Erasmus +
Aalborg, DK

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ISCTE-IUL | Integrated Masters in Architecture
UCN | Architectural Technology and Construction Management

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Academic Year 2015 / 2016

UCN | ISCTE-IUL

First and for most, I would like to thank my fellow students, colleagues and friends. That helped me thru out the years. I am very grateful to all of you. You know who you are. All the people I meet in Denmark that help or contributed to this experience and work.

To my teachers over the years, that even when things were bad you manage make me strive to do better and keep going. A thanks to my tutor Sara Eloy, for the support and guidance during the year. To all my teachers in Denmark, for the understanding and support during the year, that made all this work possible.

I would like to thanks my family from the heart Nádia, Susana, Ana, Rubén. For the constant support, for making me see that the light at the end of the tunnel is not all that far. You all made me keep going with all the laughter and smiling. No one does this alone thank you.

I would like to thanks my amazing family for the love and support I have gotten over the years. In particular, I would like to thanks my parents for supporting me to go to Denmark. My sister for always being there. I couldn`t have done it without you. Thank you.

Abstract / Resumo

This book reflects the work done during one year in Erasmus, in the city of Aalborg in Denmark. At UCN, the curriculum was more practical approach to architecture and construction. The student gets understanding of all construction process in a building, from the inception to the end life of the building.

The main project work was on a renovation building and a new construction building, divided in two semesters. This include the idea, the design, the constructive solutions, the installation of building services and the construction planning of both buildings. Both projects had requirements to be met, so imposed by the project itself but mostly related with Building Regulation in existence.

Each student was also to write an elective per semester. This is a written assignment, in which the student writes about a topic of its choice that is related with the industry. The main interest in a topic was sustainability in buildings. The first is about self-sufficient buildings and how can design influence building sustainability. The second is about the use of water in a building and how can it be reused efficiently.

This book introduces the teaching, shows all the done in two semesters and it includes the two electives written.

Key Words: Construction, Construction Planning, Sustainability

Este caderno mostra o trabalho feito durante um ano em Erasmus, na cidade de Aalborg, na Dinamarca. A UCN tem uma abordagem mais práctica em relação a arquitectura e a construcão, que se reflete no seu programa curricular. O estudante tem um maior entendimento de todo o processo de construcão do edificio, desde da sua concepção até ao seu fim de vida.

Foram feitos dois trabalho de projecto, um projecto de reabilitação e uma construção completamente nova, um em cada semestre. Os projectos incluiram a ideia, o design, as soluções construtivas, a instalação de servicos e o planeamento da construção do edificio. Ambos os projectos tinham requerimentos a ser cumpridos, imposto pelo projecto em si mas a maioria pela legislaçao em vigor.

Cada estudante tem que escrever uma electiva por semestre. Isto é um trabalho escrito, em qual o estudante escreve sobre um tópico da sua escolha relacionado com a industria. O interesse para o tema das electivas foi a sustentabilidade em edificios. A primeira electiva é sobre edificios auto-sufficiente e como o design pode influeciar a sustentabilidade em edificios. A segunda é sobre o uso de água em edificios e como esta pode ser reutilizada mais eficientemente.

Este livro introduz o ensino na Dinamarca, mostra todo o trabalho feito nos dois semestres e inclui as duas electivas.

Palavras-Chave: Construção, Planeamento de obra, Sustentabilidade

Contents

Introduction

Aalborg is a city in Northern Denmark. The city used to be an industrial city, it became a city turn to culture. This was achieved by the construction of the waterfront, where the industrial area used to be. The creation of events all year around for students related to all types of studies, or for different age range living in the city. Aalborg was now a very multicultural environment duo to the international students that study in the city.

This book presents the work done on the Erasmus+ programme at UCN - University College of Northern Denmark, during the academic year 2015/2016. The course attended was called ATCM - Architectural Technology and Construction Management. This course focus on practical and realistic approach of execution of the building. Most of the work is done in group, thinking the building from inception to handing over the client. This will include design of the building, the building services (e.g. like pluming, sewage, ventilation...) and the planning on the construction. All of this needs to be done and fulfilled accordingly by the Building Regulation.

The semester attended were 5th and 4th, by that order. In each semester there was a project work and an elective, a written work. The project work is done in group for most of the semester, the individual part of the project consists of a choice of a building elements e.g. walls, with this would show all types on walls in the building, how they are connected, tender the project for wall contractor, and do the planning of it installation in the time frame planned for the all building.

The project from 5th semester was a rehabilitation of a small apartment building in the city centre, with a creation of a commercial space on the ground floor (where wall needed to be demolished) and the extension of the building, this were requirements set for the project. This included the survey of the building, to determine what needs to be changed, then started the design process. Also thinking and calculating the structural solution to the ground floor after the demolition of the walls. Research and choice the new materials and constructive solutions to be use in the building. The new layout of building services to be installed and do calculation for installation, e.g. adding ventilation to the building and the new sewage layout. The building had no insulation, so there is a need for an energy analyses in order to find a solution, with an analyses tool. The planning of the construction and the budget are also included. The choice for the commercial area was to design an architecture studio.

All this work was in group, later in the semester there is the individual part. Each student chooses one element from the building, in this case the re-insulation of the building. This includes detail drawings, specification on installation, key points, planning for that elements installation, budget, all documents needed for the building to be tender, including e.g. risk analyses and tender control plan, and logistics delivery of materials on site.

The project in 4th semester was to design a multi-storey building in the waterfront, that area it used to be the old

industrial area of the city, now is mostly building with apartments and business on the ground floor with a new waterfront. This new building had to have 4 to 5 floor including a basement, use file foundation, and the ground floor had to be occupied exclusively by commercial area and the upper floor had to be apartments, this were requirements for the project. This project included in the beginning the creation of your own client (real or fiction) and his requirements and ideas for the project. Then after getting theses this ideas and requirements start to think of the design for the building, understand the programme for the commercial area. Research and choice of material for the building, and constructive solution of the building. The disposition and calculation of the building services, water supply, sewage, heating, ventilation and also water drainage system from the terrace, that is a very extensive area of the building. The choice for the commercial area was to do a restaurant and support facility for water activities, this were already existent on site near the building but in containers. The construction planning and the budget, also the risk analyses and winter measure, measure to be done while constructing during the winter period. Fire safety and structural analyses are done to be delivered to the Local Authorities. This was the group work part of the project, at the end of the semester was the individual part of the project. The chosen element was terraces; the building has a large area of theses. This includes detail drawings and key points, construction planning and budget, research the water drainage system was this is included in the terrace construction.

In each semester students have to write an elective, this elective is individually produced, so students can explore some themes related with construction industry. This is normally in an area of interest of the student, the approach starts with a problem or practical issue related with area of construction. The interest in this case was sustainability and self-sufficient buildings, so both elective are around that topic. The elective done in 5th semester had as topic: "How can Sustainable Design lead to a more Self-Sufficient Building?". The elective realized in 4th semester had was problem: "The economic solution, for rain water and greywater recycling system in new residential building?".

This book is divided in three main chapter. The first is a chapter on Denmark, it Education System and teaching methods. Also introducing UCN the receiving institution in Denmark, and ATCM which is the course taken during the year. At last an introduction and explanation of the "Design Methodology", this is there methodology for project work. Second chapter is the project work done during the year, divided in two parts one for each semester. On the third chapter is the electives, the chapter is divided in two parts one for each elective.

The idea behind this book is to show the work done during Erasmus in Denmark. Also it is to show a different way of teaching, that the culture influences the way we learn and

how we are taught. The work done there was quite more technical and specify more focused on the reality, and the preparation to end the education and you can go straight to labour market, understanding the all process for inception to handing out the building to the client.

Denmark

Denmark

Area: 43,075 Km^2
Population: 5 614 000 (2013)
Capital : Copenhagen
Major Cities: Aarhus, Odense, Aalborg
Language: Danish (English and German widely spoken)
Literacy: 99 %
Goverment: Parliamentary Democracy
Entered the EU: 1973
Currency: Danish Kroner (DKK)
Measure System: Metric

Fig. 1 Denmarks loction in Europe

Denmark is a part of Scandinavia. It is the smallest and most southerner of the Nordic countries. The country consists of a peninsula, called Jutland, and the larger islands of Zealand, Funen, and Lolland-Falster and 429 islands named islands between the North Sea and the Baltic Sea, 72 of which are inhabited (Study in Denmark). The bigger cities are the capital Copenhagen; Aarhus, Aalborg and Odense (Wikipedia). The Kingdom of Denmark is sovereign state that includes Denmark and the two autonomous countries of Faroe Islands and Greenland, located in the North Atlantic Ocean (Wikipedia).

Denmark`s location is privileged was it the doorway to the other Scandinavian countries and its connection to Europe. The land connection with Germany allows easy access to centre of Europe, and the remaining cities can be access easily by plane (Denmark.dk).

Denmark has a Welfare system, also known as a Scandinavian welfare model, which citizens have equal right to social security. This Danish welfare system is available free of charge, including various number of services. This model allows for an education system and health care to be given free of charge. This model is funded by the state; this leads to Denmark having one of the work highest taxation levels. (Denmark.dk)

The Danes enjoy a balance lifestyle with time for both work and leisure. They are very concerned with the community, but also very individualists about their freedom

and opportunities to achieve their full potential. They value individuality, equality, tolerance and they have a strong sense of mutual trust. These values also reflect on the workplace and the education of the youth. Denmark is a friendly society with easy access to cultural activities and nature, beaches and sports facilities. Danes are very bicycle-friendly and green. The country was one of the lowest crime rates, which allow a feeling of security (Study in Denmark).

They maintain a very balanced life between work and family life. They devoted their free time with friends, family, sports, hobbies and games. They work 37 hours a week, with monetary compensation or time off from work, if they work overtime. They have a five-week vacation period. The work is team-oriented, informal and based on open dialogue between management and employees. At most workplaces they give priority to in-job training, even university level courses (Study in Denmark).

Aalborg

Aalborg is a city located in Nord Jutland, the city is formed by the Limfjord, at its narrow point. The city its located in a trading post, dating back to the Iron Age. Vikings use the city as part of different routes that when from Norway until Portugal. The trading helped develop the city thru out the years. Later on 1970`s city was prospering duo to heavy industry, with a creation of the bridge to connect the two sides of the fjord and the arrival of the railway (Visit Aalborg).

Today the city is mostly focus on culture and education. Industry is still a part of the city but the creation of Aalborg University AAU the city turned it curse. The city was today a new waterfront the invest in public space, by creating a line that connects the front of the Fjord with the rest of the city. The waterfronts allow for water activities, like the swimming pool on the Fjord (only open in Summer) and new docking spaces for boats and the cruise ship that use Aalborg was a stop. On the culture side the city as Theatres, a Symphony Orchestra, an Opera Company, other culture venues and the Museums. The city also started to attract some tourism, with all the historical building churches, parks and events around the year. The new Musikkens Hus built by the new waterfront, was one of the best Concert Hall in Europe. The Utzon Centre design by Jørn Utzon, the architect of Sydney Opera House. He designed the space not as museum but place for students to meet, research and discuss architecture. The Utzon Centre is located by the waterfront where he spent his childhood. The KUNSTEN Museum of Modern Art by Alvaro Aalto, and the Natural History Museum, both promote cultural activities for children and young people; and the later show the city history. Lindholm Høje Museum that is one of the best preserved Vikings findings in Scandinavia, a Vikings burial site, that was buried under thick layer of sand (Visit Aalborg).

Fig. 2 Aalborg location in Denmark

The creation of Art Galleries like Platform4; and place like Nordkraft and Kultur Hus where student can see, exhibit and discuss art and culture. The Street Art all over the city, in gable façades, post lamps, electric boxes, in the parks and squares. All this show how the city was invested on cultural and youth activities. The city is trying to attract more young people, with all this changes it was became a very international location for students.

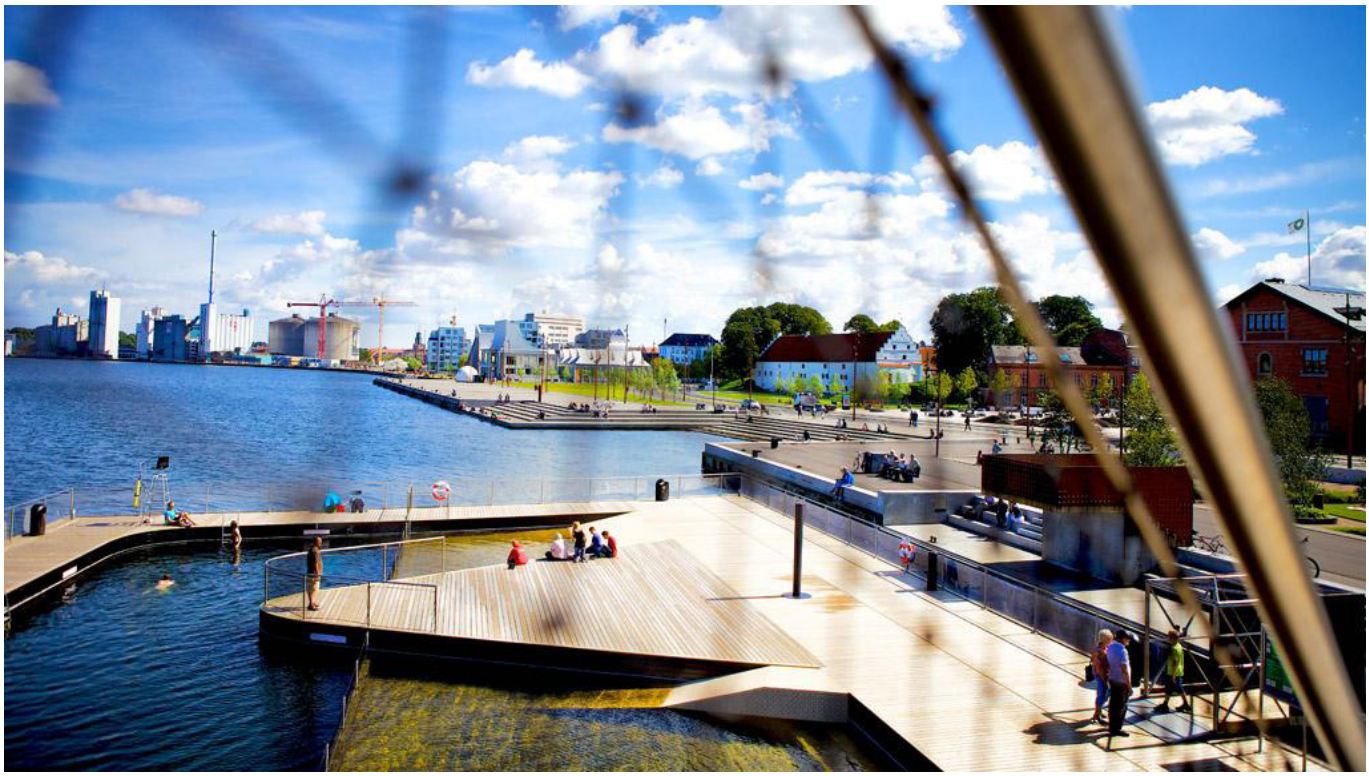


Fig. 3 View of the new waterfront from the swimming pool on the Fjord

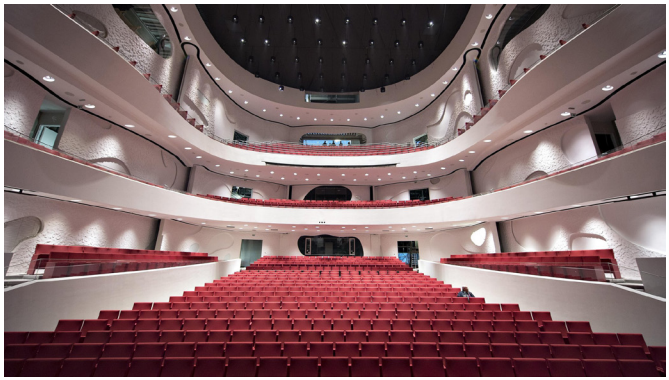


Fig. 4 Concert Hall in the new Musikken Hus (Music House)

Fig. 5 Entrance room at Kunsten Museum of Modern Art, design by Alvaro Aalto

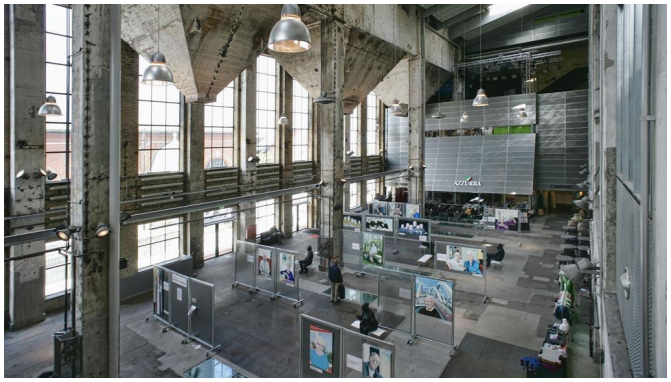


Fig. 6 Entrance room at Nordkraft

Fig. 7 View from the Fjord of The Utzon Centre, design by Jørn Utzon

Fig. 8 Street Art at Vesterbro 99, "Hippocampo" by Alexis Diaz

Fig. 9 Street Art at Kastetvej 22 B (Aalborg Westside Train), "Ejnar" by Jeppe K. Jensen

Fig. 10 Nytorv, main square in the city centre

Fig. 11 Lindholm Høje, Viking buriel site

Danish Education System

Denmark believes that education is the way to keep competitive in the global world. They combine high academic standards with innovative learning approaches. They try to prepare students to be active participants in the global world (Study in Denmark).

The basic education is mandatory. They have upper secondary school that mainly prepares the students for higher education, or vocational education and training to prepare students for a profession in trade or industry. The percentages say that 50 % of year students enrol in a higher education (Ministry for Children, Education and Gender Equality).

In Denmark, higher education achieves it high standards by putting together academic excellence and innovative research and teaching. It promotes interdisciplinary studies and project-based activities, to make sure of active and motivating learning environments. Most institutions work along with business, industry and research institutes, for more inspirational and enriching learning environment (Denmark.dk) . There is a large offer of programs taught in English, for a more diverse and international environment. This allows international students opportunities to have international recognized qualification. Any student over 18 year or above can apply for an education support grant, Statens Uddannelsesstøtte (SU) that provides fixed financial support, that is distributed monthly (Wikipedia).

They maintain high standards in Danish education with tight regulations. All institutions are finance and regulated by the state. This are approved and evaluated on an ongoing basis.

In Denmark, most people take part in adult education. This upgrades the skills towards the new needs and development of the market labour. The improvement of skills and knowledge can mean a professional advance and a change in careers, allowing to adapt to labour market (Denmark.dk).

Students are expected to take responsibility in their education. Attending to class but also by participating actively in discuss and developing their analytical and critical skills. The teaching method promotes an active role in the learning process, by working in projects independently or in small group (Denmark.dk).

Teaching in Denmark

This chapter is based on personal experience, together with on a site about teaching in Denmark (see reference 7) and an article (see reference 5).

"Denmark thru innovative teaching learning tools and informal learning, promotes creativity, self-expression, analytical and critical thinking." (Study in Denmark)

Teaching Characteristics:

-Student-centred learning and open debate during class,

-Close collaboration between students and teachers,

-Traditional lectures combined with project work with the teacher as a consultant;

-Active participation and problem solving rather than passive listening;

-Focus on turning new knowledge and learning into innovative solutions.

Students Gains:

-Excellent communication and interpersonal skills;

-The ability to work analytically and creatively in a problem-solving environment;

-The ability to work independently as well as effectively as a team member. (study in Denmark)

Project Work

The learning in Denmark consist of attending class, study independently and working on projects (individually or in small groups). The project work makes you think creatively and freely; make you use new knowledge to solve complex real-world problems. This method of project work is based on Problem-based Learning model that is adapted differently on each institution (Study in Denmark).

Danish teachers are experience professionals; they add a perspective based on a real work experience. Many institutions work together with local companies and organizations, and many programs have internships include in the education that allow for work experience (Study in Denmark).

Depending on the higher education institution, a week typically was 10 hours of tuition and 30 hours of preparation, self-study and project work. The progress evaluation will happen with oral or written exams (Study in Denmark).

Problem-based Learning

The Problem-based Learning (PLB) model was developed at McMaster University in Canada in the late 1960s. The base for the concept was "(...) being student-centred, taking place in small groups with the teacher acting facilitator, and being organized around problems." (Graaff and Kolmos, 2003, p. 1).

PBL was mostly developed based on practice. This model was adjusted during the 1970s and 1980s, mainly for pragmatic reasons. 'When teaching a routine sets in, but that may change, if something doesn't work, teacher will just change it (Graaff and Kolmos, 2003).

We can define PBL was model because includes "(...) curriculum development elements: objectives, teacher and student learning strategies, choice of content, learning methods, ICT, teachers' roles, organisation, culture and assessment." (Graaff and Kolmos, 2003). These elements are depending of each other; if one element changes it will change the others elements (Graaff and Kolmos, 2003).

"Project work is problem-based by definition" (Graaff and Kolmos, 2003). For this to work the group need to work together efficiently to understand what is the goal and how to achieve it. This learning environment allow for individual and co-operative activities, discussions and writing. Project work teaches competences like management and co-operation. The closer to reality the tasks are, more motivated are the students. Project work includes different learning process that are not include in the traditional models of teaching (Graaff and Kolmos, 2003).

The model develops the student co-operation and management skills, by "(...) dealing with problems within one discipline, the ability to show understanding and respect for one another, reflection on personal development, and communication and listening skills." (Graaff and Kolmos, p. 5)

This model is thought in a way that, to fulfil the specific learning objectives, students are free in the choices made to have the most enjoyment possible from the work (Graaff and Kolmos, 2003).

PBL model motivates and makes student work harder that traditional methods. With this model a student can "(...) reach a level of analytically complex comprehension through the problem-based work that would not be possible in conventional classes." (Graaff and Kolmos, 2003, p. 7). Part of the PBL is defining objective to accomplished, but this should be considered "(...) when planning the teaching, it is equally important in the implementation of the project and, last but by no means least, in the evaluation." (Graaff and Kolmos, 2003, p. 8).

"PBL education builds on the students' back-ground, expectations, and interests. It is common for students to be motivated to work much harder with the PBL model than with traditional teaching methods. In general, students spend more time on their studies when working with a PBL model than with traditional models. Student participation is much less in conventional courses, where the students have no say in the problem formulation." (Graaff and Kolmos, 2003, p. 7)

University Collage of Northern Denmark - UCN

The University College of Northern Denmark is located in the city of Aalborg. UCN is one of several study sites in Denmark that offers professional courses. Most of the courses are considered on the level of bachelor if enrolling in a university (Bachelor of Architectural Technology and Construction Management, 2014).

UCN was 4 schools: Business, Education & Social Studies, Health, and Technology. (ucn site pdf) It works associated with Aalborg University AAU. UCN also invest in applied research, innovation, development and continuing education, working closely with public and private business and companies (Wikipedia).

This chapter is based on personal experience and a pdf about the learning approach at UCN (see reference 2).

Reflective Practice-Based Learning - UCN`s learning approach

UCN prepares it students for the future labour market, the studies programmes are designed to reflect the reality of the work place and environment. This will make students ready for the labour market. They named this approach Reflective Practice-Based Learning. This combines theory and practice, in a way that students learn competences within the real-life base. They will learn to become innovative, independent and competent, so they can adapt and find new solution in their profession and labour market (Reflective Practice-Based Learning).

Learning and studying at UCN

The student develops they knowledge, skills and competences in their field of work. Students acquire not only professional, but personal and social competences. This with allow students to face new challenges with experience and knowledge. UCN focus on "how you learn in the best way, what you can do better, and which habits you should change in order to learn more effectively." (Reflective Practice-Based Learning, p. 4).

Students are responsible for their learning and so they "set up clear goals for your own learning so that it will be clear to see which learning results to expect from you." (Reflective Practice-Based Learning, p. 4). This focus on learning not on the classes, and so student`s knowledge will evolve from skills to competences .

"Knowledge is subject-related and understanding of facts. That means that as a student you are capable of putting your knowledge into a context and explain it to others. Knowledge can be both about theory and practice." (Reflective Practice-Based Learning, p. 4).

"Skills are what you can do or accomplish. It could be practical skills, cognitive skills, creative skills or communicative skills." (Reflective Practice-Based Learning, p. 4).

"Competences are the ability to apply knowledge and skills in a given context; and responsibility and independence are central concepts." (Reflective Practice-Based Learning, p. 4).

Close to practice

The focus of the programmes is combining theory and practice. This is done in three ways: hands-on in practice, bringing real life into the classroom and cooperation.

Hands-on in practice consists of an internship; with its students learn to manage then self's in a professional context. This is how they can experience interaction with different disciplinary groups and can develop their knowledge, skill and competences in other disciplines (Reflective Practice-Based Learning).

Bringing real life into the classroom takes the knowledge and concepts from practice and applies it in the work, with situation and project work based on reality. This allow students to learn and train their skills and competences, to be ready for labour market (Reflective Practice-Based Learning).

Cooperation with practice allow students to collaborate with companies and business communities, while doing project work. This lead to more creative solutions that can be applied in real life. The labour market is constantly evolving for better and more efficiently work forms and solutions. This allow student to be immediately employable in the labour market (Reflective Practice-Based Learning).

In this model of studies lets students be more creative, inspired and innovative, learning to be critical to words their education and experience. Student also contribute to the education process, with their values and personality. Project work make easier to learn how to share knowledge and work together towards a mutual goal. Student are all very reflective on their work, that make students more "innovative, independents and productive in the labour market." (pdf about learning approach pag 10) Reflection competences help discover strengths and weaknesses, and understand what and how to change. Seat goals to improve, and understand how to get there and work towards that.

Study Activities

UCN was developed a model, Study Activity Model, that shows a general view of the study activity in the different programmes. This model shows the student all the different side and types of study activities in their program, it shows what is expected them, to do. This model is divided in four categories; each is a different form of learning with different participations (Reflective Practice-Based Learning).

Study Environment

UCN believes that study environment is a big part of the study program. The environment should allow for a freeexchange of knowledge; and develop professional, social and personal competences. UCN tries to keep an up-to-date

facility that are good structure for study environment, such was library, auditorium and classrooms, skills rooms, workshop and labs, and social student-driven activities. This study environment is not only physical but also virtually and digitally, thru platforms, this promote a more professional approach and cooperation, formally and informally (Reflective Practice-Based Learning).

Insight Profile

This part is based on personal experience and my personal Insight Profile done ate UCN (see reference 4 and annex 1).

The students get a personal profile analyses so they have a professional feedback to how they work. This enable them to use their full potential, during and after they complete their education. This happens with a collaboration with Denmark InSights (Insights Discovery Personal Profile).

The InSights profile is based on the model of personality identified by Carl Gustav Jung. His work was published in 1921, since then studied and developed until today. The InSights profile uses Jung's typology was structure, for a better self-understanding and development. With a better understanding of self, individuals can develop tactics to improve (Insights Discovery Personal Profile).

This profile is unique to each person. The idea is to use this profile to find areas in which you can develop and/or take action. Sharing important aspects with friends and colleagues can help you and them communicate better (Insights Discovery Personal Profile) (see Annex 1).

Architectural Technology and Construction Management - ATCM

This chapter was written base on personal experience, and a pdf that explains the program (see reference 4).

The program, Bachelor in Architectural Technology and Construction Management, was a duration of three and half years (seven semesters) with the amount of 210 ECTS. The students should "be able to independently plan, manage and perform technical and administrative work within the design and execution of the building and construction industry." (Bachelor of Architetural Technology and Construction Management, p. 5).

The program was 5 mandatory modules: general, business, production, design and surveying with 125 ECTS, these modules are applied to project work. Plus, an elective part of 35 ECTS, a work placement (internship) of 30 ECTS and a dissertation of 20 ECTS (Bachelor of Architectural Technology and Construction Management, 2014).

The General module develops: communication, science, work methods, organization, cooperation, information technology, innovation, numeracy, applied mathematics & physics and a foreign language. The Business module promotes a develop of: company operation, administration and building law. The production module focus on construction production and project management. The design module to work with construction, design and project management. The last module Surveying focus on land surveying, setting-out and structure surveying (Bachelor of Architectural Technology and Construct, 2014).

Electives

Electives are written during 3th, 4th and 5th. This are independent project with an appointed tutor, from the project work. This is an individual project where students can identify their personal learning needs, research and gain necessary knowledge and writing processes to communicate

Fig. 12 ATCM diagram of the semesters, and each semesters educational element

those. This should be written so the solutions found are presented to the tutor as a professional of the industry (Bachelor of Architectural Technology and Construction Management, 2014).

The students should see Electives was an opportunity to influence their education, in specific direction and an opportunity to be involve in professional relevant topics and also the possibility to support their project work (Bachelor of Architectural Technology and Construction Management, 2014).

Work Placement (Internship)

The internship carried out the 6th semester, this links the teaching modules with the independent final dissertation. This is an individual study activity. The internship should be taken in the industry, public or private sector in Denmark or abroad. This is an opportunity to develop knowledge and skill into practise, providing also a better understanding of practical issues, methods, processes and function within a company. The student will be appointed one tutor, together with a company will follow-up on how far the student has completed the placement goals (Bachelor of Architectural Technology and Construction Management, 2014).

At the end of the internship the students much have the ability to reflect on practical work involving the profession, and knowledge on company organization, economic, administrative, social and working conditions. Student must have the skills to work with relevant professional issues within professional area and be able to work independently or in collaboration with other the different tasks within the company (Bachelor of Architectural Technology and Construction Management, 2014).

Dissertation

The students must show they can reflect on the "professional practice, application of theory and method in relation to a practical problem". (Bachelor of Architectural Technology and Construction Management, p. 17) The problem for the dissertation must be core to the education and profession, structured by the student and UCN must approve the problem (Bachelor of Architectural Technology and Construction Management).

The final semester involves an Elective and a Bachelor Dissertation. The elective is individual study activity. The Bachelor Project (Dissertation) is developed in individually, elaborated based on approved practical issue or problem. The selection and formulation of the problem, and it development must show the ability to reflect on professional practice and application of the theory and methods (Bachelor of Architectural Technology and Construction Management, 2014).

"Design Methodology" of Project Work

This chapter was written base on the book "Design Methodology" (see reference 1), the book is used as reference in design process, and personal experience in the design process used.

Introduction

A construction project, from inception to demolition, is a fluid process, which is agreed between the client and the other project participants. The education is planned so it follows in the same sequence, simulates the "real-life" situation as close as possible (Mosegaard and Broch, 2008).

This is an introduction to a "work methodology" that can be used together with normal studies process. This methodology is a base, that can be adapted on experience. This will show an overview of all the many things involved in the process. This is a way to understand and explain all the process (Mosegaard and Broch, 2008).

This describes the different phases the are usually in the construction industry. This is an example; things can be done in a different way. Explaining also how the other participants are included in the process (Mosegaard and Broch, 2008).

The main phases in this "work methodology" are: Inception Proposal/Design Brief, Outline Proposal, Scheme Design Proposal, Detail Design 1, Detail Design 2, Tendering, Construction and, Operation and Maintenance (Mosegaard and Broch, 2008).

Scenario

There are several things that can vary, not on the project but on the choices that the client can make. Such what type of tendering will the project have (this can be decided in the beginning or later in the project, but was different implication on the project) that is also connected with what type of form of construction contract to be use as base to execution the building (Mosegaard and Broch, 2008).

The choice of form of contract depends on how much influence the client wishes will have on the design of the project. This can go from the client only preparing the brief for the project and after the contractor takes over the design and construction of the building, or the client can allow the preparation of detail design of the project and then the constructor take over and only executes the building.

The project is mostly realised with a collaboration between the different participants in the different phases. For education purposes, the phases are presented with a tender where client chooses the second option. The contractor is only taking over, after the Detail Design 2 is finish, for the construction of the building (Mosegaard and Broch, 2008).

This phases are from a point of view of someone working in an architecture studio, which collaborates with a structural engineer, they are also consultants for the client from the Brief Design to Detail Design 2. Detail Design is when the basis for tender and the construction of the building are produced.

In this case, the "management, organization, manning, economy, scheduling and quality" (Mosegaard and Broch, 2008 p. 17) are the responsibility of the architect. For the education purpose the later statement is done by the student, competence that is need in "real-life". This also makes for a change in "hats". During the design and tender preparations, the student will be the "architect" but during the tender and construction student will be "contractor" who is responsible for the construction of the building (Mosegaard and Broch, 2008).

Inception Proposal / Design Brief

-advising the client before the design

"Dependent on the size and complexity of the project, several consultants may be engaged in this phase. (...) your task would be to help the client to define his/her needs, desires, demands and economy frame for the project." (Mosegaard and Broch, 2008 *,p. 20)*

Most of the time the client was an idea of what it wants. The architect should guide and inform the client in the most possible way so he can make the best informed decision (Mosegaard and Broch, 2008).

This phase is finished with a report/brief, that states the client`s idea and needs, and if there are a basis for the next phase to take place. There is no drafting in this phase. The client must approve the brief moving on to the next phase. The brief sets all the necessary conditions for the project development (Mosegaard and Broch, 2008).

Outline Proposal

Studying the brief from the previous phase leads to a good base for this phase going well. The client vision is visualized by the architect, and is developed in "drawings and text, models/3-D visualizations/illustrations (...) into a concrete proposal." (Mosegaard and Broch, 2008, p. 25).

This happens, close collaboration with engineers, that are involved in the technical part of the project, solutions for installations and electric systems. Should be elaborated a structured schedules and a provisionary budget for the project. At this phase there will be various design meeting, and the major design choices are made. This is a quick phase done by architects and sometimes no exactly finished, some demands from Building Regulations, analyses of fire demands, so they need to be reviewed (Mosegaard and Broch, 2008).

Scheme Design Proposal

In this phase, is when after looking at the Outline Proposal, and an analyse is done to understand if the building is ready to be built. The bigger project decisions are done in this phase. Most the information needed in this phase is provided by the Outline Proposal, starting by analysing it (Mosegaard and Broch, 2008).

In this phase, the work on the project is more spread evenly, between the architect, the engineers and the landscape architect office. The management and coordination of the design work would normally be done by the architect. The project gets clearer, by analysing what was done in the phase before. Most of the material produce in the phase before will be update and be more specify (Mosegaard and Broch, 2008).

Detail Design 1

At this stage in the project, the client was approved the project. The consultants have to get the project approved by the local authorities by obtain the planning permission so construction can happen. This phase can be called "Local Authorities Project", and is accomplished based on the Scheme Design Proposal. The documents produced in this phase are directed to the professionals, not the client/ laymen. The proposal should be supported with information so it can be used was the base for the final approval of the project by the local authority. If the project needs any alterations to be approved by the local authority now is the time for them to happen (Mosegaard and Broch, 2008).

The main drawings from Detail Design 1 will act as base and fully integrated in the next phase. This phase is done with the collaboration of all the participants of the project. The planning permission is normally send by the architect. This is the phase where everything for the tendering is prepared so the project is ready for bids (Mosegaard and Broch, 2008).

The documents produced in this phase should be sent to the local authorities in 3 copies. The next period is a waiting for the approval, this can take some time, several months (Mosegaard and Broch, 2008).

Detail Design 2

This phase is an adaptation of Scheme Design Proposal and Detail Design 1. In this phase are done drawings, specifications and other documents, that are directly at professional, not the client in this phase. Professional like craftsmen, contractors, suppliers and technicians. The project is prepared to detail, so the project is ready for tendering, for establishing a contract, and for the execution of the building. Normally the architect is the project coordinator (Mosegaard and Broch, 2008).

At the end of this phase the result should be "detailed so that it can communicate the project is content to the people that must price it and execute the building works." (Mosegaard and Broch, 2008, P. 43).

During the design the work develops in close collaboration between architect, landscape architect, engineers, and also other specialists. So many time the architects` drawings are the basis for the engineers` drawings and other specifications. So all process involves exchange of drawings, design meetings before Detail Design 2 is complete (Mosegaard and Broch, 2008).

From the education point of view, the students are not asked to complete all the contracts and work packages, there isn`t enough time. The students are usually asked to do one complete contract, or choose an element in the building (e.g. wall - then the student as to do everything related with that element). This will include drawings, specifications, time schedules for tender and later execution on site (Mosegaard and Broch, 2008).

Tendering the Project

This can be place in different stage of the design process, depending of the form of contract that client choice. For education purposes it considered that the tender only happens at the end of Detail Design 2. The client can choose between different tenders for the project: public tender, selective tender and private tender (Mosegaard and Broch, 2008)

Public Tender, an advertisement is placed in a newspaper. This will describe the project, informing possible contracts that may be interested, and informing the how and when can they apply for tender documents. With this form of tender, the client never knows how many bids is he going to get. Knowing only how many applied to tender documents (Mosegaard and Broch, 2008).

Sometimes the client can ask contractor to "prequalify" before they are invited to bid on the project. This means they need to prove they are qualified to do this project. The criteria for this can be quite diverse (e.g. similar project they have done; specialist of a type of construction). Based on that the contractors that qualify, they are invited to the biding (Mosegaard and Broch, 2008).

Selective Tender is when the client approaches a number of contractors that he knows beforehand. This approach can be because he knows they are qualified to do the job; this can be by reputation or he has used then before (Mosegaard and Broch, 2008).

Private Tender is normally used in small projects. The client approaches one or more contractors and ask for a bid based on the tender documents for the project (Mosegaard and Broch, 2008).

For education purposes, because of time restrictions,

students are only able to complete part of Detail Design 2. The student must choose a form of tender that want to recommend to the client in the current case, and formulate an advertisement and other documents for this tendering phase. In a "real-life" situation, the project manager, will tender the project for bids on behalf of the client (Mosegaard and Broch, 2008).

Construction

This phase is about the construction of the building. This phase ends with the handing over of the building to the client. The design work was all finished but the project still need follow-up for control in the execution is according the architectural intensions (Mosegaard and Broch, 2008).

In an educational context, the main part on this phase is the contractor - like scheduling and control of time, manning, materials and economic issues using projects scenarios from "real-life" sites (Mosegaard and Broch, 2008).

The process of handing over the finished building, happens after the contractor has completed the building and the client is now responsible for the building. There are various parties involved, and some law and regulation as basis (General Conditions of Contract, GC92) (Mosegaard and Broch, 2008).

The handing over of the building includes the 1 Year Inspection and the 5 Year Inspection. These are made to detect any defects that might occur. These two inspections do not replace or count to the operation and maintenance of the building (Mosegaard and Broch, 2008).

Operation and Maintenance

This phase goes from the formal handing over of the building until it demolished. The length of the life of the building will be "dependent on how the building is used and maintained by the users and client" (Mosegaard and Broch, 2008, p. 61).

The maintenance of the technical systems for one is a very big part of keeping the building functioning in the right way. It also important to check for any damage, vandalism, storm damage and accidents, this should be repaired. The client should maintain the building and prevent any malfunctions that occur. This includes "(...) the repair and prevention of wear, tear and damage" (pag. 61) Creating a plan to fulfil of rules and regulations, can be call operational plan (Mosegaard and Broch, 2008).

This plan helps to keep track of all the things that must be check over time. This plan is usually made by a special consultant, in the field of operation and maintenance. In the education context, this is not a very big focus area. The students will go analyses some plan for a "real-life" case and understand how it done (Mosegaard and Broch, 2008).

Project Work

Christiansgade I B

Group Work - 5th Semester
Renovation and Convertion

Introduction

The project work in 5th Semester was a renovation and refurbishment of an apartment building. The building chosen is located at Christiansgade 1 B, 9000 Aalborg. The project requirements were: old building in need of renovation, the building had to have a back staircase (that it will be demolished to allow for more area), have an attic and a basement. The project must include a full renovation of the building, the ground floor should be transformed in a commercial area, this is to be accomplished by the demolition of all the walls except the main staircase, and the creation of a beam - column structure to support the building after the demolition. In addition to this the building should be add an extension, to allow for a bigger living area, the extension is to be built in steel construction.

The project started with a survey of the building, to understand how was it built, what were the main damages and what need to be changed. This includes a cataloguing of all the building problem/damages. Then decide what in need of replacement or just needs to be improved. After all this there a need to start to think about the design for the building, the new commercial area, the redesign of the apartments, that area going to be bigger with the added extension and without the staircase. The ground floor commercial was transformed in an Architecture Studio.

With the design, there is a need to start to think of the constructive solution to the use and the material to be used, this include the insulation of the building. During this part there a time to do research on material and constructive solution, it demanded that we find and have constructive solutions for connection of the existing building with the extension, and how all the material chosen to the building will be applied.

With the redesign the sewage system needs a new layout, this includes the drawing of the new layout and calculation of slops on the pipes. The installation of ventilation system in each apartment, includes drawing the new layout with placing of pipes and aggregator, calculate the extraction and supply need for each room.

The choices of design and construction for the building always the need to check, if they fulfil the Building Regulations 2010, which includes accessibility to the building, fire safety, indoor climate, energy consumption and building services.

After the bigger decisions on design and construction are made, it time to use BE 10. This is a tool created by Aalborg University AAU, too understand the energy required to building (heating, cooling...). In this tool work when inputting everything about the building: area per floor, building envelope (wall, ceiling, floor windows) u-values, area, and sun orientation, any energy sources, the ventilation in the building, etc. At the end this give a result, where show if the building is fulfilling the Building Regulation 2010. This tool can be used to improve the building design, based on the result of the first input the design can be changed so the building energy consumption can be reduced.

The construction planning consists of construction schedule, and also a budged. The schedule includes a detail of the different works happening on site during the all construction and how each craftsmen work should go together. The budget includes the site cost, construction cost (craftsmen`s work, winter measures, margin for unforeseen expenses....) and administrative costs (fees to local authorities, insurance, building approval, water and electricity used on site...), giving a result in the end with or without VAT and the cost of the building per m^2.

All the work mentioned so far was done in group. After which start a 2-week period for individual work. The student chooses an element in the building. The focus for the individual work was the re-insulation of the building. Focusing in this, drawings, key points where done in a way that constructor could understand what need to be done on site. There is also construction planning, which includes a tender schedule, working schedule and a handing over schedule. All the documents for the tender of the re-insulation of the building: the public notice, the risk analyses and the tender control plan. A detail budget is done for the cost of the re-insulation. And a logistics delivery plan is done for the delivery of material on site.

All the work done during the semester, requires that student do group and personal planning, where student plan how many time they intend to spend on a task and how many time they have actually spend. There is also requires that student do a Project Journal, this is where there record all there question for the teacher and teacher answers, about the project. Student also should have a personal Portfolio, this is here student writes what are their interest and how will he improve and work to words their goal. Also to explain and reflect on the problem on group work and how to solve them.

During the semester there was also assignments to be done, while doing project. In this semester there where three assignments, two in group and one individually. The first group assignment had a topic "Management and Leadership", we had to do 2 task during a period of a month. In the first task each of the group member had to a MOOC course (Massive Open Online Course) on "Management for a Competitive Edge", and with knowledge learned reflect on the problem presented by the assignment. This was presented in a written report were we reflected on the problem and how we would solve it. The second task each group had to choose a topic area of communication, we choose communication in a multicultural environment. We tried to explore how can people from very different cultures communicate. The teacher suggested "When Cultures Collide: Leading Across Cultures" from Richard D. Lewis, to use was a base the work. After looking thru the book we tried to find the most opposite cultures to understand what are their values, how they communicate, what types of misunderstanding can happen. The cultures chosen where the Germans and the Portuguese. This assignment had to be presented to class.

The second group assignment was called "Sustainability and Energy", to be done in a 2 weeks` period. We were asked to thing how can sustainability be included in project work, to look the work that DGNB (German Sustainable Building Council) is doing in relation to building classification. Also to suggest and understand to what measures could be taken to make the current project more sustainable.

The individual assignment was call "Design and Planning Tools", to be done during a week period. The idea was for each student to choose an area in Planning and Management, the chosen area was Time. The student had to apply the area chosen in to the current project. This to understand the design, tender and construction phases and what tools can be used in which phase, and how which tool can improve the work being done in which phase. This task was comprised of doing schedule for all the phase, show a diagram of contract form and a diagram of site structure. This task was to be handed in, in a 5 minutes` video explaining the what was learned.

During the semester there was a Study Trip. This trip destination and all the organization and logistic was done by the students. The trip took place in Rome for a week. The trip was academic with a learning purpose, to see companies, universities, construction site and also the city. When the trip was over, each student had a 2-week period to write a report of two and half page about one building or feature of the trip. The topic chosen was the Sistine Chapel, focusing on the damage done to the building over the year with all the foot traffic, and the solutions implemented to solve those problems.

In each semester, the is a period of 2-week without class to write an Elective, in this semester with a maximum of 20 pages. The topic is chosen by the student, and a tutor is assignment to the student according to the topic chosen. The topic chosen was related with Sustainability, with the following question: "How can Sustainable design lead to a more Self-Sufficient Building?"

This is all the work done during the semester, this chapter will mainly focus on the project work. This work is present mainly in chronologic order, some of the topic are done at the same time, and are presented in a way that can be understood easier. The presentation is focus more on the design of building and construction, given less emphases to the technical area like building services.

Site

Fig. 13 Site location in Aalborg

Building

The site is located in the city historical centre. At Christiansgade 1 B, a street that connects to the Boulevarden, the main city street.

The building has 4 storeys (last one being the attic floor), basement (with laundry, storage rooms and workshop), staircase and back safety staircase accessed from adjacent to the building backyard. Each storey, including attic, is taken by one apartment. The house being built in 1900 and slightly renovated in mid- 80s is rather old and the interview with one of the tenants confirms that, for example, acoustic conditions are poor, especially through façade wall. Also, those walls were describes as cold, therefore requiring excessive heating in winter. Multiple other damages were identified: cracks, mold and rust developments and so on. Finally, it was found out that the building is connected with another one and separated by parapet wall for fire protection.

The building is also classified because of the brickwork. The preservation of the face in the historical centre was important, maintain the original front facade was only important. The only place in the facade that could be altered was the ground floor, to be different because it was no longer a residential floor.

Fig. 14 View of the building front facade

Fig. 15 View of the back facade, from the backyard

Fig. 16 View of the building from the the other side of the street

Fig. 17 View of back facade

Building Survey

The building survey on the building include several trips to the site. Building survey was done on inside and outside of the building. This allowed for an evaluation of the state of the building. The outside of the building had some problem like vandalism (graffiti), some crack on the façade, damage duo to rise of humidity from the soil. The first thing noticed was that the building had not insulation, so it will need to be insulated.

All the access door are made of wood and in a bad state they need to be replaced. The inside of the building the basement was wall with cracking and paint chips coming off, the ceiling is crumbling and falling apart. The technical room is in a better state but most of the pipes need to be re-insulated. The main staircase is made in wood structure, with regular use and are very worn off and need to be replaced. Most of the wall in the façade inside have paint crumbling. The apartments need some repairs, mostly in kitchen and bathroom. They both need new flooring, and the ventilation duct need to be bigger. The bathroom was some rooting and rust do to moister.

The building has some good features, like the hydrant near the front façade. The building structure seen to be in good condition, the roof was replaced in an earlier renovation. The apartment windows are in good condition and can be kept. The apartment wooden floor is in good condition can be kept, together radiators that are the newest version. And the sewage pipes look without leaks not need to be replaced.

Fig. 18 Hydrant, near the front door, allowing easy access in case of emergency

Fig. 19 Basement wall, all in bad state, duo to moisture for the soil, most likely the basement doesn't have a damp proof membrane

Fig. 20 The pipes in the basement, need to be reinsulated

Fig. 21 Facade damage, that was patch up, but the problem presists duo to humidity rising from the soil

Fig. 22 Vandalism (graffiti) on the facade that need to be cleaned

Fig. 23 Apartment window are double layer and are in good state., if changed for new one will be to improve the acoustic.

Fig. 24 The radiator are new and are working fine. They will be removed to insulate the building and then put back

Fig. 25 The paint on the wall in the common access staircase is crumbling

Fig. 26 Basement window are in really bad shape, and need to be replaced

Fig. 27 The main stair case is worn, and should use to be replaced

Fig. 28 The bathroom frame door is rooting because of the moisture, the frame has no moisture protection

Fig. 29 The rafts are exposed and look like there is no damage in the building structure

Existing Drawings

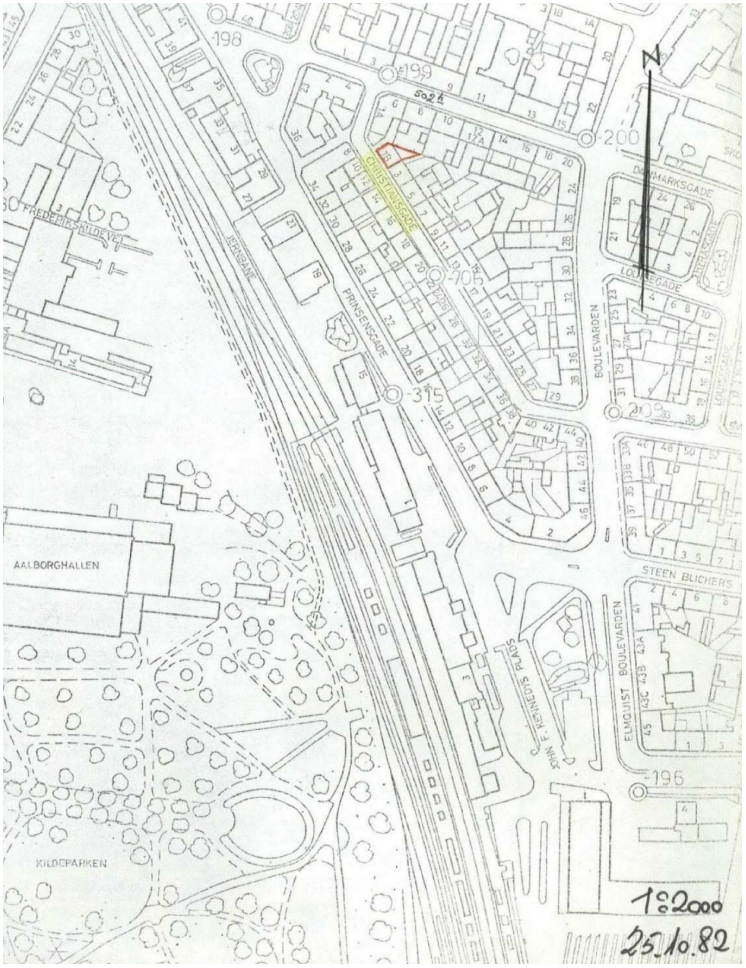


Fig. 30 Area Plan for the building zone

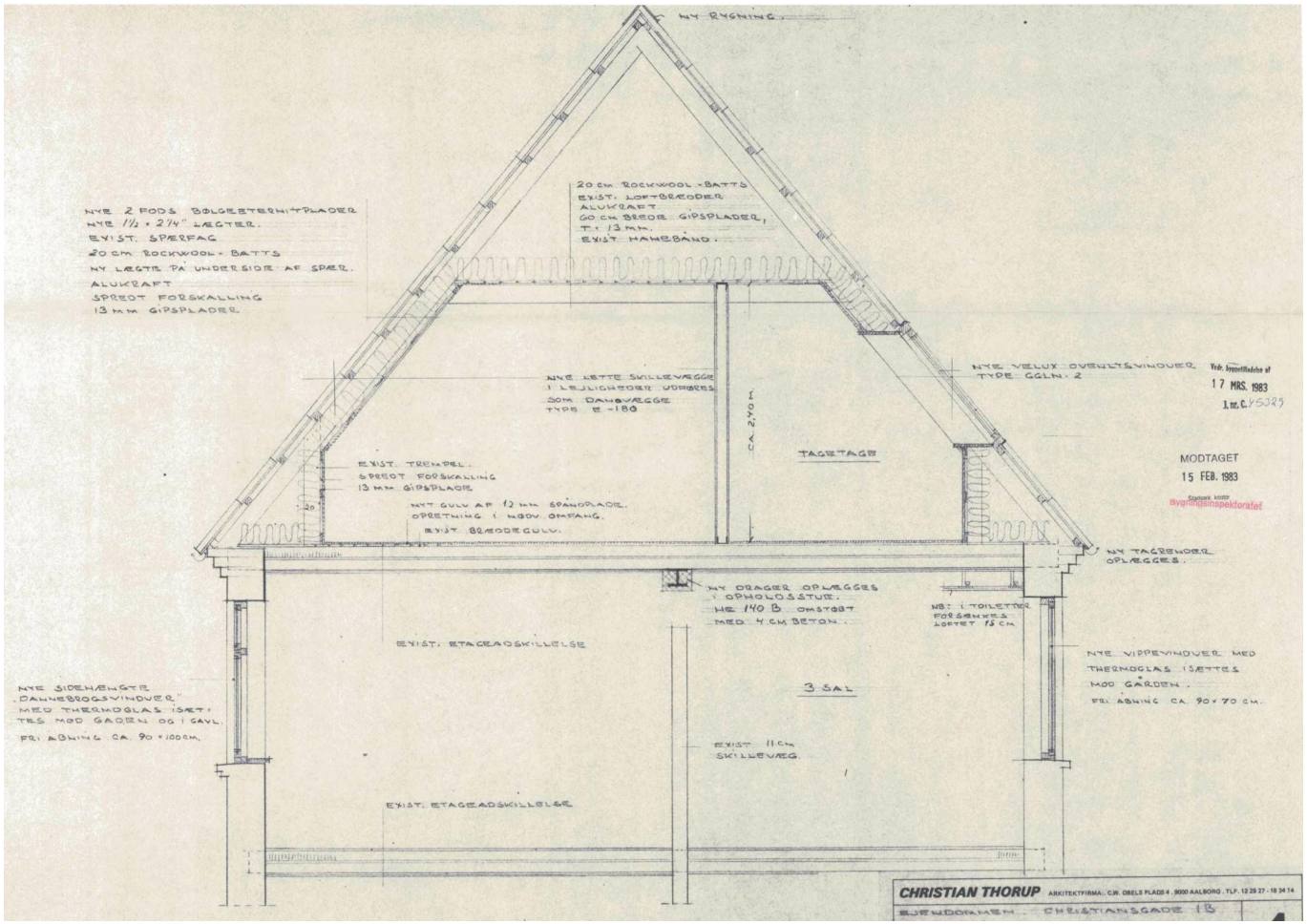


Fig. 31 Section of the attic

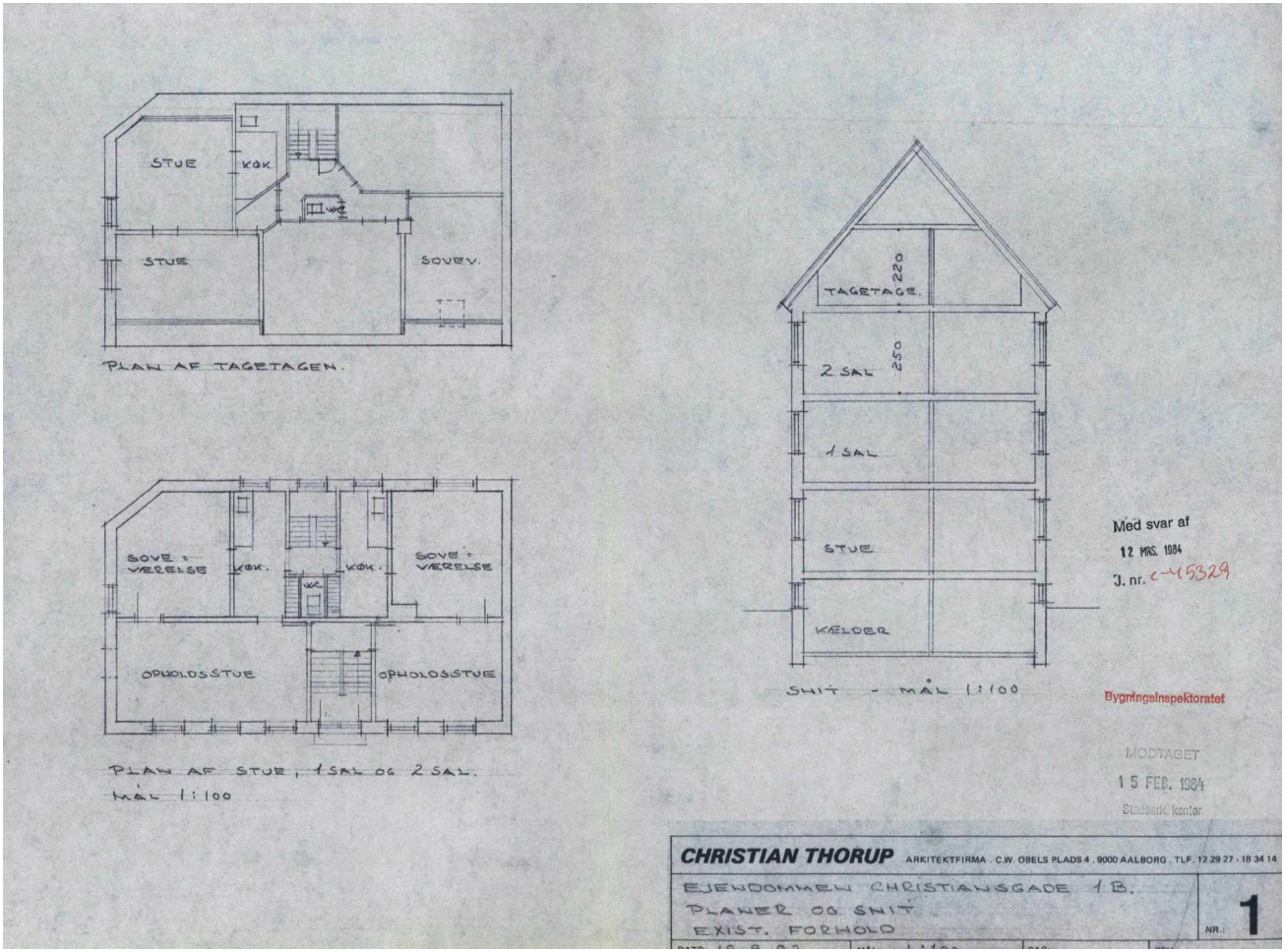


Fig. 32 Plan of the attic, ground floor, 1st and 2nd floors and section

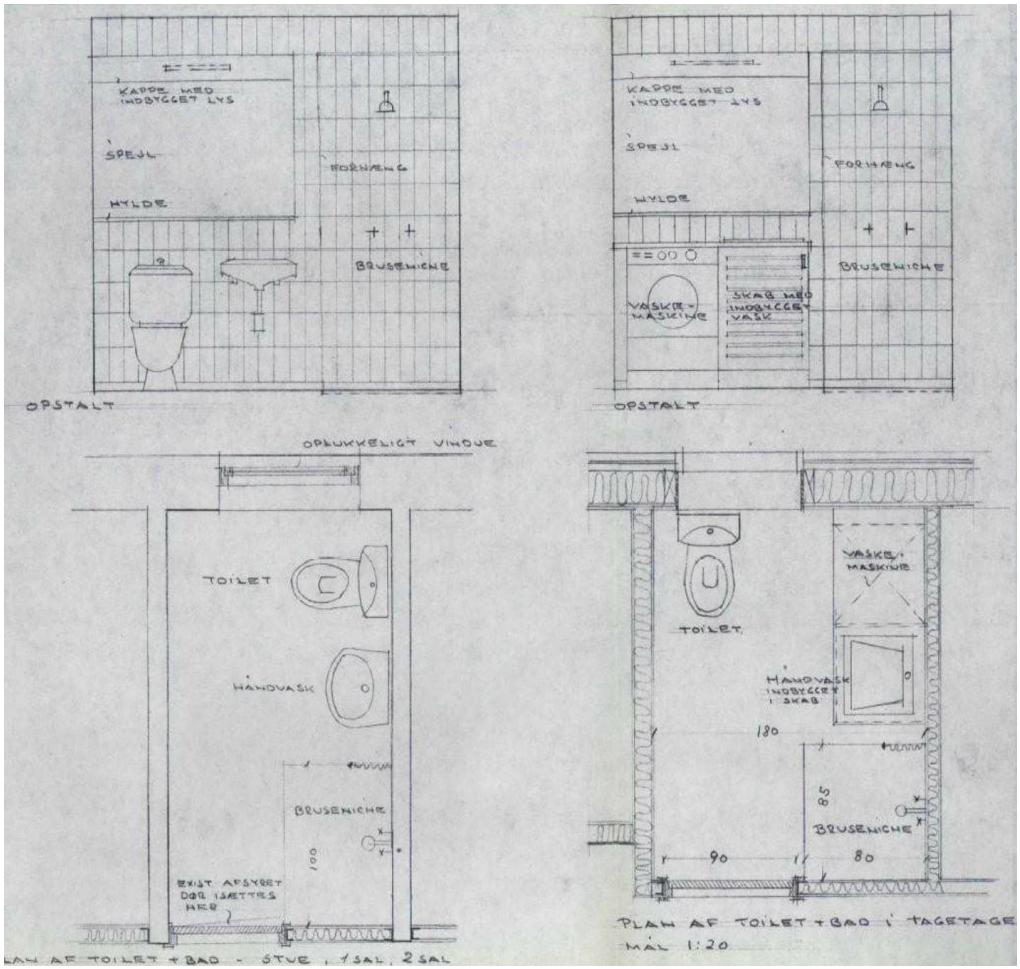


Fig. 33 Toilets layouts

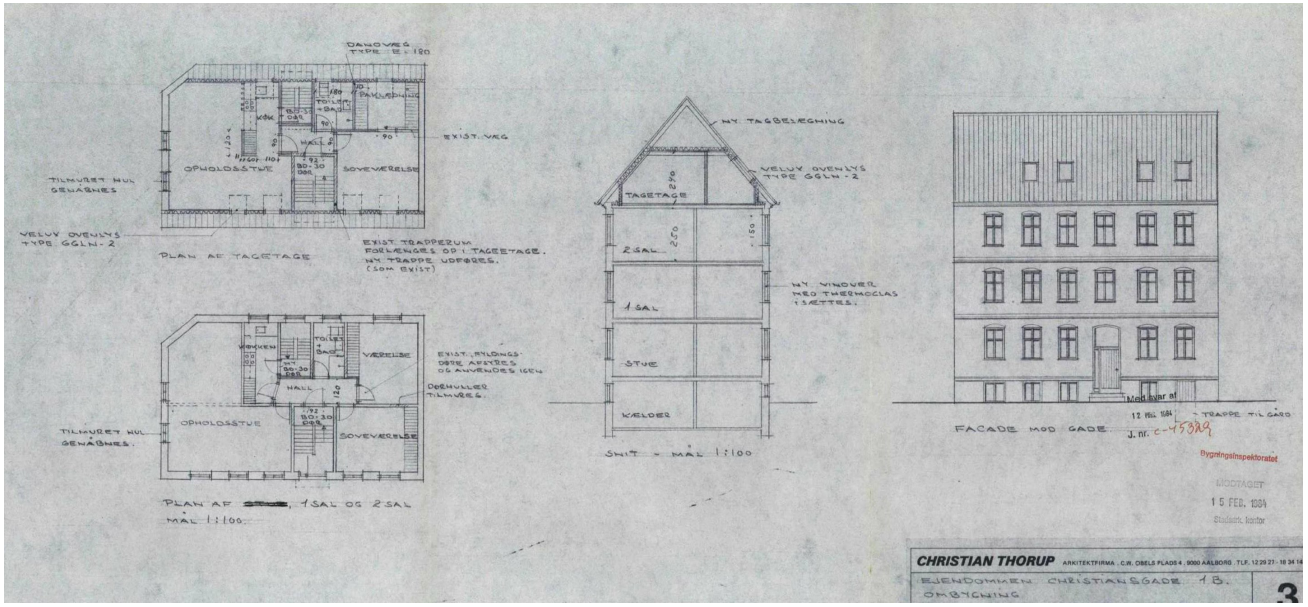
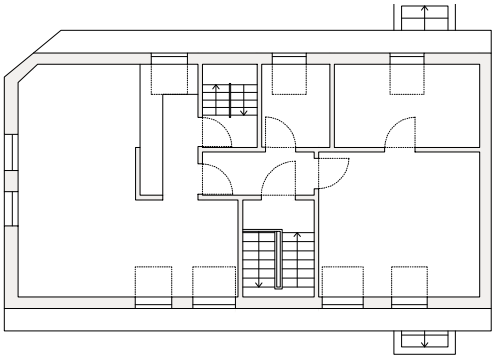
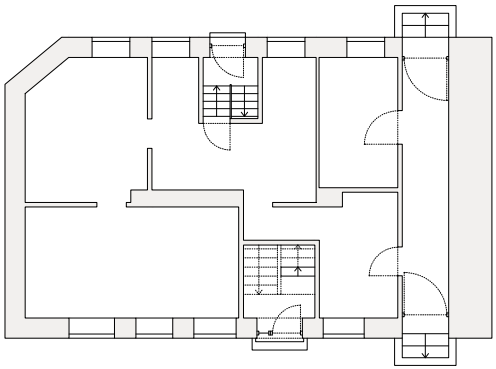


Fig. 34 Sewage layouts, section and front facade

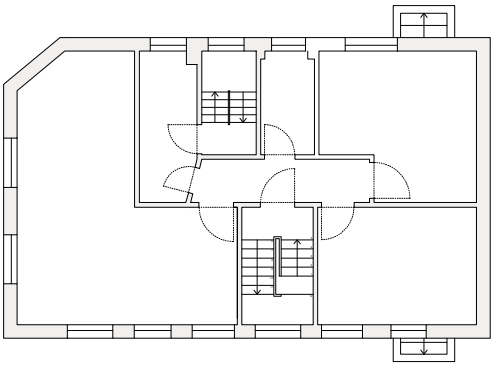
Drawings



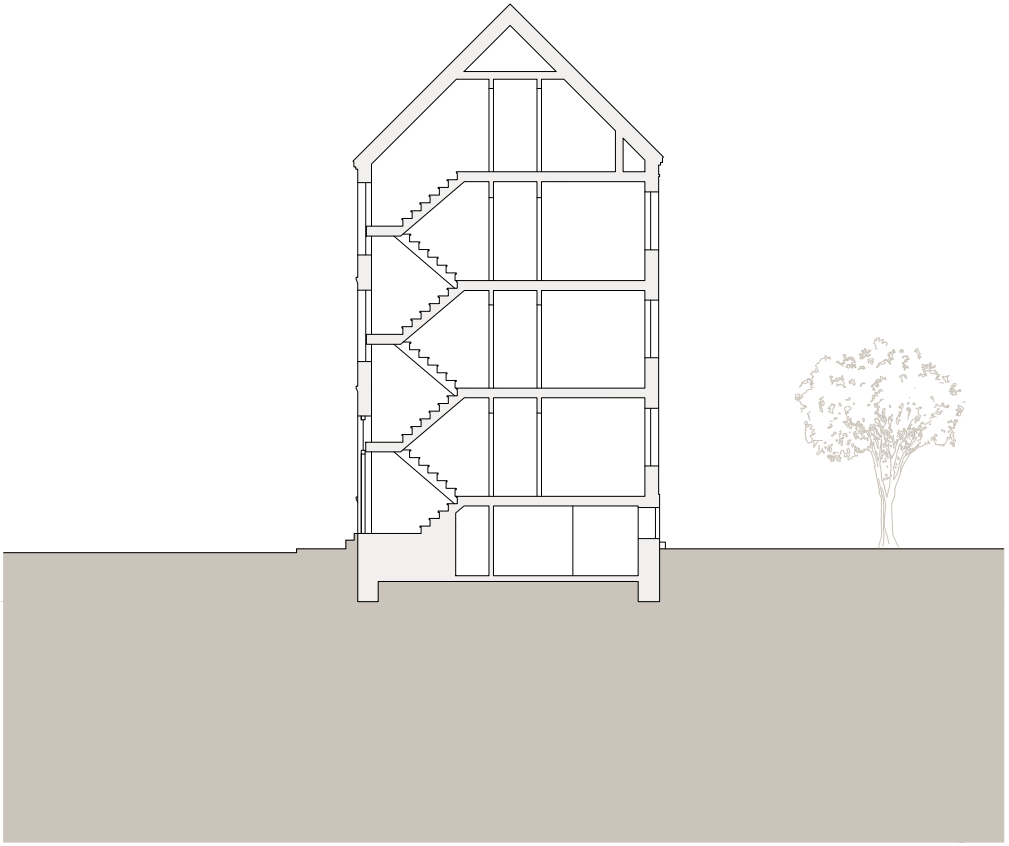
Drawing 2 Plan of Attic 1:200



Drawing 1 Plan of Basement 1:200



Drawing 3 Plan of 1st and 2nd 1:200



Drawing 4 Section 1:200

Idea

The idea for the project was to create something that would give a continuity to the building in terms of shape, but used materials to make it stand out. The time for the design phase was quite short and there wasn`t time to adjust that many things.

The idea for the extension was to prolong the existent diagonal for the cut corner and extend the building the furthest possible. This allow to create a bigger space to the building. In ground floor, the space is open after the demolition of the walls, the extension allowed to create a small toilet and a meeting room. The extension gives more ligth on the inside of the buiding.

In the apartments, the extension allowed a creation of an extra room and a walkway with a closet. Also to enlarge the kitchen and bathroom that were quite small. The living room and kitchen become an open space, making the space look bigger.

The space in the attic is smaller then the other floor but with the demolition of the back staircase the area is enlarged. The bathroom and kitchen are the main concern to make bigger, The living room and kitchen become an open space like in the other floors.

The exterior of the building the brick is kept the most possible, and the window replaced with the most similar model.

The landscape of the backyard include a cleaning of the ground but keeping what exists, in connection with the new.

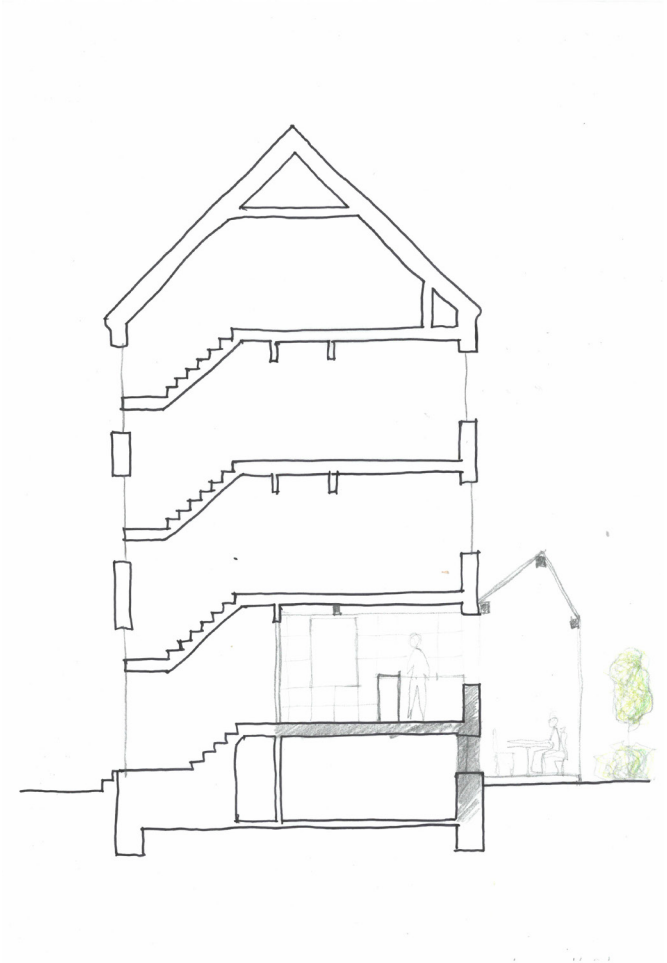


Fig. 35 Section sketch

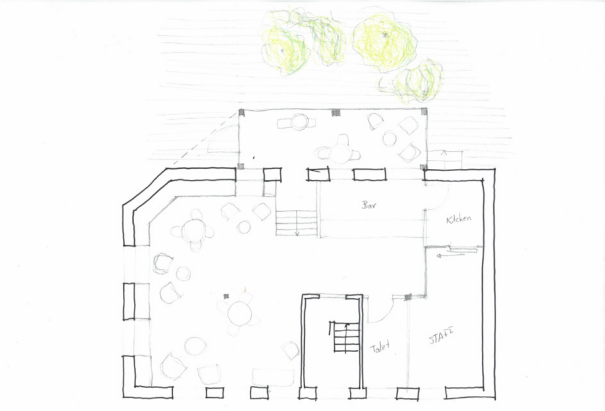


Fig. 36 Sketch idea of the ground floor

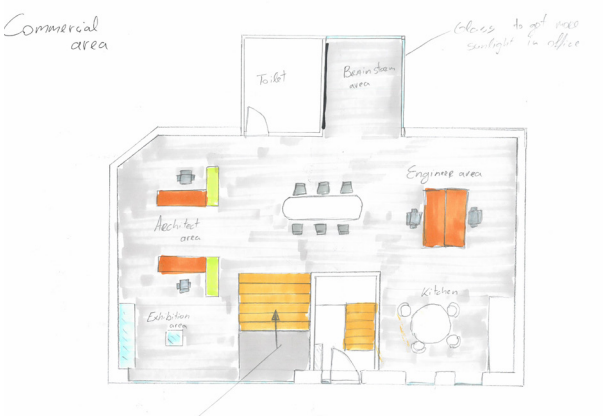


Fig. 37 Sketch idea of the ground floor

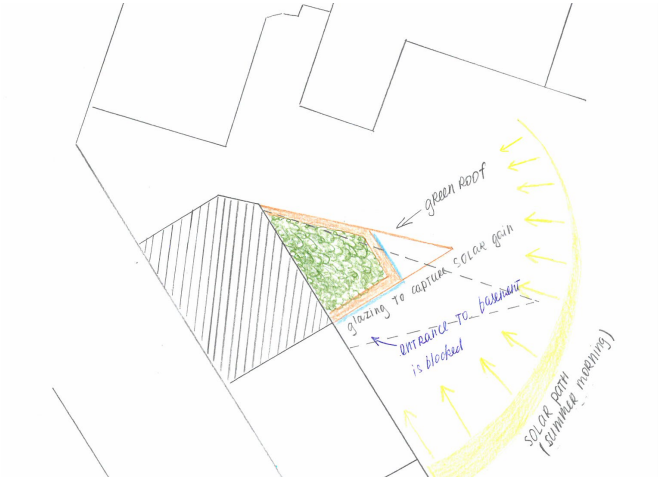


Fig. 38 Idea of shape for the building with a sun ligth study

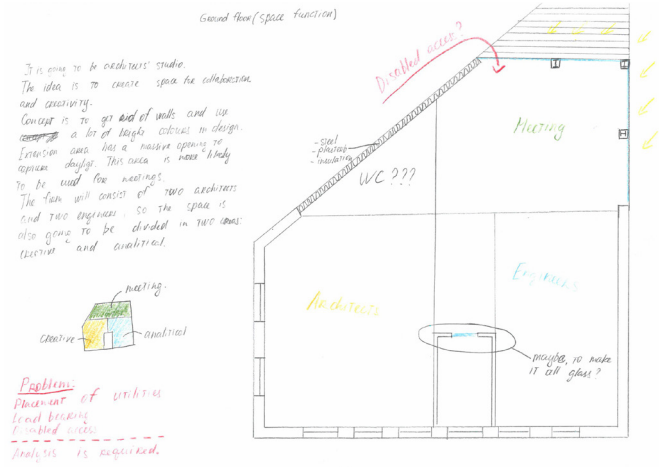


Fig. 39 Zoning skecth for the commercial area in the ground floor

Fig. 40 Sketch for the new entrance for the commercial area

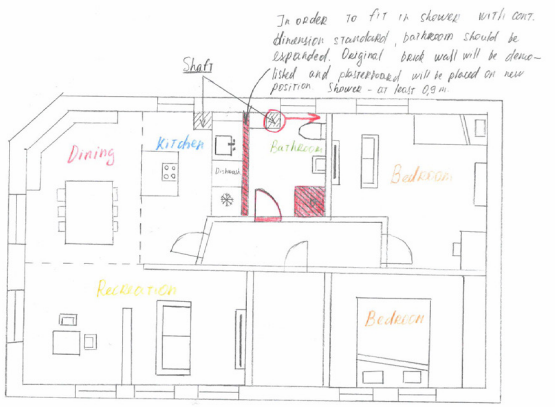


Fig. 41 Sketch for the changes on the apartments floors, making bathroom and kitchen bigger

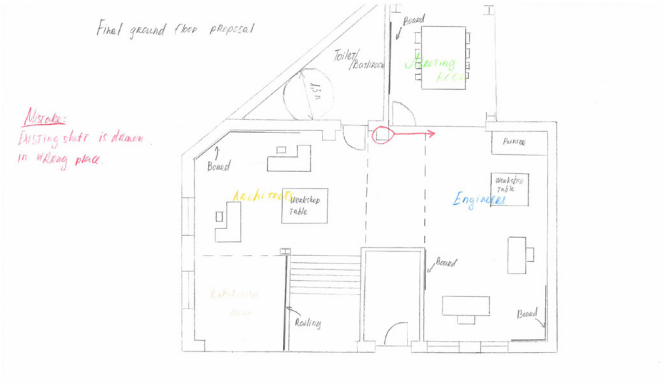


Fig. 42 Sketch layout of the ground floor, with furniture and changes to be made

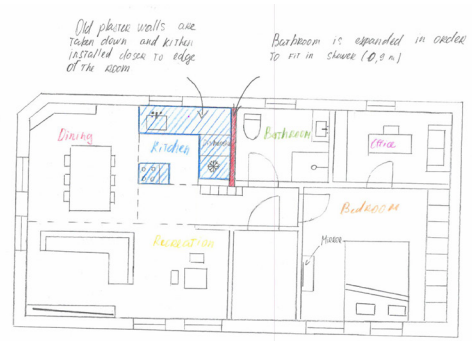


Fig. 43 Sketch layout ot the attic, with a bigger kitchen

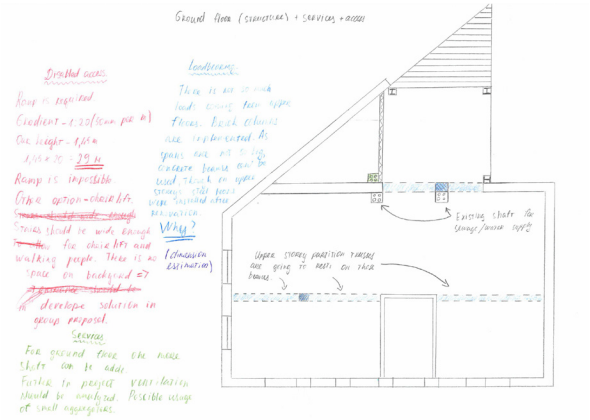


Fig. 44 Inicial sketch of the beam - column structure for the ground floor

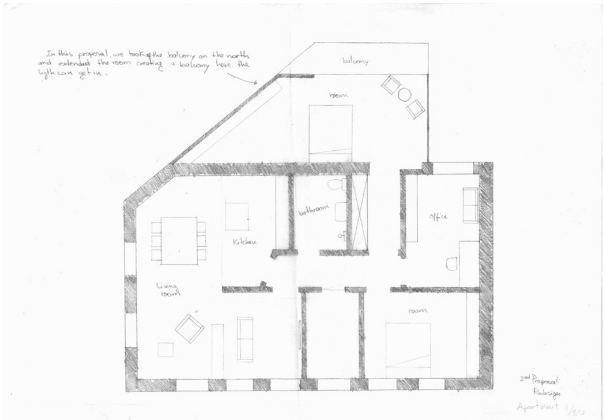


Fig. 45 Sketch for the final placing of walls and furniture

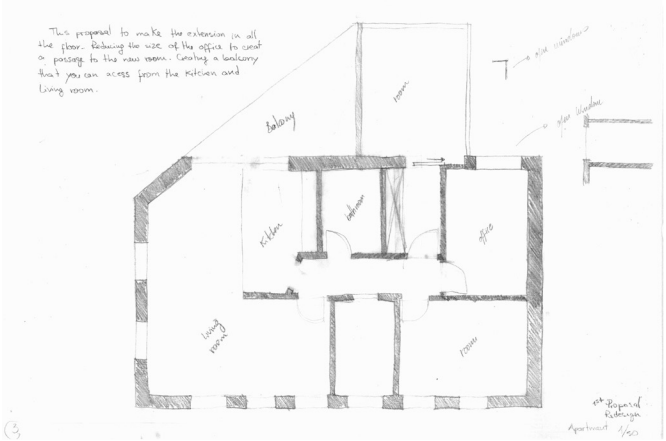
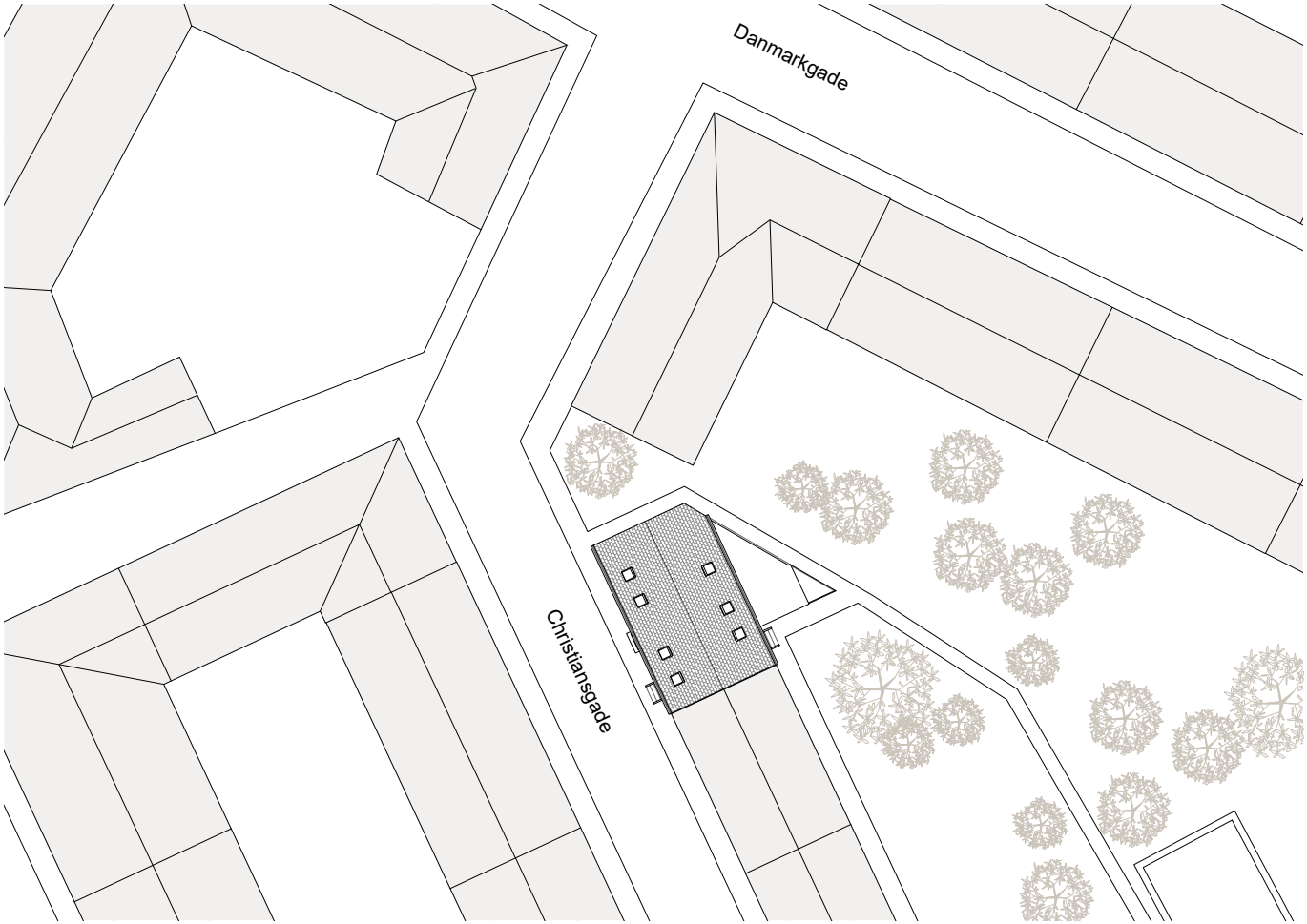
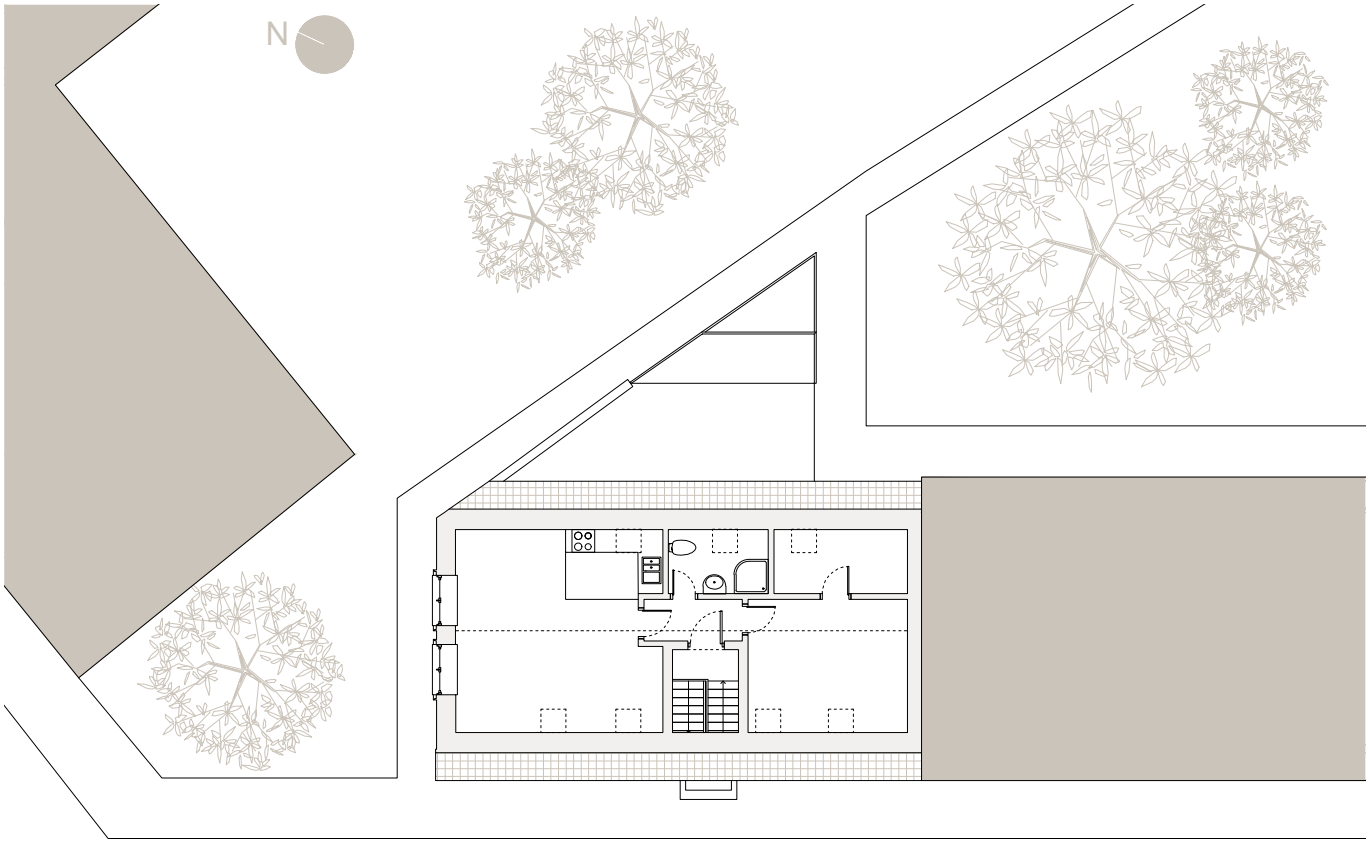


Fig. 46 Sketch for a balconie in the extension, maintaining the same layout making the room small

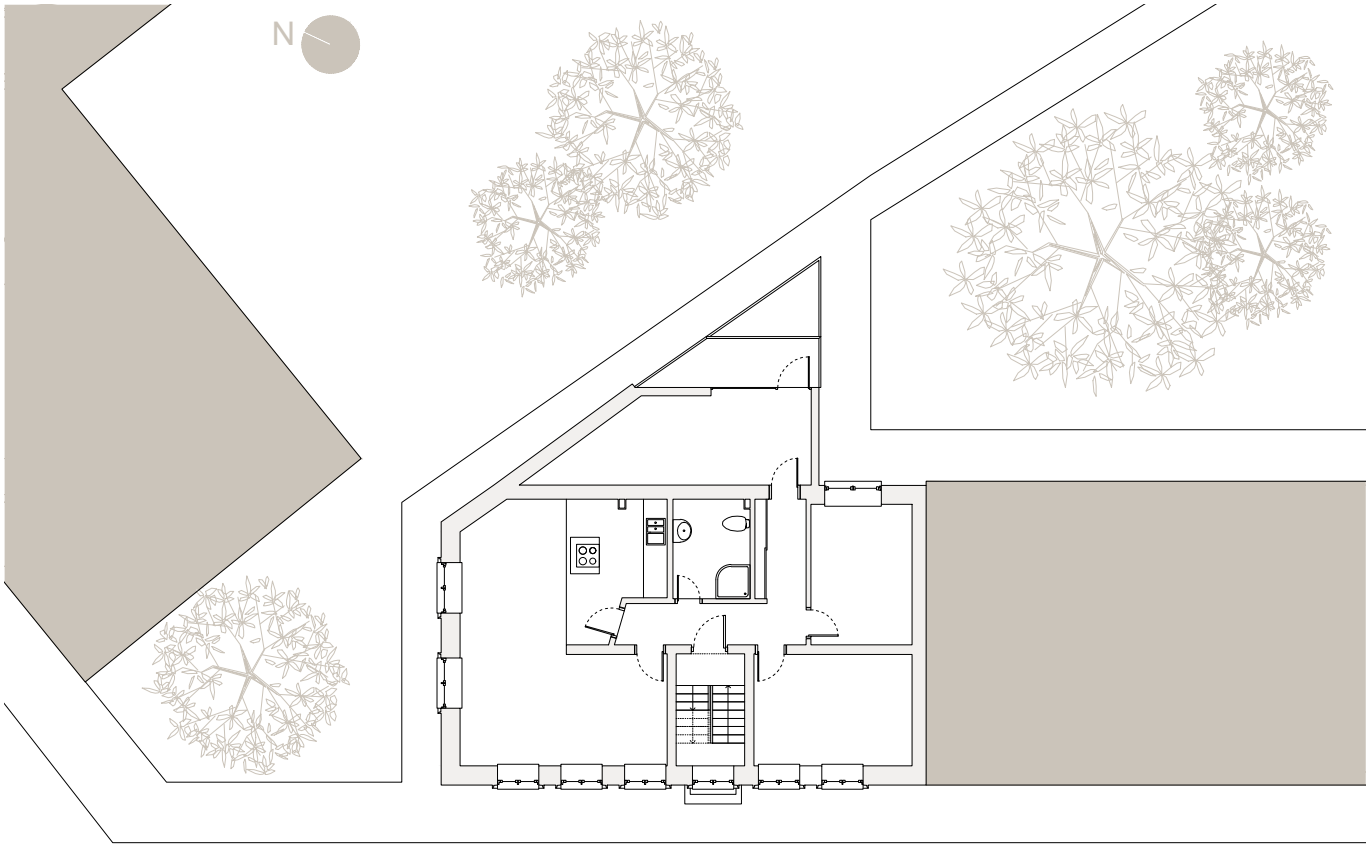
Drawings



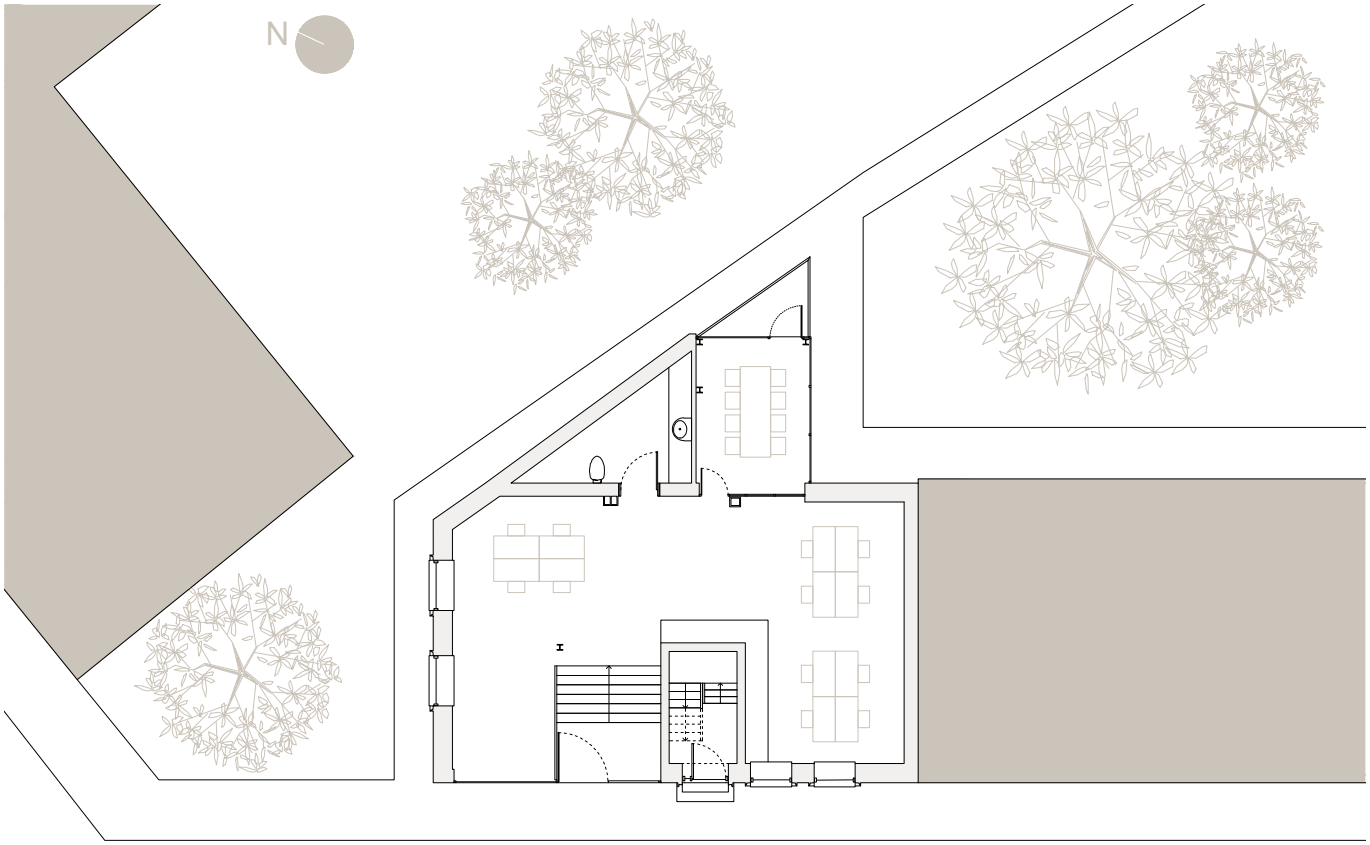
Drawing 5 Site Plan 1:500



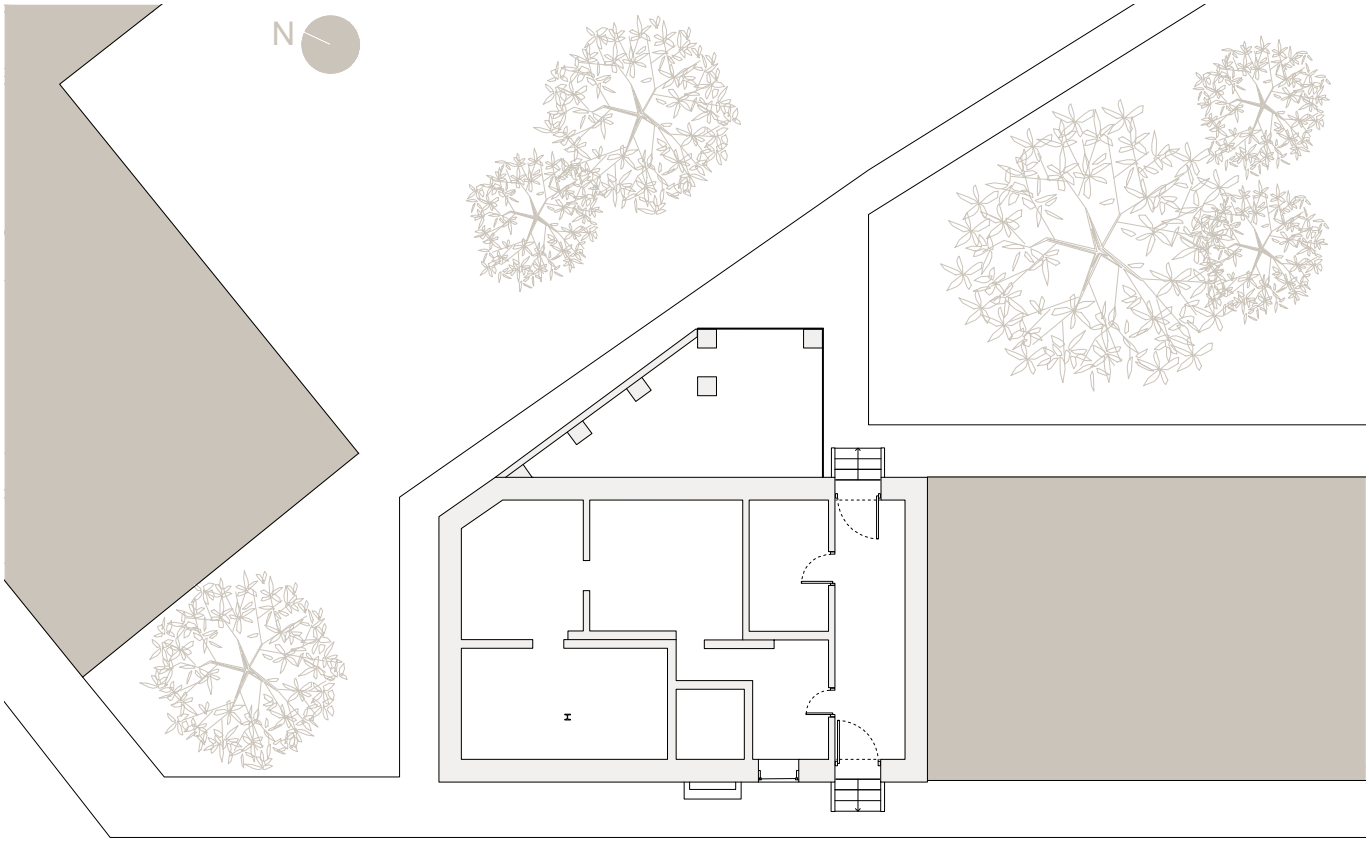
Drawing 6 Attic Plan 1:200



Drawing 7 1st and 2nd Floor Plan 1:200



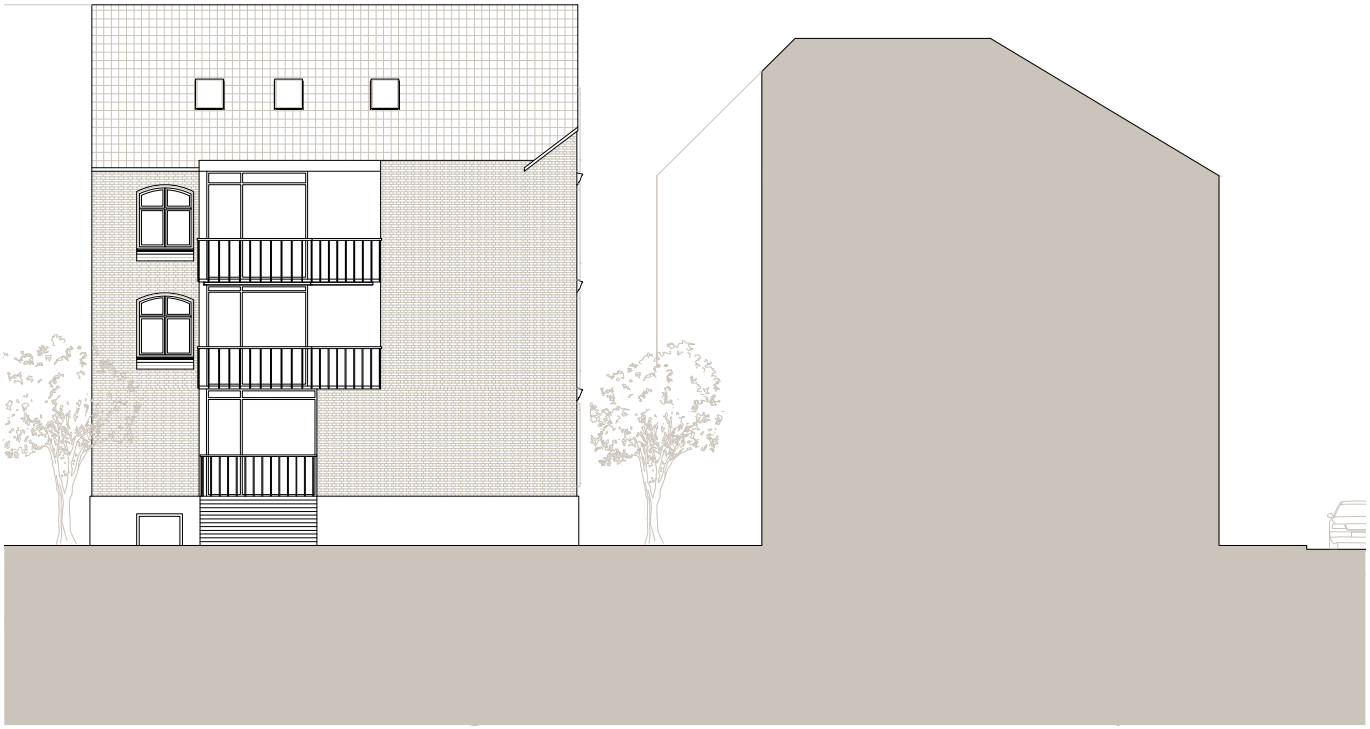
Drawing 8 Ground Floor Plan 1:200



Drawing 9 Basement Plan 1:200

Drawing 10 Section AA 1:200

Drawing II Southwest Elevation (Front) 1:200



Drawing 12 Northeast Elevation (Backyard) 1:200

Drawing 13 Northwest Elevation (Gable) 1:200

Drawing 14 Southeast Elevation 1:200

Renderings

Fig. 47 Rendering :Front facade

Fig. 48 Rendering: from the backyard

Fig. 49 Rendering: Extension

Fig. 50 Rendering: Building view from the street

Fig. 51 Rendering: Apartment kitchen and dining room

Fig. 52 Rendering: Apartment bathroom

Fig. 53 Rendering: Apartment living room

Construction

The building is built in traditional brickwork, with wood rafters to support the different floors and roof. The building doesn't have any insulation, so there will be a need to insulate The building original construction is kept, for the most of it. There is a partial removal of the front façade for the new entrance for the commercial area and the removal of most of the back façade for the extension.

The building structure it is good, beams are added to support the weight of the walls that were demolished and a beam - column system was add in the ground floor. The extension is built with steel structure, to allow a faster, lighter and drier construction on site. The roof of the extension is a green roof.

The windows are replaced, with new ones with better u-value and better acoustic. The doors are replaced for new door with a better fire resistance. The basement will remain without insulation, with the only access thru the backyard connection corridor.

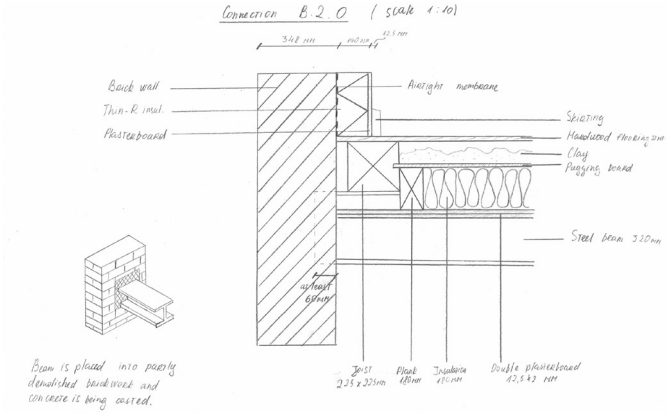


Fig. 54 Sketch: Connection of brick wall with rafts, and the new insulation and connection the steel beam with brick wall on the ground floor

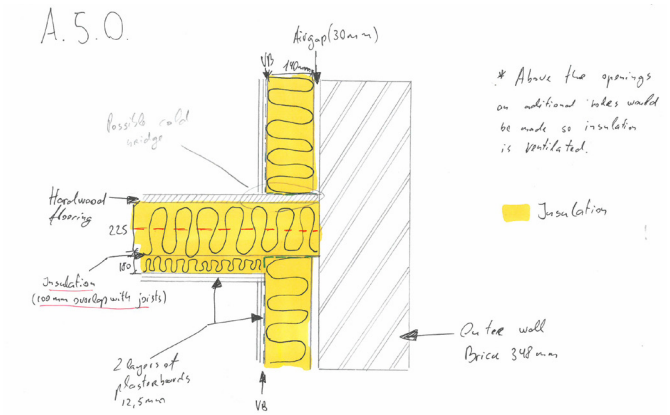


Fig. 55 Sketch: Connection of new insulation with the old brick wall

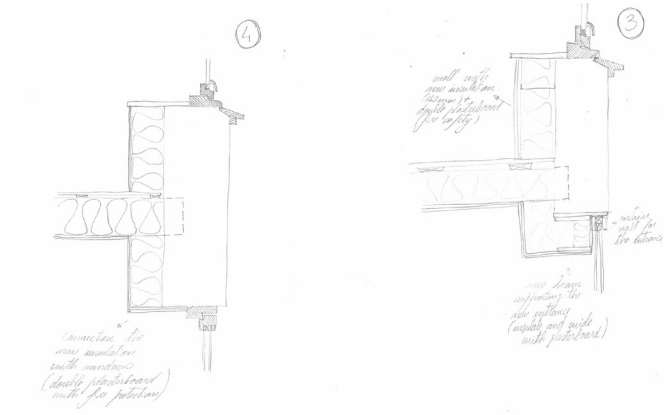


Fig. 56 Sketches: Connection of brick wall with the window and the new insulation

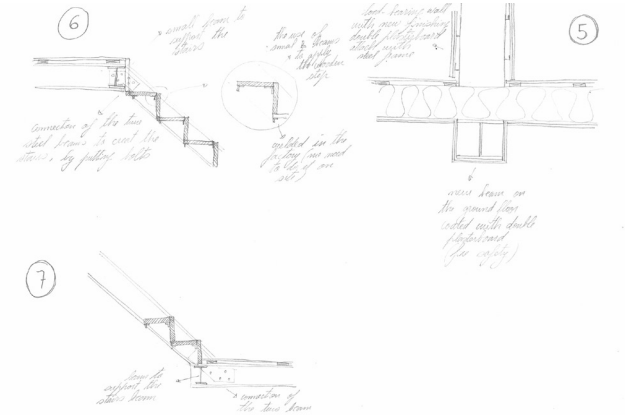


Fig. 57 Sketches: Connections of the new front entrance and key point of the beam to support the walls in the ground floor

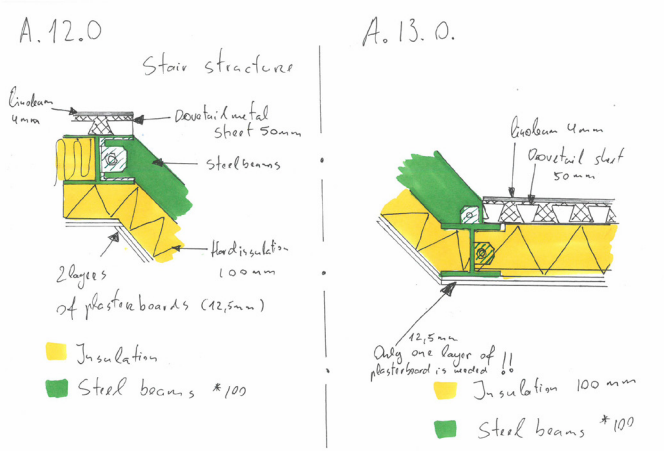


Fig. 58 Sketch: New beams connection on the front entrance new floor

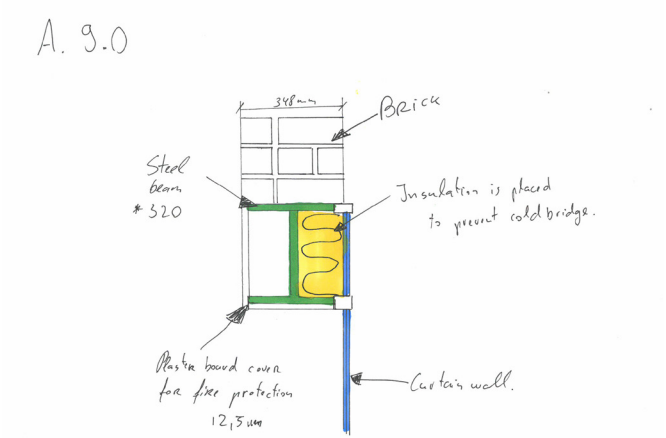


Fig. 59 Sketch: Beam to support the new front entrace

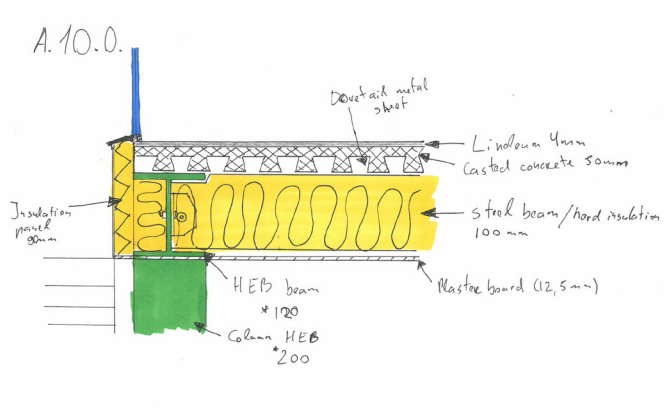


Fig. 60 Sketch: Connection of the support steel columns with the floor of the extensiton

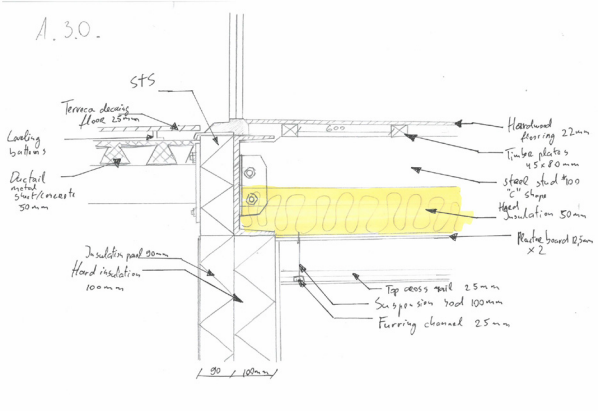


Fig. 61 Sketch: Connections of extension with the exterior balcony

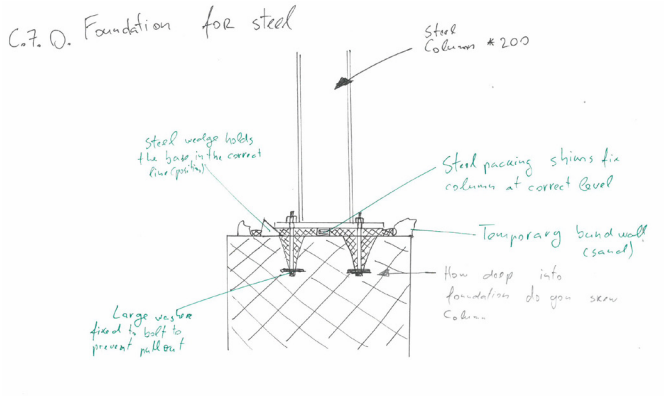


Fig. 62 Sketch: Connection of the concrete fundation with the steel columns that support the extension

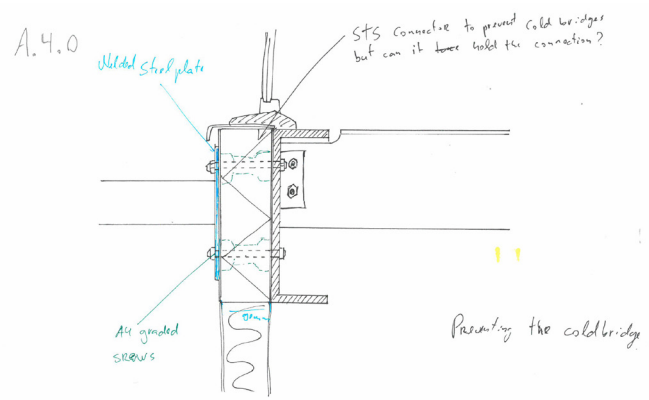


Fig. 63 Sketch: Connection of window with the extension floor

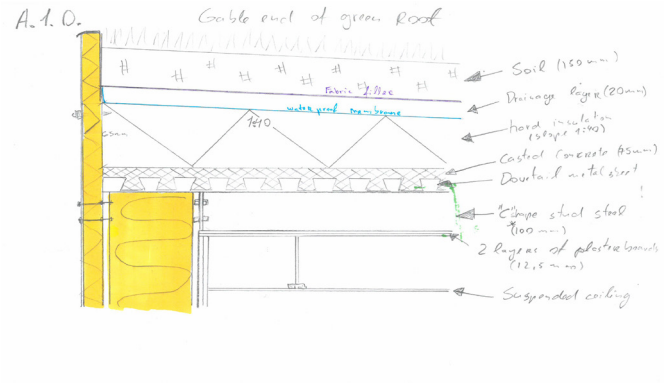


Fig. 64 Sketch: Extension Green Roof connection with the extension wall

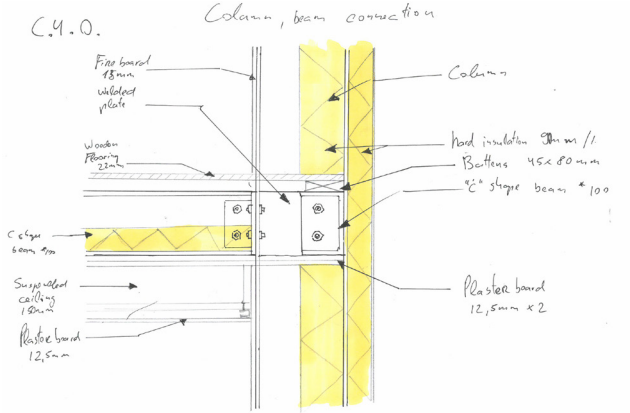


Fig. 65 Sketch: Connection of collumns and beam in the extension

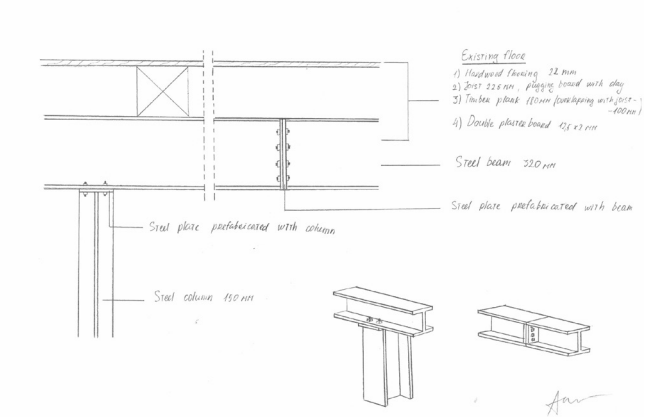


Fig. 66 Sketch: Detail of connection of beam with collumns,

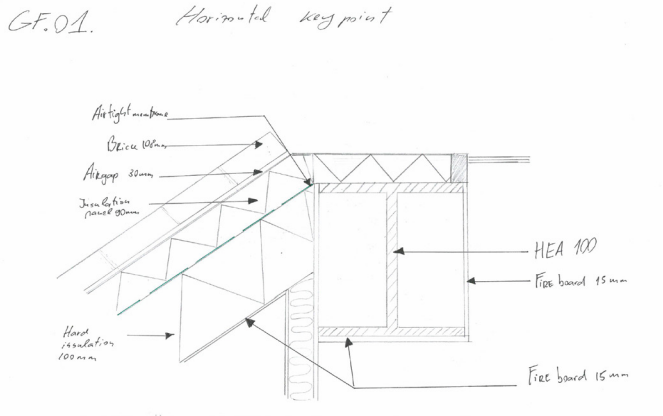


Fig. 67 Sketch: Connection of the extension collumn

Load Bearing System

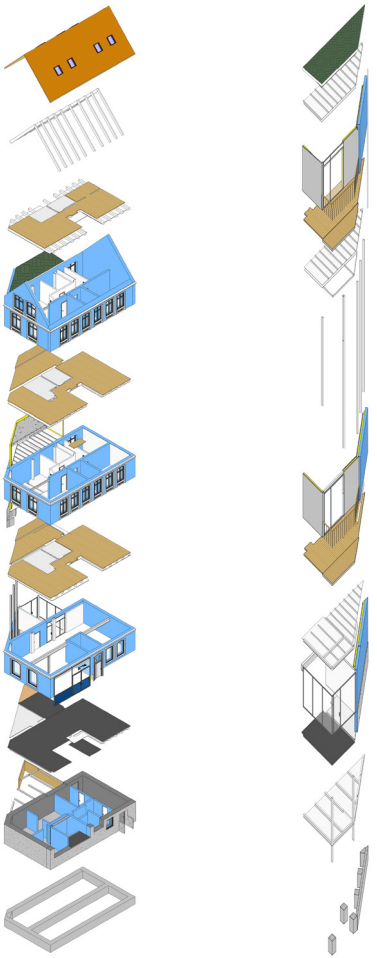


Fig. 68 Explode drawing of the building and the extension

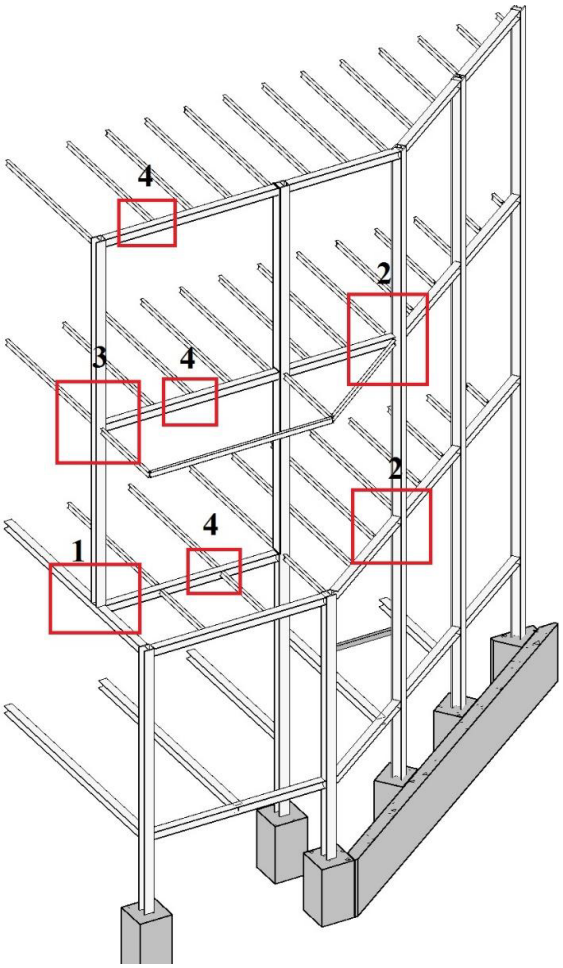


Fig. 69 Extension steel structure

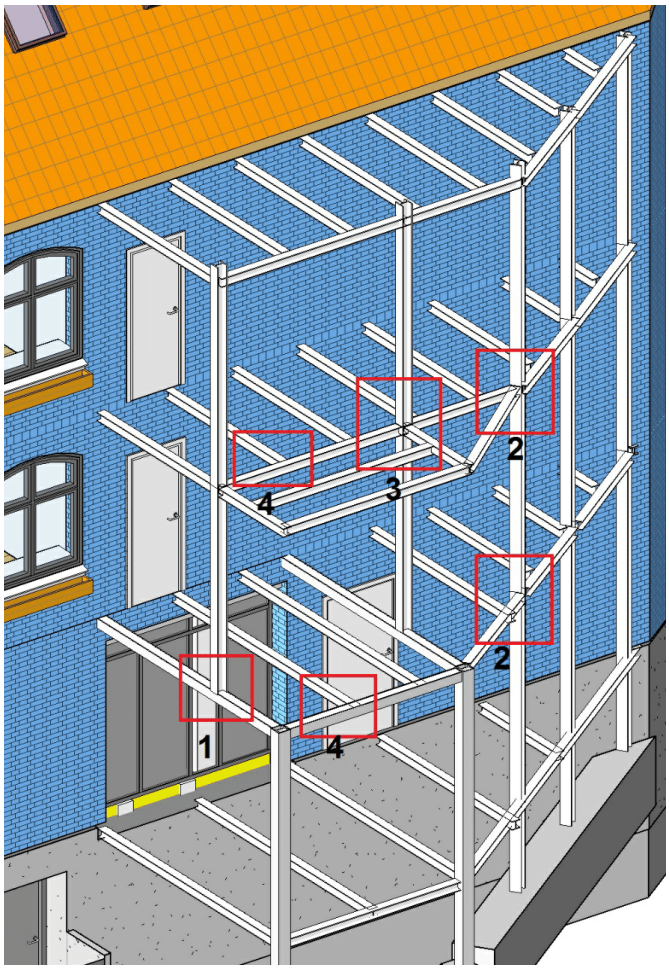


Fig. 70 Extension steel structure connection with the building

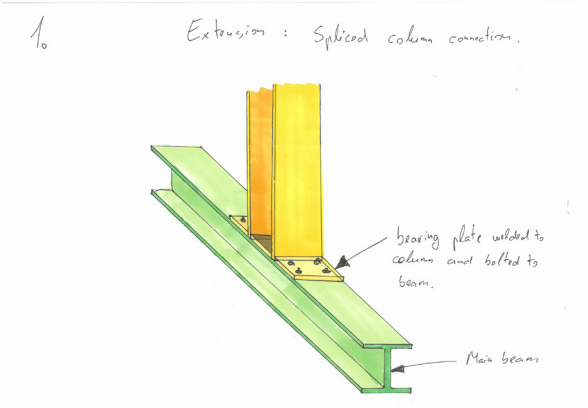


Fig. 71 Connection number 1 (Fig. 69 and Fig. 70)

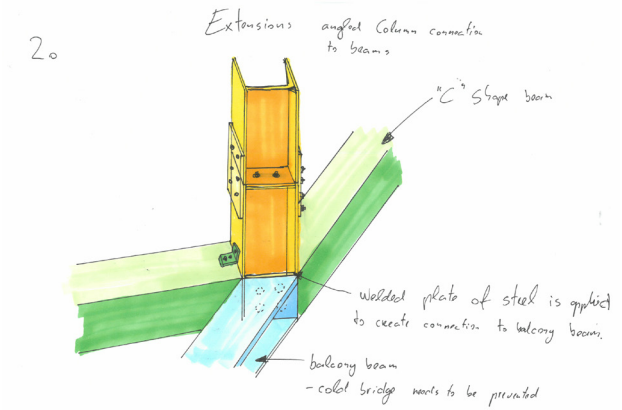


Fig. 72 Connection number 2 (Fig. 69 and Fig. 70)

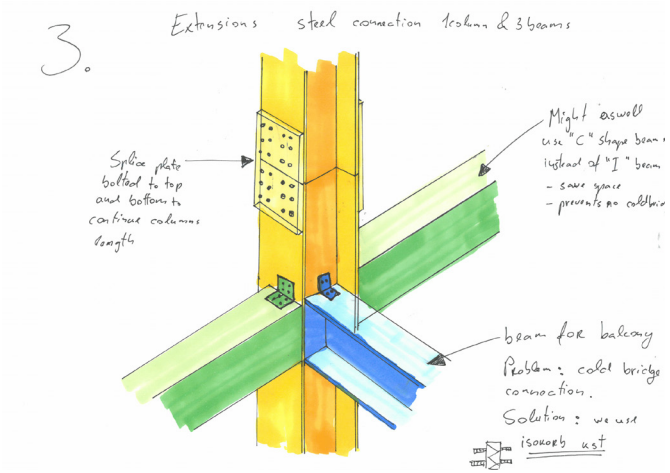


Fig. 73 Connection number 3 (Fig. 69 and Fig. 70)

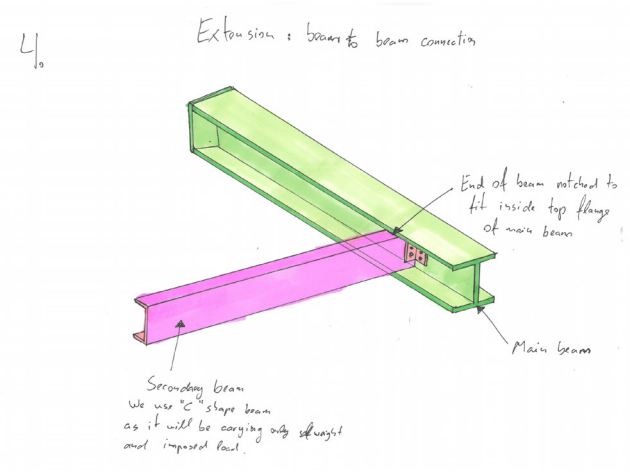


Fig. 74 Connection number 4 (Fig. 69 and Fig. 70)

Energy

In relation to energy the Building Regulation 2010 is very specific to what demand need to be fulfil. First is to decide which energy frame do the building should achieve. The building had to achieve Low Energy Building 2015. For this there are a minimum U-value that needs to be accomplished, independently of the energy frame chosen.

The building didn`t have insulation, except for the roof that was refurbish in the 80`s and some insulation was added. Insulate the building was a priority, to fulfil the requirement set. To achieve the values was a try and error until the right amount of insulation was found. The building is insulated from the inside, because the front façade needs to be kept with brick work. From all the solution found insulate from the inside allowed for the less cold bridges. Then the choices of low u-value window with a u-value of 1,1. This to keeps a tight building envelope with the least cold bridges.

	U-values	*Insulation (mm)*
External Wall	*0,0118*	*140*
Extension Brick Wall	*0,08*	*190*
Extension Wall	*0,09*	*190*
Extension Floor	*0,14*	*140*
Basement Story Partition	*0,15*	*100*
Roof	*0,13*	*280*
Green Roof	*0,11*	*100*

Fig. 75 Table: u-values and amount of insulation

BE 10

The BE 10 is used to determine if the building is fulfilling the requirements, this means if it fits the energy frame. This is done by inputting all the building data in the programme, and at the end the programme gives different tables. These tables give the energy required for the building compared with the energy frame. Also the heating required for the building, heating is the main energy consume in the building. This result gives a perspective of the energy consumption in the building. This tool allows to adapt the input to have a better result. So by try and error, this can help in the design process.

The building is not fulfilling the energy frame, duo to a late use of the tool in the design process. Also Building Regulation states that percentage of glazing should be 22% of the floor area. When the building is higher than that, this can also be prejudicial to the energy frame.

This tool is very use full but need to be used during the design process, to have a good result. The way to fix it in this project, would be to reduce some of glazing area, and increase the insulation layer (the layer of insulation is not bigger because the space that is taking on the inside of the house).

Key numbers, kWh/m² year

Energy frame in BR 2010

Without supplement	Supplement for special conditions	Total energy frame
57,3	0,0	57,3
Total energy requirement		101,6

Energy frame low energy buildings 2015

Without supplement	Supplement for special conditions	Total energy frame
32,9	0,0	32,9
Total energy requirement		97,3

Energy frame Buildings 2020

Without supplement	Supplement for special conditions	Total energy frame
20,0	0,0	20,0
Total energy requirement		70,6

Table 1 BE 10: energy frame for the building, compared with total energy required for the building

Contribution to energy requirement

Heat	21,8
El. for operation of bulding	31,9
Excessive in rooms	0,0

Selected electricity requirements

Lighting	0,0
Heating of rooms	0,0
Heating of DHW	26,3
Heat pump	0,0
Ventilators	5,1
Pumps	0,5
Cooling	0,0
Total el. consumption	62,6

Net requirement

Room heating	17,9
Domestic hot water	26,3
Cooling	0,0

Heat loss from installations

Room heating	3,8
Domestic hot water	0,0

Output from special sources

Solar heat	0,0
Heat pump	0,0
Solar cells	0,0
Wind mills	0,0

Table 2 BE 10: other energy contribution in the building

	MWh	January	February	March	April	May	June	July	August	September	October	November	December	Total
	Heating requirement													
+1	Trans.- and vent.loss	3,47	3,22	3,10	2,36	1,47	0,82	0,61	0,64	1,23	1,85	2,49	3,14	24,41
2	Vent. VF (total)	0,19	0,19	0,13	0,03	0,00	0,00	0,00	0,00	0,00	0,00	0,05	0,14	0,73
3	Vent. VGV down reg.	0,00	0,00	0,00	0,00	-0,13	-0,22	-0,26	-0,26	-0,15	-0,07	0,00	0,00	-1,08
4	Heat loss	3,28	3,03	2,97	2,33	1,60	1,04	0,87	0,90	1,38	1,91	2,44	3,00	24,76
5	Incident solar radiation	0,41	0,69	1,17	1,86	2,47	2,49	2,41	2,05	1,43	0,82	0,45	0,28	16,55
6	Internal supply	1,29	1,17	1,29	1,25	1,29	1,25	1,29	1,29	1,25	1,29	1,25	1,29	15,20
7	From pipe and VVB const.	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
8	Total supplement	1,71	1,86	2,46	3,10	3,76	3,74	3,70	3,34	2,68	2,11	1,70	1,57	31,75
9	Rel. supplement, -	0,52	0,61	0,83	1,33	2,35	3,60	4,24	3,70	1,94	1,10	0,70	0,52	
10	Part of room heating	1,00	1,00	0,99	0,00	0,00	0,00	0,00	0,00	0,00	0,43	1,00	1,00	
11	Variable heat supplement	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
12	Toal supplement	1,71	1,86	2,46	3,10	3,76	3,74	3,70	3,34	2,68	2,11	1,70	1,57	31,75
13	Rel. supplement, -	0,52	0,61	0,83	1,33	2,35	3,60	4,24	3,70	1,94	1,10	0,70	0,52	
14	Utilization factor	1,00	1,00	0,98	0,75	0,43	0,28	0,24	0,27	0,52	0,87	1,00	1,00	
15	Heat requirement	1,58	1,17	0,54	0,00	0,00	0,00	0,00	0,00	0,00	0,03	0,75	1,43	5,49
16	Vent. VF (central heating)	0,19	0,19	0,13	0,03	0,00	0,00	0,00	0,00	0,00	0,00	0,05	0,14	0,73
17	Total	1,77	1,36	0,67	0,03	0,00	0,00	0,00	0,00	0,00	0,03	0,80	1,57	6,22

Table 3 BE 10: heating required in the building

Building Services

In relation to the building services, the renovation of the building needs a new sewage layout and ventilation layout. For the sewage layout, the layout was done and pipe slop calculated. For the ventilation, was decide to have a small aggregator in each floor. This decision will save space and allow for a more freedom from the user`s part. To determine the size of the aggregator, we calculated the amount of air supply and extraction needed in each room, and then determine the size of the pipes.

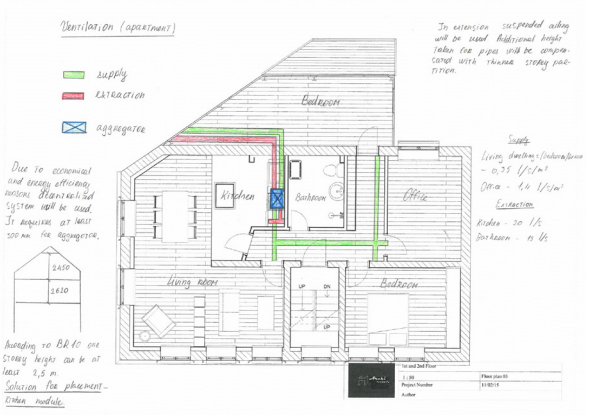


Fig. 77 Ventilation Plan: I[st] and 2[nd] Floors

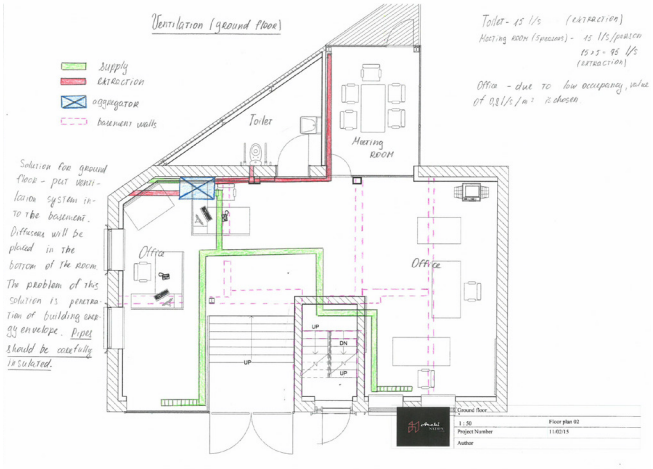


Fig. 76 Ventilation Plan: Ground Floor

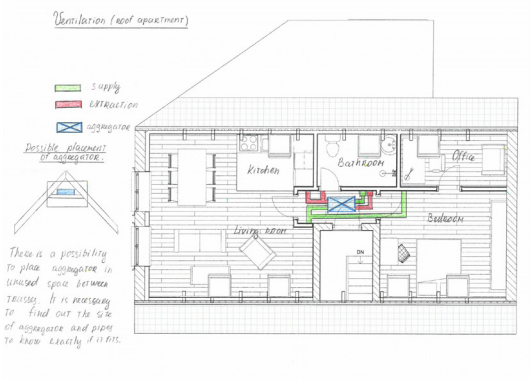


Fig. 78 Ventilation Plan: Attic

Fig. 79 Sewage Plan: 1st and 2nd Floors

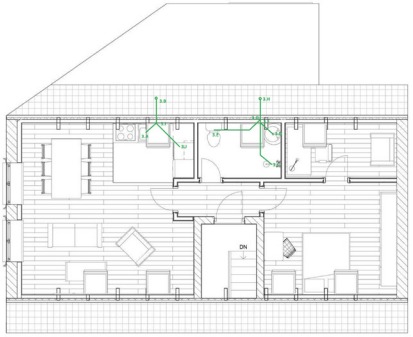


Fig. 80 Sewage Plan: Attic

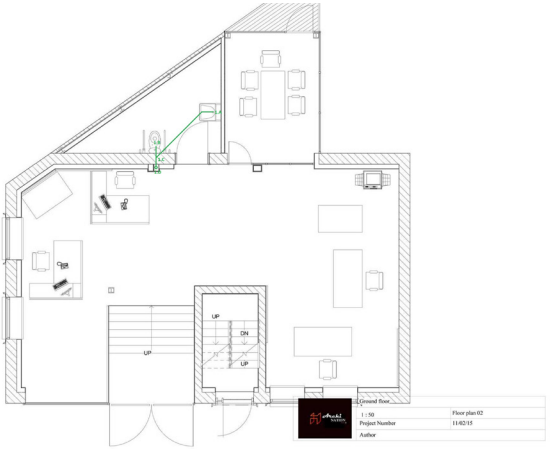


Fig. 81 Sewage Plan: Ground Floor

Construction Planning

In construction planning, a master schedule is done. So there is a time frame for the project. Also a tender schedule is done, stating which contractor activities are on site by order and for how long they are there.

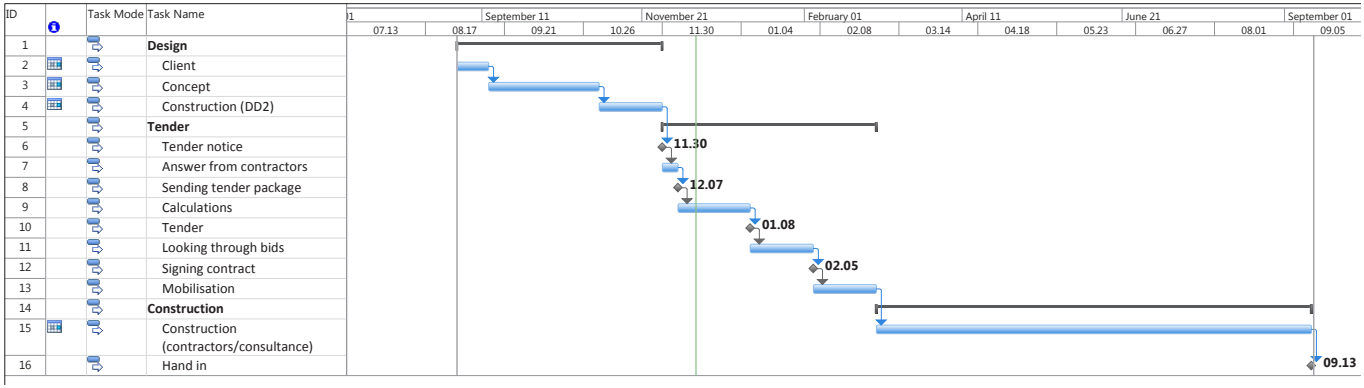


Fig. 82 Master Schedule

	Task Name	Duration	Start	Finish	Predecessors	Resource Names
1	Base	4 days	3/4/2016	3/9/2016		
6	Demolition	9 days	3/10/2016	3/22/2016	1	
16	Steel	7 days	3/23/2016	3/31/2016	6	
19	Brick laying/other	18 days	4/1/2016	4/26/2016	16	
25	Carpentry/other	39 days	4/27/2016	6/20/2016	19	
40	Building services	19 days	6/21/2016	7/15/2016	25	
49	Interior works	26 days	8/8/2016	9/12/2016	40	

Fig. 83 Tender Schedule

Budget

The budget at this phase is done so the client has an idea of how much will pay for the project. The budget includes site cost, construction costs and administrative costs, the most important to focus on is the construction cost is the one more accurate and calculated in detail. The budget was calculated in an Excel Sheet formatted for Budget calculation. All the values in the budget are in Danish Krones (DKK).

Index at calculation time:	136.1
Total area (m2):	315

Distribution of costs

A. Site costs
Surrounding areas -costs based on surveying/measurement — Kr. 20,000

B. Construction costs
Total costs based on grades and quantities — Kr. 2,613,000
Costs per m² — Kr. 8,295

C. Administration costs
Total costs (fee etc.) — Kr. 625,000

Total project cost (Excl. VAT)	Kr.	3,258,000
25 % VAT	Kr.	814,500
Total project cost (Incl. VAT)	Kr.	4,072,500
Total project cost / m² (Incl. VAT)	Kr.	12,929

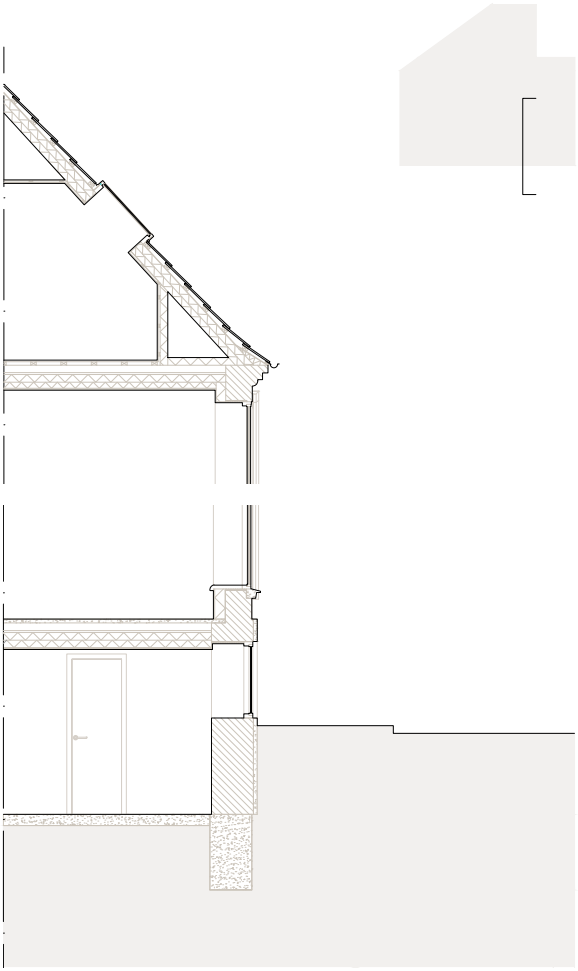
Fig. 84 Budget Calculation

Project Work
Re-insulation

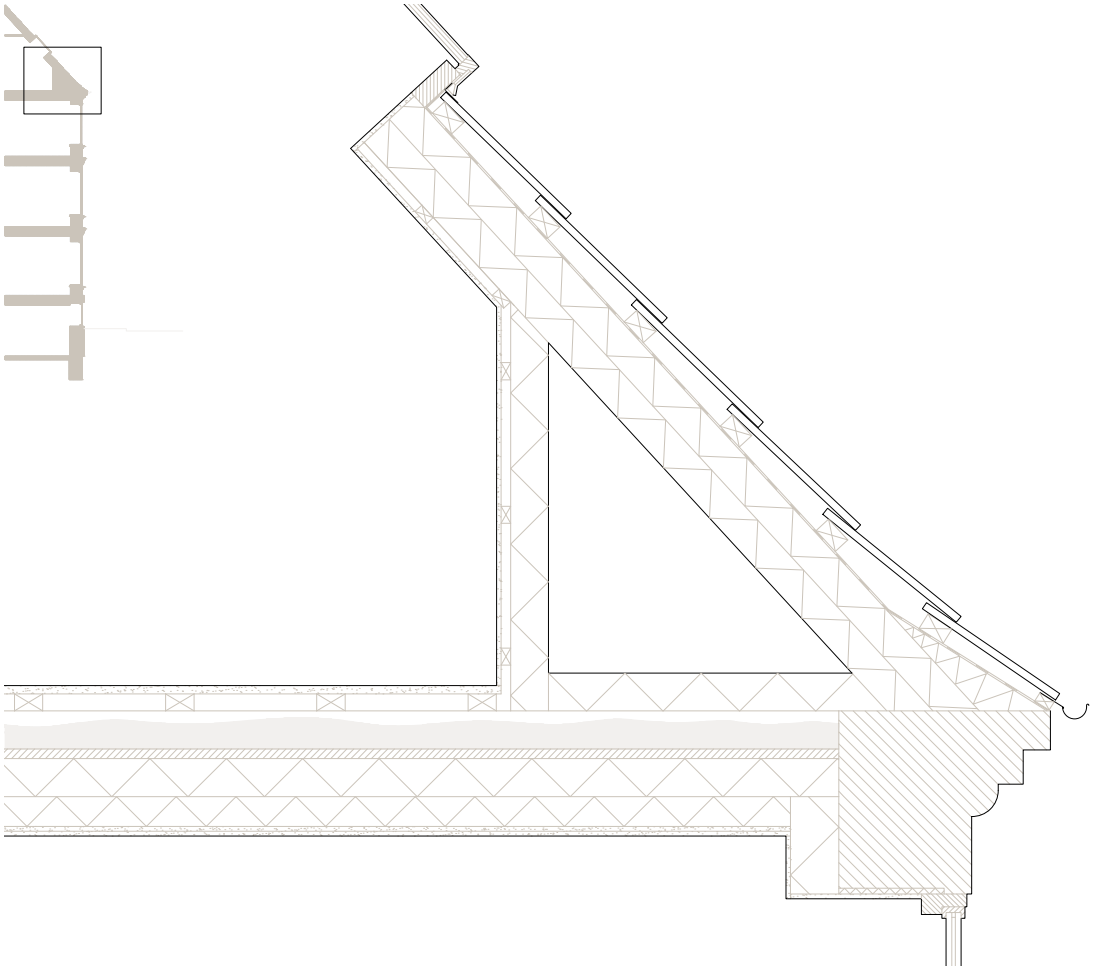
Christiansgade I B

Individual Work - 5th Semester
Renovation and Convertion

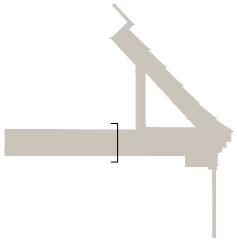
Drawings

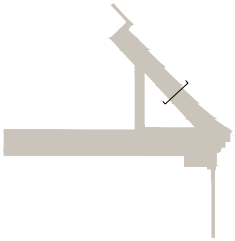


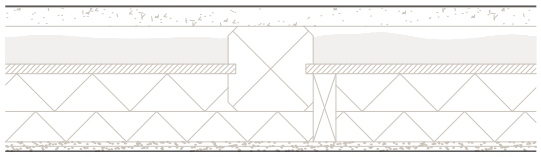
Drawing 15 Semi-Section BB 1:100

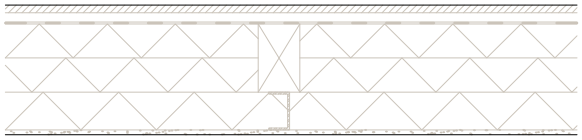


Drawing 16 Detail 1: Roof connection with storey partition and facade window 1:20



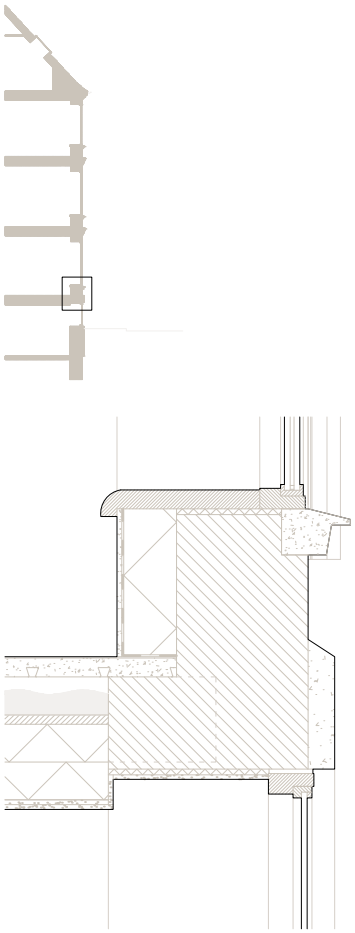




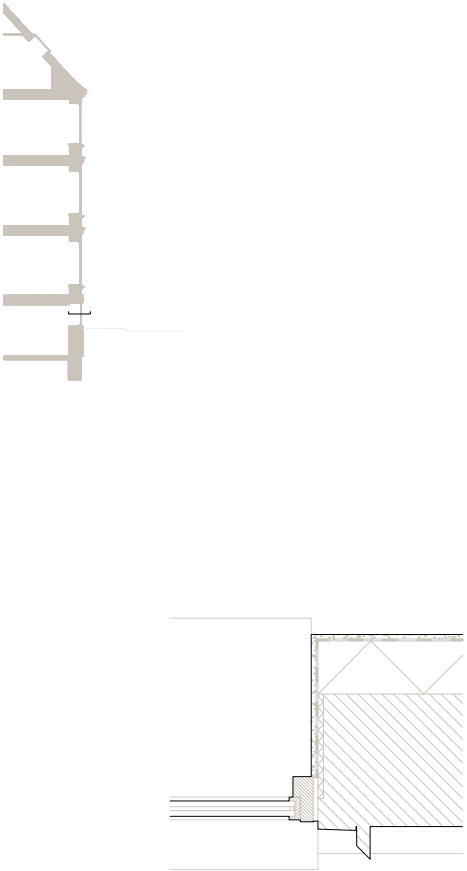


Drawing 17 Detail 2: Roof storey partition layers 1:20

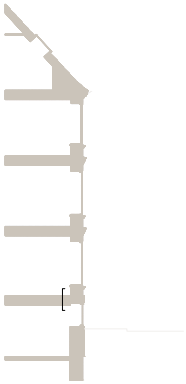
Drawing 18 Detail 3: Roof ceiling layers 1:20

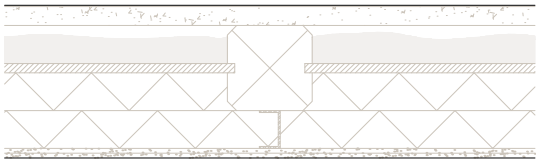


Drawing 19 Detail 4: Ground floor storey partition connection with front facade wal and windows 1:20



Drawing 20 Detail 5: Wall connection with window 1:20



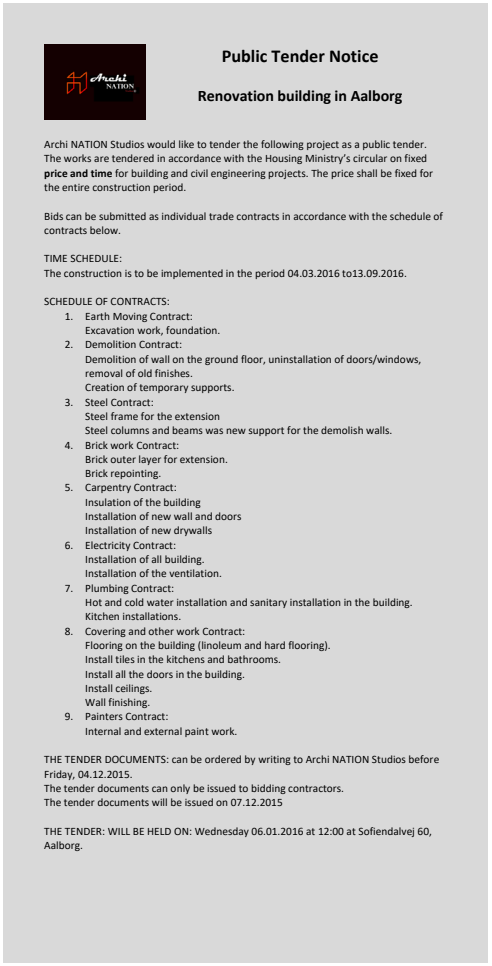


Drawing 21 Detail 6: Ground floor storey partition layers 1:20

Tender

This phase is to prepare all the documents to tender the project. For this project was done Public tender notice to be posted in the newspaper. This so that constructor know that there is a building to be built and they can bid on it.

In relation with the re-insulation of the building, a risk analyse is done, to understand what could be the problems during the installation of the insulation. When the main risks are found a tender control plan is done to make sure that, during the construction exist a follow-up and inspection of what is being done. This is to prevent any defect in the insulation.



Public Tender Notice

Renovation building in Aalborg

Archi NATION Studios would like to tender the following project as a public tender. The works are tendered in accordance with the Housing Ministry's circular on fixed **price and time** for building and civil engineering projects. The price shall be fixed for the entire construction period.

Bids can be submitted as individual trade contracts in accordance with the schedule of contracts below.

TIME SCHEDULE:
The construction is to be implemented in the period 04.03.2016 to13.09.2016.

SCHEDULE OF CONTRACTS:

1. Earth Moving Contract:
   Excavation work, foundation.
2. Demolition Contract:
   Demolition of wall on the ground floor, uninstallation of doors/windows, removal of old finishes.
   Creation of temporary supports.
3. Steel Contract:
   Steel frame for the extension
   Steel columns and beams was new support for the demolish walls.
4. Brick work Contract:
   Brick outer layer for extension.
   Brick repointing.
5. Carpentry Contract:
   Insulation of the building
   Installation of new wall and doors
   Installation of new drywalls
6. Electricity Contract:
   Installation of all building.
   Installation of the ventilation.
7. Plumbing Contract:
   Hot and cold water installation and sanitary installation in the building.
   Kitchen installations.
8. Covering and other work Contract:
   Flooring on the building (linoleum and hard flooring).
   Install tiles in the kitchens and bathrooms.
   Install all the doors in the building.
   Install ceilings.
   Wall finishing.
9. Painters Contract:
   Internal and external paint work.

THE TENDER DOCUMENTS: can be ordered by writing to Archi NATION Studios before Friday, 04.12.2015.
The tender documents can only be issued to bidding contractors.
The tender documents will be issued on 07.12.2015

THE TENDER: WILL BE HELD ON: Wednesday 06.01.2016 at 12:00 at Sofiendalvej 60, Aalborg.

Fig. 85 Public Tender Notice of the building

Project: Renovation Christiangade 1B				**Respondent by:** Joana Inglês	**Date:** 08.12.2015
What can go wrong?	The consequences (1-5) **(C)**	Probability (1-5) **(P)**	Risk number **(C x P)**	Actions	
				Preventive	Mitigation
Find moisture on the walls after removing the old insulation	3	2	6		Clean and remove everything from the wall. Check if there more moisture on the wall.
If the vapour-membrane is not installed properly moisture can appear	4	3	12	When the vapour-membrane is being installed check if there is overlapping and if it properly sealed with tape. The site manager should inspected before anything well be applied.	Remove the moisture and the material the area affected by it. Re-install the vapour-membrane and re-check the overlapping and the tape sealing and the end inspected.
The creation of cold bridges, when filling the steel frame cavity, because of the hard insulation is more difficult to install	3	4	12	When fill the steel frame cavity be extra careful to fill well the cavity so there is no empty space left. The site manager should inspected before anything well be applied.	Fill the empty space with more insulation. The site manager should inspected before installing anything else.
The creation of cold bridges in the connection windows and doors	3	3	9	Try to fill the cavity all in connection to the windows and doors. The site manager should inspected before.	Check all the connection again, fill properly the ones you aren't. The site manager should inspected it
If the wall isn't air tight, it can create draughts	3	4	12	Make sure the junctions (windows, doors, floor, ceiling, walls) are sealed before install insulation. The site manager should inspected before applying the insulation. The installation of the plasterboard should be sealed properly to complete the air tightness. The site manager should inspect in the end and do an air tightness test before the end of the construction.	Re-check all the junctions, to see where the default was and corrected. Do the air tight test again to confirm.

Translated directly from the Danish book: "Power i projekter & portefølje", by Mette Lindgaard Attrup and John Ryding Olsson, 2008

Fig. 86 Risk Analyses for the Re-Insulation

Nr.	Topic	Method/how	Frequence	Time	Requirement	Requirement to documentation	Who/ Resp.	Carry out
1	Moisture on the exterior wall	Visual inspection	100%	Before starting the of the steel installation	No visible moisture	Written report	Carpenter	
2	Air tight membrane	Visual inspection; Air tight testing	100%	Before the installation of the steel installation	Airtight test should not exceed result 0,5 l/s/m²	Written report	Carpenter /Site Manager/ Airtightness testing companies	
3	Installation of insulation	Visual inspection; Photo	100%	Before the installation of the vapor-membrane	All the steel frame cavity is well filled with insulation	Written report	Carpenter	
4	Vapor-membrane	Visual inspection; Photo	100%	Before the application of the plasterboard	Make sure that exist enough overlapping and that the membrane is sealed with specific tape.	Written report	Carpenter	
5	Windows on exterior wall	Visual inspection; Photos	100%	Before the installation of the vapor-membrane	Make sure that there insulation on the cavities around the windows for that purpose and that is filled all thru	Written report	Carpenter	

Fig. 87 Tender Control Plan for the Re-insulation

Construction Planning

For construction planning, the main focus are schedules. The schedules give the project a time frame, and organize so different areas can work at same time in the project, during construction or the design phase. The master schedule is a general schedule, that list the phase and how long they will last. This was done earlier in the project

After the design phase, the tender of the project starts, for this phase there are two schedule. The procurament schedule and tender schedule, one follows the other. The first goes from the end of the design phase until the end of the tender phase, before construction begins. It includes the bidding of the project and the signing of the contract. The second is done during tender phase for the construction phase. It lists the different contractors on site, and for how long will they be there.

For the construction phase are done different working schedules. This schedules are specific to each contractor. In this case, for the re-insulation it will be the carpenter.

After the construction is finished, a handing over schedule must be done. This states the date of the hand over the building to the client, the contractors` inspection and date until which the client need to pay the bill.

ID	Task Name	Duration	Start	Finish	Predecessors
1	**Tender**	**65 days**	**Mon 30-11-15**	**Wed 02-03-16**	
2	Tender Notice	0 days	Mon 30-11-15	Mon 30-11-15	
3	Answer from contrators	5 days	Mon 30-11-15	Fri 04-12-15	2
4	Tender Package	0 days	Mon 07-12-15	Mon 07-12-15	3
5	Calculations	20 days	Mon 07-12-15	Wed 06-01-16	4
6	Submissions of bids	0 days	Wed 06-01-16	Wed 06-01-16	5
7	Looking through the bids	20 days	Thu 07-01-16	Wed 03-02-16	6
8	Contract Signing	0 days	Wed 03-02-16	Wed 03-02-16	7
9	Preparations	20 days	Thu 04-02-16	Wed 02-03-16	8

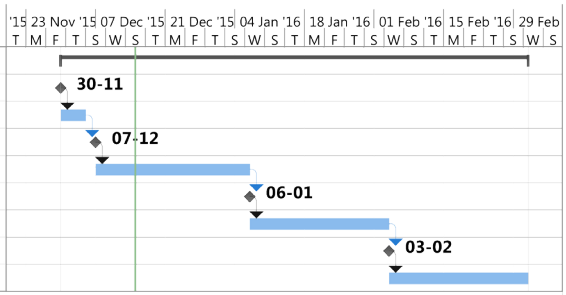


Fig. 88 Procurament Schedule

ID	Task Name	Duration	Start	Finish	Predecessors
1	**Tender Shecdule**	**116 days**	**Fri 04-03-16**	**Tue 13-09-16**	
2	Earth Moving	4 days	Fri 04-03-16	Wed 09-03-16	
7	Demolition Work	9 days	Thu 10-03-16	Tue 22-03-16	2
17	Steel Work	4 days	Wed 23-03-16	Thu 31-03-16	7
20	Brick laying/other Work	17 days	Fri 01-04-16	Tue 26-04-16	17
26	**Carpentry/other Work**	**37 days**	**Wed 27-04-16**	**Mon 20-06-16**	**20**
41	Building Services Work	19 days	Tue 21-06-16	Fri 15-07-16	26
50	Interior Works	26 days	Mon 08-08-16	Tue 13-09-16	41
64	**Handing Over**	**0 days**	**Tue 13-09-16**	**Tue 13-09-16**	**50**

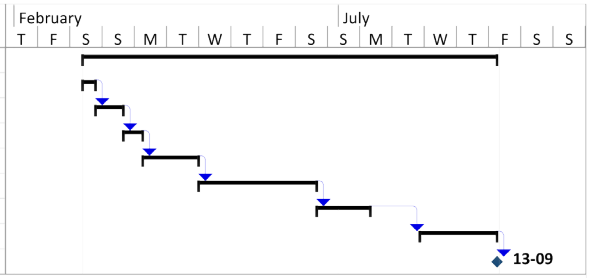


Fig. 89 Tender Schedule

ID	Task Name	Duration	Start	Finish
1	**Carpentry/other**	**37 days**	**Wed 27-04-16**	**Mon 20-06-16**
2	Extension floors	5 days	Wed 27-04-16	Tue 03-05-16
3	Balcony/terrace	1 day	Wed 04-05-16	Wed 04-05-16
4	Green roof	4 days	Tue 03-05-16	Mon 09-05-16
5	Rainwater drainpipes	1 day	Tue 10-05-16	Tue 10-05-16
6	Glazing	8 days	Wed 11-05-16	Mon 23-05-16
11	**Insulation of basement/ground floor**	**4 days**	**Tue 24-05-16**	**Fri 27-05-16**
12	**Instal steel frame**	**1 day**	**Tue 24-05-16**	**Tue 24-05-16**
13	**Fill the steel frame cavity with insulation**	**2 days**	**Wed 25-05-16**	**Thu 26-05-16**
14	**Apply the plasterboard**	**1 day**	**Fri 27-05-16**	**Fri 27-05-16**
15	**Insulation of exterior walls**	**11 days**	**Mon 30-05-16**	**Mon 13-06-16**
16	**Instal steel frame**	**3 days**	**Mon 30-05-16**	**Wed 01-06-16**
17	**Fill the steel frame cavity with insulation**	**4 days**	**Thu 02-06-16**	**Tue 07-06-16**
18	**Apply vapour-membrane**	**2 days**	**Wed 08-06-16**	**Thu 09-06-16**
19	**Apply the plasterboard**	**2 days**	**Fri 10-06-16**	**Mon 13-06-16**
20	**Insulation of roof**	**8 days**	**Wed 01-06-16**	**Fri 10-06-16**
21	**Instal steel frame**	**2 days**	**Wed 01-06-16**	**Thu 02-06-16**
22	**Fill the steel frame cavity with insulation**	**2 days**	**Fri 03-06-16**	**Mon 06-06-16**
23	**Apply vapour-membrane**	**1 day**	**Tue 07-06-16**	**Tue 07-06-16**
24	**Instal new battens**	**1 day**	**Wed 08-06-16**	**Wed 08-06-16**
25	**Apply the plasterboard**	**2 days**	**Thu 09-06-16**	**Fri 10-06-16**
26	Adding fire proofing on parapet wall/storey partitions	3 days	Thu 09-06-16	Mon 13-06-16
27	Toilet drywall (extension)	1 day	Tue 14-06-16	Tue 14-06-16
28	New drywalls	4 days	Wed 15-06-16	Mon 20-06-16

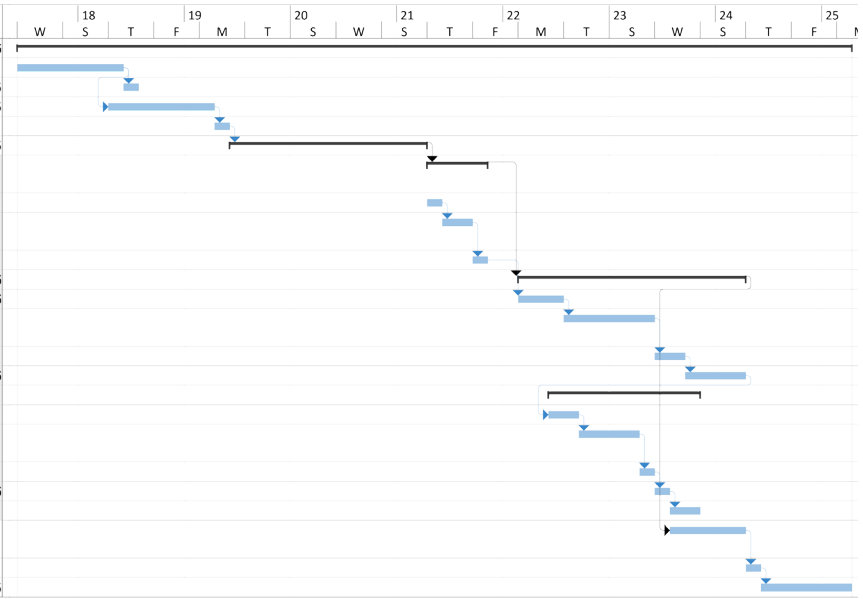


Fig. 90 Carpenter Working Schedule (the market line area the Re-insulation)

ID	Task Name	Duration	Start	Finish	Prede
1	**Handing Over Process**	**35 days**	**Thu 25-08-16**	**Wed 12-10-16**	
2	Contractors own inspection	1 day	Thu 25-08-16	Thu 25-08-16	
3	Completion	2 days	Fri 26-08-16	Tue 30-08-16	2
4	Letter do employer/client	10 days	Tue 30-08-16	Tue 13-09-16	3
5	**Handing Over**	**0 days**	**Tue 13-09-16**	**Tue 13-09-16**	**4**
6	Claims - list of defective work	1 day	Wed 14-09-16	Wed 14-09-16	5
7	Completion of defective work	1 day	Thu 15-09-16	Thu 15-09-16	6
8	Final Inspection	1 day	Fri 16-09-16	Fri 16-09-16	7
9	Final bill to send	1 day	Mon 19-09-16	Mon 19-09-16	8
10	15 working days to pay	15 days	Tue 20-09-16	Tue 11-10-16	9
11	Performance bond to be reduced	0 days	Wed 12-10-16	Wed 12-10-16	10

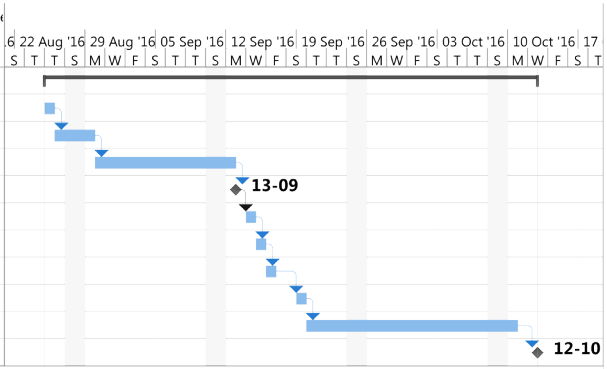


Fig. 91 Handing Over Schedule

Budget

The budget in this phase calculates only the cost for the re-insulation of the building. The calculation is detail includes all the necessary to insulate the wall. The insulation, the steel profile to hold plasterboards, the damp proof membrane is included. This calculation is made in Sigma, a programme that includes the price book and can be link with the Revit model. This calculation where made in Sigma, by looking for the material and inputting the quantity need. This gives the price of the material, labour and other associated cost (e.g electricity if need to install the material).

All the values in the budget are in Danish Krones (DKK).

Text	Unit	Quantity	Total CP	CP w/Overhead	Auto DB	Disc.	Sales Price	Total PM	Total GM
Roof									
75 mm isolering under krybekælderbjælker	m^2	290	54.191,66	54.191,66	16.257,52	0,00	70.449,00	0,231	16.257,34
100 mm isolering under krybekælderbjælke	m^2	150	35.891,43	35.891,43	10.767,44	0,00	46.659,00	0,231	10.767,57
Stålprofiler, UNP 180, demontere	lbm	140	7.515,38	7.515,38	718,93	0,00	8.234,00	0,087	718,62
Poly-filt med dampspærre til trægulve	m^2	182	8.478,71	8.478,71	2.543,61	0,00	11.022,00	0,231	2.543,29
38 x 56 mm taglægter C18 på træunderlag	lbm	280	10.345,69	10.345,69	3.103,69	0,00	13.449,00	0,231	3.103,31
Indv. beklædning, 15,4 mm brandgipsplade	m^2	150	27.716,12	27.716,12	8.314,85	0,00	36.031,00	0,231	8.314,89
			144.138,99	**144.138,99**	**41.706,03**		**185.844,00**	**0,224**	**41.705,01**
Exterior Walls									
150 mm isolering under krybekælderbjælke	m^2	200	68.884,94	68.884,94	20.665,48	0,00	89.550,00	0,231	20.665,06
Stålprofiler, UNP 180, demontere	lbm	315	15.859,40	15.859,40	1.517,13	0,00	17.377,00	0,087	1.517,60
Poly-filt med dampspærre til trægulve	m^2	190	8.825,18	8.825,18	2.647,56	0,00	11.473,00	0,231	2.647,82
Indv. beklædning, 15,4 mm brandgipsplade	m^2	160	29.412,74	29.412,74	8.823,81	0,00	38.237,00	0,231	8.824,26
			122.982,25	**122.982,25**	**33.653,98**		**156.637,00**	**0,215**	**33.654,75**
Story Partition									
100 mm isolering under krybekælderbjælke	m^2	210	48.996,09	48.996,09	14.698,82	0,00	63.695,00	0,231	14.698,91
Stålprofiler, UNP 180, demontere	lbm	100	5.521,49	5.521,49	528,19	0,00	6.050,00	0,087	528,51
Indv. beklædning, 15,4 mm brandgipsplade	m^2	106	20.144,51	20.144,51	6.043,35	0,00	26.188,00	0,231	6.043,50
			74.662,08	**74.662,08**	**21.270,36**		**95.933,00**	**0,222**	**21.270,92**
Total amount			**341.783,32**	**341.783,32**	**96.630,36**		**438.414,00**	**0,22**	**96.630,68**
VAT (25%)							**109.603,50**		

Fig. 92 Budget for the Re-Insulation

Project Work

Østre Havn

Group Work - 4th Semester
Multi- Story Building

Introduction

The project work in 4th Semester was to design a multi-storey building. The site is in Østre Havn, by the Fjord in the East side of the city. The project requirements were: a building with 3- 4 floor plus a basement, the ground floor has to be a commercial area, the use of pile foundation due to the proximity with the water. The upper floors are apartments and the last floor are 2 penthouses. The commercial area is a restaurant and a support facility for the water activities happening in the harbour right next to the site, these activities were already happening but support facility was happening in containers.

The first thing done was to create a client and it wishes for the building. We used a real person from Denmark, a famous actor, Mad Mikkelsen. After this was the elaboration of the brief design, including: all the information of the site, history, contract form, layout diagram for the different spaces, wind analyses, sun analyses, analyses of the surrounding area, accessibility and transportation to the site, an idea of the type of construction, inspiration picture for public space and apartments, provisory budget and a master schedule giving a time frame for the project and possible problems that may delay the construction like: soil freeze, wind and wet conditions.

Then starting to think about the shape and design of the building. The shape was mainly found with in relation to the other buildings around, having in account the sun light and the view. With some idea of shape then started to put the programme in the building to see how it fit. Always consider the constructive solution for the building, having in attention that the building going to be built in pre-fabricated elements duo to the weather. This has to be considered during the design process. During the choices of material for the building, a lot of research was to be done to find how to install material and if the material is according the ideas for the project. The design and material choice have to be according the Building Regulations 2015, including building accessibility, fire safety, indoor climate, energy consumption and building services.

This is time to use the BE 15, this is a tool to understand the energy required for the building (heating, cooling...). The input of the building: area per floor, building envelope (wall, ceiling, floor windows) u-values, area, and sun orientation, any energy sources, the ventilation in the building, etc., this will give a result if the building fulfils the Building Regulation. This is to be use as a tool in the design process to improve the energy consumption, if the result it not what it expected.

The building is new so there is a need to design all the building service, include water supply, terrace drainage, heating, sewage and ventilation, also place shafts in strategic places in the building. In this phase new layout were drawn for all the building services. Sewage calculation of pipe slop were done and ventilation to dimension the aggregators for commercial area and for apartments, with extractor and supply of air.

The construction planning of the building is more extensive duo to the building size. To understand the building construction time frame, a CPM (critical path method) was done on the building construction. This method lists all the different activities on site, putting them on the order they are realized and with expected time. Them with this analyses you can find the critical path of activities that can`t have delay so the construction is finished in time. The planning also includes a construction schedule and the update of the master schedule that time framed the all project. For the building was also done a risk analyses of what can go wrong during the all project including construction. A list of measures to be applied during the construction time in winter. A budget was done it includes the site cost, construction cost (craftsmen`s work, winter measures, margin for unforeseen expenses....) and administrative costs (fees to local authorities, insurance, building approval, water and electricity used on site...), giving a result in the end with or without VAT and the cost of the building per m2.

All the work done during the semester, requires that student do group and personal planning, where student plan how many time they intend to spend on a task and how many time they have actually spend. There is also require that student do a Project Journal, this is where there record all there question for the teacher and teacher answers, about the project. Student also should have a personal Portfolio, this is here student write what are their interests and how they will improve and work to words their goal. Also to explain and reflect on the problem on group work and how to solve them.

All the work mentioned so far was done in group. After the group work a 3-week period starts for individual work. The focus of the individual work is terraces, which the building was a big area of. Focusing on this, drawings, key points, where done. There is also construction planning that includes a tender schedule, a risk analyses on the construction risk on terraces, and a tender control plan to try to avoid that. All the documents for tender the terraces. A detail budget is done on the construction of the terrace.

During the semester there was also assignments to be done while doing project. In this semester there where two assignments, one in group and one individual. The group assignment was energy assignment; we were providing with an excel file to use was a tool for the base of the assignment to be done in a month period. This is an easier and faster, then BE 15, to determine if the building is spending too much energy on heating and cooling. It working much in the same way, but simpler, input some information about the building area, u-values of the wall, windows and it orientation. At the end the file gives a graphic showing how much the building spends on heating and cooling. With this result adjust the building design and try again until reduce the heating and the cooling. This assignment was to be hand in in a written report with the results.

The individual assignment was about motivation, to be done in a 2-week period. We were introduced to different motivation theories, and how can they be applied in the construction industry. We had to read GC 92 (General Conditions), that establish the legal relationship between the client and the contractors. With both this information`s we need to find in GC 92, motivational actions. Then think if the action works was motivation in that context. This assignment was presented in a form of a written report.

In each semester, there is a 2-week period without class to write an Elective, in this semester with a 15 pages` maximum. The topic chosen was: "The economic solution, for rain water and greywater recycling system in new residential building?".

This is all the work done during the semester, this chapter will mainly focus on the project work. This work is present main in chronologic, some of the topic are done at the same time, here presented in a way that can be understood easier. The presentation is focus more on the design of building and construction, given less emphases to the technical area like building services.

Site

Fig. 93 Site location in Aalborg

The area of the site is located in Aalborg by the river close to the Musikkens Hus. This is a new neighbourhood, with a converted waterfront that connects the city with the water. Creating different space for recreational culture, playground, cafe area, activity areas, square and park.

This area was always dominated by industries related to boating and fishing. Since the 1500s there has been brickwork due to fire hazard, being this an industrial area, out of town, involve mainly shipping. Later in the mid-1800s other industries were developed in the area like glasswork and gasworks. In 1911, a new power plant was built, part of the building still exists today in Nordkraft, are brick on the West of Kjellerups Square.

The area expanded fast, during the following year until 1973. After the turn of the millennium some of the building were demolished after becoming obsolete. The building in Nordkraft is now use for cultural and sport purposes since 2011. Most of the building in the area were demolished, the physical aspects of the industrialised town are gone, and the waterfront is the connection between the old and the new.

The site can be reached by land from the main road Nyhavnsgade or water from the Northern part at the Østre Hvan habour. During winter period the area might be covered by the snow, the climate most likely be windy and rainy with the close proximity to the Fjord. The soil is most likely clay substructure and affected by underground water. The wind in Aalborg is mainly from the West.

Fig. 94 View of the site for the Southwest

Fig. 95 View of the site from the North

Fig. 96 Orthophotomap, with the site marked in red

Fig. 97 View from the site, over the habour looking West

Surroundings

Fig. 98 Office building, on the other side of the street from the site on the East side

Fig. 99 SKAT Building (its the taxes builing). Across the main street to the South

Fig. 100 Rolls Royce Service, on the West side of the site

Fig. 101 Apartment building in construction, on the other side of the main street to South.

Fig. 102 Cable Water Activities happening in the harbour by the site

Fig. 103 Cable Water Activities happening in the harbour by the site

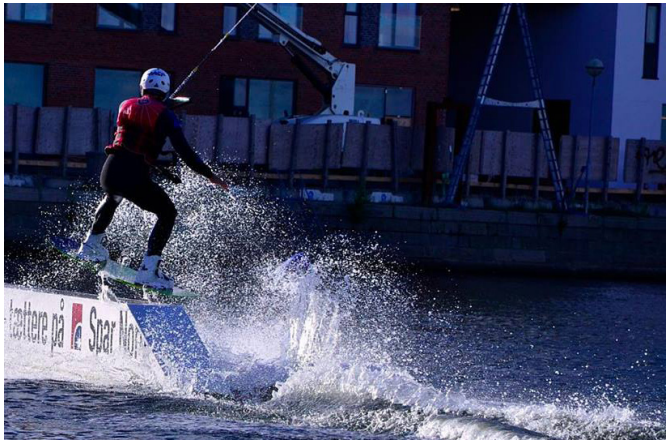


Fig. 104 Cable Water Activities happening in the harbour by the site

Idea

The project started with a connection to the water and the surrounding buildings. The water is quite important; the harbour is use for Water Activities that area quite popular thru out the all year. The area isn't dense in buildings, so the surrounding would be influence by the new building.

The shape originated from the axes of the surrounding building, together with the harbour axes, also having in account the wind direction from the West. The first floor is the complete shape but was the building gets higher the shape get cut to allow for sunlight to reach the other side of the building. This creates terraces on different levels, the terrace of the Ist floor is public for the use of the residents, also giving access to the apartments on the floor. The terraces on the other floor area private to which apartment, the entrance is made in exterior balconies. The top floor was two penthouses that can be access by elevator. The ground floor is mainly a restaurant, with a big curtain wall to the West and the North, the harbour and the Fjord respectively.

The building is place close to the harbour to allow a close connection, creating a green space around the building. The waterfront is kept allow the harbour, permitting the free use of that area. By the harbour a lower platform is create to permit the water activities easy access to the water. The green space around the building is for free use, a playground can be installed.

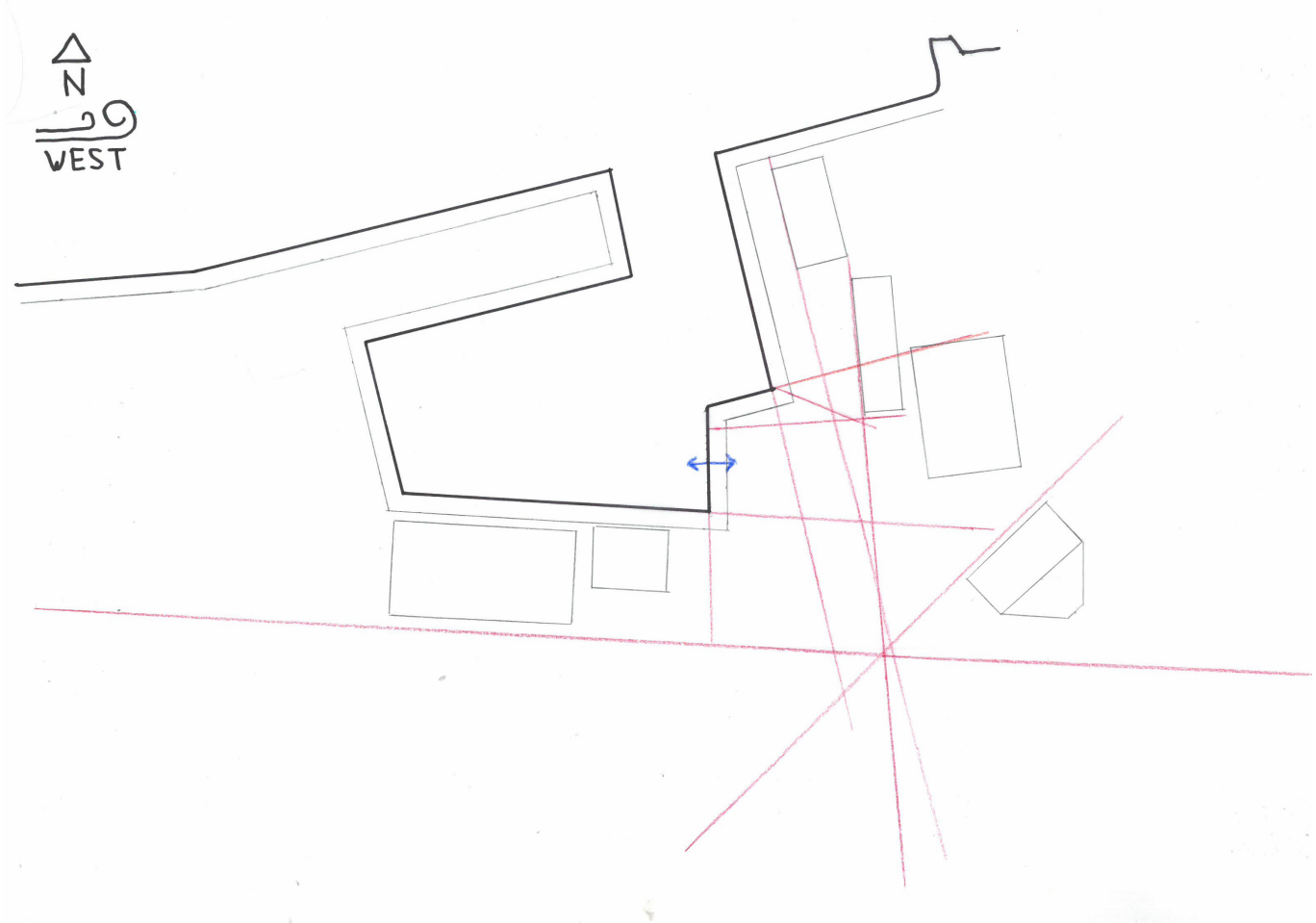


Fig. 105 Sketch: site, connection to water and building axes

Fig. 106 Sketches: different shapes for the building

Fig. 107 Sketches: different shapes, with accesses, some section of the building connection with the river

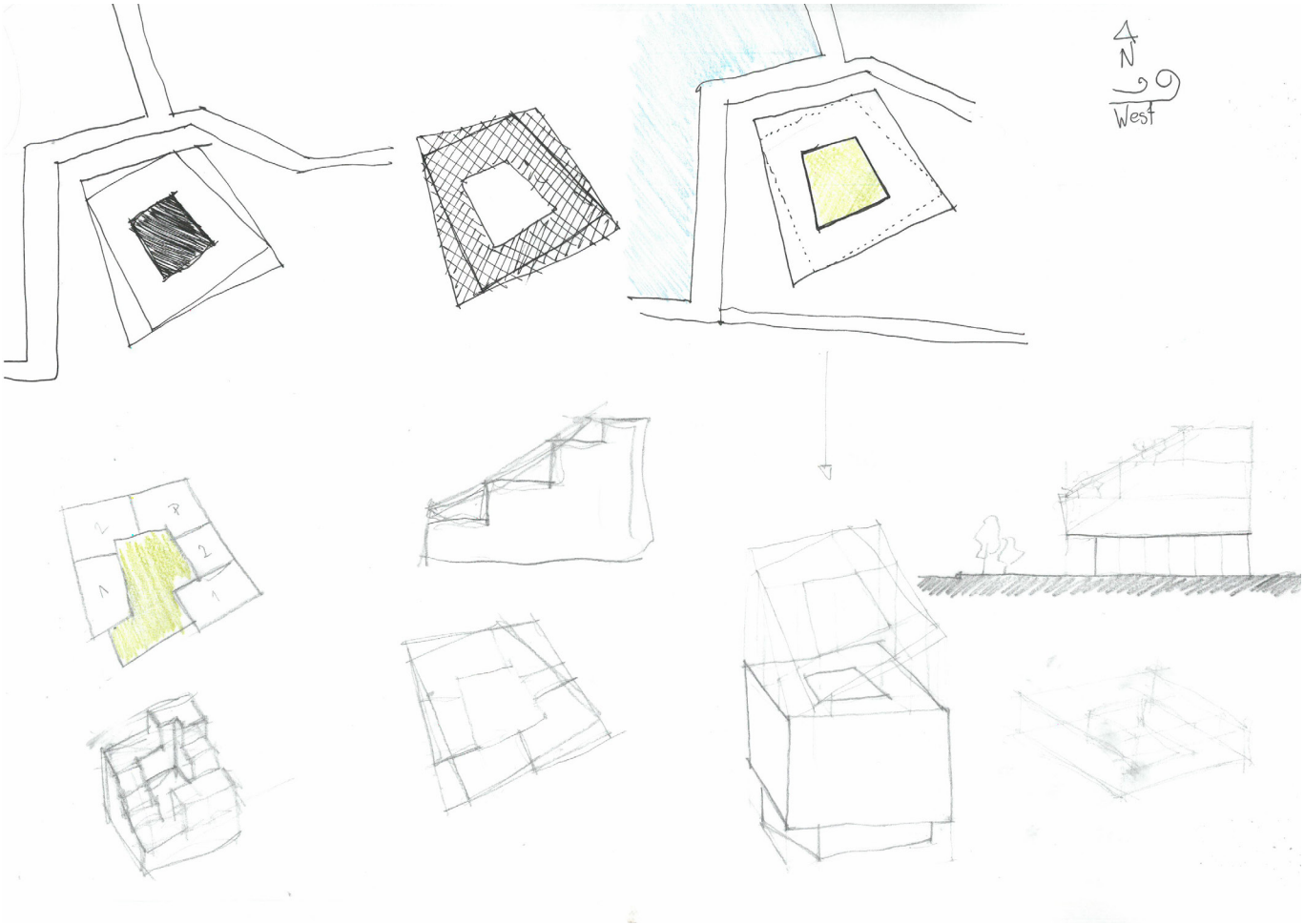


Fig. 108 Sketches: shape of the building, with the different floor cut to let the sun light in

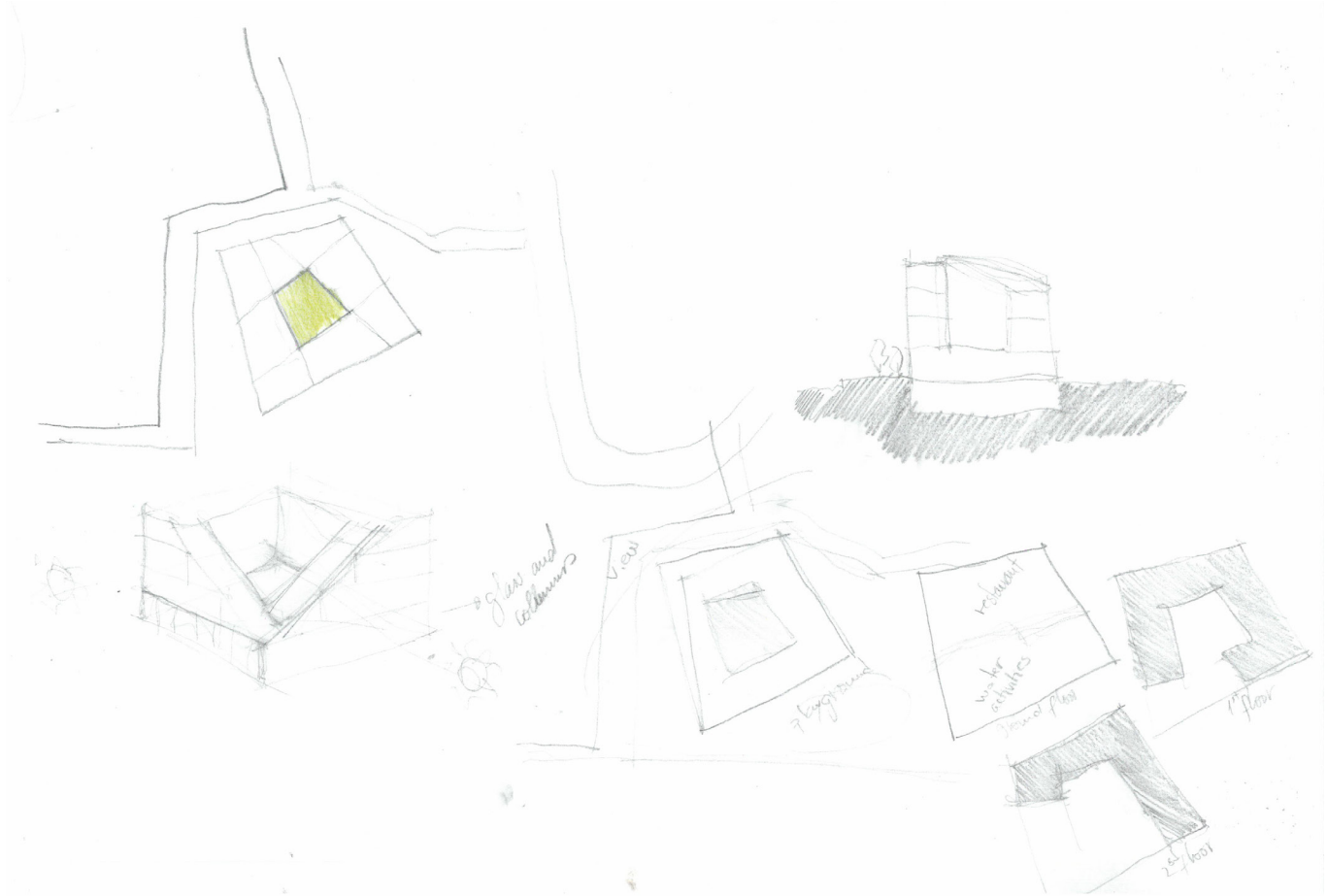
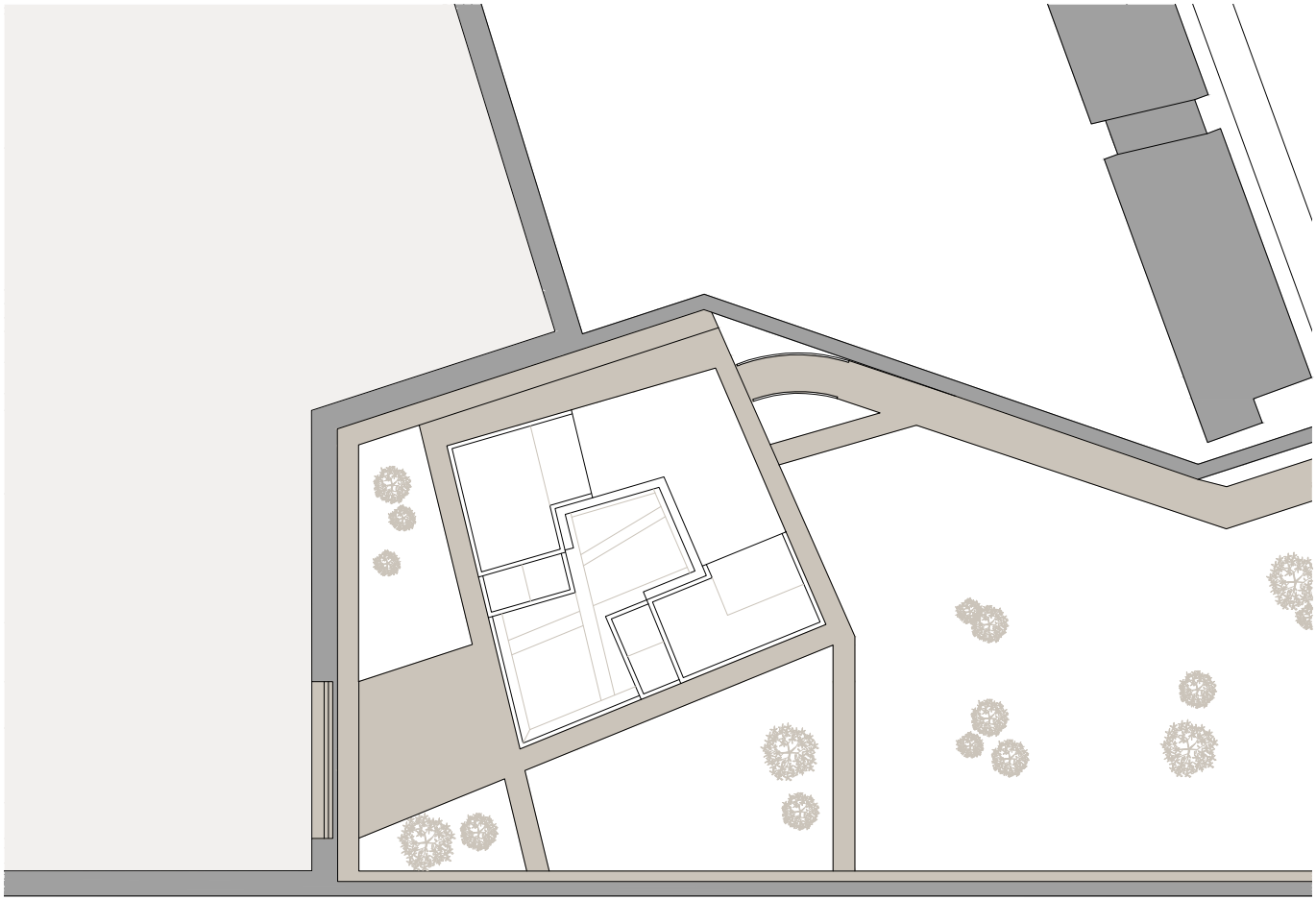
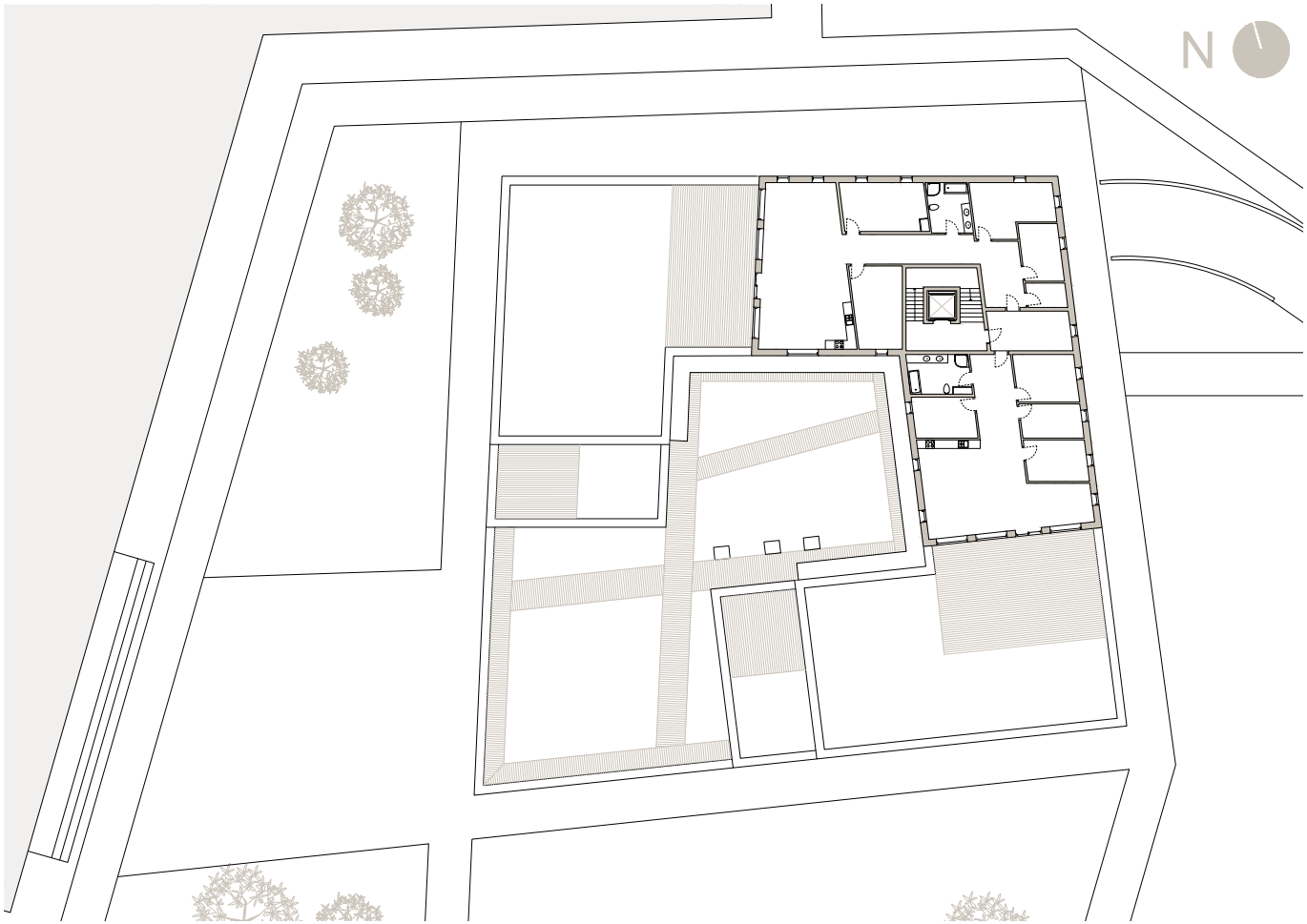


Fig. 109 Sketches: shapeof the building, with the inside court yard for the sun ligth and access to the apartments

Drawings

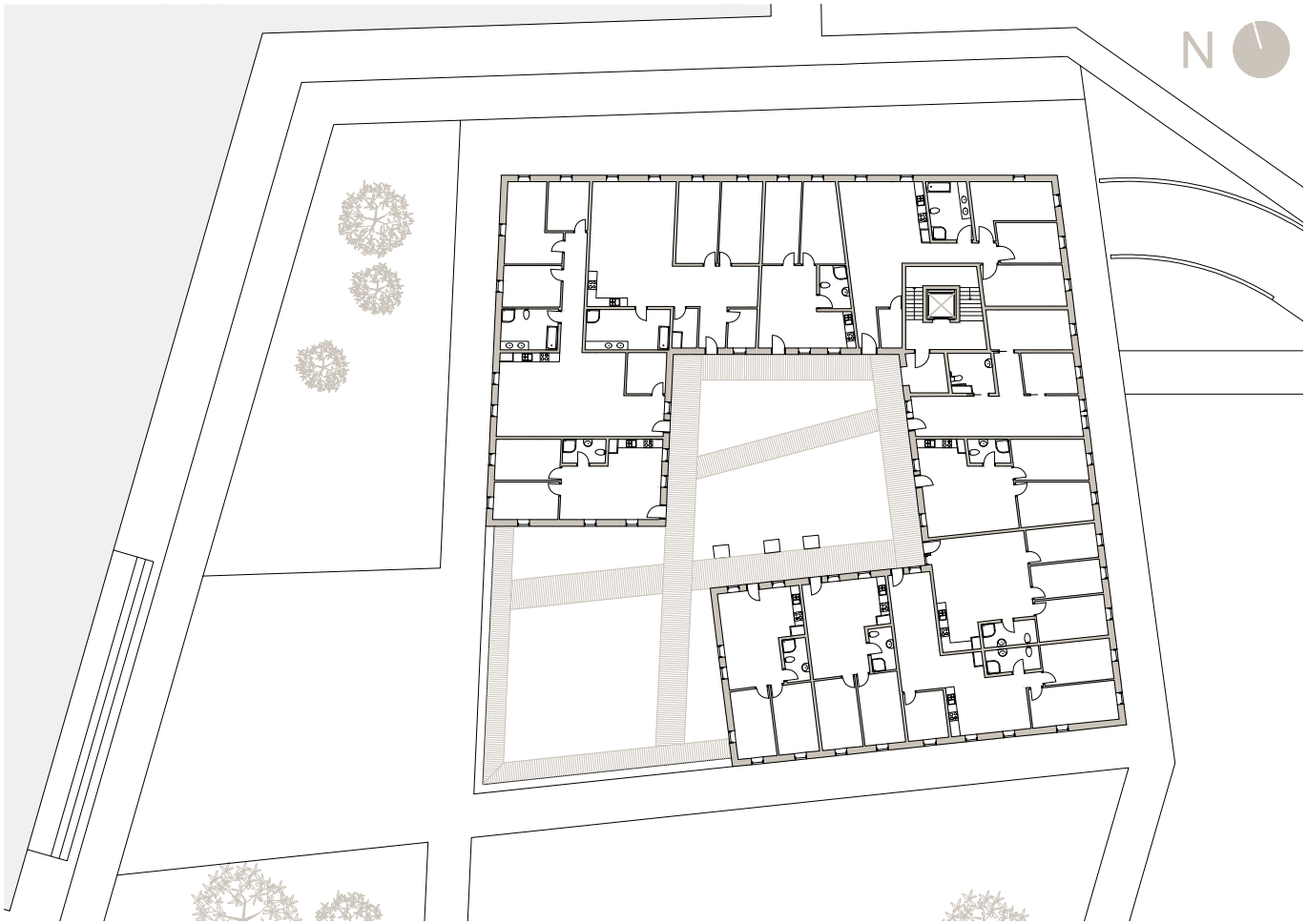


Drawing 22 Site Plan 1:1000

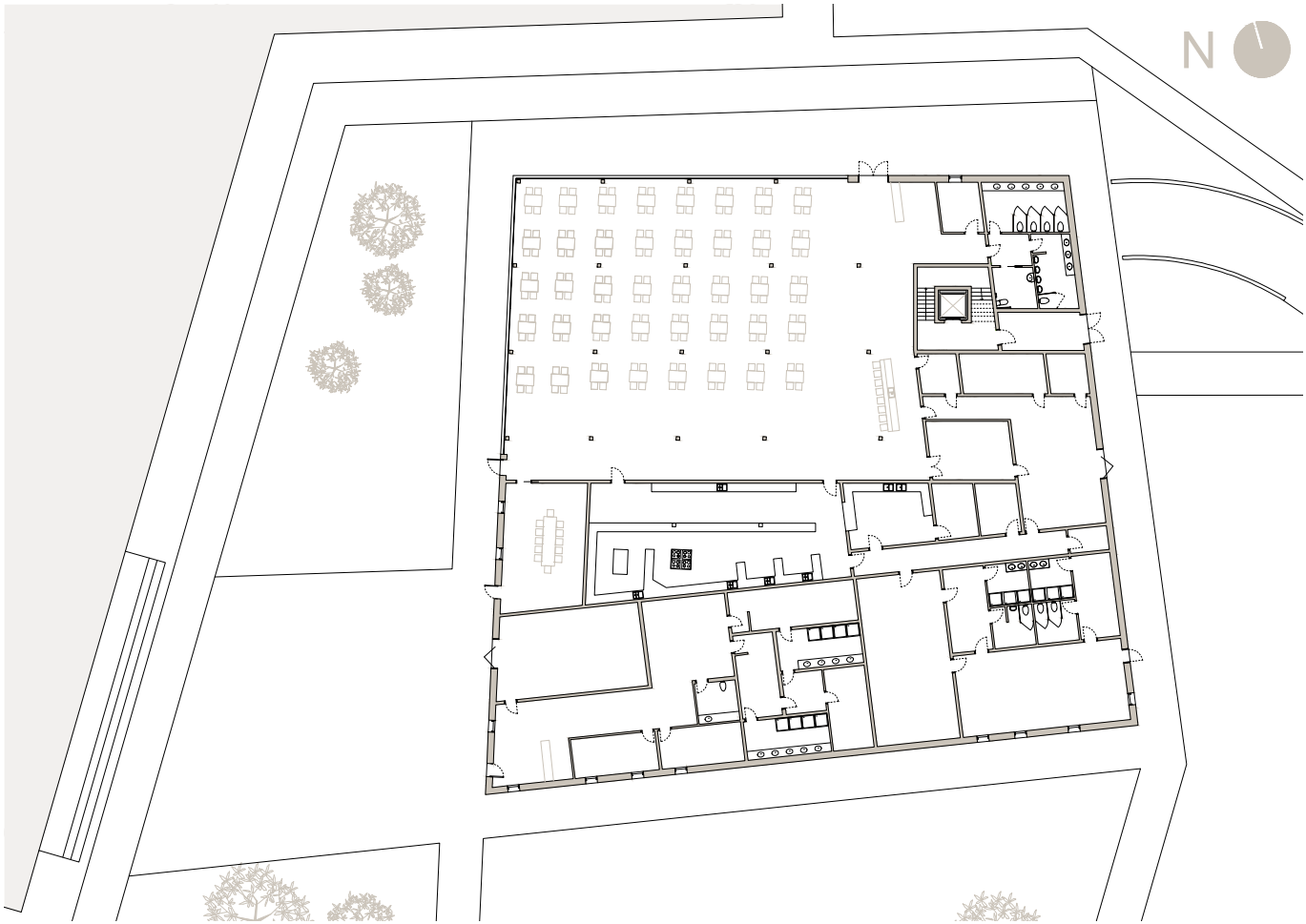


Drawing 23 Penthouse Floor Plan 1:500

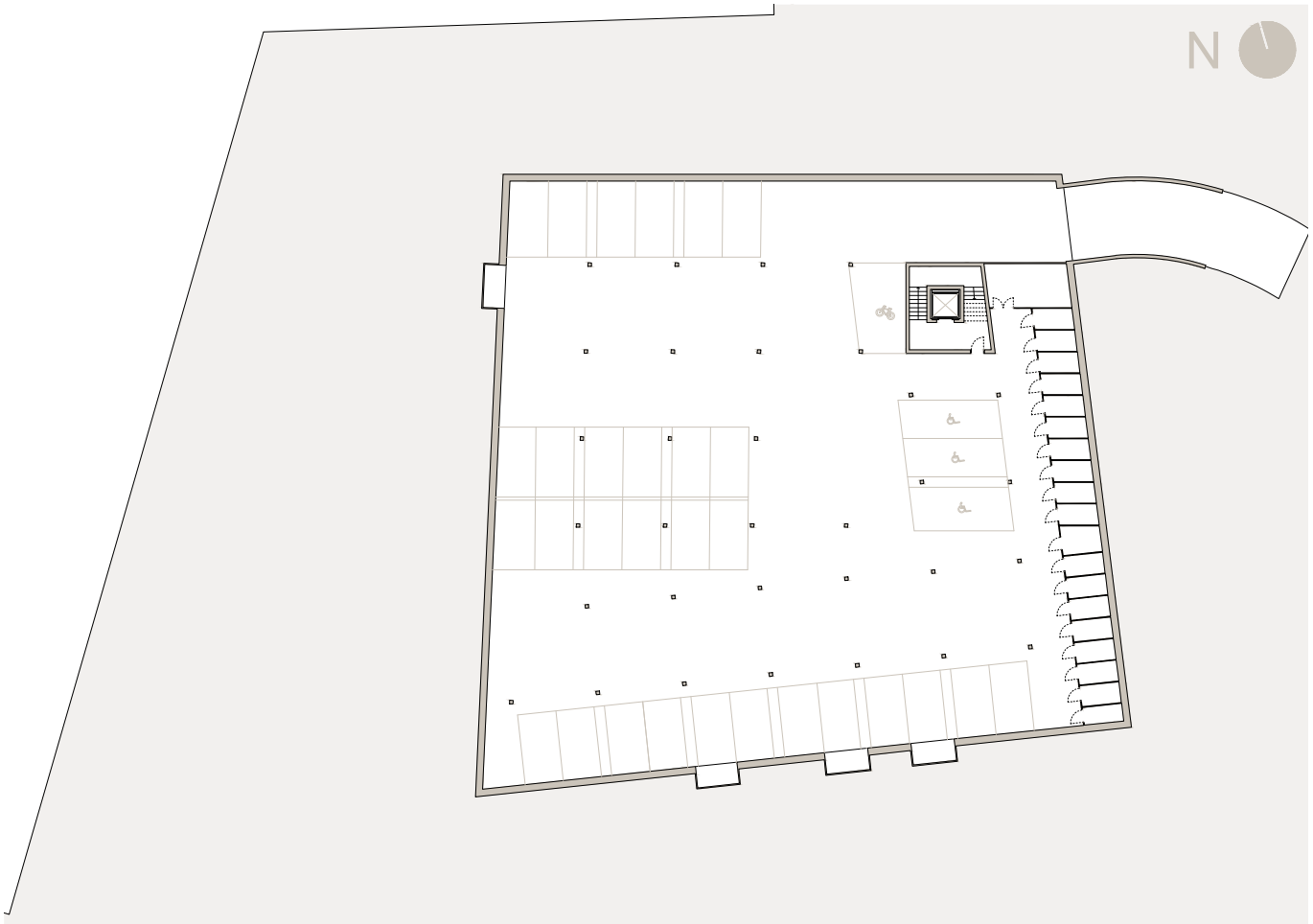
Drawing 24 2nd Floor Plan 1:500



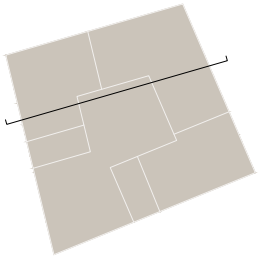
Drawing 25 1st Floor Plan 1:500

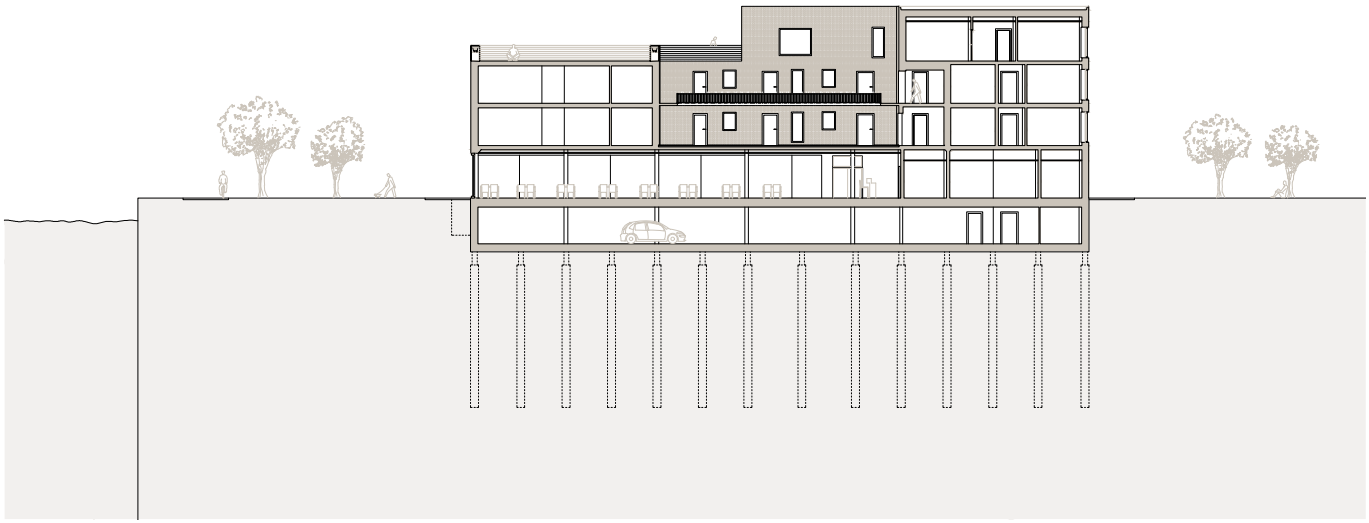


Drawing 26 Ground Floor Plan 1:500



Drawing 27 Basement Floor Plan 1:500





Drawing 28 Section AA 1:500

Drawing 29 South Elevation 1:500

Drawing 30 North Elevation 1:500

Drawing 31 East Elevation 1:500

Drawing 32 West Elevation 1:500

Renderings

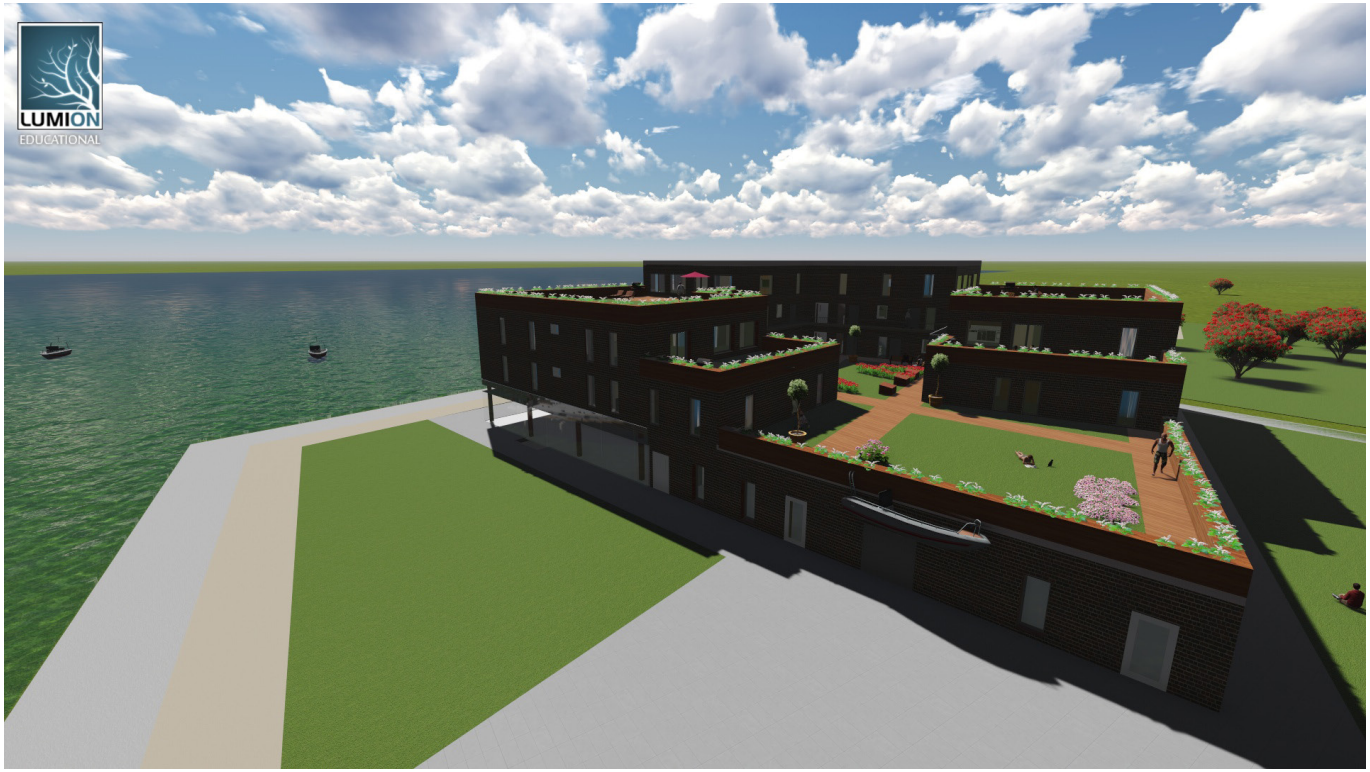


Fig. 110 Rendering: View from the Southwest side of the building

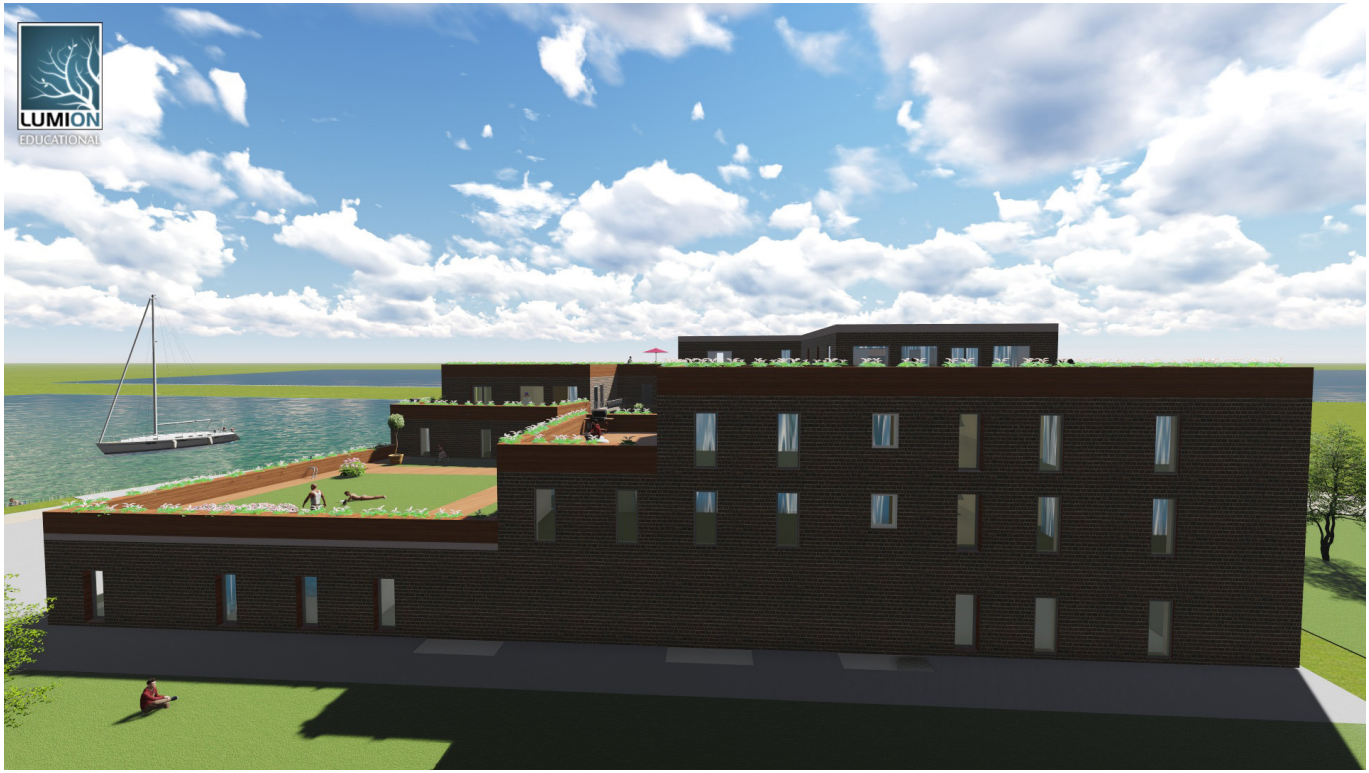


Fig. III Rendering: View from the East side of the buidling

Construction

The building structure is made of pre-fabricate concrete element, with pile foundation. The foundation and the basement are casted in situ, so the building can be sealed properly. To save time all bathroom in the building are bathroom units, with floor heating integrated. The walls that aren't load bearing are made of light steel frame, coated with plasterboard. The basement floor is made of polish concrete. The ground floor floors are made of wood, except in the kitchen and staff areas of the restaurant. The floor in the apartments are wood.

The terraces have two type of floors, one is a green roof and the other is a terrace with a wooden flooring. The terrace area allows to install skylights in kitchen areas for natural sun light.

The choice of pre-fabricate concrete elements was structure was to do with climate and weather. In winter with frost it is very difficult and expensive to build in a different type of construction. One of the main problem found in the construction was the connection of different slabs. The slabs from the inside of the building with the one for the terraces have different height. The pre-fabricate concrete element are finished on the outside with brick cladding.

The extensive area of terrace in the building uses syphonic drainage system to drain the water. This system allows for less pipes and smaller diameter pipe with no slop. The choice was made to safe space and because it very effective to drain in big areas. The syphonic drainage system required some research and understanding before installation. The method of application to keep the terraces sealed and the pipes connections. This system is not new but is mostly use in building with large area to drain.

The terrace area was a protection guard that gains volume and can have flower vases, and serves was a storage space underneath. The structure is metal, with wood on the outside. This also give some privacy to the residents the different levels.

The skylights are built with a wooden structure. This take less space and reduces the installation time.

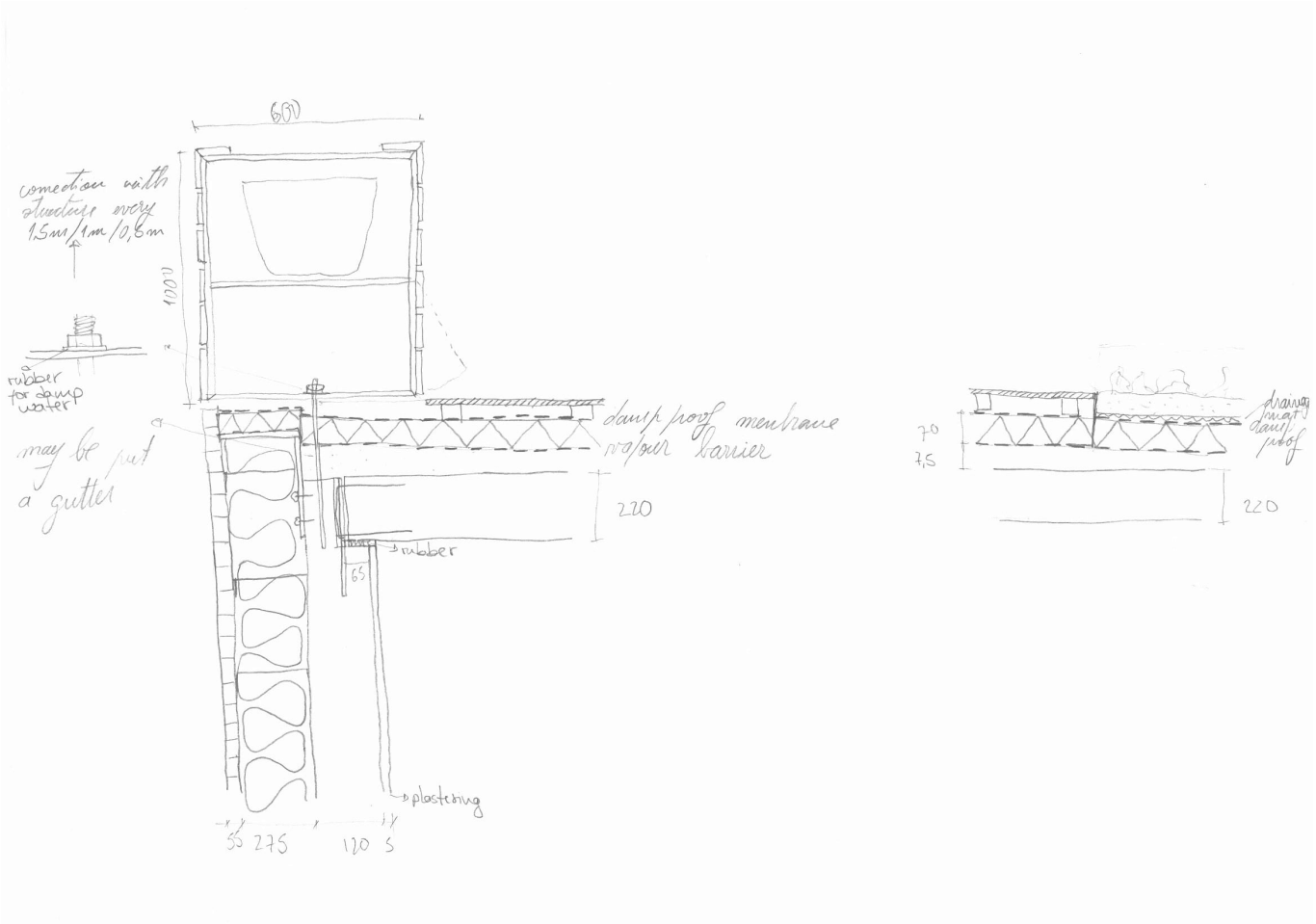


Fig. 112 Sketch: railing protection, structure and it connection to the slab and the wall. It also shows the different types of flooring in the terraces

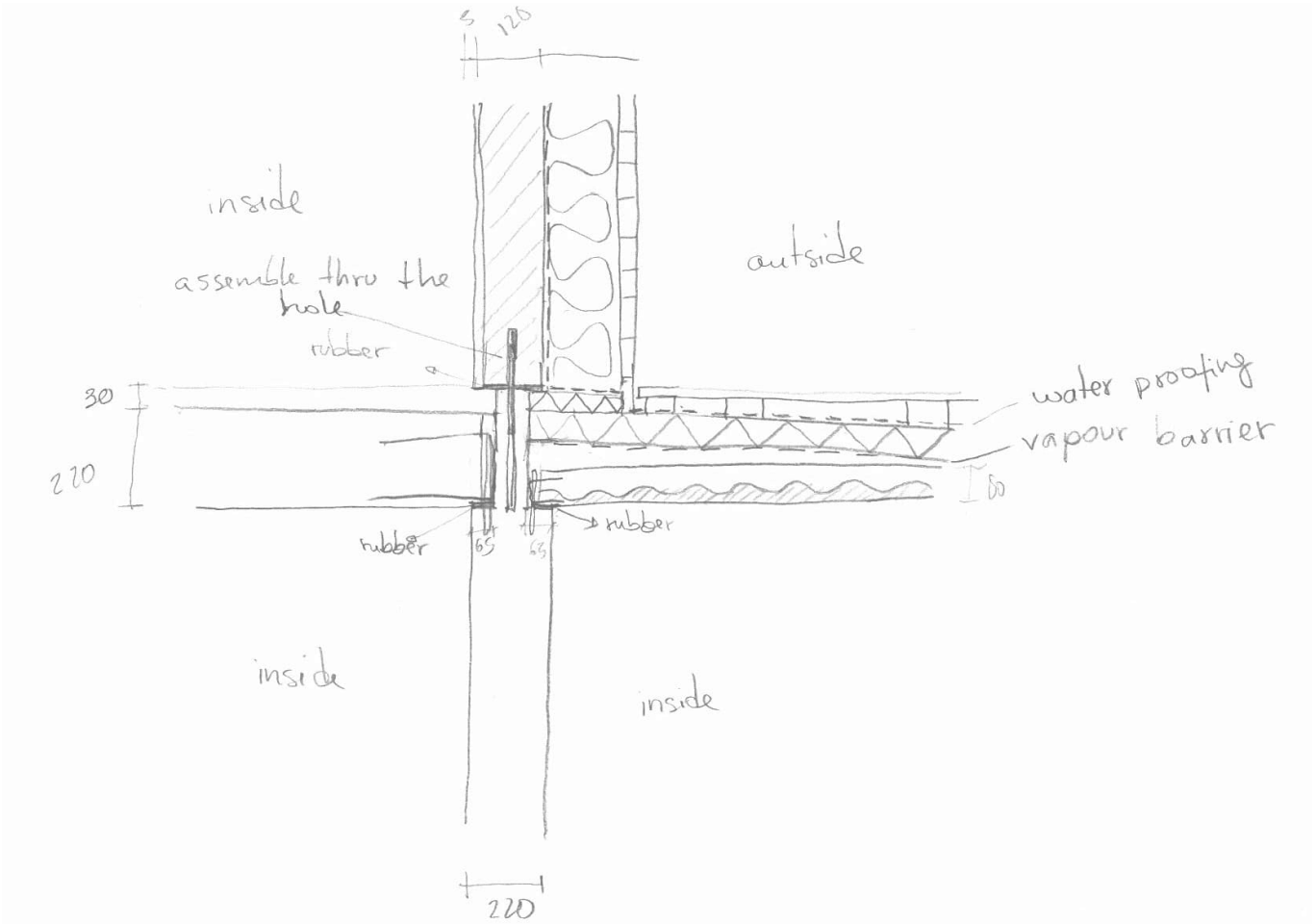


Fig. 113 Sketch: connection between different slabs and the outside wall

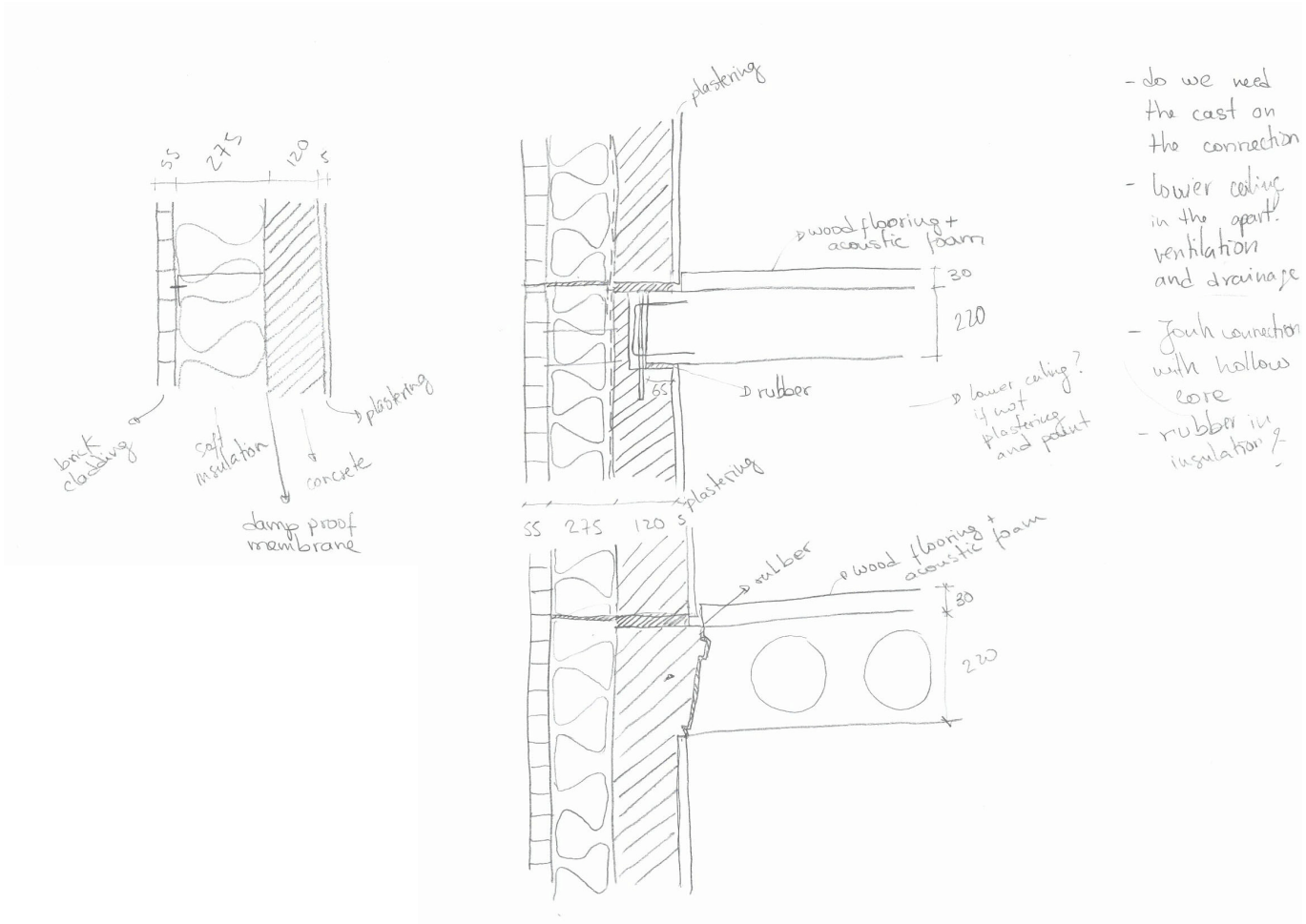


Fig. 114 Sketches: of the slab connection with the wall, depending on the slab direction

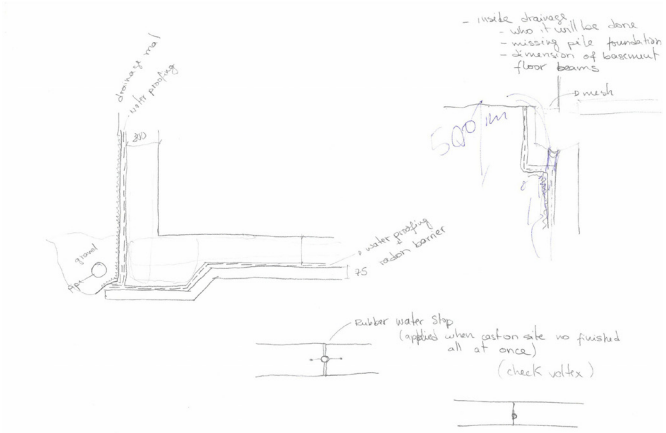


Fig. 115 Sketch: basement floor and wall, with the impermeabilization

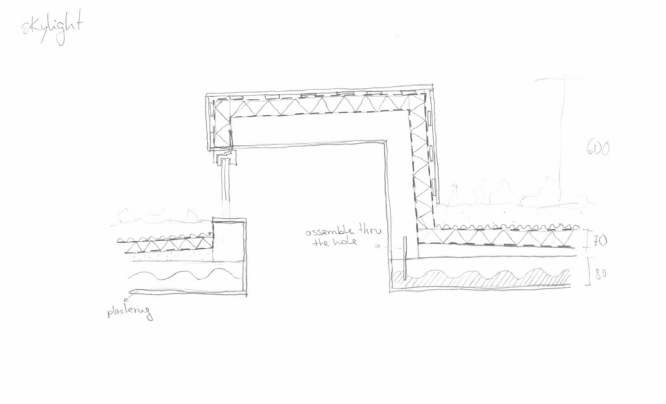


Fig. 116 Sketch: skylight, connection with slabs

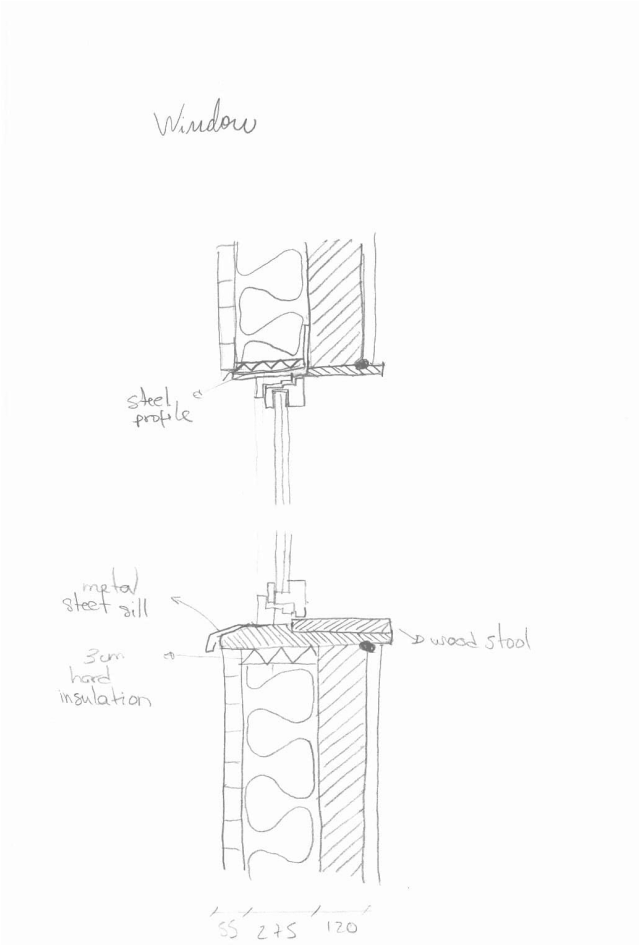


Fig. 117 Sketch: window connection with wall

Load Bearing

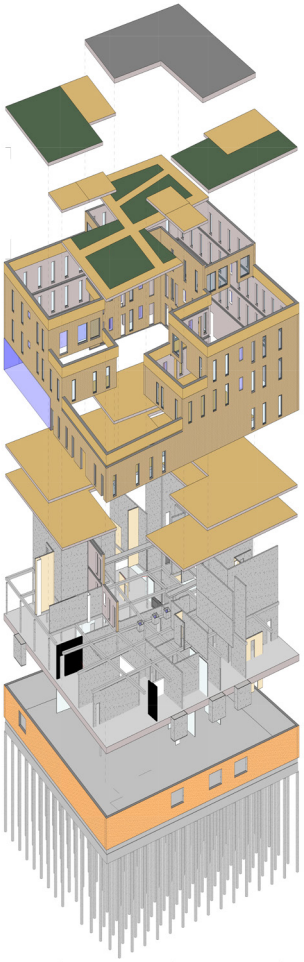


Fig. 118 Explode drawing of the building

Energy

In relation to energy the Building Regulation 2010 is very specific to what demand need to be fulfil. First is to decide which energy frame do the building should achieve. The building had to achieve Low Energy Building 2015. For this there are a minimum U-value that needs to be accomplished, independently of the energy frame chosen.

The building material where chosen to fulfil the Building Regulation. The building insulation is inside of the pre-fabricated concrete elements. The construction is made to have the minimum cold bridges possible, and the window, door also have a low u-value (Fig. 120).

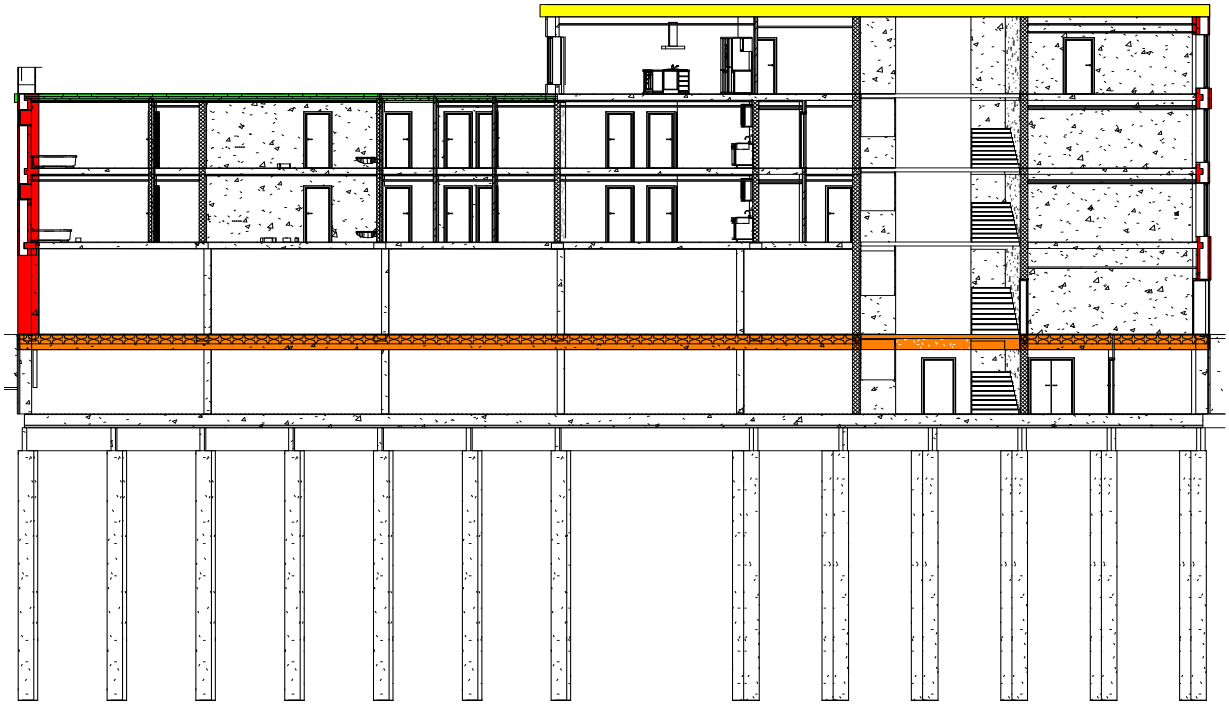


Fig. 119 U-values section

BE 10

The BE 10 is used to determine if the building is fulfilling the requirements, this means if it fits the energy frame. This is done by inputting all the building data in the programme, and at the end the programme gives different tables. The most important table is the energy required for the building in compared with the energy frame. The building is fulfilling the Energy Frame for 2015. According with Building Regulation when the commercial area is bigger than the total of the floor area of the building two BE 10 calculation must be done. One for the commercial area, that was different requirement and other for the residential part of the building.

The building fulfils the energy frame propose, in both area (Fig. 121 and Fig. 122)

Windows/doors	U-Value [W/m2K]	Demand [W/m2K]
Curtain wall	0,3	1,4
Windows	0,67	1,4
Doors	0,98	1,8
Skylights	0,67	1,4

Fig. 120 Table: u-values and demand for the building

Energy frame BR 2015		
Without supplement	Supplement for special conditions	Total energy frame
30,4	0,0	30,4
Total energy requirement		28,7

Fig. 121 BE 10: Residential area

Energy frame BR 2015		
Without supplement	Supplement for special conditions	Total energy frame
41,6	34,5	76,1
Total energy requirement		75,3

Fig. 122 BE 10: Commercial area

	U- value	Demand
External walls	0,12	0,18
Terrace (wood floor)	0,09	0,12
Floor	0,08	0,1
Terrace (green roof)	0,10	0,12
Roof	0,11	0,12

Fig. 123 U-values (Fig. 119)

Building Services

In relation to building service everything was done because the building is new. A layout for sewage and water supply was done together with calculation for pipe slop.

For ventilation, was decide that the restaurant one aggregator separate from the water activities. This gives each commercial area more freedom of use and as the water activities isn`t at the same time as the restaurant, mostly in winter is close some days of the week didn`t make sense have an aggregator together. The apartments have individual aggregators, so each apartment can use it independently. For the all building ventilation calculation were done, with amount of extraction and supply need to size the pipes.

A layout was for the building syphonic drainage system, that include the outlets location and pipe size. For this calculation was done based on amount of rain per m^2, with the area to drainage. This system allow that the drained water can go to the Fjord, it don`t need treatment.

For the heating in the building was done a layout with the disposition of the radiator and room that have floor heating. The size of radiator is calculated with date about heating demand for the BE 10.

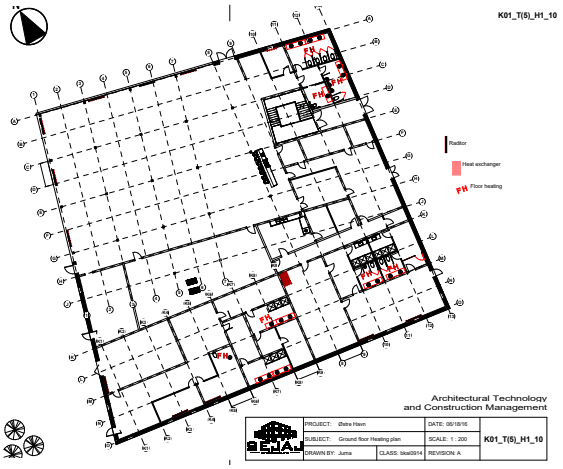


Fig. 124 Heating Plan: Ground Floor

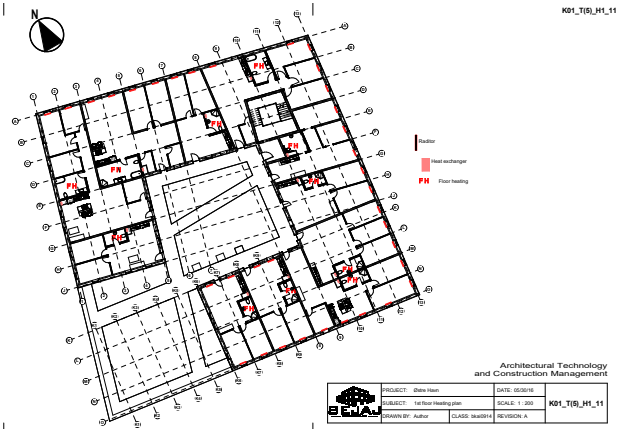


Fig. 125 Heating Plan: 1st Floor

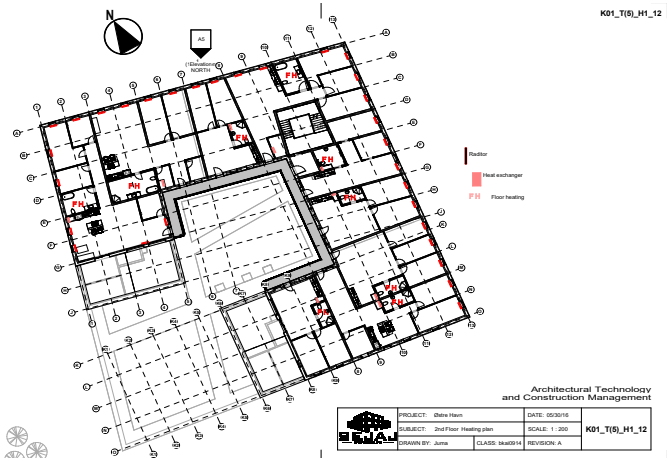


Fig. 126 Heating Plan: 2nd Floor

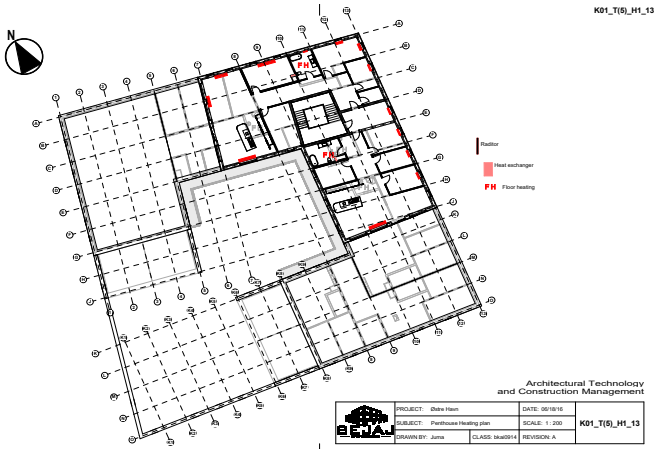


Fig. 127 Heating Plans: Penthouses Floor

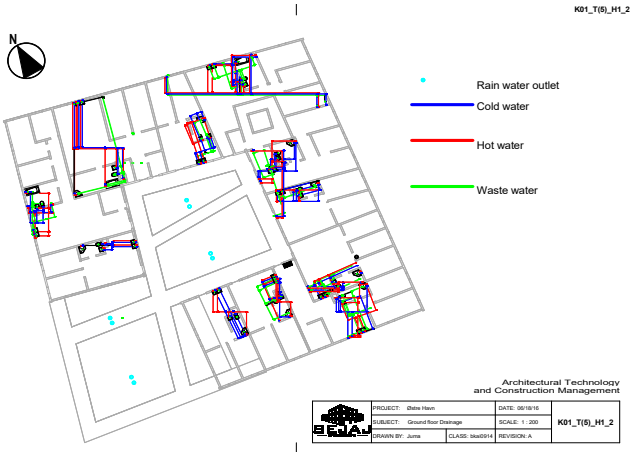


Fig. 128 Water Suppply and Drainage Plans: Ground Floor

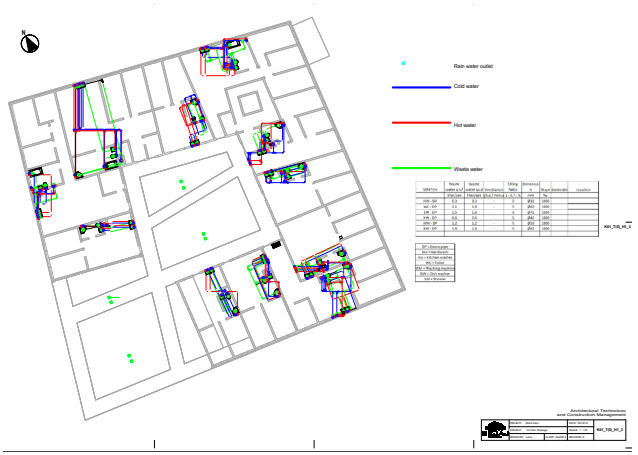


Fig. 129 Water Suppply and Drainage Plans: Ist Floor

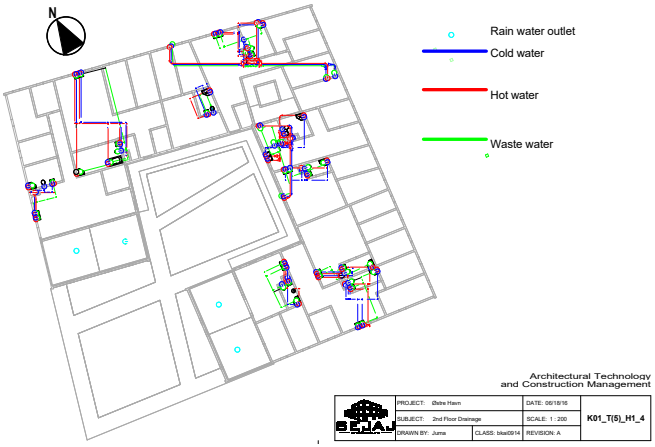


Fig. 130 Water Suppply and Drainage Plans: 2nd Floor

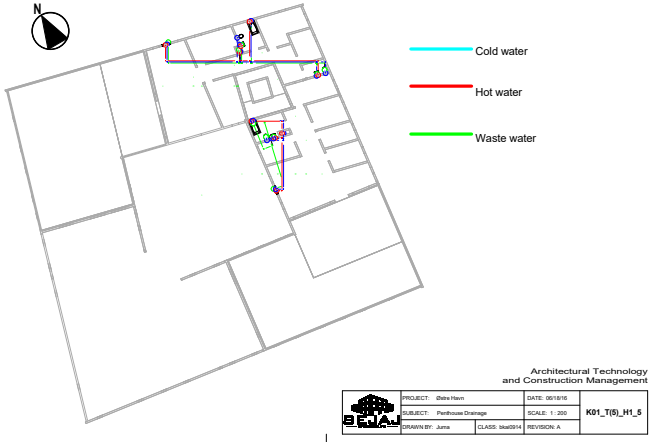


Fig. 131 Water Suppply and Drainage Plans: Penthouses Floor

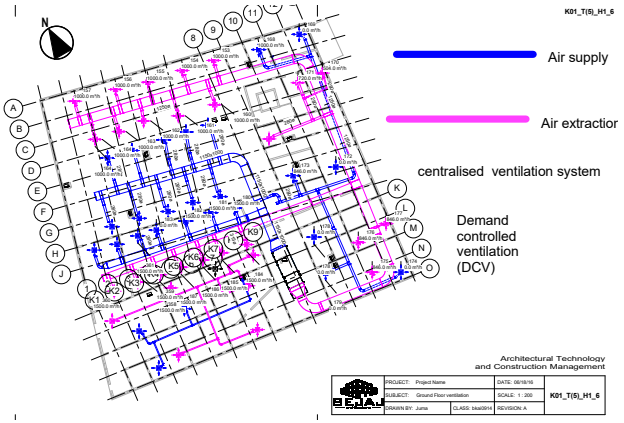


Fig. 132 Ventilation Plan: Ground Floor

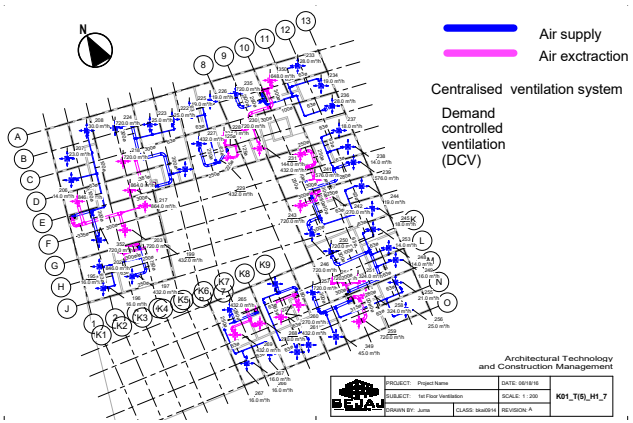


Fig. 133 Ventilation Plan: Ist Floor

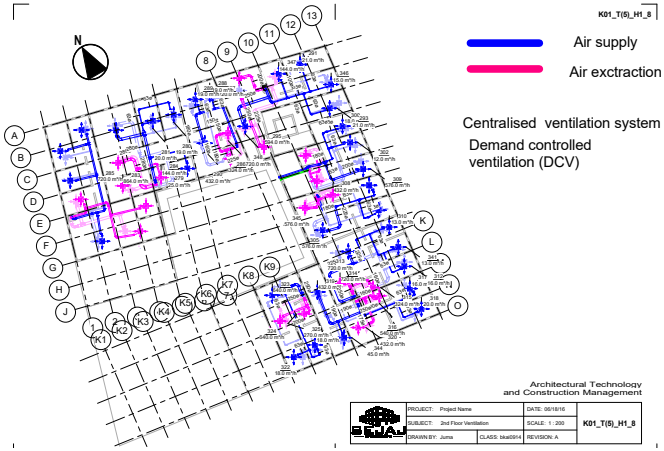


Fig. 134 Ventilation Plan: 2nd Floor

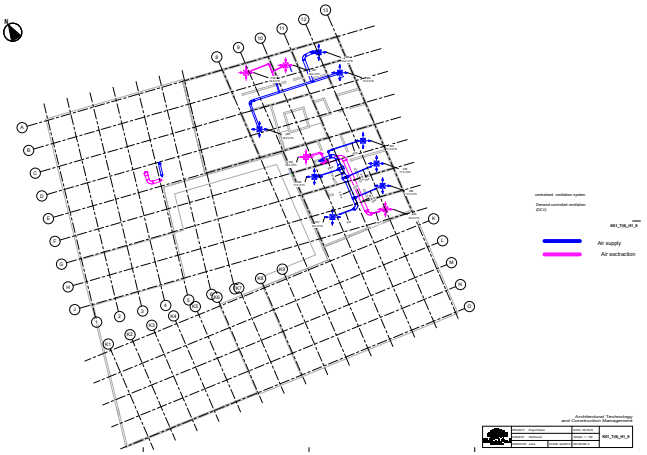


Fig. 135 Ventilation Plan: Penthouses Floor

Construction Planning

In construction planning, a master schedule is done. So the project was a time frame. A CPM (critical path method) to have a clean picture and time for the construction period. This method arranges the construction activities chronologically and time they will take. This will allow to see which is critical path of the construction, meaning what are the activities that can be delayed for the construction to be finished in time. A risk analyses is done on the possible risk on the construction period. A list of winter measures is created to be applied during the winter construction period. A case specification must be done, includes any change on the GC 92 (General Condition) the document that state the relationship between client and contractor, include also health and risk at the construction site, regulation to be fulfilled during.

Winter Measures (1st of November to 31st of March)

1. Construction site actions
- Snow removal/ clearance, gritting and de-icing
- Protection of materials against frost
- Protection of material against rain and wind
- Establish lighting system (work space and paths)

2. Actions for soil and sewage work
- Actions to prevent frost inconvenience
- Removal of rain from ground and excavations at low temperatures or high humidity
- Frost protection of land where freezing can cause damage to structures performed
- Securing the backfilling soil against freezing
- Replacement of unsuitable backfill soil
- Breaking of frost crust
- Improvement and replacement of winter-damaged bottom

3. Actions for concrete work
- Actions against snow and ice on the form, the reinforcement and the aggregates
- Actions to prevent frost damage to the curing concrete

4. Action for prefabrication assembling
- Actions against ice/frost in the connections of the elements
- Actions to prevent frost damage to occur in the pre-fabricated elements
- Action to prevent the rain and snow from accumulating on the assemble structure

5. Actions for roofing
- Actions to prevent rain water accumulation
- Drying of the roof at low temperatures
- Removal of snow, frost, ice and water

6. Actions for indoor work
- Snow removal on uncompleted floors and decks
- Heating and ventilation
- Lighting on the work spaces

Fig. 136 Winter measures of the building

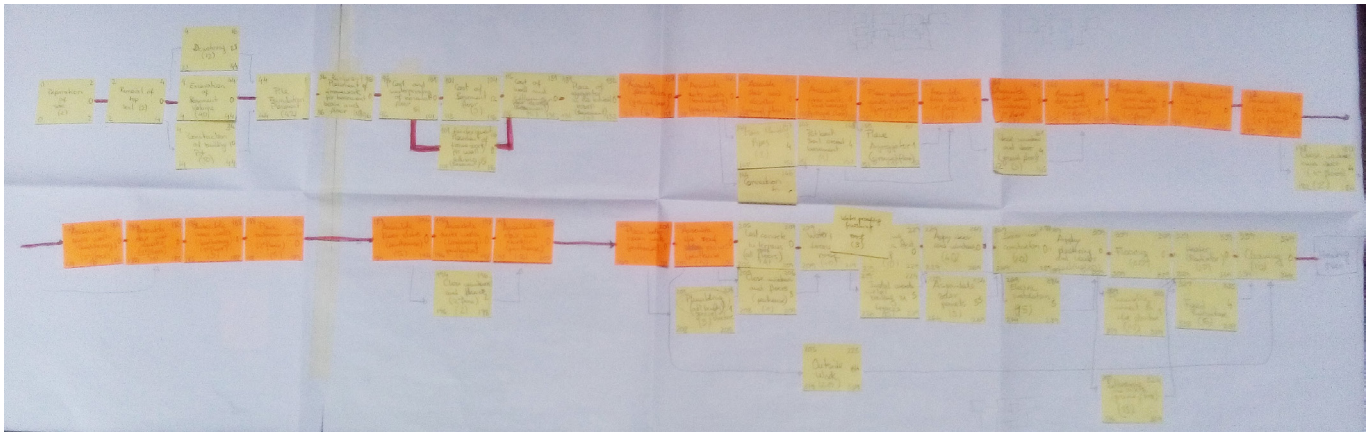


Fig. 138 CPM of the building construction

ID	Task Mode	Task Name	Duration	Start
1		**Master schedule**	**603 days**	**Mon 08-02-16**
2		Brief Design	5 days	Mon 08-02-16
3		Building Integrated Design	32 days	Mon 15-02-16
4		Scheme Design	28 days	Mon 04-04-16
5		DD1	9 days	Tue 17-05-16
6		DD2	20 days	Mon 30-05-16
7		**Tender**	**142 days**	**Fri 24-06-16**
8		Notice advert on Sitemap	0 days	Fri 24-06-16
9		Giving notice	20 days	Mon 27-06-16
10		Tender Package	0 days	Fri 12-08-16
11		Calculations time	52 days	Mon 15-08-16
12		Bids	0 days	Tue 25-10-16
13		Going through bids	30 days	Wed 26-10-16
14		Contract	0 days	Tue 06-12-16
15		Stand Still	10 days	Wed 07-12-16
16		Mobilization	30 days	Wed 21-12-16
17		Construction begin	367 days	Thu 02-02-17
18		Handing over the project	0 days	Tue 04-09-18

Fig. 137 Master schedule

Budget

The budget at this phase is done so the client has an idea of how much will pay for the project. The budget includes site cost, construction costs and administrative costs, the most important to focus on is the construction cost is the one more accurate and calculated in detail. The budget was calculated in an Excel Sheet formatted for Budget calculation. All the values in the budget are in Danish Krones (DKK).

Index	137
Area (m2):	5563

Distribution of costs

A. Site costs
Surrounding areas -costs based on surveying/measurement — Kr. 5.613.000

B. Construction costs
Total costs based on grades and quantities — Kr. 82.236.000
Costs per m² — Kr. 14.783

C. Administration costs
Total costs (fee etc.) — Kr. 17.723.000

Total project cost (Excl. VAT)	Kr.	105.572.000
25 % VAT	Kr.	26.393.000
Total project cost (Incl. VAT)	Kr.	131.965.000
Total project cost / m² (Incl. VAT)	Kr.	23.722

Fig. 139 Budget calculation

Project Work
Terraces

Christiansgade I B

Individual Work - 4th Semester
Multi-Storey Building

Sketches

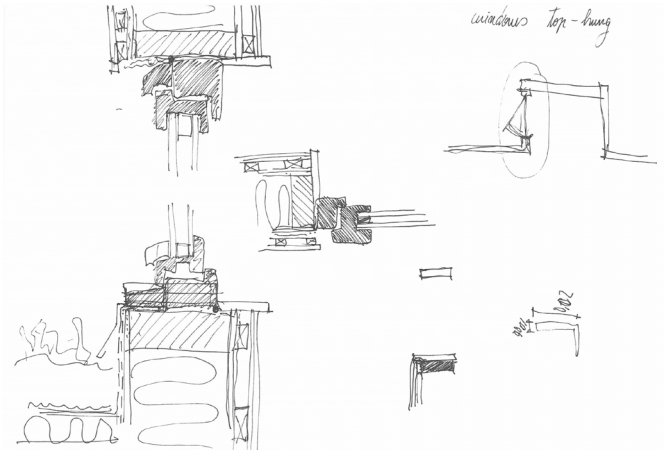


Fig. 140 Sketches: Skyligth window

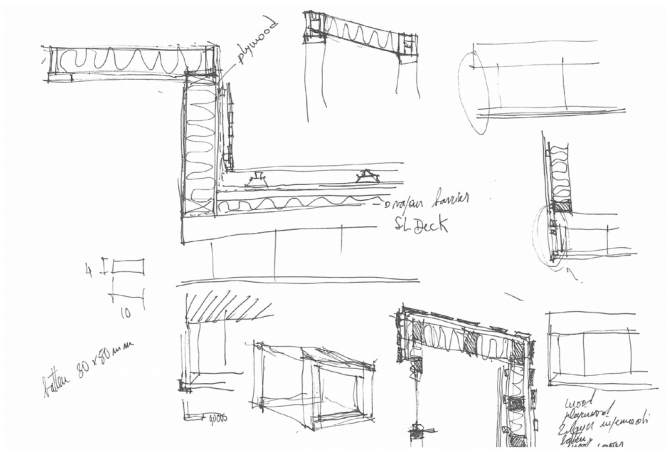


Fig. 141 Sketches: Skylight structure

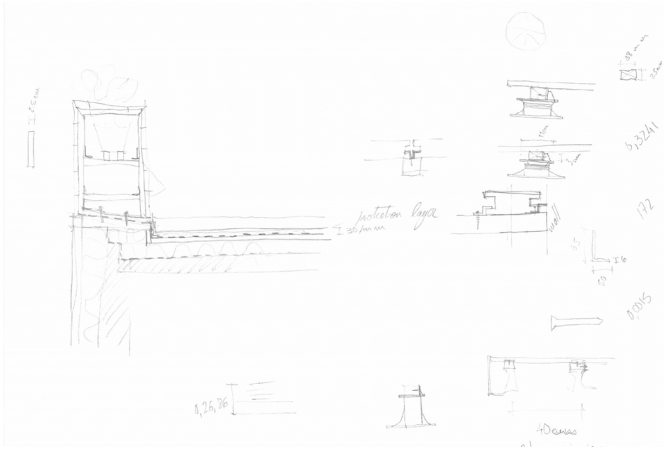


Fig. 142 Sketches: Terrace railing, supports for wooden flooring (elephant foots)

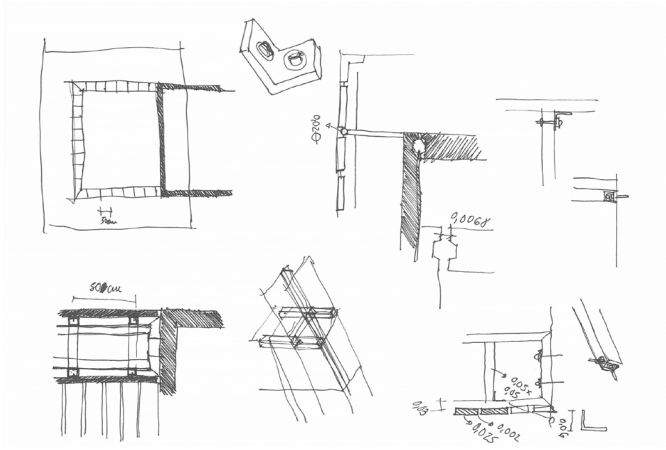


Fig. 143 Sketches: Terrace railing connection with facade wall

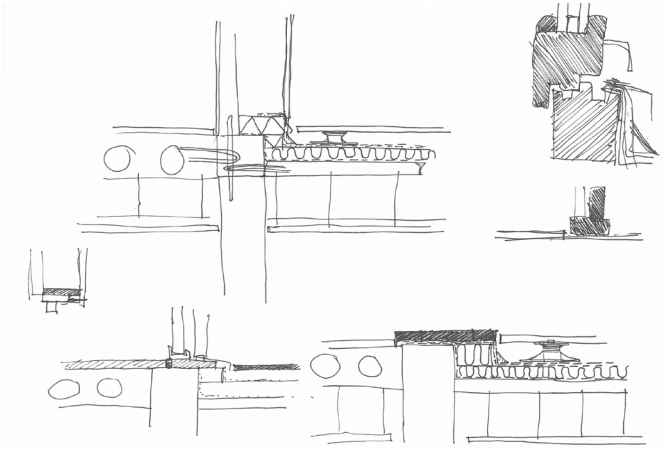


Fig. 144 Sketches: Terrace wall and slabs connection, placing of door step and height of the elefphant foots

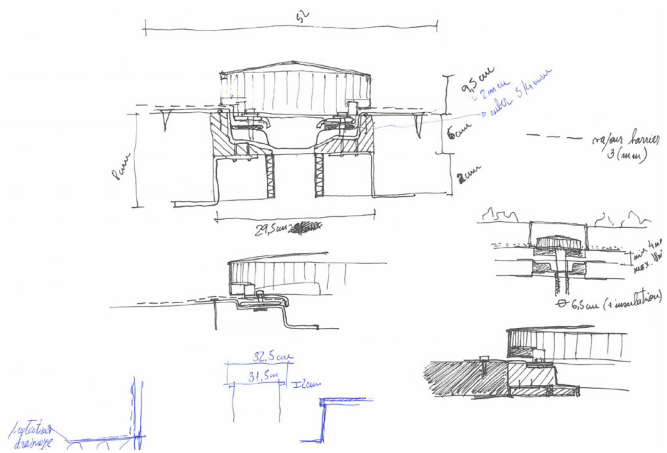
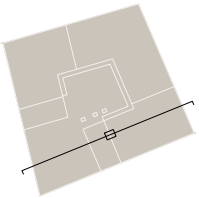
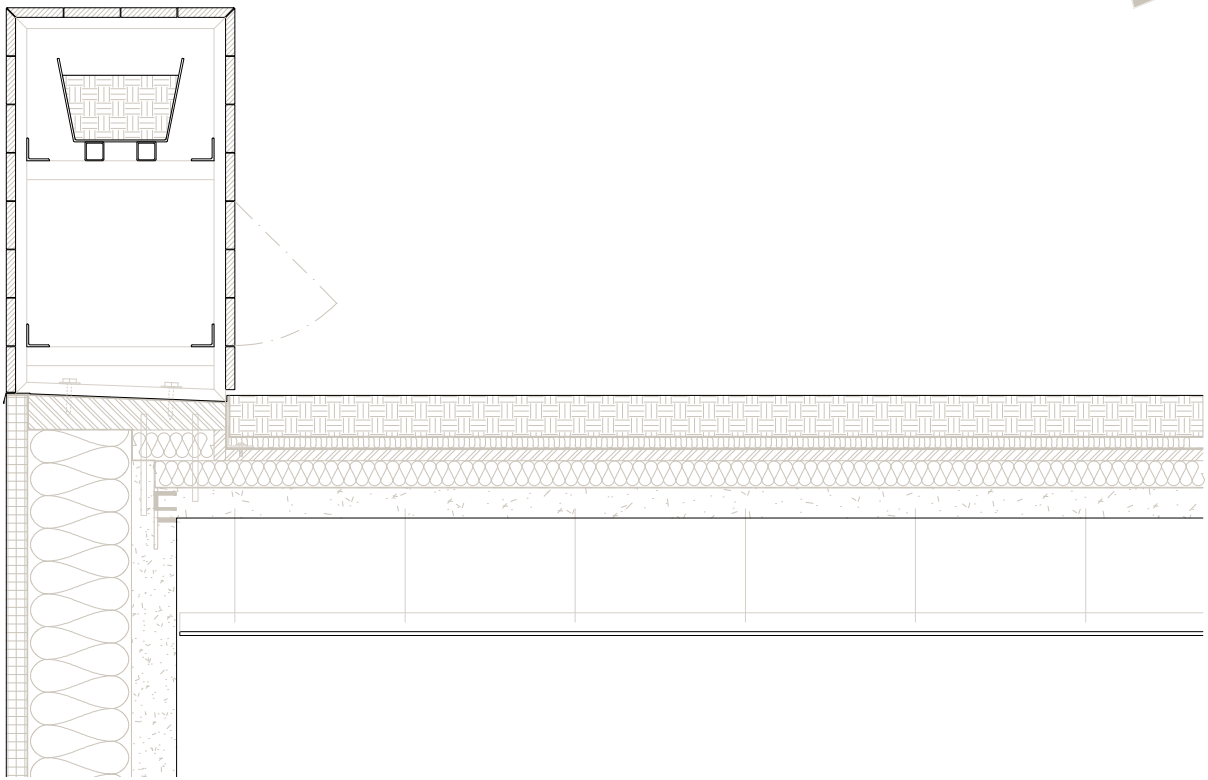


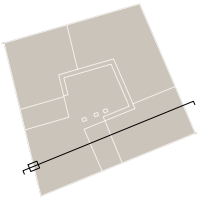
Fig. 145 Sketches: Terrace syphonic drainage outlet installation

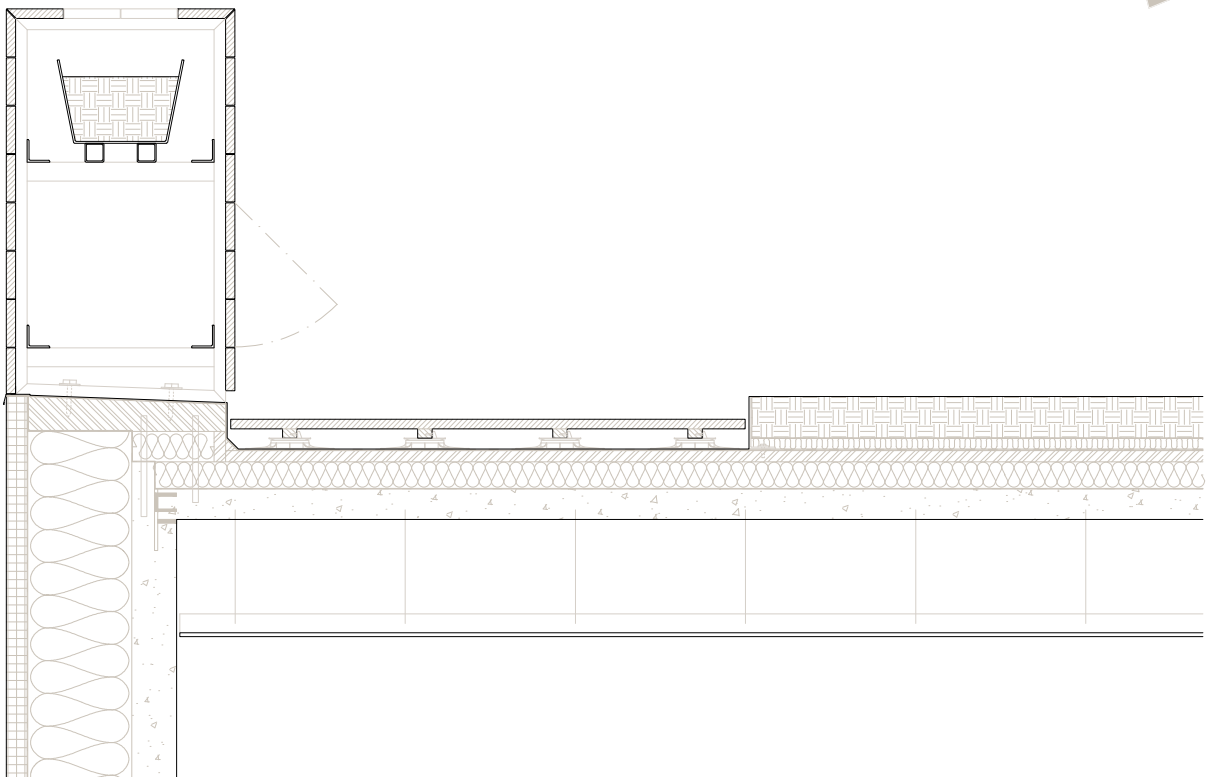
Drawings



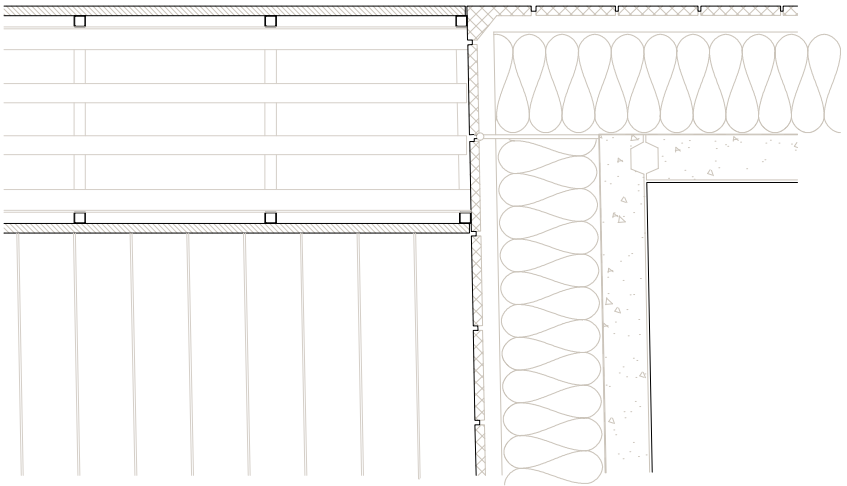


Drawing 33 Detail I: Terrace green roof connection with facade wall and wooden railing 1:20

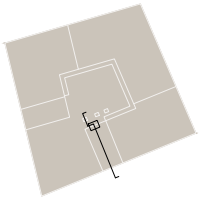


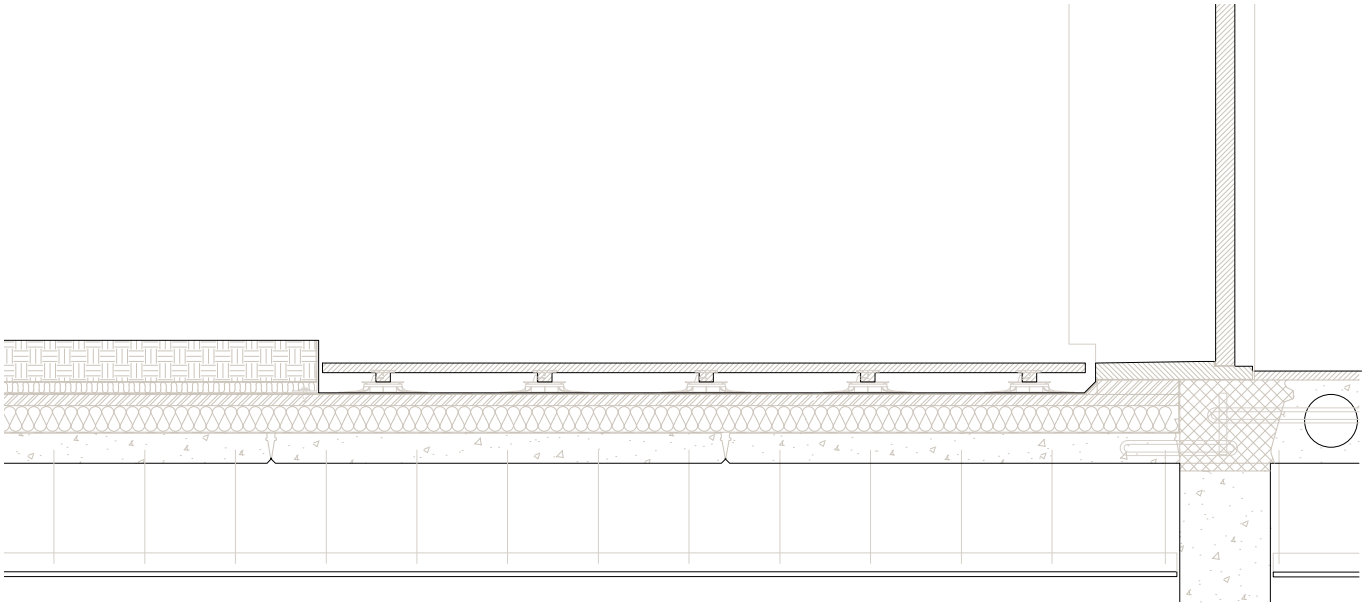


Drawing 34 Detail 2: Terrace wooden flooring connection with green roof, facade wall and wooden railing 1:20

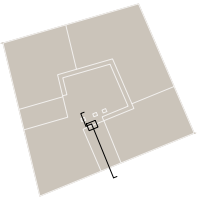


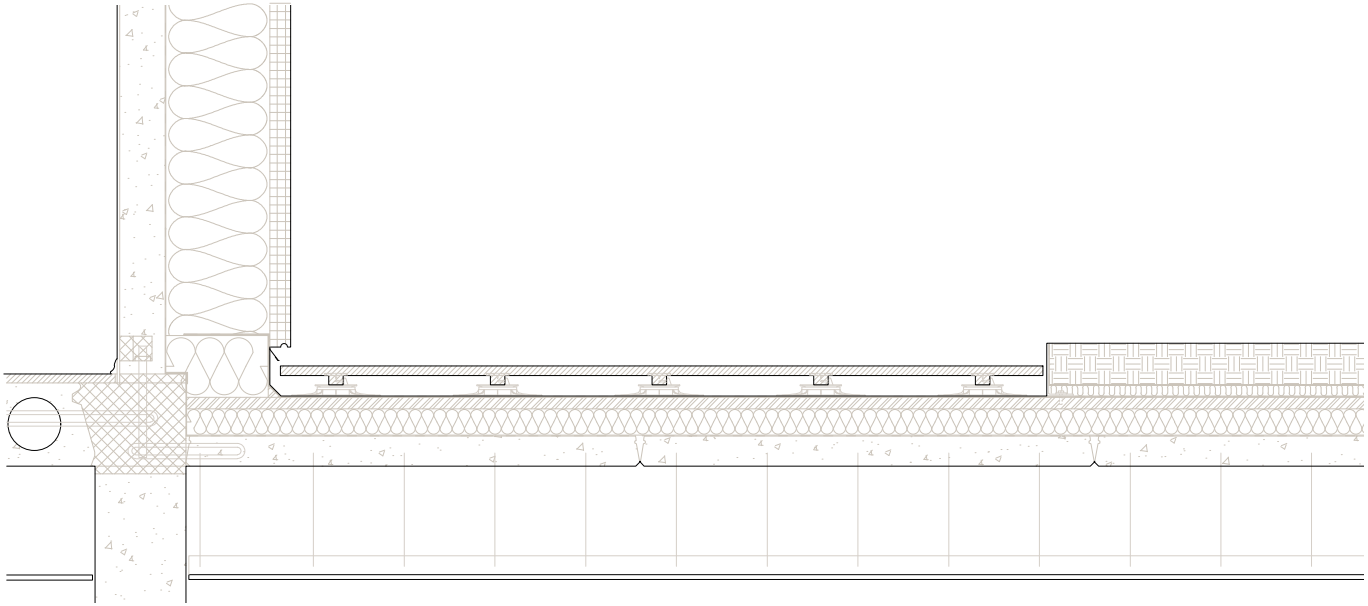
Drawing 35 Detail 3: Wooden railing connection with facade wall 1:20



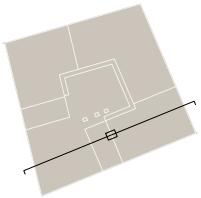


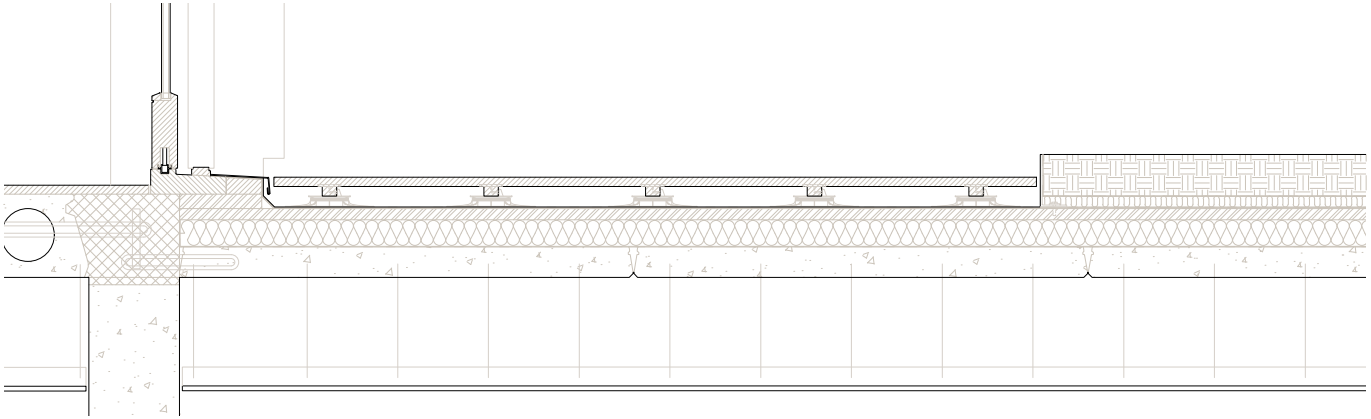
Drawing 36 Detail 4: Terrace wooden flooring connection with entrance door to apartments 1:20



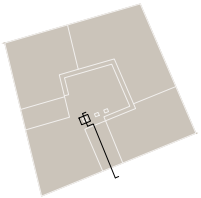


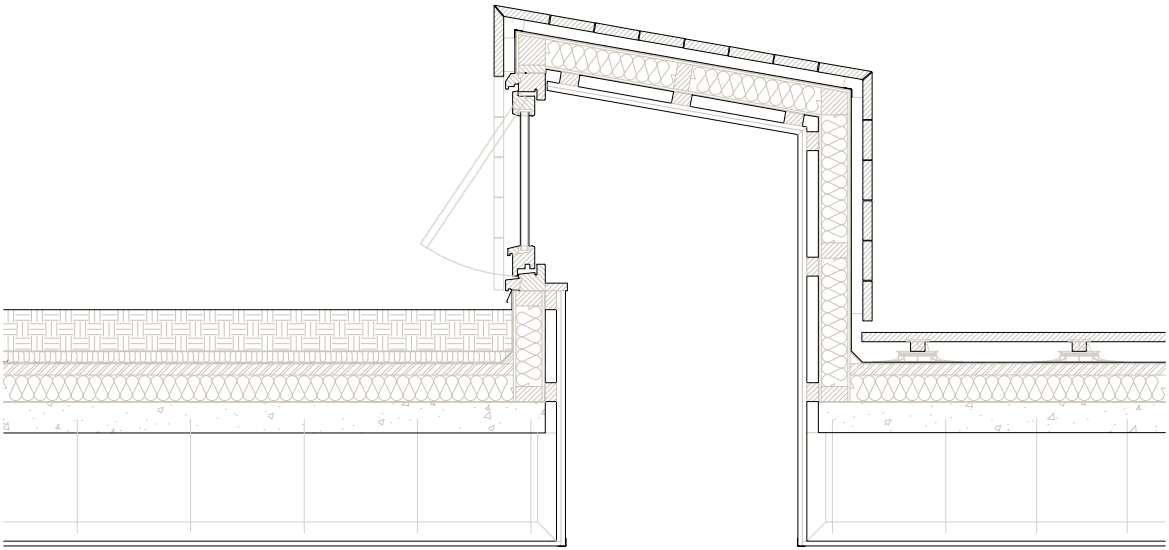
Drawing 37 Detail 5: Terrace connection with facade wall and different slab 1:20



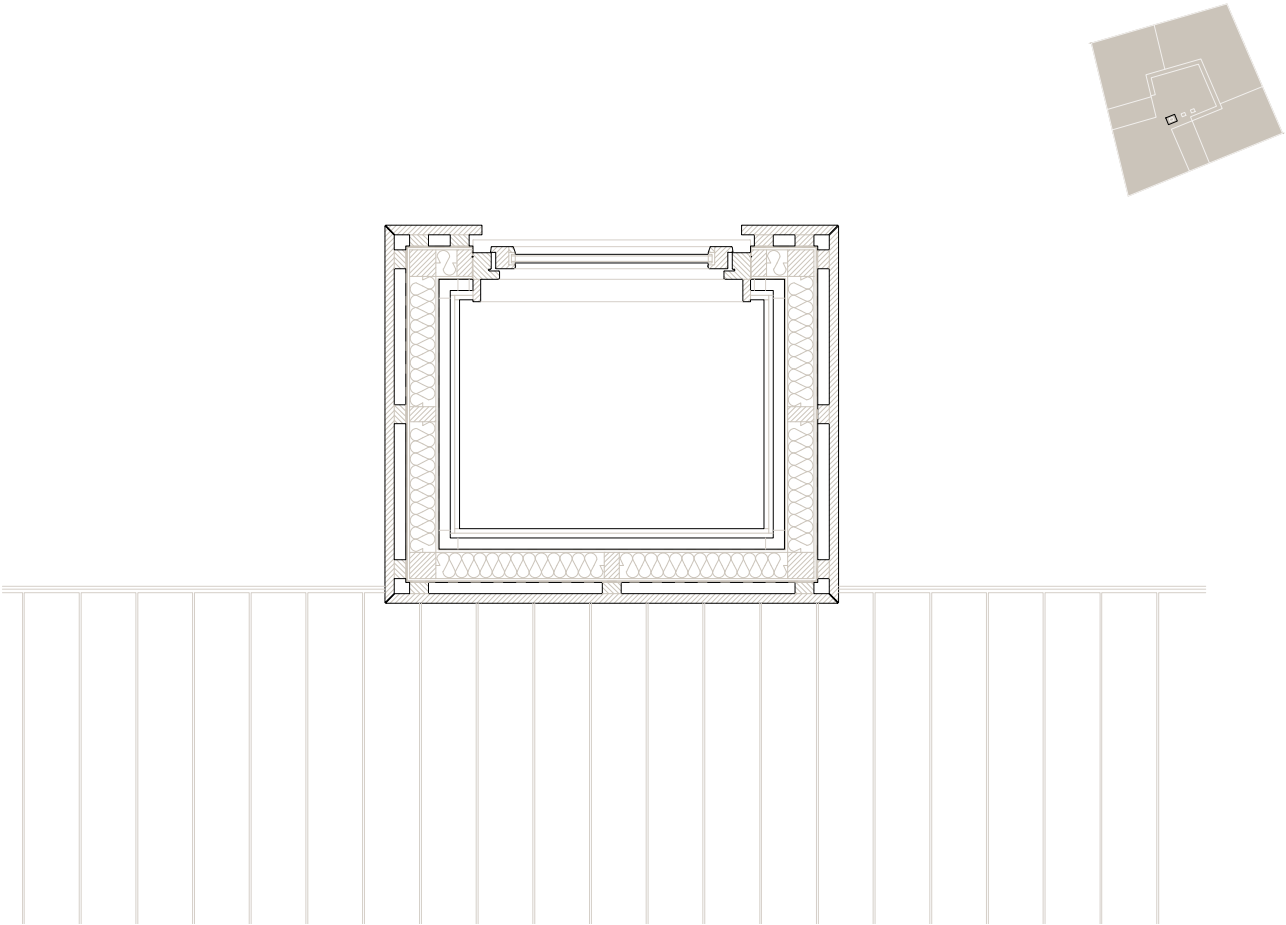


Drawing 38 Detail 6: Terrace wooden flooring connection with sliding doors in the apartment 1:20

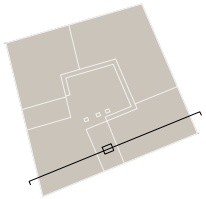


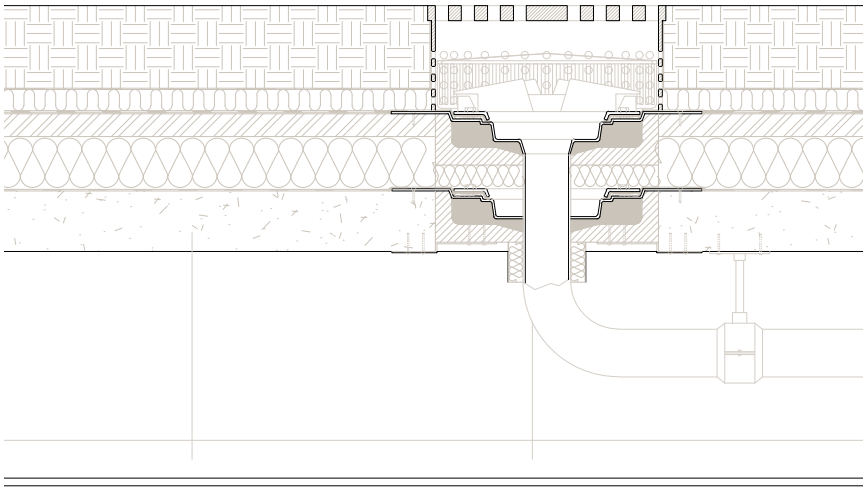


Drawing 39 Detail 7: Skylight connection with slab, green roof and wooden flooring 1:20



Drawing 40 Detail 8: Skyligth plan 1:20





Drawing 41 Detail 9: Syphonic drainage outlet connection with slab and green roof 1:10

Tender

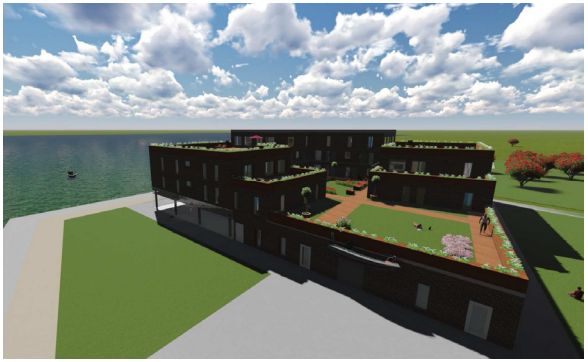
This phase is to prepare all the documents to tender the project. For this project was done Public tender notice to be posted in the newspaper. This so that constructor know that there is a building to be built and they can bid on it.

In relation with the terraces of the building, a risk analyse is done, to understand what could be the problems during the installation of the terraces. When the main risks are found a tender control plan is done to make sure that, during the construction exist a follow-up and inspection of what is being done. This is to prevent any defect in the construction.

SEJAJ architecture

Public Tender Notice

Multi-Storey Builiding in Aalborg



SEJAJ would like to tender the following project as a Public EU Tender.

The execution of terraces for a multi-storey building in the city of Aalborg, Denmark.

The work is tendered in accordance with the Housing Ministry's circular on fixed price and time for building and civil engineering projects.

The project is to be executed in the period 07.11.2017 to 11.01.2018.

Terraces Contract includes:
- waterproofing and insulation
- install drainage
- finish the flooring, wooden and green roof
- installing wooden railing structure with for flower vases

The tender documents can be requested, a pone a notice and deposit of 200 kr, which will the refunded on the return of the documents (in good condition) not later the 8 day after tender. The notice must be given to Joana Inglês, and the check send to SEJAJ. The notice should be done later than 12:00 on the 12.08.2016. Notices given after this time will be disregarded.
The tender documents will be send out on 12.08.2016.

The tender will be held at 14:00, Tuesday06.12.2016 at Sofiendalsvej 60 Aalborg, in room SD2.2.40, in the presence of the bidder is required for the bid to be considered valid.
The bids are binding for the bidder for 14:00 on the date.

Fig. 146 Public tender notice of the terraces contract

Project: Østre Havn Project				**Respondent by:** Joana Inglês	**Date:** 18.06.2016
What can go wrong?	The consequences (1-5) **(C)**	Probability (1-5) **(P)**	Risk number **(C x P)**	Actions	
				Preventive	Mitigation
Leak in the damp proof membrane.	4	3	12	When the dam proof membrane is being installed check if there is overlapping and it sealed properly with tape. Have an inspection before install any more materials.	Find where the leak is. Remove the material that is compromised. Re-install the damp proof membrane. Check again the overlapping and the tape sealing. Have it inspection before applying anything other materials.
Wooden floor uneven, from failed equipment (elephant foots) or bad installation.	3	2	6	When installing the wood batten make sure that they are properly leveed. Use good quality material.	Check the levelling of the floor. Find the problem and reinstall it, when installed need to be check for levelling.
Fail in the drainage outlet installation, malfunction or leak.	4	2	8	Install the drainage according the manufacture recommendations, check for the waterproofing in the outlet. The system should be inspectioned before the access cover to the outlets are installed.	Find out what is the problem. Depending on it, reinstall the outlets again, check for what failed before. In the end of the installation have an inspection for check the system.
Leak in the rain water drainage pipes.	5	3	15	Make sure that the pipe are installed according the recommendations from manufacture. Check the connection between pipes, before the system starts to be used.	Find the leak. Understand why the leak was happen. Reinstall or reconnect the pipes. This the system will need to be checked before the installing of the lowered ceilings.
Water overflow in the terraces.	5	2	10	Use a system that is suitable for the requirements if the project. Make sure to create an over flow system, independent from the rain water drainage. Make sure that the drainage system was dimensioned accordingly to the amount of rain and area of the terrace.	Find a mean to withdraw the water from the terraces. This without damaging the building.

Translated directly from the Danish book: "Power i projekter & portefølje", by Mette Lindgaard Attrup and John Ryding Olsson, 2008

Fig. 147 Risk analyses for the Terraces

Nr.	Topic	Method/how	Frequence	Time	Requirement	Requirement to documentation	Who/ Resp.	Carry out
1	Damp-proof membrane	Visual inspection; Photos	100%	Before installing elefant foots	Make sure that there is at least 150mm of overlapping in the damp-proof and that that is sealed with tape.	Written report; Photos	Carpenter	
2	Elephant foot and wooden terrace	Visual inspection; check with levelling tool	100%	Before installing the wooden floring	Make sure that the elephant foots are leveed	Written report; Photos	Carpenter	
3	Drainage outlets	Visual inspection; Photos	100%	Before instaling the metal mesh for promenade	Make sure that sealing of the damp-proof membrane is done according the manufactured recommendation	Written report; Photos	Carpenter	
4	Rain water pipes	Visual inspection; Photos	100%	Before installing the lower ceiling	Make sure that struture is accuraty attached to the wall. Make sure the pipes are connected correctly	Written report; Photos	Carpenter	
5	Insulation	Visual inspection; Photos	100%	Before and before installing the insulation and installing the damp-proof membrane	Make sure the insulation is install in a clear and dry deck.Make sure the insulation is installed without any gaps between panels.	Written report; Photos	Carpenter	

Fig. 148 Tender control plan for the Terraces

Construction Planning

For the construction planning, the focus is on the terraces. The creation of a construction schedule that detail all the activities on site to install the terraces. The component specification is a documents that detail the installation of the element chosen, in this case the green roof installation. The choice was green roof because it was the element that was more complete of all the other elements of the terraces.

ID	Task Mode	Task Name	Duration	Start	Finish
1		**Master schedule**	**94 days**	**Mon 08-02-16**	**Fri 24-06-16**
7		**Tender**	**142 days**	**Fri 24-06-16**	**Wed 01-02-17**
8		Notice advert on Sitemap	0 days	Fri 24-06-16	Fri 24-06-16
9		Giving notice	20 days	Mon 27-06-16	Fri 12-08-16
10		Tender Package	0 days	Fri 12-08-16	Fri 12-08-16
11		Calculations time	52 days	Mon 15-08-16	Tue 25-10-16
12		Bids	0 days	Tue 25-10-16	Tue 25-10-16
13		Going through bids	30 days	Wed 26-10-16	Tue 06-12-16
14		Contract	0 days	Tue 06-12-16	Tue 06-12-16
15		Stand Still	10 days	Wed 07-12-16	Tue 20-12-16
16		Mobilization	30 days	Wed 21-12-16	Wed 01-02-17
17		**Construction**	367 days	Thu 02-02-17	Tue 04-09-18
18		Waterproofing, insulation, drains around external wall of terrace (first floor)	2 days	Tue 07-11-17	Wed 08-11-17
19		Waterproofing, insulation, drain in the terrace (first floor)	2 days	Thu 09-11-17	Fri 10-11-17
20		Finishing terrace and instal wood railing (first floor)	4 days	Mon 13-11-17	Thu 16-11-17
21		Waterproofing, insulation, drain around external walls of terrace (second floor)	1 day	Thu 07-12-17	Thu 07-12-17
22		Waterproofing, insulation, drain in the terrace (second floor)	1 day	Fri 08-12-17	Fri 08-12-17
23		Finishing terrace and instal wood railing (second floor)	2 days	Mon 11-12-17	Tue 12-12-17
24		Waterproofing, insulation, drain around external walls of terrace (penthouse)	1 day	Thu 04-01-18	Thu 04-01-18
25		Waterproofing, insulation, drain in terrace (penthouse)	2 days	Fri 05-01-18	Mon 08-01-18
26		Finishing terrace and install wood railing (penthouse)	3 days	Tue 09-01-18	Thu 11-01-18
27		**Handing over the project**	0 days	Tue 04-09-18	Tue 04-09-18

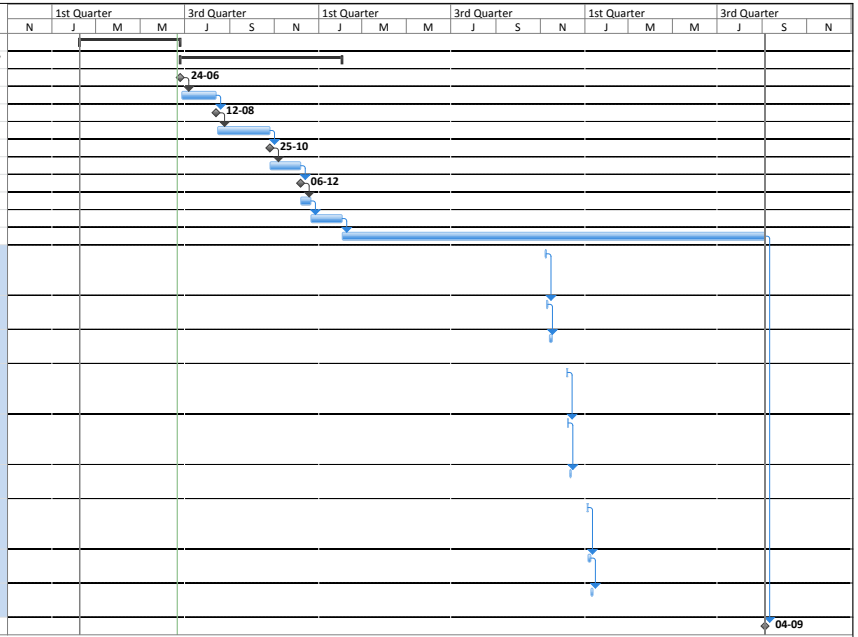


Fig. 149 Construction Schedule

Budget

The budget in this phase calculates only the cost for the installation of the terraces in the building. The calculation is detail includes all the necessary to install the terraces. The insulation, the damp proof membrane, the elephant foods and wooden flooring, the soil for the green are included. This calculation is made in Sigma, a programme that includes the price book and can be link with the Revit model. This calculation was made in Sigma, by looking for the material and inputting the quantity need. This gives the price of the material, labour and other associated cost (e.g electricity if need to install the material).

All the values in the budget are in Danish Krones (DKK).

Num	Text	Unit	MM	Unit SP	Sales Price
Green Roof					
(47)19.10,01	Retvendt tag med stenlag, U-værdi 0,10 W/m²K	m²	0,00	1.007,70	735.619,00
			0,00		**735.619,00**
Wooden					
(47)19.30,02	Duo-tag, tagterrasse m/fliser, U-værdi 0,08 W/m²K	m²	0,00	1.597,62	696.563,00
			0,00		**696.563,00**
Wood Railing					
02.70.02,03	Galvaniseret trådhegn, højde 1,0 m	lbm	0,00	159,09	64.273,00
04.55.11,09	Udv høvlet træ grunde m/alkydgrundmaling	m²	0,00	25,71	26.997,00
			0,00		**91.270,00**
Total amount			**0,00**		**1.523.452,00**

Fig. 150 Budget calculation for the Terraces

Elective

Individual Work
5th Semester

5 th Semester Elective Assigment

18 January 2016

University College of Northern Denmark
Architectural Technology and Construction Management

Joana Ramos Inglês

5th Semester Elective Tutor:
Mads Dines Petersen, Part-Time Lecturer, AAU

How can Sustainable Design lead to a more Self-sufficient building?

Introduction

Sustainability is a term use in our society in various situations, in polities, economic, companies, also applied to building. The concept is complex and can be seen in different, and quite ward to define was it implies (Fokaides and Kylili 2015). The thought of sustainability evolved thru the years, it started with the awareness to the topic with the three R's. After, evolve to understanding the materials and how this relate to nature (Bergman, 2012).

Eco Design impact the environment, but to understand the impact that could have in your life. There is a need to start to understand and question how we live, what implication would it have on our life, our way of living, on society (Bergman, 2012).

This began to be a bigger concern in 1960s, after the UN's first global climate summit, where a UN commission was created to understand sustainability (ed. Kongebro, 2012).

The main objective is to understand sustainable design and if it can helpful in the design of self-sufficient building. It identifies how design can be applied in creative process, and tries to understand if self-sufficient building should remain in remote area or also in the bigger cities.

Sustainability started with Eco Design which is present in Section 1. Section 2 and 3 give a definition of sustainability and self-sufficient, respectively. Section 4 focus on understanding what energy efficient strategies are, and what differences are between them. Section 5 analyses if and when should energy design affect the creative process. A practical application of this concept is presented in Section 6.

1. Evolution of Eco Design

The term eco design, sustainable design or green design, they can be used as the same. There may be some slight differences between them, but the point is what are they try to achieve. In the 1960s, the Eco Design was created base on the three R's, "Reduce, Reuse, Recycle", it was walk a long way since then. This phrase helped to raise the awareness to the environment and that people could also contribute by recycle their bottles and newspapers, but it doesn't stop there and the simple phrase made look like that was end of their part. This type of thinking can be the beginning of the thinking behind Eco Design, it's a good step in the right direction, but it doesn't go far enough, maybe because it limits or isolation on one subject and not the all of them (Bergman, 2012).

Pass this starting point on Eco Design, now there is a need to understand the Life Cycle Analyses [1] (LCA) which is usually

[1] This includes "...the entire life cycle of the products including the energy, carbon emissions and costs necessary for raw material extraction, manufacturing, transporting, and disposing of the products" (Fokaides and Kylili 2015, p. 92).

applied to products, but the same can be applied to buildings. The life of the building is studied from cradle-to-grave; the origin of the raw materials to how are they modified during the manufacturing process, to the energy and resources spend during it useful life, and the impact when its life cycle ends (Bergman, 2012).

The LCA attributes values that show the impact of the materials during their life cycle. In this analyses we can improve and change the process of creation. This approach is more inclusive then the three R`s, but is still limited (Bergman 2012). Bill McDonough and Michael Braungart (2009) describe the cradle-to-grave approach was "being less bad", it allows us to see and reduce the impact of what we build, but comes short on getting to the aim of sustainability.

From cradle-to-grave to cradle-to-cradle the thought was to change and turn LBA into a cycle. Everything we need is on Earth, the materials we use or may use, the air and water that keep us alive. For real sustainability, we should never use up all the Earth resources before they can be supplied back. The only exception to this is the sun, we will never run out of sun light. So any energy created from sun is lasting, like solar energy and other renewable sources like wind and biofuels, or tidal and geothermal energies that wouldn`t exist without the sun (Bergman, 2012).

Nature was it ways of being efficient and everything. In nature everything happens in a cycle, one thing can become something else. All the waste that we consider trash - organic, inorganic, industrial, residential - can become something else as well (Bergman, 2012).

Everything that consider trash can be divide in: biological nutrients [2] and technical nutrients [3]. There are some materials that can`t be recycled or returned to nature (e.g. nuclear waste and toxic chemicals). These last materials have no place in the cradle-to-cradle system, for being too expensive to deal with, and should be avoided as most as possible (Braungart and McDonough, 2009).

This was being looked at how Eco Design impacts the environment, to consider sustainability. We need to look at how we live and what would be the implication of sustainability in your lives. How that this concept impacts economy? How does this will impact communities? This types of thinking can reach the next level on Eco Design, after the R`s, the cradle-to-grave and the cradle-to-cradle thinking`s (Bergman, 2012).

[2] This are materials that when we don`t need them anymore, can return to nature and be part of something else (Braungart and McDonough 2009).
[3] This are materials that when we don`t need them anymore, we recycle and the have different cycle of usage (e.g. petroleum-based plastics) (Braungart and McDonough 2009).

2. What is sustainability?

The term sustainability became more and more used in your society. Sustainable investments, polities, economic and also sustainable buildings. Sustainability is now spread in to the companies and is now integrated part of the companies. The way the company works and runs the business, it`s a sustainable complex concept that can be seen in different ways. It`s still difficult to define what sustainability implies. In design you can start with "reduce, optimise and produce energy" (ed. Kongebro 2012).

Since the 1960s there was been a growing awareness on this topic. After the UN`s first global climate summit in Stockholm in 1972, a UN commission was created to understand sustainability (ed. Kongebro 2012).

What is sustainable design and what is its aim? The most common definition comes from the United Nations committee describing sustainable development, changing the word "development" by "design". The committee describes sustainable development was

"...development that meets the needs of the present without compromising the ability of future generations to meet their own needs. It contains within it two key concepts: the concept of 'needs', in particular the essential needs of the world's poor, to which overriding priority should be given; and the idea of limitations imposed by the state of technology and social organization on the environment's ability to meet present and future needs." (Our Common Future, Chapter 2: Towards Sustainable Development, 1987).

This explains the difference between what is your "need" and we "would like" to survive.

A more reaching definition/ understanding sustainability can be found if we overlap different concepts: "ecology, economy, and equity" (Fig. 151) This concept is about more than making a product or a building rentable, is about understanding the social cost and impact for the planet. Assign numbers to concepts like ecology and equity is difficult, but in any business this should be included easily in to concept of the business (Bergman 2012).

Fig. 151 The overlap of Ecology, Economy and Equity

This concept can also be understood like: "society, economy and environment", this are all connected. There is a difficult in distinguish the cause effect, that one was on the others (ed. Kongebro 2012).

3. What is self-sufficient?

Self-sufficient mean independent. This term can be applied to a building, in which the building is self-sufficient. Independent from the grid that supplies water, electric and everything else a building needs to function. This types of building are normally located in remote areas, and may be they are more useful there. These buildings are most efficient in this areas, because sometimes it not economy favourable to bring power or fuel to those areas (Bergman 2012).

One examples can be Zero Energy Building (ZEB), that need to generate renewable energy and have how to storage it, and work self-sufficiently at all time. If the energy produced it bigger that the amount spend it can be defined as Energy-Plus Building, this building should also have "...small-scale power generators and low-energy building techniques, including passive solar building design, and super-insulation of the building". This buildings being off-grid, and in remote areas can explore wind, hidro and geothermal energies (Fokaides and Kylili 2015).

4. Energy Strategies

When talking about energy strategies, we need to talk about energy efficiency. In sustainable buildings there is a need to think of the amount of energy spend on the building and on maintaining it. There are different strategies to reduce the ecological footprint left behind. There are two different strategies for energy efficiency: passive and active strategies (Bergman 2012).

4.1. Passive strategies

The passive strategies make a use of simpler methods and most of the times with less technology. Most of the passive strategies aren't new, this are approaches that have been used for centuries, and some were lost during the Industrial Age but are being brought back again. This techniques being old, so they are probably not technologic, the probability of maintenance and mal-functioning is much lower. These techniques are simpler, dependable and less costly (Bergman 2012).

To understand passive energy strategies there is a need to start to look at local designs. The native cultures have architecture that comes from those principles. The cooling and heating of building before the air-conditioning systems. The connection between local conditions and design was changed during the Industrial Age, when these strategies

were mix with modern architecture. This lead to standardization, where each façade could be the same independently of the sun orientation. This made it simpler to build, because different sun orientations have different needs, was well was different latitudes (Bergman 2012).

Here are some examples of passive strategies: thermal mass, double-envelope construction, solar orientation, windows and glazing, insulation, cool roofs, radiant barriers, passive house, ventilation and circulation. This a lot of the strategies used in different design solutions.

4.2. Active strategies

The passive strategies aren`t enough to get to the goal of Zero Energy Building. Even when passive energy efficiency is steered to the limit with passive housing and superefficient designs. The new demands for the new electronic devices and appliances, there is also a high demand for energy. To provide with this amount of energy we need to understand how to make the building and it interior work more efficiently, and how to make it generate energy from an alternative source (Bergman 2012).

Some active strategies are: solar thermal collectors, photovoltaics, wind energy, mechanical systems, hot-water efficiency, efficiency lighting, colour temperature, fluorescents, light emitting diodes, lighting controls, daylighting and energy modelling (Bergman, 2012).

5. Sustainability in Design

Design determines how much energy a building will consume. Design should be collaborative process. Here there is an input of different knowledge at the early stage possible in creative process. In the beginning when the sketches are being made, sustainability must be present because is in this phase that the decision about consumption of energy is made. If different possibilities and solution can be considered and studied from the beginning, then the building is likely to have a high energy efficiency (ed. Kongebro 2012).

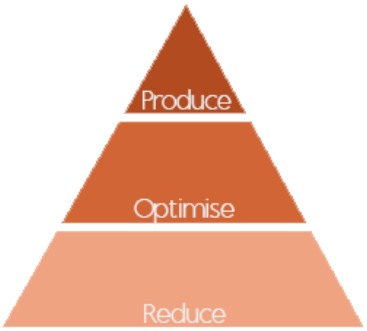
If the energy efficiency is considered in the beginning, the building will have a clear sustainable strategy. The use of passive techniques will allow the building design to be more energy-efficiency, and the energy consumption will be lower. If energy efficiency isn`t considered from the beginning there will be added costs, to install solutions to solve problems created by a less informed design (ed. Kongebro 2012).

If a building is improved later in the process with technology, that will the more expensive and the building lose in the process. When a building in informed by the knowledge during the creative process, it gains quality because it`s designed and created, with sustainability as core. This can lead the creative process of thinking building to a

different level, were isn't just the architecture and aesthetics impacting the building but also energy efficiency (ed. Kongebro 2012).

Energy design needs to be integrated part of the creative process. Technology alone doesn't solve the climate control in buildings, this would need too much energy and we wouldn't meet the energy requirements. This takes time, and adjustments have to be made thru out the all process. The design is never done in the first sketches, rather you have a design that was developed and informed by energy design (ed. Kongebro 2012).

The Integrated Energy Design is a practical approach to sustainability, can be represented in pyramid (Fig. 152):



Reduce by means of good design
Optimise by means of technical solutions
Produce by means integrated, renewable energy

Fig. 152 The practical work with sustainability can be represented in this pyramid diagram

The first level in the pyramid is the *reduction* of the energy needed. Passive strategies are a simple and effective way of reducing energy. This don't need replacing they can last as long as the building does. The second level is to *optimise* energy this means technical installation that are expensive, but this costs are returned in a short period of time. The last level is to *produce* renewable energy, this will contra balance with consumed energy in the building. This is also an expensive strategy and the one doesn't last long on life of the building (ed. Kongebro 2012).

Integrated Energy Design uses the technical knowledge to influences the creative process, while aesthetics and space allow us to reduce the energy consumption. This creates an exchange of ideas between all different of types of projects. The role of the architects and the engineers may change, if we join the "...theoretical knowledge of the engineer with the practical approach of the architect..." (ed. Kongebro 2012, p. 14) we can a better architecture.

6. ZEBs - Zero Energy Building

Zero energy buildings are buildings that have zero carbon emissions. They have reduced the amount of energy needed in the building. And use Renewable Energy Sources (RES) along with technology to reduce the energy needs. This concept was evolved thru the years from low-energy and

passive buildings design. Most of design techniques used in traditional and local areas where passed down from generation to generation. This building here normally build from local material and adequate to it use by the population in different climates (Fokaides and Kylili 2015).

There have been different experiments with passive solar design and low- energy houses thru the centuries. After the 1980s new standards were develop for the low-energy building, all thru Europe (Fokaides and Kylili 2015).

The most common is Passivhus standard. In most cases this was achieve with high levels of insulation and the least possible thermal bridging, using solar energy and internal gains for heating. For a better control of heating and cooling the building there should be a "(...) highly efficient heating, ventilation and air-conditioning (HVAC) systems" (Fokaides and Kylili 2015, pp. 92). They also include the use of class "A" domestic appliances and energy efficient lighting. The use of less lighting to reduce the heat gain and the air-conditioning use, will improve thermal comfort (Fokaides and Kylili 2015).

In southern climate, there is some limitations. In winter the buildings are expected warm but in summer the cooling is insufficient. In new revisions was recommend for passive design in the Mediterranean region, more cooling and other energy needs (Fokaides and Kylili 2015).

There can be various definitions of a ZEB, across Europe there are 23 different terms. These vary in levels of energy consumption and the minimum requirements, together with different energy consuming process and calculations of energy performance (Fokaides and Kylili 2015).

The ZEB`s are mostly use connected to the grid, in populated areas, where they can contribute with energy and use energy grid in case of shortage (Fokaides and Kylili 2015). There are ZEB`s off-the-grid, but they are located in remote areas, where is too expensive to bring energy or fuel to it, so they mostly use passive strategies (Bergman 2012).

Conclusion

This show the important part that sustainability can have in the creative process of a building. This concludes:

- that energy design is a slow process, still to be learn along the way, but it should be developed until it become a "...inherent part of the creation process and thus an intuitive practice" (ed. Kongebro 2012, p. 17). The technical knowledge should influence the creative process from the beginning, which will have to a better result in architecture.

- that buildings should be design to consume the less possible energy and produce at least the amount that the building consumes, this energy should be produce the most environment benign way possible.

- that depending on the energy design, there will be different strategies used. The build is location is critical to energy design. The differences in strategies if a building is built

in a city or a remote local change dramatically. The strategy used will be very different depending when is energy design considered in creative process.

- that one example for self-sufficient buildings can be Zero Energy Building. This can function totally off-grid normally in remote areas but they don`t have to be. If a ZEB is built in a city it may benefit better from being connect to grid, to return the excess of energy produce, for one.

- that the energy design will allow to create self-sufficient buildings doesn`t matter where they are located. The strategies use on the building wouldn`t be the same. If the building is thought from the creative process a more adequate solution will be found to achieve the goal.

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Elective

Individual Work
4th Semester

4 th Semester Elective Assigment

18 March 2016

University College of Northern Denmark
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The economic solution, for rain water and greywater recycling system in new residential buildings?

Introduction

Water is essential to life. there was been in the past years a crescent interest in the environment and it protection and it preservation. The actions of humans have led to high level of pollution, and economic crisis with fuels and carbon emissions. There have been new discoveries and technologies related to the production of energy, which is essential in the economy, industry, etc. The construction industry is one of the industries that most spend and needs water and one of the most pollutant (Stec and Kordana, 2015).

A rainwater harvesting system and a greywater treatment system can be an alternative to using to the public water supply. They can reduce cost in water and there will be more high quality water available. Most of the water in domestic use is non potable water, only 6% are for drinking and cooking. Normally, domestic water is not supplied in different pipes for different uses. The use of high- quality treated water for low quality uses, make it not energy efficient (Li et al., 2010).

The main objective is to understand the rainwater harvesting system and greywater treatment system. How do they work? Can they be applied in a regular base in residential building? Are they affordable? Do they return the investment? Also to understand what solutions are more affordable then others and if other systems can the applied together or even work together.

Water is an essential resource which in presented in Section 1. Section 2 explain what action to take in relation to water efficiency and uses for water, while Section 3 shows why water quality should be persevered and how this can be achieved. Section 4 focus on the rain water harvesting and greywater treatment system, the way the system works, their component and treatment applied to the water. Section 5 is a brief analysis what influences the costs in the systems. Section 6 explores how this system can work together and with some other systems.

1. Water as a resource

Water an essential for humanity. It essential in feeding, in health, in economy. It an exhaustible resource in the Planet. It is up to society, to create means so it use efficiently and considered a priceless good (Sacadura, 2011).

Water is a resource necessary in most major economic activities, namely agriculture and industry. It is also an important part of quality of life of the population (Barroso, 2010 and Li et al, 2010). The shortage of water is a big problem today, water is a resource that is getting more polluted and more demanded in world every day. This is treat to life, to sustainable development, to humans and the ecosystem health (Li et al., 2010).

The demand for water is getting bigger every year, in the

future there may be a shortage of water if it keeps going in the direction. The shortage of water will be a one of the main issues in the near future. The water quality was been deteriorating. In usual water sources (e.g. lakes, rivers and water reservoirs), duo to climate change and human activities (Li et al., 2010).

The increasing water demand and the deteriorating of the existing water resource is leading to focus on alternatives. The use of rain water as a supplementary water system with different uses. The use of roofs to capture water can an important option to combat the large percentage of impermeable area covered in cities. (Villarreal and Dixon, 2005).

2. Efficient uses of water

Not all the water is efficiently harvested. There is a significant part that is lost duo to inefficiencies and losses relative to the amount harvested. Water was essential to the socioeconomic development, should be considerate a strategic resource. Water should be use in the most efficiently possible way. With the different uses for the users, and the new technologic equipment`s, water efficiency should be higher, with in a long time frame (Barroso, 2010).

2.1. Measure that can be taken

Potable water is an essential to life. So with the right management and use we should be able to use it. The water needs around the world are only getting bigger, while the amount of available water is getting smaller. It necessary to take measures that lead to an efficient water use, to ensure that the objectives are fulfilled. Below are presented different measures that can be applied to the domestic use. The objective is to protect water was resource and it unnecessary use, to increasing its efficiency (Barroso, 2010).

2.2 Awareness campaigns

This campaigns should be related to the reality around us, specifically on ways to reduce unnecessary consumption. To reduce for a better efficiency use, this campaigns should incentivize the use of low consumption equipment`s and the creation of rain water collectors for domestic use and reuse some of the greywater created in domestic use (Barroso, 2010).

2.3. Reduction of losses in the distribution systems

Some of the waste water happens in the distribution system, be of cold or warm, it happens duo to leeks in the devices installed. So this doesn`t succeed, campaigns about this issues should be held. Where do they originate and then analysed extensively, and them compare sustainable construction solution with and without the use of water efficiently. There also measures that can be applied and ways to fix the existing problem (Barroso, 2010).

Analyse of buildings to understand the impact that this small loses have in terms of potable water consumption and the importance that this can have environment wise (Barroso, 2010).

2.4. Efficient devices / equipments

To reduce the level of water consumption, we should use more efficient device, meaning, flush toilets with a small discharge, well with thermostatic taps for showers, taps with flow reducing devices, etc. The solution for washing machine and dishwashers is to use equipment`s with lower volume capacity (Barroso, 2010).

2.5. Use of rain water

The use of rain water in urban areas can be seen as contribution to increase the policy of sustainable use of water. The storage of rain water and its use for domestic purposes can contribute to reduce the cost of potable water, in many cases. This use will help to reduce the amount of water that needs treatment and it later distribute (Barroso, 2010).

The rain water can be uses for different use:

-washing of clothes;

-toilet flush;

-external uses (watering green areas, wash of pavements and cars)

-industrial uses (cooling towers, fire networks, etc.).

There are different factor to have in account when use rain water, it volume it going to vary depending on the type of building, type of catchment surface and here is it location in the world (Barroso, 2010). Other factor that are considerate:

-runoff delivery system coefficient;

-annual average precipitation (mm);

-area of catchment surface;

-hydraulic filtration efficiency.

2.6. Reuse of greywater

The reuse of greywater, meaning water coming from shower and sink, after proper treatment can be used. This can be a measure to reduce the consumption of potable water in urban area, it uses is limited in certain countries (Barroso, 2010).

The use of greywater is done thru reusing the water in toilet flushes, in irrigation systems and firefighting systems. The water needs a proper treatment (filtration and disinfection) depend on what the water is going to be use for in the end (Barroso, 2010).

Just as in rain water, the use of greywater raised some issues of legal order. This justify studying different situation for good definition is achieved of types of water treatment and what parameter should this be subject to. Some parameter like bacteriologic, aspect and frequency of use, so this can have a proper legislation so this water system can be use in more buildings (Barroso, 2010)

3. Quality of the rain water

Around the world there are percentage of people that uses rain water was potable water. The risk of disease is small, the best way to avoid it is to use rain water for other purposes. The use of water for washing clothes is much safer, rain water is softer it very close to distilled water quality. Rain water is soft, clean and microorganisms free of any chemical contaminates. It during the runoff and the storage that chemical, physical or microbiologic contamination may happen (Bertolo, 2006).

In urban centre the atmosphere is polluted. So that rain water itself is not proper for drinking. Heavy metals can be very dangerous, in areas around heavy traffic areas or close to heavy machinery industries, are not proper for rainwater harvest. There are sources of atmosphere pollution but the level of contamination of rain water are low, in most of the world (Bertolo, 2006).

The major issue is when the water enters in contact with the catchment surface (roof in most cases or just soil) and during the runoff and storage. When the rain enters in contact with the catchment surface, can drag all sort of bacteria and other products to the inside of the storage tank (Bertolo, 2006).

In rural area, the pollution is normally not an issue, so there are different steps to reduce contamination to minimum. The area catch form the soil it may be contaminated, but it viable for non-potable uses, unless it gets proper treatment (Bertolo, 2006).

3.1. Protection of water quality

The best methods to preserve or improve the water quality is with an adequate project and a good operation and maintenance of it, using "first flush" devices and water treatment. Treatment is use mainly when there are suspicious of contamination. The "first flush" can be very efficient to reduce contamination as long as they are preserve correctly. A good project, and operation and maintenance of the system are the simples and more efficient ways of preserver the water quality (Bertolo, 2006).

The water quality will be preserved with the adequate project. The quality of the water will improve during storage, as long there is no sun light and the microorganisms from the storage are excluded, and the water flux don't stir the sediment at the bottom. A good operation and maintenance of the water system will preserve the water quality. Regular maintenance and cleaning of the gutters, downpipes and storage will reduce the possibility of contamination. The weak maintenance of storage was been responsible for the potential health risks. Devices like "first flush" and filtering are not essential for the water supplies but they increase significantly the quality of the water. Treatment of the water in storage, should only happen if the done properly and to make sure that contamination doesn't happen again. There are different possibilities of treatment, most commons are filtration and disinfection, the treatment applied depend of the final use of the water (Bertolo, 2006).

4. Domestic rainwater harvesting and greywater treatment systems

Domestic water system can lead to a constant supply of water with good quality for uses in the domestic environment. This will have a good impact economically, socially and ecologically. These systems can lead to a more sustainable water supplies (Li et al., 2010) The use of both systems together can lead to a reduction in water need in the house (Stec and Kordana, 2015).

4.1. Domestic Rain Water Harvesting (DRWH)

This a renewable source of water is best for domestic uses. The water is use for toilet flushing, washing clothes, car washing and irrigation systems. This water can become potable if treated. This system can lead to a substantial saving of water (Li et al., 2010).

This systems, catch rainwater that falls in surfaces and is storage for later use. The harvesting is done in the roofs of the houses. The rainwater is harvested, along with any sediments, leafs or debris, in the gutters where should there be some filtering system. Then passes thru the downpipes, with one

other filtering system, for small debris, before going to the storage. The storage will be the most expensive part of the harvesting system. The storage must be chosen carefully having in account the capacity, material and location. The storage is where the last cleaning and filtering of the water happens, before it ready for non-potable uses (Sacadura, 2011).

All the elements from this system can be designed, developed and assembled from scratch, at the same time of the building construction. This can also be installed in already finish. The system is very similar but some parameter may change. They vary: in the space available, types of devices installed, use of non-potable water, economic factors, different uses of the system (Sacadura, 2011).

4.1.1Components

4.1.1.1. The catchment

The catchment is the surface where the water is harvest, this was to be impermeable. Normally, roof of house is used for the catchment in a domestic scale. The roof surface is very important, it construction material, will influence if the harvesting and quality of the water. Galvanised, corrugate-iron sheets, corrugated plastic and tiles are the best for roof catchment. This provide a reasonable water quality. The better the catchment surface the better the water quality and the more water will be harvested. Roofs can be built specially for rainwater harvesting but mainly a normal roof is very efficient (Li et al., 2010).

4.1.1.2. Runoff

The runoff system delivers the rainwater from the roof of the house to the storage tank, with gutters and downpipes. The most usual material used is galvanized steel, fibreglass and plastic. The most efficient at transporting water are semi-circular, this are hold by eaves and sloped to lead to the downpipes. The gutter size is determined by the area of the roof. The advised is that per each 1m2 of roof area the gutter should have at least 1cm2 measured in a cross sectional.
The proper design of the gutter will lead to a better work of the rainwater system, so there isn`t any overflow when the water is discharged to the storage tank. Splash-guard can be placed to prevent any overflow in the gutters. To an efficient rainwater system, cleaning devices should be in place, to prevent leaves and other debris to for reach the storage tank. Downpipes area is normally smaller them the gutters, in cross section, because downpipes are vertical, the water moves faster than in a gutter. The maintenance and cleaning of the downpipes and gutter is vital to the efficient of the system. If the system is well design and maintained, it should be able to lead more than 90% of the water to the storage

tank. The runoff system should cost some between 5% and 15%, using the normal metal or plastic gutters and downpipes (Li et al., 2010).

4.1.1.3. "First-flush" device

After a dry period, this device can be used to flush out water before she reaches the storage tank. This first amount of water can have a high percentage of pollutant. So normally the first time it rains in some time, the water is directed out. During dry periods some pollutant can be accumulated and deposited in the roof. So this first rain can be used to clean the roof surface, removing all the pollutant and other substances. The probability of the most load of pollutant to be in the first-flush is high so it direct out away from the storage tank (Sacadura, 2011 and Villarreal and Dixon, 2005). The amount of water to be flush out is determined by different parameter like time or roof area. This device is not essential to the work of the rainwater system harvesting but increases the quality of the water to be use later (Sacadura, 2011).

4.1.1.4. Filtering devices

Rainwater is harvest in the roof directed in gutters and downpipes, it doesn`t go straight to the storage tank, and water was to pass thru filtering devices. The filter stops any debris or other substances that come in the water from going to the storage tank. This filter need to be clean and maintained. It designed so only 5% of the water harvest is waste do lead the debris away. The rainwater still goes thru a special stainless iron mesh, to filter smaller debris or sand, this need to be clean check before and after the rain season so allow the water thru. All the filtering devices should be clean and maintained so they don`t block the water passage and develop microorganisms. This filtering device can vary in size depending on the size of the storage tank, to be the most efficiently (Sacadura, 2011).

4.1.1.5. Storage tank

The storage tank is where the rainwater is stored before being use. This is the most expensive part of the rainwater system, can be between 50% and 70% of the total cost of the system. The storage can be built inside the house or independently from it, this should be design and build with care to avoid future problem (Li at al., 2010). The tank can vary in material, shape and size.

The storage tank can be underground, semi-buried and above ground with supports or elevate from the ground. The storage tank can be built in different material, depending on it

location. The different material can be cement brick, concrete, metal or fibreglass (Sacadura, 2011). The tank can assume different shapes, cylindrical or rectangular, this vary if the tank is located above or underground. The tank should be watertight, durable and be able store the water with contaminating it. A tank above ground should be rectangular or square so it easier to construct. If the tank is located underground it shape is cylindrical, so it can resist the pressure made by the soil when it empty (Li et al., 2010). The size of the tank varies based on the amount of precipitation on site, consumption of non-potable water, duration of dry periods, area of catchment, number of inhabitants of the house, aesthetics, personal preferences and budget (Sacadura, 2011).

The choice of the tank is quite important, so it don`t get full to many time of spend empty most of the time. The first can lead to an insufficient supply of water to the house and the second to a reducing of the water quality because the water is no cycle so often (Li et al., 2010). In case of overflow of the storage tank the excess water will be directed to the public water supply system and if there is not enough water to supply the house it will supply by the public water supply system. When installing the storage tank, is essential to have a foundation and proper structure, the water was a considerable weight (Sacadura, 2011)

4.1.2. Treatment

The rainwater harvest need to be treated, so it can have different uses, but it non potable unless, it treated specify treatment for drinking. The treatments to improve the water quality are simple, while the treatment for potable water is much more complicated and expensive. There are some treatments that can be use that are not very expensive and ensure an adequate water quality (Li et al., 2010).

4.1.2.1. Disinfection

Rainwater can improve its microbiological quality by the use of chlorine. This is a very easy and normal way, to kill the micro-organisms. To apply the chlorine, the rain water, can`t be inside the storage tank, so it doesn`t create unwanted reactions with anything inside the tank. The amount of chlorine to be applied is of 0.4-0.5 per liter, except for some parasitic species that have resistance to that dose. The chlorine can be applied in tablets or liquid solution (Li et al., 2010).

4.1.2.2. Slow sand filtration

This is the cheapest treatment to improve rainwater

quality. This is a biological treatment that improves the bacteriological quality of the water before use. It consists of a filter with different layer of sand, this must be constructed very carefully. The layer starts with more thick part on the top and the finest on the bottom. For this to work effectively there must be a constant stream passing thru the filter. This method filtration produce water very low in nutrients. With this treatment the micro-organisms are majorly reduce but not completely eliminate from the water (Li et al., 2010)

4.1.2.3. Pasteurisation

This treatment combines ultraviolet radiation and heat from solar energy, this treatment is quite effective and low cost. The rainwater in place with in bags or bottle, then needs to reach 50° so there is a full oxygenation of the water. This treatment was proven successful in elimination of E. coli and other bacteria (Li et al., 2010).

4.2. Greywater treatment system (GW)

Normally water and wastewater management, can be complicate on an economic and social level, but with new innovation and life changes. In the future, with the shortage of water the reuse of wastewater and greywater can be a solution to preserve high quality water, reducing pollution in the environment was well to reduce cost of water supply (Al-Jayyousi, 2003).

Greywater system is a harvesting system for wastewater from the showers, sinks, baths tubs, washing machines, kitchen sinks and dishwashers. This harvest doesn`t include toilet, bidets and urinals, which are call black water. The amount of greywater produced in a domestic house is between 50% and 80%. The reuse of greywater can have significance in the water savings. With the use of greywater there will be a decrease for high quality water, which can be use by somewhere else. This water was low quality than rainwater, duo to dissolved contaminants in the water, from detergents and/or soap products. Only 6% of water in domestic is for drinking and cooking the rest, the rest of the uses can be harvest rain water or greywater, depend on the use. With treatment greywater is usable was a low quality water for toilet flushing, irrigation systems and car washing. Complicate treatment can be applied to greywater to make it viable for washing machines and baths, these treatments are quite expensive and consume a lot of energy (Li et al., 2010)

4.2.1. Characterization of greywater

The quality of greywater depends on the water supply, type of distribution system the activity of occupants of the house. It quality can be measure in different parameters

physical and chemical. Parameter like temperature, colour, turbidity and content of suspended solid are physical. If the water temperature is too high, there is a possibility of microbial growth. Biological oxygen demand, chemical oxygen demand, and the concentration of nutrients nitrates and phosphates are chemical parameters. It essential that the storage tank is well dimensioned, so it can be cycle very often (Li et al., 2010).

4.2.2. Treatment

Greywater system should fulfil some criteria: hygienic safety, aesthetics, environmental tolerance, and technical and economical duo ability. The treatment should be done immediately and the water reuse before reaching anaerobic state. The large variety greywater is one of the major difficulties. There can be a lot of chemical changes in the greywater duo to products that where use before. There are different treatments that can be use on greywater (Al-Jayyousi, 2003).

4.2.2.1. Basic two-stage systems

This treatment consists of rough filtration with disinfection after. The filter is compost of a metal mesh, for keep the large particles and pollutant. The greywater will be clear then it added the chlorine or bromine, in blocks or liquid solution. This treatment makes greywater safer to reuse, only meeting low quality standards. This process can fail some times because of the disinfection process, the level of coliform may become too high, no goo for human health (Li et al., 2010).

4.2.2.2. Physical process system

This system consists of depth filtration, with sand and/or membranes. This process can clarify the water substantially, especially the membrane system gives a constant obstacle to particle greater than the membrane material. This treatment will achieve a better water quality then the two-stage system, but this system needs a bigger amount of energy to function. The filter should clean often, to the system to be efficiently (Li et al., 2010).

5. Cost

5.1. Rain Water Harvesting System

The cost varies a lot duo to the size of the storage tank. The choosing of the tank depends on the size of roof area, number of occupants, if the tank in aboveground or underground will change the price. The cost should include

price of the small amount of the energy consumption. The return investment in the system should be between 7 to 20 year depending on the water and energy cost. If they increase rapidly the period can be smaller. The period can be further reduced with grants or funding from the government (Li et al., 2010).

5.2. Greywater Treatment System

The use of greywater treatment system is not very usual and popular. It cost vary will depend on what system is used and what will be the water applications. The cost can be reduced if used a large system for more water applications, for garden application and toilet flushing. A system just for toilet flushing it is too expensive and complex. The chemicals, energy for treatment and pumping, and maintenance need to be considered. The return investment depends of water volume used, but can take between 20 and 35 years for system using only toilet flushing, with other uses the period with be smaller (Li et al., 2010).

6. Combination of solution with rainwater harvesting and greywater treatment system and others systems

The use of rainwater and greywater can be the way to save high quality water, the water from this system can be used as non-potable source. The more frequent use of this system together, the easier and cheaper should be to manage, and preserve the other source of drinking water. With the constant growth of the world population and the expansion of city, and the continuous need for water and energy, most of it come from fuels or pollutant sources. In future more than today, it will be a big problem, how to produce energy that doesn`t pollute the world? The rainwater harvesting and greywater use, can become together with other energy source change. This can reduce the amount of water need in a house and the amount of electricity to heat it (Stec and Kordana, 2015).

To reduce the energy consumed to warm water in residential building, different equipment`s or system can be install with the use renewable energy sources, like solar energy. Solar energy would resolve the amount of energy spend in warming water. Other systems that could work together to reduce the amount of energy spend on heating, would be the use of more efficient heating system. With the technologic advances, have been found alternative solution like use of waste energy, which includes warm waste water (Stec and Kordana, 2015).

A heat recovery of waste energy consists of a drain water recovery unit with a heat pump. The heat recovery units work with heat exchange between the discharges of sanitary sewage and greywater that supplies the water system.

Depending on the location of hot water heater and device, the system can be vertical, horizontal or e.g a built in shower tray can be applied. This system uses productively the heat in the wastewater. This system reduces the amount of energy need to warm the water temperature (Stec and Kordana, 2015).

A financial analysis, was done for multi-family residential building, in Warsaw, Poland, where they applied the Life Cycle Cost method, to understand the use of this next solution: rainwater harvesting system, greywater harvesting system and drain water heat recovery units (Stec and Kordana, 2015).

This analyses use six different alternatives installation of water supply and sewage compared with which other and the traditional installation (Stec and Kordana, 2015). Variants were:

-Variant 0 - the traditional installation;

-Variant 1 - installation of a heat exchange for energy recovery from wastewater discharged from the shower;

-Variant 2 - installation using greywater for flushing toilet bowls;

-Variant 3 - installation using greywater for flushing toilet bowls, washing and watering the green areas;

-Variant 4 - installation using rainwater to flush the toilet bowls;

-Variant 5 - installation with the use of rainwater for flushing toilet bowls, washing and watering the garden;

-Variant 6 - installation using greywater for flushing toilet bowls, washing and watering the green areas and a heat exchanger for energy recovery from wastewater discharged from the shower (Stec and Kordana, 2015).

The analyses revealed that use of the installation systems with alternative sources of water and energy are viable. Also showed that Variant 0 compared to the other variant is never the more viable. In all the comparisons there are advantages and disadvantages. All the alternative, except Variant 0, have high investment cost (Stec and Kordana, 2015).

Conclusion

This shows the importance of water to the world was a resource. Presents solutions that do an efficient use and reuse of water, that can preserve the potable water source. This concludes:

-that there is a need for reducing on the water consumption, and rainwater harvesting and greywater treatment system can help reduce the amount of high quality water in uses that can use lower water quality, with this water management can be easier and more efficient;

-that the rainwater harvesting and greywater treatment system can be financial successful, if they have a proper design, construction and maintenance, even they may have a

high investment it will be returned;

-that the use of traditional solution, without the rainwater harvesting and greywater treatment system, is more expensive that with the different presented that use the system;

-that both this systems of water harvesting are rentable being use separately or together;

-that the use of this system instead of the public water supply, will reduce the cost of the public water supply system, so the government should encourage the use of this system with may be incentives or supports;

-that this system could be use in different scale, applied to small city not just a building;

-that rainwater harvesting and greywater treatment system can be use along with other renewable energies.

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Figures

All figure in the book were taken or made by the author. With the exception:

Fig. 3-11 :Visit Aalborg, (n.d.). *Visit Aalborg*. [image] Available at: http://www.visitaalborg.com/ln-int/aalborg/tourist [Accessed 11 Aug. 2016].

Fig. 30-34 were provided by Aalborg Kommune

Drawings

Insights Discovery Personal Profile

08 February 2016
Joana Ramos Inglês

University College Nordjylland

Annex 1

Introduction

This Insights Discovery profile is based on Joana Inglês's responses to the Insights Preference Evaluator which was completed on 08 February 2016.

The origins of personality theory can be traced back to the fifth century BC, when Hippocrates identified four distinct energies exhibited by different people. The Insights System is built around the model of personality first identified by the Swiss psychologist Carl Gustav Jung. This model was published in his 1921 work "Psychological Types" and developed in subsequent writings. Jung's work on personality and preferences has since been adopted as the seminal work in understanding personality and has been the subject of study for thousands of researchers to the present day.

Using Jung's typology, this Insights Discovery profile offers a framework for self-understanding and development. Research suggests that a good understanding of self, both strengths and weaknesses, enables individuals to develop effective strategies for interaction and can help them to better respond to the demands of their environment.

Generated from several hundred thousand permutations of statements, this profile is unique. It reports statements which your Evaluator responses indicate may apply to you. Modify or delete any statement which does not apply, but only after checking with colleagues or friends to identify whether the statement may be a "blind spot" for you.

Use this profile pro-actively. That is, identify the key areas in which you can develop and take action. Share the important aspects with friends and colleagues. Ask for feedback from them on areas which seem particularly relevant for you and develop an action plan for growth personally and interpersonally.

Overview

These statements provide a broad understanding of Joana's work style. Use this section to gain a better understanding of her approaches to her activities, relationships and decisions.

Personal Styles

Joana is seen by others as pragmatic, dependable and able to get things done. She usually finds stress and chaos tough to handle. Because she is conscientious and traditional, she is bound by her sense of duty and commitment. Joana values people who take the time to understand her personal goals and values. If she makes a serious mistake at work she may feel guilty for a long time.

Whatever she is doing she will accomplish with orderliness and reliability. She tends to be fiercely loyal to her friends, prepared to sacrifice her own wants for the needs of the other person. She values and adheres to established

routines and procedures and for her there will always be some work yet to be completed. Joana is realistic and dependable. She is aware that she may become the back-office expert in her role.

She relates to, remembers and builds on positive experiences. In order to perform at her best she prefers specific and detailed instructions before starting a task. Her strength is her ability to work independently. She tends to be good with practiced tasks, interested in the how and the why of the working. She is usually neat, tidy and orderly, both at work and at home. She tackles her work very seriously and in a matter-of-fact and orderly manner, placing importance on the reading of instructions and detailed procedures.

Her modest manner can restrain her from pushing herself forward and this occasionally results in her being under-valued. Her strength is her ability to act correctly and to stay with projects until they are complete. Joana prefers to live her life in a structured and organised manner and prefers to work within established guidelines on tasks requiring detail and routine implementation. She greatly prefers to trust what she can hear, smell, taste, touch and see, rather than accept abstract or intangible ideas. Joana is dependable and responsible, with a high sense of duty.

Occasionally, her private reactions can be intense, even unpredictable and out of character, but they may not be visible to others. Her strong sense of personal values may make her reserved around strangers whose values she feels may conflict with her own. Offering a stabilising presence in the organisation and accepting her roles and responsibilities, she sees this as simply doing her duty - "doing what should be done". She needs to take care to put forward her own accomplishments, otherwise she may be overlooked. She is just as concerned with the process as with the outcome.

Key Strengths & Weaknesses

Strengths

This section identifies the key strengths which Joana brings to the organisation. Joana has abilities, skills and attributes in other areas, but the statements below are likely to be some of the fundamental gifts she has to offer.

Joana`s key strengths:

- Learns from experience - won`t get hurt by the same situation twice.
- She is logical and works well on "task" as well as "people" issues.
- Usually reads non-verbal signs effectively.
- A steady day-to-day planner.
- Consistent and trustworthy.
- Looks before she leaps.
- Lives in and for the moment.
- Finishes things that she has started.
- Practical in finding solutions.
- Relaxed about what others may think of her.

Possible Weaknesses

Jung said "wisdom accepts that all things have two sides". It has also been said that a weakness is simply an overused strength. Joana's responses to the Evaluator have suggested these areas as possible weaknesses.

Joana's possible weaknesses:

- Can seek perfection, yet underrates and underestimates her contribution.
- May not express her opinions as quickly as the situation warrants.
- May have to work at being more action orientated.
- Tends to be drawn into "splitting hairs".
- Finds it difficult to say "no" if relationships are being threatened.
- Dislikes disruptions and sudden change.
- Her need to assimilate information takes time. This may frustrate others who expect a more immediate response.
- Tendency not to act until all the facts are available.
- May lack objectivity, particularly where rapid change is concerned.
- Can miss opportunities by being cautious around strangers.

Value to the Team

Each person brings a unique set of gifts, attributes and expectations to the environment in which they operate. Add to this list any other experiences, skills or other attributes which Joana brings, and make the most important items on the list available to other team members.

As a team member, Joana:

- Bonds by remembering birthdays and special events.
- Can adhere to high standards.
- Will not be easily distracted by emotional events.
- Organises facts and gathers information.
- Encourages team allegiance.
- Accepts responsibility for the task completion.
- Is willing to make a unique contribution.
- Is a dedicated supporter of the team.
- Keeps her shoulder to the wheel.
- Enjoys intellectual stimulus.

Communication

Effective Communications

Communication can only be effective if it is received and understood by the recipient. For each person certain communication strategies are more effective than others. This section identifies some of the key strategies which will lead to effective communication with Joana. Identify the most

important statements and make them available to colleagues.

Strategies for communicating with Joana:

- Expect some resistance if you are suggesting change.
- Deal with "here and now" projects.
- Do not let her hide behind complexity and privacy. Maintain her focus upon outcomes.
- Expect her to come back later for clarification.
- Give her verifiable facts.
- Encourage her to consider flexibility and change.
- Take care that you don't overload her.
- Allow time for her the opportunity to express her feelings.
- Give her advance notice and time to prepare.
- Maintain a serious disposition.
- Be careful to maintain the status quo.
- Allow her to explain the logic behind her views.

Barriers to Effective Communication

Certain strategies will be less effective when communicating with Joana. Some of the things to be avoided are listed below. This information can be used to develop powerful, effective and mutually acceptable communication strategies.

When communicating with Joana, DO NOT:

- Use her quiet demeanour to seek to dominate or control.
- Spend too much time talking; she is more impressed by your actions.
- Undervalue her ability to make essential contributions.
- Ask lots of questions in quick succession.
- Discourage her participation by forcibly suppressing her viewpoint.
- Be oversensitive to her critical nature.
- Make promises you cannot or do not intend to keep.
- Focus on personal relationships.
- Criticise her need for solitude.
- Be too loud and hearty.
- Dismiss her work, ideas or opinions lightly.
- Speak in generalities.

Possible Blind Spots

Our perceptions of self may be different to the perceptions others have of us. We project who we are onto the outside world through our "persona" and are not always aware of the effect our less conscious behaviours have on others. These less conscious behaviours are termed "Blind Spots". Highlight the important statements in this section of which you are unaware and test them for validity by asking for feedback from friends or colleagues.

Joana`s possible Blind Spots:

Joana sees the world in terms of black and white, hands-on, reality, in which she can develop a series of procedures and regulations that will take care of the situation in hand. She has a tendency towards perfectionism which leads her to refine and polish her ideas to a point where they may even fail to emerge. She can be reserved and hard to get to know, only willing to share her inner feelings with people she trusts.

She may rely so much on her logical, analytical thinking that she overlooks the people issues. Because of her self-containment, she has difficulty sharing her reactions, feelings and concerns with others; it seems unnecessary for her to do so. Attempting to be more flexible and open-minded will help prevent Joana from becoming too rigid. Quiet and reserved, she may appear cool and aloof. She is inclined to be guarded except when with close friends or colleagues of long standing. She may have difficulty accepting what others have to say if it varies from her own certainties.

She may be seen by some as unresponsive, cool and uncaring, as one who constantly seeks correctness, predictability, analysis, logic, routine and systems. She is good at tasks which require accuracy and attention to detail and has a highly developed ability for critical perception, which may make her appear rather distant at times. A potential failing for her may be that she may not gain sufficient intimate experience of the world. As she is constantly on the alert for new sensory information and prefers to keep her options open, she appears rather indecisive to some people. Her inherent fear of what could go wrong makes her very wary about taking decisions that appear in any way risky.

Opposite Type

The description in this section is based on Joana`s opposite type on the Insights Wheel. Often, we have most difficulty understanding and interacting with those whose preferences are different to our own. Recognising these characteristics can help in developing strategies for personal growth and enhanced interpersonal effectiveness.

Recognising your Opposite Type:

Joana`s opposite Insights type is the Motivator, Jung`s "Extraverted Intuitive" type.

Motivators have the ability to equally value results and people. They dislike detailed work but can do it to achieve a specific short-term objective. They enjoy assignments that they believe makes them look good. Joana may often see them, however, as too optimistic about what they and other people can produce. Motivators may be difficult to manage. They are not natural administrators.

Joana may perceive the Motivator as indiscreet and sometimes hasty. Motivators need a variety of activities and the opportunity of working in an environment with other people. They may become workaholics if not aware of their limits. Motivators often seek material dominance, social

standing and status. They detest routine, detail and close supervision and can be devious or even chameleon-like when something or someone gets in their way.

Joana will often sense a large ego in the Motivator and may wonder why the Motivator would much rather engage in brief, intellectual banter than conclude some task or spend some quiet time on their own. The Motivator may not remain totally committed to a schedule or project if a better or more exciting challenge appears. They can often neglect important preparations that they consider unnecessary.

Opposite Type

Communication with Joana's Opposite Type

Written specifically for Joana, this section suggests some strategies she could use for effective interaction with someone who is her opposite type on the Insights Wheel.

Joana Inglês: How you can meet the needs of your Opposite Type:

- Encourage her to stick to the agenda.
- Provide dates and timescales for completion.
- Appeal to her open style of decision making.
- Don't always expect brief, specific answers.
- Add to the challenge and opportunity regularly.
- Support her goals with suggestions for achievement.

Joana Inglês: When dealing with your opposite type DO NOT:

- Be surprised if she breaks the rules.
- Leave her out of the picture.
- Impose final judgements on her views and opinions.
- Forget to agree outcomes or decide conclusions.
- Spend too much time discussing "what ifs".
- Create a hostile environment devoid of feelings.

Suggestions for Development

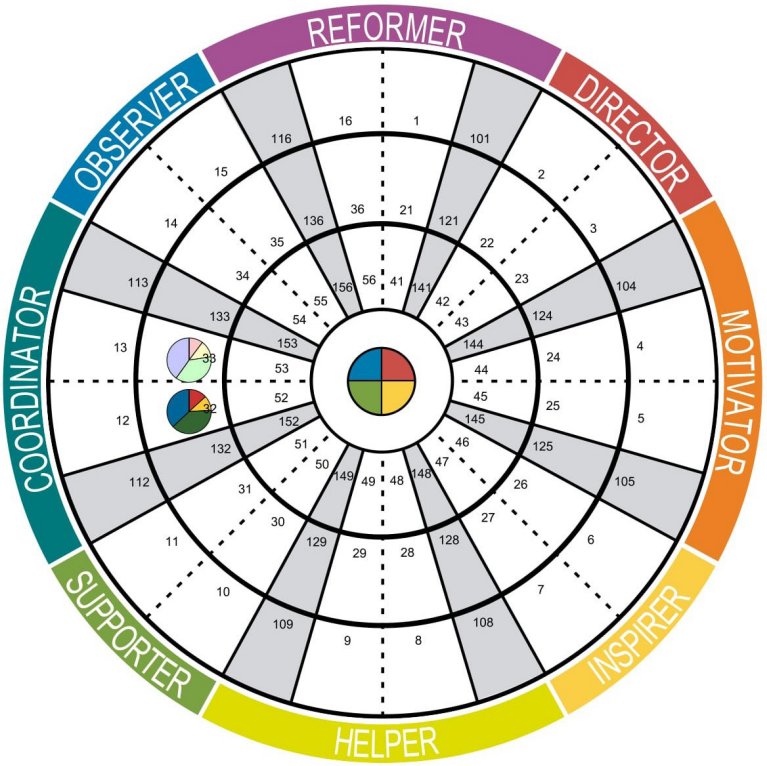
Insights Discovery does not offer direct measures of skill, intelligence, education or training. However, listed below are some suggestions for Joana's development. Identify the most important areas which have not yet been addressed. These can then be incorporated into a personal development plan.

Joana may benefit from:

- Changing her perception of aggression being a weakness to that of an essential gift that is occasionally necessary to get things done.
- Bouncing back, rather than withdrawing when she feels disappointed.
- Attempting to respond more quickly to her more extraverted colleagues.
- Acting without necessarily considering all the longer term implications.
- Maintaining a greater balance between her feeling and her objectivity.

- Taking positive action to release her potential.
- Taking the opportunity to make group presentations.
- Going out of her way to tackle something new and different.
- Accepting the inevitable and taking action.
- Being more open more quickly about what she really feels.

The Insights Discovery 72 Type Wheel



Conscious Wheel Position
32: Supporting Coordinator (Classic)

Less Conscious Wheel Position
33: Observing Coordinator (Classic)

The Insights Discovery Colour Dynamics