GRÆNNI BYGGÐ
GREEN BUILDING COUNCIL ICELAND

# REUSE HANDBOOK

## Salvaging common Icelandic construction materials and products

2026

**REUSE HANDBOOK**
**Salvaging common Icelandic construction materials and products.**

Developed by Green Building Council Iceland in cooperation with EFLA, s. ap arkitektar, and Verkís.

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The recommendations in this publication are based on current knowledge. As the world develops rapidly, it is recommended to verify information in each case against current product data.



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## Preface

The *Reuse Handbook* was created as an early-stage guide for those considering sustainable material and product selection and use in construction. The guide focuses primarily on the potential for reuse, including practical tips and the legal and hazard-related barriers associated with it. Additionally, it covers recyclability and potential carbon emission savings. The target group is not only professionals (e.g., architects, construction engineers, consultants, developers, and waste management collectors), but also every individual interested in reuse.

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We would like to develop the guide further. We therefore ask for feedback, comments and suggestions for future revisions to: gb@graennibyggd.is

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# ABOUT THE GUIDE

This guide presents 40 commonly used construction materials and products in Iceland in the last few decades, which are expected to be available for reuse in the near future. They are divided into seven categories based on their typical application. The guide focuses on old materials and products (e.g., salvaged from demolitions or renovations), not on new materials (e.g., surplus, leftovers from construction sites, materials with slight defects) available for use.

Each material/product is briefly described, and its reuse potential is assessed (understood as the technical and regulatory feasibility of reuse). Practical tips for reuse, along with the data to be collected before reuse, are also listed. When available, real-life examples of the reuse of listed items are presented. On top of that, hazards associated with reuse are highlighted.

Additionally, the guide includes information on potential repurposing (using a material or product in a different function than its original use, without breaking it down) and recycling (breaking it down to produce raw materials for other products). Last but not least, the estimated potential savings in greenhouse gas emissions from reuse are presented.

To enhance guide readability, potential reuse is presented with colours indicating reuse potential on a scale from red (non-reusable) to green (reusable without issues). This indicator is qualitatively estimated based on the information presented herein. It should be noted, however, that the information may change due to, among other things, rapid developments in the construction sector; therefore, the authors would appreciate feedback, comments, and suggestions for future revisions.

The guide was developed based on a literature review and interviews with relevant stakeholders. Subsequently, it was reviewed by experts.

At the end of the guide, hazards (i.e., asbestos, heavy metals, VOCs, PCBs) associated with surface treatment and assembly techniques (e.g., paint, grout, mortar) that apply to broad materials and products are briefly discussed.

# Why reuse?

The construction industry accounted for around 37% of global greenhouse gas emissions in 2021, a large part of which was due to the production of building materials (i.e. concrete, steel, aluminium, glass and bricks) (UNEP, 2024). In the Icelandic context, circularity in the construction sector is of great value, as around 50% of building-related emissions in Iceland stem from the production of building materials and products (Vegvísir að vistvænni mannvirkjagerð 2030, 2022).

Apart from greenhouse gas emissions, there are economic reasons to increase the circularity of the construction sector. An analysis of the renovation of Keilir's school building at Grænásbraut 910 in Ásbrú shows considerable financial benefits from reusing construction materials, even though a construction approach prioritising reuse has a higher labour-to-material cost ratio. Moreover, it is highlighted that in a market like Iceland, where most construction materials are imported, reuse should strengthen the domestic economy and support a trade surplus (Ó.Þ. Tryggvason, 2011).

From a macroeconomic perspective, the Swedish Circularity Gap report reveals an annual value loss of up to 180 billion SEK from building demolition, and the reuse of building materials is among the most effective measures to reduce this loss. Lastly, a Norwegian study shows that reusing local building materials can be a cost-effective way to reduce greenhouse gas emissions (M. Kjendseth Wiik, 2025). Nevertheless, figures from Denmark indicate that only about 4% of building materials in new buildings are recycled or reused (E. Hoxha, H. Birgisdóttir, 2025). Therefore, the handbook aims to challenge the status quo and facilitate reuse, while acknowledging the urgent need to reduce overall resource consumption.

# What to consider prior to reuse?

In the following sections, the technical and regulatory aspects of the reuse of various materials and products are discussed. However, several general considerations should be taken into account in every case of aiming for reuse.

1) Origin of materials and products

Along with information on the age of the building or material (which helps determine its properties and its initial function), it is important to learn the reason for removing the material or products. At a minimum, it is advisable to determine whether the material or product was exposed to moisture, used in a mouldy environment, or could be infested with pests. Visual inspection can help assess the condition of the material. Still, mould or pests can sometimes be hard to identify at a glance. In the case of a pest infestation risk, it is advisable to quarantine the salvaged materials (i.e., keep them separate until they are verified as pest-free).

# What to consider prior to reuse?

2) Information on materials and product properties

Determining the properties of materials and products for reuse may require archival research, physical inspection, and expert analysis.

The archival research aims to gather data on the material/product and its use over the years (e.g., as-built documentation, material/product datasheets) to align expectations with the historical qualities of such materials/products and the past techniques used. Data on past incidents or issues in the building where the material/product was used, such as leaks, should also be gathered. Archival research can help identify potential hazards associated with reuse (e.g., asbestos) at the outset. If the original documentation is unavailable, it may be necessary to find a functionally and technically similar item and compare it with the item intended for reuse.

Physical inspection of materials and products assesses their current condition and reuse potential and verifies archival findings. While visual inspection often suffices, non-destructive or destructive testing may be required to fully evaluate an item's condition.

Lastly, it is advised to contact specialists experienced in working with the specific materials and products to help identify the item's properties.

3) Storage

Proper storage of construction materials/products, both new and salvaged, is crucial for keeping or prolonging their lifespan. Materials available during demolition or renovation are typically not needed at that time in another construction project. Materials from one demolition may also be used in several constructions at different times. Given this, the best solution to address these challenges in synchronising timing would be a shared storage space for reusable construction materials/products. However, currently, no such storage space exists; these items are usually stored by their owners, or companies specialised in selling such materials (e.g., Efnisveitan).

Therefore, proper storage space for these materials prior to use (often for longer periods than in conventional purchases) must be considered from the project's outset. Depending on the type of material, this space can be indoors or outdoors; however, protection against moisture, climate, and damage, as well as the ability to assess the item's condition, is necessary in both cases.

3) Patience

Reusing salvaged materials typically requires more time and labour than conventional purchasing, and often interdisciplinary cooperation is necessary, as dismantling and sourcing items from demolition/renovation projects or recycling centres can be labour-intensive (especially since there is no central database of available materials). Additionally, the reuse of many construction materials remains uncommon, which may limit availability. While supply is expected to improve over time, patience is necessary as progress is gradual.

# ASPECTS CONSIDERED

Reuse potential

Reuse potential is assessed considering several aspects. First, the technical feasibility of reuse, as the main focus of this handbook,  is assessed, and, if deemed feasible, practical tips for reuse are provided.
Materials are divided into seven groups. For each group, an overview of regulatory requirements and general information on the material/product to be gathered before its reuse is provided at the beginning of the section. Additionally, aspects linked to CE-marking are discussed briefly at the end of this document.
Moreover, environmental and health hazards associated with reuse are listed for each material; additionally, a description of hazards associated with surface treatment (which can be shared by many materials) is presented in the Construction chemicals chapter at the end of the document. The hazards described do not include safety risks and physical hazards (e.g., falls, injuries, wounds).
Reusability of each material, based on the above aspects considered, is also visually presented in the form of a colour scale, following the logic of:

- Dark green colour: reusable without/with a few minor identified issues.
- Green colour: reusable with several minor issues identified.
- Yellow colour: reusable with some minor and major issues identified.
- Orange colour: reusable with several major issues identified.
- Red colour: reuse is possible only in rare cases.

Repurpose/recycling

For each item, brief information on its repurposing potential and current recycling route is added. Nevertheless, even though there are often many ways to repurpose listed materials, their direct reuse in the same function should always be a priority due to its lower environmental impact; repurposing should be done only when direct reuse is not possible, and recycling should be the last option.
The current recycling method for listed items is based on information from Iceland's main waste management companies (i.e., Íslenska gámafélagið, SORPA, Terra), is included. It must be noted that these companies are continually working to find more efficient ways to recycle waste; therefore, it is advised to always check the latest information on this matter.

# ASPECTS CONSIDERED

Potential greenhouse gas emission savings

Potential savings in greenhouse gas emissions are shown for the listed items identified as reusable in more than rare cases (regardless of the challenges associated with reuse). It is given to visualise often hidden “environmental savings" in the form of avoided emissions in the near future, and to aid in informed decision-making. It has to be noted, however, that in the current LCA methodology adopted in Iceland, potential savings are not included in the life-cycle carbon footprint of a building; however, for reused materials, no emissions are accounted for at any stage of the life cycle.

The estimations are based on emissions values for the so-called product stage (A1-A3 modules), including raw materials extraction, transport, and product manufacturing. For products made from biogenic materials, values for biogenic Global Warming Potential (linked to stored carbon) are omitted from the estimation. The values are based on at least three EPDs found for a material and product. EPDs for materials and products available on the Icelandic market are prioritised, followed by items used in the Nordics and Europe; when such data is unavailable, global information is used. In case no EPD is available, other sources are used. The list of sources used is available in Annexe 1.

Estimated average service life

Estimated average service life is shown for the listed items identified as reusable in more than rare cases (regardless of the challenges associated with reuse). Service life is the period of time after installation during which an assembled material is expected to meet the minimum technical and functional requirements.

Including these values in the handbook aims to better inform the initial decision-making process by providing data for assessing the effort required to salvage a material and its potential lifespan after reuse. However, it must be noted that the rate of physical degradation of materials depends strongly on several factors such as, for instance, maintenance quality, the conditions under which the material was used, and possible incidents (e.g., flooding). Therefore, an individual assessment of the material's technical condition is advised before a final decision on its reuse.

The given values are based on declared reference service life in EPDs for listed materials, declared service lifes presented in *Level(s) indicator 1.2: Life cycle Global Warming Potential (GWP)* report, and, eventually, adjusted to Icelandic conditions based on *Brunabótamat Afskriftir - Liftimar byggingarhluta* [1] in which the estimated service life of given building components, assuming average (common) level of maintenance in Iceland, is given.

[1] M. Ólafsson et al., *Brunabótamat Afskriftir - Liftimar byggingarhluta*, 2000.

# CONSTRUCTION BOARDS

# CONSTRUCTION BOARDS

Construction boards, as a versatile and cost-effective material, are commonly used for a broad range of building purposes, from internal partitions, walls, and floors to structural sheathing. They are often available in standardised sizes and thicknesses to ensure compatibility with standard construction modular framing and furniture design. The most commonly used types of construction boards in Iceland are presented herein. It is crucial to remember that to increase the reuse potential of the construction boards, it's best to keep them clean and dry.
It should be noted that surface treatment will affect the reuse potential, especially given possible hazards posed by harmful compounds in, for instance, paints. More about it can be found in the *Construction chemicals* chapter at the end of this document.

| | **Reuse potential** | **Potential saving of GHG emissions** | **Estimated average service life** |
|---|---|---|---|
| **Chipboards/particleboards** | ○●○○○ | 263-332 $kgCO_{2\_eq}/m^3$ | ≥50 years |
| **Medium-density fiberboard** | ○○●○○ | 237-474 $kgCO_{2\_eq}/m^3$ | ≥50 years |
| **Oriented strand boards (OSB)** | ○●○○○ | 101-199 $kgCO_{2\_eq}/m^3$ | 50 years |
| **Plywood** | ○●○○○ | 71-522 $kgCO_{2\_eq}/m^3$* | ≥100 years |
| **Plasterboard** | ○○○●○ | 1-2 $kgCO_{2\_eq}/m^2$ | >50 years |
| **Cement-based wall elements** | ○○○●○ | 124-207 $kgCO_{2\_eq}/m^2$ | >80 years** |

** Values vary greatly due to plywood properties and intended use – indoors or outdoors*
*** If used as intented, autoclaved aerated concrete lasts almost indefinitely.*

<u>Regulatory requirements for reuse</u>

Boards and wall elements used indoors are not subject to strict requirements in the building code, provided the structure is not load-bearing. The decision to reuse material should be subject to professional site assessment by qualified tradespeople to ensure compliance with general safety and craft standards. In such an assessment, the age of the material and the conditions under which it was used (to identify possible hazards) must go hand in hand with the technical assessment. For information on CE marking, see the *CE marking* chapter at the end of this document.

<u>Information necessary to gather for reuse</u>

It is advised to collect information on original properties of engineered wood boards (e.g. binder, flame-retardant used, OSB class) to adjust material handling accordingly. For *plasterboards*, it is advised to collect information on original properties (e.g., whether it's a standard, moisture-resistant, or fire-rated board) and the year of production/use (due to the risk of asbestos), to adjust material handling accordingly. It is allowable to reuse a specialised board for a standard application, but not vice versa. For *cement-based wall elements*, it is advisable to obtain information on the material's age, as thin mortar applied before 1983 might have contained asbestos.

# Chipboards/particleboards

Chipboards are engineered wood-based panels composed of wood waste materials (chips, shavings, or sawdust) bonded with resin under heat. Chipboards are often used interchangeably with particleboards; however, chipboards typically denote lower-density panels, whereas particleboards refer to higher-density options with finer particles. In construction, chipboards primarily serve as interior cladding, flooring, and underlaying, providing a cost-effective alternative to plywood and MDF, though with lower moisture resistance and load-bearing capacity, making them appropriate for non-structural applications. Chipboards are available in standard thicknesses ranging from 4 to 50 mm.
The most common binder used has been UF (urea-formaldehyde). However, other binders have been used, such as MUF (melamine-urea-formaldehyde) to provide high moisture resistance; PF (phenol-formaldehyde) for improved durability and strength; and PMDI (polymeric methylene diphenyl diisocyanate) for low-emission applications. Green colour often indicates moisture resistance (MUF); a darker brownish colour can recognise the presence of PF, whereas a red tint distinguishes flame-retardant chipboards.

**Reuse potential**

Direct reuse is possible (if screwed, not glued) with several aspects kept in mind:

1. Caution is advised when dismantling chipboard to avoid damage. Note that chipboards can often be glued when fixed, which might make dismantling impossible; chipboards that are nailed/screwed might be easier to dismantle. It is necessary to remove nails/screws after dismantling to avoid damage during transport.
2. Larger boards in good condition can be reused directly in similar applications as originally used.
3. Reused chipboards might have been exposed to moisture. In the absence of visible swelling, bulges, or a warped surface, a check for hidden moisture damage (e.g., sagging under its own weight, crumbling particularly around edges, cracking, or bulging) is advised.
4. If the edges are damaged, trimming a few centimetres off the edges can often salvage the rest of the sheet. In such cases, applying a sealant (e.g., paint or varnish) to exposed edges is crucial to prevent moisture absorption. However, it should be noted that, in such cases, the salvaged board size may differ from the standard size fitting the modular construction framework.
5. Removing screws or nails from chipboard leaves holes, and subsequent re-nailing in the same or nearby spots might reduce holding power or even cause the material to turn to dust.
6. Reused chipboards might have reduced strength, showing in increased fragility and brittleness.
7. It might be hard to achieve a durable finish (e.g., with paint) on damaged surfaces.
8. Storing chipboards for reuse flat, elevated off the ground, and protected from water (e.g., covered with a waterproof tarp) is necessary to prevent warping and water damage.

**Hazards related to reuse**

- Chipboards with UF, MUF, and PF can emit formaldehyde and other VOCs, whereas chipboards with PMDI can emit VOCs (excluding formaldehyde). Peak VOCs emissions, which typically occur just after production, are greatly reduced in the first few months thereafter [1].
- Flame-retardant chipboards are distinguished by a red tint and typically contain halogen-free, safer phosphorus-based flame retardants. However, older products may contain halogenated flame retardants.
- Cutting, sanding, and sawing chipboards might release VOCs and wood dust (classified as carcinogens), as well as halogenated flame retardants (classified as endocrine disruptors, neurotoxins, and carcinogens). Proper respiratory and eye protection, along with ventilation, are necessary during these activities.
- When chipboards are exposed to moisture, there is a respiratory risk from mould and rot.
- In chipboards produced before the 80s, polychlorinated biphenyls (PCBs) can be found, which are highly toxic substances classified as carcinogens. Therefore, the reuse of such chipboards is not advised.

Repurpose/recycling

MDF can be repurposed in many ways (e.g., into furniture). In terms of recycling, wood-engineered products (which contain, among others, glues) should be treated as the so-called treated timber; currently, such waste is typically incinerated.

Sources

[1] S. Sun et al., *Effects of the manufacturing conditions on the VOCs emissions of particleboard*, BioResources, 2020. DOI: 10.15376/biores.15.1.1074-1084

# Medium-Density Fiberboard (MDF)

Medium-Density Fiberboards (MDF) are engineered wood-based boards made by combining finely ground wood fibres (such as hardwood by-products and sawdust) with adhesive under high temperature and pressure. Typically, UF (urea-formaldehyde) is used as a binder. However, MUF (melamine-urea-formaldehyde) can be used to enhance moisture resistance (often tinted green), PF (phenol-formaldehyde) for improved durability and strength (darker MDF colour), and PMDI (polymeric methylene diphenyl diisocyanate) for low-emission applications. Flame-retardant MDF are distinguished by a red or blue tint.
MDF is often used for wall cladding, decorative ceiling panels, flooring underlayment, and in the furniture industry due to its smoothness, paintable surface, and potential for intricate detailing. Standard board thicknesses range from 2 to 30 mm.

**Reuse potential**

Direct reuse is possible (if screwed, not glued) with several aspects kept in mind:

1. If MDF is structurally sound, it can be painted, primed, or veneered.
2. MDF should be sealed (e.g., painted or coated) during use to prevent moisture absorption.
3. If the edges are damaged, trimming a few centimetres off the edges can often salvage the rest of the sheet. In such cases, applying a sealant (e.g., paint or varnish) to exposed edges is crucial to prevent moisture absorption. However, it should be noted that, in such cases, the salvaged board size may differ from the standard size fitting the modular construction framework.
4. It is advised to ensure that MDF is dry, checked for moisture damage (e.g., swelling, blistering paint, soft spots – particularly around edges and joints), and free from mould.
5. Removing screws from MDF might pull out the compressed wood fibres, resulting in an oversized, stripped, or crumbling hole, and subsequent re-screwing in the same or nearby spots might be impossible without repairs.
6. Reused MDF might have been exposed to moisture. In case of no visible swelling, bulges or warped surface, a check for hidden moisture damage (recognisable by, for instance, sagging under its own weight, crumbling particularly around edges, cracking, bulging or peeling of laminate/veneer) is advised.
7. Storing MDF for reuse flat, elevated off the ground, and protected from water (e.g., covered with a waterproof tarp) is necessary to prevent warping and water damage.

**Hazards related to reuse**

- MDF with UF, MUF, and PF can emit formaldehyde and other VOCs, whereas boards with PMDI can emit VOCs (excluding formaldehyde). The intensity of formaldehyde and VOCs release depends on whether MDF is coated; nevertheless, peak emissions are generally associated with the first weeks after production and then decrease significantly over the first several months [1,2].
- Peak VOC emissions, which typically occur just after production, are greatly reduced in the first few months thereafter [1].
- Untreated MDF releases more VOCs than laminated or coated MDF (as it acts as a barrier).
- Flame-retardant MDF are distinguished by a red or blue tint and typically contain halogen-free, safer phosphorus-based flame retardants. However, older products may contain halogenated flame retardants.
- Cutting, sanding, and sawing chipboards might release VOCs and wood dust (classified as carcinogens), as well as halogenated flame retardants (classified as endocrine disruptors, neurotoxins, and carcinogens). Proper respiratory and eye protection, along with ventilation, are necessary during these activities.
- When MDF are exposed to moisture, there is a respiratory risk from mould and rot.

Repurpose/recycling

Chipboards can be repurposed in many ways (e.g., into furniture). In terms of recycling, wood-engineered products (which contain, among others, glues) should be treated as the so-called treated timber; currently, such waste is typically incinerated.

Sources

[1] M. G. D. Baumann et al., *Aldehyde emissions from particleboard and medium density fiberboard products*, Forest Products Journal, 2000. Access (14/02/2026) here.
[2] J. Zhang et al., *Research Progress on Formaldehyde Emission of Wood-Based Panel*, International Journal of Polymer Science, 2018. DOI: 10.1155/2018/9349721

# Oriented Strand Boards (OSB)

OSB are engineered wood-based panels made by hot-compressing strands or chips of wood (commonly pine or spruce) and bonding them together with glue. They are often used for sheathing in construction, offering high resistance to deflection, warping, and racking. The glue used is MUF (Melamine-Urea-Formaldehyde) or, more commonly, formaldehyde-free PMDI (polymeric methylene diphenyl diisocyanate).
While OSB is a cost-effective alternative to plywood, it generally offers lower strength, moisture resistance, and overall quality. OSB is classified into four types (OSB/1-OSB/4), with OSB/3 being the most widely used in construction. It is available in standard thicknesses ranging from 6 mm to over 30 mm.

**Reuse potential**

Direct reuse is possible (if screwed, not glued) with several aspects kept in mind:

1. OSB tends to chip when dismantled; caution is advised. Note that OSB for subflooring is often glued to floor joists, which might make its dismantling impossible; OSB used for sheathing is usually nailed/screwed (hence possible to be dismantled). It is necessary to remove nails/screws after dismantling to avoid damage during transport.
2. If the edges are damaged, trimming a few centimetres off the edges can often salvage the rest of the sheet. In such cases, applying a sealant (e.g., paint or varnish) to exposed edges is crucial to prevent moisture absorption. However, it should be noted that, in such cases, the salvaged board size may differ from the standard size fitting the modular construction framework.
3. Reused OSB may have reduced rigidity and strength, so reusing them for lower loads as initially intended, non-structural, or low-stakes purposes is advised.
4. Removing screws or nails from OSB leaves holes (damage to the internal fibre structure), and subsequent re-nailing in the same spots might result in reduced holding power.
5. Exposure to moisture or excessive heat severely degrades OSB quality and, in such cases, reuse for non-structural, low-stakes purposes is advised. Mould and rot can be recognised by black, greenish, or grey spots, swelling, and structural failure.
6. Storing OSB for reuse flat, elevated off the ground, and protected from water (e.g., covered with a waterproof tarp) is necessary to prevent warping and water damage.

**Hazards related to reuse**

- In the case of OSB with MUF glue, there is a risk of formaldehyde and other VOC emissions, whereas with PMDI, VOC (other than formaldehyde) emissions can occur. However, as with other engineered wood products, peak VOC emissions usually occur a few months after production and are greatly reduced in the first year [1,2].
- Cutting, sanding, and sawing OSB might release VOCs and wood dust (both classified as potential carcinogens). Proper respiratory and eye protection, as well as ventilation, are necessary.
- In case of OSB exposed to moisture, there is a respiratory risk from mould and rot.

Repurpose/recycling

OSB can be repurposed in many ways (e.g., into furniture). In terms of recycling, wood-engineered products (which contain, among others, glues) should be treated as the so-called treated timber; currently, such waste is typically incinerated.

Sources
[1] M. Makowski et al., *Long-term development of VOC emissions from OSB after hot-pressing*, Holzforschung, 2025. DOI: 10.1515/HF.2005.086
[2] T. Adamová et al., *Volatile Organic Compounds (VOCs) from Wood and Wood-Based Panels: Methods for Evaluation, Potential Health Risks, and Mitigation*, Polymers, 2020. DOI: 10.3390/polym12102289

# Plywood

Plywood is an engineered wood-based panel made by glueing layers of wood veneer (plies) with alternating grain directions (cross-graining provides high strength, stability, and resistance to warping, cracking, and shrinking). Spruce, pine and birch are common species used for plywood production. There are various types of plywood suitable for different applications (e.g., structural framing in roofing, subflooring, walls, exterior cladding, and concrete formwork).

A few types of glues are used in plywood, depending on the application. For indoor uses, plywood with Urea-Formaldehyde (UF) glue or Melamine-Urea-Formaldehyde (MUF) glue (for higher moisture resistance) is used. Phenol-Formaldehyde (PF) is waterproof and used in plywood for outdoor and marine use. Film-coated plywood (typically with phenolic resin) is used, e.g. for concrete formwork (Mótakrossviður). Polyurethane (PUR) glue is used for non-formaldehyde applications. Plywood is available in standard thicknesses ranging from 5 mm to over 40 mm.

**Reuse potential**

Direct reuse is possible (if screwed, not glued) with several aspects kept in mind:

1. It is necessary to be cautious when dismantling plywood, even though minor damage can be repaired, as excessive damage can weaken the board.
2. If the edges are damaged, trimming a few centimetres off the edges can often salvage the rest of the sheet. In such cases, applying a sealant (e.g., paint or varnish) to exposed edges is crucial to prevent moisture absorption. However, it should be noted that, in such cases, the salvaged board size may differ from the standard size fitting the modular construction framework.
3. If layers (plies) are separating, the structural strength of plywood is compromised, and it can only be used for non-structural and low-stakes applications.
4. It is advised to use screws instead of nails when reusing plywood to avoid future damage to the material when dismantled again. It is necessary to remove nails/screws after dismantling to avoid damage during transport.
5. When using plywood for concrete formwork, it is crucial to clean it immediately after stripping to prevent hardened concrete from damaging the surface. It is also advised to apply a release agent (form oil) to make future removal easier.
6. Exposure to moisture can degrade plywood quality and, in such cases, reuse for non-structural, low-stakes purposes is advised. It can be recognised by, among others, the presence of soft "spongy" areas (especially on the edges), warping, and bowing. In case of severe damage, reuse is not advised.
7. Storing plywood for reuse flat, elevated off the ground, and protected from water (e.g., covered with a waterproof tarp) is necessary to prevent warping and water damage.

**Hazards related to reuse**

- In the case of plywood with UF, MUF, and PF glue, there is a risk of formaldehyde and other VOC emissions. Plywood with PUR is considered low-VOC. The peak VOC emissions usually occur a few weeks after production and are greatly reduced in the first year after production [1].
- Cutting, sanding, and sawing plywood might release VOCs and wood dust (both classified as potential carcinogens). Proper respiratory and eye protection, as well as ventilation, are necessary.
- Old pressure-treated plywood boards might contain harmful chemicals (such as chromated copper arsenate, or CCA) that are unsafe for residential use (e.g., furniture, fences, decks). Plywood with CCA has been legally banned for residential use in the EU since 2004. It can be recognised by a distinct green tint.
- In case of plywood exposed to moisture, there is a respiratory risk from mould and rot.

Repurpose/recycling

Plywood can be repurposed in many ways (e.g., into furniture). In terms of recycling, wood-engineered products (which contain, among others, glues) should be treated as the so-called treated timber; currently, such waste is typically incinerated.

Sources

[1] T. Cao et al., Influence of loading factors on VOCs emission from veneered plywood, European Journal of Wood and Wood Products, 2020. DOI: 10.1007/s00107-020-01557-2

# Plasterboard

Plasterboard (drywall, gypsum board) is a construction panel made out of gypsum bonded to paper liners, providing structural strength. It is commonly used for lining internal walls, creating partitions, and forming ceilings due to its good heat-storing, sound-insulating, and fire properties. Some plasterboards contain glass-fibre reinforcement (to increase their strength, impact resistance, and fire protection) or silicone (to increase moisture resistance). These boards are often paper-free. Standard thicknesses range from 9.5 to 15 mm.

**Reuse potential**

Direct reuse is possible (mostly if screwed, not glued), however challenging, as it is hard to avoid board damage while dismantling. When aiming for direct reuse, several aspects should be kept in mind:

1. The most feasible method to reuse panels is to keep them attached to their original frames (steel or timber).
2. Special caution is advised when removing screws from plasterboard to avoid cracks and other damage. When dismantling, using a manual screw gun is advised. It is necessary to remove nails/screws after dismantling to avoid damage during transport.
3. If the edges are damaged, trimming a few centimetres off the edges can often salvage the rest of the sheet. However, it should be noted that, in such cases, the salvaged board size may differ from the standard size fitting the modular construction framework.
4. For minor damage (up to 5 cm in diameter), the board can be repaired using specialised fillers. Larger damages can be repaired using a backing board and a patch.
5. Plasterboards must be stored flat and in dry conditions for reuse.
6. With future reuse in mind, it is advisable to use screws or easily removable adhesives if necessary.

**Hazards related to reuse**

- Plasterboard from before 1985-1989 may contain asbestos, primarily in finishing compounds, textured coatings, or as asbestos-containing insulation board (AIB).
- Plasterboards exposed to moisture can break down and release toxic, corrosive gas (under low-oxygen, organic-rich conditions). Hydrogen sulphide can be recognised by the smell resembling rotten eggs.
- Gypsum dust can irritate the eyes, skin, and respiratory system. Therefore, it is advised to use proper protection when handling old plasterboards.
- Moisture-resistant plasterboards (green or purple, specifically marked "mould-resistant", or installed in a high-moisture area) might have been treated with biocides, which can cause skin and respiratory irritation. Therefore, it is advised to use proper protection when handling old plasterboards.

Repurpose/recycling

Plasterboards can be repurposed as soil conditioners (in unpainted form) and for craft projects. Large, clean cutoffs can also be used to create small, non-structural elements (e.g., boxing in pipes or small shelving units). Gypsum can be recycled indefinitely, and the gypsum core from used boards can serve as a raw material for new gypsum boards. Recyclable content can reach up to 99%, although typical products from major manufacturers contain around 30% recycled gypsum. However, predominantly due to economic reasons (i.e., low cost of virgin material, low landfilling costs, expensive and complicated logistics), gypsum is not recycled, and plasterboards are landfilled.

# Cement-based wall elements

Cement-based wall elements are lightweight, stackable units primarily utilised for constructing interior walls in buildings with low load requirements, but they can also be used for exterior applications. A typical size is a 40x60 cm block with a thickness of 10 cm. These elements are made from concrete, incorporating air to enhance their lightweight properties, while pumice and expanded clay serve as fillers. Additionally, chemically aerated concrete may be employed, along with various other materials and formats.

**Reuse potential**

Direct reuse is possible, however challenging, as they are usually glued together and plastered. Reuse might require cutting the entire wall elements into specified modular elements and then refitting them as a new wall made of these modules.

**Hazards related to reuse**

- Elements used before 1989 might contain asbestos (in mortar).
- Cutting, drilling, or breaking concrete results in respirable crystalline silica (RCS) emission, a highly hazardous and carcinogenic substance. In such cases, not only is proper respiratory protection necessary, but also methods to prevent RCS from becoming airborne (e.g., using tools with integrated water delivery systems or local exhaust ventilation).

Repurpose/recycling

Cement-based wall elements can be repurposed in applications where appearance is not critical. In terms of recycling, cement-based wall elements (without non-mineral fibres or fillers) can be used as fillers in other products, such as concrete. However, they are most commonly crushed and either landfilled or used for backfilling (downcycling).

# INTERIOR FIXTURES

# FENESTRATION

# INTERIOR FIXTURES AND FENESTRATION

Interior fixtures are items permanently or semi-permanently attached to a building's structure, providing essential utilities (e.g., sanitary equipment) and aesthetic value (e.g., ceiling panels).

| | Reuse potential | Potential saving of GHG emissions | Estimated average service life |
|---|---|---|---|
| **Ceiling panels** | ●○○○○ | 3-15 $kgCO_{2\_eq}/m^2$* | ≥50 years |
| **Doors** | ●○○○○ | 22-106 $kgCO_{2\_eq}/m^2$** | 30 years |
| **Sanitary equipment: toilets** | ●○○○○ | 48-77 $kgCO_{2\_eq}$/pc | 15-30 years |
| **Sanitary equipment: basins** | ●○○○○ | 21-35 $kgCO_{2\_eq}$/pc | 15-30 years |
| **Sanitary equipment: mixers** | ●○○○○ | 5-11 $kgCO_{2\_eq}$/pc | 15-30 years |
| **Ventilation ducts** | ●○○○○ | 1-4 $kgCO_{2\_eq}$/kg | 30 years |
| **Windows** | ○○○●○ | 52-105 $kgCO_{2\_eq}$/kg*** | 30 years |

** Values differ due to, among others, material (e.g., MDF, semi-hard wood fibre boards) and surface finishing (e.g., veneer, melamine-faced).*
*** Values differ due to, among others, material (e.g., wood, aluminium), type (e.g., glazed or not), and surface treatment applied.*
**** Values vary due to, among others, material of window frame (i.e., aluminium, PVC, wood).*

<u>Regulatory requirements for reuse</u>

Interior fixtures and indoor elements are not subject to strict requirements in the building code. The decision to reuse material should be subject to professional site assessment by qualified tradespeople to ensure compliance with general safety and craft standards. In such an assessment, the age of the material and the conditions under which it was used (to identify possible hazards) must go hand in hand with the technical assessment.
External doors and windows need to meet the requirements set in the building code and other relevant regulations (e.g., accessibility regulations).
For information on CE marking, see the *CE marking* chapter at the end of this document.

<u>Information necessary to gather for reuse</u>

It is advised to collect information on the age of materials to identify potential hazards associated with their handling (e.g., PCBs or asbestos).

# Ceiling panels

Ceiling panels (sometimes called ceiling tiles or planks) are lightweight, flat or textured boards installed on or just below the ceiling surface, used in commercial and residential applications. They can be fixed in place or suspended within a grid system. They serve multiple functions – aesthetic (e.g., as decoration or to hide utilities, such as pipes or ventilation ducts) - but can also serve as acoustic control or thermal insulation. Ceiling panels are made from various materials, including mineral fibre, metal, plaster, and wood fibre bound with cement (wood-wool cement boards). Wood wool cement boards are often used for acoustic purposes and as moisture regulators in ceilings in bathrooms and swimming pools due to their moisture resistance.

**Reuse potential**

Direct reuse is possible with a few aspects to keep in mind:

1. Mechanically fastened panels or those in a grid system are easily dismountable. Remove screws, nails, or other elements during storage and transport to avoid panel damage.
2. It is advisable to avoid glueing panels if you intend to reuse them, as it significantly reduces their reuse potential.
3. Some panels may be fragile, so caution is advised when handling them to avoid physical damage.
4. Over time, panels' acoustical properties often degrade (primarily due to natural material degradation, damage, and the accumulation of contaminants). When their performance diminishes, these panels can be reused in situations where high acoustical performance is not critical, such as storage spaces, bathrooms, or utility rooms.

**Hazards related to reuse**

- Ceiling panels used in a very moist environment may have been affected by mould, posing a respiratory risk.
- Ceiling panels might have accumulated dirt and other contaminants over the years, so handling them requires proper personal protection, and cleaning might be necessary.

***It is a common practice in Iceland to reuse ceiling panels, especially in the office renovation projects within one company.***

Repurpose/recycling

Ceiling panels can be repurposed into home decor and functional items (e.g., fire screens, acoustic backing). Ceiling panels are sorted depending on the material they are made of (e.g., plaster, treated timber, mineral (inert) fraction, etc.), and recycled accordingly. Currently, plaster and mineral (inert fractions) are landfilled, and treated timber is mainly incinerated.

# Doors

Doors are usually made of wood, glulam, glass, continuous pressure laminate (CPL), or metal. A complete set of hinged doors includes the door slab/leaf, frame, hinges, handles with associated screws, lockbox with keys, door automation (with associated screws, mounting plate, and stop guard), threshold, and other accessories. When considering reuse, it is crucial to view the door as a complete set and harvest as many of its components as possible.

## Reuse potential

Direct reuse of doors is possible and quite common. A few aspects need to be kept in mind when aiming for reuse:

1. When dismantling doors, as many components as possible from the full set shall be harvested and stored together so that the elements can be assigned to the correct door. It is crucial to label set elements accurately and visibly, as losing them might result in a time-consuming search for replacement or, sometimes, even make the door unreusable*.
2. If possible, it is advised to dismantle knobs/handles to facilitate efficient storage and prevent scratches during transport.
3. If the set contains a lock cylinder, the key must be removed from it (to avoid breaking during storage and transport) and taped to the door slab.
4. It is necessary to remember to fasten the door slab, frame, and other set elements to prevent opening during transport and handling. Wooden studs can be used to prevent damage to protruding parts (e.g., door hinges, handles).
5. For glass doors, it is necessary to protect the corners and never place glass against hard surfaces.
6. When storing or transporting door sets, it is advised to place a bottom plate (e.g., corrugated cardboard) on the pallet to prevent smaller parts from falling through.

## Hazards related to reuse

- Hazards related to door reuse are mainly linked to coatings or other surface treatments they were subjected to. More about the risks linked to paints, coatings, and other surface treatments can be found in the Construction chemicals section.
- Older fire doors might contain asbestos, which poses a significant health risk when damaged.

**** In ENTRA's KA13 project, a Norwegian full-scale circular project, some reusable doors were not reused eventually because the door leaves were separated from the frames, and it was difficult to match them again. Therefore, proper labelling of complete door sets is of crucial importance.***

## Repurpose/recycling

Doors can be repurposed into home decor (e.g., tables, benches, headboards) and functional exterior items (e.g., porch swings). Doors are sorted depending on the material they are made of (e.g., metal, treated timber, etc.), and recycled accordingly. Currently, metal fraction is recycled and treated timber is mainly incinerated.

Sources and further reading

CCBuild, *Återbruk av beslag och dörrautomatik - Demonterings- och hanteringsinstruktioner*, 2018.
CCBuild, *Återbruk av dörrpartier - Demonterings- och hanteringsinstruktioner*, 2018.

# Sanitary equipment

Sanitary appliances include fixed, plumbed-in items commonly used in all types of settings (commercial, residential, and industrial). The most common components belonging to this group are toilets, sinks, showers, bathtubs, and faucets. They are typically made of ceramics, stainless steel, or acrylic (bathtubs).

**Reuse potential**

Direct reuse is possible and quite common, as sanitary appliances' design and functionality do not change much over the years, and spare parts are readily available. A few aspects need to be kept in mind when aiming for reuse:

1. It is important to remember that a complete toilet set includes mounting screws and parts built into the wall (for wall-mounted toilets), and to harvest as many of these elements as possible to avoid the need to search for spare parts.
2. Before dismantling the toilet, it is advised to empty the cistern and clean the toilet bowl for sanitary reasons.
3. Older toilets can be converted to double-flush toilets, if necessary. Single-flush toilets can be located in spaces of less frequent use (e.g., basements, less busy floors), or they may be preferred at the end of the common wastewater pipe to "rinse out" the main pipe more effectively.
4. It is important to remember that a complete washing basin or sink set includes gaskets and wall brackets, and harvest as many of these elements as possible to avoid the need to search for spare parts.
5. When dismantling a washing basin or sink, be cautious with the supply water connection, as it can be bent easily.
6. It is important to remember that a complete mixer tap or faucet set includes gaskets and detachable water connections from the wall; try to harvest as many of these elements as possible to avoid the need to search for spare parts.
7. For many old mixer taps/faucets, a flow limiter can be installed to reduce water consumption.
8. When storing and moving sanitary equipment for reuse, it is advisable to place a bottom plate (e.g., corrugated cardboard) on the pallet to prevent smaller parts from falling through.

**Hazards related to reuse**

- Hazards related to sanitary equipment reuse are predominantly linked to possible pathogens. Disinfection is necessary to avoid this risk.
- Equipment from the 80s and earlier might pose a risk of asbestos, which was incorporated in plumbing fixtures and specialised bathroom fixtures.

***Reusing sanitary appliances is quite common in Iceland, usually among individual stakeholders or between projects of the same owner. However, such secondary equipment can also be found in Iceland on the Efniveitan website.***

Repurpose/recycling

Repurposing of sanitary equipment is a rather rare practice. In terms of recycling, ceramic elements are usually crushed and landfilled, whereas metal ones are fully recyclable.

Sources and further reading:


A. Karlsson et al., *Återbruksguiden för installationer – Bengt Dahlgren*, 2022.

CCBuild, *Återbruk av VVS-produkter - Demonterings- och hanteringsinstruktioner*, 2018.

# Ventilation ducts

Ventilation ducts are typically made of galvanised steel or aluminium and come in various sizes and shapes, most commonly circular or rectangular. Their dimensions were standardised in the late 1990s to align with European standards. Since ducts are not active components, such as motors or fans, they experience a lower wear rate and therefore have a higher potential for reuse.

**Reuse potential**

Direct reuse of ventilation ducts is possible but not very common, given their low cost. To increase the economic feasibility of reuse, focusing on salvaging lengths suitable for the project is advised, as rejoining cut ducts can be time-consuming and hence costly. A few aspects need to be kept in mind when aiming for reuse:

1. It is advised to reuse ventilation ducts in areas with the lowest requirements for acoustic performance, pressure drop, and corrosion resistance if the original documentation specifying these properties is unavailable.
2. Before reuse, all gaskets are advised to be replaced to ensure tightness.
3. Flexible connections, filters, insulation, and all non-solid elements are challenging to clean properly; hence, their reuse is not advised.

**Hazards related to reuse**

- Ventilation ducts might have accumulated dirt and other contaminants over the years, so handling them requires proper personal protection, and cleaning might be necessary.

Repurpose/recycling

Repurposing of ventilation ducts is not a very common practice, but they can be repurposed, for instance, as forms for small concrete foundation pillars. In terms of recycling, metal ducts are fully recyclable.


Sources and further reading

A. Karlsson et al., *Återbruksguiden för installationer – Bengt Dahlgren*, 2022.

S. Rabie & Madeline Sjöholm, *Adaptive reuse and circularity potential of ventilation components: A Swedish case study*, 2024.

# Windows

Windows frames in Iceland are commonly made of wood, aluminium, aluminium/PVC clad wood, or PVC. A complete set of window components includes structural elements (e.g., frame, sash, and grilles), glazing (glass), and hardware (e.g., locks).

**Reuse potential**

Direct reuse of windows has been practised in Iceland, but it is uncommon due to several challenges. Firstly, in Iceland, there is a tradition of using cast-in-place windows, which are difficult to remove intact from buildings. Secondly, reusing older windows is challenging because they must meet formal requirements such as fire resistance and energy efficiency. Older windows may also have a shorter lifespan than new ones or contain hazardous substances. Therefore, windows are most often dismantled, and their components are sorted into separate waste fractions. However, it is possible to dismantle windows into individual elements (i.e., frame, glazing/glass, and other functional parts) and reuse them separately. This also allows for easier and safer transport of the individual elements.

**Hazards related to reuse**

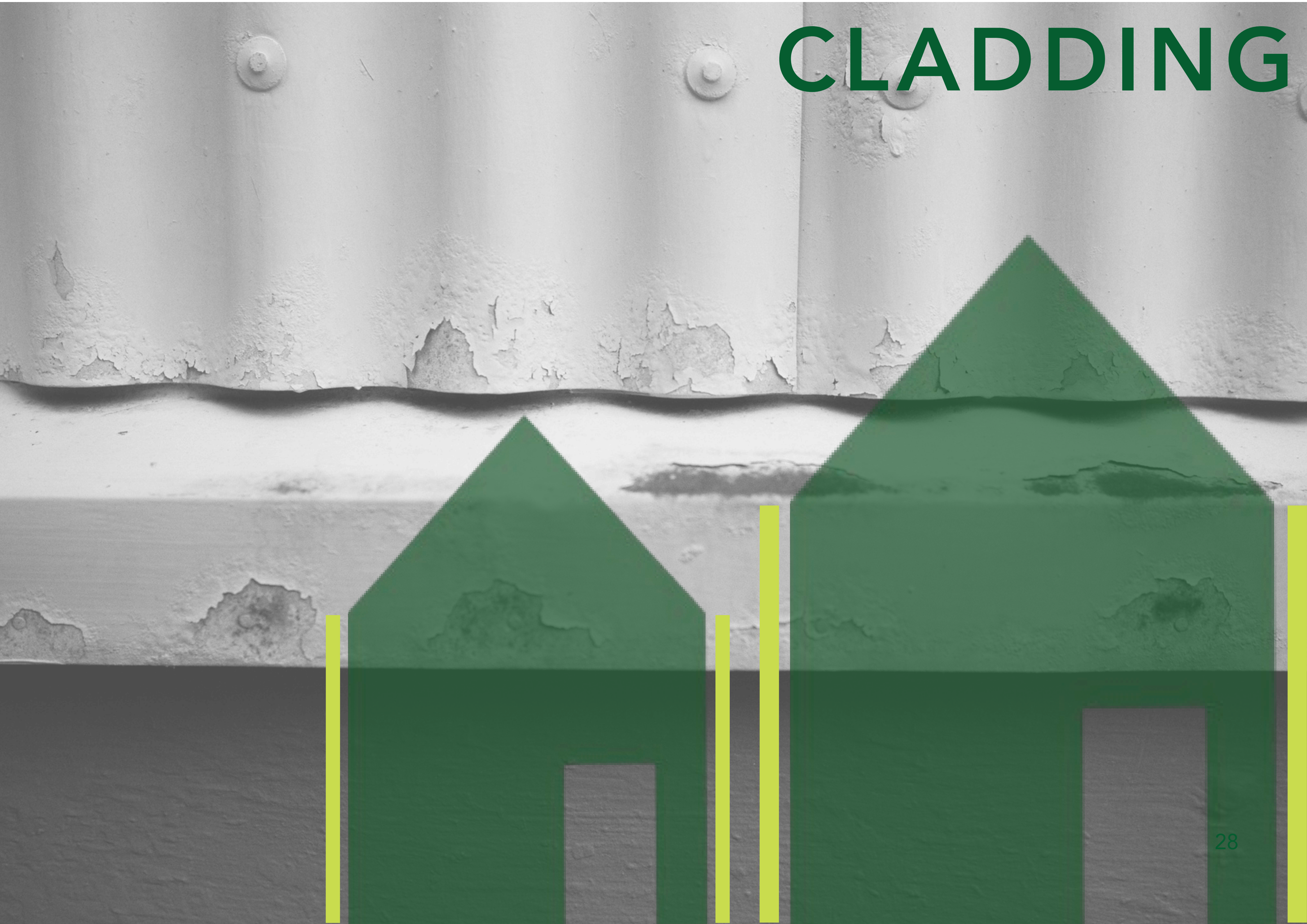
- Hazards linked to the reuse of windows are linked to surface treatment and chemicals used - see more information on the hazards in the Construction chemicals section. As an example, older window glazing putty may contain asbestos, especially in buildings from before the late 80s. Furthermore, older windows, especially from buildings from before 1980, can contain PCB in sealants around window frames and in double-glazed units. Last but not least, older window frames might be painted with lead-based paint.

***Windows from Turninn in Smáratorg, which had to be replaced, were disassembled, and glass was used to produce windows for common areas and a greenhouse in the Frakkastígur 1 project. More can be found in the recording here.***

Repurpose/recycling

Windows can be repurposed for home décor, in secondary buildings (e.g., sheds), or for functional exterior use (e.g., greenhouses). In terms of recycling, some window components can be recycled after separation, for instance, the aluminium frame. Window glazing is classified as mineral waste and is generally landfilled or used for backfilling.

# CLADDING



# CLADDING

Cladding is generally a non-structural exterior layer of a building that provides weather resistance, thermal insulation, and serves aesthetic purposes. This section presents the most common cladding materials used in Iceland.
It should be noted that surface treatment will affect the reuse potential, especially given possible hazards posed by harmful compounds in, for instance, paints. More about it can be found in the *Construction chemicals* chapter at the end of this document.

| | Reuse potential | Potential saving of GHG emissions | Estimated average service life |
|---|---|---|---|
| **Aluminium panels (flat and corrugated)** | ●○○○○ | 20-87 $kgCO_{2\_eq}/m^2$* | ≥50 years |
| **Ceramic façade systems** | ●○○○○ | 20-39 $kgCO_{2\_eq}/m^2$* | 50 years |
| **Copper and zinc sheet cladding** | ●○○○○ | 8-42 $kgCO_{2\_eq}/m^2$* | ≥50 years |
| **Fibre cement panels** | ○○●○○ | 12-24 $kgCO_{2\_eq}/m^2$* | ≥50 years |
| **Metal composite panels** | ○○○●○ | 10-52 $kgCO_{2\_eq}/m^2$* | 20-30 years |
| **Natural stone** | ●○○○○ | 62-115 $kgCO_{2\_eq}/t$** | ≥50 years |
| **Timber cladding** | ○●○○○ | 26-421 $kgCO_{2\_eq}/m^3$*** | 20-50 years |

** Varies due to, among others, cladding thickness and weight, recycled material content, etc.*
*** Varies due to, among others, type of stone used.*
**** Values vary greatly due to material used (e.g., larch, spruce, or western red cedar) and its treatment.*

<u>Regulatory requirements for reuse</u>

The decision to reuse material should be subject to professional site assessment by qualified tradespeople to ensure compliance with general safety and craft standards. In such an assessment, the age of the material and the conditions under which it was used (to identify possible hazards) must go hand in hand with the technical assessment. Additionally, for external cladding, the most important parameters to consider are fire safety class, structural strength, and durability, which can be based on the original documentation or an assessment by a qualified engineer. For information on CE marking, see the *CE marking* chapter at the end of this document.

<u>Information necessary to gather for reuse</u>

It is important to determine the age of materials designated for reuse, especially *fibre-cement panels*, to avoid asbestos exposure. For *metal composite* panels, knowledge of the core material is crucial for fire safety.

# Aluminium panels, flat and corrugated

Solid aluminium sheets are used as exterior cladding on roofs and walls. Corrugated aluminium panels are sometimes used in place of the common corrugated steel. Facade panels are often flat, but other forms are available. Aluminium sheets are produced in varying thicknesses, normally between 0.5 mm and 6 mm. The panels are fastened on a subframe with rivets or screws. Several surface treatments are available. Aluminium is naturally corrosion-resistant, so the cladding has a long lifespan. Other factors may contribute to premature damage, such as incorrect mounting, faded colour, and corrosion due to contact with other metals.

**Reuse potential**

Direct reuse is possible, with several aspects kept in mind:

1. Removal of aluminium panels is usually simple and non-destructive, even though the rivets used to mount them must be drilled through.
2. It is crucial to determine the panel material (not to confuse it with metal composite panels).
3. Restoring panels after bending is difficult; hence, caution is advised.
4. It is advised to start from the top down.
5. For longer panels, it is advised to have at least two people handling them to avoid bending under their own weight.
6. It is necessary to remember that some metals are not compatible with others, and their contact can accelerate corrosion. Aluminium, steel, and zinc are generally considered compatible. However, it needs to be kept in mind that using smaller galvanised (zinc-coated) items (e.g., nails) with bigger aluminium elements (e.g., sheets) will accelerate corrosion of galvanised elements (due to passing electrons from zinc-coating to aluminium); the reverse (aluminium nail in a galvanised sheet) does not pose such risks.

**Hazards related to reuse**

- Potential hazards are related to paints and other surface treatments present.

Repurpose/recycling

Aluminium panels can be repurposed in multiple ways, not only as a basic construction material but also for other purposes (e.g., landscaping). In terms of recycling, aluminium panels are fully recyclable. Moreover, products with high recycled content are available on the market.

Sources and further reading:
Metal Construction Association, *Dissimilar Metal Corrosion in Roofing Installations*, 2016.

# Ceramic façade systems

Ceramic façade systems consist of engineered ceramic panels (tiles or sheets), made from kaolin and clay mixed with various types of crushed stone, mounted on a metal (usually aluminium or steel) support system. They are available in various heights, lengths, colours, and with various fastening and design options (e.g., installation possible in joint cuts, without joint profiles, panels arranged horizontally or vertically in various patterns). However, their sizes are rather standardised among producers, increasing their reusability potential. This cladding is highly resistant to moisture and other contaminants present in water and air; therefore, its service life is long, often exceeding 50 years. For information on the reuse of ceramic tiles, see the section on flooring.

**Reuse potential**

The systems are suitable for dismantling and reuse (if mechanically fixed), with several aspects kept in mind:

1. Removal is usually rather simple and non-destructive in the case of dry systems (mechanical fixing). However, some original fastening system elements (e.g., clips or profiles) may need to be replaced due to wear.
2. For seamless-looking systems, it is advised first to understand the mechanism of their installation to avoid unexpected, violent stress releases that might cause damage.
3. It is advised to be cautious when removing the systems due to their weight and potential instability (e.g., caused by shifting insulation material or waterlogging).
4. Panels fixed with mortar or other adhesives are hard to salvage without damaging them.

**Hazards related to reuse**

- Cutting, drilling, or breaking ceramic tiles results in respirable crystalline silica (RCS) emission, a highly hazardous and carcinogenic substance. In such cases, not only is proper respiratory protection necessary, but also methods to prevent RCS from becoming airborne (e.g., using tools with integrated water delivery systems or local exhaust ventilation).

Repurpose/recycling

Elements of ceramic façade systems can be repurposed, often into home décor and garden features. In terms of recycling, ceramic façade systems shall be sorted into separate fractions of ceramic tiles and metal. Crushed ceramic tiles are often used for backfilling (downcycling), and metal elements are most often fully recyclable.

# Copper and zinc sheet cladding

Cladding with plain copper and zinc sheets is a traditional construction method in Europe. These metals are more expensive than aluminium and steel. This cladding often has folded seams that require careful removal. The metal sheets are fastened to the structures with nails and clips. The metal sheets have natural corrosion resistance and therefore have a lifespan well beyond 80 years.

**Reuse potential**

Direct reuse is possible, with several aspects kept in mind:

1. Removal is usually rather simple and non-destructive; however, caution is especially needed when dismantling folded seams - using force might cause considerable damage.
2. For longer panels, it is advised to have at least two people handling them to avoid bending under their own weight.
3. It has to be kept in mind that copper performs well when in contact with stainless steel or lead, but not with any other metals (i.e., it has a severe corrosive effect on aluminium, zinc, and steel).

**Hazards related to reuse**

- Cutting, welding, or soldering copper and zinc sheets requires proper respiratory and eye protection to prevent inhalation of metal fumes and to avoid potential liver or kidney damage if ingested in high concentrations.
- Copper and zinc sheets can leach metals into the environment [1].

Repurpose/recycling

Copper and zinc sheets can be repurposed in multiple ways, not only as basic construction materials (e.g., shingles, siding, or other architectural elements), but also for other purposes (e.g., home decor). In terms of recycling, copper and zinc panels are fully recyclable.

Sources and further reading:

[1] J.K. McIntyre et al., *Metals leaching from common residential and commercial roofing materials across four years of weathering and implications for environmental loading*, Environmental Pollution, 2019. DOI: 10.1016/j.envpol.2019.113262

COPPER IN ARCHITECTURE. *Facts on Characteristics and Usage of Copper for Architects*, 2019.

Metal Construction Association, *Dissimilar Metal Corrosion in Roofing Installations*, 2016.

# Fibre cement panels

Fibre cement panels are made from a mix of cement, water, sand, and cellulose fibres. They are available in various textures, colours, and sizes. The standard thickness is 8- 12 mm. They are durable (with an estimated service life of over 50 years), fire-resistant, low-maintenance, and relatively cost-effective. They can be mounted on various support systems (e.g. aluminium).

**Reuse potential**

Direct reuse is possible (if mechanically fixed), with several aspects kept in mind:

1. It is crucial to be cautious while removing the panels to avoid cracking them or damaging the edges.
2. It is easier to salvage panels when screws were used for their installation than in the case of nails. When using nails, it is advisable to pry the panels to remove the nails gently. It is necessary to remove nails/screws after dismantling to avoid damage during transport.
3. Panels fixed with adhesives are hard to salvage without damaging them; if trying, an oscillating tool to cut through the sealant is advised to make it easier.
4. For larger panels, it is advised to have at least two people handling them to avoid bending under their own weight.
5. To avoid dust emissions, panels can be wet down.

**Hazards related to reuse**

- It is crucial to determine the type of fibres used in the panels, as asbestos fibres were used in some cases before 1985-1989.
- Cutting, drilling, or breaking fibre cement panels results in respirable crystalline silica (RCS) emission, a highly hazardous and carcinogenic substance. In such cases, not only is proper respiratory protection necessary, but also methods to prevent RCS from becoming airborne (e.g., using tools with integrated water delivery systems or local exhaust ventilation).

***In ENTRA's KA13 project, a Norwegian full-scale circular project, fibre cement panels were reused for cladding.***

Repurpose/recycling

The panels can be repurposed where moisture resistance is needed, such as backing material for tiles and siding material for various outdoor applications. The panels can also be cut down to make shingles for smaller projects. Fibre-cement panels, as composite materials, are challenging to recycle and are usually landfilled.

# Metal composite panels

Metal composite panels are sandwich panels made of metal sheets (typically aluminium) bonded to a solid, non-insulating core (PU, PE, or, for better fire safety, mineral-filled). This construction results in lightweight panels with good stiffness that use less metal than solid panels. The panels are typically fastened with rivets or screws, and the subframe is attached to the building's exterior wall with anchor bolts or similar fasteners.

**Reuse potential**

Direct reuse is technically possible, as their removal is usually rather simple and non-destructive because they are usually mechanically fastened. However, the core material must be determined before considering reuse, as panels with highly combustible cores (e.g., PE) pose a considerable fire risk. In such cases, panels are recommended for reuse in low-risk, non-residential applications of smaller scale (e.g., detached storage sheds).

**Hazards related to reuse**

- The primary hazards are linked to the combustible core, which can cause rapid fire growth and spreading, both upwards and downwards through flaming droplets.
- Hazards are related to the possible coating or surface treatment applied.

Repurpose/recycling

Metal composite panels can be resized and repurposed for many applications. These panels, as composite materials, are challenging to recycle and are usually landfilled.

# Natural stone

Natural stone cladding can be made from several types of rock (e.g., basalt, granite) and is available in slabs, tiles, or blocks. For smaller/lighter stones, adhesives or mortar are used, whereas for heavier or high-rise applications, a metal framework is used on which stone elements are mounted. The service life of stone slabs is unlimited; therefore, in theory, it can be reused infinitely.

**Reuse potential**

Direct reuse is possible, with several aspects kept in mind:

1. Cleaning of old mortar or adhesive is necessary before reusing stone elements. Additionally, cleaning of moss and algae (e.g., using a high-pressure cleaner) might be necessary as well.
2. Caution is required due to the stone elements' high weight.

**Hazards related to reuse**

- Hazards are related to the possible coating or surface treatment applied.

Repurpose/recycling

Natural stone can be repurposed for many applications, both indoors and outdoors. Natural stone can often be used for backfilling (downcycling), while metal elements are typically fully recyclable.

# Timber cladding

Timber cladding is commonly used on timber houses. For Icelandic weather, a ventilated cavity is placed behind the cladding. Architectural styles typically vary between vertical board-on-board for height emphasis and water shedding, and horizontal shiplap and tongue-and-groove profiles for a streamlined, modern aesthetic. These choices significantly influence both the facade's shadow lines and its long-term maintenance requirements. For durability, high-quality wood is used, almost always with a coating or treatment. Thermally treated timber for cladding is gaining popularity as a chemical-free and durable material. Further information about timber can be found in the *General construction materials* chapter.

**Reuse potential**

Direct reuse is possible, with several aspects kept in mind:

1. The lifespan of timber exposed to Icelandic weather conditions is limited, so it is advised to thoroughly inspect its condition before reuse.
2. It is common practice to fasten cladding rigorously with nails or screws; therefore, dismantling of such cladding might be time-consuming and labour-intensive.
3. In later years, thermally modified timber is more common in cladding. This timber is generally not chemically treated. It is, however, more brittle, and that must be dismantled with more caution.

**Hazards related to reuse**

- Old cladding may contain hazardous chemicals (e.g., it might have been impregnated with chemicals to prevent rot and prolong its lifespan). Therefore, it is advised to always use respiratory protection when sawing and sanding.
- Cutting, sanding, and sawing timber release wood dust (classified as a carcinogen). Proper respiratory and eye protection, along with ventilation, are necessary during these activities.
- Other potential hazards are related to the paints and other surface treatments present. More information can be found in the *Construction chemicals* chapter.

Repurpose/recycling

Timber cladding can be repurposed, as it is a general construction material (provided it does not contain hazardous substances, which limits its repurposing possibilities). In terms of recycling, painted or chemically treated timber is considered treated timber; currently, such waste is typically incinerated.

# FLOORING

# FLOORING

Flooring, fulfilling a variety of purposes (i.e., aesthetics, acoustics, protection of the surface below), comes in countless varieties. The types most commonly used in Iceland are presented herein.
It should be noted that surface treatment will affect the reuse potential, especially given possible hazards posed by harmful compounds in, for instance, paints. More about it can be found in the *Construction chemicals* chapter at the end of this document.

| | Reuse potential | Potential saving of GHG emissions | Estimated average service life |
|---|---|---|---|
| **Carpet** | ○○○●○ | 4-14 $kgCO_{2\_eq}/m^2$ | 10-20 years |
| **Ceramic tiles** | ○○●○○ | 11-15 $kgCO_{2\_eq}/m^2$ | >50 years |
| **Laminate flooring** | ●○○○○ | 3-6 $kgCO_{2\_eq}/m^2$ | >20 years |
| **Engineered wood flooring** | ●○○○○ | 3-12 $kgCO_{2\_eq}/m^2$ | >50 years |

<u>Regulatory requirements for reuse</u>

Flooring materials are not subject to strict requirements in the building code. The decision to reuse material should be subject to professional site assessment by qualified tradespeople to ensure compliance with general safety and craft standards. In such an assessment, the age of the material and the conditions under which it was used (to identify possible hazards) must go hand in hand with the technical assessment. For information on CE marking, see the *CE marking* chapter at the end of this document.

<u>Information necessary to gather for reuse</u>

It is advised to collect information on the age of the flooring designated for reuse to avoid potential risks from asbestos or emissions of formaldehyde and other VOCs from glues. For *carpets*, it's also advisable to collect information on their use history to verify potential exposure to accumulated pollutants. For *ceramic tiles*, it is advised to collect information on the age of the tiles, as those installed before 1985-1989 may contain asbestos in the grout and adhesives.
Moreover, it's crucial to distinguish between ceramic and porcelain tiles to ensure proper adhesive selection, installation, estimate tile properties (e.g. porosity, classification), and type of glazing (to determine resistance to heat, wear, and chemical damage) to adjust material applications (e.g., indoors or outdoors, wet or dry areas) accordingly.

# Carpet

Carpets are made from a range of materials, both synthetic and natural, and are commonly available as rolls or tiles. The structure and quality vary, from woven wool carpets to temporary felt-based carpets. Typically, carpets are used in office and showroom spaces, as well as in staircases in residential buildings, to improve safety and comfort, provide noise control, and protect the underlying structure.

**Reuse potential**

Direct reuse is possible; however, it is rather limited. Carpets are usually glued or stapled down to the floor, and removing them (especially broadloom) may frequently result in tearing, backing damage or stretching, making them unsuitable for reuse. Moreover, often broadloom carpets are custom-fitted to a specific space, which poses a challenge for reusing them in other spaces; in this sense, carpet tiles are easier to reuse. Also, over time, carpets can have uneven worn patterns, fading, and dirt, limiting possible reuse due to an aesthetically unappealing look.

**Hazards related to reuse**

- Used carpets, especially those older than 10 years, can accumulate considerable amounts of dirt, pollutants, and allergens, posing indoor air quality issues.
- Carpets can potentially absorb VOCs and release them over a prolonged period of time [1].
- In the case of carpets exposed to moisture, there is a respiratory risk from mould and rot.

***s. ap arkitektar* reused carpet tiles in one of their interior design projects. The carpet tiles were removed and sold by the owner through *Efnisveitan*.**

Repurpose/recycling

Carpets can be repurposed for applications where appearance is not critical, often daily household applications (e.g., durable floor mat, protective liners). In terms of recycling, carpets are usually made of composite materials, which are difficult to recycle, so they are sorted as a bulky waste fraction.

Sources:
[1] S.A. Noorian Najafabadi et al., Impact of Carpets on Indoor Air Quality, Applied Sciences, 2022. DOI: 10.3390/app122412989

# Ceramic tiles

Ceramic tiles are a common flooring material, both indoors and outdoors, due to their durability, versatility, and moisture resistance. They are made from natural materials (clay, sand, water) and fired at high temperatures. The quality of clay and the firing process determine the tile quality. Tiles are often glazed for colour and protection. If properly maintained, ceramic tiles (especially glazed ones) can last centuries.

**Reuse potential**

Direct reuse of ceramic tiles is possible; however, it requires caution when removing them to avoid breaking. It is especially challenging to remove tiles without damaging them when they're set in thick, high-quality mortar. When aiming for direct reuse, several aspects should be kept in mind:

1. It is necessary to remain patient when removing old tiles. A methodical, slow approach to weakening the adhesive bond, rather than forcing the tiles off, significantly increases the chances of avoiding tile damage.
2. It is crucial to remove the grout around the tile first to prevent the impact from transferring to the surrounding tiles and damaging them.
3. Removing the tile should start at an edge or corner, and then work up from all sides to avoid snapping it in half.
4. A hair dryer or heat gun can be used to soften the adhesive beneath (for tiles set in mastic).
5. More persistent adhesives need to be removed using specific adhesive removers.

**Hazards related to reuse**

- Tiles installed before 1985-1989 might contain asbestos in the grout and adhesives.
- Cutting, drilling, or breaking ceramic tiles results in respirable crystalline silica (RCS) emission, a highly hazardous and carcinogenic substance. Moreover, the glazing might contain hazardous substances (e.g., lead or cadmium). In such cases, not only is proper respiratory protection necessary, but also methods to prevent RCS from becoming airborne (e.g., using tools with integrated water delivery systems or local exhaust ventilation).
- Ceramic tiles from wet environments might contain mould in pores and residual grout.

Repurpose/recycling

Ceramic tiles can be repurposed, often into home décor and garden features. In terms of recycling, crushed ceramic tiles are often used for backfilling (downcycling).

# Laminate flooring

Laminate flooring is a multi-layered synthetic material resembling wood, stone, or other natural materials. It is made from a core of dense particleboard or fibreboard, with a wear-resistant top layer (made of melamine resin) and a moisture-resistant bottom (backing) layer (made of melamine-treated paper). The boards are laid on a foam or felt layer on the floor (floating installation). The planks have been fastened together using a click-lock system since the mid-90s; previously, glue was used.

**Reuse potential**

Direct reuse is possible (if not glued) with several aspects kept in mind:

1. It is advised to check planks for wear (as their top layer cannot be reworked, as in the case of wood parquet), physical damage (e.g., warping, chipping), condition of the locking mechanism, moisture damage, swelling, rot, or mould.
2. It is advised to start salvaging by removing the baseboards/skirting, then choosing the first plank to remove, as it is most likely to have severe deterioration. It is advisable to choose the most damaged/worn-out/least important one. Afterwards, slowly lift the planks at an angle to disengage the locking mechanism without breaking it.
3. After removing the planks, thoroughly clean them to ensure a proper fit in the new installation.
4. It is often possible to reuse an underlayment if it is not damaged.
5. With glued-down floors, it is challenging to salvage planks without damaging them. Moreover, leftover glue on the back of planks might make it difficult to lay them flat. However, some planks can be rescued.

**Hazards related to reuse**

- Glue might have been used in the installation of laminated wood flooring before the 90s; in such cases, there is a risk of formaldehyde and other VOCs being released. However, the significant off-gassing occurs in the first years of use.
- In case of laminated wood flooring exposed to moisture, there is a respiratory risk from mould and rot.

Repurpose/recycling

Laminated flooring can be repurposed, often into furniture and home décor. In terms of recycling, laminated wood flooring is a composite material, which complicates recycling; therefore, it is typically incinerated.

# Engineered wood flooring

Engineered (parquet) wood flooring is traditionally made from small, individual hardwood pieces arranged in geometric, mosaic-like patterns. However, the most common is the engineered parquet made from a plywood or dense fibreboard substrate with a visible top layer of wood (veneer), often a high-quality hardwood, glued to it. The planks are laid on a foam or felt layer on the floor (floating installation), fastened together using a click-lock system. The planks have been fastened together using a click-lock system since the mid-90s; previously, glue was used.

## Reuse potential

Direct reuse is possible (if not glued) with several aspects kept in mind:

1. It is advised to check planks for wear (to assess the need for refinishing), physical damage (e.g., warping, chipping), condition of the locking mechanism, moisture damage, swelling, rot, or mould.
2. It is advised to start salvaging by removing the baseboards/skirting, then choosing the first plank to remove, as it is most likely to have severe deterioration. It is advisable to choose the most damaged/worn-out/least important one. Afterwards, slowly lift the planks at an angle to disengage the locking mechanism without breaking it.
3. After removing the planks, thoroughly clean them to ensure a proper fit in the new installation.
4. The top layer can be sanded and coated again (refinishing). A wooden floor can be refinished up to four times (on average). Solid wood flooring can be refinished more times than engineered parquet.
5. With glued-down floors, it is challenging to salvage planks without damaging them. Moreover, leftover glue on the back of planks might make it difficult to lay them flat. However, some planks can be rescued.

## Hazards related to reuse

- Glue might have been used in the installation of parquet wood flooring before the 90s; in such cases, there is a risk of formaldehyde and other VOCs being released. However, the significant off-gassing occurs in the first years of use.
- In case of parquet wood flooring exposed to moisture, there is a respiratory risk from mould and rot.

Repurpose/recycling

Parquet wood flooring can be repurposed, often into furniture and home decor. In terms of recycling, parquet wood flooring is either a treated material (coated solid wood) or a composite material (engineered parquet), which complicates recycling; therefore, it is typically incinerated.

Sources and further reading:

Bona, *Renovation for a brighter floor future*, IVL Report Conclusions.

# INSULATION

# INSULATION

Insulation is used to minimise heat loss from buildings and can also provide sound insulation. This section presents the most common insulation materials used in Iceland.

| | Reuse potential | Potential saving of GHG emissions | Estimated average service life |
|---|---|---|---|
| **Expanded Polystyrene Insulation** |  | 44-88 $kgCO_{2\_eq}/m^3$* | >50 years |
| **Metal insulation panels** |  | 21-40 $kgCO_{2\_eq}/m^2$** | 50 years |
| **Mineral wool** |  | 1-3 $kgCO_{2\_eq}/m^2$*** | >50 years |
| **Polyethylene vapour barrier** |  | - | - |

* *Values vary due to, among other, density.*
** *Values vary due to, among others, panel thickness (here 100-120 mm) or core density.*
*** *Values vary due to bulk density product category.*

Regulatory requirements for reuse

The decision to reuse material should be subject to professional site assessment by qualified tradespeople to ensure compliance with general safety and craft standards. In such an assessment, the age of the material and the conditions under which it was used (to identify possible hazards) must go hand in hand with the technical assessment. Additionally, for insulation, the most important parameters to consider are fire safety class, compression strength, and insulation properties, which a qualified engineer can assess. Over time, the compression strength and insulation properties might have degraded; however, fire properties shall not change significantly. For information on CE marking, see the *CE marking* chapter at the end of this document.

Information necessary to gather for reuse

It is advisable to determine the type of material for the best results (desired insulation properties). Further information on insulation properties can be found in Einangrunarefni - Gerðir og eiginleikar, K/001, 2017.

# Expanded Polystyrene Insulation

Expanded Polystyrene (often called styrofoam or EPS) is a lightweight, cost-effective material commonly used as insulation in construction and is available in a range of sizes and densities. Extruded Polystyrene (XPS) is a similar product but has higher compression strength. XPS is used under concrete slabs and on inverted roofs. It does not lose its insulating value over time and, if properly installed and protected from prolonged exposure to UV light, can have a service life exceeding 50 years.

**Reuse potential**

Direct reuse is possible, with a few aspects kept in mind:

1. It is relatively easy to damage EPS (e.g., by prying or pulling the board from one spot, which creates uneven pressure), so special caution is advised. XPS is stronger; however, it can still snap if bent too much.
2. EPS or XPS bonded to a substrate with adhesives might be hard to salvage; salvaging mechanically fastened or loosely laid boards intact is more likely.
3. It's crucial to break the adhesive bond rather than pull on the board itself.
4. A special adhesive remover might be needed to remove strong adhesives.
5. For large boards, two people can slide a stiff wire along the back of the board to cut through the adhesive layer.
6. EPS used or stored in very humid spaces might not be reusable, as it cannot be dried. EPS, which has absorbed considerable moisture, can be recognised by an increased weight.

**Hazards related to reuse**

- Polystyrene is not a hazardous material itself, but EPS and XPS contain small amounts of additives such as blowing agents and flame retardants, which can pose a risk to health and the environment. Boards manufactured before the early 2000s may contain CFC and HCFC blowing agents, which pose a significant environmental risk (especially due to their links to ozone depletion and global warming). Traditionally, HBCD (Hexabromocyclododecane) was used as a flame retardant. HBCD is an endocrine disruptor and is toxic to humans and the environment (including aquatic and land-dwelling organisms). This is why it's been largely phased out and replaced by safer flame-retardant alternatives.
- The boards are inherently flammable (even though flame-retardants reduce the fire risk); in the event of a fire, toxic smoke is produced, posing a significant health risk.

Repurpose/recycling

EPS/XPS, which can be easily resized or painted, can be repurposed for many applications, both indoors and outdoors, for insulation, drainage in gardening, etc. In terms of recycling, clean EPS/XPS is recyclable – if it is clean and in larger amounts it is sorted out as a foam plastic fraction (which is further recycled), whereas dirty EPS/XPS is sorted as mixed waste.

# Metal insulated panels

Metal insulated panels are prefabricated building components with metal facings and an insulating core of mineral wool or insulating foam. The panels are used for both roofs and walls, commonly in industrial and agricultural buildings. The frame they are mechanically fastened to is often made of steel or glulam. Glue or caulk is often used along panel edges to increase the structure's stiffness.

**Reuse potential**

Direct reuse is possible and relatively simple; there are multiple examples of whole buildings using metal-insulated panels, disassembled and reassembled in another location. Nevertheless, there are a few aspects to keep in mind:

1. Using glue at panel edges complicates dismantling and, in some cases, prevents the reuse of these panels.
2. The metal sheath is often thin and requires careful handling to avoid cosmetic damage.
3. The panels are typically very long (the same height as the structure). Handling, therefore, often requires appropriate machinery.
4. End-to-end joints are common but require careful attention. Overlaps are used on roofs, and square joints (butt joints) are preferred on walls. Short sections can therefore be reused, and long sections can be cut to facilitate storage.

**Hazards related to reuse**

- No risks identified.

Repurpose/recycling

They can be used as insulation and sheathing for smaller secondary construction. Recycling of this composite material is problematic. Sometimes the sheet is removed from the insulation core, enabling the metal to be recycled.

# Mineral wool

Mineral wool insulation is either stone wool or glass wool. The two types have similar properties and can be reused in the same way. Mineral wool is made by forming fibres from molten rock or glass. The fibres are collected into insulation mats or rolls, where a binder is added to provide cohesion and structural stability. The binder is less than 5% of the product weight. The most used binders for construction applications are based on phenyl-formaldehyde. Mineral wool is available in many variants for applications ranging from roof and wall insulation to heavy foundation insulation. The insulation properties and density vary greatly by application. Stone wool is more common and can be recognised by its grey colour with a greenish tint. Glass wool is generally lighter and has less strength than stone wool, and can be recognised by its yellow or pink colour.

**Reuse potential**

Direct reuse is possible with a few aspects to keep in mind:

1. The mineral wool should be clean and dry.
2. It is advised to use only large bats; pressing small patches into the frame reduces insulation properties.
3. Mineral wool should always be stored dry.
4. Mineral wool contaminated with organic material or derived from a building demolished due to leaks may absorb moisture and support mould growth, limiting its possible applications. Moreover, it is not advisable to reuse mineral wool from mouldy spaces.

**Hazards related to reuse**

- Some VOC emissions may be present after installation (usually linked to packaging or residual curing); however, mineral wool is generally considered a low- or no-VOC material in residential applications [1].
- Handling mineral wool requires proper protection to avoid skin irritation.
- Mineral wool contaminated with organic material might pose a respiratory risk from mould and rot.

Repurpose/recycling

The wool can be used in construction-related applications (e.g., insulating garden sheds) and other applications (e.g., hydroponic plant cultivation and soil conditioner). Generally, mineral wool waste is landfilled. However, as it contains an organic binder, it is not entirely inert and, during decomposition, it releases pollutants into the environment. Moreover, its lightweight nature poses challenges related to packing in landfills, leading to loose material being dispersed by strong winds. Technically, mineral wool can be ground into powder and used as a filler in asphalt and concrete or remelted into new batches.

Sources:
[1] T. Neuhaus et al., *Formaldehyde emissions from mineral wool in building constructions into indoor air*, Indoor Air, 2008.

# Polyethene vapour barrier

Polyethene vapour barrier is used to prevent moisture condensation on the cold side of the insulation. The industry standard in Nordic countries is a 0.2 mm-thick polyethene film. Its service life is designed to match the insulation's life; however, its functional service life can be longer.

**Reuse potential**

It is not recommended to reuse it as a vapour barrier, as the used film can be punctured or damaged, making it insufficiently airtight.

Repurpose/recycling

Polyethene vapour barrier can be repurposed as a general-purpose plastic film. In terms of recycling, it is sorted as a plastic fraction (which is further sorted abroad and, depending on the material, either recycled or incinerated for energy recovery).

# ROOFING

# ROOFING

The purpose of roofing is to protect the building from precipitation and other climatic stresses, while simultaneously providing the required thermal and air-tightness performance. This section presents the most common roofing elements used in Iceland.
It should be noted that surface treatment will affect the reuse potential, especially given possible hazards posed by harmful compounds in, for instance, paints. More about it can be found in the *Construction chemicals* chapter at the end of this document.

| | Reuse potential | Potential saving of GHG emissions | Estimated average service life |
|---|---|---|---|
| **Corrugated steel** | ●○○○○ | 2-6 $kgCO_{2\_eq}/kg$ | 50 years |
| **Breathable roof membrane** | ○○○○● | - | - |
| **Bitumen roof underlay** | ○○○○● | - | - |
| **Bituminous roofing membrane** | ○○○○● | - | - |
| **Gutters and downspouts** | ●○○○○ | 2-5 $kgCO_{2\_eq}/kg$* | 25-50 years* |

** Depending on the material (i.e., aluminium, PVC, steel).*

<u>Regulatory requirements for reuse</u>

The decision to reuse material should be subject to professional site assessment by qualified tradespeople to ensure compliance with general safety and craft standards. In such an assessment, the age of the material and the conditions under which it was used (to identify possible hazards) must go hand in hand with the technical assessment. Additionally, in the case of roofing, the most important parameters to consider are fire safety class, structural strength, and durability, which can be determined either from the original documentation or by an assessment by a qualified engineer. For information on CE marking, see the *CE marking* chapter at the end of this document.

<u>Information necessary to gather for reuse</u>

In the case of corrugated steel, it is necessary to determine whether the sheet material is steel or aluminium (as they have different properties). For gutters and downspouts, reuse potential often depends on the material they are made of (as PVC tends to become brittle with age).

# Corrugated steel

Currugated zinc-plated steel has been the most common roofing material in Iceland; visually similar is corrugated aluminium, also used in roofing but more rarely than corrugated steel. The basic version was relatively thick panels without colour coating. However, after about 1980, pre-painted panels became available, and the quality of the zinc (galvanised) coating improved, thus increasing service life and corrosion resistance. The panels also become thinner due to the use of higher-strength steel. After 2000, aluzinc coating became widespread in Iceland, offering significantly higher long-term corrosion and heat resistance than zinc coating.

**Reuse potential**

Due to harsh Icelandic climatic conditions, corrugated steel sheets can rust, especially around fastenings or cut edges (where the coating does not cover the steel surface). Therefore, depending on their condition, either reuse for the original or less-demanding purposes (e.g., temporary construction, sheds, etc.) is possible, with several aspects kept in mind:

1. The sheets are often fastened with screws that are easily removable. It is necessary to remove nails/screws after dismantling to avoid damage during transport.
2. Some older roofs used nails, which can often cause damage when removed. It is advised not to use a crowbar to pry the sheet up in case of nails used, as it might result in sheet bending, but to gently work a flat bar under the nail head to lift it.
3. In case of stuck screws, a wire wheel on a drill should be sufficient for cleaning.
4. When salvaging panels, it is advised to lift them rather than drag them over one another to avoid scratching the protective coating (which can cause premature rust).
5. In case of longer panels, it is advised to have at least two people handling them to avoid their bending under their own weight.
6. The salvaged panels should be cleaned immediately to prevent staining and rust.
7. When storing salvaged panels, it is important to prevent water from getting between the panels and causing the so-called "white rust".

**Hazards related to reuse**

- Potential hazards are associated with the paints and other surface treatments on the sheet.

Repurpose/recycling

Corrugated steel sheets can be repurposed in multiple ways, often in landscaping or interior design. In terms of recycling, corrugated steel is fully recyclable (regardless of whether it is rusted).

# Breathable roof membrane

The standard practice today in pitched steel roof construction is to use a breathable underlay membrane. This membrane is watertight while also permeable to vapour from inside the roof, reducing the risk of condensation. The membrane is made of polypropylene or polyethene fabric and a core film providing waterproofing and permeability. Such membranes became widespread in the early 90s and became a standard after 2000; their average service life is estimated at 30-40 years.

**Reuse potential**

Even though, in theory, it is possible to reuse durable, breathable roof membranes installed with ballast or mechanical fasteners, it is generally challenging to do so. The main reasons are the high risk of physical damage during removal (especially since such membranes are commonly glued at seams and fastened under roof battens) and the potential high wear degree due to harsh Icelandic climatic conditions. Moreover, used membranes may become clogged with dust, dirt, or adhesive or sealant residue, significantly reducing their vapour permeability. Therefore, reuse is not advisable; repurposing is a more plausible option.

Repurpose/recycling

Breathable roof membranes can be removed and used for temporary or less-demanding applications, such as covering. In terms of recycling, it is currently uncommon to recycle materials made of different types of plastics bound together (the so-called sandwich materials); therefore, such membranes are sorted as a plastic fraction and are usually incinerated for energy recovery.

# Bitumen roof underlay

Prior to breathable roof membranes becoming standard (after 2000), bitumen roof felt was used as a moisture barrier under pitched metal roofs. They were replaced by breathable roof membranes that offered greater waterproofing, flexibility, longevity, and vapour permeability. Bitumen roof underlay tends to become brittle with age and considerably lose mechanical strength; its estimated service life is 25-30 years for Icelandic use.

**Reuse potential**

Reuse of bitumen roof underlay is generally not plausible due to challenges in removing it intact and its significant loss of properties over time.

Repurpose/recycling

Bitumen roof underlay is not commonly repurposed. However, there can be found examples of using it as weed barrier in gardens or temporary waterproof cover; in such cases, however, it is necessary to be certain that it does not contain hazardous substances (e.g., asbestos in bitumen felt used until mid 90s) and is not heated (as, when heated to certain temperatures, it releases fumes containing polycyclic aromatic hydrocarbons - PAHs). In terms of recycling, bitumen felt can be used in asphalt production; however, currently, it is sorted as bulky (mixed) waste and incinerated for energy recovery.

# Bituminous roofing membrane

Bitumen roofing membrane is used as a top layer on pitched or flat roofs. It is made of modified bitumen, often styrene-butadiene-styrene (SBS) and reinforced with fibrous material. The construction is typically two-layer, with a bottom layer fastened to the substrate and a top layer glued on with molten bitumen. However, single-layer membranes are also used and are glued at the seams using molten bitumen.

**Reuse potential**

Reuse of bitumen roof membrane is generally not feasible due to challenges in removing it intact (the base layer is often glued to the substrate) and its significant property changes over time (becoming brittle).

Repurpose/recycling

Bitumen roofing membrane is not commonly repurposed. In terms of recycling, bitumen felt can be used in asphalt production; however, currently, it is sorted as bulky (mixed) waste and incinerated for energy recovery.

# Gutters and downspouts

Gutters and downspouts are used to manage rainwater runoff. They are typically made of PVC (cost-effective and light), galvanised steel (durable), or aluminium (durable and lighter than steel) to withstand heavy rain, snow-induced ice-loads, and strong winds. The typical service life of gutters and downspouts varies between 10-15 years (PVC) and 20-30 years (galvanised steel and aluminium). However, it should be noted that inadequate maintenance (e.g., cleaning, repairing leaks, etc.) can significantly shorten the service life.

**Reuse potential**

Direct reuse is possible if gutters and downspouts are in good technical condition, with several aspects kept in mind:

1. It is advised to examine gutters and downspouts for possible warping, sagging, rust, or other damage that could cause leaks or reduced performance compared to new systems.
2. It is advised to check the suitability of old gutters for new roof siding to prevent water from flowing behind the gutters.
3. It is advised to check if salvaged gutters have a proper slope; otherwise, there is a risk of standing water.
4. PVC elements tend to become brittle over time, increasing the risk of damage during removal.
5. It is advised to remove any old sealant used, clean the joints, and apply new sealant to prevent leaks.
6. It is advised to use new fasteners and screws to ensure stability; older fasteners might be damaged.

**Hazards related to reuse**

- Potential hazards are related to paints and other surface treatments present.

Repurpose/recycling

Gutters and downspouts can be repurposed in multiple ways, often in gardening, landscaping or interior design. In terms of recycling, depending on the material, it is sorted either as metal (and recycled) or as a hard plastic fraction (which is further sorted abroad and, depending on the material, either recycled or incinerated for energy recovery).

# CONSTRUCTION MATERIALS

# CONSTRUCTION MATERIALS

Concrete, steel, and timber are general construction materials used throughout most parts of the building. This includes load-bearing structures as well as simple framing and support. These base materials can also be used on surfaces such as cladding and decking.
It should be noted that surface treatment will affect the reuse potential, especially given possible hazards posed by harmful compounds in, for instance, paints. More about it can be found in the Construction chemicals chapter at the end of this document.

| | Reuse potential | Potential saving of GHG emissions | Estimated average service life |
|---|---|---|---|
| **Cross-laminated timber (CLT)** | ○ ● ○ ○ ○ | 53-77 $kgCO_{2\_eq}/m^3$ | ≥50 years |
| **Concrete (cast-in-place)** | ○ ○ ● ○ ○ | 191-332 $kgCO_{2\_eq}/m^3$* | 100 years |
| **Concrete (precast)** | ○ ○ ● ○ ○ | 57-171 $kgCO_{2\_eq}/t$ | §00 years |
| **Glulam** | ○ ● ○ ○ ○ | 81-123 $kgCO_{2\_eq}/m^3$ | >50 years |
| **Steel beams** | ○ ● ○ ○ ○ | 420-2852 $kgCO_{2\_eq}/t$ | >50 years |
| **Timber (untreated)** | ○ ● ○ ○ ○ | 26-35 $kgCO_{2\_eq}/m^3$** | depends on use |
| **Timber (chemically-treated)** | ○ ○ ● ○ ○ | 35-58 $kgCO_{2\_eq}/m^3$ | 20-30 years |
| **Timber (strength-graded)** | ○ ● ○ ○ ○ | 32-49 $kgCO_{2\_eq}/m^3$ | >50 years |
| **Timber (thermally-treated)** | ● ○ ○ ○ ○ | 126-222 $kgCO_{2\_eq}/m^3$ | >50 years |

** Values shown do not include rebar.*
*** Values given for rough sawn timber.*

# CONSTRUCTION MATERIALS

Regulatory requirements for reuse

Structural elements like concrete, steel beams, glulam, and CLT require a professional technical assessment unless original documentation is available. If used in load-bearing applications, steel beams must be evaluated and certified by a structural engineer. Evaluation is based on the steel grade and a visual inspection, in accordance with CEN/TS 1090-201*. Strength-graded timber should be re-assessed if used in load-bearing structures. This is done by a certified professional by visual inspection. Hollow-core slabs for reuse can be assessed in accordance with the NS 3682 standard. The assessment of pre-case elements for reuse could be informed by the DS/INF 671 standard; however, it should be noted that the standard has been withdrawn, so it cannot serve as a legal basis for assessment.
The decision to reuse other material for non-structural use should be subject to professional site assessment by qualified tradespeople to ensure compliance with general safety and craft standards. In such an assessment, the age of the material and the conditions under which it was used (to identify possible hazards) must go hand in hand with the technical assessment.
The fire properties of the used construction materials should not change notably over time; however, this should be confirmed by a qualified professional.
Chemically treated timber should be screened for legacy contaminants, such as chromated copper arsenate (CCA) or polychlorinated biphenyls (PCBs), which may have been present in the wood preservatives used. PCBs were used in buildings before 80s, whereas CCA were used until the mid-2000s.
For information on CE marking, see the *CE marking* chapter at the end of this document.

** It has to be noted, however, that this standard applies to products used in structures to be designed according to EN 1993-1-1 without seismic and/or fatigue design.*

Information necessary to gather for reuse

For metals, the material grade is necessary for strength determination. For timber, its moisture level should be measured. For treated timber, the type of treatment should be assessed as well as the age, as old chemical treatments may be hazardous.

# Cross-laminated timber (CLT)

Cross-laminated timber (CLT) is a prefabricated engineered wood panel made from perpendicular layers of lumber boards glued together. It serves as a load-bearing structural element due to its high strength, stability, and fire resistance. Polyurethane (PUR) is typically used as an adhesive, though Melamine-Urea-Formaldehyde (MUF) is also sometimes used.

**Reuse potential**

Direct reuse is possible with a few aspects to keep in mind:

1. CLT panels are fastened by screws and steel brackets. Therefore, they can be dismantled relatively easily and moved to another location.
2. It is possible to reduce the size of CLT panels (cut them) to fit smaller structures.
3. In case of reuse as a load-bearing structure, original properties, especially strength, have to be reassessed by a certified engineer. Such reassessment is usually based on tree species, visual inspection, and the history of use.
4. It is advised to check the history of timber's exposure to moisture to be able to fully assess its condition and potential risks linked to reuse. For example, if timber was stored outside or used in a very moist environment and then dried, it might have weakened or partially rotted, which can go unnoticed.
5. Discolouration or other signs of moisture likely indicate the risk of rot and mould. The sound from striking the timber with a hammer can reveal internal rot.
6. Excessive load can leave permanent signs, such as, for instance, cracks that run parallel to the grain and extend deep into the beam, cracks that are visible in the end grain, splintering on the bottom surface of a beam, or permanent deflection.
7. Caution is needed due to possible hidden fasteners, such as nails and screws. These can damage tools and cause risk when power tools are used.

**Hazards related to reuse**

- CLT with PUR as an adhesive are most common and is considered low-VOC. CLT with MUF can emit formaldehyde and other VOCs; however, emissions from engineered wood products decrease over time, with peak emissions close in time to their production.
- Cutting, sanding, and sawing CLT might release VOCs (when MUF is used) and wood dust (classified as a carcinogen). Respiratory and eye protection, as well as ventilation, are necessary during these activities.
- In case timber was exposed to moisture, there is a respiratory risk from mould and rot.

Repurpose/recycling

CLT can be repurposed in non-structural applications. In terms of recycling, CLT panels could serve as a resource in the production of other engineered wood products. However, if sorted as waste, it belongs to the so-called treated timber fraction, which is incinerated.

# Concrete (cast-in-place)

Concrete is the most widely used construction material and the second-most consumed material on the planet, after water. It is a mixture of cement, water, aggregates, and additives (to change concrete properties, for example, setting time). Typically, aggregates consist of sand and crushed stone in various proportions. Strength, durability, and other concrete properties are mainly controlled by adjusting the mix ratio of the components; additionally, additives are added to enhance workability, durability, and the performance of the mix.

In Iceland, concrete became a dominant construction material in the first decades of the 20th century. However, over the decades, various proportions of concrete components were used, resulting in better or worse mix properties. Moreover, before the 80s, alkali-silica reaction (ASR) was a serious problem in Iceland due to the high alkali content of cement clinker and alkali-silica reactive aggregates used. ASR, commonly called concrete cancer, can cause cracks, spalling, and potential structural failure. This has to be considered when aiming to reuse concrete from older Icelandic buildings.

**Reuse potential**

Currently, buildings are typically demolished for reasons unrelated to structural performance or material grade, which means that their load-bearing components are often structurally sound. However, concrete is typically crushed for backfill or landfilled, and its reuse is uncommon, mainly due to economic factors; harvesting concrete for reuse requires cutting elements out, which is more labour-intensive than crushing it into rubble and requires more complicated logistics and storage processes. To optimise reuse and avoid unnecessary costs, it is crucial to methodically assess and classify concrete elements based on their visual properties (e.g., cracking or deterioration), physical properties (e.g., dimensions and strength), and environmental screening for hazards. Several methods are available for testing and calculating concrete properties, including non-destructive, semi-destructive, and destructive techniques. There is no standardised method to assess concrete properties for reuse, but reusability assessment protocols exist, such as in [1], where reusability is defined by damage, use, and intervention grades.

**Hazards related to reuse**

- Cutting, drilling, or breaking concrete results in respirable crystalline silica (RCS) emission, a highly hazardous and carcinogenic substance. In such cases, not only is proper respiratory protection necessary, but also methods to prevent RCS from becoming airborne (e.g., using tools with integrated water delivery systems or local exhaust ventilation).

Repurpose/recycling

Concrete elements are commonly repurposed to serve a new function, for instance, as sidewalk slabs or as landscaping elements. In terms of recycling, concrete is an inert waste used for backfilling or landfilled.

Sources

[1] Devènes et al., *Reusability assessment of reinforced concrete components prior to deconstruction from obsolete buildings*, Journal of Building Engineering, 2024; DOI: 10.1016/j.jobe.2024.108584.

More information on the reuse of cast-in-place and pre-cast concrete elements with real-life examples can be found here. Here, a list of 77 mostly European examples of concrete reuse can be found.

# Concrete (precast)

Pre-cast concrete is produced in a controlled environment as it is cast in a reusable mould and transported to the site for installation. As it is produced in a controlled environment, it is characterised by more predictable properties, fewer defects, and higher strength consistency. Therefore, the reuse of precast concrete elements has been more common than cast-in-place concrete.

**Reuse potential**

In recent years, extensive research on the reuse of precast concrete elements, based on real-world case studies, has led to a few comprehensive sets of recommendations. These apply to elements produced after 1969 (as their standardisation occurred in the 60s) and to elements of X0 or XC1 exposure class (passive environmental exposure conditions). As an example, a set of recommendations from the Danish project (P)RECAST on dismantling, handling, testing, and quality assessment of whole concrete elements for reuse can be listed. Additionally, the methodology on non-destructive testing of precast elements, which informed the Danish standard DS/INF 671, can be found [1]. Moreover, the European project ReCreate produced a comprehensive set of procedures on handling, quality assessment, logistics, and processing of precast concrete elements. Last but not least, [2] presented the economic aspects of reusing such elements in two real-life Finnish cases, along with ways to reduce their costs.

**Hazards related to reuse**

- Cutting, drilling, or breaking concrete results in respirable crystalline silica (RCS) emission, a highly hazardous and carcinogenic substance. In such cases, not only is proper respiratory protection necessary, but also methods to prevent RCS from becoming airborne (e.g., using tools with integrated water delivery systems or local exhaust ventilation).

Repurpose/recycling

Concrete elements are commonly repurposed to serve a new function, for instance, as sidewalk slabs or as landscaping elements. In terms of recycling, concrete is an inert waste used for backfilling or landfilled.

Sources

[1] S. Karatosun et al., *Development and Validation of a NDT-Based Reuse Assessment Guideline for Structural Concrete Elements,* International Symposium on Non-Destructive Testing in Civil Engineering, 2025. DOI: 10.58286/31670

[2] Riuttala et al., *How building component reuse creates economic value – Identifying value capture determinants from a case study*, Journal of Cleaner Production, 2024. DOI: 10.1016/j.jclepro.2024.141112

More information on the reuse of cast-in-place and pre-cast concrete elements with real-life examples can be found here. Here, a list of 77 mostly European examples of concrete reuse can be found.

# Glulam

Glulam-laminated timber (glulam) is an engineered wood product made from wood laminations glued together. It offers high strength, durability, and design flexibility, and is typically used for structural applications (e.g., beams). Standard glulam is often intended for dry interior use and is therefore untreated; however, glulam for special uses can be preserved. Typically, Phenol-Resorcinol-Formaldehyde (PRF) or Melamine-Urea-Formaldehyde (MUF) is used as an adhesive; however, Polyurethane (PUR) is increasingly used due to its improved performance characteristics and higher environmental health standards.

**Reuse potential**

Direct reuse is possible with a few aspects to keep in mind:

1. Glulam beams are fastened with bolts and screws; therefore, their disassembly and reassembly are relatively simple.
2. In case of reuse as a load-bearing structure, original properties, especially strength, have to be reassessed by a certified engineer. Such reassessment is usually based on tree species, visual inspection, and the history of use.
3. It is advised to check the history of timber's exposure to moisture to be able to fully assess its condition and potential risks linked to reuse. For example, if timber was stored outside or used in a very moist environment and then dried, it might have weakened or partially rotted, which can go unnoticed.
4. Discolouration or other signs of moisture likely indicate the risk of rot and mould. The sound from striking the timber with a hammer can reveal internal rot.
5. Excessive load can leave permanent signs, such as, for instance, cracks that run parallel to the grain and extend deep into the beam, cracks that are visible in the end grain, splintering on the bottom surface of a beam, or permanent deflection.
6. Caution is needed due to possible hidden fasteners, such as nails and screws. These can damage tools and cause risk when power tools are used.

**Hazards related to reuse**

- Glulam with MUF or PRF can emit formaldehyde and other VOCs; however, emissions from engineered wood products decrease over time, with peak emissions occurring close to their production.
- Cutting, sanding, and sawing glulam might release VOCs and wood dust (classified as carcinogens). Respiratory and eye protection, as well as ventilation, are necessary during these activities.
- It is necessary to check whether the timber is contaminated with any chemicals that might pose a hazard.

Repurpose/recycling

Glulam can be repurposed in non-structural applications. In terms of recycling, glulam is treated as the so-called treated timber waste fraction, which is incinerated.

# Steel beams

Steel beams are used in many construction applications, from main structures to cable ladders. Hot-rolled profile beams are thick-walled (5-30mm) with simple open profiles (H, I, U, T), typically used for heavy load-bearing structures. Cold-formed steel sections (with thinner walls of 1-4 mm) are used for light loads in structural applications and for non-load-bearing applications. They are made by roll-forming metal sheets into profile sections or various shapes. The thin material allows for perforations, such as bolt holes, in prefabricated structures.
In a dry environment, the lifespan of steel elements can exceed 100 years; in exterior applications with appropriate coating, it can reach 100 years; whereas in coastal environments or aggressive industrial applications, the lifespan can be significantly shorter. Steel beams are often painted or zinc-coated for use in exposed and exterior applications to extend their lifespan.

**Reuse potential**

Direct reuse is often possible with a few aspects to keep in mind:

1. Disassembly is easy if the beams are mechanically fastened together. Plasma or gas cutting can be used if beams are welded or integrated into larger structures.
2. Marking is not always visible, so testing for steel grade may be needed.
3. Rust is the worst enemy of steel. Removal of coating and visual inspection are used to determine the amount of rust and if the strength is reduced due to other damage.
4. Zinc coating should not be removed as it provides galvanic protection. Damage to the zinc coating can be treated with special paint systems.
5. High temperature (over 300°C), e.g. during a large-scale fire, can reduce the strength of steel.

**Hazards related to reuse**

- No hazards associated directly with the reuse of steel were identified. The hazards, however, might be linked to paint or other coatings on the metal that contain hazardous chemicals, especially in older buildings.

Repurpose/recycling

Solid metal is a general structural building material and can therefore be repurposed in many applications. In terms of recycling, steel is fully recyclable.

# Timber (untreated)

Non-strength-graded, untreated timber serves as a fundamental utility material for diverse building applications. These products are typically used in internal, non-load-bearing partitions and ceiling battens, as well as for temporary works such as formwork and fencing. Untreated timber is available as cladding but is typically treated after installation, whereas internal wood panelling is often left untreated.

**Reuse potential**

Direct reuse is often possible with several aspects kept in mind:

1. Discolouration or other signs of moisture likely indicate the risk of rot and mould. The sound from striking the timber with a hammer can reveal internal rot.
2. It is advised to check the history of timber's exposure to moisture to be able to fully assess its condition and potential risks linked to reuse. For example, if timber was stored outside or used in a very moist environment and then dried, it might have weakened or partially rotted, which can go unnoticed.
3. Excessive load can leave permanent signs, such as, for instance, cracks that run parallel to the grain, deep into the beam, cracks that are visible in the end grain, splintering on the bottom surface of a beam, or permanent deflection.
4. Caution is needed due to possible hidden fasteners, such as nails and screws. These can damage tools and cause risk when power tools are used.

**Hazards related to reuse**

- In case timber was exposed to moisture, there is a respiratory risk from mould and rot.
- Cutting, sanding, and sawing timber release wood dust (classified as a carcinogen). Proper respiratory and eye protection, along with ventilation, are necessary during these activities.
- It is necessary to check whether the timber is contaminated with any chemicals that might pose a hazard.

Repurpose/recycling

Untreated timber can simply be repurposed in multiple ways. In terms of recycling, untreated timber is used, among others, as a carbon source in industrial processes, as a support material in a gas and composting plant, GAJA, or as a substrate for livestock.

# Timber (chemically-treated)

Chemically treated timber is typically used for exterior applications (e.g., cladding or decking) and is treated to protect it from the weather and prevent rot, often by pressure impregnation. This type of timber is characterised by a greenish tint. Over the years, new chemicals have been gradually introduced to protect timber, reducing their impact on health and the environment. For further information, consult RB sheets on protection against rot in timber [1-2].

**Reuse potential**

Direct reuse is possible with a few aspects to keep in mind:

1. Chemically-treated timber shall not be reused for interior use. Moreover, it is not advised to use it in vegetable gardens or in any place in which skin contact is likely to occur.
2. Chemically-treated timber from the mid-2000s and older should not be reused due to the high possibility of containing toxic substances.
3. Discolouration or other signs of moisture likely indicate the risk of rot and mould. The sound from striking the timber with a hammer can reveal internal rot.
4. Excessive load can leave permanent signs, such as, for instance, cracks that run parallel to the grain, deep into the beam, cracks that are visible in the end grain, splintering on the bottom surface of a beam, or permanent deflection.
5. Caution is needed due to possible hidden fasteners, such as nails and screws. These can damage tools and cause risk when power tools are used.

**Hazards related to reuse**

- Up to the mid-2000s, highly toxic chemicals were used for wood preservation: creosote, chromated copper arsenate (CCA) and pentachlorophenol. After that, less toxic copper-based and borate preservatives became widespread and are considered safe for residential use. However, they shall be used with caution as they still pose considerable risk to the environment.
- In case timber was exposed to moisture extensively, there is a respiratory risk from mould and rot. The chemical treatment only slows biological decay, so old timber may still have rot and mould regardless of treatment.
- Cutting, sanding, and sawing timber release wood dust (classified as a carcinogen). Proper respiratory and eye protection, along with ventilation, are necessary during these activities.
- When processing chemically treated wood (e.g., sawing), proper respiratory protection is necessary.

Repurpose/recycling

The repurposing of chemically-treated timber is limited due to the use of hazardous chemicals. In terms of recycling, painted or chemically treated timber belongs to the so-called treated timber; currently, such waste is typically incinerated.


Sources:

[1] VERNDUN VIÐAR GEGN FÚA 1. Viðarskemmdir og orsakir fúa, Hi.302, 2004.

[2] VERNDUN VIÐAR GEGN FÚA 2. Gagnvörn og fúavarnarefni, Hi.303, 2004.

# Timber (strength-graded)

Solid wood beams and planks have been used for load-bearing structures in timber buildings. Some constructions require timber of certain strength classes (T3, T2, T1, T0, or C30, C24, etc.). Further information on timber properties and uses in load-bearing structures can be found in [1].

**Reuse potential**

Direct reuse is often possible with several aspects kept in mind:

1. The strength grading is marked on the beams. If this is still visible, reuse is simplified. If the original grading is unknown, the strength class can be determined by a visual inspection conducted by a qualified assessor.
2. Discolouration or other signs of moisture likely indicate the risk of rot and mould. The sound from striking the timber with a hammer can reveal internal rot.
3. It is advised to check the history of timber's exposure to moisture to be able to fully assess its condition and potential risks linked to reuse. For example, if timber was stored outside or used in a very moist environment and then dried, it might have weakened or partially rotted, which can go unnoticed.
4. Excessive load can leave permanent signs, such as, for instance, cracks that run parallel to the grain, deep into the beam, cracks that are visible in the end grain, splintering on the bottom surface of a beam, or permanent deflection.
5. Caution is needed due to possible hidden fasteners, such as nails and screws. These can damage tools and cause risk when power tools are used.
6. It is necessary to check if the timber is contaminated by any chemicals.

**Hazards related to reuse**

- In case timber was exposed to moisture, there is a respiratory risk from mould and rot.
- Cutting, sanding, and sawing timber release wood dust (classified as a carcinogen). Proper respiratory and eye protection, along with ventilation, are necessary during these activities.
- It is necessary to check whether the timber is contaminated with any chemicals that might pose a hazard.

Repurpose/recycling

Strength-graded timber can simply be repurposed as general construction timber. In terms of recycling, untreated timber is used, among others, as a carbon source in industrial processes, as a support material in a gas and composting plant, GAJA, or as a substrate for livestock.

Sources

[1] RB-blað Burðarviður - Notkun | Eiginleikar | Staðlar, 2017.

# Timber (thermally-treated)

Thermally modified timber is wood subjected to temperatures between 180°C and 230°C in a low-oxygen environment. The result is a darker material with reduced equilibrium moisture content and improved dimensional stability. It has a higher resistance to decay but lower mechanical strength than the original timber. This type of timber is commonly used in exterior woodwork, such as cladding and decking.
Thermally modified timber can be supplied with fire-retardant impregnation. Modern materials are non-toxic and environmentally benign, but caution is advised.

**Reuse potential**

Direct reuse is possible with a few aspects to keep in mind:

1. Discolouration or other signs of moisture likely indicate the risk of rot and mould. The sound from striking the timber with a hammer can reveal internal rot.
2. Excessive load can leave permanent signs, such as, for instance, cracks that run parallel to the grain, deep into the beam, cracks that are visible in the end grain, splintering on the bottom surface of a beam, or permanent deflection.
3. Caution is needed due to possible hidden fasteners, such as nails and screws. These can damage tools and cause risk when power tools are used.

**Hazards related to reuse**

- In case timber was exposed to moisture extensively, there is a respiratory risk from mould and rot. The thermal treatment only slows down biological decay, so old timber may have rot and mould.
- Cutting, sanding, and sawing timber release wood dust (classified as a carcinogen). Proper respiratory and eye protection, along with ventilation, are necessary during these activities.
- When processing thermally treated wood (e.g., sawing) with suspected fire retardant presence, proper respiratory protection is necessary.

Repurpose/recycling

Thermally-treated timber can simply be repurposed as general construction timber. In terms of recycling, untreated timber is used, among others, as a carbon source in industrial processes or as a support material in a gas and composting plant, GAJA. However, in case timber contains fire retardants, it is classified as treated timber and is incinerated.

Sources

[1] RB-blað Burðarviður - Notkun | Eiginleikar | Staðlar, 2017.

# CONSTRUCTION CHEMICALS

Construction chemicals such as grout, joint foam, adhesives, and paints are used for building, sealing, fixing, and treating surfaces. Because these chemicals are present in and on many construction materials, they may affect the reuse potential of some materials by posing health hazards. As regulations and public awareness of chemical health risks have grown, some substances, such as asbestos, have been phased out. However, legacy contaminants from products used before these bans remain in existing structures and pose health risks - especially during renovation or demolition, or through gradual release into the air. The main hazards linked to these legacy contaminants are outlined below.

## Asbestos

Asbestos was used in construction products in Iceland from 1950 until 1989; it was officially banned in 1983, but some products left for retail were still sold and used throughout the 80s.

**As a precaution, all buildings from before 1985-89 should be considered to contain asbestos. Demolition or renovation should be carried out with precaution. Asbestos-containing materials must be removed from buildings by certified personnel.**

Inhaling asbestos fibres poses serious health risks, including lung damage and various forms of cancer. Asbestos-containing materials present the greatest hazard when damaged, as they release microscopic fibres into the air. However, bound asbestos can also emit fibres and remains hazardous. Therefore, these materials must be managed with stringent precautions, including specialised personal protective equipment to prevent fibre inhalation and spread.

Asbestos fibres are inorganic, strong, and heat-resistant. These properties made the material popular for fire protection, insulation, and reinforcement fibres. Examples of asbestos-containing materials in Icelandic construction are as follows:

- Fibre cement ("Eternit") panels;
- Exterior cladding and roofing (both plain and corrugated);
- Pipe insulation (often white and gypsum-like or in the form of asbestos paper - white, corrugated, rough, felt-like texture);
- Fire protection elements (e.g., thin stiff panels used to insulate heat from boilers and chimneys, inside of fire doors).

Moreover, asbestos was found in glue (e.g., asbestos mastic), caulk, cement plaster, tile adhesive and grout.

**If asbestos contamination is suspected, it is advised to have the material sampled and tested by qualified specialists. Specialised laboratories, such as Eurofins or ALS Scandinavia, can test materials for asbestos.**

**Sorpa accepts asbestos-containing waste, which is landfilled in a dedicated area.**

# Heavy metals

Historically, heavy metals were commonly used in paints as pigments or to increase durability and corrosion resistance, mainly before the 1970s. Examples are lead used in white paint, chromium used as a bright (e.g., yellow) and often anti-corrosive pigment, or mercury used as a preservative in paints. The risk associated with such paints is that, when they deteriorate (crack, peel off, etc.) or are removed, they can release small particles containing heavy metals into the air.

Only proper testing can accurately confirm the presence of heavy metals; however, a visual inspection can be a good start for preliminarily identifying their possible presence.

**If heavy metal contamination is suspected, it is advised to have the material sampled and tested by qualified specialists. Moreover, proper personal protective equipment shall be used to prevent inhalation and the spread of heavy-metal-containing dust and small particles.**

First, the building's age can indicate a higher risk of heavy metals in the paint. High oil or metallic paints often crack or wrinkle, forming shapes like reptilian hide (alligatoring), and leave chalky residue when they rub off. To find old paint layers, it may be necessary to check behind radiators or heavy appliances (e.g., stoves, washers), as owners often skip painting these areas.

**In case of contamination with heavy metals, waste shall be disposed of as contaminated (hazardous) waste.**

**During demolition or renovation, it is necessary to be cautious of the equipment that may contain traces of mercury (e.g., fluorescent lights and some older thermostats).**

# Volatile Organic Compounds (VOCs)

Volatile organic compounds (VOCs) are found in many construction materials, such as paints, varnishes, adhesives, composite wood products, insulation, carpets, and furniture. VOCs can cause eye, nose, and throat irritation, as well as headaches, nausea, and dizziness. Long-term exposure may damage internal organs, such as the kidneys, and some VOCs may increase cancer risk.
Formaldehyde is one of the most common and dangerous VOCs. It is used in adhesives, paints, sealers, and as a binder in wood products such as plywood, particleboard, and MDF. Formaldehyde can cause eye, nose, throat, and skin irritation. Long-term exposure can intensify respiratory issues, such as asthma, or increase cancer risk.
Most VOC emissions are most intense just after manufacturing or surface treatment (e.g., with paint or varnish). Hidden VOCs can also be released in significant amounts when the material or product is damaged. Some materials or products, such as oil-based paints and high-gloss finishes, can release VOCs for several years. Therefore, proper personal protective equipment is advised when handling materials suspected of containing considerable concentrations of VOCs.

**Proper ventilation is advised when storing and reusing salvaged materials since reclaimed materials can absorb VOCs from their environment over decades and release them when installed in less-ventilated spaces.**

**Currently, there are no approved exposure limits for VOCs or a total limit for volatile organic compounds [1]. Testing for VOCs from construction products in use is not a common practice.**

# Polychlorinated biphenyls (PCBs)

Polychlorinated biphenyls (PCBs) were commonly used in construction materials (especially caulk, putty, paint, sealants, and fluorescent light ballasts), mainly before 1980, for increased abrasion resistance and reduced viscosity. Despite the fact that, according to [2], the use of PCBs in fluorescent light ballasts, caulk, and double-pane insulating glass has not been documented, caution is still advised. However, it is challenging to identify PCB-containing components visually, so strict personal protective equipment is advised when their presence is suspected (e.g., in buildings built between the 50s and 80s).

Sources
[1] https://island.is/en/environmental-factors/indoor-air-quality (access: 23/03/2026).
[2] Umhverfis- og auðlindaráðuneytið, *Iceland: National Implementation Plan for the Stockholm Convention on Persistent Organic Pollutants*, 2017.

# CE MARKING

This chapter aims to very briefly cover CE marking aspects regarding secondary materials (reused) products, as they are often discussed among professionals in the context of reuse as a hindrance. It should be noted, however, that CE marking is a complex and multifaceted topic, so the information presented herein does not aim to provide a full picture of the issue, but rather to offer a general and basic understanding. In case a deeper dive into the topic is needed, contacting experts is advised.

The main focus of the handbook is direct reuse, which means reusing material in the same function without altering its form and properties in any significant way. Such a case will be discussed in terms of CE marking here.

CE marking is a declaration confirming that the material/product in question meets the essential requirements (as set out in the applicable European directives) and that its conformity was assessed using the methods specified in those directives. The responsible party for such a declaration is typically a manufacturer, a goods importer from a non-EU country, or a distributor that modifies the product under their brand. As mentioned before, the CE mark is a direct consequence of the Construction Product Regulation.

The revision of the Construction Product Regulation brought reused materials under its scope. However, according to [1,2], the reuse of construction materials and elements is considered covered by national regulations once the product is placed on the EU internal market. This means that the validation is based on a national product approval procedure rather than on mandatory CE marking and a declaration of performance.

To receive national approval in Iceland, the intended use of the product must be known to establish the so-called AVCP* system level required for your specific products. AVCP is a harmonised framework that ensures construction products meet their declared performance and provides information on the technical requirements that materials intended for reuse must meet to be considered fit for reuse in the given function.

Given the above, the suitability of building components for reuse in a project has to be assessed on a case-by-case basis, based on their intended use and the requirements for that use, local conditions, and building regulations. Close cooperation with authorities responsible for overseeing compliance with regulations and standards for construction materials is advised.

Lastly, it has to be mentioned that individuals sourcing and reusing products for their own non-professional purposes are not considered economic operators under the Construction Product Regulation (CPR), for which CE marking is a consequence, and the CPR does not impose obligations on them.

* *Assessment and Verification of Constancy of Performance*

Sources
[1] S. Kaarsberg, L. Kress, *Policies Enabling the Reuse of Construction Products in the Nordics*, 2023.
[2] Y. Zhu, K. Tähtinen, *Conditions for reuse of building components in Finland*, 2022

# ANNEX 1

| Product/material | EPDs |
|---|---|
| Chipboard | https://www.husa.is/webapi/v1.0/documents/download/A:5678102953-5637161694-175 |
| | https://www.sonaearauco.com/media/bemkosck/particleboard-uncoated.pdf |
| | https://media.bluestonepim.com/a085869b-6ba8-4824-a48f-3a9848bb45d8/4c87ddcb-183d-4be8-8764-145850a0efca/HZbBvMTLnnFNt6UDZ1EXc5jbl/0120mjeewLU0njs6YG2NSFU6W.pdf |
| | https://www.environdec.com/library/epd8588 |
| MDF board | https://www.environdec.com/library/epd18131 |
| | https://www.environdec.com/library/epd273 |
| | https://www.environdec.com/library/epd8737 |
| OSB | https://www.moelven.com/globalassets/inriver/documents/nordboard_osb.pdf |
| | https://www.moelven.com/globalassets/inriver/documents/nordboard_osb.pdf |
| | https://www.environdec.com/library/epd8738 |
| Plywood | https://estply.com/wp-content/uploads/2018/01/RTS_346_25_Estply_BIRCH.pdf |
| | https://environdec.com/library/epd4168 |
| | https://environdec.com/library/epd4904 |
| | https://www.environdec.com/library/epd24514 |
| Plasterboard | https://www.environdec.com/library/epd17752 |
| | https://www.environdec.com/library/epd4546 |
| | https://www.environdec.com/library/epd1934 |
| | https://environdec.com/library/epd1142 |

# ANNEX 1

| Product/material | EPDs |
|---|---|
| Ceiling panels | https://www.husa.is/webapi/v1.0/documents/download/A:5657974658-5637152317-118318 |
| | https://huntonit.com/brochure-documents-and-declarations/epd-environmental-declaration/ |
| | https://huntonit.com/media/9953/nepd-12971-14204_huntonit-building-boards-without-surface-treatment.pdf |
| | https://www.husa.is/webapi/v1.0/documents/download/B:2151340-24-0 |
| Doors | https://www.ringo.de/unternehmen/nachhaltigkeit.html |
| | https://www.husa.is/media/feyn150n/epd_hub-3330-swedoor-advance-line-exterior-doorsets-77-mm-glazed.pdf |
| | https://manage.epdhub.com/declarations/windows-doors-openings/jeld-wen/343/swedoor-interior-classified-60mm-doors-group-1-without-glass/ |
| | https://environdec.com/library/epd17891 |
| | https://www.environdec.com/library/epd2683 |
| | https://environdec.com/library/epd5709 |
| Sanitary equipment | https://www.epddanmark.dk/media/tx3btmb5/md-25078-en-1.pdf |
| | https://www.environdec.com/library/epd15669 |
| | https://www.environdec.com/library/epd4163 |
| | https://www.gustavsberg.com/fileadmin/user_upload/Gustavsberg/pdf-files/EPD_Nautic_toilet_1500_final_20210607_.pdf |
| | https://www.gustavsberg.com/fileadmin/uploads/Documents/EPD/EPD_Atlantic_kitchen_mixers.pdf |
| | https://www.gustavsberg.com/fileadmin/uploads/Documents/EPD/EPD_Nautic_washbasin_mixers.pdf |
| | https://www.environdec.com/library/epd6290 |
| | https://environdec.com/library/epd27801 |

# ANNEX 1

| Product/material | EPDs |
|---|---|
| Sanitary equipment | https://www.environdec.com/library/epd7814 |
| | https://assets.hansgrohe.com/celum/web/Hansgrohe-Group-EPD-Washbasins-2024.pdf |
| Ventillation ducts | https://www.environdec.com/library/epd27185 |
| | https://www.environdec.com/library/epd7750 |
| | https://www.environdec.com/library/epd22848 |
| | https://itsolution.lindab.com/lindabwebproductsdoc/assets/production/ZjRlYzA3ZjMtYjNiOS00MTY2LWJkZGEtOTY0OTY0MTk0YjRh/5250102777417078652/EPD_Lindab_Ventilation_AB_Circular_ventilation_duct,_folded_Lindab_Safe_&_Safe_Click_HUB-1016_2024-01-23.pdf |
| Windows | https://www.husa.is/media/cqfdp1bu/epd-s-p-07600-rationel-forma-topguided-pub_date2023-09-15.pdf |
| | https://www.husa.is/media/i40aeaj1/epd_ies-0024526-rationel-auraplus-formaplus-topguided-window-with-3-layer-ecoline-glazing-1.pdf |
| | https://www.husa.is/media/nbfdoj0x/epd-s-p-07591-velfac-200-energy-top-guided-rev_2023-09-14-1.pdf |
| | https://www.husa.is/media/2r4hpto0/epd-s-p-07594-velfac-ribo-wood-top-guided-2023-09-15.pdf |
| | https://www.environdec.com/library/epd21600 |
| Aluminium panels (flat and corrugated) | https://european-aluminium.eu/wp-content/uploads/2023/12/EPD_report_Novelis_Anodised-sheet-for-architectural-cladding.pdf |
| | https://www.sandrinimetalli.it/wp-content/uploads/2024/11/epd-aluminium-sheets-for-roofing-and-cladding-natural-pre-painted-pdf.pdf |
| | https://valcan.co.uk/wp-content/uploads/2023/06/Valcan-VitraDual-EPD-S-P-04405.pdf |
| | https://www.ppa-europe.eu/download/ppa-europes-epd-for-profiled-sheets-made-of-aluminium-edition-2024/ |

# ANNEX 1

| Product/material | EPDs |
|---|---|
| Ceramic facade systems | https://www.moeding.de/wp-content/uploads/2022-10-11_EPD_Keramikfassaden_Moeding_EN.pdf |
| | https://www.environdec.com/library/epd2240 |
| | https://www.environdec.com/library/epd6511 |
| | https://agrob-buchtal.de/upload/media/downloads/0001/10/ee68443064630db61abce225e4e6aabc318ceafb/2024-08-29_EPD_KeraTwin_AGROB_Buchtal_EN.pdf |
| Copper and zinc sheet cladding | https://www.ruukki.com/docs/default-source/b2b-documents/epd/en_epd_rc_facade_cladding_03_2023.pdf?sfvrsn=43638228361605630000 |
| | https://www.environdec.com/library/epd5475 |
| | https://www.rheinzink.com/fileadmin/redaktion/RHEINZINK_GLOBAL/Downloads/Technical-Documents/epd_rheinzink-classic_bright-rolled_2024-2029.pdf |
| | https://www.environdec.com/library/epd5475 |
| | https://www.ruukki.com/docs/default-source/b2b-documents/epd/en_epd_rc_facade_cladding_03_2023.pdf?sfvrsn=43638228361605630000 |
| | https://www.ruukki.com/docs/default-source/b2b-documents/epd/en_epd_rc_facade_cladding_03_2023.pdf?sfvrsn=43638228361605630000 |
| Fibre cement panels | https://www.swisspearl.com/media/23300/download/EPD%20Fiber%20Cement%20Build%20%26%20Indoor.pdf?v=1 |
| | https://svk.global/gb-en/products/facade-panels/puro-plus#downloads |
| | https://media.equitone.com/doc_275250_global/original/2075815561/epd_flat-sheets_equitone-natura_natura-pro-white-cement_18102029.pdf?brand=equitone&market=global |
| Metal composite panels | https://stacbond.com/wp-content/uploads/2026/02/EPD-IES-0027511_EN.pdf |
| | https://www.environdec.com/library/epd1289 |
| | https://www.environdec.com/library/epd3725 |

# ANNEX 1

| Product/material | EPDs |
|---|---|
| Natural stone | https://www.environdec.com/library/epd28203 |
| | https://www.environdec.com/library/epd15103 |
| | https://a.storyblok.com/f/236904/x/6e12eb7169/nepd-blue-pearl_en.pdf |
| Timber cladding | https://www.environdec.com/library/epd7188 |
| | https://www.environdec.com/library/epd8101 |
| | https://www.epddanmark.dk/media/13lnk2v4/md-25082-en.pdf |
| | https://froeslev.dk/media/uwtdukok/untreated-spruce.pdf |
| Carpet | https://www.environdec.com/library/epd28559 |
| | https://gut-prodis.eu/download/44/broadloom-vpa6/3617/epd-broadloom-vpa6-lc1-gut-e-v.pdf |
| | https://media.tarkett-image.com/docs/EPD_DESSO_AirMaster_Classic.pdf |
| | *https://alfaborg.b-cdn.net/datasheet/Vottun%20EPD%20-%20Woven%20broadloom%20carpet%20pile%20material%20max%20800g%20PA66.pdf* |
| | *https://www.environdec.com/library/epd8854quality=HIGHLINE%7C%7C630%20g%2Fm%C2%B2%7CRecycled%20polyamide%206%7CTufted%20cut%20pile&backing=Ecotrust%20350%2C%20100%20%25%20Recycled* |
| Ceramic tiles | https://www.environdec.com/library/epd22659 |
| | https://www.ceramiche-piemme.com/wp-content/uploads/AverageEPD_Template_Ceramic-Tile_8.5-9.5_2024_final.pdf |
| | https://www.aenor.com/documents/d/guest/GlobalEPD%20EN%2017160%20-%20035%20Spanish%20Ceramic%20Tiles%20ASCER%20EN |
| | https://www.settecento.com/pdf/EPD-US-Settecento-2023.pdf |

# ANNEX 1

| Product/material | EPDs |
|---|---|
| Laminated wood flooring | https://www.environdec.com/library/epd8742 |
| | https://parador.de/en/pcms/downloads/downloadfile/file_id/938/?srsltid=AfmBOorAW0TezKHrPto9AyLYZZdGQeGrm_hG_ByOqa0co1UOa7L2Um_D |
| | https://eplf.com/storage/files/epd-dpl-laminate-flooring-2021.pdf |
| | https://cdn3.quick-step.com/-/media/imported%20assets/flooring/6/4/e/epd%20direct%20pressure%20laminate%20floor%20covering%20unilinpdf264882.ashx?rev=b806418778d6478186e2940fb384079a |
| Engineered wood flooring | https://www.environdec.com/library/epd12666 |
| | https://www.pergo.is/-/media/imported%20assets/flooring/5/7/5/epd%20multilayer%20parquet%20flooring%20unilinpdf264880.ashx?rev=1f5be86ced3a4bc9b85ef866da3a97f8&type=original&filename=EPD+Wood.pdf |
| | https://www.environdec.com/library/epd6627 |
| Expanded Polystyrene Insulation | https://www.meltex.fi/wp-content/uploads/2025/12/EPD_Eristyslevy-EPS.pdf |
| | https://www.environdec.com/library/epd26596 |
| | https://de.cdn-website.com/b8305fb5363947a18d48d63d735215af/files/uploaded/NEPD-6298-5556_EPS-----Thermal-insulation-for-buildings--16-kg-m3--24-kg-m3-and-30-kg-m3.pdf |
| | https://environdec.com/library/epd9837 |
| | https://finnfoam.fi/wp-content/uploads/2022/11/finnfoamxps_rts-epd_FINNFOAM-_XPS_113-21.pdf |
| Metal insulation panels | https://limtrevirnet.is/wp-content/uploads/2025/05/NEPD-9970-9918_Slettar-yleiningar-SF-Flat-mineral-wool-panels.pdf |
| | https://api.clfyj5-jorisiden1-p1-public.model-t.cc.commerce.ondemand.com/jriassetcenter/download/asset/media/JRI_EPD-IES-20250610-JI%20SF%20WALL%201000.pdf |
| | https://api.clfyj5-jorisiden1-p1-public.model-t.cc.commerce.ondemand.com/jriassetcenter/download/asset/media/JRI_EPD-IES-20260108-JI%20TF%20WALL%201100%20Low%20Carbon.pdf |
| | https://www.environdec.com/library/epd17788 |
| | https://www.environdec.com/library/epd26322 |

# ANNEX 1

| Product/material | EPDs |
|---|---|
| Mineral wool | https://steinull.is/wp-content/uploads/2026/02/NEPD-14865-15551_Steinull-hf.-Stone-Wool-Insulation-Density-Group-100-200-kg-m3.pdf |
| | https://steinull.is/wp-content/uploads/2026/02/NEPD-14864-15551_Steinull-hf.-Stone-Wool-Insulation-Density-Group-75-100-kg-m3.pdf |
| | https://steinull.is/wp-content/uploads/2026/02/NEPD-14863-15551_Steinull-hf.-Stone-Wool-Insulation-Density-Group-20-75-kg-m3.pdf |
| Corrugated steel | https://www.environdec.com/library/epd10176 |
| | https://www.lindab.com/globalassets/commerce/lindabwebproductsdoc/assets/production/nju3mtdmmdktmdi2zs00yzqylwjjndutnza2nzjmogu5zwm1/5250636682518487852/epd_hub-1709_2025-10-03.pdf |
| | https://www.environdec.com/library/epd11073 |
| | https://www.lindab.com/globalassets/commerce/lindabwebproductsdoc/assets/production/nmqymmflm2qtzdfjzi00nzjjlthlmmetmdc2owrhyznkzjuy/5250681666882761240/epd_hub-1704_2025-11-21.pdf |
| Gutters and downspouts | https://www.environdec.com/library/epd5588 |
| | https://www.epddanmark.dk/media/w32nxavv/md-23198-en.pdf |
| | https://www.epddanmark.dk/media/jg4dsvxy/md-22036-en_rev1.pdf |
| | https://www.lindab.com/globalassets/commerce/lindabwebproductsdoc/assets/production/zjmzm2vintgtztm3ys00zge1lwjmmditogm0mti4zgy2ywm3/5250636691218050984/epd_hub-2962_2025-09-30.pdf |
| CLT | https://www.environdec.com/library/epd9949 |
| | https://www.epddanmark.dk/media/kn5kwbzj/md-25107-en.pdf |
| | https://www.klh.at/wp-content/uploads/2026/01/environmental-product-declaration-wiesenau.pdf |

# ANNEX 1

| Product/material | EPDs |
| --- | --- |
| Concrete (cast-in-place) | https://bmvalla.kreatives.is/wp-content/uploads/2025/02/EPD_Berglind_Vistvaenni_steypa_C16-20_5.02.2025.pdf |
| | https://bmvalla.kreatives.is/wp-content/uploads/2024/12/EPD-6389-5647_Berglind-Svan-Vistv-nni-steypa-C30-37.pdf |
| | https://bmvalla.kreatives.is/wp-content/uploads/2024/07/NEPD-7154-6552_Aflsteypa-C35.pdf |
| | https://www.graennibyggd.is/_files/ugd/54e708_a674d0d35e9d4e5880ed8e9798019a38.pdf |
| | https://www.graennibyggd.is/_files/ugd/54e708_5eaa864f4a15448dba84efb4db9bcd4b.pdf |
| | https://steinsteypan.is/wp-content/uploads/2025/06/EPD-vottun.pdf |
| | https://steinsteypan.is/wp-content/uploads/2025/06/EPD-vottun.pdf |
| Concrete (precast) | https://steypustodin.is/wp-content/uploads/2021/05/EPD_HUB-4903_2026-01-20_en.pdf |
| | https://bmvalla.kreatives.is/wp-content/uploads/2025/08/NEPD-12085-12074_Filigran-loftapl-tur.pdf |
| | https://www.environdec.com/library/epd2473 |
| | https://environdec.com/library/epd3856 |
| Glulam | https://limtrevirnet.is/wp-content/uploads/2025/05/NEPD-9472-9140-L-mtr-Glued-laminated-timber-GLT-Glulam-3.pdf?_gl=1*eoitqr*_up*MQ..*_gs*MQ..&gclid=CjwKCAiAh5XNBhAAEiwA_Bu8FQaxnmZQuG6MDxkuqELvZm7jrbwiQWs22u1_pH9mB7Fp41MjCAN_jBoCYtQQAvD_BwE&gbraid=0AAAAADp-E1us1Bb-Tml_xRR9zt6QCTh7D |
| | https://www.storaenso.com/-/media/documents/download-center/certificates/wood-products-approvals-and-certificates/epd/epd-glue-laminated-posts-and-beams-by-stora-enso.pdf |
| | https://www.epddanmark.dk/media/demnkofe/md-22038-en.pdf |

# ANNEX 1

| Product/material | EPDs |
|---|---|
| Steel beams | https://www.environdec.com/library/epd28446 |
| | https://www.precastcontiga.heidelbergmaterials.se/sites/default/files/2024-02/NEPD-5818-5115_Steel-Beams-H--I--U.pdf |
| | https://www.begroup.se/storage/6030632047F28CF3849967738A670ED8ABFE5F4080D152277545FDFA10D2F921/0907aef5e11448f58a1d21bcd5431ccd/pdf/media/50db284aa26a414086d4c98d7d6f2a77/BEGroup_Balk_EPD_HUB-3497.pdf |
| | https://www.environdec.com/library/epd7320 |
| | https://dofasco.arcelormittal.com/media/v5eitni5/xcarb-epd-for-cold-formed-sections-final_v3_updated.pdf |
| | https://www.ssab.com/-/media/files/en/hollow-sections/epd-structural-hollow-sections.pdf?m=20260324085437 |
| General timber | https://www.storaenso.com/-/media/documents/download-center/certificates/wood-products-approvals-and-certificates/epd/stora-enso-epd-classic-sawn.pdf |
| | https://www.upmtimber.com/siteassets/upm_environmental-product-declaration_timber.pdf |
| | https://www.epddanmark.dk/media/y1wfvthh/md-25104-en.pdf |
| Chemically-treated timber | https://www.epd-global.com/getfile.php/13191348-1741690594/EPDer/Byggevarer/Heltreprodukter/NEPD-6421-5682_Treated-timber--NTR-A--100--pine.pdf |
| | https://froeslev.dk/media/ilxls14l/ntr-ab.pdf |
| | https://www.environdec.com/library/epd8618 |
| Strength-graded timber | https://www.environdec.com/library/epd8617 |
| | https://www.environdec.com/library/epd6869 |
| | https://www.sodra.com/en/global/products/certificates-and-documents/wood-products/ |
| Thermally-treated timber | https://www.environdec.com/library/epd11801 |
| | https://rts.lca-data.com/datasetdetail/process.xhtml?uuid=95f31387-b6fe-48c3-a042-48c0e1aa51e4&format=html&lang=en&version=00.06.001 |
| | https://www.environdec.com/library/epd7192 |