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# SIT ØYA: Life Cycle Performance in regard to its early design phase and decisions on construction materials

Master's thesis in Sustainable Architecture

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# Abstract

Construction industries play a large role in contributing to the environmental problems. The building constructions in the future are inevitable, therefore we can only prevent the emission of hazardous gases. Construction materials have high embodied energy, resulting in a significant amount of carbon dioxide ($CO_2$) emissions. There are factors to decarbonize the building sector by considering the building material selections, material supply, lifetime, and reuse and recycling to optimize material use in reducing embodied emission. Life Cycle Assessment (LCA) promotes sustainable construction by providing a better understanding of the environmental impacts of the materials on the building. Integrating LCA on early design phase will influence the overall embodied emission of the building, a thorough selection of material with low environmental impact will help reduce greenhouse gas emission (GHG). Embodied emission of materials from production stage (A1-A3) used in the case study with 5 different scenarios [existing building (concrete vs. wood), refurbishment with extension and new constructed building (concrete v. wood)]. They are compared and calculated using Revit for the material quantities and OneClickLCA tool to calculate the embodied emission of materials and how it impacts each scenario. With existing buildings responsible for a major contribution to GHG emission, the result shows that existing building has a high GHG emission even with a lesser floor area than the other scenarios because it was made of pure concrete. Refurbishment scenario shows it has 24% lower GHG emission than constructing a new building, reusing the existing building reduces the GHG emission by avoiding demolition. Result indicates preliminary and are based on limited data information. Further work includes expansion of material information and selection, development of design, and full LCA analysis to have an accurate calculation of GHG emission on buildings.

# Sammendrag

# Acknowledgement

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# Abbreviations

| | |
|---|---|
| BIM | Building Information Modelling |
| EPBD | Energy Performance Building Directive |
| EPD | Environmental Product Declaration |
| GHG | Greenhouse gas |
| GWP | Global Warming Potential |
| IPCC | Intergovernmental Panel on Climate Change |
| LCA | Life Cycle Assessment |
| LCI | Life Cycle Inventory |
| PV | Photovoltaic |
| SDG | Sustainable Development Goals |
| TEK | Norwegian Standard Regulation |

# Introduction

Construction industries play a large role in contributing to the environmental problems. The building constructions in the future are inevitable, therefore we can only prevent the emission of hazardous gases. The massive depletion of resource also occurs because of the large volumes of construction materials. Construction materials have high embodied energy, resulting in a significant amount of carbon dioxide ($CO_2$) emissions (GlobalABC, 2019). The building sector is accountable of significant environmental impacts (Alwan et. al, 2016).

The objective of United Nations for sustainable development (UN SDG) is a focus on a range of issues that need to be addressed by the world; industries innovation and infrastructure (SDG 9), sustainable cities and communities (SDG 11), responsible and consumption and production (SDG 12), and climate action (SDG 13) (UN, 2015). Norway is committed to reduce greenhouse gas (GHG) emissions by 50% on 2030 compared to 1990 levels as a response to the Paris agreement in 2015 (UNFCCC, 2015). In addition, residential buildings in Europe are responsible for the 75% of the total building stock, and 273 of the total energy use in the building (De Boeck et. al, 2015). The European directive on Energy Performance of Buildings (EPBD) requires that all new buildings should be nearly zero energy by 2020 (EU, 2010).

Existing buildings are accountable for a major share of energy use and greenhouse gas emission of the construction sector (GlobalABC, 2019). Previous construction materials were not conceived if the design and its structure will withhold, especially if there is a budget that they must follow. Renovation of an existing building reduces the carbon emission as to not touching its building footprint, avoiding its demolition, and increases it energy performance. It also creates a high investment cost and additional environmental impact because of the additional materials and building integrated systems added to improve its energy performance. Concerning with these issues, there is a need to consider a life cycle approach to avoid and reduce high environmental impact between embodied and operational impacts.

There will be an increase renovation rate in industrialized countries to an average of 2% per year by 2025, and to 3% by 2040. Renovation rates in developing countries should reach 1.5% by 2025 and 2% by 2040. With the increase of in-depth renovation will enable to reduce energy consumption of an existing building by 30-50% or more (GlobalABC, 2019).

For new buildings, there is a need for higher understanding of the future net-zero buildings. With the increasing populations of 2.5 billion by 2050, new buildings will have an important effect on future buildings related to energy use and carbon emissions (GlobalABC, 2019).

Decarbonizing the buildings and construction sector is critical to achieve the Paris Agreement commitment and the United Nations (UN) Sustainable Development Goals (SDGs) (GlobalABC, 2019). There are factors to decarbonize the building sector by considering the building material selections, its material supply, lifetime, and reuse and recycling to optimize material use in reducing embodied emission. (GlobalABC, 2018).

Life cycle assessment (LCA) is introduced to evaluate the environmental performance of building throughout their life cycle. It influences designers' decision and brings a significant improvement in reducing greenhouse gas emissions. It promotes the development of sustainable construction by providing a better understanding of environmental impacts on the materials. (GlobalABC, 2018).

## Background

This section provides background to the issues in the study. The definition of global warming issues, life cycle assessment and materials in the study is described.

### Global Warming

During the COP21 in 2015, the Paris Agreement was formed to bring all countries to combat the climate change and assist countries with support to adapt to its effects in the environment. Its goal is to address and strengthen its response to the threat of climate change by keeping a global temperature below 2° C and pursue efforts to limit the temperature to 1.5° C (UNCC, 2015).

The projected impacts generated by climate hazards, exposure and vulnerability has increase due to climate change since the Fifth assessment Report (AR5). Risks are projected for the near term (2021-2040), the mid (2041-2060) and long term (2081-2100), at different global warming levels that exceed 1.5° C global warming level (IPCC, 2022).

According to an analysis of International Energy Agency (IEA), the global $CO_2$ emissions from energy combustion and industrial processes rebounded in 2021 to reach their highest annual level. An increase of 6% from 2020 pushed gigatonnes (Gt), a detailed estimation from region-by-region and fuel-by-fuel by IEA. (IEA, 2021)

## Life Cycle Assessment as an early design tool

*"A life cycle assessment (LCA, also known as life cycle analysis, ecobalance) is a technique for a product related estimation of environmental aspects and impact … LCA assesses each and every impact associated with all stages of a process from cradle-to-grave (i.e., from raw materials through materials processing, manufacture, distribution, use, repair, maintenance, and disposal or recycling."*- International Standard ISO 14040 *(reference)*

LCA method has been increasingly adapted to evaluate the environmental impact associated with the production, construction, use, maintenance, and demolition of buildings and applied to assess buildings throughout their life cycle **(**Röck et. Al. 2018**).** It is usually evaluated post-completion of the building as it has required detailed specifications for the assessment of embodied impacts of building materials. Full scale LCA is often complicated due to its time consuming and difficulty, especially when applied during early design stage due to insufficient information (Koller et. al, 2000). All LCA studies in early design will have a certain degree of uncertainty (Heinzle et. al, 1998). Currently, LCA needs to be utilized in the early design stage for environmental optimization of the building (Basic et. al, 2019).

Integration of LCA in early design phase should be the new normal practice in design and construction business. With buildings and construction materials consuming about 40% of energy annually in their life cycle stages in production, transportation, use and demolition. The total life cycle energy of a building consists of the embodied and operational energy. Embodied energy is the energy during the production, use (renovation and replacement) and demolition stage, whereas operational energy is the energy required to operate the building, such as lighting, mechanical and operating the building equipment (Petkar, 2014). Integrating LCA during the early design stage will greatly affect the environmental impact of the building.

The reduction of greenhouse gas emission will be achieved by having a well-designed building and a thorough selection of materials during early design stage. Material selection is one of the critical stages in constructing a building. With the integration of LCA on the environmental performance of each material, greenhouse gas emission will be greatly reduced.

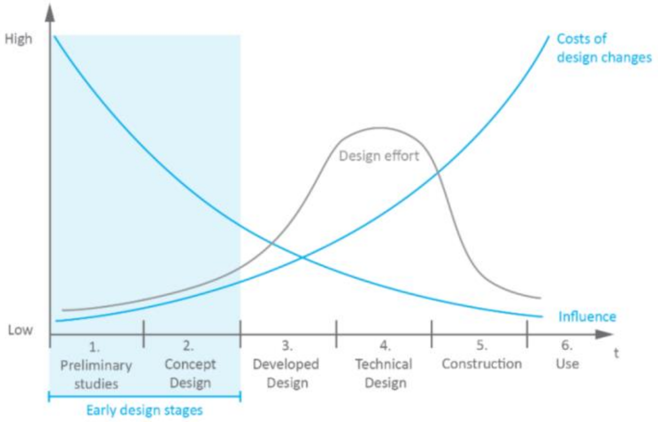


*Figure 1 Influence of the early design stages (Paulson, 1976)*

Decisions made in the early design stage have the most influence as they set the general conditions in the design process (Paulson, 1976) (see figure 1). It has affected the costs (Paulson, 1976), operational energy (Hegger et.al. 2007), and the environmental impacts (Bogenstätter, 2000). Thus, the greatest potential for optimization and reduction of greenhouse gas emissions lies in the initial stages of design.

## Material

The building sector is the main contributor of carbon emission globally with nearly 40% of global energy demand. Building operations are responsible for the 28% carbon emission while materials which are the embodied carbon are responsible for the 11% (Architecture2030).

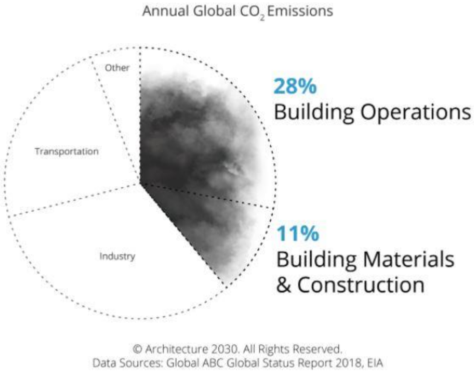


*Figure 2 Annual $CO_2$ emission percentage by sector (architecture2030.org)*

New construction that is projected to take place in the future base on UN environmental global status will have 57% embodied carbon and 43% operational carbon. It is important that we deal with the embodied carbon now if we hope to achieve zero emissions by 2040 (Architecture2030). In the coming decade is our opportunity to address buildings and construction emissions, and to prevent and avoid constructing inefficient buildings. (GlobalABC, 2019)

Materials selection will play a role to reduce the greenhouse gas emission. These 3 materials alone are responsible for the 23% of total global emissions and most of this is used in the built environment (Architecture2030).

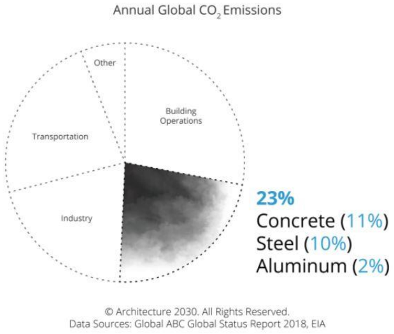


*Figure 3 Annual $CO_2$ emission percentage by material (architecture2030.org)*

In Europe, the construction and buildings are responsible for 42% of energy consumption, 35% of greenhouse gas emissions, and more than 50% of all extracted raw materials (European Commission, 2011).

Carbon emissions that result in material use in buildings is account for 28% of the annual buildings related $CO_2$ emissions. Most of these emissions are a result of cement and steel manufacturing, which have high process emissions and are used in enormous quantities. Aluminium, glass, and insulation materials are secondary contributors. The relative importance of embodied carbon in the global buildings and construction carbon footprint is therefore increasing. Cement and steel use in buildings increased 4% by weight annually from 2000 to 2015 because of construction in rapidly developing and emerging economies (GlobalABC, 2018).

Concrete is one of the most widely used construction materials in the world, but it contributes to a large amount of greenhouse gas emissions (Olivier and Peters, 2018). Cement is the highest $CO_2$) producing materials and its large amount of $CO_2$ is produced in the processing of the construction materials and the transport of these materials (Petkar, 2014) in which it is the most important ingredient of concrete.

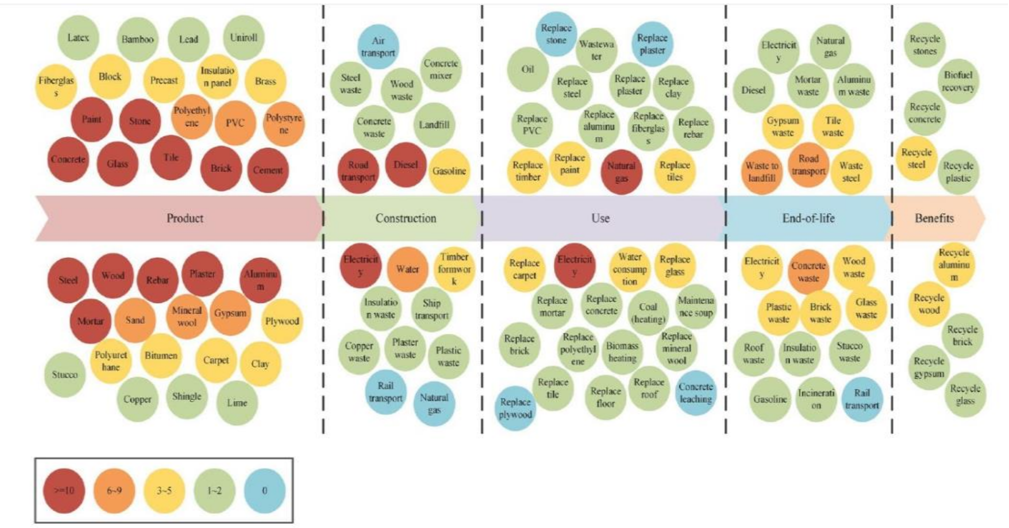


*Figure 4 Materials reviewed in several studies (Dong and Liu, 2021)*

In figure 4, several studies were conducted and indicated that the red color-coded materials in each stage are materials that contribute large amount of greenhouse gas emission such as concrete and steel (Dong and Liu, 2021).

Malmqvist et al. gave developed a set of strategies for reducing embodied emissions—substitution of materials (substitution with bio-based or recycled/reused materials), reduction of resource use (lightweight, more durable, or recycled/reused materials), reduction of construction and end-of-life stage impacts (construction-related strategies, waste management, seasonal timing etc.) (Malmqvist et. al, 2018).

Material efficiency strategies in residential buildings has potential to reduce the GHG emissions by 80-100%, and material and operation GHG emissions by up to 40% in G7 countries by 2050 (GlobalABC, 2020).

Implementing a life cycle approach can reduce the environmental impact of materials in the buildings and construction. (GlobalABC, 2019) Consumption of unrestrained construction materials will face environmental hazards and to reduce these impacts can be done with lessening of the consumption of construction materials as natural resources are gradually reducing with the growing population and demands. Recycling and reusing materials will avoid the need for new materials and thus saving the natural resources or reducing the consumption of materials. Another method is the selection of construction materials, Designers plays an important role in the selecting materials for their design by evaluating each material on their environmental performance and minimizing the environmental impacts of the materials (Petkar, 2014).

## Motivation and Research Question

### Motivation

A literature review was assumed to provide support and motivation for this thesis. The topic of integrating LCA during early design stage involves different research and reviews from various fields from construction engineering to building environment to sustainable energy.

Identifying and reviewing existing research publications in the field of Life Cycle Assessment during early design stage was done using the online Research gate, NTNU Open/Oria, etc.

The interests of the main research communities involved drove the choice of the two initial sets of keywords in the search. The first set was created to identify the publications related to life cycle assessment by using the keywords “LCA” and “life” and “cycle”, whereas the second search result related to early design stage of design development by using keywords “early” and “design”.

### Research Question

Greenhouse gas emission is becoming a major problem in the world with the building sector contributing the most carbon emission. With this issue, prevention is the key to reduce the emission in building. One method to prevent the increase of greenhouse gas emission is to integrate LCA approach on buildings in their early design process.

*How LCA can affect the environmental impact of building when applied during early design stage?*

Early design stage is an important period for the whole building design when project goals, design requirements, site development, initial design concepts, etc. are analyzed and determined (Gao et.al, 2019). Energy performance of the building is affected by the early design decisions made (Elbeltagi et. al, 2017). Many researchers claimed that integrating environmental performance tool like LCA during early design stage will support and assist designers to achieve high performance building (Negendahl, Nielsen, 2015 and Hemsath, 2013) without sacrificing environmental impact of the building.

## Structure of the report

This research is divided into 4 parts apart from the introduction and background chapter in which aim to fulfil the research goals and motivation discussed in the above paragraph.

The second chapter discusses the methodology that are needed to calculate greenhouse gas emissions. The chapter have been divided into three sections, which discusses the objectives. The second section deals with the case study and the Building Information Modelling (BIM) in which these models will be use for the material take-off. The third section discusses about the Life Cycle Assessment of the case study with sub-sections: material inventory and material selection.

The third chapter presents the result of the greenhouse gas emission calculation using OneClickLCA tool.

The fourth chapter discusses the result.

The fifth and last chapter highlights conclusion from the result calculated and gives recommendation and further research.

# Methodology

This section presents the methodology and approach conducted in this report. To better understand the case study, the project manager of Student welfare organization (SIT) had a meeting together with my supervisor. Information gathered from the site visit and from supervisor were very important. The following methods was conducted to complete this report.

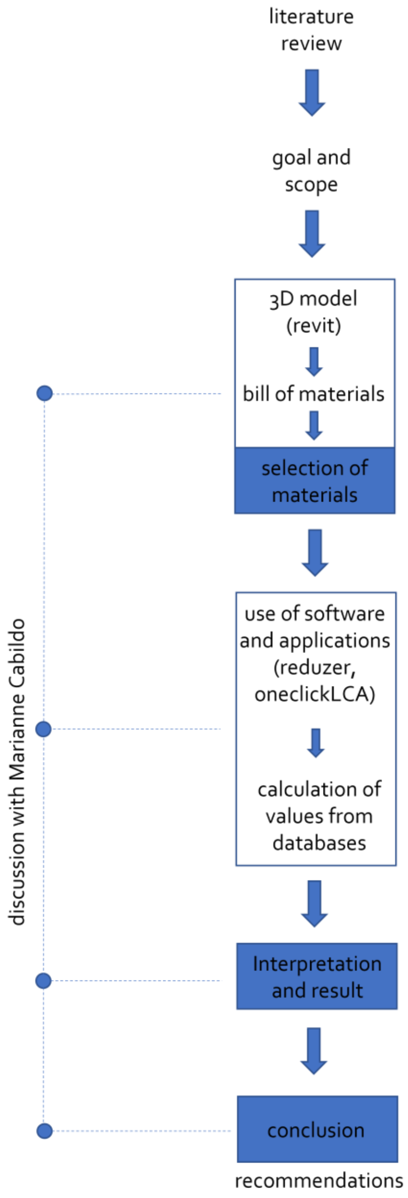


*Figure 5 Methodology used to conduct this report*

Quantitative method is one of the basis of this thesis' result. The quantitative LCA calculation on the BIM model are based on the material take-off generated in Revit as well as data received from the case study.

## Objectives

This report explains how implementing Life Cycle Assessment on early design stage affects the environmental impact of the building towards nearly/zero building by carefully selecting construction materials which are important in LCA perspective in each methodology. It will conduct several analysis and calculation from the data collected of different scenarios of the building by aiming for the lowest environmental impact. To achieve the goal of reducing the environmental impacts during early design stage towards zero emission, the most important aspects have been compared in this report which includes the environmental impacts of the existing building/case study if it is built in the present, renovating of the building/case study rather than demolishing and building a new construction. Identifying the building's environmental hotspots and taking action to reduce them, calculation the lifetime impact of building materials and products to help find the most suitable materials are presented in this report.

## Case Study

Sit Øya, a student housing of SIT located in Klostergate 56. It was constructed in 1991. This autumn 2022, SIT plan to build a new building to increase the number of units to cater to growing student population in Trondheim.

### Building Description

The student housing is a three-storey residential building connected with their entrance stairs and metal bridge walkway. According to the property manager of the Studentsamskipnaden i Trondheim (SIT), it was constructed in concrete frame load bearing structure.

Figure 6 Sit Øya

## Site Analysis

The building is located at a residential area near the city center. It is 1.0 km from NTNU Gløshaugen campus. 1,2 km to the city center. It is a perfect location for students where all their needs are in a walking distance.

Figure 7 Site Plan of Sit Øya

## BIM

The case study SIT ØYA has been modelled using Revit program to get information about the quantities of each building element of the building. The quantities of the materials are extracted (tables) from Revit and used for the calculation using OneClick LCA to obtain the amount of carbon emissions of each building element. The models are obtained from Marianne Cabildo, who is working on the design-based project of Sit Øya.

There are 5 scenarios which includes the design of the existing building, and the other design is additional floor with new building beside it.

### Scenario 1 and 2

The existing building will be the base reference with this scenario, it will show how much greenhouse gas emission will produce when the building is constructed on the present time.

Scenario 1: concrete materials for the whole building
Scenario 2: timber materials walls and floors for the $1^{st}$ to $3^{rd}$ floor of the building

*Figure 8 BIM model in reference to scenario 1 and 2 (Cabildo, 2022)*

### Scenario 3

The existing building will remain as is and will be reused with the exception of all windows due to poor thermal insulation. An additional floor has been added on top of the existing building and a new building extension to accommodate more students which are constructed in timber. Red hidden lines indicate the demolish part of the existing building.

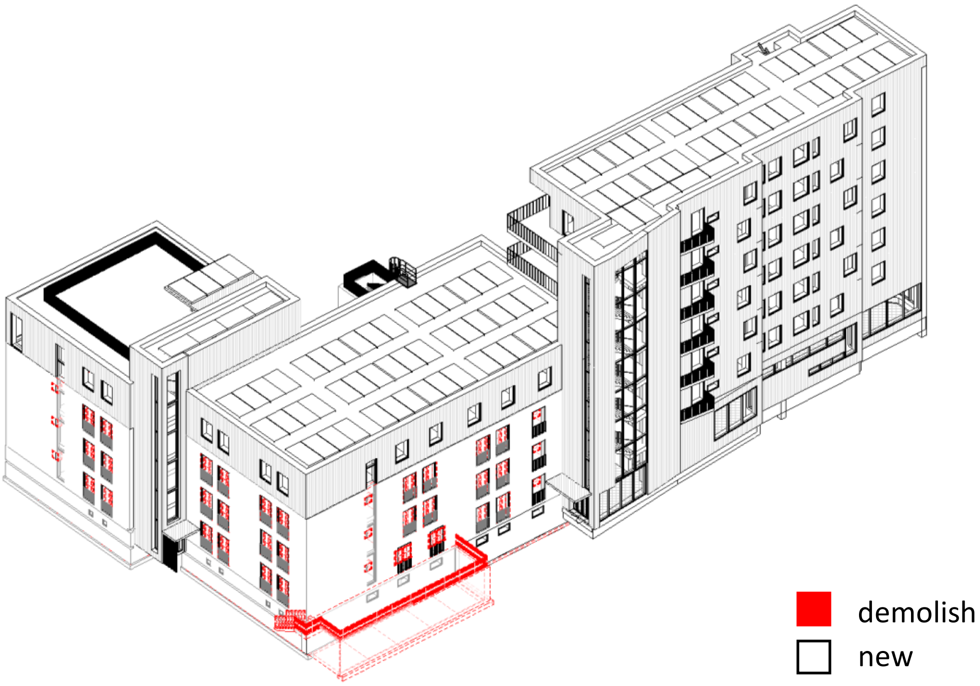


*Figure 9 BIM model in reference to Scenario 3 (Cabildo, 2022)*

*Figure 10 Axonometric model of scenario 3 (Cabildo, 2022)*

### Scenario 4 and 5

These scenarios have the same design as the scenario 3, but the building will be considered as a newly constructed building whereas,

> Scenario 4: mixed concrete and timber construction using wooden wall and floor elements except for the basement.
>
> Scenario 5: mixed concrete and timber construction using prefabricated concrete exterior wall elements and wooden floors

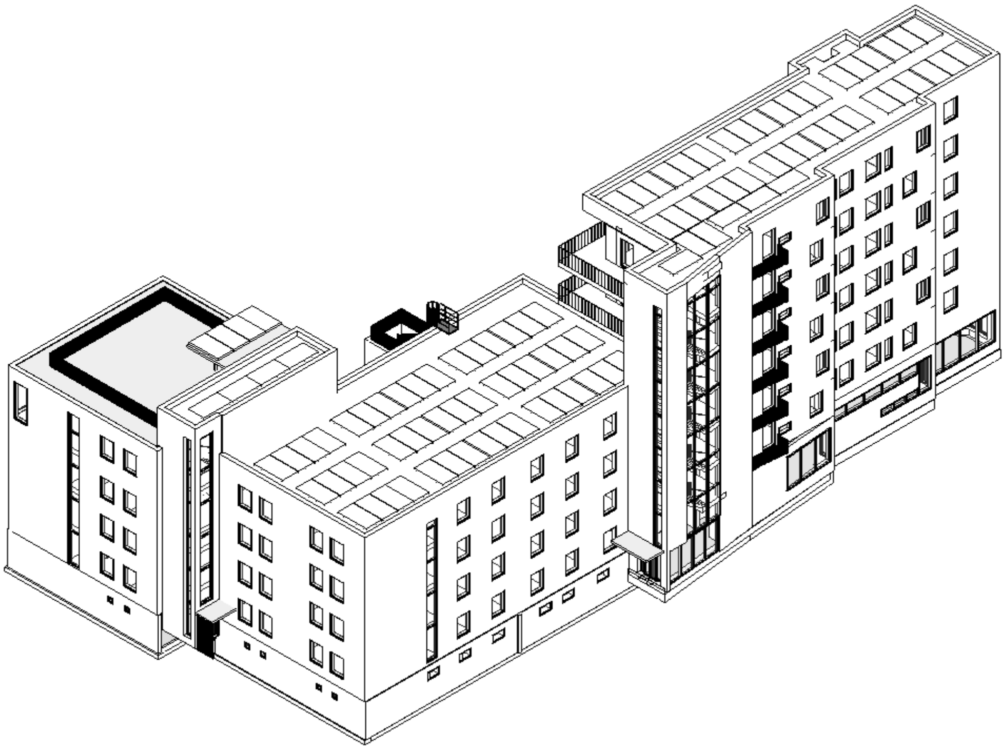


*Figure 11 BIM model in reference to scenario 4 and 5 (Cabildo, 2022)*

## LCA

Life Cycle Assessment (LCA) is used to assess a products/materials' environmental impact over its whole life cycle, from raw product extraction to disposal (cradle to gate). LCA involves the use of Environmental Product Declarations (EPDs). This is fundamentally the systematic and certified definition of a product's environmental profile (OneClickLCA, 2015). The EPD will provide and support reliable information about the product and its effect on the environment throughout its lifetime

NS-EN 15978 gives calculation principles to assess the environmental performance of new and existing buildings (Standard Norge, 2011). In this standard, system boundaries are defined for LCA of buildings. The system boundaries defined in NS-EN 15978 are A1-A3 (product stage), A4-A5 (construction process stage), B1-B7 (use stage), C1-C4 (end of life stage) and D (benefits and loads beyond the system boundary) (Eliassen, 2019).

### Goal and scope

The goal of this report is to determine the environmental impacts of different scenarios from constructing the existing building at present to refurbishment of the existing building to newly constructed building scenario. The case study is a three-story with 1618 sqm with basement parking. Located in Klostergate, Trondheim. Its construction system includes prefabricated concrete sandwich wall component on its exterior element with hollow core slab floors. The building was used as a student housing and was closed in 2021 due to future of constructing a new building to accommodate students.

### Functional unit

The functional unit has been set to: ($kgCO_2$) of the operational building lifetime'. The results are normalized according to the heated floor area of 1618 $m^2$ for the existing building and 3482 $m^2$ for the refurbishment and new construction with a building lifetime of 60 years.

### System boundary

The system boundary of the report includes A1-A3, production stages. With these stages, the report analyses each stage of the material used on the scenarios of the building. These boundaries were chosen to because it is assumed that these are the stages with the highest greenhouse gas emissions. Other stages were excluded in this report because of lack of data.

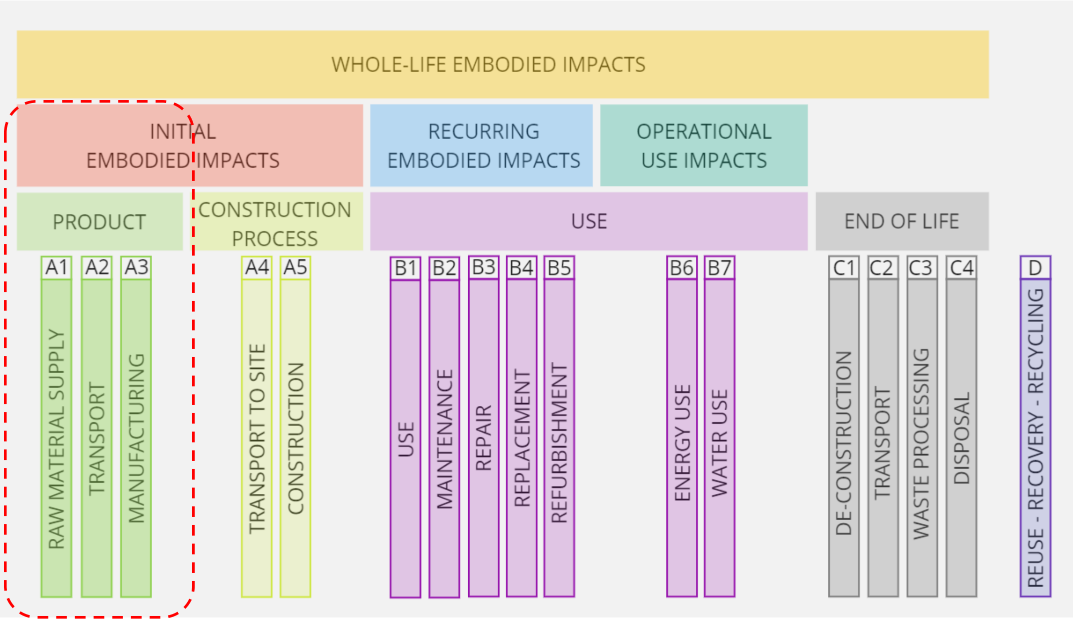


*Figure 12 Life cycle stages according to EN-15978*

## Limitation

This report is limited by the data gathered from SIT about the condition of the existing building and the building information model (BIM) made by Marianne Cabildo. The proposal of the structural components was assumed according to the suggestions of Bunji Izumi, one of the consulting supervisors. However, the structural systems have not been calculated precisely. In terms of LCA system's boundary, there was a limitation as well and not a full scope of the boundary was included in this report. The stages of the system boundary included as shown in figure 13.

A full detailed LCA calculation of the scenarios has not been done on this report because the main goal of the study is to compare the construction materials selected and how it affects the environmental performance of the building.

Biogenic carbon is not included in the greenhouse gas emission calculation because end of life is excluded.

## Life Cycle Inventory

In this report, different types of materials with its environmental product declarations (EPDs) were used to determine greenhouse gas emissions within the study’s framework boundary. EPDs used were production based in Norway for most of the materials.

The case study with different scenarios has been modelled using Revit to get the information about the quantities of each building element of the building. The quantities of the materials are extracted from Revit and used for the calculation OneClickLCA to obtain the number of carbon emission of each building element within the boundary (See Appendix A for complete list of materials extracted in Revit).

The embodied emissions include the main building elements of the building envelope and the major internal building elements such as slabs and inner walls. Stairs, doors, and tiles are also included. Finishes like paints, varnish of the external and internal surfaces is not included due to uncertainties.

## Building Envelope

An overview of material inventory extracted in Revit. It should be noted that formwork, metal studs and steel rebars have not been included in the inventory due to uncertainties. Tables show only the building element that shows high greenhouse gas emissions such as the external and inner walls, floors, and roofs. (See Appendix B for complete list of materials from OneClickLCA)

*Table 1 Material quantities that emits most GHG emissions*

| materials | scenario 1 | scenario 2 |
|---|---|---|
| cast in situ concrete | 226,15 m³ | 237,7 m³ |
| prefabricated concrete | | |
| wall | 914 ton | |
| slab | 1026 ton | 151 ton |
| column | 1.05 m³ | 1,05 m³ |
| stairs | 10,6 m³ | 10,6 m³ |
| screed | 179,2 ton | 52,43 ton |
| vapour retarder | 1555 m² | 2556 m² |
| waterproofing | 679 m² | 679 m² |
| EPS insulation | 5432 m² | 5432 m² |
| gypsum board | 6719 m² | 10759 m² |
| mineral wool insulation | 9766 m² | 26843 m² |
| vinyl | 1365 m² | 49 m² |
| doors and windows | 150,72 m² | 150,72 m² |
| wood panel | | |
| cladding | | 22,32 m³ |
| wind barrier | | 10,15 m² |
| particle board | | 1306 m² |
| Laminated plywood | | 3474 m² |
| pvc waterproofing sheet | | 431 m² |

An overview of building construction on building elements on each scenario based on the material inventory.

*Table 2 Construction of Building Elements on Scenario 1*

| Scenario 1: existing_concrete | |
|---|---|
| Outer wall | prefabricated concrete sandwich wall with insulation |
| Inner wall | The inner wall consists of 2-13mm + 100mm + 2-13mm timber stud partitions with mineral wool insulation between the gypsum boards. |
| Floor | Hollow core slab construction with 50mm mineral wool insulation and a homogenous vinyl finish. In the toilet and bath, a ceramic tile is used as the floor finish. |
| Roof | roof has a concrete construction with 200mm mineral wool insulation. Roofing tile has been used. |

*Table 3 Construction of Building elements on scenario 2*

| Scenario 2: existing_wood | |
|---|---|
| Outer wall | The outer wall element consists of 200 + 150 + 50mm mineral wool insulation with gypsum board internal finish, a vapour and wind barrier and an external timber cladding. |
| Inner wall | Same as scenario 1 |
| Floor | floor structure is described by timber construction, with 200mm mineral wool insulation and timber floor finish. In the toilet and bath, a ceramic tile is used as the floor finish. |
| Roof | Roof consists of 100 + 350mm mineral insulation with gypsum board finish, vapour and wind barrier and roofing felt. |

*Table 4 Material quantities that emits most GHG emissions*

| materials | scenario 3 | scenario 4 | scenario 5 |
|---|---|---|---|
| cast in situ concrete | 171,21 m$^3$ | 319,27 m$^3$ | 319,27 m$^3$ |
| prefabricated concrete | | | |
| wall | 11,6 ton | | 1790 ton |
| slab | 11,4 ton | | |
| column | 0,6 m$^3$ | 0,78 m$^3$ | 0,78 m$^3$ |
| stairs | 31,71 m$^3$ | 32,32 m$^3$ | 32,32 m$^3$ |
| screed | 16,61 ton | 54,33 ton | 90,63 ton |
| vapour retarder | 8651 m$^2$ | 14612 m$^2$ | 2070 m$^2$ |
| waterproofing | 203 m$^2$ | 711 m$^2$ | 711 m$^2$ |
| EPS insulation | 5728 m$^2$ | 5688 m$^2$ | 5688 m$^2$ |
| gypsum board | 16039 m$^2$ | 22974 m$^2$ | 20469 m$^2$ |
| mineral wool insulation | 41951 m$^2$ | 75252 m$^2$ | 45734 m$^2$ |
| vinyl | 24 m$^2$ | 16 m$^2$ | 16 m$^2$ |
| doors and windows | 563,34 m$^2$ | 522,37 m$^2$ | 522,37 m$^2$ |
| wood panel | | | |
| cladding | 35,48 m$^3$ | 55,9 m$^3$ | |
| roofing | 1,08 m$^3$ | 4,15 m$^3$ | 4,15 m$^3$ |
| wind barrier | 1993 m$^2$ | 3046 m$^2$ | 512 m$^2$ |
| particle board | 1796 m$^2$ | 3554 m$^2$ | 3194 m$^2$ |
| laminated plywood | 7655 m$^2$ | 7664 m$^2$ | 7664 m$^2$ |
| glue laminated column | 24,29 m$^3$ | 24,29 m$^3$ | 24,29 m$^3$ |
| pvc waterproofing sheet | 563 m$^2$ | | |

*Table 5 Construction of building element on scenario 3*

| Scenario 3 | |
|---|---|
| Outer wall | The outer wall element consists of 200 + 150 + 50mm mineral wool insulation with gypsum board internal finish, a vapour and wind barrier and an external timber cladding. |
| Inner wall | The inner walls are described by timber stud partitions with mineral wool insulation and a gypsum board. It varies depending on where it will be installed. Walls have either 100mm, 150mm or 200mm mineral insulation with gypsum board internal finish. |
| Floor | floor structure is described by timber construction, with 200mm mineral wool insulation and timber floor finish. In the toilet and bath, a ceramic tile is used as the floor finish. |
| Roof | Roof consists of 100 + 350mm mineral insulation with gypsum board finish, vapour and wind barrier and roofing felt and the other part has roof decking. |

*Table 6 Construction of building element on scenario 4*

| Scenario 4 | |
|---|---|
| Outer wall | Same as scenario 3 but will be considered as new constructed building |
| Inner wall | |
| Floor | |
| Roof | |

*Table 7 Construction of building elements on scenario 5*

| Scenario 5 | |
|---|---|
| Outer wall | Same as scenario 1 |
| Inner wall | Same as scenario 3 |
| Floor | |
| Roof | |

Construction detail of main building elements in the scenarios based on Byggforsk TEK17.

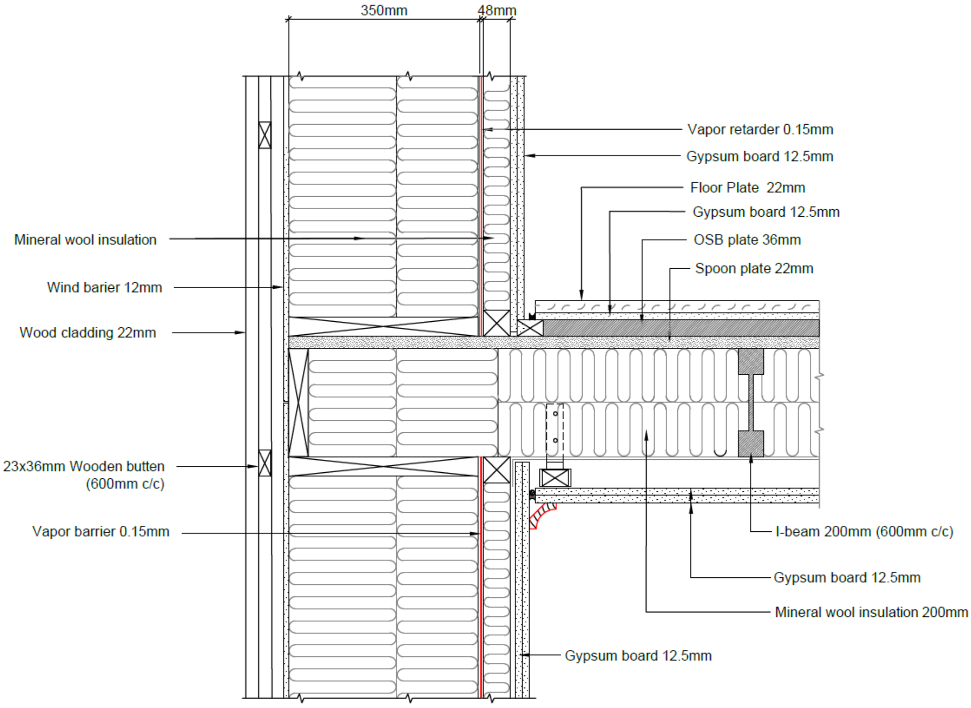


*Figure 13 timber wall and floor detail (Byggforsk TEK17)*

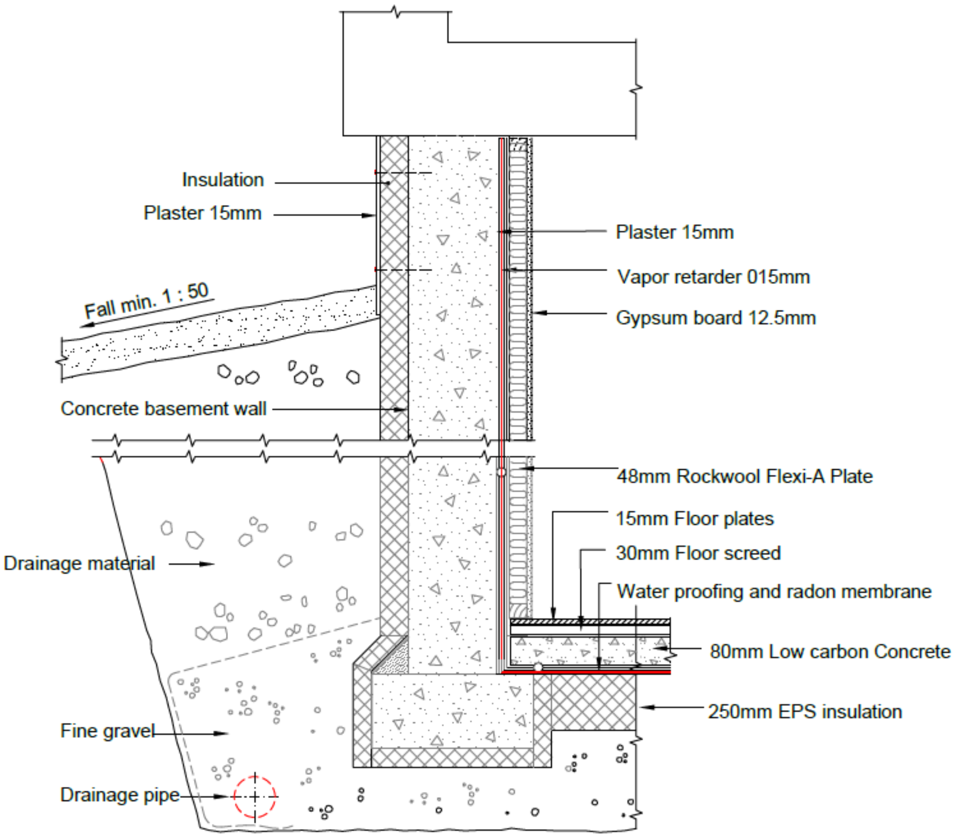


*Figure 14 concrete floor at basement detail (Byggforsk TEK17)*

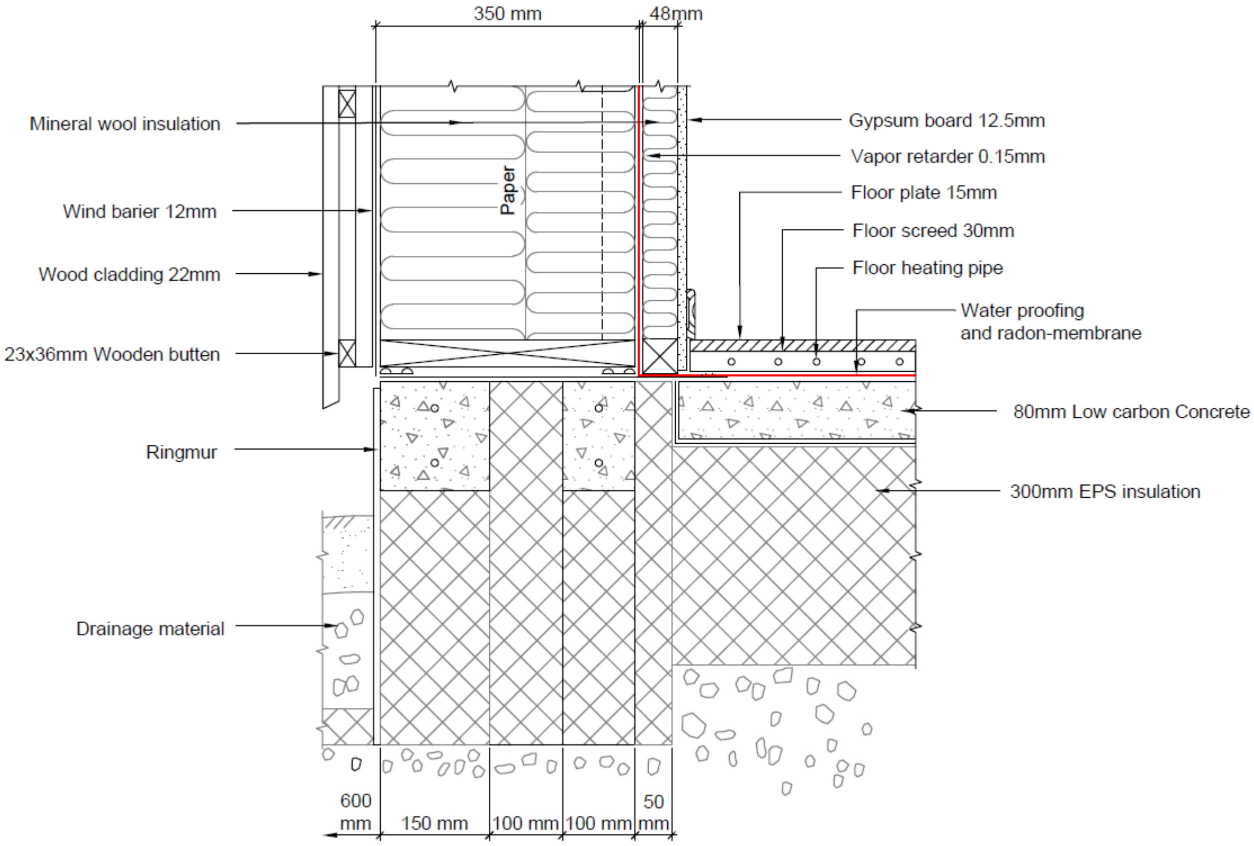


*Figure 15 concrete floor with exterior timber wall detail (Byggforsk TEK17)*

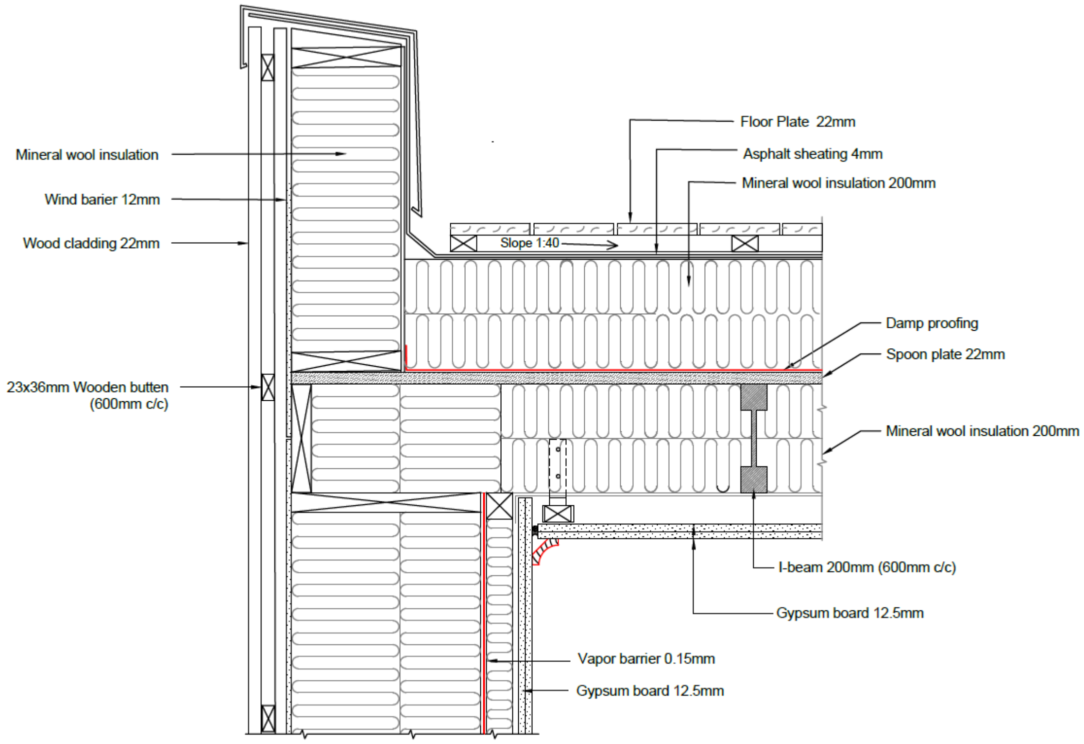


*Figure 16 wooden roof detail (Byggforsk TEK17)*

## Building Materials

### Scenario 1

The existing building of Sit Øya was built for student housing where materials used were meant for its purpose and location. It is located close to the city center and campuses. The building is a 3-strory concrete building with 63 units. It is built according to the Norwegian TEK97 standards. Exterior walls are made of prefabricated concrete sandwich wall with insulation. The slabs are hollow core slabs. The stair in the building is made of prefabricated concrete element. (See figure 8 for scenario 1 and table 3 for building construction of elements).

### Scenario 2

The scenario 2 has the same design as the scenario 1 but has a mixed wood and concrete construction. Its exterior walls are made of timber frame with wind barriers and vapour barrier with gypsum board. The floors are also made of timber frame. Only the basement which houses the parking, service and technical rooms are made of concrete (See figure 8 for scenario 2).

### Scenario 3

In scenario 3, the existing building was refurbished. The building does not comply to the current Norwegian TEK17 standard regulation, however, some of the materials can still be used. The original building frame was still used such as the prefabricated concrete sandwich wall and hollow core slabs. The exterior walls were used to preserve its architectural character and to reduce the emission of carbon from demolition. The windows needed to be replaced due to poor thermal insulation considering it was constructed in 1991 and doors, considering these materials have reached their replacement stage. (See figure 9 for scenario 3 and figure 11 for the axonometric model).

A floor on top of the existing building was added to accommodate more students and a communal kitchen, it was placed on top to utilize the view and daylight. With a total of 52 units together with the existing structure below, its exterior walls are made of timber frames with wind barrier and vapour barrier with gypsum boards. The façade cladding is wooden panels.

The concrete roof of the existing building was also replaced with timber frame flooring to reduce the load of the additional floor from the existing building.

There is a new building beside the existing which serves as an extension of the student housing. It is a 7-story wooden building with 36 units. The building was designed after the passive house standard NS 3700 to be more energy efficient (NS3700, 2013). The walls and floors are made of timber elements. Only the floor on the ground which the communal kitchen is located is made of concrete.

### Scenario 4

The scenario 4 has the same design as scenario 3 but the difference is that it will be a newly constructed building built with mixed concrete and timber frame construction. The basement wall and floors and the floor at the ground, and staircases are made of concrete and the rest are all in timber frames (See figure 11 for scenario 4).

### Scenario 5

Same as in Scenario 4 but only the succeeding floors are made of timber frame construction and the rest are built on concrete construction. The exterior walls are made of prefabricated concrete sandwich walls (See figure 11 for scenario 5).

## Result

This section presents the result from the material inventory of the building and the materials used in the different scenarios. The result will be presented in $kgCO_2$-eq for the production stage A1-A3). It is also noted that the structural system in the groundworks included is not precise such as the quantities of rebars, foundation works such as footings, etc.

### Scenarios

To perform an environmental assessment comparison, it was proper to compare several scenarios to understand different implication of construction materials affects the greenhouse gas emissions (See Appendix B for OneClickLCA list of materials).

The 5 scenarios were divided into 2 parts: Scenario 1 and 2 with the same heated floor area of 1618 m² and scenario 3, 4 and 5 with 3482 m² for an appropriate comparison. Though, scenario 3 is only a refurbishment, the existing building is considered 0 in term of its GHG emissions and the heated floor area from the existing is included.

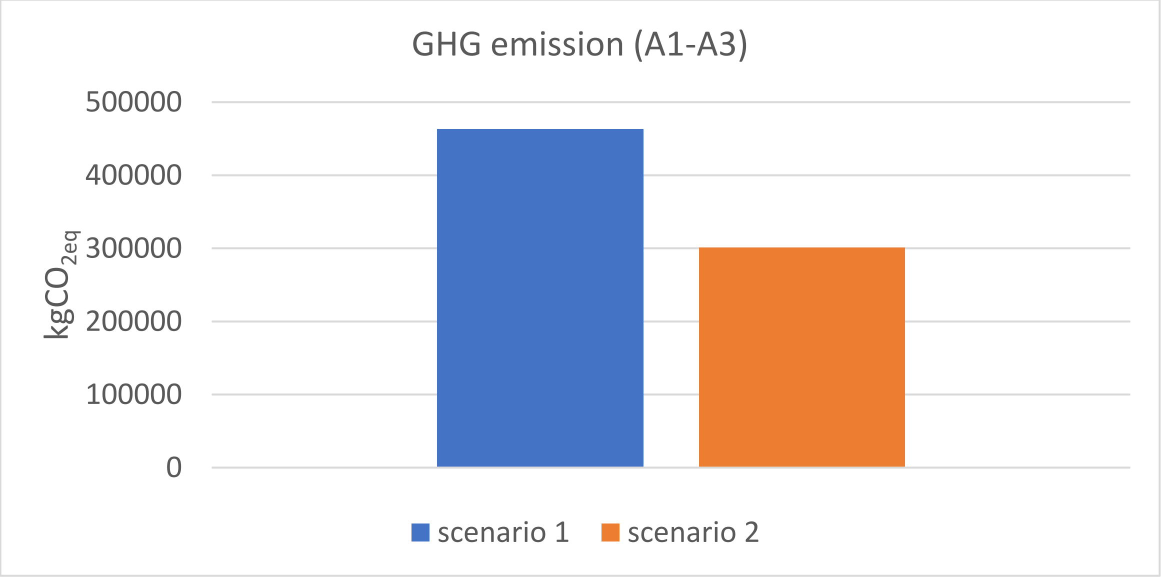


*Figure 17 Total GHG emissions from materials in production stage (scenario 1 and2)*

Scenario 1: existing_concrete
Scenario 2: existing_wood

The result shown in figure 17 is the comparison between scenario 1 and 2. The total GHG emissions for the production stage (A1-A3) is 463 041,64 $kgCO_2$-eq for the scenario 1 and 300 938,65 kg $CO_2$-eq for scenario 2 for a building lifetime of 60 years.

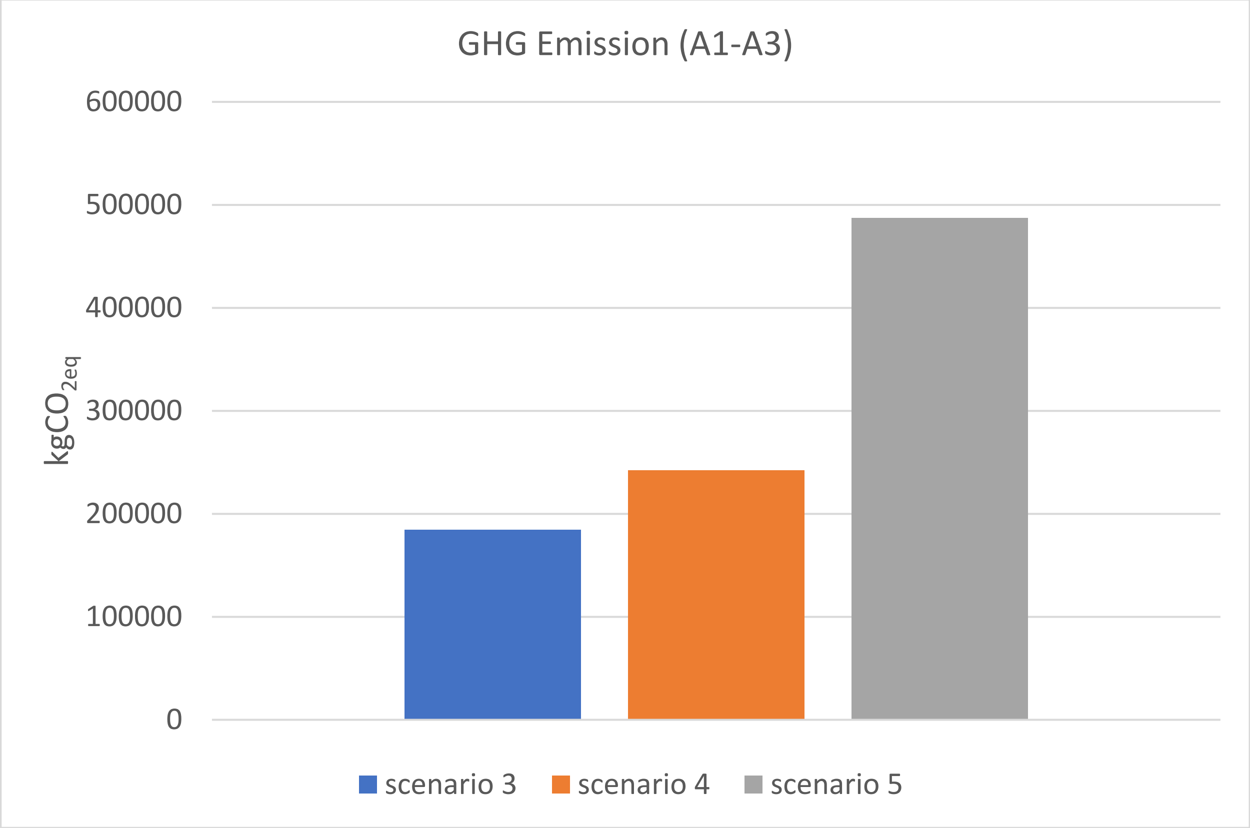


*Figure 18 Total GHG emissions from materials in production stage (scenario 3, 4 and 5)*

Scenario 3: refurbish
Scenario 4: newly constructed_wood
Scenario 5: newly constructed_concrete

The result shown in figure 18 is the comparison between scenario 3, 4 and 5. The total GHG emissions for the production stage (A1-A3) for scenario 3 is 184 758,29 kgCO$_2$-eq, scenario 4 with 242 622,72 kg CO$_2$-eq and for scenario 5 is 487 192,12 kg CO$_2$-eq for a building lifetime of 60 years.

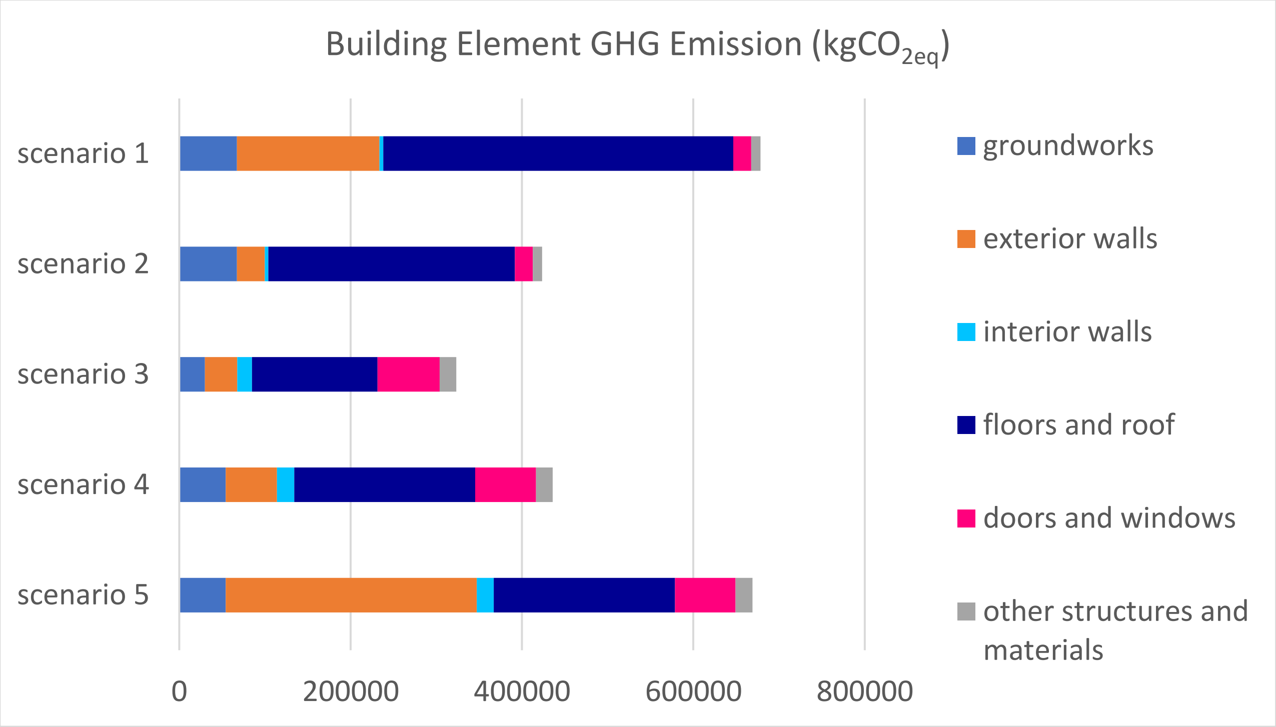


*Figure 19 GHG emissions by building element*

Scenario 1: existing_concrete
Scenario 2: existing_wood
Scenario 3: refurbish
Scenario 4: newly constructed_wood
Scenario 5: newly constructed_concrete

In the figure 19, result shows that floors and roof have the highest amount of GHG emission from the other elements. The exteriors walls have the second highest amount of GHG emission. The scenario 1 has a huge amount of GHG emission due to its concrete flooring using hollow core slabs with 102 100 kgCO$_2$-eq. On the other hand, the scenario 5 has the biggest amount of GHG emission with the use of prefabricated concrete sandwich wall element with insulation amounting 135 000 kgCO$_2$-eq.

## Building Materials

In figure 20, it shows that prefabricated concrete elements have a huge impact amounting to 240 055 $kgCO_2$-eq in the scenario 1. Some of the materials have a similar or close in amount as only the exterior and floor elements were compared.

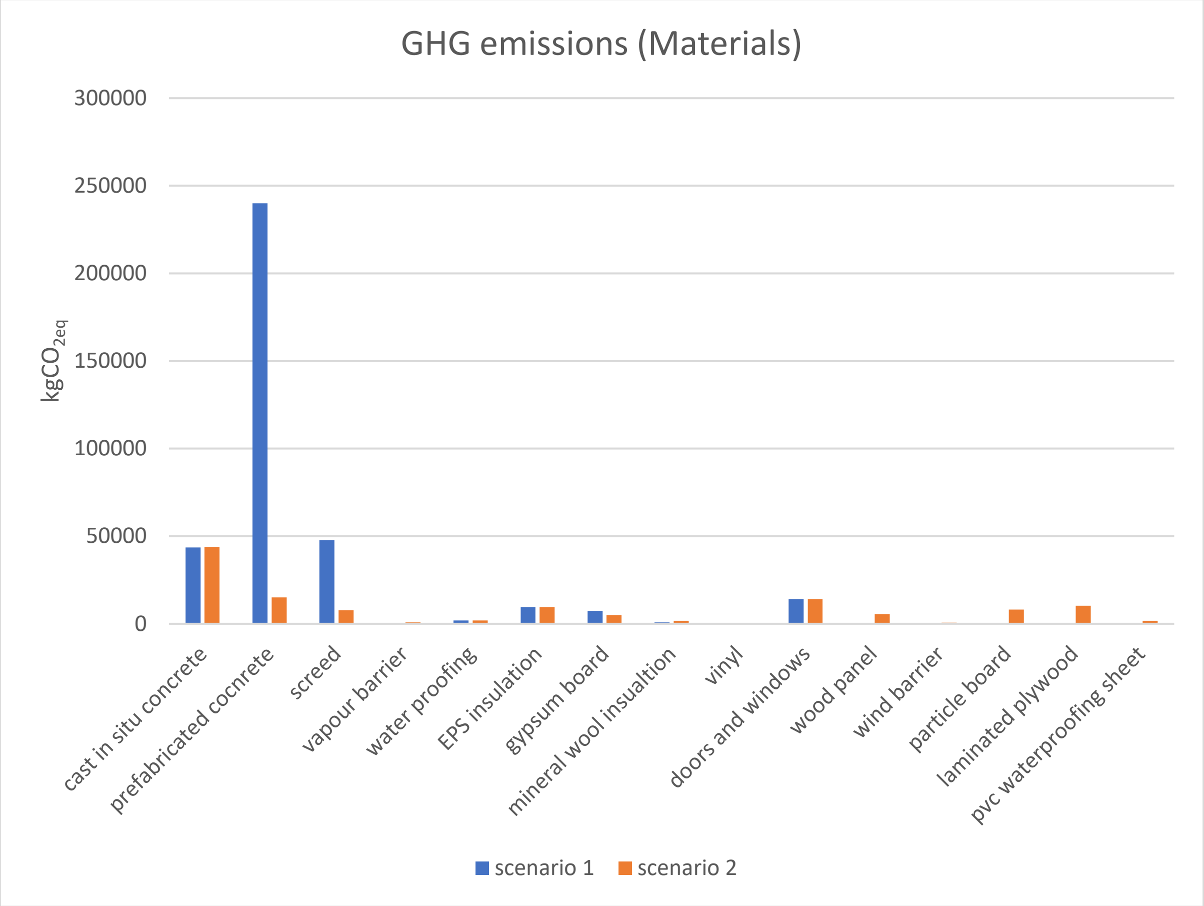


*Figure 20 GHG emissions from materials in scenario 1 and 2 for production stage (A1-A3)*

Scenario 1: existing_concrete
Scenario 2: existing_wood

In the figure 21, the prefabricated concrete on scenario 5 has a very huge amount of GHG emission due to the exterior walls made of prefabricated concrete sandwich element with insulation which emits 265 000 $kgCO_2$-eq. As mentioned previously, some of the materials have a similar or close in amount as only the exterior elements were compared. Floor construction on the 3 scenarios have the same timber frame construction except for the basement and ground floor.

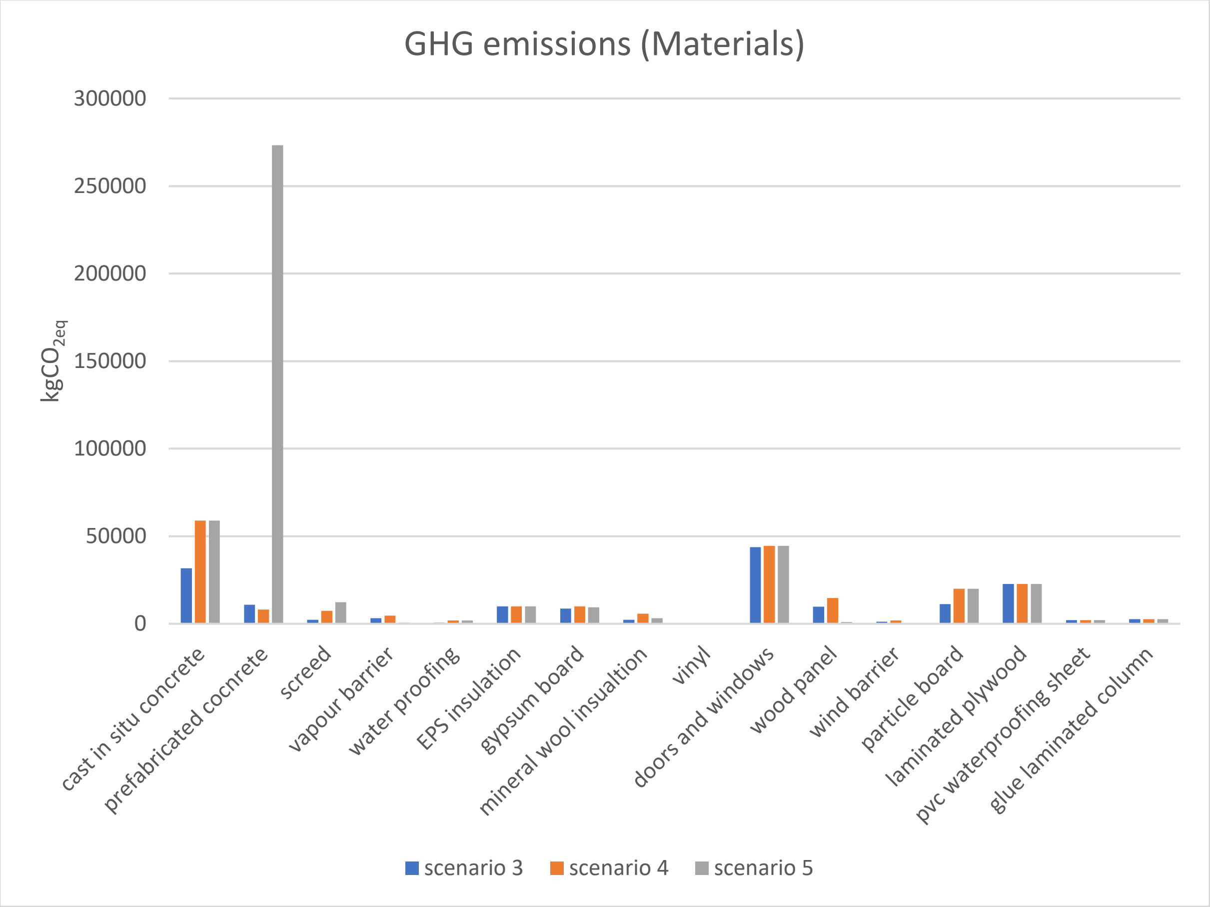


*Figure 21 GHG emissions from materials in scenario 3, 4 and 5 for production stage (A1-A3)*

Scenario 3: refurbish
Scenario 4: newly constructed_wood
Scenario 5: newly constructed_concrete

## Selection of Material

Different building materials with Environmental product declarations (EPDs) have been used in this report for the calculation of the emissions of greenhouse gas. Most of the EPDs used produce and manufactured in Norway.

A thorough selection of construction materials and multiple analysis was conducted to be more sustainable with lesser environmental impact as part of the process. Scenario 1 was made as the base reference of the materials. Materials used were according to the project manager of SIT and a condition assessment report made by Multiconsult.

Due to concrete having a huge amount of GHG emission. Prefabricated concrete sandwich wall was compared to timber wall construction. As seen in figure 19, GHG emission of external wall in scenario 2 has 32 587,97 kgCO$_2$-eq which is 80% lower than the GWG emission in scenario 1 with 166 581,99 kgCO$_2$-eq.

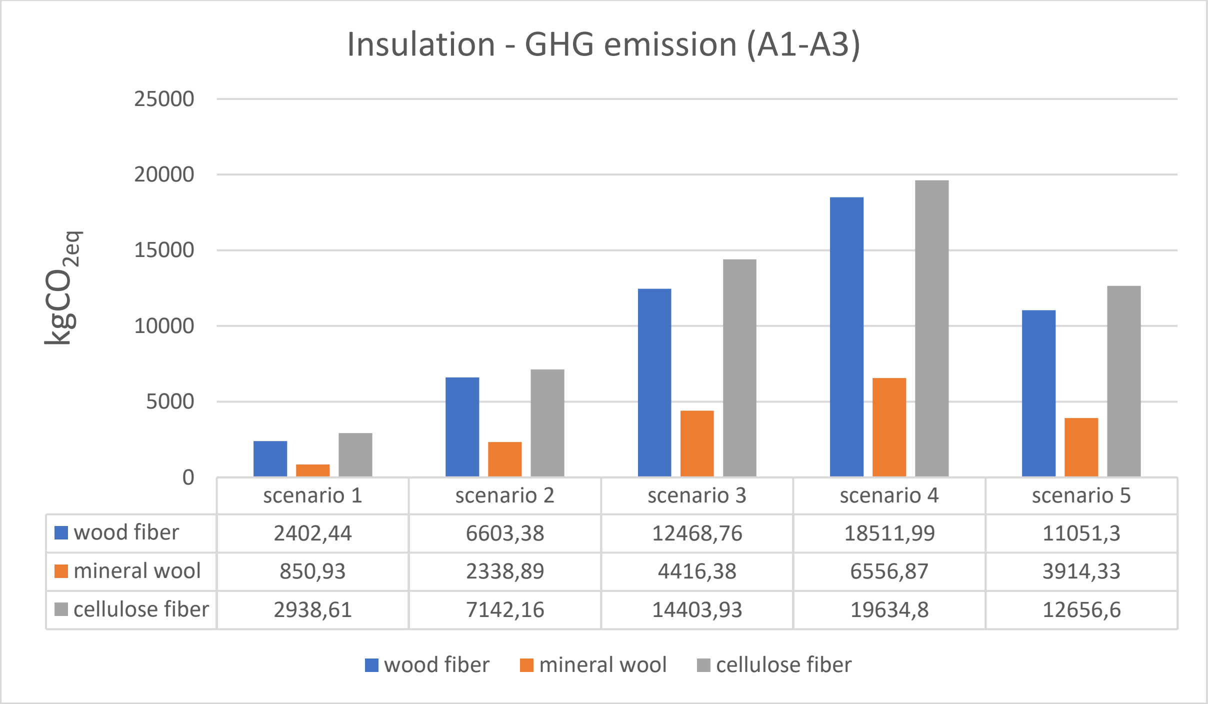
Most of the materials selected and used has a low GHG emission on A1-A3 such as low carbon concrete, mineral insulation, timber wall and floor construction without affecting the design and standards while also preserving it.

Different insulations for the external and internal walls, and floors have been also conducted for comparison. Insulation is one of the materials that contributes to GHG emission so selecting a right insulation will affect the overall GHG emission to the building. 3 various insulations were compared, 2 of those are organic and 1 is glass wool. Insulations were compared by inputting the total area $m^2$ of insulation used on each scenario in OneClickLCA compare data.

*Table 8 Total areas of insulation on each scenario*

<table>
<tr><th></th><th>wood fiber (38-40mm) *</th><th>mineral wool (38-40mm) *</th><th>cellulose fiber (100mm) *</th></tr>
<tr><td>Scenario 1</td><td colspan="2">9766 $m^2$</td><td>3710 $m^2$</td></tr>
<tr><td>Scenario 2</td><td colspan="2">26843 $m^2$</td><td>9017 $m^2$</td></tr>
<tr><td>Scenario 3</td><td colspan="2">50686 $m^2$</td><td>18185 $m^2$</td></tr>
<tr><td>Scenario 4</td><td colspan="2">75252 $m^2$</td><td>24789 $m^2$</td></tr>
<tr><td>Scenario 5</td><td colspan="2">44924 $m^2$</td><td>15979 $m^2$</td></tr>
</table>

*thickness of the insulation



| | scenario 1 | scenario 2 | scenario 3 | scenario 4 | scenario 5 |
|---|---|---|---|---|---|
| 🟦 wood fiber | 2402,44 | 6603,38 | 12468,76 | 18511,99 | 11051,3 |
| 🟧 mineral wool | 850,93 | 2338,89 | 4416,38 | 6556,87 | 3914,33 |
| ⬜ cellulose fiber | 2938,61 | 7142,16 | 14403,93 | 19634,8 | 12656,6 |

*Figure 22 GHG emission of insulation materials from A1-A3*

Scenario 1: existing_concrete
Scenario 2: existing_wood
Scenario 3: refurbish
Scenario 4: newly constructed_wood
Scenario 5: newly constructed_concrete

In table 8, different insulations were compared. 2 insulations are organic and 1 is glass wool. Wood fiber blown insulation has 0,25 $kgCO_2/m^2$ GWP while glass mineral wool with 0,42 $kgCO_2/m^2$ and cellulose blown insulation with 0,12 $kgCO_2/m^2$. Figure 22 result shows that mineral wool insulation has the lowest GHG emission despite wood fiber having a lower GWP.

# Discussion

This section discussed the result and calculation conducted. It is also noted that in this discussion of GHG emission of materials, the structural system in the groundworks included is not precise such as the quantities of rebars, foundation works such as footings, etc.

## Scenarios

The result of scenarios 1 and 2 in figure 17 are as expected since scenario 1 is built in concrete construction and scenario 2 is mixed concrete and timber construction. The GHG emission on scenario 2 is 35% lower than in scenario 1, which the external wall made of timber frame construction contributed to reducing the environmental impact in A1-A3.

In figure 18, shows that scenario 5 has the largest amount of GHG emission. It is due to the prefabricated concrete sandwich wall were used as the external wall of the building. As for the scenario 3 and 4, there is a 24% difference in their GHG emission, albeit the materials in the existing building was not included, which shows that when choosing a much lower GHG emission in material for the scenario 4 can greatly reduce the emission in it.

Figure 19 shows that the building element which contributes the highest GHG emission are the floor and roof, and the next highest is the exterior walls in the case of scenario 1 and 5. These building elements have a high GHG emission as it is made of prefabricated concrete such as concrete sandwich wall and hollow core slab.

Figure 20 shows that for scenario 1, prefabricated concrete is the material that contributes with the most greenhouse gases, followed by screed and cast-in situ concrete as this was used in the exterior walls, floors, basement, and stairs. Selecting a material with low greenhouse gas emission is essential to lower the GHG emission from concrete buildings. For scenario 2, timber played a role in lowering the GHG emission especially to the exterior and floor elements as shown in figure 20. The cast in situ concrete has the most GHG for scenario 2 as it was used in the basement floor and walls.

In figure 21, result shows that prefabricated concrete has the highest amount of GHG emission on scenario 5 in which all its exterior walls are made of concrete sandwich wall element followed by the cast in situ concrete which are used in the basement floor and wall, and the floor at the ground floor of the new extension building. Door and windows have the third highest GHG emission, and all scenarios have similarly amount of it. In scenario 3 while it’s a refurbishment, all doors and windows were replaced due to poor thermal condition, so it adds up to the GHG emission.

## Selection of material

From figure 19, external walls and floors has the most GHG emission for most of the scenarios. Materials used for these building elements were prefabricated concrete which are concrete sandwich wall with 0,15 kg$CO_2$/kg and hollow core slab with 0,0995 kg$CO_2$/kg.

For the case of scenario 1 and 5, prefabricated concrete is the material with the most GHG emission contribution (see figure 20 and 21). Replacing the prefabricated concrete with timber constructions has reduce the GHG emission as seen in figure 17 and 18.

In selecting the insulation, there are factors to consider such as thermal performance, environmental impact, and fire resistance.

Figure 22 shows that mineral wool has much lower GHG emission than the 2 organic insulations. It is also noted that the biogenic carbon in the GWP of wood fiber is disregarded as the end-of-life stage is excluded in the calculation. Mineral wool has a better thermal conductivity than wood fiber and cellulose with 0,038 W/mK than 0,04 W/mK and 0,039 W/mK respectively, it is also a good acoustic insulation and is moisture resistant.

# Conclusion and Further Research

## Conclusion

SIT wants to build a new building over the existing to accommodate more student. In line with lowering the GHG emission, this report was formed to conduct several calculations on different scenarios whether demolishing the existing building is better than refurbishing it and constructing a new building extension and how selected material affects the GHG emissions on each scenario on early design stage.

From the results in figure 17 and 18, it is concluded that scenario 3 which is the refurbishment has lowest GHG emission in A1-A3 stage. The result in figure 17 shows that scenario 1 which is the existing building with concrete construction has a higher GHG emission than scenario 2 with mixed concrete and timber construction if it will be built at present. It was also the base reference for the other scenarios. To avoid an increase in GHG emission due to demolition, it is often assumed that renovating/refurbishing of existing building will have a lower environmental impact compared to new construction. In figure 18, the scenario 3 which is the refurbishment has lower GHG emission with 24% lower than scenario 4 which is constructing a new building. Using the existing building reduces the emission enormously on groundworks.

Selecting the sustainable building materials with low GWP has massive contribution on reducing the GHG emission. GHG emission was considered the key design driver in this report. With the use of OneClickLCA and the EPDs gathered, this report has an overview of the calculation of GHG emission of materials in A1-A3 stage.

Prefabricated concrete is widely used materials at present as it is easy to transport and assemble on site, but concrete contributes a large amount of greenhouse gas emissions (Olivier and Peters, 2018). As an alternative, timber wall frame construction was used and as shown in figure 17 and 18). Scenario 2, 3, and 4 which uses timber walls and used wooden floors, their GHG emissions are significantly lower than scenario 1 and 5.

It is important to note that A4 transport may affect the GHG of each material and as much as possible to select materials that are locally produced and manufactured in Norway and B2-B5, materials have different service lifetime so maintenance and replacement will affect on the

GHG emission of the building. Also, Photovoltaic (PV) panels were not included in the materials as to properly compare the scenario 1 which do not have PV panels.

As early as start of the design project, designers should already visualize what materials the building will use. Selecting the materials with a low GHG emission is a must without affecting the integrity of each material.

## Further Research

Result shows are preliminary and based on limited data information especially with the material on groundworks and foundation. A full LCA analysis where necessary system boundary of materials is to be included for an accurate calculation of GHG emission on buildings. Widen the selection of materials to fully comprehend which materials has the lowest environmental impact and can be used as a basis for designers on their decision on material selection during early design phase.

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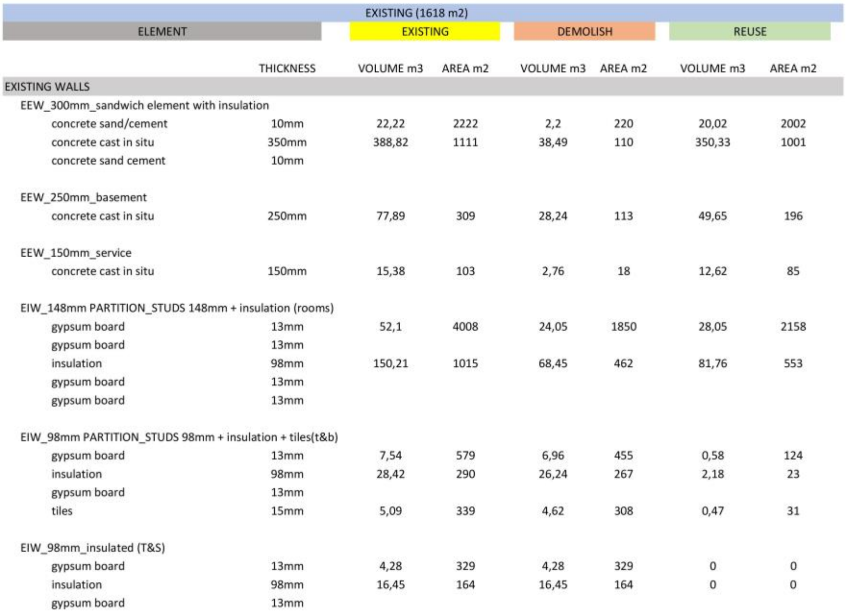
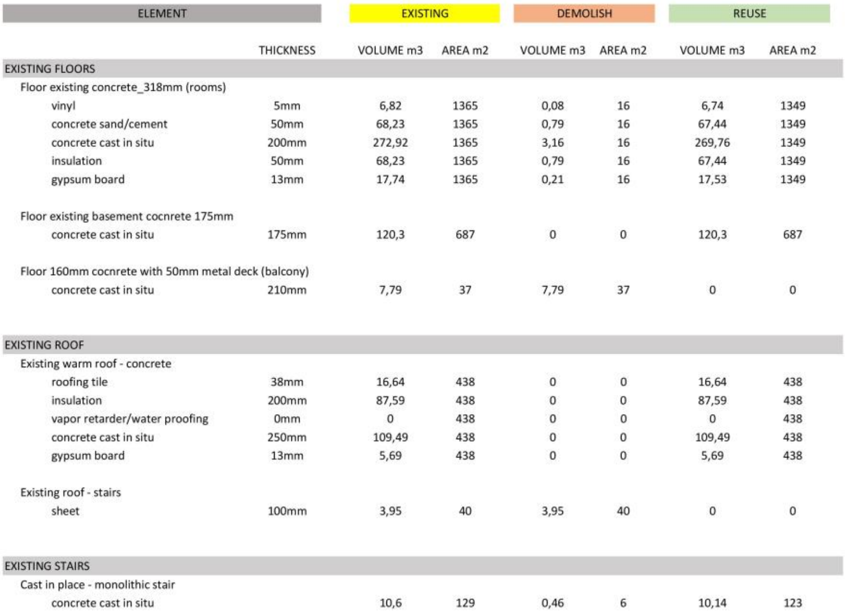
# Appendices

## Appendix A - Material list obtained from Revit

### EXISTING BUILDING



| EXISTING (1618 m2) | | | | | | | |
|---|---|---|---|---|---|---|---|
| ELEMENT | | EXISTING | | DEMOLISH | | REUSE | |
| | THICKNESS | VOLUME m3 | AREA m2 | VOLUME m3 | AREA m2 | VOLUME m3 | AREA m2 |
| EXISTING WALLS | | | | | | | |
| EEW_300mm_sandwich element with insulation | | | | | | | |
| concrete sand/cement | 10mm | 22,22 | 2222 | 2,2 | 220 | 20,02 | 2002 |
| concrete cast in situ | 350mm | 388,82 | 1111 | 38,49 | 110 | 350,33 | 1001 |
| concrete sand cement | 10mm | | | | | | |
| EEW_250mm_basement | | | | | | | |
| concrete cast in situ | 250mm | 77,89 | 309 | 28,24 | 113 | 49,65 | 196 |
| EEW_150mm_service | | | | | | | |
| concrete cast in situ | 150mm | 15,38 | 103 | 2,76 | 18 | 12,62 | 85 |
| EIW_148mm PARTITION_STUDS 148mm + insulation (rooms) | | | | | | | |
| gypsum board | 13mm | 52,1 | 4008 | 24,05 | 1850 | 28,05 | 2158 |
| gypsum board | 13mm | | | | | | |
| insulation | 98mm | 150,21 | 1015 | 68,45 | 462 | 81,76 | 553 |
| gypsum board | 13mm | | | | | | |
| gypsum board | 13mm | | | | | | |
| EIW_98mm PARTITION_STUDS 98mm + insulation + tiles(t&b) | | | | | | | |
| gypsum board | 13mm | 7,54 | 579 | 6,96 | 455 | 0,58 | 124 |
| insulation | 98mm | 28,42 | 290 | 26,24 | 267 | 2,18 | 23 |
| gypsum board | 13mm | | | | | | |
| tiles | 15mm | 5,09 | 339 | 4,62 | 308 | 0,47 | 31 |
| EIW_98mm_insulated (T&S) | | | | | | | |
| gypsum board | 13mm | 4,28 | 329 | 4,28 | 329 | 0 | 0 |
| insulation | 98mm | 16,45 | 164 | 16,45 | 164 | 0 | 0 |
| gypsum board | 13mm | | | | | | |

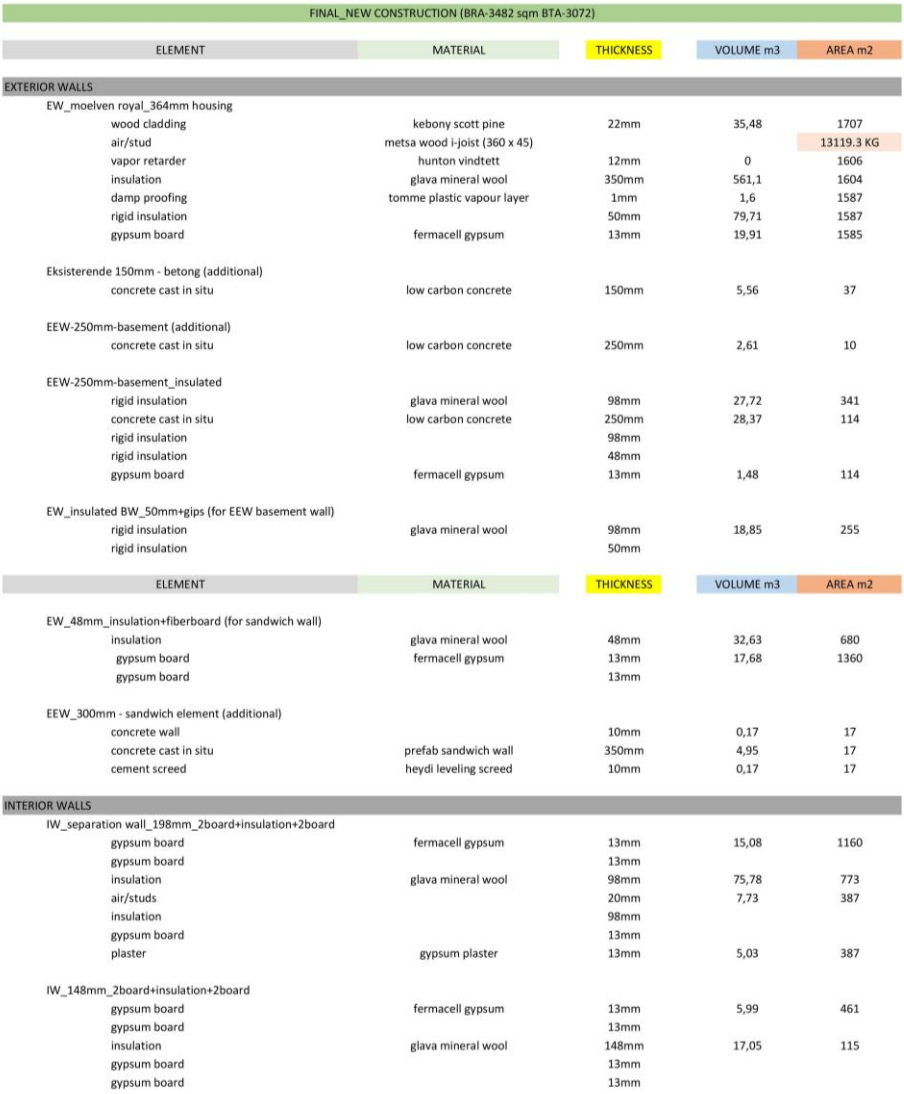


| ELEMENT | | EXISTING | | DEMOLISH | | REUSE | |
|---|---|---|---|---|---|---|---|
| | THICKNESS | VOLUME m3 | AREA m2 | VOLUME m3 | AREA m2 | VOLUME m3 | AREA m2 |
| EXISTING FLOORS | | | | | | | |
| Floor existing concrete_318mm (rooms) | | | | | | | |
| vinyl | 5mm | 6,82 | 1365 | 0,08 | 16 | 6,74 | 1349 |
| concrete sand/cement | 50mm | 68,23 | 1365 | 0,79 | 16 | 67,44 | 1349 |
| concrete cast in situ | 200mm | 272,92 | 1365 | 3,16 | 16 | 269,76 | 1349 |
| insulation | 50mm | 68,23 | 1365 | 0,79 | 16 | 67,44 | 1349 |
| gypsum board | 13mm | 17,74 | 1365 | 0,21 | 16 | 17,53 | 1349 |
| Floor existing basement cocnrete 175mm | | | | | | | |
| concrete cast in situ | 175mm | 120,3 | 687 | 0 | 0 | 120,3 | 687 |
| Floor 160mm cocnrete with 50mm metal deck (balcony) | | | | | | | |
| concrete cast in situ | 210mm | 7,79 | 37 | 7,79 | 37 | 0 | 0 |
| EXISTING ROOF | | | | | | | |
| Existing warm roof - concrete | | | | | | | |
| roofing tile | 38mm | 16,64 | 438 | 0 | 0 | 16,64 | 438 |
| insulation | 200mm | 87,59 | 438 | 0 | 0 | 87,59 | 438 |
| vapor retarder/water proofing | 0mm | 0 | 438 | 0 | 0 | 0 | 438 |
| concrete cast in situ | 250mm | 109,49 | 438 | 0 | 0 | 109,49 | 438 |
| gypsum board | 13mm | 5,69 | 438 | 0 | 0 | 5,69 | 438 |
| Existing roof - stairs | | | | | | | |
| sheet | 100mm | 3,95 | 40 | 3,95 | 40 | 0 | 0 |
| EXISTING STAIRS | | | | | | | |
| Cast in place - monolithic stair | | | | | | | |
| concrete cast in situ | | 10,6 | 129 | 0,46 | 6 | 10,14 | 123 |

| ELEMENT | | EXISTING | | DEMOLISH | | REUSE | |
|---|---|---|---|---|---|---|---|
| | THICKNESS | VOLUME m3 | AREA m2 | VOLUME m3 | AREA m2 | VOLUME m3 | AREA m2 |
| EXISTING DOORS | | | | | | | |
| Single Flush | | | | | | | |
| 662 x 2032 | | 1,22 | 69 | 1,22 | 69 | 0 | 0 |
| 762 x 2032 | | 3,03 | 167 | 3,03 | 167 | 0 | 0 |
| 915 x 2032 | | 9,83 | 525 | 9,15 | 488 | 0,68 | 37 |
| Swedoor double 1186 x 2089 | 61pcs | 4,52 | 609 | 4,52 | 609 | 0 | 0 |
| EXISTING WINDOWS | | | | | | | |
| White casement double | | | | | | | |
| 1050 x 1050 | | 0,31 | 30 | 0,31 | 30 | 0 | 0 |
| 1350 x 1050 | | 0,29 | 29 | 0,29 | 29 | 0 | 0 |
| Glass | | | | | | | |
| 410 x 410 | 6pcs | 0,01 | 1 | 0 | 0 | 0,01 | 1 |
| 610 x 610 | 12pcs | 0,03 | 6 | 0,03 | 6 | 0 | 0 |
| 1050 x 1050 | 9pcs | 0,05 | 17 | 0,05 | 17 | 0 | 0 |
| 1350 x 1050 | 2pcs | 0,06 | 20 | 0,06 | 20 | 0 | 0 |
| Sash | | | | | | | |
| 410 x 410 | | 0,08 | 7 | 0 | 0 | 0,08 | 7 |
| 610 x 610 | | 0,36 | 28 | 0,36 | 28 | 0 | 0 |
| EXISTING COLUMNS | | | | | | | |
| 300x300 | | 0,34 | 7 | 0 | 0 | 0,34 | 7 |
| concrete cast in situ | | | | | | | |
| 250x350 | | 0,71 | 17 | 0 | 0 | 0,71 | 17 |
| concrete cast in situ | | | | | | | |

| ELEMENT | | EXISTING | | DEMOLISH | | REUSE | |
|---|---|---|---|---|---|---|---|
| | THICKNESS | VOLUME m3 | AREA m2 | VOLUME m3 | AREA m2 | VOLUME m3 | AREA m2 |
| EXISTING FOUNDATIONS | | | | | | | |
| EEW_wall foundation | | | | | | | |
| concrete cast in situ 500x300 | | 22,58 | 45 | 0 | 0 | 22,58 | 45 |
| EXISTING RAILING | | | | | | | |
| Railing at windows | | | | | | | |
| vertical steel bar (1000 x 2000mm) | 26,5 kg | 793 kg | | 793 kg | | 0 | |
| Railing at balcony | | | | | | | |
| vertical steel bar (1000 x 2000mm) | 26,5 kg | 292 kg | | 292 kg | | 0 | |
| Railing at stairs | | | | | | | |
| vertical steel bar (1000 x 2000mm) | 26,5 kg | 662 kg | | 662 kg | | 0 | |
| Railing at bridge | | | | | | | |
| vertical steel bar (1000 x 2000mm) | 26,5 kg | 238,5 kg | | 238,5 kg | | 0 | |
| EXISTING BRIDGE | | | | | | | |
| Metal bridge | | | | | | | |
| galvanized steel | 30mm | 0,704 | 23,47 | 0,704 | 23,47 | 0 | |

# REFURBISH BUILDING



FINAL_NEW CONSTRUCTION (BRA-3482 sqm BTA-3072)

| ELEMENT | MATERIAL | THICKNESS | VOLUME m3 | AREA m2 |
|---|---|---|---|---|
| EXTERIOR WALLS | | | | |
| EW_moelven royal_364mm housing | | | | |
| wood cladding | kebony scott pine | 22mm | 35,48 | 1707 |
| air/stud | metsa wood i-joist (360 x 45) | | | 13119.3 KG |
| vapor retarder | hunton vindtett | 12mm | 0 | 1606 |
| insulation | glava mineral wool | 350mm | 561,1 | 1604 |
| damp proofing | tomme plastic vapour layer | 1mm | 1,6 | 1587 |
| rigid insulation | | 50mm | 79,71 | 1587 |
| gypsum board | fermacell gypsum | 13mm | 19,91 | 1585 |
| Eksisterende 150mm - betong (additional) | | | | |
| concrete cast in situ | low carbon concrete | 150mm | 5,56 | 37 |
| EEW-250mm-basement (additional) | | | | |
| concrete cast in situ | low carbon concrete | 250mm | 2,61 | 10 |
| EEW-250mm-basement_insulated | | | | |
| rigid insulation | glava mineral wool | 98mm | 27,72 | 341 |
| concrete cast in situ | low carbon concrete | 250mm | 28,37 | 114 |
| rigid insulation | | 98mm | | |
| rigid insulation | | 48mm | | |
| gypsum board | fermacell gypsum | 13mm | 1,48 | 114 |
| EW_insulated BW_50mm+gips (for EEW basement wall) | | | | |
| rigid insulation | glava mineral wool | 98mm | 18,85 | 255 |
| rigid insulation | | 50mm | | |
| ELEMENT | MATERIAL | THICKNESS | VOLUME m3 | AREA m2 |
| EW_48mm_insulation+fiberboard (for sandwich wall) | | | | |
| insulation | glava mineral wool | 48mm | 32,63 | 680 |
| gypsum board | fermacell gypsum | 13mm | 17,68 | 1360 |
| gypsum board | | 13mm | | |
| EEW_300mm - sandwich element (additional) | | | | |
| concrete wall | | 10mm | 0,17 | 17 |
| concrete cast in situ | prefab sandwich wall | 350mm | 4,95 | 17 |
| cement screed | heydi leveling screed | 10mm | 0,17 | 17 |
| INTERIOR WALLS | | | | |
| IW_separation wall_198mm_2board+insulation+2board | | | | |
| gypsum board | fermacell gypsum | 13mm | 15,08 | 1160 |
| gypsum board | | 13mm | | |
| insulation | glava mineral wool | 98mm | 75,78 | 773 |
| air/studs | | 20mm | 7,73 | 387 |
| insulation | | 98mm | | |
| gypsum board | | 13mm | | |
| plaster | gypsum plaster | 13mm | 5,03 | 387 |
| IW_148mm_2board+insulation+2board | | | | |
| gypsum board | fermacell gypsum | 13mm | 5,99 | 461 |
| gypsum board | | 13mm | | |
| insulation | glava mineral wool | 148mm | 17,05 | 115 |
| gypsum board | | 13mm | | |
| gypsum board | | 13mm | | |

| ELEMENT | MATERIAL | THICKNESS | VOLUME m3 | AREA m2 |
|---|---|---|---|---|
| IW_soundproof wall_148mm_2board+insulation+2board | | | | |
| gypsum board | fermacell gypsum | 13mm | 50,7 | 3900 |
| gypsum board | | 13mm | | |
| insulation | glava mineral wool | 148mm | 144,29 | 975 |
| gypsum board | | 13mm | | |
| gypsum board | | 13mm | | |
| IW_98mm Partition_studs 98mm+insulation+tiles (t&s) | | | | |
| gypsum board | fermacell gypsum | 13mm | 27,08 | 2083 |
| insulation | glava mineral wool | 98mm | 102,06 | 1041 |
| gypsum board | | 13mm | | |
| tiles | | 15mm | 15,62 | 1041 |
| Interior-79mm Partition - 1hr (lift) | | | | |
| gypsum board | fermacell gypsum | 13mm | 0,66 | 71 |
| gypsum board | | 6mm | | |
| metal stud | | 42mm | 0,75 | 18 |
| gypsum board | | 6mm | | |
| gypsum board | | 13mm | | |
| basic wall: concrete_300mm (elevator) | | | | |
| concrete cast in situ | low carbon concrete | 300mm | 49,03 | 169 |

| ELEMENT | MATERIAL | THICKNESS | VOLUME m3 | AREA m2 |
|---|---|---|---|---|
| FLOORS | | | | |
| existing concrete_318mm | | | | |
| vinyl | | 5mm | 0,12 | 24 |
| cement screed | heydi leveling screed | 50mm | 1,22 | 24 |
| concrete cast in situ | hollow core slab | 200mm | 4,86 | 24 |
| insulation | glava mineral wool | 50mm | 1,22 | 24 |
| gypsum board | fermacell gypsum | 13mm | 0,32 | 24 |
| concrete_domestic 450mm (new bldg-ground) | | | | |
| tiles | | 150mm | 3,04 | 203 |
| cement screed | heydi leveling screed | 50mm | 10,15 | 203 |
| plastic | tomme plastic vapour layer | 1mm | 0,2 | 203 |
| concrete cast in situ | low carbon concrete | 80mm | 16,23 | 203 |
| vapour retarder | icopal radon membrane | 1mm | 0,2 | 203 |
| insulation | EPS/XPS | 300mm | 60,87 | 203 |
| exist basement concrete 175mm | | | | |
| pavement | asphalt pavement | 175mm | 18,08 | 103 |
| basement insulated floor | | | | |
| tiles | | 15mm | 7,7 | 513 |
| wood sheathing, chipboard | fibo trespo laminated plywood | 22mm | 11,29 | 513 |
| plastic | tomme plastic vapour layer | 0mm | 0,2 | 513 |
| insulation | EPS | 300mm | 153,92 | 513 |
| insitu concrete 225mm | | | | |
| pavement | asphalt pavement | 50mm | 0,64 | 13 |
| damp proofing | tomme plastic vapour layer | 0mm | 0 | 13 |
| concrete cast in situ | low carbon concrete | 175mm | 5,24 | 13 |

| ELEMENT | MATERIAL | THICKNESS | VOLUME m3 | AREA m2 |
|---|---|---|---|---|
| wooden floor | | | | |
| wood finish | lamianate wood/parquet | 22mm | 38,73 | 1760 |
| spoonplate | arbor sponplate | 22mm | 38,73 | 1760 |
| gypsum board | fermacell gypsum | 12,5mm | 66,02 | 5281 |
| wood sheathing, chipboard | fibo trespo laminated plywood | 36mm | 63,38 | 1760 |
| insulation | glava mineral wool | 198mm | 352,1 | 1760 |
| air/studs | metsa wood i-joist (45 x 200) | | | 6236.1 KG |
| gypsum board | | 12,5mm | | |
| gypsum board | | 12,5mm | | |
| ROOFS | | | | |
| warm roof - wood | | | | |
| roofing felt | protan pvc | 1,2mm | 0,64 | 535 |
| spruce/studs | metsa wood i-joist (45 x 200) | | | 1344.21 KG |
| asphalt bitumen/plastic | tomme plastic vapour layer | 1,5mm | 0,8 | 535 |
| insulation | EPS/mineral wool | 100mm | 53,49 | 535 |
| vapour retarder | tomme plastic vapour layer | 0mm | 0 | 535 |
| wood sheathing, chipboard | fibo trespo laminated plywood | 22mm | 11,77 | 535 |
| rigid insulation | EPS/mineral wool | 350mm | 187,2 | 535 |
| gypsum board | fermacell gypsum | 12,5mm | 13,37 | 535 |
| gypsum board | | 12,5mm | | |

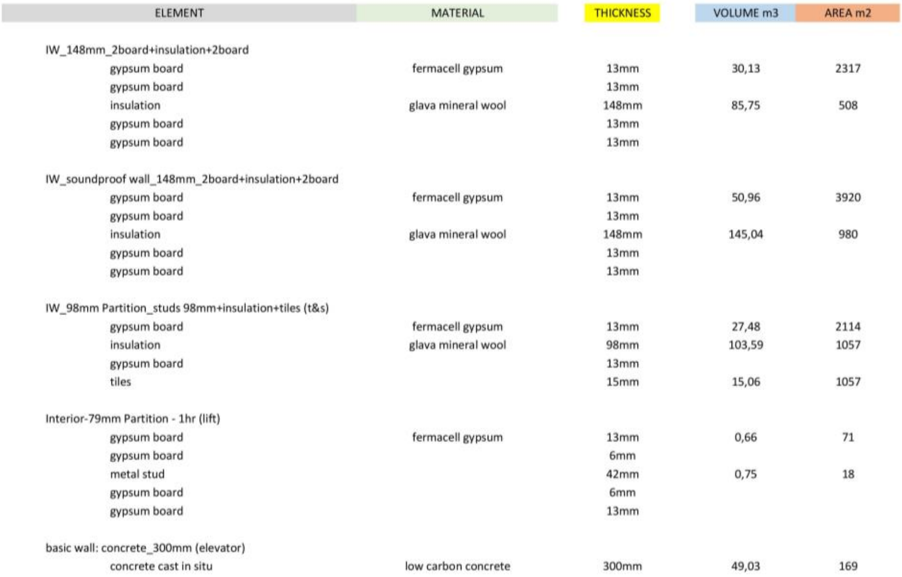
| ELEMENT | MATERIAL | THICKNESS | VOLUME m3 | AREA m2 |
|---|---|---|---|---|
| warm roof - wood (terrace) | | | | |
| wood finish | kebony | 1,2mm | 3,07 | 139 |
| spruce/studs | metsa wood i-joist (45 x 200) | | | 641.39 KG |
| asphalt bitumen/plastic | tomme plastic vapour layer | 1,5mm | 0,21 | 139 |
| insulation | EPS/mineral wool | 100mm | 13,94 | 139 |
| vapour retarder | tomme plastic vapour layer | 0mm | 0 | 139 |
| wood sheathing, chipboard | fibo trespo laminated plywood | 22mm | 3,07 | 139 |
| rigid insulation | EPS/mineral wool | 350mm | 48,78 | 139 |
| gypsum board | fermacell gypsum | 12,5mm | 3,48 | 279 |
| gypsum board | | 12,5mm | | |
| | | | | |
| basic roof: inngang | | | | |
| wood finish | kebony | 38mm | 1,08 | 37 |
| roofing felt | protan pvc | 0mm | 0 | 28 |
| cast in situ | low carbon concrete | 100mm | 2,84 | 28 |
| gypsum board | fermacell gypsum | 13mm | 0,37 | 28 |
| | | | | |
| STAIRS | | | | |
| Cast in place - monolithic stair | | | | |
| concrete cast in situ | precast?/low carbon concrete? | | 31,71 | 344 |
| | | | | |
| DOORS | | | | |
| Panel door | | | | |
| 762 x 2032 | | | 1,17 | 65 |
| 864 x 2032 | | | 5,44 | 293 |
| 915 x 2032 | | | 15,2 | 811 |
| Double door | | | | |
| 1290 x 2090 | | | 0,17 | 18 |
| 1490 x 2090 | | | 0,68 | 69 |
| vent door | | | 0,13 | 13 |

| ELEMENT | MATERIAL | THICKNESS | VOLUME m3 | AREA m2 |
|---|---|---|---|---|
| RAILING | | | | |
| Railing at hallway | | | | |
| wood | | | | |
| Railing at stairs | 336,71 meters | | | |
| wood | | | | |
| | | | | |
| WINDOWS | | | | |
| west | | | | 137,92 |
| south | | | | 89,92 |
| north | | | | 97,57 |
| east | | | | 237,93 |
| | | | | |
| GROUNDWORKS | | | | |
| EEW_wall foundation | | | | |
| concrete cast in situ 500x300 | low carbon concrete | | 43,25 | 88 |
| Glulam_column | | | | |
| 5,125 x 6 | timber | | 0,21 | 6 |
| 20 x 20 | | | 24,08 | 245 |
| Concrete column | | | | |
| 250 x 350 | precast?/low carbon concrete? | | 0,6 | 14 |

# NEW CONSTRUCTED BUILDING

FINAL_NEW CONSTRUCTION (BRA-3482 sqm BTA-3072)

| ELEMENT | MATERIAL | THICKNESS | VOLUME m3 | AREA m2 |
|---|---|---|---|---|
| EXTERIOR WALLS | | | | |
| EW_moelven royal_364mm housing | | | | |
| wood cladding | kebony scott pine | 22mm | 55,9 | 2613 |
| air/stud | metsa wood i-joist (360 x 45) | | | 19523,25 KG |
| vapor retarder | hunton vindtett | 12mm | 0 | 2534 |
| insulation | glava mineral wool | 350mm | 884,83 | 2531 |
| damp proofing | tomme plastic vapour layer | 1mm | 252 | 2508 |
| rigid insulation | | 50mm | 125,79 | 2509 |
| gypsum board | fermacell gypsum | 13mm | 31,42 | 2505 |
| Eksisterende 150mm - betong (additional) | | | | |
| concrete cast in situ | low carbon concrete | 150mm | 11,29 | 75 |
| EEW-250mm-basement_insulated | | | | |
| rigid insulation | glava mineral wool | 98mm | 70,9 | 871 |
| concrete cast in situ | low carbon concrete | 250mm | 72.6 | 290 |
| rigid insulation | | 98mm | | |
| rigid insulation | | 48mm | | |
| gypsum board | fermacell gypsum | 13mm | 3,79 | 290 |
| INTERIOR WALLS | | | | |
| IW_separation wall_198mm_2board+insulation+2board | | | | |
| gypsum board | fermacell gypsum | 13mm | 19,96 | 1536 |
| gypsum board | | 13mm | | |
| insulation | glava mineral wool | 98mm | 100,34 | 1024 |
| air/studs | | 20mm | 10,24 | 512 |
| insulation | | 98mm | | |
| gypsum board | | 13mm | | |
| plaster | gypsum plaster | 13mm | 6,65 | 512 |



| ELEMENT | MATERIAL | THICKNESS | VOLUME m3 | AREA m2 |
|---|---|---|---|---|
| IW_148mm_2board+insulation+2board | | | | |
| gypsum board | fermacell gypsum | 13mm | 30,13 | 2317 |
| gypsum board | | 13mm | | |
| insulation | glava mineral wool | 148mm | 85,75 | 508 |
| gypsum board | | 13mm | | |
| gypsum board | | 13mm | | |
| IW_soundproof wall_148mm_2board+insulation+2board | | | | |
| gypsum board | fermacell gypsum | 13mm | 50,96 | 3920 |
| gypsum board | | 13mm | | |
| insulation | glava mineral wool | 148mm | 145,04 | 980 |
| gypsum board | | 13mm | | |
| gypsum board | | 13mm | | |
| IW_98mm Partition_studs 98mm+insulation+tiles (t&s) | | | | |
| gypsum board | fermacell gypsum | 13mm | 27,48 | 2114 |
| insulation | glava mineral wool | 98mm | 103,59 | 1057 |
| gypsum board | | 13mm | | |
| tiles | | 15mm | 15,06 | 1057 |
| Interior-79mm Partition - 1hr (lift) | | | | |
| gypsum board | fermacell gypsum | 13mm | 0,66 | 71 |
| gypsum board | | 6mm | | |
| metal stud | | 42mm | 0,75 | 18 |
| gypsum board | | 6mm | | |
| gypsum board | | 13mm | | |
| basic wall: concrete_300mm (elevator) | | | | |
| concrete cast in situ | low carbon concrete | 300mm | 49,03 | 169 |

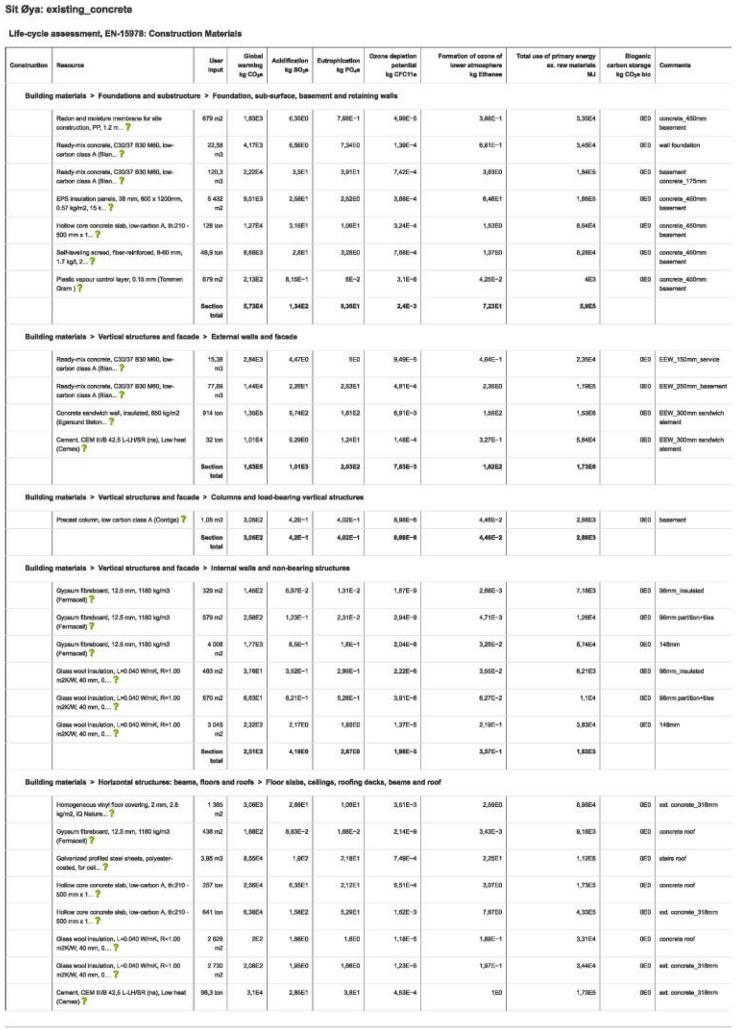
| ELEMENT | | MATERIAL | THICKNESS | VOLUME m3 | AREA m2 |
|---|---|---|---|---|---|
| basic wall: concrete_200mm | | | | | |
| | concrete cast in situ | low carbon concrete | 300mm | 0,47 | 2 |
| FLOORS | | | | | |
| existing concrete_318mm | | | | | |
| | vinyl | | 5mm | 0,08 | 16 |
| | cement screed | heydi leveling screed | 50mm | 0,79 | 16 |
| | concrete cast in situ | hollow core slab | 200mm | 3,14 | 16 |
| | insulation | glava mineral wool | 50mm | 0,79 | 16 |
| | gypsum board | fermacell gypsum | 13mm | 0,2 | 16 |
| existing concrete_318mm no insulation | | | | | |
| | vinyl | | 5mm | 0,14 | 28 |
| | cement screed | heydi leveling screed | 50mm | 1,38 | 28 |
| | concrete cast in situ | hollow core slab | 200mm | 5,5 | 28 |
| | gypsum board | fermacell gypsum | 13mm | 0,36 | 28 |
| concrete_domestic 450mm (new bldg-ground) | | | | | |
| | tiles | | 150mm | 10,67 | 711 |
| | cement screed | heydi leveling screed | 50mm | 35,56 | 711 |
| | plastic | tomme plastic vapour layer | 1mm | 0,71 | 711 |
| | concrete cast in situ | low carbon concrete | 80mm | 56,9 | 711 |
| | vapour retarder | icopal radon membrane | 1mm | 0,71 | 711 |
| | insulation | EPS/XPS | 300mm | 213,36 | 711 |
| exist basement concrete 175mm | | | | | |
| | pavement | asphalt pavement | 175mm | 19,96 | 114 |

| ELEMENT | | MATERIAL | THICKNESS | VOLUME m3 | AREA m2 |
|---|---|---|---|---|---|
| insitu concrete 225mm | | | | | |
| | pavement | asphalt pavement | 50mm | 0,64 | 13 |
| | damp proofing | tomme plastic vapour layer | 0mm | 0 | 13 |
| | concrete cast in situ | low carbon concrete | 175mm | 5,24 | 13 |
| wooden floor | | | | | |
| | wood finish | lamianate wood/parquet | 22mm | 69,48 | 3158 |
| | spoonplate | arbor sponplate | 22mm | 69,48 | 3158 |
| | gypsum board | fermacell gypsum | 12,5mm | 118,44 | 9475 |
| | wood sheathing, chipboard | fibo trespo laminated plywood | 36mm | 113,7 | 3158 |
| | insulation | glava mineral wool | 198mm | 631,68 | 3158 |
| | air/studs | metsa wood i-joist (45 x 200) | | | 9642,9 KG |
| | gypsum board | | 12,5mm | | |
| | gypsum board | | 12,5mm | | |
| ROOFS | | | | | |
| warm roof - wood | | | | | |
| | roofing felt | protan pvc | 1,2mm | 0,64 | 535 |
| | spruce/studs | metsa wood i-joist (45 x 200) | | | 1344.21 KG |
| | asphalt bitumen/plastic | tomme plastic vapour layer | 1,5mm | 0,8 | 535 |
| | insulation | EPS/mineral wool | 100mm | 53,49 | 535 |
| | vapour retarder | tomme plastic vapour layer | 0mm | 0 | 535 |
| | wood sheathing, chipboard | fibo trespo laminated plywood | 22mm | 11,77 | 535 |
| | rigid insulation | EPS/mineral wool | 350mm | 187,2 | 535 |
| | gypsum board | fermacell gypsum | 12,5mm | 13,37 | 535 |
| | gypsum board | | 12,5mm | | |

| ELEMENT | | MATERIAL | THICKNESS | VOLUME m3 | AREA m2 |
|---|---|---|---|---|---|
| warm roof - wood (terrace) | | | | | |
| wood finish | | kebony | 1,2mm | 3,07 | 139 |
| spruce/studs | | metsa wood i-joist (45 x 200) | | | 641.39 KG |
| asphalt bitumen/plastic | | tomme plastic vapour layer | 1,5mm | 0,21 | 139 |
| insulation | | EPS/mineral wool | 100mm | 13,94 | 139 |
| vapour retarder | | tomme plastic vapour layer | 0mm | 0 | 139 |
| wood sheathing, chipboard | | fibo trespo laminated plywood | 22mm | 3,07 | 139 |
| rigid insulation | | EPS/mineral wool | 350mm | 48,78 | 139 |
| gypsum board | | fermacell gypsum | 12,5mm | 3,48 | 279 |
| gypsum board | | | 12,5mm | | |
| basic roof: inngang | | | | | |
| wood finish | | kebony | 38mm | 1,08 | 37 |
| roofing felt | | protan pvc | 0mm | 0 | 28 |
| cast in situ | | low carbon concrete | 100mm | 2,84 | 28 |
| gypsum board | | fermacell gypsum | 13mm | 0,37 | 28 |
| STAIRS | | | | | |
| Cast in place - monolithic stair | | | | | |
| concrete cast in situ | | precast?/low carbon concrete? | | 32,32 | 352 |
| DOORS | | | | | |
| Panel door | | | | | |
| 762 x 2032 | 12 | | | | |
| 864 x 2032 | 50 | | | | |
| 915 x 2032 | 162 | | | | |
| Double door | | | | | |
| 1290 x 2090 | 2 | | | | |
| 1490 x 2090 | 6 | | | | |
| vent door | 1 | | | | |

| ELEMENT | MATERIAL | THICKNESS | VOLUME m3 | AREA m2 |
|---|---|---|---|---|
| RAILING | | | | |
| Railing at hallway | | | | |
| wood | | | | |
| Railing at stairs | 336,71 meters | | | |
| wood | | | | |
| WINDOWS | | | | |
| west | | | | 126 |
| south | | | | 78,41 |
| north | | | | 91,81 |
| east | | | | 226,15 |
| GROUNDWORKS | | | | |
| EEW_wall foundation | | | | |
| concrete cast in situ 500x300 | low carbon concrete | | 80,66 | 163 |
| Glulam_column | | | | |
| 5,125 x 6 | timber | | 0,21 | 6 |
| 20 x 20 | | | 24,08 | 245 |
| Concrete column | | | | |
| 250 x 350 | precast?/low carbon concrete? | | 0,78 | 18 |

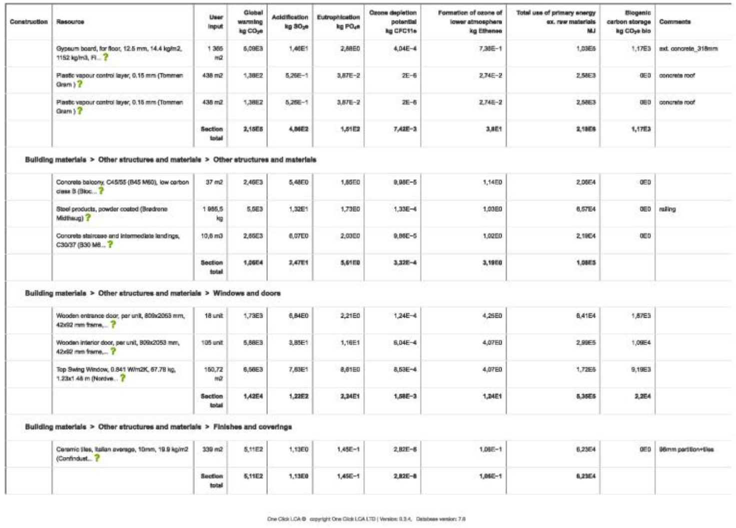
# Appendix B - Materials list in OneClickLCA tool



**Sit Øya: existing_concrete**

**Life-cycle assessment, EN-15978: Construction Materials**

| Construction | Resource | User input | Global warming kg $CO_2e$ | Acidification kg $SO_2e$ | Eutrophication kg $PO_4e$ | Ozone depletion potential kg CFC11e | Formation of ozone of lower atmosphere kg Ethenee | Total use of primary energy ex. raw materials MJ | Biogenic carbon storage kg $CO_2e$ bio | Comments |
|---|---|---|---|---|---|---|---|---|---|---|
| **Building materials > Foundations and substructure > Foundation, sub-surface, basement and retaining walls** | | | | | | | | | | |
| | Radon and moisture membrane for site construction, PP, 1.2 m... ? | 679 m2 | 1,83E3 | 6,35E0 | 7,88E−1 | 4,99E−5 | 3,88E−1 | 3,35E4 | 0E0 | concrete_450mm basement |
| | Ready-mix concrete, C30/37 B30 M60, low-carbon class A (Blan... ? | 22,58 m3 | 4,17E3 | 6,56E0 | 7,34E0 | 1,39E−4 | 6,81E−1 | 3,45E4 | 0E0 | wall foundation |
| | Ready-mix concrete, C30/37 B30 M60, low-carbon class A (Blan... ? | 120,3 m3 | 2,22E4 | 3,5E1 | 3,91E1 | 7,42E−4 | 3,63E0 | 1,84E5 | 0E0 | basement concrete_175mm |
| | EPS insulation panels, 38 mm, 600 x 1200mm, 0.57 kg/m2, 15 k... ? | 5 432 m2 | 9,51E3 | 2,58E1 | 2,52E0 | 3,88E−4 | 6,46E1 | 1,86E5 | 0E0 | concrete_450mm basement |
| | Hollow core concrete slab, low-carbon A, th:210 - 500 mm x 1... ? | 128 ton | 1,27E4 | 3,16E1 | 1,06E1 | 3,24E−4 | 1,53E0 | 8,84E4 | 0E0 | concrete_450mm basement |
| | Self-leveling screed, fiber-reinforced, 8-60 mm, 1.7 kg/l, 2... ? | 48,9 ton | 6,68E3 | 2,8E1 | 3,28E0 | 7,88E−4 | 1,37E0 | 8,28E4 | 0E0 | concrete_450mm basement |
| | Plastic vapour control layer, 0.15 mm (Tommen Gram ) ? | 679 m2 | 2,13E2 | 8,15E−1 | 6E−2 | 3,1E−6 | 4,25E−2 | 4E3 | 0E0 | concrete_450mm basement |
| | | **Section total** | **5,73E4** | **1,34E2** | **8,36E1** | **2,4E−3** | **7,23E1** | **5,9E5** | | |
| **Building materials > Vertical structures and facade > External walls and facade** | | | | | | | | | | |
| | Ready-mix concrete, C30/37 B30 M60, low-carbon class A (Blan... ? | 15,38 m3 | 2,84E3 | 4,47E0 | 5E0 | 9,49E−5 | 4,64E−1 | 2,35E4 | 0E0 | EEW_150mm_service |
| | Ready-mix concrete, C30/37 B30 M60, low-carbon class A (Blan... ? | 77,89 m3 | 1,44E4 | 2,26E1 | 2,53E1 | 4,81E−4 | 2,35E0 | 1,19E5 | 0E0 | EEW_250mm_basement |
| | Concrete sandwich wall, insulated, 850 kg/m2 (Egersund Beton... ? | 914 ton | 1,36E5 | 9,74E2 | 1,61E2 | 6,91E−3 | 1,59E2 | 1,53E6 | 0E0 | EEW_300mm sandwich element |
| | Cement, CEM III/B 42,5 L-LH/SR (na), Low heat (Cemex) ? | 32 ton | 1,01E4 | 9,29E0 | 1,24E1 | 1,48E−4 | 3,27E−1 | 5,84E4 | 0E0 | EEW_300mm sandwich element |
| | | **Section total** | **1,63E5** | **1,01E3** | **2,03E2** | **7,63E−3** | **1,62E2** | **1,73E6** | | |
| **Building materials > Vertical structures and facade > Columns and load-bearing vertical structures** | | | | | | | | | | |
| | Precast column, low carbon class A (Contiga) ? | 1,05 m3 | 3,05E2 | 4,2E−1 | 4,02E−1 | 8,98E−6 | 4,46E−2 | 2,88E3 | 0E0 | basement |
| | | **Section total** | **3,05E2** | **4,2E−1** | **4,02E−1** | **8,98E−6** | **4,46E−2** | **2,88E3** | | |
| **Building materials > Vertical structures and facade > Internal walls and non-bearing structures** | | | | | | | | | | |
| | Gypsum fibreboard, 12.5 mm, 1180 kg/m3 (Fermacell) ? | 329 m2 | 1,46E2 | 6,97E−2 | 1,31E−2 | 1,67E−9 | 2,68E−3 | 7,18E3 | 0E0 | 96mm_insulated |
| | Gypsum fibreboard, 12.5 mm, 1180 kg/m3 (Fermacell) ? | 579 m2 | 2,58E2 | 1,23E−1 | 2,31E−2 | 2,94E−9 | 4,71E−3 | 1,26E4 | 0E0 | 96mm partition+tiles |
| | Gypsum fibreboard, 12.5 mm, 1180 kg/m3 (Fermacell) ? | 4 008 m2 | 1,77E3 | 8,5E−1 | 1,6E−1 | 2,04E−8 | 3,26E−2 | 8,74E4 | 0E0 | 148mm |
| | Glass wool insulation, L=0.040 W/mK, R=1.00 m2K/W, 40 mm, 0.... ? | 493 m2 | 3,76E1 | 3,62E−1 | 2,99E−1 | 2,22E−6 | 3,55E−2 | 6,21E3 | 0E0 | 96mm_insulated |
| | Glass wool insulation, L=0.040 W/mK, R=1.00 m2K/W, 40 mm, 0.... ? | 870 m2 | 6,63E1 | 6,21E−1 | 5,28E−1 | 3,91E−6 | 6,27E−2 | 1,1E4 | 0E0 | 96mm partition+tiles |
| | Glass wool insulation, L=0.040 W/mK, R=1.00 m2K/W, 40 mm, 0.... ? | 3 045 m2 | 2,32E2 | 2,17E0 | 1,85E0 | 1,37E−5 | 2,19E−1 | 3,83E4 | 0E0 | 148mm |
| | | **Section total** | **2,51E3** | **4,19E0** | **2,87E0** | **1,98E−5** | **3,57E−1** | **1,63E5** | | |
| **Building materials > Horizontal structures: beams, floors and roofs > Floor slabs, ceilings, roofing decks, beams and roof** | | | | | | | | | | |
| | Homogeneous vinyl floor covering, 2 mm, 2.8 kg/m2, IQ Nature... ? | 1 365 m2 | 3,06E3 | 2,69E1 | 1,08E1 | 3,51E−3 | 2,59E0 | 8,95E4 | 0E0 | ext. concrete_318mm |
| | Gypsum fibreboard, 12.5 mm, 1180 kg/m3 (Fermacell) ? | 438 m2 | 1,86E2 | 8,83E−2 | 1,68E−2 | 2,14E−9 | 3,43E−3 | 9,18E3 | 0E0 | concrete roof |
| | Galvanized profiled steel sheets, polyester-coated, for ceil... ? | 3,85 m3 | 8,55E4 | 1,9E2 | 2,18E1 | 7,49E−4 | 2,25E1 | 1,12E6 | 0E0 | stairs roof |
| | Hollow core concrete slab, low-carbon A, th:210 - 500 mm x 1... ? | 257 ton | 2,56E4 | 6,35E1 | 2,12E1 | 6,51E−4 | 3,07E0 | 1,73E5 | 0E0 | concrete roof |
| | Hollow core concrete slab, low-carbon A, th:210 - 500 mm x 1... ? | 641 ton | 6,38E4 | 1,58E2 | 5,29E1 | 1,62E−3 | 7,67E0 | 4,33E5 | 0E0 | ext. concrete_318mm |
| | Glass wool insulation, L=0.040 W/mK, R=1.00 m2K/W, 40 mm, 0.... ? | 2 628 m2 | 2E2 | 1,88E0 | 1,6E0 | 1,18E−5 | 1,89E−1 | 3,31E4 | 0E0 | concrete roof |
| | Glass wool insulation, L=0.040 W/mK, R=1.00 m2K/W, 40 mm, 0.... ? | 2 730 m2 | 2,08E2 | 1,95E0 | 1,66E0 | 1,23E−5 | 1,97E−1 | 3,44E4 | 0E0 | ext. concrete_318mm |
| | Cement, CEM III/B 42,5 L-LH/SR (na), Low heat (Cemex) ? | 98,3 ton | 3,1E4 | 2,85E1 | 3,8E1 | 4,53E−4 | 1E0 | 1,73E5 | 0E0 | ext. concrete_318mm |



| Construction | Resource | User input | Global warming kg $CO_2e$ | Acidification kg $SO_2e$ | Eutrophication kg $PO_4e$ | Ozone depletion potential kg CFC11e | Formation of ozone of lower atmosphere kg Ethenee | Total use of primary energy ex. raw materials MJ | Biogenic carbon storage kg $CO_2e$ bio | Comments |
|---|---|---|---|---|---|---|---|---|---|---|
| | Gypsum board, for floor, 12.5 mm, 14.4 kg/m2, 1152 kg/m3, Fl... ? | 1 365 m2 | 6,09E3 | 1,46E1 | 2,68E0 | 4,04E−4 | 7,38E−1 | 1,03E5 | 1,17E3 | ext. concrete_318mm |
| | Plastic vapour control layer, 0.15 mm (Tommen Gram ) ? | 438 m2 | 1,38E2 | 5,26E−1 | 3,87E−2 | 2E−6 | 2,74E−2 | 2,58E3 | 0E0 | concrete roof |
| | Plastic vapour control layer, 0.15 mm (Tommen Gram ) ? | 438 m2 | 1,38E2 | 5,26E−1 | 3,87E−2 | 2E−6 | 2,74E−2 | 2,58E3 | 0E0 | concrete roof |
| | | **Section total** | **2,15E5** | **4,86E2** | **1,61E2** | **7,42E−3** | **3,8E1** | **2,18E6** | **1,17E3** | |
| **Building materials > Other structures and materials > Other structures and materials** | | | | | | | | | | |
| | Concrete balcony, C45/55 (B45 M60), low carbon class B (Bloc... ? | 37 m2 | 2,46E3 | 5,48E0 | 1,85E0 | 9,98E−5 | 1,14E0 | 2,06E4 | 0E0 | |
| | Steel products, powder coated (Brødrene Midthaug) ? | 1 985,5 kg | 5,5E3 | 1,32E1 | 1,73E0 | 1,33E−4 | 1,03E0 | 6,57E4 | 0E0 | railing |
| | Concrete staircase and intermediate landings, C30/37 (B30 M6... ? | 10,6 m3 | 2,65E3 | 6,07E0 | 2,03E0 | 9,86E−5 | 1,02E0 | 2,19E4 | 0E0 | |
| | | **Section total** | **1,06E4** | **2,47E1** | **5,61E0** | **3,32E−4** | **3,19E0** | **1,08E5** | | |
| **Building materials > Other structures and materials > Windows and doors** | | | | | | | | | | |
| | Wooden entrance door, per unit, 809x2053 mm, 42x92 mm frame,... ? | 18 unit | 1,73E3 | 6,84E0 | 2,21E0 | 1,24E−4 | 4,26E0 | 6,41E4 | 1,87E3 | |
| | Wooden interior door, per unit, 809x2053 mm, 42x92 mm frame,... ? | 105 unit | 5,88E3 | 3,85E1 | 1,16E1 | 6,04E−4 | 4,07E0 | 2,99E5 | 1,09E4 | |
| | Top Swing Window, 0.841 W/m2K, 67.78 kg, 1.23x1.48 m (Nordva... ? | 150,72 m2 | 6,56E3 | 7,63E1 | 8,61E0 | 8,53E−4 | 4,07E0 | 1,72E5 | 9,19E3 | |
| | | **Section total** | **1,42E4** | **1,22E2** | **2,24E1** | **1,58E−3** | **1,24E1** | **5,35E5** | **2,2E4** | |
| **Building materials > Other structures and materials > Finishes and coverings** | | | | | | | | | | |
| | Ceramic tiles, Italian average, 10mm, 19.9 kg/m2 (Confindust... ? | 339 m2 | 5,11E2 | 1,13E0 | 1,45E−1 | 2,82E−8 | 1,06E−1 | 6,23E4 | 0E0 | 96mm partition+tiles |
| | | **Section total** | **5,11E2** | **1,13E0** | **1,45E−1** | **2,82E−8** | **1,06E−1** | **6,23E4** | | |

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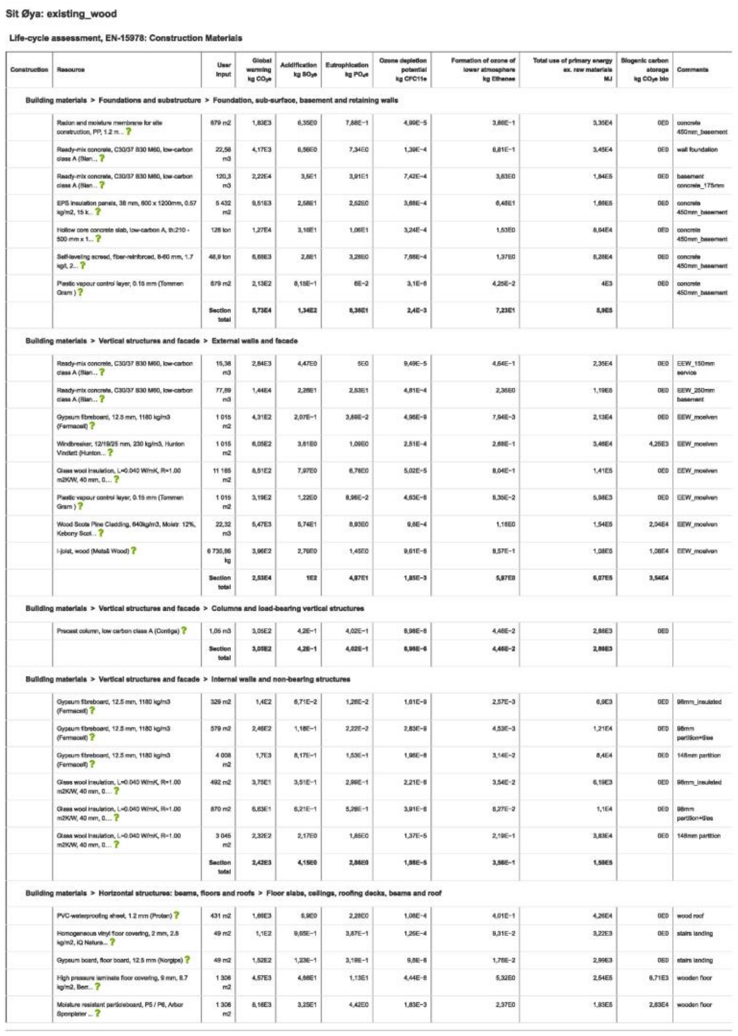
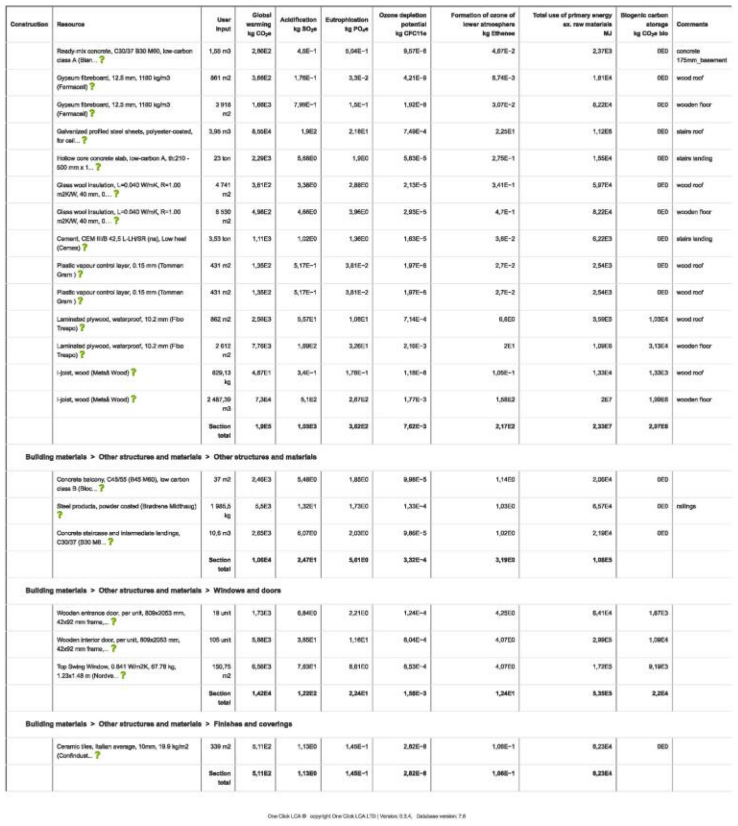


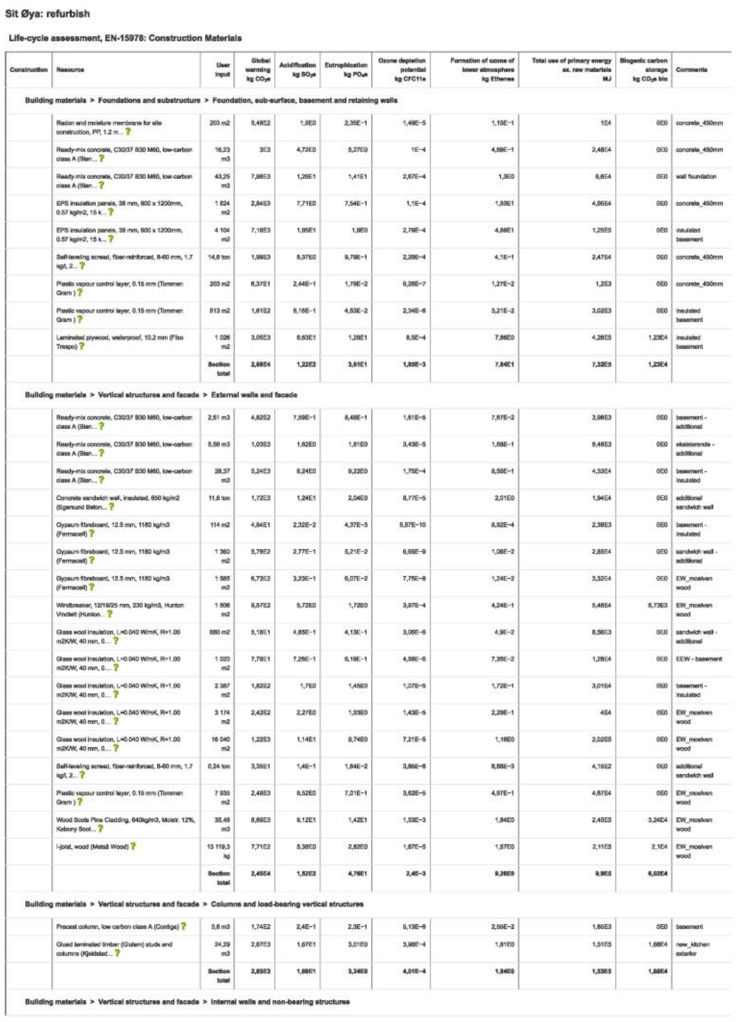
## Sit Øya: existing_wood

### Life-cycle assessment, EN-15978: Construction Materials

| Construction | Resource | User input | Global warming kg $CO_2$e | Acidification kg $SO_2$e | Eutrophication kg $PO_4$e | Ozone depletion potential kg CFC11e | Formation of ozone of lower atmosphere kg Ethenee | Total use of primary energy ex. raw materials MJ | Biogenic carbon storage kg $CO_2$e bio | Comments |
|---|---|---|---|---|---|---|---|---|---|---|
| **Building materials > Foundations and substructure > Foundation, sub-surface, basement and retaining walls** | | | | | | | | | | |
| | Radon and moisture membrane for site construction, PP, 1.2 m... ? | 679 m2 | 1,83E3 | 6,35E0 | 7,88E-1 | 4,99E-5 | 3,88E-1 | 3,35E4 | 0E0 | concrete 450mm_basement |
| | Ready-mix concrete, C30/37 B30 M60, low-carbon class A (Blan... ? | 22,58 m3 | 4,17E3 | 6,56E0 | 7,34E0 | 1,39E-4 | 6,81E-1 | 3,45E4 | 0E0 | wall foundation |
| | Ready-mix concrete, C30/37 B30 M60, low-carbon class A (Blan... ? | 120,3 m3 | 2,22E4 | 3,5E1 | 3,91E1 | 7,42E-4 | 3,63E0 | 1,84E5 | 0E0 | basement concrete_175mm |
| | EPS insulation panels, 38 mm, 600 x 1200mm, 0.57 kg/m2, 15 k... ? | 5 432 m2 | 9,51E3 | 2,58E1 | 2,62E0 | 3,88E-4 | 6,46E1 | 1,66E5 | 0E0 | concrete 450mm_basement |
| | Hollow core concrete slab, low-carbon A, th:210 - 500 mm x 1... ? | 128 ton | 1,27E4 | 3,16E1 | 1,06E1 | 3,24E-4 | 1,53E0 | 8,84E4 | 0E0 | concrete 450mm_basement |
| | Self-leveling screed, fiber-reinforced, 8-60 mm, 1.7 kg/l, 2... ? | 48,9 ton | 6,68E3 | 2,8E1 | 3,28E0 | 7,88E-4 | 1,37E0 | 8,26E4 | 0E0 | concrete 450mm_basement |
| | Plastic vapour control layer, 0.15 mm (Tommen Gram ) ? | 679 m2 | 2,13E2 | 8,15E-1 | 6E-2 | 3,1E-6 | 4,25E-2 | 4E3 | 0E0 | concrete 450mm_basement |
| | | **Section total** | **5,73E4** | **1,34E2** | **6,36E1** | **2,4E-3** | **7,23E1** | **5,9E5** | | |
| **Building materials > Vertical structures and facade > External walls and facade** | | | | | | | | | | |
| | Ready-mix concrete, C30/37 B30 M60, low-carbon class A (Blan... ? | 15,38 m3 | 2,84E3 | 4,47E0 | 5E0 | 9,49E-5 | 4,64E-1 | 2,35E4 | 0E0 | EEW_150mm service |
| | Ready-mix concrete, C30/37 B30 M60, low-carbon class A (Blan... ? | 77,89 m3 | 1,44E4 | 2,26E1 | 2,53E1 | 4,81E-4 | 2,35E0 | 1,19E5 | 0E0 | EEW_250mm basement |
| | Gypsum fibreboard, 12.5 mm, 1180 kg/m3 (Fermacell) ? | 1 015 m2 | 4,31E2 | 2,07E-1 | 3,89E-2 | 4,98E-9 | 7,94E-3 | 2,13E4 | 0E0 | EEW_moelven |
| | Windbreaker, 12/19/25 mm, 230 kg/m3, Hunton Vindtett (Hunton... ? | 1 015 m2 | 6,05E2 | 3,81E0 | 1,09E0 | 2,51E-4 | 2,68E-1 | 3,46E4 | 4,25E3 | EEW_moelven |
| | Glass wool insulation, L=0.040 W/mK, R=1.00 m2K/W, 40 mm, 0... ? | 11 185 m2 | 8,51E2 | 7,97E0 | 6,78E0 | 5,02E-5 | 8,04E-1 | 1,41E5 | 0E0 | EEW_moelven |
| | Plastic vapour control layer, 0.15 mm (Tommen Gram ) ? | 1 015 m2 | 3,19E2 | 1,22E0 | 8,96E-2 | 4,63E-6 | 6,35E-2 | 5,98E3 | 0E0 | EEW_moelven |
| | Wood Scots Pine Cladding, 640kg/m3, Moistr. 12%, Kebony Scot... ? | 22,32 m3 | 5,47E3 | 5,74E1 | 8,93E0 | 9,8E-4 | 1,16E0 | 1,54E5 | 2,04E4 | EEW_moelven |
| | I-joist, wood (Metsä Wood) ? | 6 735,86 kg | 3,96E2 | 2,76E0 | 1,45E0 | 9,61E-6 | 8,57E-1 | 1,08E5 | 1,08E4 | EEW_moelven |
| | | **Section total** | **2,53E4** | **1E2** | **4,87E1** | **1,85E-3** | **5,87E0** | **6,07E5** | **3,54E4** | |
| **Building materials > Vertical structures and facade > Columns and load-bearing vertical structures** | | | | | | | | | | |
| | Precast column, low carbon class A (Contiga) ? | 1,05 m3 | 3,05E2 | 4,2E-1 | 4,02E-1 | 8,98E-6 | 4,46E-2 | 2,88E3 | 0E0 | |
| | | **Section total** | **3,05E2** | **4,2E-1** | **4,02E-1** | **8,98E-6** | **4,46E-2** | **2,88E3** | | |
| **Building materials > Vertical structures and facade > Internal walls and non-bearing structures** | | | | | | | | | | |
| | Gypsum fibreboard, 12.5 mm, 1180 kg/m3 (Fermacell) ? | 329 m2 | 1,4E2 | 6,71E-2 | 1,26E-2 | 1,61E-9 | 2,57E-3 | 6,9E3 | 0E0 | 98mm_insulated |
| | Gypsum fibreboard, 12.5 mm, 1180 kg/m3 (Fermacell) ? | 579 m2 | 2,46E2 | 1,18E-1 | 2,22E-2 | 2,83E-9 | 4,53E-3 | 1,21E4 | 0E0 | 98mm partition+tiles |
| | Gypsum fibreboard, 12.5 mm, 1180 kg/m3 (Fermacell) ? | 4 008 m2 | 1,7E3 | 8,17E-1 | 1,53E-1 | 1,96E-8 | 3,14E-2 | 8,4E4 | 0E0 | 148mm partition |
| | Glass wool insulation, L=0.040 W/mK, R=1.00 m2K/W, 40 mm, 0... ? | 492 m2 | 3,75E1 | 3,51E-1 | 2,99E-1 | 2,21E-6 | 3,54E-2 | 6,19E3 | 0E0 | 98mm_insulated |
| | Glass wool insulation, L=0.040 W/mK, R=1.00 m2K/W, 40 mm, 0... ? | 870 m2 | 6,63E1 | 6,21E-1 | 5,28E-1 | 3,91E-6 | 6,27E-2 | 1,1E4 | 0E0 | 98mm partition+tiles |
| | Glass wool insulation, L=0.040 W/mK, R=1.00 m2K/W, 40 mm, 0... ? | 3 045 m2 | 2,32E2 | 2,17E0 | 1,85E0 | 1,37E-5 | 2,19E-1 | 3,83E4 | 0E0 | 148mm partition |
| | | **Section total** | **2,42E3** | **4,15E0** | **2,86E0** | **1,98E-5** | **3,56E-1** | **1,56E5** | | |
| **Building materials > Horizontal structures: beams, floors and roofs > Floor slabs, ceilings, roofing decks, beams and roof** | | | | | | | | | | |
| | PVC-waterproofing sheet, 1.2 mm (Protan) ? | 431 m2 | 1,66E3 | 6,9E0 | 2,28E0 | 1,08E-4 | 4,01E-1 | 4,26E4 | 0E0 | wood roof |
| | Homogeneous vinyl floor covering, 2 mm, 2.8 kg/m2, IQ Natura... ? | 49 m2 | 1,1E2 | 9,65E-1 | 3,87E-1 | 1,26E-4 | 9,31E-2 | 3,22E3 | 0E0 | stairs landing |
| | Gypsum board, floor board, 12.5 mm (Norgips) ? | 49 m2 | 1,52E2 | 1,23E-1 | 3,19E-1 | 9,8E-6 | 1,76E-2 | 2,99E3 | 0E0 | stairs landing |
| | High pressure laminate floor covering, 9 mm, 8.7 kg/m2, Berr... ? | 1 306 m2 | 4,57E3 | 4,66E1 | 1,13E1 | 4,44E-6 | 5,32E0 | 2,54E5 | 6,71E3 | wooden floor |
| | Moisture resistant particleboard, P5 / P6, Arbor Sponplater ... ? | 1 306 m2 | 8,16E3 | 3,25E1 | 4,42E0 | 1,83E-3 | 2,37E0 | 1,93E5 | 2,83E4 | wooden floor |



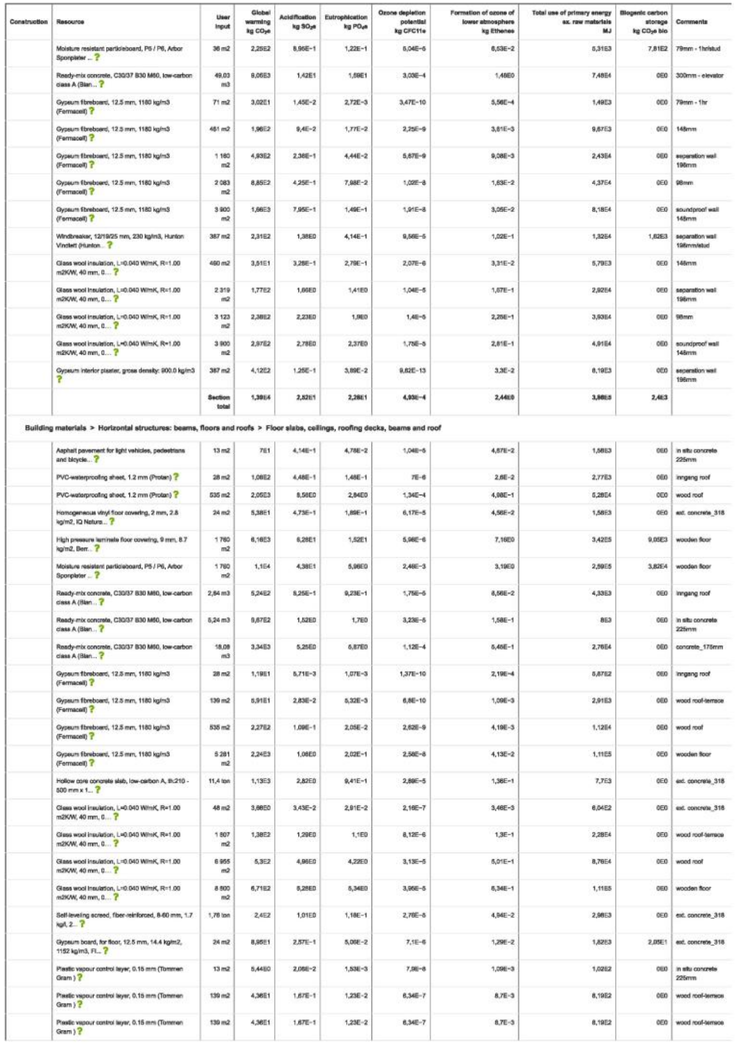
| Construction | Resource | User input | Global warming kg $CO_2$e | Acidification kg $SO_2$e | Eutrophication kg $PO_4$e | Ozone depletion potential kg CFC11e | Formation of ozone of lower atmosphere kg Ethenee | Total use of primary energy ex. raw materials MJ | Biogenic carbon storage kg $CO_2$e bio | Comments |
|---|---|---|---|---|---|---|---|---|---|---|
| | Ready-mix concrete, C30/37 B30 M60, low-carbon class A (Blan... ? | 1,55 m3 | 2,86E2 | 4,5E-1 | 5,04E-1 | 9,57E-6 | 4,67E-2 | 2,37E3 | 0E0 | concrete 175mm_basement |
| | Gypsum fibreboard, 12.5 mm, 1180 kg/m3 (Fermacell) ? | 861 m2 | 3,66E2 | 1,76E-1 | 3,3E-2 | 4,21E-9 | 6,74E-3 | 1,81E4 | 0E0 | wood roof |
| | Gypsum fibreboard, 12.5 mm, 1180 kg/m3 (Fermacell) ? | 3 918 m2 | 1,66E3 | 7,99E-1 | 1,5E-1 | 1,92E-8 | 3,07E-2 | 8,22E4 | 0E0 | wooden floor |
| | Galvanized profiled steel sheets, polyester-coated, for ceil... ? | 3,95 m3 | 8,55E4 | 1,9E2 | 2,18E1 | 7,49E-4 | 2,25E1 | 1,12E6 | 0E0 | stairs roof |
| | Hollow core concrete slab, low-carbon A, th:210 - 500 mm x 1... ? | 23 ton | 2,29E3 | 5,68E0 | 1,9E0 | 5,83E-5 | 2,75E-1 | 1,55E4 | 0E0 | stairs landing |
| | Glass wool insulation, L=0.040 W/mK, R=1.00 m2K/W, 40 mm, 0... ? | 4 741 m2 | 3,61E2 | 3,38E0 | 2,88E0 | 2,13E-5 | 3,41E-1 | 5,97E4 | 0E0 | wood roof |
| | Glass wool insulation, L=0.040 W/mK, R=1.00 m2K/W, 40 mm, 0... ? | 6 530 m2 | 4,98E2 | 4,66E0 | 3,96E0 | 2,93E-5 | 4,7E-1 | 8,22E4 | 0E0 | wooden floor |
| | Cement, CEM III/B 42,5 L-LH/SR (na), Low heat (Cemex) ? | 3,53 ton | 1,11E3 | 1,02E0 | 1,36E0 | 1,63E-5 | 3,6E-2 | 6,22E3 | 0E0 | stairs landing |
| | Plastic vapour control layer, 0.15 mm (Tommen Gram ) ? | 431 m2 | 1,35E2 | 5,17E-1 | 3,81E-2 | 1,97E-6 | 2,7E-2 | 2,54E3 | 0E0 | wood roof |
| | Plastic vapour control layer, 0.15 mm (Tommen Gram ) ? | 431 m2 | 1,35E2 | 5,17E-1 | 3,81E-2 | 1,97E-6 | 2,7E-2 | 2,54E3 | 0E0 | wood roof |
| | Laminated plywood, waterproof, 10.2 mm (Fibo Trespo) ? | 862 m2 | 2,56E3 | 5,57E1 | 1,08E1 | 7,14E-4 | 6,6E0 | 3,59E5 | 1,03E4 | wood roof |
| | Laminated plywood, waterproof, 10.2 mm (Fibo Trespo) ? | 2 612 m2 | 7,76E3 | 1,69E2 | 3,26E1 | 2,16E-3 | 2E1 | 1,09E6 | 3,13E4 | wooden floor |
| | I-joist, wood (Metsä Wood) ? | 829,13 kg | 4,87E1 | 3,4E-1 | 1,78E-1 | 1,18E-6 | 1,05E-1 | 1,33E4 | 1,33E3 | wood roof |
| | I-joist, wood (Metsä Wood) ? | 2 487,39 m3 | 7,3E4 | 5,1E2 | 2,87E2 | 1,77E-3 | 1,58E2 | 2E7 | 1,99E6 | wooden floor |
| | | **Section total** | **1,9E5** | **1,03E3** | **3,62E2** | **7,62E-3** | **2,17E2** | **2,33E7** | **2,07E6** | |
| **Building materials > Other structures and materials > Other structures and materials** | | | | | | | | | | |
| | Concrete balcony, C45/55 (B45 M60), low carbon class B (Bloc... ? | 37 m2 | 2,46E3 | 5,48E0 | 1,85E0 | 9,98E-5 | 1,14E0 | 2,06E4 | 0E0 | |
| | Steel products, powder coated (Brødrene Midthaug) ? | 1 985,5 kg | 5,5E3 | 1,32E1 | 1,73E0 | 1,33E-4 | 1,03E0 | 6,57E4 | 0E0 | railings |
| | Concrete staircase and intermediate landings, C30/37 (B30 M6... ? | 10,6 m3 | 2,65E3 | 6,07E0 | 2,03E0 | 9,86E-5 | 1,02E0 | 2,19E4 | 0E0 | |
| | | **Section total** | **1,06E4** | **2,47E1** | **5,61E0** | **3,32E-4** | **3,19E0** | **1,08E5** | | |
| **Building materials > Other structures and materials > Windows and doors** | | | | | | | | | | |
| | Wooden entrance door, per unit, 809x2053 mm, 42x92 mm frame,... ? | 18 unit | 1,73E3 | 6,84E0 | 2,21E0 | 1,24E-4 | 4,25E0 | 6,41E4 | 1,87E3 | |
| | Wooden interior door, per unit, 809x2053 mm, 42x92 mm frame,... ? | 105 unit | 5,88E3 | 3,85E1 | 1,16E1 | 8,04E-4 | 4,07E0 | 2,99E5 | 1,09E4 | |
| | Top Swing Window, 0.841 W/m2K, 67.78 kg, 1.23x1.48 m (Nordvø... ? | 150,75 m2 | 6,56E3 | 7,63E1 | 8,61E0 | 6,53E-4 | 4,07E0 | 1,72E5 | 9,19E3 | |
| | | **Section total** | **1,42E4** | **1,22E2** | **2,24E1** | **1,58E-3** | **1,24E1** | **5,35E5** | **2,2E4** | |
| **Building materials > Other structures and materials > Finishes and coverings** | | | | | | | | | | |
| | Ceramic tiles, Italian average, 10mm, 19.9 kg/m2 (Confindust... ? | 339 m2 | 5,11E2 | 1,13E0 | 1,45E-1 | 2,82E-8 | 1,06E-1 | 6,23E4 | 0E0 | |
| | | **Section total** | **5,11E2** | **1,13E0** | **1,45E-1** | **2,82E-8** | **1,06E-1** | **6,23E4** | | |



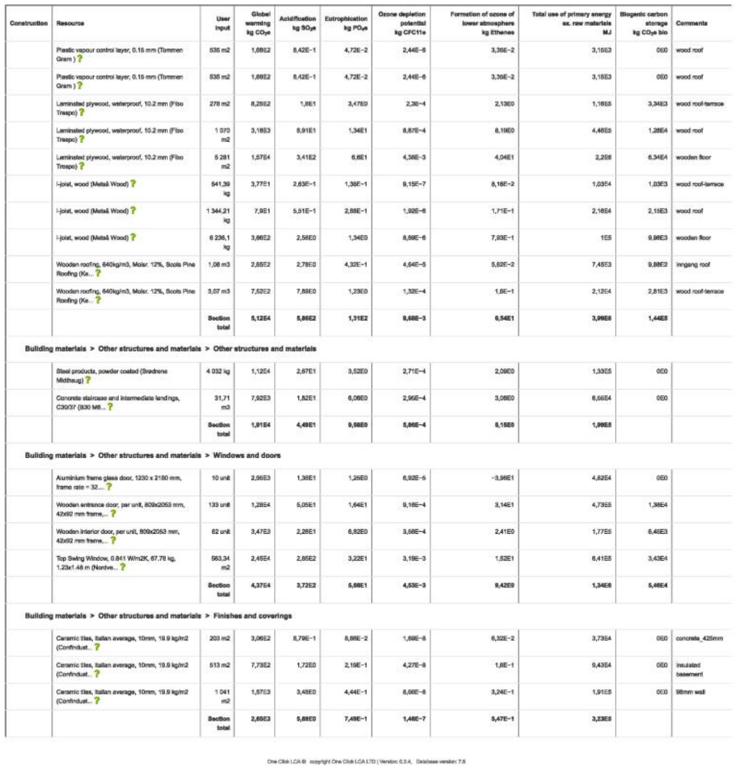
## Sit Øya: refurbish

### Life-cycle assessment, EN-15978: Construction Materials

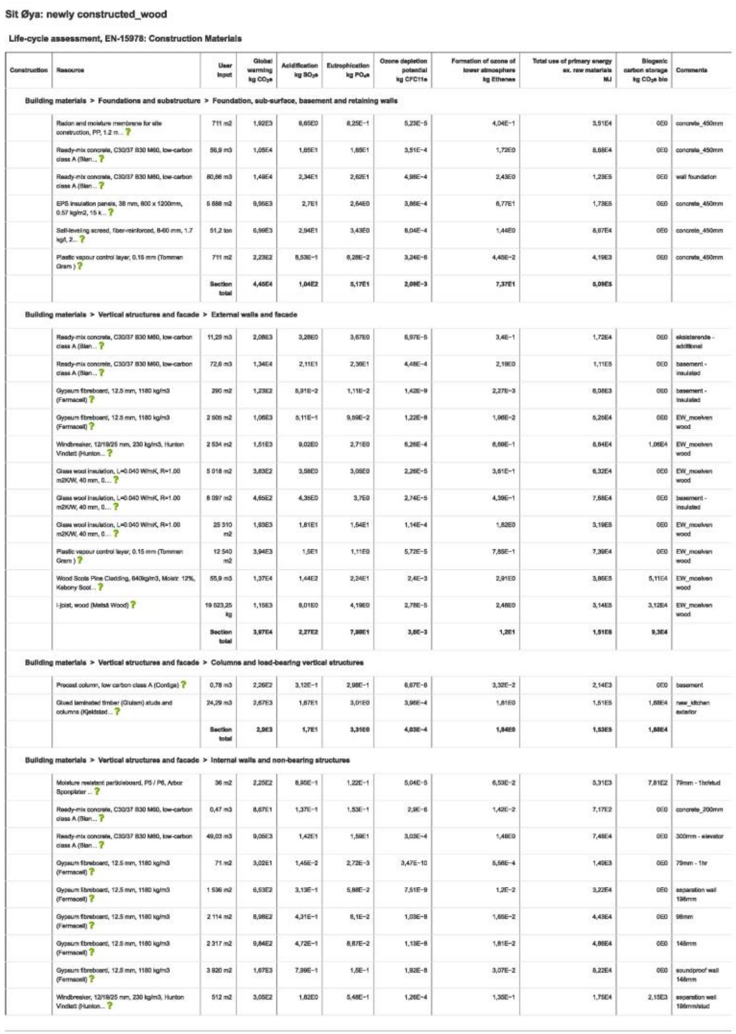
| Construction | Resource | User input | Global warming kg $CO_2e$ | Acidification kg $SO_2e$ | Eutrophication kg $PO_4e$ | Ozone depletion potential kg CFC11e | Formation of ozone of lower atmosphere kg Ethenes | Total use of primary energy ex. raw materials MJ | Biogenic carbon storage kg $CO_2e$ bio | Comments |
|---|---|---|---|---|---|---|---|---|---|---|
| **Building materials > Foundations and substructure > Foundation, sub-surface, basement and retaining walls** | | | | | | | | | | |
| | Radon and moisture membrane for site construction, PP, 1.2 m... ? | 203 m2 | 5,48E2 | 1,9E0 | 2,35E-1 | 1,49E-5 | 1,15E-1 | 1E4 | 0E0 | concrete_450mm |
| | Ready-mix concrete, C30/37 B30 M60, low-carbon class A (Blan... ? | 16,23 m3 | 3E3 | 4,72E0 | 5,27E0 | 1E-4 | 4,89E-1 | 2,48E4 | 0E0 | concrete_450mm |
| | Ready-mix concrete, C30/37 B30 M60, low-carbon class A (Blan... ? | 43,25 m3 | 7,98E3 | 1,26E1 | 1,41E1 | 2,67E-4 | 1,3E0 | 6,6E4 | 0E0 | wall foundation |
| | EPS insulation panels, 38 mm, 600 x 1200mm, 0.57 kg/m2, 15 k... ? | 1 624 m2 | 2,84E3 | 7,71E0 | 7,54E-1 | 1,1E-4 | 1,93E1 | 4,96E4 | 0E0 | concrete_450mm |
| | EPS insulation panels, 38 mm, 600 x 1200mm, 0.57 kg/m2, 15 k... ? | 4 104 m2 | 7,18E3 | 1,95E1 | 1,9E0 | 2,78E-4 | 4,88E1 | 1,25E5 | 0E0 | insulated basement |
| | Self-leveling screed, fiber-reinforced, 8-60 mm, 1.7 kg/l, 2... ? | 14,6 ton | 1,99E3 | 8,37E0 | 9,79E-1 | 2,29E-4 | 4,1E-1 | 2,47E4 | 0E0 | concrete_450mm |
| | Plastic vapour control layer, 0.15 mm (Tommen Gram ) ? | 203 m2 | 6,37E1 | 2,44E-1 | 1,79E-2 | 9,28E-7 | 1,27E-2 | 1,2E3 | 0E0 | concrete_450mm |
| | Plastic vapour control layer, 0.15 mm (Tommen Gram ) ? | 513 m2 | 1,61E2 | 6,16E-1 | 4,53E-2 | 2,34E-6 | 3,21E-2 | 3,02E3 | 0E0 | insulated basement |
| | Laminated plywood, waterproof, 10.2 mm (Fibo Trespo) ? | 1 026 m2 | 3,05E3 | 6,63E1 | 1,28E1 | 8,5E-4 | 7,86E0 | 4,28E5 | 1,23E4 | insulated basement |
| | | **Section total** | **2,68E4** | **1,22E2** | **3,61E1** | **1,85E-3** | **7,84E1** | **7,32E5** | **1,23E4** | |
| **Building materials > Vertical structures and facade > External walls and facade** | | | | | | | | | | |
| | Ready-mix concrete, C30/37 B30 M60, low-carbon class A (Blan... ? | 2,61 m3 | 4,82E2 | 7,59E-1 | 8,48E-1 | 1,61E-5 | 7,87E-2 | 3,98E3 | 0E0 | basement - additional |
| | Ready-mix concrete, C30/37 B30 M60, low-carbon class A (Blan... ? | 5,56 m3 | 1,03E3 | 1,62E0 | 1,81E0 | 3,43E-5 | 1,68E-1 | 8,48E3 | 0E0 | eksisterende - additional |
| | Ready-mix concrete, C30/37 B30 M60, low-carbon class A (Blan... ? | 28,37 m3 | 5,24E3 | 8,24E0 | 9,22E0 | 1,75E-4 | 8,55E-1 | 4,33E4 | 0E0 | basement - insulated |
| | Concrete sandwich wall, insulated, 650 kg/m2 (Egersund Beton... ? | 11,6 ton | 1,72E3 | 1,24E1 | 2,04E0 | 8,77E-5 | 2,01E0 | 1,94E4 | 0E0 | additional sandwich wall |
| | Gypsum fibreboard, 12.5 mm, 1180 kg/m3 (Fermacell) ? | 114 m2 | 4,84E1 | 2,32E-2 | 4,37E-3 | 5,57E-10 | 8,82E-4 | 2,39E3 | 0E0 | basement - insulated |
| | Gypsum fibreboard, 12.5 mm, 1180 kg/m3 (Fermacell) ? | 1 360 m2 | 5,78E2 | 2,77E-1 | 5,21E-2 | 6,65E-9 | 1,06E-2 | 2,85E4 | 0E0 | sandwich wall - additional |
| | Gypsum fibreboard, 12.5 mm, 1180 kg/m3 (Fermacell) ? | 1 585 m2 | 6,73E2 | 3,23E-1 | 6,07E-2 | 7,75E-9 | 1,24E-2 | 3,32E4 | 0E0 | EW_moelven wood |
| | Windbreaker, 12/19/25 mm, 230 kg/m3, Hunton Vindtett (Hunton... ? | 1 606 m2 | 9,57E2 | 5,72E0 | 1,72E0 | 3,97E-4 | 4,24E-1 | 5,48E4 | 6,73E3 | EW_moelven wood |
| | Glass wool insulation, L=0.040 W/mK, R=1.00 m2K/W, 40 mm, 0... ? | 680 m2 | 5,18E1 | 4,85E-1 | 4,13E-1 | 3,06E-6 | 4,9E-2 | 8,56E3 | 0E0 | sandwich wall - additional |
| | Glass wool insulation, L=0.040 W/mK, R=1.00 m2K/W, 40 mm, 0... ? | 1 020 m2 | 7,78E1 | 7,28E-1 | 6,19E-1 | 4,58E-6 | 7,35E-2 | 1,28E4 | 0E0 | EEW - basement |
| | Glass wool insulation, L=0.040 W/mK, R=1.00 m2K/W, 40 mm, 0... ? | 2 387 m2 | 1,82E2 | 1,7E0 | 1,45E0 | 1,07E-5 | 1,72E-1 | 3,01E4 | 0E0 | basement - insulated |
| | Glass wool insulation, L=0.040 W/mK, R=1.00 m2K/W, 40 mm, 0... ? | 3 174 m2 | 2,42E2 | 2,27E0 | 1,93E0 | 1,43E-5 | 2,29E-1 | 4E4 | 0E0 | EW_moelven wood |
| | Glass wool insulation, L=0.040 W/mK, R=1.00 m2K/W, 40 mm, 0... ? | 16 040 m2 | 1,22E3 | 1,14E1 | 9,74E0 | 7,21E-5 | 1,16E0 | 2,02E5 | 0E0 | EW_moelven wood |
| | Self-leveling screed, fiber-reinforced, 8-60 mm, 1.7 kg/l, 2... ? | 0,24 ton | 3,35E1 | 1,4E-1 | 1,84E-2 | 3,86E-6 | 6,88E-3 | 4,15E2 | 0E0 | additional sandwich wall |
| | Plastic vapour control layer, 0.15 mm (Tommen Gram ) ? | 7 935 m2 | 2,49E3 | 9,52E0 | 7,01E-1 | 3,62E-5 | 4,97E-1 | 4,67E4 | 0E0 | EW_moelven wood |
| | Wood Scots Pine Cladding, 640kg/m3, Moistr. 12%, Kebony Scot... ? | 35,48 m3 | 8,69E3 | 9,12E1 | 1,42E1 | 1,53E-3 | 1,84E0 | 2,45E5 | 3,24E4 | EW_moelven wood |
| | I-joist, wood (Metsä Wood) ? | 13 119,3 kg | 7,71E2 | 5,38E0 | 2,82E0 | 1,87E-5 | 1,67E0 | 2,11E5 | 2,1E4 | EW_moelven wood |
| | | **Section total** | **2,45E4** | **1,52E2** | **4,76E1** | **2,4E-3** | **9,26E0** | **9,9E5** | **6,02E4** | |
| **Building materials > Vertical structures and facade > Columns and load-bearing vertical structures** | | | | | | | | | | |
| | Precast column, low carbon class A (Contiga) ? | 0,6 m3 | 1,74E2 | 2,4E-1 | 2,3E-1 | 5,13E-6 | 2,56E-2 | 1,86E3 | 0E0 | basement |
| | Glued laminated timber (Glulam) studs and columns (Kjeldstad... ? | 24,29 m3 | 2,67E3 | 1,67E1 | 3,01E0 | 3,96E-4 | 1,81E0 | 1,51E5 | 1,68E4 | new_kitchen exterior |
| | | **Section total** | **2,85E3** | **1,69E1** | **3,24E0** | **4,01E-4** | **1,84E0** | **1,53E5** | **1,68E4** | |
| **Building materials > Vertical structures and facade > Internal walls and non-bearing structures** | | | | | | | | | | |



| Construction | Resource | User input | Global warming kg $CO_2e$ | Acidification kg $SO_2e$ | Eutrophication kg $PO_4e$ | Ozone depletion potential kg CFC11e | Formation of ozone of lower atmosphere kg Ethenes | Total use of primary energy ex. raw materials MJ | Biogenic carbon storage kg $CO_2e$ bio | Comments |
|---|---|---|---|---|---|---|---|---|---|---|
| | Moisture resistant particleboard, P5 / P6, Arbor Sponplater ... ? | 36 m2 | 2,25E2 | 8,96E-1 | 1,22E-1 | 5,04E-6 | 6,53E-2 | 5,31E3 | 7,81E2 | 79mm - 1hr/stud |
| | Ready-mix concrete, C30/37 B30 M60, low-carbon class A (Blan... ? | 49,03 m3 | 9,06E3 | 1,42E1 | 1,59E1 | 3,03E-4 | 1,48E0 | 7,48E4 | 0E0 | 300mm - elevator |
| | Gypsum fibreboard, 12.5 mm, 1180 kg/m3 (Fermacell) ? | 71 m2 | 3,02E1 | 1,45E-2 | 2,72E-3 | 3,47E-10 | 5,56E-4 | 1,49E3 | 0E0 | 79mm - 1hr |
| | Gypsum fibreboard, 12.5 mm, 1180 kg/m3 (Fermacell) ? | 461 m2 | 1,96E2 | 9,4E-2 | 1,77E-2 | 2,25E-9 | 3,61E-3 | 9,67E3 | 0E0 | 148mm |
| | Gypsum fibreboard, 12.5 mm, 1180 kg/m3 (Fermacell) ? | 1 160 m2 | 4,93E2 | 2,36E-1 | 4,44E-2 | 5,67E-9 | 9,08E-3 | 2,43E4 | 0E0 | separation wall 198mm |
| | Gypsum fibreboard, 12.5 mm, 1180 kg/m3 (Fermacell) ? | 2 083 m2 | 8,85E2 | 4,25E-1 | 7,98E-2 | 1,02E-8 | 1,63E-2 | 4,37E4 | 0E0 | 98mm |
| | Gypsum fibreboard, 12.5 mm, 1180 kg/m3 (Fermacell) ? | 3 900 m2 | 1,66E3 | 7,95E-1 | 1,49E-1 | 1,91E-8 | 3,05E-2 | 8,18E4 | 0E0 | soundproof wall 148mm |
| | Windbreaker, 12/19/25 mm, 230 kg/m3, Hunton Vindtett (Hunton... ? | 387 m2 | 2,31E2 | 1,38E0 | 4,14E-1 | 9,56E-5 | 1,02E-1 | 1,32E4 | 1,62E3 | separation wall 198mm/stud |
| | Glass wool insulation, L=0.040 W/mK, R=1.00 m2K/W, 40 mm, 0... ? | 460 m2 | 3,51E1 | 3,28E-1 | 2,79E-1 | 2,07E-6 | 3,31E-2 | 5,79E3 | 0E0 | 148mm |
| | Glass wool insulation, L=0.040 W/mK, R=1.00 m2K/W, 40 mm, 0... ? | 2 319 m2 | 1,77E2 | 1,66E0 | 1,41E0 | 1,04E-5 | 1,67E-1 | 2,92E4 | 0E0 | separation wall 198mm |
| | Glass wool insulation, L=0.040 W/mK, R=1.00 m2K/W, 40 mm, 0... ? | 3 123 m2 | 2,38E2 | 2,23E0 | 1,9E0 | 1,4E-5 | 2,25E-1 | 3,93E4 | 0E0 | 98mm |
| | Glass wool insulation, L=0.040 W/mK, R=1.00 m2K/W, 40 mm, 0... ? | 3 900 m2 | 2,97E2 | 2,78E0 | 2,37E0 | 1,75E-5 | 2,81E-1 | 4,91E4 | 0E0 | soundproof wall 148mm |
| | Gypsum interior plaster, gross density: 900.0 kg/m3 ? | 387 m2 | 4,12E2 | 1,25E-1 | 3,89E-2 | 9,62E-13 | 3,3E-2 | 8,19E3 | 0E0 | separation wall 198mm |
| | | **Section total** | **1,39E4** | **2,52E1** | **2,28E1** | **4,93E-4** | **2,44E0** | **3,86E5** | **2,4E3** | |
| **Building materials > Horizontal structures: beams, floors and roofs > Floor slabs, ceilings, roofing decks, beams and roof** | | | | | | | | | | |
| | Asphalt pavement for light vehicles, pedestrians and bicycle... ? | 13 m2 | 7E1 | 4,14E-1 | 4,78E-2 | 1,04E-5 | 4,67E-2 | 1,56E3 | 0E0 | in situ concrete 225mm |
| | PVC-waterproofing sheet, 1.2 mm (Protan) ? | 28 m2 | 1,08E2 | 4,48E-1 | 1,48E-1 | 7E-6 | 2,8E-2 | 2,77E3 | 0E0 | inngang roof |
| | PVC-waterproofing sheet, 1.2 mm (Protan) ? | 535 m2 | 2,05E3 | 8,56E0 | 2,84E0 | 1,34E-4 | 4,98E-1 | 5,28E4 | 0E0 | wood roof |
| | Homogeneous vinyl floor covering, 2 mm, 2.8 kg/m2, IQ Natura... ? | 24 m2 | 5,38E1 | 4,73E-1 | 1,89E-1 | 6,17E-5 | 4,56E-2 | 1,58E3 | 0E0 | ext. concrete_318 |
| | High pressure laminate floor covering, 9 mm, 8.7 kg/m2, Berr... ? | 1 760 m2 | 6,16E3 | 6,28E1 | 1,52E1 | 5,98E-6 | 7,16E0 | 3,42E5 | 9,05E3 | wooden floor |
| | Moisture resistant particleboard, P5 / P6, Arbor Sponplater ... ? | 1 760 m2 | 1,1E4 | 4,38E1 | 5,98E0 | 2,48E-3 | 3,19E0 | 2,59E5 | 3,82E4 | wooden floor |
| | Ready-mix concrete, C30/37 B30 M60, low-carbon class A (Blan... ? | 2,84 m3 | 5,24E2 | 8,25E-1 | 9,23E-1 | 1,75E-5 | 8,56E-2 | 4,33E3 | 0E0 | inngang roof |
| | Ready-mix concrete, C30/37 B30 M60, low-carbon class A (Blan... ? | 5,24 m3 | 9,67E2 | 1,52E0 | 1,7E0 | 3,23E-5 | 1,58E-1 | 8E3 | 0E0 | in situ concrete 225mm |
| | Ready-mix concrete, C30/37 B30 M60, low-carbon class A (Blan... ? | 18,09 m3 | 3,34E3 | 5,25E0 | 5,87E0 | 1,12E-4 | 5,46E-1 | 2,76E4 | 0E0 | concrete_175mm |
| | Gypsum fibreboard, 12.5 mm, 1180 kg/m3 (Fermacell) ? | 28 m2 | 1,19E1 | 5,71E-3 | 1,07E-3 | 1,37E-10 | 2,19E-4 | 5,87E2 | 0E0 | inngang roof |
| | Gypsum fibreboard, 12.5 mm, 1180 kg/m3 (Fermacell) ? | 139 m2 | 5,91E1 | 2,83E-2 | 5,32E-3 | 6,8E-10 | 1,09E-3 | 2,91E3 | 0E0 | wood roof-terrace |
| | Gypsum fibreboard, 12.5 mm, 1180 kg/m3 (Fermacell) ? | 535 m2 | 2,27E2 | 1,09E-1 | 2,05E-2 | 2,62E-9 | 4,19E-3 | 1,12E4 | 0E0 | wood roof |
| | Gypsum fibreboard, 12.5 mm, 1180 kg/m3 (Fermacell) ? | 5 281 m2 | 2,24E3 | 1,08E0 | 2,02E-1 | 2,58E-8 | 4,13E-2 | 1,11E5 | 0E0 | wooden floor |
| | Hollow core concrete slab, low-carbon A, th:210 - 500 mm x 1... ? | 11,4 ton | 1,13E3 | 2,82E0 | 9,41E-1 | 2,89E-5 | 1,36E-1 | 7,7E3 | 0E0 | ext. concrete_318 |
| | Glass wool insulation, L=0.040 W/mK, R=1.00 m2K/W, 40 mm, 0... ? | 48 m2 | 3,68E0 | 3,43E-2 | 2,91E-2 | 2,16E-7 | 3,46E-3 | 6,04E2 | 0E0 | ext. concrete_318 |
| | Glass wool insulation, L=0.040 W/mK, R=1.00 m2K/W, 40 mm, 0... ? | 1 807 m2 | 1,38E2 | 1,29E0 | 1,1E0 | 8,12E-6 | 1,3E-1 | 2,28E4 | 0E0 | wood roof-terrace |
| | Glass wool insulation, L=0.040 W/mK, R=1.00 m2K/W, 40 mm, 0... ? | 6 955 m2 | 5,3E2 | 4,96E0 | 4,22E0 | 3,13E-5 | 5,01E-1 | 8,76E4 | 0E0 | wood roof |
| | Glass wool insulation, L=0.040 W/mK, R=1.00 m2K/W, 40 mm, 0... ? | 8 800 m2 | 6,71E2 | 6,28E0 | 5,34E0 | 3,96E-5 | 6,34E-1 | 1,11E5 | 0E0 | wooden floor |
| | Self-leveling screed, fiber-reinforced, 8-60 mm, 1.7 kg/l, 2... ? | 1,76 ton | 2,4E2 | 1,01E0 | 1,18E-1 | 2,76E-5 | 4,94E-2 | 2,98E3 | 0E0 | ext. concrete_318 |
| | Gypsum board, for floor, 12.5 mm, 14.4 kg/m2, 1152 kg/m3, Fl... ? | 24 m2 | 8,96E1 | 2,57E-1 | 5,06E-2 | 7,1E-6 | 1,29E-2 | 1,82E3 | 2,05E1 | ext. concrete_318 |
| | Plastic vapour control layer, 0.15 mm (Tommen Gram ) ? | 13 m2 | 5,44E0 | 2,08E-2 | 1,53E-3 | 7,9E-8 | 1,09E-3 | 1,02E2 | 0E0 | in situ concrete 225mm |
| | Plastic vapour control layer, 0.15 mm (Tommen Gram ) ? | 139 m2 | 4,36E1 | 1,67E-1 | 1,23E-2 | 6,34E-7 | 8,7E-3 | 8,19E2 | 0E0 | wood roof-terrace |
| | Plastic vapour control layer, 0.15 mm (Tommen Gram ) ? | 139 m2 | 4,36E1 | 1,67E-1 | 1,23E-2 | 6,34E-7 | 8,7E-3 | 8,19E2 | 0E0 | wood roof-terrace |



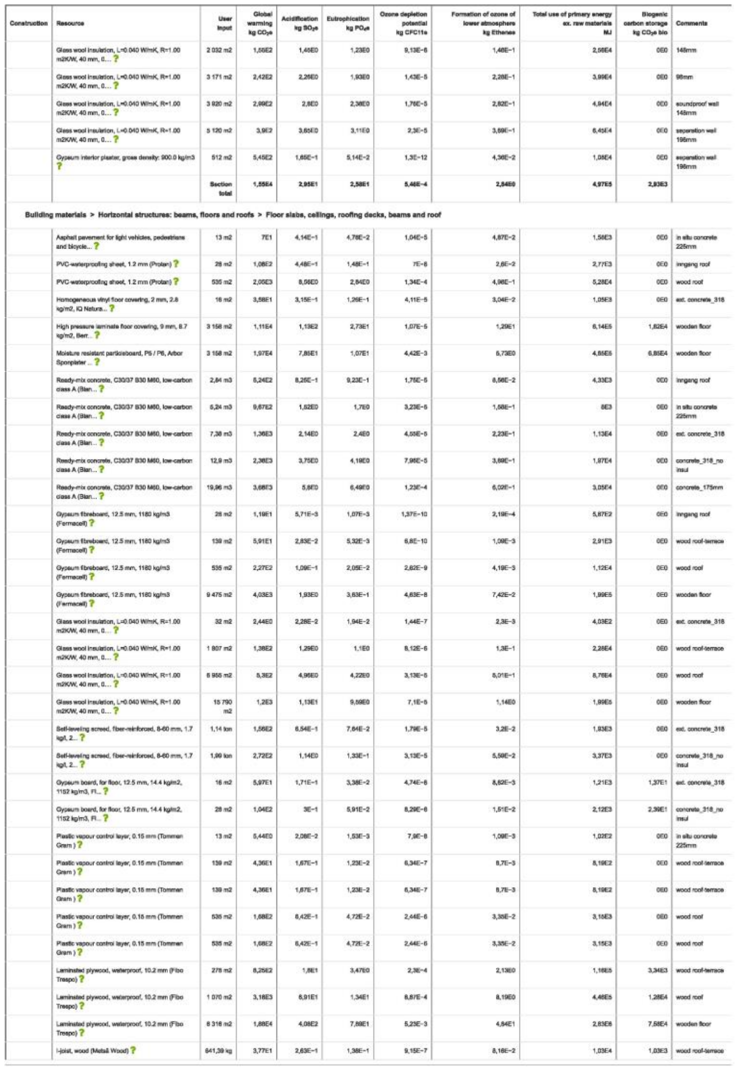
| Construction | Resource | User input | Global warming kg $CO_2$e | Acidification kg $SO_2$e | Eutrophication kg $PO_4$e | Ozone depletion potential kg CFC11e | Formation of ozone of lower atmosphere kg Ethenes | Total use of primary energy ex. raw materials MJ | Biogenic carbon storage kg $CO_2$e bio | Comments |
|---|---|---|---|---|---|---|---|---|---|---|
| | Plastic vapour control layer, 0.15 mm (Tommen Gram ) ? | 535 m2 | 1,68E2 | 8,42E-1 | 4,72E-2 | 2,44E-6 | 3,36E-2 | 3,15E3 | 0E0 | wood roof |
| | Plastic vapour control layer, 0.15 mm (Tommen Gram ) ? | 535 m2 | 1,68E2 | 8,42E-1 | 4,72E-2 | 2,44E-6 | 3,36E-2 | 3,15E3 | 0E0 | wood roof |
| | Laminated plywood, waterproof, 10.2 mm (Fibo Trespo) ? | 278 m2 | 8,25E2 | 1,8E1 | 3,47E0 | 2,3E-4 | 2,13E0 | 1,16E5 | 3,34E3 | wood roof-terrace |
| | Laminated plywood, waterproof, 10.2 mm (Fibo Trespo) ? | 1 070 m2 | 3,18E3 | 8,91E1 | 1,34E1 | 8,87E-4 | 8,19E0 | 4,46E5 | 1,28E4 | wood roof |
| | Laminated plywood, waterproof, 10.2 mm (Fibo Trespo) ? | 5 281 m2 | 1,57E4 | 3,41E2 | 6,6E1 | 4,36E-3 | 4,04E1 | 2,2E6 | 6,34E4 | wooden floor |
| | I-joist, wood (Metsä Wood) ? | 641,39 kg | 3,77E1 | 2,63E-1 | 1,38E-1 | 9,15E-7 | 8,16E-2 | 1,03E4 | 1,03E3 | wood roof-terrace |
| | I-joist, wood (Metsä Wood) ? | 1 344,21 kg | 7,9E1 | 5,51E-1 | 2,88E-1 | 1,92E-6 | 1,71E-1 | 2,16E4 | 2,15E3 | wood roof |
| | I-joist, wood (Metsä Wood) ? | 6 236,1 kg | 3,86E2 | 2,56E0 | 1,34E0 | 8,89E-6 | 7,93E-1 | 1E5 | 9,98E3 | wooden floor |
| | Wooden roofing, 640kg/m3, Moisr. 12%, Scots Pine Roofing (Ke... ? | 1,08 m3 | 2,65E2 | 2,78E0 | 4,32E-1 | 4,64E-5 | 5,62E-2 | 7,45E3 | 9,88E2 | inngang roof |
| | Wooden roofing, 640kg/m3, Moisr. 12%, Scots Pine Roofing (Ke... ? | 3,07 m3 | 7,52E2 | 7,89E0 | 1,23E0 | 1,32E-4 | 1,6E-1 | 2,12E4 | 2,81E3 | wood roof-terrace |
| | | **Section total** | **5,12E4** | **5,86E2** | **1,31E2** | **8,68E-3** | **6,54E1** | **3,99E6** | **1,44E5** | |
| **Building materials > Other structures and materials > Other structures and materials** | | | | | | | | | | |
| | Steel products, powder coated (Brødrene Midthaug) ? | 4 032 kg | 1,12E4 | 2,67E1 | 3,52E0 | 2,71E-4 | 2,09E0 | 1,33E5 | 0E0 | |
| | Concrete staircase and intermediate landings, C30/37 (B30 M6... ? | 31,71 m3 | 7,92E3 | 1,82E1 | 6,06E0 | 2,96E-4 | 3,06E0 | 6,56E4 | 0E0 | |
| | | **Section total** | **1,91E4** | **4,49E1** | **9,58E0** | **5,86E-4** | **5,15E0** | **1,99E5** | | |
| **Building materials > Other structures and materials > Windows and doors** | | | | | | | | | | |
| | Aluminium frame glass door, 1230 x 2180 mm, frame ratio = 32... ? | 10 unit | 2,95E3 | 1,36E1 | 1,26E0 | 6,92E-6 | -3,96E1 | 4,62E4 | 0E0 | |
| | Wooden entrance door, per unit, 809x2053 mm, 42x92 mm frame,... ? | 133 unit | 1,28E4 | 5,05E1 | 1,64E1 | 9,16E-4 | 3,14E1 | 4,73E5 | 1,38E4 | |
| | Wooden interior door, per unit, 809x2053 mm, 42x92 mm frame,... ? | 62 unit | 3,47E3 | 2,28E1 | 6,82E0 | 3,58E-4 | 2,41E0 | 1,77E5 | 6,45E3 | |
| | Top Swing Window, 0.841 W/m2K, 67.78 kg, 1.23x1.48 m (Nordvø... ? | 583,34 m2 | 2,45E4 | 2,85E2 | 3,22E1 | 3,19E-3 | 1,52E1 | 6,41E5 | 3,43E4 | |
| | | **Section total** | **4,37E4** | **3,72E2** | **5,66E1** | **4,53E-3** | **9,42E0** | **1,34E6** | **5,46E4** | |
| **Building materials > Other structures and materials > Finishes and coverings** | | | | | | | | | | |
| | Ceramic tiles, Italian average, 10mm, 19.9 kg/m2 (Confindust... ? | 203 m2 | 3,06E2 | 6,79E-1 | 8,66E-2 | 1,69E-8 | 6,32E-2 | 3,73E4 | 0E0 | concrete_425mm |
| | Ceramic tiles, Italian average, 10mm, 19.9 kg/m2 (Confindust... ? | 513 m2 | 7,73E2 | 1,72E0 | 2,19E-1 | 4,27E-8 | 1,6E-1 | 9,43E4 | 0E0 | insulated basement |
| | Ceramic tiles, Italian average, 10mm, 19.9 kg/m2 (Confindust... ? | 1 041 m2 | 1,57E3 | 3,48E0 | 4,44E-1 | 8,66E-8 | 3,24E-1 | 1,91E5 | 0E0 | 98mm wall |
| | | **Section total** | **2,65E3** | **5,88E0** | **7,49E-1** | **1,48E-7** | **5,47E-1** | **3,23E5** | | |



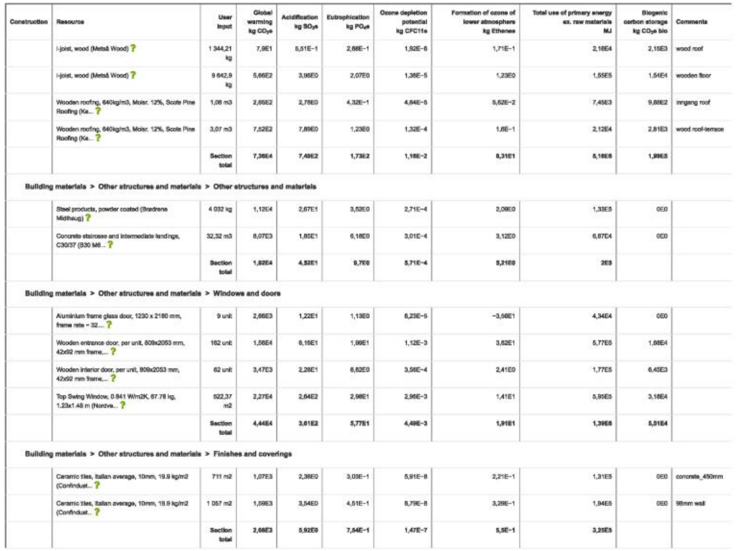
## Sit Øya: newly constructed_wood

### Life-cycle assessment, EN-15978: Construction Materials

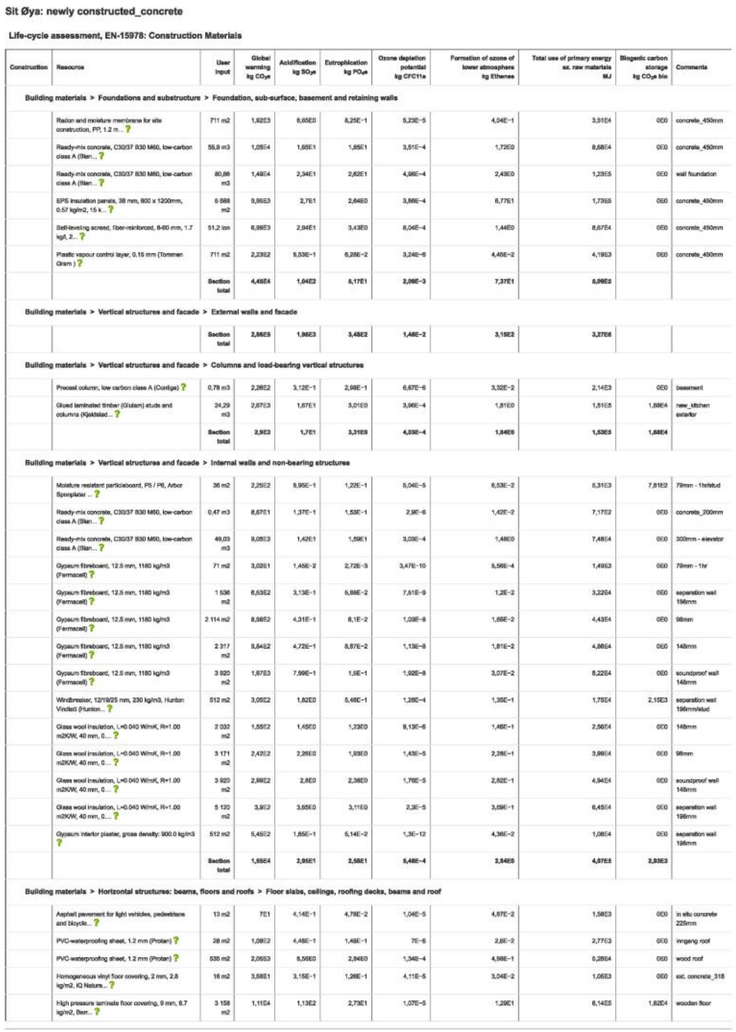
| Construction | Resource | User input | Global warming kg CO₂e | Acidification kg SO₂e | Eutrophication kg PO₄e | Ozone depletion potential kg CFC11e | Formation of ozone of lower atmosphere kg Ethenee | Total use of primary energy ex. raw materials MJ | Biogenic carbon storage kg CO₂e bio | Comments |
|---|---|---|---|---|---|---|---|---|---|---|
| **Building materials > Foundations and substructure > Foundation, sub-surface, basement and retaining walls** | | | | | | | | | | |
| | Radon and moisture membrane for site construction, PP, 1.2 m... ? | 711 m2 | 1,92E3 | 6,65E0 | 8,25E-1 | 5,23E-5 | 4,04E-1 | 3,51E4 | 0E0 | concrete_450mm |
| | Ready-mix concrete, C30/37 B30 M60, low-carbon class A (Blan... ? | 56,9 m3 | 1,05E4 | 1,65E1 | 1,88E1 | 3,51E-4 | 1,72E0 | 8,88E4 | 0E0 | concrete_450mm |
| | Ready-mix concrete, C30/37 B30 M60, low-carbon class A (Blan... ? | 80,86 m3 | 1,49E4 | 2,34E1 | 2,62E1 | 4,98E-4 | 2,43E0 | 1,23E5 | 0E0 | wall foundation |
| | EPS insulation panels, 38 mm, 600 x 1200mm, 0.57 kg/m2, 15 k... ? | 5 888 m2 | 9,96E3 | 2,7E1 | 2,64E0 | 3,86E-4 | 6,77E1 | 1,73E5 | 0E0 | concrete_450mm |
| | Self-leveling screed, fiber-reinforced, 8-60 mm, 1.7 kg/l, 2... ? | 51,2 ton | 6,99E3 | 2,94E1 | 3,43E0 | 8,04E-4 | 1,44E0 | 8,87E4 | 0E0 | concrete_450mm |
| | Plastic vapour control layer, 0.15 mm (Tommen Gram ) ? | 711 m2 | 2,23E2 | 8,53E-1 | 6,28E-2 | 3,24E-6 | 4,45E-2 | 4,19E3 | 0E0 | concrete_450mm |
| | | **Section total** | **4,45E4** | **1,04E2** | **5,17E1** | **2,09E-3** | **7,37E1** | **5,09E5** | | |
| **Building materials > Vertical structures and facade > External walls and facade** | | | | | | | | | | |
| | Ready-mix concrete, C30/37 B30 M60, low-carbon class A (Blan... ? | 11,29 m3 | 2,08E3 | 3,28E0 | 3,67E0 | 6,97E-5 | 3,4E-1 | 1,72E4 | 0E0 | eksisterende - additional |
| | Ready-mix concrete, C30/37 B30 M60, low-carbon class A (Blan... ? | 72,6 m3 | 1,34E4 | 2,11E1 | 2,36E1 | 4,48E-4 | 2,19E0 | 1,11E5 | 0E0 | basement - insulated |
| | Gypsum fibreboard, 12.5 mm, 1180 kg/m3 (Fermacell) ? | 290 m2 | 1,23E2 | 5,91E-2 | 1,11E-2 | 1,42E-9 | 2,27E-3 | 6,08E3 | 0E0 | basement - insulated |
| | Gypsum fibreboard, 12.5 mm, 1180 kg/m3 (Fermacell) ? | 2 505 m2 | 1,06E3 | 5,11E-1 | 9,59E-2 | 1,22E-8 | 1,96E-2 | 5,25E4 | 0E0 | EW_moelven wood |
| | Windbreaker, 12/19/25 mm, 230 kg/m3, Hunton Vindtett (Hunton... ? | 2 534 m2 | 1,51E3 | 9,02E0 | 2,71E0 | 6,26E-4 | 6,69E-1 | 6,84E4 | 1,06E4 | EW_moelven wood |
| | Glass wool insulation, L=0.040 W/mK, R=1.00 m2K/W, 40 mm, 0... ? | 5 018 m2 | 3,83E2 | 3,58E0 | 3,05E0 | 2,26E-5 | 3,61E-1 | 6,32E4 | 0E0 | EW_moelven wood |
| | Glass wool insulation, L=0.040 W/mK, R=1.00 m2K/W, 40 mm, 0... ? | 6 097 m2 | 4,65E2 | 4,35E0 | 3,7E0 | 2,74E-5 | 4,39E-1 | 7,68E4 | 0E0 | basement - insulated |
| | Glass wool insulation, L=0.040 W/mK, R=1.00 m2K/W, 40 mm, 0... ? | 25 310 m2 | 1,93E3 | 1,81E1 | 1,54E1 | 1,14E-4 | 1,82E0 | 3,19E5 | 0E0 | EW_moelven wood |
| | Plastic vapour control layer, 0.15 mm (Tommen Gram ) ? | 12 540 m2 | 3,94E3 | 1,5E1 | 1,11E0 | 5,72E-5 | 7,85E-1 | 7,39E4 | 0E0 | EW_moelven wood |
| | Wood Scots Pine Cladding, 640kg/m3, Moistr. 12%, Kebony Scot... ? | 55,9 m3 | 1,37E4 | 1,44E2 | 2,24E1 | 2,4E-3 | 2,91E0 | 3,86E5 | 5,11E4 | EW_moelven wood |
| | I-joist, wood (Metsä Wood) ? | 19 523,25 kg | 1,15E3 | 8,01E0 | 4,19E0 | 2,78E-5 | 2,48E0 | 3,14E5 | 3,12E4 | EW_moelven wood |
| | | **Section total** | **3,97E4** | **2,27E2** | **7,98E1** | **3,8E-3** | **1,2E1** | **1,51E6** | **9,3E4** | |
| **Building materials > Vertical structures and facade > Columns and load-bearing vertical structures** | | | | | | | | | | |
| | Precast column, low carbon class A (Contiga) ? | 0,78 m3 | 2,26E2 | 3,12E-1 | 2,98E-1 | 6,67E-6 | 3,32E-2 | 2,14E3 | 0E0 | basement |
| | Glued laminated timber (Glulam) studs and columns (Kjeldstad... ? | 24,29 m3 | 2,67E3 | 1,87E1 | 3,01E0 | 3,96E-4 | 1,81E0 | 1,51E5 | 1,88E4 | new_kitchen exterior |
| | | **Section total** | **2,9E3** | **1,7E1** | **3,31E0** | **4,03E-4** | **1,84E0** | **1,53E5** | **1,88E4** | |
| **Building materials > Vertical structures and facade > Internal walls and non-bearing structures** | | | | | | | | | | |
| | Moisture resistant particleboard, P5 / P6, Arbor Sponplater ... ? | 36 m2 | 2,25E2 | 8,95E-1 | 1,22E-1 | 5,04E-5 | 6,53E-2 | 5,31E3 | 7,81E2 | 79mm - 1hr/stud |
| | Ready-mix concrete, C30/37 B30 M60, low-carbon class A (Blan... ? | 0,47 m3 | 8,67E1 | 1,37E-1 | 1,53E-1 | 2,9E-6 | 1,42E-2 | 7,17E2 | 0E0 | concrete_200mm |
| | Ready-mix concrete, C30/37 B30 M60, low-carbon class A (Blan... ? | 49,03 m3 | 9,05E3 | 1,42E1 | 1,59E1 | 3,03E-4 | 1,48E0 | 7,48E4 | 0E0 | 300mm - elevator |
| | Gypsum fibreboard, 12.5 mm, 1180 kg/m3 (Fermacell) ? | 71 m2 | 3,02E1 | 1,45E-2 | 2,72E-3 | 3,47E-10 | 5,58E-4 | 1,49E3 | 0E0 | 79mm - 1hr |
| | Gypsum fibreboard, 12.5 mm, 1180 kg/m3 (Fermacell) ? | 1 536 m2 | 6,53E2 | 3,13E-1 | 5,88E-2 | 7,51E-9 | 1,2E-2 | 3,22E4 | 0E0 | separation wall 196mm |
| | Gypsum fibreboard, 12.5 mm, 1180 kg/m3 (Fermacell) ? | 2 114 m2 | 8,98E2 | 4,31E-1 | 8,1E-2 | 1,03E-8 | 1,65E-2 | 4,43E4 | 0E0 | 98mm |
| | Gypsum fibreboard, 12.5 mm, 1180 kg/m3 (Fermacell) ? | 2 317 m2 | 9,84E2 | 4,72E-1 | 8,87E-2 | 1,13E-8 | 1,81E-2 | 4,86E4 | 0E0 | 148mm |
| | Gypsum fibreboard, 12.5 mm, 1180 kg/m3 (Fermacell) ? | 3 920 m2 | 1,67E3 | 7,99E-1 | 1,5E-1 | 1,92E-8 | 3,07E-2 | 8,22E4 | 0E0 | soundproof wall 148mm |
| | Windbreaker, 12/19/25 mm, 230 kg/m3, Hunton Vindtett (Hunton... ? | 512 m2 | 3,05E2 | 1,82E0 | 5,48E-1 | 1,26E-4 | 1,35E-1 | 1,75E4 | 2,15E3 | separation wall 196mm/stud |



| Construction | Resource | User input | Global warming kg CO₂e | Acidification kg SO₂e | Eutrophication kg PO₄e | Ozone depletion potential kg CFC11e | Formation of ozone of lower atmosphere kg Ethenee | Total use of primary energy ex. raw materials MJ | Biogenic carbon storage kg CO₂e bio | Comments |
|---|---|---|---|---|---|---|---|---|---|---|
| | Glass wool insulation, L=0.040 W/mK, R=1.00 m2K/W, 40 mm, 0... ? | 2 032 m2 | 1,55E2 | 1,45E0 | 1,23E0 | 9,13E-6 | 1,46E-1 | 2,56E4 | 0E0 | 148mm |
| | Glass wool insulation, L=0.040 W/mK, R=1.00 m2K/W, 40 mm, 0... ? | 3 171 m2 | 2,42E2 | 2,26E0 | 1,93E0 | 1,43E-5 | 2,28E-1 | 3,99E4 | 0E0 | 98mm |
| | Glass wool insulation, L=0.040 W/mK, R=1.00 m2K/W, 40 mm, 0... ? | 3 920 m2 | 2,99E2 | 2,8E0 | 2,38E0 | 1,76E-5 | 2,82E-1 | 4,94E4 | 0E0 | soundproof wall 148mm |
| | Glass wool insulation, L=0.040 W/mK, R=1.00 m2K/W, 40 mm, 0... ? | 5 120 m2 | 3,9E2 | 3,65E0 | 3,11E0 | 2,3E-5 | 3,69E-1 | 6,45E4 | 0E0 | separation wall 196mm |
| | Gypsum interior plaster, gross density: 900.0 kg/m3 ? | 512 m2 | 5,45E2 | 1,65E-1 | 5,14E-2 | 1,3E-12 | 4,36E-2 | 1,08E4 | 0E0 | separation wall 196mm |
| | | **Section total** | **1,55E4** | **2,95E1** | **2,58E1** | **5,46E-4** | **2,84E0** | **4,97E5** | **2,93E3** | |
| **Building materials > Horizontal structures: beams, floors and roofs > Floor slabs, ceilings, roofing decks, beams and roof** | | | | | | | | | | |
| | Asphalt pavement for light vehicles, pedestrians and bicycle... ? | 13 m2 | 7E1 | 4,14E-1 | 4,78E-2 | 1,04E-5 | 4,87E-2 | 1,58E3 | 0E0 | in situ concrete 225mm |
| | PVC-waterproofing sheet, 1.2 mm (Protan) ? | 28 m2 | 1,08E2 | 4,48E-1 | 1,48E-1 | 7E-6 | 2,6E-2 | 2,77E3 | 0E0 | inngang roof |
| | PVC-waterproofing sheet, 1.2 mm (Protan) ? | 535 m2 | 2,05E3 | 8,56E0 | 2,84E0 | 1,34E-4 | 4,98E-1 | 5,28E4 | 0E0 | wood roof |
| | Homogeneous vinyl floor covering, 2 mm, 2.8 kg/m2, IQ Natura... ? | 16 m2 | 3,58E1 | 3,15E-1 | 1,26E-1 | 4,11E-5 | 3,04E-2 | 1,05E3 | 0E0 | ext. concrete_318 |
| | High pressure laminate floor covering, 9 mm, 8.7 kg/m2, Berr... ? | 3 158 m2 | 1,11E4 | 1,13E2 | 2,73E1 | 1,07E-5 | 1,29E1 | 6,14E5 | 1,62E4 | wooden floor |
| | Moisture resistant particleboard, P5 / P6, Arbor Sponplater ... ? | 3 158 m2 | 1,97E4 | 7,85E1 | 1,07E1 | 4,42E-3 | 5,73E0 | 4,65E5 | 6,85E4 | wooden floor |
| | Ready-mix concrete, C30/37 B30 M60, low-carbon class A (Blan... ? | 2,84 m3 | 5,24E2 | 8,26E-1 | 9,23E-1 | 1,75E-5 | 8,56E-2 | 4,33E3 | 0E0 | inngang roof |
| | Ready-mix concrete, C30/37 B30 M60, low-carbon class A (Blan... ? | 5,24 m3 | 9,67E2 | 1,52E0 | 1,7E0 | 3,23E-5 | 1,58E-1 | 8E3 | 0E0 | in situ concrete 225mm |
| | Ready-mix concrete, C30/37 B30 M60, low-carbon class A (Blan... ? | 7,38 m3 | 1,36E3 | 2,14E0 | 2,4E0 | 4,55E-5 | 2,23E-1 | 1,13E4 | 0E0 | ext. concrete_318 |
| | Ready-mix concrete, C30/37 B30 M60, low-carbon class A (Blan... ? | 12,9 m3 | 2,38E3 | 3,75E0 | 4,19E0 | 7,96E-5 | 3,89E-1 | 1,97E4 | 0E0 | concrete_318_no insul |
| | Ready-mix concrete, C30/37 B30 M60, low-carbon class A (Blan... ? | 19,96 m3 | 3,68E3 | 5,8E0 | 6,49E0 | 1,23E-4 | 6,02E-1 | 3,05E4 | 0E0 | concrete_175mm |
| | Gypsum fibreboard, 12.5 mm, 1180 kg/m3 (Fermacell) ? | 28 m2 | 1,19E1 | 5,71E-3 | 1,07E-3 | 1,37E-10 | 2,19E-4 | 5,87E2 | 0E0 | inngang roof |
| | Gypsum fibreboard, 12.5 mm, 1180 kg/m3 (Fermacell) ? | 139 m2 | 5,91E1 | 2,83E-2 | 5,32E-3 | 6,8E-10 | 1,09E-3 | 2,91E3 | 0E0 | wood roof-terrace |
| | Gypsum fibreboard, 12.5 mm, 1180 kg/m3 (Fermacell) ? | 535 m2 | 2,27E2 | 1,09E-1 | 2,05E-2 | 2,62E-9 | 4,19E-3 | 1,12E4 | 0E0 | wood roof |
| | Gypsum fibreboard, 12.5 mm, 1180 kg/m3 (Fermacell) ? | 9 475 m2 | 4,03E3 | 1,93E0 | 3,63E-1 | 4,63E-8 | 7,42E-2 | 1,99E5 | 0E0 | wooden floor |
| | Glass wool insulation, L=0.040 W/mK, R=1.00 m2K/W, 40 mm, 0... ? | 32 m2 | 2,44E0 | 2,28E-2 | 1,94E-2 | 1,44E-7 | 2,3E-3 | 4,03E2 | 0E0 | ext. concrete_318 |
| | Glass wool insulation, L=0.040 W/mK, R=1.00 m2K/W, 40 mm, 0... ? | 1 807 m2 | 1,38E2 | 1,29E0 | 1,1E0 | 8,12E-6 | 1,3E-1 | 2,28E4 | 0E0 | wood roof-terrace |
| | Glass wool insulation, L=0.040 W/mK, R=1.00 m2K/W, 40 mm, 0... ? | 6 955 m2 | 5,3E2 | 4,96E0 | 4,22E0 | 3,13E-5 | 5,01E-1 | 8,76E4 | 0E0 | wood roof |
| | Glass wool insulation, L=0.040 W/mK, R=1.00 m2K/W, 40 mm, 0... ? | 15 790 m2 | 1,2E3 | 1,13E1 | 9,59E0 | 7,1E-5 | 1,14E0 | 1,99E5 | 0E0 | wooden floor |
| | Self-leveling screed, fiber-reinforced, 8-60 mm, 1.7 kg/l, 2... ? | 1,14 ton | 1,56E2 | 6,54E-1 | 7,64E-2 | 1,79E-5 | 3,2E-2 | 1,93E3 | 0E0 | ext. concrete_318 |
| | Self-leveling screed, fiber-reinforced, 8-60 mm, 1.7 kg/l, 2... ? | 1,99 ton | 2,72E2 | 1,14E0 | 1,33E-1 | 3,13E-5 | 5,59E-2 | 3,37E3 | 0E0 | concrete_318_no insul |
| | Gypsum board, for floor, 12.5 mm, 14.4 kg/m2, 1152 kg/m3, Fl... ? | 16 m2 | 5,97E1 | 1,71E-1 | 3,38E-2 | 4,74E-6 | 8,62E-3 | 1,21E3 | 1,37E1 | ext. concrete_318 |
| | Gypsum board, for floor, 12.5 mm, 14.4 kg/m2, 1152 kg/m3, Fl... ? | 28 m2 | 1,04E2 | 3E-1 | 5,91E-2 | 8,29E-6 | 1,51E-2 | 2,12E3 | 2,39E1 | concrete_318_no insul |
| | Plastic vapour control layer, 0.15 mm (Tommen Gram ) ? | 13 m2 | 5,44E0 | 2,08E-2 | 1,53E-3 | 7,9E-8 | 1,09E-3 | 1,02E2 | 0E0 | in situ concrete 225mm |
| | Plastic vapour control layer, 0.15 mm (Tommen Gram ) ? | 139 m2 | 4,36E1 | 1,67E-1 | 1,23E-2 | 6,34E-7 | 8,7E-3 | 8,19E2 | 0E0 | wood roof-terrace |
| | Plastic vapour control layer, 0.15 mm (Tommen Gram ) ? | 139 m2 | 4,36E1 | 1,67E-1 | 1,23E-2 | 6,34E-7 | 8,7E-3 | 8,19E2 | 0E0 | wood roof-terrace |
| | Plastic vapour control layer, 0.15 mm (Tommen Gram ) ? | 535 m2 | 1,68E2 | 6,42E-1 | 4,72E-2 | 2,44E-6 | 3,35E-2 | 3,15E3 | 0E0 | wood roof |
| | Plastic vapour control layer, 0.15 mm (Tommen Gram ) ? | 535 m2 | 1,68E2 | 6,42E-1 | 4,72E-2 | 2,44E-6 | 3,35E-2 | 3,15E3 | 0E0 | wood roof |
| | Laminated plywood, waterproof, 10.2 mm (Fibo Trespo) ? | 278 m2 | 8,25E2 | 1,8E1 | 3,47E0 | 2,3E-4 | 2,13E0 | 1,16E5 | 3,34E3 | wood roof-terrace |
| | Laminated plywood, waterproof, 10.2 mm (Fibo Trespo) ? | 1 070 m2 | 3,18E3 | 6,91E1 | 1,34E1 | 8,87E-4 | 8,19E0 | 4,46E5 | 1,28E4 | wood roof |
| | Laminated plywood, waterproof, 10.2 mm (Fibo Trespo) ? | 8 318 m2 | 1,88E4 | 4,08E2 | 7,89E1 | 5,23E-3 | 4,84E1 | 2,83E6 | 7,58E4 | wooden floor |
| | I-joist, wood (Metsä Wood) ? | 641,39 kg | 3,77E1 | 2,63E-1 | 1,38E-1 | 9,15E-7 | 8,16E-2 | 1,03E4 | 1,03E3 | wood roof-terrace |



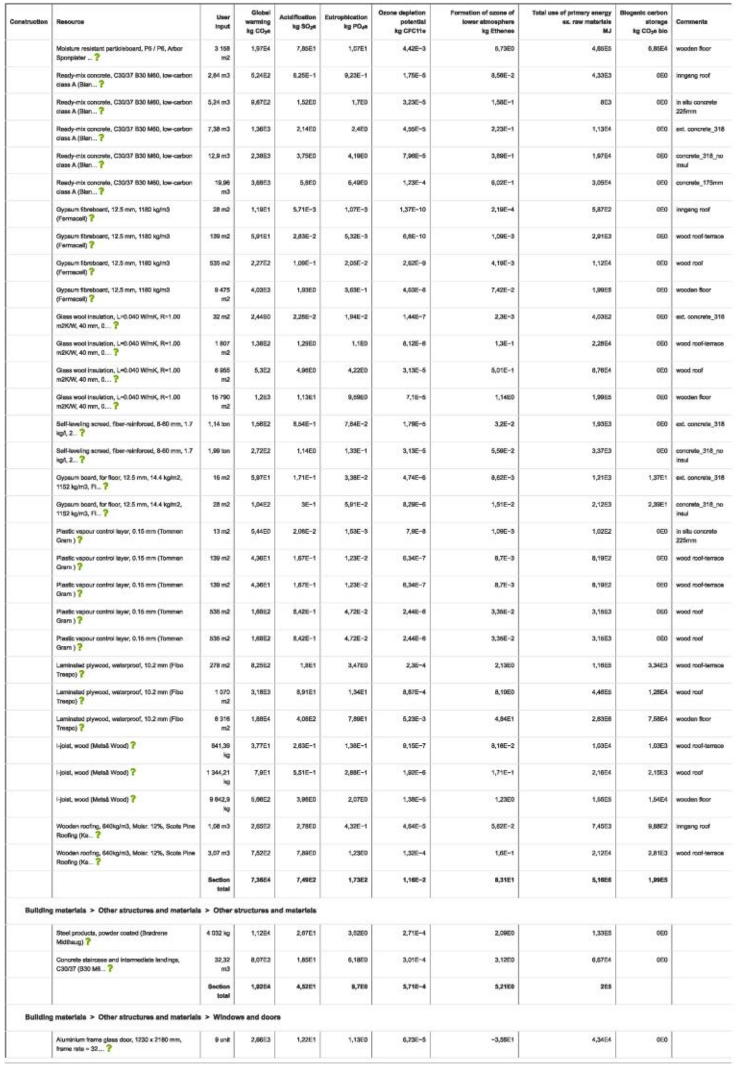
| Construction | Resource | User input | Global warming kg CO₂e | Acidification kg SO₂e | Eutrophication kg PO₄e | Ozone depletion potential kg CFC11e | Formation of ozone of lower atmosphere kg Ethenee | Total use of primary energy ex. raw materials MJ | Biogenic carbon storage kg CO₂e bio | Comments |
|---|---|---|---|---|---|---|---|---|---|---|
|  | I-joist, wood (Metsä Wood) ? | 1 344,21 kg | 7,9E1 | 6,51E−1 | 2,88E−1 | 1,92E−6 | 1,71E−1 | 2,16E4 | 2,15E3 | wood roof |
|  | I-joist, wood (Metsä Wood) ? | 9 642,9 kg | 5,66E2 | 3,96E0 | 2,07E0 | 1,38E−5 | 1,23E0 | 1,55E5 | 1,54E4 | wooden floor |
|  | Wooden roofing, 640kg/m3, Moisr. 12%, Scots Pine Roofing (Ke... ? | 1,06 m3 | 2,66E2 | 2,78E0 | 4,32E−1 | 4,64E−5 | 5,62E−2 | 7,45E3 | 9,88E2 | inngang roof |
|  | Wooden roofing, 640kg/m3, Moisr. 12%, Scots Pine Roofing (Ke... ? | 3,07 m3 | 7,52E2 | 7,89E0 | 1,23E0 | 1,32E−4 | 1,6E−1 | 2,12E4 | 2,81E3 | wood roof-terrace |
|  |  | **Section total** | **7,38E4** | **7,49E2** | **1,73E2** | **1,16E−2** | **8,31E1** | **5,16E6** | **1,99E5** |  |
| **Building materials > Other structures and materials > Other structures and materials** |  |  |  |  |  |  |  |  |  |  |
|  | Steel products, powder coated (Brødrene Midthaug) ? | 4 032 kg | 1,12E4 | 2,67E1 | 3,52E0 | 2,71E−4 | 2,09E0 | 1,33E5 | 0E0 |  |
|  | Concrete staircase and intermediate landings, C30/37 (B30 M6... ? | 32,32 m3 | 8,07E3 | 1,85E1 | 6,18E0 | 3,01E−4 | 3,12E0 | 6,67E4 | 0E0 |  |
|  |  | **Section total** | **1,92E4** | **4,52E1** | **9,7E0** | **5,71E−4** | **5,21E0** | **2E5** |  |  |
| **Building materials > Other structures and materials > Windows and doors** |  |  |  |  |  |  |  |  |  |  |
|  | Aluminium frame glass door, 1230 x 2180 mm, frame rate ~ 32.... ? | 9 unit | 2,66E3 | 1,22E1 | 1,13E0 | 6,23E−5 | −3,56E1 | 4,34E4 | 0E0 |  |
|  | Wooden entrance door, per unit, 809x2053 mm, 42x92 mm frame,... ? | 162 unit | 1,56E4 | 6,16E1 | 1,99E1 | 1,12E−3 | 3,82E1 | 5,77E5 | 1,68E4 |  |
|  | Wooden interior door, per unit, 809x2053 mm, 42x92 mm frame,... ? | 62 unit | 3,47E3 | 2,28E1 | 6,82E0 | 3,56E−4 | 2,41E0 | 1,77E5 | 6,45E3 |  |
|  | Top Swing Window, 0.841 W/m2K, 67.78 kg, 1.23x1.48 m (Nordvæ... ? | 522,37 m2 | 2,27E4 | 2,64E2 | 2,98E1 | 2,96E−3 | 1,41E1 | 5,95E5 | 3,18E4 |  |
|  |  | **Section total** | **4,44E4** | **3,61E2** | **5,77E1** | **4,49E−3** | **1,91E1** | **1,39E6** | **5,51E4** |  |
| **Building materials > Other structures and materials > Finishes and coverings** |  |  |  |  |  |  |  |  |  |  |
|  | Ceramic tiles, Italian average, 10mm, 19.9 kg/m2 (Confindust... ? | 711 m2 | 1,07E3 | 2,38E0 | 3,03E−1 | 5,91E−8 | 2,21E−1 | 1,31E5 | 0E0 | concrete_450mm |
|  | Ceramic tiles, Italian average, 10mm, 19.9 kg/m2 (Confindust... ? | 1 057 m2 | 1,59E3 | 3,54E0 | 4,51E−1 | 8,79E−8 | 3,29E−1 | 1,94E5 | 0E0 | 98mm wall |
|  |  | **Section total** | **2,66E3** | **5,92E0** | **7,54E−1** | **1,47E−7** | **5,5E−1** | **3,25E5** |  |  |



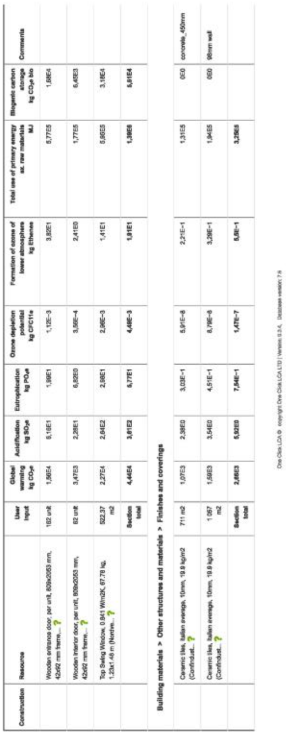
## Sit Øya: newly constructed_concrete

### Life-cycle assessment, EN-15978: Construction Materials

| Construction | Resource | User input | Global warming kg CO₂e | Acidification kg SO₂e | Eutrophication kg PO₄e | Ozone depletion potential kg CFC11e | Formation of ozone of lower atmosphere kg Ethenes | Total use of primary energy ex. raw materials MJ | Biogenic carbon storage kg CO₂e bio | Comments |
|---|---|---|---|---|---|---|---|---|---|---|
| **Building materials > Foundations and substructure > Foundation, sub-surface, basement and retaining walls** | | | | | | | | | | |
| | Radon and moisture membrane for site construction, PP, 1.2 m... ? | 711 m2 | 1,92E3 | 8,65E0 | 8,25E-1 | 5,23E-5 | 4,04E-1 | 3,51E4 | 0E0 | concrete_450mm |
| | Ready-mix concrete, C30/37 B30 M60, low-carbon class A (Blan... ? | 56,9 m3 | 1,05E4 | 1,65E1 | 1,85E1 | 3,51E-4 | 1,72E0 | 8,58E4 | 0E0 | concrete_450mm |
| | Ready-mix concrete, C30/37 B30 M60, low-carbon class A (Blan... ? | 80,88 m3 | 1,49E4 | 2,34E1 | 2,62E1 | 4,98E-4 | 2,43E0 | 1,23E5 | 0E0 | wall foundation |
| | EPS insulation panels, 38 mm, 600 x 1200mm, 0.57 kg/m2, 15 k... ? | 5 888 m2 | 9,96E3 | 2,7E1 | 2,64E0 | 3,86E-4 | 6,77E1 | 1,73E5 | 0E0 | concrete_450mm |
| | Self-leveling screed, fiber-reinforced, 8-60 mm, 1.7 kg/l, 2... ? | 51,2 ton | 6,99E3 | 2,94E1 | 3,43E0 | 8,04E-4 | 1,44E0 | 8,67E4 | 0E0 | concrete_450mm |
| | Plastic vapour control layer, 0.15 mm (Tommen Gram ) ? | 711 m2 | 2,23E2 | 5,53E-1 | 6,28E-2 | 3,24E-6 | 4,45E-2 | 4,19E3 | 0E0 | concrete_450mm |
| | | **Section total** | **4,48E4** | **1,04E2** | **5,17E1** | **2,09E-3** | **7,37E1** | **5,09E5** | | |
| **Building materials > Vertical structures and facade > External walls and facade** | | | | | | | | | | |
| | | **Section total** | **2,86E5** | **1,96E3** | **3,48E2** | **1,46E-2** | **3,15E2** | **3,27E6** | | |
| **Building materials > Vertical structures and facade > Columns and load-bearing vertical structures** | | | | | | | | | | |
| | Precast column, low carbon class A (Contiga) ? | 0,78 m3 | 2,28E2 | 3,12E-1 | 2,98E-1 | 6,67E-6 | 3,32E-2 | 2,14E3 | 0E0 | basement |
| | Glued laminated timber (Glulam) studs and columns (Kjeldstad... ? | 24,29 m3 | 2,67E3 | 1,67E1 | 3,01E0 | 3,96E-4 | 1,81E0 | 1,51E5 | 1,68E4 | new_kitchen exterior |
| | | **Section total** | **2,9E3** | **1,7E1** | **3,31E0** | **4,03E-4** | **1,84E0** | **1,53E5** | **1,68E4** | |
| **Building materials > Vertical structures and facade > Internal walls and non-bearing structures** | | | | | | | | | | |
| | Moisture resistant particleboard, P5 / P6, Arbor Sponplater ... ? | 36 m2 | 2,25E2 | 8,95E-1 | 1,22E-1 | 5,04E-5 | 6,53E-2 | 5,31E3 | 7,81E2 | 79mm - 1hr/stud |
| | Ready-mix concrete, C30/37 B30 M60, low-carbon class A (Blan... ? | 0,47 m3 | 8,67E1 | 1,37E-1 | 1,53E-1 | 2,9E-6 | 1,42E-2 | 7,17E2 | 0E0 | concrete_200mm |
| | Ready-mix concrete, C30/37 B30 M60, low-carbon class A (Blan... ? | 49,03 m3 | 9,05E3 | 1,42E1 | 1,59E1 | 3,03E-4 | 1,48E0 | 7,48E4 | 0E0 | 300mm - elevator |
| | Gypsum fibreboard, 12.5 mm, 1180 kg/m3 (Fermacell) ? | 71 m2 | 3,02E1 | 1,45E-2 | 2,72E-3 | 3,47E-10 | 5,56E-4 | 1,49E3 | 0E0 | 79mm - 1hr |
| | Gypsum fibreboard, 12.5 mm, 1180 kg/m3 (Fermacell) ? | 1 536 m2 | 6,53E2 | 3,13E-1 | 5,88E-2 | 7,51E-9 | 1,2E-2 | 3,22E4 | 0E0 | separation wall 198mm |
| | Gypsum fibreboard, 12.5 mm, 1180 kg/m3 (Fermacell) ? | 2 114 m2 | 8,98E2 | 4,31E-1 | 8,1E-2 | 1,03E-8 | 1,65E-2 | 4,43E4 | 0E0 | 98mm |
| | Gypsum fibreboard, 12.5 mm, 1180 kg/m3 (Fermacell) ? | 2 317 m2 | 9,84E2 | 4,72E-1 | 8,87E-2 | 1,13E-8 | 1,81E-2 | 4,86E4 | 0E0 | 148mm |
| | Gypsum fibreboard, 12.5 mm, 1180 kg/m3 (Fermacell) ? | 3 920 m2 | 1,67E3 | 7,99E-1 | 1,5E-1 | 1,92E-8 | 3,07E-2 | 8,22E4 | 0E0 | soundproof wall 148mm |
| | Windbreaker, 12/19/25 mm, 230 kg/m3, Hunton Vindtett (Hunton... ? | 512 m2 | 3,05E2 | 1,82E0 | 5,48E-1 | 1,26E-4 | 1,35E-1 | 1,75E4 | 2,15E3 | separation wall 198mm/stud |
| | Glass wool insulation, L=0.040 W/mK, R=1.00 m2K/W, 40 mm, 0.... ? | 2 032 m2 | 1,55E2 | 1,45E0 | 1,23E0 | 9,13E-6 | 1,46E-1 | 2,56E4 | 0E0 | 148mm |
| | Glass wool insulation, L=0.040 W/mK, R=1.00 m2K/W, 40 mm, 0.... ? | 3 171 m2 | 2,42E2 | 2,26E0 | 1,93E0 | 1,43E-5 | 2,28E-1 | 3,99E4 | 0E0 | 98mm |
| | Glass wool insulation, L=0.040 W/mK, R=1.00 m2K/W, 40 mm, 0.... ? | 3 920 m2 | 2,99E2 | 2,8E0 | 2,38E0 | 1,76E-5 | 2,82E-1 | 4,94E4 | 0E0 | soundproof wall 148mm |
| | Glass wool insulation, L=0.040 W/mK, R=1.00 m2K/W, 40 mm, 0.... ? | 5 120 m2 | 3,9E2 | 3,65E0 | 3,11E0 | 2,3E-5 | 3,69E-1 | 6,45E4 | 0E0 | separation wall 198mm |
| | Gypsum interior plaster, gross density: 900.0 kg/m3 ? | 512 m2 | 5,45E2 | 1,85E-1 | 5,14E-2 | 1,3E-12 | 4,36E-2 | 1,08E4 | 0E0 | separation wall 198mm |
| | | **Section total** | **1,55E4** | **2,95E1** | **2,58E1** | **5,48E-4** | **2,84E0** | **4,97E5** | **2,93E3** | |
| **Building materials > Horizontal structures: beams, floors and roofs > Floor slabs, ceilings, roofing decks, beams and roof** | | | | | | | | | | |
| | Asphalt pavement for light vehicles, pedestrians and bicycle... ? | 13 m2 | 7E1 | 4,14E-1 | 4,78E-2 | 1,04E-5 | 4,87E-2 | 1,58E3 | 0E0 | in situ concrete 225mm |
| | PVC-waterproofing sheet, 1.2 mm (Protan) ? | 28 m2 | 1,08E2 | 4,48E-1 | 1,48E-1 | 7E-6 | 2,8E-2 | 2,77E3 | 0E0 | inngang roof |
| | PVC-waterproofing sheet, 1.2 mm (Protan) ? | 535 m2 | 2,06E3 | 8,56E0 | 2,84E0 | 1,34E-4 | 4,98E-1 | 5,28E4 | 0E0 | wood roof |
| | Homogeneous vinyl floor covering, 2 mm, 2.8 kg/m2, IQ Natura... ? | 16 m2 | 3,58E1 | 3,15E-1 | 1,26E-1 | 4,11E-5 | 3,04E-2 | 1,05E3 | 0E0 | ext. concrete_318 |
| | High pressure laminate floor covering, 9 mm, 8.7 kg/m2, Berr... ? | 3 158 m2 | 1,11E4 | 1,13E2 | 2,73E1 | 1,07E-5 | 1,29E1 | 6,14E5 | 1,62E4 | wooden floor |



| Construction | Resource | User input | Global warming kg CO₂e | Acidification kg SO₂e | Eutrophication kg PO₄e | Ozone depletion potential kg CFC11e | Formation of ozone of lower atmosphere kg Ethenes | Total use of primary energy ex. raw materials MJ | Biogenic carbon storage kg CO₂e bio | Comments |
|---|---|---|---|---|---|---|---|---|---|---|
| | Moisture resistant particleboard, P5 / P6, Arbor Sponplater ... ? | 3 158 m2 | 1,97E4 | 7,85E1 | 1,07E1 | 4,42E-3 | 6,73E0 | 4,65E5 | 6,85E4 | wooden floor |
| | Ready-mix concrete, C30/37 B30 M60, low-carbon class A (Blan... ? | 2,84 m3 | 5,24E2 | 8,25E-1 | 9,23E-1 | 1,75E-5 | 8,58E-2 | 4,33E3 | 0E0 | inngang roof |
| | Ready-mix concrete, C30/37 B30 M60, low-carbon class A (Blan... ? | 5,24 m3 | 9,67E2 | 1,52E0 | 1,7E0 | 3,23E-5 | 1,58E-1 | 8E3 | 0E0 | in situ concrete 225mm |
| | Ready-mix concrete, C30/37 B30 M60, low-carbon class A (Blan... ? | 7,38 m3 | 1,36E3 | 2,14E0 | 2,4E0 | 4,55E-5 | 2,23E-1 | 1,13E4 | 0E0 | ext. concrete_318 |
| | Ready-mix concrete, C30/37 B30 M60, low-carbon class A (Blan... ? | 12,9 m3 | 2,38E3 | 3,75E0 | 4,19E0 | 7,96E-5 | 3,89E-1 | 1,97E4 | 0E0 | concrete_318_no insul |
| | Ready-mix concrete, C30/37 B30 M60, low-carbon class A (Blan... ? | 19,96 m3 | 3,68E3 | 5,8E0 | 6,49E0 | 1,23E-4 | 6,02E-1 | 3,05E4 | 0E0 | concrete_175mm |
| | Gypsum fibreboard, 12.5 mm, 1180 kg/m3 (Fermacell) ? | 28 m2 | 1,19E1 | 5,71E-3 | 1,07E-3 | 1,37E-10 | 2,19E-4 | 5,87E2 | 0E0 | inngang roof |
| | Gypsum fibreboard, 12.5 mm, 1180 kg/m3 (Fermacell) ? | 139 m2 | 5,91E1 | 2,83E-2 | 5,32E-3 | 6,8E-10 | 1,09E-3 | 2,91E3 | 0E0 | wood roof-terrace |
| | Gypsum fibreboard, 12.5 mm, 1180 kg/m3 (Fermacell) ? | 535 m2 | 2,27E2 | 1,09E-1 | 2,05E-2 | 2,62E-9 | 4,19E-3 | 1,12E4 | 0E0 | wood roof |
| | Gypsum fibreboard, 12.5 mm, 1180 kg/m3 (Fermacell) ? | 9 475 m2 | 4,03E3 | 1,93E0 | 3,63E-1 | 4,63E-8 | 7,42E-2 | 1,99E5 | 0E0 | wooden floor |
| | Glass wool insulation, L=0.040 W/mK, R=1.00 m2K/W, 40 mm, 0.... ? | 32 m2 | 2,44E0 | 2,28E-2 | 1,94E-2 | 1,44E-7 | 2,3E-3 | 4,03E2 | 0E0 | ext. concrete_318 |
| | Glass wool insulation, L=0.040 W/mK, R=1.00 m2K/W, 40 mm, 0.... ? | 1 807 m2 | 1,38E2 | 1,29E0 | 1,1E0 | 8,12E-6 | 1,3E-1 | 2,28E4 | 0E0 | wood roof-terrace |
| | Glass wool insulation, L=0.040 W/mK, R=1.00 m2K/W, 40 mm, 0.... ? | 6 955 m2 | 5,3E2 | 4,96E0 | 4,22E0 | 3,13E-5 | 5,01E-1 | 8,76E4 | 0E0 | wood roof |
| | Glass wool insulation, L=0.040 W/mK, R=1.00 m2K/W, 40 mm, 0.... ? | 15 790 m2 | 1,2E3 | 1,13E1 | 9,59E0 | 7,1E-5 | 1,14E0 | 1,99E5 | 0E0 | wooden floor |
| | Self-leveling screed, fiber-reinforced, 8-60 mm, 1.7 kg/l, 2... ? | 1,14 ton | 1,56E2 | 6,54E-1 | 7,84E-2 | 1,79E-5 | 3,2E-2 | 1,93E3 | 0E0 | ext. concrete_318 |
| | Self-leveling screed, fiber-reinforced, 8-60 mm, 1.7 kg/l, 2... ? | 1,99 ton | 2,72E2 | 1,14E0 | 1,33E-1 | 3,13E-5 | 5,59E-2 | 3,37E3 | 0E0 | concrete_318_no insul |
| | Gypsum board, for floor, 12.5 mm, 14.4 kg/m2, 1152 kg/m3, Fl... ? | 16 m2 | 5,97E1 | 1,71E-1 | 3,38E-2 | 4,74E-6 | 8,62E-3 | 1,21E3 | 1,37E1 | ext. concrete_318 |
| | Gypsum board, for floor, 12.5 mm, 14.4 kg/m2, 1152 kg/m3, Fl... ? | 28 m2 | 1,04E2 | 3E-1 | 5,91E-2 | 8,29E-6 | 1,51E-2 | 2,12E3 | 2,39E1 | concrete_318_no insul |
| | Plastic vapour control layer, 0.15 mm (Tommen Gram ) ? | 13 m2 | 5,44E0 | 2,06E-2 | 1,53E-3 | 7,9E-8 | 1,09E-3 | 1,02E2 | 0E0 | in situ concrete 225mm |
| | Plastic vapour control layer, 0.15 mm (Tommen Gram ) ? | 139 m2 | 4,36E1 | 1,67E-1 | 1,23E-2 | 6,34E-7 | 8,7E-3 | 8,19E2 | 0E0 | wood roof-terrace |
| | Plastic vapour control layer, 0.15 mm (Tommen Gram ) ? | 139 m2 | 4,36E1 | 1,67E-1 | 1,23E-2 | 6,34E-7 | 8,7E-3 | 8,19E2 | 0E0 | wood roof-terrace |
| | Plastic vapour control layer, 0.15 mm (Tommen Gram ) ? | 535 m2 | 1,68E2 | 6,42E-1 | 4,72E-2 | 2,44E-6 | 3,36E-2 | 3,15E3 | 0E0 | wood roof |
| | Plastic vapour control layer, 0.15 mm (Tommen Gram ) ? | 535 m2 | 1,68E2 | 6,42E-1 | 4,72E-2 | 2,44E-6 | 3,36E-2 | 3,15E3 | 0E0 | wood roof |
| | Laminated plywood, waterproof, 10.2 mm (Fibo Trespo) ? | 278 m2 | 8,25E2 | 1,8E1 | 3,47E0 | 2,3E-4 | 2,13E0 | 1,16E5 | 3,34E3 | wood roof-terrace |
| | Laminated plywood, waterproof, 10.2 mm (Fibo Trespo) ? | 1 070 m2 | 3,18E3 | 6,91E1 | 1,34E1 | 8,87E-4 | 8,19E0 | 4,46E5 | 1,28E4 | wood roof |
| | Laminated plywood, waterproof, 10.2 mm (Fibo Trespo) ? | 6 316 m2 | 1,88E4 | 4,08E2 | 7,89E1 | 5,23E-3 | 4,84E1 | 2,63E6 | 7,58E4 | wooden floor |
| | I-joist, wood (Metsä Wood) ? | 841,39 kg | 3,77E1 | 2,63E-1 | 1,38E-1 | 9,15E-7 | 8,16E-2 | 1,03E4 | 1,03E3 | wood roof-terrace |
| | I-joist, wood (Metsä Wood) ? | 1 344,21 kg | 7,9E1 | 5,51E-1 | 2,88E-1 | 1,92E-6 | 1,71E-1 | 2,16E4 | 2,15E3 | wood roof |
| | I-joist, wood (Metsä Wood) ? | 9 642,9 kg | 5,66E2 | 3,96E0 | 2,07E0 | 1,38E-5 | 1,23E0 | 1,55E5 | 1,54E4 | wooden floor |
| | Wooden roofing, 640kg/m3, Moist: 12%, Scots Pine Roofing (Ka... ? | 1,08 m3 | 2,65E2 | 2,78E0 | 4,32E-1 | 4,64E-5 | 5,62E-2 | 7,45E3 | 9,88E2 | inngang roof |
| | Wooden roofing, 640kg/m3, Moist: 12%, Scots Pine Roofing (Ka... ? | 3,07 m3 | 7,52E2 | 7,89E0 | 1,23E0 | 1,32E-4 | 1,6E-1 | 2,12E4 | 2,81E3 | wood roof-terrace |
| | | **Section total** | **7,36E4** | **7,49E2** | **1,73E2** | **1,16E-2** | **8,31E1** | **5,16E6** | **1,99E5** | |
| **Building materials > Other structures and materials > Other structures and materials** | | | | | | | | | | |
| | Steel products, powder coated (Brødrene Midthaug) ? | 4 032 kg | 1,12E4 | 2,67E1 | 3,52E0 | 2,71E-4 | 2,09E0 | 1,33E5 | 0E0 | |
| | Concrete staircase and intermediate landings, C30/37 (B30 M6... ? | 32,32 m3 | 8,07E3 | 1,85E1 | 6,18E0 | 3,01E-4 | 3,12E0 | 6,67E4 | 0E0 | |
| | | **Section total** | **1,92E4** | **4,52E1** | **9,7E0** | **5,71E-4** | **5,21E0** | **2E5** | | |
| **Building materials > Other structures and materials > Windows and doors** | | | | | | | | | | |
| | Aluminium frame glass door, 1230 x 2180 mm, frame ratio = 32.... ? | 9 unit | 2,66E3 | 1,22E1 | 1,13E0 | 6,23E-5 | -3,56E1 | 4,34E4 | 0E0 | |



| Construction | Resource | User input | Global warming kg $CO_2$e | Acidification kg $SO_2$e | Eutrophication kg $PO_4$e | Ozone depletion potential kg CFC11e | Formation of ozone of lower atmosphere kg Ethenee | Total use of primary energy ex. raw materials MJ | Biogenic carbon storage kg $CO_2$e bio | Comments |
|---|---|---|---|---|---|---|---|---|---|---|
|  | Wooden entrance door, per unit, 809x2053 mm, 42x92 mm frame,... ? | 182 unit | 1,56E4 | 5,16E1 | 1,99E1 | 1,12E-3 | 3,82E1 | 5,77E5 | 1,68E4 |  |
|  | Wooden interior door, per unit, 809x2053 mm, 42x92 mm frame,... ? | 62 unit | 3,47E3 | 2,28E1 | 6,82E0 | 3,56E-4 | 2,41E0 | 1,77E5 | 6,45E3 |  |
|  | Top Swing Window, 0.841 W/m2K, 67.78 kg, 1.23x1.48 m (Nordve... ? | 522,37 m2 | 2,27E4 | 2,64E2 | 2,98E1 | 2,96E-3 | 1,41E1 | 5,96E5 | 3,18E4 |  |
|  |  | **Section total** | **4,44E4** | **3,61E2** | **5,77E1** | **4,49E-3** | **1,91E1** | **1,39E6** | **5,61E4** |  |
| **Building materials > Other structures and materials > Finishes and coverings** |  |  |  |  |  |  |  |  |  |  |
|  | Ceramic tiles, Italian average, 10mm, 19.9 kg/m2 (Confindust... ? | 711 m2 | 1,07E3 | 2,38E0 | 3,03E-1 | 5,91E-8 | 2,21E-1 | 1,31E5 | 0E0 | concrete_450mm |
|  | Ceramic tiles, Italian average, 10mm, 19.9 kg/m2 (Confindust... ? | 1 057 m2 | 1,59E3 | 3,54E0 | 4,51E-1 | 8,79E-8 | 3,29E-1 | 1,94E5 | 0E0 | 98mm wall |
|  |  | **Section total** | **2,66E3** | **5,92E0** | **7,54E-1** | **1,47E-7** | **5,5E-1** | **3,25E5** |  |  |

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## Appendix C - Comparison of all scenarios regardless of their different floor areas