Sustainable innovation park.

Synopsis

This project aims to develop a public place for education and business collaboration, providing place for innovation. This innovation park will integrate sustainable construction qualities in technical considerations and architectural expression of the building, as well as bringing the green space qualities in to the urban city.

Title: Sustainable innovation park

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Introduction

The world is changing all the time, population continues to increase, which causes demand for more houses, buildings and public infrastructure. Energy consumption, waste production and water consumption continues to increase. The building sector must recognise the impact of global warming as well as limited energy resources.

Therefore there is need to change the way of designing new buildings to reduce their negative impact on the environment. Using sustainable constructions can improve not only energy efficiency and building impact on environment but resource efficiency as well.

"*Public space is space we share with strangers, people who aren't our relatives, friends, or work associates. It is a space for politics, religion, commerce, sport; space for peaceful coexistence and impersonal encounters. Its character expresses and also conditions our public life, civic culture, everyday discourse*" [Walterz 1995, 320]

For the building site I have chosen Karolinelund area in Aalborg city centre, where there has been an Amusement Park. As the area has been attractive to children, young and other people throughout the years, it's important to keep this function for the area. For master plan it has been chosen to keep 3rd semester projects public park master plan, in the same time keeping Aalborg municipality image of area, as green space for experiences, culture and leisure.

The best practices to get greater goals and innovation in business are cooperation between theoretical knowledge and real life experience. Therefore this project focuses on the development of a public building where education and business meets and collaborates combining architectural qualities. This public building should offer place not only for education and business but as well for free time activities, giving all these possibilities for those people who like to be active and creative in their free time while developing the talents and interacting with other people at the same time. Which means the project focuses on three user groups: students, companies and Aalborg residents, providing them educational use functions, business use functions and free time creative functions.

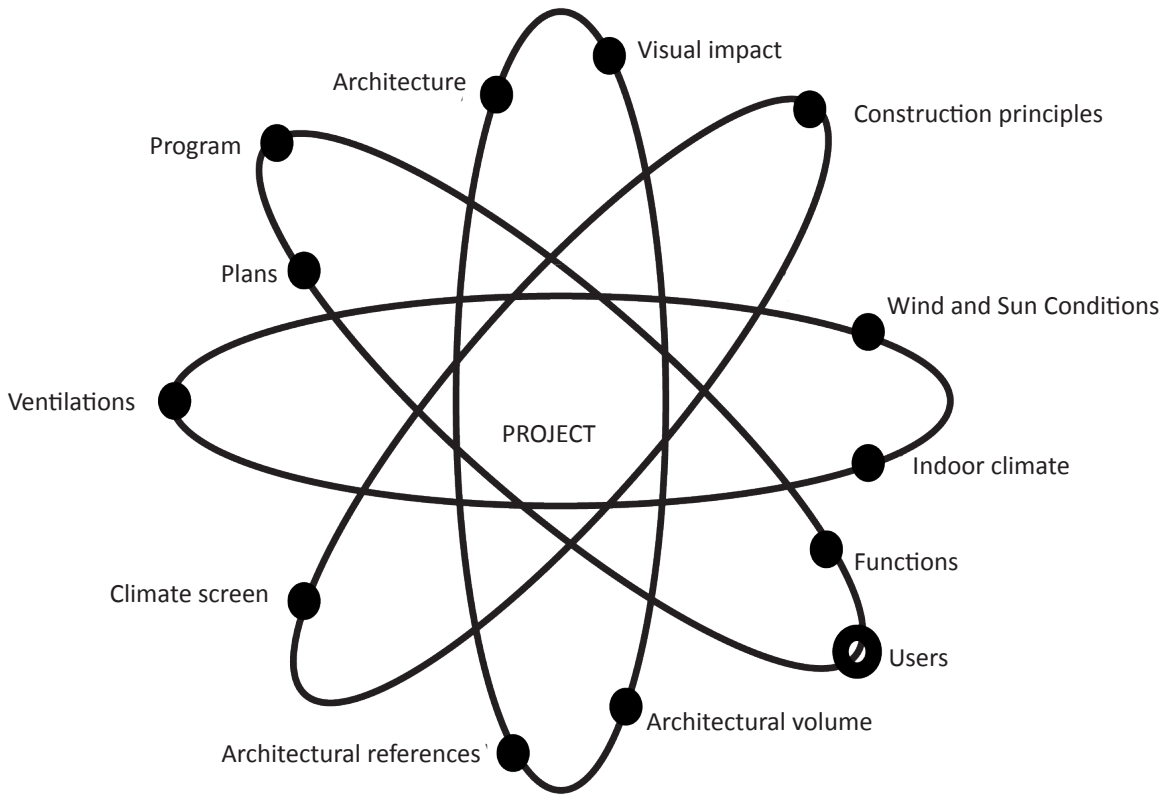
Problem formulation

How to combine different functions in order to make place attractive and suitable for creative work and cooperation. In the same time creating connection between Aalborg busy city centre and open residential area.

How to use construction materials in a way that it provides architectural expression for the building while improving visual and aesthetical qualities and in the same time providing good technical qualities.

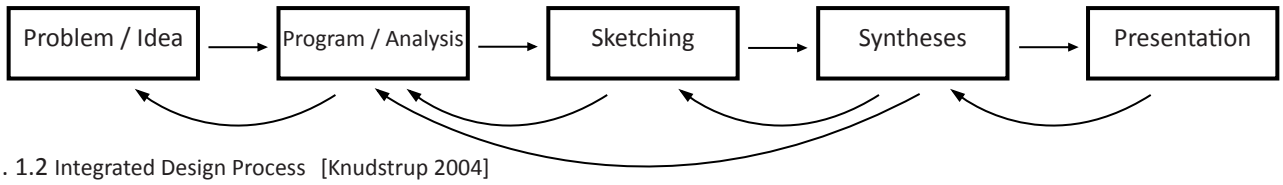
Method

This project uses integrated design process, where the architecture and the technical inputs are use from the beginning of the process, and an integrated design is an interactive process when choices has to be taken after considerations all the time and this choices must be considered again and again. The aim of this method is to combine architecture, design, functional aspects, indoor environment, technology and construction.
The project is developed in three scales – local context scale, Karolinelund scale and building site scale. First outline proposal relative to the city is based on three scales. The 3rd scale is based on the five phases – problem formulation, program and analysis, sketching phase, design phase and presentation. In all the process is used integrated design process.



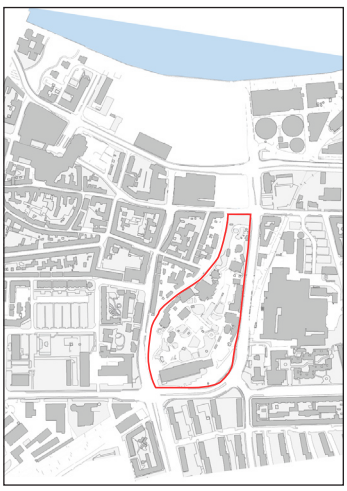
Ill. 1.1 Integrated Design Process [Knudstrup 2004]

The integrated Design Process consist of different phases:

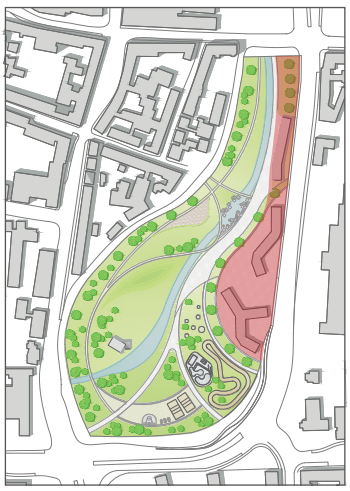


Ill. 1.2 Integrated Design Process [Knudstrup 2004]

Ill. 13 Local context



Ill. 1.4 Karolinelund context



Ill. 1.5 Building site context

Building site context are based on five phases:

Problem / Idea.
The problem statement and method, which will be used in project.
Program / Analysis
The cultural, historical and economic aspects. The initial phase develops structural, architectural, operational and environmental conditions around the site. The Program goals are to achieve a greater understanding of the site, conclusion and design criteria's, which will be base to start sketching phase.
Sketching
Sketching phase starts with vision and design parameters, which is based on initial program and analysis. It includes theory and references where the goal is to highlight the interrelationship between the perspective themes. References and theory is used as starting point.
This phase is base on generation of ideas and design development. It must transform vision into a real concept.
Synthesis
Synthesis phase includes final architectural, structural and technical considerations.
Presentation
The presentation presents a draft proposal for the project.

01 Program.

The site

1.1. Introduction

This chapter aims to give overview of the site. Mapping and site analysis is developed in 3 scales – local context scale, Karolinelund scale and building site scale. Furthermore the subchapters include historic, contemporary and future perspectives for the site.

The site is located in Aalborg city in old Karolinelund area. The site has been situated between active city centre to the west, calm residential area to north, industry area to the East and Limfjord to the West.
Being an old Tivoliland that had an important purpose in the town development and certain livelihood. Since 1947 it has been a Amusement Park and in 2010 it has been closed. As the area has been attracted by children, young and other people through the years it's important keep this function for the area. It means develop area as new place what could attract a wide audience in all ages and social classes and in the same time provide indoor public space, creating place as mix use public space.

Ill. 1.6

1.2.History of the site

1825 – in this area existing swamp was transformed in to the place for military activities.

Afterwords this area was named „Caroline lund" because of Frederick VI's dauther, Princess Caroline.

From 1850 to 1935 place was taken over by Aalborg County Farmers' Association.

At the end of 1800s a new channel from Gabriel to Teglgårdharbor was excavated. The canal was covered in 1942

In 1946 brothers Carl Bro and Volmer Lind had progress in Aalborg with their itinerant "Tivolipark Denmark" and the year after in 20 April 1947, opened "Tivoli arolinelund". The park closed in after the 2010 season.

The park served as a haven and an oasis in the city centre for the citizens and guests. It has been place where people want to enjoy the day between beautiful enviroment. Karolinelund offer a varied selection of restorants, children rides and playgrounds where families could get a good experiance. Trough the time this place has been full with child laughts, happy faces and it presents a atractive and fun place.
[Karolinelund Baggrundsinrormation, 2011]


Ill. 1.7


Ill. 1.8


Ill. 1.9

1.3. The site today

The intention was initially to restore Karolinelund, so the area could be used temporarily during theplanning process, but the municipality decided to postpone new construction until Karolinelund future is clear. After demolishen works in the site 'Påfuglen' and Tæppeland building has been retain. As well as stage, statue anf fountains.

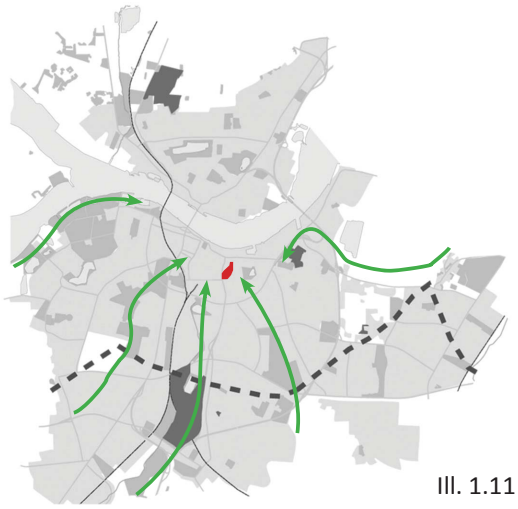
Today the area are closed for the public until the new plans for the area is determined.

Ill. 1.10 Own photos collage

1.4.The site local context

Green structure

The green structure is partly connected with the city. Karolinelund green area could be reason to continue the green structure from the south.



Ill. 1.11

Blue structure

Limfjord is the primary blue structure in Aalborg. The connection to the fjord and the waterfront become the important focus in the urban development. Mainly this water front is used for for yachts, cargo ships and all sorts of games and sports. Through the site is running under the ground old Østerå.

Ill. 1.12

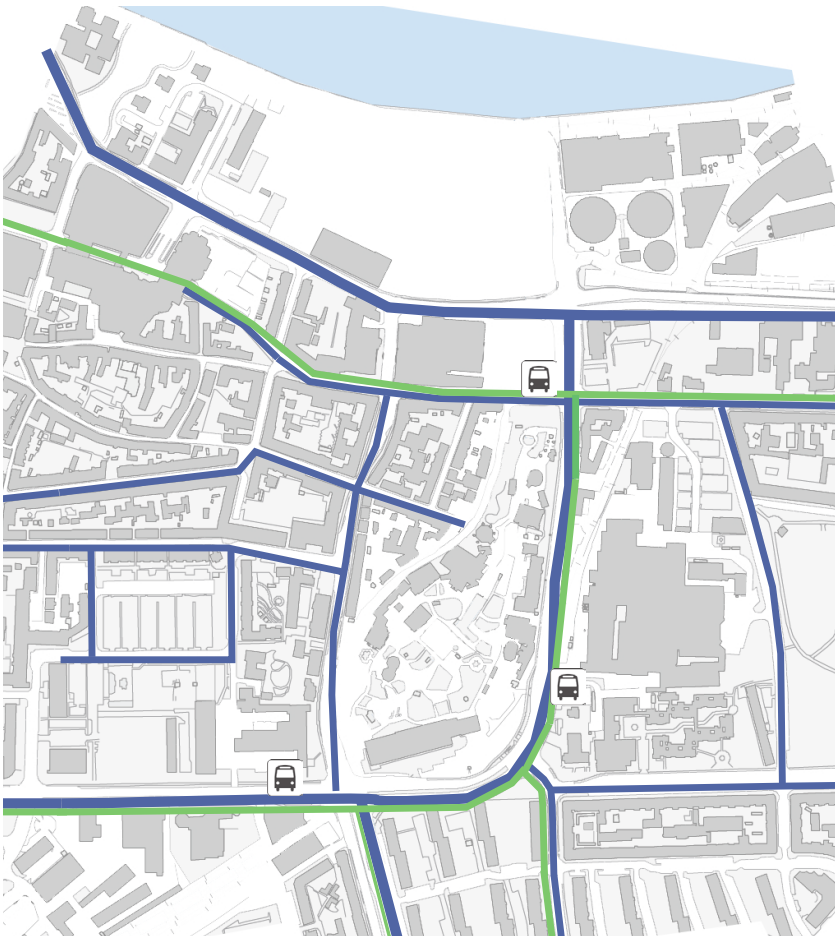
Main infrastructure

The site is located between the E45 highway and railway system. To the west is railway sistem and to the east is E45 highwaiy. From the site hightway is 5 min away by the car, and train station could be reach in 15 min by pedestrian (1 km). [Aalborg Kommuneplan,2009 1]

Ill. 1.13

1.5.The Karolinelund context

Infreastructure



Ill. 1.14 Map for the transportation

Ill.1.15 Kjellerupsgade

Ill.1.16 Jyllandsgade

Transport flows

The site is surrounded by traffic from busses, cars, bicycles and pedestrian. The main movement and flow is concentrated on east - north side of the site.
The main traffic is on Nyhavnsgade, Karolinelundsvej and Jyllandsgade. Thoses streets carries traffic around 8,000 vehicles per. day. Jyllandsgade acts like access to the bus therminal, main train station and city centre.
The location next to the traffic node can make the site less attractive as recreational area, but in the same time it can be as a good access point to the area.

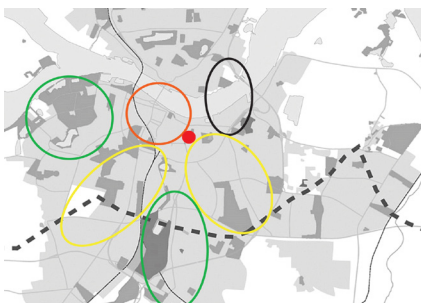
Public transport

Public transportation around the site is quite extensive. There are more bus stops which are in direct connection with the site. This applies city buses and regional buses. The main bus routes are along Østerbro that connects Aalborg East and downtown as well bus traffic from Sohngårdsholmsvej south which are dividing respectively Karolinelundsvej and Jyllandsgade.
Along the Karolinelund are passing regional bus routes from Nørhalne, Aabybro, Uttrup, Strubjerg, Airport North, Gistrup, Nøvling, Certain, Gug, Klarup Storvorde.

Functions

Ill.1.17 Map showing the functions in the area

Ill.1.17 Residental buildings



Ill.1.18

The procejt area lies between different types of buildings. In surrounding there is a mix of cultural, business, commercial and restaurants and residential housing – multi storey buildings. To the east is industrial area and park.
To the west area is marked by public services buildings like police, fire department, church, kindergarten, town administration.
To the North from Tivoliland is Aalborg central waterfront, where is range spaces with different function. Like Jomfru Ane Parken with sport activities, restaurants and outdoor swimming pool. Aalborghus Castle Square, Utzen Centre, House of music and as well Platform 4. All this area is create as a mixed urban area. To the south is large residential area.

Green areas

public green area private green area

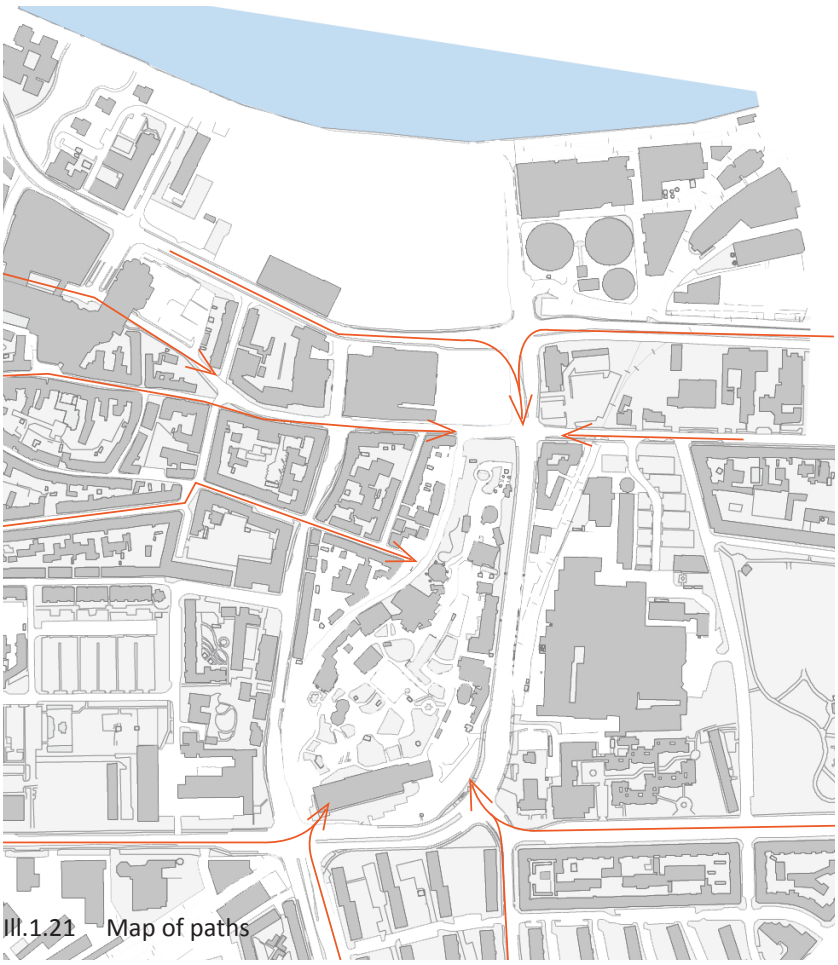
Ill.1.19 Map of the green areas

Ill.1.20 Own photos collage

Tivoliland is a green space at the edge of the central downtown. The green space will gives an important role in the development of Aalborg.

On the East of the site is Østre Anlæg park, who has public functions with opportunities to play volleyball, football and aswell spend time with children in a playground .
Mainly around the site is green spaces what is integrated into the design of the inner courtyards from the urban layout buildings. This one has a private character, what is for private use.
As the Municipality plans for the future is to create a green link from the east valley in the south to the fjord through Tivoli area. Therefore in this area is important to focus to green design of the site.

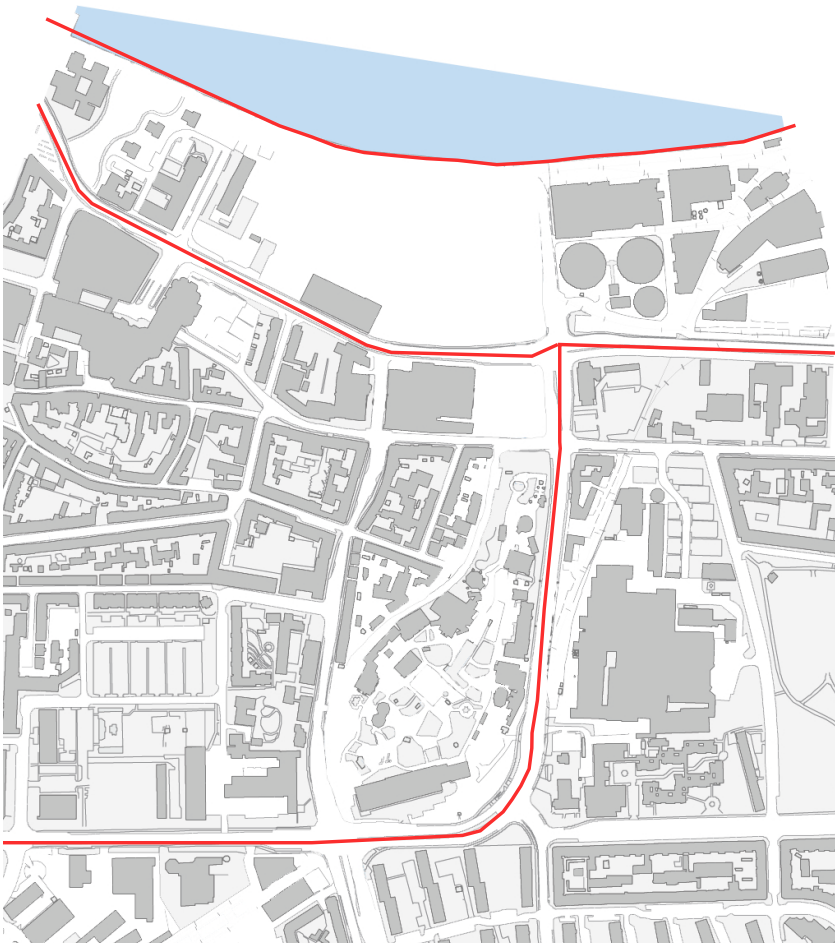
Paths



Ill.1.21 - Map of paths

Paths are the major and minor routes of circulation that people use to move out. It shows main routes which people use mostly to reach the site area.
Main paths from city centre to the Karolinelund leads people from Nytorv and Aalgade trough Østerbro. As well one of main paths from city centre to site go through Danmarksgade.
Along the Limfjord from the West and from the east main paths go through Nyhavnsgade, which can be used for cars and pedestrians.
Østerbro and Fyensgade lead people to the site from east side residential areas. From south side residential areas main paths are on Bomholmsgade and Sønderbro. From Train station and Bus terminal main path to the site is on Jyllandsgade.

Edges

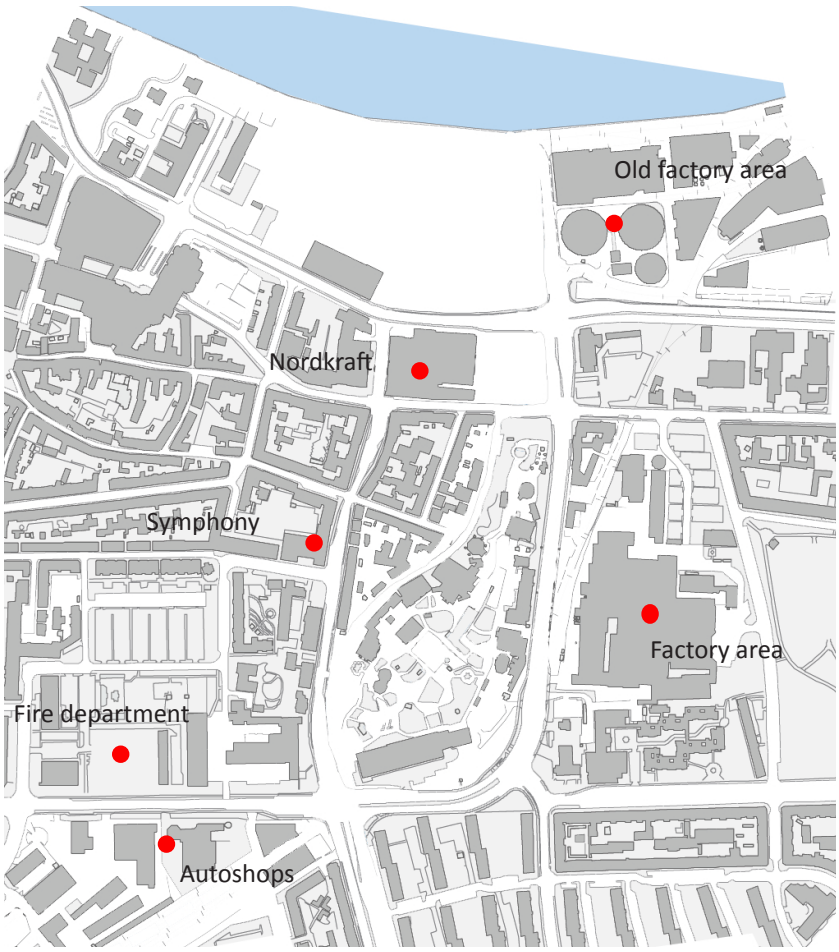


Ill.1.23 Map of edges

Edges are dividing lines between districts. They are boundaries between two phases. Around the site most clear edge are limfjord, where stops all paths, roads and movement.

Another edge around the site are Jyllandsgade and Fyensgade which are high traffic roads dividing site and residental areas to the south. These streets are not easy to be crossed, but still Jyllandsgade is important path from the Train station to the site. Karolinelundsvej is as well high traffic road, which divided karolinelund and factory area. Nyhavnsgade is minor edge. This street to the east divides old factory area to the west area along the limfjord.

Landmarks



Ill.1.24 Map of landmarks

Landmarks - simply defined physical objects: buildings, store, statue tec. Landmarks can be very small and can only be seen close up.
Around the site major landmarks are Nordkraft, old factory area and factory area to the east with their high chimneys.
As a minor Landmarks can be marked Symphony on Kjellerupsgade, auto shops, Police and fire department on Jyllandgade.
As more specific landmarks are Munk's eftf. bike store on Løkkegade and Søndergade corner; Cafe Nordkraft on Kjellerupsgade and Østerbro corner and Shell gas station to the east from the site.


Old factory area


Factory area


Nordkraft

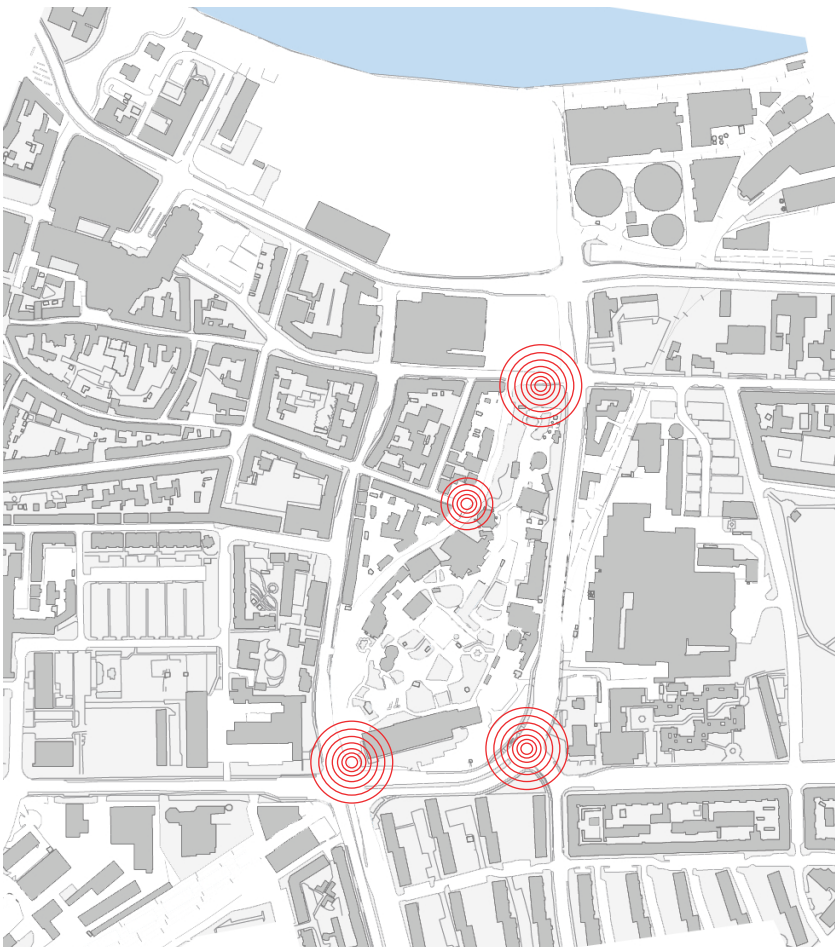

Fire department

Symphony

Auto shops

Ill.1.25 Own photos collage

Nodes



Ill.1.26 Map of nodes

Nodes - the strategic points that people can enter the site.
For Karolinelund there are two nodes which are naturally formed. One of them are in the site South-West part - main access to the Karolinelund, where is main pedestrian routes from train station and bus terminal. Other one is in northen part - where is pedestrian routes from the city center, Limfjord and from residental areas from east.

Smaller pedestrian flows leads people from center to the Karolinelund along the Denmarksgade, so one minor nodes creates in west part of the site.
From Fyensgade and Bornholmsgade pedestrian and transport flows creates a node point in a East-South side of the site.

1.6.The Building site context

Ill.1.27 Map of building site area

As a framework for building site has been chosen masterplan from 9th semester project, where has developed sustainable cultural and creative public space in Aalborg, which focuses on the social and environmental aspects, creating social active place where people can interact. The site becomes as a connection between a live city centre and residential area.
For the building site has been chosen master plan eastern part, where was located buildings. Masterplan from previous stage will be used in master theses project, keeping the same functions in a park - park / recreation area, sport area, waterfront and public area.
Building site area is 10161 m2.

1.7. Framework for the project

The starting point for the conservation of Karolinelund is not clearly defined from the political point. As there is still debate about Karolinelund there is no local plan for buildings. After debate about Karolinelund in November 2011 municipality set a main objectives for the site:

- Retain the green areas with attractive and distinctive trees.
- Cultural elements such a stage, lane track and the statue of Karolinelund founder Volmer Lind also should be retain. Until the area's future is clear, preserved also the buildings as 'Påfuglen' and Tæppeland, fountains, paving, flower pots and the wall around Karolinelund. The rest of building has been removed.
- Create the green link through the area in connection from Østerådalen in the south via Karolinelund right out to the fjord.

From municipality view for future transformation should include:

- The desire to create good environment for experiences, culture and leisure.
- The desire to maintain a green profile in the area.
- The desire to secure land for the eventual opening Østerå through the area.

On the political side, the main argument for the Karolinelund has been constant bad economy. In a future planning area should be the economic base so that site can be used for other purposes. Aalborg municipality owns the land and can control development, but as well has possibility to attach external partners who financially as well as practical can help. This makes development opportunities wider. [1]

Conclution

The sum up of the analysis part will provide some guidelines for the design part.
Conclusion from the previous project mapping has been taken in to consideration. Keeping the municipality main objectives for the site, it will function as well as a park and green link between east valley into the south and Limfjord.

Kevin Lynch mapping improve previous project analysis about access to the site, Paths and main Nodes clearly shows main accesses to the site, which is located in the same place as existing access in the master plan.

One of the clear edges which can affect the site is Karolinelundsvej. It's high traffic road who is not used often for pedestrians. It can be consider as an access to the site for cars.

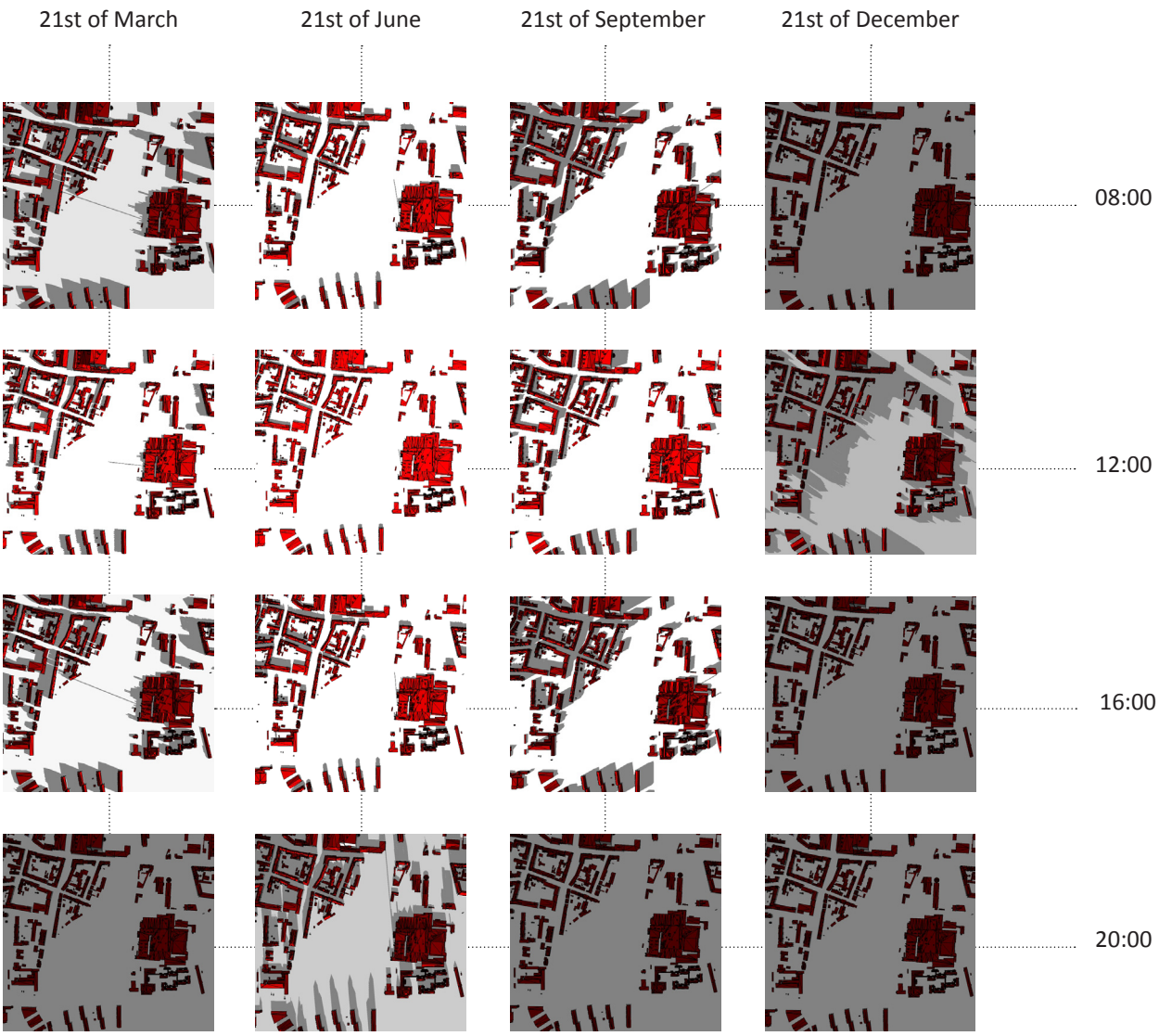
The building site has been chosen eastern part of site plan from 3rd semester project, where was located as well buildings.

1.8. Enviromental conditions

Introduction

Enviromental conditions and factors affect every place, therefore several enviromental factors are examined. It have to be taken into considerationin design process.
Danish weather is extremely changeable. Denamark is situated in the edge of the European Continent, winters are warm and summers cold. Compared to other geographical areas on the same time latitude, Denmark enjoys a relatively warm climate.

Ill.1.28

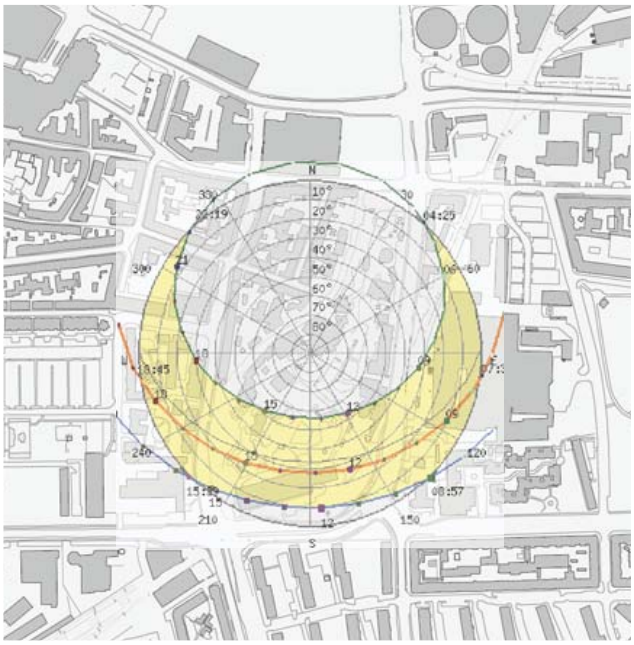


Ill.1.29 Shadow analysis

Sun path and shadows

The climate or average weather is primarily function of the sun. During the day and year the sun will follow different paths on the sky. In Aalborg the sun path in winter time is shorter and lower and in summer time it is longer and higher.
In summer day, the sun angle at midday reaches angle up to 57° while the day lasts from 4:25 am, till 10:19 pm. In winter time situation changes, with midday sun angle at 10° and the span of the day from 8:57 am till 3:49 pm.

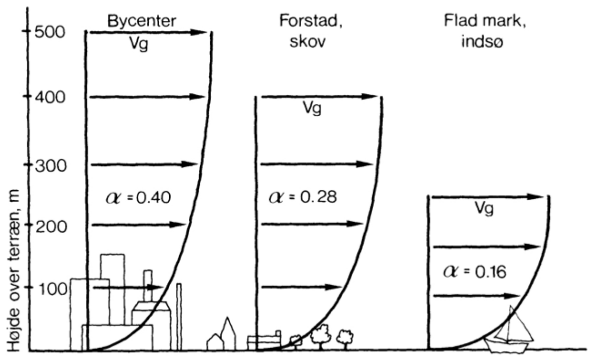
In the east and south part of the site there are no high buildings. On Kanalstien Street there is few buildings and as well Nordkraft can shadow the site west part, but it does not affect building site.
Around the building site there is no one building who could affect and shadow the building site.



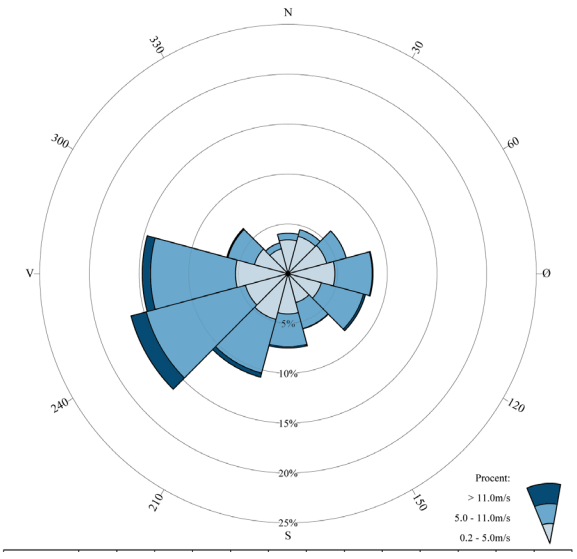
Ill.1.30 Sun path diagram on the site

Wind

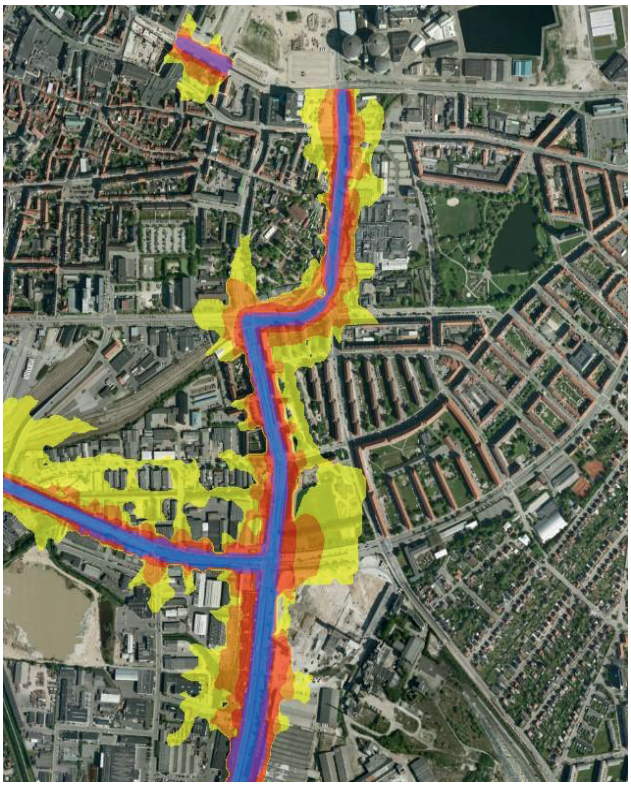
The wind rose show the distrubution of wind direction and speed. They are measured in Aalborg.
The wind is a key factor of Denmark's daily life. It is mostly windy, calm situation begin rare and the weather changes according to the wind directions.
The dominant wind direction in Aalborg is West-Soutwest. Westernly wind from the sea typically brings relatively homogeneous weather both summer and winter. Mild in winter and cool during summer, often with rain or showers. If the wind comes from the east or south, then during the summer weather is hot and sunny and in winter time cold. [Ayser Dawod Selman, 2011]
Average wind speed in Aalborg is 5,3 m/s. In this wind speed it's like gentle breeze, when leaves and smaller twings in constant motion.
As the dominant wind direction is West-Southwest it can have impact on the site during whole year, as in this part of the site surroundings does not have high buildings that could hold the wind. As well wind from North has impact on the site, as there is clear access from Limfjord, but as Northern wind is not dominated wind in this area it will have not so big impact on the site.



Ill.1.31 Wind velocity profiles



Ill.1.32 Wind rose for Aalborg



Ill.1.33 Sound level of traffic noise

55-60 dB 60-65 dB 65-70 dB
70-75 dB >75 dB

Noise

The siteoise. from the east and south side is affected by noise. As Sønderbro and Karolinelundsvej has a high road traffic distribution , the noice will spread in site east and south part. And partly it could exceed the maximum - 58 dB in recreational areas in the city. Site is affected by noise also from major roads, buses, cars. So it's important factor in urban plan creating, function location and outdoor space direction. [8]

Conclusion

Macro climate analysis gives an idea how weather affects site and functions what is located on the site.
The noise from Karolinelundvej affect the site, as building site is located next to the traffic road. Noise level in this area is between 55-60 dB, what is over the allowable noise level in recreation areas in the city – 58 dB, as the whole site function as well as park. Therefore in previous project it has been decided to locate the buildings in this area to absorb and hold the noise from traffic.
Wind impact on the site can be solving with green vegetations on the park area to hold the wind from West-south.

Sustainability

1.9. Sustainability

Introduction

Sustainable is an posability to use natural resources efficiently, which will create healthier buildings that improve human health, better environment and provide cost savings. A green building is a structure that is designed to built, operated or reuse in an ecological and resource efficient way.
There are a lot of definitions of sustainability, but although the words are different, the basic idea is unchanged: minimizing the negative impact that buildings have on the environment by developing the moderate and efficient use of materials, energy and space.; that our actions do not restrain the opportunities of the next generations.

„Sustainable development is development which meets the needs of the present without compromising the ability of future generation to meet their own needs."

(World Commission on Environment and Development ,1987)

Sustainability principles

The three basic principles of sustainable development (according to Jong-Jin Kim and Brenda Rigdon) are:

Economic principle of sustainability, which means that need to boost economic growth, and developing countries should have the chance to reach the same quality of growth as developed countries and cost reduction by economy of resources.

Environmental principle of sustainability should preserve and enhance natural resources; reduced waste, recycle materials and reduce also the human impact on the nature

Social dimensions of sustainability - human beings should be able to meet their needs in food, energy, housing, jobs ..

In order to achieve architectural sustainability a building must balance all the three principles and offer solutions that benefit the end users. [Jong-Jin Kim, Brenda Rigdon, August 1998]

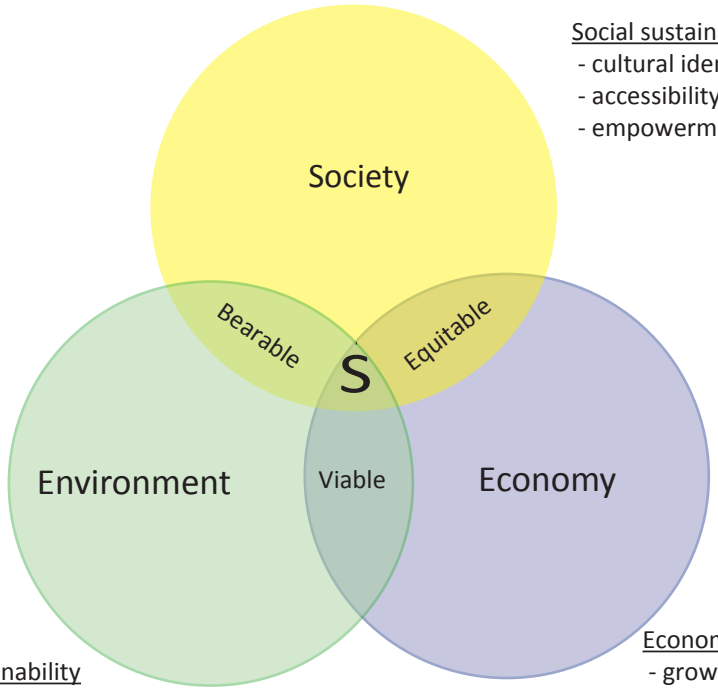
Herman E.Daly highligh an other operational principles of sustainable development:

The sustainable use of renewable resources:
renewable resources can not be faster than the regenaration. It means that all resources what we use need to be renewable.

The sustainable use of non-renewable ressources:
Non-renewable ressources cannot be faster than it can be replaced by sustainable use of renewable ressources. Which means development how to use and invested non-renewable resources into renewable material development.

Nonrenewable resource development and sustainable human development are inextricably linked, complementary, and multidimensional.

Waste:
Waste cannot be emitted faster than natural ecosystems can recirculate, obtain or neutralize it. Humans need to be aware about waste, where and how we eliminate them and how the waste renewable in to a enviroment and absorb and affect a it. [2]



Social sustainability
- cultural identity
- accessibility
- empowerment

Environmental sustainability
- ecosystem integry
- biodiversity

Economic sustainability
- growth
- development
- productivity

S Sustainable | Human well being

Ill.1.34

Methods of achieving a sustainable building:

The three principles of sustainability are associated with different strategies are meant to promote an understanding of the interaction between the building and the internal, local and global environment. (Dr. Sam C M Hui, 2002)

1.Energy conscious site planning maximize the use of local materials, southern exposure to encourage passive solar heating, evergreen plants on the north to protect from the winds, improving energy efficiency. (Ill.1.35)

2.Passive heating and cooling – the most important energy input to the building is the solar radiation that provides heat, light and ultraviolet radiation needed for photosynthesis. Shading in summer prevents overheating. (Ill.1.36 - Ill.1.39) The wind and the air flow – cooling and hygienic effects

3. Insulation- reducing the building heat transfer reduces also the heating and cooling loads and by doing so, the energy use. (Ill.1.40 - Ill.1.44)

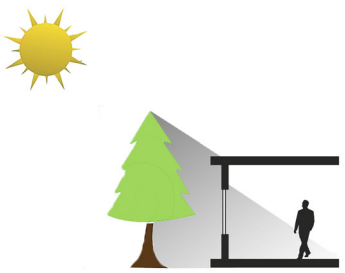
4.Daylight – buildings that use natural light will save electrical energy and in the same time increase the psychological well-being of the occupants.

5.Energy efficient equipment – even if the initial price is higher, it will be compensated by future energy savings. (Ill.1.45 - Ill.1.48)

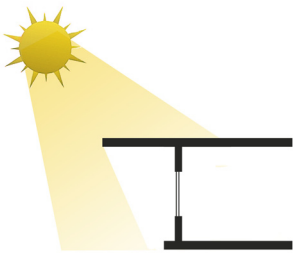
6.Water conservation – reuse water and collect rain water. (Ill.1.49)

7.Use materials that can be recycled, have a long life and low maintenance. (Ill.1.50)

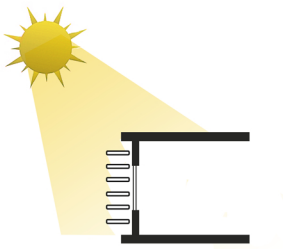
8.Comfortable designed building - people perform much better if the thermal, visual and acoustic comfort is achieved; a building with operable windows will give the occupants some degree of control over the temperature and ventilation of the interior space.



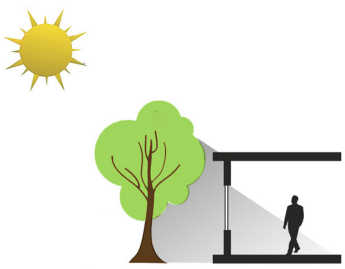
Ill.1.35 Evergreen vegetation



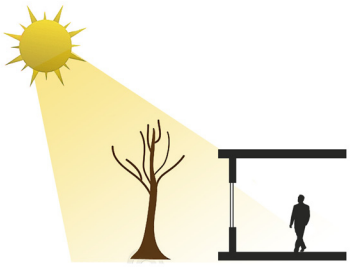
Ill.1.36 Overhang shading



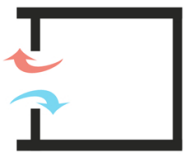
Ill.1.37 Louwers shading



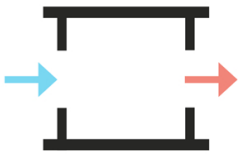
Ill.1.38 Summer vegetation



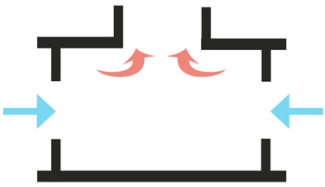
Ill.1.39 Winter vegetation



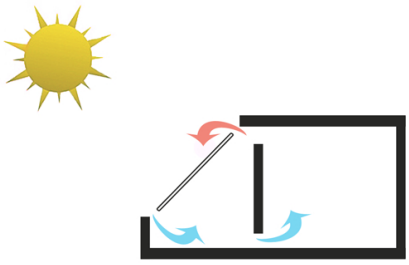
Ill.1.40 Single side ventilation



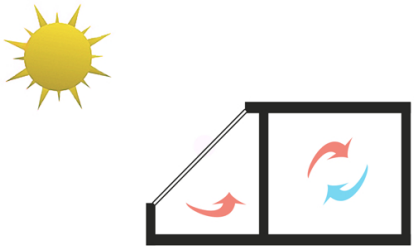
Ill.1.41 Cross side ventilation



Ill.1.42 Stacked ventilation



Ill.1.43 Summer ventilation

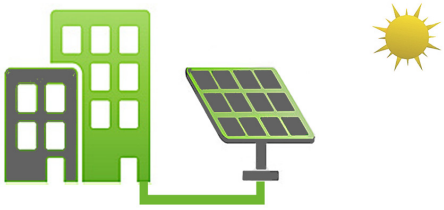


Ill.1.44 Sun space

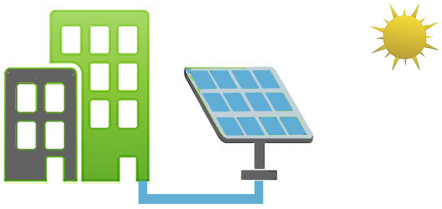
Ill.1.46 Wind power

Ill.1.45 Energy saving

Ill.1.49 Water collecting



Ill.1.47 Solar cell



Ill.1.48 Solar water heating

Ill.1.50 Material transportation

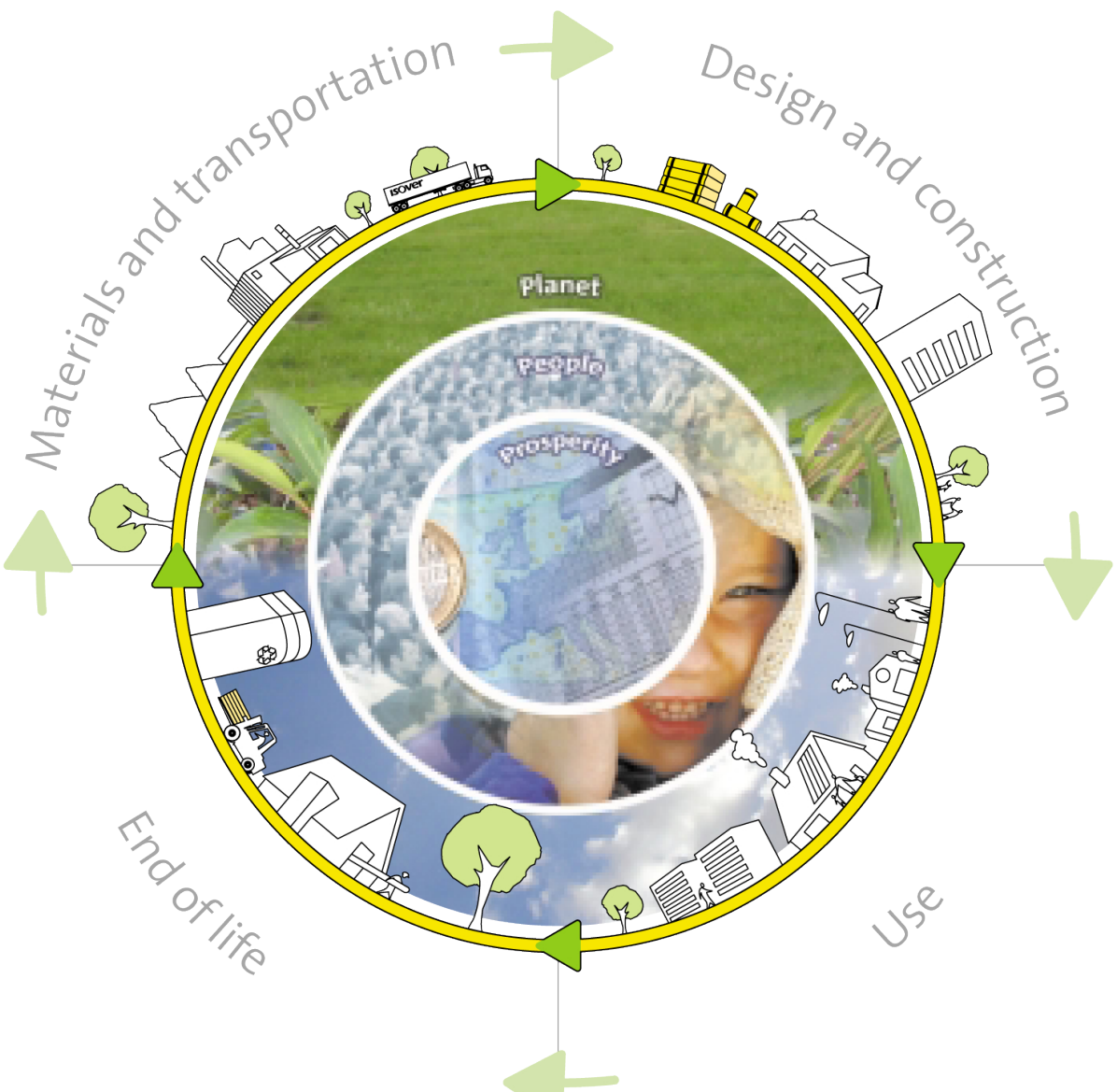
"Sustainable development is the challenge of meeting human needs for natural resources, industrial products, energy, food, transportation, shelter and effective waste management, while conserving and protecting environmental quality and the natural resource base for future development" [CERF 1996]

1.10 Sustainable constructions

Introduction

In future sustainable development important rule plays as well construction industry. As nowadays building sector as well is changing towards sustainability. The transmission of this concept into the building sector is called “Sustainable constructions” which means to design and construct buildings with a approach considering ecological, economical and socio-cultural aspects.

Sustainable construction is based on principles – long term affordability, quality and effieency. Comfort and life quality increases in each stage of life cycle of the building. This way optimizing the use of resources while minimizing negative environmental impacts, increasing the economical sustainability and reducing border between design and construction.



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Sustainable constructions

Sustainable constructions deals with the impacts caused by construction in terms of ecological, economical and social aspects in local, regional and global scale. It is an opportunity to use natural resources efficiently while creating healthier buildings that improve human health, build a better environment and provide cost savings. Sustainable constructions as well are sustainable development, which includes design, tendering, site planning and organization, material selection, recycling, and waste minimization.

Agenda 21 on Sustainable Construction

Construction industry and built environment is two important key areas to attain a sustainable development in the society. The Agenda 21 on Sustainable Constructions is intended to be a global intermediary between those global agenda in existence. It can be define as the links between the global concept of sustainable development and the construction sector. [3]

Incorporating the principles of sustainability within quality design gives us the opportunity to create better buildings with future generations in mind. Sustainable buildings provide local solutions with a global conscience. [CIB Agenda 21, 1999]

Sustainable construction key are:

- Design for minimum waste
- Lean construction and minimize waste
- Minimize energy in construction and use
- Do not pollute
- Preserve water resources
- Respect people and local environment.

Sustainable construction principles:

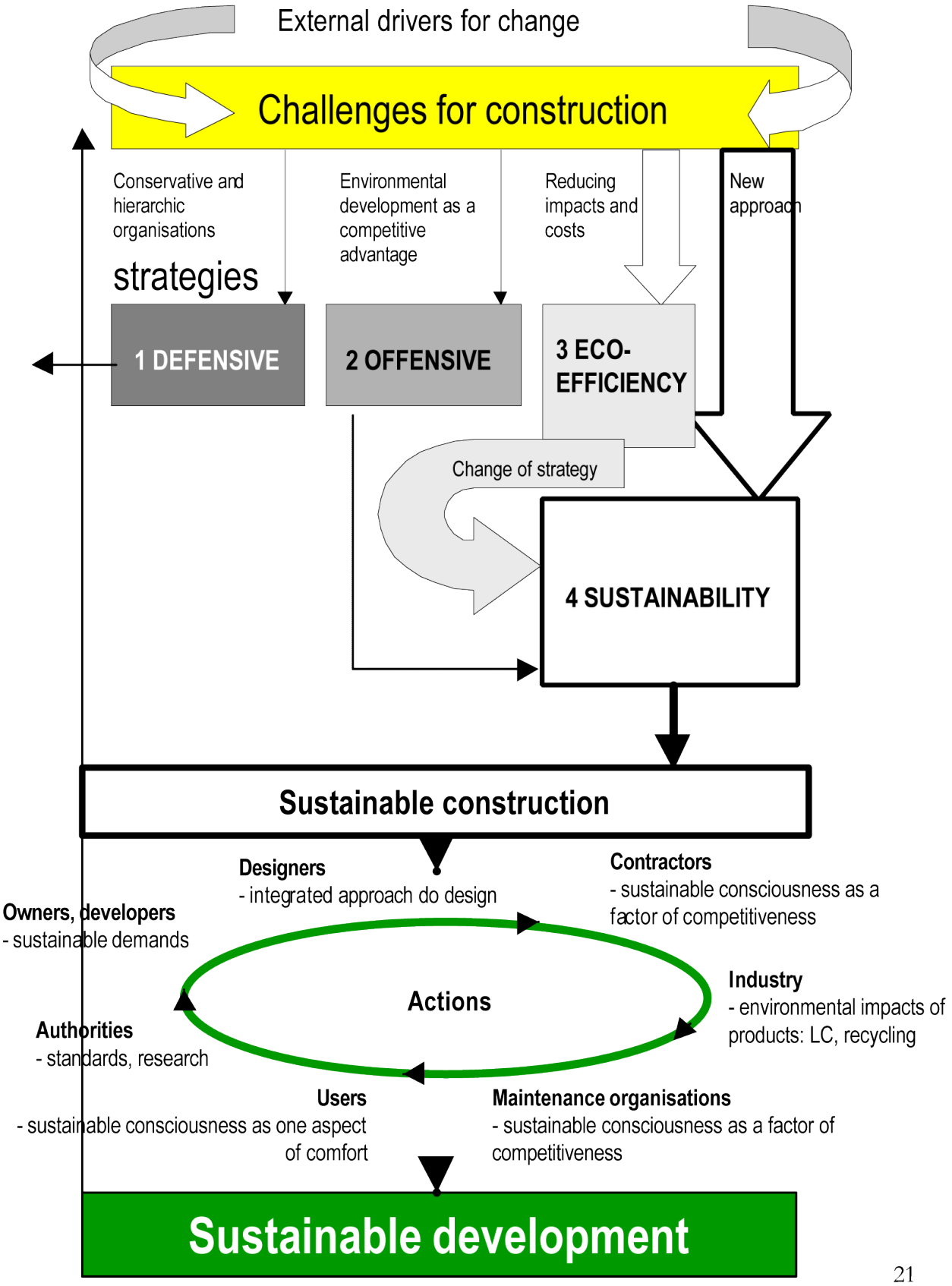
- Minimization of resource consumption
- Maximization of resource reuse
- Use renewable and recyclable resources
- Protect the natural environment
- Create a healthy and non-toxic environment
- Pursue quality in creating the build environment.

Sustainable construction principles on design stages:

-*Durability* - The soundness of a buildings construction according to the changing loads, temperature and humidity both external and internal.

- *Usefulness* – How building internal and external layout work out in connection with functions which it is to be used, changing over the time.

- *Attractiveness* – Visual expression of the building to people in and around it.


External drivers for change
Challenges for construction
Conservative and hierarchic organisations
Environmental development as a competitive advantage
Reducing impacts and costs
New approach
strategies
1 DEFENSIVE
2 OFFENSIVE
3 ECO-EFFICIENCY
Change of strategy
4 SUSTAINABILITY
Sustainable construction
Designers
- integrated approach do design
Contractors
- sustainable consciousness as a factor of competitiveness
Owners, developers
- sustainable demands
Actions
Industry
- environmental impacts of products: LC, recycling
Authorities
- standards, research
Users
- sustainable consciousness as one aspect of comfort
Maintenance organisations
- sustainable consciousness as a factor of competitiveness
Sustainable development

21

III.1.56

The targets of sustainable constructions

Material production and transportation	Design and construction	Use	End of life
• Raw material supply • Manufacturing of products: - Energy consumption - CO2 emissions - Impact on air, soil, water - Production waste • Transport to jobsite	• Use of resources • Quality of the building • Waste generation	• Most important phase for environmental impacts: - Energy efficiency - Water use - CO2 emissions • Maintenance and replacement • Impact on the built environment • Solutions for thermal and acoustic comfort • Security: fire resistance • Health: indoor air quality	• De-construction, demolition on site, recovery, disposal and transport • Impact of demolition waste • Building sustainability and ability to evolve over time

Table 1.1

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Sustainable construction materials

The main focus and goal of sustainable material use are to consume materials with higher environmental specification, greater durability, low embodied energy, and enable whole life costing and impact.

Sustainable construction use has qualities of natural resources and materials. Materials must reach the goals, which are:
- minimizing consumption and depletion of material resource,
- minimize the life-cycle impact of materials on the environment,
- minimize the impact of materials on indoor environmental quality.

To archive these goals must use salvaged and remanufactured materials cycle, use recycled content products and materials, use materials from renewable resource, use locally manufactured materials, use durable materials and use materials that are reusable, recyclable or biodegradable. [David A.GottFried, 1996]

There is a need to develope new building concepts – lightweight components and new jointing and assembly techniques. It could include:
- New materials, recycled or made from renewable resources
- Plug-in system, easy to disassemble and re-use
- Standardization and modularity of components

One of main challanges for construction site are use of renewable materials, recycling and material use from natural resources.

Resources consumption

Materials

Bio-diversity involves maintaining the natural growth of renewable materials and the conservation of the life support function of nature including the biochemical processes essential for life. Mineral resources are consumed in large quantities in the built environment. Most of these resources are non renewable and require efficient use combined with closed-loop recycling. Use of renewable or recycled materials is not common nowadays in the construction industry. The selection of materials should be based on their environmental performance, on their individual service life and on their health consequences. Jointing and assembly should be designed to allow for easy disassembly – reversible building process.

Energy

Energy use, which causes climate change and a number of air pollution problems, remains at a consistently high level all over the world.
New energy saving technologies for success in the future involve super insulation, passive heating / cooling, day light / passive lighting together with the use of renewable energy sources.
Systems that should be introduced are example:
- Heat recovery and storage
- Small CHP-units
- Electrical heat pumps
- PV-cells
- Passive and hybrid technologies for heating and cooling
- Passive lighting systems
- Translucent insulation
- New acoustic/thermal insulation materials and systems

1.11 Timber constructions

Using materials that are natural and non toxic helps to reduce the total pollution levels and energy used in bringing a building into existence. Timber as a sustainable construction solution is low energy material, natural, non toxic, renewable and recycling. The use of timber construction design enables high insulation. [3]

Using timber in constructions there is outputs in sustainable construction principles:
- Passive solar hearing and renewable energy
- Thermal mass
- Natural, non toxic local materials and products
- Greater use of timber
- Design of waste reduction
- High energy efficiency appliances
- Design for reduced personal transport use.

Passive solar heating and renewable energy
Solar heating contributes to reduced carbon emissions and is free heating. Renewable energy does not contribute to significant emissions of greenhouse gases and government energy strategies are now driving forward the uptake of renewable energy technologies.

Thermal mass
This principle stores energy harvested through passive solar gain and helps to reduce major temperature changes.

Natural, non toxic local materials and products
The specification of these materials helps to reduce the total pollution levels and energy used in bringing a building into existence.

Greater use of timber
Timber is a low energy material and the replanting of trees takes carbon from the atmosphere helping towards the re balance of the carbon cycle. The use of timber frame designs also enables super insulation.

Design for waste reduction
Approximetly 30% of all solid waste is construction waste. Declining levels of landfill sites availability and increased disposal costs make this issue a financial and environmental joint benefit. The specification of recycled products helps create a market for materials being recycled.

High energy efficiency appliances
The specification of high efficiency contributes to significantly lower running cost for the building occupiers.

The key outcomes are reducing energy use, reducing carbon emissions, reducing waste production, support for recycling, improving water efficiency, decreasing reliance on car usage and improving biodiversity.

Timber impacts compared to other materials

Every material has an impact and it is possible to compare their use in manufacture and use with LCA techniques.

Impact of the manufacture:

- Fossil fuel use to manufacture

  Timber requires much lower production energy than most comparable materials. The manufacture of rough sawn timber uses vastly less fossil fuel energy per unit volume than does that of steel, concrete or aluminium. See table 1.2

Material	Fossil fuel energy (MJ/kg)	Fossil fuel energy (MJ/m^3)
Rough sawn timber	1.5	750
Steel	35	266000
Concrete	2	4800
Aluminium	435	1100000

Table 1.2

- CO2 release and storage

During manufacture, timber store bigger amount of CO2 and release less Carbon comparing with other building materials. See table 1.3

Material	Carbon released (kg/t)	Carbon released (kg/m^3)	Carbon stored (kg/m^3)
Rough sawn timber	30	15	250
Steel	700	5320	0
Concrete	50	120	0
Aluminium	8700	22000	0

Table 1.3

Pollution impacts of different materials

- Air pollution

  Timber products are associated with lower emission of CO2, CO, SO2 and volatile organic compounds as other manufacture materials.

- Solid waste Generation

  The quantity of solid waste from timber constructions depends of construction system and builder's attention to material use. Comparing with other material residues, timber residues can be used after recycling for fibreboards, mulch, particleboard etc.

- Water Pollution

  Steel and iron manufacture has a greater impact on the quality of waste water as timber.

Impact of different construction types

On site construction stage includes all structural elements and material transportation, the energy required and other environmental effects during construction. On this stage the main impact is cause by the energy used for transportation, construction equipment and solid waste.
As timber building products are light and easy to handle with high strength, they generally require less energy to transport and position than heavier materials. Timber has lower embodied energy in construction as other materials. See table 1.4 [5]

Element	Discription	MJ/m^3
Floors (including flooring, framing, reinforcement, DPC, membranes etc)	Timber suspended sub-floor structure	740
	Timber suspended, brick sub-floor wall	1050
	Concrete slab on-ground	1235
Walls (including as appropriate framing, internal lining, insolation)	Weatherboard, timber frame	410
	Brick veneer, timber frame	1060
	Double brick	1975
Windows (including at least 3mm glass)	Timber frame	880
	Aluminium frame	1595
Roofs (including plasterboard, ceiling, R2.5 insulation, gutters, eaves)	Concrete tile, timber frame	755
	Concrete frame, steel frame	870
	Metal cladding, timber frame	1080
	Clay tile, timber frame	1465

Table 1.4

Life Cycle Assessment

A life cycle assessment (LCA) is based on ISO 14040. According to ISO 14040, an LCA is a methodical approach to evaluate the environmental impacts associated with product, process by identifying and qualifying material and energy flows. It determines benefits of sustainable construction regarding different construction techniques.

Wood outperforms other materials in LCA analysis, having a much smaller impact to the environment when considered over a buildings lifetime. Building products environmental benefits are based on recycled content, renewability and other subjective attributes.
According to LCA studies wood construction buildings produce less greenhouse gases, create less air and water pollution, and require less energy across their life cycle than other structural building products. [6]

Wood preservation

Mostly all timber need require treatment preservation to reduce the risk of degradation from water, other weather conditions, insects and fungus. Preservatives may be applied to green or seasoned timber.

For different timber components there is various types of preservation and method to use. Timber preservation must also penetrate wood without causing damage, have a appropriate effective life and must not affect the health of anyone involved in its proper manufacture.

There are three general classes of wood preservatives:
- creostone and creostone solution
- Oilbrone preservatives
- waterborne preservatives.

Most common wood treatments include:
• Boron salts – protection against insects borers, generally only suitable for weather protected timber.
• Light organic solvents – generally fungicides, these may also act as insecticides and wax and resin additives can help protect against water damage.
• Creosote – because creosote bleeding has been minimised, creosote timber can now be used in a wide range of applications.
• Cooper Chrome Arsenic – it protects timber against to insect attack and marine conditions.

All preservatives have the potential to be hazardous to human health and the environment, especially chemical treatments. Alternative methods of timber preservation can be to introducing a physical barrier between the timber and a source of moisture or increasing the airflow around the timbers.

Sustainability certifications

Sustainable certifications provide the necessary framework and criteria for the construction and property industry concerning new construction, rebuilding and improvement of existing properties in a sustainable manner.

Most known and internationally recognized certification systems are LEED, BREEAM, DGNB and HQE. All the certification systems show achieved criteria within the categories: energy, waste, transport, indoor environment, water, materials and neighbourhood.

LEED are American certification scheme. It focuses on environmental sustainability: energy and atmosphere; water efficiency; materials and resources and sustainable plot. In social sustainability they focus on indoor environmental quality, as well as on innovation and regional priorities.

BREEAM are British certification scheme, which focuses on environmental sustainability, like energy, transport, water, materials, waste, land consumption ecology and pollution. In social sustainability they focus on health and wellbeing. Priority is as well economical sustainability – management.

HQE are French certification scheme. It has focus on environmental sustainability: energy, water, waste, materials and execution and effect on neighborhood. In social sustainability it focus on thermal comfort, acoustic comfort, visual comfort, perceived air quality, healthy air quality, water quality.

DGNB are German sustainability certification scheme. This scheme focuses on environmental sustainability as environmental quality, localization quality. It focuses on social quality, economical quality, functional and technical quality and as well on process quality. [8]

As there is many certification systems, there is need to adapt system criteria to Danish conditions. There is strength and weaknesses in Danish conditions according to four main certification systems. [7]

Danish strength:

- Focus on low consumption of primary energy

- Environmentally friendly district heating

- Good central wastewater treatment

- High degree of recycling construction waste

- Good dialogue with municipality in local planning

- Location close to public transport

- Widespread use of bicycles and suitable infrastructure

- Focus on thermal, acoustic and visual quality

- Good dialogue in the building process

Danish weaknesses:
- Limited documentation of construction products
- Lack of environmental assessment for materials
- Limited environmental assessment for open spaces
- Limited restrictions concerning parking spaces
- Limited focus on emissions of VOC's
- No practice for use of commissioning

Conclusion

Wood as sustainable construction material provides many benefits – aesthetic, structural, economic and environmental. Wood is renewable and recycled sustainable building material that provides a various additional environmental advantages. Using wood in buildings it produce less greenhouse gases, air pollution and water pollution, as well as require less energy through their life time. Considering all benefits, wood has many advantages in creating sustainable building.

User profile

1.12 Philosophy

In every business important rule plays employs experience. For everyone they experience and a knowledge background starts in their education. In study period every people get technical knowledge which afterword is used in practice - in reality. Graduated students are young, with their educational background, with new and maybe bold ideas, and with their big dream about life's. These people are full with energy, ideas and determined to develop and prove themselves. They are not afraid to take challenges. The best practice to get greater goals in business are cooperation between knowledge and real life. Therefore giving cooperation possibilities between students and employees in study phase could reach greater goals in businesses. In the same it is important to give Aalborg residents possibilities for free time activities, developing and improving they own talents and hobbies.

1.13 User groups

In every city, public space, organization is important to connect people, ideas and resources. Reaching these goals place has become as attractive and active for everyone. It's important that place provide activities and functions for various user groups, giving them communication and cooperation opportunities. For this project according to project vision has been chosen to work with 3 social groups:

- Students from Aalborg University
- Employees from different companies and start ups
- Aalborg residents

Creating building for different user groups it gives the place social qualities.

Students

This user group includes all Aalborg University students and lecturer. For this user group place has educational use, which means there are different workshops, laboratories, working places for student use. It' s important to create good and suitable environment for students.

Students are one of user groups, which need a space for working in groups or individually. Place should offer different opportunities for better working environment, which could include new technologies, place for presentations and group meetings, workshops and labs.

Ill.1.58

Ill.1.59

Employees

User group includes all employees from different companies and start-ups, as well freelancers, creative entrepreneurs, and talented people, which means Innovation Park has a business use for this group. This user group needs to have comfortable and suitable work environment.

Ill.1.60

Aalborg residents

This includes all people in Aalborg – social and physically active people. Place has been used for free time activities, which gather together friends, colleges or our relatives. For this user group is important to provide different functions how to spend qualitatively they free time, providing possibilities to meet new people and contacting with others.

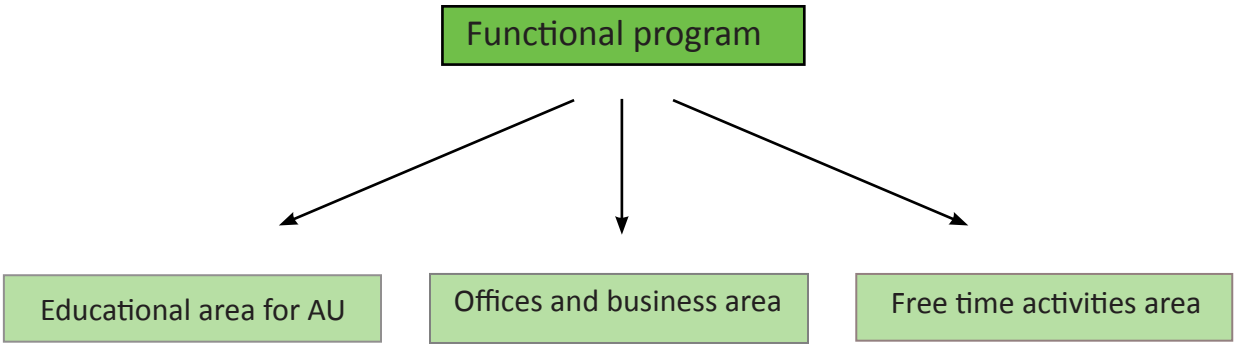
Space program

1.14 Functional program

Intermediaries are individuals, organizations, networks or spaces which connect people, ideas and resources. They can take a variety of forms – some incubate innovations by providing a 'safe' space for collaboration and experimentation; some connect entrepreneurs with the supports they need to grow their innovations; and others help to spread innovations by developing networks and collaborations.
Every public place functioned well if it is well planned. It means functions should ensure user needs and provide functions what is used all the time.
In this case it's important to provide users safe space for collaboration, businesses and they own development.

Functional program will includes such a spaces as:

- Educational area for Aalborg University
- Offices and business area
- Free time activities area



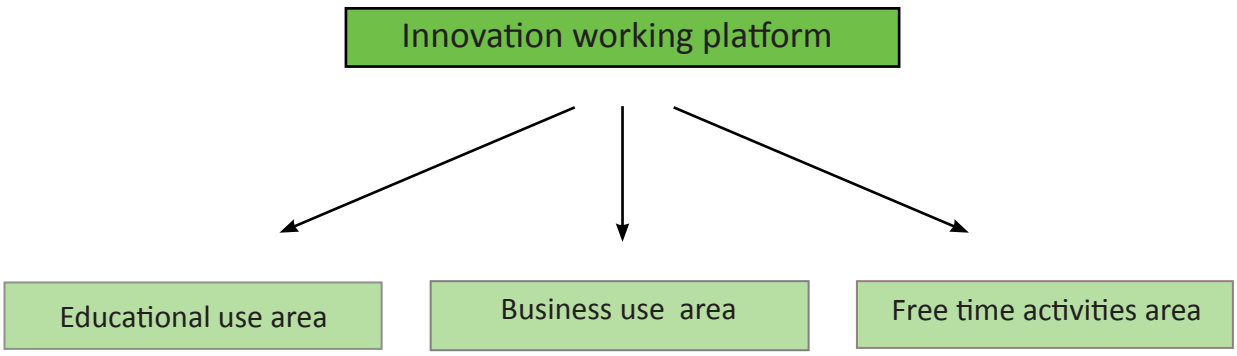
This group develop better environment for education, which means it provide Aalborg University areas for workshops, laboratories, exhibition areas, specialized shops and other areas what is need to reach high education environment. It provide all necessary functions for creative education.

This group includes private office areas for companies, open planed office platform for creative entrepreneurs, talented people, and new companies. As well providing space for seminars, exhibitions, conferences and public or private debates. This function should provide all necessary areas and functions to run a business.

It includes different activities what is social and ensure different communication possibilities. It's a place for commercial and non-commercial cultural and creative activities. It should provide various activities which would attract people. It includes workshops, cultural and social activities.

1.16 Room program

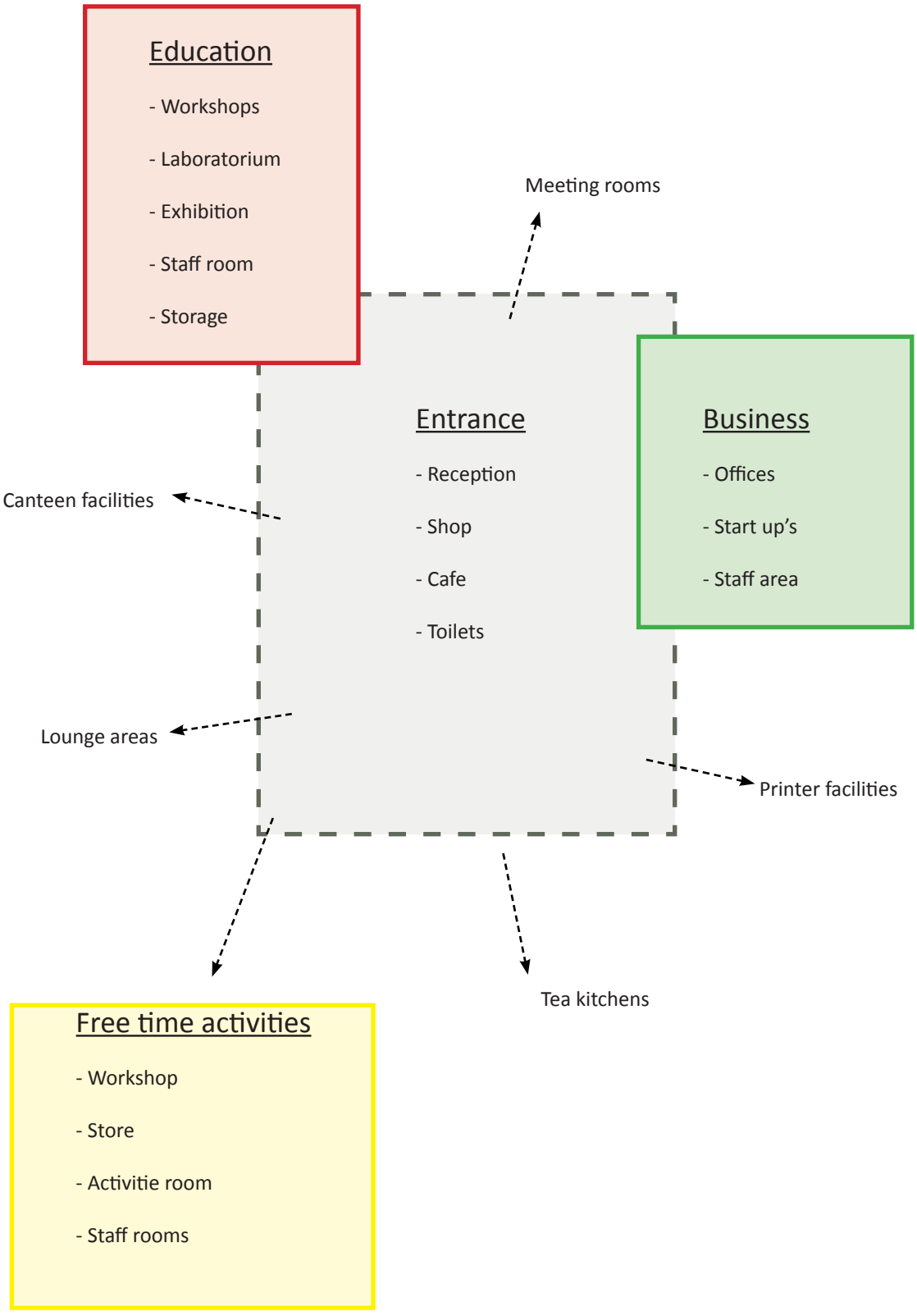
Room program is created according to users' needs and wish to create comfortable and suitable place for working.



- Workshop facilities
- Laboratories
- Exhibition area
- Conference / meeting rooms
- Lounge area
- Cafe
- Shop
- Rooms for staff
- Storage

- Office rooms
- Conference rooms
- Start up's
- Lounge
- Tea kitchens
- Printing rooms
- Canteen facilities
- Staff area

- Workshop areas
- Lounge
- Stores
- Staff room
- Activitie rooms


Education
- Workshops
- Laboratorium
- Exhibition
- Staff room
- Storage
Meeting rooms
Entrance
- Reception
- Shop
- Cafe
- Toilets
Business
- Offices
- Start up's
- Staff area
Canteen facilities
Lounge areas
Printer facilities
Tea kitchens
Free time activities
- Workshop
- Store
- Activitie room
- Staff rooms

Ill.1.61

Room program consist of three main groups: educational use area; Business use area and free time activities area. Combining all these three groups together it creates public-common areas and private areas, with they own functions. As Education and business use areas has connection and collaboration between them, they have more common areas. Free time activities area is more for use after working hours, in a free time, so in a way it should be separate from other two groups, but still in the same way it should have as well connection between other functions.

Exploring more these three main groups it will be divided in more groups:
- Entrance area
- Common Educational and Business area
- Private Educational use area
- Private Business use area
- Free time activities area

Entrance area
It's a main entrance hall / atrium where people arrive. That's why it's important that this place is light, welcoming and spacious. It includes reception, shop, cafe and toilets. All these functions have common use not only for employees and students, but as well for costumers and visitors. It's place where students, employees, customers and visitors meet and interact with each other.

Common Educational and Business area
It's area which are semi-private use, which means it is for both, educational and business use, but not for everybody, like visitors, costumers etc. This area includes printer rooms, meeting rooms, conference room, small kitchens, canteen facilities and lounge areas. All these functions provide more comfortable and suitable working environment, which means providing employees and students with self service kitchens, canteen area, places where they can take small breaks or small meetings, possibilities to hold bigger meetings or conferences.

Educational use area
This area is used for Aalborg University facilities. It includes different workshops, laboratories, exhibition area, staff room, storage. It should provide student good study environment with different working possibilities.
Workshop places – it provide students with all necessary equipment for working. It's place where student can temporary work individually or in a groups with their projects. It's as well place where can be hold different workshops.
Laboratories - it should provide a student different research opportunities where to developed and test products.
Exhibition area – is place for student's exhibitions, which can handle a semester exhibitions, workshop exhibitions and as well use for different purpose.

Business use area
Business area includes office rooms in different size, office area for start-ups and private staff area. All business area should be created and designed that it offers a good working environment providing all necessary facilities to run a business company. It includes different kind of companies, but main focus is to attract companies which are working in the same field as education in Aalborg University.
Area for start-ups is created as open planned office space, with working places. It means that people can rent they own working place not whole office, and it's more suitable for start-ups, for private entrepreneurs and smaller companies. For larger or smaller companies it's suitable different size of offices.

Free time activitie area
In connection with outdoor area – park, there will be as well some inside public functions, which will provide Aalborg citizens free time activities. It is social public space, which ensures different communication possibilities. It includes smaller conferences, workshops, place for meetings and concerts or other gathering events.
For other users as well canteen facilities is open for use.

Daylight factor

For every building and sustainable energy use it is important to maximise daylight penetration into the building, integrate daylight and artificial lighting and use energy efficient lighting equipment in an energy efficient way. For every kind of room it has different daylight factors, which provide necessary daylight quality for every room.
Daylight factor shows how much natural light is available in each room. Higher daylight factor means more natural light in a room.

Acoustic demands for rooms

The right amount of absorption for a room acoustics treatment depends on four main and related variables:
- intended use of the room and the sound source;
- room size, including ceiling height;
- materials in the room, including furnishings and wall, floor, and ceiling type; and
- the type of absorption used.

Light absorption (5-25% coverage) – it is appropriate for listening rooms, like offices, meeting rooms and rooms where people gather and converse.
Moderate absorption (25-50% coverage) – it is for listening and control rooms, like larger meeting rooms, conference rooms and rooms which use are related with music or lauder activities.
Heavy absorption (50-100% coverage) – is used in rooms which are related with high-energy music, like drum rooms, music practice space.

Ventilation

Every building must be ventilated. Ventilation may be by systems for natural ventilation, hybrid or mechanical ventilation. From sustainable approach natural ventilations systems is more suitable for energy savings. Natural ventilation systems should be used in all rooms where it is possible. Benefits of natural ventilation are that it relies on natural force, like wind; suitable for any place, relatively inexpensive; less energy is consumed.

Function	Area (m^2)	Room hight (m)	Daylight factor (%)	Acoustics (absorption)*	Ventilation rate (l/s/m^2)
Education use facilities					
Workshop area	350	3 - 5	~ 4	Light	> 5
Laboratories	250	2,4 - 3	< 3,8	Light	15
Exhibition area	~ 600	~ 6	1 - 6	Light	10 - 20
Staff rooms	45	2,4 - 3	3	-	2 - 3
Storage	200	~ 3	< 2	-	1,6 - 4,2
Business use facilities					
Officies	2000	2,4 - 3	2 - 6	Light	0,8 - 2,0
Star-up's	1000	2,4 - 3	2 - 6	Light	0,7 - 1,7
Staff area	45	2,4 - 3	3	-	2 - 3
Education and Business use common facilities					
Entrance	300	3 - 5	0,6 - 2	Light	3
Tea kitchens	35	2,4 - 3	-	-	8 - 10
Printer rooms	60	2,4 - 3	-	-	-
Conference room	~ 600	3 - 5	~ 3	Moderate	15 - 30 l/s/person
Meeting rooms	200	3 - 5	~ 3	Moderate	2,4 - 6,0
Lounge areas	200	2,4 - 3	~ 3	-	15 l/s/person
Canteen facilities	300	3 - 5	0,6 - 2	Light	15 - 20 l/s/person
Reception	25	3 - 5	0,6 - 2	-	3
Shop	~ 150	2,4 - 3	< 2	-	
Cafe	~ 150	2,4 - 3	~ 2	-	~ 4
Toilets	~ 100	2,4 - 3	-	-	25 l /s
Free time activitie use facilities					
Workshops	300	3 - 5	~ 4	Moderate Heavy	4 - 5
Activity room	150	2,4 - 3	< 3	Light	4 - 5
Lounge	45	2,4 - 3	< 3	-	15 l/s/person
Staff room	20	2,4 - 3	3	-	2 - 3
Store	150	~ 3	< 2	-	1,6 - 4,2
Toilets	25	2,4 - 3	-	-	25 l/s

Room atmosphere

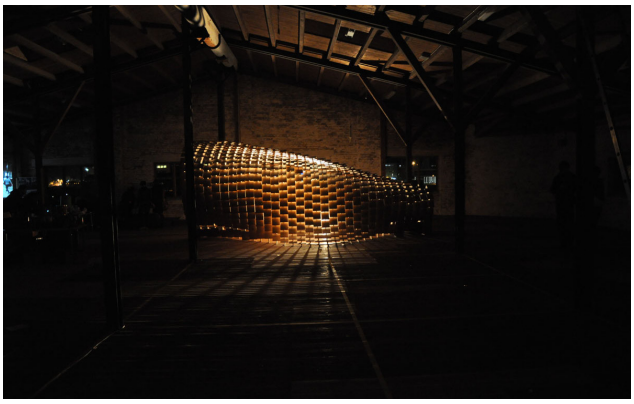
Talking about atmosphere which needs to be reached in each room, there is different demands, what need to be considered. Room atmosphere and mood depends of room planning, choice of colours, furnishing, room lighting and general design of room.

Example - office place. Creating environment in office it's important to consider as a priority people who is working there, that they feel comfortable and has productive work. It means that place should be ergonomic and well planned working environment. Considering about office equipment, furnishing, healthy environment and general office design it should be positive, warm, flexible, open and light. The main focus is to create environment that people feel comfortable and inspiring. Of course in different offices can be used different concept for design.

Working spaces for educational use. These spaces are focus to human – student well being. It should be light, inspiring, open and comfortable. As well considering material chose it's important that they are easy to clean, as these rooms are used every day. Creating positive and creative atmosphere in classrooms can be effective, motivating place to learn. It's important to create warm and inclusive working place environment, that students feels welcome.

Ill.1.62 Office interior example

Ill.1.63 Office interior example



Ill.1.64 Working space interior example

Ill.1.65 Working space interior example

As lounge areas is for more relaxing use it should create warm and calm feeling. These room mood qualities can be reached creating relaxing oasis in these spaces. And it can be reach with light effects, furnishing and decorative accessories. In colour choice it should be light and warm colours, if want to reach calm and relaxing mood in area. Creating colourful lounge area can give more energy and inspiration for working.

Ill.1.66

Meeting and conference rooms. Meeting rooms are place where most of the time companies meet with costumers. The best interior design creating right atmosphere for conference rooms takes into consideration not only aesthetic beliefs, but also the comfort of the participants so that the meeting ends on a successful note. It should have clear, creative, inspiring and simple design. Using colours and attractive interior decors and elements can make meeting room lively and attractive. For different profile companies has different need of mood in meeting rooms, but common thing for all conference and meeting rooms is that room need to be light and inspiring.


Ill.1.67

Entrance hall, as it is main place where people access a building it should be open and well planned. It must be welcoming. Creating and choosing right materials and design of entrance hall should consider that it needs to be warm, open, light and welcoming. As well entering building main directions and functions should be clearly visible. It's important keep this light, welcoming and open feeling in hall and simple design, in the same time complementing interior with some colourful and creative accessories.


Ill.1.68


Ill.1.69

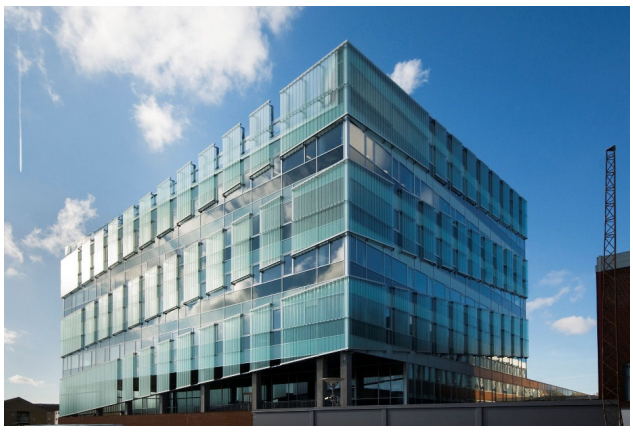
Reference projects

Vitus Bering Innovation Park

Horsens, Denmark

Vitus Bering Innovation Park offers inspiring facilities and support functions for companies and entrepreneurs focused on Innovation and growth.
VBI Park is based on three major players: VIA University College, the Energi Horsens foundation and Horsens Business, Innova-tion & Tourism Centre. VBI Park is place where knowledge and reality meets to make innovation happen. The park aim is to create the best possible growing conditions for companies and start-ups. Having education and business facilities in the same building it gives good impact on business. Which means students can give companies new knowledge, inspiration and some extra hands for a limited period to solve specific tasks. Education and business collaboration includes possibilities like trainee scheme, student jobs, Project with students etc.
VBI Park is one of Denmark's largest Innovation Parks with 8000 m2 distributed on seven floors. The VBI Park is Low Energy Class 1 building. [http://www.vbipark.dk]

Ill.1.70



Ill.1.71

Ill.1.72

Platform 4

Aalborg, Denmark

Platform4 is a non-profit organization in the Eastern harbour area in city centre of Aalborg. It is an organization which experiments with new technological and digital elements in combination with artistic and creative genres ranking of music, theatre, contemporary art, design, architecture and even more. It focuses as well to different product innovation and creative projects. Platform 4 has collaboration with Aalborg University, so this place has been used for different workshops and exhibitions. In Platform 4 happens not only experiments and creative workshops but as well music festivals and cultural performances.
Platform 4 is located in 3000 m2 former warehouse. It consists from multi-use performance and workshop hall, cafe and a workplace. [http://www.platform4.dk/]

Ill.1.73

Ill.1.74

Otaniemi Science Park

Espoo, Finland

Otaniemi is the largest technology hub in the Nordic countries. Otaniemi offers innovation ecosystem for its 16000 students and 16000 technology oriented professionals with 60-80 start-up companies. It includes 800 companies, 20 R&D centres and three universities. It combine education and business together.
Otaniemi science park focus on 6 areas: Product design, security and safety, pharma and healthcare ITC, mobile and wireless, electronics and energy.
This science park offers a complete range of office space and facility management solutions for technology companies and organizations, from start-up facilities to state-of-the-art anchor offices and technical infrastructure.
[http://www.oecd.org]

Ill.1.75

Ill.1.76

Vision

The vision for the project is to design a SUSTAINABLE innovation platform in city center, where EDUCATION and BUSINESS meets and COLLABORATE, combining with architectural qualities.

It offers these functions not only in educational and business level, but as well FOR those RESIDENTS, who like to be active and creative in their free time, giving posibilities for INTERACTING WITH other PEOPLE.

While designing place for people innovation it is important as well create this place SUSTAINABLE and environmental friendly. It means in design process need to consider ECOLOGICAL, ECONOMICAL and SOCIO-CULTURAL ASPECTS.

Design parameters

Before starting the architectural sketching phase need to identify some major design parameters that would help to archive the wanted vision for project.

Site:

- Create the connection between the building and the site, both visually and physically.
- Integrate building in to the site, creating connection between outdoor and indoor area, keeping main functional idea.
- Social sustainability by creating common outdoor and indoor spaces - public, semi-public and private; Place for people interacting

Sustainability:

- The concept should obtain energy and resource efficiently using right constructions, construction materials and technologies.
- Use sustainable construction principles: optimizing use of resources; using renewable and recyclable resources; protecting the natural environment and creating a healthy and non-toxic environment.
- Improve environmental sustainability and sustainable building principles, using timber construction and wood materials.
- Improving social sustainability by diversity in users and creating common areas for interacting with others.

Users:

- Diversity of users and functions
- Outdoor areas for private and public use.
- Public, semi-public and private outdoor and indoor areas.
- Creating areas where people can meet and interact with each other, in the same time keeping places what is private.

02

Design phase

Design.

Inspiration

Ill.2.1 Vennesla Library and Culture house, Norway, by Helen & Hard

Ill.2.2 Vennesla Library and Culture house, Norway, by Helen & Hard

Ill.2.3 Quai des Cageux, Quebec City, Quebec, Canada, by Daoust Lestage inc. architecture design urbain

Ill.2.4 Contemporary Trojan House, Melbourne, Australia, by Jackson Clements Burrows

Ill.2.5 Forest Research Center, Joensuu, Finland, by SARC Architects

Ill.2.6 Forest Research Center, Joensuu, Finland, by SARC Architects

Ill.2.7 Building at Univarsity of Laval, by Eugene H.Kruger

Ill.2.8 Bispebjerg Bakke, Copenhagen, Denmark, by Bjørn Nørgaard, Boldsen & Holm

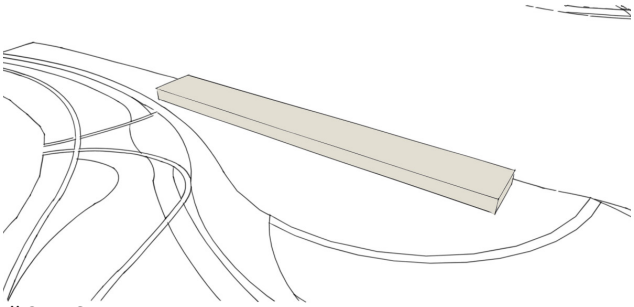
Ill.2.9 Visitors' Centre Gravesend, by Lee Evans partnership

Ill.2.10 San Francisko Retreat by Quezada Architecture

Design process

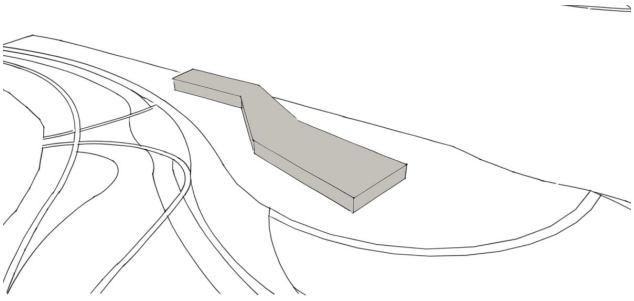
2.1 Building volume studies

Starting with volume finding for project there has been framework according to building site borders, planned room program and function for building. Therefore it has to be chosen to work with one volume. (See ill.2.11)



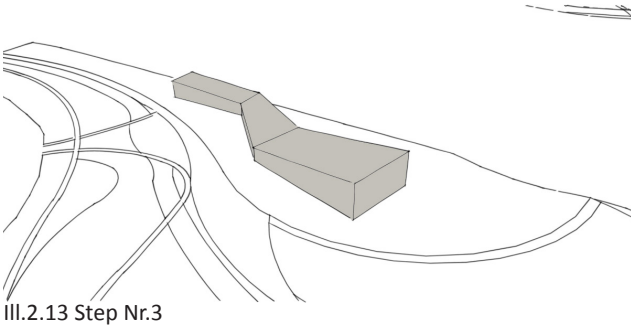
Ill.2.11 Step Nr.1

Next step is to make connections with the park and path ways creating the entrances. Changing the building volume to two different directions it becomes as two dominating entrance points in both sides of building. To the eastern side it creates entrance area with access road in connection with the Karolinelundsvej. In western part it becomes a main entrance for pedestrians and bicycles, where all the main paths on the site from other neighborhoods meets. Both entrances need to have logical connections to the site. (See ill.2.12)



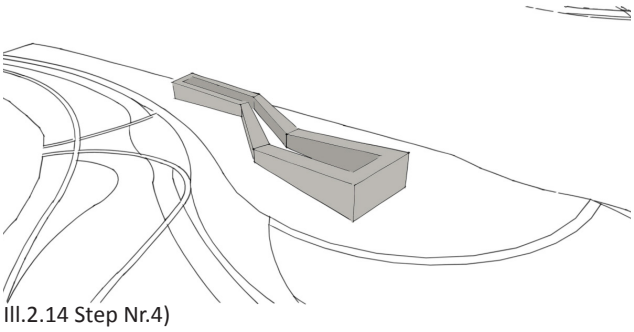
Ill.2.12 Step Nr.2

Variations between the building heights in different parts can improve the qualities of the building volume. In the same time it creates the link between building, landscape and the park. It also helps to improve and emphasize the entrances. (See ill.2.13)



Ill.2.13 Step Nr.3

In order to improve indoor climate and to give the rooms good indoor qualities next step is to create the atrium in the building volume. In this way it will provide building skylight, natural ventilation and space qualities. It means there are various options to create and design the room program in buildings according to functions. (See ill.2.14)



Ill.2.14 Step Nr.4)

2.2 LOCATION OF THE BUILDING

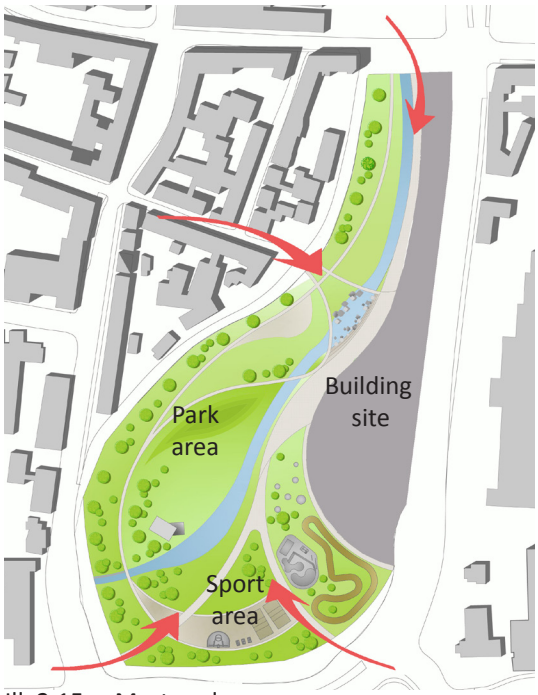
In this phase as a building site i will develope particular part of the master plan used in 9th semester. Therefore it has been used as a framework for the project site, keeping Karolinelund area qualities of public place for all Aalborg residents, which is as well main objective for the site from Municipality view.

Building site for Innovation Park is placed in previous project buildings' location, keeping general functionality for the whole park planning.

Building site has been located in current place according to environmental aspects as noise from high traffic road, main pedestrian flows from neighborhoods, functions in closer surroundings, main nodes and edges of the site etc. Due to the park planning all the pedestrian paths from neighborhoods leads people to the main plaza, which incorporates the building site. (see il.2.15)

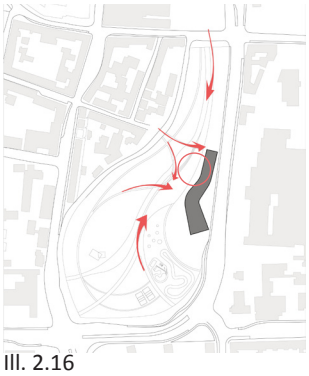
Public Park includes areas for outdoor sport activities, park area with playgrounds, barbeque places, waterfront outdoor stage and recreation areas, and main public plaza with waterfront.

During the design process connections to the park, main pedestrian paths and surrounding has to be considered as well as inside and outside functional connection, expression of building in context with the site and aesthetical aspects.



Ill. 2.15. Master plan

Main pedestrian flows to the site



Ill. 2.16
Initial location of the building

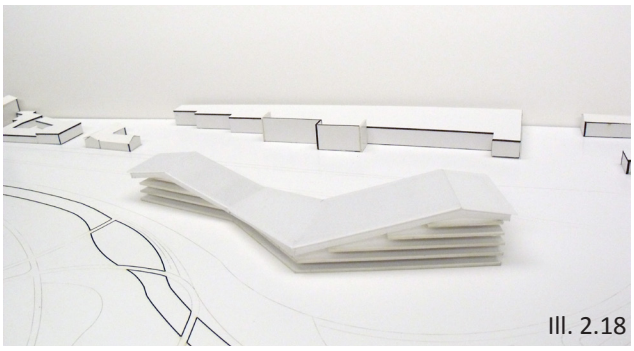
Il. 2.17
Final location of the building

At first initial idea was to locate the building so that entrance is in close connection with the main waterfront and plaza. Here, the building entrance would become as a main gathering point like it is for the whole park. It would make attractive just one part of main square. (see ill.2.16)

The final idea was to locate the building more to the south side of the building site. It creates 2 main pathways to the building from city center – one for bicycles and other for pedestrians. Using these two paths people are leaded to main entrance or to bike parking. Locating building this way two attractive points on main square will be created – main entrance and waterfront. (see ill.2.17)

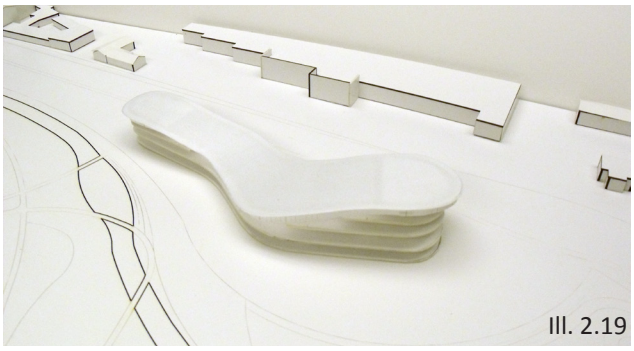
2.3 General building form studies

To develope this building form two guidelines has been used – work with organic and straight outline. To achieve the best results for main volume and roof, a number of experiments were done. Organic and straight outlines were combined, finding the best connection and link with the site, keeping in mind as well functional and esthetical aspects.



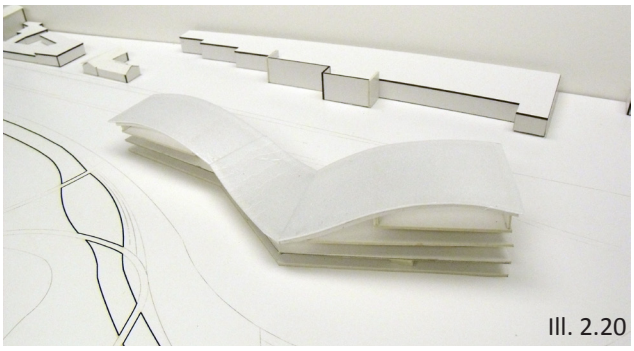
Ill. 2.18

Experiment Nr.1
Building volume and roof are designed in straight outlines. This form creates contrast and difference between the building and the site in terms of outside and inside functions.



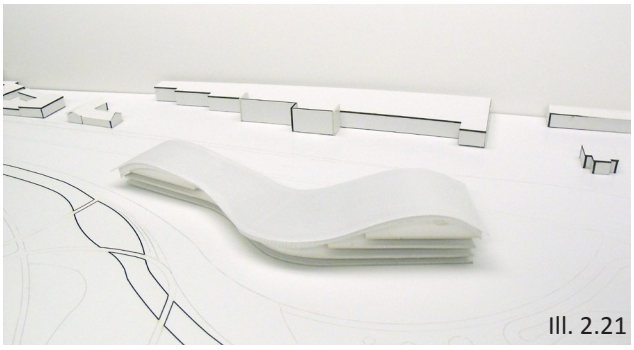
Ill. 2.19

Experiment Nr.2
For building's main volume and roof only organic outline is used. It doesn't make any link or connection with the site or surroundings. It dominates by itself, which is not the goal of the project.



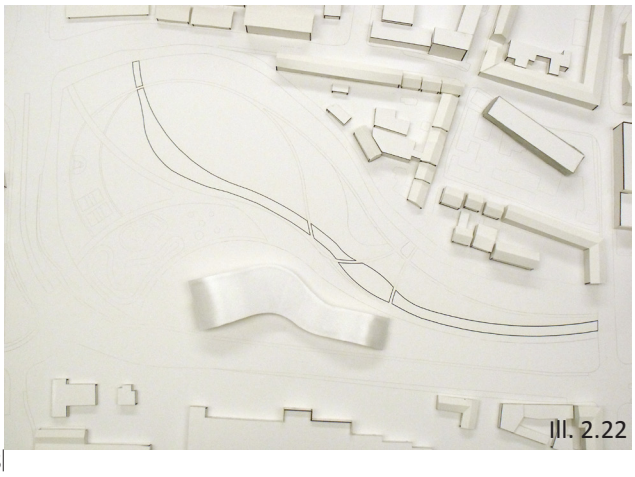
Ill. 2.20

Experiment Nr.3
Combinations - straight and organic outline. Roof is designed in organic form and building volume in straight outline. This doesn't create picture of solid volume.



Ill. 2.21

Experiment Nr.4
Combination – straight and organic outline. Unlike in the third experiment, here has been chosen to combine organic and straight outlines. Roof and walls are shaped in longest direction of building and endings are straight cutted. This experiment creates the picture of one volume and creates the link with the site.



Ill. 2.22

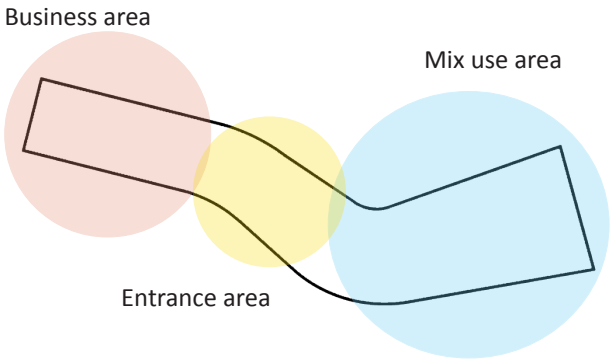
Final building form

For final building form 4th experiment was chosen. This form shows the clearest and best connection and link with the site in a plan layout and building volume. To improve the link with the site and landscape, roof constructions will be continued until the ground. This will create attractive outdoor areas and pleasant landscape. Shaped roof also reminds rollercoaster's, which was one of themost significant amusements in old Karolinelund area.

2.4 Programming the functions

According to the user groups and functional programming, place are designed for educational use, businesses and free time activities. Keeping in mind user needs, functional program will be developed in 3 directions - private space for business use, space for collaboration between business and education, and space for public use.

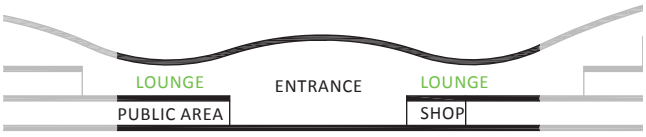
Therefore building is divided in 3 clusters – entrance area, business area and mix use area. It will provide businessmen's choice between more private area and more common area with collaboration possibilities. Business and mix use areas includes common spaces, like toilets, lounge, meeting rooms, tea kitchens and printer rooms.



Ill. 2.23 Function programming diagram

Entrance area

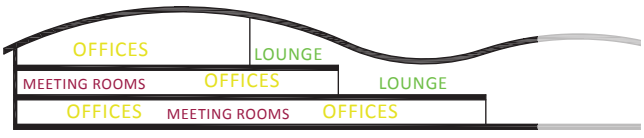
Entrance area is located in middle between two other building parts. It will be designed as open and light space/ atrium in 2 floor height. From here people are leaded to other building parts. This atrium area includes part of building which can be used for public events, seminars or concerts after working hours.



Ill. 2.24 Entrance areas functional diagram

Business area

Mix use area is located in building's southern part. It takes a place in 4 stories. Mix use building part includes working space and labs for Aalborg University use, office spaces for companies and start-up's, conference area, canteen area and shop.

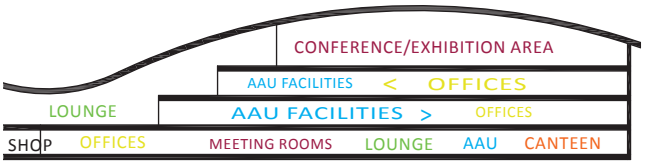


Ill. 2.25 Business areas functional diagram

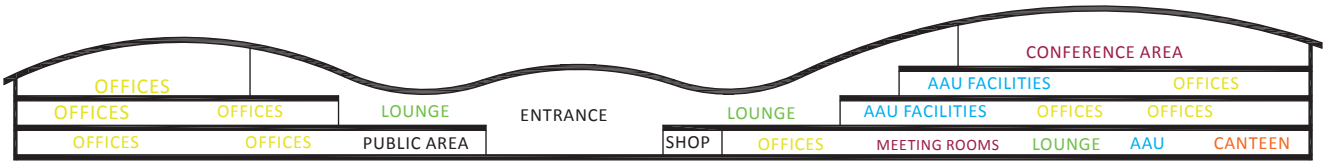
Mix use area

This part is designed that every storey has focus on some of functions. It means that in every storey is office rooms, AAU facilities and common areas, but with more focus on one of them. Programming functions this way it provides users more semi-private areas, in the same time having connection between them.

Ground floor are mix used, which means there is rooms for AAU facilities, office rooms and public use areas as canteen, shops etc. First floor is design with focus on educational use. Second floor has focus on business use and third floor are designed as conference / exhibition area.



Ill. 2.26 Mix use areas functional diagram



Ill. 2.27 Entire building's functional diagram

03

Design phase

Detailing.

Architectural considerations

3.1 Master plan

In master plan development are used all initial analysis, mapping and planned park planning. Building divides site in 2 parts – for light traffic and for heavy traffic.

Western part of the site is design with pedestrian path only for pedestrian and bicycle use. In east part, along the Karolinelundvej, has road access, where is located parking place for 56 cars. Dividing site in two parts, it provide that park will be not disturbed with traffic noise. Park and Karolinelundsvej are connected with path ways in north and south side of the site. In these parts are placed bike storage. In northern part it is under the shelter and in south part it is open bike parking.

Building location studies shows that in western part creates 2 attractive gathering points. One is in front of entrance, which could be used more for building users and second one is around the waterfront and main plaza. Both places are in close connection, in this way keeping attractive whole place.

Building roof construction continues as a landscape to northern part, creating attractive outdoor areas. Where is located bike parking under the shelter and relaxing spaces on the landscape.

Ill. 3.1 Master plan

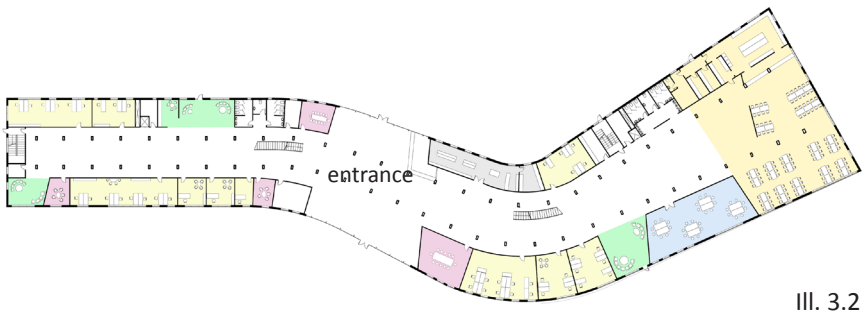
3.2 Plan layout

Final room program is designed following initial ideas from sketching phase.
In entire building each floor includes common functions as tea kitchens, lounge areas, meeting rooms, toilets and printer rooms. Other functions are located differently in each floor.

- Offices
- AAU labs/workshops
- Meeting rooms
- Lounge area / tea kitchens
- Shop (ground floor)
- Entrance / pathways
- Design labs (3rd floor)
- Canteen facilities (groung floor)

Ground floor plan

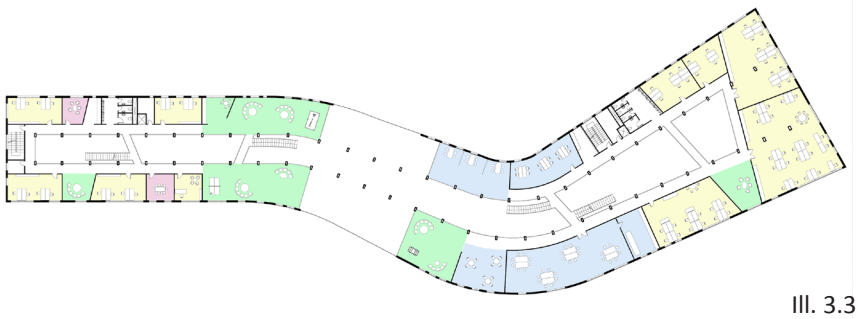
Ground floor is most public floor. In north side is located only offices and next to entrance area are located rooms for functions which are for public use. To south part next to entrance are located reception and shop. In building end part is located canteen. In other parts of south side are offices and AAU workshops.



Ill. 3.2

First floor plan

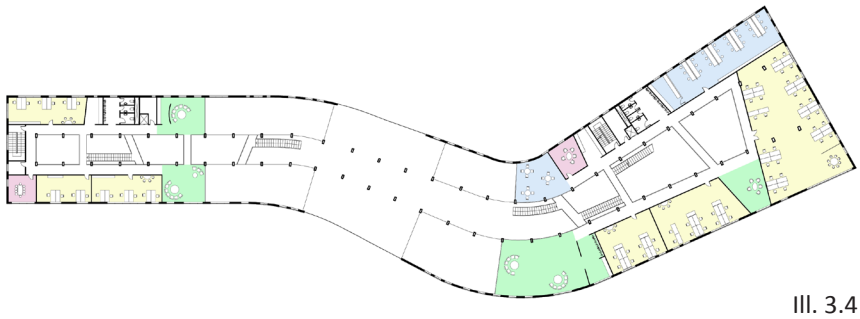
To the north part are located offices and other common spaces. South side have focus to educational use, therefore there is more working spaces and labs for AAU as for offices. This floor includes also common rooms and places.



Ill. 3.3

Second floor plan

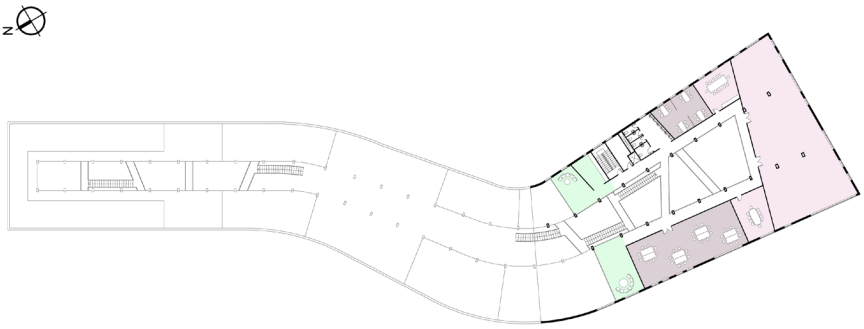
The same as other floors north side have business use and there are located offices. Second floor south part are focus more to business use, which means here are more offices as places for AAU.



Ill. 3.4

Third floor plan

Third floor plan are designed for both, AAU and business use. This floor is focus to cooperation between both user groups. It means here is located meeting rooms, workshop place, design labs and conference/exhibition room. This floor have it own function, which are not for daily use, but for specific meetings, conferences, workshops and projects.



Ill. 3.5

3.3 Facades

The facades are designed according to indoor functional program and architectural expression for the building. Facades are design in simple line division, keeping green roof structure most dominating in the building volume.

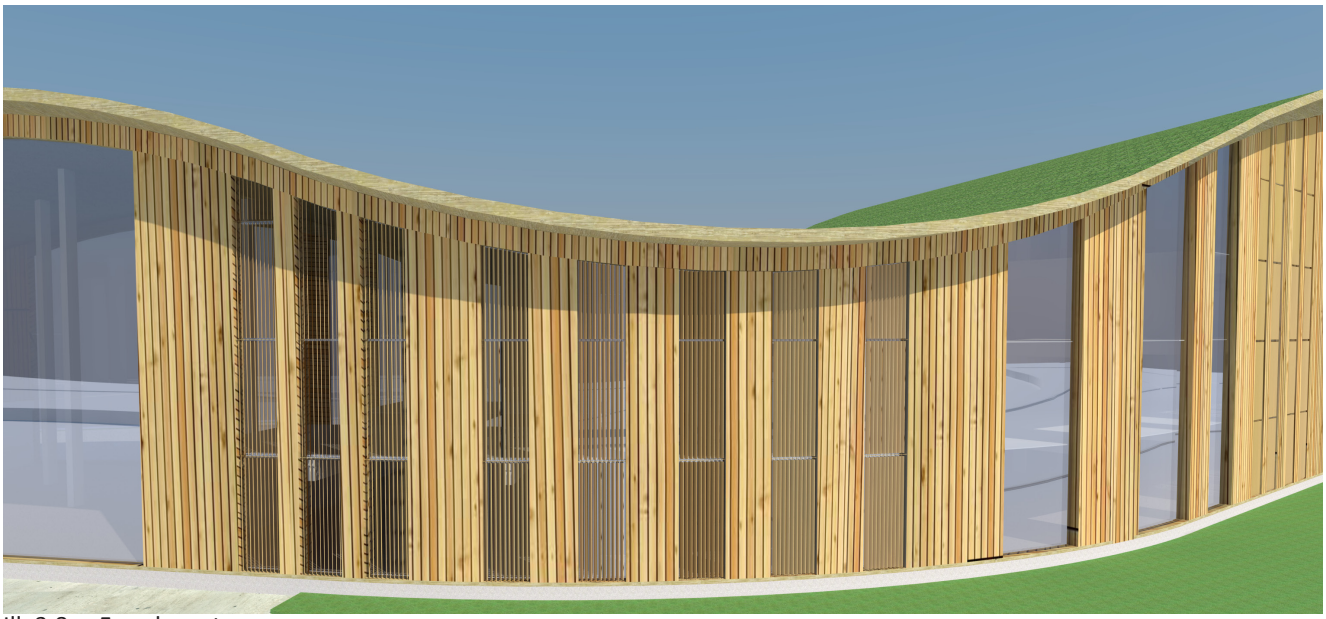
There are used 3 types of facades – open glass facade, closed facade and semi-open facade. Using these types of facade, it provides possibility to control daylight need in different areas of the building. In the same time it controls overheating of the rooms, which will improve the indoor climate qualities.

Semi-open facades are designed combining glass windows and wood shadings. These facade are used in areas where need to cut down the daylight for the rooms. Daylight control and room protection of overheating are not only functions of wooden shades. It should keep and improve the facade qualities. These facade type is designed, that it help improve indoor climate, but don't disturb the view to outside. Shades are angled, thereby it create visual experience along the whole facade. According from the view angle semi-open facades plays together with other building facade, transforming from totally open to totally close facade. It creates the experience of building, where facade is changing together with the pedestrians passing by the building.

All facades are designed in one wood cladding material, to keep one solid volume expression and make better impression of changing facade.

Ill. 3.6

Ill. 3.7



Ill. 3.8 Facade system

3.4 Roof structure

Roof is designed in shaped forms. For roof construction has chose to use green roof construction. Using green roof it has sustainable impacts on the building and environment. From sustainable approach it has many benefits. It provides thermal insulations, in the same time act as a noise barrier functions for building occupants. Especially for cities, green roof use is good in terms of, improving air quality, reducing urban heat island effect, reducing carbon dioxide in the atmosphere and biodiversity. Using green roof it gives also aesthetical impacts of the building and surrounding. It provide visual amenity to green space in busy city life. In roof construction is used skylight to provide better indoor climate.

For roof construction is used semi-intensive green roof structure. It means roof vegetation from visual aspects will be visible from farer distance. Using semi-intensive roof there is higher vegetation diversity, which will give general building overview better expression.


Ill. 3.9


Ill. 3.10


Ill. 3.11

Technical considerations

3.5 Structural chapter

In technical and sustainable construction considerations has been chosen to work with timber construction system. It provides building good aesthetic, structural, economic and environmental impact. It means it has renewable, recycled and environmental friendly constructions. Keeping in mind sustainable construction principles it has been chosen to work with simple and plug-in joints where it is possible, which are easy to disassemble and re-use.

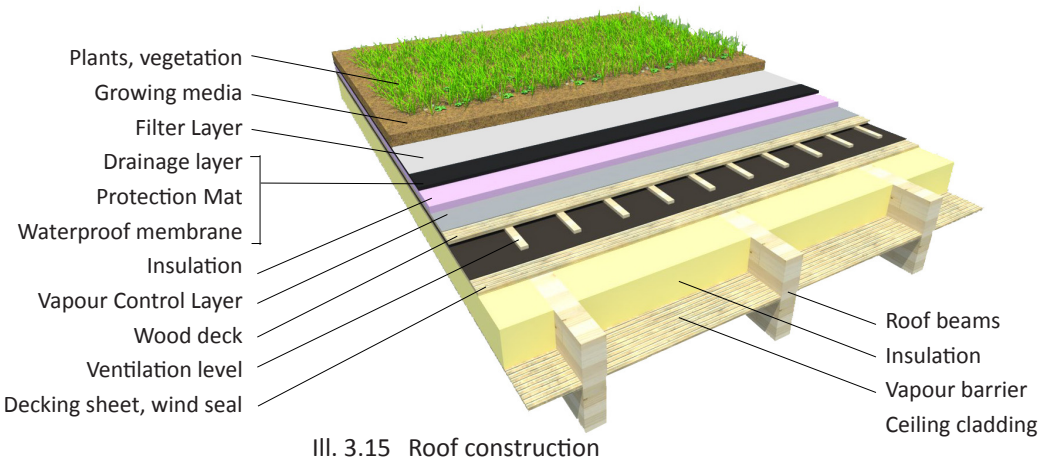
Ill. 3.12 Wall and roof overhang connection

Roof structure

Designing roof construction has been taken into considerations that it should be wood construction, with vegetative roof covering and in visible constructions from inside. Therefore it has been chosen to work with roof beam/rafter system. It has been design in a way that roof beams increase from 15 to 30m. All roof structure is supported by external walls and columns inside.
Roof are designed as most dominating part in building volume. Shape of it is straight lined all around the building and shaped in various high according to building volume in different parts. Roof structure in north part continues as a landscape until the ground in connection with the site. In this way it keeps the link with the surrounding and landscape.

The beams will be glue laminated wood (140x600mm). Letting the beam be visible from the inside gives clear understanding of construction. Roof beam plan and construction calculations can be found in appendix page 102-103.

Ill. 3.14 Roof beam and wall plug-in connection



Ill. 3.15 Roof construction

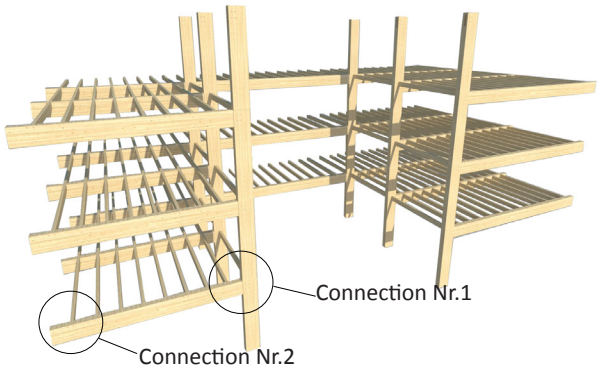
Columns and beams

As main load bearing system has been chosen to work with beams and columns and outside load bearing wooden carcass walls. Main load bearing columns and beams are in glue laminated wood. Small floor beams are in construction timber C24. Structural system consist from main column and big beam system each 4,1 m, and small beam floor partition between them, which repeats every top floor. Floor partition are supported by external wall and fixed to the columns to create a horizontal stability.
All building structure system can divide in to 3 parts. North part, which are 3 story high, Middle part which consists from column system, which supports the roof structure and southern part, which are 4 stories high.
The columns will be continues through all levels to bear the roof.

Columns will work as load bearing system for roof and floor partition, placing them in a middle and not hiding between the internal walls it gives the atrium qualities, giving people space experience along whole building.

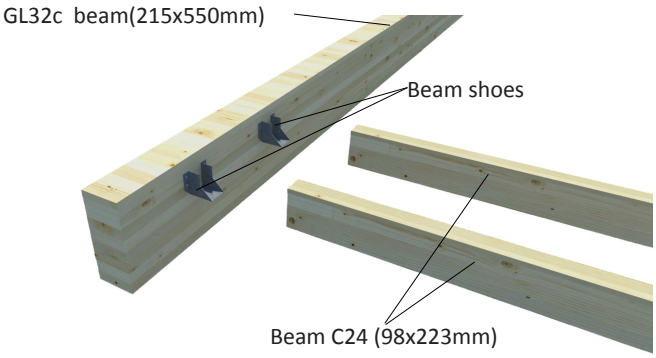
For visible constructions between columns and beams is used hidden joint system, in this way giving the construction clearness. For floor partition is used beam shoes joint system, as they will be hidden. Main focus is to keep clean and not visible joints in constructions. Main beams are in size 215x550mm, columns 250x550.

Beam and column plan and calculation can be found in appendix page 104-107.

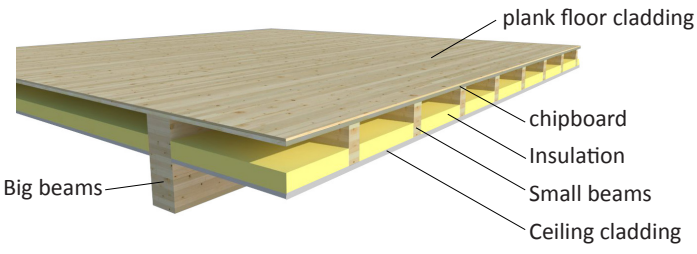


Ill. 3.15 Beam and column system

Ill. 3.16 Connection Nr.1
Plug-in connection between column and beam, which are fixt together with bolts.



Ill. 3.17 Connection Nr.2
Connection between floor beams, which are fixt with beam shoes.



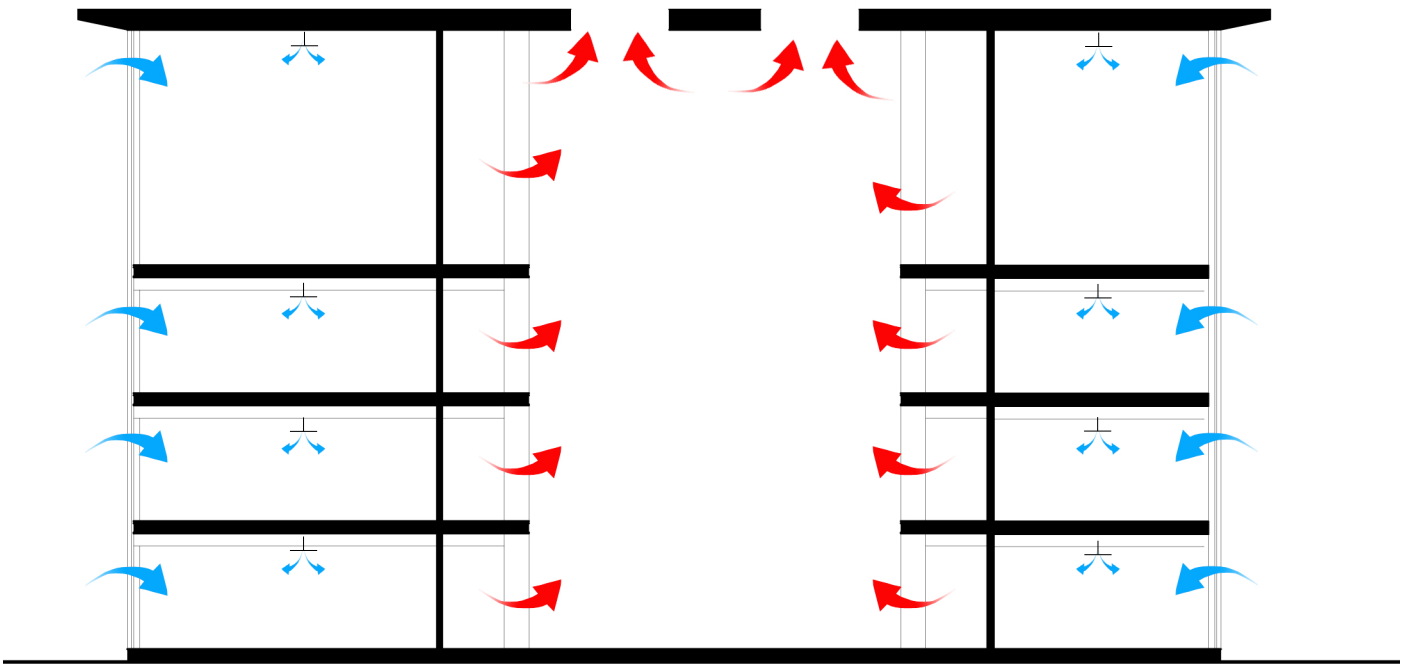
Ill. 3.18 Floor construction

3.6 Ventilation verification

For building ventilation are chose hybrid ventilation system, combining natural ventilation and mechanical ventilation. It will provide a good indoor climate, keeping well-defined air change. The natural ventilation is going to function as cross ventilation and stuck ventilation, where the atrium creates the chimney effect. As the roof has skylight, it will be automated window panels, which conducts the polluted air out. In this way it's possible to control air change in the building.

In terms of mechanical ventilation, ducts will be placed above the floor partition between the big beams. Mechanical ventilation will be divided in to 2 parts, for northern part and southern part of building. For most polluted rooms as toilets and kitchens with higher requirements of exhaustion a mechanical system will help to keep the air quality high. In big kitchen in ground floor will have separate ventilation system as in other building parts.

In this project main focus is not about ventilation. However it has been taken in to considerations about general idea of ventilation system for building, but not going deeper in details and development of exact system.



Ill. 3.19 Illustration of hybrid ventilation system

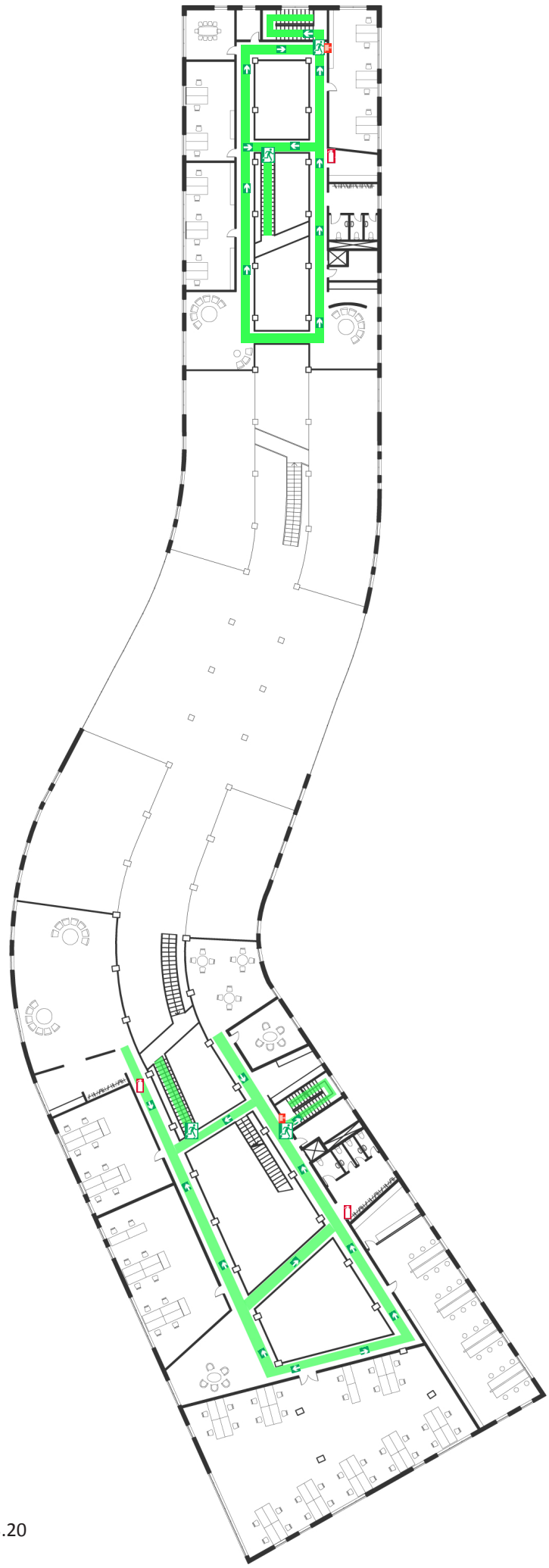
3.7 Fire verification

According to fire regulations building is either in User category 1, which includes office building functions or in user category 3, which includes class rooms etc. Therefore all fire requirements and regulations should be appropriate to both categories.

User categories

User category 1 includes section meant for day use only. The persons who are normally staying in the section are all familiar with the layout of escape routes and are all capable of rescuing themselves. It concerns buildings such as: Offices, industrial and storage buildings, certain garage buildings.

User category 3, which includes building section meant for many persons and for day use only. The persons who are staying in the section are not familiar with the layout of escape routes but are all capable of rescuing themselves. It concerns buildings such as: Shops, assembly rooms, canteens, cinemas, restaurants, function rooms, certain parts of school, sport facilities, meeting rooms, concert halls, exhibition rooms and other similar rooms designed to accommodate more than 50 persons and constituting fire unit. [BR10]



Emergency exit

Escape direction

Escape route

Waterfilled hose reel

Hand held fire extinguisher

Ill. 3.20

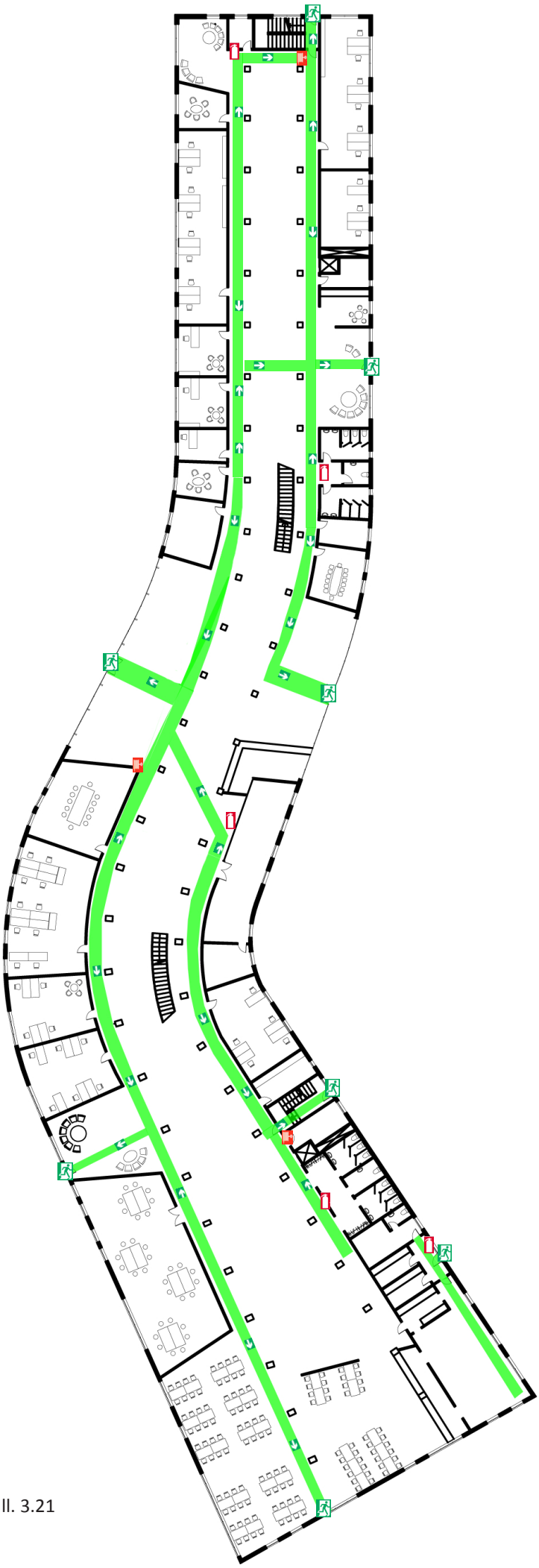
Building fire divisions

A building shall be separated in such a way that areas with different personal risk levels are divided into independent fire units. In building independent fire division are such a areas as: stairway as escape route, lift shaft, Installation ducts, gates and other pathways, which are working as access route for rescuing. The building is separated in to 3 sections, the entrance part, north part and south part, which have they own independent rescue routes.

Escape route conditions

When evaluating „sufficient Access to escape routes" such issues as number of person, fire partitioning design of fire compartment including size, arrangement and use should be considered. The maximum distance for escape route until independent fire unit is maximums 25 m.

If room area are <150 m2, there should be 1 access to rescue route, if area are >150 m2, there should be 2 accesses to escape routes. As well in every room need to be 1 rescue opening per 10 persons for which the room is designed. As in every building sections is less than 150 people escape route should be at least 1,3 m width.



Emergency exit

Escape direction

Escape route

Waterfilled hose reel

Hand held fire extinguisher

Ill. 3.21

3.8 Sustainable construction considerations

Due the design process with sustainable construction considerations need to deal with different aspects. It include considerations about sustainable material use, building durability in terms of aesthetical, physical and functional aspects, environmental, social and economical sustainability aspects.

Developing sustainable material use in buildings, need to consider different material criteria's. All criteria's can divide in 3 phases, affected by life-cycle: Manufacturing process, building use process and waste management.

In manufacturing process need to consider material waste reduction, pollution possibilities, and recycling, embodied energy reduction and if material is natural. During building use process it is important, that material provide energy efficiency, renewable energy source and water treatment, same that it is nontoxic and it have long life time. In Waste management phase it matters if material is recyclable or reusable.

Using wood in constructions and incorporating it in building materials it fulfil various sustainable material requirements. It's natural and nontoxic material, renewable and energy efficient, and it is recyclable and reusable material, as well as it have other sustainable material qualities.

Durability is another important requirement what affects the building. One aspect is functional durability of the building. It means designing building need to think also about functional possibilities in future. Innovation Park is planned that in future it can be appropriate for different function use, in case if Innovation Park doesn't fulfill it functions. Another aspect is aesthetical impact of the building. Important is not only architectural expression of the building from outside, but also how constructions, materials and general overview looks from inside. It plays the role for those people who will use building day by day. It have impact of human emotionality, how they treat and feels being inside in the building.

04 Presentation.

Master plan in context

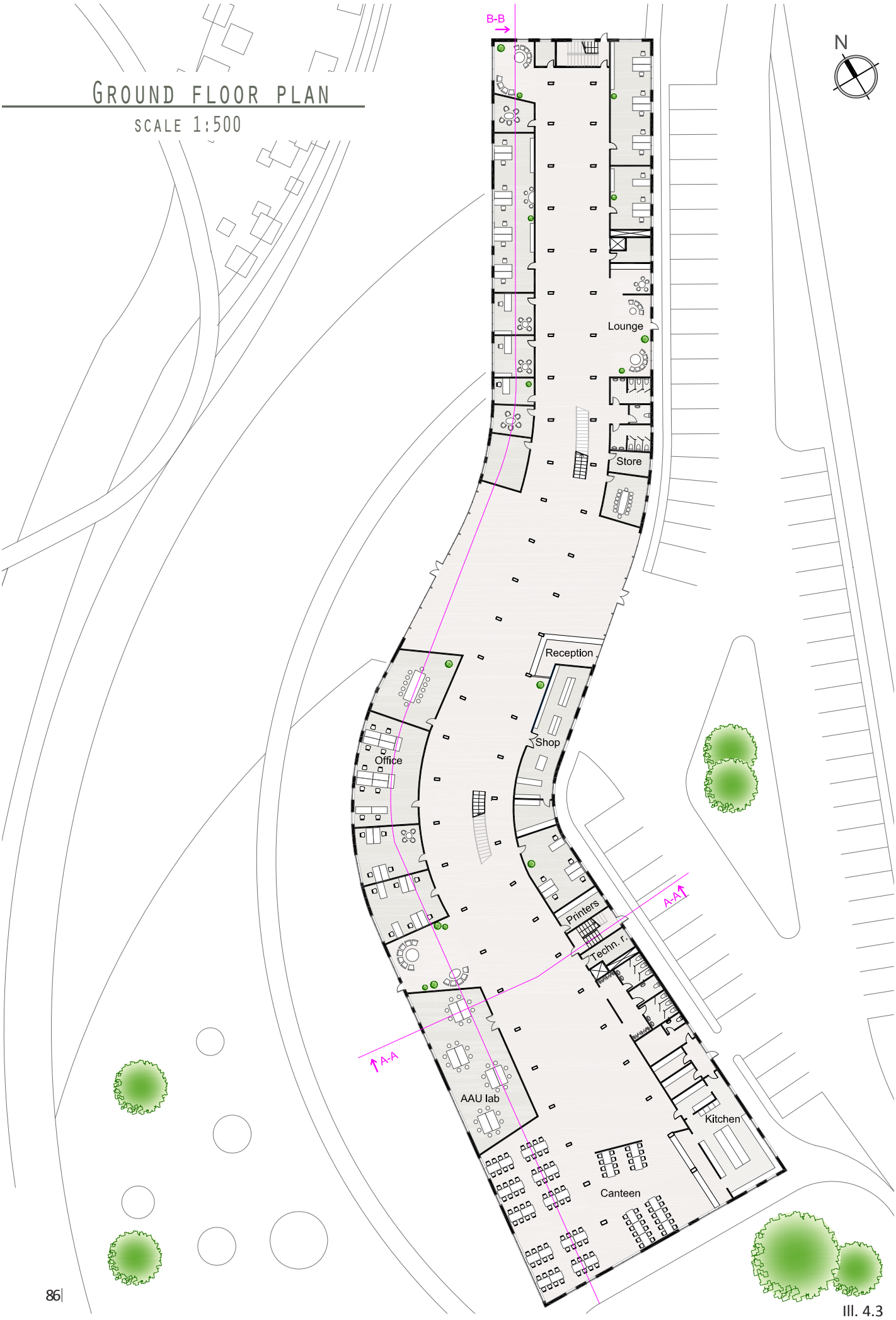
scale 1:1000

Ill. 4.1

Ill. 4.2

GROUND FLOOR PLAN

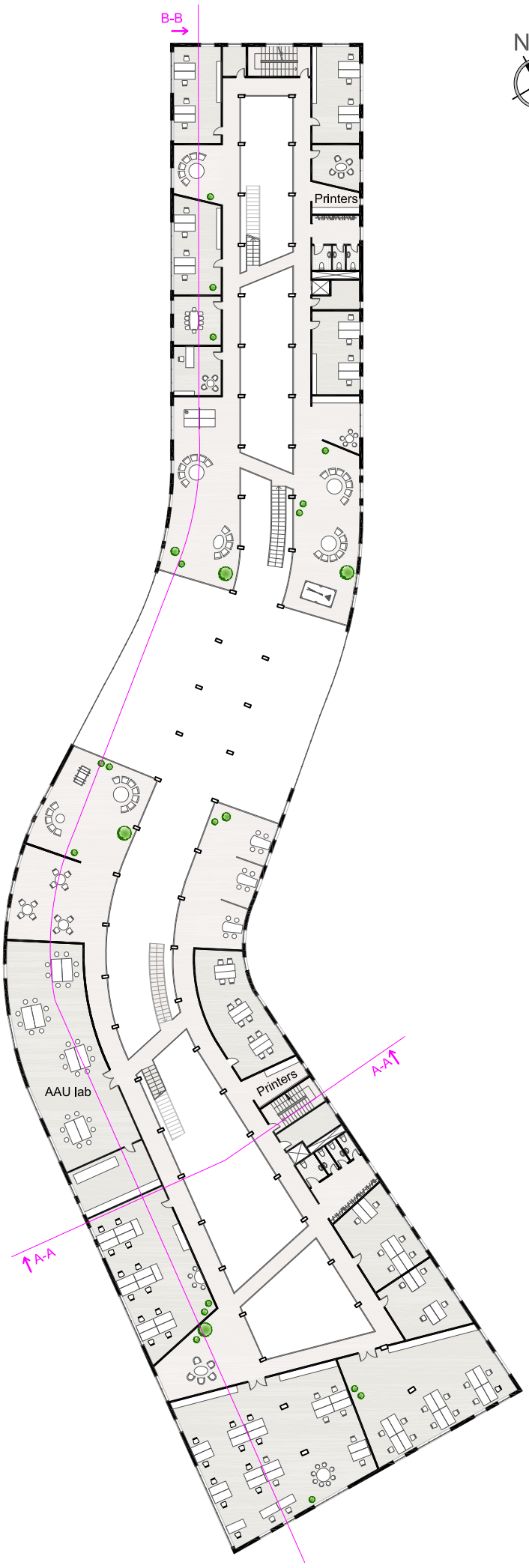
SCALE 1:500



Ill. 4.3

First floor plan

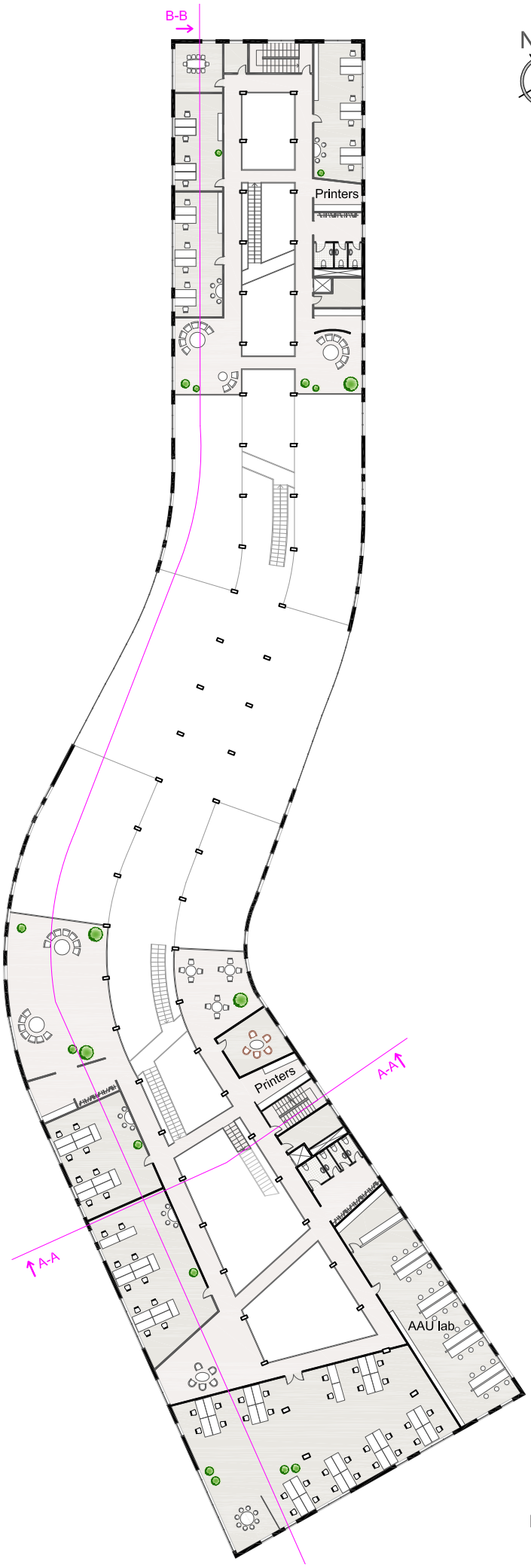
scale 1:500



Ill. 4.4

Second floor plan

scale 1:500

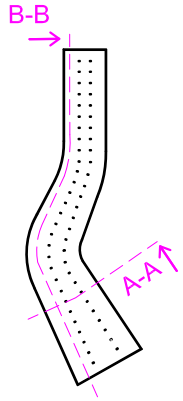


Ill. 4.5

Third floor plan

scale 1:500

Ill. 4.6



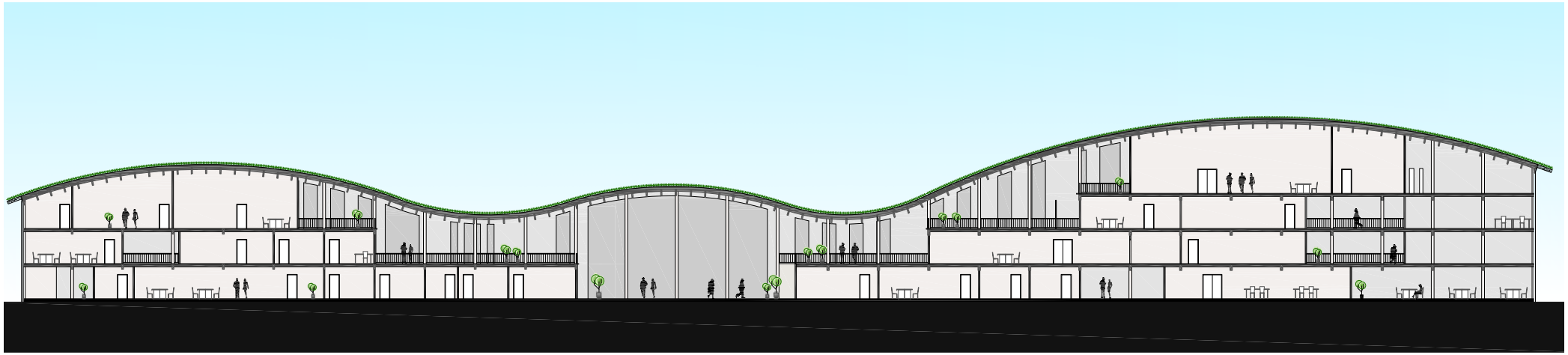
Cross section A-A

scale 1:500

Ill. 4.7

Cross section B-B

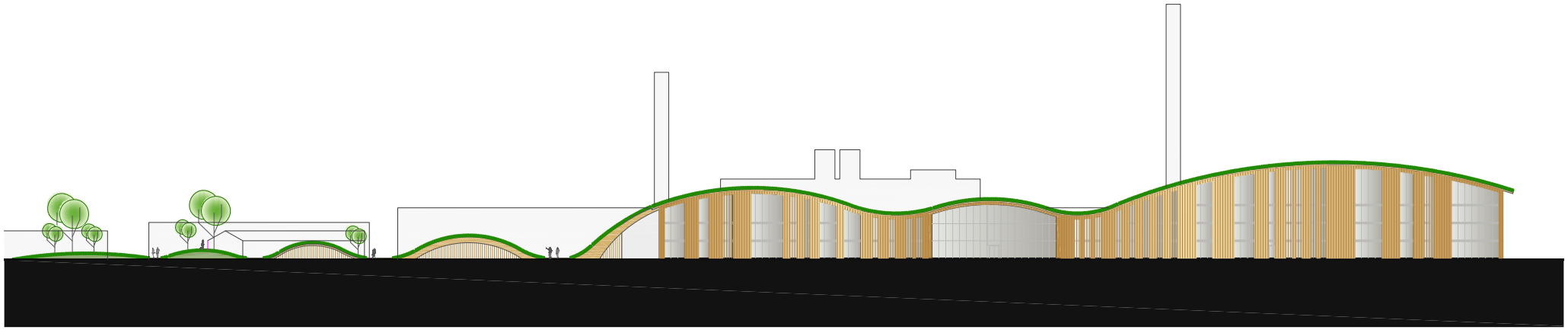
scale 1:500



Ill. 4.8

West facade

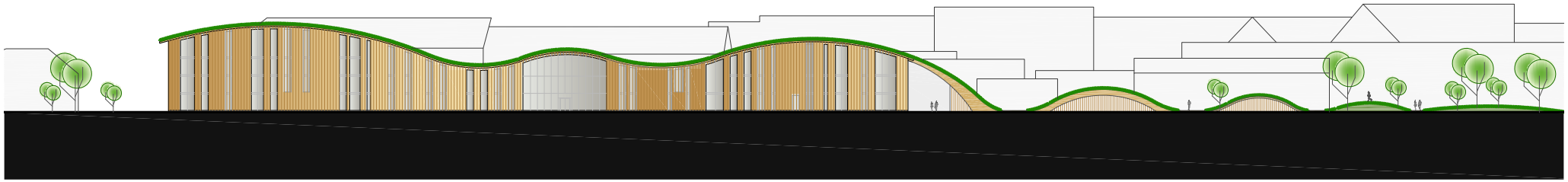
scale 1:1000



Ill. 4.9

East facade

scale 1:1000



Ill. 4.10

Exterior renders

Ill. 4.11

Ill. 4.12

Ill. 4.13

Interior renders

Ill. 4.14

Ill. 4.15

05 Conclusion.

Conclusion

The project focuses on connection between educational and business functions. To reach the best results, functions of education and business are combined, leaving space for innovation. It means designing place for Aalborg University and offices for business use. It should become an attractive and suitable place for creative working and collaboration. Functional program is divided into 3 groups - business, educational and public use. Functional planning also provides possibility to use building for public events, conferences, workshops etc. Combining all these 3 functions building reaches the goals to provide space for collaboration and public use.
Another goal of the project is to consider the material use in constructions, which would offer not only sustainable construction qualities, but also architectural expression, visual and aesthetic qualities. It was achieved using wood constructions, and considering material qualities in terms of material manufacturing, use and disposal. Aesthetic, physical and functional aspects were taken into consideration to reach better quality of the building.

Building layout is divided in to 3 parts – business area, entrance and mix use area. It will provide users choice between more private area and more common area with collaboration possibilities. Private area is only for business use. Mix function area includes labs and workshops for Aalborg University and offices for business use. This part is designed so that every storey has focus on one of functions. Focusing each floor to different function creates sensation that they are connected together, but in the same time they have semi-private space.

Building is located in old Karolinelund area in Aalborg. This place has its unique history and meaning for residents of Aalborg. Park function from 9th semester project is kept for all Karolinelund are, in this phase focusing to specific building site. Building is located close to the main pedestrian flow from city centre and residential area. Building divides the site in two parts – pedestrian area and park where there is access road to the building. Main Square turns in to a main meeting point, where all pathways from neighbourhood meet. Connection between the building and park is achieved by placing building's main entrance close to the main plaza.
Building shape follows the site layout movement, creating the link between the building and landscape. Roof has the same outer shape as walls. To improve connection with context and landscape, roof structure is designed as dominant part of the building. Roof structure continues until the ground creating the landscape in the site. We chose a green roof for the roof constructions in order to improve the sustainable construction aspects. For facades there are 3 different systems being used – open glass facade, solid wooden facade and mix system facade. Using various grids for facades helps to indicate main entrances. For mix system facade there are angled wooden shades being used. It gives sensation of moving facade, offering people experience walking by the building.

Reflection

One of the main subjects of this project is sustainable constructions. Therefore it is relevant how the final building relates to this topic. Term “Sustainable construction” has many definitions and approaches. Sustainable construction deals with impacts in terms of economical, ecological and social aspects in local, regional and global scale. Working with sustainable construction can be developed in each of project stages. During entire design process in project I was dealing with general ecological and social aspects. In each stage of project process aesthetical, ecological and technical aspects were considered in general level without going deeper into details. For further project development we could look into more detail of one or another aspects of sustainable constructions, keeping in mind other aspects as well. Used material analysis and LCA could be developed further. All in all, building can be sustainable in many ways, but it’s important that it improves social aspects in the same level as technical, economical and environmental aspects.

Another goal of the project was to create place for education and business collaboration. After all the room program analysis and functional planning, it could be developed further in more detailed level. Analysing Aalborg University education programmes can give us insight of which programs are more popular. By comparing these programs and business with each other, we could find out the best cooperation possibilities between education and business, improving the use of building function. In the same way building is designed so that it’s flexible for changes in functions. It will be flexible in layout for another use in future.

Building volume is created according to the functional program, building site borders and framework of the project. To improve better indoor climate we could experiment more with building volume and dimensions, window location and building shape.

06

Appendix.

Structural chapter

Load cases

Roof construction:

Dead load – Permanent load G:

200 mm Green roof (semi-intensive) structure:	1,961 kN/m2 (200 kg/m2)	[Green Roofs, briefing note 2, p.9]
50 mm insulation	0.15 kN/m3 (17 kg/m3)	[Isover.dk/ Flex]
24 mm Wood decking	1,8 kN/m3 (200 kg/m3)	[Teknisk Ståbi p.68 Tabel 2.16]
22 mm OSB boarding	6,12 kN/m3 (600 kg/m3)	
600 mm GL32c roof construction:	4,41 kN/m3 (490 kg/m3)	[Teknisk Ståbi p. 314 Tabel 7.1]
345 mm Isolation (Isover):	0.18 kN/m3 (20 kg/m3)	[Isover.dk/ Isover Ruller]
30 mm cladding from inside (balsa)	1,8 kN/m3 (200 kg/m3)	[Teknisk Ståbi p.68 Tabel 2.16]

Total (dead load G):

2,24 kN/m2

2,24 kN/m2 x 1,2 = 2,69 kN/m2

(The slope of the roof is between 300-600) [Teknisk Ståbi, p.168 table 4,8]

Snow load: [Teknisk Ståbi, p.168)

S=μiCeCtsk

μi =0,5

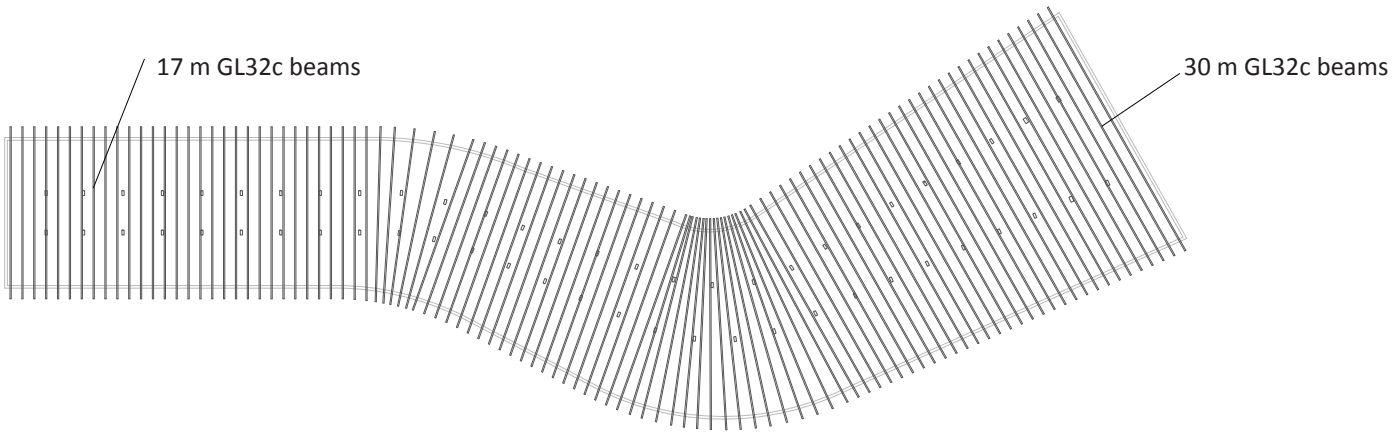
Ce = 1,0

Ct = 1,0

sk = 0,9 kN/m2

s = 0,5 x 1 x 1 x 0,9 kN/m2 = 0,45 kN/m2

For roof constructions has been calculated the longest roof beam, which is 30 m long with 4 support points.



Roof beam calulation:

3000 mm glue lam beam (GL32c), 140 x 600 mm

TRE-DIM Versjon 10.0 BJELKE

TRE-KONSTRUKSJONS DIMENSJONERING

- er programmert av ingeniør Ingvar Skarvang

140 x 600 GL36c
L = 30.00 meter

Materialfaktor:	1.15
Pålitlighetsklasse:	2
Lastvarighetsklasse:	Permanent la
Klimaklasse:	2
Kategori:	B

Bjelkens : 0.0°

JEVNT FORDELT LAST PÅ DRAGER:

NYTTELAST :	0.450	kN/m
EGENLAST :	3.620	kN/m
BRUDDLAST :	5.019	kN/m

Nedb.	-4 mm	41 mm	1 mm
	L/0	L/368	L/6964
	6000	15000	9000

Oppleggskraft:

3.9 kN	65.7 kN	69.9 kN	14.3 kN

Nødvendig oppleggs-lengde:

16 mm	213 mm	230 mm	29 mm

SNITTKREFTER:	KAPASITET.		OPPTREDENDE.		UTNYTTELSE.	
Moment :	157.8	kNm	85.3	kNm	54.1	%
Skjærkraft :	74.4	kN	39.2	kN	52.7	%

BEREGNINGSREGLER:
NS-EN 1995 - NS-EN 1993 - NS-EN 1990 - NS-EN 1194 - NS-EN 338

TRE-DIM BJELKEBEREGNING Dato : 5/11/2012 Tid: 14:00:56
Roof calculation 140x600
Registrert bruker :

Beam calculation:

- Small beams 223 mm C24 (l=4,1 m) distance 1,2 m

  Floor construction:

14 mm plank floor cladding	5,85 kN/m3 (650 kg/m3)	
22 mm chipboard	2,7 kN/m3 (300 kg/m3)	[http://www.timberman.dk]
100 mm Isolation (Isover)	0.15 kN/m3 (17 kg/m3)	[http://www.laver.co.uk]
14 mm ceiling cladding (balsa)	1,8 kN/m3 (200 kg/m3)	[Isover.dk/ Isover Flex]
		[Teknisk Ståbi p.68 Tabel 2.16]

  Total (dead load G): 0,16 kN/m2
  0,16 kN/m2 x 1,2 = 0,19 kN/m2
  Life load (offices): 2,5 kN/m2
  2,5 kN/m2 x 1,5 = 3,75 kN/

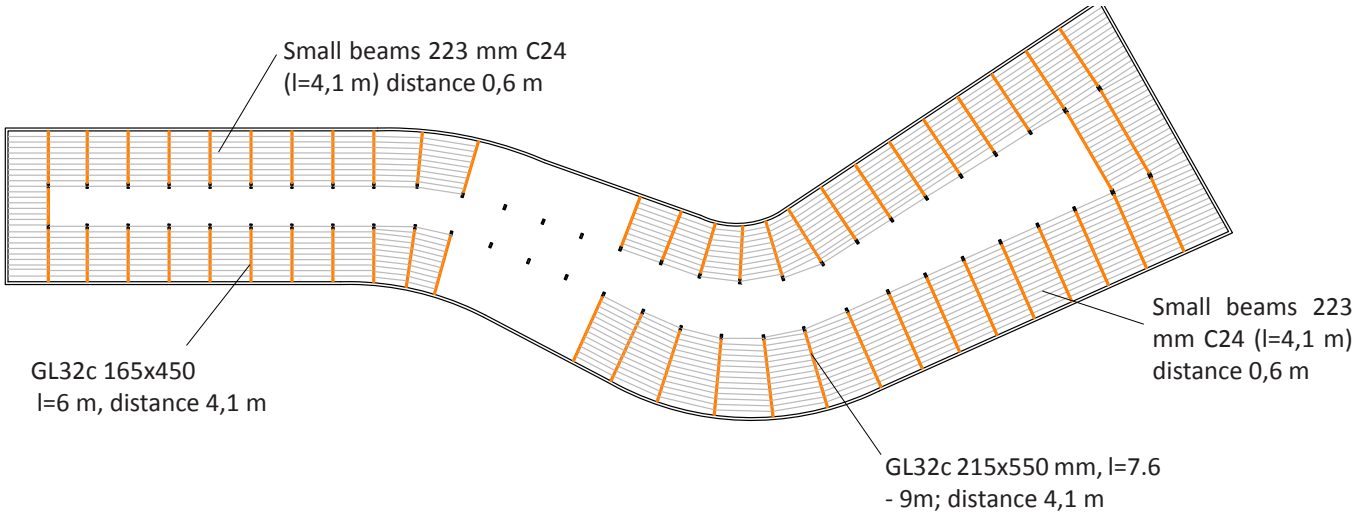
- Big beam

  GL32c 215x550 mm, l=9 m (south side)
  GL32c 165x450 mm, l=6m (north side)

  Loads:

Floor construction	0,18 kN/m2	
223 mm C24 cross beams	3,78kN/m3 (420kg/m3)	[Teknisk Ståbi p. 314 Tabel 7.1]

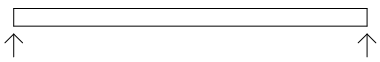
  Total (dead load G): 1,02 kN/m2
  1,0 kN/m2 x 1,2 = 1,22 kN/m2
  Life load (offices): 2,5 kN/m2
  2,5 kN/m2 x 1,5 = 3,75 kN/m2



Beam calulation:

Small beams 223 mm C24 (l=4,1 m) distance 0,6 m

```
TRE-DIM  Versjon 10.0 BJELKE
TRE-KONSTRUKSJONS DIMENSJONERING

    - er programmert av ingeniør Ingvar Skarvang

                                98 x 223  C24
                                L = 4.10 meter
```



```
Materialfaktor:          1.25
Pålitlighetsklasse:      2
Lastvarighetsklasse:      Permanent la
Klimaklasse:             2
Kategori:                B

Bjelkens : 0.0°

                                JEVNT FORDELT LAST PÅ DRAGER:
                                NYTTELAST :      2.250   kN/m
                                EGENLAST  :      0.200   kN/m
                                BRUDDLAST :      3.615   kN/m
Nedb.                  12 mm
                       L/352
                       4100
Oppleggskraft:
     7.4 kN                              7.4 kN
Nødvendig oppleggs-lengde:
     33  mm                              33  mm

SNITTKREFTER:     KAPASITET.        OPPTREDENDE.     UTNYTTELSE.
Moment      :      9.4   kNm         7.6   kNm        81.2  %
Skjærkraft  :     18.7   kN          7.4   kN         39.5  %
```

BEREGNINGSREGLER:
NS-EN 1995 - NS-EN 1993 - NS-EN 1990 - NS-EN 1194 - NS-EN 338

TRE-DIM BJELKEBEREGNING Dato : 4/27/2012 Tid: 19:59:37
Small beam 4,1 m
Registrert bruker :

215x550 mm GL32c beams (l=9 m) distance 4,1 m

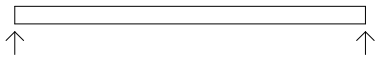
TRE-DIM Versjon 10.0 BJELKE

TRE-KONSTRUKSJONS DIMENSJONERING

- er programmert av ingeniør Ingvar Skarvang

215 x 550 GL32c

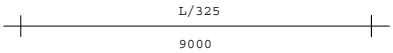
L = 9.00 meter



Materialfaktor: 1.15
Pålitlighetsklasse: 2
Lastvarighetsklasse: Permanent la
Klimaklasse: 2
Kategori: B

Bjelkens : 0.0°

Nedb. 28 mm
L/325



9000

Oppleggskraft:
51.1 kN 51.1 kN

Nødvendig oppleggs-lengde:
122 mm 122 mm

JEVNT FORDELT LAST PÅ DRAGER:

NYTTELAST : 3.750 kN/m
EGENLAST : 4.770 kN/m
BRUDDLAST : 11.349 kN/m

SNITTKREFTER:	KAPASITET.		OPPTREDENDE.		UTNYTTELSE.
Moment :	182.6	kNm	114.9	kNm	62.9 %
Skjærkraft :	88.2	kN	51.1	kN	57.9 %

TRE-DIM BJELKEBEREGNING
Dato : 5/11/2012 Tid: 17:04:26

Big beam 215x550

Registrert bruker :

BEREGNINGSREGLER:
NS-EN 1995 - NS-EN 1993 - NS-EN 1990 - NS-EN 1194 - NS-EN 338

165x450 mm GL32c beams (l=6 m) distance 4,1 m

TRE-DIM Versjon 10.0 BJELKE

TRE-KONSTRUKSJONS DIMENSJONERING

- er programmert av ingeniør Ingvar Skarvang

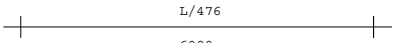
165 x 450 GL32c

L = 6.00 meter

Materialfaktor: 1.15
Pålitlighetsklasse: 2
Lastvarighetsklasse: Permanent la
Klimaklasse: 2
Kategori: B

Bjelkens : 0.0°

Nedb. 13 mm
L/476



6000

Oppleggskraft:
33.2 kN 33.2 kN

Nødvendig oppleggs-lengde:
99 mm 99 mm

JEVNT FORDELT LAST PÅ DRAGER:

NYTTELAST : 3.750 kN/m
EGENLAST : 4.540 kN/m
BRUDDLAST : 11.073 kN/m

SNITTKREFTER:	KAPASITET.		OPPTREDENDE.		UTNYTTELSE.
Moment :	95.7	kNm	49.8	kNm	52.1 %
Skjærkraft :	55.4	kN	33.2	kN	60.0 %

TRE-DIM BJELKEBEREGNING
Dato : 5/11/2012 Tid: 17:05:20

Big beam 165x450

Registrert bruker :

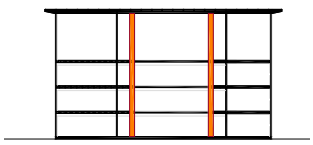
BEREGNINGSREGLER:
NS-EN 1995 - NS-EN 1993 - NS-EN 1990 - NS-EN 1194 - NS-EN 338

Column calculation:

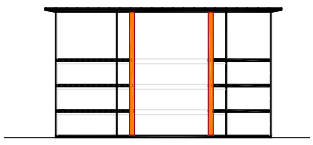
Calculating column there is two diferent size columns. In northen part there is need for 4 bigger columns as in the rest of the building.

- Columns Nr.1 350x600 mm GL32c, h=3m
- Columns Nr.2 250x550 mm GL32c, h = 3 - 9m.

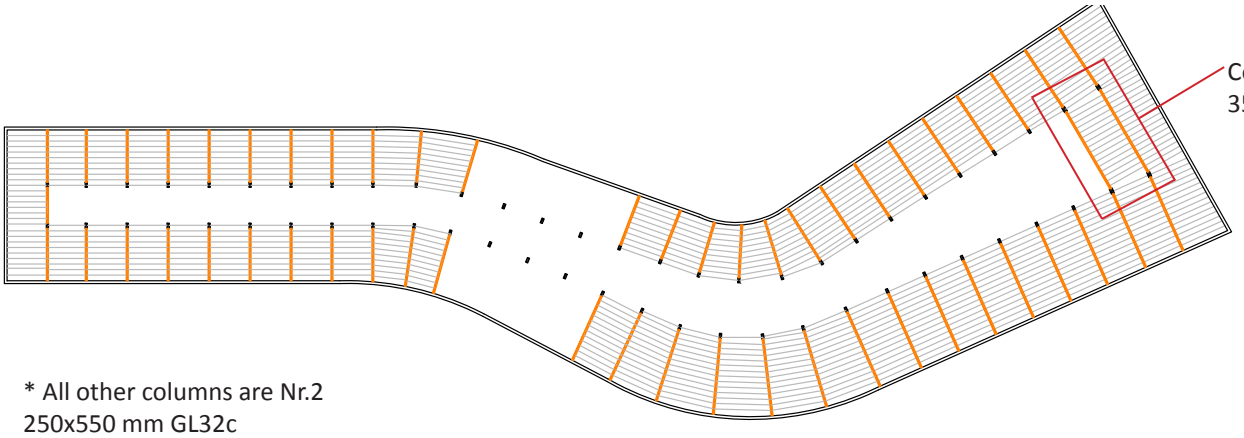
Column Nr.1



Column Nr.2



* Calculaiting ground floor column it has loads from roof, from floor partition (each or single side) and own load from top floor columns.



* All other columns are Nr.2
250x550 mm GL32c

250x550 mm GL32c column (l=3,1 m)

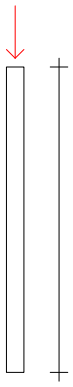
```
LAST:     69.90 kN    (Bruddlast)

TYPE SØYLE:    GL32c    250 x 550
KNEKKLENGDE =   9.500 m om Y-akse: 250 mm
KNEKKLENGDE =   9.500 m om Z-akse: 550 mm

Utnyttet kapasitet :  10.83 %      OK

Søyletrykk mot tre, utnyttet:  17.9 %
OK med søylens endeflate.
```

```
TRE-DIM   Versjon 10.0 SØYLE
TRE-KONSTRUKSJONS DIMENSJONERING

- er programmert av ingeniør Ingvar Skarvang

Materialfaktor:          1.15
Pålitlighetsklasse:        1
Lastvarighetsklasse:     Korttidslast
Klimaklasse:         2
Kategori:                H
```

TRE-DIM SØYLEBEREGNING Dato : 5/11/2012 Tid: 21:52:14
middle columns
Registrert bruker :

BEREGNINGSREGLER:
NS-EN 1995 - NS-EN 1993 - NS-EN 1990 - NS-EN 1194 - NS-EN 338

250x550 mm GL32c column (l=9,5 m)



LAST: 69.90 kN (Bruddlast)

TYPE SØYLE: GL32c 250 x 550

KNEKKLENGDE = 9.500 m om Y-akse: 250 mm

KNEKKLENGDE = 9.500 m om Z-akse: 550 mm

Utnyttet kapasitet : 10.83 % OK

Søyletrykk mot tre, utnyttet: 17.9 %
OK med søylens endeflate.

TRE-DIM Versjon 10.0 SØYLE
TRE-KONSTRUKSJONS DIMENSJONERING

- er programmert av ingeniør Ingvar Skarvang

Materialfaktor: 1.15
Pålitlighetsklasse: 1
Lastvarighetsklasse: Korttidslast
Klimaklasse: 2
Kategori: H

TRE-DIM SØYLEBEREGNING Dato : 5/11/2012 Tid: 21:52:14
middle columns
Registrert bruker :

BEREGNINGSREGLER:
NS-EN 1995 - NS-EN 1993 - NS-EN 1990 - NS-EN 1194 - NS-EN 338

350x600 mm GL32c column (l=3,1 m)

LAST: 387.10 kN (Bruddlast)

TYPE SØYLE: GL32c 350 x 600

KNEKKLENGDE = 3.100 m om Y-akse: 350 mm

KNEKKLENGDE = 3.100 m om Z-akse: 600 mm

Utnyttet kapasitet : 13.64 % OK

Søyletrykk mot tre, utnyttet: 97.5 %
OK med søylens endeflate.

TRE-DIM Versjon 10.0 SØYLE
TRE-KONSTRUKSJONS DIMENSJONERING

- er programmert av ingeniør Ingvar Skarvang

Materialfaktor: 1.15
Pålitlighetsklasse: 2
Lastvarighetsklasse: Permanent las
Klimaklasse: 2
Kategori: B

TRE-DIM SØYLEBEREGNING Dato : 5/11/2012 Tid: 17:09:07
Column 350x600
Registrert bruker :

BEREGNINGSREGLER:
NS-EN 1995 - NS-EN 1993 - NS-EN 1990 - NS-EN 1194 - NS-EN 338

Reference list

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5.ISOVER, 2009, Planet, people, prosperity Our commitment to sustainable construction.

6. Life Cycle Assessment of buildings comparing structural steelwork with other construction techniques.

7. LEED certifications.pgf, Kawneer Sustainable Solutions

8.http://www.mst.dk/NR/rdonlyres/6C1FD405-6B26-4FC4-8EAD-1774726331CE/0/godkendt_stoejhandlingsplan_09_ aalborg.pdf

Illustration list

1.1 – 1.6 Own illustrations

1.7 http://www.flickr.com/photos/322 17266@ N05/5188812365/

1.8http://www.flickr.com/photos/32217266@ N05/5188812365/

1.9 http://www.flickr.com/photos/32217266@ N05/5188812365/

1.10 - 1.27 own illustration

1.28 1.27 http://www.ultimatejourney.com/DenmarkMills. JPG

1.29 - 1.30 own illustration

1.31-1.32 Petes lectures

1.33 Noise pollution, http://www.mst.dk/NR/ rdonlyres/6C1FD405- 6B26-4FC4-8EAD-1774726331CE/0/ godkendt_stoejhandlingsplan_09_ aalborg.pdf

1.34 - 1.50 own illustrations

1.55–1.57 http://www.isover.com/var/isover_com/storage/ original/application/6d29ea576da2cf4586c77bf4be26d473. pdf

1.58-1.59 own illustrations

1.60 http://www.astarfuture.co.uk/images/Business%20 meeting%202.jpg

1.61 own illustration

1.62 http://luxury-idea.com/decor/office-designs/office-equipment-with-residential-atmosphere/

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1.65 http://www.bejoku.com/wp-content/uploads/2011/04/ meeting-room-design-contemporary-office-interior-design. jpg

1.66 http://www.blackberryinsight.com/2011/02/20/ blackberry-zone-at-the-phones-4u-oxford-street/

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1.75-1.76 http://www.oecd.org

2.1 http://www.morfae.com/1271-helen-and-hard/

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2.9 http://www.lee-evans.co.uk/community/shorne7.htm

2.10 http://www.sabmagazine.com/blog/2007/09/28/ bioclimatic-design/

2.11-2.27 own illustrations

3.1-3.5 own illustrations

3.6 http://www.morfae.com/1271-helen-and-hard/

3.7 http://www.architecture-buildings.com/ images/2011/04/zaragoza-vertical-blind-like-facade.jpg

3.8 Own illustration

3.9 http://www.zeitnews.org/images/stories/green-roof1.jpg

3.10 http://www.flickr.com/photos/49508892@ N08/4533552731/

3.11 http://img.weburbanist.com/wp-content/ uploads/2009/04/singapore-green-roof-1.jpg

3.12-3.21 Own illustration

4.1-4.15 Own illustration