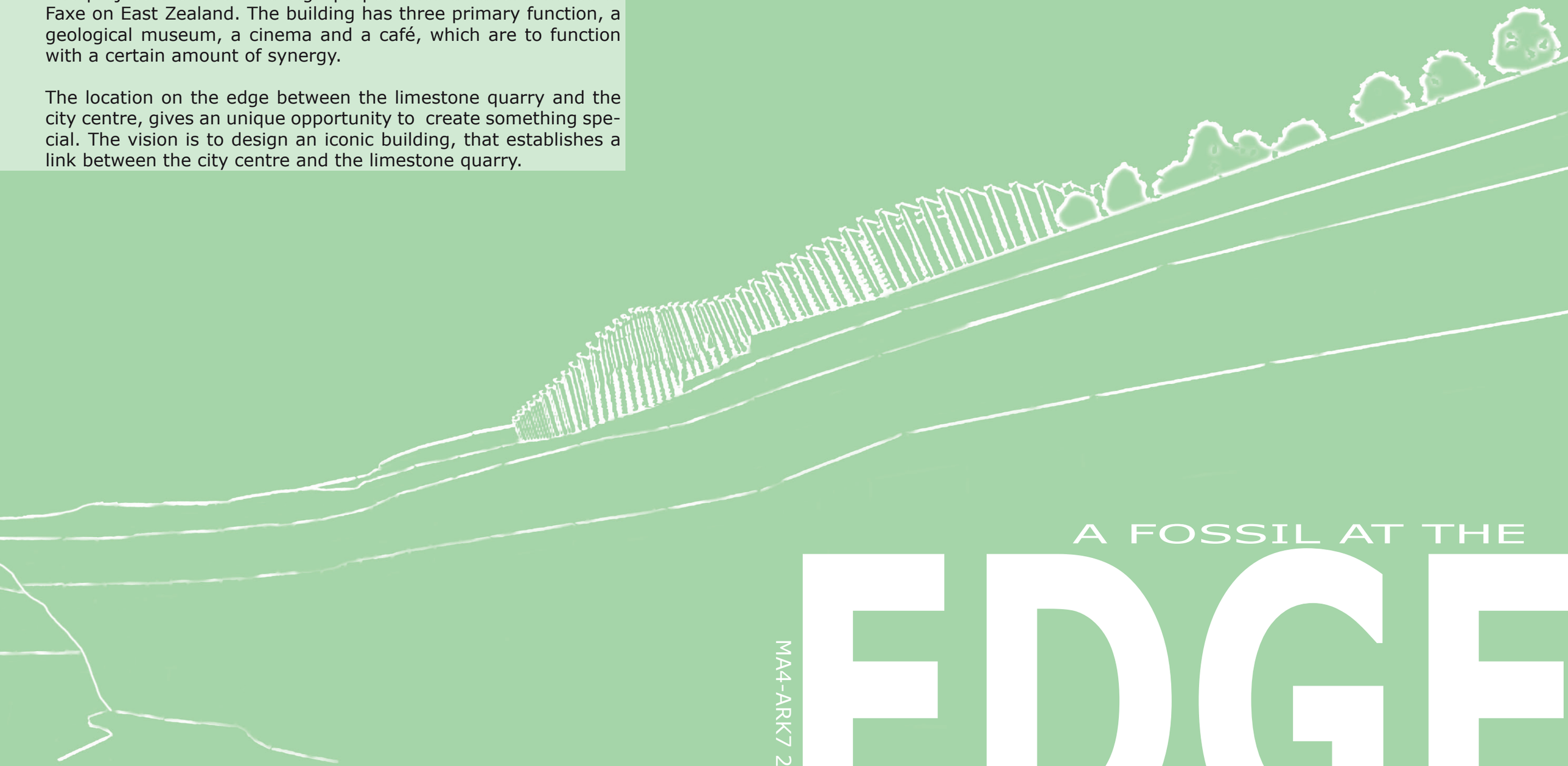
THORDUR EGHOLM 2011

EDGE

The project describes a design proposal for a cultural house in Faxe on East Zealand. The building has three primary function, a geological museum, a cinema and a café, which are to function with a certain amount of synergy.

The location on the edge between the limestone quarry and the city centre, gives an unique opportunity to create something special. The vision is to design an iconic building, that establishes a link between the city centre and the limestone quarry.



A FOSSIL AT THE

EDGE

MA4-ARK7 2011

TITLE PAGE

Aalborg University
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Thordur Egholm

SYNOPSIS

Ill 4.1 View of the site from north

The project describes a design proposal for a cultural house in Faxe on East Zealand. The building has three primary function, a geological museum, a cinema and a café, which are to function with a certain amount of synergy.

The location on the edge between the limestone quarry and the city centre, gives an unique opportunity to create something special. The vision is to design an iconic building, that establishes a link between the city centre and the limestone quarry.

PREFACE

The project is based on a open competition from September 2005, called "Kulturhuset Kanten" (Cultural house The Edge), arranged by Faxe Municipality. The competition is the first stage of a larger plan that shall integrate the lime-stone quarry with the town Faxe.

The first stage consists of designing the cultural house that includes GeoMuseumFaxe and Café Biografen (cinema). The building should work as a direct link between the city centre and the quarry, being located in the middle of "Kultur-strøget" - a visionary cultural path between the city and the quarry.

The competition program can be found on the cd included in this project.

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PROGRAM

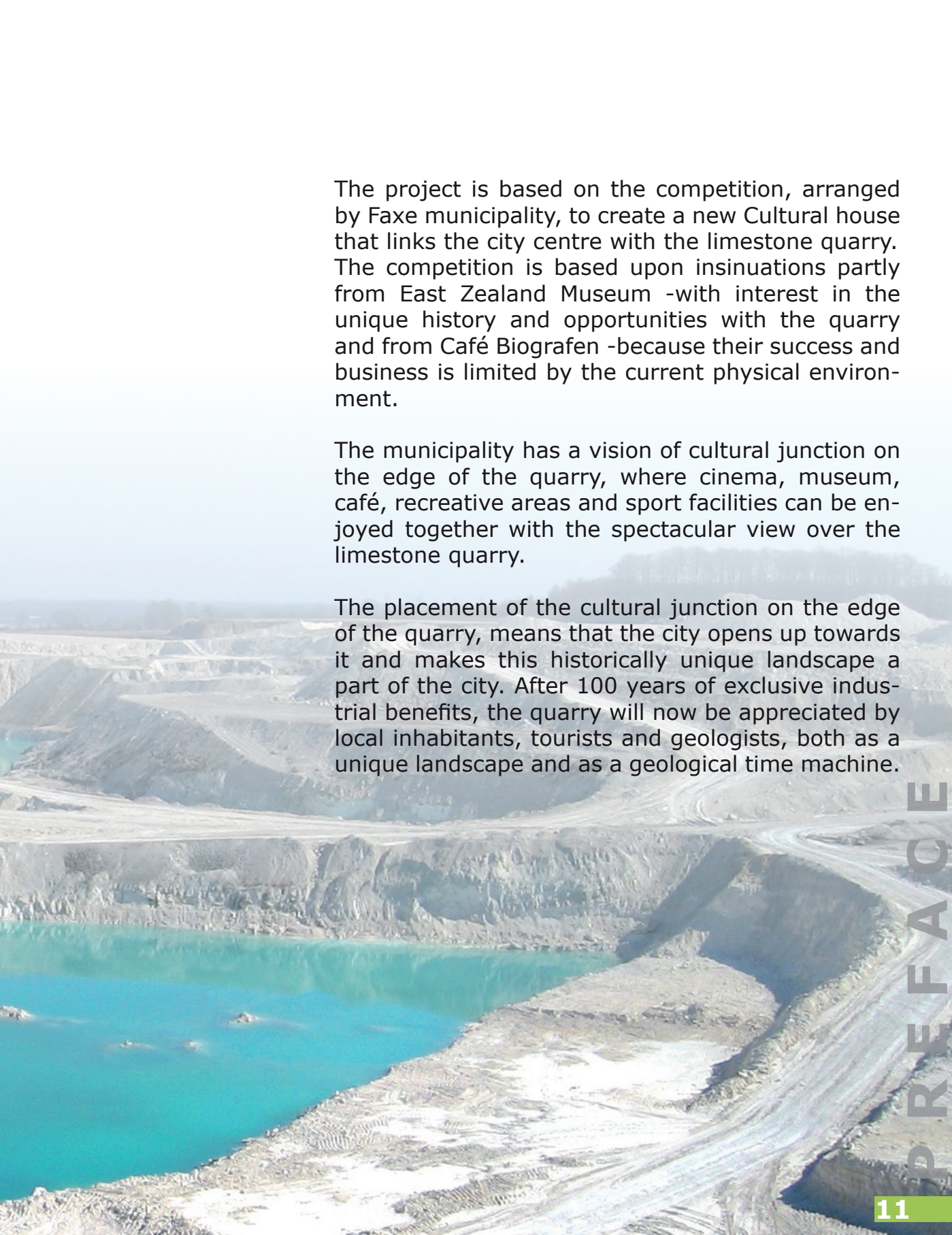
INTRO

Ill 10.1 View of the limestone quarry

The program describes the necessary research and analysis made in the early process of the project, and specifies which focus points will affect the design and functionality of the building.

First there are the mandatory regulations from government, local authorities and the competition program. Secondly there is the location's facilities and environment and finally there are specific architectural and engineerical issues that are considered more important or relevant to this project.
All of these focus points should then result in guidelines and parameters that directly initiate the design process. However when working with the integrated design process, it is usually necessary to reanalyse some topics after design conflicts.

In this project, the main architectural vision is to create an unique or even iconic building, which therefore results in a thorough analysis of what is iconic architecture and how it can be applied on this location. On the engineering side, the indoor comfort is considered most important, especially temperature-, air quality- and acoustic conditions.



The project is based on the competition, arranged by Faxe municipality, to create a new Cultural house that links the city centre with the limestone quarry. The competition is based upon insinuations partly from East Zealand Museum -with interest in the unique history and opportunities with the quarry and from Café Biografen -because their success and business is limited by the current physical environment.

The municipality has a vision of cultural junction on the edge of the quarry, where cinema, museum, café, recreative areas and sport facilities can be enjoyed together with the spectacular view over the limestone quarry.

The placement of the cultural junction on the edge of the quarry, means that the city opens up towards it and makes this historically unique landscape a part of the city. After 100 years of exclusive industrial benefits, the quarry will now be appreciated by local inhabitants, tourists and geologists, both as a unique landscape and as a geological time machine.

METHOD TOOLS

Throughout the project period, several applications are used, some for technical calculations and others for visualisation. These are listed below.

ARCHICAD is used to visualize the building in form of plans, sections and 3D.

ARTLANTIS is used to create 3D renderings of the building, with realistic lighting and materials.

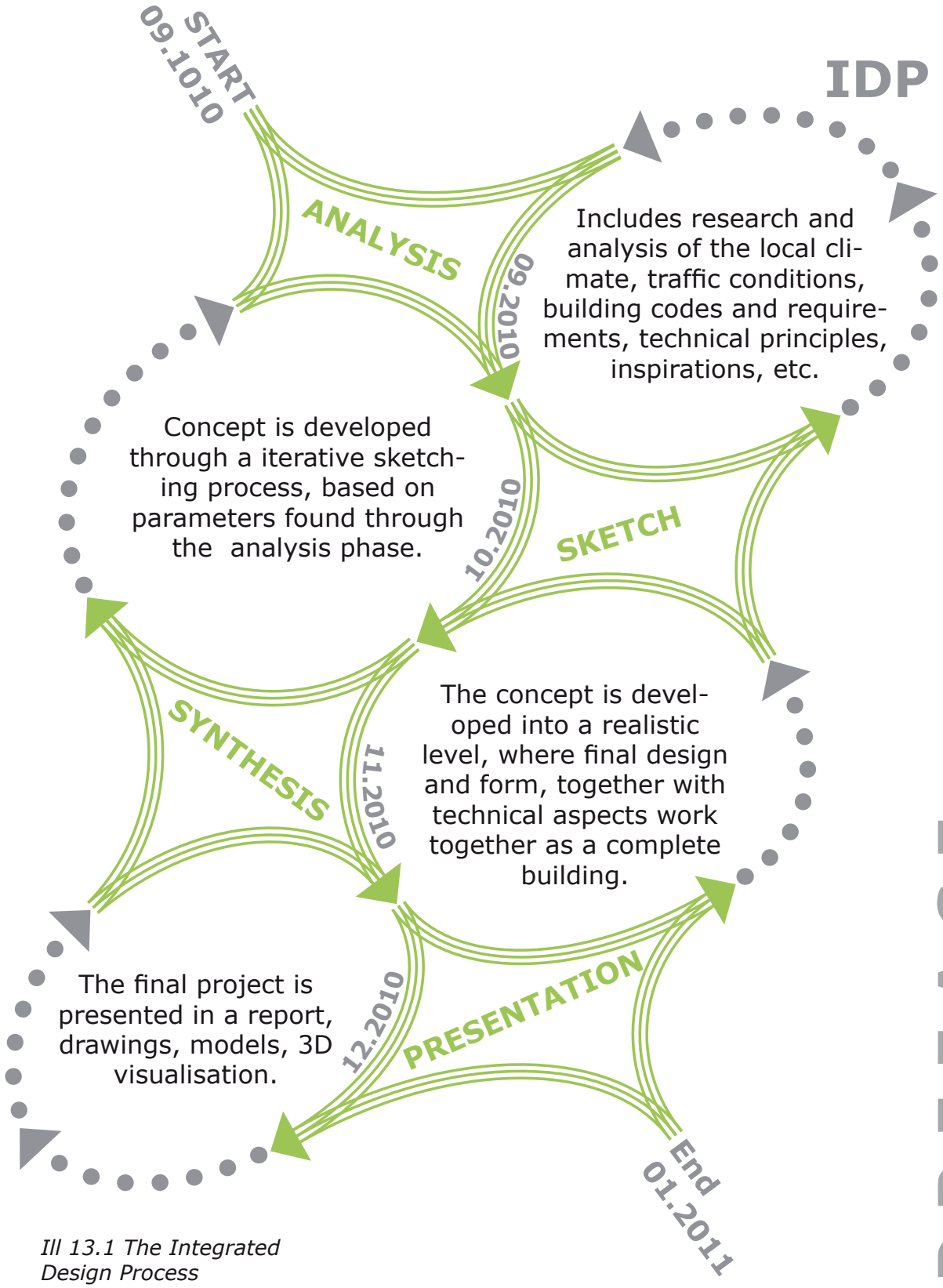
PHOTOSHOP and **ILLUSTRATOR** are used to give illustration and renderings a finishing touch and to redesign other illustrations. **IN DESIGN** is used for the layout of the report, posters and the presentation.

EXCEL SHEETS evaluate the daily and monthly temperature average, so overheating and heating demands can be reduced. They are used in the early process to quickly get an idea about energy and thermal affects by changes in building volume, window ratio, orientation, etc.

BSIM is a program that simulates and calculates various technical aspects within the building. A technically accurate building or room is built in 3D, which includes wall compositions, window type, heat loads etc. and the evaluation shows thermal changes, ventilation rate, air quality, etc. throughout a year. It will mainly be used to optimise the indoor climate in regards to temperature and air quality.

BE06 is the official Danish program to document a building total energy consumption and to find out if it fulfils the requirements. The building or room can be imported from the 3D model in BSim.

ECOTECT is used to simulate and adjust acoustics, natural- and artificial lighting and ventilation within the building. This program is mainly used in the synthesis phase.



Ill 13.1 The Integrated Design Process

MOTIVATION

Ill 14.1 Oslo Opera House, Snøhetta

The motivation to let the competition form the basis of this project, is partly the opportunity to work with the unique landscape in the context and use it as inspiration for the building design. Furthermore the functions within the building and the cultural signification of the building inspire to create something quite special.

The competition encourages the design to create a link between the limestone quarry and the city centre, as well as to create an open air stage. This is comprehended as a desire to use the building as a public attraction internal as well external, as seen with Oslo Opera House.

PREFACE

Ill 16.1-2 Map of Denmark and Faxe

LOCATION

Faxe is located on southeast Zealand and has approximately 4.000 inhabitants. The site is located on the east edge of the city with a spectacular sight of the unique landscape in the limestone quarry.

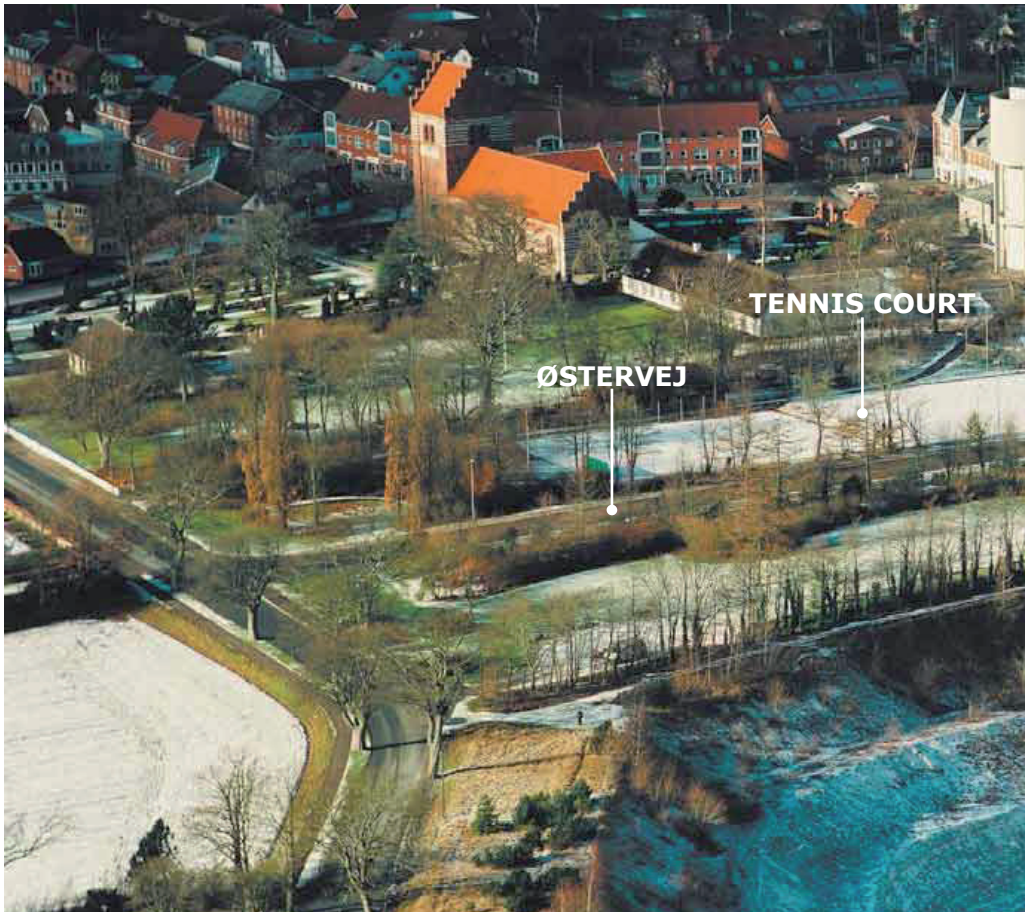
CONTEXT

SITE

The building site is 4.200 m^2 and is situated between the quarry to east and Østervej to west and to north and south there are recreative/park areas. The local plan states that 60% of the site can be built on and the building can be up to 10 meters, although the main building shall be at least 6 meters tall.

The area has scattered planting, but the competition allows for this to be modified according to building purpose/design, as well as it open up to the possibility to build underground, but it is strictly prohibited to change the quarry wall, since this is considered of highly geological value.

Ill 18.1 Perspective view of the site



SURROUNDINGS

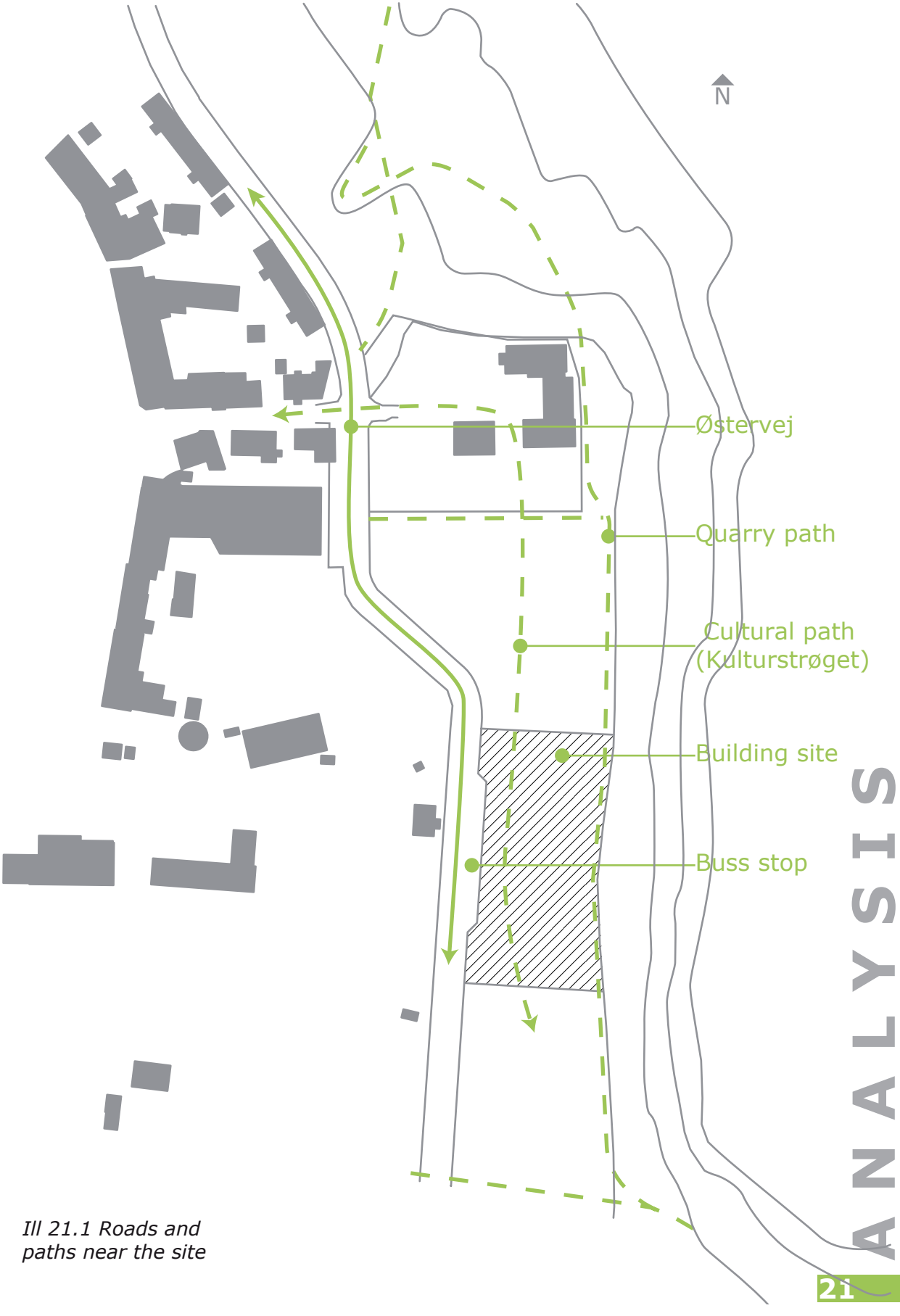
The closest buildings are Faxe Hostel (Faxe Vandrehjem), which is a scattered 2-3 stories complex, located north of the site. West of Østervej are Faxe Water tower and Faxe Church, which also are the highest structures in the area, reaching 25-30 meters. Two tennis courts are located between the church and Østervej.

ACCESS

Vehicle access to the building is to be from Østervej, while pedestrian paths must connect the building to the city centre as well as the quarry. Bicycle parking must be naturally integrated into the building, while parking facilities are not included in the project.

The pedestrian path (Kulturstøget) runs through the building site and can potentially be an integrated part of the new building, however the view of quarry from the path must be minimally disturbed.

The competition also encourages a connection to the building's closest neighbours Faxe Hostel (vandrehjemmet), so the hostels visitors easily can benefit from the new building and it's surroundings.



Ill 21.1 Roads and paths near the site

THE QUARRY

Faxe limestone quarry is quite unique because of it's geological value to science. Nowhere else is the 63 million year old coral chalk so accessible as here and it is filled with fossils, giving insight into a time when this part of Denmark was covered with water.

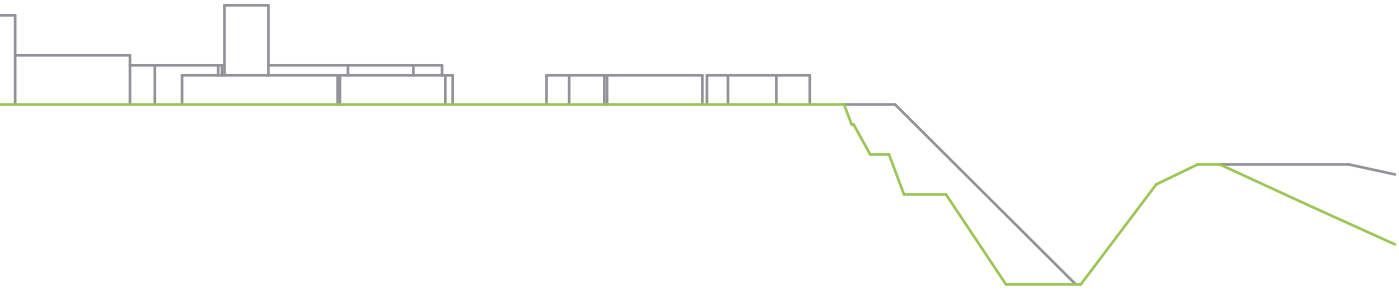
The quarry is active and has a current license to extract chalk until 2033. However the local authorities want to convert the quarry into a recreative park area, with a great variety of functions, thus changing it from being an industrial quarry into a natural and attractive part of the city.

The functions in the restoration plan include several sport activities, such as rowing, waterskiing, motocross, mountain bike, horse riding and skiing. As well as several geological, recreational and cultural activities. *(Local plan)*

Ill 22.1 Section through the site

"The quarry in Faxe is the largest man made hole in the ground of Denmark. The quarry has been active for 900 years. The limestone is formed by corals and other animals, that thrived on the bottom of a deep ocean 63 million years ago - shortly after the extinction of the dinosaurs. The limestone is unique."

- GeoMuseum Faxe.



Ill 23.1 Restoration plan

2008–2030:

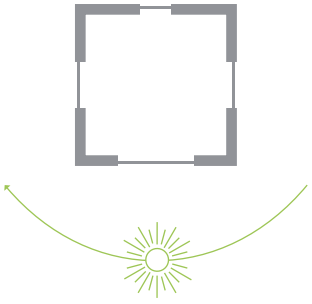
1. Adgangssti
2. Adgangsvej for k rende
3. Amphiteater
4. Bes gscenter
5. Biograf og kulturhus
6. Bypark
7. Bådudlejning
8. Dinosaurernes skov
9. Dyrefolde
10. Fossilmark m. koralkalk og bryozokalk
11. Gamle sorteringsanlæg
12. Geologisk Eksperimentarium
13. Geologisk Museum
14. Geologisk vindue med "tidssti"
15. Hytter
16. Jorddeponi
17. Jordvolde
18. Kalkindvindingsområde
19. Kalkplanteskole
20. Kalkværksmuseum
21. Kantsti
22. Kaproningsbane
23. Klubhus
24. Kunstig bakke
25. Kunstige er
26. K reteknisk anlæg
27. Materialgård
28. Motocrossbane
29. Mountainbike-bane
30. Ny vej (Østervej)
31. Ny bydel m. udsigt
32. Off-roadbane
33. Rideklub
34. Roklub
35. Rollotårnet (nyt)
36. Skibakke
37. Skovindvandring
38. Skovplantnning
39. Svævebane
40. Tidsstier
41. Tipvognsbane
42. Udsigtspunkt
43. Vandrehjem
44. Vandskiklub
45. Vandskis

mål ca. 1:10.000

MICROCLIMATE

SUN

To create a sensible indoor climate it's necessary to understand the local climate and to integrate them into the early design process.



Ill 24.1 Window ratio and orientation can significantly impact the internal temperature.

The sun conditions are based on the location's geographical position and in Denmark the difference between summer and winter is quite significant. In the summer period the building exposure to the sun can easily cause overheat and discomfort within the building, while during the winter periods it is important to exploit as much passive solar heat as possible.

Furthermore the surrounding context influences the building's exposure to sunlight. Towards east the site opens up to the quarry which means that the morning sun uninterrupted can warm up the building.

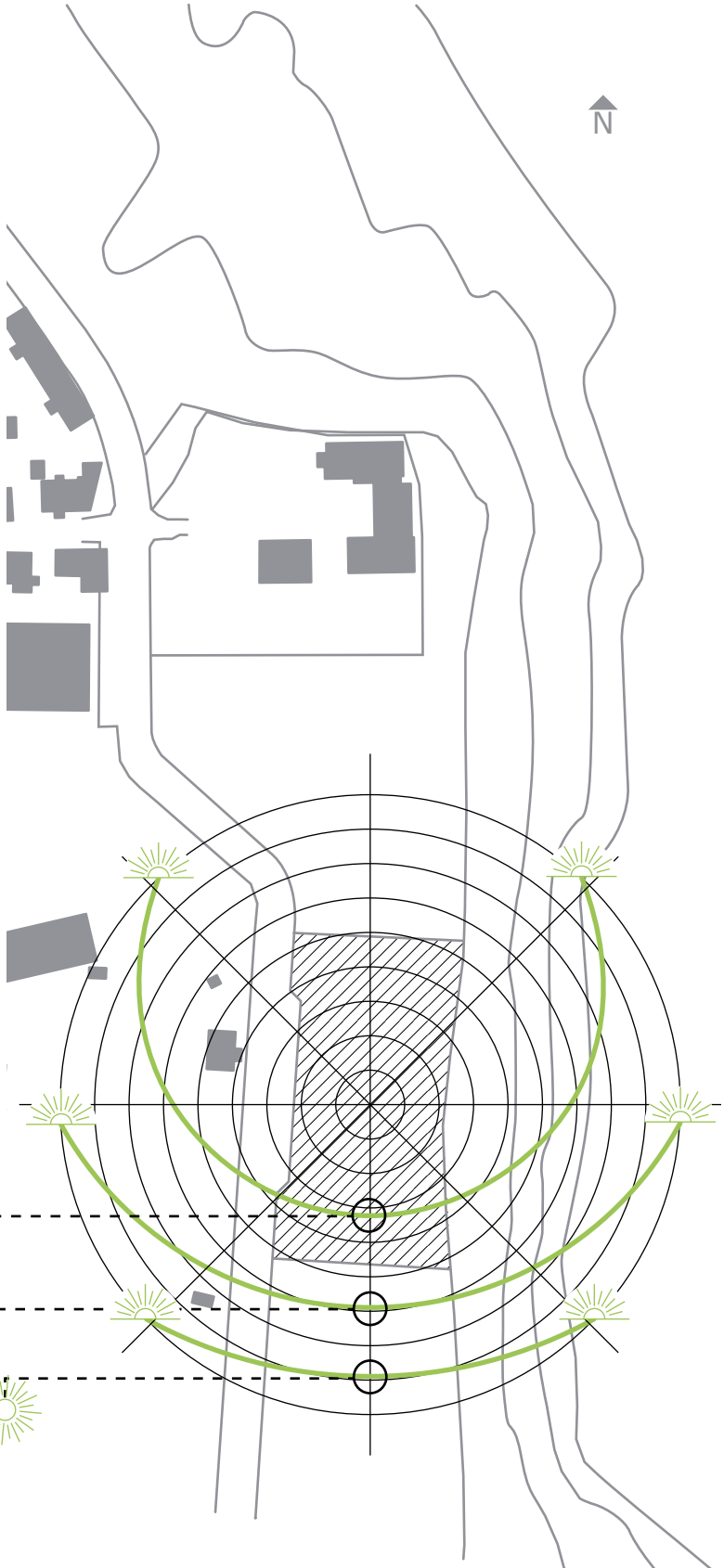
Ill 24.2 Vegetation can be used to provide shade during summer to avoid overheating.

The functions within the building state that the building will not be used during morning hours, which therefore gives an ideal opportunity to warm up the building prior to use. Towards south and west there are no structures that significantly shade the building. However the scattered vegetation in the area can be used to shade parts of the building.

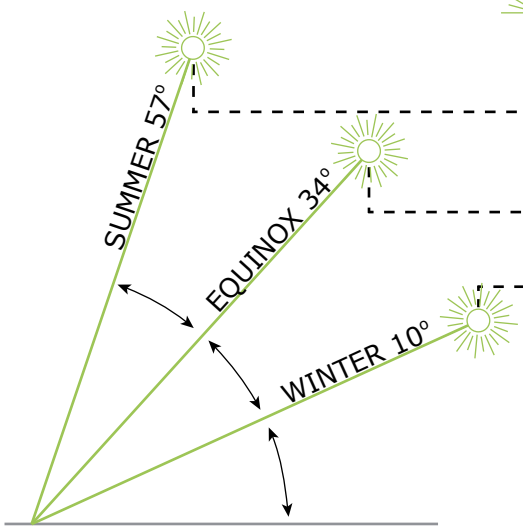
WIND

As in most parts of Denmark the dominating wind direction is from west and because the site is located on the east edge of the city, the city provides some shelter against the wind.

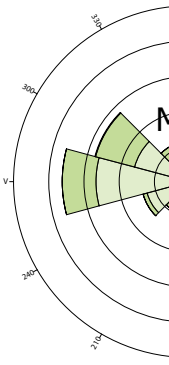
Ill 25.1 Sun azimuth angles in respectively summer, winter and equinox.



Ill 25.2 Altitude angles at noon.



Ill 26.1 Map of Denmark indicating Faxe and Bønsvig.



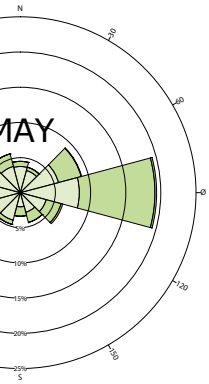
The wind rose is taken from Bønsvig weather station, located on south Zealand about 15 km south of Faxe. Bønsvig is exposed to the Baltic Sea, which therefore also affects the wind, but since the building site is located on top of Faxe bank, it is considered to be approximately the same and is therefore used as reference.

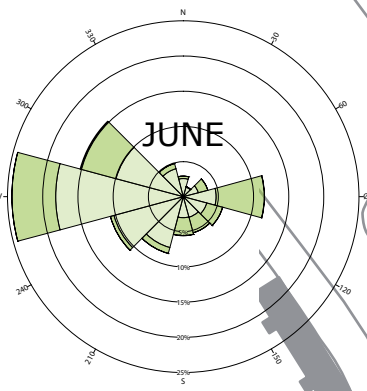
The wind can have a negative affect on the building energy consumption, the indoor- and outdoor comfort, as well as the building structure. But the wind can also be used actively to naturally ventilate the building, although this might cause discomfort with draught, if not correctly designed, and the wind speed must not exceed 0,15 m/s. *(BR10)*

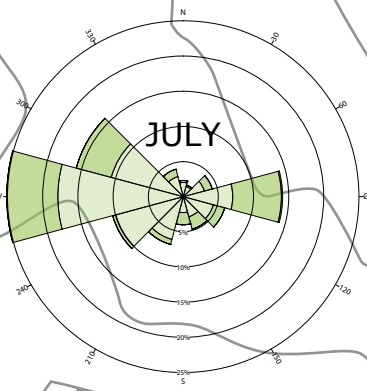
It is considered of great importance to implicate these factors in the early design process, especially when planning the building internal and external functions and orientations.

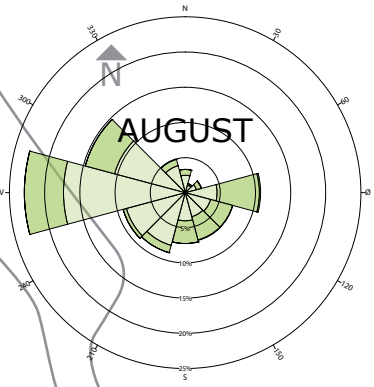
The external areas surrounding the building shall, especially during the summer periods, be an active part of the cultural and social environment of the city. Therefore it is important also to investigate the wind conditions during the summer.

The wind roses on the next page show that the wind from east is much stronger during the summer compared to the annual. The open landscape towards east does not give any shelter from this wind, therefore the building design must respect the eastern wind, if the external east areas are to be used, for example as a part of the café. *(DMI)*



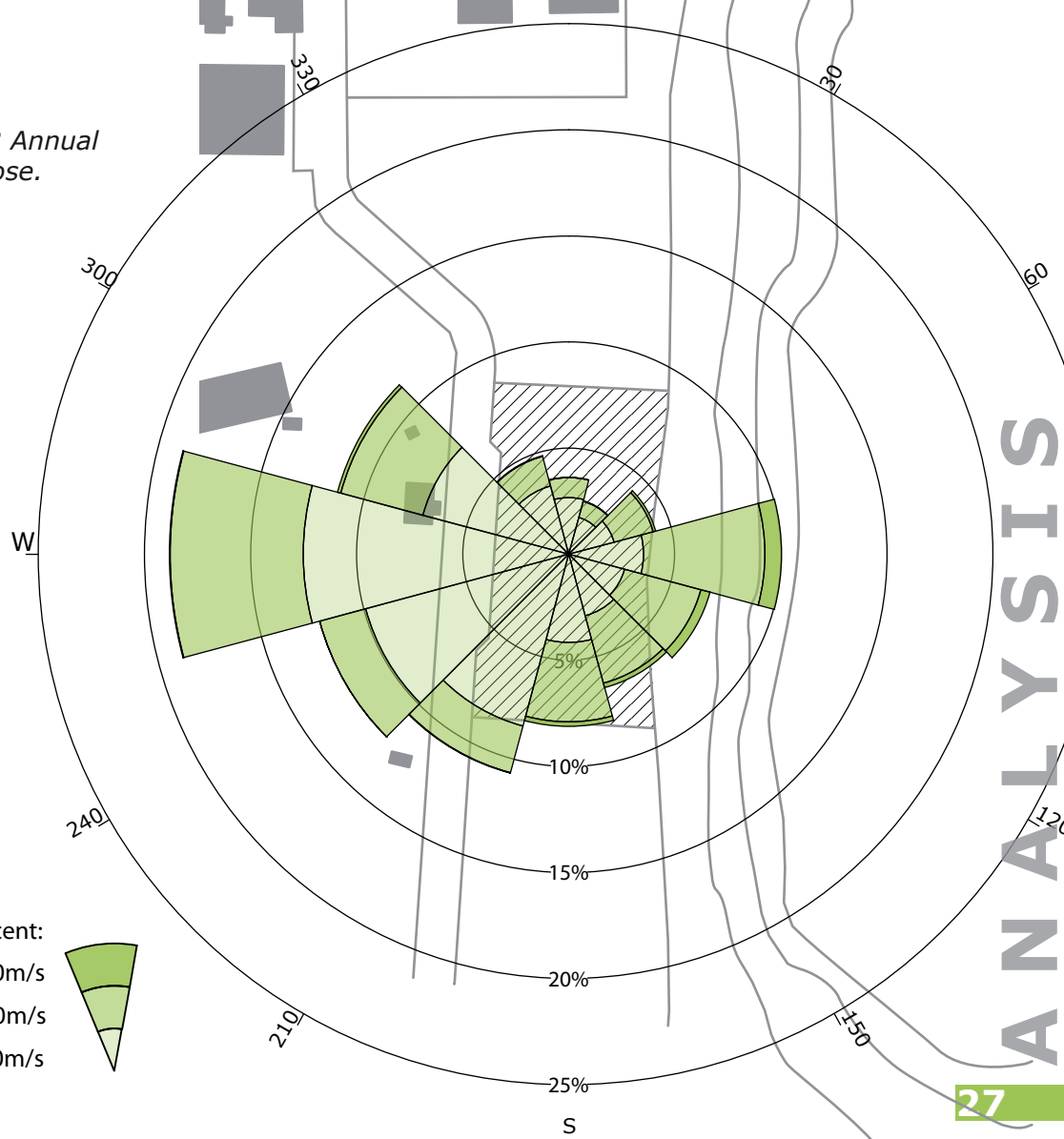






Ill 27.1 Monthly wind roses.

Ill 27.2 Annual wind rose.



COMFORT

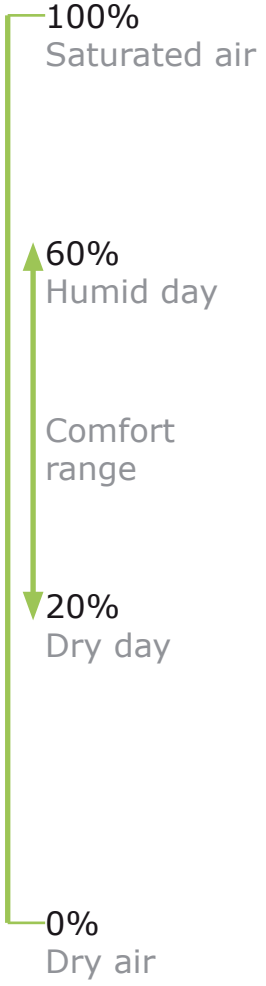
To provide Faxe with a quality cultural house, it is of great importance to consider the indoor- environment, experience and functionality along with the outdoor visual impact and architectural design. The building must be a place where both employees and visitors are comfortable at all times, whether there are 100 or 2 people and whether it is summer or winter. Because no architectural delight can compensate for the feeling of discomfort within a building.

It is important to investigate the actual conditions the building will be exposed to. The competition program states that young school classes often come to visit the museum, which means that some 20+ children, that might be noisy, must not disturb the experience for other visitors. This can be quite the challenge, especially in regards to the acoustic quality within the building. Furthermore the daylight and view requirements for the museum part, can easily cause overheat within the building.

The indoor comfort can be divided into 4 physical aspects that are measurable, air quality, thermal-, visual- and acoustic conditions. But these aspects also have a psychological affect on humans, that can't be measured, for example will the view have an huge effect on the visual comfort within a building, although it can not be measured.

Beside the exact measurable values, the subjective human factors are the most significant for the architects. This relates to the actual comfort level users get from being in the building. These levels are divided into three categories according to dissatisfied, where A has the most satisfied users and C has the least. *(CR 1752)*

HUMIDITY



Ill 29.1 Graph of relative humidity.

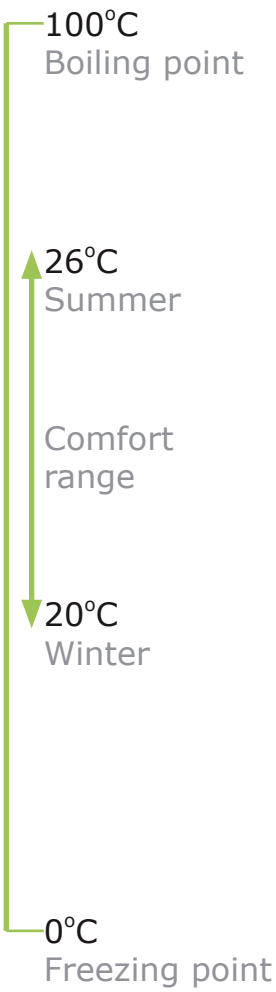
The museum and café are set to category A, while the cinema and the secondary functions are set to category B, however the cinema has other requirements according to the THX standard. *(Competition program)*

AIR QUALITY

The internal air quality in buildings has always been an important issue for architects. The Victorian architects introduced ventilation chimneys, cupolas and grilles. Especially public buildings, such as schools and hospitals used innovative ventilation principles, that still are applied in modern buildings. Some 100 years ago, the main concern was to get rid of products from human occupancy, and prevailing principle became; the more ventilation the better.

Nowadays the main concern is the energy consumption, which often means low rate ventilation and almost none infiltration rates, to minimize the heat loss. But because of pollution from humans, machines and appliances within the building, air quality will be reduces if not ventilated correctly. Humans produce carbon dioxide proportionally to their activity and too high level of CO_2 will cause dissatisfaction. Therefore it essential to investigate the expected level of CO_2 and ventilate according to it. The CO_2 level in the internal air must not exceed 0,1% in longer periods. *(BR10)*

Ensuring good air quality within the building, can be solved with three different kinds of ventilation, mechanical, natural and hybrid. There are advantages and disadvantages with all three sorts and they all effect the design of the building. Mechanical ventilation is required in some parts of the building and might be the most suitable throughout the building, because of the many occupants and the timewise



Ill 30.1 Graph of relative temperature.

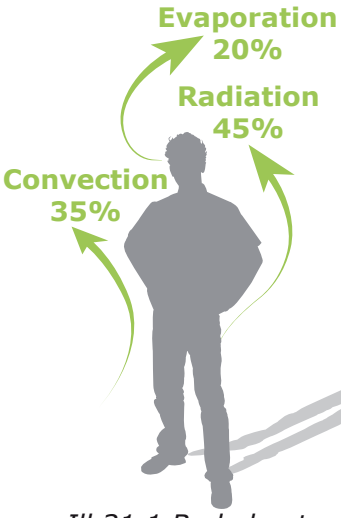
limited usage of some functions. However the natural ventilation principles can efficiently be used as additional ventilation, especially during the summer period. Therefore it is considered reasonable to use hybrid ventilation and design a building that easily can change between being naturally and mechanically ventilated. This can be done by designing according to natural ventilation principles and place mechanical inlets and outlets according the natural. Therefore stack ventilation will be used where suitable. These principle uses thermal buoyancy, where cool air entering at a low level is heated by users and appliances, and then rises upwards and is extracted.

THERMAL COMFORT

Thermal comfort relates to the thermal balance between heat gains due to the metabolism of the body and heat losses from the body to the environment. Ill 30.1 indicates the breakdown of the heat-loss mechanism. The evaporation is affected by humidity and air movement, convection by air- temperature and movement, and radiation by the mean radian temperature. *(Energy and Environment in Architecture)*

Usually discomfort can be explained by long-term imbalance of losses and metabolic gains, or extreme values of one of the environmental parameters.
Thus to provide comfortable temperatures within the building, the temperature, humidity and air movement, must relate to peoples clothing and activity level (metabolic rate). The metabolic rate is set to 1.6 in the museum, -which corresponds with light shopping, 1.0 in the café and cinema, -which corresponds with relaxed or sitting. *(CR 1752)*

The functions in the building should also be orientated and proportioned to avoid overheating, while



Ill 31.1 Body heat loss in typical conditions.

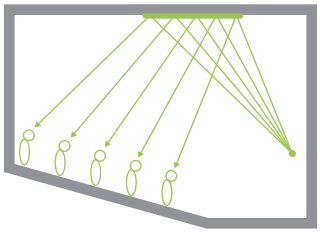
still utilising the available passive solar gains, for example by passively solar heating the café and museum area before opening it. It is also important to avoid local radiant heat-loss and down-draughts due to usage of large glazed areas. *(Energy and Environment in Architecture)*

The design temperature is 24.5 C° during summer and 22.0 C° during winter and the maximum variation in the temperature varies according to functions and user satisfaction (see Room program p.50). In extreme conditions all buildings can overheat, but this must not exceed 27 C° for more than 25 hours each year. *(DS 474)*

ACOUSTIC COMFORT

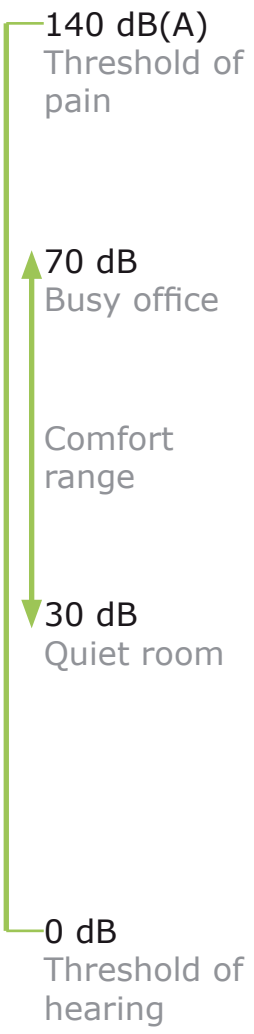
The detailed acoustic requirements for a room depend upon the purpose and function within it. The exact nature of good sound is partly a matter of personal preference. But there are some measurable factors that affect the experienced acoustic conditions. Generally to ensure good acoustic the room should have:

- **Adequate levels of sound**
- **Even distribution of sound**
- **Suitable reverberation time**
- **Reduced external noise**
- **Absence of acoustic defects**



Ill 31.2 Plane reflector of sound.

The three main parameters that affect the acoustic quality are reflection, absorption and reverberation. Sound is reflected in the same way as light, provided that the reflecting object is larger that the wavelength of the sound concerned. Which means that sound reflection can be predicted by drawing straight lines on a plan or section of a room. *(Environmental science in building)*



Ill 32.1 Graph of relative sound level.

Reflection is mainly used to ensure that sound from a source reaches its audience, for example in an auditorium. But reflecting surfaces can also cause echoes if the reflection is delayed enough, or reverberation if the room is big enough, which might become a factor in the museum.

In the cinemas the acoustic conditions are quite simple; the sound from the room and audience must be reduced, because the movie sound is distributed by use of multiple speakers strategically placed in the room. This will be solved with absorbing materials. *(THX)*

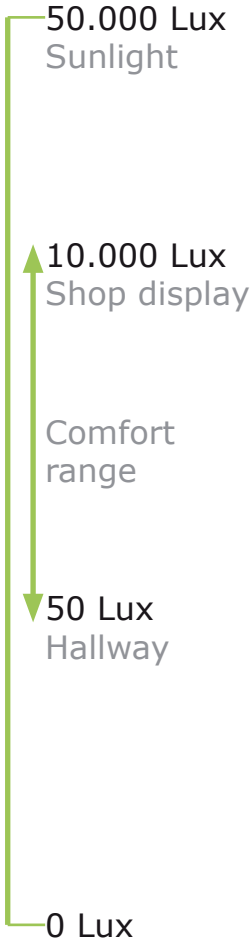
But in the museum and café, the acoustic conditions are much different and relate mostly reducing the noise from external and internal environment. Which is solved by insulation and adding absorbing materials where needed.

VISUAL COMFORT

The provision of daylight is strongly linked to the spatial and architectural design of a building. Windows have a great visual and expressive effect on the building internal and external character, but also highly influence both energy usage and the general comfort and well-being of the occupants.

The most pleasant light source for human beings is natural daylight, however both to little and to much light can cause discomfort and eye strains. The illuminance of light can be quite precisely measured in either illuminance (LUX) or by using the daylight factor (DF), which is a percentage of the available local daylight. Different functions within the building require different illuminance and the challenge is not only to provide adequate harmonious luminance, but also to avoid glare and veiling reflection.

LIGHTING



Ill 33.1 Graph of relative illuminance.

Artificial lighting is also necessary as a supplement when the daylight factor is to low, for example during night, and in some functions, like the cinemas, which don't have natural daylight.

The most important design parameter regarding visual comfort is the positioning and proportions of windows, which controls the relation between the external and internal environment as well as the transmission of light, heat, sound and air. Therefore it is of great importance to integrate the glazing proportions, orientation and type in relation to its function in the early design process.

The reflectance of the ground and room surfaces, the shape of the room and the general design of the glazed opening all influence the intensity and distribution of daylight.

Direct sunlight can be used to passively heat the building, but it must be limited in the museum, because the exhibitions must have stabile lighting and therefore diffused or artificial lighting is most applicable.

The built environment must be within the comfort range of humans. The figure above shows the range of some of the most important factors within the building. *(Environmental science in building, CR 1752 and arbejdstilsynet)*

APPROACH

The architectural vision is to create an characteristic building that unifies the quarry with the city centre. The building's functions shall furthermore enhance the public and cultural experience externally as well as internal.

To create this characteristic building, three design concepts are investigated.

ICONIC

There is no exact description of what is iconic and an attempt to identify an iconic building has to be based on buildings that are recognized by most people. However these buildings are usually very big structures, that had massive financial support, which is not the case here.
Therefore it is considered necessary to identify certain architectural features, that don't relate to size and finance.

The architect of The Burj Al Arab in Dubai, which is the most exclusive and expensive hotel in the world, states that the design is inspired by the simple structure of a sail and clearly resembles it. He came with the idea that something iconic must be simple, solely to be recognizable. This iconic description relates well visual impact and recognizability buildings have with most people. However there are also buildings which might become iconic in a negative way, but then the question also relates to the concept of beauty, which is considered to be exclusively an individual point of view. For example are Antoni Gaudi's and Frank Gehry's rather unconventional buildings considered to be either architectural masterpieces or disasters, but surely they are recognizable.

"If you can draw a building with a few sweeps of the pen and everyone recognises not only the structure but also associates it with a place on earth, you have gone a long way towards creating something iconic"
Tom Wright, architect of The Burj Al Arab.

Ill 35.1 Bølgen, Vejle, Henning Larsen

Ill 35.2 Oslo Opera house, Snøhetta

Ill 35.3 Sydney Opera House, Jørn Utzon

Ill 35.4 Burj Al Arab,Tom Wright

Ill 36.4 Swiss Re, London, Norman Foster

Ill 36.1 Cypertech Egg, Mumbai, James Law

Ill 36.2 Birds Nest, Beijing, Herzog & De Meuron

Ill 36.5 Louvre, Paris, I.M.Pei

Ill 36.3 Moon Tower, Dubai, Transparent House

BIONICS

The conceptual idea that Tom Wright used for the Burj Al Arab, with resembling a recognizable element, such as a sail, is also used is bionics, which takes it's inspiration from nature.

Nature has been an inspiration for designers, architects and many other professions for centuries. The idea that an element from nature can improve structures, functionality etc. is no secret, but the identity of an recognizable element from nature can also be used directly as an inspiration for a building design. Examples of buildings inspired from natural elements can be seen on the previous page.

Because of the building's location on the edge of the city, it's cultural value and the museum within, it seems evident to base the design on an bionic relation to the quarry. The quarry has great variety of fossils and the majority of the museum shall display the prehistorical coral reef with the fossil's found in the quarry. Therefore the bionic approach will be based on fossils from the quarry.

NORDIC

The mixture of bionics and iconic design, should ensure an highly recognizable building, but to ensure functionality within and around the building, Nordic simplicity will also affect the design.

The idea is to incorporate the building with the environment, so they can work together as one unified cultural centre. Where both building an environment create spaces that can be used at all times. This vision is highly inspired from the Oslo Opera House, where the building's complex roof create much used public spaces.

This conceptual idea relates highly to the demand from the competition program to have an open air stage and the vision is to integrate it with the building design.

Ill 39.1-2 Arken, Køge Bugt,
Søren Robert Lund og Wilhelm Lauritzens tegnestue

Ill 39.3-4 Nordens Hus, Torshavn, Ola Steen

Ill 39.5-6 Aalborg Seminarium,
Nils Andersen og Salli Besiakov

Ill 40.1 Path down to quarry

Ill 40.2 Digging for fossils

Ill 40.3 Fossil sea urchins

Ill 40.4 Coral limestone

Ill 40.5 Playful learning

Ill 40.6 Coral reef display

FUNCTIONS

MUSEUM

The new museum must be a place where entertainment and professional insight together create distinctive impressions related to the experiences available in the limestone quarry.

The museum shall have a permanent exhibition in 2/3 of the exhibition area, that displays the prehistorical coral reef and shows the museum's priceless collection of fossils found in the quarry. The exhibition must have view over the quarry and a floor-to-ceiling height of minimum 4 meters. The additional 1/3 of the exhibition area is to have a flexible display, that focuses on children's playable approach towards knowledge and displays the scientists and employees actual work with the fossils. It is required to have access to the outdoor areas and daylight throughout the display.

The two exhibition areas must be connected, the floors must be level, the ceiling structure must be able to withstand heavy displays, as well it must be possible to deliver large objects(2,5m x 2,5m) to the exhibition area. The museum part must separately lockable.

The new 400 m^2 museum will be full of modern history of nature, that shall captivate the visitors with lights, animations, movies and interactive displays, along with the beautiful millions of years old fossils.

The fossils and the modern displays along with the location on the edge of Faxe limestone quarry create a unique trio, where each element enriches the experience of the others. *(Competition program and the museum's presentation folder)*

Ill 41.1 Concept sketch of museum

CINEMA

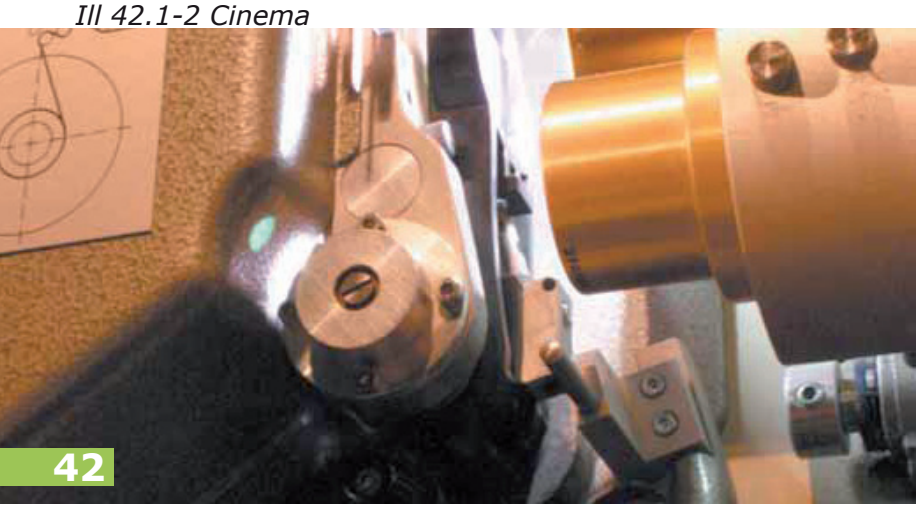
Café Biografen is considered East Zealand's quality cinema and with it's repertoire addresses a large audience. The cinema has a many public relations, such as with schools and is therefore becoming a social hub for the area's citizens. But the cinema also has it's own movie club "Delicatessen" with 12 years behind it, that shows movies that the audience otherwise would have to go to Copenhagen to see.

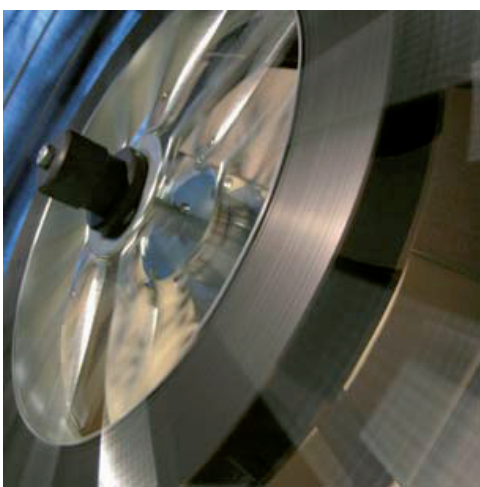
The new facilities for Café Biografen shall consist of two cinemas, with respectively 174 and 101 seats, that can be driven in interlock, thus showing films in both cinemas simultaneously.

It is required that the museum can use the cinemas facilities. The two cinemas must fulfil all requirements according to the THX-standard. Ventilation inlets are to be under the seats and exhaust shall be in the ceiling. If doors are placed on the side walls, they are to be minimum 4 meters away from the screen.

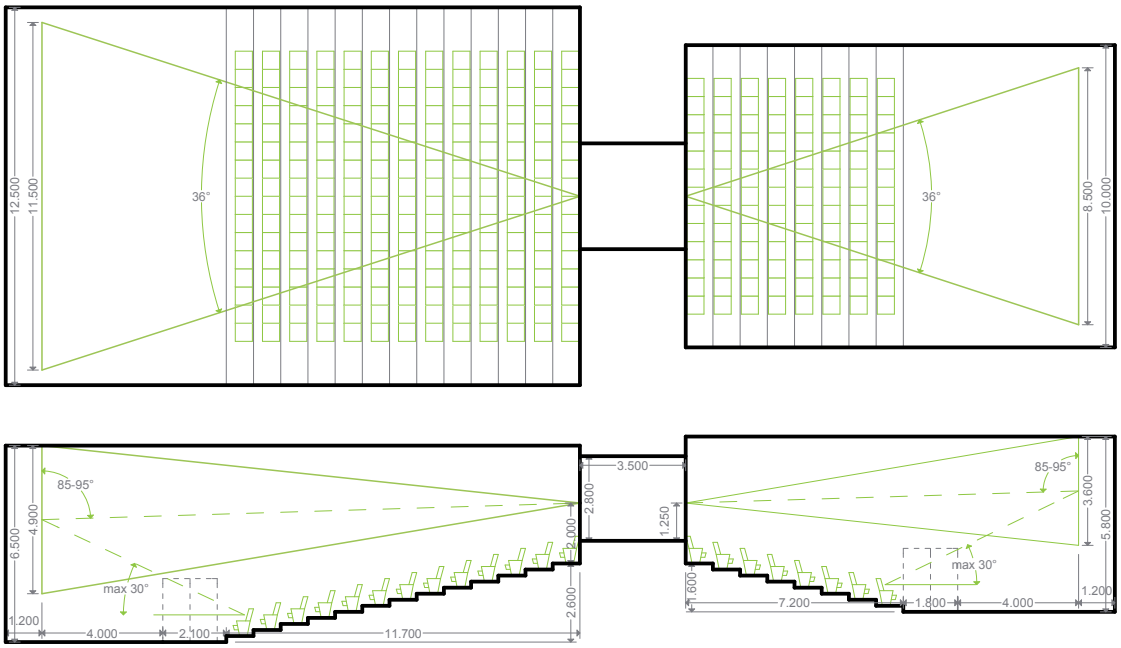
A office is to be located so that it has view over the café, as well as it is desired that it also has a view over the quarry. *(Competition program)*

Ill 42.1-2 Cinema





Ill 43.1-2



Ill 43.3 Geometrical requirements for the cinemas. Measurements are according to THX, competition program and Architects' Data by Neufert.

CAFÉ & FOYER

The café should have a central function within the building, that links the museum and cinema parts. But the café should also be available both before and after museum opening hours, being a local meeting place at the centre of the cultural path.

The vision is that the café should appear open and light, and focus should be on the view. Furthermore shall the interaction between outdoor and indoor environment be as fluid as possible.

Ill 44.1 Café

The café shall also have a more exclusive lounge area with open fireplace, where the visitors can relax, chat and get away from their daily life.

Tickets for both museum and cinema are to be bought in the café, as well as beverage, popcorn, sandwiches, etc and museum merchandises. Therefore it is evident that the café service, ticket- and museum sales interact and cooperate. The café shall also have a small kitchen where cold dishes can be prepared. A mutual repository, without windows to minimize risk of theft, for storing merchandises is also needed.

To have a good interaction between the two major functions, they have mutual toilettes, wardrobes, repository and entrance. Especially the mutual entrance with its weather porch, have an significant affect on the actual design. It is the first part experienced in the building and must therefore reflect that significance.

This mutual space is also intended to create interaction between visitors from both functions, thus preserving activity throughout most of the day.

The foyer must also be functional separately together with open air activities. The foyer is also intended as a display room for both museum exhibitions and movies in the cinema. *(Competition program)*

OUTDOOR

There are three major external function related directly to the building, the open air stage, the external café area and excursions to the quarry. The open air stage is to be integrated into the building it self and the external café area must be located to avoid wind, while still utilizing the view over the quarry.

Excursions to the quarry is an important part of the museum experience and especially school classes take advantage of these guided tours down to the quarry, where the children can by own hand search for fossils.

Ill 46.1 View from site towards quarry

This means that the building materials have to correspond with the activities they will be exposed to. Furthermore it is essential to have brushes and scraper mats externally, as well as floors and walls must be cleaning friendly against limestone.

The building is not only to be a house with cultural and social functions, but also social hub for the city. Therefore it is essential to design the external area so that it invites to social activities. The area is peaceful and has a certain serenity about it because of the location and the view. This is not to disturbed, rather embraced and magnified with the new building. *(Competition program)*

Ill 48.1 View from site towards city.
The location invites to social interactions and the building should encourage and be a part of it.

ROOM PROGRAM

	AREA [m²]	HEIGHT [m]	TIME OF USE	USERS [Persons]
MUSEUM				
Permanent display	230	4	10 - 17	40
Flexible display	160	4	10 - 17	25
Office	12	3	10 - 17	8
Repository	6	3	-	3
CINEMA				
Cinema 1	222	6.5	14 - 24	174
Cinema 2	130	5.8	14 - 24	101
Office	20	3	14 - 24	2
Projection room	20	3.5	14 - 24	2
Technical room	10	3	14 - 24	2
CAFÉ				
Cafe	110	3	10 - 22	40
Foyer	40	4	10 - 22	5
Repository	30	3	-	2
Toilette	20	3	10 - 22	2
Wardrobe	20	3	10 - 22	2
OTHER				
Staff toilette	10	3	10 - 24	1
Staff wardrobe	10	3	-	1
Technical room	15	3	-	1
Cleaning room	5	3	-	1
	a)	a & b)	a)	a)
TOTAL	**1070**			

a) Competition program - b) BR10

VOLUME [m³]	ORIENTATION [Angle °]	ROOM STRUCTURE	DAYLIGHT	LUMINANCE [lux]
920	60-120	Open	Yes	200
640	60-120	Open	Yes	200
36	30-90	Private	Yes	200
18	0-360	Closed	No	100
1443	0-360	Closed	No	200
754	0-360	Closed	No	200
60	30-90	Private	Yes	300
70	0-360	Closed	No	200
30	0-360	Closed	No	200
330	90-180	Open	Yes	500
160	270-360	Open	Yes	500
90	0-360	Closed	No	100
60	0-360	Private	-	200
60	270-360	Open	-	100
30	0-360	Private	-	200
30	0-360	Private	-	100
45	0-360	Closed	-	200
15	0-360	Closed	-	100

b)

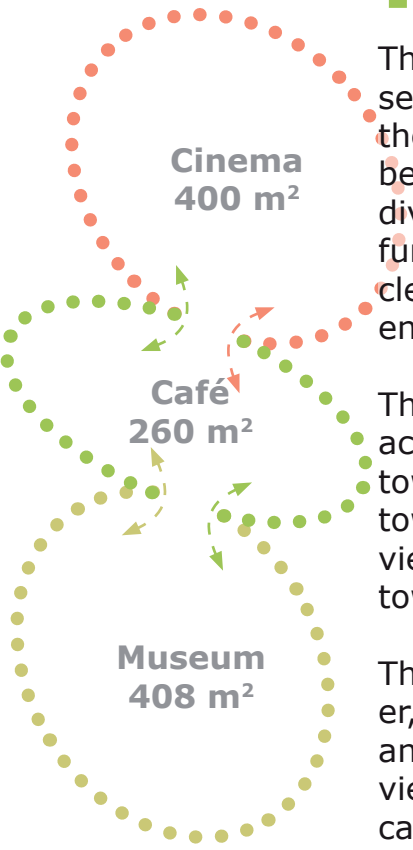
	AREA [m²]	SOUNDPROOF [dB(A)]	REVERBERATION TIME [s]
MUSEUM			
Permanent display	230	33	≤0,4
Flexible display	160	33	≤0,4
Office	12	55	≤0,6
Repository	6	45	≤0,9
CINEMA			
Cinema 1	222	33	≤0,4
Cinema 2	130	33	≤0,4
Office	20	35	≤0,6
Projection room	20	40	≤0,9
Technical room	10	40	≤0,9
CAFÉ			
Cafe	110	40/55	≤0,4
Foyer	40	40	≤0,9
Repository	30	45	≤0,9
Toilette	20	45	≤0,4
Wardrobe	20	45	≤0,9
OTHER			
Staff toilette	10	45	≤0,4
Staff wardrobe	10	45	≤0,9
Technical room	15	45	≤0,9
Cleaning room	5	45	≤0,9
		c)	c)

a) Competition program - b) BR10 - c) CR 1752

SUMMER TEMP [°C]	WINTER TEMP [°C]	VENTILATION [l/s pr m²] Type	Comfort(olf)	Health(Co2)
23.5-25.5	21.0-23.0	4.2	2.1	1.4
23.5-25.5	21.0-23.0	4.2	2.0	1.2
23.5-25.5	20.0-24.0	1.4*	2.1	1.3
22.5-26.5	19.0-25.0	0.4	1.0	0.3
23.0-26.0	20.0-24.0	11.2	6.8	6.3
23.0-26.0	20.0-24.0	11.2	6.7	6.2
23.5-25.5	21.0-23.0	1.4	1.5	0.8
23.0-26.0	20.0-24.0	2.1	1.2	0.4
23.0-26.0	20.0-24.0	2.1	0.8	0.0
23.5-25.5	21.0-23.0	5.6[1)]	3.6	2.9
22.5-26.5	19.0-25.0	0.4	2.7	2.0
22.5-26.5	19.0-25.0	0.4	1.0	0.3
23.0-26.0	20.0-24.0	0.4[2)]	2.7	2.0
23.0-26.0	20.0-24.0	0.4	1.2	0.4
23.0-26.0	20.0-24.0	0.4[2)]	2.3	1.6
23.0-26.0	20.0-24.0	0.4	1.5	0.8
23.0-26.0	20.0-24.0	2.1	1.3	0.5
23.0-26.0	20.0-24.0	2.1	2.3	1.6
c)				b and c)

[1)] Kitchen min. 20 l/s
[2)] Bathroom min. 15 l/s

PROGRAMMING



Ill 54.1 The connection between the primary functions and their relative size.

The building is divided into three elements, the museum, the cinema and the café. The idea is that the café is to work as a social hub for the city and be the central station within the building. In this division the café also includes most of the mutual function, such as toilettes, wardrobe, technical- and cleaning rooms and repositories, as well as the main entrance to the building.

The requirements for the café are mainly to be easily accessible from Østervej and have access and view towards the quarry. The museum also requires view towards the quarry, but the cinema has no need for view and is therefore placed either underground or towards southwest.

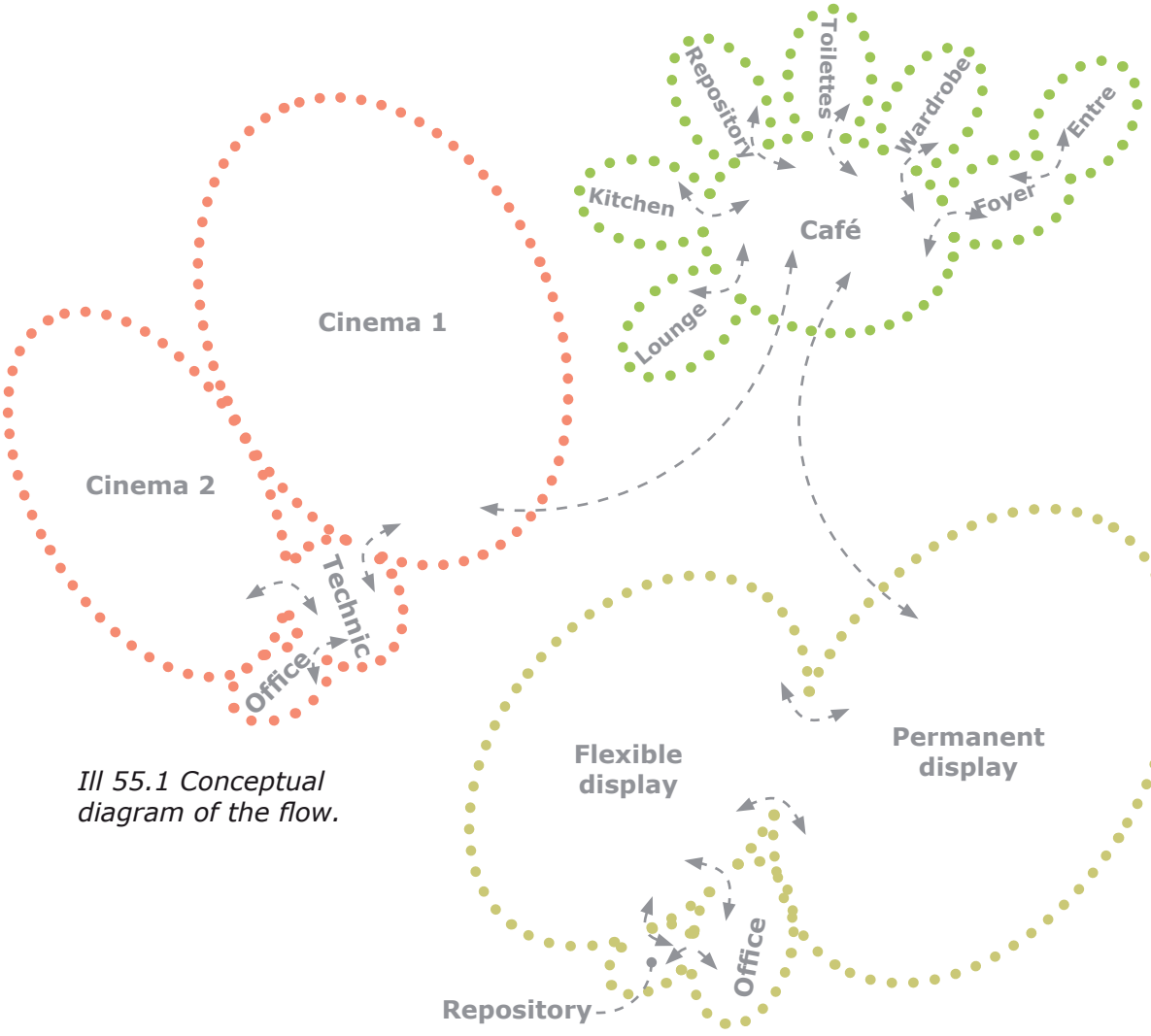
The café consists of entrance or weather porch, foyer, lounge, kitchen, wardrobe, toilettes, repository and cafeteria. The lounge and cafeteria shall have view towards the quarry, whereas the other function can be placed as best suitable.

The cinema consists of two cinemas, technical and projection room and an office. The office shall view towards the café and the quarry.

The museum consists of a permanent- and a flexible exhibition area, an office and a repository. The repository can be freely situated, while the other functions shall have view towards the quarry.

The building can be up to 10 meters high, so the possibility to build in multiple stories exists, but the idea with using roof areas as a part of the external social area, conflicts with this.
The flow concept shows how the various functions interact and the various functions with approximate square meters. The concept shows all functions

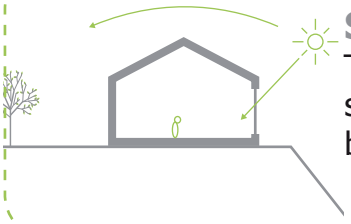
within the building, except corridors and hallways. The connection between the café and respectively cinema and museum, is not obvious, because it could be from both foyer and café. And toilettes, wardrobe and repository have to interact with this connection.



Ill 55.1 Conceptual diagram of the flow.

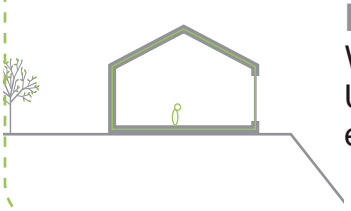
PARAMETERS

ENGINEERING



SOLAR GAINS

To reduce the heating demand, it's found sensible to utilize the morning sun to help heat the building.



BUILDING ENVELOPE

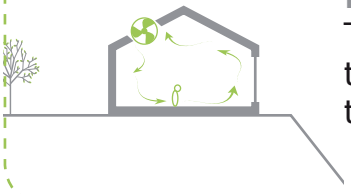
Wall compositions and windows must have low U-values to reduce the heat loss through the envelope.

ACOUSTIC COMFORT

The acoustic conditions are affected by proportions and materials, and especially the reverberation time and external noise must be respected.

NATURAL VENTILATION

Passive cooling can be applied during the summer periods to reduce the energy demand.



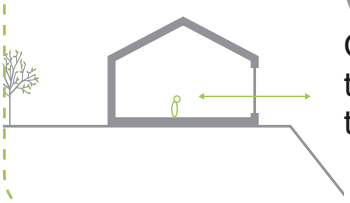
MECHANICAL VENTILATION

To ensure comfortable air quality and temperature throughout the year, mechanical ventilation will be installed.

ARCHITECTURAL

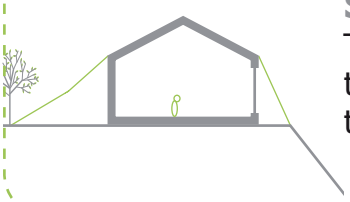
ICONIC

The architectural vision is to create a unique and iconic building. This will be pursuit by implementing a bionic relation to the quarry.



VISUAL COMFORT

Glazed areas should be orientated to provide the necessary view, as well as reasonable internal lighting.

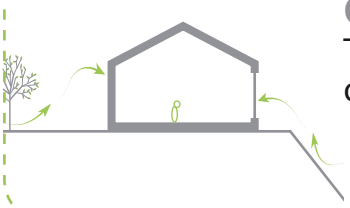


SITE INTEGRATION

The building shall function as a social hub externally as well internal with a natural connection to the site.

SYNERGY

The functions within the building shall interact in a way that occurs natural, thus creating a synergy in between.



CONNECT CITY & QUARRY

The building must indicate and intensify the connection between the city and quarry.

VISION

The overall vision with the project is to design an iconic building, that links the city to the quarry and manifests the new cultural area of Faxe as a socially interactive environment. This is implemented by integrating the building with the site, thus creating applicable external areas.

DESIGN

The external design of the building shall reflect the quarry and the geological content within. Therefore the design basis is found from fossils, that will elaborate into a recognizable explicit building.

FUNCTIONS

The museum, café and cinema must interact and achieve synergy. There shall be an unsophisticated flow through the building that highlights the view towards the quarry, without interfering with the functions.

COMFORT

The indoor environment will not be compromised against aesthetic decisions. Especially acoustic-, thermal- and atmospheric conditions will affect the design.

THESIS

The cultural building shall function as a social hub and visualize faxe's new susceptibility towards the limestone quarry with a perceptible iconic design.

PROCESS

INTRO

As mentioned in the program, the design has been developed with use of the integrated design process (IDP), and is therefore not a linear, but a iterative process. This means that many of the early design assumptions have to be reevaluated and sometimes changed on a later state, which basically means that the process have to begin again. This results in a process that included many aspects of each individual part of the design and should ultimately become a thoroughly processed building.

The program and the design parameters initiate the concept development, which in this case is much influenced by the desire to create an iconic building. This means that the visual aspect of the design is considered more important than the functional-, environmental- and practical aspects in the early process.

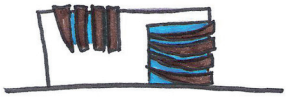
SKETCHING PHASE

CONCEPT

Ill 64.1

The first phase of the design process was to develop a concept for the external expression of the building, which should be iconic and reflect the relation to the quarry. The relation to the quarry is considered through its geological value, the extreme landscape, the coral fossils and the limestone. In the initial process especially the coral fossils where considered interesting and became the main inspiration.

Ill 64.2



Ill 64.3

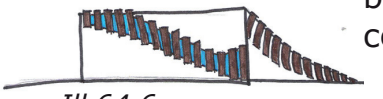
The first idea was to have an undefined building shape and experimenting with the facades, which would allow for a highly adaptable function distribution, without changing the building shape and concept. This was also considered as a way to show the fossils captured within the limestone, where the building shape was limestone and the fossils emerge and disappear randomly (ill 62.1-6).

Ill 64.4

An alternative became to show the coral reef structure together with the fossils (ill 62.7 & 63.1). Ill 63.9 shows the fossilized coral reef up close.

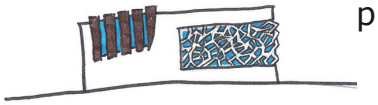
Ill 64.5

The next approach was to have a continuous structure that adapted the building with the surroundings and gave the possibility to actively use the building roof as an social outdoor area. Furthermore the continuous shape allowed for the fossil to disappear and reappear, not only within the building structure, but also down into the quarry and towards the city centre, thus creating a direct link (ill 63.2-5).



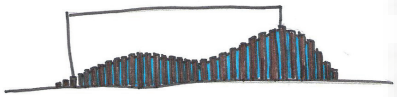
Ill 64.6

Another idea was to approach the design as a sculpture instead of a building, where especially the coral reef and the continuous bone structure where applied (ill 63.6-7).



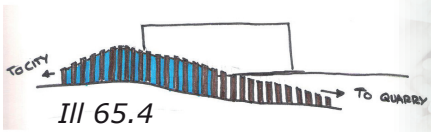
Ill 64.7

Ill 65.1

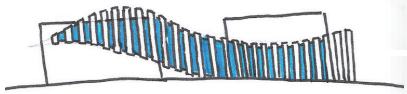


Ill 65.2

Ill 65.3

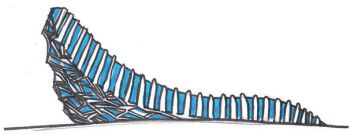


Ill 65.4



Ill 65.5

Ill 65.6



Ill 65.7

Ill 65.8 Fossils in the limestone

Ill 65.9 Fossilized coral reef

Ill 65.10 Continuous bone structure

FOSSILS IN THE LIMESTONE

Ill 66.1

Ill 66.2

Ill 66.3

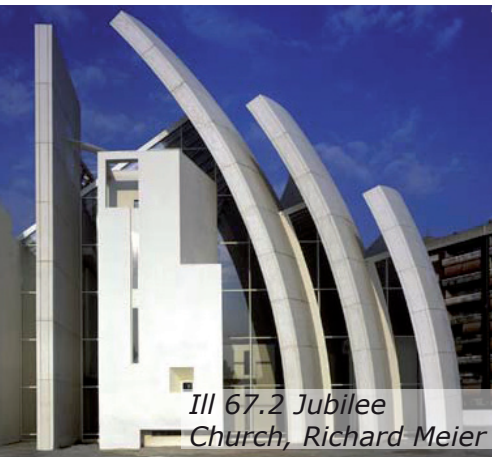
The concept can be divided into three different bionical approaches, whereas the first is the fossil in the limestone, which relates to the way fossils usually are found after millions of years. The structure of the fossil is therefore irrelevant and can be of any animal. This first approach relates more to the way the various bone structures emerge and disappear from the stone, which is directly adapted to the building design, where a bone structure is simulated by a vertical tilted structure embedded within the straight walls, that simulate the limestone.

This approach gives a highly adaptable interior and exterior, which can be arranged according to the desired functions, daylight- and energy requirements and flow within the building.

The way the bone structure cuts and extrudes the building envelope would cause the energy demands to increase because of the bigger surface causing a bigger heat loss.

On a aesthetic level the building could easily become an attraction with such a design, but the fact that the recognizability of the building would not be sufficient with such a complex design to make the building iconic, this design approach is not considered appropriate.

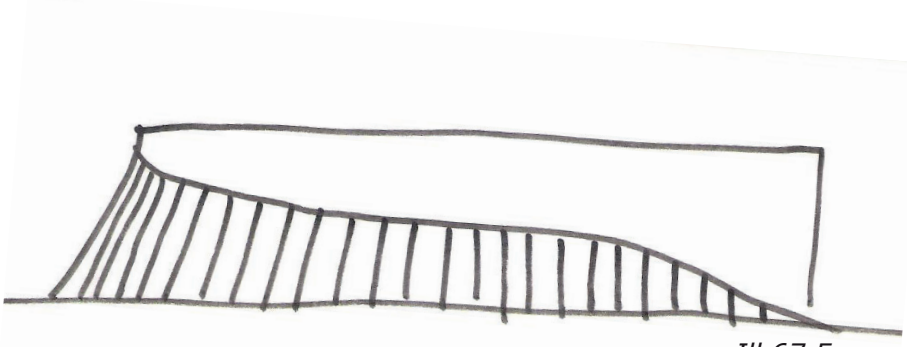
Ill 67.1 Serpentine Gallery Pavilion 2007



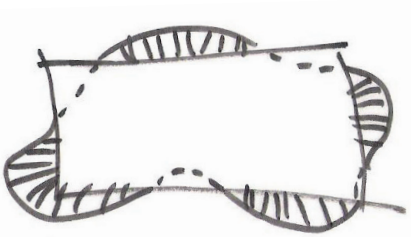
Ill 67.2 Jubilee Church, Richard Meier

Ill 67.3 Letter Box, McBride Charles Ryan

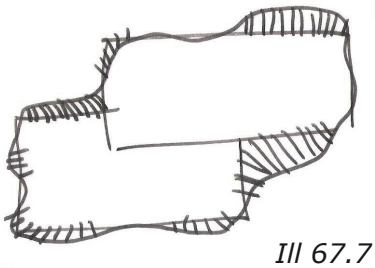
Ill 67.4 Otto Bock, Gnädinger Architects



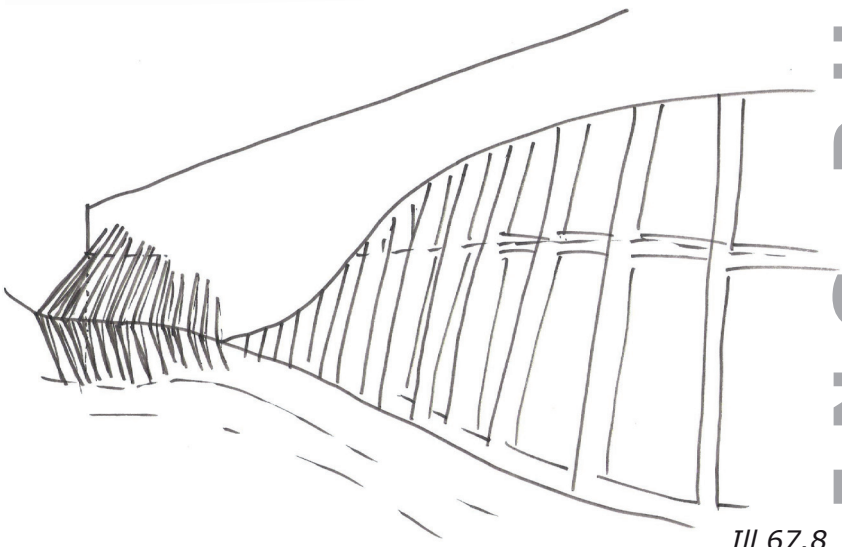
Ill 67.5



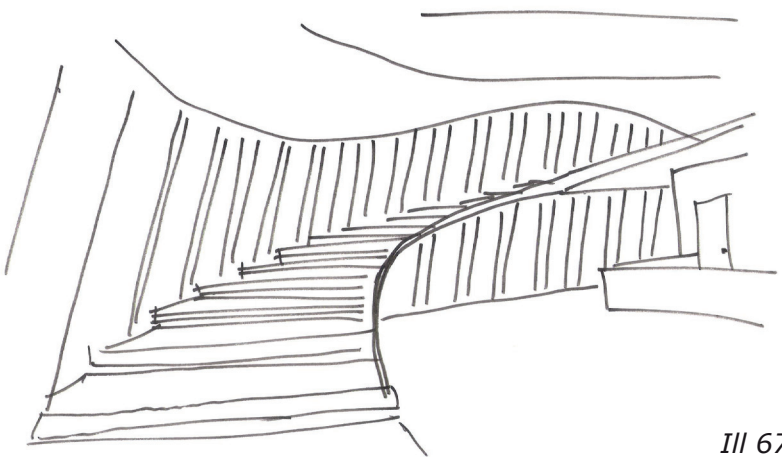
Ill 67.6



Ill 67.7



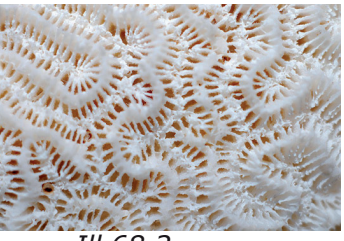
Ill 67.8



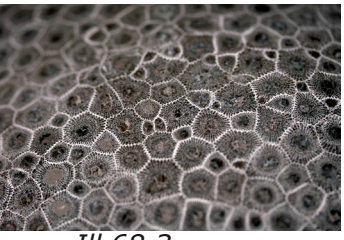
Ill 67.9

FOSSILIZED CORAL REEF

Ill 68.1



Ill 68.2



Ill 68.3

The second concept relates more directly to the quarry, which used to be a coral reef with many and various life forms.

The coral reef structure in it self is very complex, but in a simplified and highly magnified version it can be adapted to the building in many ways. The facades could have the structure in a form of external cladding (ill 67.3-5).

The coral structure could also be magnified even more and used as the bearing structure of the building or as a part of the landscaping (ill 67.1-2).

This concept somewhat allows for the building to be of any shape by adapting the texture cladding to the facades, but if the structure of the building is to be of such an irregular and undefined shape, it could become difficult to arrange the various functions within.

For the landscaping surrounding the building and the cladding on the building, this concept can be applied, although it is not considered sufficiently iconic for the overall concept.

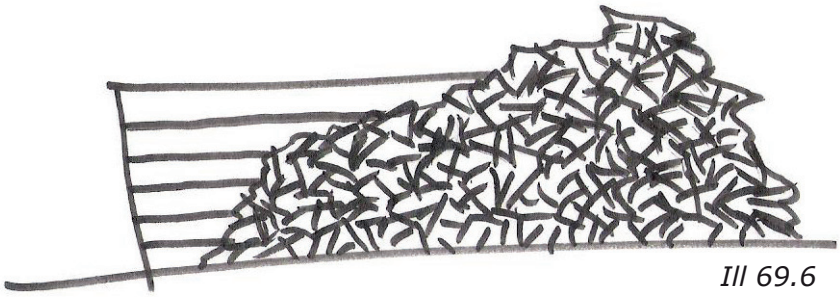
Ill 69.1 Leonardo Glass Cube, 3deluxe

Ill 69.2 Los Angeles Holocaust Museum, Belzberg Architects

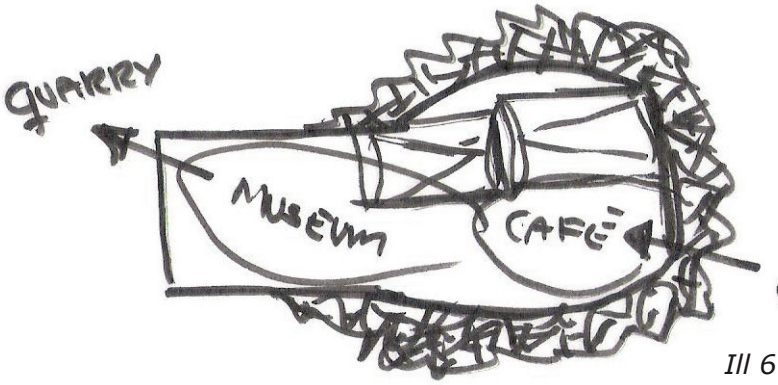
Ill 69.3 Zilerparkkade, René Van Zuuk

Ill 69.4 Austrian Pavilion, Venice 2010

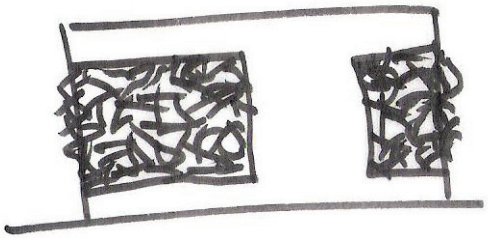
Ill 69.5 House in Bangalore, Cadence



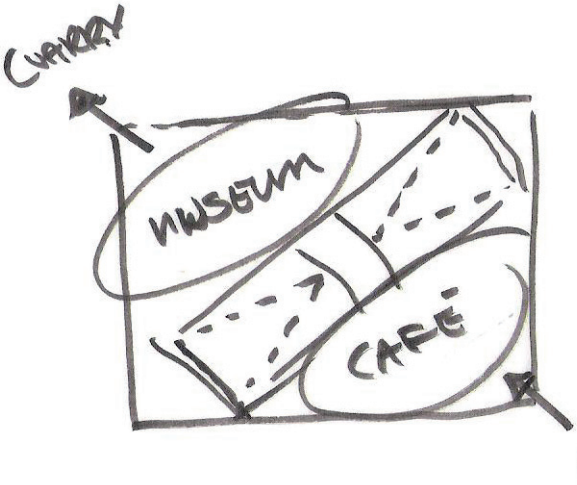
Ill 69.6



Ill 69.7



Ill 69.8



Ill 69.9

CONTINUOUS BONE STRUCTURE

Ill 70.1

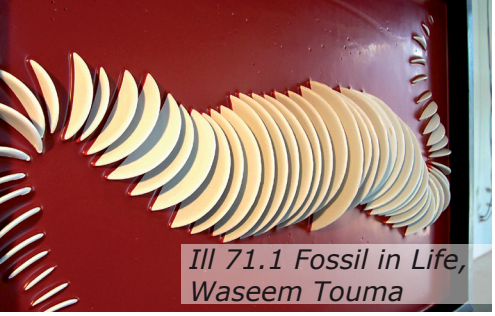
Ill 70.2

Ill 70.3

This concept immediately inspired to a structure that links the city centre to the building, -and the building to the quarry. This idea immerged from various inspirations as well as the overall idea with the new cultural house. A continuous structure would allow for the elements to appear in the city, disappear and reappear towards the building, create the buildings main visual elements, and finally disappear into the quarry. This story and experience would provide the citizens of Faxe with a direct link to both the cultural house and the quarry, as well as visitors to geological museum would be drawn into the quarry and curious by the path towards the city.

Furthermore this concept can easily become iconic if kept simple enough and according to Tom Wright; you can draw it with a few sweeps.

When thinking of a continuous bone structure, especially ribs and spines come to mind, which can be found in various animals. But only animals that directly refer to the quarry seem relevant. Since the quarry used to be a coral reef, fish and whales seem to be the most relevant.

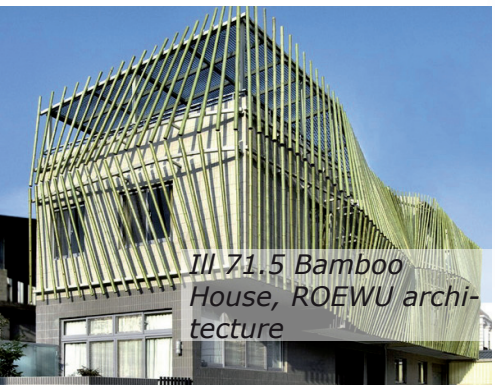


Ill 71.1 Fossil in Life, Waseem Touma

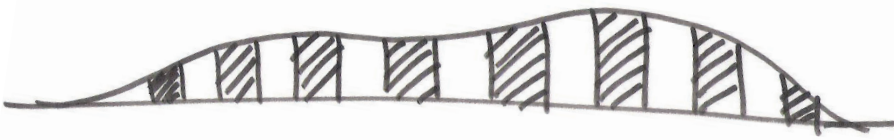
Ill 71.2 Spinal Lamp, Anonymous Studio

Ill 71.3 Casa Son Vida, tecArchitecture

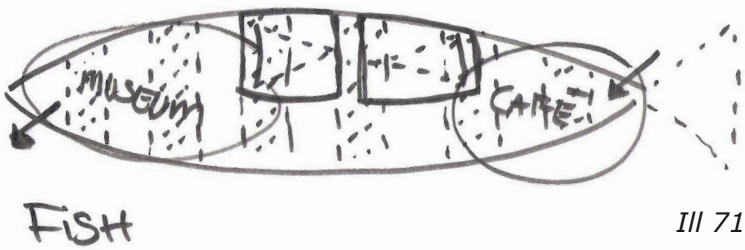
Ill 71.4 Te Rewa Rewa, Peter Mulqueen



Ill 71.5 Bamboo House, ROEWU architecture



Ill 71.6



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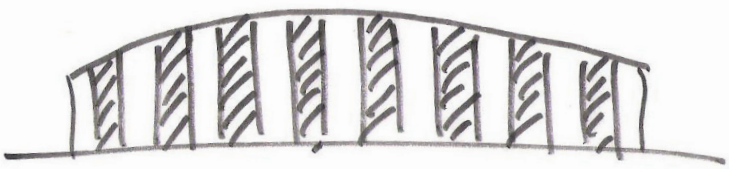

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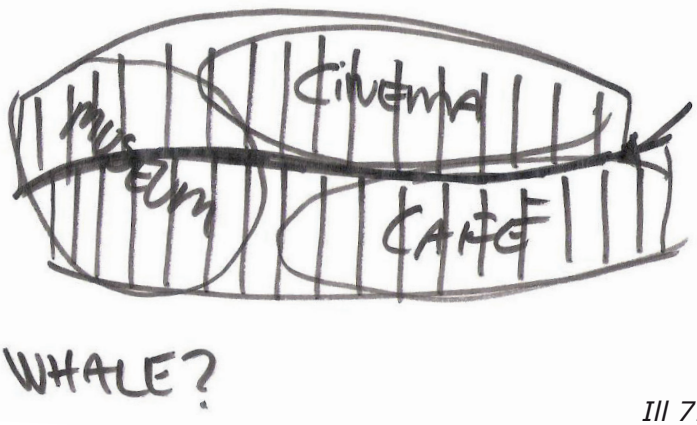
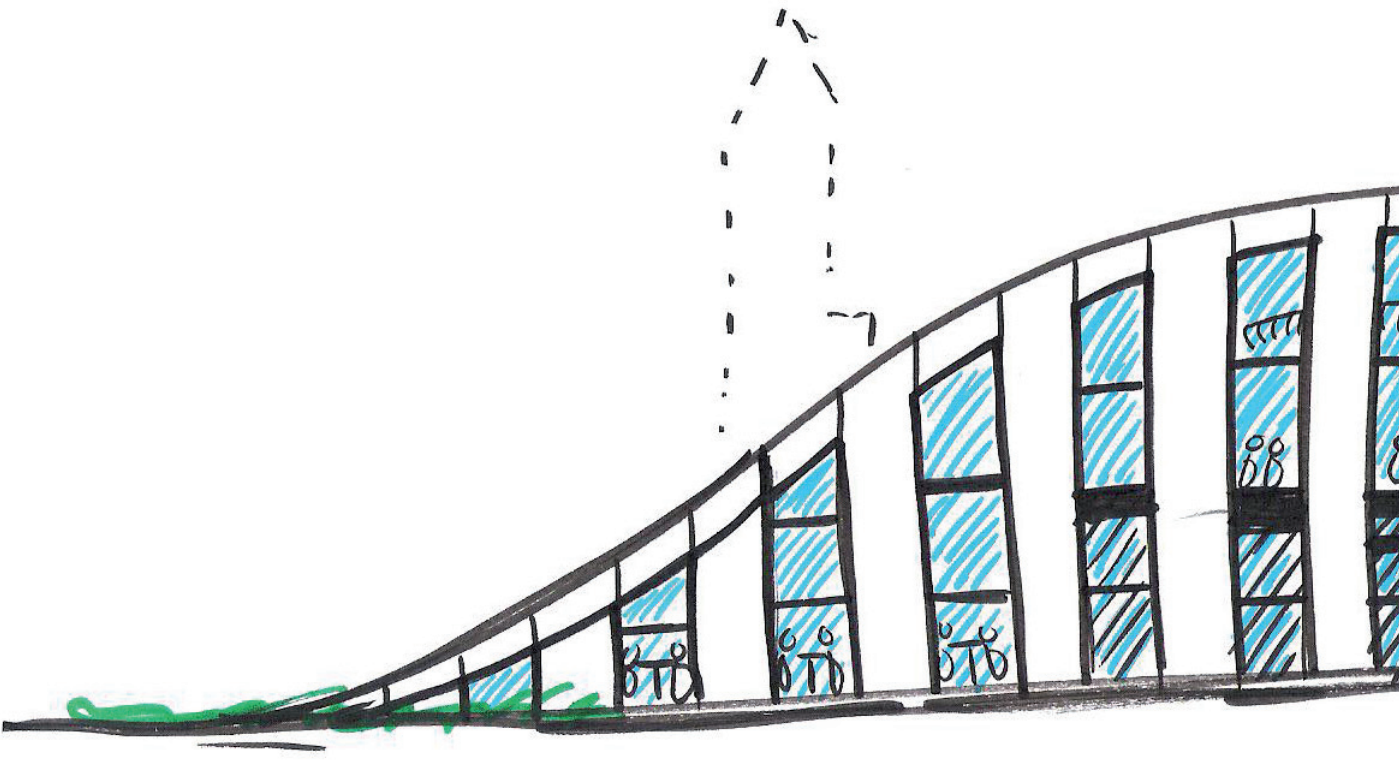


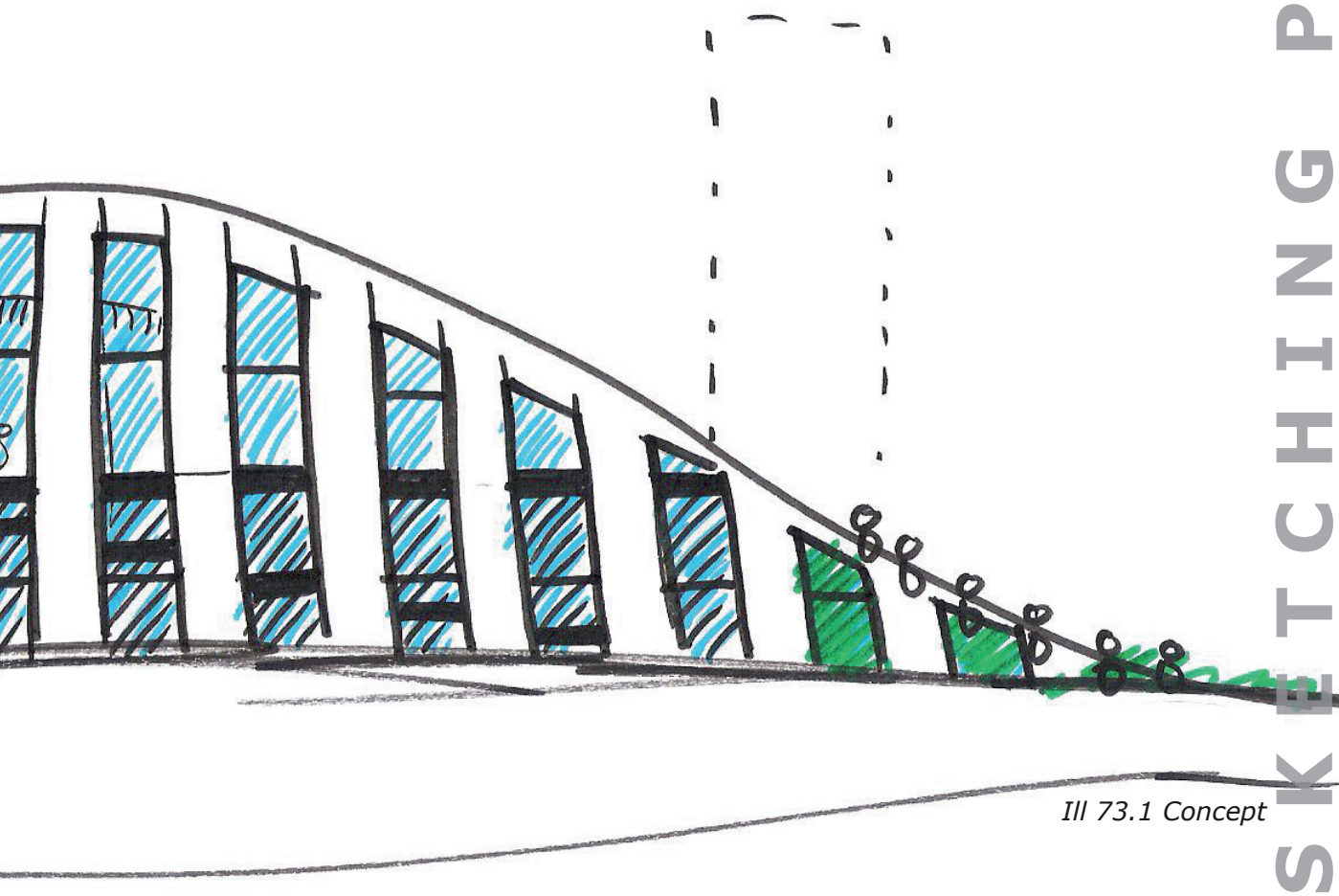
Ill 71.9

CONC

The iconic approach to the design lead to a concept that is highly recognizable and very simple. The building can be interpreted more as a sculpture than a building, which is seen as a positive aspect in regards to creating an iconic structure. The concept also opens up to a more tectonic design, rather than bionic, although the building shall represent a fossil, the bearing structure will inevitably become the leading parameter in the final design.

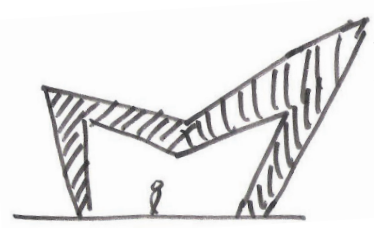


CEPT

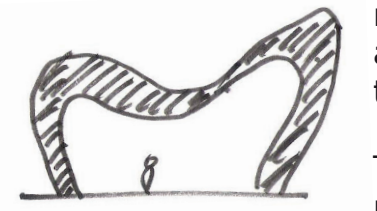


Ill 73.1 Concept

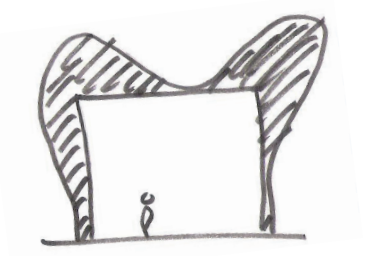
APPEARANCE



Ill 74.1 Dramatic structure



Ill 74.2 Organic structure



Ill 74.2 Organic external structure

Once the overall concept was found, the visual expression of the building had to be established. The vision was to keep it simple and recognizable, but wheatear the "bones" should have an organic or dramatic appearance, would have a massive affect on the appearance of the building. Furthermore the scale of the bones had to be established, together with the spacing in between them.

Ill 73.1-2 represent two tectonic approaches, where the structure is dramatic by using straight lined elements, which are changed according to length and angle to provide harmonious lines that represent the building envelope.

The aquatic centre, designed by late Harry Siedler, represents a different story (ill 73.3). Here the ribs are represented as glass on the inside of the arena and as a massive bearing steel structure externally.

Ill 73.4-6 show a different and rather fluidly organic interaction between each segment. Again the only change in the elements is either scale or length and angle.

Ill 72.1-3 show sections of the structures considered applicable to the building. The sketches on page 73 show the various expressions by changing the scale and space in between the elements.

Ultimately the dramatic structure together with a scale that uses 1 meter wide elements and 1.5 meter wide spacing in between was considered most suitable. This conclusion was based on structural, visual and functional parameters, together with the perceptibility of a fossil.

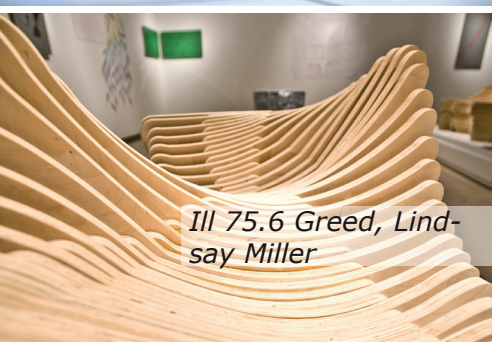
Ill 75.1 Edith Cowan University, Francis-Jones Morehen Thorp

Ill 75.2 Lyon Airport Station, Calatrava

Ill 75.3 Ian Thorpe Aquatic centre, Harry Siedler

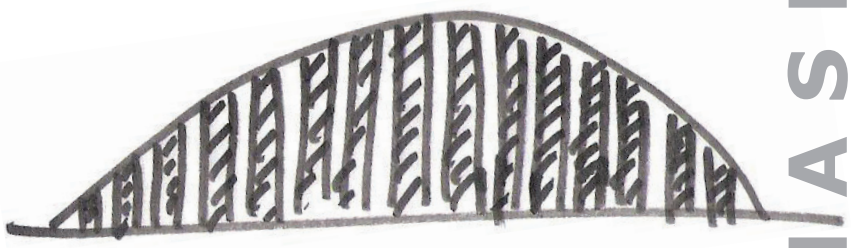
Ill 75.4 Spinal Form, Waseem Touma

Ill 75.5 Spinal Lamp, Anonymous Studio

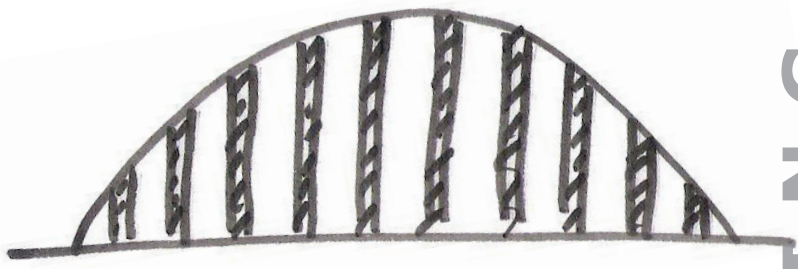


Ill 75.6 Greed, Lindsay Miller

Ill 75.7 2m glass and 2m structure

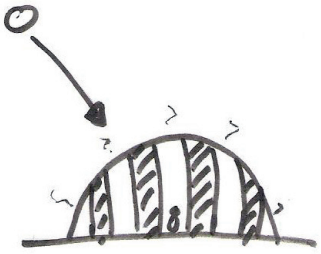


Ill 75.8 1m glass and 2m structure



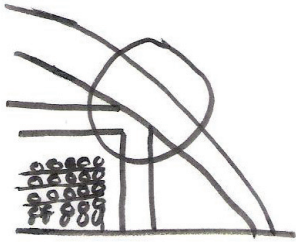
Ill 75.9 2m glass and 1m structure

Ill 75.10 1m glass and 3m structure



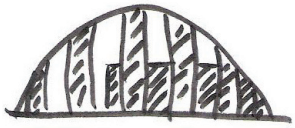
Ill 76.1

Although the chosen appearance worked fine as a resemblance to a fossil, would provide sufficient daylight and worked constructively. A spreadsheet calculation showed that the massive amount of glass in between the structure, would cause the building to overheat most of the summer period and have a huge heat loss during the winter. This would cause the energy demand to way to high to meet the requirements set by BR10.



Ill 76.2

Furthermore the very open and sculpture like structure wouldn't interact properly with the room volumes, which especially in the cinema part had to be closed.

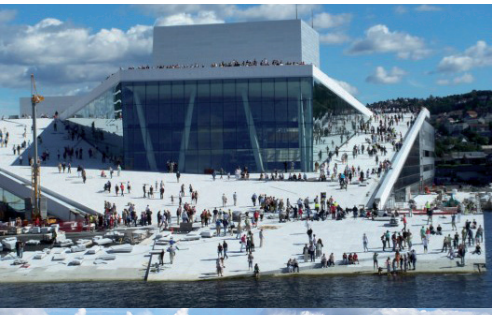


Ill 76.3

Therefore the building had to be altered to reduce the energy demand and to contain all functions without interfering with the recognizability of the building. The concept was therefore changed into a shape that emerges from the surroundings, as a fossil emerges from the limestone. This was also considered a change in the right direction in creating a social hub for the citizens of Faxe. Because when the fossil structure emerges from its surroundings, it can easily take the surroundings on to the building, by applying continuous paths and external social areas on the roof of the building (ill 75.1-6) and applied (ill 74.1 and 75.10-12)

Ill 76.4

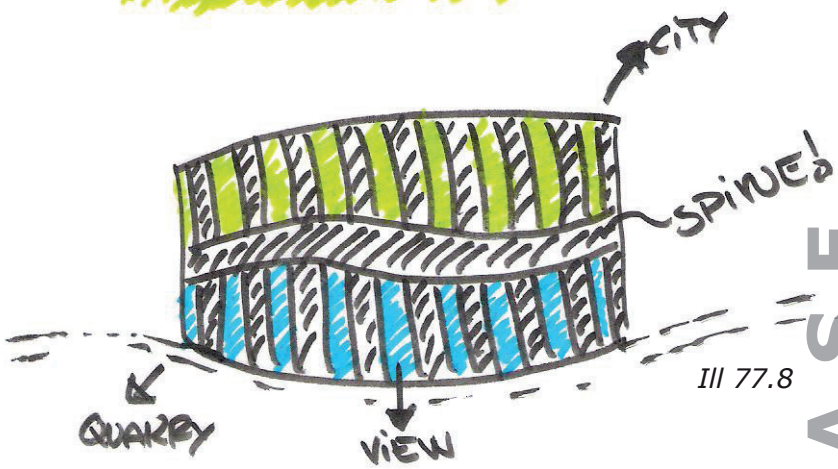
Ill 77.1-2 School of Art, David Chipperfield



Ill 77.3-4 Oslo Opera House, Snøhetta

Ill 77.5-6 Yokohama Terminal, FOA

Ill 77.7



Ill 77.8

Ill 77.9

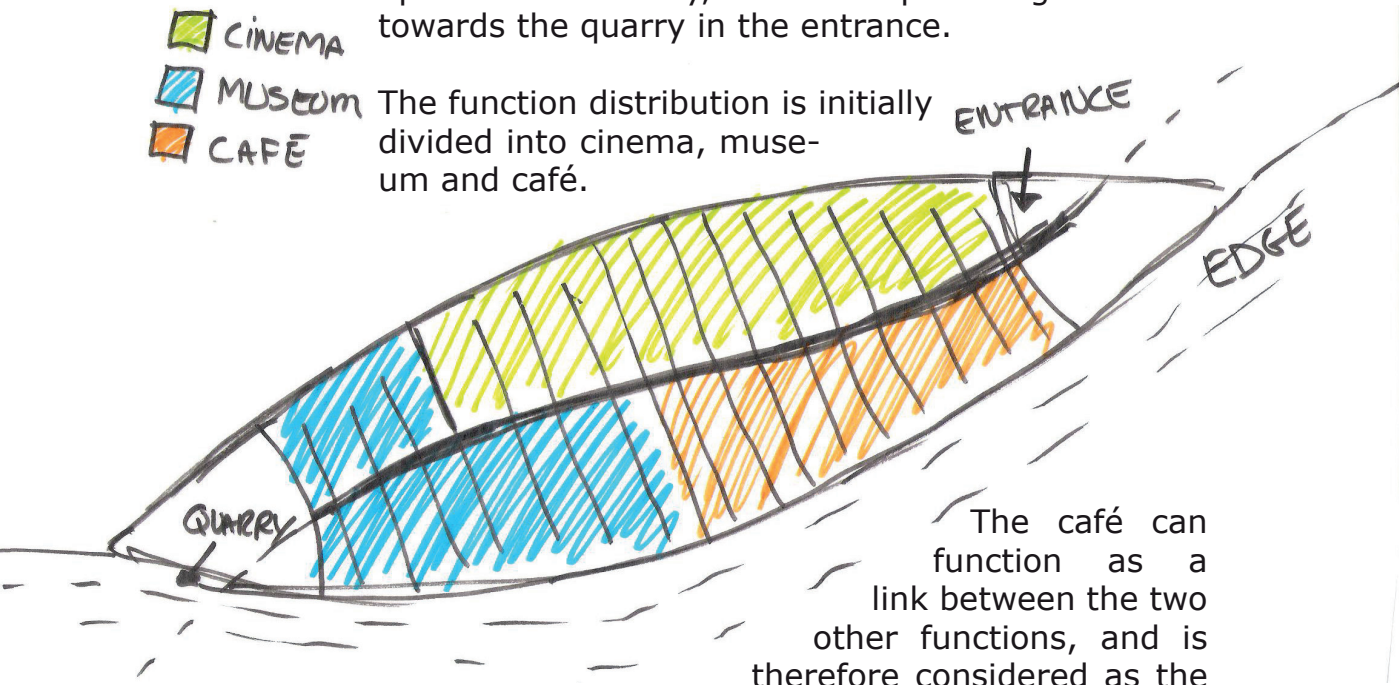
Ill 77.10

Ill 77.11

Ill 77.12

FUNCTIONS

With respect to the site and the micro climate, it seemed natural to place the entrance to the building in the north-west corner of it. The arguments in favour of this include, wind protection, opening up towards the city, while still providing the view towards the quarry in the entrance.

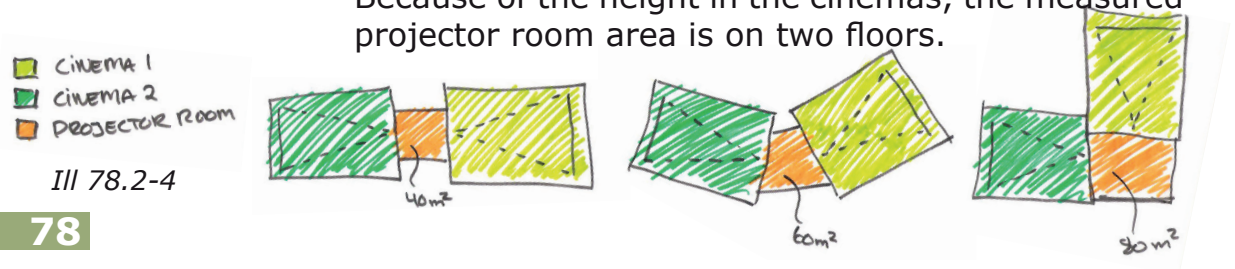


Ill 78.1

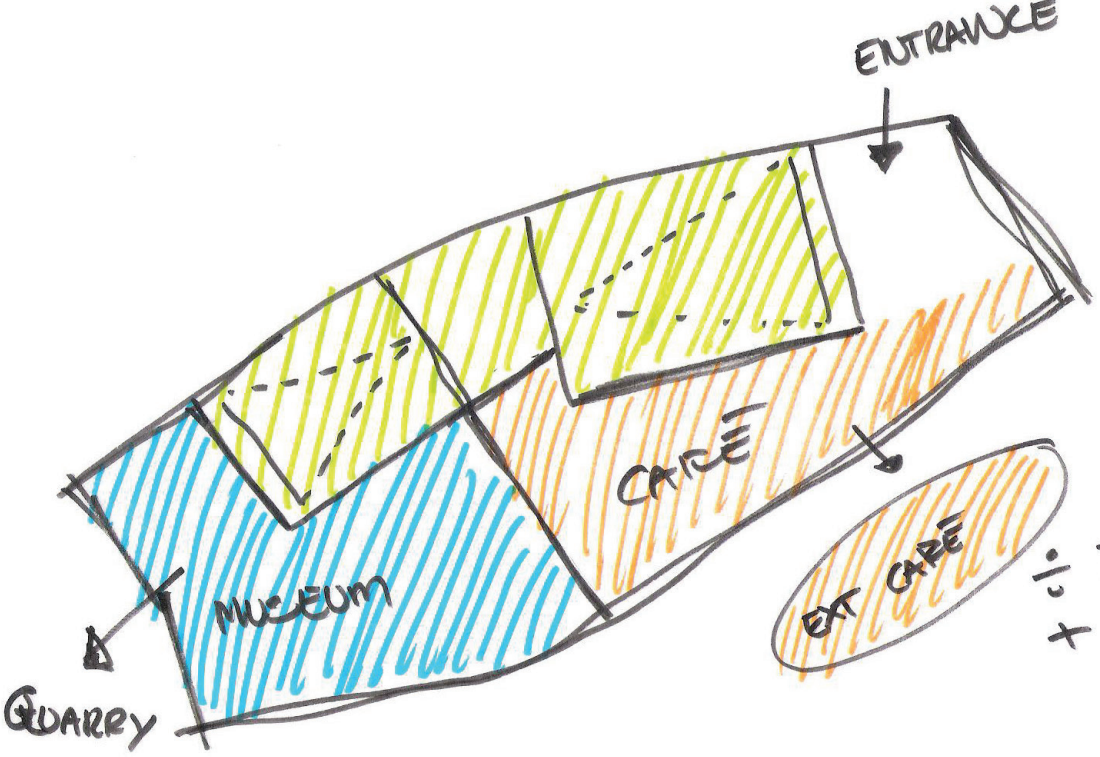
The function distribution is initially divided into cinema, museum and café.

The café can function as a link between the two other functions, and is therefore considered as the central function of the building and directly connected to the entrance.

The cinema and its functions are almost specifically determined according to the competition program, which states that they have to be connected by the projector room. Therefore the only scenarios considered possible for their layout are as displayed below. Furthermore because of the necessary depth in the projector room, the required space is as shown. Because of the height in the cinemas, the measured projector room area is on two floors.



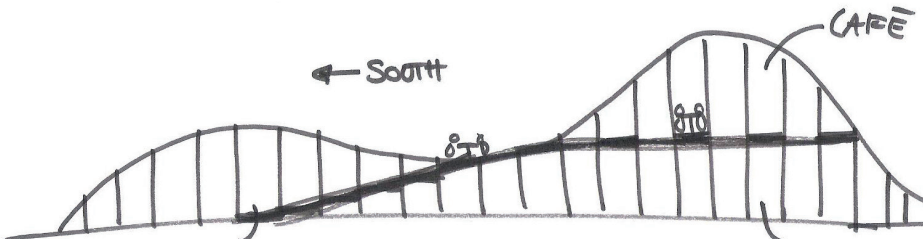
Ill 78.2-4



Ill 79.1

The initial function distribution works in most aspects, although the external café area would be in shade during the evening hours, which is considered unacceptable. Furthermore the café would not get any significant passive solar gains, which ultimately would result in to high energy demand.

In the first plan all functions where imagined on the same level, and because of the importance in providing view to the café and museum, it resulted in a conflict wether the museum or café part should be south orientated. The initial answer came from the fact the café should be the central point in the building, and close to the entrance. However by elevating the café, both functions could maintain the view, while still being orientated towards south and gain from passive solar heating.

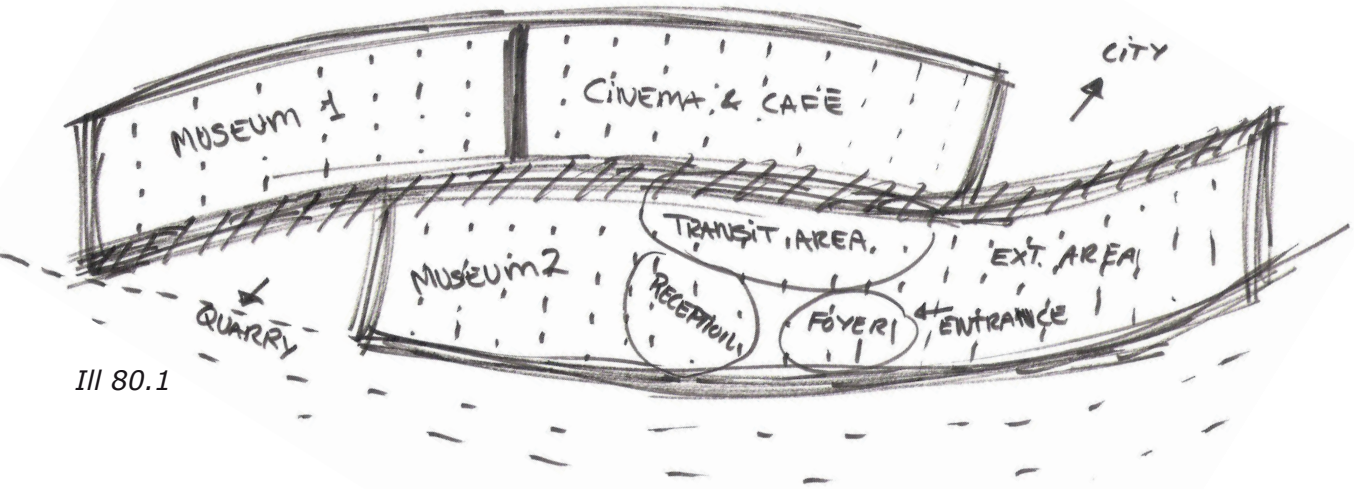


Ill 79.2

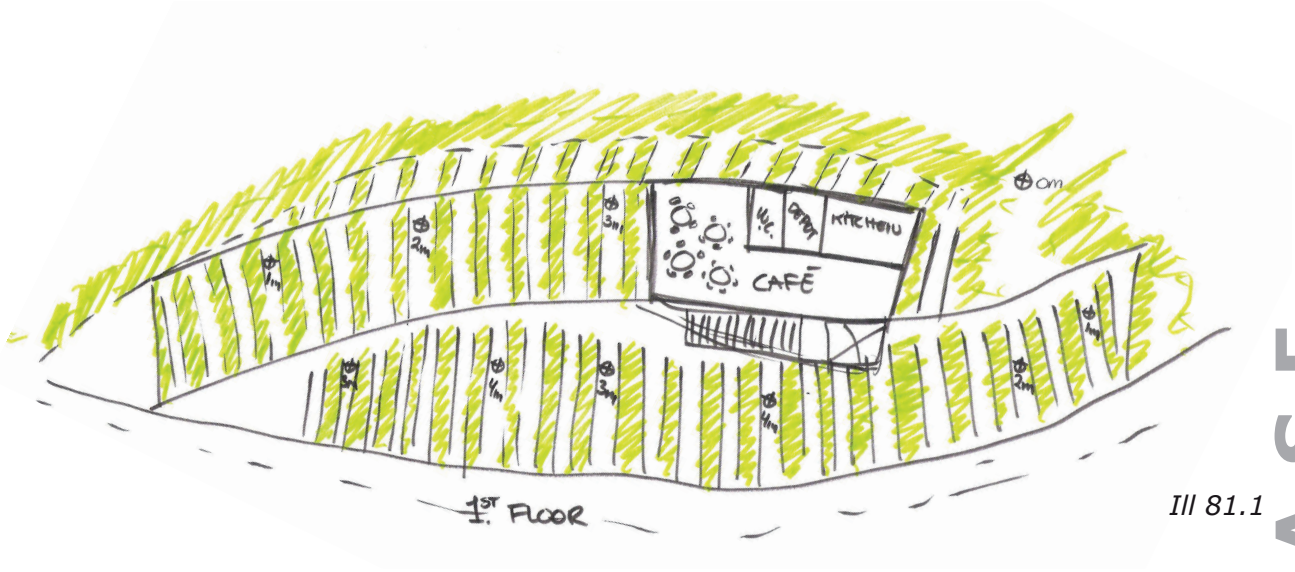
The reason the café was elevated instead of the museum, is because it is considered vital that the museum has a direct link to the quarry, thus giving the visitors an experience that encourages to a visit down into the quarry. In addition to that, the museum has open until 15.00, while the café has open until approximately 21.00 and is therefore more relevant to have a south-west orientation to exploit the heat from the evening sun and having external areas that are in direct sunlight.

A new plan emerged that instead of relating to a fish or a whale, only relates to the spine and the structure of the fossil, where the spine is the central axis of the building, constructively, aesthetically and functionally. The spine will also be visible externally as it rises from the ground and disappears into the quarry and works as the pedestrian path on the roof.

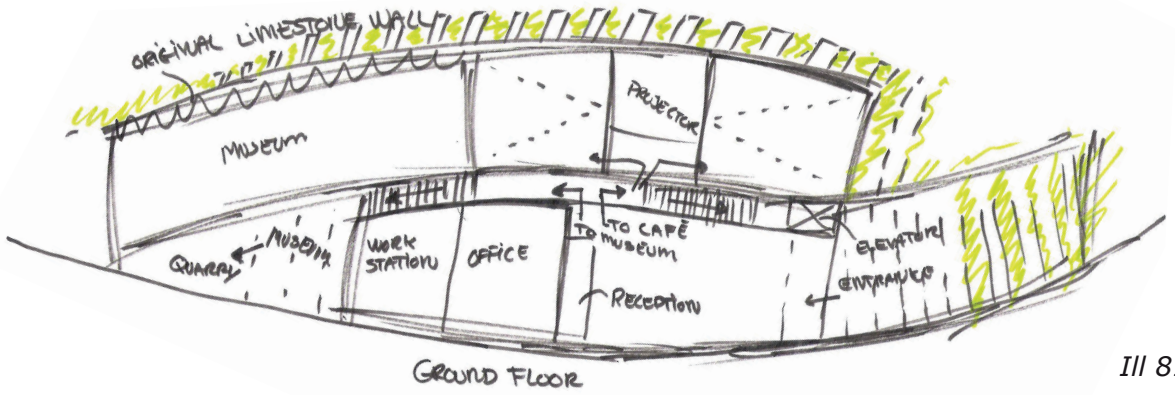
Inside the building the spine will be visible as a bearing element, divide the functions and work as a transit area in between them.



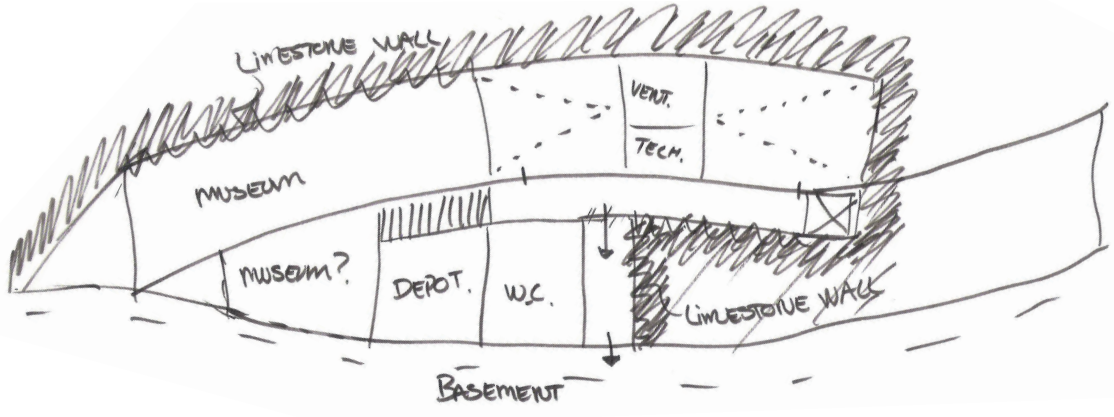
Ill 80.1



Ill 81.1



Ill 81.2



Ill 81.3

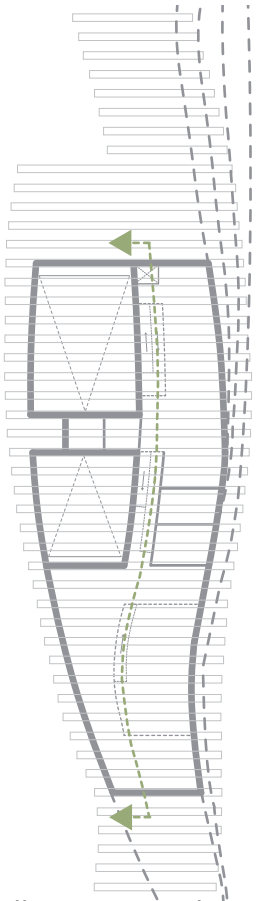
FLOW

As previously mentioned the middle of the building structure (the spine), works as a transit area within the building and links all functions and floors together by a series of Piranesi like ramps.

The main entrance is located on ground floor at the north end of the building and is connected to the foyer by a 20 m^2 weather porch. The Foyer is very open and has a continuous view towards the quarry. The cinema ticket sale and museum shop, (also cinema shop) are directly accessible from the foyer.

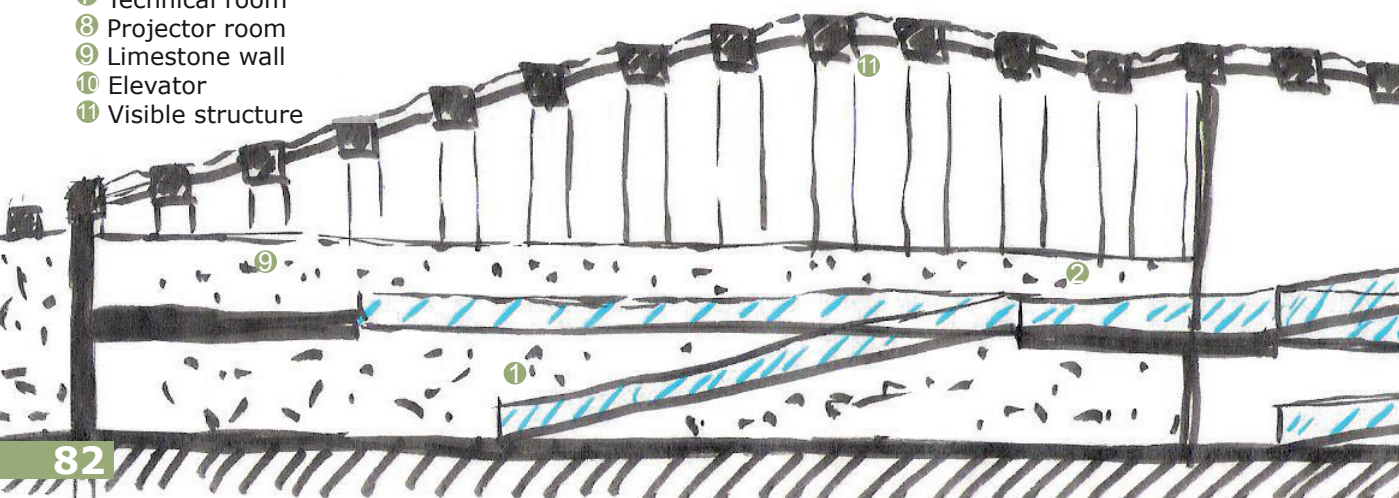
The café is on 1st floor and is accessible by ramp and elevator, located close to the entrance. On the half way point towards 1st floor, the ramp has a landing, from where visitor can get a peak preview of the museum. The café also has a lounge located on top of the weather porch, thus closer to the quarry.

The entrance to the cinemas are located below ground floor, mostly for functional reasons regarding emergency exits, but also to give the visitors



Ill 82.1 Curved section through transit area. Scale 1:200

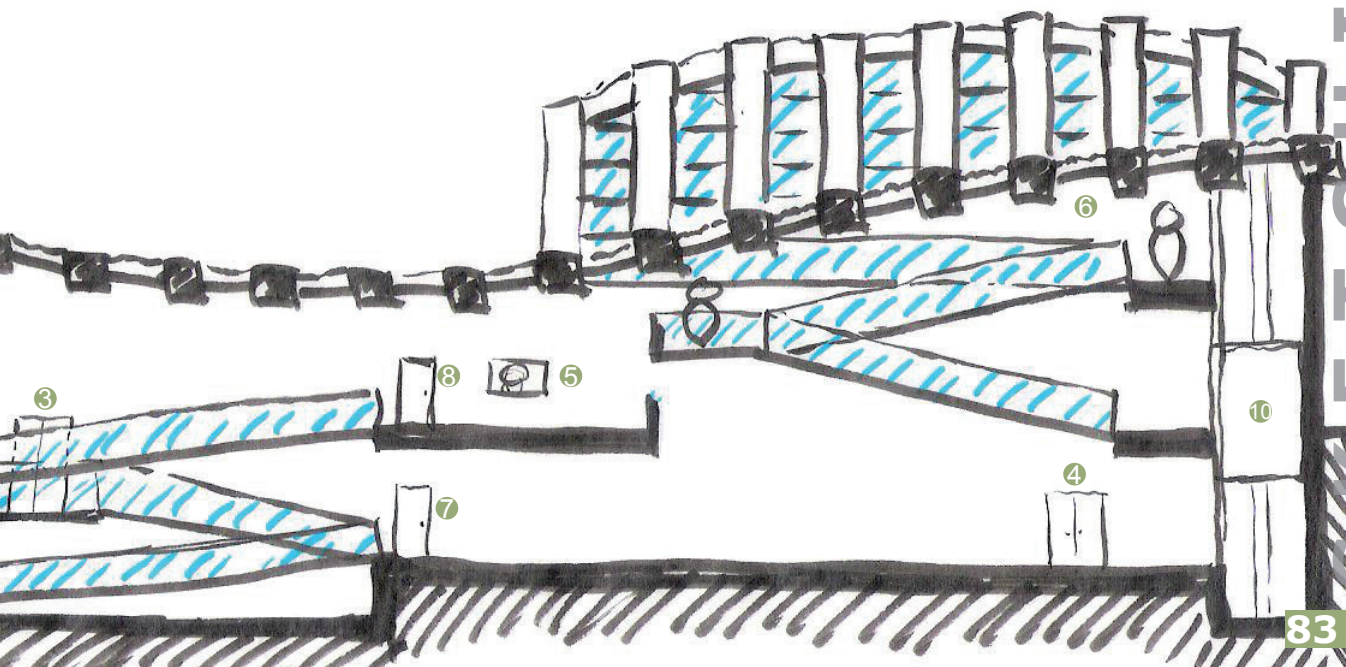
❶ Permanent exhibition
❷ Flexible exhibition
❸ Cinema 2
❹ Cinema 1
❺ Ticket sale
❻ Café
❼ Technical room
❽ Projector room
❾ Limestone wall
❿ Elevator
⓫ Visible structure

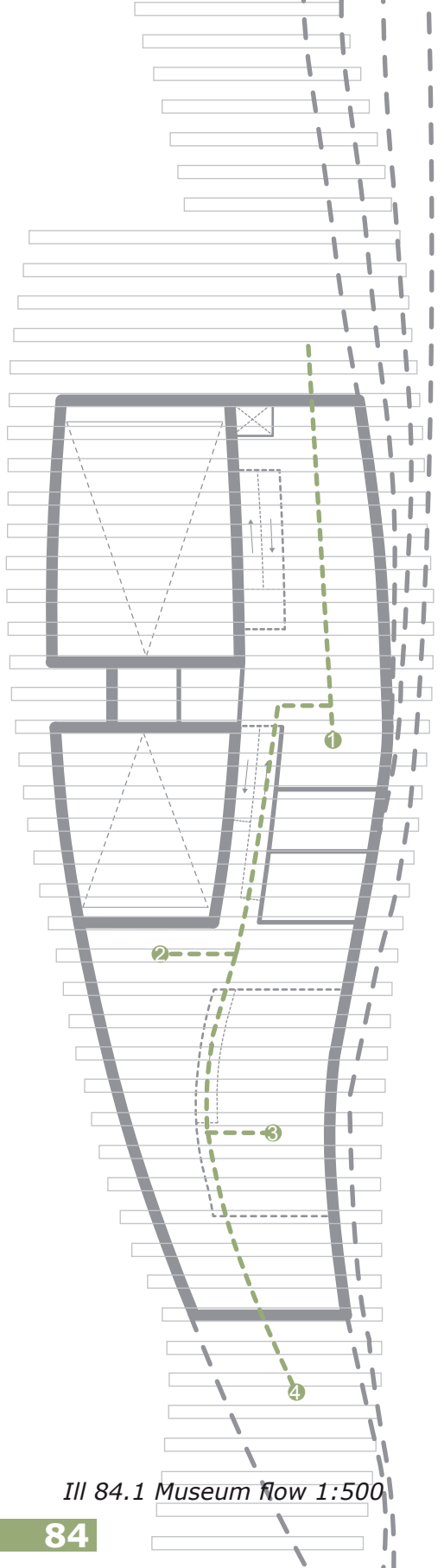


of the cinema a peak preview of the museum. Also located in the basement are the lavatories and common repository.

When entering the museum, one has to go through the narrow transit area (ill 81.1), which then opens up into a massive open space and gives the visitors a dramatic experience. When in the museum area, one can choose either to see the flexible- or the permanent exhibition area first, and potentially go outside and search for fossils.

Ill 83.1 Entering the museum





Ill 84.1 Museum flow 1:500

MUSEUM

❶ MUSEUM SHOP

When entering the museum the visitors go to the shop to buy there entry tickets, souvenirs and get information about the quarry and the exhibitions

❷ FLEXIBLE EXHIBITION AREA

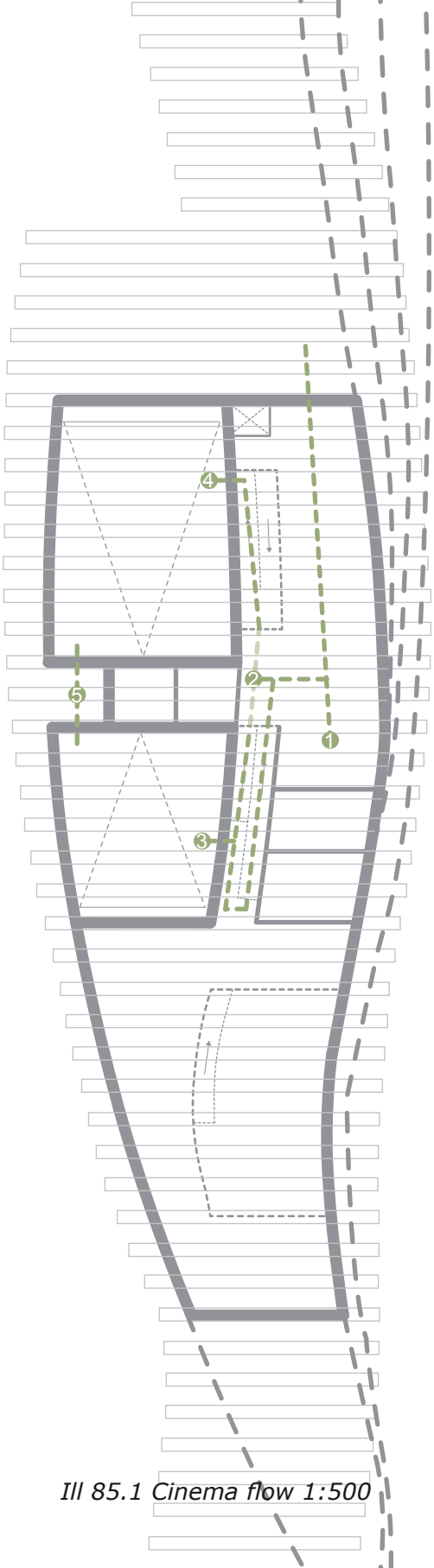
The flexible exhibition space is approximately 300 m^2 and located 2 m below ground floor.

❸ PERMANENT EXHIBITION AREA

The permanent exhibition is located 5 m below ground floor and is also approximately 300 m^2.

❹ EXTERNAL EXCAVATION AREA

The visitors can go search for fossils just outside the museum on a external platform. When outside they can continue their experience by going down into the quarry.



Ill 85.1 Cinema flow 1:500

CINEMA

❶ MUSEUM SHOP

When going to the cinema, popcorn and beverages can be bought at the museum shop. While waiting for a movie to start, the audience can wait in the foyer and enjoy the view over the quarry.

❷ TICKET SALE

The projector room and ticket sale are connected, so both can be operated by one person.

❸ CINEMA 2

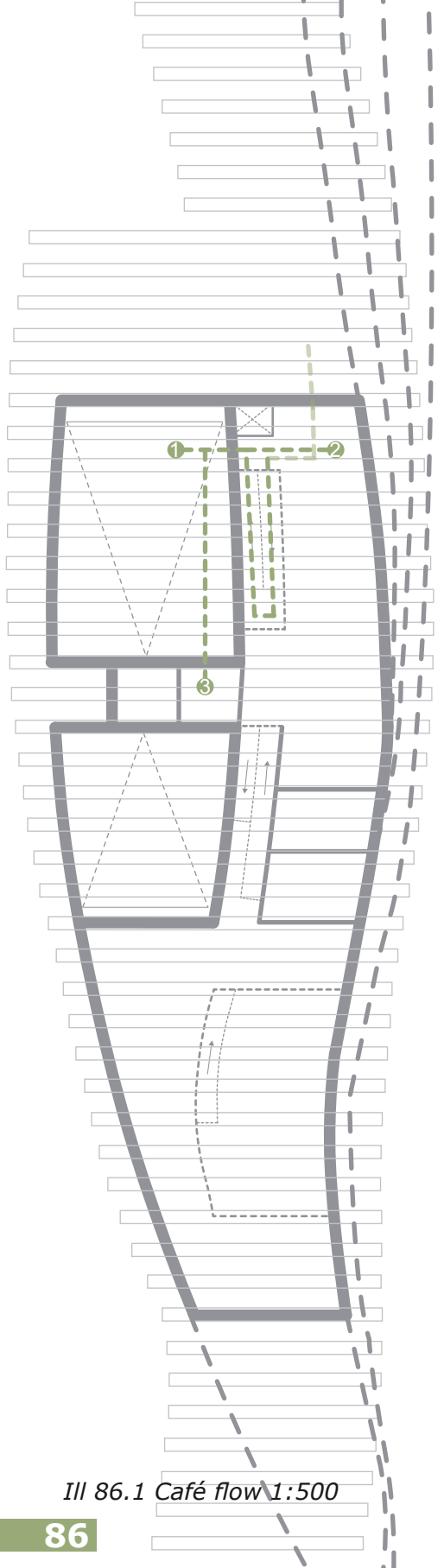
The smaller cinema is 170 m^2 and can have an audience up to 101 people. The entry is from a landing in between the ground floor and the basement.

❹ CINEMA 1

The bigger cinema is 270 m^2 and has room for 174 people. The entry is from the basement.

❺ EMERGENCY EXITS

The emergency exits are 0.5-0.9 m below ground floor and open directly to outside.



Ill 86.1 Café flow 1:500

CAFÉ

❶ CAFÉ

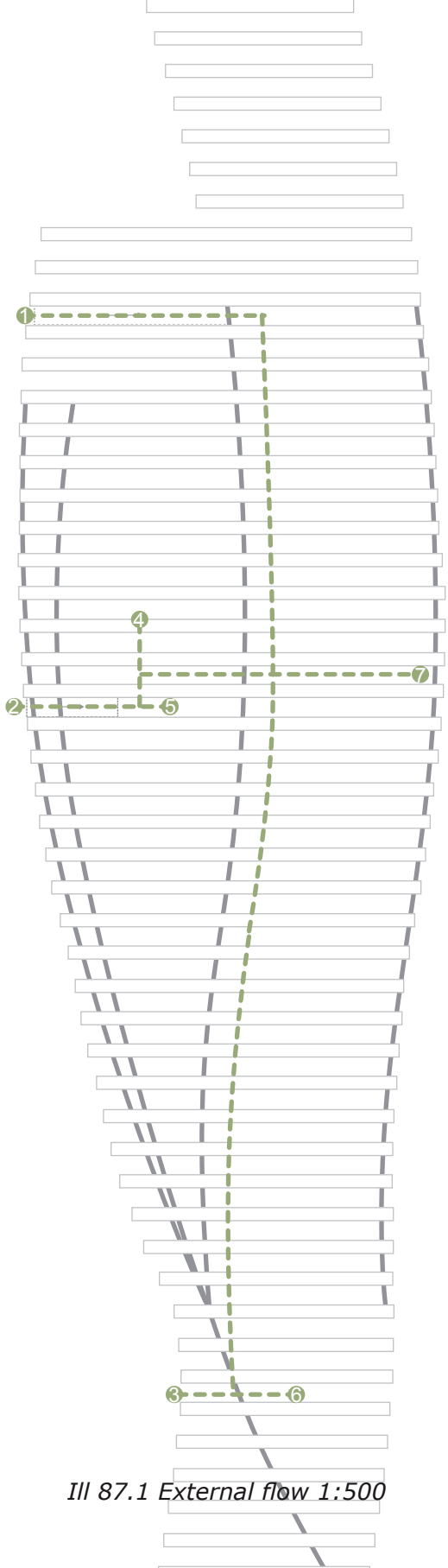
The café is situated directly above the bigger cinema and accessible through the ramp or the elevator. The café area is 266 m^2 and consists of a kitchen, a lavatory and two storage rooms.

❷ LOUNGE

The lounge is 40 m^2 and situated above the weather porch. From the lounge the visitors have view towards north and east as well as a internal view throughout the building.

❸ EXTERNAL AREA

The café has an external area towards south, where costumers can enjoy their coffee in direct sunlight. The café area is also connected to the rest of the grass roof.



Ill 87.1 External flow 1:500

EXTERNAL

❶ MAIN STAIR
The main "entrance" to the roof is located near the main entrance to the building. The stairs are located in between two "bones", which also function as railings.

❷ CAFÉ STAIR
The roof second access is located in between the two cinemas and also functions as a direct entrance to the café.

❸ GROUND FLOOR ENTRANCE
Towards south the structure disappears into the surroundings and therefore the roof is accessible straight from the parking lot.

❹ CAFÉ
The idea is that the café can be functional separately from the other functions and has therefore an independent entrance.

❺ EXTERNAL CAFÉ AREA
The furniture will be safely hidden away in the café during closing hours.

❻ EXTERNAL MUSEUM AREA
The excavation area outside the museum also functions as link to the quarry for nonvisitors and is therefore connected to ground level.

❼ VIEW POINTS
In between each bone segment, there are personal places sheltered from north and south by the structure and east by a glass rail.

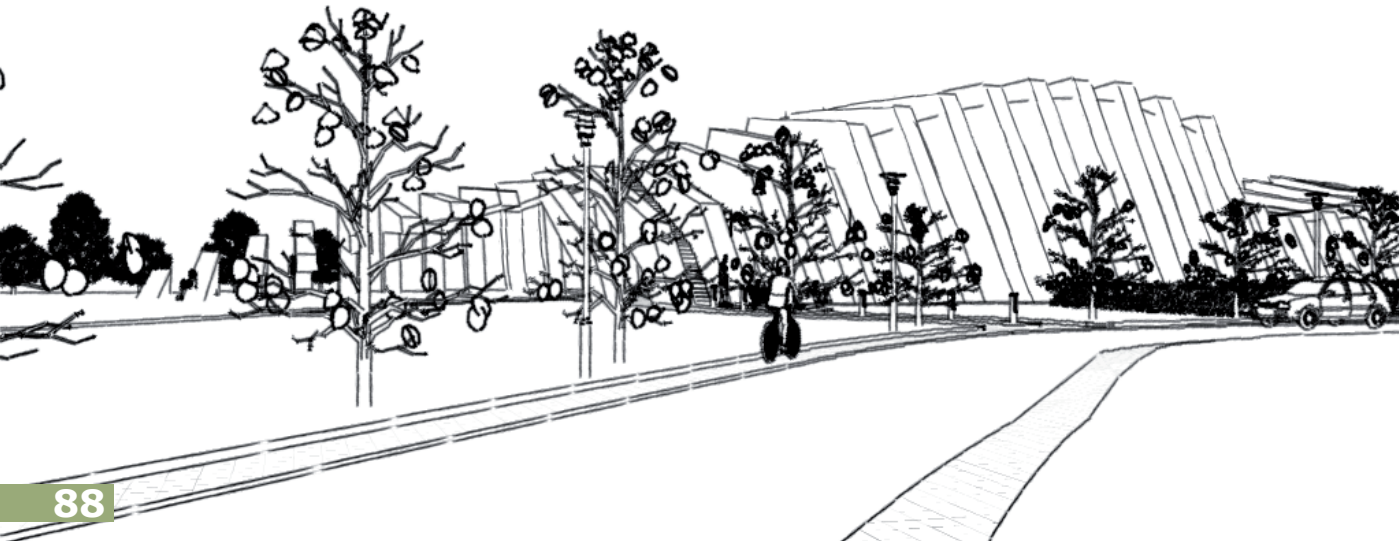
EXPERIENCES

The building is intended to resemble a fossil and the shape of the building is also much different then any other building in the city. Therefore the building would become an icon in the local area and since the quarry and the museum are among the most significant tourist attractions in the city, it should.

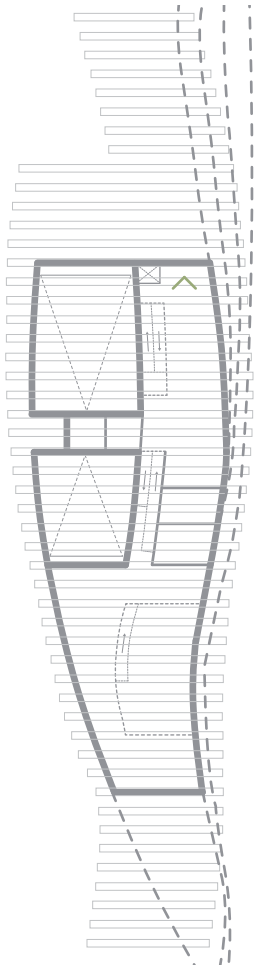
One of the initial ideas was to have the bone structure disappear and reappear miscellaneously, but continuously from the city centre into the quarry. This is not applied directly in the project proposal, but is still considered as an applicable addition.

Upon arrival to the site the building roof encourages to be explored, since it appears to rise from the landscape and is easily accessible from north, west and south.

Ill 88.1 view from northwest



Ill 89.1 View from entrance



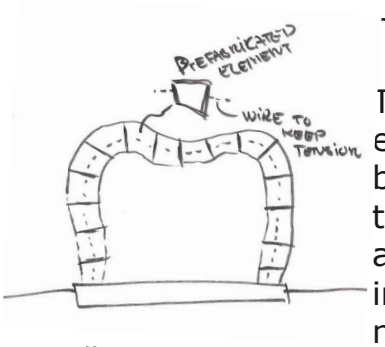
When entering the building through the main entrance, -located on the north end of the building, the continuous bone structure, experienced on the outside, remains visible throughout the length of the building (Ill 87.1), thus bringing the external experience inside.

The ramps located in the middle of the building have the primary function to link the functions and transport the visitors to their destination. But they also give an extra experience in exposure and enclosure, as they enhance and reduce the view and change from being very open to being very closed.

The two most significant elements in the building are the view and the structure, which therefore are kept intact throughout the building. It is only in the two cinemas, the projector- and technical room users won't be able to see the quarry. The structure however is visible in cinema 2 and in the projector room, and partially in the bigger cinema. Even the lavatories in the basement have a view over the quarry, and since the edge is so steep at that location it is not possible to see inside.

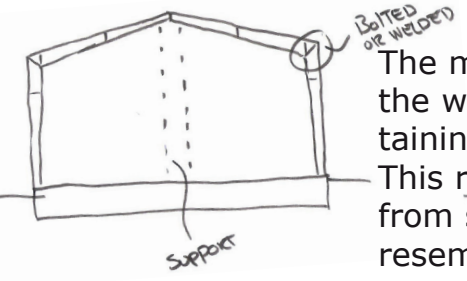
CONSTRUCTION

The initial idea for the buildup of the structure was to use concrete, but the chosen and the necessary dimensions would have caused such a structure to be extremely heavy and unpractical. Therefore alternative solutions where investigated. BE10 showed that the insulation in the roof structure had to be at least 250 mm to reach the necessary U-value, as well as the vegetated roof has to be a certain thickness. A estimated thickness of the roof was therefore set to 700 mm. Whereas the thickness of the structure varies from 1000 mm to 2000 mm.



Ill 90.1 Organic construction principle

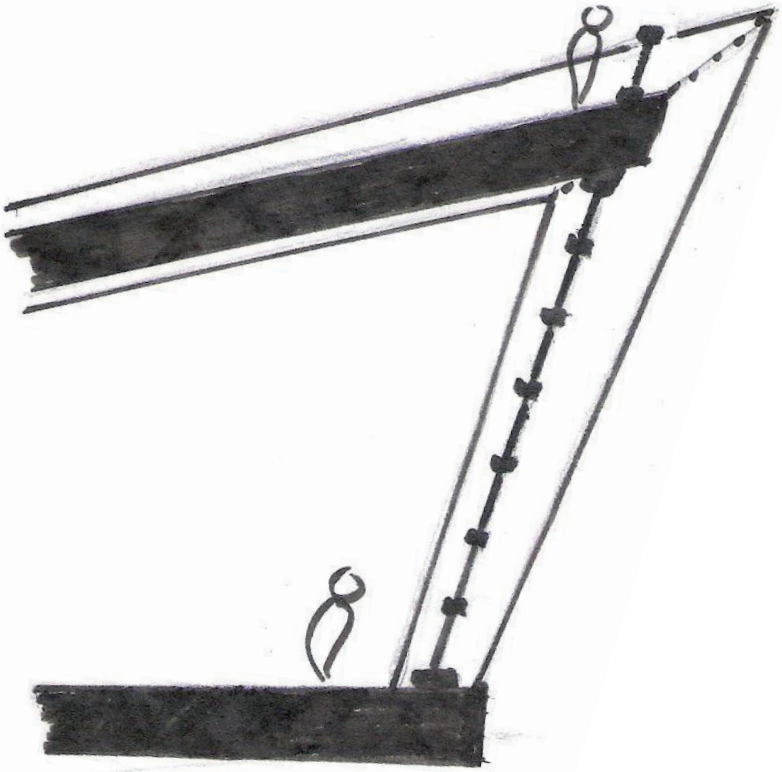
The first construction principle was to divide the each bone into several segments, which then could be held together by tensioning a wire through them (Ill 88.1). This construction principle would allow for the form of the bones to be manipulated in almost any possible way. But this construction method would be extremely expensive, because the segments would have to be fabricated with insulation and support for the roof, as well as mounting them together would be very difficult. This method was therefore excluded.



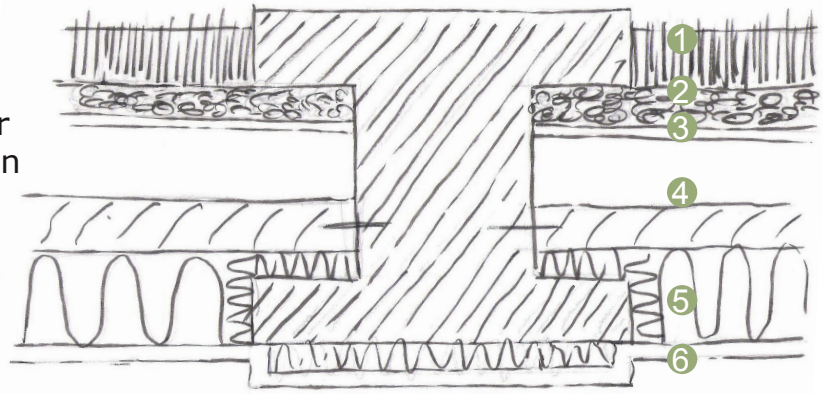
Ill 90.2 Dramatic construction principle

The main factor for the next method was to reduce the weight as much as possible, while still maintaining the size of the bones previously selected. This resulted in building up a framework either from steel or timber and then cladding it to make it resemble a bone.

In regards to weight, a steel I-profile would appear to be best suitable choice, but a U-profile and a spaced wood beam could also be used.

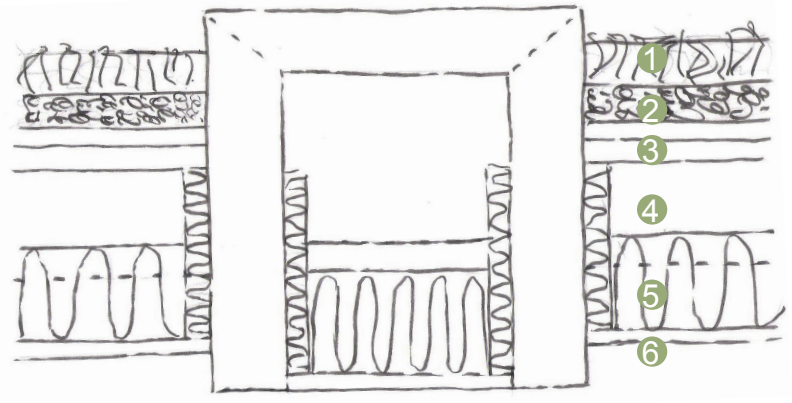


Ill 91.1 Section of construction principle. The dramatic shape of the structure makes it rise near the edge, which provides shelter. The window seems to continue through the roof, thus providing the roof with a railing.



1. Vegetation
2. Drainage layer
3. Waterproof layer
4. Roof construction
5. Insulation
6. Gypsum plate

Ill 91.2 Section of steel I-profile



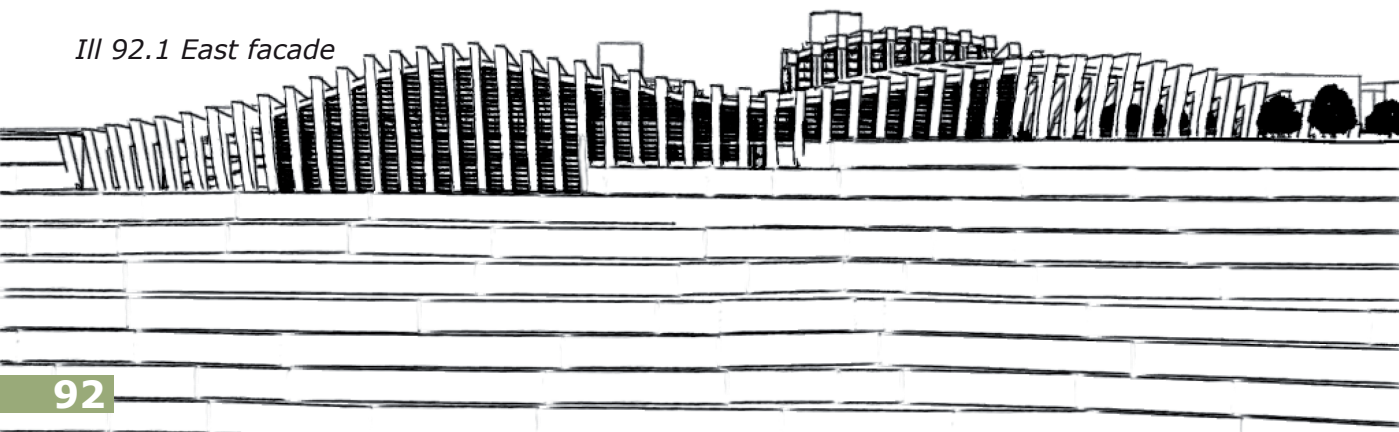
Ill 91.3 Section of steel U-profile or spaced wood beam

DAYLIGHT

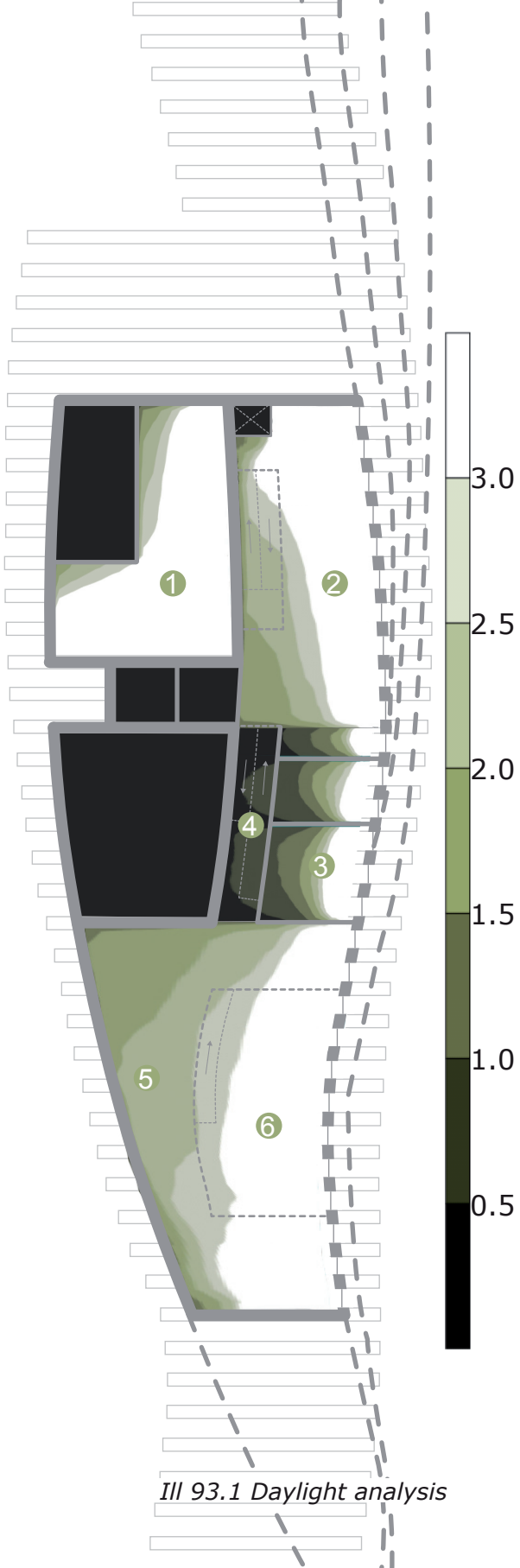
The daylight analysis is done simultaneously with the energy analysis, because they every change in the window size and orientation has an direct affect on the energy demand.

The big glass facade towards east gives sufficient daylight in most areas, however the museum area is so deep that the flexible exhibition area initially did not get sufficient daylight. The east facade was therefore changed in height to increase the light that penetrated into the flexible exhibition. But this showed that with the necessary height, the heat loss in the museum would be to much. Therefore alternative solutions where examined and resulted in adding skylights on the roof to illuminate the flexible exhibition.

The transit area in between cinema 2 and the offices was never intended to be exposed to much sunlight. But in order for it not be pitch black without artificial illuminance, the walls in the office where fitted with windows in the top. This also has an affect on the honesty of the structure, since these walls never where intended as load bearing.



Ill 92.1 East facade



Ill 93.1 Daylight analysis

1 Café

Average daylight ratio	6.6%
Minimum daylight ratio	1.6%
Maximum daylight ratio	21.1%

2 Foyer

Average daylight ratio	6.2%
Minimum daylight ratio	1.5%
Maximum daylight ratio	23.5%

3 Offices, workstation and shop

Average daylight ratio	3.2%
Minimum daylight ratio	0.8%
Maximum daylight ratio	18.8%

4 Transit area

Average daylight ratio	0.4%
Minimum daylight ratio	0.2%
Maximum daylight ratio	0.8%

5 Flexible exhibition

Average daylight ratio	2.9%
Minimum daylight ratio	1.1%
Maximum daylight ratio	4.0%

6 Permanent exhibition

Average daylight ratio	8.2%
Minimum daylight ratio	3.1%
Maximum daylight ratio	21.7%

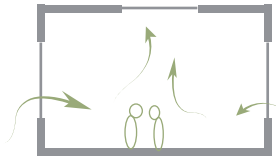
VENTILATION

Ill 94.1 One sided ventilation

The building is to be naturally ventilated as much as possible. During the summer period most parts of the building should be exclusively naturally ventilated to minimize the energy demand for mechanical ventilation. However various functions, such as the cinemas, lavatory and kitchen need to be mechanically ventilated the entire year. During the winter period the building will be mechanically ventilated to reduce the amount of heat loss through openings. The category B is applied as design criteria for the building, which states that most users will be within there comfort range at all time.

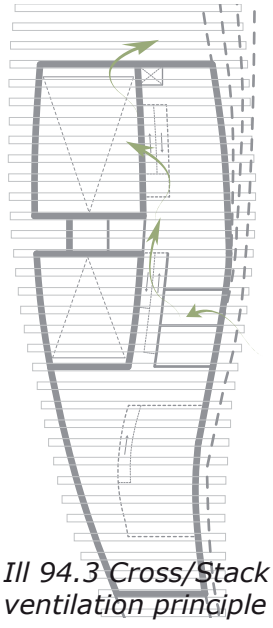
Ill 94.2 Cross ventilation (two sided)

NATURAL VENTILATION



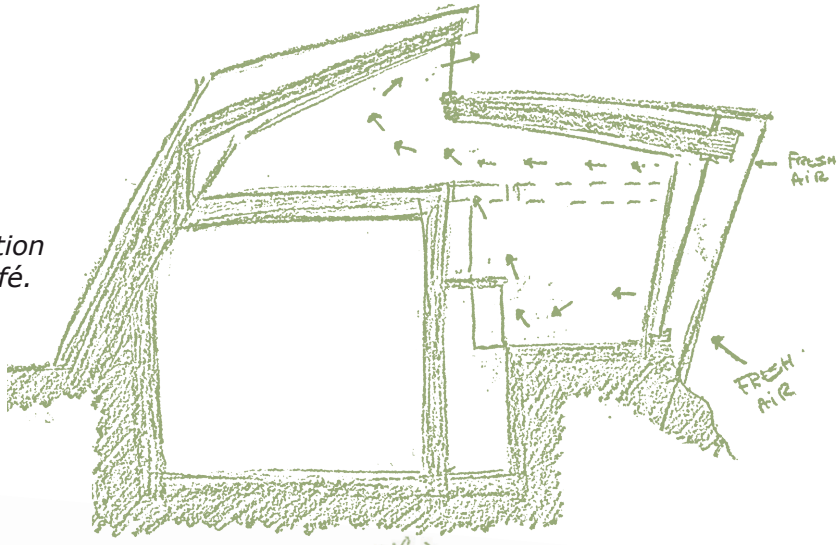
Ill 94.3 Stack ventilation

In order to have the building naturally ventilated during the summer period, it is important to consider which type of ventilation could be applied to the various rooms. The three types that where considered are one and two sided ventilation and stack ventilation. One sided ventilation is considered best suitable for the office, repository shop and workstation situated towards east. However these function could also use two sided ventilation if the wind and pressure conditions are allow it. In such a case the fresh air would come in from east, through the office, into the transit area and by thermal buoyancy and the form of the roof, towards north and out through the café (ill 94.4).

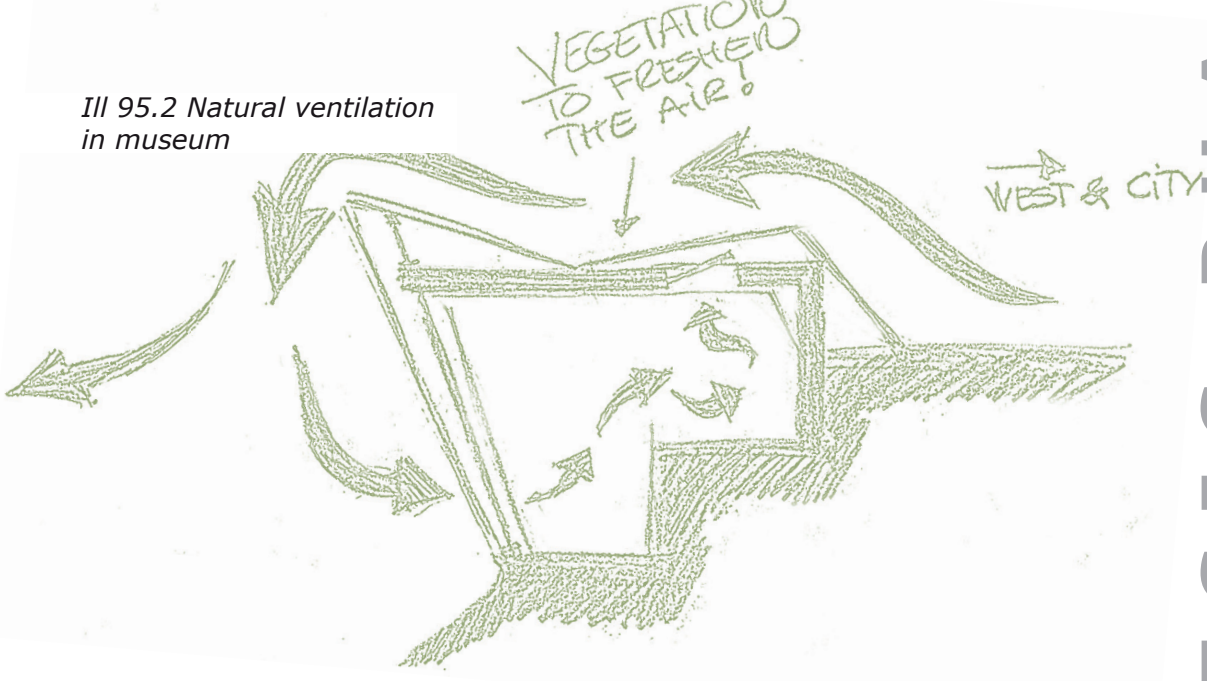


Ill 94.3 Cross/Stack ventilation principle

The foyer, transit are and cafe are to be cross ventilated together. Thus fresh air comes in through the foyer and exits through the café (ill 95.1). The museum was initially intended to be naturally ventilated by one side only, but after the introduction of the skylights stack ventilation could also be used (ill 95.2).



Ill 95.1 Natural ventilation in foyer, transit and café.

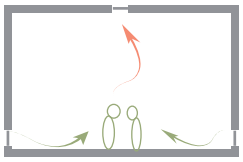


Ill 95.2 Natural ventilation in museum

Another important aspect of the applicability of natural ventilation, is the quality of the air. Since the majority of the wind in Denmark comes from west, the air goes through the city of Faxe before reaching the site. Therefore the introduction of the vegetated roof was partially inspired by means cleaning the air that ventilates the building.

There will not be conducted calculations on the specific amount of natural ventilation that can ventilate the building during the summer period.

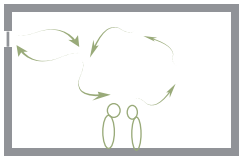
MECHANICAL VENTILATION



Ill 96.1 Displacement ventilation. Cool are supplied, warmed up by people or appliances and exhausted. Good in high ceiling rooms with high activity level.

To ensure a high level of comfort, mechanical ventilation will ventilate the building when it is not sensible to ventilate naturally.

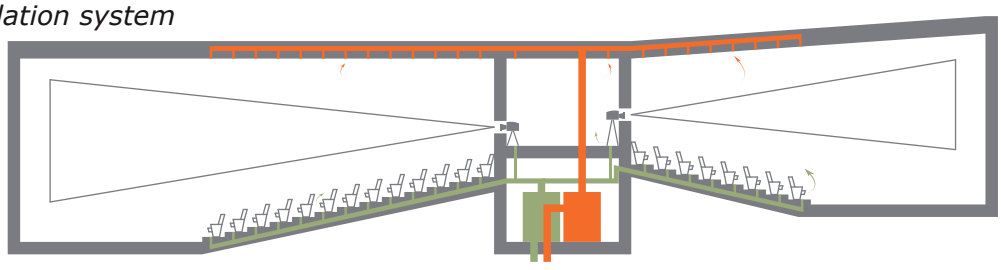
Some of the function within the building need constant mechanical ventilation, to ensure the necessary air quality, while others can be naturally ventilated a long range of the year. The cinemas shall be mechanically ventilated with displacement ventilation. Because of the amount of people in such a relatively small space, the amount of necessary fresh air supply to maintain a good air quality is considerably higher then in the other functions (see room program p.53).



Ill 96.2 Mixing ventilation. Tempered air supplied, mixed with the existing and exhausted. Good in low ceiling rooms with low activity.

This basically means that a big part of the buildings mechanical ventilation is to be applied here. Therefore it is considered most reasonable to situate the technical room with the ventilation system near the cinemas (ill 96.3). The kitchen and the lavatories also need mechanical ventilation throughout the year.

Ill 96.3 cinema section with ventilation system



Ill 97.1 Mechanical ventilation system

Displacement ventilation, which is used in the cinemas, could also be applied in the foyer, café and the museum since they these rooms have high ceiling. However the amount of occupants in these relatively big spaces could indicate that a mixing system is a better solution. A mixing system would also allow for the air vents to be placed in the ceiling or wall, thus not using valuable floor space.

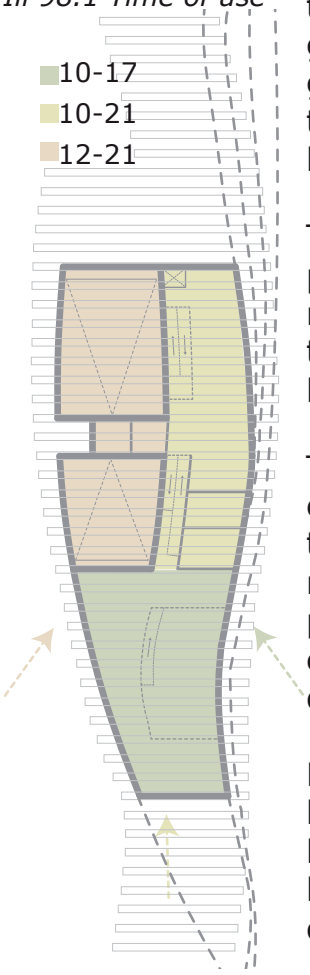
Ill 97.1 shows a principle diagram of the ventilation system. Both the displacement system and the mixing system are located in the technical room between the cinema on -1 level. Having the systems in the same location will make maintenance easier, as well as utilize the heat recovery system to its fullest.

ENERGY

In the early design process spreadsheets where used to get an idea of the energy consumption of the building. The first design ideas also showed that with a glass percentage of approximately 50, the building would always overheat in the summer, and have a very high heat loss during winter. Which therefore resulted in using the vegetated roof and instead of heaving a sculpture like structure, it would rise from the surroundings.

Another important aspect in the early process was the orientation and interaction between the functions. The museum is open from 10 till 15, while the café is open from 12 to 21 (competition program), which therefore should be orientated to gain heat from respectively the morning- and afternoon sun, to minimize the energy demand in both functions for heating.

Ill 98.1 Time of use



The construction of the roof became an essential part, since the structure was so complex and the roof was so large. The sketches on page 91 show two possible build ups, both have 250 mm of insulation and a estimated U-value of 0.15 W/m^{2}K.

The many windows towards east also have a great effect on the energy consumption. BE10 calculations showed that it was more important to minimize the heat loss, rather then to maximize the passive solar gains. The windows are three paned energy windows to minimize heat loss. The windows have an U-value of 1 W/m^{2}K.

By merging the building with its surroundings and having a big part of the floor area under ground level, a big part of the building envelope is naturally insulated by the terrain. This has a major effect on the heat loss of the building, since the external

temperature is much more stabile in the ground, compared to the air. Therefore the building not only has a lower heat loss during winter, but also a cooler surface temperature during summer, thus reducing the need for cooling.

The first BE10 calculations showed that the lighting and ventilation energy consumption was to high, and since these factors are multiplied by 2.5, it was not possible to reach the energy performance set by the building regulations. Therefore this had to changed. The solution for this had come from utilizing the daylight better. This was done relatively simple by applying skylights changing the east facade according to the functions within.

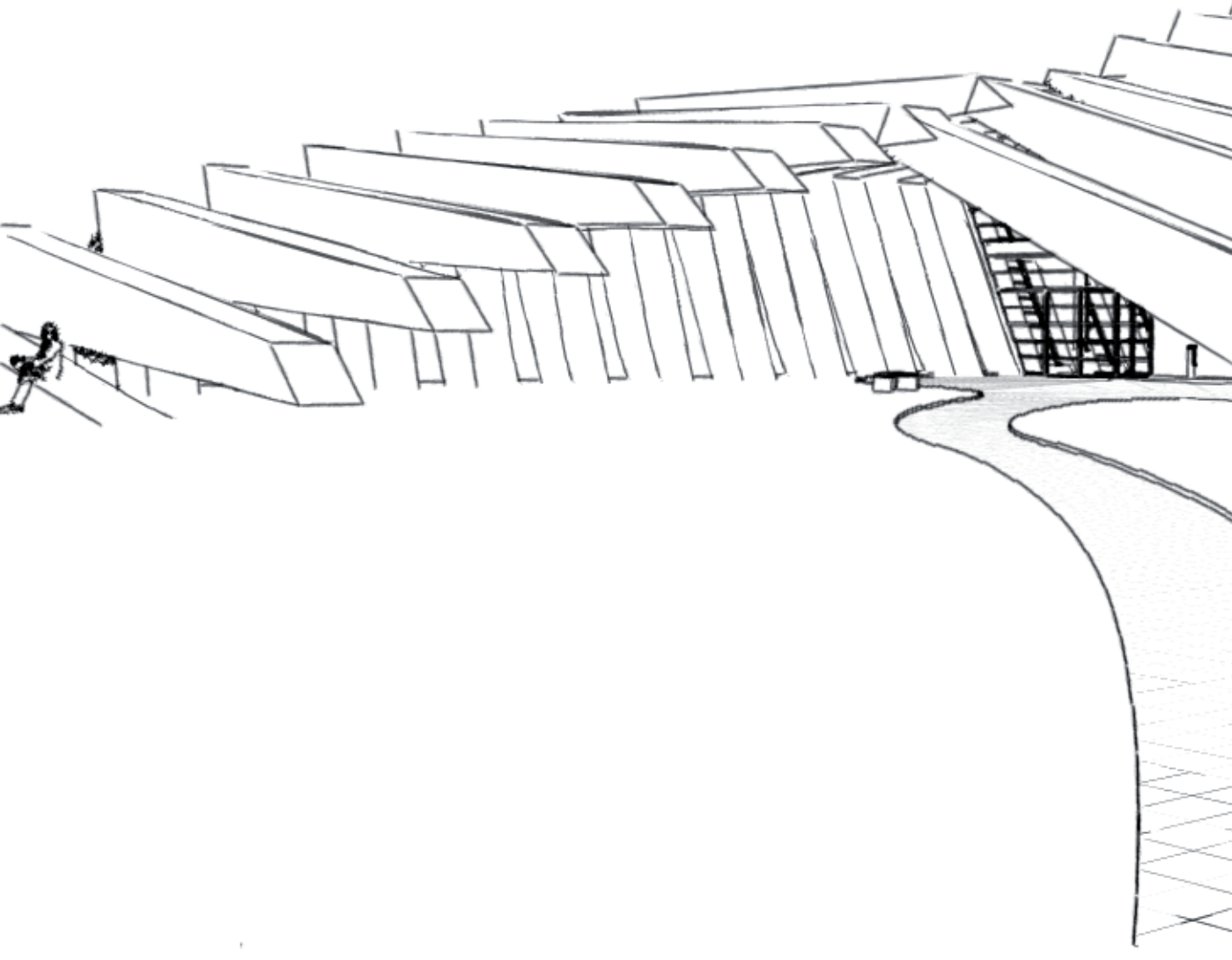
The most important parameters in the design process where always the iconic design, the view and the experience, which meant that there evidently had to be question on priority in regards to the energy. Because of the orientation and shape of the building, solar gains became a second priority,and a relatively small amount of facade is directly orientated towards south. This meant that the energy performance not could fulfil the demand for BR10 Low Energy 2015, which initially was a target. The final calculated energy performance does however fulfil BR10 and could with an addition that can be applied because of high lighting and ventilation need and high ceiling height, meet the Low Energy 2015 demands.

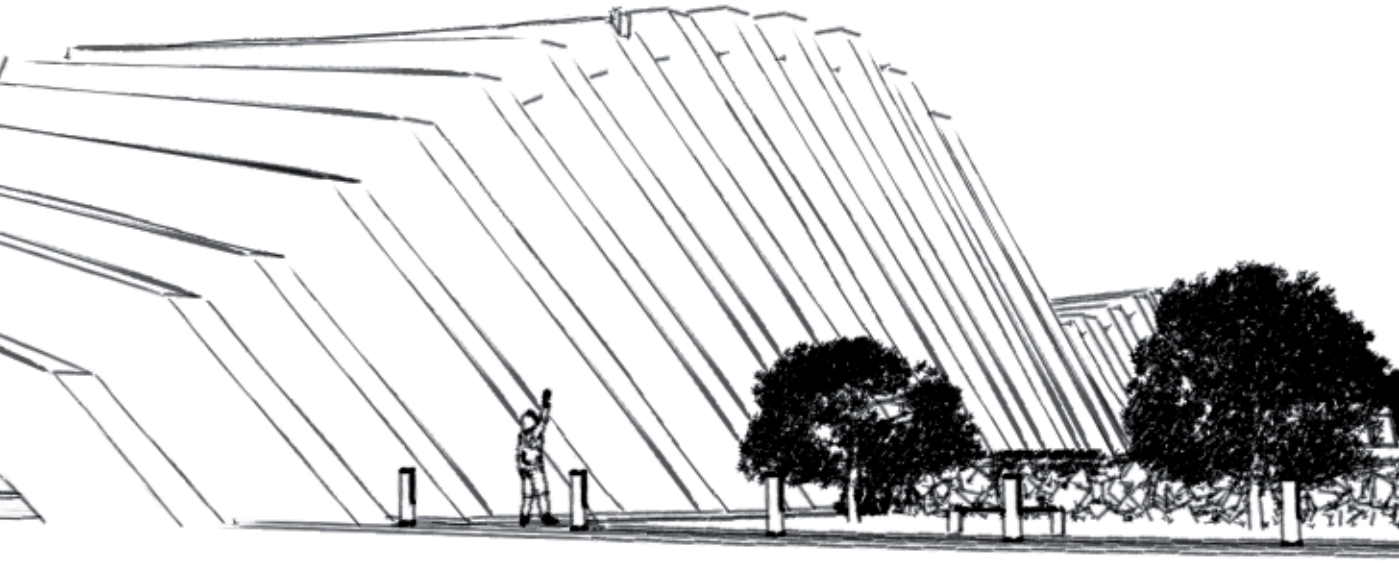
Energy Performance BR 2010: 72.2 kWh/m^2 year
Low Energy 2015: 41.6 kWh/m^2 year
Building energy demand: 52.2 kWh/m^2 year
Heating: 18.3
Electric: 13.6 *2.5

- (Details on CD)

DESIGN

ENTRANCE



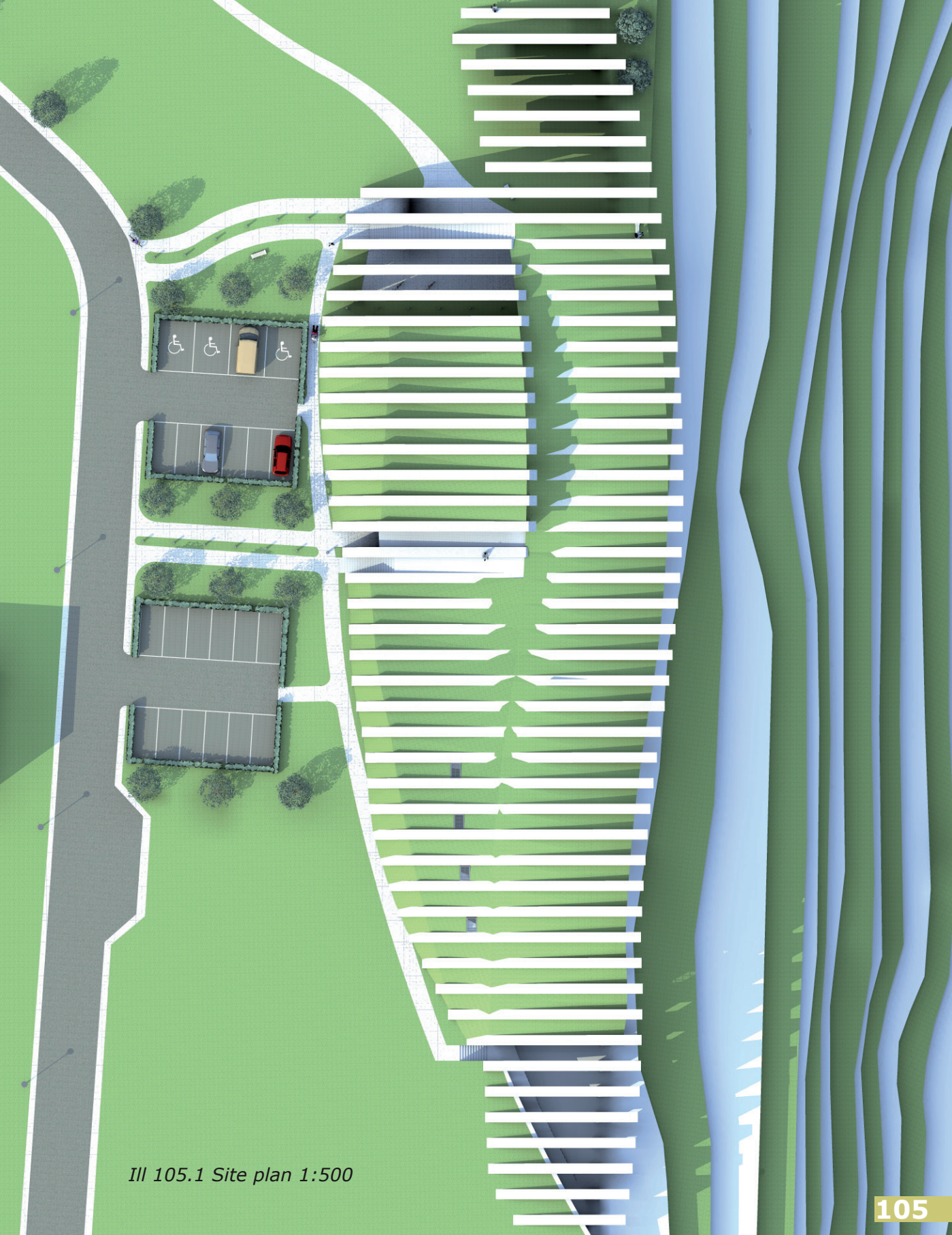


ON THE FOLLOWING PAGES THE BUILDING IS PRESENTED PLANS, SECTIONS AND FACADES.

Ill 102.1 view from northwest

SITE PLAN

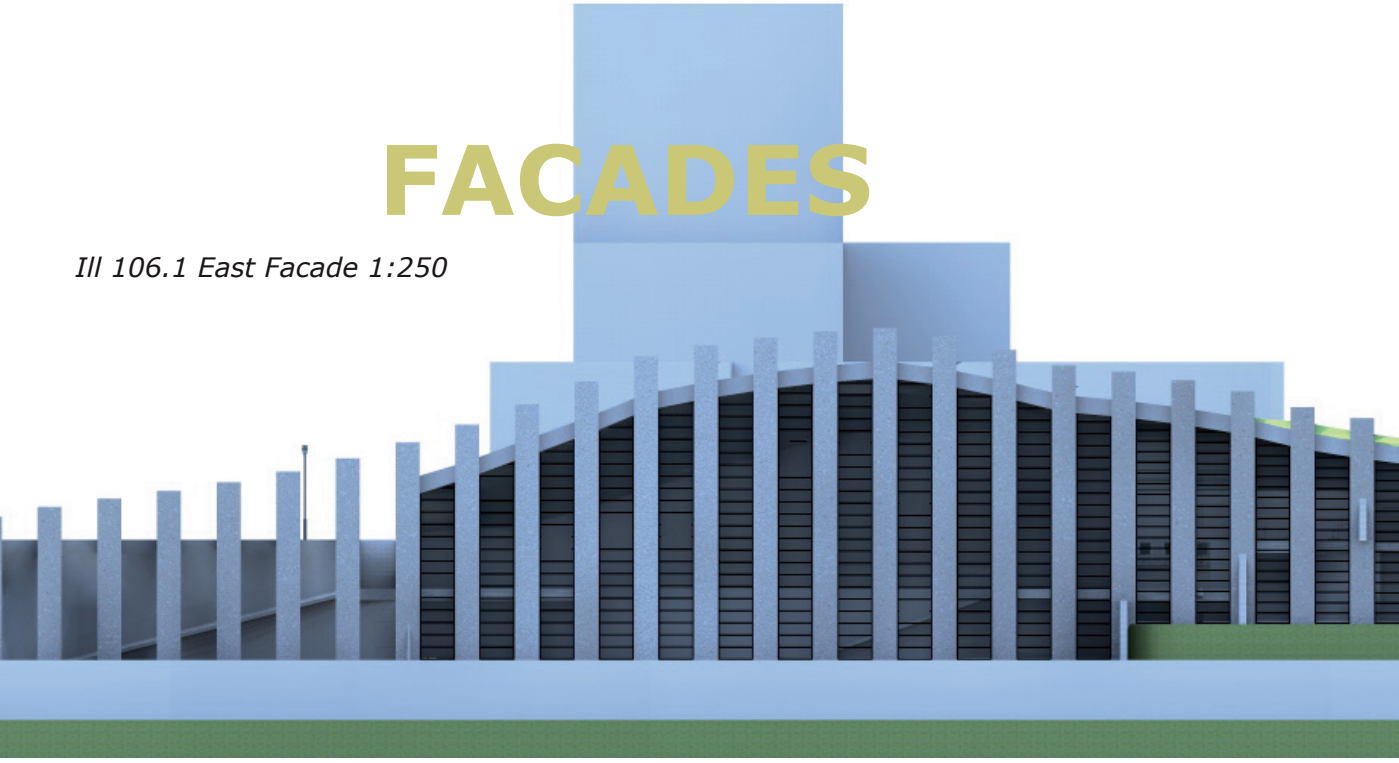
Ill 104.1 View from north



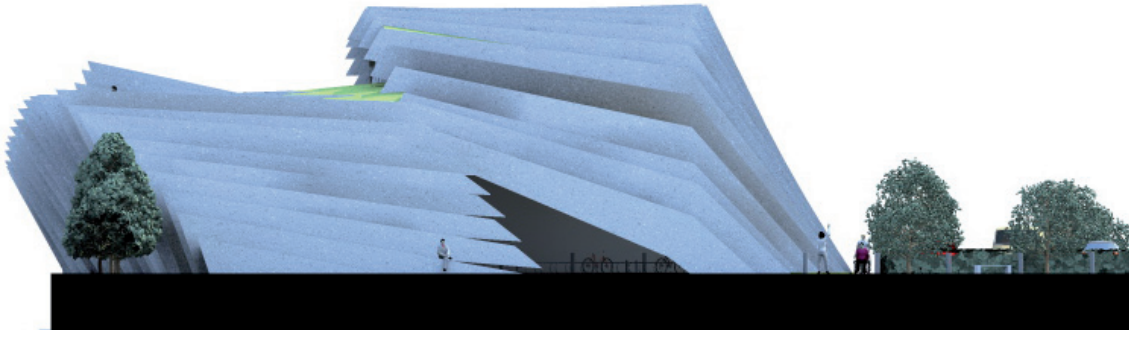
Ill 105.1 Site plan 1:500

FACADES

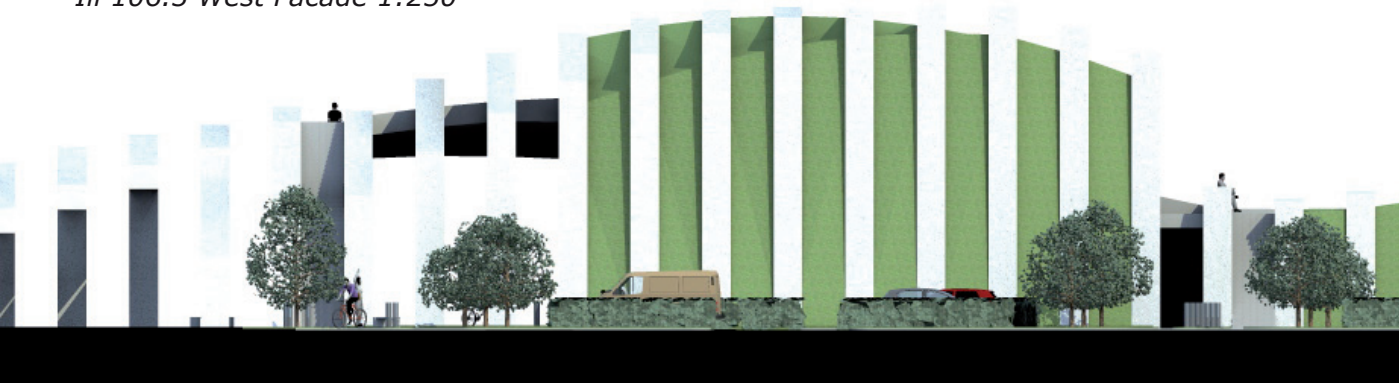
Ill 106.1 East Facade 1:250

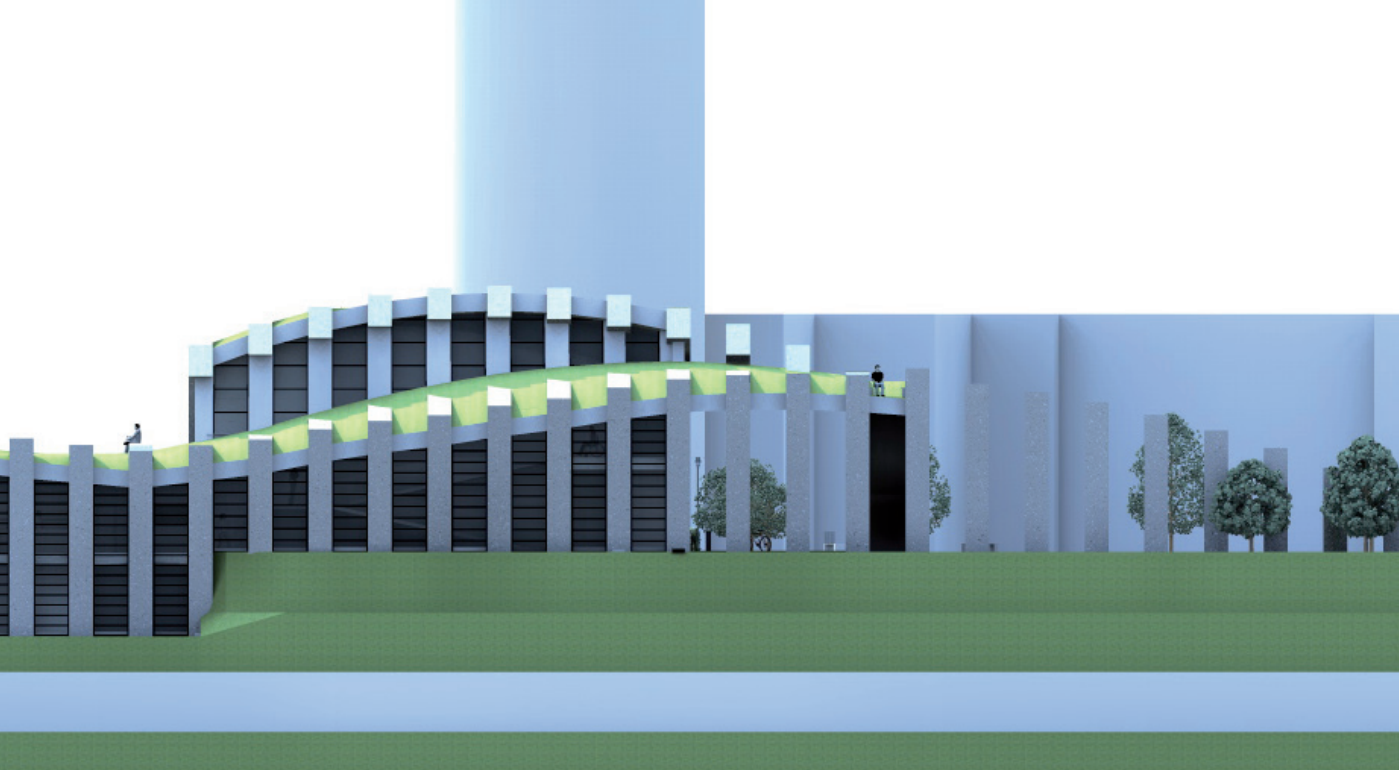


Ill 106.2 North Facade 1:250

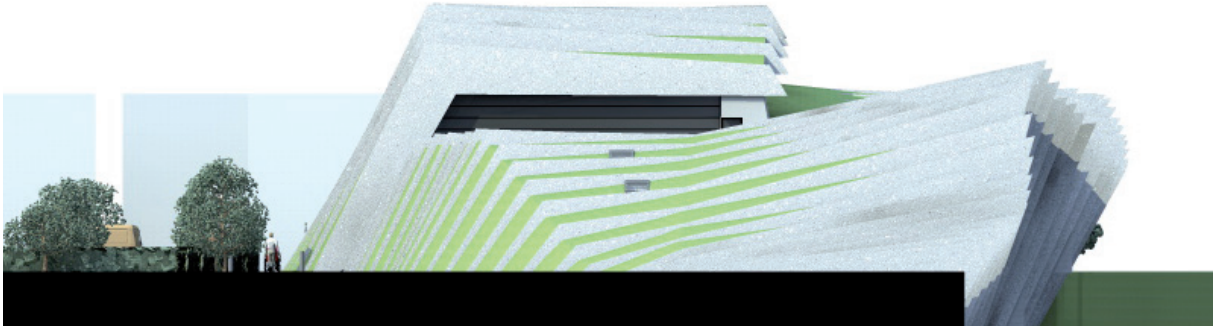


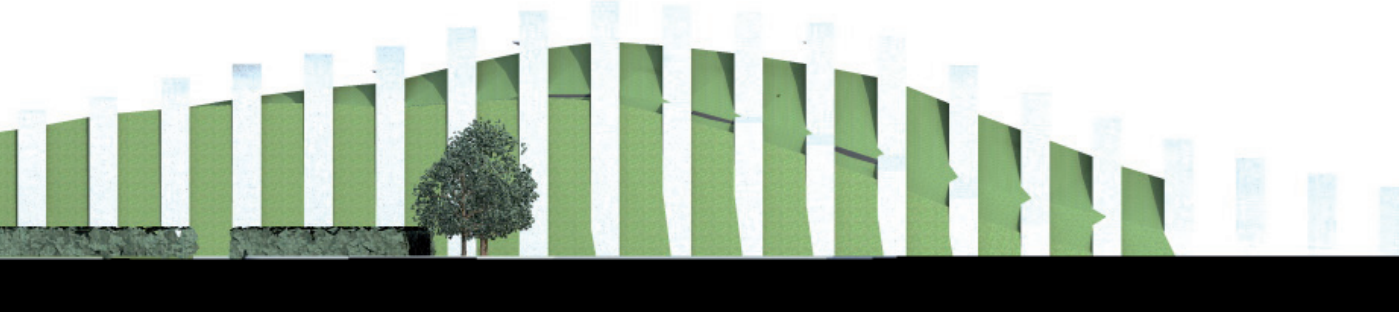
Ill 106.3 West Facade 1:250





Ill 107.1 South Facade 1:250





PLANS

❶ Cinema 1 -175 seats
A: 266 m^2
H: 4.4-7 m

❷ Projector room
A: 20 m^2
H: 3.5 m

❸ Ticket sale
A: 18 m^2
H 3.5 m

❹ Cinema 2
A: 172 m^2
H: 3.9-6 m

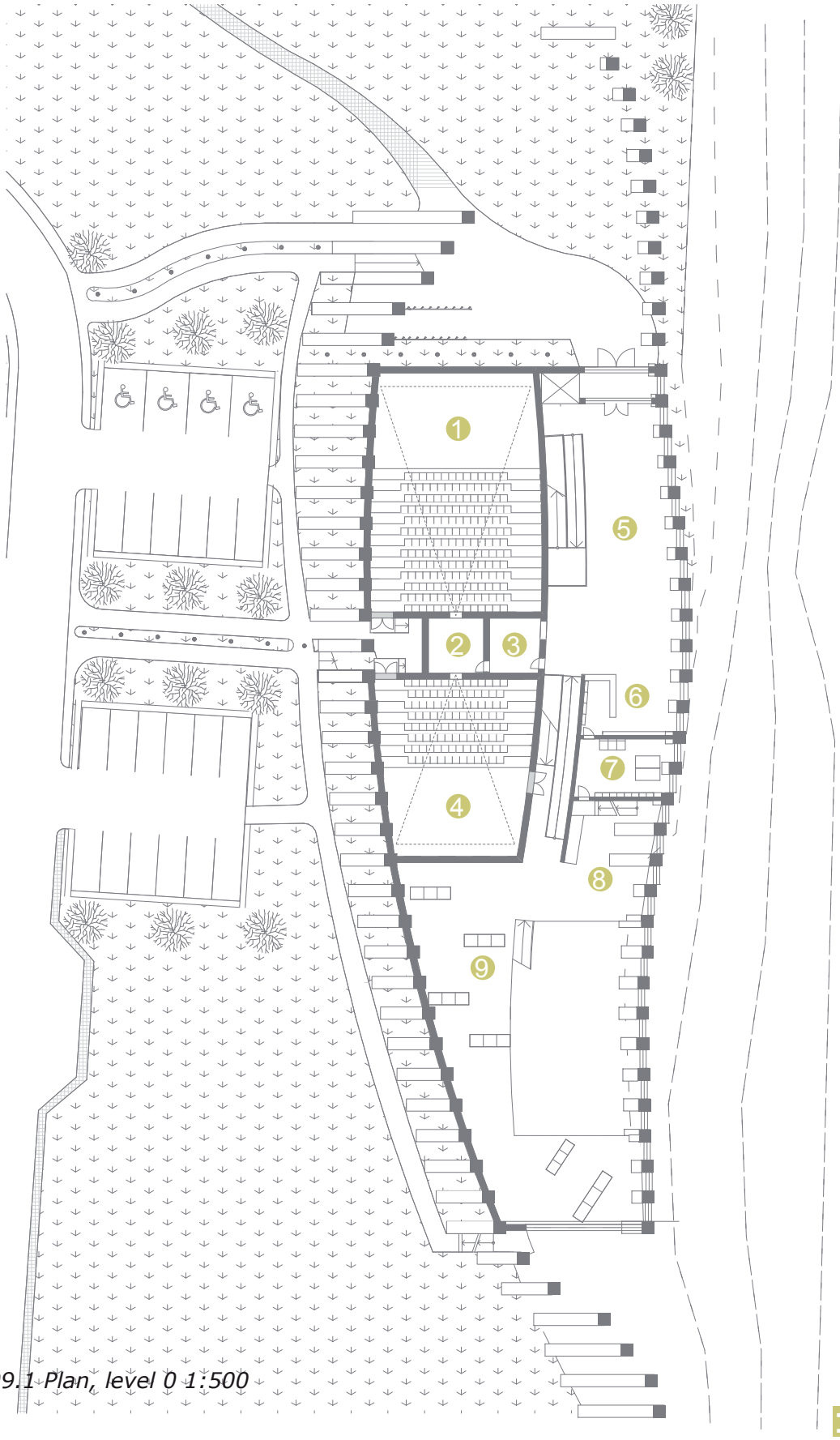
❺ Foyer
A: 150 m^2
H: 3-7 m

❻ Museum Shop
A: 35 m^2
H: 3 m

❼ Office
A: 35 m^2
H: 3-4m

❽ Museum workshop
A: 65 m^2
H: 6-6.5

❾ Flexible exhibition area
A: 250 m^2
H: 2.5-7m



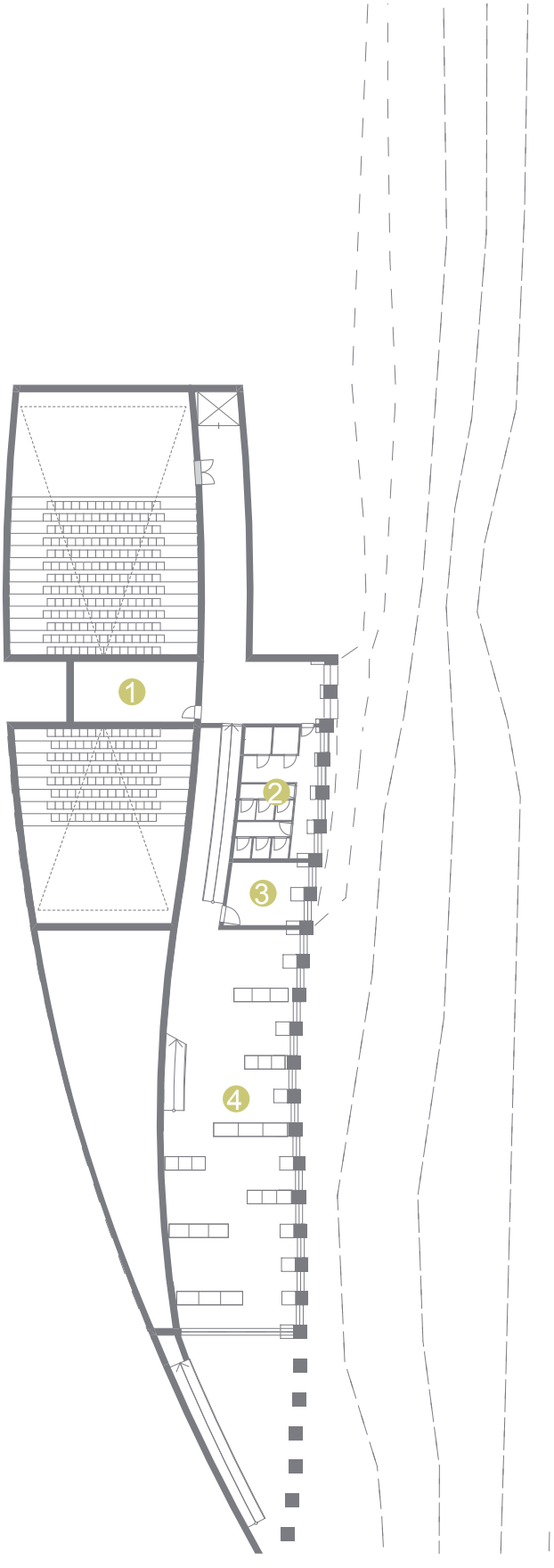
Ill 109.1 Plan, level 0 1:500

❶ Technical room
A: 40 m²
H: 3 m

❷ Lavatory
A: 65 m²
H: 3 m

❸ Repository
A: 30 m²
H: 2.5 m

❹ Permanent exhibition
A: 250 m²
H: 2.5-10 m



Ill 110.1 Plan, level -1 1:500

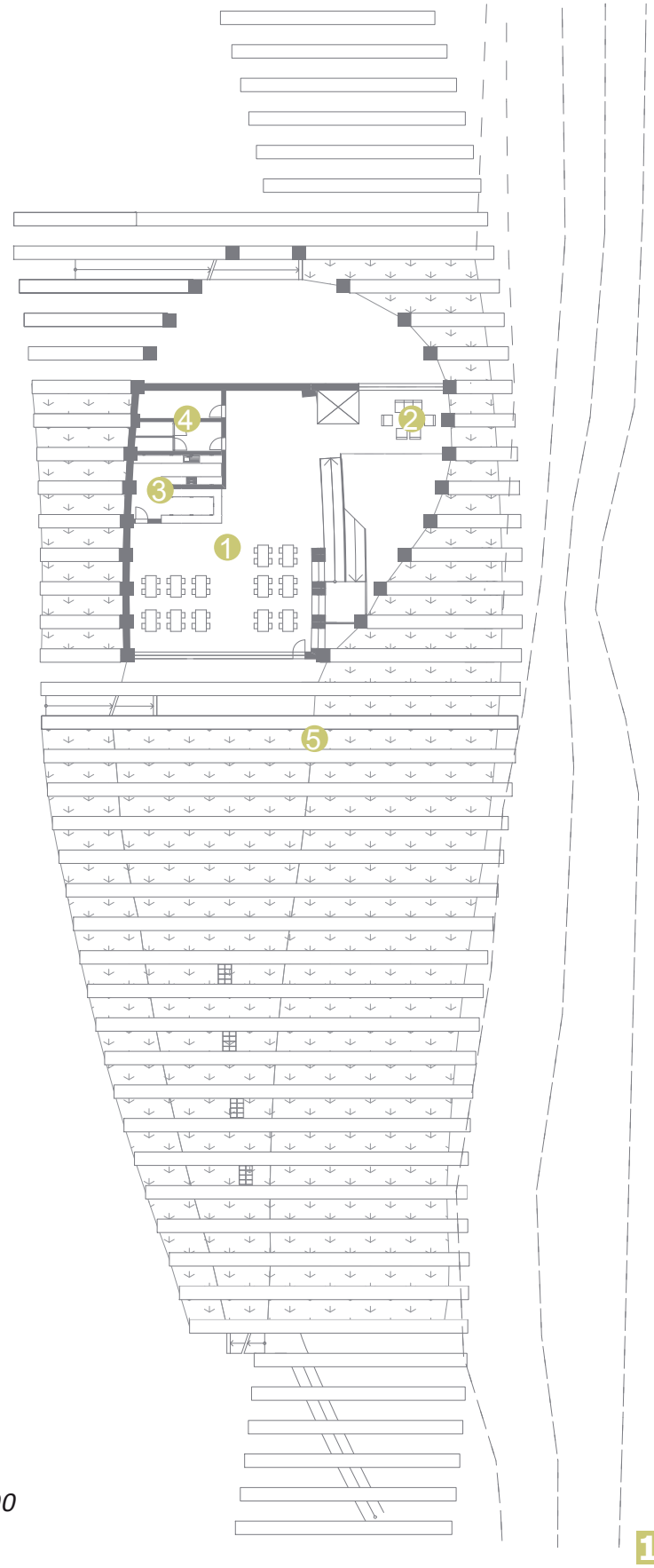
1 Café
A: 180 m²
H: 3-6 m

2 Lounge
A: 40 m²
H: 2-3 m

3 Kitchen
A: 30 m²
H: 3-4 m

4 Toilet and storage
A: 30 m²
H: 3-4 m

5 Roof area
A: 1000 m²



Ill 111.1 Plan, level +1 1:500

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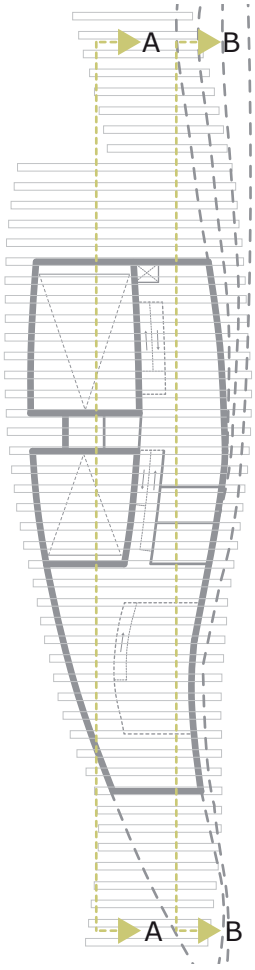
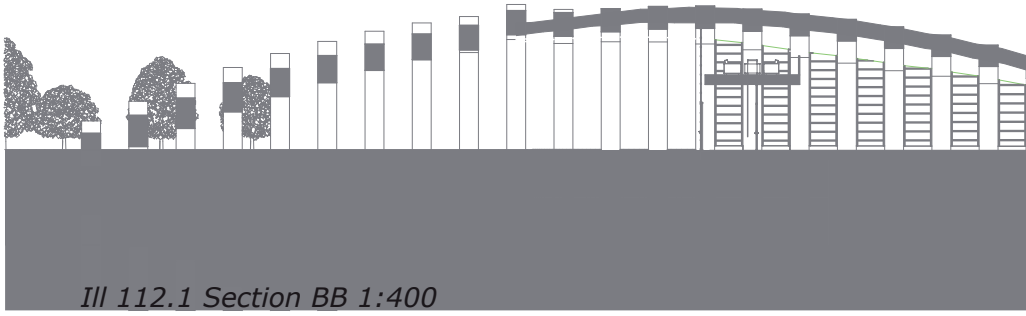
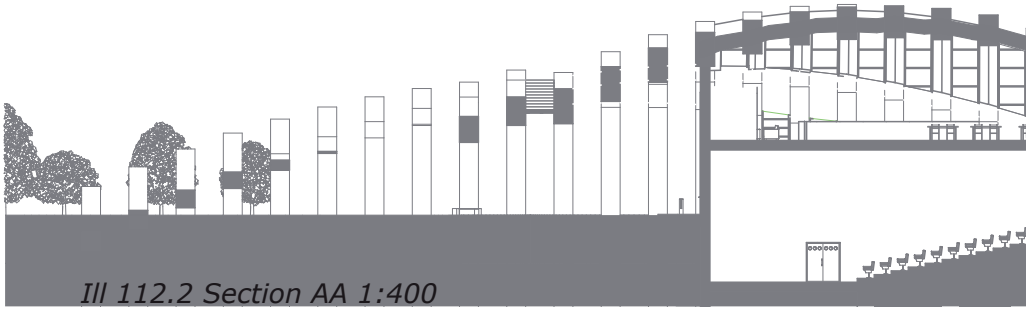




Ill 112.1 Section BB 1:400



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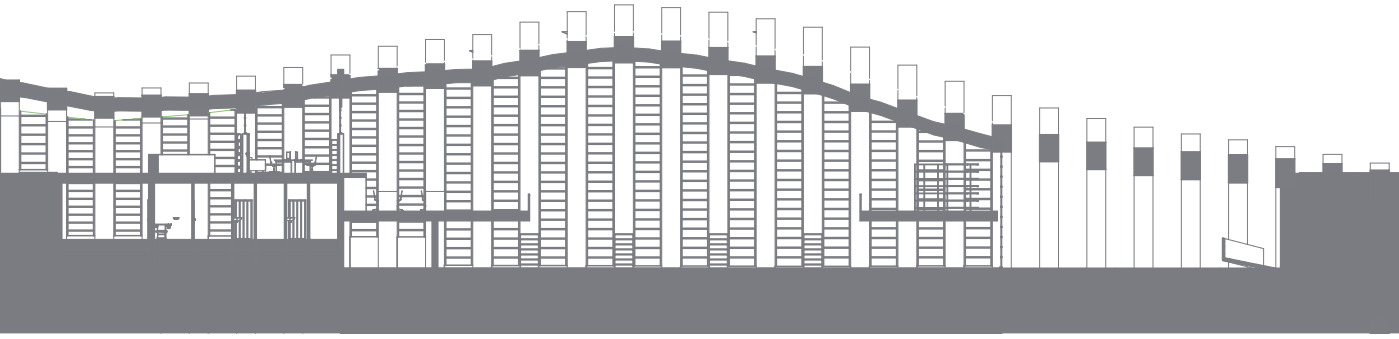
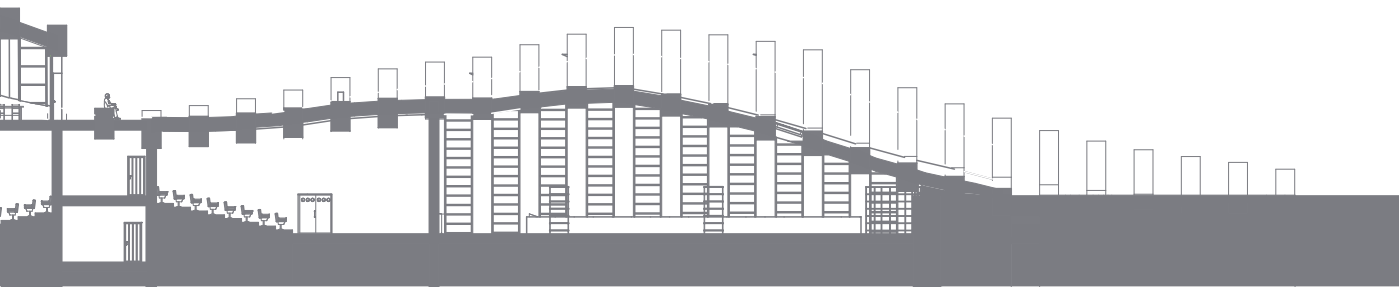
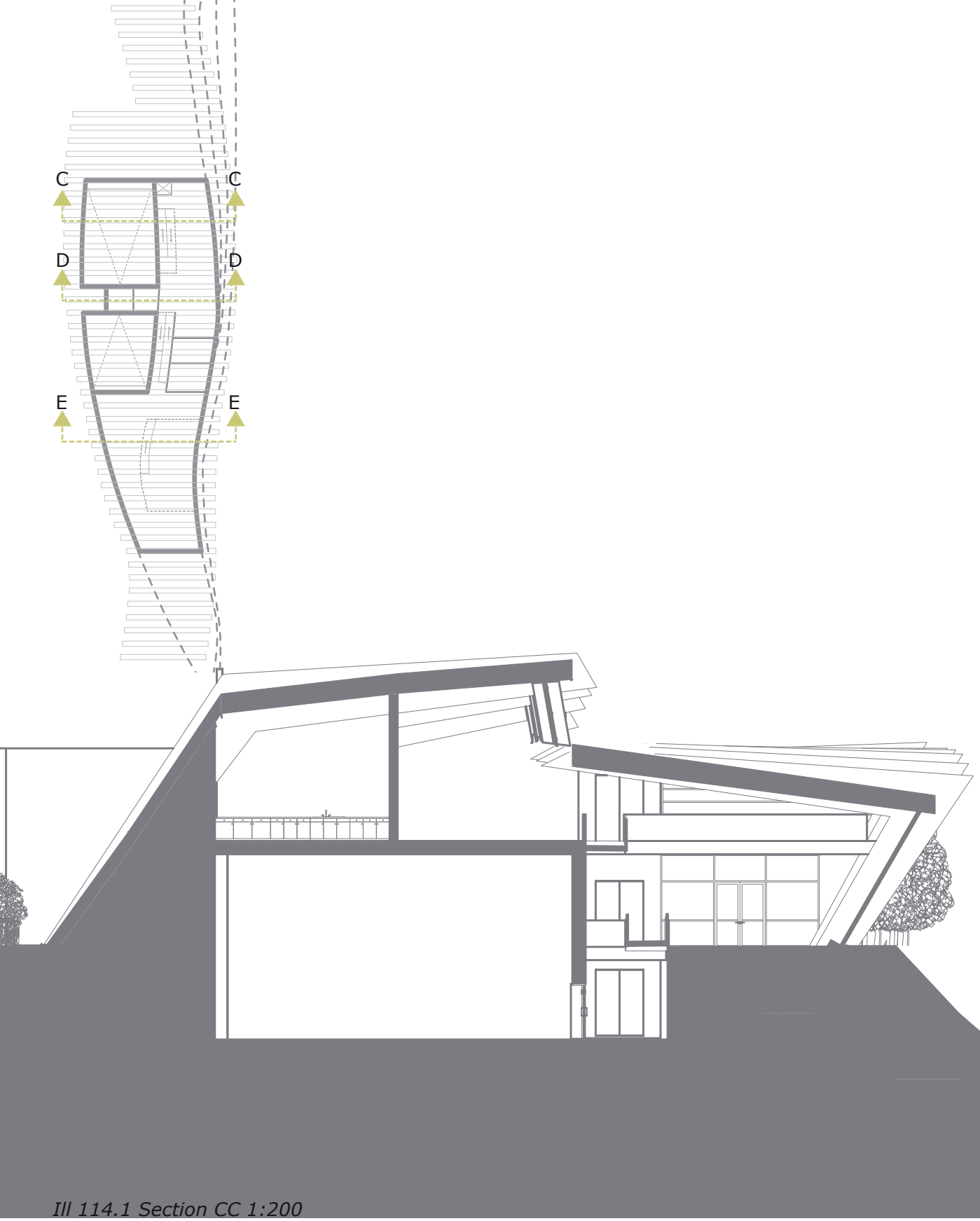
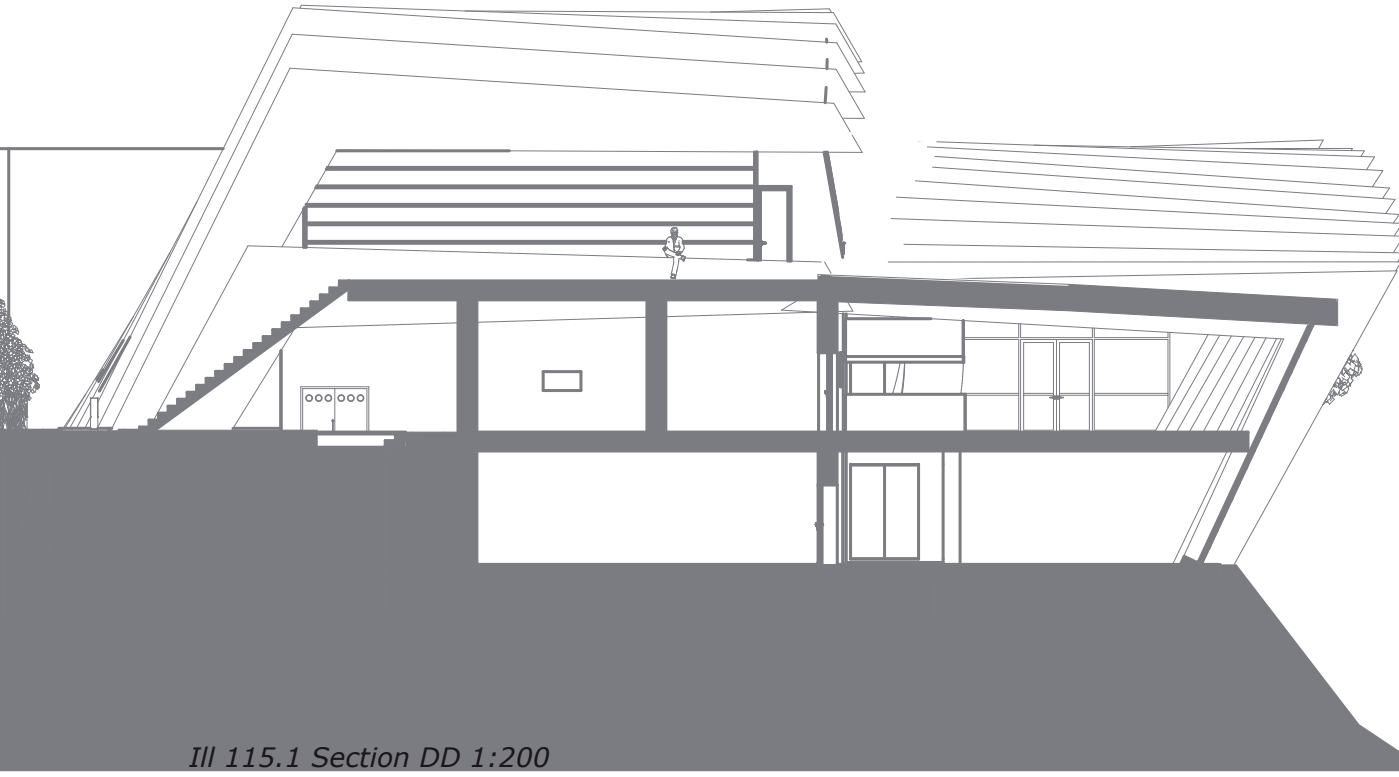






Ill 114.1 Section CC 1:200



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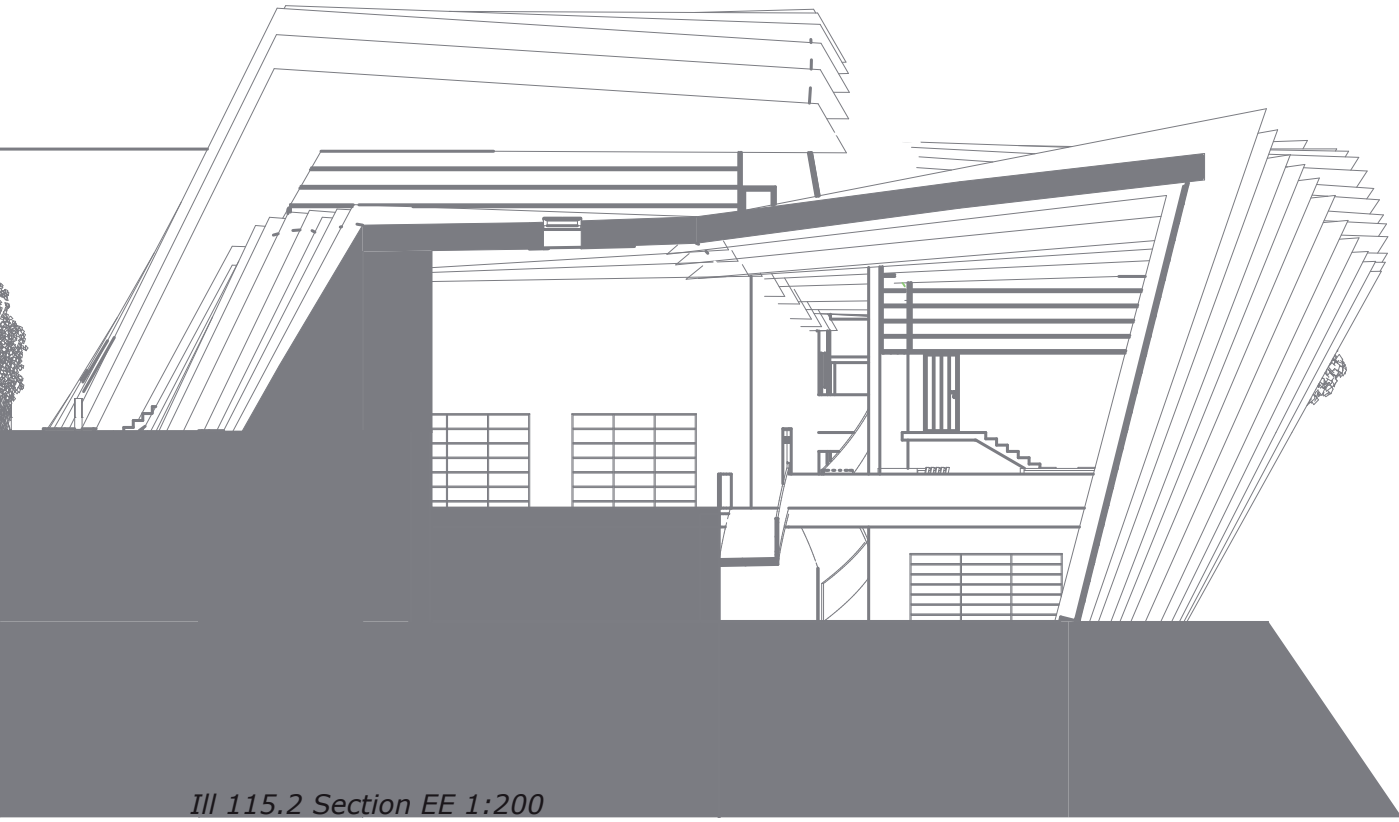

Ill 115.2 Section EE 1:200

CONCLUSION

The main vision with the project was to design an iconic building that could function as a social hub to the citizens of Faxe and creating a link between the limestone quarry and the city. The building is considered recognizable and would certainly put Faxe in the map. The cultural house and especially the roof would allow for visitors as well as inhabitants of Faxe to enjoy the dramatic landscape in the quarry from a new perspective.

The building resembles a fossil, which ha a direct connection with the unique location, as well as the main function within. The shape of the building invites visitors to explore and investigate it. A stroll on the roof can give a dramatic experience of the quarry, since the building seems to be a part of it.

When inside the building, visitors could have a biblical experience like Jonah in the whale, by seeing the continuous bone structure throughout the building. The building is very open and a common transit area connects all the functions.

In regards to the more technical aspects of the building, there are still many things that could be improved. The construction could and perhaps should be optimised with respect to tectonics, the acoustic conditions in the huge museum space should be analysed, the energy performance could probably be improved as well as the financial aspects have been totally overlooked. However because of the set parameters in the early process, the main focus of the project has always been on recognizability and the experience the visitors would get and here the project is considered a success.

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INTERNET

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ILLUSTRATIONS

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