

NATURAL LIVING

A HEALTHY HOME,
INSPIRED BY SWEDISH
TIMBER TRADITIONS

Jeanna Berger
Chalmers School of Architecture
Master's Thesis in Architecture
& Urban Design 2019
Examinor: Mikeal Ekegren
Supervisor: Björn Gross



CHALMERS
UNIVERSITY OF TECHNOLOGY

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Student Background

Chalmers University of Technology

Master's programme in Architecture 2017-2019
Material and Detail, Housing inventions, Managing design projects,
History, Theory and Method; Building climatology for sustainable design,
Sustainable development and the design professions

Lund University of Technology

Bachelor's degree in Architecture 2013-2017

Auckland University of Technology

Conflict Resolution, Leadership, Photography,
War and Peace och Pictorial Studies 2011

Lund Univeristy

Art and Architectual history 2012
Art and Design history 2013
Master of Laws Programme 2010-2011

NATURAL LIVING

Abstract

Every form of construction is following rules set by the properties and conditions of the materials employed and the requirements they must meet. Out of all structural materials, timber is the one that is most easily worked, because of this Sweden's architectural heritage is dominated by timber buildings. Surpassed by concrete, glass and steel in the 20th century timber is now experiencing a renaissance as building material and rightly so since the properties of timber fulfil the most important requirements of today; it is sustainable, and it is healthy.

Just as we are rediscovering the benefits of wood, the positive effect of nature has never been more sought after. This thesis connects these two subjects; building with timber and the positive effects of living in balance with nature and natural needs. The result is displayed in two proposed versions of the same timber structure, both versions located in rural environments.

The buildings that evolved on the Swedish countryside, timber structures dated from the 19th century and prior, built by people who lived in close connection to nature, have been the main source of inspiration. The everyday life

of the users of these buildings depended on the natural environment and this was visible in the structures they fashioned; they knew the rules of timber. The building techniques evolved over the centuries, but new technology was always used with old knowledge in mind. Somewhere in the 1900th century this knowledge was deemed less important, ever since then most buildings on the countryside talk to us about rationalisation and functionality – they bear no trace of the tactility the timber buildings they replaced possessed.

This thesis is investigating how traditional timber knowledge can be combined with modern timber technology, consequently creating a structure that reflects contemporary ideals as well as rural values in order to create a home in harmony with nature and human needs. The question guiding the project is; How can traditional timber knowledge and modern timber techniques be used to create a healthy, sustainable structure that reflects contemporary ideals as well as rural values?



Introduction

Few things have a more positive effect on our mental and physical health than the natural environment we have evolved to live in. Modern life take place in urban settings and make lots of demands on our attention which can lead to attention fatigue, stress, anxiety and depression. Stressed-out people escape the cities in order to destress, but what if that escape was made permanent? After hundreds of years of urbanisation more people than ever are looking for a life outside of the cities. It has been the intent of this thesis to investigate the rural heritage of the thousand-year-old timber tradition in Sweden and present a proposition of how it could be com-

bined with modern timber technology in a way that reflect history but also advocate a more natural way of life.

Urbanization and lifestyle changes have diminished possibilities for contact with nature in many societies and this has motivated research on the health benefits of contact with nature. According to Edward Wilson humans have an innate tendency to seek connections with the natural environment; with nature (Biophilia, 1984). There are several publications and studies showing that being in close contact with nature promotes psychological restoration (Kaplan & Kaplan, 1989), improved mood,

improved attention (Hartig et al., 2003) and reduces stress and anxiety (Grahn & Stigsdotter, 2003). There are also studies indicating that wooden buildings have a positive effects on the health of the inhabitants. Since one of the goals for this thesis has been to create a healthy building, both the benefits of place and material has been taken into account. The design has grown from studies of wood with a historical perspective but also modern architectural psychology. What types of spaces do we prefer and why? Most preferences can be explained with evolutionary reasons and this project highlights some of them.

The Japanese word for forest bathing, *shinrin-yoko*, was translated and included in the Swedish vocabulary 2017. I wonder how we never had a word for experiencing nature before that, few countries have as

much accessible nature per inhabitant. Maybe it is the growing contrast between city and countryside that have made us more aware of nature's positive effect?

Inspired by the concept of forest bathing I designed and helped build a small cabin in 2017 with VisitSweden as client. The relationship between architecture and the surrounding nature was key since the project was a collaboration with scientists at Karolinska who were looking at how staying for 72 hours in nature will affect a highly stressed person. Two leading stress researchers, Walter Osika and Cecilia Stenfors, were part of the study.

During the 72 hours of the test I witnessed how the people who stayed in the small buildings I had designed had their stress levels dropped by 70 percent. Seeing first hand what

a positive effect architecture in combination with nature could have on the dwellers I felt the need to dedicate my thesis to investigations of how a permanent resident with similar values could be designed. It was local, agricultural, timber buildings that was my aesthetical inspiration for the 72h cabin, and it is the same kind of rural architecture that is the inspiration for this thesis.

We spend most of our life inside. Architecture is creating spaces that shield us from nature, from rain, cold, sun and heat. Nature is by definition not architecture, it is not something one can create; therefore, it is the degree of accessibility I have decided to work with. In order to create a domestic domain in balance with our natural environment I have chosen rural settings. This project is

about moving away from the stress of the cities and when it comes to site, I have taken this literally. The building will relate to the natural elements of the plot, but it will also draw inspiration from local and national rural timber constructions.

This thesis strives to create something for the countryside, relating to its history as well as its future. Urban areas in Sweden constitutes 1,5 percent of the landmass, this kind of building is for the remaining, architecturally overlooked, 98,5 percent.



About The Buildings

Contacted by a client who wished for a family home on a farm in Dalsland I saw my opportunity to test my ideas of a building that promoted life close to nature inspired by our rural past. Sustainability is something that always need to be considered and there is a lot we can learn from the farmers of the past regarding this. One main thing that is included in this thesis project is the adaptability of old structures - just like they could be moved so will this one. Most old wooden buildings in Dalsland have been moved at least on time. Especially in times when wood was scarce people brought their building with them when they moved. The primary site for this project

is the clients plot, Vallmokullen, but a secondary site will also be presented, Gröntuva. Slightly altered the building will cater a different need - it will function as a service house for visitors, living in small cabins in nature.

This structure has been designed with modular thinking as a technical and aesthetical basic philosophy. It is a modern interpretation of the barn as an archetype consisting of several programmed units inspired by measurements found when looking to the history of timber building. Most old plans show a similar restriction, depending on the material available. Logs are only so long and

thusly the interior spaces are quite similar in size. After selecting the six times six-meter large structure as one the most common, functional dimension used the building was strictly developed after those measurements.

The composition is a collection of rectangles, identical in size. Units of three times six meter form larger spaces that can be individually organised to better fit the needs of a specific user and site. The buildings presented here are organised just like the buildings of rural past, one after another, all under the same roof. Skånelången is the most famous example of this way of organising space but examples can be found all over Scandinavia. The generic rectangular volume, that of a barn, is optimal for fitting into different sites.

The biometric "cradle to cradle" thinking introduced by McDonough and Braungart (Braungart & McDonough, 2002) is increasing in popularity. Thinking that the materials of a structure can have new life past its expiration date is obviously very sustainable. And this way of thinking is of course inspired by nature – there is no waste in nature. There is a use for everything, even after death.

The demands we have on a building change over time. What the

17th century farmers needed from their home is not the same as the demands we have today, nor is the demands of today something that will be coherent with the requirements of tomorrow. Buildings need to outlive their users, for the sake of the environment but also because they are a big part of our culture, nothing tell the story of how our ancestors lived and what they valued better. In order to build something that will last it need to be able to adapt to the needs of the current time. For example the technology we bring in to our home is in constant development and therefore it will be a need to replace or modify it during the lifetime of the building.

With time come different users and each user should have a chance to express themselves in their home – without removing the chance for the next generation of users to do the same. Wood is a forgiving material and make it possible to erase the trails of time. Floors and walls, especially wooden ones, get a tarnished after a while. The wear and tear of daily life will put its mark on the house. Some appreciate this patina but for those who doesn't, marks and discolorations can be sanded away (providing that the layer of wood is thick enough).

This is an adaptable structure that talks about the meeting between outside and inside, between nature and culture. The line between interior and exterior is blurred in some places and reinforced in others. There are multiple ways of movement within the house, just like nature it offers options. Users can move between more enclosed spaces to more open, view or be viewed. Nature is ubiquitous and made accessible for breathing in through and elongated veranda.

The building consists of several different elements inspired by older timber typologies. The living room and kitchen have standing interior posts, quadratically arranged, like in a stave church they help take some of the loads.

Just like the square log structure of the post larder this structure is elevated on posts. The elevated position of the old structures was to provide ventilation and protection from vermin, in this case the technique is used to give the building a small footprint and by doing so use less concrete.

By placing the structure on pillars, it is handling the height difference of the plot without making a large impact on nature. The space underneath is tall enough to be functional.

One thing apparent throughout the design of the building is the ambition to use wood as much as possible. The concrete foundation is limited to a smaller section of the structure. No metal reinforcements have been used in the wooden structure, no metal pillars or beams. Even the window frames and roofing are all made out of wood. The isolation in the external walls consists of iso-timber; a Swedish, innovation that is a one hundred percent timber-based product. Perforated boards stacked in a similar way to corner timbering both carry loads and isolate the interior structure. Plywood sheets make the walls air tight but being made all out of timber the walls are open to diffusion. Since water is allowed to move into and through the walls the interior climate becomes healthier.



SECTION OF THE SITE
West Facade
1.2000

Vallmokullen

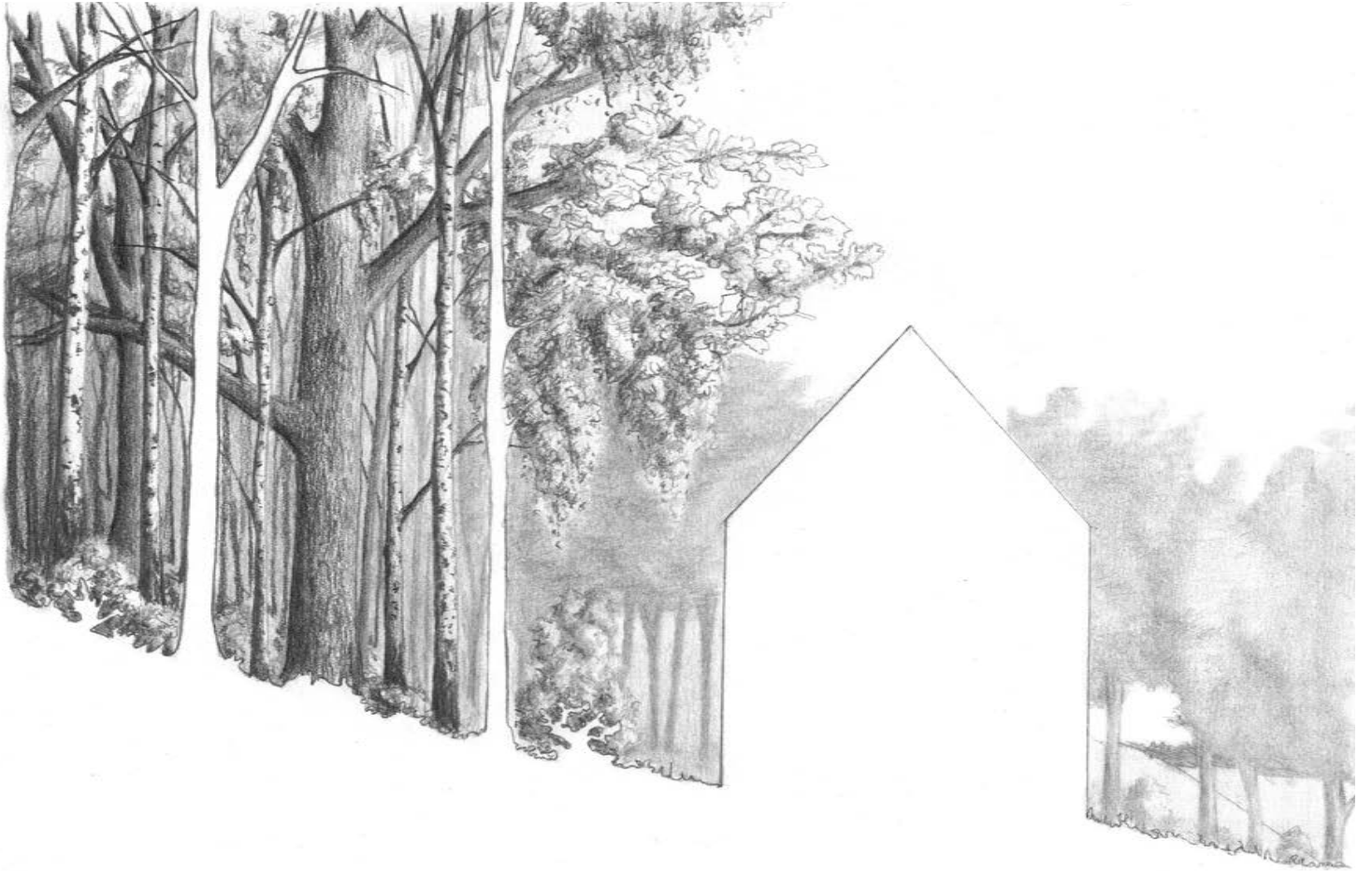
Site and Plan

The initial thought was to position the building on Vallmokullen in the same way as the old timber dwellings studied for this project – in an east-western direction with one long façade facing south for maximum sun exposure. Now the building is rotated 90 degrees to this position, it is following the slope instead of dividing it.

Oriented in an east-western direction the southern façade would be fully exposed to the lake view. Now, with a gable wall facing south the view of the lake becomes more concentrated, thus more value is created in it. The eastern and western façade is receiving a greater variation in view this way. The western side of the building is facing

a hill which the road that leads up to the house cross. East of the site, marking the property border is a line of trees – going north to south. Between the hill and the tree line is a small creek. The orientation of the building now runs the same way as the water and tree line.

A north to south orientation might not be the standard for the old cabins researched but you could say it is the standard for the barns belonging to them. Since barns usually were placed perpendicular to the main house they ended up in a north to south orientation – barns being the main inspiration for this project this orientation is more true to both research and site.



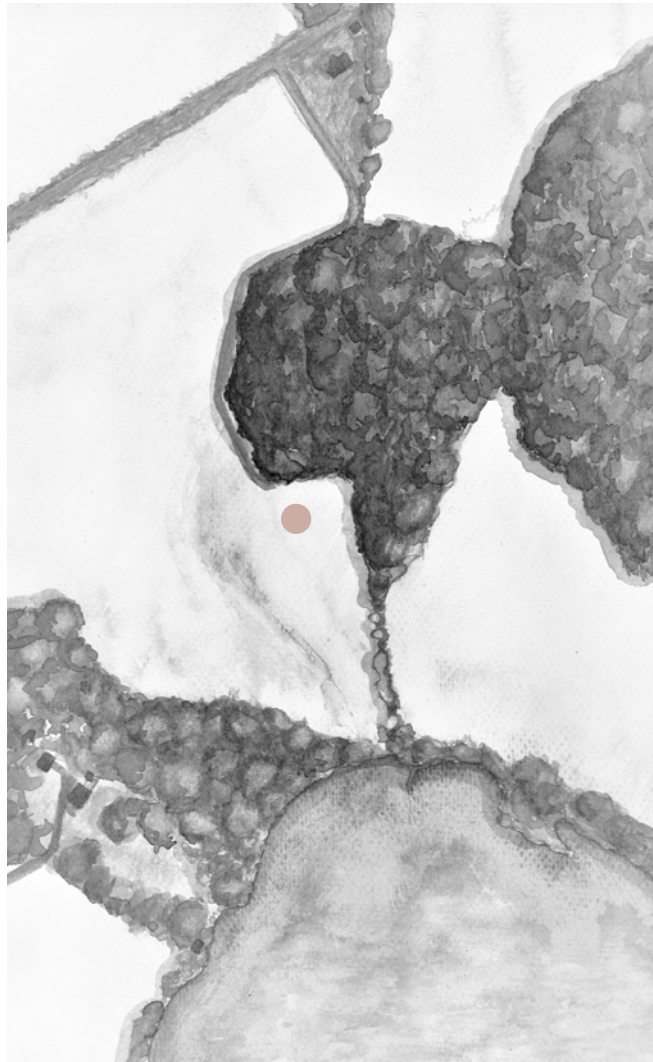
Conceptual drawing of
Vallmokullen

Since the site is a southern slope and the chosen orientation is perpendicular to that slope there is a difference in height to tackle. How would the timbermen of the past tackle this? Thankfully there are several different examples of this. When building in a slope it was common to just use longer pillars at one end to even the difference. Sometimes a cellar was added under the structure where it would be cool and shaded. Sometimes it was left open to the elements and used for storing old carriages, timber or firewood. Builders of the past were no strangers to buildings on high posts. This was an efficient way to create ventilation in buildings used for storing crops. Also it was easier to keep vermin and moisture away if the structure was elevated.

The veranda blur the line between what is considered inside and outside. The pillars and vertical planks of the outer rim of the structure are an architectural reflection of the edge of the forest next to the building. They are also there as a salute to the sparse walls of local barns. This kind of space, a loggia, bring the dweller closer to the outside. By adding a physical distance between the interior and exterior spaces a connection is created. The external pillars and the vertical boards

between them filter the sunlight and create an open and light space just outside of the walls of the building. The vertical louvres will shelter from the elements without making you lose touch with the outdoor world. Most buildings have a few clear exit points and it is around those that the life outside the interior take place. With a covered porch you have access to more of the area along the façade. It is easier to go outside, you don't even have to put shoes on! The threshold is lowered you could say, if you excuse the pun.

With its protruding placement in the landscape the building is defining those elements that were already there. If the field had been the sea and the building a ship the treeline next to it would be the pier it is attached to. The body of this wooden ship is placed on stilts so as not to fall, keeping the footprint minimal and creating a space underneath. This sheltered space, almost three meter tall can be used for outdoor activities on rainy days, a swing for children (and maybe one for adults as well) could hang in the beams above. A table one could replant plants by, a garden sofa to just sit on and watch the water on a rainy day. The soil is covered with ground wood chips. To make it comfortable and friendly to play on but also like



The sites are in different part of the county. They are close to water, woodlands and fields. No visible neighbours. Site 1 is on a slope with a forest behind it and a lake in front of it. The other is facing fields in two directions and have a lake on either side. There used to be a large barn on site 2 and the remnants of two large ramps are still there.

Map of
Vallmokullen

a remnant of the construction of the structure above. Further under the house where the ceiling is too low to go under the chips are replaced with stones. The stones have a dual function, just like the wood chips. They cover the soil, to make the ground under the house more aesthetically appealing and less dirty but they are also there as a reminder of past constructions. The timbermen would place the sills on stones, here those stones are replaced by concrete pillars, buried into the ground as foundation.

A stair on the eastern façade leads from the space under the house just described up to the porch. At the southern end, by the gable wall the porch turns into a large balcony, with a beautiful view of the lake I might add. There is a wood burner in the living room behind. The fire will be in focus during the darker parts of the year when the glass turns into mirrors. Making use of the heat storing capacity of the thermal mass of stone is an old, well-known technique. This type of fireplace is a modern, more effective version than the ones used in old cabins and barns.

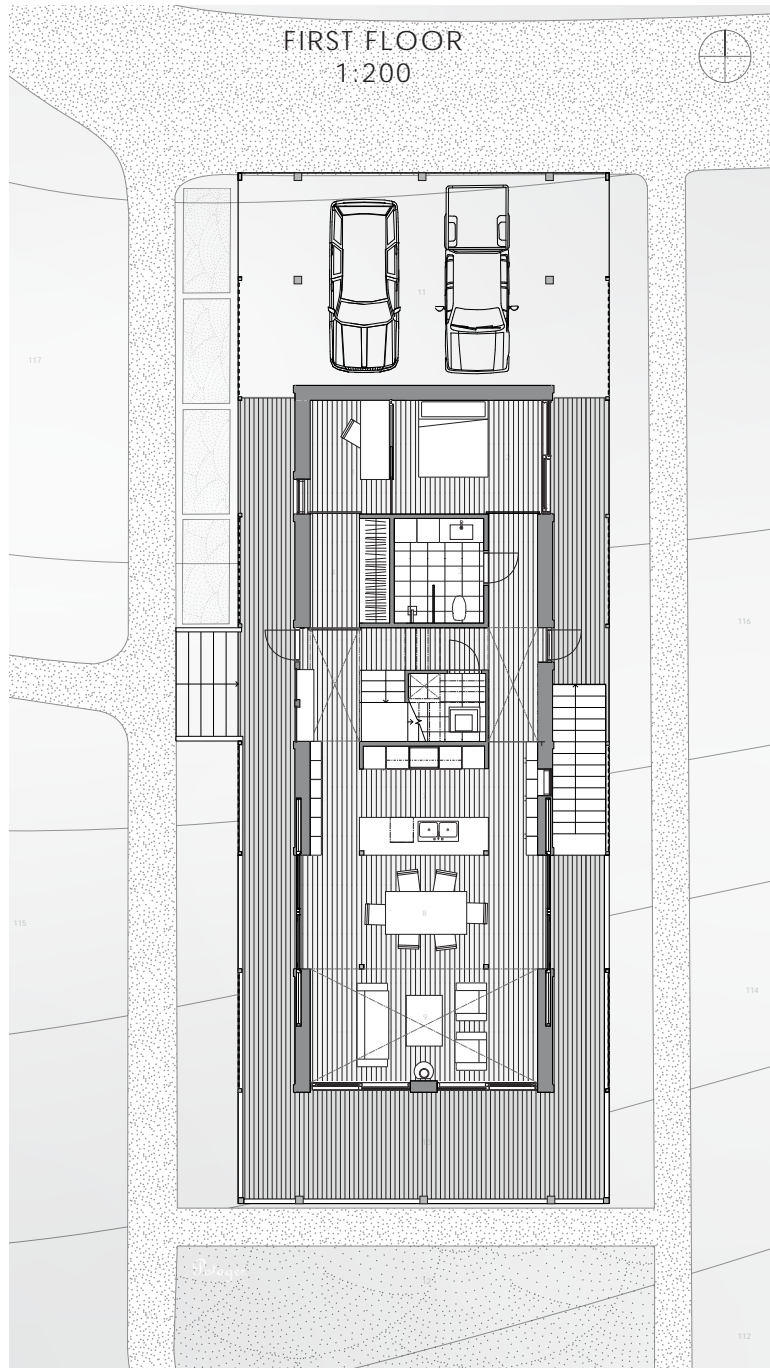
Since I just mentioned the living

room it seems fitting to start a description of the building's interior spaces, how they relate to the site and user.

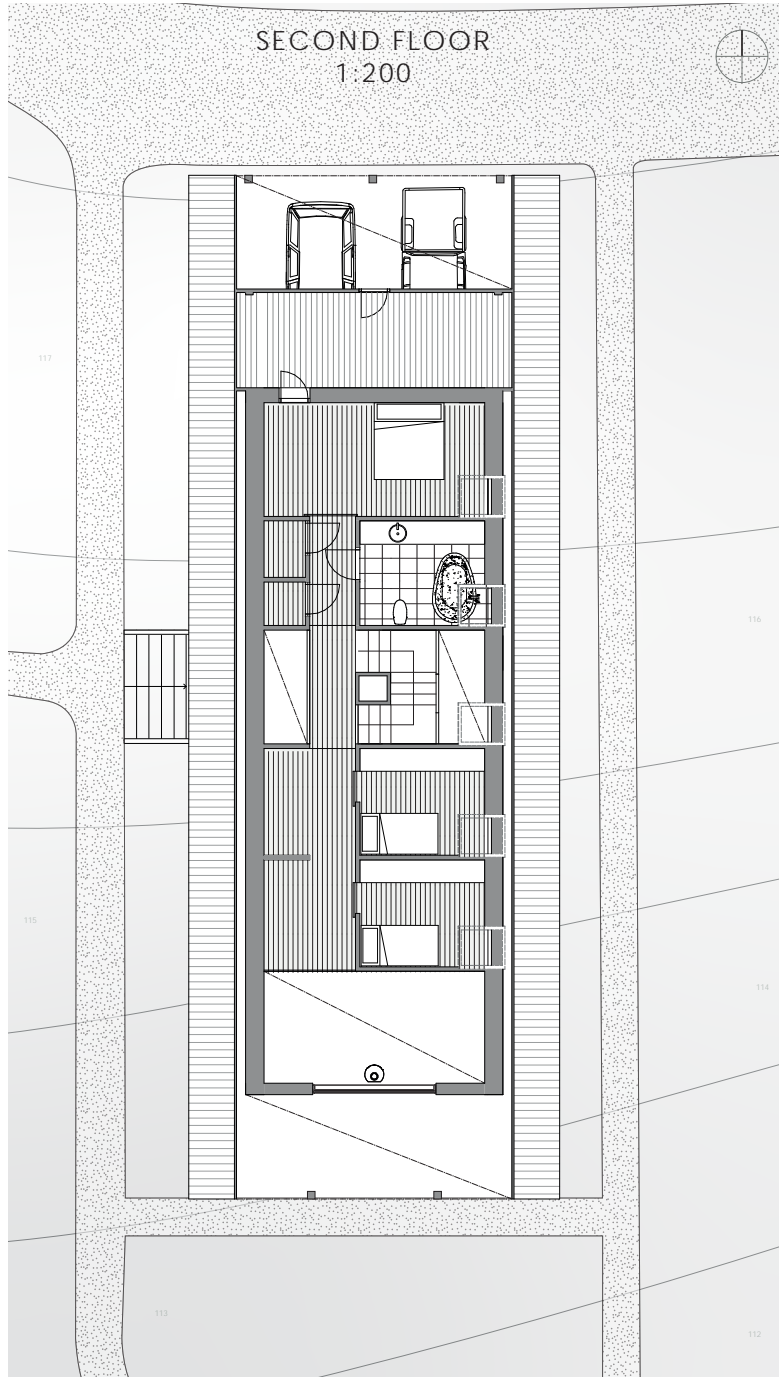
Interior spaces

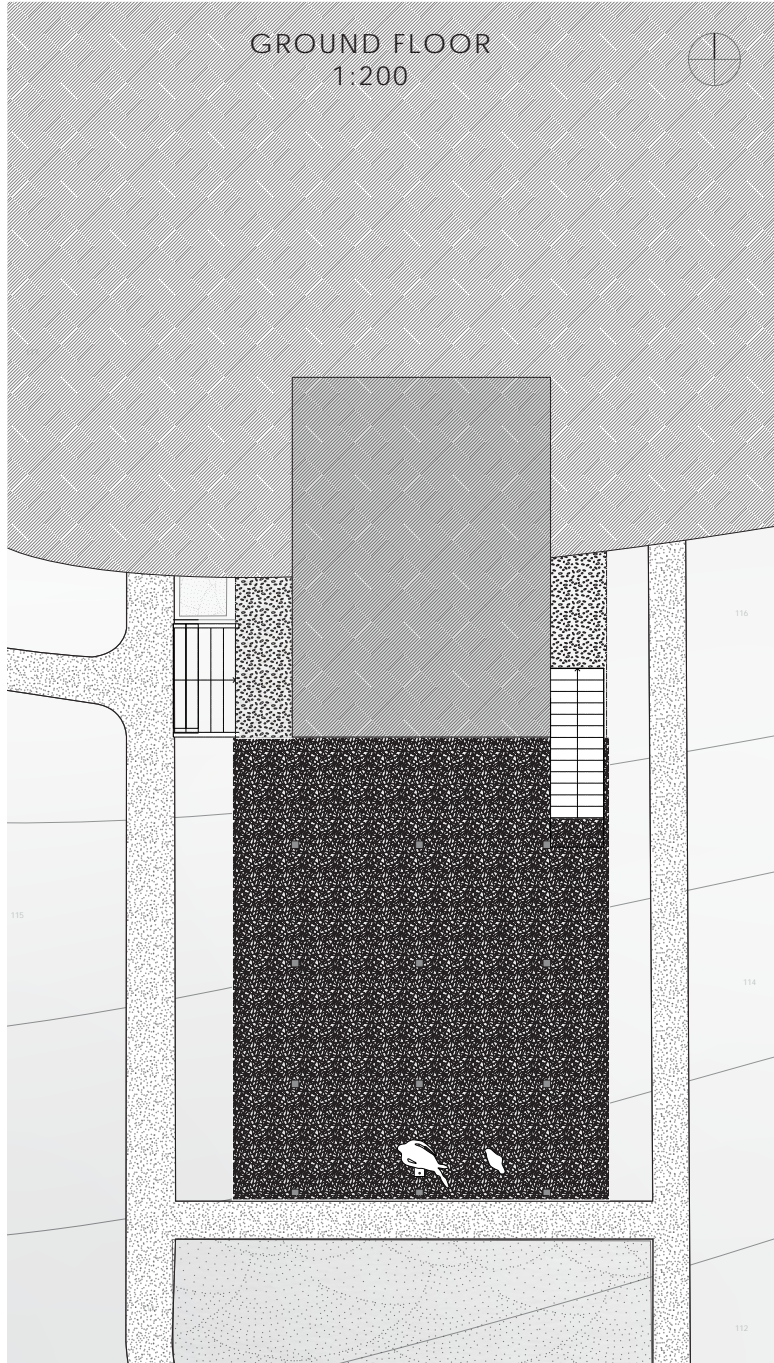
The living room is a multifunctional place; for solitary contemplation as well as connecting with others through memorabilia, a place for socializing and hosting. It is a space that avoid social stress by allowing for social encounters on individual terms. Without control, social encounters can feel threatening and uncomfortable thus causing stress.

The livingroom has a high ceiling, people tend to be more inclined to social encounters in rooms with tall ceilings. It is deigned to allow for everyday life as well as traditional events (a Christmas tree will fit nicely). The sliding doors will open the room up to the balcony and by doing so doubling its size. The living room is framing the view from both the dining area and kitchen. These three rooms have an open layout, yet distinct borders marked by the pillars carrying the floor above and the placement of windows.



SECOND FLOOR
1:200







SECTION
1:200

Talya Rechavi says the living room plays an important role in reinforcing identity through objects and experiences. Pennartz talks about having a clear relationship between the size of the living room and its effect on communication and experience of pleasantness (orientation of furniture to encourage communication, space for objects with some significant social meaning). (Keedwell, 2017) Both are valid points and have been taken into account, as well as my own idea of a living room that allow for intimacy.

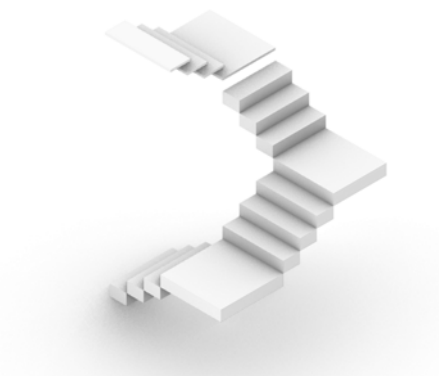
Since the dining room is located in between the living room and the kitchen it only has two walls to relate directly to. These walls are sliding doors that stretches up to the ceiling. They will disappear into a slot between the façade and isolating part of the wall and the room will be like an open passage - like the space in a barn where one could drive a carriage through to deliver crops. The large roof that covers both house and porch shield this room from direct sunlight but almost 3 meters above the floor it doesn't stop the view.

The kitchen has its back towards a

solid wall with openings on either side, there is a relatively small window on the eastern facade, for the morning light to guide hungry dwellers to their breakfast but also for airing the kitchen.

Behind the kitchen a large stair with three levels on its way up to the second floor dominates the room. On either side of the stair is a door connected by a hallway. The western one is the front door, open this one and you will face a view of rolling hills, the small creek and the road going up to the house. A few steps, perpendicular to the house, takes you down to ground level.

The other door, the eastern one, is what some would name the back door. It is a less formal door, it is smaller and glazed so you do not have to open the door to see what's behind it; trees, and a field with cows in the background. Open the door and you'll find the stair that takes you under the house. The hallway is filled with sequences of rooms to come. It is a semiprivate space, central node in the house that provides transition both from outdoor areas and between more private zones.



The occupants of the house have various ways of greeting visitors, it is possible to meet in different ways, on different "levels".

At the northern end of the interior spaces there is a room that could be a bedroom, but it might also serve as a library or TV-room (for those sane few who doesn't want a television in the living room). A sliding door and large window next to it open the room up to the porch. The view is of the same forest as though the back door but here it is denser, there are no cows that could to spy on you. Being at the end of the

building with exists concentrated to one end of the space this is room have a safe, more private character than the rest of the rooms on the first floor. Adjoining is a small office space with a tall window to the west. This room could be a nursery, or a walk-in-closet if the room next to it is used as a bedroom. Between the rooms just mentioned and the hallway is a bathroom and a closet.

Rising three meters in a vertical direction in just over 3 m horizontal once it not very comfortable, therefore, the stair in the middle of the building is turning at three





points. One apparent thing in rural architecture is the parts that have been the hardest to construct are the ones most prominent in the building. Every level of the stair has it's own character, for each level the steps get thinner – they start as solid, rectangular logs at the bottom and at the top they are just a few centimetres thick, made out of CLT. The stair is a physical representation of the timeline of Swedish timber building – it starts off with massive logs (corner timber technique), moves on to more timber saving techniques like stave building and post and plank compositions (second level). Then come the balloon frame structure and at the final steps; engineered timber (CLT) is used.

In the middle of the room stands what might be described as a wooden chimney, the stair wraps around it. At the top of this chimney, which is as wide as an old pine tree, is an FXT-ventilation system distributing air, heated by the exit air from the bathrooms and kitchen, into the bedrooms, hallway and living

room. Underneath the stairs is a geothermal heat pump making use of the temperature in the ground below to heat the water used in the house. An external water heater tank stands next to the geothermal heater in the "chimney". Under the first few steps, close to the main door are drawers for storage.

The second floor contains three bedrooms, one large and two smaller. There is a roof window for each of them. The floorplan is divided into two parts, one with a large bedroom, a bathroom and two storage rooms and the other with the smaller bedrooms and outside of them a study/play area for each room. A footbridge, above the entry connects them, it is to that one the stair connects. The windows of the bedrooms face east, there are no windows on the western façade to avoid overheating in the evenings. Also eastern windows makes it easier to fall asleep and wake up due to the properties of the light.

The bedrooms are a place for refu-



Pencil drawing of the living room with dining area and kitchen in the background.





ge. A protective space surrounded by layers and with limited insight. The sky light is soft and modelling.

The bathroom and the smaller bedrooms have a secondary ceiling that lower the height of these spaces. This is partly because of restrictions regarding ceiling height in bathrooms but mainly since there is science that tells us we feel une-

asy when we are sleeping in a room with a tall ceiling. Above this interior ceiling are remote controled skylights to light up the spaces outside of these rooms. The southern end of the second floor opens up to the living room below. Large windows in the gable wall make it possible to see the lake from the second floor as well.

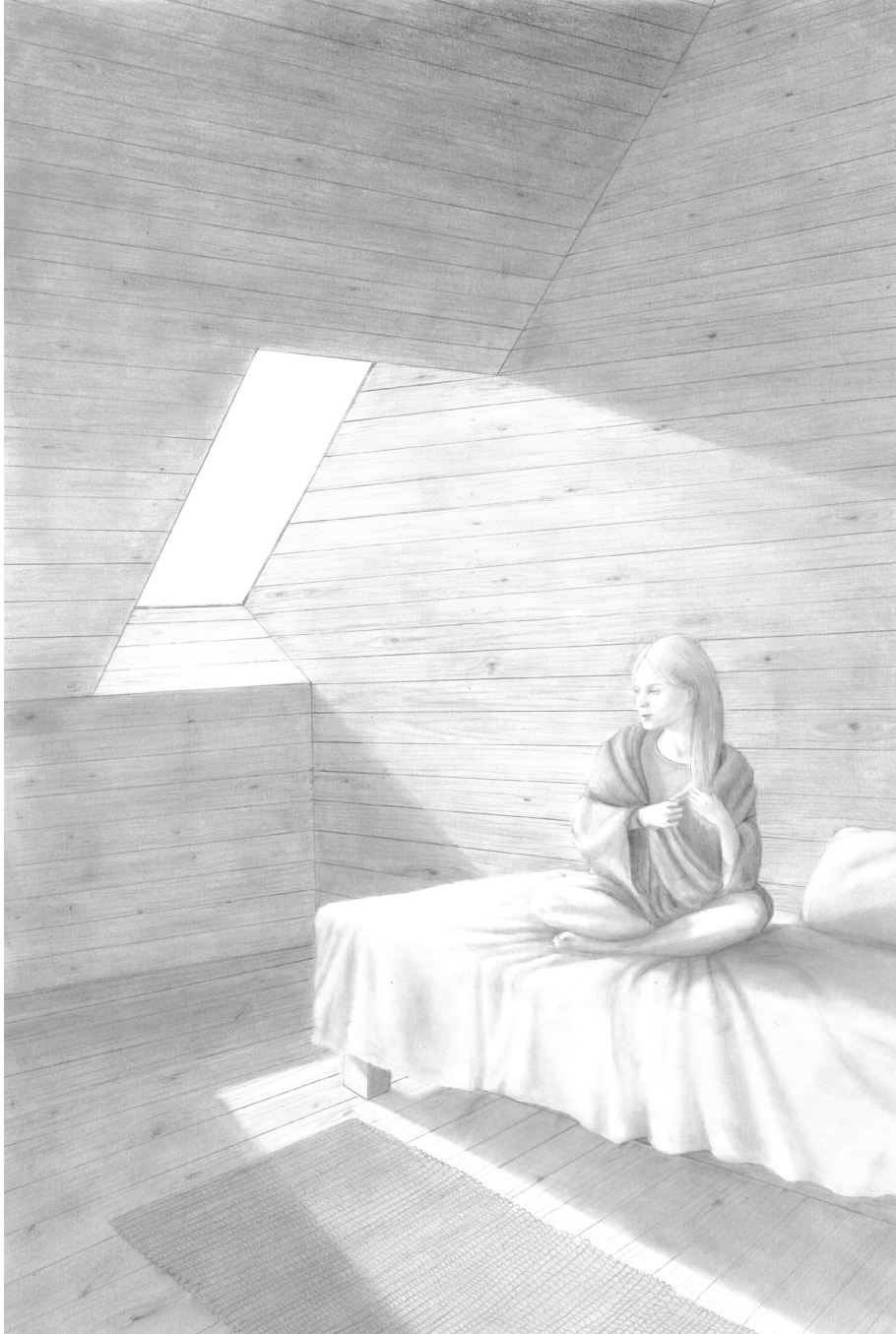
Natural Light

One thing that way very important to the design of old buildings was daylight. Even when glass was introduced it was expensive and had to be used with care. Windows were directed towards the south if possible and the way the rays move inside the house was how the inhabitants could track time.

I have tried to show the same care to the movement of the sun. They light of the sun have physical effects

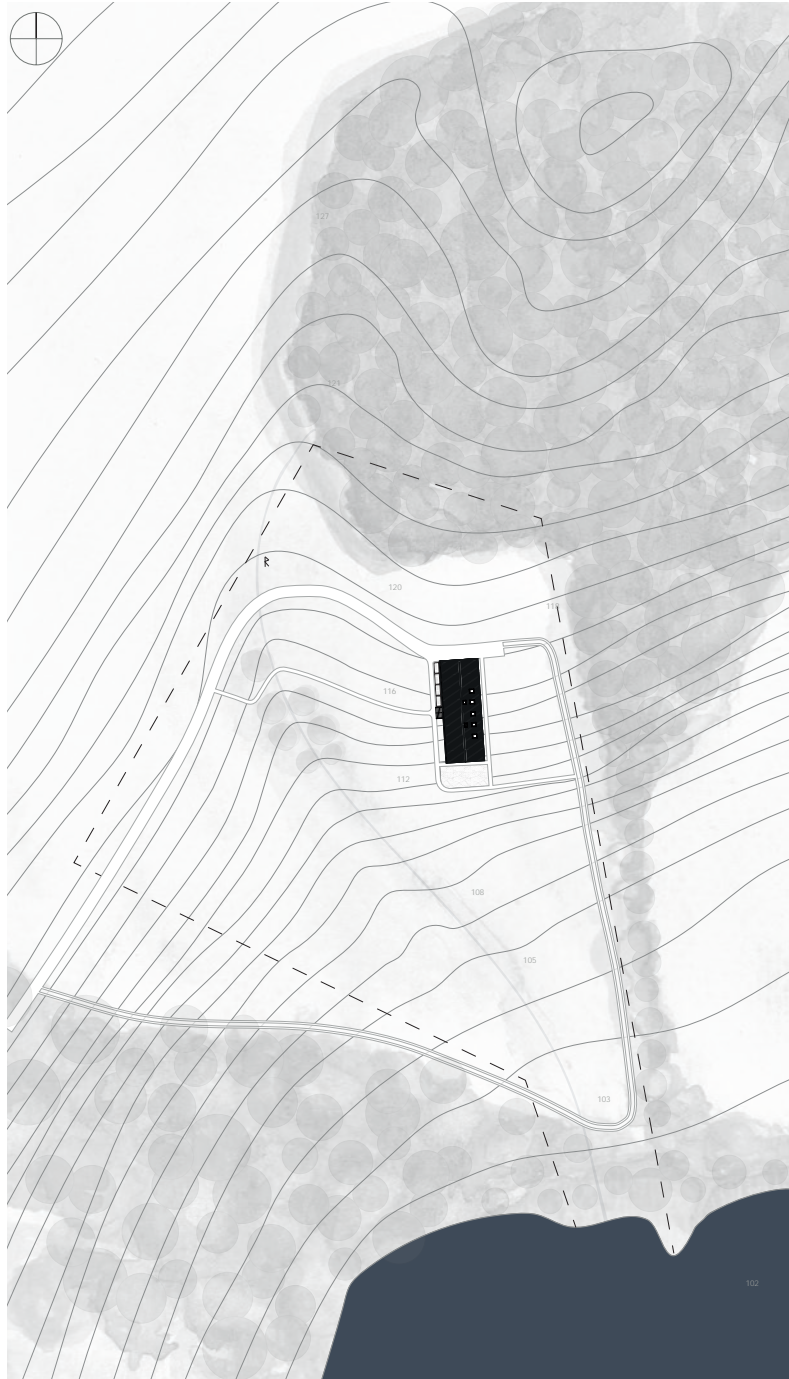
on most living things and why not incorporate that into the design?

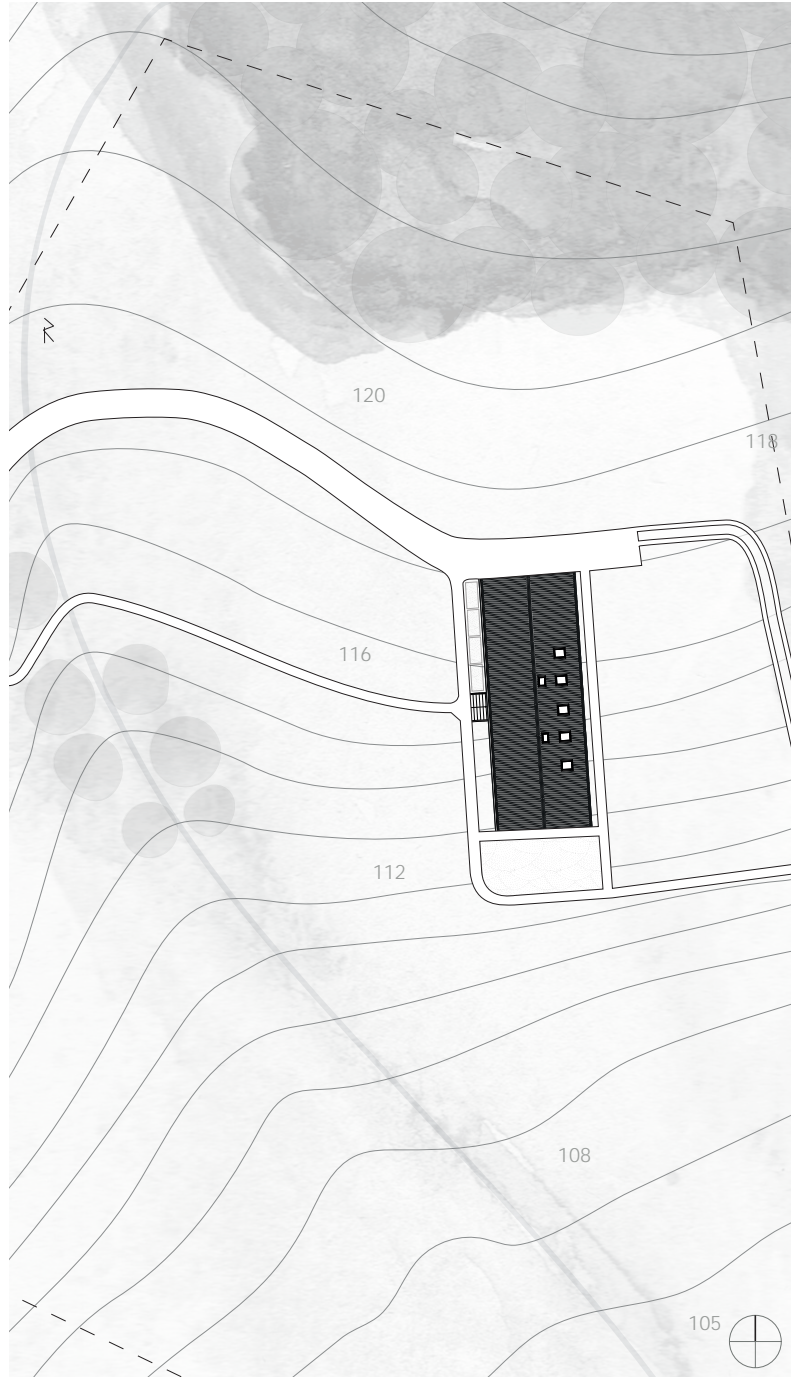
Waking up to the red and yellow rays of the morning light kickstart our brains and falling asleep is made easier by the dark blue of the sky in evenings. This is why all bedrooms are placed in the eastern part of the building, each with a window filling the rooms with natural light. The function of the room are oriented after the movement of the sun.



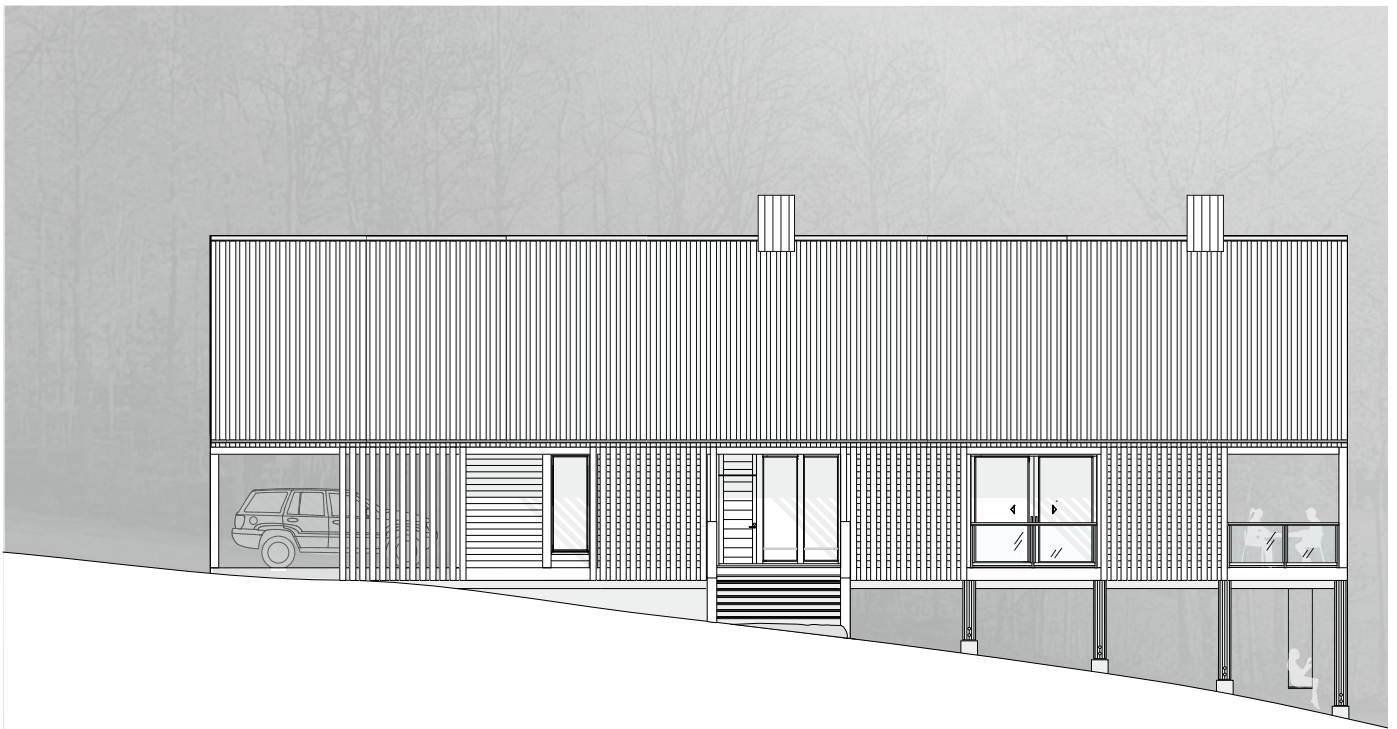
Pencil drawing of girl in bedroom.

VALLMOKULLEN
1:2000





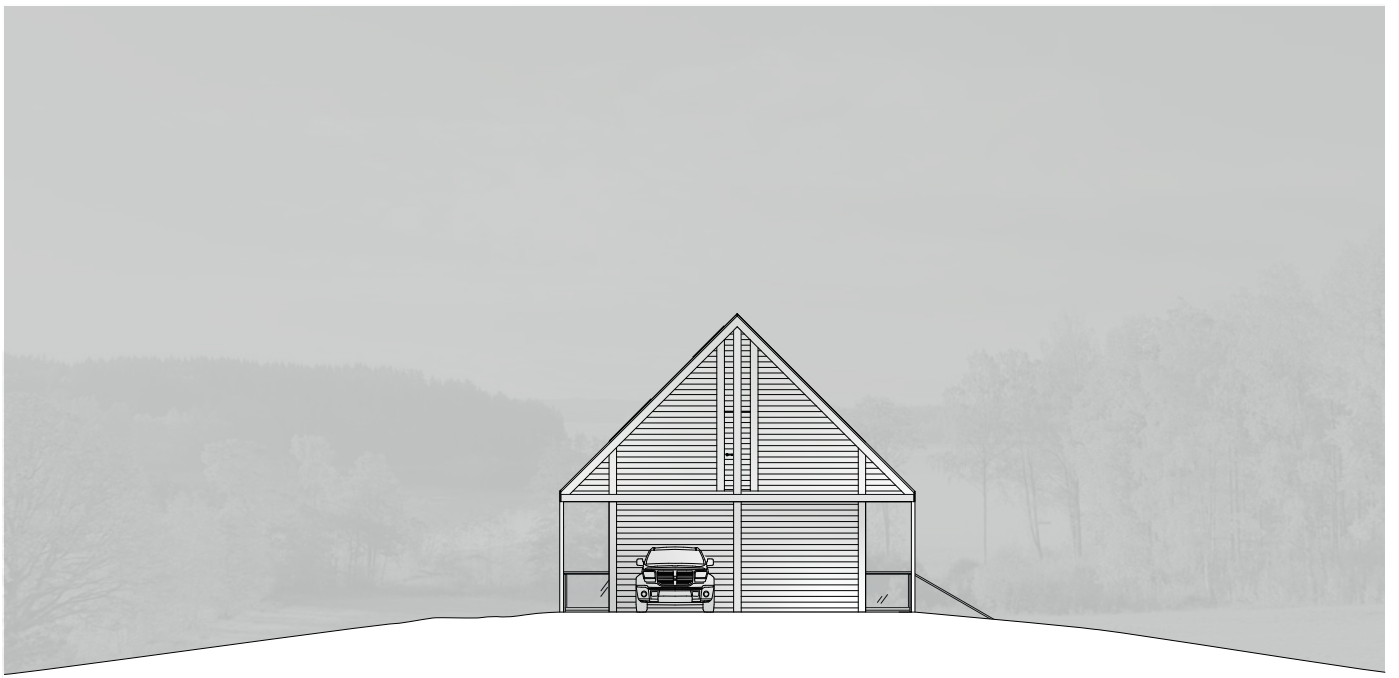
VALLMOKULLEN
1.800



WEST FACADE
1:200



EAST FACADE
1:200



NORTH FACADE
1:200



SOUTH FACADE
1:200

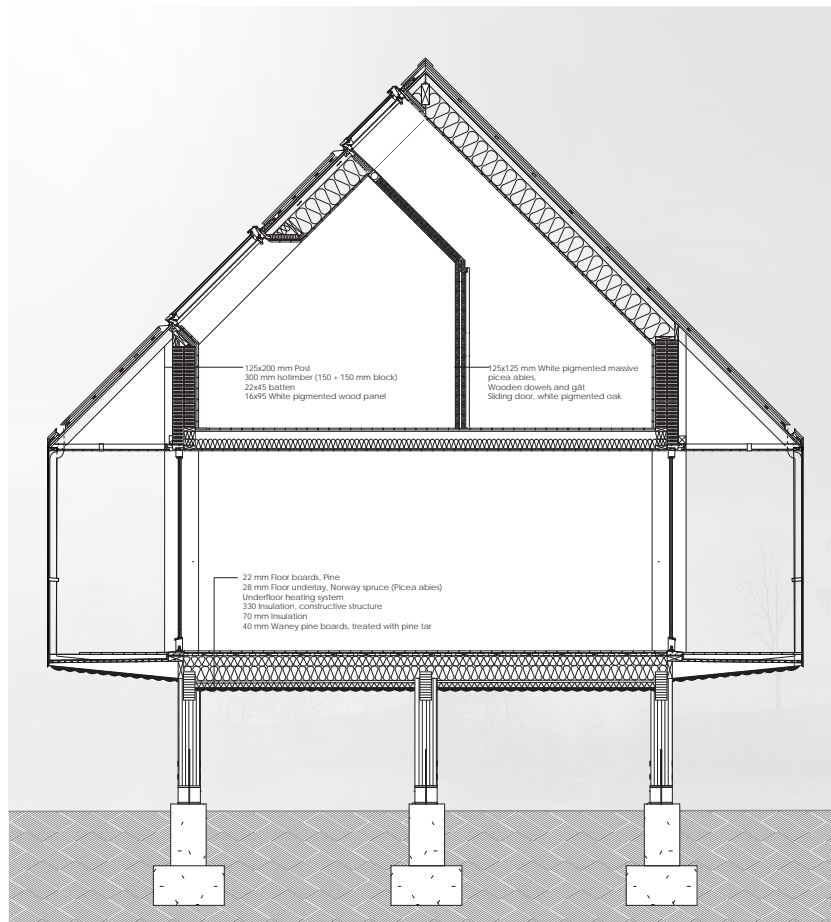
Materials and Building Techniques

This structure consists of several layers, the first layer being the porch. It relates to the thin, sparse walls of barns and storage buildings, but also to the galleries of the domestic homes (most commonly found in Dalarna and Norway).

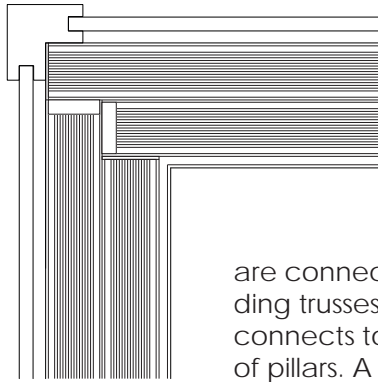
The second layer is the shell of the building – the framework and horizontal planking give the walls a rich texture because of the rhythmical shadows from the slightly protruding posts. Just behind this framework is 300 mm of iso-timber wich is basically a modern interpretation of corner timbering, it is both carrying elements as well as protecting.

The third layer is the interior walls which are fully exposed and timbered with salmon knots. This structure supports the second floor and roof along with the walls as well as shape the interior spaces.

The porch with its external pillars and the vertical planks between is exposed to the weather but protects the main walls behind it. The rainwater system is built in and the water is led down next to the pillars, under the floorboards and down into the ground along the posts carrying the structure. The second layer is the façade. It consists of a post and plank system. The posts



DETAILED SECTION
With Windows
1:100

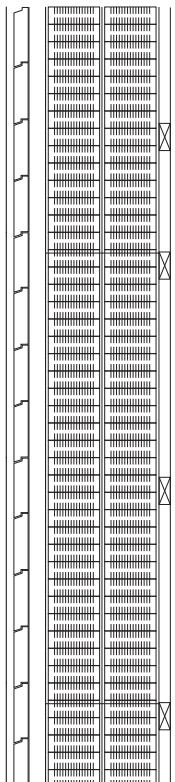


Detail of construction; corner in plan view showing how the isotimber elements are fitted.

are connected to protruding trusses which in turn connects to the outer row of pillars. A horizontal beam connects the posts of the façade to the pillars of the porch. An exterior ceiling, at the same height as the interior ceiling is attached to these beams, the outdoor lighting is fixed to this ceiling, with only the light sources visible.

natural resistance to the outdoor climate, than for example spruce.

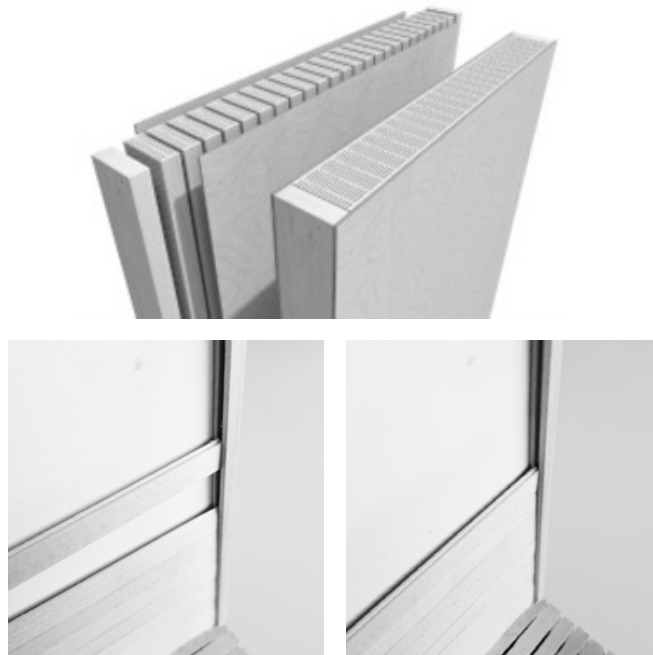
The isolating layer that follow contains timber with sawed air gaps, glued together to form solid blocks. The blocks are stacked, much like corner timbering. The material is a Swedish invention called isotimber. The λ -value of this engineered timber is 0,075 W/mK, this is twice as low as for massive wood. The λ -value might not be as good a mineral wool insulation (at 0,035) but it has other benefits that heightens the performance of the wall. It is a strong self-carrying material that can take large loads, since it is delivered pre-cut to the site construction time is much shorter then for a traditional building (the material might be more expensive but the manufacturers ensures that that money can be saved on less labour).



The framework of vertical post and horizontal planking that forms the façade is self-carrying. The posts are joined to both trusses and the beams that carry the floors, no nails or screws are needed. The façade planking fits into the post by a groove that permit sliding, which allows movement in the timber. With the passage of time the wall gets tighter. The planks are made out of pine heartwood, the posts and pillar framework around the porch are also pine, as well as the floor boards. Pine is chosen since it has a better

The core of the building, the

Detail of construction; section of exterior wall

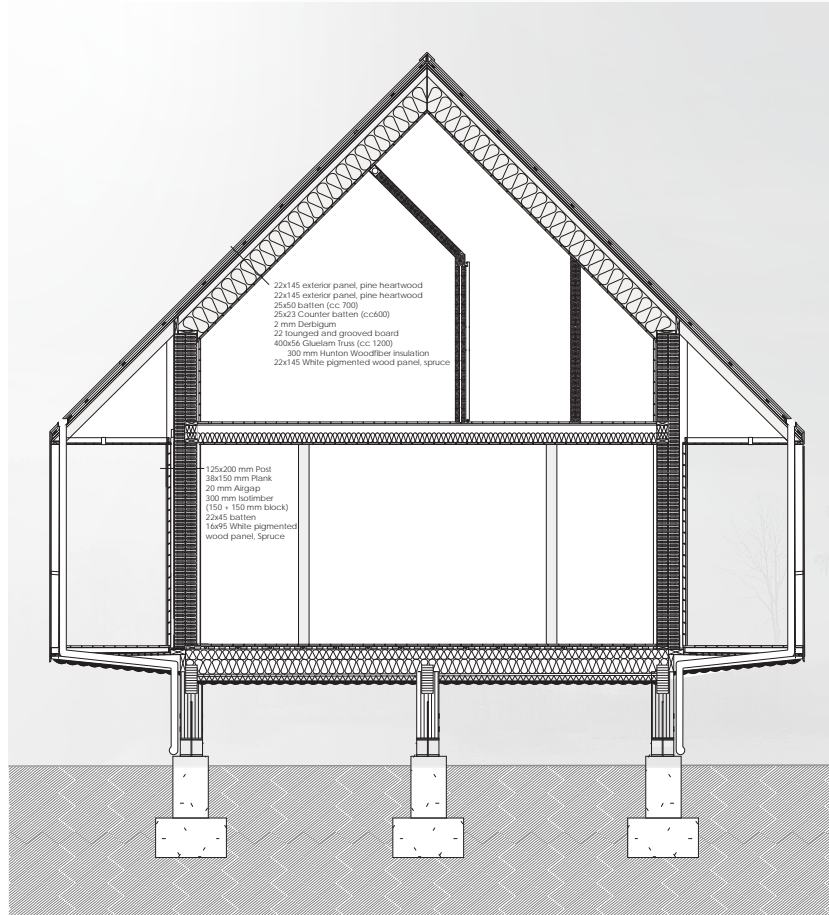


Above: IsoTimber
 Under: Detail Facade, Model 1:20
 showing how planks are slotted

interior walls of both the first and second floor are corner timbered with salmon joints and wooden dowels. They are all loadbearing, the ones on the second floor is supporting the trusses and the ones on the first-floor are taking the load down from the second floor to the beams and pillars below. In the open area between kitchen and living room four pillars are taking on the role of the walls.

One of the most appealing properties of timber is its ability to create a healthier interior climate. Timber absorbs and admits moisture in a

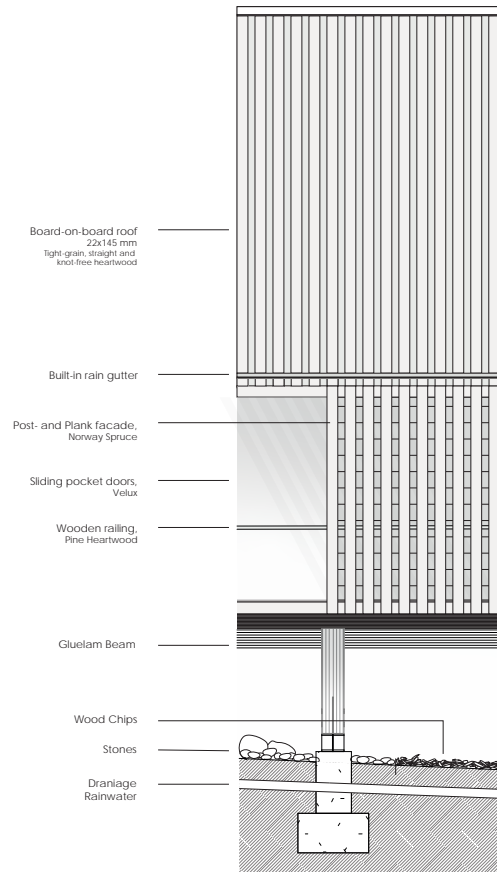
way that benefits the interior climate. When a shower is on or water is boiling on the stove the moisture content of the air is rising – timber will absorb this extra moisture and release it into the room when the air is more dry. When the moisture is absorbed heat is admitted into the room. This process have been studied with thermal cameras by scientist from Aalto-university in Finland and Tretknisk in Norway. The absorbed steam condenses into water stored in the wood, in theory the energy consumption could be lowered in rooms with walls of wood.



DETAILED SECTION
 Solid Wall
 1:100

In a study based on research from the 80's showing people feel better when surrounded with nature scientist saw that timber have a similar effect. Wood is seen as a very natural and warming material and was much liked by the focus groups. Robers Unlich test on patients with a view of natural environment versus a

non natural environment was copied but in this case there was a paintings of nature versus wooden panels. The results of the study indicated that the patients with a view of wood experienced less variation in the amount of pain and stress, they were also discharged earlier the other patients.

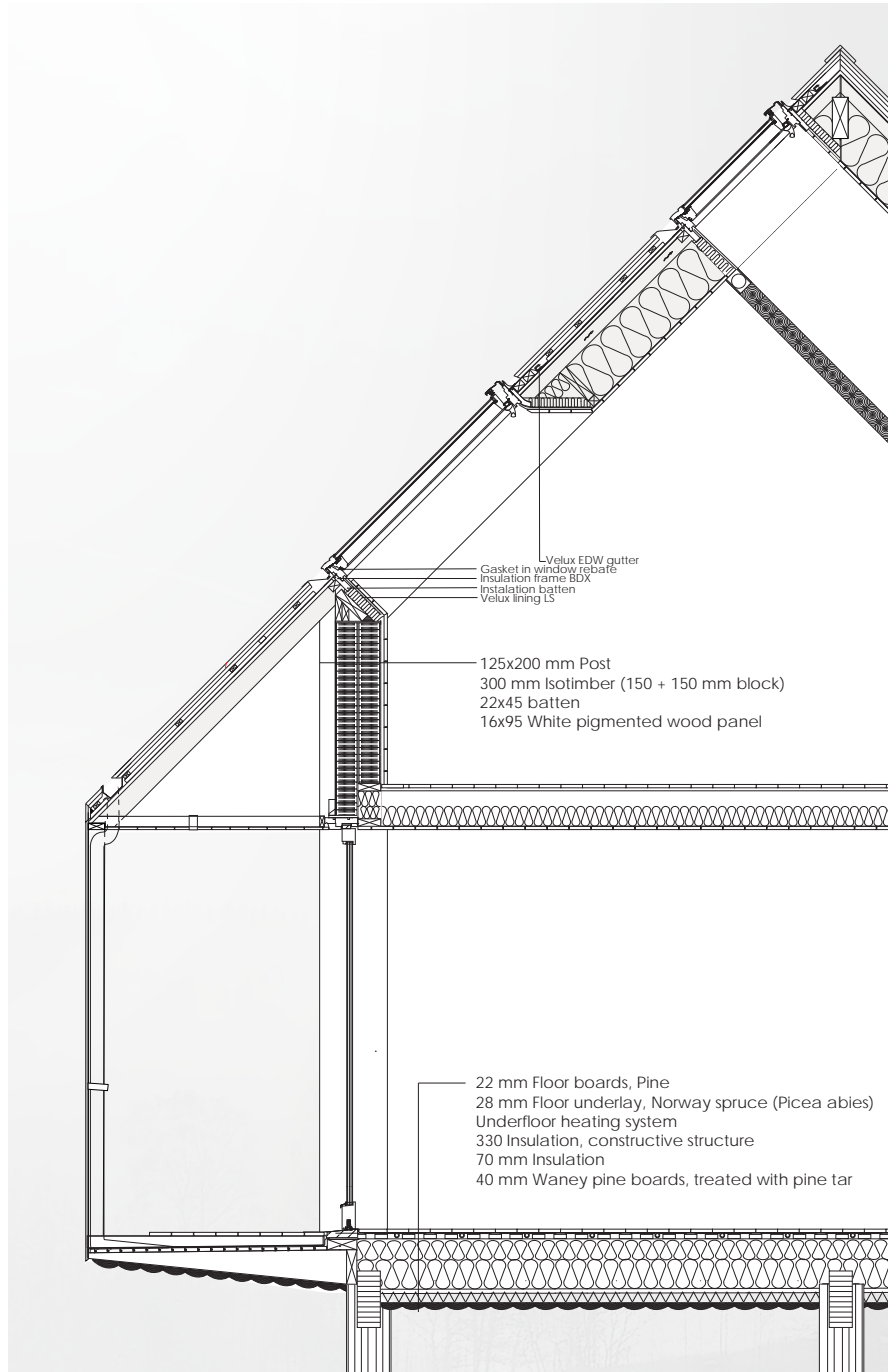


FACADE
1:100

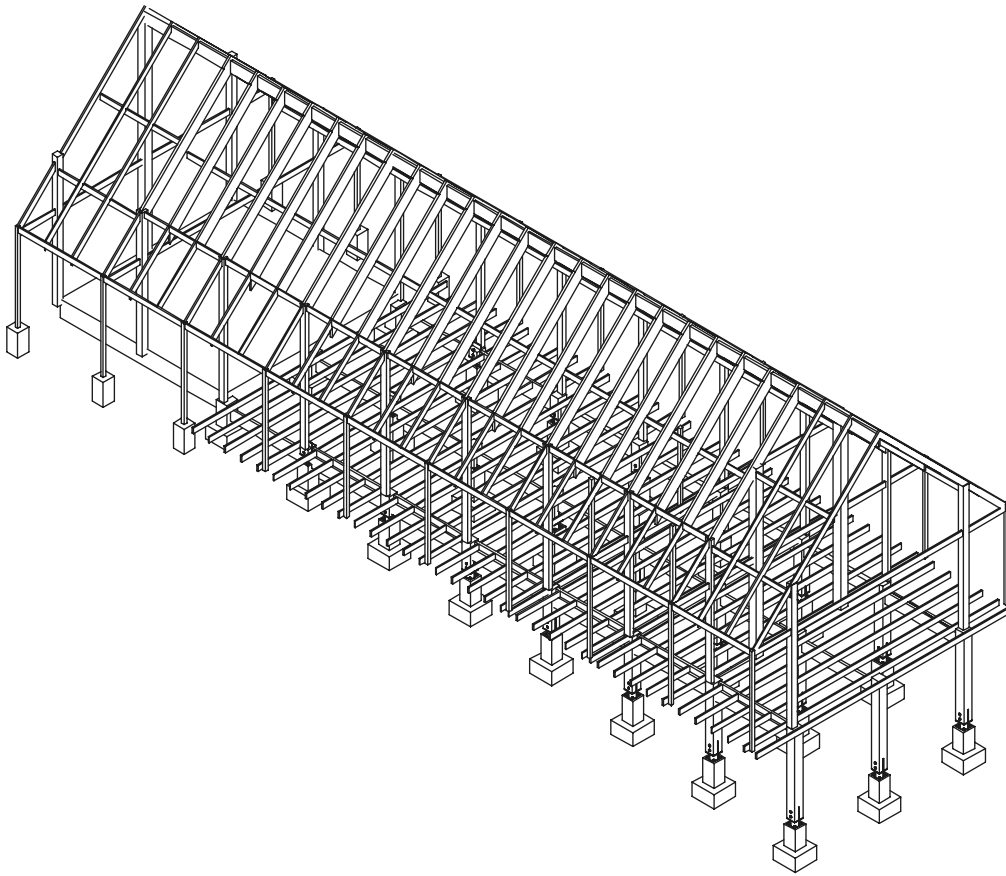
The board-on-board roof comprises a double layer of vertical boards that follows the 45 degree fall of the roof. There are two drainage grooves in each board, the boards on top has the grooves facing down and the underlayer of boards have drainage grooves in the upper side. The roof is constructed this way so that it can be aired and

any moisture can run off or be ventilated away.

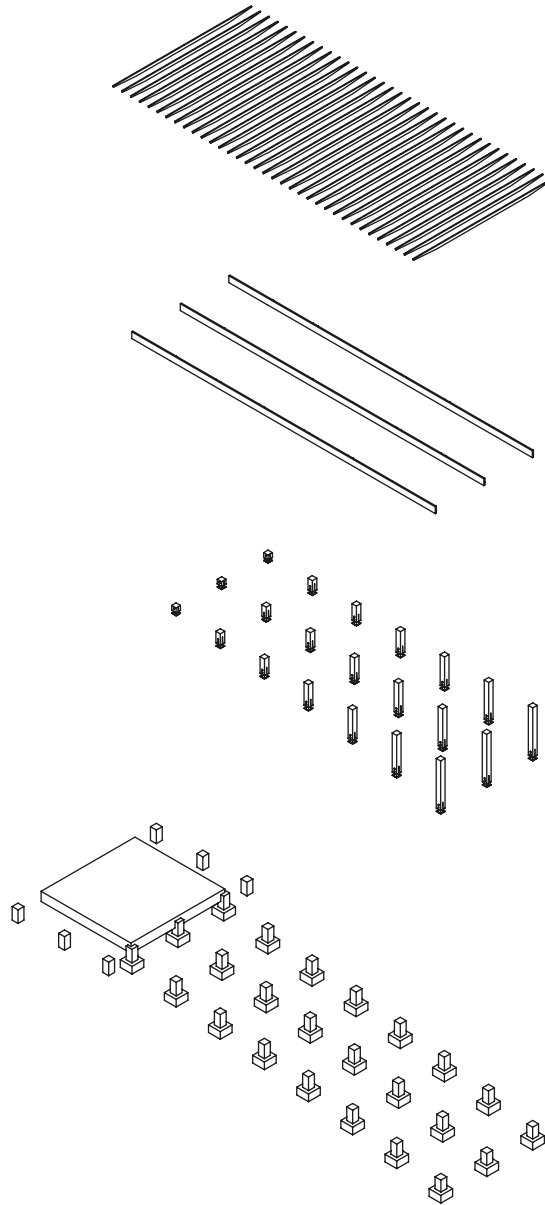
The boards tighten up against each other when they bow, this is achieved simply by installing the boards heartwood side up. The boards consists of heartwood pine that is treated with pine tar every few years.



DETAILED SECTION
 With Windows
 1:50



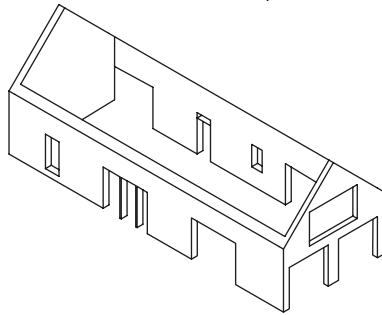
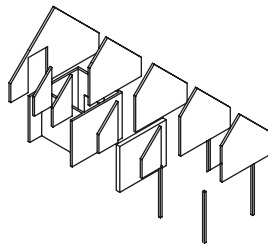
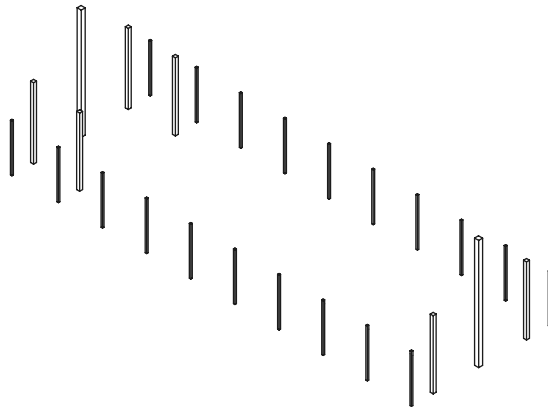
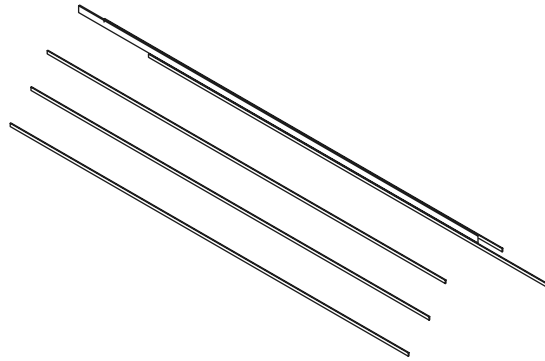
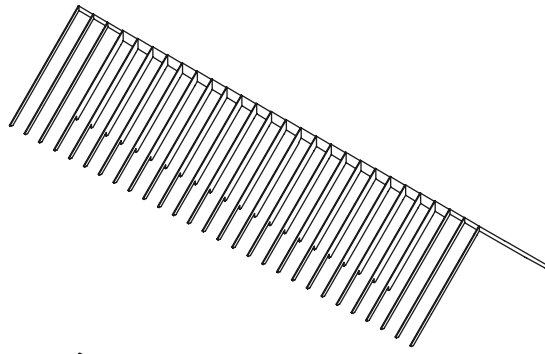
THE STRUCTURE
Without walls



ISO EXPLODED STRUCTURE

Above: Foundation, pillars, glue-lam beams & floor joists

Right: Exterior walls, interior walls, exterior posts, underpurlins & rafters.





Conceptual drawing of
Gröntuva

Gröntuva

Site and Function

In order to test my theory of relocating the structure created for Vallmokullen in the future I choose a second site; Gröntuva. This plot is on an island in Dalsland, same county as the primary site, about 4 miles away . On the same island are five small cabins, known as the 72h cabins, that are used for nature tourism.

There is a need for a service house for the guests that are staying in these small, glassed cabins. A place where they can wash up and use a proper bathroom, store personal belonging and relax protected from bad weather. Bedrooms are needed for those who interrupt their stay in the cabins for whatever reason but also for those who like to remain on the island after the

72 h has expired. The family who owns this island and run the truism company also like the house to function as a leisure home in the future.

The Island is long and narrow, meaning there is a lot of land protected since it is close to water. Gröntuva is one of few plots that could be allowed a building permit.

There was an old, massive wooden barn on the site previously but it was torn down a decade ago, the foundation is now barely visible. The two hills on either side of the site supported bridges which led to the second floor of the barn, this way the farmers could drive the harvest all the way up and out the other side.



Map of
Gröntuva



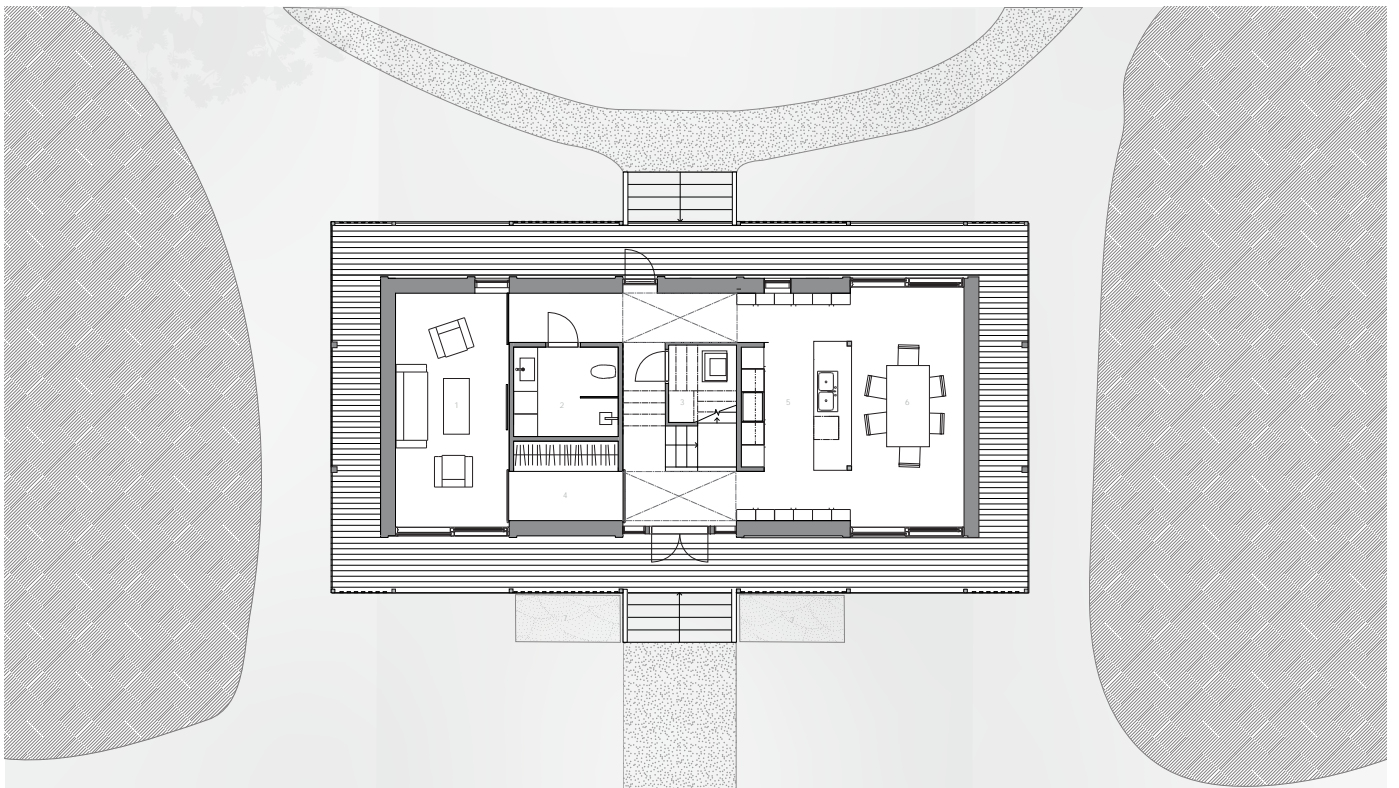
The plot is situated in a line of trees separating two fields. There are three uninhabitable, abandoned buildings close by reminding visitors of past times.

When relocating the structure to this site some things change, for once there is no need for a carport, so it is striped off. The veranda still wraps around the structure, but the large balcony is also gone. These changes are basically accomplished by removing a few sections of pillars and trusses.

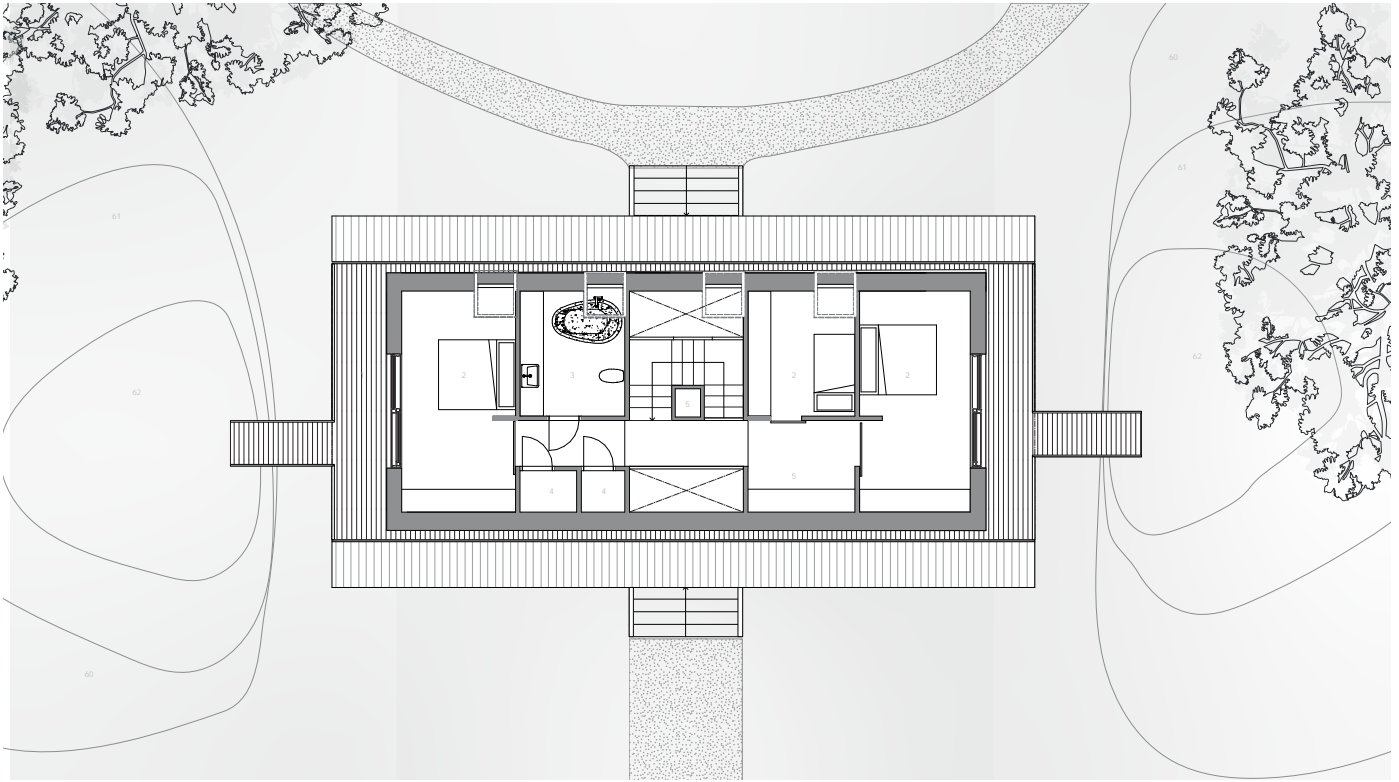
To fit between the two small hills the building had to be shorter, the

living room is therefore moved to the other end of the house and the space it occupied lost. This change does not mean any lost square meters on the second floor, only that one of the small bedrooms now mirrors the space at the opposite end.

The orientation of the structure is here an east-western; perpendicular to the previous positioning on Vallmokullen as well as to the layout of the barn located there earlier. This way the hills can be reached via bridges from the second floor and the suspended tension the empty site showed is relived.



FIRST FLOOR
1:200



SECOND FLOOR
1:200



SOUTH FACADE
1:200



NORTH FACADE
1:200



WEST FACADE
1:200



EAST FACADE
1:200



REFERENCES

The main inspiration for my work has been Swedish rural agricultural buildings, made out of timber and dated not later than the 19th century. Though these old building are a joy to behold in the landscape (those of them that are still standing intact a least) I believe that new building should be a part of the present, not a copy of the old. There is a lot to learn from these old timber structures, but they say nothing about

the world we live in today. New things, products and buildings are just that; new. Just like in nature there must be an evolution, a suggested improvement of the old, better adapted to meet the future.

Following references are all products of their own time. They have helped me keep my design from falling to deep into the past.

FARNSWORTH HOUSE & LJUNGHUSEN

These two specific buildings, both in close relation to a natural, green environment have been recurring and much debated examples in the early stages of my research process. Both designed by publicly acknowledge architects, both containing large amounts of glass and placed on green plots. They might be thought of as quite similar at first glance but they have become fundamentally different from my point of view. What I have learned from these examples I have come to by comparing them, hence I present them in a comparison and not separate as the following references.

Ludvig Mies van der Rohe's Farnsworth House and Per Friberg's Ljunghusen. A mere decade separates them in time and modernistic ideal shine through them both. One floor, flat and raised above the ground connected to a horizontal roof by transparent walls. These buildings might be some peoples image of how living close to nature should look. I think them both to be aesthetically appealing but I've wonderd alot about what the people living in these buildings think.

Friberg's Ljunghusen is now owned by his sons family and on the Swedish television show Hustoppen the viewers got a chance to hear what they think about it and they appear quite pleased with their living situation. Mies Farnsworth house is one of the most famous buildings in the world and very well documented. The woman that originally inhabited the building was very displeased with it, she had no sense of security in it and felt constantly exposed (this she wrote in her diary). From what I can imagine myself, Fribergs buildings are much more adapted to how we, as humas, like to live than Farnsworth house.

Friberg divided the functions between two buildings, the inhabitants are not left to live in a glass box but have a separate, more private building they can retreat to. The main difference between the two buildings is that of the private space.

GLEN MURCUTT & PETER ZUMTHOR

Australian Architect Glens Murcutt's architectural style is inspired by Mies van der Rohe but also the philosophies of Henry David Thoreau. He primarily design residential buildings in Australia and has received the Pritzker prize for his work. The homes he design are a harmonious blend of modern sensibility and respect for nature. Murcutt show great interest and knowledge of local craftsmanship and indigenous structures. The buildings he has created has an unusual character, yet they are curiously familiar. As I in my project take interest in traditional rural timber structures I find Murcutts moderns interpretation of the traditional inspiring.

The Kempsey House is seminal to the development of contemporary Australian housing. The rigour of its construction logic is especially evident in the layering of its external skin. The facade is composed entirely of a series of louvres, blinds and flywire. The frame lifting the house above the ground is an Miesian-derived external expression but it is executed in timber rather than steel. Despite what one might think, after an initial glance at the building, timber dominates the structure throughout the house. Murcutt has made sure each element uses species which are best suited to their particular purpose.

Another Pritzker Prize winner, regarded as one of the world's most outstanding architects is Peter Zumthor. Inspired by the environment surrounding a building, Zumthor design buildings that adheres to a minimalist, very clear style that shows great respect for the building craft.

The leisure home he designed for his wife in Leis (Swiss Alps) is made mainly from Canadian maple. The timber is visible in both ceilings and floors, inside as well as outside. The buildings, he made two next to each other (one for renting) are located on a tricky mountainside plot. They are tackling the slop in a similar way as the local 18th-century timber houses that Zumthor was inspired by. He has done a modern interpretation of the old, there are no tiny windows or low ceiling, no the spaces within have a bright and airy feeling to then.

I find they way Zumpthor always tries to integrate local building and artisan traditions in his work highly inspirational. The attention to material and detailing as well as the overall cooperation with the surrounding environment bring qualities to his work I like to include in my own.

TIMBER

Historical and current
information about the
material

Every form of construction is following rules set by the properties and conditions of the materials employed and the requirements they must meet. Although the purpose of the thesis is to encourage the wellbeing of the dweller, a home is something physical; what

we see when we look out a window affect us greatly but so does the materials that shape the room we are looking out from. Timber is a healthy material, for people as well as the planet and it is therefore the material chosen for this project.

THE PROPERTIES OF TIMBER

Wood wise

Knowing how timber works was vital to the building process. Each type of wood has its own properties and the builders of the past knew them all. Timbermen of the past knew how a tree should grow, when to make its environment lighter by cutting down other trees to make a specific one accumulated other qualities. Each tree was individually selected, treated and assigned a specific purpose.

Timbermen knew how the turn of the trunk would make the timber move in a building structure and used this to their advantaged. By knowing how the tree had grown they knew could predict the properties it inhabited. All this knowledge was used to create better buildings.

Modern timber knowledge

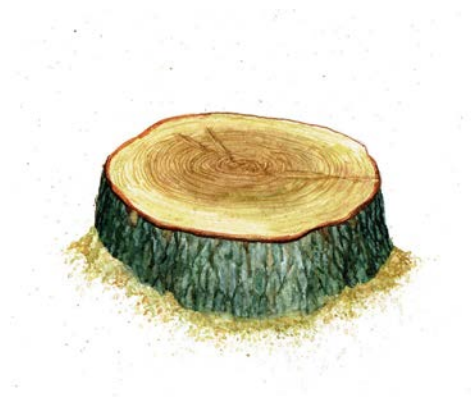
All while the timbermen's knowledge was based on generations of collected experiences modern science has revealed much new information on the subject. In this chapter a brief summary of what we know about wood today will be presented, partly to introduce terms used to describe the properties of the material but also to understand why they build as they did

Wood is a material mainly made up of hollow, elongated fibres and rays. The fibres consists of cellulose with makes for about 50-60 percent of the tree trunk, they are cemented together with lignin (approximately 20-30 percent of the trees total mass). Rays are oriented horizontally

and extend from the bark towards the centre of the tree. (Dolby, Rural Constructions in timber 1988).

Species are divided into two broad classes; coniferous trees and broad-leaved trees. Coniferous trees are also known as softwoods and broad-leaved trees as hardwoods, there terms do not confer to the hardness of the wood (some softwood trees are harder than hardwood trees).

When looking at a cross-section of a log even an untrained eye could see several distinctive zones. The core of the tree, usually darker, is the heartwood, it consists of inactive cells. The outer layer that wraps around the heartwood is the sa-



wood, this is the growing part of the log and has a lighter colour. The width of the bands of the heartwood and sapwood can vary, it depends on the environment the tree has grown in. The bands of the sapwood could be between 25 mm or less to 180 mm. Both zones are as strong as the heartwood. Sapwood is much less resistant to attack by fungi or insects. (Dolby, 1988)

Bands, or rings, indicate yearly growth. The rings are either earlywood, made in spring or latewood, also known as summerwood. The growth is more intense in spring and these bands are thicker and less dense whereas the late-

wood is much harder and thinner.

Moisture content is very important to think of when working with timber. It is expressed as a percentage of the weight oven-dry wood. It may range from about 30 per cent to over 200 per cent. The conditions at which the water in the cell cavities has evaporated but the cell walls are still saturated is known as fibre saturation point (FSP). It varies from about 25-35 per cent moisture content, any less moisture than this can alter the physical and mechanical properties of wood.

Old knowledge

When selecting trees for a domestic building it was important to not use trees that had grown on fertile lands. The location of the tree is in direct relation to the quality of its timber. Trees that have grown more closely together have fewer branches and straighter trunks. Timbermen had different names for the trees depending on where they had grown. A spruce could be called trånggran, skarpgran, kärrgran or strålgran. Kärrgran and strålgran was spruce that had grown slowly in a bog or a moss, they had dense heartwood and were excellent for domestic buildings. North facing slopes, a dry and famine site created the best pine trees.

A faxgran is a spruce that has grown freely, it will have a large crown and is not suited for building. Trees with lots of branches are rich in natural rot repellent substances and are therefore best used for vulnerable building parts such as sills. This type of wood easily twists itself and is very hard to build with otherwise. Trees with frost or storm cracks are to be avoided, these easily get rot and their ability to take loads is diminished. Also trees that have bumps, bulges or wood chipper marks (indicates insects) should be avoided.

Types of timber

Pine was preferred over spruce for buildings for men and animals. The timber is easier to work with simple tools since it is "rättkluvet" (it cracks along the fibres). If one use spruce pine would be used for sleepers (syll), doors, windows and stairs, floor boards and any material with ground contact.

There are many types of spruce but the one most common is Sweden is Norway Spruce. Traditionally this type of timber was more commonly used for barns and storage buildings. The trunk is often twisted and the timber is therefore harder to work with than pine. The tree need to be well matured and have dense heartwood. The timber is lighter and less brittle than pine, the fibres are longer, and it is consequently good

for beams and ceiling constructions. Since it is light and doesn't admits resin like pine it is also makes good flooring. The timbermen of the past always made sure to harvest spruce before it would sap (around mid-summer) this to make it easier to peal of the bark.

Oak is good for syll, doors, windows and stair. It is hard and therefore makes good floorboards but it can also be used with in contact with soil. Farmers used oak poals for their pastures.

Aspen trees were harvested on site to easily create structures for storage (ängslador). The properties of this timber also makes it good for constructions under ground as well as splits for roofing (takstickor).

Mature Trees

A tree is considered mature when the larger part of the trunk consists of heartwood. There is a relatively short time span in the life of the tree where it is considered mature, this is when it should be harvested. Wait too long and it will start to decay, the heartwood will eventually get rot fungi. There is not a specific age where you can say trees reach maturity, not can you tell just by looking at the diameter of the trunk. It depends on a wide range of factors, all of them connected to the environment the tree is growing. In the later part of the growing cycle the heartwood is increasing while the sapwood will get thinner. Timber men could rate maturity in many ways. One was to "spänta en flisa", to cut out a part of the wood.

Another technique was to hit the trunk with the back of the axe and listen to the sound it resulted in. If the tree was mature it would result in a high, singing tone. If the tone was dull it meant there was still thick and loose splint wood and the tree was still growing. The look of the branches could also help determine the maturity of the tree, unmaturing trees have robust branches with lots of coniferous. The branches of a mature tree are more brittle, they are hanging paralysed and are covered with long, string like, green grey lichen. If you look at a mature tree in spring time you will also see that it barely gets any shoots. All sense was used to determine if a tree was ready for harvest. (Werne, pg. 119)

Maturity and Sustainability

As long as a tree is growing it is picking up carbon dioxide from the atmosphere and storing it. In a time when we have an abundance of carbon dioxide, CO₂, in the atmosphere – so much that it is affecting the climate – this quality should be treasured. Trees are now being recognised as excellent sustainable raw material but there are several forces that are doing all they can to preserve trees. The problem with this

it that once a tree reaches maturity it stops storing CO₂ so while preserving trees can create a beautiful, storylike environment and help diversity of insect and animals who eat them it also stop new trees from growing and storing CO₂. It is even so that past maturity, the tree start to rot and CO₂ is released back into the atmosphere.

THE GREEN HOUSE EFFECT

The way this planet is managed right now is not sustainable. Natural resources are being exploited, vast ecosystems ruined and to top it off the climate is changing which will result in a great number of new challenges. The Earth is in an ever-changing state but the rapid changes it is now facing is primarily caused by human activities. The biggest challenge the world is facing today is how sustainable development can be achieved for all (UN, 2016).

There is scientific evidence that indicates climate is changing globally due to increasing greenhouse gas

emissions. The greenhouse effect is changing the world as we know it dramatically, it threatens life as we know it in all corners of the world. It is widely recognized that humans now are living beyond what this planet can provide, the population is growing rapidly, and the problem is increasing at the same rate. A change is bound to come or our existence on this planet is in jeopardy (UN, 2016).

The built environment is responsible for a large part of the global energy consumption, therefore the people working in this sector has an obligation to the planet and its future to

deal with this issue if our common goal of reaching a sustainable energy consumption and reducing greenhouse gas emission is to be fulfilled. The car industry for example has done great progress in the strive for sustainability but the building sector is falling behind – and there is no excuse for this (ClimateAction, 2014). In fact there are exceptional possibilities when it comes to building sustainable and most of them are related to timber.

We now have the technology to use timber efficiently as an energy source and when refined, timber could replace plastic and it can be used for fabric, it is already used in a lot of our clothes – rayon for example is a wooden product (Rozenblat, L. 2010) Most important for this project; wood makes an excellent building material.

Forests can reduce atmospheric carbon dioxide and by doing so decreases global warming. Since it is only growing trees that absorbs this greenhouse gas it is paramount that they get cut down to make room for new plants.

Timber is one of the best substitutes we have for fossil fuels so by incre-

asing the usage of timber we will both remove the biggest cause of the issues we are facing today as well as reducing the effect fossil fuels already has had. By exploiting this recourse we will tie up more carbon dioxide from the atmosphere than is released in the process (Department of Environmental Conservation, 2011).

It is important to find a balance – merely cutting down trees is not sustainable, it has the quite opposite effect (the overexploiting of the rainforest is a frightening example of this). We need to cut down the right trees, at the right places and at the right time and then make sure they are replaced so that the process could start all over. Trees only absorb carbon dioxide while they are growing – when they are old and dying they release it back into the atmosphere. Building with wood will lock up all that carbon the tree collected while growing for a long time (Department of Environmental Conservation, 2011).

Sweden has a goal of being carbon neutral by 2045 and using timber for construction is a big part of this. About 50% of a buildings environmental impact during a 50 years

lifespan herits from the construction and material choice. (Trästad Sverige, 2017)

The Consortium for Research on Renewable Industrial Materials (CORRIM) has done several comparisons between traditional building materials such as steel and concrete with wood and in every case wood turn out as the more sustainable option. Wood outperform steal in all measures; lower greenhouse gas emissions, energy use, air and water emission (Lippke).

“Using steel and concrete result in more greenhouse gas emissions, more energy consumption, and greater water quality degradation than using wood.” Bruce Lippke, Ph.D

Basically, the making of wood has a positive impact on the environment while steel and concrete has a negative impact. Steel and concrete are fossil-fuel intensive materials but they also derives from non-replaceable resources, wood on the other hand is renewable and absorbs CO2 (Lippke, 2014).

Forests that are managed in the right way will not only bind carbon dioxide they will also provide a place for recreation and make our landscape more beautiful. Swedish forestry is organised so that some plants are always left for the sake of biodiversity. It is beneficial for a forest to be biodiverse, it will help it stay more healthy – the forest industry gain from managing forests sustainably. For example; by saving a few tree stumps when cutting down a part of a forest birds will come to stay in them – birds who in their turn eat insects that otherwise would harm the new trees.

Building with wood is part of the solution to reach the UN Sustainable development goals. Apart from being a sustainable product wood is also a democratic material. It is a local resource for most civilisations and you don't need extensive tooling to turn it in to a building material. It is cheap and light. It can be reused many times over – finally as a energy source. All waste can be used to generate clean energy in biomass or cogeneration facilities.

Apart from being a very energy efficient material to produce, woodlands has a proven positive impact socially. Most people find trees beautiful and forest are being used as recreational areas all over the planet.

The building industry has two factors to address that are currently working against a sustainable future; the energy use and the greenhouse gas emissions. I don't believe timber to be the only solution to these problems but I think it's definitely one of them. When it comes to mitigate climate change the building industry has a major role to play.

The material choice has a big effect on a building's climate impact. It is during the operation stage of a buildings life cycle it has the most impact but using wood for the structural frames will result in lower primary energy and greenhouse gas emission. Wood-based building materials require less energy when manufactured compared to non-wood alternatives (Dodoo, A., Gustavsson, L., & Sathre, R. 2016).

The fact that timber store carbon during its lifetime, carbon that otherwise would speed up the greenhouse effect, gives it a unique advantage in addressing climate change and it also makes for a great argument when it comes to select building material.

Biomass residues that are produced during the manufacture and end-of-life wood products can replace fossil fuels. So if we are to reduce the use of fossil fuels wood-based buildings combined with sustainable forestry is a very good solution (Dodoo, A., Gustavsson, L., & Sathre, R. 2016).

Apart from being healthy for the planet, living in a building made out of timber can also improve the health of the inhabitants since it doesn't admit any harmful particles (Rudensam, S. 2017)

TIMBER TRADITIONS

Rural Architecture

Ragnar Östberg questions whether the farmers way of building really is architecture or not in the magazine *Teknisk Tidskrift*, 1893. Had he read Eilert Sundts reports from 1860's he might have seen the barns and cottages he visited on the Swedish countryside in a different light. According to Sundts there is a clear, reoccurring pattern of organised aesthetics rules and customs. There is no doubt that these buildings have been developed through

intricate social, economical and cultural processes, still they are intertwined with ecological environments. (Werne, 1997) I'm choosing to see Öseberg's reaction to these buildings as a testament to how well they blend with nature.

Eilert Sundt found the rural building typology 1862. Every time a new building was due the farmers followed a certain system of rules, not documented but collectively

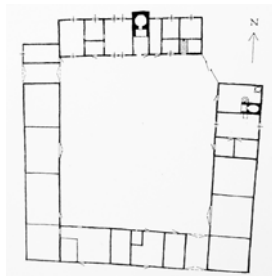


stored information on how to build. The irregularity of the buildings one might experience today hides a reoccurring, organised and coherent pattern, sustained by shared aesthetical and ethical principles. These building principles depended on local assets; the distance to different building materials and livelihood. (Werne, 1993)

Fumiohiki Maki coined the concept; investigations in collective form 1964 (Qiu, 2013). A collective form is developed continuously under a long period of and thus differ from the conscious composed or designed forms. It is open and dynamic, new parts can be added others remo-

ved or changed without dissolving the whole/the pattern. This could be discussed in relation to Leon Battista Albertis *venustas*, which is a methodical achieved harmony between all the parts of a whole, where nothing can be added, removed or changed without making it worse. (Tavernor, 2009)

The collective form is a trademark of the farmers community, developed in egalitarian villages thus generating social and spatial inseparable phenomena. (Werne, 1993) It is the collective form of these types of buildings in Sweden that have been investigated in this thesis.



Top: Farm in Northern Sweden
Middle: A farm from the middle parts of Sweden.
Bottom: Southern farm in Sweden.

The use of timber

Timber is the term used for sawn wood. Since wood is a material obtained from trees, a resource constantly renewed by natural methods every 60-120 years, building with timber is very sustainable.

Two woods dominate the forest industry in northern Europe – pine (also known as European redwood) and spruce (European whitewood). Pine and spruce will become about 20-25 m tall, 300-600 mm in diameter. This result is a timber selection that rarely exceeds a section size of 75x275, most are much smaller.

Sweden is a country covered with forests, there are only small areas without access to wood. The forests

are still an integrated part of the farms, for the farmers of the past it was the natural choice to use timber when erecting a new building. Before most woodlands were privatised there were common woods where anybody could harvest timber to build their home out of.

By traditions the farmer was also a carpenter with generations of knowledge at hand, handed down from father to son.

For centuries wood was the only material capable of spanning large distances, it has been the most important building material throughout history in Europe.



The evolution of wooden architecture spans from the ingenious simple prehistoric buildings to the highly developed handicraft timber buildings of the medieval times and to the highly technical wood industry of the present.

Early barns consisted only of a large thatched roof, carried by forked uprights driven into the ground in one or two rows with ridges resting in the forks. It was a clear distinction between what was carried and what was carrying. Walls were only a shell, they did not support the roof. These primitive buildings developed into post and head houses.

Well wooded areas such as Sweden developed the corner timber technique. A part from the Scandinavian countries this technique can be found in Southern Germany, Switzerland but also in the northern part of Asia stretching all the way to Japan. This thousand year old technique was commonly used in Sweden until the 19th century. It demands a rich availability of timber but the only tool needed is an axe. The development of new tools and the history of wooden buildings go hand in hand.

For hundreds of years the only tool

used for building was basically the axe. The axe evolved and got many forms over time, there was an axe for each part of the process – from harvesting timber to stacking it into a building. Eventually the saw was invented which led to a greater variation of buildings.

The time and resources put into old timber building are hard to mimic and nor should we, with today's technologies we can build both faster and better but that doesn't mean there is nothing to be learnt from traditional ways of building. There are many clever design tricks used that a modern villa could benefit from.

Timber was the most important building material in Sweden far into the 20th century. Almost all buildings, both in cities and on the countryside were made fully or partially out of wood prior to mid 19th century. (Werne, 1993 s. 89,91)

In a country where the climate can be very cold and damp for the largest part of the year, timber was the best choice for a comfortable interior climate. When Carl von Linné made his famous journeys throughout Sweden in the sixteenth century he wrote about how



humid and moist the stone and clay houses in Skåne were and that things placed on the ground would be covered in mould overnight. (Werne, 1993 s 91)

Kline, natural stone, brick and mortar were used instead of timber in parts of Sweden where wood had become scarce due to over exploitation of the resource.

The Swedish government acknowledge the diminished forested and timber being the number one export product they started campaigns to make the population start building with stone. Anyone who made their house out of stone

would be relieved from taxes for a period of 20 years. There was a strong resistance amongst the population and the campaigns were only successful on Gotland where timber was hard to obtain.

The influence from southern Europe is what made the upper class start desire stone buildings, resulting in timber buildings being transformed to look like they were made out of wood. Eventually, with help from new technology regarding heating, stone buildings gained higher status than timber buildings and this is the short story to how timber was outmanoeuvred as the prime building material in Sweden.



Barns are a well known building typology that most swedes have a connection to, even if it is just a romanticised image of red dots in the landscape outside a car window. Majestically some rise over the crop on the field while some crumble, overgrown by trees after decades of neglect.

Agricultural buildings, or barns, the more commonly used term (though not as including), have lost their status but historically they are the reason society is where it's at. The old barns left today are a remnant of building techniques developed by people whose daily life depended on the natural environment.

Their buildings were developed in close relation to nature, to the local context and the materials available.

It is not barns in particular that are the inspiration for this thesis, it is the building technique and values behind. Domestic homes were built much in the same ways, since few remain (and those that do are hidden under several layers of time) barns have stayed more true to the original idea. I think this type of wooden structures are beautiful, crumbling or not, and I believe there is a lot to be learnt from them especially since timber as a building material is growing more popular by the minute.

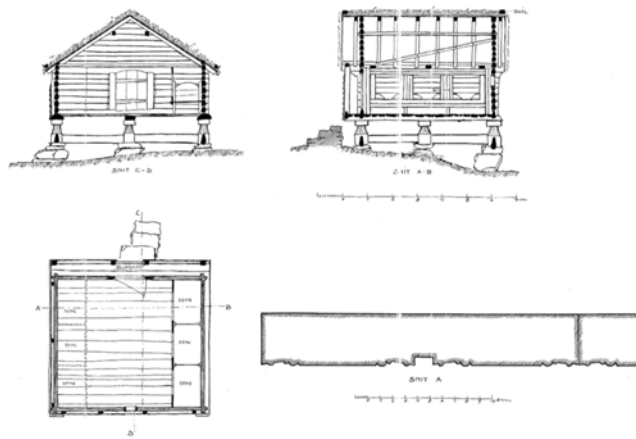
Agricultural buildings

Older agricultural buildings blend very well with the landscape. In some cases, it is almost as though the buildings seem to be sprung from the ground. The traditional shape of a barn, long and narrow, allows for a lot of natural light and makes nature more present.

The height of the ceiling and the dim light that filters through the boards can give the interior an almost sacral atmosphere. The lack of windows in most areas and large openings in others create a dramatic environment.

Wooden barns have some really admirable qualities. They inhabit a flexibility that few other constructions can compete with, this is probably why they are such a wide spread typology and have lasted for so many centuries. If the user would need more space it is a fairly simple deal to add an extension to the structure and just continue the roofline. Timber constructions are easy to add on – or remove, no advanced tools or knowledge are needed.

In order to be sustainable, the

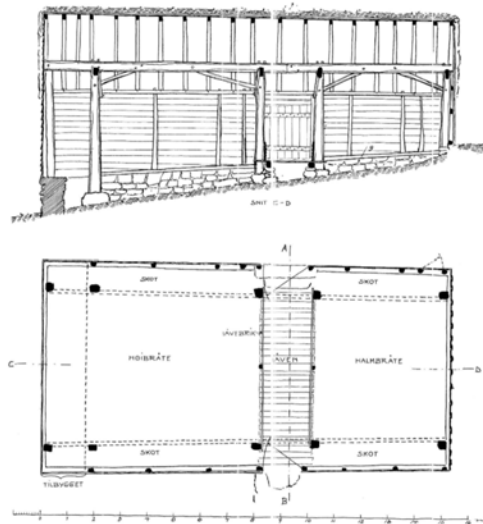


buildings we make today must last much longer than what we've grown used to the past century and since there are so many factors we can't foresee it is important to give new buildings a certain degree of adaptability.

The home is like a living organism, say architect Eugene Tsui and I agree. It should respond to changing spatial and functional needs, as any other organism in nature. Everything has to adapt to survive. Buildings that can't adapt get demolished – they go extinct, just like animals and plants that can't adapt to the

current environment.

The majority of the world's population live in dense urban environment with little or no contact with nature, still it was not long ago since the situation was the reversed. The architecture in the periphery of the cities is so much more than just the cliché "red cabin with white rims" it has been reduced to. There is a logic and organisation behind the buildings they never teach in architecture school. The barns and cottages you pass by when traveling on the countryside are not randomly paced there, they all have a story



and a purpose – just because it has been forgotten it doesn't mean it is not important to acknowledge its worth.

The buildings of the farmers society have been developed in harmony with nature for hundreds of years, nature was central in the everyday life. Traditional rural architecture is now closer to nature and landscape than it is to the architecture of

the cities, I think.

The intention of this thesis is to lift details as well as overall values from wooden buildings from the 19th century a prior. The goal has been to designed with new technology, build with new techniques but based it all on old knowledge.

Organisation and orientation of Stugan

The inner regions of the stuga was for the family. Along the wall across the exit was a bench called åltred (altar). A cronostårng marked the separation of the private and public areas. Here clothes could be hanged to dry and when crossed one entered under the lights of the lJOR in the ceiling. The lJOR was originally the only source of light in a stuga, it also worked as smoke exit. Sätet, the seat, was a long bench that stretched along one side of the cabin, here some of the dwellers slept at night. This was basically the look of a stuga up until the "modernisation" of the eighteen century.

The sun ruled the way of life on the farm, it way the only way to tell the time. Carl von Linne describes how the inhabitants of the cabin knew what time of the day it way by looking at where the sun from the lJOR landed in the room. When windows for the wall came they were placed on the southern façade, just like the lJOR had been placed on the

southern part of the roof. Windows in the wall made it possible to build a loft, or even a second floor since the skylight was not the only source of light in the room. Stugorna (the cabins) went from bjälkarstugor and ryggåsstugor to stugor with loft. Eventually this development lead to a second floor (Werne, 1993).

Stugor were built with the main side facing south. The east-west direction was not a rule as much as the dominant preference. The orientation of the main building of the farm was often "solrätt" (towards the sun) but the terrain was the deciding factor.

Most homes in Dalsland were build on higher ground on account that it gave the buildings a hierarchy but also because was dryer and they had poor foundations. (von Schoultz, 1951) Werne also confirms the east-western orientation with the slopes of the pitched roof facing north and south. (1993)

BUILDING TYPOLOGIES

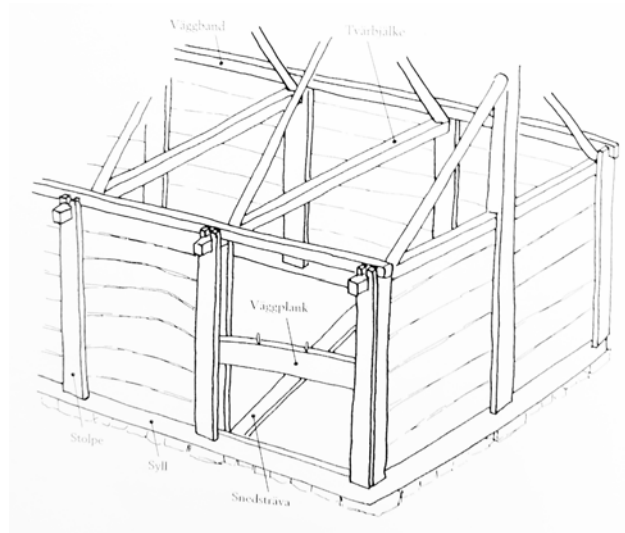
Framework with horizontal planking (post and plank)

It was in the deciduous woodlands of southern Sweden this technique was developed and it was most common in barns and stables. The reason behind the development of this technique was that it allowed for trees that were twisted and the irregular timber of hardwood to be used.

Oak was the most frequently used type of tree for these kinds of structures. The logs could be short, broad and with large branches and still suit this type of build. The roof construction consists of a tie-beam, interior

purlins and rafters. The walls consist traditionally of horizontal planks or split logs fitted into grooves in vertical standing poles that are resting on sleepers, placed on stone pillars. A frame of beams tie the structure together. The boards could be doweled together to make the structure more stiff and diagonal elements could be added.

The technique was introduced in a book in the early 19th century, it was encouraged to build this way since it saved timber and the forests in Sweden were



diminishing at the time. It became highly popular and most agricultural buildings were built this way (Svenska hus, red. Hall, Dunér 1995).

Barns made with the horizontal planking technique had a ridge purlin supported on naturally

forked post which shows similarities to the primitive buildings mentioned earlier. The Swedish name for these supporting posts is mesula, which in turn have given name another name to the typology; mesulor. (Doyle, 1988)

Half-timbering

The construction methods of framework with horizontal planking and half-timbering are constructively the same in the sense that the walls separate loadbearing parts from non load-bearing parts.

Half-timbering was developed in poorly wooded areas. It is a flexible and timber saving method; the timber framework, with primary and secondary members, is filled up with readily available materials such as wattle and daub, clay or sun dried bricks and covered with chalk. There

is a wide range of construction work spanning from very plain carpentry to master pieces of timber construction and ornamentation.

The graphically strong buildings expressed the wealth and traditions of their region. From all the reading I've done about traditional timber building women were only mentioned once; they filled the timber framework with wattle and clay and plastered the walls of half-timbered buildings in southern Sweden. (Dolby, 1988)

Stave-building

The technique of stave building was developed in Scandinavia, it is well known from the Norwegian Stave churches. Churches are the structures best preserved but the technique was also used for rural buildings in the middle ages.

The walls consist of vertical timber planking of large dimension. The walls are carrying the loads. In its most primitive form the planks were buried in the ground but in more developed from the

planks were placed on a ground sill and stabilized with a top plate. The stave churches vary a bit since they have interior poles of great dimensions standing on a ground sill quadratically arranged.

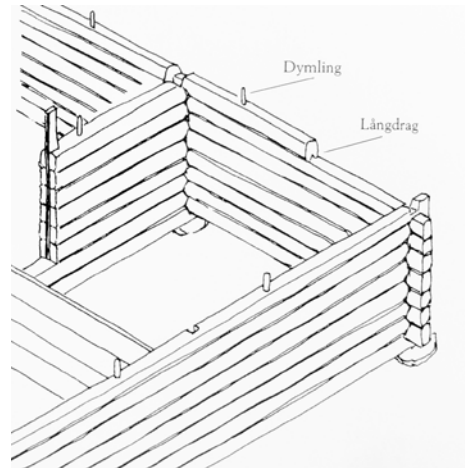
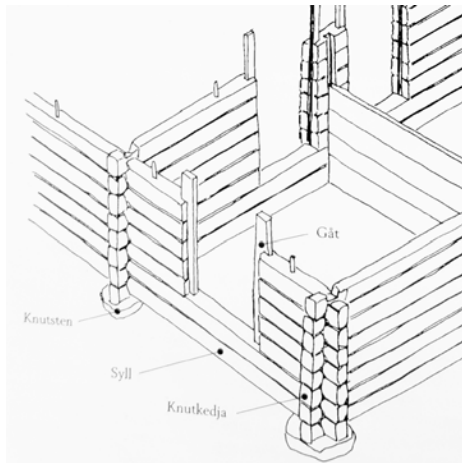
Corner timber technique

The corners are the most interesting aspect of this technique. The weight of the massive logs use makes the structure tighter with time so it was suitable for dwelling houses and store houses. The system is flexible, and it is possible to take a log building into pieces and rebuild it.

One log is put to another, locked with a clever cut in the corners and without any fixed joints. The log house represent unity between form and structure. The basic forms of these timber

buildings are the open hearth hall – a simple square of a house where the light entered through the same opening in the ridge as the smoke exited. The old Swedish word for this is ljon (see the section on Stugan).

The post larder was mainly built as a store house where a similar square log structure was elevated on posts. The elevated position of the structure was to provide ventilation and protection from vermin.



In the homes of the people, allmogehusen, the knots of the timber was originally constructed with a "scull" that became a vital part in locking the structure.

In more refined buildings, like the churches the knots lacked the scull, here another kind of knot was used – the salmon knot. The salmon knot later on became the most frequently used one, for both domestic home and barns, since it was easier to clad these types of structures to protect the timber from the weather.

The end grain is the most sensitive part of timber and therefore there are many buildings with just vertical standing planks covering the corners.

Within these two techniques hundreds of different variations evolved – every village had their own version for each time in history. (Sjömar, Byggnadsteknik och timmermanskonst, 1988)

LAGA SKIFTE

In the mid-19th century Swedish countryside went through a massive change that meant a new way of living as well as building. Prior to this people had lived in small villages, surrounded by the land they helped each other to farm it. Now, thanks to new academic ideas of efficiency and new technology these villages were ripped apart.

Old buildings were moved far from each other to form new, much smaller farms. The community of the villages were forever lost.

The sprawl of the 19-th century countryside did not just rearrange the people's sense of community but also the buildings. When people weren't depending on one and other to survive they started to compete resulting in larger, more decorated buildings. Larger barns were a big part of making farming more efficient. This event is known as the agricultural revolution. (Ulrich Lange, Tradition i trä, en resa genom Sverige, byggförlaget, Stockholm, s.181)

Before this change all resources nature could offer had been used, after the revolution farmers no longer worked in the woods, fields that de-

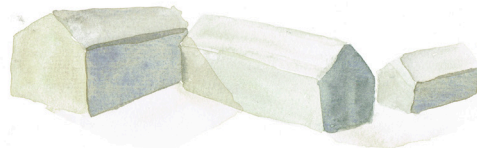
manded much energy and labour as well as paddocks were abandoned as the farming was concentrated to the fertile fields. It was now possible to get yearly crops from these fields thanks to new ways of treating the land, fertilising was one innovation. (Lange)

Larger crops meant that large buildings to store it was needed. The architecture of the countryside went through a massive change at this point. The knowledge of the timbermen was overlooked – if it didn't derive from a propped education, knowledge didn't count as much.

A long trial and error process of experimental building with new solutions followed, new technology and materials made way for more practical and efficient structures.

There was a search for more lasting materials than timber. Alfred Nobel's invention of dynamite made stone an easy accessible building material. The barns of this age are the ones children would draw today if asked to draw a barn; large rectangular volumes, sometimes in the shape of an L, with falu-red painted plank walls. (Werne)

The architectural values of the farmers community



There was a difference between the city dwellers and farmers, John Berger discusses this in his book *Pig Earth*. Farmers does not play roles in the same way, the distance between what you don't know of somebody and what everybody know is too small for that. In the same way the gap between what everybody knows about a building and the aesthetic show you could put on is too small, hence the farmers building had a very honest expression. There was no need to pretend a building was something else than what everybody knew it to be. Instead there was a preference among timbermen to enhance

their solutions to different technical solutions. All critical parts were articulated, for example corners and doorposts. In some areas and time these parts were decorated with carvings. This is something that can be found in most tradition-bound societies buildings. It is left as an architectural syntax in the Greek antique culture for example. In the roman culture the constructive elements are hidden behind something that is just portraying constructive elements. One might argue that the architectural design is an analogue reflection of the social relations of the community creating it.

HUMAN NATURE

Nature vs City

Today more people than ever live in cities, and since evolution is a very slow process, compared to how fast humans have changed their lifestyle our minds basically still work in the same way as they did when we lived in caves. We are not yet adapted to our current urban environments. Anxiety, stress and depression are symptoms to this. One thing that is a proven cure is nature. This chapter contains the motive behind my thesis project, it explains the benefits of a domestic domain in close connection to the natural environment.

Urbanization and lifestyle changes have diminished possibilities for contact with nature in many societies and this has motivated research on the health benefits of contact with nature. According to biologist Edward Wilson, humans have an innate tendency to seek connections with the natural environment; with nature (Biophilia, 1984).

There are several publications and studies showing that being in close contact with nature promotes psychological restoration (Kaplan & Kaplan, 1989), healthier mood (Barton & Pretty, 2010; Roe & Aspinall,



2011), improved attention (Hartig et al., 2003) and reduces stress and anxiety (Grahn & Stigsdotter, 2003).

There are several scientists who are currently looking into how architecture and well-being are connected. Environmental psychologist Roger Ulrich, Professor of Architecture at the Center for Healthcare Building Research, is a frequently cited researcher internationally when it comes to evidence-based design and he also writes that nature reduces stress and anxiety (Ulrich et al., 1991). In a now classic study performed by Ulrich, of patients who

underwent gallbladder surgery; half had a view of trees and half had a view of a wall, the patients with the view of trees seemed to tolerate pain better and spent less time at the hospital. How a space relates to nature can change not only mood and endocrine levels but also affect how the immune system is working. (Hartig, 2014)

Architectural Psychology

Maslow's pyramid of human needs pinpoint what it is that we humans require. Security is a basic need, but we also need a place for intimacy and sex. It is important that we can express ourselves, consequently all homes need biographical texture. Since the psychology of the home extends beyond its four walls location is very important, what we see when we look out a window affect us greatly. A home has to meet our basic needs for refuge, intimacy and expression of identity.

From early age we build dens. There is a need for cave-life refuge

imbedded in our DNA, still we like to have a view of our surrounding, preferably a natural environment says Ulrich. We prefer landscapes with a hint of mystery, environments that spark our curiosity. Ulrich says satisfaction is higher if some of the scene falls away and is hidden, so that we can anticipate a new landscape immediately beyond the limits of what we can see, waiting to be discovered. This is also true for interiors, spaces that are not completely revealed to us at first glance, rooms that extend beyond our field of vision. We like a trail of exploration to satisfy our need for

mystery and discovery. (Keedwell, 2017). Niches and nooks invite novel use and satisfy curiosity, I think it is because they remind us of those dens we used to play in.

But since nothing is more satisfying than having our anticipation confirmed by reality there need to be a form of rationality behind every structure. (Keedwell) Complexity is intriguing but only if there is some form of order and completeness behind it, if we can't make sense of our surrounding they can be cause for stress. The reason for this preference is of course and evolutionary one; environments that are to wild and crazy are unsettling feel overwhelming since we can't predict the threats it imposes. Instinctively we have a need for a clear exit.

Prof van Berg tells us that our instinctive attraction to nature is expressed in how effortlessly our attention is held by natural scenes (Rachel Kaplan calls this soft fascination) when nature capture people's attention pessimistic thoughts are blocked,

and negative emotions are replaced by positive ones. Spending longer time in natural landscapes gives us space to contemplate bigger life questions, make sense of who we are and what direction out life should take next. Not true for all landscapes, desert that from an evolutionary point are less favourable to wellbeing and survival, felt more stressful and depleting. Deserts reduces feelings of vitality (which affected ability to change negative habits and addictions like smoking). Viewing a desert is still better for feelings of vitality than viewing an urban scene, devoid of any nature. A scene with water increased motivation for change and increased subjective vitality. Study by Idit Shalev Ben-Gurion University in Israel researchers in Sweden has shown that daily exposure to nature improves mental health and attention in response to personal crisis. Nature build up our immunity to the impact of a stressful life event.

Natural light has a much more powerful effect on performance



than artificial light (no matter how carefully designed) access to natural daylight is thought to improve learning because it reinforces the natural sleep wake cycle (circadian rhythm) Circadian neuroscience Russell Foster Uni of oxford says natural light contains more blue light than artificial, ex. more than 500 times more than LED. The blue light photoreceptors in our retinas are tasked with regulating our daily rhythms and evolved separately from vision. Fluorescent lighting contain a certain pigment which uses blue light as a signal that the brain should suppress the sleep-inducing hormone melatonin and release

brain chemicals that make us more alert. Exposure to sunlight produce engaged happy and productive people. Warmer colours also has a positive effect on mood, they are associated with less depression and fatigue. LED lights are therefore better than fluorescent conditions, but no artificial lights are better than being exposed to natural light.

Architecture as a result of our nature or architecture that shapes us?

There are many factors in architecture we like or dislike for evolutionary reasons. What we prefer can of course differ a lot from individual to individual but on a general plan one can see distinct similarities in preference between children as a group, also women, men and elderly have clear preferences when viewed as a group.

These things can be explained through evolution, for most part, some differences between groups is cultural (but this is outside of the delimitations of this theses and not something that will be furthered

discussed). Most studies available have seen to a western population.

Alain de Botton tackles our relationship to buildings in his book *The Architecture of Happiness* (2006). Here he claims that we are different people in different places, thus suggesting architecture can shape who we are, or at least how we define us. Is it architecture's task to "render vivid to us who we might ideally be"?

Personalities and Plan

Nature has a positive effect on almost all people but there is a danger in thinking all humans have the same preferences. Like mentioned earlier other cultures is not a factor discussed here but personalities and gender will be briefly mentioned.

Several studies tell us most women are less drawn to high-rise and glass and like the feeling of refuge in a home, while men prefer open landscapes and favour open views.

Extroverts prefer open-plan living, introverts more privacy. If there is a mismatch between the space we

inhabit and our deep psychological needs it will cause stress and annoyance. (Keedwell, 2017).

Carl Matthews from the school of architecture at the University of Texas did a study about the correlation between Myers-Briggs defined personality types and design preference. Extroverts & introverts, Sensing (rational) & intuiting (free-thinking), thinking & feeling, judging & perceiving. (Keedwell)

Extroverts prefer a more direct access into rooms and less separation between public and private spaces.

They also like a higher void to solid ratio and lines of sight through the interior. Introverts on the other hand prefer indirect entry to the living area better (through a hallway or lobby). Boundaries between rooms as well as a lower void to solid ratio is their preferences (wants to overlook life rather than be exposed to it).

Sensing personalities desire concrete information, they have a preference for order, symmetry and grid-based layouts, both internal and external. People with an intuiting personality trait have a more romantic and explorative approach to living, favoured secret spaces which revealed themselves gradually.

Thinking personalities prefer rational symmetrical designs, grid-based layouts and exteriors. They avoid interior openness, colour warmth and transitional entrances. Empathic personalities like open layouts and direct entrance arrangements, soci-

al environments and warm colours. George Kelly reasoned that we all see the world through a unique lens. In this repertory grid technique experiments to see what the ideal home of the participants, no two people choose the same constructs nor exhibit the same emotional response to the same pictures. We all have unique aesthetic and architectural preferences, something that is important do consider when designing a home - it need to have some level of flexibility adaptability in order to please those how might live in it.

Home and identity

Oliver Marc writes in his book *Psychology of the house* (1977) "the most aesthetically pleasing and psychologically healthy home is one that emerges organically from the efforts of local people serving their own needs and using materials sourced from their own location.

People who self-build need the project to succeed not just for their own welfare but for strong emotional and social reasons. This leads to a greater sense of ownership of home and neighbourhood. New-build homes lack a sense of history, something that adds much to a

sense of place and of homeliness. Identity is about distinctiveness, a sense of place.

A home should be a secure place but it also has to provide consistency, remind us of our connections with our past and future in order to help us feel centred and whole. Expression of identity helps us remember who we are, a building can help reinforce who we are, it can be more than just practical on a physical level.

By allowing those who inhabit a structure to express their unique



personalities, passions, interests and journeys through life – to function as a physical manifestation of our personal biographies – it will help preserve identity.

Allowing owners to shape their homes as they see fit increasing the sense of ownership. Personality has a big part to play in shaping a home's identity. A unadorned home is revered by many but fails to resonate with and thereby reinforce a healthy sense of self. Domestic architecture needs to find a balance between art and function, most pe-

ople do not wish to live in a sculpture. Since a building need to have a long life to be sustainable it is good if it can be adapted to better fit the needs of a current used rather than being demolished.

CITY, COUNTRYSIDE AND CULTURE

Paul Keedwell writes in his book *Headspace* (2017) about what stressful places cities are today. Rates of anxiety and depression are proved to be higher in the cities than they are in the countryside.

Today's architectural debate in Sweden revolves around the city, Staden. When it comes to architect's involvement on the countryside it is mostly regarding exclusive retreats. The current economy has created a different landscape. Rationalisation, modernisation and specialisation have erased the building culture of past farmer communities. Just like they should

our communities are evolving, but like always we can look back to our past and learn from those who live before us.

The political populism is larger on the countryside, Dalsland (the location for this project) have been called the rustbelt of Sweden. A country need to be viewed upon as a whole if it is to stay healthy. The countryside is not just the area outside of the city, it is the backbone of the country. Architecture have the power to effect how we feel and even tell us about who we are, have been or should strive to become. Just like a country needs

to be viewed upon as a whole, it is important to put focus on rural Swedish architecture as well as that of the city.

City and countryside are inter-reliant regarding everything from food production to space for recreation. The general view is that people move to the cities from the countryside. The urban population is growing but this is mainly because of more people being born on in the cities. The countryside is not dying, no, it is growing. More and more people than ever are moving from the cities to smaller towns on the country. The abundance of the last decades

has suppressed the need within us to save, store and not waste.

This way of thinking was key on the country in the past and you can see that these values are now slowly re-entering our communities. We are realising that we need to live more sustainable. The drought in Sweden the summer of 2018 and its repercussions is a testament to how sensitive we still are to the whims of nature. It is easy to forget this when living in cities, on the countryside - despite all modernisation - it is much more obvious that nature still rule life.

Problems in Urban Environments

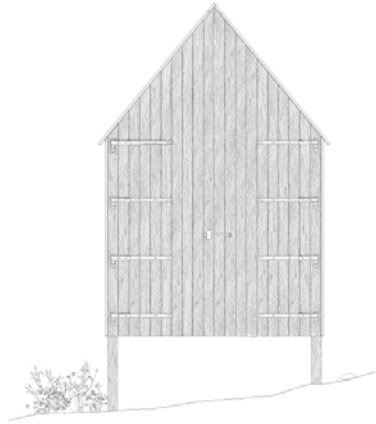
Cities are stressful environments for us because of the many factors beyond our control. Large cities suffer from bystander apathy. People are more willing to assist strangers in less crowded places because they are free of urban overload. Forced to share spaces, unwanted and frequent intrusion by strangers on our homeward journeys are stressful, and can lead to irritation, conflict and aggression. Strangers are therefore shrugged of as a protective mechanism (Keedwell, 2017).

Traffic, railways or industry noise can adversely affect our mental and physical health if it invades the buildings we inhabit. Learning in children is adversely affected by noise. Noise make the stages of sleep shallower, making your wake up feeling less refreshed, also there are evidence telling us that noise creates problems with sustaining attention, memory and compromise reading comprehension. The noise in the cities is a major public health issue says Neil Weinstein of Rutgers,

The state university of New Jersey.

Air pollution is just like noise commonplace in cities and it too can have cognitive effects. There are higher levels of anxiety and depression among people who live in areas associated with greater levels of air pollution. (Keedwell, 2017)

In the book *Last child in the woods* (2005) Richard Louv tell us that a nature-deficient childhood has strong connection to attention disorders like ADHD, obesity a dampening of creativity and even depression. The accessibility of vegetation buffer against the impact of life stressors for children in the same way as it does for adults, through providing a retreat. Even short visits to parks show reduces levels of the stress hormone cortisol in saliva of city dwellers (study in Finland, Helsinki). A study in Dundee Scotland showed that the greater amount of time exposed to green areas in a day the lower cortisol levels throughout the day. (Keedwell, 2017)



THE 72 HOUR CABIN

I think most of us are aware of that nature makes us feel better, just walking in a park can do the trick. I first came in contact with this kind of research 2017 when I designed, and helped build, a small cabin with the intent to make its inhabitant healthier. The relationship between architecture and the surrounding nature was key since the project was a collaboration with scientists at Karolinska Institute who were looking at how staying for 72 hours in nature will affect a highly stressed person. Two leading stress researchers, Walter Osika and Cecilia Stenfors, were part of the study. During the 72 hours of the test I witnessed how the subjects who stayed in the small buildings I had designed had their stress levels dropped by 70 percent.

The success of the experiment was visible in how the faces of the people who took part in the study had changed from arrival to departure. It made me reflect about what power architecture can have on our lives; the way we live greatly affect how we feel, what kind of persons we identify as and strive to be.

It is in light of the research mentioned above, and with the 72h cabin project in mind, that I decided to design a villa, far from the urban environment, that would be receptive to nature and allow its inhabitants to indulge in the benefits a life in close connection to nature comes with.

PROCESS

Method

The process to achieve my design outcome has not been based on empathic intuition alone, scientific studies and research by those more accomplished on the matter have been a big part of it. Designing is a creative process and despite all research, empathy is needed to interpret facts in order to translate it into physical spaces.

The structure this study resulted in is the sum of my personal interpretation of what we need from a home, not a universal answer.

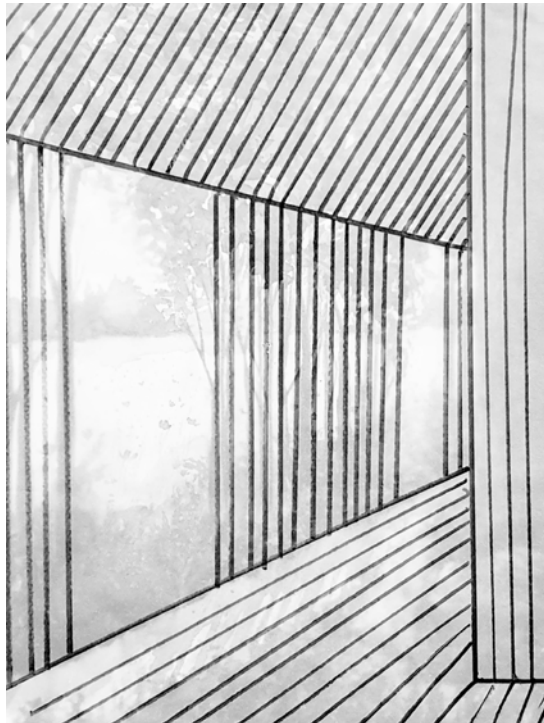
Making models and sketches have been my way of thinking and processing knowledge required from various sources of literature and scientific studies. I have also made my own research of spaces in nature through drawings and diagrams.

My method have been quite eclectic, it is not truly evidence-based design, nor is it, solely, designed based research. It is a combination of the two, I have chosen a parallel process in order to inform my design decisions.



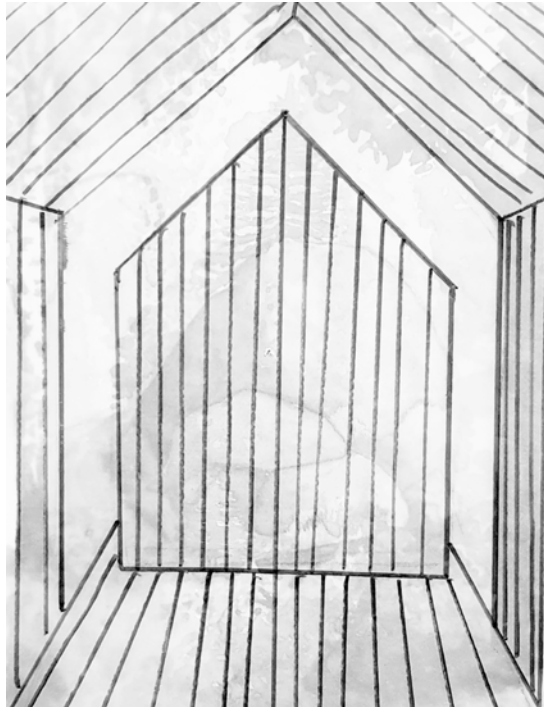
In order to start my design process, I visited parts of the woods surrounding both plots to find spaces in nature I could translate and use in my design. A water stream ran like a hallway through the woods, transporting the eye of the viewer to new elements.





The vail of trees sepatating the trail from the field was directly translated into the ribbs of the veranda.



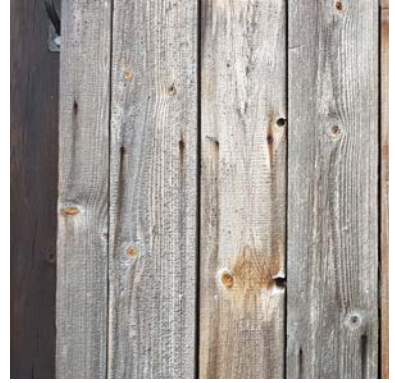


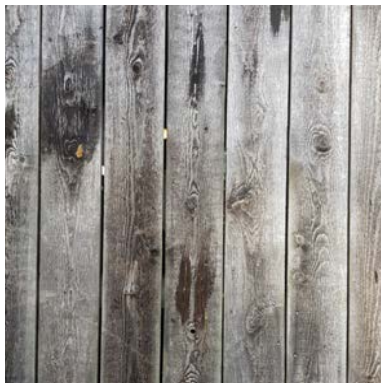
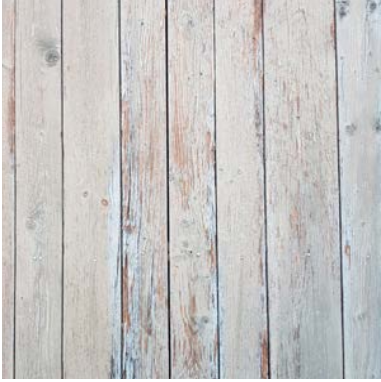
Everywhere in nature are elements that force us to make a choice - right or left? There is almost always an option and this gives you a sense of freedom. The first floor of my design is inspired by this.

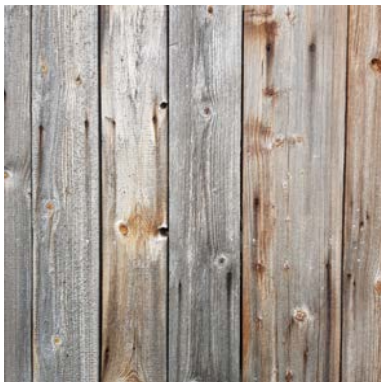
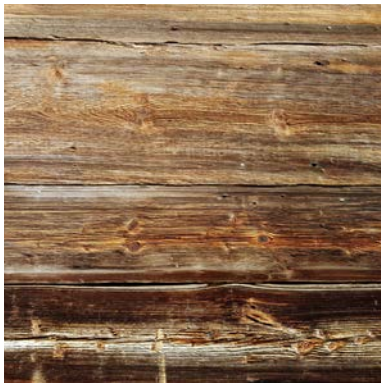


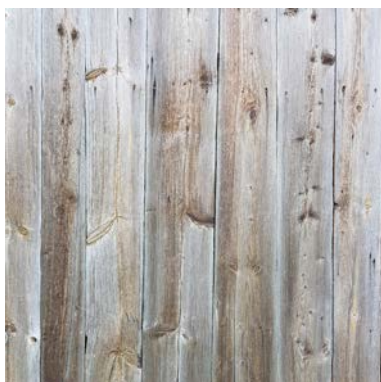
Facades

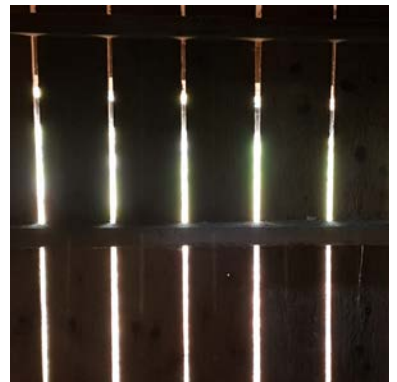
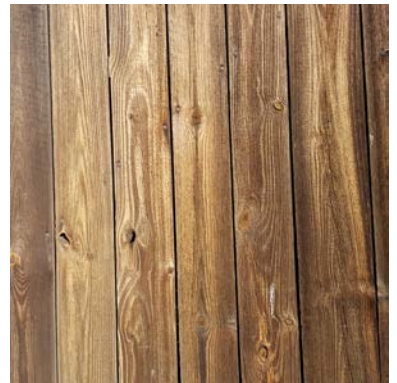
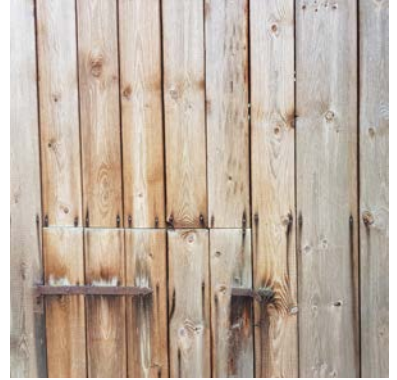
Visiting nature have been important to the process but also study visits to the kinds of rural, timber buildings I've read so much about. Touching the materials and seeing how the timber has been used was important for finding the right expression of the building I was creating.

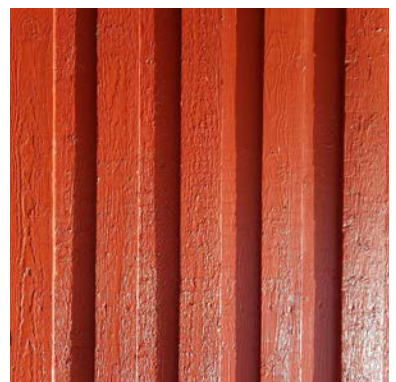
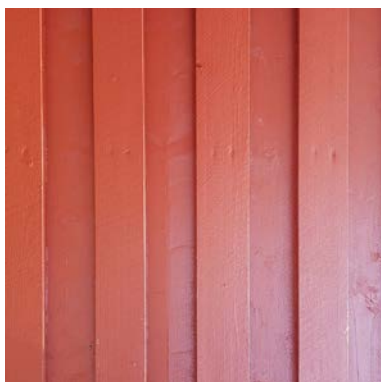
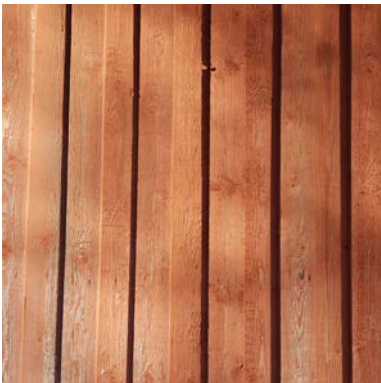






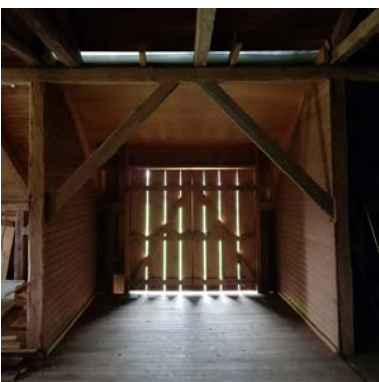
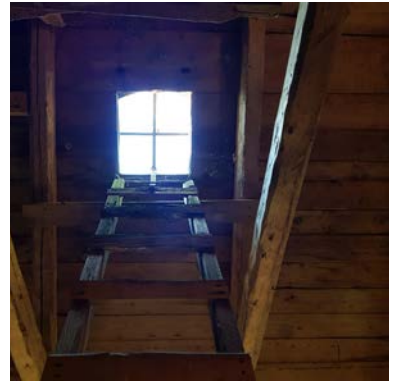


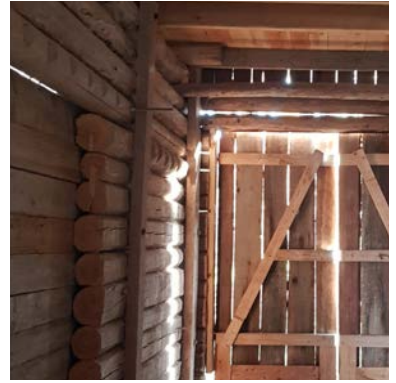




Interiors

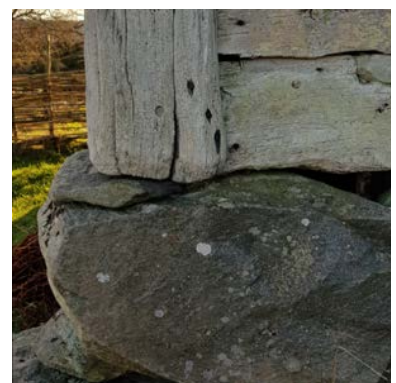


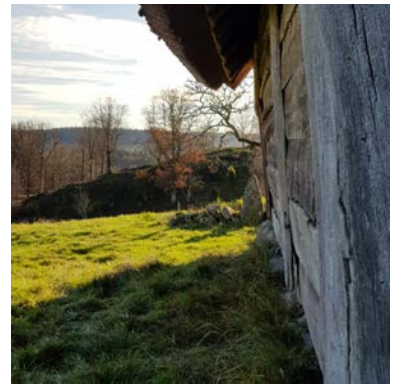




Exteriors











Vallmokullen

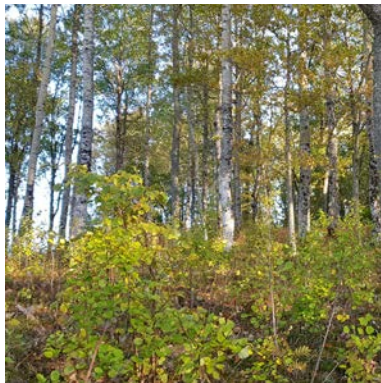
photos of the site



Left: Vallmokullen seen from north east at sunrise in August
Right: Same view as the previous image but in October



Over: View to the south from the site in late August.
Under: Same view as the previous image but in
October



Gröntuva

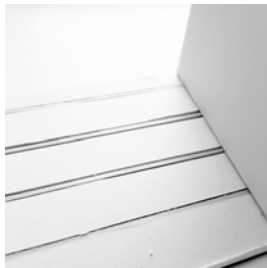
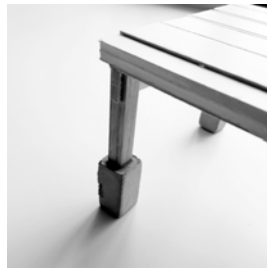
photos of the site



Left: Western hill.
Right: Eastern hill.



Models and sketches



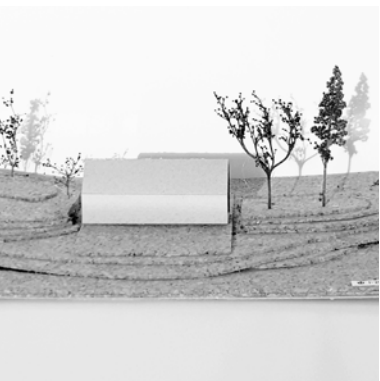
Details from
model 1:20

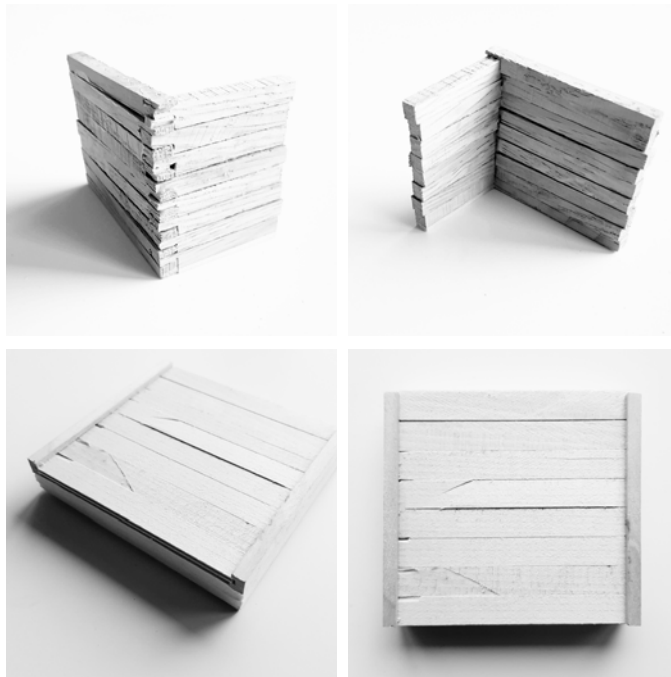


Modular thinking



Making models and studying internal spaces as well as how the volume is experienced in a landscape model have been a big part of the design process.





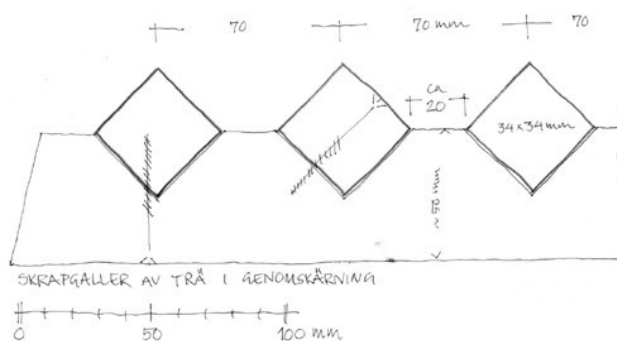
Detail models of exterior
and interior walls



MODEL
Scale 1:50



There have been an ambition to use wooden solutions as much as possible. This is a part most commonly made out of metal or rubber but here the solution to the problem of dirty shoes is integrated with the floor boards outside the front door simply by using timber with a different dimension.

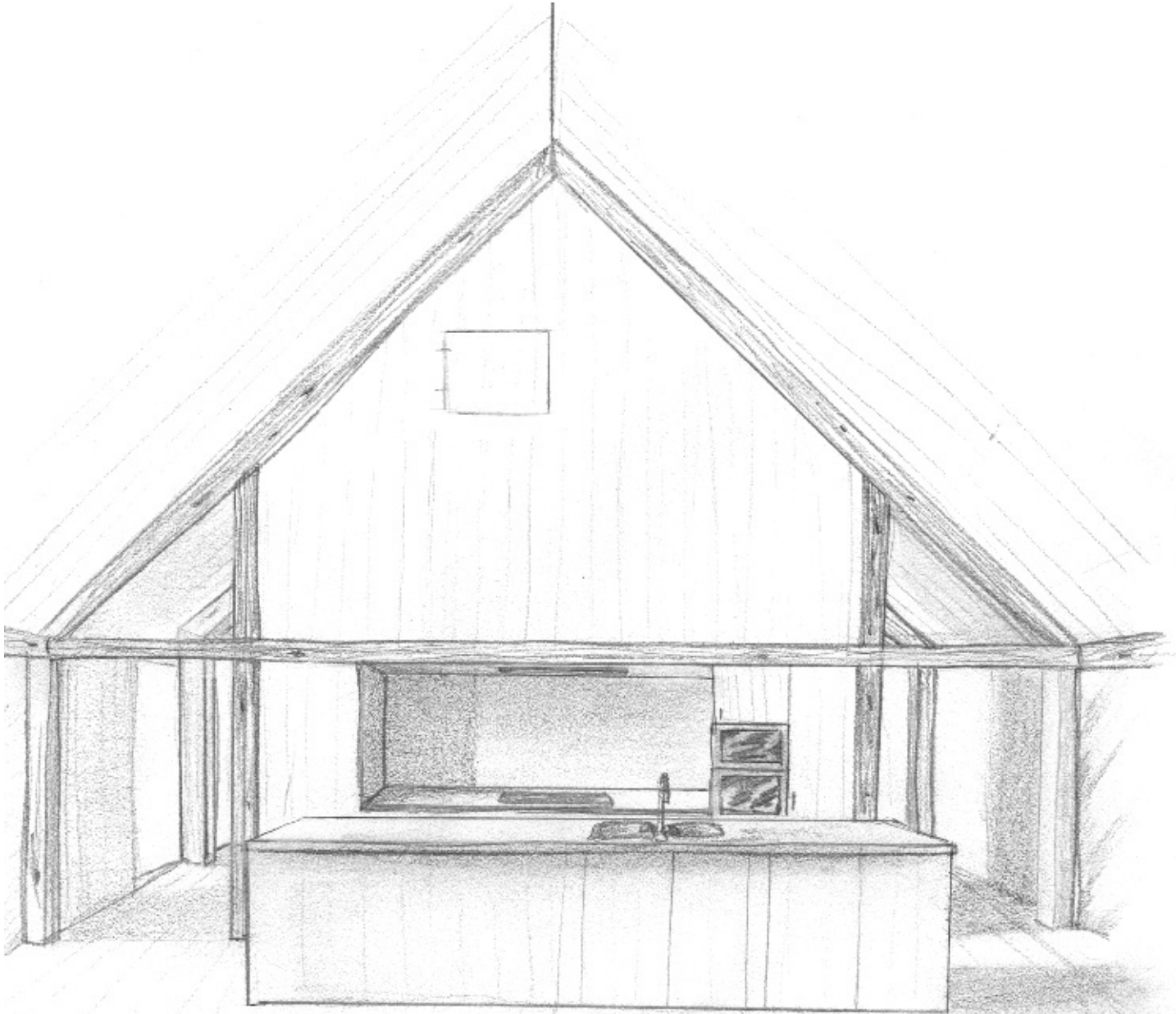




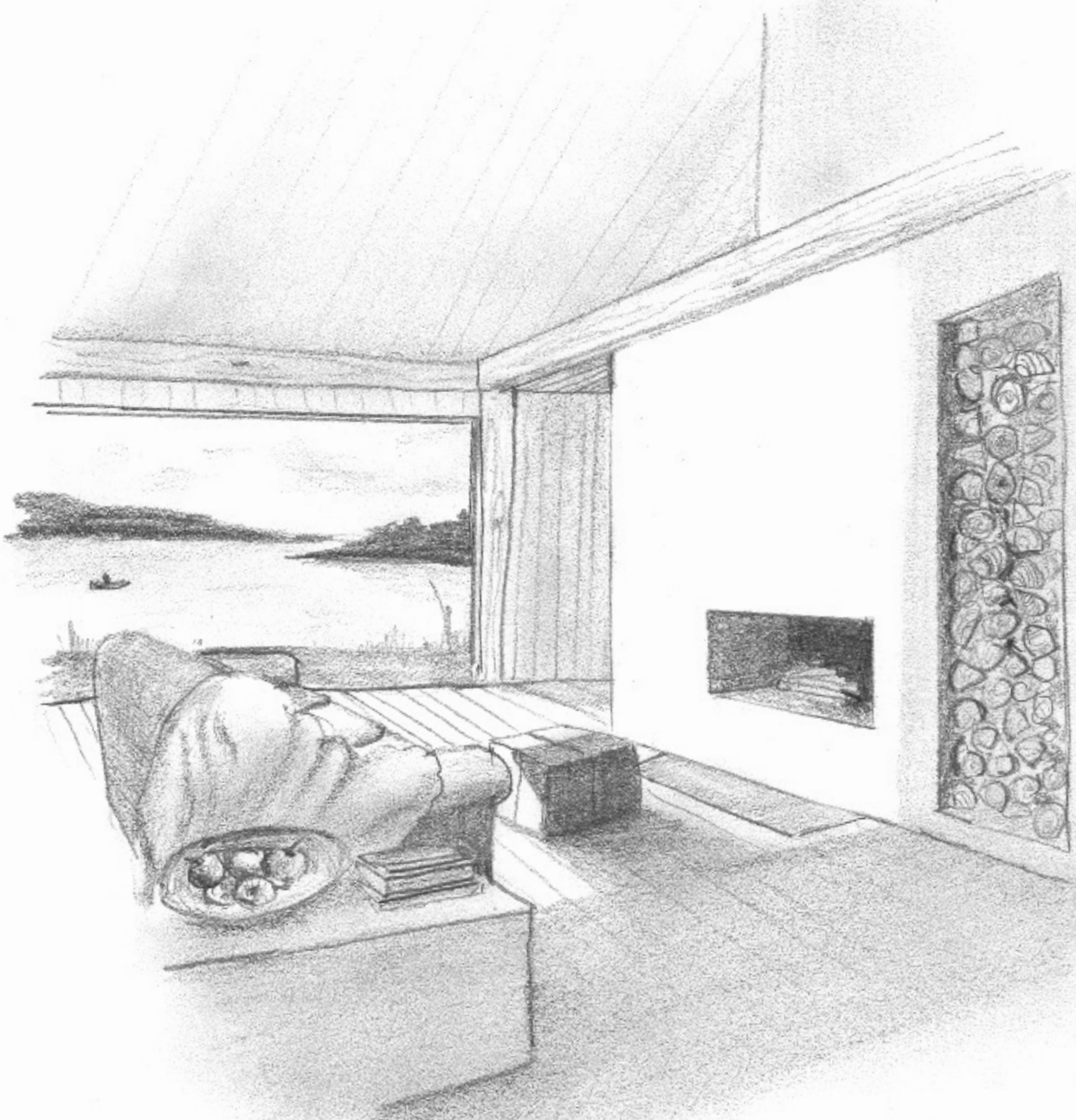
Proportion study for modules

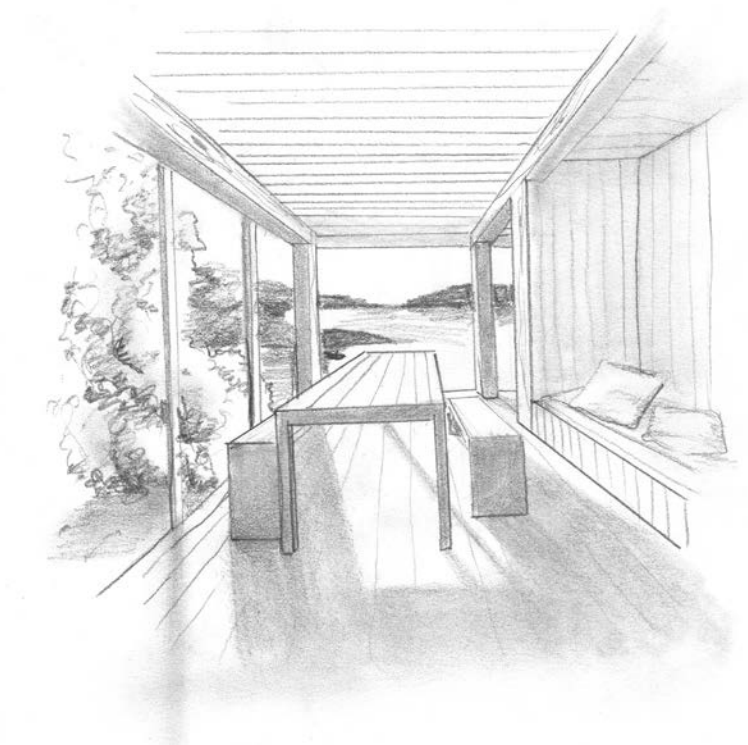
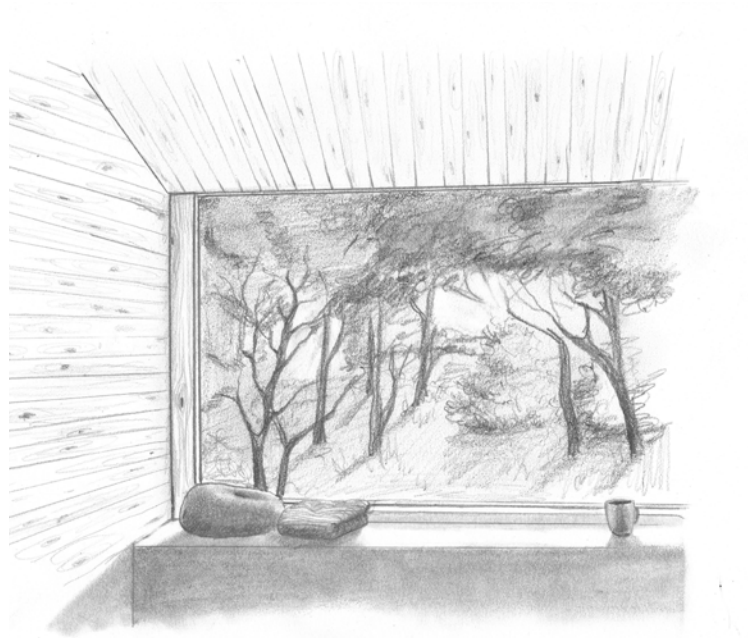


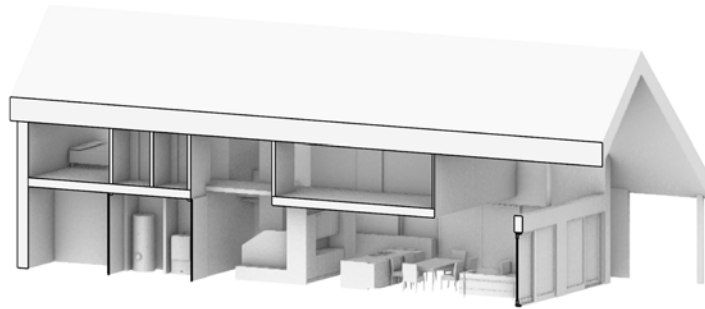
This was an early idea for the wall construction, made out of CLT. In the final version the CLT was replaced by Iso-timber.



By studying the interior spaces of physical models of varying scales I imagined different types of rooms.



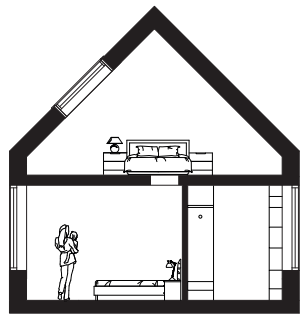




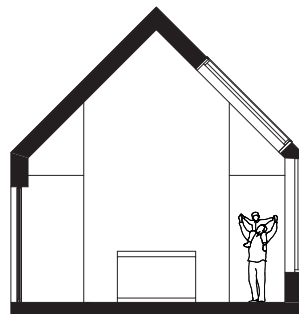
Almost all versions and aspects of the structure have been modeled digitally as a tool for understanding the spaces created better.

MIDCRIT VERSION

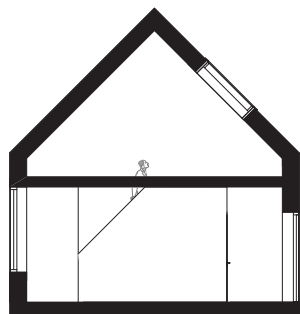
(modular based version)



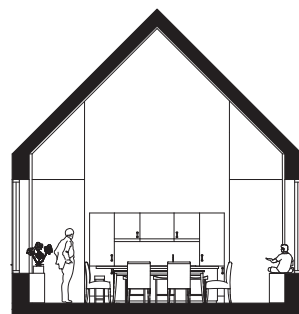
BEDROOM
⊕ 1:50



LIVING ROOM
⊕ 1:50

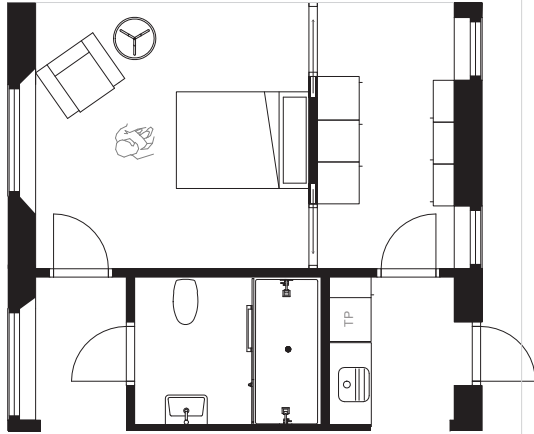


HALLWAY
⊕ 1:50

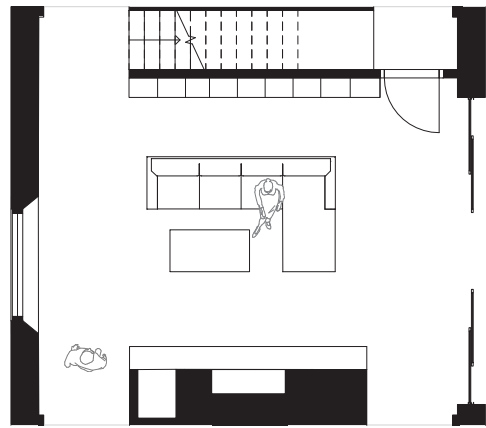


KITCHEN
⊕ 1:50

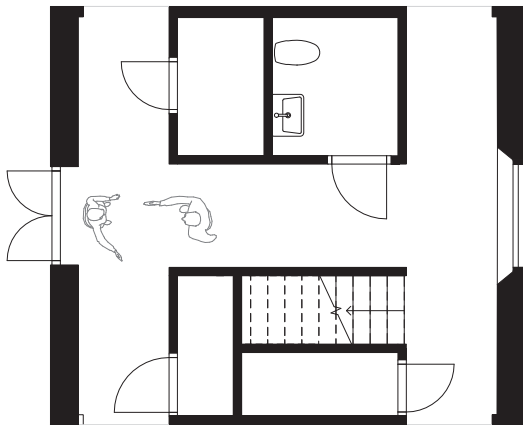
Given scale not accurate
due to layout



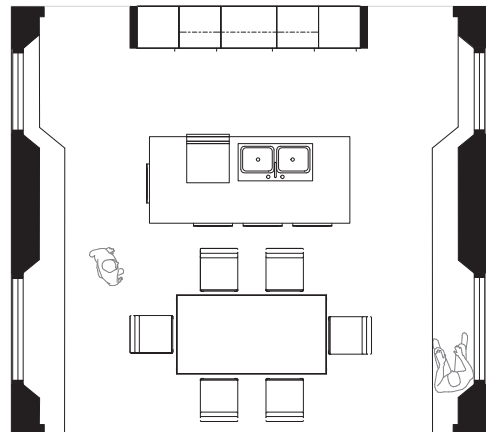
BEDROOM
⊕ 1:50



LIVING ROOM
⊕ 1:50



HALLWAY
⊕ 1:50



KITCHEN
⊕ 1:50

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