synopsis

This project concerns the transformation of three industrial buildings, located at Østre Havn in Aalborg. The design is being converted to fulfil the modern demands both in terms of its architecture concerning aesthetic and programme. Furthermore the project will focus upon sustainable architecture and the principles here fore, implementing them in the design to optimise the energy consumption and fulfilment of modern demands in the selected buildings.

ill. 01 Østre Havn as seen from north

"Development that meets the needs of the present without compromising the ability of future generations to meet their own needs"

[Brundtland commission]

transform

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table of content

program

process

preface

This project is a graduating master project in Civil Engineering with speciality in Architecture at the institute of Architecture & Design, Aalborg University.
The project concerns the transformation of existing industrial buildings into a new modern utilization.

The project has been made in collaboration with architectural and technical supervisors at Aalborg University. Furthermore A. Enggaard and the municipality of Aalborg have been helpful regarding the existing and future plans for the area.

Notes are made after the Harvard method, and sources are listed at the end of the report, as well as all illustrations and photos not created by the project group.

The report is organised in three magazines of which the first concerns the site analysis and design process where technical simulations and requirements are introduced.
Additional information about the technical investigations can be found in the technical magazine. The last folder is a presentation of the final proposal where the design will be explained through renderings, drawings and text. The idea is that the receiver can read the process while comparing this with the final proposal.

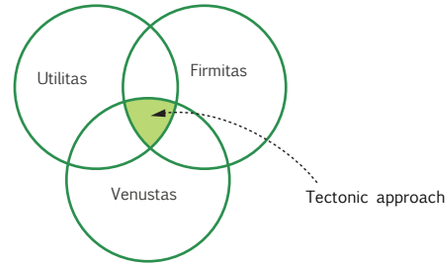
Alon with the reports follow a CD with a digital version of the project, additional calculations and files. Furthermore a drawing set is art of the project where site plans, sections, elevations and details can be found.

"...All these must be built with due reference to durability, convenience and beauty"

[Vitruvius]

methods & tools

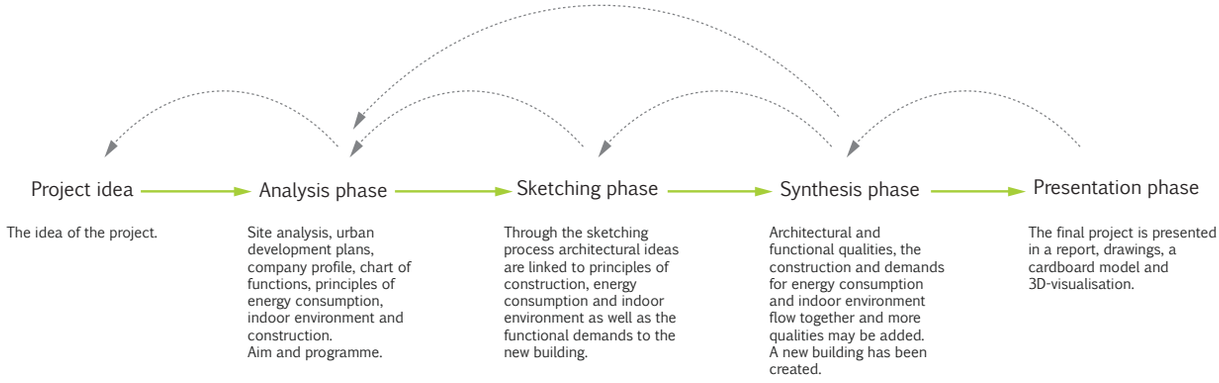
To create architecture of high quality the approach of tectonic is used as a tool during the design process. Tectonic is the interaction between the abstract and the tangible, where the two aspects affect and emphasize each other by working together to become one coherent design. It is the area of tension between the objective and the subjective – the point where the engineering aspects together with the architectural expression becomes the aesthetic.



ill. 02 The definition of tectonic, Vitruvius

This collaboration between the different aspects of architecture has been described very early in time by Vitruvius, who divides architecture into three subdivisions; Firmitas (technique), Utilitas (function) and Venustas (aesthetics). By using an integrated design approach these values can be achieved with great success, hence ensuring a tectonic result.

The method, Integrated Design Process in a Problem Based Learning environment (IDP in PBL), is used through the entire project, to ensure the right focus upon the different parameters, as IDP in PBL deals with the professional knowledge of architecture and the parameters from the engineering field in an integrated process, that enables the architect to gain control of a lot of parameters

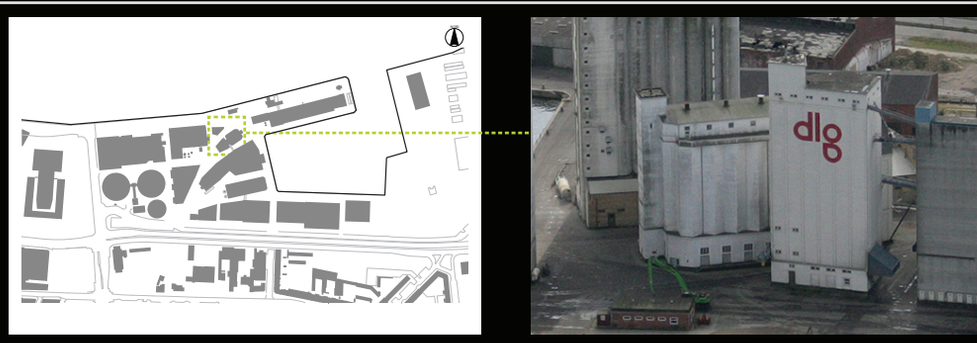


ill. 03 Integrated Design Process diagram

simultaneously in the creative process of developing beautiful and aesthetic architecture for the future. [http://vbn.aau.dk]

The project group works together as a group through the entire process of the project. The Analysis phase and the Presentation phase will contain more individual work, but the outcome will still be validated and adjusted by the entire group, to ensure high quality of the result. Workshop for sketching and modelling have been held with the aim to create a large interaction between ideas and perspectives throughout the group. A study trip to visit similar projects has been arranged early in the process to gain inspiration and proof of success for the selected ideas implemented. Weekly updated schedules for “current state of project”, “workshops”, “tasks” and “deadlines” have been planned to keep the right focus at the right time in the project.

By using the Integrated Design Process together with time management and the approach of tectonic it is possible to control the project and keep it on right track throughout the entire project, and ensure a project of high quality.



ill. 04 The chosen buildings

introduction

During the last century the society has been through a transformation from a focus upon the industrial technology and production to a knowledge- and science-based technology. This has implied that many old industrial buildings are being converted to a new lease of life as towns focus upon leisure, culture and service centres.

The city of Aalborg is in the middle of this transformation phase from an industrial magnet on the Danish market towards a landmark of knowledge and culture. The initiative spans across urban design, architecture and development of new concepts and program constellation. All developed to create a more interesting and diverse city with several opportunities for enjoying life.

This project operates with a transformation that can attract 'The Creative Class' defined by Richard Florida, which is seen as an important group to attract as they are seen as the engine in this transition.

'The Creative Class' is a group of highly educated and creative people, which according to a new survey includes about 40 % of the Danish population [www.ugebreveta4.dk]. They are attracted to communities with abundant high-quality amenities and experiences, great lifestyle options and cultural diversity. The environment has to be rich in terms of experiences and opportunities for expression, personal growth and interaction. [Florida, 2003, cap. 12]

In this perspective the area around Østre Havn has a large potential in the further development of the city. The area is located on the edge of the city influenced by the ongoing transformation created at the harbour front. Furthermore the area is now housing different cultural opportunities to kickstart the new development. This enables the possibility to create a second option for the city centre with a mixture of functions and lifestyle.

This project concerns the transformation of three industrial buildings located at Østre Havn.

ill. 05 Existing skyline of Østre Havn

Instead of demolition, these old industrial remembrances are analysed for the possibility of refurbishment, extensibility or new life based on a different sort of use and hereby create new architectural ingenuity knitting past and present together.

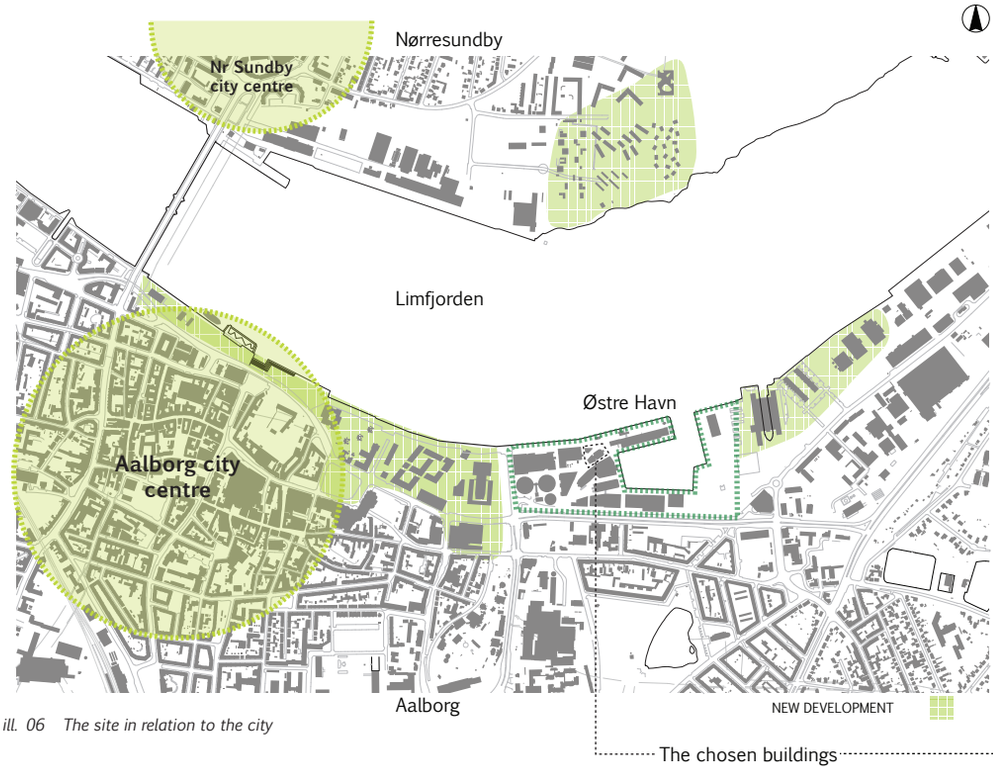
The project will focus upon utilising the benefits of keeping the history but still convert the architecture to meet the demands of a modern society and lifestyle. The transformation to the new area happens in alliance with the objective of Aalborg municipality that wishes to change the image of Aalborg from industry into a city of knowledge and culture, however still maintaining the industrial character, which is a strong part of the identity of Aalborg.

By transforming the industrial buildings to a present era, sustainable parameters and environmental concerns are seen as important values. Today the building industry is responsible for 45 % of the carbon dioxide emission.

The present lifestyle has an enormous impact on the global environment and the lack of focus or knowledge of environmental sustainability has resulted in an unconcerned use of energy without considering the impact on the natural resources.

The challenge is to create contemporary modern architecture as an ideal expression of responsibility in relation to climate, energy consumption and sustainability. The project wishes to incorporate new trends in relation to functions, organisation and constellation of architectural design combined with the historical perspective.

The main theme is to create an interdisciplinary project, where the sustainable components are incorporated into the architectural concept, and the aesthetic expression is executed in coherence with sustainable principles. The approach strives to achieve authentic evidence through continuity and integrity between form, concept and structure.



ill. 06 The site in relation to the city

context

Looking upon Aalborg it is obvious to see that the city is in a transformation phase. The development of the harbour front is in the process of a major transformation, where the existing city centre is bound together with the former industrial districts, which previously have been an important aspect of the identity of Aalborg.

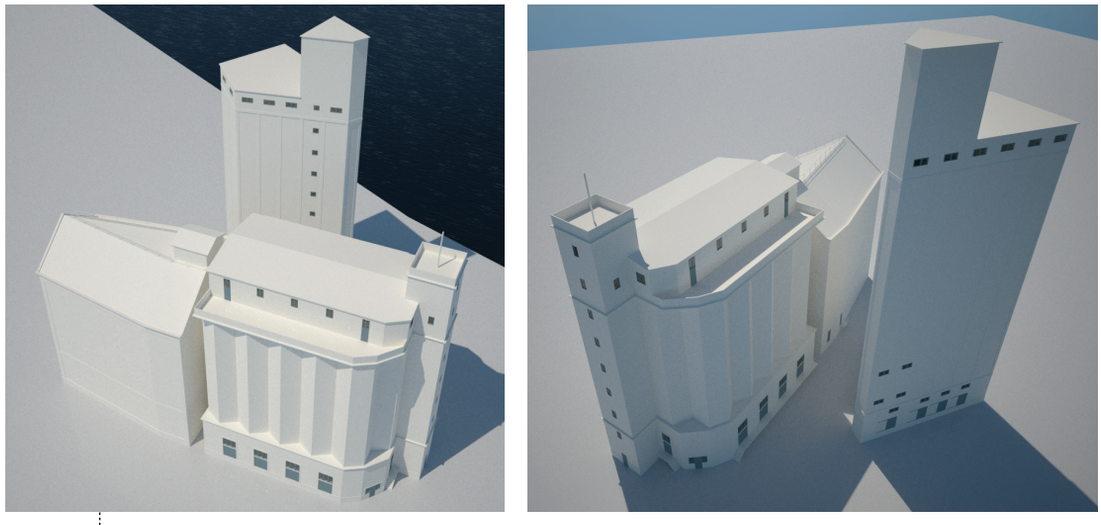
The present development of the city is moved from heavy industries to high technology and knowledge-based innovation. This transformation induces that the old industrial production is being removed to other areas, leaving empty massive remembrances of the industrial era close to the city centre. This is the situation for Østre Havn located on the edge of the city centre of Aalborg.

The architecture of the area contains many remembrances and visible tracks of the life that was lived in these environments. The buildings are interesting by the combination of the historical aspect and the functionalism, yet aesthetical appearance by which the buildings have been created.

The great volumes that exist in the area can be explored and utilised to a range of functions being optimised for attracting 'The Creative Class', which is a class of scientists, engineers, university professors, poets and architects. But also

> *"includes people in design, education, arts, music and entertainment, whose economic function is to create new ideas, new technology and/or creative content"* [Florida, 2003, p.8].

This group of people has a high potential for a city in relation to economical development and growth, however it is necessary to create a city that offer a great spectra of lifestyle options, cultural diversity and activities to keep or attract them.



ill. 07 The chosen buildings, 3D image

'The Creative Class' seeks environments that focus upon interaction, experiment and formation of new opportunities. It is important for the city to incorporate 'the three T's' of *Talent*, *Tolerance* and *Technology* to become a magnet for 'The Creative Class'. Diversity at all levels is the most important focus in their choice of location - both in terms of the people living there and the architecture of the city.

> *"they equate authentic with being 'real', as in a place that has real buildings, real people, real history. An authentic place also offers unique and original experiences"* [Florida, 2003, p. 228].

The originality and uniqueness of Aalborg lies within the industrial buildings along the harbour front, why it is of big importance for the diversity within the city of Aalborg to maintain or redesign some of the industrial remembrances, which are located at Østre Havn.

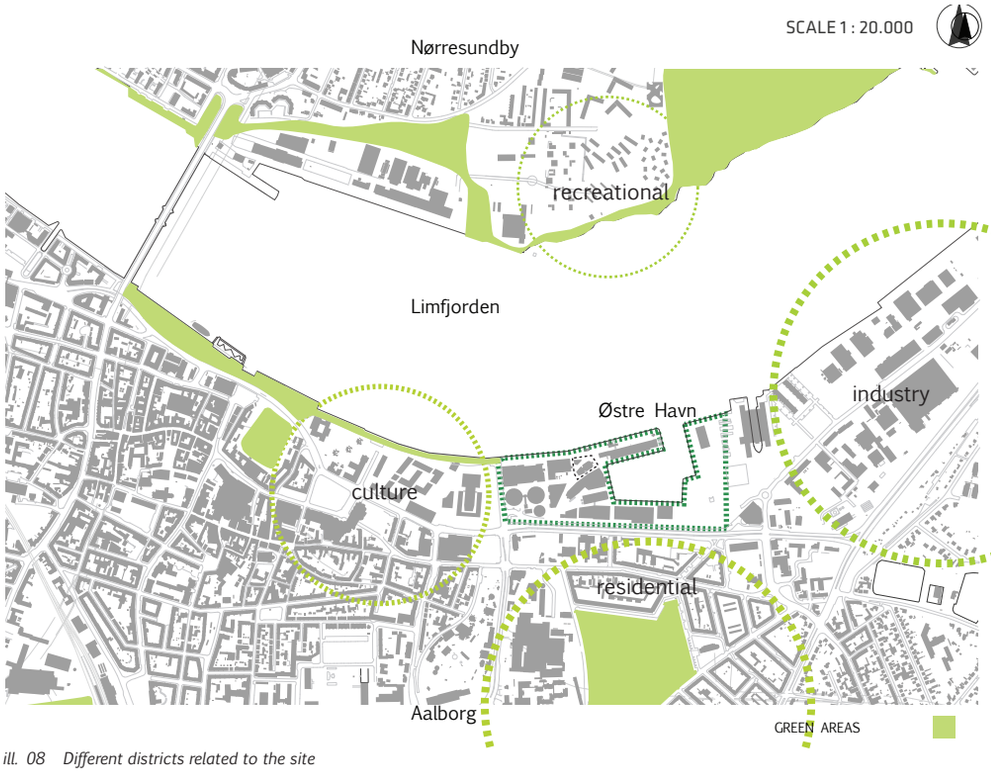
Furthermore the creation of Aalborg University has created a large potential for the city to attract 'The Creative Class' as the university consist of these. The issue is however that people think of Aalborg as an education base and not a long term stay. This has mainly been concerning the lack of activities and offers from the city. However during the past years the municipality of Aalborg has been focused upon the conversion from an industrial city towards a landmark of knowledge and culture. In 2008 Aalborg was elected to this year "municipality of architecture" for their effort in the transformation. [http://peterolesen.blogs.berlingske.dk] The present development is in the preliminary phase concentrating on the urban transformation of the harbour front. The transition is planned to extent to the area of Østre Havn.

In the following, the areas of and around Østre Havn are being investigated to create an understanding of the opportunities, which the city contains.

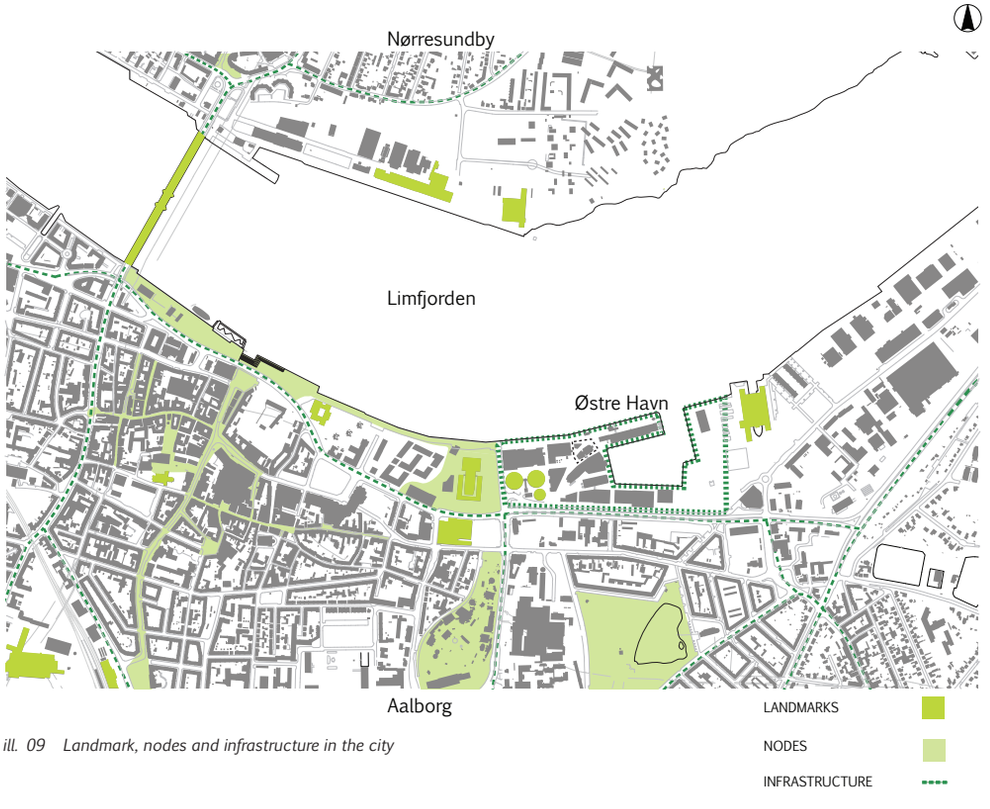
mapping

Here present districts and characteristics existing in the city have been mapped.

The mapping has been developed in relation to Kevin Lynch's methods by locating the different districts in the city, which have an identifying character. The first map (ill. 08) illustrates the residential, commercial, industrial and green areas in Aalborg. The next map (ill. 09) illustrates the characteristics in the city in relation to paths, landmarks and nodes where paths are defined as the channels by which people move along. Landmarks mark objects that aid in orientation when finding way. Nodes mark strategic spots that have an extra focus or added concentration of city features. [Lynch, 1995]



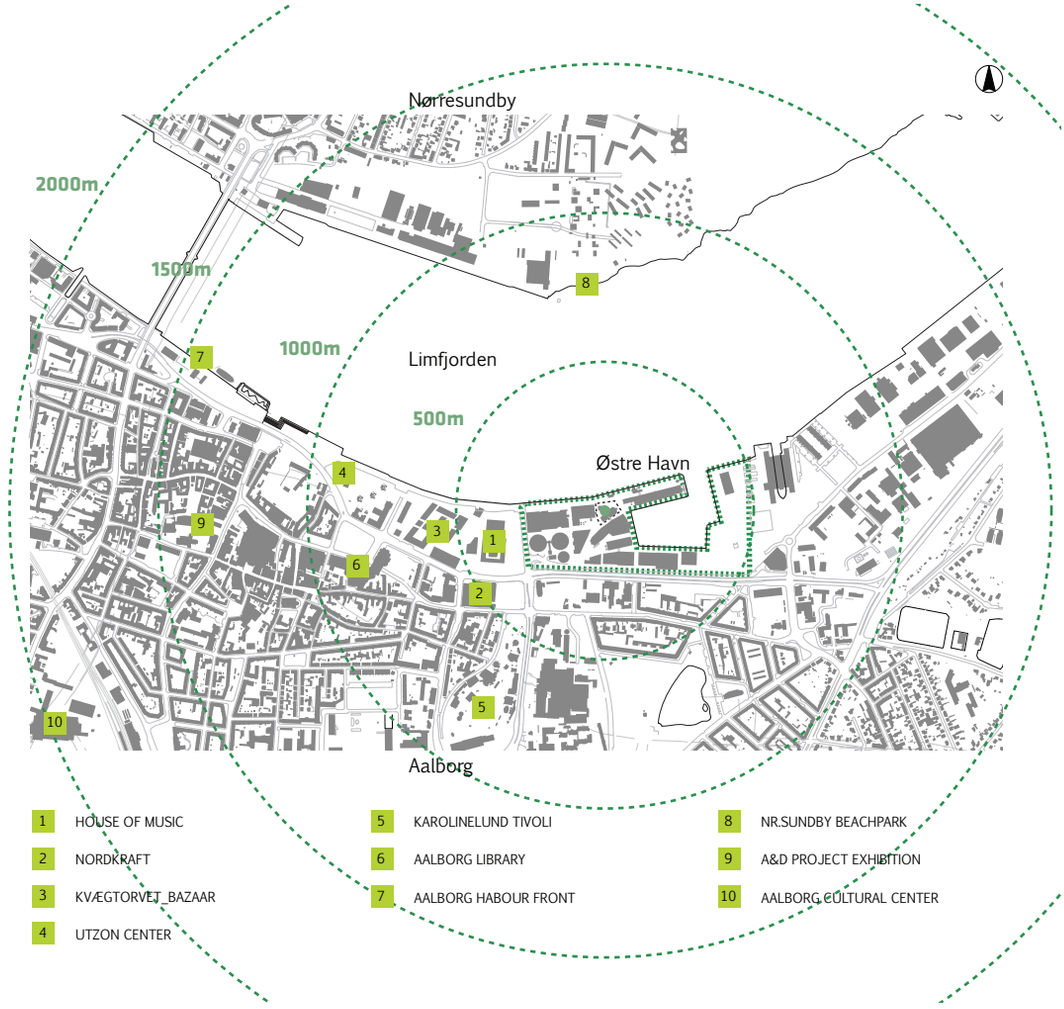
ill. 08 Different districts related to the site



ill. 09 Landmark, nodes and infrastructure in the city

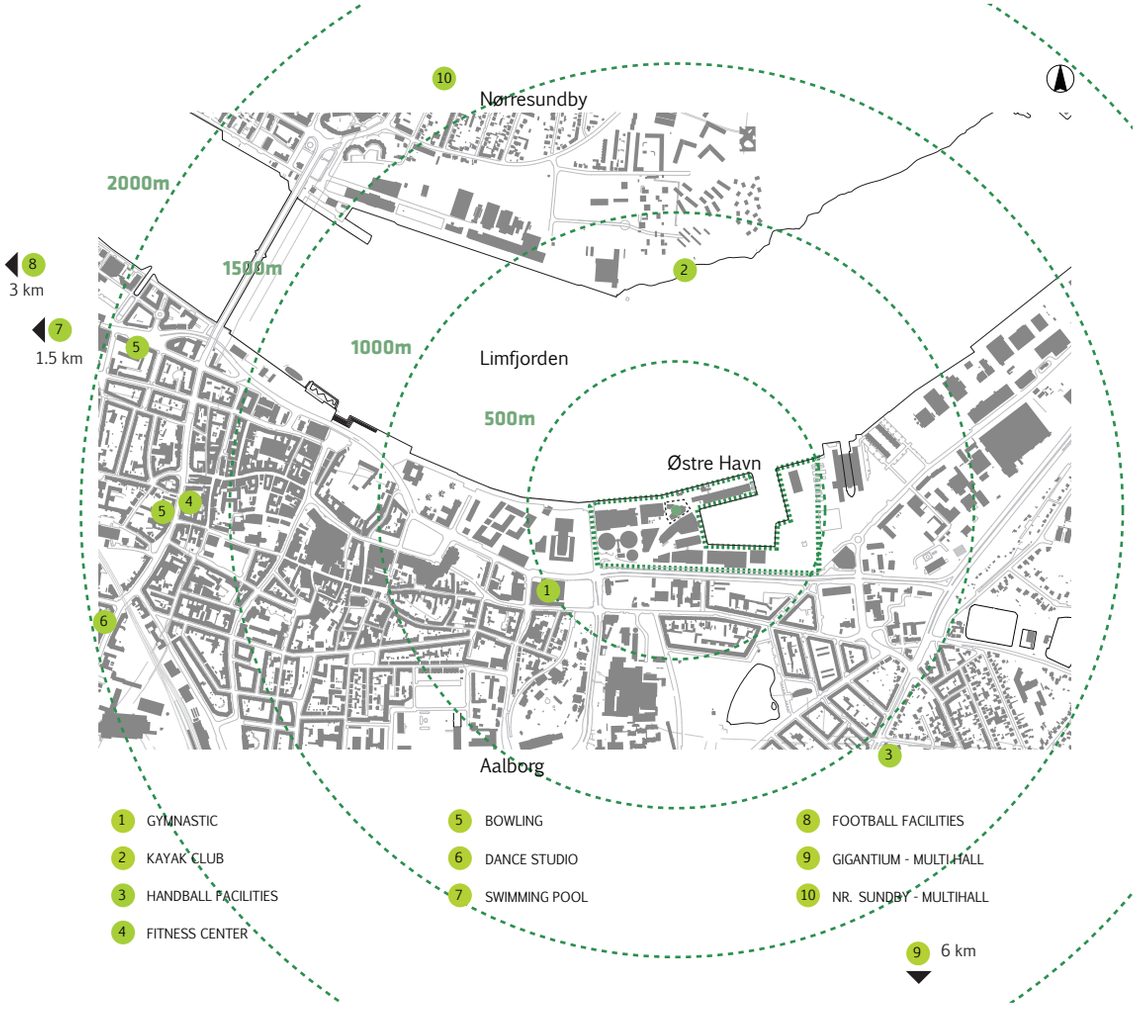
cultural activities

Additional important cultural and recreational activities have been marked to give an impression of the activity level, diversity in functions and their location within the city.



ill. 10 Cultural activities within approx 2 km

Furthermore sports activities have been illustrated to create an image of the amount of opportunities and the distances between them.



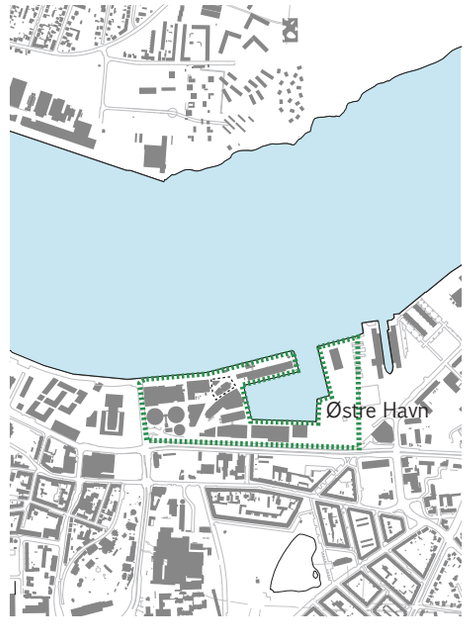
ill. 11 Sports activities

ill. 13 Building typology of Østre Havn

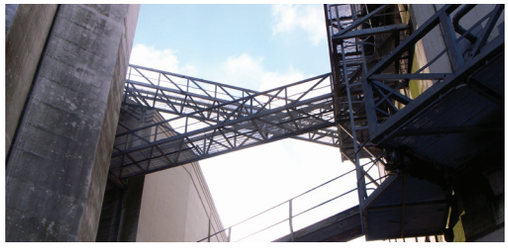
østre havn

History of Østre havn
In 1901-1903 Østre Havn was constructed to ensure a modern harbour in the city of Aalborg. In connection with the harbour the industry expanded to become larger and larger during time and these building volumes are today a very big part of the skyline of Aalborg.

The development of the area of Østre Havn started with the first building being build in 1916 as a part of the harbour being used for corn and agricultural feeding; Korn- & Foderstof Kompagniet (KFK). The building was a five-story building constructed from red brick and represented the scale of the area at this point in time. Later taller and larger buildings and silos were built to correspond the ongoing development. These buildings are more common constructed of in situ concrete.[PDF; Komplet registrering Østre Havn]



ill. 12 Historic harbours of Aalborg



ill. 14 Characteristic elements of the area

Present conditions

The current expression of Østre Havn is a continuation of the industrial development in the area of Østre Havn. All the volumes are positioned according to the shoreline and the infrastructure in the area needing soft curves to create the rail lines.

The area around Østre Havn has been utilized for different corn and agricultural feeding companies, such as KFK and DLG for almost 100 years until the municipality of Aalborg bought the area in 2005 and the production was closed down.[www.noks.dk]

In 2007 the municipality of Aalborg sold the area to the developer, A. Enggaard. The area is now a part of the ongoing transformation along the harbour front in relation to the development of the House of Music.

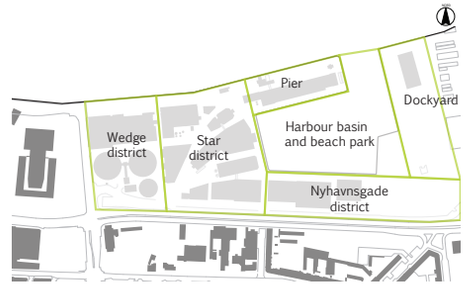
future plans

Introduction
The municipality of Aalborg has developed a future plan for the area of Østre Havn in an open public dialog with the citizens of Aalborg by facilitating several workshops focusing upon creating a new area in the city, fulfilling the needs and wishes of its inhabitants. To boost the ideas for the area five architectural offices were asked to give their answer to different themes laid out for the area: City life, Cultural inheritance, Science City, Sustainability and Little Manhattan.
A proposed master plan and course of process was developed for the area as a result of the workshops.

The following illustrations will show some of the principles for the area, which were agreed upon by the municipality of Aalborg in June 2008.

Apart from the below mentioned plans there is also developed a SAVE registration of the area, this will be looked into in its own chapter of this report.

Districts and functions
The area is divided into districts with different functionality, architectural expressions and identity as follows.



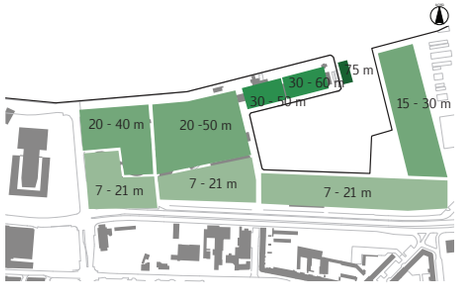
ill. 15 Districts and functions diagram

The Wedge district
Apartments, office, education, service.
The Star district
Office, education, local shops, restaurant/ café, service, culture, apartments.
The Pier
Apartments, public function at ground level.
Nyhavnsgade district
Environmental friendly business, apartments.
The Harbour basin:
Marina, water- and recreational activities, cultural events.
The Dockyard district
Apartments, office, service.

Heights
Two models have been proposed, a historic one being true to the original layout of the industrial harbour placing the highest buildings according to the highest silos.

The other model is more urban and the building height rises from Southwest towards Northeast, starting less dense and evolving into tower buildings, the highest being placed on a new island in the harbour entry. The outermost buildings will adjust to the surrounding building height.

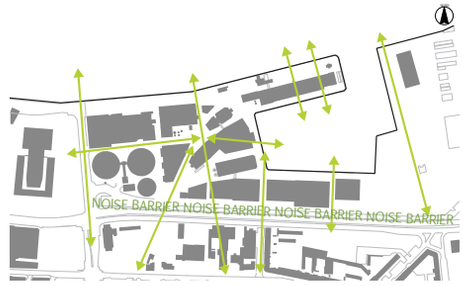
The urban model, as illustrated here, has been chosen as reference to the master plan.



ill. 16 Heights diagram

Parking
All parking must be placed below ground or in multi storey car park with active facades toward public areas.

Noise and sightlines
It is the wish to avoid the noise from Nyhavnsgade, but at the same time maintaining and utilizing the views to the fiord and harbour basin from the city behind the area of Østre Havn.



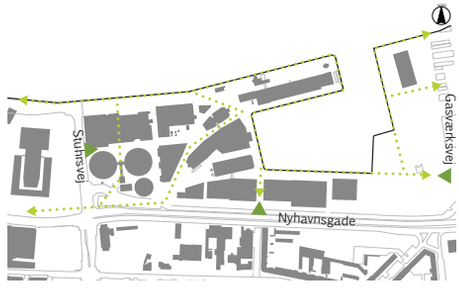
ill. 17 Noise and sightlines diagram

future plans

Car- and soft traffic

The Wedge district, the Star district and the Pier are accessed from Stuhrsvej and Nyhavnsgade. The Nyhavnsgade district and the Dockyard district are accessed from Gasværksvej.

A connecting path for walking, cyclist and skaters must follow the harbour front continuing the new harbour promenade starting from the Limfjordsbroen. Connections to the city centre and the area of Østerbro must also be fulfilled. The internal paths of Østre Havn are preferable for soft traffic only, but must be dimensioned for bus traffic.



ill. 18 Car- and soft traffic diagram

Green paths

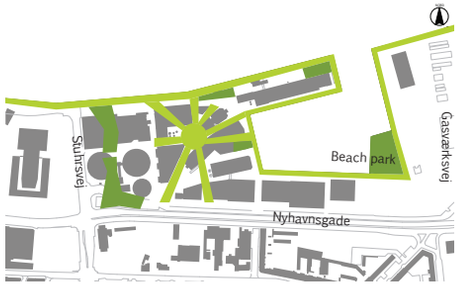
The green belt of "Karolinelundskilen" is to be extended towards the harbour front along Stuhrsvej, through the Wedge district and by using the existing railroad tracks in the Star district.

ill. 19 Green paths diagram

Urban space

Different architectural expressions, scale and functions are to identify the future urban spaces. The Star district acts as the central urban area, and the beach park as the primary green and recreational area [see next page].

A key element is that all the urban spaces have full public access and that apartments have common outdoor areas on street- or roof level. Finally there must be a visual connection from the central square in the Star district to the harbour basin.



ill. 20 Urban space diagram

Architectural ambitions

It is the wish from the municipality to create an interrelation between the existing industrial heritage and new modern architecture of high quality with the aim of an environment, which emphasizes human activity and wellbeing. At the same time it is a request that sustainable principles are integrated in the design process.

Conclusion

This layout from the municipalities of Aalborg seems to be well thought and elaborated. Implementing citizens in workshops, and buying ideas from professional architectural firms have created a base of high quality. This project group sees the future plans as a foundation for the further development of the selected buildings, making them fit into the master plan for Østre havn developed from these principles.

[PDF; Østre Havn, Planprincipper og procesforløb]

restrictions

SAVE – Østre Havn

To ensure that the characteristics of the area are being preserved, the municipality analyzed Østre Havn according to the method SAVE (Survey of Architectural Values in the Environment) which has clarified the worth of preserving the different buildings in the area.

To obtain a more urban awareness of the preserving values at Østre Havn the method KIP (Kulturmiljøer I Planlægningen) has been used, as this method deals with the mapping of cultural history's main features in the landscape described through coherent industrial related totalities, structures and elements.

SAVE deals more specific with the architecture in a smaller area, where the buildings are registered according to the three subjects; dominating features, building patterns and elements in the buildings seen in the perspective of architectural observation, historical analysis and topographical investigations.(ill. 21)

These investigations of the area ended up with a clarification of the preserving values of the different buildings.(ill. 24)

SAVE	Dominating features	Building patterns	Elements in the building
Architectural observation	✓	✓	✓
Historical analysis	✓	✓	✓
Topography investigations	✓	✓	✓

ill. 21 SAVE parameters

Furthermore the municipality has recommended different characteristics of the area to be preserved, such as the overall pattern of the buildings, the height and assembled expression especially along the fiord and the inner harbour. Another very important feature in the area to preserve is the railway lines (ill. 22), whereas these have been a very important part of the functionality within the area, when still being used for the agricultural feeding industry, and are also the reason why the foot prints of the buildings have the shape they do.

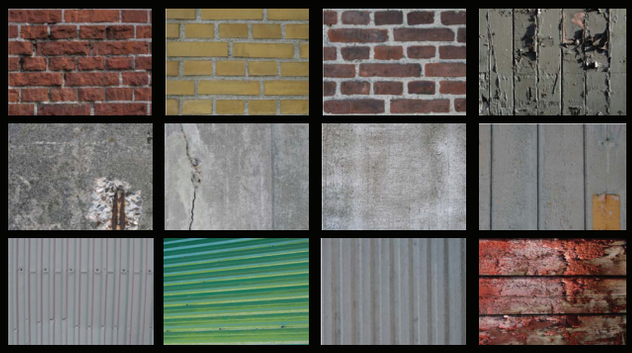
ill. 22 Railway lines in the area to be preserved

To maintain the historical expression of the area, features such as the cranes and the transportation systems between the buildings are to be preserved or reinterpreted in new building volumes to ensure the maintenance of the skyline and the industrial characteristics at Østre Havn.

architecture

details

materials



pavement

ill. 23 Photos from the area

existing building conditions

ill. 24 Worth of preservation and highlight of the chosen buildings

ill. 25 Silo 03 Soyagade 13

ill. 26 Silo 02 Soyagade 14

ill. 27 Silo 04 Soyagade 16

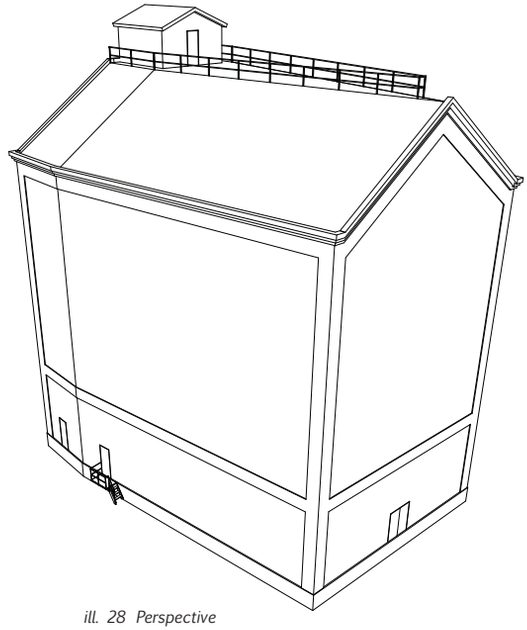
Silo 2 - Soyagade 14; Function: Corn silo. Constructed from fibre concrete in 1930 and has a footprint of 345 m^2. The footprint of the building is a skew heptagon and constructed in situ. The silo constructions are also constructed from concrete in quadratic formations. Staircase is to be found in the end of the building. The foundation of the building is made on piles and there is no insulation in the walls.

Silo 3 - Soyagade 13; Function: Corn silo. Constructed from fibre concrete in 1960 and has a footprint of 189 m^2. The footprint of the building is a pentagon and constructed in situ. The silo constructions are also constructed from concrete in quadratic formations. Elevator and staircase are to be found in the end of the building. The foundation of the building is made on piles and there is no insulation in the walls.

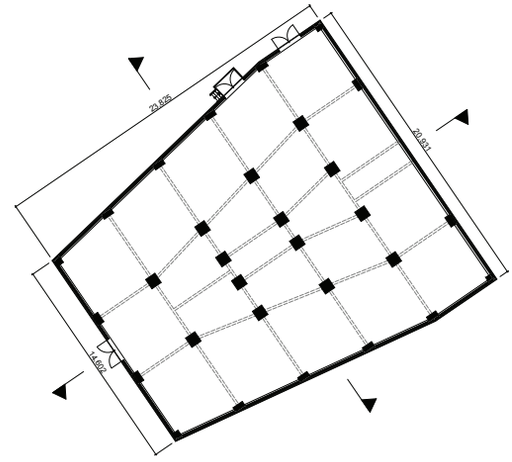
Silo 4 - Soyagade 16; Function: Corn silo. Constructed from lightweight concrete in 1931 and has a footprint of 589 m^2. The footprint of the building is rectangular and constructed in situ. The silo constructions are also constructed from concrete in heptagons, which can also be seen on the exterior of the building. Elevator and staircase are to be found in the end of the building. The foundation of the building is made on piles and there is no insulation in the walls. [Skov & Thomassen; Aalborg Østre Havn, Bygningsregistrering. 2007]

The reconstruction of the buildings into new utilisations will undoubtedly be expensive to obtain the new demands for especially fire regulation and energy consumption. To maintain some of the historic features it is considered, according to the Danish building requirements, as a necessity to release the old buildings from the requirements in the Danish Building regulation – as a complete wrapping of the facades will be necessary to fulfil the demands regarding thermal bridges and heat insulation. [Skov & Thomassen; Aalborg Østre Havn, Bygningsregistrering. 2007]

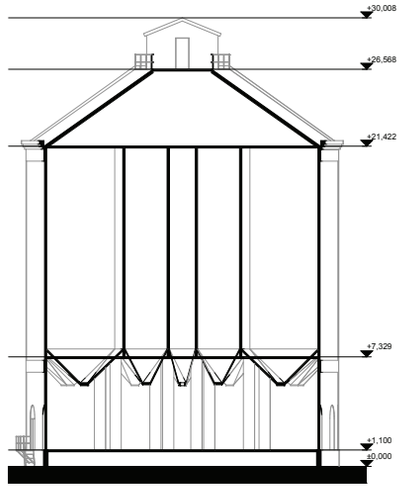
silo 02



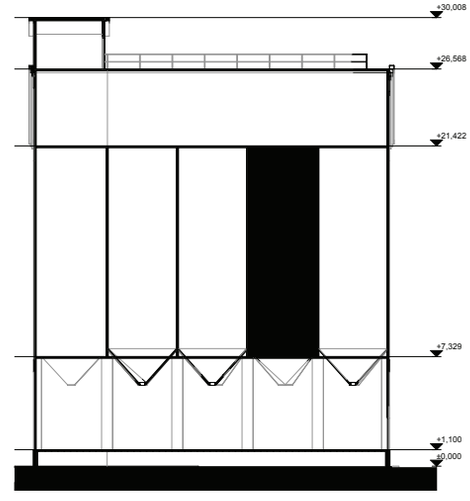
ill. 28 Perspective



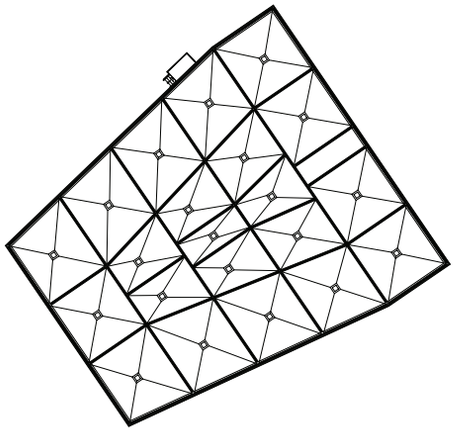
ill. 29 Floor plan



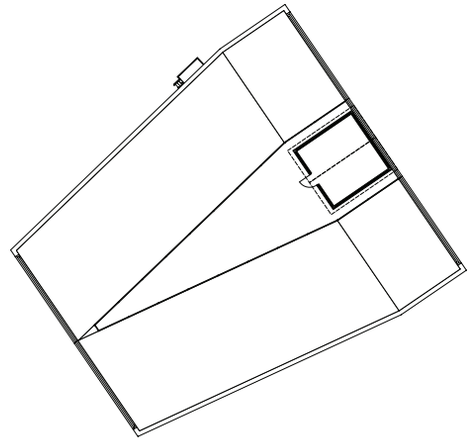
ill. 30 Cross section



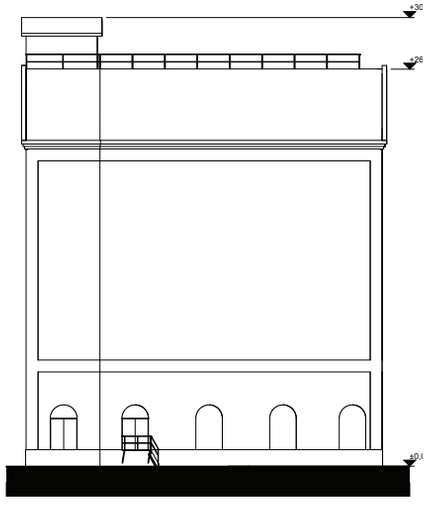
ill. 31 Longitudinal section



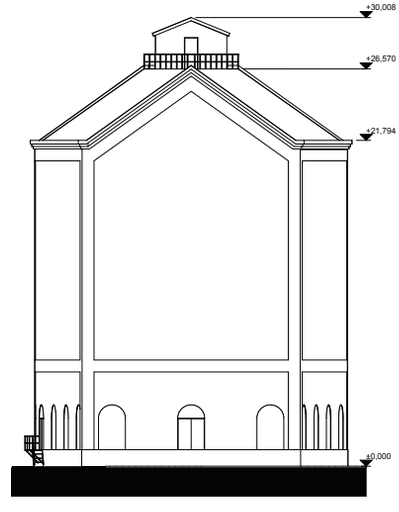
ill. 32 Silo plan



ill. 33 Top plan

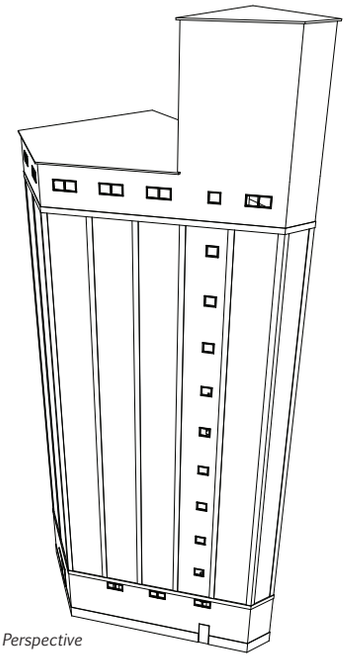


ill. 34 North elevation

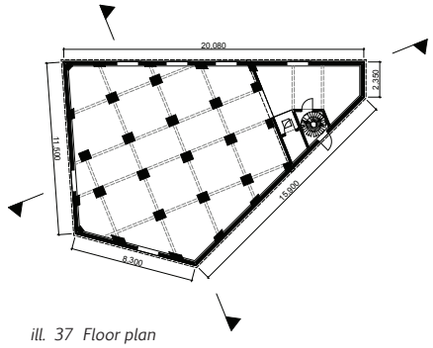


ill. 35 West elevation

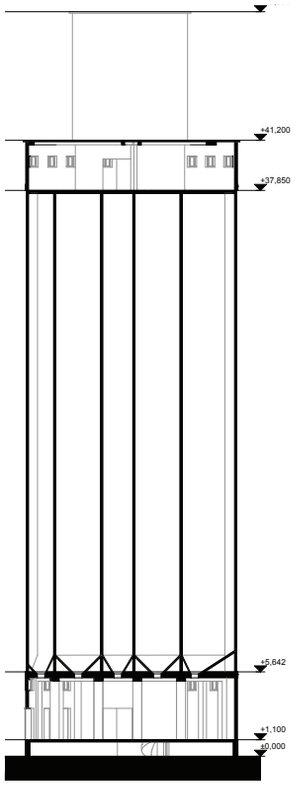
silo 03



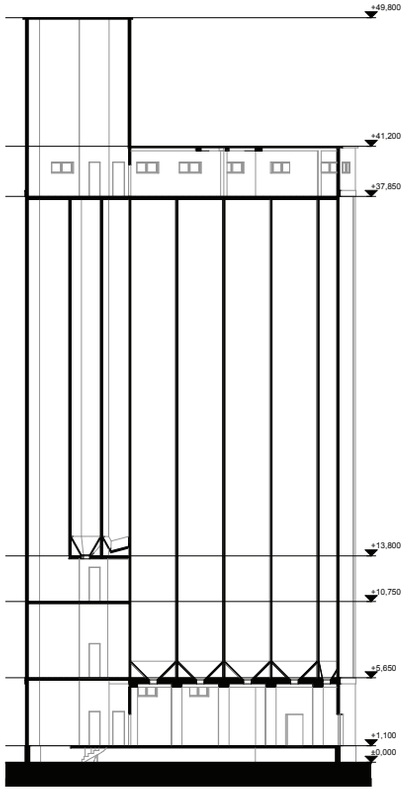
ill. 36 Perspective



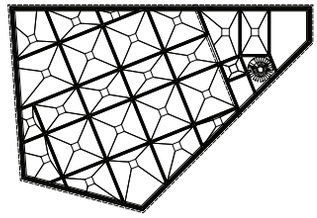
ill. 37 Floor plan



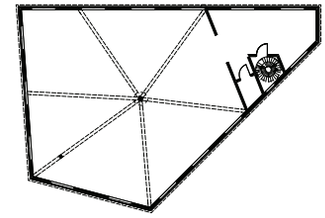
ill. 38 Cross section



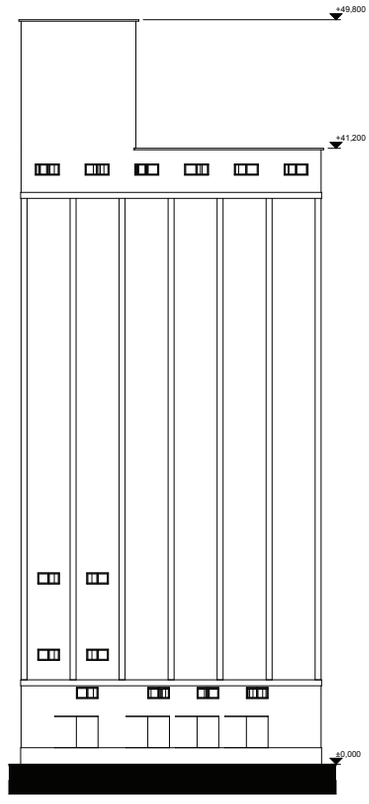
ill. 39 Longitudinal section



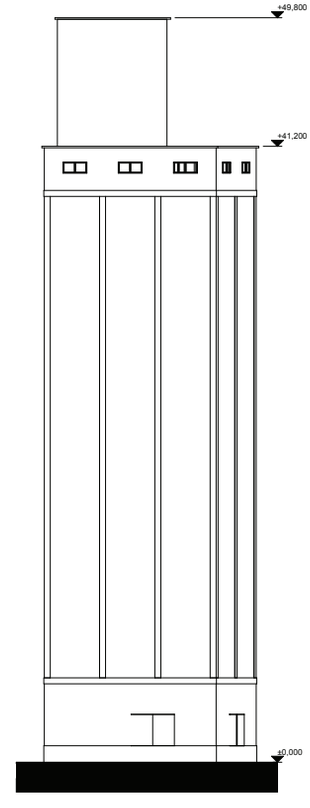
ill. 40 Silo plan



ill. 41 Top plan

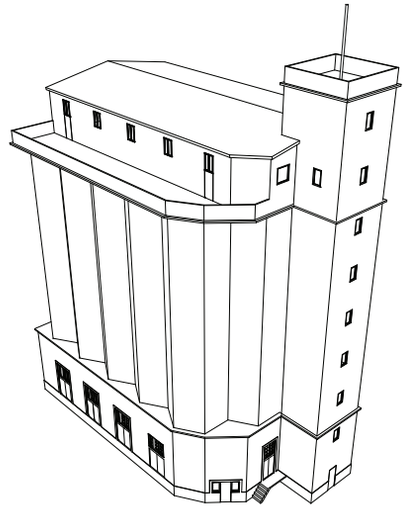


ill. 42 North elevation

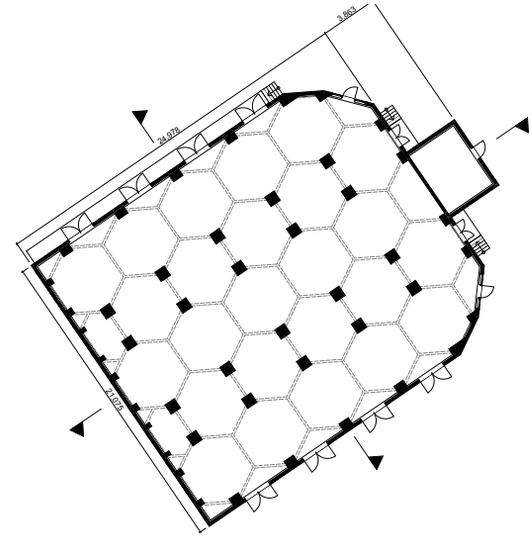


ill. 43 West elevation

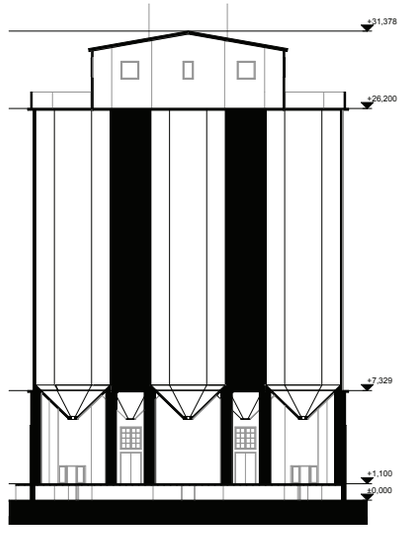
silo 04



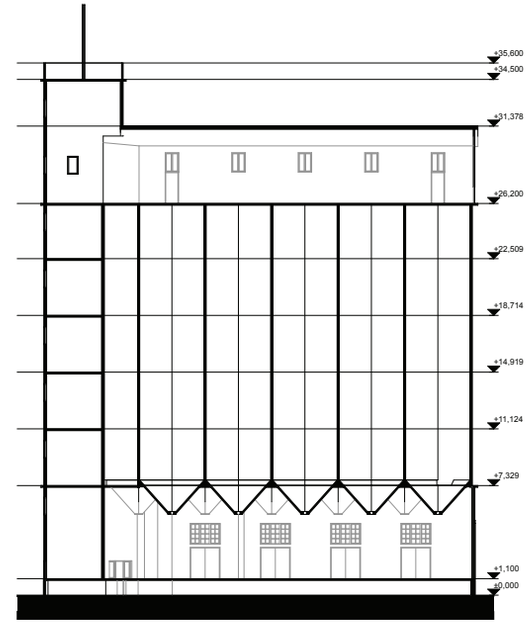
ill. 44 Perspective



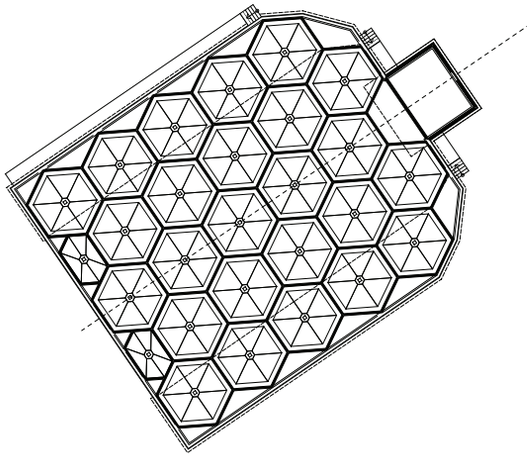
ill. 45 Floor plan



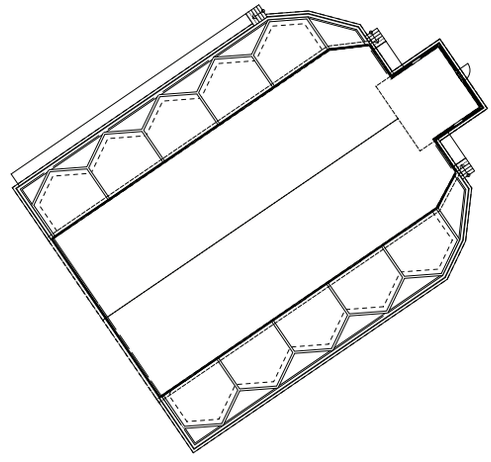
ill. 46 Cross section



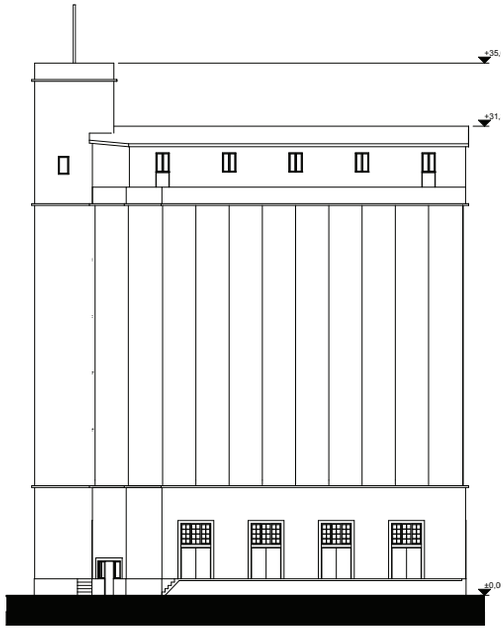
ill. 47 Longitudinal section



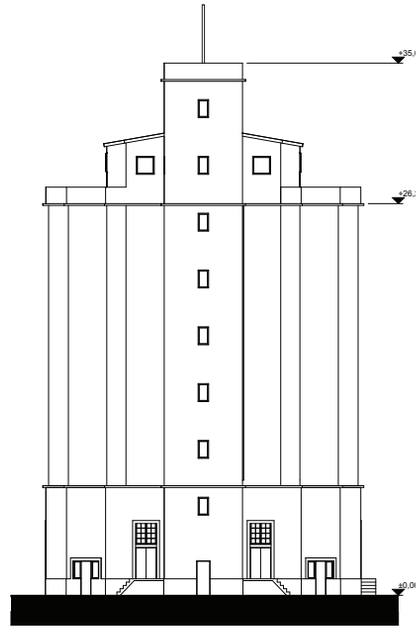
ill. 48 Silo plan



ill. 49 Top plan



ill. 50 North elevation



ill. 51 West elevation

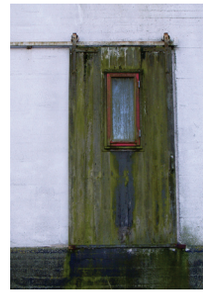
existing building conditions

architecture

elements







bridges



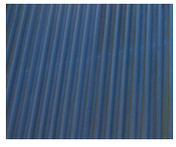
views


interior




materials





urban layout

ill. 52 Urban design proposal from SHL Architects

shl architects

The workshop arranged by the municipality of Aalborg ended up with an overall master plan for the area, where Danish Smidth/Hammer/Lassen Architects (SHL) elaborated a master plan for the area financed by the developer, A. Enggaard.

The architectural expression of the area has found its inspiration in the industrial history with large differentia in the height of the volumes and size of the footprints, however still maintaining some of the marks from the former layout and the location, for instance by interpreting the existing railway lines as stones indicating their earlier positions.

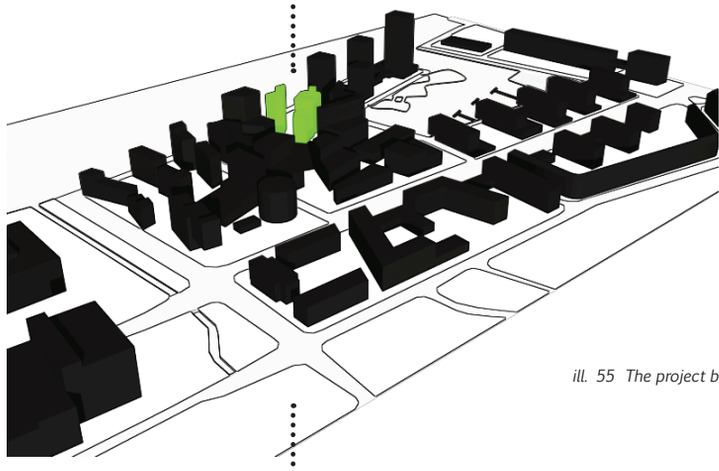
The reference to history can also be seen in the work with water on the site. As a suggestion the old stream, running along Karolinelundskilen has been excavated, as a part of the green areas west of Østre Havn.

An important part of the urban layout in the area has been the sightlines and views, where the connection between the back lying city and water has been essential.

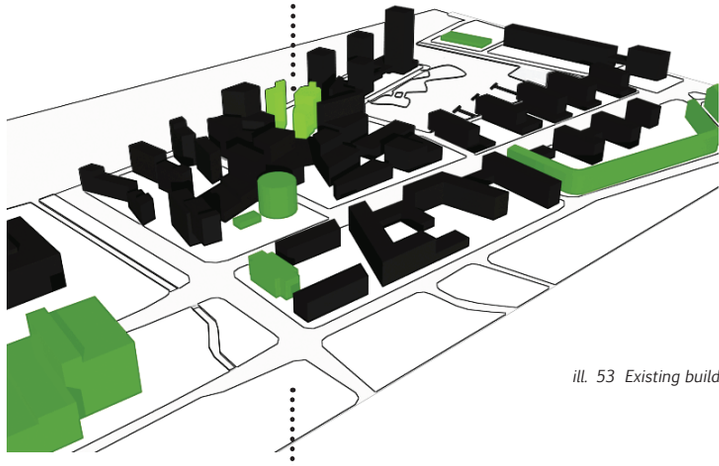
The proposal creates an alternative city centre within the city of Aalborg. Here there is a mixture of commercial and residential functions, arranged in a layout, that consider views to the surroundings, green urban spaces, infrastructures and imprints of history.

The urban solution has kept the buildings being mentioned in the SAVE analysis from Aalborg municipality, and created a new infrastructure and architectural expression that focuses upon the new era of modern architecture.

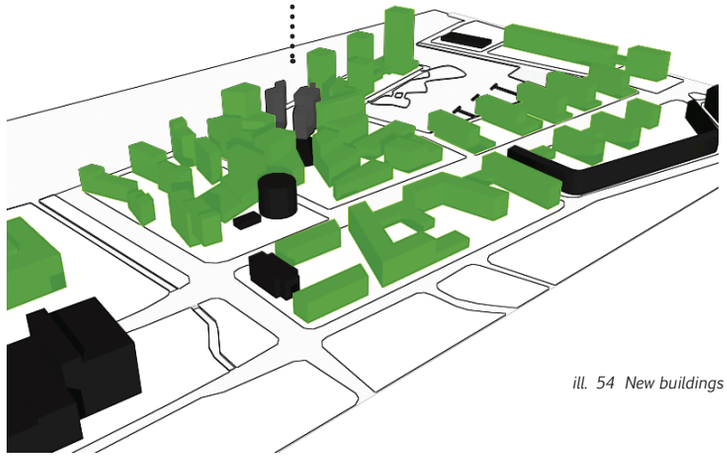
the project buildings



ill. 55 The project buildings



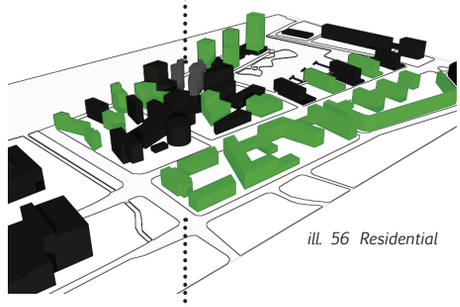
ill. 53 Existing buildings



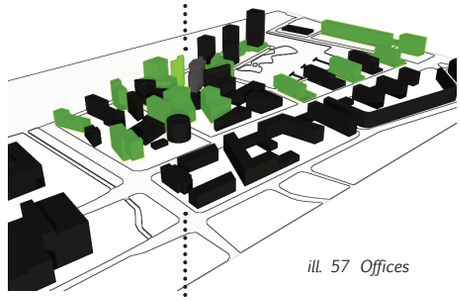
ill. 54 New buildings

urban layout

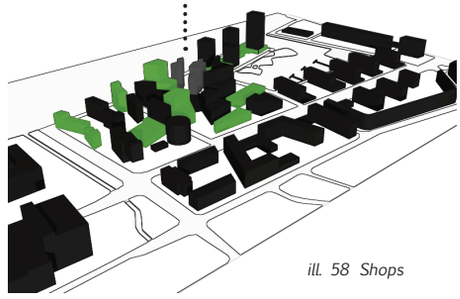
the project buildings



ill. 56 Residential

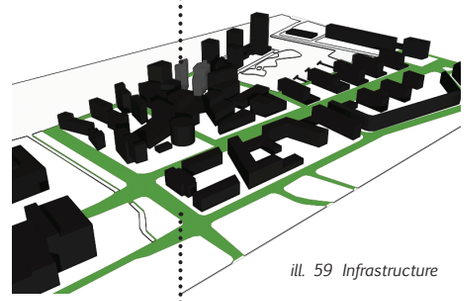


ill. 57 Offices

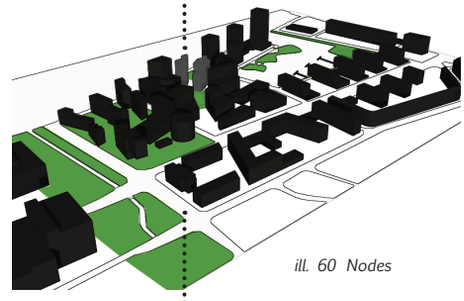


ill. 58 Shops

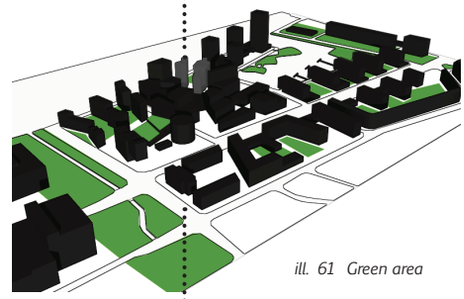
the project buildings



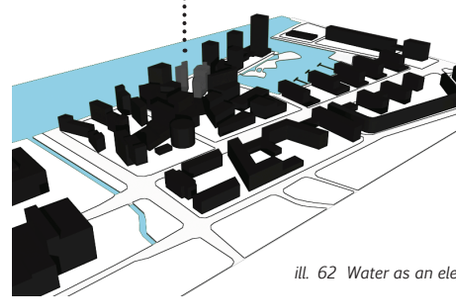
ill. 59 Infrastructure



ill. 60 Nodes



ill. 61 Green area



ill. 62 Water as an element

summary

The work put into the development of Østre Havn is showing in the new master plan. Ideas from professional and citizen workshops, have been combined and used here, as have the early analyses of the area. One could wonder why so many buildings are to be demolished and replaced by new building shapes. It has not been possible to get a clear definition of this, but economy has undoubtedly played its part, together with creating a coherent new area. However, the history of Østre Havn is left to be told through a few extents of buildings and an interpretation of existing railroad tracks. This is however another discussion and as the focus of this project is to convert three of the existing buildings the urban strategy for SHL is seen as a good starting point.

The new context, combined with the history of Østre Havn, has been carefully studied, and will be further evaluated as the project evolves during the design phase. Some of the nearby buildings may be subject to changes, if analysis is showing, that a change is favourably for lowering the energy consumption, improve thermal comfort and the quality of architecture within the buildings of this project.

ill. 63 Skyline of the SHL's master vision.

sustainable architecture

Regarding the environmental changes and the building processes that the word is facing today, many new subjects have to be taken into account, including the field of architecture. To meet the increasing concerns environmental sustainability has been introduced, which will be described in the following.

Concerns have been raised regarding a wide range of environmental problems such as CO_2 emission, the destruction of the ozone layer, the consumption of natural resources and fossil fuels and the green house effect, which causes global warming. Through the last 100 years the global average temperature has increased with 0,74 degrees and it is expected to increase even more if nothing changes regarding the energy consumption[www.energistyrelsen.dk]. The concept of environmental responsible architecture has primary risen from the necessity to save energy, avoid waste of resources and reduce pollution. In the future architects have to be increasingly aware of the climatic impact of buildings and the processes attached to these. The Danish building regulation aims to decrease the energy use in new buildings [www.folketinget.dk]. The diagram beneath illustrates the different classes and their total energy consumption.

Sustainable architecture is a wide concept with no single clear definition. In general it is perceived as a building aiming to fulfil environmental goals. Sustainable design is the thoughtful integration of many parameters including durability, appropriate materials, relevant utilisation of the context etc. However the environmental aspects needs to be combined with the traditional architectural aesthetics of proportion, scale, texture, shadow and light. It is important when creating sustainable architecture to incorporate many different design parameters in an integrated process. Here it is important to understand, analyse and evaluate different factors that influence the sustainability of the design.

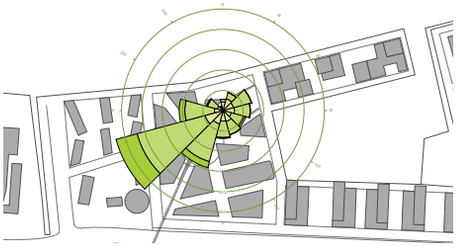
By reutilizing an old industrial building one of the most important benefits is the retaining of the energy that are incorporated in the existing building components and construction, such as raw materials, manufacturing of materials and requirement. However these elements do not always pay to reuse if the process and expenses exceed what is needed to produce new materials. Furthermore the condition of the components needs to be evaluated.

For offices, schools and institutions	Standard energy class	Energy class 2	Energy class 1
Total energy consumption*	90 kWh/m² pr. year	70 kWh/m² pr. year	50 kWh/m² pr. year
Additional, A = heated floor area*	2200/A kWh/year	1600/A kWh pr. year	1100/A kWh pr. year

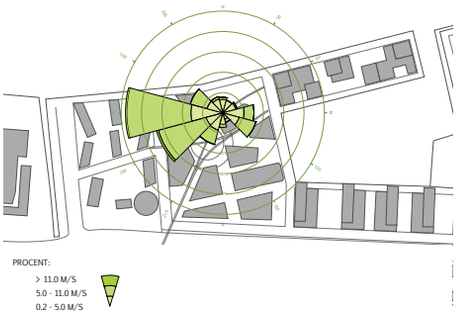
[* for heating, ventilation, cooling, hot water and lighting]

ill. 64 Energy consumption, BR08

Dealing with sustainability it is very important to understand the context. Therefore sustainable design initiates with an intimate understanding of place. Here the different nuances of place are examined which can help determine design practices such as solar orientation, predominant wind direction, utilization of the natural environment etc.



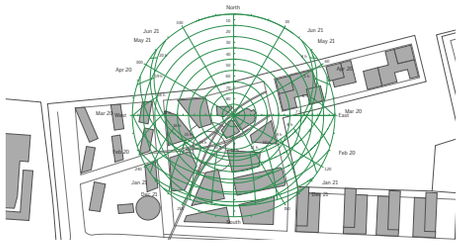
ill. 65 Windrose diagram for February.



ill. 66 Windrose diagram for July

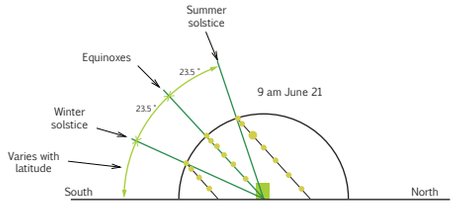
The predominant wind direction is from west, and because of the open area around the fiord the wind can often be perceived as stronger on the site. The western wind is especially dominating during winter and summer; where the strongest wind occurs during winter. In spring and autumn the wind conditions are more evenly distributed.

The wind needs to be taken into consideration regarding the natural ventilation strategies as this parameter can affect the air flow rate in the building.



ill. 67 Sun diagram

The location of the site in relation to the path of the sun has an important impact on the orientation of the buildings to optimise heat gain from the southern sunlight and prevent heat loss from the northern angle. The height of the sun influences the amount of sunlight into the building with a low altitude during winter and high during summer.



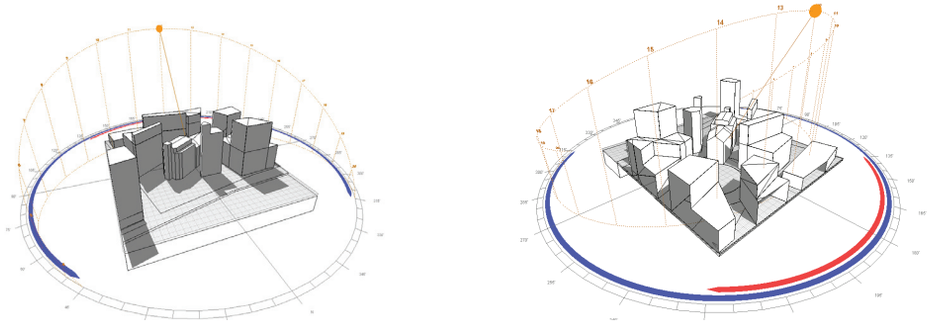
ill. 68 Variation of the height of the sun

The facades need to be adjusted to the solar radiation to achieve heat gain and avoid glare. Furthermore vegetation and surrounding buildings need to be taken into account when looking upon direct sunlight and also in relation to the utilisation of wind.

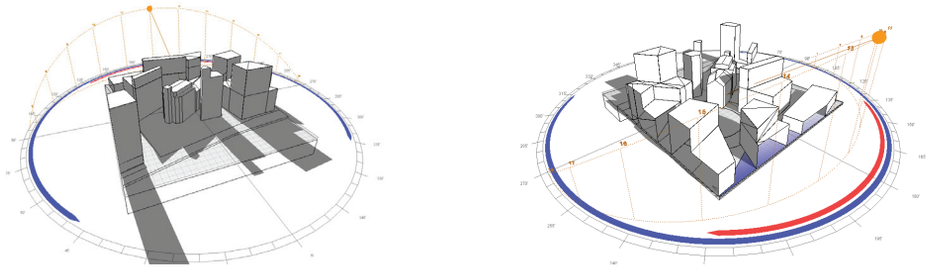
sunstudies

Sun studies have been carried out to get a visual image of the influence the new buildings from the master plan, developed by SHL Architects, have on the project buildings. The red and blue colours on the plan indicate the shortest and longest day of sunlight.

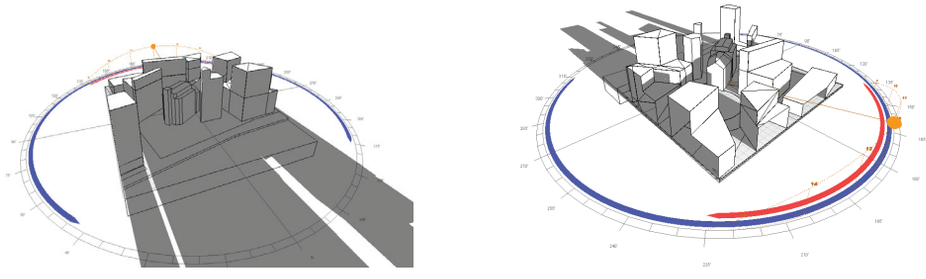
It is clear that the new buildings will cause a lot of shade during the winter season, but not much during summer, which calls for further investigations in this matter.



ill. 69 June 21st at 12.00



ill. 70 March 21st at 12.00



ill. 71 December 21st at 12.00

sustainable design

Sustainable design can be achieved through a variety of approaches and incorporated in many different ways. To create sustainable architecture different design parameters can be used to fulfil the criteria. Hanne Tine Ring Hansen has investigated these parameters in a scientific research project for Aalborg University. Here the parameters are arranged according to different sustainable approaches.

The parameters are listed in the following:

Preserve or improve biodiversity
Lifecycle assessment of materials
Reduce private transport (and transport in general)
Insulation of building envelope
Thermal mass
Orientation of windows
Surface to floor area ratio
Window to floor area ratio
Utilization of daylight
Natural ventilation
Mechanical ventilation
Renewable energy sources
Energy producing elements
Embodied energy
Energy efficient solutions
Zoning
Mobility (of building)

[Hanne Tine Ring Hansen, Aalborg University]

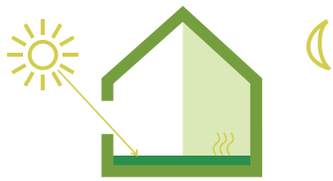
As this project focuses upon minimising the energy consumption the parameters in green have been chosen to be the main focus in this project. Furthermore the aspects highlighted in dark green have an influence upon the choice of materials.

sustainable parameters

Insulation of building envelope

Increasing the insulation of the building envelope creates a reduction in use of energy for heating. The insulation thickness is only feasible up to approximately 40 cm for traditional insulation material beyond that the cost of producing the materials are too high compared to the energy saved on heating.

Thermal mass

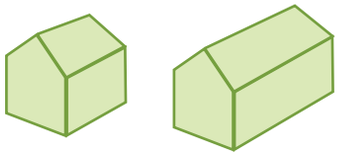


Thermal mass is the capacity of the material to store heat. Here materials with a high specific heat capacity and high density are ideals materials, e.g. concrete, bricks, water and soil. These will absorb heat when the surroundings are hotter and release it when the surroundings are cooler. Thermal mass can help balance the indoor temperature. The materials have to be exposed to direct sunlight to be most effective.

Window orientation

Window orientation has to be carefully considered to gain from passive solar energy. The orientation is preferred towards south (favourable 15-30 degrees towards east) which is seen as gain where orientation towards north is loss. It is also important to correct the shading and overhangs (solar angle) to let the winter sun pass and shade for the summer sun.

Surface to floor ratio

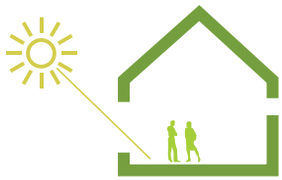


With less surface area the building emits less heat to the outdoor. Here compact building shapes are preferred to minimize the heat loss.

Window to floor ratio

In general fewer windows gives less heat loss because glass is a poor insulator, however heat is also gained from the south facing windows during the day. Windows are important for the daylight in the interior and qualities of views to the outside therefore this parameter also needs to be evaluated regarding the individual comfort level.

Utilization of daylight



The building design should promote the use of natural daylight in the interior of the building to reduce or eliminate daytime use of artificial light. Today artificial light accounts for about 50% of the energy used in offices [A green Vitruvius, 1999]. Natural daylight can create better light quality than artificial light and provide healthier and more pleasant living conditions for the users.

Natural ventilation

Regarding natural ventilation there are two different strategies to consider; wind driven and stack ventilation. The most efficient design for a natural ventilation building should implement both types of ventilation.
Natural ventilation is only effective during summer when there is no need for heating the building.

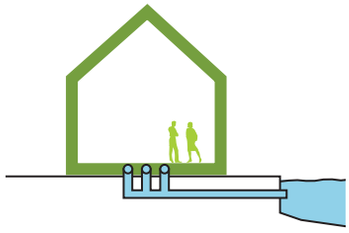
Mechanical ventilation

Mechanical ventilation is favourable to use during winter when there is a need for preheating the air.
To obtain the best result it is recommended that the system have a heat recovery of 85-95%. There are two strategies concerning mechanical ventilation; mixing and displacement ventilation.

Zoning

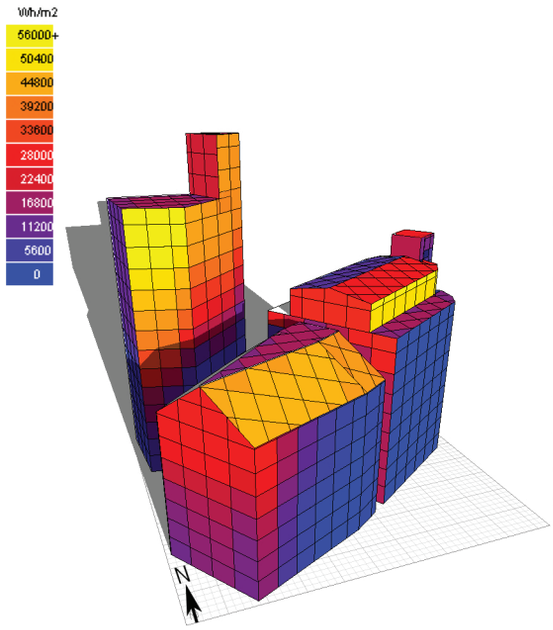
The functions within the building have different requirements for temperature, daylight conditions and ventilation. Therefore by dividing and organising the functions into groups in relation to their specific thermal demands can minimize the energy consumption for the building, and furthermore create better comfort for the users.

Water cooling



As an extra parameter, giving the location close to the fiord, water-cooling is introduced as a possible initiative. By letting the water cool (summer) and heat (winter) the inlet air or structural elements within the building energy reductions can be made. This can be done by either direct or indirect methods. Caution must be taken to the increase in air humidity, which can be significant.

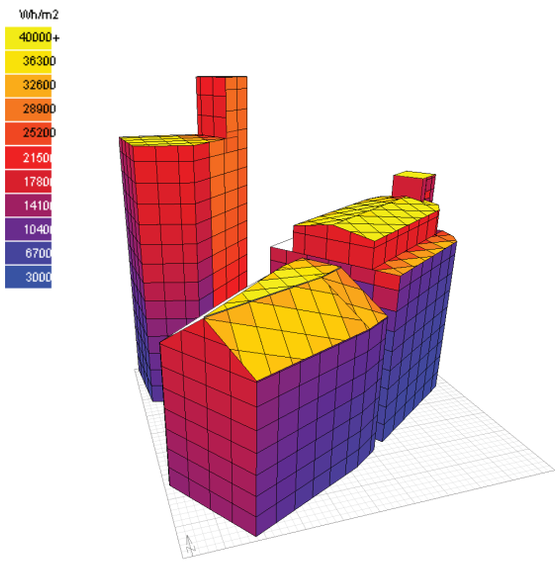
solar radiation



ill. 72 Direct solar radiation

Introduction
Two studies concerning radiation availability of the southern facades have been made for a winter period ranging December 1st to February 28th, from 8.00 to 18.00 every day. The values are cumulative, meaning that they are a sum of all values over the calculation period. The context of the site has been removed for at better view, but the values are calculated with the context. Calculations have been made in Ecotect. [www.ecotect.com]

Direct solar radiation availability
This concerns the available radiant energy from the sun and has been carried out to determine both the shading influence of the surrounding buildings and as an indicator for the possibilities of passive heating. Other purposes of this analysis can be placement of program. There might be an idea in allocating the more heat generating functions, such as offices and stores, in areas with less direct radiation, allowing less heat generating functions, such as apartments, to benefit from solar radiation.



ill. 73 Diffuse solar radiation

Diffuse solar radiation availability

The diffuse radiation is an indication of the energy available from the entire sky dome on the facades.

This analysis shows that even though the neighbouring buildings to the south have great height, and thereby shades greatly from the direct radiation, there still is significant diffuse radiant energy compared to that of direct radiation.

These studies are to have more iterations as the sketching phase progresses. By adjusting the height of the neighbouring buildings, it might be possible to get a more favourable solar radiation on the buildings of this project. Having top lit rooms or atriums to extend the sunlight to the lower floors of the building, might also be a way of solving some of these problems.

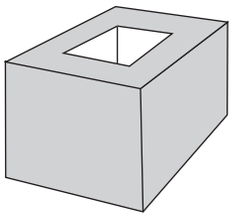
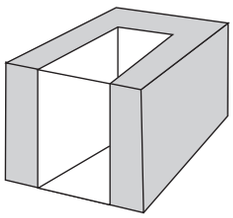
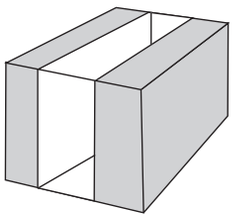
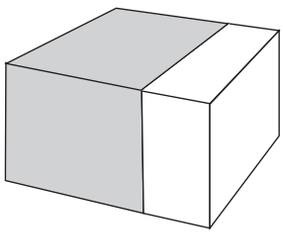
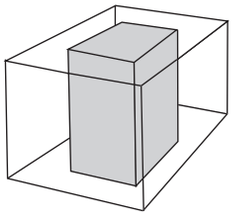
Def: Atrium;

In the roman domus (house), the atrium was the central hall that followed the entryway of the house, and opened into the reception area where the guests were greeded.

[www.ablemedia.com]

atrium

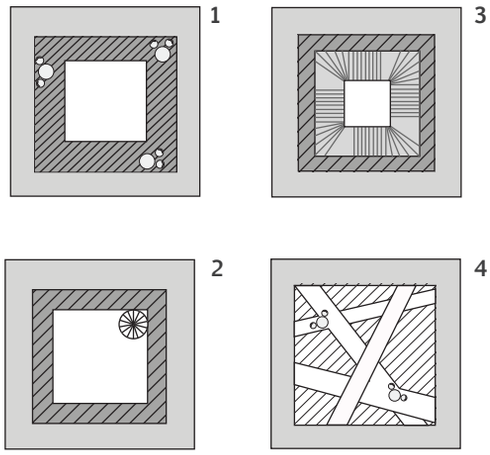
The main reason for incorporating an atrium in the architectural design is the space as an open element in the building used for a better distribution of natural daylight and circulation around the building. The open space ensures visibility and openness in the architecture and creates a natural meeting point in the building, as all adjacent spaces meet here.
The right design of the atrium is crucial to ensure the right use of the space in terms of sustainable reasons, as it can highly affect the energy consumption characteristics for the building if the temperature differences within the space are too high.
The atrium can however contribute with the possibility for better utilization of natural ventilation and preheating of inlet air for ventilation in the adjacent spaces.

	There are 5 different types of atriums;	Characteristics;
	**Core atrium;** The classic atrium type providing a glazed courtyard in the centre of the building surrounded by adjacent spaces on all sides. The external envelope of the atrium is limited to the area of the roof glazing.	**Core atrium;** Lighting: difficult in the lower storeys Ventilation: difficult conduction of supply air In summer: danger of overheating in the upper storeys Particular characteristics: access zones
	**Integrated atrium;** An integrated atrium is a glazed space that is positioned in the building such that only one side faces the exterior. It may or may not have a glazed roof.	**Integrated atrium;** Lighting: good Ventilation: good In summer: effective shading required Particular characteristics: sound insulation
	**Linear atrium;** The linear atrium covers an open space between two parallel building blocks ending with glazed gables on both sides.	**Linear atrium;** Lighting: difficult in the lower storeys of the middle zone Ventilation: through ventilation possible In summer: thermally less critical Particular characteristics: passageway
	**Attached atrium;** The attached atrium is a glazed space added to the external wall of the building envelope.	**Attached atrium;** Lighting: good Ventilation: good In summer: thermally critical, efficient shading required Particular characteristics: winter garden, sound insulation
	**Envelope atrium;** The envelope atrium is characterized by an entirely enclosed building covered by glass representing a “house-in-house” concept. The large external envelope glazing may include one facade of the building.	**Envelope atrium;** Lighting: good - 20% less than open facades Ventilation: good In summer: danger of overheating in especially the upper storeys Particular characteristics: winter garden

ill. 74 Type of atriums

Flow

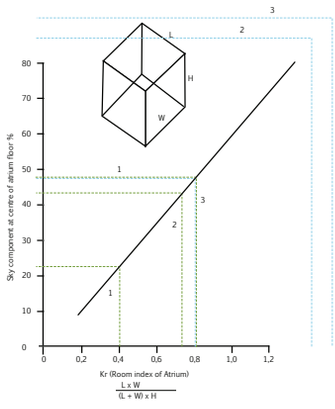
The use of the atrium for circulation in the building can be designed more or less as an element and contribute with quality to the adjacent spaces depending on demands and wishes for the atrium.

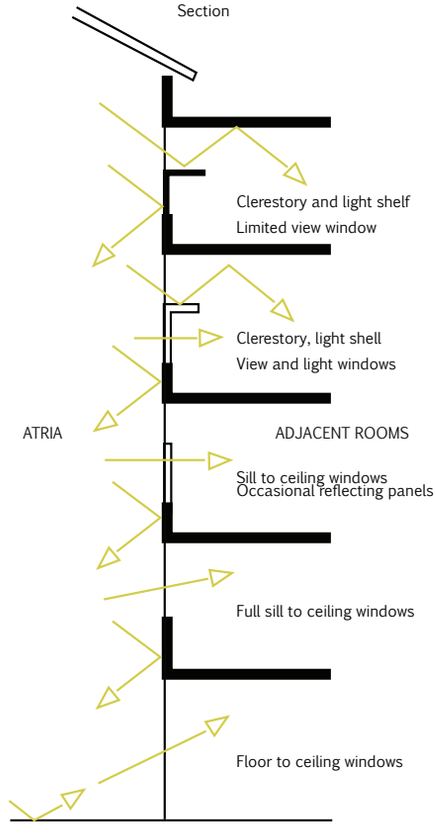


1. Open space towards the atrium contributes with visibility in the building.
2. Hallway towards the atrium with a minor connection between the levels.
3. The stair as an element in the atrium providing great circulation between the levels.
4. Circulation and open space becoming a part of the atrium, where the functions merge together.

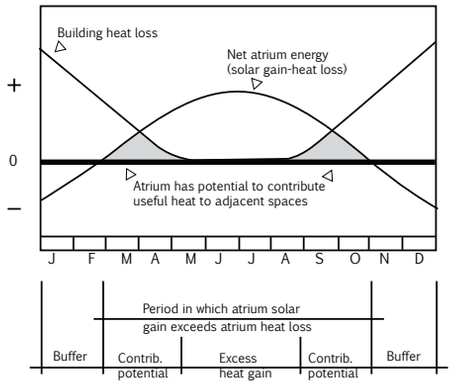
Daylight distribution

The amount of daylight in the atrium depends on the dimensions of the space, which needs to be taken into considereation in the design. The distribution of the daylight into the adjacent spaces can furthermore be optimised through the layout of the intermediate boundary of the atrium.





Heating
The atrium and the adjacent rooms can during the day and the year contribute to a better indoor climate in the two parts of the buildings, if the atrium is designed in the right way.



ill. 75 Atrium vs. adjacent spaces - heat gain and transmission loss

On year basis an atrium can in the transition periods between summer and winter contribute with great heat gain to the adjacent spaces, where these spaces have a larger transmission loss. During summer the solar gain in the atrium can become very high, why a solution for cooling down the atrium can be essential. Opposite to this a buffer zone appears during winter and needs to be solved in regards to heating up the building volumes.

Depending on the design of the atrium large temperature differences can appear in the atrium because of the high amount of solar gain, but also because of the high amount of transmission loss through glass panels. To counteract on the large temperature variations thermal mass can be introduced within the atrium.

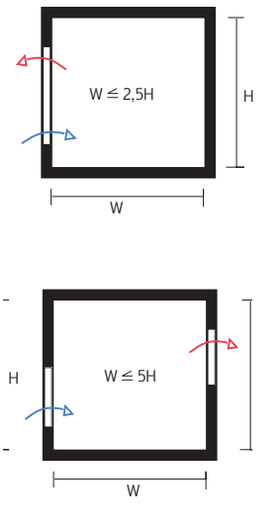
This can affect the risk for overheating during the day, as the heat will be stored during the day and emitted back to the room during night. The combination of thermal mass and night cooling can be essential aspects to achieve a comfortable indoor climate.

Temperature differences;
Depending on the design of the atrium the temperature differences in vertical direction can vary, why the position of the different functions can be essential to meet the comfort demands for the different rooms.

Ventilation strategies
Because of the large temperature differences within the atrium and also the pressure differences depending on the height of the space, an atrium is an optimal element to incorporate in the ventilation strategy for the entire building. As the depth of the adjacent spaces can be determined of the chosen ventilation strategy it can be profitable to use the atrium for cross ventilation as this result in deeper room possibilities. (Single-sided ventilation; W smaller than (2,5 x H) and for Cross ventilation; W smaller than (5 x H)).

To determine the right ventilation strategy for the building three parameters are governing; Temperature, wind and pressure differences. These parameters can be put into play alone or simultaneously in the ventilation strategies; Single-sided, cross or stack ventilation. When using the atrium for stack ventilation sound and odour transmission are essential to take into consideration, which can be controlled by the “Neutral Plane”, where inlets are underneath and outlets above the “Neutral Plane” because of the pressure differences inside and outside the building volume.

ill. 77 Temperature differences in vertical direction



ill. 76 Ventilation strategies - sections

materials

The overall parameters dealing with materials in a larger scale is the choice of materials, the construction site and building changes, repairs & maintenance.
When choosing materials for sustainable architecture two approaches can be used. Both approaches concern the CO_2 emission and the use of non-renewable energy resources. These are to increase the use of natural resources, that are already known in the building industry and second to reduce the use of conventional manufactured materials.

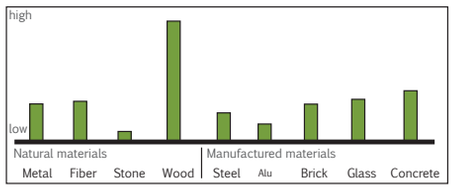
The manufacturing process results in a lot of CO_2 emission and the use of non-renewable resources. This will through time result in global warming and a necessity of reinventing the non-renewable resources to ensure the same lifestyle in the future as we live today. Another dimension to take into consideration regarding the choice of material is the CO_2 emission during transportation of the materials to the construction site, and the amount of waste during construction, which can be reduced by choosing locally produced materials and to reuse the leftover materials on the construction site.

Changes of the building, repairs and maintenance are also to be considered when seeking for the right material. The use of materials with high quality and durability ensure less maintenance during the years. The durability should however be compared with the energy consumption during manufacturing procedure of the given material. [PDF; Jayawardena, Buildings for sustainability: Materials and construction]

When choosing material for sustainable architecture many different parameters are to be taken into consideration. They can not all be fulfilled, why it is important to counterbalance the different parameters according to the project and the focus point in the architecture.

lifespan

maintenance



ill. 78 The lifespan and maintenance of the materials depend on the preparation of the final product and the position of the material in the construction, why the graphs show the lifespan and maintenance according to other materials, but not telling any numbers regarding amount of time or scale.

Considerations that need to be taken into account are; embodied energy, preserving of the natural biodiversity, renewable resources and maintenance, which means that materials can be "sustainable" in different ways depending on different phases.

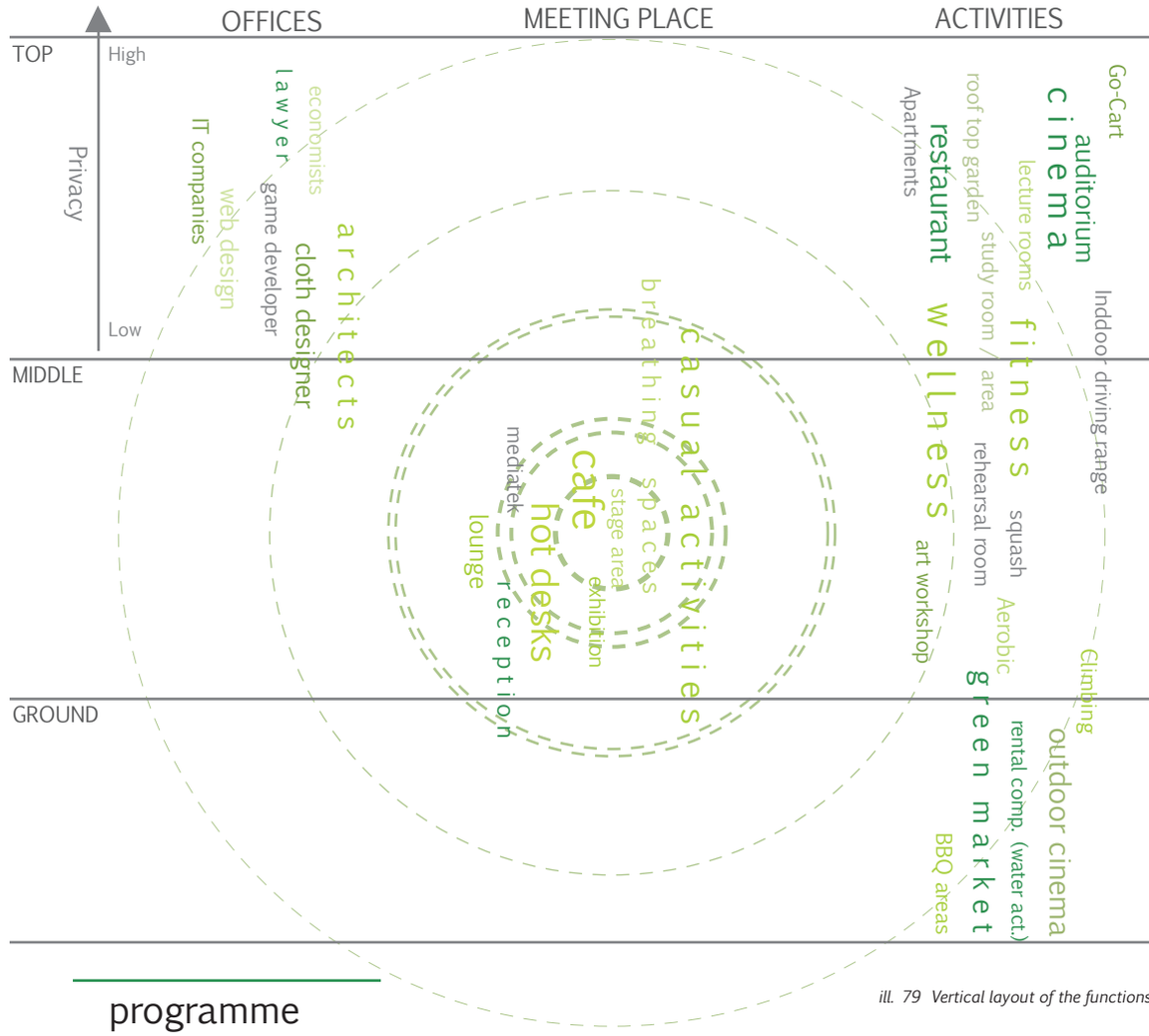
Embodied energy; the energy used during the mining of raw material, manufacturing and transportation to the construction site. By using local materials the energy used for transportation can radically be reduced.

Preserving of natural biodiversity; during the cutting process, large areas of forests can be distinguished, and even though the forests today are being replanted some places, it does not give back the natural biological diversity in the forests, as "mono-forests" can not provide the same standard of living for the wildlife. This development has however resulted in the concept "selective cutting", which means that only the trees needed and those large enough for further production are removed from the natural environment.

Renewable resources; reduction in the use of fossil fuels and non-renewable materials in mining, manufacturing, transport and construction.

Maintenance; lifespan of a given material and the need of maintenance after the end of construction.

There can be made a division of materials into two categories; natural materials and manufactured materials, where the use of natural materials is the most reasonable, seen from a sustainable point of view, as these materials need less manufacturing process and therefore emit less CO_2 to the surroundings. Manufactured materials are produced with the use of natural materials, but the procedure from raw material to final product is longer and much more polluting than the manufacturing procedure for natural materials.



ill. 79 *Vertical layout of the functions*

programme

"What people want is not an either/ or proposition. Successful places do not provide just one thing; rather they provide a range of quality of place options for different kinds of people at different stages in the life course."

[Florida, 2003. p. 233]

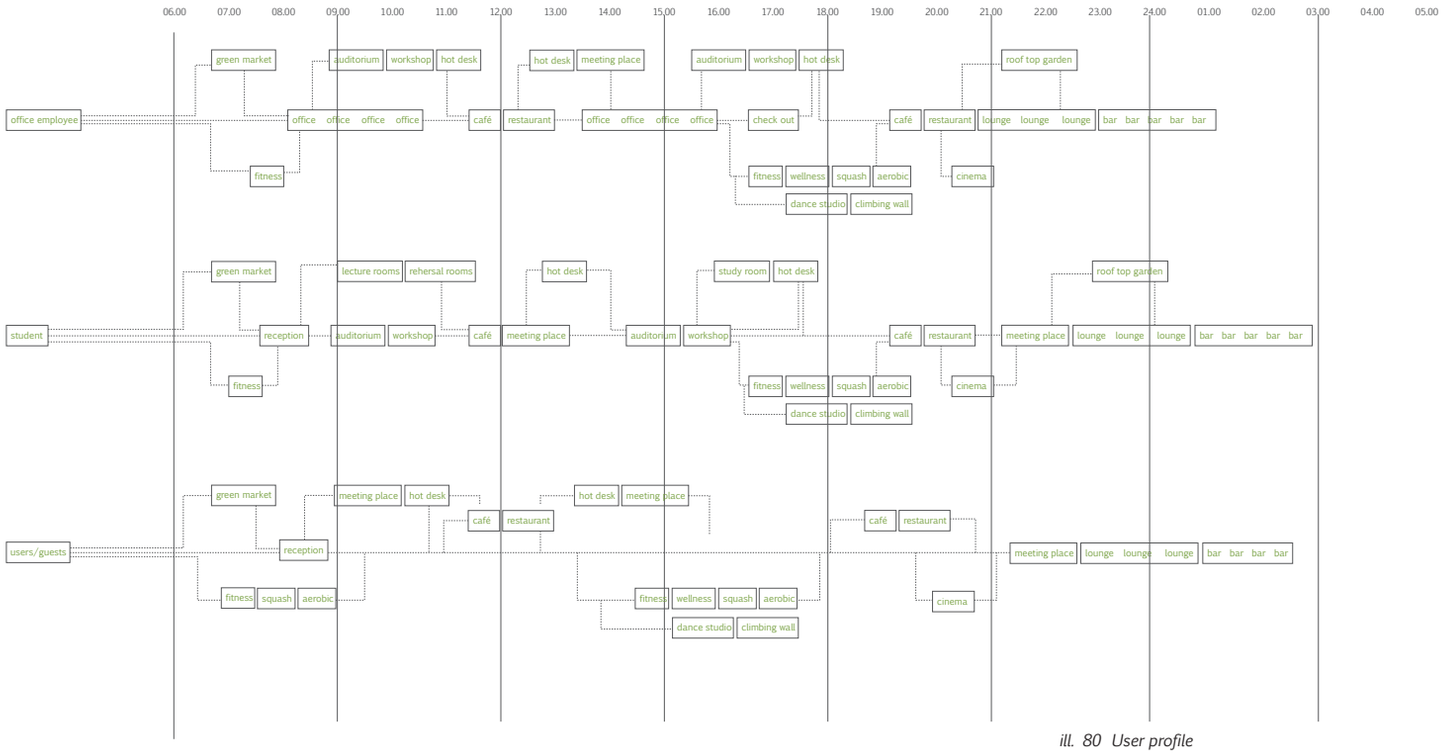
The constellation of the program has been effected by diversity to meet the demands of *"The Creative Class"* and hereby create an interesting environment that can contribute with a lot of different activities and aspects to a more vibrant lifestyle. As the latter of the three dimensions; *What's there, Who's there and What's going on*, which defines quality of space, a mixture of diverse, exciting and creative activities in a more free constellation is what together with the diversity of people attracts the population.

"What's going on; the vibrancy of street life, café culture, arts, music and people engaging in outdoor activities – altogether a lot of active, exciting, creative endeavours." [Florida, 2003, p. 232]

The programme of the building will all have one point of circulation in the "meeting point" of the building, that will link the rest of the activities together, and become the free constellation containing the more informal activities, which can be used by individuals or a group of friends at any giving time of the day. An area that can be used for any activity concerning exhibitions, cafe, mediatek, networking, casual activities as table tennis, gaming or just relaxing, and hotdesks, where employees and students can work and network during the day without the necessity of being a permanent part of the house. The "meeting point" is a place the population of Aalborg can use at any given time, and the way they wish to.

To ensure diversity in the building the programme surrounding the "meeting point" contain different workshops, minor companies, sport related functions, dance studio, exhibitions, music and offices that create a large variety and diversity in the building.

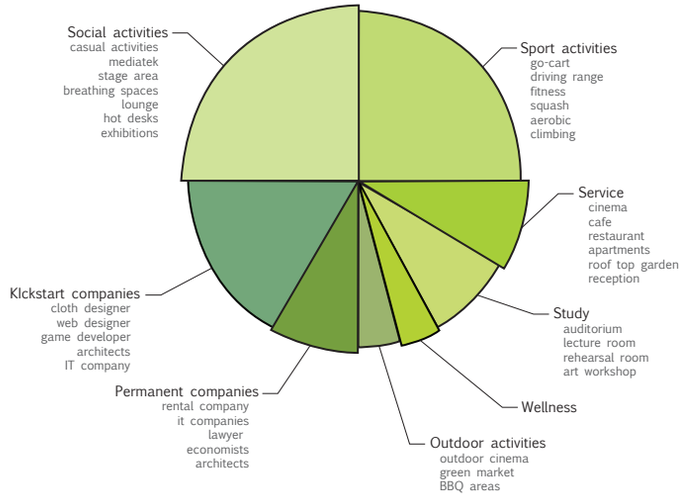
USER PROFILE



ill. 80 User profile

The main focus of the project will be at the flow and logistics of the building, both in terms of the flow inside the building, regarding the interaction between the meeting point and the different in-house activities, and the interaction with the surrounding activities.

This is an extension to the previous diagram, showing the percentage of different functions, related to each other. The diagram is without values, since this is meant as an indication of the program subdivision, and no exact area calculation has been decided yet.



ill. 81 Distribution of functions

chart of functions

The table below shows the different parameters and demands for fulfilling the indoor climate and thermal comfort. Some of the values are to be used in future calculations.

Function	m^2	load	view	daylight	light artificial (lux)[1]
meeting place	1200	30	+	+	500 (cont. read/write) 200 (occ. read/write)
cafe	90	40	+	+	200
lounge	157	30	+	+	500 (cont. read/write) 200 (occ.read/write)
restaurant	286	100	+	+	500 (prep. of food) Varies (seating area)
dance studio	145	10	+	+	200
fitness	226	30	+	+	200
wellness	722	40	+	+	100
cinema	458	150	-	-	50
auditorium	458	80	-	+	200
rehearsal room	71,5	16	+	+	200
workshop	150	15	+	+	200
rental company	145	3	+	+	200 (office)
lecture room	150	15	+	+	500 (cont. read/write) 200 (occ. read/write)
squash	62,4	2	-	-	200
study room	150	5	+	+	500 (con. read/write) 200 (occ. read/write)
office	145	10	+	+	500 (cont. read/write) 200 (occ. read/write)
apartments	0	4	+	+	500 (work) 200
aerobic	190	20	+	+	200
climbing	-	8	+	+	200
technical room	50	2	-	-	200
changing room	214	40	-	+	200

Notes
1 DS 700 Kunstig belysning i arbejdslokaler
2 CR1752 p. 53
3 BR08
4 ISO 7730 p. 21

activity (met)[2]	public	acoustic[3] (reverberation time sek.)	cloth insulation summer	cloth insulation winter	optimum temperatures[4] (cat. A) summer	optimum temperatures[4] (cat. A) winter
1,2	+	0,6 or less	0,5	1,0	23 - 26 ºC	20 - 24 ºC
1,6 (employee) 1,0 (customer)	+	1,2 or less	0,5	1,0	21 - 25 ºC 23 - 26 ºC	16 - 22 ºC 21 - 25 ºC
1,0	+	1,2 or less	0,5	1,0	23 - 26 ºC	23 - 26 ºC
1,6 (employee) 1,0 (customer)	+	1,2 or less	0,5	1,0	21 - 25 ºC 23 - 26 ºC	16 - 22 ºC 21 - 25 ºC
4,0	+	1,6 or less	0,3	0,3	18 - 22 ºC	18 - 22 ºC
4,0	+	1,6 or less	0,3	0,3	18 - 22 ºC	18 - 22 ºC
0,8	+	1,2 or less	0,1	0,1	27 - 29 ºC	27 - 29 ºC
1,0	+	1,6 - 1,8	0,5	1,0	23 - 26 ºC	23 - 26 ºC
1,2	+	1,6 - 1,8	0,5	1,0	23 - 26 ºC	20 - 24 ºC
1,6	+	1,0 - 2,4	0,5	1,0	22 - 26 ºC	16 - 22 ºC
1,6	+	1,0 or less	0,5	1,0	22 - 26 ºC	16 - 22 ºC
1,2	-	0,6 or less	0,5	1,0	23 - 26 ºC	20 - 24 ºC
1,2	+	0,7 - 1,1	0,5	1,0	23 - 26 ºC	20 - 24 ºC
4,0	+	1,6 or less	0,3	0,3	18 - 22 ºC	18 - 22 ºC
1,2	+	0,6 - 0,8	0,5	1,0	23 - 26 ºC	20 - 24 ºC
1,2	-	0,6 or less	0,5	1,0	23 - 26 ºC	20 - 24 ºC
1,2	-	0,4 - 0,6	0,5	1,0	23 - 26 ºC	20 - 24 ºC
4,0	+	1,6 or less	0,3	0,3	18 - 22 ºC	18 - 22 ºC
3,0	+	1,6 or less	0,3	0,3	18 - 22 ºC	18 - 22 ºC
1,2	-	0,6 - 1,2	0,5	1,0	23 - 26 ºC	20 - 24 ºC
1,2	+	1,2 or less	0,3	0,3	24,5 - 27,5 ºC	24,5 - 27,5 ºC

VISION

It will be the aim of the project to create a highly diverse community within the building, where the population of Aalborg can meet and interact in a more or less free constellation of functions and offers aiming for 'The Creative Class'.

This will be accomplished through different approaches during the design phases of the project, where the main parameter will be knitting past and present together to become architecture for the future. This will happen with great respect to the historical expression of the existing buildings, but with the aim of adding a new and multi-diverse unitt to the buildings, that appears different and interesting in its architectural expression.

This new element will be the logistic centre for the three buildings and their functions. The project buildings, as a whole, will differ in transformation, hierarchy of old and new together with contrasts, just as transparency and interrelationship between the diverse functions will be evident for this project. The aim is to create an environment emphasizing a high activity level at all times within the building, an area where 'The Creative Class' feels alive and contributes to the life lived there.

CHARACTERISTICS

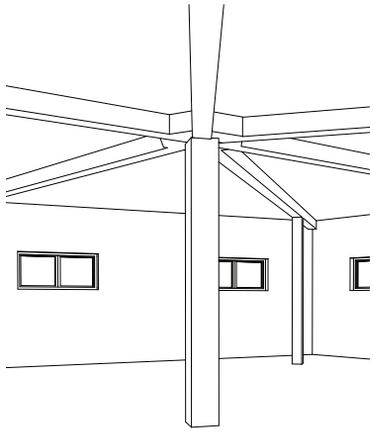
The characteristics of the buildings have been selected for preserving to ensure a transformation that links to the existing buildings however these elements can be liberally interpreted.

SILO 02

Ornament in the façade (esp. West façade)
Sporadic organization of the columns – simulate trees
Silo taps – diversity in expression

SILO 03

Footprint
Verticality in expression
Window band
Facade ornamentation
Roof construction



SILO 04

Hexagon silos and taps
Facade structure
Doors with window band above
Expression of the East façade

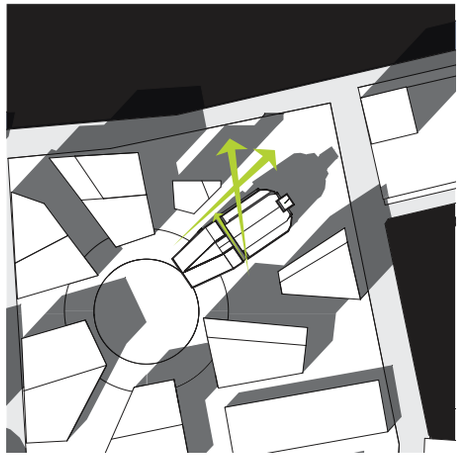
DETAILS

Pathways between the buildings

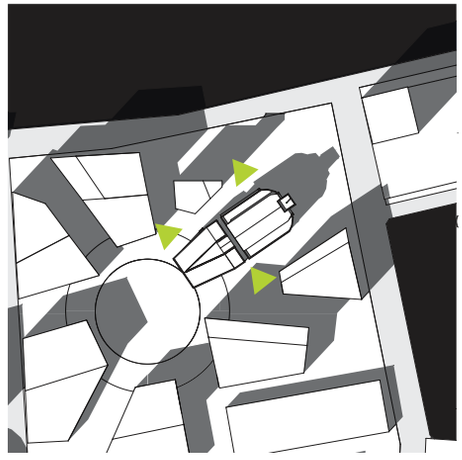
Old expression with the different diversity and characteristics from the buildings are wished to be kept. However the new elements should create the connection and cohesion between the buildings to make them reassemble one unit. Here the detailing of the new and the encounter with the old are crucial points.

DESIGN PARAMETERS

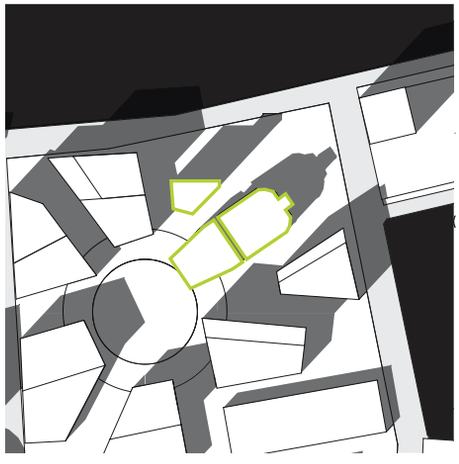
01



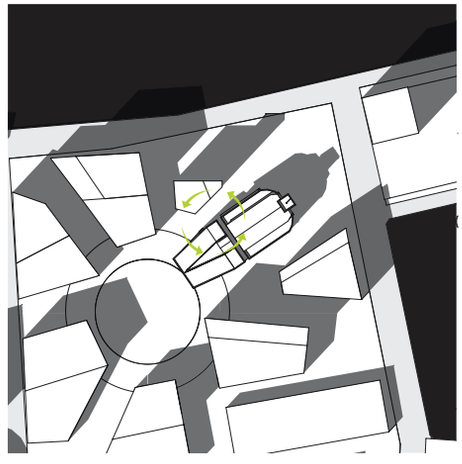
02



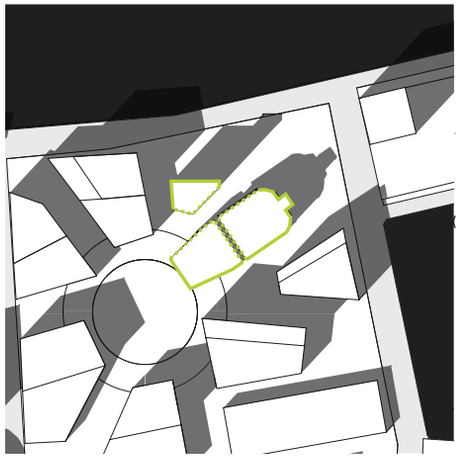
03



04



05



Different contextural parameters have been outlined accordding to the aim of this project. These are illustrated in the diagrams.

01 Interesting views in relation to the buildings
02 Indicate access point to the complex
03 Retention of the existing footprint
04 Internal connection combing the three building
05 Treatment of the facade between the buildings where as the outline is maintained.

I The concept of infill architecture, where the right balance between old and new is evident, in a vertical direction relating to the silos and the history of Østre Havn.

II To ensure diversity within the building, flexibility and flow are crucial elements to be able to meet any extra-ordinary idea or intension that has occurred in a glimpse moment.

III The diversity will be emphasized through open visible structures and a high activity level, that ensure a constant movement in the building, creating a feeling of community at all hours of the day.

IV To contradict the high activity level, small niches consisting of green breathing spaces and more casual activities will be implemented in the layout of the functions. This will make it possible for the individual to enter a lot of different situations during the day. Furthermore these places will enhance the social meeting between people.

V The architectural expression of the building will reflect the activities inside the different rooms through the work with diversity in the expression as well as the choice of materials, which naturally deals with the sustainable aspects of the project.

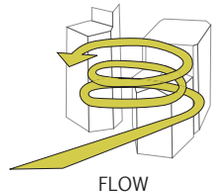
VI To create architecture for the future, it is crucial to implement the parameters from sustainable architecture, as this approach will be the future regarding the worldwide environmental issues concerning energy consumption, and the future interaction between nature and architecture.

I

KNITTING PAST & PRESENT

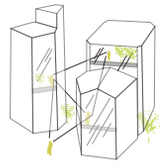
II

FLEXIBILITY IN ORGANISATION

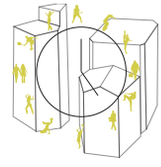


FLOW

III

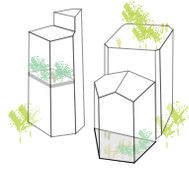


OPEN VISIBLE STRUCTURE



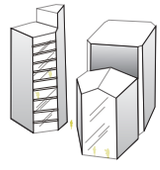
HIGH ACTIVITY LEVEL

IV

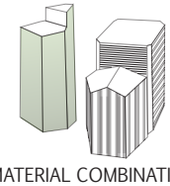


GREEN STRUCTURE

V

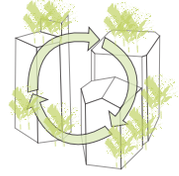


DIVERSITY IN EXPRESSION



MATERIAL COMBINATION

VI



SUSTAINABILITY

ARCHITECTURAL REFERENCES

The analysis phase has resulted in selecting two main focus points in the transformation of the selected project buildings;
hierarchy and contrast. These are supposed to act as guidelines in the design phase, ensuring it stays on track and ends up as one coherent design.

Hierarchy is the tipping point of which design factors are dominating each other. In each case a stand must be taken, deciding what overrules the other, hence making it clear what is the prevailing factor. Is it a new addition, that must take shape as the old, or is it an alien shape inheriting the material or texture of the existing building. In each case it must be clear what dominates the other.

Contrast is used for distinguishing the existing shapes, materials, textures and atmospheres from the new. It is used to illustrate the hierarchy in the building. A new design extending the old can inherit the architectural language, but may have a different surface roughness, hence being dominated, or controlled, by the existing. Contrast can be colours, textures, materials, differences in shapes or how things are attached or interact with each other.

Whether there will be a clear indexation of the hierarchy in the building, or if it will be a more spread out experience, the design phase will show.

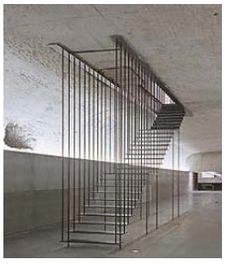
ill. 82 Castelvecchio, Carlo Scarpa.

In the following, examples are given of how these focus points can be achieved.

The consistency of the detail level in Castelvecchio is remarkable. Here prevails a fine balance between new and old. The way Carlo Scarpa handles the hierarchy and contrast between new and old is seen as an important parameter in this project.
Here the photos illustrate a clear separation and definition of the existing components and the additional elements.

ill. 83 Church Extention, Hassell

ill. 84 Office Space, M2



ill. 85 Nuevos Ministerios

ill. 86 Tate Modern, Meuron

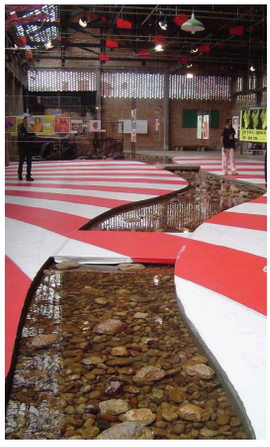
The interaction between the historic remembrances and the new elements have to be balanced and controlled very carefully, where at some stages the old elements are guiding the detailing and the new features obey the existing conditions.

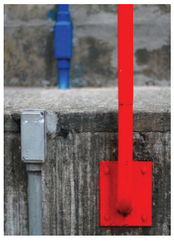
Examples of this are seen at the photos from the Church extension designed by Hassel and the Office transformation made by M2 architects.

ill. 87 Museum, Jean Nouvel

ill. 89 Herzog de Meuron

ill. 88 Castelvecchio, Carlo Scarpa





ill. 90 Sesc Pompeia, Lina Bo Bardi

At other places the concept is reversed and instead the new elements take the command illustrating the new modern power. Here the new components determine the interaction. Furthermore the use of various materials processed with different expressions and textures are seen as important characters for the architectural expression. Materials can be used to distinguish between new and old creating a contrast between the old massive blocks and new translucent functions.

Colours can be helpful indicators for highlighting changes or a remark of expression. Colours can refract the grey concrete expression in a very effective way. In this project colours will be used to create a contrast and indicator for the transformation.

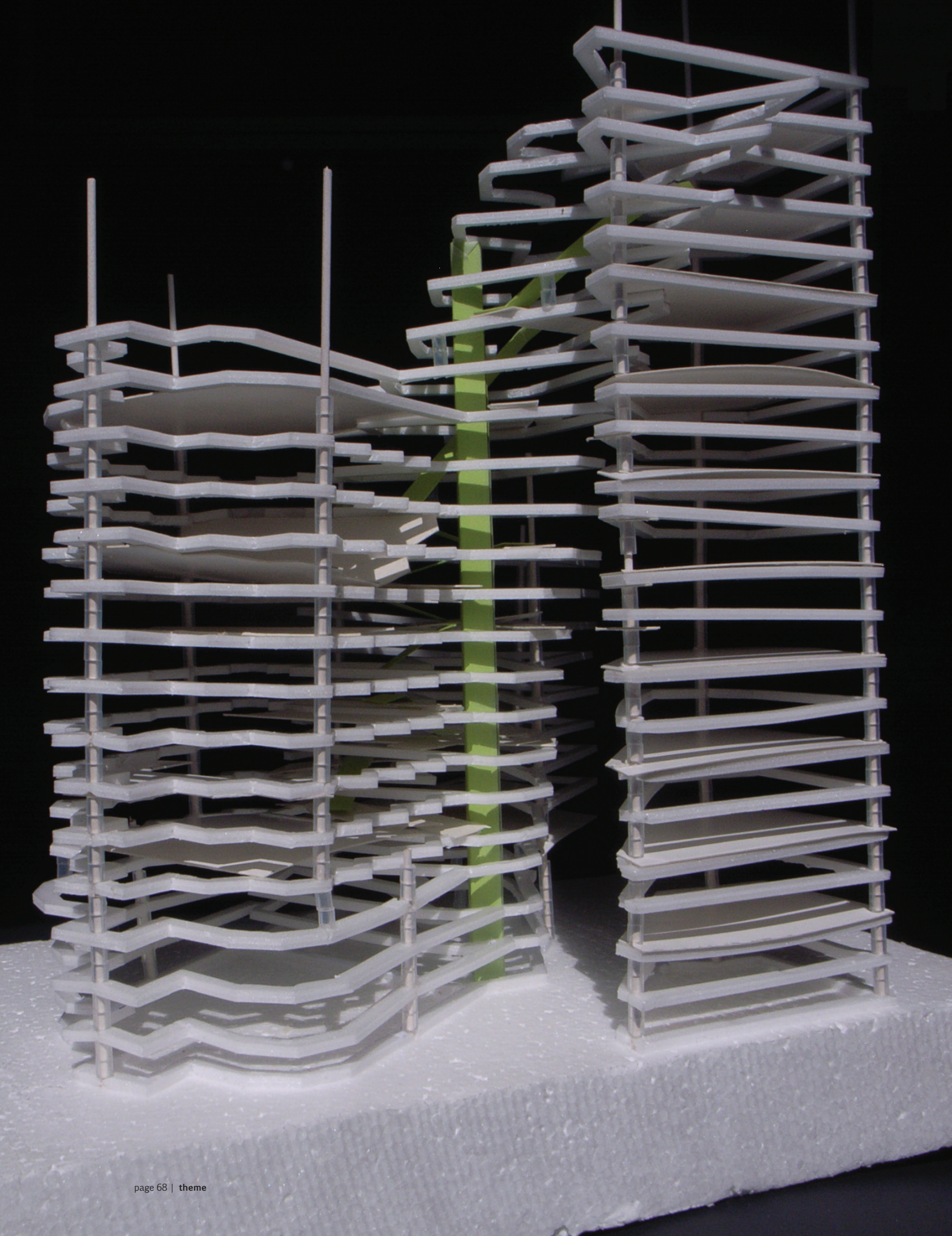
DECLINATION

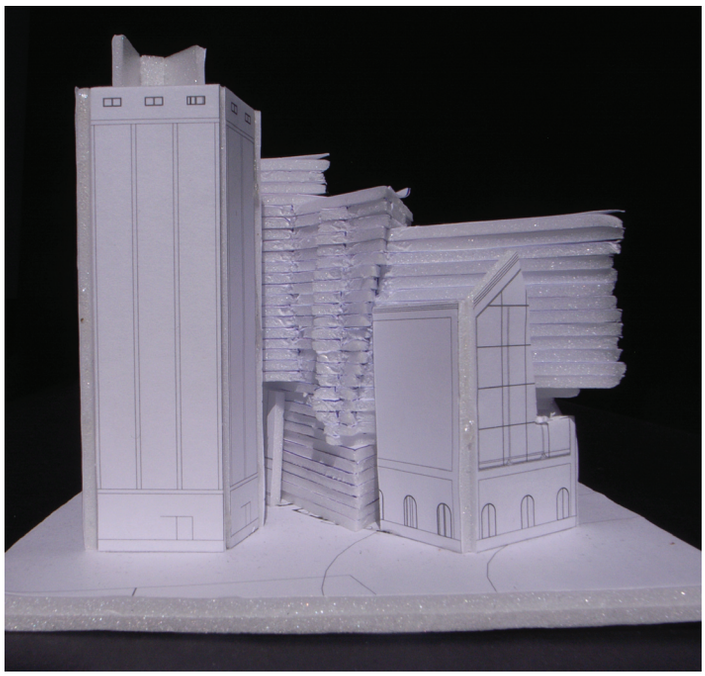
As the authenticity within the cities is of big importance when creating environments for 'the Creative Class' it is the conviction of the project group that preserving the old industrial buildings are essential to the aim of the project, why the economical discussion concerning whether or not it is financial convincing to reuse or rebuild the architecture, is seen as less relevant for the project.

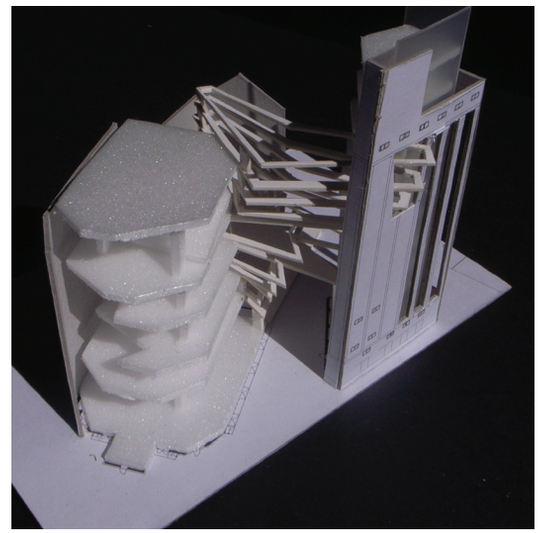
Another issue concerning the reconstruction of old buildings is the demands from the Danish building regulation, as these can be extremely difficult to fulfil without interfering with the expression of the buildings. These aspects are though seen as important for the project to succeed, why it will be the aim of the project to fulfil both the Danish building regulation and maintain the existing expression of the buildings.

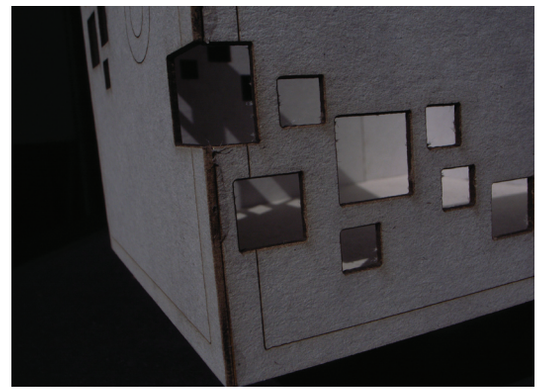
The multi functionality within the buildings is seen as essential when aiming for a new creative and active centre in the city of Aalborg, but also the flow and logistic around and inside the buildings is important to ensure the wanted interaction between all the disciplines. The flow and the meeting place connecting all the activities and the creation of a coherent design combine the architectural expression, sustainable principles and structure as a whole.

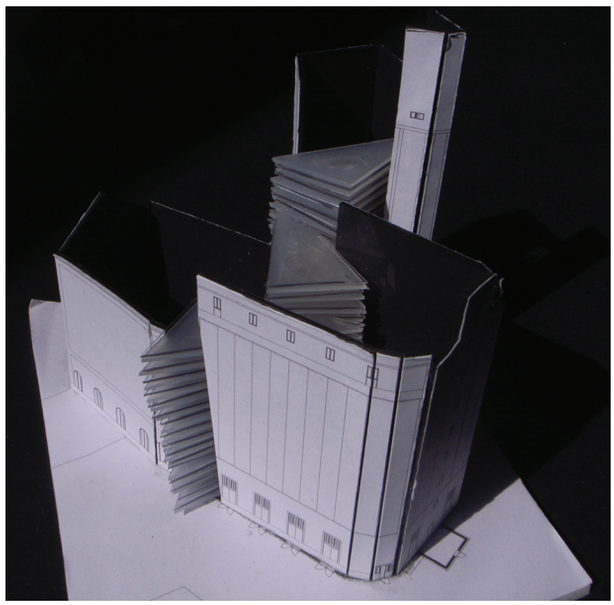
However the complexity of the project will create a differentiation in the detail level where the project group find it essential to create a unified design displaying different proposals for the transformation and optimisation which entails an outdistancing from some elements.



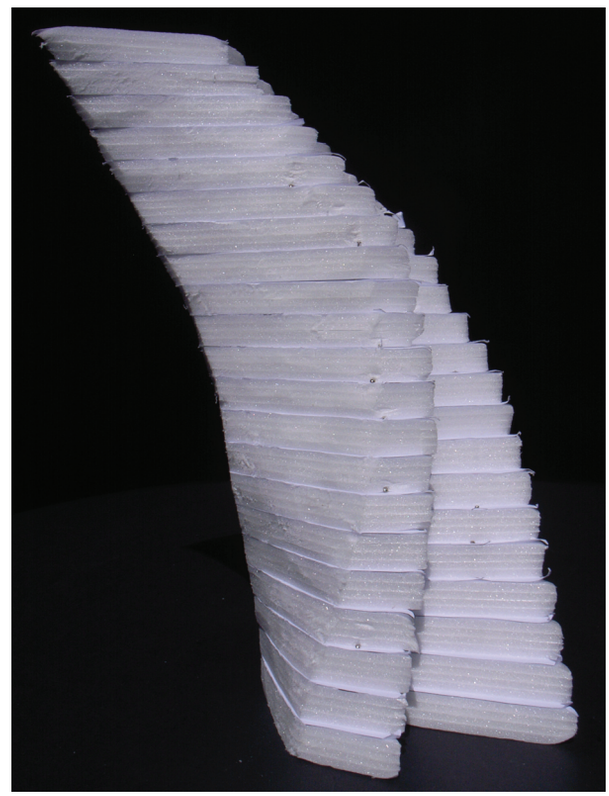








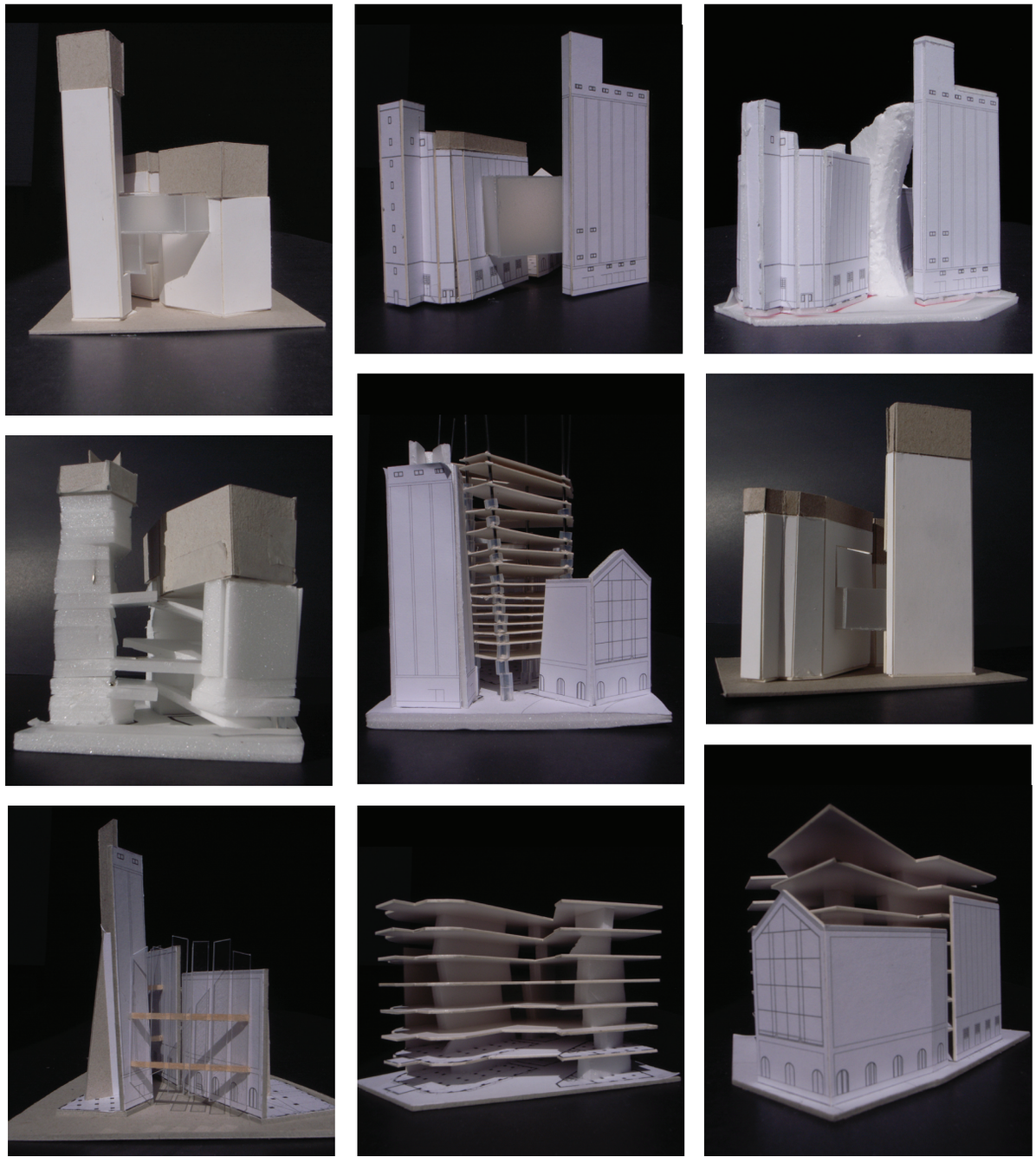
PROCESS



initiating process

In the following paragraph the sketching phase will be presented. Through the design process various ideas and sketch proposals have been investigated. Throughout the sketching phase it has been important to introduce a new architectural element that connects the three buildings. This connection has been investigated through a range of different expression and values evaluated according to the architectural concept and the creation of flow between the existing buildings.

Consistently through the sketching phase it has been a continuous discussion how to adapt and differentiate the existing elements in collaboration with the new. The hierarchy and encounter between these elements have been of big importance.



ill. 02 Various models from the initiating process

connection

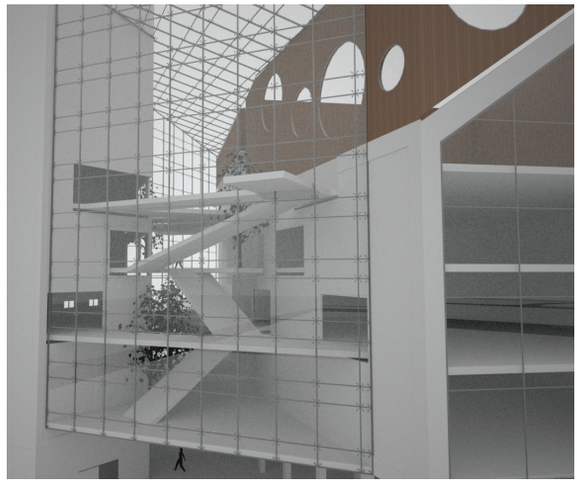
During the process the focus has changed between different scales and levels of details. In the beginning the models were concentrated upon the architectural expression and element that could connect the existing buildings and indicate the new era of the complex.

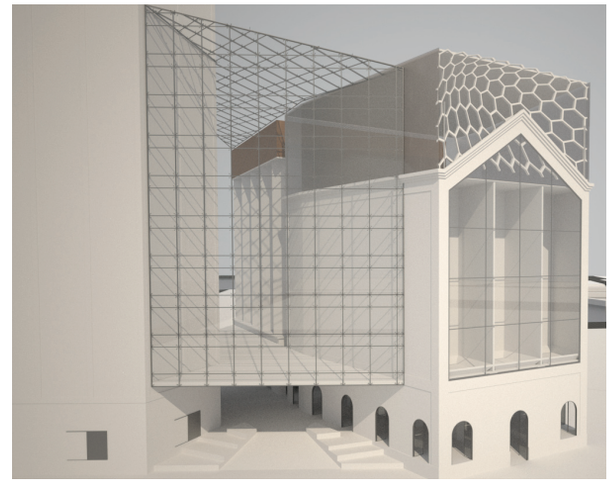
The models illustrate some of the proposals created in the initiating process. Here different aspects and parameters were examined and evaluated. For example how to illustrate the transmission towards the new utilisation and still keep the atmosphere of the old.

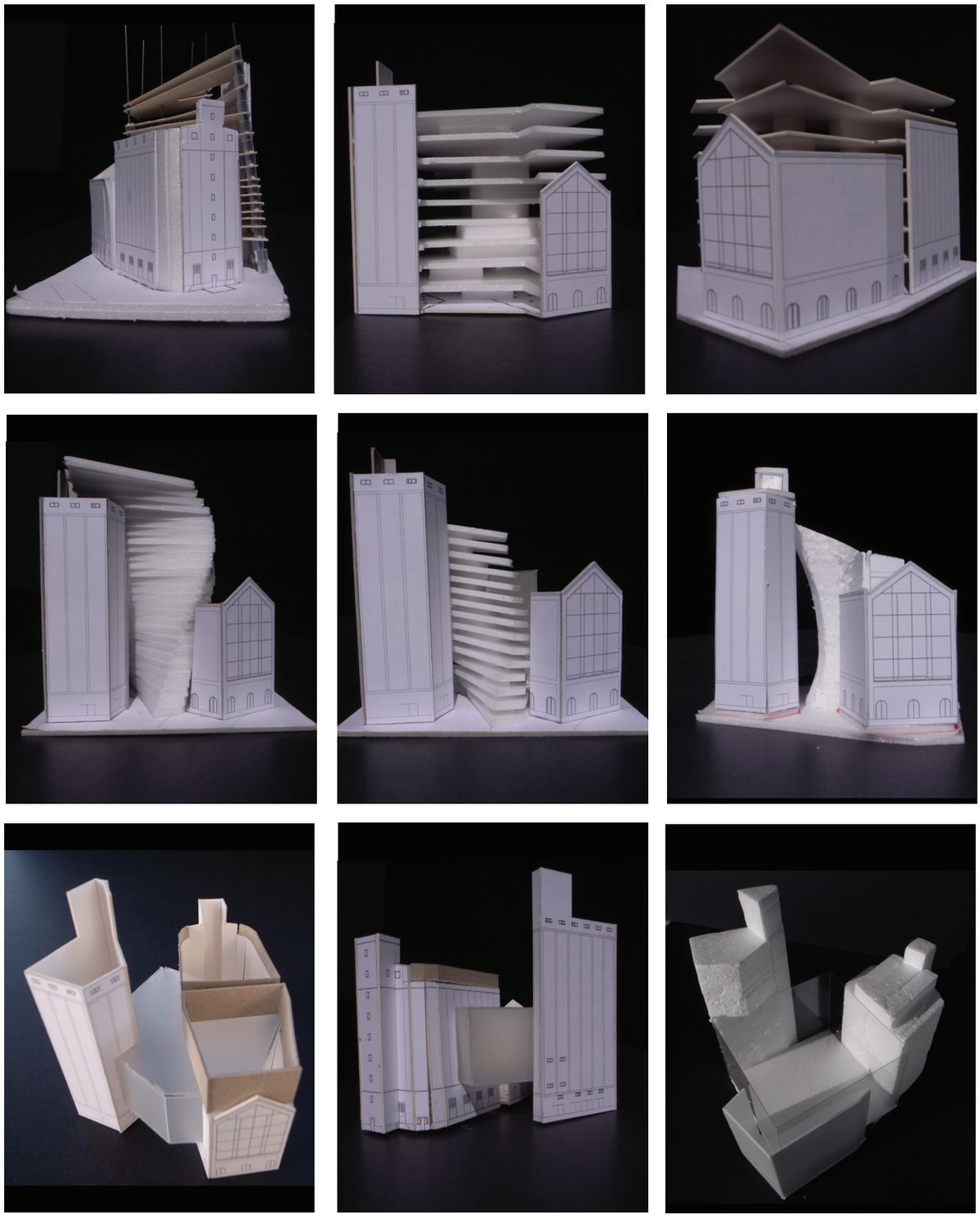
Furthermore the architectural expression, volume and direction of the new connection between the three volumes were investigated.

Many of the proposals exhibit an atrium that can act as the connector between the functions and create a coherency between the buildings. Furthermore an atrium can help reduce the energy consumption and improve indoor environment through natural ventilation principles.

Therefore the atrium as a sustainable aspect has been investigated.



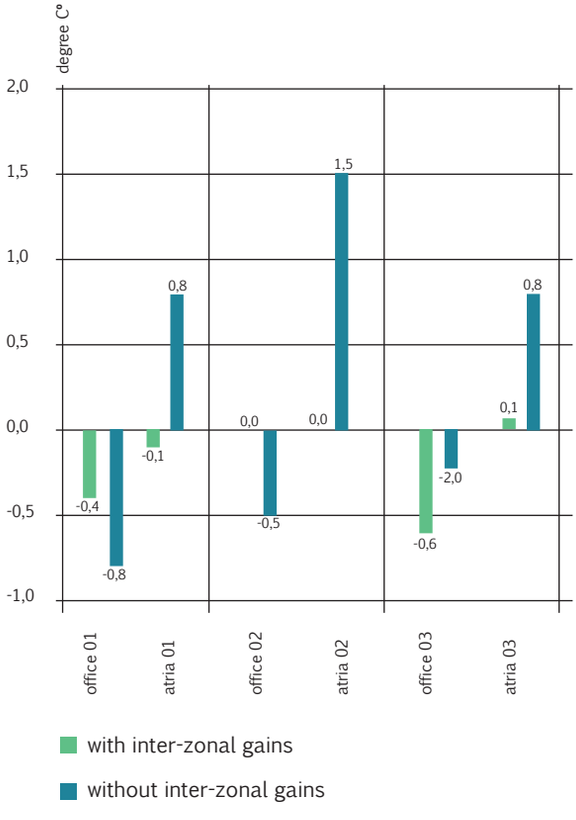




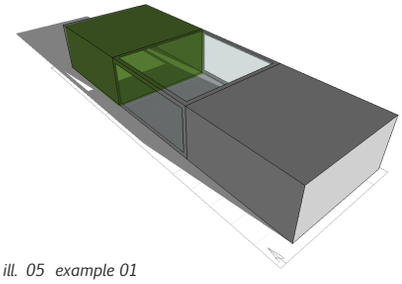
ill. 03 Models illustrating different proposals for the connection between the buildings

Internal gains
During the architectural investigation different atrium solutions are examined through Ecotect where benefits and effects of introducing an atrium in the design proposal were investigated.

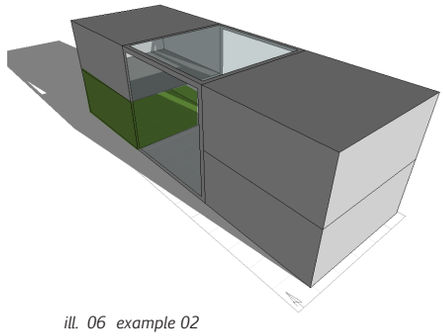
The first scenario explores the atrium effect on internal temperatures in the adjacent rooms with different height of the atrium. This indicates that the office benefits from the passive solar heat generated in the atrium. The selected office is highlighted in green.



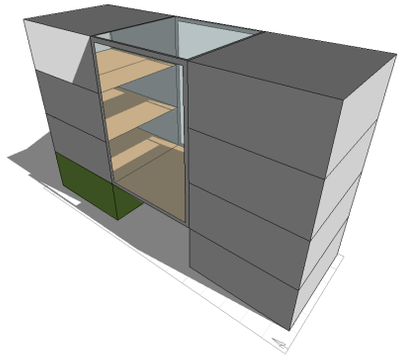
ill. 04 Investigations in Ecotect



ill. 05 example 01



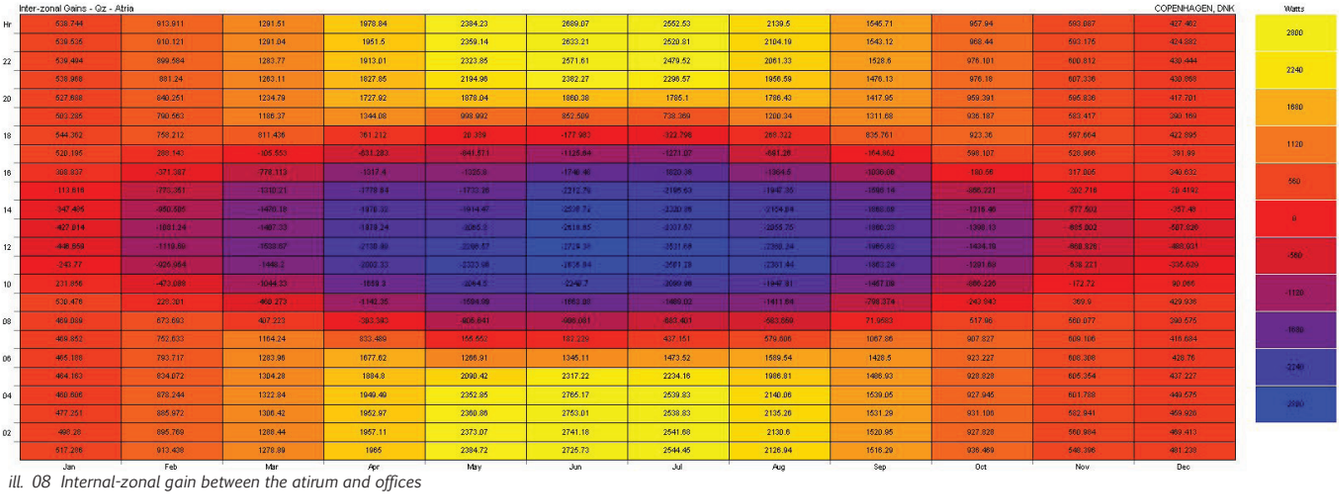
ill. 06 example 02



ill. 07 example 03

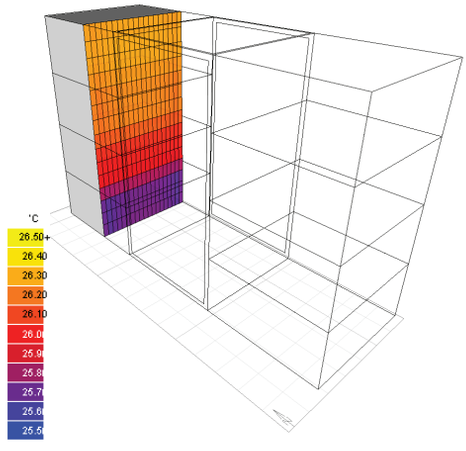
This graph illustrates the inter-zonal gains between the atrium and offices. This investigation is carried out through a whole year. Here the negative values indicate when the atrium releases heat towards the office. This is mainly mid-day during summer.

This principle is reversed in the evening and night where the atrium receives inter-zonal gains from the offices, because these have a higher temperature at this time as a result of their higher thermal mass.

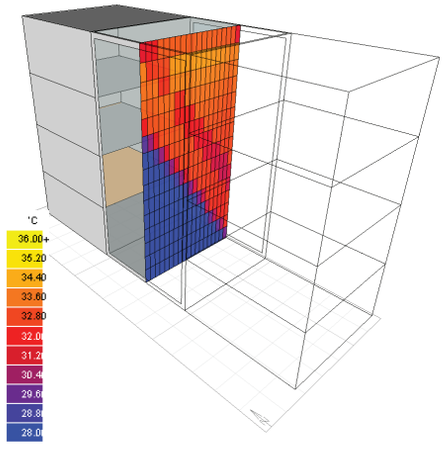


ill. 08 Internal-zonal gain between the atirum and offices

Here the vertical radiant temperature difference in the offices and atrium is investigated. This illustrates that there are great differences between ground and top in the atrium which needs to be accommodated through the design process. However the vertical radiant temperature differences in the office zones are not as high and more stable. Again this relies on the difference in thermal mass and subdivision into smaller office spaces versus one big atrium.



ill. 09 Radiant temperature differences in the offices - average temperature 26,4°C



ill. 10 Radiant temperature differences in the atrium - average temperature 30,6°C

Ventilation strategies

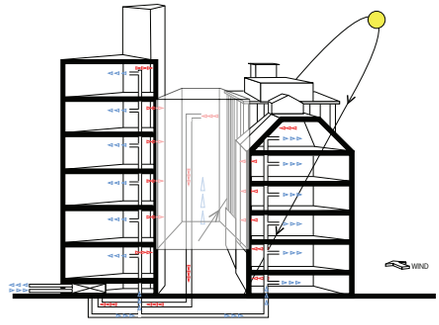
Here ventilation strategies are examined. Looking upon the different ways of natural ventilation incorporated upon the selected buildings. The introduction of an atrium will affect the airflow and generate the possibility to create natural ventilation through the whole complex. See the illustration below.

ill. 11 Diagram of the different ventilation strategies implemented to the selected buildings

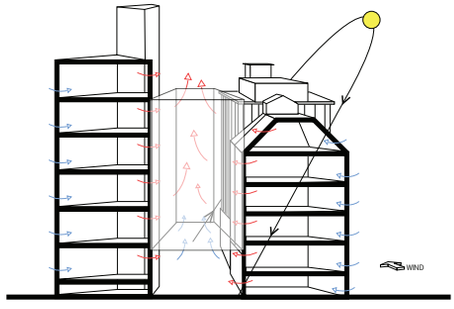
natural ventilation

mechanical ventilation

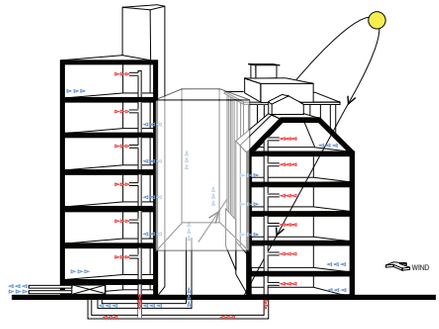
legend;
natural inlet / outlet
mechanical inlet / outlet



Ventilation strategy for mechanical ventilation during winter time



Ventilation strategy for natural ventilation during summer time

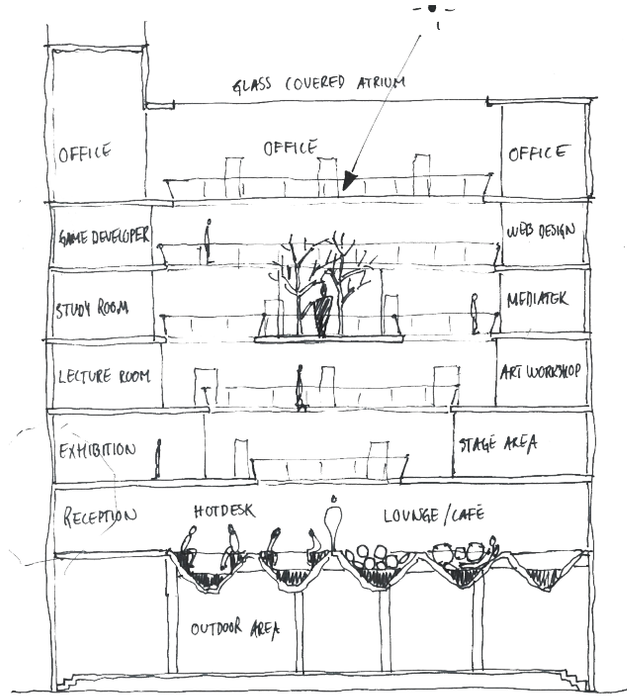


Ventilation strategy for mechanical ventilation during winter time

The natural ventilation can be designed in different ways to ensure the best possible indoor climate at all times. This is depending on the microclimate of the surroundings and the temperature differences within the building and on the outside. It can be difficult to determine the exact ventilation of an atrium as flow of the air depends on both functions, temperatures, wind and thermal buoyancy.

Mechanical ventilation will be used during winter with a high heat recovery to ensure a low energy use to warm up the inlet air. The mechanical ventilation can be controlled why it is possible to reverse the ventilation strategy if needed, depending on the pollution of the occupancies.

In the transition period between summer and winter hybrid ventilation is used. This strategy exploits the benefits from both strategies. The hybrid ventilation optimises the balance between indoor quality, thermal comfort, energy use and environmental impact.[Heiselberg, 2006]



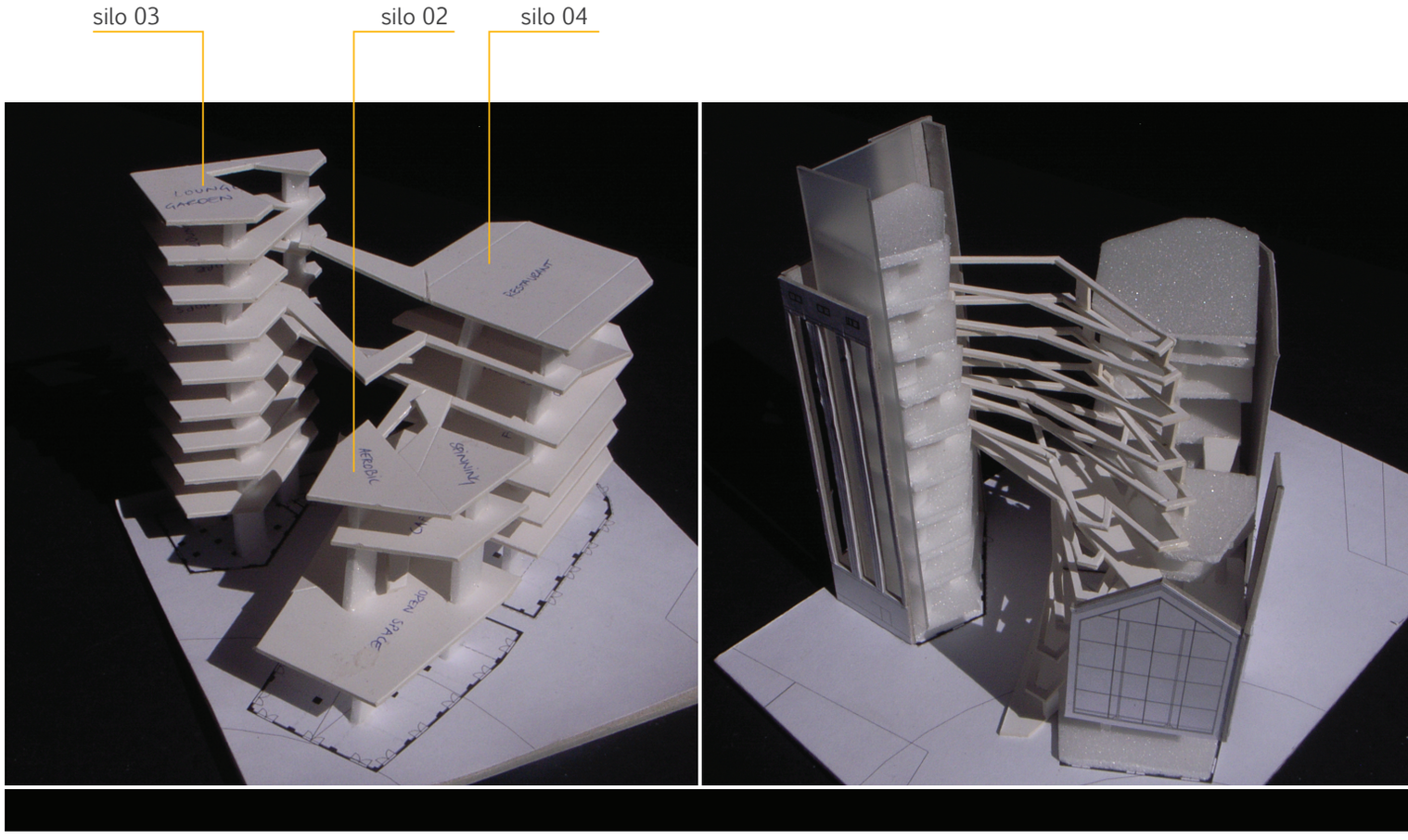
function distribution

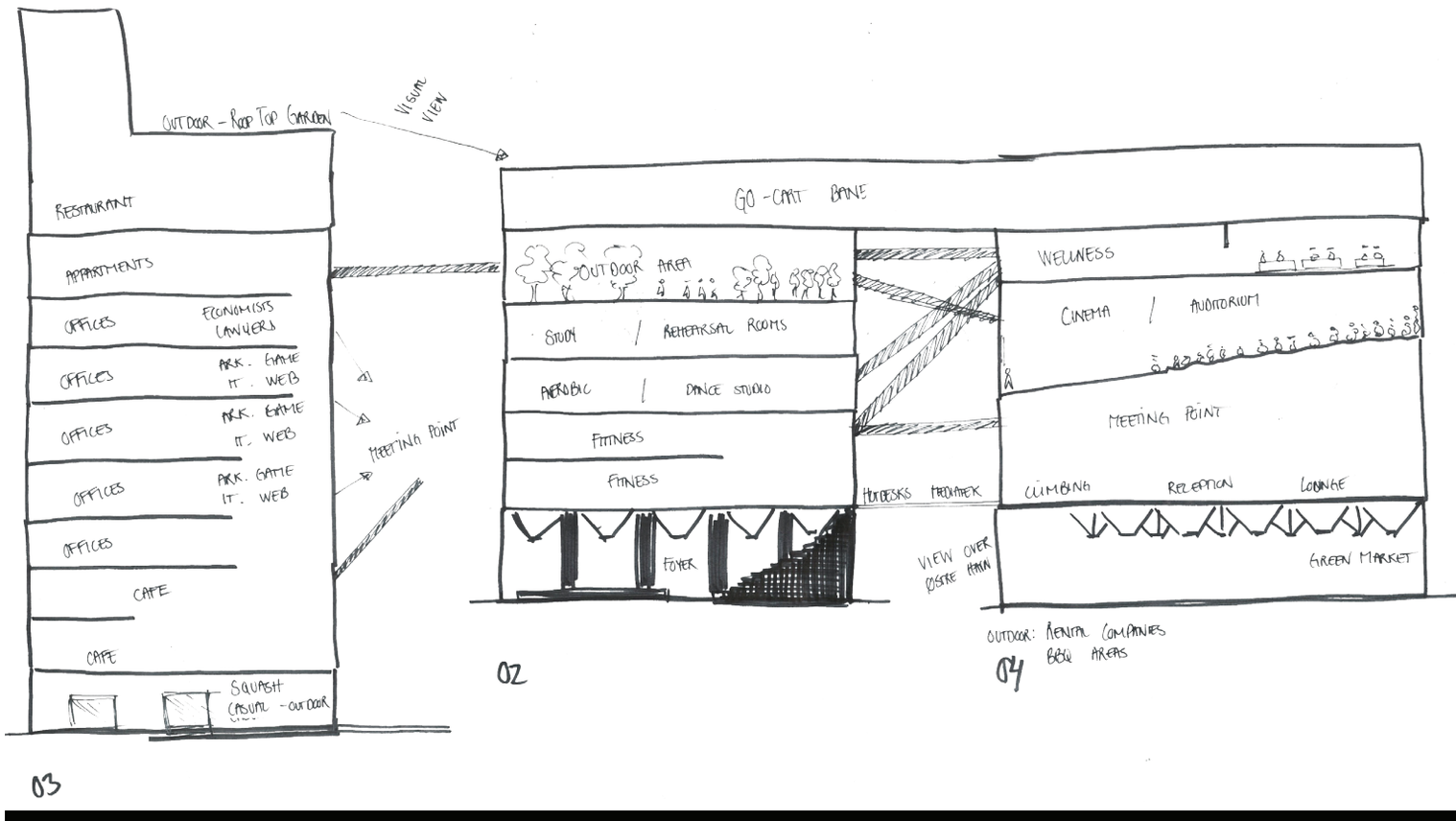
The distribution of the functions are investigated in relation to the orientation of the buildings, the optimal connection and the requirement to room height and area of the different functions [see cd, pdf; space requirements].

Here it is the wish to create an environment with great diversity in the functions and where the functions are spread across the complex to create an optimal flow between the functions.

The idea to utilise the existing silo walls of silo 04 for acoustical purposes became a driving parameter for placing the auditorium or cinema here.

Furthermore the tall silo 03, which has a great facade towards north is optimal for offices. Offices have a high internal gain why the orientation towards north will be beneficial in relation to the heat loss generated through a northern facade. Furthermore the existing layout and area of this building is seen as favorable for the offices in this project.





ill. 12 Models illustrating different proposals of the function distribution

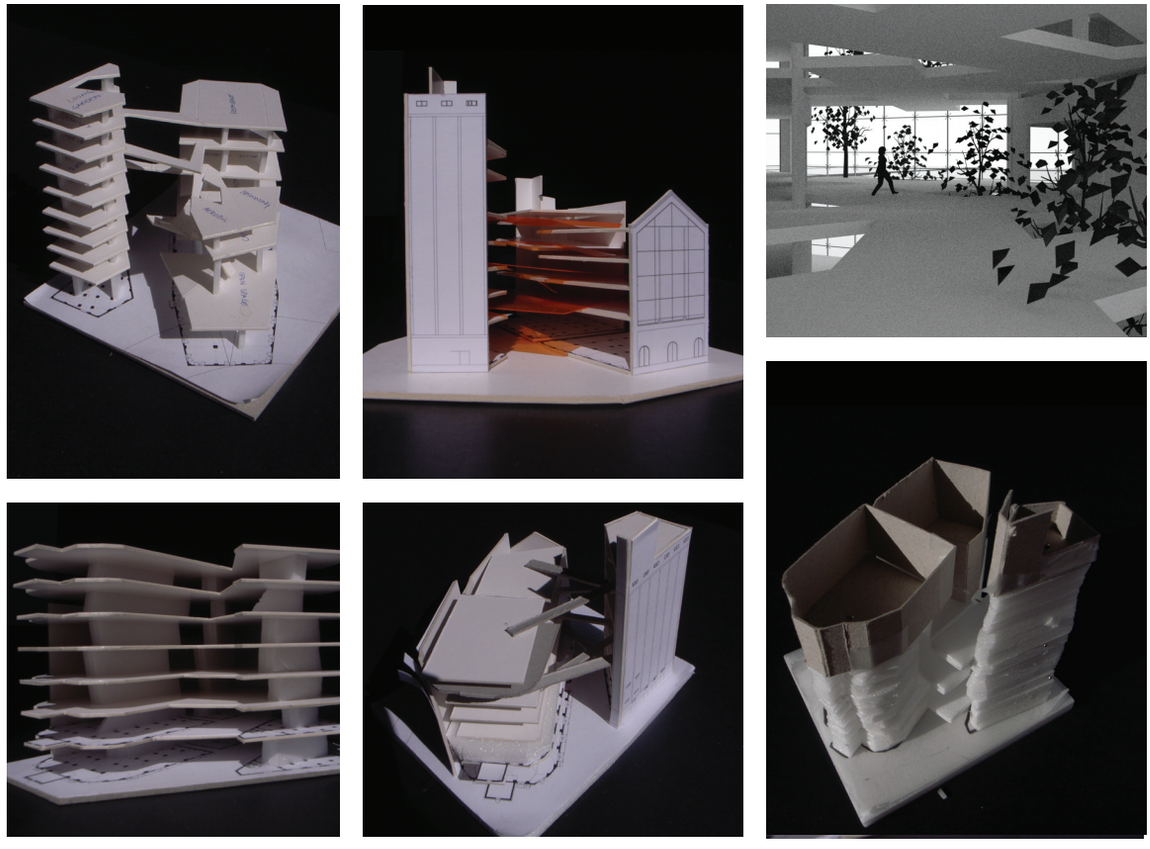
flow

Simultaneous with the investigations of the connection between the volumes, investigations were made in relation to the flow between the functions.

The movement in the complex is seen as an important parameter to create a vibrant and dynamic environment.

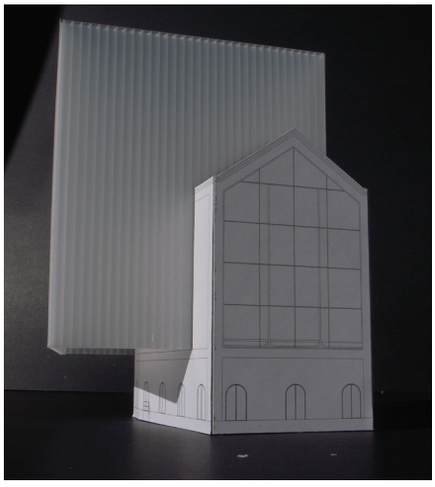
Casual meetings and circulation are not determined to one point in the building, but should be spread out creating various spots for different activities and breaks.

Furthermore it has been crucial to create a certain visibility up through the atrium, to ease the orientation and to see the life created by the different functions.



ill. 13 Proposals of the flow system

The flow between the buildings is here used to create both the connections but also the possibility to create common spaces where the regular users and the guests can meet. Furthermore there is a level of transparency between the levels in a vertical direction.

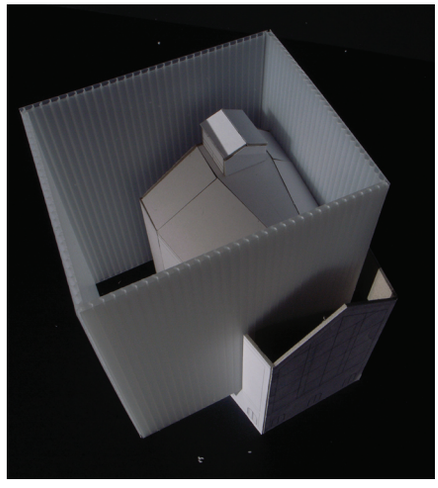


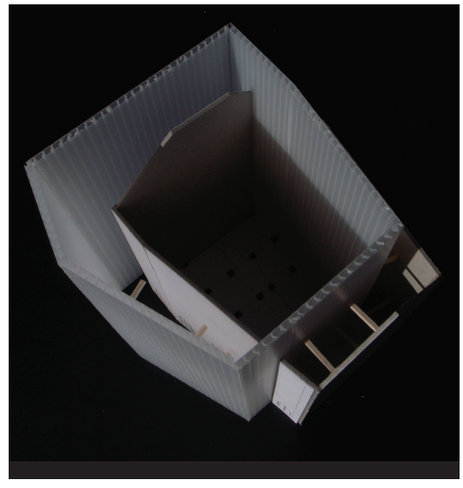
facade investigations

The initiating process also concerned the transformation of existing facades of the old silos. Here the challenge was to distinguish in the detailing between the remembrance of the old and the expression of the new. It has throughout the process been important to create a hierarchy where it is obvious which element dominate and determine the connection.

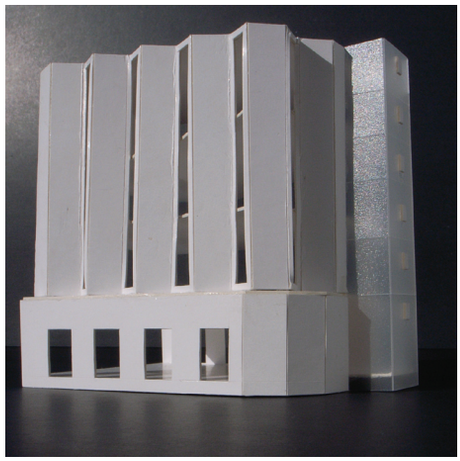
It has been essential to enhance the difference between new and old. This could for example be indicated by creating places where the users could see both the new elements and the existing elements. An example is illustrated here where existing walls of silo 02 is transformed to become an exhibition or installation in the new.

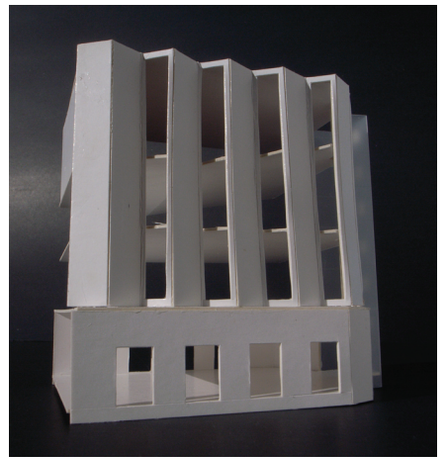
Furthermore sustainable principles have been investigated in relation to the optimisation of the walls to meet the Danish Building regulation and still create a clear separation of new and old material.





ill. 14 Model proposals illustrating the differentiation between old and new. This example convert the existing walls to represent a remembrance of the old.

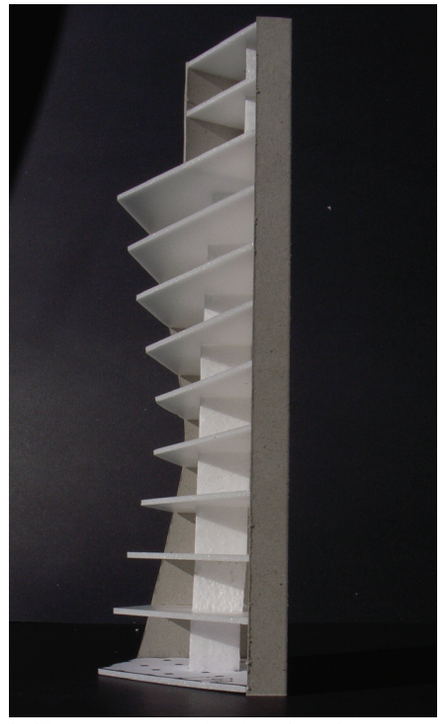




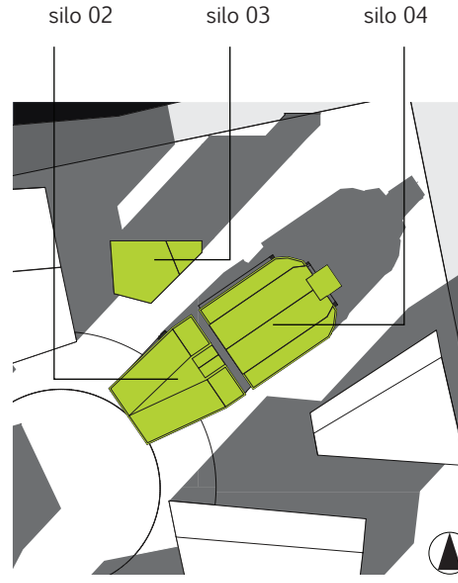
ill. 15 Facade principle for silo 04 where the windows are orientated towards south

ill. 16 Facade principle for silo 02 where a glass panel has been introduced on the exterior side of the window to create a tromb wall.

ill. 17 Facade principle for silo 03. Here the facade towards north is converted to a sunspace creating the opportunities to open the facade more due to the passive solar transmission of the sunspace.



ill. 18 Here a treatment of the floors in relation to the sun orientation is illustrated.



window area

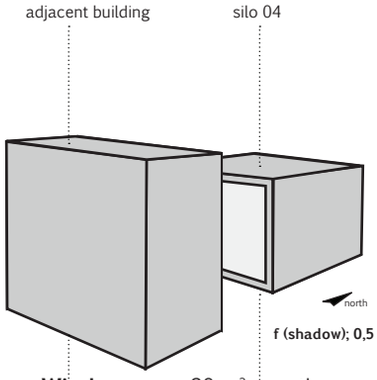
The implementation of windows is further investigated through 24 hour average, which develops an understanding of the temperatures within the rooms and monthly average, which creates a preliminary insight in the energy consumption. These investigations give an indication of how much window area is possible due to heat gains- and losses.

The master plan of shl architects illustrates a tall building located to the south of silo 04. This means a reduction in the solar gains through the south located windows why different arrangement of the windows have been investigated [see appendix, 24H + Month average for further knowledge about the iterations].

These studies illustrate that an eastern facade can provide as much solar gain as the southern facade with the current situation of a shading building to the south.

Silo 03 has also been investigated in these spreadsheets. Here the amount of windows in the northern facade has been determinant to create a great view towards the fiord from the working places in the offices. The investigation looks upon one office unit [see appendix].

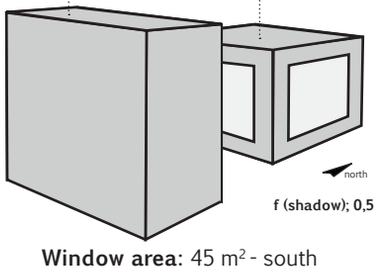
silo 04



Window area: 90 m² - south
20 m² - north

24-hour average;
Average temperatures: 23,6 ˚C
Temp variation: 6,5 ˚C
Max. temperature: 26,9 ˚C

Month average; [kWh/m² year]
Energy consump. for heating: 18,10

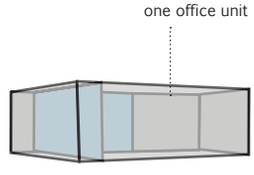


Window area: 45 m² - south
45 m² - east
20 m² - north

24-hour average;
Average temperatures: 23,9 ˚C
Temp variation: 7,0 ˚C

Month average; [kWh/m² year]
Energy consump. for heating: 18,60

silo 03



U-values;
north/west: 0,65 W/m² K
south/east: 0,2 W/m² K
floor/ceiling: 0,2 W/m²K
Windows: 1,1 W/m²K

Window areas;
south: (4 x (2,4 m x 3,6 m)) 31 m² **
east: 0 m²

** wider window bands; 1,6 m --> 2,4 m

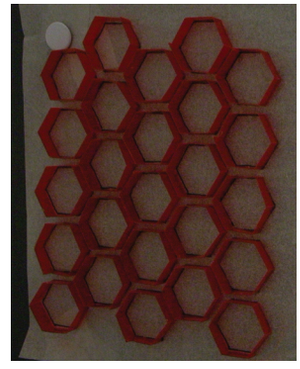
24-hour average;
Average temperatures: 22,8 ˚C
Temp variation: 3,5 ˚C
Max. temperature: 24,5 ˚C

Month average; [kWh/m² year]
Energy consump. for heating: 27,7

detail investigations

01



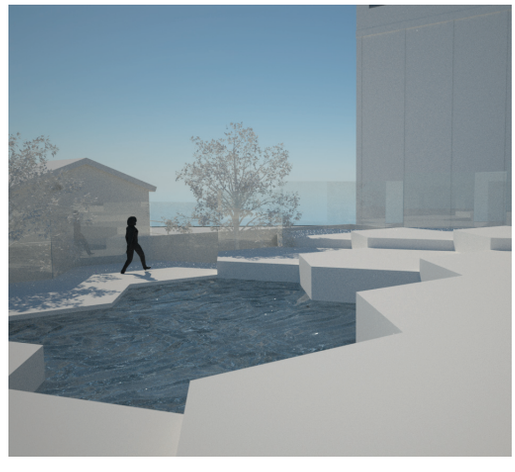
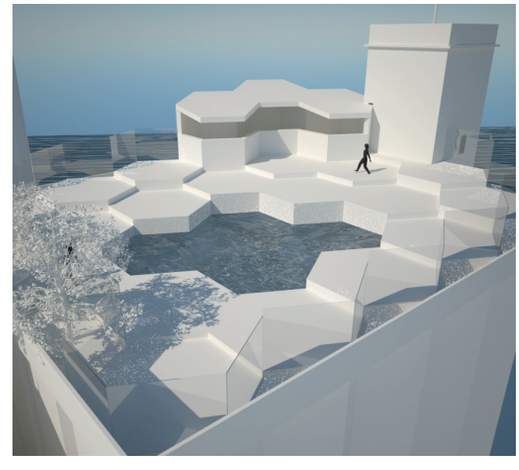


Here different proposals for how to reuse the existing characteristics in a new way are explored.

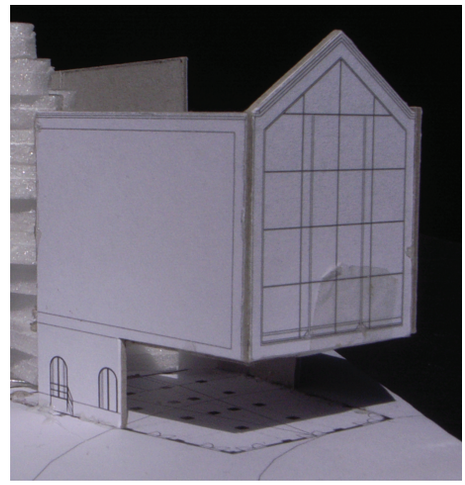
01
The hexagonal shape of silo 04 is very characteristic and can create different arrangement both regarding floor and ceiling. The ceiling and walls could be used for acoustic reasons in for example an auditorium where the sound destribution is essential.

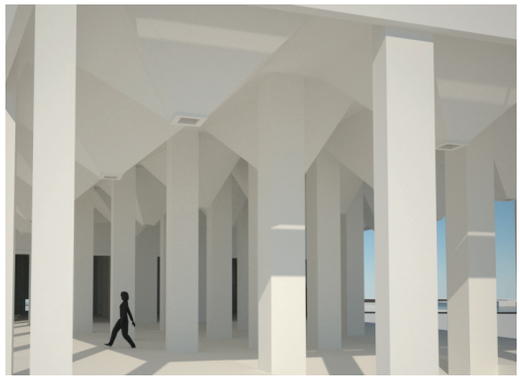
02
The shape could also be used as furnitures and create different plauteaus or pools for new functions.

02

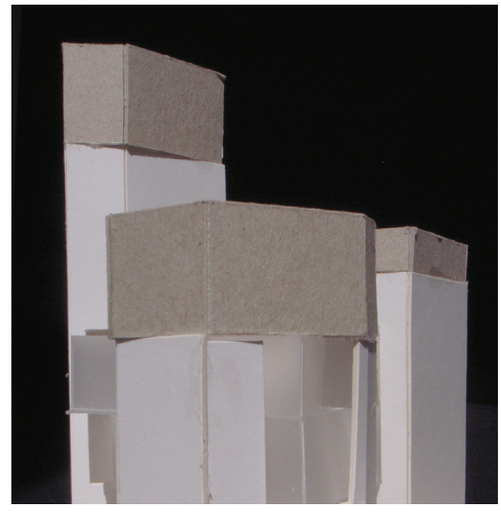



03

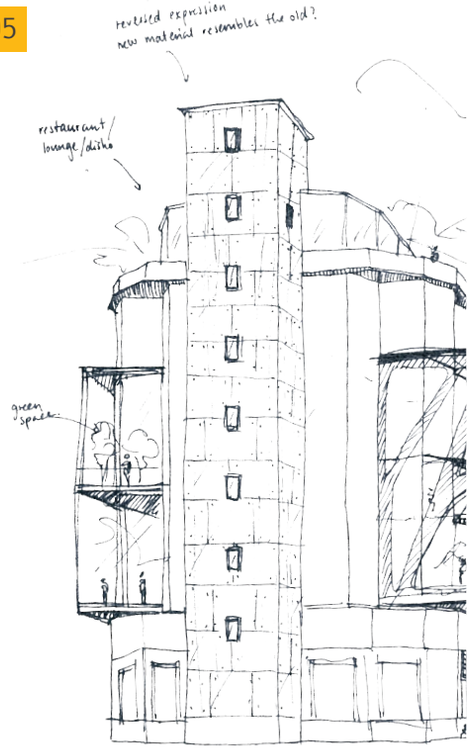




04



05



03
The old silo tabs at the groundlevel create a significant expression, which is the wish to maintain and display. Different solutions on how to create an open structure at the groundlevel have been investigated.

04
The height difference of the buildings could be eliminated by a new structure.

05
A new material resemble the existing structure.

ill. 19 Conceptual sketch for the atrium

concept

It is the aim of the project to transform the existing silos into new leases with great respect to the expression of the different buildings. The three buildings have, as a result of construction year and function, different footprints and expressions in the facades, which have been of big importance to maintain. At the same time the silos are to be connected to become one unit both in terms of internal flow and external expression of the architecture.

To solve this paradox a new building component is implemented in the design of the complex - a meeting place that connects all three buildings and creates a close connection between the different functions. Visibility and flow to and between the different spatialities are the most important elements in the design of the new unit to ensure a natural and more unpredictable flow of people, where occupants with different circadian rhythms meet and interact in different setups.

The new unit is not only seen as distributor of flow, different informal meeting places are incorporated to generate a life between the functions.

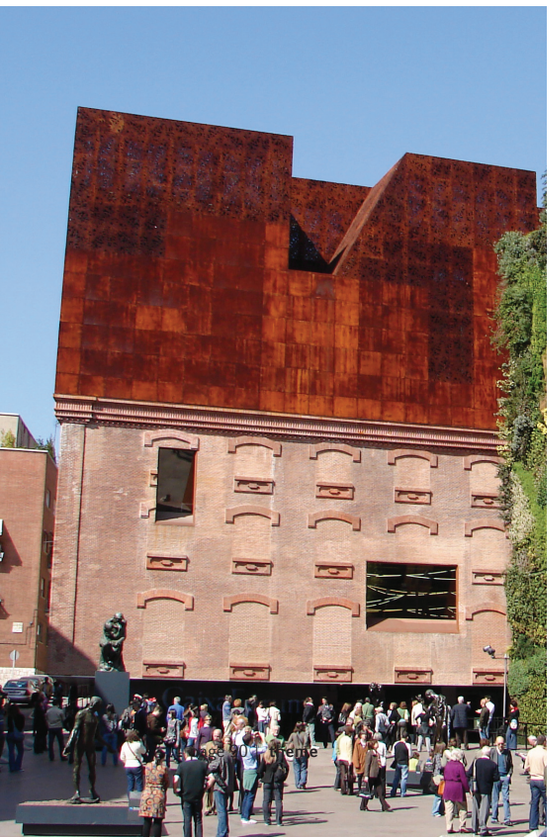
MATADEO MADRID

Madrid's Old Slaughterhouse -'Matadero Madrid'- is transformed into a new centre for contemporary creation. Here the old expression is maintained and kept in the same style as when the house functioned as a slaughterhouse.
In the detailing the old elements are the dominant factor.

RAPHAEL MONEO, PRADO MUSEUM, MADRID

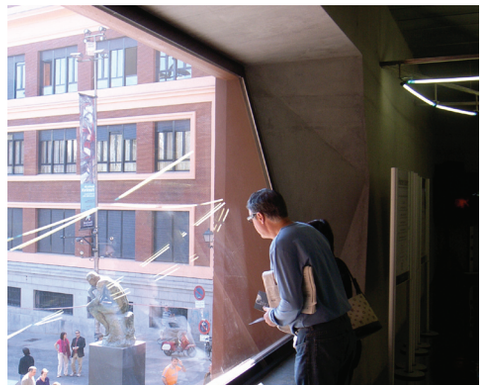
The Prado Museum was recently renovated by Raphael Moneo. In the contemporary section the existing walls are transformed to become the exhibition with only few items displayed.

In relation to the detailing the interesting point is how the walls have been optimised where a distance have been created between the old and new elements to create a clear separation.



HERZOG & DE MEURON, CAIXA FORUM, MADRID

This structure is a conversion of a former power station, which today contain a cultural center. The crucial point in this project is the entrance and the way the new elements are placed without consideration to the old remarks.
However the interior is totally transformed without old remembrances. Only through the windows the old structure become visual.



CARLO SCARPA, CASTELVECCIO MUSEUM, VERONA

The treatment of the hierarchy and contrast between new and old in Carlo Scarpas restoration of castelveccio has inspired the process. Here reigned a clear separation and definition of the existing components and the additional elements.

expression of the existing

Diversity is a key element in the transformation of the buildings to meet the expectations of the 'Creative Class'. The development of a continuous experience through the complex is important to the design. This develops a concept of creating a journey where the hierarchy and tension between new and old is exhibited and detailed in different ways. Hereby creating principles for the way of preserving the existing and revitalise the new elements.

Silo 02

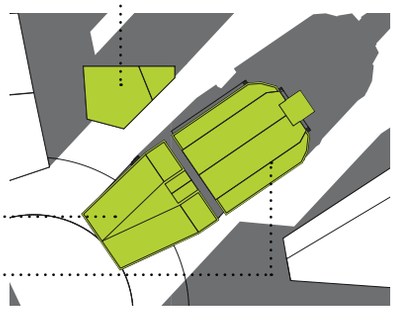
The transformation of this building takes its inspiration in Matadeo Madrid, where the old elements are the dominating factor and kept rough and unchanged.

Silo 04

This building is interesting with its characteristic hexagonal shape which is the wish to utilise and accentuate in the transformation why the upgrade of walls and implementation of windows are inspired by the Prado Museum by Rafael Moneo, where old elements are maintained and exhibited in the spaces. Furthermore the way Caixa Forum, by Herzog & De Meuron, exhibits the layers of the wall construction at the windows are seen as a inspiration to optimise the existing walls. The detail level how the new and old elements are meeting takes its inspiration of the way Carlo Scarpa works. In this building the hierarchy between new and old are mixed.

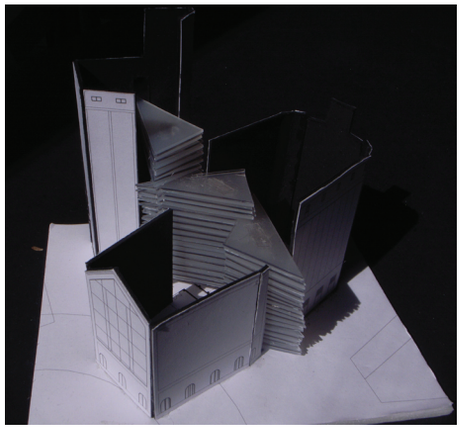
Silo 03

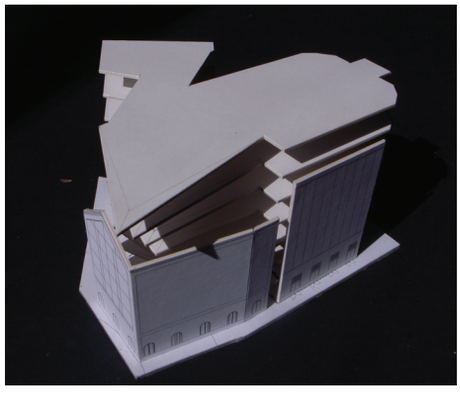
This building contains offices where the interior is seen as new elements. Here the new overtake and the existing facade will be seen from the exterior. In the interior the modern sphere will be dominating where only few elements from the past will be kept.



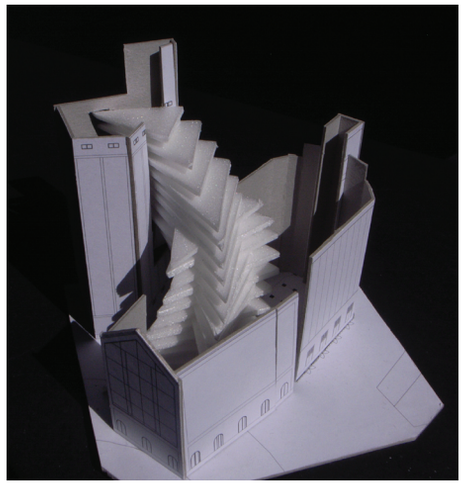
ARCHITECTURAL DEVELOPMENT

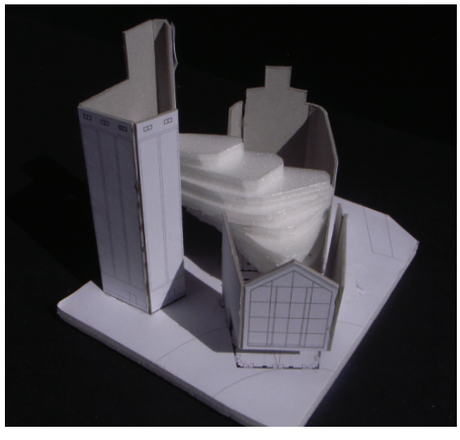
THE ATRIUM

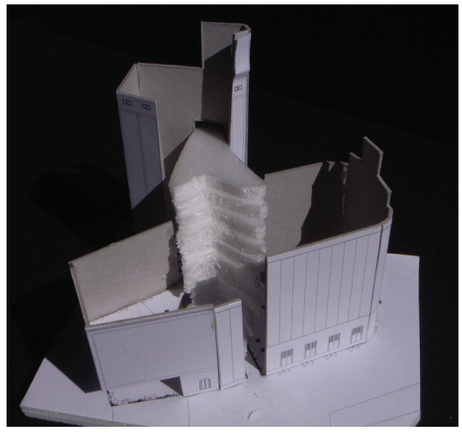




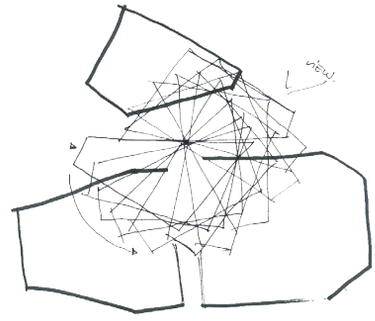
01 Different orientation and expressional direction of the atrium was investigated through models. The level of attachment to the old was evaluated, where a fine balance regarding the hierachy between new and old became the determinant force.



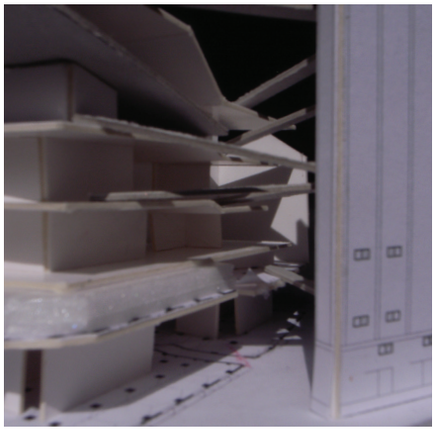


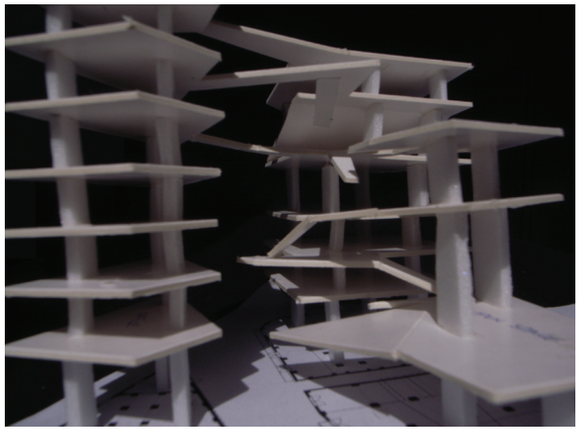


02 The expression was investigated according to the flow between the buildings where a close connection between silo 02 and 04 was essential to create at the bottom due to the function distribution. Whereas the connection to the tall silo 03 was first crucial at a higher level creating privacy to the offices.

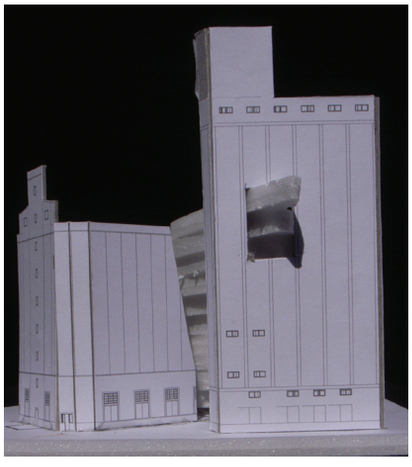


03 This twist created the connections into the buildings and the shape of the atrium where a simple shape being twisted gave the atrium a dynamic and more complex expression.

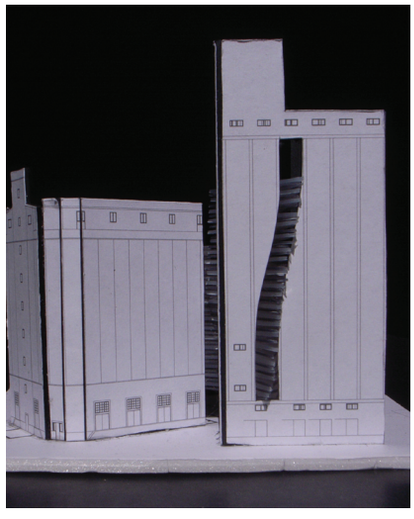




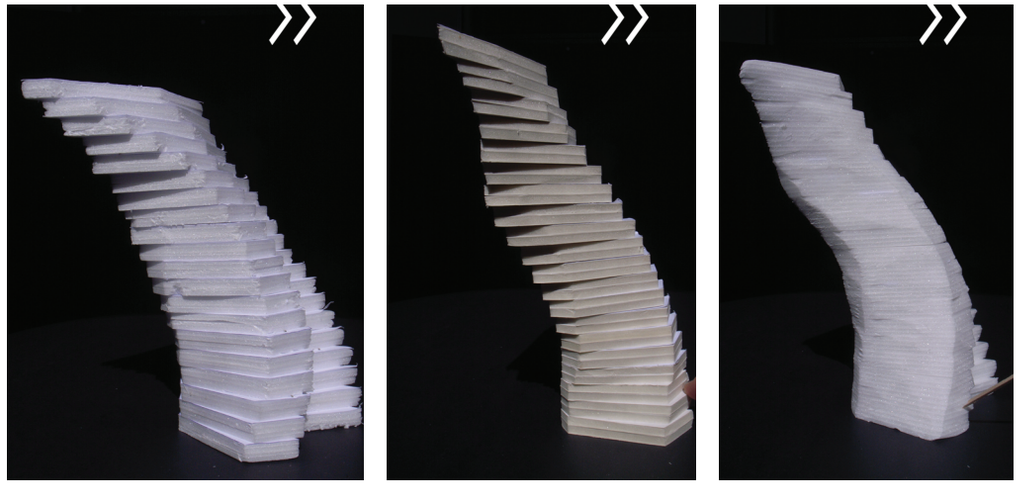
04 The shape has additionally been optimised in relation to the flow distribution between the buildings and functions

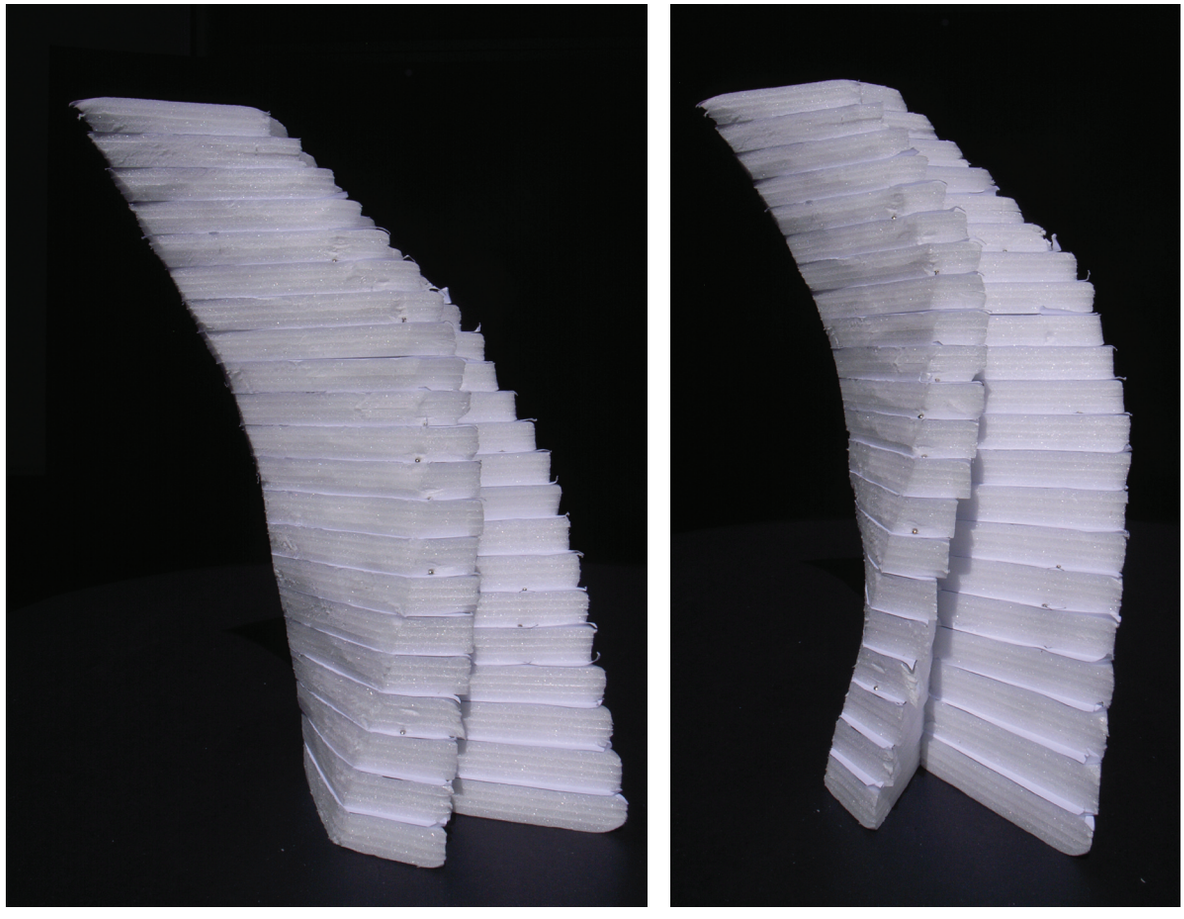


05 The atrium becomes visual towards the harbour creating a teaser and an indication of the transformation according to the view from the fiord and the city of Aalborg.



» FURTHER INVESTIGATIONS OF THE SHAPE ISOLATED FROM THE BUILDINGS TO ENSURE A GREAT COHERENT EXPRESSION

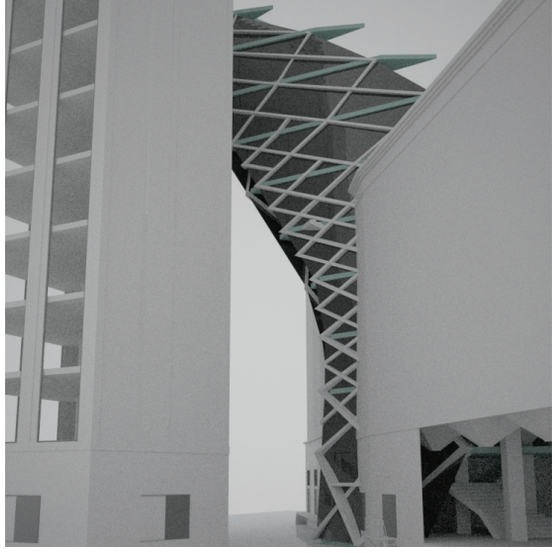


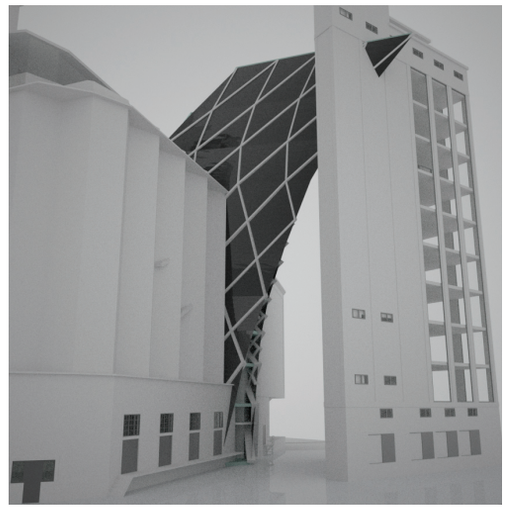


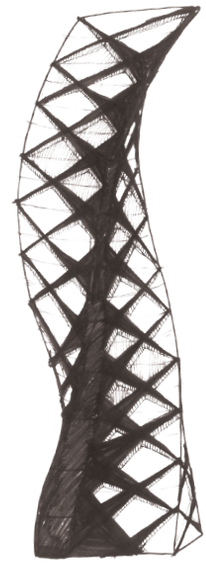
DEVELOPMENT OF THE ATRIUM

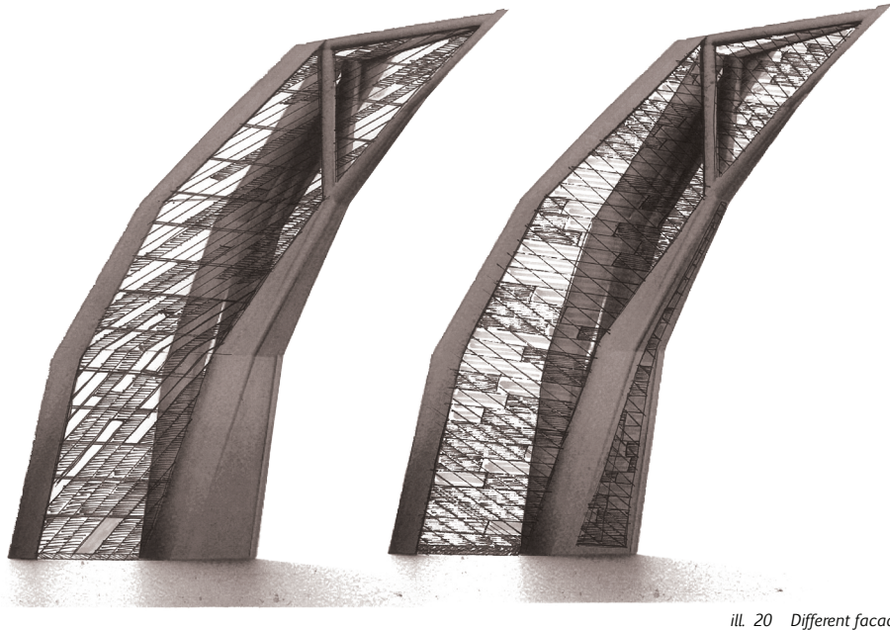
To create a coherent shape of the atrium, both in relation to its own architectural expression and the coherency with the existing buildings, a lot of iterations have been done both in 3D applications and physical models, where the dynamic, architectural expression and inner flow have been crucial form parameters for the final design of the atrium.

The introduction of the twist in the design made it possible to open up the different buildings at different levels which could provide some of the functions with a certain amount of privacy. The twist in the facades was investigated in several models to ensure a clear understanding of the shape and the twist.







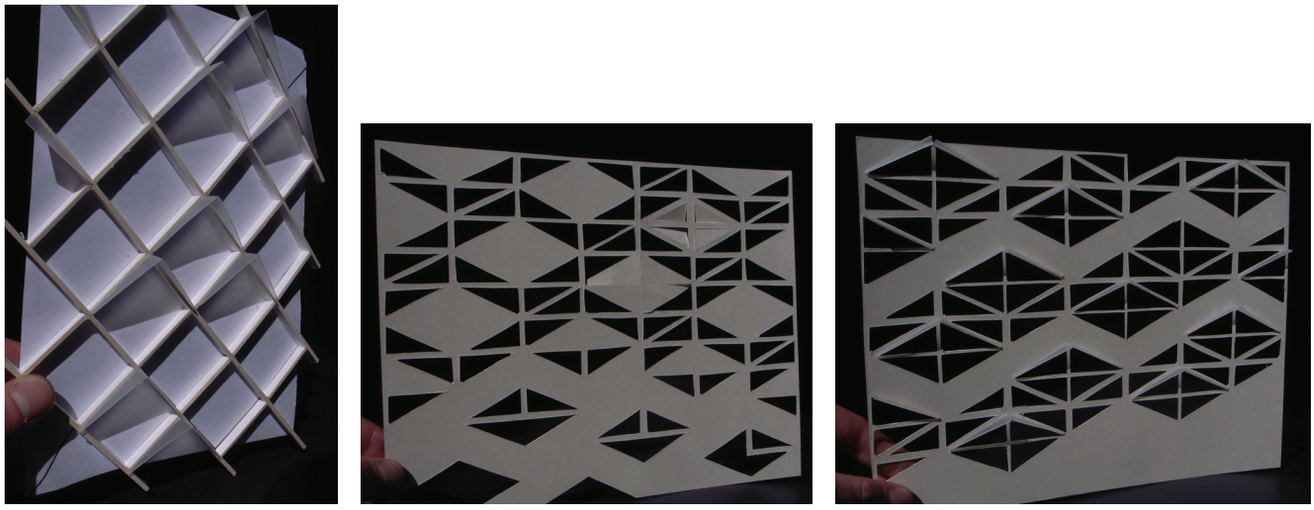


ill. 20 Different facade investigations

FACADE INVESTIGATIONS

The parameters for the facade proposals have been to accentuate the characteristic of the shape and create a visual bearing structure where the loads transformed through the system will be read in the facade. This combined with a structure flexible enough to incorporate areas according to the functions adjoined to the atrium.

ill. 21 Conceptual plan drawing where the structural supports are enhanced



ill. 22 Proposals for the facade structure where awnings and shading devices have been incorporaterd

An important factor when dealing with an atrium is the comfort level and temperatures inside. Due to the high volume and often open facade there is a high risk of overheating. The average temperature in relation to different facade graduations have been investigated through 24 hour average to gather information about the allowed window areas and the needed shading to avoid high maximum temperatures and a high temperature variation.

The atrium will act as flow distribution why stairs and slabs to connect the functions are introduced. [see appendix, 24H+Month average for further details].

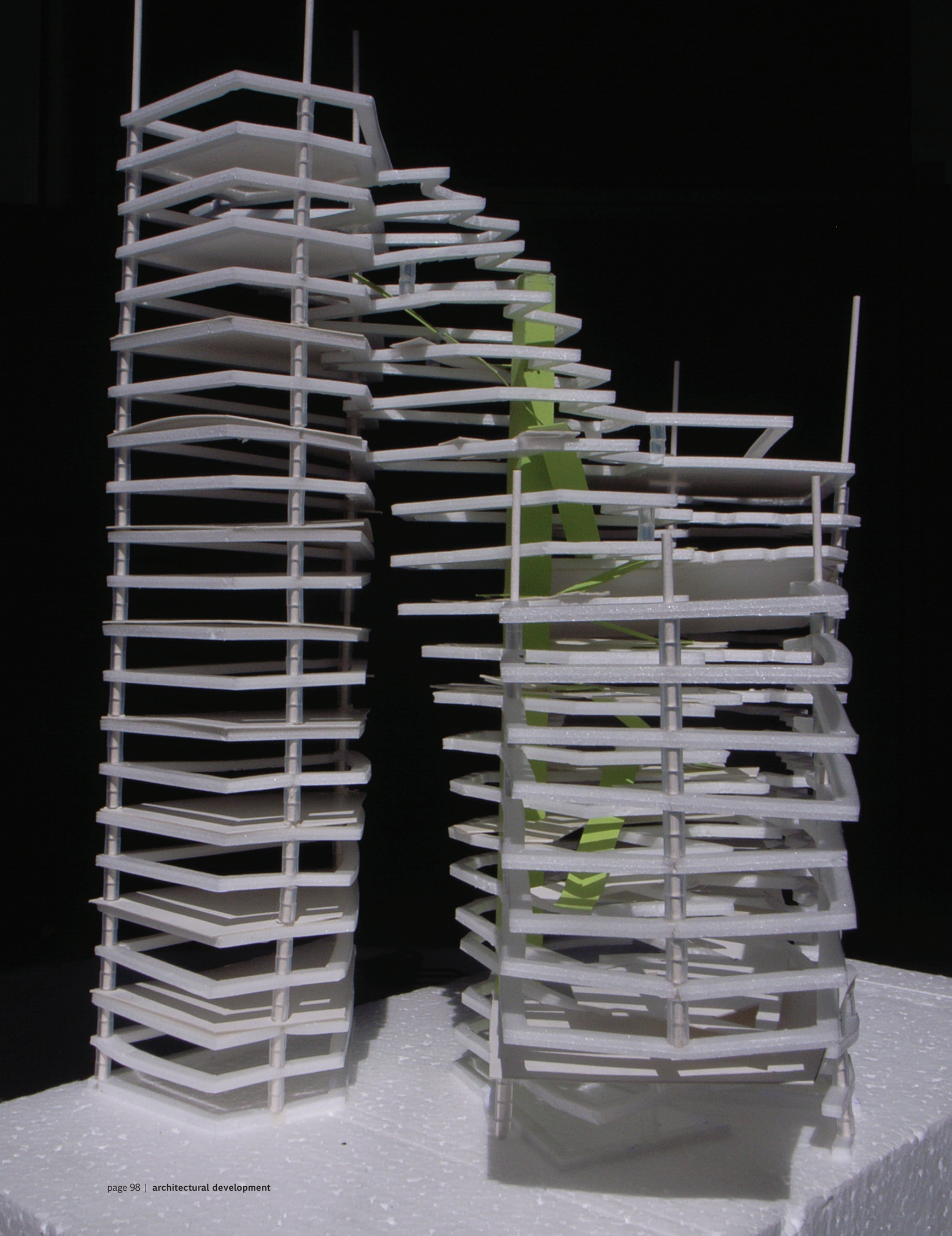
The amount of windows and wall elements creating a satisfying comfort level.

	wall	windows
south	288 m^2	192 m^2
north	410,88 m^2	69,12 m^2
west	435,6 m^2	244,75 m^2
east	489,6 m^2	190,4 m^2
ceiling	171,36 m^2	32,64 m^2

These inputs have been transferred to the monthly average spreadsheet for investigation on the energy consumption.

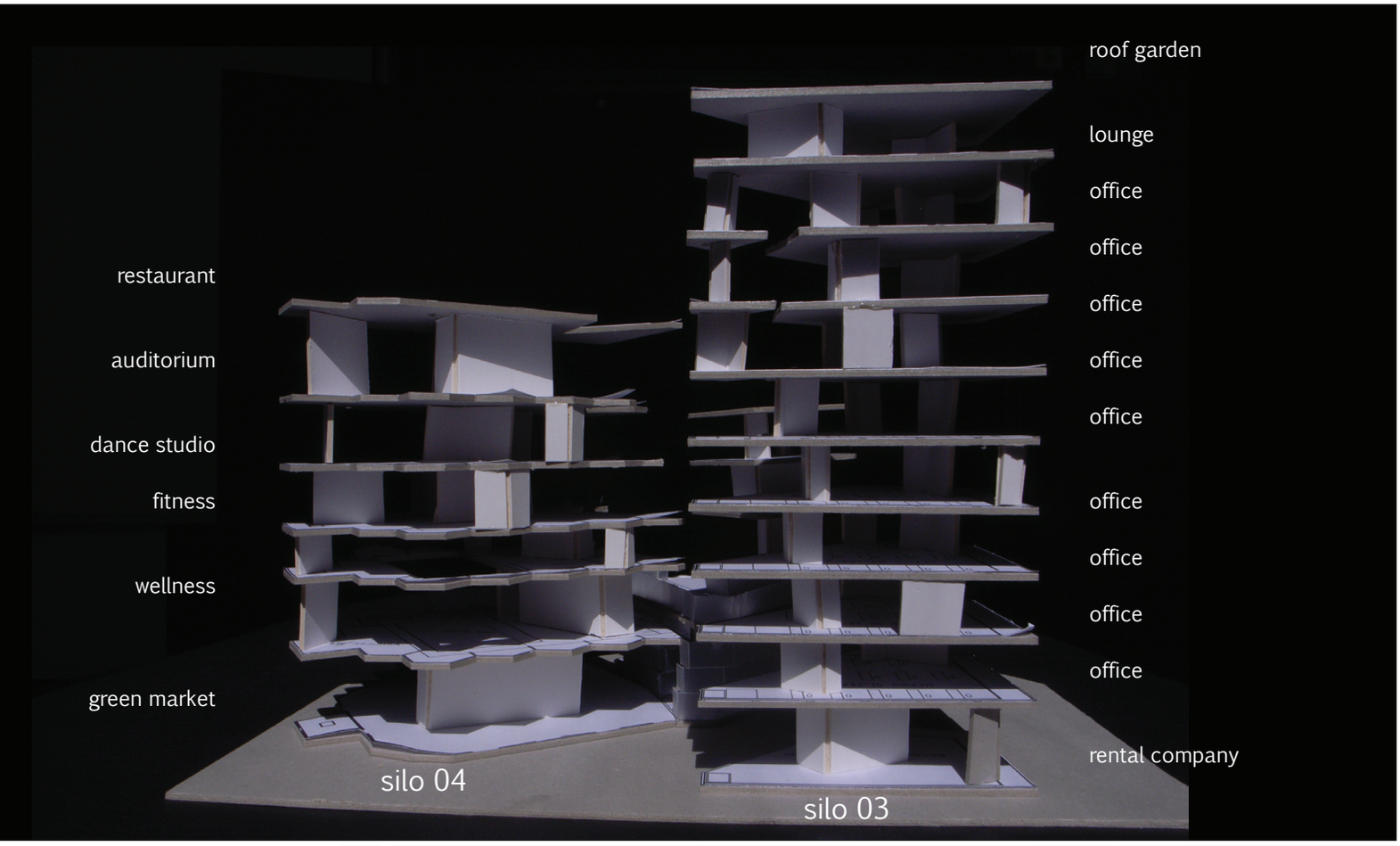
24h - July
Average : 22,7
Variation : 8,2
Max temp. : 26,8

Month average
Heating : 22,2 kWh/m^2 pr year
Cooling : 7,9 kWh/m^2 pr year



transformation of the existing buildings

In the following paragraph the transformation of the existing buildings will be displayed. The aim has been to investigate the posibilities and opportunities that the existing shapes provide. Over the process different principles and guidelines have been generated to ensure a coherence and yet varying expression through the complex.



The overall distribution of functions has been through a range of iterations regarding the flow and the area provided in the existing buildings. The idea of creating a continuous and dynamic flow in the complex has been leading according to the layout of the functions.

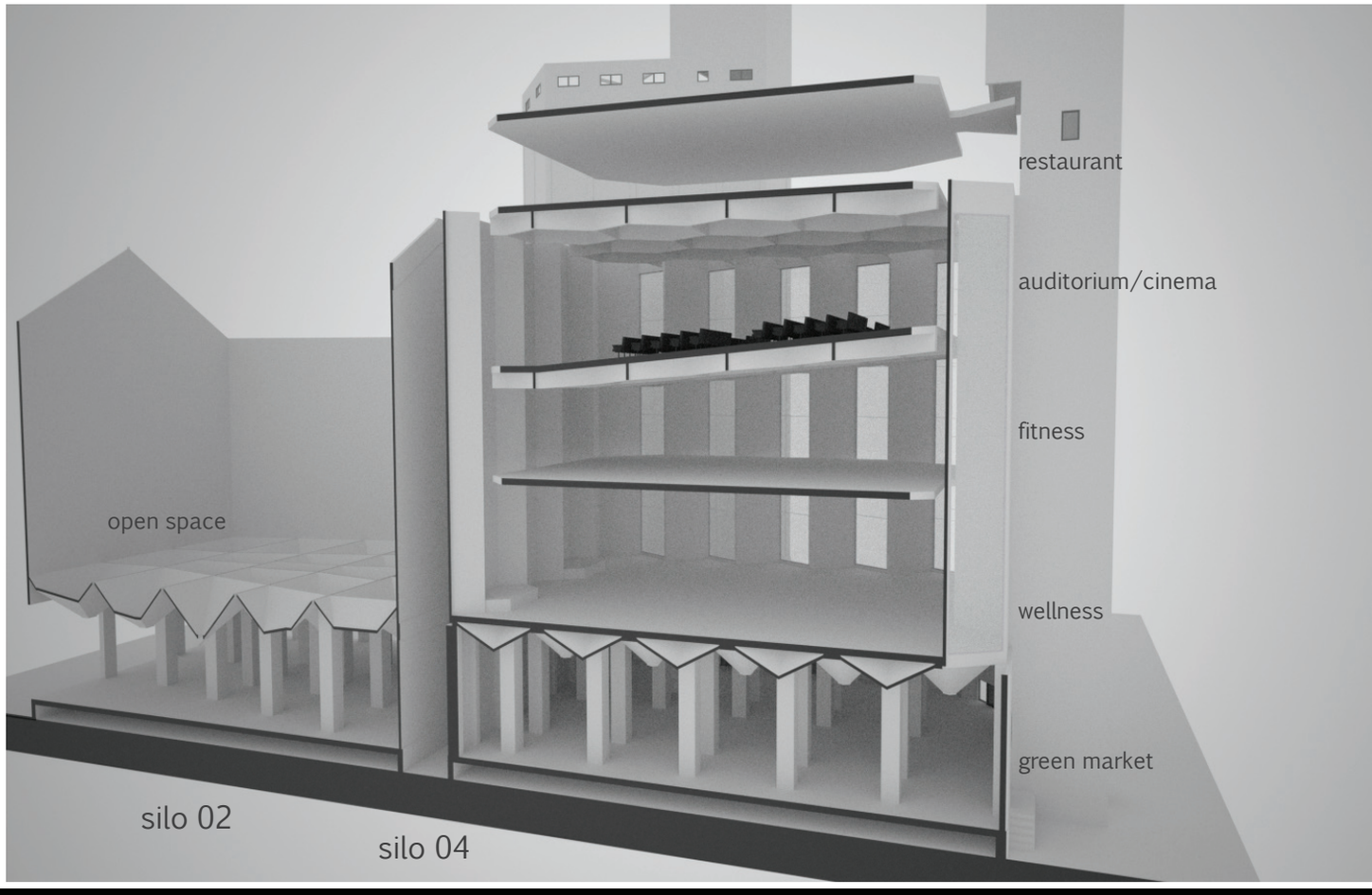
Here different flow diagrams have been developed to create an understanding of the movement and relationship between the functions and their users.

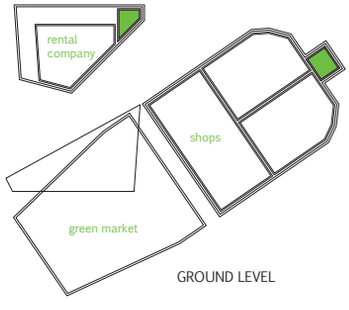
The layout reflects these investigations and supports the desired experience of the spaces according to the conceptual idea (described at page 55).

Silo 02 is transformed to a very open and public space with a constellation of free activities. The space is seen as an experience area, which also connects to the inspiration of Matadeo Madrid.

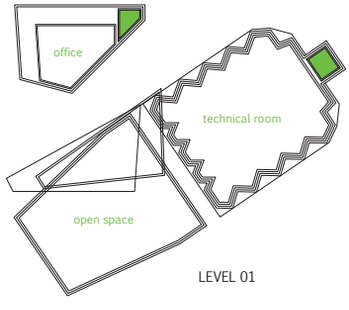
In Silo 04 it was significant to utilise the existing shape in relation to the functions, why an auditorium and wellness early in the project were appointed to this building, where an auditorium can benefit acoustic from the concave and convex facade and furthermore the hexagonal shapes serve as small spa or pool areas. Fitness and aerobic were also reasonable to locate here in relation to the size of the building to the recommended space for these activities and with connection to the wellness facilities.

Silo 03 contains mainly office facilities however workshops, lounge and a rooftop garden is located at the top to utilise the great view towards the fiord. The offices have been divided by a dance studio, which generate dynamic to the building. Additionally the offices located at the bottom floors are seen as more established companies where the top floors are seen as a more dynamic environment with up-coming companies that benefits from the great coherence between the floors at the top and the close relationship to the whole complex.





GROUND LEVEL

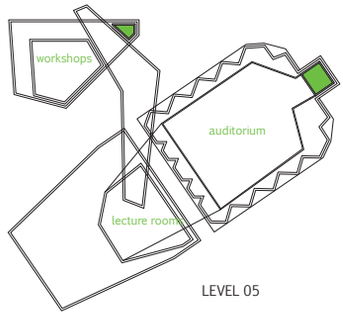


LEVEL 01

LEVEL 02

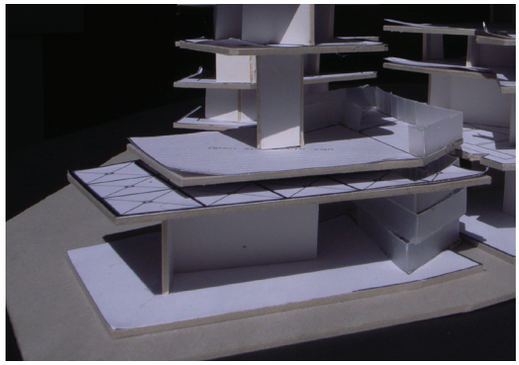
LEVEL 03

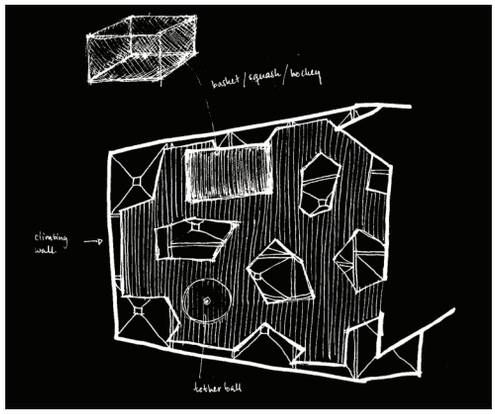
LEVEL 04



LEVEL 05

ill. 23 Different proposals for the function distribution





ill. 24 Ground floor and enclosed outdoor space

transformation of silo 02

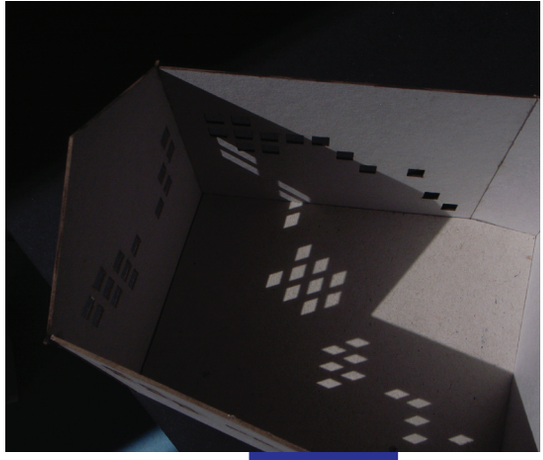
Silo 02 is categorised as the exhibition silo where the industrial features are kept as to day. It has been important to create an environment with the atmosphere significant for the industrial area. The rough expression has been preserved and kept as the dominating factor for the transformation strategy.

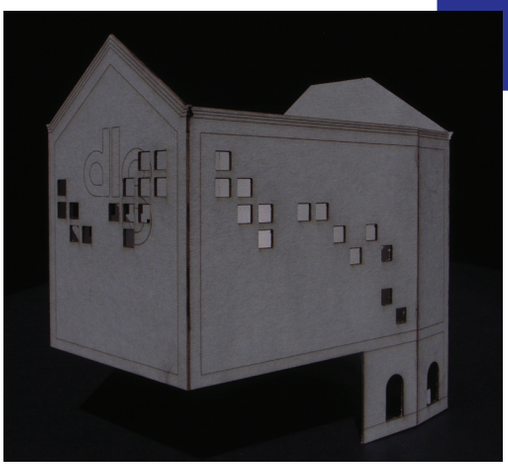
This concept leads to an enclosed outdoor space, where the existing walls define the space. Furthermore the introduction of a new slab above the silo tabs creates views both into and through the tabs towards the ground level.

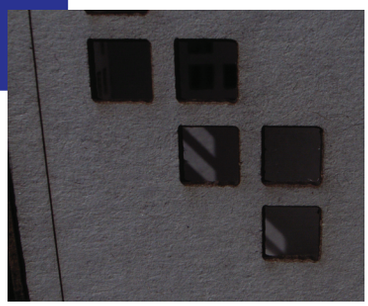
The atrium defines a facade which creates tension between the new and old.

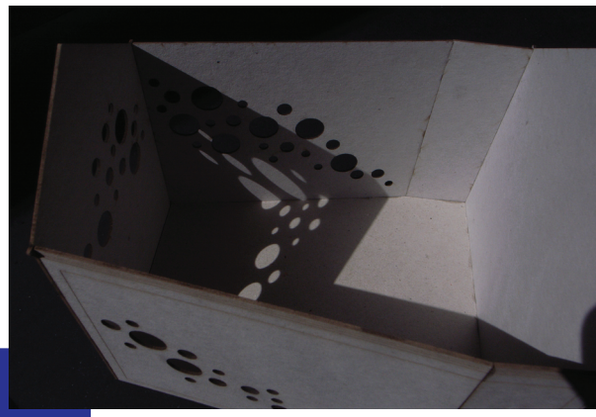
Facade investigations
It has been essential to maintain the characteristic surface of the existing facade only creating few holes in the wall introduced according to the view and light distribution in the enclosed outdoor space.

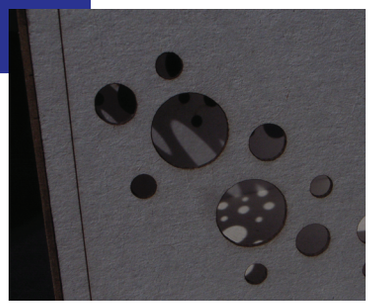
During the design process the possibility of having an open ground level occurred when considering the flow from the public square located just West of Silo 02. This entails a large cantilever. The cantilever has been investigated in STAAD Pro to determine the dimension required for structural stability. Due to the industrial inspiration cranes and large steel construction have influenced the perspective of strategy and structural system [see appendix, STAAD Pro for iterations].

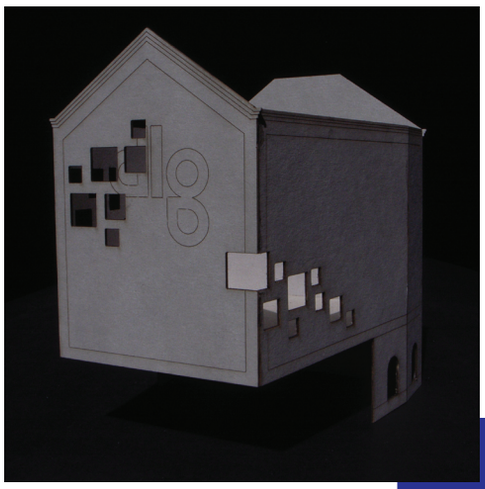


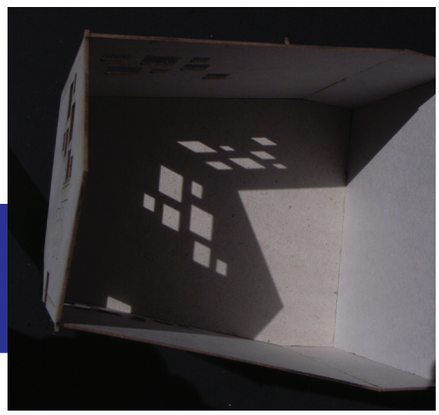


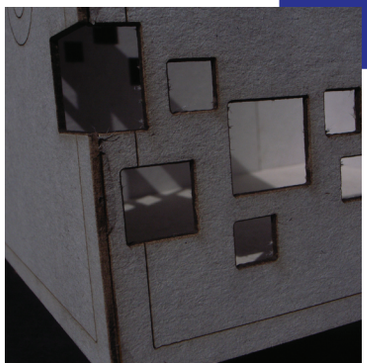




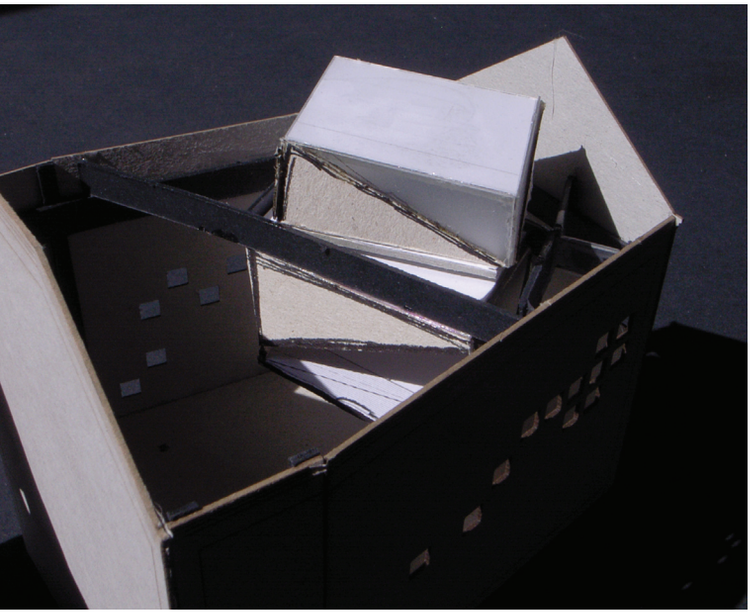




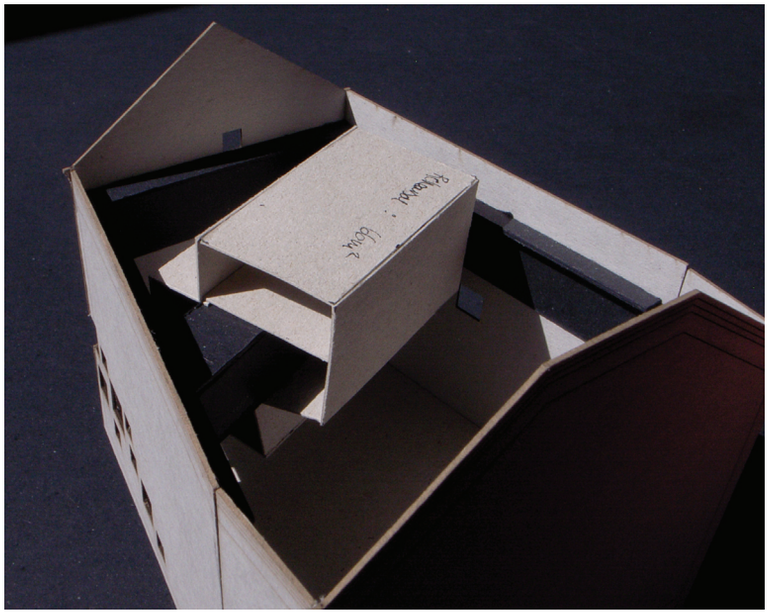




ill. 25 Facade investigations

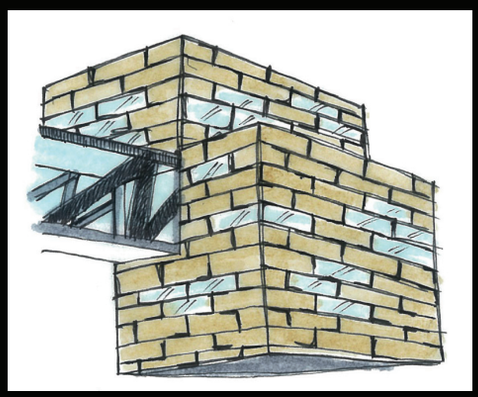


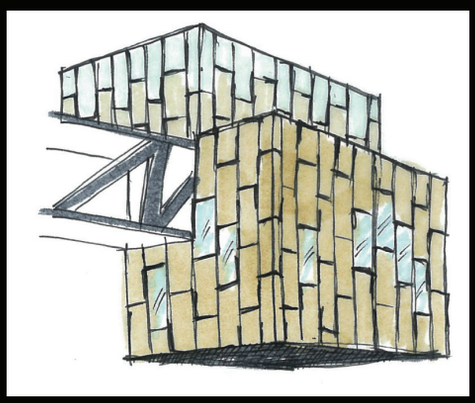
The café and rehearsal room are surrounded by the structural components and attached to the structure. However the amount of space required and the view from the open space is being reduced.

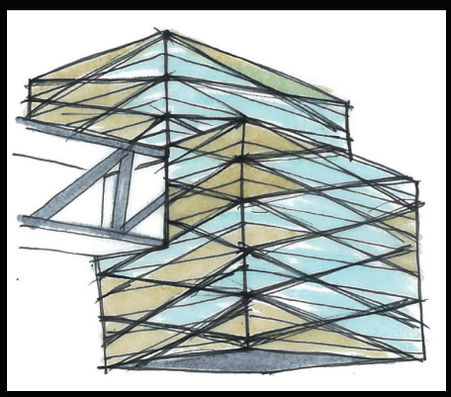


Instead the structural system runs through the volume creating a path through the building which continues to silo 03. This path is constructed from industrial girders creating an explication of the characteristic existing footbridges. The structural component is then utilised in the interior arrangement.

Inspiration for the facade design where the plates are angled creating a three dimensional effect.







Different facade solustions that emphasises the sharp shape with a three dimensional play.

transformation of silo 02

Additionally a café and rehearsal room have been introduced as a new element hanging above the enclosed outdoor space. This has been developed in accordance with the raw surroundings, where the profile used to sustain the stability of the existing facades has inspired the design of the café and rehearsal room.

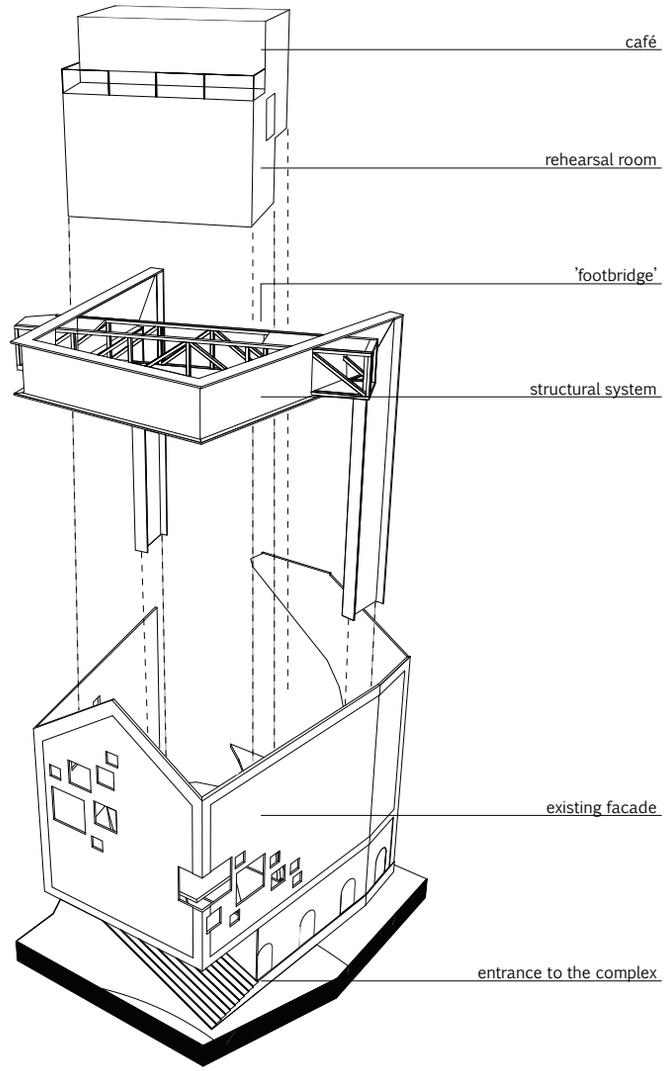
Different proposals have been created with different approach on how to incorporate and adapt the structural system to the café.

It was important to create an adjusted balance between the open space and the component, where the urban life of the open space is not limited by the introduction of the café and rehearsal room.

The layout and expression of the facades have been investigated. It has been significant to generate an expression that follows the concept of silo 02 and at the same time indicates a new component.

BE06

Even though the complex is seen as one coherent building the energy investigations have been divided on each building section to ease the process.
Here BE06 calculations for the café are illustrated.



ill. 26 Diagram illustrating the organisation of silo 02

scenario 01		
energy frame	49,2 kWh/m^2 year	Complies with normal energy building class
transmission loss	5,1 W/m	Must be below 8 W/m2 for buildings above 3 stories

transformation of silo 04

The arrangement of the functions in silo 04 has been developed to create an interesting flow that applies the mode of the hexagonal shape. At ground level green market and minor shops have been introduced to generate life to the urban area. Then a wellness section is located across two floors with a changing room that supplies both wellness and fitness located above.

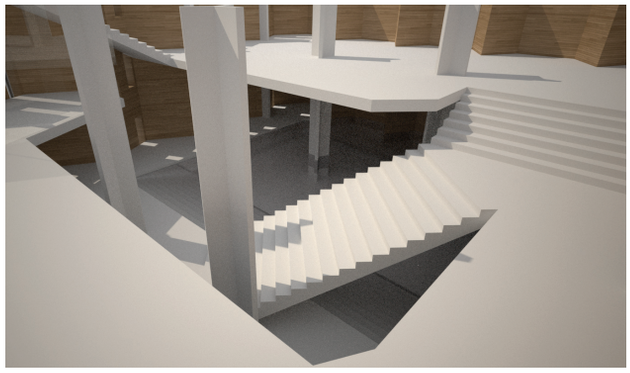
This creates demands according to the flow distribution where the reception area and access points to both activities have to be arranged sensible in relation to the movement pattern.
At the top of this silo an auditorium/cinema is designed with a sloping floor optimal for a great screen, and finally a restaurant has been introduced with view to the fiord and neighbouring area.

ill. 27 Section illustrating the distribution of functions

▷ entrance from the arium

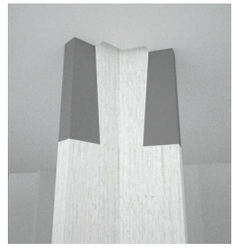
flow

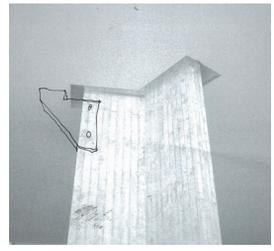
01



02

03





04

05

01 *The flow in the wellness section is created with a high degree of visibility between the zones.*

02 *Some of the existing silo walls have been preserved and implemented as the structural system for the slabs.*

03 *The detailing of the meeting between slab and column have been investigated.*

04 *The utilisation of the hexagonal shape is used as sound distributer and the hexagonal shape has been maintained in the ceiling adding an interesting surface where acoustic panels easily could be incorporated.*

05 *The importance of light to create the ambiance in relation to the function. Here for example diffuse light produce an harmonic atmosphere to the wellness.*

Acoustic investigations
The design of the auditorium has been investigated in relation to the sound distribution, where the reuse of the existing walls has been examined [see appendix, acoustic]. The spatiality is to be used both for speech and small music performances, as for cinema. The criteria's aimed for is primarily a good reverberation time, that can fulfil both speech and music, since a cinema can be controlled by adjusting the sound speakers.

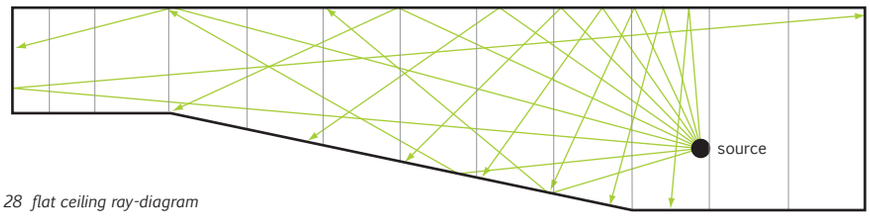
This has been investigated through ray-diagrams, direct- to reflected sound ratio and reverberation time in Ecotect. Essential sections are shown, however for detailed review see appendix, acoustic.

Ray-diagram iterations - vertical
▼ Different solutions have been tried out to investigate the effect of the ceiling according to the sound distribution inside the auditorium, as shown by these vertical sections.
A sloping ceiling or reflectors improve the sound distribution, making it possible to have reflected sound to the rear of the room.
Having reflected sound from several reflectors gives a better feeling of the room and the sound in general.

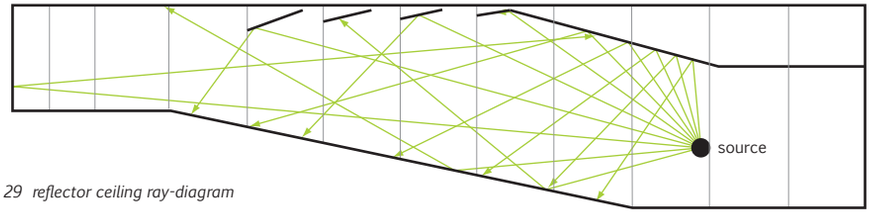
Ray-diagram iterations - horisontal ▶
The layout of the existing walls is examined for the same reason as for the ceiling. Here there is a problem with sound backfiring at the source position (blue lines), creating a situation with the risk of echo [ill. 118].

To adjust this, the angle of the walls have been changed to create a better distribution of the sound[ill. 119].

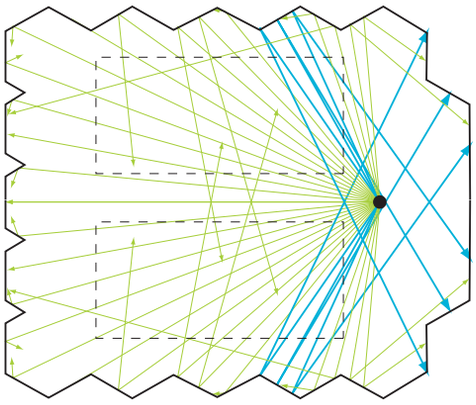
These acoustic investigations have effected the layout of the auditorium where the results have been implemented to the design creating an interesting spatiality that now performs in accordance to the parameters that an auditorium demands.



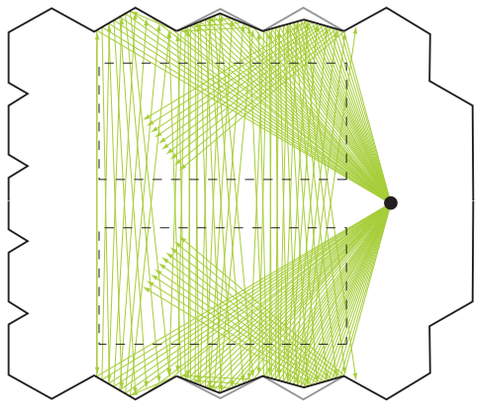
ill. 28 flat ceiling ray-diagram



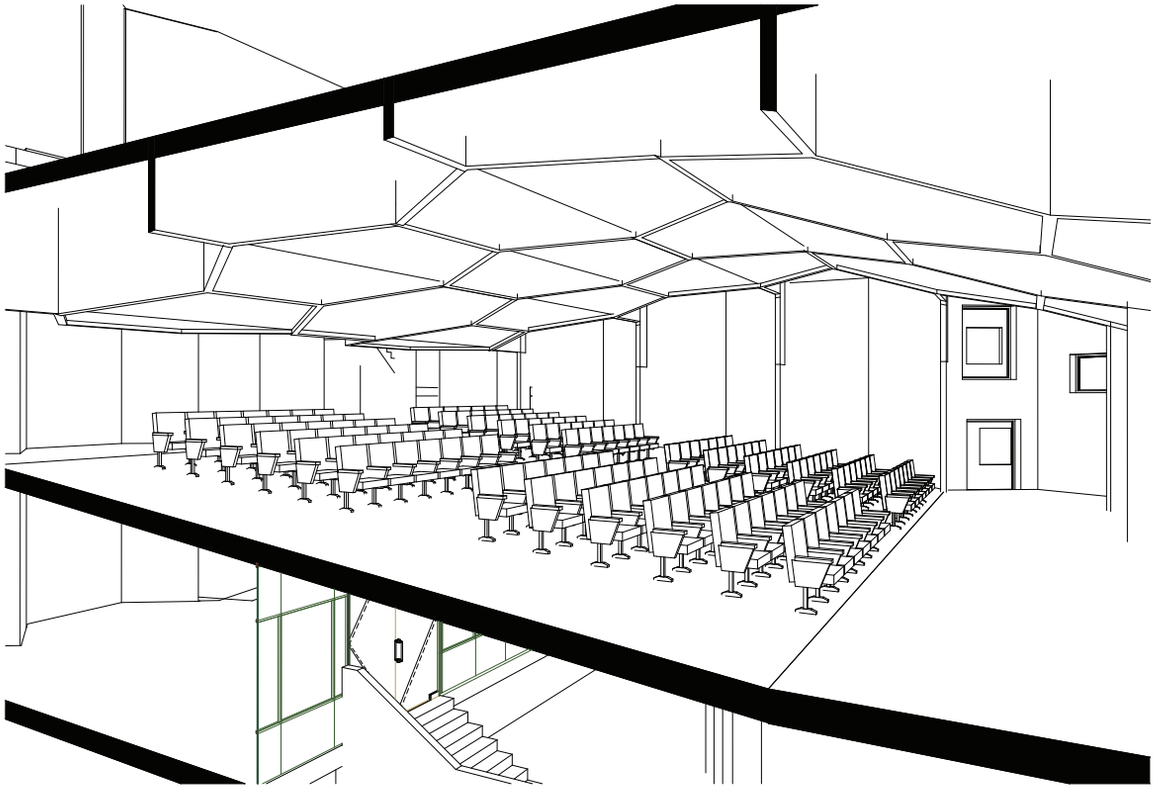
ill. 29 reflector ceiling ray-diagram



ill. 30 Existing building layout, showing problems with reflected sound towards speaker



ill. 31 Wall adjustment to distribute reflected sound better



ill. 32 Line perspective of the auditorium, showing the adjusted ceiling

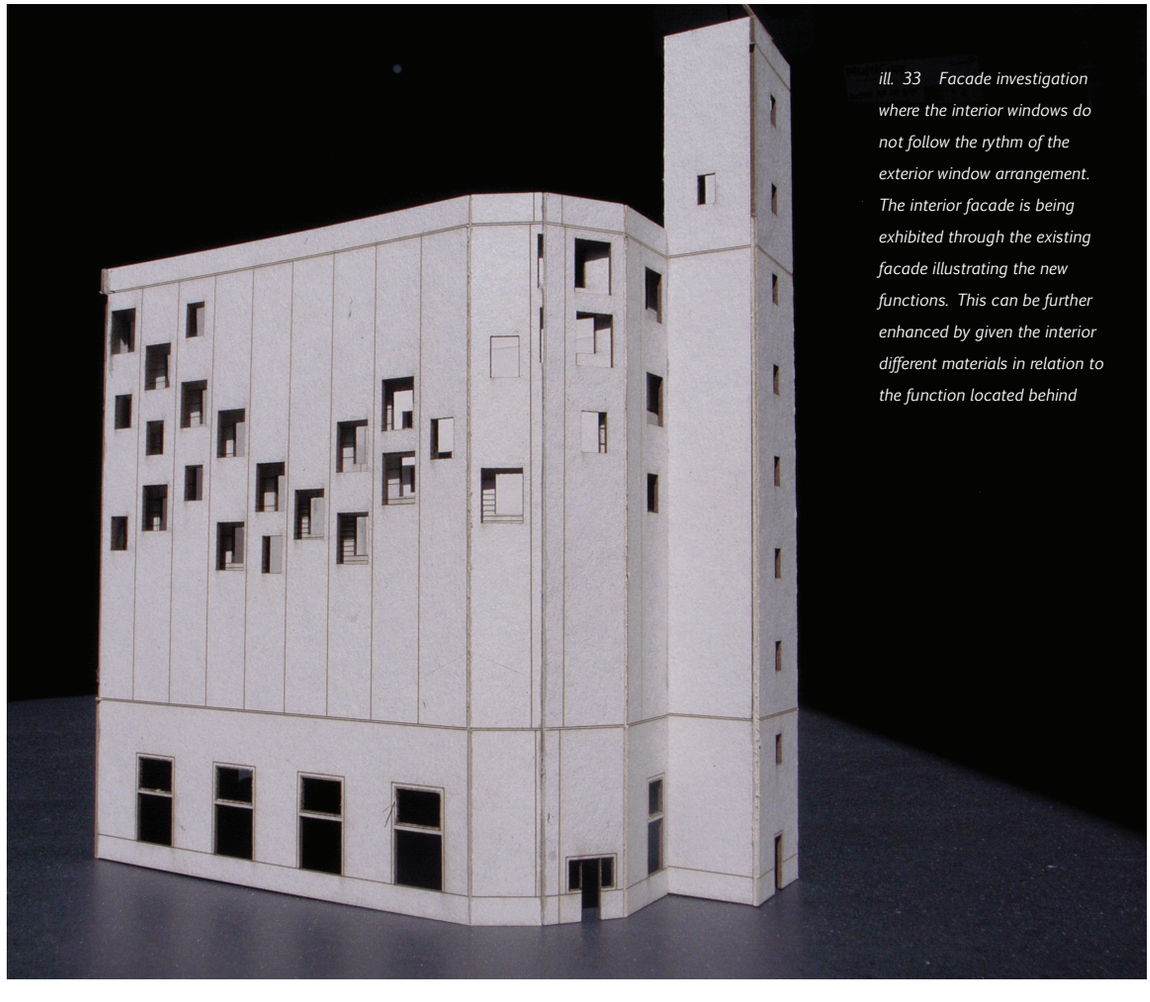
transformation of silo 04

The characteristic hexagonal expression has been important to maintain in the transformation and optimisation of the facades. It has furthermore been important to create a visible link between the new and old in the building, where the different elements were displayed at the same time however with an evident difference. This generated an idea, where the existing external facade was visible inside the building by creating holes in the old smaller than those in the new optimized facade, making the old wall a part of the interior expression.

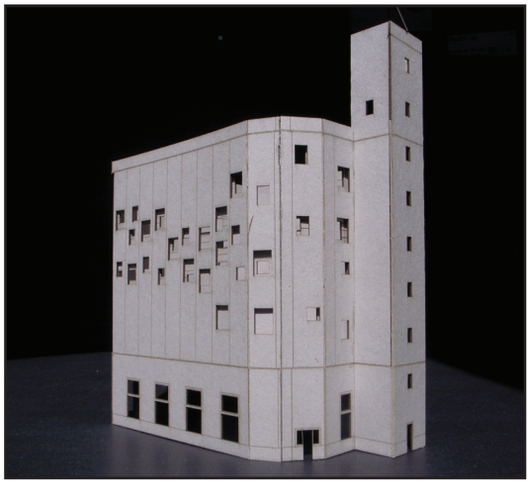
This was further developed by introducing the same element but reversed so the new interior was exhibited to the exterior facade by differentiating the holes in the exterior and interior facade.

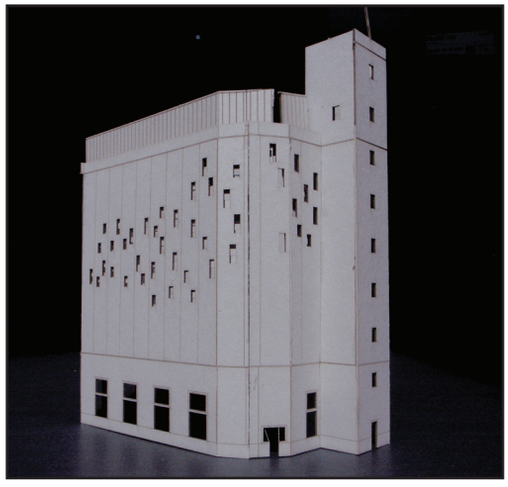
The functions located in silo 04 have different requirement in relation to light. It has been the wish to display this difference on the facade so the amount and sizes of the windows indicated the function behind. This differentiation has also been pursued in relation to choice of materials where the interior materials indicate the function inside.

It was essential to find a balance in the diversity of the interior materials in order for them not to dominate the characteristic of the building. So instead of introducing a new material to each function the material was treated in relation to the specific function.

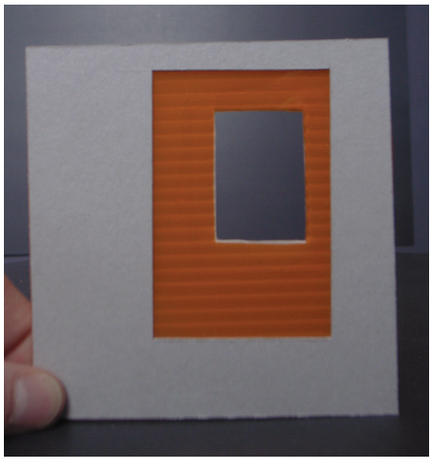


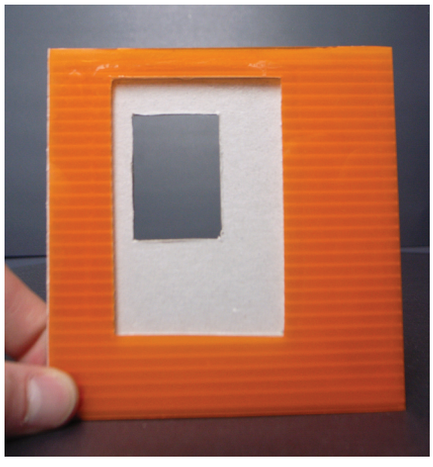
ill. 33 Facade investigation where the interior windows do not follow the rythm of the exterior window arrangement. The interior facade is being exhibited through the existing facade illustrating the new functions. This can be further enhanced by given the interior different materials in relation to the function located behind





ill. 34 Other facade investigations where the typology of windows interior and exterior changes to create a dualism in the expression.





ill. 35 Principle models of the different expression created through the window arrangement where the new material is framed by the existing facade and vice versa inside the building.

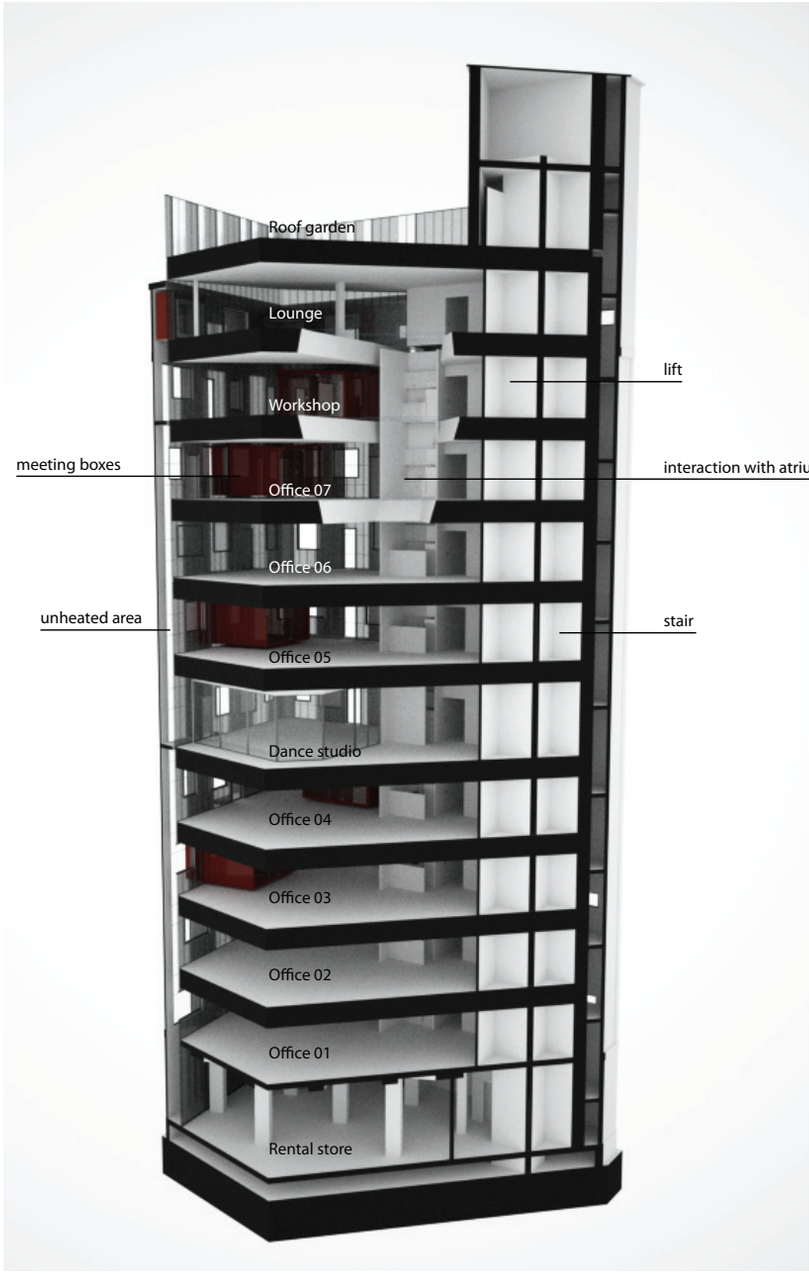
BE06

The building has been investigated through BE06 to ensure that the building meet the low energy class 1. As the functions in the building require a high ventilation[see appendix, air change], the first iteration shows a high energy consumption, however according to the Danish building regulation a supplement is given corresponding the extra ventilation rate, why the rate has been reduced in relation to the requirement prescribed in BR08[6.3.1.3,stk 2]

[See appendix, BE06]

scenario 01		
energy frame	85,9 kWh/m^2 year	Complies with normal energy building class
scenario 02		
energy frame	**44,9 kWh/m2 year**	**Complies with low energy building class 1**
scenario 02		
energy frame	44,9 kWh/m2 year	Complies with low energy building class 1
in all scenarios		
transmission loss	5,6 W/m	Must be below 8 W/m2 for buildings above 3 stories

transformation of silo 03



ill. 36 Section illustrating the programme of silo 03

Silo 03 is situated at the edge of the shoreline which generates great views to the fiord and city of Aalborg. This location is essential to take advantage of, however the direction is towards North which raises limitation to the size of windows in relation to sustainable designs.

This parameter has influenced the choice of functions why offices with a high internal heat load has been chosen to balance the heat loss through the northern facade.

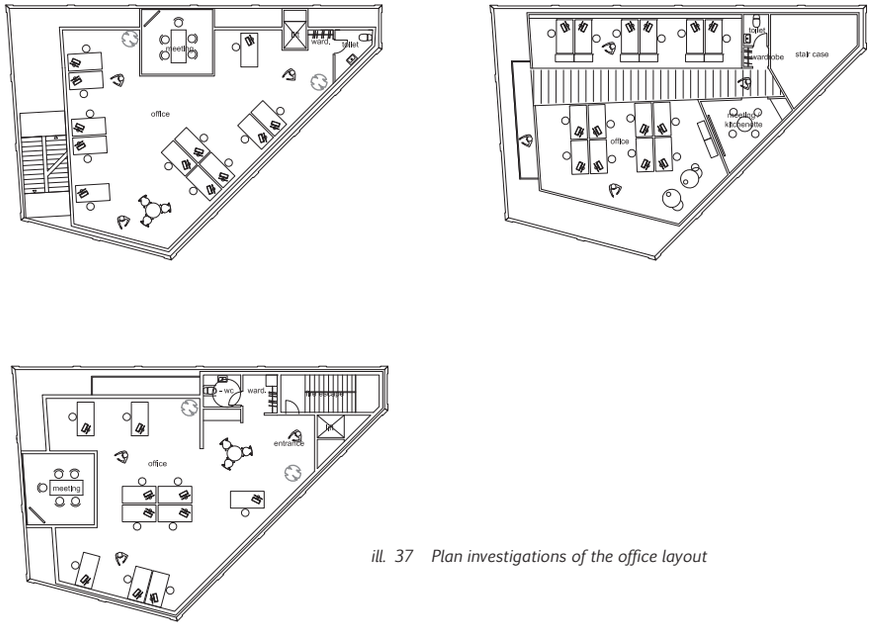
The idea of implementing an unheated area was developed by moving the office facade inwards to create an area of higher temperatures than outdoor to reduce heat transmission loss through the office facade. The area is designed to work both in terms of lowering the energy consumption as to create an outdoor area for the users of the building, enhancing the architectural quality of the offices.

The enclosed space creates the possibility to enjoy the great view towards the fiord and city of Aalborg. In addition meeting boxes have been introduced providing the offices with great meeting rooms where clients and employees can enjoy the view.

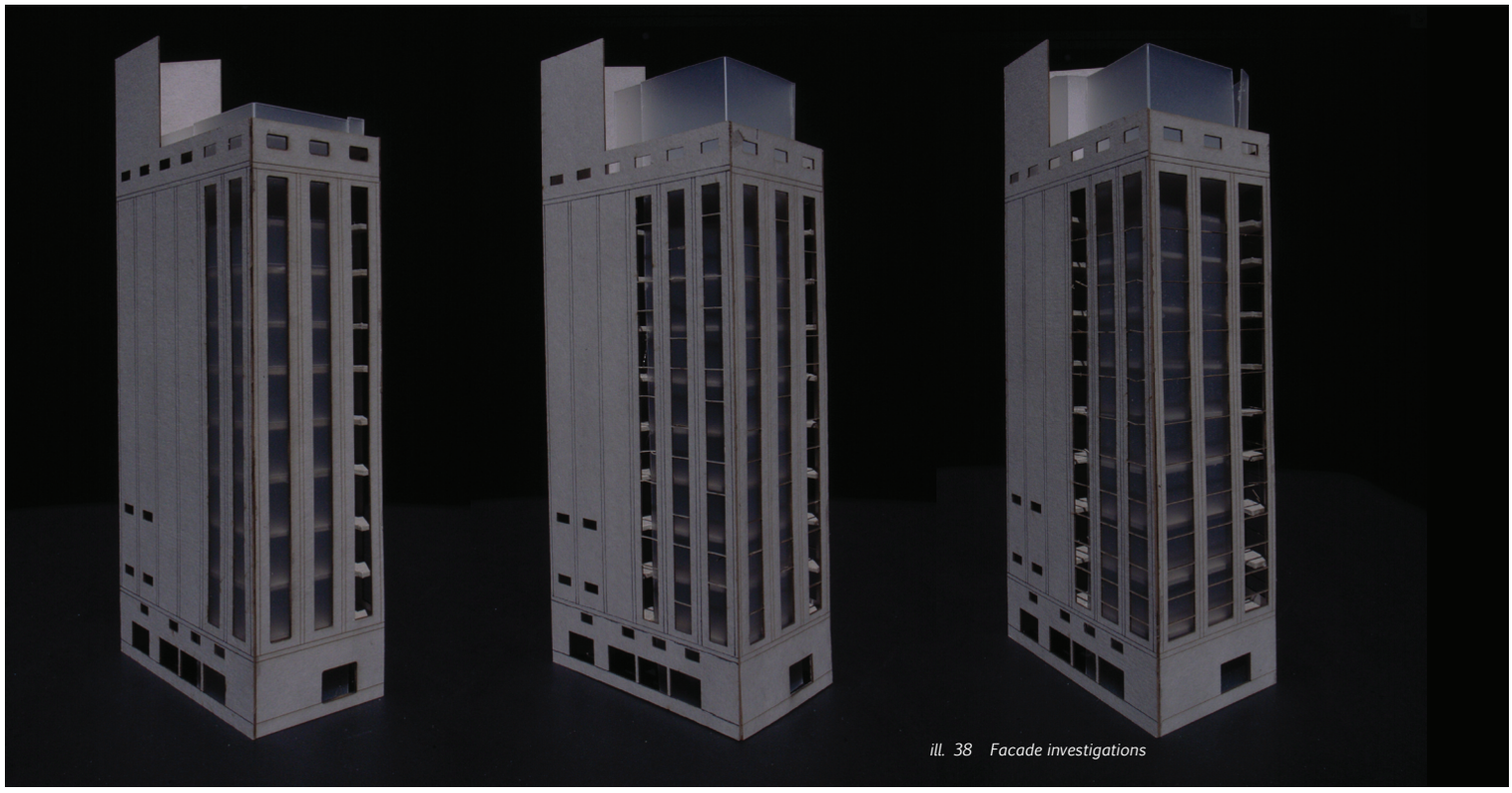
The constellations of the facades, the unheated area and the layout of floor plans have been through a range of investigations to determine the right expression.

Below is illustrated different proposals for the office layout and location of access points and fire escapes.

The proposals were evaluated in relation to the flexible layout, the utilisation of the unheated areaand the flow.



ill. 37 Plan investigations of the office layout

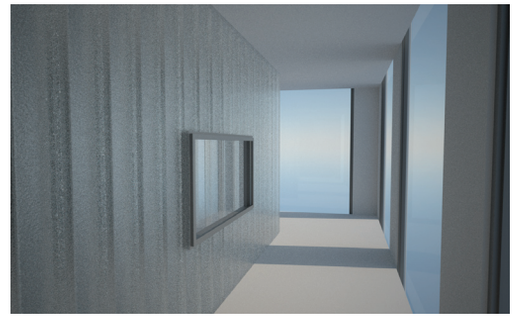


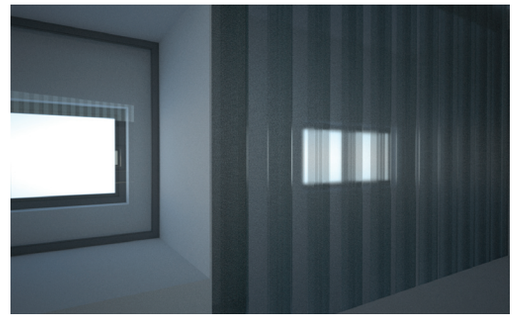
ill. 38 Facade investigations

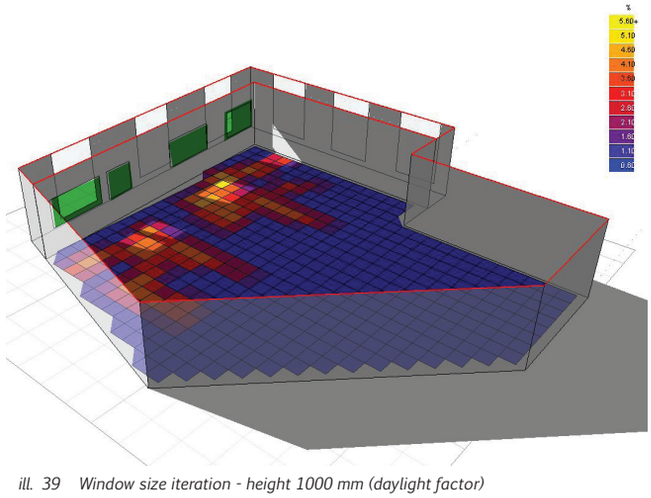
transformation of silo 03

It has been a wish to create a light expression why a translucent material creating a diffuse light in the office environment has been chosen. Here the daylight factor and illuminance level have been investigated through Ecotect to ensure good light conditions in the offices [see appendix, lighting analysis for full description].

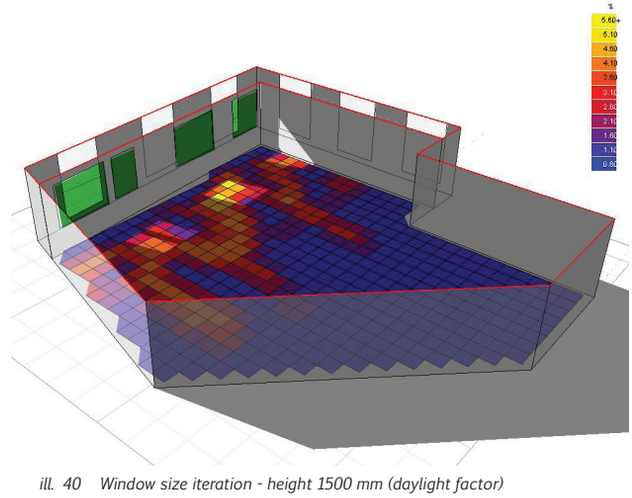
Here the height of the windows and the floor material have been investigated to generate good working environment for the employees. The effect of having higher windows is significant in relation to the depth of the room, as have been proved(see illustrations beneath), why this height is chosen for all windows towards North and West.
Other aspects are more favourable views out both when standing and sitting.







ill. 39 Window size iteration - height 1000 mm (daylight factor)



ill. 40 Window size iteration - height 1500 mm (daylight factor)

Requirements according to BR08

Temperature; 21,00 - 26, 00 C

Hours permitted;
Above 27 C; 25 h
Above 26 C; 100 h

Infiltration; 0,5 h^{-1}

CO_2 emission; 810,00 ppm

The outcome from BSim

Mean temperature: 21,88 C

Hours under 21 C; 7.979,00 h
Hours above 27 C; 0,00 h
Hours above 26 C; 0,00 h
Hours under 18 C; 0,00 h

Infiltration, mean; 0,18 h^{-1}

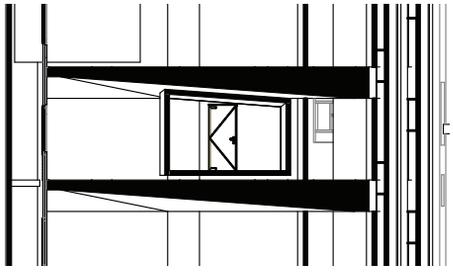
CO_2 - emission; 468,20 ppm

Another crucial parameter for the design of an office environment is to ensure thermal comfort. The employees utilise the zone many hours during the day where concentration and effectiveness are important parameters. To ensure a satisfied indoor climate for the occupants, an office floor has been simulated in BSim.

BSim verifies that the ventilation rate correspond the CO_2 emission and the average temperature create a satisfied indoor climate for the occupants. Iterations have been made to see the effect of the sunspace which reduced the hours above 26 and 27 C.

The results illustrates that the building is very stabil all year round according to temperatures and that there is no overheating during summer [complete procedure placed in the appendix, BSim].

In addition it has been the aim to design a clear office expression without disturbing elements such as columns or walls that can limit the degree of interior arrangement. This lead to investigation of a cantilevered slab because of the light facade structure. This structure has been investigated through STAAD Pro to ensure stability and adjusted dimensions[see appendix, STAAD Pro].



ill. 41 The floors have been corrected according the investigations in STAAD Pro

BE06

At the end the energy consumption has been verified through BE06. Here the use of polycarbonate and the profit gained from the space between the polycarbonate and the existing facade has been investigated. Through these investigations it is obvious that this space assists to obey the low energy class 1.
[See appendix, BE06 for detailed notification]

scenario 01		
energy frame	53,2 kWh/m² year	Complies with low energy building class 2
scenario 02		
energy frame	**49,9 kWh/m2 year**	**Complies with low energy building class 1**
in all scenarios		
transmission loss	7,1 W/m	Must be below 8 W/m2 for buildings above 3 stories

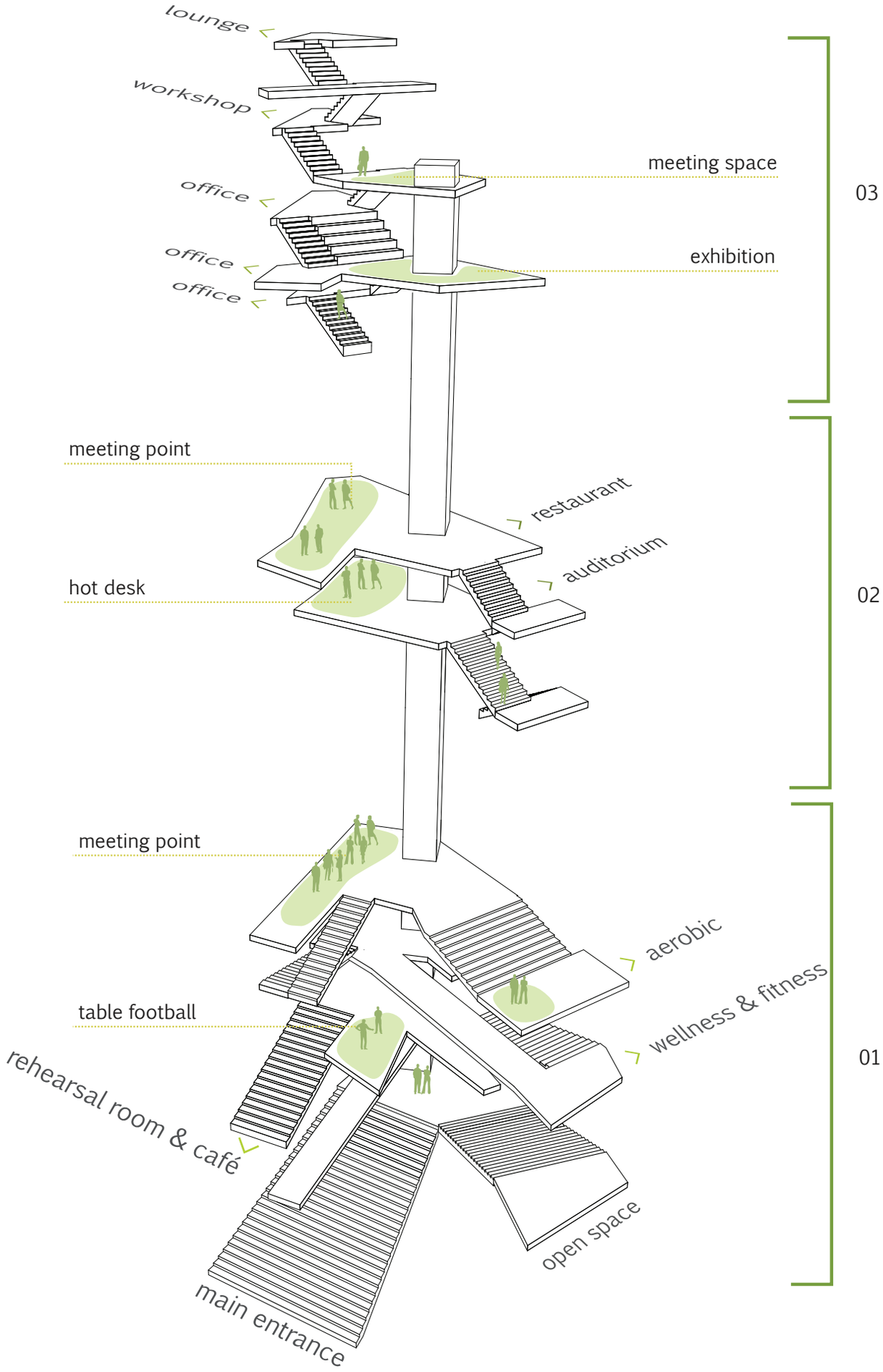
transform

The composition of the process can lead to an assumption that the different volumes have been adapted separately from the coherent expression. This is however not the issue. The different iterations have been performed with decision of the whole complex ensuring a unified expression where the arrangement of functions, the flow system and the interaction throughout the complex have been of great importance. Here especially the interaction between the atrium and the buildings has been crucial where the connection and shape of the atrium have been generated in relation to the desired flow and contextual circumstances.

The location of the main entrance beneath silo 02 was created to sustain the existing footprint and exterior flow between the buildings. The atrium assigns to the existing context and evolves to be more dominant in the vertical direction creating the understanding of a new sphere. The twist of the atrium was introduced to create connections according to the implemented functions and their need of privacy.

The distribution of functions in silo 02 and 04 were essential to combine early in the journey whereas silo 03 contains offices with different variation of privacy. The established companies are located at the bottom where as more conceptual new-started firms are located at the top with a close connection to the atrium and thereby to the flow of people generating interaction and visibility to the offices.

Through the design process different contextual views have been of big importance both in terms of the visibility and integration of the context but also in relation to the created views from the interior spatiality's to the surrounded context. The registration of the complex from the city of Aalborg has been significant to adjust in the design. Furthermore the arrivals to the complex from different angles have been evaluated through the models presented. This has been reviewed in relation to different aspects and moods where the graduation of visibility and expression of the transformation to the surroundings differentiate creating an interesting tension.



ill. 42 Diagram illustrating the flow system in the atrium

Through the distribution of the function the arrangement of the flow in the atrium has been developed. It has been crucial to create a continuous flow influenced by a range of informal meeting points. Additionally the requirements according to stairs, ramps and lifts have to be fulfilled. However designing an atrium with focus upon flow it has been significant to generate a pleasant travel for the users why the stairs have been kept to a minimum in areas where interaction and casual meetings are located (01 + 03). However in the middle section of the atrium it is more a question of moveing from A to B why the steps have been moved to the normal standards(02).

Due to the irregularity of the atrium the flow has been through different iterations to explore the possibility both in terms of the requirements but also in relation to the expression and visibility between the flow and the interaction areas.

In addition the paths have been investigated through STAAD Pro to determine the dimensions required to span the length of the atrium.

The criteria of the investigation were to keep relative slim thickness of the pathways so they do not occur dominating in the atrium. This resulted in a maximum span of 18 meters with a thickness of 300 mm [see appendix, STAAD Pro].

The choice of material for the path is concrete both in terms of the relation to the atrium but also to implement thermal mass to the atrium which will help equalise great temperature variations. Iterations have been created in 24 h average and monthly average spreadsheets to see the effect on temperature and energy consumption of different material types with different heat capacities. [see appendix, 24H + Month average].

This also influenced the data in BE06, which illustrates that the preliminary investigations creates a satisfied energy consumption. The first scenario is adjusted in relation to the calculated air change rate as a function of the people load, activity and volume. However according to the Danish building regulation an air change of only 0,5 h^{-1} is required, which has been corrected in scenario 2[see appendix, BE06 for detailed information].

Results from BE06

Scenario 01		
Energy frame	46,7 kWh/m^2 year	Complies with low energy building class 1
Scenario 01		
Energy frame	49,0 kWh/m^2 year	Complies with low energy building class 1
Transmission loss	7,1 W/m^2	Must be below 8 W/m^2 for buildings above 3 stories.

ventilation strategies

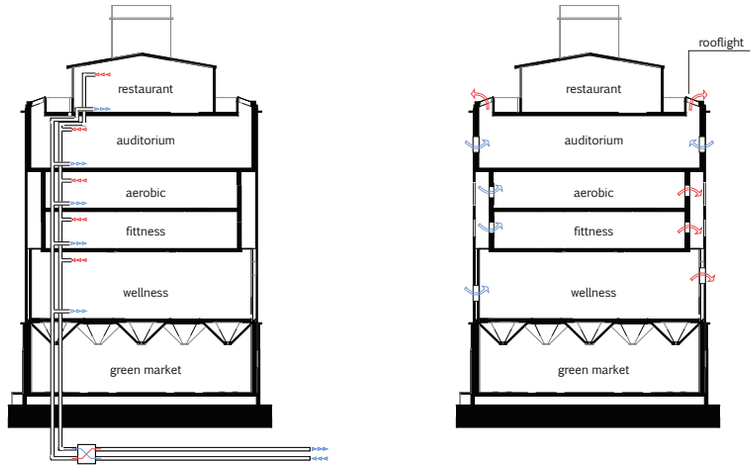
The building complex operates with different strategies for natural ventilation where both thermal buoyancy and wind driven strategies are in use[see appendix for further details]. The strategy depends on the function, orientation, adjacent elements and wind velocities. When dealing with natural ventilation it can be difficult to predict the affect of the changes in weather conditions. In order to predict the details of the natural airflow in the complex, numerical computational fluid mechanics models(CFM) can be used. These computer simulations create an accurate analyse of the airflow in relation to the buildings.

Silo 04 contains wellness, fitness and aerobic which are functions that require a high airchange due to the high activity level. This denotes that the air change is controlled by mechanical ventilation to ensure a good indoor environment. However, natural ventilation is seen as a supplement to the mechanical ventilation
The auditorium utilises the openings in the facade as inlets and the sky light as outlet illustrated in the diagrams.

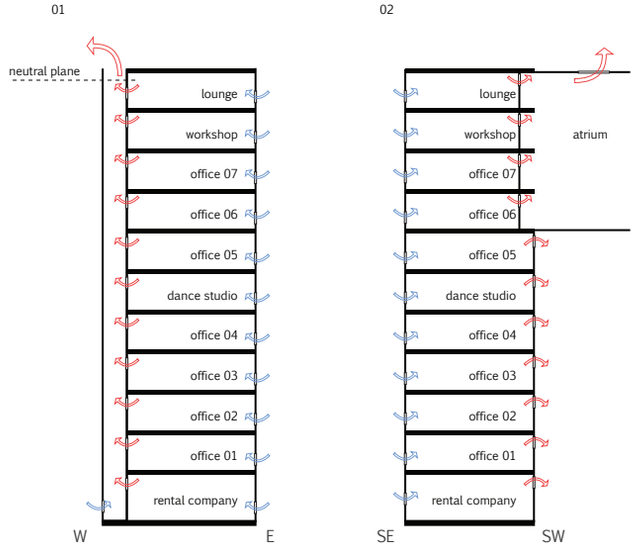
Silo 03 consists mainly of offices. The adjacent space between the office space and the existing facade has been introduced to perform as a double facade creating both an architectural quality for the offices as well as reduce the heat transmission through the northern facade. Furhtermore the space can assist the natural ventilation during periods with low wind velocities.

The atrium is arranged between the existing buildings in a West - East direction which is optimal for in relation to the prevealing wind drection from West. The openings in the atrium are distributed at both side ensuring good possibility for cross ventilation during summer time. In transission periodes natural ventilation is used when the surrounding conditions suit this mode. In these periods the natural ventilation will be dominated by stack effect induced by the internal heat sources and the solar heat gain .

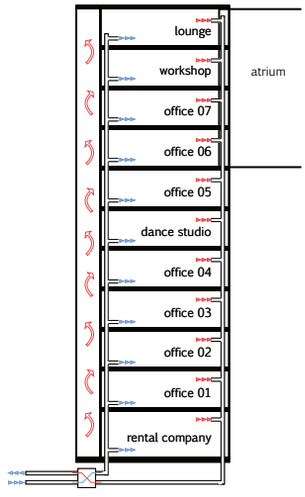
The buildings operate with hybrid ventilation, which exploits the benefits from both natural and mechanical ventilation. Hybrid ventilation is a two-mode system that adjust the ventilation mode according to the weather conditions. The mechanical system has a heat recover effeciency of 85 % where a counter-flow heat exchanger is located between the inbound and outbound air flow minimising the heat loss. The equipment for the mechanical ventilation is located at the bottom of the atrium creating a minimum length of ducts to the different spaces.



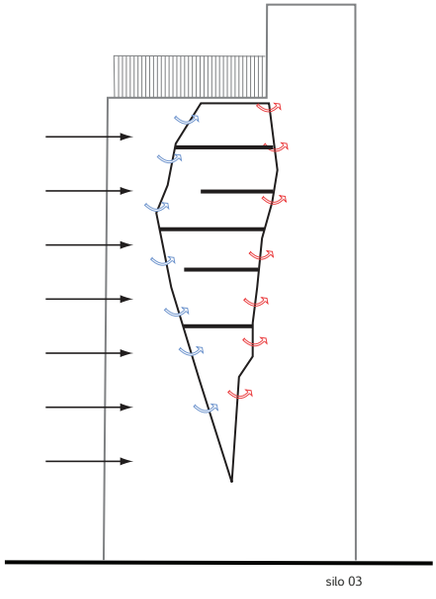
ill. 43 Ventilation strategies for silo 04



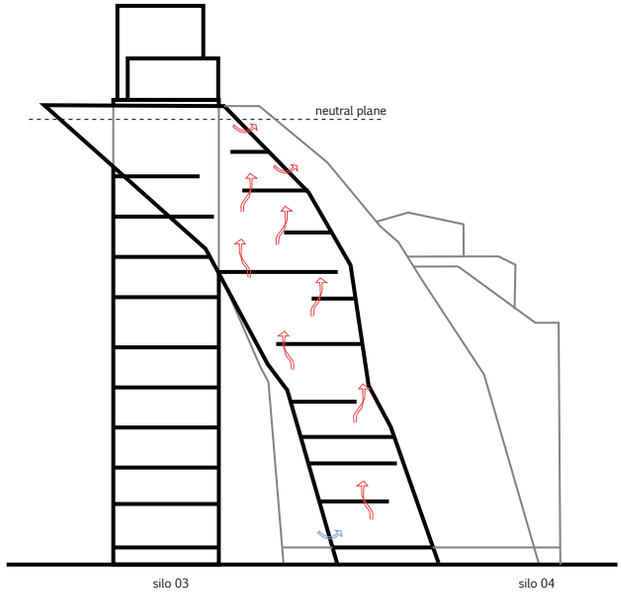
ill. 44 Ventilation strategies for silo 03.
01 The unheated area act as a chimney.
02 Cross ventilation of silo 03.



ill. 45 Mechanical ventilation where the unheated area helps reduce the transmission loss through the facade stowards this space.



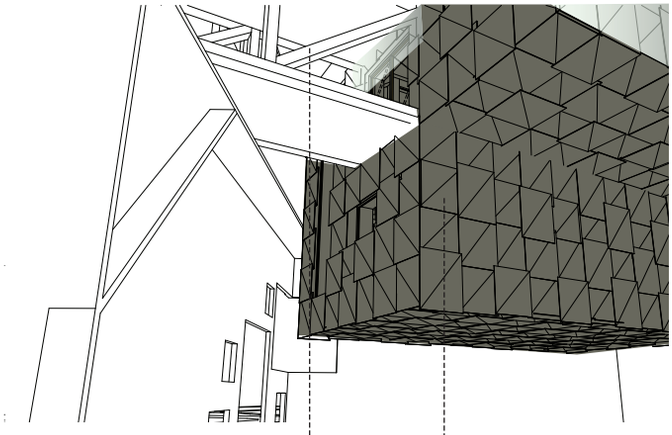
ill. 46 Diagram illustrating the strategy for natural ventilation during summer for the atrium



ill. 47 Diagram illustrating the strategy for natural ventilation for the transission periods for the atrium

choice of materials

The choice of materials has been evaluated in relation to the expression and the contrast or cohesion with the existing materials. Futhermore the choice has been evaluated according to the more technical aspects such as sustainability, acoustic and daylight distribution within the different spatialities[The considerations about the choice of materials are to be found in the appendix, materials].



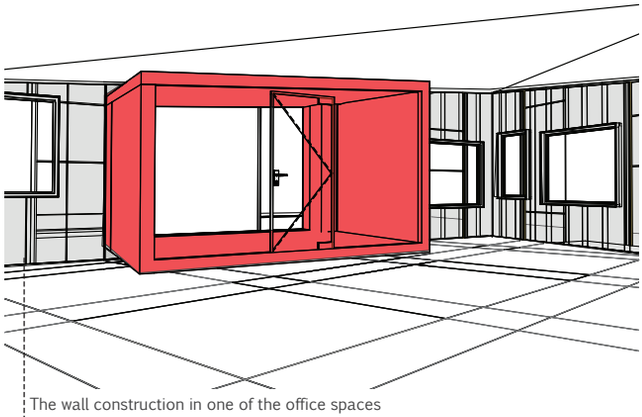
The metal cladding of the cafe

Polycarbonate

Metel cladding

Silo 02

The open space in Silo 02 being an embraced outdoor area resulted in aiming for a more rough expression in this part of the complex, why the chosen materials for the cafe and open space slab are inspired by the materials used in urban cityscapes. Also the constructive element in the design that carries the awning of the cantilevered building has been constructed from large I-profiles to obtain a very industrial appearance. The large slab that merges into the silo is the new element of the outdoor area, why the choice of material and finishing of the surface has been investigated.
The large constructive solution for the awning has also been used in the design of the cafe, which gives the hanging volume a more harsh expression in the open silo construction.
The facade solution for the cafe has been investigated to ensure the right appearance of this hanging element.



The wall construction in one of the office spaces

Polycarbonate

nanogel

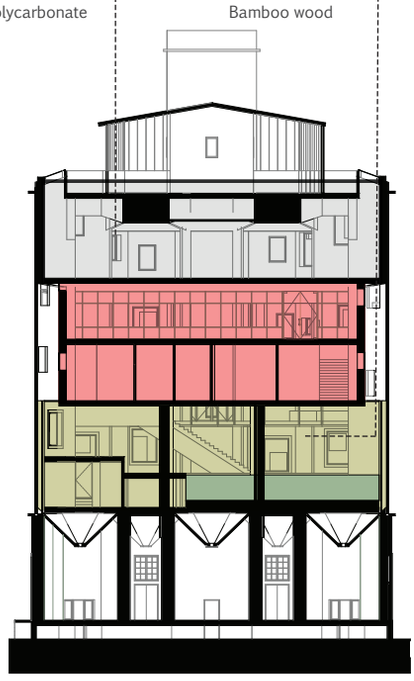
Silo 03

The expression of silo 03 has been with largest focus upon the new materials, why optimisation of the existing walls will be mounted directly on the outer wall of concrete and a new wall construction towards North and West have been introduced. The wall should provide the offices with larger amount of daylight through a translucent wall construction. The existing wall will be maintained as outer shell with large window areas to let in as much daylight as possible. The double facade will additionally create possibility for using the void for small balconies with a view, natural ventilation and reduction of the transmission loss towards North giving larger window areas in this direction.

The angled pattern of the silo walls in the existing building will be projected onto the floor as guidelines for the layout of the flooring to create a remembrance of the historical past of the building, but as the new elements are to be the dominating expression in this building volume the link to the past will become more symbolic and humble.

Coloured polycarbonate

Bamboo wood



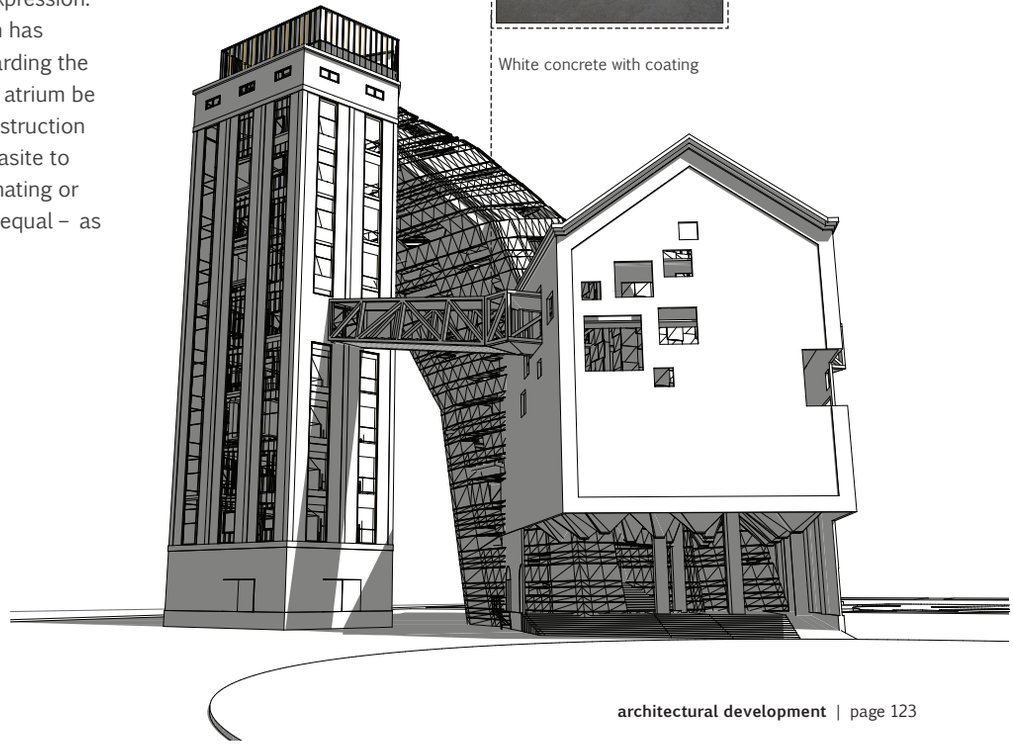
Silo 04

The concrete construction from the existing building, where the optimisation of the facades regarding the demand for low energy consumption will be implemented on the inside of the wall construction. The window holes in the inner wall will differentiate from the window holes in the outer construction in size and layout and create a tension between old and new where the existing wall construction can be seen from the inside through the windows and the new material depending on the functions inside can be se from the outside. The meeting between old and new will be emphasized in the windows in silo 04, why processing of the materials here has been of big importance. The window frame will be constructed as a smooth concrete surface that stands in contrast to the rougher surface of the existing wall construction.

Atrium

The atrium is the new element of the complex, why it needs to separate itself from the rest of the complex in its architectural expression. The way of distinguishing the atrium has been through a lot of iterations regarding the wanted expression. How should the atrium be seen in the context. Should the construction be a completely new element, a parasite to the existing building volumes, dominating or should the two elements appear as equal – as one unit.

White concrete with coating



fire regulation

Fire escape strategies have been considered where the requirements for the complex in relation to escape routes, rescue openings and fire escapes have been investigated and related to this project.

The complex is divided into different sections corrected in relation to the application.

Offices located in silo 03 will be in application category 1 as the users are familiar with the building and thereby with the fire escapes and routes, while the café and rehearsal rooms arranged in silo 02 are application category 2 where the maximum people load does not exceed 50 people. Furthermore the functions placed in silo 04 (wellness, fitness, aerobic and auditorium) as well as the atrium between the buildings are application category 3, which are functions with a people load of more than 50 persons and where the people do not know the subdivision of the building in relation to fire. [BR95, 6.1.1]

Fire escape

The offices are divided into fire cells where the fire can not disperse. Each office zone is provided with two of each other independent exits, through the main external fire escape located at the North or through the atrium which is seen as an enclosed fire section.

Looking upon silo 04 the atrium serves as a fire escape which has access to the outdoor. Furthermore is an external stair located on the east facade opposite the atrium ensuring that the maximum distance between the openings does not exceed 25 m [BR95, 6.2.6].

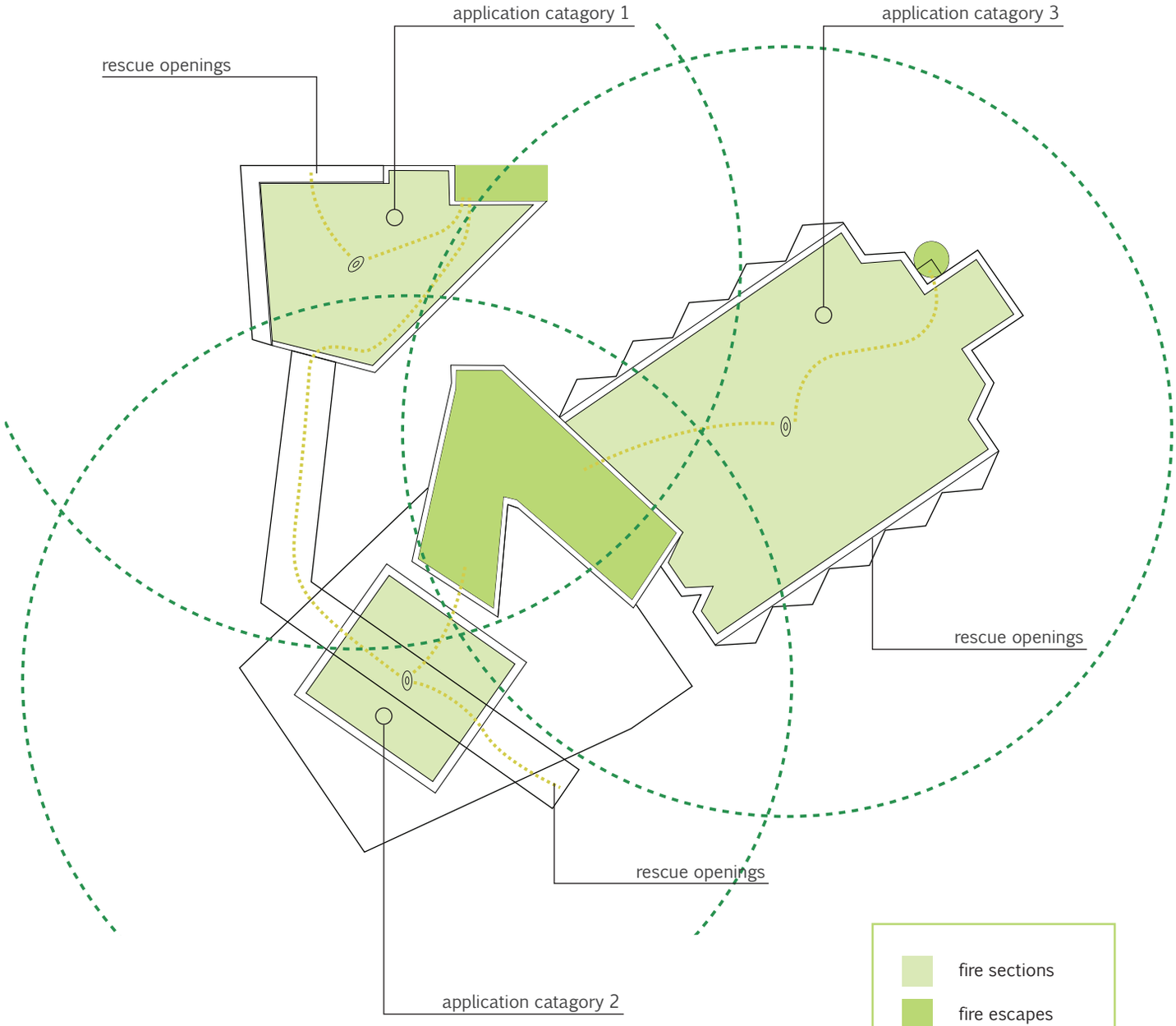
It is important to create wide openings and corridors for a smooth evacuation. The different functions act as an independent fire section where the fire can not diffuse to other building sections during the time necessary for evacuation.

The café and rehearsal room located in silo 02 are connected to the atrium and furthermore the footbridge running through the volume is seen as a fire escape route that either directs the occupants to a secure place as the location of the café and rehearsal room do not exceed 22 m from the ground level the bridge can be reached by the stairs of the fire department. Another possibility is to follow the bridge to silo 03 where a secure fire stair is located.

The atrium is seen as an independent fire section which indicates that the fire can not diffuse to other building sections during the time necessary for evacuation. The atrium is connected to the other building volumes which have individual fire escapes that also can be used for the atrium as escape routes.

In case of fire fans are located on the roof to ensure the venting of smoke and warm air. This system is constructed on the basis of fire technical configuration. These ventilators can furthermore be used during the week to help fulfil the ventilation rate if the wind pressure or thermal buoyancy are not enough to secure a comfortable indoor climate.

[For further details see appendix, fire regulation]



ill. 48 Plan illustrating the complex in relation to fire regulation

conclusion

The project has throughout the entire process been focusing upon the paradox that lies within the field of transforming old industrial buildings, with a story to tell, into new leases without any of the two dominating and blurring the expression of the other. The right balance between the two is extremely essential for the project to succeed, why it needs to be evaluated and taken into consideration in any scale regarding the architectural expression, choice of materials and level of detail. The same paradox arises when aiming for a transformation addressing current solutions and lifestyles. The concern for the environment and especially the impact of the high energy consumption in the building industry results in more rigorous demands concerning optimisation of building construction. It has been necessary to implement new elements in the facade to meet the present demands. These elements are evaluated according to the new functionalities, expression and hierarchy of old and new. To clarify the significance of the tension between existing and new, old and modern, dominating and humble, a hierarchy has been drawn up for the context, the three silos and the new architectural element.

The new element links the three buildings together through its expression, shape and functionality. This generates a clear definition of the wanted expression in the different building volumes, which has resulted in the three silos still being perceived as three buildings. However through the introduction of the atrium, that provides the architecture and the functionalities within the complex with breathing spaces, meeting points and circulation, a coherent and inseparable complex has been created. The atrium connects to the different silos at different levels depending on the need for contact or wish for privacy, which is the reason why the atrium only connects to the top floors of Silo 03, where the public spaces of the building volume are to be found.

The hierarchy in the architecture also means that the users, through the natural flow inside the buildings, will be presented for different experiences, architectural solutions and processing of the transformation. The flow starts at ground level where the observer will be confronted with the first meeting between old and new. The existing buildings are mainly untouched in ground level, where the atrium and its rather massive roothold will be the dominating element and give a clear definition of the entrance and the functionality of the atrium being the link and the point of circulation in the project. The defined entrance is further emphasized through the cantilevered building volume of Silo 02, which also generates a natural flow from the surrounding squares and activities. The close and easy connection with the surroundings is crucial for the atrium to become the link between the flow inside and outside the building, which will ensure diversity and life in and around the complex and hereby create the wanted expression of “Transform”.

The large diversity and possibilities with regards to the functions within the complex, have been the main design parameter for the project to generate an environment relating to individuals and smaller groups using the complex several times during the day or the week. A complex where the occupants can join the ongoing activities and diversity within the building wherever and whenever they feel like.

The various meeting points provide opportunities for networking, workshops and exhibition areas where employees and students can work and network during the day without the necessity of being a permanent part of the house.

The large diversity within the building is not only depended on the functions and activities in the building, but also the implementation of atmospheres and creation of diverse environments within the buildings related to the different activities and utilization of the spaces. The further development of details will be essential for the overall expression of the complex. This project has focused upon the conceptual guidelines with regard to the different treatment of the hierarchy between new and old and the creation of a coherence complex.

The project being complex and extensive results in some lacks in relation to for example constructive solutions, but as the amount of work and limited timeframe, it is not possible to detail the entire building complex why certain details have been left out for detailing at a later stage in the project.

Through the use of the integrated design process in the project, where the professional parameters of architecture together with the more technical aspects of the project; sustainability, construction and thermal comfort within the spatialities, have ensured a design solution which in different levels, functions and transformation strategies display the tension between the kept existing elements and the introduction of new element. The diversity in the transformation and activities meets the demands from the occupants, alongside with fulfilling the demands for low energy consumption and a good indoor climate in the spaces.

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