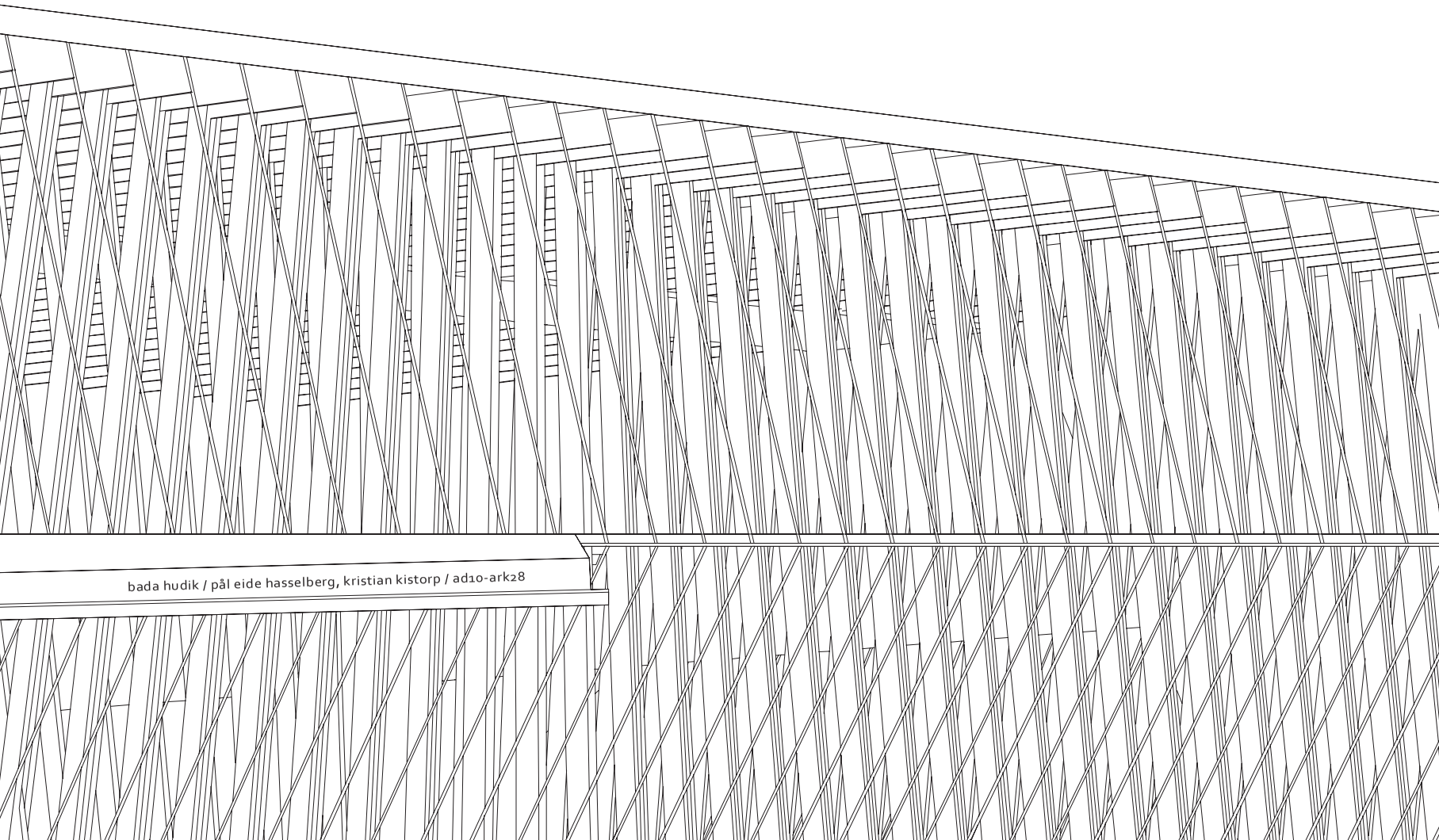
bada hudik / pål eide hasselberg, kristian kistorp / ad10-ark28

BADA HUDIK

FEB. 4th - JUN. 4th 2008

authors : Kristian Kistorp
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supervisors : Peter Mandal Hansen
Poul Henning Kirkegaard

PREFACE

This report is the result of a 10th semester architectural project, developed at the department of Architecture and Design at Aalborg University.
It describes the basis for the project, as well as the process towards the design of a bathhouse.

The design proposal is presented through a report (this booklet) and a folder holding the drawings and illustrations of the final building design.

The booklet consists of five main chapters: the assignment, analysis, sketching and conceptualizing, development and presentation. They represent different aspects of Bada Hudik's influences and process steps. The order in which the chapter and their contents are presented is more or less chronological. Hence the full understanding of the project is best caught by reading the report as a whole, from front to back. However, each chapter is structured in a manner making it possible for it to be read, and understod alone. The presentation part is complemented by a drawing folder where plans and sections are presented.

Sketching and modelling have been important for the project and its development. It has been the main media of Bada Hudik's process, and therefore fills a large part of the report. The illustration texts are placed vertically to the right of each spread. These explanations hold important information which often come as additions to the main texts, and should be read along with the rest.
Along with the explanatory texts, follows a title showing the chapter of the current spread.

All illustrations have been produced by the authors.

In addion to our supervisors, we would like to thank the good people of Hudiksvall Municipality for making us feel welcome in their town, and providing valuable information for the project.

INTRODUCTION

The offset for the assignment is an open design competition for a new bathhouse and the redesign of an old pier in the town of Hudiksvall, Sweden. Deadline for the competition was February 18th 2008. Therefore we will not be participating directly in the competition. However we have established a dialogue with the municipality and city architect, and have an open invitation to submit our design proposal to the local authorities after completion.

Our interest in this competition program was first of all triggered by the magnificent site, and the challenge to create a meeting between city and water. We were also keen on exploring the typology of an indoor swimming pool, and try to create an alternative to the stereotypic rectangular pool plan, which allows the building volume to relate more to other parameters such as the natural context. This opens up for a more site specific experience of swimming and experience of architecture.

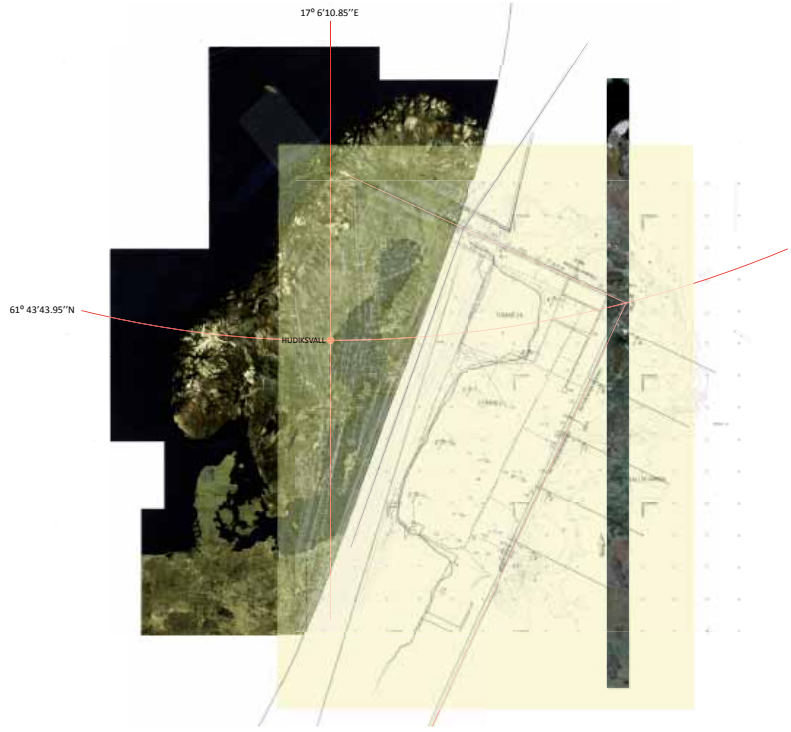
Furthermore the program and the scale of the project was well suited for an investigation into the field of parametric modelling, seeking to explore the potential of digital parametric modeller's in combination with more traditional hands on physical modelling and form finding. We wanted to see how we could use the parametric modeller Generative Components as a tool for handling complex tasks in the building; the conversion of simple principles into complex sequences. We ended up using it with success on an interior timber structure.

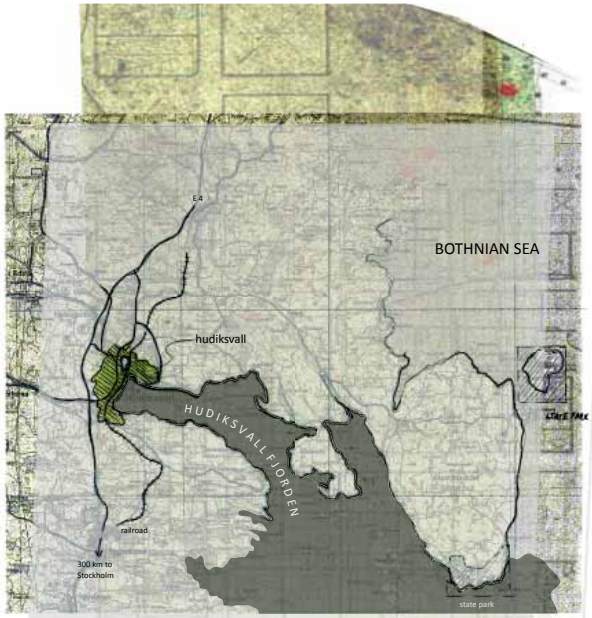
Bada Hudik is an investigation in between scales and elements. It finds inspiration in the nature and culture of Hudiksvall and translates it into a bathhouse that becomes icon, public sphere and catalyst for the development of the harbor front.

panoramic collage of the view from the allocated site for the bathhouse

THE ASSIGNMENT

This chapter provides an introduction on the town of Hudiksvall. The site's characteristics and history, along with the municipality's visions for the area. The main objectives in the design competition are explained with our interpretation and focus along with a description of the aims and elements of the design competition. Our interpretation and focus are presented as a priority between three levels /areas for design, where the bathhouse, area 1, is prioritized.


17° 6'10.85''E
61° 43'43.95''N
HUDIKSVALL


E4
BOTHNIAN SEA
hudiksvall
HUDIKSVALL FJORDEN
railroad
300 km to
Stockholm
state park

HUDIKSVALL

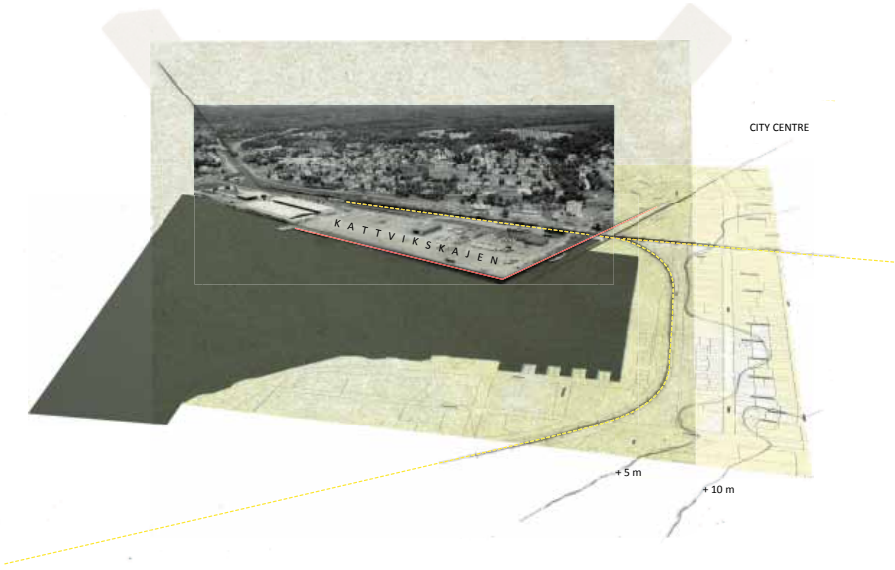
Hudiksvall lies on the western shore of the Bothnian Sea 300 km north of Stockholm. Founded in 1582, the town has a long history revolving around heavy industry, trade and shipping. Trees from the great inland forests supplied the timber that formed the basis of the trade and shipping industry. The need for efficient transportation brought the railway to Hudiksvall in 1860, it was used to transport timber from Forsa just west of Hudiksvall to the harbour where it was loaded unto ships for further transport.

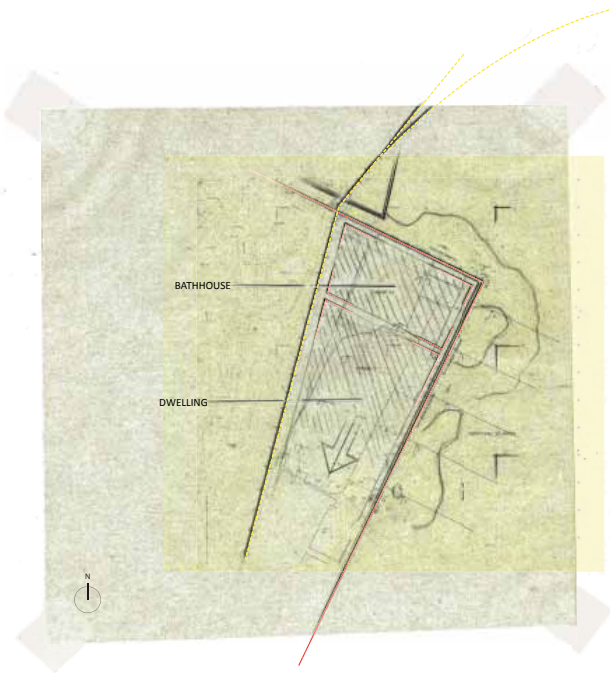
Up till this day, signs of the timber industry are still visible throughout the townscape. Iggesund sawmill still owns big warehouses in Hudiksvall harbour. A series of abandoned railway tracks remain after timber was transported by freight. The warehouses are more or less abandoned and serve as ad hoc storage for campers and cars. Other industrial buildings are still in use and expanding, like the hydraulic factory that overlooks the harbour and city centre from a small hill to the south of the harbour basin.

The fjord narrows towards the city centre and creates a natural harbor basin overlooked from the sloping terrain that falls towards the water, and treats the surrounding buildings with a prime view over the harbor and further out the fjord towards the open sea.

In essence, Hudiksvall can simply be translated to an image with fjord as foregound, city as focus, and forest hills painting the landscape in the background.

opposite top: ortho scandinavia hudiksvall / opposite bottom: hudiksvall fjord location


KATTVIKSKAJEN
CITY CENTRE
+ 5 m
+ 10 m


BATHHOUSE
DWELLING
N

SITE

The official site for the new bathhouse is at the north-eastern corner of Kattvikskajen, a central location in the harbour basin. The geology of the area, in combination with the history of Hudiksvall, ties the city to the water and the harbour basin. Storage and shipment of timber, which used to be the function of the site, has been moved further south, to the town of Iggesund. Big warehouses along the harbour in Hudiksvall bears witness of the days when timber was transported by ships along the waterways. Kattvikskajen, a landfill in the middle of the harbour, is a leftover from this time, when timber and other types of goods were stacked along the pier and transferred to and from ships.

The corner of Kattvikskajen has developed over the years, from a simple pier with an old bathhouse, to an industrialized landfill for the shipping industry, and serves today as a parking facility in connection to the bus- and train station. The location is connected to a channel which is lined with Hudiksvall's characteristic red boat houses, which have become symbol of the city. The channel continues through the city centre to a lake that emerged as a result of land elevation after the icecap from the last ice age retreated.

The site is dominated by two main directions along the existing pier. One is flanked by the channel outlet and ties city centre to the harbor basin. The other stretches along the length of Kattvikskajen and ties the old wood house part of town, through the harbor-basin, to Kattvikskajen and the fjord landscape. These two directions become important parameters in the conceptualization of a building layout (see sketching and conceptualization: perpendicular directions).
Another characteristic of the site today is the vast openness, and feeling of desertion. The challenge is to provide a new topology and characteristic to this blank canvas.

opposite top: kattvikskajen and harborbasin / opposite bottom: kattvikskajen future plans
this: historic photo kattvikskajen

AN OPEN DESIGN COMPETITION

The municipality of Hudiksvall has recently purchased Kattvikskajen and plan to bring life back to the deserted piece of land. The transformation from a leftover landfill to an active part of the town and harbourfront is kicked off through an open design competition for a bathhouse.

There is already a vision for a residential area at Kattvikskajen, but a final decision has yet to be made. To comply with this future vision we adjust adjust part of our assignment to include a rough sketch of this area. This will allow for a less restrained design of the bathhouse, and a more coherent landscape. The dwellings will be located to the south overlooking the fjord, and the new bathhouse to the north in the same location as the old bathhouse, which was demolished in the 1940's.

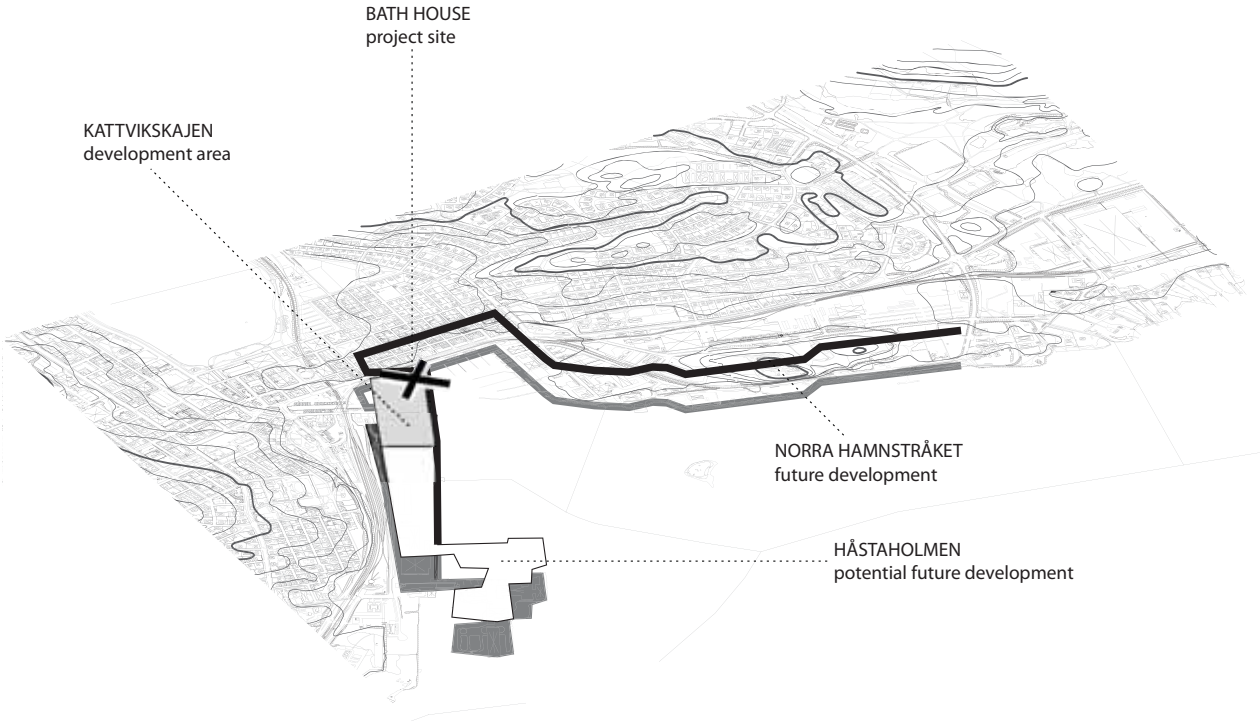
An excerpt from the program states the goal of the competition:

"The old bathhouse of Hudiksvall, built in the fifties served the town well over many years. Once it was the finest bathhouse in the region. Now it's time to build a new bathhouse. The funds are there and there is political consensus.

We have chosen a site on historical grounds in the middle of Hudiksvall harbour district where the old Fernes harbourbath was situated. The new bathhouse of Hudiksvall is to become an intriguing landmark, and serve as a catalyst for the transformation of the old docklands around Hudiksvallfjorden."

the assignment

top: hudiksvall and fjord / bottom: kattvikskajen


BATH HOUSE
project site
KATTVIKSKAJEN
development area
NORRA HAMNSTRÅKET
future development
HÅSTAHOLMEN
potential future development

MEETING THE LOCAL AUTHORITY

To get a first hand impression of the site and Hudiksvall we went on a three day trip to Hudiksvall. The trip was performed in winter; from the 13th till the 16th of February 2008, and involved documenting the site and the surrounding areas through sketches, photos and general mapping. Part of the research done on this trip is presented in the analysis chapter.

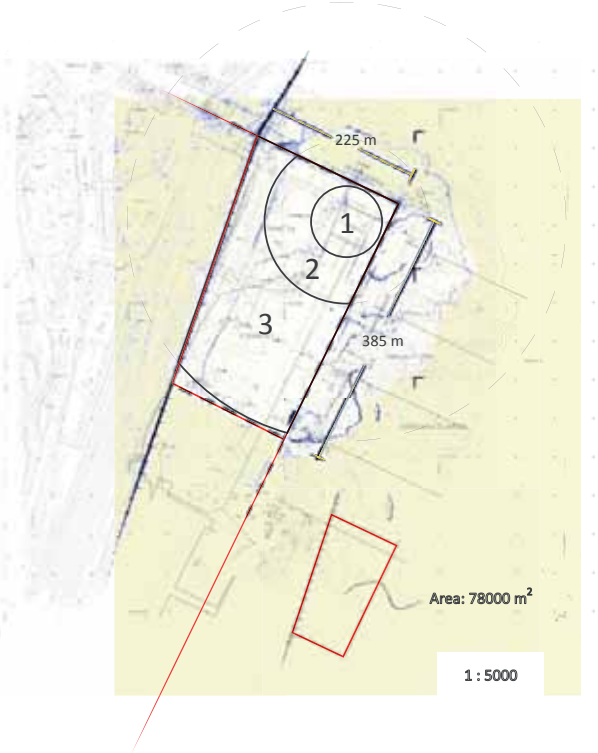
Prior to the trip, we had correspondence with Hudiksvall Municipality, and arranged a meeting with planning officer Lars Persson and the city architect Mats Gradh who both welcomed us with great interest and enthusiasm. We received information about the bathhouse and Kattvikskajen, in addition to local culture and history:

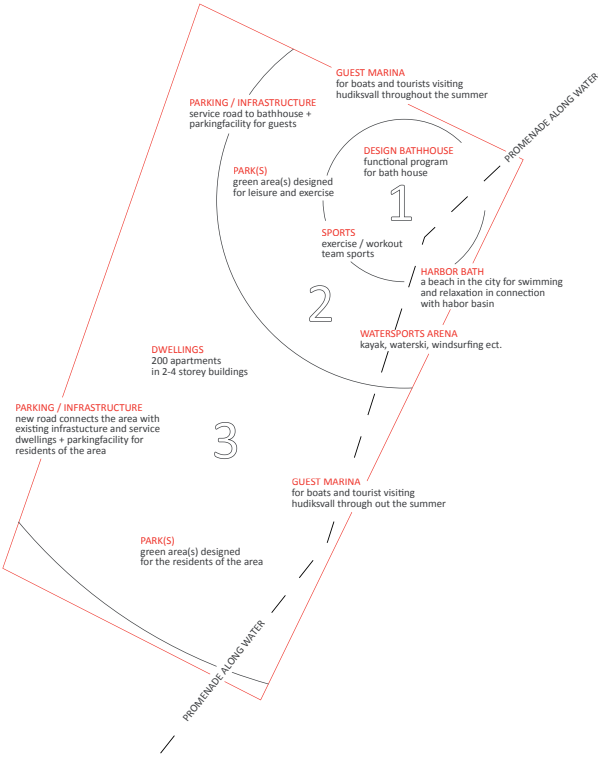
The town has an yearly growth of about 75 housings. Kattvikskajen will be a big step with approximately 200 apartments planned. The attractive location is most likely to cater to the middle- and upper middle class.

The municipality wishes to create a coherent environment surrounding the harbour basin. A continuous promenade along the edge of the water, starting at Kattvikskajen, lining the northern quay/Hamngatan and continuing along the water passing Köpmannsberget, all the way to the CHP-plant (combined heat and power plant)."Emphasis on life and qualities for pedestrians should be in focus. What's the name of that dane?..–Jan Gehl!"

In addition to the development of Kattvikskajen, there is a parallel vision for Norra Hamn Stråket, the area from Hamngatan to the CHP plant. The remaining part of the quay, south of Kattvikskajen, and the peninsula Håstaholmen will probably also be developed in the future. Everything aims towards the harbor basin; the bath's location and program, making it the natural centrepiece of the area.

The vision for the area as presented by the municipality combined with the program for the design competition form the basis of the project.


225 m
385 m
1
2
3
Area: 78000 m²
1 : 5000


GUEST MARINA
for boats and tourists visiting
hudiksvall throughout the summer
PARKING / INFRASTRUCTURE
service road to bathhouse +
parkingfacility for guests
PROMENADE ALONG WATER
DESIGN BATHHOUSE
functional program
for bath house
PARK(S)
green area(s) designed
for leisure and exercise
1
SPORTS
exercise / workout
team sports
HARBOR BATH
a beach in the city for swimming
and relaxation in connection
with habor basin
2
WATERSPORTS ARENA
kayak, waterski, windsurfing ect.
DWELLINGS
200 apartments
in 2-4 storey buildings
PARKING / INFRASTRUCTURE
new road connects the area with
existing infrastucture and service
dwellings + parkingfacility for
residents of the area
3
GUEST MARINA
for boats and tourist visiting
hudiksvall through out the summer
PARK(S)
green area(s) designed
for the residents of the area
PROMENADE ALONG WATER

FUNCTIONAL PROGRAMMING

Filtering of the material supplied by the municipality combined with the functional program leads to an initiating problem:

To design a new bathhouse for the town of Hudiksvall, and develop a rough design scheme for the future development of Kattvikskajen.

However the sheer size of the site calls for a more detailed description of the initial problem, in order to localize the different foci of the project; subsequently the site, and the project, are subdivided into three main areas.

The subdivision of the area into 3 prioritized zones helps guide the focus of the project towards a designscheme for the bathhouse, which will influence, and spread to the rest of the area. Thus turning Kattvikskajen into a consistent area through a 3 step process, starting with the building of a new bath house, followed by the development of the surrounding area.

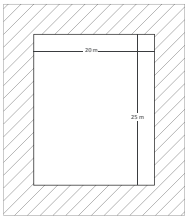
Area 1, holds the functions of the bath house.

Area 2, the perimeter of the bathhouse, is programmed with functions that support the bath, and the overall theme of water, sport and recreation.

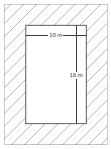
Area 3 is programmed with basic functions, such as dwellings and infrastructure that service the different buildings, parks and parking facilities.

Aside from the overall theme of water, sport and recreation, the areas are tied together by a promenade that runs along the water and helps connect them to the city centre north of Kattvikskajen.

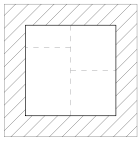
Area 1 is the part for which we produce a sketch design. The other zones are part of the rough design ideas for Kattvikskajen (expressed in Landscape workshop2 page 82).



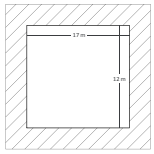
+MAIN BASSIN
500 m2 + ekstra 500 m2



+LERNERS POOL
160 m2 + ekstra 160 m2



+HOT POOL(S)
possibly in sections
220 m2 + ekstra 200 m2

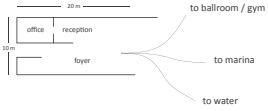


DIVING POOL
depth min 5 m
200 m2 + ekstra 200 m2

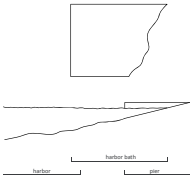
+CHANGE MEN
120 persons
150 m2 + sauna 10 m2

+CHANGE WOMEN
120 persons
150 m2 + sauna 10 m2

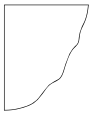
+STORAGE ROOM(S)
? m2



+RECEPTION / FOYER
100-200 m2



+HARBOR BATH
in connection to pier
? m2



+TECHNICAL ROOM(S)
for pumps and water treatment
? m2

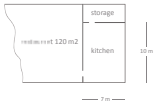
+SUN TERRACE
flexible outdoor area
? m2

SAUNA MEN + WOMEN
15 persons
15 m2

The functional program for the bathhouse, (area 1) is the result of a refinement of the list supplied by the municipality. All excess rooms and function have been removed, resulting in a simple program that serves as offset for the building design.

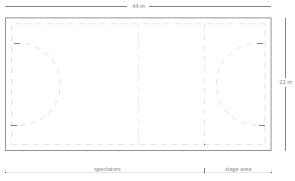
It is divided between core functions (in red) and optional functions. The core functions are those we see as essential for the bathhouse, and must be included in some form. The optional ones are more dynamic and present functions that might find their way into the final design scheme. Some of these may also be transferred to the program of zone 2.

The estimated total area of the bathhouse is thought to be between 3000-3500 m2, including the exterior terrace. The size is an approximation and will be fine-tuned throughout the design process.



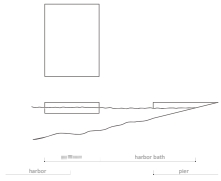
RESTAURANT + KITCHEN (75 PERS)
toilet facilities incorporated in foyer
200 m2

FITNESS
can be split into 2 seperate rooms
200 m2



BALL ROOM / GYM
for indoor sports and events
970 m2 + storage ? m2

CONFERENCE ROOMS
70 m2



FLOATING PONTOON FOR SWIMMERS
possibly extended with harborbath/pool
min. 100 m2

the assignment

diagrammes showing initial sizes of functional program
opposite : functional program for area 1, the bathhouse
this : optional program for area 2, surrounding the bathhouse

ANALYSIS

This chapter explains Bada Hudik's investigations and registrations. To help the design process and to get an impression of Hudiksvall and the site, we went on a three day study trip to the town. The trip involved documenting the site and the surrounding areas through interviews, sketches, photography and general mapping.

The chapter offers an insight into Hudiksvall's tourism and activities, and the potential user group of the bathhouse, along with a phenomenological investigation of the contex .

This resulted in the emergence of three elements which became important inspiration for the rest of the project; wood, water and land. In addition an analysis of climate data gives an idea of which strategies can be used for reducing energy consumption while maintaining comfort levels.

TOURISM; WELCOME TO GLADA HUDIK

During our trip we visited the office of tourism to find out what Hudiksvall has to offer. The tourist season in Hudiksvall is concentrated around the summer months, between May and September. Visitors in boats stop by the harbor for gas and supplies on their way up north along the coast, as the only gas station for many miles is located in Hudiksvall. The majority come for relaxation and the opportunity to spend time with their relatives. More than 80% of the tourists have family or friends in the area. The opportunities for leisure are many, with the sea as a prime resource.

Activity in Hudiksvall's harbour basin changes following the seasons of the year. Sailing is very popular, and the central location of the marina connects the boating community directly to the city centre. Two times a year, large shoals of herring colour the water with live silver, and fishermen gather along the quays and piers hauling in the fish.

Another preferred activity is going to the long sand beaches east of town. However, this requires a car, as it is of some distance to the town centre. It is also possible to do water sports such as jet-skiing, wakeboarding, and windsurfing.

Further east on Hornslandet, the unique nature showcase the meeting between the rough sea and old pine forest. This area, rich in wildlife, used to be an archipelago, but has unified to a large peninsula due to the land elevation, which is still ongoing after the thick ice melted 6-7000 yrs ago. The area is protected by Sveaskog as an ecopark and is ideal for camping and fishing.

USER GROUP

To facilitate the process of designing a new bathhouse for Hudiksvall it is necessary to consider who we will be designing for. The open design competition was created by the municipality of Hudiksvall, making the town of Hudiksvall the client - more precisely the citizens of Hudiksvall.

Hudiksvall presents itself as a fairly homogeneous middle size town. It is one of the largest towns in the area, housing middle schools and a gymnasium collecting teens from the surroundings. It also holds many shops and a small variety of restaurants and pubs, which serve as attractions for people living in the villages and isolated houses from the surrounding countryside.

Throughout winter, the hotels in Hudiksvall make a living by arranging conferences. Otherwise the town does not receive many visitors in this season. Come summer, Hudiksvall is visited by tourists that arrive by car or by boat to experience the town, visit old farms in the area that have been turned into cultural centres, or enjoy the surrounding nature and beautiful scenery along the fjord. This fluctuation between summer and winter, suggest that the bathhouse and the area around Kattvikskajen will be visited more throughout the summer months than during the winter.

Observing the people moving around the city in winter, we saw three groups that were of larger representation; the elderly, families with young children, and young teenagers. The typical student segment was missing, which is quite natural as the town does not have a college. The young adults we did see typically worked at cafés, or cruised around in what locally can be referred to as "raggar" cars (often stylish Volvos, more than twenty years old), a cultural phenomena in the province, well known in Sweden.

The demographical composition of Hudiksvall, combined with the aspect of spare time for the different groups, produce a simple estimate of who will be using the bathhouse and at what time:

Morning-afternoon: Elderly, babies/parents
Afternoon-evening: Children
Evening: Families, teenagers, adults
Weekends: Families

Schools and other institutions will probably be able to book parts of the bath at daytime. It is normal that swimming clubs get assigned times in the evening, and sometimes entire weekends to host competitions. The hotels might also be interested in booking the bath in connection to some of the conferences they arrange.


WOOD


WATER


LAND

3 ELEMENTS

Through our trip, three elements emerged as very present in both past and present relations to the site and region. Wood, Water, and Land have become categories of inspiration for the design process.

Hudiksvall grew up, based on a strong timber industry combined with its location by the fjord. The fjord is a strong land feature which provides shelter from the heavy weather of the Bothnian Sea. Much of the land that the city rests upon is a result of land elevation. Forestry has dominated the entire region, and in turn made space for cultivated land. The landscape typologies change from glacially formed skerries and small fishing villages on the coast to deep forests and thousand year old villages inland.

WOOD : resource, industry, texture, permeability. The source of economy and mystique of the region.

WATER : surface, states, culture, patterns. The projects dominating element.

LAND : history, formations, layers, minerals. The broad context that holds the other elements.

The investigation of water, wood and land, in combination with the mappings, serve as the basis for the form finding process, where the information, which has been collected and analyzed through collages and sketches, help inspire the actual design of the bath house, and the reshaping of Kattvikskajen.

References to the three categories have influenced the design of the building, and are presented in connection to various aspects of the building design.

MAPPING HUDIKSVALL

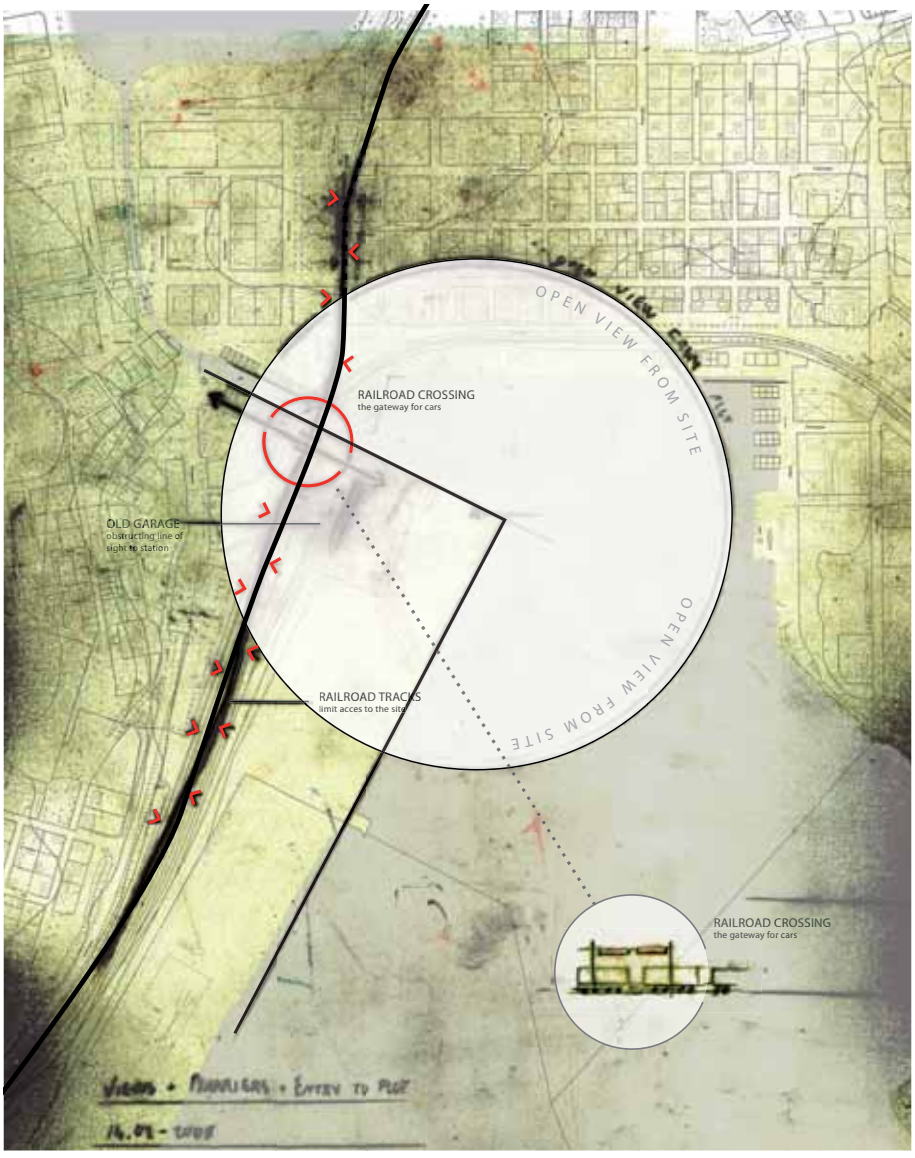
The study trip to Hudiksvall was used to gather information and interpret the context. Mappings are used to grasp the area, the site, and the immediate context surrounding the site. Different maps are created through collages that highlight the characteristics of the site such as materiality, lines of sight, access and infrastructure. Interpreting the context, and working with it through graphics and sketches, form the basis for a deeper understanding of the site and its characteristics, and ultimately eases the process of designing a building specifically for the site.

MATERIAL TYPOLOGY WOOD, STONE AND STEEL

The area is dominated by three main categories of materials in continuum. The small ridge stretching along the northern quay, where the fishermen's village used to be, is dominated by traditional tree houses. Wood is also very much present at the waterline in "Fiskarbodarna" and "Sjøbodarna" (the red and black boathouses) along with the yellow warehouses.

The western flank of the city is built of stone, bricks and concrete, much a result of fire destroying previous timber structures. Here the buildings also tend to be taller than two storeys in height.

The third material is steel. The railroad slices through the city mass as a linear dynamic element. Edges along the quay are reinforced by rusty steel profiles and warehouses are clad in corrugated metal sheets.
The final bathhouse design creates communication between timber as material in the bathhouse and the wood part of town. The same relationship is established for a concrete façade and the stone part of town.


OPEN VIEW FROM SITE
RAILROAD CROSSING
the gateway for cars
OLD GARAGE
obstructing line of
sight to station
RAILROAD TRACKS
limit acces to the site
OPEN VIEW FROM SITE
RAILROAD CROSSING
the gateway for cars

BARRIERS, VIEWS AND ENTRY TO SITE

The railroad to the west of the site is a major barrier, cutting the site of from the railroad and bus station that is located on the other side of the tracks. Today the only point of entry for cars to the site is through the railway crossing that serves as a gate to Kattvikskajen. Pedestrians can use the old railway bridge to cross the small channel, Sundskanalen that runs to the north of the site.

In contrast to the restricted access from the west, the site is open and easily accessible from the water that borders the site towards the north, south and east. The prime location offers a panoramic view over the city, the harbor and the nature along the fjord.

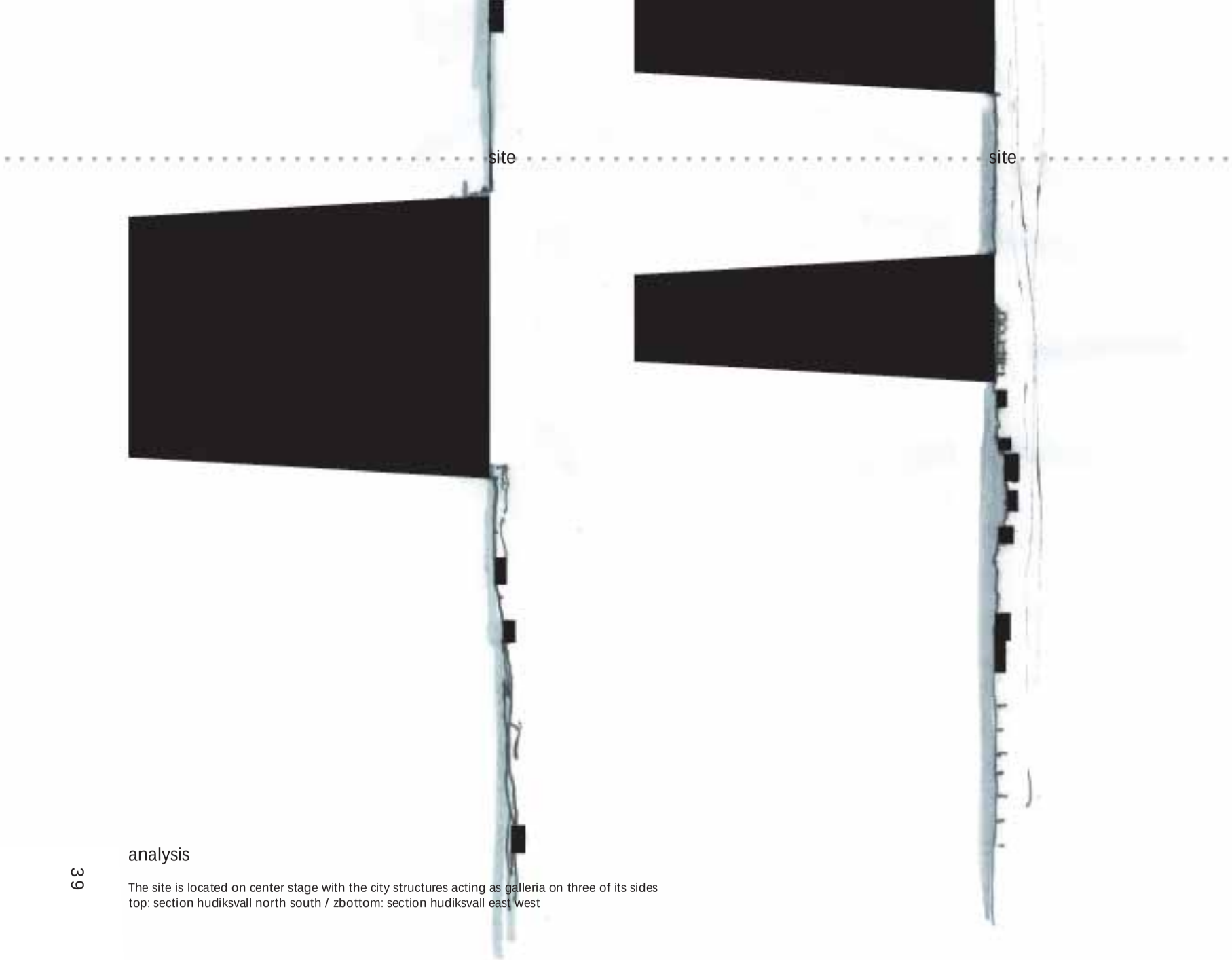

URBAN RESIDENTIAL
concrete quay
city
nature
RESIDENTIAL NATURE
RESIDENTIAL NATURE
harbor BACKSIDE
harbor FRONTSIDE
SUN EXPOSURE
INDUSTRY NATURE
INDUSTRY
rubble shore

VIEW SEGMENTS AND EDGES

A panoramic view from the site offers many different impressions. A rough categorization of the different visual impressions experienced from the site outline a mental line crossing the site from the south-west corner towards the north-east corner. North of the line the view is mainly dominated by the city, south of the line nature and the fjord dominate.

The shift from the cultivated landscape to the natural is underlined by the lining of the harbour basin, which shifts from cast concrete, to wooden piers, to a natural rubble shore as the view is rotated from north towards the south.

The landscape design concept dissolves the edge of the pier at Kattvikskajen and creates a more natural character similar to the rubble shore on the opposite side of the harbour basin.



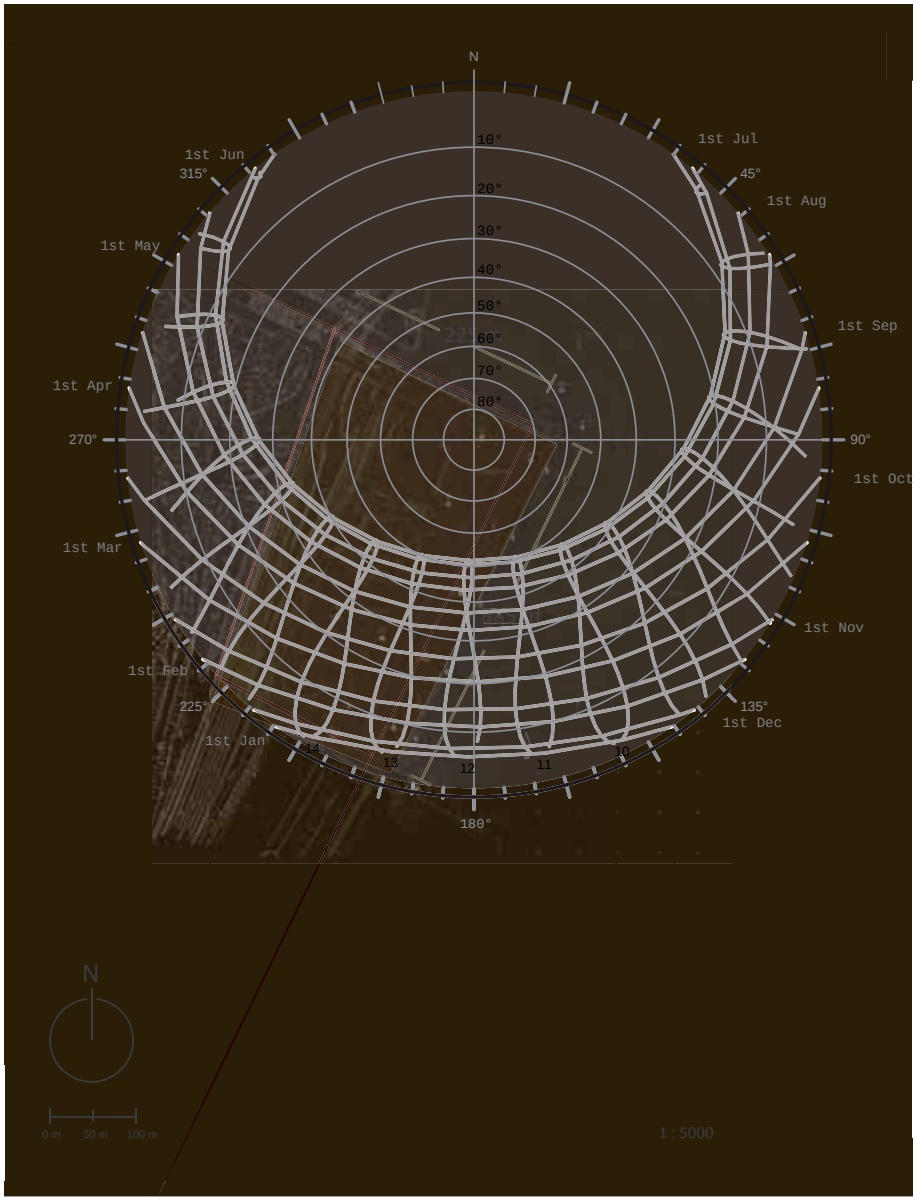
analysis

The site is located on center stage with the city structures acting as galleria on three of its sides
top: section hudiksvall north south / zbottom: section hudiksvall east west

CLIMATE

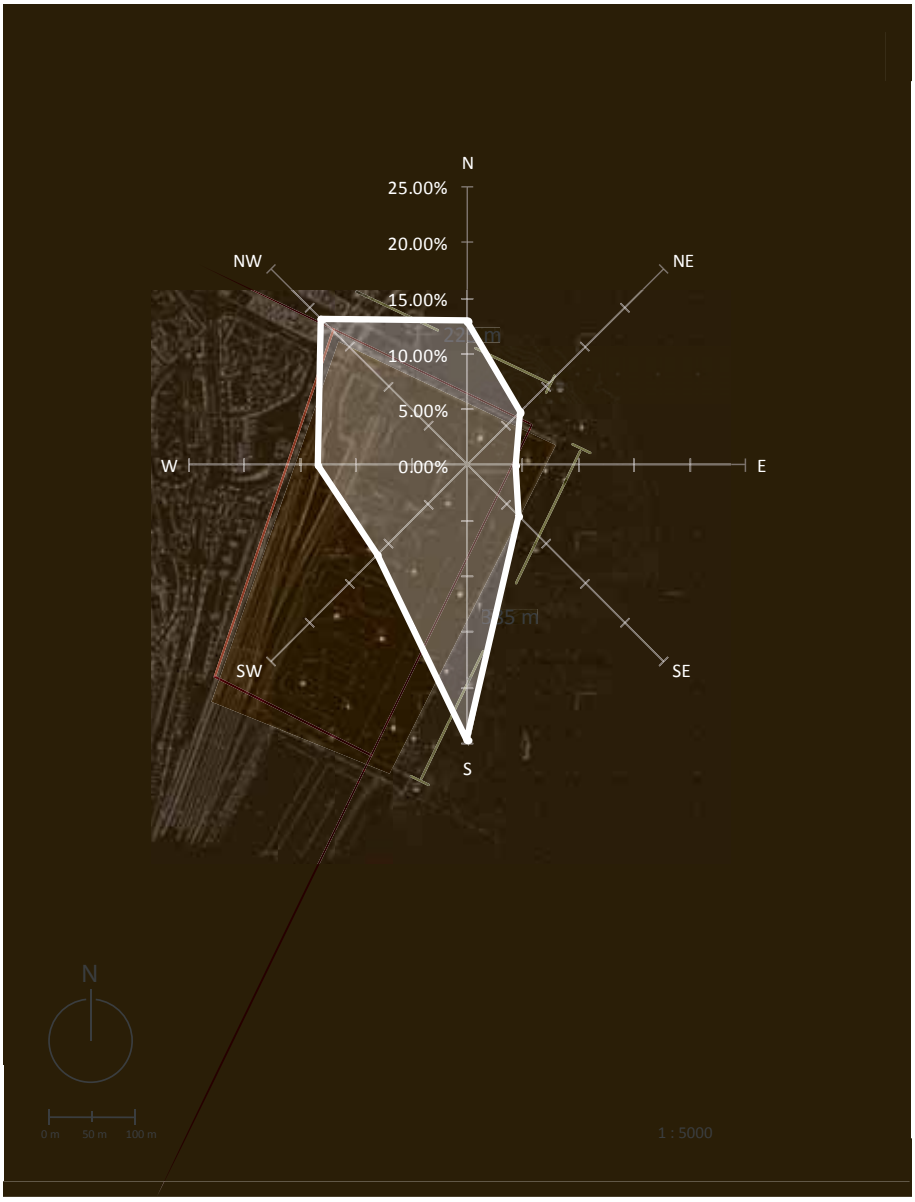
Weather data is collected through SMHI (Sweden's Meteorological and Hydrological Institute), www.smhi.se, and processed through excel to fit our needs. The weather station closest to Hudiksvall is located at Kuggören, at Hornslandet 15 km east of town.

The sun rides low on the horizon and creates long shadows, especially in winter. At winter solstice the sun rises at 09:40 and sets at 14:20, while the longest summer days have sun from 03:20 to 22:30. This contributes to give a sense of time and season. Careful consideration of orientation of the buildings openings could help harvest heat energy from the low winter sun.



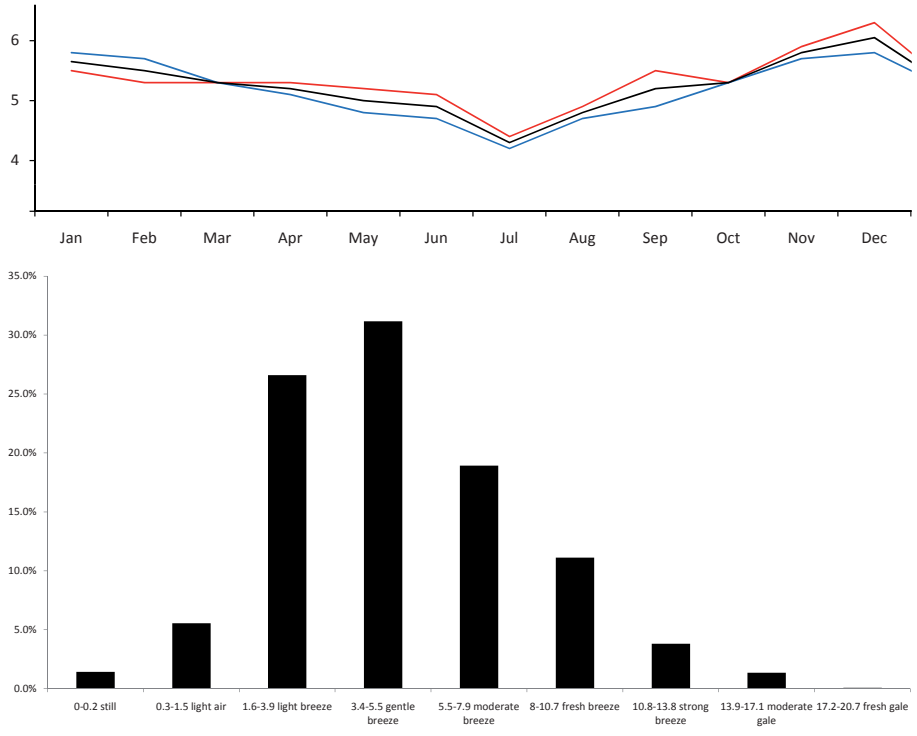
analysis

opposite : sky over Hudiksvall
this: sun stereographic diagram


N
25.00%
20.00%
15.00%
10.00%
5.00%
0.00%
NW
NE
W
E
SW
SE
S
N
0 m
50 m
100 m
1 : 5000

Wind directions seem to be influenced by the landscape and the fjord; dominantly coming in from the south –southwest. This could create a conflict between the desire to stay in the sun and in peace from the wind at the same time.

Average wind speeds are a little bit higher in winter, but the variations are not large throughout the year. The days we visited the site, winds where quite strong, which enhanced the cold temperature, and made the environment unbearable for long stays. An analysis of the wind data shows that wind strength is above light breeze (noticable on exposed skin) 93% of the time; hence the wind as an element is very present.

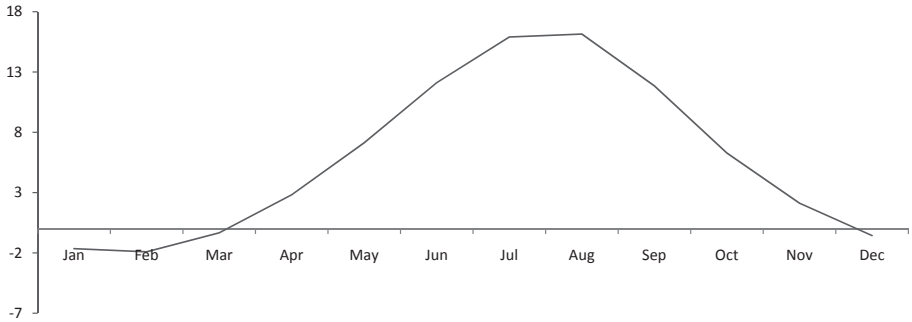


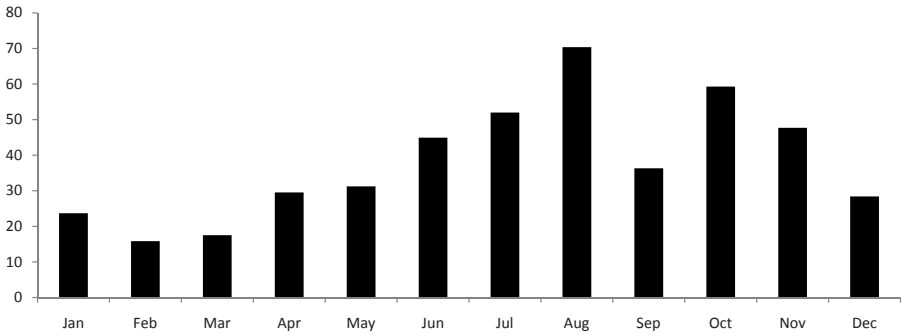
analysis

opposite: wind directions by radar diagram
this top: average windspeeds by month (m/s) / this bottom: percentage of windspeeds windspeeds (class/m/s)

Even though the site is quite far north, the proximity to the ocean makes the climate relatively mild. However; data between 1996 and 2006 shows temperature peaks at -21˚C and 29˚C. Average temperature throughout this period is 5.9˚C. In summer, the water temperatures reach a maximum of 18-20 degrees. Just warm enough for a swim.

Rainfall is stronger in the summer months, when warm air from the sea is pressed up towards the inland mountains.

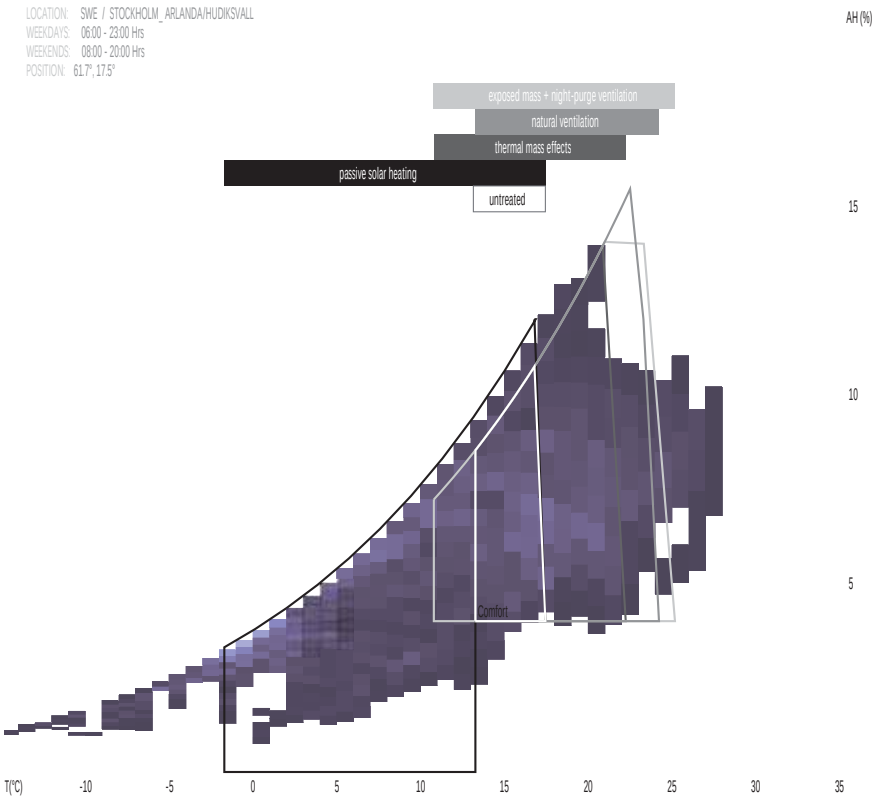




BIOCLIMATIC DESIGN

It is a good idea to keep passive energy systems in mind early in the design process, to get a high level of integration; we perform an analysis of the weather data to get indications of which passive design concepts would be relevant.

The psychrometric chart gives a graphic presentation of the state the air contains at any time. A Horizontal scale shows temperature (˚C), and the vertical shows absolute humidity (%). The weather tool produces a psychrometric chart and indicates an overlaying comfort zone based on activity in the building. We set the activity level to medium, as we have high range activities such as swimming and aerobics, but also have zones of relaxation (ref. Weather Tool help file).



analysis

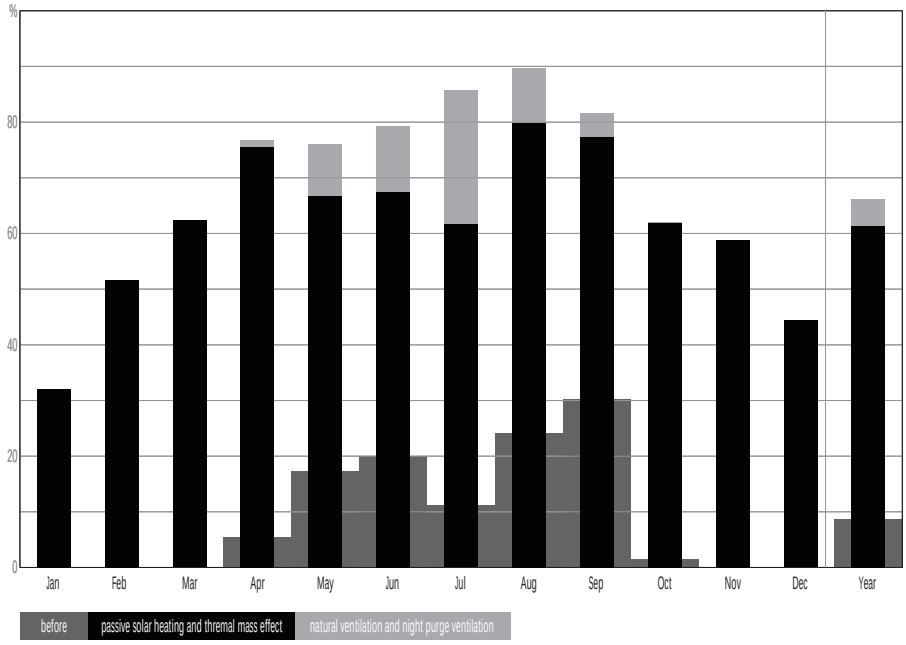
opposite top: average temperature (degrees C) / opposite bottom: average rainfall (mm)
this: psychrometric chart (weatherdata has been completed with values from Stockholm)

The comfort zone can increase and withhold a broader specter of psychrometric conditions by applying bioclimatic- / passive design principles. We find that being in a cold climate zone (almost arctic); we have to focus on passive heating. For passive heating we can adjust a number of conditions or parameters: Glazing on the southern facing façade should be kept high (the graph relates to 100% glazing ratio). The insulation level, referring to the entire building envelope should also be high to retain the gained energy. Furthermore the efficiency should be high. This refers to shading coefficients, color of surfaces, heat storing capacities, and location of air vents. The graph relates to 100% glazing ratio.

In summer temperatures can come over a certain level of comfort at times which supersede the average ranges. The thermal mass helps in stabilizing the temperature, and when necessary, one can assist by natural ventilation. No mechanical cooling system should be necessary.
The chart, showing percentages of comfort throughout the year, indicates that there is a lot to gain from implementing bioclimatic design; an overall increase of comfort from 8% to 66%.

The results suggest that there is a lot to gain by optimizing the building for passive heating with strategic placement of windows and thermal mass. This means orientating towards the sun / south. Furthermore; application of light natural ventilation in hot summer days will also have a noticeable impact on comfort levels. It should not be necessary to install mechanical cooling.
Even though there is a lot to gain from passive strategies, the building will be dependent upon mechanical systems. Mechanical ventilation with heat recovery will make sure the heat loss is minimized in winter. In summer one can probably run hybrid ventilation, which implies utilizing the wind to cool down the building. For heating there are various systems one can use to heat both the air, water in pipes and the water in the pools. Solar collectors on a southern faced roof can effectively collect heat from the sun and a heat exchange pump could be used to harvest energy from long tubes distributed in the harbor basin.

LOCATION: SWE / STOCKHOLM_ ARLANDA/HUDIKSVALL
WEEKDAYS: 06:00 - 23:00 Hrs
WEEKENDS: 08:00 - 20:00 Hrs
POSITION: 61.7°, 17.5°

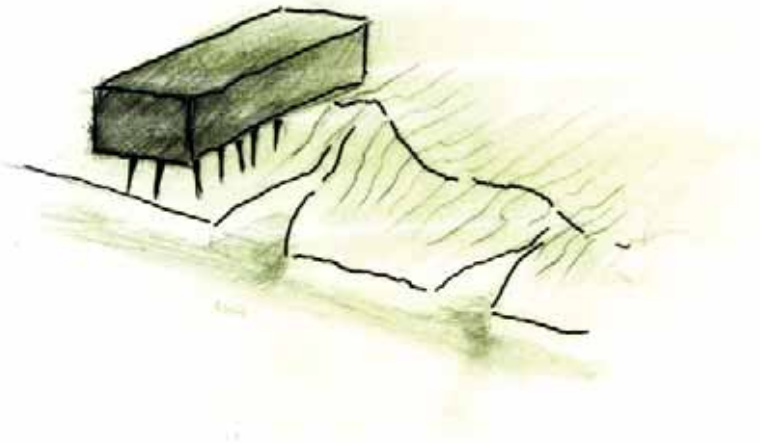


analysis

this: levels of comfort (%) with and without passive desing concepts

SKETCHING AND CONCEPTUALIZING

Findings from the analysis are translated to a problem description, which is investigated through a wide variety of conceptual models. An evolution and combination of the different models lead to a set of architectural concepts expressed through one single model, which constitutes the basis for more refined development. The order in which the ideas are presented is more or less a chronological reflection of the actual process. The ideas that investigate the same theme are numbered in sequence.



STARTING POINT FOR CONCEPTUALIZATION

A redevelopment of the initial problem puts focus on the assignment at hand. This includes considerations regarding the needs of the town, in addition to architectural values:

How does a bathhouse compliment the site in the middle of the harbor and tie the city to the waterscape?

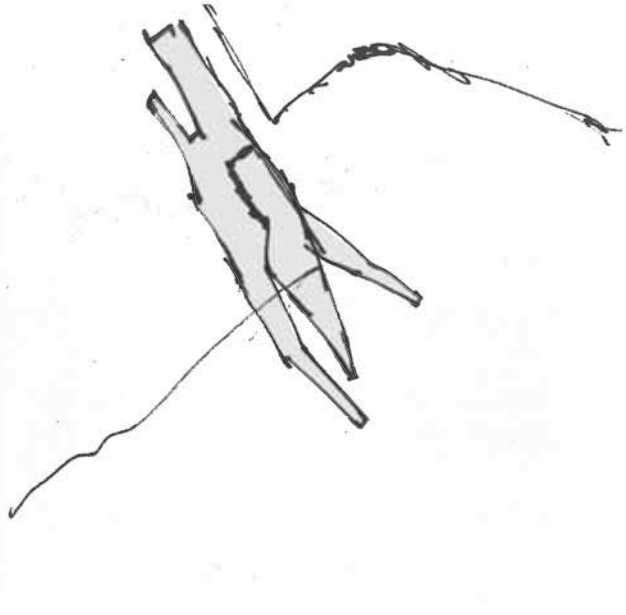
The intention is to create architecture inspired by the essence of local culture and nature; a joint combining bathouse, water, wood and land. The design should be a dynamic structure which breathes, and adapts to the rhythm of the seasons. Opening up to the exterior scenery in summer, optimized around its core functions in winter. A climatically aware structure which nurtures it's resources.

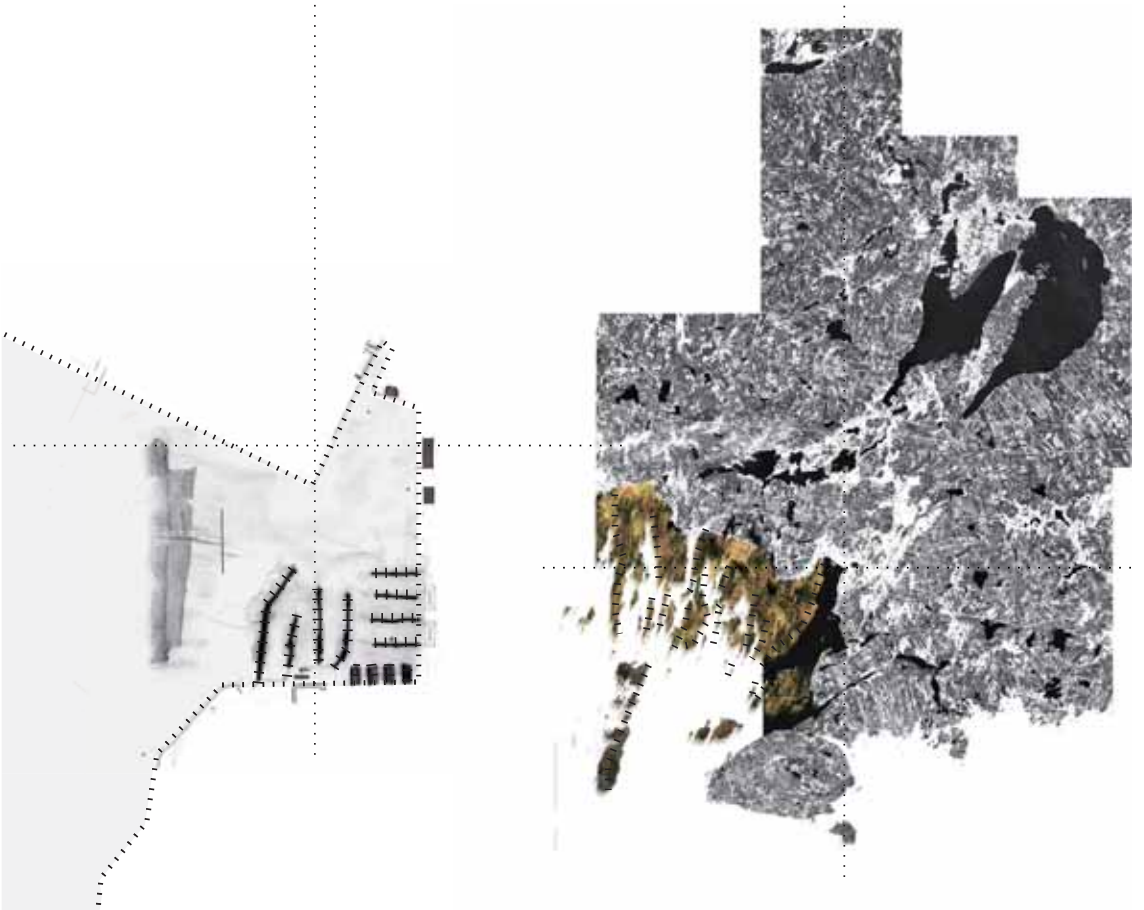
The assignment contains many factors, which are all centred in the design of the bathhouse. It will be a centrepiece and icon of a new area, as well as the rest of the Hudiksvall.

CONTACT TO WATER

South of Hudiksvall tongues of land cut the water edge into long repetitive horizons. A multiplication of shoreline increases attractive land with the rare quality of water and land correspondingly. These are marks of ice retracting from the land, and water in motion through time. Dynamic carvings, grand scale erosion.

In the harbor basin surrounding the site, the marina's pontoon are built to maximize linear surface between land and water. A building sculpted like fingers, divide the water into sheltered quality zones.



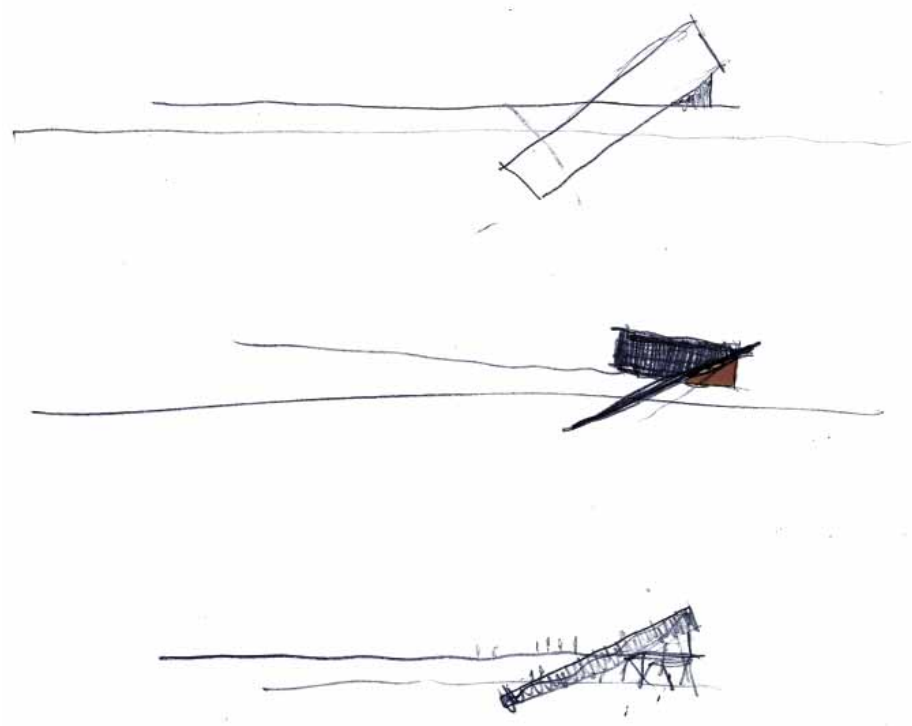


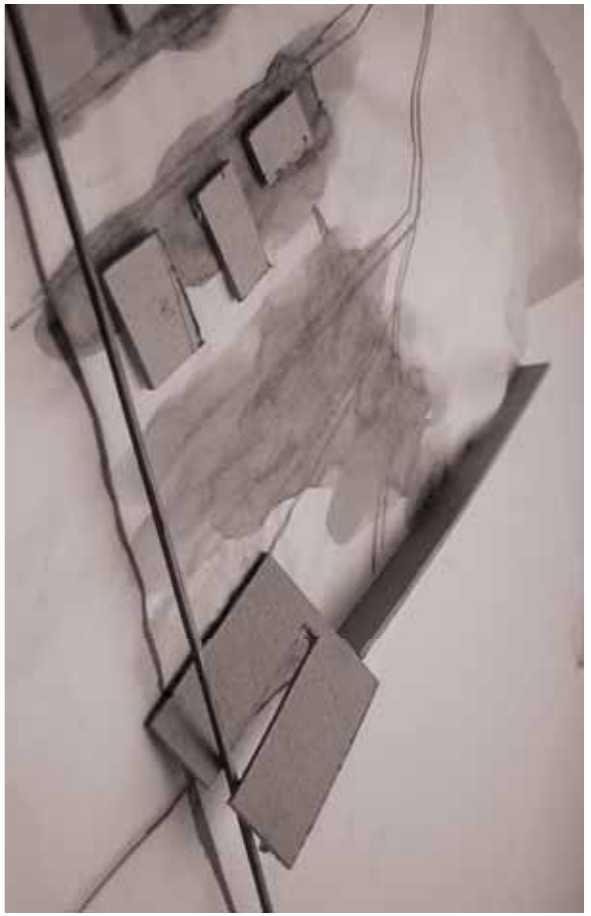
sketching and conceptualizing

opposite : roof plan sketches of elongated volumes, dissolving the edge between water and land
this : landscape inspiration; tongues of land stretch into the Bothnian Sea.
The elongated elements are already present in the harbour basin through the marina and the boathouses

TILTED SURFACE 1

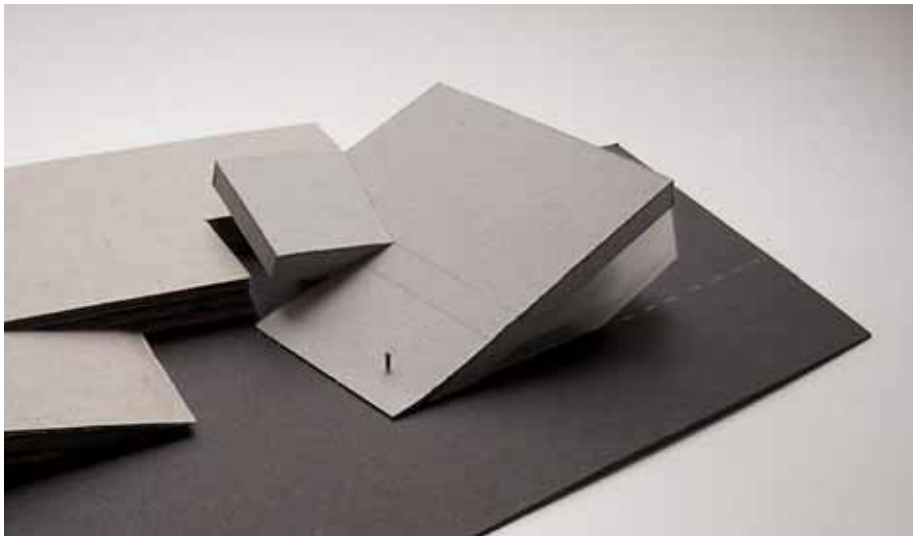
In winter a thick layer of ice covers the fjord. The movement of water masses underneath, combined with the expansive forces of ice, accumulates a dramatic transition from water to land. The ice breaks into slabs which are pressed upward onto the shore.
A tilted surface. Building translated into slab. Falling from the elevated city structure to the north, into the water in the south.
The top of the "slab" is concrete, which communicates with the mineral materials in the city structure flanking the site on its western long edge.
Timber structure underneath the slab opens up and communicates with the wood housing climbing a small hill on the north side of the harbour basin.

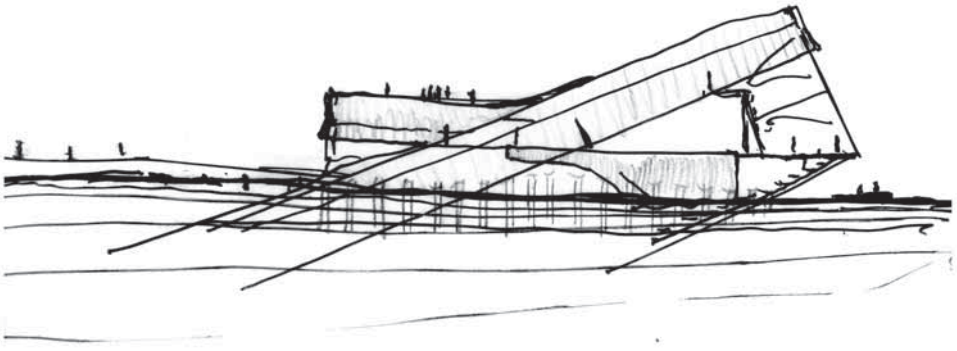


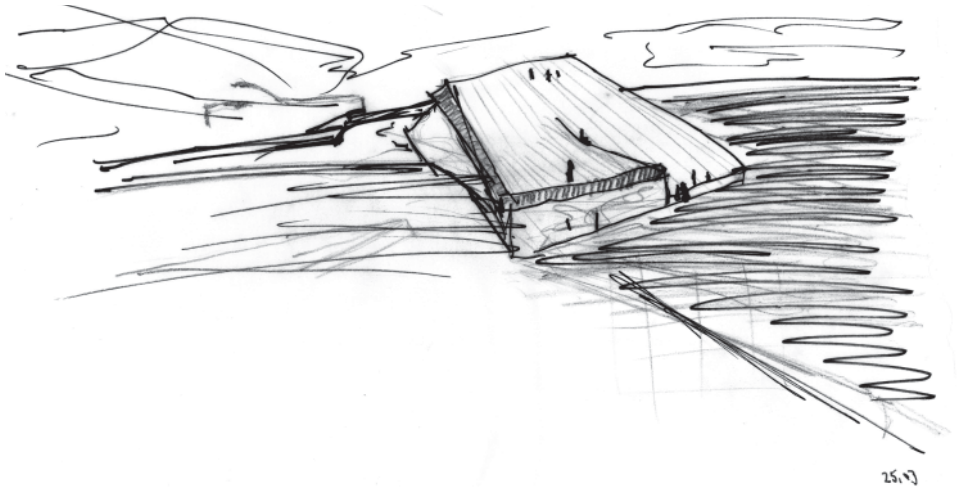


sketching and conceptualizing

opposite : first sketch series of the tilt
this top : ice packing up on the sandy beaches east of Hudiksvall
bottom : tilt collage model establishing relations to the landscape.





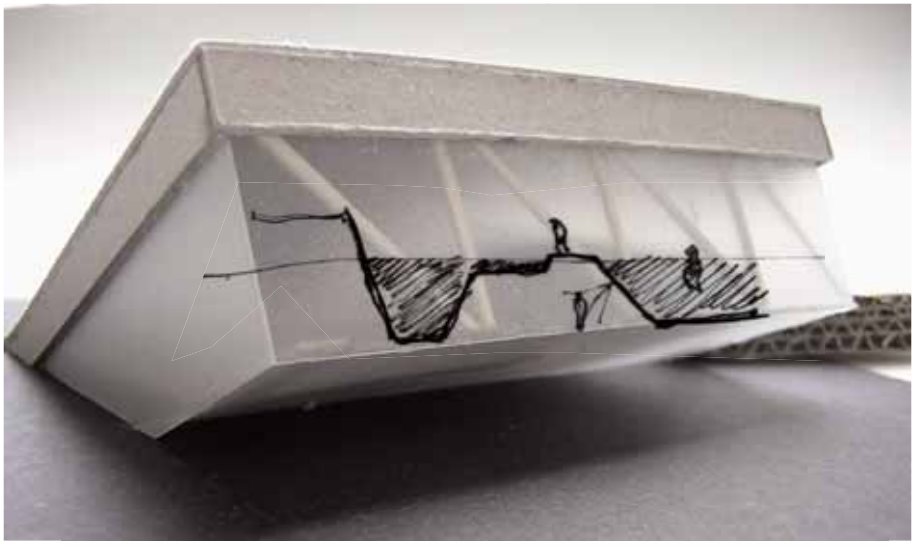


TILTED SURFACE 2

Sheltered bath, open bath. The tilted surface provides shelter from the elements for the interior bathhouse. On the opposite side it becomes a scene for the open air harbor bath. A surface that is a medium between city and water, man and nature.

The idea of an open air bath works well with the fact that large amounts of tourists come to town in summer. The bath's capacity grows along with the temperature outside.

opposite : model and sectional drawing of a box shaped slab. The shape splits to make a stronger relationship to the pier.
this : relationship to the water surface



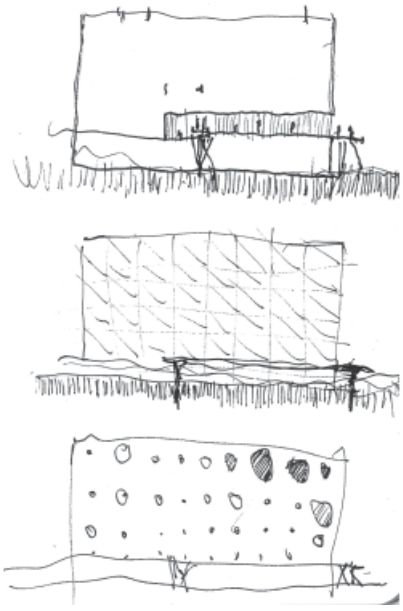
WEIGHT OF WATER1

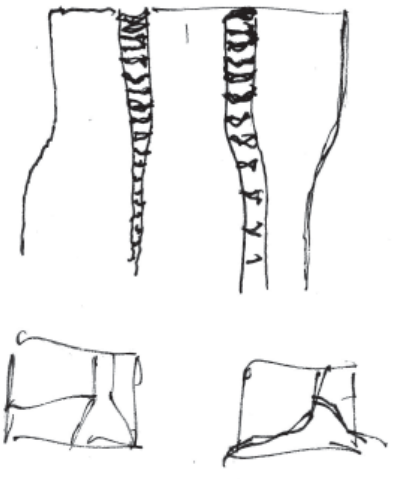
"Bodarna Grottorna" located 10 km south of Hudiksvall are Swedens largest known system of grottos. They are most likely a result of post glacial movements during the land elevation. These movements have caused the massive rock to crack in a north-south, and east-west direction. Narrow hallways lead to grand halls that extend to a height of three stories*(Siden, A, AB Soderhamn-Kurirens Tryckeri , 1983).*

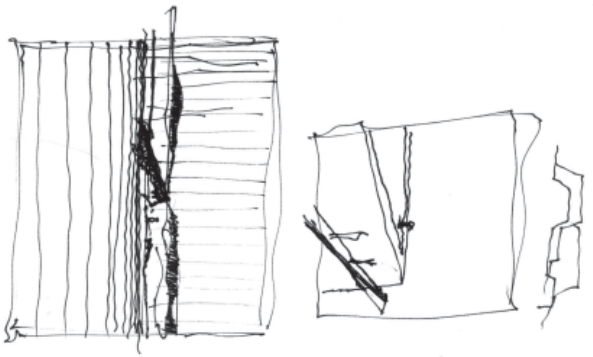
To exhibit the element of water, the swimming pools are exposed and elevated in grand concrete vessels on top of the ground floor. The weight of the masses of water becomes evident.

sketching and conceptualizing

opposite : the idea of a free surface interacting with a horizontal water line exposed inside the building volume
this : the tectonic landscape on top of Bodarna Grottorn







sketching and conceptualizing

sketch series exploring different ways of dissolving the roof slab for admittance of light

PERPENDICULAR DIRECTIONS1

The bathhouse as connecting joint:

west – east axis : city – bathhouse – water
north – south axis : city – water – bathhouse – Kattvikskajen

This interrelationship between two connecting directions becomes essential in the design quest. Bada Hudik takes its offset in processing space between these lines.

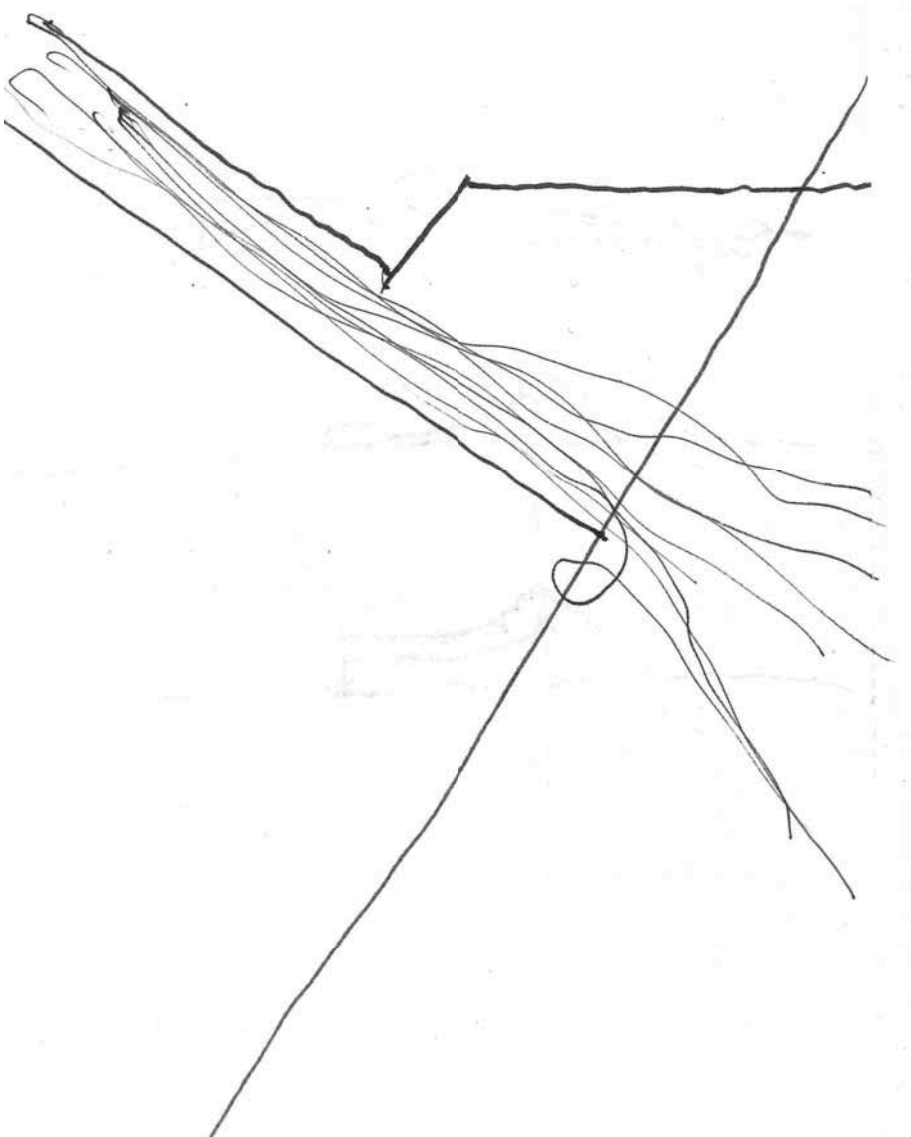
The converging lines suggest a weaved joint of passages that interact and create space.

opposite : model exploring the meeting of directions at Kattvikskajen
this : arial photograph of Kattvikskajen. The dynamic pattern of the railway tracks is dominant

PERPENDICULAR DIRECTIONS 2

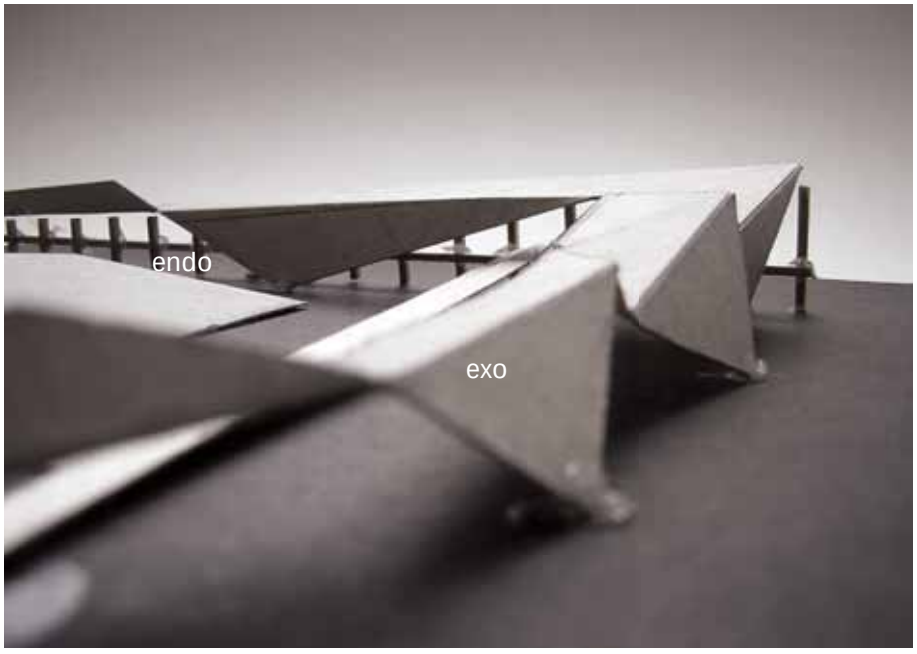
Flows translated into roofs and corridors.

The **element of water** is dynamically present through the channel that runs parallel to the site and rounds the corner. This channel connects site to city through Hudiksvall's pride and identity; the red boat houses. The bathhouse will contain many passages that serve as circulation system for guests, employees, and installations. A sculptural approach mixes this circulation with the directions recognized at Bada Hudik's site. Logistic paths becomes journeys through the building.



sketching and conceptualizing

opposite : water flows around the corner of Kattvikskajen
this : model translating the corner into a series of flows

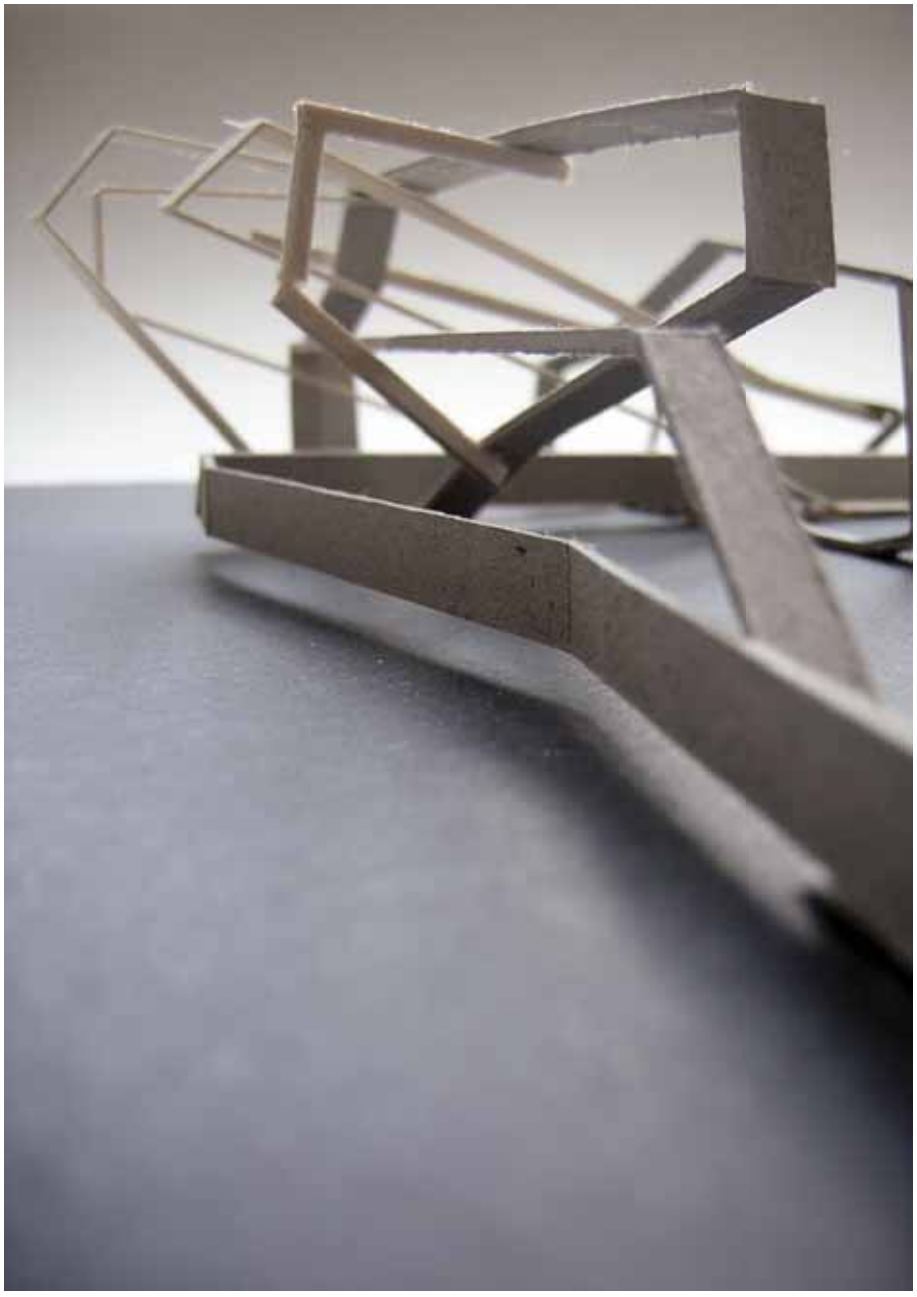

endo
exo

ENDOSKELETON EXOSKELETON 1

Traditionally the harbor basin has been dominated by **wood structures**. Slim timber columns carrying large volumes elevated over the surface of water. The idea of a shell / exoskeleton interacting with a refined endoskeleton / fibres is born. The outer shell is held up by a fine timber structure, which in turn is protected- and stabilized by the load of the shell.

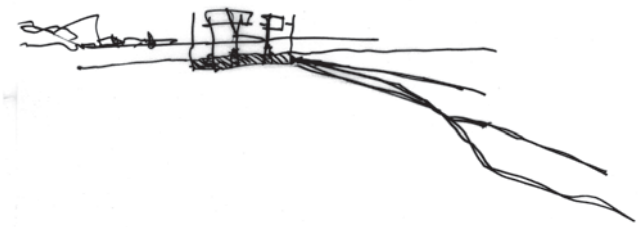
The smaller scale structural members in the endoskeleton carries with them relations of a more humane scale. They also provide effects of transparency and depth.

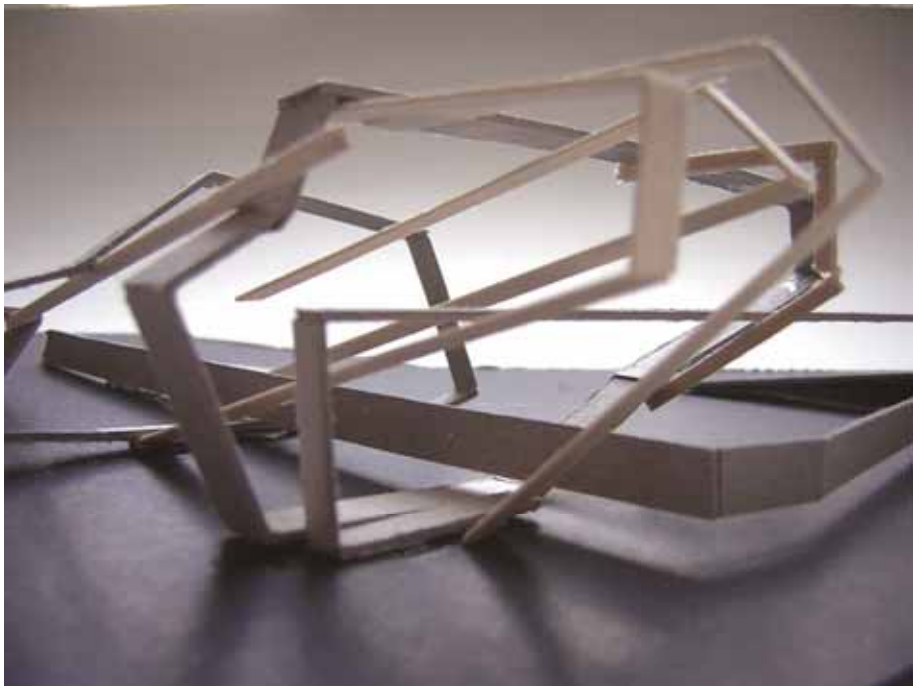
opposite top : model of a sequence of shells carried by a light timber structure / bottom : the inspiration; a forest of slim poles carrying a heavy volume.
this : idea for relationship between shell and fibres. A refined transparent carrying system in timber holding a concrete façade.



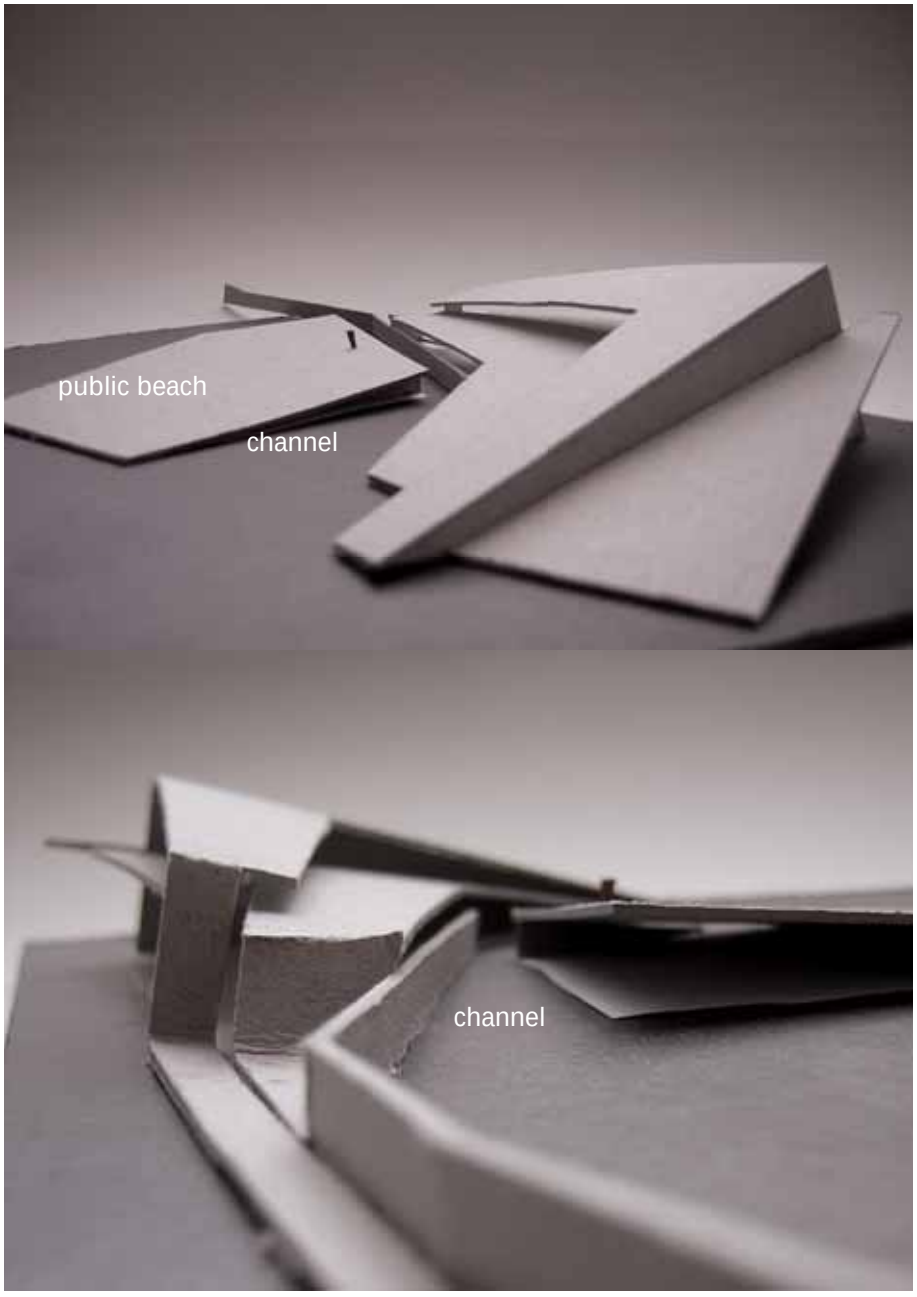
PERPENDICULAR DIRECTIONS 3
/ ENDOSKELETON EXOSKELETON 2

Morphological mutation of skeletal structures and directional passages. The exoskeleton is suggested by frames in concrete. These displaced shells create an envelope around perpendicular frames in wood; the endoskeletal members. Structurally the two elements combined constitute stability to horizontal loads from all directions.





in between the abstract frames, ideas of a building envelope emerges.
A carrying system that connects the vertical to the horizontal

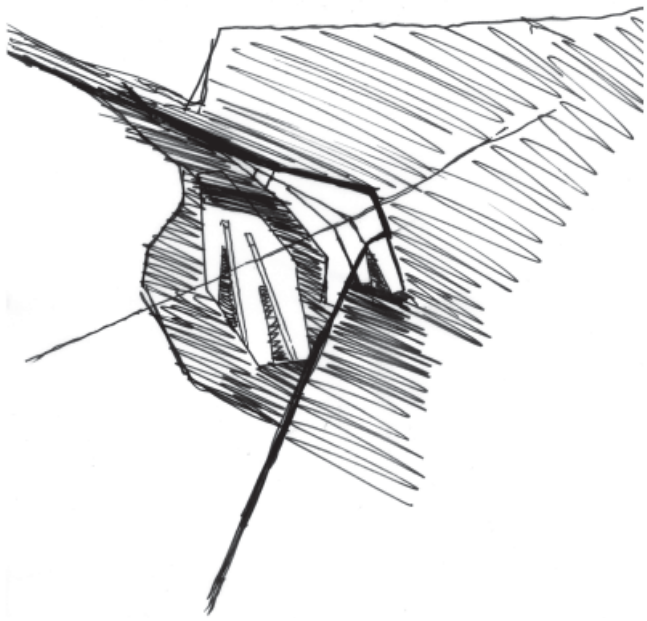

public beach
channel
channel

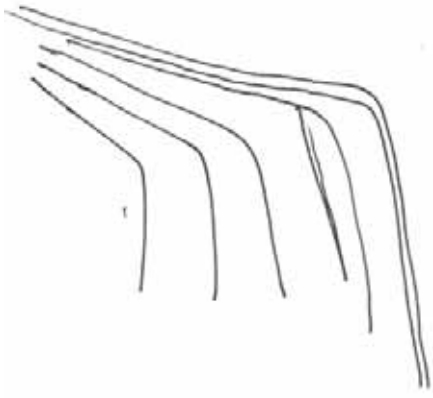
TILTED SURFACE 3

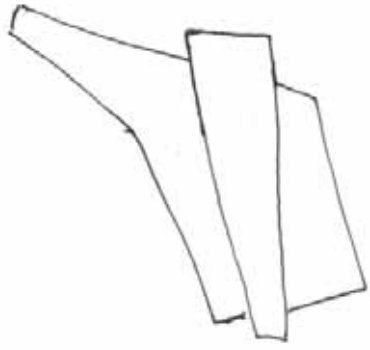
The concept of a slab falling into the water is combined with an articulation of the corner. This corner fixes the city to the water and Kattvikskajen. The surface is split up to strengthen the effect of both the tilt and the corner. Light is permitted through the split so that direct sunlight enters in winter to warm the building up. However in summer, when the sun's altitude is high, the light that gets through is diffuse and indirect.

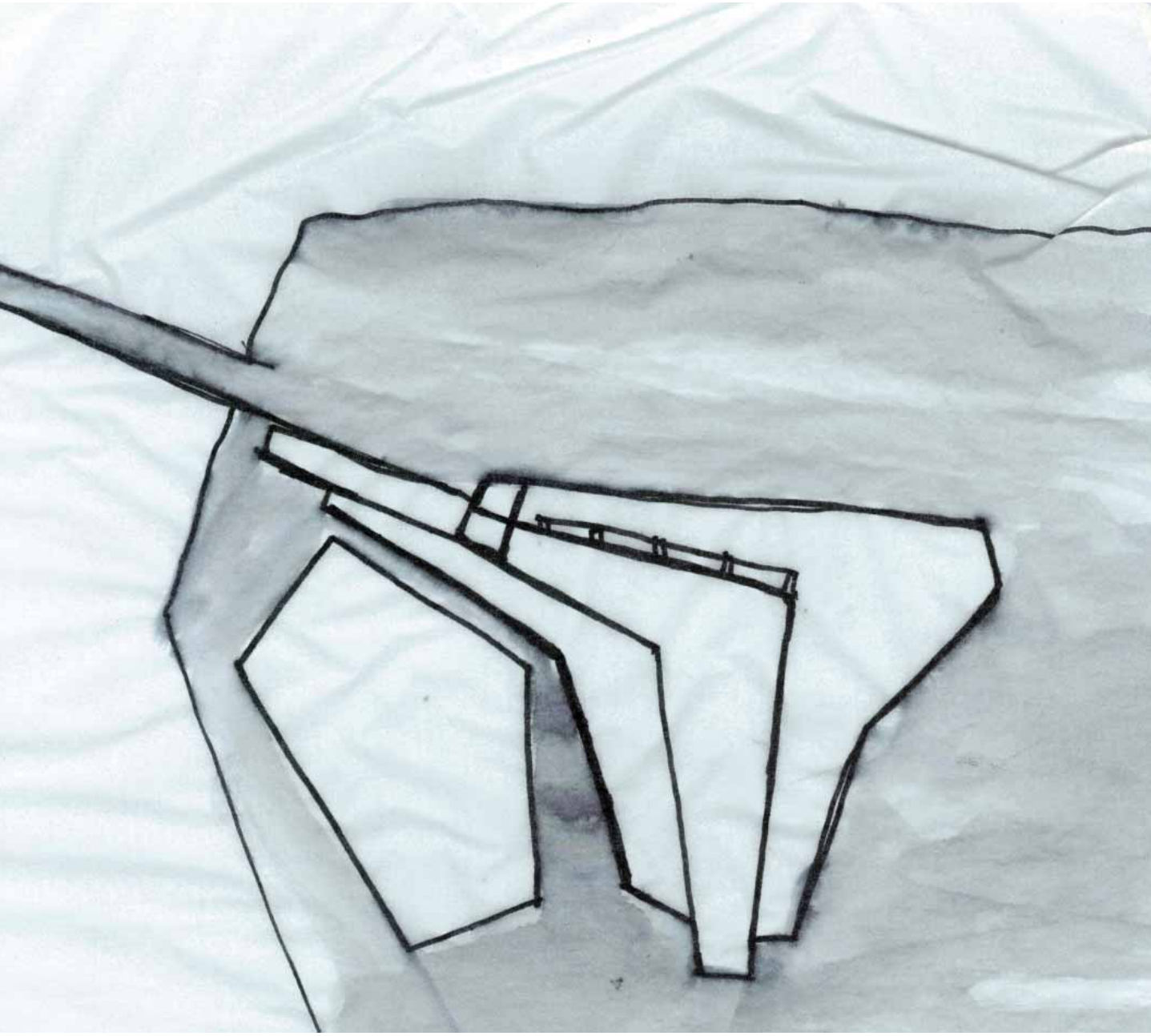
Furthermore the building is disconnected from the pier, so that it becomes an island, only connected through a narrow bridge. The harbor bath is put in connection to a second volume, which also tilts into the water and creates an artificial beach. The space between the volumes is filled by a channel of water, which connects to the existing channel. This helps in changing the water in the harbor bath.

opposite : the building rising slowly up from the water and stretching towards the city
this : Inspiration for how the shape splits and cuts the corner comes from the element of water in different conditions; ice braking and packing, and turbulence of the channel exiting



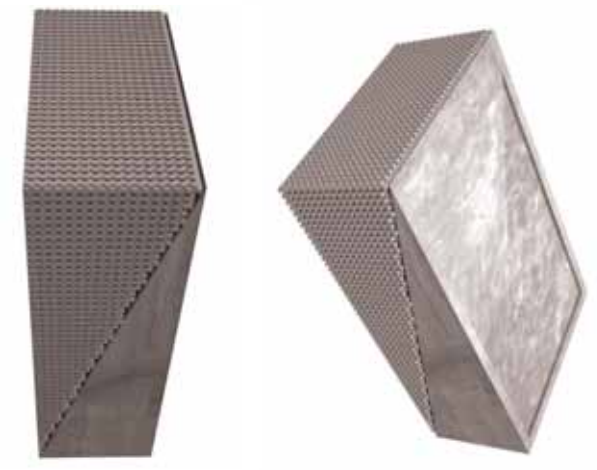






WEIGHT OF WATER2

The main swimming pool is split up into two times four lanes in a V-shape where the pools are cantilevered above the ground floor. Working with the concept of a endoskeleton of wood, carrying the heavy concrete members, experimentation with structure starts. The contrast in material, and load bearing capacity becomes evident.



sketching and conceptualizing

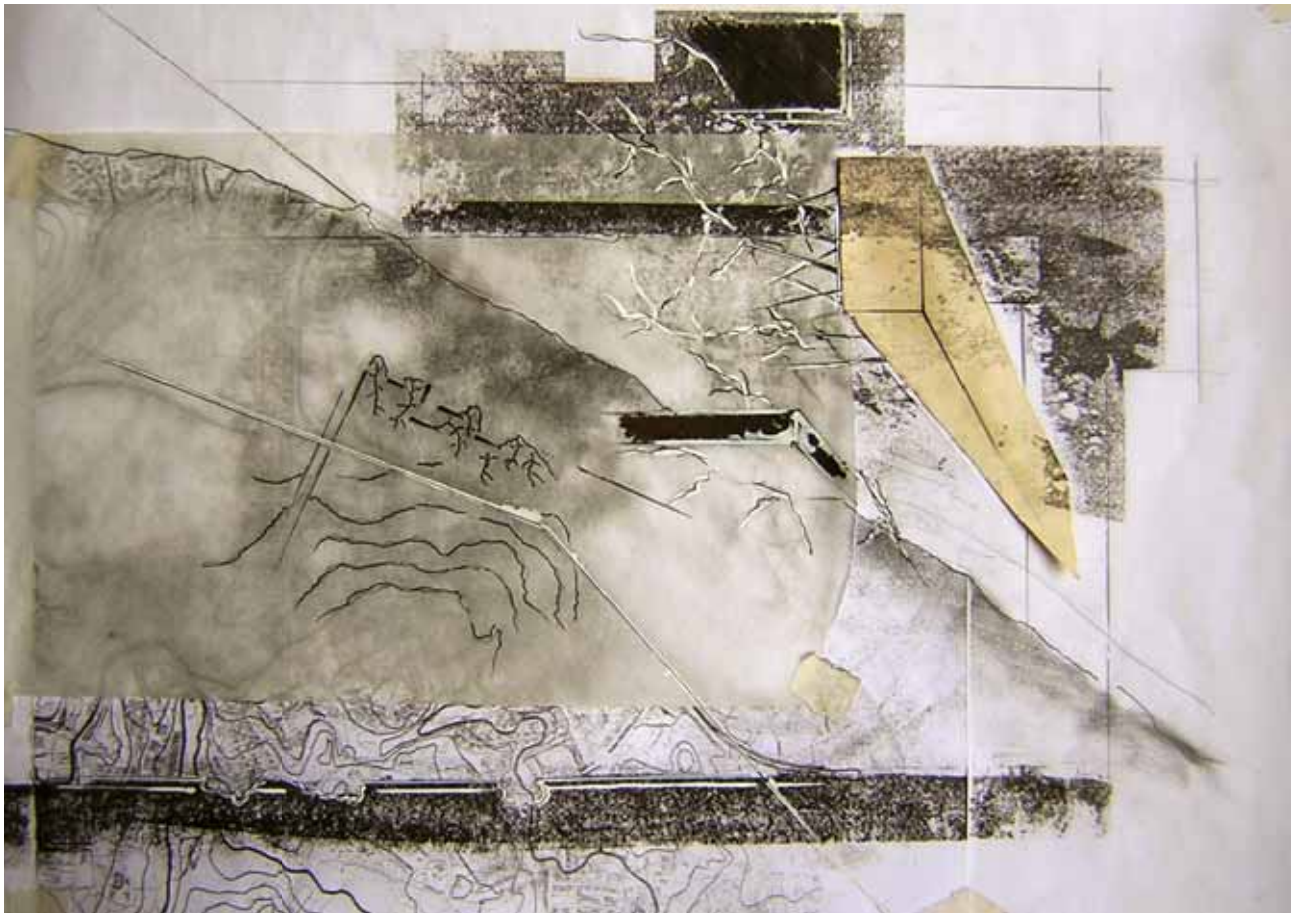
opposite : the effect of the elevated pools has a dramatic effect on the space underneath
this : detail investigation of how the heavy pools could be supported by wood

LANDSCAPE WORKSHOP1

During the process there has been two workshops performed together with urban design students under the theme of conceptualization. Bada Hudik's focus during these workshops has been on cultivating the landscape at Kattvikskajen, the bathhouse's immediate context.

The result of workshop1 was a determination to create a new nature from the masses of dirt and gravel that fills the landfill Kattvikskajen is built up on today. A dissolvement of the existing edge gives a combination of masses eroding into the fjord and masses that are secured by simple concrete manmade structure. The masses are "scraped" to create small hills on the site, the nature of the topology and edge is set naturally by gravity and erosion.

A boardwalk runs along the edge of the water, supported by pieces of the old concrete pier, left standing after the alteration of the landscape inspired by tongues of land found in the landscape south of Hudiksvall. The aim is to recreate a natural contact between land and water while preserving the history of the site.

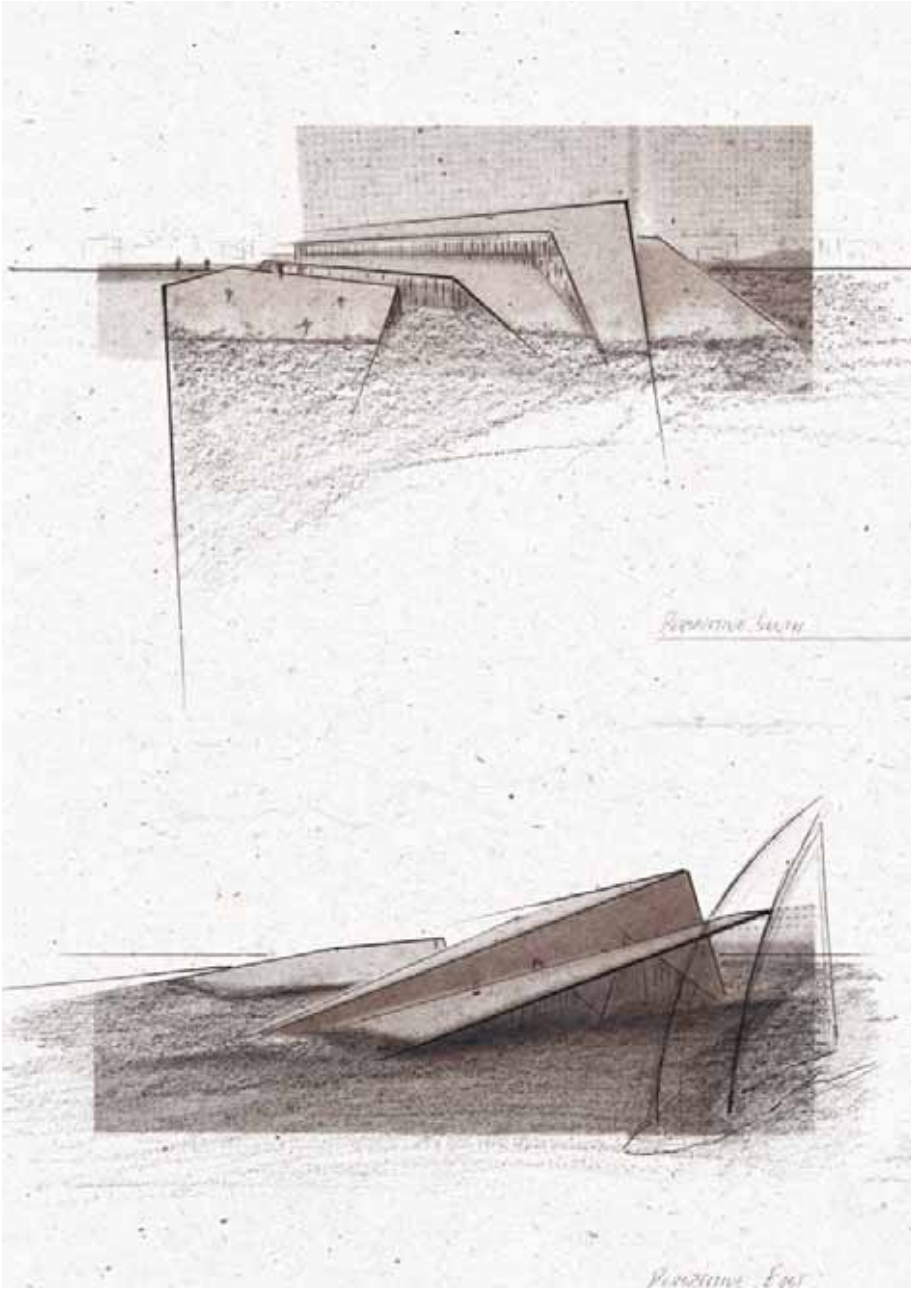


sketching and conceptualizing

opposite : principal model showing concrete elements supporting and interacting with the landfill
this : vision collage expressing the presence of different elements in the landscape at kattvikskajen

sketching and conceptualizing

cultivated landscape (forestry patches) along North Dellen, a lake west of Hudiksvall. Wood, water and land are present.



ARCHITECTURAL CONCEPT

A building that slowly descends into the sea. The combination of southern facing facade and roof, creates a surface directed to harvest sunlight. This exterior shell becomes a public beach which remains hot and comfortable to sit up against on long summer nights. When the weather is inhospitable it protects the interior from the harsh natural elements. The tilted surface acts as membrane between inside/outside, city/nature and indoor pools/harbour bath.

The volume is weaved together from elongated segments overlapping on different levels. These passages relate to the two main axes of the site and create connections between them. The building becomes an articulated corner; a joint connecting Hudiksvall to the water.

Throughout the course of the building, three elements come into play. The tectonic plates of the exoskeleton relate the to the element of land. The refined timber structure of the endoskeleton is made from, and relates to the dense woodlands, which have been the backbone of the region. The water element rests in a vessel between the two other elements. It is exhibited through the properties; volume, weight, and surface. The three elements compliment and respond to each other. Bada Hudik is the product of these elements and the atmosphere that emerges between them and the people.

sketching and conceptualizing

the concept expressed through mixed media montage. The overall shape and dynamics of this model is the basis for the further development.

DEVELOPING AND ADJUSTING THE SHAPE

To make the concept work in a functioning building implies an introduction of several considerations and refined adjustment of the structure.

Firstly the development of the concept is applied to the larger context through a second landscape workshop.

Organization of the functional program is combined with spatial qualities and the notion of a journey through the building.

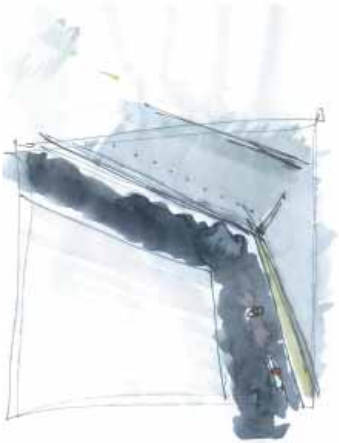
Natural light studies are performed to see where adjustments are pertinent. Development of the endoskeleton structure is explained in a longer sequence including the use of parametric modelling to facilitate and explore the potential of the structure.

Visions for ventilation systems and location of the technical machinery and circulation are also introduced.

LANDSCAPE WORKSHOP2

The second workshop was a conglomeration from segmented ideas of the landscape and its relationship to the building. Sketches visualise the journey from the city centre to Bada Hudik, the space and relationship between the building and the surrounding elements, and materiality of the residential area at Kattvikskajen.

The direction from the city centre along the boat houses is accentuated by a bridge leading to the building. Concrete structures along this passage strengthens the concept further and provides zones of shelter from wind. The slab next to the bathhouse creates an intimate water filled channel space. The upper side of the slab is a public leisure zone. Underneath there is space for storage of kayaks and rowing boats, which fits the recreative maritime environment.

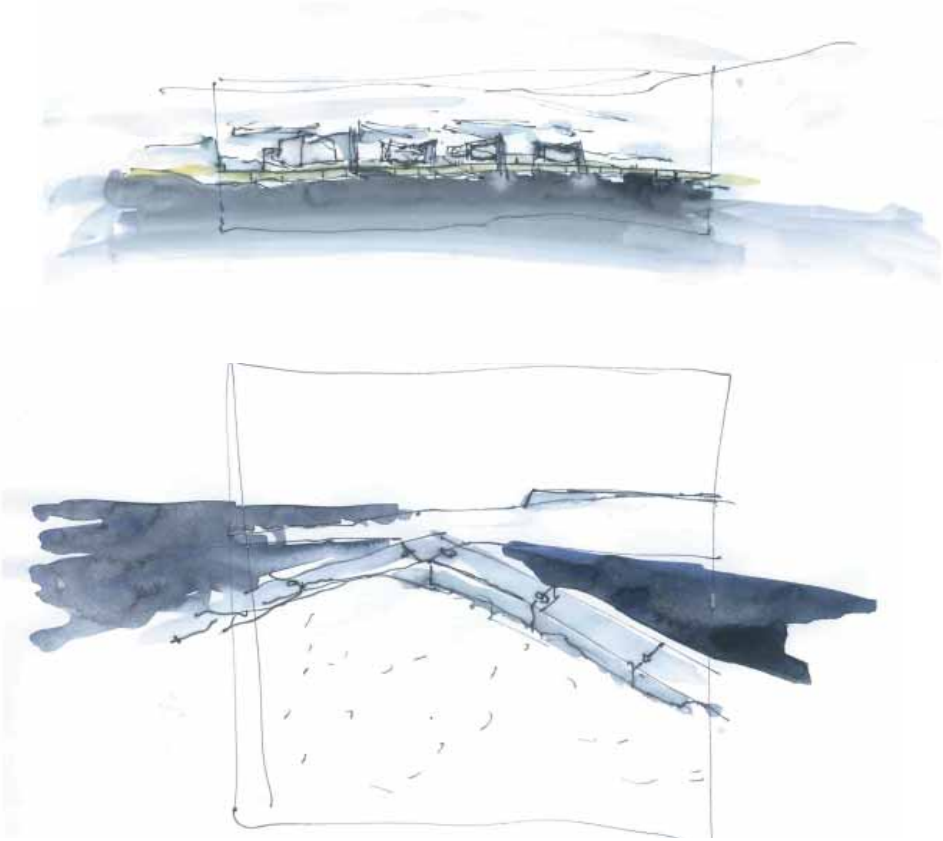


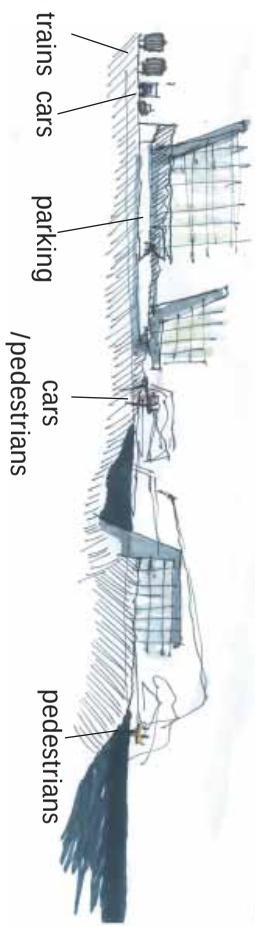
development landscape

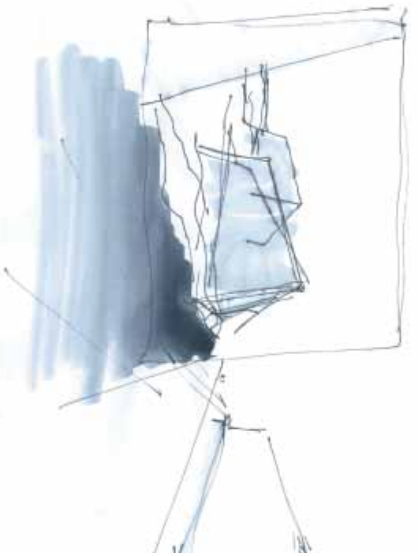
opposite : view from red boat houses
this top : bridge leading to the building / mid : new channel along the south side of the bathhouse
bottom : public leisure zone south of the bathhouse

Kattvikskajen is a mix of concrete elements and filling masses partly supported, partly sliding into the water. A boardwalk is laid out along the edge, utilizing the remains of the old concrete pier as support.

The Structures making up the dwellings at Kattvikskajen have the duality of an exoskeleton in concrete and a more light endoskeleton. The concrete structures create sheltering angles opening up towards the south. Inside the corner is an ideal location for light structures making up the dwellings. Facing the north with nature and blue mountains as scenery one sees a series of slanting concrete shells. Opposite, when one is facing the city, one sees the light structured dwellings, decks, beams and columns.





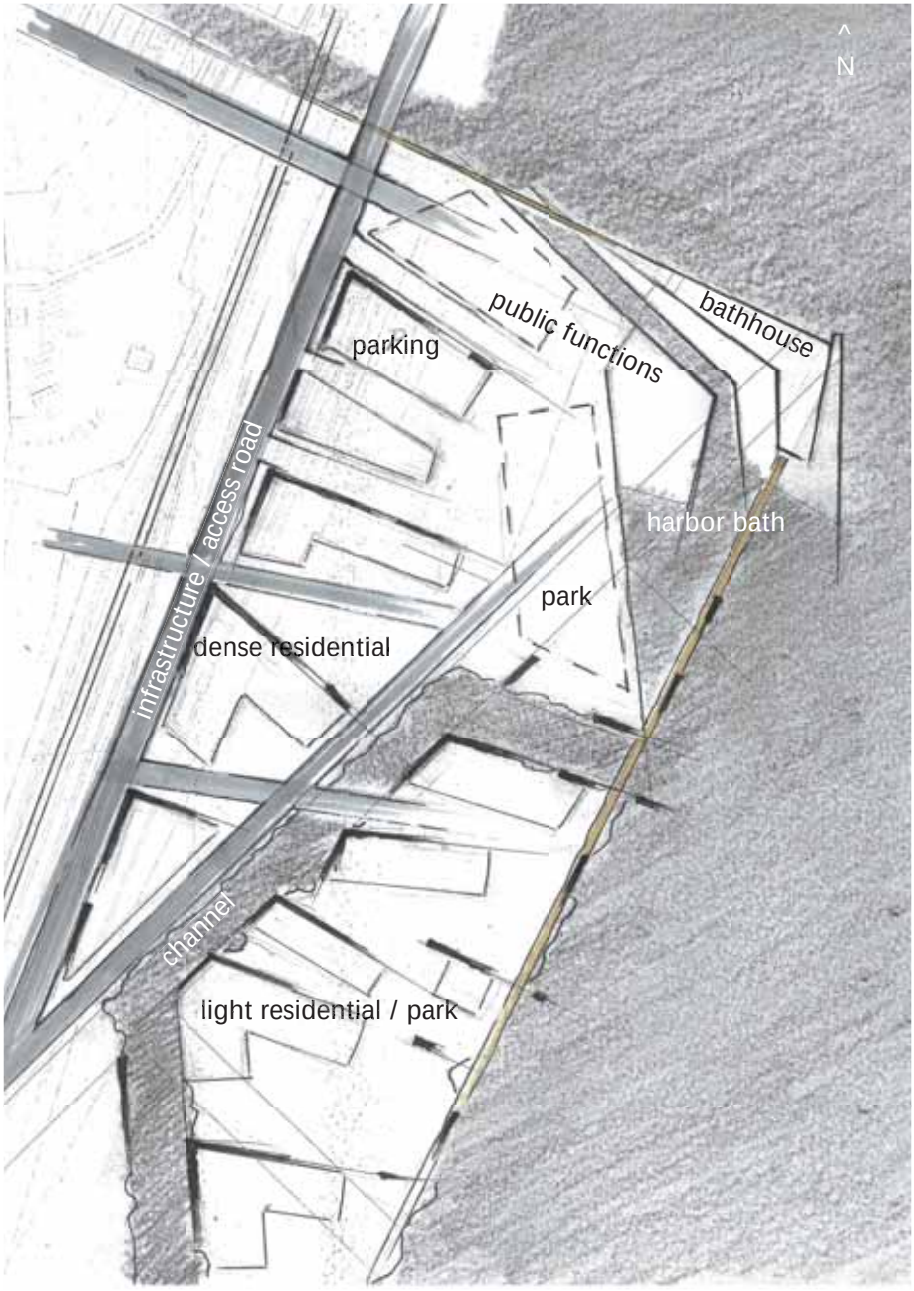


development landscape

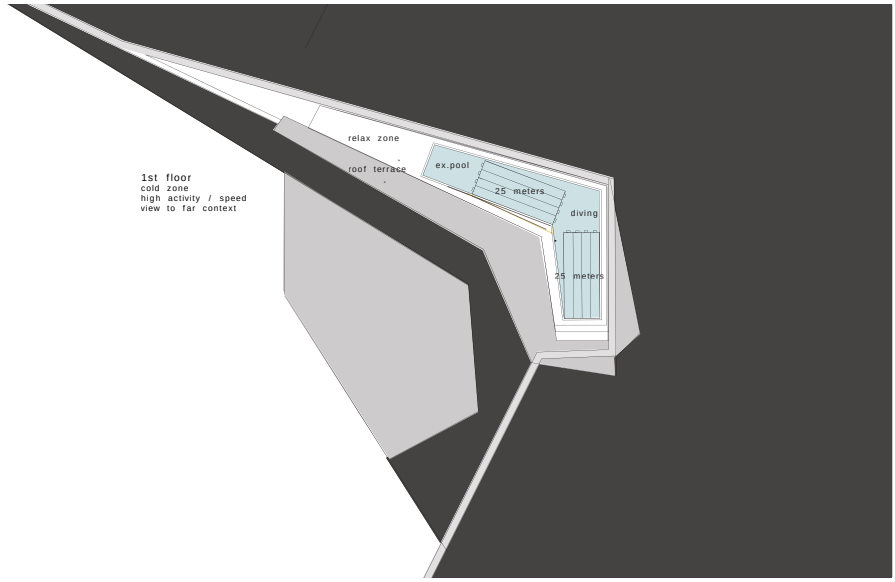
opposite top : new skyline at Kattvikskajen, seen from the east / bottom concrete elements creating an angle which holds landfill masses
this top + mid.: concrete tilted walls of housing at Kattvikskajen, becoming sculptural elements in the landscape
bottom : section through residential plan.

To create a closer relationship to water throughout the area a channel is drawn diagonally pointing from the main access road in the southwest of Kattvikskajen towards the bathhouse.

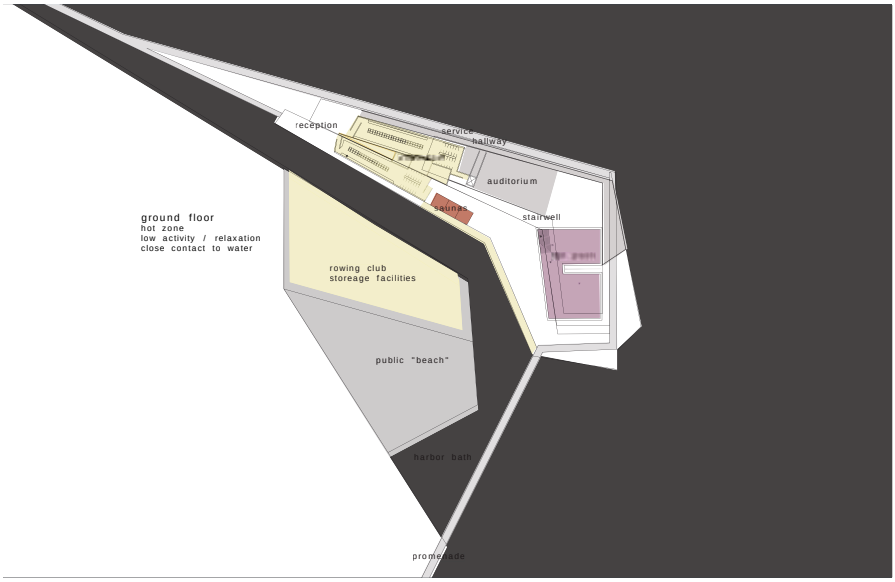
Housing on the western bank of the channel is placed on top of parking facilities for the area, attached to the heavy infrastructure and more dense in its expression than the housing on the east side, which one can only access by pedestrian walkways. The housing blocks become sculptural elements in the natural landscape which seems to be eroding into the sea.



opposite : disposal plans for Kattvikskajen
this : rough vision for functional distribution and pattern formation at Kattvikskajen



1st floor
cold zone
high activity / speed
view to far context



ground floor
hot zone
low activity / relaxation
close contact to water

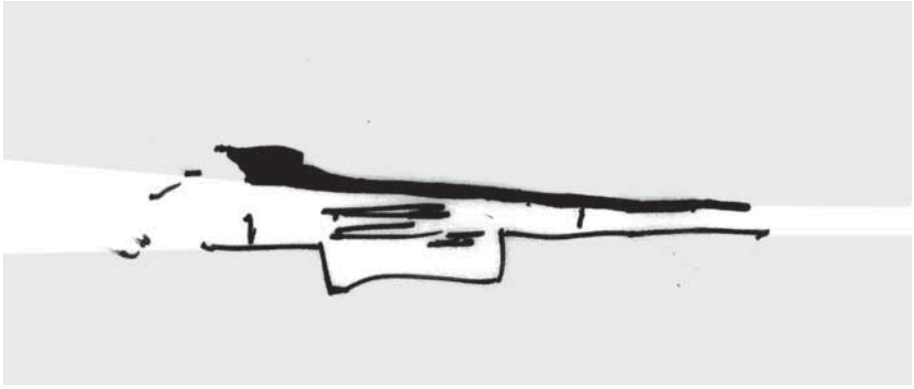
FUNCTIONAL ORGANIZATION, PERCEIVED ATMOSPHERE

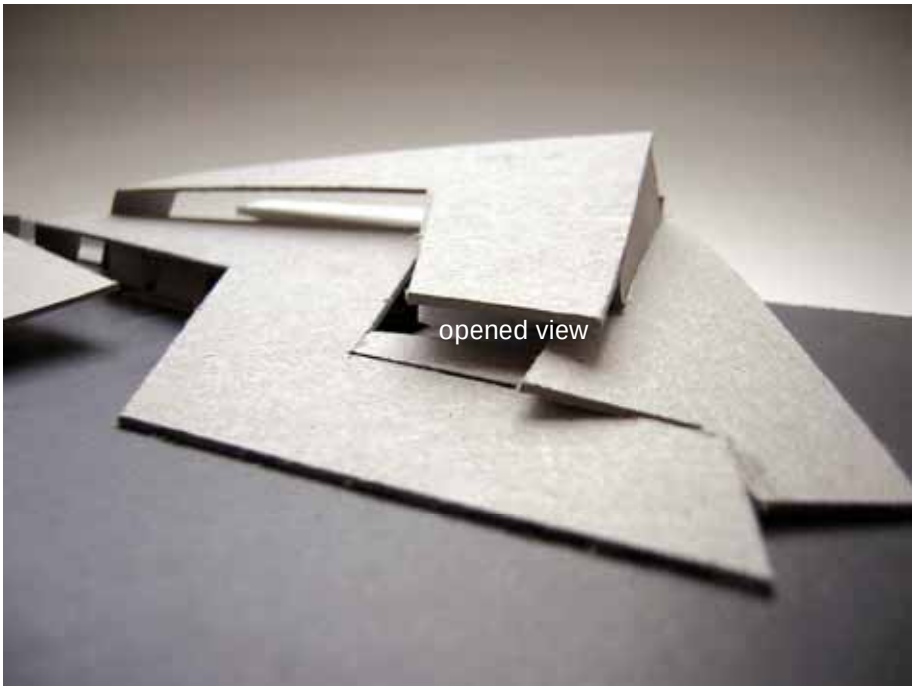
The programmatic concept of the building has a simple layout. One enters the reception area from the ground floor level. Sequentally on the same floor comes the wardrobes, a foyeer, saunas and hot pools. The first floor is the warm intimate zone of the building. Here the tempo is slow, and contact to the near context is imminent. The shape of each ripple and wave stands out and one can explore the harbour basin. Themes are relaxation, intimacy and the personal space. The space has more niches and brings attention to the smaller scale.

From the foyer one can take a staircase to the first floor, which holds the main swimming pools, the excersize pool and the diving pool. This is the active zone. Tempo and activity levels are high and relations are drawn to the landscape and horizon. The zone is elevated and relates to the city in the north side and nature on the south side. The space is large and open with an almost uninterrupted plane surface that seems to continue into the open water outside. Man in a large context. This cool water-zone contrasts and compliments the warm zone below.

A reference can be drawn to two lakes ("Dellensjoerna") northwest of Hudiksvall. They emerged in the crater of a meteor striking the area 250 million years ago. The local stone "Dellenite" origins in these lakes. "North Dellen" holds black "Dellenite", while "South Dellen" holds brown. One of the two lakes is said to be warmer than the other.

opposite : early plans showing organization and zones, top : first floor, active zone / bottom : ground floor, relaxation zone
this : collage of "Dellensjoerna" and their stone color




opened view

EXOSKELETON ADJUSTMENT

According to the idea of an open space connected to the landscape, the exoskeleton shell is adjusted with a noselift. To improve the experience of swimming in the southern wing swimming pool, the roof is elevated so that one's view swimming southward is open to the water and horizon outside. Swimming lanes can be tiresome and relatively boring when there is nothing else to do but count. On the north south axis, swimmers will be presented with great views over city and nature. The swimming vector becomes a symbol of connecting city to the fjord.

opposite top: principal sketch / bottom : cardboard moedel

NATURAL LIGHTING

An important design parameter for Bada Hudik is admittance of daylight. Natural lighting creates a strong relationship to the environment outside the building. This is desirable physiologically; to maintain a natural day-rhythm. It also blurs the border between inside and outside. Furthermore there is the sustainable effect of saving electric energy for lighting.

Throughout the process there has been worked on different façade concepts in relation to light and passive heat accumulation. The first concepts worked with long horizontal openings, which is also the solution for the final layout. In between there was worked on a monotonous surface of small shells admitting an evenly spread light.

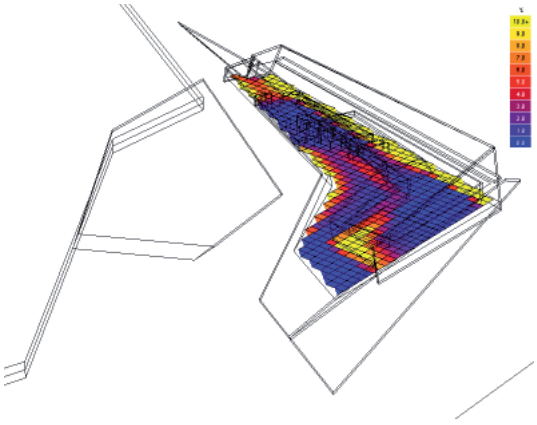
Daylight iterations are presented in three steps; daylight analysis1 , -2 and -3

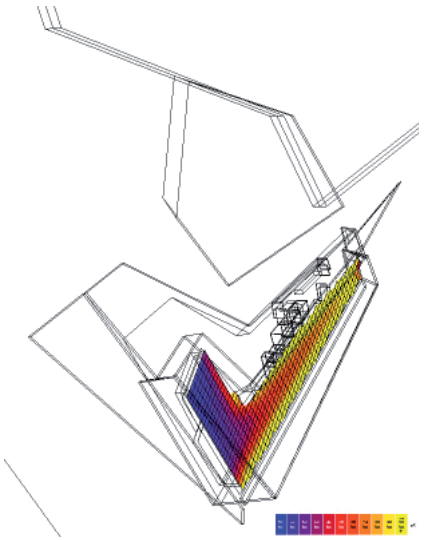
Opposite : early vision for roof structure filtering in the light . man on divingboard. facing south

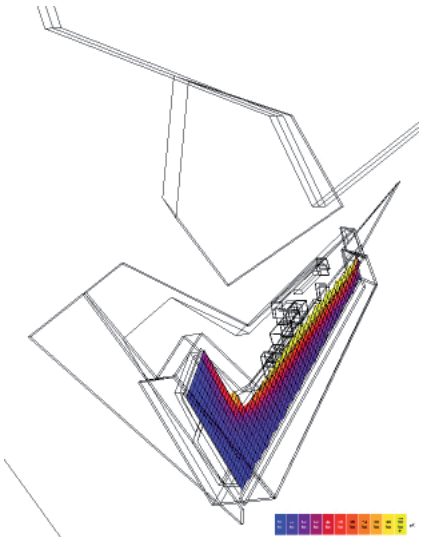
DAYLIGHT ANALYSIS1

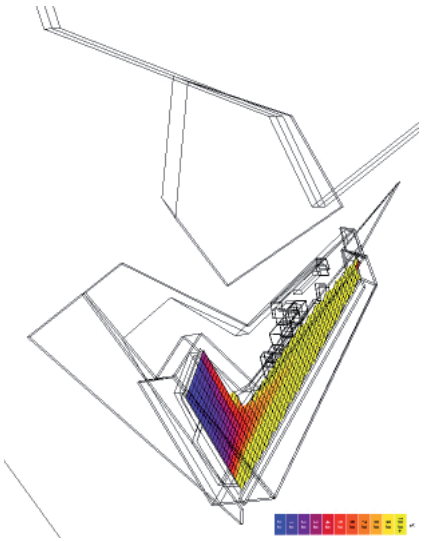
Developing Bada Hudik for natural lighting is done by analyzing daylight factor levels throughout the plan. This gives a rough idea of the amount of light available from natural resources at different stages of the design. Plans and sections are adjusted to accommodate natural lighting in addition to structure and functional program.

The initial design admits light through the façade in the openings underneath the main elements of the exoskeleton. Daylight levels are high on the first floor and more modest on the ground floor level. Initially this is in coherence with the desired concept of the building; the upper level being open and light, while the lower level has a more closed and intimate feeling. However the analysis does detect potential problems. The wardrobe areas are completely dark, natural light is absent. The first floor southern wing is also quite dark along the solid wall. These are areas where light levels should be better. Furthermore, as the design develops, and load carrying structure (the endoskeleton) is added to the building, the levels will change.









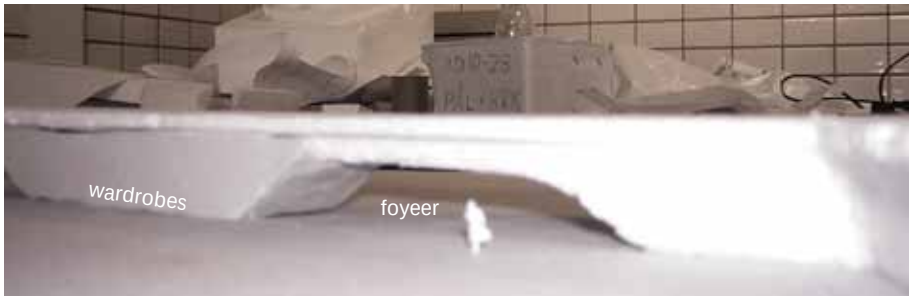
development light

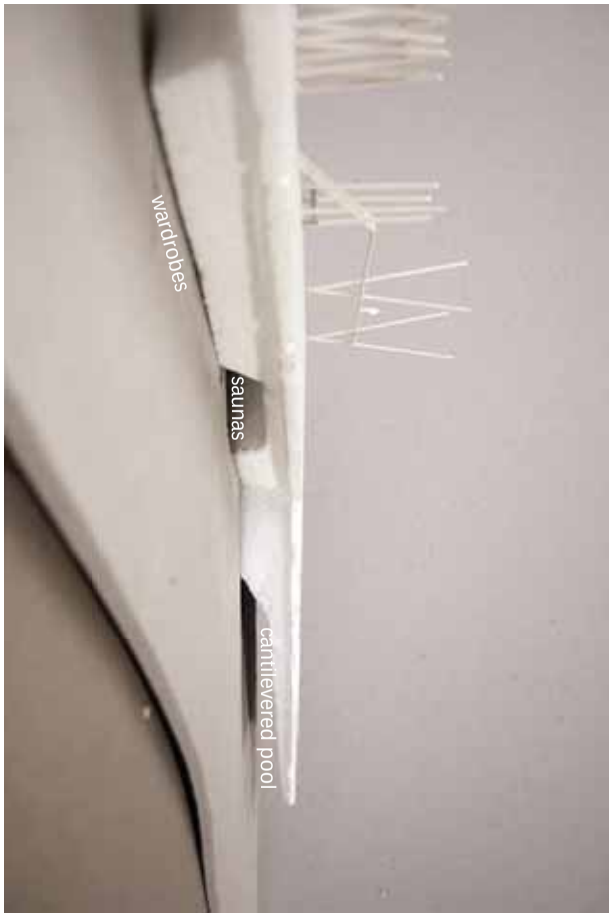
opposite : layout1 ground floor / daylight factor analysis (made in ecotect)
this : layout1 1st floor / daylight analysis with 100%, 0% and 40% transparency on north façade (made in ecotect)

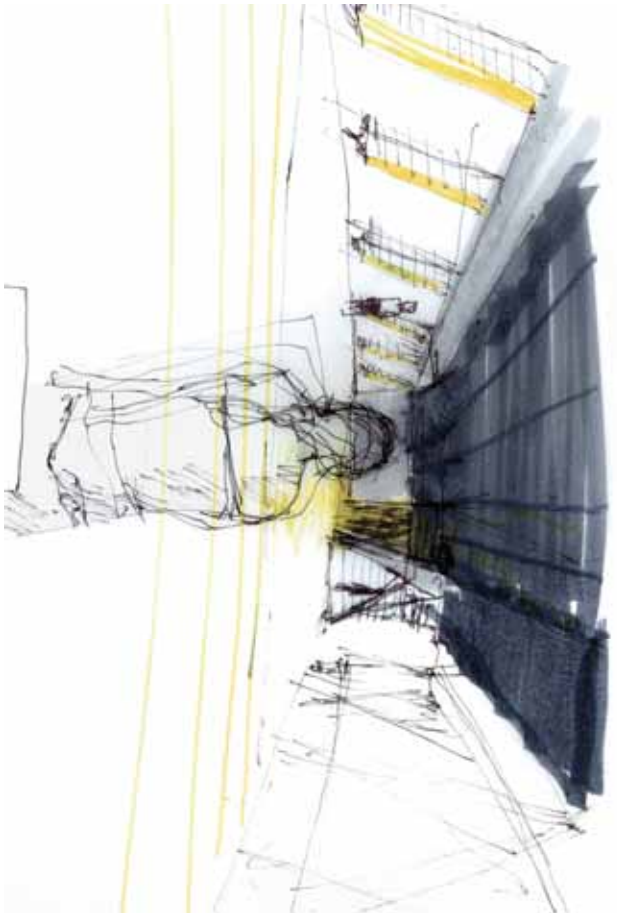
CONCRETE SCULPTURE

The elevated pool becomes a sculptural element in the building. It's a concrete core that runs through the entire bathhouse, from reception to swimming pool. The top is a sleek plane which extends the water surface of the large pool complex. Under this surface the form morphs and evolves according to the functions below. It hovers above the reception and creates a shell around the women's dressing room. It bridges over the central foyer and dives again to hold the pool's deep end (the diving section), before it lifts its head in the southern facing swimming pool.

Connected to the deep end of the pool, the saunas are integrated into the concrete volume with access to the foyer. The saunas are entered through square cuts in the slanting concrete wall, and are a mix of concrete and wood interior. This section has a grotto like feel.

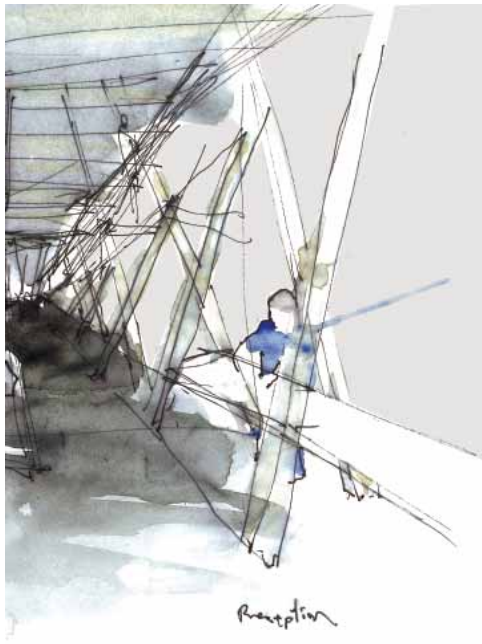


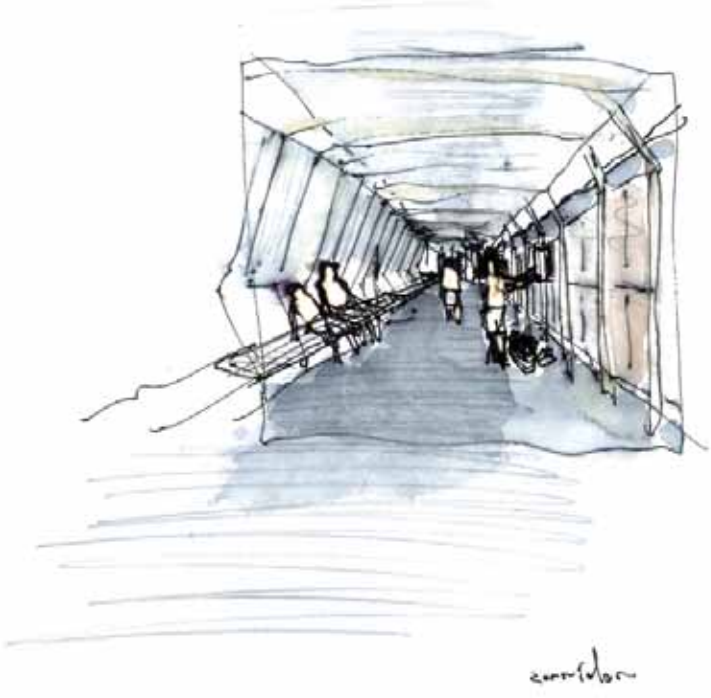


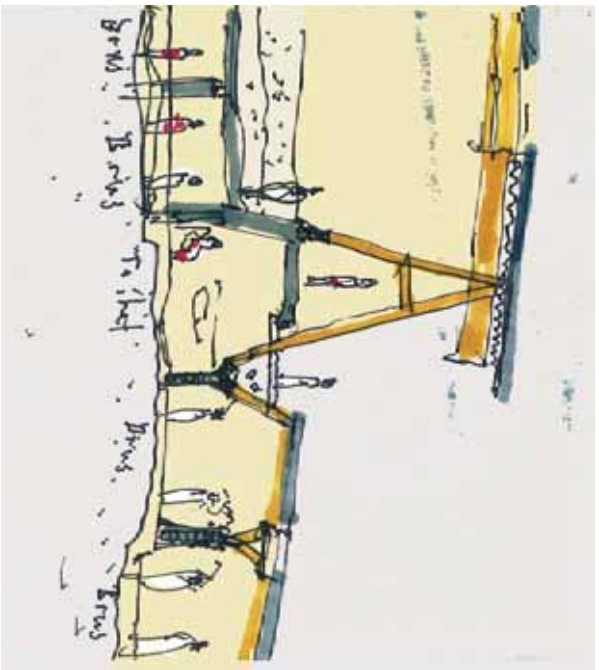


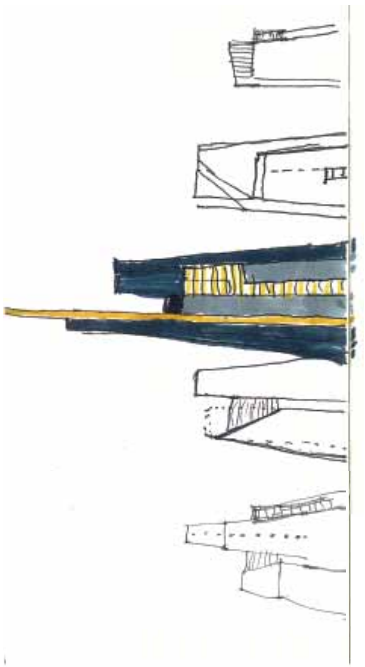
development organization

opposite : two models experimenting with the expression of the concrete pool in the foyer area
this top: sketch of a girl exiting the saunas into the foyer facing the entrance to the women's wardrobe and the stairs to the first floor /
bottom : model of concrete pool complex


Reception







development organization

Sketches visioning and experimenting with the organization of the reception and wardrobes.
opposite top : reception desk integrated in endoskeleton / bottom: men's dressing room.
this top: roof plans / bottom : section through wardrobes. An exterior walkway articulates the transition from façade to roof and holds the dressing rooms' toilets underneath.

SUPPORTING THE WEIGHT OF THE CONCRETE POOL

A part of the architectural vision for the building is to display the contrast between wood and concrete, lightness versus mass. Simple mass calculations compared to a table of the load bearing capacity of wood columns are used to get a general idea of dimensions, and the number of columns required to support the weight of a concrete tub filled with water.

The calculations are based on a concrete tub detached from the overall concrete structure, transferring the entire weight of the tub to the wood columns. In reality some of the weight would be supported by the remaining concrete structure as the tub could be seen as a cantilevered part of the main construction.

Digital modelling is used to create the tub, and the software is used to facilitate the calculation of volume and mass.

A table of the load bearing capacity of wood columns is constructed and transferred to excel where the force supported per column is calculated and compared to the table.

Calculations are based on columns transferring the weight via pinned joints.

The concrete construction is constructed using extra durable concrete for aggressive environments. Mass 2600kg/m3.

loadbearing capacity, P-load, in kN for wood column with pinned joint. Class of use 3

column length	2	2,5	3	3,5	4	4,5	5	5,5	6
cross section mm x mm									
150 x 150	94,08	81,76	65,52	51,464	40,824	32,984	27,104	22,624	19,208
175 x 175	134,4	124,32	108,08	89,04	72,8	59,36	49,056	41,16	35
200 x 200	180,88	171,36	157,36	137,76	116,48	97,44	81,2	68,88	58,8
225 x 225	232,4	224	211,68	194,32	171,92	147,28	125,44	106,96	91,84

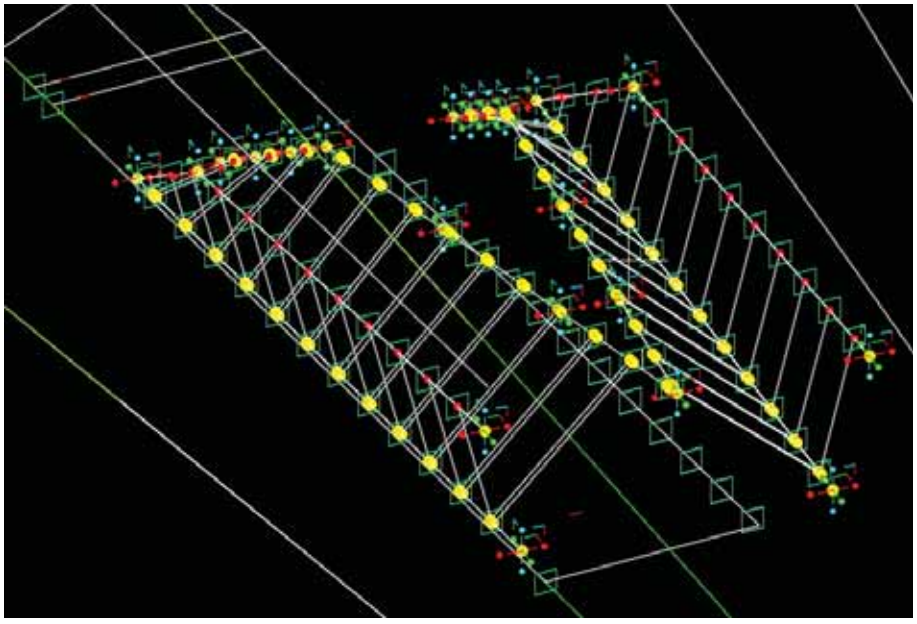
mass calculation for raised pool

dimensions of pool: 2,61m x 13,35m x 16,09m	
bottom area of pool (m2)	214,8
density concrete (kg/m3)	2600
density water (kg/m3)	1000
concrete volume (m3)	250,05
water volume (m3)	310,58
weight concrete (kg)	650130
weight water (kg)	310580
total (kg)	**960710**
force: weight x gravity / 1000 (kN)	**9414,96**
force pr. m2 (kN)	**43,83**

force pr. column

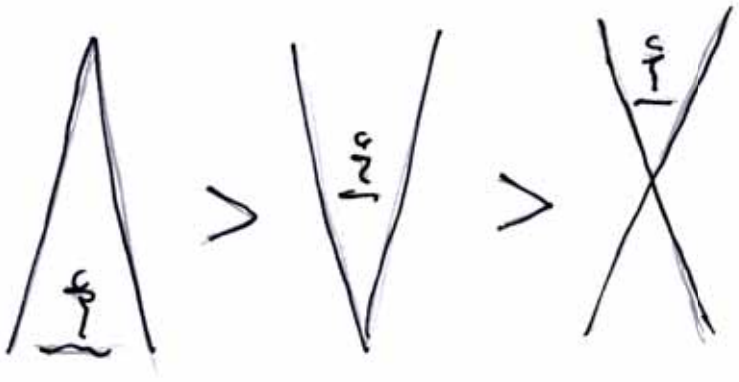
number of columns	force (kN)
20	470,75
30	313,83
40	235,37
50	188,30
60	156,92
70	134,50
80	117,69
90	104,61
100	94,15

A comparison of the results for force per column, and the load bearing capacity from table 1 give a general idea of the dimension and number of columns required to support the concrete tub. The design of the building limits the length of the columns to a maximum of approximately 4 meters, resulting in 80 columns measuring 200 x 200 mm. The dimension and number of columns could most likely be reduced, as they support the entire weight of the tub, keeping in mind that the tub is part of a larger concrete structure that will support some of the load.



To explore space and light and the arrangements of the columns, the findings from the calculations are explored using a scale model of the tub supported by approximately 80 columns measuring 200 x 200 mm.

opposite top : model picture light and structure / bottom: scale model
this : the principle of the structure is transferred to a digital parametric model



DESIGNING AND DIMENSIONING THE ENDOSKELETON

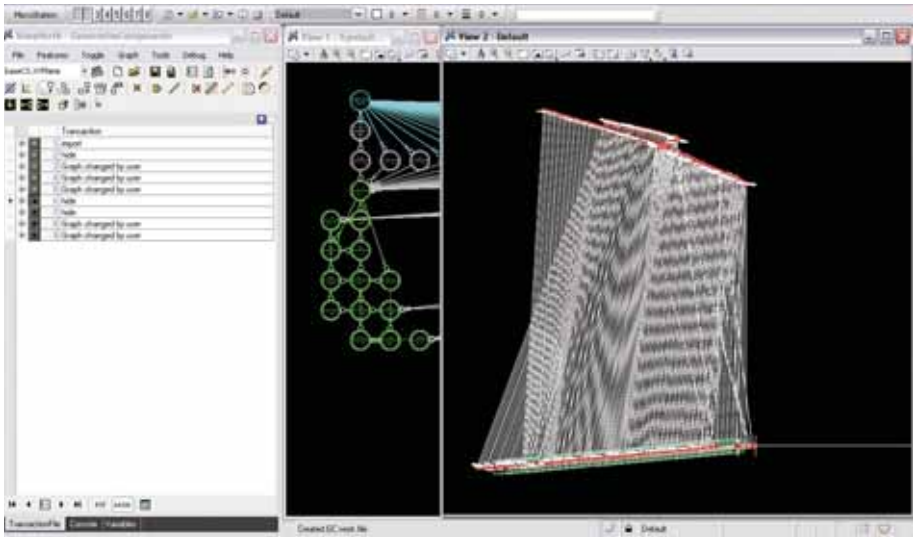
The potential of the wood structure is explored further through scale models. Combining the endoskeleton of the building with internal and external pathways highlights the capabilities of the structure to create fluent sequences and guide the visitor through the building, while supporting the overall structure and pathways within the building.

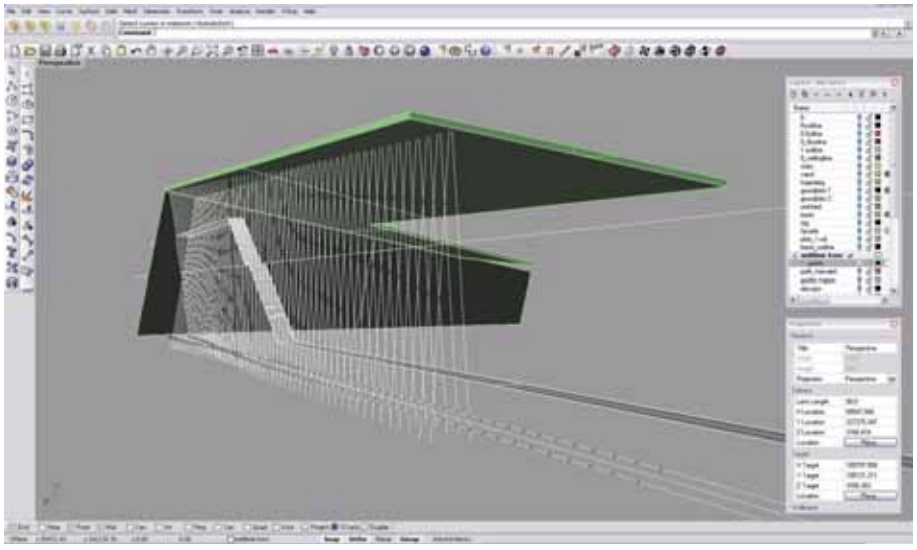
Parametric modelling is utilized to help understanding the structure and show of the potential of a fluent transition as the structure is transformed from a basic A-frame, through a V-shape to end up as an X-shaped structure. The structure is transferred from Generative Components to Rhino where the transformation from A to X shows the potential for holding a stair and supporting the roof and façade of the building.

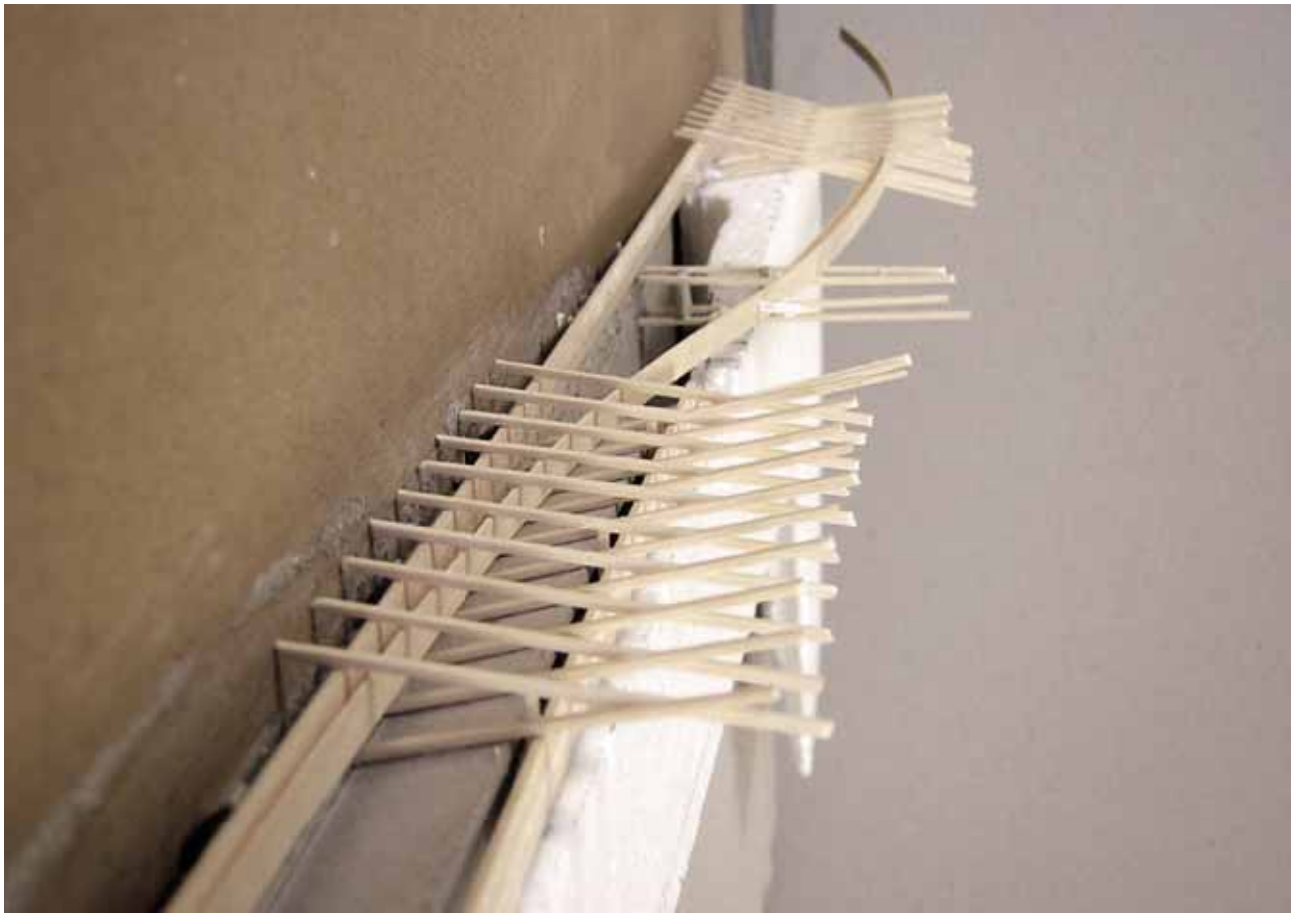
opposite top and bottom: model picture path and structure
this: sketch diagram from A-shape to V-shape to X-shape

development structure

inspirations for endoskeleton.
opposite : pine forests in the area around Hudiksvall. top : silhouette / bottom : the warm evening sunlight is filtered through the tree trunks
this : boat houses on the east side of the site are dominant in the harbor basin. Timber arcades flank the sides of the volumes.

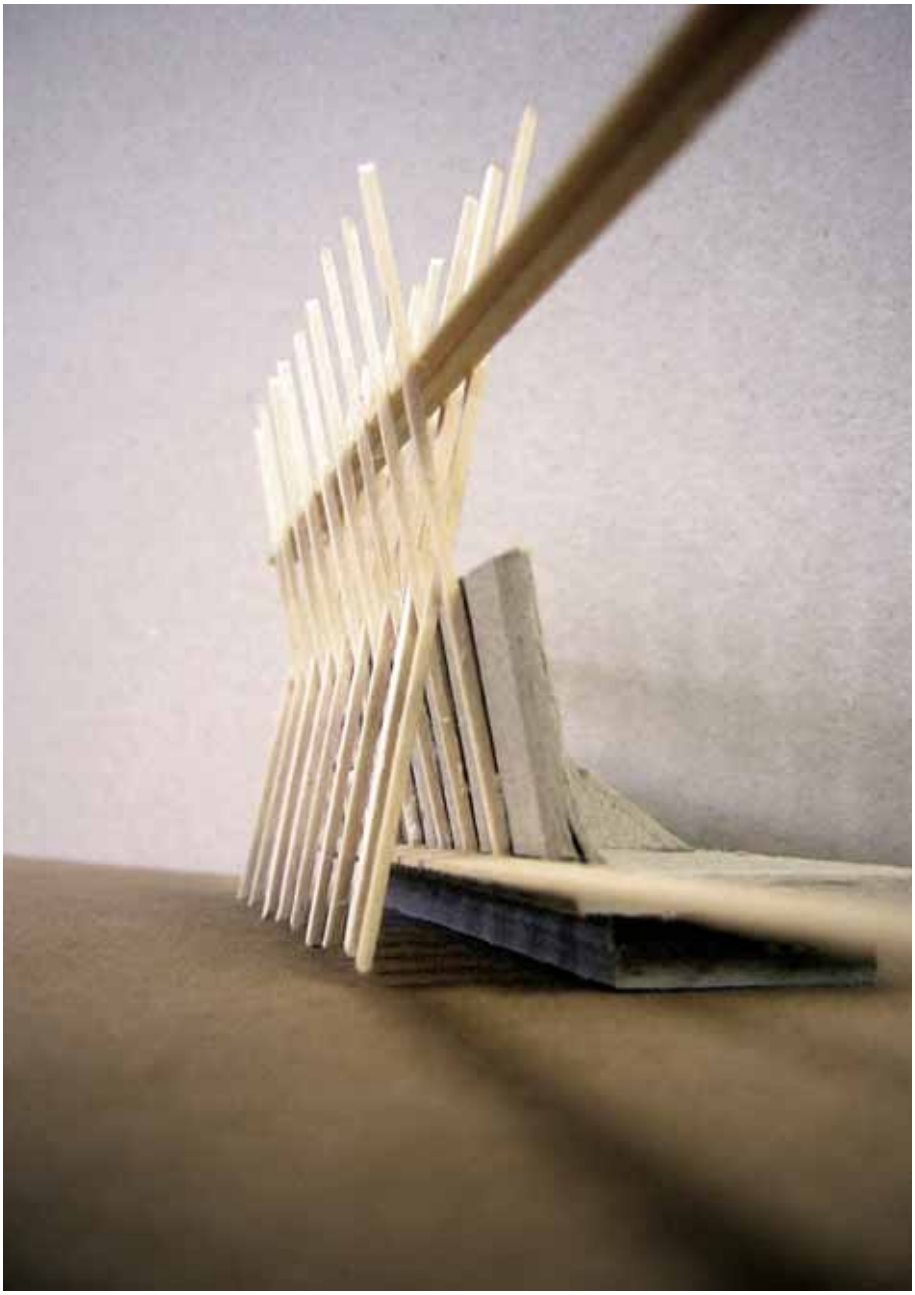


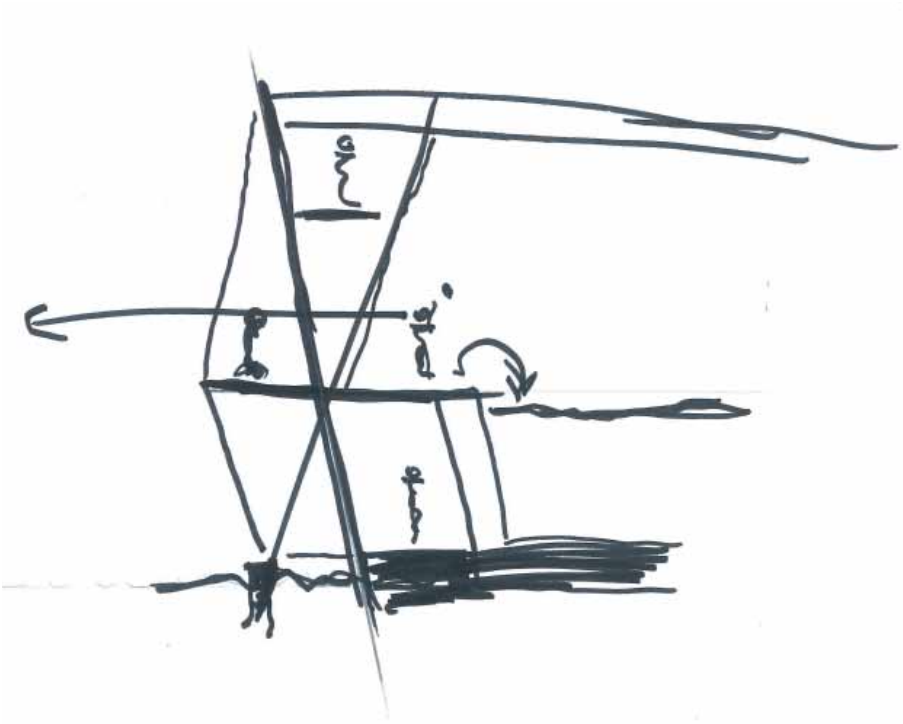




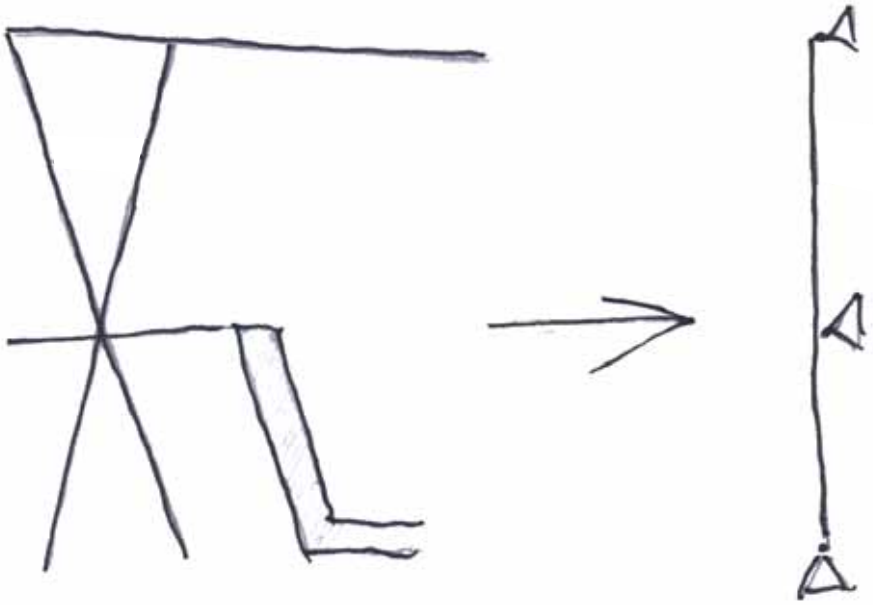
development structure

opposite top : screendump from Generative Componets : screendump from Rhino
this: scale model of path and wood construction



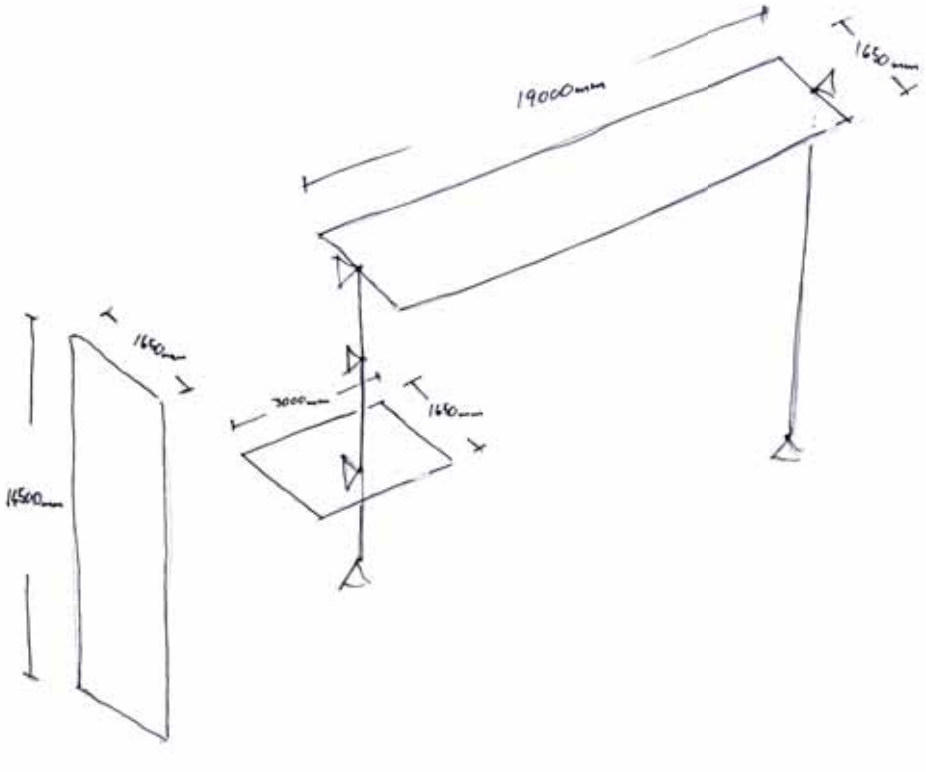


The relationship between a light wood framework, contrasted by a heavy concrete structure is explored in various models and sections. The result is a design that will function as a support for the façade and roof, while holding extra functions such as a balcony for visitors, a walkway alongside the pool, and a boardwalk flanking the outside of the building.



The section is developed further, and arrives at a diagram that serves as the basis for calculation and dimensioning of the two wood columns in the X-frame.

opposite: model picture wood construction and concrete tub
this: sketch diagram of column and supports



areal tag = 31 m2

last		kraft
egenlast	0,8 kN/m2 x 31m2	24,8 kN
snelast	0,8 kN/m2 x 31m2	24,8 kN

areal dæk = 5 m2

last		kraft
egenlast	0,4 kN/m2 x 5m2	2,0 kN
nyttelast		3,0 kN

areal facade/glazing = 24 m2

last		kraft
egenlast	0,4 kN/m2 x 24m2	9,6 kN
vindlast	1,1 kN/m2 x 0,7	0,77 kN/m2

Calculation of loads is based on a strip of the building from the north-east corner where the height of the columns in the façade is tallest, 14.5 meters, and the span over the main pool is at a maximum of 19 meters. The width of the strip corresponds to the average distance between the columns, 1.65 meters.

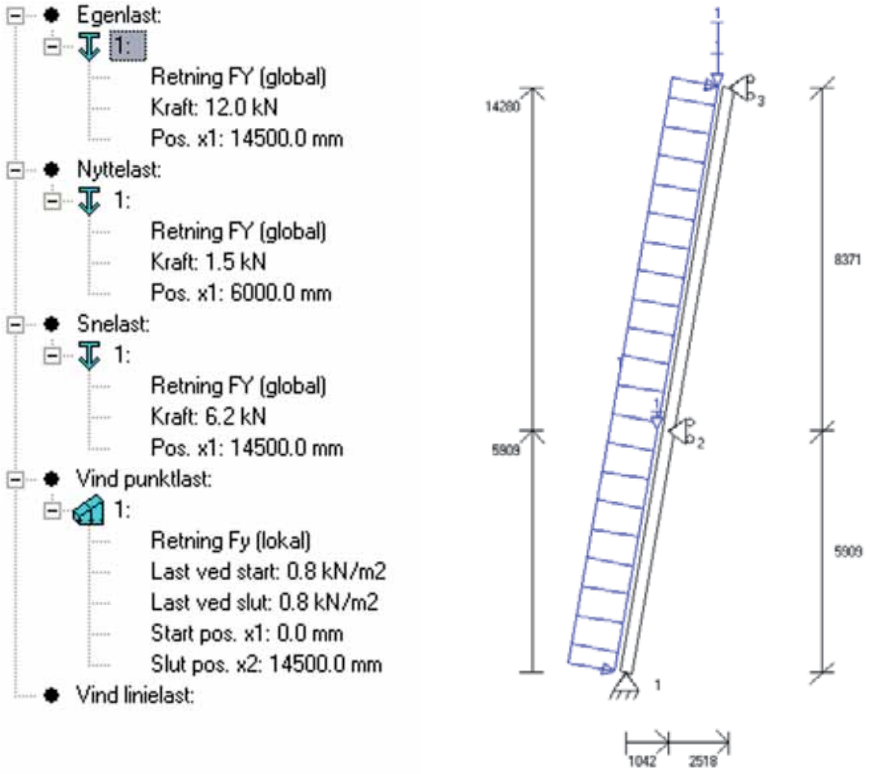
lastpåvirkning på søjle i facade

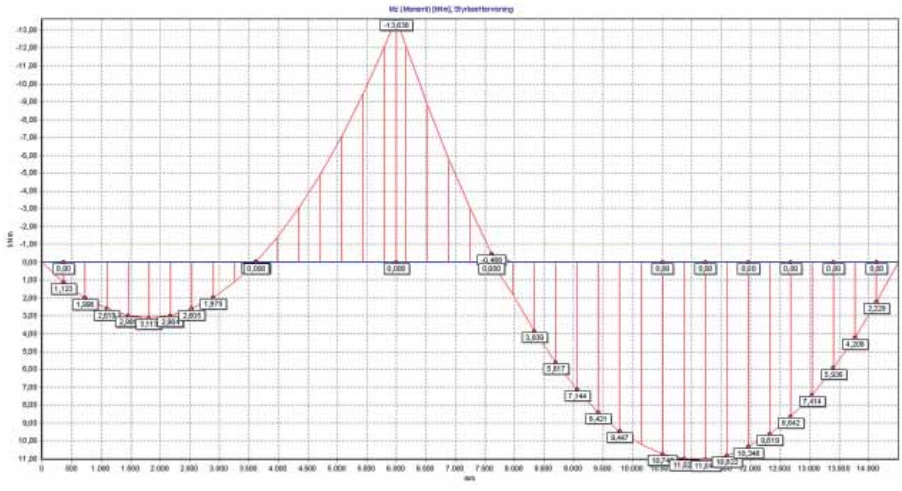
last		kraft			kraft
egenlast fra tag	0,5 x 24,8 kN	12,4 kN	pr. søjle	0,5 x 12,4 kN	6,2 kN
snelast fra tag	0,5 x 24,8 kN	12,4 kN	pr. søjle	0,5 x 12,4 kN	6,2 kN
egenlast fra dæk		2,0 kN	pr. søjle	0,5 x 2,0 kN	1,0 kN
nyttelast fra dæk		3,0 kN	pr. søjle	0,5 x 3,0 kN	1,5 kN
egenlast fra facade		9,6 kN	pr. søjle	0,5 x 9,6 kN	4,8 kN
samlet last på 2 stk søjler i facade		39,4 kN			
samlet last på 1 stk søjle i facade					19,7 kN

egenlast på 1 stk søjle i facade	**12 kN**
nyttelast på 1 stk søjle i facade	**1,5 kN**
snelast på 1 stk søjle i facade	**6,2 kN**
vindlast på 1 stk søjle i facade	**0,77 kN/m2**

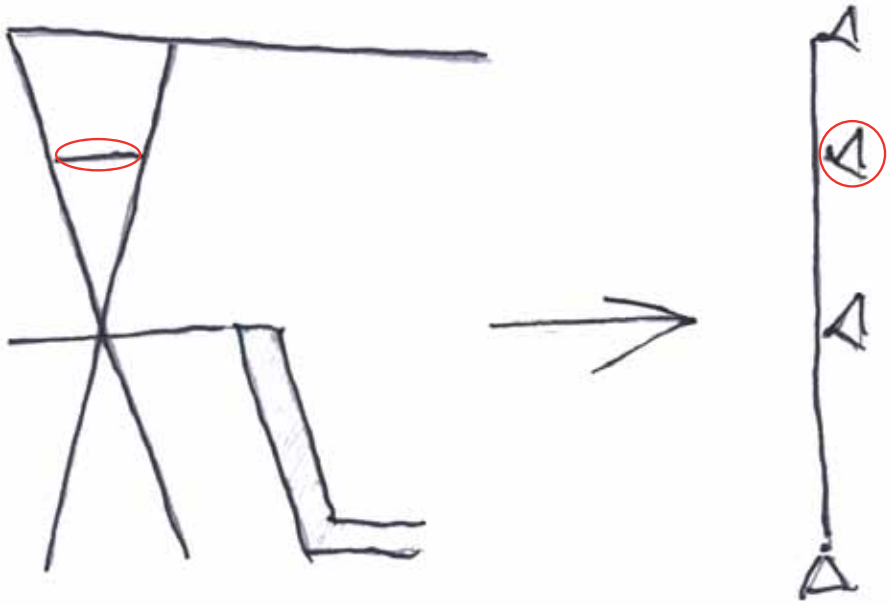
The loads affecting the column are transferred to finnwood 2.0, a finite element program specifically designed for dimensioning wood constructions. First the column is designed according to length, types of fixations and the distance between the columns of 1.65 meters. Forces are added to the structure according to placement along the column, and the software generates a possible dimension for the column, along with graphs showing stress and moment within the structure.

Initial calculations are performed on a column with 3 supports; one at the bottom, one at the edge of the concrete tub, and one at the top of the column. Graphs generated using the software show a large moment, resulting in a large column measuring 90 x 450mm.

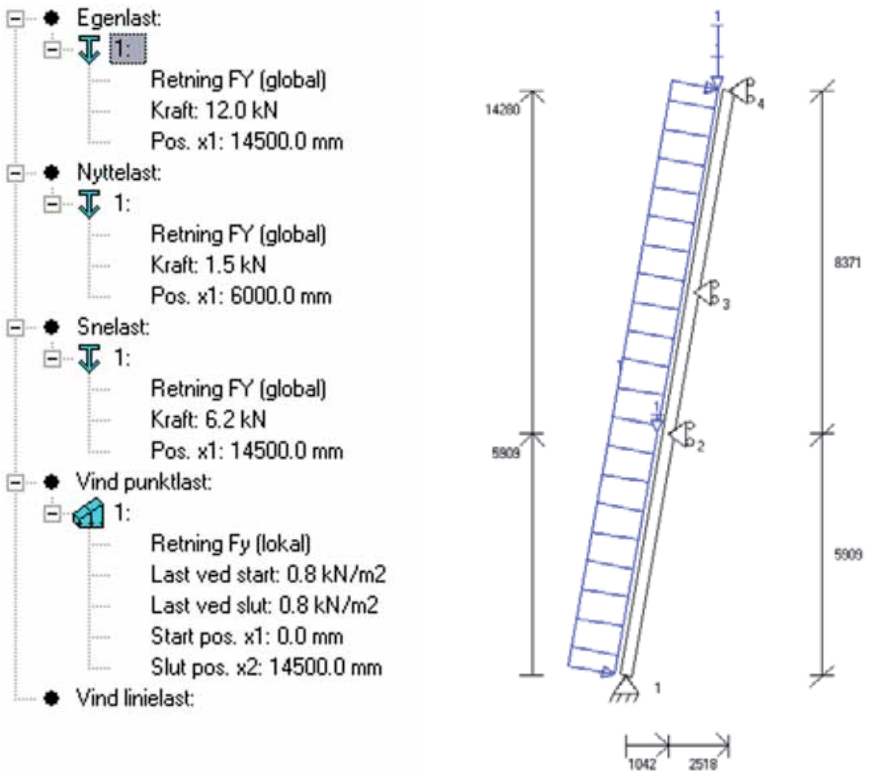


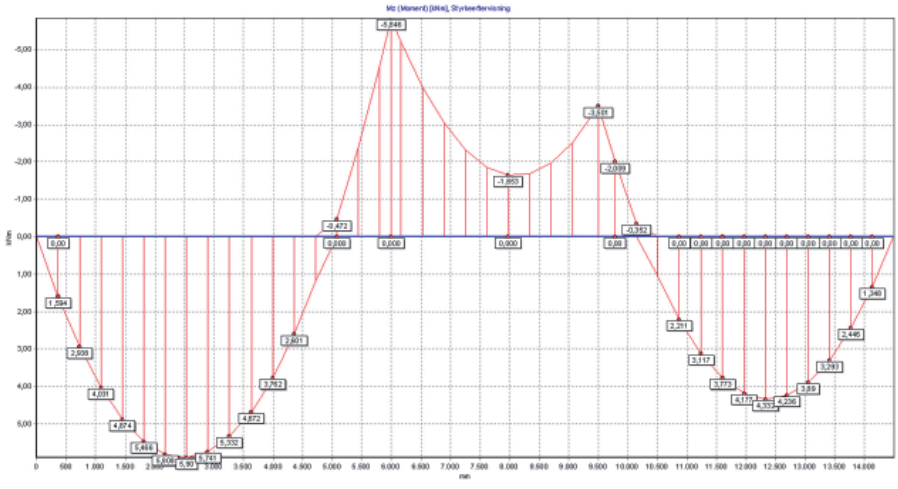


this top: forces + diagram of column with 3 supports / bottom: graph of moment for column with 3 supports

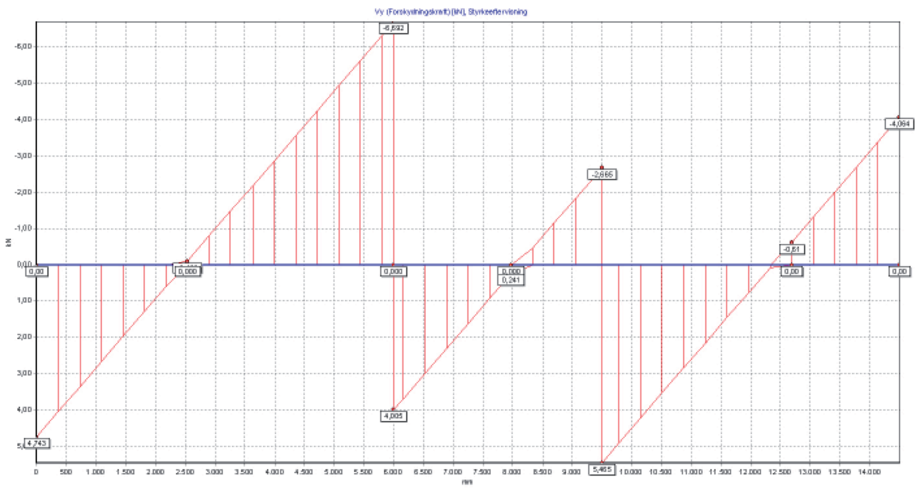


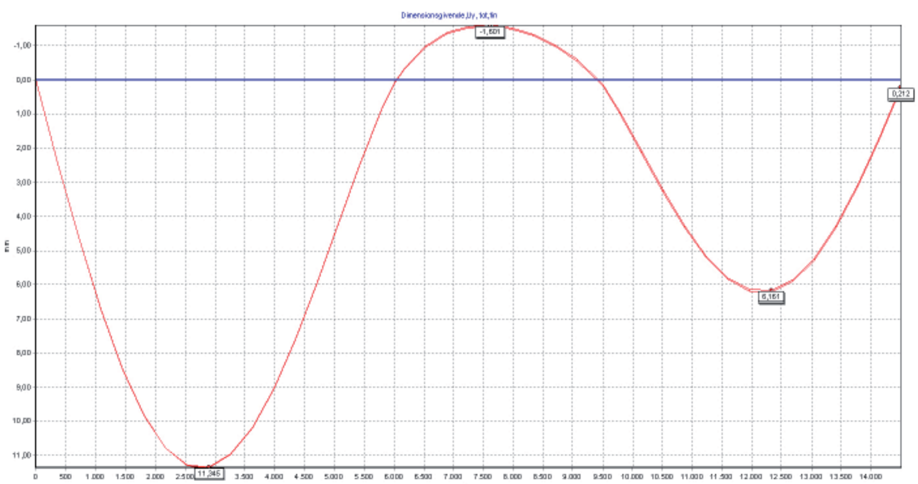
By redesigning the structure and adding a fourth support it is possible to reduce the effective length of the columns in the façade, thus reducing the moment and ultimately the dimension of the columns. The walkway suspended within the X-frame is introduced as a fourth support. The extra support reduces the effective length of the columns in the façade, thus reducing the moment and ultimately the dimension of the columns.





opposite: sketch diagram of column with 4 supports
this top: forces + diagram of column with 4 supports / bottom: graph of moment for column with 4 supports


Vy (Forskydningskraft) [kN], Styrkeeftervisning
kN
mm
-6,592
-4,064
-2,665
-0,61
0,00
0,000
0,241
4,005
4,743
5,465


Dimensionsgivende,Uy, tot,fin
mm
-1,601
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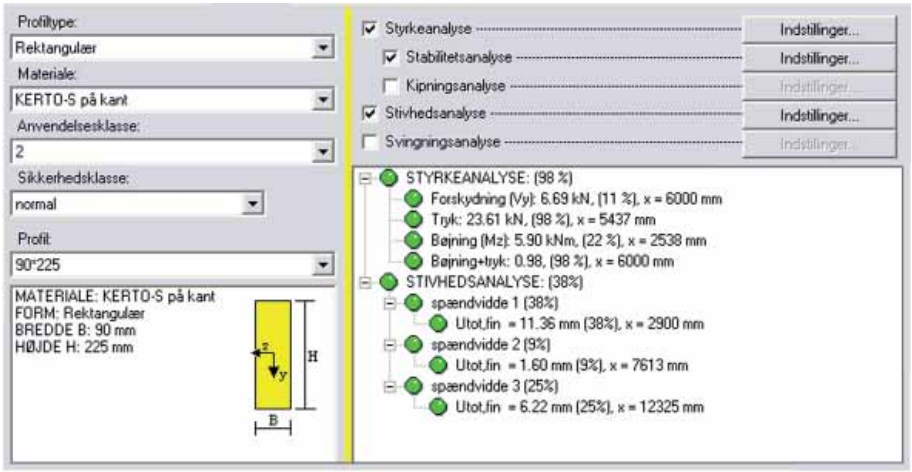
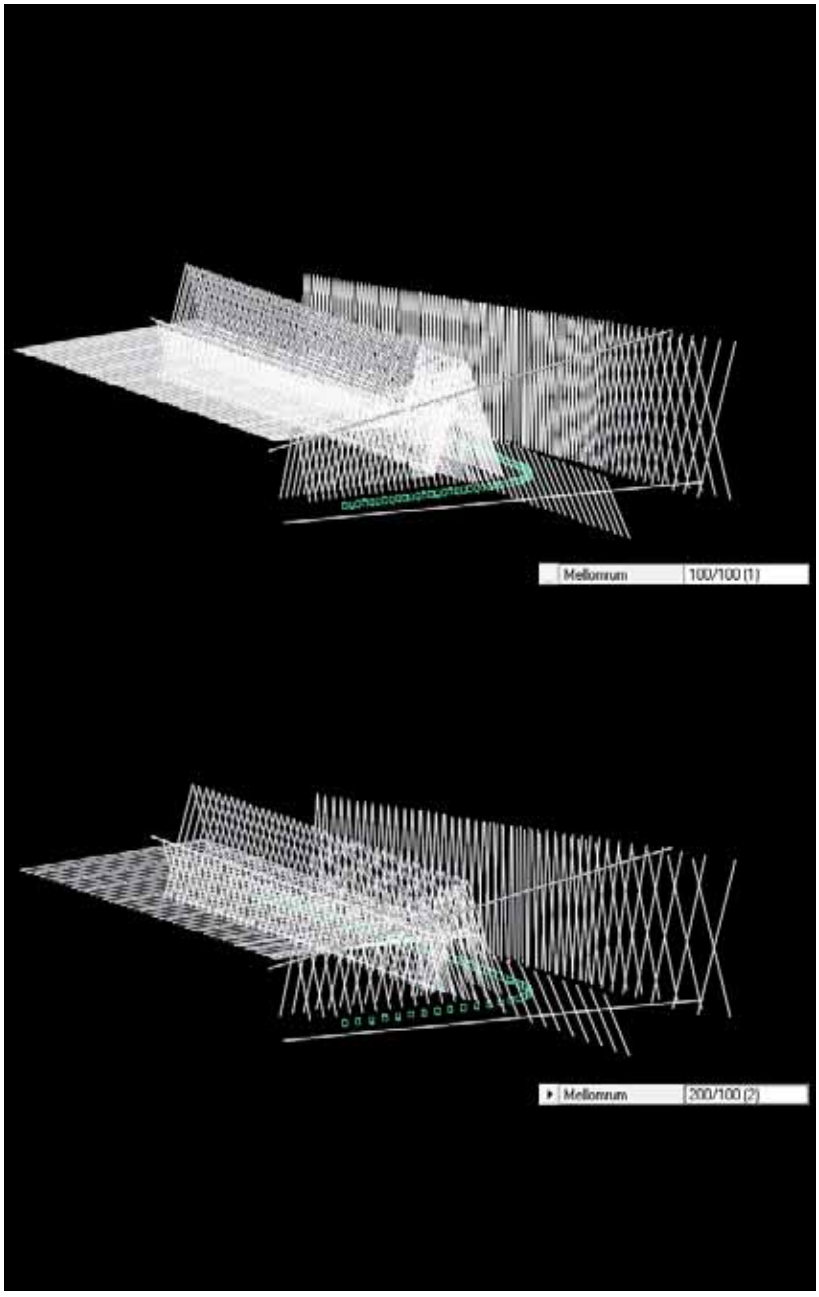


The column with four supports is analyzed according to stress, moment and how much the column can be expected to flex when subjected to forces. The result: a laminated wood column measuring 90 x 225mm.

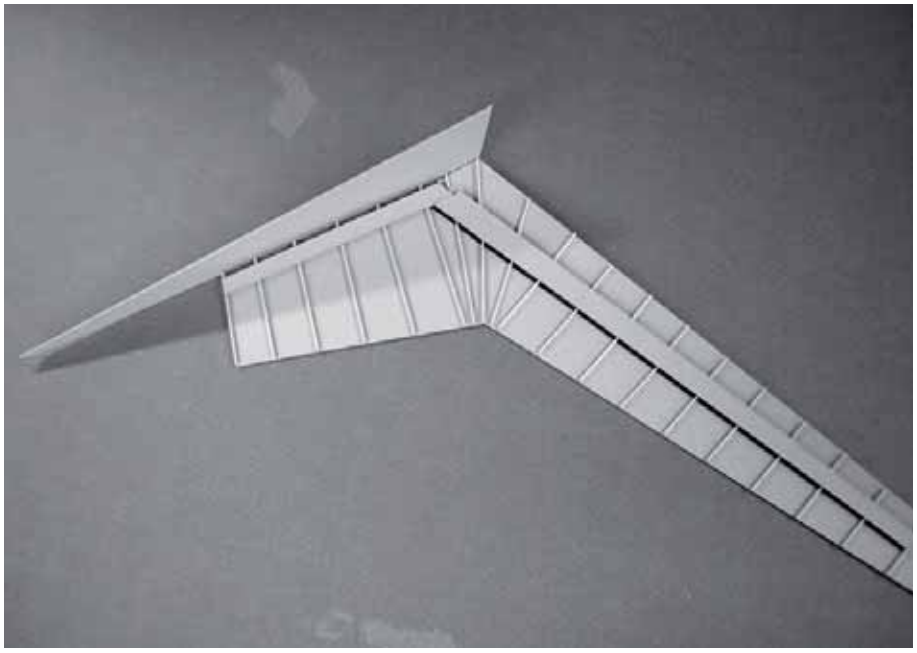
opposite top: diagram of stress / bottom: diagram of movement
this: result from finnwood 2.0

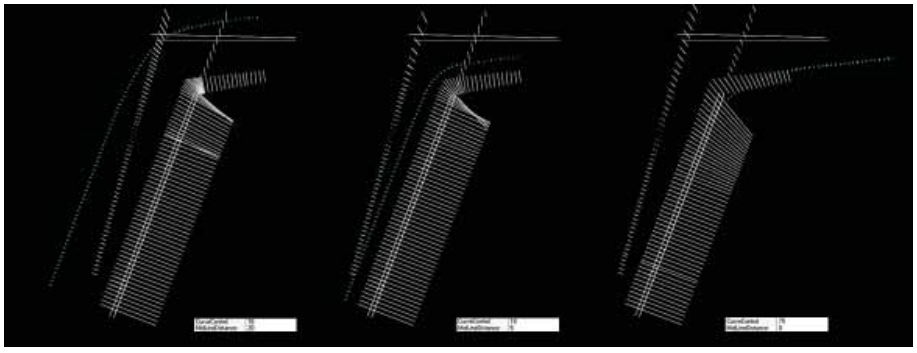

Mellomrum
100/100 (1)
Mellomrum
200/100 (2)

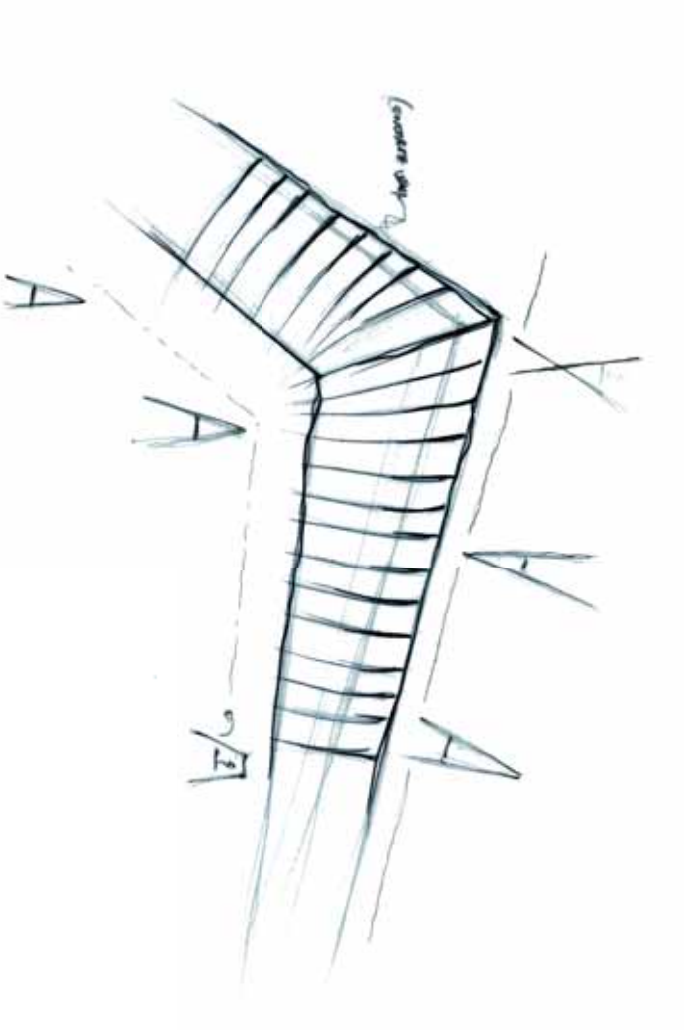
PARAMETRIC DEVELOPMENT OF THE ENDOSKELETON

Parametric modelling is utilized to further develop the load bearing endoskeleton of the building. Lines from an early CAD 3D model generated in Rhino are imported into the parametric modeller Generative Components (GC) where they serve as fix-points and pathways for the development of the wood structure.

The benefits of parametric modelling are made clear as GC is used to facilitate the design of the wood frames as they turn around the corner of the pool, creating a fan-like effect in the ceiling as the beams running along the ceiling change direction. The rotation angle and expression of the bend around the corner is controlled by a centre curve with perpendicular planes, which cut out the paths for the frames. The objective of the GC model was to control the trajectory of this centre curve along with the ability to change the distance between the columns and their dimensions. A play between GC and finite element allowed us to find a satisfactory relation for the distance between columns and their dimension.

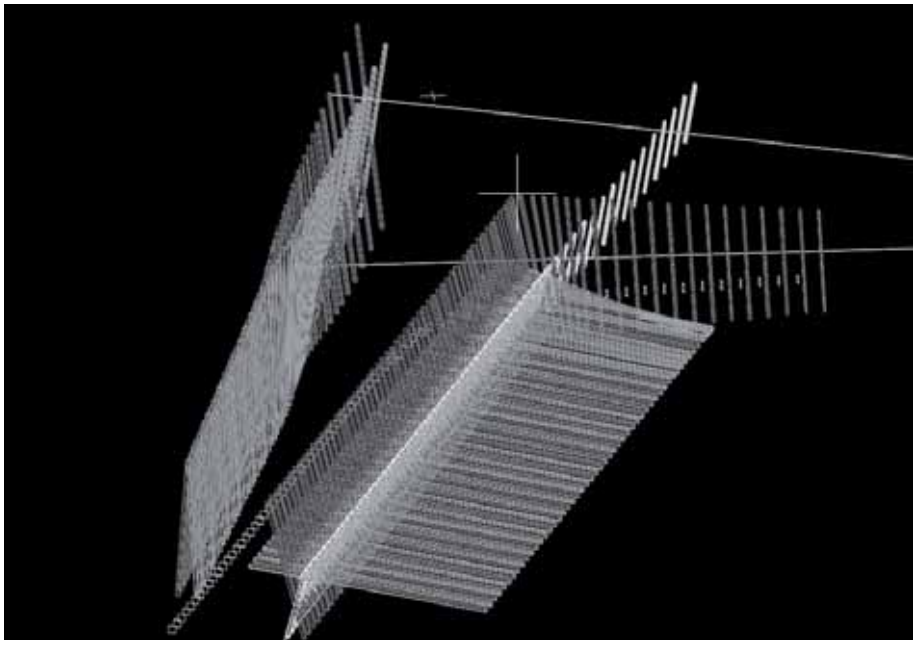




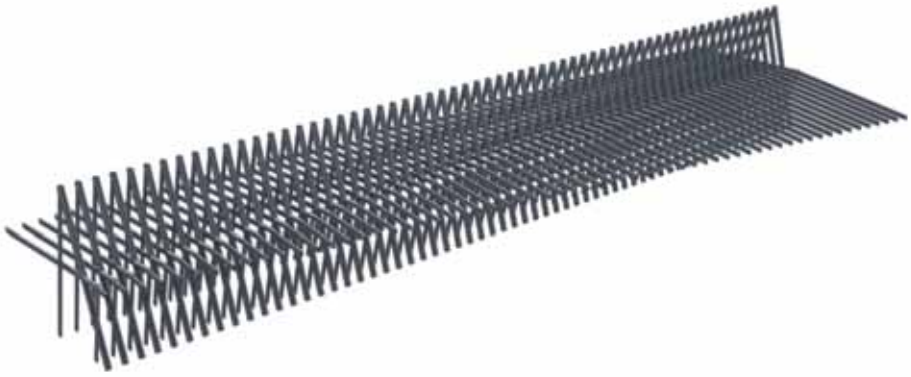


development structure

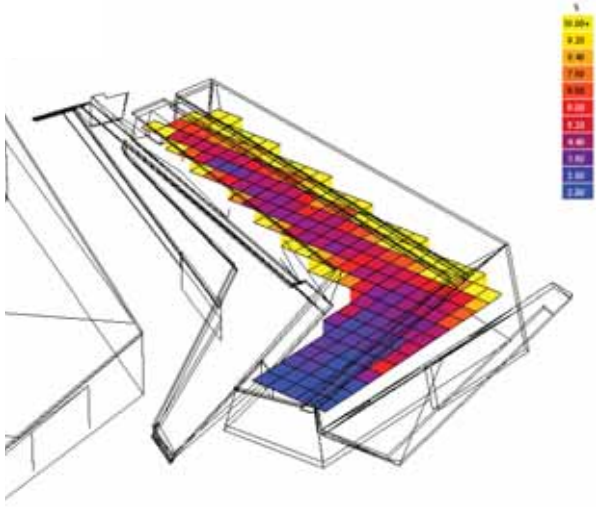
opposite top: scale model of roof structure / bottom: screendump of structure in Generative Components
this: sketch of roof structure

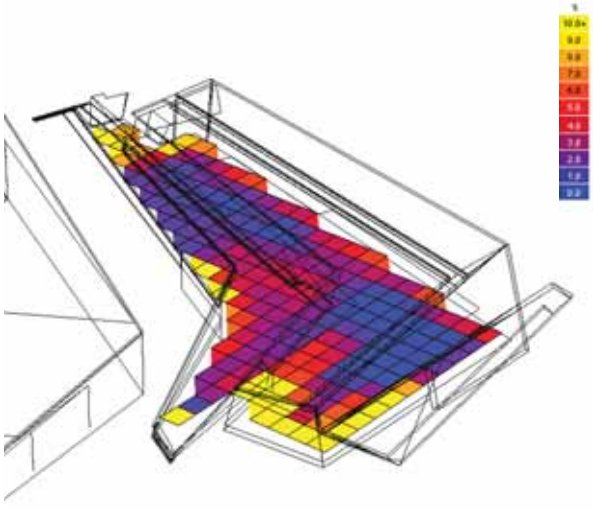


Finally the structure is exported from GC and returned to Rhino, where it is fused with a three dimensional model of the building design, used to generate plans, sections and façades.



opposite: screendump from generative componets
this: test renderings from Rhino



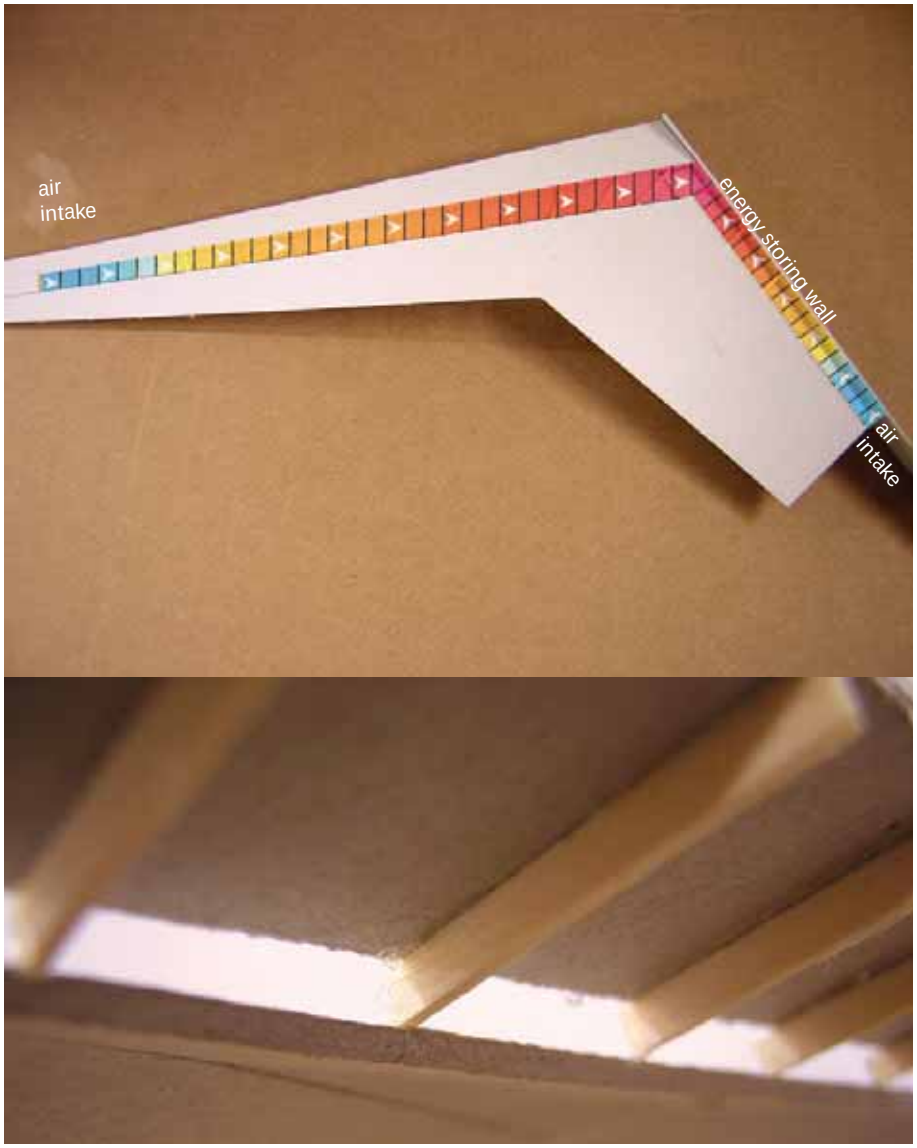


DAYLIGHT ANALYSIS2

A second daylight analysis is performed after adding the endoskeleton. Adjustments have also been made to the shape of the exoskeleton in order to accommodate the functional program elements.

Immediately these results show some of the same problems as the first layout. The first floor southern wing, above the swimming pool, is still rather dark. The ground floor has improved light levels in the foyer area, but light levels in the dressing rooms could improve. Adjustments of the exoskeletal elements could help in addressing these issues.

ecotect results for daylight factor
top : layout 2, first floor
bottom : layout 2, ground floor


air
intake
energy storing wall
air
intake

VENTILATION / HEATING STRATEGIES

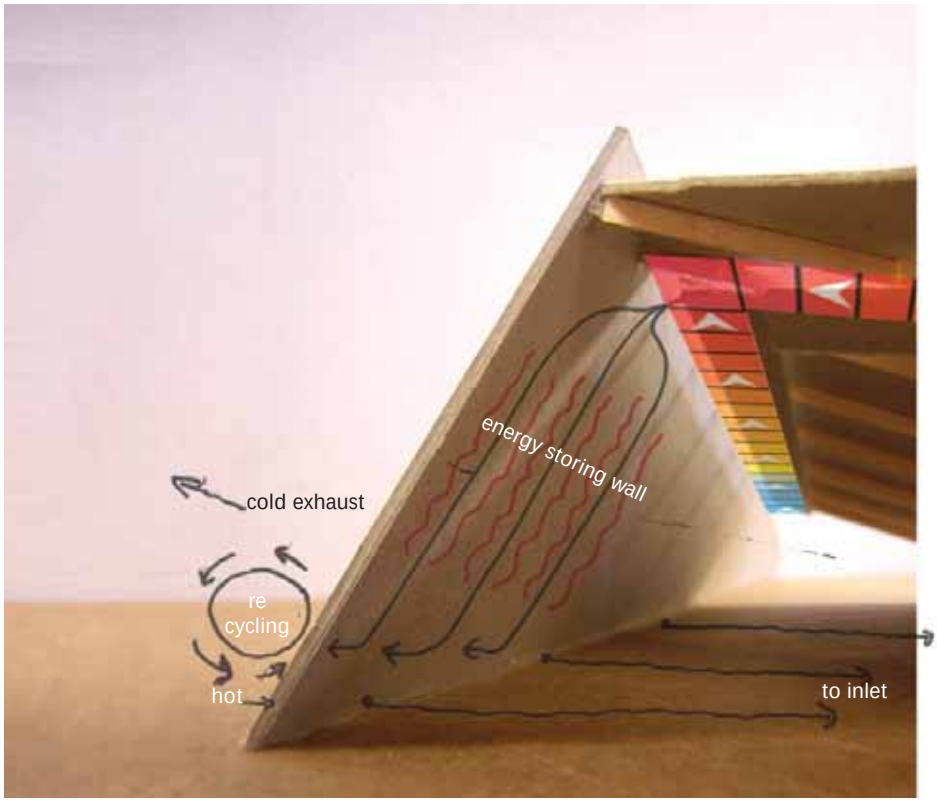
Generally public pools use a lot of energy for many tasks. Heating pools, heating water for showers, warming up the air temperature, ventilation and lighting all require large amounts of energy. Bada Hudik tries to reduce som of these energy costs by integrating energy saving systems.
One of the largest energy expenses is for heating of water. The cooler swimming pools can be heated almost entirely by the air around them, while the hot pools need to be heated actively.

To reduce costs, solar panels are installed on the timber construction members on the south façade. The amount and effect of these are not calculated here, but an effective system should be able to supply heat for both utility water and pools.

The integration of a grove in the upper roof shell combines many principles that work well both from a sustainable point of view and structurally. In addition to being a natural light well and structural stabilizer of the roof, the grove is utilized as a preheating system for the intake air for the ventilation system. A closed box is created between the glass skylight, the lowered panels and two glass windows. By reinforcing the wood beam in the centre with steel or carbon fiber, it can be perforated to allow air to run through.

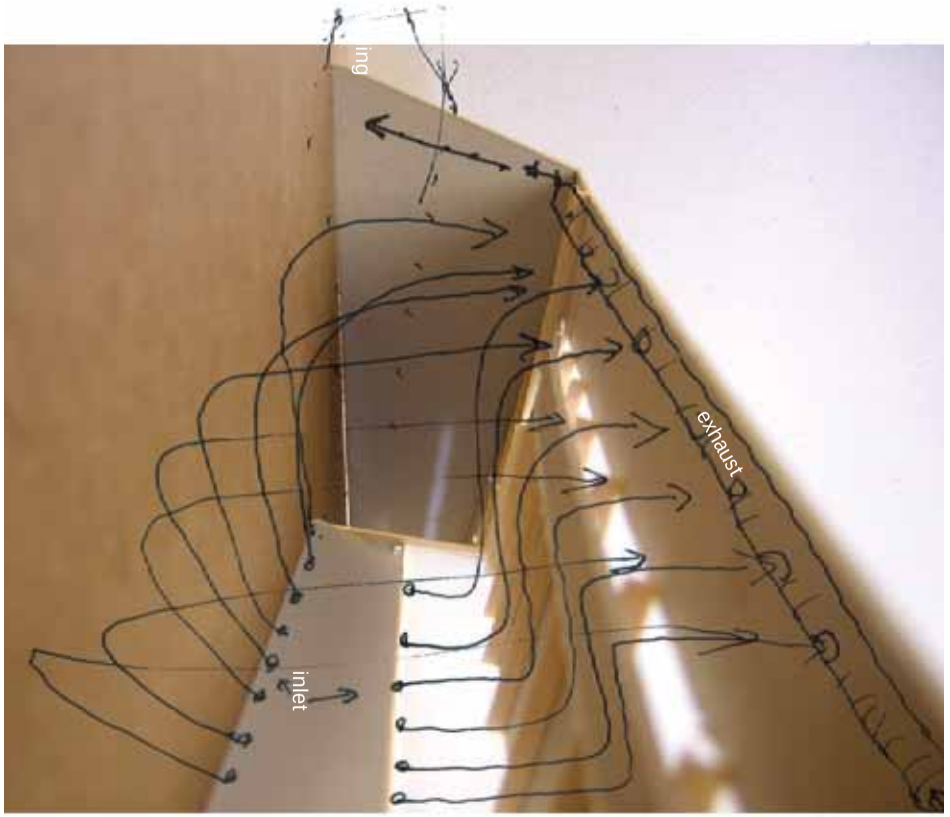
This creates a chamber between each "beam-box", which lets light into the room below and heats up the air through direct sunlight. Air intakes are located at the tips of the wings. As the air travels from these tips towards the connecting corner, heat slowly accumulates from one chamber to the next. The warm air travels down through the eastern concrete wall to the ventilation machinery, located in the east corner of the building. The eastern concrete wall is heavy, and accumulates some of the heat. Turning the wall into a large energy bank that will continue to preheat the intake air after sun down. To further increase the efficiency of the system a cross-heat-exchanger is installed. The heat exchanger recycle heat from the exhaust air, and can be used the raise the temperature further of the intake air when needed.

top : skylight location in roof, heat gradually accumulates in two directions towards the corner
bottom : model picture of structure interacting with the skylight



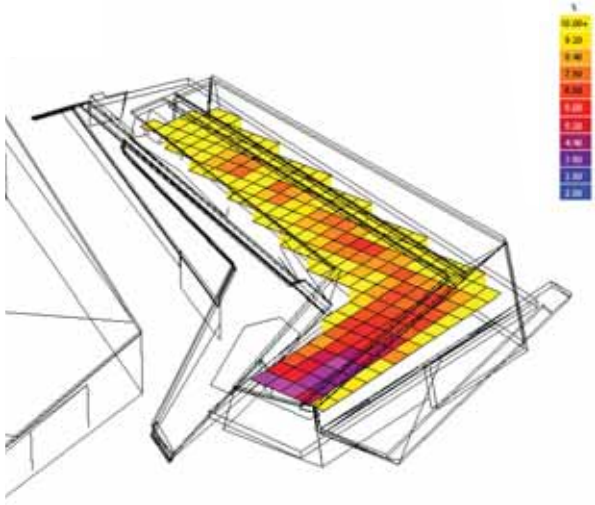
The building is ventilated through displacement. Air inlets are located on floor levels, along the windows and carrying structure. This prevents condensation from building up, which is normally a big problem with indoor swimming pools.

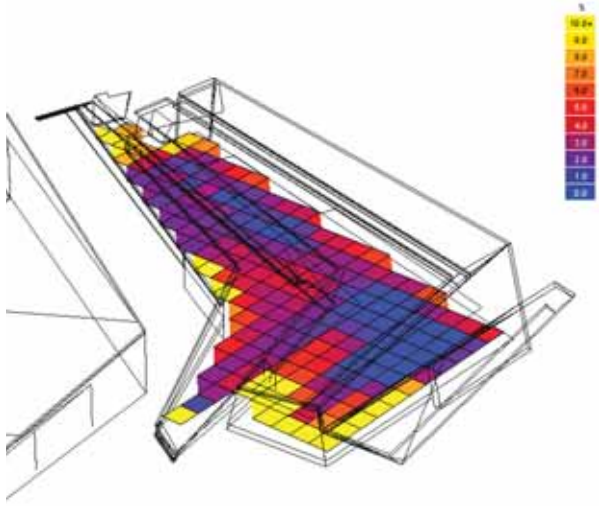
Air is taken out through a pipe in the upper corner of the ceiling, from where it is transported through the same wall as the intake air, to be recycled. There is plenty of space for ventilation pipes in the cavities of the timber structure. This puts the piping and installations behind a transparent filter, making the installations visible, but not dominating.



development tech

opposite : air temperatures accumulate through the structure. intake to inlet
this : inlets are located along the facade in a displacement ventilation principle





DAYLIGHT ANALYSIS3

After implementing the light well in the roof structure, daylight levels improve dramatically for the first floor. The daylight factor is more evenly distributed over the entire main pool. A daylight factor of five is generally viewed as excellent conditions; the result for the first floor shows levels of four and above.

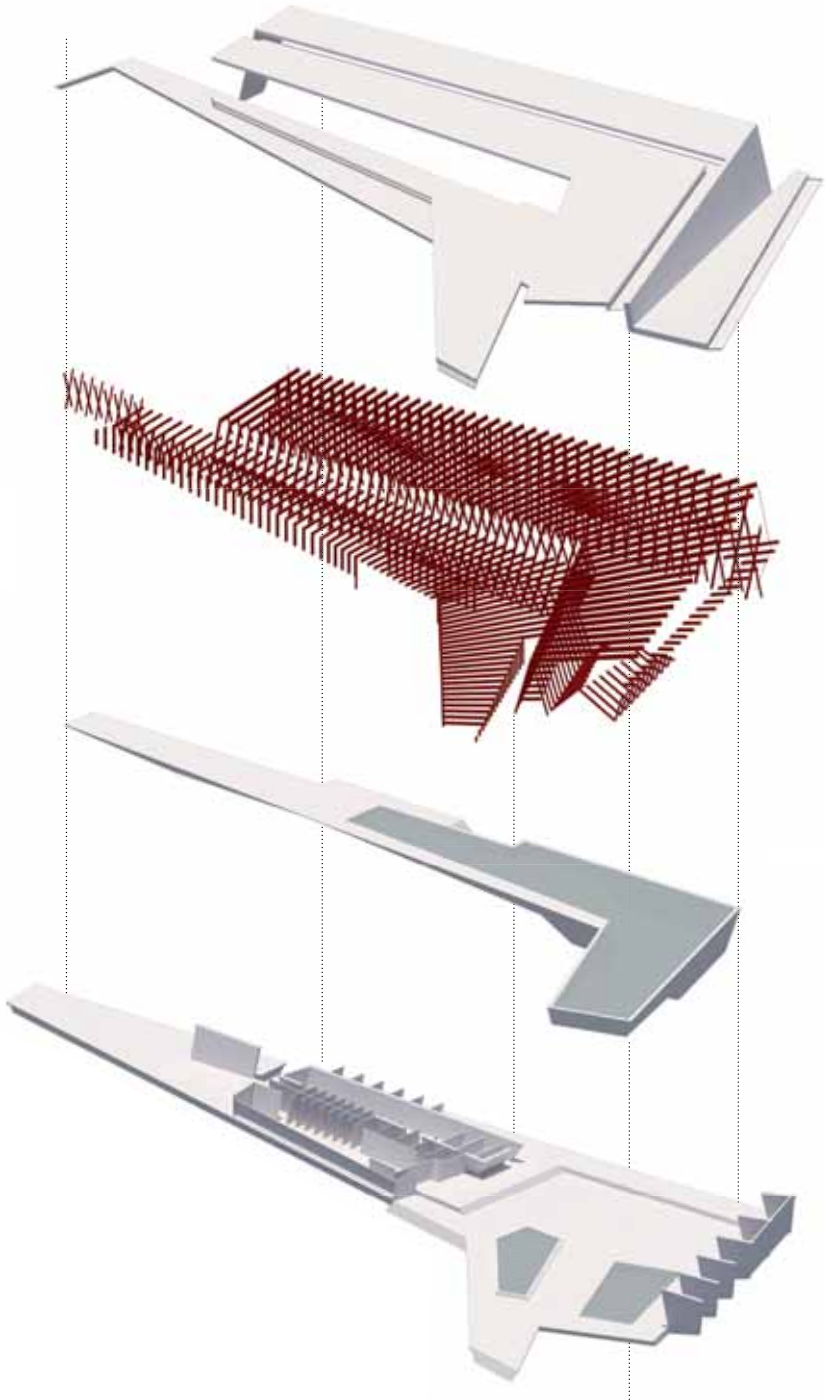
To enhance the results for the dressing rooms, the roof is cut elegantly to implement a clerestory. An additional lightwell/clerestory is implemented in the detail separating the lower roof from the first floor facade. This separation has an integrated walkway to accentuate the transition between glass facade and roof structure. This walkway is lowered with translucent glazing filling the gaps that admit light into the men's dressing rooms and the passage holding toilets. The effect of this is noticeable by 1-2 levels on the daylight factor scale. Although levels are improved, artificial light will still be of essence in the dressing rooms. The effect of the clerestories does however bring with it a relation to the outside and attention to the interplay between the intricate structure members.

This analysis ends the investigations into light. The results are an example of the building layout's development from concept towards an integrated solution. Structure, space, and light have reached a whole through interplay and iterations.

ecotect results for daylight factor with integrated lightwell
top : layout 3, first floor
bottom : layout 3, ground floor

PRESENTATION

This final chapter shows the sketch project layout of the bathhouse. It is the result of the process introduced in the previous chapters. Additional plans, sections and layouts are to be found in the attached drawing folder, which is to be viewed as part of the presentation.



The design proposal for the bathhouse is comprised of four elements:

- a base
- an elevated pool
- an endoskeleton
- an exoskeleton

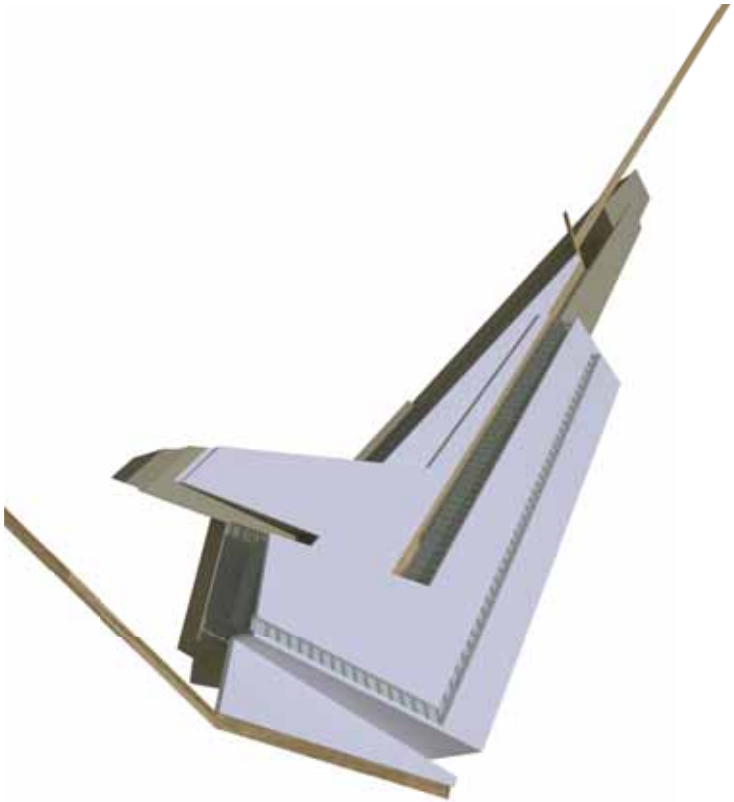
The angled concrete base protrudes into the harbor basin creating a detached island for the bathhouse and a sheltered harbor bath facing south towards the open fjord and the landscape. The east wing of the base holds practical functions such as foyer and changing rooms and is stretched out towards boardwalk leading to the city centre, welcoming the visitors to the bathhouse. The terrain is lowered and the base sweeps towards the south to bring the visitors close to the water surrounding the building, creating an intimate zone holding two hot water pools.

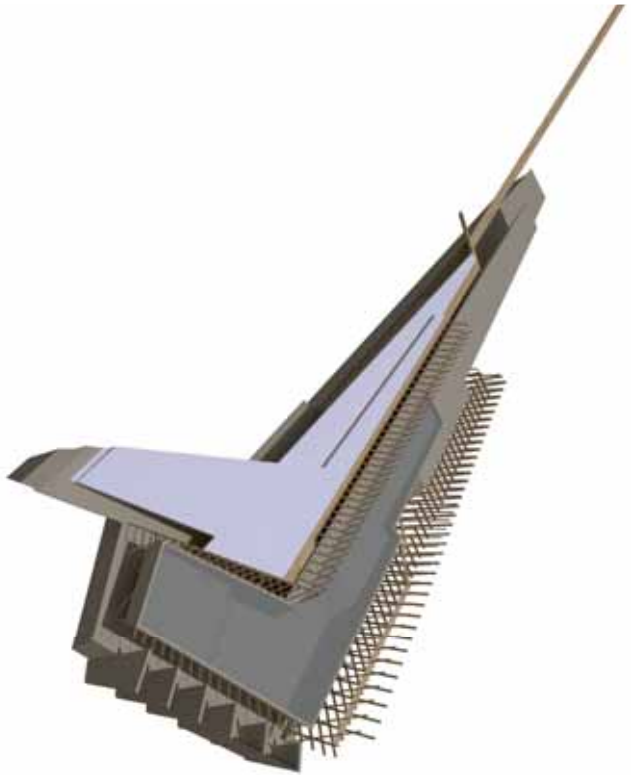
The massive concrete tub holding the main pool starts out as a public terrace hovering over the entrance to the bathhouse. The concrete structure runs undisturbed into the building where it touches down and holds the women's changing rooms, before continuing in a sculpted concrete tub raised over the base of the building.

A wooden endoskeleton touches down on the concrete base and along the edges of the raised tub giving adding warmth and structure to the interior of the building, while supporting the weight of the concrete tub hovering over the hot pool towards the south.

The shell of the building is envisioned as a hard exoskeleton covered with fibrecement shingles, thus creating a rugged outershell protecting the 'soft' interior of the building. Cuts in the exoskeleton reveals the warmth of the endoskeleton, and lets daylight filter into to interior of the building.

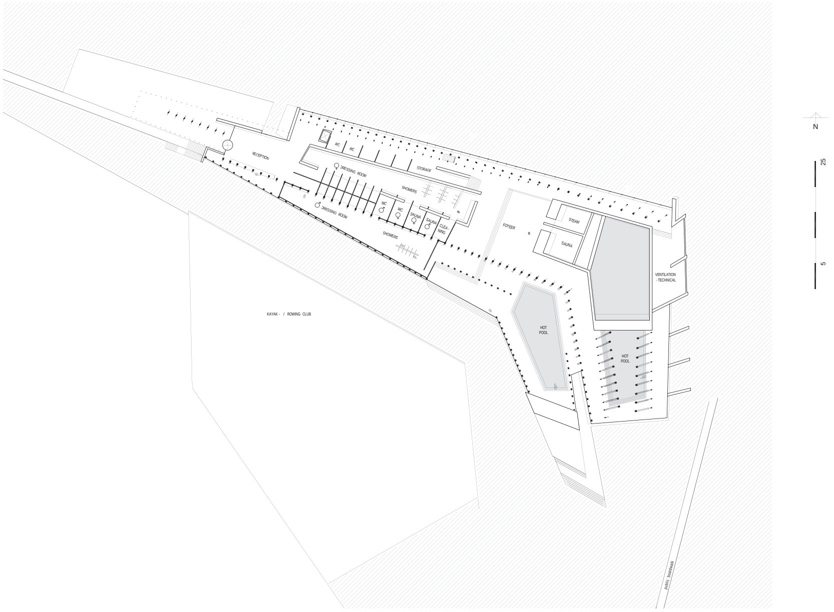
opposite top: exoskeleton / mid top: endoskeleton / mid bottom: elevated pool / bottom: base

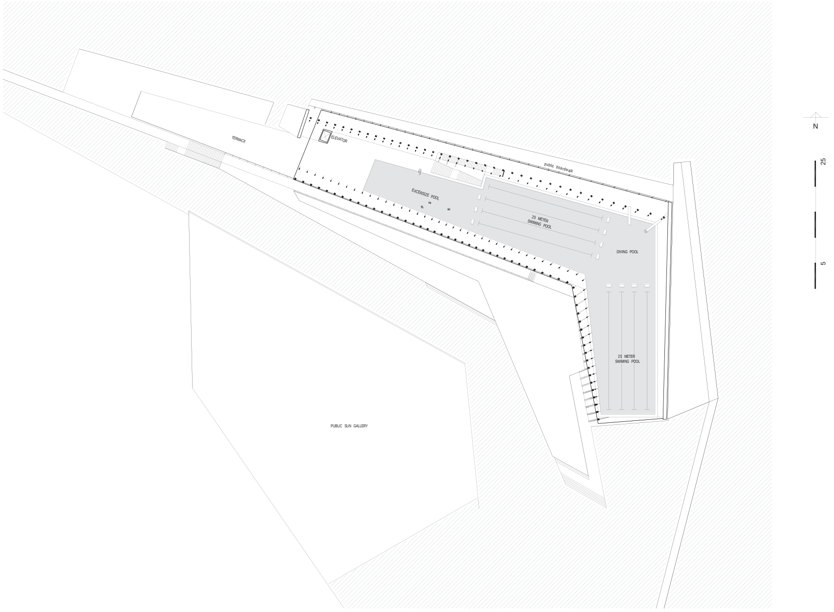


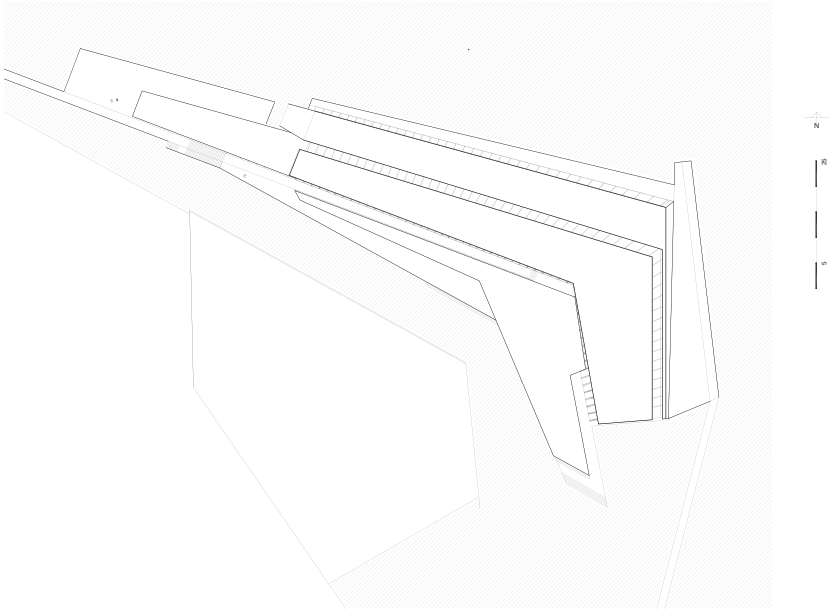


presentation

opposite top: base and concrete walls / bottom: concrete base and wood supports
this top: elevated pool and endoskeleton / bottom: exoskeleton and boardwalk


RECEPTION
WC
WC
STORAGE
DRESSING ROOM
SHOWERS
DRESSING ROOM
WC
WC
SAUNA
SAUNA
CLEA-
NING
SHOWERS
FOYEER
STEAM
SAUNA
VENTILATION
- TECHNICAL
HOT
POOL
HOT
POOL
KAYAK - / ROWING CLUB
N
25
5


TERRACE
ELEVATOR
public boardwalk
EXCERSIZE POOL
25 METER
SWIMING POOL
DIVING POOL
25 METER
SWIMING POOL
PUBLIC SUN GALLERY
N
25
5



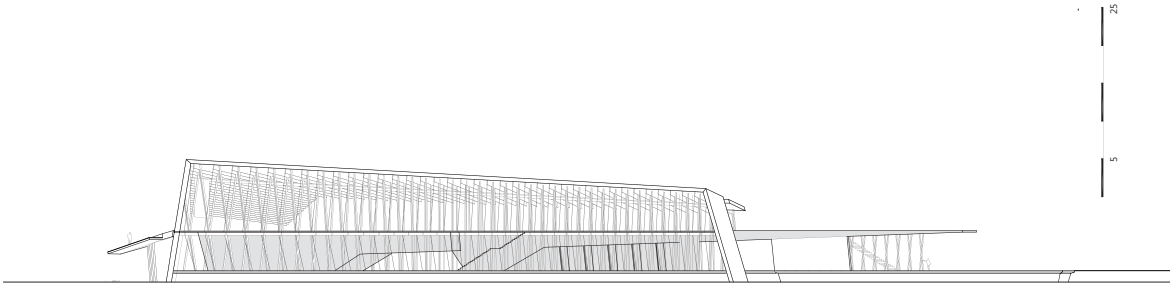
The building consist of two levels with a combined indoor area of approximately 4000 m2, and a public outdoor area on roofs and terraces of about 1100 m2.

The overall impression of the building is a dense, intimate ground level dominated by concrete surfaces and a ceiling height of maximum 5 meters. The second level is light and more open, focusing on long extended views over the fjord and harbor, with a direct connection to the outdoor terraces on the overhang above the entrance area.

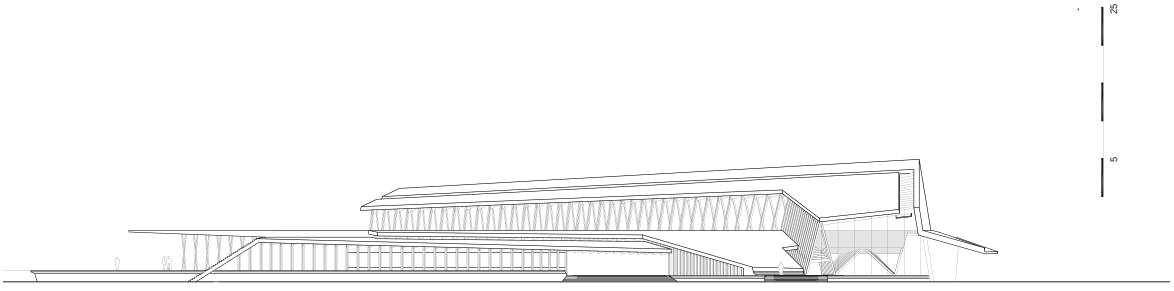
The angled layout of the plan along with the tilted roof directs focus on the sheltered harbor bath. During summer the concrete shingles covering the roof are heated by the sun, providing a warm surface for the visitors to relax on when using the harbor bath. Towards the north, the ribbed structure of the warm wooden endoskeleton is revealed, creating an elegant and welcoming façade facing the city centre of Hudiksvall.

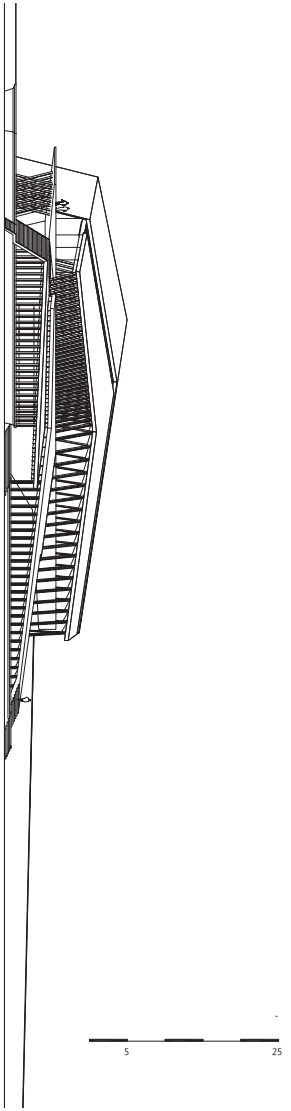
opposite top: elevation +3000 scale 1:1500 / bottom: elevation +8000 scale 1:1500
this: roofplan scale 1:1500

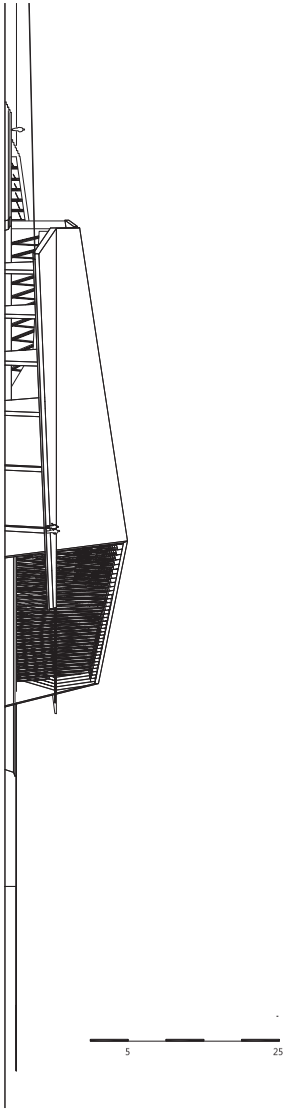
5 25



5 25







presentation

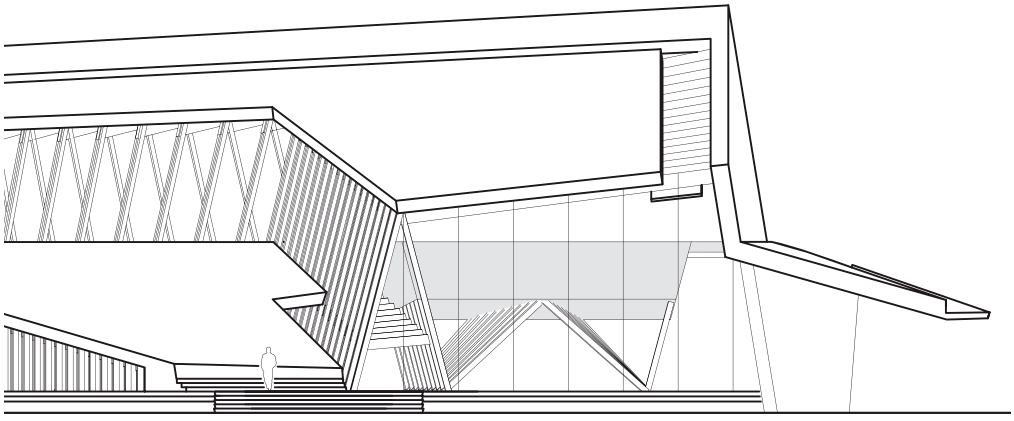
opposite top: facade north 1:1000 / bottom: facade south 1:1000
this top: facade east 1:1000 / bottom: facade west 1:1000

The directions established by the building and the site, are weaved into the building via a boardwalk running along the outside of the building, and over the roof, leading the visitors to the harbor bath, or around the outside of the building, offering a birds eye view of the city and harbor front to the north, and the nature along the fjord to the south.

The glazed norhtern façade in combination with the sloping roof creates a warm and 'soft' façade, as the wooden endoskeleton is exposed.

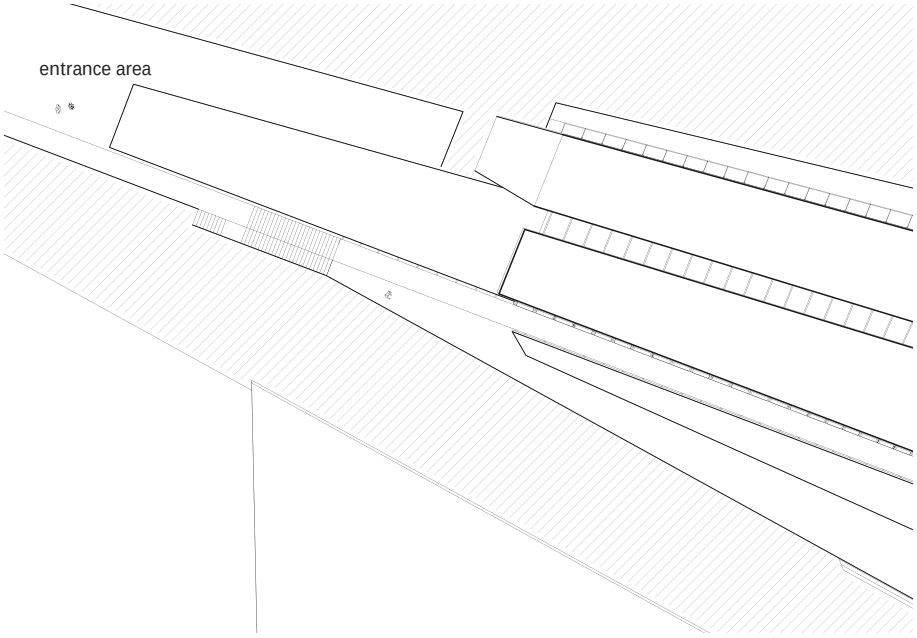
presentation

opposite: facade north 1:800
this: perspektive along north facade



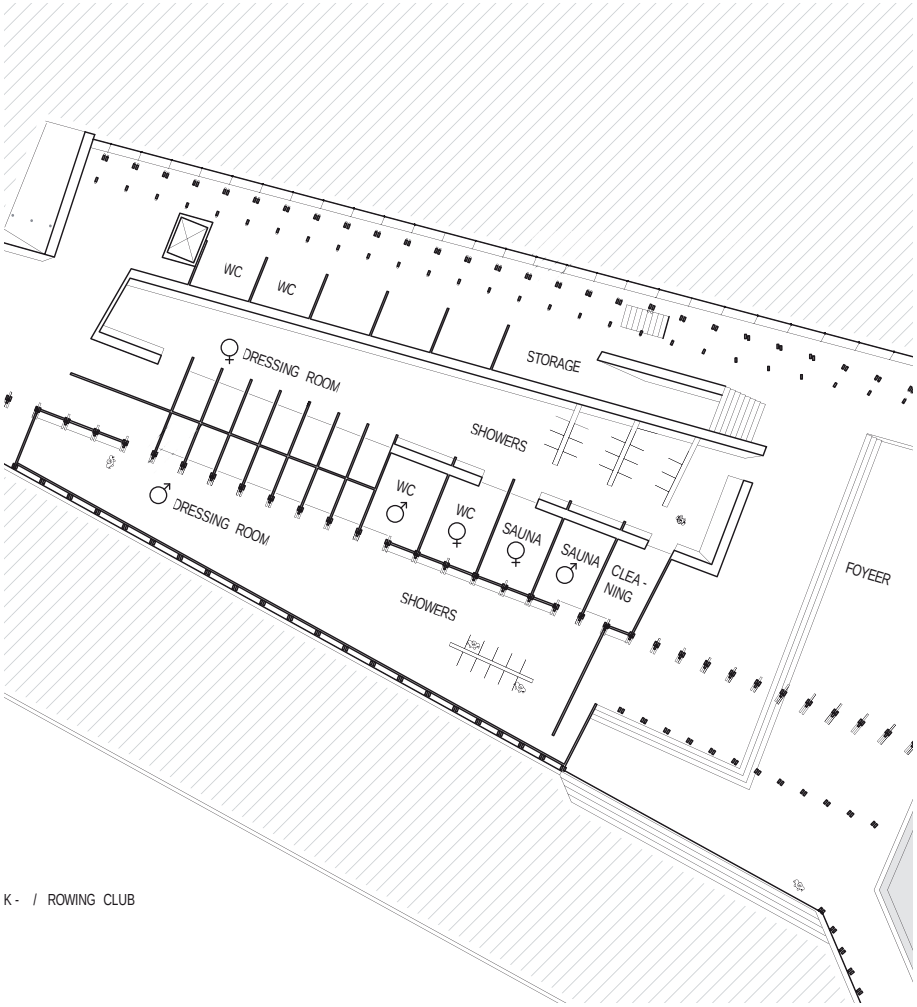
presentation

opposite: facade south 1:300
this: perspektive south

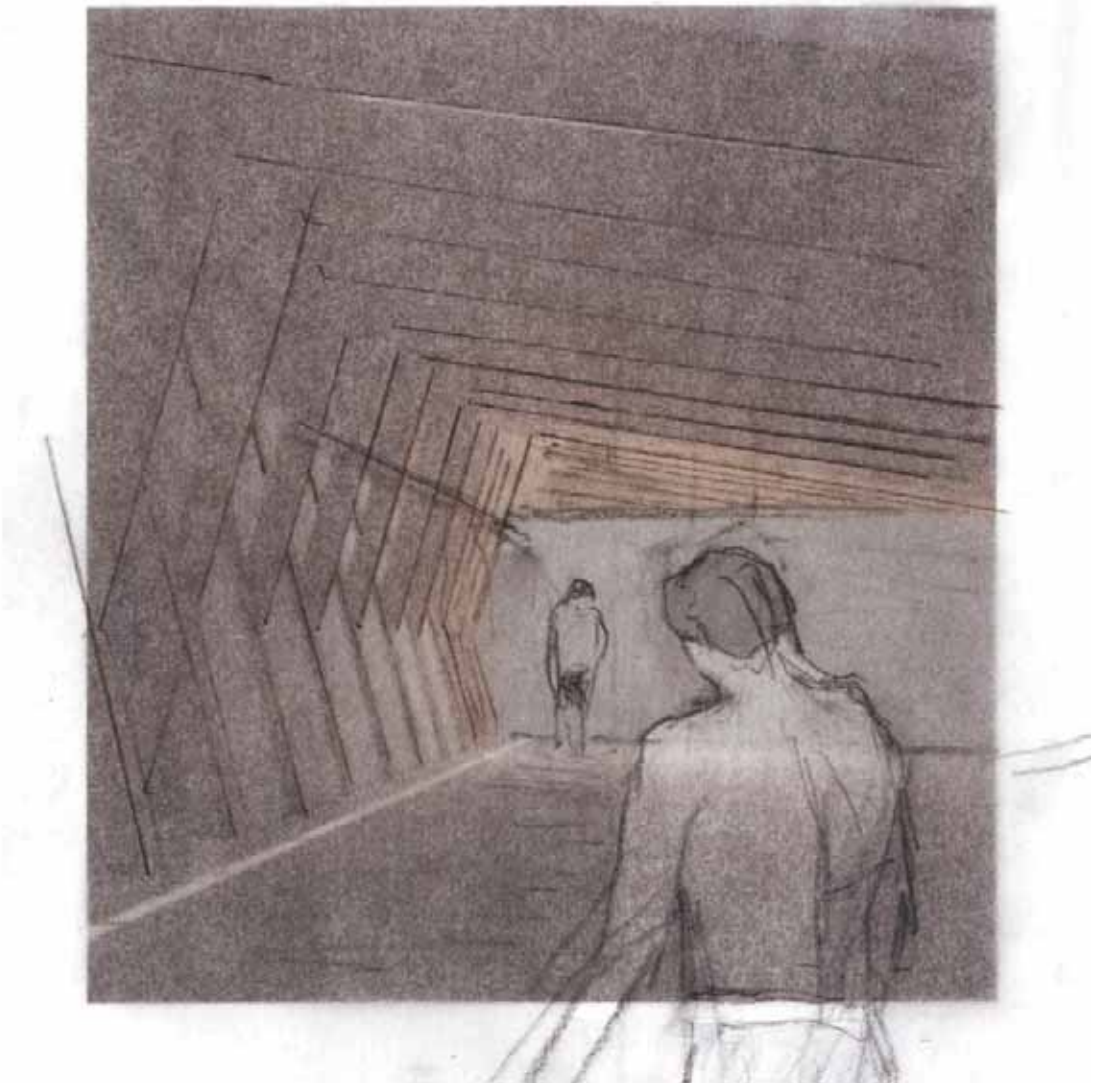


The entrance to the building is marked and sheltered by the continuance of the pool structure creating an overhang supported by timber columns. Public paths are accessed through a set of stairs ascending on the south flank of the entrance and reception area.

The more semi-public path runs along the south facade separating glazed facade from the lower roof structure. This path ends up in a dead end at the harbour bath. The low energy glazing reveals the warm endoskeleton, and draws natural light into the building.

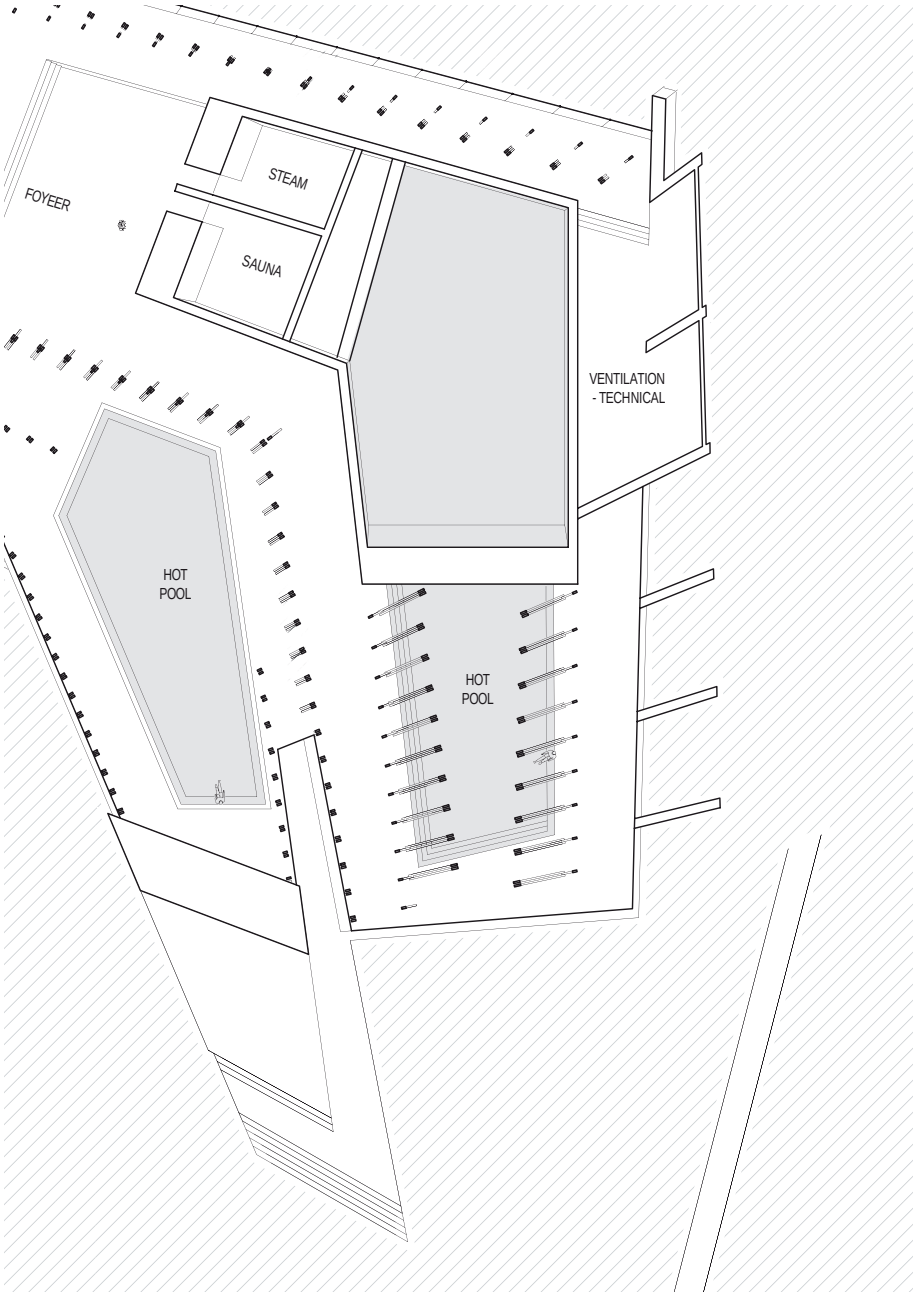


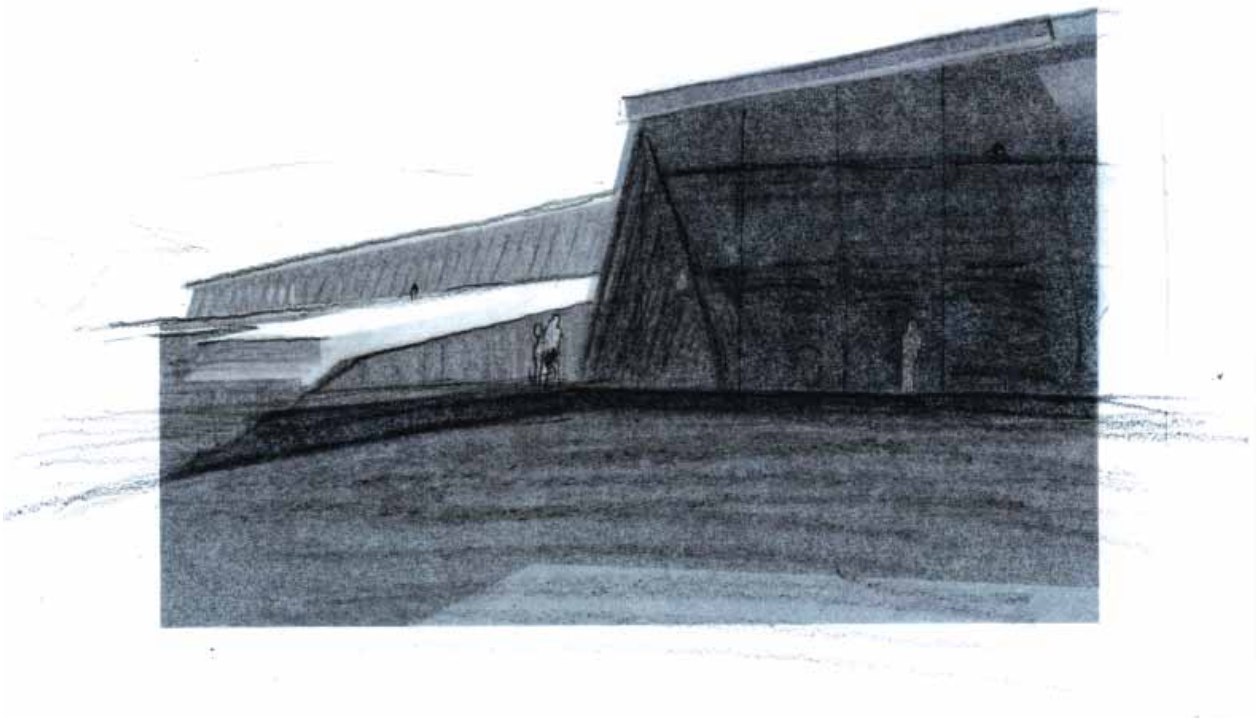
K - / ROWING CLUB



Inside the men's change room the qualities of the endoskeleton is revealed as the timber is contrasted by rough concrete walls. Daylight filters in through translucent gaps in the exoskeleton.

opposite: elevation +3000 1:400
this: perspektive from men's cahnge room

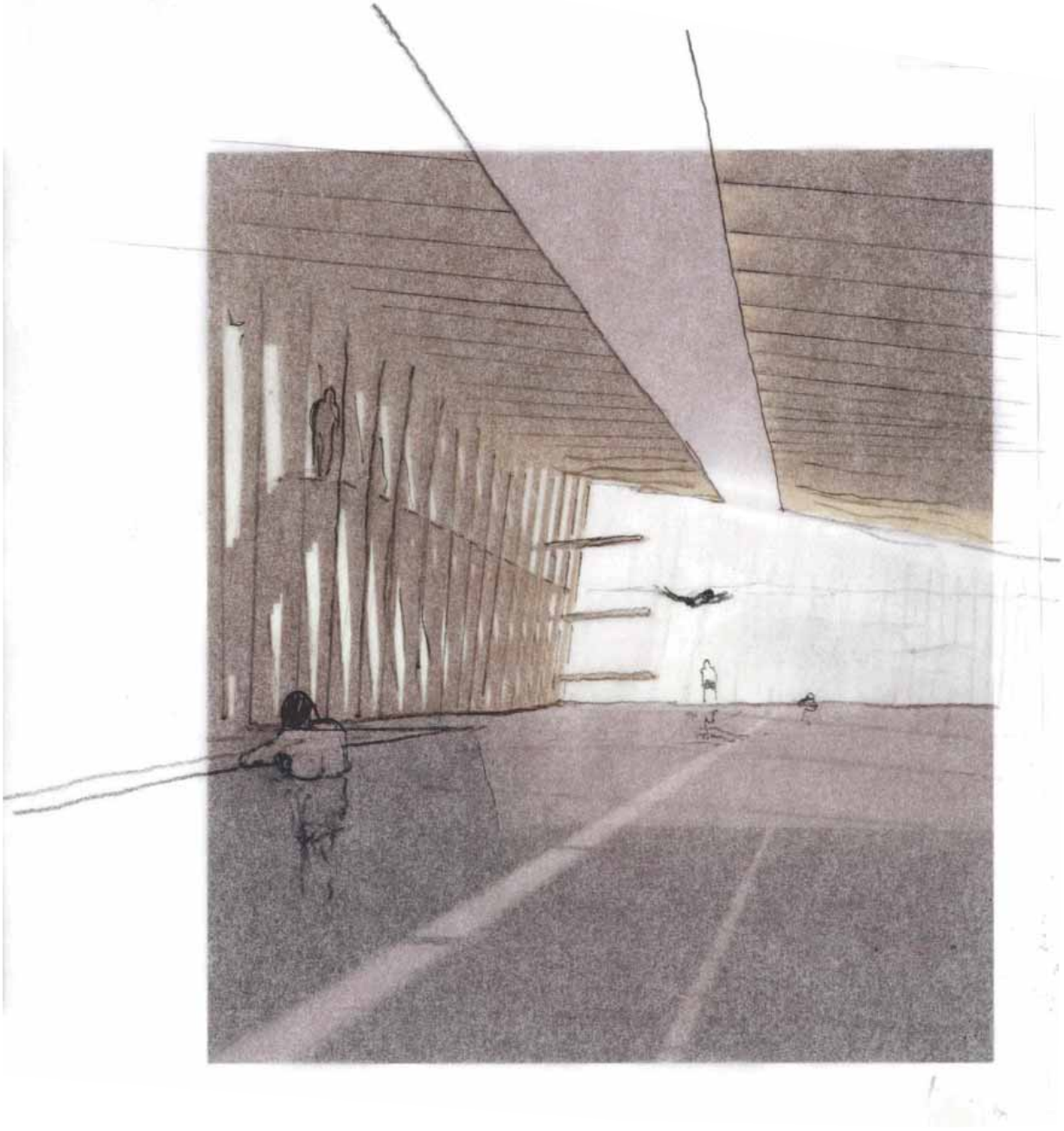

FOYEER
STEAM
SAUNA
VENTILATION
- TECHNICAL
HOT
POOL
HOT
POOL

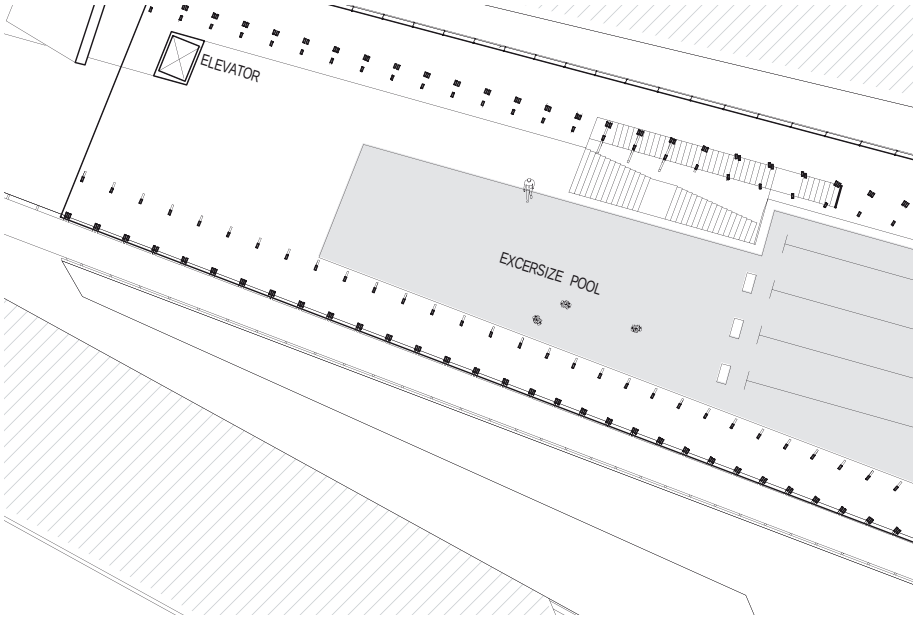


Moving south- east through the building, the level falls half a meter towards the hot pools, bringing the visitors close to the cool refreshing water of the harbor bath, and creating an intimate space, as the ceiling height drops towards the south, and the elavated pool hovers over head.

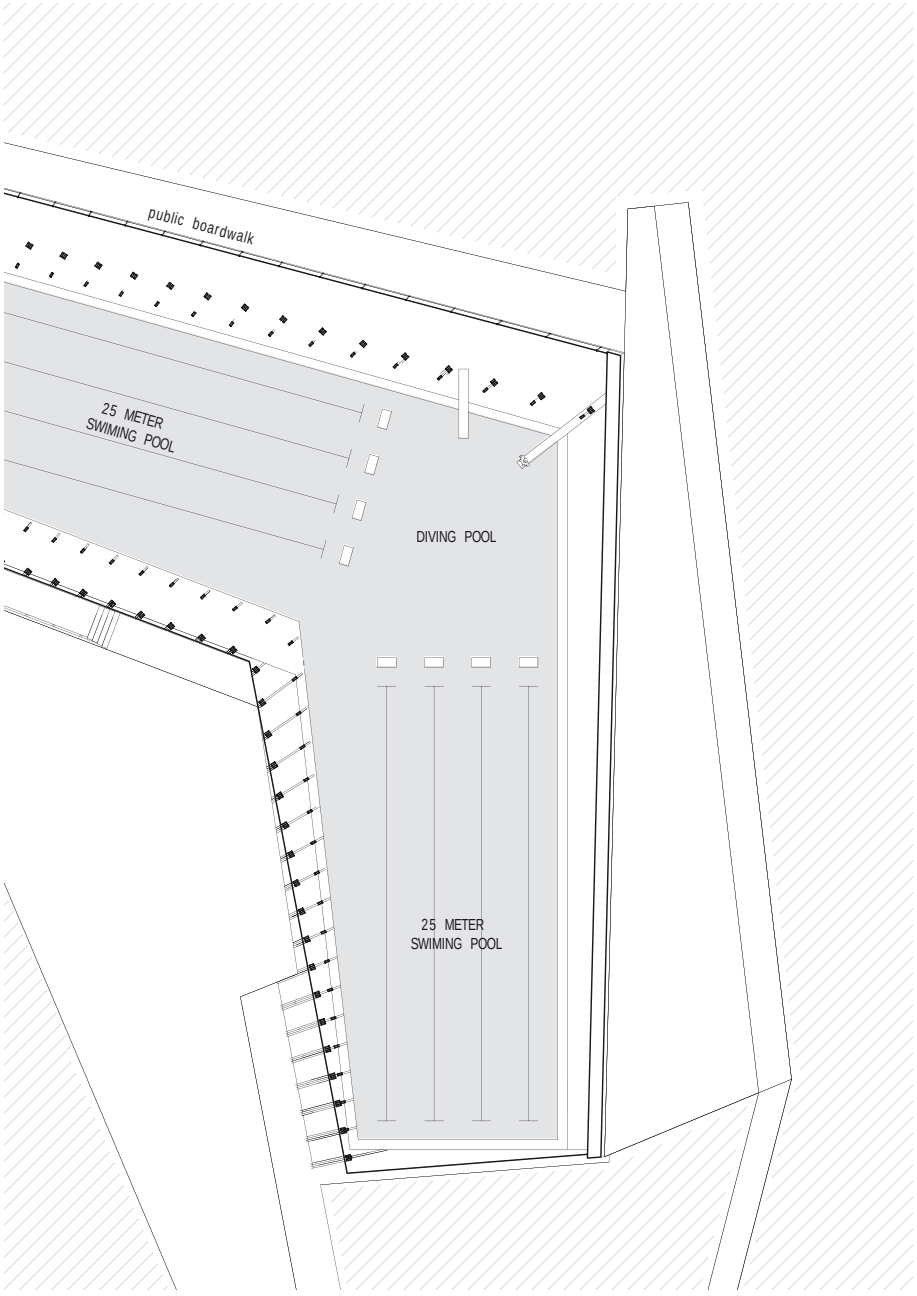
The exterior of the sloping roof is utilized during summer, as the sun heats the concrete shingles creating a pleasant warm surface ideal for relaxing and enjoying the harbor bath, along with the scenic view out the fjord directly to the south of the building.

opposite: elevation +3000 1:400
this: perspektive south east corner





The first floor holds the open active zone of the building. The pool is a continuing element consisting of a shallow exercise pool and four 25 meter lanes in the west wing. A diving pool connects to the remaining four swim lanes in the south wing. This wing is meant for more serious swimmers, while the west wing is more of a family and play zone.


public boardwalk
25 METER
SWIMING POOL
DIVING POOL
25 METER
SWIMING POOL

presentation

opposite: elevation +8000 1:400
this: perspektive looking south along main pool

PERSPECTIVE

To swim is a dynamic exploration of the body in a strange dimension. It's the escape from gravity and filtration of auxiliary sensory inputs. It is the notion of movement in a fluid element; the resistance of water, the friction from turbulence and the kinetic energy of the body in motion. The body travels with a vector bound to a direction. Changing the direction requires effort in the sense of force; a sequence of new vectors is added stroke by stroke.

Bada Hudik translates this into a physical building. The bathhouse revolves around a trajectory, starting with a linear movement from the city towards the harbour basin. This is the vector tying Hudiksvall to the water. A perpendicular vector is added to the equation; the related direction points from an elevated city towards the fjord and landscape. The product is the movement of a body that turns and descends slowly into the water.

The journey through the building is an anticipation related to the transit into water. The concrete pool is an expression for defile of gravity. This notion grows gradually with the shape of the pool. Frame by frame the mass of water above ones head increases. It's the exhibition of a volume of water with a dynamic topology falling into the room. Ascending the stairs one emerges through the surface and enters the vast context; a space with a plane in continuance of the water-surface and horizon outside. The roof opens up to the city and forest covered landscape in the north.

The ceiling reveals the movement from city to water; a refined endoskeleton that archs around its spine section by section. The desire to connect Hudiksvall to the water is reflected in the entire timber structure. All the pieces are parametrically controlled by the trajectory spine. The combination of different frame typologies and repetition along the trajectory creates an evolving structure that carries with it different experiences and qualities. Observed from a distance the most spectacular effect is the organic development of the northern façade. The filtered effect of transparency and interference brings the structure to life, it seems to be crawling around inside its shell.

Inside, interaction with spatial organization creates rhythm. The frequency increases along the north façade; as the sections turn around the corner and the distance between the columns is shortened. This densification works well with the intimate atmosphere of the hot water zone and the proximity to the water outside.

In addition to incorporating and communicating with the city and topologic context, the building holds relations to a more tactile layer. The importance of the subjectively sensed elements, wood, water and land, is very much present, easily recognized both as separate entities and in their synergetic combination.