some architectural gems but many examples of subsidized housing which could be characterized as junk. (Bendsen, 2012). Volume of construction over building quality began to be the trademark of this housing type.

In recent years subsidized housing has been associated with affordable housing for citizens of various cultures and ethnicities. This has often been seen in a negative light by the general population. A campaign called "Danmarks almene boliger" has set out to change this negative association with the housing as just 'cheap apartments'. They argue:

"Ikke fordi vi har svært ved at leje dem ud, men fordi både vi selv og resten af Danmark har brug for at få et mere nuanceret billede af de almene boliger. Danmarks almene boliger tilhører os alle og det kan vi godt være lidt mere stolte af." [Link 9]

The different housing associations have no trouble renting out these apartments, in fact, the waiting lists are long. However, to create a more nuanced picture of subsidized

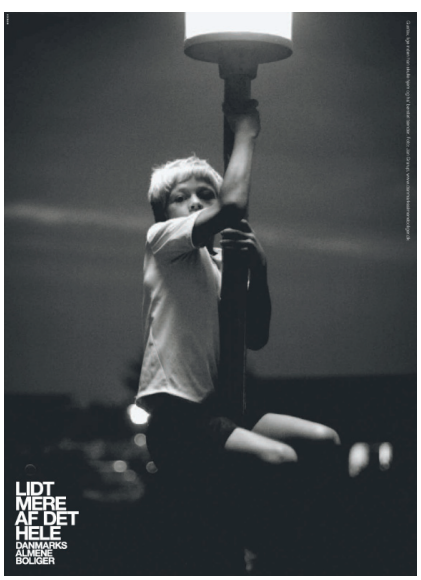
housing, the campaign was made to show who lives in these housing types. It is an insight into the residents and communities. The campaign asserted that 'We should be proud of our subsidized housing – it belongs to us all'.

The original goal of subsidized housing was to give the working class better living and housing conditions, which roughly can be summarized as healthy homes filled with light and air. This goal remains today, to solve housing issues where resources are scarce. (Bendsen, 2012).

The housing agreement of 2010 defines the demands and properties of today's subsidized housing as such (Engell, 2013, p. 22) (Boligaftalen 2010, 2010):

- Solve building social purposes
- Provide suitable housing for all with a need
- Allow an equitable rent
- Provide tenant influence
- Create efficient housing associations
- Create well-functioning housing developments
- Support Diversity and well-being
- Emphasize safety
- Counteract ghettoization
- Provide new developments in high quality
- Provide up to date housing
- Ongoing maintenance and modernisation
- Be a role model for the construction industry

The intentions are to create the subsidized housing of the future, which means bringing back the quality to inexpensive housing developments and future-proof them. They are for all citizens and must therefore be attractive to all. The quality is defined by aesthetics, functionality, materials and technical solutions; and only when all four aspects are incorporated in the design process, will high quality occur. In this way, the poor associations related to subsidized housing can be avoided.



Pictures from the campaign "Danmarks almene boliger" by Jan Grarup. [Link 9-10]

Legislation related to subsidized housing

Subjects regarding the legislations of subsidized housing:

- Everyone has a right to subsidized housing
- Buildingplan 2010, 2013
- Spatial requirements
- Functional requirements
- Funding
- BR10
- Energy requirements
- No touch of luxury

The fundamental principle of subsidized housing is that all people have a right to this housing and that all people have a right to a roof over their head. This means that anyone can apply for a subsidized home but that in specific cases the housing will be used by municipalities to fulfil social needs.

SPATIAL REQUIREMENTS
In short the spatial legislative requirements can be summed up as following:

- Family housing must not exceed 115m2 and must contain own toilet, bath and kitchen.
- Youth housing must not exceed 50m2.
- Housing for the elderly must consider accessibility.

(Den almene bolig i korte træk, 2013) [Appendix 1]

Besides these requirements, subsidized housing must follow the building regulations and energy requirements set by the state and stay within the budget set by the municipality. Each subsidized housing association is run by the classic Danish model of residential democracy for rental housing, where the municipal funding is distributed between the different maintenance tasks. [Link12]

LUXURY
The legislation of subsidized housing requires no added luxury, but what 'luxury' includes is not defined. The subsidized building legislation, in Danish called Almen Boliglov, paragraph 108 states:

"Boligerne skal være udstyret og indrettet således, at de opfylder de boligsøgendes rimelige krav til boliger af den pågældende art. Boligerne må ikke have luksuspræg."

This states that the housing must be equipped and furnished so to fulfil reasonable demands for the housing seekers of the housing type in question. The housing is not allowed to have a touch luxury. (Den almene bolig – I korte træk, 2013, p. 4)

What is luxury?

The necessary equipment includes the demands stated earlier: own toilet, bath and kitchen. But what can be categorized as added luxury and what is simply good quality? Luxury is defined as following in the dictionary:

"a material object, service, etc., conducive to sumptuous living, usually a delicacy, elegance, or refinement of living rather than a necessity" [Link 13]

While good quality is defined as an adjective meaning 'of a high standard'. [Link 14]

When it comes to designing subsidized housing these definitions explain why all design elements and decision must have a purpose. If an element is added in the design without having a specific purpose it can be seen as luxury since it is a "refinement of living rather than a necessity", using the words of the dictionary.

Designing 'good quality' and choosing solutions of 'good quality' can be seen as choosing durable, low maintenance solutions. Although subsidized housing should be inexpensive, some details and materials can be argued to be chosen in a good quality to reduce maintenance and life-cycle costs. However, there must be a reason to choose a more expensive solution i.e. that the choices in the design process must be defended as being economically responsible so as to avoid an appearance of added luxury. It is therefore the project's intention to have arguments for the decisions made during the design process.

Demographic

CONCEPT OF SUBSIDIZED HOUSING
The concept of subsidized housing is based on the idea of creating homes for all. It is a way of taking social responsibility and securing every Danish citizen a place to life. Subsidized housing is something that should be upheld and cherished as a Danish tradition, which is why campaigns like the "Danmarks Almene Boliger" work hard to change the perception of subsidized housing. This leaves a large and diverse demographic consisting of families, young people, students, singles and elderly to be accommodated. To better define their needs and desires for the design approach of creating good homes, the demographic tendencies of these people are studied. How do these people live, both in regards to their work and social life, but also in relation to their physical surroundings? (Danmarks almene boliger, 2012) [Link 9]

THE MODERN DANE
Danes are very private and wish to maintain their privacy independent of which housing type they live in. The research project "Fremtidens By" by Raldania takes a closer look at the modern Dane and expected future tendencies.

The research states that the contemporary society is a knowledge-based society. This means most jobs require a low level of physical activity and that most Danes sit still for most of the day. Some spare time is spent exercising, preferably in close proximity of the home, while the rest is spent in the home relaxing.

Studies also show that although people spent less time at home, they spent considerably more of their money on it. The home is a reflection of the individual, which is highly important in a community where the individual is in focus rather than the communal. People's interpersonal interaction has also become more media based and neighbourliness is often forgotten.

The standard of living of modern dane has also evolved and people have higher demands on both the home front and at work. The idea of personal development and well-being has become a focus, as people are busy achieving their individual dreams and shift between different jobs, partners, interests and homes in the pursuit of happiness.

The tendency of moving to the cities is expected to continue, with more women than men moving to urban areas. In the cities people often live alone, with about a quarter of the inhabitants over the age of 18 in Copenhagen living alone. This tendency is expected to evolve to a third of individuals in this demographic.

In regards to sustainability, it is believed that the modern Dane is interested in sustainable products and the future Dane will increasingly demand environmentally conscious solutions.
(Fremtidens By, 2010)

TEMPORARY LIVING
Subsidized housing is characterised by being rental homes. Ownership has been introduced, but has not yet achieved any visible success. Rental housing is often used by people as a temporary home, as it is less binding than ownership. Even though many housing associations allow people to move from one apartment to another within the association to accommodate changes in the family situation, the tendency is for people to move from the affordable housing as soon as their economy allows. (Ærø, 2002)

Based on the tendency of people moving from subsidized housing and rentals in general, the 'home' becomes more temporary and relationships with neighbours can be considered to be harder to form, as neighbours change. In addition the tendency to move when financial conditions allow makes it difficult to create communities with a variety of economic incomes. This is a focus for government efforts but is almost impossible to achieve according to Ærø's research. (Ærø, 2002)

The inhabitants of subsidized housing can be generally divided in two categories: The voluntary demographic, who choose to live in subsidized housing, and the involuntary demographic, who have been assigned a subsidized home or do not have the economics to live in any other housing type.

THE VOLUNTARY DEMOGRAPHIC
Based on the studies by Thorkild Ærø from 2002, the profile of people who live in subsidized housing can be summarised as such:

Considerations:

- Selection of shops in close proximity of the home
- Neighbourliness
- Choosing not to live in mid-town
- Close to public transport and bicycle lanes
- No emphasis on the architecture of the building. When the rent is low, so are the expectations to architecture.
- No emphasis on the reputation of the area
- The apartment is often a temporary home.

Profile:

- Often without a job.
- Has a low income.
- Often they did not grow up in an owner-occupied home.
- Often from parents without an academic education.
- Prefer to live amongst like-minded, especially young people 18-25 years and adults aged 40+ have this preferency.

(Ærø, 2002)

DEMOGRAPHIC BY NECESSITY

Besides the demographic that chooses to live in subsidized housing, a part of the inhabitants live there by necessity, either by being assigned by the municipality or not having the economy to live anywhere else. This type of inhabitant will have an affect on the image of the housing development and thereby the voluntary demographic.

The municipality assign people to a housing development in cases they call urgent social housing tasks. The exact reasons are not listed, but can be in case of divorce or people who involuntarily become homeless. [Link 11]

This demographic is a mixture of people choosing to live in subsidized housing, but also some who live there by necessity. This gives a motley demographic of different life situations, heritages and family situations. Many of the characteristics seem very negative when summed up in this matter. In this project the emphasis will be on creating good homes no matter the heritage and job situations and focus on the needs which are stated, such as proximity to shops, transport and creating a good neighbourhood. Other factors such as architectural quality and recreational areas will be additional qualities to raise the standards of subsidized housing.

DEMOGRAPHIC OF THE COMPETITION

The competition defines the demographic through its spatial program. The wish is to create 40 apartments in Lisbjerg, 5 for young people and students and 35 for families. The focus is therefore on families and by demanding more apartments with three or more rooms, they target families with children. Lisbjerg is a family oriented area with a new school and playground, which will be further analysed later in the context and site analysis. The profile of the modern Dane and the person choosing to live in subsidized housing will therefore be seen in connection to the demographic of the competition, which is mostly families with children. (Fremtidens Bæredygtige Almene Boliger – Åben konkurrence, 2013-2014)

DEMOGRAPHIC CONCLUSIONS

- Focus on the human scale.
- Creating a sense of belonging through quality and pride in living there.
- Green recreational areas.
- Opportunity to both exercise and relax.
- Attractive common facilities.
- Attractive apartments.
- Heighten the standards of subsidized housing.

- Room for the individual in the home – private zones to withdraw and relax.
- But simultaneously create common areas in the home – common zones for socializing and higher activity level.

"The good home"

The subject of the project is 'sustainability' and the objective is to use DGNB in a sustainable integrated design process, yet the most important task is to create a good home. Regardless of the process and the standards of sustainability, the human and the home constitute the most important role in creating housing.

HUMAN SCALE
It is the architect's purpose to relate to the human and to human needs. As Lisa Heschong describes it:

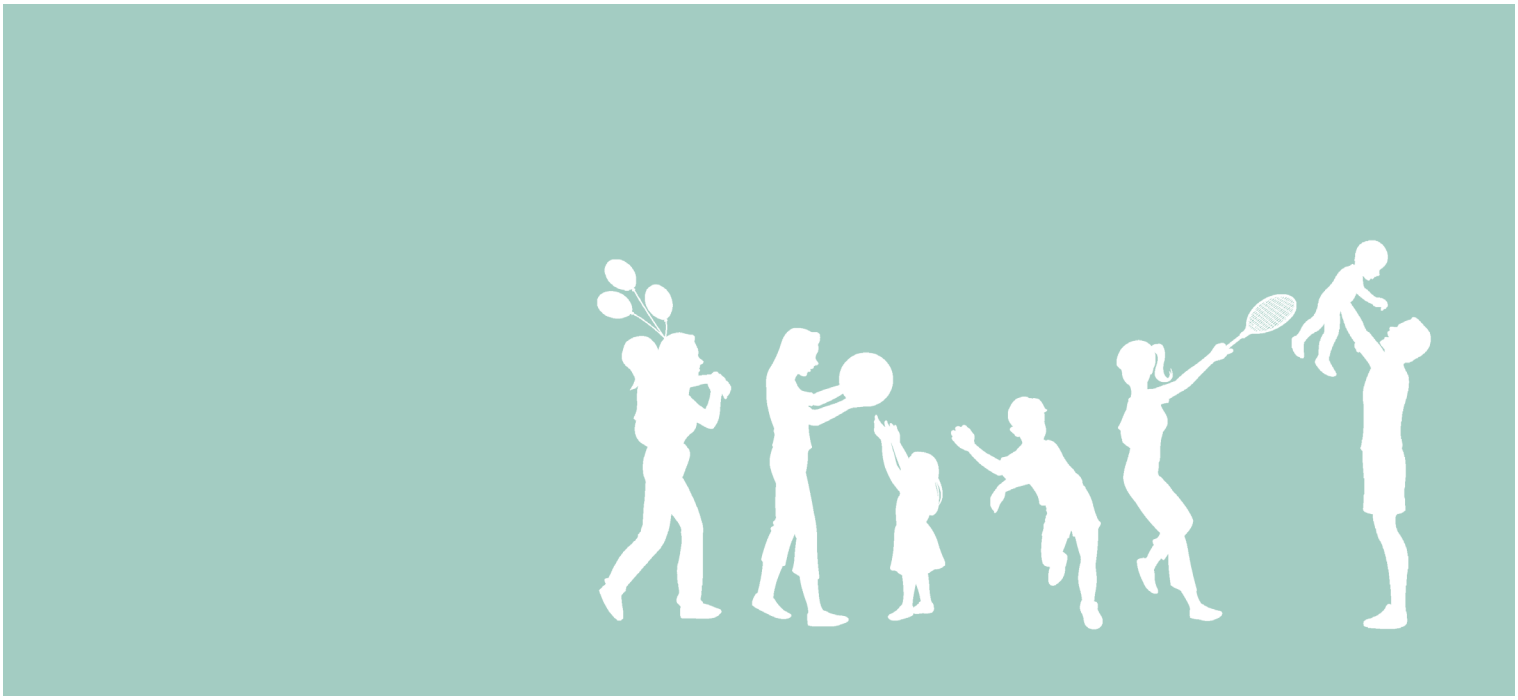
"I have looked at the examples not with the eye of a historian (How did it come to be?) or of an engineer (How does it work?) but rather with the eye of a designer (How is it perceived? What role does it play in peoples' lives? What is wonderful about it? How is it part of a greater whole?). (Heschong 1979, viii-ix)

The design must reflect an understanding of human needs and how humans live, to be able to create a home. The focus will be on the human and give, as the competition wishes, quality in the everyday life of the inhabitants. The goal is to design for people's needs and for the future, while remembering quality and comfort. Designing housing affects the life of the inhabitants. This must be remembered throughout the entire project.
'HOMENESS'
"The ultimate condensations of existential meaning are the images of one's room and home. The experience of 'homeness' condenses our feelings of self, belonging, security and meaning. Architecture arises from the concept and experience of home, and even the multitude of other functions of buildings - work, gathering, worship - derive from the mental essence of dwelling. Due to its primordial significance, the house continues to be, poetically, the most potent design task in architecture along with the buildings of belief and worship [...]" (Pallasmaa 2011, p. 120)

Juhani Pallasmaa underlines the importance of the poetic task of creating a home and especially his statement 'The experience of 'homeness' condenses our feelings of self, belonging, security and meaning.' will be used in the understanding of a home and in the creation of such.

The definition of a home has changed from one decade to another based on how the home is used. The housing researcher Mark Vacher compares the production society, when people lived in a farmhouse and worked at the farm, with the consumer society, where the consumer leaves the home to work and the home thereby becomes a refuge and a place to relax. [Link 17] The transformation of the home can also be explained as by Neufert Architects' Data, 4th edition:

"Living in houses, originally the spatial realisation of basic human needs, has developed in modern society into a



complex interaction of a multitude of influences subject to the most varied requirements and individual quality standards." (Architects' Date Fourth Edition, p. 135)

Creating a subsidized home is about combining the legislative parameter (building law, district plan and subsidized regulations) with the qualitative and poetic parameters (architectural visions and user needs and wishes). The project wishes to regard the 'individual quality standards', but not in the way of individual influence as in a detached house designed for one particular family, but seeing the individual needs and quality standards as the needs and quality standards of the society; or the demographic.

WHAT IS A HOME?
The feeling of home is having a special place to sit, to eat, read, relax, talk etc. It is having a favourite place to miss, being homesick. You hide away from everything, cuddled up in your favourite place. Mark Vacher has tried to describe a home based on interviews with people who have lost their home in the fireworks accident in Seest i.e. based on his theory that people who have lost a home can better describe what the home was to them.

"Et hus er en genstand. Men et hjem er en tilstand - en relation, et forhold, en forbindelse mellem et menneske og en genstand." [Link 17]
Translated the quote states that a house is an object, but a home is a condition – a relation, a relationship, a connection between a human and an object. To lose a home is like losing a part of one's self, which means the home reflects the inhabitant and becomes a part of them. A home is connected to safety, family, comfort and warmth in the northern countries. Home is something to miss and not wanting to leave, like the warmth of the cover in the morning when the alarm clock goes off. [Link 17]

This connection to a home is acquired over time, a gradual development where a person inhabits a house or room and makes it his own. Vacher comes to the conclusion that a home is:

- Personally decorated
- Personally furnished
- A reflection of the inhabitant
- A place of relaxation
- A place to put your feet up
- Warmth
- Security
- Cosiness
- A fortress of protection
- A place of comfort
  [Link 17]

The design challenge will be to accommodate these qualities in the subsidized housing or to create frames where these qualities can evolve.

At Midummer's Eve people in Denmark still gather around the fire.

"The classic common and individual areas within a house are becoming less significant in terms of area, and the 'multi-purpose room' (living-working room, shared living spaces as in a flat etc.), which occurs in both private and public housing, is developing into a significant room type."
(Architects' Date Fourth Edition, p. 135)

The open concept home is evolving and has become a popular plan solution for many users. The 'multi-purpose room' is often located in the living room and kitchen area of the home, where cooking, relaxing and socialising can be combined with work and play.

Traditionally the place to gather is the kitchen, by the warmth of the stove and in the aroma of the food being prepared. Especially warmth and fire has been the centre of gathering since the beginning of man. The gathering around the bonfire evolved to the open fireplace or the hearth, but with the modern technology of heating and cooling systems the hearth has become a symbolic thermal centre of the home or simply absent. (Heschong 1979)

But the longing for that one place to gather remains. We have a need for a gathering point, where we relax, find comfort and spent time with friends or family. The kitchen is still often considered a warm place to gather and meet – even though all the other rooms might be the same temperature - it has taken on a meaning and association of its own (Heschong 1979)

In the book Thermal Delight in Architecture, the story of Lawrence Wylie and his family tells how a winter in a cold French cottage brought the family together. Keeping all the fires burning and the heating of all of the rooms was a time consuming affair and the family decided to move into the kitchen for the duration of the winter. They changed their behaviour to work, play and eat in the same room, spending time together and apart in close proximity with each other. In the summer, their life moved outside and out in the public.

Had the family not been influenced by the thermal conditions, they would probably have spent less time together in the French cottage, a time he seems to recollect with fondness. The story inspires to create a place to gather in the home, maybe not by necessity but by choice. Instead of all users sitting in their respective rooms, their activity can be collected in one room of the apartment and maybe create an increased socialisation in the family. This room could be the open concept solution of a living and kitchen area. The objective is to create the room to attract the residents and encourage them to stay.

The feeling of warmth, literally, symbolically or in association, can be the focus of the room, since keeping warm is a focus in the northern climes.

"With its circle of warmth, the fireplace had once been the centre of family life. Its dancing light, smoky smells, and warm crackling created ambience that made a house more a home." (Heschong 1979, p. viii)

The different variations of warmth in a home will be explored in the process and the qualities of a home, mentioned earlier in this text, can be transferred to the place of gathering in the home.

CONNECTING TO THE SOCIAL SPACE
The good home and the good community go hand in hand. The social gathering in the community is just as important as the gathering in the home.

"New communities need shared spaces, shared rituals & support to build social networks."
(Woodcraft 2012, p. 31)

It was, therefore, the intention of the project to create an outdoor space for the inhabitants to socialize and to support the social sustainability. The outdoor areas has been divided in zones of semi-public spaces, primarily being used by the inhabitants, and private areas for all.

The goal was to connect the private gathering in the apartments and the public gathering on the site, either physically or visually.

Sustainability

To understand what the term sustainability is, a general overview of the orgins and understanding of the term are necessary. An understanding of the history and definition helps create an individual understanding and usage of the term.

The broad understanding of sustainability defined as the three branches of social sustainability, ecological sustainability and economic sustainability is derived from the 1987 UN-report "Our common future" by the World Commission on Environment and Development, also known as the Brundtland-report. The goal was to broaden the knowledge and understanding of sustainability and to create an agenda regarding the resource and environmental problems of the world. [Link 1]

This all inclusive understanding and usage of the term sustainability is also, according to the Association of Danish Developers (Bygherreforeningen), the only correct way to approach the topic of sustainability. (Hvidbog om bæredygtighed i byggeriet, 2013, p. 17)

In terms of building works sustainability is the taking of responsibility and helping to plan for the future. It is an ethical approach to building and demands that people in the future do not suffer from current decisions and our over usage of raw materials.

To be all-inclusive in sustainable developments, all three branches must be addressed at different scales: the global scale, the city scale, the building scale and the building component scale. In both the analysis phase and the design phase, it was important to maintain an overview and think sustainability in its totality and not only focus on energy reduction, which is the common misunderstanding in the building sector. (Hvidbog om bæredygtighed i byggeriet, 2013)

The goal has been to meet the demands of the present without compromising the future, by working systematically with each of the branches of sustainability and combining it with building technical knowledge and architectural quality.

The focus is to create comfort, while reducing the use of resources and waste at all stages; design, procurement, construction and operations of the building. (Christiansen, 2013).

In a global sense, cities are the great sinners when it comes to CO2 emission and pollution. However, it is still more sustainable for people to live closely together in regards to space, material and energy consumption. It also frees more land for agricultural use. Presently, cities around the world are the great polluters, but they are also the answer to a lower carbon footprint. It is a question as to how we use the city and how the city is planned. (Hvidbog om bæredygtighed i byggeriet, 2013)

"Creating cities and communities that work socially, economically and environmentally and can be sustainable in the long term will be one of the main challenges of this century."

The statement comes from the report "Design for social sustainability" by Social Life in England (page 49) and supports the idea of incorporating all three branches of sustainability, especially focusing on the social sustainability, which provides for a functioning community. (Woodcraft 2012)

ENVIRONMENTAL SUSTAINABILITY

Environmental and especially low energy building design is the focus at AU Architecture and Design and therefore of this project. The goal is to achieve low energy design and live up to the 2020 energy demands of the Building Regulations, while creating high quality architecture and a good indoor climate.

The environmental branch of sustainability is the one most used in the understanding of sustainability regarding building design. It is measurable and can be certified e.g. with DGNB, BREEAM or LEED – the three most common systems, when demonstrating sustainability awareness and environmental responsibility. Certifications give an environmental image for the building and its owner. Even the legislation of the Building Regulations 2010 (BR10) focuses primarily on environmental goals, such as indoor climate and energy consumption. (Hvidbog om bæredygtighed i byggeriet, 2013)

In terms of environmental sustainability, it is important to choose durable materials of high quality. Sustainable materials are local materials, which are renewable and reusable. Danish architecture has a long history of building with durable local materials, which also increased the overall image and perception of the buiding works i.e. contained components of social sustainability as well..

Aspects of environmental sustainability:

- Climatic conditions
- Land usage
- Materials and life expectancy
- Lifecycle analysis
- Energy consumption
- Generation of waste
- Indoor climate
- Physical health

(Christiansen, 2013)

ECONOMIC SUSTAINABILITY

In regards to the building sector, the economic branch of sustainablilty deals with securing long-term economical interests and investments for both cities and buildings. Another factor is resource and planning optimisation. Planning is especially important when considering economy, since many extra and unforeseen expenses can be avoided through thorough planning in all phases; process, building, planning, renovation and use. Budgets are often limited and changes, unforeseen problems and amendments are often very expensive. The focus should be on creating long-range solutions of high quality.

The economical incitement is often the one missing when companies consider building sustainable. A widely held view is that the money is too scarce to build sustainably due to the financial crisis. (Hvidbog om bæredygtighed i byggeriet, 2013). Companies are also not willing to pay extra for a building “just” to be called sustainable. It is therefore important for the public sector to go in the lead and show examples of how it is economically viable to build sustainably and not necessarily an extra cost to make a sustainable decision.

This project tries to show a thorough planning process and take into consideration how the cost of materials, construction and maintenance would be fundamental to our choices. Many decisions have taken the Lifecycle Costs into consideration, but this is not a part of the learning plan and an actual LCC has therefore not been possible.

Aspects of economic sustainability:

- Secure long-term economical interests and investments
- Optimising resources
- Optimising planning process
- Focus on life expectancy
- Lifecycle cost
- Legislation
- Optimising maintenance

(Christiansen, 2013)

SOCIAL SUSTAINABILITY

Social sustainability is based primarily on soft values such as social conditions, human aspects and aesthetics, which are difficult to measure compared to environmental and economic sustainability. User satisfaction surveys are one of the few quantitative tools used in evaluating social sustainability. Other methods may include general information collected by the authorities including crime and vandalism rates, ecomomic composition of residents, etc.

Classic design issues related to social sustainabilty include creating healthy environments and varied, well-functioning societies, both for residents of today and in the future. (Hvidbog om bæredygtighed i byggeriet, 2013). The Dainish Ministry of City, Housing and Rural idstricts (Ministeriet for By, Bolig og Landdistrikter), emphasize the importance of creating a good environment and avoiding ghettoization in both old and new housing developments. Focus on social sustainability can help achieve this goal. (Boligaftalen 2010, 2010)(Boligaftalen 2013, 2013)
In terms of social sustainability, this project has focused on the creation of a building environment, which could be attractive to all socio-ecomomic segments of the society. Good buildings that respond to demographic tendencies of the focus on the private individual's home, while still strengthening a sense of community, can hopefully counteract the ghettoization of subsidized housing and its use as 'temporary' housing.

Aspects of social sustainability:

- Create desirable cities
- Create comfort
- Support quality of life
- Support social diversity
- Reduce illness
- Create variety
- Support well-being
- Allow accessibility
- Reiforce cultural quality
- Support spiritual quality
- Provide architectural quality

(Christiansen, 2013)

SUSTAINABLE EFFECT ON THE DESIGN
All technical decisions have an effect on the design and architectural expression – shape, volume, light, surfaces, layout, interior etc.

MATERIAL
The choice of material is an important factor in the project as well as belonging to all three branches of sustainability.

ENVIRONMENTAL
Low energy design with optimisation of the embedded qualities and use of passive technologies, will have on impact on the design. If necessary and according to the energy demand, renewable energy production technologies can also be included.

Renewable materials, which will affect the environment the least, e.g. using local materials and minimise waste – can be compared to the carbon footprint approach to environmental consciousness.

ECONOMIC
Subsidized housing has limits for how costly each home is allowed to be and includes requirements for the size of each apartment, as well as a demand for no luxury. The focus regarding economy will be planning and optimizing maintenance, in regards to surfaces and spatiality.

Choosing a material, which is durable and has a long life expectancy and demands low maintenance, affects the cost of the building througouth its entire lifetime – this can be compared with the Lifecycle Cost (LCC) approach. Also planning of both design and building phases can provide economic efficiency.

SOCIAL
Creating healthy and attractive environments affects the thermal comfort and indoor climate, daylight, outside areas and accessibility amongst other issues. The goal has been to create green outside areas for recreation and activity, both for residents and the general public. The form and dimensions of the apartments reflect an understanding of comfort and life quality, which is discussed through a definition of a good home and a tectonic approach.

Materials often create associations for people and this association can affect the image of the entire building complex. It has an impact on which people want to live there and the way it patinates can have an impact on who remains a resident and how the area evolves socially.

Certification Methods

Certification councils.
Governments regulate building standards in their respective countries and continuously strive to keep a high standard of architecture and design. In recent times the direction has been toward sustainability. This project addresses the environmental problems that have emerged through many years of backward thinking decision making in the building sector and to create a better future for the next generations. The focus of sustainability has therefore opened a new market for developing knowledge to aid the design process and secure a sustainable approach. Different certification methods have emerged because of this. The four broadest methods are outlined on the following page:

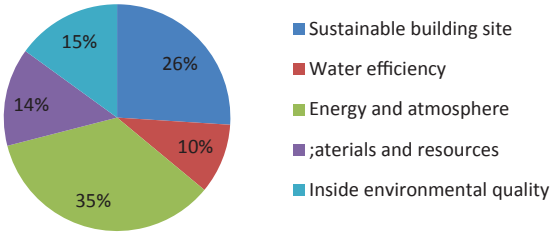
LEED - *Leadership in Energy and Environmental Design*
Introduction: 1999
Revised: 2009
Origin: United states
Countries:
Argentina, Brasil, Canada, Chile, Columbia, India, Italy, Jordan, Mexico,
United Arab Emirates (Both LEED and BREEAM)
Polen (Both LEED and BREEAM)
Romania (Both LEED and BREEAM)
Russia (Both LEED and BREEAM)
Spain (Both LEED and BREEAM)
Sweeden (Both LEED and BREEAM)
Turkey (Both LEED and BREEAM)

BREEAM - *Building Research Establishment Environmental Assessment Methodology*
Introduction: 1990
Revised: 2011
Origin: UK
Countries:
Netherland, Norway,
United Arab Emirates (Both LEED and BREEAM)
Polen (Both LEED and BREEAM)
Romania (Both LEED and BREEAM)
Russia (Both LEED and BREEAM)
Spain (Both LEED and BREEAM)
Sweeden (Both LEED and BREEAM)
Turkey (Both LEED and BREEAM)

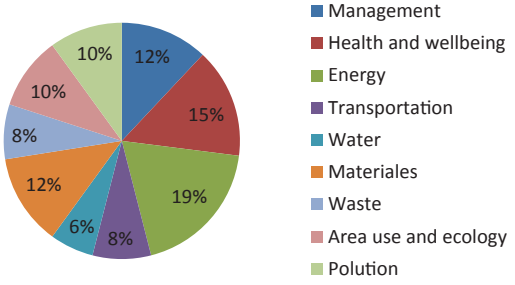
DGNB - Deutsche Gesellschaft für Nachhaltiges Bauen
Introduction: 2009
Revised: 2009
Origin: Germany
Countries:
Bulgaria, Denmark, Switzerland, Austria

HQE - High Quality Environmental standard
Introduction: 1992
Origin: France
Countries:
Belgien, Luxembourg, Algeria, plus several more

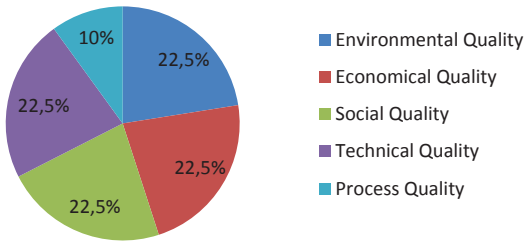
LEED



BREEAM



DGNB



HQE

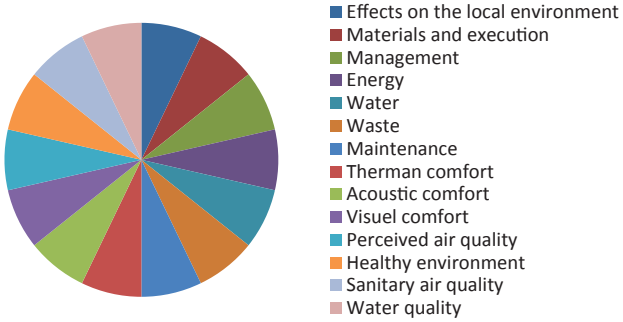
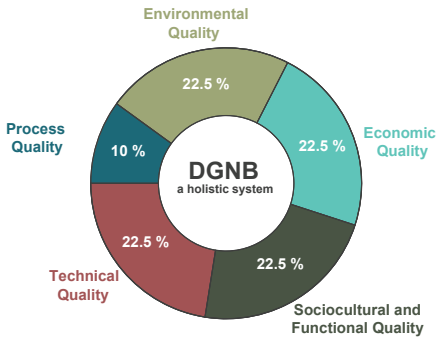


Diagram of the individual schemes weighting of the main categories. In HQE all 14 categories assigned equal weights corresponding to approx. 7% for each category.

DGNB
Deutsche Gesellschaft für Nachhaltiges Bauen

DGNB is a certification system that is used to certify that a building is sustainable. The system looks into all phases of the design process to ensure a complete solution. The DGNB is divided into 6 categories, Environmental quality, economic quality, Sociocultural and Functional quality, technical quality, process quality and site quality. The first 4 mentioned each weigh 22.5 % of the final score and the final 10 % is the process quality. The site quality must be taken into consideration for certification. The method is widely spread in germany and has in the later years begun to be implemented with the danish building regulations.



The equality created by weighing the 4 qualities (environmental, economic, sociocultural and functional and technical quality) shifts the direction of sustainability from todays energy efficiency focus to a wholesome sustainable solution. The certification method makes it possible to measure sustainability and thus improve buildings/ neighbourhoods.

As Christine Lemaitre states sustainability all comes down to one thing: Better quality of life - for us and for future generations. (DGNB.de, nov, 2013)

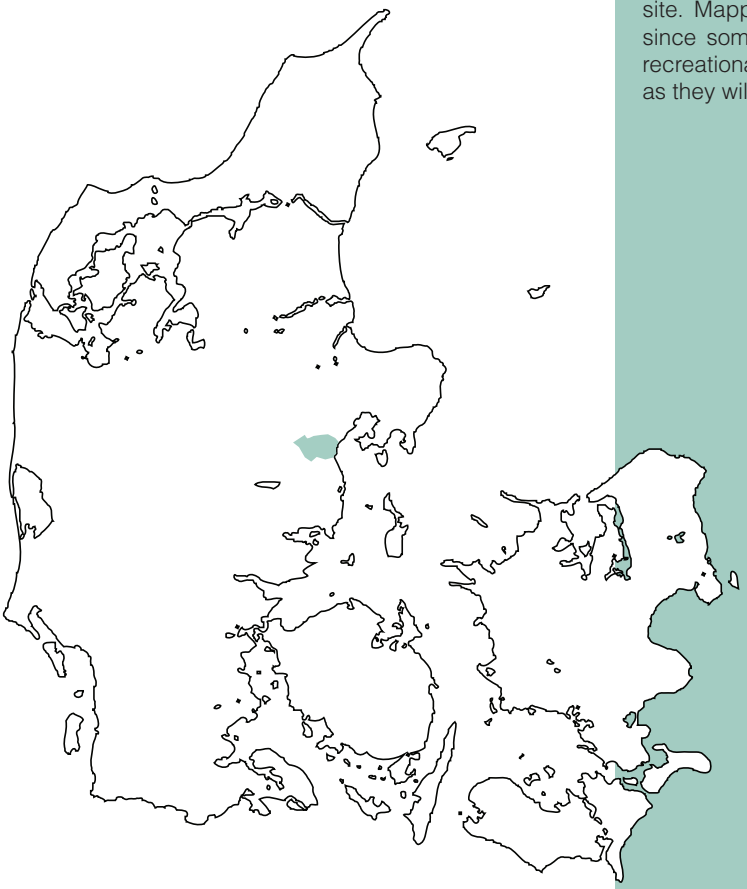
In 2011 DK-GBC (The danish green building council) chose DGNB as the main certification method for measuring sustainability. (dk-gbc.dk, nov, 2011) The reason was to make it easier for investors, tenants and financial partners to use one system to figure out how sustainable a building is.

The intention of this project is to implement the DGNB into the design process by first interpreting the DGNB criteria through the limited information that is available to the public, and then later translate these criteria that are created for office buildings to fit to a residential building.

Context analysis: Lisbjerg

Lisbjerg is located in Central Jutland, north of Aarhus. Lisbjerg seems more like a village than a suburb to Aarhus with only one bus stop, no shopping possibilities and cars rushing through the main street much faster than allowed. Plans are being made, however, to expand Lisbjerg to house the many people who wish to live close to Aarhus.

The context and site analysis contains an observation of traffic, access, facilities, landmarks and typologies of the context and includes a topographical analysis of the site. Mapping of green areas and vegetation is included, since some of the green areas must be kept as parks or recreational areas. The future plans for Lisbjerg are included as they will significantly affect the site in the future.



ACCESS

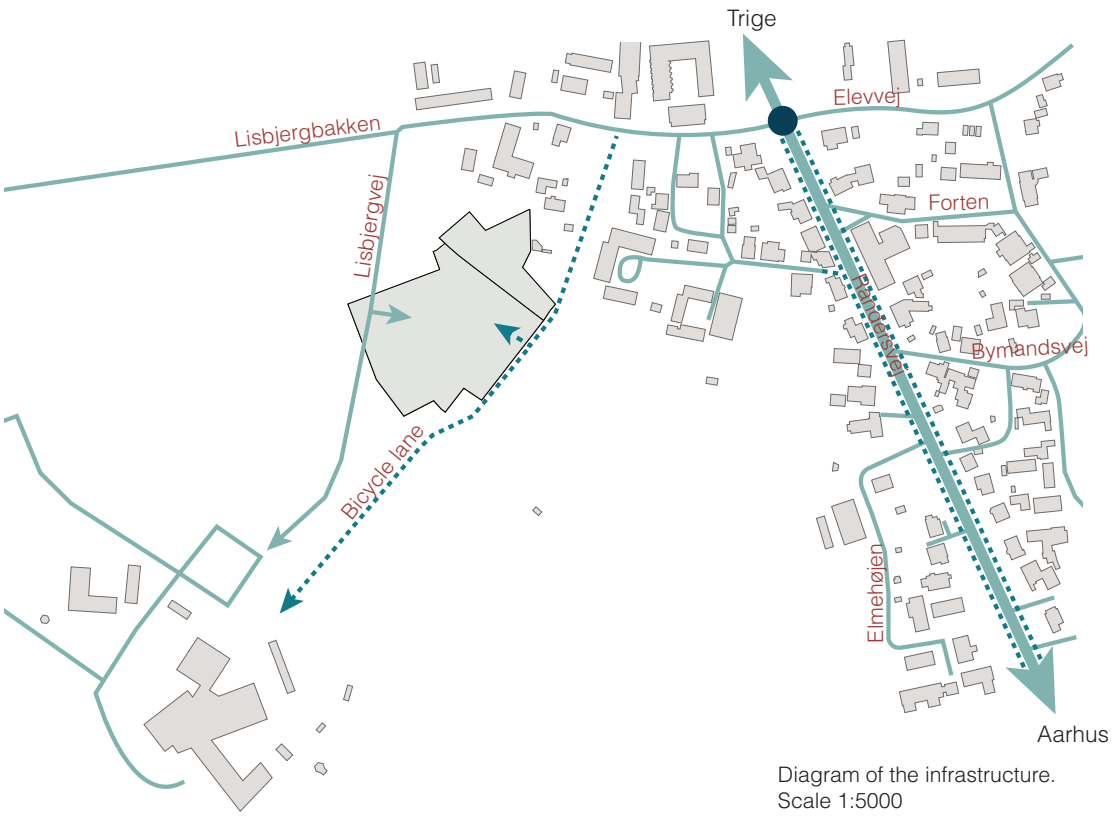


Diagram of the infrastructure.
Scale 1:5000

The direct access to Lisbjerg is by the main road Randersvej. The main road is heavily trafficked by cars and bicycles and divides Lisbjerg in two, the older part to the east and to the west a mixture of old and new buildings. Lisbjerg has one bus stop at Randersvej, where the bus can be taken to the Aarhus train station in approximately 30 minutes.

The site is a 5 minutes walk from the bus stop, but can also be entered by car or bicycle. By car, the site is accessed from the west using Lisbjergvej and on bicycle the site can also be accessed from the east from a bicycle path.

Main road

Secondary roads

Bicycle lane

Bus stop

FACILITIES, LANDMARKS AND TYPOLOGIES

Diagram of facilities and typologies.
Scale 1:5000

Lisbjerg consists mostly of detached one family houses with their own garden and garage. A few newly constructed row houses and one dormitory can also be found in the town. The demographic is primarily of families with children and an automobile is almost a necessity, as Lisbjerg has no other shopping options other than a petrol station and a pizzeria.

The town has some small business owners, such as a hair salon and a driving school, but both businesses are a part of private homes.

Lisbjerg has two large public institutions, the newly built school and the church. The church is located in the old part of town, while the new large school is located on the edge of the town towards the newly planned town expansion south of the site.

Detached family houses

Row houses

Supporting functions
e.g. garage, shed

Shop, business, school

1 > Lisbjerg Church

2 > Daycare

3 > Lisbjerg Forest

4 > Aarhus Camping

5 > Recycling Centre

A Lisbjerg School

B Youth Centre

C Dormitory

D Hair dresser

E Pizza
Car repair shop
Real estate agent

F Lisbjerg Fritidsliv, shop

G OK Plus, petrol station

H Driving School

VEGETATION

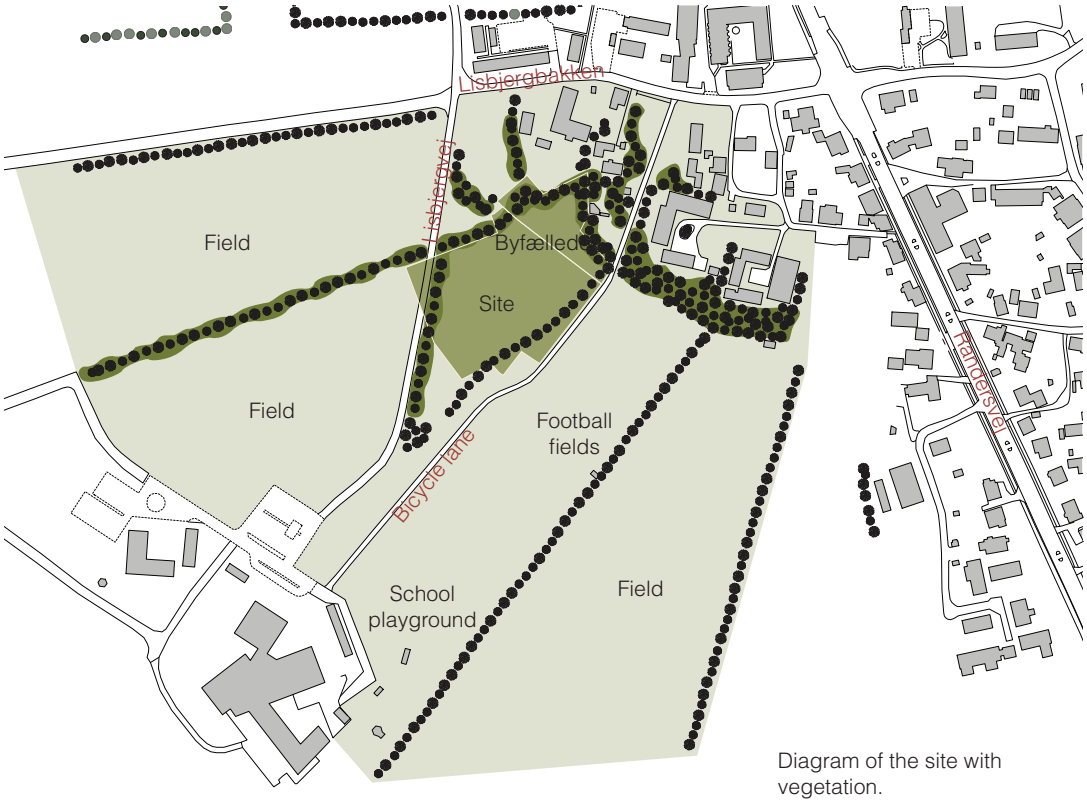


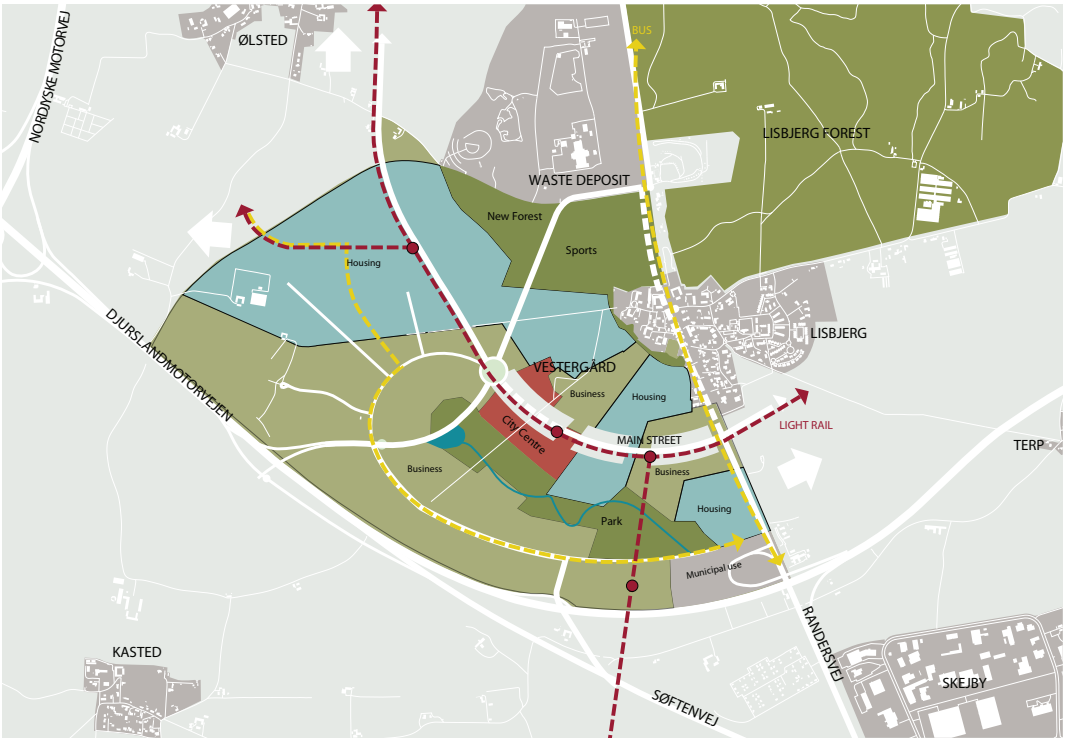
Diagram of the site with vegetation.
Scale 1:5000

Byfællede to the north-east of the site. It is an extension of the site, but must be held clear of buildings and used as a green recreational area in Lisbjerg.
The green area separates the site from the surrounding neighbours.

To the south-east three football fields leave a large open green area for sports and socialisation. Aarhus can be seen from the treeline adjacent to the football fields and will also be visible from the upper floors of the building.

To the south-west the school has green areas and a playground close to the site. The playground is available for use by the public outside of school hours. It has therefore not been considered necessary to place a playground on the site.

FUTURE LISBJERG



Municipal plans for the future of Lisbjerg. [Appendix 2]

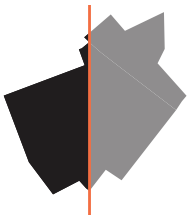
Lisbjerg is expected to be expanded from the present 900 inhabitants to 25.000 inhabitants in the future. This expansion is divided in three phases, from which the first phase includes the project site and is included in the urban plan.

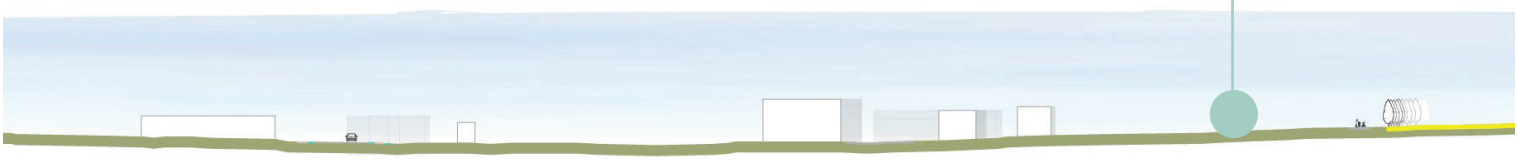
Lisbjerg plans to construct a new main street and city centre. Most of the traffic passes through or originates at this main street. A light rail system is planned to follow the new main street, while busses will pass through the old main street. A new super bicycle path will begin at the new main street and run to Aarhus city centre.
The plans for the expansion involves a variation in typologies and functions including mixing housing, business, cultural and recreational facilities as shown on the illustration above, which is based on the municipal plans for Lisbjerg. The source of information is shown in appendix 2.

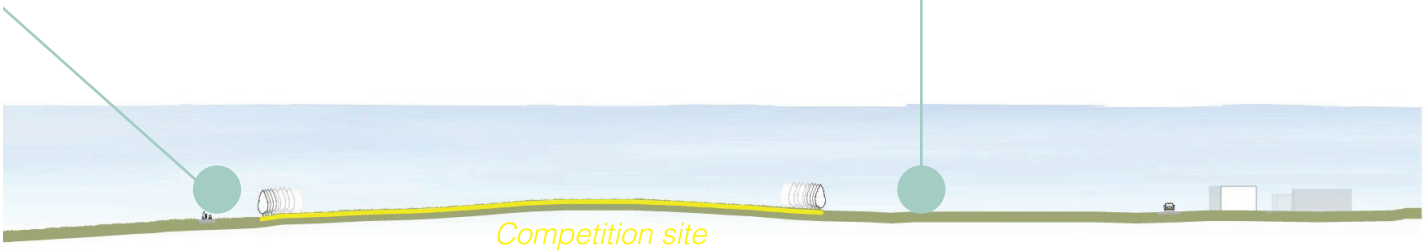
The site is located on the edge of the expansion area and is therefore situated between the old and the new Lisbjerg. The site is not directly connected to the new city centre yet, lies close to the newly built school.

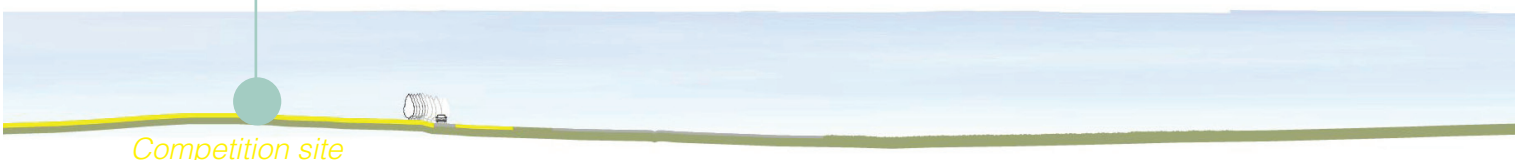
Site analysis

These pictures show how the site looks today. They were taken at the site visit, a trip planned to explore and understand the site conditions.



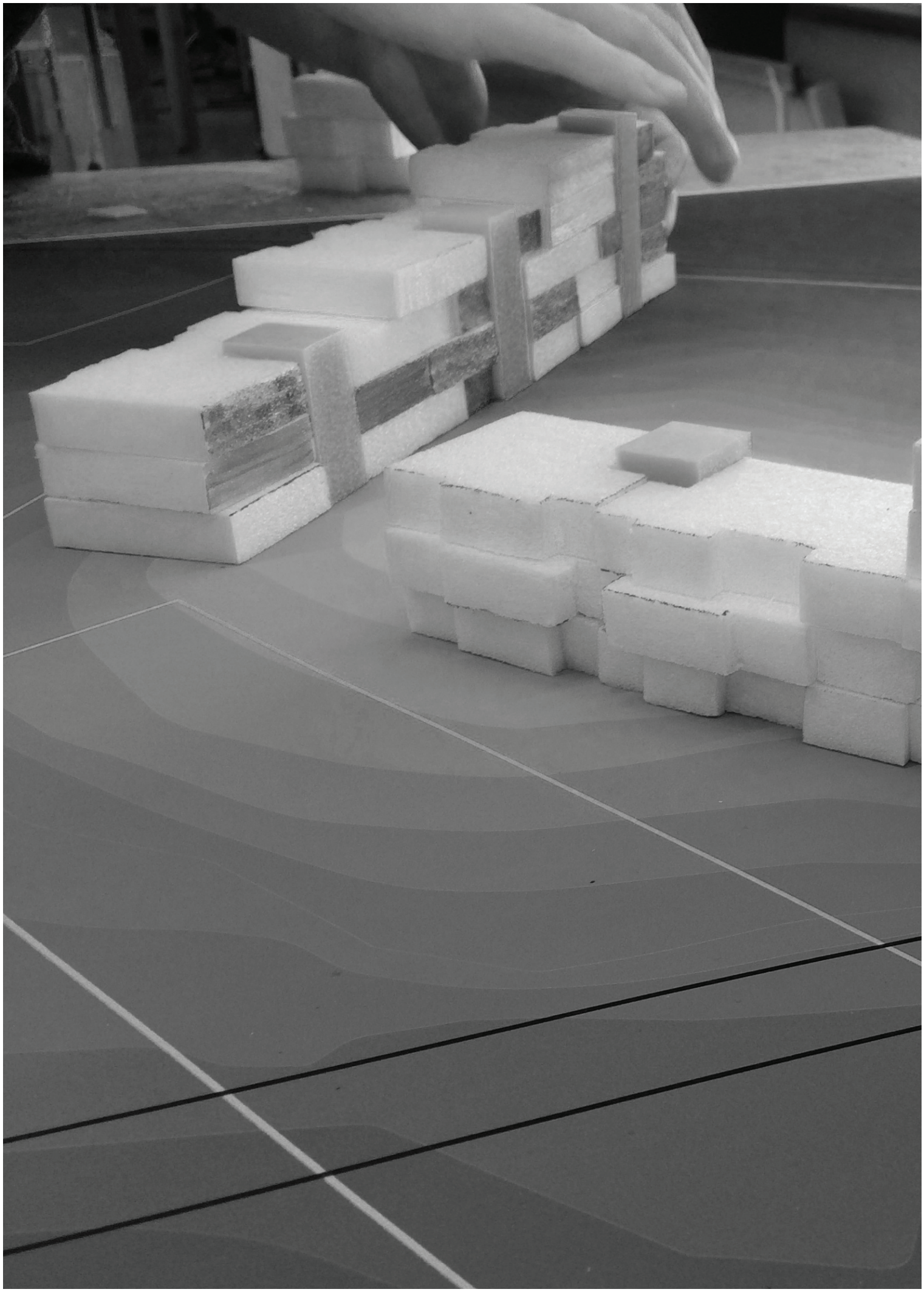


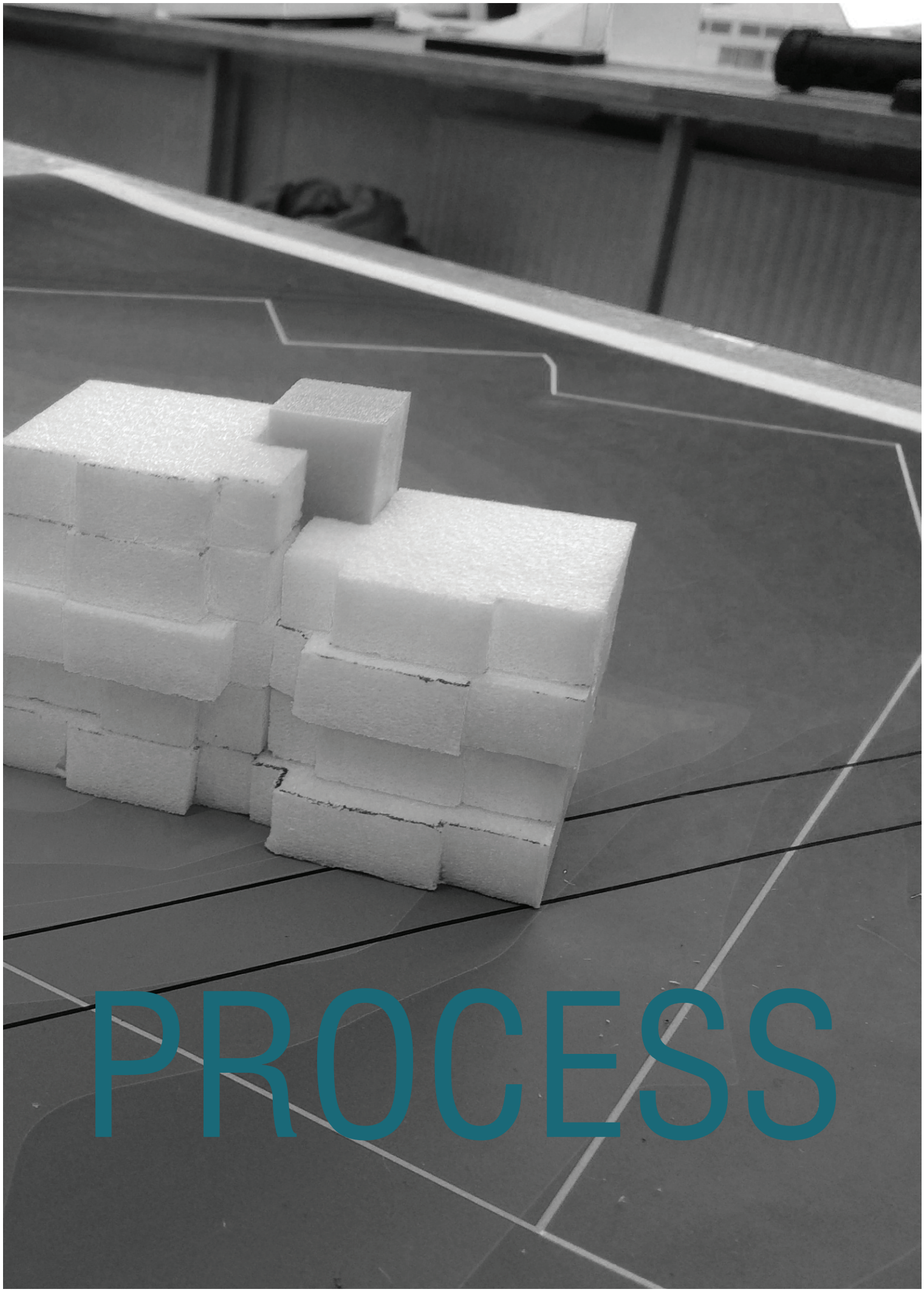

Competition site


Competition site

Vision

The project's aim is to design subsidized housing for the Lisbjerg site-specifications described in the competition "Fremtidens bæredygtige Almene Boliger". A critical view to sustainable buildings is addressed through focusing on the human qualities and designing sustainable homes rather than sustainable houses. To achieve this DGNB is integrated in the design process, and as such, includes the social aspects of the certification method.





PROCESS

Idea

The idea that will help shape the design is based on the conclusions of social sustainability, subsidized housing legislation, demographic and especially the subject of “the good home” and the act of gathering.

In subsidized housing and social sustainability some of the same conclusions are made namely the goal of creating healthy and comfortable homes and adding life quality to the lives of the inhabitants. The demographic text sums up a wish for attractive apartments and heightening the standards of subsidized housing, through good quality and use of social sustainability. It also states a goal creating common areas in the homes by creating social zones, but remembering the individual and the need of withdrawing from the common area.

The idea of creating a common area can be connected to the act of gathering and creating a social warm centre of the home. This idea was in the beginning formulated as creating a heart of the home; a place where people were drawn to and wanted to gather.

The warm centre of the home can be achieved through different means. The classical approach would be to add a hearth or wood stove to the living room and create a physically warm area of comfort in the home. Thereby gathering around the fire as one would do in the early ages around a bon fire for survival in winter.

Another warmth is the one created in the kitchen from cooking. This is both physical warmth from the stove or oven, but also warmth in association, the warmth of the family embrace and the common meal.

Light can also create a feeling of warmth, either by letting in the heat of the sun on a seating area and thereby inviting people to sit on the lit spot, or the warmth of seeing the light and associating it with warmth. In the north sunlight always has a joyous effect on people.

Warmth can also be drawn from material association. If a room is build of grey heavy materials such as concrete, the room can seem cold, while a room with wood can seem more warm. The concrete or white walls will seem colder than the brown wood, which is more associated with the warm yellow light, the yellow light as seen both from the sun and fire.

GATHERING

The idea is to focus on the gathering and attracting the users to stay in the same room. The kitchen and living room are the common areas of a home and often involve gathering as it is, these rooms can be used for the gathering around warmth and be the heart of the home.

The community is just as important as the individual homes as stated earlier in the project. The outdoor common area can therefore encompass the public heart and the public gathering, while the private heart is the heart of the home. These two can be connected; either physically or visually, and thereby create a connection between the private gathering and the public gathering.

The opportunity to withdraw is still an important factor. The idea is for the users to gather and socialize, but being able to withdraw from the social area is important. But instead of the users staying in their own rooms and closing the door to the common area, the idea is to incorporate the act of withdrawing in the social area. Ideally the user can withdraw in a corner, niche, furniture etc. and still physically be in the same room as the family. As a family much time is spent apart, at work, school or other activities. It is therefore the wish to gather the family in one room while they are at home, but not necessarily having to interact or do activities together. Like the story of Lawrence Wylie of the family in the French cottage mentioned in “The good home” earlier in the report, they could live in one room, the children playing, the mother cooking and the father working. It is an old view of family roles, but still a description of a gathered family, but not around the same activity. Rather gathered by comfort and warmth. (Heschong, 1979)

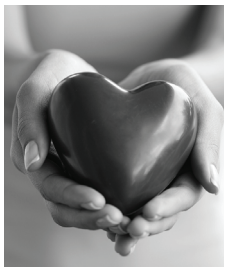
CONCLUDING

The idea is therefore to create a room of gathering with the opportunity to withdraw. The gathering must be by choice and not forced. The room must attract the users, possibly through warmth and comfort. The idea has led to a function and an action. The thought is to embody the idea in a ‘gesture’.

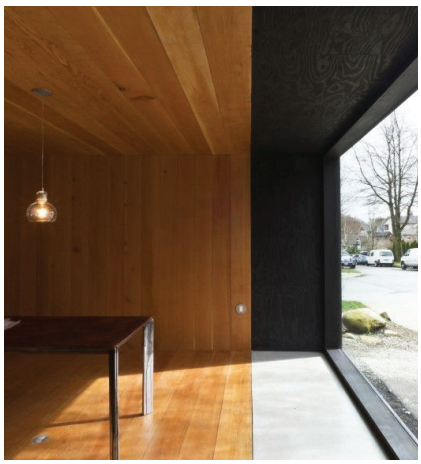
Cooking

Hearth

Light



Heart



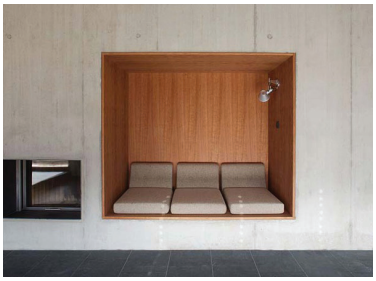
Wood

GESTURE MOODBOARD

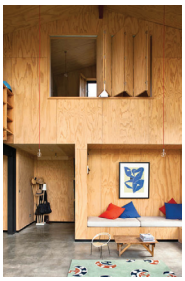
The moodboard is a collection of inspiration pictures, which reflects the process of defining a ‘Gesture’ for the project. The ‘Gesture’ defines a space in the space and creates an added quality. These are a mix of ideas that could be implemented in the design with the focus on certain keywords: gathering, relaxing, withdrawing, the warmth of wood and playful living.

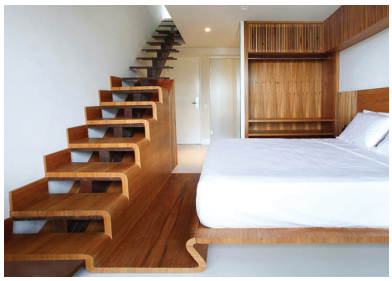






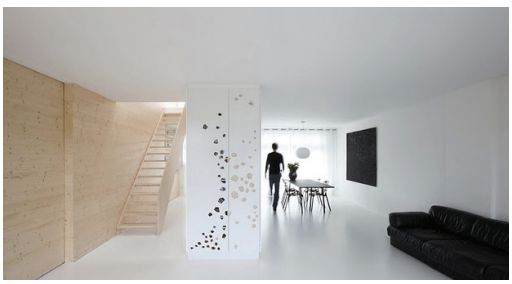




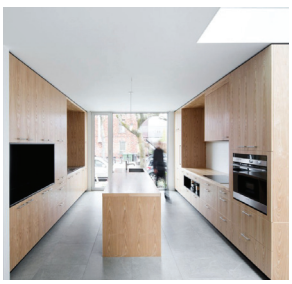










Spatial program

PHYSICAL DESIGN BOUNDARIES

Before starting the design of the apartments the area demands must be established to give the project scale. The total area of each apartment is chosen based on three factors; the competition brief, the area limit of subsidized housing and rent subsidy regulations. All areas are brutto areas, since this is the way the municipality and rent subsidy calculate with area and according the law of Bygnings- og Boligregistrering.

The total building area:

- 40 housing units
- 4000m^2 (including common areas)

The competition states:

- 5x Youth housing, total 250m^2
- 10x Family housing, 2-3 rooms, total 850m^2
- 25x Family housing, 4+ rooms, total 2725m^2

Total: 3825m^2
This leaves 175m^2 for common areas.

(Fremtidens Bæredygtige Almene Boliger – Åben konkurrence, 2013-2014)

The spatial requirements of subsidized housing:

- Family housing must not exceed 115m^2, unless one or more residents are severely handicapped.
- Youth housing must not exceed 50m^2.
- Housing for the elderly must consider accessibility.

(Den almene bolig i korte træk, 2013) [Link 15]

Since the demographic often qualifies for rent subsidy, as established earlier 'Demographic', the spatial limits for receiving subsidy will take part in deciding the apartment sizes. The amount of rent subsidy is based in apartment size, rent, number of occupants and total income, therefore the apartment size has a rather large part in the economy of the inhabitant.

The rent subsidy regulations of 2013 states following:

- One adult recieves max. rent subsidy for 65m^2.
- For each added person (child or adult) 20m^2 can be added.
- The allowed income is increased for each child in the home.
  [Link 16]

CONCLUDING ON THE APARTMENT SIZE

Youth housing

5 x 1 room

The maximum area for youth housing is 50m^2, but this is still a rather large apartment. The youth housing mostly houses students and is more temporary than the family apartments. The chosen size should therefore reflect a small, compact apartment and inspired by minimal housing. The chosen size is 35m^2, which should be enough to accommodate both bath, bedroom and kitchen niche. Less space also reflects on the rent, which will be lower than had it been the max. of 50m^2, which can only be seen as a benefit for the occupant.

Family housing

10 x 2-3 rooms

The smallest of the family apartments has 2-3 rooms and will be planned for 2-3 inhabitants. The size in which 2 people can receive max. rent subsidy is 85m^2, which seems fitting for a small family, couple or single mother.

3-4 rooms

To get a more varied selection of apartments, the demand of 25 units of 4+ room apartments has been divided in two:

- 10x 3-4 rooms
- 15x 4+ rooms

The 3-4 room apartment is chosen to be 95m^2 and will accommodate 3 to 4 people. The number of 4+ apartments is based on the competition wish to have most 4+ housings.

4+ rooms

The largest family housing can accommodate 4 to 6 people and could according to the rent subsidy be up to 125m^2, but the subsidized housing legislation demands a max. of 115m^2 and therefore the size is decided to be 115m^2.

FUNCTIONAL NEEDS
The basic functional demands are:

- Kitchen
- Bath
- Toilet
- Space for standard size bed in the bedrooms

SUMMARIZING

- 5x Youth housing, 1 room: 35m² (175m²)
- 10x Family housing, 2-3 rooms: 85m² (850m²)
- 10x Family housing, 3-4 rooms: 95m² (950m²)
- 15x Family housing, 4+ rooms: 115m² (1725m²)

  In total: 3700m²

This leaves 300m² for common facilities, storage units (2m² pr. apartment) and staircase.

The common facilities include common wash house, since only the 115m² apartments have space for washer and drier in their bathroom, a drying room and a common house for celebrations and social gatherings. Bicycle sheds and shed for the groundskeeper are not included in the area amount.

A CRITICAL ASSESSMENT OF THE COMPETITION
The competition prioritizes subsidized housing for families. This fits with Lisbjerg as it is today, single family detached houses in the suburbs of Aarhus. But the plans to expand Lisbjerg and create a larger city will attract other demographics, than the demographic currently living in Lisbjerg, with the new transportation options, shopping and cultural events. Subsidized housing as a housing type attracts more people living on their own, than families. Only 11% of the inhabitants in subsidized housing are families, while people living alone constitute 56%. It has become more normal to get divorced and a larger amount of people live alone for a period of their life. The nuclear family is becoming rarer. This tendency is thought to increase. (Bech-Danielsen, 2013)

The distribution of apartments will therefore be changed to fewer large apartments and more 2-3 room apartments, since these will preferential belong to people living alone.

The new apartment distribution::

- 5x Youth housing, 1 room: 35m² (175m²)
- 15x Family housing, 2-3 rooms: 85m² (1275m²)
- 10x Family housing, 4 rooms: 95m² (950m²)
- 10x Family housing, 4+ rooms: 115m² (1150m²)

  In total: 3550m²

This leaves more space for common facilities, staircases and storage and secures a buffer, should the spatial demands not be overheld in its entirety.

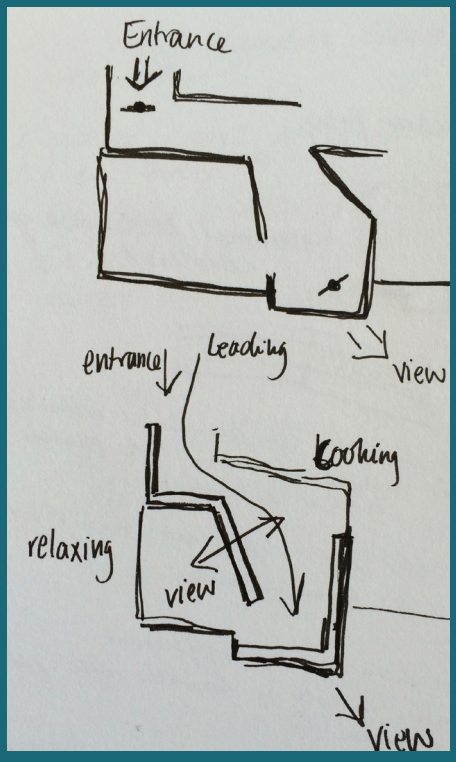
	APARTMENT PROFILE: YOUTH HOUSING		
	Living room	Kitchen	Bath
Area	32m^2	Included in the living room area	3m^2
Utilisation	In use during all hours at home, due to there being only one room.		No specific time.
Light	Natural daylight Mid-day and evening sun is desirable.	Natural daylight Morning sun is desirable.	No daylight requirements.
Functions	Eating area, entertainment area and accommodate bedroom	Kitchen niche	Toilet, sink, shower
Connection	In a one room apartment all functions are connected.		
View	View to the common outdoor area.	View to a green area.	No requirements.
Experience	Small and functional home where all functions besides bath are gathered in one. Build in furniture can make the room feel more spatious. The first home after leaving the parental home, probably for a student.	Compact kitchen. Build in furniture for a minimalistic home. Inspiration from micro homes.	Practical bath.

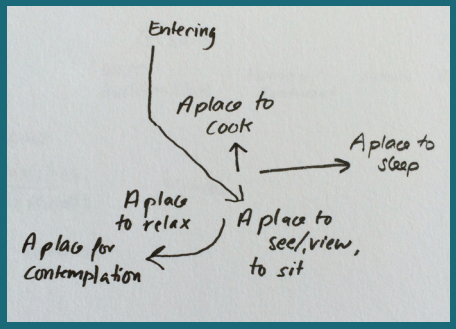
APARTMENT PROFILE: FAMILY HOUSING

Living room	Kitchen	Bedroom	Bath
40-50m^2	Included in the living room area.	8-15m^2	5m^2
Mid-day to evening.	Early morning and late afternoon to evening.	Master bedroom: Late evening and mornings. Childrens room: Mid-day to evening.	No specific time.
Natural daylight Mid-day and evening sun is desirable.	Natural daylight Morning sun is desirable.	Master bedroom: Morning sun is desirable.	No daylight requirements.
Eating area, entertainment area and social gathering.	General kitchen appliences and counter space with sink based on the apartment size.	Master bedroom: Double bed and closet space. Childrens room: Single bed, closet space and preferrably space for a desk or toy storage.	Toilet, sink, shower Large family housing: Accommodate washer and dryer.
Connected to kitchen and bedrooms.	Connected to living room and circulation area.	Connected to circulation area and living room.	Connected to circulation area.
View to the common outdoor area.	View to a green area.	View to a green area.	No requirements.
A place to gather in the home, to socialize wih family members and guests. But also having a place to withdraw without closing oneself off in another room. Physically being togehter, but not allways having to interact. The visual connection can be enough to feel toegtherness. Feeling a warmth around the gathering place, either physical, visual or through association. Taking part in the social life is a choice, even when physically in the same room.	Creating a connection between the kitchen and the living area, possibly an open plan concept.	Master bedroom: A place to rest, preferrably cooler than the rest of the rooms. Childrens room: Functional but with room to play or study.	Practical bath.

CONNECTION DIAGRAM

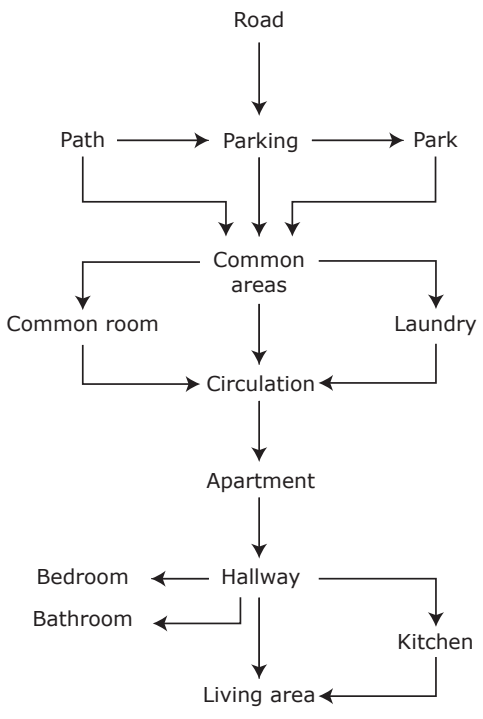
To help the design process a connection diagram is mapped to show flow and circulation. It shows how different functions are connected from arriving to the site to entering the apartment and sitting on the sofa. The connection diagram will actively be used in the design process. The transitions and meetings of different functions will be explored through the design.



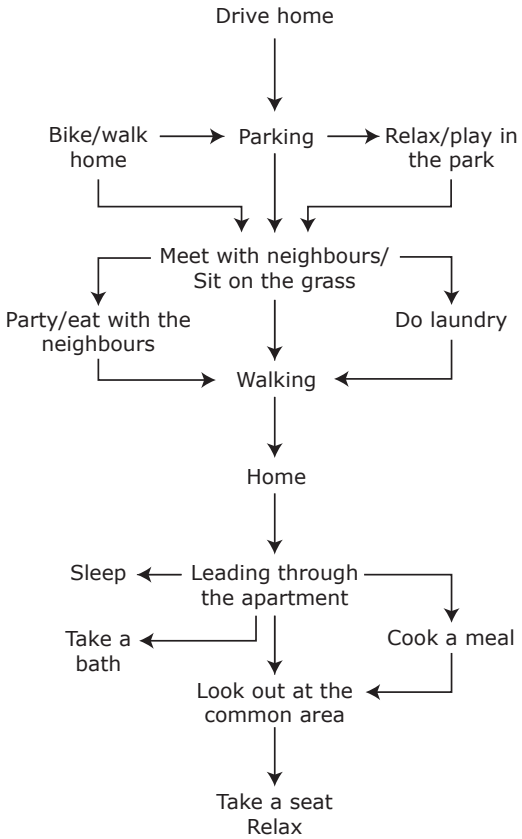


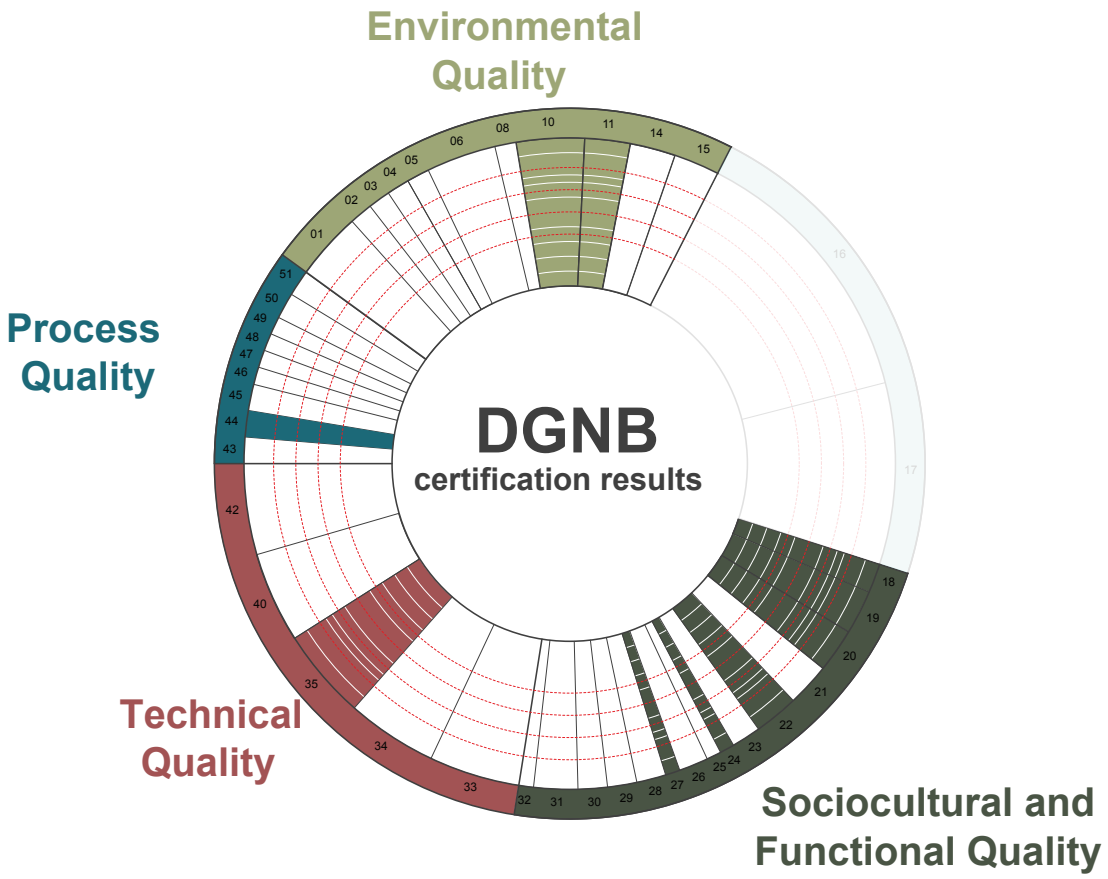
Sketching ideas to the apartment flow.

The function:



The action:



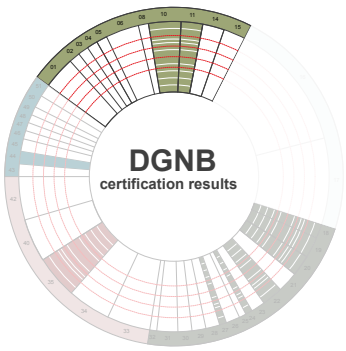


The 10 criteria in focus

Before using DGNB in the design process, there should be defined a focus of the project. Each criteria must be considered and the user must decide what the desired goal for each criteria is to be achieved.

10 criteria have been selected as the main focus in this project. The criteria have been selected from the competition demands and the competencies acquired as an architect from Aalborg University. The main themes are: energy consumption, indoor climate and site locations.

Environmental Quality



10. Nonrenewable primary energy demand

The focus will be on the reducing and optimizing the consumption of nonrenewable primary energy sources by efficient planning and implementing passive methods (8th semester slide). The passive methods include:

Insulation.
Reduces transmission of hot and cold air between indoor and outdoor.

- Affects thickness of walls thus dictating the depth of the window openings.

Orientation.
Relates to the local site condition for sun and wind.

- Affects heat gain and provides shelter from the wind.

Solar gain.
Decrease summer solar gain and increase winter solar gain.

- Affects solar shading of building to take in winter sun, but keep out summer sun.

Thermal mass.
Heat absorbed during day is released at night.

- Affects the choice of material.

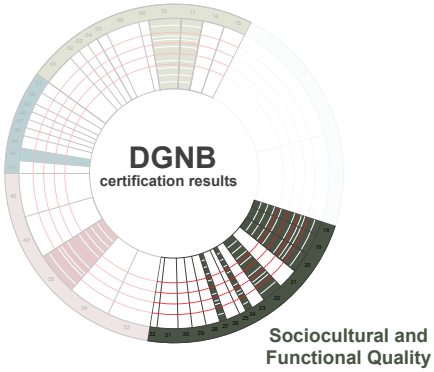
Natural ventilation.
Remove heat by airflow.

- Affects if the windows are openable or not.

11. Total primary energy demand and proportion of renewable primary energy

Minimize the primary energy demand and maximize the renewable energy supply.
DGNB calculates the percentage of the renewable energy of the total energy demand.
The share of renewable energy is calculated as a percentage of the ratio of renewable primary energy and the total primary energy demand.

- Affects the amount of the PV panels needed for the building.



18. Thermal comfort, winter

The goal is to create a comfortable climate in the apartments and not exceed the temperature limits.

- Finding a ventilation system, which suits the housing type and a system, which avoids high level of humidity and thereby mould. Which as stated is a problem often occurring in residential buildings.

19. Thermal comfort, summer

See criteria 18.

20. Indoor air quality

This is a “knock-out criteria”, if these demands are not met, the building cannot be certified.

- Air quality is connected to the thermal comfort. The air quality should be perceived clean when entering a room.

22. Visual comfort

The goal of this criteria is to achieve a good daylight factor and ensure comfort in the apartment by considering the view so the tenant can follow the daily rhythm, weather conditions etc.

- Achieve minimum 3% daylight factor in 50% of the apartment.
- Solar shading strategy that does not restrict view.

24. Quality of outdoor spaces

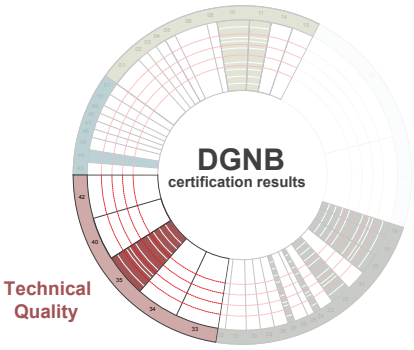
Creating quality in the outdoor spaces for the inhabitants and connecting the site to the context.

- Create green areas and pathways to and from site.

27. Efficient use of floor area

The goal is to create functional plans for the apartments. Being subsidized housing the apartments must be affordable for the residents and have a cost efficient layout.

- Create plans that limit the amount of non usable space in apartment.



35. Building envolope

The building envelope should decrease the heat requirement, secure thermal comfort and shield and avoid moisture in the constructions.

- Affects the thickness of insulation therefore creating thicker walls

56. Site location risks

The site is located in Denmark in the middle Jutland, and is therefore in the risk of flooding caused by rain and wind and rain storms.

- Design strategy for dealing with excessive rain.

DGNB

10. Nonrenewable Primary Energy Demand
11. Total primary Energy Demand And Proportion of Renewable PrimaryEnergy
18. Thermal Comfort in Winter
19. Thermal Comfort in Summer
20. Indoor Air Quality
22. Visual Comfort
24. Quality of Outdoor Spaces
27. Efficient Use of floor Area
35. Building envelope
56. Site Location Risks

Competition brief

BIM

Ecotect
Vasari
Revit

Parametric

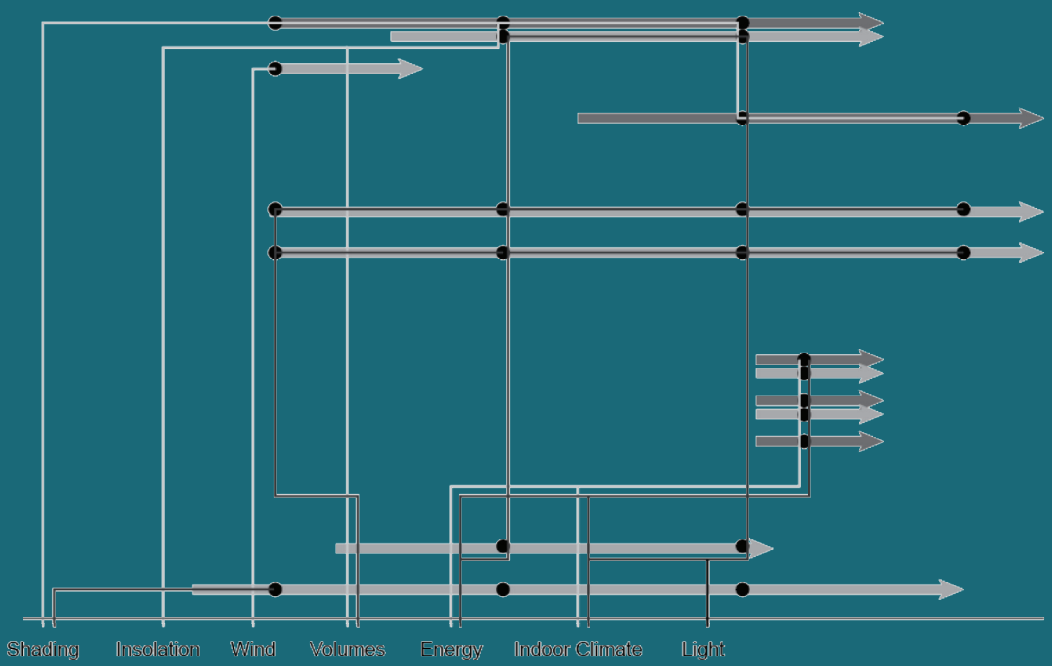
Grasshopper
Rhino

Simulation/ Calculation

Bsim
BE10
Energy Plus

Other

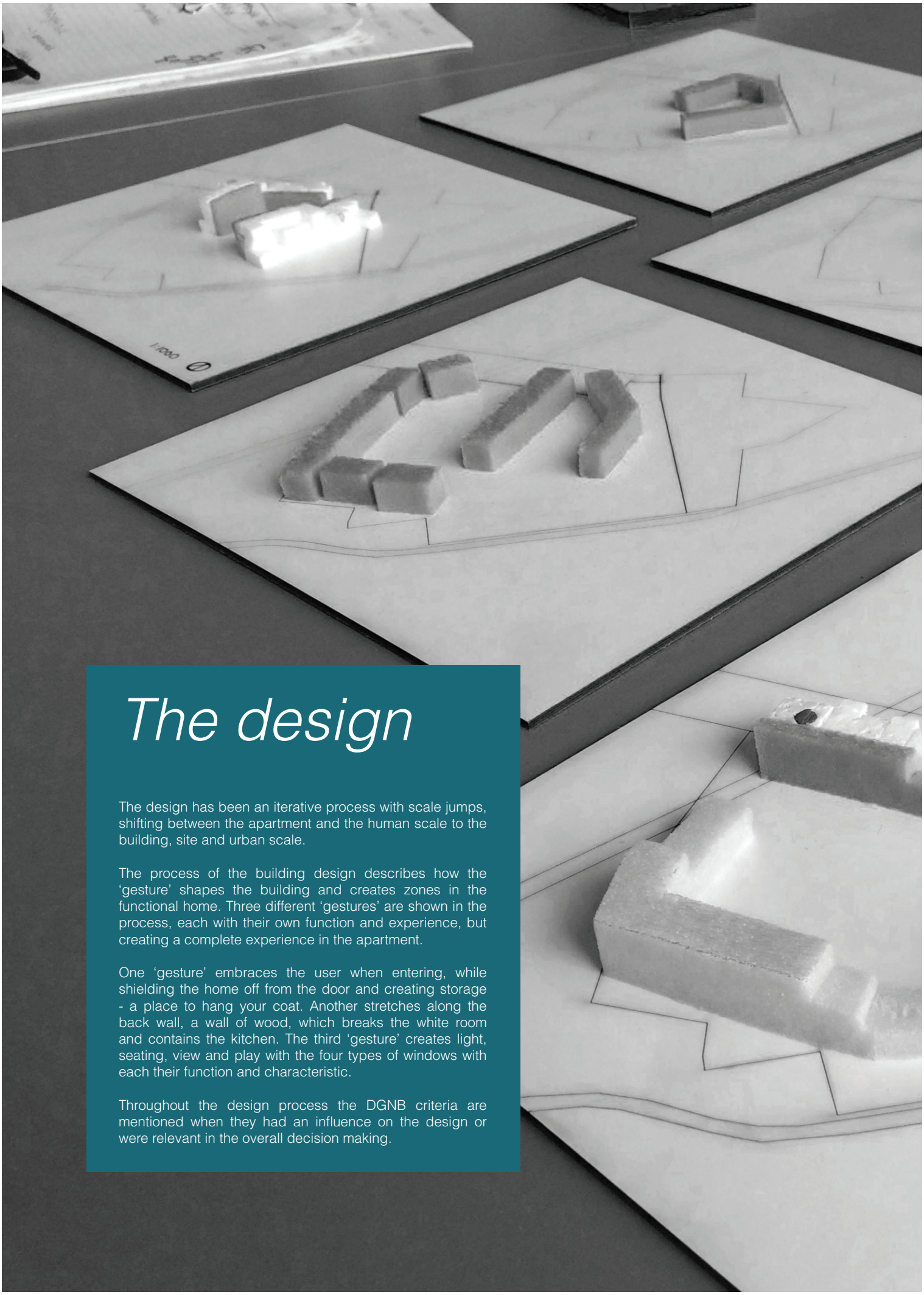
Spreadsheets
Analogue



DGNB in an Integrated Design Process

"Educating for a carbon neutral future" is paper written by Mads Dines Petersen in 2014. Three student projects are used as reference to address issues about low-energy architecture and how knowledge about parameters that help affect the passive performance of the building can be integrated in the design process. (Petersen, 2014). The parameters are simulated and analysed using a various amount of software. The use of software is articulated in the diagram shown to the left.

This diagram is used as a stepping stone to articulate when and where each criteria is implemented. Appendix 4 discusses how each DGNB criteria is documented through either simulation software or a drawing. This discussion derives where each DGNB criteria is addressed in the design process.



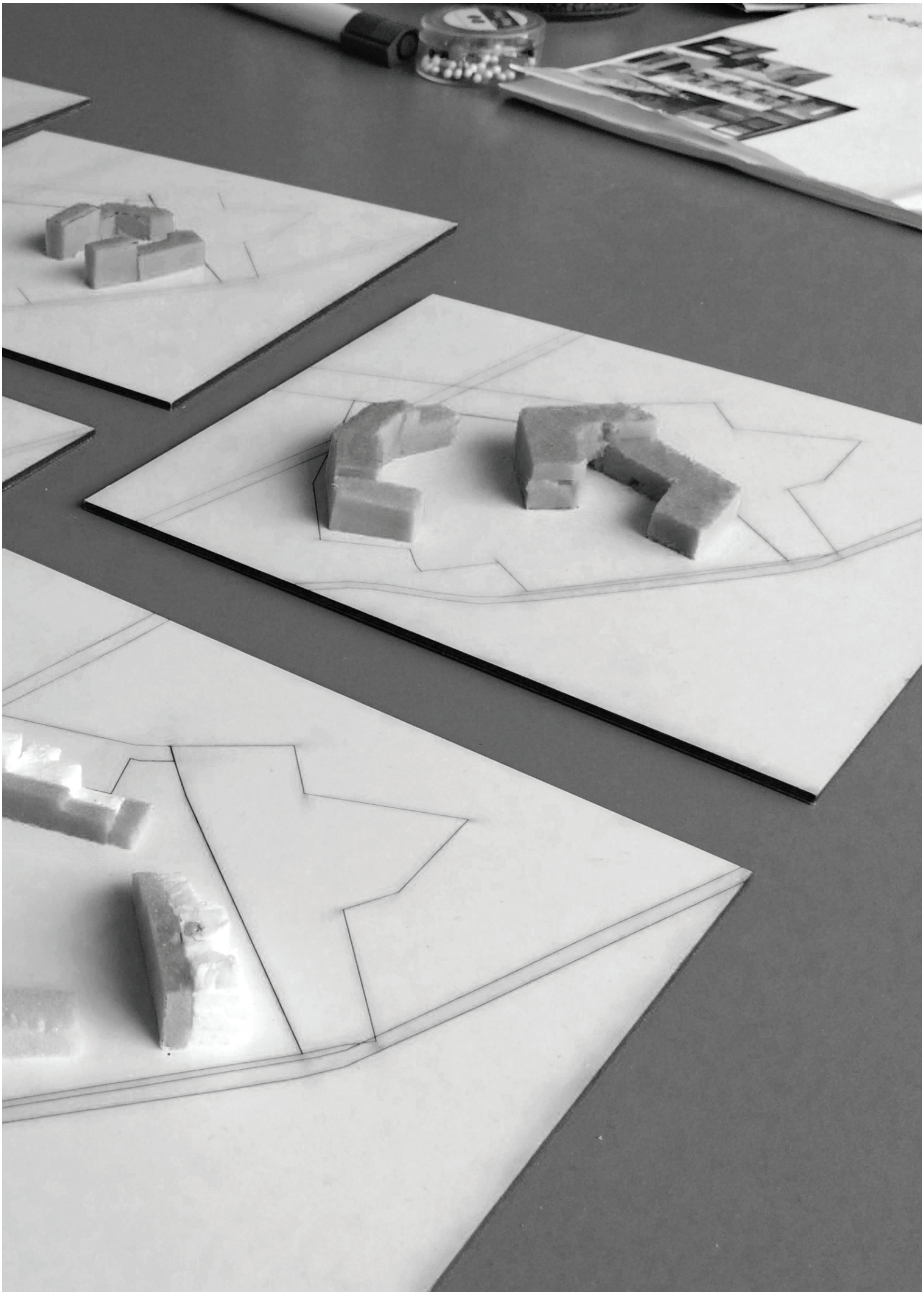
The design

The design has been an iterative process with scale jumps, shifting between the apartment and the human scale to the building, site and urban scale.

The process of the building design describes how the ‘gesture’ shapes the building and creates zones in the functional home. Three different ‘gestures’ are shown in the process, each with their own function and experience, but creating a complete experience in the apartment.

One ‘gesture’ embraces the user when entering, while shielding the home off from the door and creating storage - a place to hang your coat. Another stretches along the back wall, a wall of wood, which breaks the white room and contains the kitchen. The third ‘gesture’ creates light, seating, view and play with the four types of windows with each their function and characteristic.

Throughout the design process the DGNB criteria are mentioned when they had an influence on the design or were relevant in the overall decision making.



Model of the first design concept.

The 'gesture' shaping the building

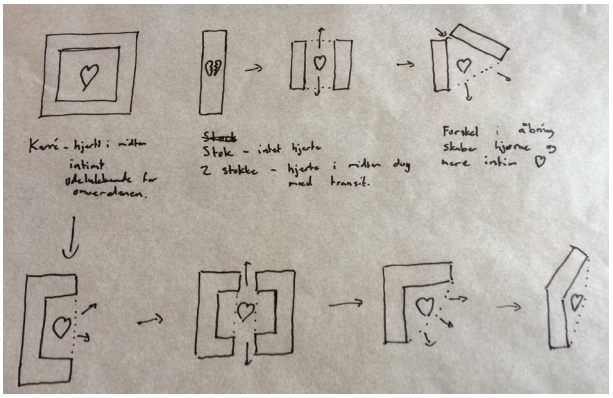
The 'gesture' adds human scale and architectural quality to a sustainability and DGNB focused project.

The idea was to let the 'gesture' create a space of gathering and let the element or experience shape the rest of the building. The 'gesture' is in focus and the rest of the functions are drawn out of the space in centre. Defined as the heart of the home the 'gesture' was the centre of the home. The centre of the home must have the best light, the best view, the most attractive room and functions, while the remaining rooms, bedrooms and bath, are held functional and specifically designed for the purpose of sleeping and bathing.

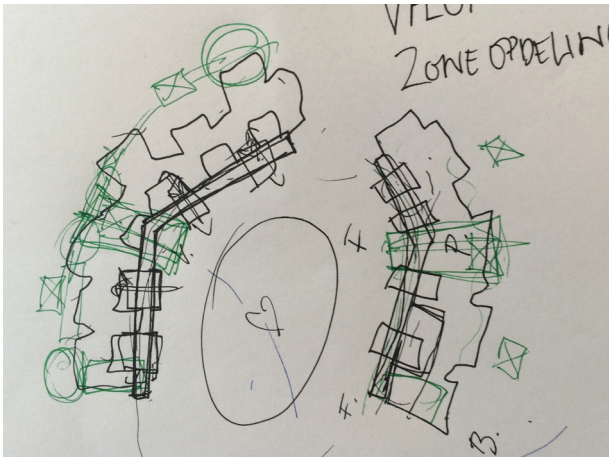
By creating focus on the common area of the home, the kitchen and the living space, the hope is to attract the inhabitants to gather in the social room of the home, the heart of the home as named earlier in the process.

GESTURE

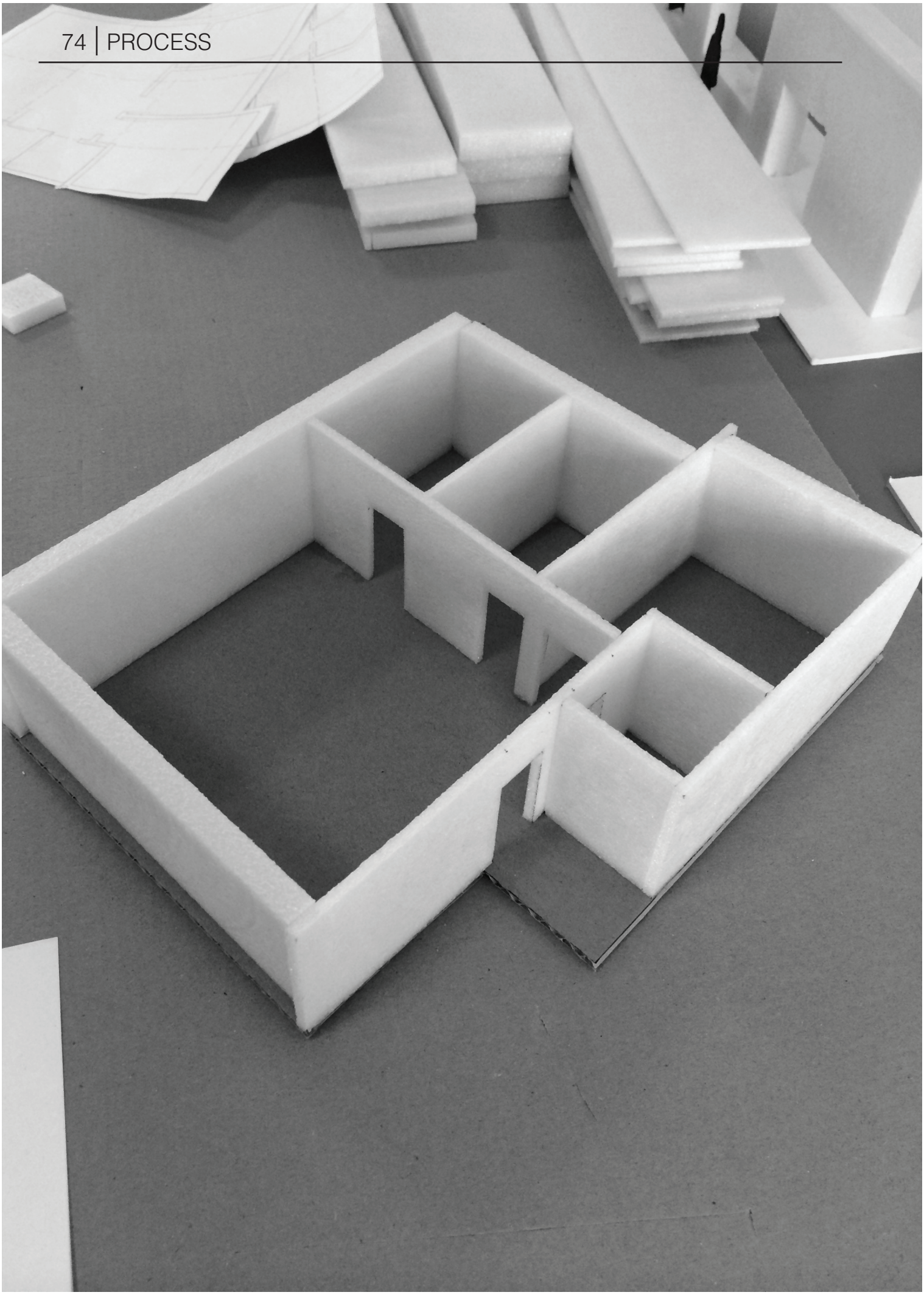
- Incorporated in the building
- The heart of the home
- Enclosing
- Withdrawing
- Relaxing
- Creating zones
- Welcoming
- Warmth
- Gathering
- Intimate space
- Light
- Visual connection to the outdoor area



TYPOLOGY
Different typologies were mapped to see how they relate to the 'heart of the community' and the building block was chosen on the grounds of its ability to embrace the common outdoor area.



FIRST DESIGN CONCEPT
A building block with the a prominant wall to the centre of the site and the functional rooms extruded to the back.



The functional frame of the home

When designing subsidized housing the plan is expected to be functional and making use of all the space available. The apartment easily becomes a functional white box.

The design concept is based on creating two parts of the apartment, the southern orientated common area and the northern orientated private spaces such as bedrooms and bathrooms. The common area is designed to attract people to stay and therefore the most attractive light is given to this room. While the more private spaces such as bedrooms have less of a need to draw in the heat and light of the sun. Often it is considered more comfortable for the bedroom to be cooler and darker.

The functional shape also developed from the use of grid lines to fit the parking measurements and the prefabricated concrete elements of the structural system.

The DGNB criteria “Efficient use of floor area” (nr. 27) is formulated to fit an office building, but in a housing complex this can still be of great importance. It is the goal to keep the staircases and hallways to a minimum size and avoid rarely used hallway area in the apartments. The focus on the optimized building plan originates from the aim to decrease resource consumption. (Appendix 4)

The wall 'gesture'

The idea of the wall 'gesture' was to make use of the already existing function of the window and adding an extra function of the seating. This idea evolved to the entire facade being a piece of furniture. Sitting in the window, partaking in the socialisation of the home, while having contact to the outside, inspired the wall 'gesture'. The window can be the link between the indoor gathering and the outdoor gathering in the common area, while also drawing in light and creating a view.

Windows are the eyes of a building and a building is judged by its windows (Pallasmaa, 2011), which make the windows an essential part of the building other than the demands for visual comfort as DGNB states.

The function of the wall started with the idea of the windows as withdrawal and seating and evolved into an idea of containing other functions. Firstly the concept was thought to be enhanced, making the wall three meters in depth and truly enhancing its expression. But with this expression the windows would draw in very little light and the walls would be so thick that they would be build hollow.

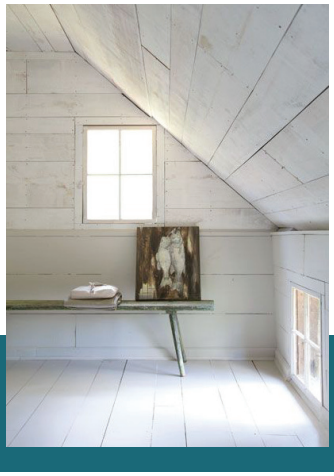
Instead of building a massive and overgrown wall the thickness of the wall instead evolved to the wall becoming a zone of living room and kitchen, which in the hallways could contain the staircases. Instead of just one 'gesture' of the wall the zone of the 'gesture' made room for the gesture to draw into the apartment and become a part of the home, rather than just the link between apartment and common area.

The first 'gesture' shown is the window niche. After the studies of the window openings based on inspiration pictures, foam studies and studies of window sizes compared to human anatomy, four keywords were connected to the window openings:

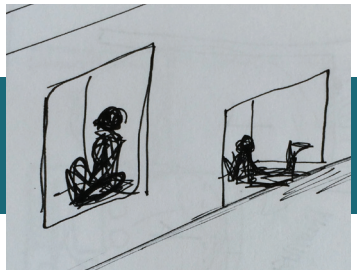
- Light
- View
- Seating
- Play

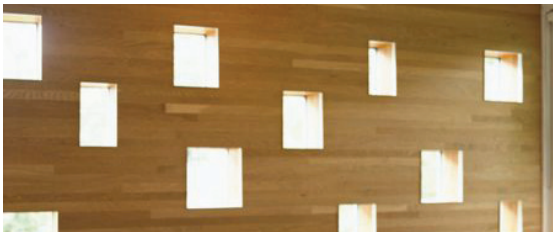
Woman reading a book, sitting on her window sill in the sun. Frederiksberg.

INSPIRATION PICTURES TO WINDOWS, INSIDE AND OUTSIDE.



The light entering from different heights.

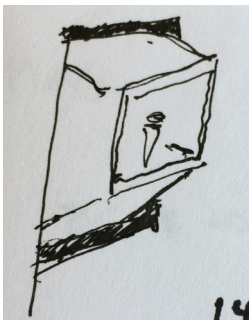


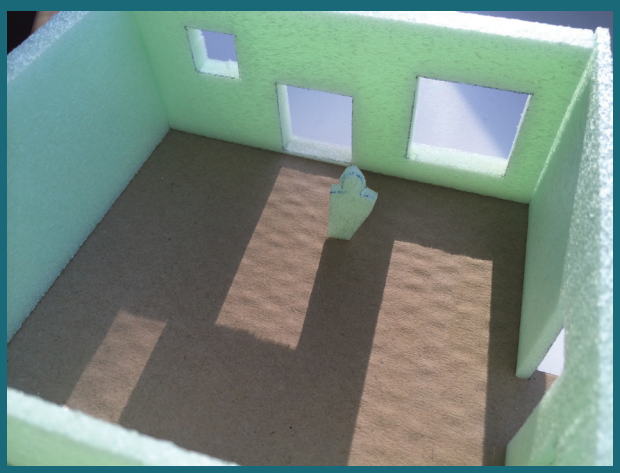


Creating a visual connection to the outdoor space.

Seating in the window to retreat and keep a visual connection, while relaxing in direct sunlight.

A playful window for children, but large enough to fit an adult. Crawl down on the floor and into the window.



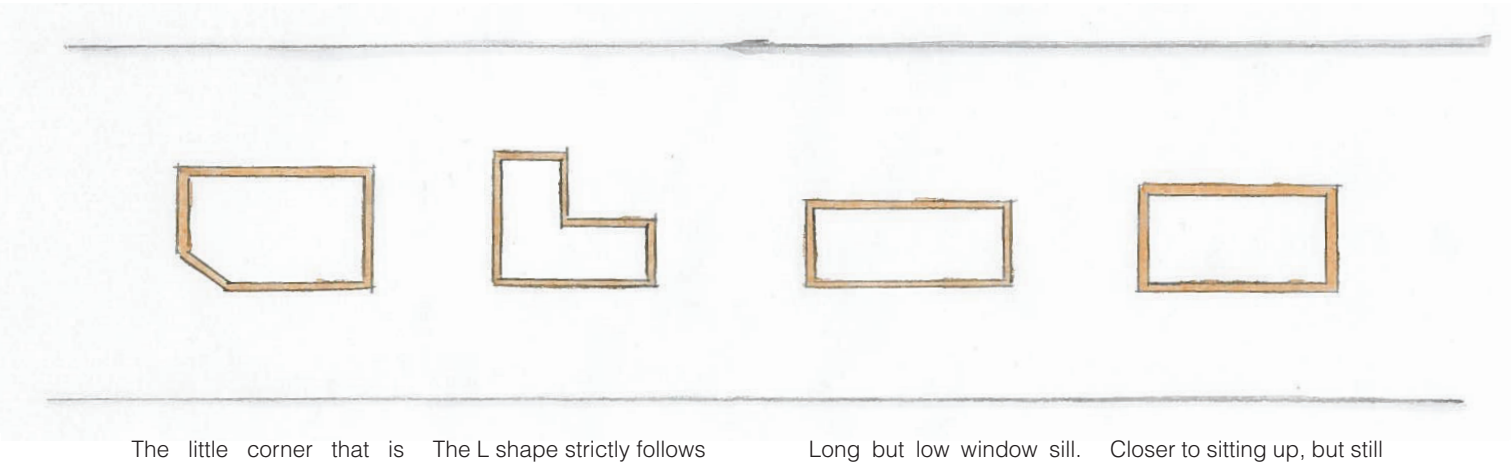


FOAM STUDIES

The foam studies were conducted to study different openigs and to see the window openings in scale and with people taking them in use. The first studies in the orange foam primarily centred around the act of sitting and viewing, while the next studies in green foam started investigating the four words: seating, view, play and light.

These studies were overall studies of openings in the facade and show the vision of creating a place to sit and exploring other possible functions.

Different windows were tested, to see how the four words: Light, view, Sitting and playful could affect the design of the windows.

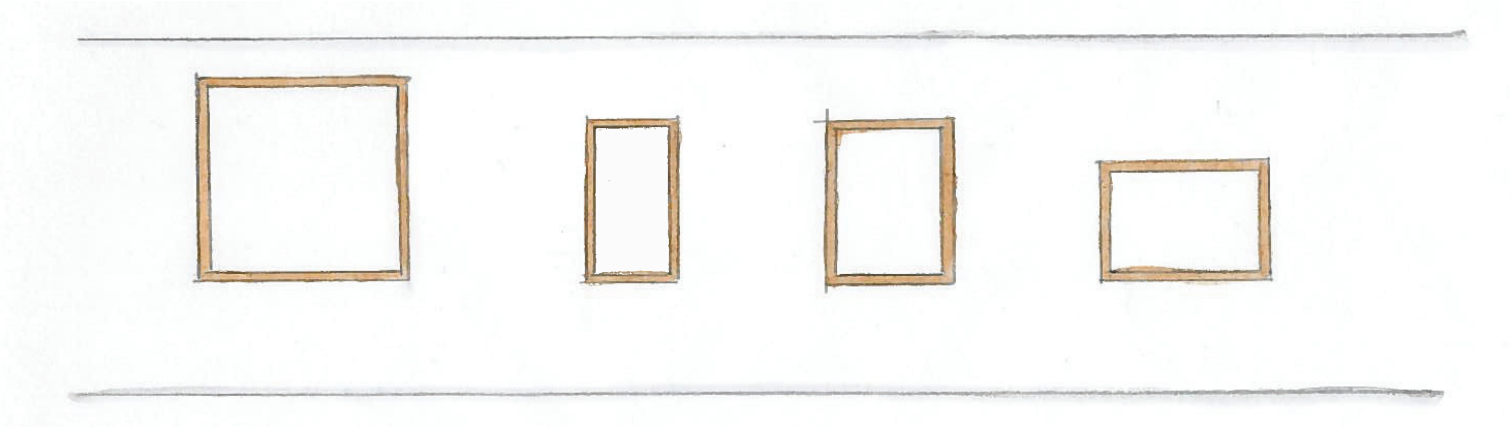


The little corner that is chamfered off in the bottom left, gives a little back support for curling up and sitting in the window sill. Applies to sitting and playful.

The L shape strictly follows the shape of a human sitting on the buttocks. It is too strict and neither playful nor sit friendly

Long but low window sill. tries to be long enough to lay in, but becomes small and claustrophobic

Closer to sitting up, but still slightly claustrophobic.



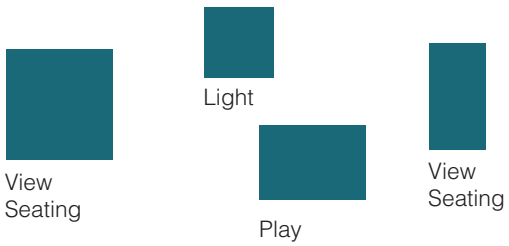
Relates to view, light and sitting. The large windows give the opportunity to have a great view while taking in the light into the space.

Narrow window that relates to sitting and light. It gives the opportunity to sit in the window and relate to the interior.

A little wider than the one to the left of it.

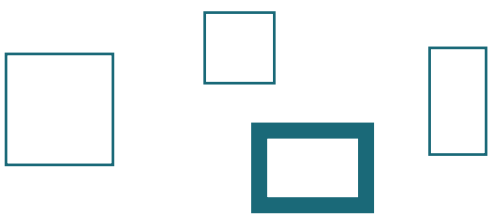
900mm tall is the perfect height for when sitting in an enclosed space. This window relates to all of the four words.

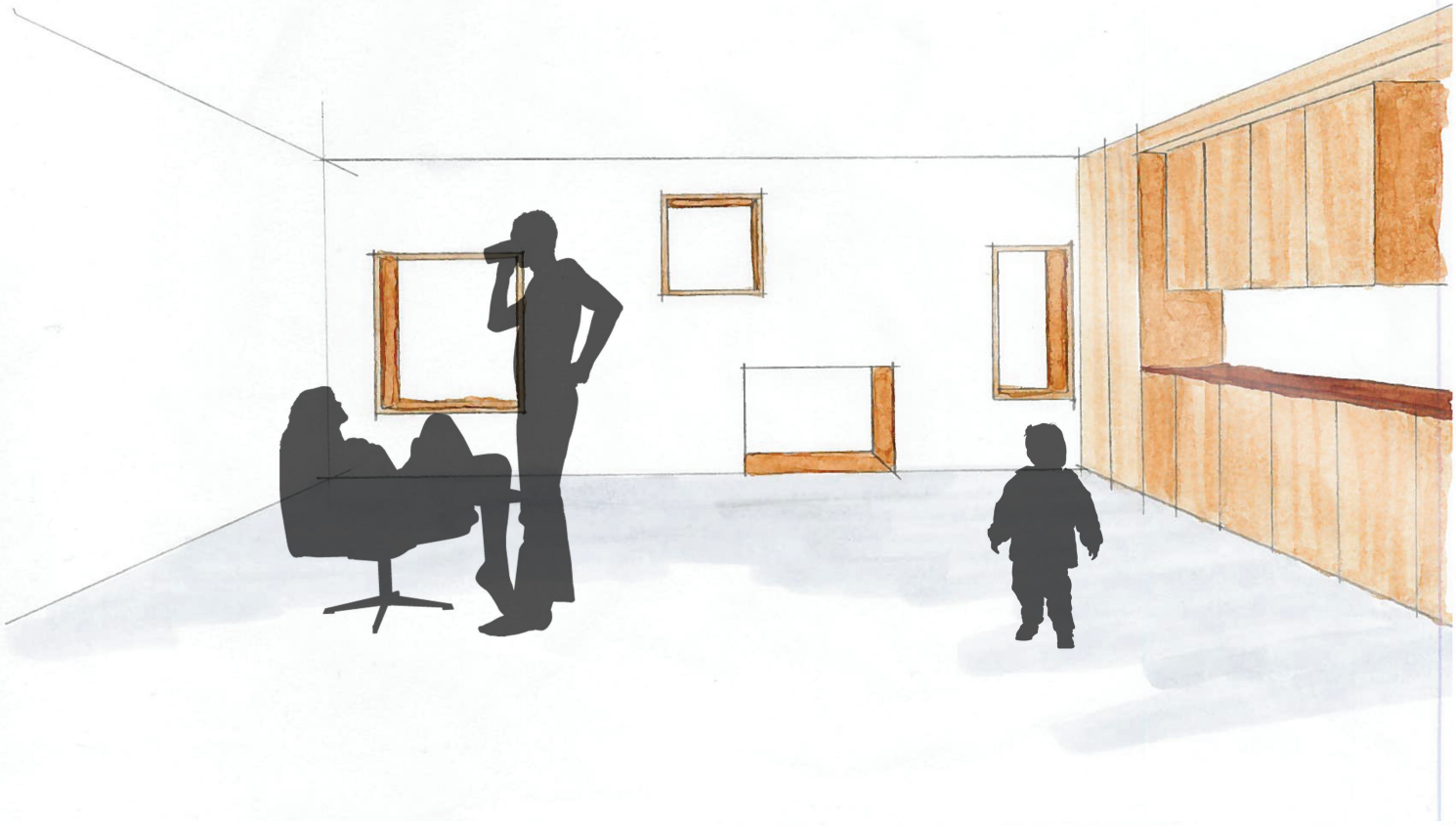
The four windows seen from inside the apartment.

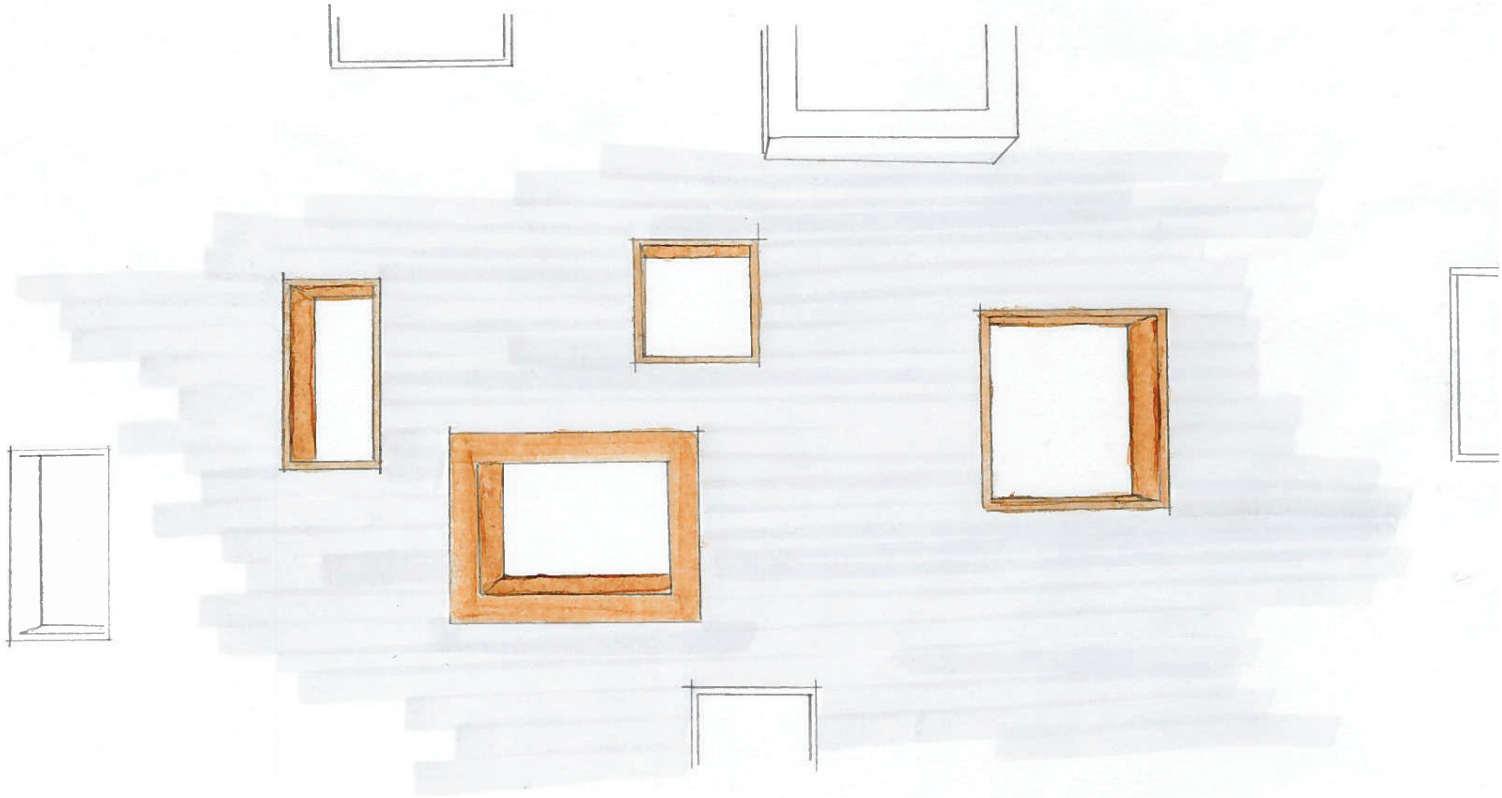


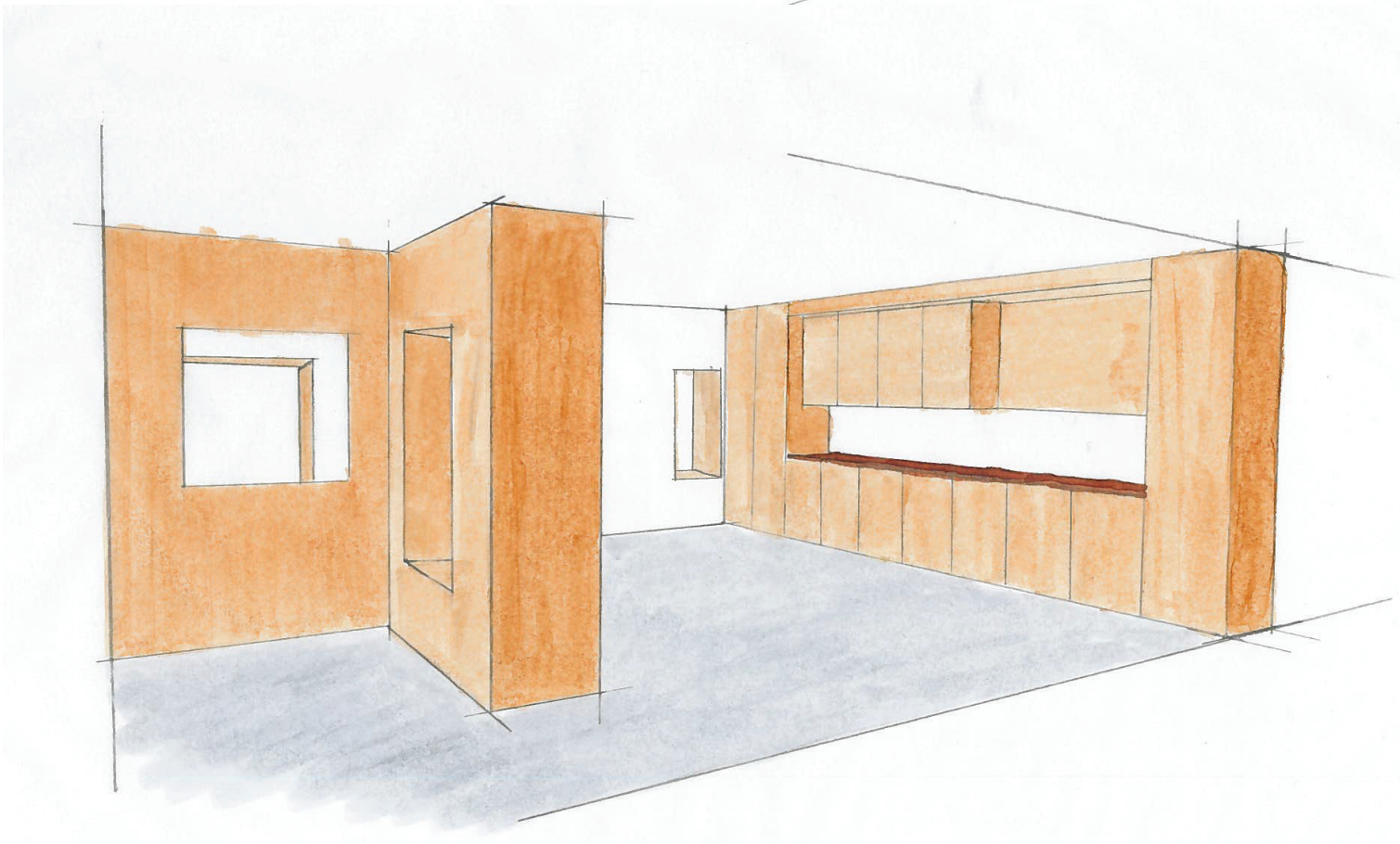
The four windows on the facade.

The wooden frames of the windows as a contrast to the concrete wall.









Adding functions to the 'gesture'

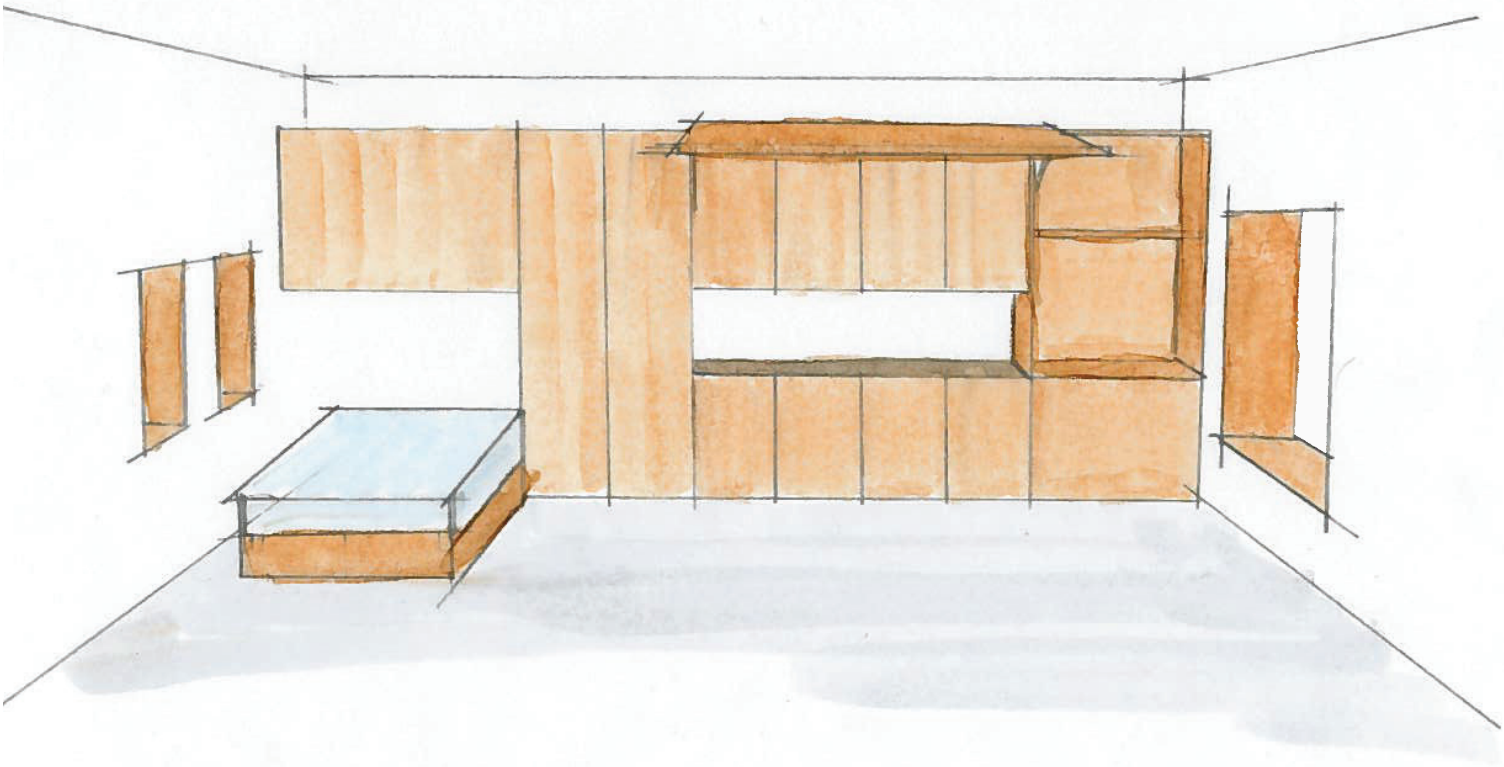
KITCHEN

The 'gesture' in the facade is an experience between the indoor gathering and the outdoor common gathering. To connect to the apartment the gesture reaches into the room and breaks the open white box and creates zones and functions in the room. From the facade a wooden wall stretches along the side of the apartment, creating a warm wall against the naked white. The wooden wall is the kitchen and the warm gathering around a meal. It contains all the functions and installations of a kitchen, hidden in the wooden furniture. By covering the entire wall the wooden kitchen 'gesture' becomes a part of the room and not an added element.

ENTRANCE

The open room stood with a wooden wall and window niches, but the entrance to the home was directly into the open living space. The almost square room was too open to create comfortable small niches or zones to sit in and most importantly a place to put the shoes and hang the jacket was missing.

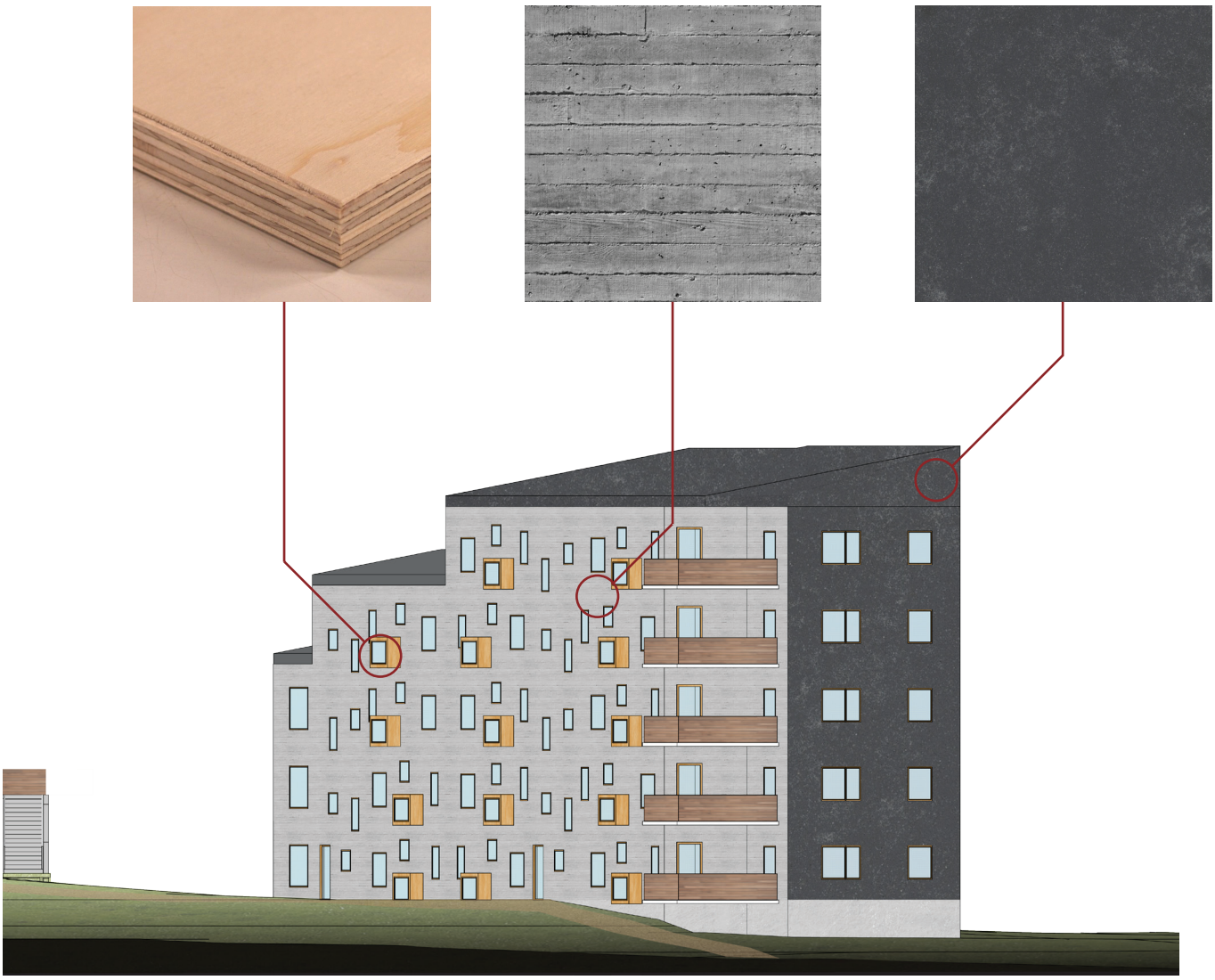
Therefore a wooden gesture was created, as a mixture between the wooden wall of the kitchen and the sitting niche of the window. A furniture piece was added to enclose the entrance and embrace the user when entering. Behind the door is made room to put the shoes and room is made for the jacket to hang inside the closet of the entrance 'gesture'. A visual connection to the living room seating area can be made through an opening in the furniture, which also lets in light to the entrance zone, while the other and larger opening creates a connection to the kitchen and also functions as seating.



YOUTH HOUSING

The youth housing is 35m2 in total. The Living area consists of kitchen, social room, tv room, dining room and bedroom all in one. To create as much floor space as possible all functions are gathered in one piece of build in furniture, only the bathroom is separate. The kitchen ‘gesture’ as used in the other types of apartment is expanded to include storage, a space for the bed, storage underneath the bed, place for a television or books and a kitchen niche which can be closed off. The inspiration to the youth housing comes from micro housing, where a home can be unfolded.

The small youth housing only has one window gesture, which is larger than the rest to let in more light and can be used as additional seating when having visitors.

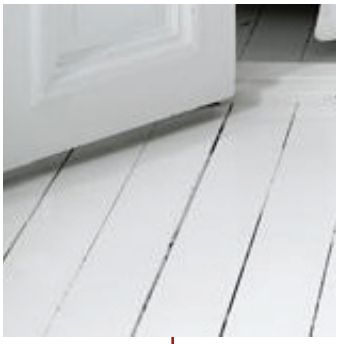


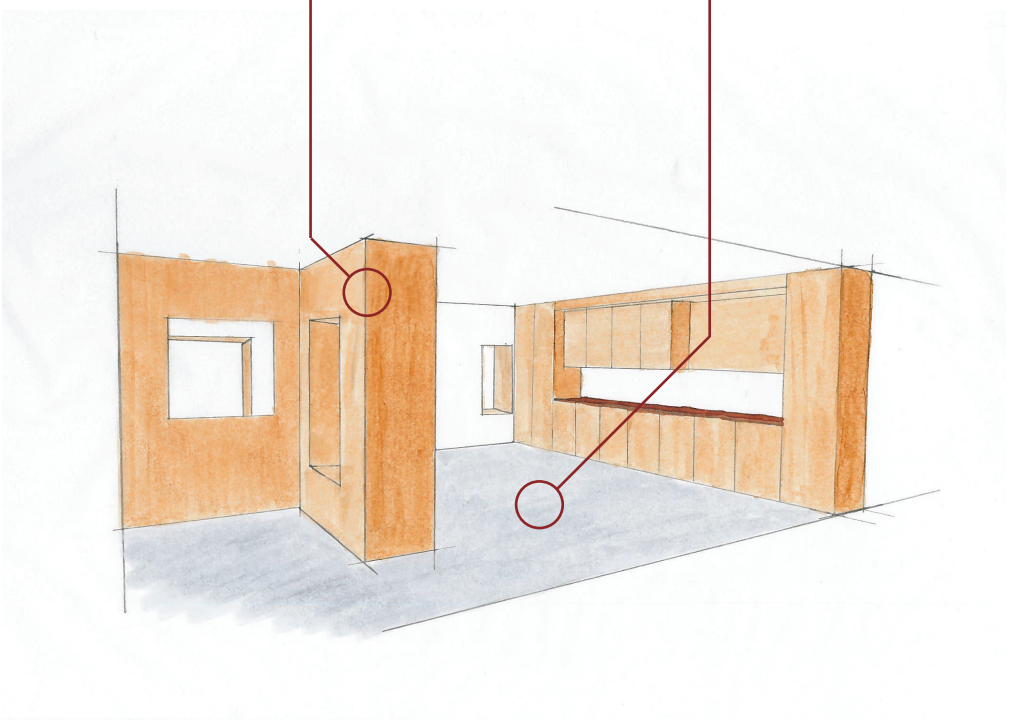
Materials

EXTERIOR
To emphasize that the middle of the site is being embraced by the buildings, it was important to differentiate between the 'inside' and the 'outside'. The inside should feel warm and embracing while the outside should feel heavy and resilient.

As the structural system is built up from sandwich concrete elements, the facades already have the properties of being heavy, strong and resilient. To create the contrast of creating something that is both warm and embracing and heavy and resilient, it was decided to work with color contrasts and texture contrasts. The outer facades are dark and mat concrete which embrace and protect the inner facade. To make the inner facade feel warm the concrete is board formed concrete, so it resembles wood.

To create a connection between the exterior and the interior the windows that are emerging out of the inner facade are cladded with plywood similar to the material of the interior gesture.





INTERIOR
The furniture gesture that emerges from the wall and embraces the kitchen and livingroom area is made in wood, to give the the space the warmth and coziness that wood reflects. To consider the means of selecting a type of wood, plywood is selected to ensure that it has properties of giving warmth and coziness, but still is cost-friendly. The floors are white painted wooden floors.

Common areas

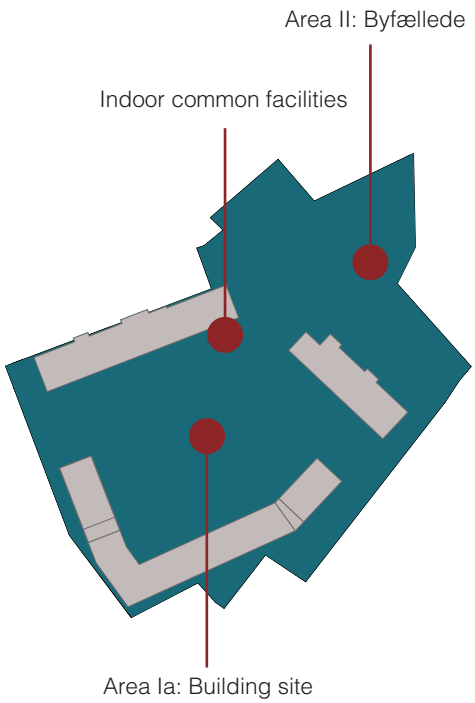
INDOOR COMMON AREA
The competition states that indoor common facilities such as a common eating area or party facilities are optional and to be included in the 4000m2. Common facilities such as washing and drying facilities are to expected in a subsidized housing complex. (Fremtidens Bæredygtige Almene Boliger – Åben konkurrence, 2013-2014)

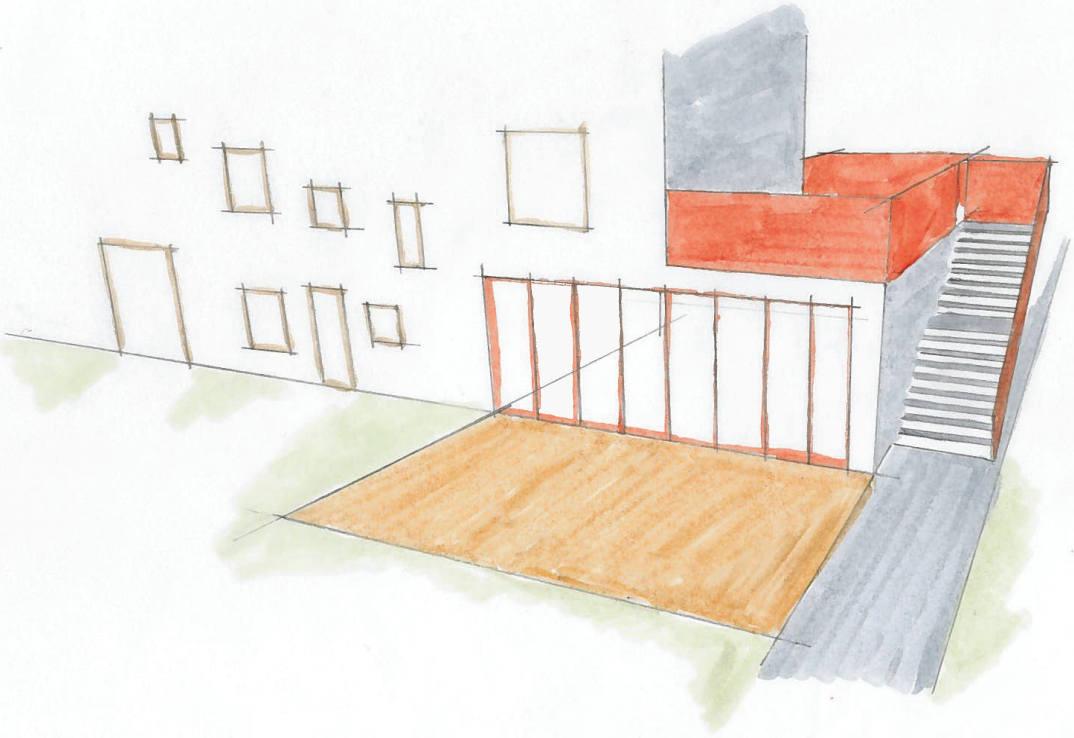
Social sustainability encourages common areas and common facilities to create a better community:

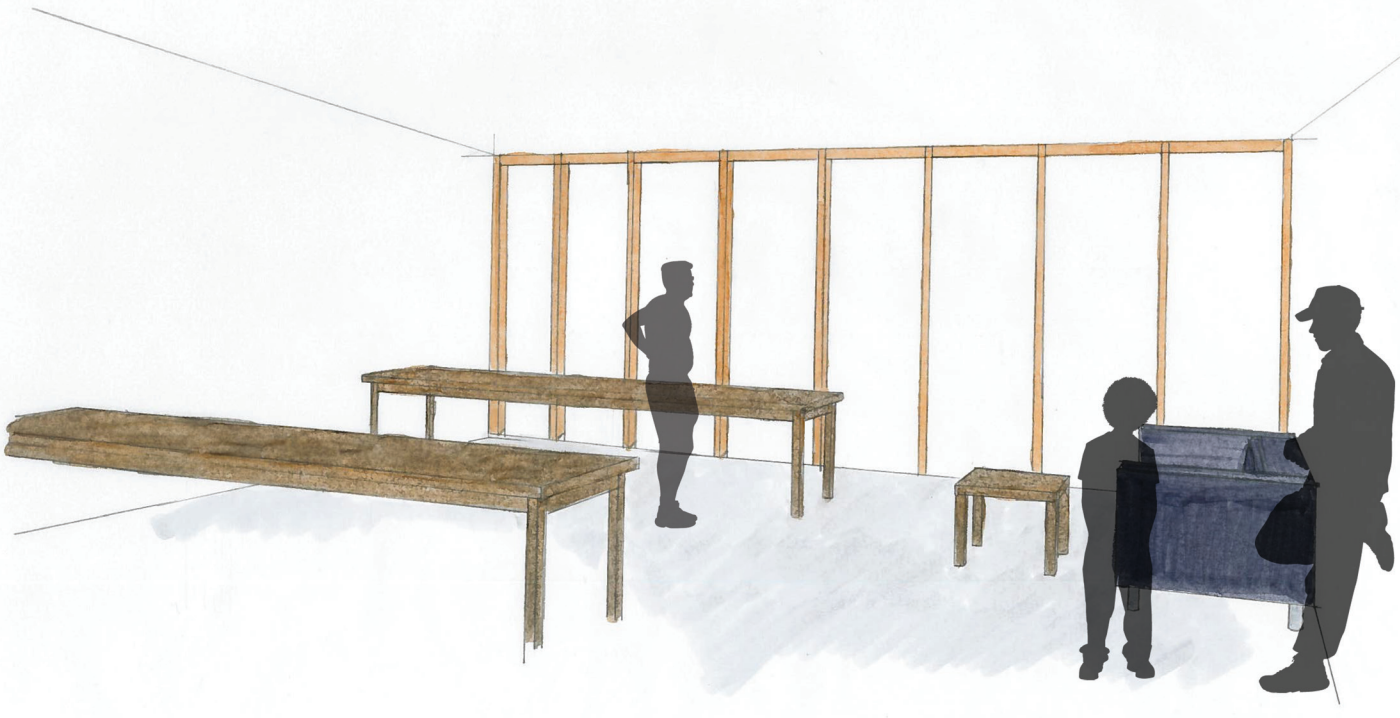
"New communities need shared spaces, shared rituals and support to build social networks." (Woodcraft, 2012, p. 31)

The expansion of Lisbjerg will create a new community in the area and the site of this project will be a part of the new area. It is in close proximity to the old Lisbjerg, but will in the eyes of the community in all probability be seen as the new Lisbjerg.

Common facilities in regards of DGNB criteria are non existent, since the available material in Denmark is designed for office buildings. Only the "Quality of outdoor spaces" of the ten chosen criteria can be regarded as basis for common areas. But no demands are made for indoor common areas. Therefore social sustainability and the tradition of building common areas for rental apartments will be regarded more when designing the common facilities.







OUTDOOR COMMON AREAS

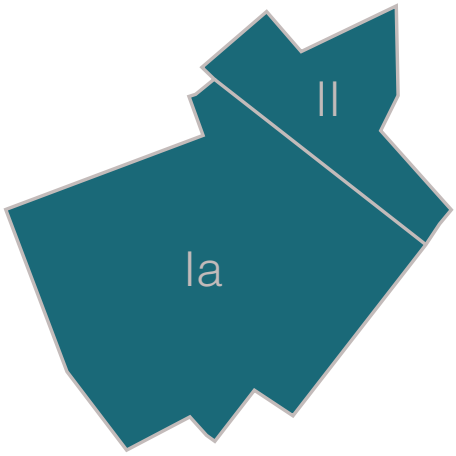
The site is divided in two parts. The most northern part called II of the site is the 'Byfællede', a small green area with wild vegetation. This part of the site is planned to stay green and be used as a park between the old and the new housings. (Fremtidens Bæredygtige Almene Boliger – Åben konkurrence, 2013-2014) This part of the site can be utilised but not be build on, the project will therefore show the possible usage and planning of the northern green area but not use it for habitation.

The southern part of the site called IA is meant to be the inhabited part of the site with both the subsidized housing complex of this project and an equally large building of 4-6000m2. The outdoor area is thought as a large green space between the subsidized housing and the other planned building on site as a park in the area, open for use by all in the context.

The open green space can be used for playing and relaxing or gathering on the grass. But to add extra value and usage to the park area an inspiration is taken from the 'gesture' used inside the apartments and used as window niches on the facade. The outdoor common area will accommodate wooden gathering points in the form of wooden pavilions and decks. The decks can be used for gathering around a meal, grilling in the summer, and the pavilions give the opportunity to gather in not just in summer but also in spring and autumn, when the weather is more unpredictable and the chance of rain is substantial.

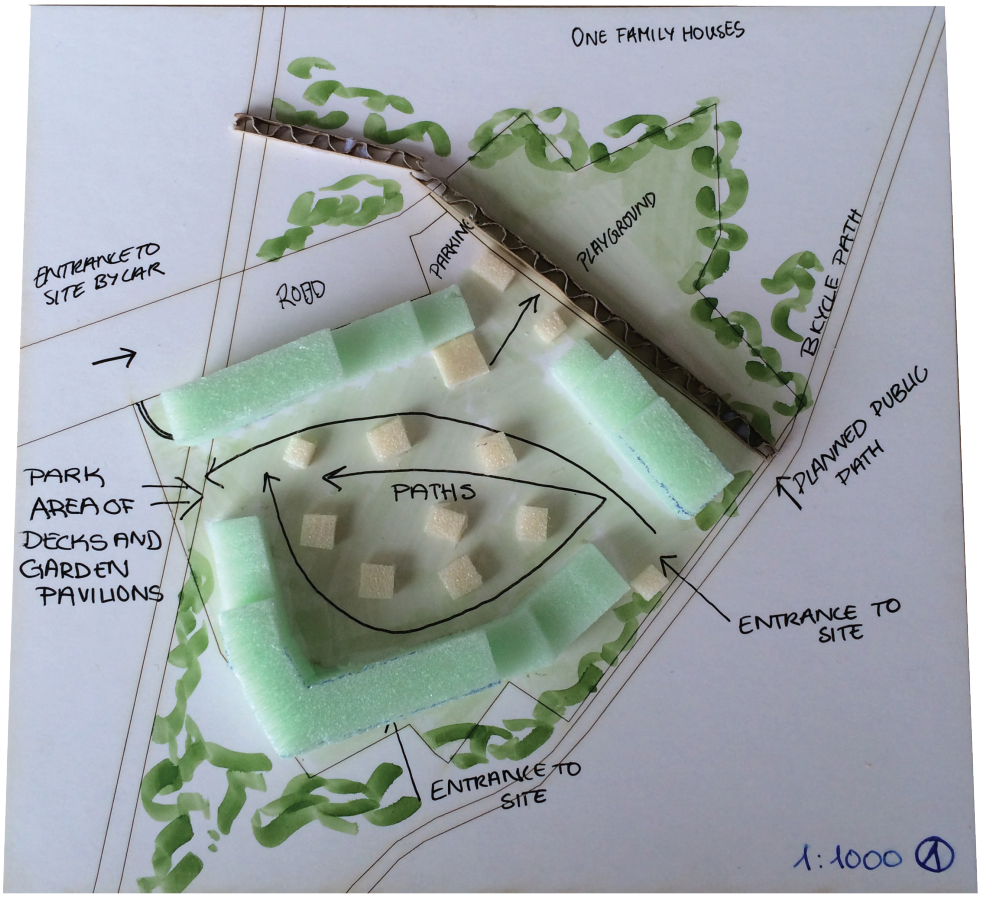
The analysis of the microclimate shows great risk of rain and wind. The users can withdraw from the open areas of the site in the pavilions and sit alone or gather in smaller groups or they can be protected from wind and rain.

The wooden decks can be used for gathering around a barbeque. Inspiration picture from Ecospace studies, seen on the picture are their garden pavilion Ecocube. [Link 21]

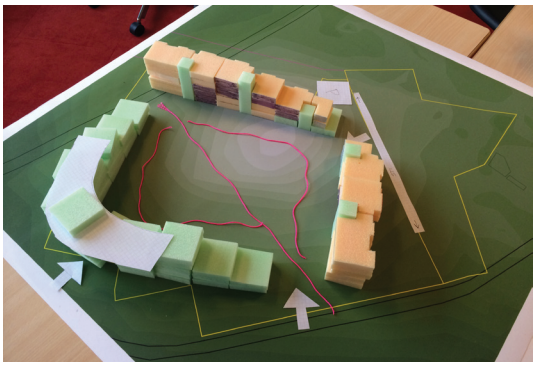


AREA II: BYFÆLLEDE

AREA IA: BUILDING SITE



Mapping zones & flow of the site



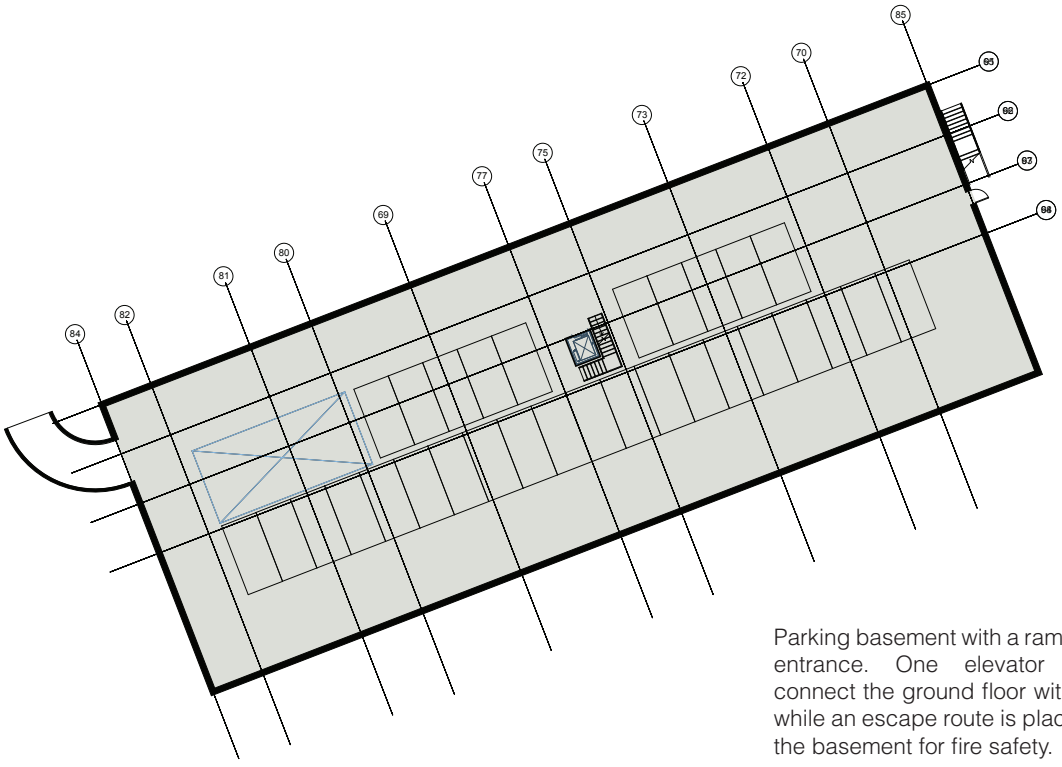
Process model working with flow of the path system on site and connections to the context.

CONCLUDING

The indoor area and the roofed garden pavilions give an opportunity to use the common social areas all year, but people can still feel the change in season and they move the location of the social activities after the season. In winter the private gathering is inside the apartments and the social gathering is in the indoor common facilities, while both social and private occupation of space can happen in the outdoor facilities of the site, either out on the open grass sitting by a tree or more private in the wooden pavilions.

The pavilions can shelter the rain and most of the wind, but will not be closed off and heated in winter. The experience of changing seasons can also be important as Alvar Aalto describes about the Technical University at Otaniemi:

“The university has an extensive sports area for the students and a large hall where summer sports can be pursued during the winter. Personally I’m against sports becoming universalized so that summer is turned into winter and winter into summer. I think that one should pursue a sport and change it according to the time of year so that one may experience the natural change of the seasons.” (Hawkes 2011)



Parking basement with a ramp as the western entrance. One elevator and staircase connect the ground floor with the basement, while an escape route is placed to the east of the basement for fire safety.

Parking

With a new building follows a demand for parking. To keep the outdoor area green and usable for other than parking a demand has been set by the competition brief to place most of the parking in the construction.

The competition brief states:

- 30 parking spaces in construction
- 4 parking spaces on site, preferably for shared cars
- 3 handicap parking spaces
- 80 bicycle parking spaces, of which 50 should be shielded or locked up

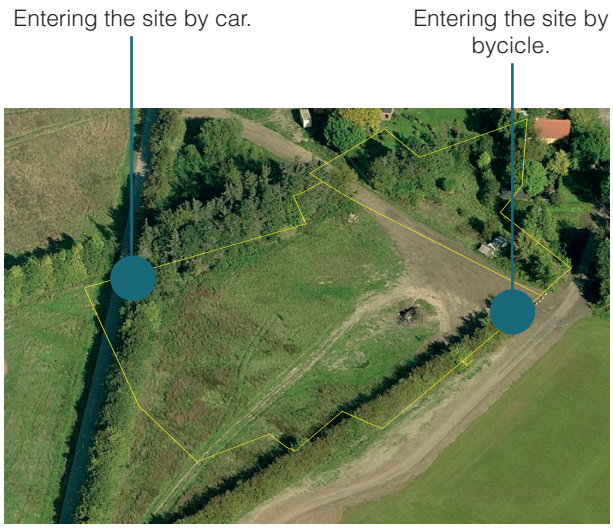
(Fremtidens Bæredygtige Almene Boliger – Åben konkurrence, 2013-2014)

CAR PARKING
When planning the car parking the entrance to the site played a large role. The natural entrance to the site is from the road west of the site. A ramp leads down into the basement to parking facilities and a technical room.

The parking basement under the largest of the two buildings is shaped to accommodate the 30 parking spaces. This turned out to be a difficult task, since the building is narrow and throughout most of the process had a structural systems, which left little room for parking spaces in the building. The structural system was therefore chosen to both fit the functions in the apartments, but also to fit the right amount of parking spaces in the basement. A grid system for the construction was created, which not only helped with the planning of parking but also helped with shaping the apartments, optimizing the use of prefabricated elements and helped keep track of the 3D model in Revit and AutoCad.

The grid system is 3,6m x 3,6m, but with the staircases having its own grid measurements.

Parking is situated on the largest building, while the smaller building is thought to contain the storerooms and possibly extra bicycle parking.

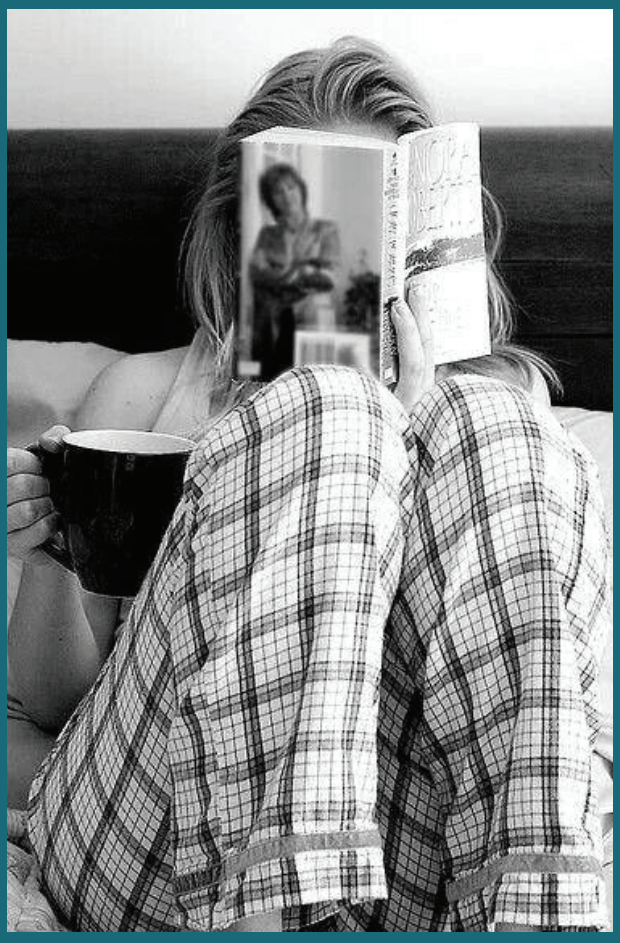


BICYCLE PARKING
The inhabitants have several places to park their bikes. The entrance on bike is from the bicycle lane east of the site. a path along the buildings can be taken to either common bicycle sheds or unsheltered parking spaces in front of each entrance to the buildings.

The thought is to reuse the design of the garden pavilions to create sheltered bicycle parking placed around the site, preferably close to the path and the entrances to the site.

Thermal comfort

INDOOR CLIMATE
Indoor climate is of great importance, since people spend most of their lives inside, either at work or at home. The optimal indoor climate is to achieve comfort for the users, and not just avoid diseases and discomfort. The building design should be based on the planned function and activity level. In residential buildings the activity level is often low and the function is living. The functions of the different rooms can be considered, such as differentiating the material and ventilation for living areas, kitchen and bathroom. (SBI-anvisning 182,1995)



Parameters impacting the indoor climate:

- Thermal conditions; air temperature, emission temperature, air velocity and air quality
- Air quality is described by the amount of pollution it contains; dust, moisture, gas, fumes and smell static electricity
- Light; intensity of light, colour, contrast and reflection
- Noise; volume and frequency
- Radiation such as radon

(SBI-anvisning 182,1995, p. 18)

Elements impacting the indoor climate of the building:
Impact of the site:

- The site can be contaminated
- Radon

Impact of the microclimate:

- Orientation regarding daylight
- Orientation regarding the building's absorption of heat
- Orientation regarding wind (sheltering and natural ventilation)

Impact of the building:

- Materials can give off gases and filth
- Easily cleaned surfaces to avoid accumulation of filth
- Light; window size, glas percentage, light transmittance, orientation
- Noise; insulation for impact sound and noise from neighbours
- Cold; insulation in walls, cold bridges and draft
- Heat; absorption of heat in winter (thermal mass, heat transmittance of windows) and avoiding overheating in summer (insulation, venting, sun screening)

Impact of the building plan:

- Room height and depth in relation to daylight
- Room height and depth in relation to natural ventilation
- Placement of room in relation to pollution sources

Impact through use:

- Cooking fumes from the kitchen
- Damp from the bathroom
- Heat from equipment; electronics and domestic appliances
- Heat, smell and moisture emitted by the users

THERMAL COMFORT

"Thermal comfort is the condition of mind which expresses satisfaction with the thermal environment."
(DSEN ISO 7730, 2006, p. 10)

Thermal comfort is an individual sense of a comfortable environment. The sensation of thermal environment can change from person to person, depending on age, gender, origin etc. but common for all is that humans have a sensitivity to temperature changes and have their own individual thermal comfort zone. A small change in temperature can make a great difference for the inhabitants of the housing complex. Thermal comfort usually exists when thermal conditions go unnoticed. People detect if the temperature is too hot or to cold, never when it is perfect. (Heschong, 1979) Just like design and building constructions. People detect flaws and not the lack of flaws.

General guidelines for the range of comfort are formulated to achieve the highest comfort level for as many people as possible. These are e.g. formulated in the Danish Building Regulations, BR10, and the "Code for Indoor Thermal Comfort", also known as DS474. (DS474, 1993)

CONTROLLING THE THERMAL COMFORT

"With the control of fire, people can generate heat at will to warm themselves and their environment. [...] To fire, we have added other sources of energy, such as electricity, to power equipment that has given us ever more precise control of our environment. Fascination with this potential for control of our environment has prompted the invention of mechanical systems that have made natural thermal strategies seem obsolete by comparison." (Heschong, 1979, p. 11)

The fascination of controlling the thermal conditions is a human trait, but despite the comfort thermal control can create Heschong stays sceptical and compares the electrical systems of thermal control with replacing regular food with astronaut food. She describes:

"A few tubes of an astronaut's nutritious goop are no substitute for a gourmet meal. They lack sensuality - taste, aroma, texture, temperature, color."
(Heschong, 1979, p. 17)

The inherent thermal qualities of the building are just as important as the gourmet meal and not to be completely substituted with artificial thermal conditions. Heschong's position is supported by the modern use of sustainability, where methods such as the pyramid of Louis Becker, from Henning Larsen Architects, emphasize the importance of inherent qualities and passive strategies. Even though their reason to support inherent qualities might differ, where Heschong emphasises on the poetics of thermal conditions, while Becker's model refers more to an energy saving approach, the message is alike.

(Louis Becker, Henning Larsen Architects)

The application of thermal control enable people to use buildings at all hours of the day and all seasons of the year, a comfort people of today are accustomed to. It is not the goal to venture back to times without thermal control, but it can be important to remember that it is alright to be able to feel a difference between winter and summer.

"Excessive convenience and functionalization in general tend to dilute architectural meaning. Efficient central heating turns the fireplace into a mere visual luxury."
(Pallasmaa, 2011, p. 131)

It is important not to forget the architectural meaning as Pallasmaa implies. The fireplace has become obsolete and something people add to their homes for the atmosphere. This is why the project has focused on creating a link to the warmth of the home and gathering through other means than adding fire and thereby warmth literally. The apartments designed have a heating and cooling system in form of heated floors and mechanical ventilation in winter, while summer is aired out through the windows, natural ventilation.

When adding thermal control to a building Dean Hawkes reminds the designer that technical installations must always serve the poetics of the building, never the other way around.

"…we see these technological means consistently applied in the service of qualitative ends, technics subservient to poetics." (Hawkes, 2008, p. 24)

FLOOR HEATING

The nostalgia of the hearth and the open fire will be achieved through wood and its association of warmth, through light and the warmth and comfort of gathering with family and friends. The expression of the room creates a focus on the wooden 'gestures' of the home; the kitchen, the entrance and the window niches. This focus would be disturbed had radiators been placed along the facade or beneath the windows, which is custom. The decision was therefore to gain heat control by adding floor heating.

Beyond being chosen from an aesthetic point of view the experience of floor heating is said to be more comfortable than radiators. The heat is in the floor and thereby ensures warm feet and colder air in head level, which by many is preferred than the sensation of having cold feet in winter. [Link18]

By removing the radiators the room becomes easier to clean and furnish. Economically speaking floor heating is more costly to install than radiators, but cheaper in use and maintenance. As the supplier Uponor describes it:

"Uponors gulvvarme giver en fremragende temperaturkomfort til bolig- og arbejdsmiljøet til laveste mulige omkostninger. Vores lavenergiløsninger er ideelle ved anvendelse af vedvarende energikilder og hjælper med at nedbringe energiforbruget og CO2-udledningen. Vores løsninger er medvirkende til at give det bedste indendørsklima. [...] En lidt højere investering til at begynde med i forhold til konventionelle varmesystemer vil blive tilbagebetalt mange gange i løbet af bygningens levetid grundet det lavere energiforbrug." [Link 19]

In short the they state that the floor heating provides excellent temperature comfort at a low cost. The investment in the building phase is slightly higher, but the investment will be repaid in the lifetime of the building due to the low energy consumption of their system.

Floor heating equals more comfort, Better climate, Less energy consumption and less CO2 emission. [Link 19]

THERMAL COMFORT AND DGNB

The DGNB criteria regarding thermal comfort are 'Thermal comfort in winter' (nr. 18), ' Thermal comfort in winter' (nr. 19) and 'Air quality' (nr. 20).

The main goal of the three criteria can be described as BR10 formulates it:
"Sustain a healthy and satisfying temperature considering the activity level of the inhabitants." (BR10, 6.2 thermal indoor climate)

While also regarding the air quality, mainly the CO2 levels in the building, which affects the perceived air quality of the room. The thermal comfort as described is all an incorporation of the DGNB criteria in both a technical approach but also an approach based on experience and building poetics. Both equally important, even in the eyes of DGNB.

The three criteria are explained in Appendix 4, but shortly they state the following demands:

Temperature demands

- Hours pr. year under 20°C: 0h
- Hour pr. year above 26°C: max. 100h
- Hours pr. year above 27°C: max. 25h

Air quality

- According to EN15251, category II: The CO2 levels must not exceed 500ppm at any time during the year.

The direct approach to the indoor thermal comfort and air quality is to make use of floor heating, as earlier mentioned, and a ventilation system during winter, while natural ventilation is used in summer. The floor heating and absorption of solar heating through the windows secure adequate temperatures in winter, while the ventilation system and venting both lower the indoor temperature and the concentration of CO2 in the air.

Other passive methods such as shading can help secure lower temperatures in summer and insulation can keep out heat in summer and cold in winter.

BSIM

Bsim, which stands for Building Simulation, can analyze energy and indoor climate of a building by simulating the building's thermal indoor climate, energy consumption, daylight, moisture, natural ventilation, heating and building integrated solar cells. [Link 20]

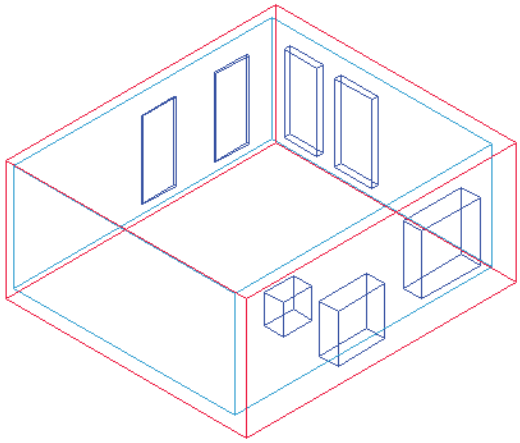
In this project the Bsim results in focus are the CO2 levels and temperature. The earlier mentioned temperature demands and maximum CO2 levels will be checked in the Bsim model to secure a good indoor climate.

The simulation is performed in the kitchen and living area of the 85m2 apartment, which is identical to the kitchen and living area of the 95m2 apartment.

The chosen settings in Bsim are based on the building plan and heating and ventilation system chosen for the building. The systems added in the model are based on the use of the room:

- Equipment load - domestic appliances
- People load - number of inhabitants and their activity level
- Heating system - floor heating in winter
- Ventilation system - mechanical ventilation available all year, but mostly in use in winter
- Venting - Natural ventilation by opening the window after need
- Infiltration - unintentional or accidental outside air through the building envelope

The settings and results are described and discussed in Appendix 5.



Energy consumption

The general approach to sustainable buildings at Architecture and Design is the low-energy or zero-energy houses. In this project the energy consumption consideration is represented through the DGNB criteria “Non renewable primary energy demand” (nr. 10) and “Total primary energy demand and proportion of renewable primary energy” (nr.11).

The implementation of passive strategies can influence the total energy consumption. With passive strategies regarding energy following can be mentioned:

- Insulation
- Orientation
- Solar gain
- Solar shading
- Thermal mass
- Natural ventilation

These also refer to the two DGNB criteria, where the goal is to minimize the primary energy demand and maximize the renewable energy supply. (Appendix 4)

The energy goal is based on the 2020 demands for energy consumption of the Building Regulations. This states that the total energy consumption must stay below 20kWh pr. square meter heated floor area. The aim is to decrease the energy consumption through passive strategies and use renewable energy sources to cover the excess energy demand.

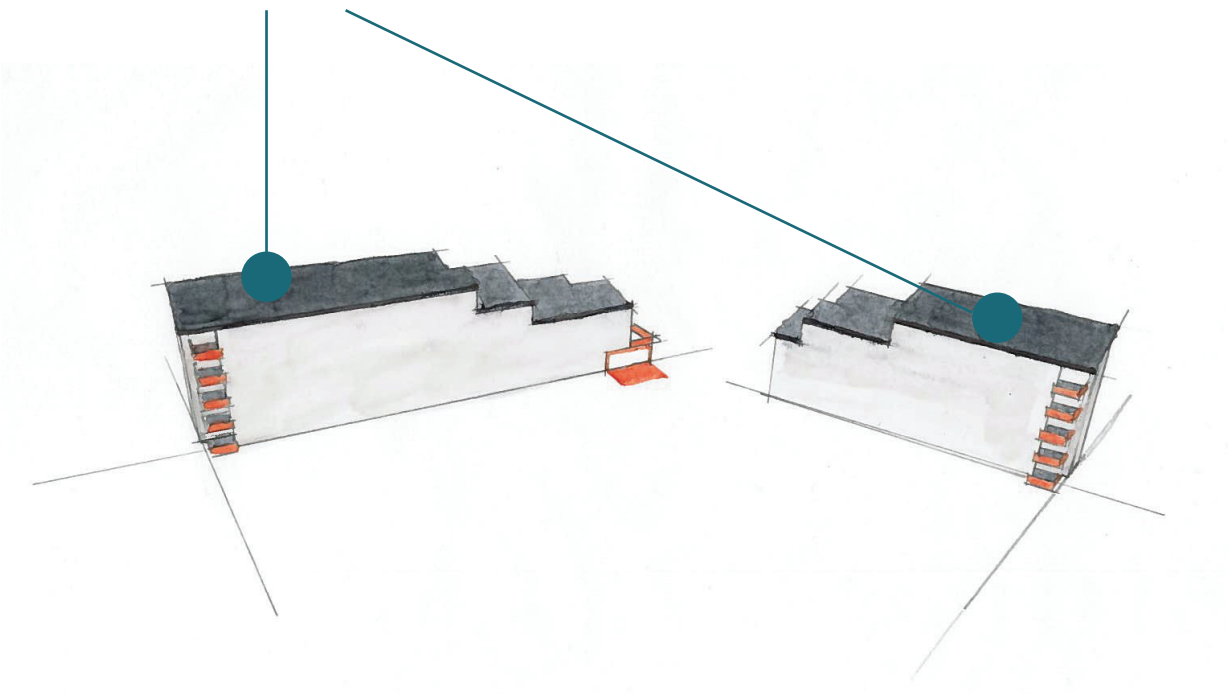
It is expected that the energy consumption exceeds the limits of the 2020 energy demands in this project and a renewable energy source has been used to meet the energy demand. (Appendix 6) The chosen renewable energy source are solar cells, which can be either implemented in the facade or placed on the roof. The sloping roof of the building is designed to support the solar cells. The slope of the building is 10 degrees, while the solar cells will have an angle of 30 degrees for optimal energy gain. The southern orientation of the roofs make them the perfect placement of solar cells. (Marszal, lecture 2012)

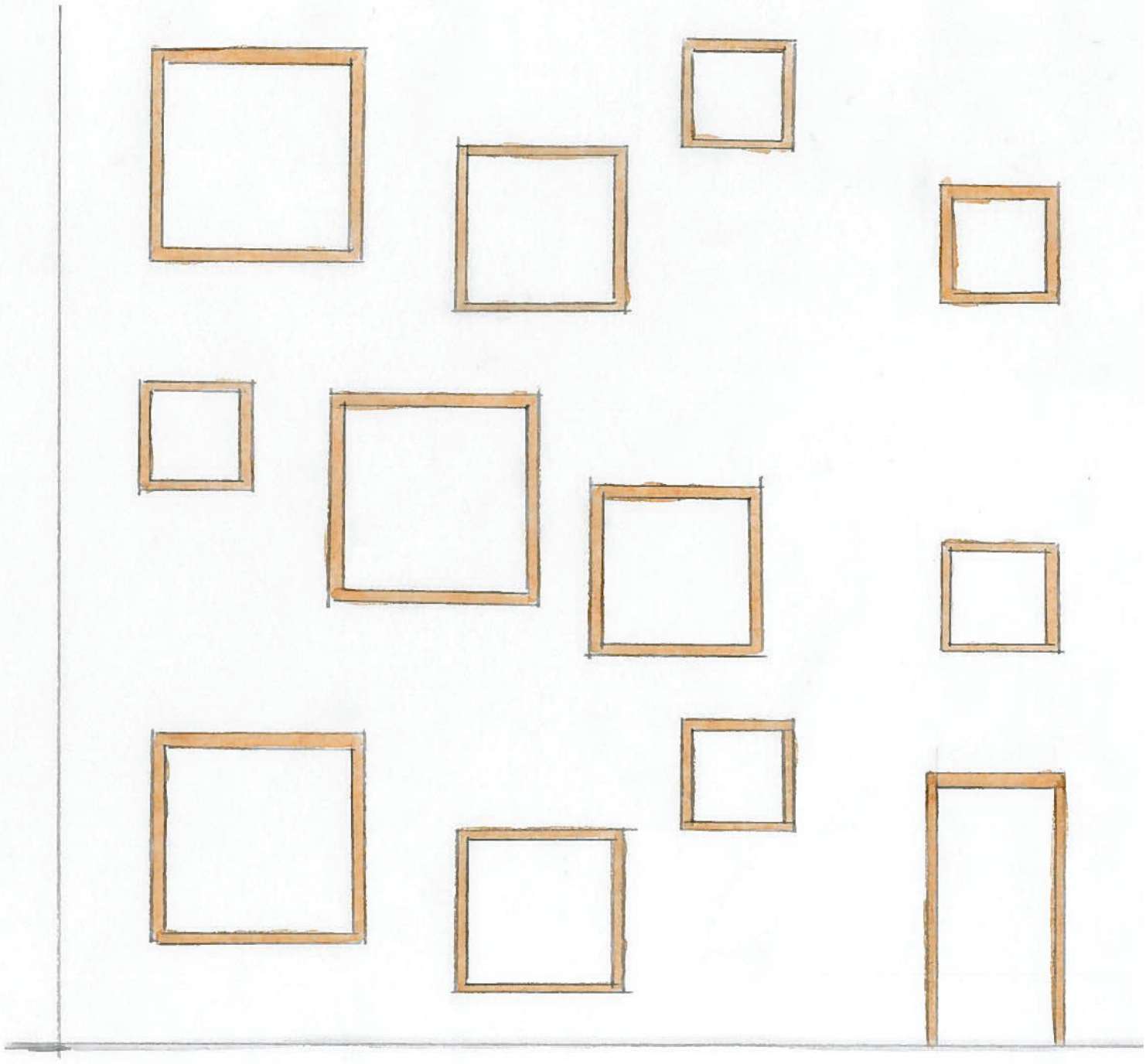
BE10

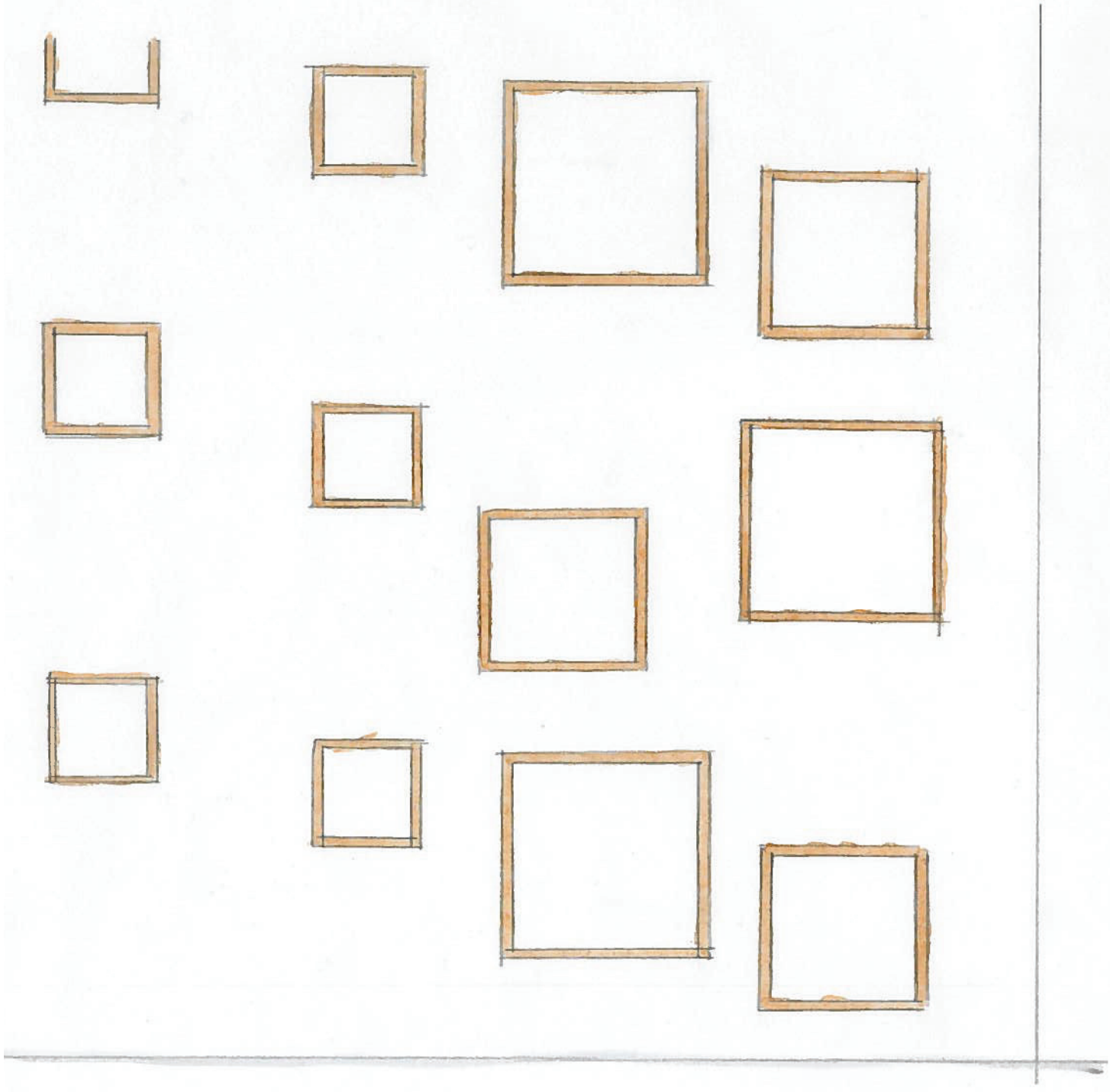
Be10 as a computational tool can be used to calculate the total energy demand of the building. During the process Be10 can be used to try out the changes of the building and see if they have an affect on the energy consumption. Based on the calculations in the program the amount of solar cells needed is concluded and can thereafter be applied on the building.

The solar cells will be placed on the roof of the buildings, in a 30 degree angle and facing south. The thorough examination of Be10 and the Be10 results are found in appendix 6.

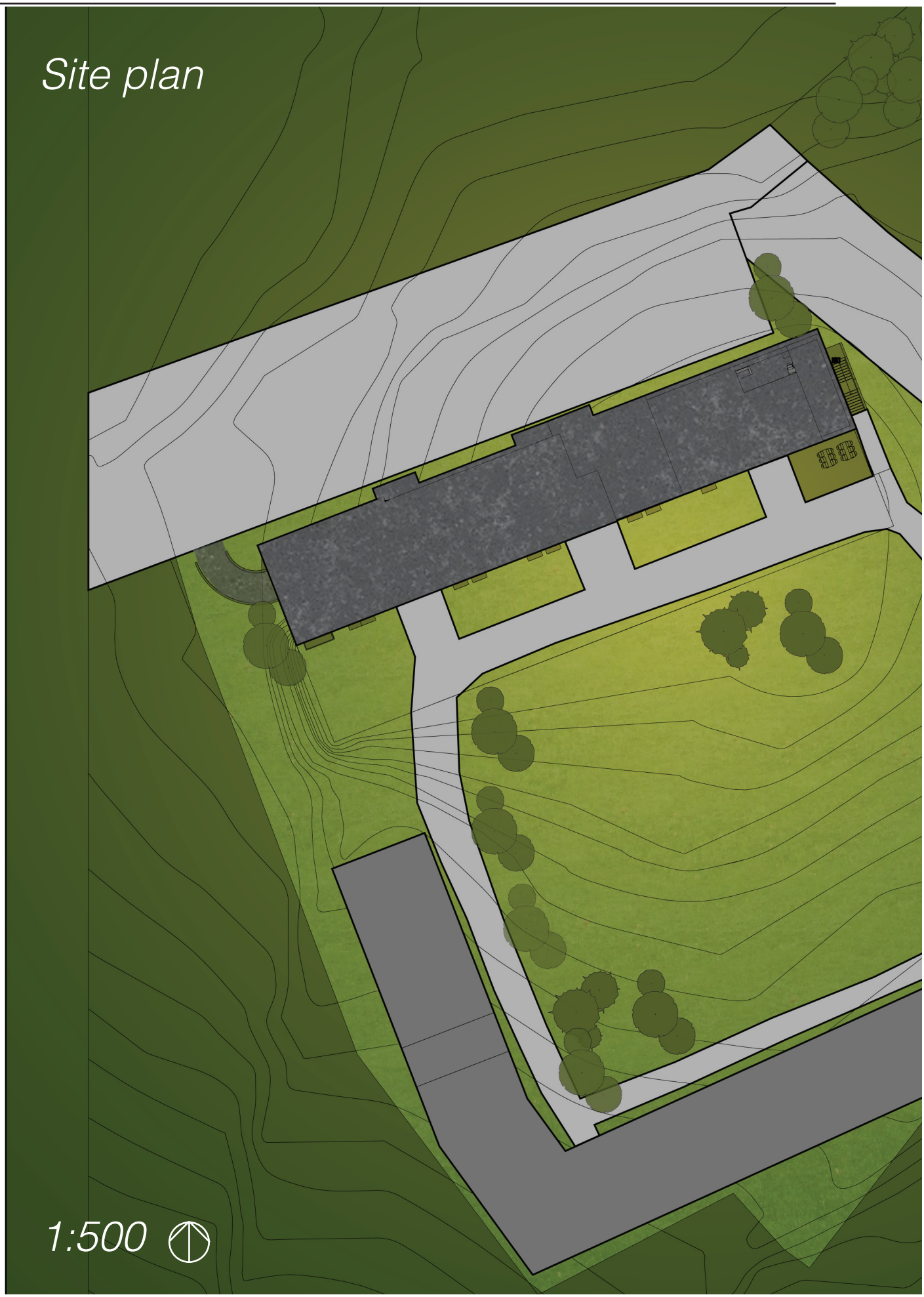
Placement of solae cells on the building.







PRESENTATION


Site plan
1:500

Plans

Ground floor to 4th floor

Ground floor

1st floor

2nd floor

3rd floor

4th floor

1:500

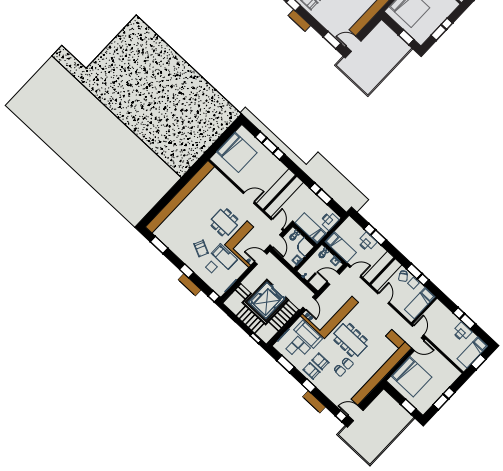
N

Ground floor

1st floor

2nd floor

3rd floor

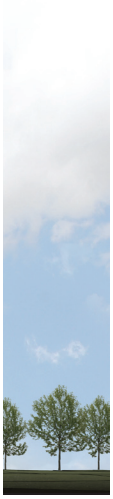


4th floor

Elevations

1:500 *SE facade*

1:500 *NW facade*



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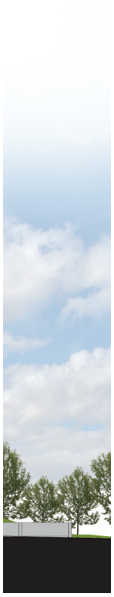
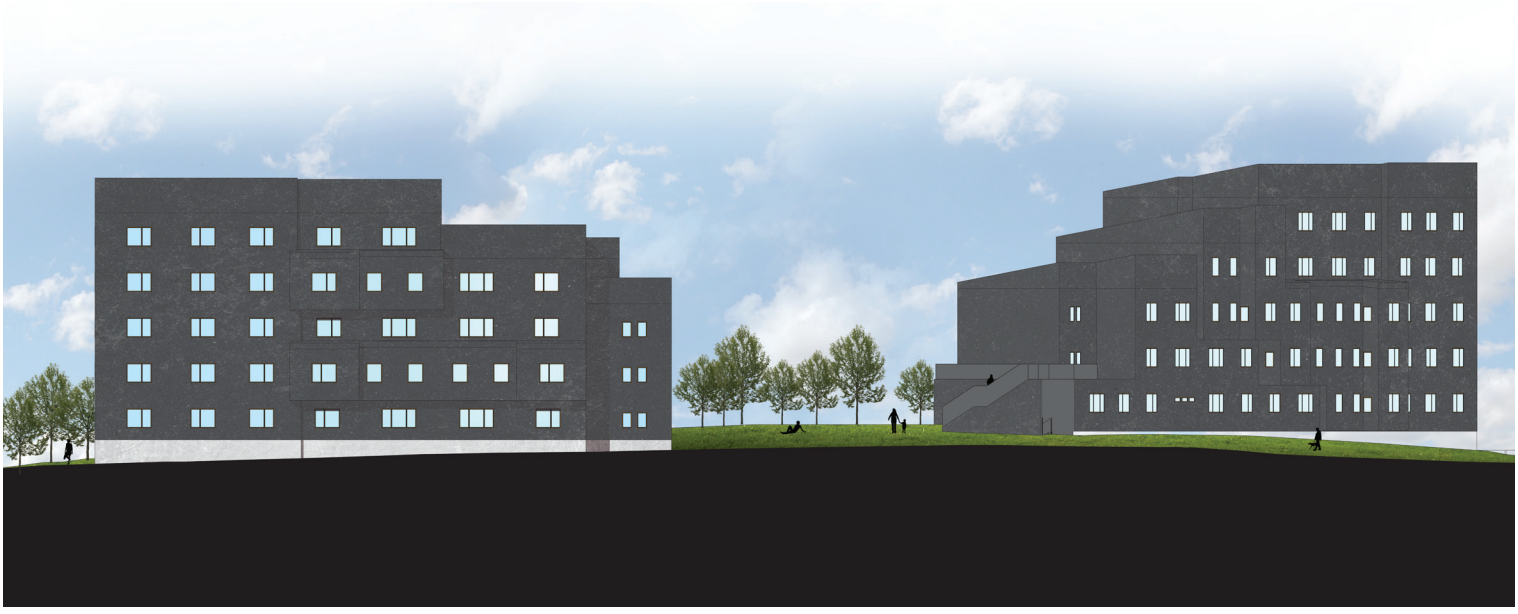
AA Section

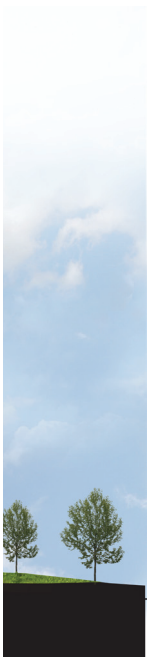


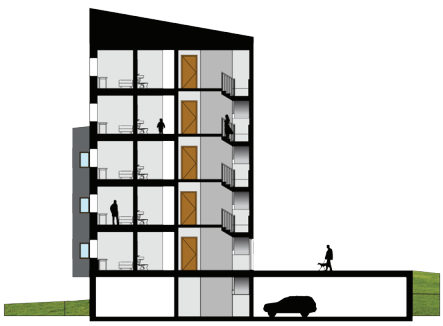
Sections



1:500 NE facade

1:500 SW facade





1:500

AA Section

Conclusion

The project's original intent was to integrate architectural quality and the human scale with measurable sustainability criteria of the DGNB. The inclusion of DGNB was, however, extremely challenging as its requirements are very comprehensive. Our original focus on social sustainability was overly difficult to balance with the technical and environmental criteria demanded by the DGNB system. The lack of DGNB public information and the fact that the limited information needed to be 'translated' to a residential project did not give an adequate basis for a four month design project. Residential criteria is expected to be produced in the near future for DGNB. Our experiences would suggest the system can be a positive design tool on the future for architects, but that more extensive documentation and training in its use is needed.

Reflection

SCOPE IS IMPORTANT

When we chose our thesis subject we saw the potential of the use of DGNB and DGNB as the up and coming sustainability tool for building in Denmark. We saw it both as an interesting subject to investigate and as useful knowledge once we leave Aalborg University. The potential we saw in DGNB was the structured documentation of requirements and its incorporation of social sustainability. Social sustainability is weighed as highly as ecological and economical sustainability, which shifts the focus of existing sustainable buildings in Denmark from being solelyfocused on low-energy design.

The initial idea of the thesis was to create a new method of using DGNB, while simultaneously designing a building. Our knowledge of DGNB was limited to one or two lectures at previous semesters, which resulted in this semester being heavily influenced by the collection of information, expanding our knowledge and defining the substance of the different criteria. The gathering of knowledge was conducted while the method was being created and left little to no time to test the method on the design. We discovered that very little information is available to the public and no DGNB system has been made for residential structures. As a result during this process, we concluded that the scope of using DGNB needed to be significantly reduced. The original thesis concept of implementing DGNB required re-evaluation in order to develop the design.

The original thesis concept was also based on including all criteria to achieve a complete sustainable design method, which is not even how DGNB is usually used. Usually a selection of criteria are chosen from DGNB based on the focal point of the project. These are chosen together with a DGNB consultant and defined from the DGNB manual.

The investigative process leading to the re-evaluation of scope took approximately half of the semester. After gaining this knowledge the project limited the DGNB criteria to 10, which were strongly influenced by the learning goals of Architecture and Design at Aalborg University.

We also learned that although DGNB and Architecture and Design's Integrated Design Process have many similarities, the scope of required DGNB analysis documentation is extremely high and is too time consuming for the scope of this thesis. In retrospect, the DGNB research restricted the time available for project design and limiting the DGNB criteria should have been undertaken earlier in the process.

NEXT STEPS

The limited time available for the design and documentation of the project has left a few items that we would wish to develop further.

- Windows
  Although the layout of windows and this use in the architectural gesture were considered positive, the size of the windows could be re-evaluated, especially to increase the daylight factor to interior spaces.

- Shading.
  The integration of shading elements could not be achieved in the reduced design time. We would like to further investigate the issue both aesthetically and in terms of solar gain.

- Materials
  The use of board cast concrete on the façade was chosen for practicality, cost and the high design signals the material presents. We would like to further investigate the balance between the architectural 'design' qualities and the sometimes perceived harness of the material and how it is seen with the wooden facades.

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Picture references

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Page 55: Woman cooking
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Old fireplace
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Dogs in sunspot
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Heart
http://www.aheartnote.com

Wood
http://www.pinterest.com/pin/535928424380133590/

Page 56: Mood board, in order of appearence
1 http://www.woodindesign.com/2013/04/10/wood-design-wood-kitchen-cabinets/
2 http://www.woodindesign.com/2013/04/10/wood-design-wood-kitchen-cabinets/
3 http://plastolux.com/triendl-fessler-modern-architecture-house.html
4 http://www.flickr.com/photos/trevorpatt/6438479099/
5 http://plastolux.com/triendl-fessler-modern-architecture-house.html
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7 http://www.powerhouse-company.com/canal_house_hg.html
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9 http://www.trendir.com/interiors/plywood-built-in-furniture-by-big-game.html
10 http://www.woodindesign.com/2013/02/27/wood-design-living-room-wood-walls/
11 http://www.pinterest.com/pin/535928424379835488/
12 http://www.pinterest.com/pin/535928424379547035/

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1 http://www.woodindesign.com/2013/04/24/wood-design-residential-architecture/
2 https://lh4.googleusercontent.com/-OUEQHALvC-o/TrQCNU9CKOI/AAAAAAAAAD6Y/bglgr3rrPeA/Screen+shot+2011-11-04+at+11.17.44+AM.png
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(Educating for a Carbon Neutral Future : A Danish perspective in a Global World, Mads Dines Petersen, 2014)

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