*"In the Norwegian reality you are standing there on the ground and has nothing else to relate your thoughts to than nature. The intellectual realm meets the landscape and in this duel which arises, beauty is born. In that respect you can not be sentimental, you do not start to scrabble with the landscape. The more precise you can be, the more ruthless you can design this meeting, the more intensively the accentuation of nature will be, and the stronger your architectonic tale will appear."*

Interview with Sverre Fehn [Yvenes, 2008, p. 39]

# Velleseter

## A Contemporary Norwegian Mountain Cabin

# Colophon

| | |
|---|---|
| Project title: | Velleseter - A Contemporary Norwegian Mountain Cabin |
| Main theme: | The interplay between architecture and nature |
| Project group: | ma4 - ark27, Martin Wikkelsø Brandt |
| Semester: | Thesis project<br>4th semester, Architectural Design<br>Department of Architecture, Design & Media Technology<br>Aalborg University |
| Project period: | 1st February 2010 - 2nd June 2010 |
| Main supervisor: | Peter Mandal Hansen<br>Architect MAA<br>Aalborg University |
| Technical supervisor: | Asger Hyldgaard<br>Department of Civil Engineering<br>Aalborg University |
| Report print: | 6 |
| Pages: | 163 |

*Martin Wikkelsø Brandt*

## Acknowledgements

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In addition to his assistance and guidance during the visit to Velleseter, I would also like to thank Inga Lindstrøm, *Bergen Arkitekt Skole*, and Knut Slinning, *Juvet Landscape Hotel*, for their generous help with making my study trip to Norway an unforgettable experience.

## Summary

This project focuses on examining the interplay between architecture and its context. The project leads to the design of a contemporary interpretation of a Norwegian mountain cabin.  This is done by a phenomenological approach to understand the natural surroundings with the integration of tectonic principles, to reach a design proposal that expresses a distinct relation to its given context.

# Table of contents

# Foreword

This project was completed as a master thesis during the 4th semester Architectural Design project unit as part of the master programme of Architecture and Design at Aalborg University. The project was completed during the period of 1st of February to 2nd of June 2010.

The report is written so that the different phases of the project are presented in a logical chronology, although the project is based on an iterative design process. This means that design solutions and ideas might be presented at an earlier stage to best explain the design process. The final design proposal is therefore presented before the sketching and synthesis phases to give the reader an early idea of what the final design looks like and to better understand the thoughts and solutions developed during the design process. The presentation part of the report is complemented by a drawing folder where technical drawings and details are presented.

# Readers guidance

The building typology of the project is referred to as a mountain cabin. This term was chosen to represent the translation from a Norwegian 'fjellhytte'. The term 'cabin' is also used by the Norwegian Trekking Association and covers all unstaffed shelters, while the term 'lodge' is used for larger staffed shelters or hotels.

Throughout the report references are used in accordance to the Harvard Method [Author, year] for books and articles and [designated name] for web pages. References for illustrations are indicated by continuing numbers [Ill. #]. The references can be found at the end of the report. If nothing else is indicated the illustration is own production. Appendixes are referred to by their respective [name].

# Introduction

With a subject area of understanding and utilising the interplay between nature and architecture, this project demonstrates the author's abilities to achieve a combination of design and technical solutions in an integrated whole. This is done by using theories and methodologies, along with skills and competencies acquired throughout the bachelor- and master programme in Architectural Design.

The project is based on a collaboration with a local division of the Norwegian Trekking Association (Den Norske Turistforening, DNT) to design a contemporary mountain cabin. The Norwegian Trekking Association has multiple of these cabins, which are used for tourism and overnight stays during trekking in the extensive network of routes covering the Norwegian fjell. However, all of these cabins look the same, stressing the 'national romantic' style with references to both the *Arts and Crafts* movement in England, Swiss cottage architecture, and local building traditions. The cabins show only little or no development in their architectural expression or building techniques, therefore this project aims to answer the question: *What does a contemporary Norwegian mountain cabin looks like?*

This also includes perspectives of the future concept for the DNT cabins and the design should therefore implement current tendencies of Norwegian tourism. Thereby the mountain cabin will gain the perspective of forming a model on which a future typology of DNT cabins can be based. The idea is although not to let the specific design proposal function as a universal modular unit which can be copied to all given locations, but that for example the organisation, architectural expression and design strategy can be transferred to other projects.

# Motivation

The thesis project covers a theme and project brief chosen by each individual student. The report should therefore reflect the individual references of the student. My motivation for this project was to work with contextual design in a context different from an urban environment. This led to a theme of understanding the interplay between architecture and nature, and raised the following initial question:

***How can marked characteristics of a given landscape be extracted and used in architecture?***

To answer this question a distinct context, with inherent possibilities and qualities to use in the architecture, is essential. From here it developed to a project brief that focuses on the design of a Norwegian mountain cabin. This offers the possibilities of focusing on the interplay between buildings and landscape, but furthermore includes central themes as phenomenology and vernacular architecture.

# Methods

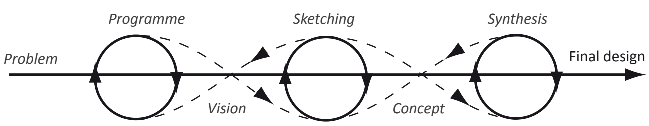
Throughout the project several methods are used to control and form the creative process. The main method used for this project is the ***Integrated Design Process (IDP)***. This strategy contains four phases; Programme, Sketching, Synthesis and Presentation, and promotes the integration of both aesthetic and technical parameters, which through multiple iterations will lead to an integrated design.

To control the project weekly agendas are used in combination with a ***Gant scheme*** that shows the assessed time use and chronology of the different phases of the project, see Appendix [Gant scheme].

For the programme phase two different methods will be used adapted to this specific project, ***mapping*** by Kevin Lynch and ***serial vision*** by Gordon Cullen. A context analysis will be made, which contains a mapping of the different characteristics of the site, while the approach to the site will be described visually through a serial vision to enhance the phenomenological understanding of the site.

The sketching phase will use the ***systematic sketching***-method by Steen Agger, to systematically evaluate each sketch to ensure that ideas and qualities are carried on in the design process.

Both the sketching- and synthesis phase will implement several ***tools***. Among these are hand sketching, physical- and digital models, multiple digital tools such as 3D Rhinoceros, 3ds Max, AutoCAD Architecture, Revit Architecture, Excel spreadsheets and STAAD.Pro.




*Ill. 001: The Integrated Design Process*

# Project brief

As described in the Introduction, this project concerns the design of a Norwegian mountain cabin. It should be noted that it is a fictive project, yet based on collaboration with Ålesund & Sunmøre Turistforening (ÅST), a local division of the Norwegian Trekking Association. DNT has more than 460 cabins across the country, all situated in beautiful scenic surroundings. The cabins are divided into three categories: Staffed lodges, self-service cabins and no-service cabins. Common for all of them is that they are locked with the standard DNT cabin key, which can be acquired by all DNT members.

Among the different DNT cabins I chose to work with the site of Velleseterhytten because of the qualities and potential of the landscape and for practical reasons, such as possible access during winter. Today Velleseterhytten functions as a no-service cabin with beds for 9 guests, but the idea of this project is to expand the cabin to a staffed lodge or self-service cabin with 30-40 beds. The justification for this expansion is based on regional tendencies and educational aspects. In the last few years the neighbouring cabin, Patchellhytta, has seen an increase in overnight guests and is therefore expanding from 27 to 50 beds [Fjellposten, 2009]. This points towards an increased awareness of and interest for the qualities of the region, and the expansion of Velleseterhytten is therefore seen as a possible catalyst for the tourism of the region. Furthermore an expansion will help form a project of a substantial extent, regarding proportions and possible educational challenges. The brief can thereby be summarized as:

***To design a proposal for a new extended Velleseterhytte.***

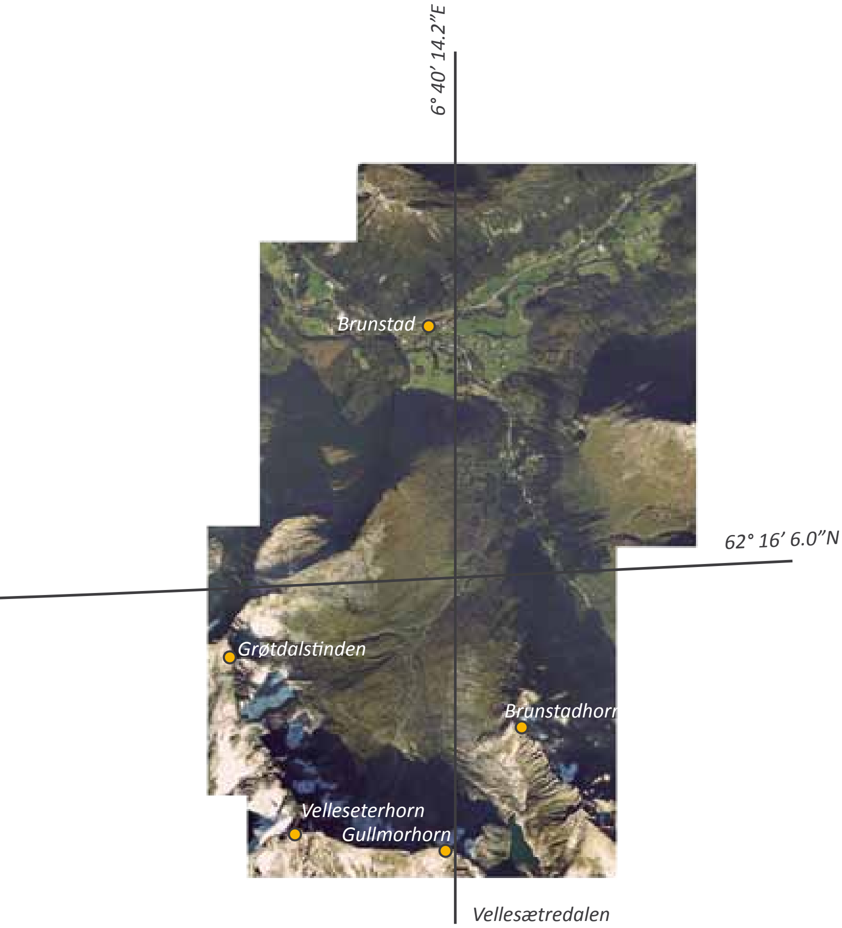
This will be done by an integration of the phenomenological approach and tectonic principles, such as specifying constructional details, materials and structural system. These aspects will form the base for defining the vision, which will be described at the end of the programme phase.

*Ill. 002: Existing DNT cabins*

# Context analysis
## Velleseter

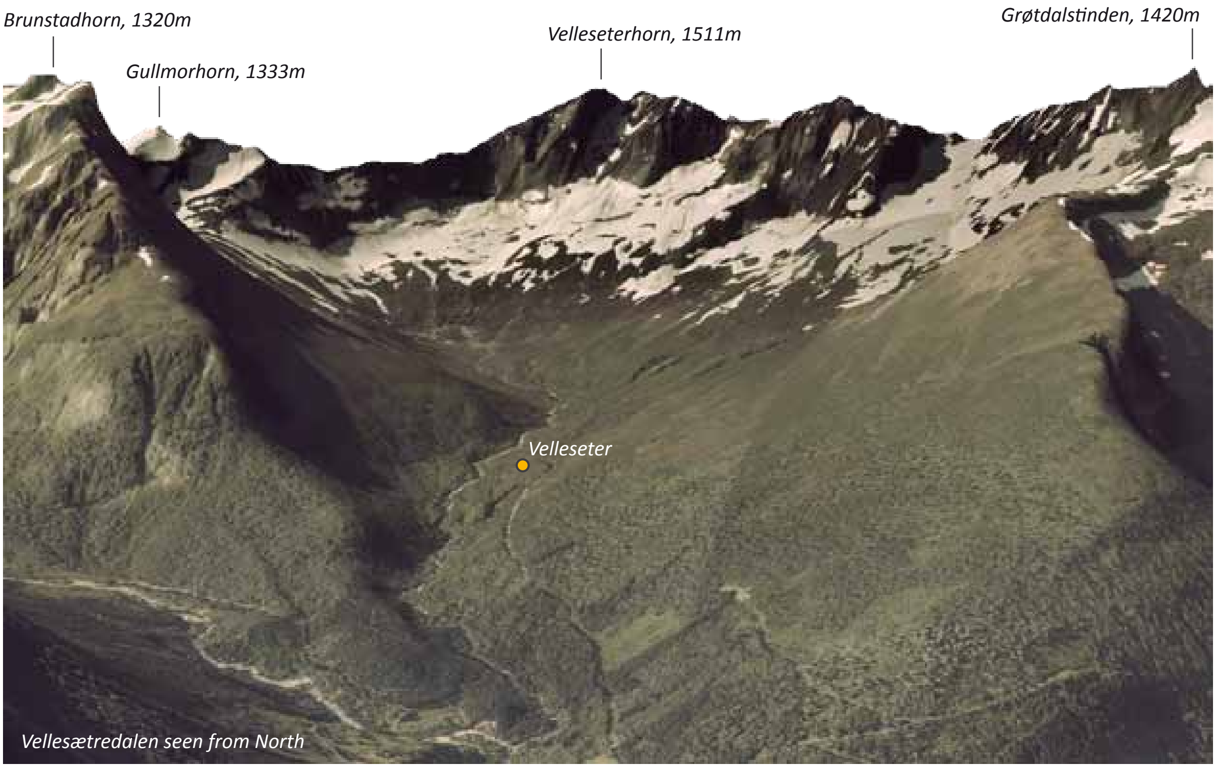

With reference to the initial question raised in the previous *Motivation,* an analysis and mapping of the project site is essential. The following chapter therefore starts with an introduction to the chosen site and aims to describe the context of the site together with its qualities, and mark its characteristics.

**Vellesætredalen**
Vellesætredalen is situated at Sykkylven Kommune 40km South-East of Ålesund on the peninsula Sunnmøre. It forms a valley approximately 3km wide and 4km long, and is named after the neighbouring valley, Velledalen, in which the small village Brunstad is situated. The valley is closed towards south by the mountain ridges of Velleseterhornet and Brunstadhornet among others, while it opens up towards North and Brunstad.




‘Sætre‘ refers to the small area of Vellesætredalen which was used as a *seter* (mountain pasture), an area with vegetation cover that can be used for grazing of livestock. The *seter* was used during the summer months, where seven to eight people lived on the *seter* to shepherd the livestock, and was in use until 1966. In 1969 ÅST arranged with the owners of Velleseter to manage Velleseter and the first recreational mountain cabin was built, Velleseterhytten [Velle, 2003].

# Site



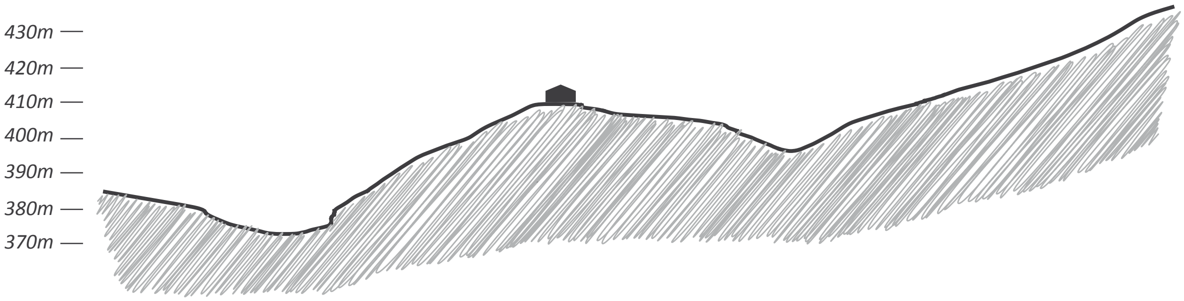
*Vellesætredalen seen from North*

As it is seen on the illustration above, Velleseter is placed at the mouth of Vellesætredalen with the scenic mountain ridges as an impressive backdrop. At the bottom of the illustration the path from Brunstad towards Velleseterhytten starts. The path starts at 120m above sea level and continues for about 2km into the valley until it reaches Velleseter at 410m above sea level. This height difference of 290m provides a panoramic view towards Brunstad from the site. The walk along this path is described from a phenomenological point of view in the chapter *Phenomenology*.

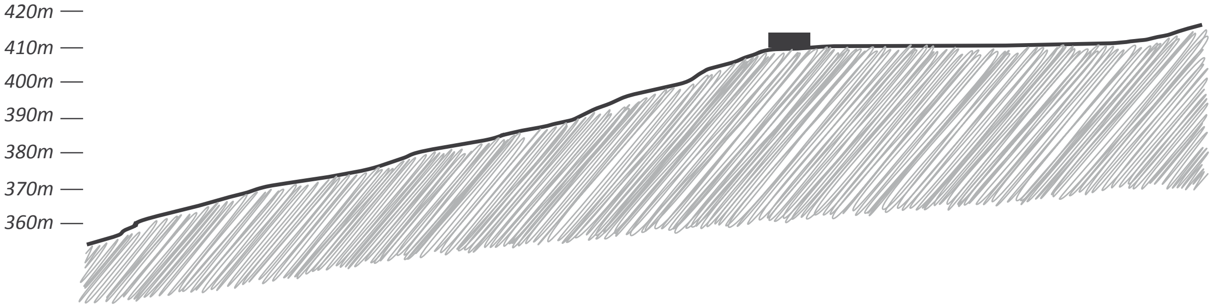

Velleseter is defined by its vegetation which marks a clearing among the low bushes of Vellesætredalen. This marks the *seter* as an area of about 9000m$^2$, by being 60m wide and 150m long. East of Velleseter runs the small river, Skreelva, while the western edge is defined by the noticeable smaller brook, Sætreelva.

In the center of the above illustration Velleseterhytten can be seen. It functions as a no-service tourist cabin for ÅST, which means that the cabin can be used for lodging and is equipped with cooking facilities, but there is no water and provisions. The cabin can be used all year round, but requires a DNT-key to get in. The system and use of DNT's mountain cabins is described in the chapter *Project brief*.

## Topography



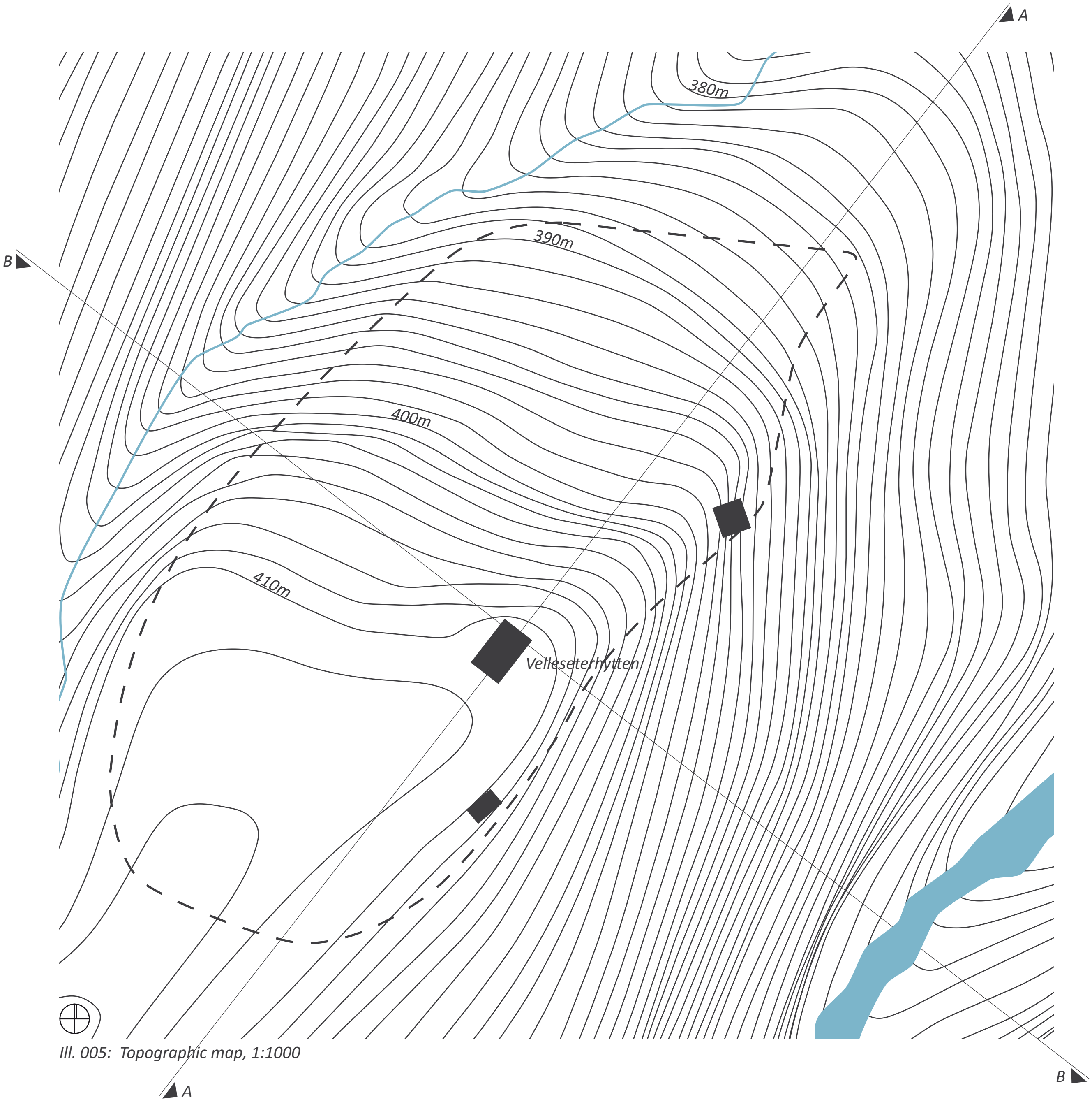

*Ill.003: Site section BB*




*Ill. 004: Site section AA*

Velleseter is naturally defined by the topography of Vellesætredalen, as a hilltop which marks the entrance to the valley. On the top of the climb the terrain flattens and this plateau forms Velleseter.

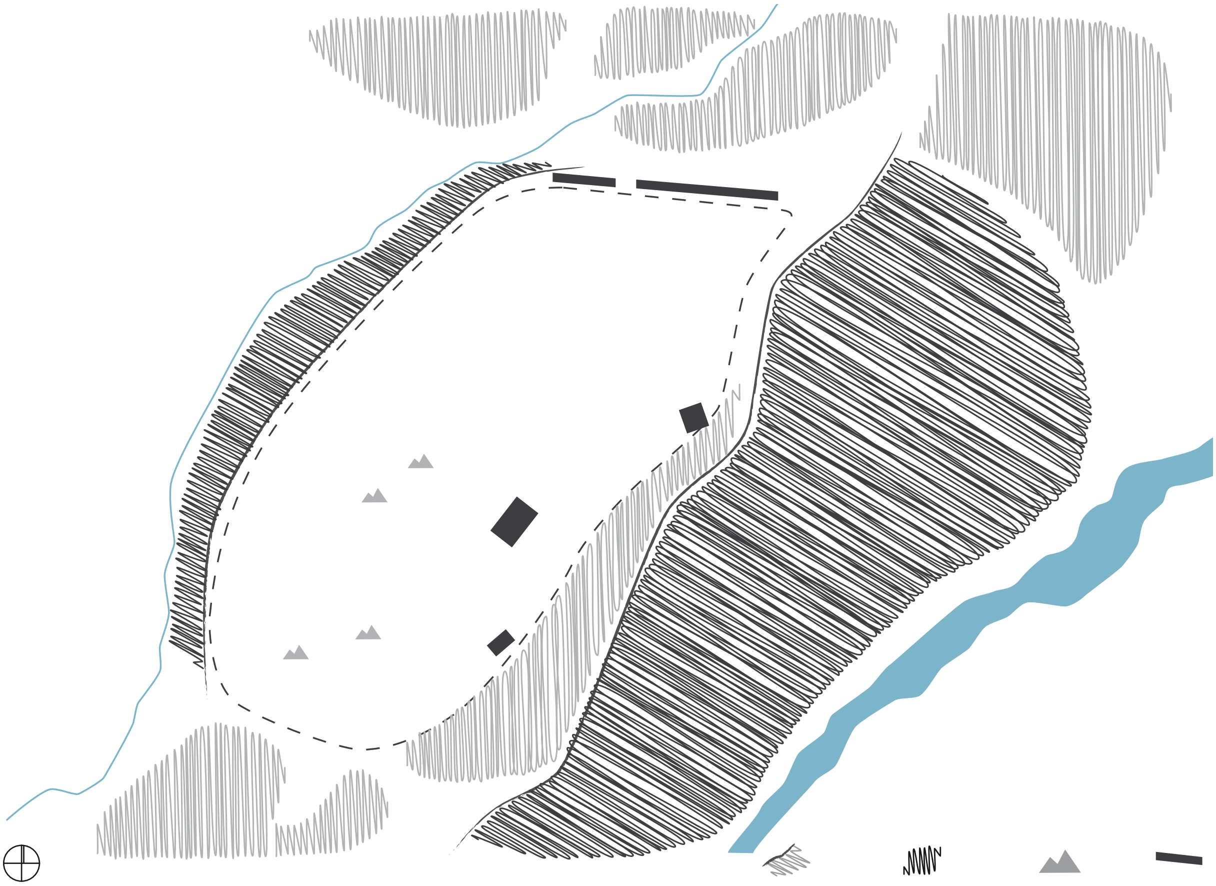
The odd angles of the two site sections shown above are chosen because they follow the contour lines of the site. This orientation is primarily shaped by the two small rivers on either side, and the main approach paths to the site follows this orientation, as it will be shown on the following pages. The *topographic map* and *section BB* shows how the hilltop narrows towards North and forms a natural focus point, where the existing Velleseterhytte is placed. The ascend towards this focus point is seen on *section AA*, and it follows the terrain with a sloping of roughly 15%. The illustrations shown on this spread thereby provides an understanding of the terrain and ideas for the location of the mountain cabin.




Ill. 005: Topographic map, 1:1000

## Registrations

*Ill. 006:  Characteristics of Velleseter*




*Ill. 007: Mapped characteristics and edges*

**Characteristics**
As described earlier, Velleseter marks a clearing among the low vegetation of the valley. The soil consists of a thin top layer of 10 to 20cm earth with hard mountain rock, fjell, underneath. This could be utilized when defining how to build foundations. Although the fjell breaks through the soil on multiple areas of the site, there are only a few places where boulders higher than 1m above the soil are formed. These have been marked on the map above.

**Edges**
The site of Velleseter is defined by steep slopes towards the two small rivers. These slopes are covered by more dense and higher vegetation than the other marked areas on the map above and to build here will therefore have a drastic impact on the surroundings. As an alternative the vegetated area just South-east of Velleseterhytten can be seen as a possibility to build on a lightly vegetated slope. Towards north, the site is defined by a low stone wall, which marks the entrance to the *seter*.

*Ill. 008: Bridge and existing cabins*

*Ill. 009: Mapped paths and views*

### Paths

The primary path of arrival to Velleseterhytten is from North, across the small bridge. This arrival is described more thoroughly in the chapter *Phenomenology*. Another path leads from Patchelhytten, across the mountain ridges and Gullmorbreen, and leads to Velleseterhytten from South. The hike from Patchelhytten to Velleseterhytten takes about 6 hours during the summer period.

### Views

The marked views have been prioritized to function as a design parameter for the orientation and placement of the different functions of the room programme. While the primary and secondary views are spectacular and should be taken into account in the design, the tertiary views have a lower priority. The different views are presented on the following spread.

*Ill. 010:  Primary view towards North*

*Ill. 011:  Secondary view towards Northeast*


*Ill. 012:  Primary view towards South*


*Ill. 013:  Tertiary view towards West*

## Macro climate

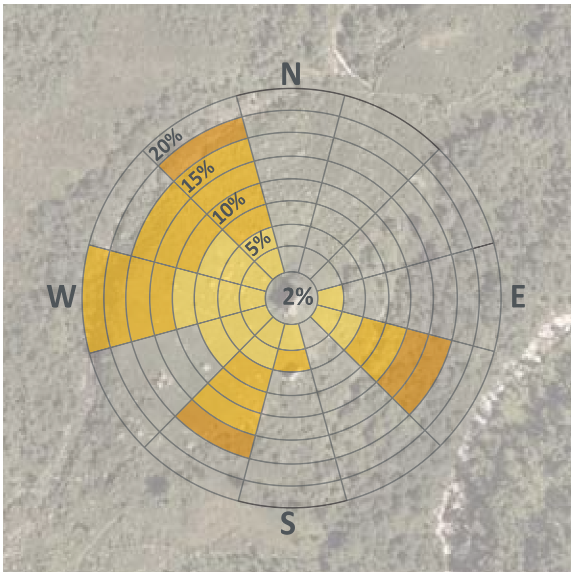
**Wind conditions**
The wind roses illustrate the wind conditions for a reference site. These data were measured by a weather station situated only 8km from Velleseter in a landscape similar to Vellesætredalen [eKlima]. The wind roses do therefore not illustrate the exact wind conditions of Velleseter, but are seen as plausible.

From the illustrations it is seen that the prevailing wind direction depends on the seasons. Although the wind roses show dominating winds from West and North-west, a visit to the site revealed that the prevailing wind direction in Vellesætredalen is actually South and South-east. Winds from South and South-east will therefore be used as a design parameter in the continued process.

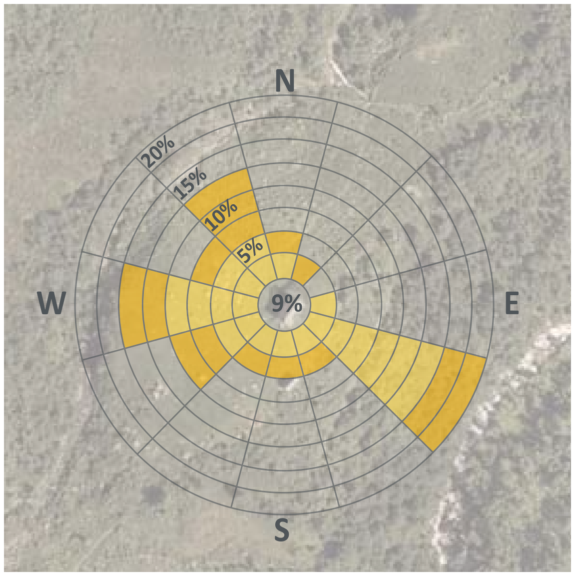
Furthermore if we relate the wind speed to the Beaufort-scale, it is seen that only in a small percentage of time in the winter period the wind reaches velocities above 7,5m/s, which categorizes to *fresh breeze* and stronger. This means that most of the time the wind is categorised as a *moderate breeze* or milder and therefore describes some rather mild wind conditions [Beaufort]. These conditions are especially determined by the surrounding mountains of Vellesætredalen, which help to protect the valley from strong winds.

Knowledge of the wind conditions can be used for determining the appropriate positioning of building volumes to create shelter for possible outdoor spaces, and the dominating wind direction are also used for determining the wind loads used in structural calculations. Furthermore the wind conditions will have an effect on how snow drift across the site and can be used to investigate how snow will shape around the mountain cabin.

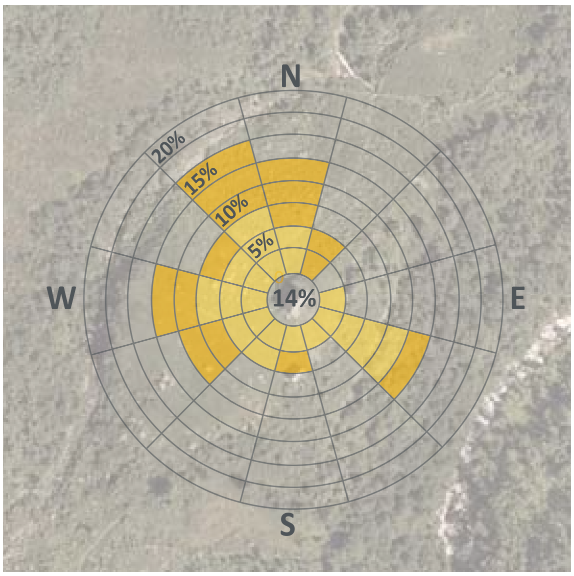
% calm    0-3,8 m/s    3,8-7,5 m/s    > 7,5 m/s



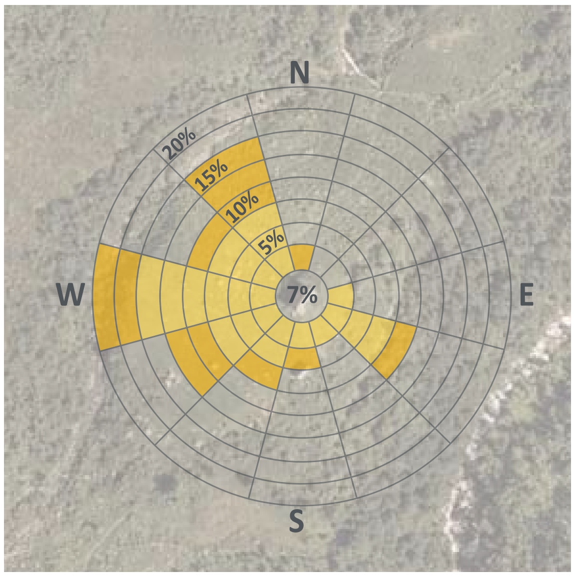
*Wind rose: Dec - Feb*



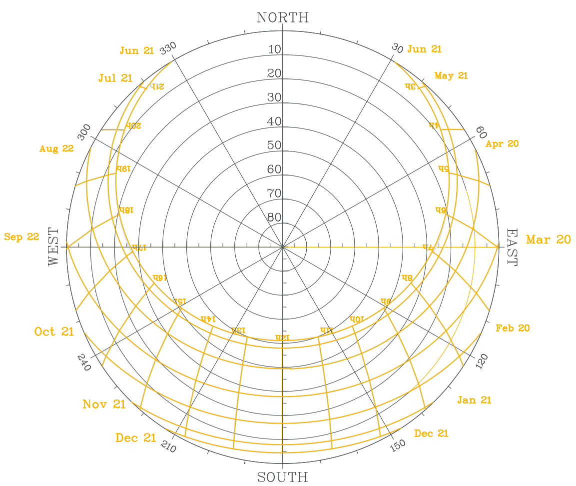
*Wind rose: Mar - May*

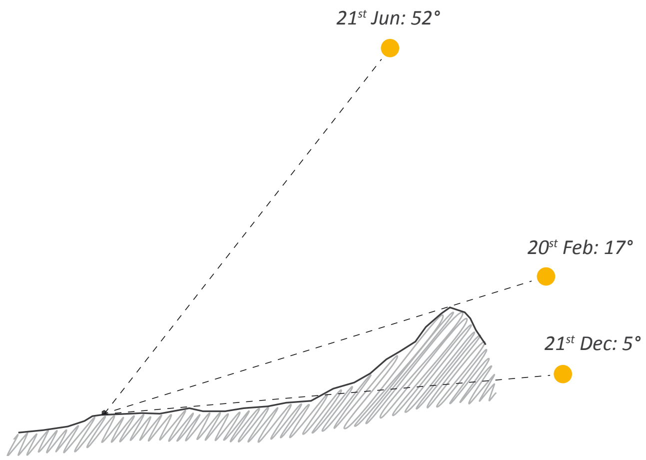


*Wind rose: Jun - Aug*



*Wind rose: Sep - Nov*




**Sun path**

A determining factor for the macro-climate of the site is the high latitude position of 62.3°. According to the sun path diagram shown above, this means long and bright evenings during the summer months and less than 5 hours of sunlight during winter.

But as Velleseter is situated in a valley, the topography of the surrounding mountain ridges will shade from the sunlight. This is illustrated on the figure above where the angle between the horizon and the height difference between Velleseter and the ridge has been calculated. As seen the angle is calculated to 17°. When compared to the sun path diagram, it shows that the solar altitude angle will only be above 17° from about the 20th of February to the 21st of November. This means that there will be no direct sunlight on the site in three months during the winter!

Of course this has an effect on choosing relevant design strategies, as it will not be possible to exploit passive solar heating during winter time. Likewise this means that alternative heating strategies are necessary and could have an effect on limiting the seasonal period of use of the cabin.

**Summary**

Velleseter is primarily approached from North along a natural path leading up the steep hillside towards Velleseterhytten at the top. The topography of the site thus naturally marks this location as dominant. East of this location the site slopes towards the small river and creates an interesting terrain which should be challenged in the design phase. Furthermore, because the terrain levels at the top of the hill, a plateau is created, which could be usable for a possible outdoor space.

Opposite to the primarily approach from North, a secondary arrival path leads to Velleseter from South. The directions of these two arrival paths also cover the two primary views, which should be emphasized by the architecture. This of course concerns the orientation of the mountain cabin, which is also influenced by the climatic conditions. Although the wind conditions are rather mild, the prevailing wind direction is South-east, which will influence for example how snow will form around structures. Also the sun path diagram showed that there will be no direct sunlight on the site from mid February to mid November. This speaks for a seasonal division of the use of the cabin.

# Phenomenology
## An architectural approach


*Ill. 014: Point of departure*

This chapter aims to introduce the concepts of phenomenology to the project, to define and understand this particular architectural approach and utilize it in the continuing process. Therefore the chapter will start with a general introduction to the term and explain why it is relevant to include phenomenology in this project. This continues with a focus on the concept of dwelling and relations between building and landscape, and ends with a phenomenological description of experiencing the project site at Velleseter.

### Relevance
Phenomenology is a theoretical approach to architecture which focuses on depicting phenomena without using the categories of natural sciences. It is a way to describe and analyse architecture based on experience and sensory properties, as a contrast to physical proportions and the stylistic expression of a building [Pallasmaa, 2005].

Because phenomenology describes the experience of architecture it has to include a context for this experience to take place. That is why phenomenology concerns the perceived relation between a building and its surrounding landscape, and therefore relevant for this project.

### The phenomenological approach
In order to create a relation between building and site it is central to understand the character and atmosphere of the site, known as *genius loci*. This should not just be understood in local terms, *genius loci* does not just relate to the physical proportions of a site, but is also affected by broader perspectives such as regional traditions and culture [Norberg-Schulz, 2000]. Because the phenomenological approach focuses on understanding the *genius loci* of a place, it has to use human experience and perception as it basics. And as the understanding of an environment always involves several senses, sensing a place and its architecture is not just a visual experience. Herein lays a critique of much contemporary architecture. A broad spectre of architectural projects seems to be only visually determined, intended for the front covers of magazines, and does not contribute to an understanding of their surroundings or man himself.

## To dwell

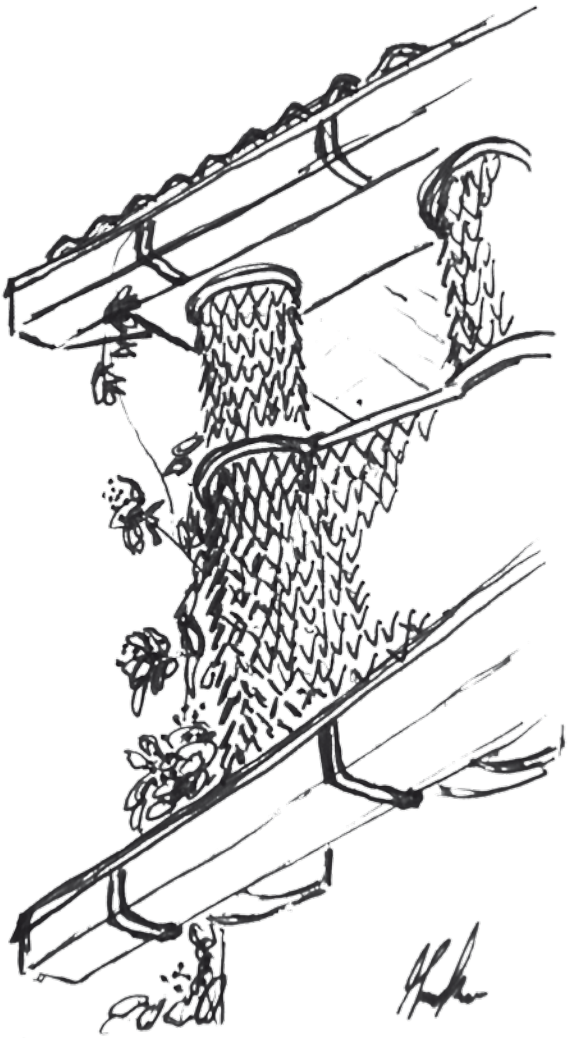
The concept of dwelling does not just relate to having a shelter, but with regard to phenomenology requires a more existential interpretation. To dwell means to belong to a given place, to understand the *genius loci* of it. Furthermore this certain place requires a building, a house, that both enables the individual to express and understand his thoughts, and also relates to its surroundings and expresses its atmosphere and qualities, to make it an ‘inhabited landscape‘ [Norberg-Schulz, 1985].

This provides some parameters for defining the phenomenological approach of Velleseterhytten. First of all the mountain cabin needs to express the *genius loci* of the surroundings, but should also set up a framework for the existential levels of its habitants. This is what separates a mere shelter from a building which enables its habitants to dwell. If related to Maslow’s hierarchy of needs, often represented as a pyramid, the latter would be at the top of the pyramid, while the shelter would belong to the bottom layer [Larsen, 2008]. Here it should be added that it is not the purpose of Velleseterhytten to function as a ‘home’ in the phenomenological sense of the word. ‘Home‘ is the individual expression of the dweller’s personality, according to Juhani Pallasma [Pallasmaa, 2005]. It therefore requires rituals, personal rhythms and routines of everyday life, something which all takes time and therefore not possible in the shorter stays meant for Velleseterhytten.

Instead the mountain cabin should function as a refuge with two primary purposes. One, to function as a shelter from the surroundings, and secondly to act as point of departure for the continuing exploring of the same surroundings. A particular strong experience of approaching a refuge, is “*seeing the illuminated windows of our house in a dark winter landscape, and sensing the invitation of warmth*“, as Pallasmaa has described in the book *Encounters - Architectural Essays* [Pallasmaa, 2005, p. 117]. In this way the refuge of Velleseterhytten should be experienced as the exact opposite of a kafkaesque castle. Furthermore it describes the importance of the hearth and points towards more concrete aspects of the phenomenological relation between architecture and landscape.

*Ill. 015: Primitive shelters*

*Ill. 016: A kafkauesque castle*



*Ill. 017: Sketch of detail from studytrip to Hvitträsk, Finland*

**Architecture and landscape**

According to Christian Norberg-Schulz there are two ways of working with relation between a building and its environment: Either in letting the architecture represent the context or in complementing the environment by adding something that is lacking, to establish a meaningful whole [Norberg-Schulz, 1996]. The two ways can also be combined, for example in respectively the exterior and interior of a building. Building typology and structural principles of vernacular architecture often represent basic regional qualities, while the interior complements the surrounding environment. An example of this is the white colored rooms of the South to minimize the absorbed heat from the sun, while the wooden interiors of the North also complement the environment by adding a sense of warmth to the colder climate [Norberg-Schulz, 2000].

While a house could represent its surrounding environment by repeating and emphasizing qualities, it should still be recognizable as a house. This can be done by utilizing archetypal elements of architecture, as for example a gable or chimney, and again shows the relevance of principles from vernacular architecture [Norberg-Schulz, 2000]. Furthermore, as the mountain cabin functions as a refuge it needs to establish a clear boundary between building and environment. For this purpose windows can be used to frame the surroundings and mark a clear boundary, while the glass walls of contemporary architecture dissolve this boundary and thereby weaken the tension between the refuge and its surroundings. This boundary should be emphasized and not weakened, as it intensifies both  the feeling of shelter and the sensing of the surrounding elements [Pallasmaa, 2005]. Herein lies a contradiction between how Pallasmaa and Norberg-Schulz perceive 'home'. Where Pallasmaa speaks of emphasizing the boundary between building and environment, Norberg-Schulz wants to express the 'home' as a 'point of departure' by projecting roofs, verandas and bay windows" [Norberg-Schulz, 2000]. Either approach is plausible and determining which is most suitable for this project depends on the understanding of the *genius loci* of the site. Therefore the following chapter will describe the phenomenological experience of Velleseter.


*Ill. 018: Sketch of terraced landscape from studytrip to Säynätsalo Town Hall, Finland*

# Photographic essay - Approaching Velleseter

As a continuation of the phenomenological approach related directly to this project, the chapter describes the experience of a visit to Velleseterhytten. This visit was made as part of a study trip, see appendix [Study trip], during which I had the opportunity to spend 24 hours at Velleseterhytten together with the contact person of Ålesund Sunmøre Turistforening, Arild Bergstrøm. The description is presented as a photographic essay. It is inspired by the method *Serial Vision* by Gordon Cullen, where the urban landscape is seen as a series of related spaces [The Concise Townscape].

The start of your approach towards Velleseter is marked by the crossing of the river Brunstadelva. This is the same river that divides and leads into Vellesætredalen and the trail follows it along its right bank.

In 2010 a minor hydroelectric plant is being built close to the crossing of Brunstadelva. You can reach this point by car, but from here on you must continue on foot. It starts at 120m above sea level and after 2km you will reach Velleseterhytten at 410m above sea level.

Our approach started at 11.30 am. We chose not to use ski or snowshoes, known as “truger” in Norwegian, as the first part of the trail was prepared for walking. This first part is rather open and you walk directly towards Brunstadshornet, the mountain ridge dividing Brunstaddalen and Vellesætredalen, as a clear but distant goal.


*Before you reach Brunstadshornet the river and trail split up and we now continue along the smaller path leading into Vellesætredalen.*

*In this second part of the trail the path is narrower and steeper. It is a continuing slope up and into the valley with no flat stretches offering a natural possibility to rest. In the heavy snow you need either skis or "truger" to be able to move forward, and progress is therefore slow; you walk 10m and then rest for a few seconds before you walk another 10m. This cycle continues for the whole trail. From here you do not see Velleseter or the mountain ridge that closes the valley. This, in combination with the heavy snow, makes this part of the approach particularly exhausting both physically and mentally.*

*An added factor to the mental fatigue is the fact that the path continues straight ahead as far as you can see. You don't round any corners that would otherwise enable you to 'divide' the path into minor stages. This, however, also has an advantage, because about 45min after you start your approach, your strength is renewed as for the first time you spot Velleseterhytten straight ahead at the top of the sloping path. From there on the cabin becomes a clear mental 'lighthouse', a man-made structure distinguishable from its natural surroundings offering rest and shelter.*

*As you slowly move forward among the low bushes and trees, silence is complete. There is no wind, as the valley lays protected from the mountain ridges, and only your own heavy breathing and the sound of snow crunching under your boots can be heard. As you raise your head to spot the distance to the cabin, you realize that the altering vegetation changes the visibility of the cabin and it becomes more difficult to estimate the remaining distance.*

*However, this changes as the path turns left and out of the low vegetation where you have to cross the small river, Sætreelva. And so your approach to the cabin ends in the same way as it started, with crossing the river. In this way the bridge marks the physical value of crossing the small river, but also has a symbolic value, as it marks the crossing from 'approach' to 'arrival'.*


*Once you have crossed the bridge a small stone wall leads to the formal entrance of Velleseter. In wintertime it is covered with snow, but the sign marking the entrance is visible. From here you still have to make your way up the steep slope until you reach the cabin at the top.*

*At about 1:00pm we reached Velleseterhytten after about 1,5 hours of walking. In summertime the approach will only take half as long or less, depending on how much equipment you bring. The first room you enter is a small entrance where you leave your equipment. Once inside you realize that because the cabin is insulated it is colder inside than outside; at our visit the outdoor temperature was -6.7°C, while it was -9.1°C inside!*
*Therefore the first thing to do is not resting, but lighting a fire in the wood stove. You must also turn on the gas for the fireplace to be able to melt the snow and gain water. After about 40min the temperature reached 0°C and continued to increase about 10°C per 45min.*

*This was possible because of the lightweight building materials and by using a strategy where only necessary rooms are heated. All doors to adjoining rooms are closed and only when the temperature reaches 20-22°C a door is opened and another room heated.*
*By evening all rooms were heated with an indoor temperature of 29°C and -6.8°C outside! You enjoy the warm shelter and along with the temperature difference, the view through the windows to the complete black surroundings marks a clear boundary between outside and inside. In such an environment this boundary must be emphasized and not weakened by a diffuse transition.*

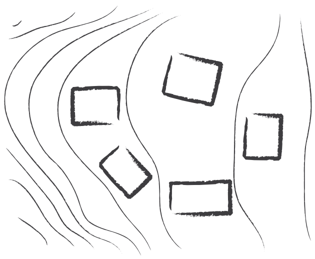
*You become very aware of this boundary as the firewood and toilet are located in a nearby wooden shed. Because you have to walk outdoor between the two buildings you are constantly aware of the surroundings. In this way a link between the buildings and the context is established by how they are used. Also in other ways the use of the cabin is influenced by the surroundings. As there are no street lights or other light pollution to keep away the darkness you go to bed earlier.*
*During the night the temperature dropped and in the morning it was -11.7°C outside and 5°C inside. We left Velleseter at around 10.30am and the descent to the bridge across Brunstadelva only took about 45min, half the time of our ascent the day before.*

**Summary**
The mountain cabin should make Velleseter an inhabited landscape by expressing the genius loci of the site. This is done by local building traditions and other cultural aspects, but also encompasses the interplay between architecture and landscape. Such an interplay is often expressed by representation or complementation, where building typology and structural principles of vernacular architecture often represent basic regional qualities, while the interior complements the surrounding environment. During the visit to the site it was obvious that a clear boundary between building and environment is necessary and that a link between buildings and surroundings can be established by separation of functions and uses.

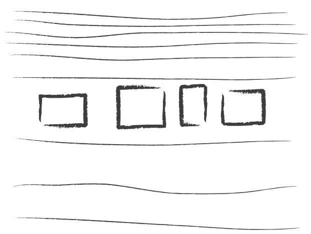
# Tectonic
## Vernacular building traditions

The following chapter aims to give an understanding of how different aspects of tectonics can be used to relate a building to the regional traditions in a contemporary design.

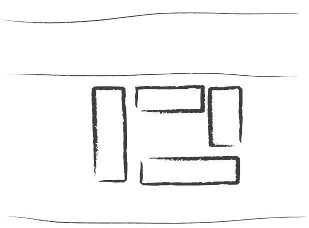
As mentioned in the previous chapter, *Phenomenology,* vernacular building traditions can be used to emphasize the relation of a buildings to its context, as it expresses the character and qualities of a region. This can be done by understanding local building traditions and implementing its principles in a contemporary context. That is why it is relevant to look at vernacular architecture, its typologies, materials, structural principles and details.



*Ill. 019: Cluster tun*



*Ill. 020: Linear tun*



*Ill. 021: Enclosed tun*

**Basic typologies**

Norwegian vernacular architecture is maybe more than in other regions determined by the surrounding landscape. The jagged landscape of fjords and mountain ridges made the establishment of villages very limited. This meant that people had to settle where ever the landscape gave possibilities of living, and therefore the settlements were scattered and based on individual farms. These small settlements or farms are known as *tun* and studies of the Norwegian vernacular architecture has shown three different typologies for their disposition: The *cluster tun* of the western coast, the *linear tun* of the central valleys and the *enclosed tun* in the eastern regions. These three typologies are similar to traditional forms of settlements found in other regions of the world, as the cluster for example reappears in Italian rural villages, the linear form in Indonesia and the enclosed settlement is apparent in East Africa [Norberg-Schulz, 1971].

The three typologies are obviously related to the landscape and this is also the case in Norway. The cluster tun developed in Vestlandet, where the hilly and irregular sites demanded a free disposition of buildings. The linear tun is found along edges and in the long and narrow valleys, while the enclosed form is used in more flat and open landscapes. This describes how the three typologies reflect the spatiality of their respective landscapes. If related to the phenomenological approach it is seen how the delimitation of the tun *complements* the surrounding landscape while the choice of typology *represents* the spatial qualities of the landscape [Norberg-Schulz, 1996].

*Ill. 022: Italian hilltop village - cluster settlement*

*Ill. 023: Indonesian village - linear settlement*

*Ill. 024: Masai village in Tanzania - enclosed settlement*

## Materials

*Ill. 025: Stone base*

*Ill. 026: Concrete foundation in Villa Busk, Bamble, by Sverre Fehn*

As in all vernacular architecture the choice of building materials depends on the availability of the surroundings. In Norway 1/3 of the country is covered by forest, and with the easily accessible bedrock it is obvious that wood and stone are the two main Norwegian building materials [Martens, 1993].

The local accessibility of wood enhances the sustainable qualities of the material which has a low thermal conductivity compared to metals, glass and concrete. The insulating properties of wood are also the reason why this material was used for buildings containing the living quarters, while stone traditionally was used for storage buildings and to form a stable base for the building [Byggeskikk]. These principles have been interpreted in many modern buildings, and today concrete often substitutes stone to form the foundation of the building.

## Structure and detail

Ill. 027: Detail of a log

Ill. 028: Horizontal logs forms the exterior wall.

In his book *Nightlands* (1996) by Christian Norberg Schulz he seeks to define Nordic building. He argues that the architecture of Southern Europe is more figurative and appears as 'bodies', where the architecture of the Northern countries seems more skeletal [Norberg-Schulz, 1996]. This can be seen in the traditional structural systems of Norway, log- and stave construction.

**Log construction**

The horizontal logs are placed on top of each other to form a compact wall protecting from wind and weather. Combined with the insulation properties of the wide logs this structural system is often used for houses. Where the walls meet, the stacked log ends can be joined in multiple ways and the extending logs can be used for the roofing or cantilevered elements [Byggeskikk].

*Ill. 029: Loft with combination of log- and stave construction*

*Ill. 030: Grind construction*

**Stave construction**

Stave construction is based on vertical staves as bearing elements upon which the trusses rest. This gives a skeletal system, where standing planks are used to fill the voids between the staves to form the facade walls. The structural system found its most expressive form in the stave churches, but is also seen in combination with the log system to form the artistic loft-buildings. Another variant is the so called *grind construction,* where multiple *grinder* (frames) are placed in the length of the building. Each *grind* consists of two staves with a cross-beam and braces at the joints. These constructions are often used for a building which does not require heating and are often placed on a stone base [Grindverk].

*Ill. 031: Dipoli Conference Center, Otaniemi, Finland, by Reima Pietila*

**Summary**

Based on this chapter there are several parameters, which influence the design process. The choice of disposition of the buildings can be related to the qualities of the landscape, while building form and structural system depend on its function and materials. It can therefore be concluded that vernacular building traditions play an important role in expressing a strong relation between building and context. It is, however, central that the principles of these traditions are not just simply copied, but instead reinterpreted to a contemporary use. Only this continuing development will prevent the architectural expression from being nostalgic and loose its dynamic relationship to the changing of the surroundings.

# Case studies

## Juvet Landscape Hotel

*Ill. 032: Siteplan*

*Ill. 033: A place to dwell*

**Intro to case studies**

Selected projects are studied to create a frame of reference and form an initial design vocabulary for the following design process. These projects have been chosen on the basis of representing the different parameters of the previous chapters. Among these parameters, the three case studies represent respectively a cluster-, linear- and enclosed disposition, and provide three different solutions to the relation between a building and a hilltop.

**Juvet Landscape Hotel (2008), Valldal, JSA**

The following case study aims to identify especially the architectural qualities and the conceptual approach on modern tourism and so the case study is based on a visit to and talk with both the architect's office in Oslo and the owner of the hotel. The owner, Knut Slinning, kindly offered the opportunity to spend a night at the hotel and this provided the basis for the following description of how the landscape hotel is experienced.

Close to the spectacular scenery of Gudbrandsjuvet, where the river Valldalø forces itself through the narrow canyon, the Juvet Landscape Hotel by Jensen & Skodvin Arkitektkontor is located. Unlike many modern hotels, which are organised as large buildings containing all rooms and functions, Juvet is based on an organisation of separate cabins, each as individual houses for two persons with own toilet facilities. This organisation can be seen as a contemporary interpretation of a traditional Norwegian *cluster tun*, where an old traditional farm house located close to the cabins contains common functions as reception and dining facilities.

**Geotourism**

The untraditional organisation is based on the conceptual understanding of contemporary tourism. Knut Slinning explains that the concept of Juvet combines cultural history with modern architecture in the beautiful and wild Norwegian landscape. In this way the hotel focuses on presenting to their guests not only the spectacular landscape, but also an understanding of local traditions and living by collaboration with both local farms and tourist attractions. This approach on tourism, where the main experiences of the guests are focused on local culture and the natural surroundings is similar to the concept of *geotourism*. *Geotourism* has just recently been thoroughly described and defined as a niche in tourism, but it refers to tourist-projects that enhances the geographical character of a place, where the economical contribution from the visitors functions as an incentive to preserve what the tourists are coming to see [Geotourism]. Such an approach or aspects of it could be incorporated in defining the future concepts of the Norwegian Trekking Associations mountain cabin.

The landscape hotel also tries to depict future tendencies in Norwegian tourism by providing a more luxurious and individualised experience. Whether a more luxurious approach is suitable in this project can be discussed, but the idea of letting the architecture provide the framework for an individual experience of nature and ultimately oneself seems highly relevant regarding the phenomenological aspects of dwelling.

### Nature and architecture

As mentioned earlier the architecture consists of multiple Cartesian volumes scattered in the landscape. Each of them is raised and supported by steel rods drilled into the rocky surroundings, where some cabins are dramatically cantilevered above the sharp rocks and roaring river below. This clearly articulates how the architects approached building in these surroundings. It is based on a respect and sensitivity towards nature, where nature dominates the buildings.

The concept of blending in with the surroundings is maybe most prominent in the large panoramic windows. Seen from the surroundings the windows function as mirrors, and this effect has determined the dark colours of the interior to prevent any shiny objects from disturbing the reflection of the surrounding nature. In the same way the surrounding topography and views have been determining for the layout of the cabins. The panorama window of each individual cabin displays an unique view of a specific part of the surroundings, so that no view from the cabins are similar. It all points toward a hotel focusing on the surrounding nature rather than its own architecture.

### Tectonics

The carefully designed interplay between building and nature is one of the factors which characterize Juvet as an example of Norwegian architecture. Another factor is the choice of materials, as Norwegian larch is used for the facades. Yet despite of the

*Ill. 034: The spa*

*Ill. 035: Sensitivity towards nature*

*Ill. 036: Representing and complementing the surroundings*


Ill. 037: View from the sauna


Ill. 038: Winter evening at Juvet


Ill. 039: Winter night

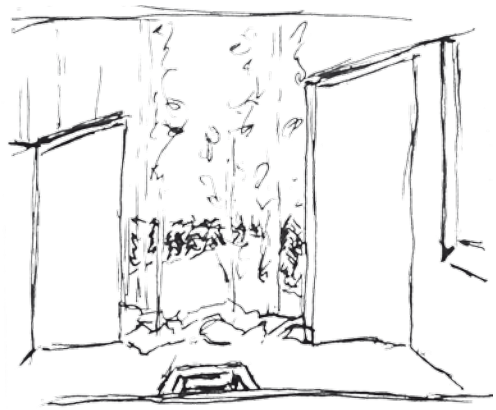
almost national romantic approach towards the surrounding nature, the architecture has a contemporary expression. When asked how the project relates to the Norwegian building traditions, the contemporary is again emphasised by the architects. It is an approach on architecture that does not focus on copying or referencing traditions, instead on be original with focus on creating a 'Norwegian feeling' by the architecture. For example, the flat roof of the landscape hotel is clearly breaking the tradition of the Norwegian pitched roof. The function of the pitched roof is to let the snow run off, whereas the snow is seen as an active contributing element in the landscape hotel. Therefore the roof construction has been dimensioned to carry the extra snow load and instead of removing the snow from the roof, it functions as an added layer of insulation during the winter months.

An extra layer of insulation is useful, as the cabins are only very lightly insulated and therefore will need extensive heating during the cold winter months. This is, however, a deliberate choice as the hotel has its majority of bookings during the summer months, and the cabins are therefore usually not in use during the coldest months. This is thus an example of how the climatic conditions have been considered in defining the usage of the hotel. Another aspect where the environment has influenced the project is the building process. To protect the terrain construction took place during winter, where a heavy layer of snow would cover the terrain. And as there is limited accessibility to the site, snow scooters and 4x4 trucks were used to transport construction elements. This favours smaller building elements and lightweight structures, which are important issues to consider in this project.

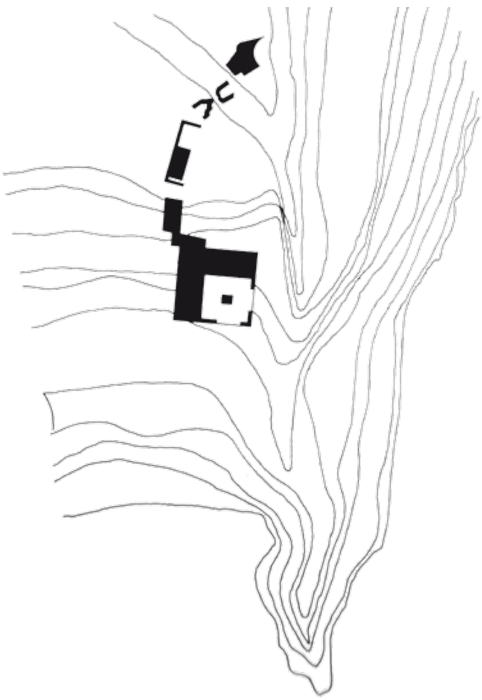
**Summary**

The understanding of how Juvet Landscape Hotel adapts to the environment is one the important factors to consider in the design process of the new mountain cabin. The usage has been optimised to the climatic conditions and the architecture has a clear concept of how to interact with the surroundings. This collaboration with nature is also fundamental for attracting guests. Juvet functions as a base, where guests can enjoy a high level of comfort and individualism, while the focus is on outdoor activities that let you experience nature and local culture. This points towards some of the future tendencies in tourism and could therefore be implemented in the design of the contemporary mountain cabin.

*Ill. 040: Sketch of cabin overlooking the snow covered Valldøla river*



Ill. 041: Courtyard seen from living room



Ill. 042: Head-and-tail disposition

**Experimental House (1953), Muuratsalo, Alvar Aalto**
The Experimental House functioned as a summer house for Alvar Aalto and his wife Elissa, and was built on the island Muuratsalo, about 270km north of Helsinki. The summer house consists of an L-shaped main building with an enclosed courtyard and an extending guest wing and woodshed. This forms a disposition similar to the typology of a Norwegian *linear tun*, although Aalto's interpretation is referred to as a *head-and-tail* organization [Weston, 1995].

### Setting
The summer house is situated on a rocky site close to a small cove of the nearby lake Paijanne, from where Aalto would access the site as there was no bridge to the island in the 1950's. Today you access the site along a humble path leading through the typical Finnish forest of pine and birch trees. The small rocks and boulders are covered with moss and bilberry bushes and as you walk along the winding path you will start to see glimpses of the summer house between the trees. By colour and form, the buildings clearly distinct themselves from their surroundings as man-made structures and this concept of contrasting nature is intensified when you enter the enclosed courtyard.

During a study trip to the site, it came as a surprise to experience that Aalto chose such an introvert shape in these natural surroundings, which already created a strong atmosphere of tranquility and contemplation. This, however, makes sense as you realize that the main theme of the summer house is to create a outpost of civilization in the wilds, to illustrate man's attempt to conquer nature, where the summer house functions as a necessary shelter from its surrounding environment. This is exemplified by the central open fire place of the courtyard. For guests approaching the site, the sight of the glow and reflections from the fire creates an expectation of shelter and warmth.

### Materials
The use of materials and texture continues this contrast, with the use of white painted brickwork externally, while the courtyard is defined by a patchwork of red bricks. This patchwork is one of the characteristics of the summer house, and it illustrates how Aalto experimented with more than 50 different styles of brickwork.

### Landscape

The terrain slopes downwards towards the shore of the nearby lake and the main building of the summer house is placed where the terrain flattens, in the same way as the existing Velleseterhytte. This position on 'top of the hill' of course enhances the theme of man's attempt to conquest nature, and it reveals how Aalto works with the interplay of building and landscape.

Another aspect of this interplay is found in one of the other 'experiments' Aalto defined for his summer house: experimenting with building without foundations. This resulted in the precise placement of the buildings, by using exploiting existing rocks as foundations. Likewise, the placement of the bearing wooden columns of the nearby woodshed was determined by exposed rocks and resulted in a free-form layout. This 'experimental approach' was also why Aalto thought the tax laws of Finland would enable it to be paid for as a legitimate business expense, however, the authorities would later disagree [Weston, 1995]

The tension between culture and nature is seen at the wooden piers of the cove, where this time nature becomes the dominating part. Yet despite of the constant proximity of nature The Experimental House lacks a trademark detail of much of Aalto's architecture, the serpentine line, which is often used as a reference to nature. A reason for this can be that such a form would 'soften' the man-made shape and thereby weaken the contrast between building and nature.

### Summary

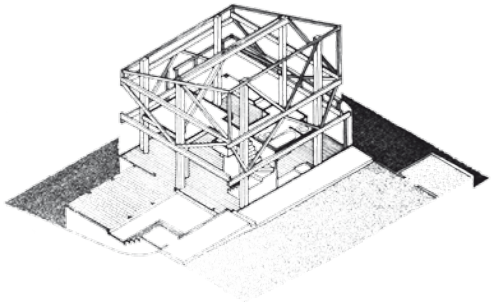
If seen from a phenomenological approach the white-painted exterior and the clearly man-made form *complement* its surroundings. Still some aspects, as the choice of typology and the use of the terrain as foundation for the buildings, visualize and *represent* the context. Similar to Pallasmaa's understanding of a refuge, The Experimental Houses emphasizes the boundary between building and environment and, together with the characteristics and qualities mentioned above, forms a place where one can dwell.

*Ill. 043: The exterior form contrasts the surroundings*

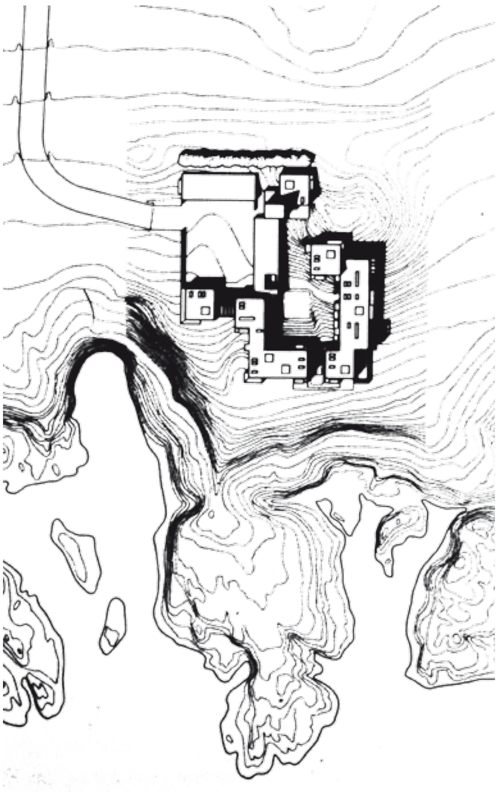
*Ill. 044: Nature dominates*

*Ill. 045: Brick experiments and central fire place*

## Sea Ranch



Ill. 046: Wooden structure



Ill. 047: Enclosed disposition

### Sea Ranch - Condominium One (1965), California, MLTW

The Sea Ranch is a landscape development covering 16km of the northern California coast, USA. It forms a community of approximately 500 people who live permanently on the Sea Ranch, sharing more than 9km$^2$ of land. This case study will focus on the buildings of Condominium One, which consists of ten separately owned condominium units.

### The founding vision

Geologically, the Sea Ranch is situated between the top of a ridge towards east and the Pacific Ocean towards west. The experience of the landscape is therefore dominated by the sloping towards the sea and the exposure to the insistent western wind. These characteristics were the determining design factors and lead to the objective of designing buildings that would relate to the land, its vegetation, the wind, and the need for solar radiation in both indoor and outdoor living spaces. The central vision for the Sea Ranch was therefore:

*"The land should remain primary; the buildings added to it should complement the essential character of the landscape that they would inhabit."* [Lyndon, 2004, p. 19]

In the quotation above the significant term is 'complement', which should not be understood as contrasting the surroundings, but *"by developing forms that are sympathetic to the forces that have shaped that environment and by building with materials appropriate to the locale."* [Lyndon, 2004]. And although multiple architects have designed houses for the Sea Ranch, the central vision formed a common 'design vocabulary' which is clearly visible in Condominium One: Shed roofs to deflect the wind, with no overhangs for the wind to flutter; and cladding of vertical redwood boards with large windows punched through them. Windows should be placed to maximize light and views rather than create an artful exterior composition.

### Process

In the book *The Sea Ranch* [Lyndon, 2004] the architects, MLTW, of Condominium One describe how the central vision and the interplay between building and landscape effected the design process. Because of the challenging landscape, the architects stress the importance of working with a three-dimensional model of the site instead of two-dimensional section and plan drawings.

This prevents the buildings from being simple areas of square meters set within the boundaries of the property lines, to instead being conceived as three-dimensional structures that touches the landscape.

The solution to build on the sloping landscape was to arrange the separate condominium units around a common courtyard to form a disposition similar to that of a Norwegian *enclosed tun*. The placement of the separate units was determined by the terrain, so the floor height steps upwards with the terrain. A single sloping roof functions as the unifying element. Afterwards each of the units was adjusted to the particular conditions of the site by the use of for example a greenhouse, projecting bay windows or a panoramic spread of windows.

*Ill. 048: Courtyard*

### Tectonic

As with the above mentioned vision, there was a clear formulation of how the structure should be expressed. It should be *"an active element in forming the experience of place, (and) should not be hidden away"* [Lyndon, 2004]. This resulted in a structure made of heavy timber, a local material, with redwood boards externally. The choice of a wooden structure and redwood boards can be seen as a reference to the local building traditions of the vernacular farms and barns of the region. A significant detail for the expression of the structure was that the horizontal beams would all project beyond the vertical columns and be attached by bolts to them, instead of being placed on top of the columns. This articulates the columns as individual elements that enhance the vertical character of the interior. Verticality is also expressed by the placement of functions on multiple floors, so that kitchen, bathroom and closets become floating elements in the interior volume, instead of 'servant spaces' that form boundaries for the 'served space' according to Louis Kahn's terminology [Lyndon, 2004].

### Summary

The important aspects of this case study are the formed vision of the relation between building and landscape. While the units can be separately adjusted, there should be an element unifying the building. In Condominium One the choice of an enclosed disposition *complements* the landscape, while the sloping roof and separate units *represent* the landscape and can be seen as a possible solution of how to build on a sloping hillside.

*Ill. 049: Condominium One between sea and ridge*

# Room programme

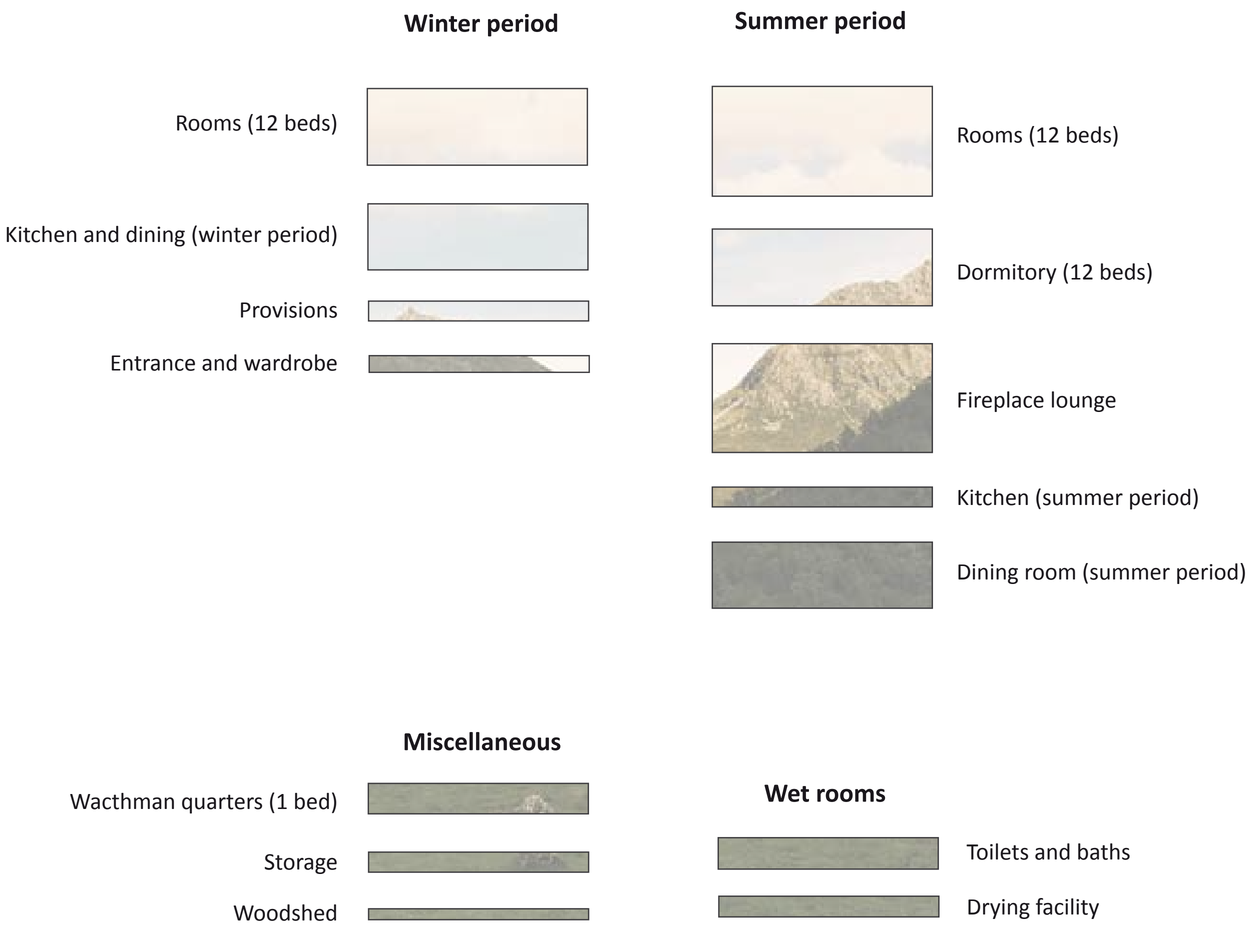
The room programme for the mountain cabin is illustrated by the diagram to the right. As written in the *Project brief* the room program covers a mountain cabin with 37 beds. The definition of the functions and facilities and their dimensions is based on discussions with ÅST and modeled on room programmes of contemporary built DNT cabins and lodges, such as the neighboring Patchelhytta, Preikestolen Fjellstue and Turtagrø Hotell.

| | |
|---|---|
| Rooms (24 beds) | 84m² |
| Dormitory (12 beds) | 35m² |
| Fireplace lounge | 50m² |
| Wacthman quarters (1 bed) | 14m² |
| Toilets and baths | 15m² |
| Kitchen and dining (winter period) | 30m² |
| Provisions | 10m² |
| Kitchen (summer period) | 10m² |
| Dining room (summer period) | 30m² |
| Entrance and wardrobe | 8m² |
| Drying facility | 10m² |
| Storage | 10m² |
| Woodshed | 5m² |
| Outdoor campfire | |
| **Total** | **311m²** |

# Room organisation

Conceptually the use of the mountain cabin is seasonal determined. During winter the cabin will function as a regular self-service cabin, while there will be one or two watchmen employed during the summer period, so that the cabin functions as a so called assisted self-service cabin. It does therefore not function as a hotel with staff, but resembles more a self-service hostel. This means that in the summer period it is possible to book private rooms for multiple nights and meals can be served, but all facilities are shared with the other guests. The private rooms available during the summer period are thought as small individual cabins with only two beds. These are meant for couples who want to stay for one or more nights. With the private cabins and common facilities the mountain cabin will thereby function as a sociable accommodation with qualities of individualism and privacy.

By facilitating a pipe connection to either of the two small rivers running nearby the site it is possible to supply fresh water during both summer and winter period. Likewise it will be possible to supply electricity by connecting to the dam, which is being built a couple of hundred meters North of Velleseterhytten, and functions as part of the small hydroelectric plant in Brunstad. Free water and electricity is therefore obtainable and so the functions can be divided into four sub-categories, as seen on the diagrams to the right.


Winter period
Rooms (12 beds)
Kitchen and dining (winter period)
Provisions
Entrance and wardrobe
Summer period
Rooms (12 beds)
Dormitory (12 beds)
Fireplace lounge
Kitchen (summer period)
Dining room (summer period)
Miscellaneous
Wacthman quarters (1 bed)
Storage
Woodshed
Wet rooms
Toilets and baths
Drying facility

# Concept

The following chapter will describe some of the thoughts and ideas that form the concept for the new Velleseter mountain cabin. These are stated as design criteria which, together with the following presented vision, will form guiding principles for the sketching process.

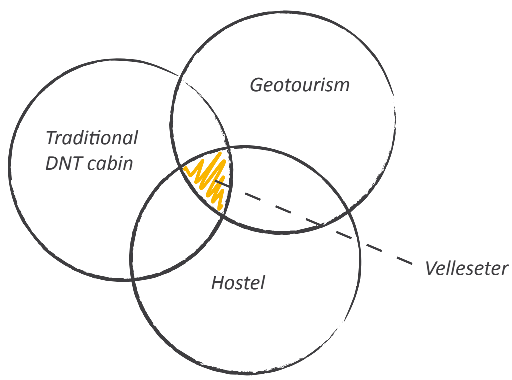
### Future tendencies

Although the room programme is based on functions and facilities of traditional DNT cabins, thoughts on the future tendencies of Norwegian tourism should also be incorporated, such as aspects of geotourism. This term has briefly been described in the *Juvet Landscape Hotel case study*, as a collaboration between tourism and the geographical qualities of a location, the 'sense of place' or *genius loci*. Geotourists travel to experience this 'sense of place'. To expand the perspectives on geotourism, the National Geographic Society has defined a Geotourism Charter, which Norway was the first European country to sign in 2005, to function as a strategy for future tourism in Norway [Geotourism]. This strategy should therefore be implemented in the concept for the contemporary DNT cabin.

Regarding the level of comfort, focus is on the experience of the surroundings as well as personal contemplation. Therefore only a basic level of comfort should be applied, as the luxurious facilities and features of many modern hotels are not necessary. Instead of the traditional understanding of luxury, this project works with the concept of immaterial luxuries which include concepts as *contemplation, privacy, slowness, escapism* and *authenticity*.

### Strategy

An approach on incorporating the future tendencies is by redefining the purpose of the new Velleseter mountain cabin. Where many of today's DNT cabins serve the main purpose of shelter for a single overnight stay, the idea is to let the mountain cabin function more as a base camp. Guests should be encouraged to stay for multiple nights and use the daytime to experience the local nature and culture, before returning to the cabin at the end of the day. This strategy resembles the organisation of a traditional hostel, were one can stay for multiple nights with shared kitchen and toilet facilities. In this way the cabin becomes more than just a shelter, it also becomes a point of departure for exploration of the surroundings and a retreat one can come back to. Such values correlate with the phenomenological approach and will therefore allow better possibilities for guests to 'dwell' or, in other words, experience the 'sense of place' at Velleseter.



# Design criteria

**Architectural**
The mountain cabin should
- Express a contemporary design.
- Express a 'Norwegian feeling'.
- Be recognizable as a house, a settlement in the landscape.
- Emphasize the boundary between building and environment.
- Utilize the marked characteristics of the surroundings by:
    - Framing specific views of different scales.
    - Considering how the building is perceived by the guests approaching the site.
    - Focusing on the northern paths as the main direction of arrival.
    - Shaping the building to prevent snow from blocking the entrance.
- Be organised according to the topography.
- Express the seasonal differences of the site.
- Let the interior complement the surroundings.
- Be based on an interplay between architecture and nature instead of a forced relationship.
- Avoid artificial regulation of the terrain or other drastic impacts on the existing landscape.

**Tectonic**
- Represent regional qualities by referencing building typologies, structural systems and materials.
- Take the limitations of the sites accessibility into consideration regarding the building process.
- Integrate climatic sustainable principles, such as minimizing energy consumption, on a conceptual basis.

**Phenomenological**
- Function both as refuge and point of departure to promote aspects of dwelling.
- Promote the guests' experience of 'sense of place' by expressing the genius loci of the context, to make Velleseter an 'inhabited landscape'.
- Enhance the experience of immaterial luxury, by spatial qualities of privacy, contemplation and authenticity.
- Create an experience of interplay between building and surroundings by separating functions.

**Premises**
- The existing Velleseterhytte and sheds are not part of the design proposal, as the brief is to design a new Velleseterhytte and not an extension to the existing.
- Fresh water can be supplied from the two small rivers and electricity from the dam nearby.


Ill. 050: Vellesætredalen seen from surrounding mountain ridge

## Vision

The vision of this project is to design a mountain cabin that has a distinct relation to the specific site of Velleseter, with a contemporary Nordic architectural expression. The design is based on a concept that encompasses the phenomenological approach, tectonic solutions and aspects of geotourism to hereby contain perspectives for the design of future DNT cabins.

# PRESENTATION

## Approaching Velleseter

Velleseter mountain cabin is situated at the top of a sloping landscape surrounded by mountain ridges. From here it overlooks the entire Vellesætre valley and marks the entrance to the peaks of the Sunmøre Alps.

When you approach Velleseter the mountain cabin remains a visible aim of your journey at the top of the slope. It is clearly recognizable as a man-made structure, a shelter distinguishable from its natural surroundings, which tells the story of the *seter* as an inhabited landscape. The hilly topography means that the entire mountain cabin is not visible during the approach. Only a part of the architectural story is revealed and you have to reach the top of the slope for the story to fully unfold.

Along the slope low stone walls marks this path to the top. These form a gentle transition from the natural surroundings to the civilised mountain cabin and marks the transition from approach to arrival.

*Approaching Velleseter mountain cabin*

# Site plan

The organisation of the mountain cabin is based on a reinterpretation of the traditional Norwegian *tun*. The separate volumes of six small private cabins are able to individually adapt to the sloping terrain and together forms a cluster combined by pathways. These lead to the common facilities which are unified within a linear row composition at the top of the slope, where the terrain is more flat. The common facilities are divided into three separate cabins according to their seasonal use. The northern cabin contains the winter functions, the larger southern cabin contains the summer functions, and the small cabin in between contains storage and toilet facilities. This means that the summer cabin and six private cabins are only in use during the tourist season of the summer months.

As you spend the day exploring the surrounding mountain ridges of Vellesætredalen, you will be able to see the mountain cabin from an aerial view. However, instead of seeing a dominating roof surface, the vegetated roof will appear as part of the landscape and the enclosing organisation of the freestanding walls becomes visible. The vegetated roof thereby minimizes the figure of the mountain cabin to emphasise the composition of freestanding walls that indicates the spatial organisation of the cabin.

*Siteplan, 1:500*

# Site section

Velleseter forms a landscape dominated by two distinctive types of topography, the plateau and the surrounding slopes. These two types expresses a difference in character, where the open and exposed terrain of the plateau contrasts the smaller scale and intimacy of the more vegetated slope.

This understanding of the landscape is emphasised by situating the private cabins on the slope where you are better able to experience the solitude and proximity to nature. Likewise, the social functions of the common facilities are situated on the plateau where the exposed position will be the first thing new guests meet when arriving at the mountain cabin. The different private- and social functions of the mountain cabin are thereby organised so they emphasise the inherent qualities of the surrounding landscape.


*Site cross section AA, perspective, 1:300*

# Experiencing Velleseter

Like the traditional living unit on a Norwegian *seter*, a *sel*, the private cabins lay scattered across the sloping terrain as small simple volumes. A low window band detach the wooden walls from the stone foundation, to form an expression where light is used to visually separate the cabins from the landscape, as a contrast to the heavy stone walls of the common facilities that solidly rest on the hard *fjell*. The stone walls of the common facilities provide a back on which the separated private cabins can “lean“ on, as an architectural horizon on top of the slope that unifies the cabins.

In accordance with their simple expression, the cabins function as basic shelters, offering only a bed for two persons and a place to keep your luggage. A wooden wall directs the orientation of the cabin, while a stone wall encloses the bed against the sloping terrain.
Instead of adding traditional luxurious elements to the experience, the private cabins focus on the proximity to the surrounding nature. This is possible as the topography allows a layout where the cabins are orientated individually, so that no cabin looks at another. Each cabin thereby has an individual view of the dramatic landscape to gain the feeling of being in an unique place.

*The mountain cabin seen from the eastern slope*

# Longitudinal section

Even though the plateau is relatively flat the height of the terrain differs with more than 1m from one end of the cabin to the other. The longitudinal section illustrates how the floor level is adapted to the changing height of the terrain, as an articulation of the nearest topography.

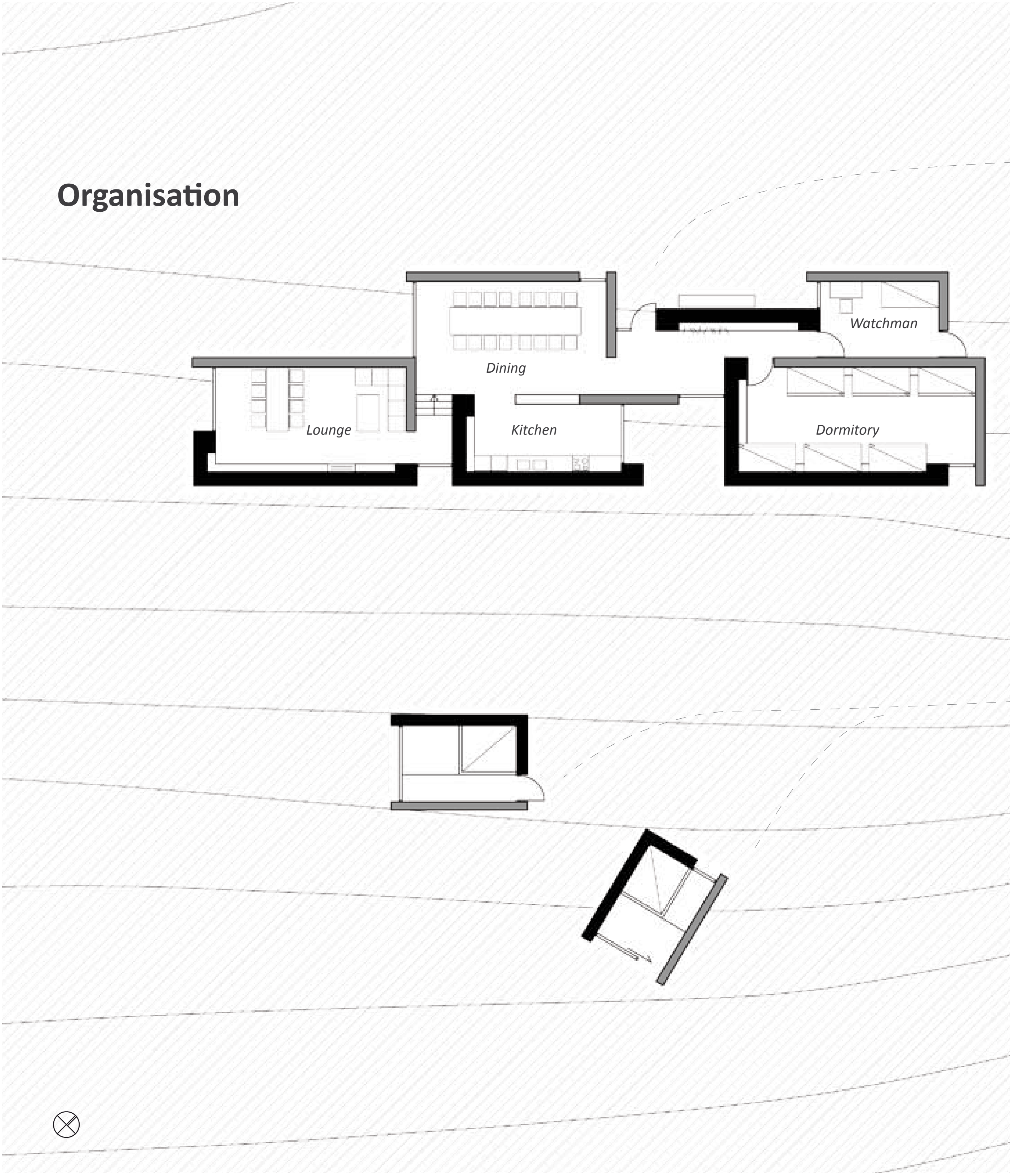
Where the floor level follows the changing heights of the terrain, the different functions also have different ceiling heights. The rooms of the winter cabin as an example have lower heights than the summer cabin to minimize the volume to heat. These shifting roof heights allow voids for horizontal window bands similar to those in the private cabins. This both improves the interior daylight level and adds to the spatial experience of the mountain cabin.



*Longitudinal section BB, perspective, 1:200*

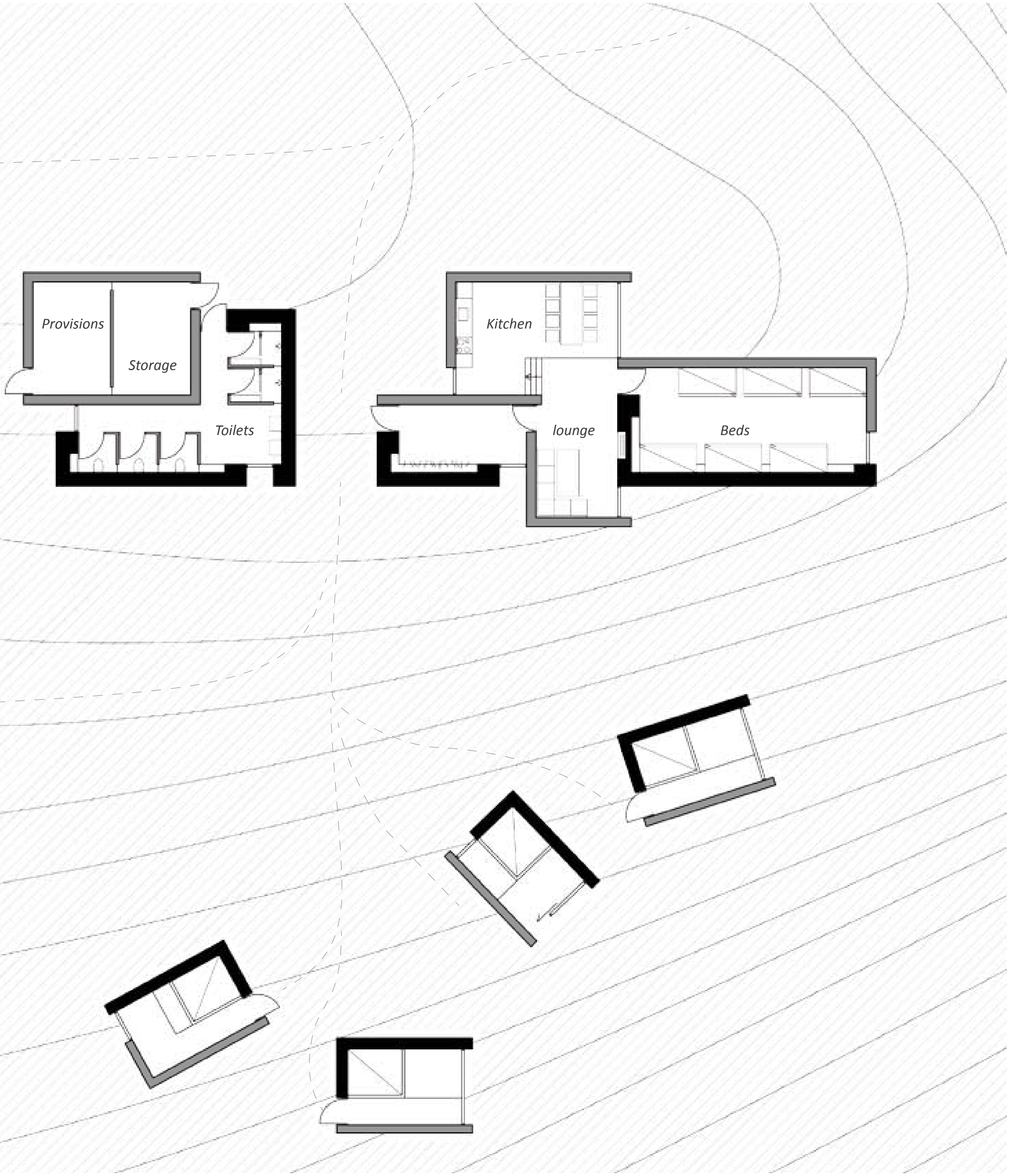

B
B

## Organisation






*Plan, 1:200*


Provisions
Storage
Toilets
Kitchen
lounge
Beds

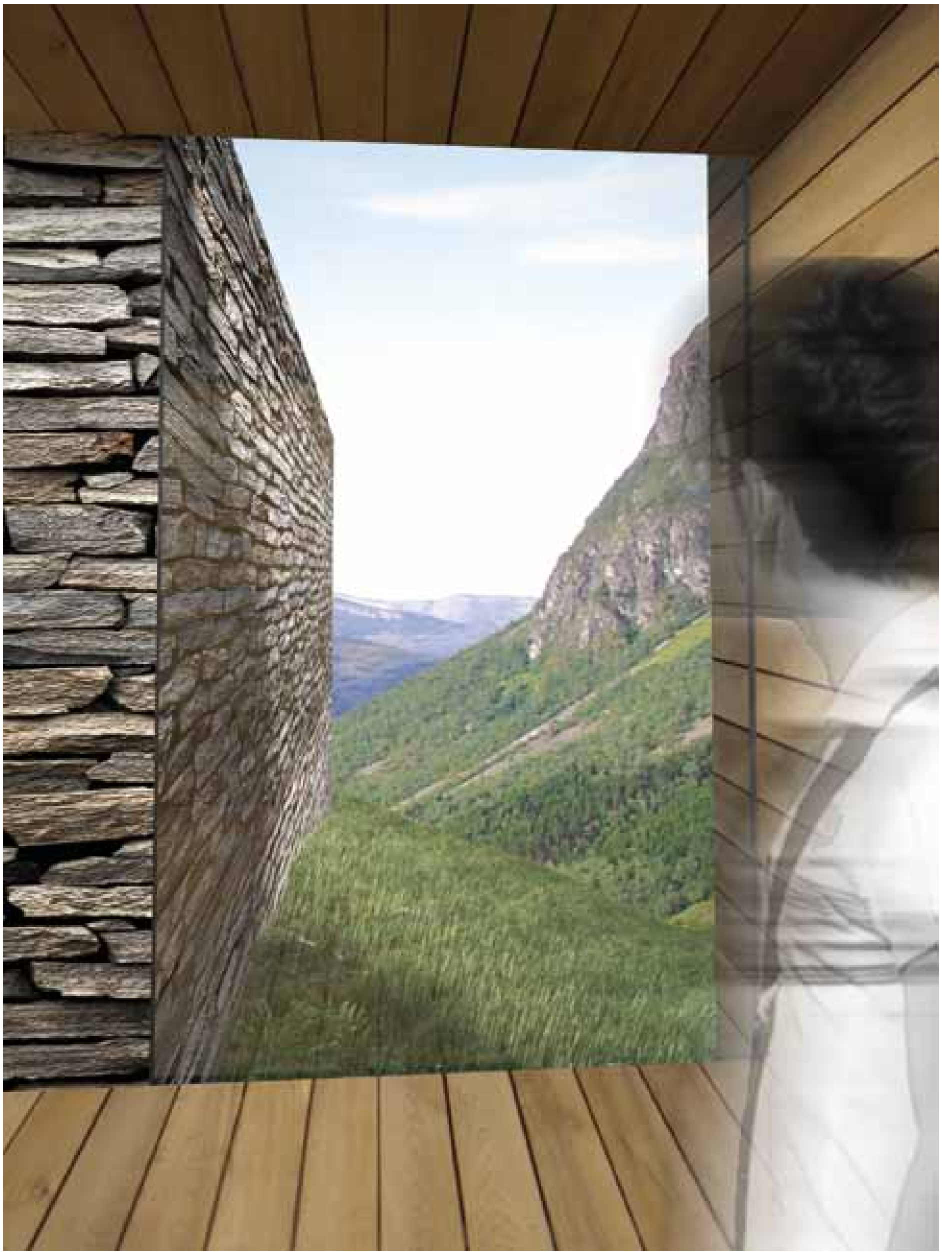
## Interior expression

The organisation of the common facilities is based on the separation into three different units; a summer cabin towards south, a winter cabin towards north, and miscellaneous functions in between. Both the summer- and winter cabin is organised with the social functions of kitchen and dining area as the central rooms. Around these functions freestanding walls are used to continuously develop the spatial flow, as an interpretation of the free and dynamic movement through the mountain landscape, where new spatial experiences are constantly revealed along your path.

Within this spatial organisation the stone walls are used as both functional elements containing fireplace, kitchen- and toilet facilities, and as architectural elements that defines the hierarchy of the spatial organisation. The stone walls brings rhythm to the architectural expression and becomes a functional “spine“ around which the wooden walls are more freely distributed.

Between the freestanding walls voids occur. These provide a variety of considered views of the surroundings, where new visual experiences of the landscape are revealed as you gradually move through the interior.

The enclosing exterior walls represent the primary sheltering function of the mountain cabin. However, through the voids and by the choice of materials the surrounding context is always present. Where the stone walls provides a massive and rough expression to the interior, the use of wood functions as a more “warm“ and smooth contrast. These qualities of shelter and proximity to nature shape the mountain cabin so it becomes, not just a shelter or a refuge, but also a point of departure from where you can set off to explore the mountains.



*View towards north from the lounge of the winter cabin*

# Facades

The simple volumes of the mountain cabin form a contrast to the dynamic landscape. These complement the pragmatic building programme, as it is not the intention to create a kind of “signal architecture” that try to dominate the otherwise untouched landscape. Instead the building initiates a dialog with the surroundings by constantly complementing and representing the inherent qualities of the landscape.

*North elevation, 1:500*

*East elevation, 1:500*


*West elevation, 1:500*

*South elevation, 1:500*

# SKETCHING

# Volume analysis

This chapter has the purpose of analysing the energy consumption of different volumes in relation to their respective surface areas.

The aim of the analysis is to gain some design principles for the conceptual use and organization of the functions of the mountain cabin. Therefore an Excel spreadsheet, *MonthAverage*, has been used, as it effectively calculates the monthly energy consumption of a building based on only the most basic input data, such as building geometry, heat losses and internal heat loads. Because the spreadsheet only includes these basic inputs the results cannot be regarded as qualitative values of the building's energy consumption. For a more accurate calculation of the energy consumption, more detailed tools are necessary, such as Be06 or BSim, which is beyond the scope of this project. Instead it can be used for a mutual comparison of the different case scenarios, to extract usable design principles.

**Calculation parameters**

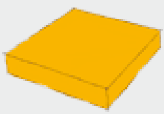
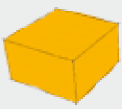
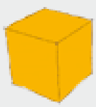
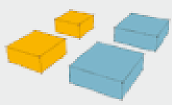
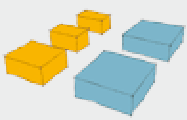
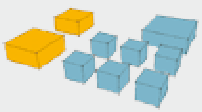
For each case the energy consumption during both summer period (June - August) and winter period (September - May) was calculated and thereafter combined to the total annual energy consumption per floor area. The outdoor temperatures used in the calculations are based on reference data from the same local weather station as used for the wind conditions [eKlima].

All cases are based on a net area of 400m2 with a gross area of 448m2 and a floor height of 4m. Also no windows have been included in the calculations as their distribution and orientation would blur the results. The basis of the calculation is described to the right:

*Room temperature in case of heating: 22 °C*

*Heat capacity: Wooden construction = 40Wh/Km²*

| | ***Summer*** | ***Winter*** |
|---|---|---|
| ***Ventilation rate*** | | |
| *- Service hours:* | *2 x volume/h* | *0,5 x volume/h* |
| *- Outside service hours:* | *0,5 x volume/h* | *0,5 x volume/h* |
| | | |
| ***Internal heat loads*** | | |
| *- Persons:* | | |
| | *09:00 - 18:00: 2* | *09:00 - 16:00: 0* |
| | *18:00 - 09:00: 40* | *16:00 - 09:00: 16* |
| | | |
| *- Activity level [Met]:* | | |
| | *07:00 - 21:00: 2,0* | *07:00 - 09:00: 2,0* |
| | *21:00 - 23:00: 1,0* | *09:00 - 16:00: none* |
| | *23:00 - 07:00: 0,8* | *16:00 - 23:00: 2,0* |
| | | *23:00 - 07:00: 0,8* |
| | | |
| *Lighting [W/m²]:* | *4* | *4* |
| | | |
| *Appliances [W/m²]:* | *3,5* | *3,5* |
| | | |
| *Use of lighting and appliances:* | | |
| | *07:00 - 09:00: 100%* | *07:00 - 09:00: 100%* |
| | *09:00 - 18:00: 0%* | *09:00 - 16:00: 0%* |
| | *18:00 - 23:00: 100%* | *16:00 - 23:00: 100%* |

| | Surface to floor area ratio - Winter | Surface to floor area ratio - Summer | Heated volume - Winter [$m^3$] | Heating demand - Winter [kWh] | Heating demand - Summer [kWh] | Total energy consumption [$kWh/m^2/year$] |
|---|---|---|---|---|---|---|
|  1 volume, 1 floor | 0,69 | 0,69 | 1600 | 20857 | 1410 | 49,7 |
|  1 volume, 2 floors | 0,52 | 0,52 | 1600 | 16325 | 643 | 37,9 |
|  1 volume, 3 floors | 0,49 | 0,49 | 1600 | 16244 | 555 | 37,5 |
|  1 volume, 5 floors | 0,52 | 0,52 | 1600 | 18427 | 669 | 42,6 |
|  4 volumes, 1 floor | 0,92 | 0,87 | 620 | 6177 | 2446 | 19,2 |
|  5 volumes, 1 floor | 1,03 | 0,91 | 620 | 7776 | 2690 | 23,4 |
|  9 volumes, 1 floor | 0,92 | 1,01 | 620 | 6177 | 3291 | 21,1 |

*Ill. 051: Orange volumes are heated while blue volumes are unheated*

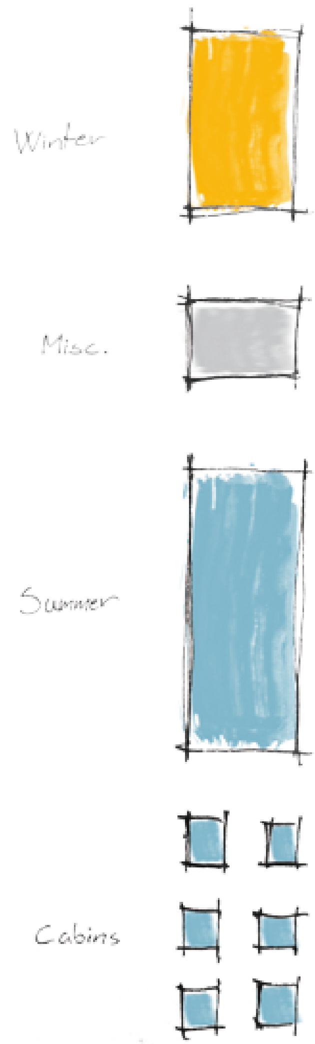
**Results**

Because there was only heat gain from persons, lighting and appliances and no passive heating through windows the results show large values of heating demand and no cooling demand in any of the case scenarios.
The results also show that the more compact structures have a lower energy consumption compared to those cases with higher surface area to volume-ratio. Regardless of how compact the volumes get, it is, however, much more efficient to divide functions into separate units according to the seasonal use of the functions. Such strategy has been used in the cases 5,6 and 7, where the much smaller heated volumes during the winter period, results in a corresponding lower energy consumption.
In case 6 an additional division of the winter functions means a higher surface area and therefore higher energy consumption. When the same additional division of the summer functions is done in case 7 the effect is different. The increased surface area only results in a slightly increased energy consumption of less than 1kWh/m2 year.

**Summary**

The design principles that should be used in the continuing process is therefore to organize the functions into three separate units according to their seasonal use; a winter unit, a summer unit and one unit with the miscellaneous functions. In the winter period only the winter functions are heated while summer functions are not used and therefore unheated. The toilet facilities need to be kept frost free, so the miscellaneous functions are minimally heated. The illustration to the right shows the separate units, where the orange colour means that the volume is heated in the winter period, grey means frost free and blue means unheated.

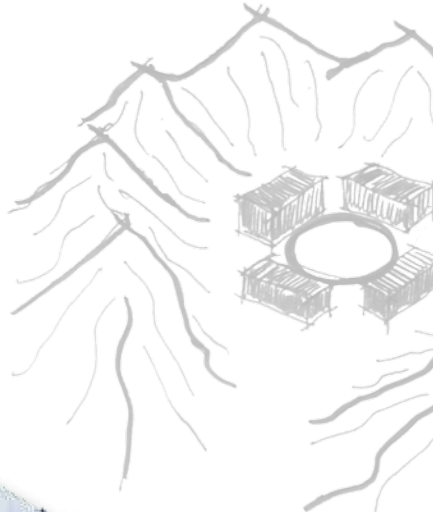
Furthermore the winter functions should be as compact as possible, while an increase of the surface area of the summer functions will not have great effect on the buildings' energy performance. This means that the private two-bed rooms could be organised as individual cabins scattered in the landscape.

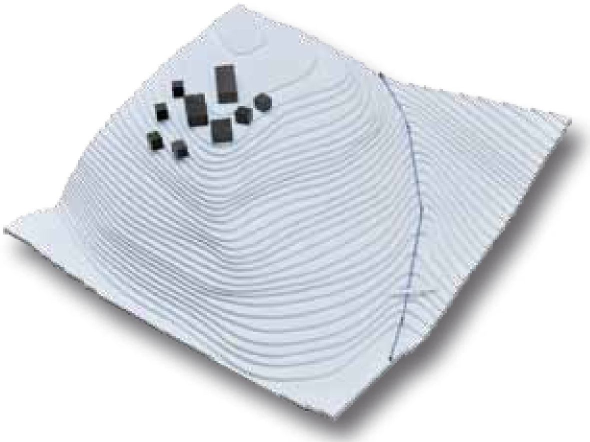


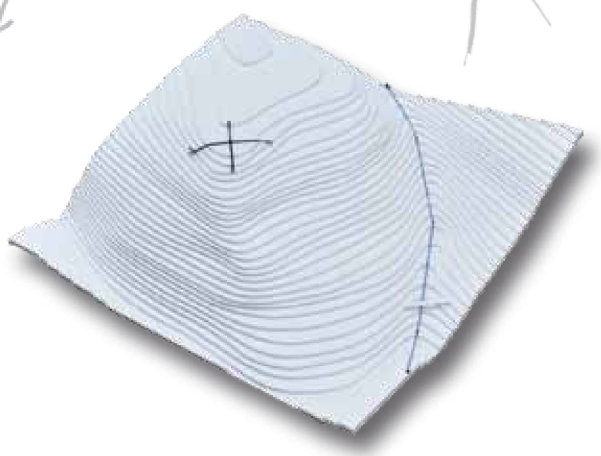

*Ill. 052: Orange volumes are heated, grey is frost free while blue volumes are unheated during winter period*

# Design principles

The following chapter is based on the *Context analysis* and shows different design principles defined from an understanding of the topography of the site. These provide different ideas on where to situate and how to orientate the mountain cabin.



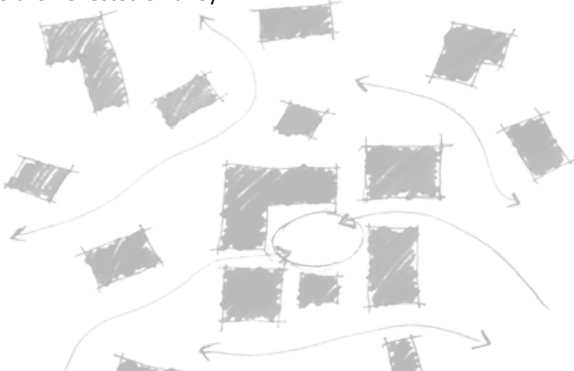


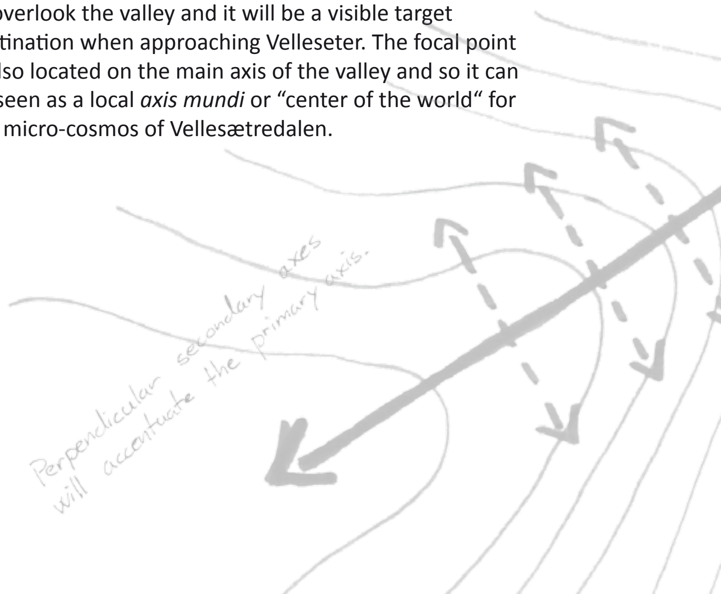
### Disposition

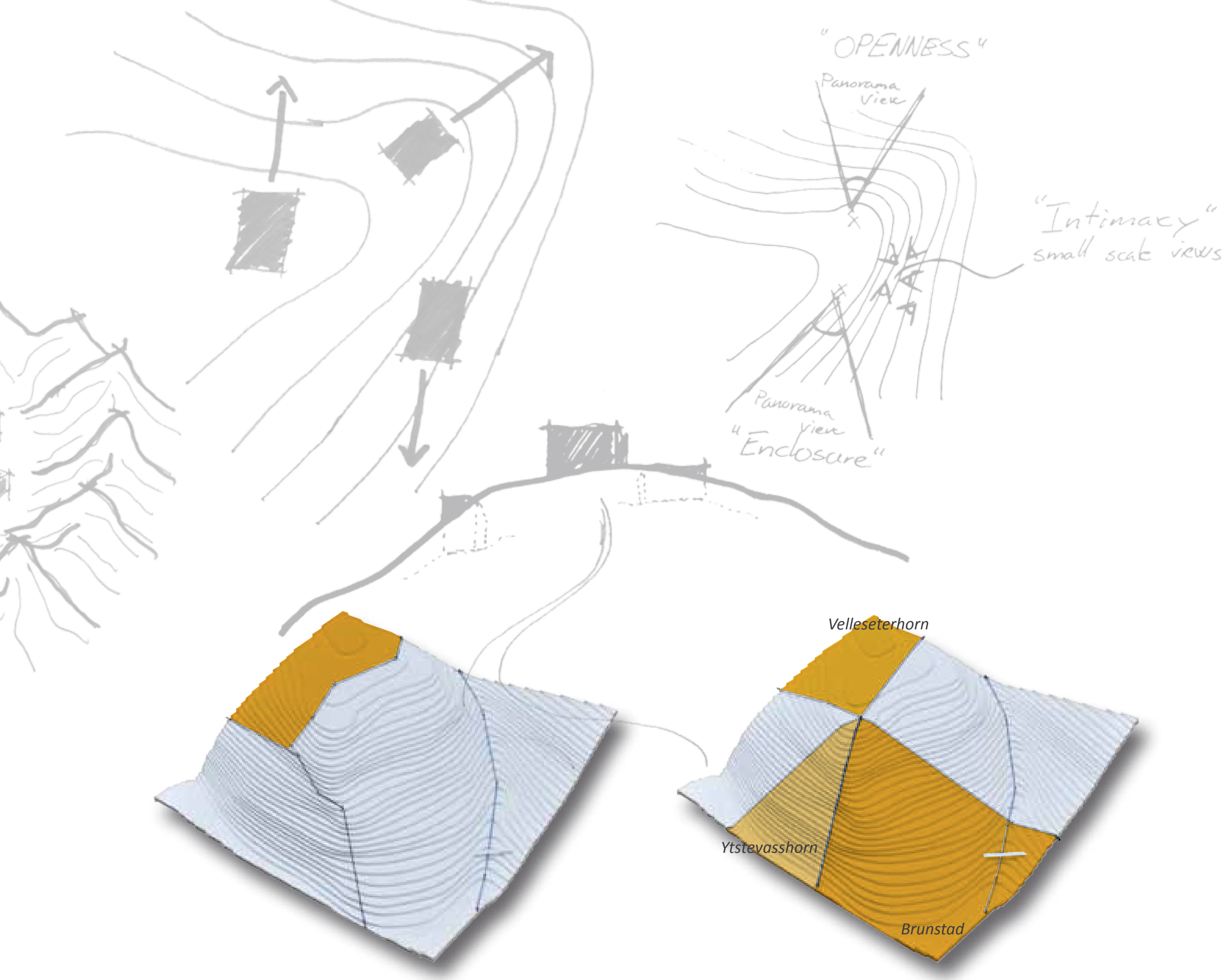
The topography of Velleseter depicts a hilly and irregular landscape. It therefore requires a more free approach on the disposition of buildings to organise the mountain cabin according to the landscape. This is possible by a cluster disposition, which also corresponds with the conclusions of the volume analysis to divide the cabin into separate units based on the seasonal use of the functions. An idea could be to let the cluster of buildings enclose a courtyard, in the same way as the mountain ridges enclose the Vellesætre-valley.

### Focal point

The height lines of the landscape illustrate a natural focal point on top of the hill. From here it is possible to overlook the valley and it will be a visible target destination when approaching Velleseter. The focal point is also located on the main axis of the valley and so it can be seen as a local *axis mundi* or “center of the world“ for the micro-cosmos of Vellesætredalen.







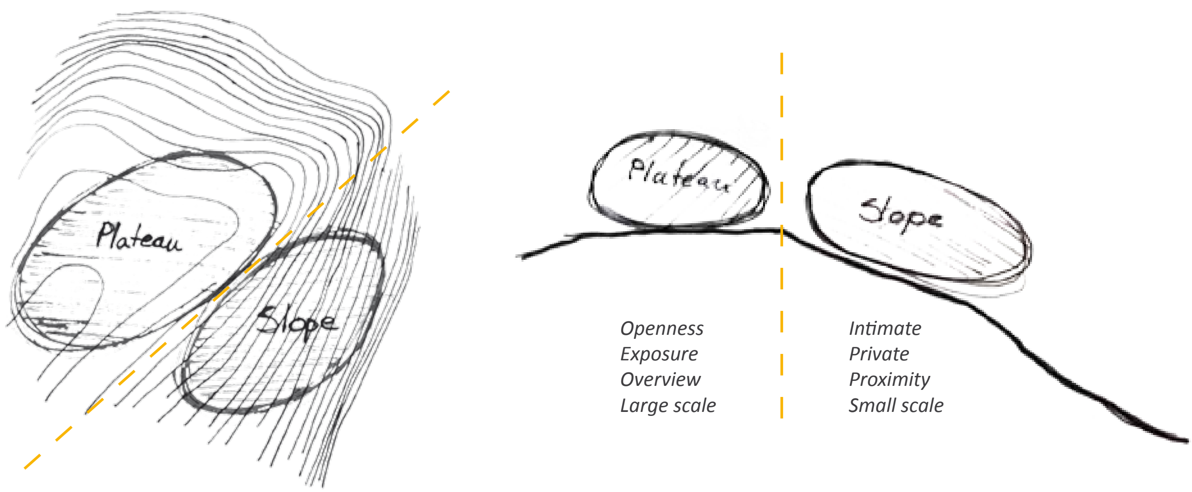

**Approach**

The visual experience of the mountain cabin when approaching Velleseter will mainly be based on a building located at the previously described focal point. As this has some advantages it might also be relevant to place some parts of the mountain cabin, so that they are not visible from the main approach path. In this way the whole ‘story‘ of the architecture is not revealed already during the approach, but develops also when you have reached the cabin. The orange marked area above indicates where one-storied buildings can be placed without being visible from the main approach path. In this way the shape of the terrain is actively used in the visual experience of approaching the mountain cabin.

**Orientation**

The orientation of the mountain cabin depends on multiple parameters, such as utilisation of daylight and views. The marked darker orange areas on the illustration above indicate the direction of the two primary views towards Brunstad and the mountain ridges of Velleseterhornet. These directions indicate large scale views or panoramas and the different buildings could be oriented towards these two primary views. Simultaneously there need to be small scale views that show the near context to complement the scenic panoramas of the large scale views. These can be found on the slopes, one of them marked as the lighter orange area directed towards the peak of Ytstevasshornet.

# Concept



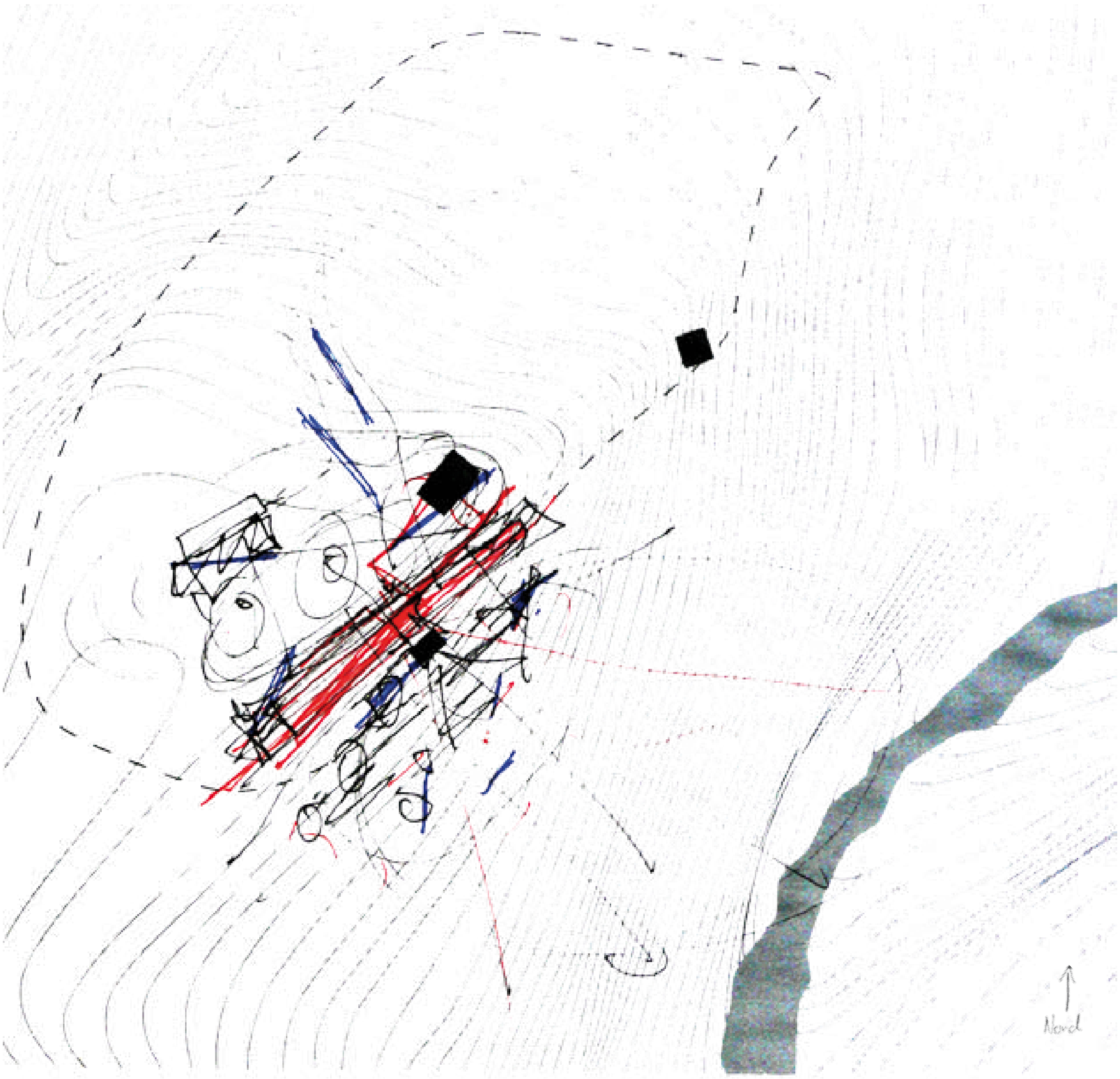

*Ill. 053: Transition between plateau and slope*

**Plateau and slope**
The previously described design principles help to gain an understanding of the landscape. Basically the landscape can be ‘read‘ as a plateau surrounded by slopes towards north and east.

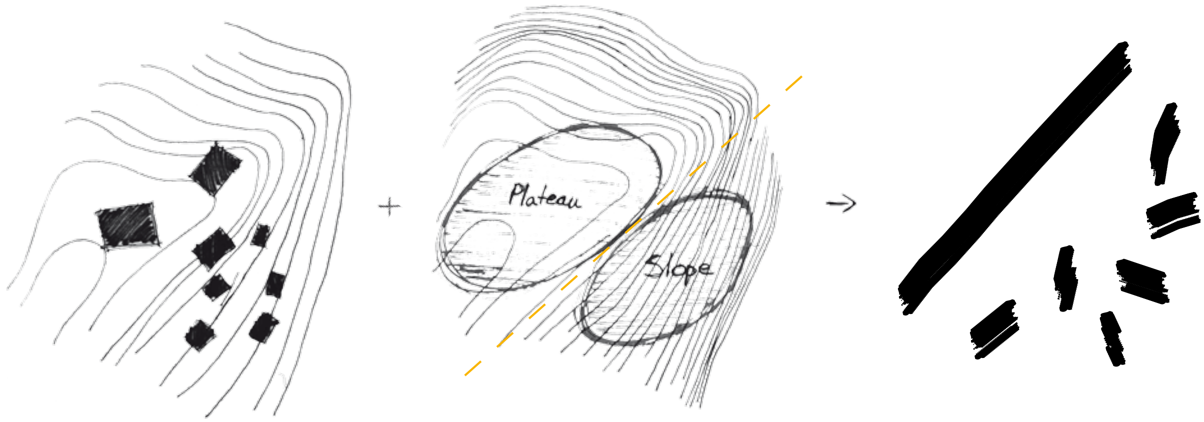
It might seem obvious to place the mountain cabin on the northern slope because of the panoramic view towards Brunstad, but this placement would make it difficult to utilize passive heating from the summer sun and also difficult to achieve privacy in the small private cabins, as the main approach path runs up the northern slope. Instead the eastern slope has qualities that are consistent with the wanted expression of the private small cabins.

**Difference in landscape character**
From the contour lines of the site it can be seen how a line can be drawn along the contours to separate the plateau from the slope. Simultaneously this fictive line aligns with the previous mentioned ‘axis mundi‘ of Vellesætredalen and also points in the directions of the two primary views.

On the open, flat plateau you are exposed and from here you have an overview of the landscape, you are able to see the surrounding mountain ridges as you have a 360° panoramic view of the landscape. The plateau therefore relates to openness, the exposed public domain and the large scale views. On the contrary the slope does not provide an overview of the surroundings. Instead you focus on specific directed views and the near surroundings and you are able to hide between the low vegetation. The slope therefore has a more intimate and private character. This difference in character between the plateau and slope forms the basis for the following concept.




*Ill. 054: Sketch of conceptual development*




*Ill. 055: Concept*

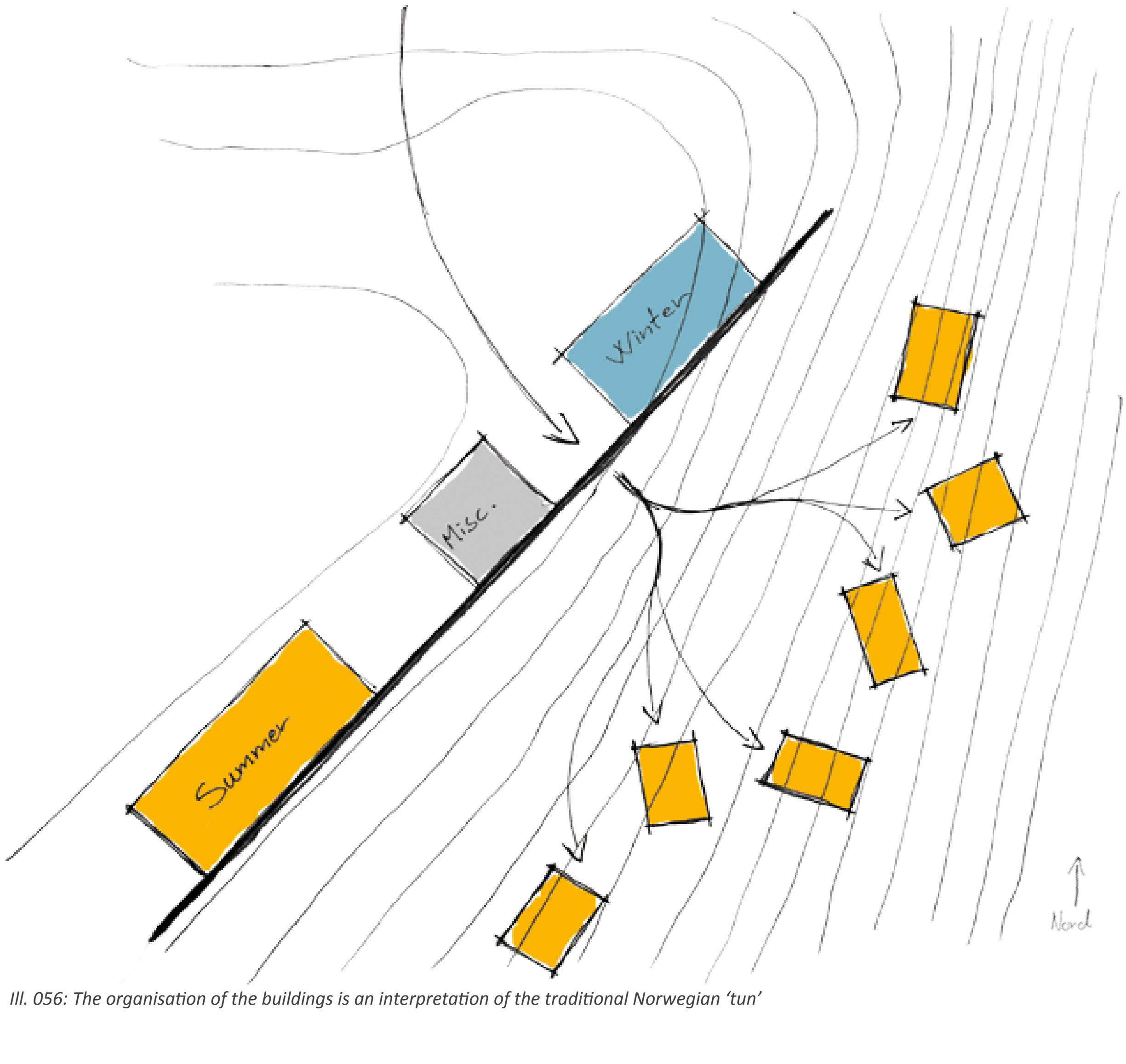
**The concept**

The concept links the different characters of the landscape to the different functions of the mountain cabin. In this way the small, private cabins should be situated on the slope, where the focus on the small scale view leads to a more introvert and intimate experience in relation to the future tendencies of geotourism and focus on immaterial luxury.

In contrast to the more private cabins the common facilities, as kitchen, lounge, storage, toilets etc., are situated along the fictive line that marks the transition between plateau and slope. In this way the common facilities are situated on the plateau and form a place where you meet fellow hikers and share your adventures, before you go to your private cabin on the slope.

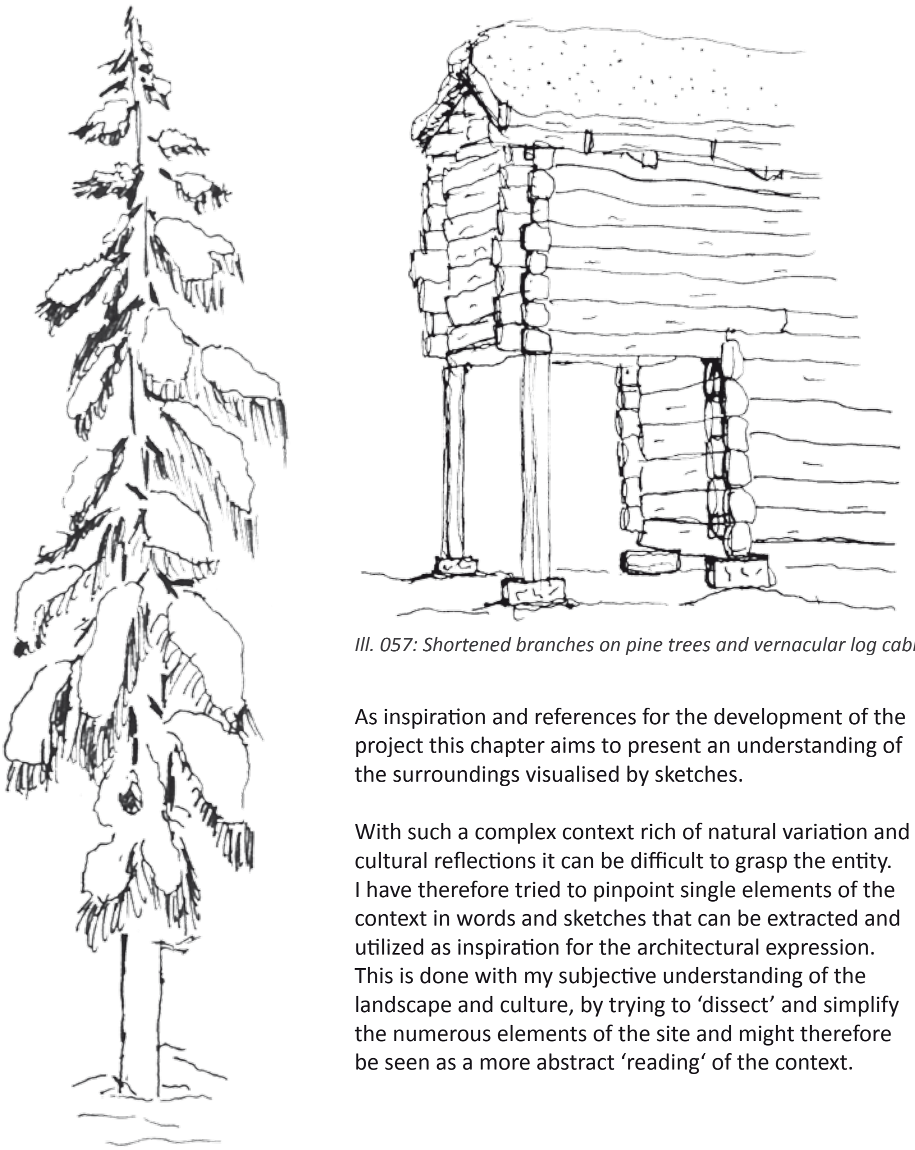
The concept thus forms a simple composition consisting of the common facilities situated along an edge, with private cabins loosely scattered across the slope. The organisation of the buildings is furthermore a modern interpretation of the traditional Norwegian *tun*, where the proximity of the cluster is combined with the unifying qualities of the linear *tun*.

This means that the aim of the concept is to let the mountain cabin display the different character of the plateau and slope, by working with a difference in the level of *scale, proximity, mass, intimacy and detailing*.



*Ill. 056: The organisation of the buildings is an interpretation of the traditional Norwegian 'tun'*

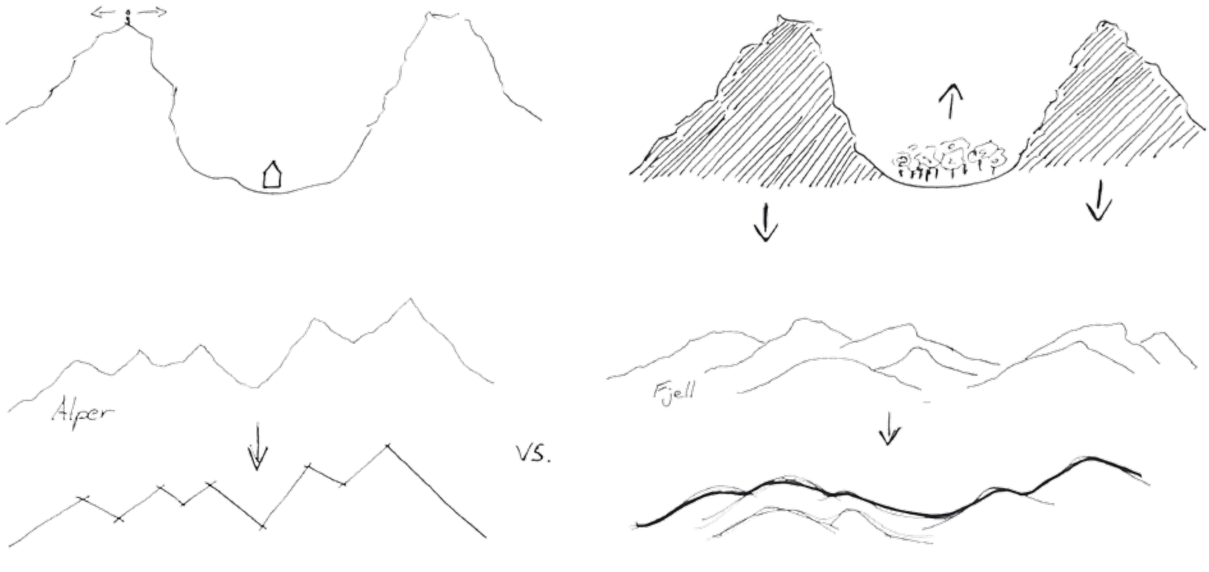
## Abstractions



*Ill. 057: Shortened branches on pine trees and vernacular log cabin*

As inspiration and references for the development of the project this chapter aims to present an understanding of the surroundings visualised by sketches.

With such a complex context rich of natural variation and cultural reflections it can be difficult to grasp the entity. I have therefore tried to pinpoint single elements of the context in words and sketches that can be extracted and utilized as inspiration for the architectural expression. This is done with my subjective understanding of the landscape and culture, by trying to 'dissect' and simplify the numerous elements of the site and might therefore be seen as a more abstract 'reading' of the context.




*Ill. 058: Various abstractions of the landscape*

### The Sunmøre Alps

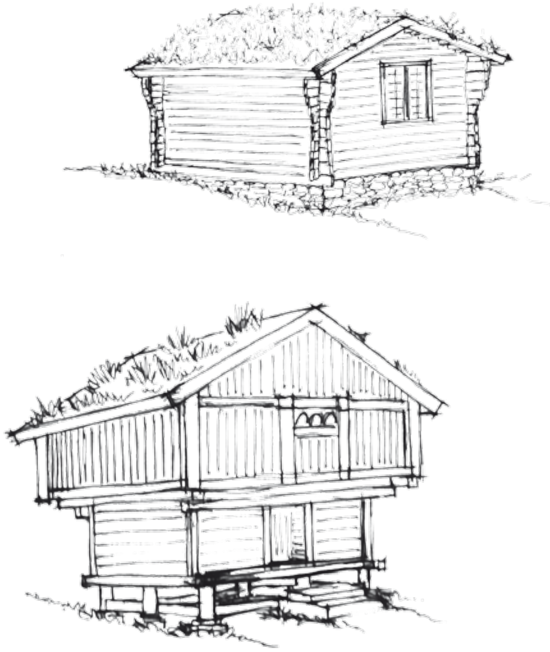
The dominant element of the context is the massive mountains surrounding the valley. These mountains of the Sunmøre region distinct themselves from the more rounded off mountain tops characteristic of the Norwegian fjell, by having sharp ridges and peaks like the Alps. They are therefore known as the *Sunmøre Alps*. These peaks and ridges form a more wild and serrate contour line of the surrounding mountains,  as a contrast to the more soft and vegetated landscape which they enclose.

In the tension between mountain tops and valleys also lies a strong contrast of how you experience the context. While Velleseter and the rest of the valley provides 'safety', your existential 'freedom' is experienced on the mountain tops. In this way the mountains and valleys supplement each other in man's understanding of his relation to the landscape.

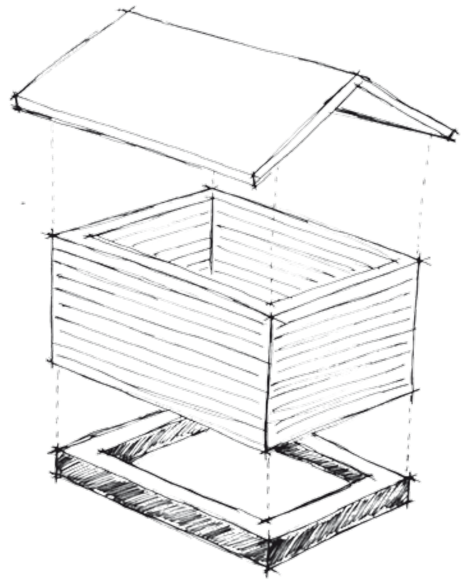
In relation to this, it should be noted that it is not the aim of the Velleseter mountain cabin to provide a replacement to this experience of 'freedom', as this is to be found in the surrounding landscape. Instead the mountain cabin should provide the necessary 'safety' and shelter from where one can explore the surroundings. If related to the fundamental question raised by Louis Kahn, '*What does the building wants to be?'*, the answer could be: **A base camp for encountering the freedom of the mountains**.

*Ill. 059: The 'sel' is the traditional cabin used for housing on a seter*

In the landscape other elements can also be extracted. The mountains express a solid and massive character and as the shortened branches of the pine trees suggest, long cantilevered elements are found in neither nature nor buildings, as they would crack from the heavy load of snow in the winter.



*Ill. 060: Traditional log building and two-storey loft*



*Ill. 061: Simplification*

**Byggeskikk**

This leads to an understanding of the vernacular building traditions, known as the local '*byggeskikk*'. The characteristic to-storey *loft* and traditional log cabins are well known examples, while the *sel* are the traditional cabin used for housing on a *seter*, such as Velleseter. Such *sel* were also found on Velleseter, where the small cabins were carefully situated as simple volumes in the landscape. Today only the granite foundations are left.

The different building types, however, all express the same tradition and by trying to simplify this expression the following terms are found to describe the Norwegian '*byggeskikk*':

- *Simple volumes*
- *Skeletal*
- *Logic structure*
- *Variation in detail*
- *Separation*
- *Linear orientation*

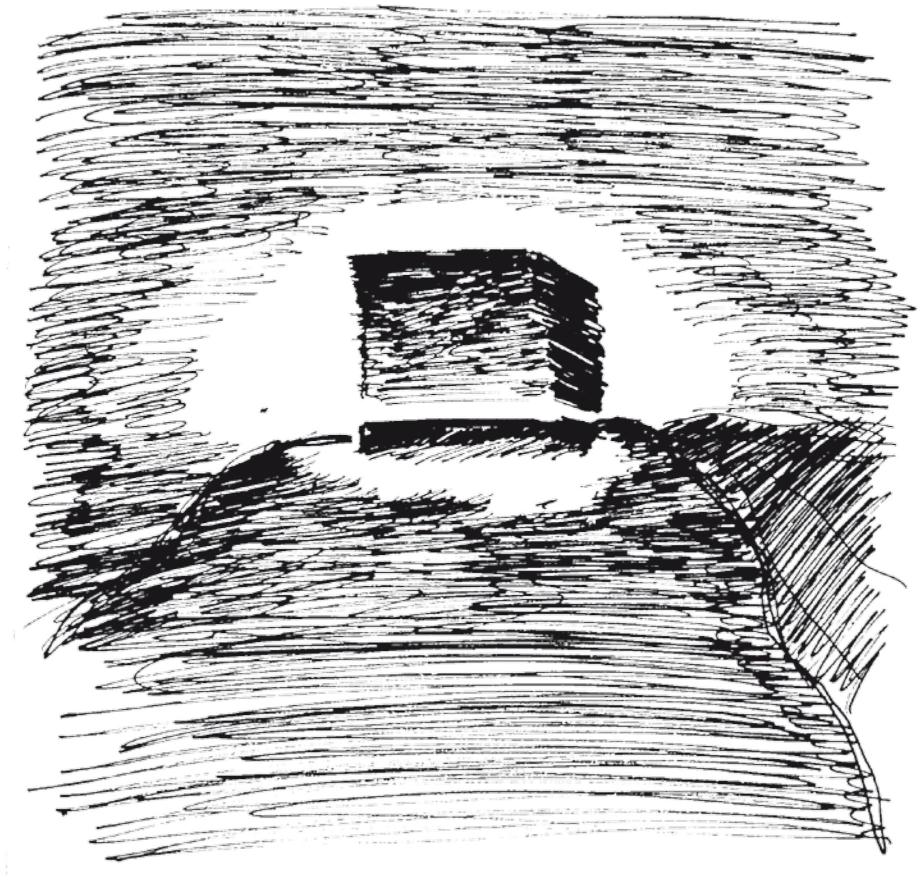
**Architectural expression**
The terms, simplifications and abstractions described above all form the basis for the development of the following architectural expression of the project:

**Exterior expression**

- Lightness
- Separation
- Individual components
- Simple volumes
- Direction
- Sharp edges
- A ‘lighthouse‘ of man’s presence in the landscape

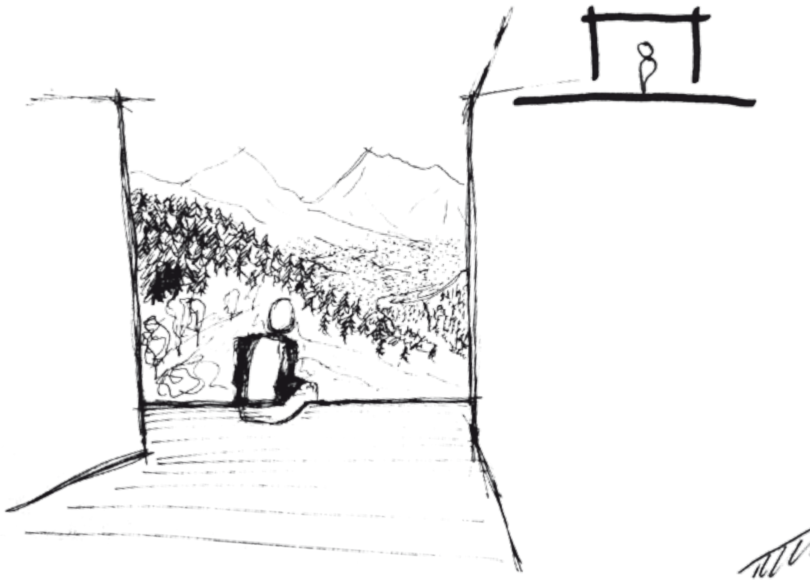
**Interior expression**

- Enclosure
- Direction
- Warmth
- Visible structure
- Physically enclosed, but symbolically open



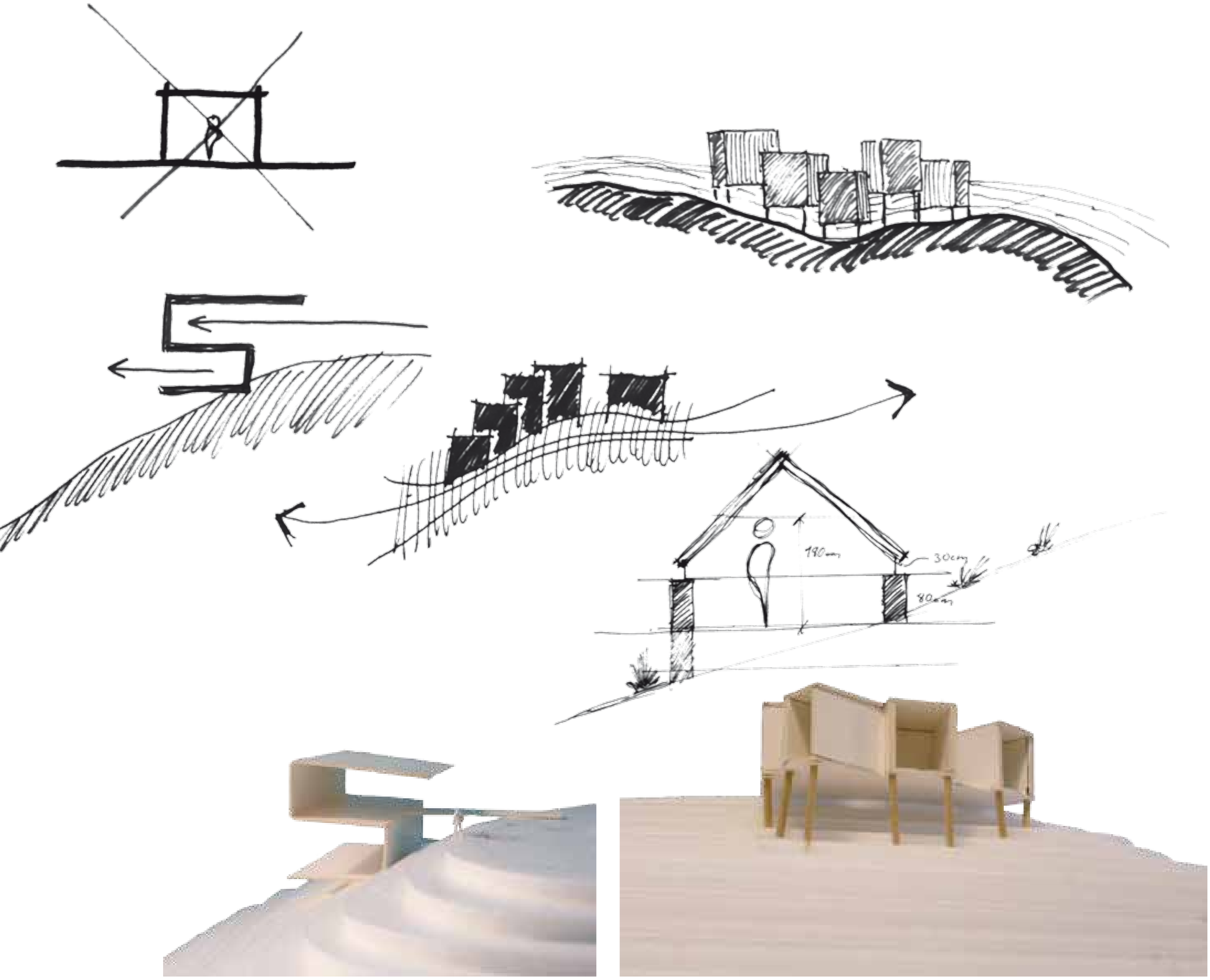
*Ill. 062: Sketch from site visit during study trip*

# Form finding

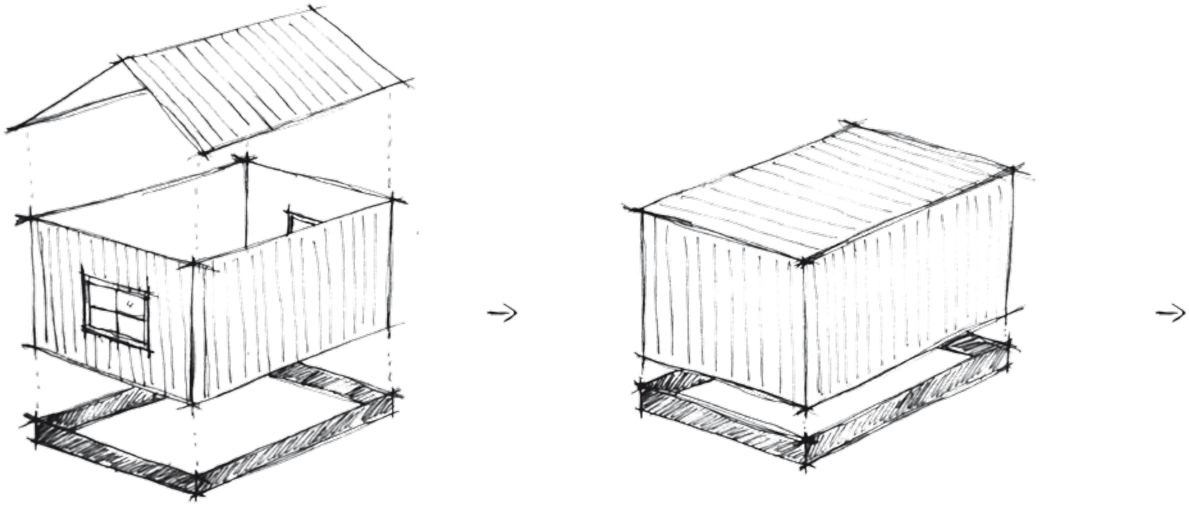


Based on the architectural expression described in the previous chapter some of the initial sketches and models are presented on the following spreads.

These ideas all reflect different principles on how the building relates to the landscape, whether it is clearly lifted from the ground, based on platforms or forms solid foundations. As described in the chapter *Context analysis*, the soil consists of hard mountain rock 10 to 20cm below a thin surface layer of earth. This means that it is not possible to excavate the site and place the building below ground level, without the use of drilling and explosives. Such extensive impacts on the landscape are directly opposite of the approach of this project and therefore all the sketches focus on the transition from ground to building. This transition is further studied by inspiration from the vernacular building traditions in the following spreads.




*Ill. 063: Various models and sketches of initial ideas*

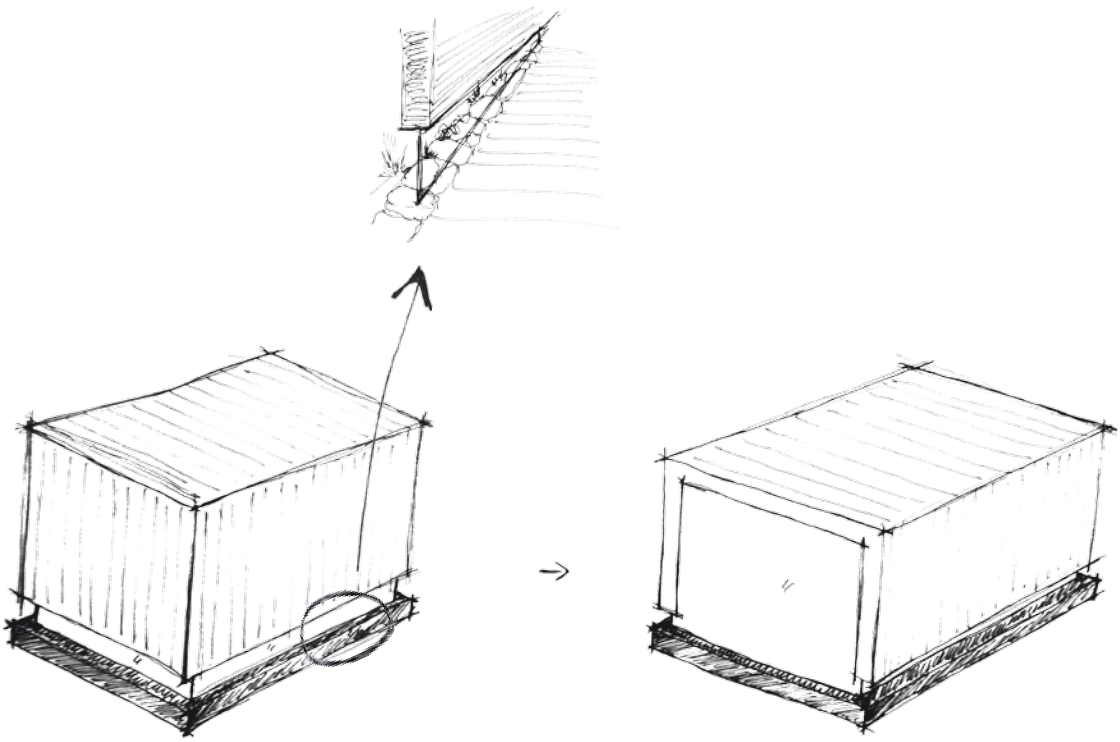


*Ill. 064: From vernacular- to contemporary ‘sel‘*

### A contemporary ‘sel‘

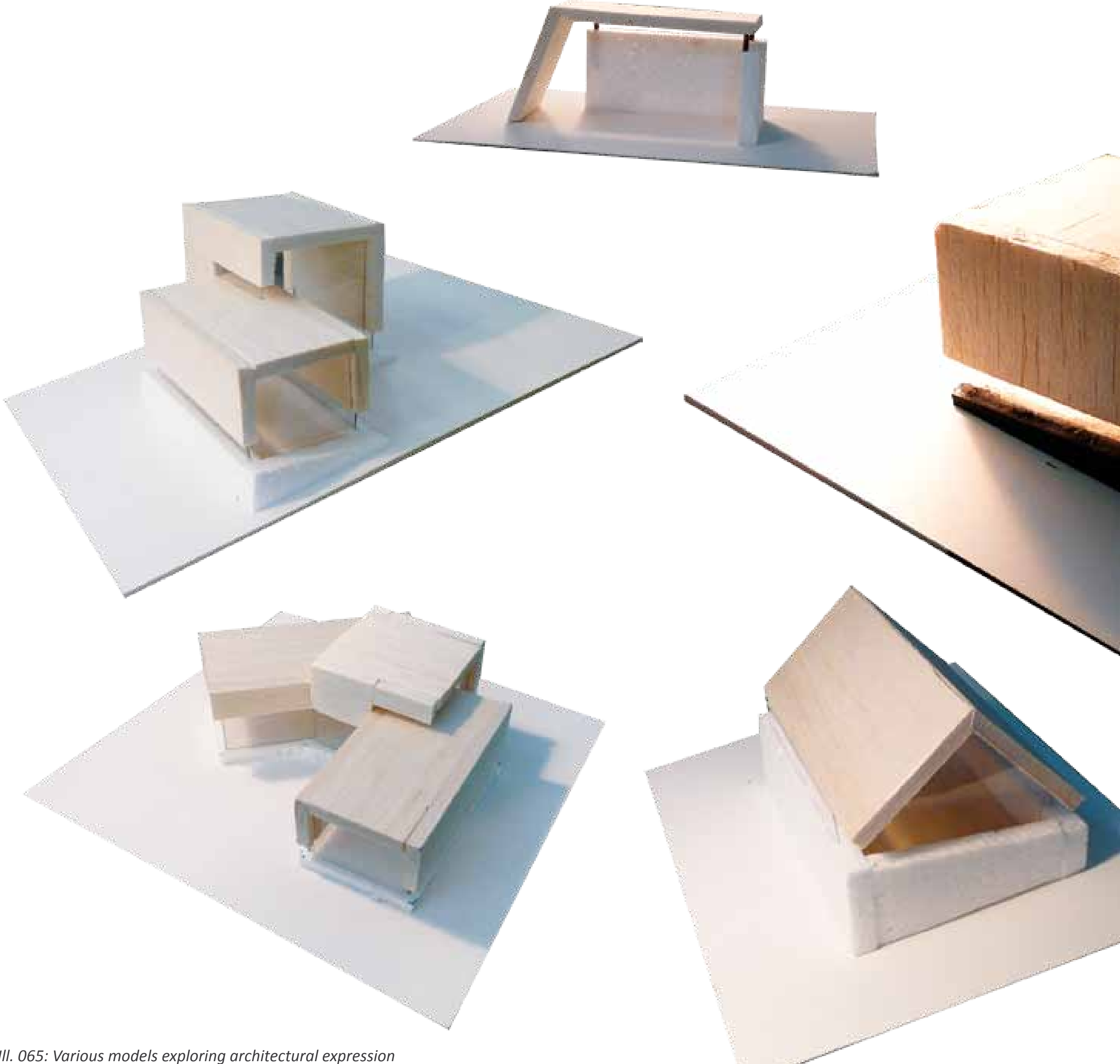
In the previous chapter the local ‘byggeskikk‘ was described by terms, such as skeletal, lightness, separation and direction.  The sketches on this spread show how this simplified understanding of a typical ‘sel‘ can be expressed within a contemporary framework. This can be used as inspiration for the design of the private cabins.

**Simplification.** First the pitched roof is lowered. This is done to lower the ceiling height, to express enclosure and shelter in the interior.



**Lightness.** Next the separation between foundation and walls are accentuated by a low window band. The idea of the low window band is to make the direct contact between building and landscape visible. In this way the window band will only show a small scale view of the nearest context, while it simultaneously lifts the building from the landscape.

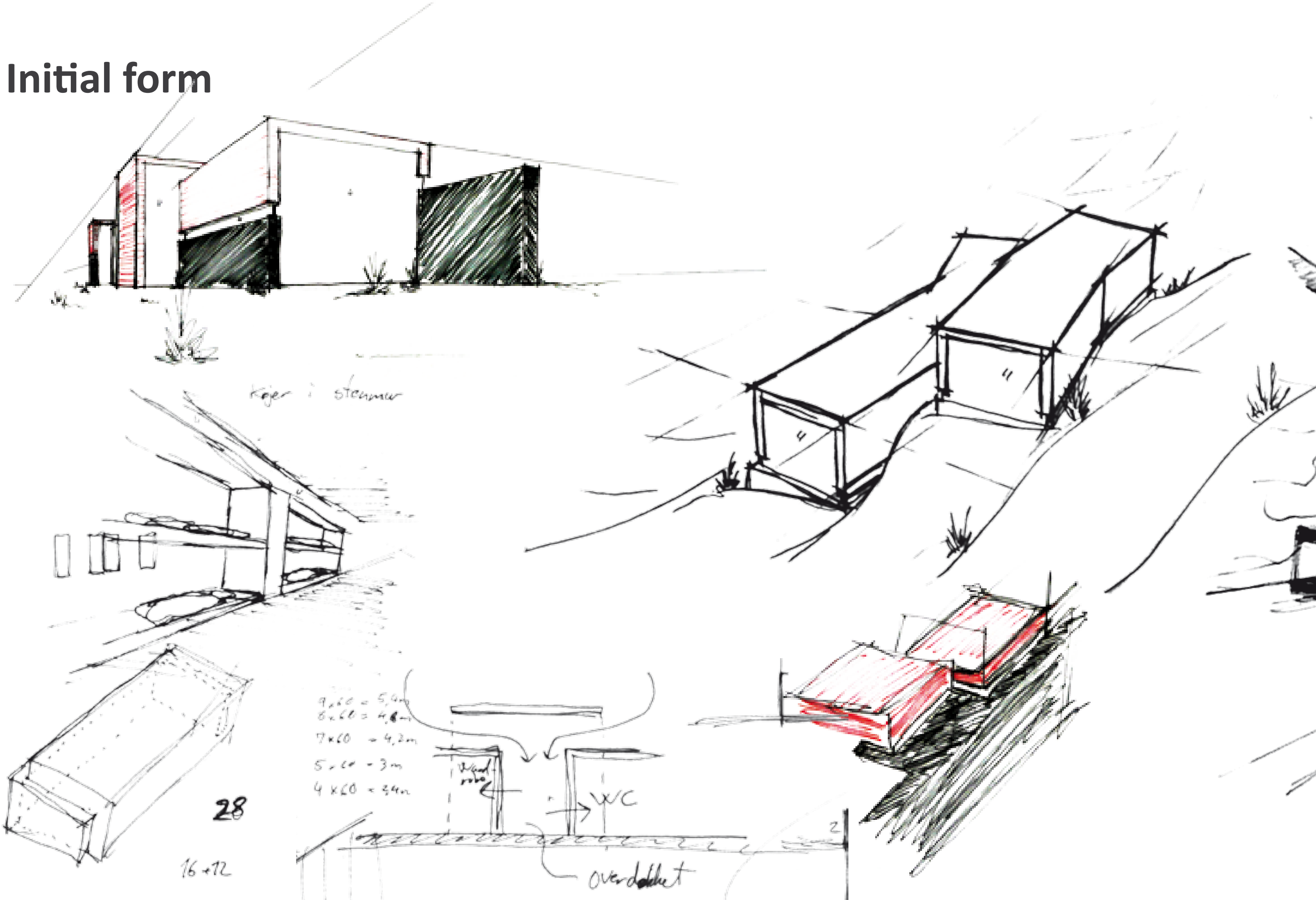
**Direction.** A vernacular ‘sel‘ is clearly oriented and has window openings and doors placed only on the opposite ends, thus enhancing the orientation. In the same way entrance and windows in the contemporary cabin should be oriented in opposite ends and a larger window opening could supplement the low window band.



*Ill. 065: Various models exploring architectural expression*

The expression derived from the sketches on the previous spreads is further explored through simple models.  They are based on a clear distinction between the architectural objects, voids, wall and foundation. Like the vernacular building typologies the models are formed by simple volume with ideas of how to combine these to form larger building volumes.

# Initial form

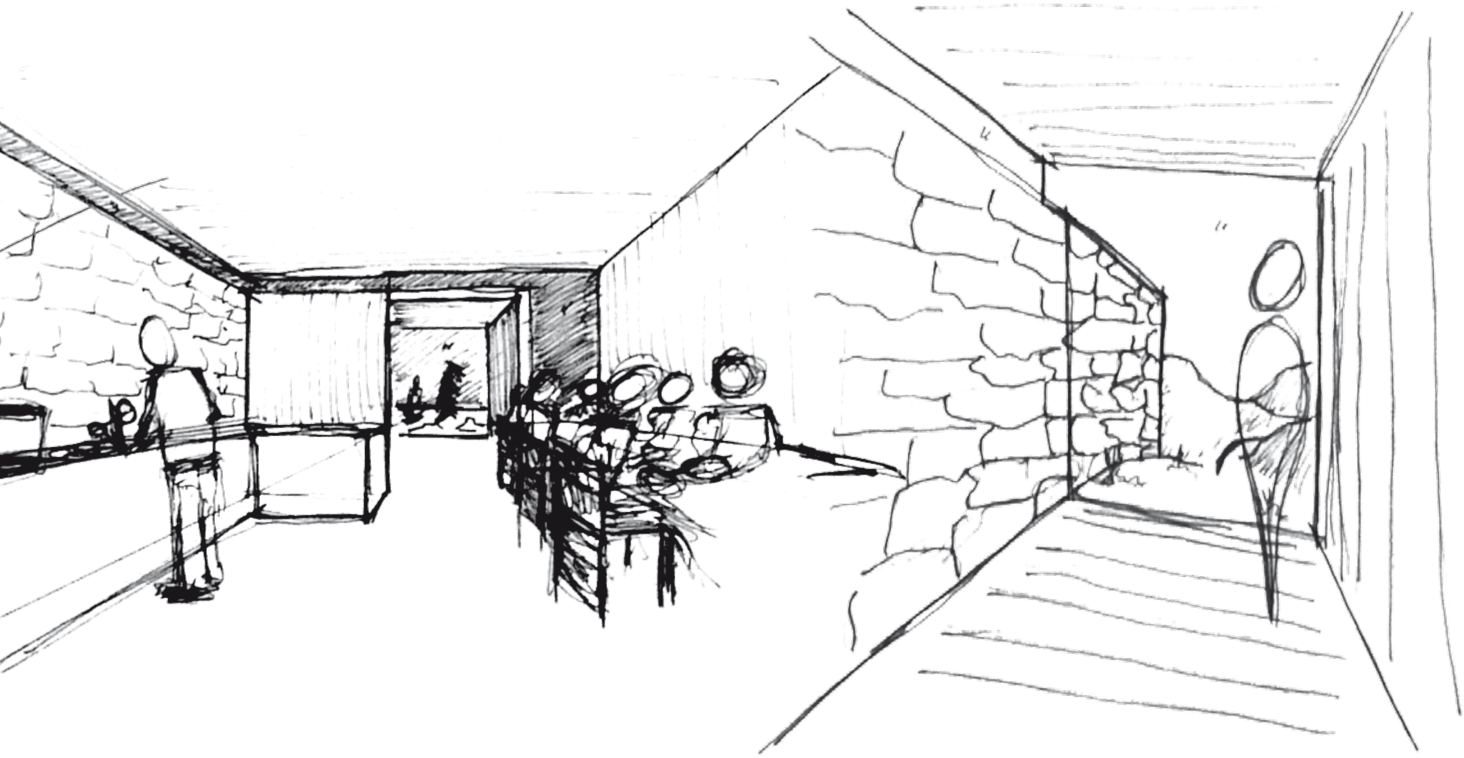



*Ill. 066: Various sketches*

The following pages describe the continued development of the principles and form findings presented in the previous chapters. This will lead to a short presentation of the initial design of the mountain cabin at this stage of the design process.

**Concept and form**

The concept of the mountain cabin is to have the common facilities gathered along the boundary between plateau and slope. This boundary is emphasised by a stone wall that unifies all the common facilities. The stone wall could also contain practical functions as cooking, toilets, showers, bunk beds etc. In this way the wall becomes both a practical element and an architectural element which clearly defines the boundary between the private cabins of the slope and the more public facilities of the plateau.

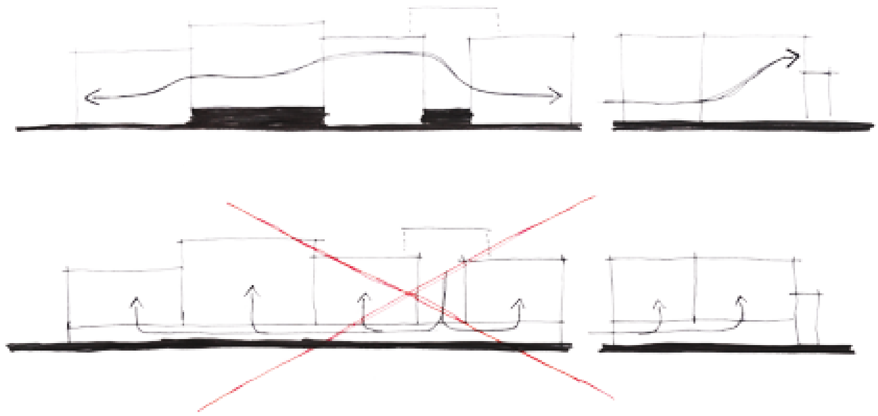


*Ill. 067: The wall directs the view towards the panoramic scenery*

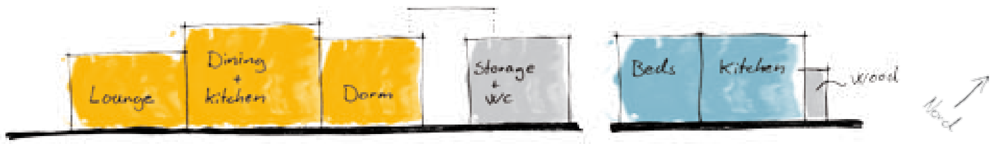
**Interior**

Like the use of the facilities differs, so should the interior expression. This means that the spatial qualities of for example the private cabins are different from the dining room and fireplace lounge, in the same way as the winter facilities have a more enclosed and introvert expression than the summer facilities should have.

The spatial qualities of the private cabins should express the intimacy you experience while you sit and enjoy your morning coffee and feel the solitude and the proximity to nature. After a long day of exploring the mountains you return tired to Velleseter and meet your fellow hikers at the dinner table. Here the focus is on the communal meal and social life, and therefore no needs for large panoramic views of the surroundings you have already spent the whole day exploring. The evening is spent in the fireplace lounge where you watch the last rays of sunlight on the surrounding mountain peaks while the fireplace warms the room.  In this way the different spatial qualities should match their use.



Ill. 068: *The flow should be ‘free‘ and dynamic as the landscape.*




*Ill. 069: Organisation of functions, with orange as ‘summer‘, grey as ‘storage and wc‘ and blue as ‘winter‘*

**Flow**

The different perception of the spatial qualities is much dependent on how one moves through them. Therefore the idea of the spatial flow is to be ‘free‘ and dynamic like when you move through the landscape, so that different spatial experiences is continually revealed as you move through the interior. The opposite concept is that of moving along a corridor and choosing to open a door into a different spatial experience.

**Initial design of the mountain cabin**

At this stage of the process the design of the mountain cabin shows how the common facilities are organised along, and unified by, a linear stone wall. The different functions are attached and extruded into each other, so it looks like they almost ‘grow‘ along the wall, while they also support the direction of the wall. Beneath the common facilities the private cabins lay scattered across the slope as small volumes that barely touch the landscape.

This design forms the basis for the following development of the project.

*Ill. 070: Model pictures of initial form*

# Materials

*Ill. 071: Granite used for walls in traditional sel.*

The choice of materials is based on the contextual design approach. This means that the aesthetic, structural and environmental concerns of choosing materials are compared to the specific context of the project.

**Granite**

In the previous chapters it was described how the architecture of the mountain cabin is based on a functional and unifying stone wall. On Velleseter there are remains of granite foundations from previous settlements which preferably can be reused in the new mountain cabin. This, in combination with additional supply from local stone quarries, will benefit sustainable aspects of the project. The use of stone provides a rawness and solidity to the architectural expression, and as the stone wall forms both a structural and symbolic link to the surrounding *fjell*, it reflects an honesty in the use of the material.

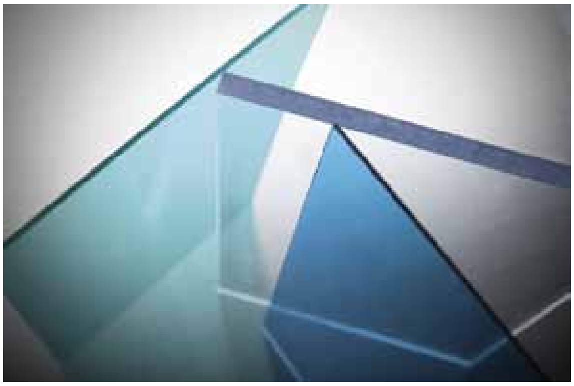
*Ill. 072: Rough texture on Sunpu church by Taira Nishizawa Arch.*

*Ill. 073: Larch facade, Sal Haaken by Stein Halvorsen Arkitekter*

### Wood

As the wooden exterior will be exposed to the harsh conditions of the Norwegian climate, it is necessary to choose a type of wood that can resist these conditions. Therefore the strong heartwood of larch is used for the facade cladding. The resistant qualities of larch furthermore mean that wood proofing containing chemicals can be avoided and that there will be a longer span between changing the cladding of the facade.


The architectural expression of the facades should appear as a rough texture to both reflect the surroundings and form a contrast to the more “clean“ lines of the architectural form. Therefore large boards with a untreated finish are used. The heartwood of larch will have a warm red color, but will eventually desaturate according to the exposure to sun and rain. Larch will also be used for the interior cladding. Where the stone wall provides a massive and rough expression to the interior, a more “warm“ and smooth contrast is needed. Therefore the sapwood of larch is used, as it has a lighter color tone. Furthermore sapwood is less weather resistant than heartwood, which complies with its use in the protected interior [Treteknik.no].



*Ill. 074: Solid polycarbonate sheets*

*Ill. 075: Translucent polycarbonate used as facade cladding*

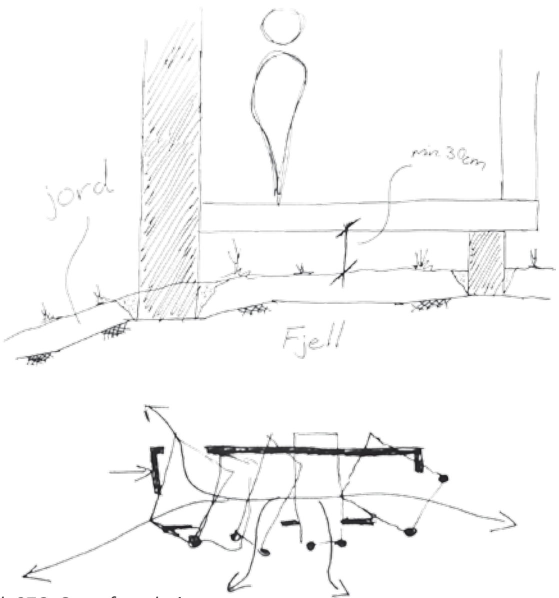
**Polycarbonate**

Where stone and wood both represent vernacular building traditions, there also needs to be an element that reflects the contemporary frame of the project. As described during the *Form finding* a low window band is used to separate stone- from wooden elements. As this low window band is placed close to the ground it will be vulnerable to impacts, which limits the use of traditional glass windows. Instead polycarbonate is used, as it offers a high impact resistance (polycarbonate is used for security equipment and bulletproof shielding) along with a transparency and light transmittance similar to glass [RIAS]. Polycarbonate is a plastic often used in industrial design, but also in larger scale as roof lights and in greenhouses.

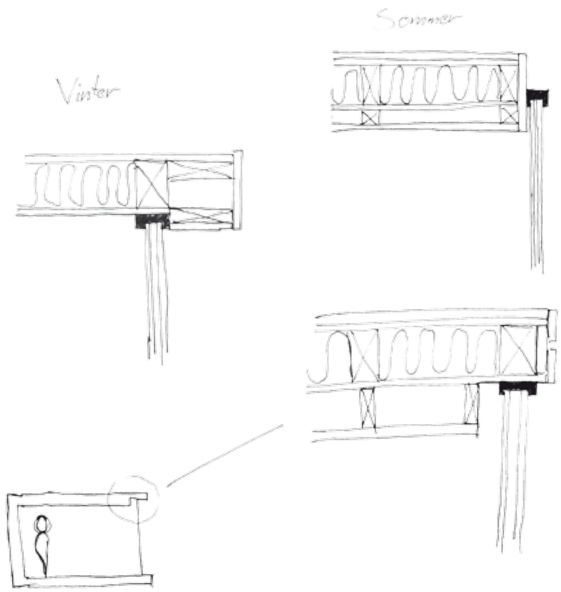
Furthermore solid polycarbonate has a high thermal resistance with a R-value of *0.21W/(m·K)* compared to approximately *1.0W/(m·K)* of solid glass, which means that the material has better insulation qualities compared to glass [Materialebogen, 2008]. This, along with a fire rating of B-s1, d0 (very low contribution to fire) and good weather resistance, means that polycarbonate can be used as an alternative to traditional glass [RIAS].

Because of the material qualities it could be interesting to investigate the design perspectives of using polycarbonate. Perhaps the strength of the material could be utilized, so that the polycarbonate is not just a transparent element within a frame, but instead also functions as a load bearing structural element. These material perspectives are further investigated in the following chapter.

# Structural principles
## Details




*Ill. 076: Open foundation*



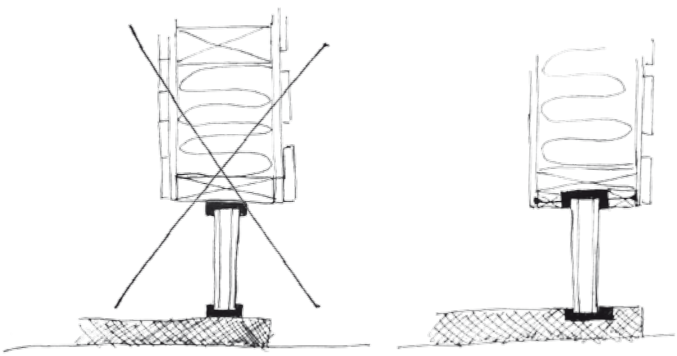

*Ill. 077: Visible and hidden window frames*

In this chapter some of the principles regarding the structural system are presented as initial sketches of constructional details and estimated calculations.

**Foundation**
This project relies on the interplay between building and landscape and should not make unnecessary modifications to the existing terrain. Therefore a traditional foundation where the terrain is leveled by heavy machinery seems as a too drastic solution. Instead an open foundation is used, where the stone walls function as stripe foundations and the wooden volumes rest on point foundations. The open foundation also has the advantage of being highly ventilated, so the wooden floor deck is less vulnerable to moisture. To prevent moisture in the deck, the distance from ground to deck should be 30cm or more.

**Windows**
The detailing of how the windows are situated within the walls can be used to emphasise the spatial expression. The reason for this is that a window represents an open boundary between the enclosure of the building and the surrounding landscape as described in the chapter *Phenomenology*. If the frame of the window is visible and emphasised the window will seem as a physical element that clearly marks the boundary to the outside. If instead the window frame is hidden there will be no visible element and the boundary becomes more blurred. Such a detail, as seen on the sketches above, has often been used by Alvar Aalto. These different perceptions caused by the detailing can be used to distinguish the spatial expression in the winter cabin from the summer cabin.

## Initial calculations



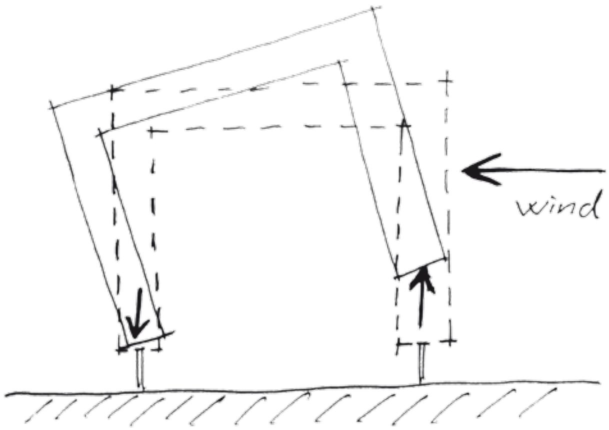
Ill. 078: A hidden frame enhances the idea of a separated structure.

Ill. 079: The polycarbonate carries the walls.

From the form finding process the idea of a low window band in the private cabins was introduced. The material used for this window band is thought to be polycarbonate as described in the previous chapter. As the window band is thought as an element that separates the walls of the cabin from its base it is not desirable with visible columns within the window band. Instead the idea is to let the polycarbonate of the window band function as the load bearing element.

**Estimated calculations**
To find out if it is plausible to have the polycarbonate as a load bearing element, some estimated calculations have been made. These can be found in the appendix [Initial calculations]. The aim of the calculations is not to find precise dimensions of the window band, but to gain some principles for the continued design process.

**Structural system**
The polycarbonate member follows the length of the cabin's walls. In these calculations a member with the dimensions 5000mm x 400mm x 40mm was used. If the wooden walls and roof are assumed to be a rigid structure, the polycarbonate member only has to obtain vertical loads as seen on the illustration to the right.




*Ill. 080: The polycarbonate only obtains vertical loads*

**Design principles**

Based on the calculations the table to the right shows the amount of internal stresses in the polycarbonate window band and how its slenderness affects its stability. The allowable dimensioning stress of polycarbonate is 14MPa and so much higher than the max. internal stresses. The low values of internal stresses means that it is the stability of the window band, or risk of buckling, that will be determining for the dimensions. If the applied loads, *N*, are larger than the critical column load, the column is considered unstable, which has been marked by red characters in the table.

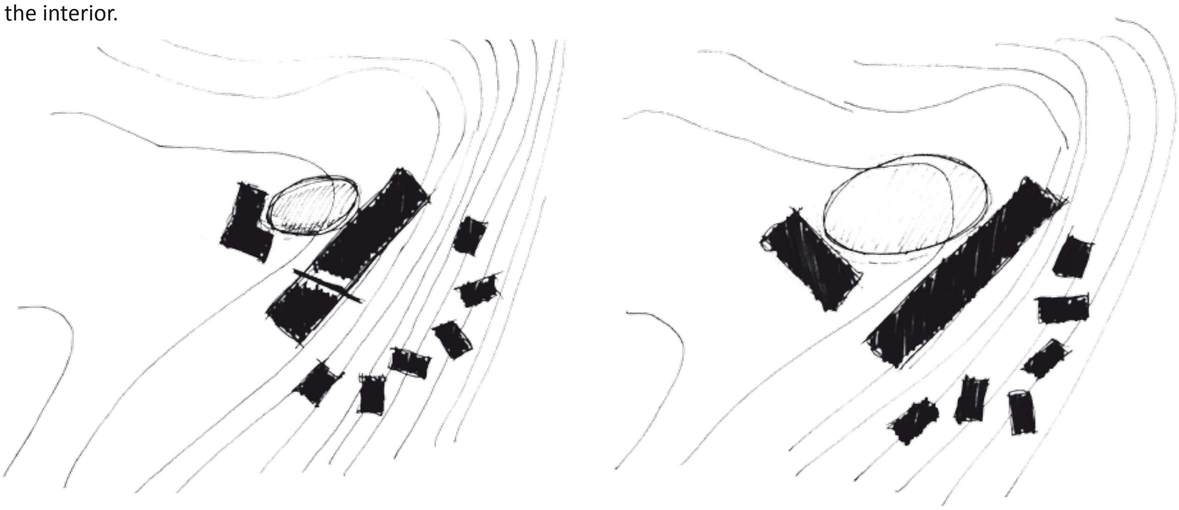
The table shows that the thickness of the polycarbonate window band has to be 20mm or above and the height 600mm or less. In the following design process a window band with a thickness of 20mm and height of 400mm is used.

| *Height x thickness, mm* | *Int. stress, MPa* | *$N_{cr}$, kN* | *N, kN* | *$N_{cr}$ > N, kN* |
|---|---|---|---|---|
| *400 x 40* | *0,26* | *947* | *51* | *947 > 51* |
| *400 x 20* | *0,51* | *118* | *51* | *118 > 51* |
| *400 x 15* | *0,68* | *50* | *51* | *50 < 51* |
| *400 x 10* | *1,0* | *15* | *51* | *15 < 51* |
| *300 x 20* | *0,51* | *210* | *51* | *210 > 51* |
| *600 x 20* | *0,51* | *53* | *51* | *53 > 51* |
| *1000 x 20* | *0,51* | *19* | *51* | *19 < 51* |

# SYNTHESIS

# Form development
## Plateau and building

The initial form that ended the sketching phase is further developed in the following iterations of the synthesis phase. Some of the design aspects which need to be investigated and clarified are how the common facilities relate to the plateau, the interaction between the stone wall and wooden volumes, and the spatial organisation of the interior.



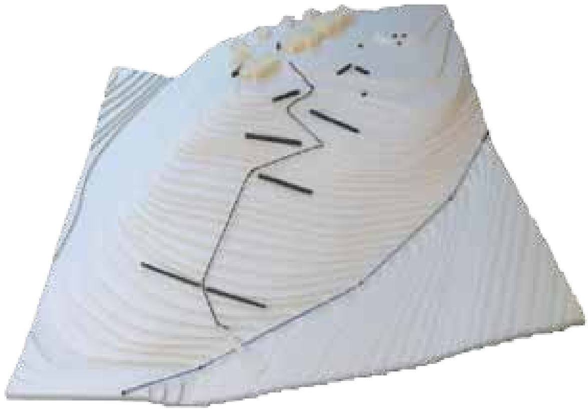
*Ill. 081: The plateau is activated by a defined area between buildings*

### Activation of plateau

In the initial form the long building with the common facilities only has openings in the same direction as the orientation of the building. This emphasises the boundary between the plateau and slope, but at the same time lacks to express that the common facilities should be related to the plateau. One way of marking this relation could be by placing some of the functions or activities on the plateau to activate the use of it.

Since the winter- and summer facilities are separated in two buildings, one of them could be placed on the plateau to create a defined area between the buildings. While the idea of activating the plateau by a defined area has qualities, the use of a separate building to do this is not seen as the solution. Placing a detached volume on the plateau will interfere with the open and large scale character of the plateau and at the same time the 'extra' volume will disturb the compositional coherence, meaning that an added or removed element will disturb the clarity of the concept.

Instead of placing a building on the plateau, the outdoor campfire could be used to activate and mark a defined area. This could be done using a low rise wall that simultaneously encloses the campfire and defines an outdoor area between campfire and building.



*Ill. 082: Stone walls follows the path to the mountain cabin*

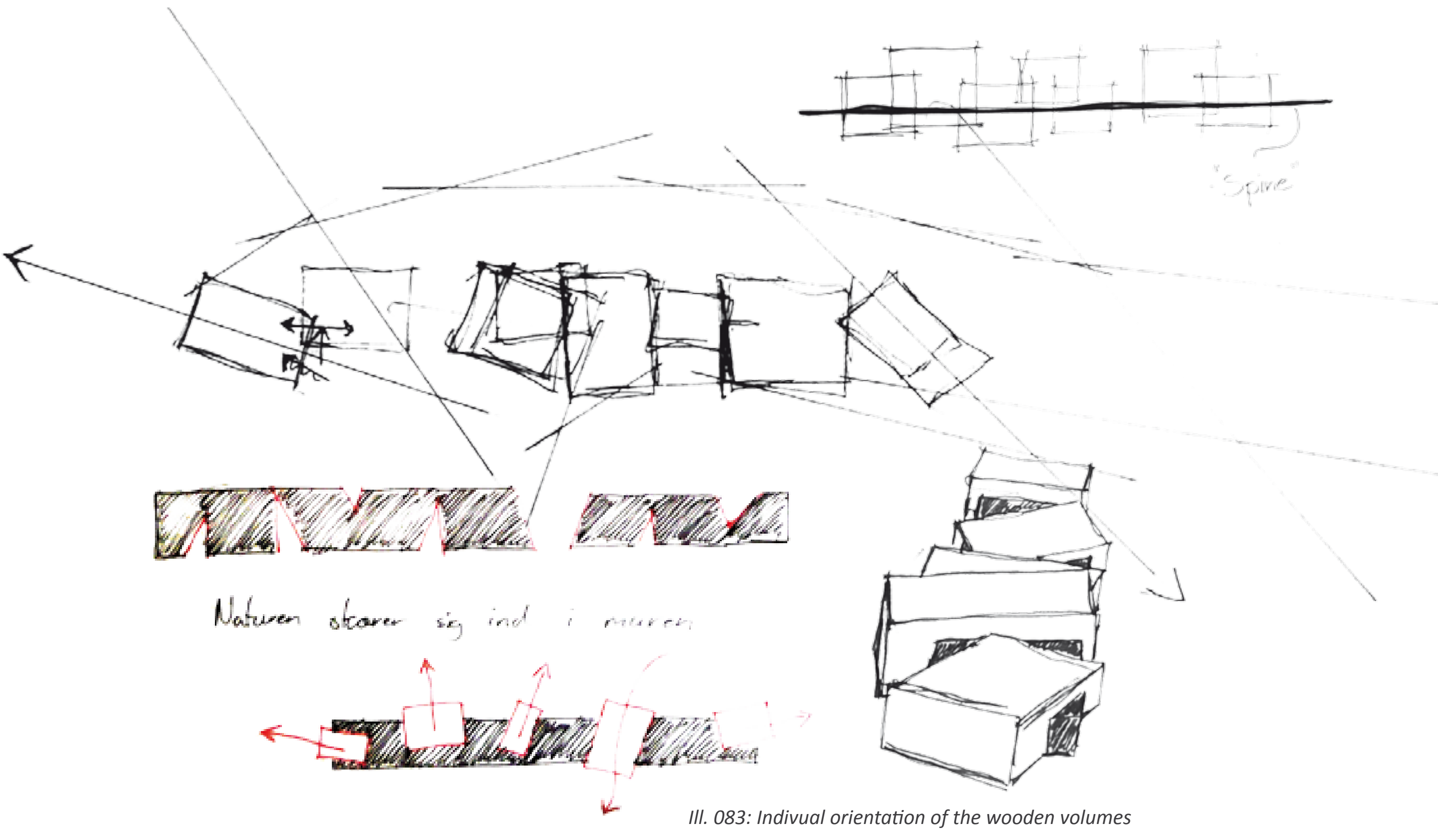
**Approaching Velleseter**

The idea of using low stone walls to define and shape the landscape is already present at Velleseter. Today when you approach the mountain cabin, the "entrance" to the *seter* is marked by a low 0.5m stone wall. Through this marked entrance the path follows the height of the terrain and leads up to the mountain cabin. Where the terrain is too steep, the path breaks and follows alongside the terrain for a more comfortable slope.

This idea is continued so that similar low stone walls are used to mark the path up the slope. The stones walls are placed according to the terrain, so that they help holding back erosion to level the slope. Furthermore the retaining stone walls become landscape elements linking the story of the approach to the architecture of the mountain cabin.

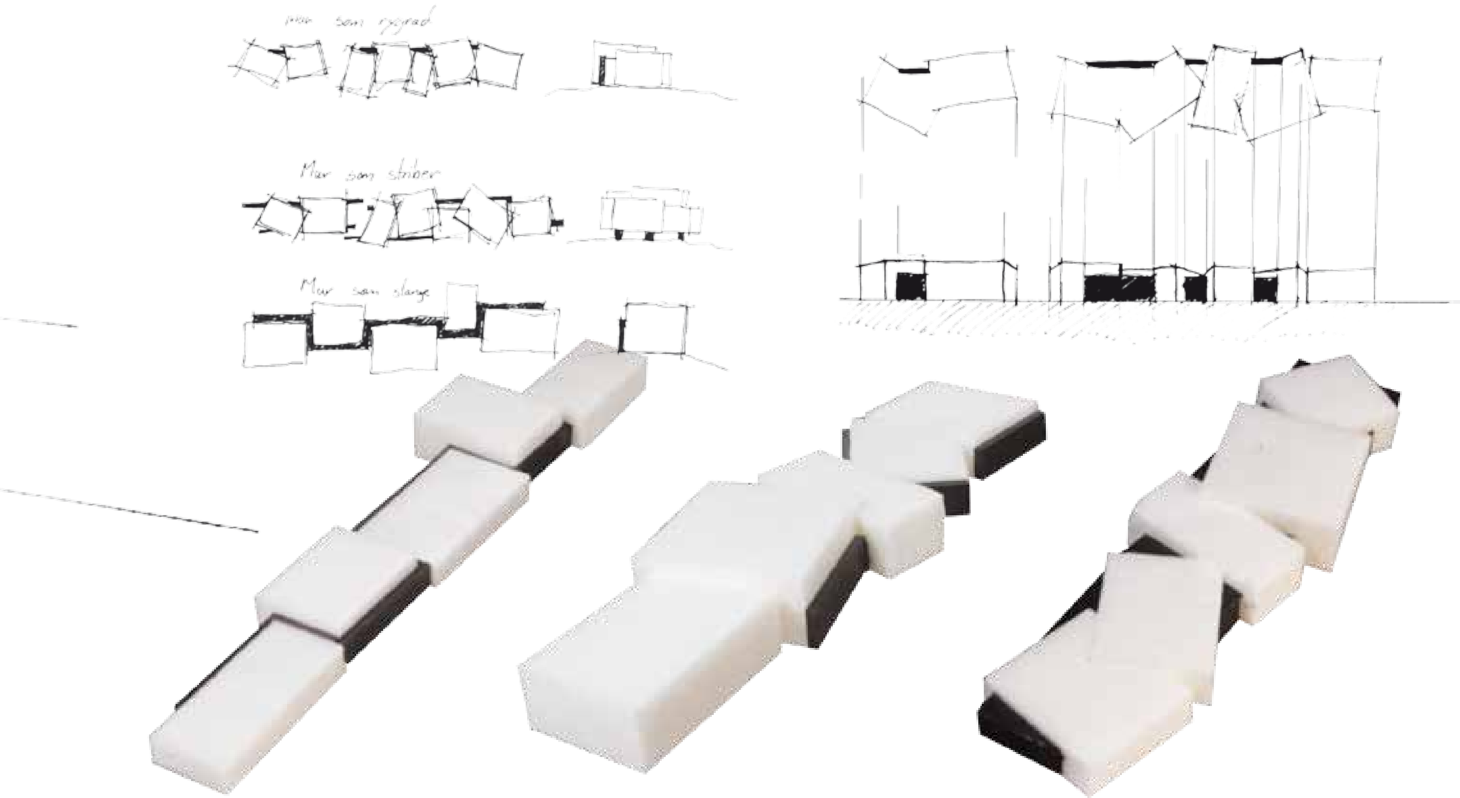
At the top of the slope an angled wall is placed to "end" the story of the approach. This angled wall encloses a small outdoor area, which is thought to be used as area for the campfire. The angled wall is orientated towards the north-west, so that you can sit and enjoy the sunset while having a scenic panorama view of the entire Vellesætredalen. Thereby the plateau is not just an open undefined area, but becomes an activated area that links the mountain cabin to the campfire and the approach.

## Wall and volumes




*Ill. 083: Indivual orientation of the wooden volumes*

The primary architectural elements of the initial form are the long stone wall with wooden volumes attached along it. In this initial form both the wall and the volumes supported the overall orientation of the building, which seems unnecessary. This chapter therefore presents some of the models and sketches that helped to develop the interplay between the stone wall and wooden volumes and to gain an understanding of their architectural expression and hierarchy.



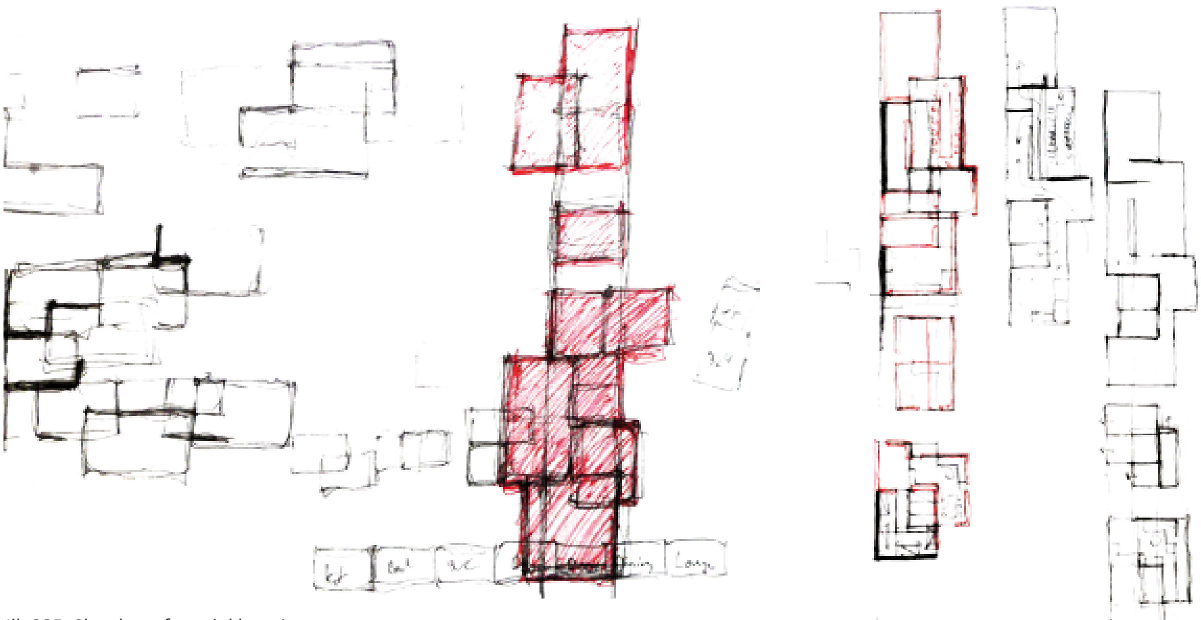

*Ill. 084: Form studies of the interplay between wall and volumes*

**Orientation**

If the stone wall is kept as a “spine“ that connects the buildings, the wooden volume could be treated more freely. An idea was to have each function oriented according to different views, where the stone element could either be a long thin wall or a wider volume wherein the wooden volumes would “float“. In either way the overall form of the building already marks the boundary between plateau and slope, so the wall does not have to be a single long element, but could instead be divided into smaller elements. The hierarchy of the elements although still means that the stone wall has to be the connecting “spine“ of the more freely treated volumes.

To further understand the geometry of the form it will be necessary to clarify the spatial organisation of the interior, which will be done in the following chapter.

## Spatial organisation

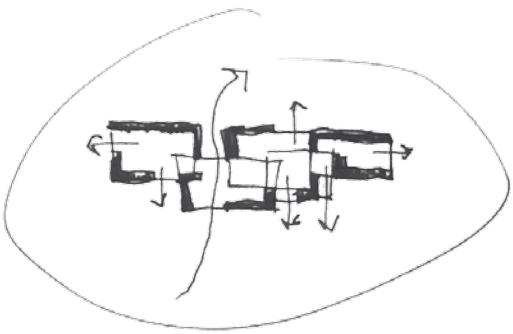


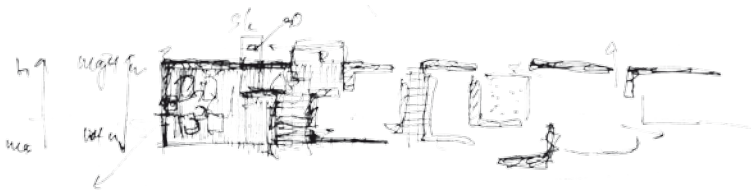
*Ill. 085: Sketches of spatial layering*

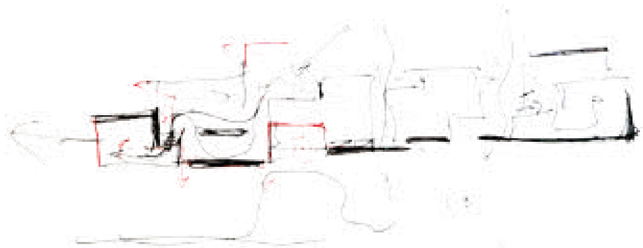
In the  chapter *Initial form* it was described how the spatial flow should be 'free' and dynamic like when you move through the landscape, so that different spatial experiences are continually revealed as you move through the interior. This chapter develops the spatial flow and organisation of the common facilities and explains how this influences the form of the mountain cabin.

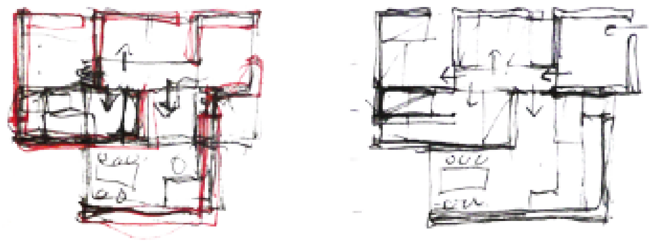
### Spatial layers

With the linear distribution of the functions as a basis, the functions are overlapping each other to create multiple spatial layers. Within this overlapping and layering new spatial qualities are made, which can be used to bind the interior flow together.









*Ill. 086: Freestanding walls direct the flow*

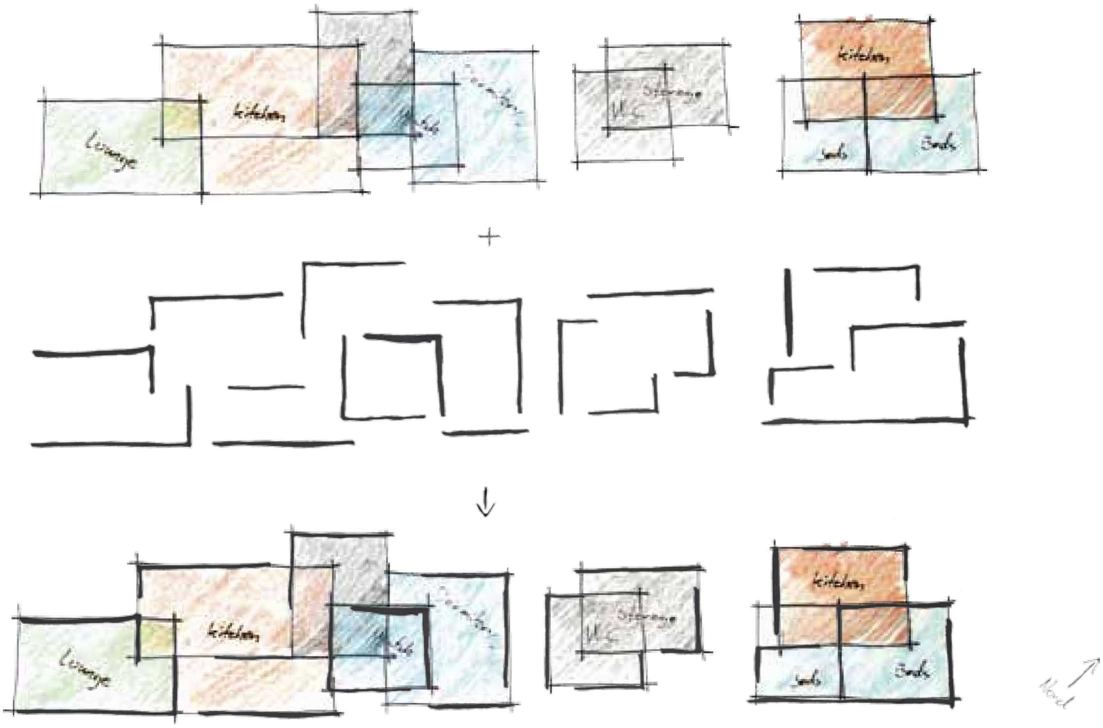
*Ill. 087: The interior spaces are tailored to fit their functions*

### Freestanding walls

Clearly inspired by the modernists’ perception of free-flowing open spaces, the freestanding walls of the mountain cabin are used to direct the interior flow and create dynamic overlaps of the spatialities. But the spatial layout of the mountain cabin distances itself from the modernists’ open spaces, as the Nordic context requires a more enclosed expression with a marked boundary between interior and exterior. This is done by carefully altering the distance between the freestanding walls so the created spatialities both fit the purpose of the functions and also defines a boundary to the surrounding context.

### Tailored spaces

The development of the spatial layout requires mutual considerations of the flow and necessary spatial dimensions. In a remote context like Velleseter the functionality of the cabin needs to be prioritised. Therefore the rooms are accurately dimensioned according to their use. These interior “tailored“ spaces are furthermore what causes the exterior form of the mountain cabin, as the interior functions ”push” the exterior walls to create a cabin designed from the inside and out.

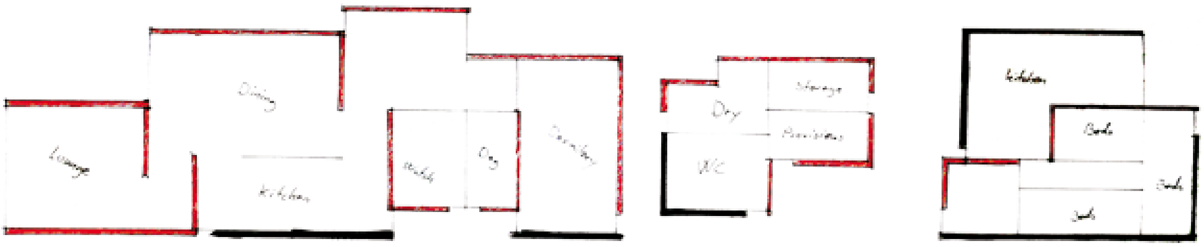



*Ill. 088: The spatial layout is based on a combination of overlapping functions and freestanding walls*

**A typology**

The combination of the freestanding walls and the individually dimensioned spaces forms a typology, where the spatial layout is organisationally based on the same concept as the initial form, but has a different understanding of the architectural elements and therefore a different expression. Whereas the extruded wooden volumes of the initial form only had a one-way orientation, the freestanding walls provide a better indication of the common facilities link to the plateau.

The facade towards the slope is still kept tight to mark the boundary between plateau and slope and to function as a ruling line from which the interior spaces are set off. The principle of the freestanding walls also affects that the stone wall is divided into smaller elements and is now used primarily as a 'functional' element for build-in beds, toilets, kitchens etc.



*Ill. 089: Wooden walls marked in red and stone in black encloses the interior*

## Placing the units

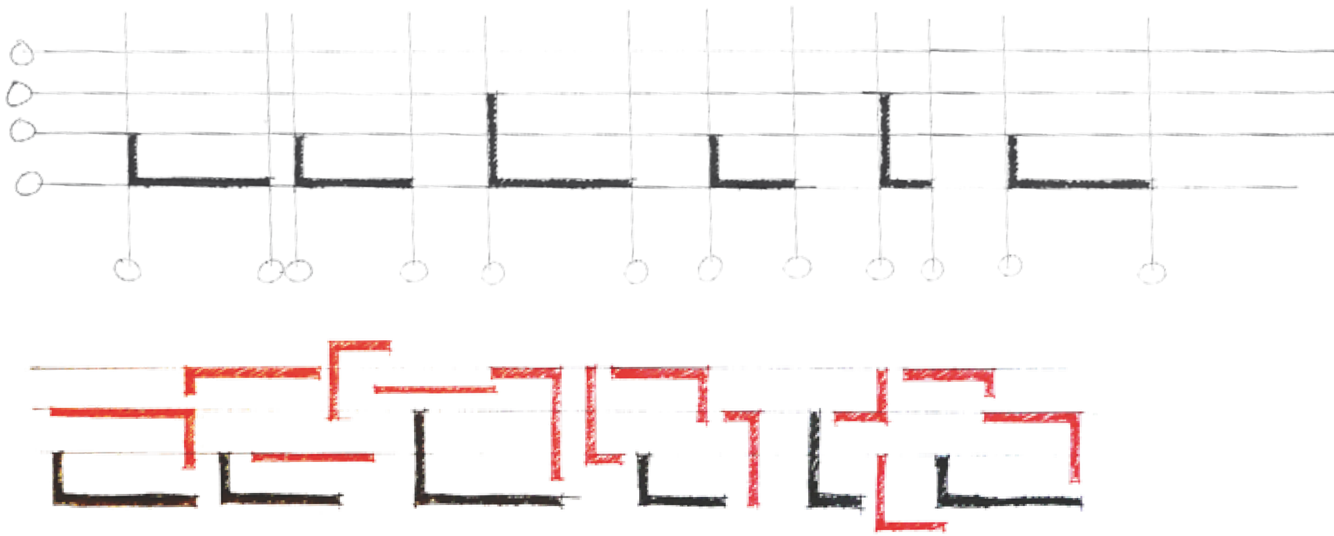
The common facilities are divided into three units according to their seasonal use and heating strategy, as described in the chapter *Volume analysis*.

The winter unit lies at the northern end of the building and on the top of the hill. This position is an important focal point, as mentioned in the chapter *Design principles*. Therefore the winter unit, which is in use all year, is placed here. The miscellaneous functions, being toilet facilities, storage and provisions, are also in use all year. This unit has therefore been placed between the summer- and winter unit for accessibility. The summer unit is situated at the southern end of the building to be orientated towards the summer sun and scenic views into the valley.

In the current phase of the project the design is represented by the sketch above. The design needs to be further clarified with rules or design principles that should be applied to control the geometry and strengthen the architectural concept. The understanding and use of the typology therefore needs to be further investigated to develop the project, which is the aim of the following chapter.

# Adjusting plan and form

## Plan



*Ill. 090: The wooden walls are arranged more freely around the angled stone walls*

The mountain should present a *civilised* relationship with nature. It is not a romantic shelter in a make-believe world where building and nature becomes one, but instead a cultured outpost of man's presence in nature. Therefore it is necessary with design rules or principles that rationalise the design.

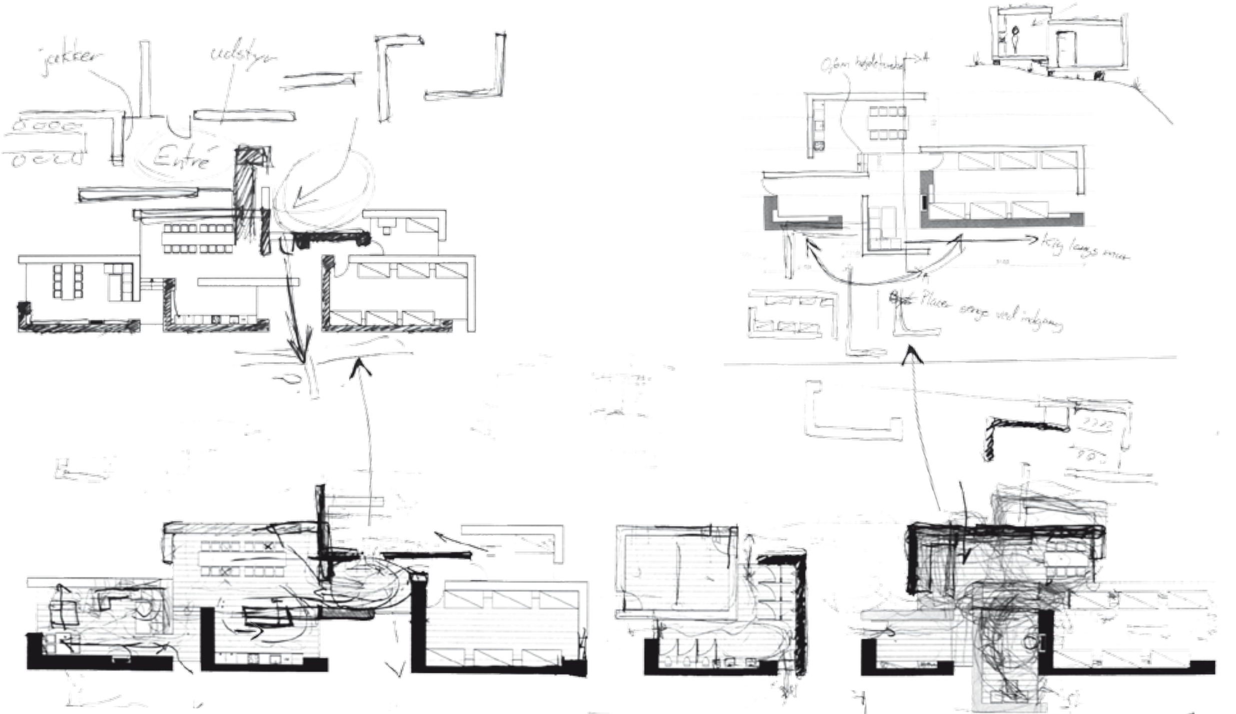
**Rhythm and balance**

The composition of the plan is based on the grid represented on the sketch above. This grid relies on a repetition of angled stone walls placed with the same distance between them to provide an underlying rhythm to the composition. Around this "spine" the wooden walls are arranged more freely according to both the dimensions of the functions and the interior flow. The entity of the composition should thereby form an asymmetrical balance of the functions placed along the angled stone walls.

**Organisation of functions**

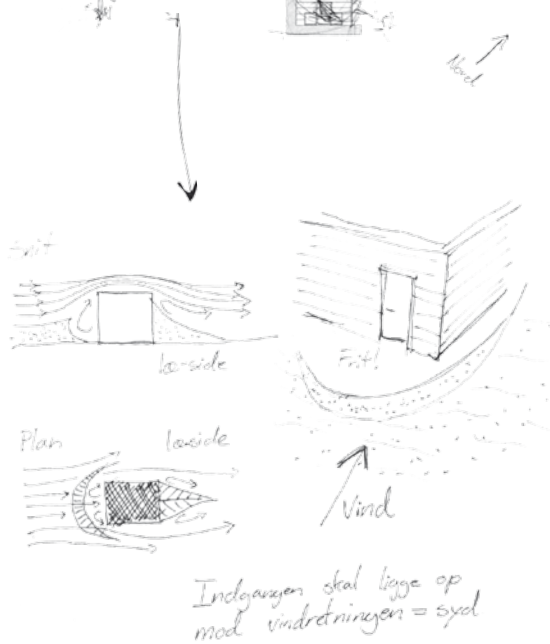
Through several iterations the plan was developed to the sketch seen on the right.

The summer unit (the southern part of the building) is organised around a central entrance, which at one side opens up to the kitchen and dining room, and at the other side leads to the more private quarters of the dormitory and watchman. Both lounge and dining room are orientated towards the scenic view of the valley and, together with the kitchen and entrance, form the open social space of the mountain cabin. On the opposite the quarters of the watchman are placed more secluded to gain privacy, while the room still has an open view towards the entrance of the building to be able to follow who is coming and going.




Ill. 091: The adjustments are focused on specific areas.

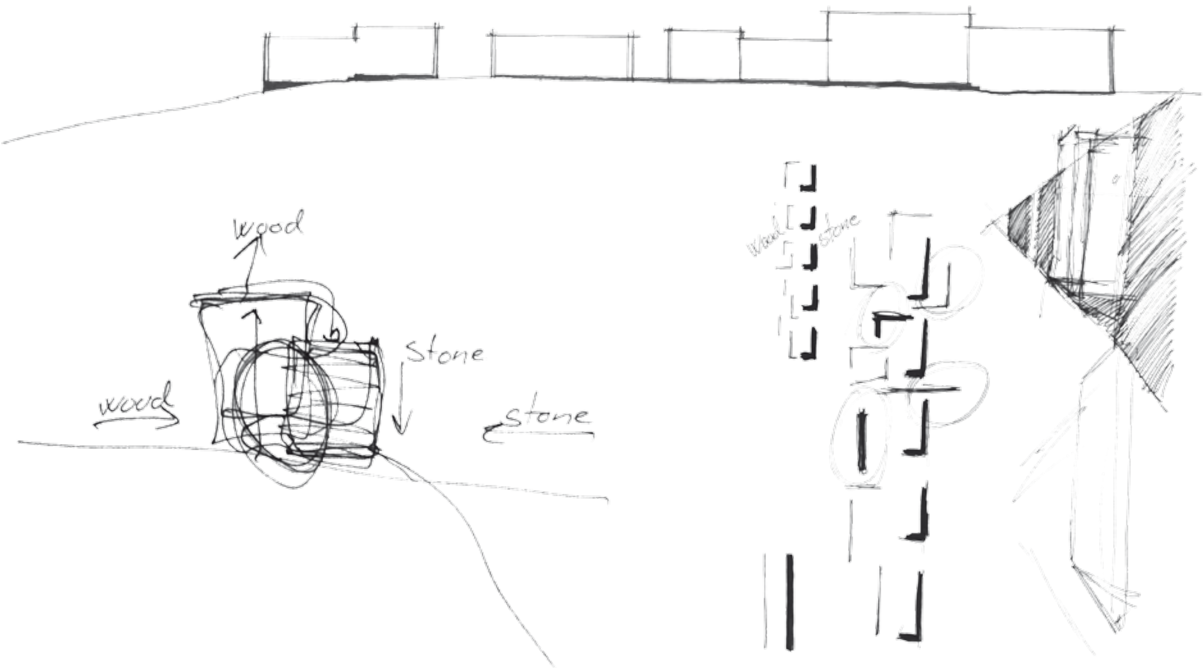
The winter unit is entered from a south-facing wall as this faces the dominating wind direction during winter, and so the wind will blow the snow away from the entrance to keep it clear. The entrance space is more practical and does not have the same central distribution function as in the summer unit. Although the winter unit is not based on the entrance as being the central space, it still uses the same idea of an open centrally placed space that links to kitchen, dining and bedrooms. Like in the summer unit, the social spaces of dining and kitchen are more open compared to the enclosed quarters of the bedrooms.




## Focal areas

The continued development of the plan is narrowed down to a few focal areas. These are the areas that are highlighted on the sketch above and illustrate the final adjustments to form the plans as they are seen in the *Presentation*.

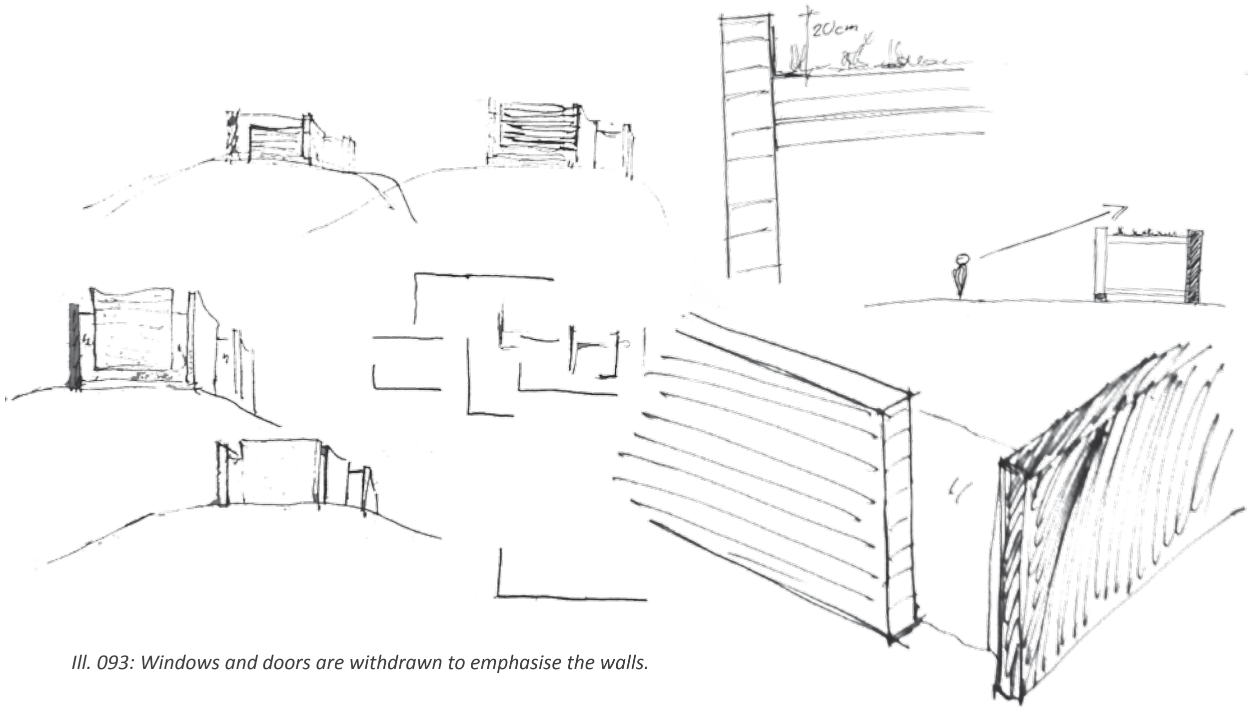
## Form




*Ill. 092: The meeting between wood and stone*

### Walls

The mountain cabin consists of two primary architectural elements, the functional stone wall and the more freely positioned wooden walls. The shape of the mountain cabin is therefore seen as an expression of how these two materials meet. The open and lighter wood is used to express the common facilities connection to the open plateau, while the dense stone marks the edge of the slope. The same understanding of the lightness of the wood and density of the stone is found in the choice of foundation. The heavy stone walls form line foundations that solidly rest on the hard *fjell,* while the lighter wood is raised from the terrain by point foundations. The meeting between the two materials is not based only on contrasts, but also on an interweaving of the two elements, so that on selected occasions the wooden wall “pokes“ through the stone walls or opposite. This idea is used to emphasize a certain design aspect, as for example to use a stone wall to mark the main entrance or a wooden wall that breaks the rhythm of the stone walls to provide a spectacular view along the stone wall.



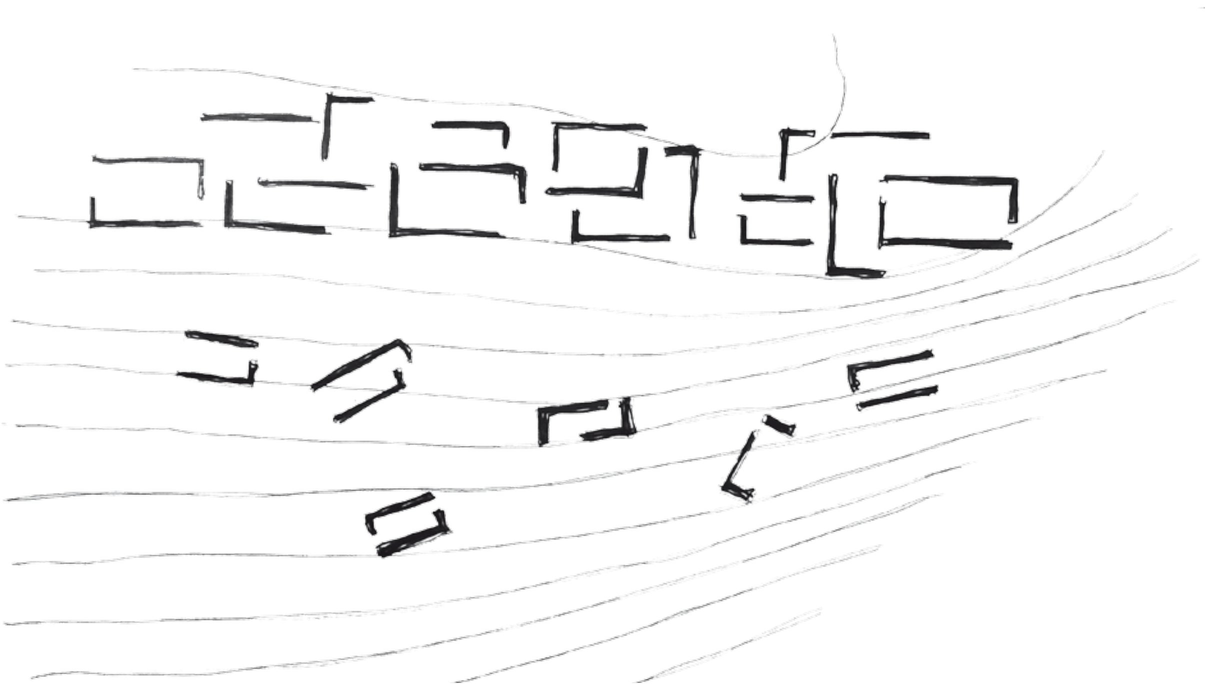

*Ill. 093: Windows and doors are withdrawn to emphasise the walls.*

**Floor level**

While the plan is determined by the dimensional needs of the functions, the section shows how the floor level is adapted to the different heights of the terrain. This difference in floor levels is especially visible in the winter unit where the height difference of about 0.6m is used to separate the kitchen and dining area from the lounge area. In combination with a difference of the room heights, the shifting floor levels lead to a dynamic profile of the section that follows the terrain.

**Voids**

The typology of the freestanding walls is based on the spaces that are defined between them. In this project the walls are seen as individual objects with voids between. Along the perimeter of the building these openings form the connection to the surroundings defined by windows and entrance doors. To emphasise the expression of voids between the freestanding walls, the windows and doors are drawn back from the facade line. This means that the window openings should be seen as a void between two walls and that floor and roof structure should therefore be less visible. This principle is further described in the chapter *Details*.

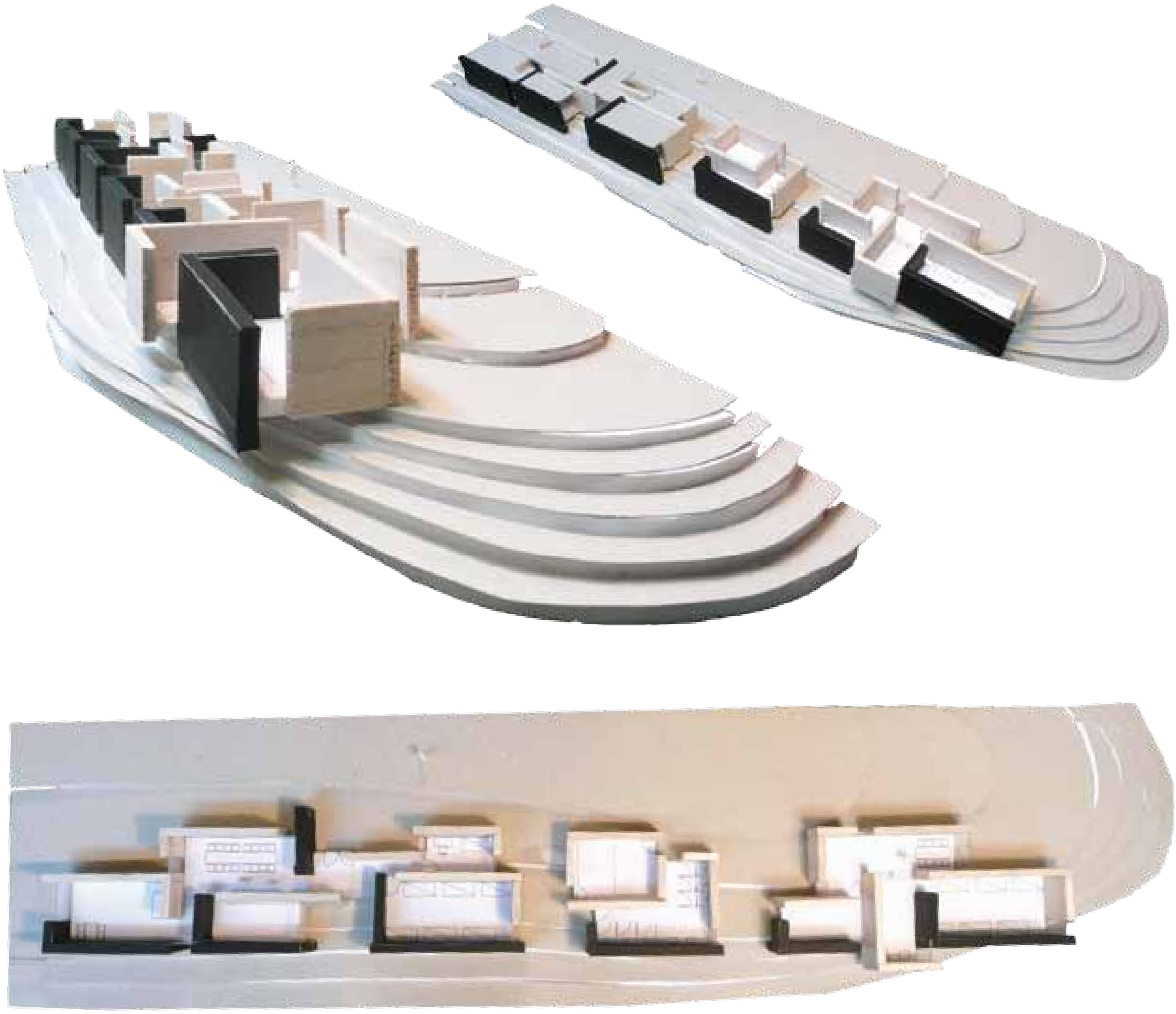

*Ill. 094: Only the freestanding walls are visible when the cabin is seen from the surrounding mountains.*

**Roof**

The roof is seen as an individual element like the freestanding walls. The idea is that one should not look at the cabin from the top of the surrounding mountain ridges and see a large roof structure dominating a large area of the landscape. Instead the building should communicate the dynamic composition of the freestanding walls, on which the architectural concept is based. Therefore the visual effect of the roof structure should be minimized.

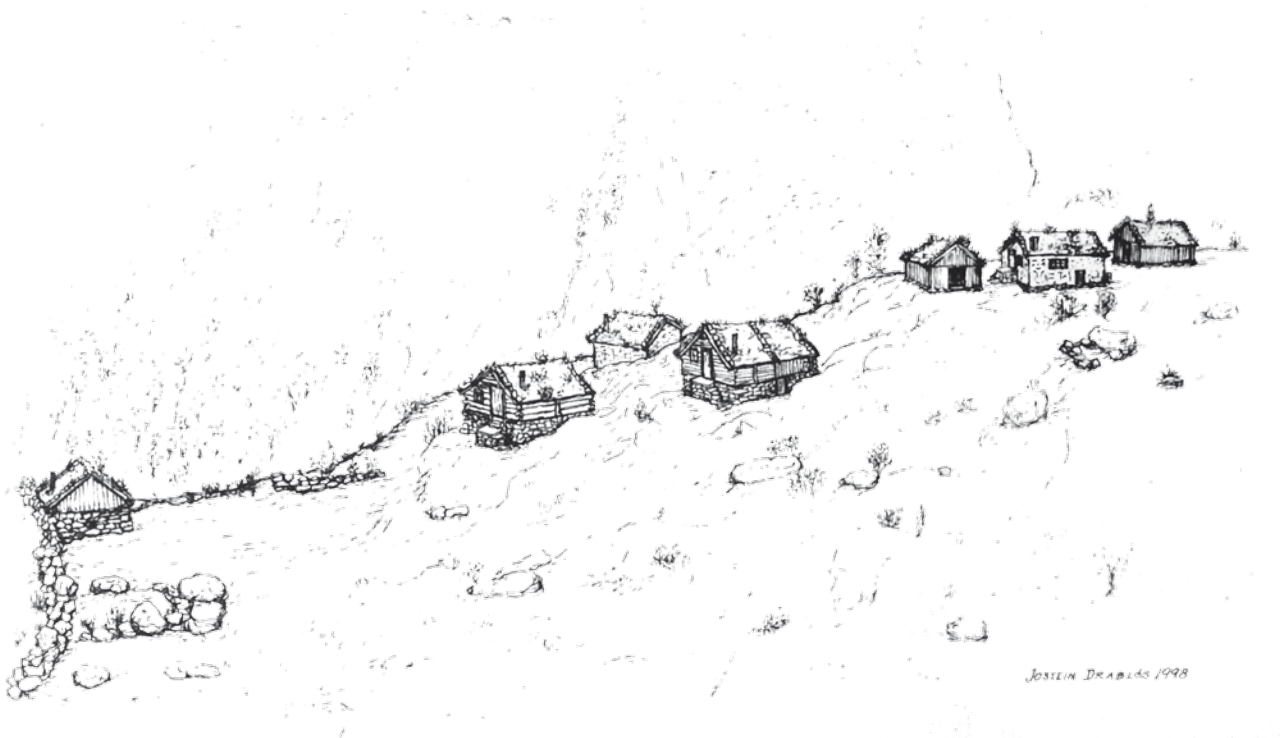
This is done by lowering the roof and the use of vegetation. A vegetated roof will minimize the visual footprint when the building is seen from above. However, it is not the intention that the vegetated roof should be visible when you approach the mountain cabin, so shorter vegetation should be used, which will not be visible because of the higher facade walls.
The use of a vegetated roof is also well suited for a flat roof, because it reduces the need for drainage of rainwater by being capable of retaining and absorbing more than 60% of the rainwater [Green Roof Research]. Furthermore the vegetated roof provides extra isolation to the roof structure to prevent superheating during the summer period and cooling during the winter period.

Thus the use of a vegetated roof is related to both functional aspects and the architectural expression. When the mountain cabin is seen from above, it will appear as a composition of walls enclosing and defining spaces within the natural surroundings.



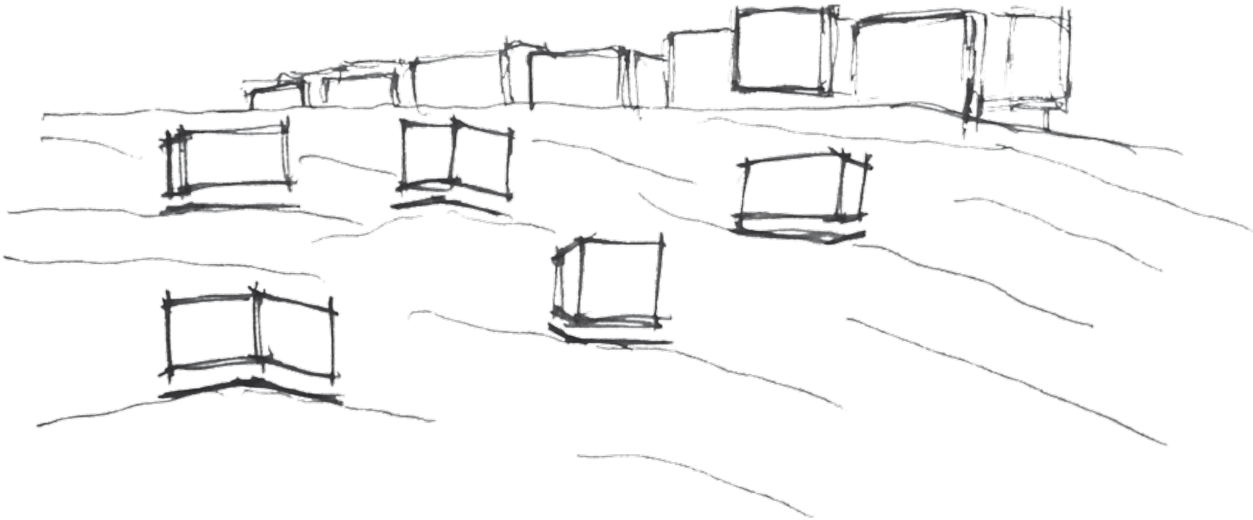
*Ill. 095: Model pictures*

# Cabins




*Ill. 096: Traditional 'sel'-cabins scattered on a slope*

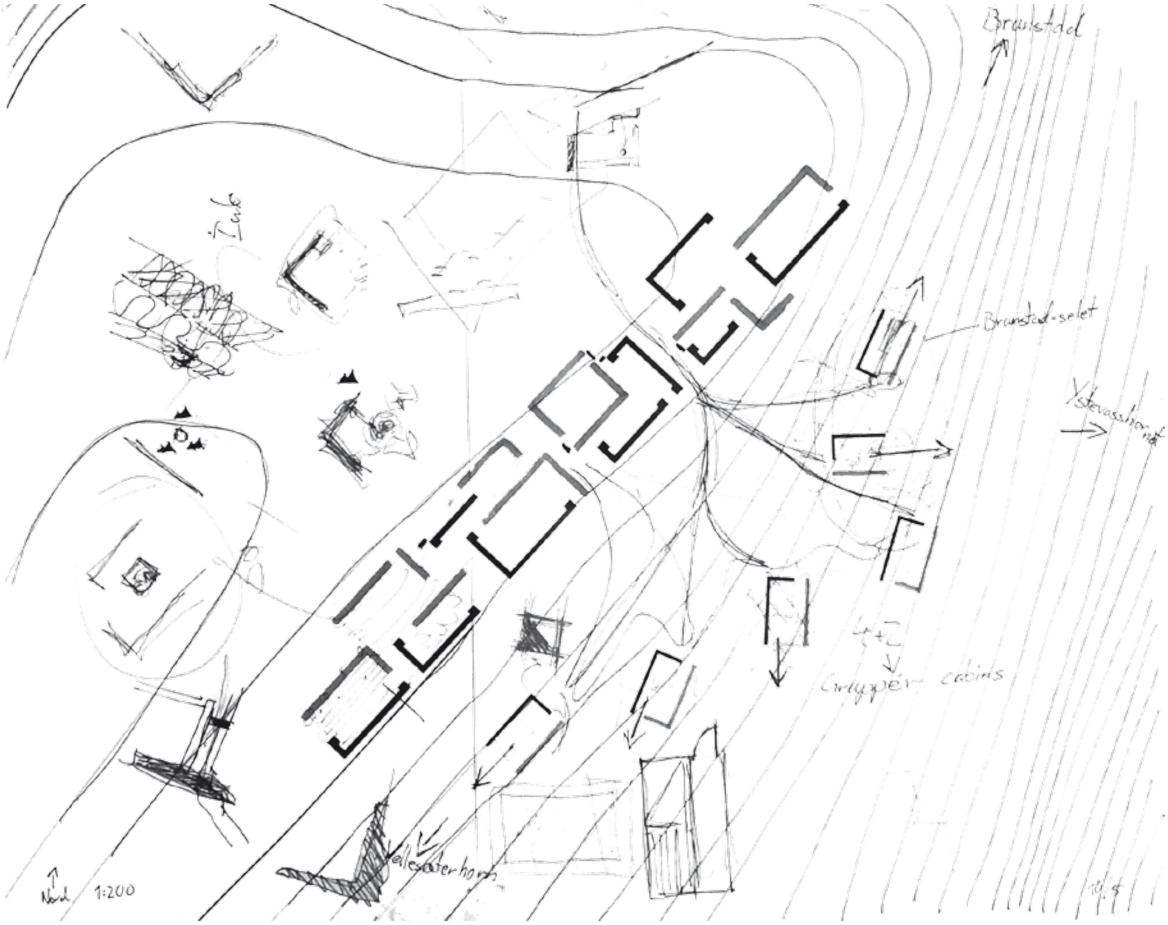
During the form finding it was described how the understanding of the local 'byggeskikk' could be used as inspiration. In particular the private two-bed cabins are based on a dissection of the traditional housing unit on a Norwegian *seter*, the *sel*. As seen on the sketch above the *sel*-units lay scattered across the terrain, each with their own individual orientation. This composition is interpreted into the modern framework of this project, to form the organisational layout of the private cabins.



*Ill. 097: The private cabins should be simple volumes scattered on the slope like the tradtional 'sel'*

## Silence

The aim of the private cabins is to express privacy, intimacy, warmth and enclosure, they should form a simple shelter where one can retreat after a long day in the mountains. Once inside the cabin you should be able to experience the solitary and contemplating effect of the *fjell*. This experience has been described as *architectural silence* by Pallasmaa, where the architectural experience eliminates external noise and turns your consciousness inwards, to yourself (Pallasmaa, 2005). The cabins are therefore simple shelters where the silence of the surroundings and the architecture lead to an introvert experience.

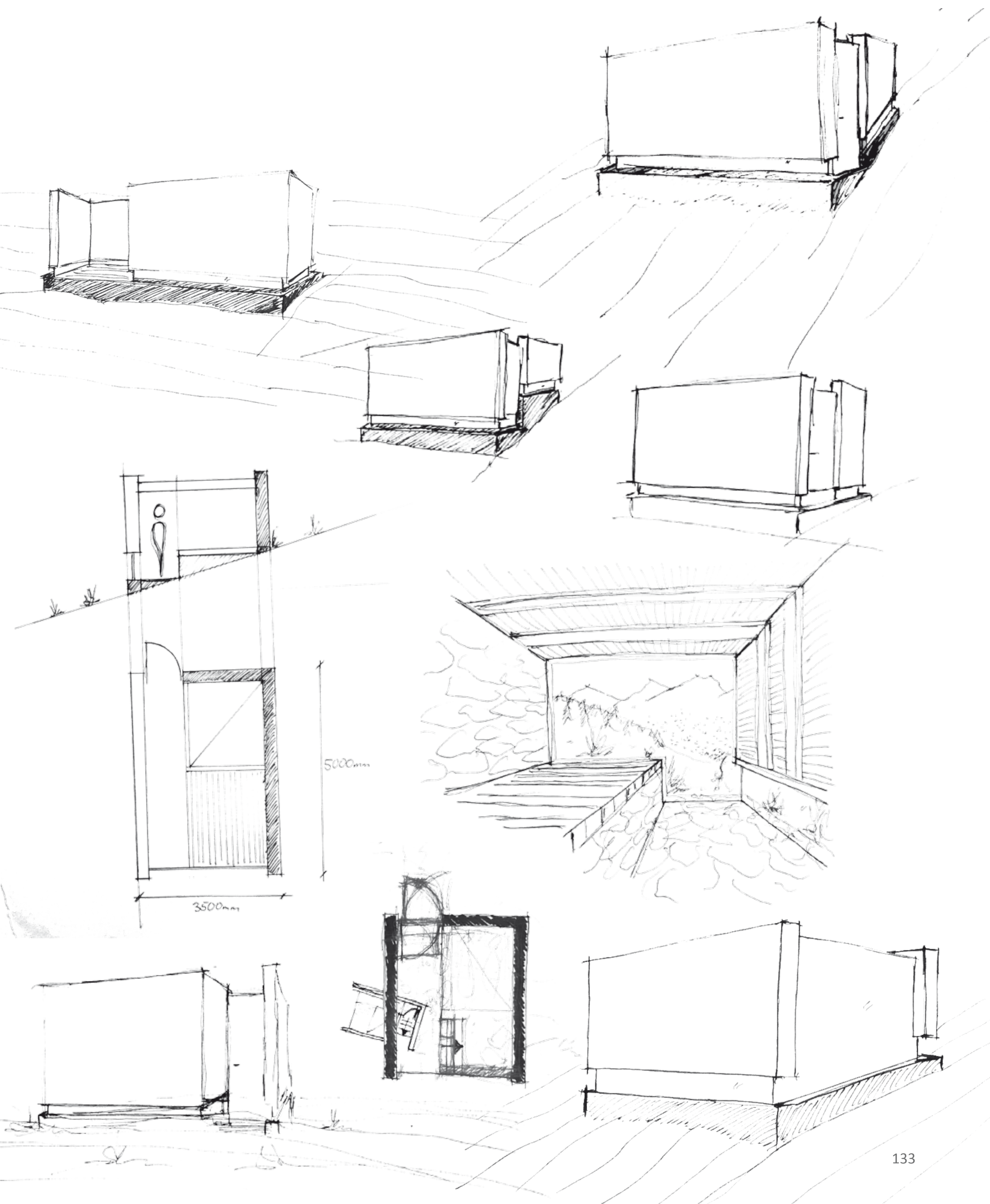



*Ill. 098: The cabins are orientated according to individual views*

## Individual orientation

Although the six cabins are organised like a traditional cluster *tun*, the proximity to the surrounding nature has been given a higher priority than the neighboring cabins. This has been done to emphasise the wanted experience of solitude and privacy. The topography allows a layout where the cabins are orientated individually, so that no cabin looks at another. Each cabin thereby have an individual view of the dramatic landscape.

These views have been determined by experiencing and analysing the site, so that some cabins are oriented towards specific mountain peaks, while others are focused more on the nearer context, as the river running close by. An idea could be to have the cabins named after their individual orientation, as for example *Brunstad-selet* or *Ystevass-selet*.


5000mm
3500mm

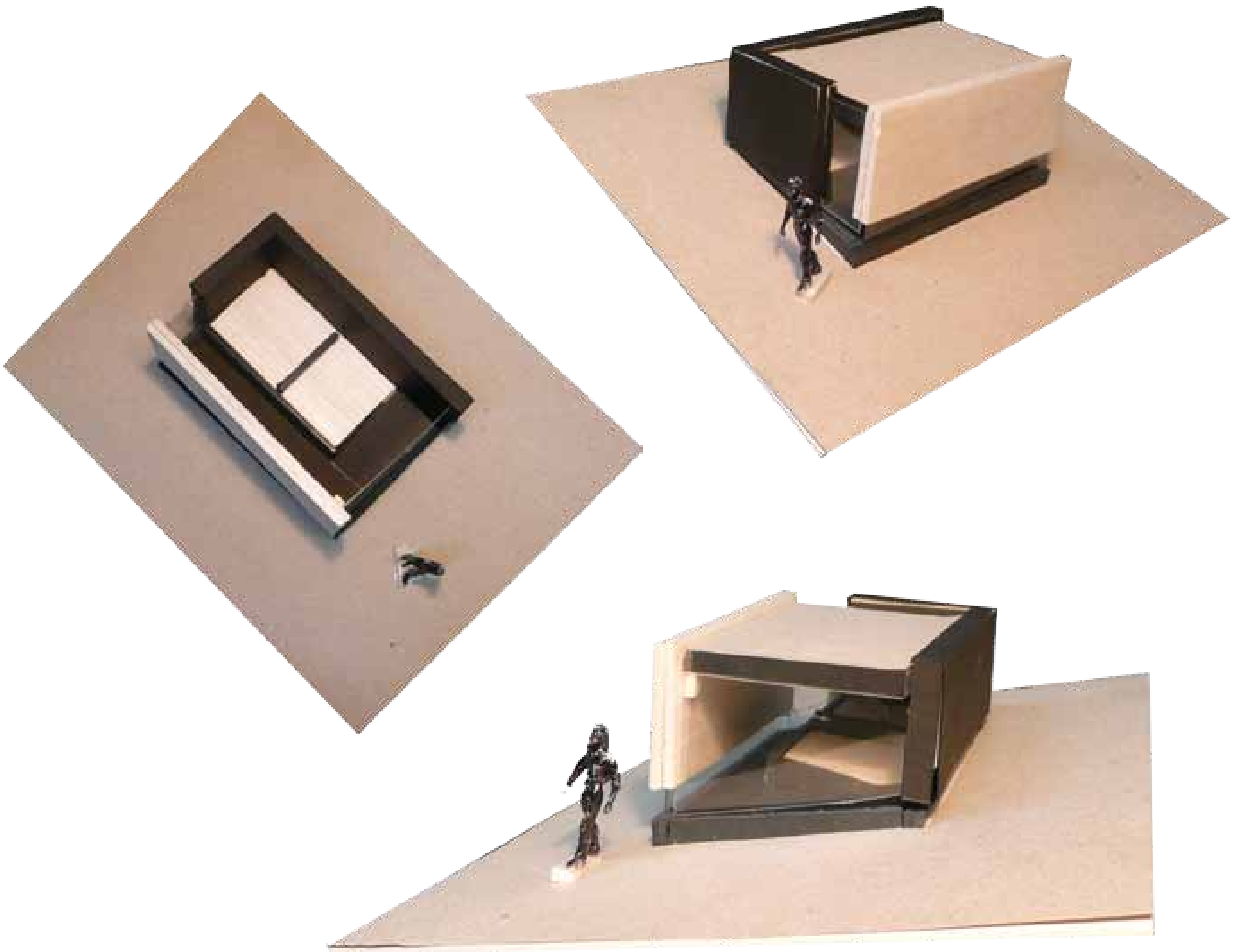
*Ill. 099: Separation by materials*

## Form

Common for the otherwise individually orientated cabins is that they are all based on the same form and architectural expression. As the concept of the entire mountain cabin is based on the different character of the plateau and slope, the private cabins should express the smaller scale, proximity to nature and intimacy that characterises the slope. Therefore the dimensions of the cabins are kept minimal, as they should only fit the needs of a primitive shelter, meaning there should be a bed, a place to keep your equipment and preferably a small area where you can sit and enjoy the view of the surroundings.

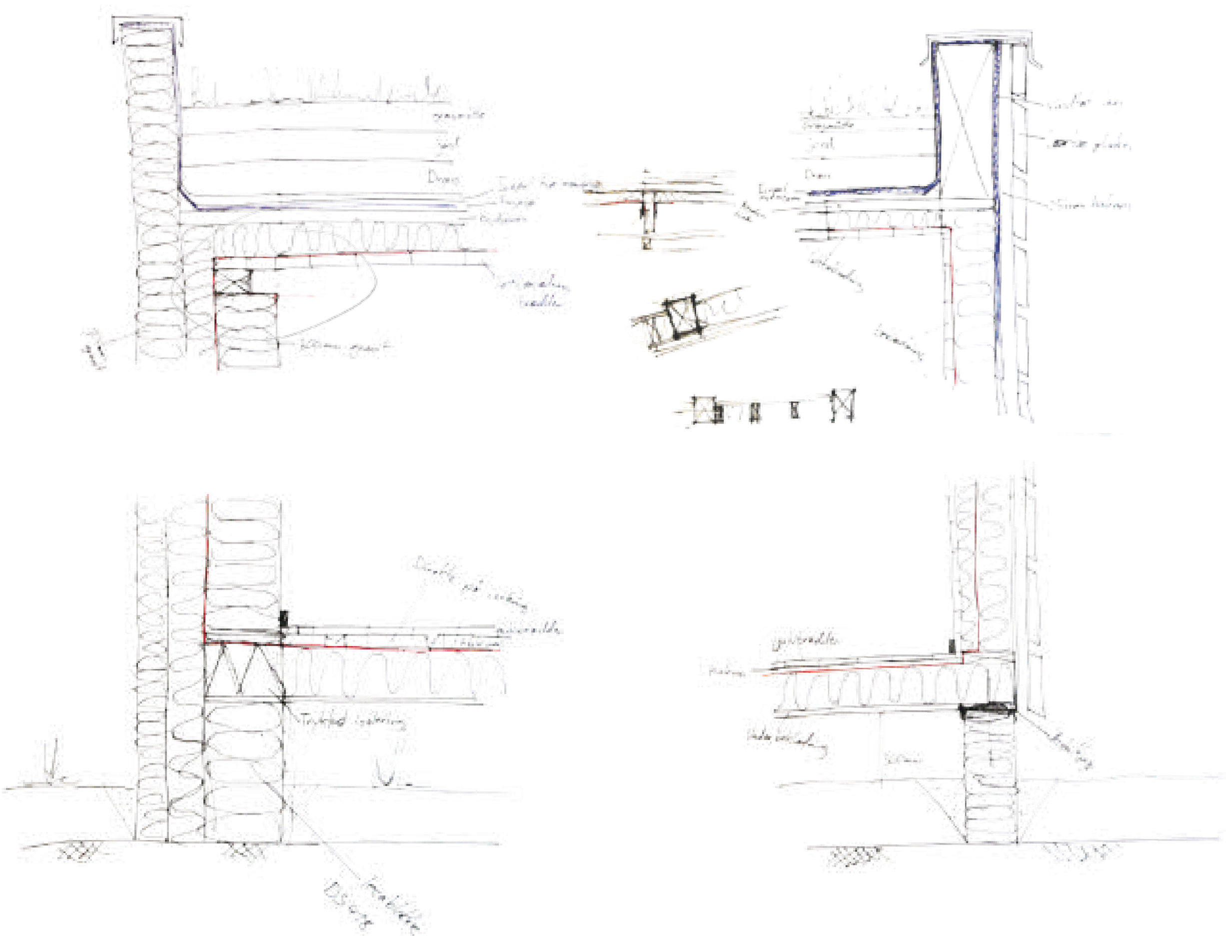
The focus on keeping a small scale also has to do with how the cabins should be perceived in the landscape. Like the traditional *sel*, the cabins should have a low profile with a minimal height. As the soil consists of hard mountain rock about 20cm below the surface it is not possible to have parts of the cabin placed below the surface of the terrain. Instead the cabins have different floor levels that follow the sloping terrain. The lower level is used for entering the cabin, while wooden boards form a platform 0.5m higher that can be used for bed and seating area.

Earlier in the process the cabins were thought as wooden walls resting on transparent polycarbonate window bands. The idea of the low window band is both to provide a presence of the small scale context and to form a horizontal void that separates the wooden wall from the stone foundation. Through the design process this has although been changed, so that the lower wall is a stone wall that encloses the interior of the cabin in the same way as in the summer- and winter unit. Thereby the stone wall forms a “back“ against the sloping terrain and provides a more intimate interior where you can crawl into your bed or sit and enjoy the presence of nature.

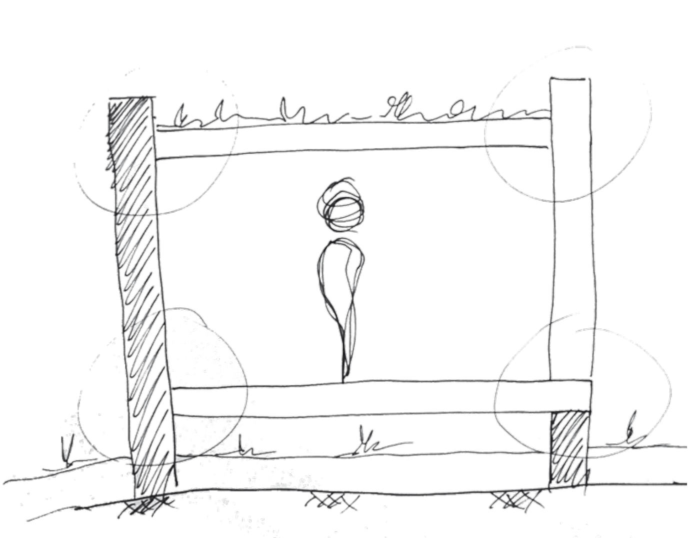


*Ill. 100: Model pictures*

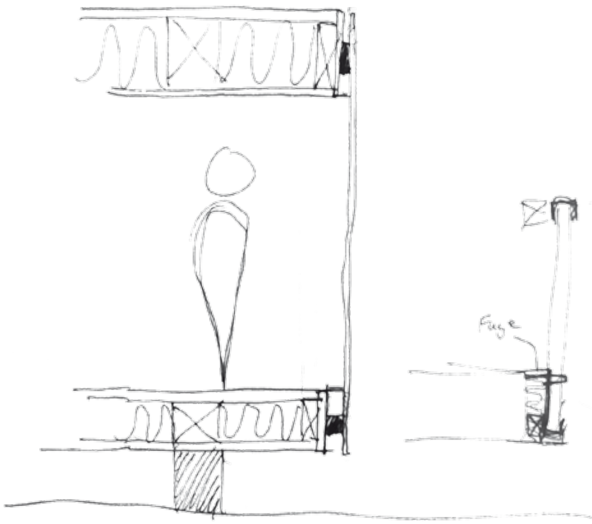
# Details



*Ill. 101: Vertical section details of common facilities.*



*Ill. 102: The detailed joints between walls, floor and roof.*



*Ill. 103: Window frame are attached exterior to roof- and floor deck.*

The details on this spread and the calculations in the following chapter are a continuation of the structural principles that ended the sketching phase. The final details are presented in the attached drawing folder.

The idea of an open foundation has been further detailed as seen on the opposing page. These sketches of details explain the structural build of the mountain cabin, which consists of a heavy stone wall that carries a light wooden frame construction with horizontal exterior larch boards. Horizontal boards are also used in the interior, with a more smooth texture as a contrast to the raw stone walls. The roof consists of a flat (1:40 slope), vegetated *Veg Tech* structure with a height of 130mm [Icopal]. The need for drainage is partially eliminated by the absorbing vegetation as described in the chapter *Adjusting plan and form*. This roof structure is carried by cross laying wooden beams that rest on both the stone- and wooden walls. The detail of how these wooden beams rest on the stone wall has been encircled on the opposing page. Instead of a direct contact at the ceiling corner a small void is formed. This void will create a shadow that visually separates the two materials from each other in consistency with the architectural concept.

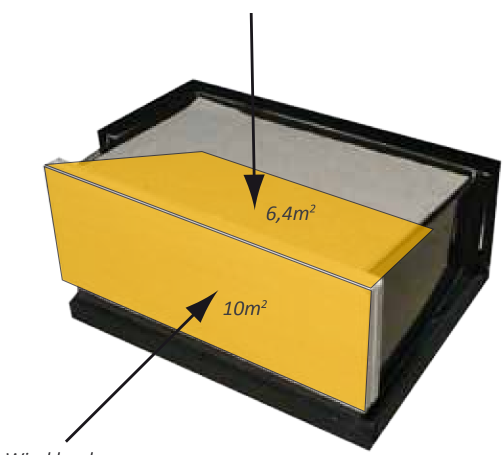
The same idea of architectural voids are used for the windows. These functions as separating voids that defines the freestanding walls. Therefore the roof- and floor deck should not be visible. This is done by an exterior attachment of the windows as seen on the sketch above. The window will not be visible from the interior and perceived as a void. Seen from the outside, the roof- and floor deck is covered with a black sheet, so that the entire window becomes one uniform surface.

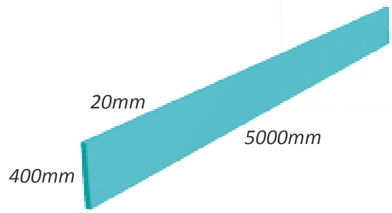
# Calculations

The initial calculations provided an early estimate of the dimensions of the polycarbonate window band in the private cabins. These calculations are continued and described in this chapter. The actual calculations can be found in the appendix [Calculations].

As the initial calculations revealed it will not be the internal stresses of the polycarbonate member that will be the dimensioning factor, but instead the stability which is determined partly by the slenderness of the polycarbonate member. Therefore the final calculations focus on calculating the possible section profiles (height and thickness) of the member.

The difference between the initial calculations and the final ones, are the inclusion of wind load and the considerable load from the vegetated roof structure.




With these additional loads the calculations proved that a window band with a height of 400mm and thickness of 20mm would be stable. To find out which alternative dimensions of the polycarbonate member can be used, the calculations were repeated with different thicknesses and height. The table on the right illustrates the results of the calculations, where the critical column load, $N_{cr}$, has to be larger than the applied loads, *N*, for the polycarbonate member to maintain stability.

The calculations also proved that the upward tension created from wind loads is less than the weight of the structure. This means that risk of an upward lift of the structure is low and that the joint between the wooden wall and polycarbonate member therefore can be kept simple.

| *Height x thickness, mm* | *$N_{cr}$, kN* | *N, kN* | *$N_{cr}$ > N, kN* |
|---|---|---|---|
| *400 x 40* | *947* | *65,4* | *947 > 65,4* |
| *400 x 20* | *118* | *65,4* | *118 > 65,4* |
| *400 x 15* | *50* | *65,4* | *50 < 65,4* |
| *500 x 20* | *76* | *65,4* | *76 > 65,4* |
| *600 x 20* | *53* | *65,4* | *53 > 65,4* |
| *600 x 30* | *177* | *65,4* | *177 > 65,4* |

# Reflection

Based on the initial questions raised in the *Introduction* and the stated vision, this chapter ends the design process by concluding on the project design and discussing the perspectives of the project.

**Building and landscape**

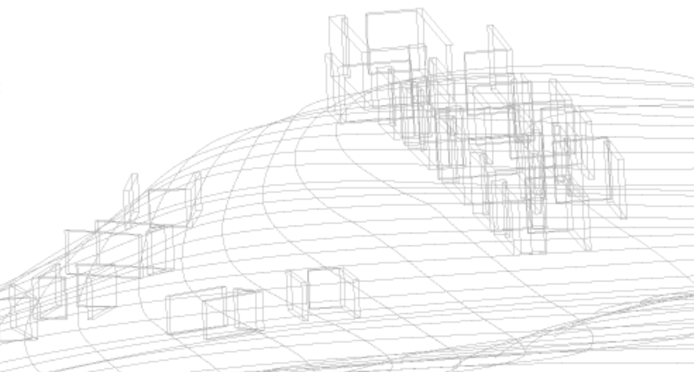
While the mountain cabin is basically a shelter that should define a protected boundary from the surroundings, interplay between the site and building is still necessary. The challenging context of the project demands specific solutions on the organisation, logistic and construction, which all have to be adapted to the given surroundings. These aspects have shaped the new Velleseter mountain cabin so it initiates a dialog with its context. The varying heights of the near topography are articulated in the section of the mountain cabin, and the organisation of private cabins and common facilities reflects the inherent qualities of the slope and plateau. Hereby the design references the context, while other aspects complement the surroundings. An example is the form which utilizes the synergetic effect emerging in the contrast between the simple building shape and the dynamic contour of the landscape. A linear contrast to the shapes of nature. The result is a design that enhances the understanding of its surroundings.

This is an approach that not only relate to the exterior expression, but also the interior. It is my impression that the spatial qualities of contemporary mountain cabins are often neglected by an interior organisation based on closed rooms connected by a linear corridor with only little spatial differentiation. In this project it is therefore aimed to reference the qualities of freestanding walls to define the spatial organisation by simultaneously enclosing the functions and providing a more dynamic flow guided by the composition of the walls.

## A contemporary *byggeskikk*

As mentioned, the distinct character of the Norwegian *fjell* becomes a determining parameter in the design of a mountain cabin. In Norway, the increased amount of newly built private cabins during the recent years has led to a discussion of how this interplay between building and landscape should be formed. Often these new cabins are erected as traditional log cabins with a pitched roof and small windows, as this is thought to represent a context aware design. New mountain cabins do, however, not have to copy the design of vernacular architecture to be adapted to its surroundings, as this project demonstrates.

A new definition of contemporary Norwegian mountain architecture or *byggeskikk* is therefore needed. In defining the architectural expression of the buildings for the 1994 winter Olympics in Lillehammer, the reflection on both traditional- and contemporary Norwegian architecture was stressed. The architecture should represent a Norwegian character, which was defined as: *"Simple volumes in wood and stone consciously organised and positioned according to the location and topography."* (Butters, 2006, p. 193). Log construction, pitched roof and small windows were not mentioned as necessary elements to define the Norwegian character. In relation to this the project can be seen as a comment to the discussion of a contemporary *byggeskikk* adding terms as skeletal, logic structure, separation and linear orientation to the definition.



## DNT typology

The project also contains perspectives on the future design of DNT tourist cabins. However, the specific form and organisation of the Velleseter mountain cabin should not be perceived as a typology generally suitable for the Norwegian mountain landscape. Instead the implementation of context aware design, tendencies of geotourism and references to the organisation of a hostel, are seen as universal usable aspects. For example the idea of separate private cabins could be an interesting supplement to the experience of the Norwegian mountains. Hereby the project provides an approach and strategy that could well be implemented in the future design of DNT cabins.

# Appendix list

References
Illustrations list
Gant scheme
Study trip
Initial calculations
Calculations

# Appendix References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# Appendix Illustrations list

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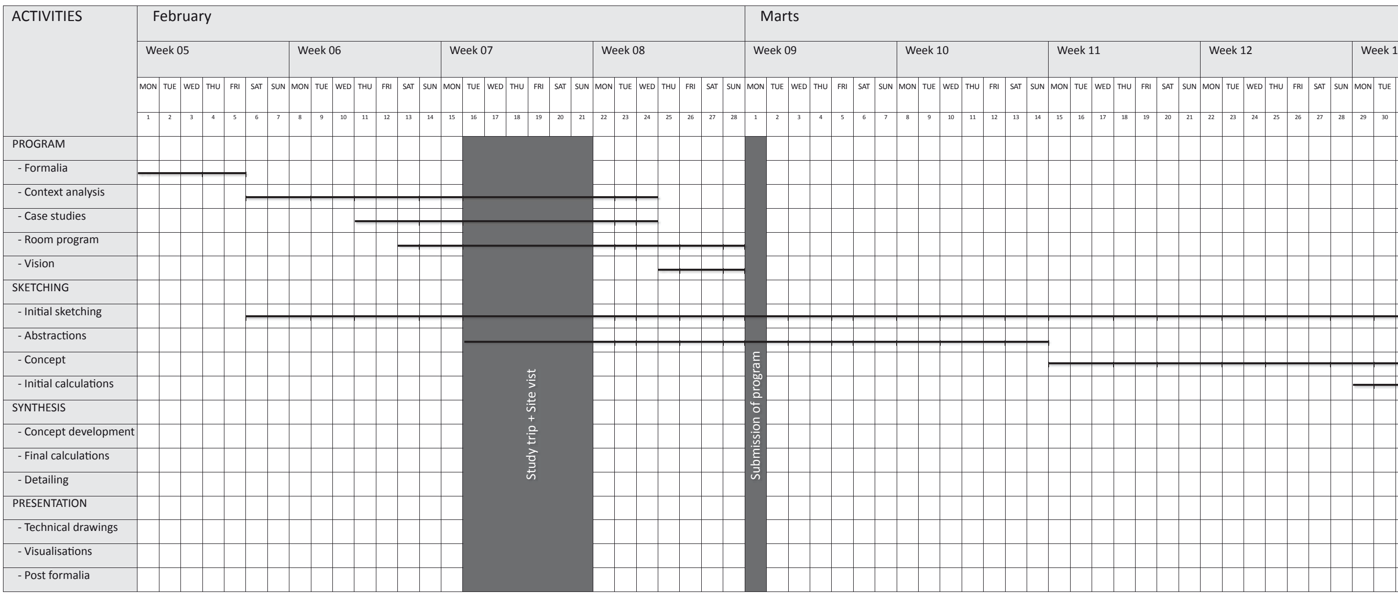
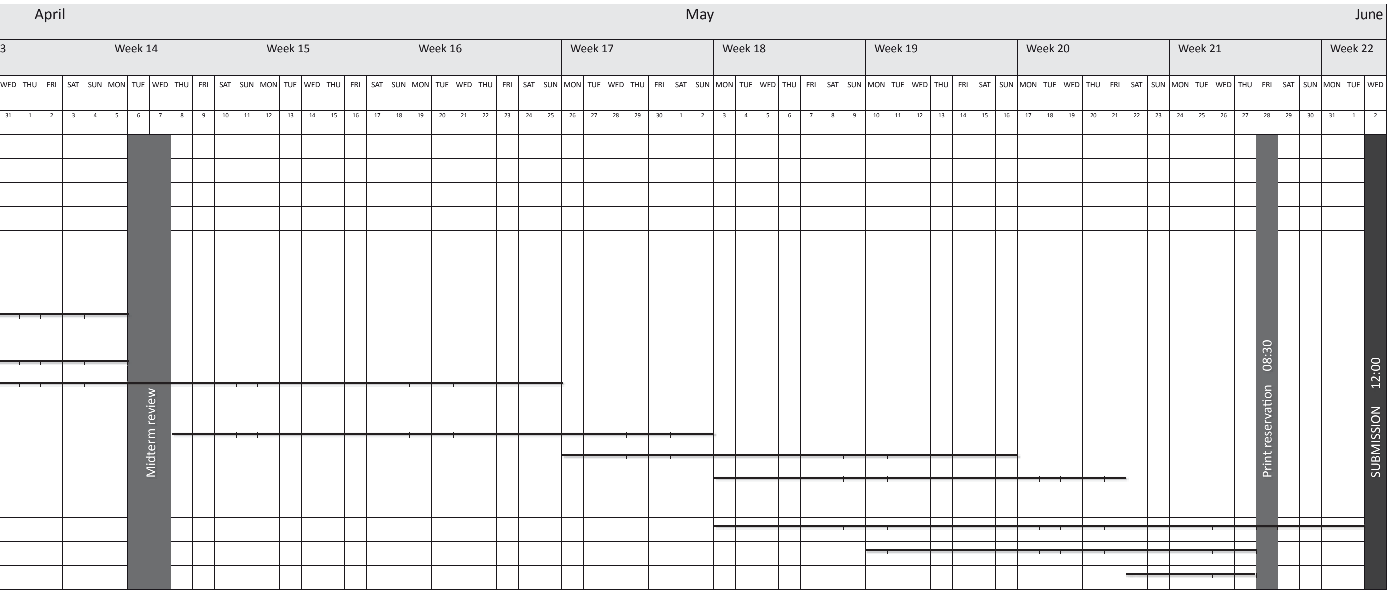
# Appendix Gant scheme




April
May
June
3
Week 14
Week 15
Week 16
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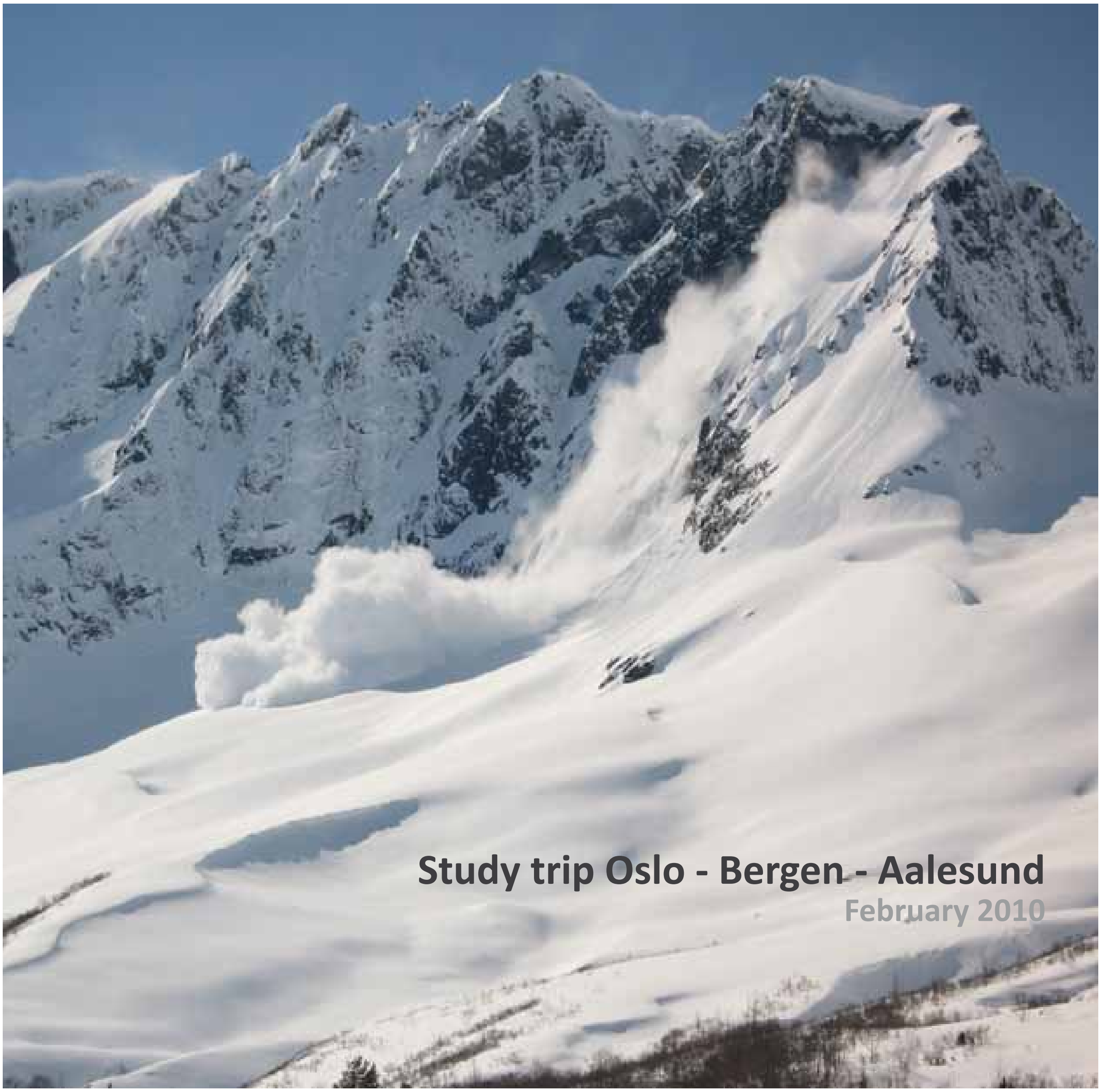
Week 18
Week 19
Week 20
Week 21
Week 22
Midterm review
Print reservation 08:30
SUBMISSION 12:00

# Appendix Study trip

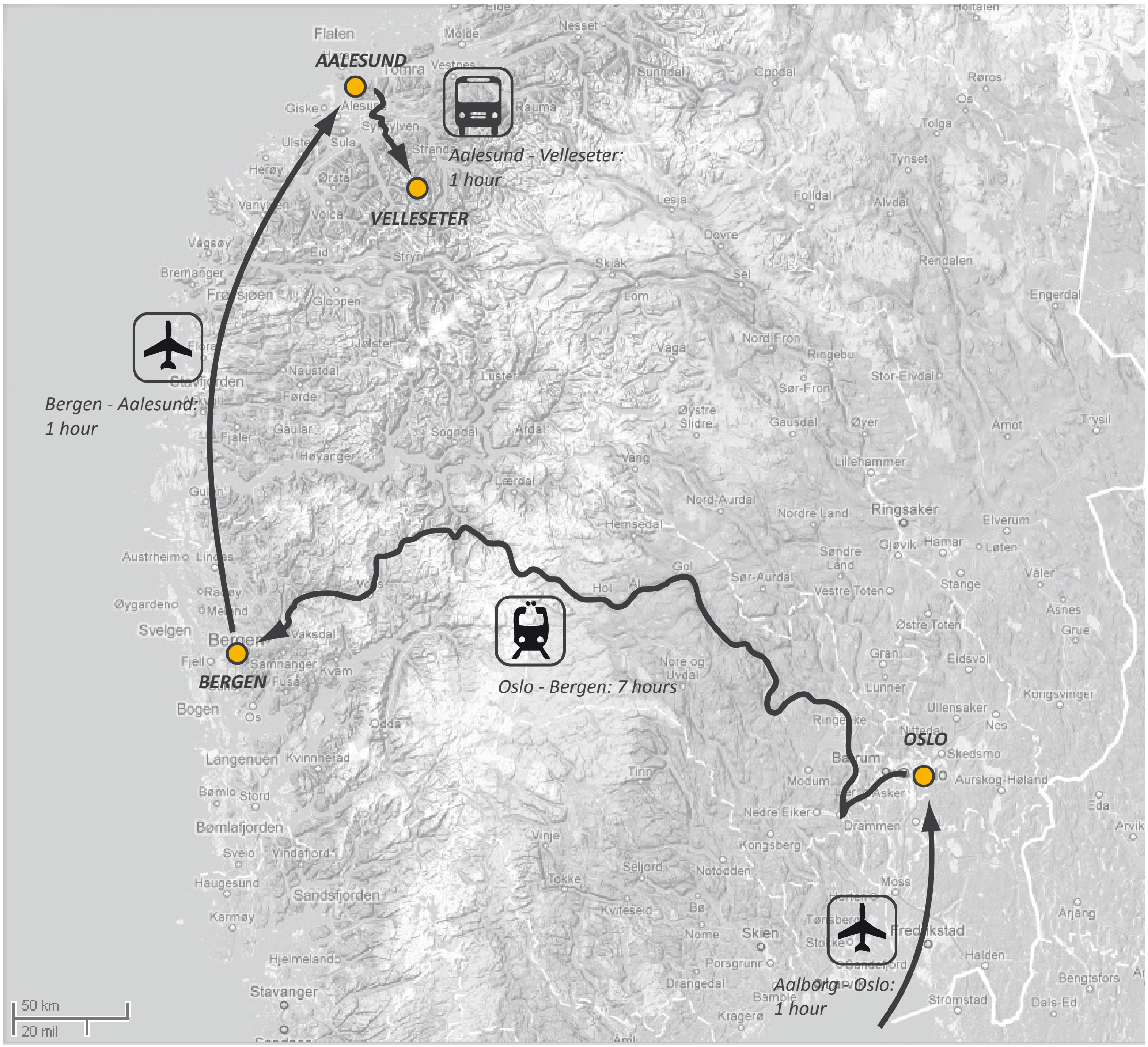


*Avalanche in Vellesætredalen, foto: Arild Bergstrøm*

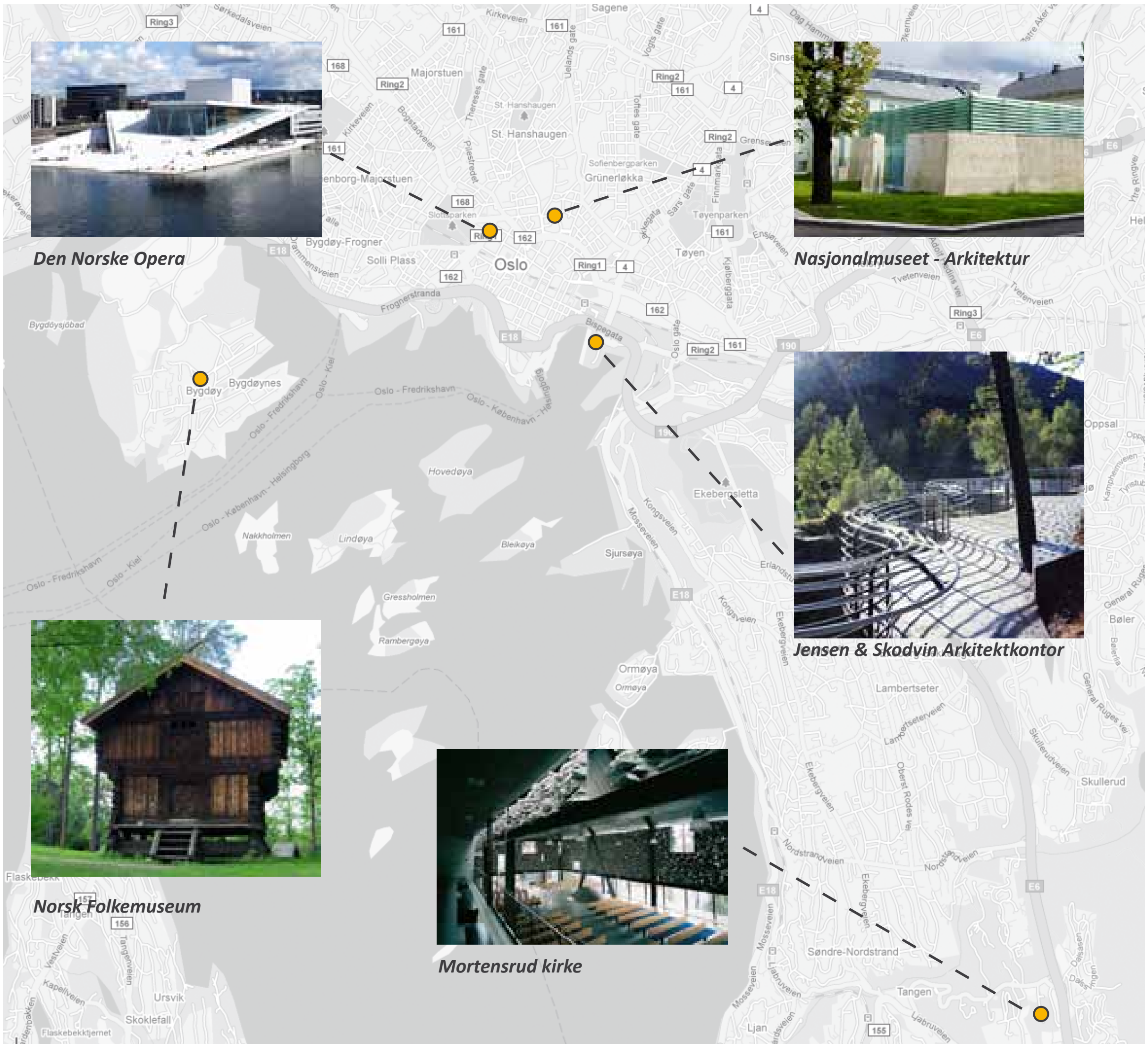
# Organisation

| Activity | Description | Adress | Opening hours |
|---|---|---|---|
| OSLO | Arrival: 16th Feb., 17.45<br>Depart: 18th Feb., 08.11 | | |
| - Mortensrud kirke | Modern church by Jensen and Skodvin Architects | Helga Vaneks vei 15, Oslo | mon-thu: kl. 10-14,<br>fri kl. 10-12 |
| - Jensen & Skodvin | Visit and meeting at JSA-office | Fredensborgveien 11, 0177 Oslo | Appointment at 17th Feb., 11.00 |
| - Norsk Folkemuseum | Large collection of traditional Norwegian buildings | Museumsveien 10<br>N-0287 Oslo | Mon-Fri: 11-15<br>Sat-Sun: 11-16 |
| - Nasjonalmuseet - Arkitektur | National museum of architecture | Kristian Augusts gate 23, Oslo | Tue, wed, fri: 10.00 - 18.00<br>Thu: 10.00 - 19.00 |
| - Den Norske Opera | The Norwegian Opera by Snøhetta Architects | Kirsten Flagstads pl. 1<br>N-0150 Oslo | Foyer is open mon-fri:<br>10:00 - 23:00 |
| BERGEN | Arrival: 18th Feb., 14.52<br>Depart: 19th Feb., 07.55 | | |
| - Bergen Arkitekt Skole | Visit | Sandviksboder 59-61a, No-5035 Bergen | - |
| - V-Rom | Meeting with Architect Inga Lindstrøm | Vetrlidsallmenningen 27 A<br>5014 Bergen | Appointment |
| - Bryggen | City center of wooden houses | Bryggen, Bergen | - |
| AALESUND | Arrival: 19th Feb., 08.40<br>Depart: 21th Feb., 16.35 | | |
| - Aalesund jugendstil | City center of jugendstil houses | - | - |
| - Gudbrandsjuvet | Viewing platform | Gudbrandsjuvet,<br>NO-6210 Valldal | - |
| - Juvet Landskapshotel | Visit and meeting with Knut Slinning | JUVET™ landskapshotell<br>Alstad, 6210 Valldal | Appointment with Knut Slinning the 19th Feb. |
| - Velleseterhytten | Visit and meeting with Arild Bergstrøm | Velleseterhytten,<br>Velledalen, 6230 Sykkylven | Appointment with Arild Bergstrøm the 20th Feb. |

## Travel route



## Oslo




*Den Norske Opera*

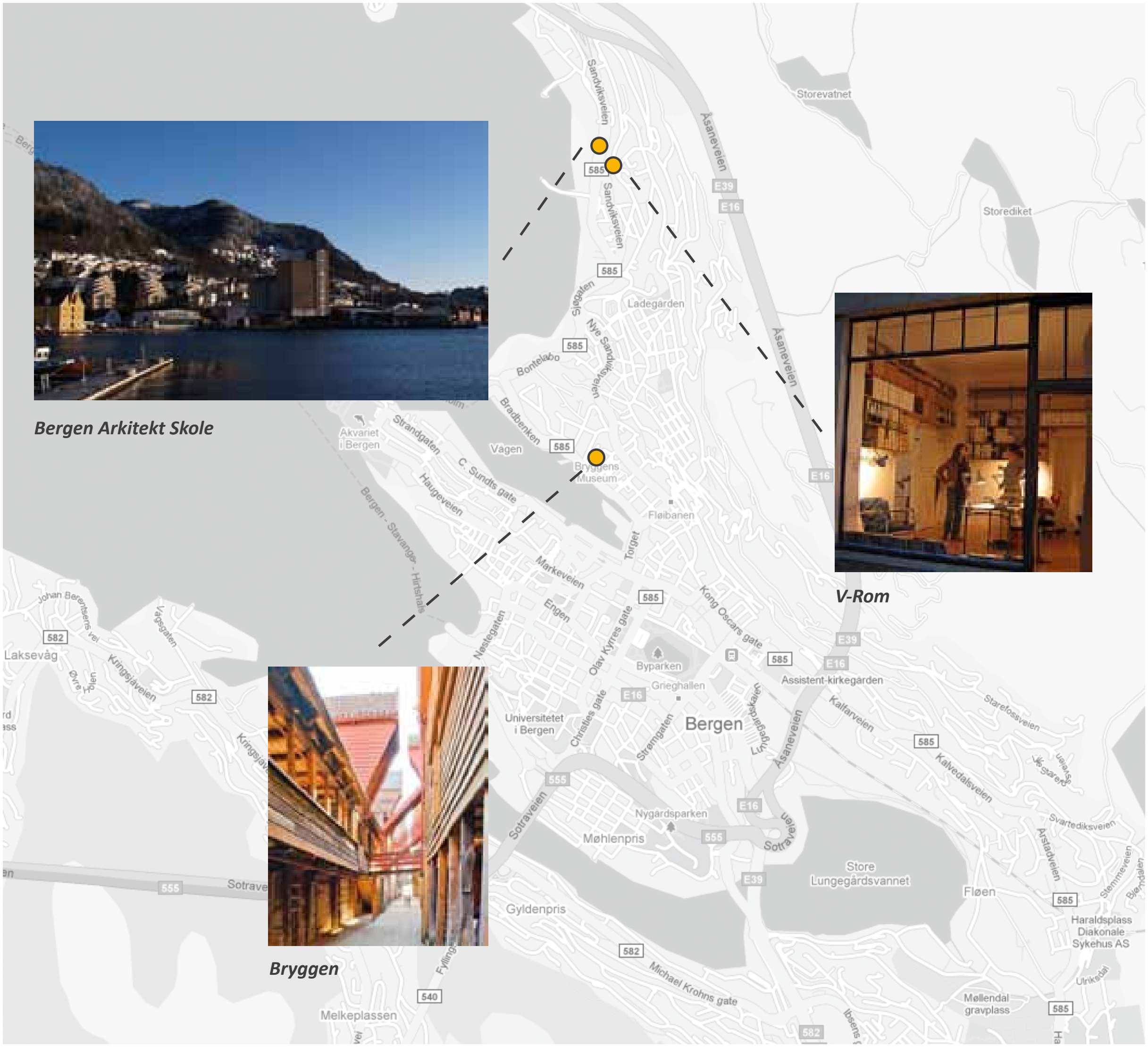
*Nasjonalmuseet - Arkitektur*

*Jensen & Skodvin Arkitektkontor*

*Norsk Folkemuseum*

*Mortensrud kirke*

# Bergen

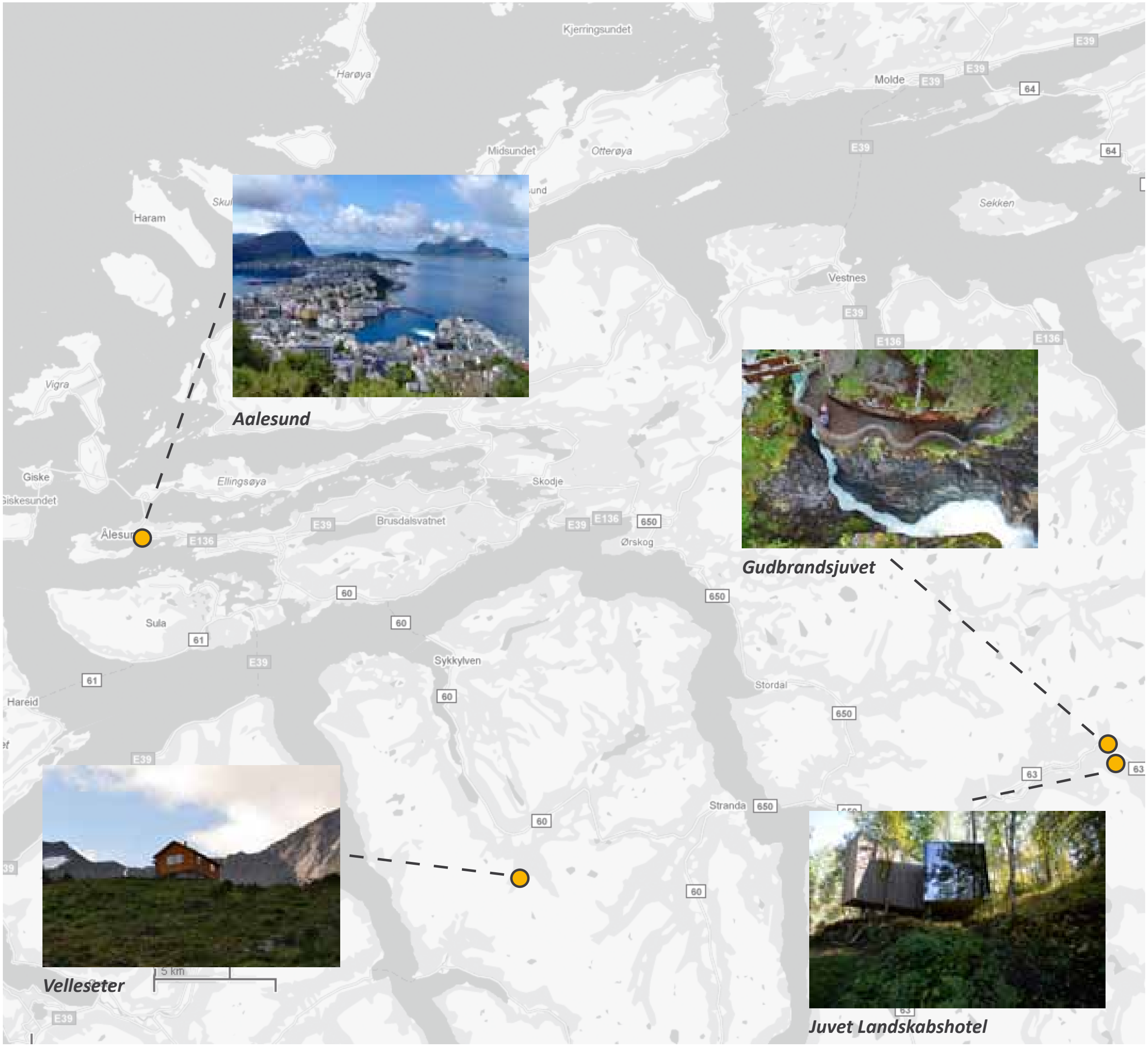



*Bergen Arkitekt Skole*

*V-Rom*

*Bryggen*

# Aalesund


Aalesund
Gudbrandsjuvet
Velleseter
Juvet Landskabshotel
Kjerringsundet
Harøya
Molde
Midsundet
Otterøya
Sekken
Haram
Vestnes
Vigra
Giske
Ellingsøya
Skodje
Brusdalsvatnet
Ørskog
Sula
Sykkylven
Stordal
Hareid
Stranda
5 km

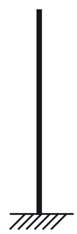
# Appendix Initial calculations

This appendix contains the calculations related to the chapter *Structural principles*.
Calculation conditions:
Euro codes are being used according to the partial coefficient method.
Safety class: Normal

## Finite element analysis

### Geometry, supports and material

Geometry: The member is regarded as a fixed column with a height of *400mm*:



A section is then assigned to the column so it has the dimensions *5000mm x 400mm x 40mm*:

Support: Fixed at bottom and free at top

Allowable dimensioning stress of polycarbonate:
*14MPa*

### Ultimate limit state

First the loads are determined. As the wooden walls and roof is assumed to be a rigid structure, the polycarbonate member will only obtain vertical loads. Wind load is not considered in these initial calculations.

Permanent loads:

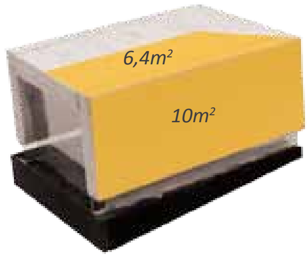
There are two permanent loads, $G_{k,p}$:
- Self weight from polycarbonate member.
- Load from walls: Light façade wall = $0{,}5kN/m^2$ [Trehus, 1990]

This is then converted to a point load

$$G_{k,p} = self\ weight + 0{,}5kN/m^2 \cdot 10m^2 = self\ weight + 5{,}0kN$$

Variable loads:

Snow load:
The polycarbonate member carries the snow load from a roof area of 6,4m²:




The snow load is defined as

$$s = \mu_i\ C_e\ C_t\ s_k \text{ [DS EN 1991 5.2]}$$

where:

$\mu_i$ is the snow load shape coefficient (see Section 5.3 and AnnexB)
$s_k$ is the characteristic value of snow load on the ground [DS EN 1991 4.2]
$C_e$ is the exposure coefficient
$C_t$ is the thermal coefficient

The snow load on the ground, $s_k$, can be found in Annex C, which presents the different snow maps of Europe. The annex shows that Aalesund has a snow load on the ground of

$$Q_{k,s} = 4{,}75kN/m^2$$

The roof area covers $6{,}4m^2$, so the total snow load is

$$Q_{k,s} = 4{,}75kN/m^2 \cdot 6{,}4m^2 = 30{,}3kN$$

**Load cases:**

LC1 (Dominating snow load):

$$\gamma G\ G_{k,p} + \gamma Q_{,s} Q_{k,s} = 1{,}0G\ G_{k,p} + 1{,}5Q_{k,s} = self\ weight + 5{,}0kN + 30{,}3kN$$

## Results

The maximum stress of the structure is calculated to $0{,}26N/mm^2 = 0{,}26MPa$.
As this is much lower than the maximum yield stress of polycarbonate,

$$0{,}26MPa < 14MPa$$

smaller dimensions can be used.

When the thickness of the polycarbonate plate is reduced to 10mm, the maximum stress of the structure is 1,0MPa.
If the thickness of the polycarbonate plate is further reduced to 1mm, the maximum stress of the structure is 10MPa.

If the thickness is kept at 10mm and the height lowered from 400mm to 200mm, the maximum stress of the structure is 1,0MPa.

This shows that the internal stresses of the polycarbonate have little influence on the dimensioning of the polycarbonate member. Instead it is more relevant to investigate the stability and calculate for possible buckling of the polycarbonate member, to determine how the slenderness, height and thickness, affects its stability.

## Stability

The calculations are done according to the method used in Teknisk Ståbi 3.6.2 [Teknisk Ståbi, 2007].

Like in the finite element analysis the polycarbonate member is regarded as a column fixed in one end and free in the other.

If the critical column load, $N_{cr}$, is greater than the applied loads, $N$, the column is considered stabile. The self weight of the column is not included in the calculations.

### Applied loads

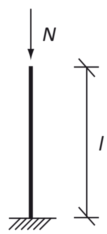
$$N = 1{,}0G\ G_{k,p} + 1{,}5Q_k, = 1{,}0 \cdot 5{,}0kN + 1{,}5 \cdot 30{,}3kN = 51kN$$

### Critical column load

$$N_{cr} = (\pi^2 \cdot E \cdot I) / l_s^2$$

Where:

$E$ is the materials modulus of elasticity, known as Young's modulus
$I$ is the moment of inertia
$l_s$ is the free column length determined as $l_s = 2l$ (Teknisk Ståbi 3.6.2 figure 109):




Moment of inertia:

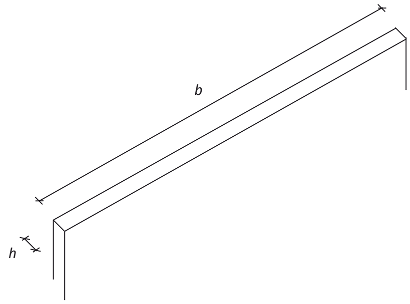
For a rectangular section the moment of inertia, $I$, is determined as

$$I = (b \cdot h^3) / 12$$

Where:

$b$ is the width
$h$ is the height

The width and height are defined as




And so the moment of inertia can be calculated as

$$I = (5000mm \cdot (40mm)^3 / 12 = 2,67 \cdot 107mm^4$$

This means the critical column load is

$$N_{cr} = (\pi^2 \cdot 2300N/mm^2 \cdot 2,67 \cdot 10^7 mm^4) / (2 \cdot 400mm)^2 = 947kN$$

As the critical column load is larger than the applied loads

$$N_{cr} \geq N \quad => \quad 947kN \geq 51kN$$

a smaller thickness of the polycarbonate member, *h*, can be chosen.

If the thickness is lowered from 40mm to 10mm the critical column load is $N_{cr} = 15kN$. This value is lower than the applied loads and therefore a higher thickness is necessary.

If instead the thickness is changed to 20mm the critical column load is $N_{cr} = 118kN$.

Also the height of the polycarbonate member has an influence as the free column height is changed. If we have a thickness of 20mm and change the height from 400mm to 600mm, the critical column load is $N_{cr}$ = 53kN.

This means that in the following design the minimum thickness and maximum height of the polycarbonate member should be:

Thickness ≥ 20mm
Height ≤ 600mm

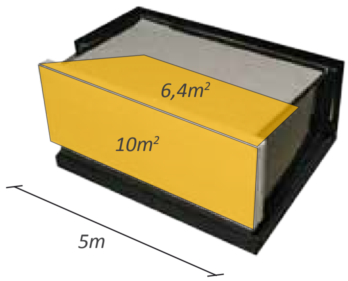
# Appendix Calculations

This appendix contains the calculations related to the chapter *Calculations*.
Calculation conditions:

Euro codes are being used according to the partial coefficient method.
Safety class: Normal

## Stability

The calculations are based on the same method as the initial calculations, where the polycarbonate member is regarded as a fixed column [Teknisk Ståbi 3.6.2]. In these calculations additional load cases that was not included in the initial calculations has been applied. These additional loads are wind load and the roof structure. The geometry and load area the polycarbonate member has to carry is 6,4 $m^2$ from roof and 10 $m^2$ from walls:




The member is regarded as a fixed column with a height of 400mm:

If the critical column load, $N_{cr}$, is greater than the applied loads, N, the column is considered stabile. The self weight of the column is not included in the calculations.

### Applied loads

To define the load cases we need to determine the different cases by eurocodes DS EN 1990 6.4.3.

*(k)* = characteristic loads
*(d)* = design values

Definitions for load combinations [DS EN 1990 6.4.3.2]:

$\Sigma_j{>}1\ \gamma G_{,j} G_{k,j}$ "+" $\gamma PP$ "+" $\gamma Q_{,1} Q_{k,1}$ "+" $\Sigma_i{>}1\ \gamma Q_{,i} \psi 0_{,i} Q_{k,i}$

where,

| | |
|---|---|
| "+" | means "combined with" |
| $\Sigma$ | means "the combined load from" |
| $\gamma G$ | is the partial coefficient for permanent loads [DS EN 1990 A1.3] |
| $\gamma Q$ | is the partial coefficient for variable loads [DS EN 1990 A1.3] |
| $\psi$ | is the load reduction factor [DS EN 1990 A1.2.2] |

We therefore have to determine the permanent and variable loads.

Permanent loads: There are two permanent loads, $G_{k,p}$:

**Load from walls**

Light façade wall = $0{,}5kN/m^2$ [Trehus, 1990]

**Load from roof**

The roof consists of wooden cross beams and plywood that carries a vegetated roof, type Icopal spec. nr.: 9.5-1 K [Icopal].

Load from the wood cross beams and plywood: $0{,}5kN/m^2$ [Trehus, 1990]
Load from vegetated roof: $140kg/m^2$ [Icopal] = $1{,}4kN/m^2$

The loads are then converted to a point load, so the total permanent load is:

$$G_{k,p} = 0{,}5kN/m^2 \cdot 10m^2 + 0{,}5kN/m^2 \cdot 10m^2 + 1{,}4kN/m^2 \cdot 6{,}4m^2 \underline{=\ 19kN}$$

Variable loads: We have two variable loads, snow- and wind load.

**Snow load**

The snow load is calculated the same way as in the initial calculations, this gives a snow load of:

$$Q_{k,s} = 4{,}75kN/m^2 \cdot 6{,}4m^2 \underline{= 30{,}3kN}$$

**Wind load** [DS EN 1991 1-4]

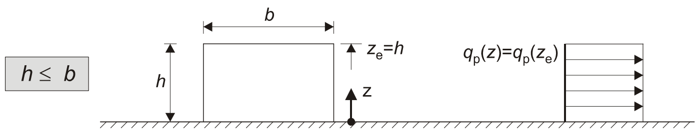
The wind pressure acting on the external wall surfaces, $w_e$, should be calculated from the expression

$$w_e = q_p\,(z_e) \cdot c_{pe} \qquad \text{[DS EN 1991 1-4, 5.2]}$$

where:

| | |
|---|---|
| $q_p(z_e)$ | is the peak velocity pressure |
| $z_e$ | is the reference height for the external pressure |
| $c_{pe}$ | is the pressure coefficient for the external pressure |

First the reference height, $z_e$, is defined by the illustration below:



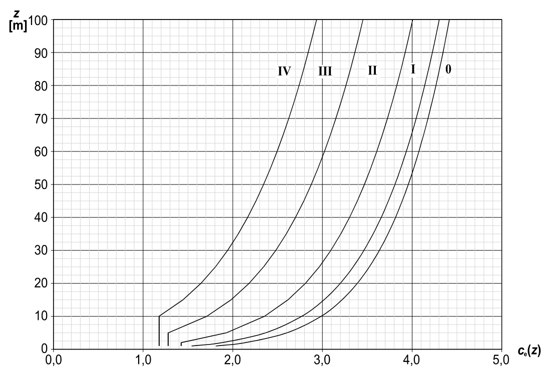

As the height is $h = 2$m and width $b = 5m$, the reference height is $z_e = 2m$.

To calculate the wind pressure we first need to calculate the peak velocity pressure, which is defined as

$$q_p(z_e) = c_e(z) \cdot q_b \qquad \text{[DS EN 1991 1-4, 4.5]}$$

where:
$c_e(z_e)$ is the exposure factor
$q_b$ is the basic velocity pressure

$c_e(z_e)$ can be defined from the tabel below:




The terrain category is defined as category III and with a reference height of *2m*, the exposure factor can be read to $c_e(2) = 1,3$.

$q_b$ needs to be calculated by the expression

$$q_b = ½ \cdot \rho \cdot v_b^2 \qquad \text{[DS EN 1991 1-4, 4.5]}$$

where:

$\rho$ is the density of air, set to $1,25kg/m^3$
$v_b$ is the basic is the basic wind velocity, defined as a function of wind direction and time of year at 10 m above ground of terrain category II, defined by the national annex.

The basic wind velocity, $v_b$, is calculated from the expression:

$$v_b = c_{dir} \cdot c_{season} \cdot v_{b,0} \qquad \text{[DS EN 1991 1-4 4.2]}$$

where:

$V_{b,0}$ is the fundamental value of the basic wind velocity, defined in the national annex
$c_{dir}$ is the directional factor
$c_{season}$ is the season factor

The basic wind velocity is therefore

$$v_b = 1 \cdot 1 \cdot 24m/s = 24m/s$$

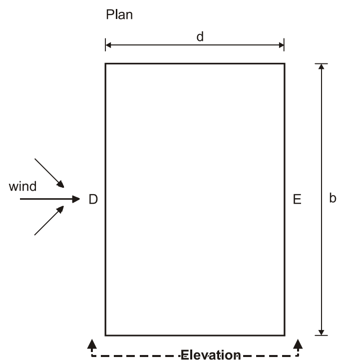
This value is used to calculate the basic velocity pressure, which is

$$q_b = ½ \cdot \rho \cdot v_b^2 = ½ \cdot 1,25kg/m^3 \cdot (24m/s)^2 = 360N/m^2 = 0,36kN/m^2$$

Now the peak velocity pressure can be calculated:

$$q_p(z_e) = c_e(z) \cdot q = 1,3 \cdot 0,36kN/m^2 = 0,47kN/m^2$$

To determine the wind pressure on the wall, we still need to determine the external pressure coefficient, $c_{pe}$, which is done by the following illustration:




As we are interested in knowing the pressure acting on the polycarbonate member, the direction of the wind is determining for the pressure coefficient. When the wooden wall is the windward side the coefficient for zone D should be used, $c_{pe,10} = 0,8$. This will mean an upward tension in the polycarbonate member. Oppositely when the wooden wall is facing the leeward side the external pressure coefficient for zone E should be used, $c_{pe,10} = -0,7$. This will cause a pressure on the polycarbonate member. The coefficients can be found in tabel 7.1 [DS EN 1991 1-4, 7.2.2]. As we are interested in knowing the applied pressure on the polycarbonate member $c_{pe,10}$ = -0,7 is used in the following calculations (at the end of the calculations it will be calculated what the effect will be when the wooden wall faces the windward side so there is an upward tension in the polycarbonate member).

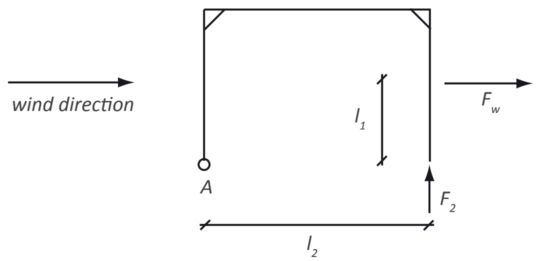
We have now determined both the peak velocity pressure and the pressure coefficient, and so the wind pressure on the wooden wall can be calculated.

$$w_e = q_p(z_e) \cdot c_{pe} = 0{,}47kN/m^2 \cdot (-0{,}7) = -0{,}33kN/m^2$$

This means that the total wind pressure on the wall is

$$w_e = -0{,}\ 33kN/m^2 \cdot 10m^2 = -3{,}3kN$$

The next thing we need to do is to calculate what load the wind pressure will apply on the polycarbonate member. This is done according to the system defined by the illustration below:




From the illustration it is seen that the vertical reaction on the polycarbonate member can be calculated by

$$\Sigma M_A = 0 = F_w \cdot l_2 - F_1 \cdot l_1 \quad <=> \quad F_w = (F_1 \cdot l_1) / l_2$$

This means that the load from wind pressure is

$$F_w = (3{,}3kN \cdot 1m) / 3m \underline{= 1{,}1kN}$$

**Load cases:**

Each load combination should contain one dominating variable load. This gives multiple combinations. As we want to know the worst case scenario we focus on the load cases, where the snow is the dominating variable load:

LC1 (Dominating snow load):

$$\gamma G\, G_{k,p} + \gamma Q_{,s} Q_{k,s} + \gamma Q_{,w} \psi_{0,w} Q_{k,w} = 1{,}0G\, G_{k,p} + 1{,}5Q_{k,s} + 1{,}5 \cdot 0{,}6\, Q_{k,w}$$

$$= 1{,}0 \cdot 19kN + 1{,}5 \cdot 30{,}3kN + 1{,}5 \cdot 0{,}6 \cdot 1{,}1kN = 65{,}4kN$$

This is therefore the applied load on the polycarbonate member

$$\underline{N = 65{,}4kN}$$

which has to be lower than the critical column load for the column to maintain stability.

### Critical column load

We use the same method as in the initial calculations were the critical column load were defined as

$$N_{cr} = (\pi^2 \cdot E \cdot I) / l_s^2$$

Based on the same dimensions of the polycarbonate member as in the initial calculations (5000mm x 400mm x 20mm) the critical column load is calculated to be

$$N_{cr} = 118kN$$

As the critical column load is larger than the applied loads,

$$N_{cr} \geq N$$

a polycarbonate member with a height of 400mm and thickness of 20mm will be stable and can therefore be used in the design.

### Windward tension

As mentioned during the calculations of wind pressure there will be an upward tension in the polycarbonate member, when the wooden wall faces the windward side. If this tension is greater than the permanent load the wooden walls would be lifted from the polycarbonate member. This would mean that it will be necessary to detail the joint, so the wooden wall is fastened to the polycarbonate member.
We therefore calculate if the upward tension, $F_w$, is greater than the permanent loads, $G_{k,p}$:

$$F_w > G_{k,p}$$

The upward tension is calculated from the same method as the wind pressure, but with a different pressure coefficient, $c_{pe,10} = 0,8$. This gives an upward tension of

$$w_e = q_p(z_e) \cdot c_{pe} = 0,47kN/m^2 \cdot 0,8 = 0,38kN/m^2$$

The vertical reaction on the polycarbonate member can then again be calculated:

$$F_w = (3,8kN \cdot 1m) / 3m \underline{= 1,3kN}$$

As this value is less than the permanent loads,

$$F_w < G_{k,p} \quad \Leftrightarrow \quad \underline{1,3 < 19kN}$$

there will not be an upward lift of the wooden wall.