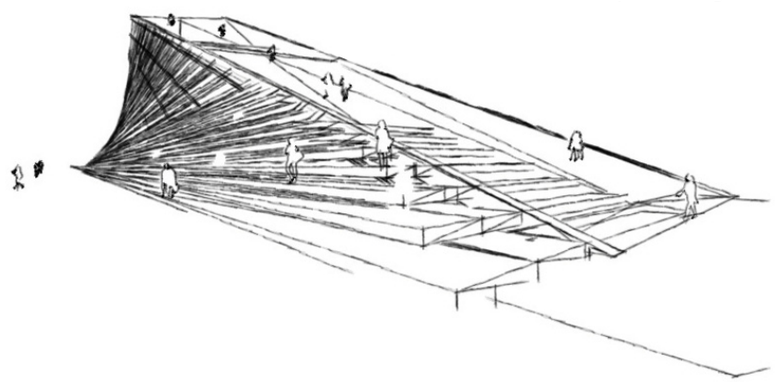
The Heart of the Metropolis

New Central Library for the City of Helsinki

Master thesis **Sonny Holmberg** and **Luke Lorimer Baylis,** ma4-ark52, may 2012



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Title: New Central Library for the City of Helsinki

Theme: The Heart of the Metropolis

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Synopsis

This paper deals with designing a new library in the center of Helsinki as part of an open international competition. The competition brief is very detailed and extensive demanding a range of requirements from sustainability to an aesthetically timeless iconic building that will attract the entire city as well as tourists. It will be a library for everyone and be more than just a library offerering an array of many different functions all bundled neatly into an exciting package nested in the heart of Helsinki.

Our project began with the theme of sustainabilty, however since the competition brief demanded so many different requirements and given that we had planned to enter the competition we strived to fulfill every element of the competition brief. This resulted in creating a project that evolved around a broad range of topics without focusing too much on anything in particular. The main topics varied from sustainability to technical aspects to designing something timeless. The final design is an impressive library made from concrete, steel and glass, something you can walk on and interact with inside and out. It complements and integrates into the existing Helsinki environment and thus becomes The Heart of The Metropolis.

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Introduction

An open international competition is being held by the City of Helsinki for the design of a new Central Library. The central library is part of a bigger project called World Design Capital Helsinki 2012.

Already in the 1990's the widespread opinion among the general public in the City of Helsinki, was that there were needs for a public central library suitable to the scale of the city.

The need of a new Central Library is based on strategic principles of developing the wellbeing of the citizens, urban fabric, competitiveness and also the changes that have taken place within the field of library operations. The objectives for the new Central library is described in a strategy programme from the City of Helsinki and in 2008 a review report called "Central library: The Heart of the Metropolis - The Heart of Helsinki" is published. It describes how the new library should be a meeting place for information, skills and stories. It enforces learning, personal cultivation, culture as a basis for well fare and user centred innovative environments.

In essence what is needed is a contemporary, innovative new Central Library that is not just a library but a node for encounters in the very centre of Helsinki that offers something for everybody and also enlivens and diversifies the new urban environment created in the Töölönlahti area.

"The new Central Library will be much more than a traditional library. It enforces learning, skills, personal cultivation and culture as a basis for welfare and competitiveness" (Competition Program,2012)

Methods

The project will be divided into five phases with a basis on an integrated design process. The phases include: an idea program/competition, a program, a sketching phase, a synthesis phase and a presentation (ill. 1)

The idea/problem phase is given by the competition outline and description. The integrated design process is an iterative process and the separate phases must not be seen as a linear development, but as a work in progress where moving back and forth between different phases is necessary.

The Program

Everything in the program that affects the project will be described. Encapsulating the project site and it's geographical reference as well as it's urban location, climate conditions including the prevailing wind, the sun and shadows and the context. There will also be research into sustainability; including a general understanding of the subject and what our focus will be. Furthermore some inspiration from architects Finland itself along with some case studies we found interesting. The program will give us a good understanding of the site, it's climatic conditions and it's surroundings which we can then move forward with and begin the sketching phase.

The Sketching Phase

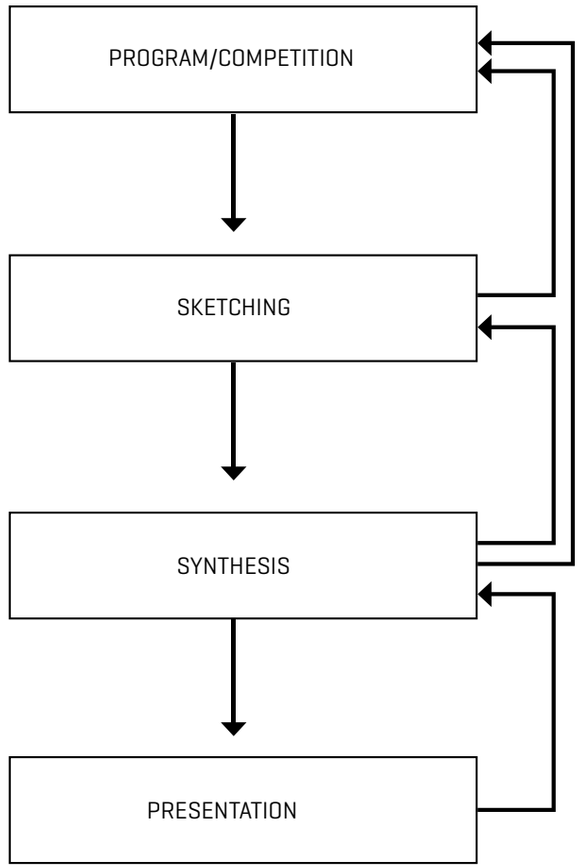
The sketching phase will convey architectural ideas upon which concepts are conceived whilst keeping in mind and combining constructional, energy, functional and climatic principles. Within the sketching and synthesis phases we will implement two main programs, namely Revit and Ecotect to analyse and make iterations of our design to find optimal solutions. An integrated design process diagram is presented in the Process chapter on page 59.

The Synthesis Phase

In the synthesis phase the different aspects from the program and the sketching phase are combined. It is within this phase that the final concept is developed.

Presentation

In the presentation the final design and solutions will be exhibited through various renderings and plan/elevations. The program basically consists of two parts, including a mapping of the area and collection of data. The data collection will provide wind diagrams and different types of typologies and sustainability that has been explored.



ill.1 Design Process

Mapping

Within the mapping of the area we used Kevin Lynchs method of analysing an urban space and Gordon Cullens Serial Vision. This is done to visualize the most important observation in the area.

Kevin Lynch approach

In 1960 Kevin Lynch published book titled “The image of the City” which encapsulated five years of city mapping research. The goal of his project was to identify which physical characteristics in buildings were the most important for people living in the city. Lynch found five key elements that constitutes peoples perception of the city, these included roads, edges, districts, nodes and landmarks. (Sundilson, 2001)

PROGRAM

CONTEXT AND SITE: TÖÖLÖNLAHTI

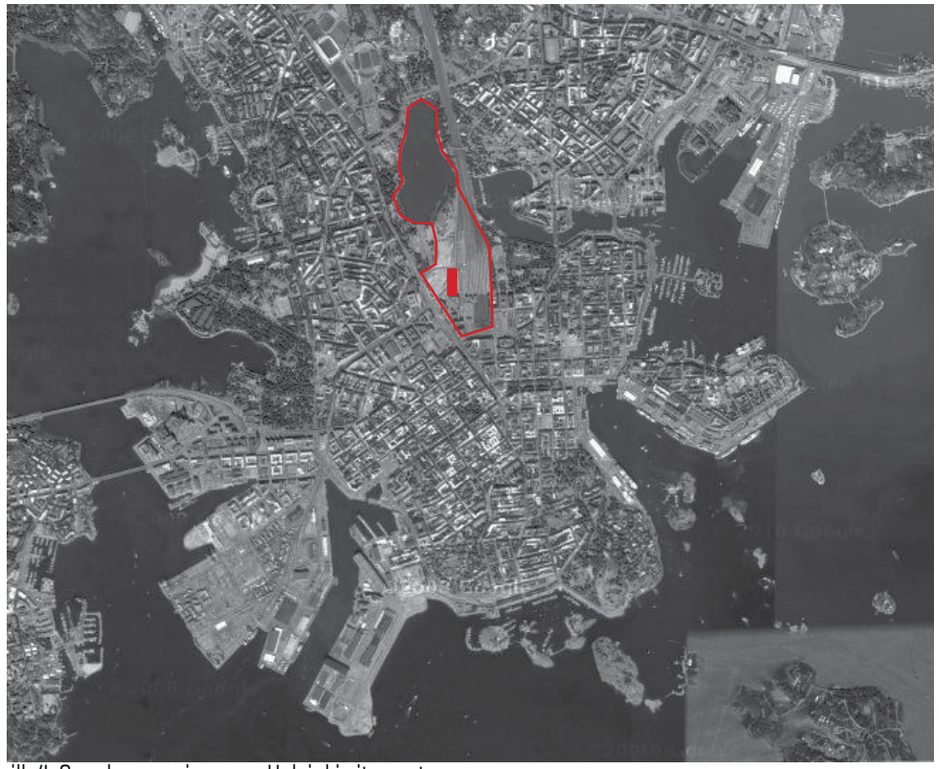
A site is chosen by a committee from the Helsinki municipal, and the site chosen is in the very center of Helsinki city. In this chapter we will analyse the site and its surroundings to get a good understanding of the area where the new central library is being built.

ill. 2 Site Töölönlahti, Helsinki

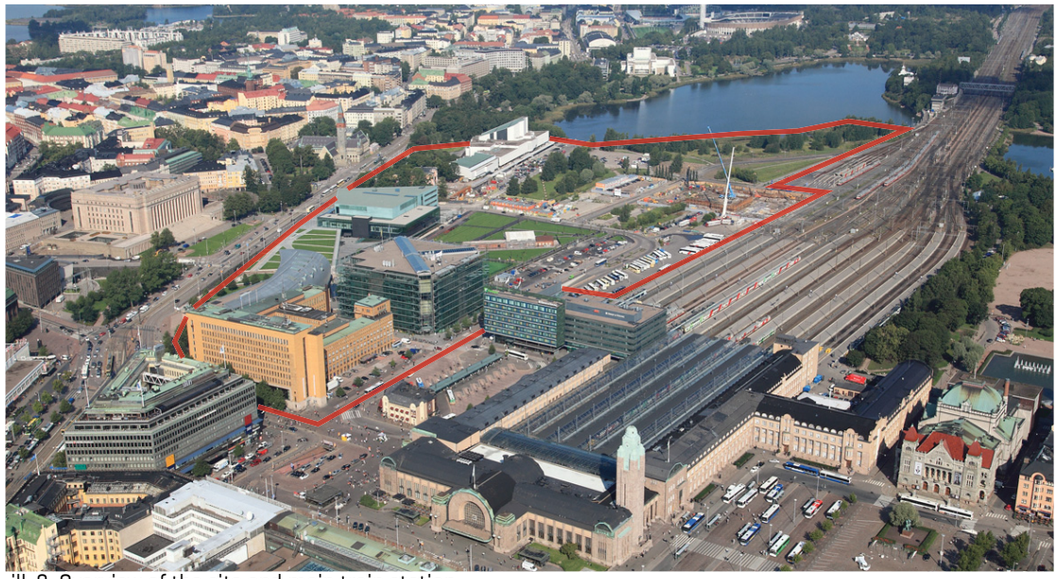
Location

The competition site lies in the Töölönlahti region of Helsinki Finland, which is noted as one of the most valuable areas in the Helsinki city centre. Amongst this area includes several important buildings such as the Finnish Parliament building architect Johan Sigfrid, Finlandia Hall architect Alvar Aalto, Kiasma Museum of Contemporary Art architect Steven Holl, Helsinki Music Centre, architects Marko Kivisto, Ola Laiho, Mikko Pulkkinen and the Helsinki central railway station architect Eliel Saarinen. Before any construction began here the designated competition area was formly a railway yard, see page 31.

The site reaches out to the Töölönlahti bay which penetrates the city centre, and the future plan for the area is to integrate water canals from the bay in the area of the site.

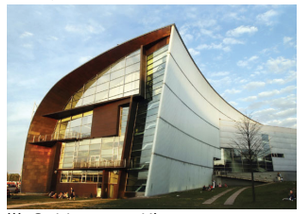


ill. 4 Google map view over Helsinki city centre



ill. 3 Overview of the site and main train station.

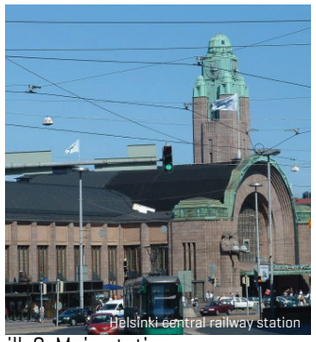
ill. 5 Finlandia Hall



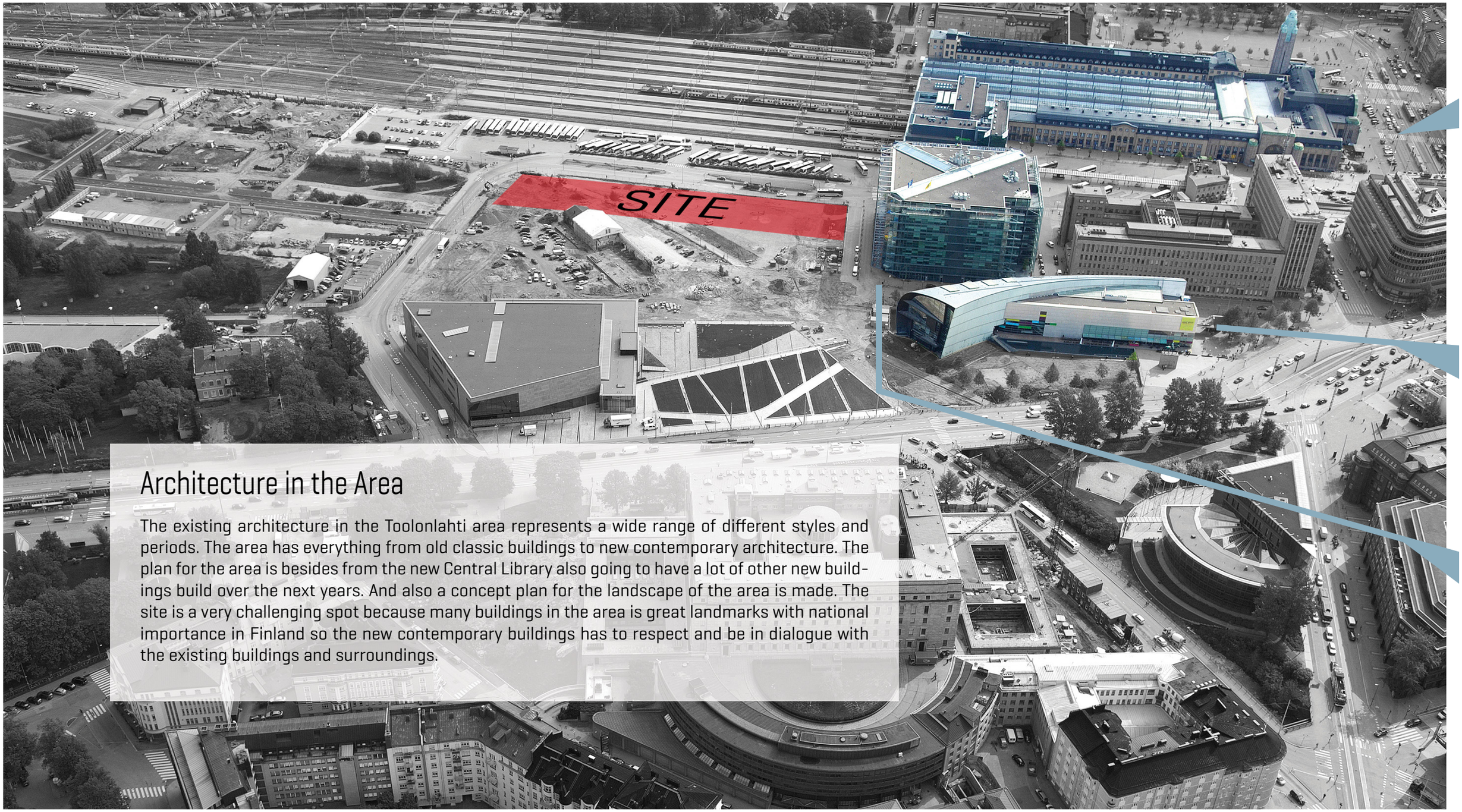
ill. 6 Museum Kiasma

ill. 7 Helsinki music centre

ill. 8 Museum Kiasma and new opera in construction



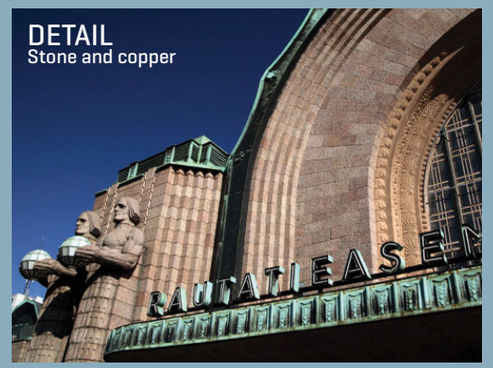
ill. 9 Main station



Architecture in the Area

The existing architecture in the Toolonlahti area represents a wide range of different styles and periods. The area has everything from old classic buildings to new contemporary architecture. The plan for the area is besides from the new Central Library also going to have a lot of other new buildings build over the next years. And also a concept plan for the landscape of the area is made. The site is a very challenging spot because many buildings in the area is great landmarks with national importance in Finland so the new contemporary buildings has to respect and be in dialogue with the existing buildings and surroundings.

ill. 10 Site Töölönlahti, Helsinki



Helsinki Central Station

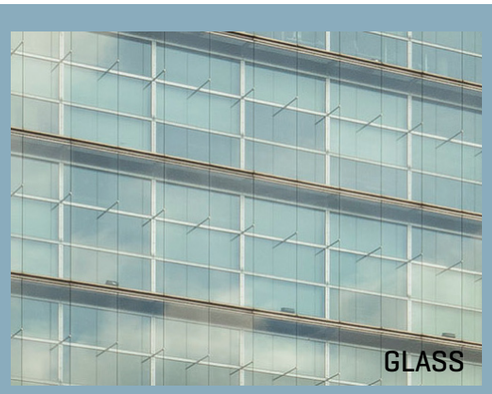
The central station is designed by Eliel Saarinen and was built in 1919. The station is a landmark for the centre of Helsinki and is the most visited building in Helsinki with around 200.000 passengers each day. The station also hosts a metro station which is the busiest metro station in Helsinki. [Edward 2010]

ill. 11, 12, 13 Helsinki Central Station

Kiasma Contemporary Art Museum

The museum is built by the American architect, Steven Holl. He won a competition with 513 competitors in 1993 and the museum was built in 1998. The museum is brings attention to contemporary art and aims to strengthen it's status. [Finnish National Gallery, 2010]

ill. 14, 15, 16 Kiasma Contemporary Art Museum



Sanomatalo

The building is designed by the Professor Jan Söderlund and architect Antti-Matti Siikala after a competition. The building was built in 1999 and is an open space office building which functions as headquarter of the SanomaWSOY Media Group. In the ground floor the building also contains some retail functions.

ill. 17, 18, 19 Sanomatalo

Helsinki Music Center

The music centre is designed by the architects Marko Kivistö, Ola Laiho and Mikko Pulkkinen and was finished in 2011. The building is home to a lot of orchestras and the Sibelius Academy. The architecture an understated building that aims to unify the surroundings and not compete with them. [Hume, 2011]

ill. 20, 21, 22 Helsinki Music Centre

Finlandia Hall

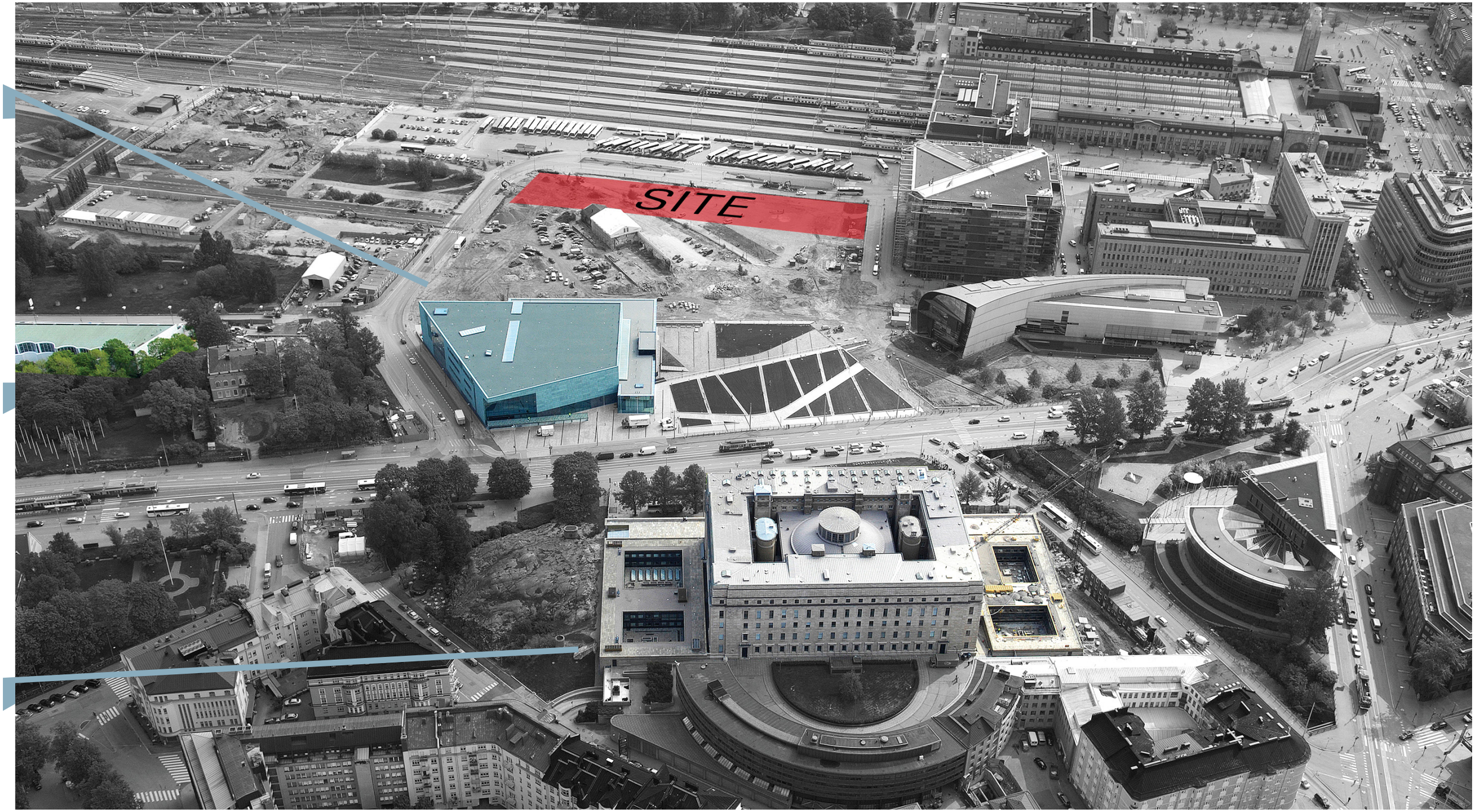
Alvar Aalto was commissioned to design the building and it was completed in 1971. The building functions as concert and congress centre. Apart from the marble material the building also has a roof of copper. The architectural features is a great horizontal mass and the auditorium rises as a tower. [Alvar-Alto, 2002]

ill. 23, 24, 25 Finlandia Hall

Parliament House

The Finnish architect Johan Sigfrid Sirén designed the Parliament House after he won a competition in 1924. The project was called Oratoribus(Latin for "for the speakers"). The building was completed in 1931. The architecture is a style combining Neoclassicism with early twentieth century modernism [The Finnish Parliament, 2002]

ill. 26, 27, 28 Parliament House



ill. 29 Site Töölönlahti, Helsinki

Future Buildings

The implementation plans for the southern-most city block adjacent to the railway lines is currently being initiated. The city block, situated east of the library block, is owned by Etera Mutual Pension Insurance Company. The main user of the office floors of the building will be KPMG Oy. The design was based on an invited architectural competition, the results of which were announced in November 2011. (Helsinki library competition program, 2012)

Building to the east of the library site.

ill. 30

The building of offices for the company UPM Kymmene in the city block north of the library along the railway is owned by UPM Kymmene. The design is based on an invited architectural competition and is currently in preparation. Both of these buildings add to the fusion of developments going on in this area, and both are strikingly different which is consistent with the entrire surrounding area which hosts a variety of different shaped buildings and different materials. Both of the new buildings affect the area in terms of blocking out the somewhat noisey main train station and act as a barrier between the noisey trains and the library, which in hindsight is an ideal situation. (Helsinki library competition program, 2012)

Building to the north east of the library site.

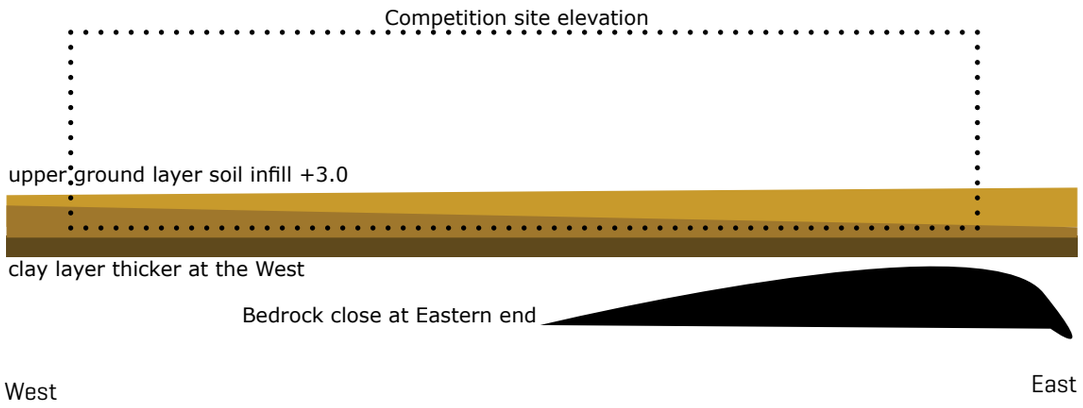
ill. 31

Surrounding Parkland & Developments

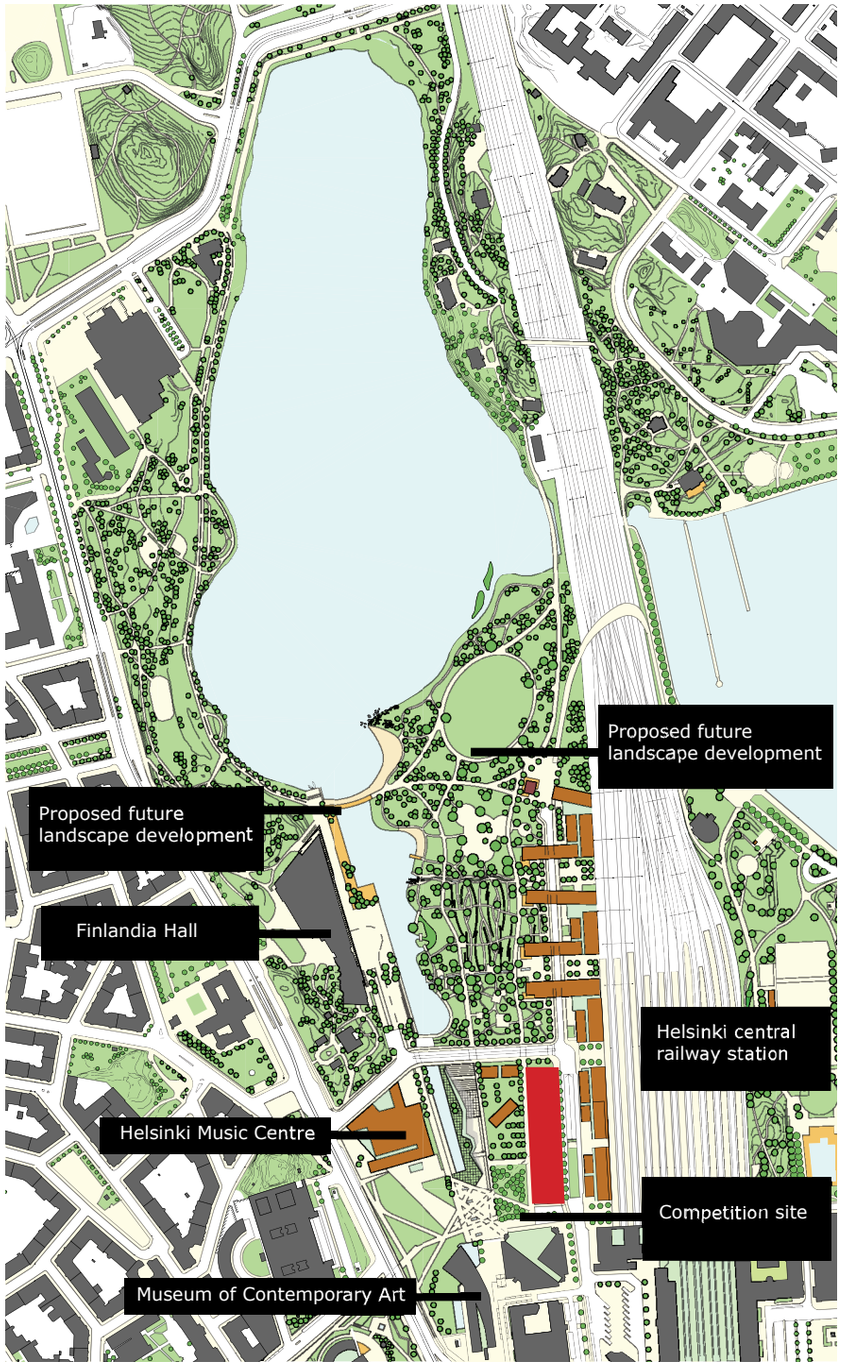
The surrounding parkland in the Töölönlahti area has been designed by international landscape architects Artto-Palo-Kaijansinkko-Rossi-Tikka. The master planning is currently underway commissioned by the City Planning Department.

Since the area is quite flat with a landscape tilt of approximately +3.0 degrees the area accommodates perfectly well as a pedestrian hub, therefore walking and cycling is the main mode of movement. The area hosts main bicycle routes which are located next to the railway lines and next to Mannerheimintie road. There is also a bicycle route through the west part of the park which connects Helsinki Central Park to the city centre.

The upper ground layer on the site contains coarse aggregate soil infill. Under the infill later is a clay layer which gets thicker at the west end of the block. At the eastern end the lower surface of the clay is very close to the bedrock. The bedrock in the competition block area is a level of -0 to -10. (ill. 32)



ill. 32 Drawing of the earth's soil layers and the bedrock.



ill. 33 Birds eye view of the surrounding site.

Site Analysis

Districts

The following illustration (ill. 34) shows the different areas in the surroundings of the site. The typology analysis shows that the site is situated in the park creating a barrier to the railway lines. Around the southern part of the park lies the higher dense city with open lower landscape and railway to the north. In between these main districts lies the parkland mixed with other larger buildings.

For a long time the area was a train railway yard (see page 31). Construction of the first stage involved the completion of the edge of the urban fabric of the Kluuvi area with new buildings (Kiasma, Sanoma House, Railway station hotel Holiday Inn and the Elielinaukio piazza bus terminal and Eliel car-parking garage).

ill.34 Districts

Heights

The following illustration (ill.35) shows the different heights in referece to the districts which follows a similar pattern.

ill.35 Heights

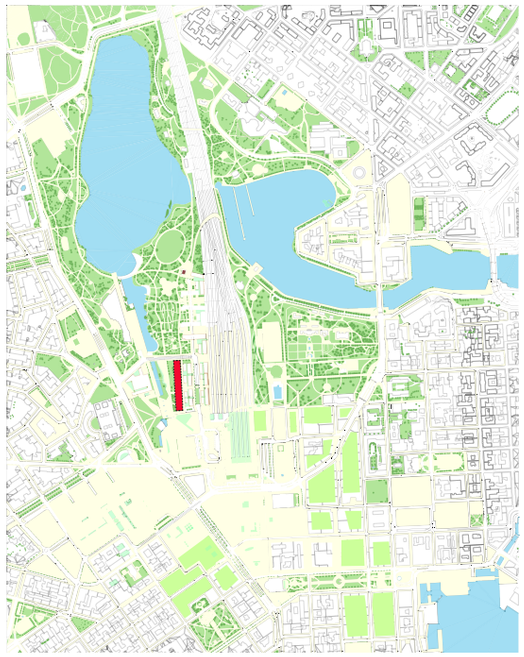
Green Areas

The site is located in a luscious green hub that flows down into the lake, with the majority being open and flat. A setting for many activities in summertime. Rows of trees tend to be placed along the side of roads or bordering the limits of different blocks.

Grassy areas

Trees

Water



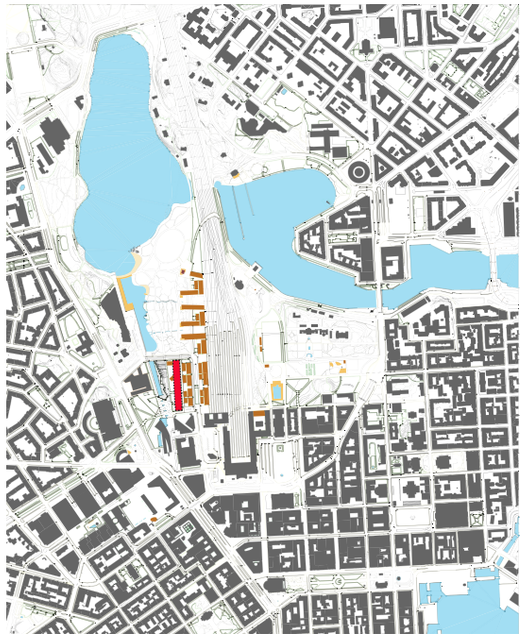
ill. 36 Green areas

Existing Buildings

Shows the placement of existing buildings in the area, and placement the future buildings.

Existing buildings

Future buildings



ill. 37 Existing buildings

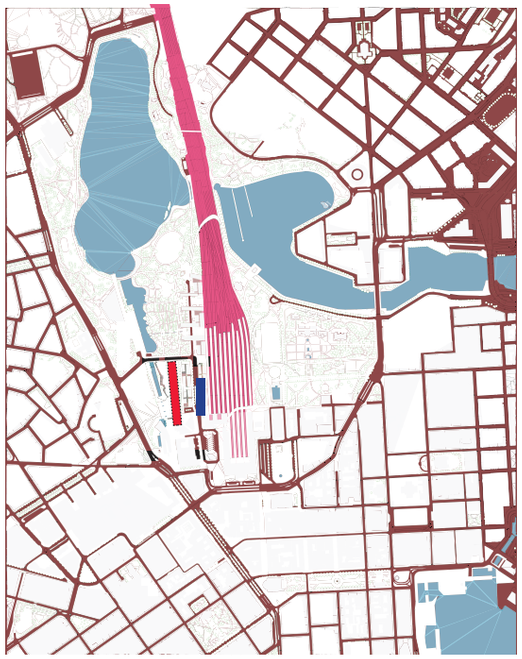
Streets and the Train lines

Busses and cars are the most frequent users of these streets, while also pedestrians and bicyclists use the smaller roads and paths in the area. The train lines act like main arteries pumping life into the center of Helsinki. To the left of the train lines lies a bus terminal where busses are stored. However during future development this bus terminal will be moved to new location.

Roads

Train lines

Bus Terminal



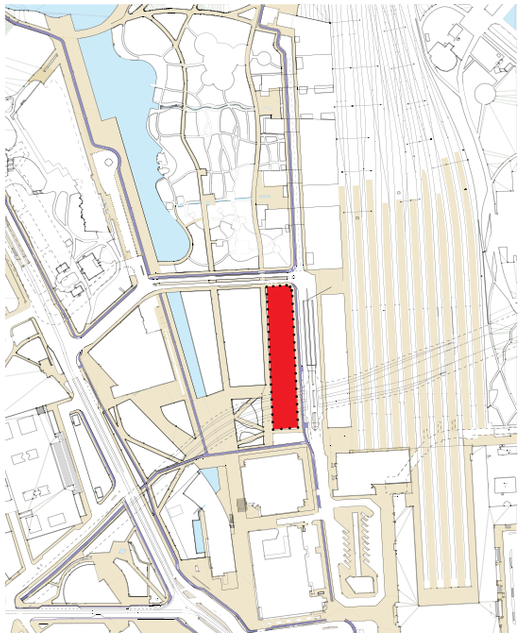
ill.38 Main roads, travel routes

Human flow

The human flow is dictated by pedistrian and bike paths. The human flow has an impact in the area because it divides the area into two during the year, for example during summer there is intensive human traffic in and around the parks and lakes and in winter the human traffic becomes abandoned in these areas and is pushed back into the city.

Bike paths

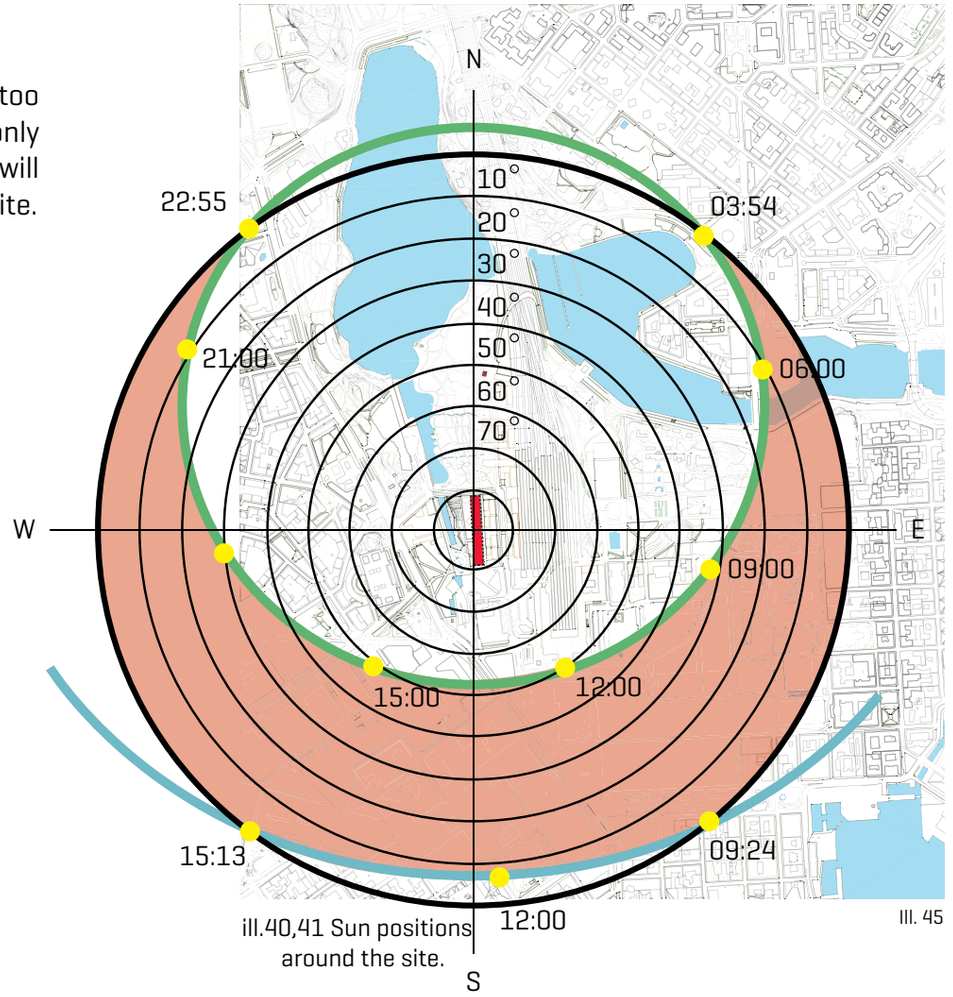
Pedestrian paths



ill.39 Human traffic

Sun

Many buildings surround the site however are not high enough to cause too much shading therefore maximising solar energy and daylight. The only shading in comes from the building directly south of the site, which will effect the placement of solar energy in the southern most area of the site.

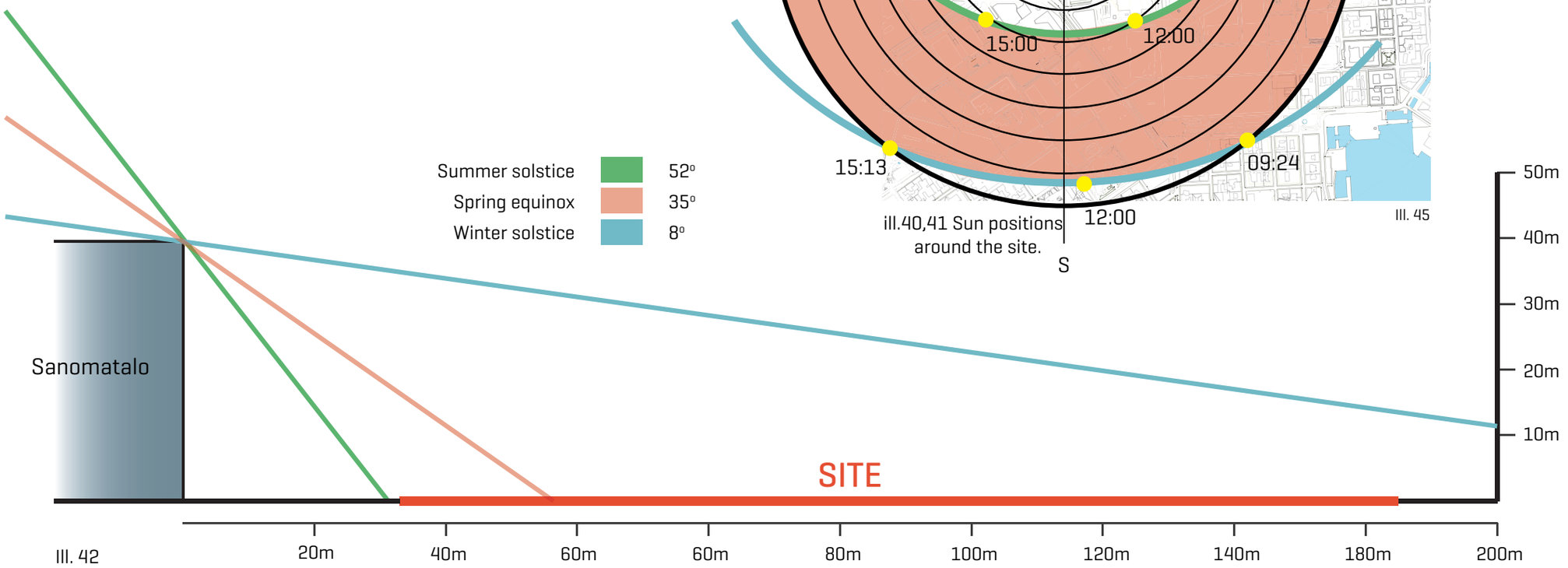


ill.40,41 Sun positions around the site.

III. 45

Annual variation
Time of the day
Winter solstice
Summer solstice

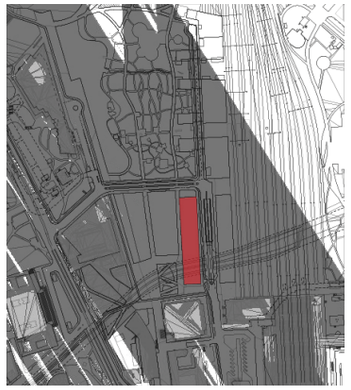
Summer solstice 52°
Spring equinox 35°
Winter solstice 8°



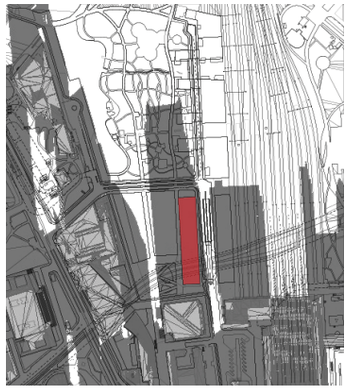
III. 42

Winter Solstice

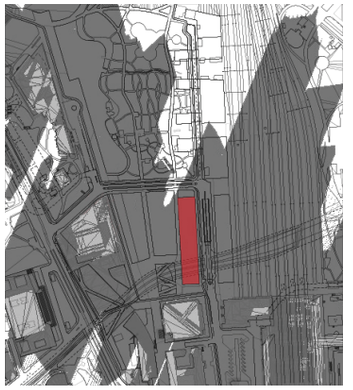
Winter solstice in Helsinki is the shortest day of the year. The day is only 5 hours and 49 minutes long. Shadows will hit the site in some way most of the day because of the sun's low altitude. The shadows will mainly come from the eight story Sanomatalo building south of the site.



Time of the day: 10:00



Time of the day: 12:00

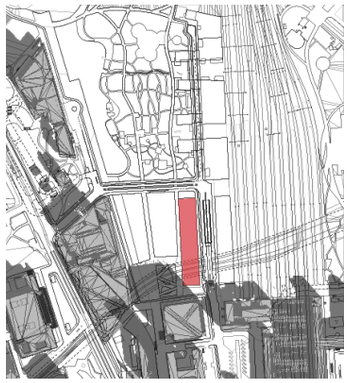


Time of the day: 14:00

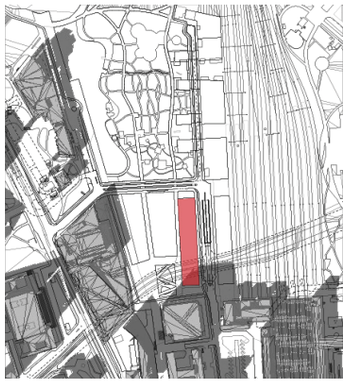
Equinox, March

Equinox occurs in March and October. Here is shown an example from March and most of the site is actually exposed to direct sunlight all day. The site is only hit by shadows from the Sanomatalo building in the southern part of the site. The shadows will only hit the site a few hours in the middle of the day.

Time of the day: 10:00



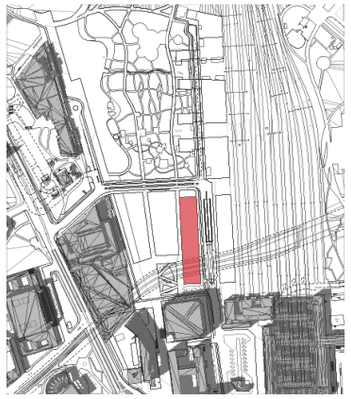
Time of the day: 12:00



Time of the day: 15:00

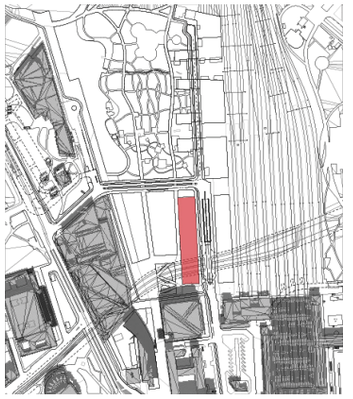
Summer Solstice

In summer time in Helsinki the day is very long because of the high altitude of the sun. The day is 18 hours and 56 minutes. Not many shadows are casted from the surrounding buildings during summertime and the site is actually exposed to direct sunlight all day. Throughout the seasons all of the shadows are being cast towards the north to north/east/west, with the shadows coming from the southern city buildings.



Time of the day: 10:00

Time of the day: 12:00



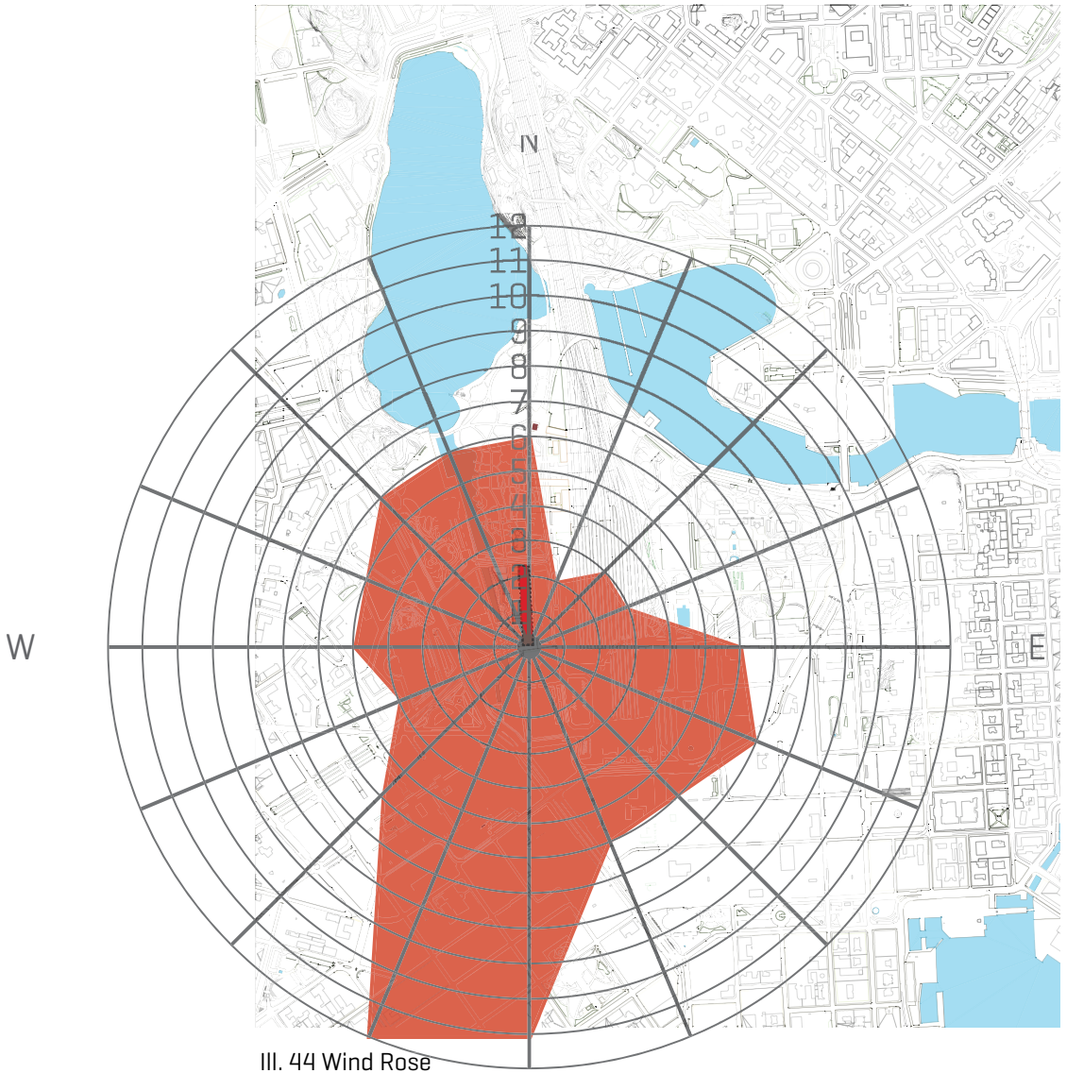
Time of the day: 15:00

ill.43 Ecotect Shadow studies

Wind

A climatic energy force can be found with the strong wind dominating from a southern direction. Though the wind is fluctuant and appears from all directions it prodomenitley comes from the south to south east/west offering great possibilities for wind generated energy and incorporating natural ventilation particulary in the summer months. This will be explored through the design process.

During summer months beginning with June the wind spirals from the north west to the south west and around to the south east, with the wind strongest from the south west as per the wind ill.44. During July the wind becomes slighty weaker from all of the mentioned diections but becomes stronger from the south east. During August the wind becomes yet weaker again in all of the above directions.



Ill. 44 Wind Rose

Ventilation Strategies

Natural Ventilation

Natural ventilation is when an indoor space is supplying and removing the air through it without use of mechanical ventilation systems. Natural ventilation has two types of ventilation principles producing the movement of air in an indoor space. One type is driven by thermal buoyancy, and another type is driven by wind.

Thermal buoyancy is driven by the differences in the density of air inside and outside a room. Mainly, the density differences in the air is caused by temperature differences in the air (but also moisture can be a factor). Warmer air has a lower density and will therefore rise creating an up going air stream. If a room is ventilated by this principle it means that it needs openings for inlet in the lower part of the room and outlets in the upper part (ill. 45).

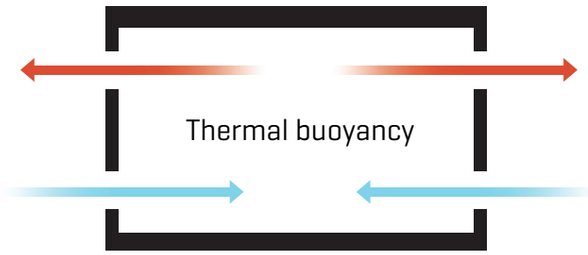
Wind driven ventilation is caused by pressure differences on different facades. A building can be designed according to wind by creating over pressure and under pressure where it is needed. The wind will move from over pressure to under pressure making the air move through a building.

Some basic natural ventilation systems are described in the following:

Cross ventilation occurs when you have a room with openings on two different facades. The pressure differences and the wind will make the air flow through the room from one opening to the other. Cross ventilation is mostly used in room with a width of no longer than 5 times the height.

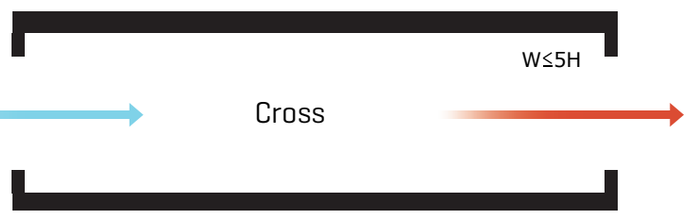
Single sided ventilation is when openings in the room are placed on the same side of a facade. For a simple ventilation like this to be an effective ventilation a rooms width should not be more than 2 times it's height.

Stack ventilation is driven by thermal buoyancy. The wind is let in through windows or other inlets in the facade and the hot air is let out in the top of the building through window openings in an atrium for example or simply in a chimney or similar.

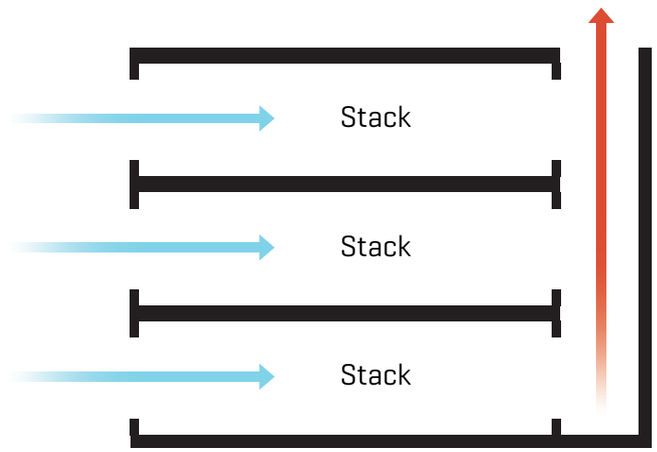


ill. 45

ill. 46



ill. 47



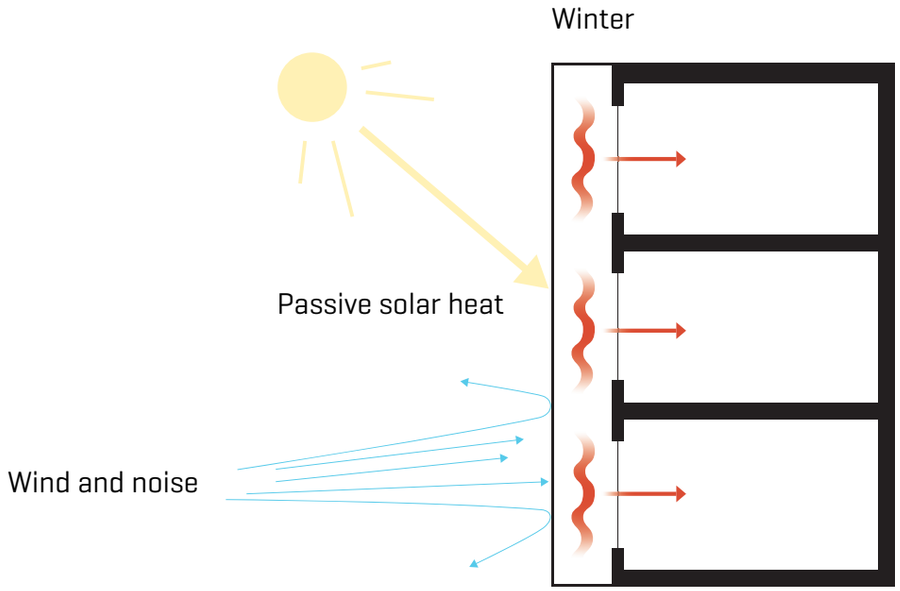
ill. 48

Modern use of natural ventilation: The Double Skin Facade

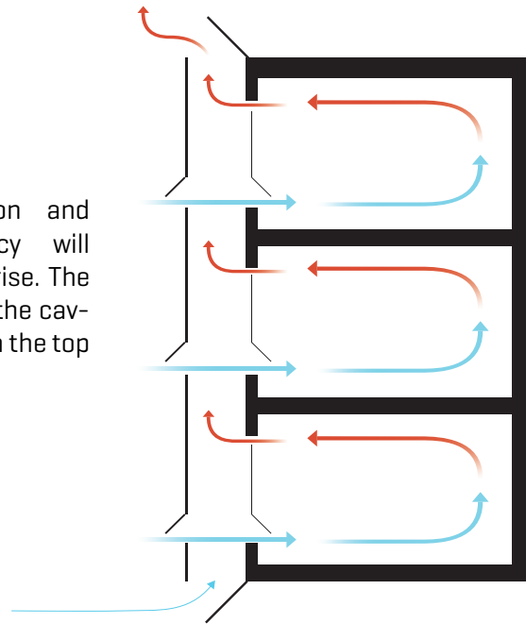
A modern way of bringing down the energy use of a building is to use double skin facades and natural ventilation. Double skin facades are already used in many countries in Europe - including Finland, (Andersen, June 21, 2010). A double skin facade can have it's advantages and disadvantages. It is more expensive to build a double skin facade than a normal facade. Also if a double skin facade isn't used right it will not bring down the buildings energy frame and examples have been seen where overheating have been a problem with double skin facades. But if the facade is used right it will have a positive impact on the buildings use of energy. (Gerlach & Lading, 2008).

A double skin facade has it's advantages both in summer and winter. In winter the extra layer prevents the wind from actually hitting the building envelope and also in general the extra layer functions as a screen against sounds and noise from the street. In winter the double skin facade is also able to harness the passive solar heating from the sun. In summer it is possible to ventilate the cavity with wind and also the hot air will rise and can be let out in the top of the facade. It is also preferable to have solar screening in the cavity to keep them protected from the weather. (Gerlach & Lading, 2008).

These are just the basic principles for how a double skin facade can work. In the project we will work with integrating some of the new and modern ways of using double skin facades and natural ventilation.



ill. 49



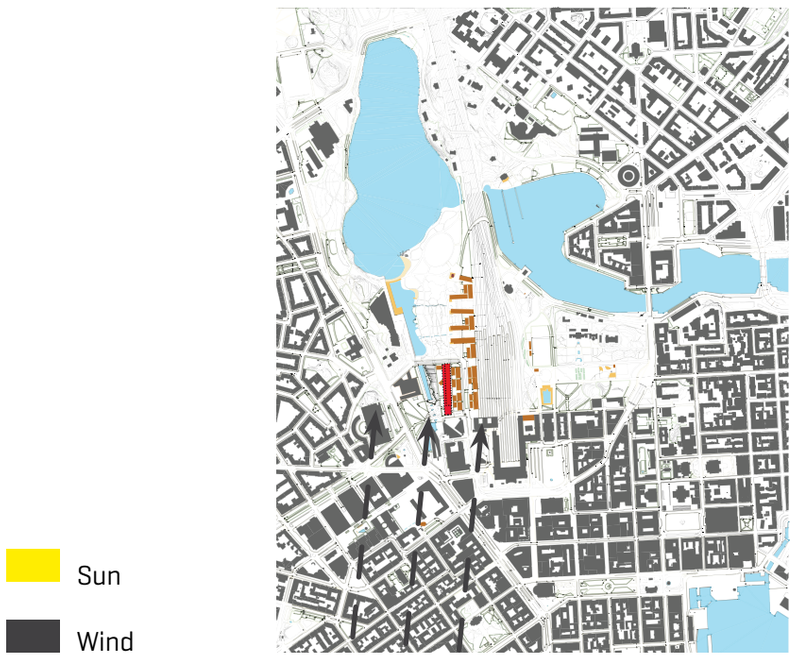
Natural ventilation and thermal buoyancy will make the hot air rise. The hot air will rise in the cavity and be let out in the top of the facade.

ill. 50

Energy Sources

The main energy sources in our area are provided by the mother nature. The wind is moderately strong, and our site has a lot of protection from the main south to south west wind direction. Since the city sitting prodomitely to the south
much of the wind will be protected thus loosing chances of wind energy gain. However looking closer at the site there are significant gaps between buildings which will create great possiblities for wind to enter the site. The most obvious opening is in between the Music hall and the art museum. Here the wind is able to stream straight through onto the face of the library.

Aside from this, the sun can be used as an energy source for heating. Both the ground and the water can be used for earth heating. Solar panels will be very effective during the summer, spring and fall but in winter the day is very short and the shadows long and solar panels will be less effective.

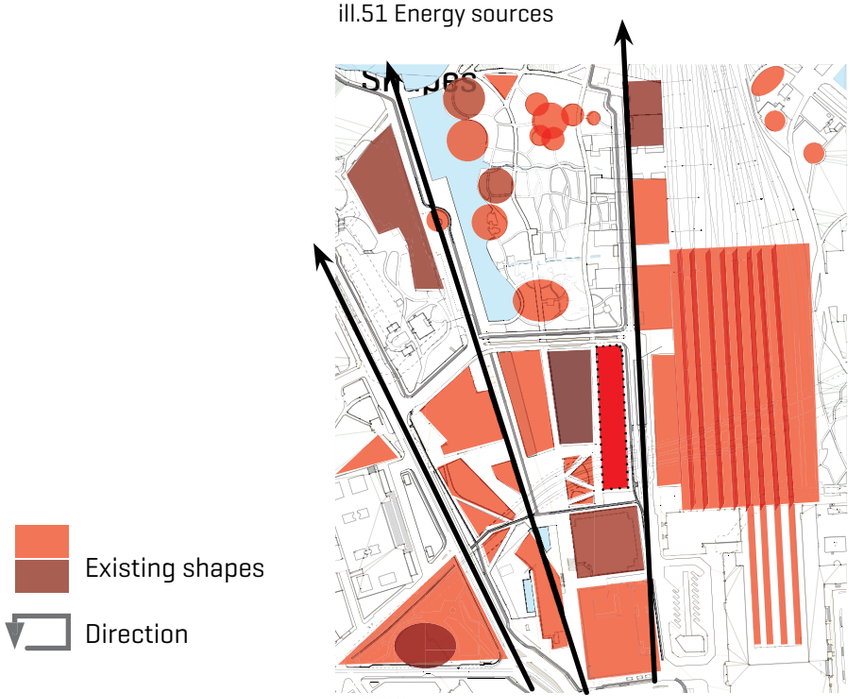


ill.51 Energy sources

Shapes

Some geometrical shapes can be identified in the land and city scape. Many circles and squares appear in around the site, with a strong vertical axis of train lines heading from south to north. There is also the branched leaf pattern from the paths dividing the park up next to the lakes just north of the site. The site also provides some strong diagonal direction fanning out over the region.

Finding outlines and shapes of the surrounding site could guide and help us find a design direction. It will also strengthen our knowledge of the context through the pure forms that exist creating justification and meaning to the final concept, whether we consciously use it or not.



ill.52 Shapes

Reflection upon Anaylsis

The analysis stage has proved to show a lot of interesting factors to take into consideration whilst we are designing our library. Most importantly to note are the passive energy solutions such as, passive solar energy for heating during winter distribution of functions, good daylight to minimize electricity usage, the wind and natural ventilation during summer. Implementing and incorporating these sustainable solutions early on in the design process will greatly benefit the final result, considering the layout and overall design of the building can greatly affect performance and sustainable energy solutions.

Other things to note about the weather in Helsinki and Finland include:

- It has the most freezing days and the climate is similar to that of Alaska.
- 25% of Finland lies north of the Arctic Circle.
- During the winter, northern Finland experiences no sun for 51 consecutive days.
- In summer the sun does not set for 73 days. In the north, snow cover usually lasts for seven months, from mid-October to mid-May.
- Average low of -6 in winter and an average high of 16 in summer.
- In europe Helsinki has the most freezing days, under 0 degrees (169 days).
- In europe Helsinki has the most days of snow (101 days).
- In europe Helsinki is rated 6th for the highest rainfall at 203 days a year. (web2,2002)

From these statistics it is obvious to note that Helsinki and Findland is a place of extremes with a very cold and long winters with minimal sunlight, to very long days full of light in summer, but not so warm with an average high temperature of 10 degrees.

ill.53 The site area when it functioned as an old railyard.

DESIGN CRITERIAS FROM THE COMPETITION

From the municipal of Helsinki is given a competition program which describes how the library should function, how it should fit into the area, criterias according to architectural quality, and technical requirements. In this chapter we will narrow down what is important for the project and identify what we think the municipal of Helsinki wish for their new central library.

ill. 54 Site Töölönlahti, Helsinki

Architecture

The architecture of the central library should be a timeless design of the highest standard and express the functional concept in an intriguing way. The library should also be inviting and be a symbolically significant building.

The exterior is recommended to open up with a café, restaurant etc, and include “reading terraces”. Especially the ground floor of the building which should be visually open plan in design.

The interior spaces in the building should be spatial extremely flexible. The interior should be designed so it is very open and universally applicable. The spaces should be easily modified and it should be possible to design “spaces within a space”. A lot of different functions should adapt to these open and flexible spaces and also commercial functions as a café and restaurant should be integrated in the building.

The building is placed in the new contemporary Töölönlahti area which is in the very centre of Helsinki. The building should relate to the other new buildings with it’s contemporary design. (Transpress nz, 2010)

ill. 55 Sanomatalo


ill. 56 Helsinki music centre


ill. 57 Klasma Contemporary Art Museum

Functions

There are certain operations that a library needs to fulfil. But the municipal of Helsinki don't just want the library to be a place where you go and lend a book and return it again. They want a multifunctional public building that offers everything from "meet-the-author" events to LAN-parties for young people.

The expected number of visitors in the new central library is around 5000 a day and will be 1,5 million per year. The library plans to have long opening hours and the intended opening hours should be 08.00-22.00 in week days and 10.00-22.00 in weekends.

The spaces in the library should be able to adapt to different situations and events. Visibility and openness is an important factor, e.g. That a parent should be able to look after a child while reading a book or magazine. Also in this factor it is important that you can see the activity going on in the library e.g. That a gaming room is visible from the lobby.

The library is supposed to contain a lot of different functions. The library should attract all different kind of ages and different kind of people. The intention is that the library should be a place where all kind of different people meet each other.

The library will together with external corporation partners host different events and happenings which will take place in the library's "performance spaces". This could be things such as reading circles, exhibitions, publication and presentation events, and events for young people and children. Rooms for events like this could be a cinema, multipurpose hall, stage, and "Children's World" performance space. By all of this it is clear that a library able to adapt to different situations is needed. The specific rooms wanted by the competition is specified in the room program (Competition Program, 2012)

ill. 58 The Black Diamond student party

ill. 59 The Black Diamond student party

Quote: Library operations are statutory in Finland. According to the Library Act, the basic task of the library is "to promote equal opportunities among citizens for personal cultivation, for literary and cultural pursuits, for continuous development of knowledge, personal skills and civic skills, for internationalization, and for lifelong learning" (Competition Program, 2012)

Room Program

Main lobby
And central public service spaces

Lobby functions
Public toilets
Public services
Meeting and lounge area
Stage
Pop-up info spots

Area:
1150m²

Spaces for external service providers

Café
Restaurant
(Public sauna)
(Bookstore)

Area:
840m²

Service spaces

IT and equipment
Server room
Cleaning facilities
Refuse store
Building maintenance
Service and loading area
Distribution substation

Area:
710m²

Staff facilities

Office facilities
Staff lounge
WC, changing and washing rooms

Area:
430m²

Library logistics

Library collection storage
Return automat room
Library material handling

Area:
480m²

Event spaces

Cinema
Multi-purpose hall
Furniture
Stage prop storage
Lobby area
Back stage
Living lab
Library exhibition space
Rentable exhibition space
Local storage points

Area:
1570m²

The collections area
and spaces linked to it

Library collections area
Fixed client service point
Interactive spaces
Lounges, "oases"
Quiet areas

Area:
2780m²

Learning and doing

"Childrens world"
Workrooms (for clients)
Personal office spaces (for clients)
Music, recording and video studio
Digital-psysical workshop, "fab lab"
Listening, viewing and games room
Teaching, group work and meeting spaces

Area:
2040m²

Rooms not included in the 10000m² room program:
Civil defence centre, spaces for city centre and reservation spaces for City Centre Tunnel.

Total area:
10000m²

Sustainability

ill. 60

ill. 61

The Central library has the objective to be a nearly zero-energy building. The demands from the competition program demands, that the yearly energy performance for the building must be maximum 120 kWh/m2 (gross area). In the Finnish building regulations the building belongs in Class 4, which is a commercial building.

Also a good indoor environment conditions is required in the library. The requirements is due to the Finnish regulations. According to the competition brief the minimum requirement for the indoor environment is a "good indoor climate" as defined in accordance with Category S2 of the Classification of Indoor Environment 2008. (Competition Program, 2012).

The choice of materials used for the library should strive for solutions favourable for the environment without compromising on the quality of the city scape and architecture.

A social sustainable solution for the library is wished by the competition holders. The place should be lively and active many hours everyday with internal and external events and should have a lot to offer for all kind of different people and ages. (Competition Program, 2012)

Our approach will be to integrate sustainable principles such as natural ventilation in the building design to reduce the use of energy and to provide a good indoor climate. According to the energy frame set up we will aim towards a NET zero energy building, which means that the building will give and take energy from the "NET" to make it more self sufficient and not using much energy.

The choice of materials used for the library should strive for solutions favourable for the environment without compromising on the quality of the city scape and architecture. (Competition Program, 2012)

Inspiration & Finland

Throughout our research we sought out and gatherd inspiration derived from both Finland and architects. We chose Louis Kahn and Robert Venturi since both architects offered opposing perspectives in the approach to architecture, Kahn concerned with the human and being while Venturi is thinking about the context. This combination offered us the perfect ideal that is “being in context”. Along with the Finnish architect Alvar Aalto who gave us some insight and inspiration into post modern Finnish design and architeture. This varied inspiration conveyed unique ideas about how we could approach our library design in a different way. Consequently we drew out are own thoughts and ideas resulting in a library we think is best suited for the center of Helsinki.

“Kahn typically asked such questions as: “What is a school?” - Louis Kahn

ill.62 Salk Institute, Los Angeles, Louis Kahn.

Louis Kahn & Robert Venturi

One of the key requirements from the competition brief was to create architecture of the exterior and interior spaces with proposals that are of high quality and timeless, and also expresses the new functional concept of the library in an intriguing way. In this case we feel Louis Kahn in combination with Venturi is a very relevant reference.

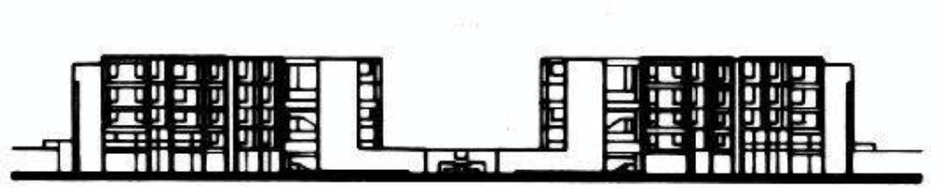
Louis Kahn was connected with the timeless qualities of the being looking for the fundamental essence in buildings concerning their natures and origins. Kahn typically asked such questions as: “What is a school?”. On the contrary Venturi engaged another methodology which was concerned with the context. (Lobell, 2004)

Venturi would suggest that the human being is a historical creature, only existing in history and personal contexts hence he is more concerned with the time and place and context of a building. Both architects approach architecture from two different perspectives, however if one combines the two theories this can blend a meaningful approach to architecture that has been labelled being-in-context. (Lobell, 2004).

Kahn’s most obvious works that exemplify his theory of being include the Salk Institute 1959 in Los Angeles and The National Assembly Building, Dhaka 1962 to 1974. The Salk Insitute is notable for it’s simple plantonic forms and it’s compositions whilst also maintaining sympathy for the the site. Both the Salk Insitute and The National Assembly Building create a feeling of being whilst also relating to the context.

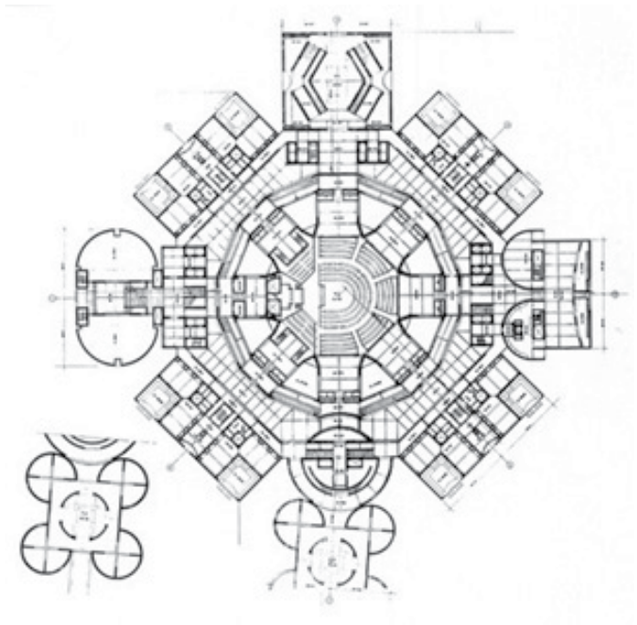
It is Kahn’s idea of being and what is a library? that could help provoke an idea to revolve around, and how could we could apply such principles of being and context into our final design for the Helsinki library. Taking history and context of the area into a grander scale while not forgetting the qualities of being and how the human actually interacts with buidlings and the world given it’s purpose.

ill. 62 Salk Institute 1959, Louis Kahn, Los Angeles



ill.63 Salk Institute 1959, Los Angeles

ill. 64 The National Assembly Building, Dhaka 1962 to 1974.



ill. 65 The National Assembly Building, Dhaka.

ill. 66 Vanna Venturi House 1962.

ill. 67 Vanna Venturi House section, 1962.

Rocky Finland & the Flipping Book

The overall landscape of Finland is a mixture between, terra firma and granite rock that sparatictly protrudes through the surface at many locations all over Finland and Helsinki as you can see in the picture on the following page ill. 71. It has became such a characteristic of Finland even the Temppeliaukio Church Helsinki, designed by Timo Suomalainen and Tuomo Suomalainen in 1969, is built and designed into the granite rock bed. The granite rocks were blasted open to create a pit which became a basis for the entire interior. Natural light pours through the dome roof into the interior resulting in a very natural and spiritual space which is again the perfect example of the Kahn and Venturi, being- in-context.

This rocky terrain of Helsinki has contributed to our development and ideas of a rock creating or becoming the the library. As our design is basically a protrusion of the earth to the north, compared to that of a rock piercing the earths surface. However not to be mistaken as a rock but adopting the same idea of a rock.

Another simple yet strong inspiration for our design is flipping the pages of a book. We somehow wanted to incorporate some reference to books in our structure and played with forms that portrayed books falling on each other. However the simple flipping of a book grabbed our attention the most as it created a dynamic moving expression, as we believe a library should be dynamic and flexibil whilst constantly changing with the times and technology.

ill. 68 Simple dynamic expression of a book flipping pages.

ill. 69 Interior, Temppeliaukio Church Helsinki.

ill. 70 Exterior, Temppeliaukio Church Helsinki.

ill.71 Picture taken in Töölönlahti parkland.

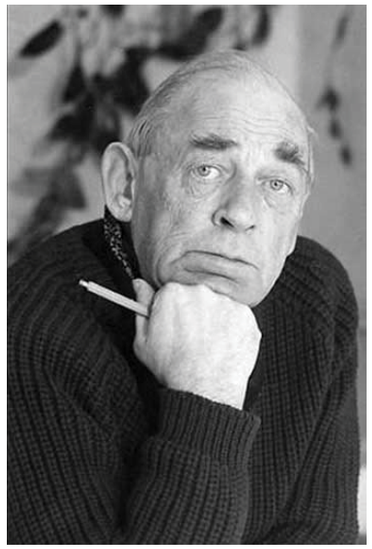
Alvar Aalto

We feel our design for the library in Helsinki could benefit from some research into Finnish architecture and design, and who else better to commemorate and be inspired by the most but the late Alvar Aalto.

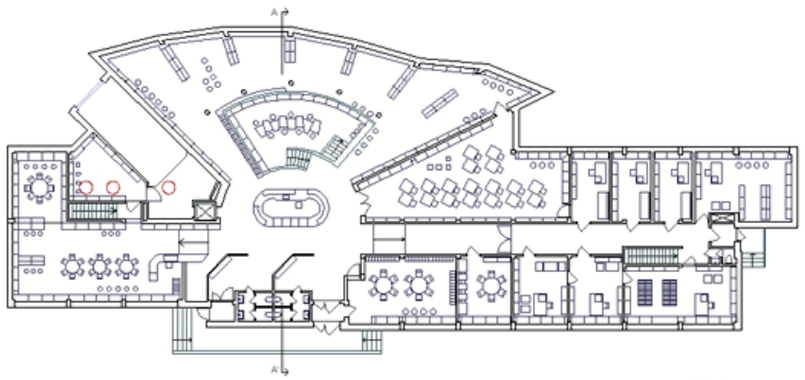
Alvar Aalto (1898-1976) was a modern architect of his time, however his designs combined complex forms, spaces and elements from a traditional cultural heritage and physical environment of Finland, thus a modernist surfacing from traditional roots. (Aalto Alvar, 2002)

Aalto was know to treat all of his buildings as one complete work of art, designing everything right down to the furniture and light fittings. One main distinctive feature that seems to arise repeatedly from Aalto's work is the fan like shape notably seen from above from some of his buildings, including his Seinajoki library in Finland 1963-65, House of Culture 1955-58 Finland, Helsinki university School of Science and Technology main building 1969 and Finlandia 1971. Even his famous Aalto vases released in 1937 adopted this distinct fan waving shape, see ill. 76. Aalto's fan like inspiration for the vase came from a lake he had seen in Finland.

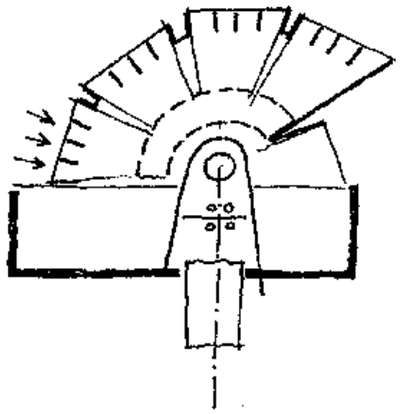
Another distinct feature obvious in his architecture is his continual use of circular lighting which lets natural light flow into his buildings, see image over the page.



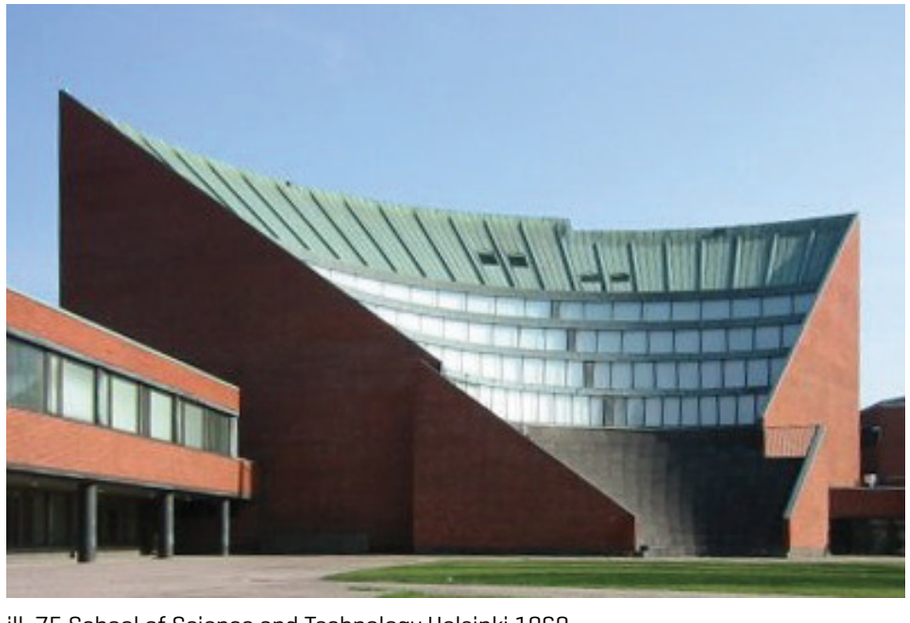
ill. 72 Alvar Aalto



ill. 73 Seinajoki library in Finland
1963-65



ill. 74 House of Culture, Finland 1955-58



ill. 75 School of Science and Technology Helsinki 1969

ill. 77 Finlandia, Helsinki, 1971

ill. 76 Aalto vase 1937

ill. 78 Interior of an Aalto library

CASE STUDIES

We have chosen three libraries which we believe offer something unique that we can adopt and adapt into our project. All of the case studies we chose reside within a close proximity from Helsinki, which we think is important for climatic and sustainability reasons. All of the case studies are modern and have been built within the last 10 years.

ill. 79 The Black Diamond from Christianhavn

Project: The Black Diamond Copenhagen
Architects: Schmidt Hammer Lassen
Date: 1999
AREA: 20,733

Named for it's outside cover of black marble and glass, in addition to the library it houses a concert hall. It is formed by two black cubes that are slightly tilted over the street. In the middle of them there is an eight storey atrium whose walls are white and wave-shaped, with a couple of transversal corridors that link both sides, and balconies in every store.

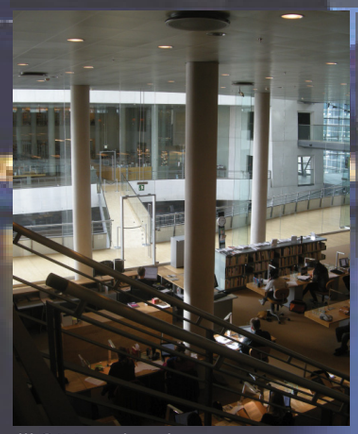
The atrium's exterior wall is made of glass, so you can see the sea and the other side Christianshavn. In the ceilling of the big bridge there is a huge painting by Danish painter Per Kirkeby. And it can transform into different functions such as a night club scene for students.

We chose the Black Diamond as a case study foremostly since it is a modern library and it is a library that we are able to visit often. Other interesting aesthetical elements include the way the library is semi shut off from the outside world with it's dark facades, but then revealing itself with a slice through the middle creating an opening/atrium and connection to the fjord. So in a sense it is open and closed at the same time, hard edged on the outside and soft on the inside like a crab.

ill.82,83 Windows of the Black Diamond and the central interior atrium

Things that we didn't like about the black diamond include it's huge reading rooms that seemed too large and not flexibile or adaptable to changing situations. The library also did not accomodate for childrens areas and was more focused just for students or people studying. We found the views from the silent studying areas could have utilised the views out to the fjord more effectively given it has such stunning views. Also the exterior of the building looked a little closed and uninviting appearing more as an office building than a library. Finally the entrance to the building could have been more effective if they placed it in the middle of the building on the fjorde side and not on the left side of the building, as you arrive directly into the cafe area and have no option to reach the library until you meet the esculator in the middle of the building.

ill.81 The Black Diamond sections and plans



ill.84 Interior views

Things we like to adopt into our library.

- It's nice views out to the natural environment.
- It's ability to adapt into different functions, a night club etc.

ill.80 The Black Diamond at night from Christianhavn

Project: Library of Philology, Berlin
Architects: Foster + Partners
Completed: 2005
Area: 6290m²

The building is called "The Berlin Brain", because the design takes it's inspiration from a cranium enveloping a brain. (Urbika, 2010) The cranium(envelope) is a double layered facade held by a steel construction. The inner membrane consists of translucent grass fibre filters that diffuses the sunlight and creates an atmosphere of concentration.[2] The double facade functions as a breathing skin for the building. It has a natural ventilation system that also uses heat recovery. The building regulates the temperature by opening or closing flaps in the outer facade depending on the weather. (Urbika, 2010)

The building has concrete cores that function as a passive thermal funnel. In winter the warm heat between the inner and outer facade will rise and be drawn into the concrete cores to provide heat. (Sullivan, 2006)

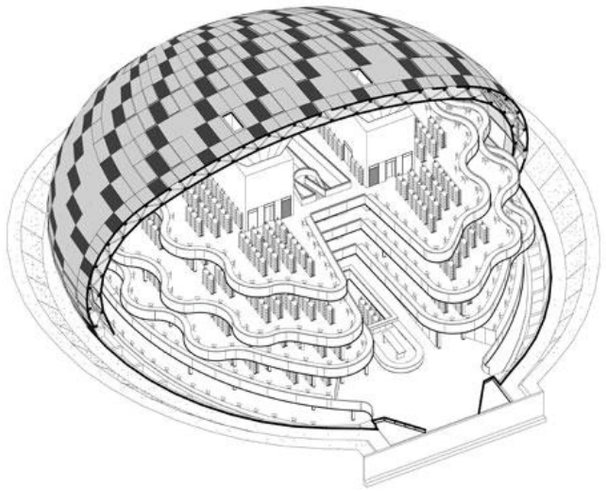
Spatial the building can be characterised as introvert. The building has floating plans in the centre of one big open space. This creates good visible connection between the plans and a good overview of the building. The downside to a plan as open as this library could be the acoustics. It is necessary to think materials and surfaces as sound absorbing in a room like this.

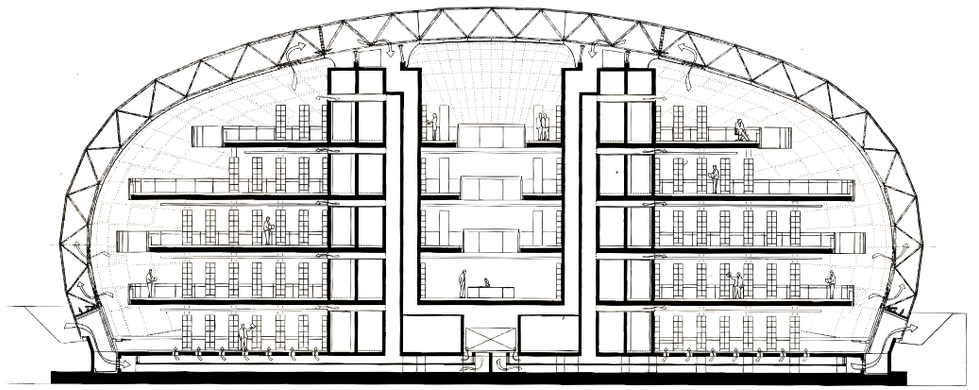
The building uses new sustainable active and passive energy solutions. Working with similar sustainable solutions could be beneficial for our library. The City of Helsinki want a library with open and flexible plans, so in that case it is necessary to rethink the traditional plan of a library and the Philological Library in Berlin shows a good example of that.

Things we like to adopt into our library.

- Double skin facade, with some shading.
- Open Plan layout
- Fire saftey, smoke dams preventing fire chanelling the smoke away from emergency exits.
- Entrance from an end creating a vertical flow
- Interesting sculptural shape.

ill. 85 **Library of Philology, Berlin**





ill. 86,87 **Library of Philology, isometric section and section showing the ventilation concept**

ill. 88,89 **Library of Philology, facade and open plans**

Project: Openbare Bibliotheek, Amsterdam
Architects: Jo Coenen
Date: 2007
AREA: 28.000 m2

It is the largest public library in Europe. The new image of the Oosterdokseiland as an 'Island of knowledge' fits this philosophy perfectly. Here the new Central Public Library of Amsterdam, with an expected 7000 visitors per day.

The complex has a floor surface of 28,500 m2, spread out over 10 floors. The library divides its services into four main areas. Information, for communication, for education, for culture and its associated activities as well as being a meeting place for the community. Increasingly the library is developing away from being a warehouse full of books into an exciting, stimulating and multifarious information source. (Competition Program)

ill. 90 Openbare Bibiliotheek Amsterdam

The bibliotheek in Amsterdam is known as the 2.0 of modern day libraries. The site is situated very close to the main train station and water front, which is also very similar to the Helsinki location. Similar to Helsinki, Amsterdam is a youthful and an exciting city and the public library reflects that with its quality sources.

Things we like about this library revolve around it's ability to create spaces in an open plan environment and adapt to change if need be. The circular shelves you see to the right can be moved and pulled into different positions creating totally different spaces within the library, something the competition brief for the Helsinki library consistently suggests.

Things we like to adopt into our library.

- Open Plan layout
- Circular shelves that can be moved into different positions, thus creating a more flexibil environment.

ill. 91 Interior kids area

ill. 92 Interior kids area

ill. 93 Exterior entrance

ill. 94 Interior kids area

ill. 96 Interior kids area

ill. 95 Exterior entrance

ill. 97 Exterior at night

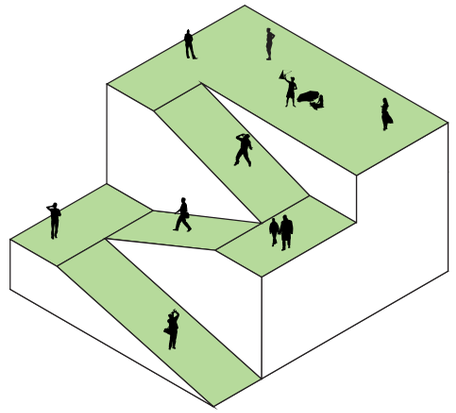
ill. 97 Exterior at night

Vision

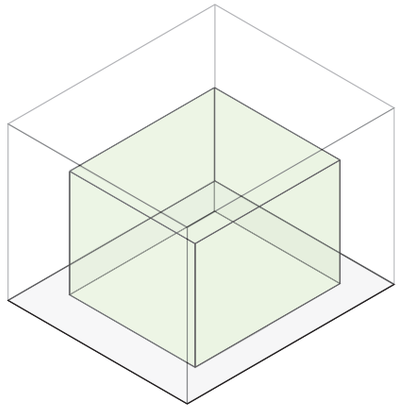
The vision for the project is to create a library that moves people around it emotionally with human scale in mind. It should be sustainable and an aesthetic iconic building that will attract the entire city as well as tourists. It will be a library for everyone and be more than just a library offerering an array of many different functions all bundled neatly into an exciting package nested in the heart of Helsinki.

The library opens up to the public and offers something for everybody in the society of Helsinki and thereby being the place to meet in the heart of Helsinki. The interior of the library will be designed with open plan flexible and adaptable spaces.

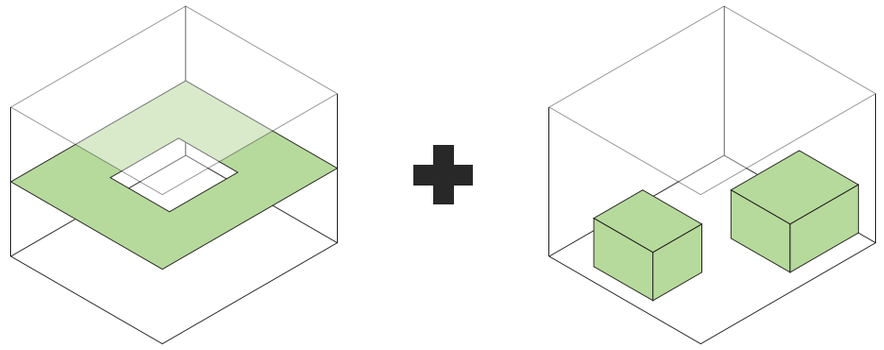
The final design will be an impressive library, something you can walk on and interact with inside and out. Whilst also obtaining a low energy consumption through the use of sustainable methods. It will be of high quality and timeless and will complement and integrate into the existing environment and thus become the heart of the city.



A library that interacts with people on a human scale.



Integrating innovative sustainable solutions in the building envelope.



Creating open, flexible and adaptable spaces to fit every need for the new lively library.

Design Criterias

The following criterias have been considered throughout the entire design process, They contain all the principles and ideas that will determine thefinal project based on the vision meantioned previously and decisions that will be explained in later chapters.

Flow

Bringing the flow from the city through the south east and west, producing and entrance at the southern end of the building. And thus continuing the flow towards the green areas and parkland north of the site.

Outdoor Areas

Creating a hillside that enables the visitors to experience the library from the inside and out. And implementing other elements of the building that create a chance to interact with the library , wheather it be steps, or ramps that create a human scale and thus a connection to the ground.

Climatic Conditions

Taking into consideration the orientation by analysing the light conditions for each floor of the library. Whilst blocking out the warm sun to the south. and obtaining good sunlight conditions from the west and the east.

Achieving a good indoor climate by preventing overheating in the summer and creating comfort during the winter and the rest of the year.

Functions

Creating a mixed use library which consists of many different functions that would be considered more than just a library.

Library

Creating library that opens out to the exterior (e.g. café, restaurant, collections area). The library interacts both functionally and visually with the adjacent Makasiinipuisto park. During the summertime the functions will extend out into the park, while during the wintertime the building “breathes in”, capturing the wintry park views as part of the interior.

Achieving a good indoor climate by preventing overheating in the summer and creating comfort during the winter and the rest of the year.

Materials

In the choice of materials and structural solutions, we will strive for material efficiency and a small environmental impact. The objective is to avoid structural solutions that have unfavourable environmental impacts without, however, compromising on the quality of the cityscape and architecture.

Expression

The architectural design of the exterior and interior of the proposal is of a high quality and timeless. The proposal expresses the new functional concept of the library in an intriguing way.

Pasisve Buidling Principles

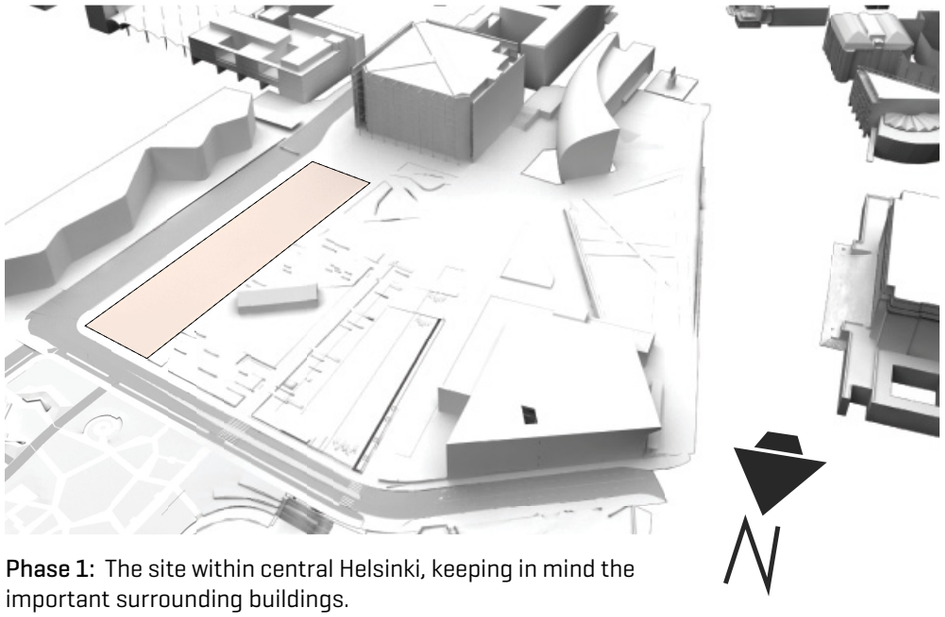
Using passive building principles (hybrid ventilation, compact form and renewable energ) in order to reduce heat losses and the energy consumption whilst increasing the indoor comfort.

Zero Energy Buidling

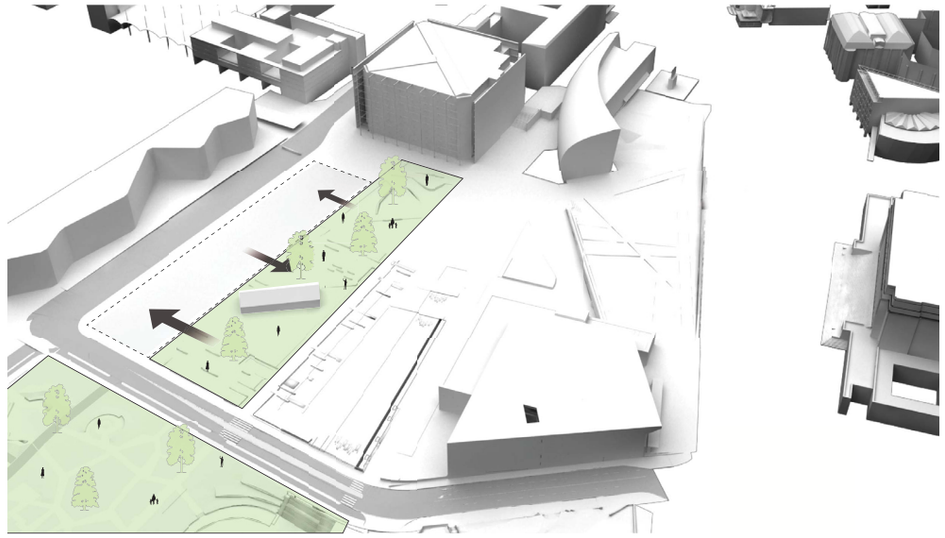
The objective is that the library will be a nearly zeroenergy building. The target E-value of the Central Library is a maximum of 180 kWh/m2 (room programme area) (the building’s room programme area is in total 10,000 m2) which corre-sponds to 120 kWh/m2 (gross internal area).

PRESENTATION

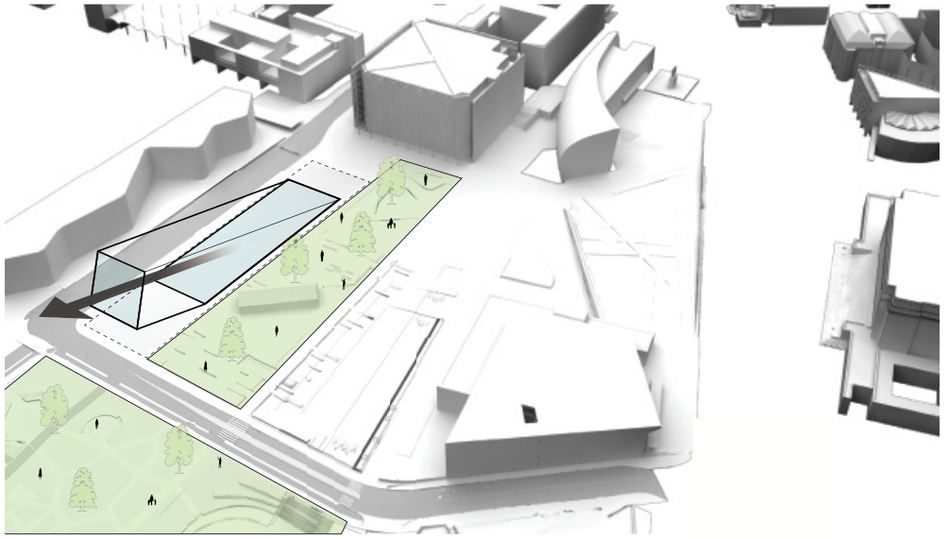
Building Concept



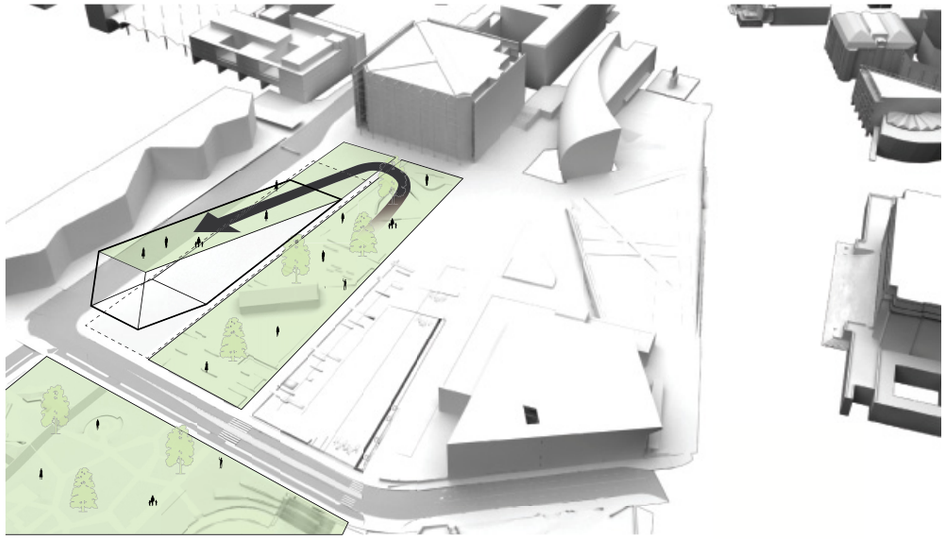
Phase 1: The site within central Helsinki, keeping in mind the important surrounding buildings.



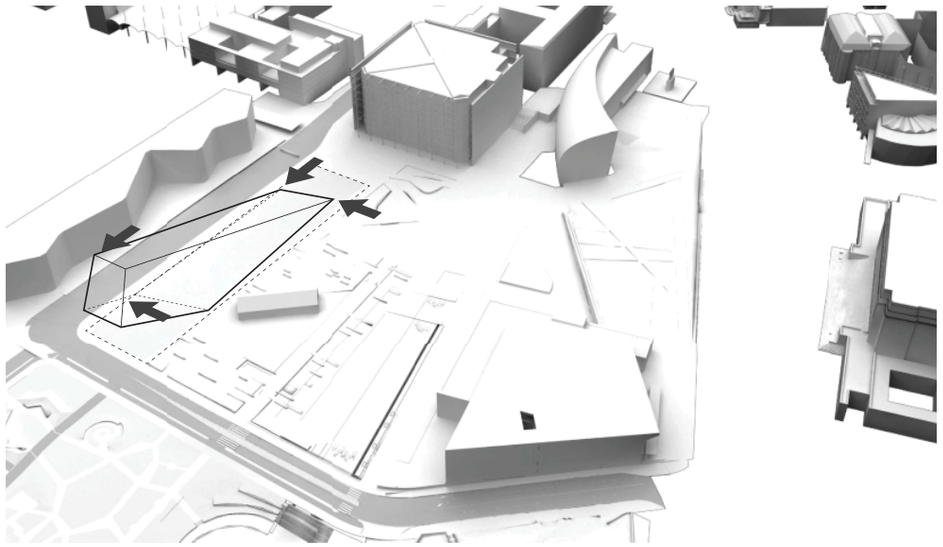
Phase 2: Interaction with the neighbouring parkland.



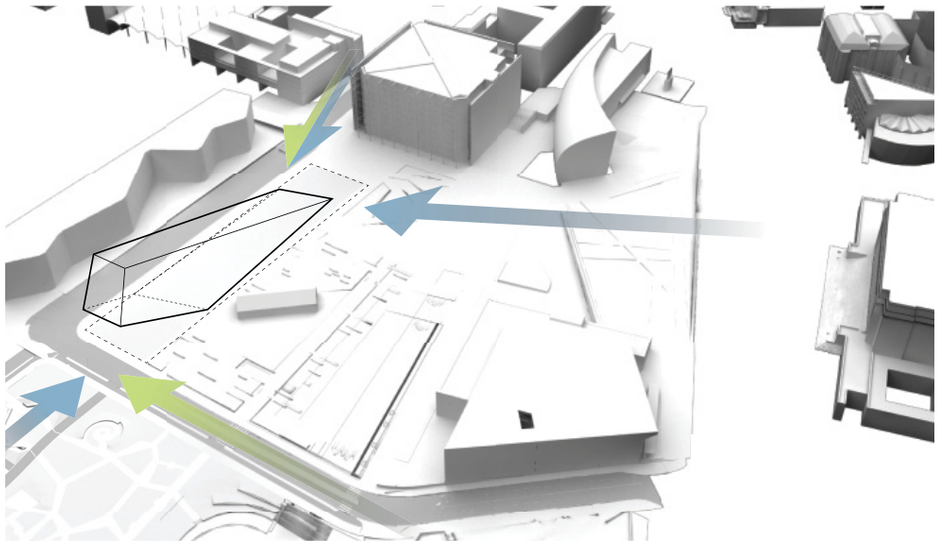
Phase 3: Basic form of the site extruded towards the northern views and parkland.



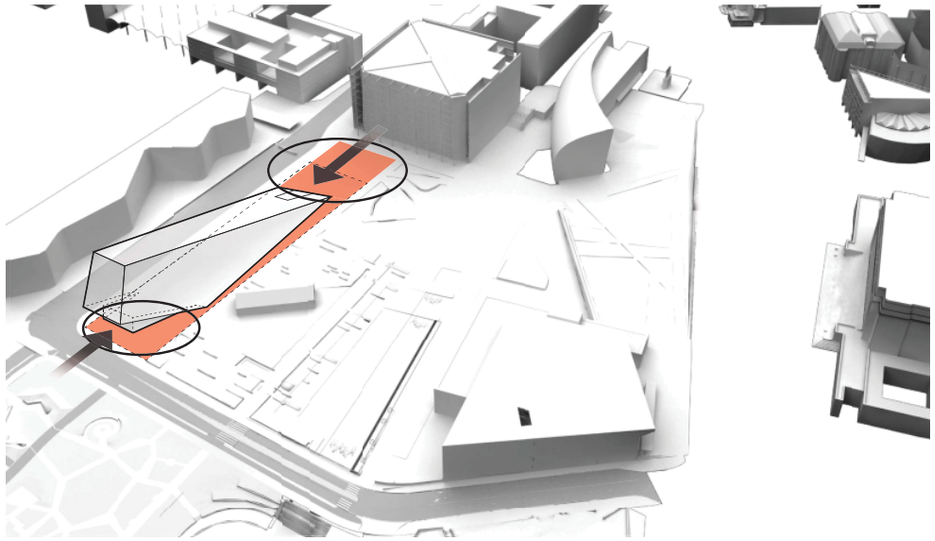
Phase 4: Connecting the hillside of the building with the parkland.



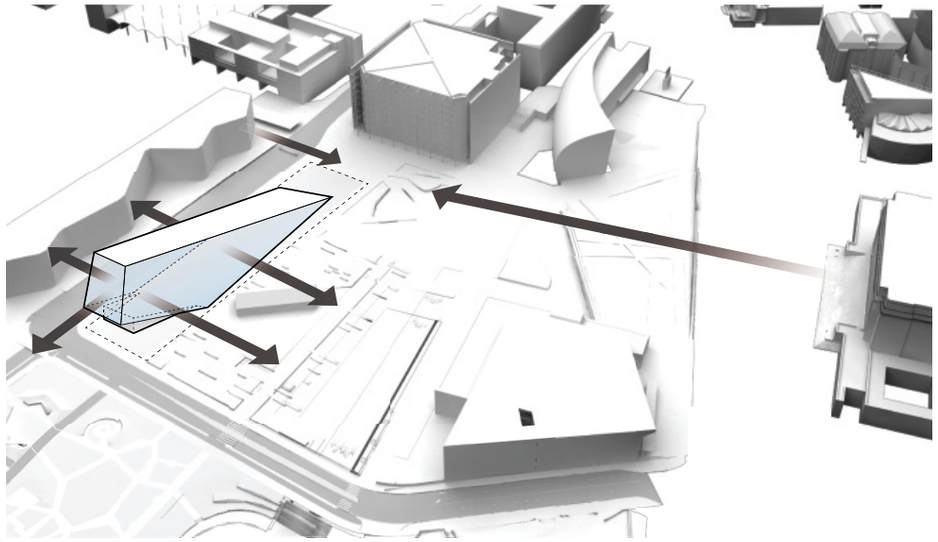
Phase 5: Slight alteration of the building to accomodate for entrance points and to face the northern part towards the bay.



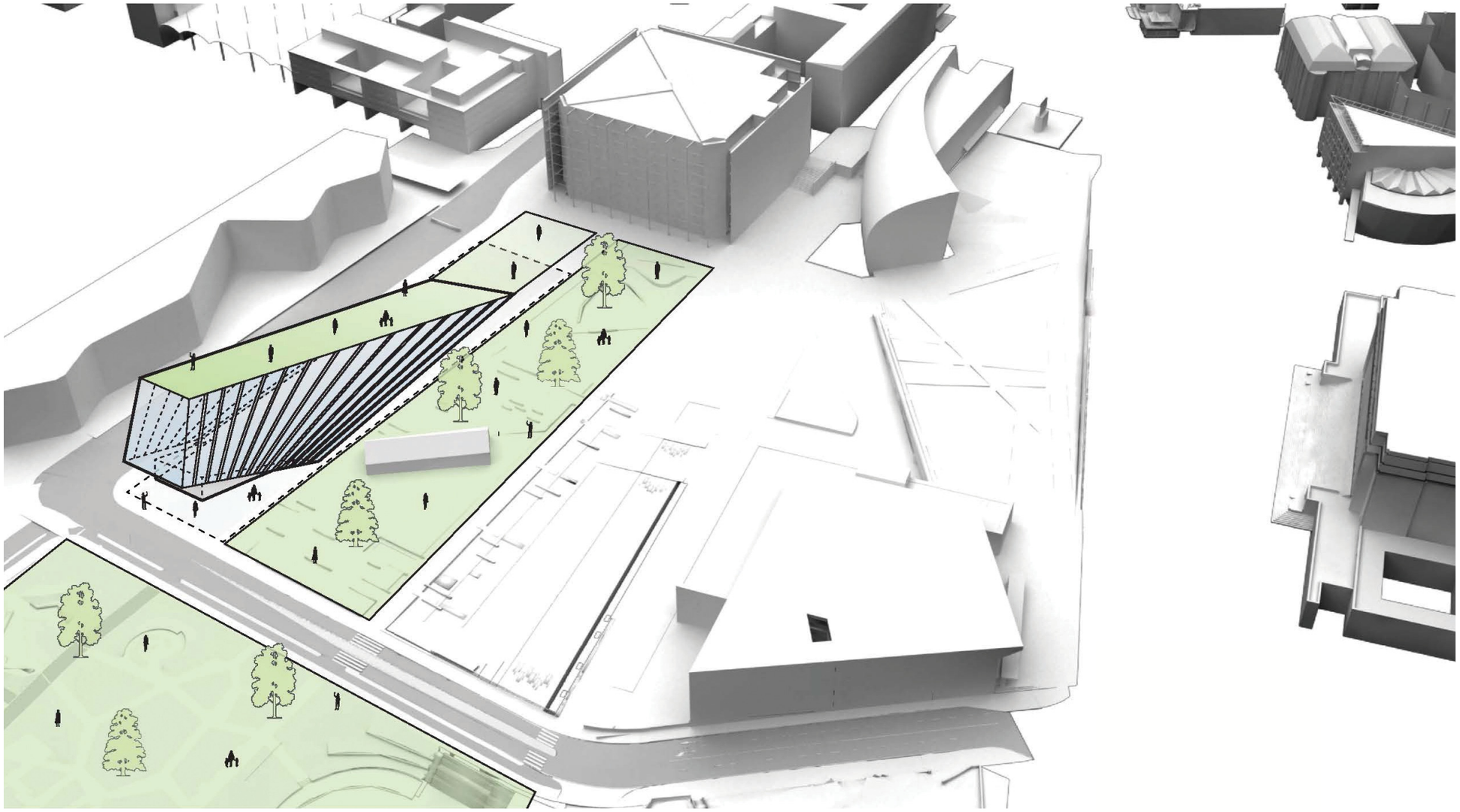
Phase 6: Main traffic flows including cars and pedestrians.



Phase 7: Two main entrances, one in the south and one in the north making the building very accesible and free flowing without congestion.



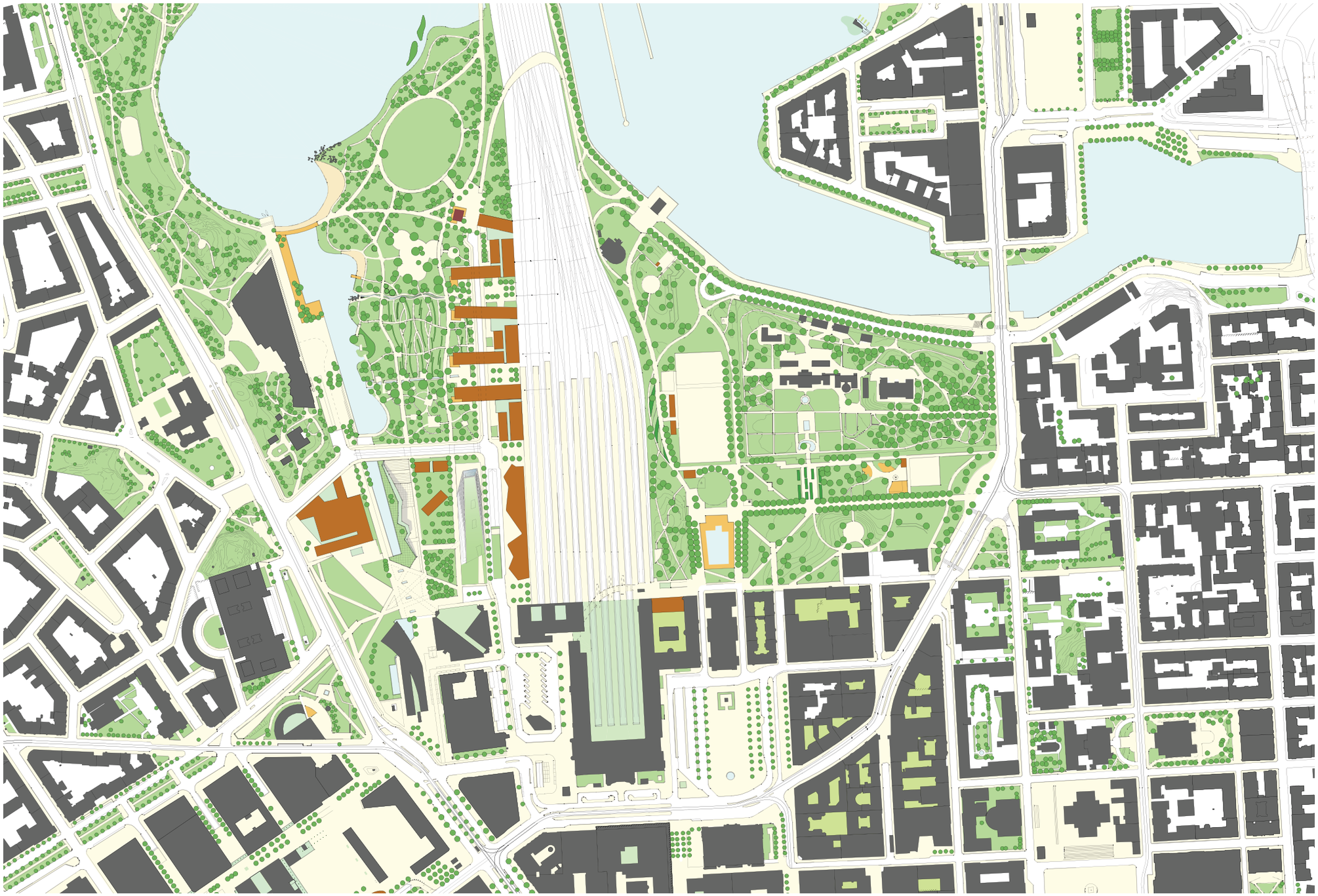
Phase 9: Utilising a double skin facade allowing for a more transparent buildwithout interupting with the existing environment. Whilst respecting the surrounding buildings.



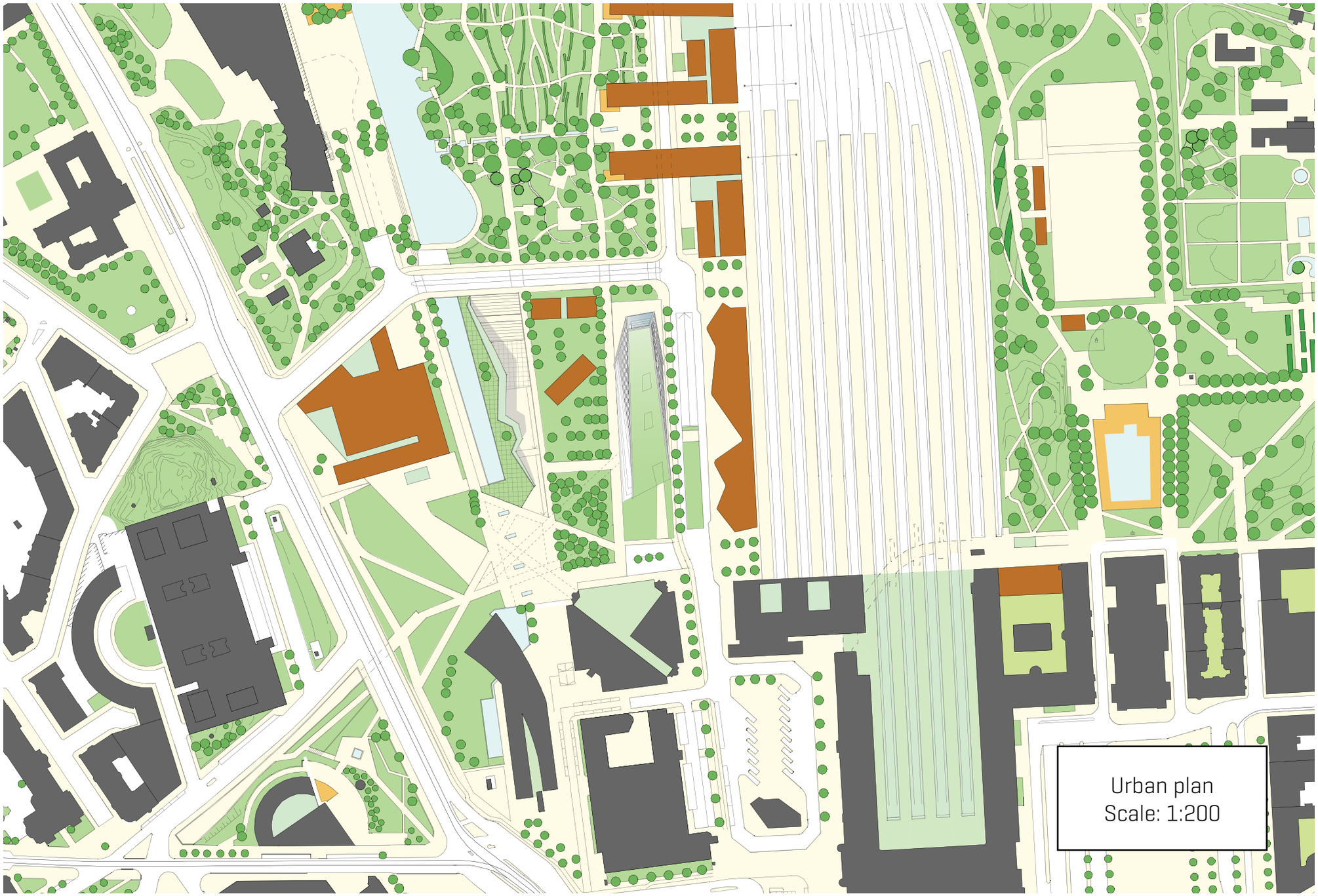
Phase 9: Final conept in context.

Aerial view from the north showing the building and Töölönlahti site. The picture shows how the building is relating and respecting the surrounding buildings.

Urban Situation



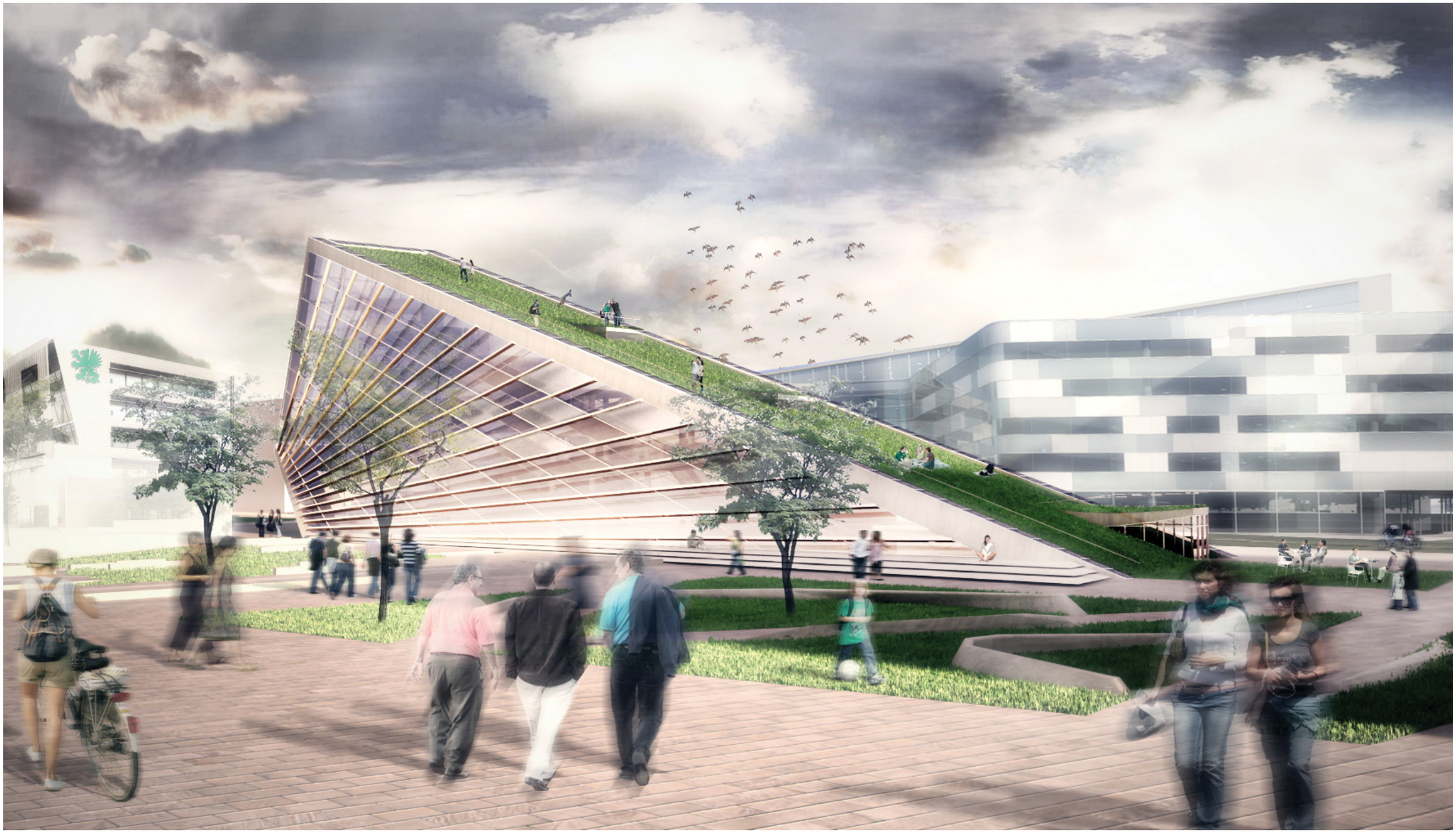
Masterplan of the Töölönlahti area and the surrounding urban areas, showing how the area is located in the centre of Helsinki and is connected with the bay and the parkland to the north.



Urban plan of the future Töölönlahti area. The park has been dragged into the city centre and it is seen how the building fits into the park area and respecting it's context.

Perspectives

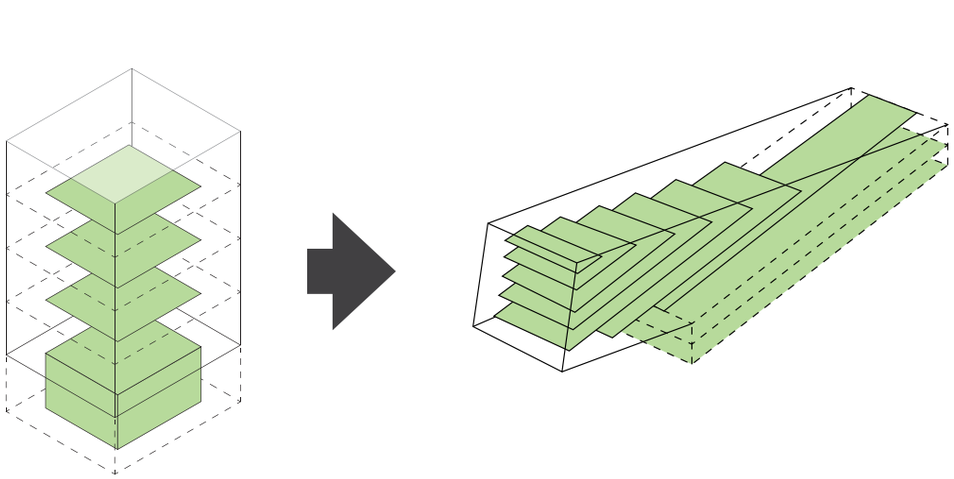
Masterplan of the Töölönlahti area and the surrounding urban areas, showing how the area is located in the centre of Helsinki and is connected with the bay and the parkland to the north.

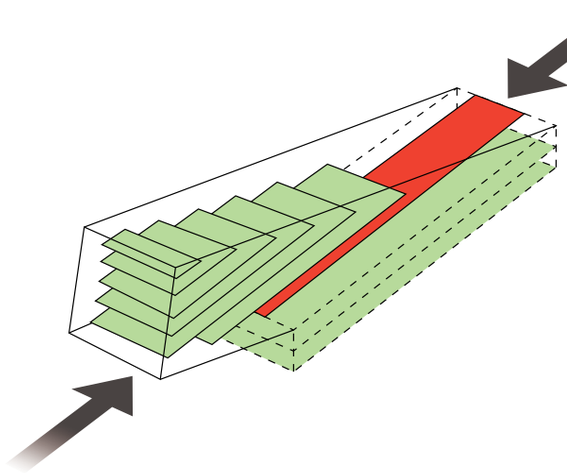


Building viewed from The Kiasma Musseum. It is seen how people can walk up the sloped roof and how the building interacts on a human scale with its surroundings.

Inner organisation

The concept for the inner organisation in the building is to have an open space between the floor plans and the facade. This is a kind of inverted atrium that connects the floorplans visually as the heart of the building. The ground floor is offseted from the facade in two sides and that creates a flow through the building and gives possibilities to use the base as functions that you would normally not have in a basement.





Functions

The concept for the functions is showed in the diagram below. The functions that needs light an would be preferalbe with a view is placed in the upper part of the building. Some areas of the basement is used for events and exhibition spaces that you would normally not see in a basement. This is possible because of the floor plan concept.

Functions from room program:

Main lobby
And central public service spaces

Event spaces

The collections area
and spaces linked to it

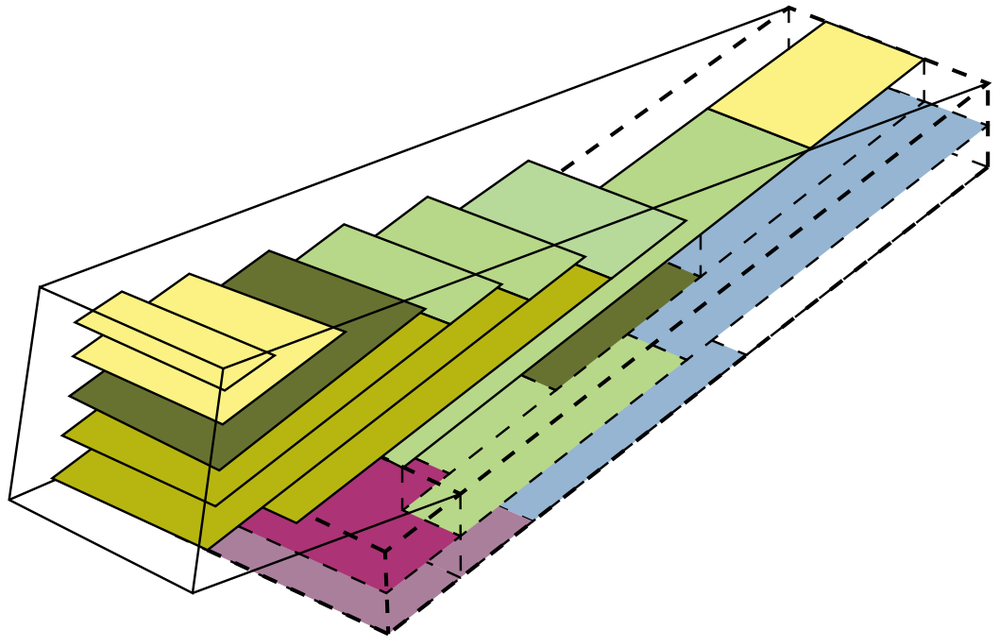
Learning and doing

Spaces for external service providers

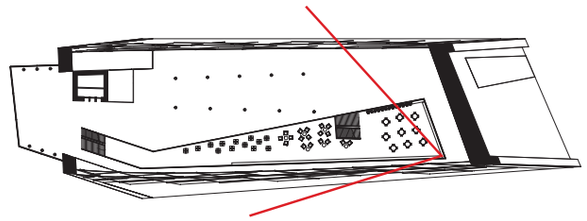
Staff facilities

Service spaces

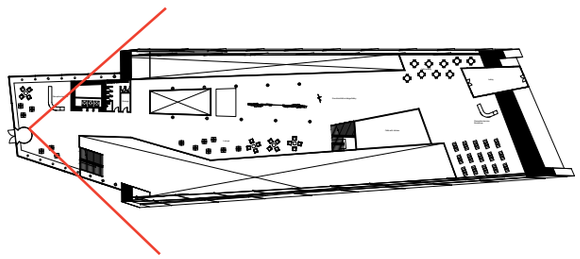
Library logistics



ill.174 View from the ground floor, the northern entrance.

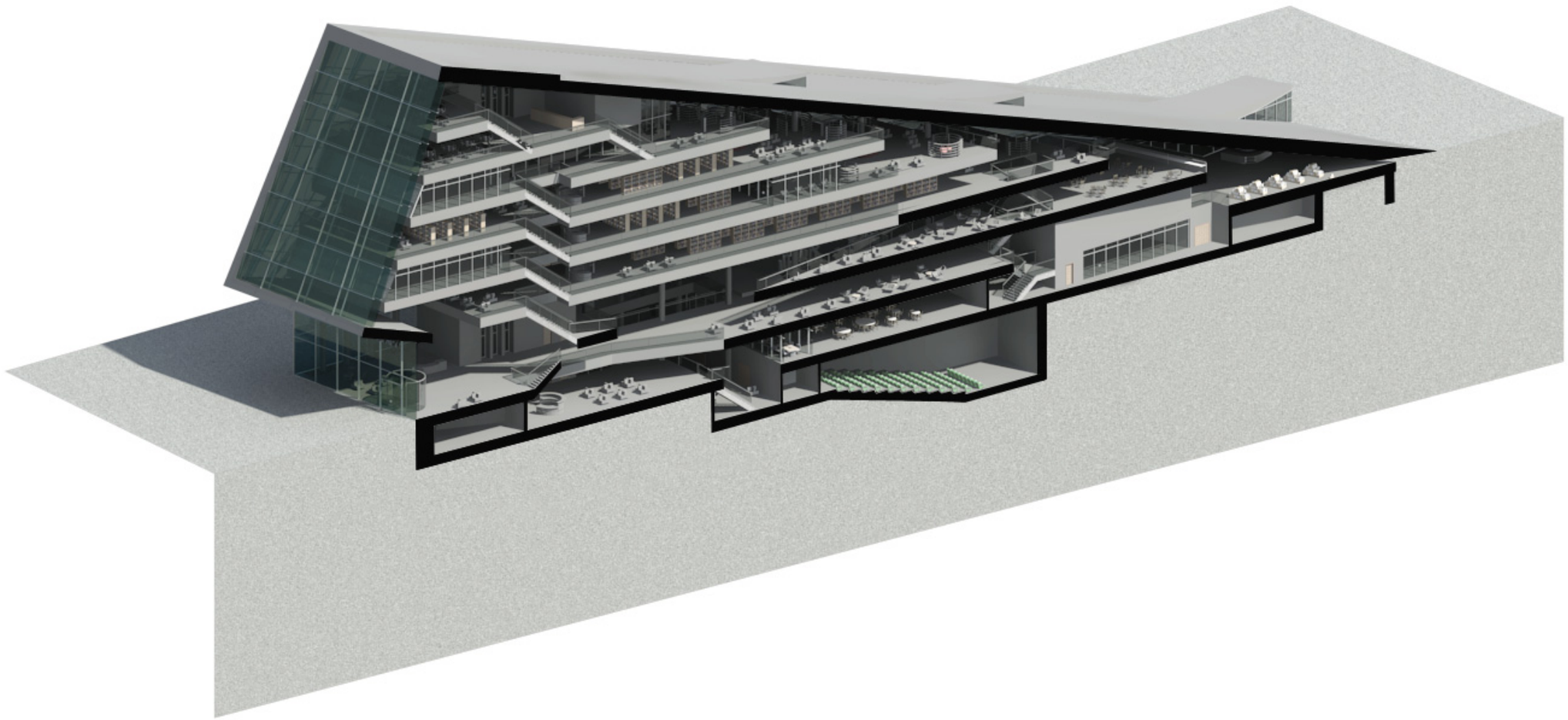


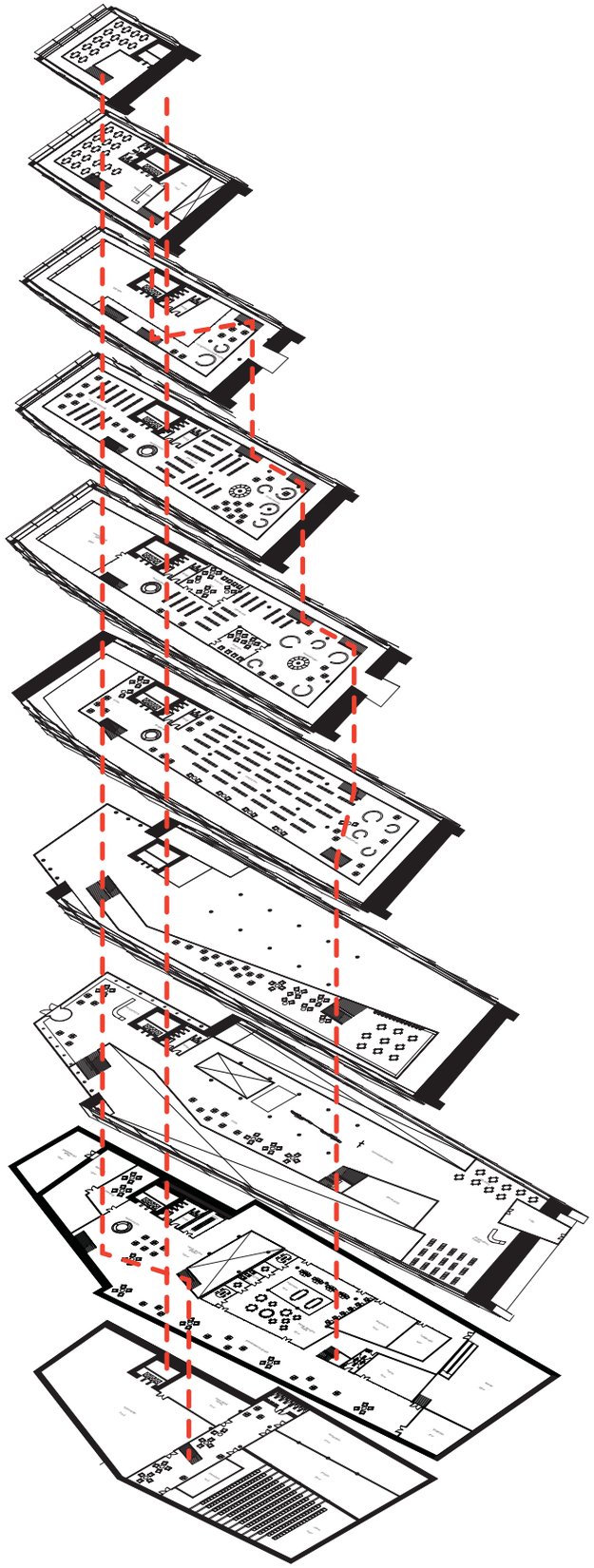
ill.175 The mezzanine, 2nd floor. Visual connection between the floors and it is clear how the floor plans creates the centered organism in the building.



Floor plans

The building has 10 stories. Two is placed underground, making the building 35 meters at it's highest point. The buildings total floor area is 11287 m^2.

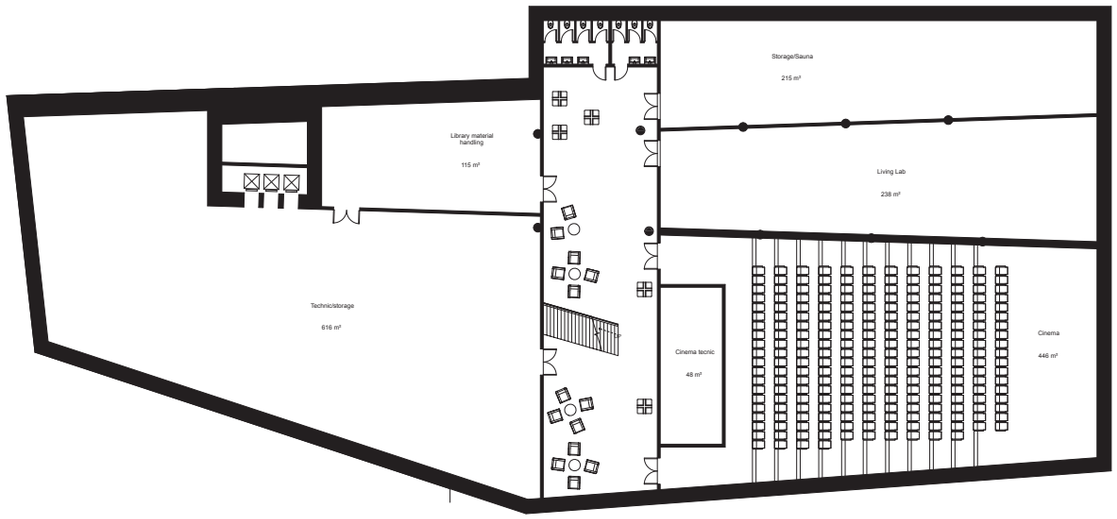




The illustration shows how the floor plans develope in the building and how the vertical flow developes.

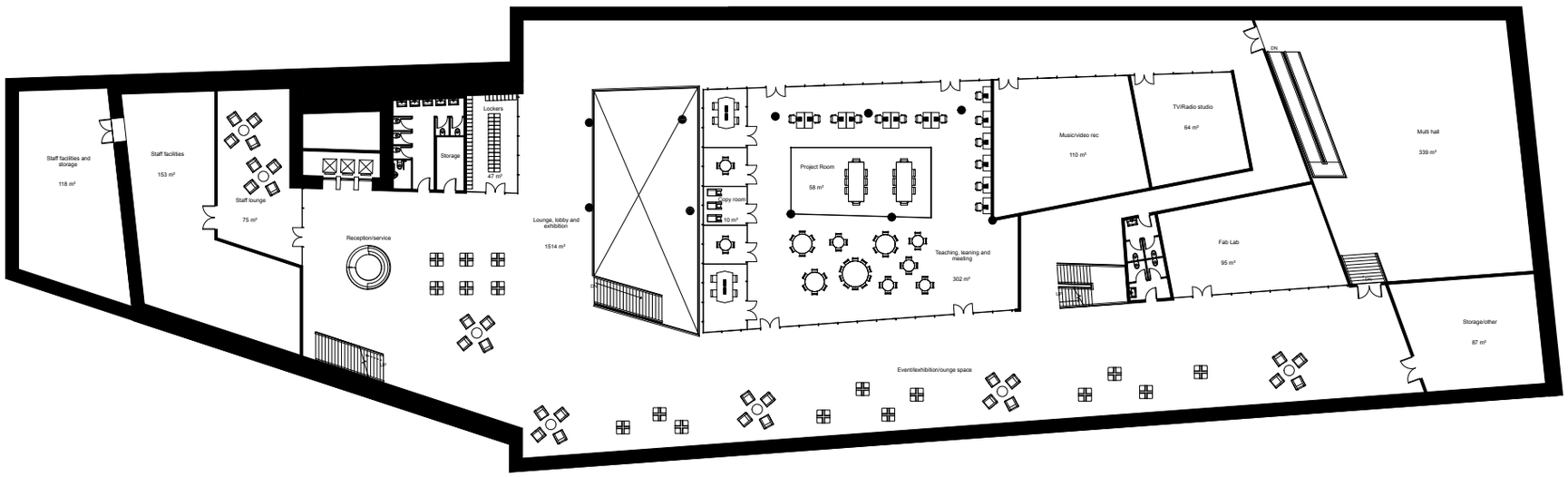
Vertical connections

Basement floor -2 is containing functions such as a cinema and technical functions, that doesn't need daylight. The lobby for the floor is in open connection with the rest of the open buildingspace.



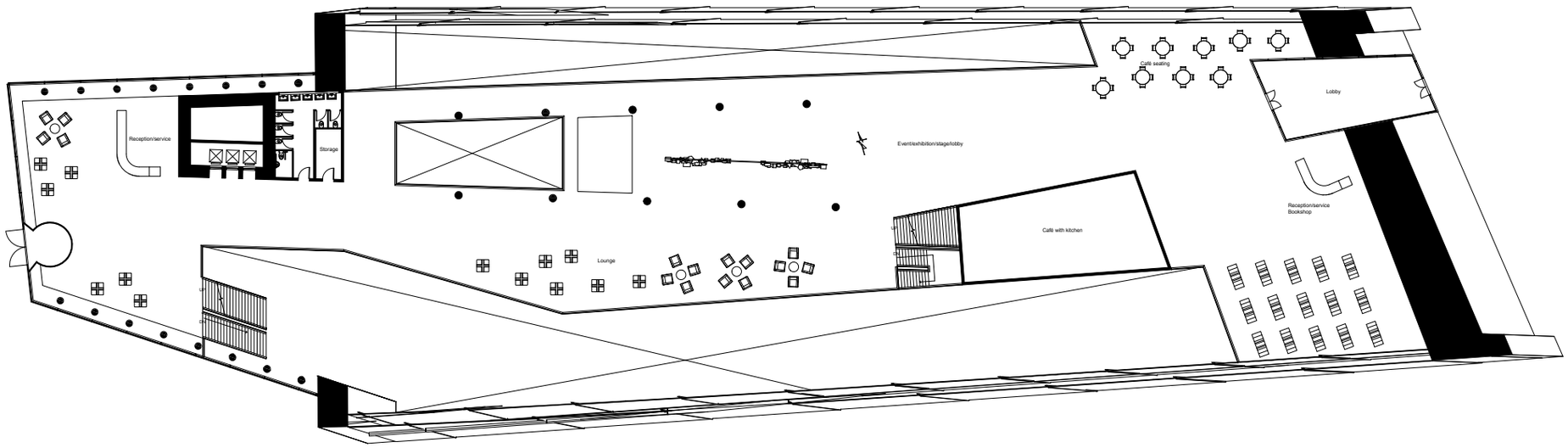
Basement level -2
Scale: 1:500
Area: 1802 m²

Basement floor -1 has good light conditions and high spacial quality towards the south and west facade, because of the offseted ground floor plan. Functions that has to be able to be closed off and that doesn't need a big amount af natural dayligt is placed under the centered ground floor.



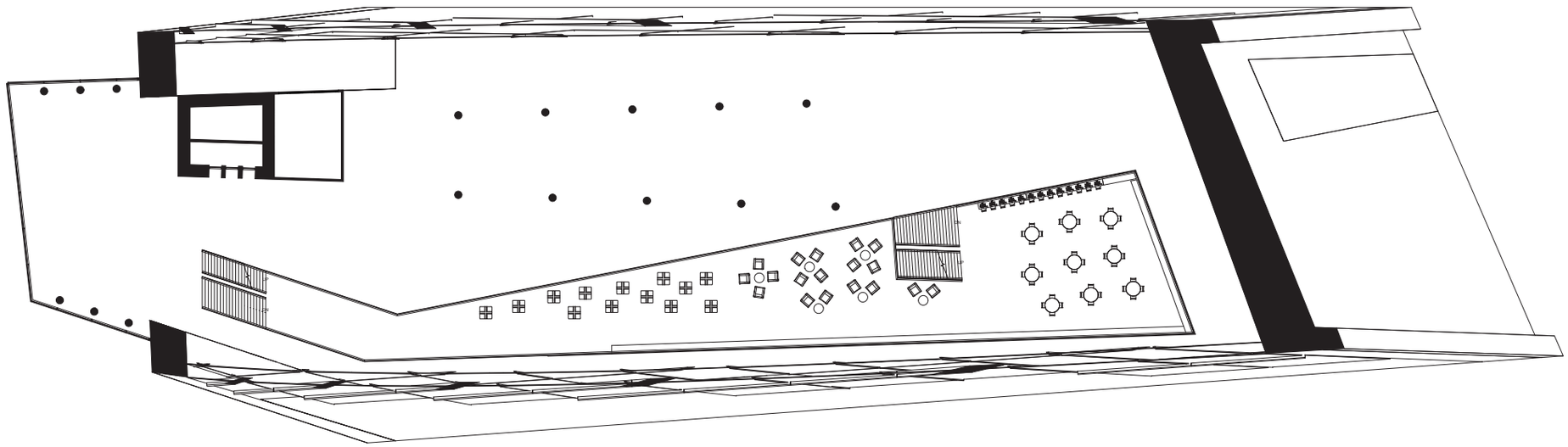
Basement level -1
Scale: 1:500
Area: 2797 m²

The ground floor has an entrance to the north and the south creating a flow through the building. It is very open and has a high room height giving the room a lot of options for adapting to different situations.



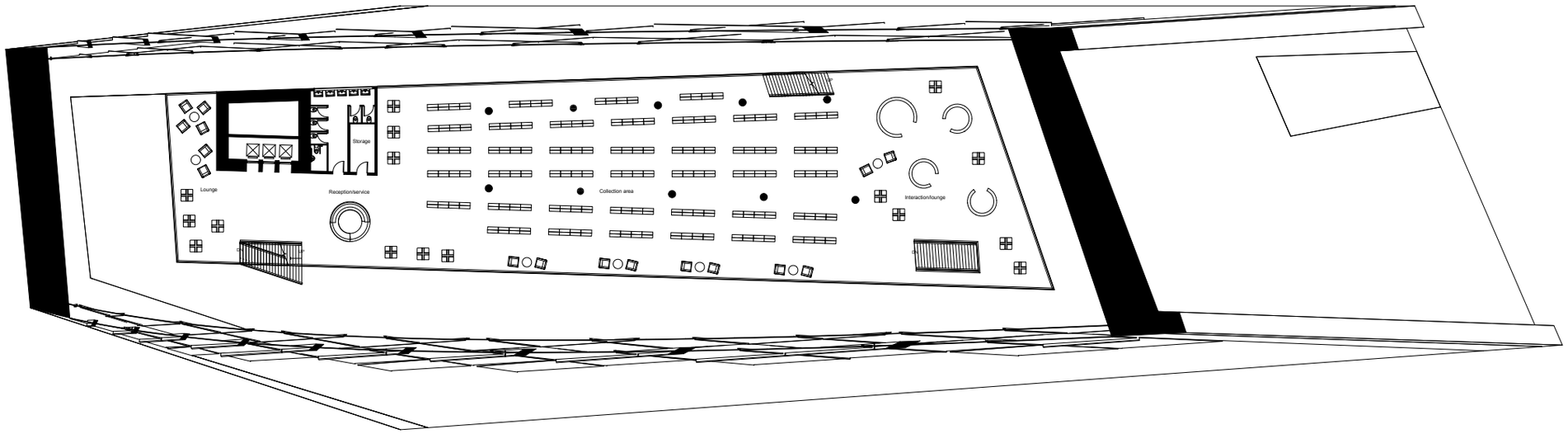
1st floor, ground floor
Scale: 1:500
Area: 2030 m^2

The ground floor has an entrance to the north and the south creating a flow through the building. It is very open and has a high room height giving the room a lot of options for adapting to different situations.



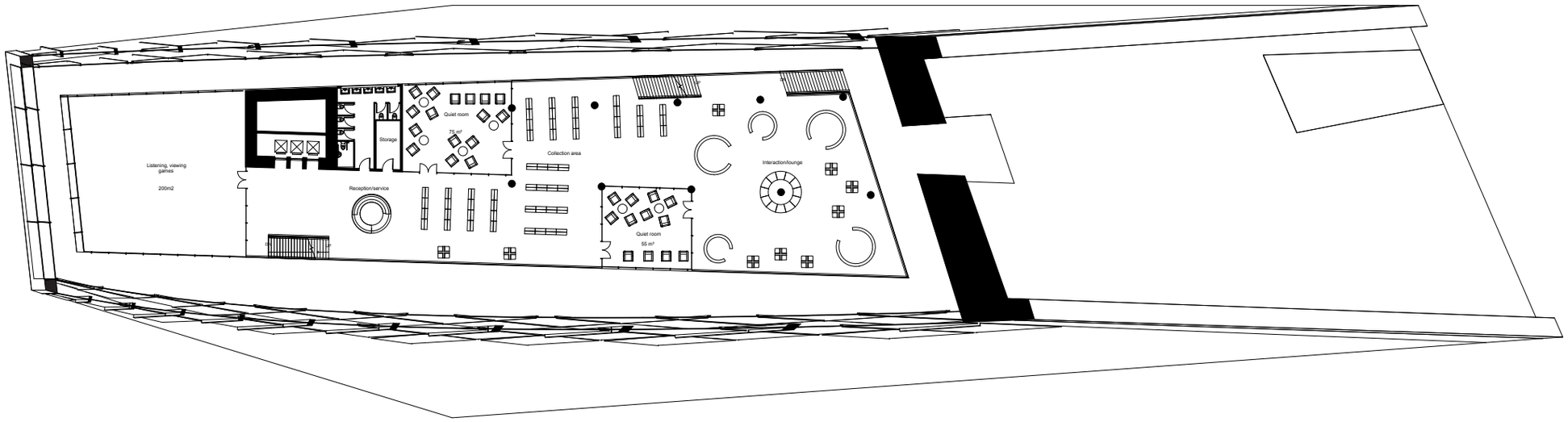
2nd floor, the mezzanine
Scale: 1:500
Area: 606 m^2

The 3rd floor's primary function is as collection area. It also has places to read and relax. The southern end is open an is intended as a flexible space for the library to have interactions for people or maybe just a lounge/reading area. Because the floor plan is kept simple and open it has a lot of possibilities for adaption.



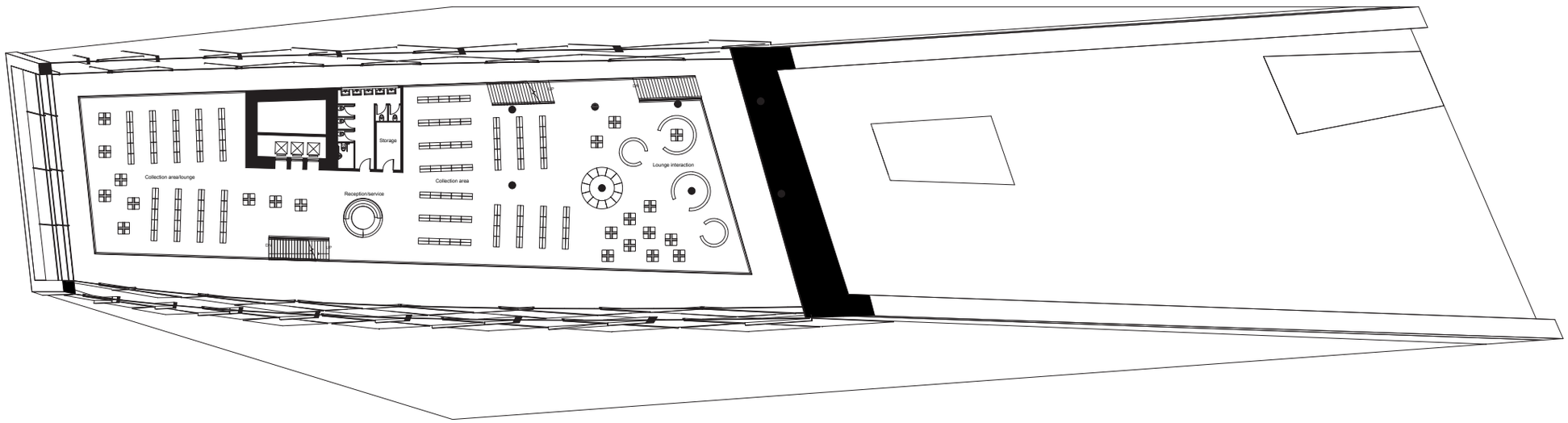
3rd floor
Scale: 1:500
Area: 1176 m^2

On the 4th floor is located the Listening, viewing and games room. Also collections and quite rooms are found on the 4th floor. The southern end is open an is intended as a flexible space for the library to have interactions for people or maybe just a lounge/ reading area. Because the floor plan is kept simple and open it has a lot of possibilities for adaption.



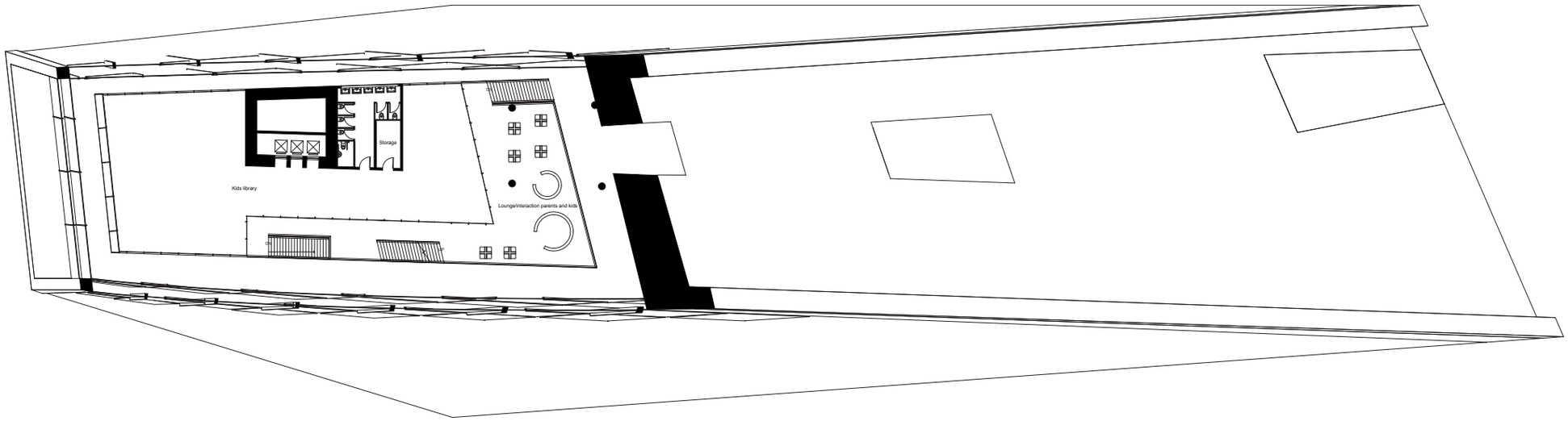
4th floor
Scale: 1:500
Area: 1092 m²

The 5th floor's primary function is pretty much the same as the 3rd floor's; collection area. Again the southern end is open an is intended as a flexible space for the library to have interactions for people or maybe just a lounge/reading area. Also this floor is kept simple and open making it adaptable.



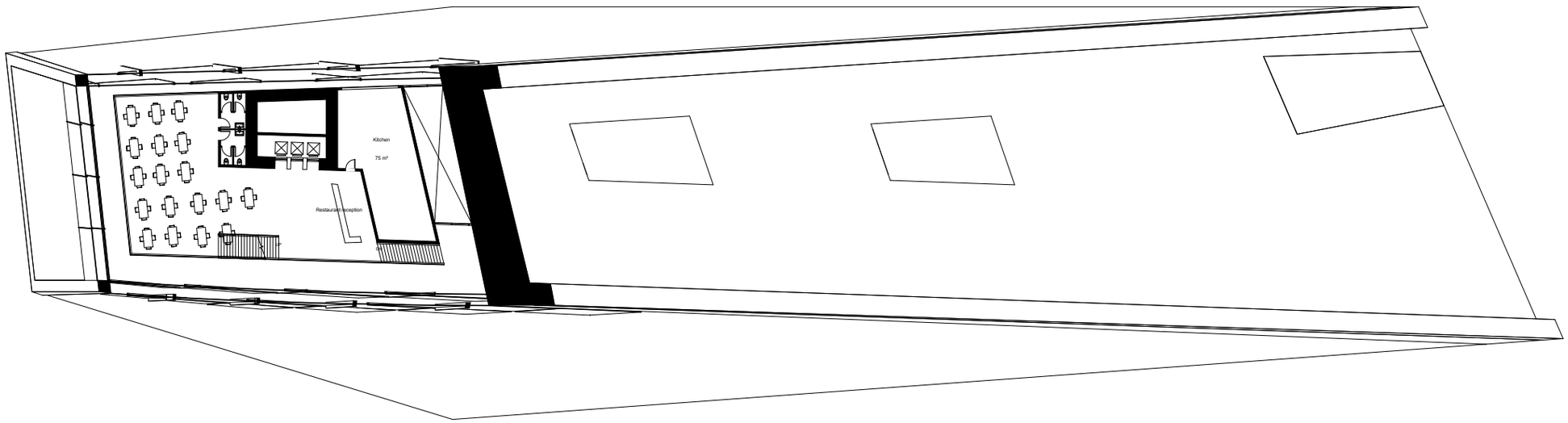
5th floor
Scale: 1:500
Area: 789 m^2

The 6th floor is reserved for kids and parents. The 6th floor is in close connection to the restaurant on the floor above, giving the possiblity for parents to enjoy a quite dinner while the kids can play nearby.



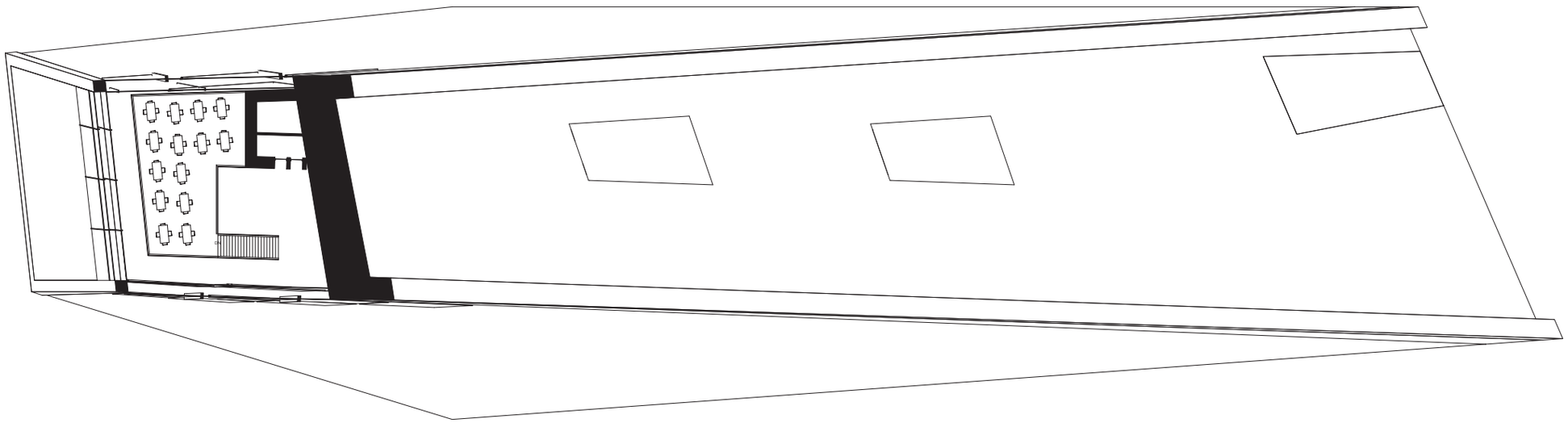
6th floor
Scale: 1:500
Area: 553 m²

The 7th floor's is the restaurant. The seating area is placed north with a good view over the bay and parkland.



7th floor
Scale: 1:500
Area: 789 m^2

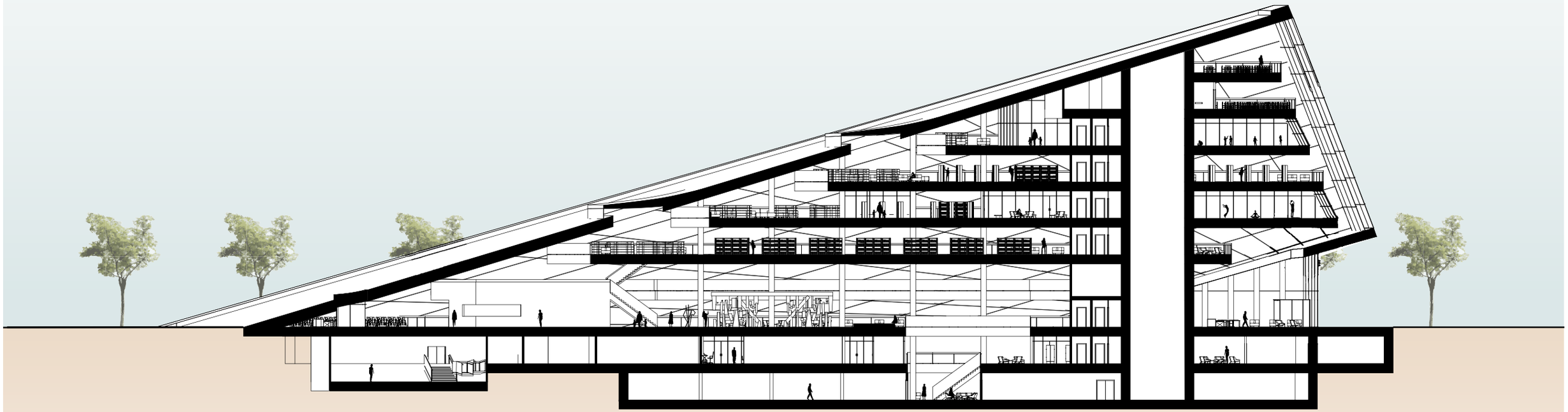
The 8th floor's is seating area for the restaurant. The seating is again placed north with a good view over the bay and parkland.

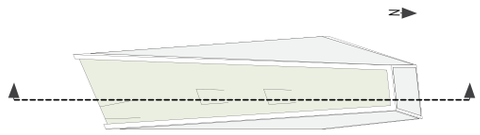


8th floor
Scale: 1:500
Area: 553 m^2

Section

Section B-B
Scale: 1:500

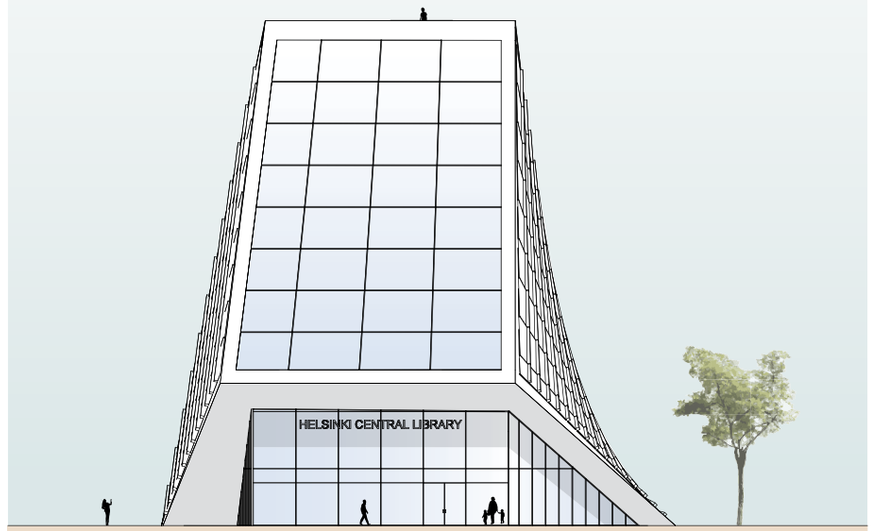




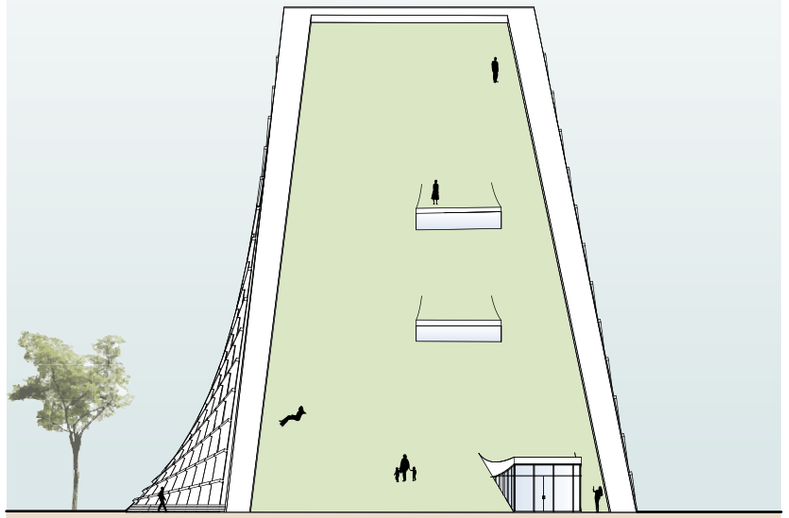
Section B-B

Elevations

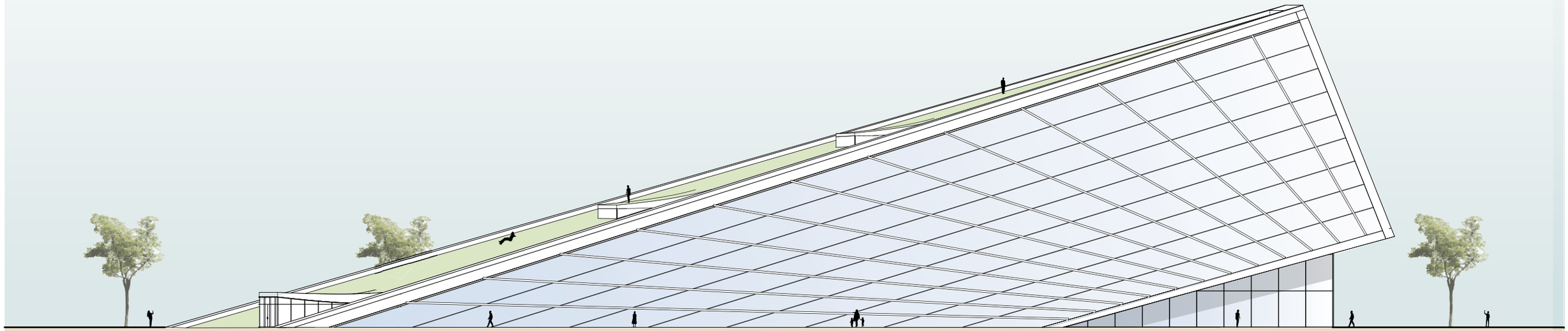
North elevation
Scale: 1:500



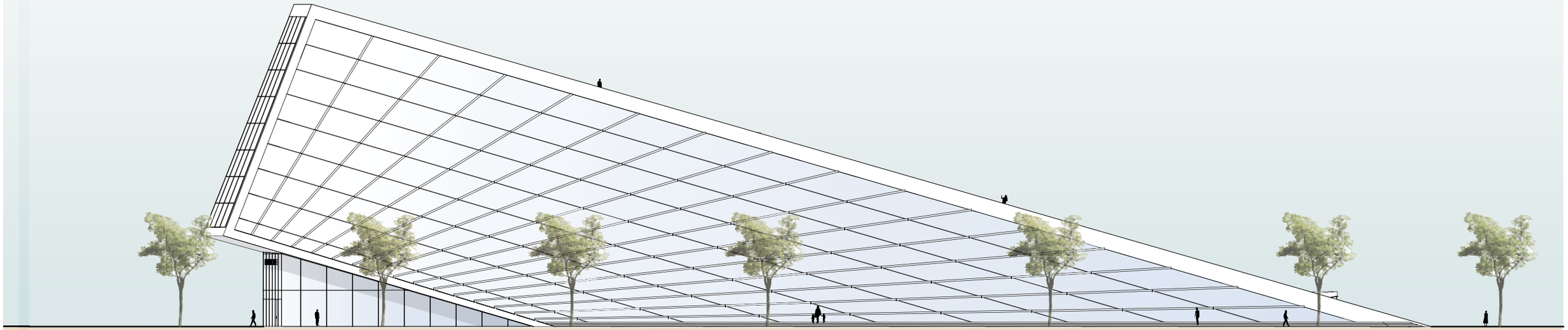
South elevation
Scale: 1:500



East elevation
Scale: 1:500



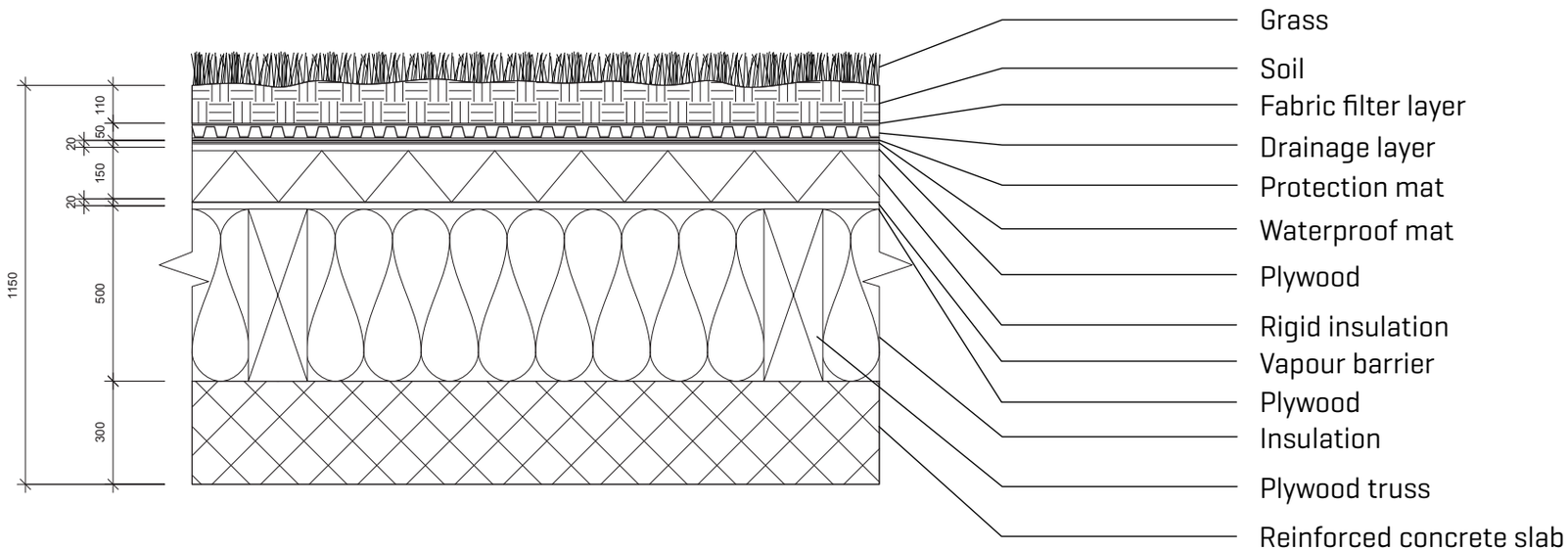
West elevation
Scale: 1:500



Technical Aspect

Green roof

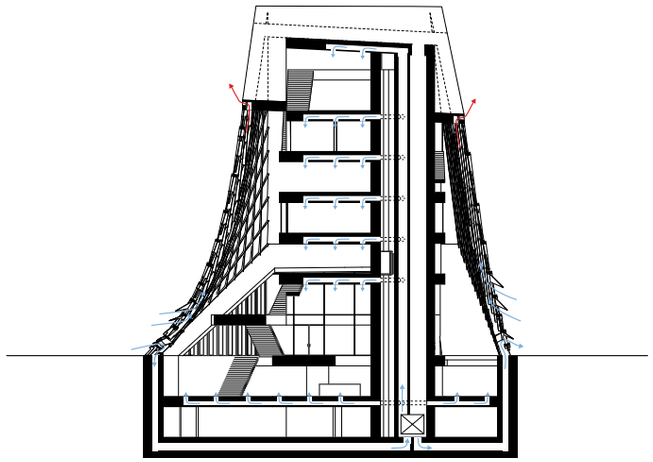
Detail of the roof constuction in 1:20 (U-value 0,05 W/m²K)



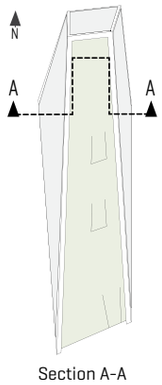
Energy performance

The buildings energy performance is base on “early stage” calculations and is only an assumption. We have a result from the program A + E saying 54 kWh/m^2 and one from BSIM saying 88 kWh/m^2. The results are not very accurate but with the advanced hybrid ventilation system driven by natural ventilation through double skin facades and mechanics, it should lower the energy frame significantly. Also the building is equiped with 500 m^2 of monocrystalic solar cells.

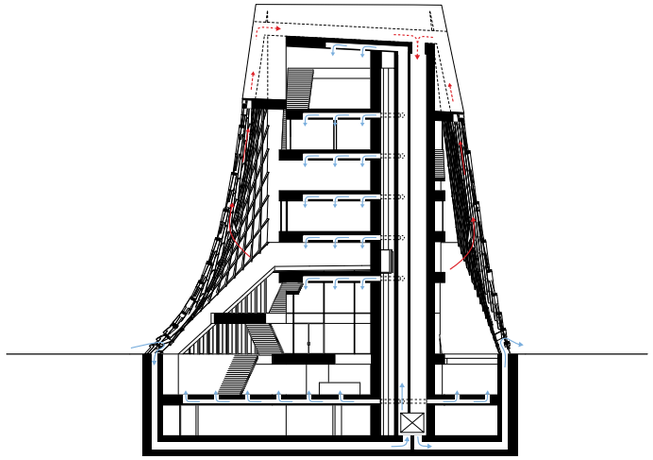
Ventilation principles



Section A-A, Summer situation



Section A-A



Section A-A, Winter situation

PROCESS

Methodology

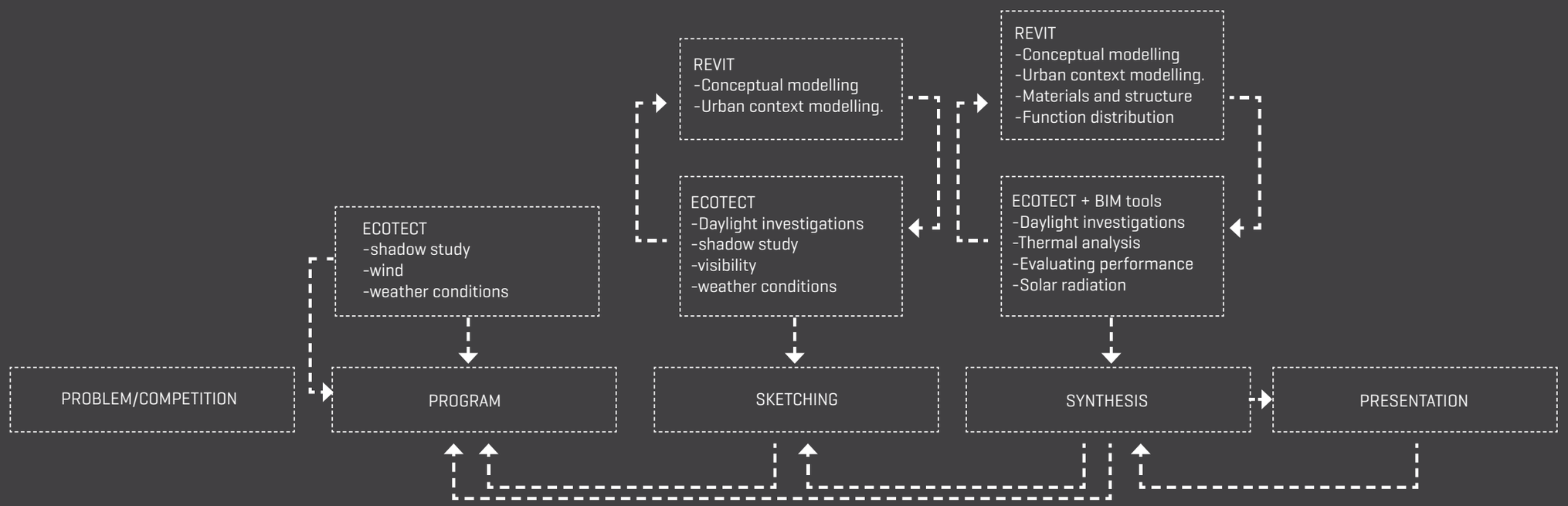
The design of the library will respond to the surrounding climatic conditions in Helsinki to achieve a low energy building. The library will strive to meet this low energy frame without losing the architectural vision and intention encapsulating the aesthetics, spaces and the overall idea. With this in mind the design process will incorporate an integrated design process (IDP) that incorporates climatic principles fused with design and form experimentation.

We began the sketching phase by asking simple questions such as Kahn's famous what is a library? how should a library behave in the present and the future? Questions such as these married with the requirements and ideas presented in the competition brief along with our vision provided us with a more affirmative direction for the entire project.

We then began sketching concepts, searching for an initial idea. After finding our desired shape we then tailored and considered all the environment and sustainable approaches we could use to improve the building that conveys and reflects what the our vision and competition brief requires.

To gain an agreement between the overall design form and the techincal demands a process must be implemented to ensure all parameters have been investigated and tested to optimise the design solution. Different evaluations and iterations with various techniques will be explored to maximise and tweek the final result and performance.

Revit for modelling combined with Ecotect and Bsim/spreadsheets are chosen as the BIM tools for further analysis and how they can be used throughout the integrated design process (IDP) to improve and refine the design. ill. 98



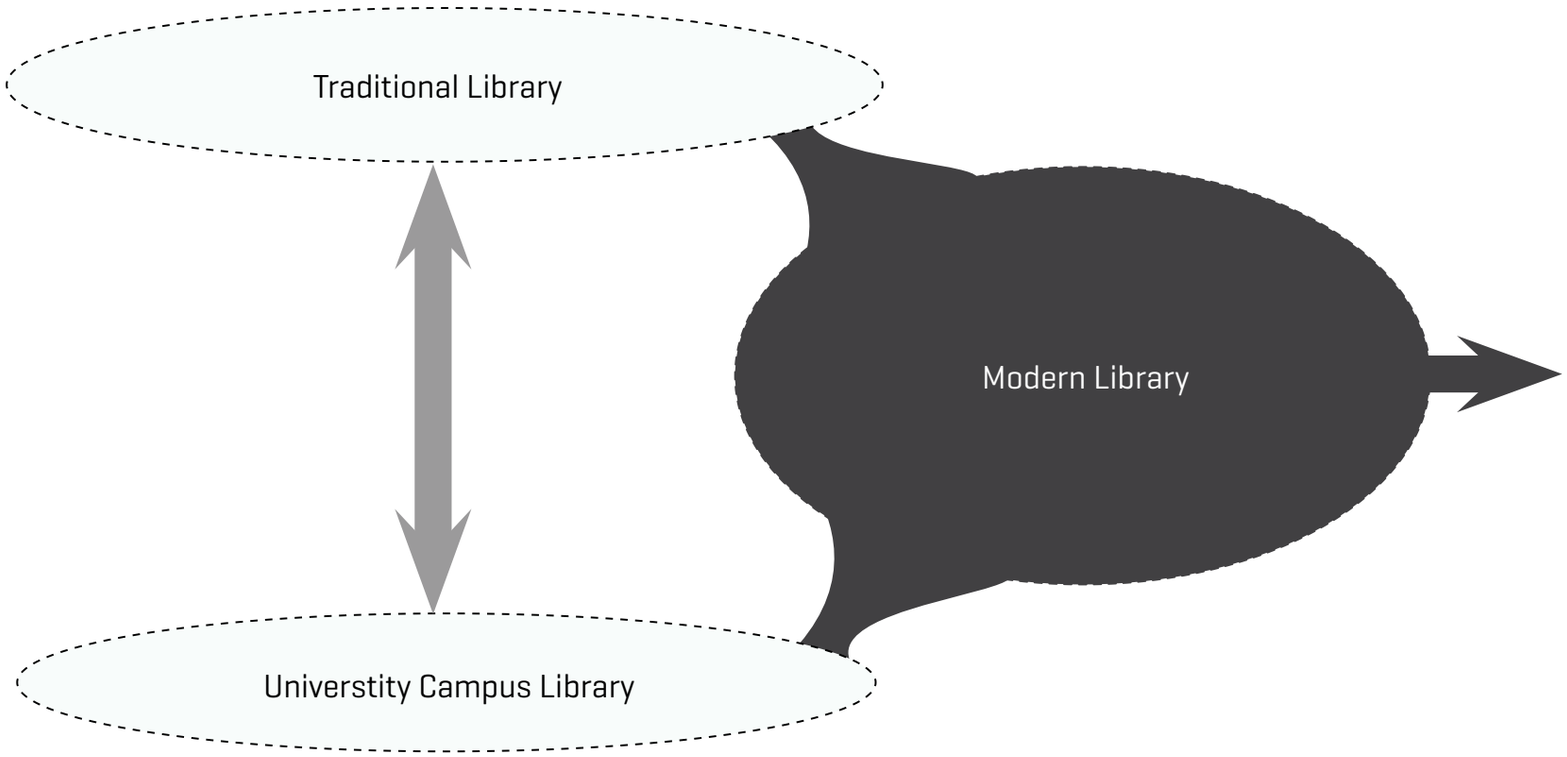
ill.98 methodology and process

“What is a Library?”

The role of a library is changing, obviously as technology changes society changes thus libraries will also change and adapt. So how does one design a library with this dynamic change in mind, and where does one search for inspiration for a library that can constantly change with the times. According to Juul Frost from Juul Frost architects the key is to look at university campus libraries, since a library must adapt with the latest trends and technology just like a university does. University libraries are always thriving with students and also act as a meeting point and are constantly being evolved as time and technology progresses. Frost also believes a library should be open around the clock and become a space for creative reflection. (Frost, 2011)

Also feedback and response from the residents of Helsinki to help improve and development the library according to the needs from the end user, not just what the designer believes the library should be.

“This way, a library could be created in Helsinki as well, where it would be easy to meet other people — whether you are a tourist, student or city resident. It also makes the city an interesting centre that lays emphasis on information, learning and interaction.” However one must not forget the traditional roots of a library and it’s main task of sharing, storing and organising books and information. (Frost, 2011)



ill.99 The Traditional library combined with the always adapting University Campus Library can help evolve and produce the Modern library.

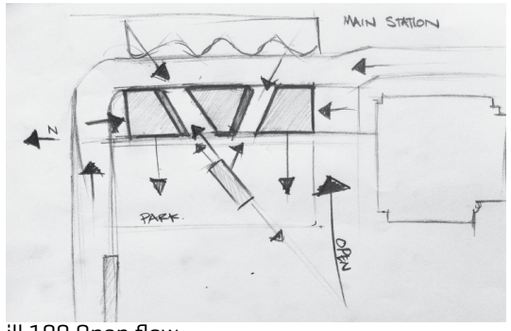
Masterplan & Typology Investigations

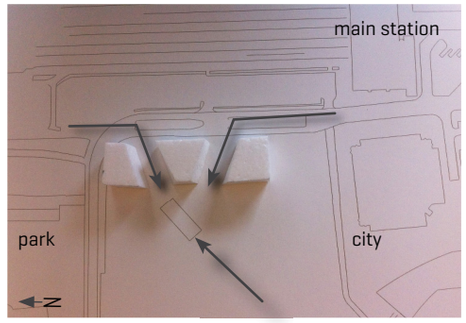
Through these sketches we tried to work out where the main points of entry and exit were, whilst also trying to find a nice flow in and around the site. How the library could connect to the surrounding context of the cityscape, the main train station and the parkland, whilst maintaining and respecting a dialogue to the surrounding buildings.

The beginning idea was to connect the parkland into the library and make that a main drive for the library, as this woud connect the public at a human scale into the library and not disconnect it from it's surroundings. These studies and sketches then provided information that would decide the best entries and exit points. And at the same time this created urban spaces for meeting and just socialising around the library. With all this in mind we also wanted the library to maintain it's own identity and not be overwhealmed by the parkland and cityscape.

The typology of the other surrounding buildings also played a huge role in deciding where our library should block or free up space creating urban spaces or closing off an area. Main road typologies also played the same role in dictacting but not controlling certain aspects of the library.

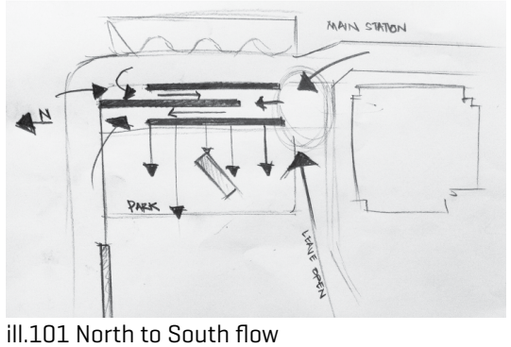
ill.100 The sketch and model to the right explores the different flows around the site and how we could initiate the site according to angles from both the parliament building and the small old railhouse building. Slicing up a basic monolithic mass and thus creating different openings and producing a more open/exposed solution.

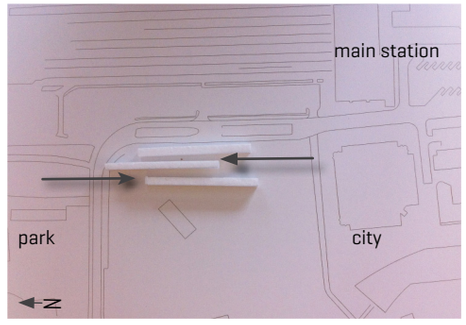




ill.100 Open flow

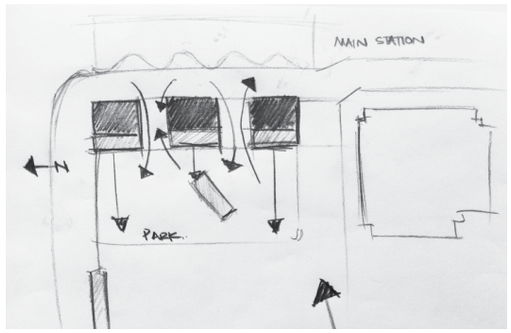
ill.101 This sketch and model deals with similar directions and flows around the site but tends to block them out and instead creates a vertical linear flow, only allowing entry and flow from the north to the south. This idea from north to south was very appealing to us as it created a nice opportunity for entry points at both the south and north ends and would ideally keep an uninterrupted flow throughout the ground floor of the library.

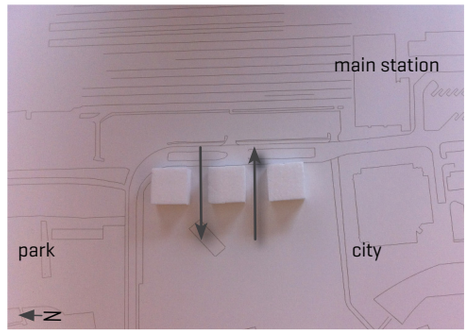




ill.101 North to South flow

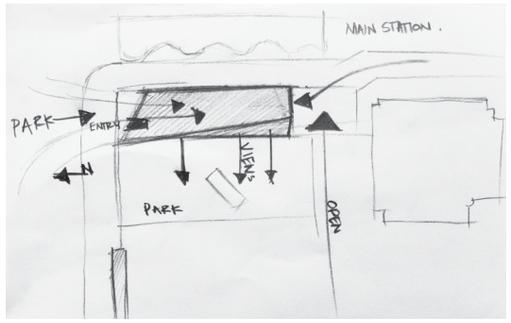
ill.102 This sketch and model deals with similar directions and flows around the site, however turns the site and building into different square segments, and thus opening up the site from west to east. This structure could become confusing as it creates multiple entry points and it lacks unity since all the segments are not linked in anyway.

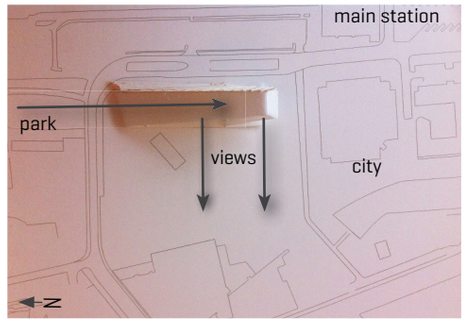




ill.102 Block openings, vertical flow

ill.103 This sketch and model deals different flows compared to the previous iterations. It attempts to drag the park from the north up into the building, establishing a connection to the park and thus creating hillside where people can meet and socialise whilst enjoying the views of the parkland. This horzontal linear idea also created entry points in the north and in the south similar to the second iteration.





ill.103 Park integration, linear flow

Basic Energy Investigations

When a building's energy consumption is compared to it's relativity of compactness, without disregarding other factors it is obvious that the more compact a building is the lower the energy consumption will be. Other factors include the design and geometry, the orientation of the building and the percentage and distribution of windows on the facade, which all contribute to the buildings overall energy consumption.

With this in mind we have explored a few different basic forms to give us an idea of how we can maximise a low energy frame while still maintaining a functional and aesthetical pleasing building.

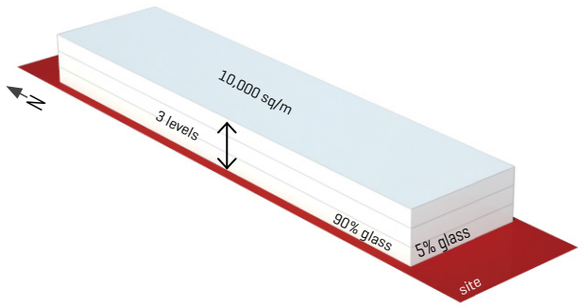
These studies investigate energy consumption using A +E energy software, and investigate an energy frame given it's shape, size and window openings plus the orientation on the site in Helsinki.

Basic A + E Volume Studies

Simple volume studies with the library requirement of 10,000 sq/m2. All facades are calculated with 90% glass except the southern facade which has 5%, as that would be facing the southern sun. All iterations also inculde 1 metre deep floors, and floor heights of 3 metres, and vary in height and dimensions as you can see per the illustrations.

In Phase 1 we tried a simple extruded rectangle with 3 floors using most of the site thus creating a buidling with a large surface area, this equated to quite a large energy frame of 71,3 kWh/m2. In Phase 2 we tried extending the volume upwards, thus creating a slightly more compact design. This reduced the energy frame down to 70,5 kWh/m2, which was not very impressive. In Phase 3 we then extruded the volume up higher to 8 floors creating an even more compact design, spreading the surface area more equally around the volume and thus producing a more satisfying energy frame of 59,2 kWh/m2. This small study reinforced that if we are to obtain a low enery consumption we will need to design our library using less of the site therefore designing compactly.

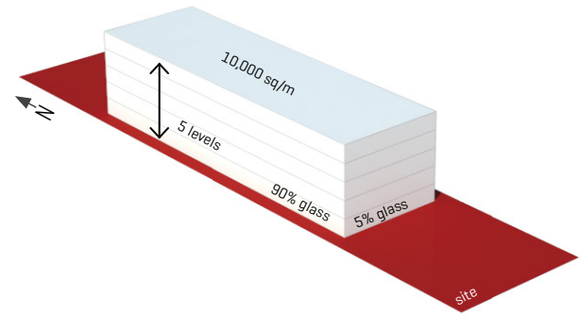
Phase 1



ill.104 Geometry: 103m X 32m
Window Facades %:
W: 90%
E: 90%
N: 90%
S: 5%

U-Value
Roof: 0.5
Facade: 0.75
Energy Frame: 71,3 kWh/m2

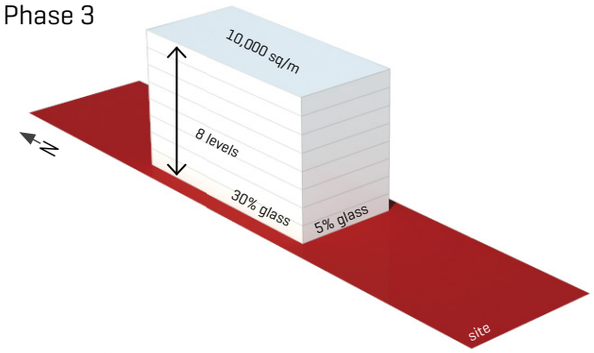
Phase 2



ill.105 Geometry: 62m X 32m
Window Facades %:
W: 90%
E: 90%
N: 90%
S: 5%

U-Value
Roof: 0.5
Facade: 0.75
Energy Frame: 70,5 kWh/m2

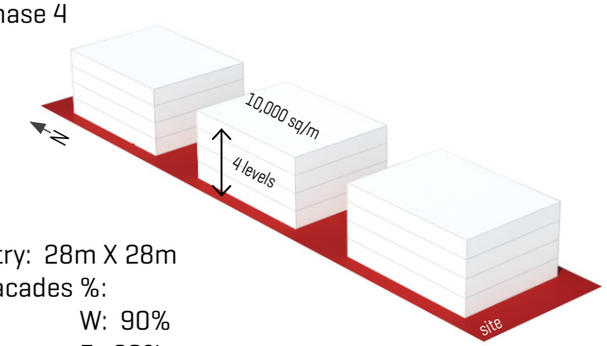
Phase 3



ill.106 Geometry: 33m X 39m
Window Facades %:
W: 90%
E: 90%
N: 90%
S: 5%

U-Value
Roof: 0.5
Facade: 0.75
Energy Frame: 59,2 kWh/m2

Phase 4

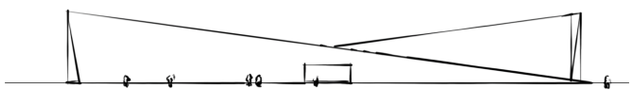


ill.107 Geometry: 28m X 28m
Window Facades %:
W: 90%
E: 90%
N: 90%
S: 5%

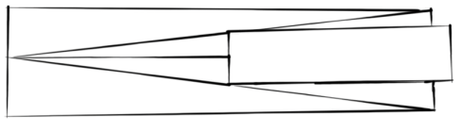
U-Value
Roof: 0.5
Facade: 0.75
Energy Frame: 77,5 kWh/m2

Initial Ideas & Form Finding

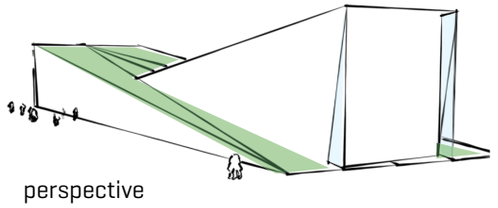
After we had finalised our research and gathered sufficient knowledge about the competition brief we embarked on journey of finding forms that could best fulfil the existing site. At this stage we were trying to perceive how the library could look and fit into the cityscape and interact with the people, and at the same time thinking about sustainble ideas and approaches that we could intergrate into the library. The following sketches portray a mixed fusion of ideas, all trying to explore what they could offer to the site and the surroundings. Each idea also tries to encapsulate some fundamental principles such as; human interation, relativity to the site, intergration of parkland, possible sustainable schemes and the core functions of the library.



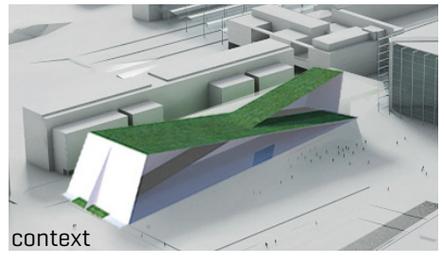
front



plan

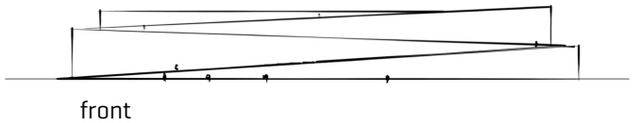


perspective

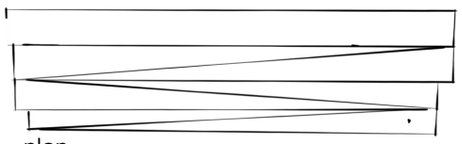


context

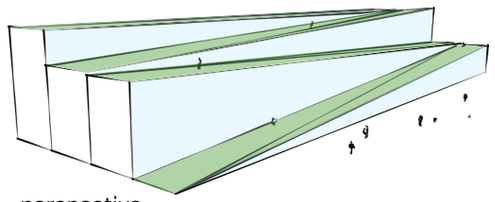
ill.104 Elevated hillside concept.



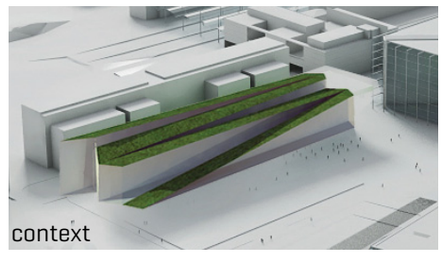
front



plan

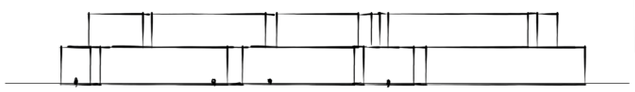


perspective



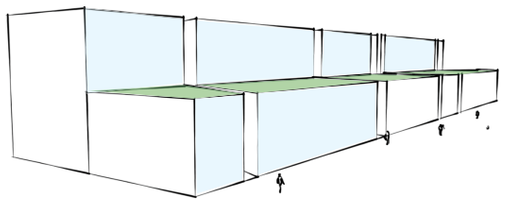
context

ill.105 Ramp up concept.

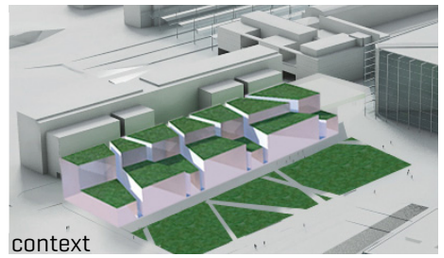


front

plan

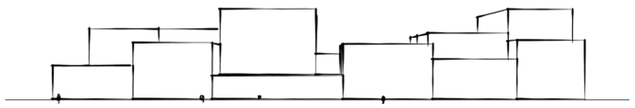


perspective

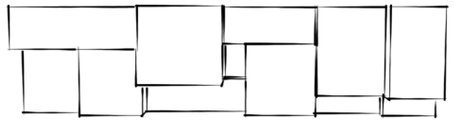


context

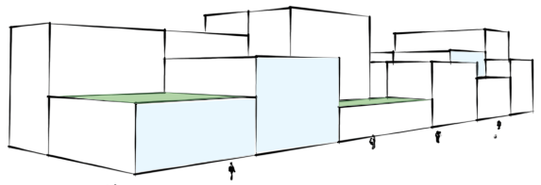
ill.106 Relating to the environmental context.



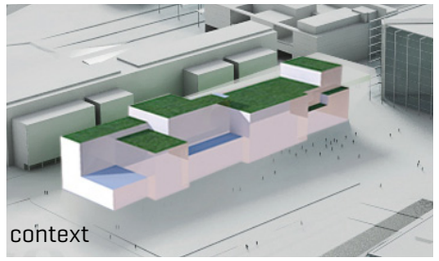
front



plan

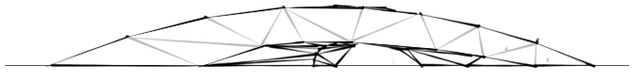


perspective

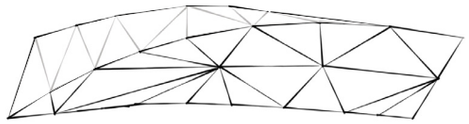


context

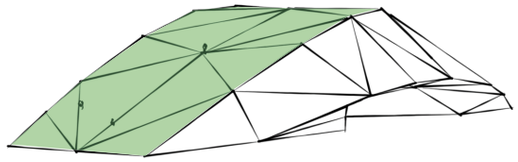
ill.107 Relating to the building context.



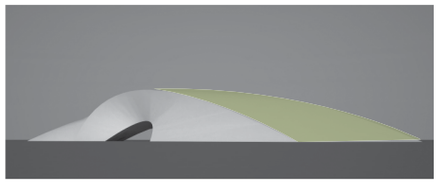
front



plan



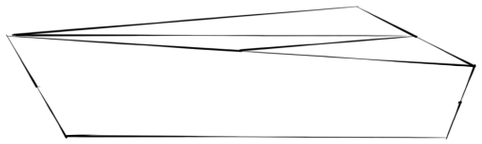
perspective



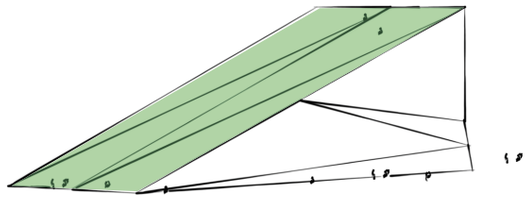
context

ill.108 Curved hillside concept, city to landscape connection.

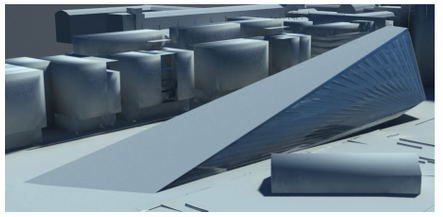
front



plan



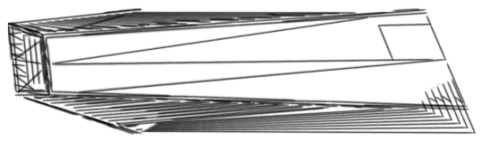
perspective



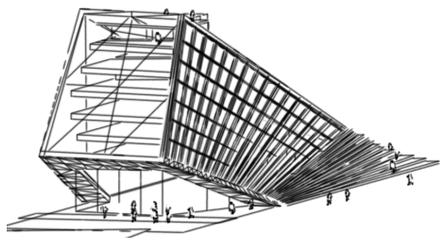
context

ill.109 Final shape and concept to develop.

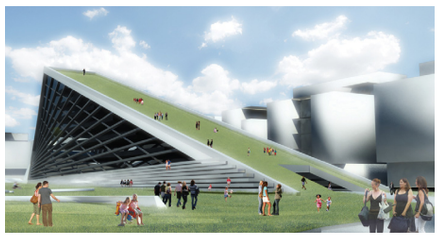
front



plan



perspective



context

ill.110 Final concept to develop.

III.104: Revolved around the the idea of creating a hill in the city through a basic triangular form. It would create entrance points on the western and southern facades and mostly be made of glass.

ill.105: Played with the idea ramps, and how they could encourage people to walk up and around the library, creating possible entry points on higher levels of the library not just at the ground level. However this idea could become distracting if you are trying to study whilst people are walking past the windows.

ill.106: Attempts to create a connection to the existing lanscaped environment. However we do not wish our design to be ditacted by exactly lies around it.
After searching for a suitable form and concept that fulfilled our vision and the ill. 107 Attempts to create a city within a city and forgetting about it's surroundings and becoming it's own entity. However this approach lacks a connection to the ground and our fundamental vision of having a library you can walk on and thus embracing the city.

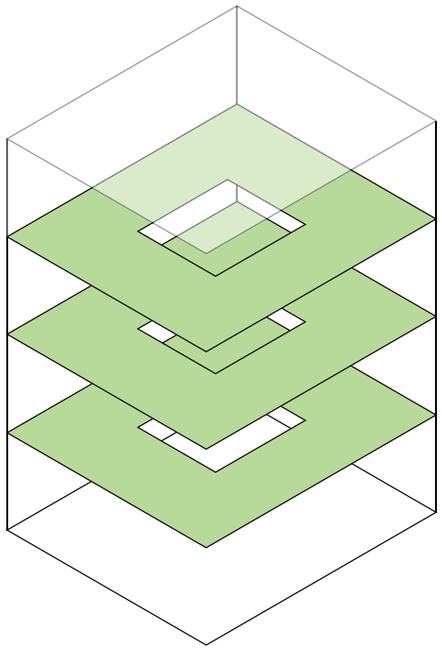
ill. 108: This design attempts to become many things through a more organic form. It wants to embrace the park to the city through a curved bridge whilst leaving a void under the bridge to create an opening for an entrance and connection to the main train station.

After searching for a suitable form and concept that fulfilled our vision and the fundamental parameters of the competition brief we felt confident to continue with concept ill.109/110. This idea best suited the site and weather conditions as well as integrating into the site and surroundings. It is also obvious to see we have incorporated ideas from the various concepts explored. Beginning with ill.a where the main thrust of this design was the hillside, and also in ill.b where the ramps become a stepping stone to interact with the library. Then again in ill.e which tried to bridge the city to the parkland thus creating more of a relationship with the landscape and the city, which we think is very important if this library is to become a sucessful one.

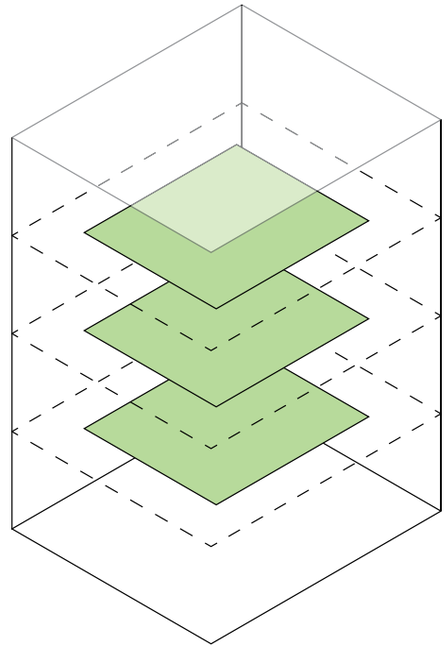
Inner Organisation

Concept

The floorplans in many modern buildings has an atrium (or multiple atriums) in the building that lets light into the building and creates a visual connection between the floors. This is usually seen in many public buildings and offices. We are rethinking the traditional way of building an atrium. In a library we need spaces that don't want direct sunlight and some that don't need daylight at all. Books for example shouldn't be exposed to to direct sunlight (bookstellyouwhy, 2012) and the cinema shouldn't have any daylight at all. Our interpretation of an atrium is instead of having an opening in the center of the floorplans, we are having the floorplans offset from the facade. This creates an illusion of the floorplans floating in the center of the building. Instead of having the building divided into different closed flooplans the spaces inside the building is then in within the same space. The centred floor plans will be the heart of the building creating a kind of organism for the building, instead of having the floorplans dividing the building into different closed spaces as seen often. To keep good spacial quality and good light conditions the building envelope is therefore kept very open.



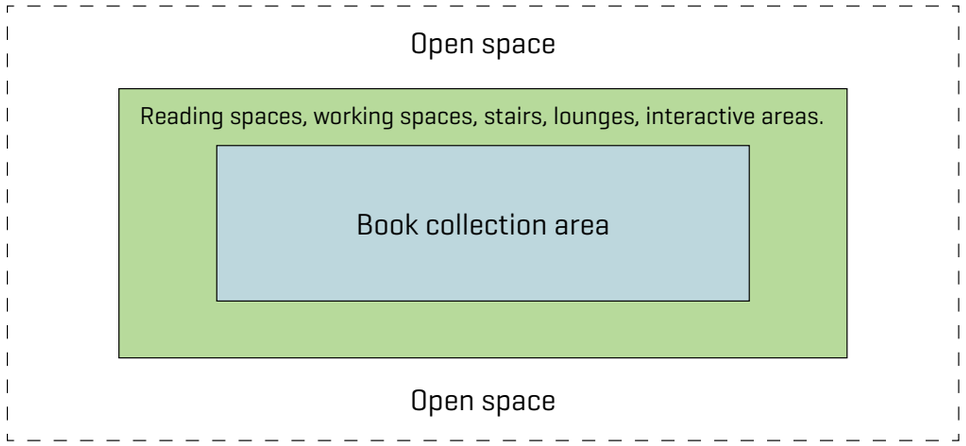
ill.111 Normal traditional atrium in a building.



ill.112 Atrium reversed to the outside of the volume.

Floorplans functions concept

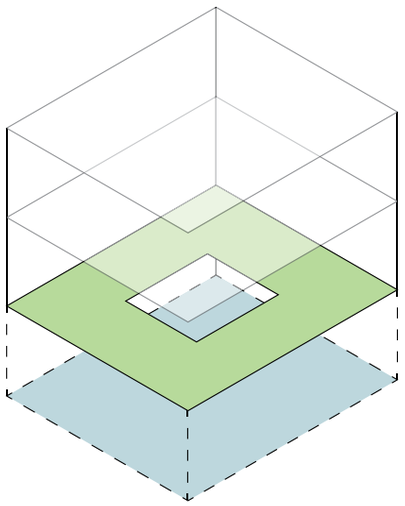
To the right shows a simple diagram of the concept of the upper floors in the building. The floorplan is kept completely open for the library owners to decorate themself - of course with the functions in mind as shown in the diagram. Book shelves should be kept in the center of the floorplan and reading spaces etc. should be kept closer to the facade where the light conditions is better. Those open floorplans gives the library many oppotunities of decorating the floorplans. This makes it very flexible and adaptable for future changes which is a requirement of the competition brief.



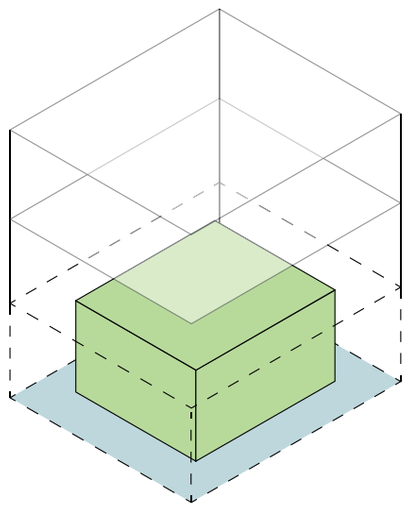
ill.114 Simple diagram of how the spaces would be organised with an open space surrounding the inner core.

Basement

Our interpretation of the traditional way of thinking a basement follows the concept from the rest of the building. Instead of connection the ground floor to the facade everywhere it is also offseted from the facade. Instead of making the ground floor as a floating floorplan it should create a space within the space. This creates an opportunity to put functions, that don't need direct sunlight and should have the possibility of being closed of completely, into those spaces. Further it gives possibility of good spacial quality and light conditions in areas of the basement. This way some of the basement area can be used for functions that you usually wouldn't think of as functions to put into a basement.



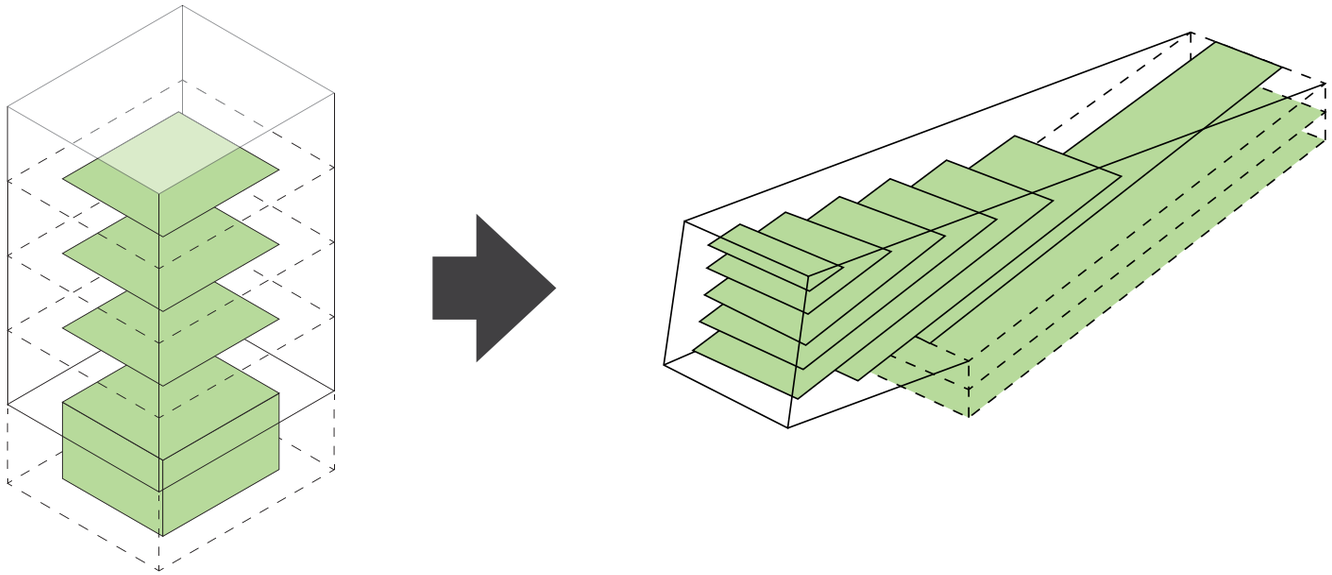
ill.113 Normal atrium used to get light into the basement.



ill.115 Again atrium pushed to the side to get light into the basement.

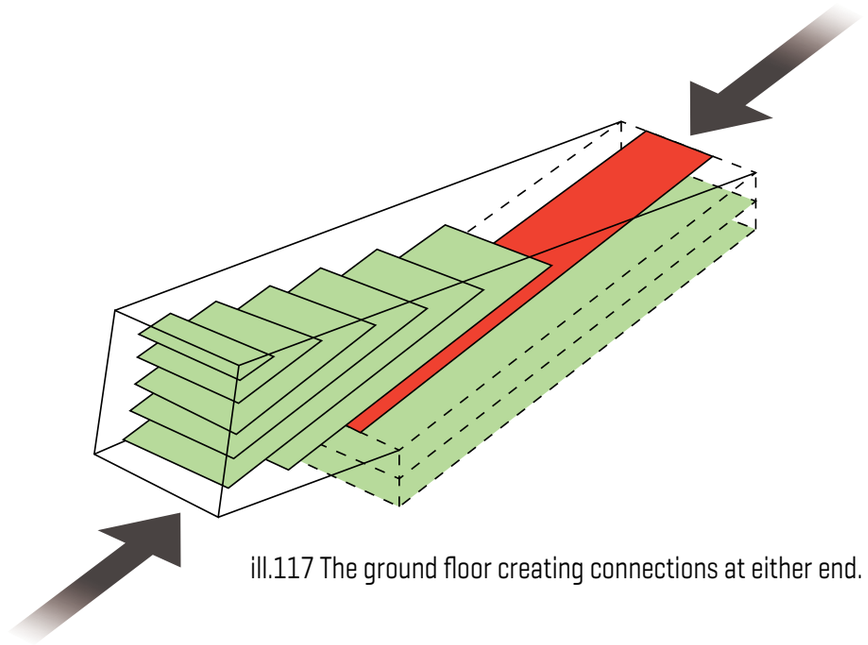
Fitting Concept to Building & Site

The described concept for the floorplans is fittet into the extruded shape for the narrow site. It is then skewed down on its side to create a hillside and connection to the city, as well as blocking the southern sun out of the library. And at the same time creating views out to the northern parkland and lake, whilst creating a place to put solar cells.



ill.116 Atrium reversed to the outside of an extruded volume, then the volume is simply skwed on it's side.

The groundfloor is connected to the facade in the south and north end of the building, creating a flow through the building.



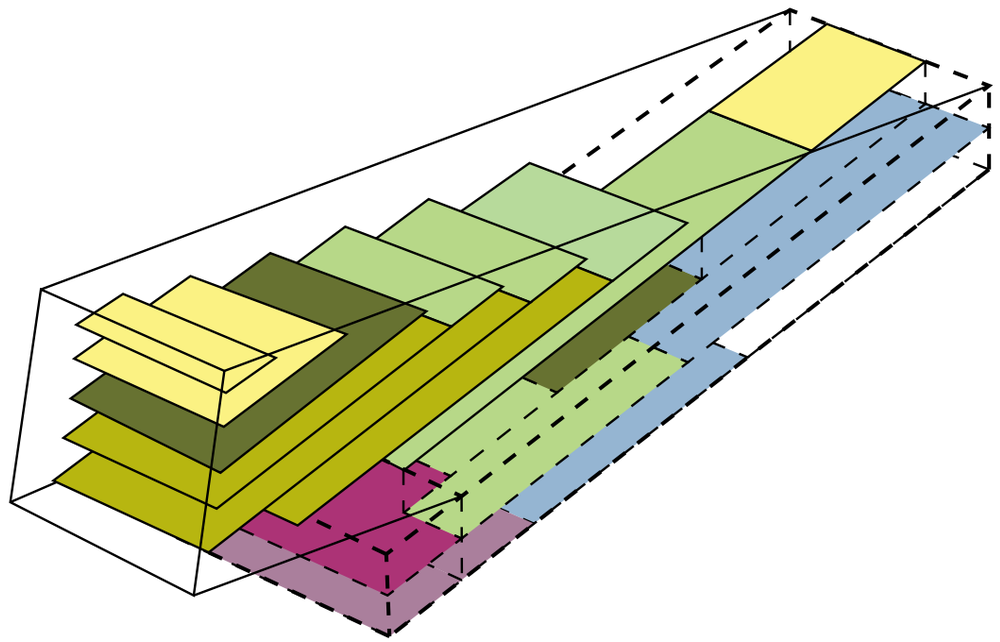
ill.117 The ground floor creating connections at either end.

Functions

The diagram shows a concept for how the functions will be destributed throughout the building. The functions is distributed according to it's purpose set by the requirements from the competition program. Also it is distributed according to light conditions and acoustics. Bookshelves are distributed in the center of the floorplans protected from direct sunlight. Reading places, working places, lounges, interactive areas are distributed places where the lightconditions and the view to the park and bay is good. The cinema and music/video studio is placed in the basement where natural light isn't needed. In the basement is also placed functions like event spaces and lounges which will prefer light. These functions is placed where the light conditions are good in the basement which is possible because because of it's design. For a more detailed room program see App C.

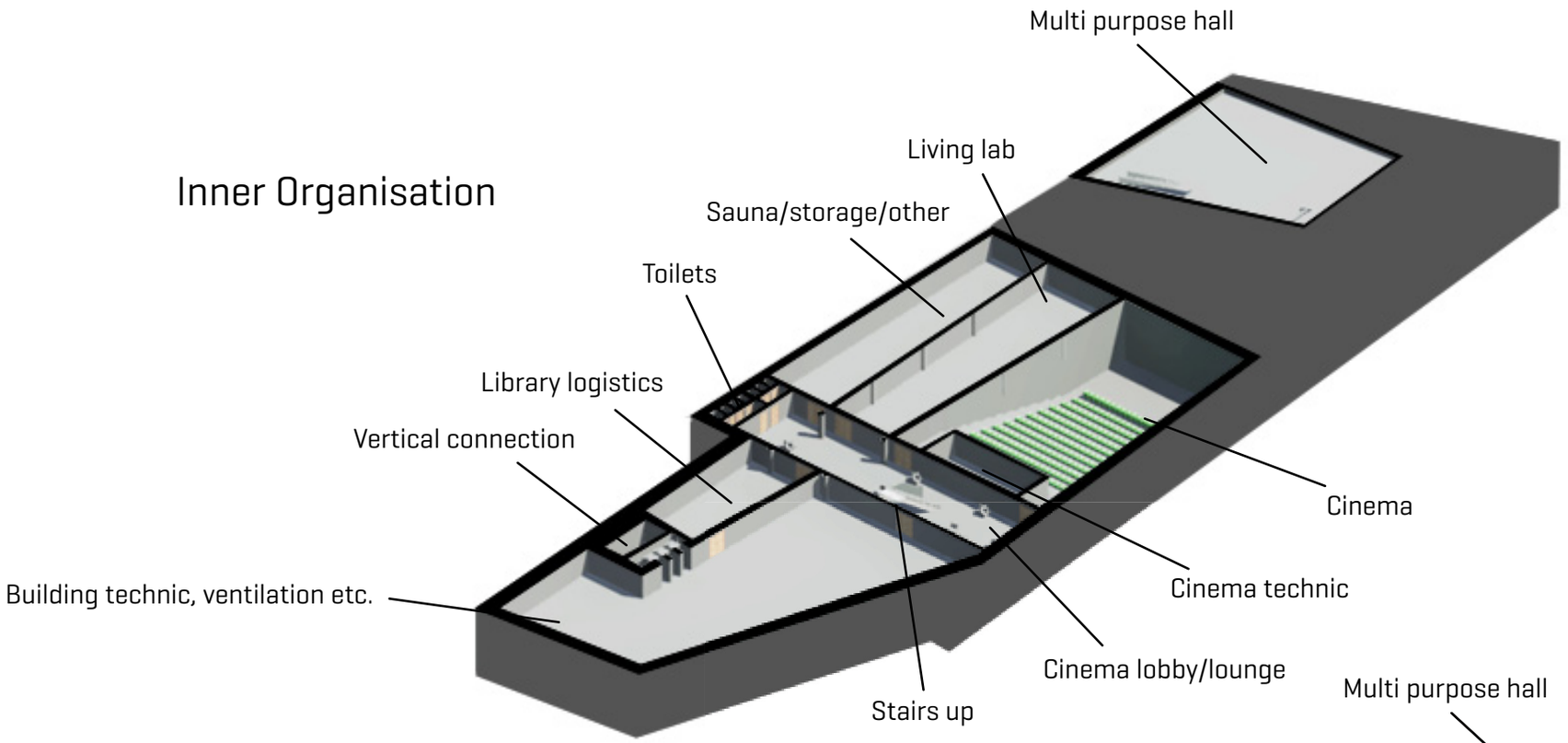
Functions from room program:

- Main lobby
  And central public service spaces
- Event spaces
- The collections area
  and spaces linked to it
- Learning and doing
- **Spaces for external service providers**
- **Staff facilities**
- **Service spaces**
- **Library logistics**

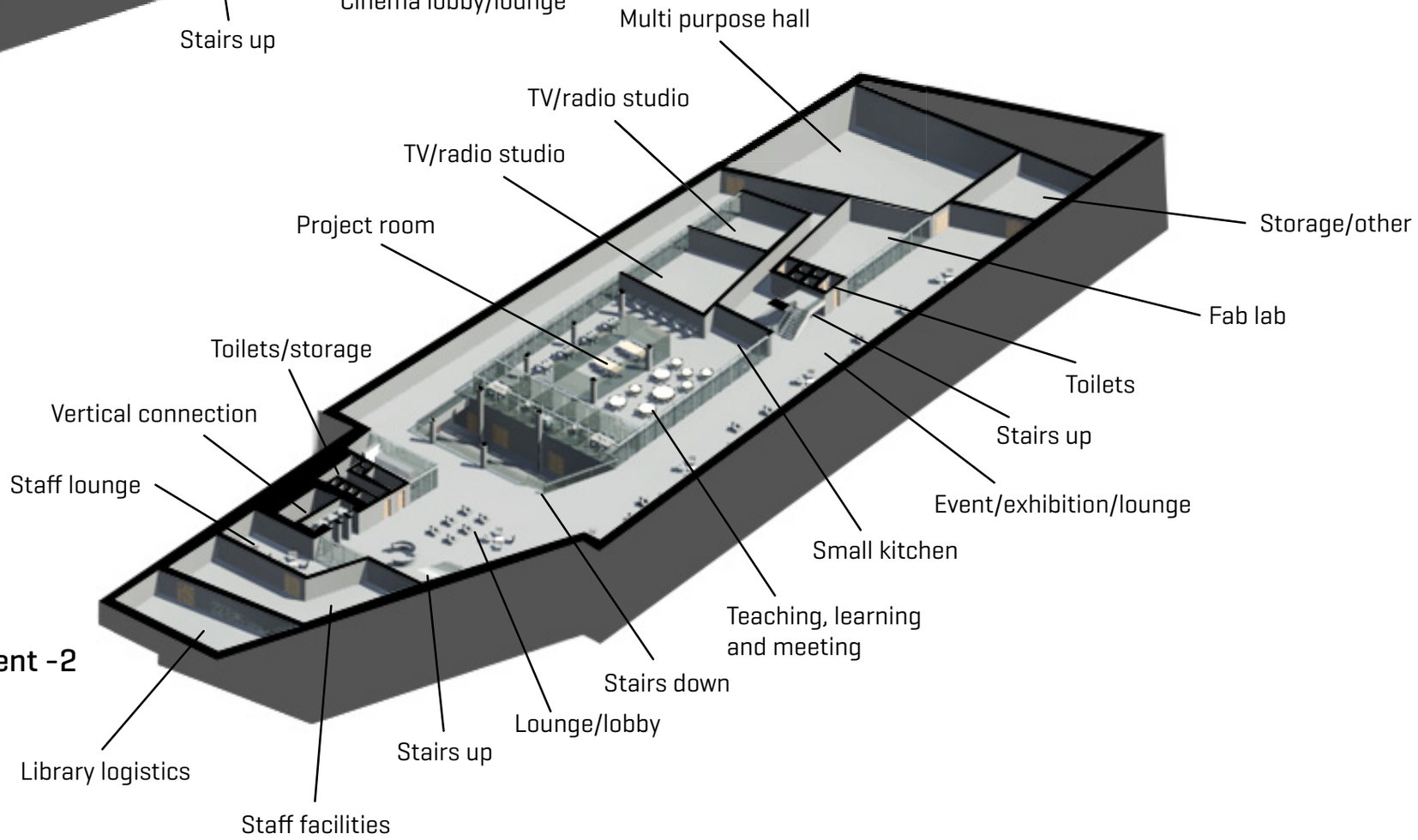


ill.118 The organisation of functions throughout the building.

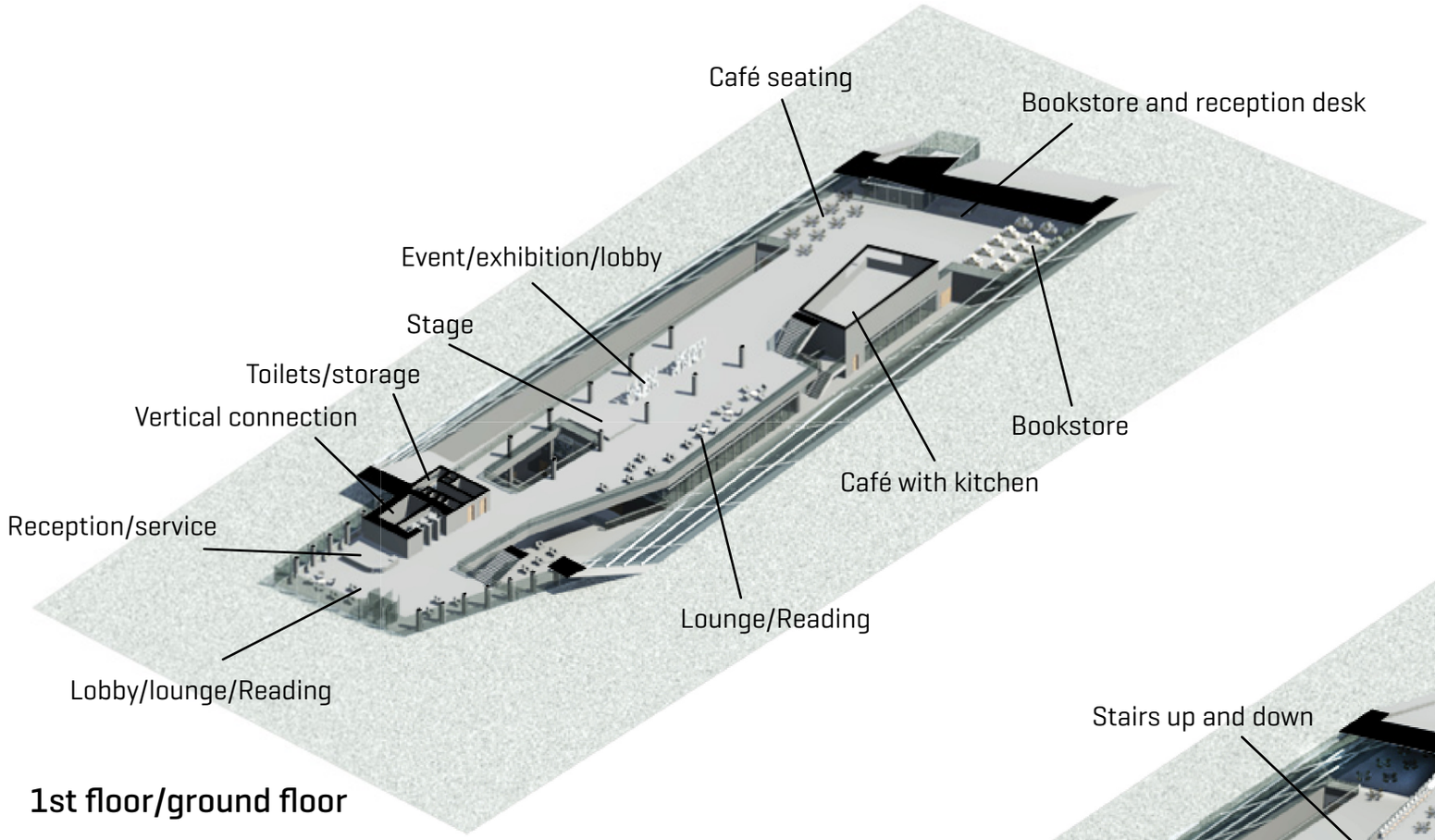
Inner Organisation



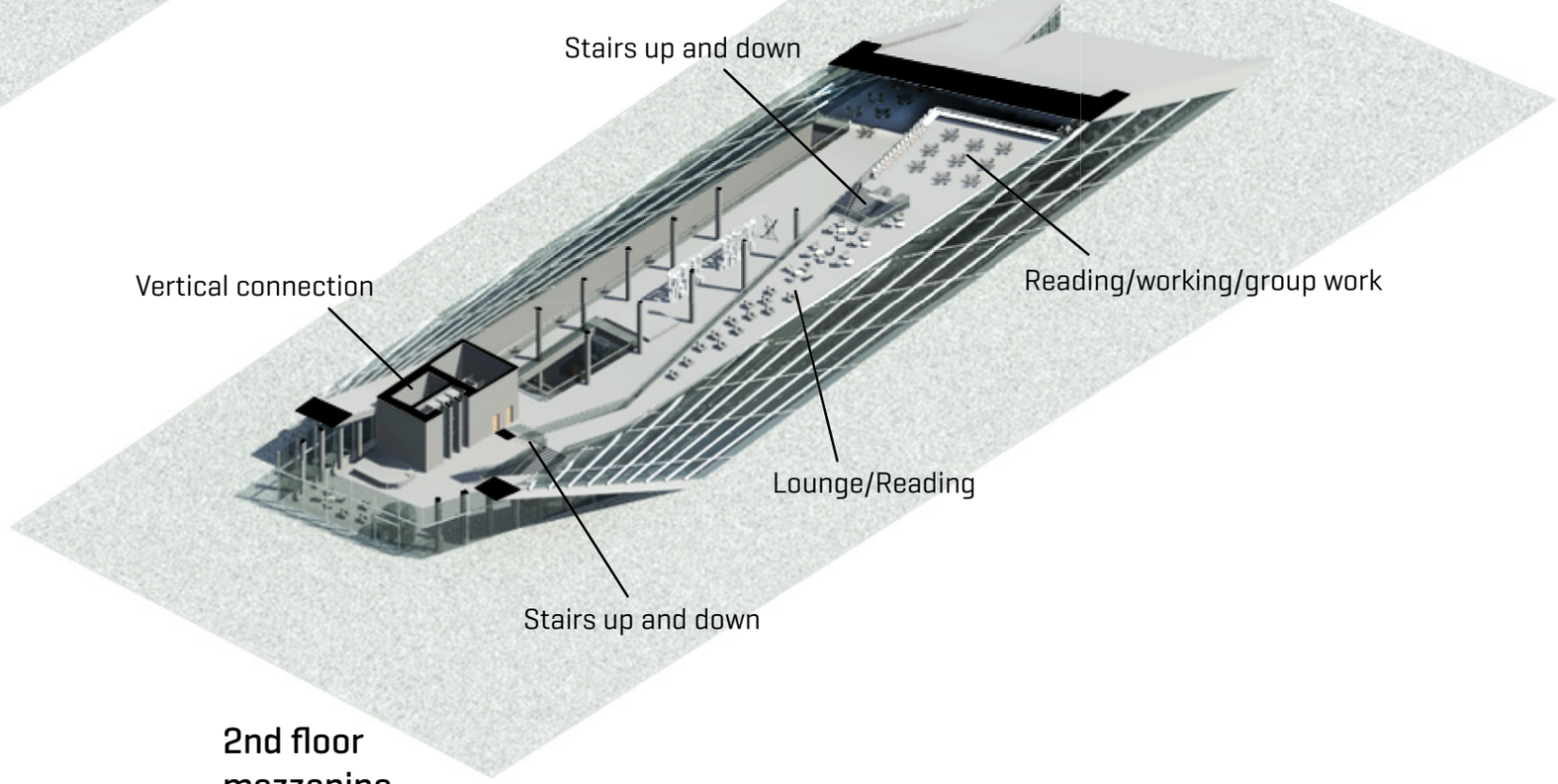
Basement -1



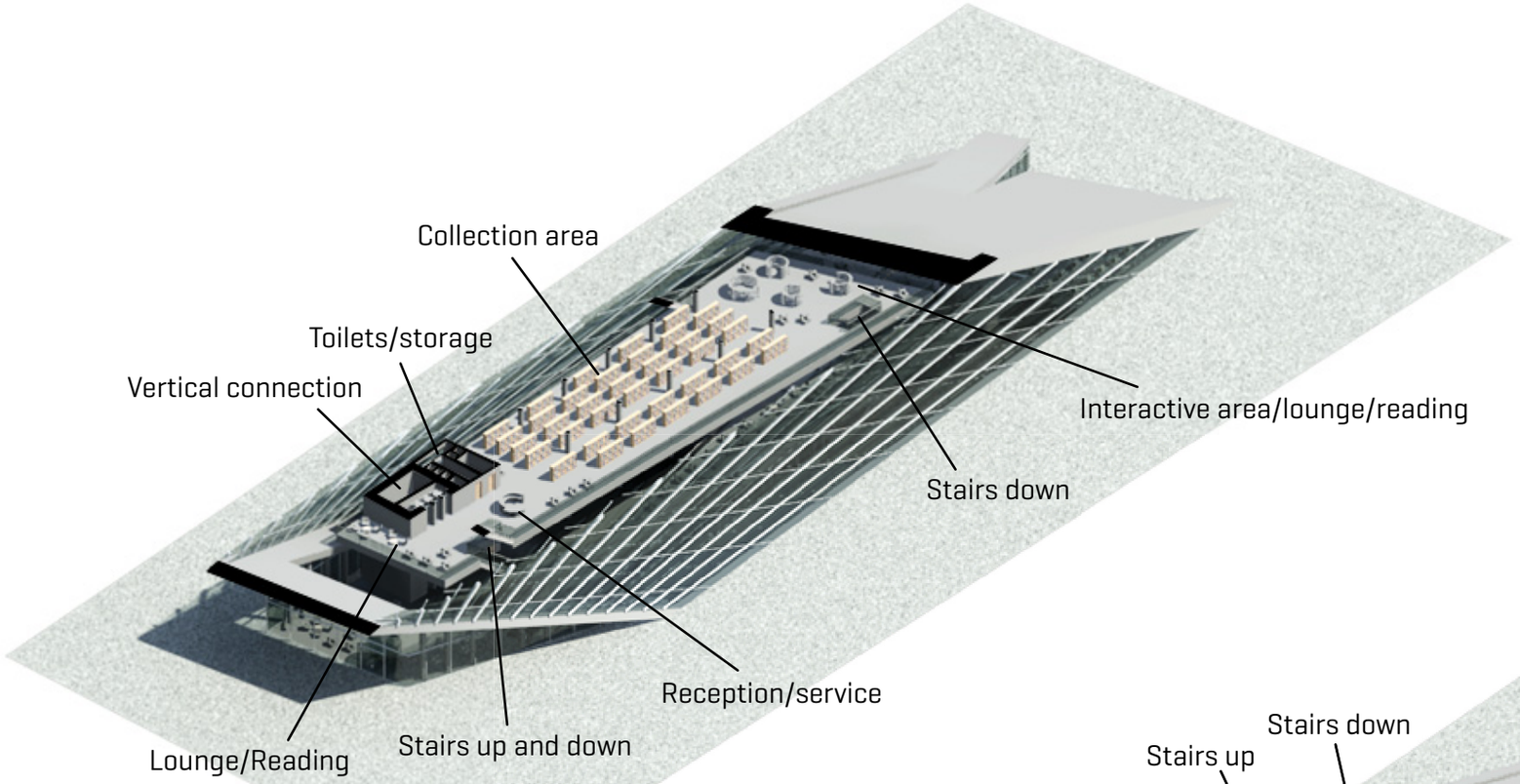
Basement -2



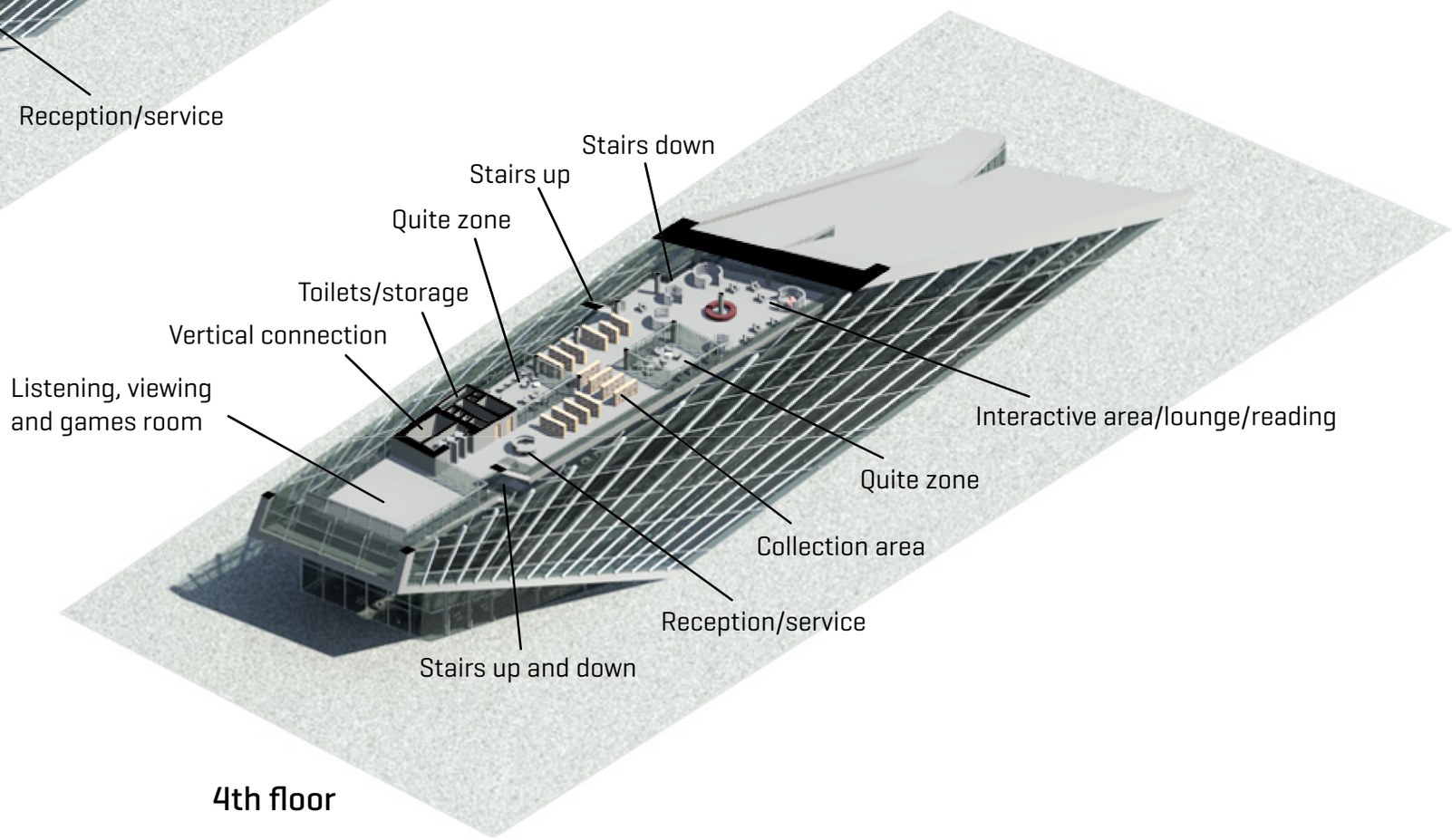
1st floor/ground floor



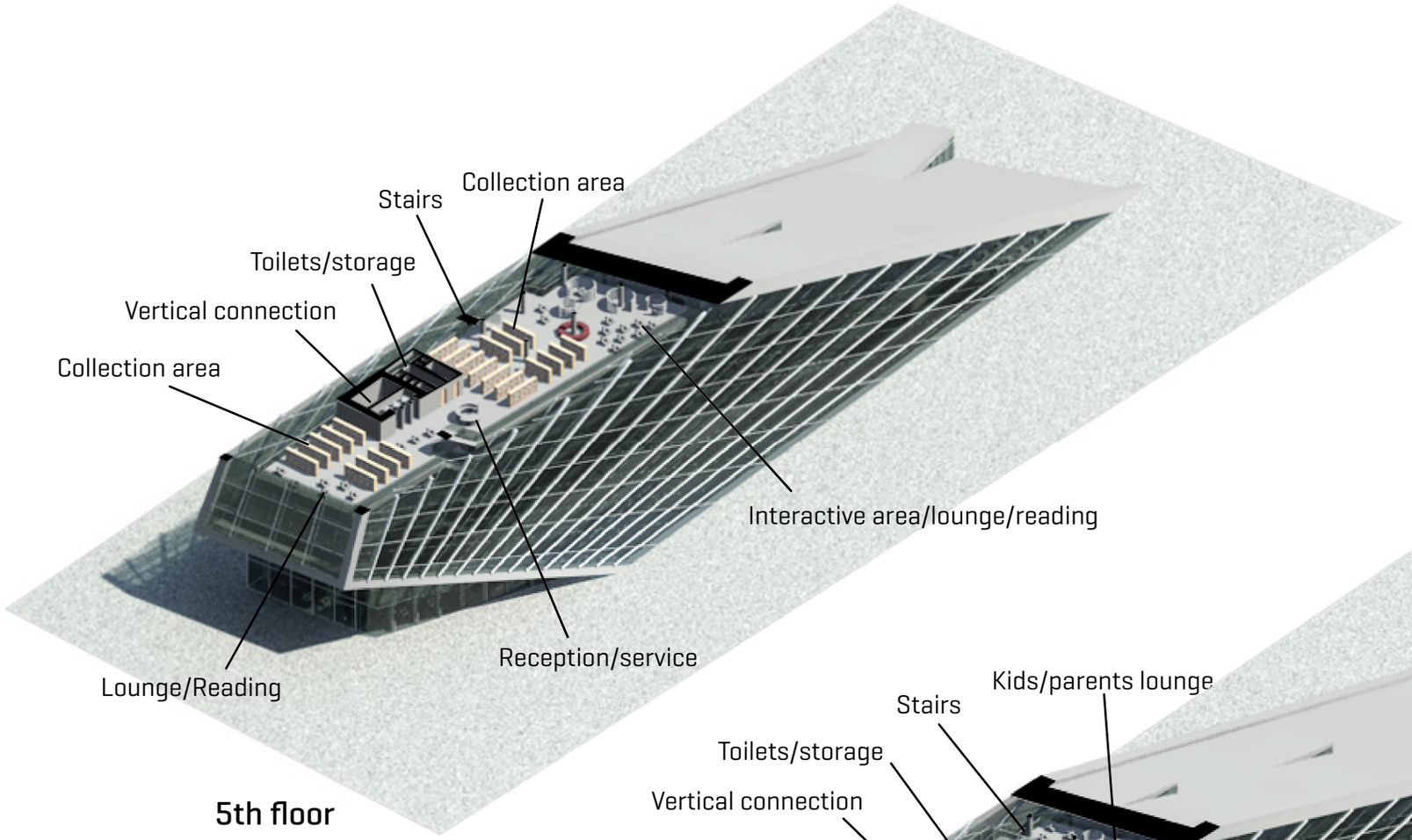
2nd floor mezzanine



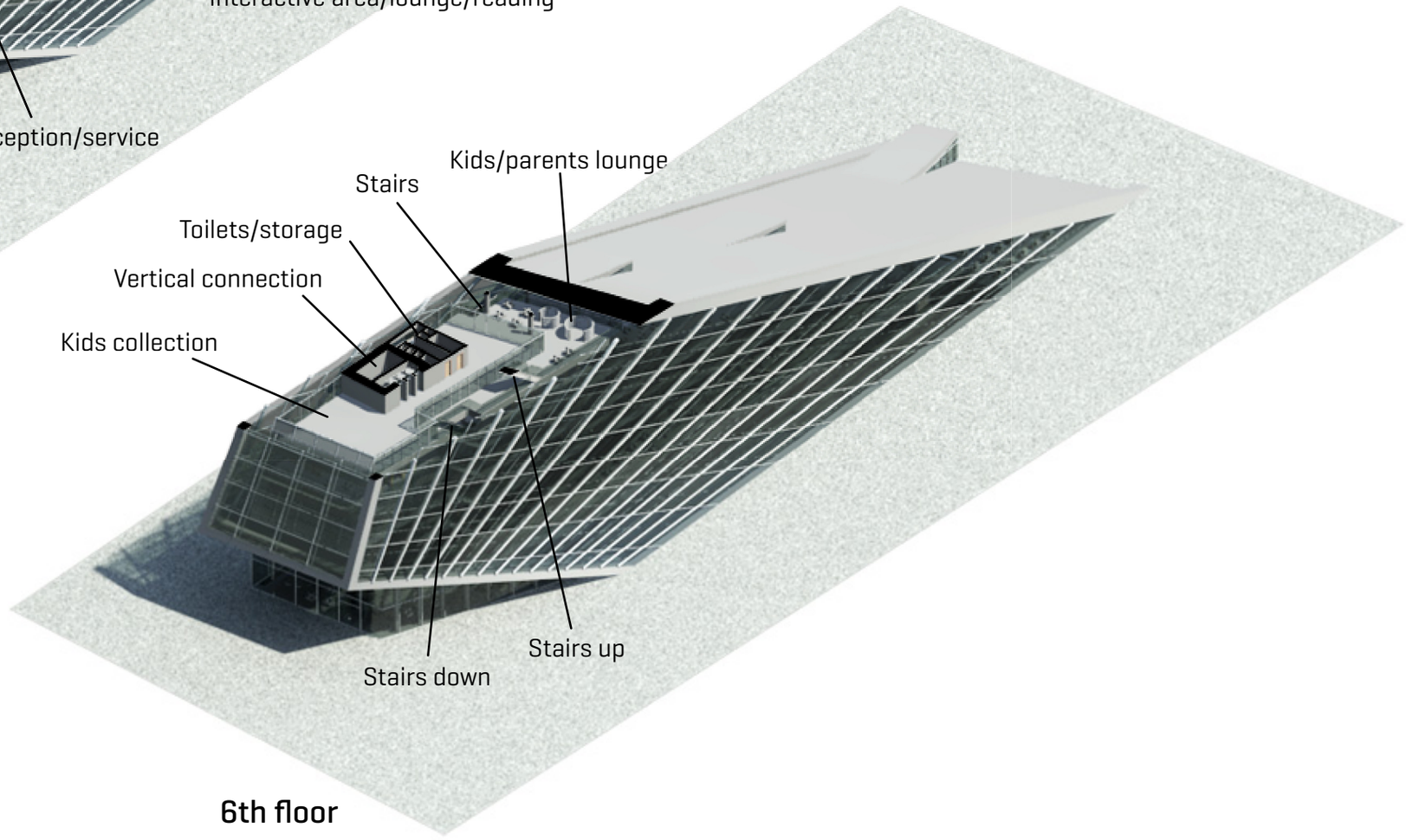
3rd floor



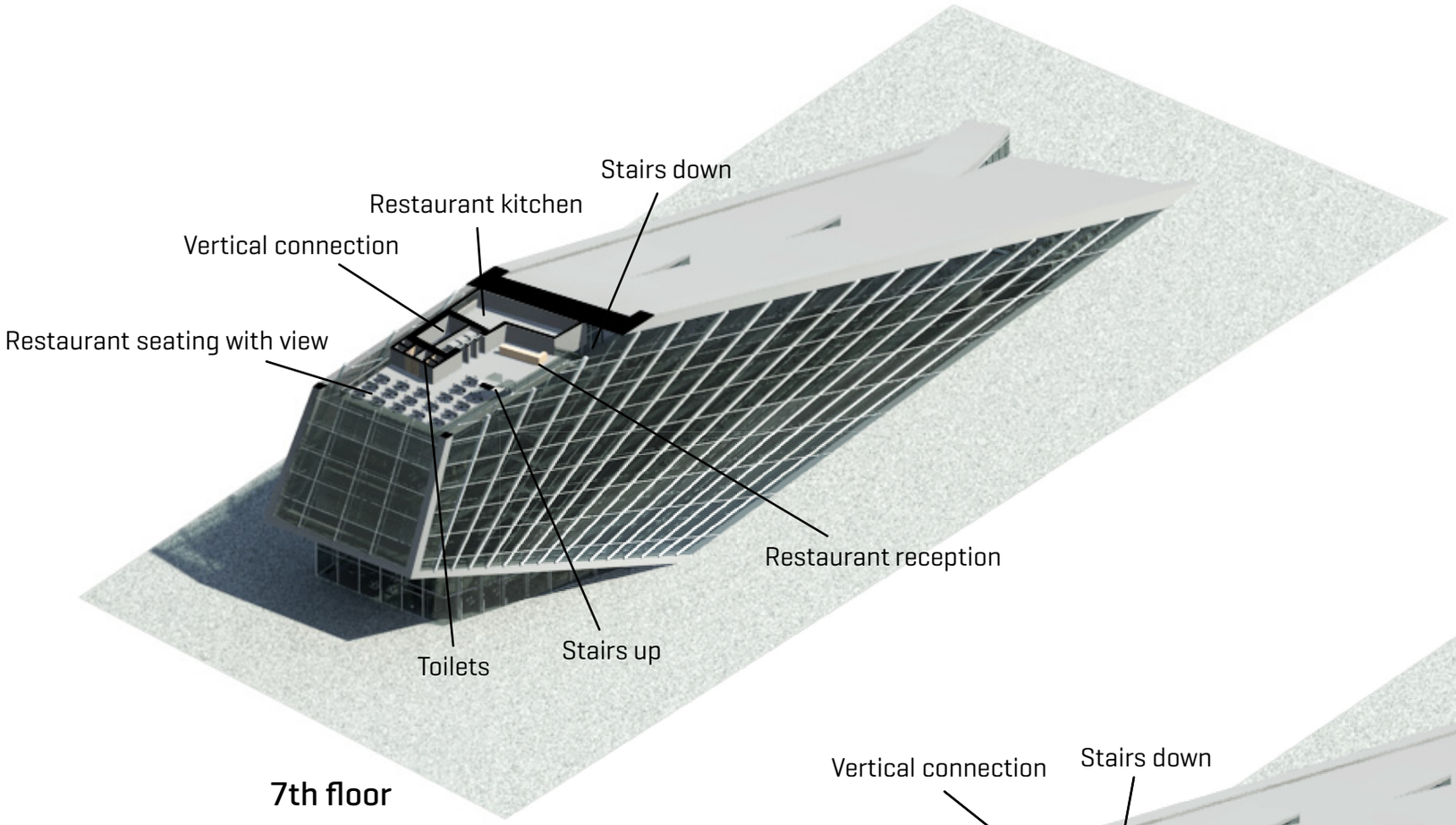
4th floor



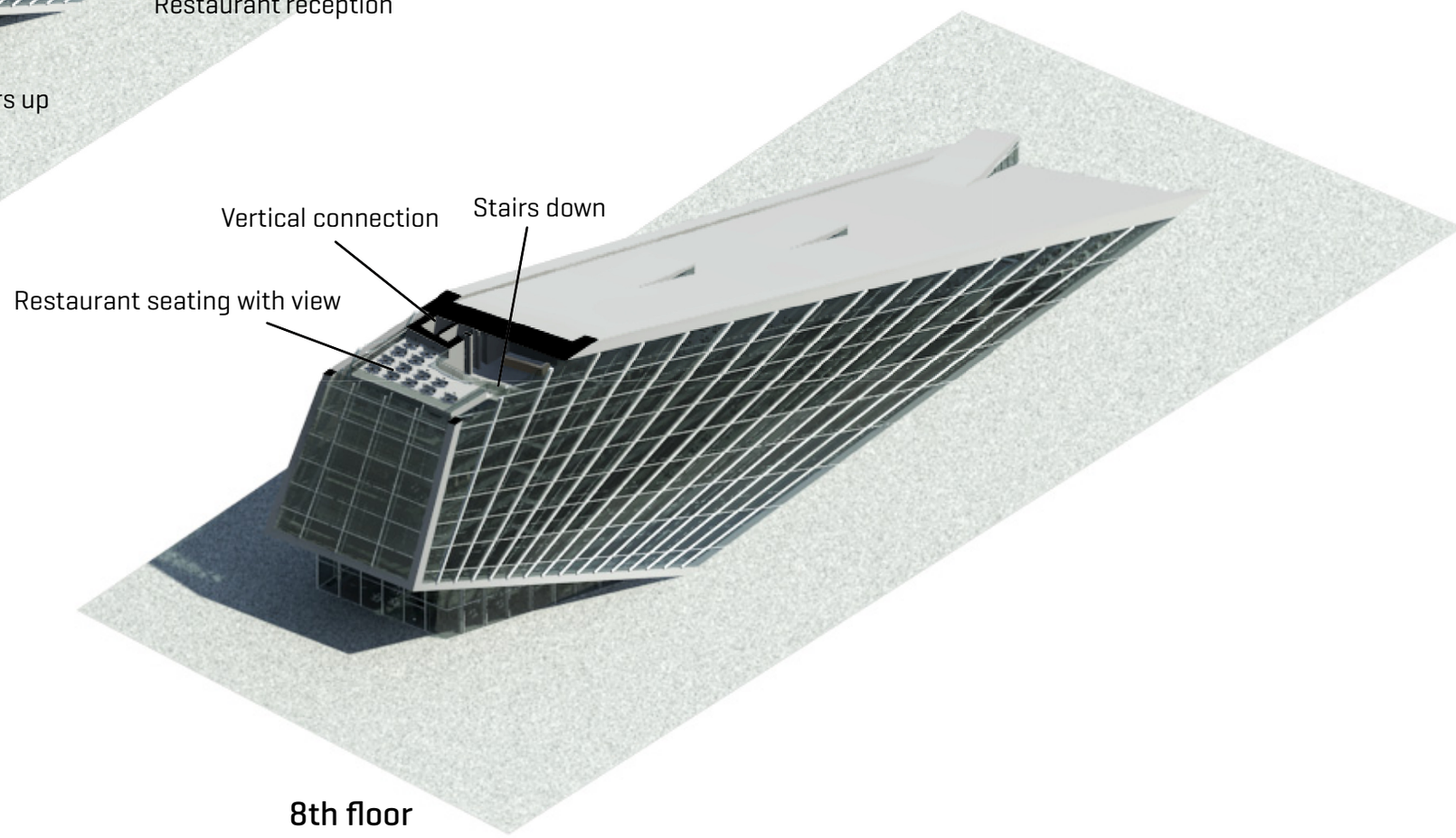
5th floor



6th floor

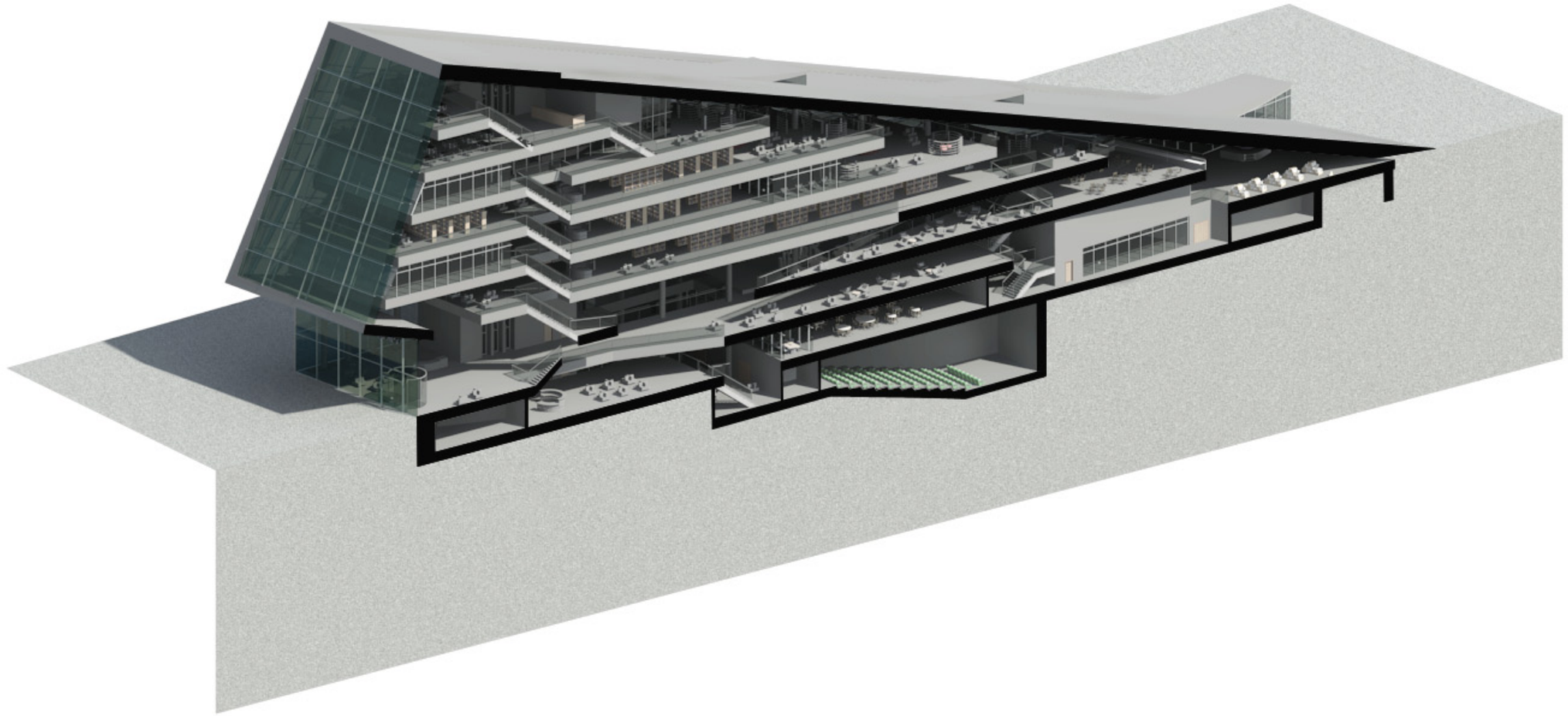


7th floor



8th floor

Section



Fire Escapes & Fire Dams

The new library in Helsinki is categorized as category 3, which is defined as a building section for daily use for a large amount of people, who does not necessarily have knowledge about the fire escapes of the building section, but themselves are able to reach safety. This category includes facilities as restaurants, assembly rooms, concert halls, exhibition rooms etc. for more than 50 people. (de Place Hansen, 2010)

Fire escapes

Total evacuation of the library occurs via the two main fire escapes on each level, all exceeding the minimum 1.3 m regulation width. Depending on which level you are on the fire escapes will lead the visitors and the staff directly out through outward opening doors with dimensions from 1-2 meters.

The building is planned, so that the distance from any point in the building to the nearest fire escape does not exceed 25 meters, which is recommended in order keep the escape route as clearly identifiable for the visitors. ill. 120.

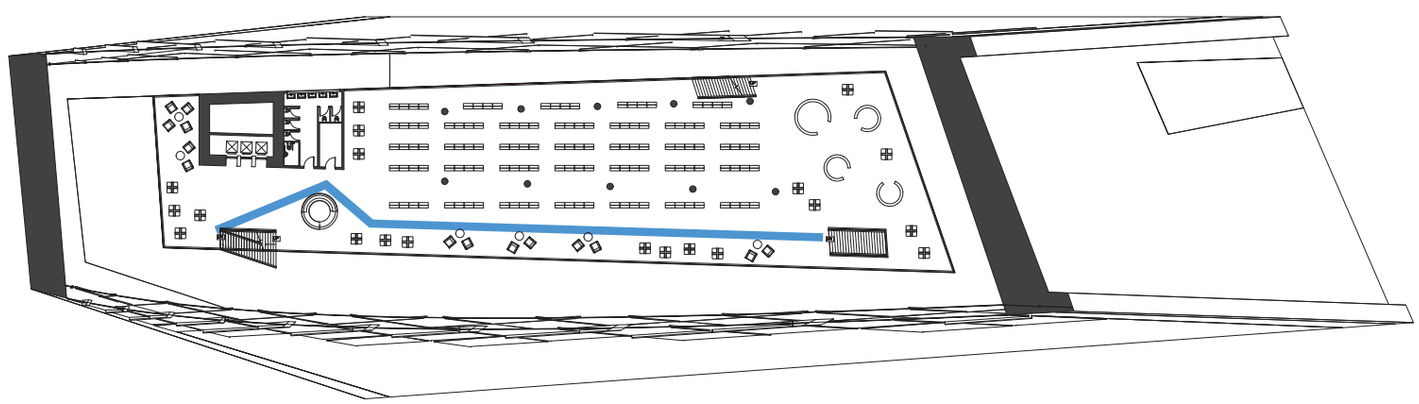
Access road

There is easy access to the library from all sides, so that the rescue service can easily rescue the staff and the visitors of the building.

Smoke Dam

The library will be also fitted with smoke dams. Smoke dams are a smoke guarding system made out of clear glass that helps with smoke ventilation in the case of a fire emergency. Smoke dam systems are commonly fitted to shopping centres and other large buildings for the purpose of encouraging the channelling of smoke away from one area to another area. This ensures damaging smoke is channelled away from emergency exists during fire emergencies. ill.119

ill.119 Smoke dams sit below the floor to channel the smoke out and away from the emergency exits.



ill.120 3rd Floor fire exit route highligted in blue. Which is uses the same principle for every floor on how to escape the building in case of a fire.

Fire escape route

Maximising the Views & Public Interaction

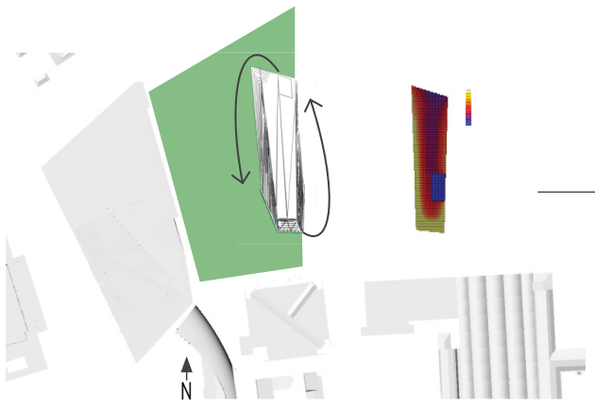
These sketches and models investigate with the views and how the public can interact with the surroundings, considering the sun orientation and directions of flow in and around the site.

We firstly began with our library facing south ill. 121, exposing all views and huge glass openings towards the strong southern sun. We did this to in a effort to drag the park up into the library creating a human interaction and human scale, however this lead to many problems of over heating in the front of the library and not enough sun reaching the northern end of the library where the hill was to be situated. So we flipped the library from facing south to facing north and the benefits prospered in many ways. Views were maximised directly out to the park in the west and to the north, also turning away from the direct southern sunlight and overheating.

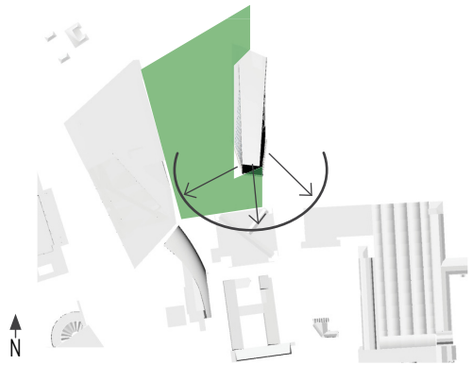
Since the hillside of the library is now facing the south it enhanced and encourages the public to enter from the city and the main station as well as the opposing western parkland. So instead of turning it's back on the city the hillside of the library embraces and welcomes the city onto and into the library. Along with the hillside the steps on the western side of the library encourages people to sit along the library acting as a main meeting point or a place to eat lunch and watch life unfold before them like a stage.

Flipping the library around also opened up a crucial space in regards to the surrounding buildings, most particulary the Parliament building. Through creating this space at the southern end of the site the library develops a dialogue and respect for the Parliament building.

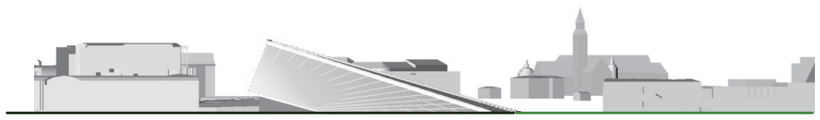
Phase one

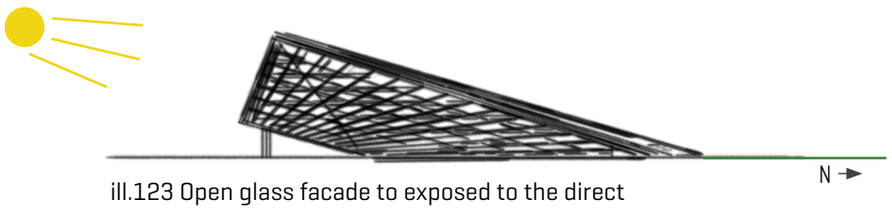


ill.121 Initial design, building and views facing south into the city, and into the hot southern sun.



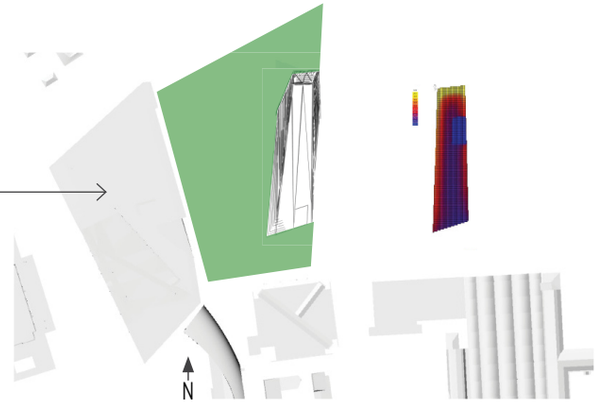
ill.122 Views were looking straight into the city



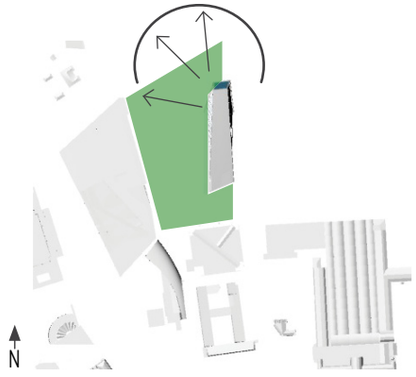


ill.123 Open glass facade to exposed to the direct southern sun.

Phase two



ill.124 Flipped the building to the north to face views of the park, and lake and block the heat from the southern sun.

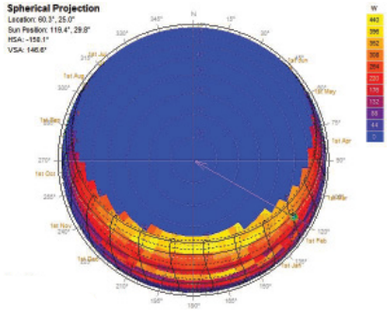


ill.125 Views now looking out to the parkland

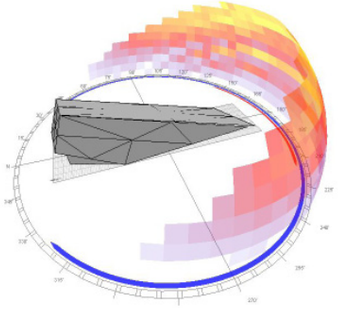
ill.126 Sun now being used to bath people in sunlight on the hill-side and generate energy via the solar cells placed on the hillside.

Sun Path and Solar Radiation

The amount of daylight and the suns path over the site play a key role in sustainable architecture. Therefore it is important throughout the IDP to investigate sunlight conditions. Via the use of Ecotect we explored ways to orientate our building to maximise the use of the sun and how it could positively contribute to our building in regards to daylight, energy, thermal and indoor climate conditions.

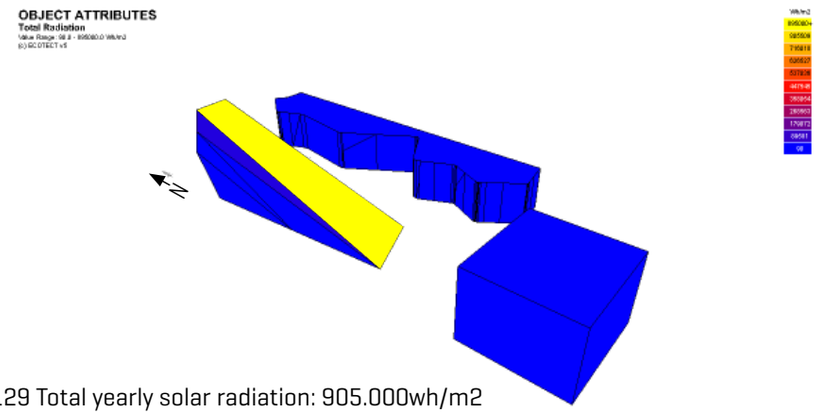


ill.x 127 diagram of the yearly direct solar radiation.



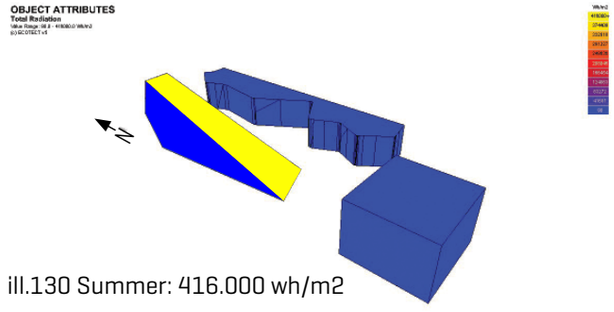
ill.x 128 diagram of the yearly direct solar radiation on the site.

Sun Solar Path showing the solar radiation on the site over the year. This indicates a good reason to place the solar panels on the southern hillside facade.

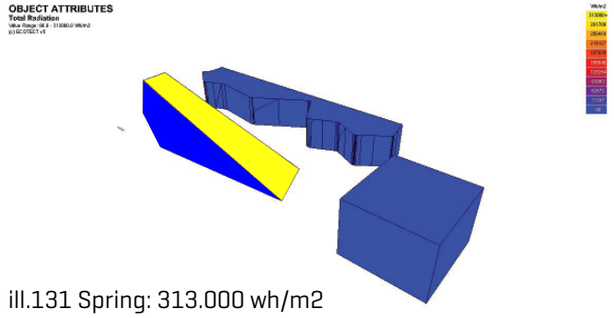


ill.129 Total yearly solar radiation: 905.000wh/m2

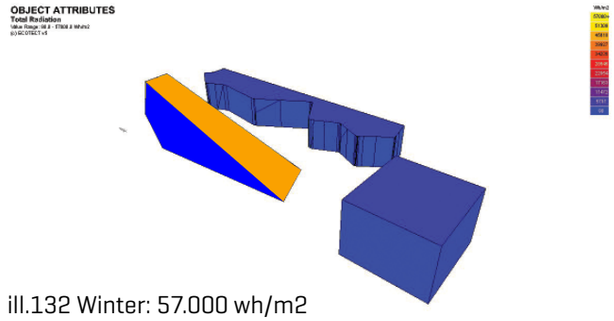
Yearly solar radiation on the southern hillside facade, (905.000 wh/m2). This result justifies a good reason to place the solar cells on this facade. ill.130 to ill.133 shows the total solar radiation by each season on the southern hillside facade.



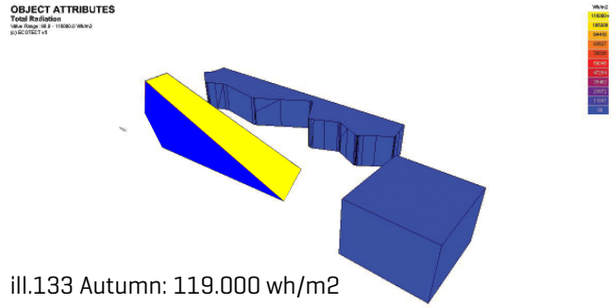
ill.130 Summer: 416.000 wh/m2



ill.131 Spring: 313.000 wh/m2



ill.132 Winter: 57.000 wh/m2



ill.133 Autumn: 119.000 wh/m2

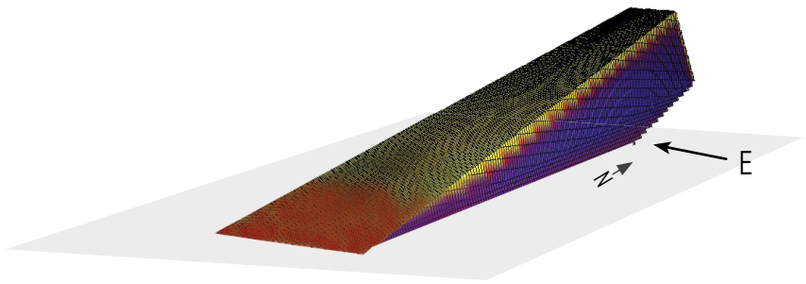
Shadows & Solar Exposure Studies

The solar montlhy exposure for the western facade and southern hillside facade are investigated to confirm the correct location of solar cells. Since the eastern facade is not affected by direct sunlight and is masked in shadows by it's neighbouring buidling no further investigations will be carried out on this facade. Also to note that the eastern facade has much less work areas and includes functions such as stairs, the main core elevator and toilets. ill.136.

The following two ecotect illustrations show where the direct solar exposure is and what sq/m2 is exposed throughtout the months including the average shading from the existing environment.

We chose to analyse these two facades as they were the most exposed to the sun throught the entire year. It is obvious to see from the AVG shading result that the western facade is much more covered covered during the entire year with a low of 49% in June/July to a high of 79% in December. Whereas the southern hillside facade is far more exposed with a low of 5% June to a high of 49% in December.

Along with the this result we are able to see the incident solar radiation per Wh/m2. It is clear that the southern hillside facade receives a lot more solar radiation throughout the entire year due to it being more exposed. For maximum annual energy gain to feed the solar cells an angle of 45° is most desired, however since you can walk up the southern hillside facade an angle of 15° is more practical and appropiate.

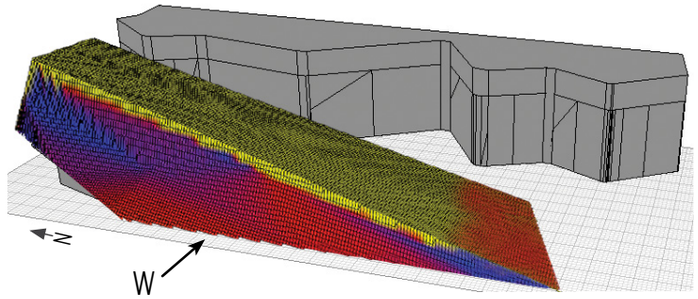


ill.136 Direct solar exposure eastern facade.

TOTAL MONTHLY SOLAR EXPOSURE
HELSINKI, FIN [Direct Only]
Objects: 4 [Exposed Area: 2438.381 m2]

MONTH	AVAIL. Wh/m2	AVG SHADE	REFLECT Wh/m2	INCIDENT Wh/m2
Jan	11151	71%	0	1445
Feb	43550	64%	0	6517
Mar	57262	58%	0	10915
Apr	82337	50%	0	23515
May	133479	51%	0	39980
Jun	114706	49%	0	34798
Jul	115515	49%	0	38310
Aug	80396	52%	0	23611
Sep	42656	52%	0	9231
Oct	25845	55%	0	4998
Nov	5385	56%	0	514
Dec	1359	79%	0	52
TOTALS	713641		0	193886

ill.134 Solar exposure/shadows.

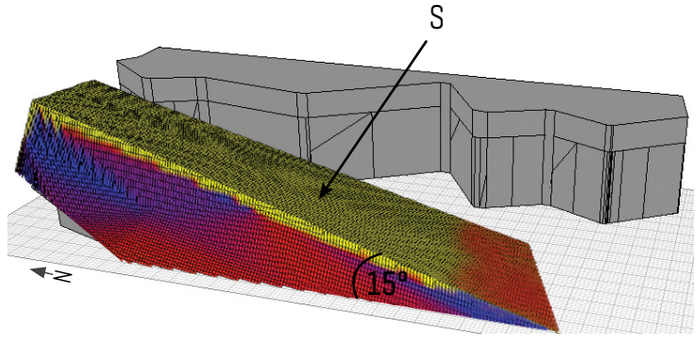


ill.137 Direct solar exposure shadows western facade.

TOTAL MONTHLY SOLAR EXPOSURE
HELSINKI, FIN [Direct Only]
Objects: 4 [Exposed Area: 2854.977 m2]

MONTH	AVAIL. Wh/m2	AVG SHADE	REFLECT Wh/m2	INCIDENT Wh/m2
Jan	11151	28%	0	3088
Feb	43550	20%	0	17444
Mar	57262	11%	0	30605
Apr	82337	9%	0	48853
May	133479	9%	0	88018
Jun	114706	5%	0	79153
Jul	115515	6%	0	82785
Aug	80396	5%	0	55468
Sep	42656	10%	0	25700
Oct	25845	13%	0	12490
Nov	5385	30%	0	1520
Dec	1359	49%	0	241
TOTALS	713641		0	445366

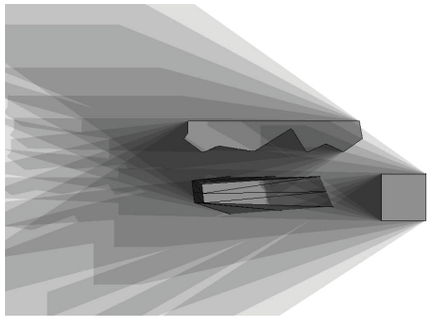
ill.135 Solar exposure/shadows.



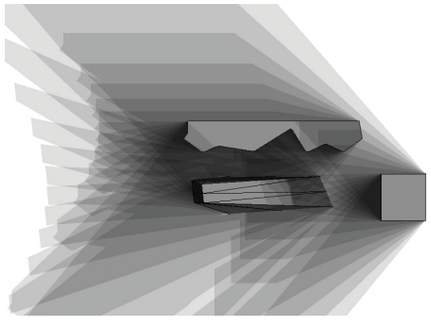
ill.138 Direct solar exposure southern hillside facade.

Shadows Studies

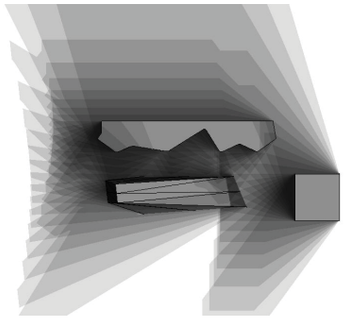
These shadow studies in ill.139 were taken from each month of the year from 9am to 7pm and indicate there is not many shadows from the two neigbouring buildings. This study was important to complement and confirm our idea of placing solar cells on the southern hillside facade.



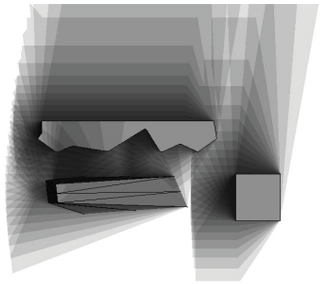
January



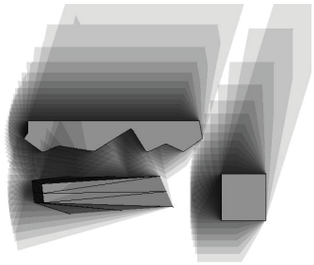
February



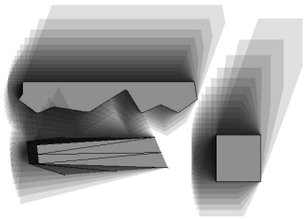
March



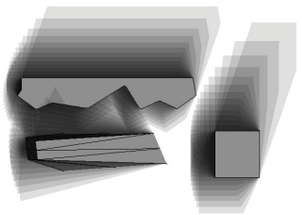
April



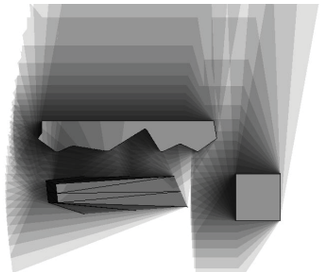
May



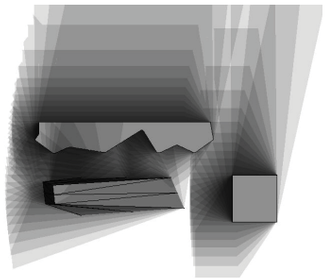
June



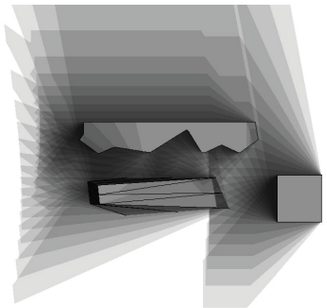
July



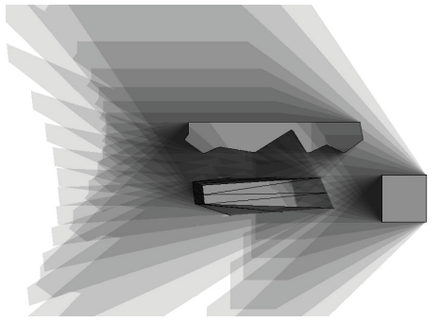
August



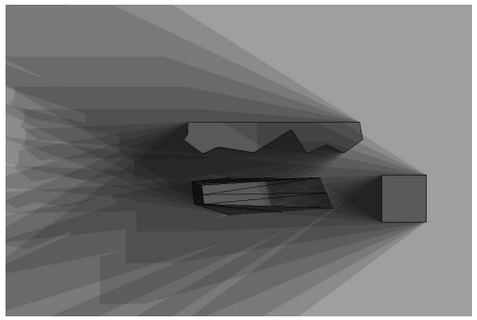
September



October



November



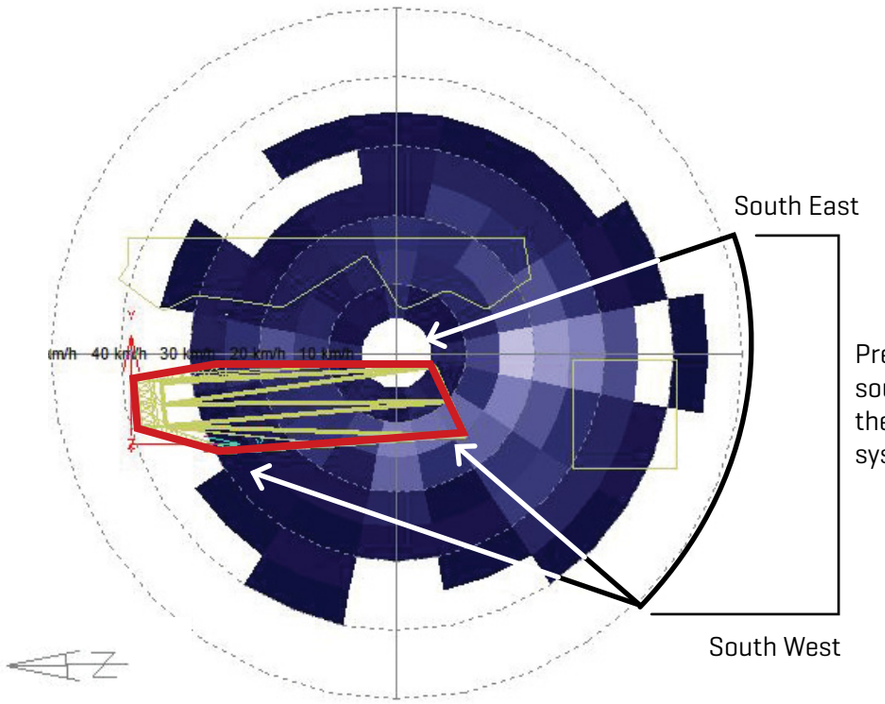
December

ill.139 Monthly shadow studies showing how much each of the facades becomes shaded from surrounding buildings, note the eastern facade is always deep in shadows and lacking direct sunlight, thus we have refrained from further investigation as it is not a concern for direct sunlight or a place to put solar cells, and also note our building does not greatly over shawdow the neighbouring buildings.

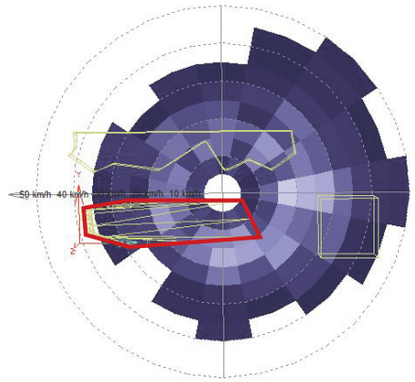
Wind and Ventilation studies

The wind can have a great influence on the conditions of the site especially with the integration of natural ventilation used mostly in the summer months. The summer wind rose shows that the wind is prevailing from the south east to south west thus we have decided to place the intake ventilation system on either side of the building within the west and east facades. Since the western facade is the most exposed and open to the prevailing south west wind it seems this facade could become uncomfortable during peak windy periods, however the parkland infront of the building will have a lot of vegetation and trees planted therefore acting as a barrier blocking too much strong wind.

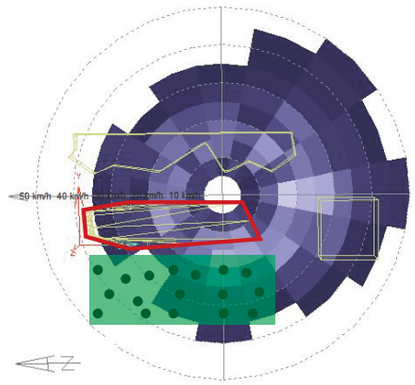
Other aspects to consider include that the site ill.140 is located within a relatively dense city thus the wind and weather conditions will change suddenly and often therfore is it not continuously accurate to depend soley on the results of the wind rose.



ill.140 Wind rose on the site in Helsinki for summer, the season we will use natural ventilation the most.



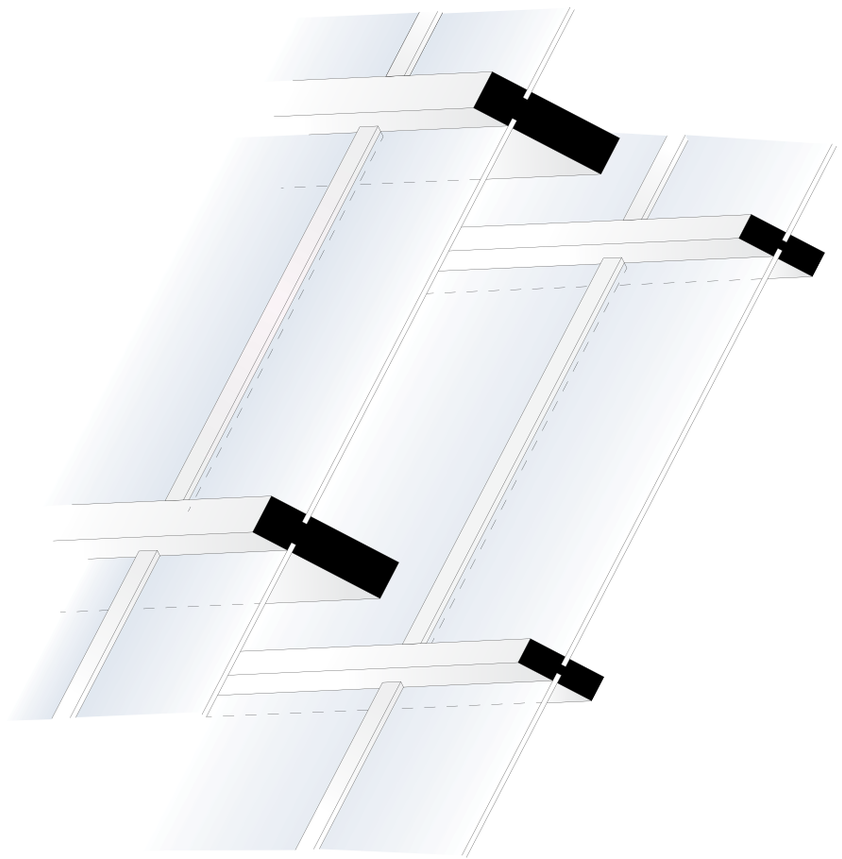
ill.141 Wind rose on the site in Helsinki for the entire year.



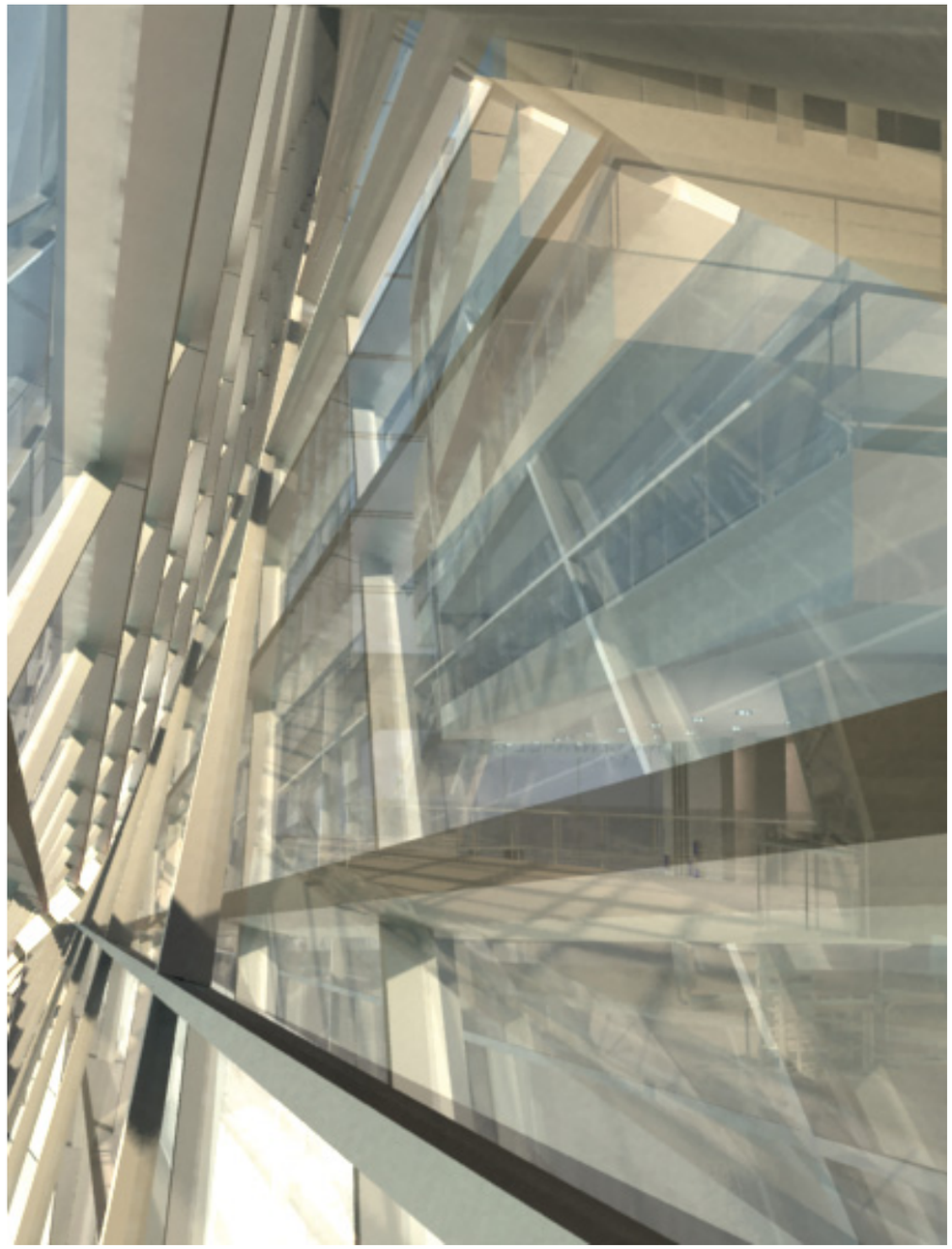
ill.142 Parkland with vegetation and trees protecting the building.

The Double Skin Facade

The building is equipped with a double skin facade. One facade consists of two layers of a steel grid structure with glass. The distance between the two layers is 1 meter and it creates the cavity where the air flow and ventilation will occur. In the bottom part of the outer layer, it will be possible to mechanically open some of the windows as flaps to take in air from the outside. Similar intakes appear on the inside layer to suck out the air from the inside.



ill.x143 Location of section for the ventilation diagrams.

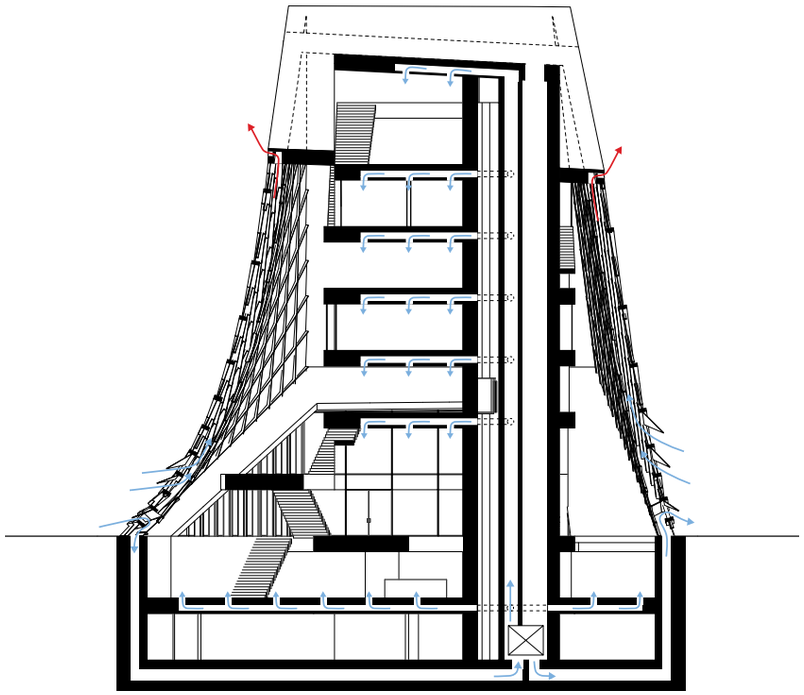


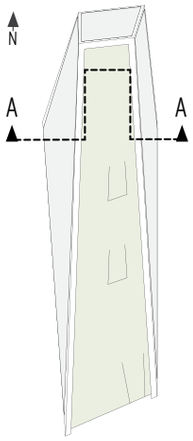
The Ventilation System

The ventilation system in the building is a kind of advanced stack ventilation system. It is a hybrid system driven by the buiilding's double skin facade and a mechanical heat recovery system.

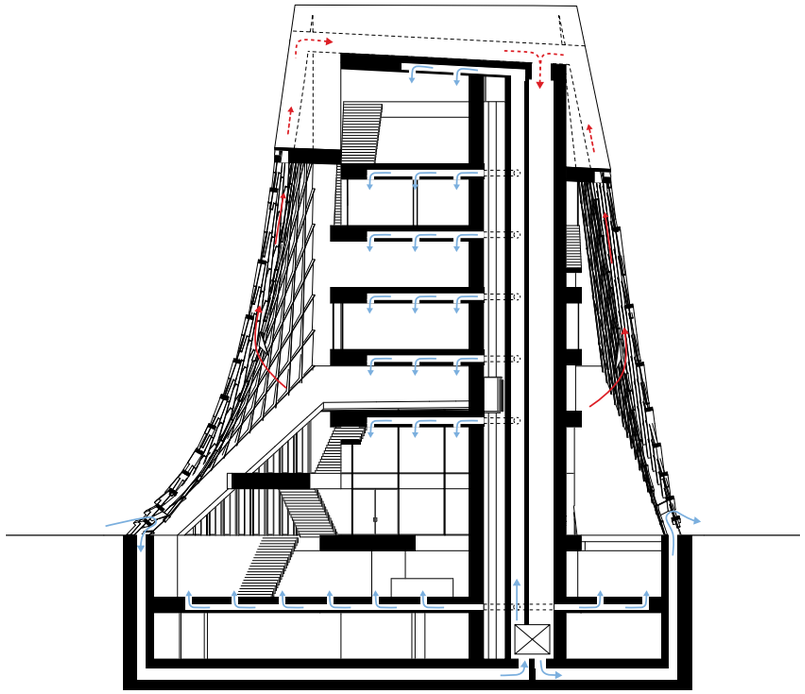
The way the system should be used depends on the climate situation. The double skin facade creates different possibilities of ways to ventilate and heat the building with a combination of passive and mechanical systems. The system could be controlled by sensors registrating the climate outside and inside the building and also by the cavity. In this way the system should be adaptable to the climate conditions and if used correctly optimize the building's energy performance and maintain a good indoor climate.

The double skin facade has the possibility to ventilate the cavity by taking air from the outside in and also has the possibility to exhaust the air in the cavity in the top of the facade. Furthermore it has the opportunity to take air in and suck it into the buildings mechanical system.





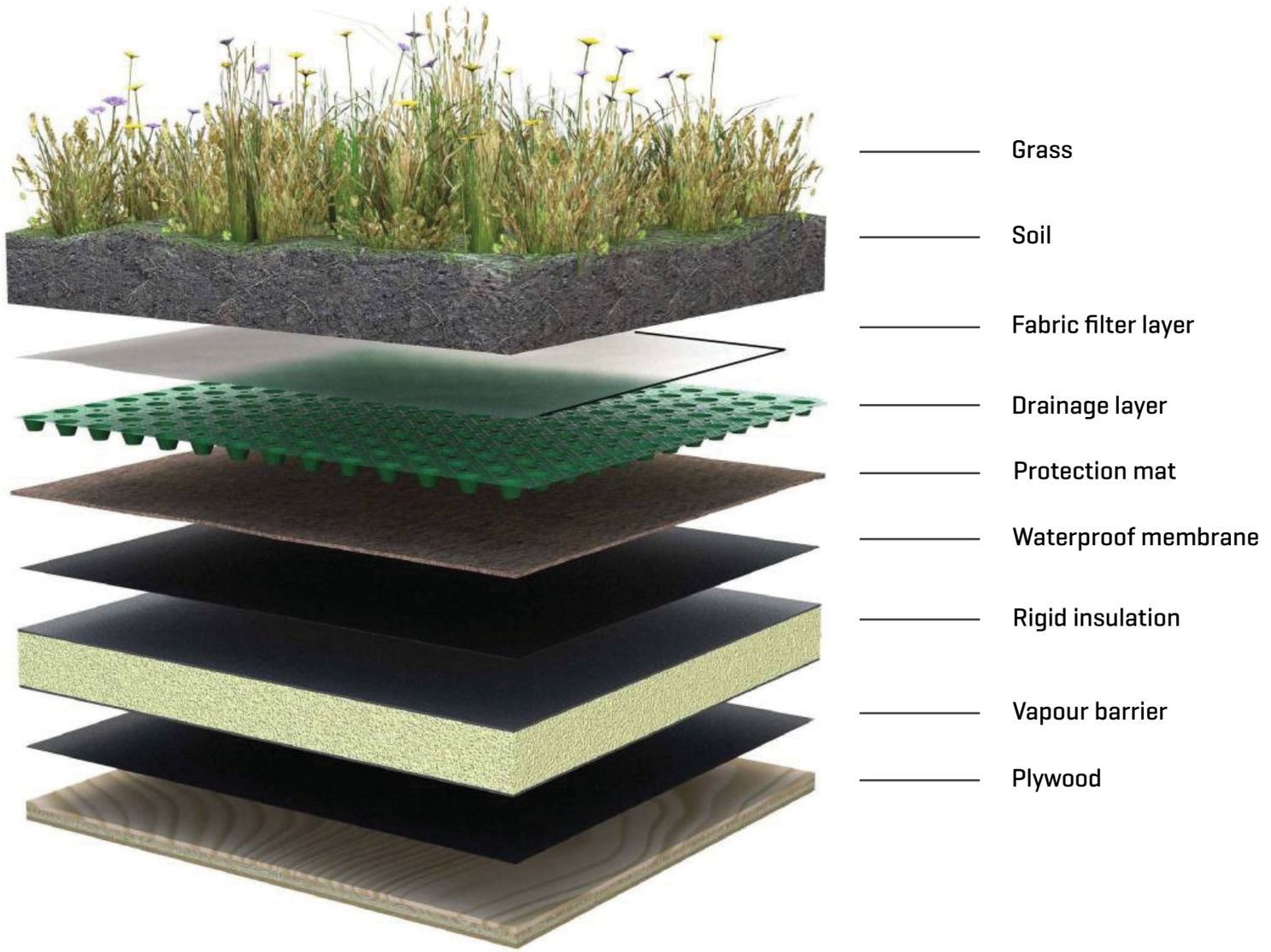
Section A-A



Section A-A, Summer situation. When the air outside is hot and the inside temperatures need to be kept at a comfortable level, the double skin facade will exhaust the hot air created in the cavity by passive solar heat in the top of the building. This functions as a kind of stack ventilation because the hot air will rise and the air flow will be help be ventilating the cavity naturally.

Section A-A, Winter situation. When the climate outside is colder the inside temperatures, the heated air from the inside will rise and be let out into the cavity and will be sucked into the ventilationsystem through the building's core to reuse the heat from the air in the heat recovery system.

Green Roof



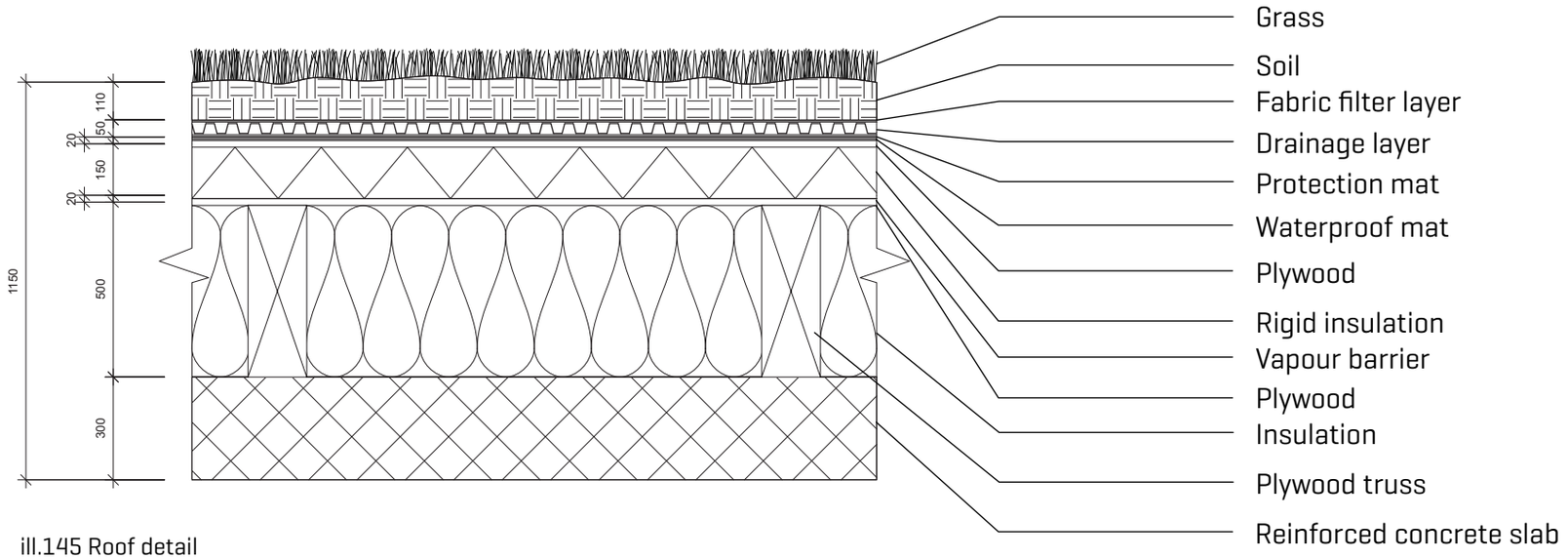
ill.x144 Location of section for the ventilation diagrams.

The sloped roof of the building is a green roof, which means that the outer layer of the roof will consist of soil and plants. The sloped green will connect the building to the ground and thereby connecting it to the surrounding park.

The green roof will function as a part of the park integrated to the building as a hill. It is facing south and will be a nice place for people to stay especially in the summer period.

In a sustainable point of view it gives us a possibility to drain the water through the soil and reuse it as water for toilet flushing in the building. Also the fact that the roof is green as the nature integrated in the building gives the building an signalling effect with the symbol that it is aware of environmental issues.

Detail of the roof construction in 1:20 (U-value 0,05 W/(m²K))



ill.145 Roof detail

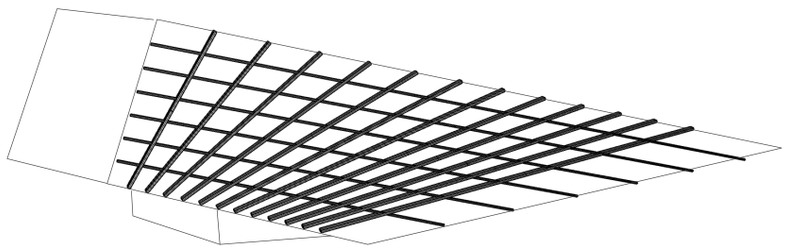
Daylight Factor Investigations

To find a suitable working space in the library day light factor investigations need to be experimented with to find the optimal lighting conditions whilst not disregarding the overall form and aesthetics of the building.

Since the majority of the building and window openings are facing north, west and east we had less problems with too much direct light entering the building. The following investigations play with different options of shading around building, altering the interior lighting conditions to find the best possible conditions. The three main parameters we altered and experimented with were the diagonal banners, the steps outside and the frosted glass shading. See below for explanations of each shading device. For further iterations of the other floors see Appendix B.

The Diagonal Banners

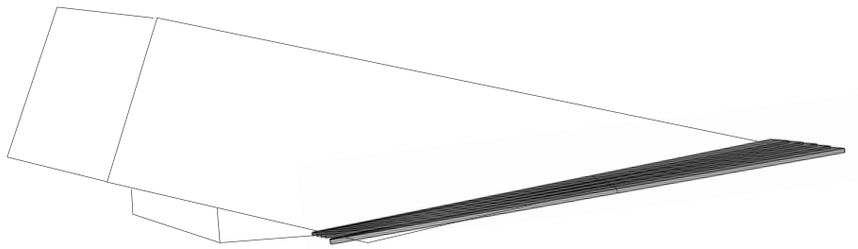
The diagonal banners which also acted as supports were altered in space and number to experiment with and thus find a good daylight factor within the floors.



ill.146 The diagonal banners.

The Steps

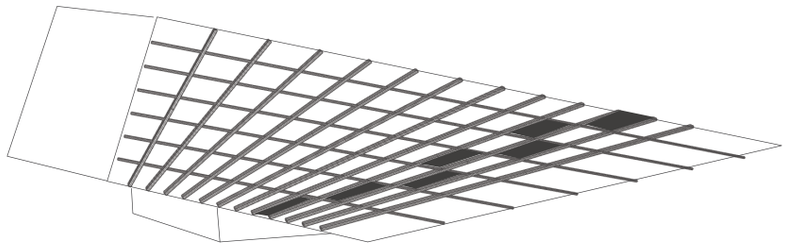
The steps outside the building were altered from 0 steps to 3 steps to 5 steps, to allow more or less light into the ground floor and the basement.



ill.147 The steps outside the western facade.

The Frosted Glass Shading

The frosted glass shading was added within the doube skin facade banners to alter the light within the ground the mezzanine floors. Since the mezzanine floor was most exposed to direct sun light we targeted the frosted glass around this floor.

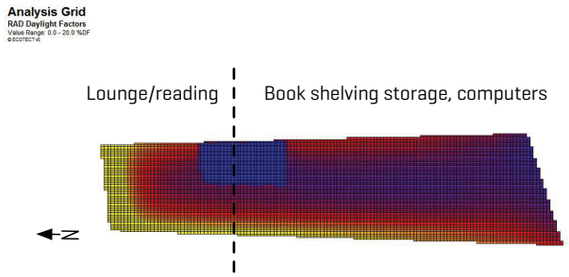


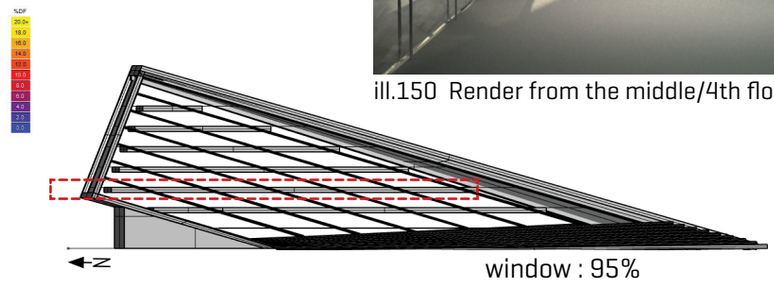
ill.148 Frosted glass shading.

Middle/4th Floor, Diagonal Banners

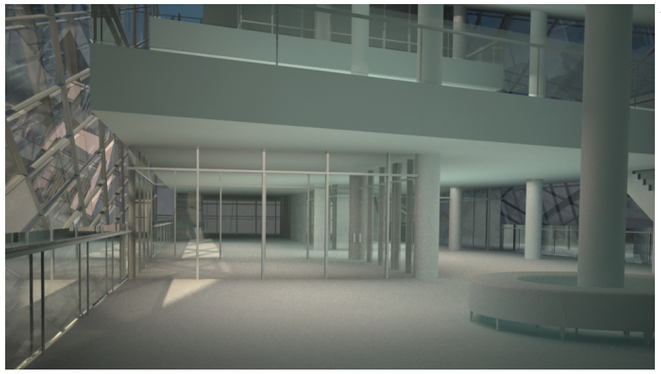
Here we experimented with the diagonal banners on the western facade to maximise a good daylight factor into the building. We experimented with the middle floor to get an idea of the overall light entering.

The first iteration had no diagonal banners and let a lot of light in.



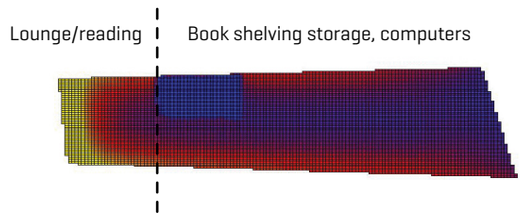


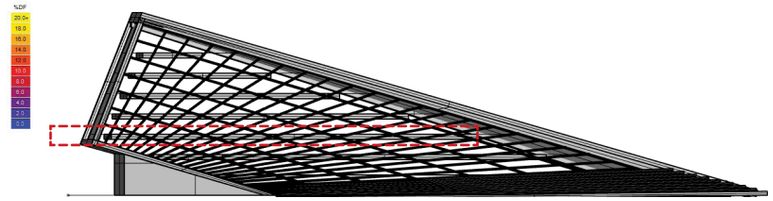
window : 95%
No vertical Banners



ill.150 Render from the middle/4th floor.

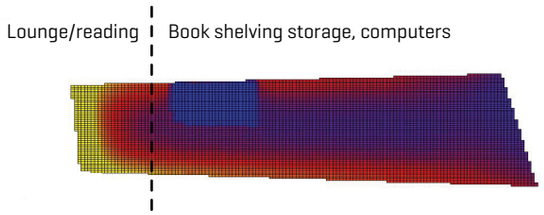
We then added 20 banners and the interior light became a lot less.

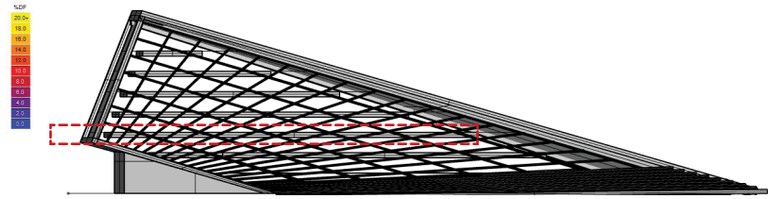




window: 60%
20 Banners

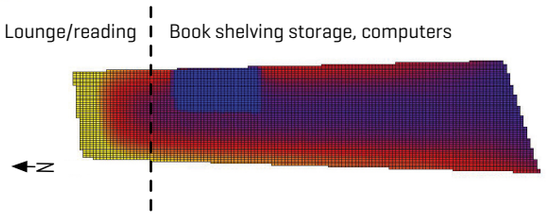
We then reduced the banners to 15 but were still not happy with the overall light.

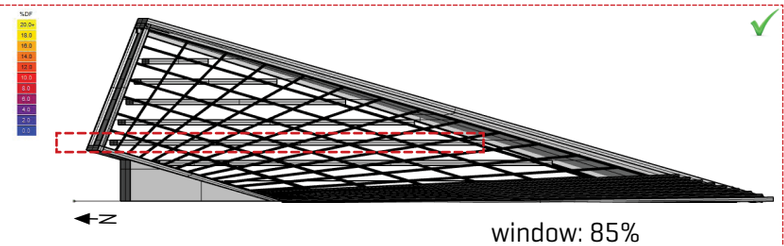




window: 80%
15 Banners

We then reduced the banners to 12 and thus satisfied with the result. The floor is zoned into different areas, where there is more daylight falling we have placed reading and lounge areas and where there is less light we have placed the book shelving and storage and computers.



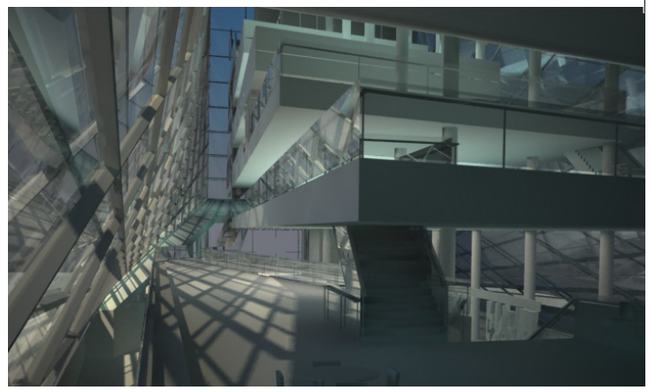


window: 85%
12 Banners

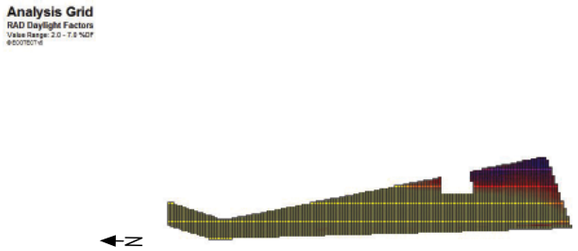
Mezzanin Floor, The Frosted Glass

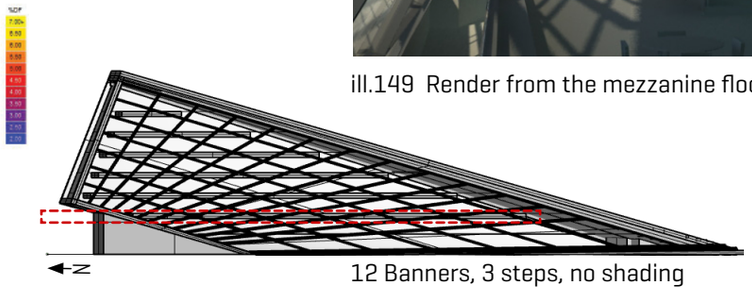
The Mezzanine or half floor is most exposed to the window and direct light so we have experimented with some shading devices such as frosted glass to diffuse the sunlight on this floor. These daylight factor studies show how the frosted glass shading improved the light conditions.

The first iteration is without any shading device and as you can see it is quite bright on this floor. Then we added some frosted glass as you can see in this iteration the light is more diffused.

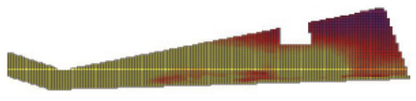


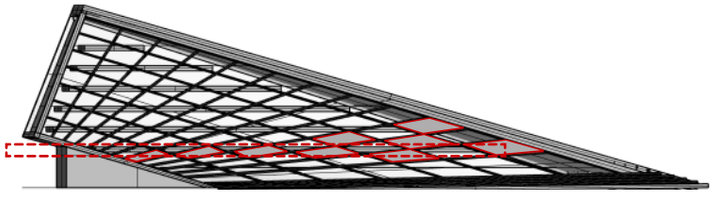
ill.149 Render from the mezzanine floor.





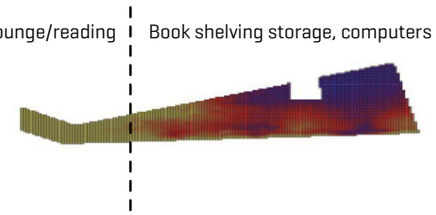
12 Banners, 3 steps, no shading

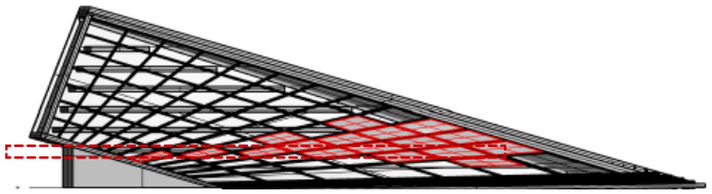




With Shading devices, frosted glass.

We then added some more shading but added the frosted glass on one of the outside layers of the double skin facade and one on the inside layer of the double skin facade. Consequently we were much happier with this result.

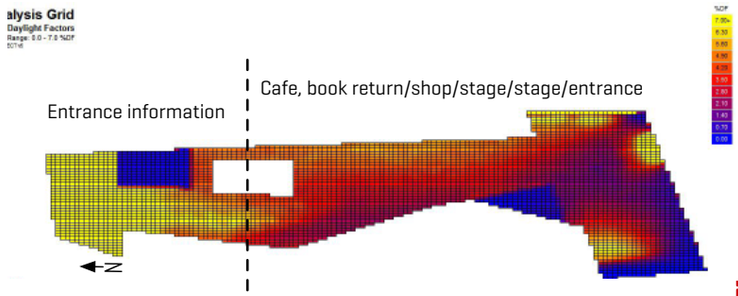


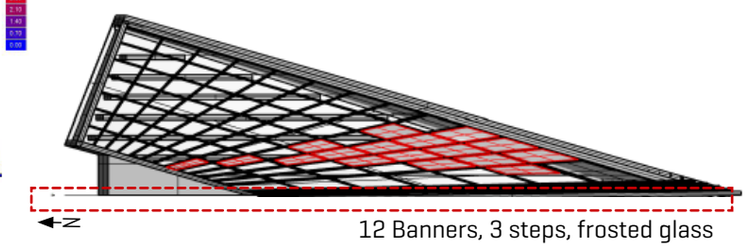


With more frosted glass.

Ground Floor

It was also important for the ground floor to get a lot of light, since we had a double floor height we were able to let a lot of light flowing into the ground floor despite the frosted glass shading.

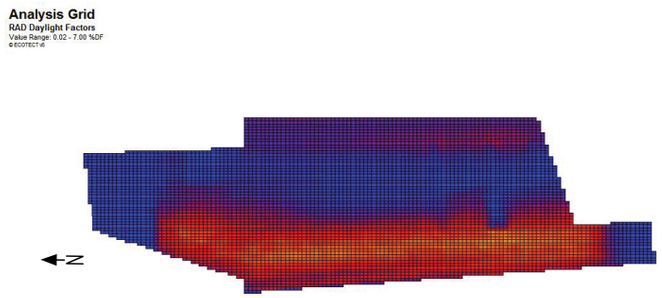


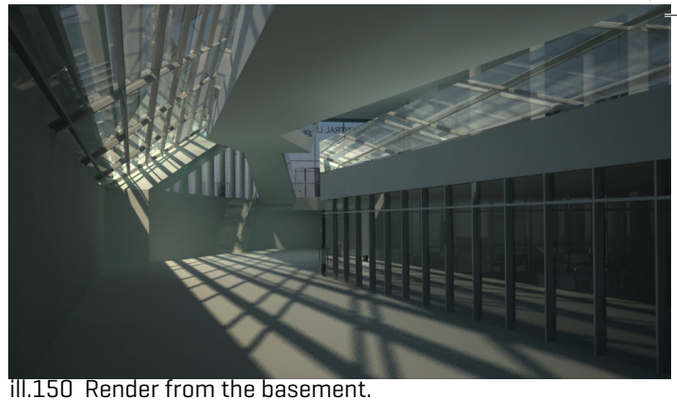


12 Banners, 3 steps, frosted glass

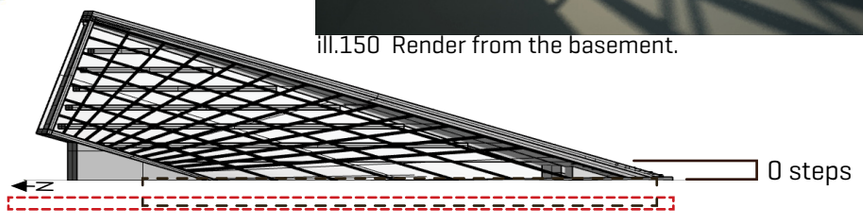
The Basement, The Steps

Since the basement would be lacking the most sunlight we experimented with reducing the steps on the outside to maximise the most sunlight. This first iteration is with no steps.



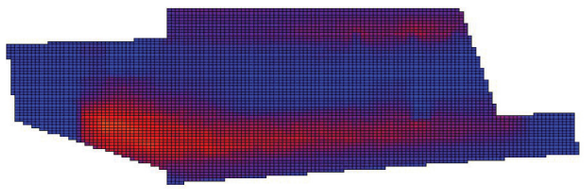


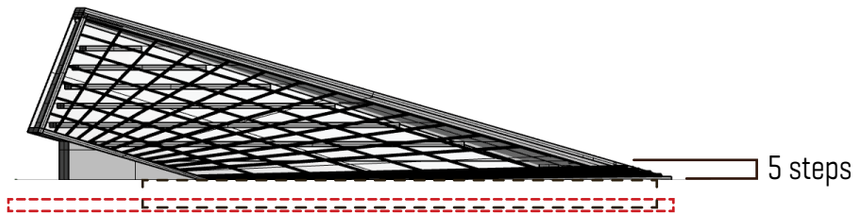
ill.150 Render from the basement.



window 80%, 12 banners

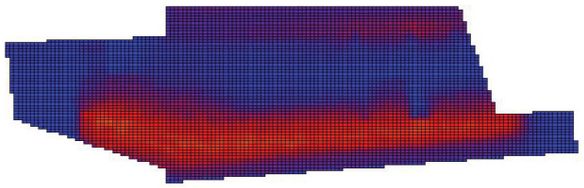
This second iteration is with 5 steps. As you can see the 5 steps are bocking too much light into the basement.

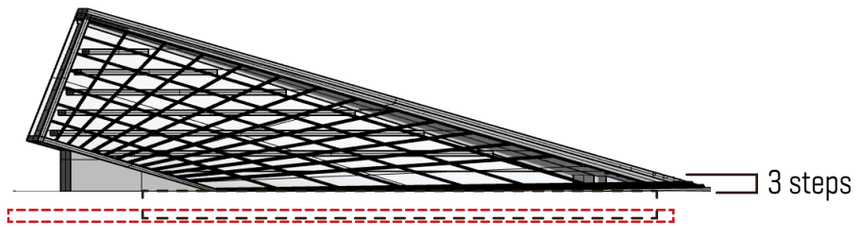




window 80%, 12 banners

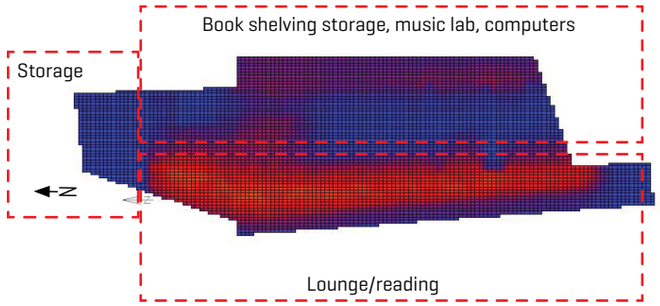
The third iteration and the one we are most happy with is with 3 steps. This lets just enough light into the basement.

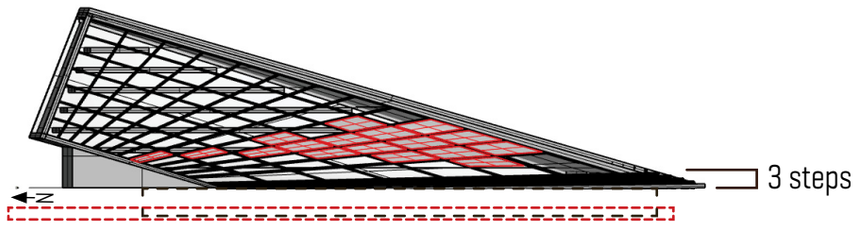




window 80%, 12 banners

The forth iteration includes the frosted glass shading which doesn't seem to affect the basement at all.

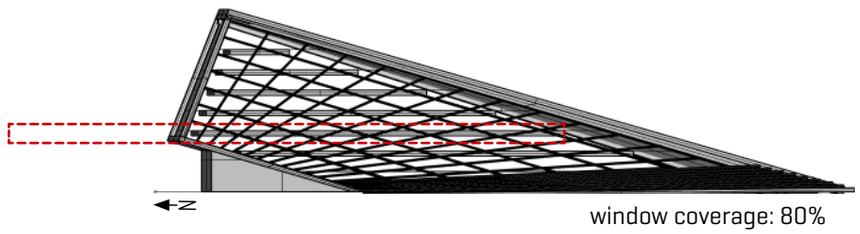




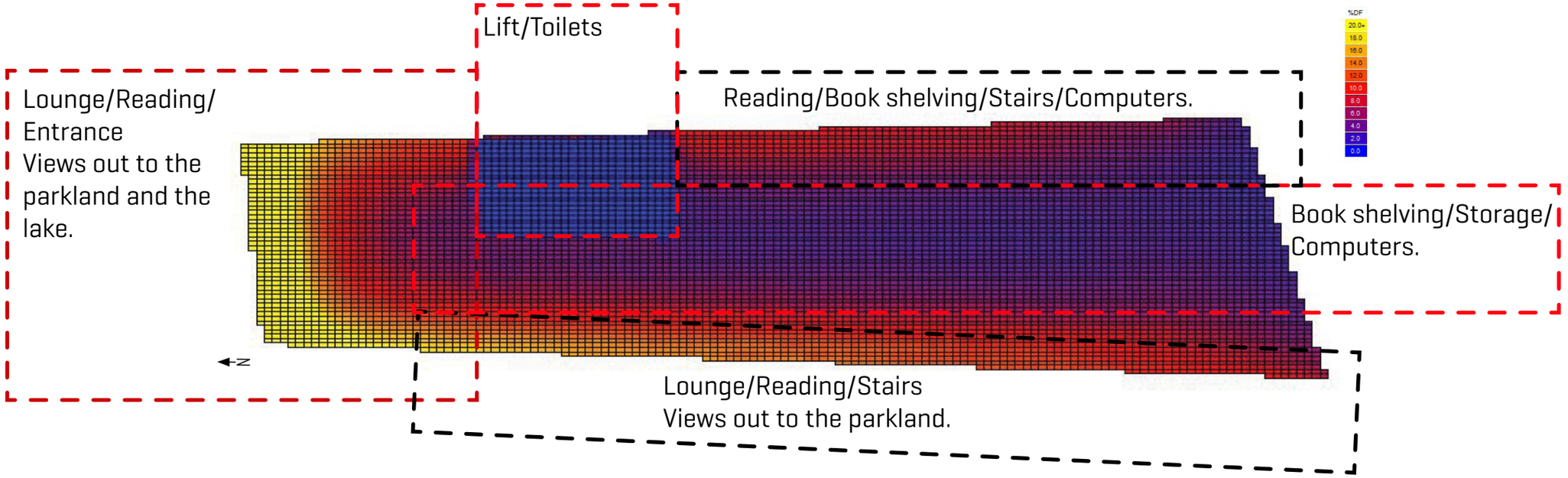
window 80%, 12 banners,
frosted glass shading

Zoning Areas According to Light

This study shows a more detailed explaination how each area of the library will be designed and orientated according to the layout of the building and the light. The middle floor is used in ill.151/152 as a template and guide for the entire library and is the chosen configuration after experimenting with the diagonal banners, steps and frosted glass shading. It produced the best daylight and created different zones relating to different functions. Since the designated site was quite restricted, considering it's long rectangular shape with a strong north to south orientation the obvious idea was not to allow too much of the southern direct light enter the building. As this would consequently create an uncomfortable working environment. So placing the hill towards the south shaded most of the direct light thus allowing us to let the light gently in around the library mainly from the west and east facades, creating a optimal working conditions that allowed for zones of strorage in the middle of the library where there is not much light and reading and lounge areas placed around the edges of the library where there is more light. See Inner Organisation on page XX for further detail on all of the functions in the library.



ill.151 Location of the middle floor where the study is conducted.



ill.152 A middle floor study of the breakdown of functions according to light distribution, used as a template and guide for the entire library.

Sun Rays

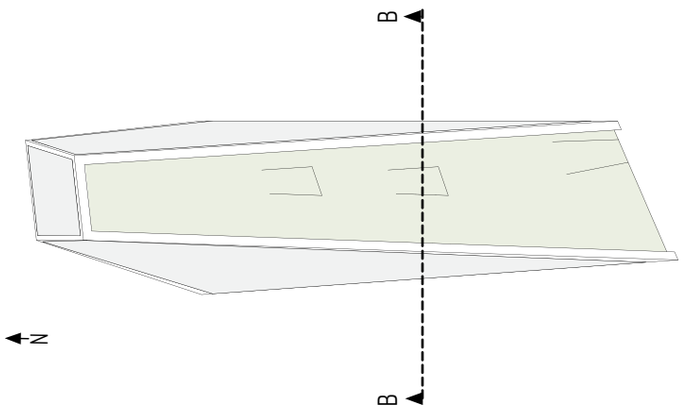
This study shows a cross section of where the sunlight will fall and enter the western facade during summer and winter. The green arrows indicating where the light will be diffused and or deflected into the building. The ill. 154 clearly indicate that enough light will enter into the basement and the upper floors. Most important is the sunlight entering into the mezzanine floor as it is placed closest to the facade therefore receiving maximum sunlight. Thus we have integrated some frosted glass shading on the windows around this floor, but without disturbing any sunlight from entering the basement and ground floors. This frosted glass shading study can also been seen in the previous individual floor daylight factor investigations.

Types of sunlight

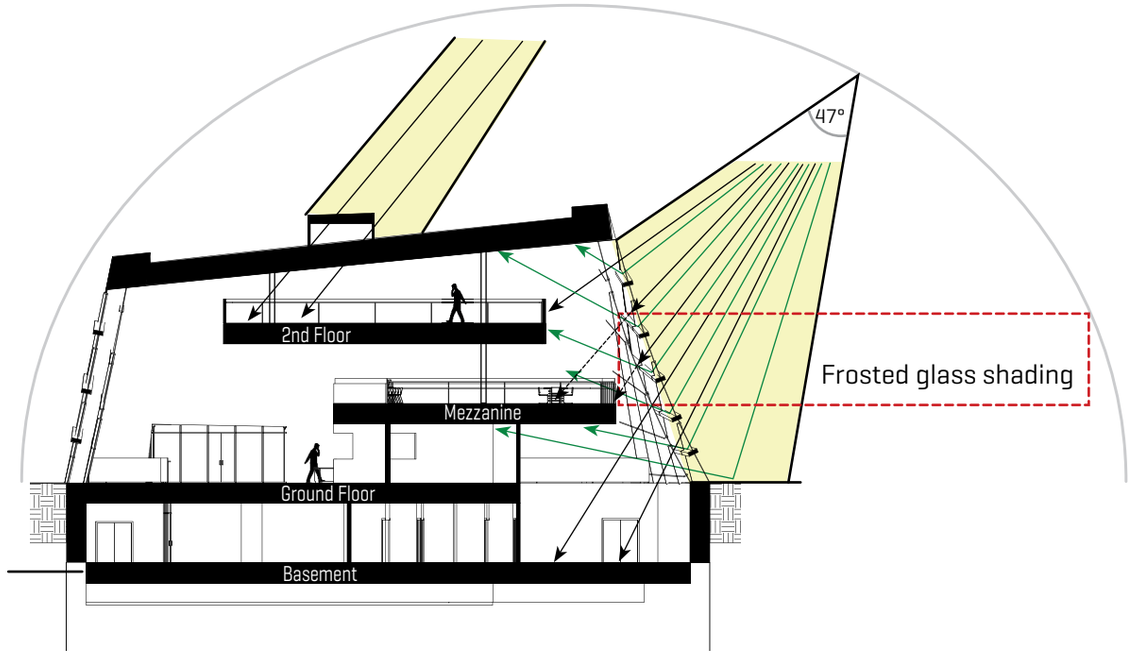
Direct sunlight

Diffused/deflected sunlight

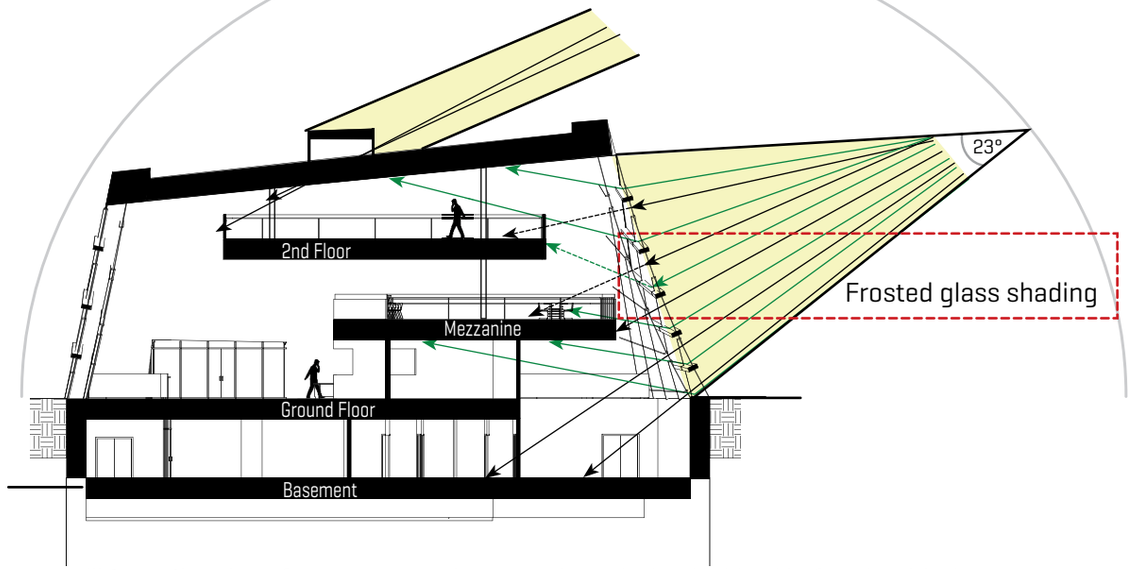
Diffused from shading



ill.153 Location of section for the sunlight diagrams.



ill.154 Direction of sun rays once it enters through the double skin facade with the suns summer angle of 47°.



ill.155 Direction of sun rays once it enters through the double skin facade with the suns winter angle of 23°.

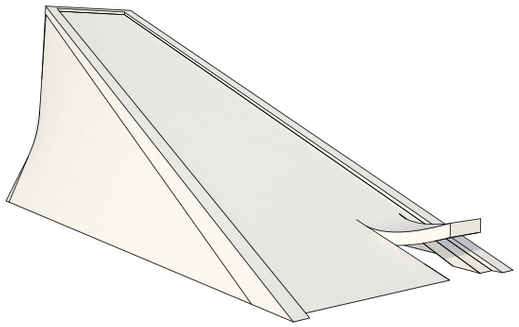
Entry/Exit & Hillside Openings

This study shows how we experimented with different entry/exit's, located at the southern hillside end of the library. We tried some basic iterations on a the same idea of gently peeling up the facade surface to create an extension of the facade which in return softly denotes the entrance location to the library. The image below designed by effekt architects ill.156, encapsulates this idea where the outline of the building is simply extruded or peeled up from the earth.

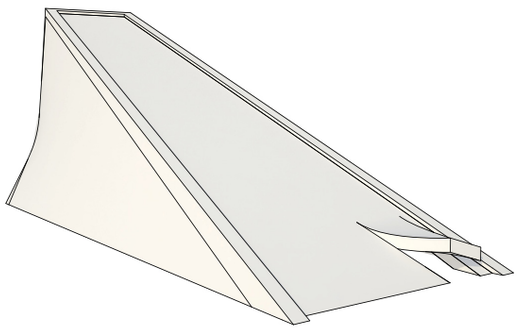
ill.156 Inspiration for the peeling effect of our hillside entrance and hillside window openings.

Iterations

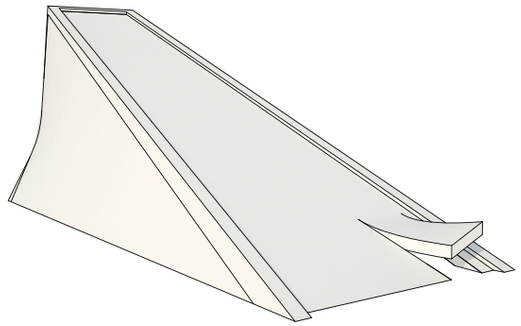
Each entrance iteration is slightly altered to gain the most elegant and practical opening in the facade. This approach of peeling up the surface was also applied to two locations up the hillside allowing some light in whilst creating some views out of the library and creating a place for people to rest on their journey up the hill. ill.161 was as the perfect entrance as it worked with the overall form and appeared to look the most effortless with it's light weight tapered edge.



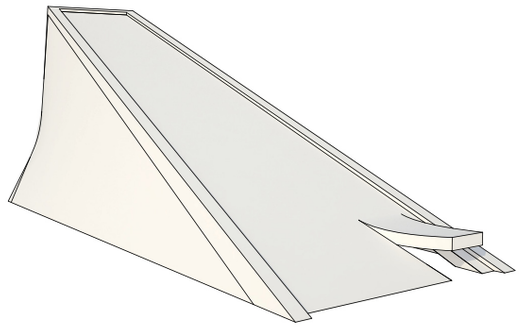
ill.157 Basic idea of peeling up the entrace vertically.



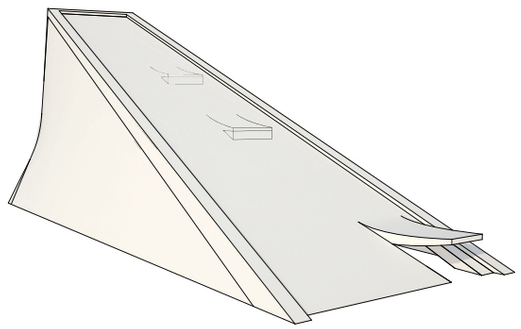
ill.158 Peeling up and twisting of the entrace to the left.



ill.159 Peeling up and twisting of the entrace to the right



ill.160 Peeling up the entrace vertically.



ill.161 The chosen entrance, peeling up the entrance vertically whilst tapering the end to give it more of a light feeling.

Indoor Climate Studies

The space inside the library is simulated in Bsim to give us a perception of the thermal indoor climate. The minimum requirement from the competition brief for the indoor environment is a "good indoor climate" as defined in accordance with Category S2 of the Classification of Indoor Environment 2008. (Competition Program, 2012)

Since Bsim is limited to Denmark weather conditions the results will not be accurate, also with the inclusion of a double skin facade, which Bsim can not calculate thus making it furthermore inaccurate. As you can see in the results where the sum of hours over 27 degrees is 155 which is considered unacceptable, with the Danish regulations of 25 hours over 27 degrees and 100 hours over 26 degrees. however again with innaccuracy of using the Danish climate in Bsim and the exclusion of calculating the double skin facade it is near impossible to gain the exact results. ill. 162/163.

The Bsim results shows the thermal investigation of two scenerios, one with shading and one without shading. Indicating the need for cooling and heating throughout the different months of the year. Since the building is directed to the north away from direct sunlight and due to the weather and climate of Helsinki the building only needs cooling through the summer months.

It is clear to see from the Bsim results that the shading on the building benefits the hours that are above 27 degrees, ranging from a peak of 95 hours over 27 degrees in July without shading compared to a peak of only 53 hours over 26 degrees in July. For further detailed Bsim results see app D.

With shading — Month of the year

	Sum	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hours > 26	243	0	0	0	0	22	73	81	64	3	0	0	0	
Hours > 27	155	0	0	0	0	11	52	53	38	1	0	0	0	
Hours < 20	3077	631	439	340	159	34	2	0	6	67	272	473	654	

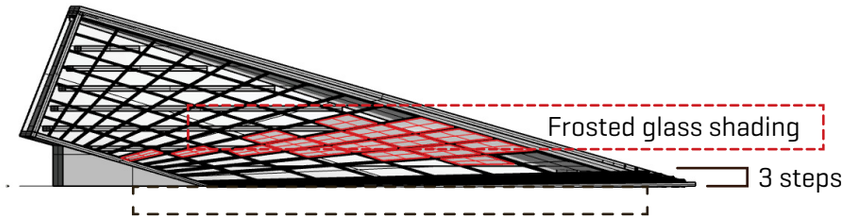
ill.162 Thermal investigation of the months of the year and its corresponding temperature and the amount of hours, with shading devices.

Without shading — Month of the year

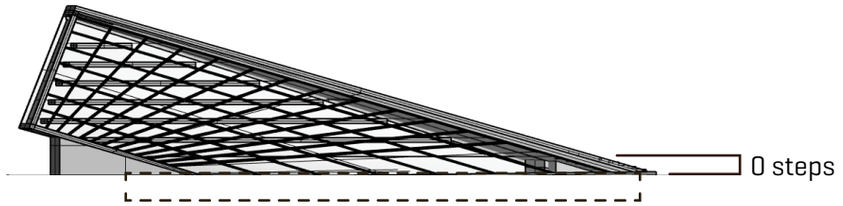
	Sum	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hours > 26	400	0	0	0	1	55	114	126	95	9	0	0	0	
Hours > 27	304	0	0	0	0	42	86	95	77	4	0	0	0	
Hours < 20	3003	631	435	329	135	30	1	0	4	49	262	473	654	

ill.163 Thermal investigation of the months of the year and its corresponding temperature and the amount of hours, without shading devices.

ill. 164 The Bsim results calculated with shading, including the frosted glass panels over the windows, and the 3 steps. Glass coverage amounting to 60%.



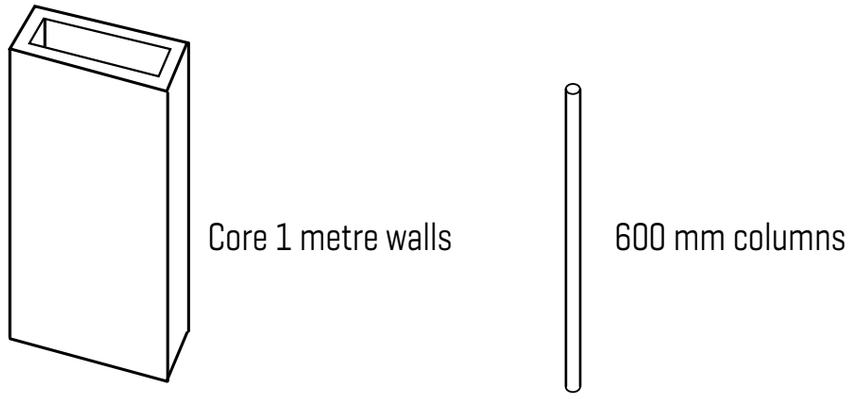
ill.165 The Bsim results calculated without shading, including the frosted glass panels over the windows, and without the 3 steps. Glass coverage amounting to 80%.



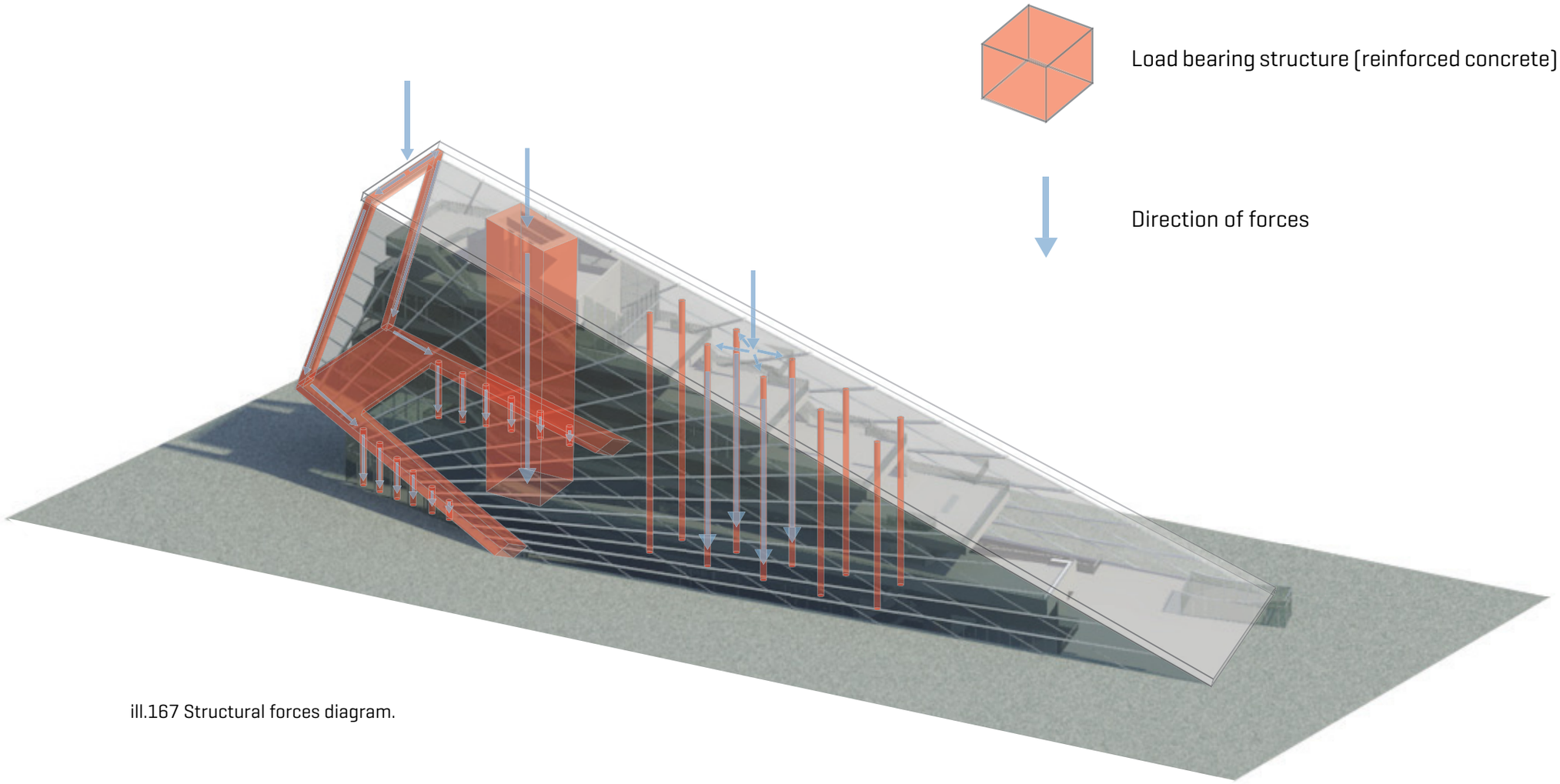
Structural Principle

The structural system displayed below highlights the vertical forces from the roof and floors which are transfered through the building down into the 10 reinforced 600mm diameter concrete columns. Throughout our design process we always had a vision of a very free and open space within, as the competition brief suggested, using columns combined with a main core made this possible.

The main rectangular core contains vertical services shafts and a lift which is the main structural element that is taking a large majority of the loads, it has 1000mm thick walls. To the north the overhang over the entrance area is also supported by reinforced 600mm diameter concrete columns. The roof construction is a 300 mm thick reinforced concrete slab. ill. 166.



ill.166 Load bearing forces and structural elements.



ill.167 Structural forces diagram.

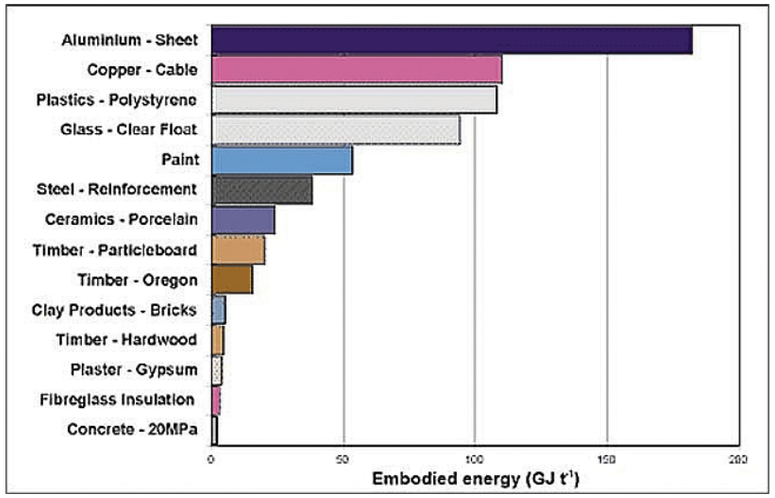
Materials

According to the competiton brief when considering materials and structural solutions the competitiors must strive for material efficiency and aim for small environmental impact avoiding solutions that have unfavourable environmental impacts, but at the same time not compromising on the quality of the cityscape and the architecture. (Competition Program, 2012)

Considering the competitions brief of obtaining a small environmental impact we have considered using materials with a low embodied energy. Embodied energy being the amount of energy that has gone into producing the material and the transportation from the materials origins to the factory and then to the site. As the production of energy from fossil fuels is environmentally unfriendly, materials that have a lower embodied energy are more sustainable than those with a higher embodied energy. see ill.168 (Tucker, 2001)

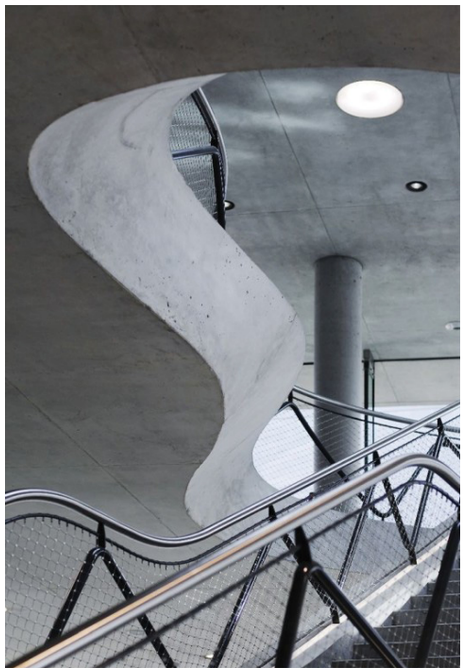
We have decided to use a combination between concrete, steel and glass. The majority of the building constructed in concrete, which incidentally has the lowest embodied energy ill.168. Amongst the materials from the table steel also has a reasonable embodied energy result sitting in the mid range. However glass which is used all around the building indicates quite a high embodied energy.

We feel the concrete has a timeless appeal, resembling qualities of stone, a material that has a presence that trancends time. Something that can be sensed in Louis Kahn's Salk Institute which is compromised mostly of concrete. Furthermore most of man's greatest architectural and artistic wonders are built from stone. Also not to forget our original intention of imitating the granite rock/stone that protrudes out of landscape all over Finalnd and Helsinki.



ill.168 (Tucker, 2001) The embodied energy of many construction materials, with concrete proving to have the lowest ebodied energy.

Concrete



ill.169 Representation of how we would like to use the concrete in our library.

Steel

ill.170 Representation of how we would like to use the steel in our library.

Glass

ill.171 Representation of how we would like to use the glass in our library.

Energy Performance

Table 1

Dagslys		Termisk Indeklima		Primærenergiforbrug	
Mål:	2%	Mål:	15%	Mål:	71,5 kWh/m²
Beregnet:	0,8%	Beregnet:	9%	Beregnet:	54,4 kWh/m²

Parametre

Bygning		Kontekst	
Samlet bygnings areal	10.025,3 m²	Afstand til nærvedliggende bygninger	10 m
Etage antal	8	Højde af nærvedliggende bygninger	30 m
Bygnings længde	35,4 m		
Bygnings bredde	35,4 m		
Bygnings højde	32,5 m		
Etage adskillelse	1,0 m		
Etage højde	3,0 m		
Bygnings Orientering	183,0 °		

Table 2

Dagslys		Termisk Indeklima		Primærenergiforbrug	
Mål:	2%	Mål:	15%	Mål:	71,5 kWh/m²
Beregnet:	0,7%	Beregnet:	7%	Beregnet:	54 kWh/m²

Parametre

Bygning		Kontekst	
Samlet bygnings areal	24.000,0 m²	Afstand til nærvedliggende bygninger	10 m
Etage antal	8	Højde af nærvedliggende bygninger	30 m
Bygnings længde	100,0 m		
Bygnings bredde	30,0 m		
Bygnings højde	32,5 m		
Etage adskillelse	1,0 m		
Etage højde	3,0 m		
Bygnings Orientering	183,0 °		

The building's energy performance is calculated with a program called A+E. The program's engine is based on Be10, which means that it is calculated according to Danish standards and Danish climate. The difference in location is not very big, so it is therefore not such a big problem.

Another thing that is a bigger factor in terms of getting an accurate energy frame for the building, is that the program is only able to base it's calculations on a box defined by four walls and a roof.

Because our building envelope is so irregular shaped it is very difficult to get an accurate result. Also the effect of the double skin facade is impossible to calculate into the buildings energy performance. If they are used right the double skin facade can reduce a buildings energy performance by 90%, but if used incorrect in can cause overheating and downdraft. Because double skin facades is still relatively new, methods to calculate energy and ventilation for buildings with double skin facades is still being developed. Aalborg University, COWI and SBi(Statens Bygningsforskningsinstitut) is developing a method to calculate it and expect it to be ready in 2013 (Pedersen, 2011).

The tables to the left show an approximated energy frame for a box that imitates our building envelope as close as we can get. In Table 1 the envelope is represented by a building with a square footprint, eight stories high, and approximately the same floorplan area as our building. Because

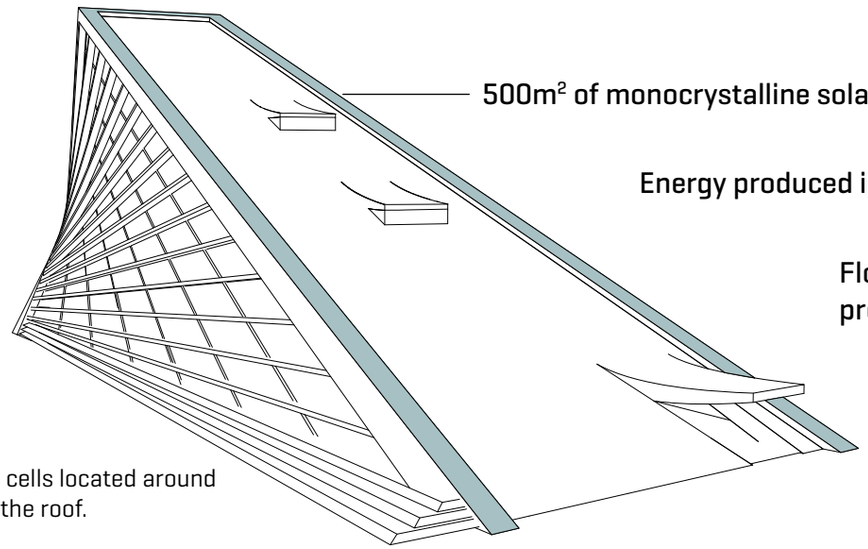
ill.172 The A + E energy results.

of the big double skin facades the percentage of glas in the east, west and north facade is chosen to be 90%. The south facade only has 10%. Table 2 is represented by a building with approximately the same sized footprint as our's. This gives a much bigger floorplan area because it is not possible to put in a atrium or similar in the building. Both intepretations of our building give approximately the same energy performance, which is 54,4 kWh/m^2 for Table 1 and 54 kWh/m^2 for Table 2.

We also did an energy calculation in BSIM, with the result of an energy frame saying 88 kWh/m^2. The calculation is described in App D.

In Denmark an energy frame on 54 kWh/m^2 would easily fulfill the requirements that we have today, and would not be so far from the 2015 requirements[41 kWh/m$^{2)}$. The 88 would not be fulfilling these days. But we have to consider that these calculations we have done is only for use in the early stages of a design proces. Because of the tools we have available today it has not been possible to get a more accurate result.

Never the less If we look at the two energy frames, they are not that high, taken into consiteration that the advanced hybrid ventilation system with the double skin facades and the heat recovery system, will work - it should contribute with a big impact to lower the building's energy performance. Furthermore the building will be equiped with solar cells on the sloping roof which will prowide energy from a renewable source and thereby minimize the need of external supply. The area on the sloped roof reserved for solar cells is 500m^2. According to danish standards based on a book called "Solceller i byggeriet" (Rasmussen, 2000) we have calculated how much energy this will produce and with an energy frame of 54 kWh/m^2 we have calculated how many squaremeters of the building's total area we can cover with solar energy (Ill. 173). For the detailed report of A + E calculations and results see App E.



ill.173 Solar cells located around the edge of the roof.

Conclusion

The heart of the metropolis has now arrived, the heart of Helsinki is the new central library that we have conceived and manifested. It is now one with the city of Helsinki and provides the missing link to their society. The citizens of Helsinki and the world can now enjoy an added benefit to the city, something unique, something green, something timeless.

This timeless iconic building will attract the entire city as well as tourists. It will open its arms to everyone and be more than just a library. It will become a meeting point, a place to be educated or just a place you come to admire and take on the beautiful views of Helsinki as well as admiring the other attractive buildings it is nested in within.

The library blends seamlessly into the parkland, protruding out like the granite rock all over Helsinki and thus becoming an extension of the existing parkland it rests in, and at the same time not neglecting the city and it's surroundings but respecting it. The final library design is made from concrete, steel and glass, something you can walk on and interact with inside and out. The interior will be a very open flexibil space filled with diffused light which melts through the twisting double skin facade creating an enchanting place to visit. The library also offers stunning views from most of the floors and of course the restuarant on the top floor which looks directly out to the northern parkland and lake.

Our inspiration from flipping pages in a book, to education, to the Finnish culture and landscape, to architects such as Louis Kahn "being-in-context" and sustainability has driven us towards our vision of a utopian library, one that shall stain a footprint in the soil of Helsinki and thus become a testament of time, becoming "The Heart of The Metropolis".

Reflection

Upon reflection and considering we intended to enter the competition, which expected the competitors to cover many requirements from sustainability to something timeless to something new and exciting. Basically the brief was asking for a lot which resulted in creating a project that evolved around a broad range of topics without focusing too much on anything in particular. Which could be seen as a failure however at the same time we have now learnt a great deal from this experience, covering all aspects of architectural design to sustainable ideas to something iconic.

Thus it brings together a nice collective from the previous semesters. Since 7th semester and the viking museum dealt mostly with tectonics and structure with a feminological approach, to 8th semester which drove deep into sustainability and the engineering side of architecture. Now this final master thesis draws in on both the artistic tectonic side and the engineering sustainable side creating a chance to bring them both together in the best possible way. And we feel we have attempted this as best as we possibly could.

We do of course have some down sides and things we think could improve the design of the library. Things such as including suspended floors to really free up the space inside. We did begin to investigate the suspended floors early on in the process but felt it would be too hard to achieve with the floors offset from the facades of the building. However through further investigation maybe we could have been successful in this direction. Also in regards to structure more studies and calculations could have been done to reinforce and prove that a core and columns can withstand the floor loads throughout the library.

Since it was impossible to calculate the double skin facade it is obvious to want to experiment with this further for indoor climate, daylight investigation and energy results to confirm that it really can work. However Aalborg university is currently working with COWI and SBi to produce a method which can calculate on double skin facades, which will be available to use around next year in 2013. Other possible changes and improvements could have been to alter the 15 ° degrees hillside angle and thus make it easy to walk upon. Although we did compare it to Delft library which has an incline of 13-15° degress. Maybe stretching the building out abit further could have resolved this creating a more gently hillside to walk upon.

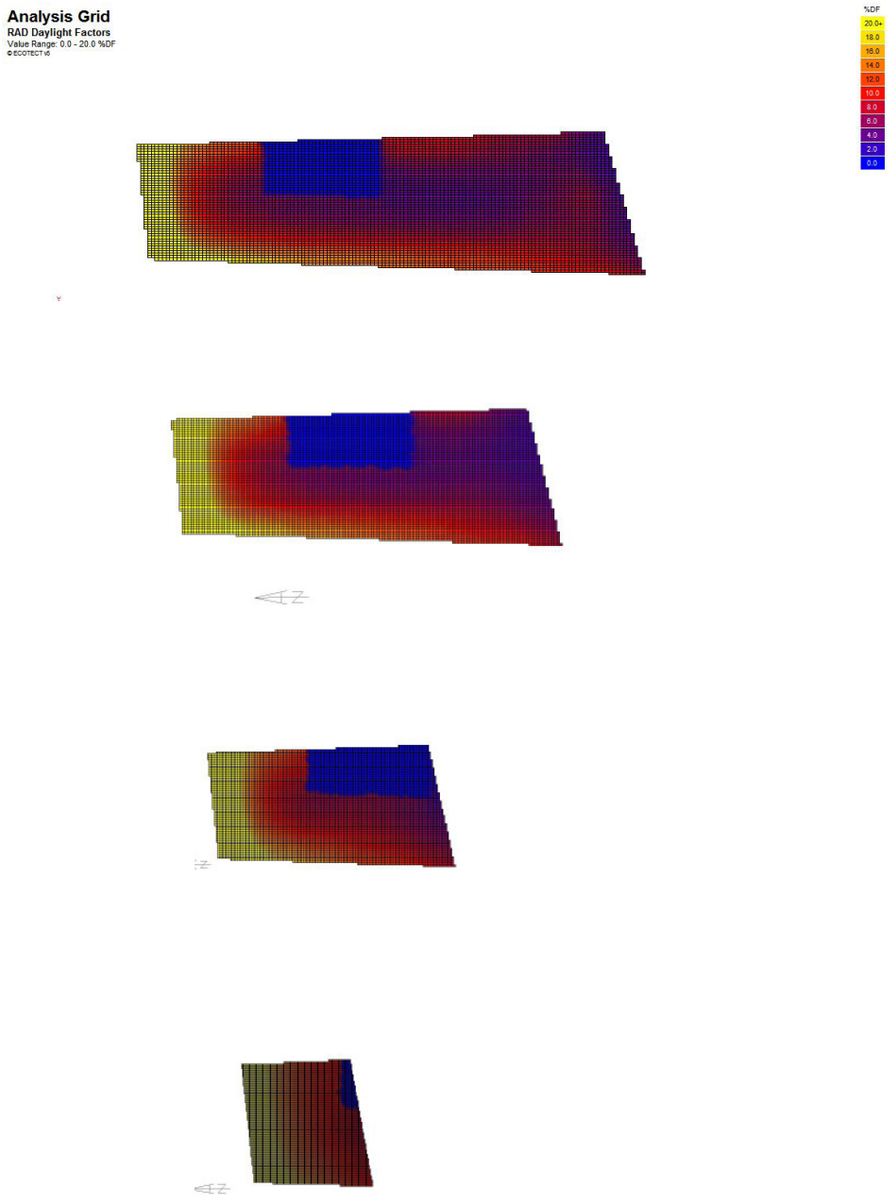
The steps outside the library which made a connection to the parkland and place to sit and interact on the outside of the library could also have been investigated and tested a little more. We did investigate a few different styles and amounts of stairs but maybe with further experimentation with the steps could have interacted with the building and the hillside more, creating a library that works more as one unitthan separate entities.

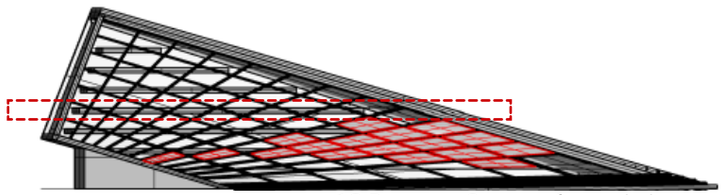
In an overall perspective we think the library successfully covers many requirements of the competition brief, and in hindsight has worked on many different levels from sustainability through solar cells and the use of a double skin facade to creating a library that you can interact with inside and out. On a broader scale we also believe it suits and fits into this region of Helsinki, becoming part of the rocky landscape through it's protruding rock metaphor and also appearing as book flipping it's pages. We have also been successful in respecting the surrounding buildings and thus creating a dialogue with the Finnish Parliament building by leaving a void in the area it faces. Other positive outcomes is the hillside which you can walk upon and view the city from a new perpspective, and the views within the library which would be stunning out to the parkland and the lake. Having two main entrances also created a nice flow and access through the building, we did consider placing an entrance on the western facade however the flow of traffic and people suggested we would need one at each end thus also making it a very inviting and open library to visit.

APPENDIX

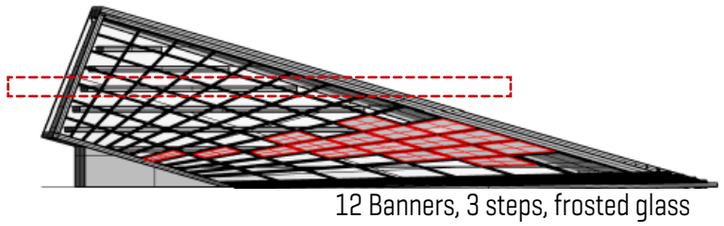
Appendix A/B

Daylight factor studies for the other floors in the building.

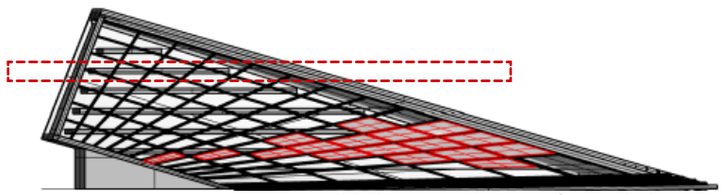




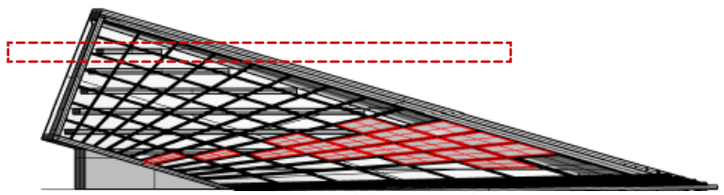
12 Banners, 3 steps, frosted glass



12 Banners, 3 steps, frosted glass



12 Banners, 3 steps, frosted glass



12 Banners, 3 steps, frosted glass

Appendix C - Room Program

* NOTE.
The room programme must be read in parallel with the competition programme sections 3.2 "Operational objectives", 3.4.1 "Building design guidelines: General", and 3.4.2 "Design guidelines for spaces and spatial groups".

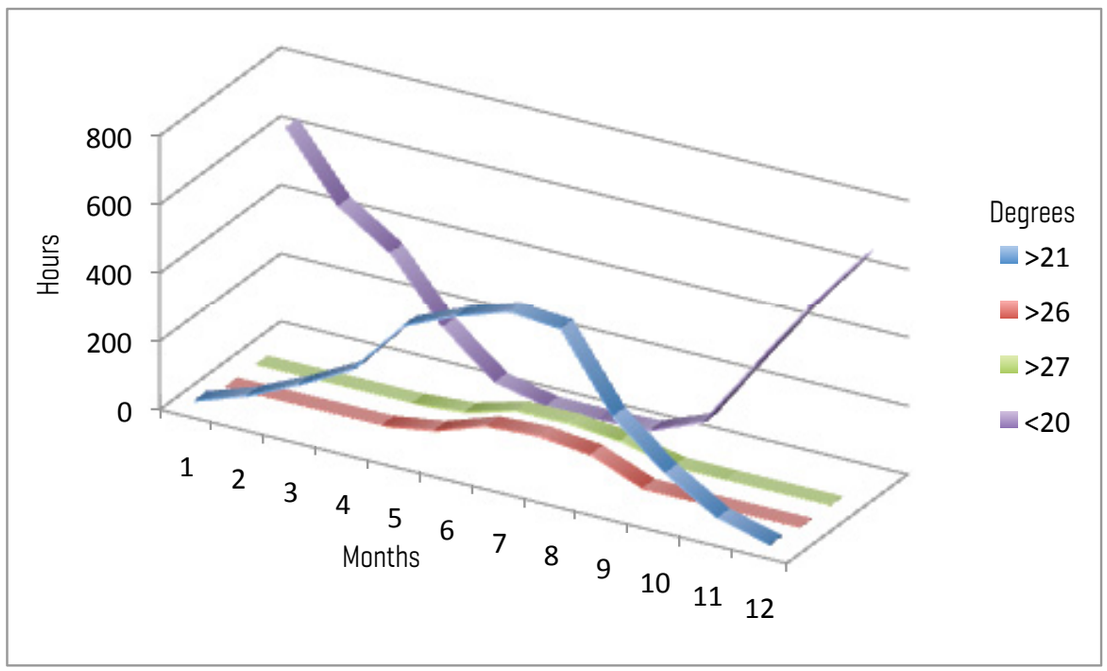
Main lobby and central public service spaces	**1150**	
Lobby functions	160	- draught lobby/ies - pram/pushchair parking facility, approx. 40 m² - lockers (50-100 pcs) - space reservation for a cloakroom (approx. 550 persons)
Public toilets	250	Distributed throughout the building; disabled WC (2 pcs per floor), babycare room 20 m²
Public services	170	- Reception and information point + control room, total 40 m² - Client service point + separate work space, total 40 m² - Client photocopying, print-out and scanning point, 20 m² - Self-service returns automat (connected to returns automat room) - "Book bar", approx. 20 m² - Reservations pick-up area, 50 m²
Meeting and lounge area	440	
Stage	30	Performance technology (sound and lighting)
Pop-up info spots (space reservation)	100	
Events spaces	**1570**	
Cinema	490	Incl. machine room, 40 m². Silent air-conditioning.
Multi-purpose hall	350	
Furniture and stage prop storage	150	
Lobby areas		Open foyers that can be separated off from the lobby areas - cinema foyer, 150 m² (incl. VIP area, 50 m²) - multi-purpose hall foyer, 125 m²
Back stage	40	Serves all performance spaces, lockers, separate kitchenette, 2 WCs + 2 showers
Living lab	200	Good AV + IT equipment
Library exhibition space	120	
Rentable exhibition space	180	
Exhibition spaces, local storage points	40	Approx. 20+20 m²
Spaces for external service providers	**840**	
Café	200	Incl. Kitchen 30 m² + staff social spaces, approx. 15 m², possibility for separate use
Restaurant	300	Incl. Cloakroom (unsupervised) and WCs, in total approx. 20 m²; kitchen approx. 90 m²; catering manager workspace plus staff social spaces approx. 25 m², possibility for separate use
Public sauna	240	Men's and women's separate changing and washrooms and sauna + lounge/cooling off area, possibility for separate use
Reservation for commercial premises (e.g. bookstore)	100	
The collections area and spaces linked to it	**2780**	
Library collections area	1600	
Fixed client-service point	140	Collections area, 1 per floor - client service point (2 staff + 2 clients) - separate work space, approx. 15 m² (work points for 2 persons) - local storage point, approx. 5 m²
Interactive spaces	240	Distributed through the collections area, 4 pcs à 60 m²
Lounges, "oases"	500	Distributed through the collections area and other parts of the building, 9-12 pcs, à approx. 50 m²
Quiet areas	300	3-6 pcs, e.g. à 90 m² and 30 places
Learning and doing	**2040**	
"Childrens' World"	600	Incl. fixed client service point à 30 m² (see Collections area) and lightweight construction 'Children's World' performance space (performance technology)
Workrooms (for clients)	150	à 8-10 m², workpoints for 2 persons
Personal office area (for clients)	400	- work points, total approx. 350 m² - fixed client-service point à 30 m² (see: collections area) + laptop lending point - photocopying, print-out and scanning point, 20 m²
Music, recording and video studio	100	AV equipment, computers
TV and radio studio	60	TV studio lighting, sound-system
Digital-physical workshop, "fab lab"	100	
Listening, viewing and games room	230	
Teaching, group work and meeting spaces	400	10-14pcs à 16-60 m², the larger spaces are combinable, one 60 m² project space, one communal kitchen
Staff facilities	**430**	
Office facilities	300	- pigeon holes + staff personal storage cart "parking area" approx. 35 m² - meeting rooms, 3 x 12-20 m² + 1 pc à 45 m². - 4 workrooms á approx. 10 m² - open workpoints for 15 persons, inbetween them a 'team area', in total 120 m² - quiet space, 2 x approx. 7 m²
Staff lounge	50	Easily accessible to all staff
Changing and washrooms	50	Separately for mean and women, ratio approx. 1:1
WCs	30	Approx. 1 WC à 3 m² / per floor; additionally in connection with the office facilties 3 WCs, 1 of which is an disabled WC
Library logistics and library material handling facilities	**480**	
Library collections storage	200	Partly mobile shelving, can be situated in the basement
Returns automat room	80	Connected to the selfservice return automat and 'book bar' in the main lobby, and further to the library material handling facilities
Library material handling	200	Connected to the returns automat room as well as the service and loading area
Service spaces	**710**	
IT and other equipment areas	60	On different floors
Building management monitoring and server room	50	Approx. 10 servers, control room, can be placed in the basemen-
Cleaning facilities	80	Cleaning centre (can be situtaed in the basement, near a lift) à 50 m², as well as cleaning cupboards, approx. 10 pcs à 3 m², distributed through the building
Refuse store	60	Connected to the service and loading area
Building maintenance store	40	Also an external connection, can be located in the basement
Service and loading area	400	Access for a delivery van, free height of at least 4,5 m.
Distribution substation	20	Preferably on ground level, with door directly out
Civil defence shelter		Situated in connection with the excavated underground parking area
Technical spaces		Approx. 7 % gross floor area, of which the spatial requirement for the AC machine room is approx. 1000 m², not included in the room programme area
Space reservations required for the City Centre Tunnel		Shafts 2 pcs à 20 m² (extract and fresh-air intake) and reservation for a stair connection, not included in the room programme area
Programme floor area in total (m²)	**10 000**	

(Competition Program, 2012)

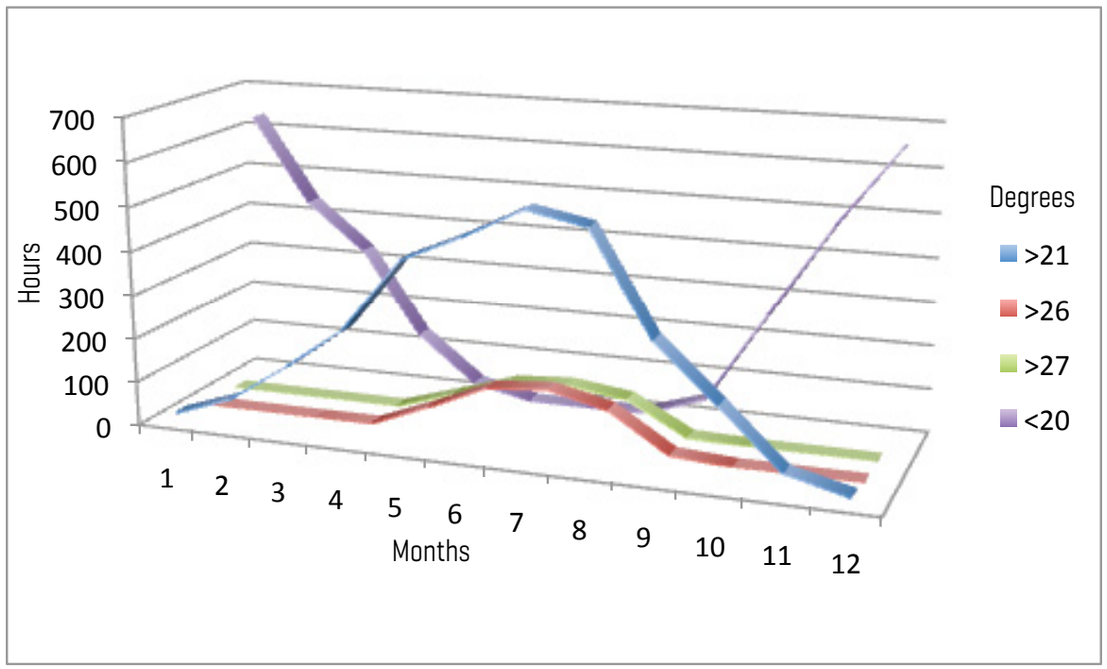
Appendix D- Bsim Results

Indoor Climate With & Without Shading

The two graphs displayed represent each month of the year and the relative above or below temperatures along with their corresponding hours. As was discussed and anaylsed in the Indoor Climate Chapter of the report.



With Shading devices



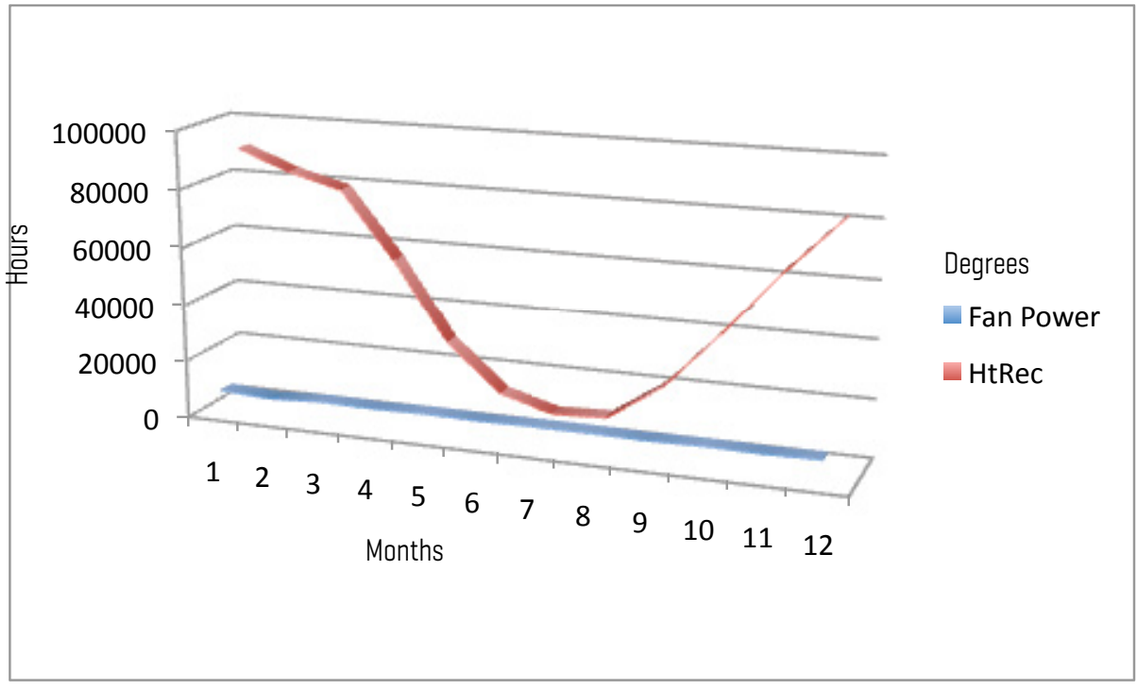
Without Shading devices

Bsim Results

Fan Power and Heat Recovery

The graph displayed indicated how much fan power used over the months of the year, as you can see it is used most of the the year consistantly, but of course without Bsim calculated the double skin facade this result would have varied as the fans would have been used less in summer as the natural ventilation would have been utilised.

The result for the heat recovery would have also been a lot different if the double skin facade was taken into consideration, as a lot more of the heat woud have been recovered during the winter months. And of course not needed throughout the winter months as the graph suggest.

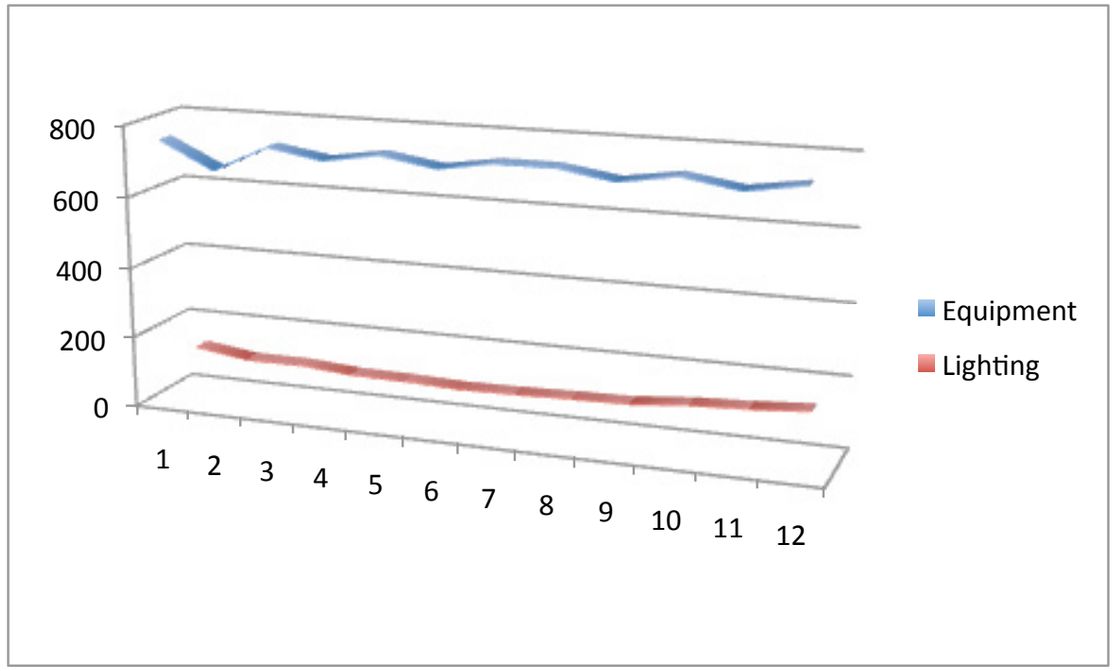


Fan Power and Heat Recovery.

Bsim Results

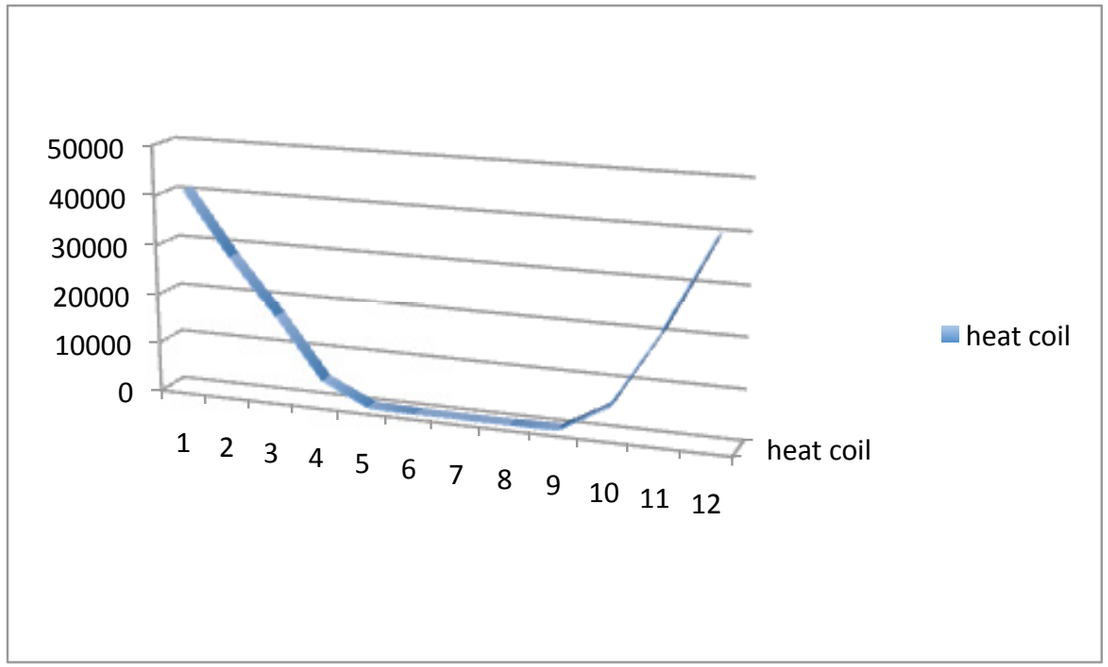
Lighting & Equipment usage.

The graph displayed shows the usage of both equipment and lighting. Both are consequently used consistantly throughout the year, with the lighting maintaining a consistant consumption however increasing slightly in the winter months when the lighting is required the most .



Equipment and lighting usage.

The heating coil graph to the right shows the heating coil which has a relative increased usage over the during the winter months. However without the inclusion of the double skin facade in the calculations this figure would be dramatically reduced.



Heat coil usage.

Bsim Results

The Bsim primary energy result is calculated through a combination of the following elements. However if calculated with the double skin facade and if the Bsim was adjusted to the climate of Helsinki we would perceive this result to be much lower, more comparable to A + E energy result. Although both results are still under the required 120 kWh m2 per year competition brief requirement.

qHeating	581195
qEquipment	8913.3
qLighting	1205.92
FanPow	104088.9
HtRec	569804.5
ClRec	0
HtCoil	160847.1

Heating:	581195*0,8	464,956
Equipment:	8913.3 * 2,5	22,283.25
Lighting:	1205.92 * 2,5	3,014.8
Fan Power:	104088.9* 2,5	260,222.25
Heat Coil:	160847.1 * 0,8	128,677.68
Total		= 879,153.98
Primary Energy		= 87.91 kWh per m2 per year

Appendix E: A + E Energy Calculations

Table 1

Dagslys		Termisk Indeklima		Primærenergiforbrug	
Mål:	2%	Mål:	15%	Mål:	71,5 kWh/m²
Beregnet:	0,8%	Beregnet:	9%	Beregnet:	54,4 kWh/m²

Parametre

Bygning		Kontekst	
Samlet bygnings areal	10.025,3 m²	Afstand til nærvedliggende bygninger	10 m
Etage antal	8	Højde af nærvedliggende bygninger	30 m
Bygnings længde	35,4 m		
Bygnings bredde	35,4 m		
Bygnings højde	32,5 m		
Etage adskillelse	1,0 m		
Etage højde	3,0 m		
Bygnings Orientering	183,0 °		

Facade 1		Facade 2	
Glas areal	90%	Glas areal	10%
Glas type	Mere Dagslys	Glas type	Mere Dagslys
Varmetab	Mindre varmetab	Varmetab	Mindre varmetab
Fast solafskærmning	Ingen	Fast solafskærmning	Ingen
Bevægelig solafskærmning	Ingen	Bevægelig solafskærmning	Ingen

Facade 3		Facade 4	
Glas areal	90%	Glas areal	90%
Glas type	Lidt solafskærmende	Glas type	Lidt solafskærmende
Varmetab	Mindre varmetab	Varmetab	Mindre varmetab
Fast solafskærmning	Vandret typisk	Fast solafskærmning	Vandret typisk
Bevægelig solafskærmning	Ingen	Bevægelig solafskærmning	Ingen

Materialer		Teknologi	
U-værdi, alle facader	0.075 W/m²K	Belysning	Dagslysstyring & lav energi
U-værdi, tag	0.075 W/m²K	Ventilation	Mekanisk typisk
U-værd, terrændæk	0.075 W/m²K	Varmeforsyning	Fjernvarme
Varmekapacitet	Tung	Køling	Overtemperaturer

Table 2

Dagslys		Termisk Indeklima		Primærenergiforbrug	
Mål:	2%	Mål:	15%	Mål:	71,5 kWh/m²
Beregnet:	0,7%	Beregnet:	7%	Beregnet:	54 kWh/m²

Parametre

Bygning		Kontekst	
Samlet bygnings areal	24.000,0 m²	Afstand til nærvedliggende bygninger	10 m
Etage antal	8	Højde af nærvedliggende bygninger	30 m
Bygnings længde	100,0 m		
Bygnings bredde	30,0 m		
Bygnings højde	32,5 m		
Etage adskillelse	1,0 m		
Etage højde	3,0 m		
Bygnings Orientering	183,0 °		

Facade 1		Facade 2	
Glas areal	90%	Glas areal	10%
Glas type	Mere Dagslys	Glas type	Mere Dagslys
Varmetab	Mindre varmetab	Varmetab	Mindre varmetab
Fast solafskærmning	Ingen	Fast solafskærmning	Ingen
Bevægelig solafskærmning	Ingen	Bevægelig solafskærmning	Ingen

Facade 3		Facade 4	
Glas areal	90%	Glas areal	90%
Glas type	Lidt solafskærmende	Glas type	Lidt solafskærmende
Varmetab	Mindre varmetab	Varmetab	Mindre varmetab
Fast solafskærmning	Vandret typisk	Fast solafskærmning	Vandret typisk
Bevægelig solafskærmning	Ingen	Bevægelig solafskærmning	Ingen

Materialer		Teknologi	
U-værdi, alle facader	0.075 W/m²K	Belysning	Dagslysstyring & lav energi
U-værdi, tag	0.075 W/m²K	Ventilation	Mekanisk typisk
U-værd, terrændæk	0.075 W/m²K	Varmeforsyning	Fjernvarme
Varmekapacitet	Tung	Køling	Overtemperaturer

Appendix E: A + E Energy Calculations

Model:	SBi Beregningskerne 5, 11, 3, 4
Be10 key numbers: Institution 2010 v36	
Transmission loss, W/m²	
Building envelope excl. of windows and doors	2,4
Energy frame in BR 2010, kWh/m² year	
Energy frame in BR 2010, without addition	71,5
Addition for special terms	0,0
Total energy frame	71,5
Total energy requirement	54,4
Energy frame low energy 2015, kWh/m² year	
Energy frame low energy 2015, without addition	41,1
Addition for special terms	0,0
Total energy frame	41,1
Total energy requirement	51,6
Contribution to energy requirement, kWh/m² year	
Heating	13,7
El. for service of buildings, *2,5	14,0
Excess temperature in rooms	5,7
Net requirement, kWh/m² year	
Room heating	8,4
Domestic hot water	5,3
Cooling	0,0
Selected el. requirements, kWh/m² year	
Lighting	11,4
Heating of rooms	0,0
Heating of domestic hot water	0,0
Heat pump	0,0
Ventilators	2,2
Pumps	0,2
Cooling	0,0
Heat loss from installations, kWh/m² year	
Room heating	0,0
Domestic hot water	0,1
Output from special sources, kWh/m² year	
Solar heat	0,0
Heat pump	0,0
Solar cells	0,0
Wind mills	0,0
Total el. requirement, kWh/m² year	
El. requirement	28,1

Model:	SBi Beregningskerne 5, 11, 3, 4												
Be10 results: Institution 2010 v36													
Total energy requirement													
MWh	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Heating	28,14	22,64	13,23	6,84	4,52	4,37	4,52	4,52	4,37	5,05	14,57	24,26	137,02
El. (factor 2,5)	40,44	32,53	30,64	24,71	22,44	20,92	21,56	22,13	24,15	30,93	37,85	42,22	350,52
Excess temperature in rooms	0,00	0,00	0,00	0,00	2,43	20,14	22,31	12,52	0,00	0,00	0,00	0,00	57,41
Total	68,58	55,17	43,87	31,55	29,39	45,44	48,38	39,17	28,52	35,98	52,43	66,48	544,95
kWh/m²	6,8	5,5	4,4	3,1	2,9	4,5	4,8	3,9	2,8	3,6	5,2	6,6	54,4
Heat requirement. External supply to building													
MWh	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Boiler/district heating	28,14	22,64	13,23	6,84	4,52	4,37	4,52	4,52	4,37	5,05	14,57	24,26	137,02
Gas radiators	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Gas water heaters	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Cooling	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Total	28,14	22,64	13,23	6,84	4,52	4,37	4,52	4,52	4,37	5,05	14,57	24,26	137,02
kWh/m²	2,8	2,3	1,3	0,7	0,5	0,4	0,5	0,5	0,4	0,5	1,5	2,4	13,7
El. requirement. External supply to building. Building service													
kWh	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Central heating plant	440	401	266	0	0	0	0	0	0	0	348	412	1867
Domestic hot water	39	35	39	37	39	37	39	39	37	39	37	39	455
Ventilation plant	3596	3248	2702	1454	501	216	184	298	963	2266	3480	3596	22505
Boiler/district heating	52	47	52	50	52	50	52	52	50	52	50	52	611
Heat pump	0	0	0	0	0	0	0	0	0	0	0	0	0
Solar heat	4	3	4	4	4	4	4	4	4	4	4	4	44
Room heating	0	0	0	0	0	0	0	0	0	0	0	0	0
Local el. water heaters	0	0	0	0	0	0	0	0	0	0	0	0	0
Cooling	0	0	0	0	0	0	0	0	0	0	0	0	0
Lighting	12048	9279	9194	8338	8381	8061	8344	8460	8606	10010	11222	12784	114729
Total for building service	16178	13014	12256	9884	8976	8369	8622	8853	9660	12370	15142	16887	140210
kWh/m²	1,6	1,3	1,2	1,0	0,9	0,8	0,9	0,9	1,0	1,2	1,5	1,7	14,0
El. requirement. External supply to building. Other el. consumption													
kWh	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Other lighting	0	0	0	0	0	0	0	0	0	0	0	0	0
Equipment	11987	10827	11987	11601	11987	11601	11987	11987	11601	11987	11601	11987	141142
Total for other	11987	10827	11987	11601	11987	11601	11987	11987	11601	11987	11601	11987	141142
kWh/m²	1,2	1,1	1,2	1,2	1,2	1,2	1,2	1,2	1,2	1,2	1,2	1,2	14,1
El. requirement. External supply to building. Total el. requirement													
kWh	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
The building	28165	23841	24243	21485	20964	19969	20610	20840	21261	24358	26742	28874	281352
Solar cell performance	0	0	0	0	0	0	0	0	0	0	0	0	0
Wind mill performance	0	0	0	0	0	0	0	0	0	0	0	0	0
Resulting el. requirement	16178	13014	12256	9884	8976	8369	8622	8853	9660	12370	15142	16887	140210
El. for heating	0	0	0	0	0	0	0	0	0	0	0	0	0
El. for other purpose than heating	16178	13014	12256	9884	8976	8369	8622	8853	9660	12370	15142	16887	140210
Room heating, Heating requirement													
MWh	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
In rooms	17,53	12,90	3,89	0,00	0,00	0,00	0,00	0,00	0,00	0,00	7,28	14,81	56,41
Heat coil	6,09	5,66	4,82	2,47	0,00	0,00	0,00	0,00	0,00	0,52	2,92	4,93	27,41
Pipe loss	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Total	23,62	18,56	8,71	2,47	0,00	0,00	0,00	0,00	0,00	0,52	10,20	19,74	83,83
Total, kWh/m²	2,4	1,9	0,9	0,2	0,0	0,0	0,0	0,0	0,0	0,1	1,0	2,0	8,4
Room heating, Fulfilment of heat requirement													
MWh	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Boiler/district heating	23,62	18,56	8,71	2,47	0,00	0,00	0,00	0,00	0,00	0,52	10,20	19,74	83,83
Solar heating plant	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Heat pump	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
El. heating of rooms	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00

Total	4,52	4,08	4,52	4,37	4,52	4,37	4,52	4,52	4,37	4,52	4,37	4,52	53,18
kWh/m²	0,5	0,4	0,5	0,4	0,5	0,4	0,5	0,5	0,4	0,5	0,4	0,5	5,3

Domestic hot water, Fulfilment of heating requirement

MWh	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Boiler/district heating	4,52	4,08	4,52	4,37	4,52	4,37	4,52	4,52	4,37	4,52	4,37	4,52	53,18
Solar heating plant	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Heat pump	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
El. heating of central water container	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
El. tracing of DHW pipes	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Local el. water heaters	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Local gas heaters	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Total	4,52	4,08	4,52	4,37	4,52	4,37	4,52	4,52	4,37	4,52	4,37	4,52	53,18

El. requirement in heating plant

kWh	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Direct room heating	0	0	0	0	0	0	0	0	0	0	0	0	0
Pumps	440	401	266	0	0	0	0	0	0	0	348	412	1867
Total	440	401	266	0	0	0	0	0	0	0	348	412	1867
kWh/m²	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,2

El. requirement in hot-water discharge plant

kWh	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
El. heating of central water container	0	0	0	0	0	0	0	0	0	0	0	0	0
El. tracing of DHW pipes	0	0	0	0	0	0	0	0	0	0	0	0	0
Charging pump	1	1	1	1	1	1	1	1	1	1	1	1	17
Circulating pump	37	34	37	36	37	36	37	37	36	37	36	37	438
Total	39	35	39	37	39	37	39	39	37	39	37	39	455
kWh/m²	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0

El. requirement in ventilation plant

kWh	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Heat coils	0	0	0	0	0	0	0	0	0	0	0	0	0
Ventilators	3596	3248	2702	1454	501	216	184	298	963	2266	3480	3596	22505
Total	3596	3248	2702	1454	501	216	184	298	963	2266	3480	3596	22505
kWh/m²	0,4	0,3	0,3	0,1	0,0	0,0	0,0	0,0	0,1	0,2	0,3	0,4	2,2

Boiler/district heating exchanger, Heat

MWh	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Performance	28,14	22,64	13,23	6,84	4,52	4,37	4,52	4,52	4,37	5,04	14,57	24,26	137,01
Consumption	28,20	22,69	13,29	6,90	4,52	4,37	4,52	4,52	4,37	5,10	14,63	24,33	137,45
Utilizable heat loss	0,06	0,06	0,06	0,06	0,00	0,00	0,00	0,00	0,00	0,05	0,06	0,06	0,43
Efficiency	100	100	100	99	100	100	100	100	100	99	100	100	100

Boiler/district heating exchanger, El. requirement

kWh	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Burner, kWh	0	0	0	0	0	0	0	0	0	0	0	0	0
Automatics, kWh	52	47	52	50	52	50	52	52	50	52	50	52	611
Total	52	47	52	50	52	50	52	52	50	52	50	52	611
kWh/m²	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,1

Heat pump, Heat

MWh	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Performance, Room heating	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Performance, DHW	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Total	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Contribution ratio, room heating	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	
Contribution ratio, DHW	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	

Heat pump, El. requirement

kWh	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
El. requirement, room heating	0	0	0	0	0	0	0	0	0	0	0	0	0
El. requirement, stand-by room heating	0	0	0	0	0	0	0	0	0	0	0	0	0
El. requirement, DHW	0	0	0	0	0	0	0	0	0	0	0	0	0
El.													

stand-by DHW													
Total	0	0	0	0	0	0	0	0	0	0	0	0	0
kWh/m²	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Solar heating plant, Heat													
MWh	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Performance, Room heating	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Performance, DHW	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Total	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Contribution ratio, room heating	0,00	0,00	0,00	0,00	1,00	1,00	1,00	1,00	1,00	0,00	0,00	0,00	
Contribution ratio, DHW	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	
Solar heating plant, El. requirement													
kWh	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Pump	0	0	0	0	0	0	0	0	0	0	0	0	0
Automatics	4	3	4	4	4	4	4	4	4	4	4	4	44
Total	4	3	4	4	4	4	4	4	4	4	4	4	44
kWh/m²	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
El. requirement for lighting. Included in the building's performance													
kWh	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
General during service life	10163	7577	7309	6514	6496	6237	6459	6575	6782	8125	9398	10899	92534
General stand-by when not in service	0	0	0	0	0	0	0	0	0	0	0	0	0
Working lights in service life	1885	1703	1885	1824	1885	1824	1885	1885	1824	1885	1824	1885	22195
Total	12048	9279	9194	8338	8381	8061	8344	8460	8606	10010	11222	12784	114729
kWh/m²	1,2	0,9	0,9	0,8	0,8	0,8	0,8	0,8	0,9	1,0	1,1	1,3	11,4
El. requirement for lighting. Other lighting													
kWh	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
During service	0	0	0	0	0	0	0	0	0	0	0	0	0
Night consumption	0	0	0	0	0	0	0	0	0	0	0	0	0
Basement													

car parkings													
Outdoor lights	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0	0	0	0
kWh/m²	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
El. requirement for epuipment													
kWh	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Equipment	11987	10827	11987	11601	11987	11601	11987	11987	11601	11987	11601	11987	141142
Night consumption, equipment	0	0	0	0	0	0	0	0	0	0	0	0	0
Special equipment during service	0	0	0	0	0	0	0	0	0	0	0	0	0
Special equipment always	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	11987	10827	11987	11601	11987	11601	11987	11987	11601	11987	11601	11987	141142
kWh/m²	1,2	1,1	1,2	1,2	1,2	1,2	1,2	1,2	1,2	1,2	1,2	1,2	14,1
Solar cells and wind mills													
kWh	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Total el. requirement	28165	23841	24243	21485	20964	19969	20610	20840	21261	24358	26742	28874	281352
Solar cells	0	0	0	0	0	0	0	0	0	0	0	0	0
Wind mills	0	0	0	0	0	0	0	0	0	0	0	0	0
Total performance	0	0	0	0	0	0	0	0	0	0	0	0	0
Balance	-28165	-23841	-24243	-21485	-20964	-19969	-20610	-20840	-21261	-24358	-26742	-28874	-281352
Surplus	0	0	0	0	0	0	0	0	0	0	0	0	0
Adjustment of performance	0	0	0	0	0	0	0	0	0	0	0	0	0
Solar cells, included	0	0	0	0	0	0	0	0	0	0	0	0	0
kWh/m²	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Wind mills, included	0	0	0	0	0	0	0	0	0	0	0	0	0
kWh/m²	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Net heating requirement in rooms													
MWh	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Heat loss	54,18	49,58	48,99	38,50	26,33	17,03	14,30	14,77	22,74	31,53	40,33	49,46	407,76

solar radiation	6,50	12,37	23,77	39,65	54,57	55,35	53,51	43,11	29,84	15,72	7,03	4,01	345,42
Internal supplement	32,03	27,32	29,17	27,67	28,36	27,40	28,32	28,44	27,94	29,99	30,56	32,76	349,96
From pipes and water container	0,05	0,04	0,05	0,05	0,05	0,05	0,05	0,05	0,05	0,05	0,05	0,05	0,55
Total supplement	38,57	39,74	52,99	67,37	82,97	82,79	81,88	71,59	57,83	45,76	37,63	36,82	695,93
Relative supplement	0,71	0,80	1,08	1,75	3,15	4,86	5,73	4,85	2,54	1,45	0,93	0,74	
Utilization factor	0,95	0,92	0,81	0,56	0,32	0,21	0,17	0,21	0,39	0,66	0,87	0,94	0,58
Part of month with heating	1,00	1,00	0,65	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,98	1,00	
Heating requirement	17,53	12,90	3,89	0,00	0,00	0,00	0,00	0,00	0,00	0,00	7,28	14,81	56,41
Heating in ventilating heat surface	6,09	5,66	4,82	2,47	0,00	0,00	0,00	0,00	0,00	0,52	2,92	4,93	27,41
Net. room heating	23,62	18,56	8,71	2,47	0,00	0,00	0,00	0,00	0,00	0,52	10,20	19,74	83,83
Total, kWh/m²	2,4	1,9	0,9	0,2	0,0	0,0	0,0	0,0	0,0	0,1	1,0	2,0	5,6

Solar shield, forced vent., night vent. and cooling

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Solar shield, red. factor	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	
Forcing, share	0,00	0,00	0,25	0,58	0,86	0,94	0,95	0,92	0,72	0,37	0,00	0,00	
Night ventilation, share	0,00	0,00	0,00	0,19	0,44	0,68	0,75	0,66	0,31	0,00	0,00	0,00	
Mechanical cooling, share	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	

Mean ventilation. Sum of natural and mechanical ventilation

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
m³/s	3,90	3,90	4,25	5,45	6,83	7,90	8,19	7,78	6,14	4,41	3,90	3,90	
l/s m²	0,39	0,39	0,42	0,54	0,68	0,79	0,82	0,78	0,61	0,44	0,39	0,39	

Share of time at 26,0 °C room temperature or above

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Time sha<re	0,00	0,00	0,00	0,00	0,18	0,30	0,33	0,26	0,00	0,00	0,00	0,00	0,09

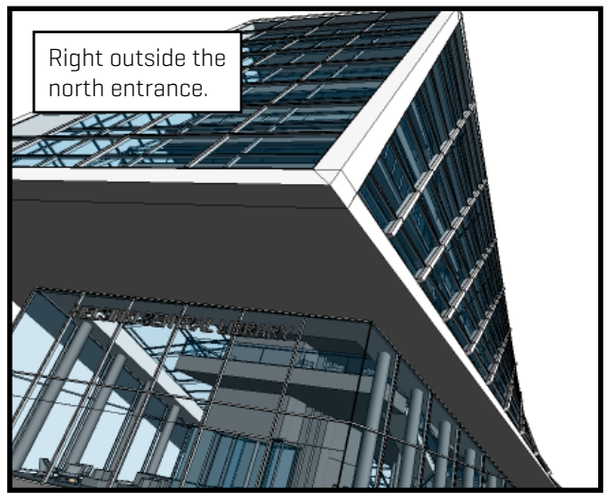
Mechanical cooling, net

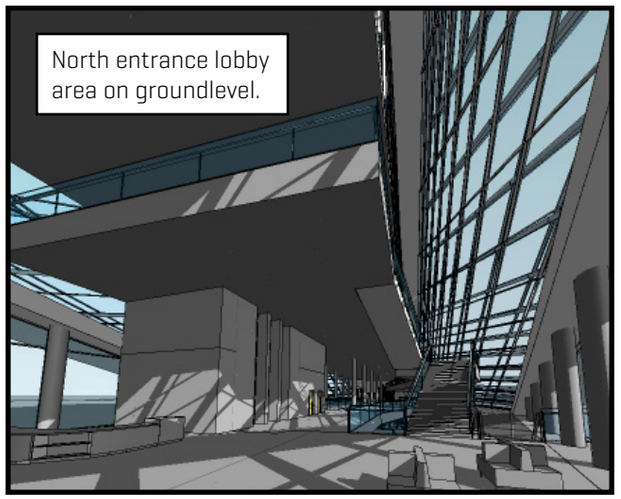
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
MWh	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
kWh/m²	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0

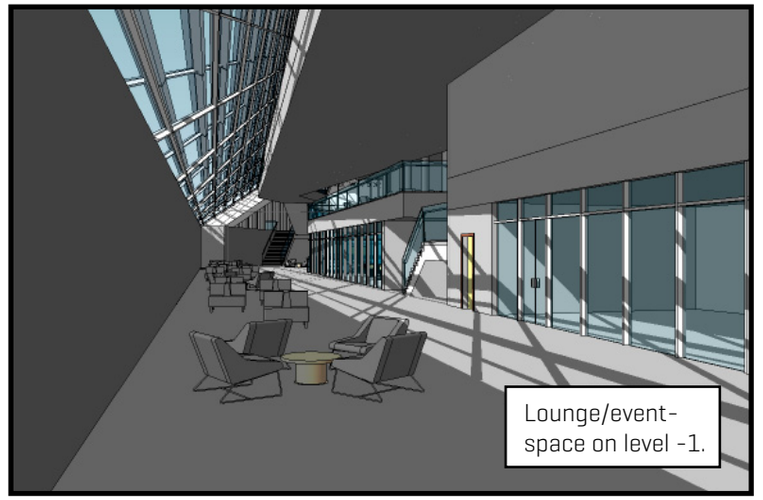
Total heat loss, W/m²

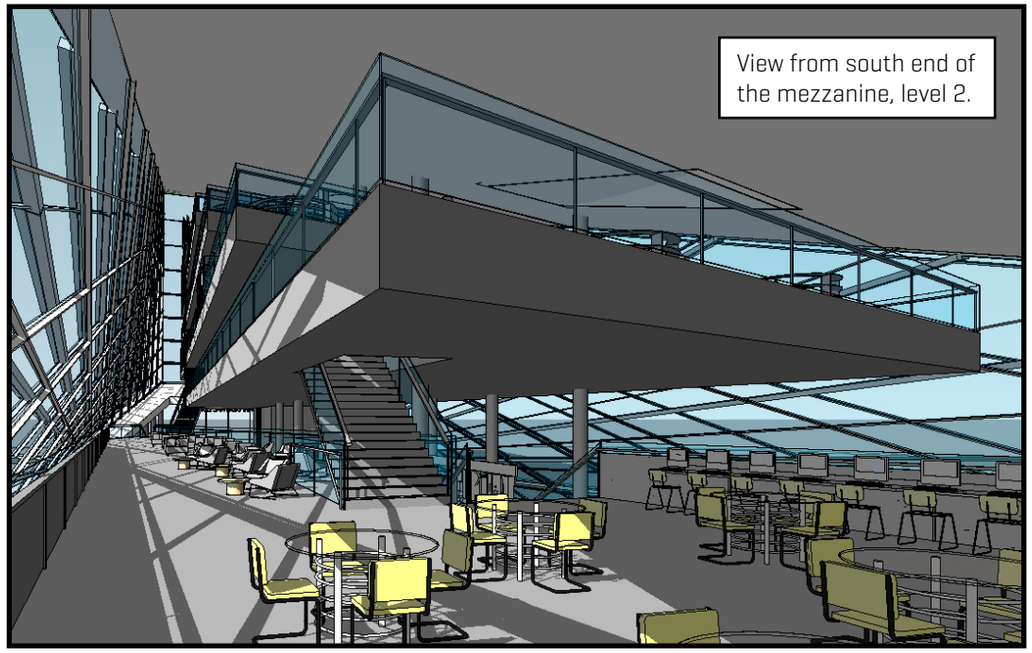
Heat loss	7,6
Ventilation without HRV in winter	49,9
Total	57,5
Ventilation with HRV in winter	12,8
Total	20,4

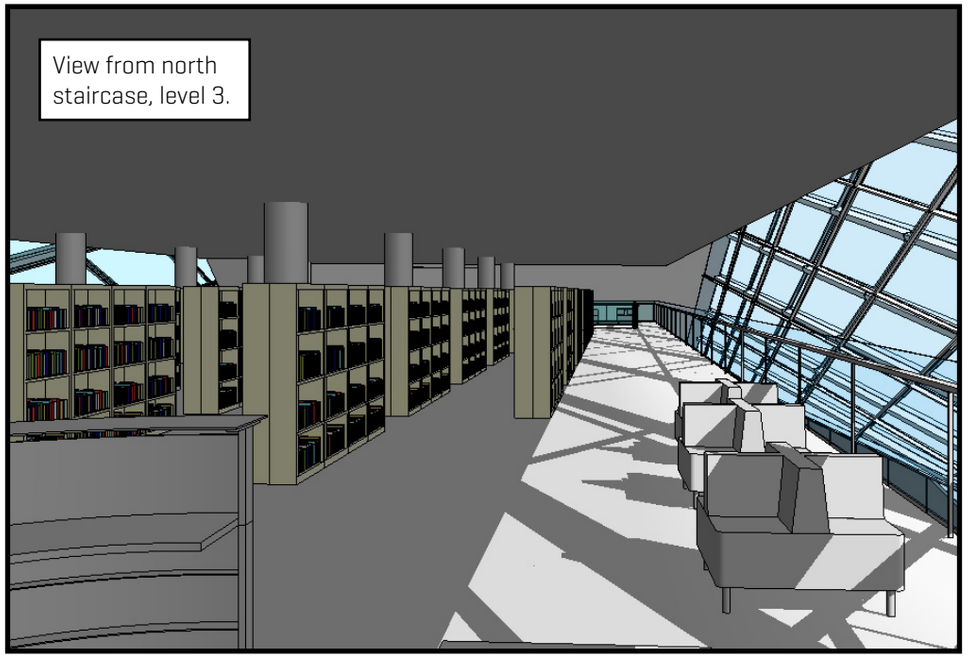
Appendix F: Interior Views in the Building

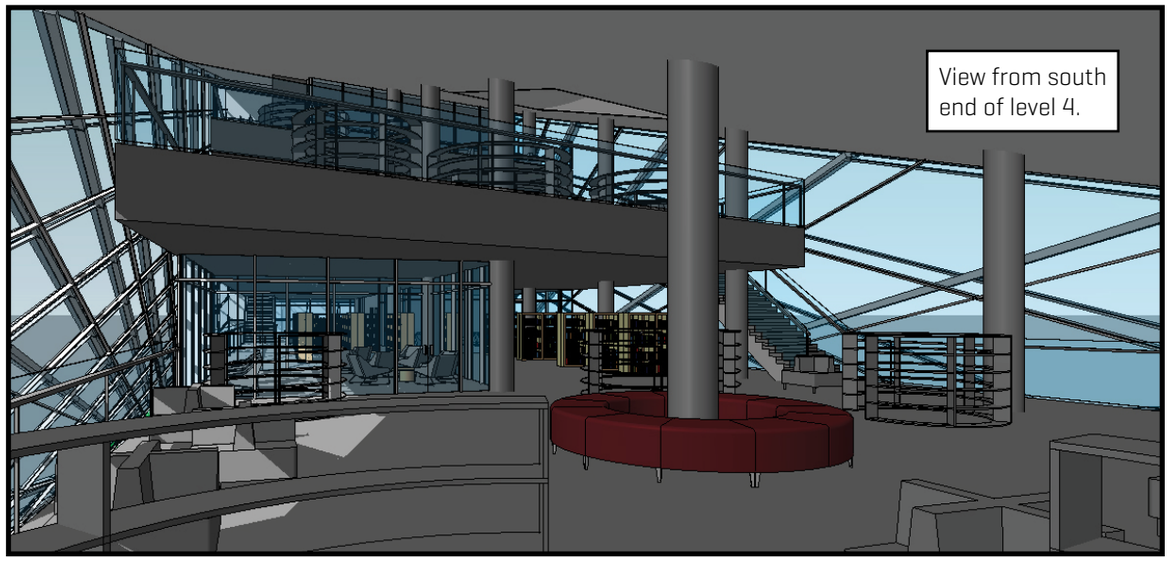


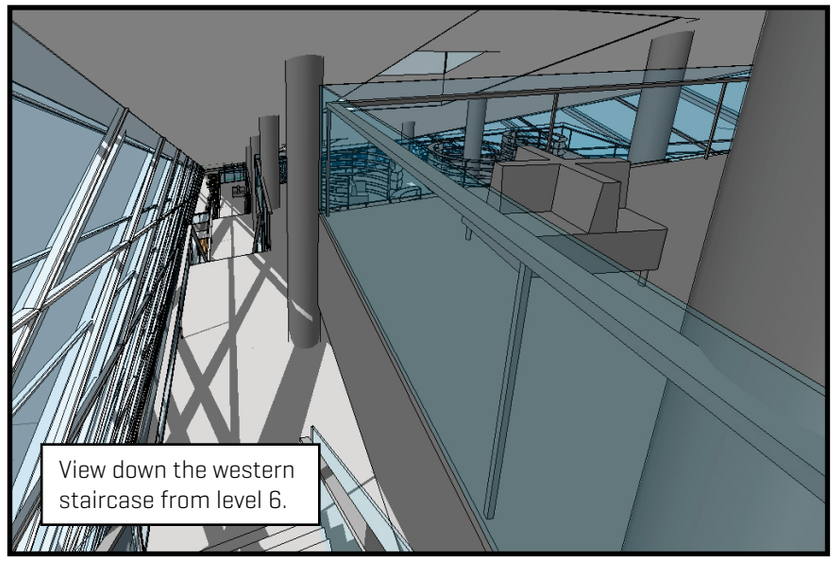


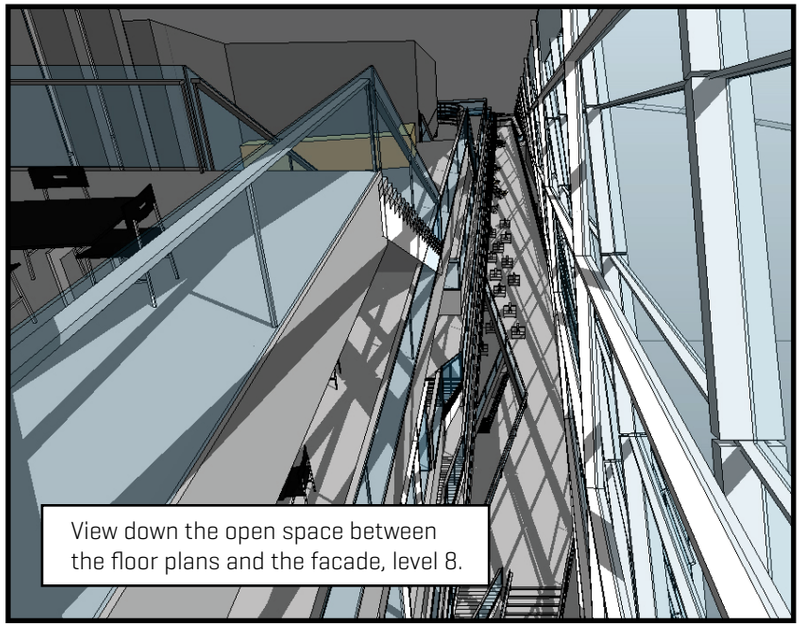


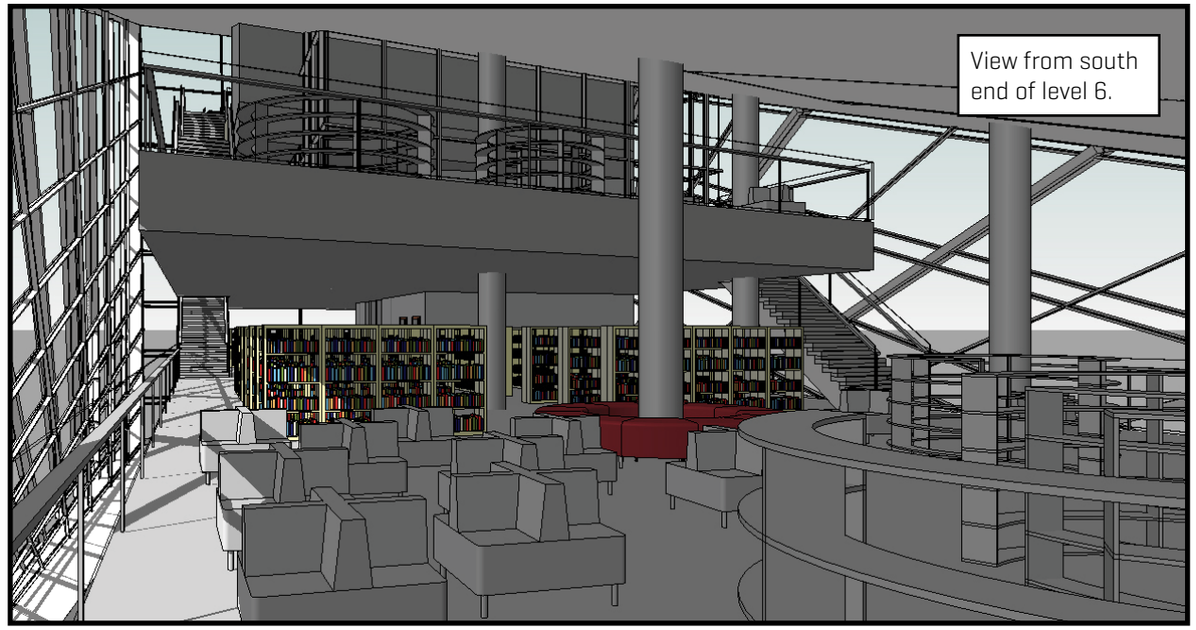





View from south
end of level 4.


View down the western
staircase from level 6.


View down the open space between
the floor plans and the facade, level 8.


View from south
end of level 6.

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ill. 2: From competition program
ill. 3: From competition program
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ill. 15: From competition material
ill. 16: From competition material
ill. 17: From competition material
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ill. 31: From competition material
ill. 32: Our own drawing
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ill. 35: From competition material

ill. 36: From competition material
ill. 37: From competition material
ill. 38: From competition material
ill. 39: From competition material
ill. 40: Own diagram, information gathered fromhttp://www.gaisma.com/en/location/helsinki.html
ill. 41: From competition material
ill. 42: Own diagram, information gathered from http://www.gaisma.com/en/location/helsinki.html
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