NORDLANDSBUA

SHARED CABIN
FROM A CIRCULAR ECONOMY PERSPECTIVE

Master thesis in Industrial Ecology
By Anneli Kolås

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NTNU, Trondheim

SAMMENDRAG

Denne masteroppgaven beskriver min del av et tverrfaglig team, for å designe en delingshytte for Salten Friluftsråd. Målet med arbeidet var å fordype seg i sirkulær økonomi og ta det inn i prosjektet, og diskutere mulighetene og utfordringer knyttet til det. DNT har sirkulær økonomi som en av sine bærekraftsmål, og det har vært fokus på å redusere materialbruk og ha gjenbrukte materialer i prosjektet.

Design av hytten foregikk som et samarbeid mellom tre studenter fra 2-årig masterstudiet Sustainable Architecture. Konseptet for Nordlandsbua ble en liten nødbu med et sommerskall som kan benyttes som ekstra overnattingsplass på sommertid, da flere går i fjellet. Nødbua ble bygget i løpet av to uker i mai, og presentert på Friluftsliv Landskonferanse i slutten av mai. Det ble det gjort intervjuer med friluftsinteresserte som ga tilbakemeldinger om Nordlandsbua og tanker om sirkulær økonomi.

Det er fokusert på å redusere materialbruk i forhold til å bygge en liten og kompakt nødbu med et sommerskall. Fokus på å redusere avfall under bygging er også blitt gjort. FutureBuilt sine kriteria er brukt for å anslå sirkulariteten av Nordlandsbua.Den bygde delen består nå av 12% gjenbrukte materialer. Hvis sommerskallet bygges med gjenbruksmateriale, vil dette økes. Ombrukbarheten består av mellom 10%-90%, avhengig av tilstanden på materialene når det gjenbrukes.

Gjenbrukte materialer krever planlegging og mulighet for oppbevaring. Dette gjør det tidkrevende og lite lønnsomt. Mye skulle planlegges på kort tid. Til tross for at delingshytten skulle være liten. Ekstra stort ansvar var det også med tanke på at hytten skulle bygges i Bodø, der vi var prosjektledere for første gang. Stort tidspress førte til at det som hastet mest var det som ble prioritert.

ABSTRACT

This master thesis describes is a mix of individual and communal work, to design a shared cabin in Nordlandsruta. The goal of the individual work was to look at circular economy and how that can be influenced into the project, and the opportunities and challenges related to it. DNT has circular economy as one of their sustainable goals and there has been focus in how to reduce material use and the use of reused materials to the project.

The concept of Nordlandsbua is to provide a space for hikers to get rest and dry their clothes, get a good night sleep and a place to cook their dinner. We designed a winter core with the possibility of an outer shell. The core is insulated and has a small stove as heating in the winter months. The oater shell provides the possibility to have more visitors during the summer. DNT's trails are more used in the summer months. Instead of making a big cabin that would require more energy to get warm, this makes it more flexible and will decrease the demand for wood - with the correct use. The outer shell is not insulated and will be encourage to be built with reused materials, to reduce the need of new materials.

There is space for four people to sleep comfortable, and the lower beds can be used as seating. The construction is built built by studwork with crossbracing. Wood fiber insulation was chosen as insulation because it is a natural product and the client had experienced moisture demage and problems with mouses when using glass wool insulation. Vapor break was chosen since the building is not fully occupied, in order to make the construction to breath out. The drying room is designed so the users can get their clothes and gears dry without fully occupying the space around the stove and kitchen area.

A key goal of the project was to present the prototype and get feedback at Landskonferanse Friluftsliv 2022 in Bodø.

FutureBuilt's methods and criteria for circular buildings were used to evaluate the circularity of the project. The built core is consisting of 12% of reused materials and the reusable materials is between 10%-90%, depending of the condition when reusing. If the outer shell is made from reused materials the share of circularity will increase.

Reused materials requires time and coordinating. The project period needs to be longer and it needs to be planned early in the project. There needs to be room to change the design in order to see what materials you get.

MASTER THESIS

This report is a final delievery of student Anneli Kolås, finishing the degree of Industrial Ecology. The thesis is written through the department of Design, with collaboration with Sustainable Architecture. The topic is given by DNT and Salten Friluftsråd.

Prior to starting on Industrial Ecology program in Trondheim, I did my bachelor in Civil Engineering and Design (Byggdesign) at the University of Agder. During my studies, my interests and concern about the environment grew and I wanted to learn more about how to minimize the natural system. I decided to move to Trondheim after the bachelor, to live closer to mountains and hiking oportunities and to start on the 2-year master degree in Industrial Ecology the autumn 2019. I have always had a personal interest in architecture and design, and decided to do a semester in Sustainable Architecture the spring of 2021, before finishing my degree in Industrial Ecology. The Industrial Ecology program collaborates with Industrial Design and from there I got contact with Pasi Aalto which offered a unique thesis topic that combined my interests of nature, architecture, design and circular economy.

The topic for the master thesis is circular economy in terms of using the circular economy strategies to implement in the design of a shared cabin in Nordlandsruta. In the originally describtion of the master thesis it was mentioned that all the materials would be reused. In reality, this was not possible. It was restricted how much reused material was possible to get hands on in a time frame of four months. The literature review done for the project has been in terms of designing the prototype about materials and about circular economy. The interviews did not have as a big part as originally thought, but a few interviews were done under exhibition of Nordlandsbua.

NTNU
Fakultet for arkitektur og design
Institutt for design

Masteroppgave for student: Anneli Kolås

Tittel Fremtidens delingshytte: fra et sirkulær-økonomisk perspektiv
Title Shared cabins – from a circular economy perspective

Bakgrunn:
Sirkulær økonomi bidrar til mer effektiv bruk av ressurser, ved forlenget levetid av produkter, reparere og gjenbruke (Miljødirektoratet). Dette har et stort potensiale i byggebransjen, men per dags dato er det tidkrevende og dyrt.

Dagens private hyttemarked har stor etterspørsel. En konsekvens av Covid19, førte til at nordmenn måtte feriere i eget land. DNT har hatt eksplosiv vekst i antall besøkende og hyttemarkedet har aldri vært hetere. Dagens hyttemarked er langt unna å være forenlig med samfunnet vi ser for oss i 2050 og det er utfordringer til bærekraft, energibruk og bruksmønster. En av endringene som er mest interessante er å utvide bruken av delingsøkonomi og DNT lurer hva som skal flere dropper å bygge egen hytte, men heller velger DNT og en mer bærekraftig tilnærming til sin fritid.

Oppgaven er todelt. I samarbeid med NTNU wood og medstudenter ved Sustainable Architecture, skal det designes en prototype av en liten delingshytte. Hytten skal bygges av gjenbruksmateriale. Den andre delen er relatert til sirkulærøkonomi og delingshyttens varighet i et livsløpsperspektiv. Her vil det gjøres kvantitative og kvalitative studier.

Oppgavens gjøremål
- Design av delingshytte
- Litteratursøk om gjenbruk av materialer, sirkulærøkonomi, varighet av bygg
- Intervju kan være aktuelt

Oppgaven utføres etter "Retningslinjer for masteroppgaver i Industriell design".

Ansvarlig faglærer (hovedveileder ID): Nils Henrik Stensrud
Biveileder: Pasi Aalto
Bedriftskontakt: Bjørn Godal

Utleveringsdato: 7. januar 2022
Innleveringsfrist: 7. juni 2022

NTNU, Trondheim, dato

Nils Henrik Stensrud
Ansvarlig faglærer

Sara Brinch
Instituttleder

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I would first and foremost want to thank my supervisor Nils Henrik Stensrud for your encouragement and constructive feedback. Thank you for the inspiring talks and guidance during this semester.

Thank you Pasi, Bjørn and Sami for making this project possible and managing so our prototype of Nordlandsruta could be built.

I want to thank the department of Industrial Ecology and Industrial Design for doing this collaboration between the study programs. Given the oportunity to collaborate with students accross the fields of study is unique and opens oportunities.

Thank you Peter and Jorg at the workshop for advice with materials and for letting us store and occupy the workshop to do the necessary prework.

Thank you Arkitekt- og Design revyen for giving us the lumber and to Martin and “byggegruppa” for removing all the screws and for helping with the transport to Gløshaugen.

Thank you family and friends for your insights in the project and be supportive. Thank you Oda for keeping me with company when driving to Oppdal.

Last. but not least - thank you to my dear team members for the group work, fun memories and effort that has been put in this project together. We have built a cabin! I look forward to visit it with you.

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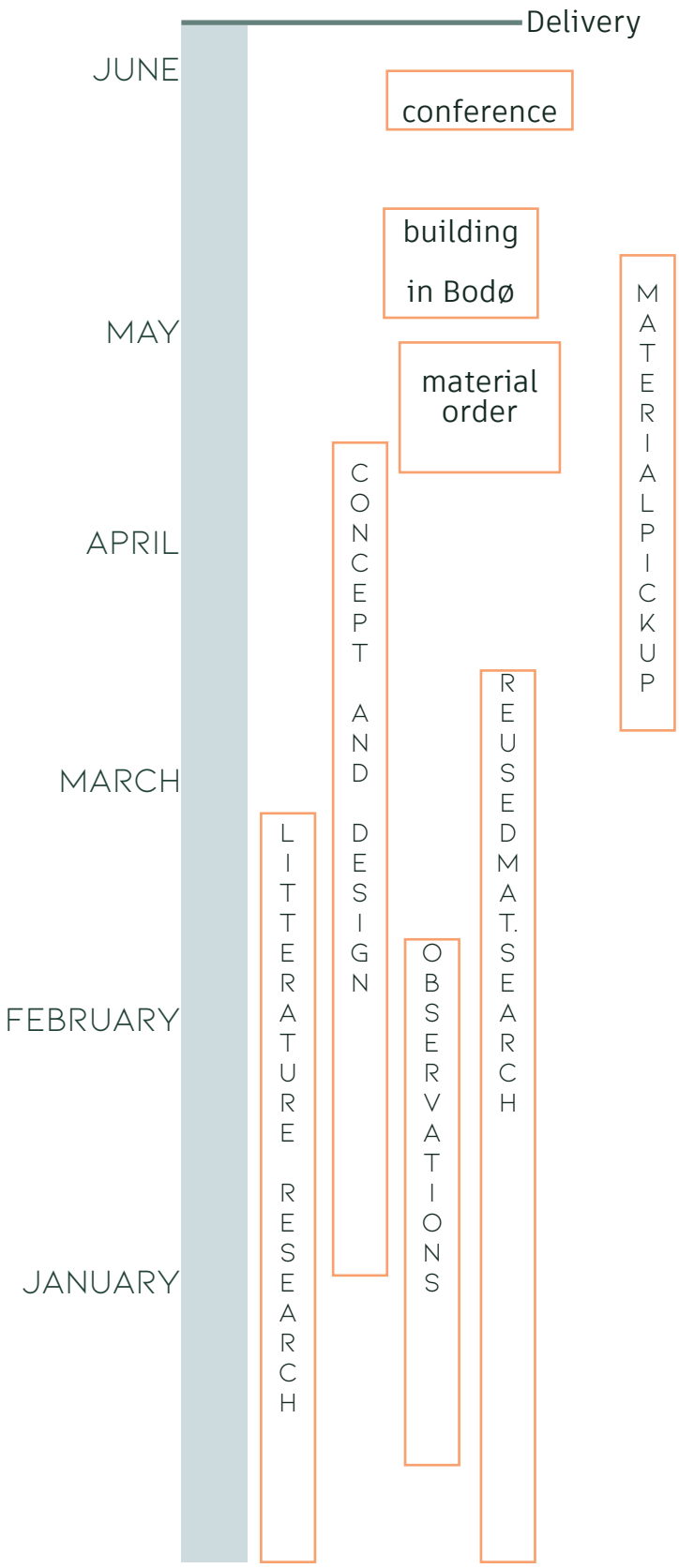
TIMELINE


Delivery
JUNE
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conference
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material order
MATERIALPICKUP
CONCEPT AND DESIGN
REUSEDMAT.SEARCH
OBSERVATIONS
LITTERATURE RESEARCH

1. INTRODUCTION

A introduction to the project, the motivation and process behind it.

Growing up by the sea, in between the mountains and fjords, west in Norway, there has always been a fascination and love for nature. Hiking in different times of the year. The scent of the forest. Crossing mountains and cooling down in fresh meltwater in the summer months. Skiing in winter, admiring the landscape covered in a white blanket, while the cold air strikes your chin. It gives a feeling of freedom.

This feeling of freedom has more people discovered, and with an increased amount of people experiencing nature (Friluftsliv, n.d.). However, as I prefer the primitive, simple nature, more people seek to relax in private cabins. Earlier, these cabins have increased in usable area from 62m2 per-cabin in 1983 , today they are over 100m2 (Skjeggedal, Ericsson, Arnesen & Overvg, 2010). Also, studies shows that the nearby hiking trips has decreased, and those who were seeking to the nature during lockdown, was the ones that was already active. The nature itself also suffer when more people are visiting.

Often tourism visit the same places, and with massive tourism. People tend to go after places seen on Instagram (Refseth, 2021).

Climate changes caused by human-induced interference have already affected many kinds of weather and climate extremes in many regions across the globe. These rapid changes across the Earth's climate system; in the atmosphere, oceans, ice floes, and on land, are rapidly observed by scientists (UN, 2021)

United Nation came with a warning in 2021 that it is code red for the human race. Area of land is occupied by our greediness and loss of nature. If our human actions continue like it has, we will reach 4 degrees temperature within 2050. This will lead to an increase in temperature, more moisture is available from precipitation, and the presence of excess moisture in the air contributes to shifting winds and weather patterns (Smith, 2010). Making part of the world uninhabitable, increase in dangerous weather patterns and unsafe.

To avoid this from happening, action needs to be taken. Our best scenario is 1.5 degrees. The seventeen climate goals is made as a guide to take action. A recognition of our actions will affect the outcomes in others, and this development is balanced through social, economic and environmental sustainability (ipcc, 2014).
Up to 10 of the climate goals are related to outdoor recreation. The Norwegian Trekking association (DNT) has included 6 of them in their sustainable strategy, published in 2021 (DNT, 2021a). DNT's sustainability goals and ambition is to reduce the outdoor trekking footprint, to become Norway's most sustainable and leisure offer, and be a clear voice for the outdoor trekking enthusiasts and our common nature heritage (DNT, 2021a)

NORDLANDSRUTA

Nordlandsruta was established between 1988 – 1992. The marked trekking route expands for 650 km along Nordland and borders areas between Norway and Sweden (DNT, 2021b).

In the fall semester, my project work was within the same topic – Nordlandsruta. However, focusing on transportation to make the site more accessible for non-driving hikers. This is something which is currently under progress to improve in terms of their sustainable strategy.

The figure above is from the visit I had to Nordlandsruta in the fall.

PROCESS

The team of this project is four students, studying 2-year masters in NTNU Gløshaugen. Me from the industrial ecology programme, writing the thesis industrial design. Sonja, Anastasia and Julie are taking their masters in Sustainable Architecture Since the master studies are two year, the bachelor background is different for all.

The process of the design was worked on as a group. This resulted in a communal report which is placed as chapter two in this thesis. In this thesis the evaluation of the circular economy is done. The potential and challenges of it and an evaluation in how circular the current core is.

Both before and during the construction period of the project, there was coordinating that needed to be done. I was responsible for ordering the car and have communication with the client and the supply shops in order to get the material ordered. Searcing for reused materials took time and so was coordinating the prework of the reused materials. The two weeks before leaving to bodø went into coordinating and administration of the project. The day before leaving, the van was filled up with reused materials and tools and the 10 hour drive to Bodø to build the core of Nordandsbua could begin. Further detail og the process is described in chapter II.

During the constrction period, there was many trips to the shops to buy materials and tools that we needed. Problems occured and they were sorted out together with the group and the carpenters.

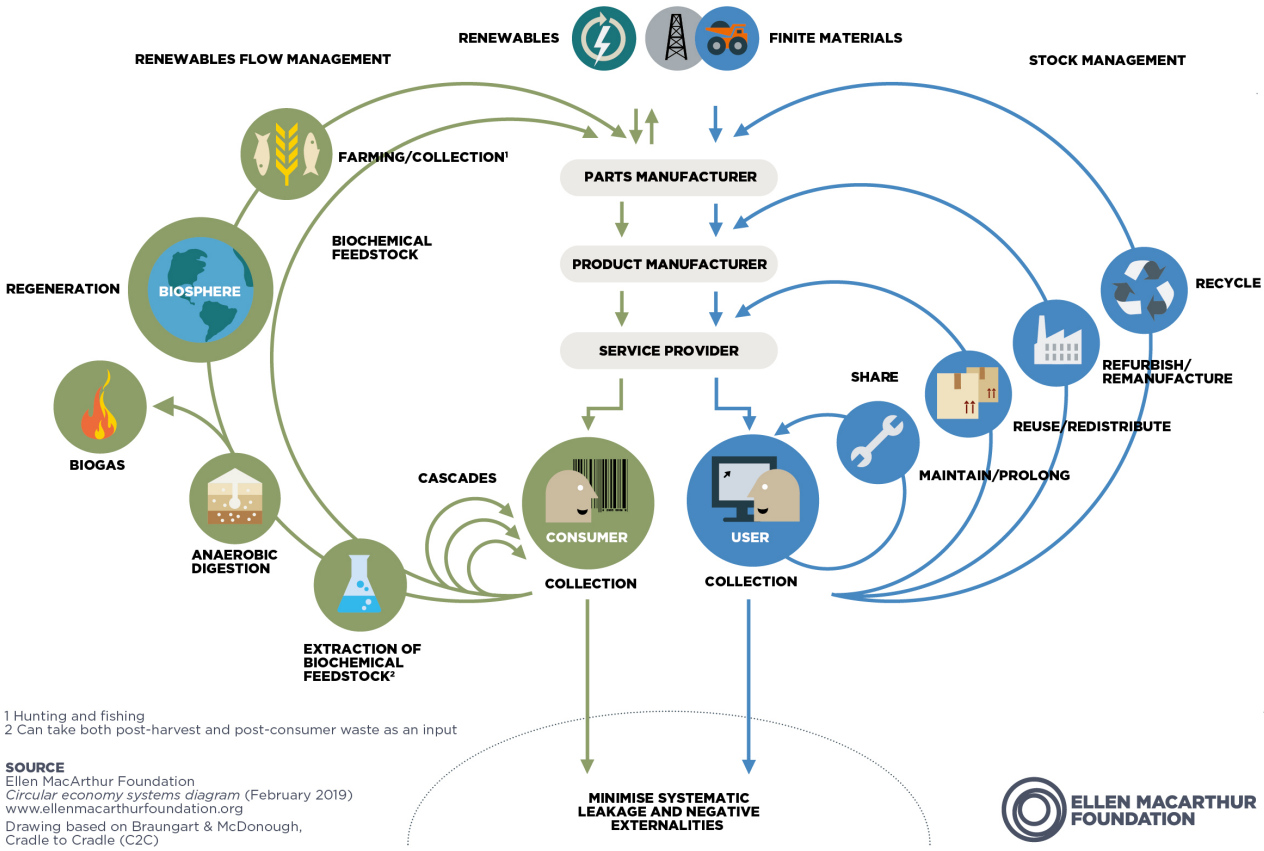

FIGURE: Circular Economy model (EllenMacArthurFoundation, n.d.)

CIRCULAR ECONOMY

Principles within the circular economy aims to keep materials in the system, instead of throwing them away as waste, like the linear process (EllenMacArthurFoundation, n.d.)

CRITERIA FOR CIRCULAR BUILDINGS

Future Built define a circular building when the resources utilization is facilitated at the highest possible level, with a consistency of at least 50 per cent reused and reusable materials and components (FutureBuilt, 2019). At least 20 per cent of these should be reused materials and another 20 per cent should be reusable. In FutureBuilt's criteria for circular building, the waste hierarchy is mentioned as principle that can be used in building design.

The top priority of the waste hierarchy is reduction. Reducing resources within the built environment can be achieved by building compact with high degree of utilization, for example with communal use of the building (FutureBuilt, 2019). Design for the possibility to change and for reuse is two strategies for reducing material resources. The next priority is reuse, which in the built environment can either mean to refurbish a building instead of demolishing, or to reuse old construction materials into the building. The most sustainable way of reusing building elements is retained on site and for the same usage. When reusing material, in the way where it is given a new value in terms of reinventing or by maintenance, it is defined as a upcycling.

It is difficult to predict what will happen with the material in the future, Planning for reuse of building materials is increasing the chance of reuse in the future. To achieve the 20% of reusable materials, the list in TABLE A shows strategies in how to succeed. These strategies were used when choosing materials. In chapter III the table is used again to evaluate materials used in the project.

Futurebuilt describes methods in how to calculate reduction of emission when going for circular materials (Resch et al., 2021). When the materials are documented as reusable in the criteria for circular building of futurebuilt, it can be added a "climate effect" with a reduction of 10% for these material. When reusing materials, 80% reduction from the emissions from production of the material (A3), or a similar product that would have been used instead, can be withdrawn (futurebuilt, 20 [p. 17]).

STRATEGIES	HOW TO SUCCEED
Robust materials choice	Minimize the number of material and components. Homogen materials Use durable materials that can be reused in generations of buildings. Avoid materials which is a danger for the health and environment (even if the values are approved).
Flexible connections	Use reversable connections between construction components. For instance screws and bolts. Avoid welding, glue, foam etc. Minimize the number of connection and design with use of simple tools. Use components durable to be disconnected and reconnected. Design in terms of expected lifetime of the components. Same expected lifetime for joint components.
Available information	Mark materials and the type of components. Mark attachment points and make sure they are visible and available. Declaration of materials, to give information about mainainance and deconnection. The geometry of the building is documented through and open BIM (Building Information Model).
Producer agreement	Leasing agreement. Return agreement with producer. Temporarily use of components for original use (pre-cycling).

TABLE A: Strategies to design for reusable materials and components (Future-

In order to get some insight and inspiration to the project, observations was done both for already built cabins and for reused materials in interior design. The cabin observation can be read in the chapter II. Observations for reused materials in interior design was done at Deichman library in Tøyen (Oslo) and BrukOm, a secon hand shop in Nyhavna, Trondheim.

TØYEN BIBLIOTEK

The library in has made their interior mostly by reused materials. The first figure shows a bench built on old wooden doors. The doors were tilted with an angle to make it more comfortable to sit.

The vibe of being in a place of combined, old materials was a good feeling. It was quite popular place, with a veriety of age. An old woman said to me “I really like the athmosphere here. It is a nice place to read the newspaper and I find books about garden plants.” However, it was a bit noisy the day she visited, on a saturday. The library also offered free seeds to plant yourself and offered free rental of tools. The spirit of shared economy was thriving.

Interior at Deichman Tøyen

BRUKOM

Brukom is a second hand shop, drifted by Trondheims Renholdsverk, that provides the waste collection, disposal and recycling service in Trondheim municipality (TRV, n.d.).

The visit at brukom was first to see if there was any second hand materials that could be used in the project. Unfortunately there was only interior doors and old windows. Most construction waste went to incineration. However, the design of their furniture and cabin display was interesting as it was all made from materials collected at the waste facility. If the project would have a longer time frame, more contact with Brukom and TRV could have been possible in order to collect materials from the waste sorting facility.

Brukom, cabin for display with reused material

Brukom, second hand interior

II. NORDLANDSBUA (COMMUNAL REPORT)

This chapter is the communal thesis report and is written in collaboration with Anastasia Tsivileva, Julie Nyland Nilsen and Sonja Morzycki. It is included in this thesis as it descibes the communal process and work thoughout the project of the Design and process of the construction of Nordlandsbua.

ABSTRACT

In the last two to three decades, there has been a severe change in the development of private cabins in Norway. As a result, the climatic footprint of cabins are expanding due to size, building standards, and the rapid pace of development. This thesis is written as a response and encouragement for sustainable cabins with a low carbon footprint and the ambition to drive shared cabin culture further.

Local travel in Norway has become more popular since the COVID-19 pandemic. By encouraging shared cabin culture, more people will be able to visit them; it is a more economical and sustainable investment than private cabin culture. Along the trekking route, Nordlandsruta, there is a need for 15 or more small sustainable cabins to accommodate more visitors, shelter as emergency huts along the trails, and encourage a more sustainable leisure lifestyle for visitors. The cabin in this thesis, therefore, is a built prototype. It is designed around sustainable material choices yet considers longevity and robustness in the final design and construction.

This thesis is presented in seven jointly written chapters and four individual sub-topics related to the project. Foremost, the beginning of chapters I through III gives the reader an overview of the challenges Norway is facing in terms of unsustainable leisure lifestyle, the encouragement and introduction of eco-friendly shared cabins, as well as an introduction to the context of where the cabin will be located.

Furthermore, chapters IV, V, VI and VII represent the design process from concept form leading up to the final design before the construction process begins. Chapter VI gives a detailed overview of the experience, challenges, the changes during the building development and the building process. Lastly is the reflection of the whole experience and our learning outcomes from this project.

Additionally, this thesis has four sub-topics. The first topic is related to climatic design, site analysis, and adaptation of the cabin with the outer shell. The second subject focuses on Life Cycle Analysis, which researches the cabin's material choices and different material combinations. Thirdly, the topic is analyses energy usage and demonstrates the heating solutions and heating demands for the cabin, intending to reduce the resource usage and emissions for the cabin. Lastly, the final topic is on the circular economy of the cabin, written for the study MSc in Industrial Ecology.

With all chapters and topics reviewed together, this thesis explores and identifies sustainable architectural solutions, the potential and benefit of small cabin designs, their adaption to climate and energy, and the possibility for further development into more self-sufficient cabins.

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The cabin project would not have turned out as it did without the carpentry students from the Staatliches Berufliches Schulzentrum in Immenstadt, Germany. Their expertise and hard work was poured into the building process and is exemplified in the final cabin. It was a great pleasure to work alongside you all.

Also, a big thank you to Remi and Harald for taking time out of their busy schedules to construct our interior design.

Lastly, we'd like to thank Bjørn Godal, Salten Friluftsråd and DNT for inviting us to be a part of this project. It's not often that one gets to see their master's thesis come to life, and we are grateful for the opportunity.

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ABBREVIATIONS

BIM	BUILDING INFORMATION MODEL
°C	DEGREES CELCIUS
CO_2	CARBON DIOXIDE
DNT	DEN NORSKE TURISTFORENING
EPD	ENVIRONMENTAL PRODUCT DECLARATION
EPW	ENERGYPLUS WEATHER FILE
ICT	INFORMATION & COMPUTER TECHNOLOGY
KG	KILOGRAM
KW	KILOWATT
KWH	KILOWATT-HOUR
LCA	LIFE-CYCLE ASSESSMENT
LEED	LEADERSHIP IN ENERGY AND ENVIRONMENTAL DESIGN
SOT	SULITJELMA OG OMEGN TURISTFORENING
TEK17	BYGGTEKNISK FORSKRIFT
OSB	ORIENTED STRAND BOARD
U-VALUE	THERMAL TRANSMITTANCE
ZEB	ZERO EMISSION BUILDING

THESIS STRUCTURE

This aim of this project is to design and construct a shared cabin. This thesis is delivered in two parts, a common written part and four individual sub-topic research reports focusing on different aspects and methods leading up to the final design of the Nordlandsbua.

I. INTRODUCTION

II. METHODOLOGY

III. CONTEXT

Establishment of the research issue, boundaries and studies

IV. CONCEPT & FORM

V. DESIGN RENDITIONS

Exploration of development and variations of design prior to construction

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VI. THE BUILD

VII. CONCLUSION

Building schedule, challenges, resolutions and reflections during and after construction

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INDIVIDUAL RESEARCH BOOKLETS:

VIII. CLIMATE RESEARCH AND OUTER SHELL DESIGN
Julie Nyland Nilsen

Climate exploration of the site, how the cabin can be adapted into different areas along Nordlandsruta and design of the outer shell

IX. MATERIALS SELECTION AND LIFE CYCLE ANALYSIS
Anastasia Tsivileva

Process of material choices and LCA calculations of three different material combinations of the cabin.

X. HEATING AND FIREWOOD CONSUMPTION ANALYSIS
Sonja Morzycki

Investigation of heating solutions and the heating demand of the cabin, with the aim to reduce resource-usage.

XI. CIRCULAR ECONOMY
Anneli Kolås
(Master's thesis in Industrial Ecology)

Analysis of circular economy and the influence of reused materials on the construction and the lifetime of Nordlandsbua

1. INTRODUCTION

BACKGROUND

NORWEGIAN CABIN CULTURE

Norwegian nature is unique. The country has extensive coasts, high mountains, and immense forest areas. This composed landform is home to unique flora and fauna. The Norwegian people have always felt notably connected to this nature; it is part of the Norwegian identity. Therefore it is considered valuable to experience and be linked with it. Contemporary cabins stem from a variety of origins, including farmhouses, forest huts (skogstuer), mountain huts (setre), and tourist and sports-club overnight centers (Garvey, 2008, citing Gardåsen, 1999). 'A small, simple wooden house' is one of the definitions of a cabin. Traditionally, this conjures up the perception of Norwegian cabin life as primitive; it is about a simple way of living, getting back to nature, and getting away from modernity. (Xue, Næss, Stefansdottir, Steggancen & Richardson, 2020).

Narratives of norms and ideals depict a cabin life that is friendly, respectful, and harmonious to nature. The simple physical setting of the cabins and people's activities, like fishing, berry-picking, hunting or hiking around the cabin area, exist within nature. Nonetheless, a noticeable change in development and trend has deviated from the traditional narratives in recent years. The back-to-nature simplicity of life is replaced with new social norms for convenience, comfort, and extraordinary experience (Vittersø, 2007). The climatic footprint of cabins is growing rapidly, and the standards and associated infrastructure around the cabin are growing additionally. This development leads to negative climate conclusions.

CLIMATIC STRAIN AND SIZE OF PRIVATE CABINS

In the last two to three decades, there have been significant changes in the development of cabins in Norway, not in the pace of development but size, standards, and form of development. The average usable area has increased from 62 m^2 per–cabin in 1983 to 100m^2 in 2008. (Skjeggedal, Ericsson, Arnesen & Overvg, 2010). In addition, the number of households with more buildings at their disposal, built with a high housing standard and the associated infrastructure is growing. (Vistad, Eide, Nellemann & Kaltenborn, 2004. Vittersø, 2007).

Surveys done by Statistics Norway show that approximately 22% of the Norwegian households own a cabin, and 40% have access to one. (Steffensen, 2018). There are 445 513 cabins and leisure buildings as of January 2022, an increase of 8,6% in the last ten years. In addition, the count includes to the cabins and leisure homes that Norwegians own abroad (SSB, 2022).

FIGURE 1. Myrkdalen cabin development area (Bøe, B., 2020)

Cabin areas are seizing more and more nature. The development is forwarding towards several dense built-up cabins with interventions in electricity, water and sewage, roads, and parking spaces. The increasing size of the cabin, and the increasing size of mountain villages of cabins, threaten the natural areas and vulnerable species, for example, by threatening wild reindeer herds with development in the mountain areas. Furthermore, carbon is released into the atmosphere with increasing development in bog areas. The contiguous leisure building area, which also includes infrastructure and green space between the cabin, was 7,9 times the total area of Oslo Municipality in 2018. (Solbraa & Walnum, 2020). The increasing terrain intervention from cabin construction also increases the overall energy use. Thus, energy consumption serves as a good indicator of the overall environmental consequences of cabin life.

FIGURE 2.
Holtardalen in Rauland, 2004
(Statens kartverk, Geovekst og kommunene, 2004)

FIGURE 3.
Holtardalen in Rauland cabin village development, 2021
(Statens kartverk, Geovekt og kommunene, 2021).

FIGURE 4.
Sjusjøen in Hedemark, 2001
(Statens kartverk, Geovekt and kommunene ,2001)

FIGURE 5.
Sjusjøen in Hedemark cabin village development, 2021
(Google Earth, CNES and Airbus, 2021)

DEVELOPMENT IN THE USE OF HOLIDAY HOMES

The market for holiday homes is rapidly increasing, and these properties have become essential investments. Previously, the Norwegian cabins were first built in the vicinity of the larger cities. With increasing mobility, cabins or holiday homes were built in the most attractive areas, by the sea or mountains (Vittersø, 2007). Today, cabins located in the mountains are used when there is snow, while cabins by the coast are mainly used during summertime (Figure 6). This leaves the cabins empty for significant parts of the year.

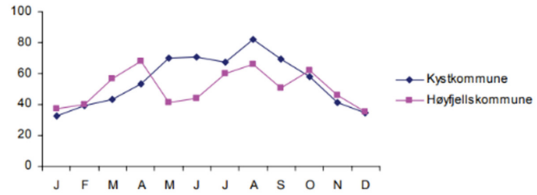


FIGURE 6. Percentage of people who have visited their cabin in selected types of cabin municipalities. (L. Vågane, 2006)

The environmental impact of energy consumption from cabin life must be reduced. The UN's climate panel has said that if the world is to stay below a target of a maximum of two degrees increase in the global average temperature, compared to pre-industrial times (Paris Agreement, 2015), the greenhouse gases must be almost zero before the end of the century. If we succeed in reaching our target, energy consumption must also decline; it is not possible within the short deadline to replace all fossil energy used today with environmentally friendly renewable energy (Aall, 2014). This means that the relative environmental impact per cabin must be reduced by heating as much as possible through wood. In addition, as much as possible, cabins should be self-sufficient in electricity from the sun or wind. Further, cabin waste must be recycled, and transportation to and from the cabin must be done by public transportation more than is today- or at least by electric cars.

PRIVATE VS PUBLIC

The new developments toward more and larger cabins create conflicts between the demand for infrastructures, such as roads, electricity and water, and the need for nature preservation and public access to nature. In addition, consumption at the cabin demands increasingly more resources. The development of cabins seems to follow the trends of general housing consumption; Norwegians prefer cabins with higher standards, including newer and more household appliances and ICT equipment. With this higher cabin standard, frequent trips to the cabins lead to increased energy consumption and greenhouse gas emissions.

So, how should the cabin market become more sustainable? We know that the cabin's footprint needs to be reduced to become more sustainable. A solution would be to design smaller and smarter cabins that provide a more climate-friendly lifestyle, reduce the pace of development and change our holiday habits.

Environmentally friendly cabin trips must replace the more climate-hostile forms of holiday homes (Solbraa & Walnum, 2020). Transportation to and from the cabin is possible in a climate-friendly way by renting or driving one's electric car. However, this trend will not change for a good couple of years. Therefore, public authorities and private cabin developers' job is to import a climate-friendly transportation infrastructure such as charging stations and efficient public transport services. Efficient but gentle utilization of plot area and associated infrastructure will also minimize the area footprint and safeguard natural areas and species.

As local travel in Norway has become more popular since the COVID-19 pandemic. Cabin sharing and cabin rentals serve as a good counterweight to holidays abroad. This concept will make cabins more available to most people. As we are heading into an unknown future, holiday preferences may also change with potential extreme unstable weather. Impulsive holiday habits with a short time horizon will increase the

demand for cabin sharing and cabin rental as a form of holiday. (Solbraa & Walnum, 2020)

More extreme weather types can also provide more maintenance assignments for cabins and infrastructure for local contractors. As a result, knowing how climate change affects locally, becomes a more critical competence for planning, construction, operation, and maintenance in the cabin areas.

NORDLANDSRUTA

The COVID-19 pandemic has resulted in recreation and leisure outside the country of residence becoming almost inaccessible to most tourists worldwide. The situation has also affected Norwegian residents, who have begun to rediscover tourist and hiking routes within the country. Many tourist spots inside Norway began to experience a massive influx of residents who purposefully came to rest in these places. Not very popular among tourists in the past, many tourist routes have not been adapted to such demand.

One of these routes is Nordlandsruta. This wilderness trail extends from Bjørnfjell station at Ofotbanen and down to the border of Børgefjell National Park in Hattfjelldal. The route winds between mountains and valleys, forfeits countless good fishing lakes, and crosses the Arctic Circle. The route is 650 km long and has 43 stages with accommodation options between each stage. The increased interest of tourism in the trail's passage showed the shortcomings of the existing options for stops. For example, the distance between some stops on the path exceeds 30 km, which makes this section of the trail inaccessible to many groups of tourists. The number of places to sleep at stops also varies greatly: one station can accommodate up to 20 people, and the next only up to 4 people. Thus there is a good reason for the increase in the number of huts, cabins, and lodges along the way.

Following its sustainable development concepts, Den Norske Turistforening (the governing organization of Nordlandsruta) wants to introduce about 15 new cabins along the Nordlandsruta trail to solve the problems of accessibility and make it even more attractive for tourists from Norway and all over the world. DNT foresees these cabins as extremely sustainable huts that are off-grid, can be built by locals, and contribute to the quality of the trails in all positive ways.

THE CLIENT

Norway's largest outdoor organization is Den Norske Turistforening (DNT), or The Norwegian Trekking Association. They own and maintain over 500 cabins, which are open for short-term rentals, and manage around 22,000km of walking, hiking, and skiing trails around Norway. They are major advocates in getting Norwegian residents to participate in activities outdoors, and also offer services such as equipment rentals, courses, guided tours, and an extensive amount of information about nature in Norway. Since their founding in 1868, their goal has been to 'work for a simple, active, versatile and nature-friendly outdoor life and for securing the natural and cultural basis of outdoor life.' (Den Norske Turistforening, 2021)

DNT released their Sustainability Strategy for 2021 – 2030, which builds off of the UN's Sustainable Development Goals, which were published in 2015. The document outlines the five key areas in which DNT aims to improve their environmental standards:

1. Activities
2. Cabins & Routes
3. Nature, Cultural Heritage & Environment
4. Methods
5. The Sustainability Pact

In short, DNT's ambition is to promote more accessible outdoor activity, while reducing their environmental impact on a local and national scale. For the duration of this thesis, we have focused primarily on the 'Cabins & Routes' category; the trajectory being that 'DNT's cabin and route network should be Norway's most sustainable holiday and leisure alternative'.

Given that the current cabin culture in Norway is very privatized, expensive and high in energy consumption, DNT plans to promote the usage of public, rentable cabins in Norway, with the desire that 'people choose short-haul trips and use DNT's cabin offers instead of flying abroad or acquiring their own cabins' (Den Norske Turistferening, 2021). DNT also aims to reduce the overall energy consumption and resource usage of its cabins, while also phasing out fossil fuel usage by 2030. Lastly, under 'Cabins & Routes', DNT will champion 'circular economy' strategies in their cabin maintenance and construction of new cabins, which 'involves reuse and efficient utilization of resources [including] reducing food waste and other waste, choosing products with good quality and long life, as well as reusing materials.' (Den Norske Turistferening, 2021).

In coordination with, and as a liaison for DNT, we will also be working with Saltan Friluftsråd, the outdoors authority in the district of Saltan. Their purpose is to "increase the understanding of the importance of outdoor life, work for a better outdoor culture and the spread of outdoor life, as well as secure and develop the region's outdoor opportunities", through the promotion of biking, hiking and paddling, sharing of nature tourism information, and "revitalization of Nordlandsruta" (Salten Friluftsråd, n.d.).

As part of its plan to make the outdoors and shared-cabins more accessible and attractive, DNT jointly with Saltan Friluftsråd, proposed the construction of 15 new cabins along the Nordlandsruta hiking trail, in order to shorten distances between existing cabins, replace aging ones, and accommodate more hikers.

We have continually referred to DNT's sustainability goals in order to guide us through the research and design process.

SCOPE

The scope of this thesis is to design and construct a small cabin to be installed on a site along Nordlandsruta. The first site on which the cabin will implemented is Tjoarvihytta. The cabin, which is appropriately named Nordlandsbua, must meet the bounds of DNT's Sustainability Strategy, Saltan Friluftsråd's specific design demands, as well as our own sustainability goals that we set as a group. We have selected not to design to ZEB, LEED, Passivhaus, or any other standardized sustainability measurement. This is due to the fact that the cabin will be occupied only for short periods at a time and used purely for recreational purposes. The cabin will also not be connected to running water or electricity, aside from an optional solar panel used for phone charging. Although this decision may be unconventional for a thesis in the Sustainable Architecture field, given the size of the project and the client's requirements (DNT and Saltan Friluftsråd), the authors of this thesis and our supervisor agreed it was an appropriate decision.

PERSONAL SUSTAINABILITY GOALS

Throughout this thesis, the needs and goals of our client (detailed in Appendix A, as well as in the Design Boundaries chapter) have been respected, but our own sustainability goals for the project have also been established. These goals are influenced by the waste hierarchy and circular economy, which is further elaborated on in Anneli Kolås's sub-thesis on this topic. Attention will be paid to reducing material usage and choosing previously used materials when suitable. The cabin should be lightweight to minimize its emissions during transportation, while also being designed for longevity and surviving harsh climates. Materials should be chosen in terms of a circular mindset, and local materials are preferred. Designing for disassembly is also a goal in this project, in that it should be easy to repair a part of the cabin, should it become damaged.

In terms of placement on-site, there will be careful consideration to not disturb the existing ecosystem as much as possible. Effort and research will also be placed into reducing heat loss and minimizing excess firewood usage for heating purposes. These goals will be examined further in each individually written sub-thesis.

Nordlandsbua should offer modest but comfortable amenities and be designed in a way that is intuitive to its users. Additionally, in line with DNT's desire to motivate more shared cabin go-ers, both the exterior and interior design should still display a sense of modernity in order to cater to a variety of visitors.

Lastly, Nordlandsbua is designated as a prototype. Therefore, the design must be easily duplicable and must consider the possibility of future variations and adjustments.

OVERVIEW OF PERSONAL SUSTAINABILITY GOALS

- REDUCE MATERIAL USE
- REUSE MATERIALS
- CHOOSE RECYCLABLE MATERIALS
- KEEP WEIGHT TO A MINIMUM, TO MINIMIZE EMISSIONS FROM TRANSPORTATION
- DESIGN FOR DISASSEMBLY
- DESIGN FOR LONGEVITY
- PRIORITIZE LOCAL MATERIALS

LANDSKONFERANSE FRILUFTSLIV

One of the key aspects of the project present the built cabin prototype at the Landskonferanse Friluftsliv 2022 in Bodø, which is held from May 30th to June 1st. This conference is organized by The Norwegian Association for Outdoor Organizations and is focused around four goals:

- Development of environmentally friendly and public use of nature and natural resources in Norway;
- Promotion of issues of interest to internal organizations, with the participation of the government and target groups;
- Encouraging the public right to access nature, facilitating this access and use;
- Boost the ideas of health, enjoyment, and a deep understanding of the intrinsic value of nature through familiarity with the surrounding.

The conference exists to discuss future development plans, make decisions on current issues, and distribute finances among internal organizations. This year's theme is 'sustainability goals and outdoor life'. As seen in the conference program (Appendix B), conference attendees will have the opportunity to see the completed cabin. The conference also gives us the opportunity to receive feedback, from people who were not involved in the building process.

THE BUILD

In order to showcase Nordlandsbua in the Friluftsliv conference, the cabin must go through construction. Early in the project, the period of May 2nd to 13th (2022), was designated as the building period. The build would also take place in Bodø, along with the conference.

As part of the Erasmus program, 9 carpentry students and their instructor, from the Staatliches Berufliches Schulzentrum in Immenstadt, Germany, would travel to Bodø to build the Nordlandsbua design as the final project in their apprenticeship program.

II. METHODOLOGY

DESIGN BOUNDARIES

THE CLIENT'S NEEDS

One of the major influences on the Nordlandsbua design are the clients, DNT and Saltan Friluftsråd. Through correspondence with DNT by way of our supervisor, Pasi Aalto, as well as Bjørn Godal (Head of Salten Friluftsråd), we were given some specific design requirements and requests. The full project proposal can be found in Appendix A, which lists all the necessities that the cabin should fulfill. However, some additional points were expressed in our various meetings:

1. The maximum area of the cabin should be 15m^2, but 12m^2 or less would be ideal

2. Reduce indoor humidity as much as possible.

3. In terms of insulation materials, there is a preference to use something other than fiberglass/Glava. This is due to its tendency popularity as nesting material for mice and insects.

4. Firewood storage should be available on site

The first three points, as well as the list provided in the Appendix A, have been incorporated into the main design of the cabin and are included in this thesis. We have also accounted for firewood storage in the shell design which is detailed in Julie Nyland Nilsen's sub-thesis, 'Climate research and outer shell design'.

TRANSPORTATION BOUNDARIES

The size and weight of the cabin are set to certain boundaries, due to the necessity of moving it from its build location, where it will be presented in the conference, to its final resting location. The dimensions of the cabin could not exceed 8 x 2,5 m due to truck bed size and width. Surpassing the width of 2,55 m would require permission from the regional road office for driving within the region, as the cabin would be considered wide cargo. The weight of the cabin is limited to 3,6 tonnes, as that is the maximum load a helicopter can lift. Another type of vehicle that could be used for the transit of the cabin is a crane truck or a mobile crane. However, these vehicles have a limit to the amount of tonnes and meters that they can extend, in order to move the cabin from the truck bed and onto the site. For the specific location of Tjoarvihytta, both the helicopter and the crane truck, can be used to move the hut to the foundation. However, for more rural and inaccessible areas, a helicopter is the only possible form of transportation, unless the cabin would be built on site.

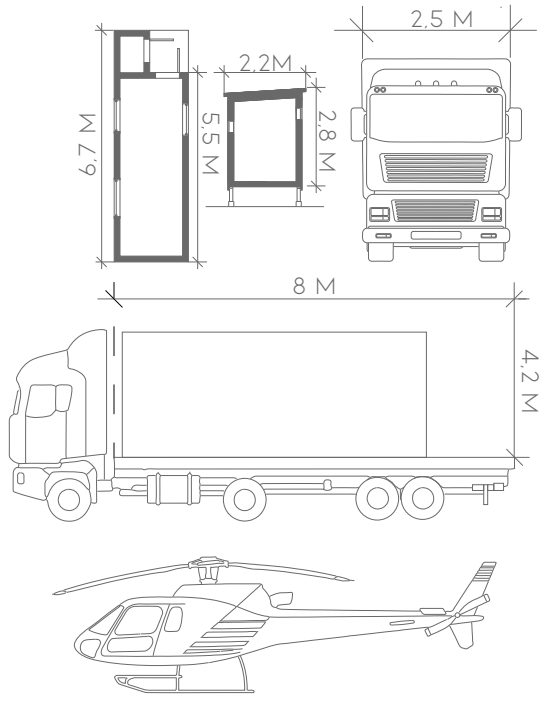


FIGURE 7. Transportation options & their boundaries

TEK17

TEK17 is Norway's building construction standard, published in 2017. All new construction projects must evaluate whether and which TEK17 guidelines apply, including the Nordlandsbua design.

In reading TEK17, the cabin would most likely qualify as a 'leisure home'. Although there is no definition provided for 'leisure home', given that the cabin will not be continuously occupied throughout the year and is used for recreational purposes, we can assume that the term applies. However, there is some ambiguity in other definitions in TEK17, which created some uncertainty about whether the entirety of TEK17 would apply to our project.

In TEK17, leisure homes contain at least one dwelling unit, which is defined as ''housing unit with all the primary functions and which will be used for residential purposes'' and primary functions are defined as a ''living room, kitchen, bedroom, bathroom and toilet. This term is only used in connection with dwellings and requirements relating to accessible dwelling units''(Direktoratet for byggkvalitet, 2017).

Although Nordlandsbua, on a basic level, does include all the listed spaces, the definition does not specify whether those spaces need to include electricity or running water in order to be considered primary functions. Therefore, the application of the term dwelling unit, and the regulations regarding leisure homes, was unclear. The Direktoratet for byggkvalitet (the building authority that published TEK17) was contacted to resolve this confusion and it was determined that, yes, Nordlandsbua does need to comply to TEK17. Due to its size and the site's remote locations, there are some clauses that apply to leisure homes that do not apply to the cabin. Nevertheless, Nordlandsbua does comply with TEK17 standards, and any relevant clauses will be mentioned throughout this thesis.

PRELIMINARY RESEARCH

TRADITIONAL CABIN RESEARCH

Prior to designing the cabin, existing examples of traditional and modern cabin buildings in Norway and beyond, were studied. Traditional variants of houses in countries such as Russia, Canada, and Sweden were considered. The methodological analysis of these structures gave an idea of the traditional material choices, common building forms, the organization of the internal space, and common passive strategies. The next step was the analysis of modern cabins, where for the general concept, many variants of existing structures were considered (Figures 14, 15, 16). Finally, for a more detailed analysis, the Snippen cabin in the province of Trøndelag was chosen (Figure 13).

MODERN TIMBER CABINS

The group selected the Snippen project for a more detailed analysis for several reasons. The first is the size of the cabin, which is only 12m^2, and houses two adults and two children. Since our client requested the cabin to be designed within 15m^2 and accommodate at least four people, it was interesting to see an existing facility that praised the same compact lifestyle. The second, is a similar climatic component. Snippen Cabin is located in the middle of Norway, which suggests its ability to adapt to the country's climatic conditions. Thus, construction technologies were taken into account as possible options for our project. The third, is the choice of materials. The architects of this cabin opted for local and maximally natural building materials that would require minimal maintenance and have the highest possible durability. Our group wanted to implement a similar approach to the choice of materials in our project, so we tried to adopt this experience.

The cabin is located in a forested area adjacent to a separate sauna, storage room with toilet, tree-house, water collector, outdoor benches, and an organized campfire site (Figure 8).

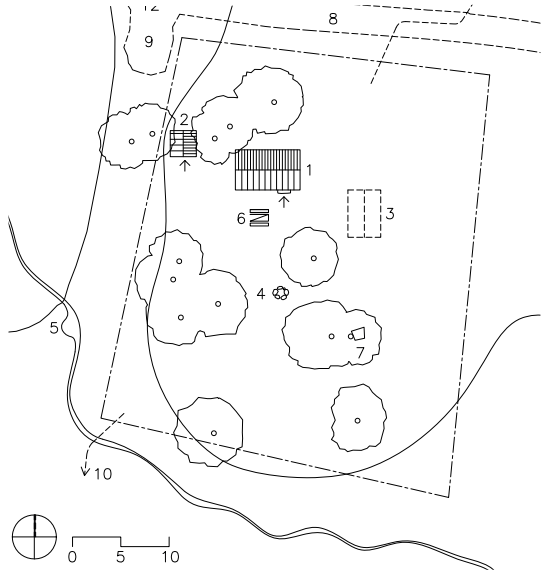


FIGURE 8. SNIPPEN CABIN. MASTERPLAN

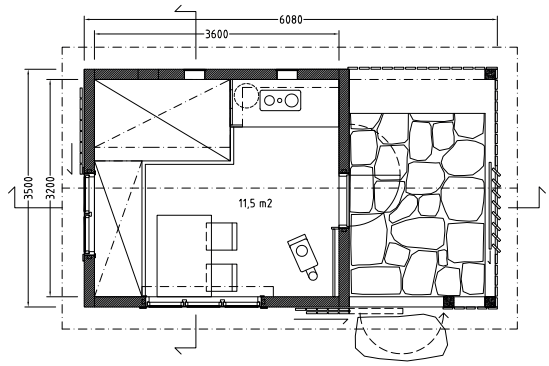


FIGURE 9. SNIPPEN CABIN. PLAN

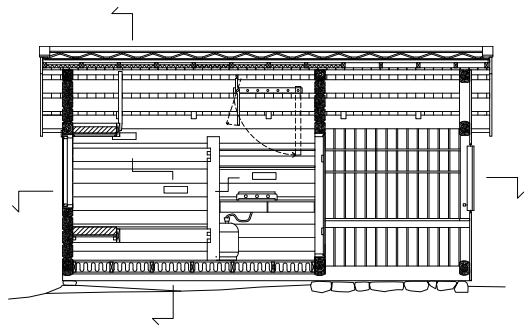


FIGURE 10. SNIPPEN CABIN. SECTION

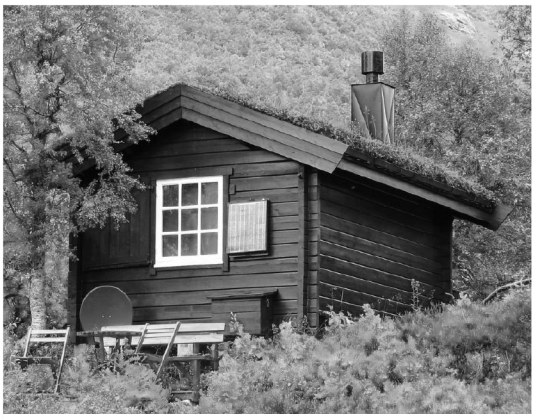


FIGURE 11. TYPICAL NORWEGIAN CABIN

FIGURE 12. TRADITIONAL NORWEGIAN CABIN

FIGURE 13. SNIPPEN CABIN, TRØNDELAG

FIGURE 14. DIY CABIN

FIGURE 15. HYTTE GYRDALEN IN NORWAY

FIGURE 16. LAKE CABIN

In plan, the cabin is divided into two main zones, heated and unheated (Figure 9). The unheated entrance area is designed to store outdoor clothing and equipment and can also be used as a washing room. The heated area consists of a small kitchen, a wood-burning stove, a dining table, and four beds, where two are standard size single beds for adults and two smaller options on the second tier for children (Figure 10). At the ceiling level, there are also racks for clothes drying. (AnneLise Bjerkan, Bendik Manu, 2017)

CABIN VISITS

Purely for education purposes, cabin visits were done to observe the user experience and to get insight into the pros and cons of what is already built. For this project, a cabin in Jotunheimen and a cabin outside of Røros were observed.

SPITERSTULEN is located in the middle of Jotunheimen, surrounded by Norway's highest peaks (UT.no, 2022). The visit of Spiterstulen gave insight into design strategies used in bigger shared-cabins. Notably, a drying room was included in the design. After a long day of skiing, it was convenient to put all the wet gear in one room, separate from the sleeping area. The sleeping room was 10m^2, designed for four people, with two bunk beds. Being three people, it was noted that often there were belongings lying around and always a need for a place to hang up wool to dry. The rooms were not designed for activities other than sleeping, as there was a reception area and restaurant. In order t save money, breakfast was eaten in the sleeping quarters, although there was no table, and the bunk beds were not a comfortable height to sit in. The transport method to this cabin was by car. The stay was for three nights.

FINDINGS

- Preferable to have the space between bunk beds that allow for comfortable seating on the bottom bunk
- In a small room, placing luggage for four people creates a space problem. It is important to have enough space underneath the beds for storage.
- Essential to have enough hooks to hang gear.
- Drying room is convenient

FIGURE 17. SPITERSTULEN (UT.NO/SPITERSTULEN, 2022)

FIGURE 18. FINDING SPACE FOR LUGGAGE (PRIVATE PHOTO)

FIGURE 19. DRYING ROOM, SPITERSTULEN (PRIVATE PHOTO)

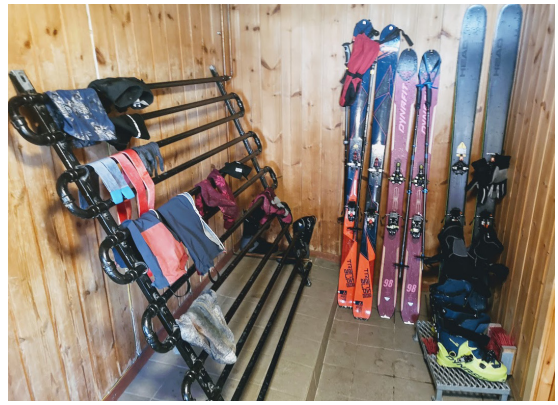


FIGURE 20. DRYING ROOM, SPITERSTULEN (PRIVATE PHOTO)

KROKTRØBUA is a cabin of a smaller size, owned by Statsskog, located outside of Røros. It has space for two to sleep, unless you bring a sleeping mat and sleep on the floor. Normally in a cabin, one would remove their shoes, but the floor was cold and dirty with mice faeces, so shoes were kept on. It was later noticed that a large gap in the lower corner joint of two walls acted as a doorway for these mice, and they were clearly audible throughout the night.

When entering through the door, the stove was located directly to the right. This was convenient, as starting a fire is this is the first thing one does when entering a cold cabin. The stove, Jøtul 601, was the same model of stove that would be chosen for our cabin and could therefore be observed when visiting. However, this was an old and not well maintained stove.

It took a while before the cabin was heated. The cabin did not include any chairs, however, the table was the correct height and in a convenient location to use the beds to sit on. Kroktrøbua was poorly insulated, and as soon as the fire had died down, the room went cold. The beds were 90 cm wide, and the two visitors made the choice to sleep together in one to stay warmer during the night.

The transport method to this cabin was by bus and then foot. The stay was for one night.

FINDINGS

- The importance of insulation and tight joinery
- Lack of maintenance made the cabin feel dirty and not completely safe in terms of fire-proofing.
- Stove by the entrance was convenient
- Comfortable with 90cm bed
- Multifunctional with table by the beds, both for a night table and to eat food.

FIGURE 21. KROKTRØBUA (PRIVATE PHOTO)

FIGURE 22. JØTUL 601 STOVE AT KROKTRØBUA (PRIVATE PHOTO)

FLOOR TAPING

As a method to visualize the size of the cabin and experience the use of space, we taped the plan to the floor in size 1x1. The dimensions were based on those described in Transportation Boundaries. Taping the floor made it easier to imagine how the cabin would feel when built and allowed us to try different solutions in terms of interior design and logistics of where to place things.

Figure 23, below, shows the first day of taping the plan. After this we moved the tape around and played with different layouts (Figure 24).

FIGURE 23. JULIE TESTING THE SPACE FOR SLEEPING WHEN THE WALL IS 300MM IN THICKNESS (PRIVATE PHOTO)

FIGURE 24. SPACE FOR INTERIOR IS TAPED TO THE FLOOR (PRIVATE PHOTO<9

III. SITE CONTEXT

NORDLANDSRUTA

FIGURE 25.
Cabin locations on the Nordlandsruta, with Tjoarvihytta lighted in orange.

TJOARVIHYTTA

The first version of Nordlandsbua will be installed at the site of Tjoarvihytta, located about midway on the Nordlandsruta.

Here, we see the existing cabins on the site, as well as their proximity to the road/ski path and Ner-Tjoarvi lake. A more in-depth site analysis can be found in Julie Nyland Nilsen's sub-thesis 'Climate Research and Outer Shell Design'

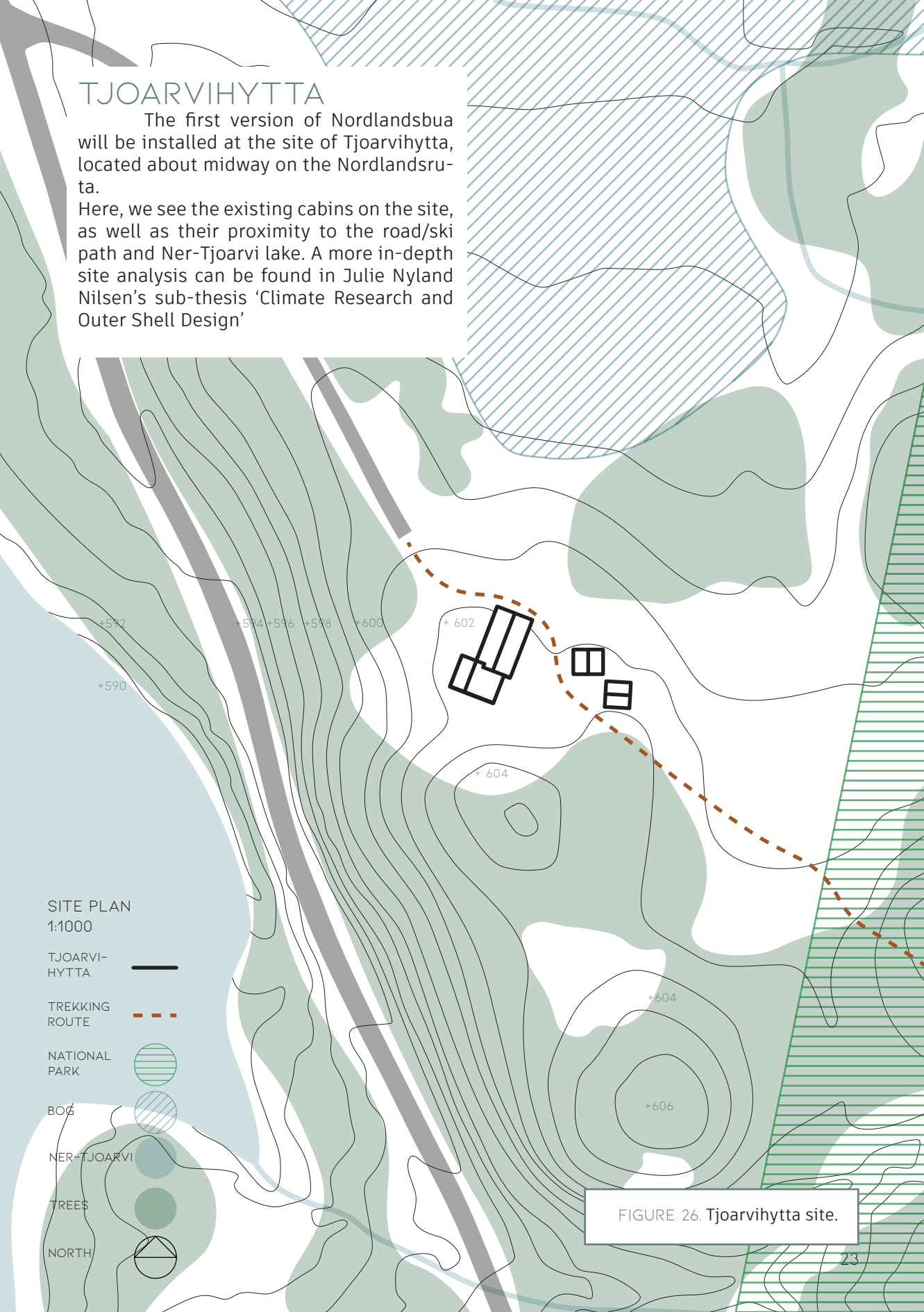


FIGURE 26. Tjoarvihytta site.

IV. CONCEPT & FORM

FORM EXPLORATION

The following diagram depicts the progression of the transportation boundaries to the building's basic form. The interior area of Nordlandsbua would house 4 people, however, by request of the client, there should be a possibility to shelter more visitors in the summer. Thus, the 'shell design' was implemented. The shell's conception and complete design, can be found in the sub-thesis 'Climate Research and Outer Shell Design'.

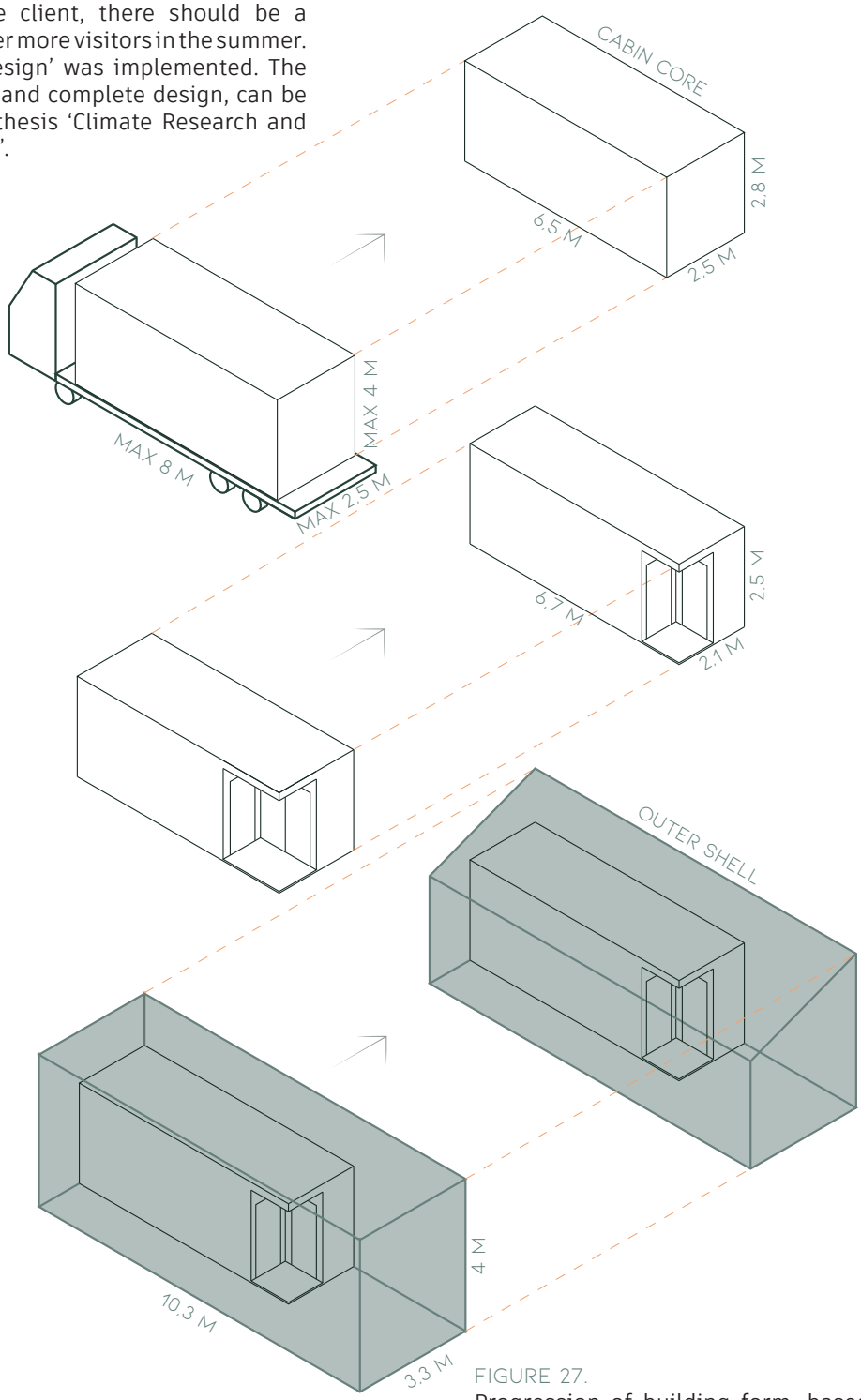
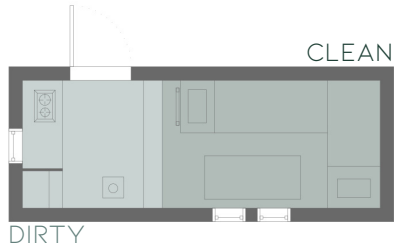


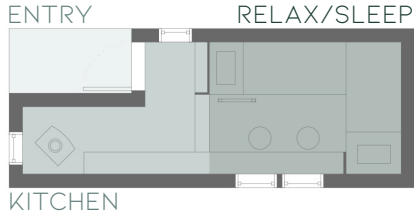
FIGURE 27.
Progression of building form, based on transportation boundaries

ZONING

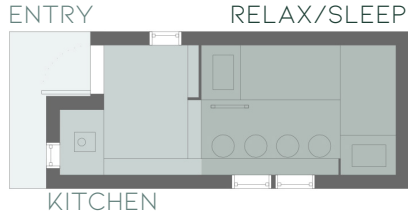
1. The first interpretation of a zoning plan divides the space into two zones: dirty, where visitors can walk in with their hiking shoes and leave their outdoor clothing, and clean, where their shoes and wet clothes must be removed. The two zones are divided by a step.



2. In this version, the addition of an external entry zone is added. The two aforementioned zones still remain, but also coincide with the kitchen area and sleeping area.



3. In the third version, the zones remain the same. However, their area shifts with the changing the building form.



4. In this final zoning plan, a new interior space is added: the drying room. Here, visitors will have space to store their wet clothing and gear, so as to keep excess moisture out of the main living space. The drying room still includes an air shaft, which allows warm air from the stove to flow through the drying room and speed up the drying process. The rest of the interior is still divided into an entry space, kitchen space and the bedroom and relaxation area, and still includes a divisional step. On the exterior, the space protected by the shell is added, representing the extended outdoor living space.

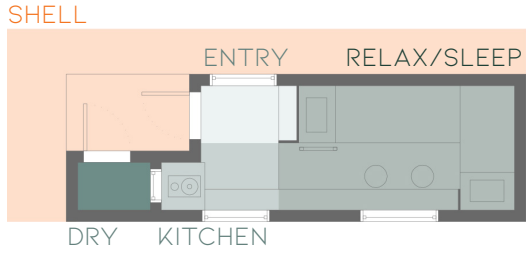


FIGURE 28.
Progression of cabin zoning

ROOF DESIGN

From an early stage in the project, it was desired to have the possibility to use the roof for easy accessibility in terms of the outer shell. Therefore, the roof is 3° and can be used without the outer shell for a few months. However, it is highly advised to install the outer shell before winter. More information about the outer shell can be read in the sub-topic “Climate research and outer shell design” written by Julie Nyland Nilsen.

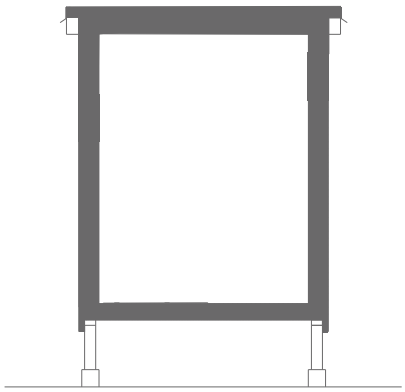


FIG. 29. CONCEPT ROOF SHAPE

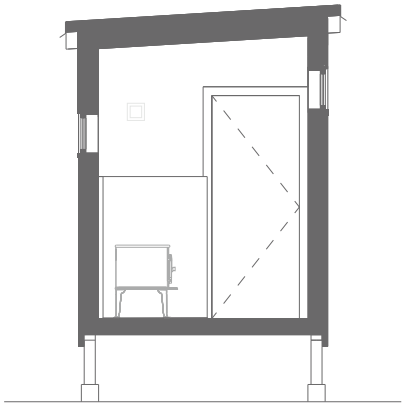


FIG. 30. 3° CURRENT ROOF SHAPE

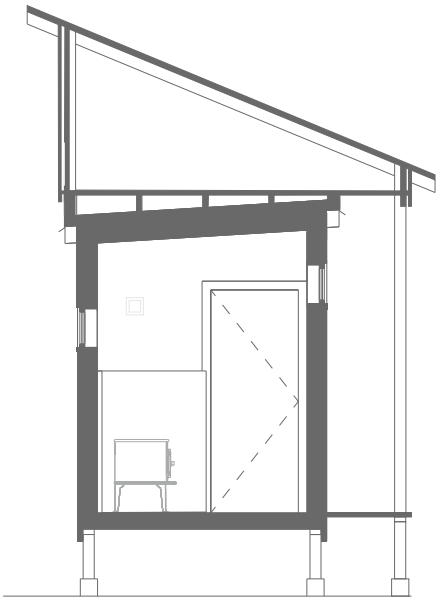


FIG. 31. OUTER SHELL ROOF CONCEPT

PASSIVE & ACTIVE STRATEGIES

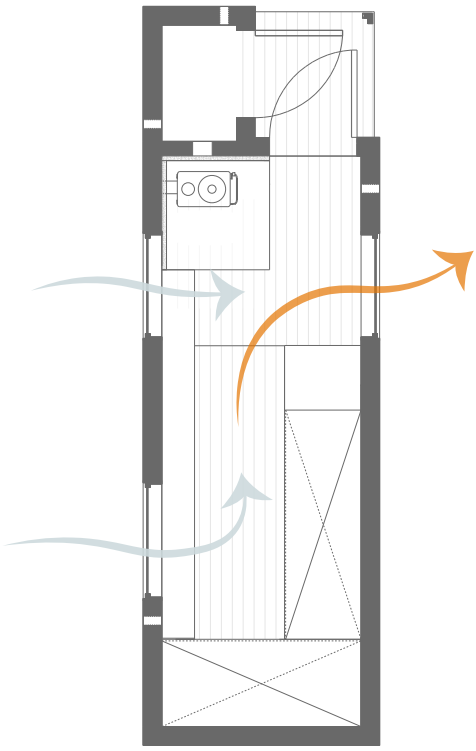


FIG. 32. CROSS VENTILATION IN PLAN

Nordlandsbua uses natural ventilation. There are three vents in the core, one located low on the south long wall and the other located high on the long north wall. The vent between the drying room and the cabin allows easy heat transfer into the drying room.

There are two vents in the drying room for constant airflow, one located low in the long south-facing facade, the other high in the short wall facing west.

There are no active strategies implemented in this project. However, a solar panel can be installed in the future to charge phones, etc.

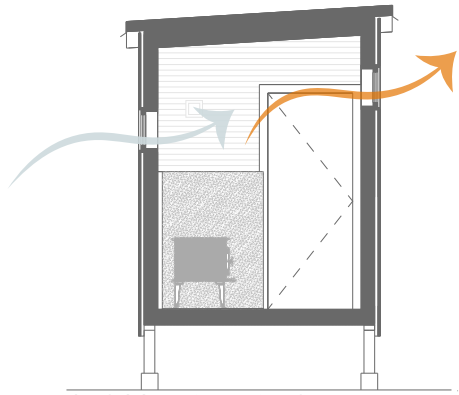


FIG. 33. CROSS VENTILATION IN SECTION

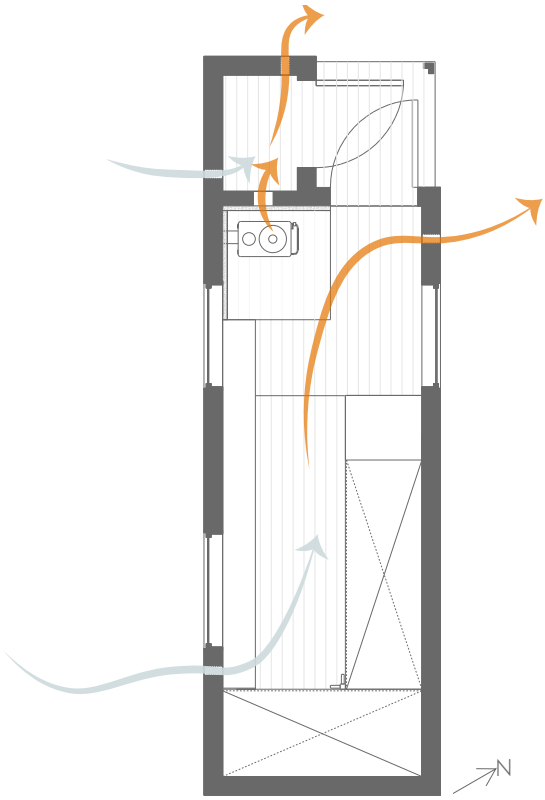


FIG. 34. VENT VENTILATION

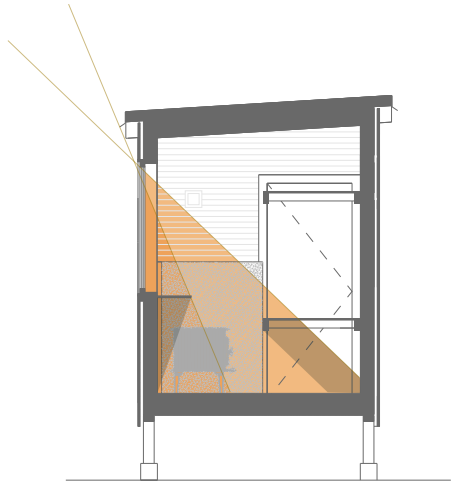


FIG. 35. EQUINOX SUN ANGLE 22.6°
SUMMER SOLSTICE SUN ANGLE 46.2°

V. DESIGN RENDITIONS

MATERIAL EXPLORATION

The process of selecting materials and calculating their quantity turned out to be a challenging experience. During this exploration, it became clear that there is a two-way relationship between the materials needed for the design and the constructive solutions. Furthermore, since the cabin's design evolved daily between March and May, there was no absolute certainty in the layers of structural elements and the necessary materials before construction began. Thus, the sheet of materials changed and expanded every day.

The choice of materials largely depended on the design solutions, client expectations, knowledge of the materials and their properties by the team members, environmental factors, and the weight of the material. Subsequently, the availability of this material for purchase or order within the specified construction time was added to this list, which significantly influenced the use of certain materials in constructing the prototype. A more detailed description of the reasons for choosing one or another material and the correlation of decisions with the design of the prototype is described in the sub-thesis, 'Materials selection and life cycle analysis', written by Anastasia Tsivileva.

A BIM model was created in the modeling program, Revit, to calculate the quantity of materials. The model was used by all members of the design group throughout the concept process. The group attempted to create the most detailed and up-to-date model of the building, which would provide information about the amount of certain materials in different structural layers. The model was also used to calculate the approximate weight of the cabin, which is a critical condition in its further transportation.

Table 1, proposed for order by the thesis group and sent to the materials supplier, shows the initially selected materials, their dimensions, the required quantity, and links for purchase. Further communication with suppliers led to replacing some materials with those available for order by the start of construction.

TABLE 1: Material list

MATERIAL NAME	ART. NR	DIMENTIONS	REQUIRED LENGTH, M	REQUIRED M2	NUMBER PER PALL	M2/ PER PIECE (ROLL)	LINK
PINE CLADDING *(FURU 19X173 REK KLED MALM 90%)*	48062242	**19MM * 173MM**		**40**			HTTPS://WWW.BYGGMAKKER.NO/PRODUKT/FURU-19X173-REK-KLED-MALM-90/7071859015401
NTR-CLASSIFIED TIMBER *(30X48 IMPR. LEKT)*	8730048	**48MM * 30MM**	**84**				HTTPS://WWW.BYGGMAX.NO/30X48-IMPR-LEKT-P08730048
NTR-CLASSIFIED TIMBER *(KONSTRUKSJONSVIRKE CU-IMPREGNERT)*	54186194	**48MM * 98MM**	**116**				HTTPS://WWW.BERGENEHOLM.NO/PRODUKTER/TRELAST/KONSTRUKSJONSVIRKE/K-VIRKE-C24-FALLENDE-LENGDER
NTR-CLASSIFIED TIMBER *(KONSTRUKSJONSVIRKE CU-IMPREGNERT)*	54186156	**48MM * 148MM**	**95**				HTTPS://WWW.BERGENEHOLM.NO/PRODUKTER/TRELAST/KONSTRUKSJONSVIRKE/K-VIRKE-C24-FALLENDE-LENGDER
NTR-CLASSIFIED TIMBER *(KONSTRUKSJONSVIRKE CU-IMPREGNERT)*	54186175	**48MM * 198MM**	**29**				HTTPS://WWW.BERGENEHOLM.NO/PRODUKTER/TRELAST/KONSTRUKSJONSVIRKE/K-VIRKE-C24-FALLENDE-LENGDER
HUNTON VINDTETT PLUS	5623/24647935	**1200MM * 2740 MM** THICKNESS **12MM**		**41**	76	3,288	HTTPS://WWW.OBSBYGG.NO/BYGNINGSPLATER/TREFIBERPLATER/2124084
HIGH-PERFORMANCE WOODFIBRE INSULATION BOARD *(NATIVO TREFIBERISOLASJON PLATE)*	9901/55406733	**565MM * 1220MM** THICKNESS **100MM**		**37**	48	0,6893	HTTPS://WWW.OBSBYGG.NO/TRELAST-OG-TYNGRE-BYGGEVARER/ISOLASJON-OG-VINDSPERRE/2113834?V=OBSBYGG-7022611099016 HTTPS://WWW.BYGGMAKKER.NO/PRODUKT/TREFIBERISOLASJON-NATIVO-100X565X1220-HUNTON/7022611099016
HIGH-PERFORMANCE WOODFIBRE INSULATION BOARD *(NATIVO TREFIBERISOLASJON PLATE)*	9902/55412117	**565MM * 1220MM** THICKNESS **150MM**		**20**	30	0,6893	HTTPS://WWW.OBSBYGG.NO/TRELAST-OG-TYNGRE-BYGGEVARER/ISOLASJON-OG-VINDSPERRE/2113834?V=OBSBYGG-7022611099023
HUNTON INTELLO ® PLUS	4350/48662494	**1500MM * 50000MM** THICKNESS **0,2MM**		**92**	20	75	HTTPS://WWW.BYGGMAKKER.NO/PRODUKT/DAMPBREMS-INTELLO-PLUS-15-M/4026639153333
PLYWOOD SHEETS *(KRYSSFINER FURU)*	10087	**1250MM * 1250MM** THICKNES **7MM**		**9**		1,5625	HTTPS://WWW.BYGGMAX.NO/PLYWOOD-FURU#1245=53808
OSB PLATE	10081	**1200MM * 2400MM** THICKNESS **12MM**		**17**		1,5625	HTTPS://WWW.OBSBYGG.NO/BYGNINGSPLATER/KRYSSFINER-OG-OSB/2331916?V=OBSBYGG-7040431916498
PINE INTERIOR CLADDING *(MOELVEN INNVENDIG PANEL)*	7040431917334	**13MM X120MM** THICKNESS **13MM**	**418,6**	**46**		9,1 M/ M2	HTTPS://WWW.OBSBYGG.NO/TRELAST-OG-TYNGRE-BYGGEVARER/INNVENDIG-PANEL/2279580?V=OBSBYGG-7040431917334
UNIFLEKS SBS 4500 MULTIROOF *(OVERLAGSBELEGG SVART)*	17253	**7000MM * 1000MM** THICKNESS **3 MM**		**16**		7	HTTPS://WWW.BYGGMAX.NO/YTPAPP-SVART
HUNTON UNDERTAK	5670/22512743	**595MM * 2420MM** THICKNESS **18MM**		**16**		1,4399	HTTPS://WWW.OBSBYGG.NO/BYGNINGSPLATER/TREFIBERPLATER/2324408
GROOVED WOOD *(28X120 TERRASSEBORD, RILLET)*	8728121	**28MM * 120MM** THICKNESS **20MM**	**67,2**	**8**		8,4 M / M2	HTTPS://WWW.BYGGMAX.NO/28X120-TERRASSEBORD-RILLET-BRUN-P08728121
HUNTON SILENCIO ® PARKETTUNDERLAG	6020 / 22064166	**600MM * 1800MM** THICKNESS **12MM**		**8**	180	1,08	HTTPS://WWW.HUNTON.NO/PRODUKTER/GULV/HUNTON-SILENCIO-PARKETTUNDERLAG/?FBCLID=IWAR3OCXSZMLGRWTZXTU6D7XPF5EUV4SS-XSUAM2Y6PFNOSCCMTAHCKS7T0PO
PARQUET OAK FLOOR		**160MM * 5650MM** THICKNESS **20MM**		**8**		15	HTTPS://WWW.FINN.NO/BAP/FORSALE/AD.HTML?FINNKODE=251547889
LINOLEUM GULV	57396318	THICKNESS **10MM**		**3**			HTTPS://WWW.BYGGMAKKER.NO/PRODUKT/VINYL-AQUA-GULV-3M-ROCK-COOL-GREY/3423128610611
FIRE RESISTANT SURFACES		THICKNESS **10MM**		**2,5**			HTTPS://WWW.FINN.NO/BAP/FORSALE/AD.HTML?FINNKODE=104575568

INFLUENCE OF SECOND-HAND MATERIALS

As mentioned in the 'Personal Sustainability Goals' sub-section in the Scope chapter, it was an early goal to try to find second-hand items or materials to reuse in the cabin. Our leading platforms for finding these items were Finn.no, a website for private sales in Norway, usually of second-hand goods, and Facebook Marketplace, a section of Facebook used for the same purpose.

Some challenges with finding second-hand items is that it requires much patience, time and coordination. Collecting re-usable items, particularly large building materials, also requires access to storage space to hold the materials until the build time. Since our building location (Bodø) and our usual city of study and residence (Trondheim) are so far apart, coordinating the collection of materials from private sellers was tough. Sellers in Bodø had to be willing to reserve items until we arrived there, and the long transportation journey to Bodø had to be considered for any items picked up in Trondheim.

Despite these challenges, the following materials were collected second-hand for Nordlandsbua:

- Oak flooring was bought on Finn.no, collected in Oppdal, and restored at the NTNU workshop in Trondheim before being transported to Bodø.
- Two windows were collected from a private seller on Finn.no, and one from Facebook Marketplace
- The paint for the Brannmurr was leftover paint and was given for free by a building supply shop in Bodø
- Coat hooks were collected for free on Finn.
- A large quantity of 2x2inch timber planks were given to us, as they had been leftovers from a 'revy' production.
- An older model of the Jøtul 602 wood stove was given to us by a contact of our supervisor

Further exploration into the use of second-hand materials and their contribution to the circular economy can be found in the sub-thesis written by Anneli Kolås.

PROGRESSION OF DRAWINGS

During the design period, the size of the cabin, its shape, solutions for zoning, and facades were constantly changing. The process of evolution was due to constant work on the design, finding more exciting or practical solutions, adjusting to the client's needs, and taking supervisors' advice. All designs were offered within established boundaries, such as customer requirements and shipping conditions. The cabin change process can be divided into four key steps.

STAGE 1

The first cabin design in the plan was a rectangle, in the cross-section a structure with a multi-level gable roof. This variation was conceived using a life-size space taping technique on the floor. This method helped to understand the size of the room and imagine where different functions could be located. The entrance is located on the extended side, the kitchen and storage area is located to the right, and the double beds and table is located to the left. The wood stove is located directly in front of the door. The windows are located over the table and kitchen area and in the space between the roof slopes.

STAGE 2

The second design option proposes introducing an outdoor terrace at the entrance area, cutting off part of the rectangular plan. The roof is a flat surface for convenient operation in the future. The space is proposed to be divided by levels, into clean and dirty zones. Combining the kitchen counter with the table is also proposed, making a continuous countertop along the long wall. A wood-burning stove is located in the corner of the room. It was decided to make a storage cabinet against the front door. Windows are located in the entrance, kitchen, and table areas.

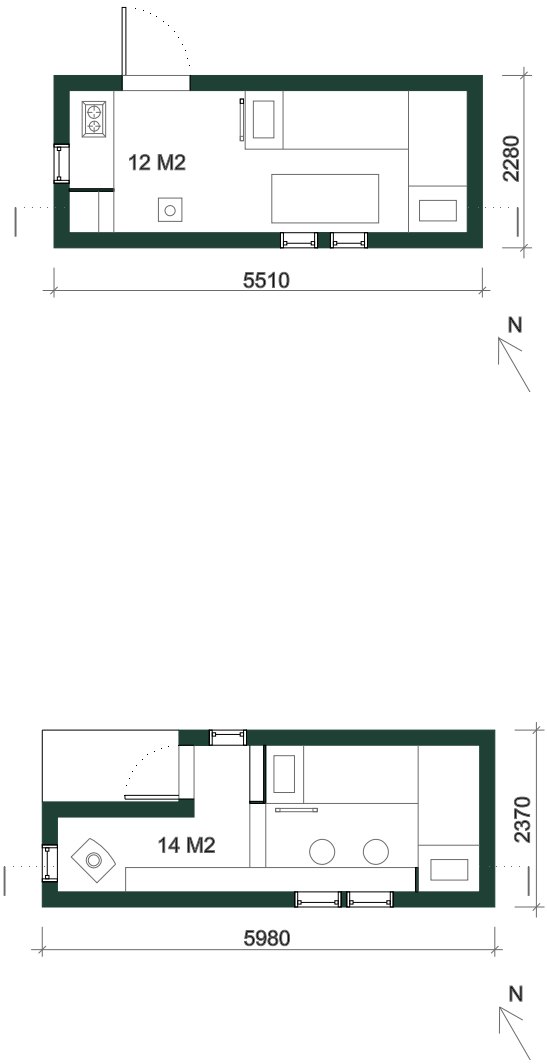
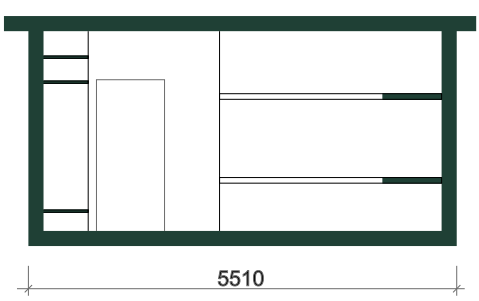
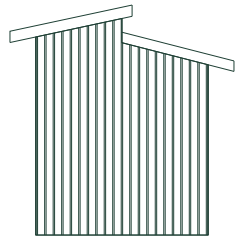


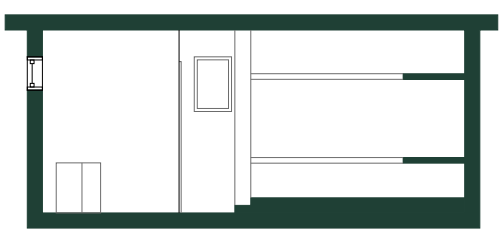
FIGURE 36. PROGRESSION OF DRAWINGS. PLANS

STAGE 1





STAGE 2



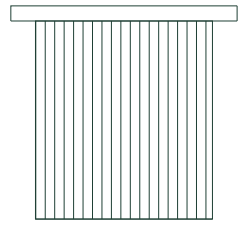
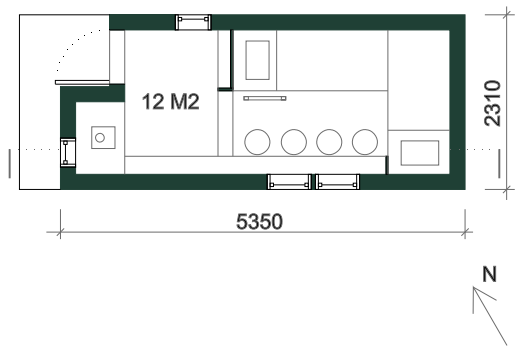


FIGURE 37. PROGRESSION OF DRAWINGS. SECTIONS

FIGURE 38. PROGRESSION OF DRAWINGS. ELEVATIONS

STAGE 3

The third option borrows many elements from the second design. However, the area and the shape of the terrace are changed, and a wood-burning stove is placed on the kitchen table. The roof gets a slight slope of 2 degrees.



STAGE 4

The fourth and final design before the start of construction suggests the introduction of a new room - a drying room. The level difference between clean and dirty areas is now one notch. The windows are located between the living area and the drying room and the entrance and the dining table area.

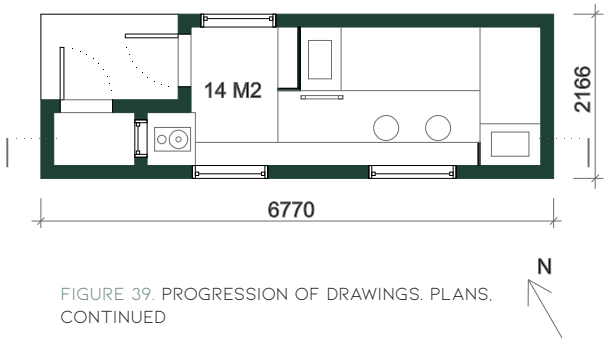
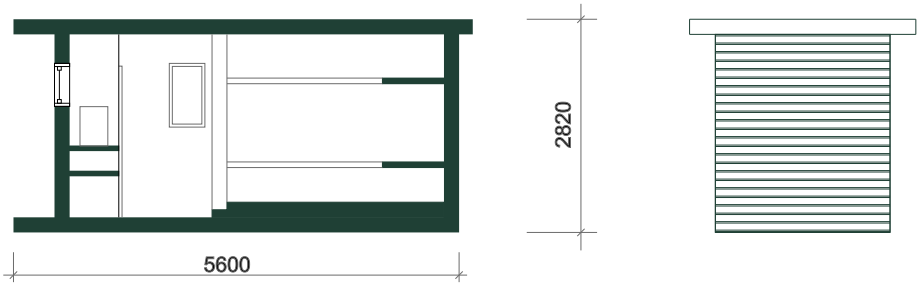


FIGURE 39. PROGRESSION OF DRAWINGS. PLANS. CONTINUED

STAGE 3



STAGE 4

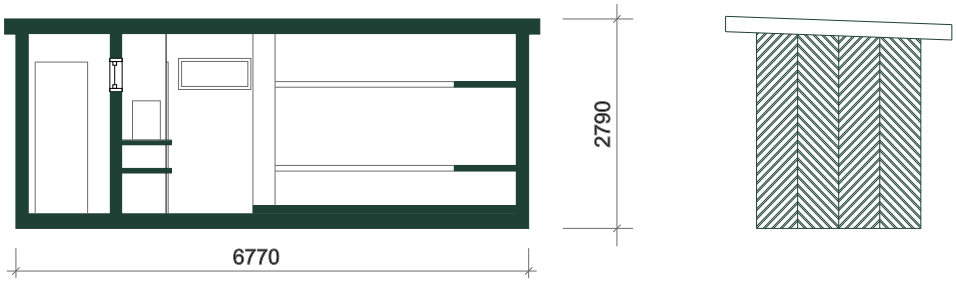


FIGURE 40. PROGRESSION OF DRAWINGS. SECTIONS, CONTINUED

FIGURE 41. PROGRESSION OF DRAWINGS. ELEVATIONS, CONTINUED

FINAL DESIGN PRIOR TO THE BUILD

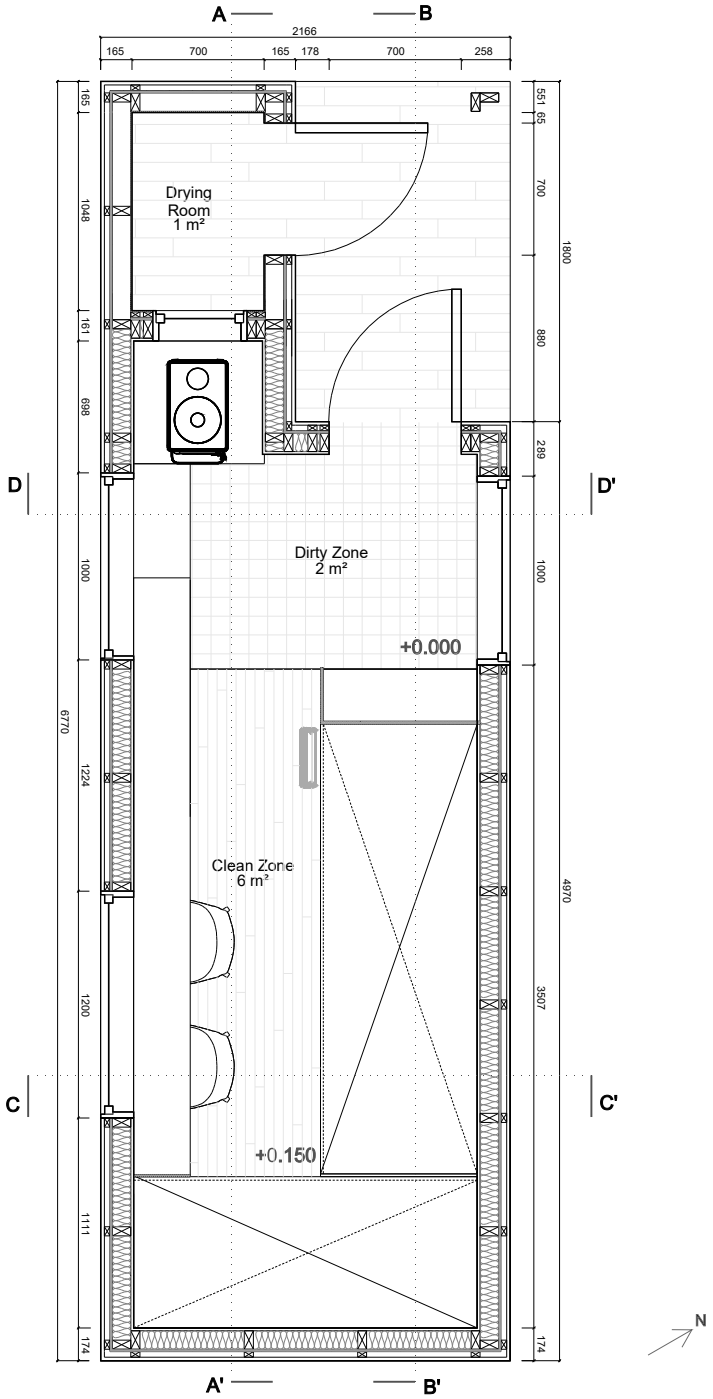


FIGURE 42. PLAN PRIOR TO THE BUILT. SCALE 1:40

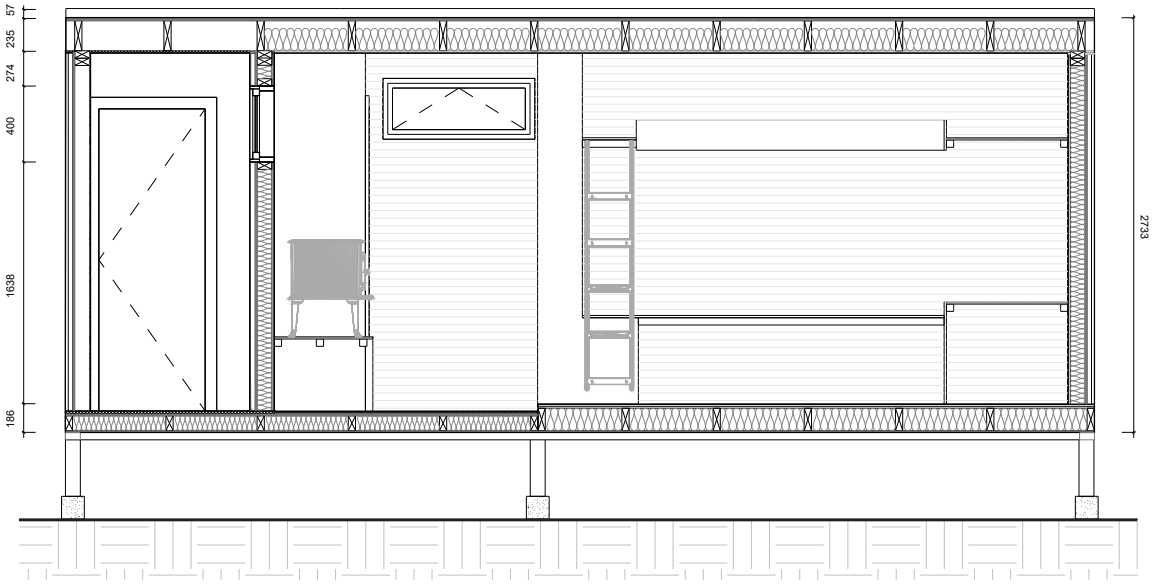


FIGURE 43. SECTION A-A PRIOR TO THE BUILT. SCALE 1:50

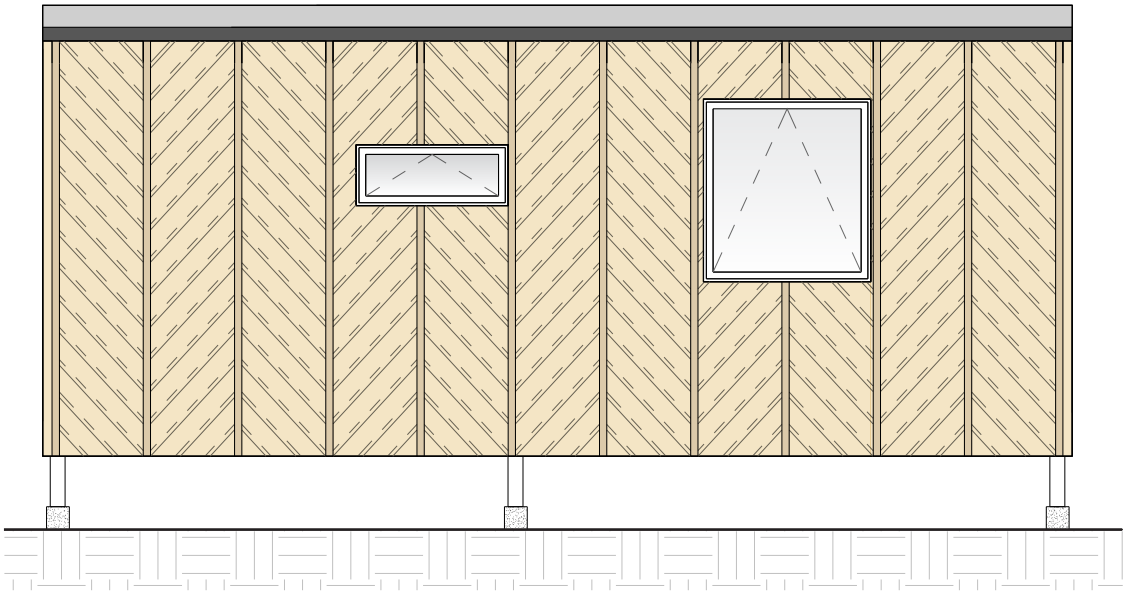


FIGURE 44. ELEVATION A-A PRIOR TO THE BUILT. SCALE 1:50

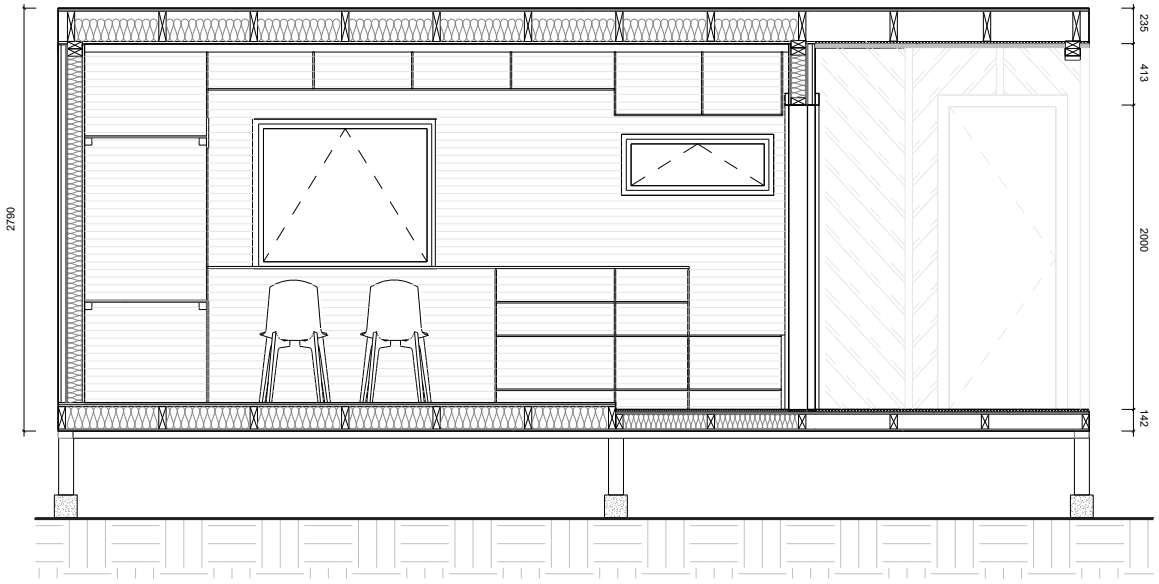


FIGURE 45. SECTION B-B PRIOR TO THE BUILT. SCALE 1:50

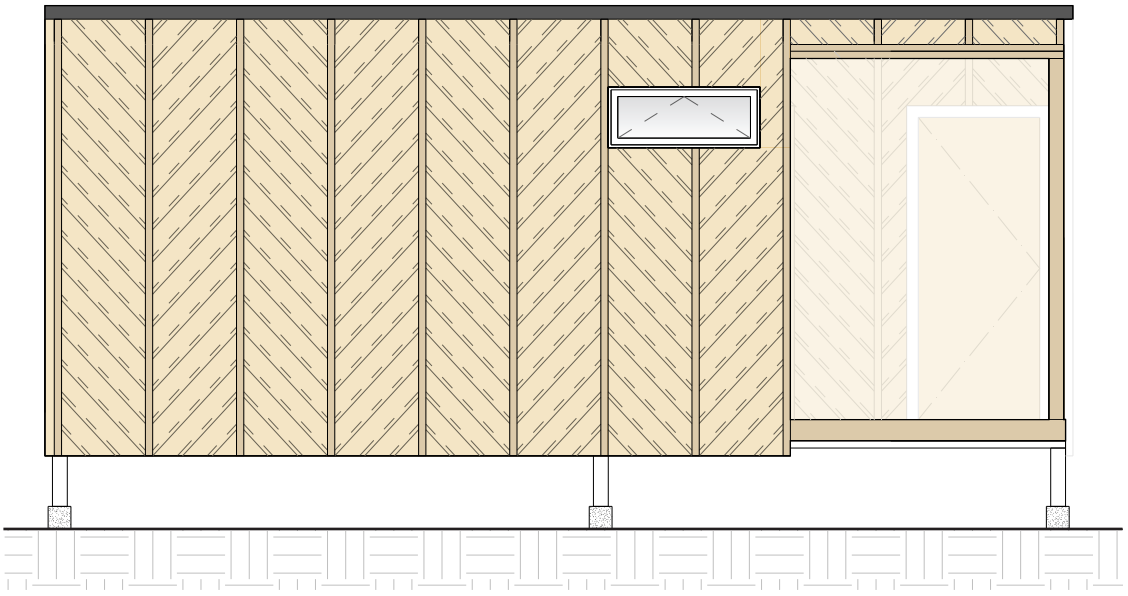


FIGURE 46. ELEVATION B-B PRIOR TO THE BUILT. SCALE 1:50

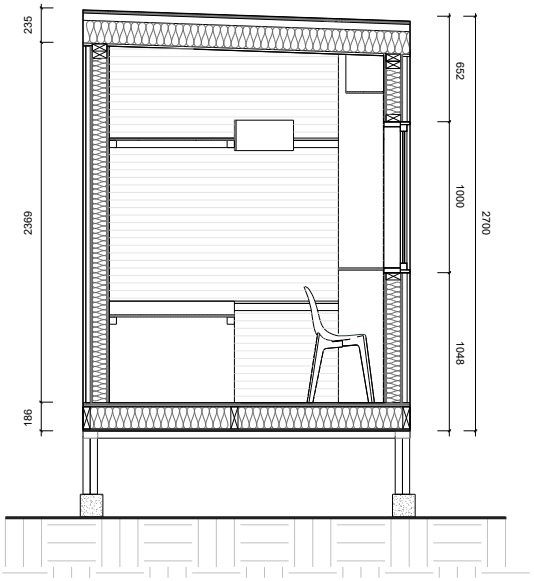


FIGURE 47. SECTION C-C PRIOR TO THE BUILT. SCALE 1:50

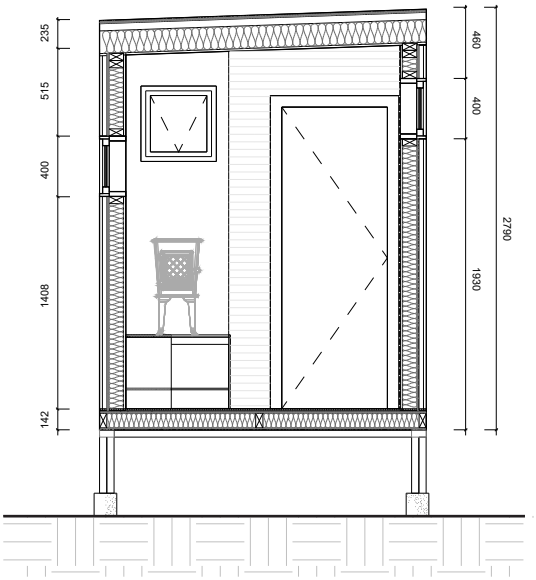


FIGURE 48. SECTION D-D PRIOR TO THE BUILT. SCALE 1:50

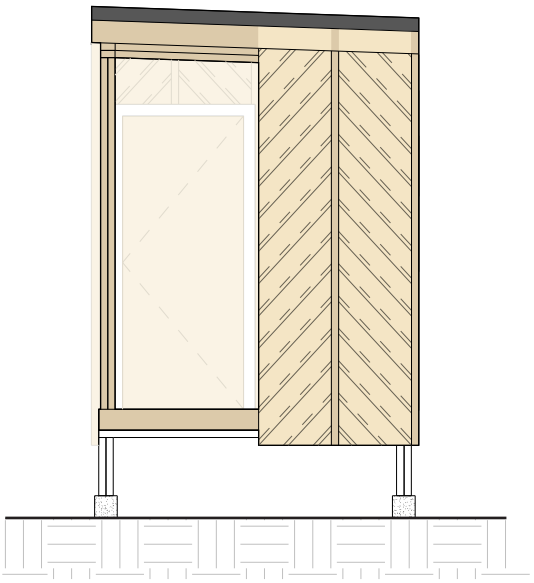


FIGURE 49. ELEVATION C-C PRIOR TO THE BUILT. SCALE 1:50

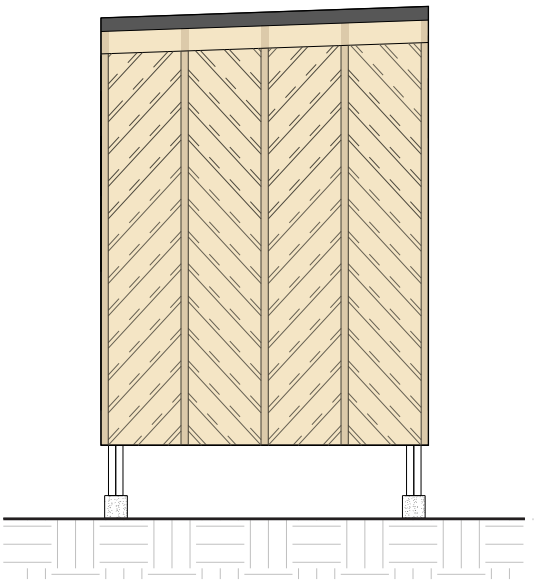


FIGURE 50. ELEVATION D-D PRIOR TO THE BUILT. SCALE 1:50

VI. THE BUILD

PARTICIPANTS

CARPENTERS

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Elias H.

Daniel G.

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DRAG Industrier

SHOPS

XL-BYGG, Kåre Abelsen

Julius Jakhelln AS, Bodø

Obs BYGG, Fauske

Obs BYGG, Bodø

Bodø Varme- Flis & Steinsenter AS

BUILDING SCHEDULE

WEEK 1

DAY 1 — May 2

1. Correction of wooden structure drawings
2. Receiving delivery of ordered materials
3. Purchase of missing materials
4. Making a wooden floor frame
5. Making a Wall 1 frame
6. Trip to pick up windows in Bodø

DAY 2 — May 3

1. Correction of wooden structure drawings
2. Purchase of missing materials
3. Trip to pick up thermal insulation in OBS Bygg Fauske
4. Making a Wall 2 frame
5. Insulation of Walls 1 and 2
6. Installation of a wind barrier and facade studs on a Wall 1
7. Installation of a vapor barrier on Walls 1 and 2
8. Construction of the floor's bottom OSB layer, outer coating with a mixture of tar and oil
9. Trip to pick up windows in Bodø

DAY 3 — May 4

1. Correction of wooden structure drawings
2. Purchase of missing materials
3. Trip to pick up thermal insulation in OBS Bygg Fauske
4. Installation of supports from pallets under the floor
5. Insulation of the floor
6. Making a Wall 6 frame
7. Installation of a wind barrier and facade studs on a Wall 2
8. Installation of a vapor barrier on Wall 6
9. Construction of the floor's top OSB layer
10. Installation of Walls 1, 2 and 6 on the floor

DAY 4 — May 5

1. Correction of details drawings
2. Purchase of missing materials
3. Making of Walls 3, 4 and 5 frames
4. Installation of Walls 3, 4 and 5 on the floor
5. Insulation of Walls 3, 4, 5 and 6
6. Installation of a wind barrier and facade studs on a Walls 3 and 6
7. Construction of roof beams
8. Installation of a vapor barrier on Walls 3, 4 and 5 and on the ceiling

DAY 5 — May 6

1. Correction of details drawings
2. Purchase of missing materials
3. Installation of a wind barrier and facade studs on a Walls 4 and 5
4. Creating roof layers
5. Windows installation
6. Search and purchase of doors

DAY 6 &7 — May 7 & 8

Weekend off

WEEK 2

May 9 — DAY 8

1. Report writing
2. Receiving delivery of ordered materials
3. Purchase of missing materials
4. Facade installation
5. Creating roof layers
6. Windows installation
7. Installation of ventilation shafts
8. Door installation

May 10 — DAY 9

1. Report writing
2. Purchase of missing materials
3. Facade installation
4. Creating roof layers
5. Installation of interior wall panels
6. Installation of terrace floor
7. Ordering metal elements of windows and roofing
8. Installation of heat- resistant panels in the oven area

May 11 — DAY 10

1. Report writing
2. Purchase of missing materials
3. Creating roof layers
4. Installation of interior wall panels
5. Installation of interior ceiling panels
6. Installation of metal elements of windows and roofing
7. Installation of a vent window between the heated area and the drying room
8. Windows final installation with screws

May 12 — DAY 11

1. Report writing
2. Purchase of missing materials
3. Creating roof's top layer
4. Installation of interior ceiling panels
5. Installation of drying room wall panels
6. Oak floor installation

May 13 — DAY 12

1. Cabin cleaning
2. Construction tent cleaning
3. Waste sorting
4. Tools packaging
5. Packaging and return of unused materials
6. Plastering and painting of heat- resistant panels

May 14 — DAY 13

Trip back to Trondhiem

FIGURE 51. BUILDING SCHEDULE

SUMMARY OF BUILDING EXPERIENCE

For all of us, the two-week build was an entirely new experience. Aside from being architects, we also took on the roles of project managers, forewomen, carpentry assistants, material-order coordinators, delivery personnel, translators, and caterers, just to name a few. We encountered many challenges and were faced with difficult decisions within such a short amount of time. These two weeks gave us a taste of working environments in the construction industry. We also gained some insight into the differences in attitudes and building styles in Germany vs Norway, and the availability of materials between the two countries.

Aside from the challenges, we also felt that this was an incredible learning opportunity. In architecture, we are often separated from the real construction of projects, and it is not often necessary to know in detail how everything fits together. So, working side-by-side with carpenters, who both challenged and broadened our ideas and understanding, was an enriching experience.

This thesis chapter will demonstrate the various difficulties and accomplishments we encountered and the changes made during the building process. We will also describe the steps we took to arrive at the finished project and how we suggest future iterations of the cabin could be built more successfully.

MATERIAL CHALLENGES

Organizing materials was by far the most significant challenge throughout the whole project. Apart from making material decisions for aesthetic and design purposes, our material list depended on the availability of materials in Bodø or their order times.

A failure on our part was that our material list was completed shortly before Easter, so the order had to wait until after the holidays were finished to be sent out. Thankfully, the majority of important materials made it to the building site on time.

Although much of the material decisions had been completed prior to arriving in Bodø, changes in design, the need for new or different materials, or materials that had not yet been chosen, called for often quick, on-the-spot decisions when choosing a new material. For some, like the exterior cladding, we had to accept what the local shops had to offer. Although most material changes could not have been foreseen, it is safe to say that it would save us time, effort, and stress if the materials were ordered sooner. This challenge very much influenced the whole building process.

Some material pick-ups were also our responsibility. The vapour barrier was bought in Trondheim and was transported in the van when driving to Bodø. Obs Bygg in Fauske, which is a one hour drive from Bodø, had the wood fiber insulation in stock and was collected on building days two and three. Given the driving time and size of the material, multiple trips were needed to fetch all the insulation. Our time in Bodø was also filled with many trips to the local building supply stores since there were materials we were not aware that we needed until we arrived on site and had spoken to our carpenters. Additionally, the German carpenters experienced some frustration due to the lack of familiar materials in Norway. With Germany having an extensive array of easily available supplies and tools, they were shocked that certain items do not exist in Norwegian stores.

The most significant decisions and changes were made throughout the two weeks regarding material choices. Subsequently, we will describe the most prominent material challenges that we faced.

OSB

One of the most used prototype construction materials was unexpectedly, OSB sheet panels. They are used as a sub-floor, leveling material under parquet flooring, load-bearing material for roof construction, and between roof insulation and air space. Initially, this material was supposed to only be used as a sub-floor. However, due to the lack of previously proposed materials in stock and lack of time, it was decided to use OSB as their replacement.

Problems with the material began at the very beginning of construction. It turned out that the use of OSB panels as a bottom sub-floor is a short-lived and questionable solution due to its poor moisture resistance. Nevertheless, since the material was ordered and delivered, and there was no time to wait for something new. An attempt to extend the material's durability by covering the plates with two layers of a mixture of linseed oil and tar was made. After this incident, the realization of the fragility of OSB came out, together with the truth about its low potential for reuse or recycling. After consulting with the carpenters, it was concluded that ordinary pine planks would have been the best material to replace the OSB. However, this decision has its own nuance - due to the higher thickness of the boards, the total weight of the layer would increase by about 50%.

Another weakness of the material is that it does not have high bending strength. Due to this, two layers of OSB had to be used in the roof structure, which increased the weight of the structure and the number of materials used. The material previously selected for these purposes did not have satisfactory strength characteristics either. The subsequent use of plywood sheets with a thickness of 20 mm or more can solve this problem and reduce the structure's weight.

However, there were also positive findings regarding OSB sheets. The material has good wind resistance and can be used as a wind barrier. In parallel with the constructive side of the material, this was the function the material performed in the floor and roof layers. Further, the material was successfully used as a base for the oak flooring, replacing the previously selected and unavailable Hunton Silencio.

PRESSURE-TREATED LUMBER

The choice of ordering pressure-treated lumber occurred due to time constraints and misunderstanding. It was assumed that it was the only construction material available, and it is often what they use in northern Norway, due to the harsh climate. It later turned out, that we could have instead used natural wood material, as we noticed that it was available after the building process had started. Moreover, the pressure-treated material was already on-site, and the carpenters had started on the construction frame. However, pressure-treated wood is more stable than the option of using natural spruce. In that case, the durability of the building is better with pressure-treated lumber though it can not be recycled or sustainably disposed-of. The further treatment of the visible construction lumber is to let it become grey and then treat it with a mixture of linseed oil and tar.

TERRACE DECKING

Outside of the cabin's front-door is a small exterior 'terrace'. The original construction plan prior to arriving in Bodø, was to clad this terrace with terrace boards from the company, Marnar Bruk. The material ordered from XL Bygg was 28x120 in size and made of pine in a royal brown colour. As construction of the cabin proceeded, problems around the height of the terrace decking arose. To close the door, the terrace decking needed to be thinner. Using the material we ordered was not an option anymore, as the construction frame was already in place. Another factor in the decision to not use these terrace boards, was that in December 2020, an inspection of Royal-treated cladding with fire-retardant surface treatment had determined that they had poorer fire properties than first stated. Also, the ordinary royal-treated cladding had not been third-party tested. (Brekkhus, 2021).

Therefore, we decided with the carpenters to use left over cut-offs of the structural wood to make an embedded decking with the construction frame. Although the structural pressure-treated wood is not in itself sustainable, since it was a material that was already ordered and used, it was the more sustainable option to use as much of this wood as we could in our construction, rather than using a new material.

EXTERIOR CLADDING

Initially, the exterior cladding chosen to be used on Nordlandsbua was Ore-pine. Ore-pine can stay untreated and or can be naturally treated by resin (Øvrum & Flæte, 2008). However, due to long delivery, only natural spruce cladding was available in Bodø. This exterior cladding is cheaper, and so is the quality. To protect the exterior cladding, we have decided, with advice by Sami Rintala, that it should be treated with the same mixture of linseed oil and tar that the OSB was treated with to protect it from water damage. Due to time pressure, this must be done after the two week construction period and before the cabin is moved to the Tjoarvihytta site.

The pattern of the exterior cladding had many adaptations, as seen in 'Progression of Drawings'. At the beginning of the building period, the 'herringbone' design was pitched, and there was much debate amongst the carpenters as to whether it would work. Ultimately, it was decided against, as it would result in many small cut-off pieces of cladding. Additionally, the bottom part of the cladding, closest to the ground, would be affected first by the ground's moisture. In conclusion, a classic horizontal cladding pattern was chosen, with the bottom two planks having accessible screws for easy removal and replacement..

STRUCTURAL CHALLENGES

The pre-construction documentation process was partly supervised by Anton Lieb, head of the carpentry team. However, these consultations were not enough to create the correct drawings. During the building process, changes had to be made daily, in parallel with the cabin's construction. The structures of all elements of the building (floor, walls, roof) evolved numerous times, which created many challenges at the construction site.

FLOOR

The floor structure is a joist-system consisting of two connected platforms with beams of two different sizes. The decision to use beams of different sizes was driven by the idea of creating a multi-level space inside the Nordlandsbua. Although a larger 'step' was planned, there was some confusion about what size beams were available to order, and 98x48 mm, and 148x48 mm beams were the sizes chosen. However, during the construction, it became clear how the difference in height between the selected beams was too small to create a full-fledged step that would be comfortable for the user. This issue could be solved by using beams with 98 mm and 198 mm section height.

The changes at the construction site only affected the previously proposed mid-span block, which turned out to be an optional structural element.

WALLS

The wall structure is a system of studs and top and bottom plates. It is first assembled on the floor, and subsequently lifted up and attached to the floor structure. The main challenge in planning the wall structure was the distance between the studs and the quantity of studs needed. In the first version of the drawings, it was 600 mm and equaled 48 pieces. However, it turned out on site that the material of the wind barrier, which should be attached to the studs with screws, did not align properly with the stud distance. Thus, changing the stud distance in some places, as well as adding additional studs would allow for the full 1200 mm sheets to be installed without needing to cut them. Also, additional studs were added to the design in the corners and joints of the walls in order to mount internal panels.

An important addition was the introduction of wall cross-braces, which increased the stability of the structure for its later transportation. In the final version, it was impossible to maintain the universal distance between the studs; the quantity of studs summed up to 52 pieces. The number of cross-braces was 12 pieces.

ROOF

The roof structure consisted of beams installed at an angle of 3.6 degrees on the top plates of the walls at a distance of 600 mm from each other. In the original version, the angle of inclination of the beams was only 2 degrees; however, the installation requirements for the bitumen-felt roofing needed a minimum roof inclination of 3 degrees. The size of the beams had undergone a change, which previously was 198 mm by 48 mm in cross-section. It was decided to use two types of beams with cross-sectional dimensions of 148x48 mm and 48x48 mm on top of each other. This change was caused due to the addition of an OSB layer between the beams to create a wind barrier. Additionally, the length of the overhang of the beams, which was completely absent in the original version of the design, has changed. This change was made to prevent weather-related damage in the future.

CHANGES IN TIMBER STRUCTURE

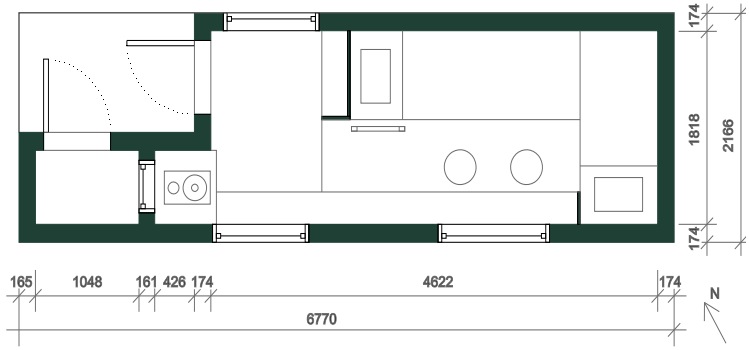


FIGURE 52. CHANGES IN PLAN BEFORE AND AFTER BUILD

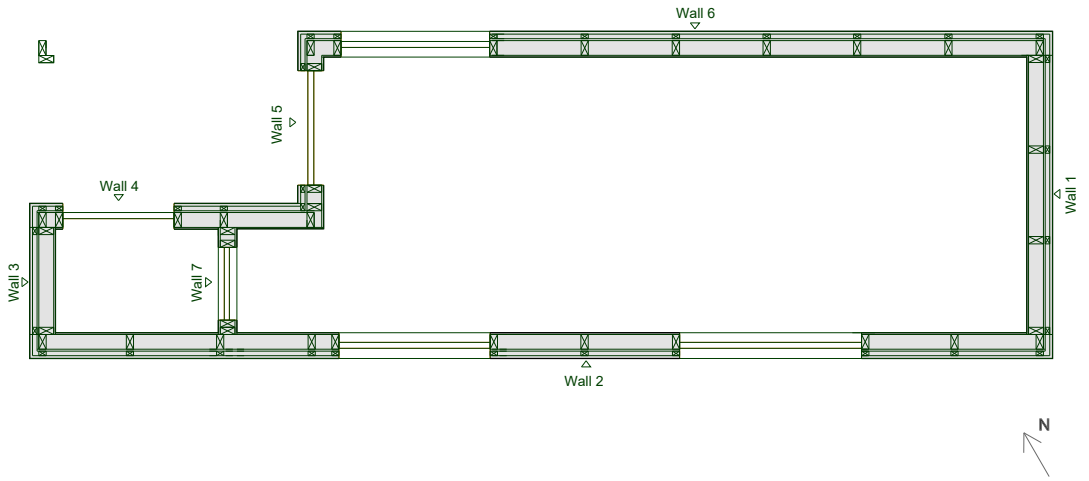


FIGURE 53. CONSTRUCTIONAL WALL'S PLAN BEFORE BUILD

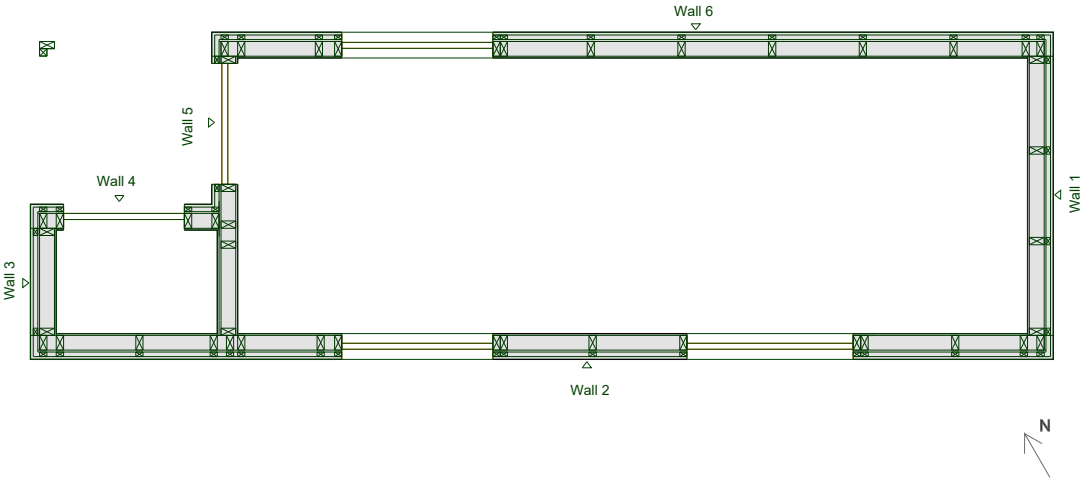


FIGURE 54. CONSTRUCTIONAL WALL'S PLAN AFTER BUILD

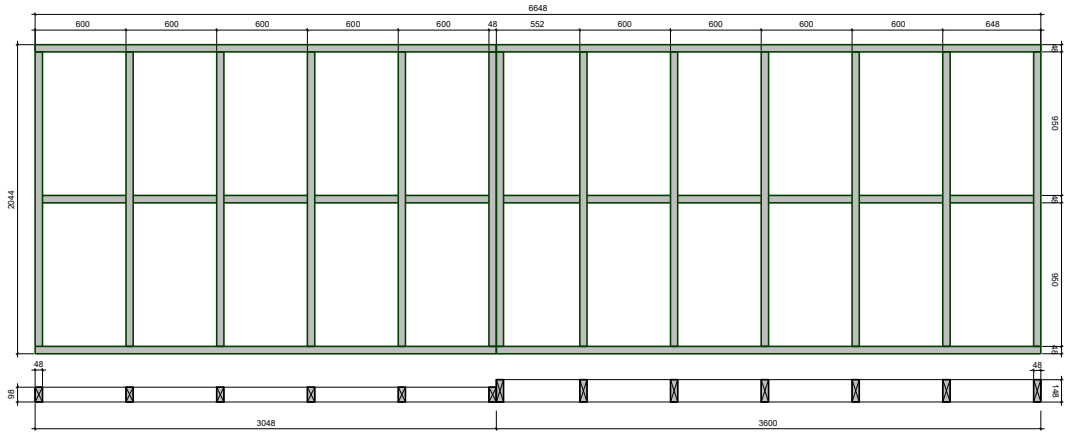


FIGURE 55. CONSTRUCTIONAL FLOOR PLAN BEFORE BUILD

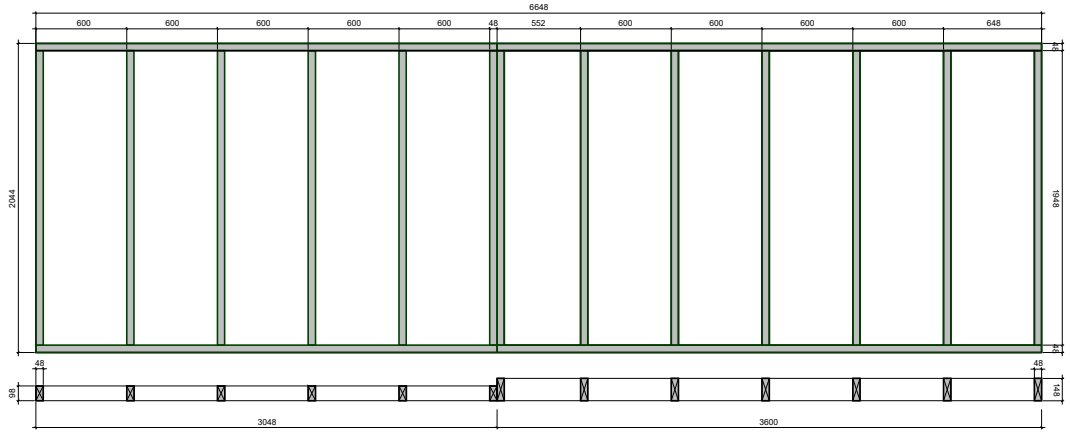


FIGURE 56. CONSTRUCTIONAL FLOOR PLAN AFTER BUILD

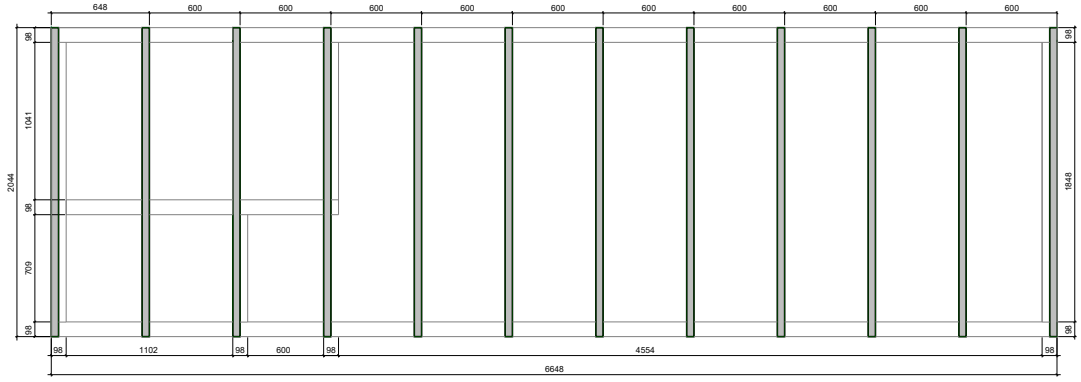


FIGURE 57. CONSTRUCTIONAL ROOF PLAN BEFORE BUILD

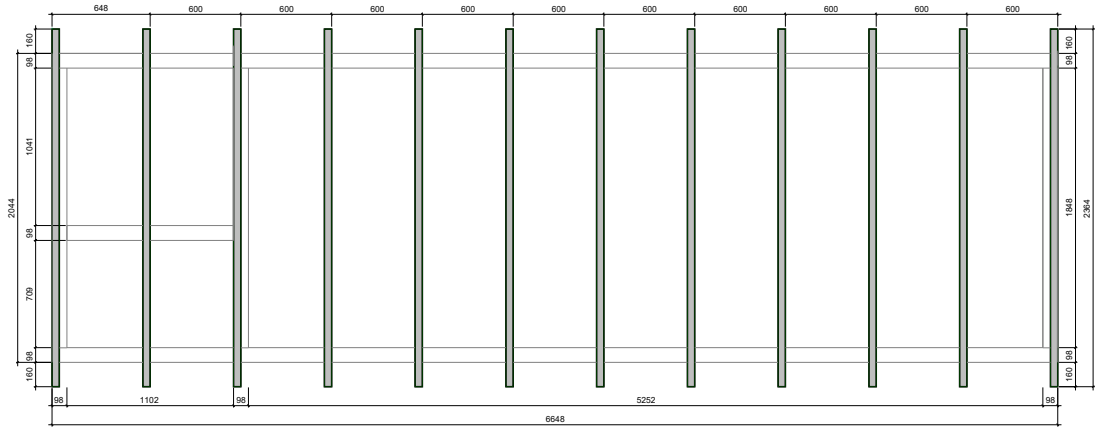


FIGURE 58. CONSTRUCTIONAL ROOF PLAN AFTER BUILD

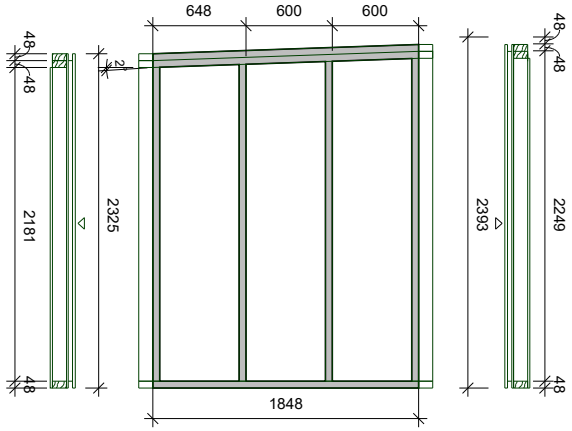


FIGURE 59. WALL 1 BEFORE BUILD

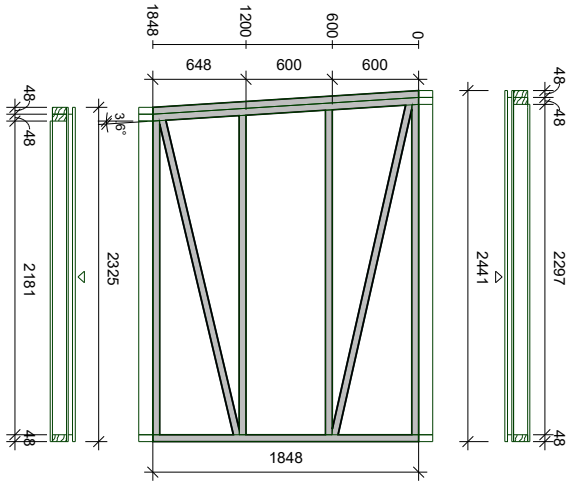


FIGURE 60. WALL 1 AFTER BUILD

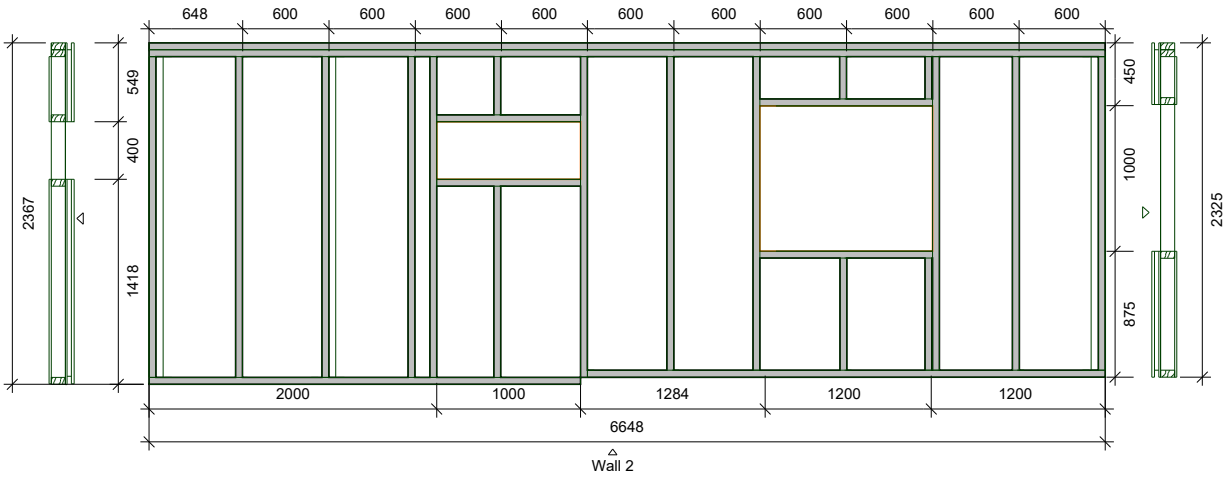


FIGURE 61. WALL 2 BEFORE BUILD

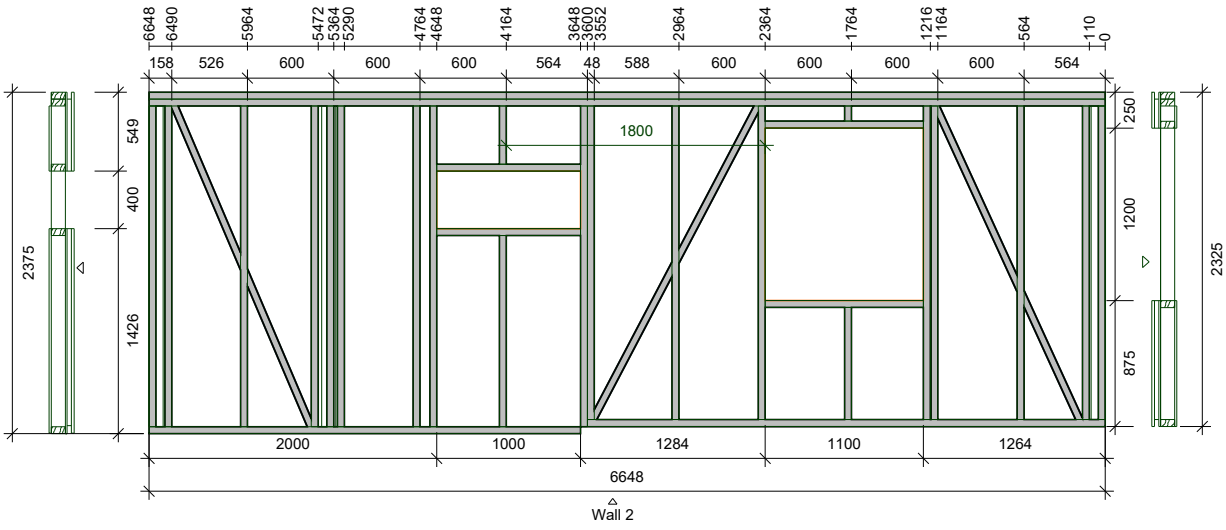


FIGURE 62. WALL 2 AFTER BUILD

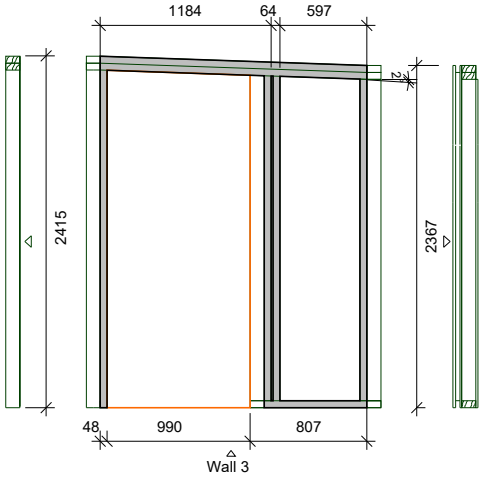


FIGURE 63. WALL 3 BEFORE BUILD

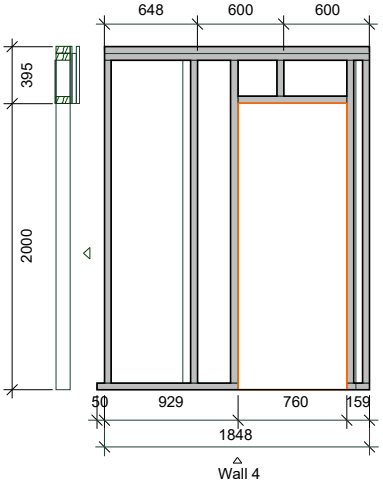


FIGURE 65. WALL 4 BEFORE BUILD

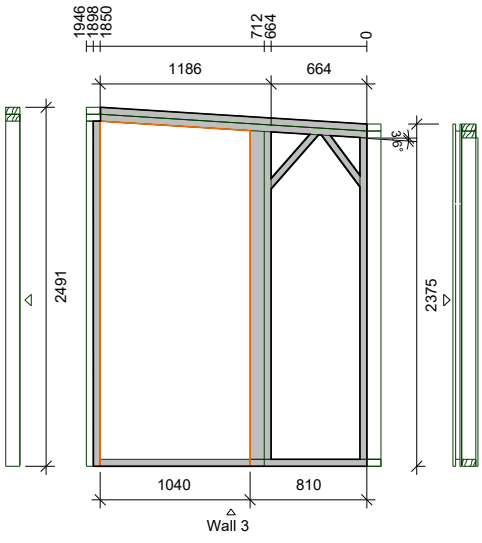


FIGURE 64. WALL 3 AFTER BUILD

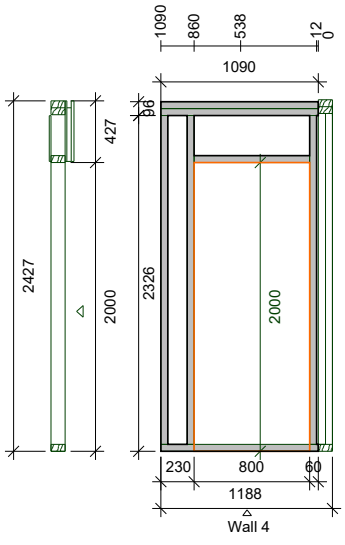


FIGURE 66. WALL 4 AFTER BUILD

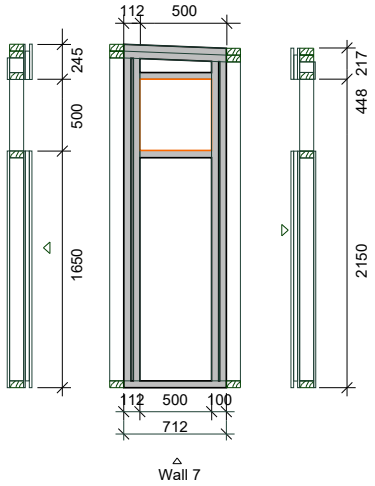


FIGURE 67. WALL 7 BEFORE BUILD

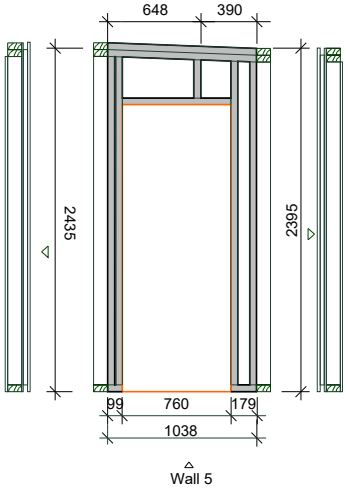


FIGURE 68. WALL 5 BEFORE BUILD

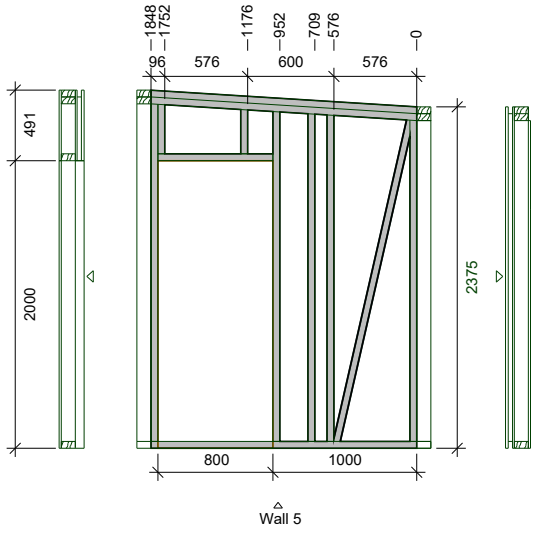


FIGURE 69. WALL 5 AFTER BUILD

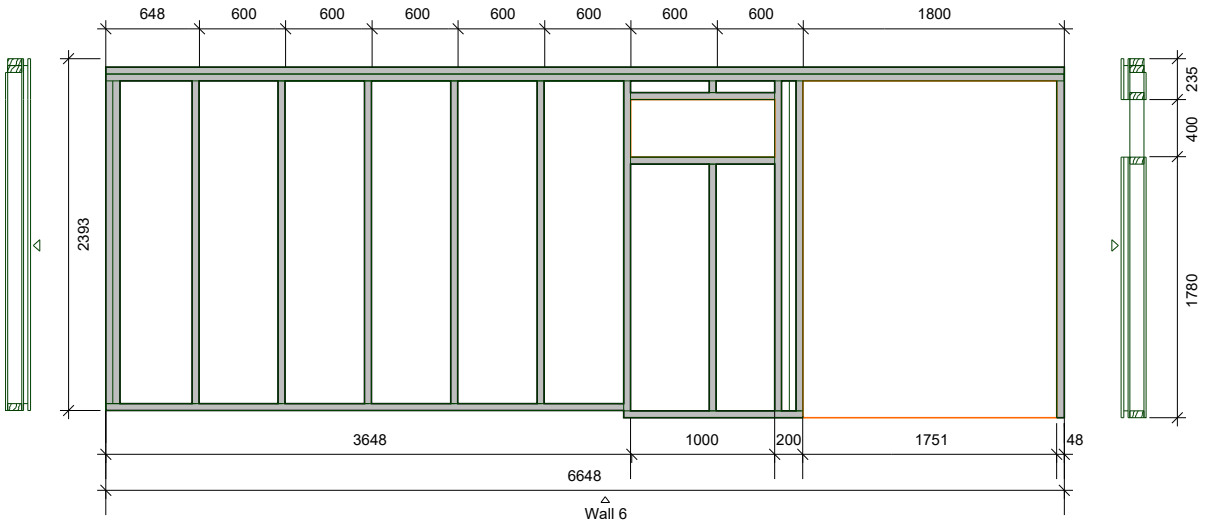


FIGURE 70. WALL 6 BEFORE BUILD

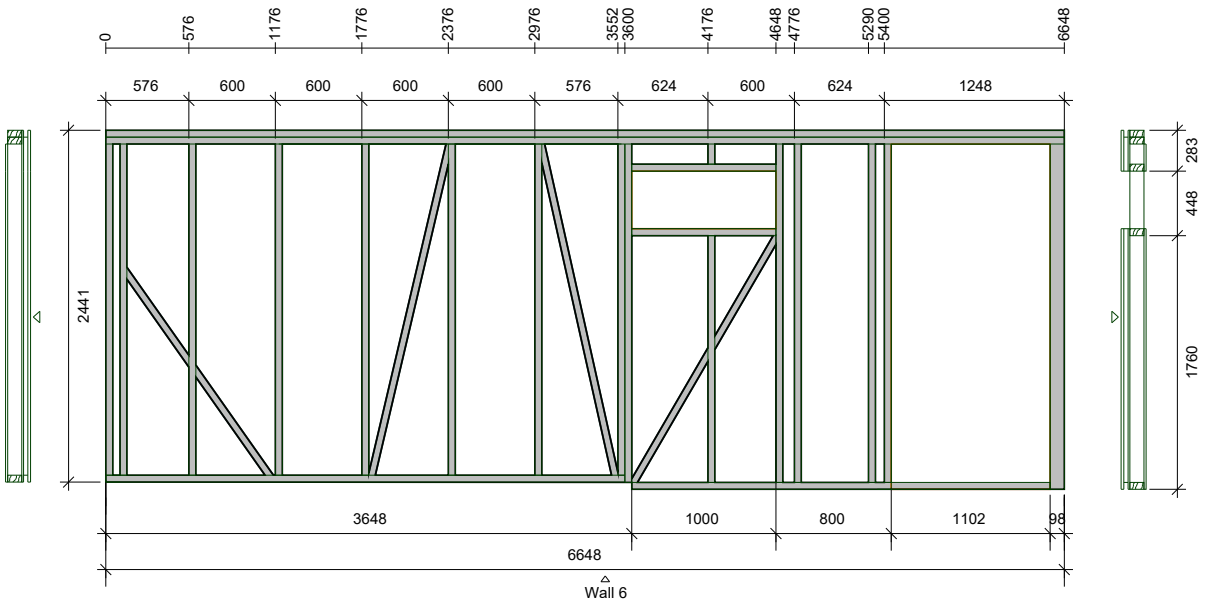


FIGURE 71. WALL 6 AFTER BUILD

STOVE & DRYING ROOM

Two aspects of the design that developed in conjunction with one another were the stove and its installation, and the addition of a 'drying room'. An exploration into the stove/heat source choice can be found in Sonja Morzycki's thesis 'Heating and firewood consumption analysis', but in conclusion, a Jøtul 602 stove was chosen as the heating element in the cabin.

One of the requirements in the project proposal by Saltan Friluftsråd was to provide a good solution for drying clothes. At first, we thought to simply include some unique drying fixtures that could be hidden up in the ceiling (similar to the Snippen cabin). Still, wet clothing in the heated main living space would increase the humidity, which may not have an opportunity to escape. So, inspired by the Spiterstulen cabin, we decided to create a room to store damp clothing and gear. The room would be separate from the main heated area and initially was not planned to be insulated. However, winter temperatures in the area drop well below freezing, so it was clear that the drying room would still require some access to heat from the stove, to prevent the clothes from just freezing. A variety of design solutions ensued.

ORIENTATION & CHIMNEY PLACEMENT

It must first be mentioned that our initial idea of how the chimney would look is based on very old cabins that use the Jøtul 602 stove (such as in Kroktrøbua). Initial thoughts were that the chimney is not insulated or fireproofed whatsoever; therefore, it has a diameter of only ~120mm. Unfortunately, the Jøtul website offers very little information about stove accessories. While in Bodø, we visited Bodø Varme- Flis & Steinsenter AS to ask about installation. We determined that the actual chimney diameter is ~400mm with fireproof insulation.

In the beginning, it seemed instinctive to place the stove in a position so that the chimney could be located near the wall of the drying room (Fig. 72). Our first idea was for the chimney to go through this wall and then exit through the roof of the drying room (Fig. 73). The thought was that the heat from the chimney could be used in the drying process. However, we questioned whether it would remove too much heat from the main room and whether the chimney passing through both a wall and a roof would cause problems with fire safety.

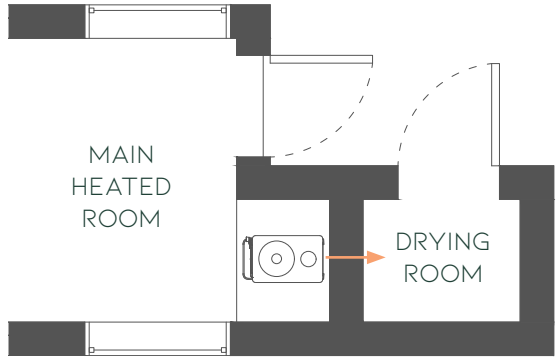


FIGURE 72. Stove orientation in plan

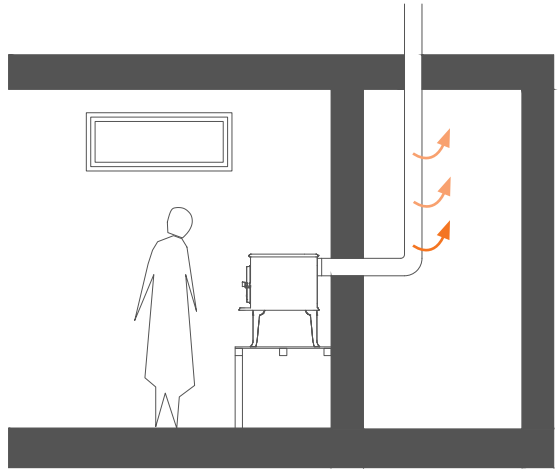


FIGURE 73. Section with chimney going through the drying room

The second idea was to direct the chimney through the roof above the stove but implement an opening in the wall between the stove and the drying room in order to allow heat through (Fig. 74). A version of this strategy made it to the final build.

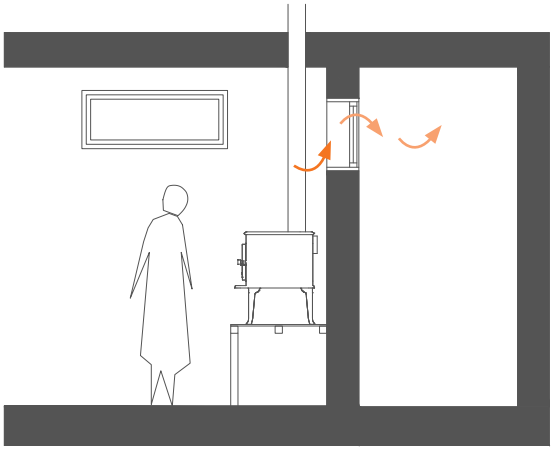


FIGURE 74. Section with opening in wall to drying room

During the build, in a meeting with Sami Rintala, the orientation of the stove was changed to its final position. Due to concerns about fire safety, it was determined that the chimney should exit the building immediately behind the stove (Fig. 75). The opening between the stove and the drying room would remain, however, this also became another difficult design choice.

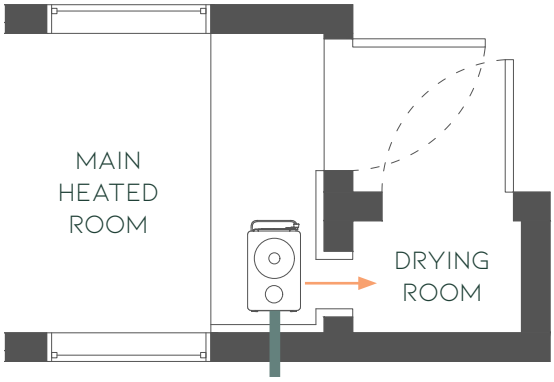


FIGURE 75. Section with opening in wall to drying room

FIRE-PROOF MATERIALS

Once the stove location was determined, multiple ideas floated around concerning the fireproofing needed around the stove area. Early on, when it was thought that we would purchase a new stove (most likely a Jøtul 602 ECO), the strategy was to mount metal plates on the walls, and with the stove placed an appropriate distance from the wall, this would be a sufficient solution. However, the metal plates would not be produced by a stove company but by DRAG Industrier (the local metal shop in Bodø). Nevertheless, due to the stove's efficiency and 'clean-burning' (having an opening that allows fresh air to enter the stove and create a 'second-combustion'), we could still get a fire-safety approval.

However, a few days prior to the build, we were notified that a used older model of the Jøtul 602 stove was at our disposal. Since we aimed to optimize the amount of reused materials and items in the cabin, having a second-hand stove would lift a significant burden off of our CO_2 emissions. Although the stove was also 'clean-burning', this Jøtul model is no longer in production, so it would be wise to apply additional fire-safety measures. Since these measures had not been explored prior to arriving in Bodø, we had to choose something readily available in-store; that being 50mm 'Brannmurr' panels made from calcium-silicate. Many calcium-silicate producers state that their product is environmentally friendly, however, more details on this material's emissions can be found in 'Material Selection and Life Cycle Analysis', written by Anastasia Tsivileva.

There was also some debate about how the Brannmur should be attached to the studs. Initially, four bolts were used for each panel, but we soon learned that this was not recommended, as the metal bolts could transfer heat to the wooden studs.

For installation, we followed instructions provided by Jøtul, which suggested the Brannmurr, with the stove at a distance of 250mm from the wall, or the fireproof material with the addition of a metal heat-proof plate (attached the to stove itself) and the stove at a distance of 100mm from the wall (Fig. 76).

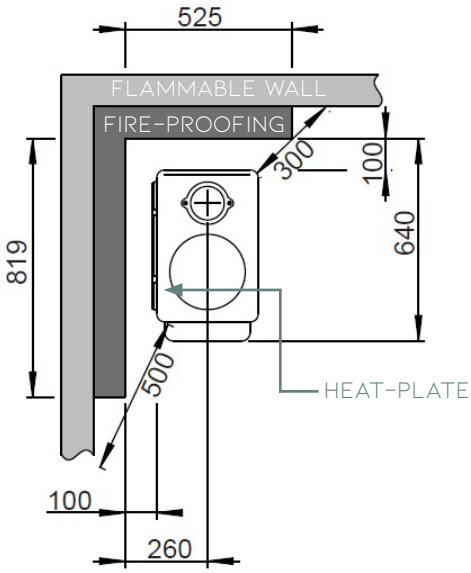


FIGURE 76. Jøtul 602 Stove Installation with Exterior Fire-proof Wall and Additional Heat-Plate (*Jøtul 602 ECO Oppstillingsvilkår*)

Although it would have been ideal to place the stove at a distance of 250mm away from the wall to avoid the purchase of an additional heat plate, the location of the construction studs and the large diameter of the chimney (400mm) prevented this.

To cover the calcium-silicate plates, it was still thought that thin metal plates could still be used. Nevertheless, the cost of custom sheets and their production time was questioned. Furthermore, waiting for the metal sheets to be made would also prevent the carpenters from completing the interior cladding. Therefore, another solution was chosen here as well. It was suggested to us by the sales associates at Julius Jakhelln to use instead a plaster-like material, which is used to install floor tiles (Fliselim), directly on the calcium-silicate in order to create a stone or concrete-looking effect. This plaster could then be painted over with a colour of our choice.

To protect the floor under the stove, metal sheeting was also the first choice material. It was thought that the metal sheet would extend across the room to the entrance area to prevent the oak floor from being damaged by wet shoes (as described in the 'wet-zone' and 'dry-zone' concepts). In this scenario, we would end the oak flooring at the metal plate and then use a different material (such as OBS) underneath the metal plate to avoid wasting oak flooring by hiding it under the metal (Fig. 77).

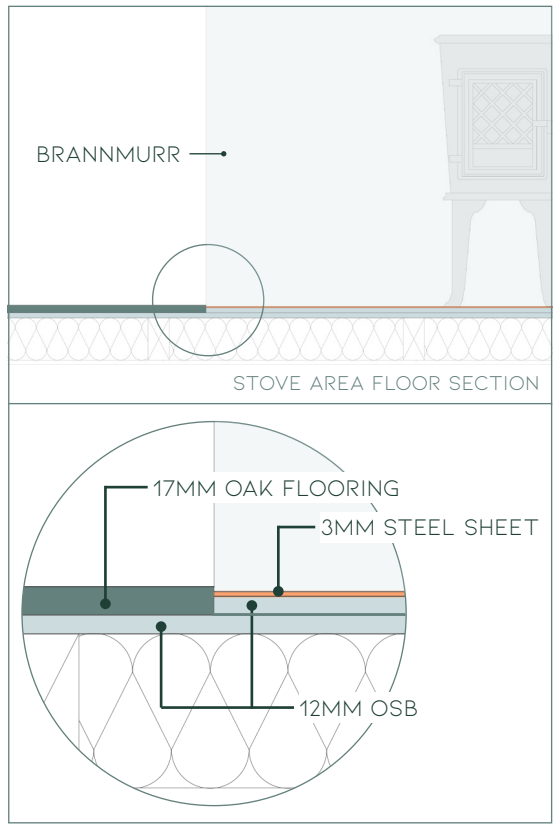


FIGURE 77. Flooring scenario where oak floor ends at Brannmurr, and an additional layer of OSB is layed under the floor, resulting in an uneven surface

We were advised against this solution, as cutting the oak flooring short would create many un-usable cut-offs, the differences in material thicknesses would create an awkward 'lip', and the floor would not be flush. Having metal on the floor in the entrance area would also be a safety hazard, as it would create a slippery surface if wet. The entrance's location next to the stove would also increase this safety risk.

The final solution resulted in the Brannmurr being adhered to the studs using the Fliselim, which was also used to coat the panels, giving it a stone-like texture. In order to avoid un-usable excess cut pieces, two full-sized (1000x1200mm) Brannmurr panels were used, although this was not necessary for safety. At Julius Jakhelln, we were given a can of returned paint (in dark grey) for free, so we used this to paint the exterior of the Brannmurr panels. On the floors, the oak floorboards were laid across the entire floor, and it was concluded that we would use a transparent glass plate underneath the stove, so the oak flooring would be visible, while still protected. However, the glass plate would not extend to the cabin entrance, and a different solution would be sought to handle the challenge of wet shoes.

FIGURE 78. Final fire-protection solution (without glass plate)

''THE VENT''

As mentioned earlier, we planned to create an opening between the stove and the drying room to allow some heat to aid in drying clothes and other gear. Unfortunately, we encountered many difficulties with this element, as we would have to design something custom, and we were unsure how much fireproofing would be needed around the opening. Perhaps it could have a door or just be a larger vent. Frankly, we avoided designing this mechanism until we were on-site due to our apprehension.

When we planned to cover the Brannmurr with metal, we had thought to place the vent opening in the Brannmurr, line the opening with metal, and add a perforated metal to prevent any unwanted guests from crawling through. Unfortunately, this option came to a quick close, as the lining of the vent and the perforated metal would need to be welded together and, therefore, would be very expensive.

On the building site, time was running short to make a decision, so the next thought was to go for a store-bought rectangular vent, approximately 400x60mm in size. Unfortunately, due to some miscommunication with our German carpenters, it was determined that cross-bracing was placed in the wall we planned to install the opening in without our knowing. Thus, our options ran short for creating a large opening.

Although it was not the solution we had hoped for, we tried to make the best choice given the situation. The carpenters had opened the packaging to a small wooden ventilation unit earlier in the build week. We had purchased it as a back-up, but planned to return it if it would not get used. Unfortunately, as will be mentioned later, there were a few mishaps regarding the opening of materials, without being sure that we would use them. However, this wooden ventilation unit had been taken out of its packaging and was no longer fit to return to the store, therefore, it became our new 'opening' between the stove and the drying room. Granted that it was not the size we had planned for, its wooden cover and frame blended well with the wooden interior cladding.

The idea of this vent was undeniably experimental. However, the nature of the cabin as a prototype will allow for its

functionality to be tested and for future iterations of the cabin to be the hosts for improvements.

THE DRYING ROOM

Prior to arriving at the building site, there were no plans to insulate the drying room, but in an attempt to retain some heat in the drying room while things dry, we decided to insulate the walls and floor. Whether or not this will successfully retain some heat (since the roof is not insulated) will have to be tested once the stove is installed.

The interior of the drying room is cladded with some plywood sheeting that had at first been placed on the ceiling in the main room but was decided against. Since the pieces had been already cut, we decided to use them in the drying room to avoid wasted material.

When the build was finished, the area that had not been sorted out was the floor of the drying room. Accounting for water drippage and likely puddles on the floor, we had not quite determined a way to water-proof the floor while also having a way in which the water could evaporate and leave the drying room. Although we installed two small ventilation units in the drying room to allow for some airflow, we did not see this as sufficient enough in the case of large amounts of water sitting on the floor.

Luckily (although after the build was already over), Bjørn Godal suggested that a drain be installed on the floor of the drying room. This solution will most likely be implemented when the cabin is placed at Tjoarvihytta, and a temporary flooring solution was installed for the Landskonferanse friluftsliv.

INTERIOR DESIGN

During Nordlandsbua's build period, the interior furnishing did not get constructed by the carpenters, due to poor time management. Instead, the interior was constructed by carpenters hired by Sami Rintala, a week before the conference.

The interior design for Nordlandsbua is compact and simple and makes it possible to cook, dry clothes in the drying room, heat and get rest all year round. It is designed for four people to stay the night.

The final design is simple and intuitive. The top of the kitchen counter is meant to cut and prepare food, the lower one is for storage where baskets can be used for smaller items. Since the design is simple, it gives the opportunity to add more shelves if needed later.

There are two beds which are fixed in place and two foldable ones. If the upper, foldable beds are not needed, they can be collapsed to allow for more space, and the carabiners that are used to secure the beds can be used for hanging clothes. The securing system of the foldable beds also works as an extra security net for the people sleeping in the upper beds. When the beds are folded down, they will work as a backrest for the lower beds.

Two steps are placed by the end of each bed to make climbing into the top beds easier. The lower beds are 10cm wider to make it easier to climb in the top beds, and allow space for comfortable seating when the upper beds are in use. The beds are attached to the wall studs, but a bed leg in the longer bed was needed for extra support. The hinges are sprayed black to match the fireproof material, which is also black. It was decided to make the bed go all the way to the step so it can also be used as seating by the entrance.

Below the window, there is a foldable table at a comfortable height to eat and play cards with a view and daylight from the window.

The flooring we used is second-hand oak which was found on Finn.no, which was sanded down. Then, two layers of varnish were added to sustain the wood. Oak was chosen based on the meeting with the client about having hardwood as material on the floor.

There was a noticeable lack of hooks during different cabin research visits in the semester. Therefore, the entrance area of this cabin will have hanging options, that will be installed later on.

The drying room is a place where wet clothes and gear are stored and dried during one's stay. Here, various hanging solutions will also be later installed. In addition, a better solution for handling moisture in the room, such as drainage system, is needed, as mentioned in 'Stove & Drying Room'.

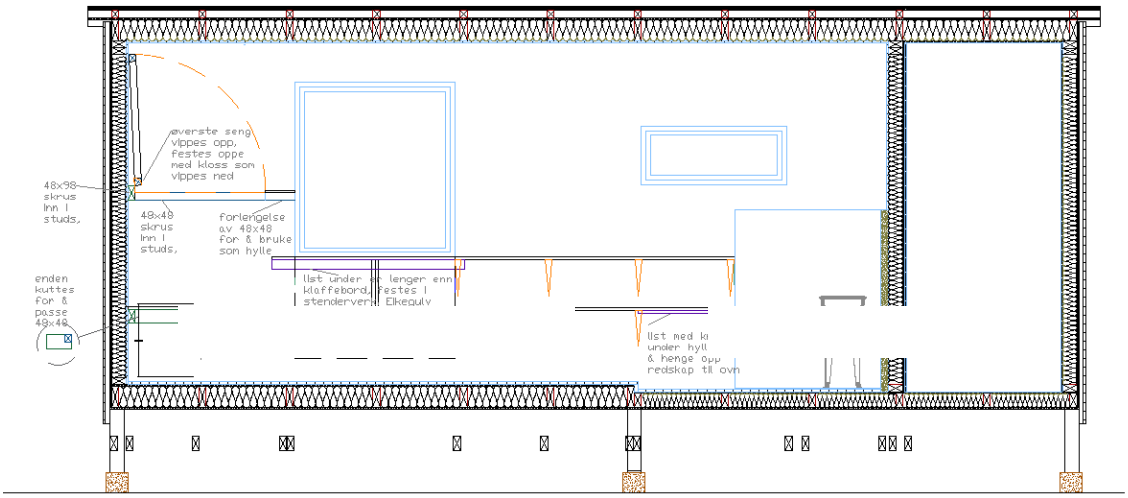


FIGURE 79.
Interior design section

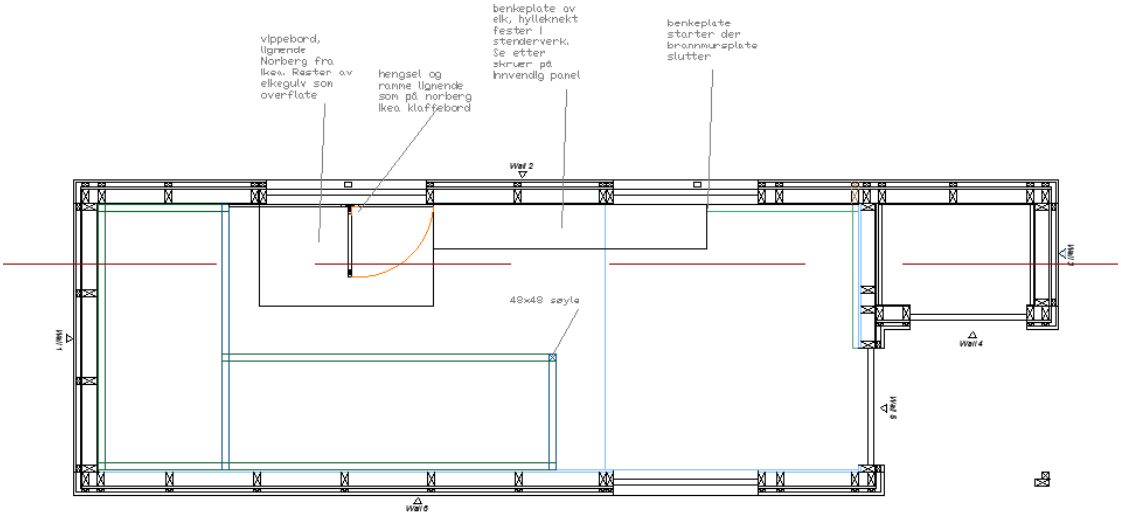


FIGURE 80.
Interior design plan

COLLABORATION WITH CARPENTERS

The carpenters from Germany were in their final semester of training at the Berufliches Schulzentrum in Immenstadt. They were in the process of finishing their two-year carpenter study while simultaneously working in carpentry firms until this point. Us as architects, being new to the practice of construction work, were guided by the carpenters, who shared their practical knowledge. However, there was also some differences in the approach of being a German carpenter in Norway. The following section is reflected on both the differences, but also the guidance we got from their expertise.

CULTURAL DIFFERENCES IN BUILDING METHODS

The following are some differences in building methods and knowledge, encountered by the German carpenters in Norway.

First and foremost, the difference in building methods for an arctic climate compared to the milder climate they were used to.

Second, their technical approach to building varied from the Norwegian building techniques and our approach to design for easy disassembly, for example, how the screws were used during the timber frame construction. Another difference in construction methods is the distance of the stud system. For example, in Norway, we use the CC60 stud system, which was used during the construction, while in Germany, they use the CC65 stud system.

Third, the different methods and use of material. It was clear early on in the building process that Germany and Norway have different methods and approaches to various building problems. As the building will be raised above the ground, we needed a good solution for moisture resistance on the bottom of the floor. This discussion was a major one among all participants. Typically, the solution in Germany would be to use a concrete deck or bitumen-covered bottom deck. As neither of these options was sustainable or available, we considered using a UV resistant foil that would cover the bottom. Unfortunately, the foil was not available, and the risk of damage to the foil leading to water and moisture damage was too great of a risk. The next explored solution was a bitumen paint, but the only available material in Bodø was small cans for roofing repairs. The final solution was painting the OSB subfloor using two layers of wood tar (ekte tretjære) mixed with linseed-oil; however, the bottom will need to be repainted every 2nd year.

Fourth, in order to screw into the vapour barrier (dampbrems) and prevent air leaks, the carpenters suggested a butyl tape (sløyfebånd) to cover the vapour barrier where the studs are located. This approach is typically used on roof constructions. However, we decided to use this solution on the interior walls and roof.

Fifth, in Germany, there is a possibility to buy pre-made flashing that can be clipped in underneath the windows. Unfortunately, this type of flashing is not available in Norway for wooden-framed windows. Therefore, we had to have the window flashing custom-made by DRAG Industrier (metal order drawings available in Appendix C).

Sixth, language barrier. Although all participants were skilled in English, there were some miscommunications and misunderstandings throughout the build.

MISCOMMUNICATION ABOUT SUSTAINABILITY STRATEGIES

Although the carpenters were extremely skilled in their craft, it was apparent that certain methods to increase sustainability, were not part of their training. Unfortunately, us architects were not always able to be present on the building site to make sure that certain measures were being executed.

For starters, one of our requests to the carpenters, was to be weary of opening product packaging until we were absolutely certain that we would use it. This was also extended to not damaging products in case we decided not to use them. Although this was repeated, it was not always followed. This resulted in a few products that were prematurely taken out of their packaging, having multiple half-used open products rather than only opening one at a time, and footprints and coffee ring stains on materials that should have gone back to the store.

Next, we noticed that with longer materials, there was little effort to reduce the amount of short un-usable cut-off pieces. For example, the exterior cladding was centered when screwed onto the facade, and then cut from either end, resulting in small left-over pieces. The cladding boards could have been aligned to one side, resulting in a larger cut-off that could be used for a smaller facade or somewhere else. However, the fault here was with us, as we could have made it clearer that we wanted to avoid this.

Lastly, which was not apparent to us nor the carpenters, there was a better way to screw together the wooden structure that would allow for easier disassembly in the future. It was our supervisor, Pasi, who brought this to our attention. However, by that time, the structure had already been constructed. In his own words: ''This is a simple discussion of from where do you access to the screws that hold the studs. The traditional way (which you also used) is to lay the wall on the floor and screw the studs in from each end, i.e. top and bottom. When the element is in place, these screws are not accessible, making disassembly impossible. A better way would be to screw them from the insulation cavity at an angle.'' (P. Aalto, private communication, 2022).

DRAWINGS OF BUILT PROJECT

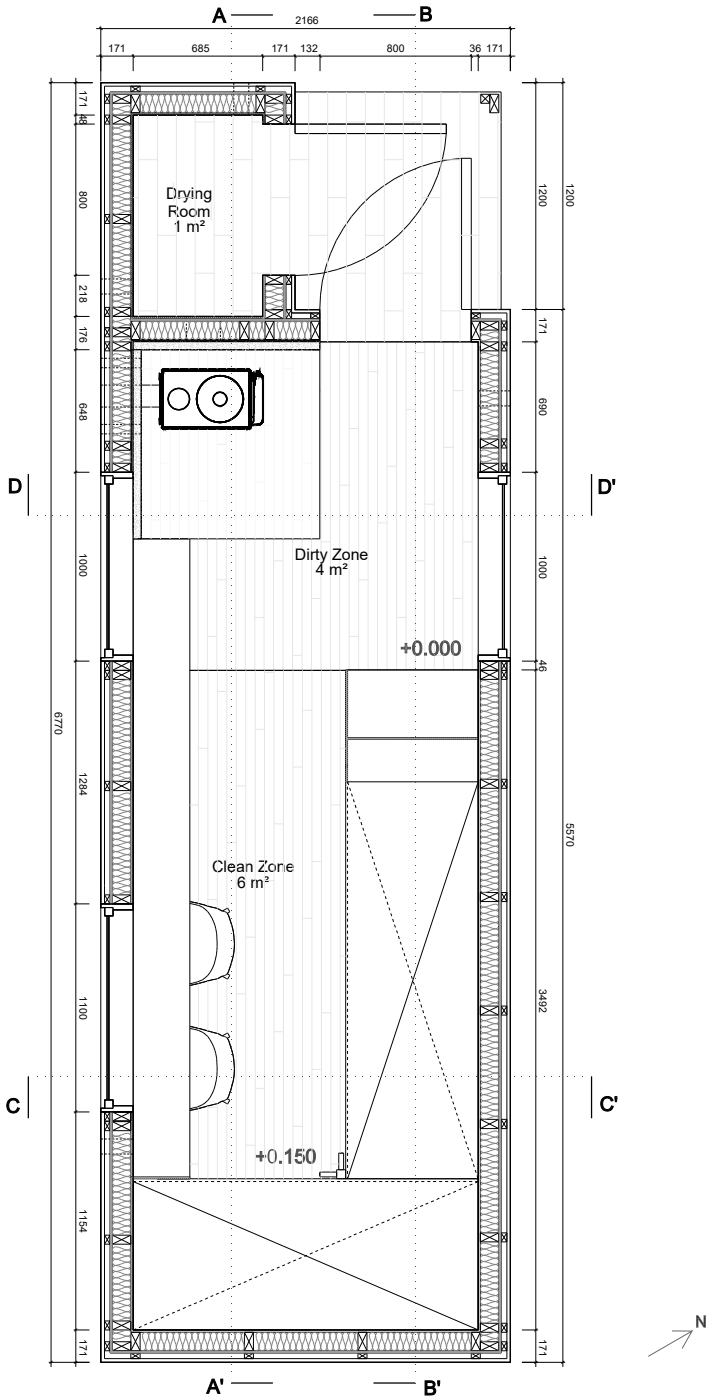


FIGURE 81. PLAN OF THE BUILT CABIN. SCALE 1:40

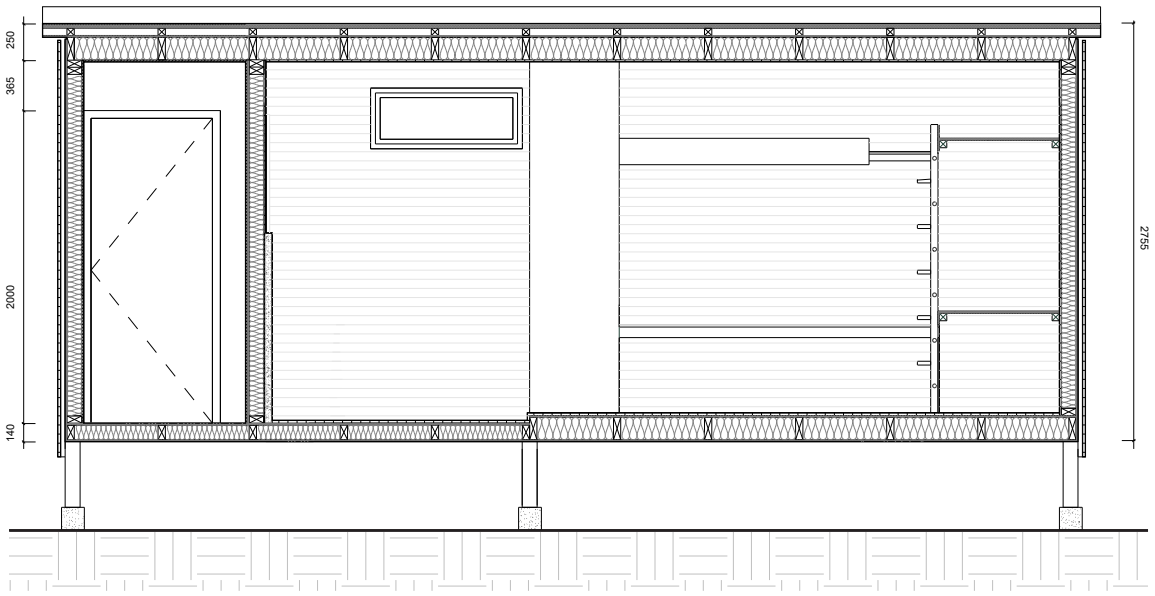


FIGURE 82. SECTION A–A OF THE BUILT CABIN. SCALE 1:50

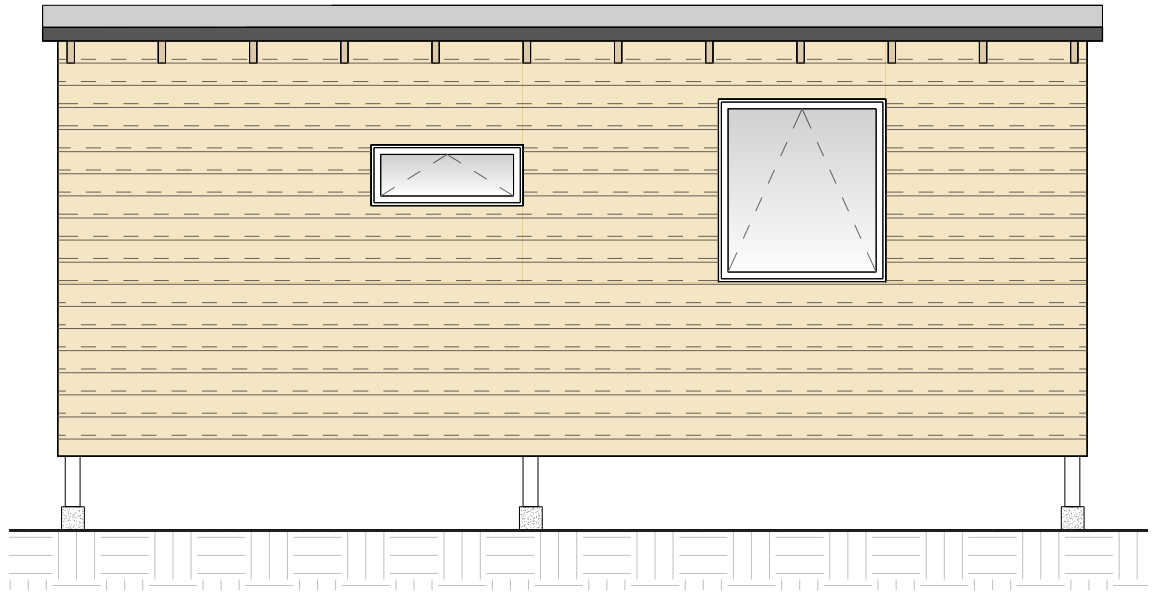


FIGURE 83. ELEVATION A–A OF THE BUILT CABIN. SCALE 1:50

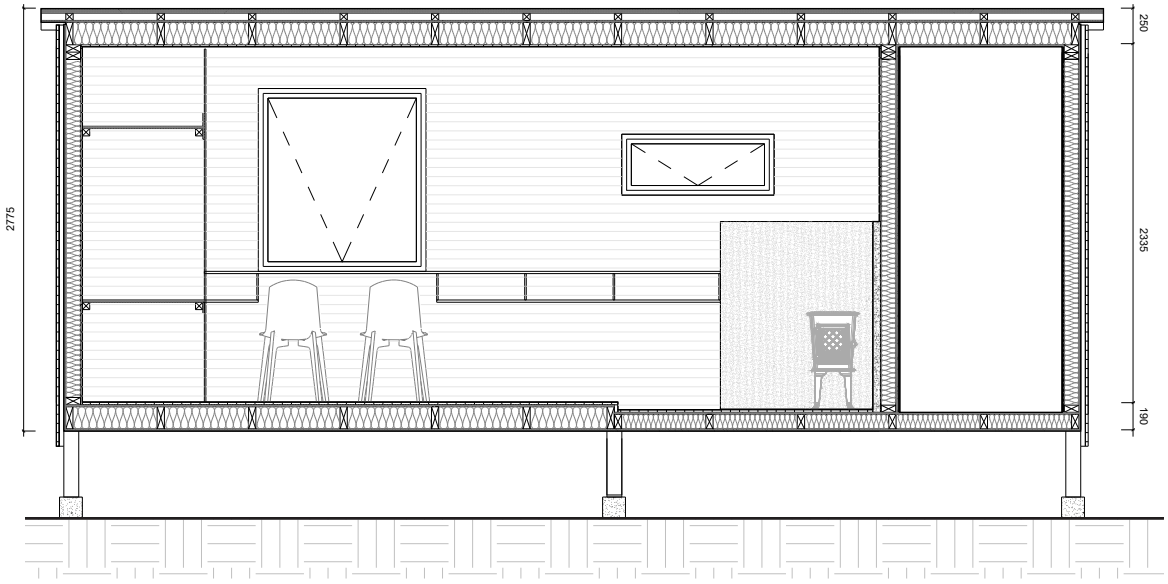


FIGURE 84. SECTION B–B OF THE BUILT CABIN. SCALE 1:50

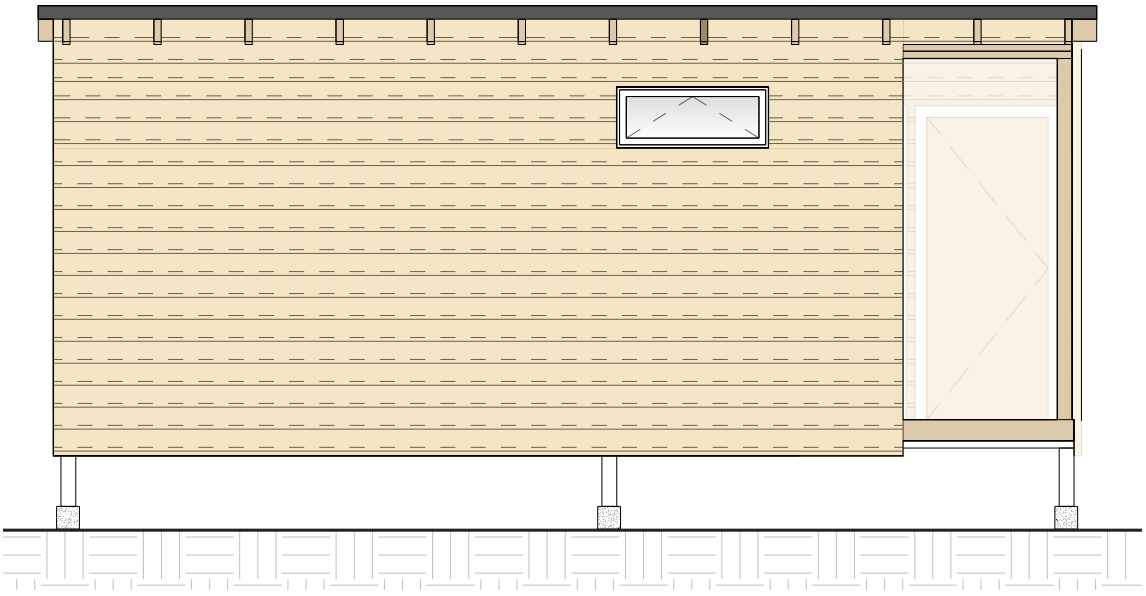


FIGURE 85. ELEVATION B–B OF THE BUILT CABIN. SCALE 1:50

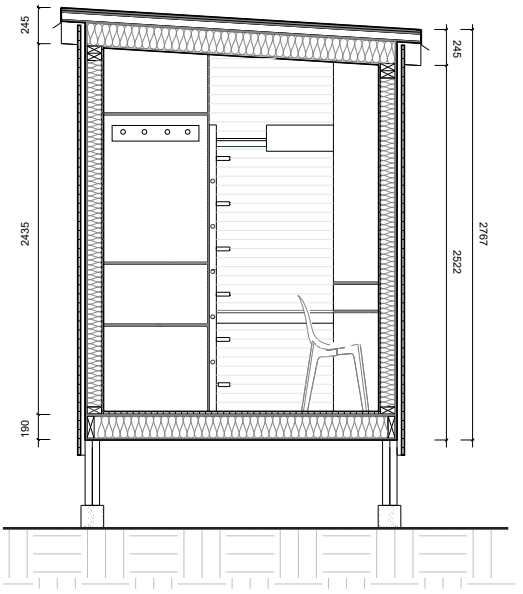


FIGURE 86. SECTION C–C OF THE BUILT CABIN. SCALE 1:50

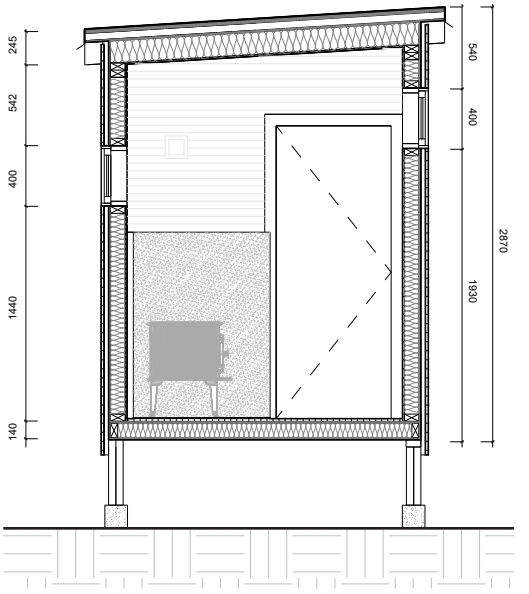


FIGURE 87. SECTION D–D OF THE BUILT CABIN. SCALE 1:50

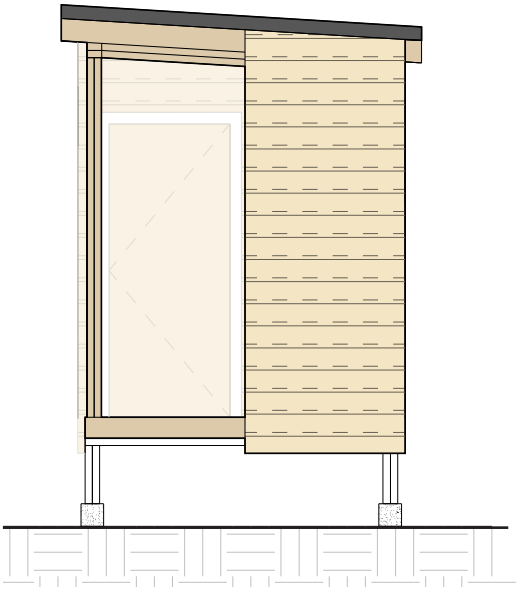


FIGURE 88. ELEVATION C–C OF THE BUILT CABIN. SCALE 1:50

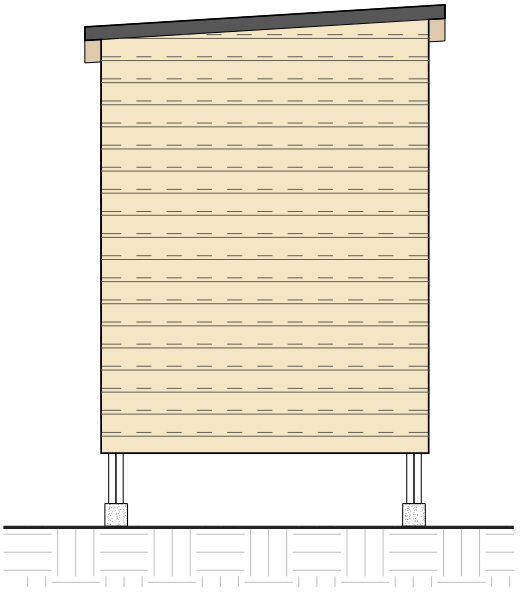


FIGURE 89. ELEVATION D–D OF THE BUILT CABIN. SCALE 1:50

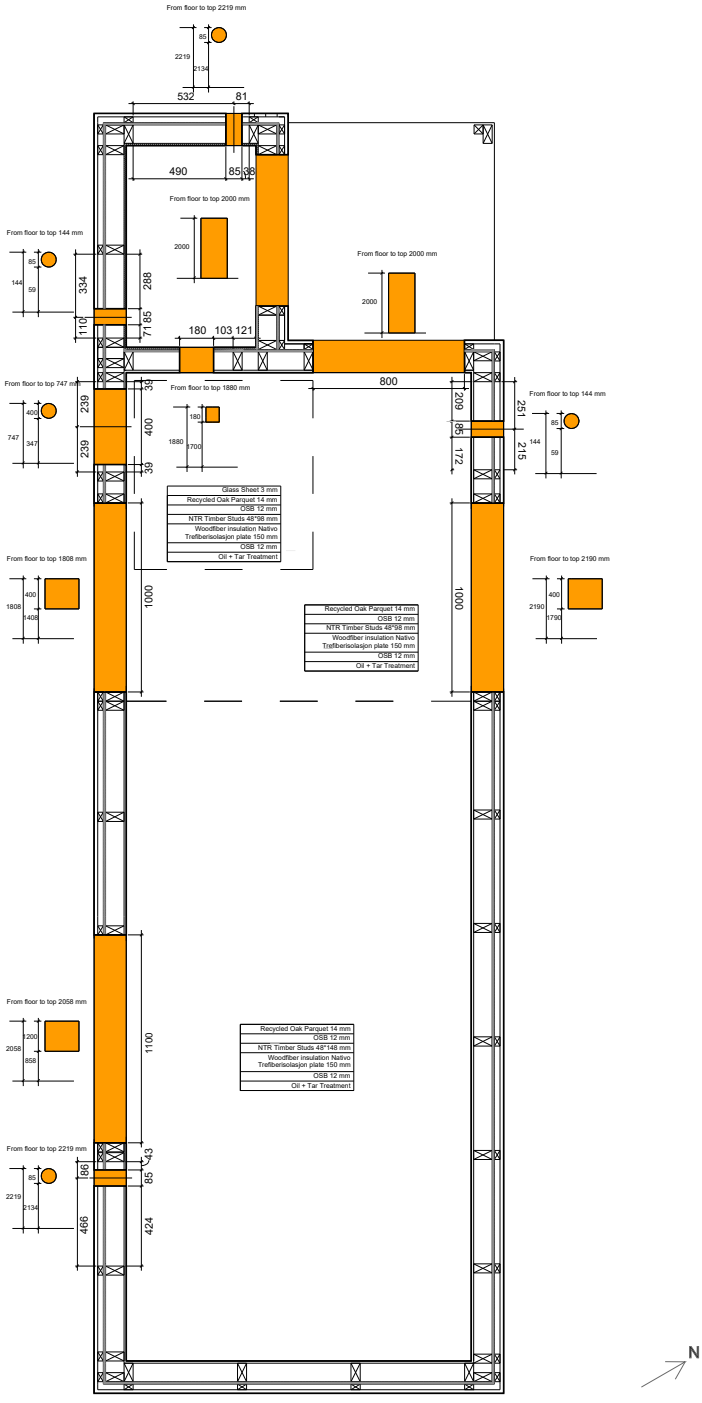
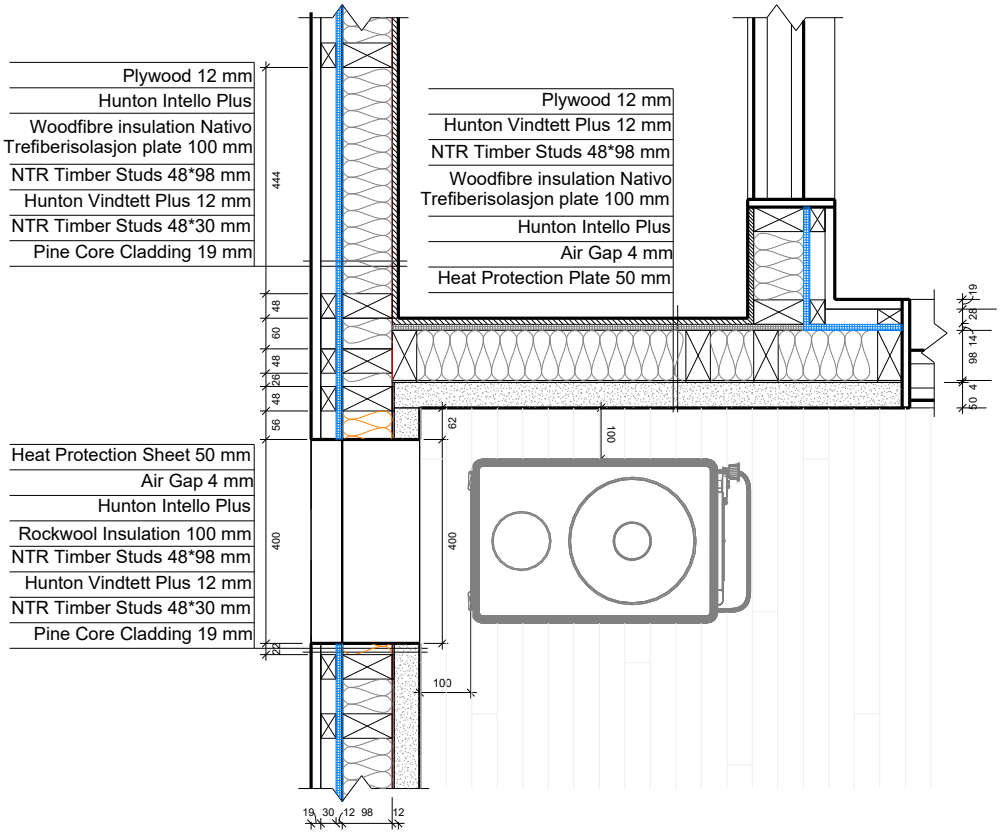


FIGURE 90. PLAN OF WALL'S OPENINGS. SCALE 1:40



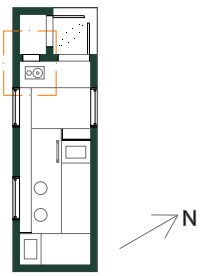


FIGURE 91. DETAIL OF PLAN. SCALE 1:10

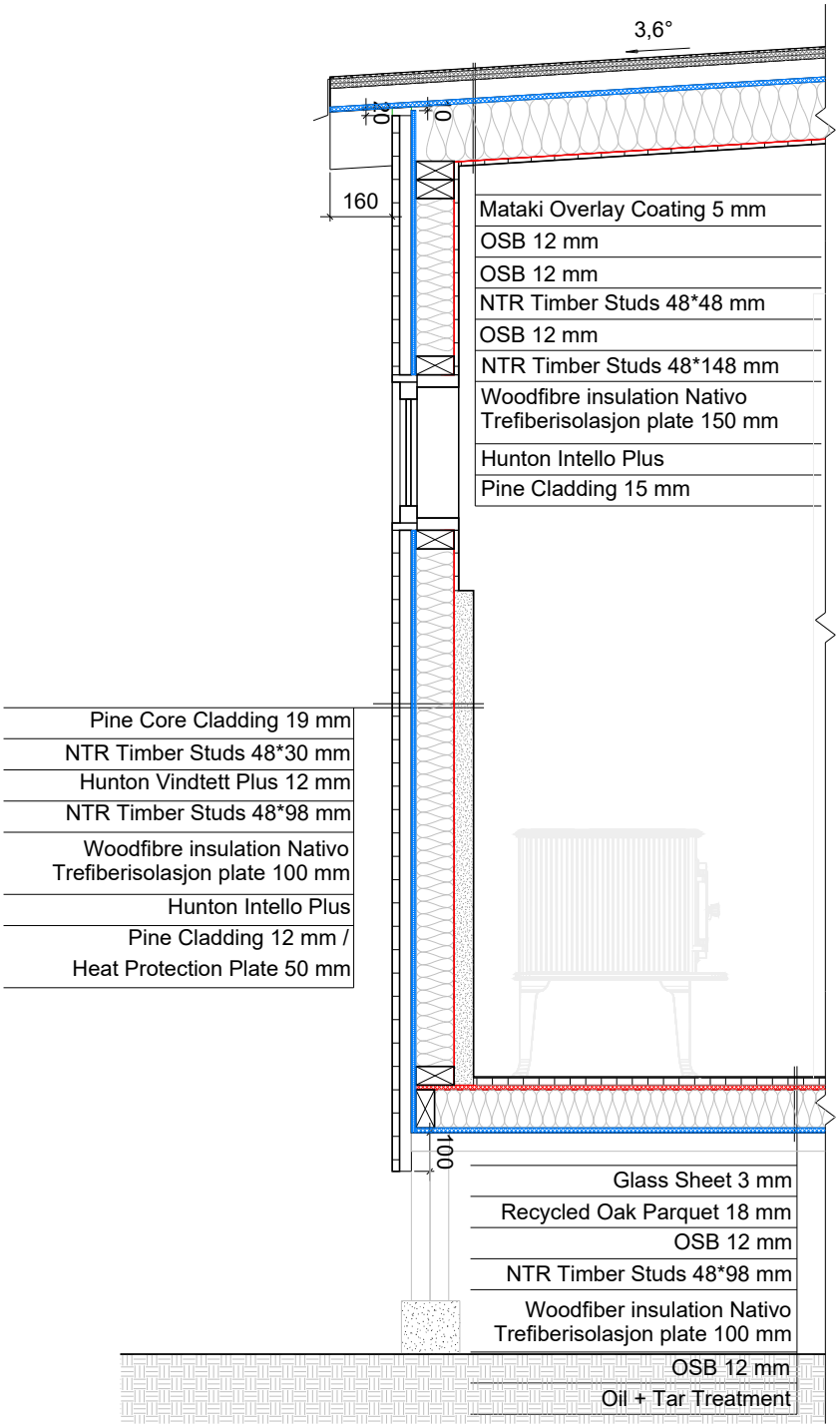


FIGURE 92. DETAIL OF SECTION D-D. SCALE 1:20

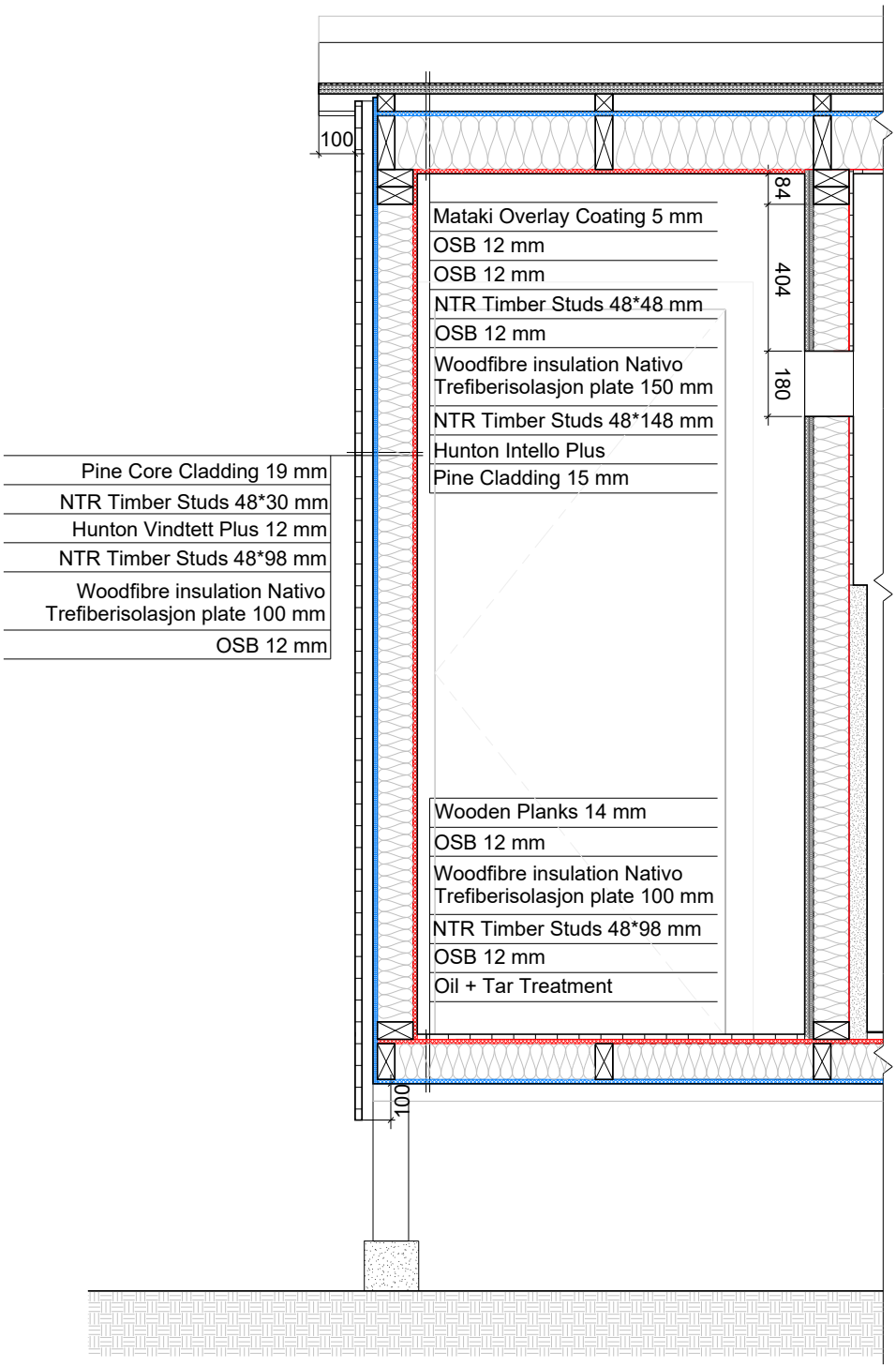


FIGURE 93. DETAIL OF SECTION B-B. SCALE 1:20

BUILDING PROCESS

The following is a series of photographs that follow the process of building the cabin and it's various stages.

The photographs were either taken by the authors of this thesis, or provided by the carpentry students.

PREPARATIONS IN TRONDHEIM

FIGURE 94.
Planing oak flooring boards in NTNU wood-shop

FIGURE 95.
Varnishing oak floor boards

FIGURE 96.
Picking up second-hand Jøtul stove

FIGURE 97.
First day in Bodø

FIGURE 98.
Material delivery by XL Bygg

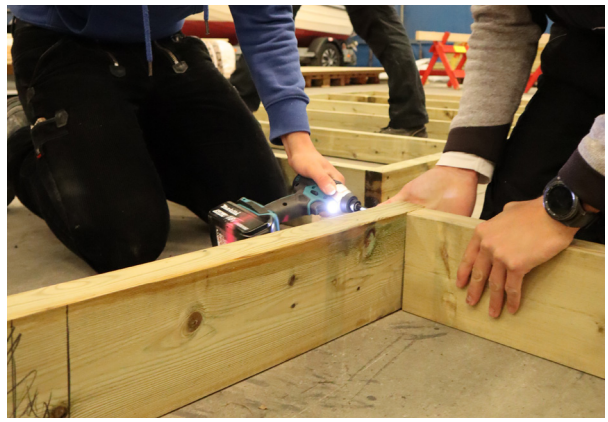


FIGURE 99.
Construction of floor

FIGURE 100.
Adding OBS floor base

FIGURE 101.
Picking up insulation in Fauske

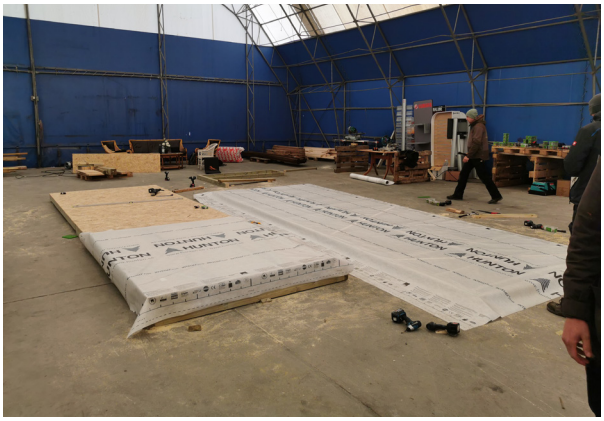


FIGURE 102.
Adding Hunton Vindett Plus wind barrier to interior of wall structure

FIGURE 103.
Painting tar and linseed oil mixture to floor base for waterproofing

FIGURE 104.
Simultaneous construction of floor and walls

FIGURE 105.
Adding of insulation to walls

FIGURE 106.
Adding of Hunton Intello Plus to walls

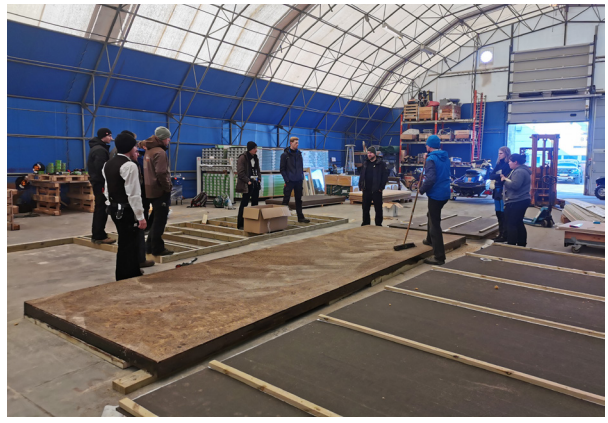


FIGURE 107.
Saw dust was brushed on the floor base the next day to absorb any extra oil
After this, it was flipped over and insulation was added

OSB was then added on top of the floor insulation.

FIGURE 108.
Joining the walls to the floor

FIGURE 109.
Walls standing and fixed to the floor

FIGURE 110.
Screwing walls together

FIGURE 111.
Addition of extra cross-bracing

FIGURE 112.
Vapour barrier added to the ceiling and roof construction begins

Cladding studs are added to the exterior and roof beams are installed

FIGURE 113.
Taping vapour barrier down in window cavities

FIGURE 114.
Frame of outdoor deck is added

FIGURE 115.
Insulation is added to the roof

FIGURE 116.
Exterior cladding is mounted

Windows are installed.

FIGURE 117.
Exterior cladding prior to being cut to size

FIGURE 118.
Thick tape is added to studs to protect the vapour barrier as the interior cladding is mounted

FIGURE 119.
Interior cladding being screwed into place

FIGURE 120.
Exterior cladding completed

FIGURE 121.
Trim is added to edges of exterior cladding

FIGURE 122.
Custom metal roof flashing is installed along with bitumen-felt roofing

FIGURE 123.
Installation of oak flooring

FIGURE 124.
Door frames are built, and doors installed

FIGURE 125.
Decking from scrap materials is completed

FIGURE 126.
Finished interior cladding and flooring

FIGURE 127.
Fire-proof paneling adhered to wall in stove corner

FIGURE 128.
Fire-proof paneling after plaster and paint

FIGURE 129.
Materials are sorted and warehouse cleaned

LATER ADDITIONS
(AFTER THE BUILD)
Photographs provided by Sami Rintala

Furniture installation by Sami Rintala's carpenters.

FIGURE 130. Completion of lower beds.

FIGURE 131. Upper beds in horizontal position

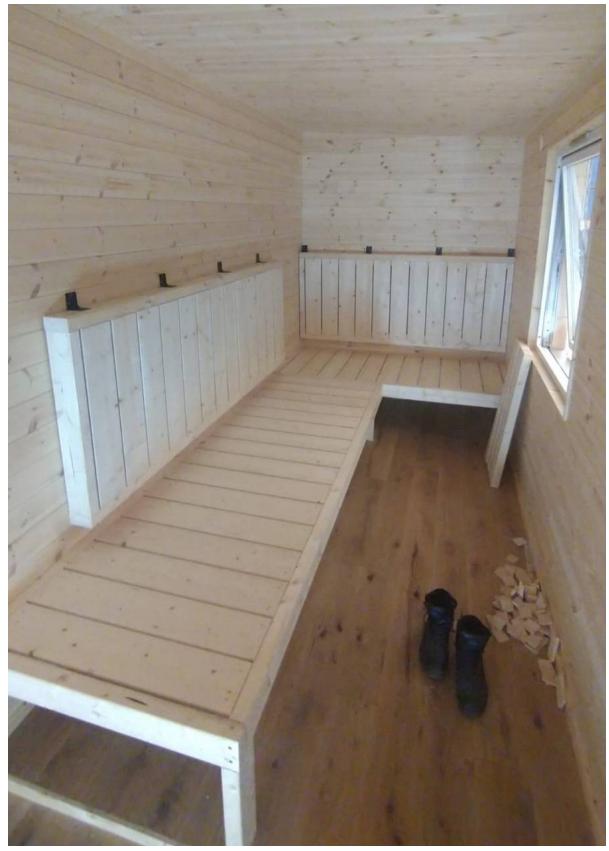
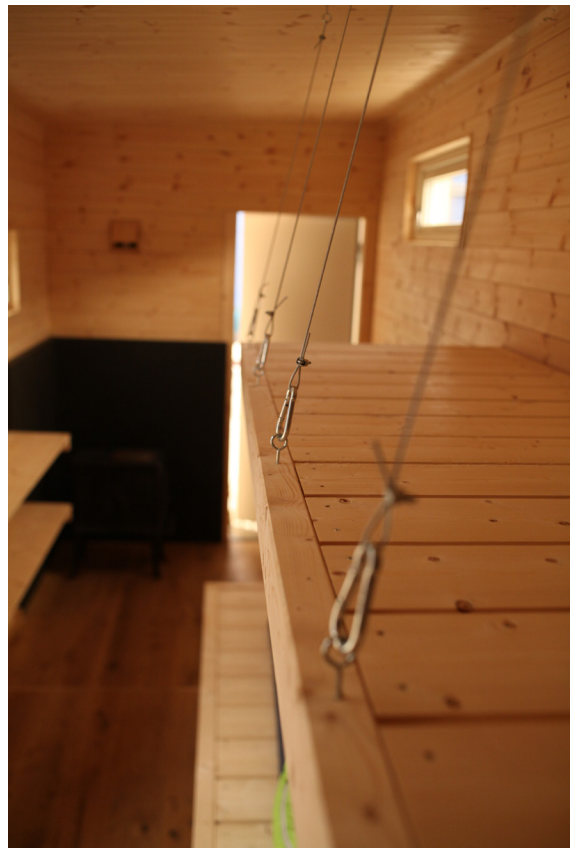


FIGURE 132. Upper beds in folded position

FIGURE 133. Finished interiors

COMPLETED CABIN



VII. CONCLUSION

REFLECTIONS

DESIGN PROCESS

Although much could be said about our design process prior to the build, it quickly became clear to us as we started working in Bodø, that our biggest disadvantage was that we had not been in contact with the carpenters sooner. It may not have been possible, as they themselves had only met each other at the airport on their way to Norway, but if this type of project were to be repeated, that would be our greatest advice. It would have benefited us to have designed the project in collaboration with them from early on, and have had a full understanding of how the design fits with the building assembly, before we all meet in Bodø. Not doing this resulted in much turmoil, as we hastily tried to re-adapt our design to the fit the structure, sometimes unsuccessfully (such as with the 'vent'). A more elegant and seamless design could have been created if we worked in tandem with the carpenters from the get-go. However, given that this opportunity was not available to us, we could have prepared ourselves a bit better by researching German-style timber construction more thoroughly.

In addition to this, our overall design process could have been more systematic. Decisions could have been made more effectively, moving us along more efficiently. We arrived on the building site with things not-yet decided, due to our hesitation to make decisions as a group. Despite this, throughout the design process, we still worked cooperatively as a group, which we are very grateful for.

BUILDING PROCESS

Entering the building weeks, we really felt the consequence of this lack of earlier contact with the carpenters, as well as the weight of responsibility that fell on our shoulders. During this short period of time, we took on so many additional roles (i.e. material delivery personnel, time-management, food and break organization, project managers, etc) on top of our main role as architects and students. We noticed the lack of these positions that would, in a normal working environment, have been taken care of by other people. Some prior insight, and in turn, prior preparation, would have benefited us greatly.

Much miscommunication also occurred between us and the carpenters, both on a language level and on a construction comprehension level. As mentioned earlier, sooner collaboration would have assisted in the building process. We would have had a greater knowledge of their building techniques, as well as the materials that they need, and they would have had a greater understanding of our sustainability and design goals. Had we hatched a detailed plan before the building process, things would have ran much smoother.

In a positive light, the build was an incredible learning opportunity. We became aware of the complexities of the building industry and the importance of all involved parties and their collaboration. We emerged with a better sense of certain aspects of construction, such as the size, weight and cost of materials, which are not often discussed in a university setting.

Overall, we were overwhelmed by the experience of seeing our ideas and drawings develop into a real, tangible building.

OUR SUSTAINABILITY GOALS

Early on in the design process, it was decided that it would not be suitable for this project to try to reach any existing sustainability standards or certifications. However, it would have been beneficial if we had set more quantitative goals for ourselves, rather than purely qualitative. Had we done so, we could have concluded the project with more measurable proof if we had met these goals or not. However, it is still valuable to reflect on the qualitative targets we had set.

1. REDUCE MATERIAL USE

In all the goals, we had both successes and failures. Much of the project involved discussions about which sustainability measures contradicted one another, and what the trade-offs are. For example, in reducing materials, we had chosen to use less insulation, with the possibility that this will raise the need for firewood heating. Within this same goal, we also struggled to convey the importance of this measure to our building team, and additional attention to this point was not taken. However, with the original floor footprint being planned as 12m^2, its decrease to 9,7m^2 created a significant reduction in material usage.

2. REUSE MATERIALS

Although more materials could have been found second-hand, searching for and coordinating these materials would have been extremely time-consuming, and would also require an available vehicle and storage space. Therefore, given the time constraints and the distance to our building site, the amount of second-hand materials we were able to incorporate into our design was satisfactory.

3. CHOOSE RECYCLABLE MATERIALS

Of course, the biggest downfall in this goal, was our use of pressure-treated lumber, as it cannot be reused or sustainably disposed of. But aside from this, our considerable use of natural wood products, including the cladding and insulation, have potential to be reused elsewhere or will be carbon neutral in their disposal.

4. KEEP WEIGHT TO A MINIMUM TO MINIMIZE EMISSIONS FROM TRANSPORTATION.

With the maximum weight for truck transportation being 5.5 tonnes, and helicopter transportation being 3.6 tonnes, we have successfully reached this goal with our total building weight calculation, included in Anastasia Tsivileva's sub-thesis on LCA, resulting in 3,34 tonnes.

5. DESIGN FOR DISASSEMBLY

Elaborated on in 'Miscommunication about sustainability strategies', a method of connecting the wooden structure in a way that makes the screws more easily accessible, and in turn, the structure easier to disassemble, was unbeknownst to us and the carpenters during the assembly of the structure. Nonetheless, other successful measures were taken, such as with the exterior cladding.

6. DESIGN FOR LONGEVITY

The use pressure treated lumber, although didn't support our goal for recyclability of materials, contributes to our goal of durability. The future testing of the prototype will reveal how this decision affected Nordlandsbua's lifespan.

7. PRIORITIZE LOCAL MATERIALS

This goal was positively met, as almost all of our materials were produced in Norway. Nevertheless, Norway is a very large country, and transportation of materials from north to south may span up to 1000km. Given the northern location of our building site, it was to be expected that some of the building materials would derive from the south of Norway, but was still the preferred choice over ordering materials from other, more distant countries. Additionally, Norway's domestic shipping and road transport have ambitious goals for emissions reductions or eliminations in the future (Simonet, 2019), which could relieve some of the material transportation emissions in future editions of Nordlandsbua.

LEARNING OUTCOMES

During this thesis, we have accumulated various forms of new knowledge regarding sustainability, project management, cabin architecture and cultural building methods. The small size of the project allowed us to design to great detail and have an in-depth understanding of the project's construction. We were able to experiment, compare and test different design solutions and concepts and see them be realized in a real-built project.

Various analyses allowed us to use simulation tools to make decisions based on materials, climate and energy, and see their results be practically implemented. We were also able to see how these various analyses were interconnected and affect one another.

We accumulated new knowledge and valuable experience as sustainability consultants and architects, project leaders, project managers and coordinators in a building project. We were able to foresee the entirety of the building process and understand the various parties and roles that go into a building project. The opportunity to collaborate with those in the construction field was also an immensely enriching experience, and demonstrated the importance of relationships between designers and builders.

After the cabin's construction, we were able to reflected on the building process, identify our shortcomings, and create new solutions that would evolve the project and improve the next cabin

This thesis and building project has been an engaging experience. We have cultivated new insight, knowledge and understanding of the architectural field, which we will bring forward into our future careers within sustainability and architecture.

IMPRESSIONS FROM LANDSKONFERANSE FRILUFTSLIV

Even before our presentation at the conference, the locals in Bodø were excited to see the "tiny cabin". Being such a small city, rumours went around about our project and the German carpenters who came to build it. Upon returning to Bodø for the conference, we were invited to talk about the project both on local radio and television. Given that the conference theme this year focused on sustainable cabins and combatting the luxury cabin culture that is thriving in Norway, the idea of cabin less than 10m^2 in area, intrigued people.

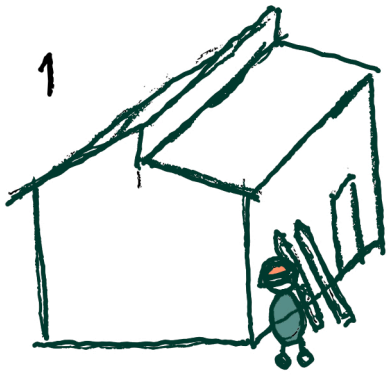
During the presentation of the cabin as part of the conference, we received much constructive feedback. Many of the attendees were long-time cabin owners or had experience constructing cabins. The comments and suggestions we received were:

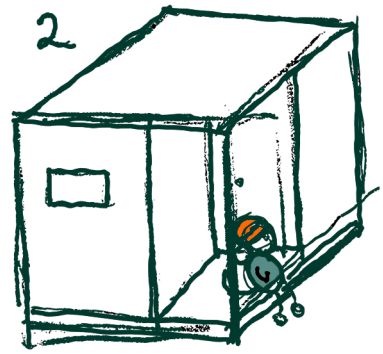
- beware of the corner trim of the exterier cladding, as this will rot the quickest
- visitors may not respect the 'clean' and 'dirty' zones, so additional protection must be added to the lower floor
- some visitors stated that they would prefer to dry their belongings in the main heated area, rather than a separate room
- additional storage and seating options
- there was a suggestion to add a hook in the terrace area to create an 'outdoor shower' with a hanging water sack.
- more ventilation was recommended
- questions were raised in regard to the shell, and whether it would be better constructed adjacent to the cabin, rather than on top
- although the cabin should have no problems with snow load on the roof, there were concerns about wind blowing large quantities of snow against the facade
- the lower vents should have some sort of covering, since they may get blocked by snow
- some of the older attendees made note that the step was a trip hazard
- modifications to the dimensions and size could be made if a prefabrication system was designed
- the main and drying room doors opening into eachother is a bit awkward
- on a positive note, they thought that DNT could learn something from this project, as they often have large cabins or lodges that are used very infrequently

This list is only a snapshot of the conversation that was held between us and the conference attendees. It was extremely beneficial to get perspective from others who were not a part of the cabin's conception. Their invaluable feedback will be taken into consideration in the improvements made to future versions of Nordlandsbua.

III. CIRCULAR ECONOMY EVALUATION

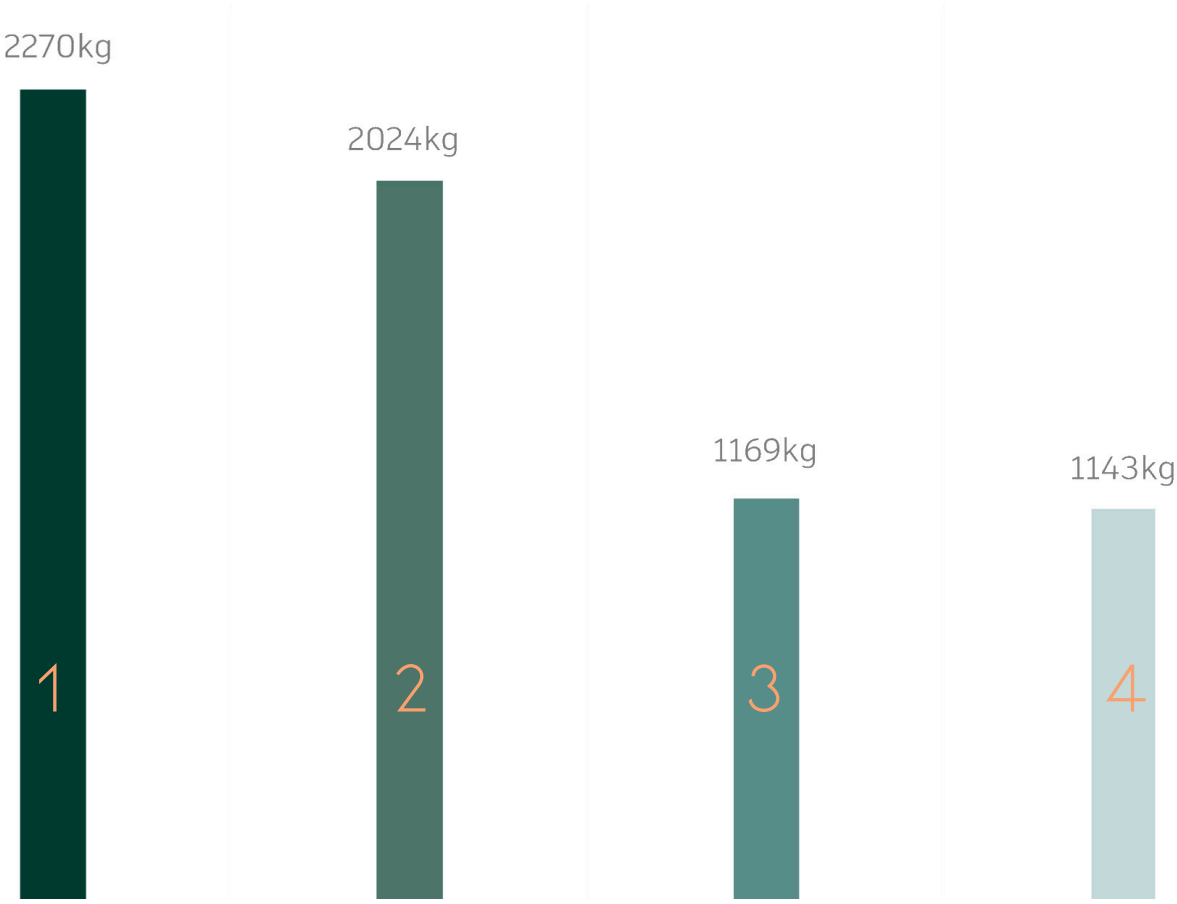
In this chapter there will be an evaluation of how circular economy is implemented into the project in terms of reduction of materials, the use of reused materials and reduction of waste. Further there will be an evaluation if Nordlandsbua can categorize as a circular building, based on the criteria of futurebuilt. Lastly, the posibilities of the life time of the shared cabin of Nordlandsbua will be discussed.





Illustrations of the stage process described in chapter II: Progression of drawings (page 36)

REDUCING MATERIALS



One of the sustainable goals was to reduce material use. Page 36 of the communal report describes the cabin change process in four steps. . From the previous design, the insulation thickness decreased from 200mm to only 100mm. By reducing the thickness, almost 200kg is saved in weight and material use of the insulation.

The windows changed in the last version, because there was found a set of windows on finn.no. It was wanted by the group to have one bigger window, and to have a dimention which is easy to get hold on, 1110x110 was chosen.

Evaluation

In the last version more windows and an extra door was added to give room for a seperated drying room. This increased the weight. Also the step increased the weight, even if it is minimal in 5cm. The total width of the cabin remained the same, as only the outher walls decreased. In order to make a better space for the inside, it could have been wider on the short side. The difference in having the entrance area with the corner, didnt make a difference in termes of materials.

EVALUATION

It would be interesting to compare to ways to reduce the material use even more. A

OAK FLOOR after maintenance

REUSED MATERIALS

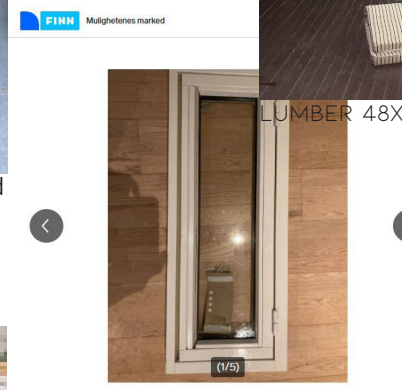
As mentioned on page 34 in CHAPTER II,this project had some influence of second hand materials. The figures on these pages shows what was collected.

The OAK FLOORING, stove, 48x48 LUMBER and HOOKS were collected before going to Bodø. The WINDOWS were reserved from sellers in Bodø and picked up when arriving. The NORDAN WINDOWS were new, but since it comes from a private seller, we have categorized it as reused. The bigger window was used. The seller of these had two, and in order to get one, it was required that both were bought. When collecting the windows from facebook marketplace, we were offered one package of ROCKWOOL INSULATION for free. This was planned to use for the wall where the pipe for the stove will be places, due to fire safety. However, some miscommunation might have lead to that it was not used after all, as the package were still not opened after the two weeks of building.

Leftover PAINT, that we got from a building supply store, is the last reused material that was picked up. It is used on the fire proof material, and the store had already opened buckets of paint.

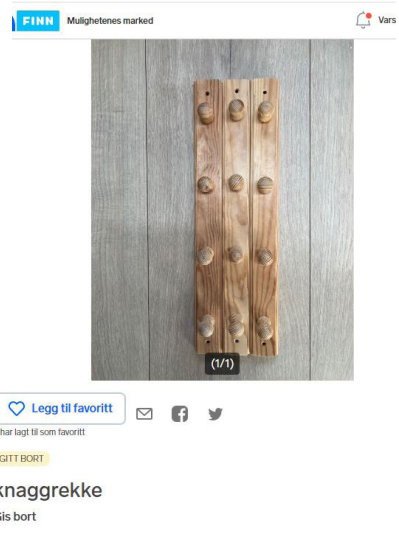
STOVE: free from Pasi's friend

LUMBER 48X48, free from AD-revyen



NORDAN WINDOWS, 1700kr Finn.no

WINDOW from markedplace, 1000kr for two



HOOKS for free from Finn.no

ROCKWOOL INSULATION, for free

PAINT, free from local store in Bodø

From the meeting with the client earlier in the semester it was mentioned, in terms of wood type, that it was better with a hard wood on the floor, for durability and a lightweight wood type on the walls and roof for humidity to dry out.

THE EIGHT STEPS OF PREPARING THE OAK

Oak is a material which is seen as durable and luxurous, but the wood sold new in Norway is normally not from Norway. After a search on Finn.no (STEP 1), I found a person selling a 15 square meter floor in Oppdal, 120km driving from Trondheim.

Luckily, the seller agreed that we could pick the floor up after easter, as we had no place to store it over a long period of time. A car was rented from Trondheim Bilkollektiv. I spent total 6 hours to pick up the floor (STEP 2).

The material was first stored under a tarp (STEP 3). A few days later, the rain had managed to make some of the material wet due to wind which had blown a corner of the tarp away. The team helped to get all the material into the workshop to dry.

The day after we planed and sanded all the top surfaces with machines at the workshop (STEP 4).

To protect the oak, it was used Osmo varnish (hardvoksolje), after recommendation from both the producer and Jorn at the workshop. Old spoonges was used to lay a thin layer of the oil (STEP 5).

Peter and Jorn at the workshop were kind to give us the space needed to leave the oak to dry (STEP 6).

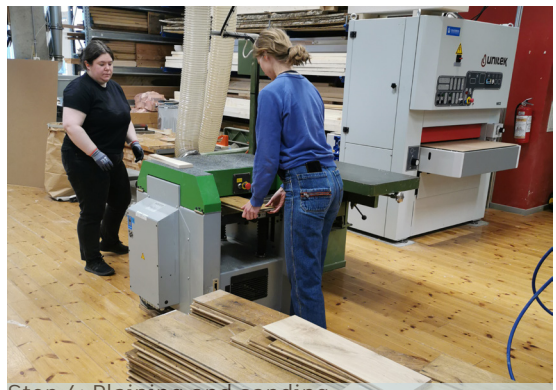
The second coat was layed the day after (STEP 7), the whole group dine an amazing efford in preparing the floor.

When packing for the travel to Bodø, we taped the material and filled the van (STEP 8).

STEP 1: Search and find


STEP 2: Collecting the material


STEP 3: Storage


Step 4: Plaining and sanding

STEP 5: Treatment of varnish


STEP 6: Let it dry


STEP 7: Repeat step 5 and steo 6


STEP 8: Transport to building cite

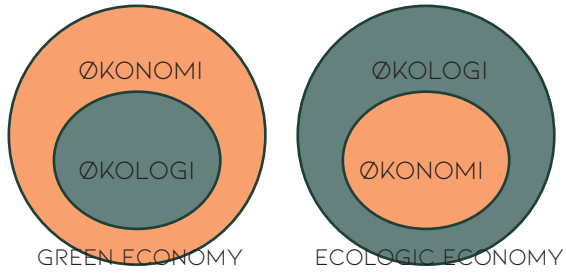
COST OF THE OAK FLOOR

The step of preparing the oak floor took time and effort. In business, time is money. Even if we, as students, did the work for free it is interesting to see what the cost would have been if we were payed. Table D shows the calculations based on this. The expences for the van was first devided by half, bacause the floor were driven one time. Then by four, which is the number of reasons for renting and driving to Bodø. These reasons were 1) bringing tools, 2) bringing our self, 3) bringing reused materials and 4) using the car being in Bodø.

TABLE D: COST OF OAK FLOOR

	PRICE	TIME	SALARY
Oak floor 15m^2	10000		
Transport	1600	7 hours	1200
Maintainance	800	10x4 hours	8000
Transport to bodø	1500		1500
Cost without salary			**kr 13 900**
Cost included salary			**kr 24 600**
Cost of new oak 12m^2			**kr 24 000**

The seller sold us 15 square meter of floor. If we had bought the floor new 12 would be enough. When assuming 200kr as salary per hour the cost for the reused floor is almost the same. On the other hand, looking at the value of increasing the lifetime of the oak floor it can be discussed if the worth is an ecological perspective is enough. In the conference in Bodø, Ove Jakobsen, professor at Nord University had an interesting talk about how we should shift from a green economy, where the economy decides for the ecology, to a ecologic economy, where the ecology decides for the economy as illustrated in the figure below.



GREEN ECONOMY ECOLOGIC ECONOMY

THE PROCESS
WERE LONG...

..."BUT LOOK HOW
BEAUTIFUL"

Emissions from mainainance

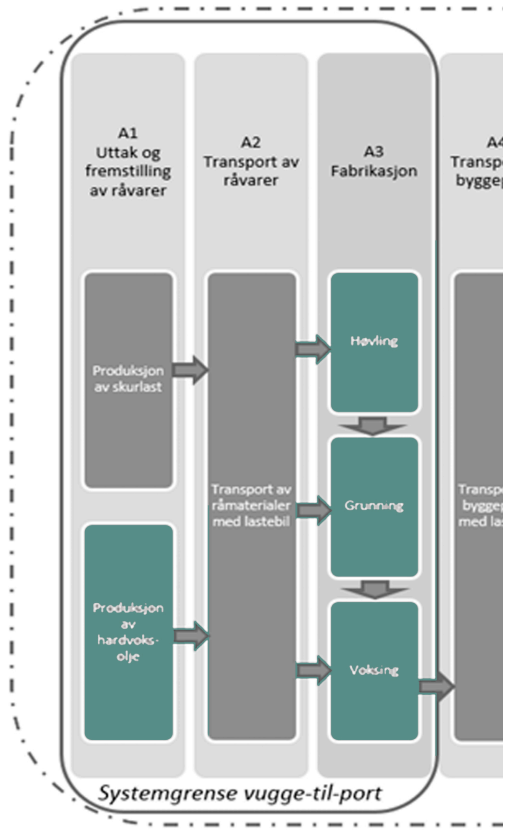
It is difficult to predict what will happen with the material in the future, Planning for reuse of building materials is increasing the chance of reuse in the future. Futurebuilt with documented (ombrukbarhet) in the criteria for circular building and can therefore be added a KLIMAEFFEKT on reduction of 10% for these material.

When reusing materials 80% reduction from the emissions from production of the material (A3), or a similar product that would have been used instead, can be withdrawn (futurebuilt, 20 [p. 17]).

In this project an example of a product would be the oak flooring. However, if we would not have found a reused one, linoleum would have been picked. Therefore, it is more relevant to compare the emissions from production of this. The calculation would be needed to account for how many times the linoleum would needed to be changed and the waste that comes with it.

To calculate the emissions for the reused oak flooring, the epd for a same type of floor, but with pine, was used. The system boundaries in our case is a bit different in the cradle to gate, as harvesting the raw material had already happened. In the figure above, the flows included in my calculations is marked. In the EPD the environmental impact from A1-A3 comes joint. This is estimated to be the unmarked parts in the figure above.

The futurebuilt method to reduce emissions by using reused materials, is as mentioned in the insight chapter, to reduce the impact of production (A3) with 80 percent. When looking at the number for the epd of pine flooring, the A1-A3 is net negative. Reducing the number will therefore look like more emissions is emitted. Moreover, looking at the system boundaries from cradle to gate, A3 is something that was done to the material to maintain it before reusing it. A more correct estimate of impact from the reused oak would be to only use the data for A1 (for varnish), A2 (but our own transport from Oppdal to Trondheim) and A3. This EPD shows the impact from A1-A3 combined. Therefore, numbers from an EPD of sawn wood of pine of spruce is used to get a more correct estimate of emissions from the maintenance we did of the oak floor.



FIGURE

Bags of mixed waste

WASTE REDUCTION

Looking at the table in last chapter, all that material was used in the core of Nordlandsbua. However, there was also some materials that where ordered, cut and not used - so called cut offs. How we wish these would not exist, but they do.

There was done some action to minimize the waste during the construction period:

- Telling the carpenters to not open anything that they were not sure would be used. The message was repeated a few times, and even though a few things were opened, also it seemed that they were thoughtful about it.
- Suggesting to keep opened boxes and unopened boxes of screws seperate
- The terasse boards were ordered to use for the entrance area, only for one square meter. I suggested to use cut offs from the pressure treated wood, and then deliever the terasse boards back. This also solved the problem of having a too high level in terms of opening the entrance door. So it solved two prioblems.
- The plywood was first decided not to use and the carpenters were told not to place any coffe mugs of tools on the surface to avoid stains, so we could return them later. However, some of it was used after all and this resulted in some cutoffs.
- After the building period was done, we successfully managed to return 8 wind barier sheets, all the terasse boards, 13 boards of plywood, 8 48x148 timber and 11 boxes of screws.

Natural wood cut-offs

Pressure treated timber cut-offs

Leftovers from wood fiber insulation

Cut offs from plywood

EVALUATION

Even if some actions were made to reduce the waste, it is suprising that our tiny buillding created this amount of waste. It would be interesting to have numbers in how much, but in lack of time and a scale it was difficult to manage. Based on the photos, some of the materials could have been avoided to be waste. For instance, the wood fiber insulation. Almost one full package could have been returned if it hadn't been opened. However, eight other packages were returned.

The definition of waste is defined by the eye who sees it. Could this waste be used? The natural wood could be used as fire wood. The pressure treated would can be used to make an outside bench to enjoy the sun after a long hike. The wood fiber insulation is usable, but needs to find it's user. The plywood can be used for storage shelfs in the outer shell.

Potentially, there could be minimum of waste, but who will do the coordination of it? This is the big challenge of circular economy.

The failure in ordering pressure treated timber did create more waste. The originally plan was to use cut-offs and leftovers of the timber structure for the interior materials. Also, using more of the 48x48 lumber in the construction. This was not possible when the timber was pressure treated. It was therefore bought in extra material after the building period in Bodø so that Sami's carpenters could finish the interior design. However, they did use some of the 48x48 reused lumber as seen in table B of weight of each material and component.

When building it was noticed that to use the full dimensions of the materials would be a beneficial way to decrease this. For instance, the OSB. There was always 30 cm extra material when the sheet were used in the construction. The challenge is that if it fits on the inside, it would not fit on the outside. The project was made in cc60, however minor details weren't thought of as none of us had been in this type of setting before.

CIRCULAR BUILDING?

Thoughout the project it was looked at ways to reduce the material use and waste, how to implement reused materials and value of it. Looking back at FutureBuilt criterias of having 50% of the material, by weight, should be either reused or reusable, it is interesting to see if we achieved this or not. The table for weight calculated is shown in the table B

REUSED MATERIAL IN THE CORE

The first criteria for a circular building was that 20% of the building material, by weight, was reused.

SCENARIO A is the current built core of Nordlandsbua. The reused materials include windows, spruce lumber, oak flooring and leftover untreated spruce cladding from the construction. The spruce cladding is also categorized as reused because it was bought in for the construction and not calculated to be used for interior. The diagram shows the weight of reused materials in the total weight of Nordlandsbua. 12% is not enough to call Nordlandsbua a circular building.

SCENARIO B shows the share of reused materials if the original plan with using more of the 48x48 lumber would go through. Originally it was planned that the use of 48x48mm lumber in the construction would be the reused one. The share would have been 15%, which is still not enough to categorize as a circular building.

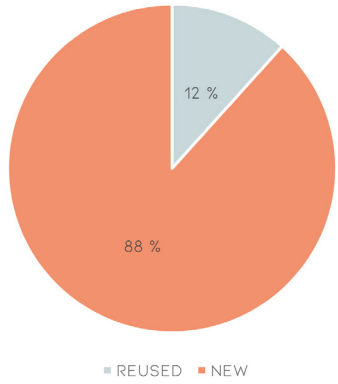
SCENARIO C has the same materials as reused as the two previos scenarios, but also included the natural spruce cladding which add more than 500kg extra to the share of reused materials. 29% is encough to be categorized as circular based on reused materials.

The goal of 20% is not achieved. However, the percentage of reused materials will also be influenced when including the total weight of the outer shell of Nordlandsbua. If this would be made of reused materials, the share of reuse would increase. A estimation in how much has not been calculated in this thesis.

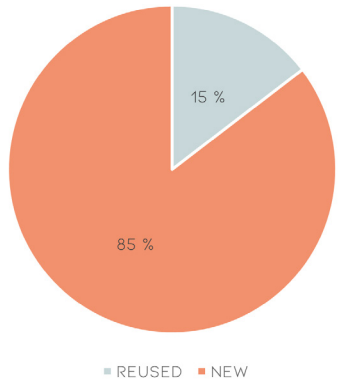
THE SHARE OF REUSED MATERIALS BY WEIGHT

TOTAL WEIGHT	3584KG
REUSED	417KG
NEW	3167KG

SCENARIO A: BUILT DESIGN



SCENARIO B: PLANNED DESIGN



SCENARIO C: POSSIBLE DESIGN

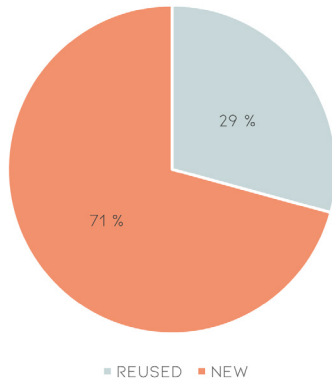


TABLE B: WEIGHT OF EACH BUILDING ELEMENT OF BUILT CORE

	Product	Building Element	Amount	Unit	Density (weight	Weight (kg)
New	Aluminium screws	in all elements	estimated number			15kg
New	Fliselim plaster board 1000mm * 1250 mm	Walls	0,062m³	m³	700	43kg
New		Walls	0,062m³	m³	700	43kg
New	Hunton Intello Plus, 1500mm * 50000mm, thickness 0,2mm	Walls	38,28m²	m²	0,12	5kg
New		Walls	4,08m²	m²	0,12	0kg
New		Roof	15m²	m²	0,12	2kg
New	Hunton Nativo Trefiberisolasjon plate, 565mm * 1220mm, thickness 100mm	Walls	3,828m³	m³	50	191kg
New		Walls	0,204m³	m³	50	10kg
New		Floor	0,410m³	m³	50	21kg
New	Hunton Nativo Trefiberisolasjon plate, 565mm * 1220mm, thickness 150mm	Floor	1,185m³	m³	50	59kg
New		Roof	2,100m³	m³	50	105kg
New	Hunton Vindett Plus, 1200mm * 2740 mm, thickness 12mm	Walls	0,459m³	m³	235	108kg
New		Walls	0,024m³	m³	235	6kg
New	Interior pine pannels, 120mm * 13mm	Walls	0,420m³	m³	435	183kg
New		Walls	0,012m³	m³	435	5kg
New		Roof	0,205m³	m³	435	89kg
New	Opus Ytterdør, white, 800mm * 2000mm	Walls	2pcs.	pc	35	70kg
New	OSB Plate, 2400mm * 1220mm, thickness 12mm	Floor	0,360m³	m³	600	216kg
New		Roof	1,080m³	m³	600	648kg
New	Plywood sheets, 1250mm * 1250 mm, thickness 12mm	Walls	0,042m³	m³	600	25kg
New		Walls	0,024m³	m³	600	14kg
New	Pressure impregnated timber, 48 mm * 10 mm	Walls	0,002m³	m³	480	1kg
New		Walls	0,002m³	m³	480	1kg
New	Pressure impregnated timber, 48 mm * 148 mm	Bearing structure	0,360m³	m³	480	173kg
New	Pressure impregnated timber, 48 mm * 30 mm	Bearing structure	0,151m³	m³	480	72kg
New		Floor	0,027m³	m³	480	13kg
New	Pressure impregnated timber, 48 mm * 48 mm	Roof	0,067m³	m³	480	32kg
New	Pressure impregnated timber, 48 mm * 98 mm	Bearing structure	0,710m³	m³	480	341kg
Reused	Reused 48x48 lumber	Interior	24m		480	26kg
Reused	Reused NorDan small window top hinged, white wooden frame,	Walls	2pcs.	pc	25	50kg
Reused	Reused NorDan Villa top swingwith valve, white wooden frame, 1100 mm * 1200 mm	Walls	1pcs.	pc	85	85kg
Reused	Reused Oak Recycled Parquete	Floor	0,216m³	m³	500	108kg
Reused	Reused Rockwool I-PLATE A, 1200mm * 600 mm, thickness 100mm	Walls	0,204m³	m³	60	12kg
Reused	Reused stove	Interior				78kg
New	Roof overlay Self-builder 3 °, 1000 mm * 7000 mm, thickness 3 mm	Floor	1,30m²	m²	4,5	6kg
New	Roof overlay Self-builder 3 °, 1000 mm * 7000 mm, thickness 3 mm	Roof	16,50m²	m²	4,5	74kg
New	Shelf bracket 200x250mm, 20mmx16mm	Interior	4m		480	1kg
New	Temprered glass plate, 1000mm * 1000mm, thickness 4mm	Floor	0,004m³	m³	2520	10kg
New	Untreated lumber new 48x198mm	Interior	26m		480	58kg
New	Untreated spruce cladding, 145mm * 16mm	Walls	1,090m³	m³	480	523kg
Reused	Untreated spruce cladding, 145mm * 16mm	Interior	52m		480	58kg

The second criteria to call the building circular is that 20% of materials should be reusable. The table above shows an evaluation of the final building materials for the core. The decition of categorizing the materials is done by reading about each individual material and own experience in waste sorting analysis.

If the building parts achieve the creteria of 20% reusable materials depends if both green and blue color should be included. It is the potential receiver who is in the power of deciding the condition of the material, if it is reusable or not.

If the blue color is included as reusable, the goal of 20% reusable material is achieved. In fact more than that. I am optimistic, and I believer in the future, it will be reused.

TABLE C: REUSABLE MATERIALS AND COMPONENTS

MATERIAL	REUSE	RECYCLE	INCINERATION
Steinless screws			
Steinless nails			
Fliselim plaster board			
Fliselim			
Hunton Intello Plus vapor break			
Dampsperretape			
Sløyfebånd			
Hunton Nativo Trefiberisolasjon plate			
Hunton Vindett Plus			
Vindsperretape			
Interior pine pannels			
Opus Ytterdør, white, 800mm * 2000mm			
OSB Plate thickness 12mm			
Plywood sheets thickness 12mm			
Pressure impregnated timber			
Reused 48x48 lumber			
Reused NorDan window top hinged, white wooden frame, 1000mm * 400mm			
Reused NorDan window, white wooden frame, 1100 mm * 1200 mm			
Reused Oak Recycled floor			
Reused stove			
Roof overlay Self-builder 3 °			
Shelf bracket 200x250mm, 20mmx16mm			
Temprered glass plate, 1000mm * 1000mm, thickness 4mm			
Untreated lumber new 48x198mm			
Untreated spruce cladding, 145mm * 16mm			

EXPLAINATION OF COLOR CODING

YES

DEPENDS ON THE CONDITION/PARTS OF IT CAN/HOPEFULLY IN THE FUTURE

NO

The materials were chosen by the thought that it could easily be changed and reused later. The goal was to have as homogen material as possible, unless there was a technical reason to chose someting else. As time went by, choices in materials was influenced by it and some materials were not choicen as well thought of as others. The materials that came late into the material list was OSB and plywood. OSB is often used for flooring, but would then be a thicker dimention than what we chose, 12mm, to give the stiffness to the building. Also, materials planned was different than materials bought, in lack of materials in stock. An exable was the core pine, which has a better durabilty than what we ended up with, normal spruce. The pressure on time also made decisions needed to be taken in the moment, and others problems weren't noticed before later. As previous mentioned, neither of us had any previous experience with practical construction work, unexpected problems occurred and we learned a lot in the process.

The tag of being a circular building is not achieved. At least not yet. If the outer shell would be included and would be reused materials, the share of reuse materials would increase and most likely be over 20%. The exact number of reusable materials is not calculated, but looking at the table it could be everything from 10% to 90%. Depending how much of the blue color category is included. The only material that can not be reused at all is the tape and roof., as it is assumed that it will be destroyed when dismanteling it.

Figure

LANDSKONFERANSE FRILUFTSLIV

Landskonferansen i friluftsliv (Norways conference in outdoor recreation) happened in Bodø 30th to 1st of June with over 200 participants. FN climate goals and sustainability was the agenda for the conference. Different speakers held presentations about trekking and outdoor recreation (friluftsliv). It had a undertone of the fact that we need to combat the climate crisis in order to still enjoy the nature as we do today and how we need to change the negative trend of overuse, area use and traveling long distances in order to do so. Ellen Hambro, leader of Mijødirektoratet, finished the conference with a well reflected speech in how “friluftsliv” would be compared to if we meet the UN climate targets or not and imagined herself being in year 2052. First as if the world had reached 5 degrees, and i Norway 5. Second, if we manage the targets and stop by 1,8 degrees how more happy our lives would be then.

EXHIBITION AT NORDLANDSBUA

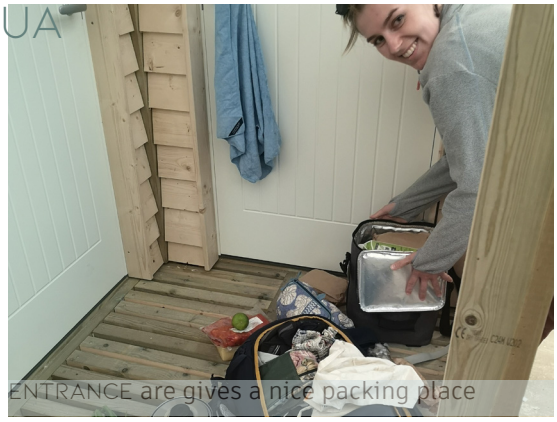
A group of people from the conference came to look and give feedback to Nordlandsbua. In order to get some feedback on the shared cabin and their thoughts on circular economy, some questions were prepared and asked. The question and answer can be seen in APPENDIX D.

A NIGHT IN NORDLANDSBUA

After the conference, Sonja and I stayed a night at Nordlandsbua to test out the space. It was a nice space to be, now with the smell of new wood. Hopefully, this smell will change to be like a well used cabin next time we visit.

EVALUATION

- The entrance area was a nice place to sort out the things you need in the backpack when arriving.
- When the bunk beds is not in use, the hooks works well for hanging up clothes. Hopefully there will be enough hooks in bua to avoid this, but you never know. However, the hooks that holds the bunk bed up when in use were found as enoying when sleeping.
- It was nice with wide space for your sleeping matress. There was plenty of space to leave a book, your phone and a water bottle next to you. However, it would be nice to have a small table by the top beds. This could also make a nice playing area for kids when parents are cooking the food.
- We designed the space under the bed to be high enough to fit the backpacks to make the floor tidy, and it worked well.
- Since the kitchen counter is so narrow and not so steady it might not be as intuative to stand there and cook the food. We used it more as a storage shelf. On the other hand, we did the cooking outside, by the water.
- The table in front of the window, will most likely not be used for computer work. but is giving the most daylight to eat your food, read a book or play cards. However, there might be a space than people will prefer to cook, because of more light.



ENTRANCE are gives a nice packing place

BUNK BED solution can be used as extra hooks

SPACE UNDER THE BED works well as storage

TABLE by the window

CONCLUSION

To implement reused materials in the building takes more time and enegy to do as it is today. It needs to be planned early, and the more which is planned, the better. Ordering materials directly from shops is easier, and to encourage the building industry to use reuse, it needs to have the same system. Which materials that is chosen also depends on the calculated energy emissions. Decreasing the A3 of production for wood will have a less change in the result than if it is for a metarial with higher emboddied emissions.

There is anyway the value of reusing material and giving it a longer life span. Even if many building material has 60 years life span, you often see that is last less. However, they can last much longer.

In terms of shared economy and the possibilty of nordlandsbua, it is important that it is known and used in order to stay sustainable. In needs to be maintained.

For a sustainable use strategies to encourage people to carry up extra wood for a discount can be used or the use of green card, dicount when you take public transport.

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IMAGES & GRAPHICS

FIGURE 1:

Bøe, B. (2020). *MDG vil avgrense bygging av nye hytter til allereie eksisterande hyttefelt, som her i Myrkdalen. Det kan vere fornuftig, men andre verkemiddel dei føreslår er ikkje de* [photography]. Bergens Tidende. https://www.bt.no/btmeninger/leder/i/MRKKbr/hyttebygging-boer-avgrensast-men-ikkje-ved-aa-nekte-vatn-og-do

FIGURE 2:

Statens kartverk, Geovekst og kommunene. (2004). *Dette er Holtardalen I Rauland I 2004* [photography]. NRK. https://www.nrk.no/vestfoldogtelemark/xl/hvor-mange-hytter-skal-bygges-i-norge-i-framtiden_-1.15923600

FIGURE 3:

Statens kartverk, Geovekt og kommunene. (2021). *Slik ser det ut i 2021* [photography]. NRK. https://www.nrk.no/vestfoldogtelemark/xl/hvor-mange-hytter-skal-bygges-i-norge-i-framtiden_-1.15923600

FIGURE 4:

Statens kartverk, Geovekt and kommunene. (2001) Her er et bilde av Sjusjøen i Hedemark fra 2001. [photography]. NRK. https://www.nrk.no/vestfoldogtelemark/xl/hvor-mange-hytter-skal-bygges-i-norge-i-framtiden_-1.15923600

FIGURE 5:

Google Earth, CNES and Airbus. (2021) Dette er fra 2021. Hva er gramtiden? [photography]. NRK. https://www.nrk.no/vestfoldogtelemark/xl/hvor-mange-hytter-skal-bygges-i-norge-i-framtiden_-1.15923600

FIGURE 6:
Percentage of people visiting cabins in the coast and mountain area. “Daglige fritidsaktiviteter, hytte-båtliv og svenskehandel” by L. Vågane, 2006, TØI rapport 861/2006, p.23 (https://www.toi.no/getfile.php?mmfileid=4905). Copyright 2006 by Transportøkonomisk institutt

FIGURE 8:
Snippen. Situasjonsplan. (2010). [Illustration]. https://arkitektur-n.no/prosjekter/snippen

FIGURE 9:
Snippen. Plan. (2010). [Illustration]. https://arkitektur-n.no/prosjekter/snippen

FIGURE 10:
Snippen. Snitt. (2010). [Illustration]. https://arkitektur-n.no/prosjekter/snippen

FIGURE 11:
Norwegian cabins. (2022). [Photograph]. https://www.visitnorway.com/hotels-more/cottages-cabins/

FIGURE 12:
Setesdal 1739. (2022). [Photograph]. https://norskfolkemuseum.no/en

FIGURE 13:
Snippen. Om vinteren. (2010). [Photograph]. https://arkitektur-n.no/prosjekter/snippen

FIGURE 14:
Small cabin loft DIY build plans. (2021). [Photograph]. https://www.etsy.com/il-en/listing/950433772/small-cabin-loft-diy-build-plans-12-x-20

FIGURE 15:
Hyttas stramme og moderne arkitektur blir myk og ru med tradisjonell kledning. (2020). [Photograph]. https://bo-bedre.no/boliger/hytter/denne-langstrakte-hytta-maksimerer-utsikten-mot-sirdalsheiene

FIGURE 16:
Lake cabin. (2014). [Photograph]. https://www.archdaily.com/543570/lake-cabin-fam-architekti-feilden-mawson

FIGURE 76:
Innfelt brannmur. Jøtul 602 ECO Oppstillingsvilkår*.* Jøtul. https://www.jotul.no/sites/norway/files/products/inst_measures_F%20602%20ECO_NO-P00.pdf

APPENDICES

APPENDIX A: PROJECT PROPOSAL FROM SALTAN FRILUFTSRÅD

Salten Friluftsråd

Salten 09.05.21

Prosjektskisse:
Utvikling små overnattingsbuer uten vei, vann- og strømnett

Prosjektmål: Utvikle små buer som er attraktive for brukerne og dekker deres behov samtidig som de er enkle å drifte for frivillige. Buene skal ha et så lite miljømessig avtrykk som mulig gjennom hele livsløpet (fra etablering til demontering).

Gjennom prosjektet ønsker vi å bidra til at flere velger å bruke allment tilgjengelige hytter/hyttedelingsløsninger, framfor private hytter. Buene skal utvikles med tanke på behovet knyttet til allment tilgjengelige hytter generelt. Utprøvingen skal skje i tilknytning til Nordlandsruta.

Prosjektet skal være et utviklingsprosjekt der vi utvikler buene over noe tid (for eksempel 3 (4-6) år). Der første bu/tun bygges for utprøving, neste bu/tun bygges etter at det er høstet noe erfaring, osv.

I inngangen til prosjektet tilpasses størrelsen av buene til 4-6 personer med et belegg på 50-100 bruksdager i året. Dette kan justeres etter hvert som det høstes erfaringer i prosjektperioden.

Til prosjektet knyttes organisasjoner som har som formål å legge til rette for allment friluftsliv, kompetansemiljøer innen byggteknikk, arkitektur og tekniske løsninger (toalett, varmeløsninger). Det er ønskelig å knytte forskning til prosjektet, kanskje også gjennom mastergrader/phd.

Konkret

Utvikle små buer for overnatting for allmennheten (hyttedeling) i fjellet som:

1. er bygd i tre
2. med så kompakte løsninger som mulig, løser behovet for matlaging, klestørk, varme og hvile for brukerne hele året
3. sikrer rask oppvarming av varme rom og godt inneklima
4. har byggtekniske løsninger som er varige og gjør oppsetting/demontering effektivt i felt (transport, fundamentering, tid)
5. har et så lavt karbon- og miljøavtrykk som mulig i hele livsløpet (bygg, oppsetting, drift, bruk, gjenbruk)
6. avveier behovet for private og kollektive løsninger for brukerne
7. oppleves som attraktive, praktiske og gode for brukerne
8. krever minst mulig av de som skal drifte buene
9. gjør det lett å utvide kapasitet ved behov (både akutt og over tid)
10. gjør det artig for unger å komme på besøk

Det er aktuelt å utvikle ulike modeller som gir rom for differensiering av funksjoner mellom buer på et tun/steder

Utvikle modeller for tunløsninger som:

1. innbyr til bruk av uteområdet om det er en eller flere buer med eller uten flere elementer (feks gapahuker)
2. kan ta unna topper i bruken med tanke på overnatting og opphold
3. gir rom for funksjonsdeling i bygg og uteområde

Utvikle gode kriterier for plassering som:

1. sikrer god landskapstilpasning (fjell, skog, kyst)

Besøksadresse: Prinsens gt. 113a, 8002 Bodø (Teamgården) Postadresse: Postboks 915, 8001 Bodø
Tlf.: 75 54 86 00 Mobil: 950 68 985 Web: salten.no/friluftsradet E-post: friluftsradet@salten.no

2. sikrer at buene er synlig nok for brukerne
3. som minimerer terrengslitasjen og slitasjen på buene

Finne (utvikle eller ta i bruk eksisterende) løsninger for toalett som:

1. gir en god driftsmessig løsning (varige løsninger, minimere behovet for transport)
2. gir en brukervennlig løsning (lukt, dobesøk, intuitive løsninger)
3. gir en god miljømessig løsning (produksjon, transport, utslipp, forsøpling, drift, …)

Finne (utvikle eller ta i bruk eksisterende løsninger) for varme-/energikilde(r) som:

1. gir miljøvennlige løsninger både i etablering, drift og destruksjon/etterbruk
2. gir løsninger med minst mulig transport
3. er robuste og brukervennlige/intuitive
4. gir god mulighet for klestørk og matlaging
5. kan innebære at brukeren må ta med energibærer til egen varme

Utvikle kommunikasjon og driftsmessige rutiner som:

1. skaper lyst til å ta buene i bruk
2. bidrar til god adferd hos brukerne (forbruk, slitasje, sosialt)
3. sikrer et samsvar mellom det buene er og det brukerne forventer å få når de besøker dem

Organisering

Prosjekteier:
Prosjektledelse:
Prosjektdeltakere: DNT, Friluftsrådenes landsforbund (FL), Statskog, NTNU, Salten friluftsråd,

Framdrift

Lab over 4-6 år(??).

Budsjett

Kostnader

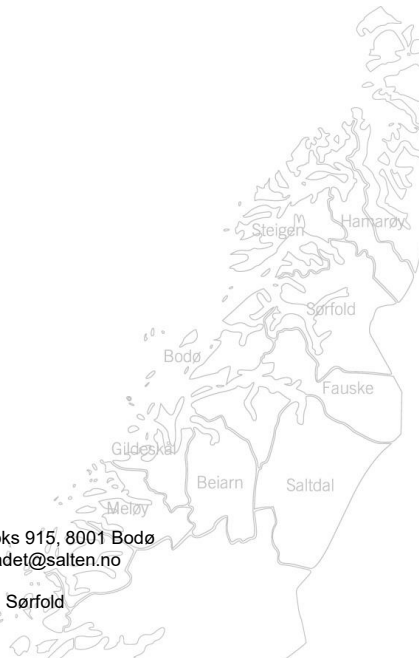
Utviklingskostnader
Byggkostnader
Prosesskostnader
Forskning
….

Finansiering

Spillemidler
Private fond
Forskningsrådet
…….

Med hilsen

Bjørn Godal
Faglig leder



Besøksadresse: Prinsens gt. 113a, 8002 Bodø (Teamgården) Postadresse: Postboks 915, 8001 Bodø
Tlf.: 75 54 86 00 Mobil: 950 68 985 Web: salten.no/friluftsradet E-post: friluftsradet@salten.no

APPENDIX B: LANDSKONFERANSE FRILUFTSLIV PROGRAM

Hovedrammer i programmet

Mandag 30. mai
11.00 Åpning i plenum
13.00 Lunsj og utstillingsvandring
14.30 Konferansen fortsetter i plenum
17.30 Slutt for dagen
18.30 Bussavgang fra hotellet til Rønvikfjellet, vandring 40 min til Keiservarden for middag (mulighet for skyss ved behov – si fra i påmeldingsskjema)

Tirsdag 31. mai
09.00 Sesjoner/arbeidsverksteder – 6 alternativ
12.00 Pause og utstillingsvandring
13.00 Lunsj
14.00 Befaringer – 7 alternativ
17.00 Avslutning befaringer (kan variere noe)
19.00 Middag på hotellet med markering Salten Friluftsråd 30 år

Onsdag 1. juni
09.00 Konferansestart i plenum
10.30 Pause (og utsjekk)
11.00 Konferanse i plenum
13.15 Konferanseslutt og lunsj

(14.30 Årsmøte Friluftsrådenes Landsforbund)

Tilleggsmuligheter i regi av Salten Friluftsråd
Badstue eller via ferrata?
Badstueflåte, sjøbad 200 m fra hotellet.
Kr 150,-. Ta med badetøy.
Via ferrata: Mulighet for de som er på befaring 2. Kr 800,-.

Påmelding og betaling på konferansen (antallsbegrensning, ingen værforbehold).

Forlenge oppholdet i Bodø/Salten?
Lurer du på hva annet du skal gjøre i Bodø/Salten, før eller etter konferansen? Ta en titt her:
https://friluft.salten.no/forside/?Article=214

Spørsmål?
Kontakt Friluftsrådenes Landsforbund
v Lisa Lundh (945 03 027)
v Morten Dåsnes (416 18 459)
post@friluftsrad.no

14.00 Befaringer

Innhold i befaringene samsvarer i stor grad med tema i sesjonene, men du velger fritt deltakelse på befaringene ved påmelding.

Husk egna tøy og sko til den befaringa du melder deg på og ut fra værmelding. Ta gjerne med vannflaske og sitteunderlag.

1. Kyststi

Mest relevant for sesjonene allemannsrett og bærekraft, og bærekraftig tilrettelegging for friluftsliv.
Ny kyststi, med stor tilretteleggingsgrad ferdig prosjektert men ikke igangsatt. Skal gå gjennom tettbygd, etablert boligområde, boligområder under etablering og i natur/kulturlandskap. Problemstillinger knyttet til privatisering av areal, tilretteleggingsgrad og materialvalg. Avveining tilgjengelighet og fastboende sine interesser

Transport: Buss, ca 10 min. **Kapasitet**: ca 50 pers **Krav til deltakerne:** Forflytning ca 2 km i bygater og terreng.

2. Ausvika friluftsområde, Bratten aktivitetspark og Bratten via ferrata,

Mest relevant for sesjonene allemannsrett og bærekraft, og bærekraftig tilrettelegging for friluftsliv.
Ausvika friluftsområde og Bratten Via ferrata. I Ausvika er tematikken knyttet til tilrettelegging som tiltak for å avhjelpe økende bruk og forholdet mellom naturbevaring og økende bruk. I Bratten er tematikken etableringen av en kommersiell via ferrata og det det har utløst av diskusjoner og vedtak knyttet til allmennhetens tilgang til anlegg i utmark, brukerbetaling og ivaretakelse av naturverdier når nye områder åpnes for bruk gjennom tilrettelegging. De som vil kan gå Via ferrataen (egenbetaling) etter befaringen og ta bybuss tilbake til hotellet (se eget punkt i programmet).

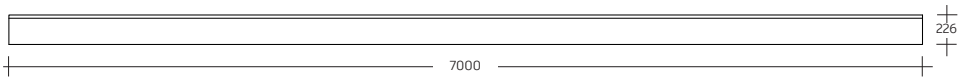
Transport: Buss, ca 15 min. **Kapasitet**: ca 50 pers **Krav til deltakerne:** Forflytning ca 1 km på gode grusstier

3. Nordlandsbua,

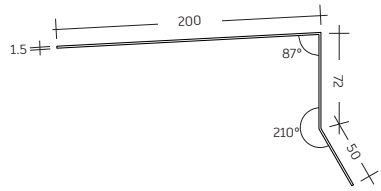
Mest relevant for sesjon bærekraftig tilrettelegging for friluftsliv.
Nyutviklet bu for overnatting i fjellet som skal være mest mulig miljøvennlig i oppsetting, bruk/drift og sanering, besøkes. Utviklet i samarbeid mellom Nordlandsruta, DNT, FL, Statskog og NTNU. Prototypen skal flyttes og brukes som sikringsbu i Sulitjelma etter konferansen. Målet med befaringen er å presentere bua og drøfte løsningene som er valgt med tanke på videre utvikling. Om tida strekker til, settes prosjektet også inn i et besøksforvaltningsperspektiv.

Transport: Ingen **Kapasitet**: ca 15 pers **Krav til deltakerne:** Forflytning ca 1 km i bygater.

APPENDIX C: CUSTOM METAL ORDER FOR DRAG INDUSTRIER

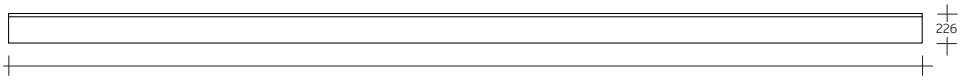


TOP-VIEW

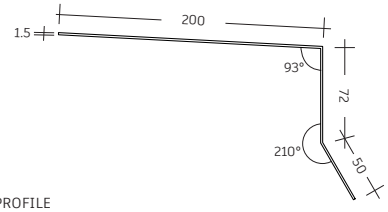


PROFILE

ROOF-FLASHING A



TOP-VIEW

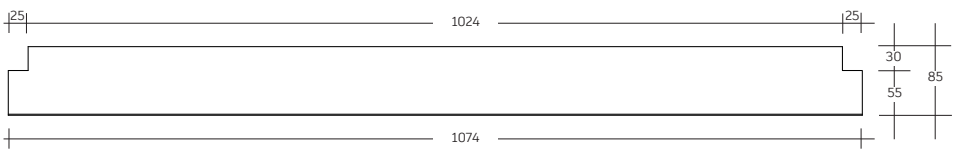


PROFILE

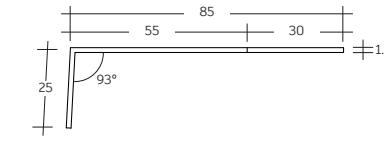
ROOF-FLASHING B

SONJA MORZYCKI
10.05.2022

UNITS: mm

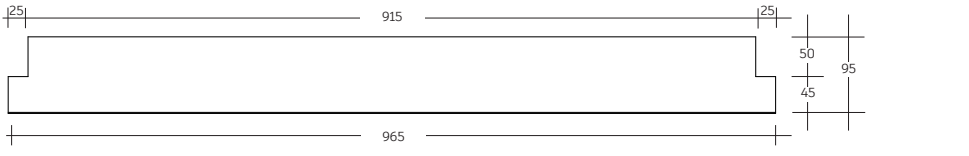


TOP-VIEW

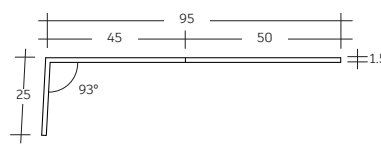


PROFILE

UNDER WINDOW-FLASHING A | QUANTITY: 1



TOP-VIEW



PROFILE

UNDER WINDOW-FLASHING B | QUANTITY: 2

SONJA MORZYCKI
10.05.2022

UNITS: mm

APPENDIX D: INTERVIEW QUESTIONS

- Hvordan opplever du nordlandsbua?
- Noen kvaliteter du vil trekke fram?
- Noen utfordringer du ser for deg kan komme?
- Hvordan vil du si bua løser behovet for matlaging, klestørk, varme og hvile for brukerne?
- Hvordan tenker du barn vil oppleve bua?
- Tror du det norske folk er klare for mer delingsøkonomi?
- Hvordan få flere folk til å benytte seg av delingshytte?

INTERVJUPERSON 1 (dame, 25 år)
INTERVJUPERSON 2 (mann, 35 år)t

- Hvordan opplever du nordlandsbua?

1.Brukervennlig, primitiv
2. sjarmerende, flashback til gamle hytter

- Noen kvaliteter du vil trekke fram?

1.Ned og opp sengene er stilig. De tar ikke plass unødvendig. Jeg liker at det er adskilt tørkerom, slik at man slipper å ha det inn i hytten.
2.Bærekraftidéen er positiv

- Noen utfordringer du ser for deg kan komme?

1.Vanskelig å komme seg opp og ned på en stabil måte. Rent praktisk i hytten.
2.Bordplass, hvis man er fire stykker som skal lage mat og spise og spille kort. (men så ikke at det var foldable bord). Da er det greit, men bordet kunne vært mer stabilt

- Hvordan vil du si bua løser behovet for matlaging, klestørk, varme og hvile for brukerne?

1.Det er på plass. Du har ikke andre forventninger enn det du trenger og det som er der.

- Hvordan tenker du barn vil oppleve bua?

1.Barn vil synes den er fin.
2.De kommer til å krangle om øverst.

- Tror du det norske folk er klare for mer delingsøkonomi?

1.Det er ganske delt tror jeg. Det blir mer og mer, folk som kjøper bolig sammen. Kanskje det er holdningsendring. Det er dagsturhytter som er populær, så det er vilje blant turglade folk. Men ikke alle. De som har egen privat hytte er gjerne ikke de som oppsøker disse.
2 er enig. Dette er bra for de som går fra hytte og hytte

- Hvordan få flere folk til å benytte seg av delingshytte?

1. Det må ligge en positiv opplevelse i bunn, markedsføring. Renhold må være på plass. Hvis man kommer til skitten hytte er ikke det så hyggelig.
2.Ti på topp er noe som motiverer. At man samler hytter i en app

MANN ALDER: 60 ÅR. YRKE: BYGGINGENIØR OG TØMRER, + DAGLIG LEDER I FRILUFTSRÅD

- Hvordan opplever du nordlandsbua?

Vindekspornering. Beskymret for den. Hvordan løse det? Enten forankre i bakken. Passe på vindretningene i forhold til stedet. Vinduet, plasseringsmessig. Ville hatt et til vindu.
Enig med malmfuru hadde vært fint. De hadde tålt masse juling. Og vært bevist hvilke kvalitet du hadde brukt har. Furu bør sages utifra hva det skal brukes til. Få rett fra produksjon slik at det kan gjøres.
Furu er ikke bra i seg selv, den må håndplukkes.
Jeg ville heller gått for elementbygg. Kanskje hatt møne på taket.
Snakk om ikke å være instavennlig. Men jeg ville tenkt mer arkitektur. Og heller kjøpt vindu for å oppfylle akkurat den funksjonen. Jeg mener alle bør oppleve god arkitektur. Alt fortjener et snev av det (god arkitektur) (denne personen snakket også om hvordan redusere vekten)

- Noen kvaliteter du vil trekke fram?

Likte innhuket for å kunne dusje. Her er vaskeplassen, det er veldig artig.

- Noen utfordringer du ser for deg kan komme?

Har ikke tro på tørkeløsning. Ville hatt tørkerist over vedovnen for å sette sko og strømper. Folk vil henge over alt. Folk har gått i to-tre dager for å tørke.
På gulvet i våt sone ville jeg hatt noe som tålte mer vann.
Hjørnene på bygget er for svake.

- Hvordan vil du si bua løser behovet for matlaging, klestørk, varme og hvile for brukerne?

Burde hatt mer solid bord.

- Hvordan tenker du barn vil oppleve bua?

Dette er jo barneparadis. Enkelt. Sengen og. Nesten som å komme inn i dokkestue. De har behov for bord, kanskje et eget bord for de mens foreldre lager mat.

- Tror du det norske folk er klare for mer delingsøkonomi?

Jeg ser at dnt går mer og mer i booking. Vi tålte mer før med å dele med andre.
Det at DNT går mer i retning av booking styrker deres produkt.
Jeg tror arkitektur spiller en rolle. Arkutektur er viktigere og viktigere. Alle er veldig opptatt av at det er et element. Jeg er uenig i at det er om å lage ikke intavennlig. «god design er god design, om det funker for forburket»
Med denne hytten her vil den oppfylle behovene jeg har. Den fyller det, men jeg er veldig glad selv i å ha det lille ekstra. Veldig opptatt av funksjon.
Jeg tror tanken lever i befolkningen. Minimalisme. Det enkle friluftslivet. I oslo er den minste hytten den mest populære. Jeg tror denne hytten treffer brukergruppen

- Hvordan få flere folk til å benytte seg av delingshytte?

Gjenbruksmaterialer:
Jeg tror man kan bruke mye. Men man må ha enorm tilfang og bruke. Bruke gammel kledning for eksempel. Hvis du river et bygg, så er mye brukbart. Hvis man skal bygge med gjenbruk, så må man starte et år i forveien. Hvem som skal samle disse? Da må man ha et sted å oppbevare.

Det som er viktig med prosjektet er å starte og ha noe å jobbe fra. Jeg tror virkelig en prototype er en idé og dra erfaringer.

Behandlet med kalkolje i sitt prosjekt. (naturlig produkt)

1x2,5 vindu forventet jeg det skulle være. «det er ingenting som å sitte inne og se på dårlig vær»

DAME, VIKEN FYLKESKOMMUNE (LIKE Å GÅ TUR)
JOBBER MED FRILUFTSLIV, KARTGRUNNLAG.
40 ÅR

- Hvordan opplever du nordlandsbua?

Den ser... Jeg tenker hvordan jeg ville brukt det, alene eller med venner. Og den svarer til at det jeg har behov for. Savner gjerne rist over ovnen (tørkemulighet). Det viktigste er tørre sko. Jeg knyter de opp under risten. Flere knagger. Jeg ville fått av våte av vann. Trenger plass til infotavle (hvor du henter vann). Blåse opp madrasser og gjøre klar senger. Bruker kvelden for å spille kort og spise.

Som fotturist, hvis du skal gå flere hytter. Det at du må ta med liggeunderlag og ekstra ting er teit. Enten ville jeg gått forbi hytten. Jeg ville sjekket hytten på forhånd utifra utstyr.

I sommer har jeg valgt en rute med ubetjent hytte (billigere), men innimellom valgt litt mer komfor. Da kan jeg ha lenger tur. Da vet jeg at jeg bare kan ha lakenpose. Jeg har lurt på om jeg skal ha liggeunderlag likevel, for madrassene er vonde. Vekten er viktig for meg på tur.

Jeg synes designet er [bra]. Det er innpå noe med skall. Jeg ville ikke vært ute i snø. Tørking er viktig og god utsikt.

Jeg er interessert i hvor mye dugg.

- Noen kvaliteter du vil trekke fram?

Fint med småvinduene at man kan åpne de. (men savner det store vinduet). Synes det er morsomt at man ender opp med tradisjonelt design.

- Noen utfordringer du ser for deg kan komme?

Jeg ser for meg at folkk bruker tørkerommet for å lagre ved. Lager uvane med det.

Lave senger må opplyses om. Jeg kunne ikke dratt på tur med tre venner. Alle er rundt 180cm, så det funker ikke.

Ha innsektsnett, det kan bli et problem.

Savner rist over ovn

- Hvordan vil du si bua løser behovet for matlaging, klestørk, varme og hvile for brukerne?

Det oppnår formålet. Men det blir litt lakenpose. En venninne hater termos. En av oss ville hatt gassfyring. Hvis jeg går hyttet til hytte ville jeg ikke hatt gass. Det måtte opplyst om det er eller ikke. Plassmulighet er helt fair.

- Hvordan tenker du barn vil oppleve bua?

Barn synes det er koselig når det er lite tror jeg. Jeg tror de ville filet med krokene. Foreldre som roper «ikke gjør det». Spørs om man er stresset ang nærme ovnen. Og barn vil like å leke under sengene.

- Tror du det norske folk er klare for mer delingsøkonomi?

Jeg kjøper alt utstyr brukt. Når du skal ha det vet du ikke om det er tilgjengelig. Jeg har prøvd å bruke higlo. «Hva om jeg ødelegger teltet, må jeg kjøper 12k nytt telt», «funker det for mitt behov». Litt som airbnb, før var terskelen lav men nå er det dyrt. Idéen er bedre enn gjennomføringen. Men jeg personlig kjøper alt mulig rart på finn. I forhold til hytter kjenner jeg på at du håper på at du kommer fram. Det var betryggende med booking under korona. Men fleksibiliteten går bort ift vær. I forhold til ruten kan jeg tåle å ligge på en madrass en natt hvis jeg vet det er fullt men vet at jeg kommer til en egen seng/rom neste plass. Jeg personlig vil aldri ønske meg hytte, vil heller reise på en betjent hytte. Jeg synes det er mer økonomisk. Ville heller brukt delingshytter enn å kjøpe.

Tidligere bodde jeg på hostel når jeg var yngre. Sover dårligere når man er eldre. Selv om jeg har slitet meg ut på fjellet, vil jeg sove godt.

Jeg har en hypotese at det finnes en sporty spice per vennegjeng. Jeg finner nye på fjellet. Min vanlige vennegjen er ikke turgåere. Noen av de har private hytter.

Kollektivt begrenser en del for meg (har ikke bil og førerkort), rome to rio.

Golsfjellet er helt off. Har ikke prøvd meg på nordnørge. Ellers hiker jeg.

- Hvordan få flere folk til å benytte seg av delingshytte?

Ta de mens de er unge. Blant mine venner aksepterer man mer. Når pris er viktigere enn tidspunkt. Jeg har sittet mye rundt på svette busser, for da kan jeg være lenger på ferie. De som er 50 år vil ikke. De som er 40-50 ser ikke på det som dies oppgave å være opptatt av bærekraft.

Jeg tror den nye generasjonen har empati og følelsene mer tilstede. Kan bidra til at man tar sitt eget fotavtrykk mer personlig. Jeg hadde trodd at min generasjon skulle få til mer.

De folka som sitter med egne hytter (rister på hode). De som ble grinete av korona hytteforbud kan ta seg en bolle. Og de tror bollene på joker gir nok inntekt til kommunen.

Jeg var på tur og trodde jeg var i urørt natur. Så over fjellet var det enda et hyttefelt.

Fellesskap og tillit tenker jeg det handler om. Man må stole at når jeg feier, så feier andre også. At du kommer fram og det er gjort opp for seg. Tanken om at «hvis jeg har råd til det, så fortjener jeg det».

- Gjenbruk av hytten

Jeg tenker at hvis det skal produseres hytter må det være forutsigbarhet, spesielt på prisene. Måtte brukt mye resurser. Jeg lurer på om fordelene og ulempene. Sånn som du var innpå. Du vet ikke hvilken stand det er i. Så skal de som skal drifte må vite om det er lett å holde i stand. Disse turlagene har ikke allverdens med økonomi. Jeg lurer på om ved å skalere opp heller har nøye planlagte materialer. Optimaliserer heller designet for å redusere svinn. Hva om man kan bruke gjenrbuke for interiør? Hvis man kan basere det på kortreist materialer fra gode leverandører, driver heller plukkhost enn flatehogst. Bare eksempel hvis jeg skal leie ski, og jeg vet ikke om det er en sko som passer min fot. Det er en fin tanke, men jeg ville heller spart inn på andre ting. Men om noen donert plassen og det hadde optimalisert stedet.

Eksempel hvis hjørnet hadde vørt mindre materialbruk ved å gjøre det annerledes.