TO ACHIEVE WITH THE LEAST POSSIBLE MEANS A HOME OF ONE'S OWN

DESIGNING A WOOD MASONRY BUILDING USING OFFCUTS FROM THE SAWMILL INDUSTRY

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Abstract

Historically, times of crisis and scarcity have forced people to use what materials they have available in the most frugal way and invent ingenious methods of building using previously disregarded materials. Yet amidst today's climate crisis, when timber is hailed as the key to a more sustainable construction industry, as much as 80% of the timber produced in Sweden is used to make short-lived goods. This is despite the fact that environmental organizations deem it crucial that as much as possible is used in building construction, in order to reap the benefits of the wood's carbon sequestration properties.

This thesis argues that one way to utilize the material more efficiently is to rethink which types and qualities of wood we use for construction, and that historical buildings might provide direction. It focuses on a vernacular building technique which was in use in parts of Sweden and Norway between 1850 and 1950 but has since fallen into obscurity. The technique is a form of masonry using wood, and though there are several known variations across Europe under the umbrella term 'wood masonry', this thesis concerns one using short plank offcuts which were laid like bricks in a running bond.

Rather than merely trying to revive this forgotten building technique, it is examined from a contemporary perspective, by studying flows of byproducts from today's timber industry, and relating the design work to architects who have worked with or in relation to vernacular architecture, including Francis Kéré internationally, and Jan Gezelius from Swedish tradition. Writings by Swedish architectural theoretician Finn Werne helped position the thesis design work in relation to the existing cultural heritage of both the technique itself and the geographical region of Bohuslän, which the plank masonry technique specifically had strong ties to.

The result is the design of two single-family houses, constructed in the plank masonry technique using offcuts taken from the production of finger joint lumber at a specific sawmill. Finally, a discussion is had that evaluates which measures would be needed for the technique to prove a viable alternative in construction today.

Keywords: vernacular architecture, wood masonry, timber industry, sawmills, waste wood, Bohuslän

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Contents

Background

The idea for this thesis began to take shape after encountering a vernacular building technique that was in use in Sweden roughly from the mid-1800s to the mid-1900s, but has since fallen into obscurity. Today it appears to be mostly unknown, even amongst professionals like historians, architects and building antiquarians. The technique seemed at first glance to have originated from the sawmill communities along the northeast coast of Sweden in the mid-1800s, but diving deeper it became clear that there had been clusters of these kinds of houses in various parts of Sweden, not all of which shared those same conditions.

The technique in question has different names, connoting both dialectal peculiarities and differences in the technique itself, but for the sake of this thesis, "wood masonry" is used as an umbrella term. And it is just that: masonry using short wood components. Sometimes it looks virtually just like conventional masonry, the wood building blocks laid like bricks in a running bond (Swedish: *½-stensförband*). In other examples, the walls are constructed by stacking normal firewood like one would a woodpile. The mortar was historically always made from clay reinforced with some kind of fibre such as straw or animal hair.

What all variations have in common is that they utilize wood which is either not originally intended to be used for construction (such as offcuts from sawmills or normal firewood), or wood that is salvaged from another construction and re-used in a new way (such as logs from older timber houses, sawn into shorter pieces). This way of using and reusing all available timber until the very end of its service life displays a frugal approach to material resources that is sorely lacking in society today, not least in the building sector.

This thesis focuses especially on one variation of the technique which evolved in relation to the industrialization of the timber industry, and made use of plank offcuts to construct affordable homes for sawmill workers as well as common folk. As will be presented in part I of this thesis, it emerged partly out of material scarcity: with large parts of Sweden suffering from deforestation, log timber was hard and expensive to come by, forcing people to turn to cheaper alternatives. The offcuts, which had defects like rot or knots and were sawn off to improve the quality of the remaining lumber, provided such a cheap – sometimes even free – alternative building material.

Over time, as the sawmills evolved and increased their productivity, construction lumber (planks much like the lumber we use today), became accessible even to the common people (Swedish: *allmogen*), and the wood masonry technique appeared to have played out its part. Might now be the time to again make wood masonry part of our construction repertoire?

Today, Sweden is again suffering a timber shortage with record-high timber prices as a consequence (Skogssällskapet, 2024). Simultaneously, the world is facing an urgent climate crisis which will require us to drastically change our patterns of consumption. With the demand for wood products likely to keep increasing as the construction industry tries to shift away from steel and concrete into building with timber, the question of how we actually utilize the timber produced in our forests is more relevant than ever.

And yet despite this, as much as 80% of the timber we produce in Sweden is used to make short-lived products, such as pulp for paper. The Swedish Society for Nature Conservation (*Naturskyddsföreningen*), whose stance is that the way the timber industry generally operates today is devastating for the climate and biodiversity, specifically says that we need to use more of the wood from the trees we fell to build houses, retaining the embodied carbon for as long as possible (2022).

This thesis does not aim to advocate for a revival of the wood masonry technique for purely nostalgic reasons, but rather to use it to show by example that there are ways of constructing a building with low-quality and defect timber and lumber of non-standard, short dimensions – material which is today simply discarded and burnt as biofuel.

READING INSTRUCTIONS

This opening background chapter intends to provide an overview of the research subject and the relevance it holds by presenting the aim, research questions, method and delimitations. The booklet is thereafter divided into three main parts: Introduction, Implementation, and Conclusion.

Part I (Introduction) introduces the main research topics: the history of the wood masonry technique and its built heritage, the subject of vernacular architecture and how architects might relate to it in a contemporary way, and the timber industry historically and today.

Part II (Implementation) implements the theories presented in part I as well as the technique itself by means of a design project. The design proposal itself is presented alongside some of the references that have influenced it.

Part III (Conclusion) summarizes the thesis results and discusses them in relation to the ambitions outlined at the outset.

The main material is followed by appendices which contain the design explorations done in the starting phase of the design work as well as photographs of physical models and exhibition material.

Thank you for reading.

AIM

The main intention of this thesis is to show one example of how waste wood of a kind that many large Swedish sawmills today routinely generate might be put to use in construction, giving it a long service life instead of burning it as biofuel. This example consists of applying a vernacular building technique (which was in use for roughly a century up until the mid-1900s) to a modern context by means of designing two single-family houses.

On a large scale, the thesis thereby strives to contribute to the discourse around how we utilize the material resources that we consume. With the timber industry providing a forum for the discussion, it aims to present a viable proposal for one way to use the timber resource more effectively, without the need of major interventions in the sawmill production line.

The intention is that by not only giving an account of the technique's history, but also presenting it as a viable option for modern construction, the thesis will shed light on the forgotten piece of cultural heritage that the wood masonry buildings constitute. For this reason, the structural and architectural qualities of the technique will be considered of equal importance.

THESIS QUESTIONS

- Letting traditional vernacular architecture that utilizes waste and byproducts inform solutions to problems that we face today, could the wood masonry technique in particular again become relevant as an alternative to common-practice building techniques?

- What might an application of the wood masonry technique look like if placed in a contemporary context using byproducts from the modern sawmill industry, and considering both its architectural qualities as well as its structural integrity?

- Which problems would need to be solved for the technique to be a viable construction method today, with regards to, for example, consumer demand, contemporary building regulations and production logistics?

METHOD

For the sake of clarity, this chapter distinguishes between the methods for conducting the thesis research in general, and more design specific methods intended to inform the design of the prototype buildings.

RESEARCH METHODS

A specific timber company, Derome, and a specific sawmill of theirs was chosen as an object of study for the thesis. In order to understand the material flows of the sawmill industry in general, information was gathered from their own website and publications, as well as from other industry representatives (Swedish: *Skogsindustrierna*). Two study visits were also conducted, one to Derome's house factory, and one to the sawmill in question, to reveal any streams of byproducts with potential to be used in the design project. Additional information and answers to questions have been received through personal correspondence with contacts at Derome, in particular with Niclas Persson who is the site manager at the sawmill in question.

Research into the history of the sawmill industry and the use of timber as a building material was done through literature studies.

For research into the wood masonry technique and built heritage, material was received through personal contact, most importantly with Olle Hagman. This includes past inventories done by antiquarians and further developed by him as well as papers he has written on the technique. These readings also provided references to more literature on the subject, not least the Norwegian body of written work.

In the beginning of the project, efforts were made to find built examples of wood masonry houses in the nearby area by contacting community associations (Swedish: *hembygdsföreningar*). One study visit to a wood masonry building was conducted, with the contact facilitated by Olle Hagman.

DESIGN METHODS

For the design project, though it has no specific site in mind, it has been important to intentionally tie the prototype building to the local history of the wood masonry technique in Bohuslän county in west Sweden. Research into vernacular architecture both in general and specific to the geographic location was conducted through literature studies, in order to understand which cultural context the new construction was to be inserted into.

Based on photographs, drawings and text descriptions from historic literature, a sort of catalog was established with illustrations of building components and architectural traits of built wood masonry buildings, excerpts of which can be found accompanying the text in Part I. This was done by 3D-modelling sections of certain interest, trying to get a deeper understanding for how the buildings were constructed by "assembling" them digitally.

This catalog was used as a springboard to start reinterpreting the technique using new building blocks, consisting of the specific byproducts identified at Derome. The focus was to understand how the wood masonry walls might be combined with and connected to conventional solutions for building components such as joists and foundations. Some of these illustrations, done in the same manner as those of the historic examples, can be found under "Design Explorations" in the appendices.

In parallel, studies were made of facade expressions and materials through digital collages, studying the architectural potential of the wood masonry itself with regards only to visual characteristics.

Examples of architects who in one way or another have worked with or reimagined vernacular architecture were analyzed through literature studies, reading interviews and biographies, and looking at their self-published material online.

As a bridge between the research phase and the design phase, all of the references above were distilled into a selection of design principles and features which were collected in the diagram on page 29.

A NOTE ON AI

AI has been used in writing this thesis to the extent of using ChatGPT to propose synonyms and translate certain words. This is further described under "Use of AI" in the appendices.

DELIMITATIONS

One specific sawmill was chosen as the subject of investigation when researching the modern sawmill industry and mapping its material flows. This is Derome's sawmill located in Veddige in the southwest of Sweden. Derome is one of the largest sawmill companies in western Sweden, and the Veddige sawmill is their largest facility. This made them interesting to study not only because of their significant market share, but also because their production line was assumed to be fairly representative of other sawmills operating at an industrial scale.

For the design project, one specific byproduct from the sawmill was chosen for the wood masonry walls: short pieces of construction lumber containing various defects, which are currently used as biofuel at the Derome site. Initially, another byproduct was also considered, namely defective tongue-and-groove boards which today are sold to international markets as a lower-grade product. While these boards are mentioned in the booklet and some studies involving them are included in the appendices under "Design Explorations", they were included for the sake of discussion only and were not used in the final design project, nor were any other byproducts from the Derome sawmill.

The thesis does not look into the reuse of post-consumer timber for contemporary wood masonry. It also does not consider other kinds of waste wood than the kind described above, such as waste that is generated after the lumber leaves the sawmill (for example lumber that gets discarded at the Derome-owned building supply stores, where some of their lumber is sold).

The final design proposal does not take into account how one would classify the defective wood offcuts with regards to load-bearing capacity and fire resistance for legal use in construction. The issue is however discussed in the final reflection.

I. INTRODUCTION

"Within the area a certain building technique occurs which may be worth a mention. It originates from the aspiration to achieve with the least possible means a home of one's own."

"Inom området uppträder en speciell byggteknik, som må vara värd ett omnämnande. Den har sitt ursprung i strävan att med minsta möjliga medel åstadkomma ett eget hem."

From Allmogehuset i Bohuslän utmed linjen Lysekil-Vassbotten, Leif H. Nilsson (1959). The text refers to a cluster of a certain kind of wood masonry buildings found in the northern part of Bohuslän, which are described further in the chapter "Nothern Bohuslän". Quote translated by the authors.

Wood masonry

As will become apparent in this chapter, the history of the wood masonry technique in Sweden is strongly connected to that of the sawmill industry, and the technical evolution of the saw itself. Though this history is little known and little documented, a few efforts have been made to summarize it and inventory the remaining building stock. Olle Hagman, a now retired social scientist and engineer located in Gothenburg, is a prominent wood masonry enthusiast in Sweden, and has written two books on the subject which deal both with the history and the modern applications of the technique. For the sake of this thesis, he has provided through personal communication an inventory of known Swedish wood masonry houses done in the early 00s by fellow enthusiast Bengt Fagerström, as well as his own additions to it.

Much of what has been written on the subject of the Swedish wood masonry building stock refers to writings by Karsten Karstensen, a Norwegian author who took interest in the technique in the 1970s. He was the first to document the large stock of wood masonry buildings in Østfold, the southeasternmost region of Norway, and claims that a unique type of plank masonry flourished in the sawmill districts there in the second half of the 1800s, which then spread to Sweden on the well-established shipping routes to nearby Swedish coastal communities, especially those in the Bohuslän county.

This specific kind of plank masonry that sprung out of the unique conditions in that coastal region will be presented below, following a brief introduction to the history of wood masonry in general.

THE WOOD MASONRY TECHNIQUE IN SWEDEN

The history of the wood masonry technique in Sweden has been dated back at least to the mid-1800s, when the sawmill industry saw rapid expansion, thanks in part to the invention of the steam-powered saw. Before this time, homes were commonly built by stacking log timber, which was processed manually using an axe. Beginning in around 1850, several conditions conspired to bring about a massive expansion of the sawmill industry, spurred on by a large demand for lumber throughout Europe. In just a few decades, the timber export industry evolved massively, soon becoming a vital part of the country's economy (Klingström, 2018).

It is important to note that during this time, Sweden and much of Europe is plagued by a timber scarcity that strongly affects the common folk's access to building materials, caused by a long period of over-exploitation of timber-producing forests. Already in the 1700s, Swedish forests were exploited mainly to be exported to countries with even less access to timber, like England, Holland, Denmark and Germany (Werne, 1980, p. 224), and timber became a commodity that, for common people, was expensive and hard to come by.

Finn Werne, a Swedish architectural professor who has written extensively about the vernacular building culture in Sweden in general and in Bohuslän county in particular, wrote his doctoral thesis *Allmogens byggnadskultur* (which in English might be translated to "The building culture of the common people") in 1980 on the dissolution of Swedish vernacular building culture caused by the industrialization in the centuries leading up to the 1900s. On the subject of the industrialization and marketization of the sawmill industry in the 1800s, he writes:

> *"As land and forests are privatized and forest products are turned into commodities for the lumber export industry, the common folk are forced to invent new building techniques to reduce the use of timber. This was nothing new. All over the world, people have invented methods and techniques of building houses with the materials they have at hand." (p. 284, authors' translation)*

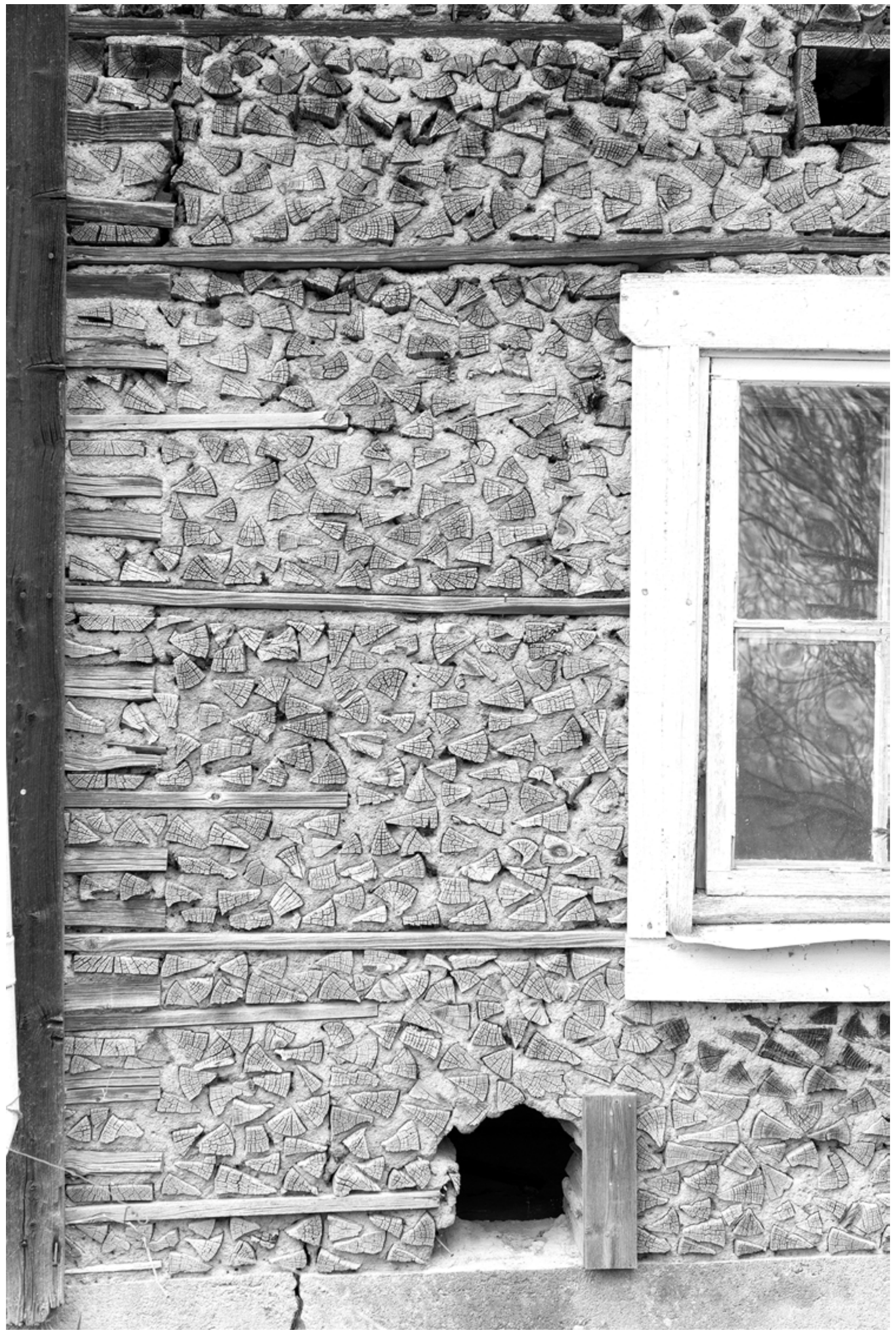
The boom of large-scale production of sawn lumber (planks) in itself led to the development of new building techniques which were more material-efficient than building with log timber, and more resemblant of the stud walls commonly utilized when building in timber today. However, this production also generated large amounts of waste: offcuts with defects that were sawn off the planks to improve the overall quality of the lumber.

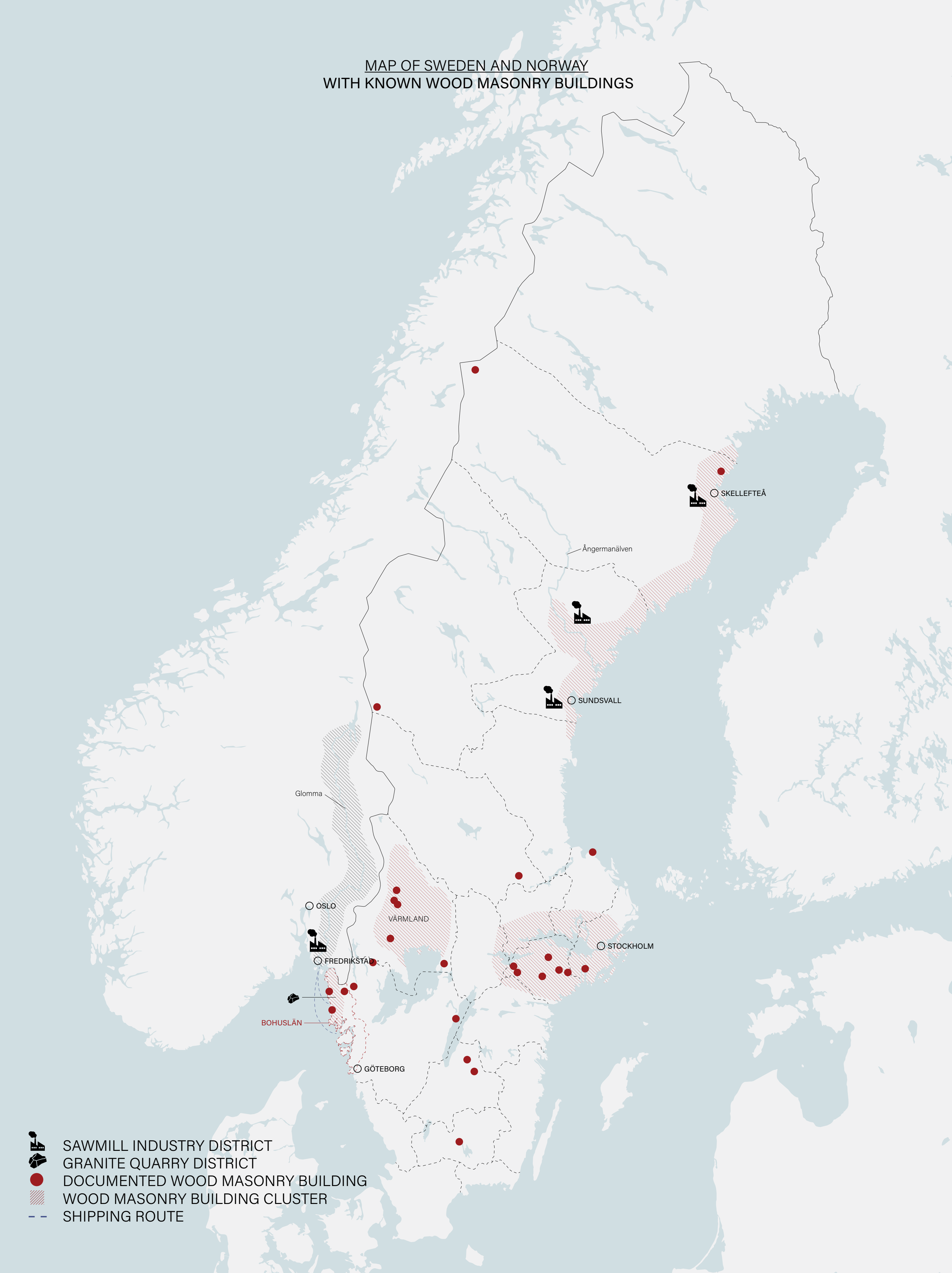
A common narrative, therefore, is that the wood masonry technique originated in the communities that were built up around the sawmills around this time, emerging organically and rather independently in each of those places as a consequence of material availability, rather than spreading across the country from one location to the next. The building technique proved a resourceful way to make use of offcuts and other byproducts, using an established craft – masonry – that was already well-known to both laymen and craftsmen. With clay being used to make mortar, all materials necessary to build a house were cheaply and easily available.

However, there have also sprung up wood masonry variations in Sweden that use other kinds of building blocks. Generally, wood masonry houses were built either using by-products from the sawmill industry or other related industries (such as wood shingle mills); using demolition log timber, sawn into shorter pieces; or using normal firewood. When built with firewood, the masonry was most commonly used as infill in a post-and-beam construction (Swedish: *korsvirke*), though houses have been documented that have load-bearing walls built with stacked firewood as well, such as in the example from Gräsmark, Värmland pictured on the following spread. The mortar was almost exclusively made using clay as a binder, sand as aggregate and any easily accessible suitable material for reinforcement: seaweed, straw and animal hair are some examples.

While many farm buildings that remain today have their wood masonry walls exposed, the residential buildings historically built in this technique had a facade clad either in wood paneling or clay render. This was not only for the sake of protecting the walls themselves, but possibly also to conceal their composition from neighbors, as wood masonry is thought by some to have been considered a poor man's technique (Hagman, 2025). The heaviness and airtightness of the wall then made for a relatively comfortable indoor climate. Contrary to the log timber buildings typical of the time, wood masonry walls which had

Figure 2-3: One of the more grand examples of a stovewood barn in Gräsmark, Värmland, a region notable for its many wood masonry buildings, many of which still remain today. Photographed by Lars Sjöqvist for an inventory done of cordwood buldings done by Värmlands Museum in 2024.





the wood laid with the end grain facing outward allowed uninhibited moisture transport between inside and outside. Additionally, the wood could be laid thicker than a log timber wall, providing a higher thermal insulation.

GEOGRAPHIC SPREAD OF THE TECHNIQUE

The inventories introduced above have concluded that there are four main clusters of wood masonry buildings in Sweden: the Stockholm area; Värmland county (specifically the Gräsmark region); the sawmill district along the far northeast coast; and the granite quarry district in the north part of Bohuslän county (Jerer & Westerberg, 1998). Out of the buildings still standing at the time of each of the inventories, the majority were found in the Stockholm area.

However, as the houses are often hidden in plain sight, their internal structure concealed behind facade cladding, and as very few people know about the building technique at all and therefore may not recognize its cultural value when they come across it, it is likely that there are many more which are still unknown.

WOOD MASONRY VARIATIONS

On the right is an illustration of the most common variations of the wood masonry technique identified in the built examples around Sweden, divided into load-bearing masonry and infill-type construction.

CORDWOOD MASONRY

Swedish: *kubbhus* (also *klanthus, klabbhus*)

Timber (historically often demolition timber from old log houses) or firewood (whole or cleaved), laid with the wood's grain direction orthogonal to the wall's longitudinal direction. The terms "stackwall" or "stackwood" are sometimes used as well. In Swedish, the term *kubbhus* – *kubb* roughly translating to "block" – is sometimes used as an umbrella term to include all wood masonry techniques.

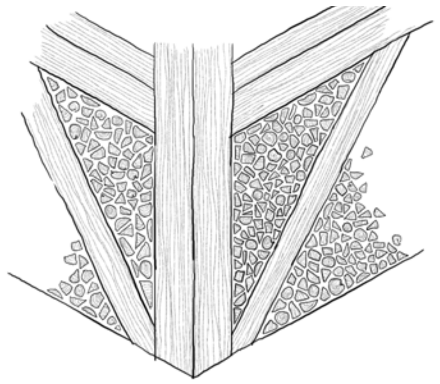
PLANK MASONRY

Swedish: *knopphus, knubbhus*

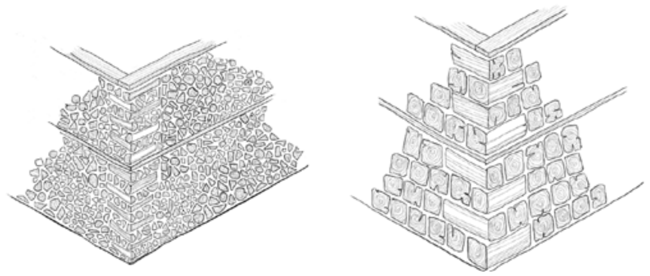
Sawn lumber (planks), laid with the wood's grain direction parallel to the wall's longitudinal direction, usually in a stretcher bond (Swedish: *1/2-stensförband*). The planks are laid in mortar but can sometimes also be nailed together. The Swedish word "knopp" is considered specific to Bohuslän, while *knubb* is used for the same construction type in most other parts of the country and Norway.

CORDWOOD MASONRY
SWEDISH: KUBBHUS

INFILL

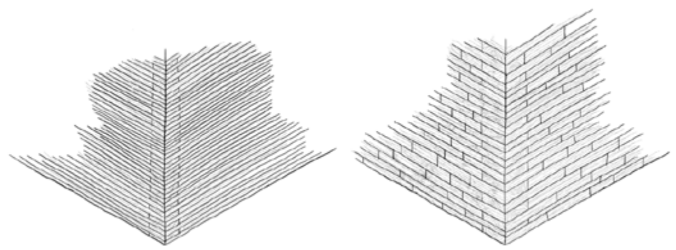


STRUCTURAL

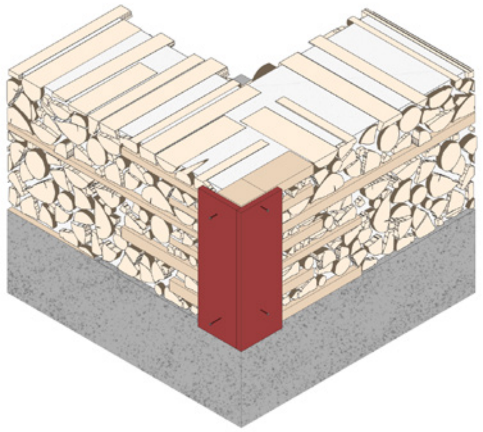


PLANK MASONRY
SWEDISH: KNUBBHUS, KNOPPHUS

STRUCTURAL

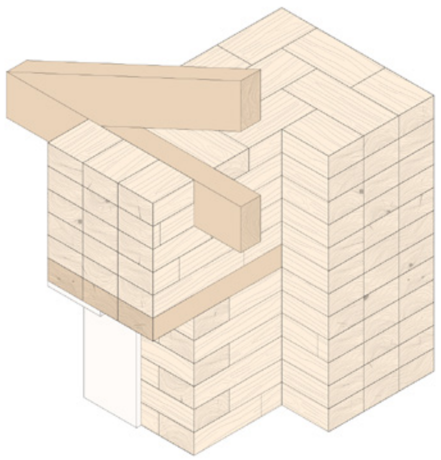


EXAMPLES OF DETAILS FROM HISTORIC WOOD MASONRY BUILDINGS
SCALE 1:30



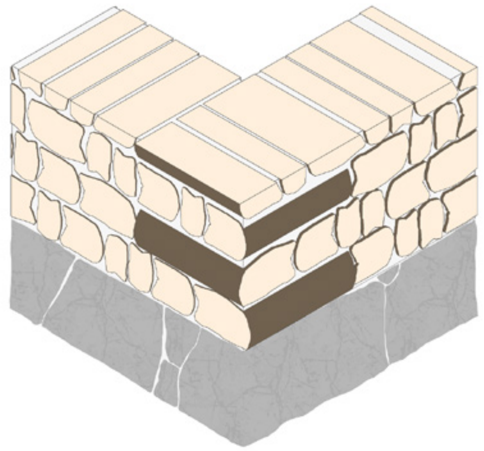
STOVEWOOD WALL CORNER

Illustration based on a photograph of a barn in Värmland county. notable for its load-bearing stovewood walls rather than the usual post-and-beam infill. The wood rests directly on a cast concrete foundation, with horizontal battens laid of roughly even distances to give an even base to the courses above. Shorter criss-crossing battens help stabilize the corner, and the facade is left unpanelled, except for the planks covering the corners.



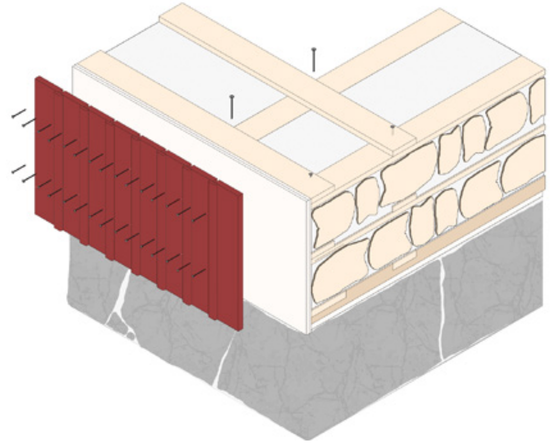
PLANK MASONRY WALL CORNER

Load bearing exterior wall made of three layers of plank stumps which all have the same thickness and width, 85x150 millimeters, and a mean length of 500 millimeters. Based on sketches of a building documented by Karstenssen in his book *Knubbehus* (1986, p. 23).



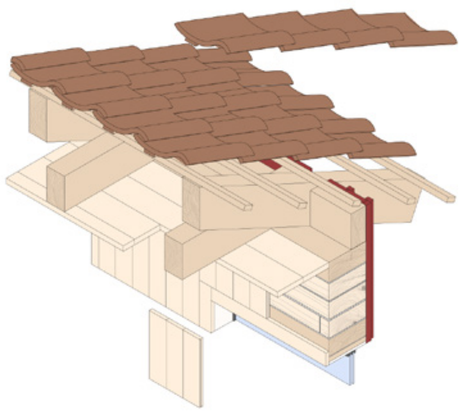
CORDWOOD WALL CORNER

Structural cordwood wall made from reused log timber, laid crosswise in the corners atop a natural stone foundation. Though based on a built example from Värmland county in the middle of Sweden, it was a common technique just across the border to Norway, in Østfold.



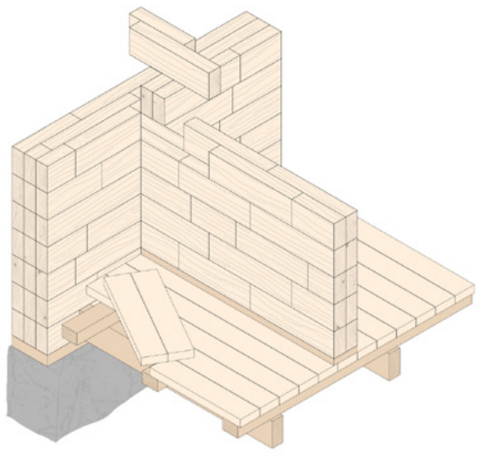
CORDWOOD WALL CORNER

Cordwood wall made from reused log timber laid on sole plates over a natural stone foundation. Each timber course is separated by battens to level the next. The wall was coated inside and out with clay mortar and lime plaster, with exterior wood paneling nailed to the battens. Based on an 1870 text from *Nya Wermlands Tidningen*, quoted in the inventory of Värmland's wood masonry buildings provided through personal communication.



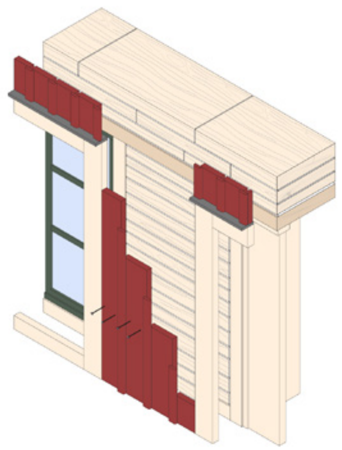
PLANK MASONRY WALL & ROOF CONNECTION

Load bearing wall built with only one layer of wood, 65x160 millimeters, in varying lengths ranging from 250 to 500 millimeters. Based on images and descriptions of a Norwegian house in an inventory done by Karsten Karstenssen, as presented in his book *Knubbehus*.



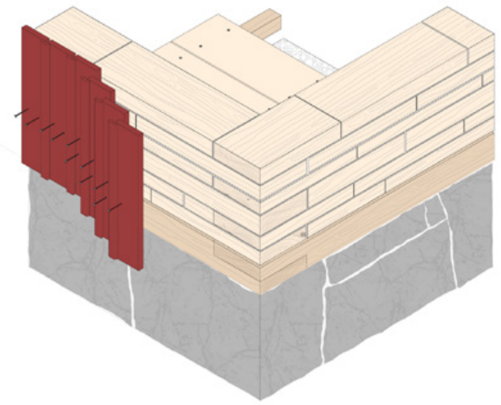
PLANK MASONRY EXTERIOR & INTERIOR WALL

Exterior and interior wall based on sketches and descriptions of a Norwegian house in an inventory done by Karsten Karstenssen (1986, p. 24). It is built from pieces of equal dimensions, 50x100 millimeters, which are stacked in a wild bond pattern and standing on their short side.



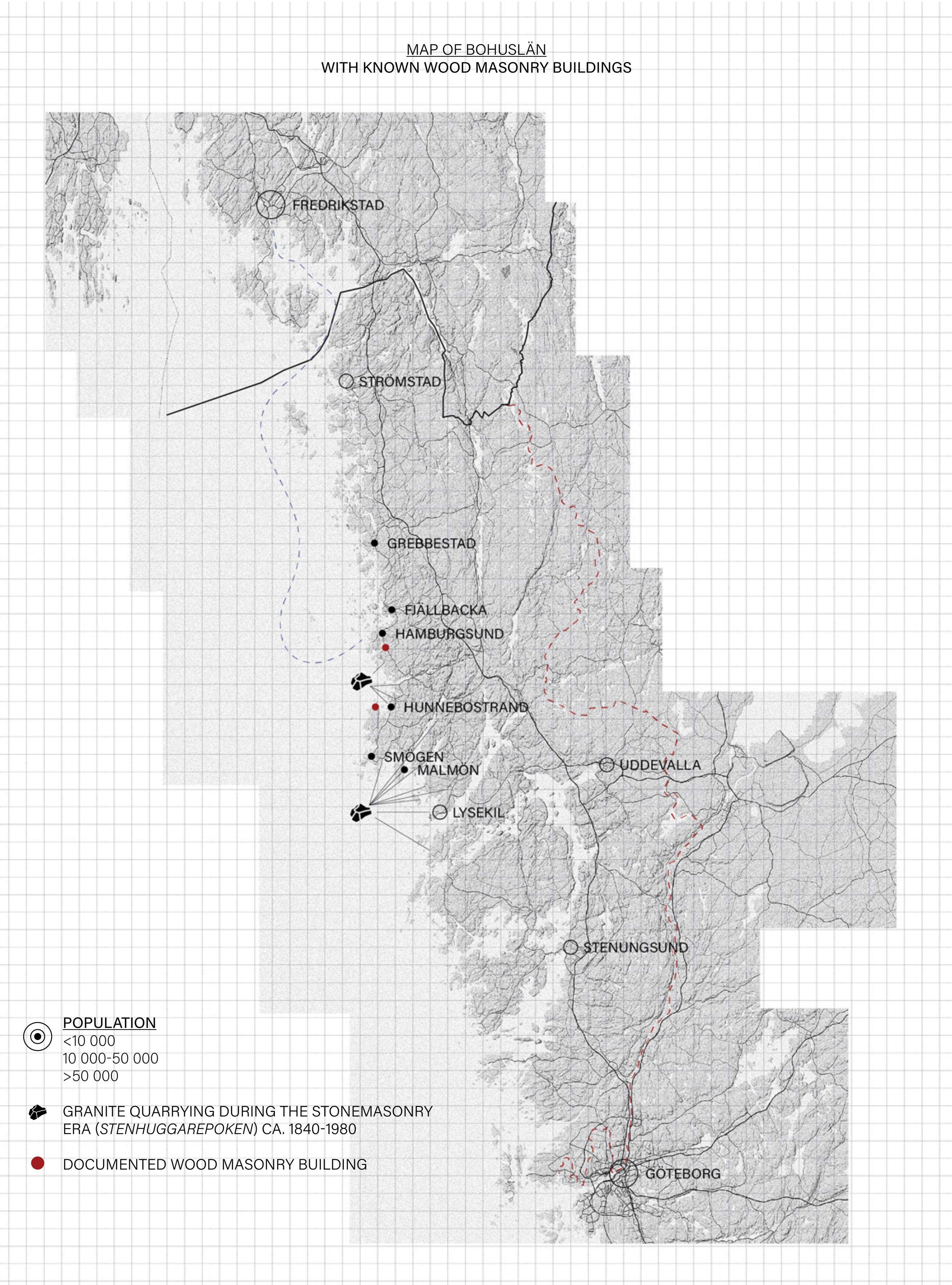
EXTERIOR WALL DETAIL

Based on a photograph from Skellefteå in the north of Sweden. Between two openings, here a window and a door, the plank masonry is made up of consecutive, equally long plank stumps. Were the stumps sawn to the same length, or was the distance between the openings made to fit the length of the planks?



PLANK MASONRY WALL CORNER

Plank masonry wall laid on log timber sole plates on top of a solid natural stone foundation typical for Bohuslän. The plank stumps are laid crosswise in the corners, and variants exist both with or without sole plates, with the wood masonry laid directly on top of the stone foundation, which is first evened out with mortar. A typical board and batten siding (Swedish: *lockläktspanel*) is nailed directly into the wood masonry.



BOHUSLÄN COUNTY

In the northern parts of Bohuslän – the westernmost province of Sweden, located just north of Gothenburg – certain conditions conspired to create a particular kind of melting pot for wood masonry construction. The industrial development in this area is largely characterized by the stone industry – specifically granite, earning the region its nickname "the granite coast" – which developed from the mid-1800s and grew increasingly. In 2008, a pre-study was done by Östlund et al. in the local culture cooperative Rio, of which above-mentioned antiquarian Conny Jerer was a part, on behalf of the county administration into potentially turning the granite coast into a cultural reserve. This document provides some insight into the history of the industry.

A hint of how substantial the stone industry had become by the turn of the century can be seen in Hunnebostrand, located just north of Lysekil, where the quarries sustained over half the population in 1909. Following the industrialization of the industry the communities around it grew, and new ones sprung up in relation to the quarries from almost nothing. Consequently, there was an increased need for housing, and some communities are completely dominated by houses built for the quarry workers. This includes both residential quarters built by the quarry companies established in the area, as well as houses built by the workers and their families themselves. Often, the houses that the workers built themselves were built on leased land, and the houses were sometimes mortgaged to give the worker the right to quarry stone in the area.

On the rocky island of Ramsvik across the fjord from Hunnebostrand, today a nature reserve, a community evolved around the quarry in the early 1900s. The quarry owner, a Norwegian cobblestone company, built rental barracks for the workers, and a number of single-family houses, which at the time the pre-study was done in 2008 still remained standing. All of these buildings, including the two-story rental building, informers said, were rumored to have been built in the plank masonry technique. In their detailing, the antiquarians say, the houses differ from local and even Swedish tradition.

One house in Hunnebostrand, a two-family home for two brothers employed as smiths at the local quarry, was also said to have been built with plank masonry, and stands out because its plan has no apparent connection to local building traditions.

In the communities along the granite coast of Bohuslän, it is apparent that the plank masonry was not always part of the region's building traditions, but was imported from somewhere else.

IMPORTING THE PLANK MASONRY TECHNIQUE FROM NORWEGIAN SAWMILL DISTRICTS

By the second half of the 1800s, Bohuslän had largely no forests left, so most homes were made from log timber that was transported from inland. As the sawmill industry grew more efficient, plank construction began to replace log timber, and log houses too were beginning to be covered in plank cladding. To the northern part of Bohuslän, the planks typically came from Norwegian sawmills in the area around Fredrikstad.

In Vikarvet Historical Society's 1958 yearbook, Leif Nilsson gives an account of his inventory of the vernacular homes from the 1800s along the coast of northern Bohuslän, where he writes:

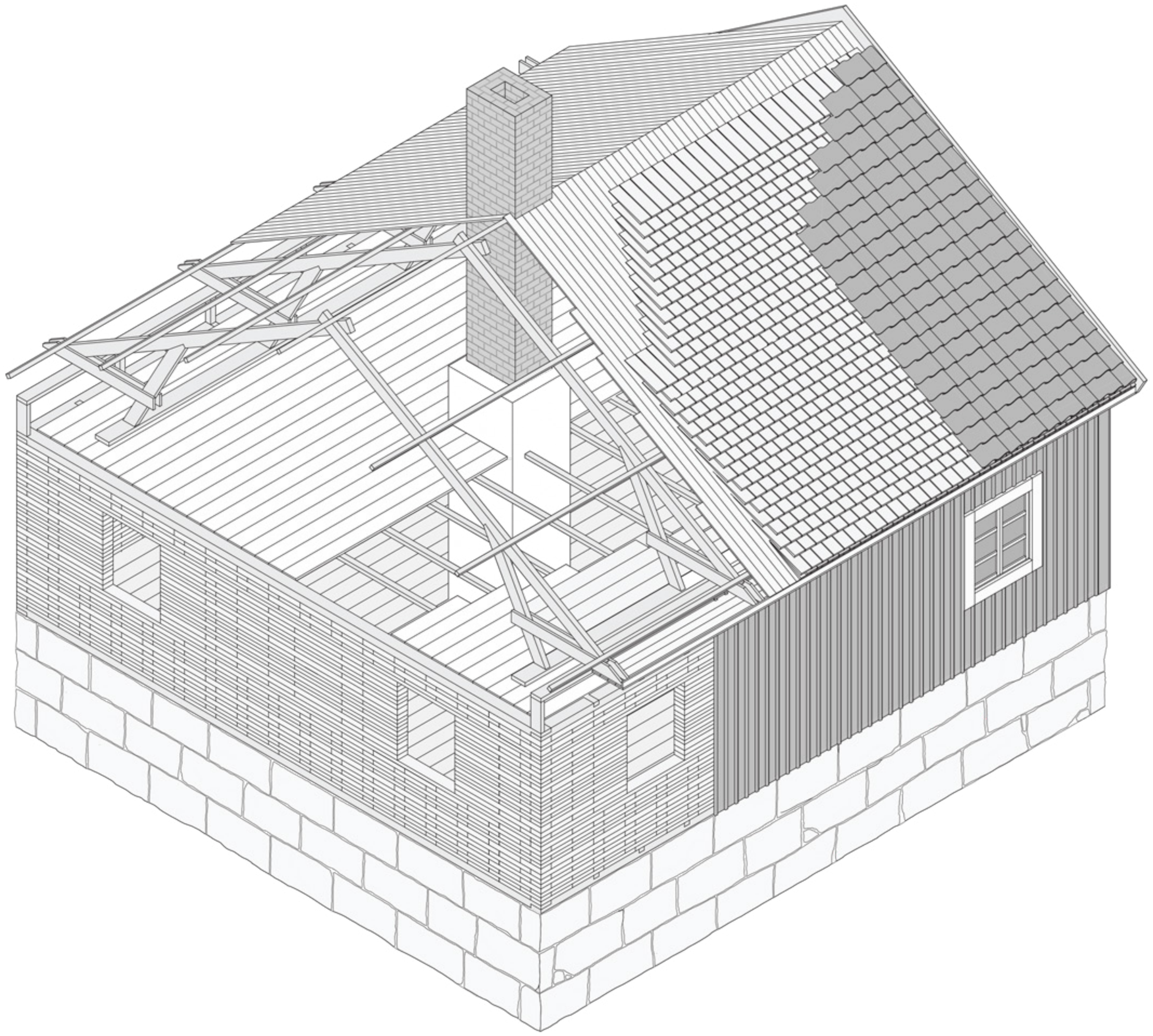
> *"Within the area appears a certain construction method, which may be worth a mention. It originates from the aspiration to achieve with the least possible means a home of one's own" (author's translation).*

Thanks to the favorable conditions for sea transport and the already established trading relations with the forestry industry in nearby Norwegian cities like Sarpsborg and Fredrikstad, a certain kind of wood masonry technique evolved in the quarry workers' communities of the granite coast.

In the above-mentioned pre-study, several sources informed the authors that the granite cobblestones were shipped from the quarry communities of Bohuslän to Sarpsborg and Fredrikstad in Norwegian Østfold, and that plank stumps left-over from the sawmills there was taken as ballast on the ships' journey home.

Nilsson, too, reports that Norwegian ships would transport offcuts from the sawmills to be sold cheaply by the cubic meter on the granite coast. For a low price, the workers there could buy the materials necessary to build themselves a home. In order to do so, a technique had to be developed which worked for those specific materials, as the by then conventional plank construction required planks of longer and equal lengths. The houses in question were therefore built by laying the irregular planks horizontally, like bricks, binding them together with clay mortar.

The description of the technique and the houses included in the text is based on Nilsson's own interviews with individuals who had worked as carpenters in the area during this time. It is described, in 1958, as having been a rational method to build affordable and functional homes, which were both warmer and less drafty than the plank and timber houses otherwise typical of the time. Still, these houses are said to have had low social status, and today, it is hard to find a trace of any such buildings, or even anyone who has heard of them, ever existing.



PLANK MASONRY

Several Norwegian authors have written about the extensive built heritage of plank masonry houses in Østfold, the southeasternmost region of Norway which in the east shares a border with three Swedish counties: Bohuslän, Dalsland and Värmland. Norway's longest river, Glomma, historically the country's most important log floating river, flows into the Oslo fjord in Fredrikstad, a city long characterized by a booming sawmill industry. With its strategically located harbor, it was an important center not only for timber export, but for other export industries as well. Its brickworks and stone quarrying industries were especially prominent at the time.

The period between 1860 and 1930 in Fredrikstad goes by the name Sagbrukstiden, the Sawmill Period, and in the book *Fredrikstads Bys Historie III* (1973) about this period, author Martin Dehli writes that nearly all housing for the large population of sawmill workers during this time were built in the plank masonry technique.

In a book written in 1984 by Arne Oldem, active in the Fredrikstad area, about Norwegian building culture in the 1800s there is a chapter dedicated to the plank masonry houses found especially in the sawmill districts around Fredrikstad. Noting that the plank masonry technique was an option near at hand in any area with good seaborne shipping connections – the material itself existed in near unlimited amounts, and was cheap or even free, making the issue of transportation the limiting factor – Oldem highlights (p. 119) its spread to the coastal communities in Swedish Bohuslän. Referring to the descriptions of the construction process provided by Leif Nilsson in *Allmogehuset i Bohuslän*, cited above, Oldem however also notes some differences from the Norwegian common practice in how the masonry technique came to be utilized in Sweden.

One notable difference is the use of what is referred to as "binders": a consecutive band of planks that forms a kind of frame around the whole perimeter of the building, often laid on window-sill and lintel height and as the final course of the masonry before the roof construction. Oldem takes this as an implication that the buildings most likely also had a sill plate (Swedish: *syll*), a conclusion that is supported by examples from Värmland county, an inventory of which the authors have provided through personal communication. In the Fredrikstad area, the longest offcuts were laid as the first course on top of the foundation instead as a kind of sill plate. This was likely for purely economic reasons, as long planks would of course have to be bought at full price, which might indicate that the Swedish plank masonry houses were built by people of greater economic means than the sawmill workers in Fredrikstad. Though Swedish wood masonry expert Olle Hagman is sceptical towards the fact that the buildings were historically associated with low social status, to Oldem at least that seems to have been very much the case in Norway.

Karsten Karstensen, a Norwegian who has researched the history of wood masonry, writes that while workers in the sawmill districts often received the plank offcuts for free, those without connections in the industry could buy the material for a price corresponding roughly to a fifth of a normal year's salary (1986, p. 69). Wood masonry houses, he concludes, were not built solely by sawmill workers of little economic means, but it is safe to say that they were built by "all kinds of common people" (p. 72). They were sawmill, brickyard and quarry workers, who took the existing building traditions that they already knew well and reinvented and redefined them. Laying building blocks in clay mortar – even building blocks made of wood – was not a new invention, but rather an ingenious new way of applying an ancient logic of building.

Left: Illustration based on a text description of a plank masonry house located in Apelsäter, in Tanum municipality, about a mile north of Grebbestad and slightly inland. The house was built in the early 1890s and is constructed as a typical Bohuslän double house, with four rooms around a central fireplace and an unfurnished attic. At the time of the inventory done by architect Conny Jerer and antiquarian Stefan Westerberg in 1998, which we have received through personal communication, the house was in severe disrepair after being uninhabited since the 1940s. It is unlikely that it remains at all today.

Both the interior and exterior load-bearing walls were constructed in the plank masonry technique, using stumps of 6" planks, 2-3" thick. The stumps are all roughly the same length, 1 ½ feet, which indicates that they might have been produced with the intention of being used for wood masonry. They are laid atop a 4" sole plate (Swedish: syll) with very thin layers of mortar in between the courses, and "frames" of longer lumber laid on uneven height intervals that act as a sort of stabilizing layer. This building component, usually referred to as "binders" (Swedish: bindare) is a peculiar detail that frequently occurs in the plank masonry houses of Bohuslän, but never in the Norwegian models that they are inspired by.

The house was covered in a typical red-painted board and batten siding (Swedish: lockläktspanel), nailed directly onto the wood masonry, and the original shingle roof had been covered with clay tiles.

Clay mortar was not only used for the wood masonry, but for the whole chimney. The clay render of the chimney stack in the attic was still intact in 1998.

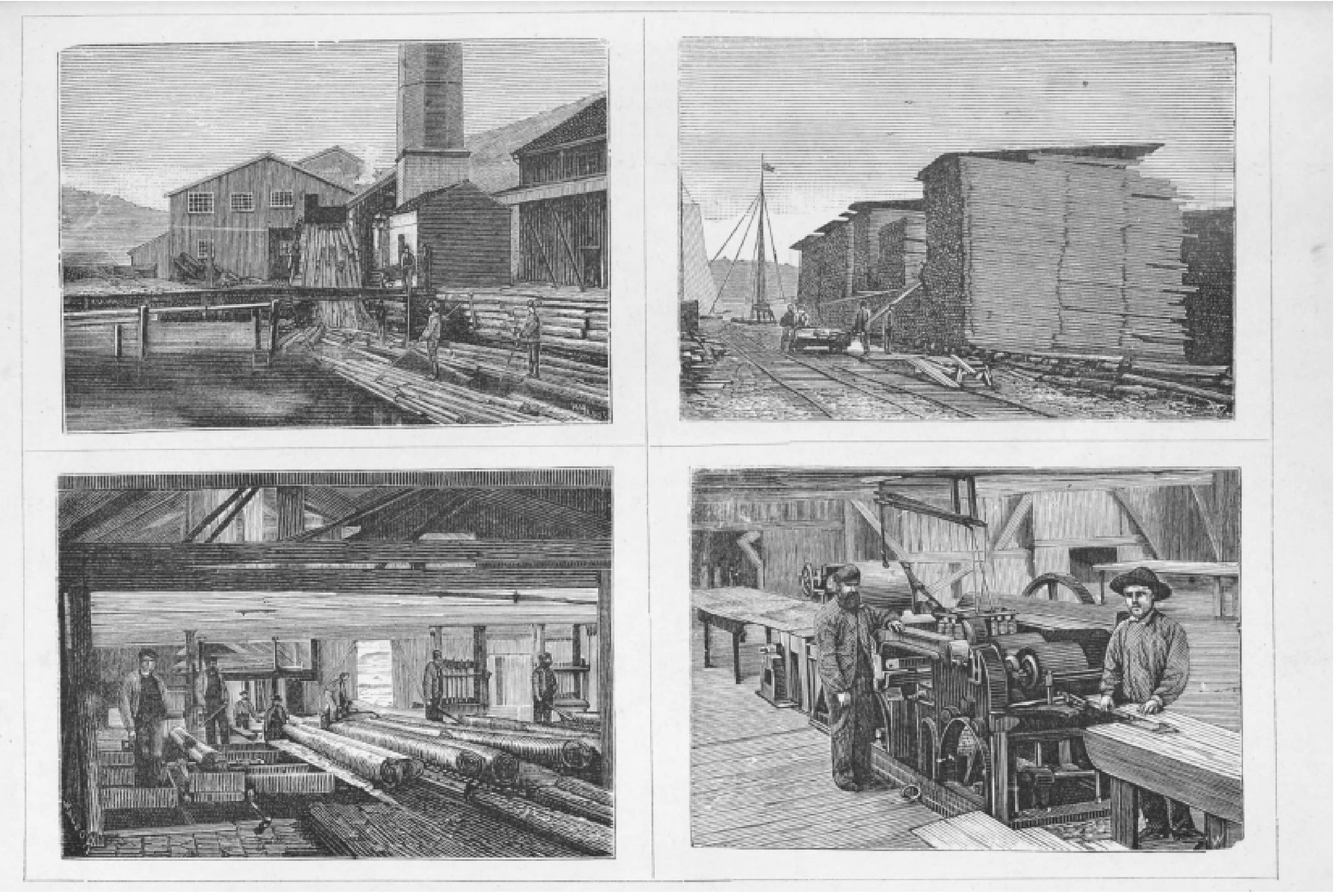


Figure 4: Illustrations from the book "Norges land og folk, statistisk og topografisk beskrevet. 1: Smaalenenes Amt" done by the Norwegian Bureau of Statistics in 1885. The drawings depict a sawmill and planing mill in Fredrikstad, Norway. Note the similarity of the lumber piles in the second drawing to those in the photograph of a lumber stack at Derome's sawmill on page 22.

Figure 5: A photograph of a plank masonry home located in Solheimrabben, in Borge just southeast of Fredrikstad, taken in 1917. The house, whose gable facade has not yet been covered with panel, is owned by Mr Johansen, a local brickworks employee from Sweden. Pictured standing in the garden are his wife, Mrs Johansen, their daughter and her friend.

Figure 6: The plank masonry house mentioned on the previous page, built in 1890 by policeman J.O. Grenholm in the corner of Nygatan and Viktoriaesplanaden in Skellefteå. Photos taken by Ernst Westerlund during demolition in 1950.

Figure 7: Photograph from Skellefteå Museum's collection showing a family outside their wood masonry home, whose façade has not yet been clad with panelling.

Figure 8: Charcoal drawing by Ferdinand Boberg (1860-1946) from 1925 depicting a Fiskebod, a fishing shed, located in Gäddvik on the western shore of Bottenviken. Boberg was a well known architect in Sweden, and after his retirement he traveled across Sweden, creating over 3000 paintings and drawings showing the cultural and industrial heritage of Sweden. Boberg recognized that amidst rapid modernization and industrialization, much of the cultural history embedded in architecture connected to processes within different economic activities was otherwise at the risk of being forgotten as the industries it was shaped for changed.

Reinventing the vernacular

There are known examples of wood masonry houses being built by members of upper social classes, such as a two story plank masonry villa built by a local policeman (Swedish: *länsman*) in central Skellefteå in the 1890s, as pictured on the previous spread. Many large and well-built farm buildings are known that utilize different variations of wood masonry, which are likely to have been built by relatively wealthy farm owners (Hagman, 2025).

However, as presented above, this thesis concerns itself with the connection between Swedish Bohuslän and Norwegian Østfold, and in particular with the kind of plank masonry that came to be developed in the communities of workers along the Swedish west coast. There, the plank masonry technique was introduced into a distinctive vernacular tradition, and the homes that were built took the shape of one or a few well-established regional typologies. Leif Nilsson, having examined and documented these typologies in order to define them, says (1958/1959) that the plank masonry houses were usually one of two types, which he calls the stonemason's house (Swedish: *stenhuggarhuset* and the double house (Swedish: *dubbelhuset/dubbelstugan*).

In the design project to follow in this thesis, the buildings are therefore designed to relate to this particular regional cultural heritage. Though no specific site is chosen for the buildings, they are viewed as relating to a certain local building tradition.

Vernacular architecture is, fundamentally, an architecture that is created without the involvement of architects. As Finn Werne writes in his 1980 doctoral thesis, building culture has throughout history been generated and supported by the common people. Knowledge about building was passed down from generation to generation through oral tradition, through the younger generation's participation on building sites, by watching and learning from each other. Though knowledge was generated locally, it was also receptive to external impulses, and new techniques would be reinterpreted and assimilated into the existing culture (p. 117).

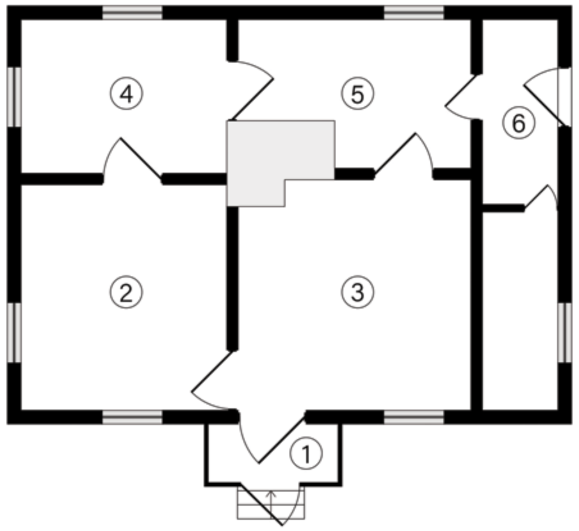
On the subject of relating as architects today to the existing built heritage, Werne writes:

> *"The architect's most important task is to create places that we can inhabit and feel at home in, that respond to us in some way, answer us. Such a place must accommodate a balance between conventions and intentional aesthetic and ethical positioning that speak to us and our way of living in and with the world. There must be something that I can recognize, that makes me feel at home, that I am somehow used to, but there must also be something that attracts me, something I am tempted by, that I am challenged by and that speaks to me over and through all that I am familiar with and that would otherwise bore me." (1995, p. 34)*

Humans have a fundamental need of being anchored to a place, to feel part of a society and a history. While architecture needs to evoke a sense of place by relating to its surroundings, Finn Werne also recognizes the need for it to challenge conventions in order to stimulate the senses of its users. He means that there are two equally important sides to the architectural profession: knowledge of existing conventions of architectural typology, materials, habits and practices; and the ability to innovate with intention, in tune with the aesthetic and ethic intentions of others (i.e. the client or user). These conventions, Werne writes, are visible in the built heritage, and should be the starting point for architectural design: to be able to invent something new from conventions and traditions, they have to be thoroughly examined and well-understood. "Only in history and conventions", he writes, "can we find common ground to build further upon" (1995, p. 38).

On the basis of this, the goal of the design project in this thesis is not to reinterpret or reinvent a certain vernacular tradition, but rather to try and learn from it and to implement that knowledge in a modern way that might resonate with a hypothetical user today while still paying homage to the accumulated experience that generated that knowledge.

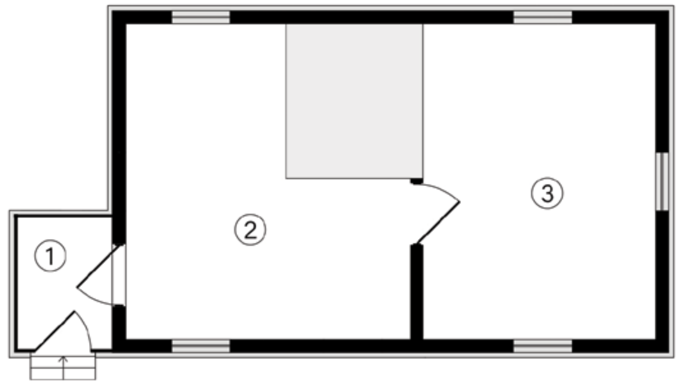
Figure 9: A double house typical for north Bohuslän located in Ramsö, photographed by Sara Östnäs in 1982



THE DOUBLE HOUSE
SCALE 1:100

1. Entry (Swedish: Förstugekvist) 2. Common room, bedroom (Swedish: Stuge, "Stöva") 3. Kitchen 4, 5. Common room, bedroom 6. Annex (Swedish: Bislag, kök-/stugkammare)

The double house was the largest amongst the house types common for stone quarry workers in the region studied by Nilsson. It fits three rooms and a kitchen, with additional narrow rooms on the gable end side which are characteristic for the house type. The houses were originally built using log timber and had a tiled roof. They were clad with wooden boards painted in a white or pale yellow color in the southern parts of Bohuslän but red in the north. In the region where wood masonry buildings have been found, most homes built as double houses were constructed after the 1850s.



THE QUARRY WORKER'S HOUSE
SCALE 1:100

1. Entry (Swedish: Förstugekvist) 2. Kitchen 3. Common room, bedroom (Swedish: Stuva, "Stöva")

This type of house is almost only found in the middle of Bohuslän, and it is named after its main builder and resident; the stone quarry worker. The house type was developed during the expansion in the stone extraction industry, which in the area took place around the 1880's. Typically, stone quarry workers would live as lodgers together with another household for some time, until eventually desiring a home of their own. Not seldom, the means for this could be obtained from lending money from the stone extraction companies.

As mentioned, the double house was already a common house type in the area. With modest economic resources, the quarry workers developed a rationalized version of it by excluding the two rooms on the short end side. The quarry worker's home is either a timber or plank construction, apart from the entry (1) where the walls instead are built using thin boards, and it rests on a rather tall stone foundation with a basement. They were always painted in a bright color. The house consists of two rooms, a kitchen (1) and a common room (2).

ARCHITECTS AND VERNACULAR ARCHITECTURE

Following are some examples of various modern architects who have, in different ways, worked with vernacular building traditions through direct application, reinterpretation or reference. After brief analyses of their different ways of working, the positioning of this thesis' design project is presented in relation to the references studied.

DIÉBÉDO FRANCIS KÉRÉ

Diébédo Francis Kéré, founder of Studio Kéré, was born in Burkina Faso, a west-African nation which struggles with poverty and lack of access to education. The first in his community to attend school, Kéré left his family at the age of seven and went on to move to Berlin, first for a vocational carpentry scholarship and then on a scholarship to study architecture at Technische Universität, motivated by "a personal commitment to serve the community he grew up in, and a belief in the transformative potential of beauty" (Kéré Architects, n.d.).

His first built work was a primary school in his hometown of Gando, which was born out of a near collaboration with the local community, who provided knowledge, resources and labor. The design builds on the local vernacular but uses Kérés knowledge of modern engineering as well as architectural form to create sophisticated solutions to the problems that the school buildings he himself grew up with suffered: maintaining a comfortable indoor climate while still providing light to the interior spaces.

During his practice, especially in Africa, he has developed an architectural language characterized by distinct roof constructions, which are engineered to optimize natural ventilation, shading and rainwater retention. In the example of Gando Primary School, separating the conventional corrugated metal roof from the building is key to prevent it from overheating the interior, but visually it has the effect of visibly distinguishing between that which conforms to the tradition and that which is added onto it.

His architecture is vernacular in the sense that it is truly for and of the community. The vernacular typology is improved upon with modern engineering where it provides solutions to problems, but in other aspects trusts the skill, judgment and experience built into the local vernacular. While distinct and inventive in form, his architecture tends towards a kind of materialistic minimalism, emphasizing the inherent beauty of the materials (clay in particular) and the rationality of their composition.

JAN GEZELIUS

Jan Gezelius, (1923-2016) was a Swedish architect and professor, recognized for his works in both residential and public architecture. In the book *Houses and Landscapes – Works by architect Jan Gezelius* (Engfors & Vial, 2004), Jerker Lundquist describes Gezelius' design approach as a middle way between uncritically adhering to present day materials and techniques, and having a nostalgic relation to the vernacular, which, Lundquist argues, not seldom results in mere kitsch. Instead, Gezelius holds a stance that he himself refers to as "libertarian tradition". This may sound contradictory, as libertarian stands for the right to transgress, but not break, certain rules, while tradition instead offers a set of customs to follow. While the libertarian tradition allows for the designer to freely draw upon different traditions, Lundquist also identifies a search for the beginning of tradition, for the genuine and archaic, in the works of Gezelius.

Another way to describe Gezelius' approach is "dynamic conception", coined by Ulf Jansson in his book *Vägen till Verket* (1998). In the book, Jansson explains Gezelius' design process not as one where one particular idea is refined, but as involving two or more and aspiring to merge them. His works, Jansson argues, can be seen as a juggling of contradictions; local tradition and contemporary culture, the monumental and mundane, nature and artefacts, and the architecture of Gezelius is the result of this interplay.

Relating architecture to people's specific way of life is a large part of Gezelius' legacy, which many of his students testify in the book*Houses and Landscapes* His teaching is described as incorporating a rich portion of general and architectural history, something that he himself describes as "a vaccine for short-lived trends", and he is portrayed as eager to enthuse his students to learn about not only the architecture itself, but its context and origin too.

THESIS APPROACH

The resulting design project of this thesis will apply the plank masonry technique to single-family houses in a modern context, building in some ways on the local vernacular tradition that that certain variation of the technique was born out of. Architecture built using the technique at that time, through its resourceful use of waste material, often necessitated by scarcity, had the ability to tell a poignant story about the time in which it was conceived. Applying the same technique today means allowing another narrative to unfold alongside the historical one, telling a similar story about the conditions of today. For us, that means allowing current building techniques and conventions to shape the architectural expression in the way that seems most rational, inspired by the pragmatic rationality of the wood masonry technique itself. That might mean combining high-tech with low-tech, manual labor with prefabrication, conventional solutions with specially tailored ones.

It intends to relate to that tradition to the extent that the design work, as Finn Werne recommends, departs from a thorough examination of the local tradition it inserts itself into. This concerns everything from materials and details to building typologies, including the evolution of those typologies as well as the internal differences within them. Here, there are several parallel tracks to examine: both the geographical context of west Sweden, and the context of the Swedish built heritage of wood masonry buildings in general.

The approach means to generate a design whose broad strokes – silhouette, window placement, proportions – recalls something familiar and recognizable. A way of doing so without it becoming "mere kitsch" is by taking specific prominent traditional characteristics, such as the rough-hewn stone foundations typical for the granite coast, and overexaggerating those features. Another way could be to recreate those characteristics using materials that contrast with those traditionally used. As the design project will result in the design of two houses, there is an opportunity to test different approaches, and combinations of approaches, in the two.

Figure 10 (left): Gando Primary School in Burkina Faso, built in 2001 by Francis Kéré Architects.

Figure 11 (right): Villa Drake by Jan Gezelius, built in 1970.

Stacks of construction lumber stored at Derome sawmill in Veddige in Halland, Sweden, before going into the drying kiln.

The timber industry

In recent years, the Swedish forest industry has become a subject of heated debate, both within the country and on an EU level. The industry is responsible for emitting more carbon than all traffic and all other industries in the country do combined (SVT Nyheter, 2022), and the common practice of clear-felling and replacing natural forests with monocultural tree plantations has been heavily criticized for its negative effects on the climate and nature's biological diversity.

With the demand for wood products only increasing as the construction industry begins to try and shift from steel and concrete, this debate is more relevant than ever. And yet, out of the timber produced in our fiercely debated forests, as much as 80% is used to produce short-lived consumer goods. The Swedish Society for Nature Conservation (*Naturskyddsföreningen*), whose stance is that the way the industry operates today is devastating for climate and biodiversity alike, specifically say that we need to use more of the wood from the trees we fell to build houses, retaining the embodied carbon for as long as possible (2022).

While recognizing that what we most of all need is to transition from the forestry practice that we have today into a more sustainable one entirely, we also believe that it is crucial to, even now, start utilizing the resources we produce more responsibly. As much as possible of the valuable log wood needs to be used to build houses, the most long-lived product that we have at our disposal, instead of becoming pulp or biofuel.

Already, some argue that an even higher rate of logging is needed before we can fully transition to bio-based energy sources. Others warn that the initiative to replace fossil fuels with bioenergy in some cases has counteracted the development of truly resourceful forestry practice that would have had an ever lower impact on the environment (Röstlund, 2022, p. 57). Although wood-based biofuel is often labeled a "green" energy source, it's worth noting that, per unit of energy produced, wood actually emits more CO_2 than both oil and coal (Röstlund, 2022, p. 52). A common ground one could argue is that as long as the biofuel is made from waste wood, there could be no better use for it. However, this thesis argues that one way of shifting towards a more resourceful forestry is to re-evaluate what is considered waste altogether.

DEROME TIMBER

In 2025, there are around 130 sawmills in Sweden that produce over 10 000 cubic meters of sawn products every year. In 2019, the ten largest companies were responsible for 60% of that, and the 20 largest for 80% of it (Svenskt Trä, n.d.). One of them is Derome Timber, which is part of the company Derome Group and is Sweden's largest family owned company within the wood industry.

It was founded in 1946 and operates within both forestry, the sawmill industry as well as within the building and construction sector. They are focused on the west part of Sweden, which is also where their main area for forest purchase is. Derome Timber is the department within Derome Group that focuses on forestry and runs the company's sawmills (Derome, n.d.-a).

Derome Timber has five production facilities located in the west of Sweden; four sawmills (Anneberg, Derome, Kinnared and Maa) and a planning facility in Okome. While the Anneberg facility is specialized in refining pine, the other sawmills almost only produce spruce products. About half of their products are exported, and the rest is either sold through retailers or used by other departments within the company, such as the company's house production (Derome, n.d.-b).

Export goods are mainly shipped out from the harbor in Varberg, which is the largest in Sweden when it comes to timber export (Via TT, 2019). Most of the export is to countries that work with the same dimensions of timber as Sweden: England, Denmark, and the Netherlands to name a few (personal communication, February 19 2025).

For this thesis, we contacted Derome's facility in the city of Derome, located about an hour south of Gothenburg, and were given a guided tour of the mill. Unless otherwise stated, the facts presented in the following chapter are recounted from this study visit.

The Derome sawmill produces around 400 000 cubic meters of sawn lumber each year and the production line has a yield percentage of around 71.5%, meaning their lumber recovery factor (LRF) is around 0.72. It primarily produces construction lumber, finger joint lumber (Swedish: *fingerskarvat virke*) – the process of which is described further in the next chapter – tongue-and-groove boards (Swedish: *råspont*), and panels made from tongue-and-groove boards (Swedish: *råspontluckor*). The manufacturing process naturally yields different streams of by-products, such as sawdust, wood shavings and bark.

Out of the wood shavings – a byproduct of the planning process (Swedish: *kutterspån*, *hyvelspån*) – the whole volume goes to Derome's internal pellet production, and is packaged and shipped to their pellet mill in Kinnared to be turned into pellets that are sold to both industries and private customers.

The process of producing finger-jointed timber yields a by-product in the shape of short offcuts of defect timber, which are cut away before the remaining lumber is joined. Currently, these are chipped and burnt as biofuel for the mill's drying kilns (Swedish: *virkestorkar*), as is the bark. These are the offcuts focused on in this thesis. It is worth highlighting here, however, that Derome has an excess of both bark and wood chips, and the surplus of both of these byproducts is sold to external heating plants and, in the case of the wood chips, paper mills. Longer offcuts generated during the same process are instead cloven and used as stickers – planks that are laid between layers of lumber stacked for drying (Swedish: *truckströ*) – which Derome usually has a need for internally, though any surplus that occurs is sold.

Just as with the construction timber, imperfections in tongue and groove boards are also cut away in order to create finger-jointed boards. However, Derome also exports boards where the defects have been kept, and sells them at shorter lengths as a lower quality. The main purchaser for these boards is China.

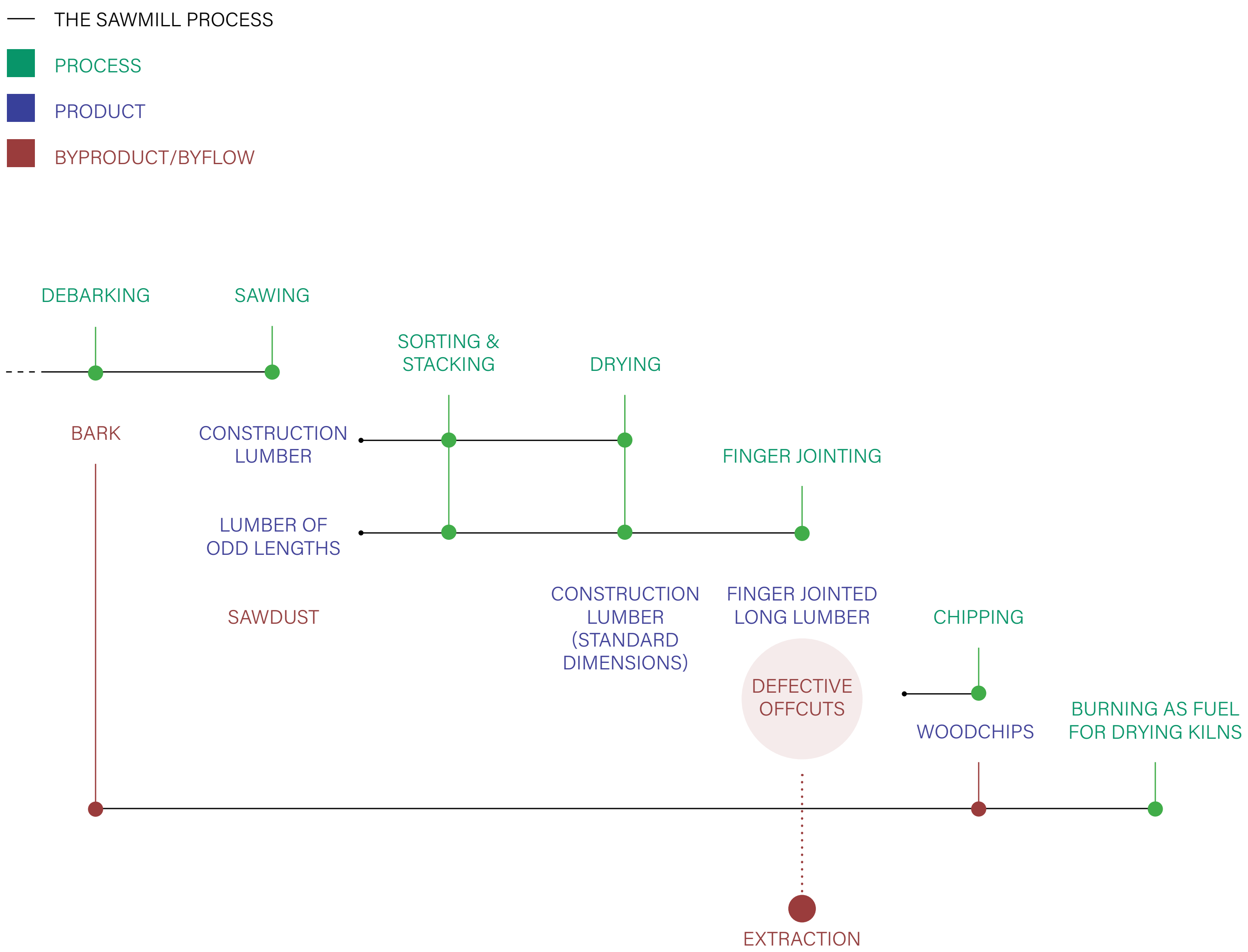
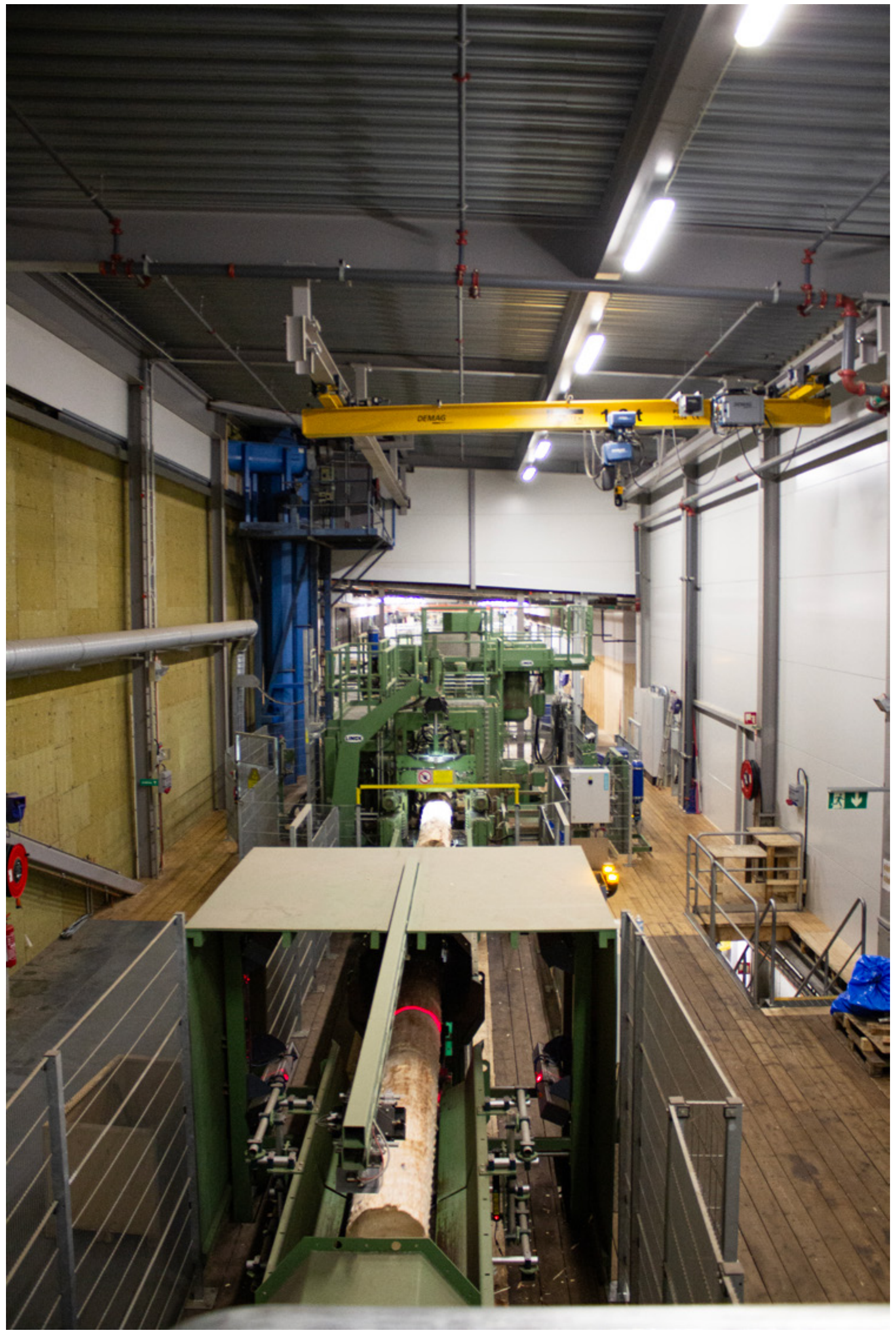


Diagram showing how the offcuts are generated during Derome's production line.

This is the first room that the logs enter in the sawmill production chain, where the debarking happens. On the left, the bark which has been taken off the logs visible on the right is extracted to be burnt as biofuel to power the sawmill's drying kilns.

After passing through the debarking room in the previous picture, the logs enter the sawmill line at this point. At intervals, the log passes a measuring frame with a laser, as visible in the bottom of this picture.



Every shift, one person works here, monitoring the whole sawmill line through cameras placed at each step of the process and making sure to quickly fix any errors that cause a stop in production.

The lumber leaves the conveyor belt in the first building looking like this, and proceeds to be sorted and stacked in forklift-friendly piles, with layers of stacking sticks in-between to ease the wood's drying. From here, the piles go into one of the three drying chambers, where it is dried for, on average, three and a half days, making it the most time-consuming step of the process.

The uneven lengths in one of the stacks is a consequence of the highly modernized sawmill production line, which optimizes the sawing to get the highest possible yield from every log. The scanners take any defects like knots or cracks into account and makes sure that all lumber is of high quality, but of shorter length if that is necessary to avoid the defects.

These shorter planks of varying lengths are what, after drying, gets passed on to another building to be turned into finger jointed lumber.

This picture is taken inside the building where planks of varying lengths are finger jointed together to make lumber as long as 14 meters. In the highlighted square, a conveyor belt goes to a container outside, as seen in the picture on the right. When defects are found on the planks, they are sawn off with as small a margin as possible, leaving only high-quality lumber that can then be finger jointed together again.

This container holds the defective pieces of spruce wood sawn off for finger jointing, in lengths of around 30 centimeters maximum, and widths varying between 10 and 25 centimeters.

Today, these pieces are chipped and used internally as biofuel to power the drying kilns.

OUR OFFCUTS

The byproduct generated on the production line for finger jointed spruce lumber, as described on the previous spreads, is a short piece of wood that is removed so that the remaining, jointed timber can be strength graded according to common standards, in this case C24. About 5% of the timber that goes into the finger-jointing production line is cut away, and depending on how much has been deemed defective the pieces vary in length, with the shortest being about 100 mm and the longest around 250-300. The dimensions of finger jointed timber that Derome Veddige produces, and consequently the dimensions of the off-cuts that end up in the container are listed in the chart below, as well as the percentage of each dimension based on figures received from Derome in the spring of 2025.

When producing the finger jointed timber, only one dimension of timber is produced at a time. However, the production runs 17 hours per day and depending on the demand, several shifts that process different dimensions may take place after another before the container is filled, meaning that currently the timber is not sorted according to size in the container.

Dimension	% of production
45 x 150	19
45 x 175	10
45 x 200	26
45 x 225	19
45 x 250	11
60 x 225	1.7
75 x 150	1.5
75 x 175	1.3
75 x 200	2.6
75 x 225	5.7
75 x250	1.2

The different imperfections that have caused the pieces to be cut away vary, but typical issues are knots or cracks in the timber. Some blocks are brittle due to internal cracks and split already when landing in the container. In others, the only cause for cutting the piece away is a small knot or other imperfection that would otherwise make the timber unpredictable in the affected area.

MATERIAL PROPERTIES

To evaluate how well an exterior wall performs in terms of insulation capacity, its thermal transmittance, or U-value, is estimated The U-value is the amount of heat that passes through 1 square meter per difference in temperature between the indoor and outdoor. To calculate this, each ingoing layer's thermal conductivity, its λ value, as well as the thickness of the layer is added into an equation. For spruce, the λ value of wood with a moisture content of about 12% is around 0.10-0.12 W/m°C.

As mentioned in previous chapters, the mortar used for the plank masonry houses built in the Bohuslän was clay, and this is also what will be used in the design project presented later in the booklet. Depending on the mixture the λ value differs, but as a reference the figure for clay mixed with straw is around 0.7 (Slöjd & Byggnadsvård, 2013). Since this is less effective than wood in terms of insulation, the amount of clay used in the wall should be taken into account when estimating the wall's overall thermal performance. In addition to the wooden offcuts and the clay mortar, insulation and any potential cladding are also included in the calculation of the wall's total U-value.

The timber used in the finger jointing process has a moisture content of about 18%. By the time it is installed in a structure, this has usually decreased to about 16%. However, after landing in the container, the off-cuts do not share the same conditions as the construction lumber, and so the latter figure does not necessarily represent the moisture content in the cut away blocks. As the moisture content in the wooden blocks changes, they will continue to either shrink or expand. Being an anisotropic material, the changes differ depending on the direction of the fibres. As a rule of thumb, it can be said that for each percentage point difference in moisture content in the wood, the shrinkage or swelling is around 0.26 percent in both the radial and tangential direction, and around 0.01 percent along the fibres (Träguiden, 2017).

The photograph to the left shows the cross section of a typical offcut piece, 45x220 mm, in real size when printed on A4 paper. Apart from knots and other imperfections, its edges are slightly defect and the wood is bent.

II. IMPLEMENTATION

"Every project is a stance towards, affirmation of or denial of one life form, culture [or the other]. (...) For whom and for which life forms the architect takes a stance in his project is not only a cultural act but also a political and ideological act."

"Varje projekt är ett ställningstagande till, bejakande eller förnekande av den ena eller den andra livsformen, kulturen, språkspelet. (...) För vem och för vilka livsformer arkitekten tar ställning i sitt projekt är inte bara en kulturell handling utan också en politisk och ideologisk handling."

Finn Werne in "Om Arkitekturens Förlorade Sammanhang" (roughly translates to "On the Lost Context of Architecture"), written in 1995 (p. 37). Quote translated by the authors.

Design project

The thesis project consists of designing two single-family houses which take the plank masonry technique and implements it within the framework of today's construction industry. As has been presented in the previous chapter, it uses as its main building block the same kind of plank offcuts that were used historically, extracted from one of Derome's local sawmills.

Inspired by the rationality and pragmatism that historic wood masonry buildings showcase, the intention has been to combine the masonry with conventional building components, like joists and roof trusses, in a simple and logical way.

The prototypes can in a way be regarded as being somewhat in the vein of the mid-century Case Study Houses: they aim to utilize industrial products and conventional components to design low-cost houses, but which still bear the distinct mark of an architect. The resulting design therefore combines high-tech with low-tech, manual labor with prefabrication, conventional solutions with specially tailored ones.

In order to make the architect's touch felt, it has been important to emphasize the unique tectonic qualities of the masonry through careful detailing: the thickness of the walls, the treatment of the openings and the visual and tactile characteristics of the exposed masonry itself. For this, we have allowed ourselves to take inspiration from stone and brick masonry construction.

Two buildings have been designed, which have slightly different character, to be able to test different ways of expressing these qualities architecturally, and different combinations of those approaches.

House no. 1 is a one and a half story villa, with a low and wide ground floor and an upper floor with a high pitched ceiling. The plan draws inspiration from that of the double house (Swedish: *dubbelstugan*), and the silhouette is a somewhat overexaggerated reference to that of such traditional Bohuslän buildings. The openings are made possible by what we have chosen to call binders: instead of individual lintels above each window (which are instead concealed within the wall), a consecutive band of planks runs around the whole perimeter of the building.

House no. 2 has two stories, with the ground floor's exterior walls constructed as massive load-bearing masonry walls, whereas the upper level's load-bearing walls are an infill-type construction with the wood masonry used as filling between the studs. Inspiration for the overall architectural expression is drawn from the granite foundations characteristic of north Bohuslän's granite coast.

DESIGN EXPLORATIONS

In order to familiarize ourselves with the technique before applying it, and to help build a framework for the design project, different exercises referred to as "design explorations" were carried out. This includes drawings and collages, scale models, 1:1 experiments as well as digital models.

The aim was to explore different ways to construct a plank masonry building that meets contemporary standards, drawing on photographs and written descriptions of historical buildings for reference, but using the offcuts from the modern day sawmill as building blocks instead. They were also a tool for understanding how the technique can be used in combination with common-practice materials and building components. Not least, the design explorations were a way to study the materiality of the building blocks themselves and to identify what unique qualities a plank masonry building could have that we could carry with us into our design.

The design explorations will not be presented further in this chapter, but a selection of them is included in the appendices under "Design explorations".

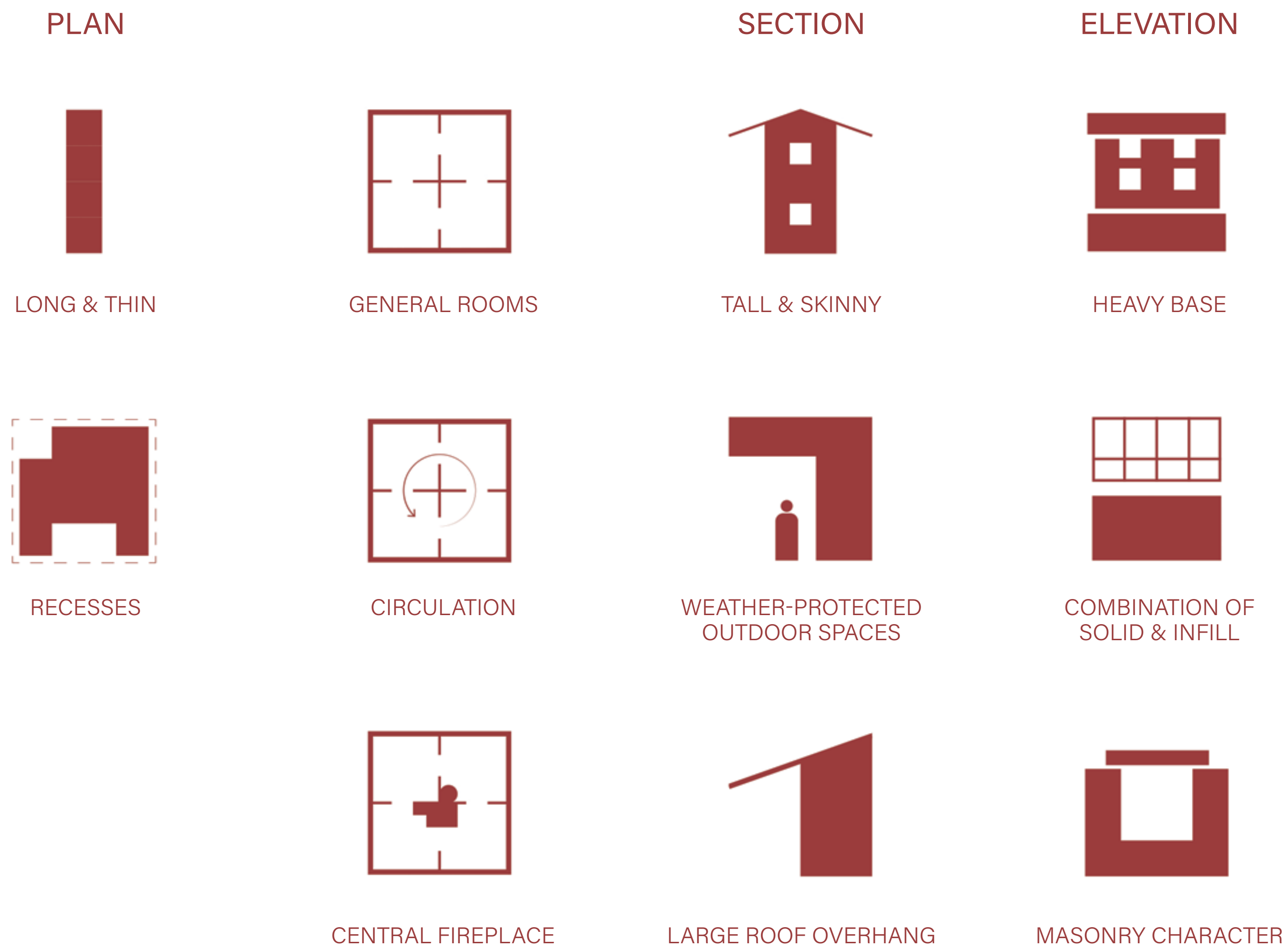
Design principles

This photograph shows a dry stacked wall segment done as part of the design explorations, which can be found in the appendices. The wall is roughly 650 millimeters thick, and consists of two layers of offcuts with a layer of loose-fill hemp insulation between them. Perpendicular connectors made from regular construction lumber are placed at random intervals throughout the wall that serve to make the two masonry layers function as one unit. For the load-bearing plank masonry walls in both of the design proposals to come, this is the principle that has been used.

As a starting point for the design project itself, the most important takeaways from the historical research and reference studies as well as the design explorations were distilled into the following design principles, or design features. Though there are different motivations for each of them, the overarching goal is to utilize and tectonically express the wood masonry's strengths and weaknesses. For example, for it to be possible to have an exposed wood masonry facade, it needs to be weather-protected by large overhangs, or through a clever orientation of the unpanelled exterior walls.

As the project takes its starting point the plank masonry architecture in Bohuslän, some principles draw inspiration from the local vernacular architecture of that region specifically, such as the qualities of the floor plan of the double house (Swedish: *dubbelstugan*) and the stonemason's house (Swedish: *stenhuggarhuset*). Another example is the Bohuslän tradition of building large basements and foundation with heavy granite blocks, which also ties into the region's stonemasonry heritage. The "heavy base" principle is derived from an aspiration to interpret that tradition but using a "faux" building block – one that does not at all behave like neither granite nor timber, at least not as we are used to handling it. To achieve this visual effect, one option might be to make the walls of the upper floors thinner by having a post-and-beam structure with masonry infill instead of a solid masonry wall, etc.

The resulting designs, which cherry-pick freely from these design principles, are two residential buildings that will be presented on the following spreads.



House no. 1

160 sqm with up to four possible bedrooms, this house can be said to be a modern reinterpretation of the double house (Swedish: *dubbelstugan*) typical for north Bohuslän, but cast in a masonry mold. The four equally sized rooms of the traditional double house, centred around the fireplace, have evolved into a central combined kitchen and dining room, and extended with a kind of annex that holds a bathroom with laundry, a rough entrance and the staircase to the second floor.

The pronounced concrete foundation has an exaggerated plinth that extends along the whole perimeter of the building and serves as additional moisture protection for the wood masonry walls. Entering the building, you take a small step up onto the foundation into the weather-protected entrance area where the wood masonry facade is left unplastered. With the exception of the front entrance, the openings on the long sides are all symmetric and equal in hierarchy: all can be fully opened up and used as garden entrances.

Stepping into the hallway, the first thing you see is the central fireplace in the kitchen (see render on page 46), whose connected site-built bench has room for a long table where eight people can comfortably gather for dinner. Past it are two rooms of 3.5x3.5 meters which could either be furnished as living rooms or bedrooms, one of which has an additional wood-burning stove. At the other end of the entrance hallway is the combined bathroom and laundry. A utility room with its own sink outside creates the possibility of a rough entrance where crops or dirty gardening tools can be brought in for cleaning (see render on page 49).

The low ceiling with its exposed beams and the large roof overhang that is visible through the windows stand in stark contrast to the high vaulted ceiling that meets you when you go up the stairs. On the second floor are three enfilade rooms with skylights which can be used as one or two more bedrooms, or as a separate TV room and a master bedroom. Niches on both sides of the stairs can be furnished as reading nooks or two comfortable offices for working from home.

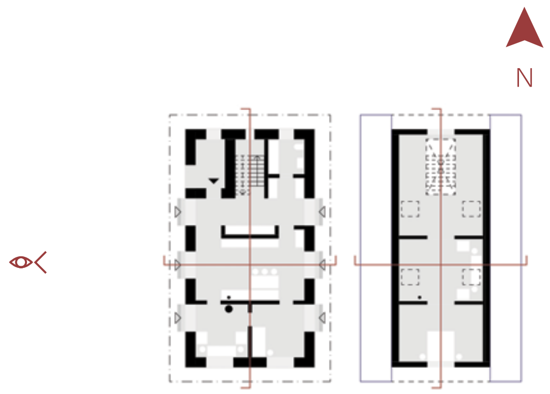
The load-bearing exterior masonry walls are constructed like in the photograph on page 28, with two layers of masonry aligned to have an even outer and inner face, and with loose-fill hemp insulation filling the gap between the two layers, amounting to a wall thickness of 650 mm. Calculated without the clay render, which adds up to roughly 30 millimeters on each side of the wall, the U value of just the masonry wall amounts to 0,1275 W/m^{2}K. This is taken as a mean of the worst-case and best-case U values, as the ratio between wood and insulation varies throughout the wall.

There are randomly spaced connectors between the layers (running orthogonal to the wall's longitudinal direction) and on lintel height, along the whole perimeter of the building, runs what we have chosen to call a binder. As mentioned previously on page 11, this was a unique characteristic that historic plank masonry houses in Bohuslän had which the Norwegian houses did not, and which we therefore thought important to include it and make visible both in the facade and in the interior.

Traditionally, in Bohuslän plank masonry houses, the binders would be made up of long, consecutive planks laid on somewhat equal heights throughout the masonry wall. However, in the thick double-layer wall proposed here, the binders are necessary only to bridge the door and window openings.

In the interior, the tectonic qualities of the masonry wall are emphasized by visibly distinguishing between what is massive masonry and what is regular construction lumber laid on top of it. Atop the visible binder on lintel-height the beams that carry the intermediate floor are left exposed, contributing to the low and enclosed feeling of the ground level in contrast to the loftier second floor.

Photograph of a 1:75 scale model of House no. 1 showing the volume and exterior materials in abstraction: a concrete foundation, a plastered facade and a light metal roof.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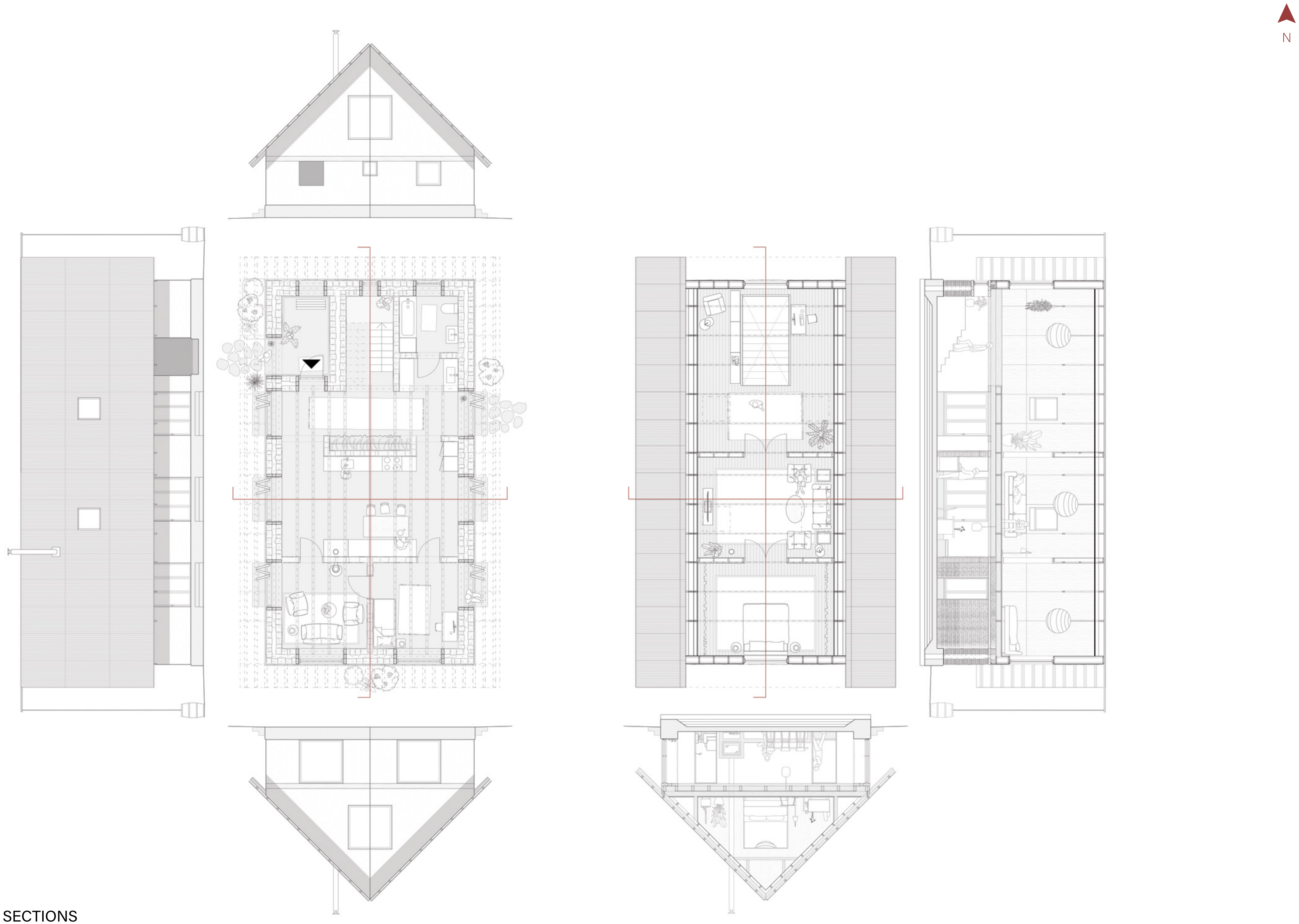
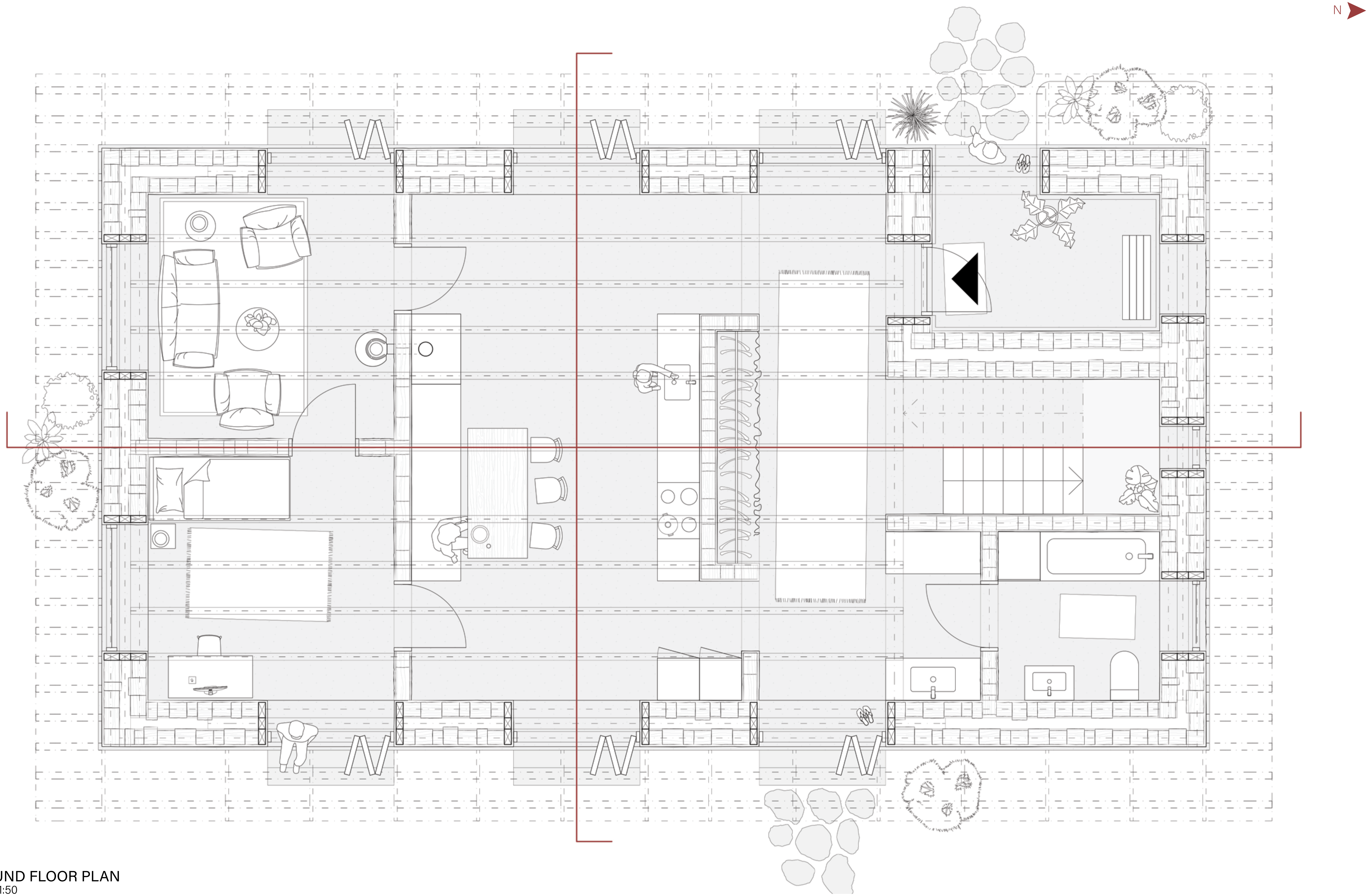
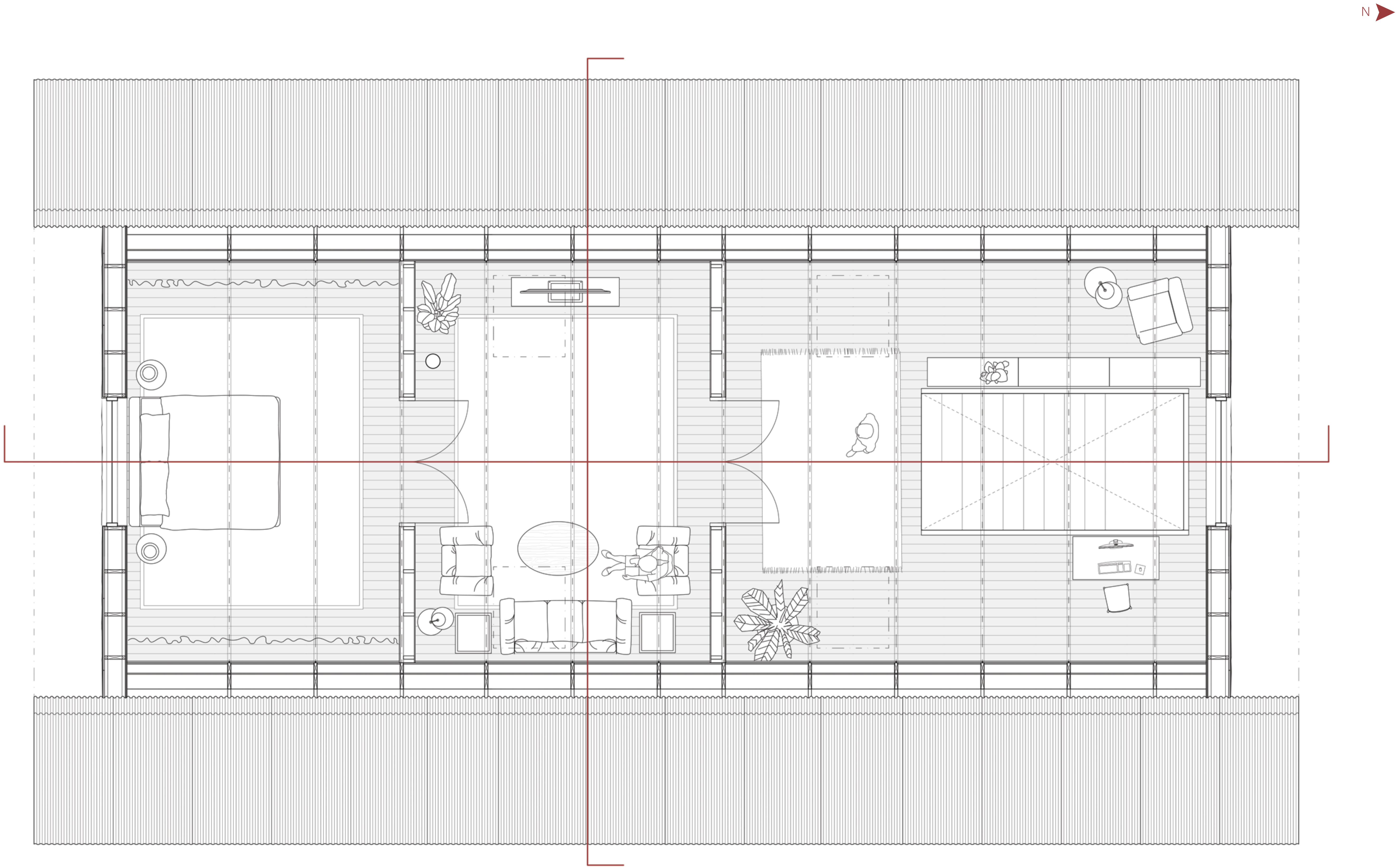


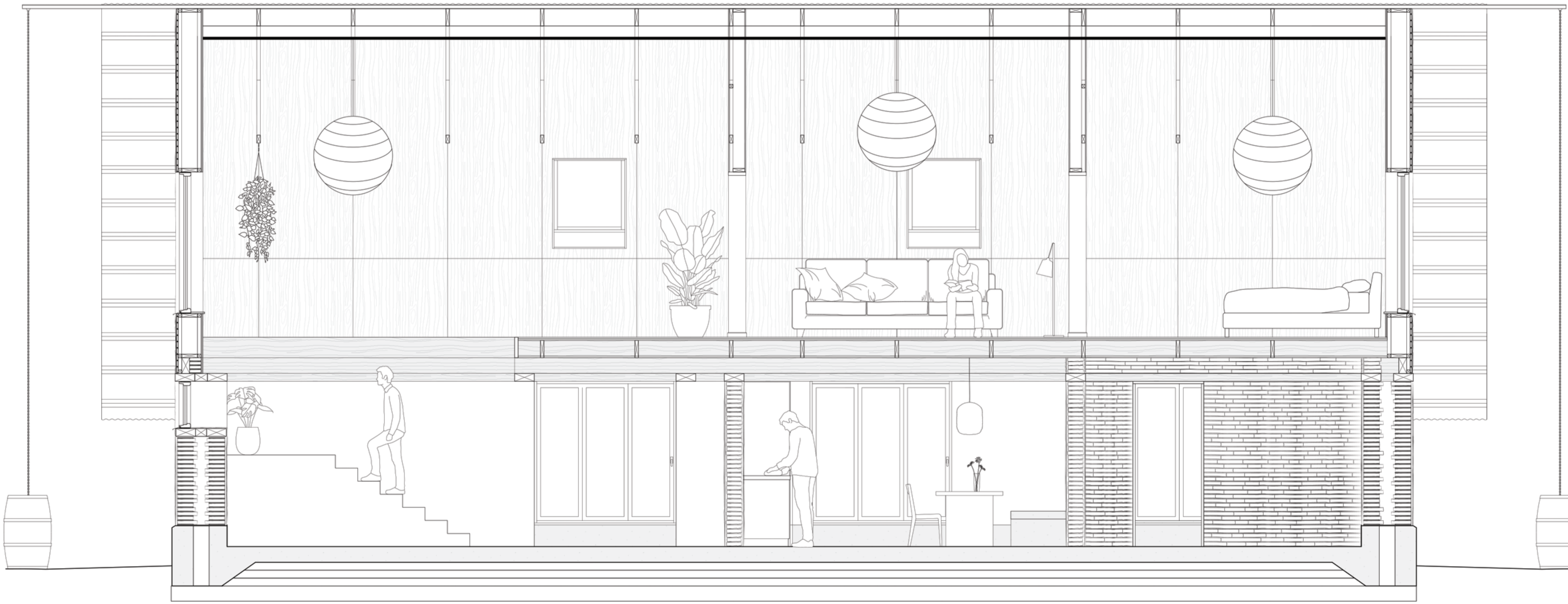
PLANS, ELEVATIONS & SECTIONS
SCALE 1:150



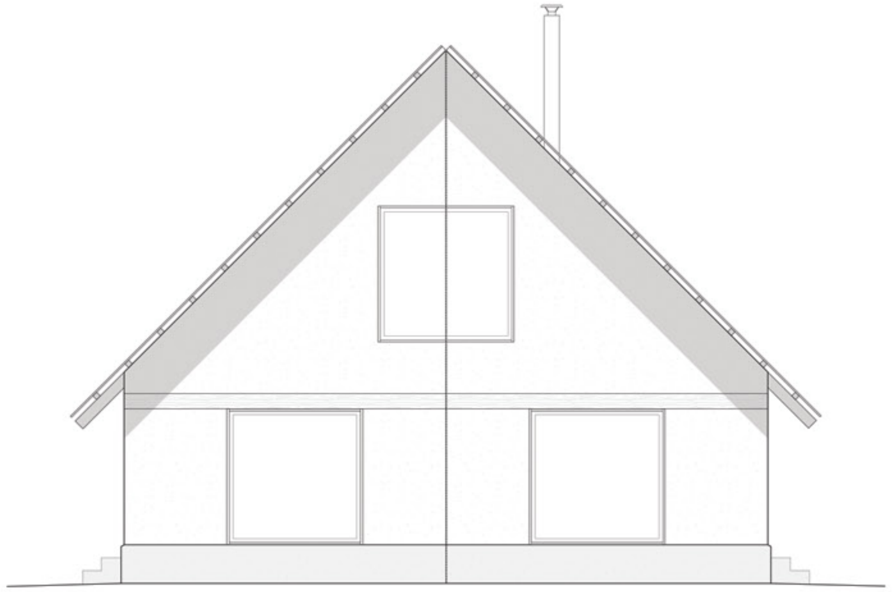
GROUND FLOOR PLAN
SCALE 1:50

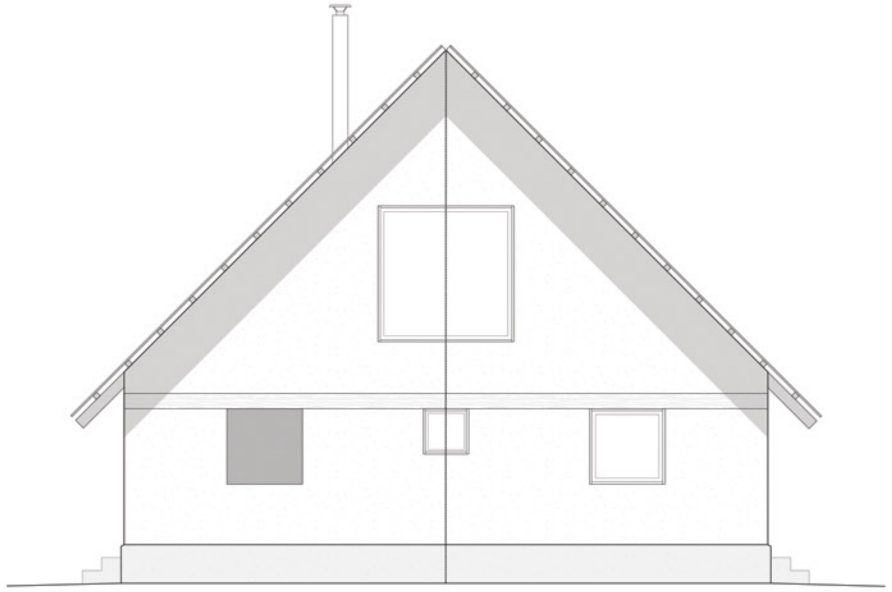


2ND FLOOR PLAN
SCALE 1:50

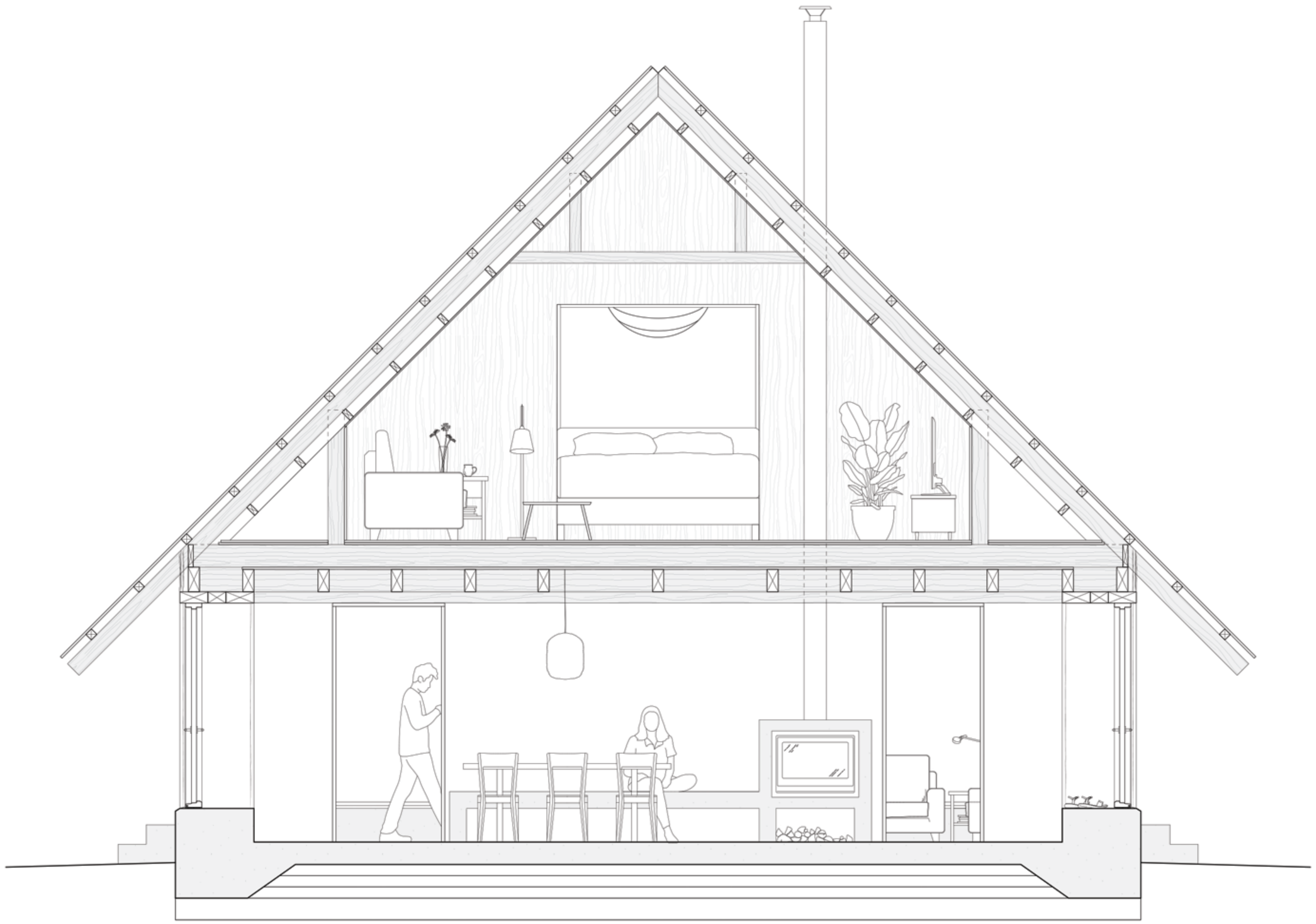


DETAILED SECTION
SCALE 1:50

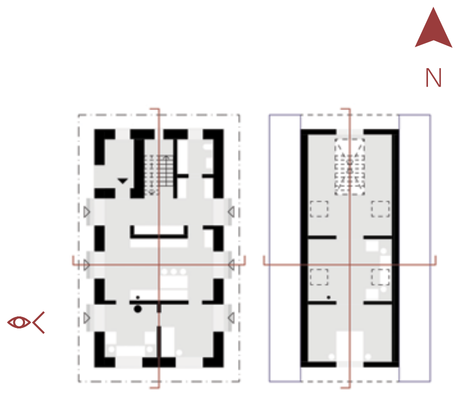




SOUTH & NORTH ELEVATION
SCALE 1:100



DETAILED SECTION
SCALE 1:50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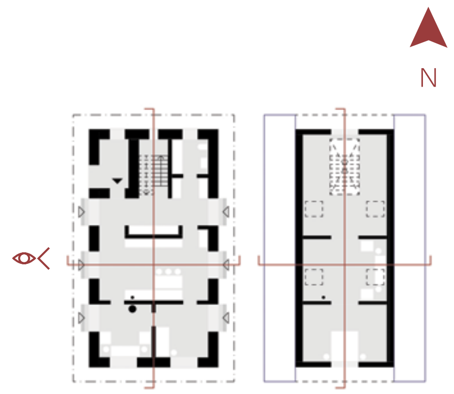
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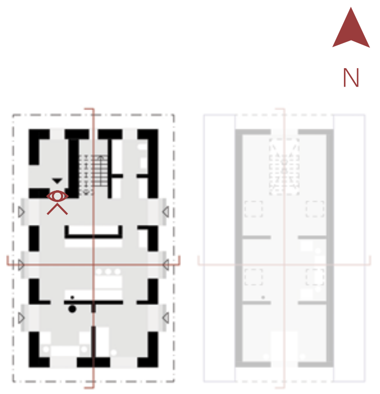
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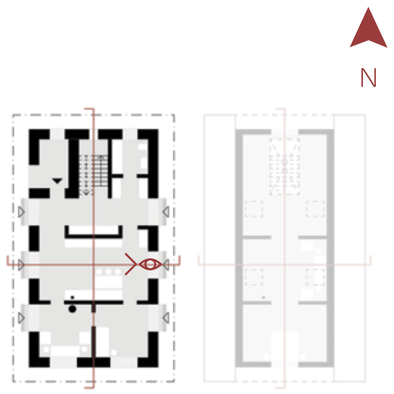
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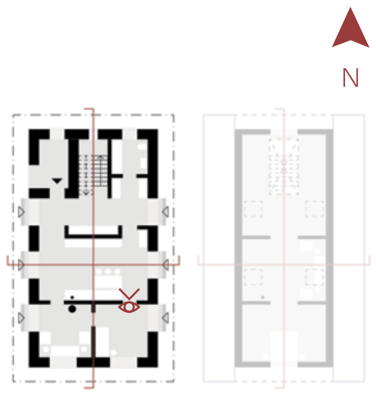
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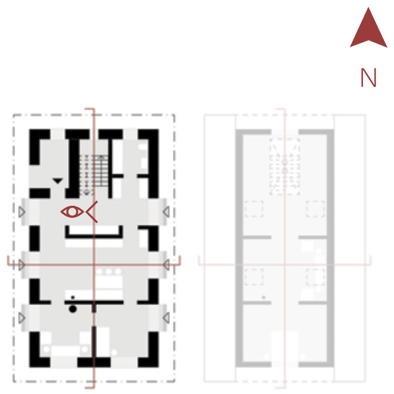
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House no. 2

The two-storey villa, measuring 17.5 meters in length, 6.3 meters in width, and totaling 160 square meters, presents a narrow silhouette inspired by the gable end of a traditional Bohuslän villa, as seen in the reference photos on pages 54-55. The walls on the first floor are plastered, as is the base plate, with the intention of making them appear as a single unified element. In contrast, the second floor is clad in wood paneling to emphasize the difference between the two levels and allow the first floor to present itself as the heavier structure, suggesting stone or masonry. However, the main entrance is approached through a weather-protected passage where the plank masonry walls are left exposed, revealing the true building blocks to the visitor.

The openings in the facade on the first floor continue all the wall up to the wooden cladding, as opposed to having a visible and perhaps accentuated lintel. This too is a feature inspired by Bohuslän architecture where the openings in the heavy stone foundation, traditionally a basement, meets the sill plate (Swedish: *syll*) carrying the second floor, all clad in wooden panelling.

In the roof structure are four purlins (Swedish: *takåsar*) on each side of the house, a common feature in traditional Bohuslän architecture, which carry the rafters and the corrugated metal roof. As a way to emulate a clay tile roof, the sheet metal roofing is laid in smaller segments, although exaggerated if compared to the size of a clay tile, and with the seams intentionally left visible.

The structural system is a combination of load bearing plank masonry exterior walls on the first floor and an infill structure on the second, where only the outer layer is load bearing, and the inner layer is constructed independently of it. On the balcony, this is visible as the outer layer continues along the house's outer perimeter while the inner layer instead takes a detour in the shape of an L, creating a weather protected balcony where the plank masonry can be displayed. The U-value for the first story wall is estimated to 0.15 W/m^{2}K, and 0.13 Wm^{2}K for the second floor.

Both storeys are laid out with a central spine that divides the house into three zones, with a furnished zone on either side of it. The ground floor holds a main entrance as well as a garden entrance with a laundry room. The central axis then continues through the kitchen and dining room before ending with a fireplace centered in the living room. The second floor holds three bedrooms and a bathroom, office and storage as well as a small, second living room and a weather protected recessed balcony facing south.

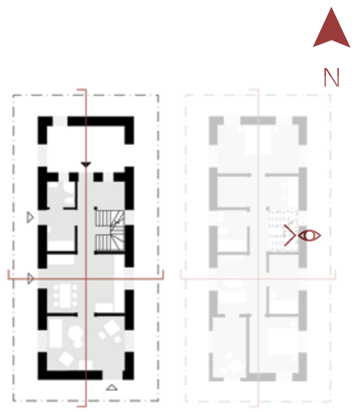
The floors are also divided in segments along the main axis by exposed plank masonry walls. They are constructed in the same way as the inner layer of the cavity wall on the second floor, meaning that all types of the plank masonry construction are in fact visible not everywhere, but somewhere, in the house.

The bays created between these walls allow for further subdivision, and here, timber stud walls are inserted between the masonry. Being noticeably lighter and thinner, they become subordinate in character. This feature is part of an overall ambition to make a building that is easy to read, with a clear hierarchy and distinction between its different parts.

This approach also resulted in surface finishes and wall-mounted furnishings applied to the interior plank masonry walls — such as shelves in the kitchen and laundry room — being attached via vertical studs that are allowed to sit exposed on the face of the walls. Furthermore, any installations are mounted externally wherever possible, and otherwise run through cavities within the masonry structure.

The resulting design leaves the building's tectonics exposed, with a clear distinction between its various elements. These are not only separated by structural versus non-structural roles, but also allow for surface finishes and installations to be displayed as something in between the fixed building component and furnishings.

Photograph of a model built House no. 2 in scale 1:75 showing the volume and exterior materials: plaster for the first floor, wooden panelling for the second and a thin metal roof.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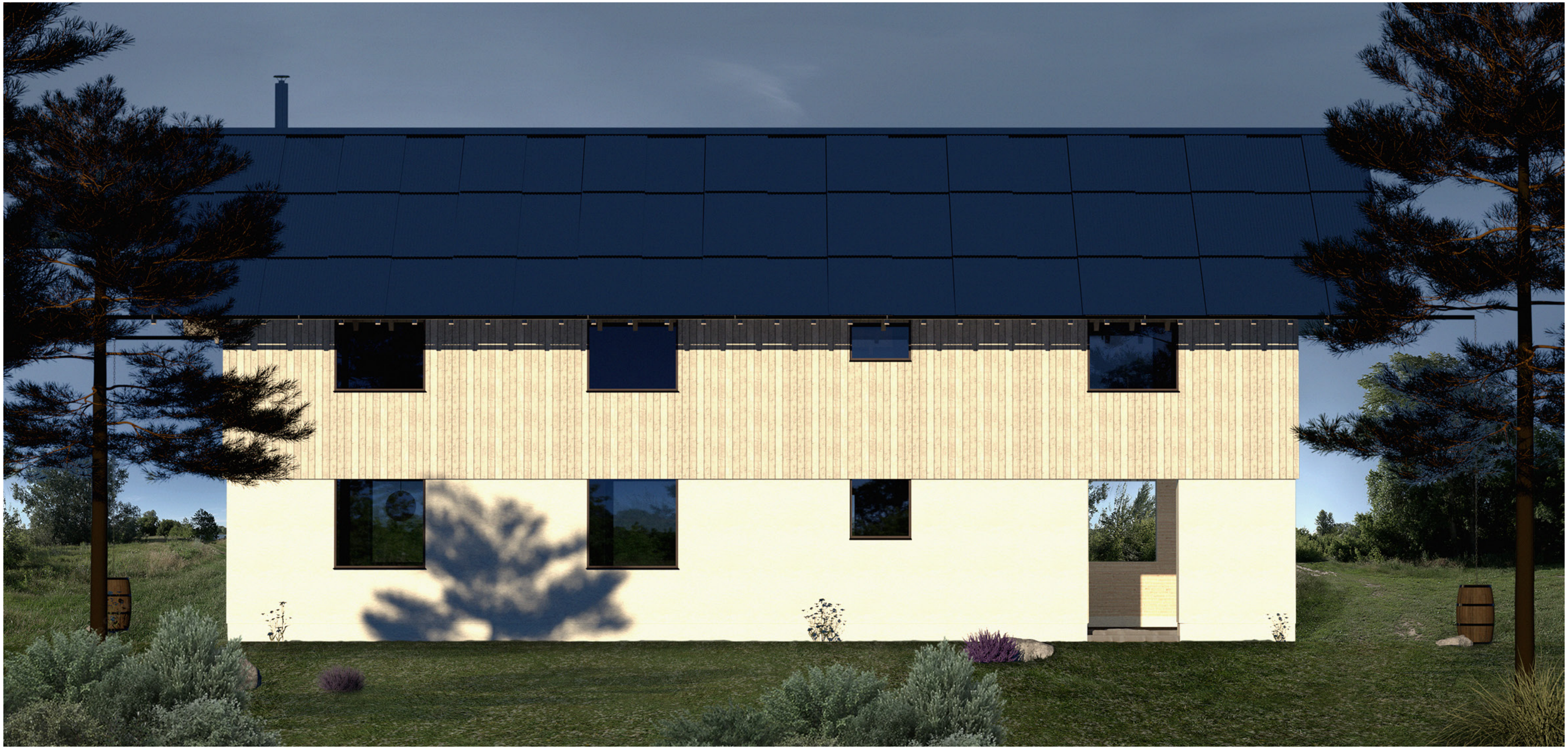


Figure 12: The entrance to a high furnished basement with double walls of wedged granite in Ulebergshamn, photographed by Sara Östnäs in 1982. In the 1890s, when stonemasons from other parts of the country had become established in Bohuslän, high granite basements like these became a common sight amongst the fishermen's houses. The basement walls were, as is the case in this example, made from two layers of granite with earth filling the space between them. In the summers, the family would move down into the cool basement, which usually had an extra kitchen with a stove for that purpose (Werne & Östnäs, 1983).

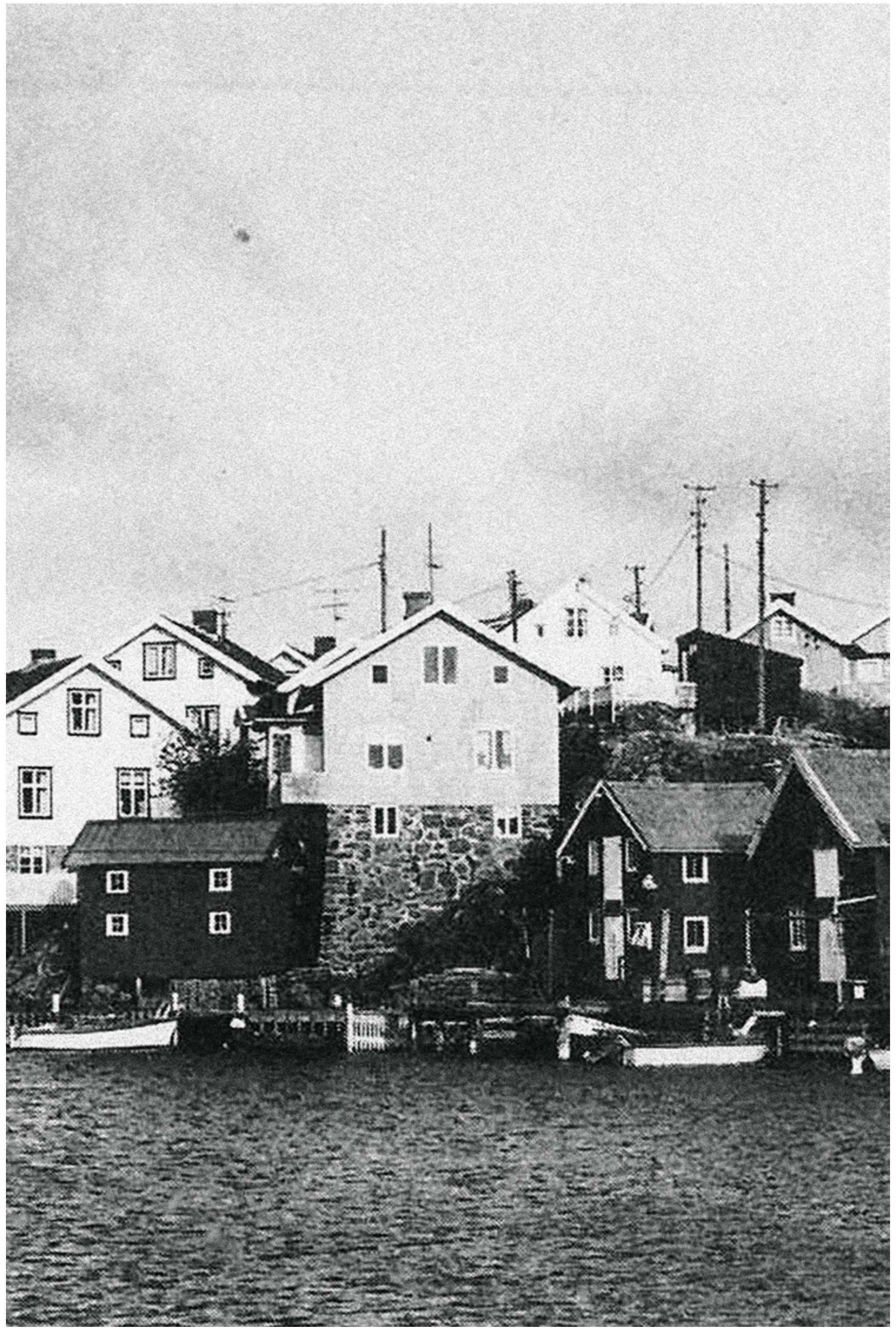
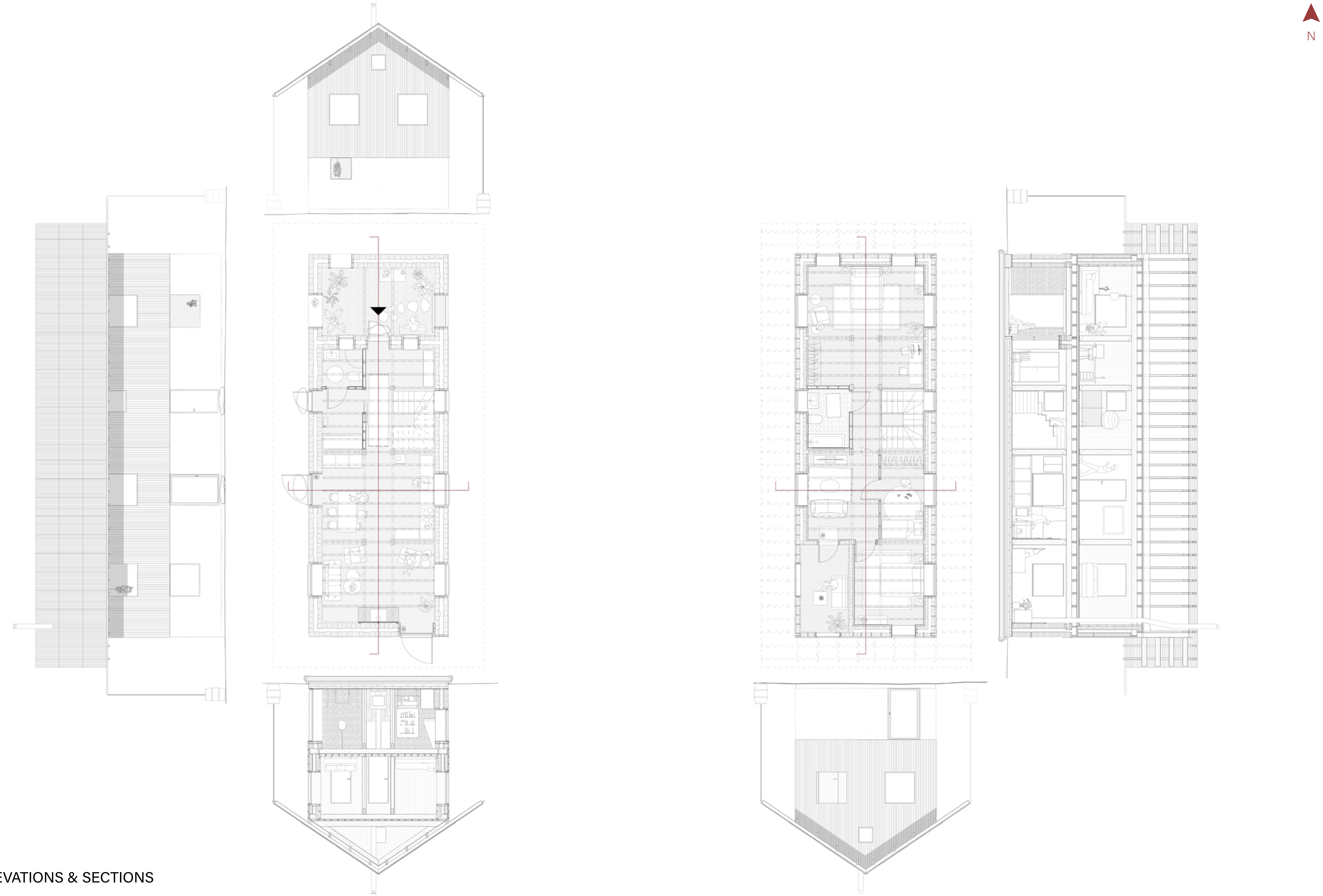
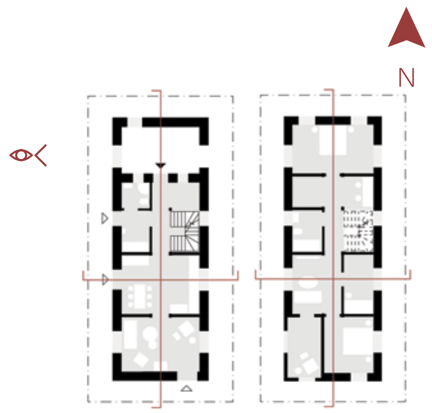


Figure 13: The island of Gullholmen, one of the most densely built-up areas in Sweden, photographed by Sara Östnäs in 1982. Though basements like these are common in the rocky coastal landscape of Bohuslän, this one is an especially impressive example.



PLANS, ELEVATIONS & SECTIONS
SCALE 1:160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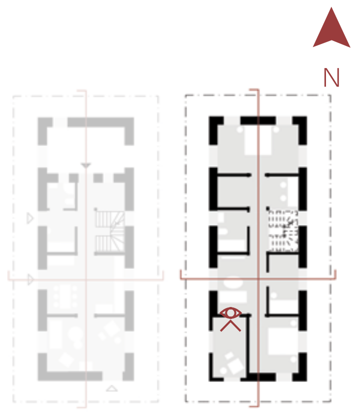
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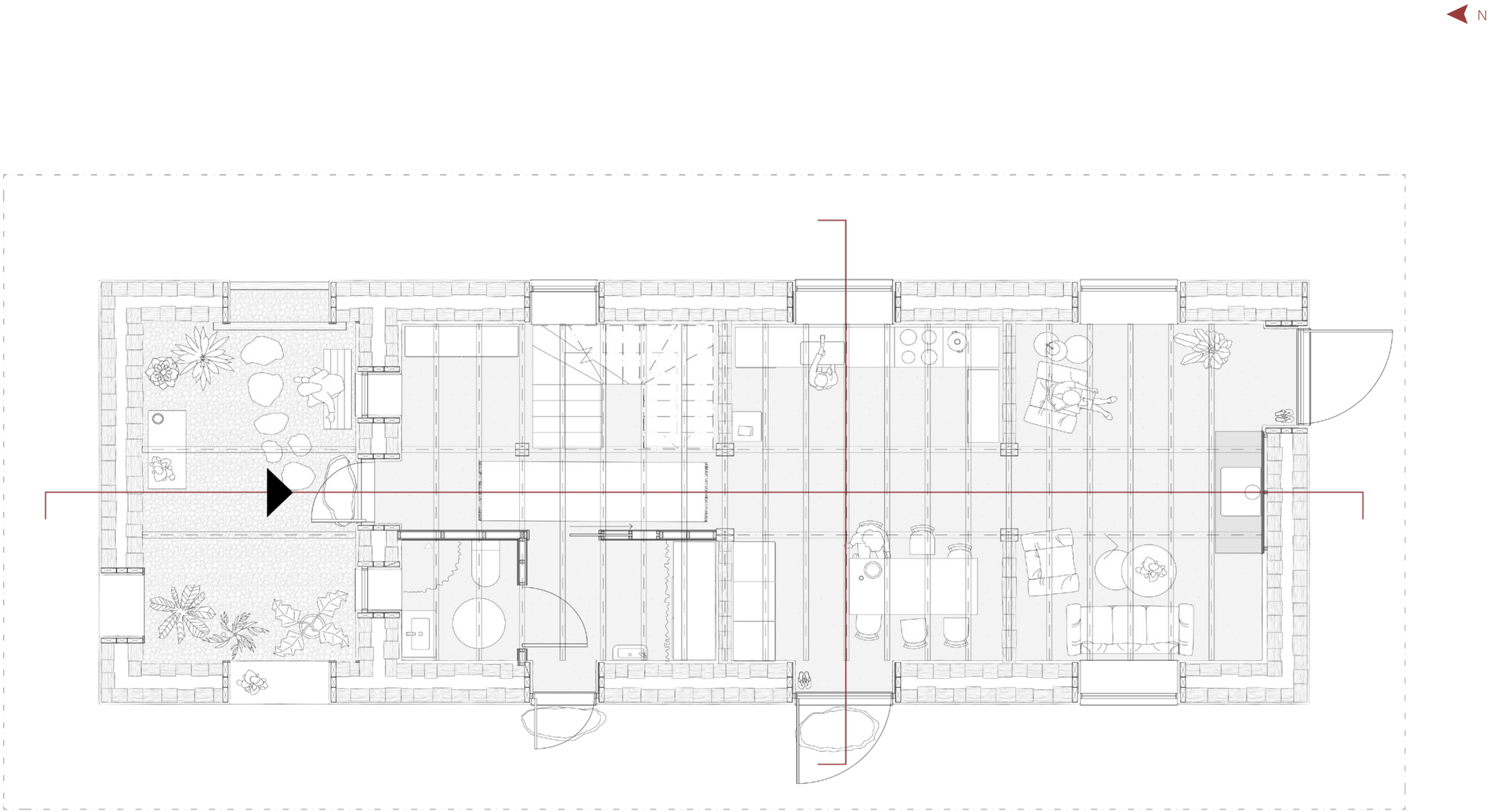
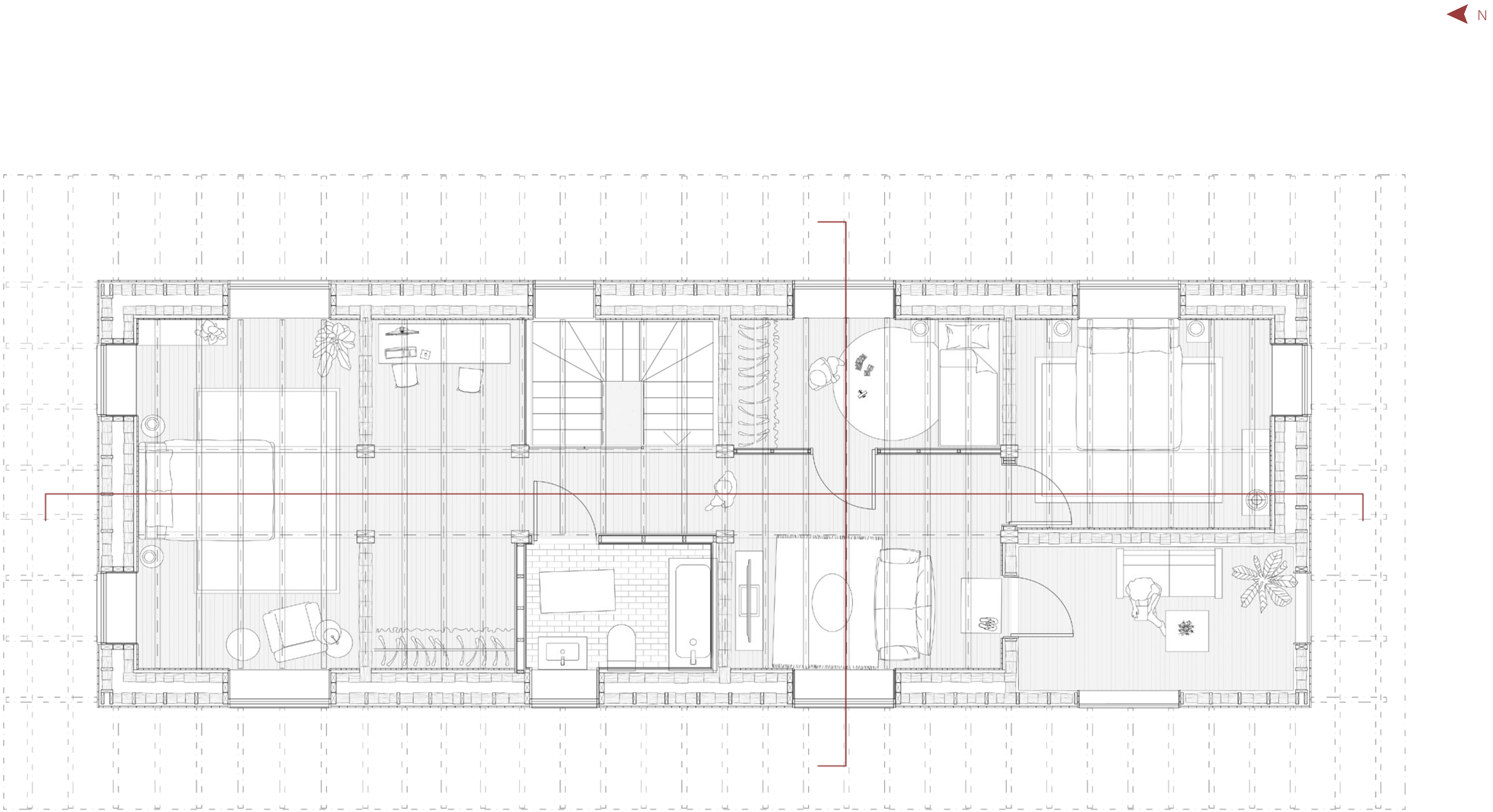
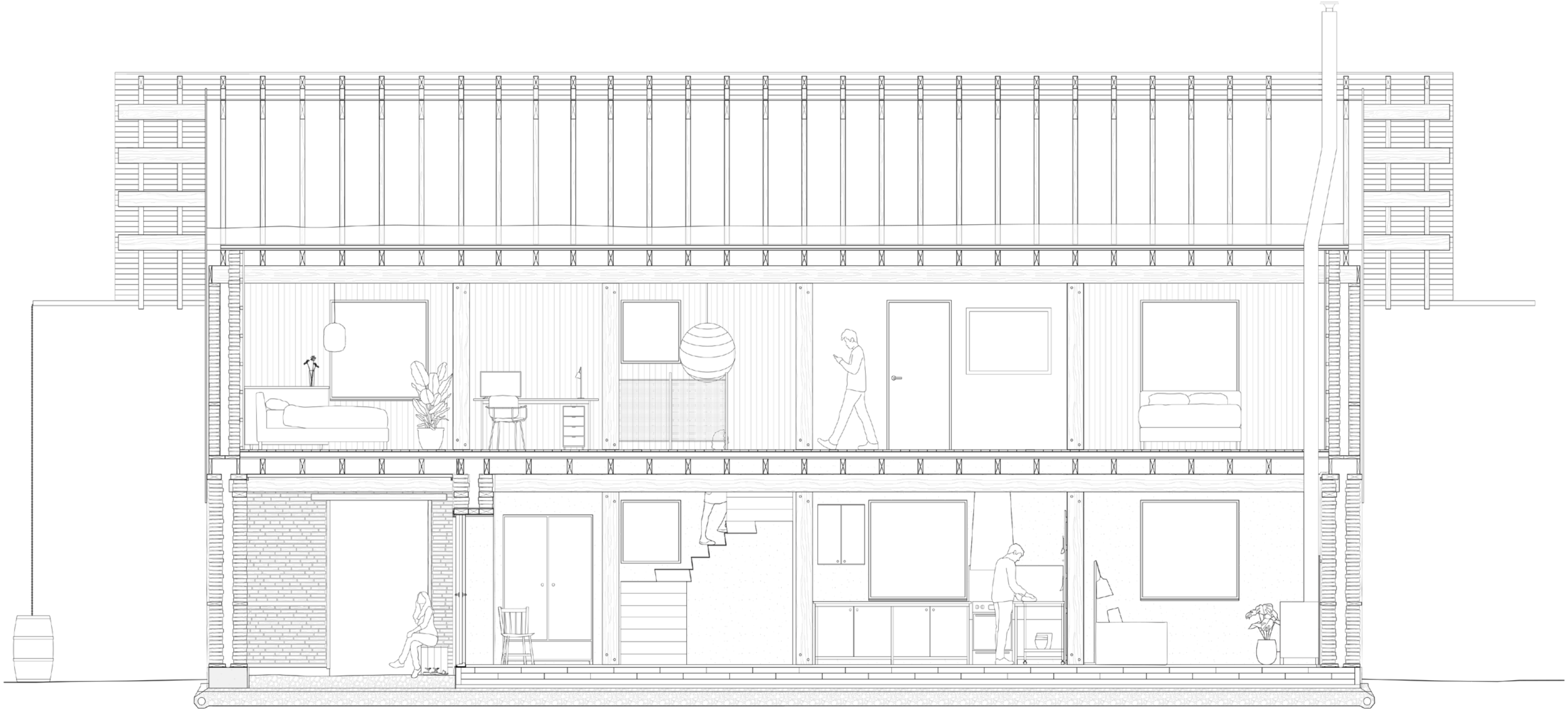


GROUND FLOOR PLAN
SCALE 1:60

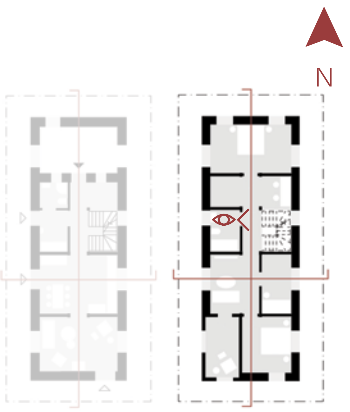


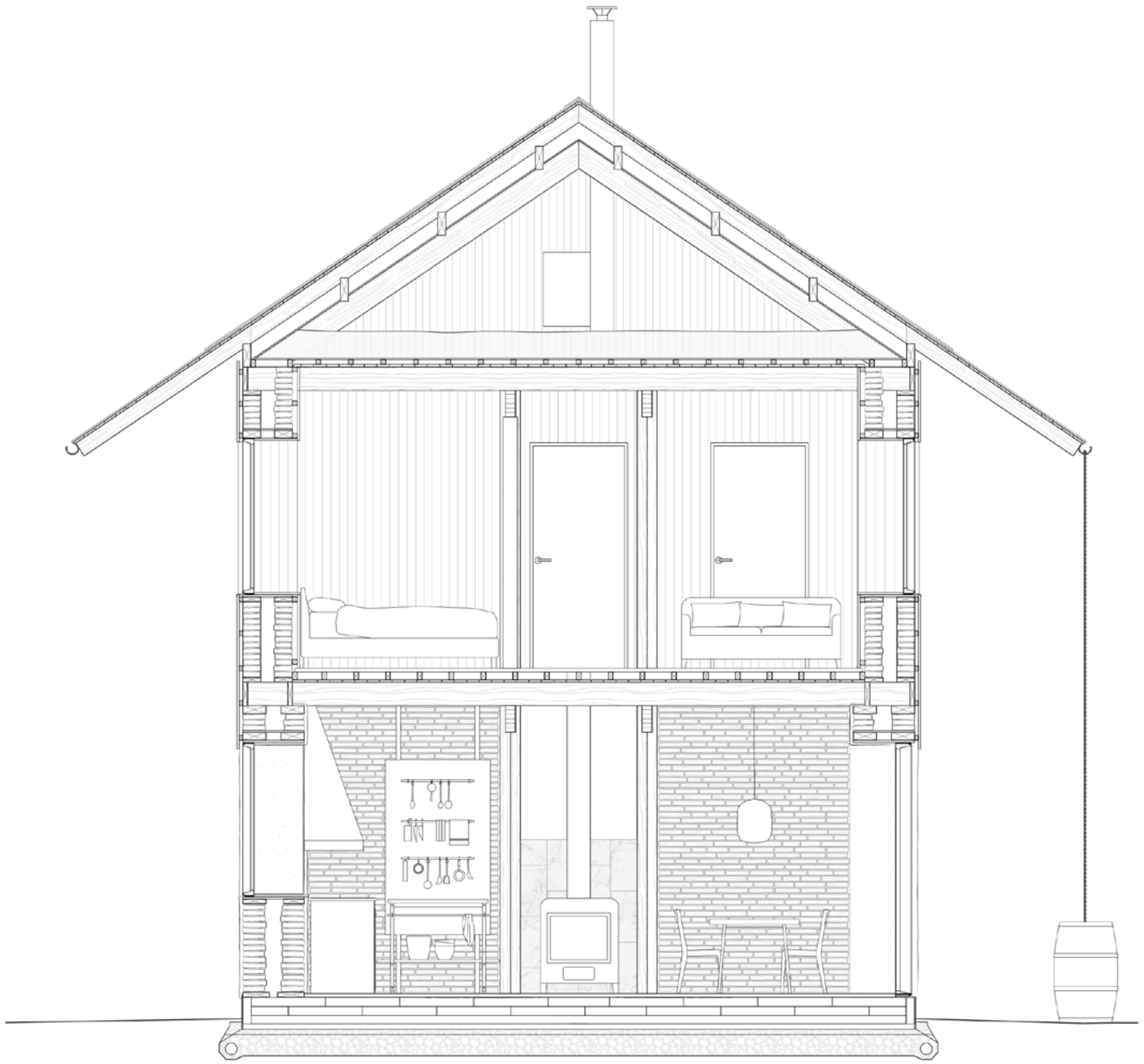
2ND FLOOR PLAN

SCALE 1:60

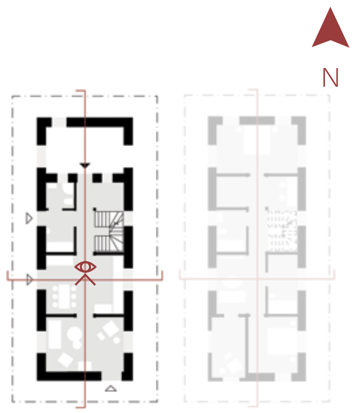


SECTION
SCALE 1:60





DETAILED SECTION
SCALE 1:60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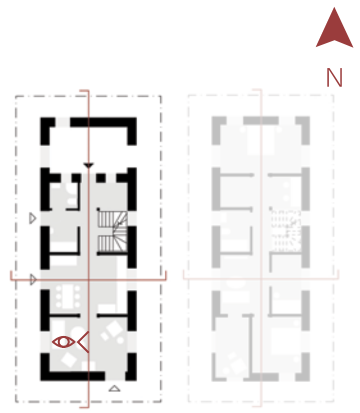
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III. CONCLUSION

"In some places the exclusive reliance on local building materials alone guarantees the persistence of time-honored construction methods. Conversely, when alien materials and alien methods are introduced, local traditions wither away, customs are displaced by trends, and the vernacular perishes.

The question is not whether the demise of the vernacular is merely regrettable – most people couldn't care less – but whether life in general is impoverished by it. To put it differently: Does the disappearance of architectural species native to the soil upset the balance of civilization in the same way as the disappearance of certain animals and plants upsets the ecological balance?"

Bernard Rudofsky in The Prodigious Builders (1977), p. 13.

Result

To summarize, this thesis began by stating that the wood masonry technique flourished during a time in history of severe timber shortage when common people struggled to access affordable building materials. As the sawmill industry evolved and expanded in the second half of the 1800s, large flows of byproducts were generated and the wood masonry technique proved an ingenious way to utilize that material to build houses.

Parallels can be drawn to today, as essentially the same offcuts that were used to build plank masonry houses historically are still generated within the modern sawmill industry now, albeit in shorter lengths thanks to the highly optimized production line. Today, too, Sweden is again – or rather, still – suffering a timber shortage, with record high prices as a consequence, leading us to pose the question whether these defective pieces, too, have the potential to be used in construction instead of being burnt as fuel. An important reason for this is also to call for a more ecologically sustainable use of the timber resource that ultimately strives to give wood products the longest possible service life.

By applying the logic of wood masonry to the established framework of modern conventional construction, the two design proposals presented in Part II in the thesis booklet showcase how the masonry might be combined with the typical building elements normally used when building single-family houses in Sweden today.

The buildings both utilize the same fundamental plank masonry technique, but in slightly different ways. Both have load-bearing plank masonry exterior and interior walls, which are visible from the outside in the weather-protected entrance spaces where the masonry is left bare. Where plastered or panelled, features like the lintel-height binder of House no. 1 and the transition from first to second floor in House no. 2 suggest to the observer that there is more to the building's structure than a conventional stud construction.

DESIGN EVALUATION AND PRACTICAL VIABILITY

In the final week of design work (May 6, 2025), the design proposal was presented to Yutaka Goto, researcher at Chalmers' department of Architecture and Civil Engineering, who specializes in timber engineering and sustainable wood construction and has previous experience with the combination of wood and clay. He provided valuable input into which challenges the proposed building structure might pose, and which key aspects would need to be addressed were the project to be taken further in the future.

Generally, he was positive that potential challenges would be possible to overcome within the framework of conventional construction today. With the tools and technologies available, it would be a simple task to test and evaluate the performance of the proposed design with regards to structural integrity, thermal performance and moisture-related behavior.

One thing that would need to be done is a moisture simulation to evaluate the moisture performance of the wall construction. Additionally, a first estimate of how much the wood shrinks and swells with moisture fluctuations in relation to the clay mortar can be gained from quite simple calculations. This of course varies throughout the year as it is dependent on temperature, but insulating the outside of the wall instead of the space between the layers of masonry would equalize the temperature difference between the two masonry layers, possibly making the moisture-related behavior of the structure more predictable. However, this could be considered a less elegant solution from an architectural point of view, as it leaves no option to have the masonry exposed or distinguishable from outside.

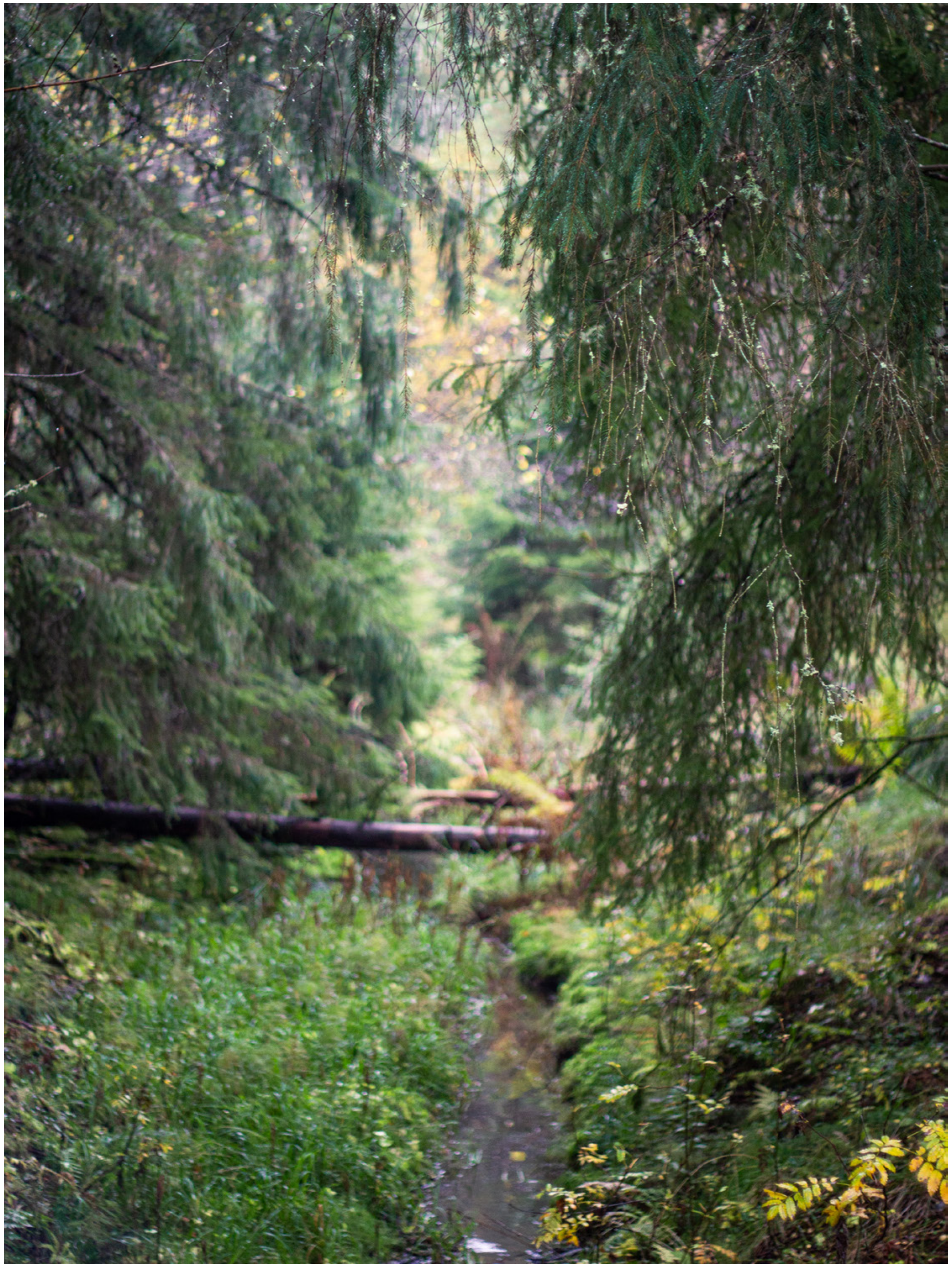
The proposed diffusion-open construction is what Yutaka himself would have recommended as well. While a conventional stud wall requires a vapor barrier to prevent moisture problems between the wall layers, in a structure where two of the layers are massive wood—rather than having insulation placed between studs as in a typical stud wall—the timber itself functions as enough of a moisture retarder for that to be unnecessary. The clay itself also has moisture buffering qualities which help prevent moisture-related problems and benefit the indoor climate.

Estimating the structural capacity of the wood masonry is another challenge. While Yutaka believed that the horizontal loads are easily handled with conventional methods of building joists and roofs, the shear behavior of the wall is less predictable and has of course never been studied. Cracks in the mortar and gaps forming between the wood and the mortar when it dries will highly impact the shear capacity of the walls. From an engineering standpoint, it would be ideal for the mortar to be made to move along with the wood, similarly to how reinforced concrete behaves. However, this would entail using a fossil-based polymer mortar, which does not align with the ambitions of ecological sustainability that underpin the project.

In the design proposal, the two layers of the walls are interconnected with what is in the project description above referred to as binders, intended to make the wall function as one unit instead of just one masonry layer being load-bearing and help distribute the vertical and horizontal loads. The same goes for the lintels and window sills, made from boards and planks in combination. Yutaka approved of this principle, saying that it is likely best with regards to shear capacity and settling to try and make the wall layers function as much as possible as one. As the binders are unavoidably laid with the wood's grain end perpendicular to the wall's longitudinal direction, it makes sense to not have too many of them, and for them to be placed at random like the design proposes, rather than focusing them to one limited area, in order to not create thermal and moisture-related problems.

Based on the input from Yutaka Goto, it is evident that from an engineering standpoint, it is realistic to think that a wood masonry building like this could technically be made fit for construction within the framework of current Swedish codes and regulations, provided that the investigations recommended above are carried out.

In the following section, the thesis questions are revisited, and the question of whether the technique has actual potential to become an alternative to common-practice construction is discussed further.



Discussion

In the beginning of this thesis, the following research questions were posed:

- Letting traditional vernacular architecture that utilizes waste and byproducts inform solutions to problems that we face today, could the wood masonry technique in particular again become relevant as an alternative to common-practice building techniques?

- What might an application of the wood masonry technique look like if placed in a contemporary context using byproducts from the modern sawmill industry, and considering both its architectural qualities as well as its structural integrity?

- Which problems would need to be solved for the technique to be a viable construction method today, with regards to, for example, consumer demand, contemporary building regulations and production logistics?

For the discussion chapter, we will begin with discussing what an extraction of the offcuts in question might look like and what consequences it might have on the production logistics.

Following that, it is discussed how the offcuts might perform within a structural system, with the two design projects providing a canvas, and based on the input received from Yutaka Goto.

Lastly, we will revisit the subject of vernacular architecture in general and the plank masonry technique in particular, whose strong ties to the industrialization of the sawmill industry and the way it was merged with local traditions makes it a part of our built heritage that relates to both our industrial history and the living conditions of its workers and their families, as well as to regional vernacular architecture in general from this time.

TIMBER INDUSTRY & LOGISTICS

Finding alternative uses for a byproduct that is currently used as biofuel, branded as "green energy", is not an uncomplicated issue, and it of course poses the question of what would replace it were it not to be used as fuel. Ultimately, solving the issue of transitioning into a more resourceful forestry practice and minimizing the environmental impact from the building sector risks creating whole new problems on its own, which is why this thesis does not aim to argue for any drastic interventions in the production logistics of the sawmill industry.

Rather, we reserve the right to operate within the existing framework, proposing only a subtle shift in how a material currently regarded merely as "useful waste" is utilized. The aim is not primarily to challenge the operational systems of sawmill companies, but to question the mindset of our consumer society—particularly within the building sector—which has played a key role in shaping those systems. In doing so, we also call into question the role of the architect, whose responsibility, as we see it, should include pursuing resource-efficient design, be it through designing materially efficient structures as such, or by proposing the use of unconventional building materials based on which resources are available instead of the other way around.

Though Derome themselves are actively working to find alternative uses for their own byproducts, it naturally ultimately boils down to whether or not the proposed alternative use provides a more economically profitable alternative than the status quo-option of using it – or selling it – as biofuel. However, it is worth remembering that, though biofuels are universally agreed upon to be preferable to fossil fuels, they are ultimately a short-lived product, and, at that, one which in this case takes 60-80 years to produce. Also, as Derome themselves presented the offcuts to us as a by-flow that they are interested in finding new use for, we are also positive that should there prove to be an alternative use that is as economically profitable, they would be open to reconsider it.

While the wood shavings that the sawmill generates today become biofuel used in both industrial facilities and villas, the excess of sawdust and wood chips are instead sold to pulp factories to be used in the production of paper products. On one hand, this is easily justifiable by arguing that paper products are a greener alternative to single-use plastic products. However, looking at it from a consumer perspective, a supply and demand loop unfolds: why change my consumer habits when the paper products are made from by-flows either way?

While the thesis does not seek to position itself within the topic of resourceful forestry practice, it does rely on the stance held by the Swedish Society for Nature Conservation (Swedish: *Naturskyddsföreningen*) who, as previously mentioned, argue that it is crucial in the dire situation that our climate is in that as much as possible of the wood that we do harvest is given the longest possible service life.

We would therefore like to suggest that perhaps one possible scenario could be to utilize the by-products currently used for paper products as biofuel instead, reducing their service life only marginally when considered in the context of a tree's or timber building's full lifespan, and to use the lumber offcuts to build houses, which have a much longer lifespan. While this shift would likely require changes in our consumption of paper products due to reduced material availability, it might force us to reconsider what we consider to be waste in the first place, and help us gain a more accurate perception of what resources we truly do – or rather, do not – have at our disposal.

Additionally, as the building sector shifts towards an increased use of timber, it can be assumed that there will be an increased production rate as well, resulting in increased volumes of by-flows. Having to possibly make use of even larger quantities of by-products than before, it might be that there is no conflict as to whether the offcuts used for this thesis are used for biofuel or for buildings – there may well be enough for both.

EXTRACTING THE WOOD MASONRY BLOCKS

As previously described, the offcuts from the finger jointing process are spat out in mixed dimensions in a container. Were plank masonry construction to be considered an alternative use for these offcuts, the logistics of extracting and packaging the material in a rational way would need to be considered. Factoring in predictability with regards to which dimensions are delivered could be an additional step towards a more consumer-friendly framework for both architects and self-builders.

One proposal that would not interfere with the way the production line operates today could be that the containers are switched between the shifts, ensuring that each container only holds pieces of one size. Another step could be to allow the offcuts to be a bit longer than needed, or even to decide upon a fixed length which would make it possible to package them in a structured manner and deliver them on a regular pallet, and to plan the design more accurately in advance.

Were the offcuts to be sawn to a slightly longer length than what the optimized sawmill process suggests, say at least around 400 mm or more (or some other length where a sweet-spot between resistance to internal shearing and a satisfactory ratio between defective and high-quality lumber is achieved), the imperfections would still cause the piece to have an area with unpredictable behavior, at least if evaluated according to standards developed to assess timber used for post and beam constructions, but the overall quality of the block would also be slightly improved. Through laborations, the structural integrity of these pieces could then be assessed with the aim to develop a quality stamp adjusted for these specific building blocks and what structures they would be meant to be used for.

This procedure would involve having to evaluate the wood in a way that currently the building sector does not do. Apart from determining what parts of the log could function as a post or beam according to its tensile and compressive strength, it would also include evaluating parts of the log according to whether it could function as a kind of soft brick. There are no natural laws that say wood isn't meant to function this way, only modern conventions shaped by our perception of how wood can be used structurally. This conception, we argue, needs to be reconsidered in light of the climate crisis we are facing, which demands a drastic shift in how we utilize the planet's resources.

Although current regulations – which require the removal of defective areas before the remaining lumber can be approved for structural use – are based on constructions that are more material efficient than plank masonry (at least when compared to conventional timber frame buildings, and considering only the amount of lumber used), this thesis argues that, from a broader perspective, using forest resources responsibly involves more than just building material efficient structures (which, of course, should always be a goal). It also includes making use of every part of the tree that we can. While plank masonry may not be the most material efficient method for constructing a load-bearing system, it gives new purpose to portions of the log that would otherwise not have been considered for structural use at all.

STRUCTURAL INTEGRITY

There are many examples of plank masonry buildings – even multi-level ones – that have stood for many decades in both the Swedish and, even more so, in the Norwegian built heritage. However, the offcuts used are generally said to be slightly longer on average than the offcuts that are used for this design proposal. Karsten Karstensen in his 1986 book on plank masonry provides a medium length of somewhere between 40 and 50 centimeters (page 22) based on his studies of the Swedish and Norwegian building stock. Some could be as long as one and a half meters.

The modern-day sawmill production line is highly optimized to minimize the amount of waste, and the offcuts that we have received seldom exceed 25 centimeters. Longer offcuts do also occur, but these are seen as a valuable product in themselves as they can be cloven and used as stickers (planks that are laid between layers of lumber stacked for drying). Though not drastically different in length, the shorter pieces might still be disadvantageous for the wall's shear capacity. However, the structural capacity requirements on horizontal loads (wind loads) is not particularly high in our climate, especially seeing as the buildings are only a maximum of two stories.

Existing or documented plank masonry buildings have almost exclusively been constructed with load-bearing walls consisting of a single layer of planks, usually of equal width. The interconnected double-layer wall proposed here can therefore be expected to perform much better with regards to shear capacity.

As has been presented in the previous chapter, engineer Yutaka Goto was positive that the construction is possible to evaluate and test with the tools available to us today, allowing it to be taken further and made a viable construction method within the framework of modern building codes and regulations.

DESIGN & METHOD

When designing the buildings with the plank masonry technique in mind, we have sometimes found ourselves thinking of it as a general kind of masonry. We have aimed at allowing the building to speak a distinct masonry language – either fully, as is the case with House no. 1, or as a contrast to another structure, as is the case with House no. 2 with its second floor infill wall – for example through the size and detailing of the openings, drawing inspiration from conventional stone and brick masonry.

Still, if one were to regard the buildings as masonry buildings, one might say we have missed some opportunities to fully exploit the unique advantages of the masonry technique, which begs the question if, when designing, we have sometimes been too set in our post-and-beam ways, leading to a strictly orthogonal "design language". Some strengths of the brick wall, like the ability to build vaults and arches, are of course made possible because of the stone's compression strength, an area in which our wood building blocks do not compare. The ability to build curved walls, for example, however, would likely have been just as easily done with wood as it is with stone, and might have been beneficial for the overall structural integrity of the exterior wall.

As for the framework for the design project, one of the parameters we ourselves defined was combining the traditional plank masonry walls with conventional methods of building and joining other components, like roofs, joists and foundations. Since assessing what a re-introduction of the wood masonry technique might require is already a complex issue, combining the plank masonry walls with conventional solutions instead of attempting to reinvent the entire building structure became a way to keep the project focused. Additionally, if the technique was to be suggested as an alternative way to construct load bearing walls, our idea was that it might help the cause to re-introduce it if it was possible to merge it with industrialized solutions, which can be assumed appeals to both builders and suppliers.

The unique behavior of our low-quality wood building blocks has also made it necessary to combine the masonry with regular construction lumber, which has led to having to comply with a set of rules associated with conventional timber construction, for example when it comes to dimensions and joining methods. However, it might be that allowing the construction process to accommodate more tailored solutions and hands-on craftsmanship would have opened up for design features, both aesthetic and tectonic, that relate closer to traditional masonry architecture, though this of course is also a question of labor intensity.

Our version of the plank masonry technique therefore falls somewhere in between the realms of masonry and timber construction, borrowing from both. Sometimes it has the consequence of the architecture appearing less true to one or the other, or contradictory to itself.

These discrepancies are sometimes a consequence of trying to relate to a certain reference from local tradition or the vernacular wood masonry heritage. One example is in House no. 1, which intentionally carries some resemblance to the double house (Swedish: *dubbelstugan*) typical for north Bohuslän. As was also the case with the plank masonry buildings built in this same typology, the gable walls above lintel height are not made from masonry but constructed as conventional stud walls. They would historically be clad with wood panelling, as would the rest of the facade. In the case of our design, we tried to achieve a more contemporary expression through the use of a monochromatic plaster facade, in combination with the exaggerated silhouette and the choice of corrugated steel for the roof. As it is not necessarily conventional to plaster a timber-frame wall, this necessitated a custom solution for the upper level facade.

In House no. 2, the offcuts are used both as a load bearing plank masonry wall on the first floor and in an infill-structure on the second floor. On the first floor, the wood is used to mimic a heavy stone base, which became a way to relate to the building tradition of Bohuslän while at the same time raising the question if we could reconsider our idea of how wood can work structurally. While the plastered plank masonry walls, built from "faux" bricks, could be viewed as a way of cheating the observer, the question could also be reversed, asking: "Who said that wood cannot work this way too?"

REVISITING THE TOPIC OF VERNACULAR ARCHITECTURE

Historically, Norwegian and Swedish plank masonry architecture constructed from industrial offcuts was built by and for working men and their families. While the buildings themselves are the result of vernacular building tradition and knowledge in construction passed on between both carpenters and laypeople, the technique itself, too, bears cultural significance for the sake of its close relation to this chapter in industrial history. Exploring ways to re-implement the technique itself, possibly in a manner that bears resemblance to its origins, could perhaps therefore be said to be part of interpreting and building further upon our cultural heritage, regardless of the shape and form of the resulting architecture.

In discussions during the design work, we have often returned to the question of whether we as architects are even within our rights to take the liberty of interpreting a vernacular heritage in which architects historically have had no place. Just because we are applying or reinterpreting a vernacular technique, do we necessarily have to claim to do the same with the vernacular building tradition itself? Could we, and should we, instead have tried to design a building which appears in its architectural expression entirely "new" and contextless? Here, our view has been, like Finn Werne argues in the citation on page 26, that our task as architects is in fact to relate to the existing and the familiar, and that it would be impossible for us to design in a vacuum. Still, one might wonder how the buildings we designed might have looked if we had made an effort to try and detach the technique completely out of its context. Would it have created any possibilities to use the technique in a way which we have now not been able to see?

BY AND FOR WHOM?

Finally, we would like to discuss a parallel track which, for us, has been present and relevant throughout the design work, but which is not necessarily conveyed through the design project. This is the question of self-building, and connects both to the question of who an application this technique today might be suitable for, and that of whose interest it would be in to introduce the wood masonry technique into our contemporary repertoire of common-practice construction methods.

Historically, the wood masonry technique has almost exclusively been practiced by self-builders building homes for themselves and their families, which is why we have imagined it as potentially being suitable for modern-day self-builders too. However, needless to say, we no longer have the knowledge and tradition of craft that prevailed in the 19th and 20th century, and, in Sweden, the masonry craft in particular is maybe the most rare of all. It is not a given that, however cheap and ecologically sustainable, the wood masonry technique would be an obvious choice at all for a self-builder looking to build themself a home today, when the established tradition of the stud frame is rational and simple enough as it is, not to mention accessible through detailed drawings and instructions found online. It is maybe more likely – as is the case with the wood masonry buildings that do get built today – that the method requires an enthusiast with, if not previous knowledge, then high ambitions when it comes to building with alternative and ecologically sustainable materials and methods.

In our view, it is easy to imagine wood masonry houses being built within the framework of what might be called a building collective (Swedish: *byggemenskap*): a community of organized self-builders that has an established network for knowledge sharing and logistics, and sometimes even resources (or the resources to apply for state funds, for example) to hire architects to help design the houses.

With a wood masonry house, like with other "eco-friendly" alternative building methods, the building requires maintenance, care and repair over time. Its construction does not necessarily end the day the roof is lifted into place, but must be allowed time. The clay mortar has to dry before the facade can be clad with panelling, and the clay plaster facade will erode over time and need to be reapplied. The knowledge necessary to take on the task of caring for the house comes for free when you have built – or participated in building it – yourself, and would be hard to sell to someone who has no interest in such things.

However, although it may seem utopian, it is possible to imagine a future where contemporary plank masonry houses have become so common that their maintenance can be outsourced to "ordinary" carpenters – just like repainting or replacing the windows of a timber-framed house – making it possible for people to build or buy their own plank masonry home even if they are not particularly handy themselves.

Within the framework of the system we live in, where the built environment and people's access to a home of their own is governed by market forces and political power, change is driven by grassroots movements that manage to mobilize those that see the need for other alternatives.

We do not with this thesis aim to serve the interests of the timber industry by proposing a new way to make profit. If anything, our approach is the opposite: it is only by creating a demand for a product that it becomes in the industry's interest to make that product accessible to the consumer.

We would therefore also like to raise the question of who even has the capacity to initiate making this material specifically (i.e. industrial wood offcuts), which is currently not available as a building material, approved for structural use. While there are versions of wood masonry which use other types of wood, we would like to highlight the large quantities yielded of these offcuts specifically as one of the key reasons to even reintroduce the technique: the material is already being produced at an industrial scale right under our nose, but nobody recognizes it as a building material.

It is important to recognize that today's building sector of course is governed by far more regulations than what was the case in the late 1800s, when the technique was first introduced into Swedish building tradition. It is not certain if, today, it would even be legal for somebody to purchase the offcuts with the intention of using them in a load-bearing structure. For the sawmills, there are also uncertainties regarding whether it would be worth the cost to test and certify the material before offering it as a building material, unless there is a clear demand for the product known in advance.

Until it can be assumed to generate sufficient profit compared to using or selling the wood as biofuel, it's therefore not at all a given that the sawmill companies would be the ones to take the initiative. Smaller scale efforts, whether by a building cooperative (Swedish: *byggemenskap*) or a private individual are likely too limited in resources to convince the sawmills that any potential upfront costs would pay off.

The situation resembles a stalemate: there may be both a willing buyer and a willing seller, but with neither side confident they'll come out ahead, no one makes the first move. Perhaps what's needed is an intermediary – say, an architect – who could act as a guarantor and help initiate a few pilot projects where the technique's potential can be displayed in practice.

Regardless of who initiates the introduction of this alternative construction method, it will influence the kind of architecture that ultimately emerges. Imagining an initiative being taken to build wood masonry houses by Derome, perhaps at their own house factory where they prefabricate industrial house modules, recalls a very different picture than imagining a collective of self-builders doing the same.

To reintroduce the technique using these or similar by-products from the modern day production line through a strong player, who manages the entire process, from offcut to turnkey home, and whose budget and time frame is of vastly different proportions than that of the individual self builder, might be simpler or quicker than relying on a grassroot initiative. However, while a full-scale industrial implementation might be what allows for widespread adoption, it also risks shifting the technique further out of reach for ordinary people, potentially changing it into something entirely different from what it was originally described as: a way to, with the least possible means, achieve a home of one's own.

While acting just as much in favor of a more sustainable sawmill industry and building sector, if not potentially more so compared to a grassroot movement, much smaller in scale, it must still be acknowledged that it would be disheartening to see a technique historically so closely tied to the self-building efforts of ordinary people – a process that not only can serve as a form of emancipation, but has the added potential of creating tailored, context-sensitive architecture – become reserved for a major player, with whole other interests in mind. Ultimately, being forced to choose only one would inevitably mean losing the benefits of the other.

Conclusion

We recognize that what defines vernacular architecture is an accumulation of experience, knowledge and tradition, passed on from generation to generation, in part through participation in the craft and the building process. While we mean that it is part of our job description as architects to relate to the existing built environment and our collective cultural heritage in the new architecture that we produce, we do not mean to claim the vernacular tradition of wood masonry as our own and apply it as a one size fits all solution. Rather, our hope is that by showing an example of how we as architects approach this technique, we may plant a seed within someone else, who might then make something of their own out of it based on their unique skills, needs and experiences.

Another objective has been to show that even within the system that we live in, where the built environment and people's access to a home of their own is governed by market forces and political power, there might be room for alternative ways of building that are more accessible to common people. This might, for one, mean accessibility in terms of economic means, as building materials in recent years have become more expensive than ever. It might also mean a kind of physical accessibility: clay and defective wood can be obtained from alternative sources than your local hardware store chain (one could even apply a "take what you have" approach). They don't need to be refined using expensive tools, and the building blocks are physically manageable by hand. Or, lastly, it could mean providing access to alternatives to industrial building and the costs associated with it, by means of organized building cooperatives that provide the resources and knowledge needed.

As a final note: although new questions have arisen during the thesis work, we are perhaps even more positive now than we were at the outset that the wood masonry technique – and the plank masonry technique using "our" offcuts in particular – could in fact prove to be one step towards a more resourceful utilization of our forests, and we are curious to see what the architecture might look like that would emerge were the technique to be employed today.

The challenges that arise when employing the plank masonry technique instead of, for example, building a timber frame building – such as the need for manual labor on-site, or the fact that much more material is needed – do not necessarily have to be regarded simply as limitations. Rather, they can be understood as the seeds for a new kind of building tradition, one that is not born out of a lofty architectural ambition, but is instead shaped by what resources are available, and by the dedication of the builder working on-site.

Considering the climate crisis we are facing, we recognize that what is most important is that the offcuts – which we argue have the potential to be a structural material, once properly tested and evaluated – are used to their full potential. However, we also believe that there is potential to reinvent the plank masonry technique in a way that is true to the history of the original: by using it to create architecture that responds to the conditions surrounding it, anchoring it both to its context and to the people that practice it.

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FIGURE LIST

Figure 1 (cover page): Skellefteå Museum (n.d.). *Family outside plank masonry house in Skellefteå*. [Photograph]. Skellefteå Museums samlingar. Retrieved May 8 2025 from: https://samlingar.skellefteamuseum.se/objects/c61-298641/?cat=96036&offset=31

Figure 2: Sjöqvist, L. (n.d.). *Stovewood barn in Gräsmark, Värmland*. [Photograph]. Received through personal communication with the photographer.

Figure 3: Sjöqvist, L. (n.d.). *Stovewood barn in Gräsmark, Värmland*. [Photograph]. Received through personal communication with the photographer.

Figure 4: Det Statistiske Centralbureau (1885). *Illustrations of a sawmill in Fredrikstad*. [Drawings]. Nasjonalbiblioteket. Retrieved May 8 2025 from:
https://www.nb.no/items/13b814ac3ccd2c72bfc659cb687e-daf1?page=363&searchText=plank

Figure 5: Karstensen, K. (1917). *Plank masonry house in Borge*. [Photograph]. Retrieved May 8 2025 from: https://www.nb.no/items/aec061a9d8dd4995ae8511f5cc83220e?page=7&searchText=karsten%20karstensen

Figure 6: Westerlund, E. (1950). *Skellefteå plank masonry house*. [Photograph]. Skellefteå Museum. Retrieved May 8 2025 from: https://samlingar.skellefteamuseum.se/objects/c61-114628/

Figure 7: Skellefteå Museum (n.d.). *Family outside plank masonry house in Skellefteå*. [Photograph]. Skellefteå Museums samlingar. Retrieved May 8 2025 from: https://samlingar.skellefteamuseum.se/objects/c61-298641/?cat=96036&offset=31

Figure 8: Boberg, F. (1924). *Fiskebod i Gäddvik*. [Drawing]. Nordiska Museet. Retrieved 8 May 2025 from: https://digitaltmuseum.se/011023658732/kolteckning

Figure 9: Östnäs, S. (1982). *Ramsö Double House*. [Photograph].

Figure 10: Francis Kéré Architecture. (28 March 2012). *Gando Primary School*. [Photograph]. Wikimedia Commons. Retrieved 8 May 2025 from: https://commons.wikimedia.org/wiki/File:Kere_schule_1.jpg

Figure 11: Wikimedia Commons. (6 April 2010). *Villa Drake by Jan Gezelius*. [Photograph]. Retrieved 8 May 2025 from: https://commons.wikimedia.org/wiki/File:VillaDrakeBorl%C3%A4nge.JPG

Figure 12: Östnäs, S. (1982). [Photograph].

Figure 13: Östnäs, S. (1982). [Photograph].

APPENDICES

Use of AI

As stated in the Method section, AI has been used in writing this thesis to the extent of using ChatGPT to propose synonyms and translate certain words. Specifically, this has meant translating technical terms that concern the sawmill industry, names of specific building parts and techniques. ChatGPT has been preferable over other translation tools as it is possible to include context and definitions of the words to be translated in the prompt. One example of such a prompt is "In masonry, what is the name of one layer of bricks that is laid at the same time? In Swedish the word is '*skift*'."

Design explorations

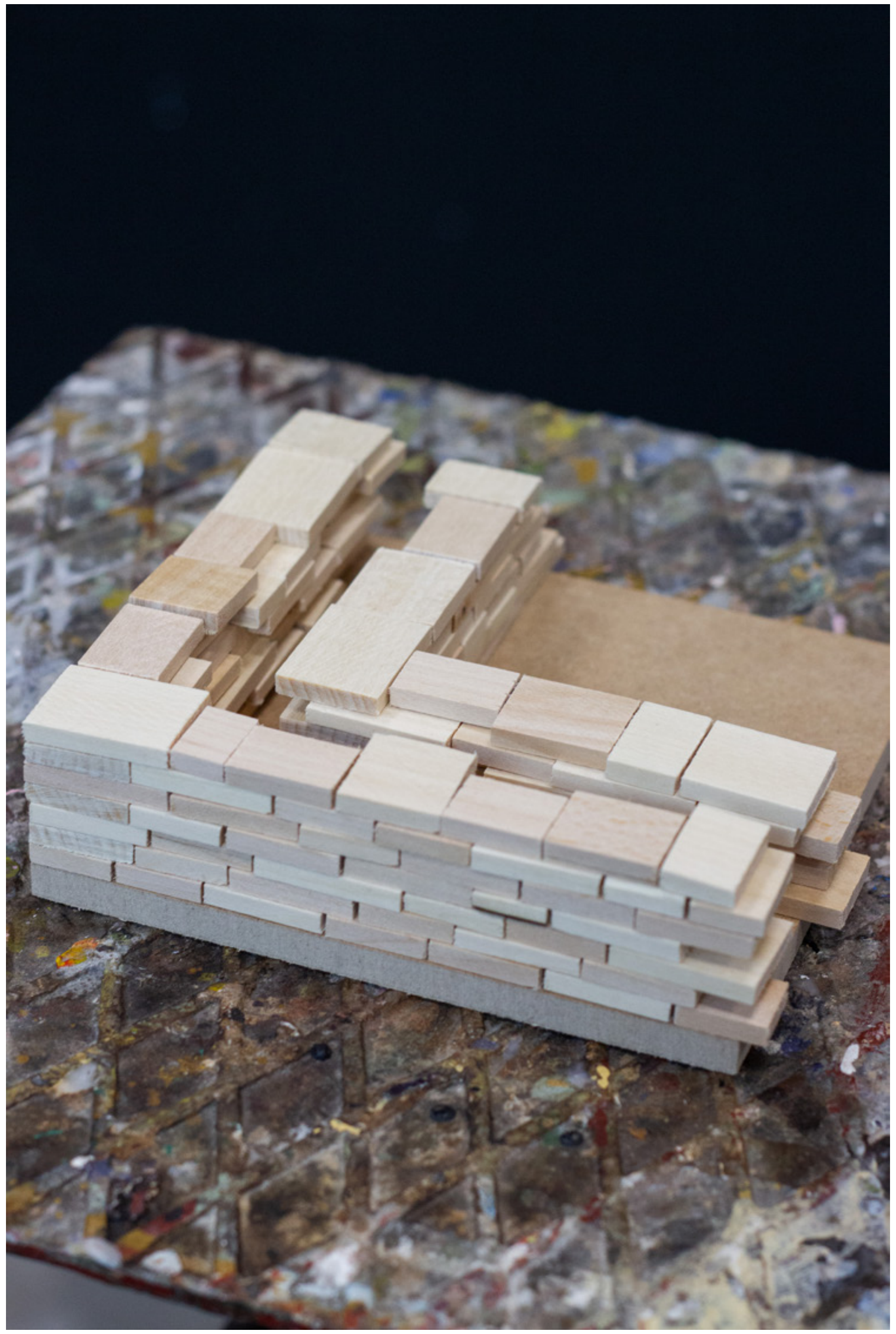
The following pages show examples of design explorations, which were different exercises - drawings, scale models, 1:1 experiments as well as digital models - that we carried out in order to familiarize ourselves with the technique. These exercises helped us begin to envision how the method might be applied in a contemporary context, considering both the use of modern-day offcuts and the potential for combining plank masonry with conventional materials and construction practices in Sweden today.

Wooden offcuts laid out to show the range of dimensions and the characteristic defects and imperfections of the material. The image to the right also shows a tongue and groove plank which was part of the early design explorations as it is another one of the by-products that the Derome sawmill generates. The reason for sorting out these planks is the same as for the construction lumber —material imperfections. However, unlike load-bearing lumber, these boards can still be sold as lower-grade material. Some of the planks are cut to 1.2 meters and sold at a reduced price, while others are finger-jointed after removing the defective sections, creating a similar by-product stream as with the lumber offcuts.

Dry-stacked wall where the lower grade planks described on the previous spread are added to help stabilize the wall. The offcuts are stacked in one layer only, without any prior sorting according to width or length.

Above: Dry stacked prototype of a plank masonry wall corner, made from pieces that are either 45 or 75 mm thick.

Right: Pieces of varying dimensions without any prior sorting according to width or length. The pieces are piled as a cavity wall with binders that help connect the two layers and with loose-fill hemp insulation in between.



A 1:10 scale model of a wall similar to the cavity wall in previous photographs, but without binders connecting the layers. It is imagined as an exterior wall, with loose-fill insulation between the two layers of wood.

Left: Digital collages that explore different expressions for an interior plank masonry wall. The pieces are either stacked vertically or laid in a running bond, both with the grain-end facing out and with the grain direction running parallell to the wall. Different expressions are tried for the mortar joints, here done in a light color instead of the natural color of the clay mortar, resembling more the expression of a brick wall.

Right: The wooden offcuts from Derome are stacked without prior sorting to test the wall's stability while also exploring different elevation expressions. In the top photo, every fifth layer protrudes slightly, allowing plaster to be applied in segments between them, while the end grain of the offset layers remains exposed.

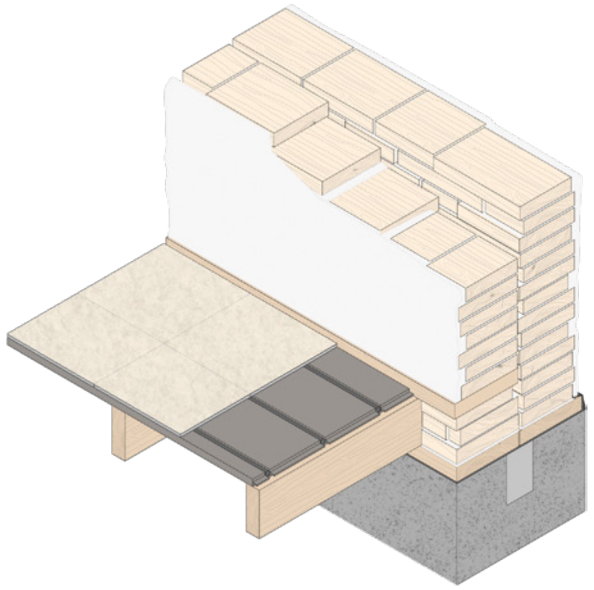
Above: A 1:10 scale model of two different types of plank masonry walls. The left utilizes the offcuts, which are in a running bond (Swedish: ½-stensförband) in two layers, creating a massive timber wall with clay as a mortar. The right is instead a cavity wall built from the 1200 mm long tongue and groove planks laid in a similar manner, and with binders connecting the two piles for extra stability.

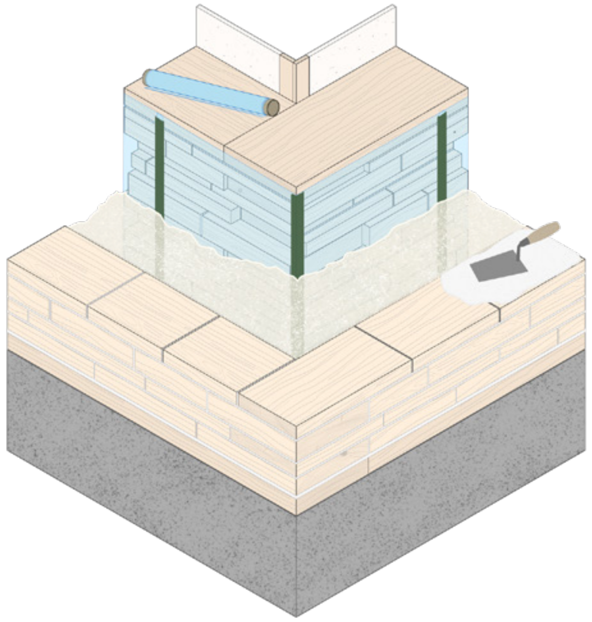
Right: A 1:10 scale model of an exterior plank masonry wall, in which only the two outer layers function as the load-bearing structure. It proposes a method for incorporating a vapor barrier, which would be installed directly onto the outer, load bearing layer(s), before adding the interior layer. On the inside, the end grain faces the room and can be left exposed.

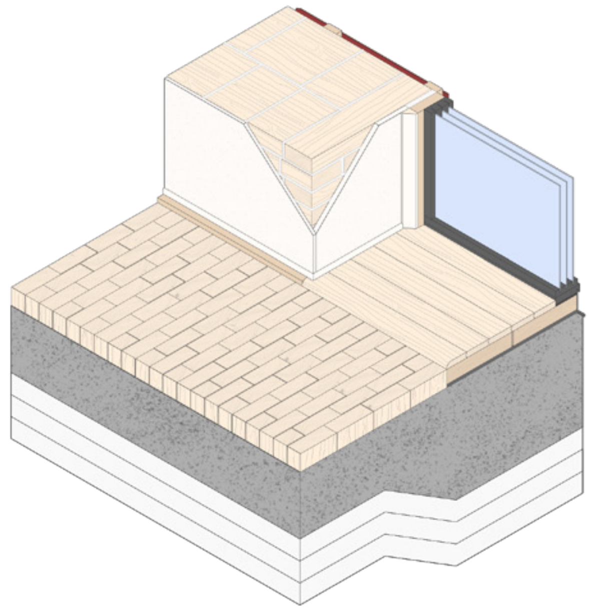
Above: 1:10 scale model showing the corner of an exterior wall, imagined as a cavity wall with loose-fill insulation where the two different by-products from Derome, the offcuts and the planks, are used in combination.

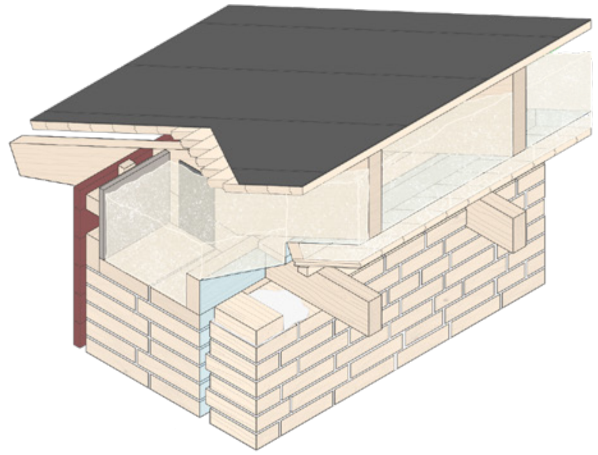
Right: 1:10 scale model where the plank masonry is used as infill in a post and beam structure. In the middle section, the wooden blocks are rotated so that their end grain is showing.

DETAIL STUDIES
SCALE 1:25









DOUBLE-LAYER WALL ALIGNED INWARDS

Wall consisting of two layers of offcuts, without any additional insulation between them. The pieces are laid in a running bond using clay as mortar, and are then plastered on both sides, creating an air tight but vapor permeable exterior wall. The blocks are 45 mm thick and between 145-170 mm wide and are placed so that they are somewhat evenly aligned inward but are allowed to protrude on either side of the wall, creating a surface full of character.

EXTERIOR WALL CORNER

Exterior wall with two layers of plank masonry and loose-fill insulation between them. The offcuts are sorted based on thickness only, but allowed to vary in width. The masonry is laid, after laying the sole plates and insulation, so that the inside of the interior layer and the outside of the exterior layer are both even. In the corners, every other layer crisscrosses over the next, similar to how a dovetail corner looks. The inwards-facing side of each layer is allowed to be uneven, as the space will later be filled with loose cellulose insulation. Connectors made of long lumber are laid at window sill height.

OPENING IN EXTERIOR WALL

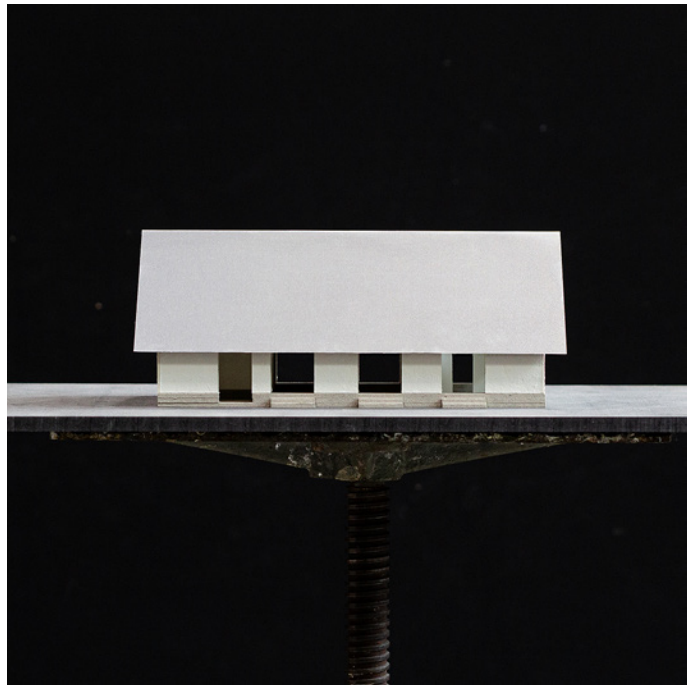
Load bearing exterior wall with window or door frame. The two layers are placed next to each other, with no insulation in between, creating a solid timber wall. The layers consist of pieces of varying sizes, based on Derome's standard dimensions for finger jointed lumber, which are paired so that the total thickness is always around 450 millimeters. The exterior side is clad with wooden panelling, while the interior is plastered which evens out the irregularities that will occur from stacking the pieces in this manner.

TRIPLE-LAYER WALL & ROOF CONNECTION

Exterior wall consisting of two exterior layers of plank masonry carrying a roof truss, and one interior layer which is not load bearing. Loose insulation is added to the roof construction, while the wall instead acts as a solid timber wall about 550 mm thick. Between the middle and inner layer is a vapor barrier, which is attached after the two exterior layers are in place and before the inner layer is added. The exterior is clad with wooden panelling, and the interior side can either be plastered or left as it is, showing the end grain of the wood.

Collages made as a first exploration of various facade expressions, testing different material combinations. In some, the wood masonry is exposed in varying degrees, and in some, the concealed load-bearing structure is hinted at in other ways, like using exposed wood lintels.

Physical models



Above: A 1:10 scale model of the wall used in both design proposals: a cavity wall built from offcuts of mixed dimensions laid in a running bond, with one face kept flush. The wall is plastered on both sides, with loose-fill insulation added between the layers.

Model in scale 1:10 showing the exterior wall of House no. 2. The structural system is a combination of load bearing plank masonry exterior walls on the first floor and an infill structure on the second, where only the outer layer is load bearing, and the inner layer is constructed independently of it.

June 2025 diploma exhibition

Thank you for reading.