åSe Mountain HOTEL

Group MSc4Ark12 Line Løvås & Balazs Endrodi

Report

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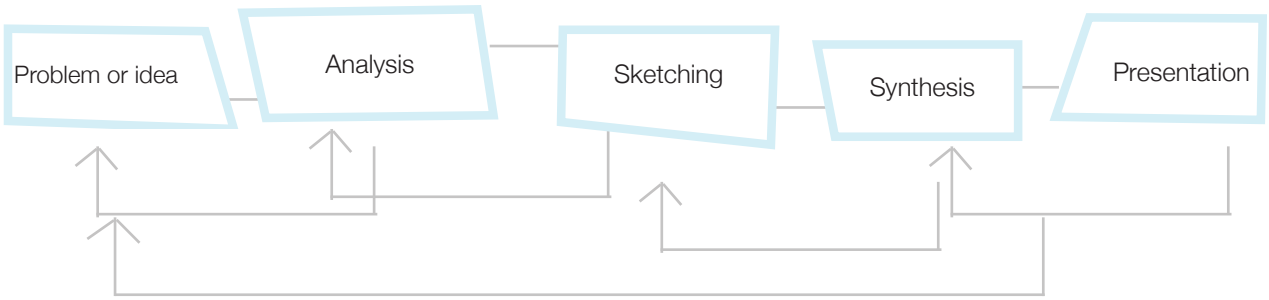
Synopsis

What follows is the master thesies of group Msc04 Ark 12. Our goal is to design an autonomous,sustainable hotel in Åse, Norway. Although Norway is considered as a rich and developed country they are somewhat behind the other Scandinavian countries on the field of sustainable buildings. Therefore a sustainable building combined with quality design could be a flagship project, that pushes the society towards a more sustainable living. In our opinion sustainable architecture can only be successful if it gains recognition, therefore we would like to focus on the architectural qualities of our design and not under prioritizing to sustainability. Good design and sustainability should go hand in hand. Åse and the surrounding area offers a fantastic, almost untouched nature. Our aim is to design a building that, while it meets the needs of a modern hotel and its guests, does not impose itself on the landscape.

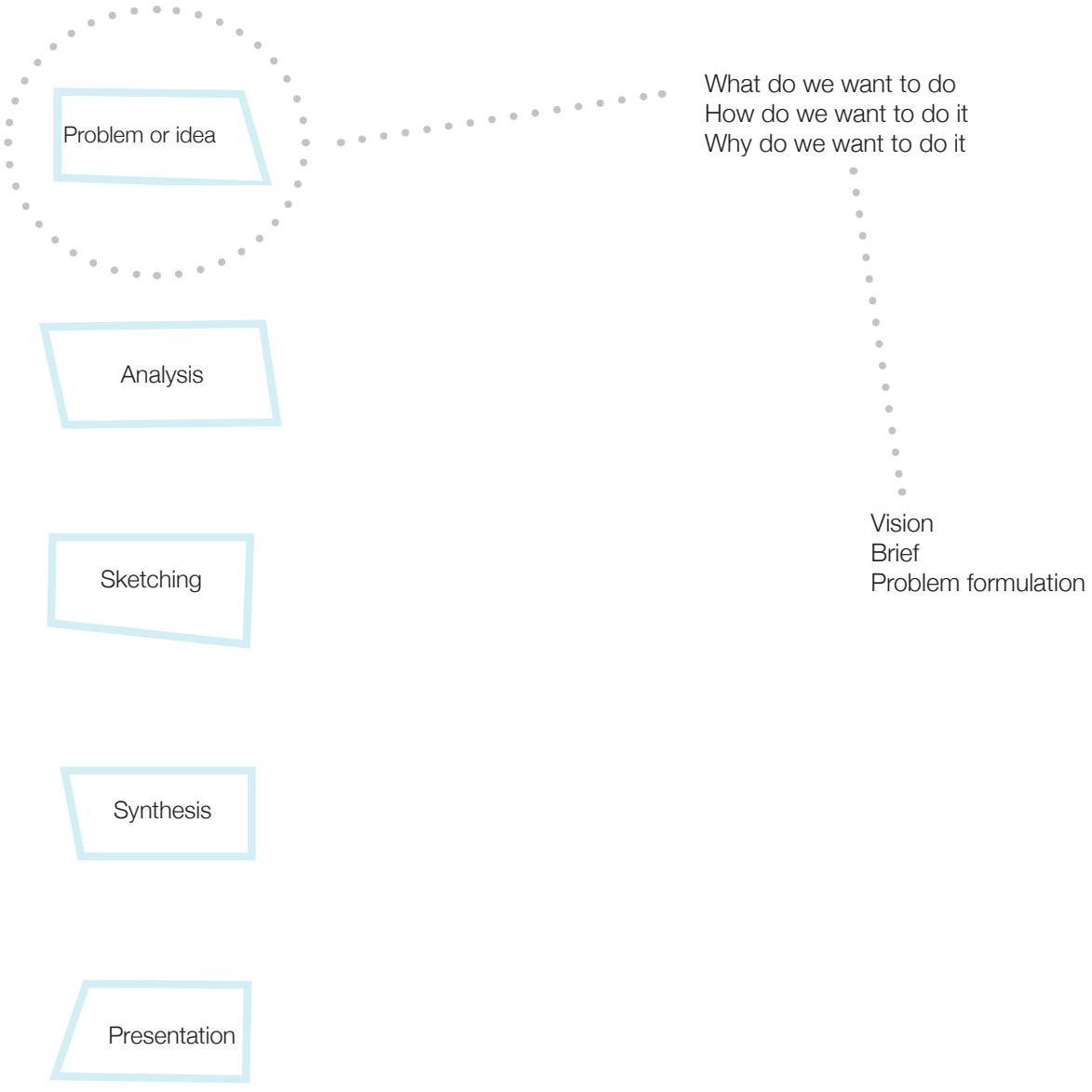
Method

Integrated Design Process



This project seeks to use an iterative process called the Integrated Design Process (IDP). This methodology represents a holistic approach to architecture. Where the technical solutions are integrated to the design from the initial phase of the project. The method is divided into five phases and different aspects of building design such as; construction, aesthetics, functionality, technology, indoor environment and energy consumption are considered and rewired through the different phases of the IDP. These dynamic W at the different phases, displays possibilities and limitations, and contribute to the architectural and technical optimization of a project. [Knudstrup, 2004]

<<These phases are also being used for structuring the report, in order to assist the reader to understand the project>>


Problem or idea
What do we want to do
How do we want to do it
Why do we want to do it
Analysis
Vision
Brief
Problem formulation
Sketching
Synthesis
Presentation

Problem & Idea

Vision

Disconnecting from the measurable and immeasurable. By creating a well designed Hotel , focusing on a sustainable luxury experience in harmony with nature.

Brief

Design:

-Roughly 2000 sqm cumulated floor area

-Space for 50-70 guests
-The design be in touch with its own environment

-Restaurant and additional functions available not only for guests

-Design the hotel of such quality that it itself, combined with the natural landscape becomes the reason for visiting

-Make the views one of the prominent features of the hotel rooms

-Use materials that are in touch with the site and its surrounding
-Combine high quality architecture and sustainability

-Landscaping should be an integrated part of the design

-Common spaces for the visitors both to add to the experience and to encourage the interaction between the guests

-The hotel's main profile is disconnectedness, therefore it should function much like a retreat for those who would like to escape from the modern, super connected, super fast lifestyle.

The rooms:

-To have a number varieties in order to cater for different types of guests

-Suitable for longer stays used as a retreat

-Suitable for creative working

Problem formulation

While the main goal of tourism, to experience or do something new, remained the same ever since the 19th century, the tourism industry is going through some significant changes. With more and more people living in busy, urban regions the different means a quiet, peaceful, rural place for many.

Although a great many in Norway enjoys the benefits of the booming industry, those living on the countryside in small villages and on farms, far from the prosperous economical areas like Oslo or Stavanger, are in a vulnerable situation. To them, rural tourism, can offer new possibilities.

The area around Åse, Hjelmeland is one of those areas that has very little connection with the rest of the country and where rural farming is still not just part of the every day life but the main source of income for the majority of the families.

This disconnectedness is nowadays turning into a valuable asset and makes it ideal for tourism. Only one hour away from the site is the world famous Preikestolen and Kjeragbolten attractes around 200 000 visitors every year. Thus, the large number of visitors is also a danger.

The tourist industry has to balance the number of visitors in order to maintain the qualities of the area.

Tourism, as every industry, also has to pay its fair share in sustainability, especially to preserve the unspoiled nature, being the main attraction in the area. As the main energy consumption in tourism is connected to travelling, designing hotels where visitors could and would stay longer would cut back on the ecological footprint of the tourist industry.

Nevertheless, hotels are fantastic places to advertise sustainable living. If the visitors stay in a comfortable, stylish yet almost zero energy place, they might convert their homes in the same manner.

Zero energy is not only a green statement but also a result of physical constraints. Åse has very little connection with the main grid system so it has to be almost fully selfsupportive. Although, the location of the site renders PV and solar panels almost useless, it also offers great opportunities for wind, bio and hydro energy.

Furthermore, while connecting to a water main is possible, sewage has to be treated on the site. District heating is also not available, therefore heating and DHW supply has to be part of any proposal.

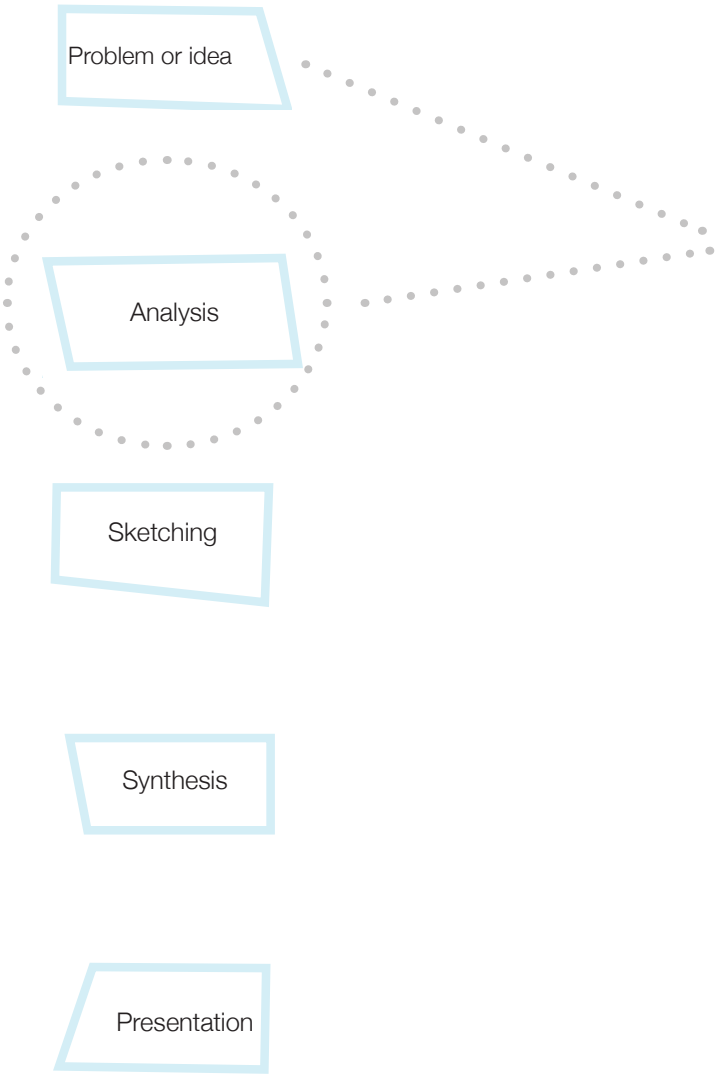
In brief, our aim is to design a sustainable hotel that becomes an integrated part of Åse.

Integrated by the means of architecture that is not imposing itself on the landscape, but builds on the qualities of nature.

Sustainable in terms of energy, by disconnecting from the main grid, using locally available and renewable resources, and by using as little energy as possible.

Sustainable in terms of economy, by not swallowing up its own main feature, the unspoiled, quiet and peaceful environment.

Sustainable in terms of socially, by designing places that encourages visitors to disconnect from the stressful, modern society and reconnect with themselves, nature and other human beings.

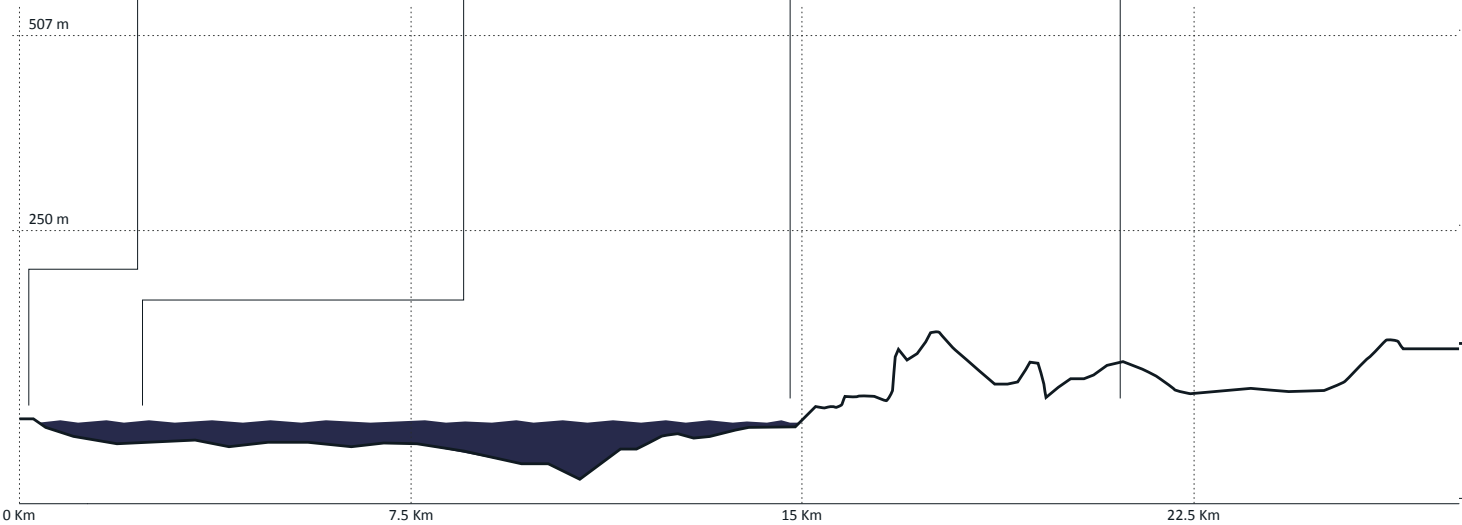


Based on the problems and ideas we need to research:

The location
The climate there
Sustainability
Trouism
Vernacular architecture
Nordic landscape

Analysis

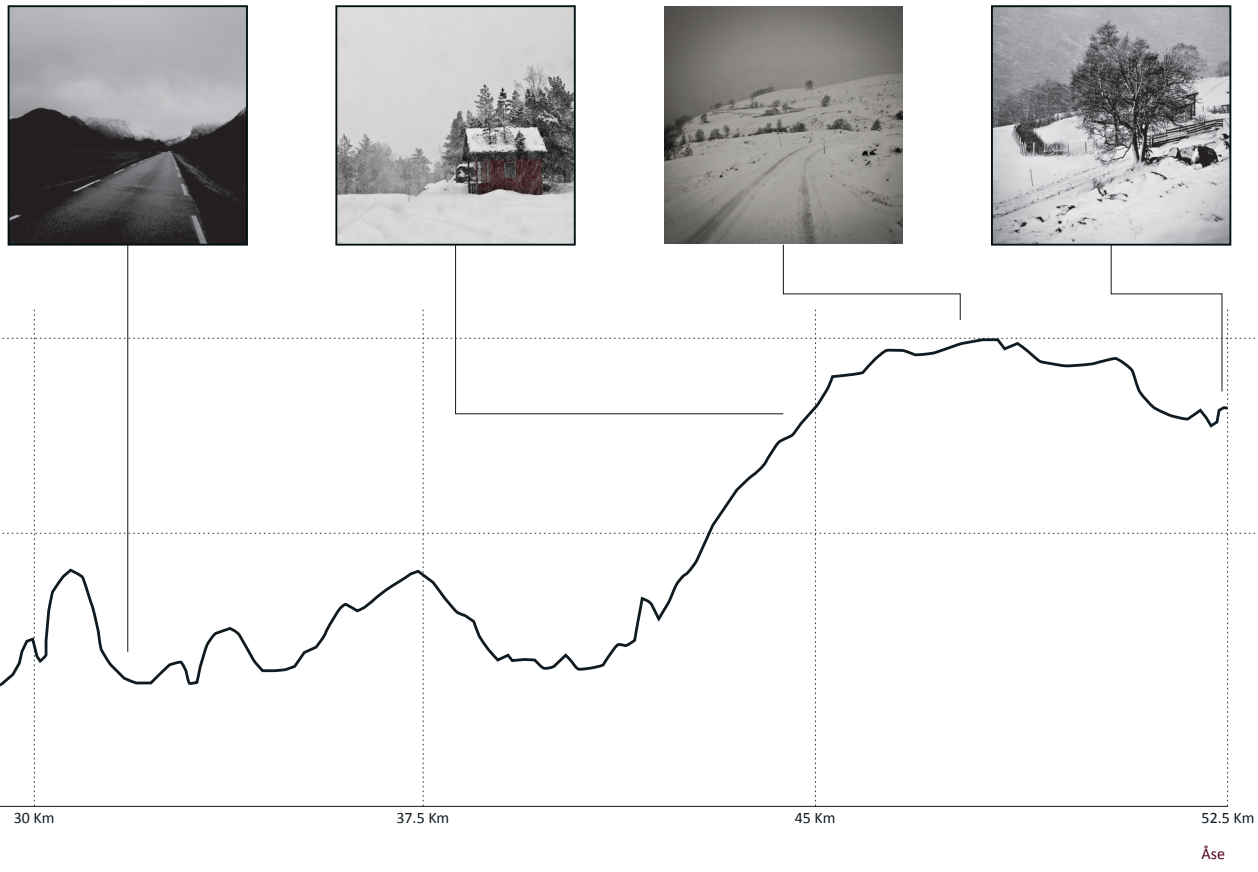
To the site



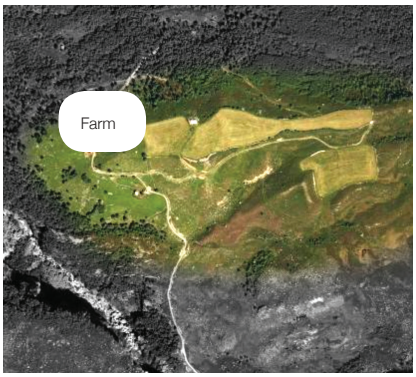
Stavanger

Tau

This is the journey that will take you from the cityscape of Stavanger to landscape of Åse. Departing from the harbor in the center of Stavanger, a large city with 238 153 inhabitants. Stavanger is considered the oil capital of Norway, having a fast paste and international associations. The ferry to Tau departs every 40 minutes. Once on the ferry you get to enjoy the view of Stavanger center from a distance, spotting the famous Oil museum and the new concert hall. This is a passage where you are recommended to stay on deck or close by a window to get the best outlook. The boat sails underneath the legendary City Bridge from 1978, the first larger cable-stayed bridge in Norway. The bridge is 1067 meters long, and the main span is 185 meters. Approaching Tau after about 40 minutes, you can glimpse the old mill of the village in the horizon. Tau is a village in Strand municipality and the village has 2,858 inhabitants. Tau is a gateway with frequent ferries and express boats connecting Stavanger to Fiskå, Hjelmeland and Jørpeland. Already you notice that the atmosphere and settlement in the village is different from Stavanger, it is a smaller scale and less busy. Continuing on road 13 you see the presence of agriculture and the large mountains, directing you into a valley. It is as if the paste of the landscape start to ease in collaboration with the journey. A good advice would be to have a camera available, there are many places to stop, yet it get more and more scenic. You leave the city, you leave the tall buildings, you leave the stress, and continue in the valley of Ryfylket. Sometimes the mountains are too large to drive around, and you have to go thought a tunnel. This experience is quite unique, being inside a mountain, thus not knowing how it looks from the outside. You feel enclosed and captured, the focus it only in one direction, forward. When the tunnel ends, there is light, and a new landscape is being processed in your mind. From road 13 you turn to the right and enter the small village of Årdal in Hjelmeland municipality with just over 700 inhabitants. From this valley the road is all uphill, it turns and is very steep. Implicating that you have to go slow, slowing down will enhance the experience of polarizing with the landscape. You encounter the mountain, there is no houses, no sign of settlement. Even if you sit in a car, you sense the quietness from the outside, there is nothing disturbing, only appreciation of the untouched nature. Reaching a peak, there is a plateau, where you again have to turn. This time into an even smaller road, a handmade road. Which means that the paste has to become even slower. The pace has eased in to you, it is preferred, since it gives you time to reflect and adapt to the panoramic view and rural atmosphere. You feel as if no one have been here before, you feel alone, but not lonely. Following this small road is like entering a new realm, a realm of mother earth that presents itself to you gradually. There are trees, mountains, wetlands, and sometimes you even spot the ocean in the far back. The road is 5 km, but before you know it, you see Åse, this is when the destination ends and the real journey begins.



Location Hjelmeland



HOW TO GET THERE:
From Denmark or any other destination you can arrive at SOLA international airport in Stavanger. From Stavanger center you take the ferry to Tau. From Tau you drive to Hjelmeland. It is 55 km from Stavanger to Åse

WHAT IS THERE NOW:
There is only one road leading to the site. It was built in collaboration with the farm. The farm is run by one person, being the only inhabitant at the site. The cabin is private owned, and only used a few times a year.

WHERE:
The site is located on a place called Åse. This is in Hjelmeland municipally in the County of Rogaland. The closes city is Stavanger being situated 55 km away. The cite itself is 500 000 m2. However only a piece of this area is going to be utilized for the project.

INDUSTRY:
- Important industry are aquaculture, agriculture, sand and stone quarrying and tourism
- In 2011 55,000 tons of salmon was exported from Hjelmeland
- The municipality has over 200 farms in operation, of which 43 with dairy and 142 sheep farming.
- On a yearly bases it is shipped out about one million tons of sand and gravel, and large quantities of natural stone for masonry and slate.
- Hjelmeland is host to over 1000 private cabanas, and a similar number of beds in cabins to offer.

FACTS ABOUT HJELMELAND:
- Approximately 2,800 inhabitants
- Area: 1,092 square kilometers - the second largest municipality in Rogaland.
- Around a quarter of the municipality is a protected conservation area or nature reserve.

Mapping

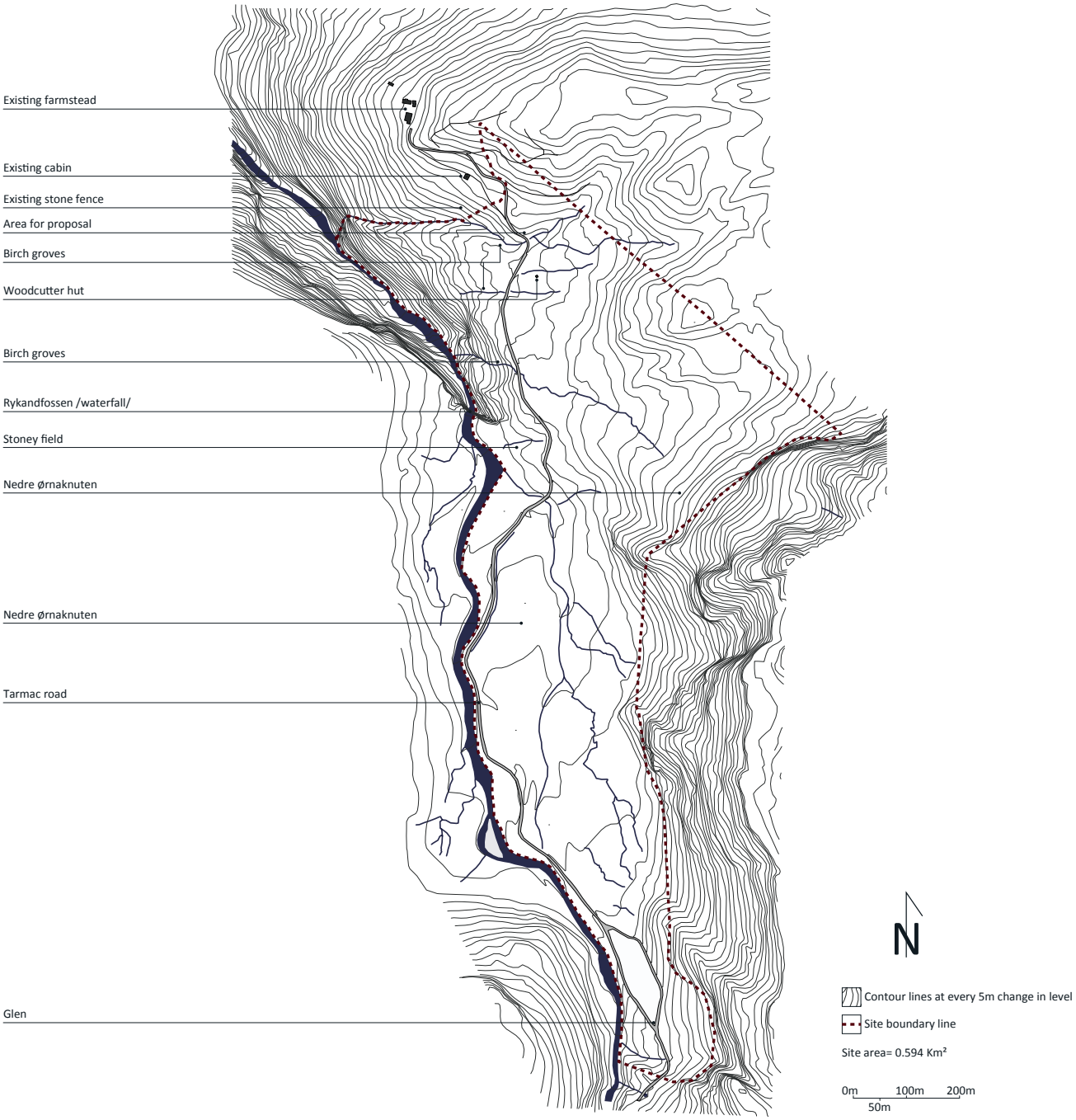
Things to do

The site is situated in one of Norway's most beautiful areas. Every year over hundred thousands of tourists from all over the world come to visit these spectacular fjords. The plot is set for outdoor activities. And the National tourist organization has many hiking routs only a few kilometers away.

These hiking routes can easily be reached from the site. In this rough landscape, there are no limits for the type of activity you want to do. Having the sea, mountains, forest and fjords as a playground.

There is not any commercial infrastructure or facilities nearby. However, the most essential things such as food and medicine are available at the local village, Hjelmeland 30km away. Sola (SVG) Airport is 70 km away.

Map of site


Existing farmstead
Existing cabin
Existing stone fence
Area for proposal
Birch groves
Woodcutter hut
Birch groves
Rykandfossen /waterfall/
Stoney field
Nedre ørnaknuten
Nedre ørnaknuten
Tarmac road
Glen
N
Contour lines at every 5m change in level
Site boundary line
Site area= 0.594 Km²
0m
100m
200m
50m


Existing cabin


Birch groves


Nedre Ørnaknuten


Rykandfossen


Existing farmstead


Area for proposal


Woodcutter hut


Gravel road


Existing stone fence


Stony field


Glen

<<The different seasons change the colors and atmosphere at the site>>

Site atmosphere


Quiet Remote Peace Harmony
Untouched Inviting Extreme
Respectful

Nordic landscape
-How to understand and design

"We experience the North spontaneously upon arrival. Another mood envelops us, but we are not immediately aware of what happened: is it light, is it the land itself, is it the vegetation, or is it the built environment that is somehow different? It is indeed all of these. Here is North, the sun does not rise to the zenith but grazes things obliquely and dissolves in an interplay of light and shadow"
(Norberg – Schulz,1996 p.1)

When designing in the Nordic it would be significant to consider the given qualities. What is this Nordic landscape and furthermore why is it essential to understand the place? The famous Norwegian architect Christian Norberg – Schulz says that the expression "life take place" suggests that life and place form a unity, emphasizing that a satisfactory analyses of place is necessary as it holds the life which place admits. (Norberg – Schulz,1996)

When approaching a site for the first time, layers with information are being possessed by the mind, and the senses. This information can be measurable or immeasurable. The relevance of these sensations is to understand how it can be translated in to a design.

The light is defining the Nordic, and it infuses all things with a mood (Norberg – Schulz, 1996). This unique Nordic light withholds information and atmosphere, it changes throughout the day and throughout the seasons. Light is perhaps the basic element in Nordic design, it can define a space giving a room a function and atmosphere. The living room, bedroom or workspace, can be enhanced according to distinctive light setting. In order to do this, the design has to be adapted to the site, since the natural light is not a factor that can be controlled.

Further on, how can the site be understood in relation to architecture? Norberg – Schulz wrote about 'genius loci', the spirit, identity, space and character of a site. He underlines that architecture must take into account and designed in such a manner that it interprets, highlightes and preserve the site's 'genius loci'.

Norberg - Schulz points out the importance of architecture, ie man-made, must comply with the site's genius loci, ie the nature created, for the place to retain its genius loci. When architecture adapts to nature, it can be a tool and means to show people where they are.

Through the use of local materials architecture translates a characteristic given by nature and the location. Vernacular architecture is an example of this. However, Norberg - Schulz says that one should not be retrospective and nostalgic, but on the contrary, he points out that modern architecture will follow the profound changes taking place in society.(Norberg – Schulz, 1992) This is also supported in the theories of critical regionalism by Kenneth Frampton.
Kenneth Frampton the British architect and Professor, addresses the question of how architecture can be both local and global to make sense at a time where architectural focus is set on advances, pressuring architecture to be innovative and universal. Frampton argues that the local culture is beginning to lack from the mass culture, pointing out that the globalization that are taking place is both a step forward for mankind, but also a setback and a challenge to local cultures.
Frampton says that the challenge is to be both local and global assuming that all cultures are the result of increasing the influence of different factors and the dynamics that occur.

The expression "critical regionalism" implies that architects must attend and understand the local culture, since it is displaying the site's character and tradition. Thus, be open and have the capacity to absorb new influences and impacts from external factors. In terms of architectural design, critical regionalism is about the relationship of the building and its environment, where the existing and static complement with global influences and technological advances. Critical regionalism is not favoring any particular style, but rather some critical analyze skills that focuses on how buildings can make sense to people.

Taking everything into consideration, the principle of this text displays that when designing in a landscape, one have to consider what the place holds.
Moreover, it is vital to understand the

local perspective and use the given qualities, whereas it should not only be a replication of something, it should be complementing by the means of the existing context. One aim for this project is to gain an understanding of these issues. This leads to research of local history, poetic analyses of the site, local buildings and materials. As well as researching sustainability, the dynamics and the profound changes taking place in society.

A poetic analysis of enouncing the site

How can the experience of a site be translated in to words? Imagine leaving your home for a week, with the desire to voyage somewhere else, somewhere you have not been before, some place different. Åse, in Norway is your destination. This is the realm of untouched nature where the mountains greet the horizon, gesturing a warm welcome and a spectacular break. This is the place where emptiness turns in to optimism.

However, you will experience it just as it, without any presumptions that the sun will determine your experience. The sun will be a precious gift to you stay, and you are prepared to be patient. Approaching Åse the scenery shifts, it is not cityscape anymore, it is a Nordic landscape, yet it is yours to encounter.

Welcome to Åse, you look around and the familiar are turned in to unfamiliar. The mountains enclose the landscape and frame the view of the horizon. There is no sign of civilization it is you alone with nature. You feel small in this ever-shifting landscape. Everywhere you look, your mind is triggered to explore and experience something diverse. No position will offer the same scenery. You are present at this very moment, there is nowhere else to be at this moment, only see, touch, hear, feel, sense, and smell what nature has to offer you. Moving on, you hear a rushing sound, this is the Rykand waterfall poring down the melted snow from last winter. You might even grasp your own reflection in the small lake, this crystal clear water is so crisp and clean. Even all the rocks look like they were placed at this exact place impartial for your gratitude. Looking around, there are countless of color shades, the birch trees along with other vegetation will articulate the time of year. They change with the seasons, and are well grounded having survived the harsh storms. The wind is present at this moment; it is the pulse of the site, whispering the lyrics of the landscape. If you listen very closely, you might also hear the birds chanting on their way to the south. From above derives indeed the mellow shadows and light, together they paint the truth of the weather, they brush the ground, exploiting a color palette of harmony and symphony. Here is earth, stone, trees, water, mountains and you. You can stay as long as you want, this is for your sensory to possess. Once aging welcome to Åse, the place to feel small yet think big.

A theoretical analysis of encountering the site

The previous text was about the poetics of the site. The following is a theoretical analyses of the site, focusing on the geology. To give an informative explaination the geomorphology of Åse and its environment, it is necessary to look far back into geological history. These facts are based on the book from Norsk Geologisk Forening, 'Landet blir til, Norges geologi,' Ramberg, Bryhni og Nøttvedt, 2007.

Landscape

e analysis

A mountain range that was greater than what the Himalayas are today

Between 500 to 400 million years ago, the great lithospheric plates of Laurentia (partly Greenland) and Baltica (partly Norway) collided to form the Calledonian mountain range. This mountain range was greater than what the Himalayas are today, with peaks up to 10 000 m.a.s.l. Later, the continents drifted apart and for many hundred millions of years, these mountains were eroded down into a relatively flat landscape at sea level. Only a few outstanding mountain regions were left. However, at about 50 million years ago, Norway experienced a tectonic uplift due to movement in the mantel of the earth. The flat land and old seabed was thereby lifted up to an elevation of up to 1000 m.a.s.l. (Ramberg et.al. 2007)

The glaciers created the valleys and fjords

During the last 2,7 million years, the earth has experienced a colder climate. Glaciations with up to 100 000 years intervals have created an enormous ice sheets covering all of Scandinavia. In Norway the ice is estimated to have been 3 km thick at most. Due to the pull of gravity, the ice in an icesheet moves like a slow flowing river. From its center dome it moves inn all directions, and cause continous erosion on the landsurface in form of abrasion and plukking. The ice preferrably follows small depressions like rivers paths in the terrain, and here the ice is concentrated into ice streams, faster moving part than others of the ice sheets. Here the erosion is greatest, and so it will further increase the depressions in the terrain and eventually form valleys and fjords. These glacial processes formed most of the landforms we see in Norway today. (Ramberg et.al. 2007)

Why the south side of Vigdalen is not a cliff

For Åse and its surrounding environment, the ice has mainly been moving from the high elevated mountain plateu in east towards the sea in west. This is the reason why Vigdalen, and also most of the other valleys, lakes and fjords in the region have a roughly east-west orientation. However, there has also been more local movement in other directions than east-west. This is because of local topography and again gravity. At times when the ice sheet has not been continous in the region, it is likely that a small outlet glacier moving north from Myrane towards

Åse has merged with a larger glacier down in Vigdalen. Also, the fact that Myrane is maped to consist of glacial river deposits supports this theory. Today Myrane is a marsh plain with remains of a braided river system. During melting, the glacier retreated southward up this valley and created this wide plain of branched river systems. Therefore, a likely explanation to why the south side of Vigdalen is not a cliff like the north side is that the ice approached from both south and east, and by ablation processes made the surface gentle and smooth. (Ramberg et.al. 2007)

Site section

Challenges with the site

The site sections shows that there is significant height differences at the site. There is about 20 meters drop from the road to the river, and the waterfall has a 50 meters drop.

The height differences impacts the access and flow of the site. Since some of the building have to universally designed, the access needs to be considered in the design phase. This would mean that if there is 1m height difference, there has to be 20m of ramp.

This could be a challenge, but it can also be a benefit if the ramp is used as the main flow at the site, so that the ramp protects the landscape.

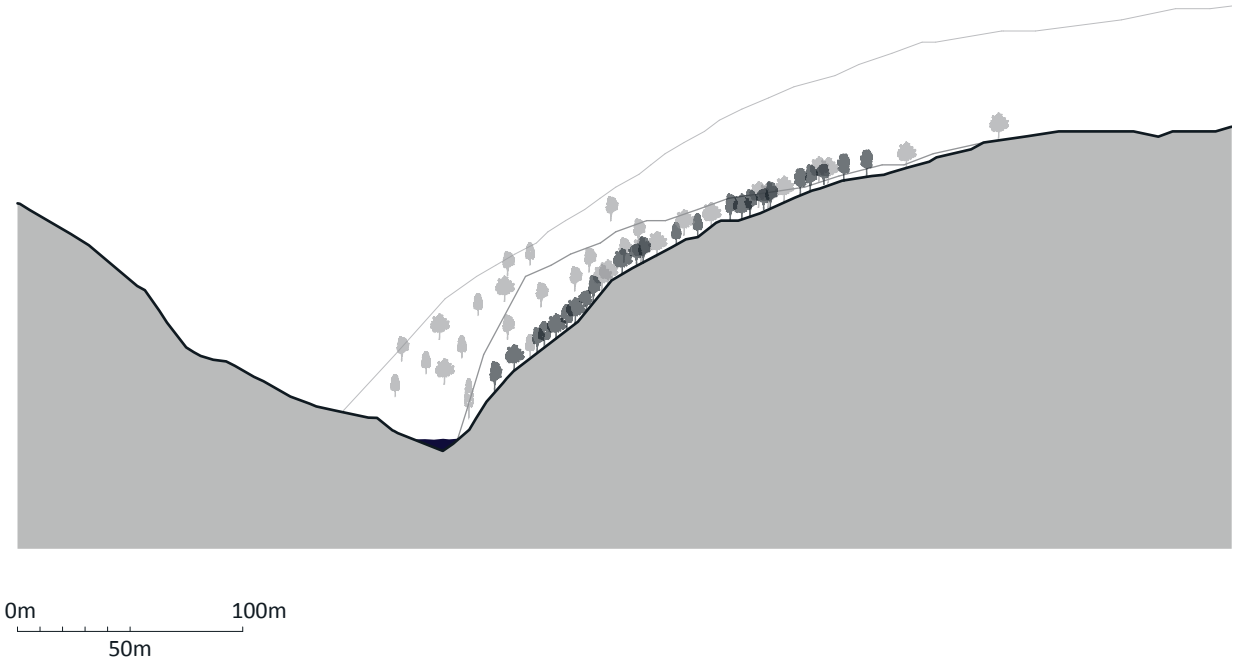
The surrounding mountains will also impact the design, in terms of energy consumption. There will be less solar heat during winter. This means that it can be a challenge to reach the energy frame of 20kWh/m2.

The bedrock at Åse

The bedrock at Åse is mainly Granite and Gneiss from the old basement rock of Norway (more than 1 billion years old) Granite is an igneous rock formed deep down in the crust. During the events explained above, the Granite has been subject to heat and pressure (metamorphism) and turned into Gneiss. The minerals (building blocks) in these two rocktypes are the same, but the structure is slightly different. However, both rock types are very strong and great fundamental for constructions.

On top of the bedrock is a layer of till. Till is an unconsolidated and strongly unsorted sediment left by glaciers in-situ. The grain size of the sediment range from clay, silt and sand to large blocks and boulders of many meters. When the last glaciers retreated from Åse for about 12 000 years, the rocks frozen to the base of the glacier were left behind in the terrain because of melting. The till layer is again covered by a thin layer of humus (organic material).

The bedrock at Åse



Climate

The site is located 59º on the Northern latitude and as a result of the closeness of the Atlantic sea, the site has a maritime climate. This means cool winters and warm summers, but not cold or hot. The difference between maximum and minimum temperature is narrow.

Nevertheless, storms and strong winds are usual, making the perception of the temperature much lower. As an example, the relatively mild -5 ºC in a wind speed of 30km/h would feel as low as - 20 ºC. The effect of the sea decreases deeper inland especially in the mountains where hills and valleys can have a somewhat different micro climate, usually resulting in harsher weather.

Precipitation

With the precipitation well over 1600mm and an average of 202 rainy (or snowy) days in a year it is clear that precipitation has a great effect on the perceived climate of the site. In comparison to Aalborg the average yearly precipitation is 689mm(43%) When choosing the construction materials and methods the effects of such wet conditions has to be considered.

When it comes to snow, only on average once in every 10 years does the depth of the snow reach 20cm. This is as a result of the maritime climate, which is not as likely as one would expect in Norway.

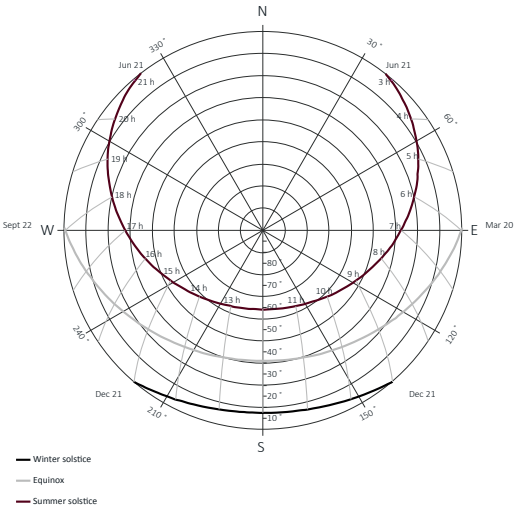
Natural light

The sun diagram indicates the normal pattern expected from such a Northern location. While at winter the sun rises at 9 o'clock in the morning and sets at 3 o'clock in the afternoon peeking just over 10º at summer the sun rises before 3 o'clock in the morning and sets as late as 9 o'clock in the evening. More importantly, the number of sunny hours shows that only about 1/3 of the daylight hours is actually sunlight. During the design process it should be one of the primer goals, to use as much as possible of the very little sunny hours available.
Also, the usages of PV panels is likely to be limited by the low number of sunny hours.

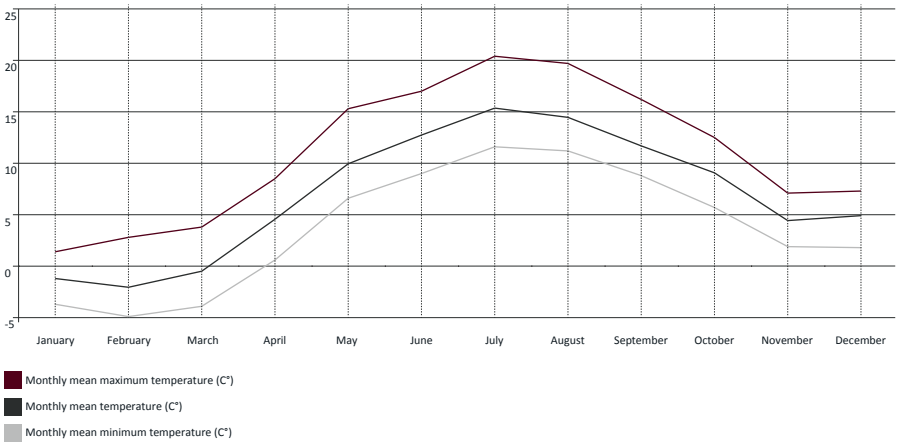
Temperature

The average air temperature shows clear signs of the maritime climate. Even during the coldest winter months the temperature rarely drops bellow zero degrees. The effect of the wind chill should not be underestimated. The same applies for the summer temperature. As a result of the cooling effect of the nearby sea the temperature, even on the warmest days, hardly goes over 28 degrees. Because of the mild climate, overheating and heat loss should not be the most difficult issue to tackle.

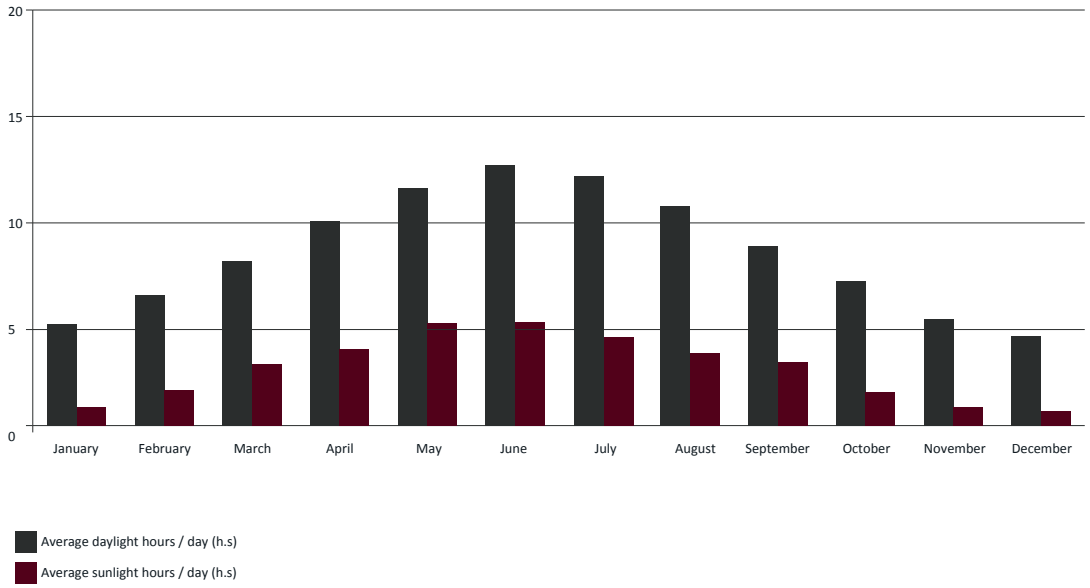
Sun path polar chart



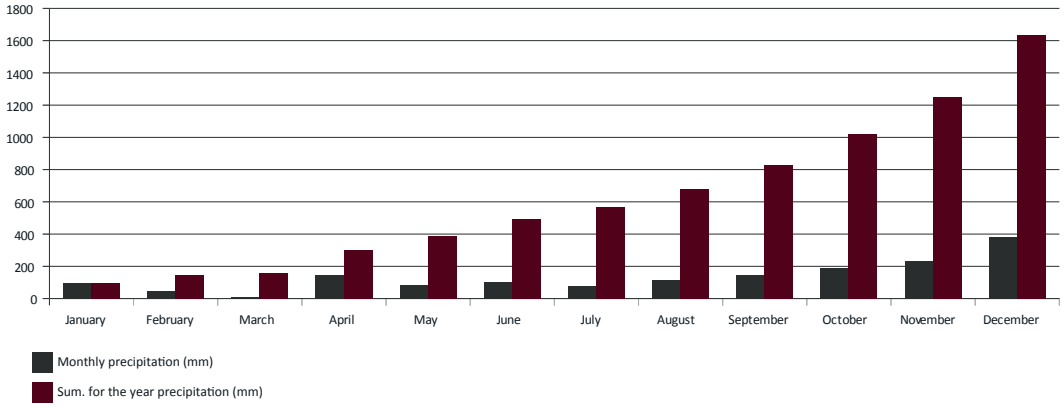
Temperature



Daylight



Precipitation

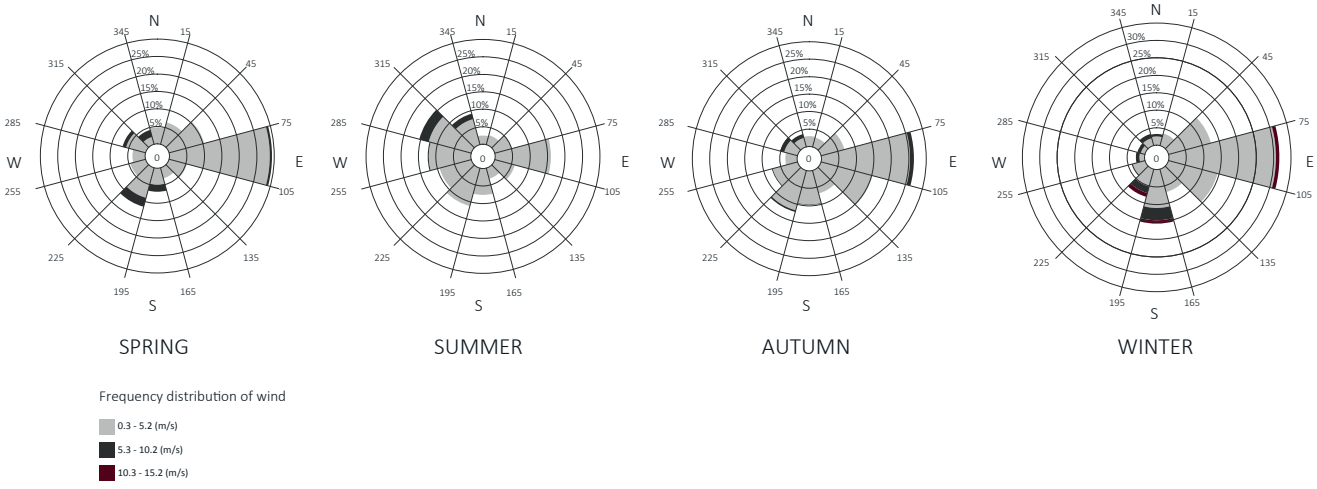


Wind

Strong winds are usual in the area and according to the data there is always wind. The strongest wind occurs during the winter months, but strong winds are not unusual during the summer time either. While the wind is predominantly coming from the East to the west, it must be noted, that, especially during the summer months, strong winds occur from the West as well. With the average wind speed over 10km/h the use of windbreaks is inevitable, in order to make the site more liveable. Also, the use of windbreaks, as a result of lowering the wind chill effect near the buildings, allows for saving heating energy.

Vegetation

The vegetation at Åse is a result of the rather harsh climate. What is there, consist of flora that are able to survive the changing climate. The most dominant tree is birch, but there are also pine and oak. On the ground there is heather, soil, and moss. The land that is being used by the farm is fertilized grass, which is a contrast to the untreated grass in combination with rocks and marshes. Through out the seasons all the colors of the vegetation change, and the atmosphere will thereby differ according to the time of year.



History of Hjelmeland

As the previous texts displays the site is located in Hjelmeland, and therefor it is not only interesting to look at the present situation, but also to look back at the old history.

Hjelemland has a history dating back to year 300, based on the archeological findings of farms. The discoveries of jewelry and belongings witness about a time of wealth and profit. At the end of the migration period in year 500-600 a plague that ravaged Europe reduced the population by half. Many farms were abandoned and left empty. In the year 600, there were about 50-80 farms in Hjelmeland.

The population of Hjelmeland participated in Viking plunders giving them the impetus from Europe and European trades. A characteristic from medieval farming, was that the fields were more intensively fertilized, which led to having a production that could continue from generation to generation. Another change from this time is that the old longhouses from the migration period were replaced with smaller and more specialized buildings.
Such as; food storage, house, barn, hay barn, cookhouse and smithy. In the Middle Ages the landscape was already designed and characterized by use of earlier generations. The available forest, was used for fuel, building materials and feeding grounds.

During the Viking era came a new development in Hjelmeland with new settlements and farms. Throughout the Viking Age about 40 new farms were established in Hjelmeland. By the year 1000 there were around 93 settlements in Hjelmeland. The farmers lived off what they cultivated and harvested from nature, and these goods they used to trade for other goods.

It was these people who made the history, through the recession and plague, and progress and immigration. The local society was characterized by the community spirit. Where the daily tasks consisted of cultivating the soil, tend the livestock, harvesting, fishing, logging, and they were all interdependent. (web: Hjelmeland sogelag, 2014)

The interesting finding from history would be how the society survived locally. They dependent on what was given at the site. This could perhaps be reintroduced in the project, so that the aim is to use as much locally recourses as possible.

Another interesting aspect is the building layout, that there where different buildings for different functions, this also opens up for a possibility for a modern interpuration of the farm community.

Vernacular Architecture

Vernacular architecture, sometimes called architecture without architects is, as Edwards (2014) points out, " the simplest form of addressing human needs " furthermore " embracing regionalism and cultural building traditions ".

These techniques were developed and perfected over hundreds of years. While in Europe after the industrial revolution the evolution of vernacular architecture has stopped, in the less industrialized part of the world the traditional methods are still in every day use.

Although the simplicity embedded in vernacular architecture is very appealing, there are a number of other reasons why this text investigates vernacular architecture in a greater depth. Most importantly, vernacular buildings are almost always low energy, usually on the expense of comfort.

Moreover, partly to achieve low energy state and partly as a reflection on the local culture, vernacular buildings are always well integrated into the environment.

As such, vernacular architecture can be seen as the outcome of a low energy, integrated design proposal. But, it must be noted, that not every old techniques are sustainable, ecological disasters were always part of the human existence whether we are thinking of the Icelandic colonies on Greenland or the irrigation cultures of the ancient Middle East. Thus, the critical approach must be maintained when it comes to vernacular architecture. As it was mentioned above, vernacular buildings tend to be highly energy efficient and use only low quantities of energy.

While nowadays, sustainable architecture aims to use less energy because our planet is running out of resources, prior to the industrial revolution resources – materials, energy - were simply not available only in very limited quantities.

Consequently, the people had to be resourceful and make the most of what they had. This included the usage of local materials and the maximisation of the natural forces such as sun and wind.

The invention of industrialised brick production combined with steam trains – a cheap form of transportation – allowed to build unified buildings anywhere. Due to the unprecedented availability of resources and energy making the most out of the natural resources was not a priority any longer.

It is clear, that the pre-industrial ages were very different from the 21st century, but as we thrive to once again use less energy as we do now, it is important to look into those energy saving methods that were developed in the past hundred of years. Architecturally the connection can be the thrive to integrate the buildings into their environment. With this, shifting from generic, towards site specific design.

Local building analysis

The local building analysis is based on the book 'HUS På Vestkysten gjennom 4000 år', by Brekke and Schjelderup,2004.

Point of departure is to understanding the essential relationship between house, climate and available resources, relative to human adaptation to the environment within its surroundings.

Examining the building history from the west coast of Norway indicates that the house functioned as a frame between human life and activity, being a protection from the weather, sheltering specific functions for different use. As well as it was a place to make practical, symbolic, religious, or aesthetic work.

The first traces of people who left the leather tents and started to build houses goes 5000 years back in time. Findings of beams from a roof structure convey a new paradigm, when the house becomes a part of human activities and everyday life.

Taking into consideration that the area of Norway is about 400 000 km^2 only a small fraction of Norway's vast land is suitable for continuous soil cultivation. This has resulted in a population that in the time of primary industry was surprisingly small. A distinctly dispersed settlement pattern is the consequence of a modest population in such a large geographical area, where the industry strongly depended on natural resources.

On the West Coast old buildings were made of stone and wood, constructed in grids that has its origins back to the Bronze Age. The building tradition indicates an architectural-reflection from different ages currents in Europe. Thus, being suitable for the local requirements and the need to protect from harsh coastal climate. Most importantly, a tradition that in all its simplicity was foremost about building to fulfill the most basic requirements. While the structure and form was an expression of man's urge to create something that made sense, being sustainable and logical.

In a European perspective what characterizes Norway as a civilization and as a nation, is the "northern route" by sea to the north. The coastal settlements established a unique cultural geographical region in Europe. As such, the West Coast developed its own architectural expression, characterized by fishing and shipping. Consequently, only the materials and methods that could sustain were applied to the buildings. Skills and knowledge about buildings were being passed on from generation to generation.

Summing up, the history of the houses on the West Coast is extensive and still influential. It is generally about building in its simplest and most basic form; a house for a harsh climate, a house for several functions and purposes. It could be a house of stone being resistant and maintenance-free or a house of timber using renewable resource and a living material. Foremost a place to live and make sense of and within the surroundings. (Brekke&Schjelderup,2004)

For this project it is of relevance to try to reestablish the relationship between house(building), climate ,available resources, and human adaptation to the environment within its surroundings. As mentioned earlier, this is also some of the strategies for sustainable design today.


Brandlarm

Local buliding materials

Whether a material travels long or short distance does not have a significant effect on the embodied energy of a building. Yet, using local building materials allows buildings to fit much better into their environment, both the built and natural. As well as using local suppliers and tradesmen also have benefits in terms of social sustainability and local know-how. In such harsh environment as the one at Åse having local knowledge and expertise can not be overvalued.

Wood is the most important building material in Norway. With the Norwegian timber industry sustainability harvesting about 12 million qm of wood there is a steady supply of different wood products.
The most important types of wood are pine (33%) spruce (47%) hardwood – birch, ash, oak, alder – (20%). Norwegian wood, as a result of the cool climate, is regarded as very high quality. Wood, as a renewable resource, is widely accepted as one of the most sustainable building material.

Moreover, the timber industry is one of the most efficient industries. By-products such as sawdust or low quality wood is tuned into biofuel and other useful products.

The second most important building materials is concrete. While it is a building material with one of the biggest embodied energy and CO2 footprint, it is still very popular. Recent developments in the construction industry were also aiming towards making concrete more eco friendly. With a number of cement substitutes, such as fly ash, blast furnace slag to name but a few mixed with recycled aggregate the CO2 footprint of concrete can be greatly reduced. Also, concrete as a result of its high density (about 2400kg/qm) has a great thermal storage capacity.

Natural stone, along with timber is a traditional building material, still in use, in Norway. The popularity of this material is due to its resistance against the harsh weather conditions and its availability. The three main types of stone are slate, granite and gneiss. Slate is one of the most water resistant natural stones. Therefore it is most often used as a roof tile, but it can also be used as wall cladding or masonry units. On rare occasions it is also applied as flooring material. Using it outside as a paving material is not advised as, when wet, its surface becomes very slippery.

Granite was traditionally used as foundation. It is also very durable and resistant. In the recent years it became popular as flooring material, but granite should not be used inside, because it is a natural source of radon. Gneiss has a great strength and can resist extreme climate and large changes in temperature as well. It is one of the most popular stone types in the building industry, virtually used for anything from cladding to flooring.

Sheep wool, although not a typical building material is also available locally. With a dramatic change in the textile industry in 1960s the price of wool has dropped largely. After the drop in prices sheep were grazed for the meat and not for the wool, making wool a by-product that usually not used for anything. But, wool is a great insulator and with a thermal conductivity of around 0.034 it is more efficient than some of the modern glass fibre insulations. As such it is not just a natural insulator with low embodied energy that is locally available, but it is also very efficient.

As stated in the problem formulation, this project aims to use local materials for the design. All the materials mentioned above are available at site or found in close proximity too. If implemented in the design, the use of local materials can create a strong architectural and sustainable statement.

Sustainability

Sustainable development according to Brutland (1987) is "...development that meets the needs of the present without compromising the ability of future generations to meet their own needs."

Many are familiar with this idea, which is a great indicator of how much the world has changed in the recent years. It was only about half a decade ago – 2006 – that the former Vice President of the United states of America could shock the world with his campaign movie; An Inconvenient Truth. Likely the movie would not surprise as great many today as it did back then.

This positive change towards a more sustainable future might be misleading though. Surveys carried out by Gallup in 2013 are suggesting, that people are actually less concerned about global warning than they were in 1989. The author's professional experience is in line with the study, while a great many are aware of climate change, many of them are convinced that things are going to be fine and that we already have the solutions to the problems.

The truth could not be further from this. Sustainability, climate-change etc. are just as hot topics as they were 10 or 20 years ago. In fact, an article published in the Guardian (2013) claims, based on the research of Professor Steven Sherwood, that the climate-change is likely to be worse than expected. Climate-change is just one of the many serious problems an other serious issue is linked to the consumption of finite resources. While there are a great many claiming that our resources, especially fossil fuels, are plenty and new deposits are discovered every day and therefore we are safe, it is not entirely true.

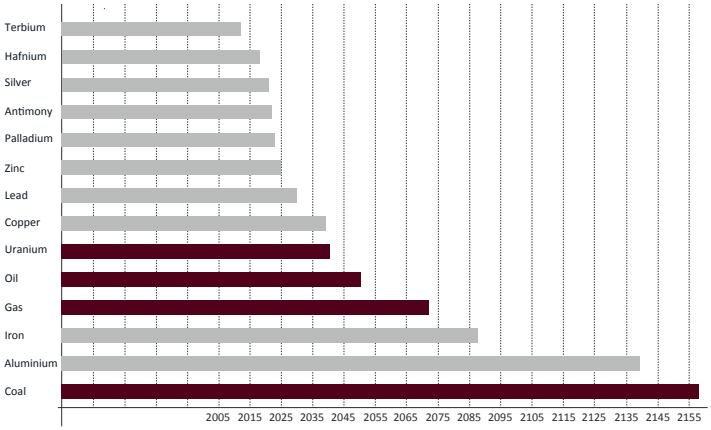
Although the logical problem might look very complex, in reality it is very simple. Earth as a system is limited and we are using up many of the limited resources much faster than they replenish in order to fuel further growth. This makes it clear that, unlimited growth is not possible in a limited system. As our current financial and social system is based on the hope of constant growth it is easy to see how our lives are not sustainable.

As the built environment is responsible for about 40% of the energy usage in the world, it is obvious that amendments have to made to tackle the future threats.
New buildings, mostly as a result of building regulations, are excelling in terms of energy usage. However, it has to be noted, that the energy sustainability is related only to one of the three main components – environmental, economical and social – of sustainability.

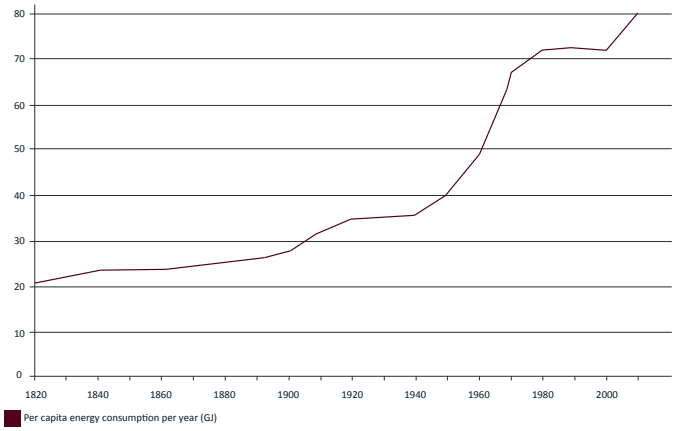
Economical sustainability is an interesting issue to look into, particularly in light of the economical meltdown in 2008, although it is not necessarily a field that architects can greatly influence. But, the social sustainability is a problem that architects could and should address. According to Sir Peter Hall (2012) There is a widespread understanding of the physical and environmental challenges, but there is very little understanding of social sustainability. Real sustainability can not be achieved, by neglecting one of its main ingredients, especially since it is not so much our buildings, but the way we live in those buildings, that is responsible for a large part of our energy consumption.

The modern fast paced life is only maintainable by burning fuel on an extensive scale. Crucially, the ever faster speed of life does not only eat up or resources but leaves a great many unhappy. Maybe if architects create spaces that allows for slowing down or places that allows for high quality time, our energy footprint would most likely significantly decrease.

Expected depletion of different resources



World per capita energy consumption - estimate



Energy consumption

1Kg beef
225 MJ

1Kg pork
90 MJ

1Kg chicken
75 MJ

Operational energy
of a
BR 2010 house
for 1 day
69 MJ

1Kg fish
13 MJ

Perception of sustainability

Undoubtedly, the building industry has to go through some radical changes in the near future in order to meet with our energy goals and even more importantly, to make our buildings sustainable and affordable in the future.

While different building regulations and other governmental legislations, can enforce some of the necessary changes at the end of the day, it is the clients - families, investors etc. - who can make the real difference, simply by demanding low-energy buildings. For this end, it is crucial, to make low-energy buildings more appealing for the winder public and not only for a small segment of the society. One of the ways to do this is to have successful projects, as Brunsgaard (2011) points out in her work Understanding of Danish Passive Houses based on Pilot Project Comfort Houses "A satisfied user is important – if not the most important success criteria to get the marked (sic) dedicated to the passive house concept."

In her research Brunsgaard describes a number of different approaches towards sustainable buildings and concludes, that the early attempts of low energy buildings, Villa Vision and Friland to name but a few, failed to attract the wider public, because they were very different from a traditional Danish house and also because to live in them would have meant a dramatic change in the potential occupants lifestyles, moreover the physical appearance of the named buildings is very different from what Danish people would see as an appropriate dwelling. However, Brunsgaard also mentions that there are prejudice against sustainable buildings, especially in relation to their aesthetic qualities and the compromised living conditions, in the projects Brunsgaard investigated, three of the comfort houses, the clients were very happy about the architecture, but not so satisfied with the features related to sustainability. The most important problems were related to the low level of user control over the environment in the houses and to the overheating during the summer period.

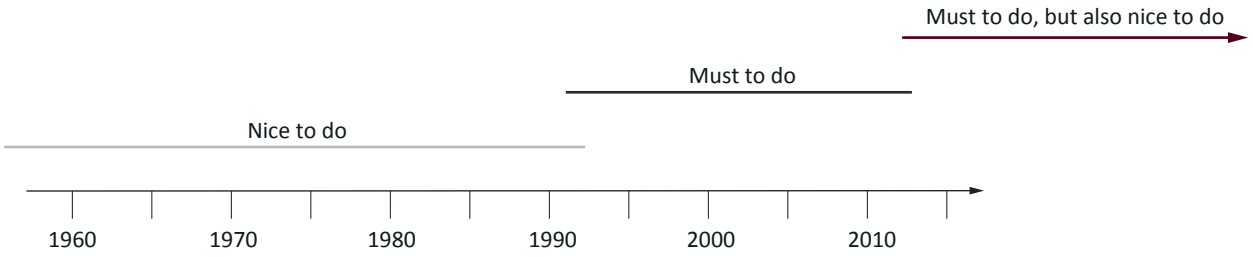
It seems that the comfort houses, fell short on their promise. Even though architecturally they are a success, it is hard to see how it would be possible to sell the idea as the future of living while some of the occupants had to leave their home due to the overheating during summer. Most importantly, it appears that some of the prejudice about sustainability are not without reason.

Nevertheless, it is also important to remember, that sometimes the quality of a product has nothing or very little to do with its popularity. As Rory Sutherland (2012) reminds everyone "Things are not what they are; they are what we think they are" Steve Howard (2013) explains how much, for a long time sustainability was explained to people as an uncomfortable compromise that we all had to do. In his opinion, the highlight should be on the positive contribution sustainability has on our lives.

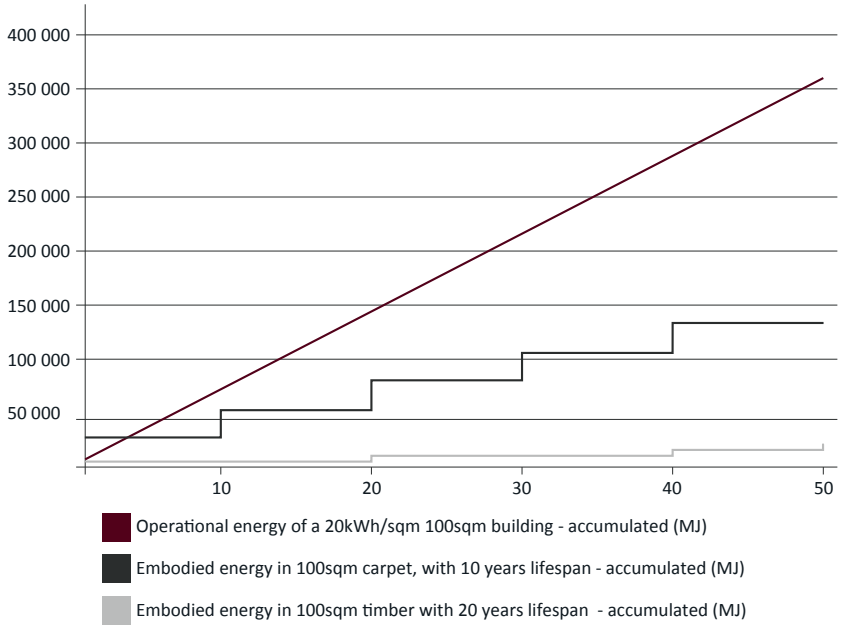
In brief, perhaps sustainable architecture was for too long treated as an engineering exercise, where humans were more and more forced out of control of their own environment in order to create much more efficient buildings. The problem with this approach is, that it made sustainable buildings something vile instead of appealing. Consequently, further improving the efficiency of the buildings that none wants to live in, is not likely to solve the energy issues human race has to face in the next 50 or so years. Some of the problems reported by the occupants of the comfort houses are in line with this claim. The absence of a bathtub and fireplace leads to the loss of feeling of being at home.

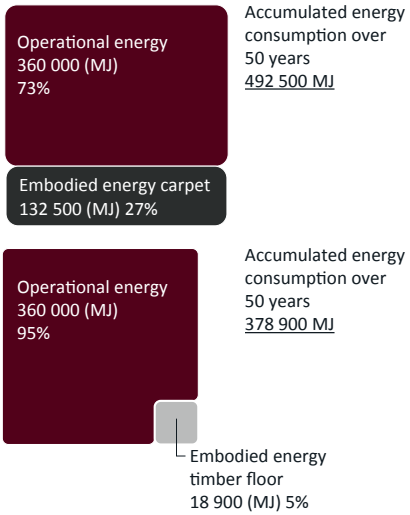
The same applies to the ventilation and temperature control, the limited possibility for human interaction goes against the findings of Sutherland, according to him, "The circumstances of our lives may actually matter less to our happiness than the sense of control we feel over our lives." A shift in focus from the engineering solutions, efficiency and the numbers towards making the future living more comfortable and pleasant could make sustainable buildings much more accepted.

Perception of sustainability



Energy consumption over a period of 50 years





Most important issues reported by the occupants of the comfort houses:

–Mechanical ventilation has to be supported by natural ventilation
–The possibility for natural ventilation is limited
–The indoor temperature can not be well controlled. At winter it can be too cold while at summer too warm and the occupants can do very little about it.

–Missing homely features, such as fireplace.

Architecture, tourism and sustainable development

In the brief it is stated that this project will design a sustainable hotel and therefor it is of relevance to look in to the topic of tourism, involving reasons, types and challenges with tourism.

Recent research has discovered that the psychological benefits from experiences related to tourism, has greater impacts beyond motivation and satisfaction. As such, empirical research indicates that there is a connection between tourism, and other spheres of people's lives and experiences. Discovering that there is a link between happiness, subjective well-being and quality of life. (Dolnicar, Yanamandram, & Cliff, 2012). Consequently, this would mean that in general one might say that tourism will make you happy.

According to The International Ecotourism Society (2000), 60% of international tourists are considered to be nature-based tourists, and there is an increased demand for sustainable destinations in Europe. Perhaps being a result of the growing environmental awareness or the desire to try something different than amusement parks such as Disneyland or big 20 stories hotels. However this tendency can also indicate that people seek a more basic type of tourism in the 21th century. Where the destination can offer something different than at home, maybe a desire to retreat and relax?

More over, there still is l an ongoing discussion in the tourism literature to define nature-based tourism and nature tourists. Valentine (1992) integrates the recreation element in the definition, claiming that "nature-based tourism is primarily concerned with the direct enjoyment of some relatively undisturbed phenomenon of nature." Valentine (1992). While others may argue that nature-based tourism has a broader definition embracing all types of activities and experiences in nature or outdoors.

Lindberg (1991) suggests that there are four types of nature tourists:
"(1) nature tourists who conduct scientific researchers designed for education.
(2) nature tourists that goes to protected areas in order to understand local, natural and cultural history.
(3) nature tourists who visit such destinations as the Rainforest or safari as an unusual trip.
(4) nature tourists, who partake of nature as part of a broader itinerary." Lindberg (1991)

Nevertheless, there has been a long tradition in Scandinavia to spend the leisure time in the outdoors. Already in 1923 Fritjof Nansen a Norwegian explorer and scientist, expressed the importance and benefits of being outdoors (Greve, 1974). Being embedded in the Norwegian culture, Norwegians can easily accesse the nature. Consequently, people in the Nordic countries usually have the skills and equipment to do outdoor recreation, where as this would most likely not be the case for the mainstream tourist. Although the desire to stay and experience the nature is present, there would still be a request to stay more comfortable with familiar facilities. Leading on to the next topic 'Tourism and architecture'.

The architectural expression of tourism is mostly recognized as being a hotel. Thus, implying the fact that the architectural expressions of hotels differ according to context and geographical location.

More over, a hotel usually offers multiple services having large amount of facilities, which could be understood as a synonym for unsustainability. Meaning that the buildings that are necessary to run a fully 24- hour serviced hotel would consume a large amount of energy. According to an article about Architecture, tourism and sustainable development, Feio (2013)

"Buildings that make possible tourism occupation, involve extra consumption of energy and natural resources." That is why the architect has such an important role when designing a hotel. "To overcome such problems (***energy consumption***) attention to architecture and construction detail of tourist facilities is central… avoiding the negative impact on the ecology, culture and aesthetics" (Feio, 2013)

Summing up, the challenge is to make the hotels sustainable in such a manner that they are attractive to tourists. As such, this is one of the main goals for this project. Making sustainable architecture, not architecture sustainable. Implying that this project aims to redefine the meaning of good architecture, that is sustainable, and part of the design process itself.

Case Study

The searanch

The Searanch project is located in the USA, California only a few miles from San Fransisco, on the beach of the Pacific sea. Searanch is not one building but a larger area, consisting of small, detached cottages to cluster of condominiums and even a few shops.

The main focus of this research is on the condominium designed by Charles Moore – the masterplan of the area was done, by the landscape architect Lawrence Halprin and Associates. Charles Moore explains the design approach of his firm in great lengths in his book, The place of houses and therefore it is going to be used as the main source of information.

According to Moore, the site offers not only a magnificent view, but the site itself is beautiful as well. On the other hand, the site is exposed to the elements, strong winds and salty water to name but a few. To Moore and his team it was clear, that on a site like this, buildings should not blend into nature as they would offer very little, if any feeling of safety and protection.

Consequently, the aim was to design something, that while sticks out of its surrounding and creates a contrast with it still feels like a complementing part of it, almost as a rock on the fields or like an old castle on the top of the hill.

This duality of the site was the core of the design idea and followed through the entire process. A great example of that is the different level of shelterdness. To start with, the entire building block has a very clear, almost sharp edge where it meets the landscape, making a clear 'cut' in between sheltered and exposed.

The court, the next level of protection, formed by the apartments surrounding it, continues in the same fashion. While it offers some level of protection, especially against the wind, it is still exposed to the nature. On the edge of the courtyard are the apartment buildings, usually with only a door facing towards the court, making it clear, where to look for even more protection.

Nevertheless, the court offers a great place to interact with the other occupants of the building and thus create a community, something that for a long time was one of the cornerstone of the very survival of human beings.

The next level of protection is the inside of the dwelling. The small open plan and the single slope roof enhances the feeling of sitting under one roof, together, boosting the sense of safety. The large, but far from overly large as in case of the case study houses, windows are offering great view to the nature, from the previously explained safety of the room.

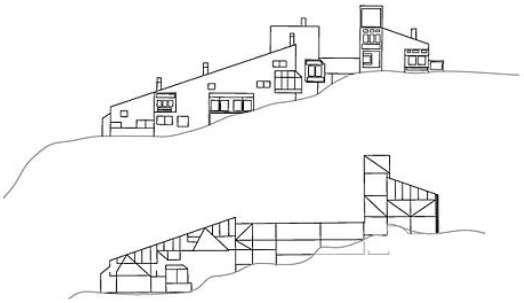
While in most cases the inside of the house is the last and greatest level of safety, Moore designed a so called 'superfurniture' a room in the room hosting the kitchen and the bathroom.
Likely, one of the most interesting aspect of the project for us was, how Moore challenged the connection of human and nature. While many modernist were in constant struggle to create in-between spaces and blur the boundaries within nature and human Moore creates a clear division. Reminding us that the original reason for dwelling was to find protection from devastating elements of nature.

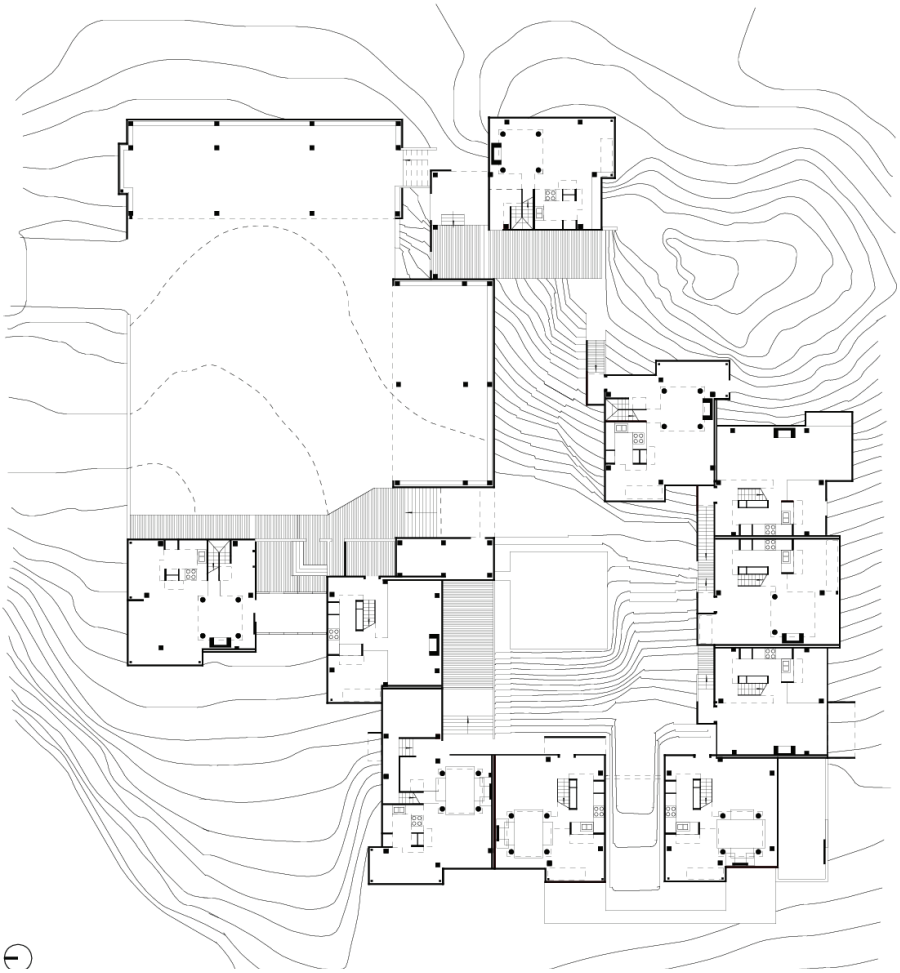
The other interesting aspect of the project is how much Moore and his colleagues managed to keep the existing landscape unspoiled. The plan of the court, with its maze of stairs and landings mixed with the ever-changing landscape going up and down are in an almost perfect harmony, yet the materiality and the sharpness of the man made makes it easy to read where built and unbuilt meets.

In his book Moore offers very little insight about the future of the condominium, but hits a rather critical tone when talking about the future of the area.

But, he makes one interesting point, that was interesting in our case. The future developments in the area have paid little respect to the landscape and this combined with the increasing number of dwellers killed some of the magic of the place.

Reminding us, that some of the magic of such places is the result to the isolation from the civilization and consequently developments that are too dense or that are losing the connection with their surrounding





can take this magic away in a very short time.
It is worth mentioning that Moore, probably consciously, avoids the word privacy and instead uses words such as shelter, protection, safety.

Moreover,
In order to do that, different levels of ‘shelteredness’ were created on the site. Starting with the courtyard, surrounded by the flats.

Case Study

Juvet Landscape Hotel

Juvet Landscape Hotel is located in a valley near the town of Åndalsnes north-west in Norway close to the spectacular waterfall «Gudbrandsjuvet». The hotel was built in 2008 and designed by Jensen & Skodvin Arkitektkontor (JSA).

The hotel has a total area of 800 m2, spread out in different small building, functioning as the hotel rooms with a panoramic view framing the landscape. According to the architects “The idea of a landscape hotel emerged as an opportunity to exploit breathtaking scenery with minimal intervention, allowing locations which would otherwise be prohibited for reasons of conservation.” Juvet (2014)

The site for were the hotel is located is a nature reserve. It took extensive negotiations with conservation authorities to get a building permission. The specifics of this site suggested a construction only possible without the rock blasting or changes of the terrain. The architect argues that the current concern for sustainability in architecture focuses predominantly on the buildings energy consumption.

However, they believe that conservation of topography as a characteristic of sustainability. Supporting the argument that a typical building procedure involves destruction of the site in order for accommodating foundations and infrastructure. Thus, implying that conserving and protecting a site is an approach to respect nature.

Furthermore, by observing the existing topography one can conduct an interpretation where the structural geometry highlights irregularities of the natural site, consequently articulating itself within its context. Establishing a sustainable relation between building and site.

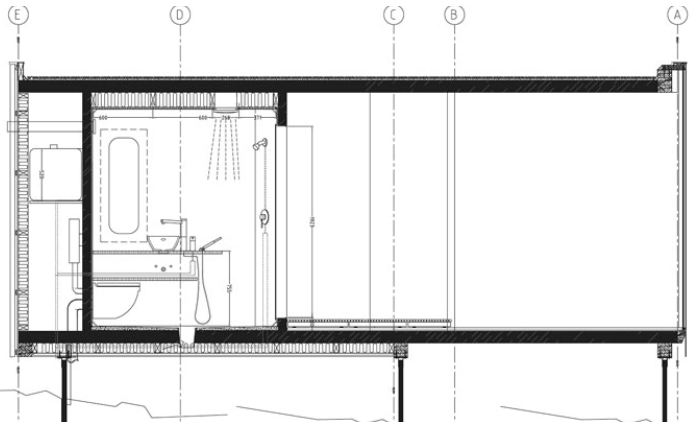
The aim was not to create a conventional hotel with rooms arranged together in one building. The idea was rather to create individuality by different small scale buildings spread out on the site at different locations. This strategy is very well accomplished in the design, giving every building a uniqueness and identity.

The individual cabins have an extroverted focus, being a large experienced interior space. Few elements are being used on the inside, so that the focus can be outward and to the ever-changing nature. In two phases a total of nine rooms have been built as individual cabins and one spa building. The main approach is to give the rooms an experience of the landscape. To achieve this none of the rooms are alike. They all have slightly altered designs, according to the specific topographical position. This is an optimization in terms of privacy and view.

Each cabin has one fully glazed façade allowing an exclusive view of the landscape. The existing topography is not changed; all the rooms are situated on top of the terrain. As argued by the architect this can be understood as a sustainable approach, thus not in terms of energy consumptions. Yet, there is a strong emphasize on the social sustainability, which has been mentioned earlier, also is one of the three main pillars of sustainability. The experience and peacefulness given at this hotel, will doubtfully add to the quality of life. While being there (in 2012) senses and curiosity are overwhelming, the architecture is unpredictable yet clever. Every room has a plot and a story to convey. The space has a duality of notion as being protected from the outside, yet present at the outside.

Juvet has been used as a case study in this project because of its relation and respect to nature. The landscape at Åse consists of somewhat the same characteristics, and a similar approach will also be relevant for this project. The fact that it is a hotel located in Norway also made sense in terms of this study, because the architecture is used as a tool to appreciate nature, and being site specific.

As a case study it is inspiring to see how the architecture is used as methodology to convey the realm of the landscape, without making a stereotype mountain cabin. On the other hand it can be up for discussion if it could be optimized according to energy efficiency and become even more sustainable.
Juvet(2014)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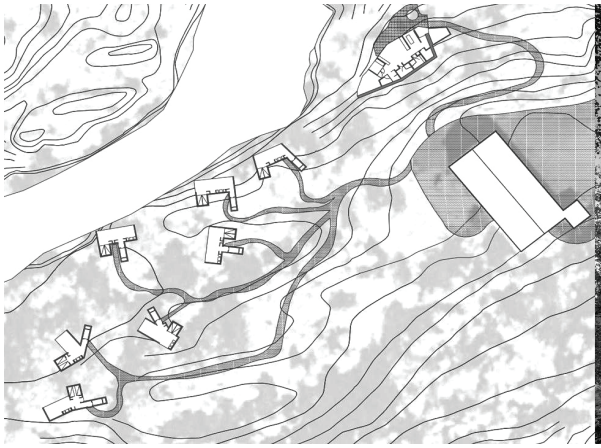
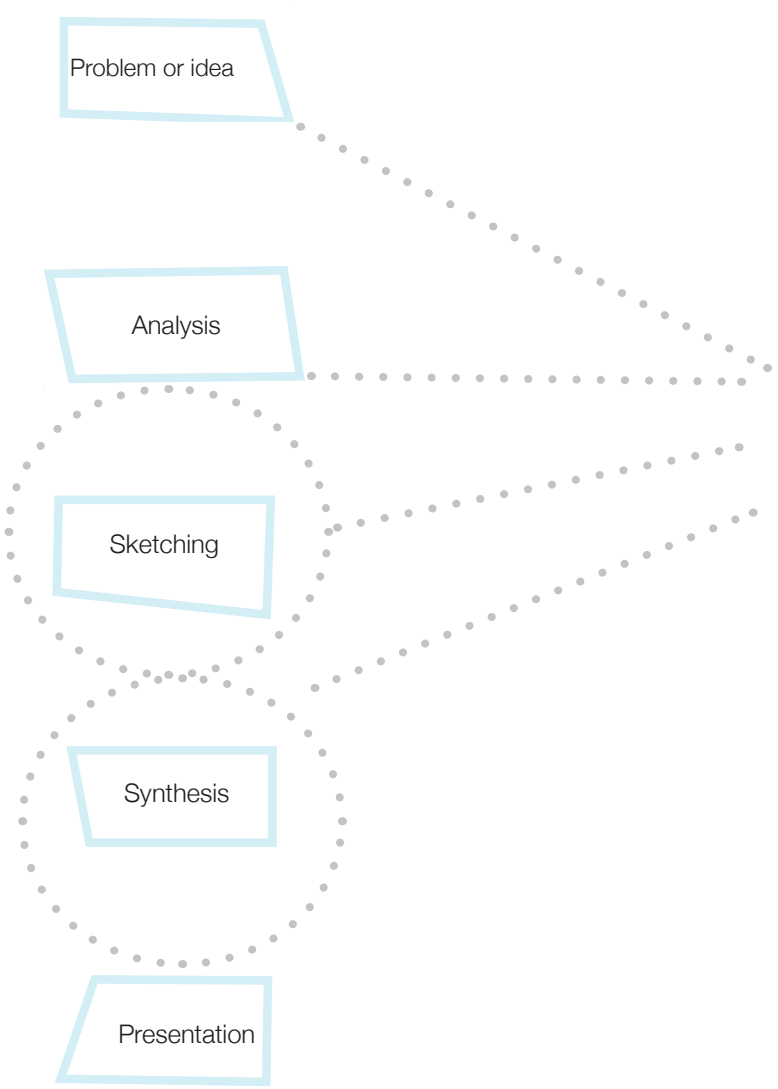




Based on the analysis we will now sketch proposals acoring to:

The location
The climate there
Sustainability
Tourism
Vernacular architecture
Nordic landscape

Based on the sketching we will also test proposals acoring to:

The energy consumption
The daylight factor
The wind
The indoor climate
The orienation
Ventilation

The tools uses for this is:
BE10
BSim
Velux Daylight visulazor
Vasari

Sketching & Synthesis

Introduction

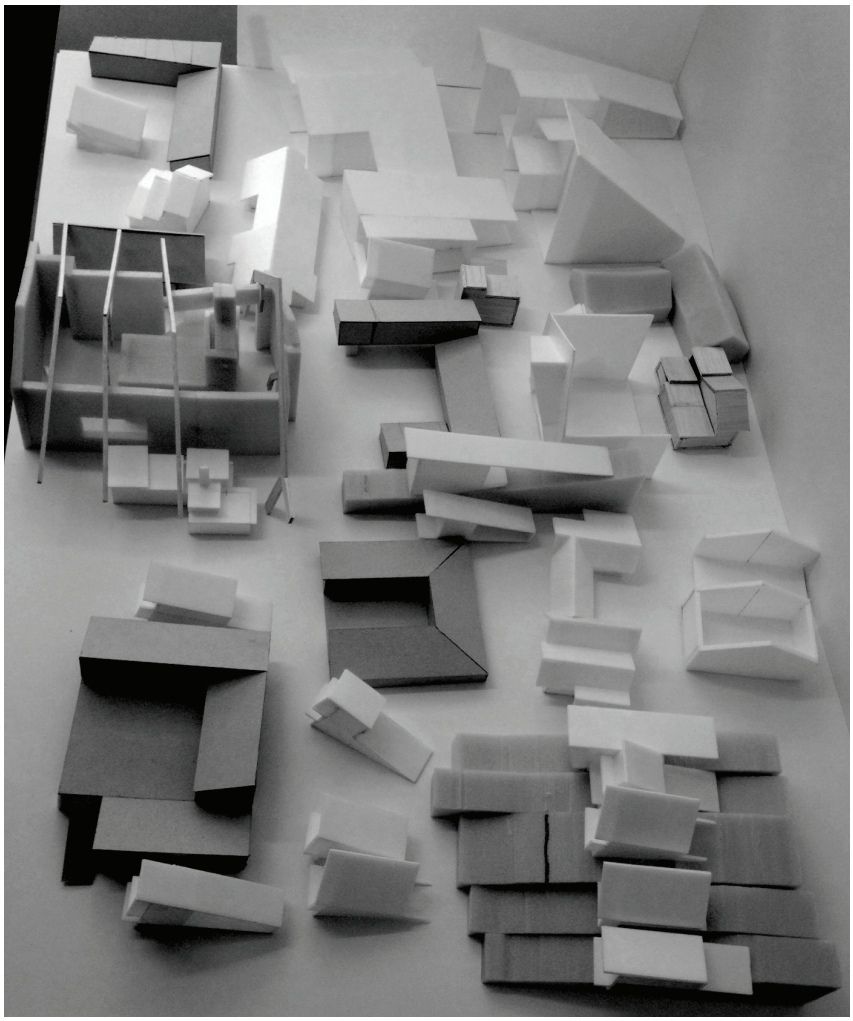
This two phases are presented together. That is because we have worked simultaneously. We have used different tools to test and optimize the design. Or in other terms “made the calculations poetic”.

The left side will present the strategies and development of the project, on the right side there are various sketches and models from the specific topic. And the different topics are

-Getting started
-Development of masterplan
-Development of building layout in terms of community and privacy
-Development of design through the use of different tools.
-Development of plan

Firstly, it is important to mention that all the findings presented are related to this specific project and the exact location. This means that if a result will benefit this design, it does not imply that it would give the same result at another location.

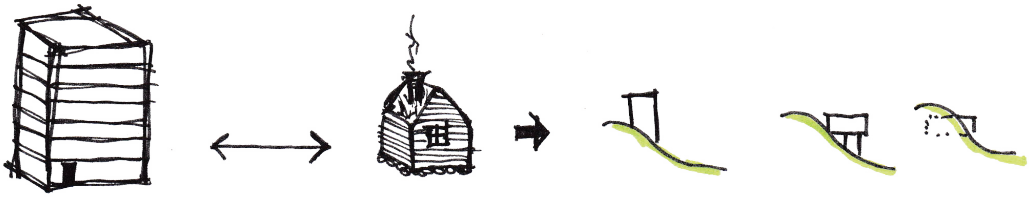
Secondly, this is meant to show the process, however it should not be read as a timeline, or as separate developments. This is an attempt to illustrate the progress and how design decisions were taken, as an integrated design process, there were several iterations involved.



On the following page is a list of desires for this project, in the epilogue the response to the desires will be presented. A note to the terminology of sustainability is that it is used in relation to this specific project. Being aware the term has a greater understanding. The awareness of global warming and reduction of natural resources are not excluded from the term, but in the desires, sustainability is regarding this specific project.

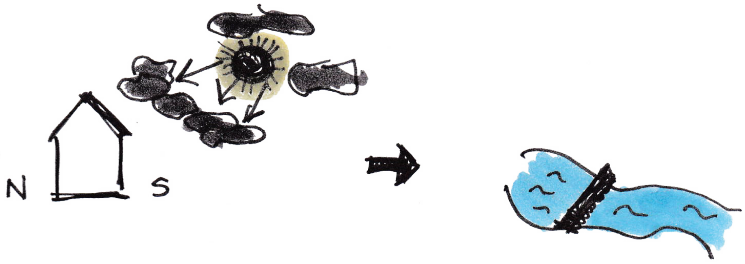
Social sustainability	Disconnect from urban life Reconnect with nature, yourself and others Enhance slow life
Environmental sustainability	The quality of the site is the untouched nature and landscape
Energy demands	Use renewable energy for production and supply, since the site is disconnected Meet the energy frame of 2020 regulations
Locality	Lower embodied energy Enhance locality
Good Indoor environment	Provide high quality spaces, enhances satisfaction and experience of guests Correlation between general health and indoor environment Meet the comfort Class II CR 1752
Poetic Calculations	Make sustainable architecture, and not architecture sustainable. Integrate sustainable strategies in the design process
Financial Sustainability	Energy efficient buildings have high embodied energy, if they fall in disuse they are not sustainable

Getting started



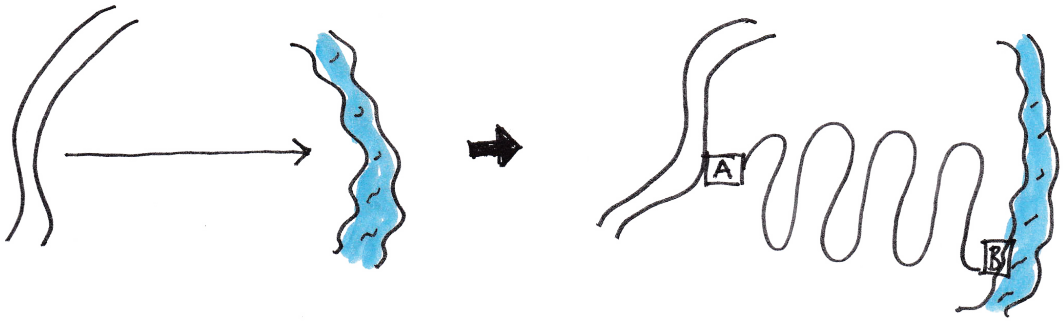
How to come up with a design that is not a large hotel or a traditional mountain cabin

This lead to experimenting on how a building would fit in to the landscape



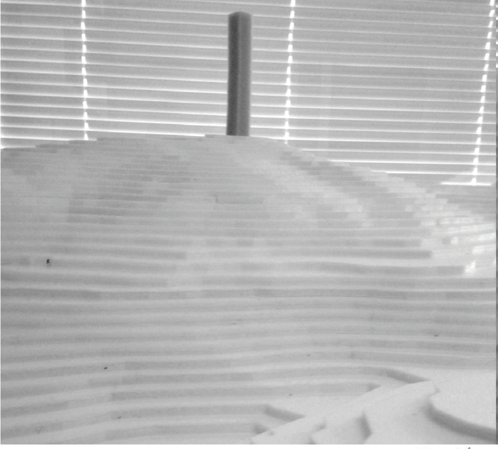
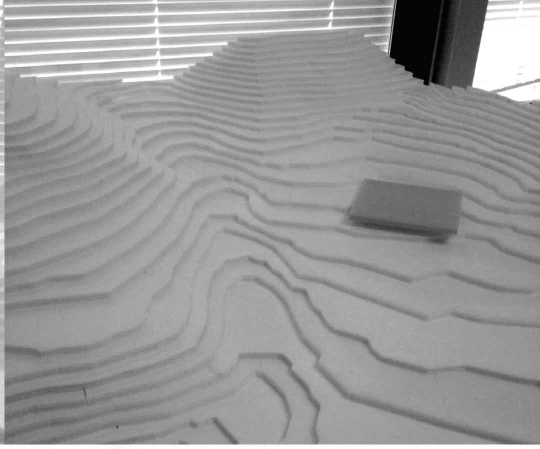
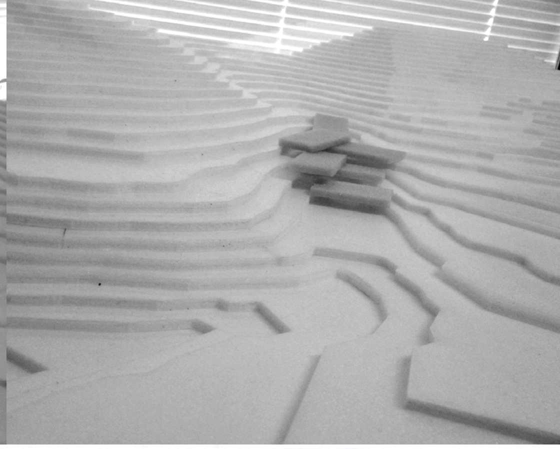
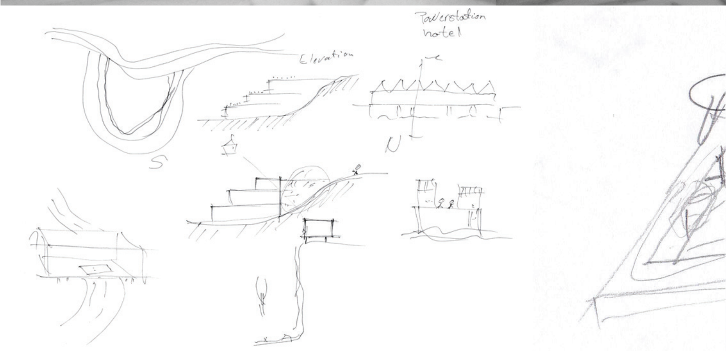
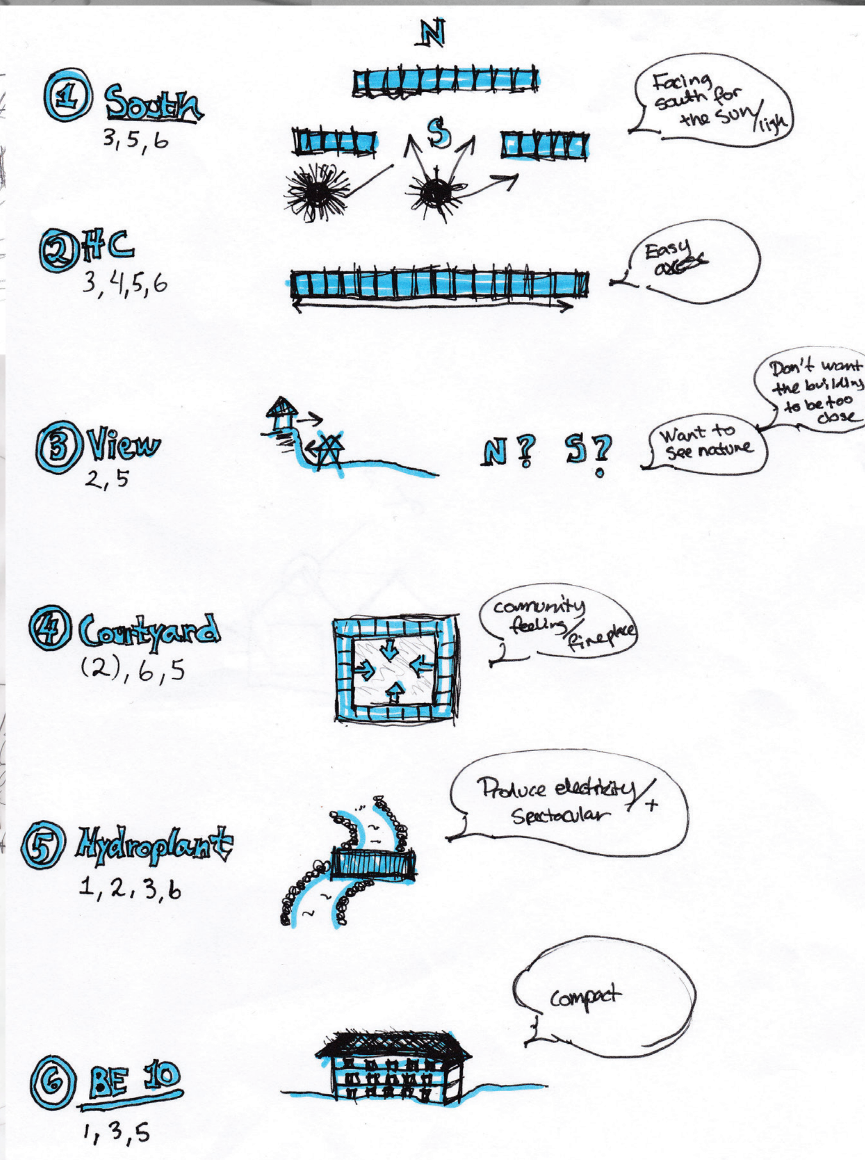
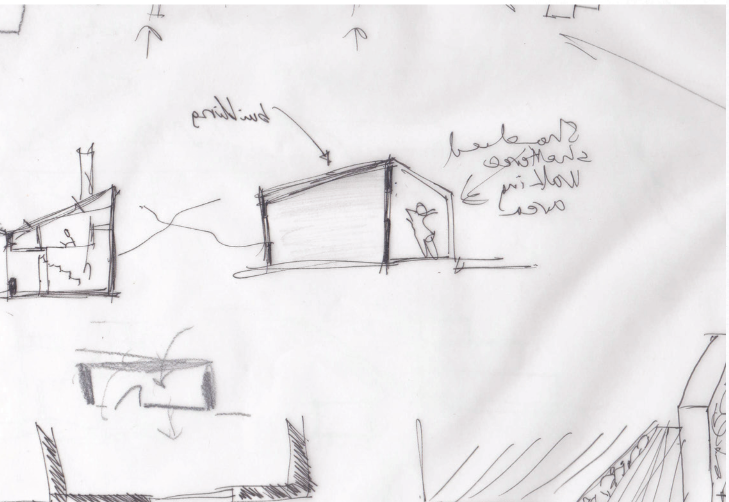
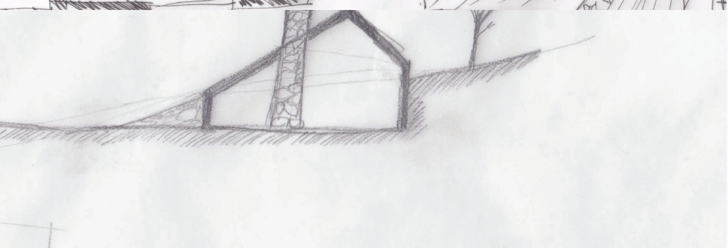
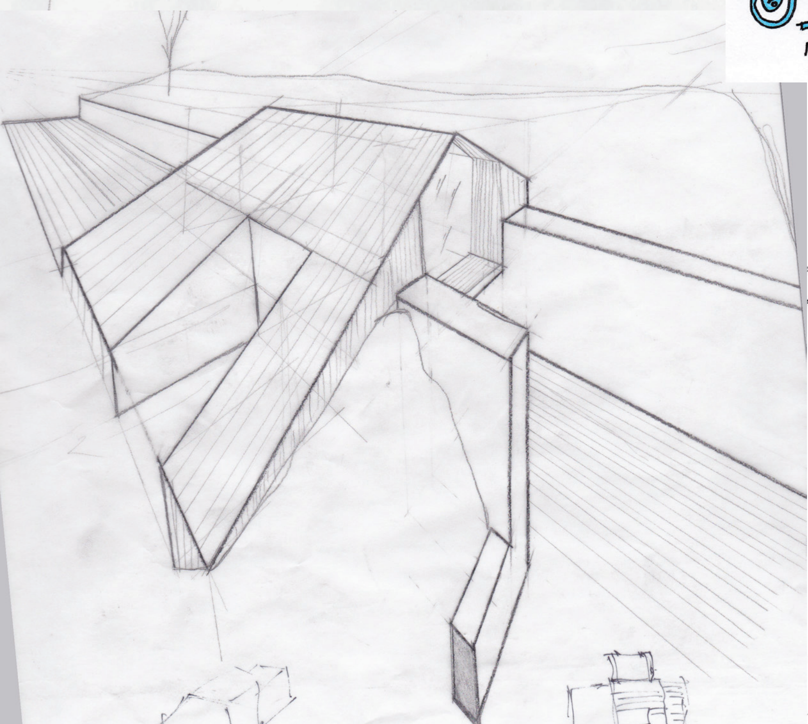
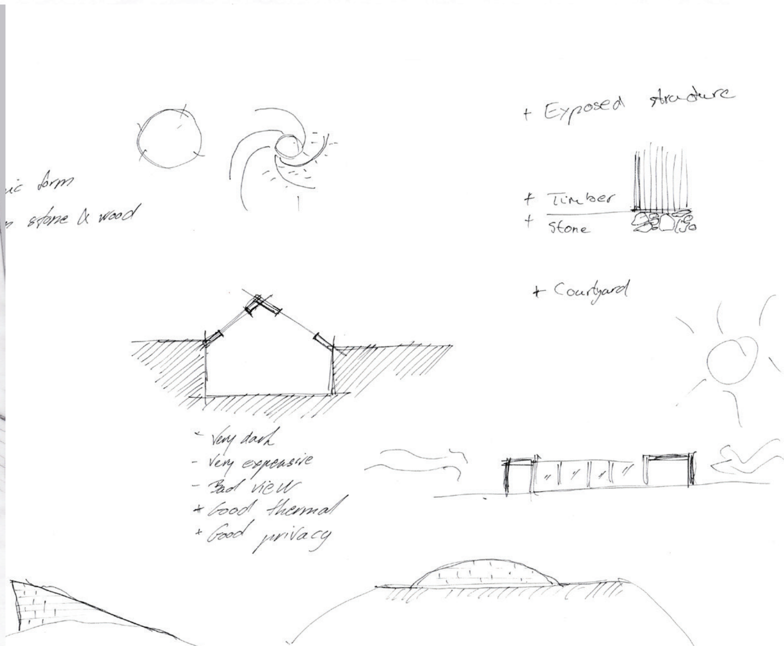
According to the climate analysis, there would not produce enough electricity on site by PV-panels

This lead to the decision of moving the project close to/ on the river, in order to produce electricity by a hydro plant



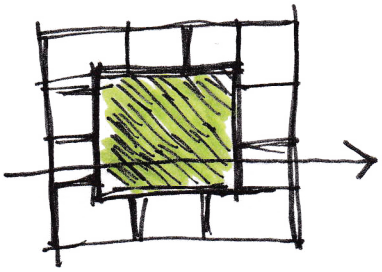
How to get from road to river

This lead to the decision of creating a ramp (1:20), in order for the site be accessible for everyone and create a journey through the site





Powerstation hotel
Elevation
S
N

N
1 South
3,5,6
S
Facing south for the sun/ligh
2 HC
3,4,5,6
Easy
3 View
2,5
N? S?
Don't want the building to be too close
Want to see nature
4 Courtyard
(2),6,5
community feeling/fireplace
5 Hydroplant
1,2,3,6
Produce electricity/ Spectacular +
6 BE 10
1,3,5
compact




+ Exposed structure
+ Timber
+ Stone
+ Courtyard
- Very dark
- Very expensive
- Bad view
+ Good thermal
+ Good privacy

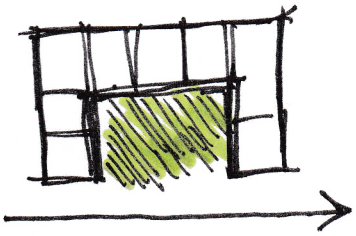
Community and path

1



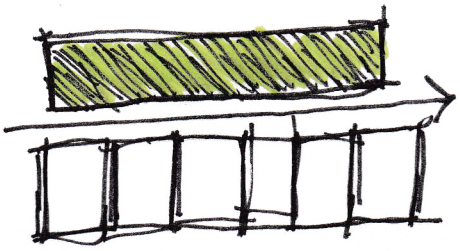
This layout would create too much shadow for each other, and would not be good in terms of sustainability

2



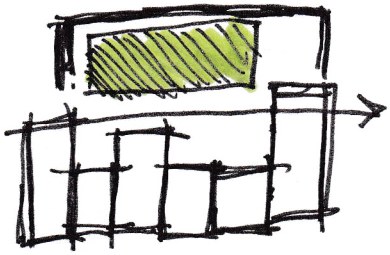
This layout would not allow enough privacy when the buildings would have direct view towards each other

3

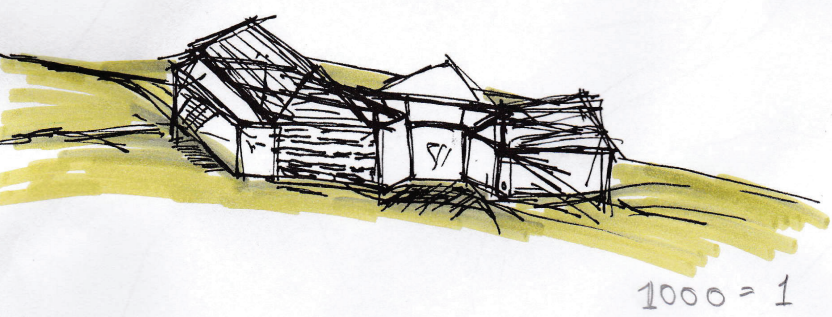


By moving the square and path to the back, the issue of privacy will be solved. However, this layout would work as a wind tunnel, and there would be too much wind on the backside

4



By creating a retaining wall behind the building and push the buildings in the landscape would solve all the above-mentioned problems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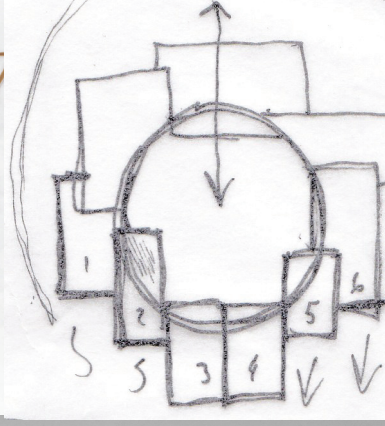
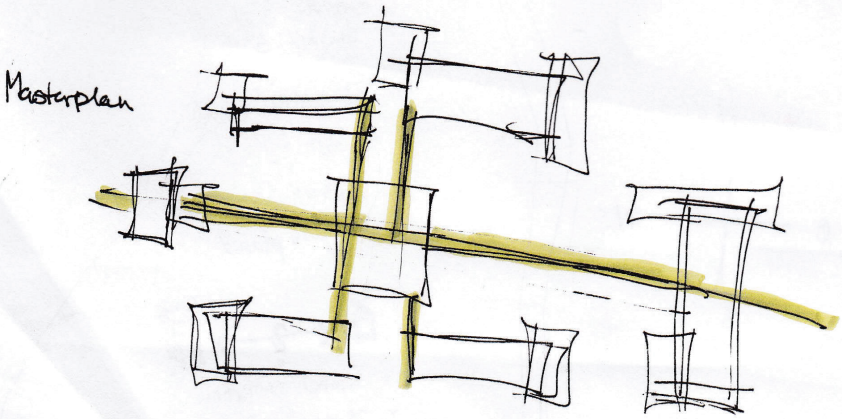
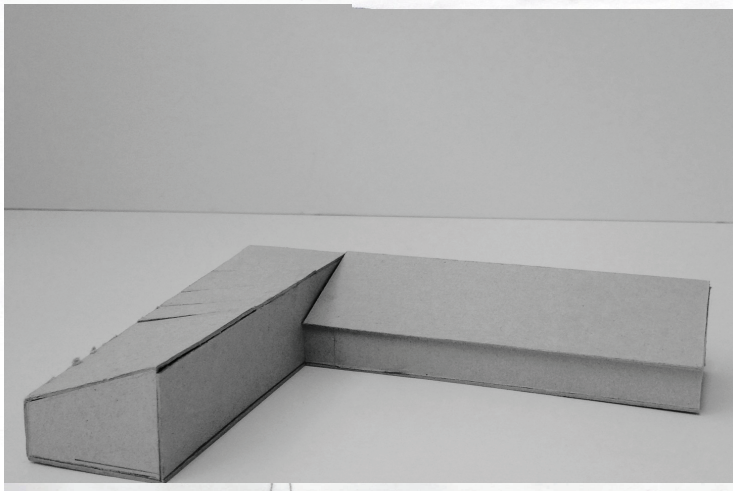
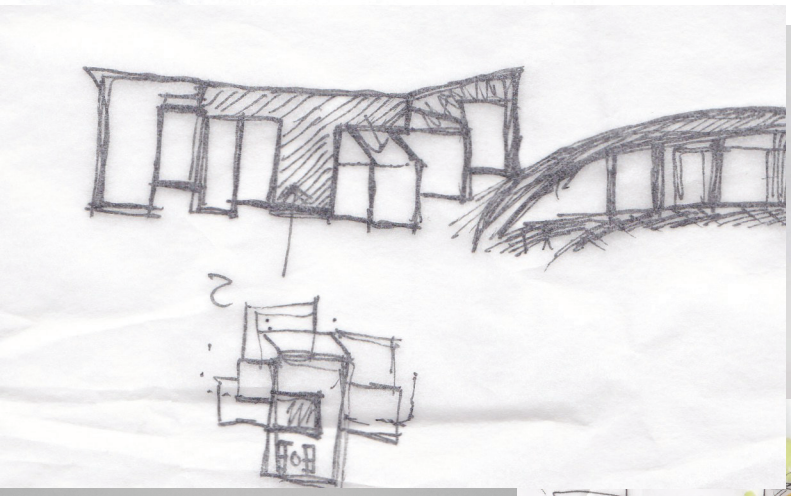
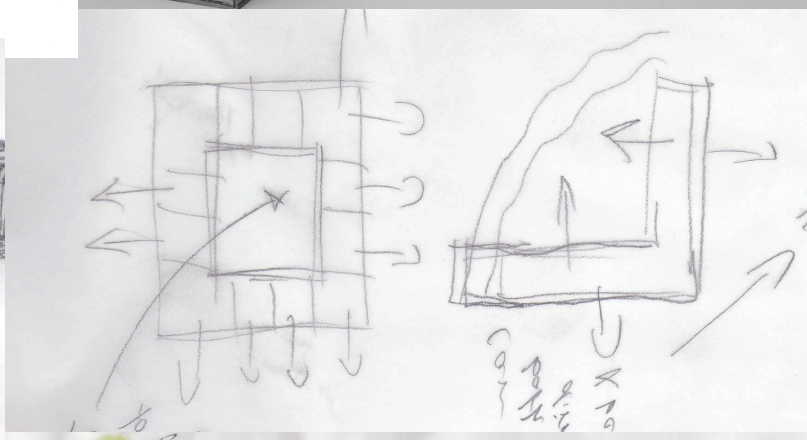
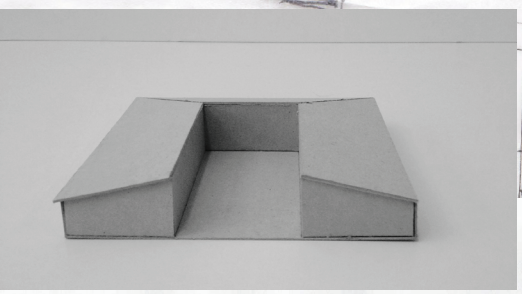


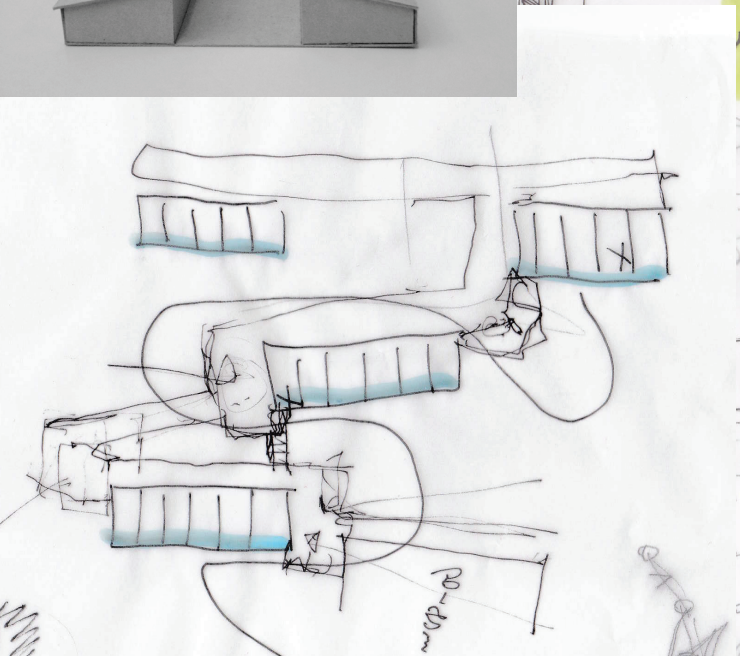

Masterplan









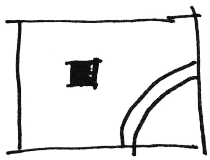


Master plan Development

The initial approach was to place the building on the upper side of the road. However, then there would be problems with creating onsite electricity by PV- panels. This lead to moving the project to the river, and produce electricity from the water, by a hydro plant. If the building were only located by the river, it would be difficult to get optimal conditions for sun and view.

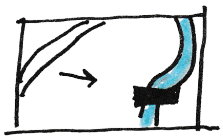
The next step was to move the building within the range of the road to river, and connecting them by a path. One of the cloisters are located close to road, and all these buildings are universally design for people with disabilities.

1



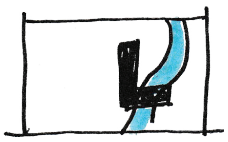
Initial proposal for project on the upper side of the road

2



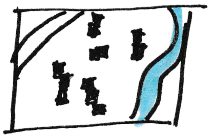
Project moved to river to produce energy by a hydroplant

3



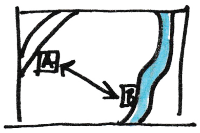
One volume for “rooms” and one volume for “main building” situated at the river

4



Spreading out building to get better condition for sun and view

5



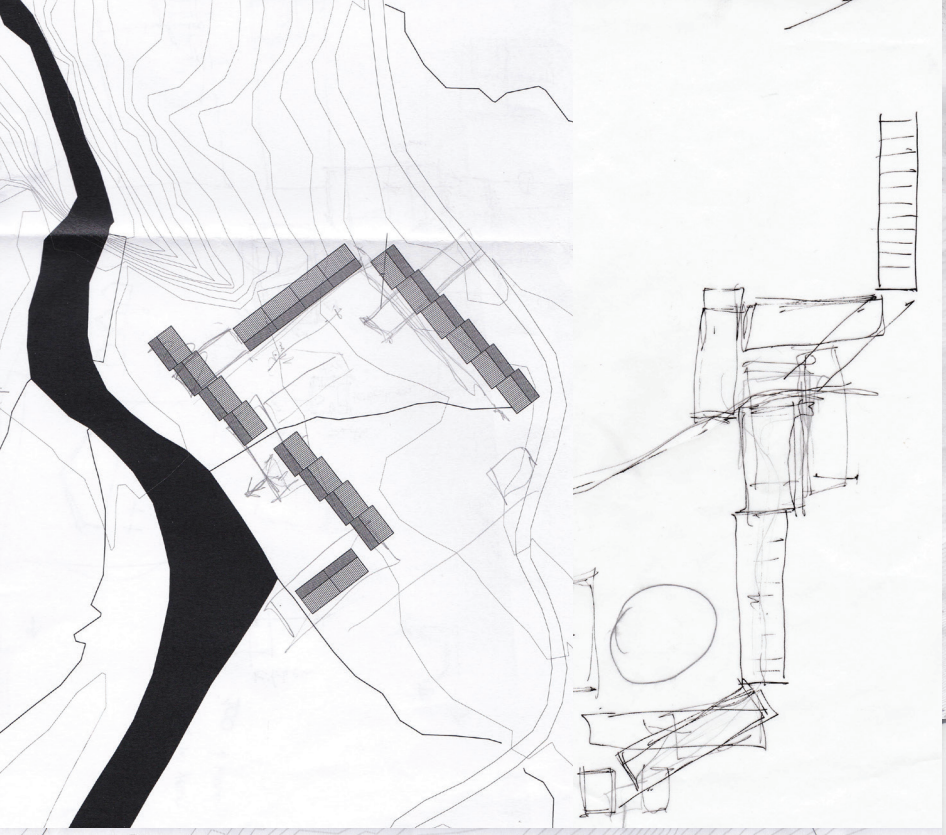
Established a division of A) reception building at the road, B) main building at the river, and rooms/ cabins spread out within this range

6

Connecting the project by a path (1:20 slope, ca.20m drop in terrain)

7

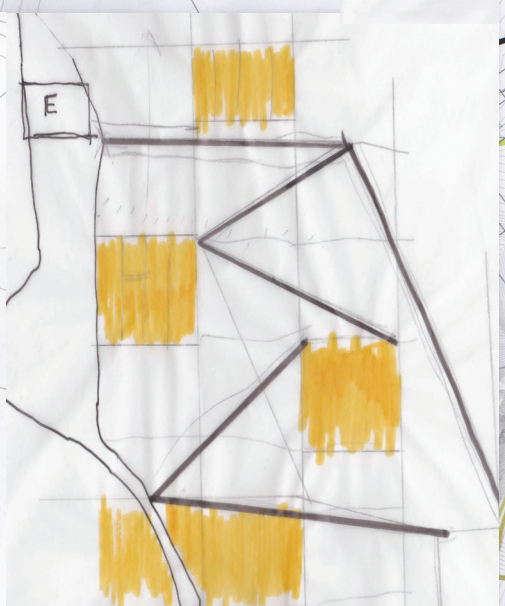
Reception at the road, main building at the river,4 cloisters of cabins, one next to the road, allowing access for people with disabilities

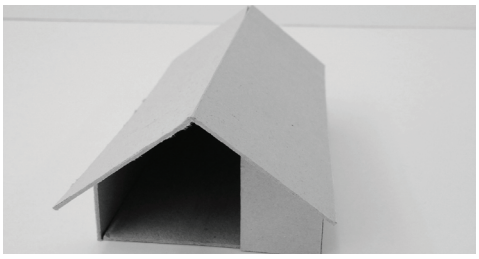
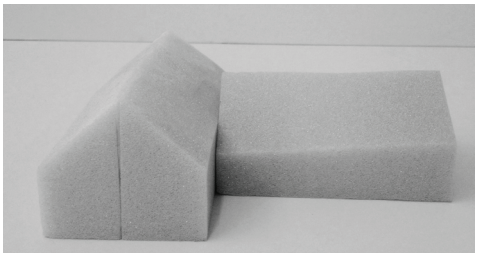
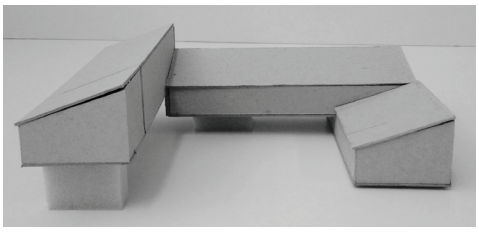
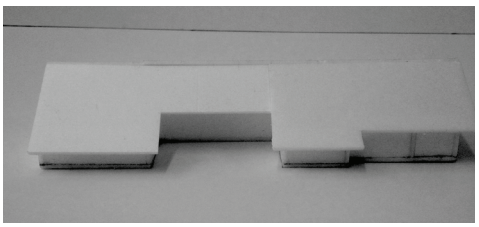
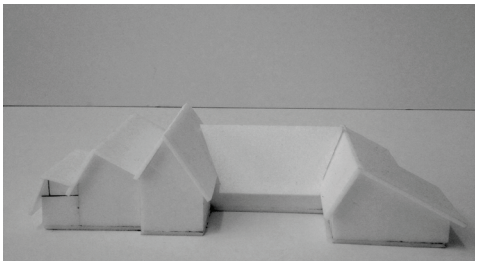
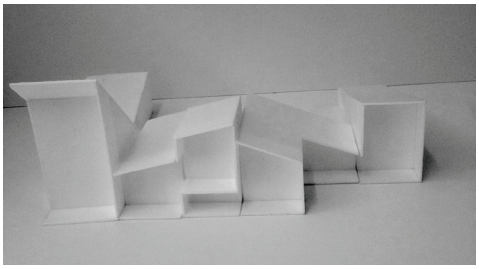
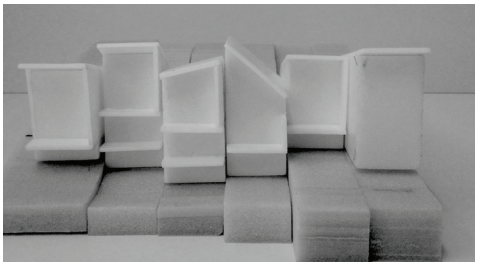



1
2
3
4

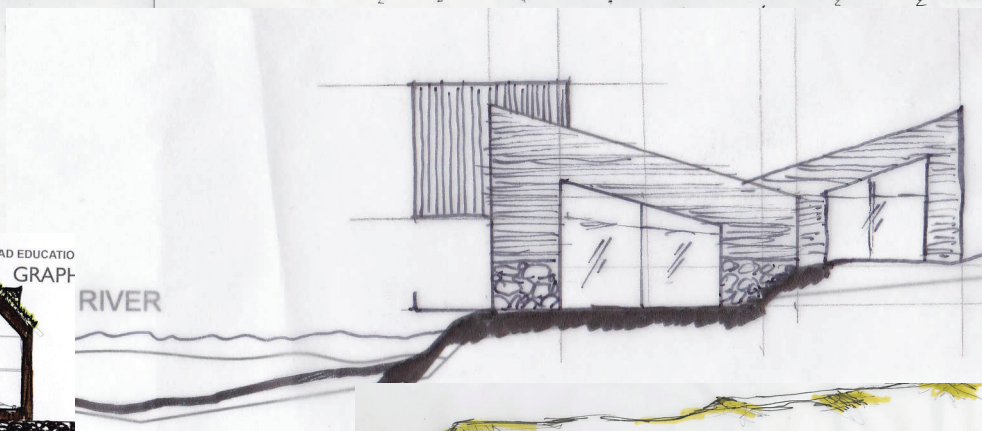

Reception
Staff admin
Outdoor seating
Kitchen
Workshop


Troops
Mast solar power

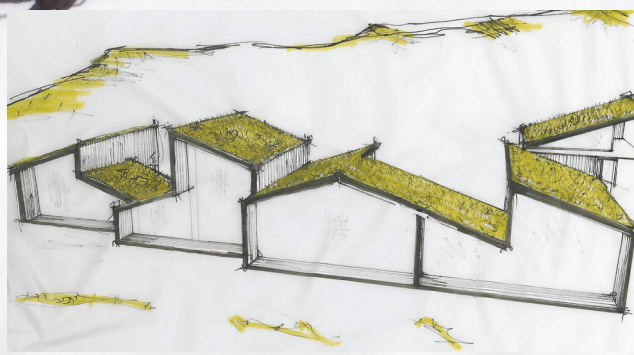

E

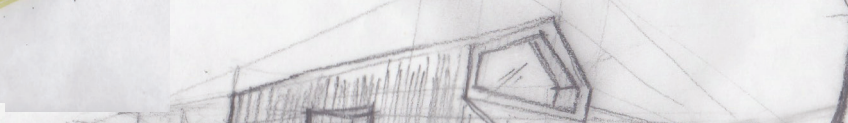
TEST:	TOOL:		OUTPUT:
Form	Be10		-Need a more compact building enalope
Building envelope	Be10 BSim		-Optimal to be south facing
Orientation + overhang	Be10 BSim		-Do not need to be directly facing towards south, in order to benefit from solar heating, but within the range of +-30° -Need overhang to protect from overheating
Volume	Be10		-Need more compact buildings with more stories
Density	Be10		-When the buildings share the same building envelope, there is less transmission loss, and heat loss. In this case it was up to 5-6 buildings. With more buildings it would not really make a difference
Microclimate	Vasari		-Protect from wind -Use the landscape for protection
Elevations	BSim		-It is possible to have lagre windows towards the south

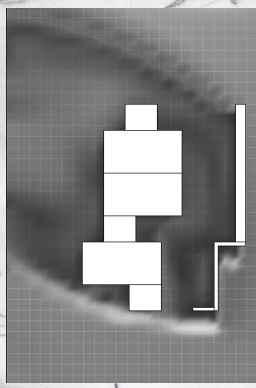

timber
building with
green roof

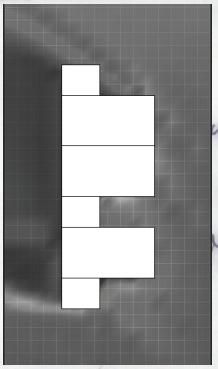

RIVER

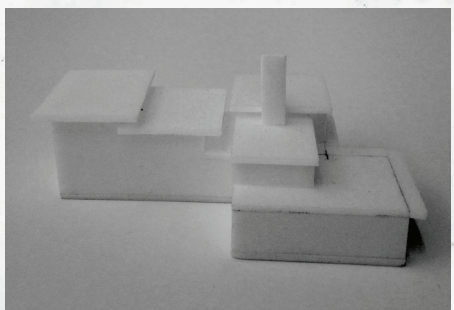

ARCHICAD EDUCATIO
GRAPH



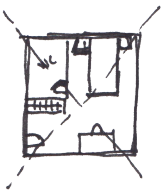




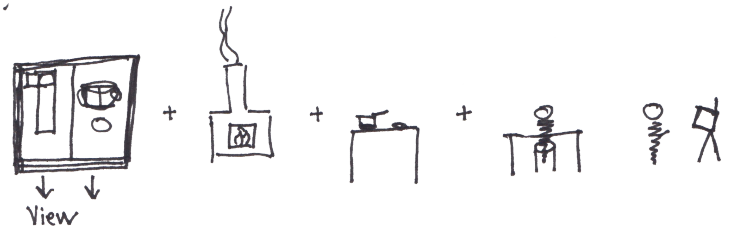




Development of plan

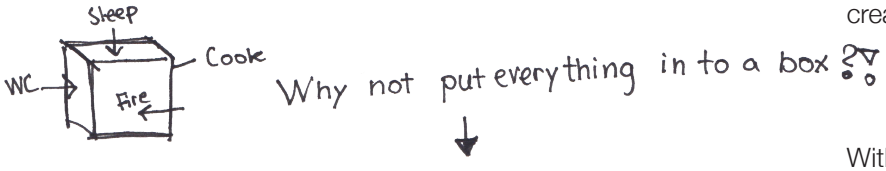


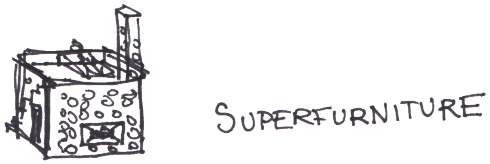
The first idea was to design something that would offer more than a standard hotel room, it should be suitable for longer stays.



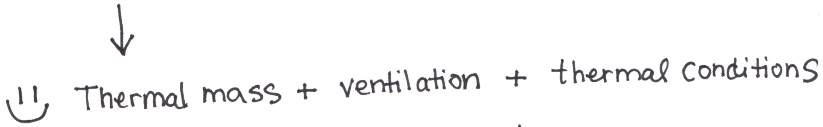
On focal point was the view, so that the guest could enjoy the view from the living area as well as from the bed

The features we wanted to implement was: A fireplace, a kitchen, a place to study or work creative

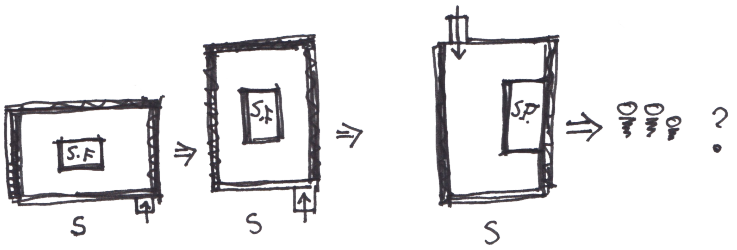




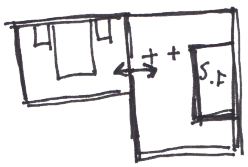
With the superfurniture we could benefit from having an open plan, and not a building separated by walls, but offset the rooms vertically. This created better condition for the indoor environment



The superfurniture contains all the necessary functions; inside is the bathroom, on the south wall is the fire place, on the north wall is the kitchen, and on top is the bed and a desk



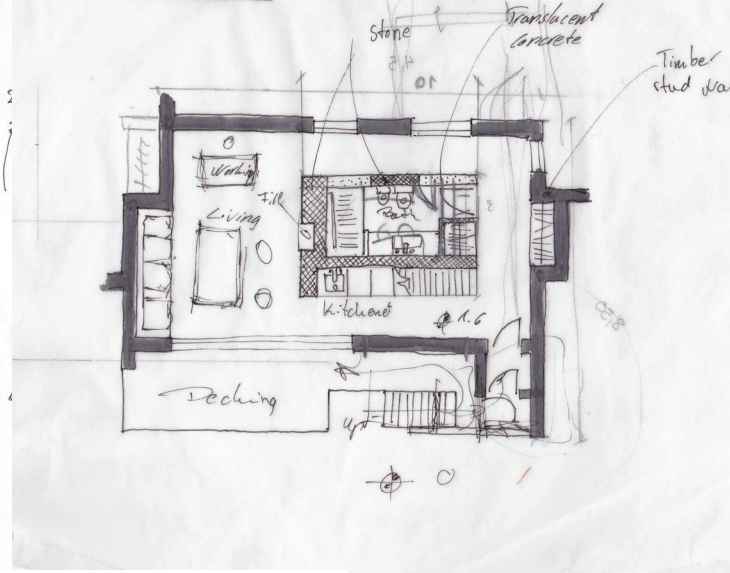
According to BE10 it would be better to turn the plan 90° so the shorter side was facing towards the south

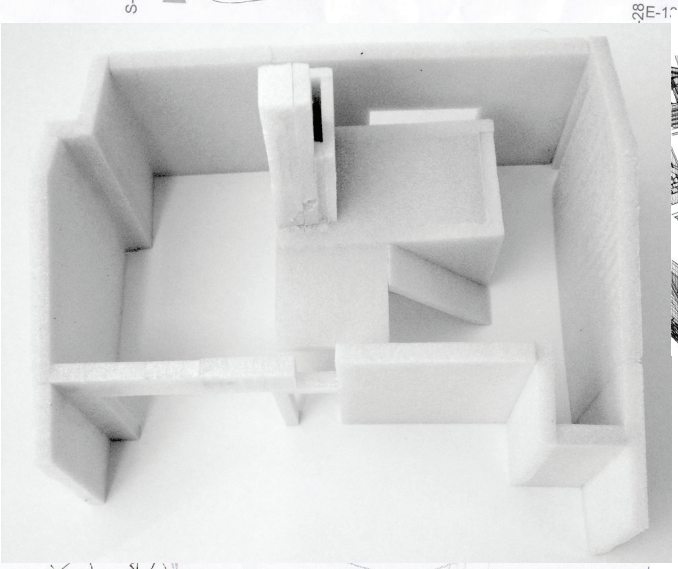


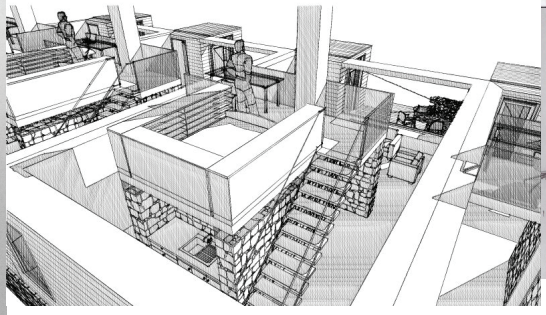
Also moving the entrance to the back was better in terms of privacy, view, and heat gain.

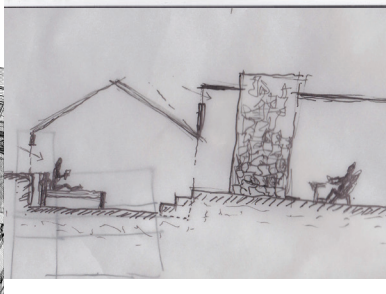
The plan of the building with the superfurniture can host 2-4 persons, so there was added an extra building with a bedroom, and study space. This functions as one unit, with a door connecting the two.

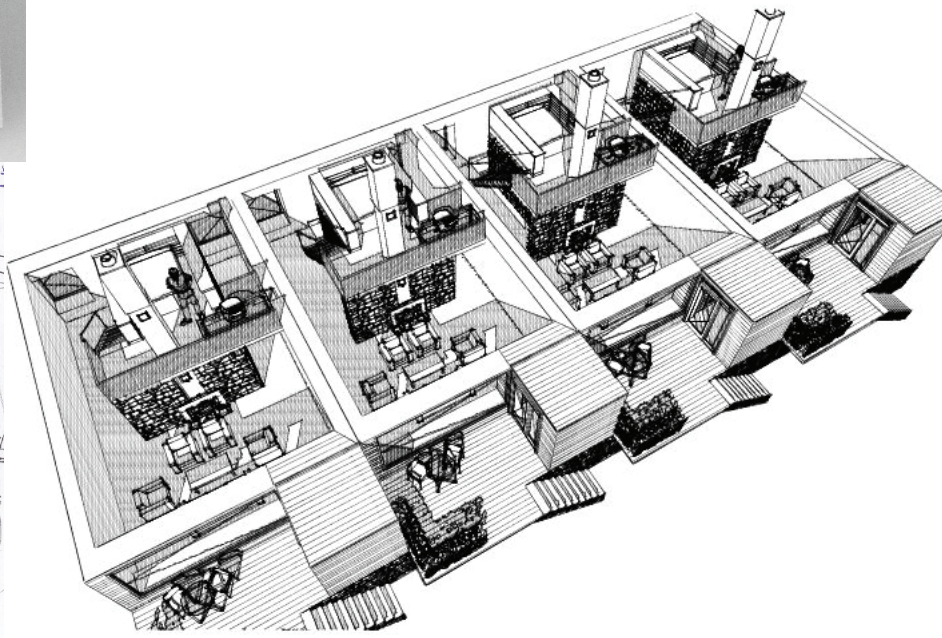

29,096 m²
63,013 m²
1.1
3.7
1.1

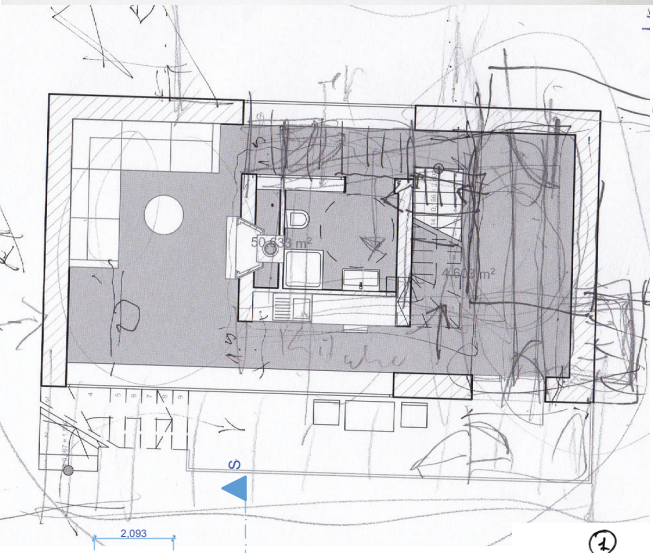

Stone
Translucent concrete
Timber stud wa
Living
Kitchen
Decking

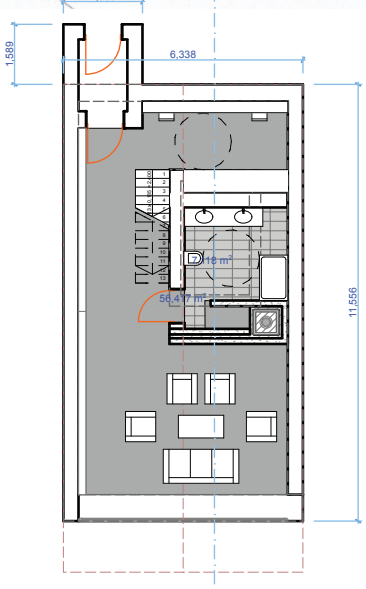


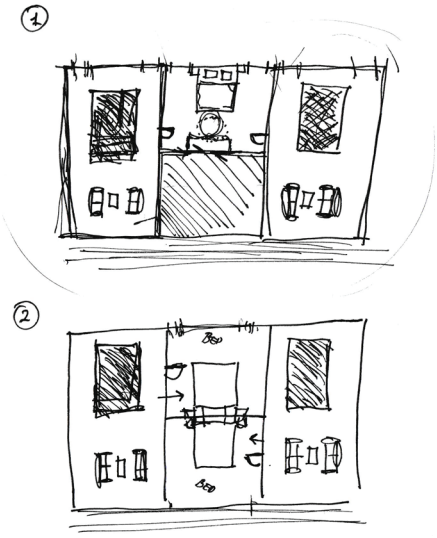


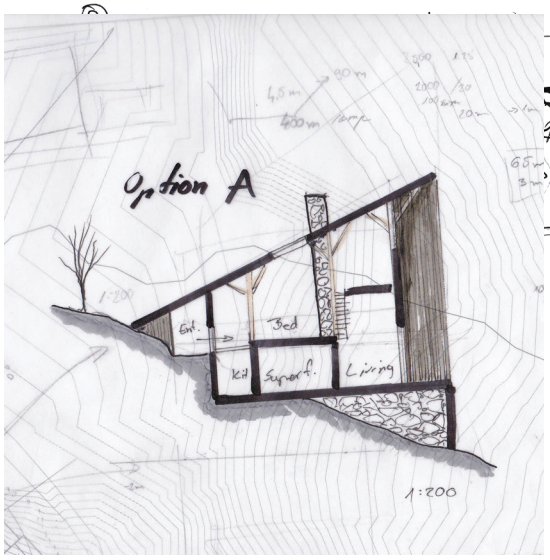




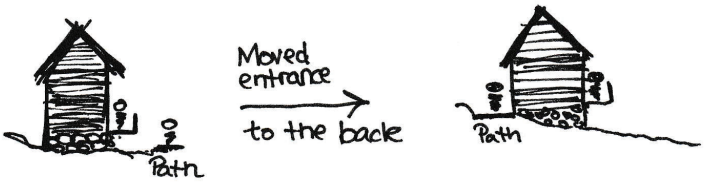

50,033 m²
46,603 m²
2,093


1,589
6,338
11,556
18 m²
56,417 m²

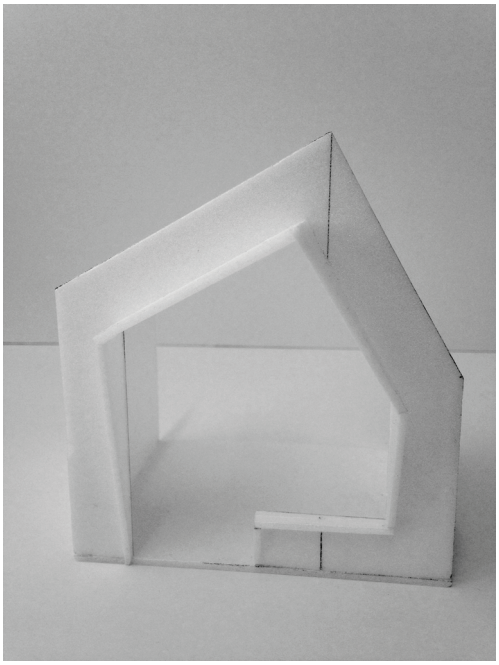

1
2

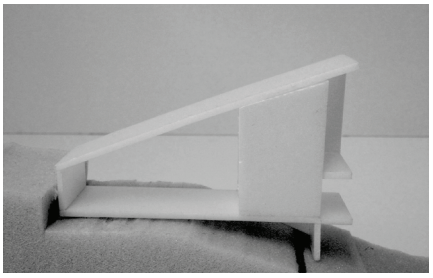

Option A
Ent.
Bed
Kit
Superf.
Living
1:200

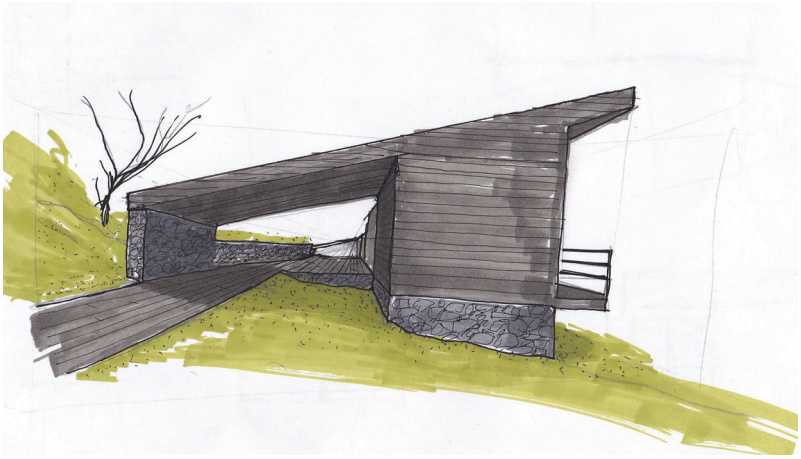
Privacy



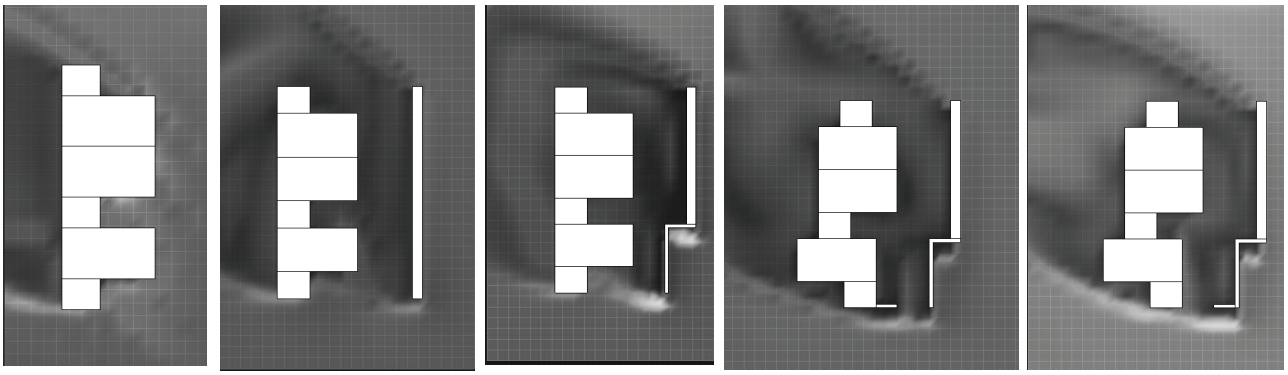
By sketching, modeling and with BSim and Be10 we tested optimal shading and glazing of windows.
In terms of privacy and aesthetical reasons.







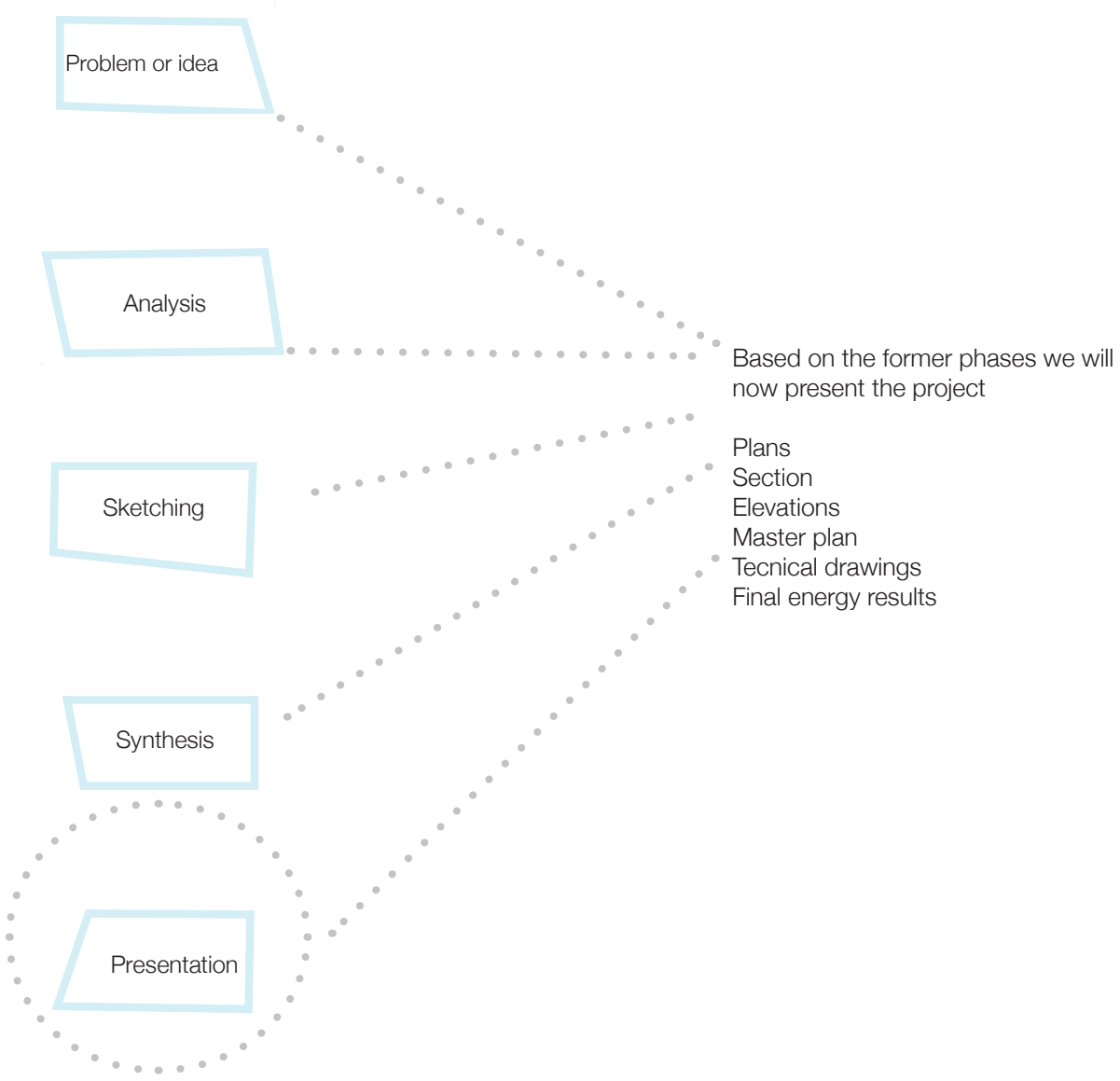
Wind analysis



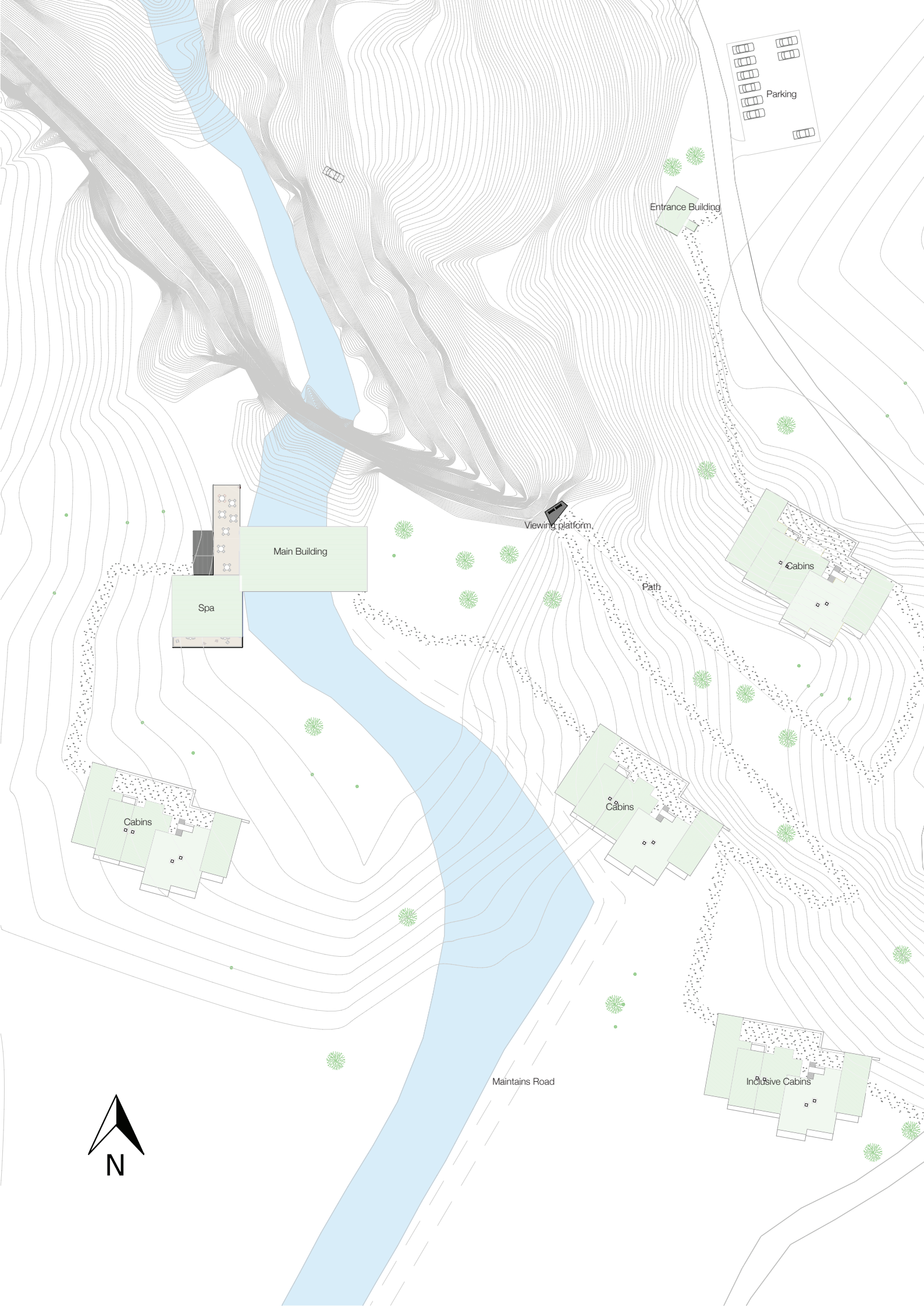
In Vasari we tested the microclimate, and this gave us findings that indicated that how to design the court behind the buildings.

The daylight factor

With Velux we tested different window options, showing us what solutions would give us a good daylight factor. Simultaneously we used BSim to find out if the windows were optimal, and how much glazed area we could have.


Problem or idea
Analysis
Sketching
Synthesis
Presentation
Based on the former phases we will now present the project
Plans
Section
Elevations
Master plan
Tecnical drawings
Final energy results

Presentation


Parking
Entrance Building
Viewing platform
Main Building
Spa
Cabins
Path
Cabins
Cabins
Maintains Road
Inclusive Cabins
N

What to expect at Åse Mountain Hotel

Master plan 1:1000

At Åse Mountain Hotel you can treat yourself with a wonderful getaway. This is the place to come when you want to retreat from a busy life and disconnect. It is time to connect with nature, yourself and others.

The hotel is located in a beautiful area offering a spectacular view of the breathtaking landscape. Every room has a good view to frame this amazing nature.

This hotel emphasizes on the fact of being disconnected. It is disconnected in terms of location, energy and standard features. There is no television or internet in the rooms. You are left to your self and your own thoughts. However, there are a great variety of things to do in the area, so you wont get bored. Perhaps this is the place you go to finish a book, or a project you are working on, or to reconnect with friends, family or colleague.

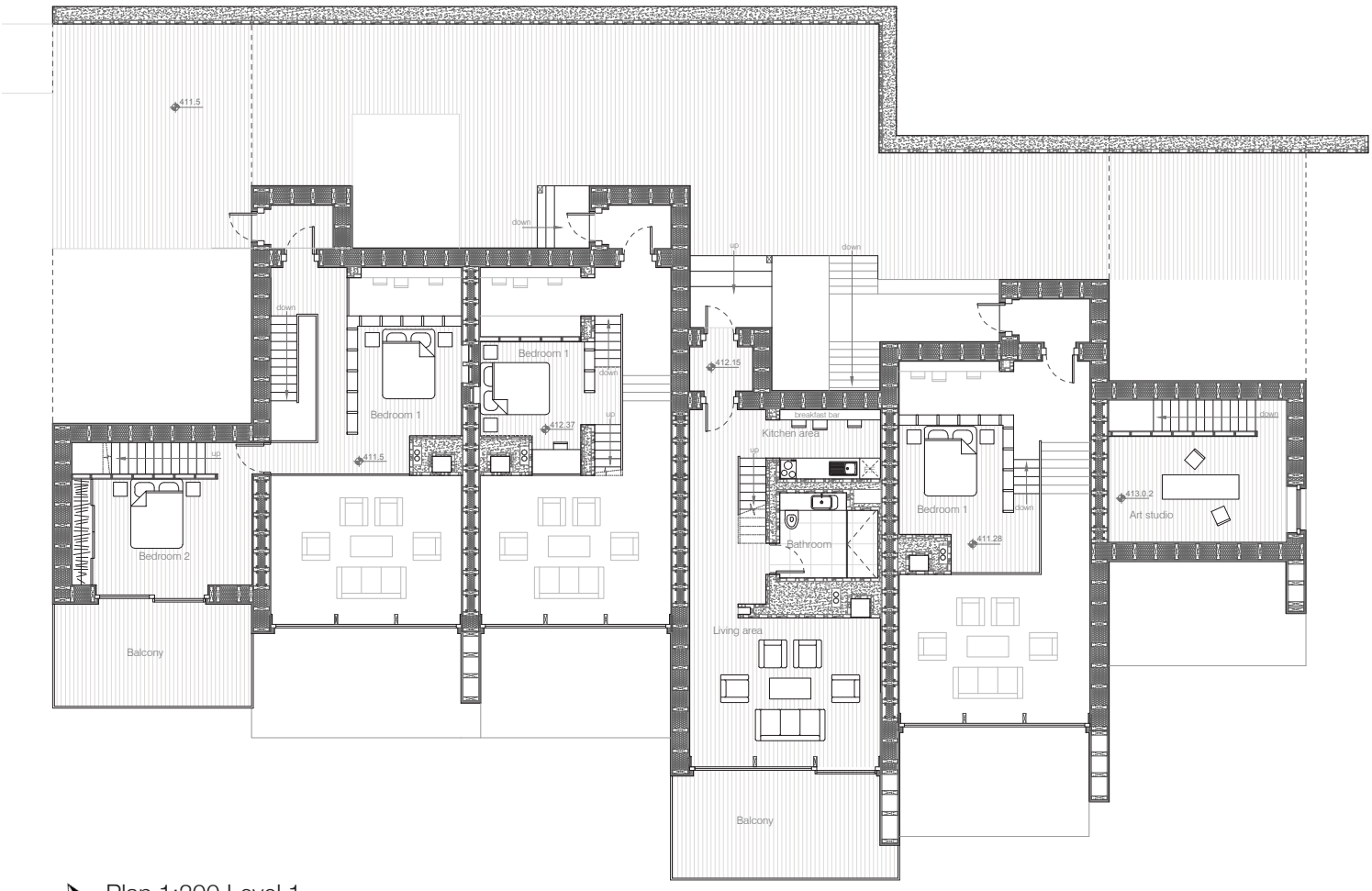
If you are in mood for deep relaxation you can also visit the hotels spa department or take a walk to one of the viewpoints. Welcome!

Plans Cabins

The cabins are the interpretation of a hotel room. Being designed as a private cabins, optimal for longer stays. On the site there are 4 cloisters of cabins, and each cabin is slightly different. They are all situated to fit on the accurate location in the terrain and are altered according to the path.

As you enter the cabins from the north side on the path, you have the kitchen and eating area. The superfurniture is separating the living room from the kitchen. Inside the superfurniture is the bathroom, and on top of it is the bed. The living room uses one of the walls of the superfurniture as the fireplace.

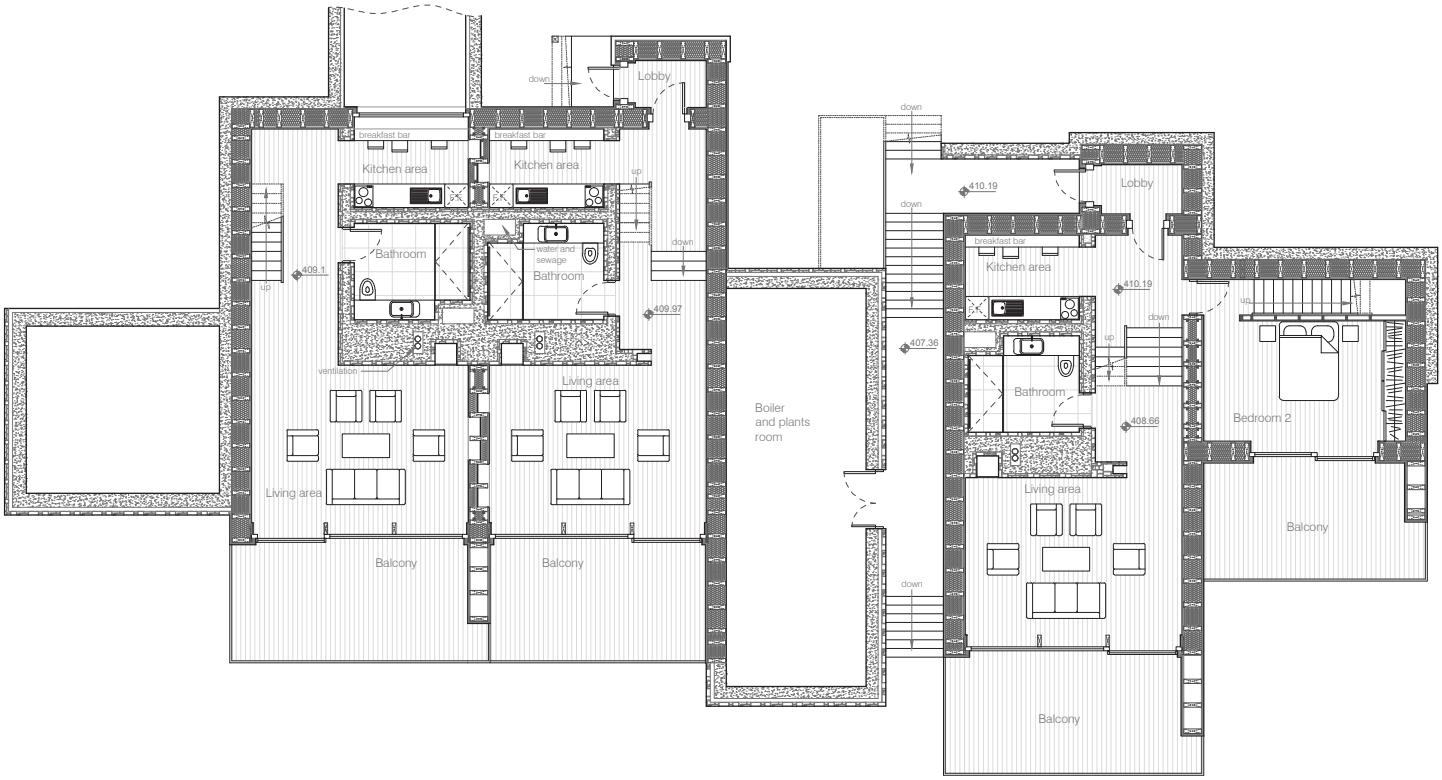
The main experience of the building is the view, and you are able to experience it all times of the day and all times of the year. Due to the large overhang, the south facing balconies are sheltered, and are ideal for having a barbeque in the summer, or even sit protected and watch a snow storm.



Plan 1:200 Level 1

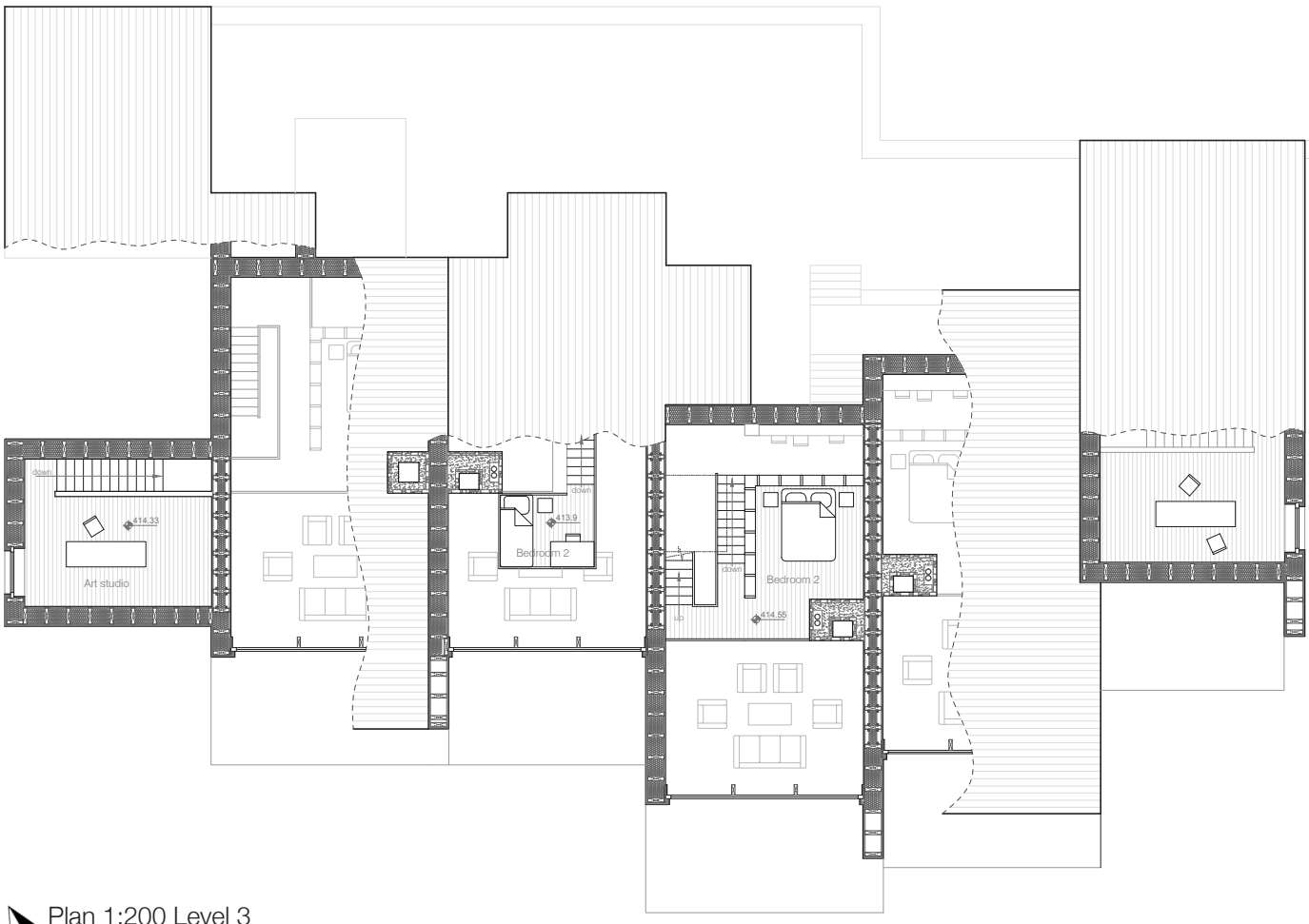
From the outside it looks like 6 different building volumes, but it is 4 unites. Two of the unites have an additional building with an extra bed, if you are more people, and a extra workspace or an art studio. All of the building have a place to study, some of them are located on a story above the bed.

<<The following drawings are the cabins located at the top of the site, closes to the entrance building>>



Plan 1:200 Level 2

Plans Cabins



Plan 1:200 Level 3

Elevations Cabins

Elevation 1:200 SOUTH

Elevations Cabins

Elevation 1:200 NORTH

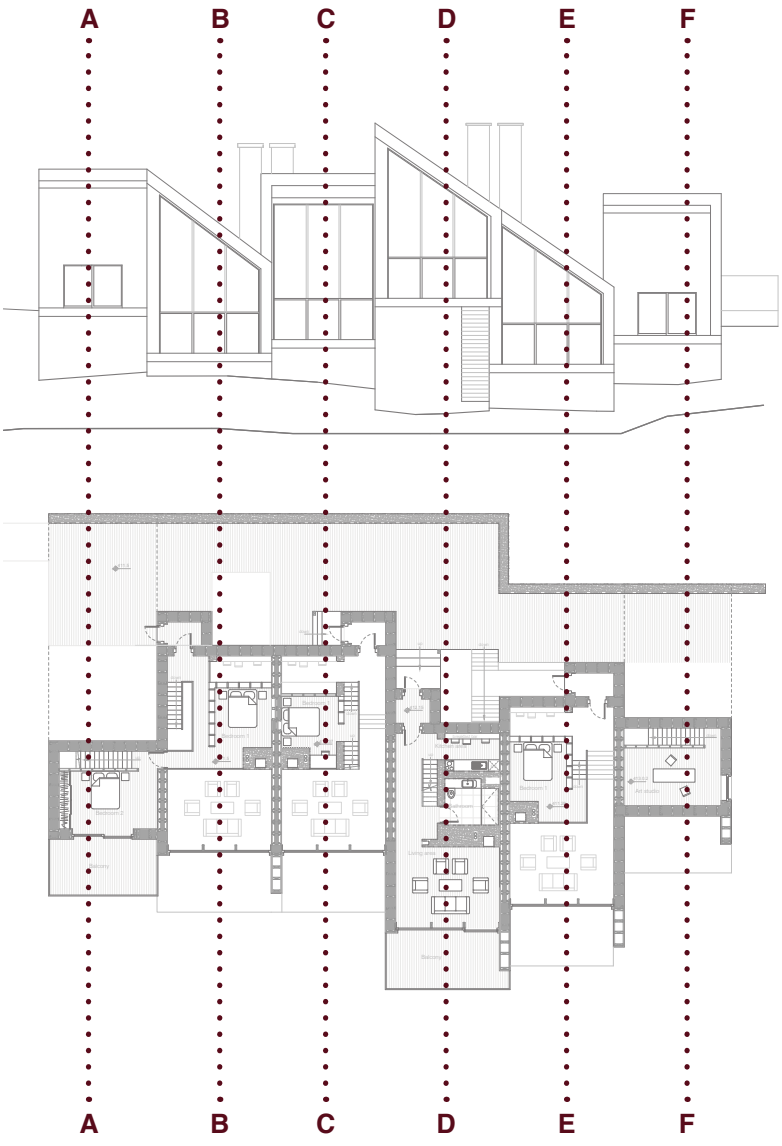
Elevations Cabins

Elevation 1:200 EAST

Elevations Cabins

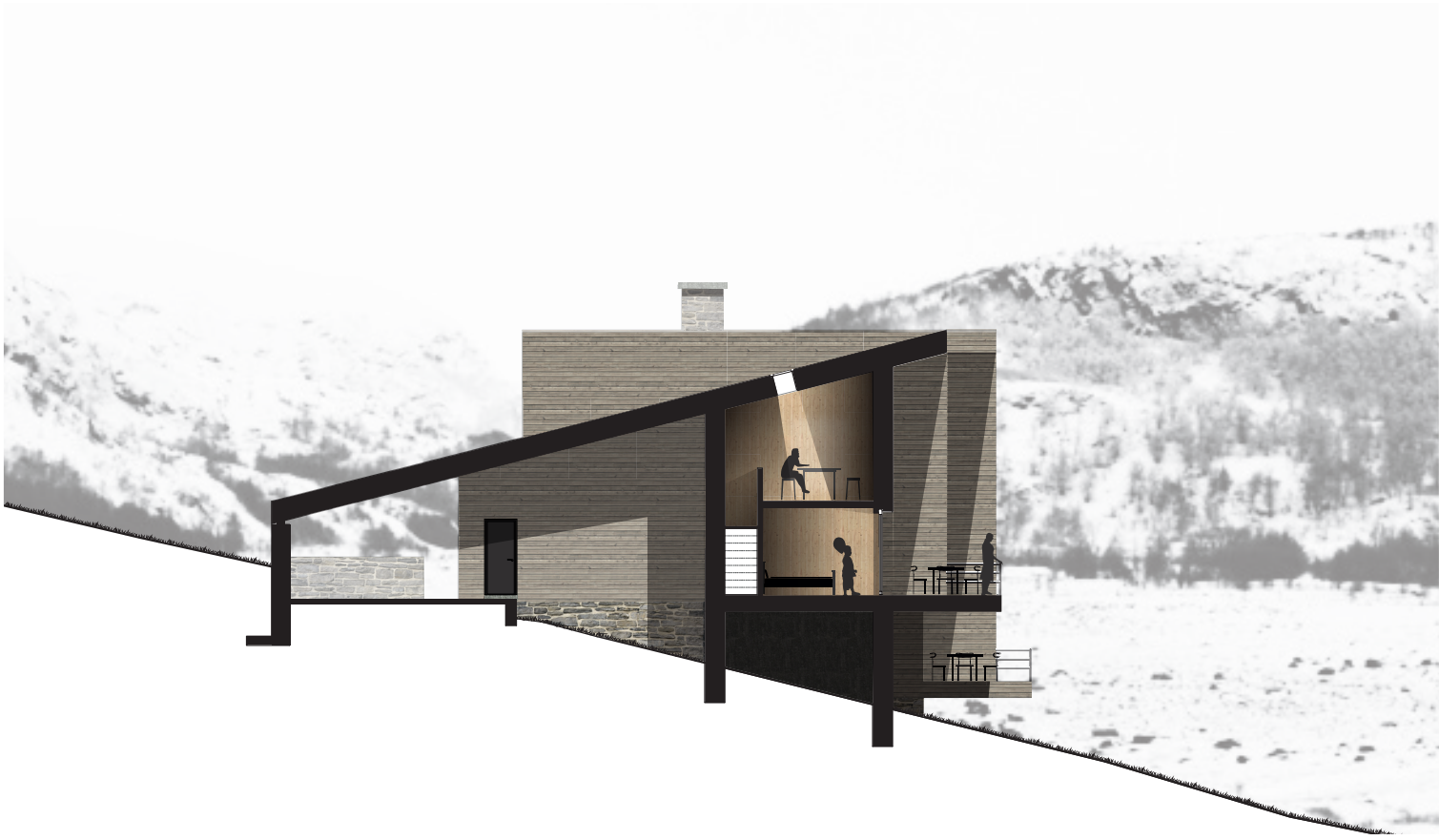
Elevation 1:200 WEST

Sections Cabins



N

Sections Cabins

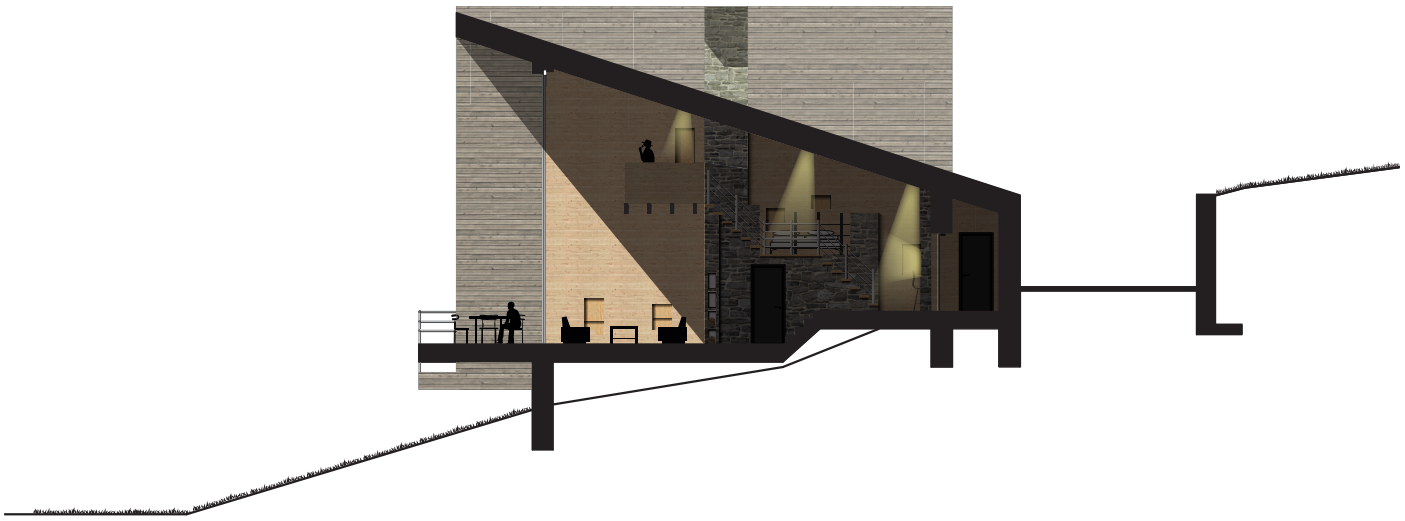


Section A-A 1:200

Sections Cabins

Section B-B 1:200

Sections Cabins

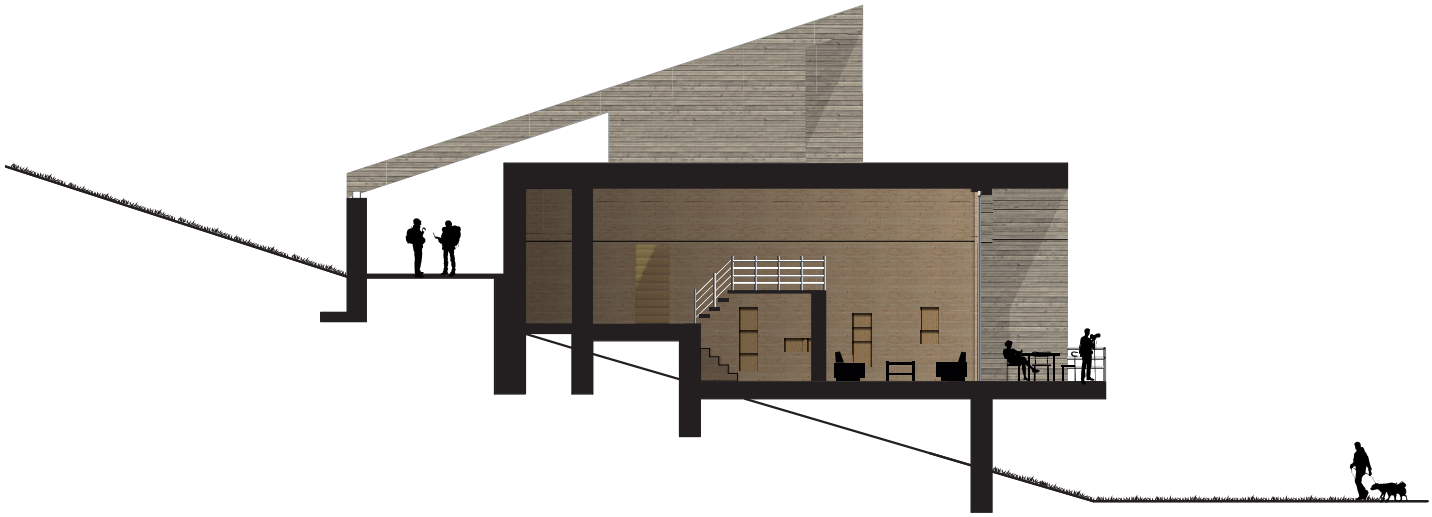


Section C-C 1:200

Sections Cabins

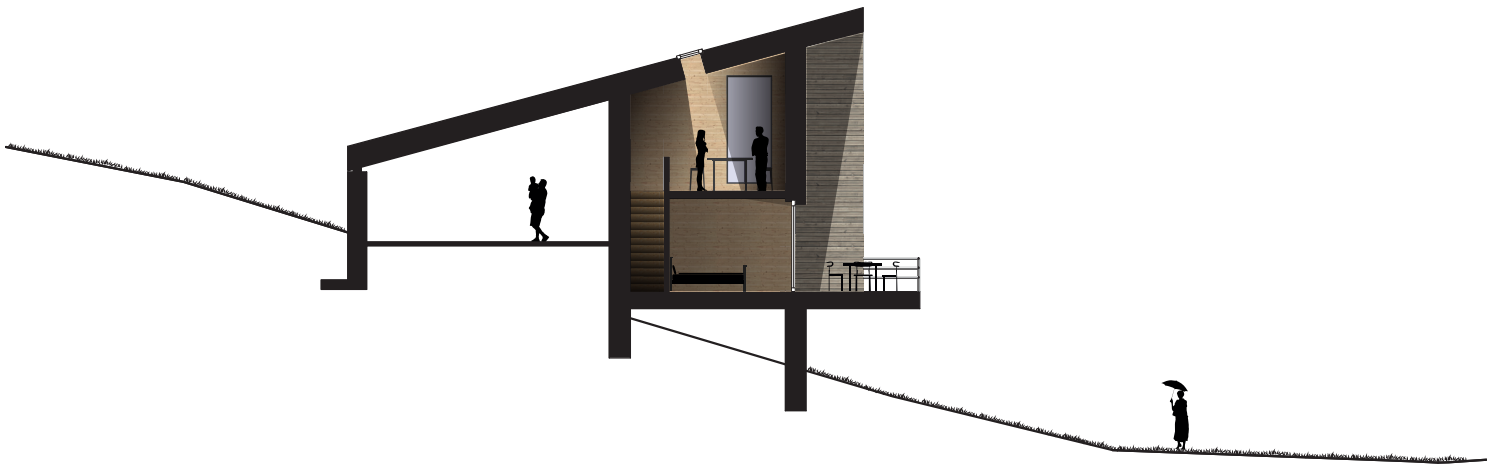
Section D-D 1:200

Sections Cabins



Section E-E1:200

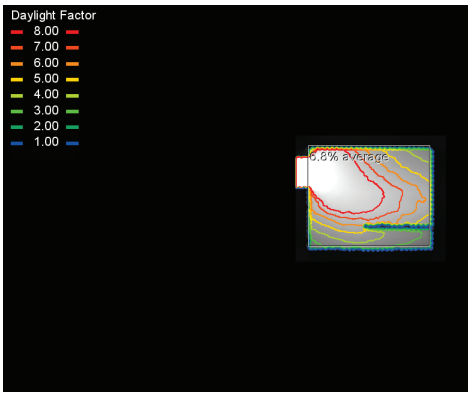
Sections Cabins



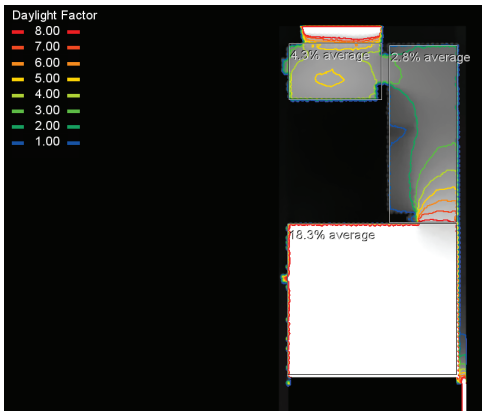
Section F-F 1:200

Daylight factor Cabins

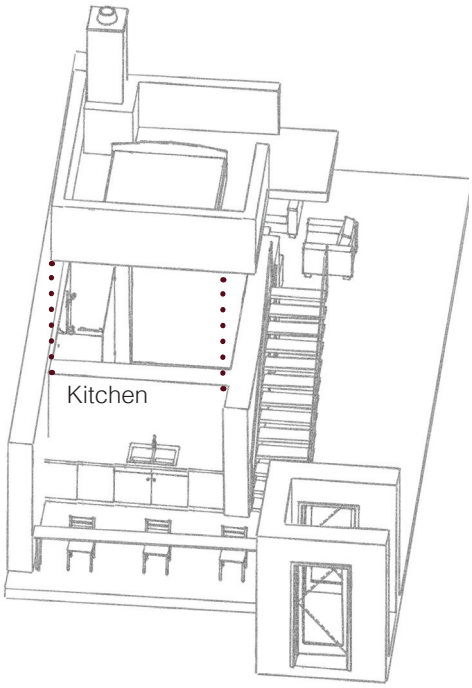
Daylight factor for studio

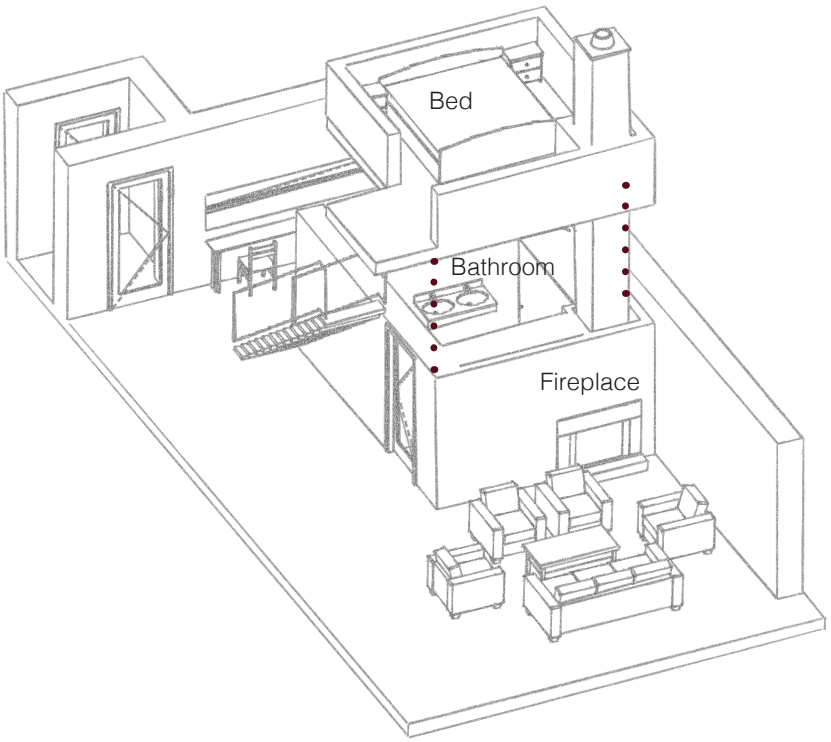


Daylight factor for cabin



Superfurniture Cabins





The superfurniture is the main feature of the buildings. It is the core of the cabin and includes all the main facilities. It is a stone structure and a fireplace. 1 side has the kitchen, inside is the bathroom, the long side has the entrance to the bathroom and a stair going up. The wall facing to the south is the fireplace and the chimney. On top of the superfurniture is the bed.

Some of the cabins also have an additional level up from the bed area, where there is a study.

Due to the massive stone construction, the superfurniture is also thermal mass. During daytime it stores heat, and at night this stored heat is released.

Materials

Spruce

Gneiss

Sheep wool

Pine

Grass

All of the materials are local from Hjelmeland and the insulation is from site. By this we use very little embodied energy.

Materials exterior

-Kebony Pine cladding, being sustainable a highly durable

-Grass on the roof, traditional and environmentally friendly

-Gneiss foundation, has a great strength and can resist extreme climate and large changes in temperature

Materials interior

-Spruce cladding and floor, carbon and chemical free.

-Gneiss superfurniture

Insolation

-Sheep wool, Non-toxic a sustainable source from the local farm

Main building

The main building is the building for social activities. It is where people come together. The building is based on the same design as the cabins, having a superfurniture with functions inside it as well as on top of it.

The entrance is on the east side and the first thing you see when you enter is the eating area, with the long tables. This is where the guest sits together and has their meals. The principle of this area is community and to encourage the social gatherings and interactions between the guests. People can share their knowledge, experiences or have a good laugh together. The cabins are deliberately designed with limited cocking facilities, in order to encourage the guests to cook together in the common kitchen. Next to the common kitchen is the lounge, this is a more private space in the sense that you are inside the superfurniture. The lounge has a fireplace that is also sheared with the kitchen, and while sitting there you have a grate view of the landcape.

At the west end of the building is the bar, which also can be served from the outside. From the bar you have direct access to the balcony, and at summer time you can get a unique view of the waterfall, being situated on to of the river. This is a good place to have a drink, read a book or take photos.

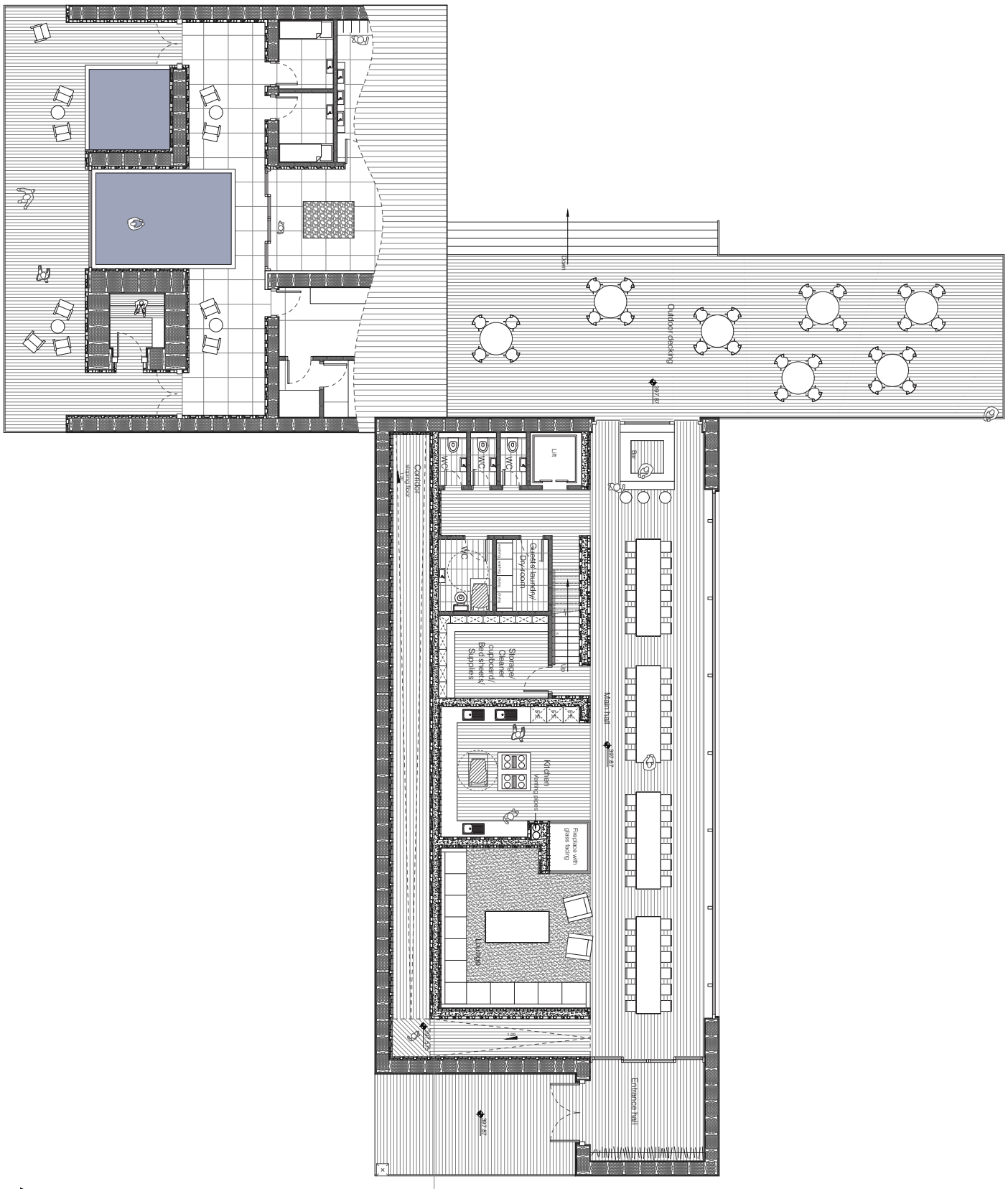
Basic facilities such as toilets, storage and laundry are also located inside the superfurniture. If you are visiting the hotel for business purposes, there is a conference room on the upper level of the superfurniture. One the same level there is also a staff room, where the employees have their office.

One of the special facilities that the hotel offers is the luxurious and rural spa department. To get to the spa you enter through a long corridor. The narrow corridor is a mental and physical transmission.

The spa is located 1.6 meter underneath the ground floor, you are actually crossing the river as you enter. The spa has a cave like atmosphere. It is designed with the intention of offering full relaxation for the guests. Inside is a warm pool facing towards the only window in the room, framing the landscape. The spa has one indoor and one outdoor area. At the outside area you can sit in a traditional Scandinavian sauna, and if it gets too hot there is a cold pool with fresh water from the river.

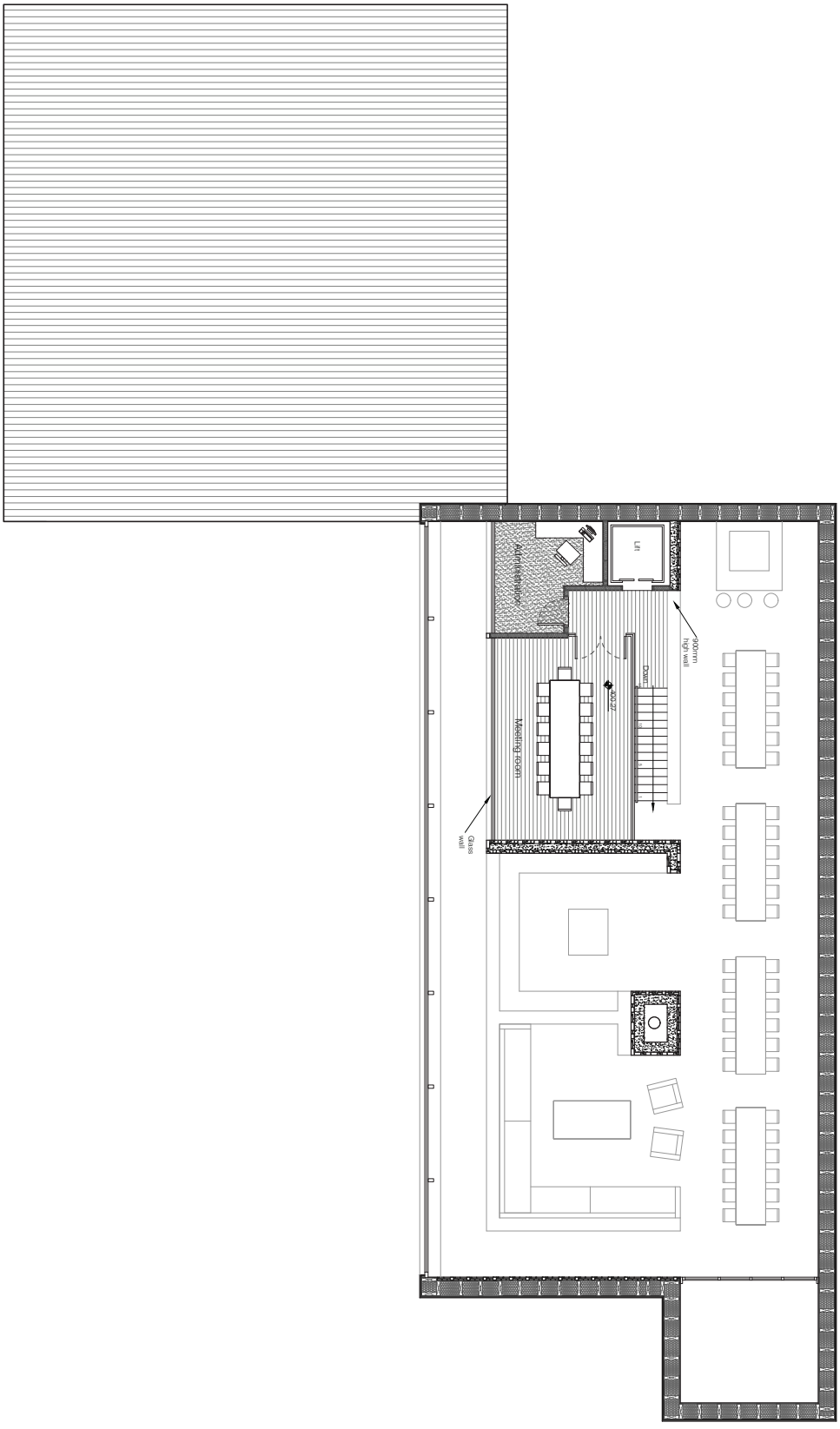
The hotel has a sustainable profile, and uses and procures only recourses from the site. The reason for the main buildings location over the river is that it produces its own electricity by a mini hydro plant system. In addition the hotel is heated from a central wood boiler, using and producing local fuel.

Plans Main Building



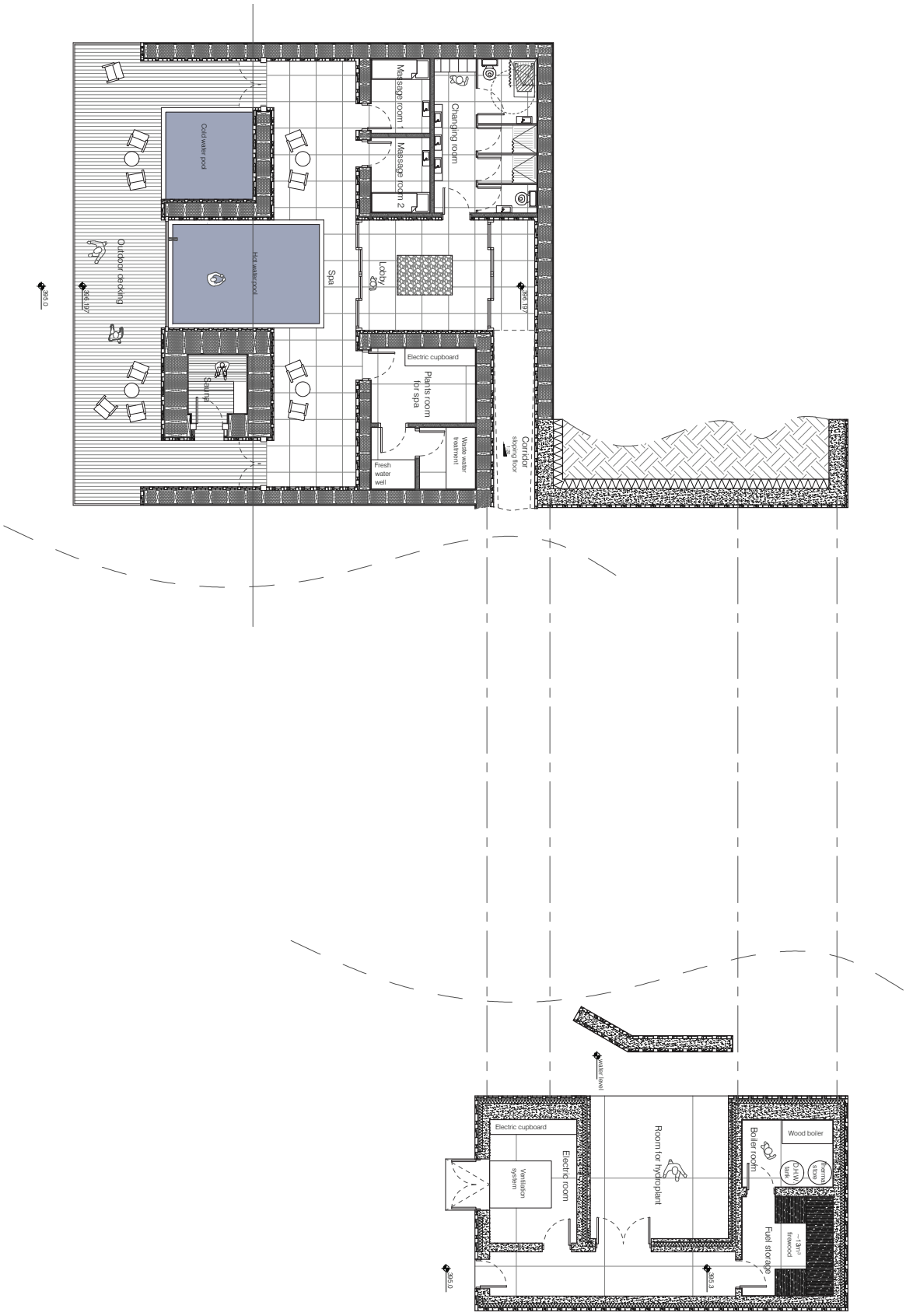
N Plan 1:200 1.Floor

Plans Main Building



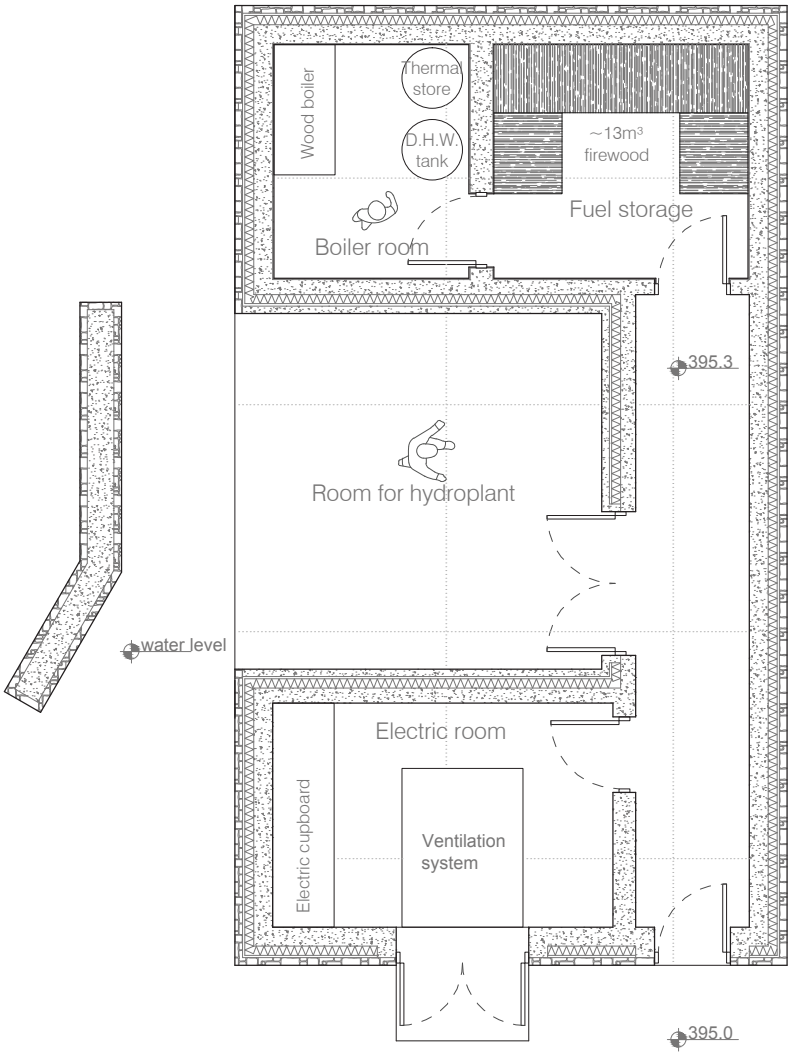
N Plan 1:200 2.Floor

Plans Main Building



N Plan 1:200 Ground Floor

Plans Main Building



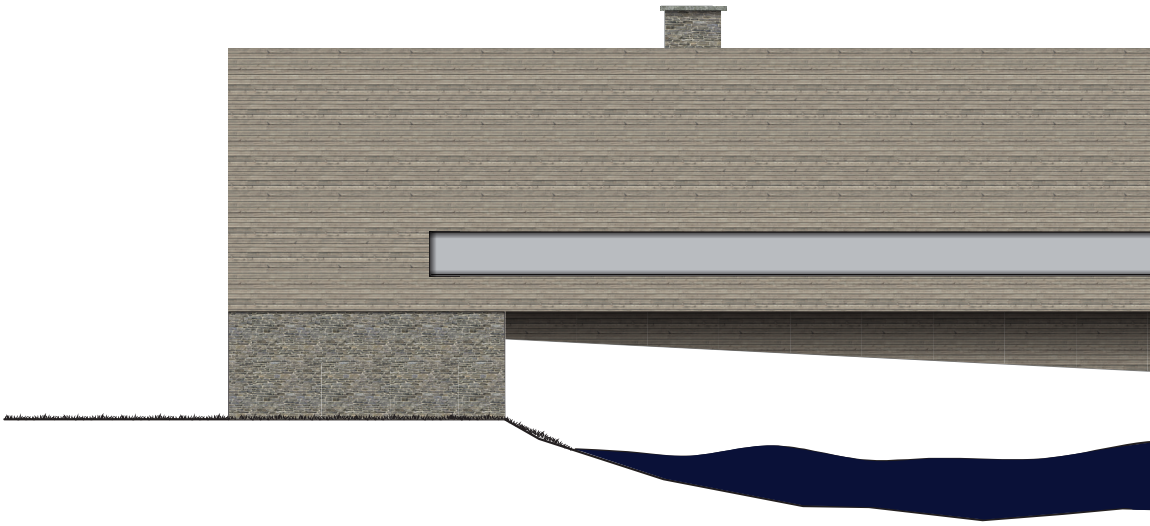
N

Plan 1:100 Tecnical Room

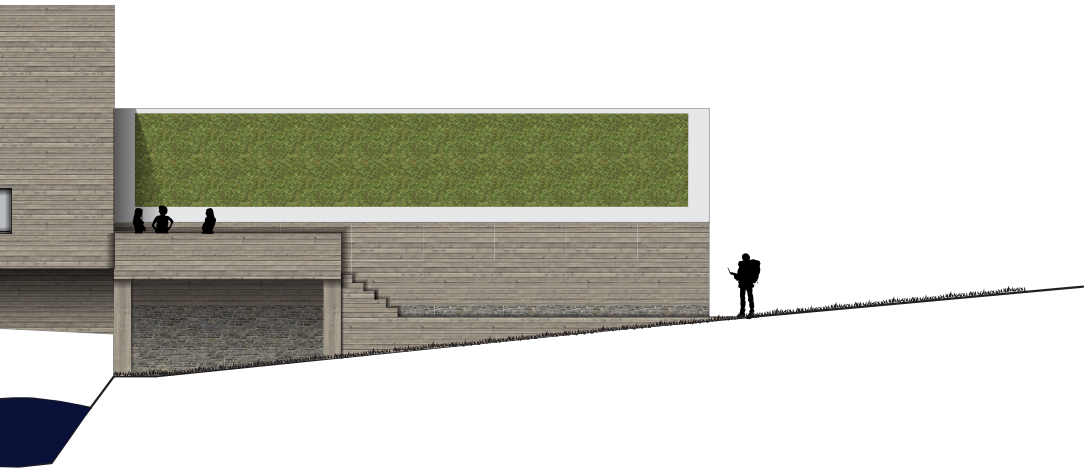
Elevations Main Building

Elevation 1:200 SOUTH

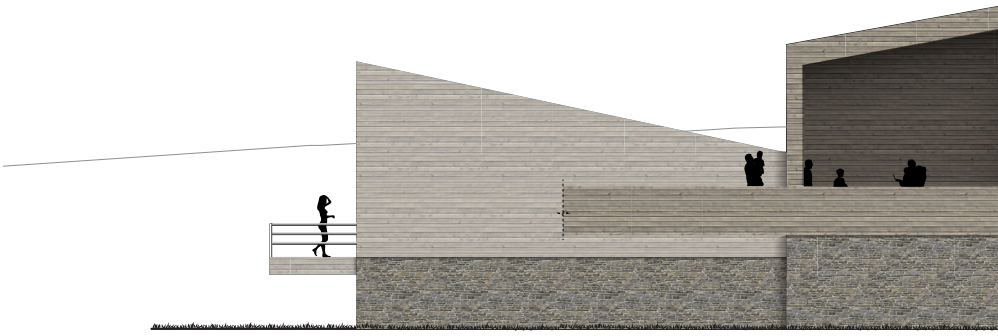
Elevations Main Building



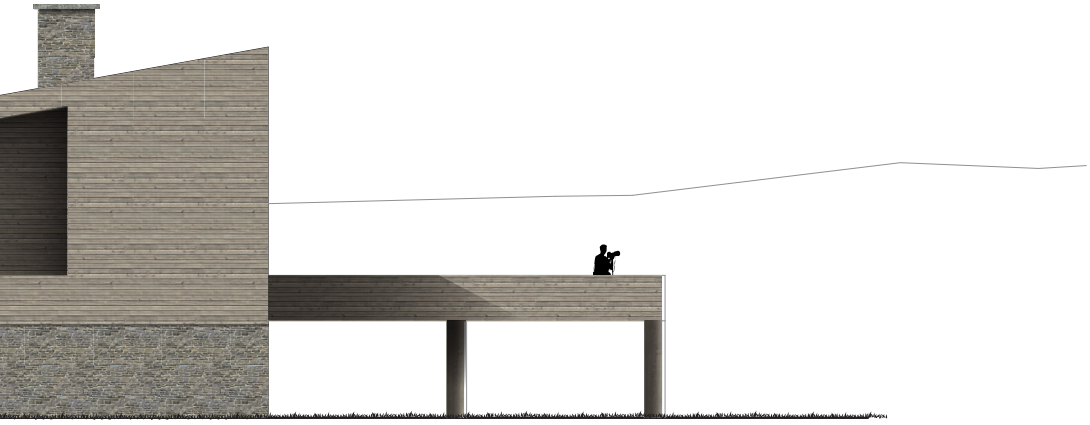
Elevation 1:200 NORTH



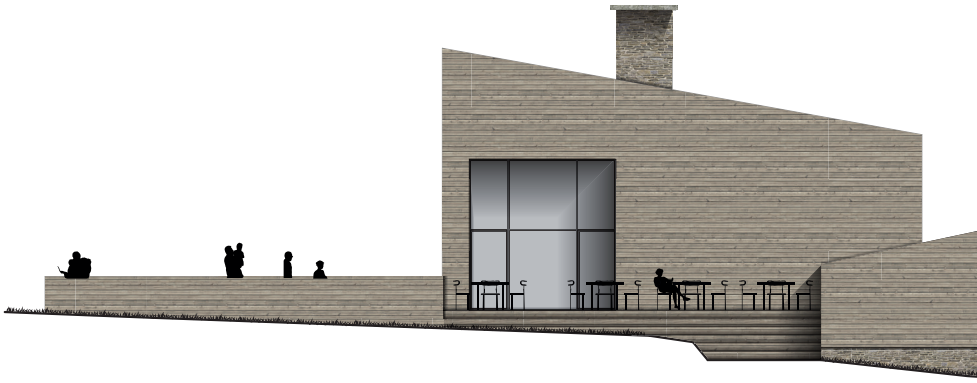
Elevations Main Building



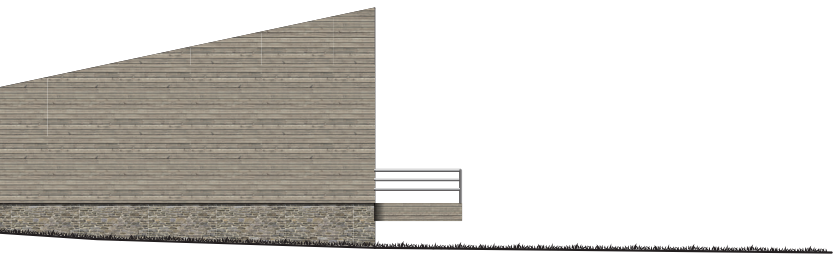
Elevation 1:200 EAST



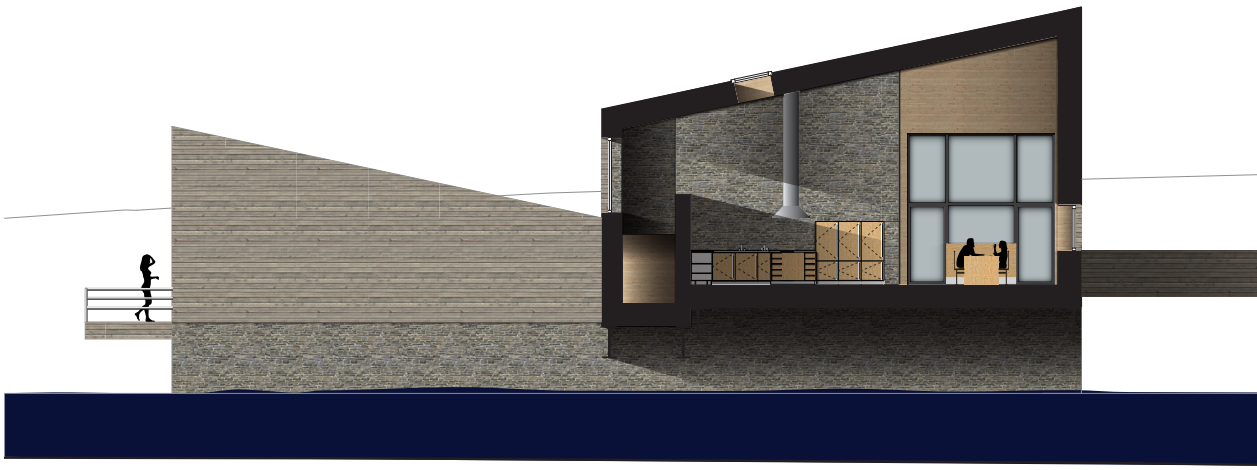
Elevations Main Building



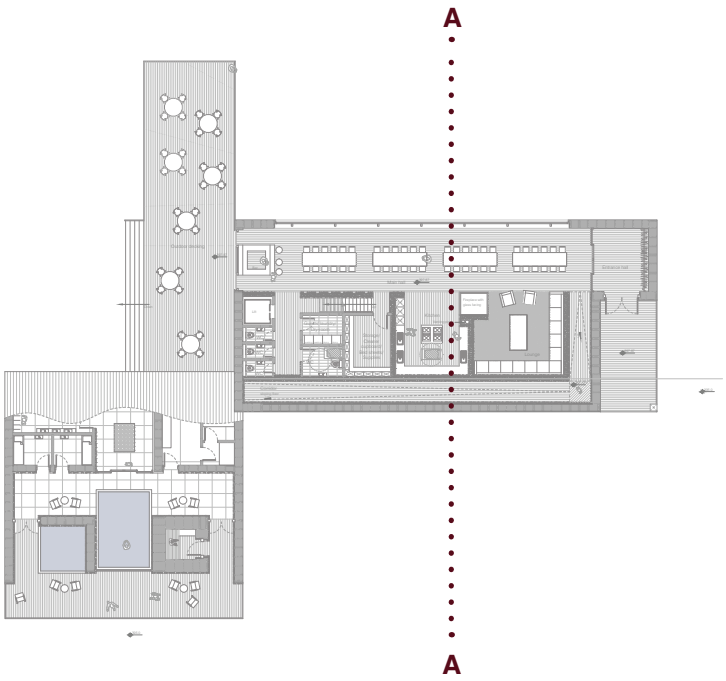
Elevation 1:200 WEST

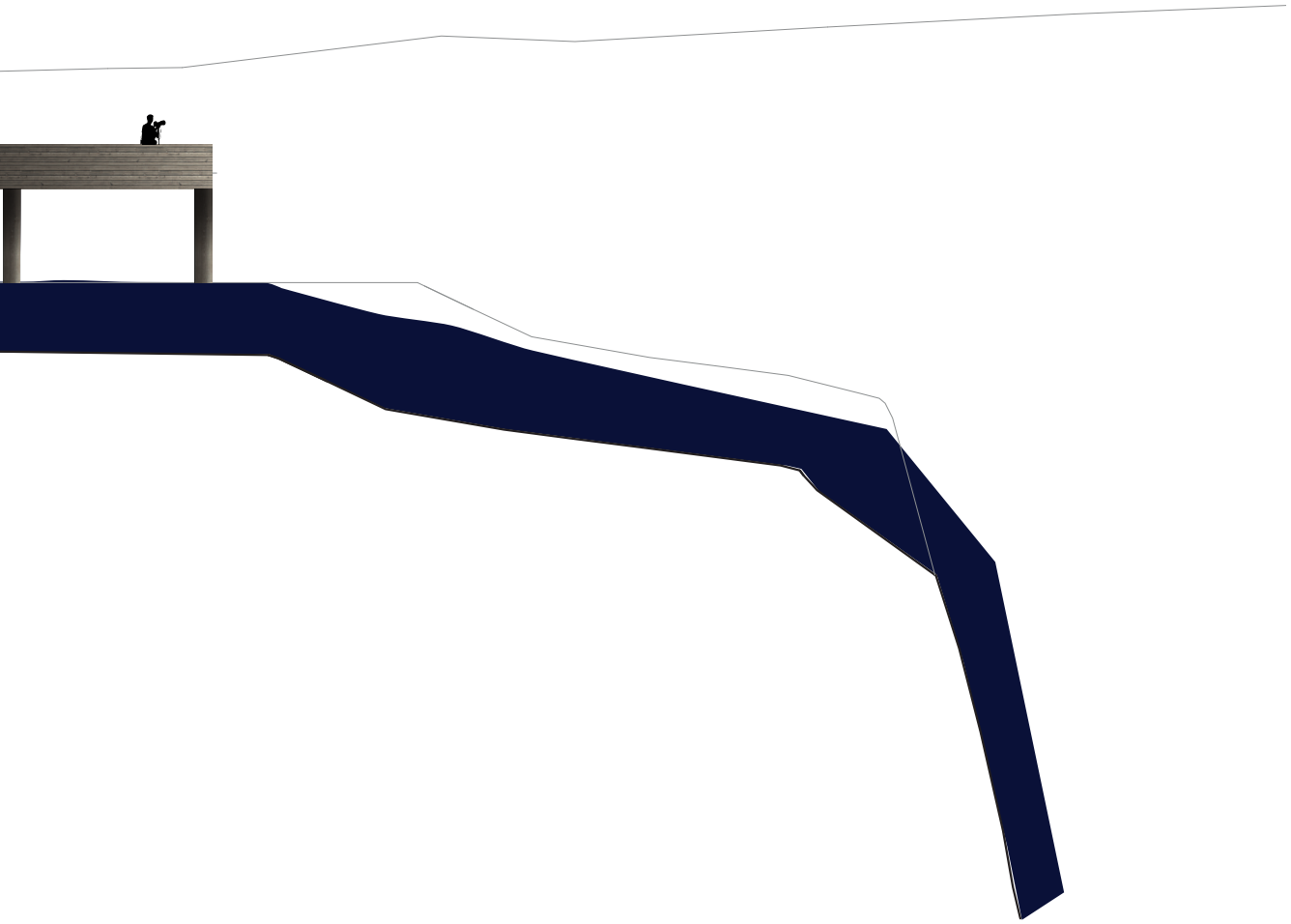


Section Main Building

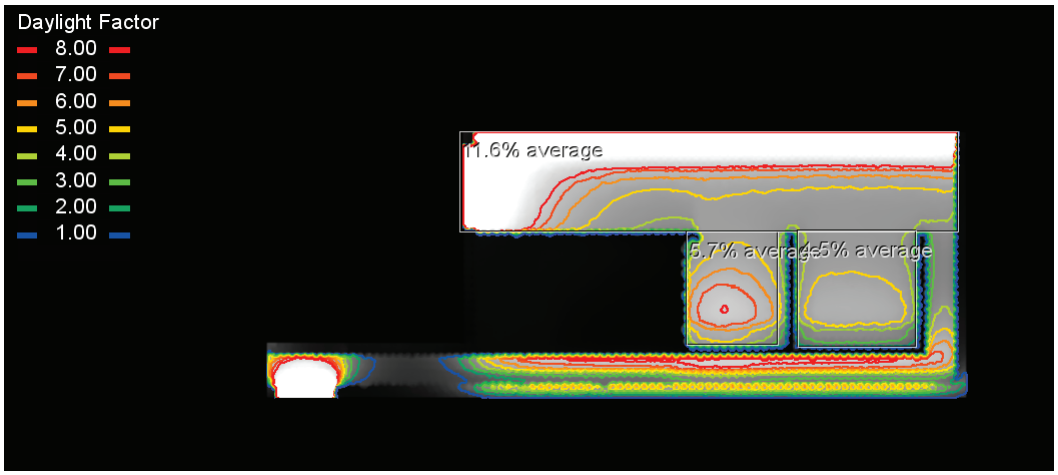


Section A-A 1:200


A
A



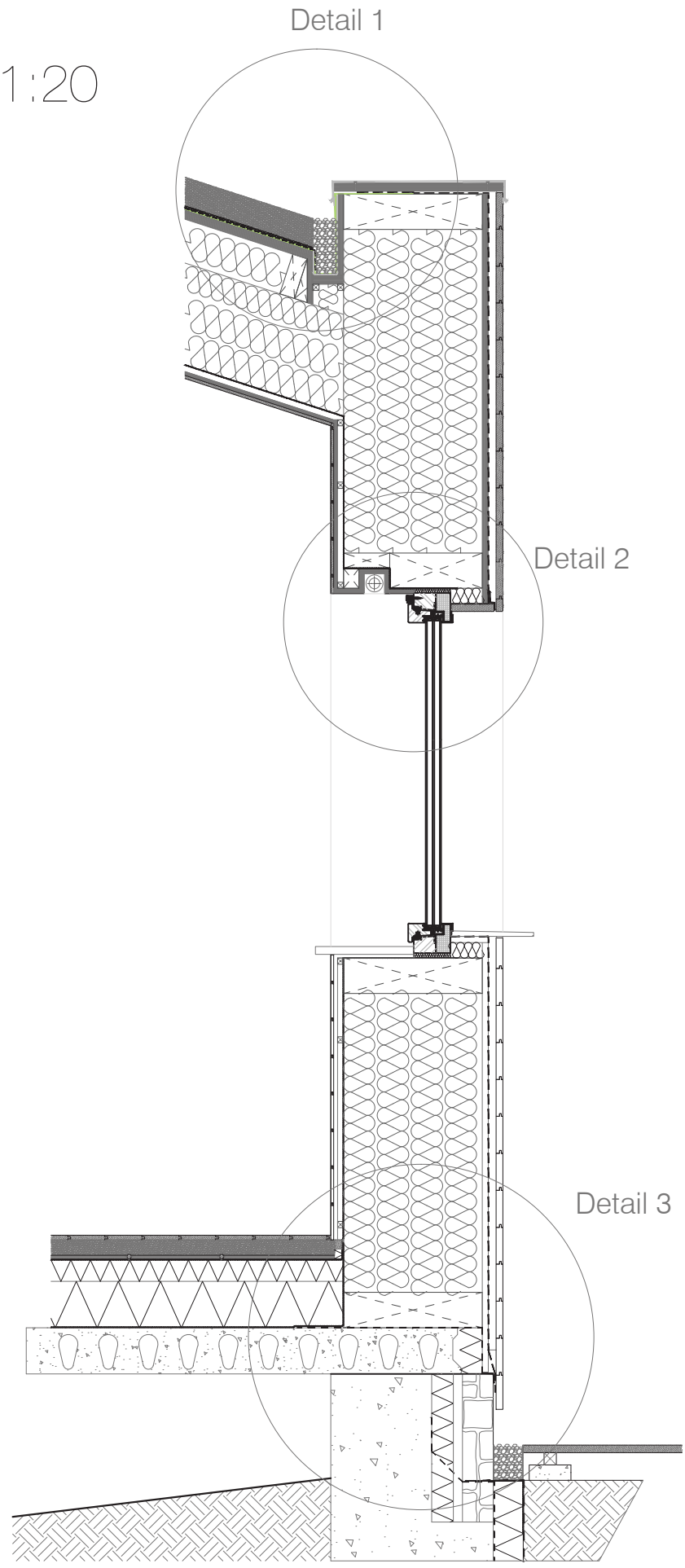
Daylight factor Main Building

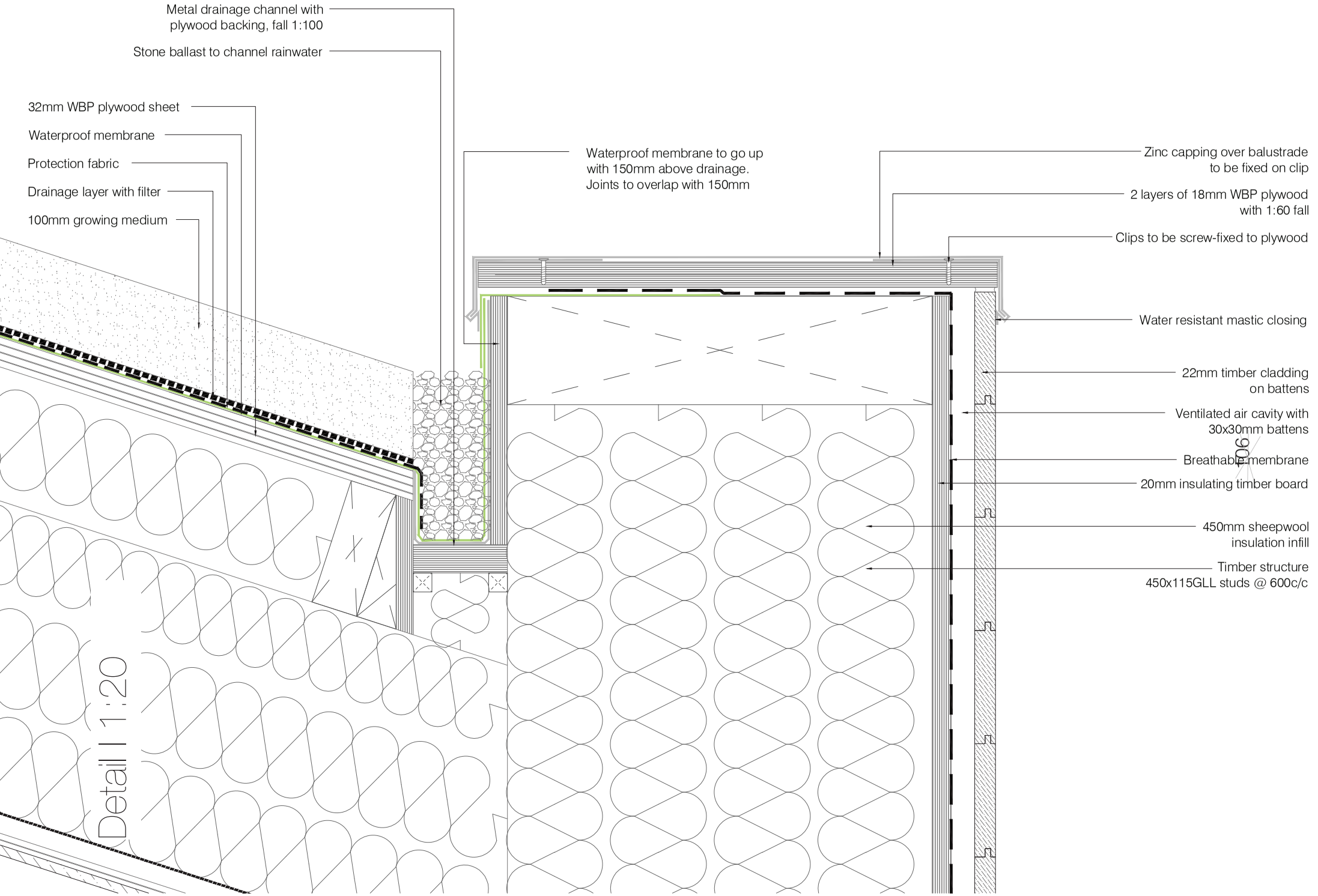


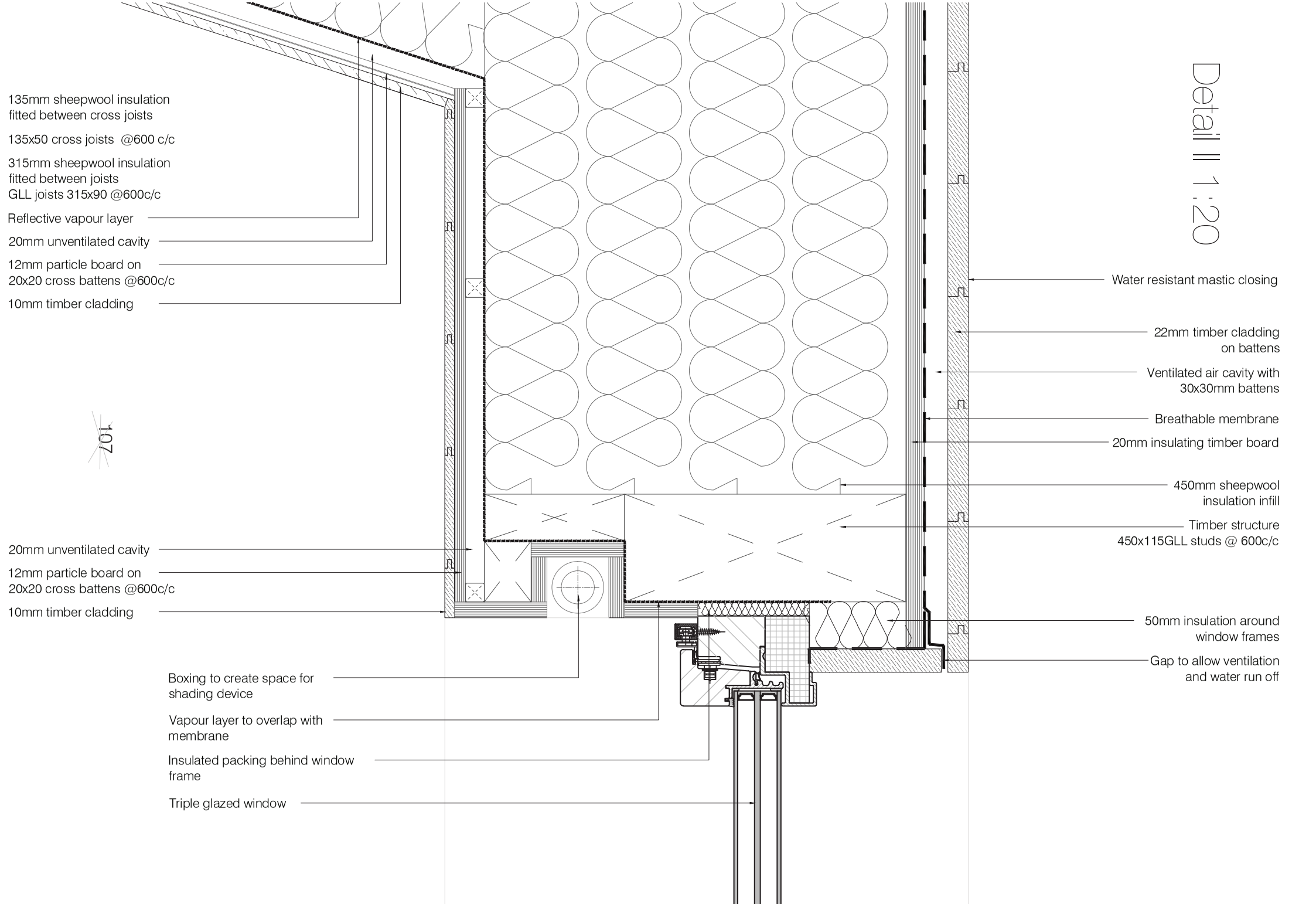
Daylight factor for Spa

Daylight factor for 1.floor

Details 1:20

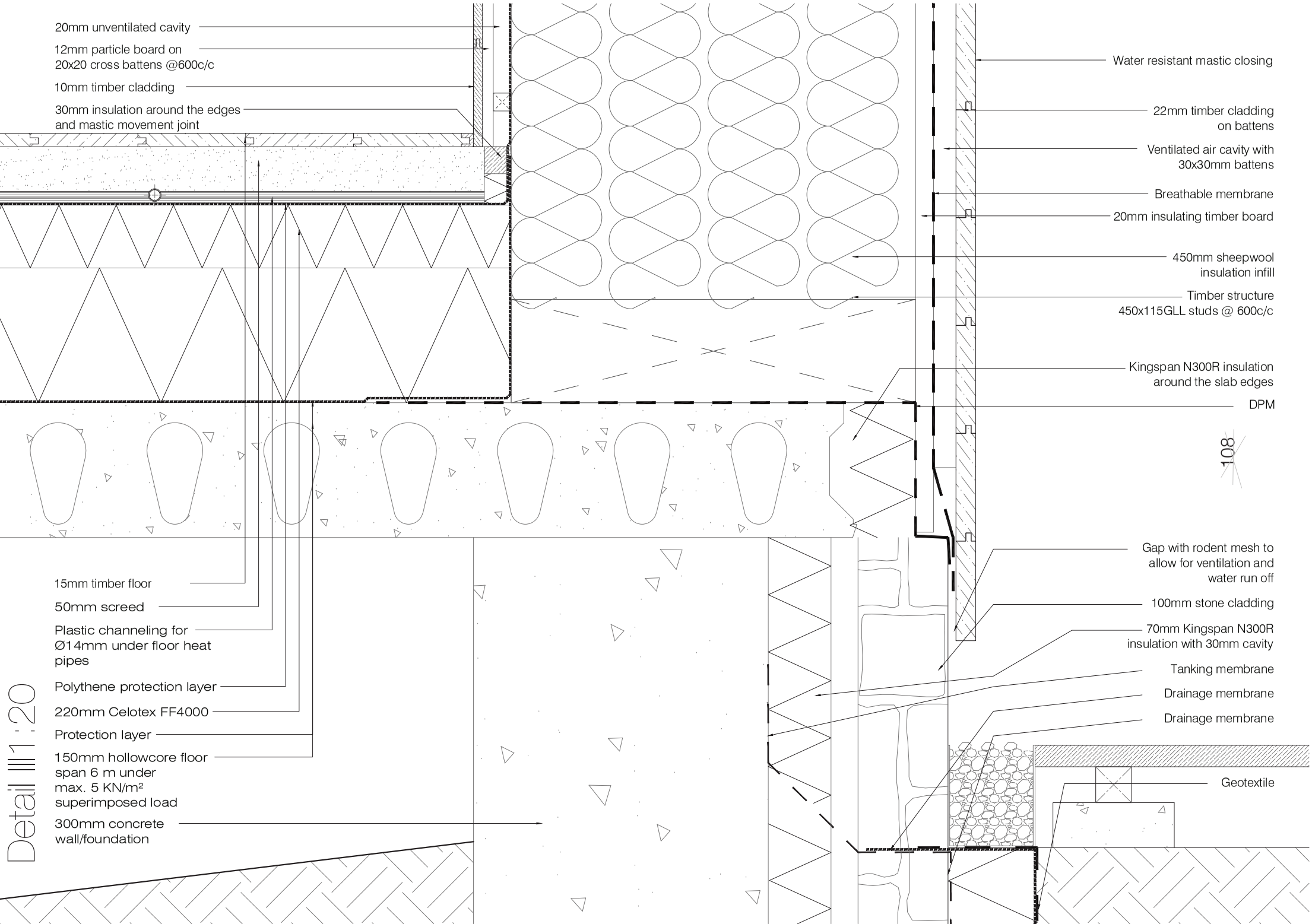



Metal drainage channel with plywood backing, fall 1:100
Stone ballast to channel rainwater
32mm WBP plywood sheet
Waterproof membrane
Protection fabric
Drainage layer with filter
100mm growing medium
Waterproof membrane to go up with 150mm above drainage. Joints to overlap with 150mm
Zinc capping over balustrade to be fixed on clip
2 layers of 18mm WBP plywood with 1:60 fall
Clips to be screw-fixed to plywood
Water resistant mastic closing
22mm timber cladding on battens
Ventilated air cavity with 30x30mm battens
Breathable membrane
20mm insulating timber board
450mm sheepwool insulation infill
Timber structure 450x115GLL studs @ 600c/c
Detail | 1:20



Detail II 1:20

107


20mm unventilated cavity
12mm particle board on
20x20 cross battens @600c/c
10mm timber cladding
30mm insulation around the edges
and mastic movement joint
Water resistant mastic closing
22mm timber cladding
on battens
Ventilated air cavity with
30x30mm battens
Breathable membrane
20mm insulating timber board
450mm sheepwool
insulation infill
Timber structure
450x115GLL studs @ 600c/c
Kingspan N300R insulation
around the slab edges
DPM
108
15mm timber floor
50mm screed
Plastic channeling for
Ø14mm under floor heat
pipes
Polythene protection layer
220mm Celotex FF4000
Protection layer
150mm hollowcore floor
span 6 m under
max. 5 KN/m²
superimposed load
300mm concrete
wall/foundation
Gap with rodent mesh to
allow for ventilation and
water run off
100mm stone cladding
70mm Kingspan N300R
insulation with 30mm cavity
Tanking membrane
Drainage membrane
Drainage membrane
Geotextile
Detail III1 - 20

Structural calculations

While structural calculations were not part of our brief in our opinion, doing some very quick and basic calculations has great benefits. Especially in our case, where the insulation is partly fixed in between the joists, hence it is important to know how much space there is for insulation, consequently it gives a very good indication to the expected roof thickness.

For the calculation we used hand tools and load tables available by suppliers, as such, they should not be considered as 100% accurate. Moreover, the size of the joists has a great impact on the weighted U value calculations.

Roof load calculation - rough calculation

Snow load

Characteristic snowload:	4 kN/sqm
Roof angle:	15°
Form factor:	0.8
Actual snowload maximum:	3.2 kN/sqm

Roof weight

Insulation 40mm:	0.086 kN/sqm
Green roof 100mm:	1.3 kNsqm*
Plywood 30mm:	0.157 kN/sqm
Total weight:	1.543 Kn/sqm

Wind load

Wind load:	1.3 kN/sqm**

Total load:	4.688 kN/sqm

Structure

Roof area:	60 sqm
Total roof load	140.664 kN/sqm
No. of joists @600c/c	19
Load/joist:	7.4 kN/sqm
Joist length:	6 m
Load/m:	1.23 kN/m

Permissible Loads - Breadth: 65, 90 and 115mm Roof Beams

Kilonewtons per metre run of beam for:

Standard Glulam Straight Roof Beams

Typical Glulam Section available off-shelf

Breadth:65mm

Span	Depth			
	180	225	270	315
4.0	1.15	2.26	3.86	5.46
4.5		1.58	2.72	4.28
5.0		1.14	1.98	3.14
5.5			1.48	2.35
6.0			1.12	1.80
6.5				1.40

Notes:
*the weight is from zimco-greenroof.com, not a calculated value
** the windload was calculated with the following online program;
http://www.buildingsguide.com/calculators/structural/ASCE705W/
*** the data chart from which the elements were chosen are available at:
http://www.glulam.co.uk/specGuide_brochure/tableRoof1.htm

Acoustics

More often than not, the acoustic conditions for normal dwellings are not tested. Likely in the past it had very little importance, as due to the heavy furnishing and the high building envelope/volume ratio acoustics was not a problem.
But, as Camilla B. points out in her study about comfort houses (Brunsgaard, C., Knudstrup, M. & Heiselberg, P. 2012), residents were complaining about the echo in the house. As she points out, it is one of those problems that could have been eliminated easily if there was at least a quick hand calculation carried out.
One of the reasons, for long reverberation time can be the low building envelope/volume ratio, one of the main thrives of sustainable architecture. Since these two desires are working against each other, it is very important to keep an eye on the reverberation time. It would be a shame, if low energy buildings were associated with bad acoustics.
Our initial calculations were in line with Camilla's findings, as our design was suffering from long reverberation times. Later on with the addition of the extra gallery spaces, we managed to increase the surface areas. Also, the shelves pushed into the wall are not just functioning as storage spaces and features, but they also help in increasing the surface area as well.
Our final reverberation time is 0.8s for 125Hz and 1.3s for 250Hz, both in the range of good reverberation time for a house.

material	area (sqm)	absorption	
		125Hz	250Hz
Wood floor	65	0.15	0.11
Wood wall	140	0.24	0.19
Glass	34	0.18	0.06
Stone	22	0.01	0.01
Ceiling	65	0.24	0.19
Gallery space (wood)	60	0.15	0.15
Mean sound absorption		0.1924611399	59.134020619
Total sound absorption		74.29	57.36
Building volume		413	
Reverberation time		0.889487145	1.1520223152

Recommended Reverberation Time - Ta - (s)			
Room Volume (m3)	Conference room, school, cinema	Concert Hall, Normal Music	Church, Organ Music
10000	1	1.5	2
1000	0.8	1.3	1.6
100	0.6	1.1	1.2

Final BE10 Results

Be10 is a program predominantly used, for energy certification. While, during the design process we used Be10 as a sketching tool to quickly analyse different proposals, in what follows we are going briefly explain some of the critical points of the final Be10 file and analyse the results.

Our design consist a number of detached building blocks. In our opinion, describing each building in a different Be10 file is much more realistic than combing all of them together in one Be10 file. As a result we were testing the main building and one of the cabin blocks. Since we used the same materials, and methods we are only describing the model for the cabin blocks in detail.

In the main data, although our design is a hotel for the building type – in the case of the cabins – option nondetached was selected instead of other. For hotels option Other applies normally, but in our view, the use and the design of the cabins is surely closer to dwellings.
For the heating system, both district heating and block heating could apply, but in our opinion district heating is the more likely opinion, since we have only one heating unit in the main building and the hot water is distributed from there, in pipes, to every building block scattered around the site.
The wind turbine option was turned on as well to replace the hydro plant, an option not available in Be10.

In building envelope menu the only unusual feature is that, despite the floor heating, the b value for the floor is 1 and not 1.3. During the sketching phase it became clear that the floor can easily account for almost 30% of the total transmission heat loss, as such keeping the b value as low as possible was crucial. With the crawling space under each building we could not just position bour buildings better into the landscape but also managed to push down our b value to 0.7. for this an 0.3 was added as a result of the underfloor heating.

The line losses were determined based on Trehus Boka

For the windows we used data from real life suppliers, for details see the attached CD. To calculate the effective U value, the average of the frame and the glazing we used values derived from Bsim.
For the Fc value we used -0.4 where the 0.4 represents linen blind and the minus for that the blinds are closed during night time at winter, a common practice in Norway.
The size of the roof overhangs and sidefins were optimized in Bsim and from there imported into the design.

Maybe the most interesting aspects of our buildings are the extensive south facing glazing combined with a rather high, on average 6m, ceiling height. The glazing provides extensive solar heat gain, almost eliminating the need for heating, but also would cause overheating.
One of the most efficient ways of dealing with overheating is to use the cooling effect of natural ventilation.
Based on the Bsim model an estimated 2.1 l/s/sqm was used, but as it proved to be inefficient it had to be increased to 2.6 l/s/sqm. In most buildings such a high volume of ventilation would result in an airchange rate much higher than 5/h, the maximum comfortable rate of airchange, but as a result of the large building volume in our case the ventilation rate stayed well under 2/h.

BE10

Due to the skylights and the cross ventilation the 2.3 l/s/sqm can be easily achieved even in worst case scenarios.
For the hand calculations determining the minimum airchange, maximum capacity of natural ventilation see the appendix.
Moreover, as every building is fitted with a fireplace we added an 0.8 l/s/sqm mechanical ventilation for 10% of the time during the heating season. The 0.8 l/s/sqm ventilation volume is the minimum should there be a fireplace in use.

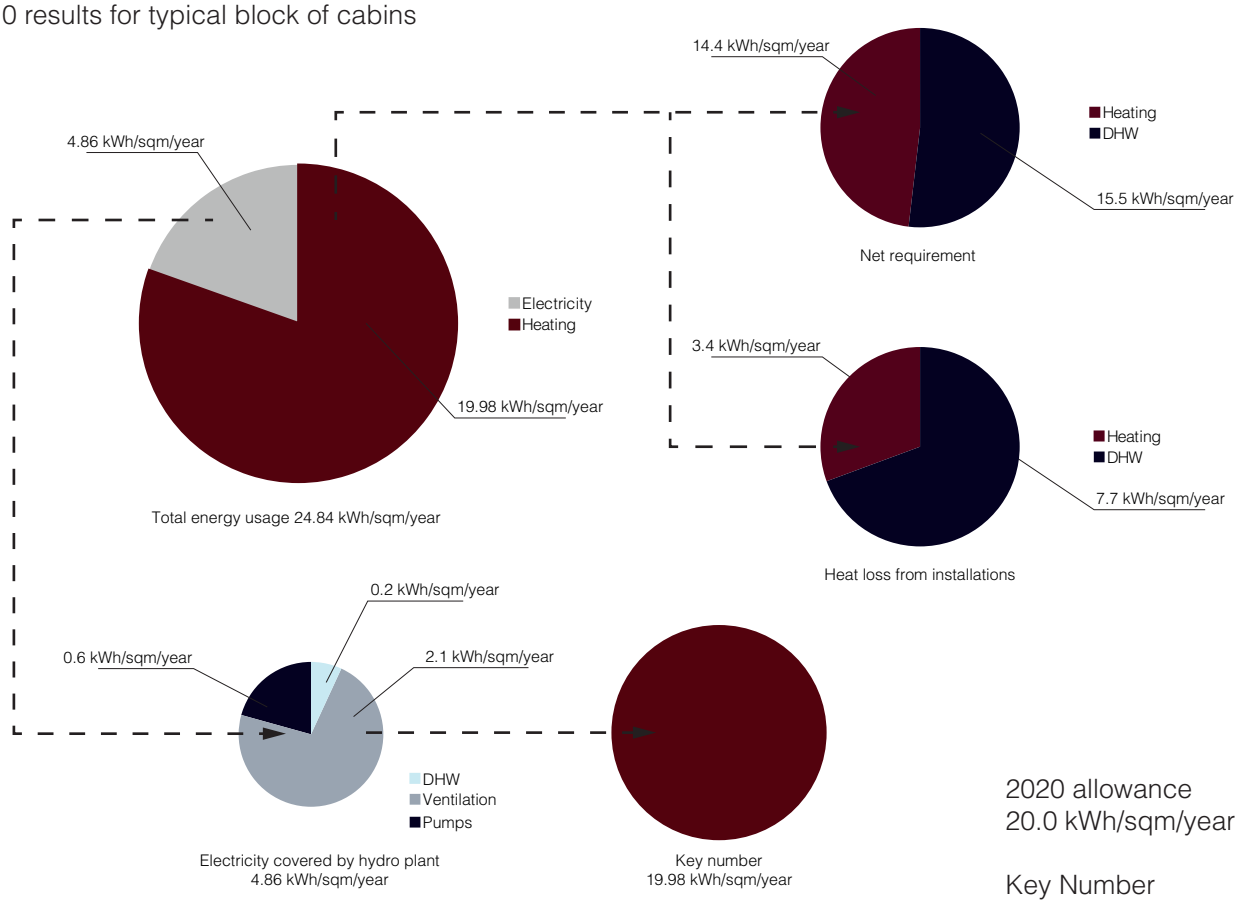
For the internal heat supply for the appliances standard values were used and for the people load the one that exported from Bsim based on the the dayprofiles.

One of the main advantages of using floor heating is that the temperature of the water in the system is much lower than in other conventional heating systems.
Thus, the heat loss through the hot water pipes is much lower.
For the pipe length we accounted for the heating pipe running in the building in the crawling space (b=0.7) and also for an average length for the distribution pipe running from the main building to the block.
The size and type of the pump was determined by a qualified building engineer.

For the hot water usage we used the normal 250 l/sqm value, but we would argue that since our building is not equipped with washing machine, bathtub etc. this number should be lower. Therefore we used 150 l/sqm

The final results shows, that our building combined with the electricity coming from the hydro plant does meet the requirements of the Danish standards for 2020.
It must be noted, that even with the exclusion of electricity supply the building would meet with the Danish 2015 regulation.
Moreover, it is also clear, that the DHW is accounting for the bigger half of the total energy consumption, together with heat losses from the installations, an unfortunate result of the long pipes required for connecting scattered buildings.
While, having a heating boiler in every unit would eliminate this problem, it would be very difficult to maintain 5 separate boilers at the same time. Furthermore, the efficiency of boilers increases with their size. For example an average domestic stove has only 71% efficiency, while a much bigger log gasification boilers can exceed 90% or even above.
Maybe the most important finding of our project was, to realise how much sustainable architecture has to relate to its location. To test and to demonstrate this key finding the exactly same Be10 model was tested in a Danish location. The “re-located” building did not perform well at all and did not even meet the 2015 requirements, predominantly due to overheating. Which is, in real life as well, one of the biggest challenge passive and low energy buildings are usually facing.

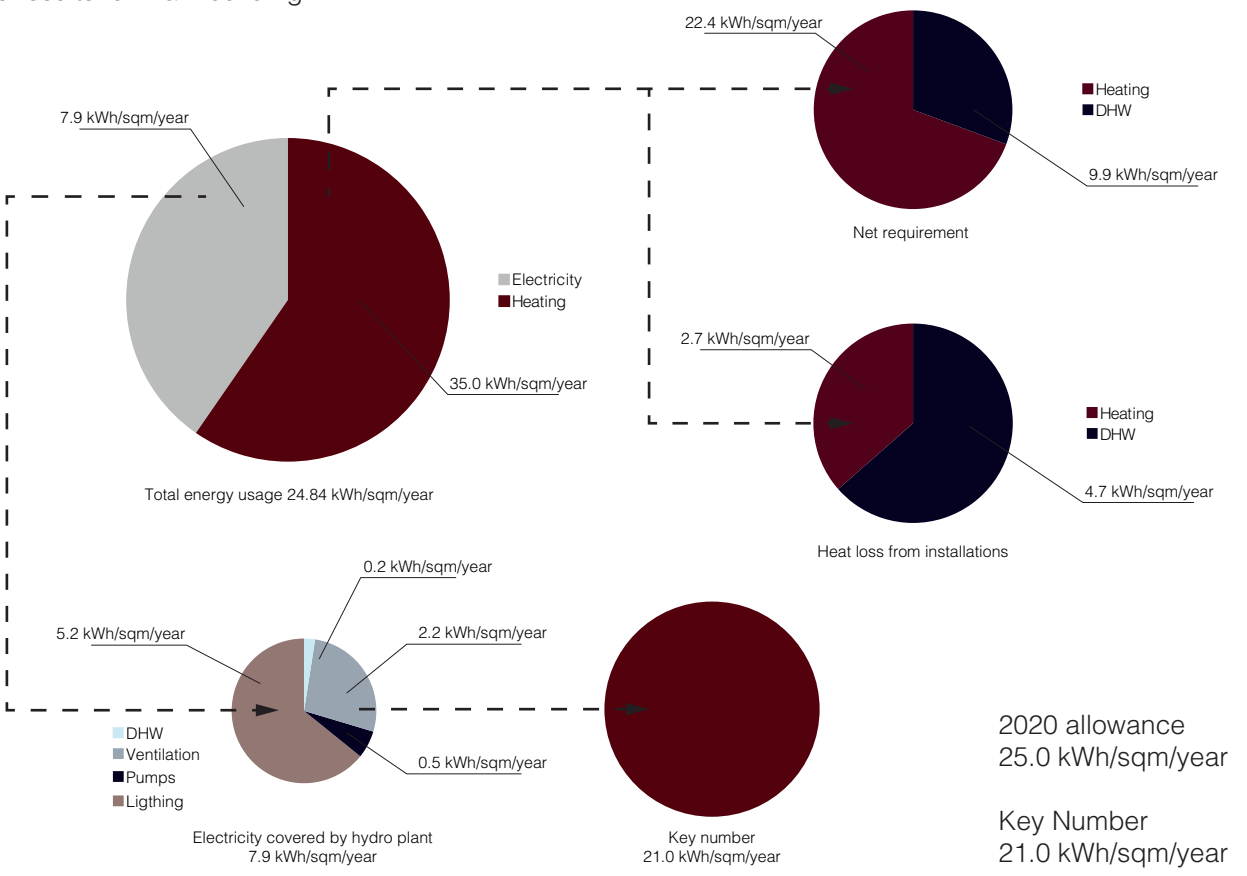
Be 10 results for typical block of cabins



2020 allowance
20.0 kWh/sqm/year

Key Number
19.98 kWh/sqm/year

Be 10 results for main building



2020 allowance
25.0 kWh/sqm/year

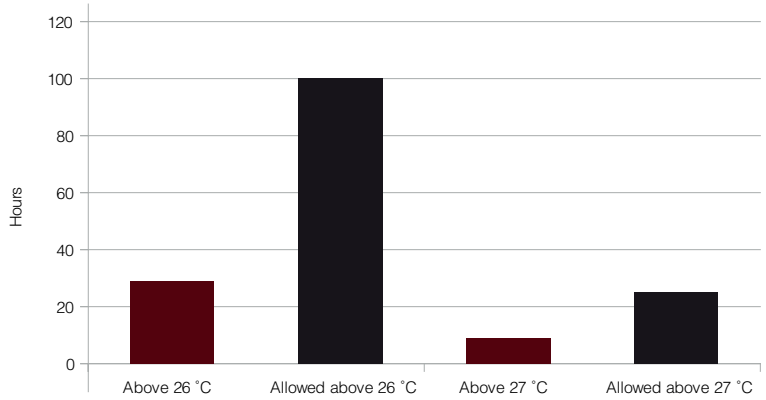
Key Number
21.0 kWh/sqm/year

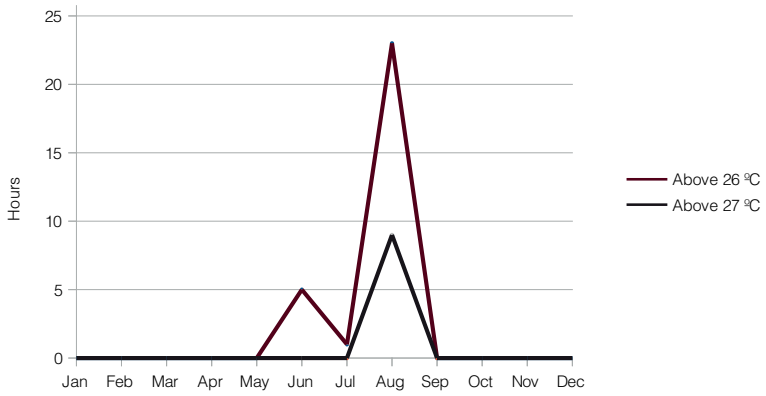
Final BSim Results

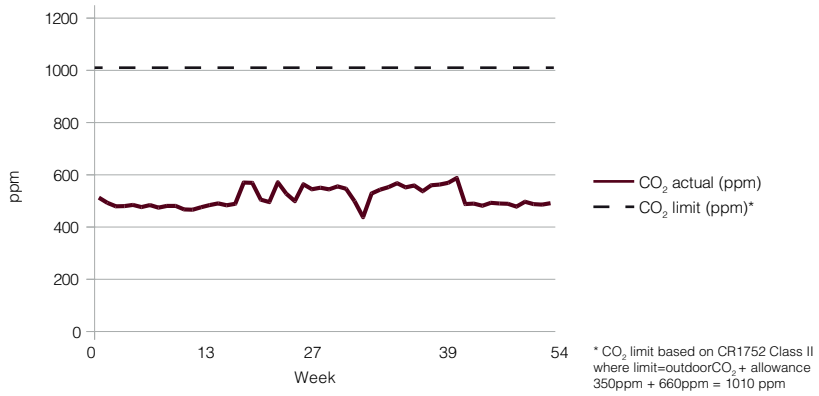
From an early stage of the project we used Bsim in order to evaluate different design options.
For those tests we used only generic shapes, forms and materials, but they still provided us with sufficient information at the early stage. For example we learned it very soon, that overheating is not a likely to become problem and also that the constant and strong wind would enable natural ventilation.
In the later and final stages Bsim was used to determine the exact size of the roof overhangs and side fins and to test different material options.

Once we had a working model, it was easy to change the properties of the windows in line with the products of different suppliers. These tests very quickly abolished two myths.
Myth number one was, that the windows with lower U values are always better. While low U value is efficient against heat loss, it is always coupled with low g values and hence the solar heat gain decreases. Should the windows be well orientated and positioned, the solar heat gain of a window with higher g and higher U value can perform better due to the increased solar heat gain.
Nevertheless, myth number two, that we abolished was that having only a double glazed window , with average U value and very high g value can perform better than a triple glazed window. While this theory might be right in places with more winter sun than in Norway, in our case it was not true.
Once again, these very simple and quick Bsim tests have proved that there are no simple answers in sustainable architecture. On the contrary, every specific location needs exhaustive research, analysis and testing.
For the results of these tests see the appendix.

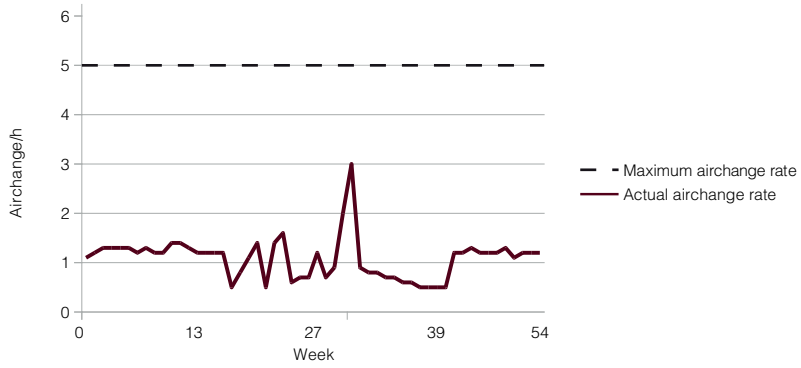
For the final model we not only modelled only one typical unit of our cabins and used worst case scenario people and appliances load for overheating. We have not only modelled the shape of the building but also the construction of the building to get a more accurate result.
An additional benefit of modelling our own materials, including membranes was, that the tests could be run with the moisture transport option on.
As the finals tests were running very smooth, we would only highlight some of the interesting parts of the tests.
One of these issues are the infiltration. Likely as the result of the high wind, the infiltration rate is very heigh, even when we used the most modern air tightness measures. This lead to some anomalies in the final results. Meaning that the annual energy loss due to the infiltration is three times higher than the combined energy loss due to ventilation and venting.
Unfortunately, we could not find an answer for this problem.
Although Bsim has an option for entering the parameters of the objects around it, in our case the numerical method delivered significantly different results than in the case when the surrounding objects were modelled. As our window has as non rectangular shape, we assumed that the modelled version is more likely to give realistic results and therefore we chose that option.
Thirdly, during the early tests, we experimented with dividing the open plan into different thermal zones the air flow between those was not sufficient and the mixing system gave very unreliable results. Consequently, we decided to use only one thermal zone for the entire open plan. We are well aware of the fact that this method drastically reduces the chances of overheating in the living area, but we are of the view that the kitchen, living area, sleeping area, stairs are much closer to one open space than to separate zones.
The aim of the final Bsim tests was to establish a scenario where the Co2 levels and the overheating is not exceeding the allowances set in the Danish Standard (DS -check it). Since the minimum level for both the mechanical and the natural ventilation was set to meet the requirements related to odour levels, usually much higher than Co2, we were not expecting high levels of Co2. Even in bathroom during peek hour the Co2 level hardly reaches 1000ppm for short periods.
Overheating on the other hand was a much more difficult issue to deal with and for that a number of shading options were tested before we reached the final form where the ventilation rate did not reach the 5/h level.







* CO_2 limit based on CR1752 Class II where limit=outdoorCO_2 + allowance 350ppm + 660ppm = 1010 ppm



Epilogue

DESIRES		DESIRES AND RESPONSES
Social sustainability	Disconnect from urban life Reconnect with nature, yourself and others Enhance slow life	View and experience of nature Gathering around the fire Duality of privacy in the cabins and community in the main building, and at the path.
Environmental sustainability	The quality of the site is the untouched nature and landscape	Kept the landscape as untouched as possible Buildings are designed according to the landscape Green roofs
Energy demands	Use renewable energy for production and supply, since the site is disconnected Meet the energy frame of 2020 regulations	There are 3 steps to lower the energy consumption; save, passive, active. Save: extremely low U-values for construction Optimize building envelope, Orientation,Protect from wind Passive: Optimize U and G values, Thermal mass, Natural ventilation, Large building volume, few and efficient appliances. Active: Hydroplant, Local wood boiler for central heating demand
Locality	Lower embodied energy Enhance locality	The use ofmaterials in line with local tradition and availability On site sheep wool as insulation
Good Indoor environment	Provide high quality spaces, enhances satisfaction and experience of guests Correlation between general health and indoor environment Meet the comfort Class II CR 1752	Open floorplan effective for cross ventilation. Skylights for improved daylight and stack ventilation -Large south facing windows allow good daylight factor and the overhang improves the thermal comfort -Good acoustics in the room.
Poetic Calculations	Make sustainable architecture, and not architecture sustainable. Integrate sustainable strategies in the design process	The use of BSim and BE10 as sketching tools for design. Making design decisions based on calculations
Financial Sustainability	Energy efficient buildings have high embodied energy, if they fall in disuse they are not sustainable	There is special focal and interest for rural and nature truism in Norway

Conclusion

Point of departure and vision for this project was to design a sustainable hotel that becomes an integrated part of Åse. More over a place where ordinary people likely to live in a busy environment, can spend some quality time while disconnecting from the rest of the civilization.

More specifically a list of desires was created as guidelines for the design. These desires have been answered for in the previous page, thus it is of relevance to explain the journey of how Åse Mountain Hotel was created.

By following the steps of the integrated design process, the problem formulation led to a list of research areas. The research brought the attention towards different topics. From every area of research the aim was to determine what could be used for the next phase of sketching and testing.

For this project the phase of sketching and synthesis was the most dominant, and there were conducted a numerous of test and iterations. The design decisions were at all time interrelating creating a symbiosis between wish and result. Moreover the final result is a product of many layers in terms of measurable and immeasurable factors. A grate inspiration for this project was the Sea ranch project my Moore. Where the landscape was too overwhelming, and the focus was put on sheltering.

Åse Mountain hotel will to some extent display somewhat the same principles of layers. First layer is the path, being open and unsheltered. The next layer is the court, where the degree of shelter is grater. Moving through the narrow entrance, and entering in to a light shell, the cabin. Withholding the core, the superfurniture, which is massive and strong. The superfurniture will offer the most present sense of shelter and safety.

The materials have also been used as tool to make a design that can level of recognition. The aim was to offer something not too alien, yet not to obvious. In relation to this it is also worth mentioning that by having different plans in every building, the guests can come back and experience something different, by not conveying the same story in every building, thus not to unrecognizable.

Scale was also a focal area during the process, when choosing to place the buildings within the ratio of the river and the road, one can relate to the old traditional farm cloisters. Secondly it respects the landscape and the site by not trying to dominate or overrule the nature. Thirdly it also made possible the integrated design, which was one of the main goal. Having a building on the waterfall not only speaks of a spectacular experience, it also creates and produces the measurable, energy. When relating to renewable energy it is often though of as PV panels and wind power. Never the less, water is also a successful source of energy if the location allows it.

Further more, the choice of having an external building serving the cabin with various facilities, also made possible an other aspect of the vision. The social aspect, where people are deliberately encouraged to interact at the main building. Yet there is a duality of the privacy aspect, the guests have the choice to what extent they want to connect or disconnect. There is perhaps no disconnection unless the is a degree of connecting?

Taking everything in to consideration, this process can on one hand be seen as the process of making sustainable architecture and not architecture sustainable. On the contrary this project did not meet the energy frame of 2020 by passive means. This can again be agued that it is due to the conditions in Norway, and the fact that it is a more difficult climate.
However it can be up for discussion if Åse Mountain hotel will contribute to some of the other aspect of sustainability, fulfilling the needs of social sustainability.

Reflections

The aim of our project was to create a place that counters the extreme speed of our modern society, a place where one can disconnect from the cyber world, virtual networks and re-connect with themselves, nature and other human beings, a pace where instead of quantity one can experience quality.

Maybe unconsciously, but this desire for balancing and to find the optimum followed through the entire process. As a starting point we wanted to design a building that is not a Holiday Inn but also not a single cabin. We also knew that we wanted to connect our buildings with its stunning environment and blend the division between inside and outside. Yet we also knew that the local climate and weather can be very harsh and unforgiving, and therefore our design had to offer shelter and protection, both in terms of spiritually and physically.

Moreover, although we wanted a sustainable, low energy building, we did not want to design something that screams sustainability, rather something where the visitors can have a first hand experience of the benefits of low energy buildings.

This constant act of balancing made the design process much slower than we expected. But in the other hand the early and constant testing of ideas both aesthetically and energy wise led us to a number of very interesting findings. Against the common belief we found that there is no instant recipes for sustainability. On the contrary, sustainable design has to pay a grate respect to the site and to its surroundings.

Also the early implementation of Be10 and BSim allowed us to evaluate different proposals not only from an aesthetic point of view, but also from a more rational. While a great many would claim that these rational decisions are turning architecture into a boring balancing act of numbers, in our opinion if the quantitative methods are implemented early then at the end both the engineering and the architectural necessities will speak the same language and hence instead of countering they contribute to each other.

Nevertheless as it was mentioned above, a process of this kind especially in such landscape was very time consuming and therefore a number of other tasks were neglected. For example we had no time for making 3D renderings of our project. Also we had little time to work with one of the most interesting features of our design, namely the hydroplant integrated into our main building. But, should we be able to redo the project we would be likely to stick to this process, most importantly because it allowed us to research and test ideas, that in a professional environment, where often glossy renderings are the most important products, we could have done. As such instead of relying on already gained knowledge and established skills we have gained new ones. A well worthy finishing of our academic years.

Should we point out one thing where we could have saved time, it would be the site and the program. While fictionary architecture has a number of benefits, in our care deciding on the location and writing our own program took a very long time.

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Reference of Photos in order of apperance

Front page, left to right:
1) own image
2) own image
Synopsis: own image
Vision: own image
Brief: own image
Problem formulation: own image
To the site:
1) to 8) own image
Location photos, from left to right:
1) https://www.google.dk/maps/dir/%C3%85lborg/%C3%85se,+4137,+Norge/@58.0931781,6.8654644,8z/data=!3m1!4b1!4m13!4m12!1m5!1m1!1s0x464933b25fdf3d0d:0x4eb1b46a2eec26c3!2m2!1d9.921747!2d57.0488195!1m5!1m1!1s0x46396325c0918d0d:0x49ea22429f86864a!2m2!1d6.367124!2d59.14531?hl=no,
2) http://kart.gulesider.no/?q=%C3%A5se%20hjemmeland
3) Own image
4)https://www.hjelmeland.kommune.no/hjelmeland-kommune/om-kommunen/turistinformasjon/aktivitetar-nyttig-informasjon/
Mapping imagines, from left to right:
1)http://smaavoll.blogspot.dk/2011/08/lysefjorden-rundt.html
2)http://no.wikipedia.org/wiki/Fil:Rock_Ptarmigan_(Lagopus_Muta).jpg
3)http://www.visitnorway.com/no/Reisemal/Sorlandet/Sirdal/Aktiviteter-i-Sirdal/Turforslag-i-Sirdal/
4) http://de.academic.ru/dic.nsf/dewiki/1128702
5)http://www.nsg.no/getfile.php/NSG-bilder/For%20pressen/Sau_3.JPG
6)http://travel4joy.info/?tag=kjerag
7)http://www.turistforeningen.no/nyheter/75-fjellsportkonferanse-i-sogndal/
Map of site, from left to right:
1) to 11) own image
Site atmophere
1) to 3) own image
Nordic landscape: own image
Landscape analysis: own image
Site section: own image
Vegetation image: own image
History of Hjelmeland:
1) own sketch
2) own image
3) http://tangerinetravel.com/blog/wp-content/uploads/2012/10/IMG_8074.jpg
Local building analysis:
1) own sketch
2) own sketch
3) own image
Local building material: own image
Architecture, tourism, and sustainable development:
http://bcchoice.com/uploads/3/4/1/7/3417067/9027174_orig.jpg
Case study, The searanch:
1) to 5) http://introduccionalaaquitectura.blogspot.dk/2011_09_01_archive.html
Juvet Landscape hotel
1) to 5) http://designalmic.com/juvet-landscape-hotel-jsa-jensen-skodvin-arkitektkontor/juvet-landscape-hotel-by-jsa-jensen-skodvin-arkitektkontor-section/
Introduction
1) own image
2) own image
Getting started: all own material
Community and path: all own material
Masterplan dewelopment: all own material
Development of plan: all own material
Privacy: all own material
Materials
1) Grass http://www.gservice.as/torvtak.html
2) Timber http://tuvabulous.com/2011/02/21/kebony/
3) Wool http://www.hifisentralen.no/forumet/mitt-a
7)Geneiss: http://sim2007.com/images/1.9%20Gneiss%20Blue%20Marine%20Small.jpg
Epilogue:
1) Own image
2) Own image
3) Own image

Illustrations

Method: own illustration based on Knudstrup's method
Map of site: Map from hjelmeland
Site section: Own illustration
Clima: Metrologisk institutt
Sustainbility: http://www.bbc.co.uk/bbc.com/future/BBCF_infoData_stock_check.pdf
Preception of sustainbility:
1)WWhttp://ourfiniteworld.com/2012/03/12/world-energy-consumption-since-1820-in-charts/
2)http://www.ashrae.gr/PDFs/EinB2013%20presentations/EinB2013_Presentation_Trachte.pdf
Structual Calculations: www.glulam.co.uk (see ill)
Acoustics: own illustration
Be10: own illustration
BSim: own illustration

Back page: own illistration

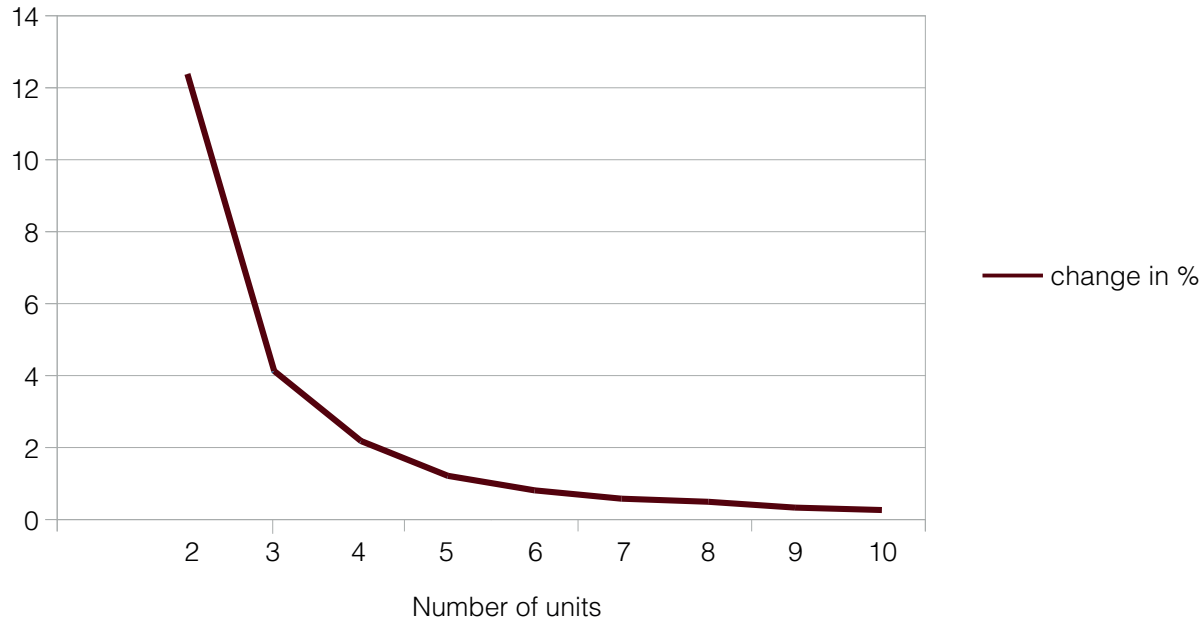
Appendix

1) Density
2) Be10 Key numbers
3) Minimum Ventilation
4) Minimum Air Change Rate
5) Window tests
6) U Values
7) Orientation
8) Firewood Calculations

1) Density

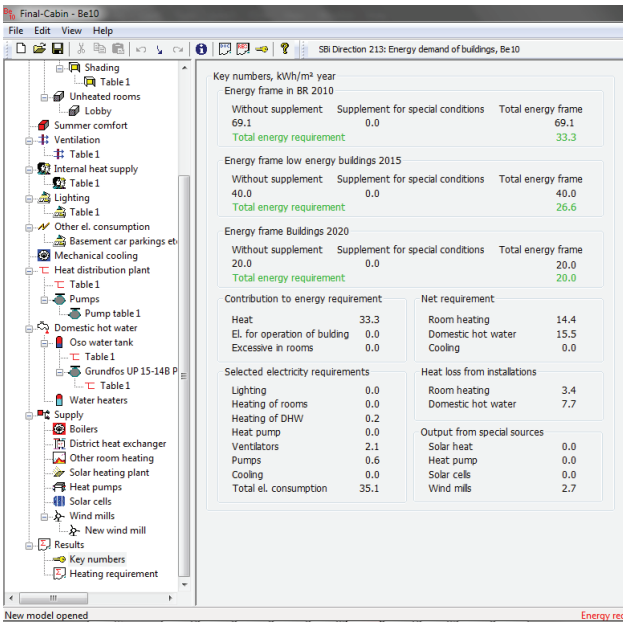
The chart above explains what happens with the heating energy requirement/sqm when we are stacking buildings together.
As a starting point we used a typical building L=10m W=6m H=2.5m
Following the first test we ran a second one where two of the above descried buildings were attached to each other with their longer side.The change was dramatic, the heating energy/sqm demand has dropped by more than 12%.
Further tests showed, that stacking building together, in order to increase density and thus energy performance has its limitations. Over 5 , 6 buildings the relative change has dropped under 2% and with more than 10 attached buildings the relative change is well under 1%.

These results made it clear for us, that while we desire compactness, we should not limit our design to one long continuous building block as over 6 building it has very little if any effects.
Our typical group of buildings consists 6 units.

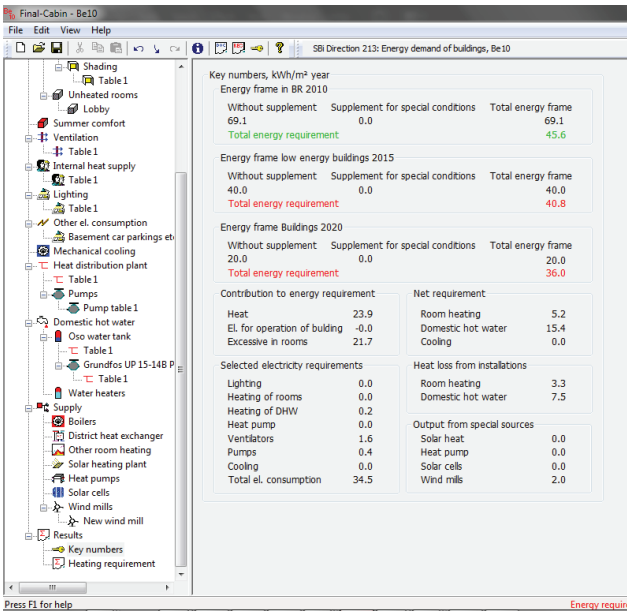


2) Be10 Key Numbers

Group of cabins

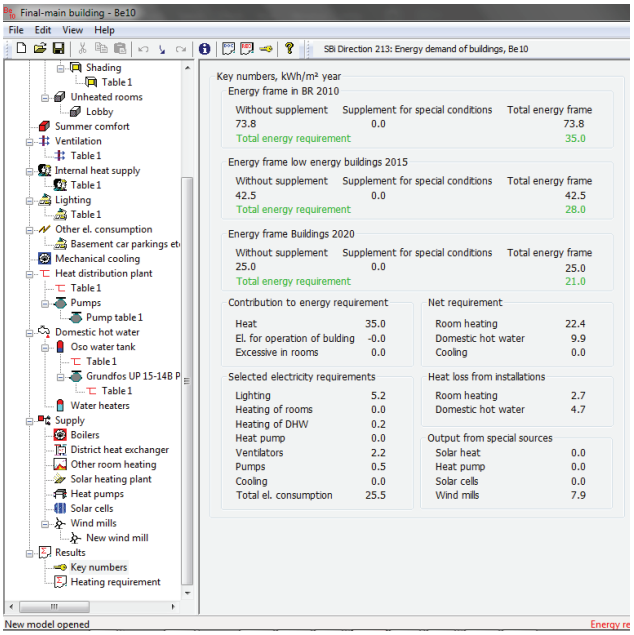


Be10 results with Norwegian - Bergen - climate data

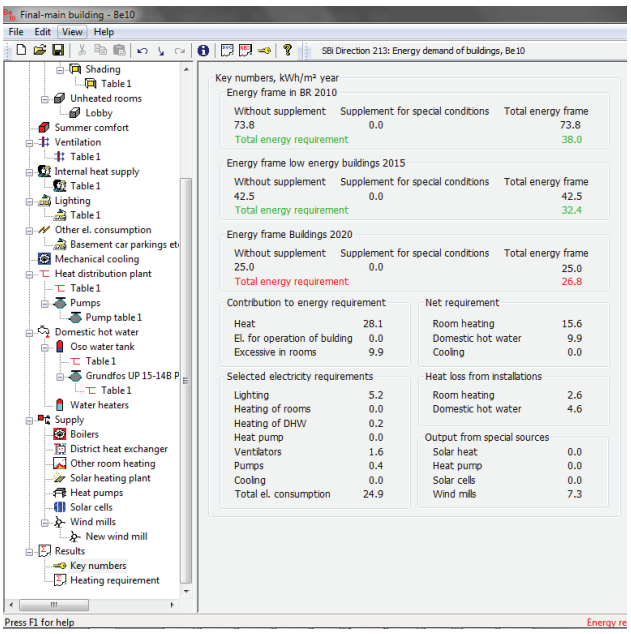


Be10 results with typical - Danish - climate data

Main building



Be10 results with Norwegian - Bergen - climate data



Be10 results with typical - Danish - climate data

3) Minimum Ventilation

CO_2 Calculation		
Number of occupants	15.00	
Average occupancy [64.5%]	9.68	
Pollution load of chemical [l/h·person]	19.00	CR1752: Class II
Allowed Co_2 -level difference [ppm]	660.00	CR1752: Class II
Effectiveness [-]	0.90	CR1752: Class II
Floor area [m^2]	398.30	
Air change volume for CO_2 [l/s·m^2]		0.19
Air change ratio [1/h]		0.12

CO_2 Calculation	
Total pollution load	0.46
Allowance in time	2.38
Pollution per m^2	0.02
Apartment volume [m^3]	2349.97
Apartment volume [l]	2349970.00
Air change volume [l/h]	278522.73

Odour calculation		
Number of occupants	15.00	
Average occupancy (64.5%)	9.68	
Person pollution [olf/person]	1.00	non-smokers
Building pollution [olf·m^2]	0.05	low polluting building
Desired air quality	1.40	CR1752: Class II
Perceived outdoor air-quality	0.10	
Effectiveness	0.90	
Floor area	398.30	
Constant	10.00	from formula
Air change volume for odour [l/s·m^2]		0.63
Air change ratio [1/h]		0.39

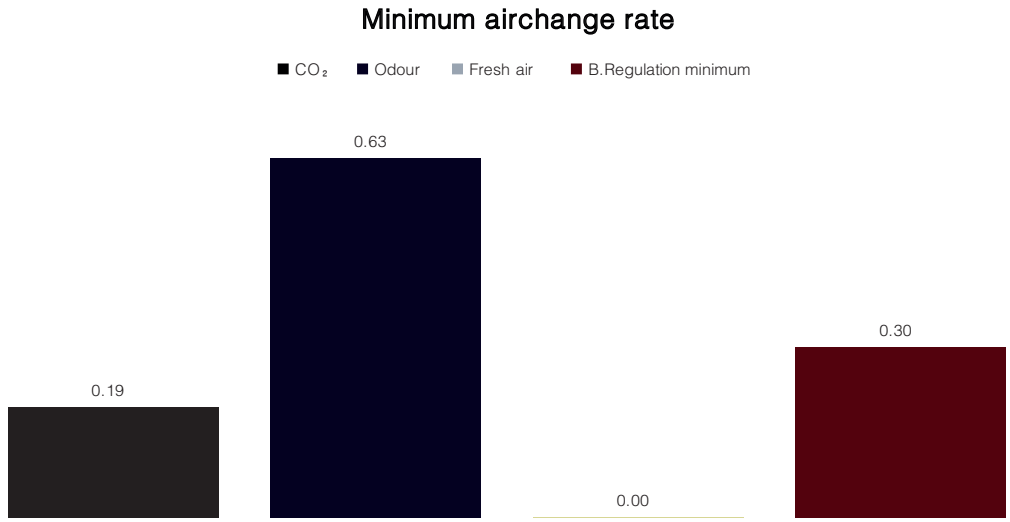
Odour calculation	
People pollution for area [olf/m^2]	0.02
Sum of pollution for area [olf/m^2]	0.07
Air change volume [l/h]	910461.54

Fresh air need calculation		
Number of occupants on average	9.68	
Fresh air need for 1 person [l/h]	7.00	CR1752: Class II
Fresh air need [l/h]	67.73	
Air change volume for fresh air [l/s·m^2]		0.000047232

Overall air-change volumes		Overall air-change volumes	
CO_2	0.19	CO_2	0.19
Fresh air	0.00	Odour	0.63
B.Regulation	0.30	Fresh air	0.00
Odour	0.63	B.Regulation	0.30

Highest air-change volume	0.63

4) Minimum Air Change Rate



Pressure Coefficient		Windfactor	0.57	Pwind	0.0 pa		
Windward	0.05	Vmeteo	0.3 m/s	Pmin	0.0 pa		
Leeward	-0.3	Vref	0.171 m/s	Pmax	0.0 pa		
roof	-0.4						
Location of neutral plan, Ho	2.8 m			Buildingvol.	m3		
Outdoor temperature	22 C			Volume	m3/section/floor		
Zone temperature	25 C						
Discharge coefficient	0.7			Internal pressu	pa	0.00	0.00
Air density	1.25 kg/m3						

	Area m2	Eff. Area m2	Height m	Thermal Buoyε pa	AFR (thermal) m3/s	Press Coef	Wind press pa	AFR Wind) m3/s	Wind pressu pa	AFR total m3/s
door	3.6	2.520	3.18	-0.047	-0.69	-0.3	-0.001	-0.120	-0.002	-0.700
kitchen	1.94	1.358	1.5	0.161	0.69	0.05	0.005	0.121	0.005	0.699
Skylight	2	1.400	7.8	-0.618	-1.39	-0.4	-0.003	-0.101	-0.003	-1.395
				Massebalance	0.00		Massebalance	0.00		0.00

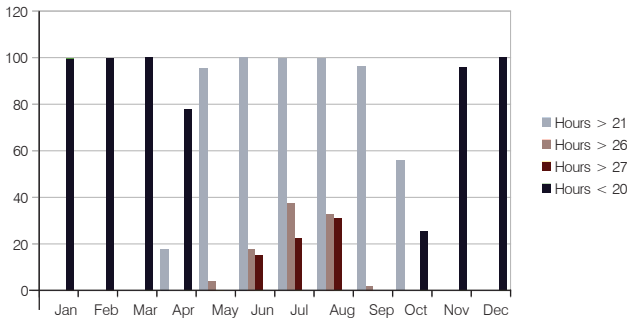
Vl (m³/h) 2517.74865

Maximum possible air supply during summer at lowest wind speed and worst wind direction = 2517.74 m³/h

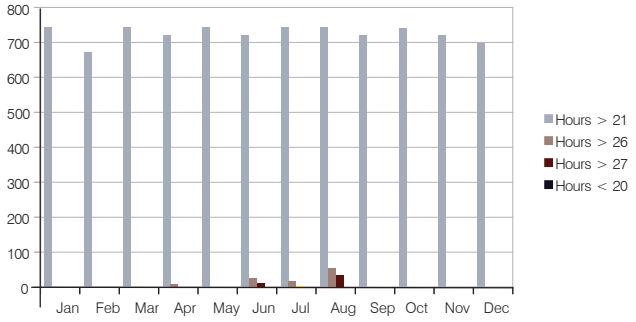
Ventilation need at 2.3 l/sec/sqm = 496.8 m³/h

5) Window tests

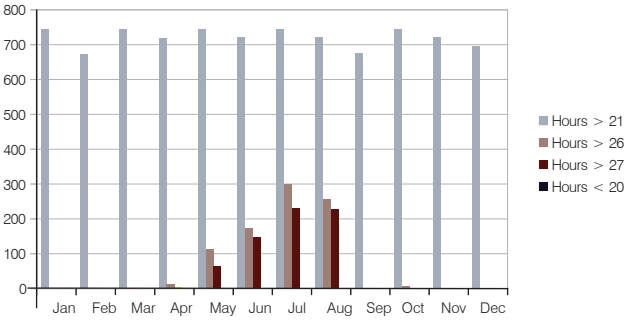
Excample 1



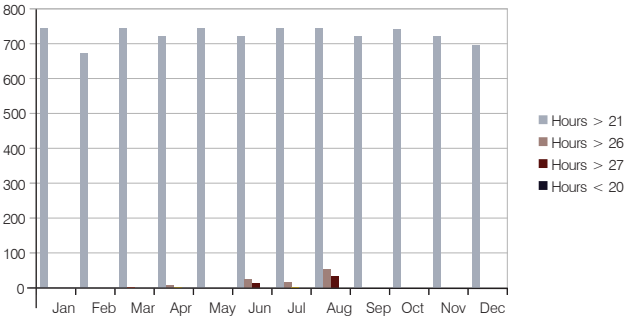
Option B



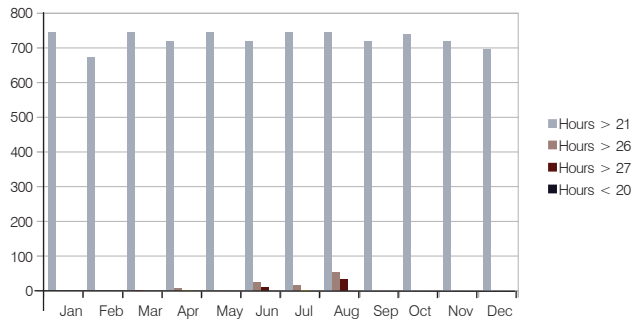
Option A



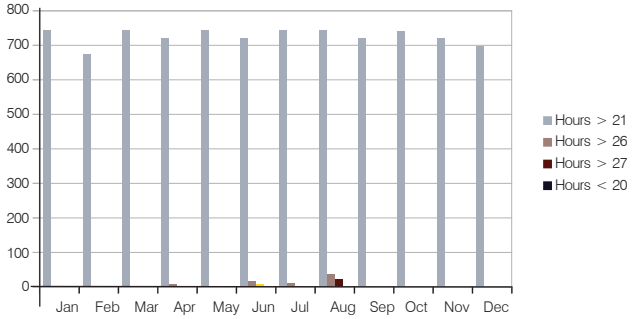
Option C



Option D



Option F



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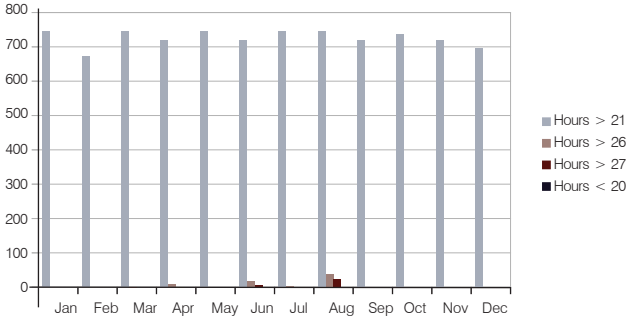
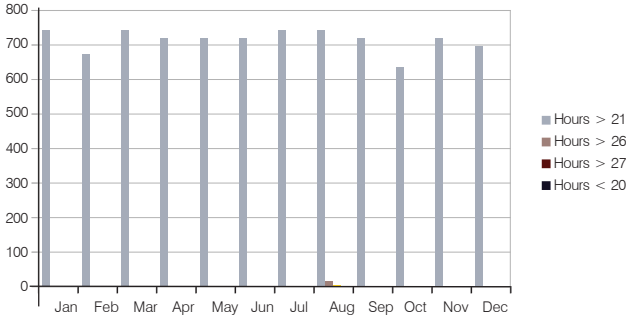
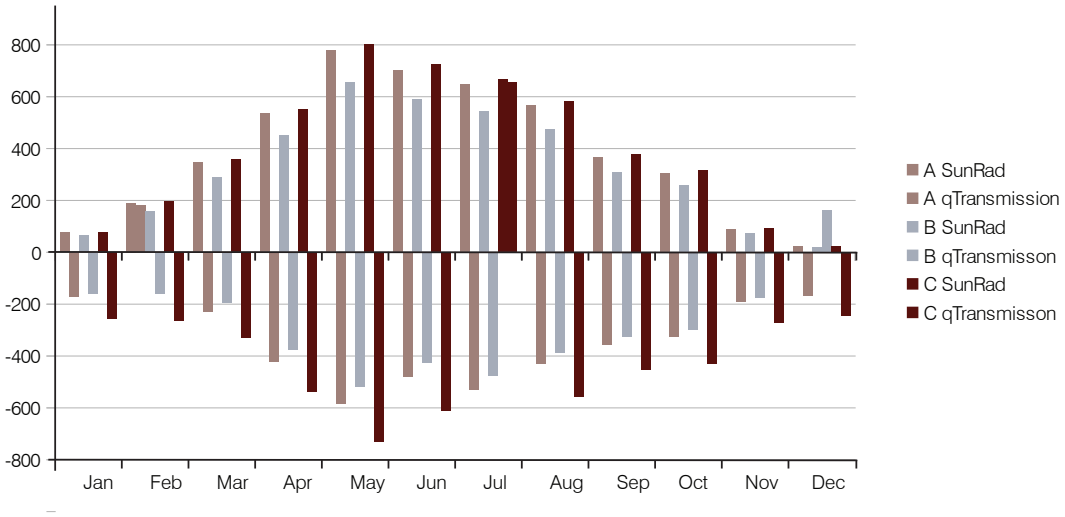


Option G

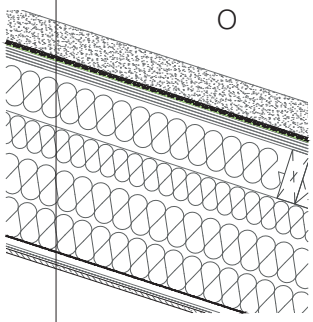


5) Window tests



6) U Values

Roof U value estimation



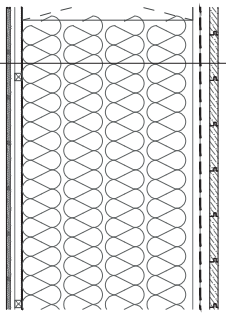
I

-100mm growing medium
R-not applicable
- Membranes
R-not applicable
-32mm Plywood
R=0.750
-135mm Sheepwool insulation with 135x50 joists @600c/c
R=3.462 joist R=1.125
-315mm Sheepwool insulation with 315x90 joists @600c/c
R=8.077 joist R=2.625
-Reflective vapour layer by Tyvek
R=0.67
-Unventilated cavity
R=0.18
-12mm particle board
R=0.09
-10mm timber cladding
R=0.083

Rw=12.29 sqmK/W
Uw=0.081 W/sqmK

Wall U value estimation

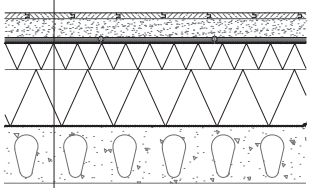
I O



- 22 mm timber caldding
R=0.183
- Ventilated cavity
R-not applicable
-20mm insulating timber board by Gutex
R=0.455
-450mm Sheepwool insulation with 450x115 joists @600c/c
R=11.538 joist R=3.75
-Reflective vapour layer by Tyvek
R=0.67
-Unventilated cavity
R=0.18
-12mm particle board
R=0.09
-10mm timber cladding
R=0.083

Rw=11.49 sqmK/W
Uw=0.087 W/sqmK

I



O

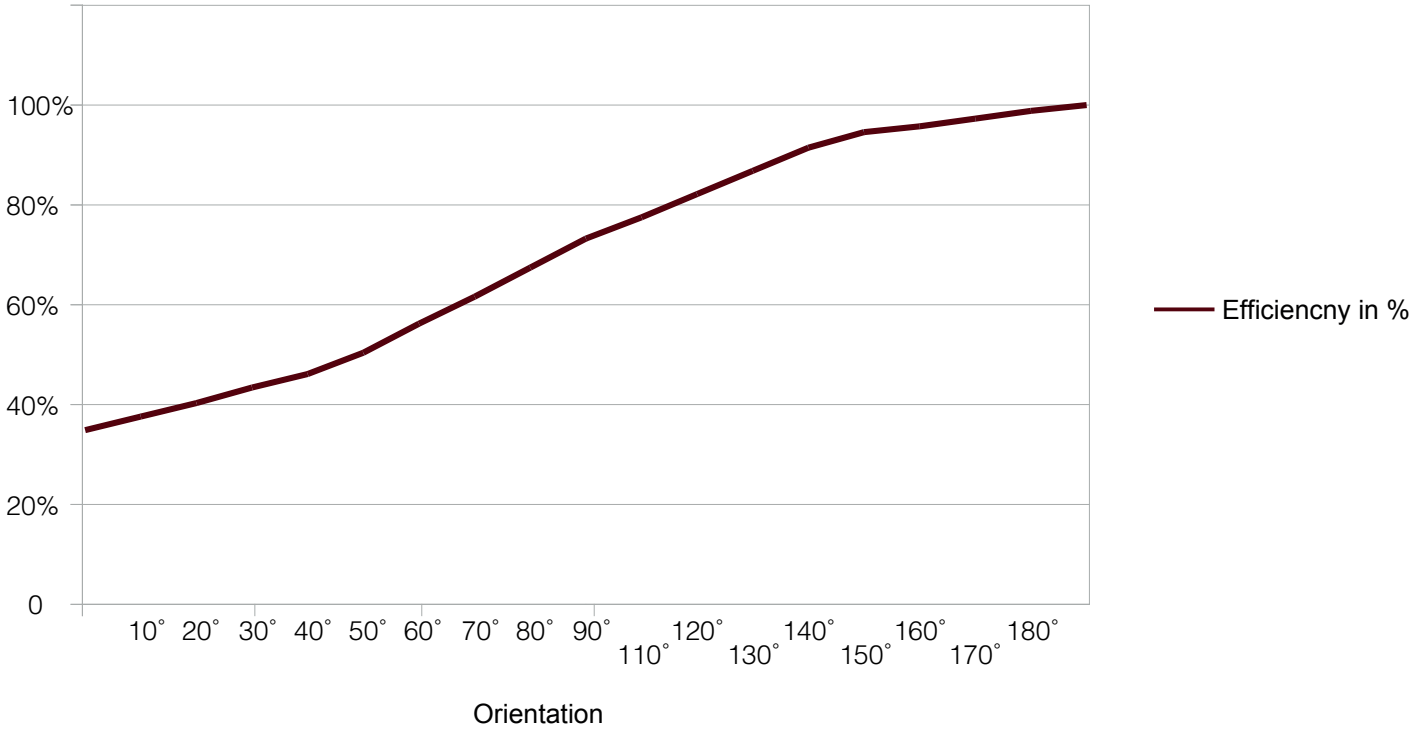
- 15mm timber floor
R=0.125
- 50mm screed
R=0.205
-20mm insulating timber board by Gutex
R=0.455
-15mm plastic channel for underheating pipes
R-not applicable
Reflective protection layer
- 220mm FF4000 Celotex insulation
R=10.0
-150mm concrete hollow core element
R=neglectable
P/A ratio=0.29

U and R value from table
www.celotex.com

Rw=12.05 sqmK/W
Uw=0.083 W/sqmK

7) Orientation

The following chart is the result of our tests where we explored the connection in between orientation and solar heat gain and loss.
The tests were all carried out in Be10 and we used a typical building W=6m L=10m H=2.5m with one 1sqm window without any shading.
Initially the window was facing to the south and we established this situation as the best in terms of solar heat gain and transmission loss, on a yearly basis, through the window.
In the following tests the building was rotated each time by 10 degrees and the sum of the solar heat gain and transmission loss was recorded and evaluated in relation to the first option – 100%.
While the common belief, that windows facing to the South are the most energy efficient was proved it also became clear very soon, that turning the building with even 30 or 40 degrees to the east or to the west has very little effect on the solar heat gain.
Should the building, and with it the window, be turned by as much as 50 degrees the solar heat gain would be still only 10% less than in the South facing version.
As a result of this tests, we felt much more confident to turn our buildings away from the South. In our particular case, where the most interesting view was not towards the South this was a great help.



8) Firewood

Energy need (thermal)		
	kWh/sqm/year-Cabin	Main
Heating	14.40	22.40
Domestic HW	15.50	9.90

Based on Be10 estimations

Energy content of wood types				
Wood type	mBTU/Cord	kWh/m3	Density	kWh/kg
Birch	21.70	1754.60	650.00	2.70
Calculative value*	-	-	-	4.50

** The Sustainable Energy Development Office (SEDO)*

Energy supply					
Building area (sqm)	Heating energy (kWh)	DHW (kWh)	Birch (kg)	SEDO (kg)	
1506.80	21697.92	23355.40	8038.10	4821.76	heating only
			8652.13	5190.09	DHW only
			16690.23	10011.85	Total
557.60	12490.24	5520.24	4627.07	2775.61	heating only
			2045.00	1226.72	DHW only
			6672.07	4002.33	Total
		Sum	23362.30	14014.18	

Available firewood				
Permanent forest				
Area (sqm)	Years	Firewood(kg)	Firewood(kg)/year	Firewood(kg)/year/sqm
1.00	5.00	4.00	0.80	0.80
Harvested forest				
1.00	30.00	65.00	2.17	2.17

Boiler efficiency 91%

Minimum forested area to meet energy requirements			
Permanent forest	forest needed (sqm)	Permanent forest	forest needed (sqm)
Birch		SEDO	
Heating	17398.79	Heating	10436.89
DHW	14695.18	DHW	8815.09
Total	32093.96	Total	19251.98
Harvested forest	forest needed (sqm)	Harvested forest	forest needed (sqm)
Birch		SEDO	
Heating	6424.37	Heating	3853.74
DHW	5426.08	DHW	3254.90
Total	11850.44	Total	7108.64

Total forested area reuirement varies between 3.2 Ha to 0.7 Ha depending on the type of forest, usage and calculation method. SEDO is the generally accepted method the other method is based on experience.
Permanent forest means a forest that is never harvested only cleared out in every 5 years.
Harvested forests are logged in every 30 years. While the later is more efficient the first option, permanent forest is much more sustainable.
In comparison, Norway has about 7 million Ha of productive forests.