Gyproc SAINT-GOBAIN

ISOVER SAINT-GOBAIN

weber SAINT-GOBAIN

Ecophon SAINT-GOBAIN

A SOUND EFFECT ON PEOPLE

CLT buildings

Design Guide

SAINT-GOBAIN

Guide for the design of CLT buildings – using solutions from Saint-Gobain for thermal and acoustic comfort and with consideration of moisture protection

CLT buildings

This design guide is aimed at providers, architects, constructors and designers for the construction of sustainable and efficient cross-laminated timber structures.

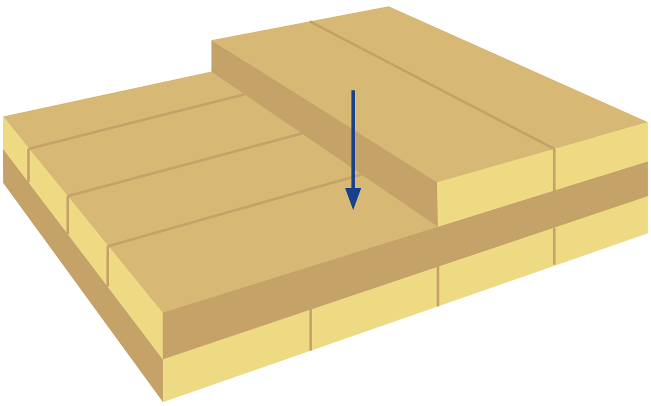
The information provided in this guide must be considered indicative for the early stage of the design process. Project-specific calculations are required for the final dimensioning

WHAT IS CLT?

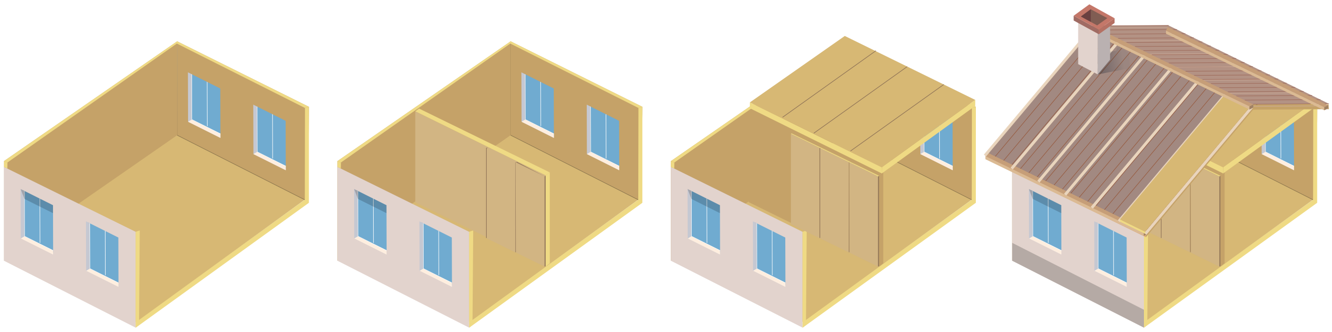
Cross-laminated timber, CLT, is a timber-based construction product produced as panels and made from an uneven number of layers of planed wood. Three, five, seven or nine layers are normally used. Each layer consists of finger-jointed planks ("boards") laid side by side. Each board layer is oriented perpendicularly relative to the adjacent layers. The layers are then glued together and compressed (see illustration 1 below). Some producers use edge-glued boards, which means that the boards in each layer are also glued together side to side along the edges.

Cross-laminated timber was developed at the end of the 1970s and mass production started during the 1980s, mainly in Austria. In CLT structures, all or parts of the structure can be built using these CLT panels, see illustration below. Now there are a number of players and suppliers of CLT, some of which carry out production in Sweden, e.g. Martinsons, Stora Enso, Södra and Setra.

Buildings can be constructed using either CLT panel elements (2D) that are joined together at the workplace and finished internally and externally or using three-dimensional (3D) CLT modules that are usually pre-finished internally and joined at the workplace for subsequent external finishing.



Focus on the design and construction phase



EXTERIOR WALLS | PARTITION WALLS | JOISTS | ROOFS

In recent years, the focus has shifted from carbon-emissions occurring during the operational phase of a building in connection with energy use to a greater focus on the actual construction of the building. In addition to the requirements already set out by the Swedish National Board of Housing, Building and Planning's building regulations (BBR), the Swedish government intends to introduce requirements for developers to prepare and submit a climate declaration in connection with the construction of new buildings from 1 January 2022.

CLT buildings are reported to have some advantages compared to traditional multi-storey buildings constructed from concrete, e.g. lower carbon emissions, better building ergonomics and shorter construction times. However, there are challenges related to e.g. fire safety, moisture protection, the acoustic environment and the mechanical stability of tall buildings constructed using CLT. Proper design is therefore crucial.

The following section describes the critical areas and priorities that we at Saint-Gobain have placed at the top of the agenda when it comes to creating sustainable constructions for the future. We will briefly look at the Swedish National Board of Housing, Building and Planning's building regulations (BBR) within the areas that have the greatest impact on the construction of CLT structures.

We will then delve more deeply into the topic of construction physics, for example thermal comfort/energy consumption, moisture protection and acoustics. Here you will also find information about what life cycle assessments (LCA), EPD (Environmental Product Declaration) involve, as well as links to fire safety information.

We will then describe the different and alternative solutions that we at Saint-Gobain have identified for various applications (exterior walls, intermediate floors, partition walls, etc.). The solutions are adapted for either homes or premises (offices, schools, hotels, hospitals). We have attempted to link performance to generic CLT framework, i.e. so that it works regardless of the chosen framework supplier.

Finally, we will give a short presentation containing more detailed information and descriptions of the strategic solutions available from Saint-Gobain.

NB! This design guide does not take into account dimensioning based on the mechanical performance of the CLT elements or their panel points/joints. We have chosen to use typical dimensions as the basis for the data presented. In order to change input data and see the consequences within the aforementioned area, please contact Saint-Gobain. All buildings are different so please do not hesitate to get in touch for further information.

Information can also be found on our website, www.saint-gobain.se/kl-tra

The challenge is to satisfy both comfort and sustainability requirements

We all have a shared responsibility to reduce our impact on the planet, thereby slowing down global warming. At the same time, we need to ensure that homes that are constructed are safe and secure to live in. There are several dimensions to the concept of sustainability, in which ecological sustainability is attributed fundamental importance and viewed as a prerequisite for both social and economic sustainability. In order to meet the sustainability targets, there are now certification systems available that have been designed for the purpose of showing how sustainable construction can be achieved.

Naturally, it is important to use the correct materials in the correct place and it is likely that wooden structures will be more common in the future, including tall apartment buildings, often using CLT framework. Several players in Sweden have chosen to invest in expanding their capacity to produce these and, within a few years, we will go from a production capacity of 23,000 m³ CLT to closer to 250,000 m³. (Source: Swedish Wood)

> [...] We have made the commitment today to reach **zero net carbon emissions by 2050**. This long-term goal must guide all our strategic decisions and must be a factor in encouraging our teams' cohesiveness and their additional commitment.
>
> **PIERRE-ANDRÉ DE CHALENDAR**
> **Président-Directeur général**

Saint-Gobain offers a number of products and solutions that allow for the construction of safe buildings with high levels of comfort. We take the sustainability challenge very seriously and we have set a goal to become a climate-neutral producer of construction materials by 2050. We are also committed to supporting Sweden's goal of achieving zero net greenhouse gas emissions by 2045 and we are also a signatory to the Roadmap for a climate-neutral and competitive construction sector by 2045.

Additionally, to help the industry, we have prepared externally verified life cycle assessments (LCA) in the form of environmental product declarations (EPD). The Saint-Gobain Group has more than 800 EPDs in total and Saint-Gobain Sweden AB has around 70. You can find further information about these in this design guide.

Further information about our products, certification system and sustainability matters can be found at www.hallbartbyggande.se.

For further information on how we at Saint-Gobain can help, please see www.hallbartbyggande.se

Indoor comfort

We spend around 90% of our time indoors. Our buildings should therefore be designed primarily for people and our needs.

- CLEAN AND FRESH AIR
- NATURAL LIGHT
- NATURAL SOUND
- COMFORTABLE TEMPERATURE

We can provide knowledge and solutions to create outstanding indoor environments.

Using our solutions, you can achieve a better acoustic environment, more natural daylight, more even and comfortable temperature, as well as getting a more sustainable building.

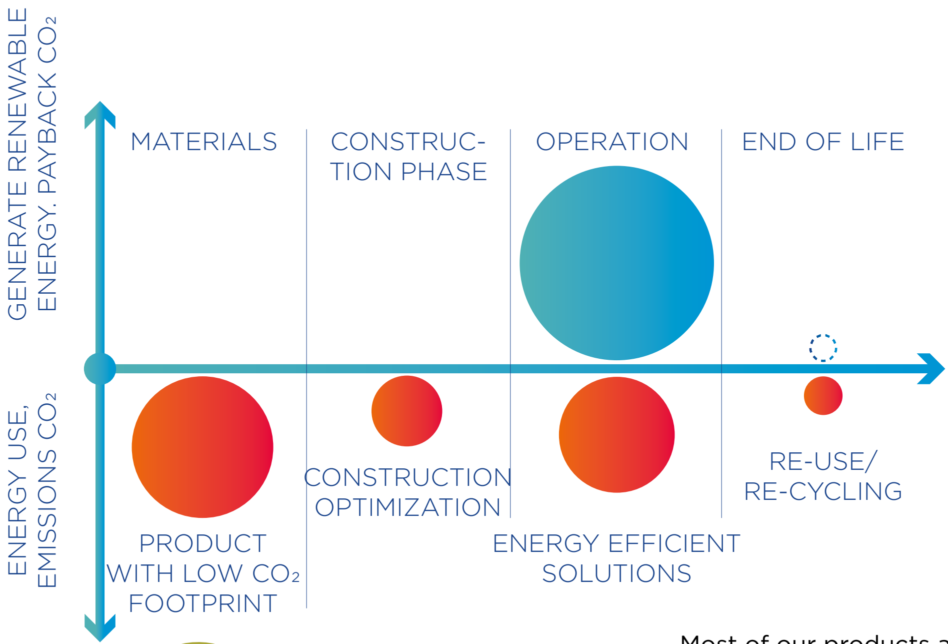
Sustainability

At Saint-Gobain, we are actively committed to environmental issues and sustainability is one of our top strategic priorities. We are proud to be a recognised leader in our industry and believe that we can be much more than just a supplier of materials to the construction industry. In order to offer sustainable and climate-smart solutions for buildings that also provide added value, we have developed expert teams within the area of sustainability.

Our focus is on optimising buildings and reducing their carbon footprint throughout the entire life cycle of the building:

1. during the development and production of materials and products
2. during the construction phase to reduce installation time and wastage at the workplace
3. during the operational phase through energy-efficient solutions for the climate envelope
4. at the end of the life cycle through potential recycling systems.

This is all to make it possible to develop climate-neutral buildings.



Most of our products are already registered in the systems used by industry to evaluate environmental performance.

Our highly talented team at Saint-Gobain can help you achieve high classification in systems such as BREEAM, LEED, Green Building (Sweden Green Building Council) and Nordic "Svanen" Ecolabel.

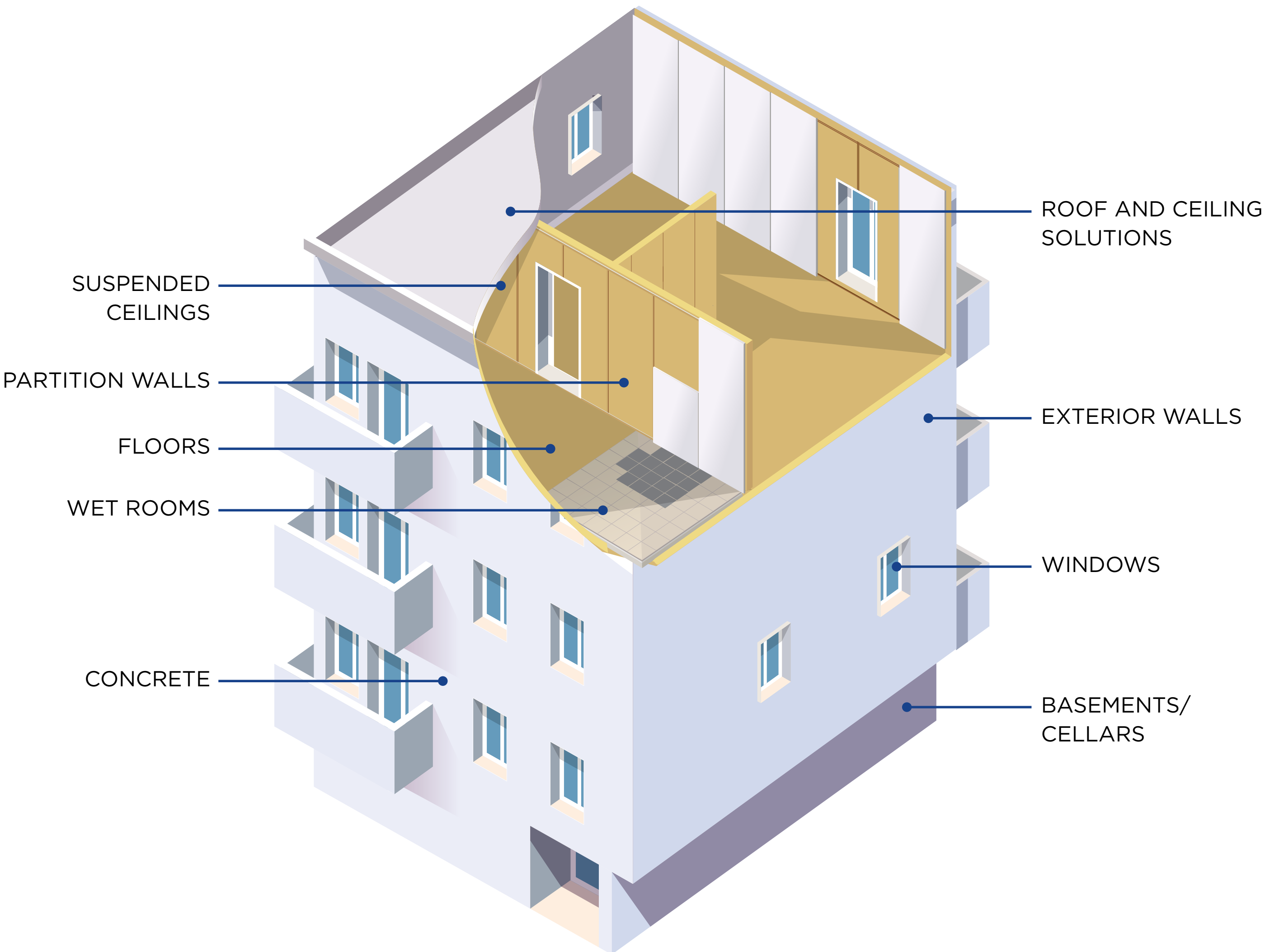
Construction optimization

Over the years, we have distinguished ourselves as a partner that can enable efficient construction processes with minimal wastage by offering support and advice to customers during the design phase. In this way, we reduce the number of different solution variants, are able to measure, mark up and deliver the right products at the right time, to the right place, saving time in the workplace.
We thereby also reduce the proportion of wastage from installation and end up with a smaller carbon footprint. We call this Construction optimization.

KNOWLEDGE WITHIN SEVERAL AREAS

Most construction projects are unique and that is also the case for the associated issues and challenges within e.g. sustainability and comfort.

With knowledge spanning a multitude of application areas and a number of well known brands, we are able to develop high-performance solutions for almost all types of buildings and building elements.



General information about construction physics and regulations

Buildings and their installations must be designed so that thermal comfort is achieved for each area based on area of application under normal operating conditions in accordance with the BBR (Swedish National Board of Housing, Building and Planning's building regulations).

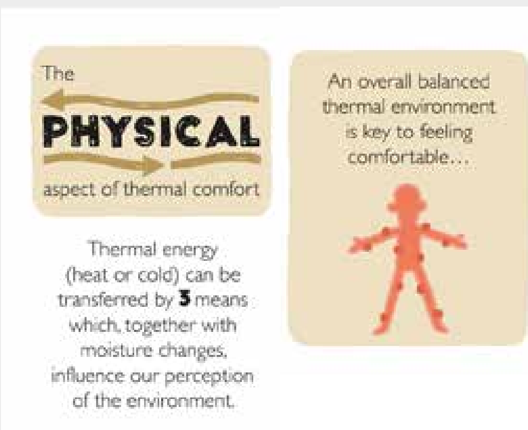
According to the BBR, buildings must be designed so that the lowest operating guideline temperature in the occupied zone is calculated as:

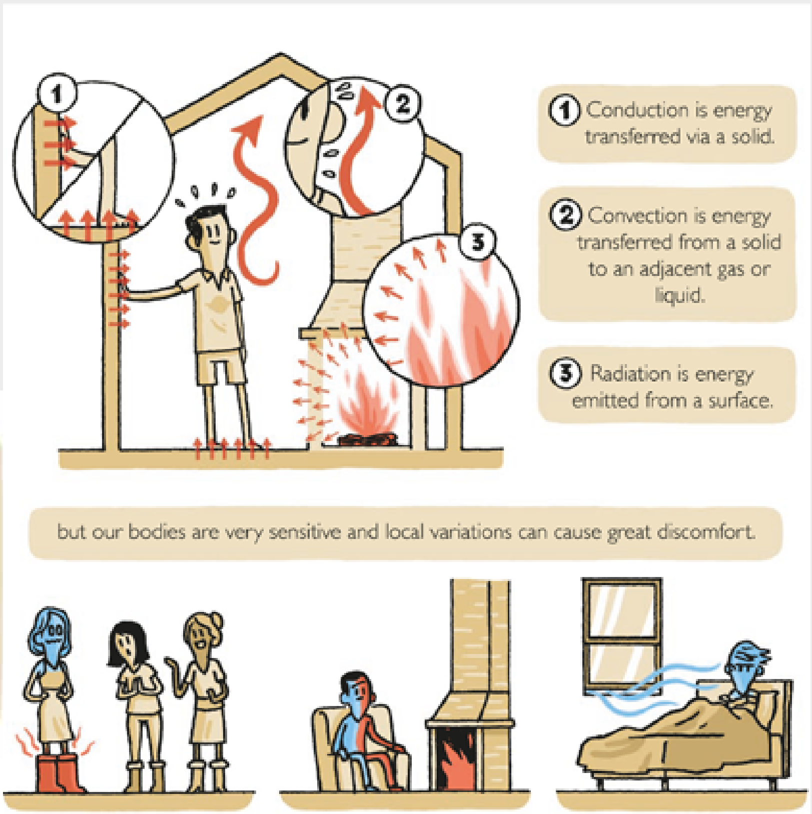
- ≥ 18°C in living and work spaces;
- ≥ 20°C in hygienic and care premises, as well as spaces for children in preschools and the elderly in care homes and similar,
- the operating guideline temperature difference at different points of the occupied zone of the room is calculated as max 5°C and
- the surface temperature of the floor below the occupied zone is calculated as no lower than 16°C (in hygienic spaces no lower than 18°C and in premises intended for children no lower than 20°C) and can be limited to maximum 26°C.
- The air velocity in the occupied zone of a room should not be calculated to exceed 0.15 m/s during the heating season and the air velocity from ventilation systems in the occupied zone may not exceed 0.25 m/s during the rest of the year.

COMFORT AND ENERGY CONSUMPTION

(THERMAL COMFORT)

The body reacts to temperature fluctuations (hot or cold) and air movements, such as draughts.





Construction physics includes knowledge of how to design sustainable buildings to meet the requirements for energy consumption, moisture protection and acoustic comfort.

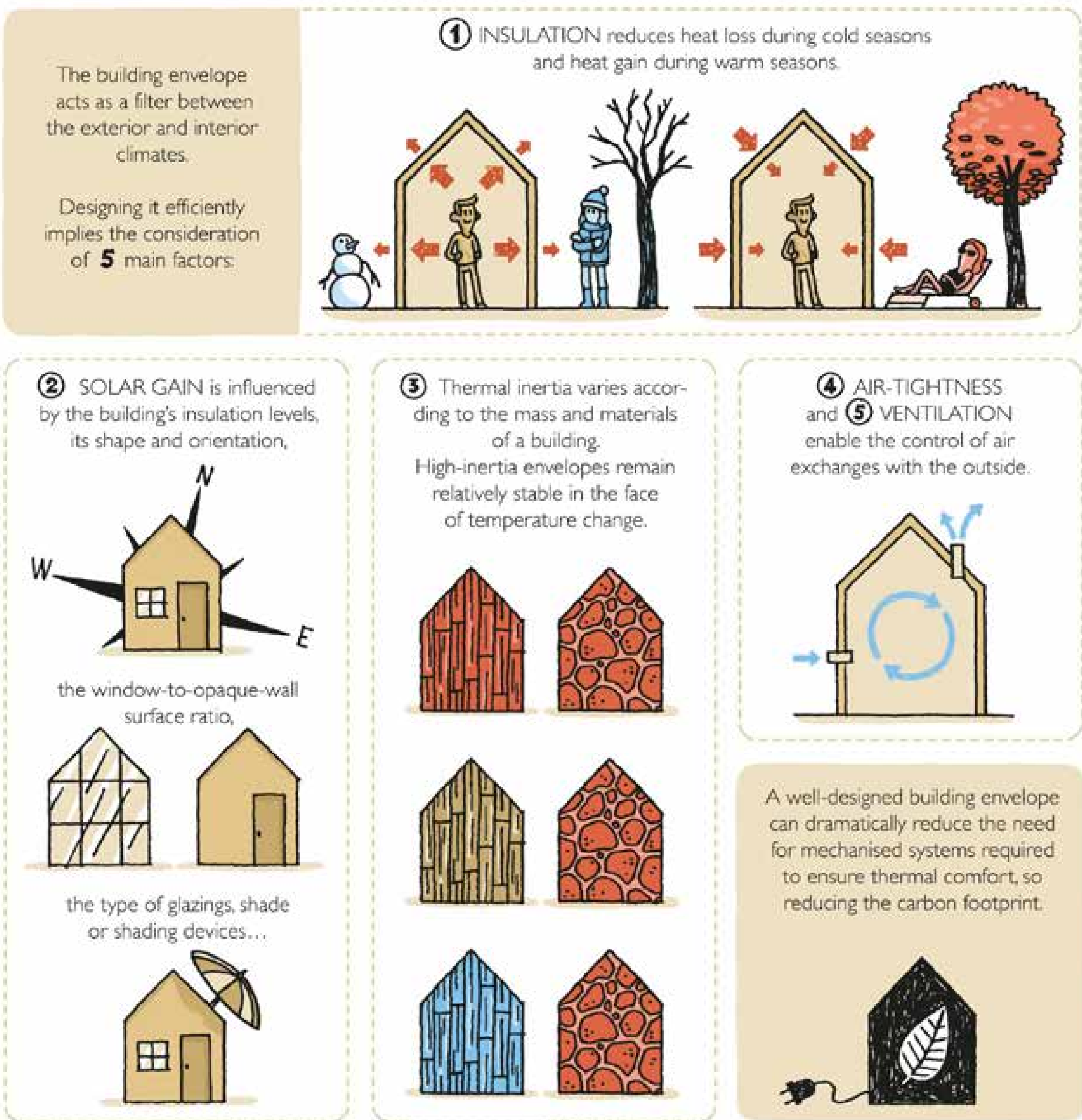
The design of a climate envelope and selection of materials based on a sustainability and life cycle perspective are often issues that are managed in the same way as user experience and health in relation to the indoor climate of the building.

Fire safety normally falls outside of the scope of construction physics, but is, of course, an extremely important aspect to consider when choosing a solution for each building element.

THE SWEDISH NATIONAL BOARD OF HOUSING, BUILDING AND PLANNING'S BUILDING REGULATIONS

The Swedish National Board of Housing, Building and Planning's building regulations (BBR) contain regulations and general advice for certain requirements set down in the Swedish Planning and Building Act, PBA, and the Swedish Planning and Building Regulations, PBR.

BBR sets down minimum requirements for a number of areas, such as Accessibility and Design; Fire Safety; Hygiene, Health and Environment; Noise Protection; Safety during Use and Energy Management. Thermal comfort, especially during the winter in our cold climate, is achieved through the high-quality climate envelope, i.e. well insulated roof, exterior walls, windows, doors and floors. Poorly insulated walls and windows



may result in cold downdraught of air and condensation. Draughts are often caused by leakiness or leaking doors or windows. In turn, this affects comfort.

There are currently just over 4.9 million residential homes in Sweden, of which around two million are single-family homes. It goes without saying that efficient climate envelopes are of the utmost importance when it comes to minimising energy consumption and saving our resources.

Continuous waterproofing, no loss/leaks in the climate envelope, few/small thermal bridges ("cold bridges"), proper windows and effective heat recovery are required for an efficient climate envelope with high insulating performance (= low U value). When the above is in place, we are able to minimise energy requirements for heating by using smart and energy-efficient equipment in the building.

Of course, it is great if it is possible to use solar energy via solar cells on roofs or façades. Window surfaces should face south as far as possible, in order to get free solar energy during the winter.

REQUIREMENTS CONCERNING ENERGY CONSUMPTION

On 01/09/2020, the Swedish National Board of Housing, Building and Planning introduced new Building Regulations (BBR) concerning energy consumption, amongst other things. In brief, the new regulations concerning energy consumption for heating have been tightened for buildings heated using electricity or fossil fuels and eased for buildings heated using district heating.

For some years now, the Swedish National Board of Housing, Building and Planning has set down requirements concerning the energy performance of buildings (in accordance with the BBR) as a primary energy figure ((EP_{pef}) specified in kWh/m². This value must not be exceeded in the design and must take into account energy consumption for:

1. Heating (E_{heat})
2. Comfort cooling (E_{cool})
3. Hot water (E_{hw})
4. The property, i.e. ventilation, pumps, lifts, etc. (E_{prop})

The primary energy figure is affected by

1. The heating source type (electricity, district heating, wood burning, gas, etc.) used, i.e. "the weighting factor for each energy carrier" (WF);
2. Where in the country you live, i.e. the "geographic adjustment factor" (F_{geo})
3. The total area of all floor, attic and basement levels for temperature-controlled spaces intended to be heated to more than 10°C "A_{temp}".

The calculation formula is as follows:

$$EP_{pef} = \frac{\sum_{i=1}^{6}\left(\frac{E_{heat,i}}{F_{geo}} + E_{cool,i} + E_{hw,i} + E_{f,i}\right) \times WF_i}{A_{temp}}$$

In addition, it is important that the designer ensures that the following defined values are not exceeded

a. installed power (kW)

b. Average heat transfer coefficient (U_m)

Highest permissible primary energy figure (EP_{pef}) and average heat transfer coefficient (U_m)

BFS 2011:6 with amendments up to and including BFS 2020:4

	Energy performance expressed as primary energy figure (EP_{pef}) [kWh/m² A_{temp} per year]	Average heat transfer coefficient (U_m) [W/m² K]
Apartment buildings	75	0.40
Premises	70	0.50

DIMENSIONING EXAMPLES FOR ENERGY CONSUMPTION

If we assume that we have an apartment building situated in Stockholm, without cooling requirements, that does not produce its own energy and will be heated using a geothermal heat pump, we can make the following assumption:

City/town	Energy carriers	Building type	(E_{heat}/	F_{geo}	+ E_{cool}	+E_{hw}	+E_f)	*	WF_{in}	/A_{temp})	=	EP_{pef}
Stockholm	El	Apartment buildings	22	1	0	10 [1]	10 [2]		1.8	1	=>	75

[1] Hot water for apartment buildings, 25 kWh/m² per year and an efficiency of 2.5 for geothermal heat pumps in accordance with BEN2

[2] Property energy for apartment buildings, 10 kWh/m² per year (best experiences from Sveby)

This means that the building may use a maximum of 22 kWh/m² per year on heating using electricity.

On the other hand, if the building is heated using district heating but otherwise with the same assumptions as the aforementioned example, the following will apply:

City/town	Energy carriers	Building type	(E_{heat}/	F_{geo}	+ E_{cool}	+E_{hw}	+E_f)	*	WF_{in}	/A_{temp})	=	EP_{pef}
Stockholm	District heating	Apartment buildings	72	1	0	25	10		0.7	1	=>	75

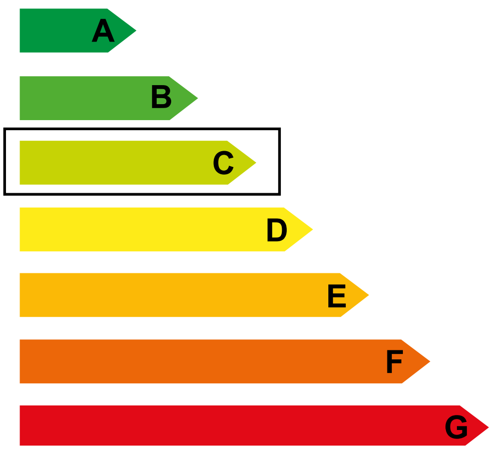
This means that the building may use a maximum of 72 kWh/m² per year on heating using district heating.

However, the requirement concerning U_m value according to the previous table must also be met and remains the same for both examples above.

The above example illustrates that the solutions can vary depending on the heating system used for the building that will be constructed.

The Swedish National Board of Housing, Building and Planning's requirements correspond to labelling in accordance with Energy Class C.

Energy classes



NB!

1. As shown in the example above, the cost for the consumer, as well as environmental impact, are likely to be much higher if constructing a building that is heated using district heating in accordance with the Swedish National Board of Housing, Building and Planning's minimum requirements. Of course, there is incentive to exceed the BBR requirements.
2. The primary energy figure for the building must be verified after construction. When verifying the primary energy figure for the building, the building's energy consumption must be determined in accordance with the Swedish National Board of Housing, Building and Planning's regulations and general advice (2016:12) on the determination of buildings' energy consumption in normal use and in a normal year, BEN.

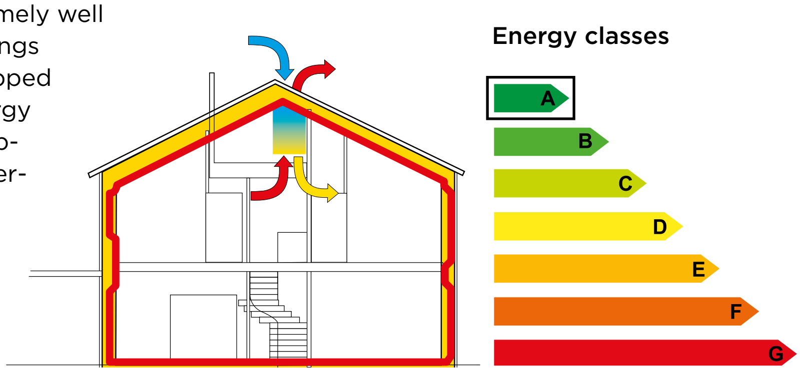
A modern building with well insulated and airtight structures has surface temperatures that are close to the air temperature. The temperatures therefore do not vary noticeably and this means you achieve comfortable conditions even at the lowest of air temperatures, which in turn favours low energy consumption.

The coldest surfaces in a building are glass surfaces, but windows at normal height and glazed doors with low U values carry a minimal risk of cold downdraughts.

Draughts from gaps are minimised when constructing airtight structures. Sensible placement and choice of supply air devices normally do not result in issues with excessive air speeds and draughts.

PASSIVE HOUSE

The Passive house standard stands for extremely well insulated, airtight and energy-efficient buildings with minimal heat leakage and that are equipped with technology to efficiently utilise the energy generated indoors by people, electrical equipment and sunlight. All of this reduces the energy requirements for heating to a minimum.



By definition, a passive house uses a maximum of 15 kWh per m² per year for heating, in accordance with the international design method and equivalent in accordance with FEBY requirements and Swedish design methods. In other words, less than half compared to the current BBR if electricity is used to heat the house.

With passive house thinking as the basis for the design of a building, it is easy to meet the requirement levels set down in BBR and energy class A can be achieved.

PLUS-ENERGY HOUSE

Through solar panels installed on the roof in combination with passive house, it is possible to create a building that can generate more net energy than it uses on an annual basis – this is known as a "plus-energy house".

Illustration: Derome

The option of building passive and plus-energy houses is a benefit when it comes to CLT structures. This is because timber, in itself, has fairly good insulating properties and insulation is almost exclusively installed outside of the framework. This creates fewer cold bridges and therefore also a greater possibility of achieving a lower mean U value (U_m) for the building.

Moisture protection

BBR sets out requirements for how buildings must be designed to ensure a good indoor climate. Among other things, it mentions that buildings and installations must be designed so that moisture does not cause damage, odours or microbial growth that may affect hygiene or health.

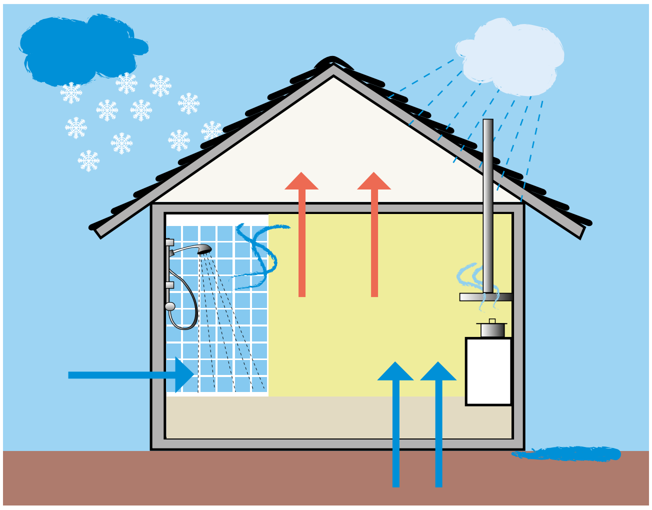


Illustration 4. Different sources of moisture indoors.

CLT is an organic material, which means that there may be a risk of microbial growth, which could have a negative impact on the indoor climate if the elements are exposed to high levels of moisture during production, transport or installation of the elements, as well as during finishing. It is therefore essential that the CLT elements are handled in a moisture-proof manner throughout the entire construction process.

Moisture-proof construction using CLT elements means protection against precipitation, as well as protection against long-term exposure to air with high relative humidity.

PROTECTION AGAINST PRECIPITATION

CLT suppliers use different methods and have different recommendations for protection against precipitation during the construction phase, with one of the methods being installation under tents. This method is of course the safest and generally reduces any disruption to the work due to weather. The tent also results in a slightly higher temperature, which, in turn, results in lower relative humidity, as the tent creates a mild "greenhouse environment".

If the CLT framework is erected without weather protection, the structure must be temporarily protected using tarpaulins or other temporary rain protection. This method is best suited for CLT installed without any form of cladding and it is important that drying can take place easily. Good planning is required for dewatering, protection of end timber and for drying of surfaces that have become wet.

A common solution is to protect joints and end timber against water penetration by carefully taping each element joint and leadthroughs but leaving the flat surfaces of the CLT exposed to weather. The use of traditional vapour barriers (PE film) as water protection is often called into question, as the vapour resistance is high and may cause problems in connection with the drying out of construction moisture and the dynamic moisture function of the structure during the operational phase.

Other films (e.g. variable vapour barriers) are available as alternatives to PE film for weather protection and are similar to PE film but have properties that allow for drying out at a high relative moisture level. A variable vapour barrier can then be used for temporary weather protection to limit the amount of moisture that the CLT is exposed to during the construction phase. The temporary protection against precipitation can then also be combined with a permanent air-sealing function with an efficient installation procedure on the exterior of the CLT framework. It is important that this film/vapour barrier is UV-stabilised to withstand external exposure during installation.

Regardless of the method used, it is of the utmost importance to establish a control plan in connection with the design work for moisture protection and to ensure the possibility of monitoring/documentation of the construction process.

HUMIDITY PROTECTION

The wood used for the CLT elements has been dried to a moisture content that is optimal for the production of the elements at the factory. These elements are usually delivered with some transport and weather protection. The relative humidity (RH) of the outdoor air will be high during most seasons and the CLT elements will adapt to the ambient moisture level. A short installation time should therefore be strived for. The building is normally closed up again as soon as possible, for weather protection and to allow for heating.

A redistribution of moisture takes place the first time a building is heated and this follows the temperature gradient through the climate envelope. When it is warmest inside, the moisture is moved out towards the coldest surface of the building and must not come into contact with vapour-sealed layers, as this could cause condensation, which increases the risk of mould growth and deformations in the CLT. Another key measure for protection against high humidity is ventilation and/or dehumidification indoors from the time at which the building is closed up again.

It is usually recommended that CLT elements and other wood are kept below a weight percentage of 13 in terms of moisture content, which corresponds 70% RH. This gives a small margin for the critical moisture state, while also being a highly practical and manageable level bordering on the cut-off point for the wood sorption curve. It also takes into account the fact that new wood has a clear inertia to changes in moisture content due to moisture variations. In the diagram below, this is illustrated by a flatter section for the curves between 25% RH and 70% RH.

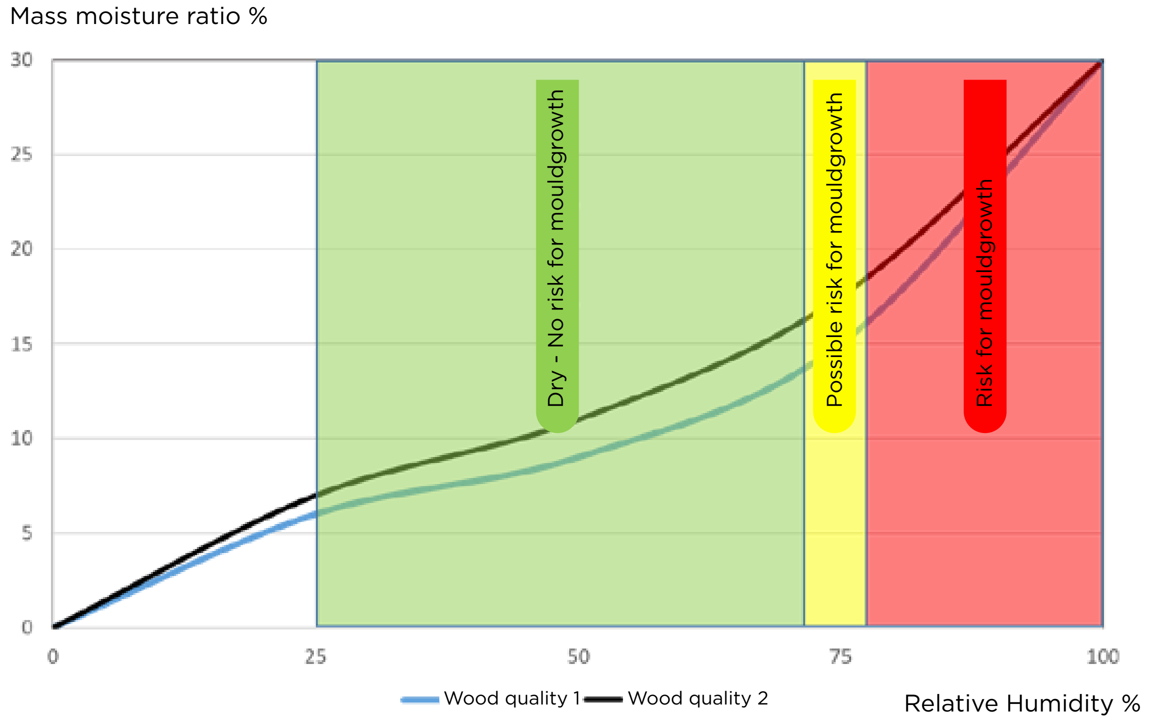


Illustration 5. Critical moisture conditions for wood of differing qualities.

It is usually easy to achieve a sufficiently dry environment in the building by heating to approximately 5°C above the outside temperature and dehumidifying or ventilating any moisture evaporating from all building elements. However, you can always allow for an indoor temperature of between 5 and 10°C in case of frost outside. Higher temperatures, i.e. 20°C or above often lead to the evaporation from other materials/ building elements becoming too high and uncontrollable at first.

The building should never be left heated without dehumidification/ventilation also being in operation. There is a risk of a very high RH indoors, which could in turn lead to condensation and moisture accumulation in the structure. As it takes a long time to dry out a moist structure, there is a risk of mould developing before the structure reaches its stabilised moisture level.

With correct dehumidification, the moisture content rapidly reaches the correct level and it is not enough to take delivery of elements and other wood that are "factory-dry" since the RH of outdoor air or "indoor surroundings" is often significantly higher than 70% RH, regardless of season. It takes only a week before

Photo: Martinsons/Jonas Westling

ordinary wood structures with a thickness of 45 mm adapt to the RH of their surroundings. For thicker structures, such as the majority of CLT elements, it takes longer, but they also take a correspondingly longer time to dry out again.

In order to achieve a moisture-proof building during the service phase, the chosen materials and building details must be able to work together to achieve a functional moisture-proof whole.

We usually have higher levels of added moisture in our houses today than in the past. It is therefore important that buildings have airtight climate envelopes (see Illustration 6 below) to provide the conditions for a good indoor climate with proper ventilation and without a risk of moisture migrating into the structure due to convection. Efficient ventilation is currently a prerequisite for healthy houses and has three functions: Frequent replacement of indoor air and keeping this fresh; removing moisture from the building and allowing for energy recovery from heated air.

With regard to the external protection of the structure, it is, of course, important to ensure that seals, weather barriers and water runoff are designed and installed in critical building elements and that these have been constructed professionally and with precision. This is to ensure that moisture that may temporarily penetrate the structure always has a way out.

Last but not least, it is important to design the building in such a way that the most diffusion-sealed layer is always closest to the building and that the outermost layers are diffusion-open to allow for drying out during the winter months. As a result of single-step sealed façades with sealed plastic insulation on wooden frameworks with internal plastic film, we know that moisture that penetrates but is unable to get out can cause great damage.

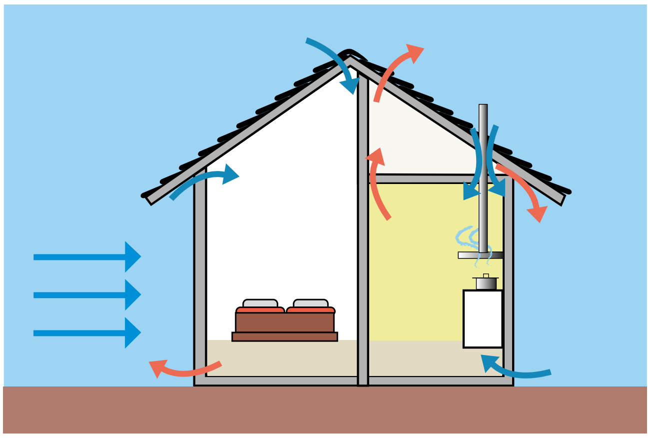


Illustration 6. Permeable house with poor control of airflow.

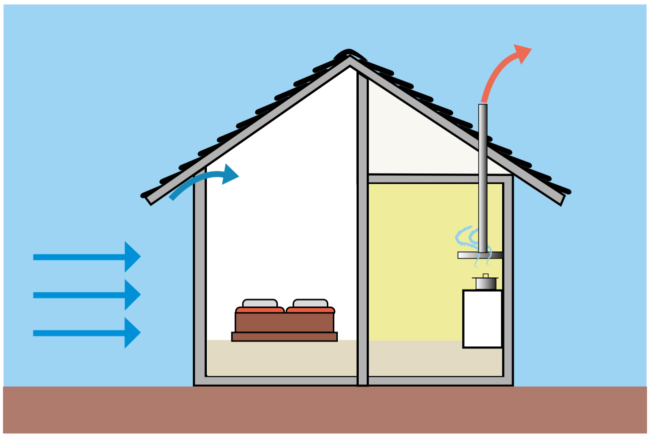
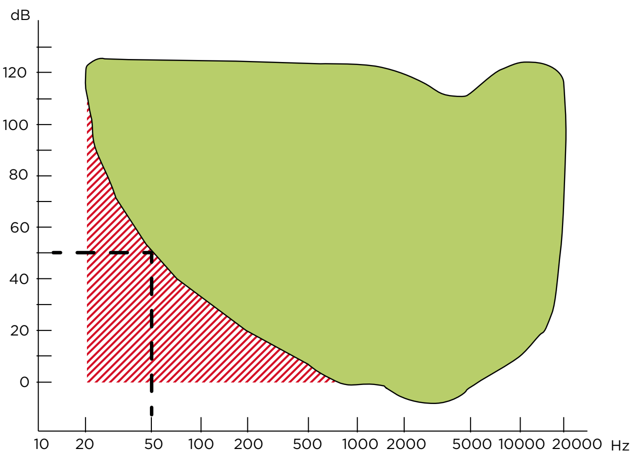


Illustration 7. Non-permeable house with control of airflow.

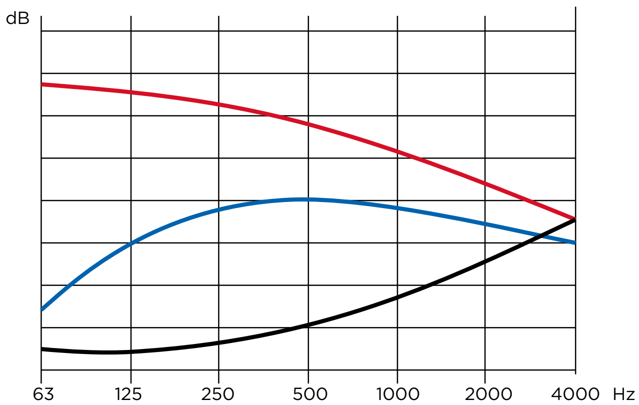
General information about acoustics

There are two parameters in particular that must be managed when it comes to building acoustics. Sound strength, measured in decibels (dB), and sound frequency, measured in hertz (Hz). Human hearing has some limitations and not all sounds are audible.



The green area shows the audible range for a young person. A teenager hears sounds from 20 Hz up to 20,000 Hz. The lower limit of the audible range is known as the hearing threshold. The hearing threshold varies depending on frequency. We hear sounds around 3,000 Hz at low levels while a sound of 50 Hz must have a strength of around 50 dB to be audible. As we get older, the hearing threshold changes, making it harder for us to hear high-frequency sounds. Crickets make high-frequency sounds and it is rare for older people to be able to hear crickets. Sounds below the hearing threshold (the dotted area) are not audible but they still affect us. Low-frequency sounds make us tired and it is therefore important to avoid such sounds indoors.

THERE ARE DIFFERENCES BETWEEN DIFFERENT SOURCES OF SOUND



The black line shows the sound level at various frequencies from the chirping of birds, the blue line shows a voice and the red shows an idling lorry.

Our hearing has adapted to listen for natural sounds such as the chirping of birds, gusts of wind from trees, rippling streams and human voices. Natural sounds include very few low-frequency sounds. Low-frequency sounds are not good for people and since we spend around 90% of our time indoors, it is important to ensure that such sounds do not occur in our buildings.

Since lorries generate a lot of low-frequency sounds, exterior walls should have proper sound insulation at low frequencies, so that the sounds do not enter the building. An office wall that must prevent a voice from passing through does not need to be as good for low frequencies. However, a wall between two apartment does require good sound insulation for low frequencies, as the neighbour may have an audio system with a powerful bass. Low-frequency sound is often generated when people walk on a floor. Joists therefore require good sound insulation for low frequencies.

The challenge associated with building acoustics is to protect people from low-frequency sounds.

BUILDING ACOUSTICS

1. External sounds – The building must prevent external sounds from entering the building.
2. Airborne sounds from other rooms – Voices and other airborne sounds must not spread to other rooms.
3. Footstep impact sound – If someone is walking on a floor, the sound should not be heard in other rooms.
4. Sounds from installations – Building installations such as lifts and ventilation systems should not interfere.
5. Room acoustics – The rooms must have the right kind of sound reflection to create good room acoustics.

1. SOUNDS FROM TRAFFIC AND OTHER SOUNDS OUTSIDE OF THE BUILDING

If the building is located near traffic routes or if there are other sources of sound nearby, it is important that the building envelope has adequate sound insulation so that outdoor sounds do not disturb the people in the building. Windows and supply air devices are often the "weak" link in a façade. Sound insulation for exterior walls is shown using R_w. R_w is a weighted single-digit value adapted for a reference curve. R_w+C is a weighted single-digit value adapted for "regular sounds" outside the building. R_w+C_{tr} is a weighted single-digit value adapted for traffic noise. The sound insulation of exterior walls is shown using R_w and R_w+C and R_w+C_{tr}.

2. AIRBORNE SOUND INSULATION

Airborne sound insulation is about preventing airborne sound such as voices and sounds from speakers from spreading to other rooms or apartments. Low-frequency sounds from bass speakers are often distracting. The challenge is to prevent low-frequency sounds from spreading in the building.

The need for sound insulation depends on the sources of sound in adjacent rooms, as well as the need for silence and freedom from interference. The table shows the correlation between the sounds from an activity, the building's sound insulation and the degree of interference. The table shows that a loud conversation can be heard if the sound insulation is 40 dB. If the sound insulation is increased to 48 dB, the loud conversation will no longer be audible.

The airborne sound insulation requirements in BBR are so-called field values and are designated as R'_w or $D_{nT,w}$. The field values are measured in the finished building and must not be confused with laboratory values. The sound insulation of the walls is shown using an R_w value. R_w is a laboratory value showing the sound insulation of the wall when this is measured in a laboratory.

$D_{nT,w}$ R'_w	Sorl	Normal conversation, office machinery in a quiet environment	Normal conversation, office machinery	Loud conversation	Screams	Speaker sounds, moderate level	Discos
35 dB							
40 dB							
44 dB							
48 dB							
52 dB							
60 dB							

The sound is audible

The sound is audible

The sound is not audible

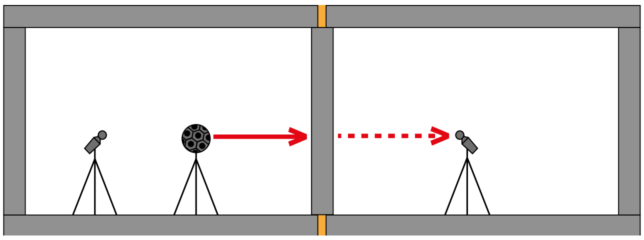


Illustration 1

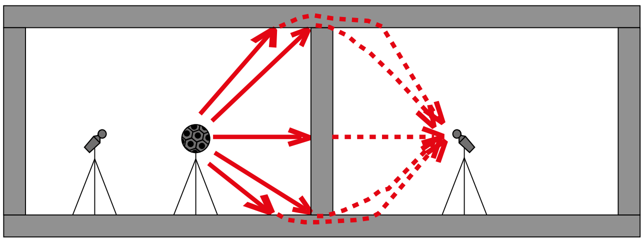


Illustration 2

Illustration 1 shows a sound insulation measurement of a wall in a laboratory. The framework in the laboratory has been "soundproofed" so that no sound can pass the wall via the framework. The R_w values show only how much sound passes through the wall.

Illustration 2 shows a measurement from a finished building, referred to as a field measurement. The field value is designated R'_w or $D_{nT,w}$ and is affected by flank transmissions and leakage as well as the wall sound insulation.

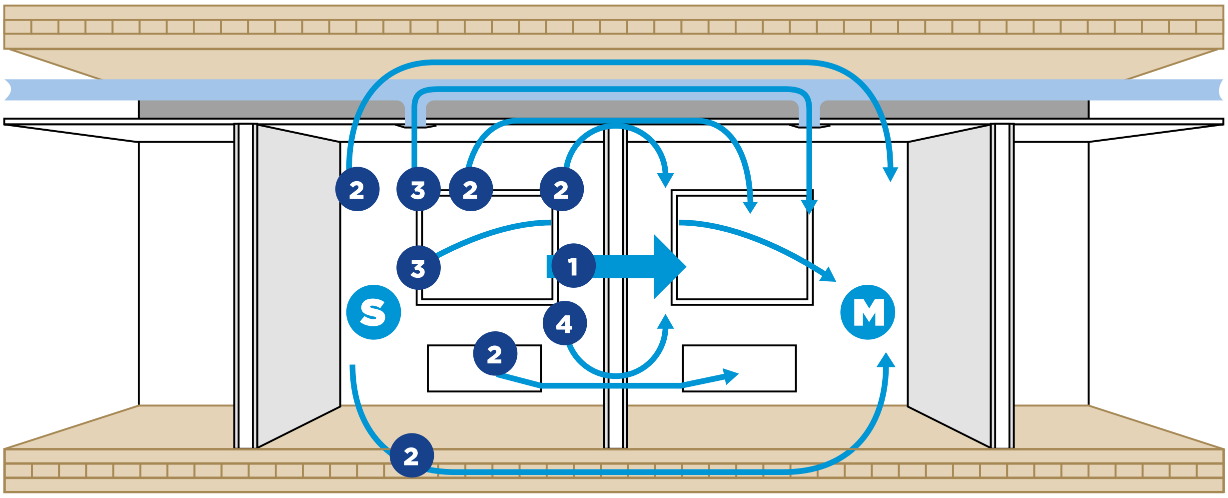
Flank transmissions are greater in a CLT framework than in a heavy concrete framework.

BBR sets out various requirements concerning airborne sound insulation depending on building type. The requirements for an office building are between 100 and 3150 Hz. The requirements for a residential property are between 50 and 3150 Hz. The sound requirements in BBR are field values. The requirements in BBR apply both horizontally and vertically.

The laboratory value of the partition walls is shown using R_w and $R_w+C_{50\text{-}3150}$. R_w shows only a weighted single digit value for the wall sound insulation between 100-3150 Hz. $R_w+C_{50\text{-}3150}$ shows a weighted single digit value for the wall sound insulation between 50 and 3150 Hz.

Because the requirements that apply between apartments are reduced to 50 Hz, it is important to look at the wall $R_w+C_{50\text{-}3150}$ value.

EXAMPLE OF HOW AIRBORNE SOUND CAN SPREAD BETWEEN TWO ROOMS



S – Sender room

R – Receiver room

Arrow 1 – shows sound transmission through the wall (affected by the wall's R_w value)

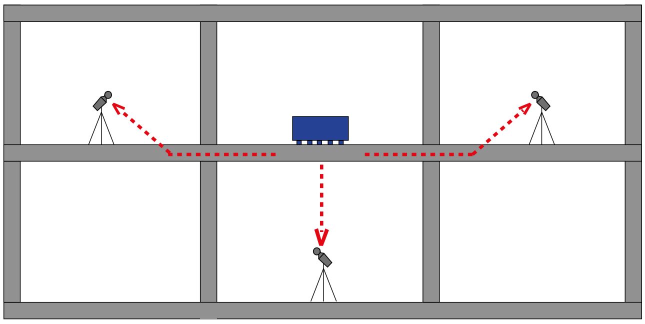
Arrow 2, 3 and 4 – show examples of other routes that the sound can take. These are examples of flank transmission, crosstalk and leakage.

Sounds are like water, anyone who has ever owned a wooden boat knows that the water always finds that tiny gap in the hull that makes the boat leak. In the same way, sound will find the gap that causes the sound insulation to deteriorate.

Airborne sound can spread both horizontally and vertically in a building.

3. FOOTSTEP IMPACT SOUND LEVEL

A sound is made when a person walks on a hard floor. If you are in an adjoining room and can hear someone walking on the floor, the sound is called footstep impact sound. A standardised impact device is used to measure footstep impact sound levels in a building. The impact device has five metal pistons that hit the floor to mimic the effect of a person walking on the floor. The impact device is placed on the floor in the sender room and the sound levels in the adjacent rooms are then measured. Footstep impact sound can spread both vertically and horizontally.



The illustration shows how footstep impact sounds from an impact device can spread in a building. If a low footstep impact sound level is measured in a room, the joists have high footstep impact sound insulation. The BBR requirement concerning footstep impact sound levels is a field value designated $L'_{nT,w}$.

BBR sets out various requirements concerning footstep impact sound levels depending on building type. In an office, footstep impact sound levels down to 100 Hz should be measured, while footstep impact sound levels down to 50 Hz should be measured for residential properties.

The need for a low footstep impact sound level depends on whether people walk, run or jump on the floor. Table 1 shows the correlation between the measured footstep impact sound level, footstep impact sound activity from the “sender room” and whether or not the sound is audible.

Table 1 shows that calm walking in heels is audible if the measured footstep impact sound level is 64 dB. If the measured footstep impact sound level of the joists is reduced to 52 dB, calm walking in heels will no longer be audible.

$L'_{nT,w}$	Calm walking in soft shoes	Calm walking in heels	Rapid walking/ running in soft shoes	Rapid walking/running in heels	Children playing/ jumping, “normal”	Children playing/ jumping, “advanced”	Gymnastics, heavy thuds, etc.
64 dB							
60 dB							
56 dB							
52 dB							
48 dB							
44 dB							
40 dB							

Table 1. “Heavy” joists

The sound is audible

The sound is audible

The sound is not audible

$L'_{nT,w}$	Calm walking in soft shoes	Calm walking in heels	Rapid walking/ running in soft shoes	Rapid walking/running in heels	Children playing/ jumping, “normal”	Children playing/ jumping, “advanced”	Gymnastics, heavy thuds, etc.
64 dB							
60 dB							
56 dB							
52 dB							
48 dB							
44 dB							
40 dB							

Table 2. “Lightweight” joists.

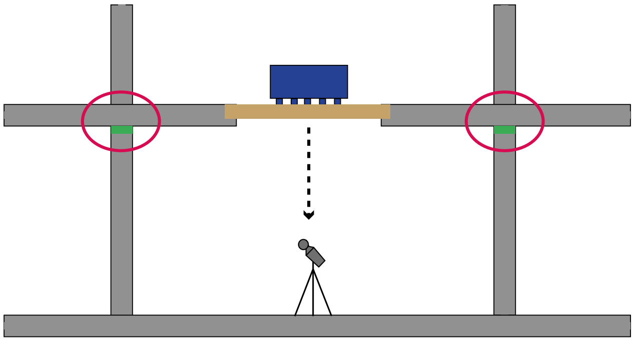
The sound is audible

The sound is audible

The sound is not audible

When it comes to footstep impact sound, there is a perceived difference between “heavy” and “lightweight” joists. See Table 1 and 2. This is because we normally measure footstep impact sound levels down to 50 Hz. The difference in perception is due to the fact that sounds below 50 Hz pass through “lightweight” CLT joists more easily than through “heavy” concrete joists. Since we hear sounds down to approximately 20 Hz, we experience more sound passing through the lightweight joists. If building condominiums with “lightweight” joists, it is advisable to inform future tenant-owners about the differences between the measured and perceived footstep impact sound level.

The requirement concerning footstep impact sound level in BBR is a field level and designated $L'_{nT,w}$. The field values are measured in the finished building and must not be confused with laboratory values. The insulation capacity of joists when it comes to footstep impact sound levels is designated $L_{n,w}$ and is measured at a sound laboratory.



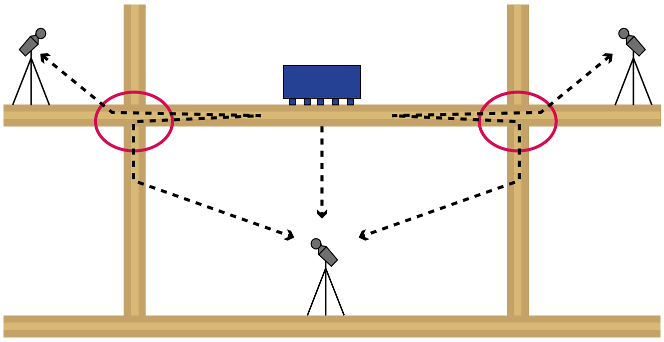


Illustration 1 shows a footstep impact sound measurement in joists at a laboratory. The framework in the laboratory has been "soundproofed" so that no sound can pass to the receiving room via the framework. The laboratory value for the joist is designated $L_{n,w}$ and shows only how much sound passes through the joists.

Illustration 2 shows a field measurement. The field value is designated $L'_{nT,w}$ and is affected by flank transmissions via the framework in addition to the footstep impact sound insulation in the joists. The panel points (highlighted in red in illustration 2) must be executed correctly to prevent footstep impact sound from spreading into adjacent rooms.

It can be very expensive to rectify incorrectly executed panel points at a later stage. Consult an experienced wooden house acoustician about how to execute panel points.

BBR sets out various requirements concerning footstep impact sound levels depending on building type. The requirements for an office building are from 100 Hz. The requirements for a residential property are between 50 and 2500 Hz. The sound requirements in BBR are field values.

4. SOUND FROM INSTALLATIONS

People are negatively affected by high sound levels from installations. Installations often emit low-frequency sounds that make people tired. Sound levels from installations must therefore be low, especially at low frequencies. BBR normally sets out two requirements concerning sound levels from installations, dBA and dBC. When measuring sound levels in dBA, a filter is used in the sound meter to filter out low-frequency sounds. When measuring sound levels in dBC, low-frequency sounds are not filtered out. A dBC measurement therefore reveals whether there are any low-frequency sounds in a room. It is therefore important to check sound levels in both dBA and dBC.

5. ROOM ACOUSTICS

When listening to a person speaking in a room, you can hear their voice and the sound reflexes of the room. Depending on activities in the room, there will be many or few reflexes. A choir singer wants lots of reflexes so that the song is strong and sonorous. A teacher wants the classroom to be more subdued so that students can understand what they are saying. In restaurants with a lot of sound reflexes, the sound levels become high as people raise their voices to be heard.

BBR sets out requirements concerning room acoustics using a measurement called reverberation time. Reverberation time is measured using a speaker that creates a sound level in the room (approximately 100 dB). The speaker is then turned off and measurements are taken to see how long it takes for the sound level to drop by 60 dB. This time is called reverberation time. The reverberation time is affected by the volume of the room and how much sound absorption there is in the room. The need for sound absorbents varies depending on what the room will be used for. Absorbents are classified in different absorption classes from A to E, with absorption class A absorbing most. It is important to use the right type of absorbents to create good room acoustics. The most common problem associated with room acoustics is that the room has too little absorption at low frequencies.

Fire safety

In order to prevent fire from occurring and spreading, proper knowledge about fire development and how different materials and building structures affect fire is required. The most important knowledge is the ability to distinguish between the two terms “fire reaction” and “fire resistance,” which easily demarcates the phases before and after flashover. Both are crucial for the development of fire but in different phases of fire development.

FIRE REACTION

During the first phase, from the time at which any material in the building is ignited until flashover, it is only the materials, building and interior materials that will affect the development of the fire. In this first phase, the most important criterion is to quickly evacuate the premises.

How the surface of the materials behaves in the event of fire, fire reaction, is therefore of central importance during this phase.

The BBR requirements concerning different surface layers or façades are specified using Euroclasses in accordance with European standards. Below are some examples of products that are in the best class, A1/A2-s1, d0, previously referred to as non-combustible materials.

Euroclass	Example
A1 / A2	Mineral wool, plasterboard, façade mortar, floor screed
B	Painted plasterboard
C	Plasterboard with paper wallpaper
D	Wood
E	–
F	–
NPD*	XPS/EPS, mineral wool with paper

* Performance not determined

BBR sets out requirements concerning fire protective cladding of surfaces, such as partition walls and suspended ceilings. For apartment buildings (BR1) of up to four floors, for example, minimum B-s1, d0 will apply and for partition walls, minimum C-s2, d0.

FIRE RESISTANCE

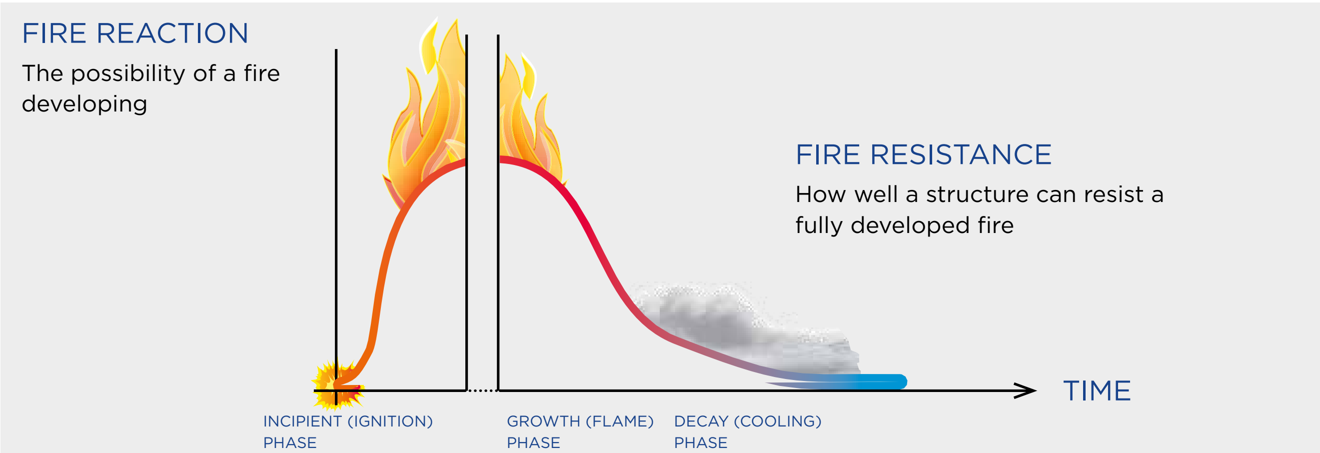
When it comes to the fire resistance of the structure, it does not help to look at the surface layer properties or temperature resistance of single products. Instead, it is about how the whole combination of materials works together in the different structures, walls, floors, ceilings, etc. Understanding how materials interact in a structure is extremely important when it comes to preventing the spread of fire. Since materials change form; some swell and increase in volume, while others shrink and combustible materials char when heated, it is important to look at the entire structure.

Fire resistance requirements are defined according to BBR based on the intended operations, evacuation requirements and the number of floors in the building. Applicable regulations and requirements can be found at www.boverket.se

FIRE SPREADING ALONG THE FAÇADE – SP FIRE 105

Exterior walls with façade materials that have a lower rating than class A2-s1, d0 at the lowest and thereby do not meet BBR’s general requirements for buildings in class BR1 can, as an alternative, be tested according to method SP Fire 105. Here, a room fire and how it spreads along the façade on the exterior walls is simulated.

Since 1994, the Swedish National Board of Housing, Building and Planning has developed building codes that allow for the construction of wooden buildings of more than two floors. Previously, this was not permitted due to fire requirements. Nowadays, wooden houses mostly have up to eight floors, but there are wooden houses designed for up to 19 floors in Sweden.



Supplement to BBR

VERIFICATION AND CERTIFICATION

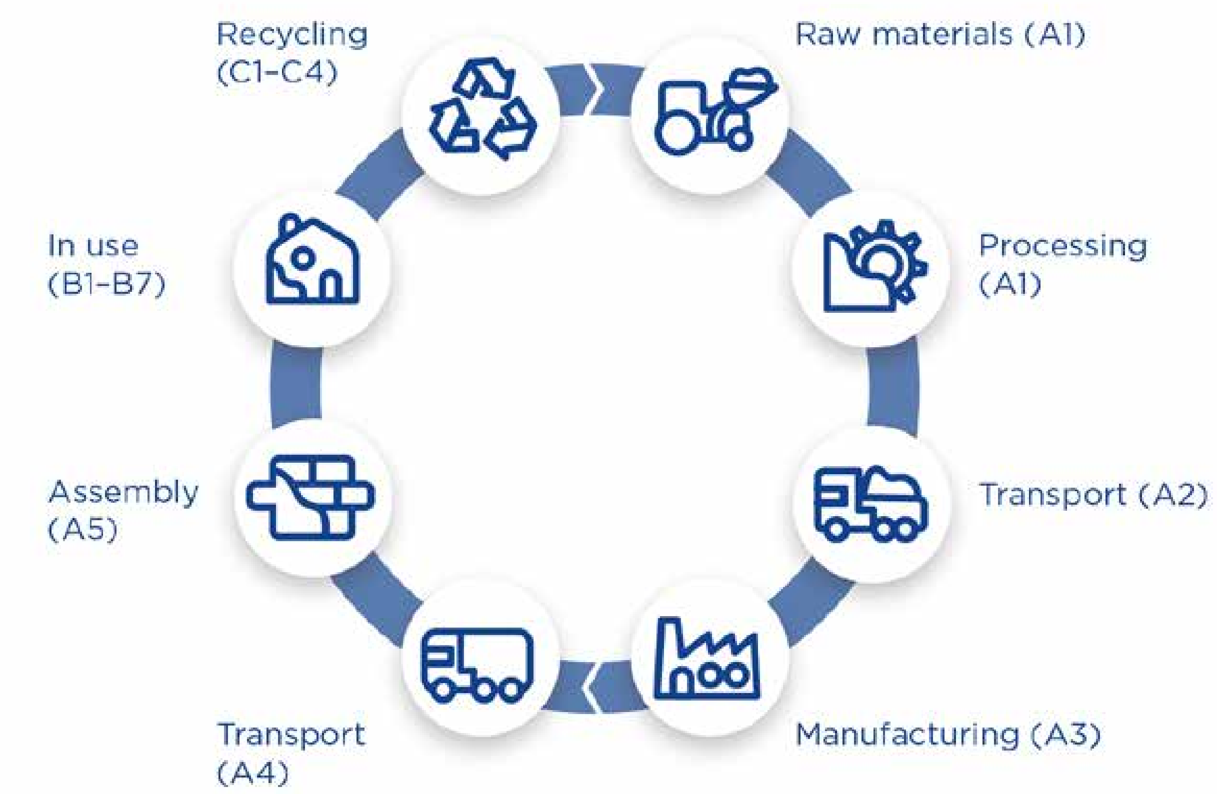
Products that will be used in structures in the Swedish market must meet the criteria concerning CE-marking and the requirements for e.g. fire protection set out in BBR. It is also important to ensure that solutions are installed in accordance with the design documentation. This to achieve the building's intended energy, sound and moisture performance and that fire safety, in terms of both fire resistance and fire spreading, is achieved.

In order to ensure that the finished building complies with the requirements set down in applicable regulations (BBR), the developer must ensure that this is verified at an early stage. How verification will be performed in the case in question must be determined in the control plan. Verification should take place after execution in accordance with the design documentation.

CLIMATE DECLARATION FOR BUILDINGS UNDER CONSTRUCTION

As previously mentioned, from 1 January 2022, the BBR will be supplemented to include requirements concerning climate declarations during the construction of buildings. Climate declarations will show the climate impact a building has during the actual construction phase and will be affected by the chosen building materials, transport to the workplace and the way in which the building is erected. It is highly probable that the construction phase (Phase A1-A5) will have to be taken into account and that the aspects that will have to be evaluated are load-bearing structural elements, climate envelope and partition walls.

LCA and EPD



Life Cycle Assessment (LCA) is a method for obtaining an overall impression of the overall environmental impact of a product's life cycle from raw material extraction through production processes and use to waste management, including all transport and all intermediate energy consumption.

The results of the LCA for each product are now most commonly reported using an Environmental Product Declaration (EPD). The development of an EPD follows international standards and this allows for several different reporting types. EPD = third-party verified LCA in accordance with international standards; EN 15804 and ISO 14025.

ENVIRONMENTAL PRODUCT DECLARATION (EPD) / LCA CALCULATIONS VERIFIED BY A THIRD PARTY

Since sustainability is a strategic priority for Saint-Gobain, we have developed LCA analyses in the form of EPDs for a multitude of products. EPDs are developed in accordance with an international standard (EN 15804) and allow for transparent information about a product and its impact on the environment/climate. Environmental product declarations are available for the following products in accordance with this standard:

Business unit/ Company	Product
Saint-Gobain	Silent wall – curtain wall (wooden stud)
	Silent wall – curtain wall (steel framework)
Dalapro	Dalapro Nova
	Dalapro Habito® Joint
	Dalapro Roll Nova, Lightning Nova, Airless Nova
	Dalapro Joint, Roll Joint, Lightning Joint
	Dalapro Premium, Roll Premium, Lightning Premium
	Dalapro Max PLUS, Roll Max PLUS, Lightning Max PLUS
	Dalapro Lightning Medium PLUS
	Habito® Joint Mix
	Dalapro S, Dalapro Airless S
	Gypfill X Ray Protection/Promix X Ray
Gyproc	Gyproc Normal (standard plasterboard)
	Gyproc ErgoLite® (lightweight board)
	Gyproc Habito®
	Glasroc H GHO 13 Ocean® – wetroom board
	Glasroc H Storm®
	webertherm 500
	10 mm Gyptone Activ'Air®
	12.5 mm Gyptone Activ'Air®
	Gyproc Floor plasterboard
	Gyproc Suspended ceiling board
	Gyproc Protect F Fire Board®
	Gyproc Wind Barrier – Sheathing Board
	Gyproc Renovation Board
	Gyproc X-Ray®
	Gyproc Aquaroc®
	Glasroc F Firecase®
	Glasroc F Multiboard®
	Gyproc GIS X-Ray Protection Board
	Steel profiles and accessories
ISOVER	Stud insulation, lambda 33
	Stud insulation, lambda 35
	Stud insulation, lambda 37
	ISOVER ROBUST Ceiling Panel
	ISOVER ROBUST TP (Ceiling Board)
ISOVER	InsulSafe®
	Cavity Wall Board 32 and Truss Board 32
	Façade Board 30
	Vario® Xtra (variable vapour barrier)
	ISOVER FireProtect®
	ISOVER Winter Mat
	ISOVER ULTIMATE
	PLUS+ Board 32
	Piano® Acoustic Board
	Piano® Sound Roller
	CLIMPIPE Section Alu2 (technical insulation)
	ISOVER Cleantec® G35
	ISOVER Cleantec® PLUS
Weber	weberfloor 110 fine
	weberfloor 120 reno DR
	weberfloor 130 core
	weberfloor 150 dura
	webertherm 342 façade mortar
	webertherm 340 substrate mortar / webertherm 343 base mortar
	weber multiglue
	weber rex fix
	weber basic fix
	weber rex light fix
	weber supra light fix
	weber supra rapid light fix
	weber flow fix
	weber flow rapid fix
	weber flex fix
	weber rock fix
	weber REP 65 repair mortar con
	weber shotcrete reduce 0-4
	weber REP 930 construction concrete 0-4
	weberfloor 140 nova
	weberfloor 4955 acoustic mat
	weberfloor 4040 combi rapid DR
	weberfloor 4610 industry top
	Glava footstep impact sound board 20 mm
Ecophon	Ecophon Advantage™
	Ecophon Akusto™ One
	Ecophon Akusto™ Wall
	Ecophon Extra Bass
	Ecophon Focus™
	Ecophon Gedina™
	Ecophon Hygiene™
	Ecophon Master™
	Ecophon Master™ Rigid
	EPD for Ecopho Solo™

Saint-Gobain solutions for construction using CLT

In the coming section, we describe a number of different solutions for each application and the associated performance from several aspects.

The information provided in this guide must be considered indicative for the early stage of the design process. Project-specific calculations are required for the final dimensioning. Our ambition for the coming section was to present solutions that meet or exceed the statutory requirements according to BBR.

Solutions are available for residential properties and premises in accordance with the following sketches. We have also included certain solutions for those cases where modules are constructed using CLT for intermediate joists and partition walls.

The results for each solution are presented for the entire structure with regard to

1. Fire resistance (and, if relevant, any approval for façade fire in accordance with SP Fire 105).
2. Sound reduction, specified as laboratory values.
3. U value (for structures linked to the climate envelope).
4. Carbon footprint (kg CO_2 equivalents/m² structural surface, emissions for phase A1-A3, the source list for which is available on our website).
5. Weight/m² structural surface.
6. Thickness of the entire structure in accordance with drawings.

For fire resistance, we use the term µfi, which is the "permissible capacity of the accidental limit state" in the development of fire. Limit state capacity is calculated as a percentage (%) and specifies the ratio between the CLT element capacity in the ultimate limit state and the impact in the event of accidental limit state.

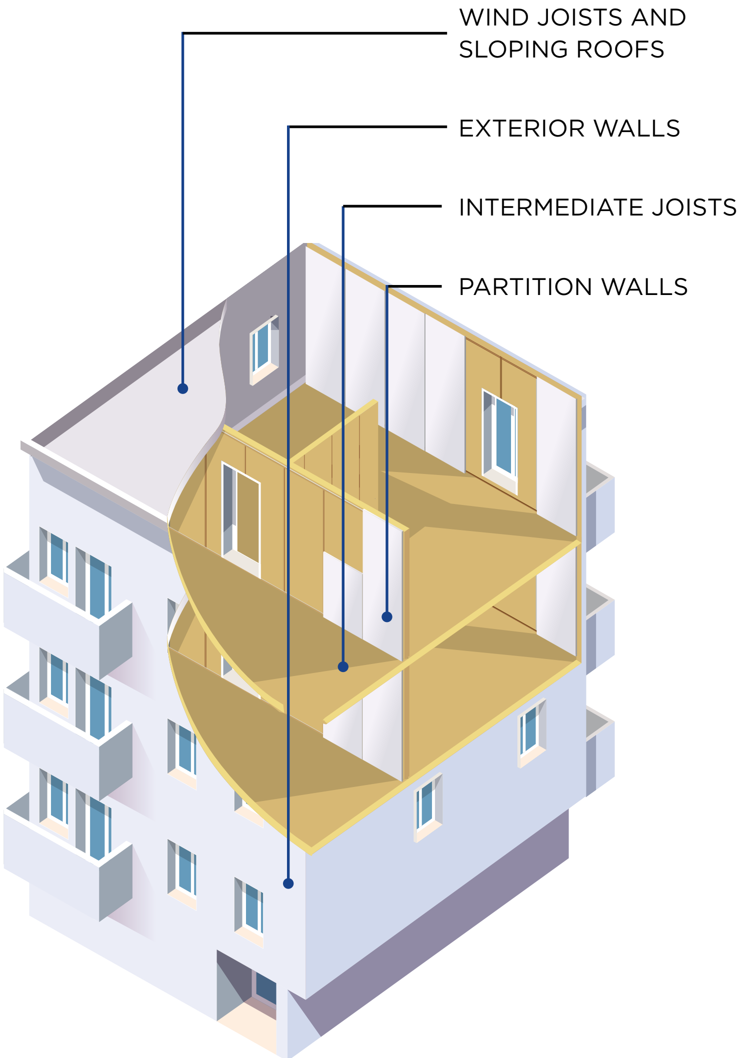
The assessment/calculation of µfi was performed by our fire consultant.

Example:

- If, for example, the CLT element has a maximum ultimate limit state capacity of 500 kN/m, 50% means that 50% capacity remains, i.e. 250 kN/m after the specified period of time (60 or 90 minutes).

The sound reduction value of each table comes from calculations, laboratory measurements at Lund University or from laboratory values in accordance with the information available in the Gyproc Manual.

With regard to "carbon footprint," calculations were made based on official third-party verified EPDs (module A1-A3) for each material used in the structure. If there is no EPD available for a specific product in the structure, EPDs from similar materials or LCA investigations from the producer have been used instead. For CLT, the mean values from Stora Ensos and Martinson's EPDs have been used without regard for biogenic content. Weight/m² structural surface has been calculated based on the thickness and density of each material.

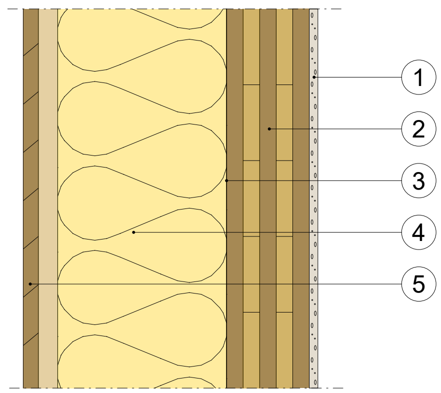


Exterior walls

Wooden façades on façade-bearing insulating systems

ISOVER PLUS+

Fire resistance [2] (inside and out)	REI	REI 60 (μfi=60%) REI 90 (μfi=40%)
Façade fire	SP Fire 105	Approved [1]



1. 12.5 mm Gyproc GNE 13 Normal
2. 120 mm CLT element
3. 0.2 mm ISOVER Vario® Xtra
4. 220 mm ISOVER PLUS+ Board 32 between
   245 mm ISOVER PLUS+ Stud 1
5. 22 mm Wooden façade Moelven Thermowood

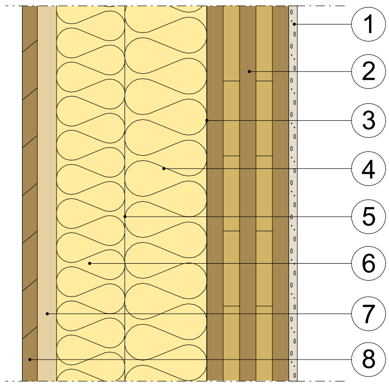
PERFORMANCE BASED ON THE SELECTED THICKNESS

Properties and definitions		Thickness (mm) ISOVER PLUS+ Board 32 / ISOVER PLUS+ Stud							
		120/145	145/145 [6]	170/195	195/195 [6]	220/245	245/245 [6]	265/290	290/290 [6]
Sound reduction	R_w	45 [3]	45 [3]	45 [3]	46 [3]	46 [3]	46 [3]	46 [3]	47 [3]
	R_wC	40 [3]	40 [3]	41 [3]	41 [3]	41 [3]	41 [3]	42 [3]	42 [3]
	R_w+C_{tr}	35 [3]	35 [3]	36 [3]	36 [3]	36 [3]	36 [3]	37 [3]	37 [3]
U-value	W/m^2K	0.22 [4] 0.22 [5]	0.19 [4] 0.19 [5]	0.17 [4] 0.17 [5]	0.15 [4] 0.15 [5]	0.14 [4] 0.14 [5]	0.12 [4] 0.12 [5]	0.12 [4] 0.12 [5]	0.11 [4] 0.11 [5]
Carbon footprint	kg CO_2 per m^2	15.7 [4] 15.0 [5]	16.5 [4] 15.8 [5]	16.9 [4] 16.1 [5]	17.9 [4] 17.1 [5]	18.7 [4] 17.7 [5]	19.5 [4] 18.5 [5]	20.4 [4] 19.1 [5]	21.1 [4] 19.9 [5]
Weight	kg/m^2	81 [4] 80 [5]	83 [4] 81 [5]	84 [4] 82 [5]	84 [4] 83 [5]	84 [4] 83 [5]	86 [4] 85 [5]	86 [4] 84 [5]	88 [4] 86 [5]
Structural thickness	mm	300	325	350	375	400	425	445	470

[1] Tested at Rise in accordance with SP Fire 105 with approved results and Moelven Thermowood – fire-impregnated wooden panel.
[2] Utilisation rate in accidental limit state relative to ultimate limit state. 5-layer CLT (20-40-20-40-20).
[3] In accordance with calculations.
[4] NB! centre distance 600. Calculation with ISOVER U-value calculator for ISOVER PLUS+ studs. Biogenic carbon not included in the carbon footprint calculation.
[5] NB! c 1000. Calculation with ISOVER U-value calculator for ISOVER PLUS+ studs. Biogenic carbon not included in the carbon footprint calculation.
[6] In the case of full insulation, nailing battens/ventilation battens must be placed on the ISOVER PLUS+ stud and this must be taken into account in the carbon footprint.

WOODEN LATCHING AND ISOVER FAÇADE BOARD 30

Fire resistance [1] (inside and out)	REI	REI 60 (µfi=60%) REI 90 (µfi=40%)



1. 12.5 mm — Gyproc GNE 13 Normal
2. 120 mm — CLT element
3. 0.2 mm — ISOVER Vario® Xtra
4. 120 mm — ISOVER Uni Board 35 between
   120 mm — Wooden stud
5. 0.4 mm — ISOVER Vempro wind barrier
6. 100 mm — ISOVER Façade board 300
7. 28 mm — nailing battens/ventilation battens
8. 22 mm — Wooden façade

PERFORMANCE BASED ON THE SELECTED THICKNESS

Properties and definitions		Thickness, studwork (mm) / Façade board 30 (mm)					
		120/50	120/80	120/100	145/50	145/80	145/100
Sound reduction	R_w	45 [2]	46 [2]	46 [2]	46 [2]	46 [2]	46 [2]
	R_wC	40 [2]	41 [2]	41 [2]	41 [2]	41 [2]	42 [2]
	R_w+C_{tr}	35 [2]	36 [2]	36 [2]	36 [2]	36 [2]	37 [2]
U-value	W/m²K	0.18 [3]	0.15 [3]	0.14 [3]	0.16 [3]	0.14 [3]	0.13 [3]
Carbon footprint	kg CO_2 per m²	17.4 [4]	18.7 [4]	19.6 [4]	18.0 [4]	19.3 [4]	20.2 [4]
Weight	kg/m²	88	89	91	90	91	93
Structural thick-ness	mm	350	380	400	375	405	425

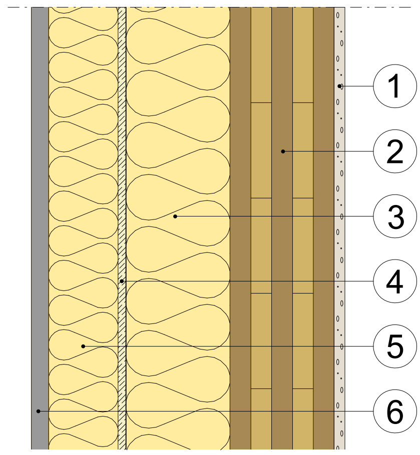
[1] Utilisation rate in accidental limit state relative to ultimate limit state. 5-layer CLT (20-40-20-40-20).
[2] In accordance with calculations.
[3] Calculation in accordance with the ISOVER U-value calculator.
[3, 4] Structure with wooden studs, centre distance 600.

Dual-step sealed and drained plaster façade

WEBER SERPOROC PREMIUM 32 AND WOODEN LATCHING

YV3

Fire resistance [1] (inside and out)	REI	REI 60 (µfi=60%) REI 90 (µfi=40%)



1. 12.5 mm Gyproc GNE 13 Normal
2. 120 mm CLT element
3. 120 mm ISOVER Uni Board 35 between 120 mm Wooden stud
4. 9.5 mm webertherm 500
5. 80 mm webertherm 371
6. 20 mm webertherm 340 substrate mortar, webertherm 323 mesh, webertherm 342 façade mortar

PERFORMANCE BASED ON THE SELECTED THICKNESS

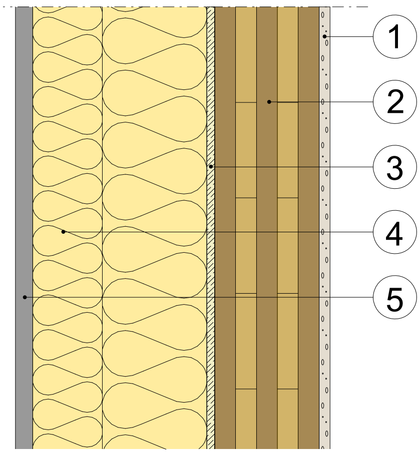
Properties and definitions			Thickness studwork, centre distance 600 (mm) / webertherm 371 Premium (mm)		
			120/100	145/80	145/100
	Sound reduction	R_w	56 [2]	56 [2]	56 [2]
		R_wC	54 [2]	54 [2]	54 [2]
		R_w+C_{tr}	50	50	50
	U-value	W/m^2K	0.14 [3]	0.14 [3]	0.13 [3]
	Carbon footprint	kg CO_2 per m^2	28.9	28.5	29.5
	Weight	kg/m^2	126	126	128
	Structural thickness	mm	381	386	406

[1] Utilisation rate in accidental limit state relative to ultimate limit state. 5-layer CLT (20-40-20-40-20).
[2] In accordance with calculations.
[3] Calculation in accordance with the ISOVER U-value calculator.

YV4

WEBER SERPOROC PREMIUM 32

Fire resistance [1] (inside and out)	REI	REI 60 (µfi=60%) REI 90 (µfi=40%)



1. 12.5 mm Gyproc GNE 13 Normal
2. 120 mm CLT element
3. 9.5 mm webertherm 500
4. 120+80 mm webertherm 371
5. 20 mm webertherm 340 substrate mortar
   webertherm 323 mesh
   webertherm 342 façade mortar

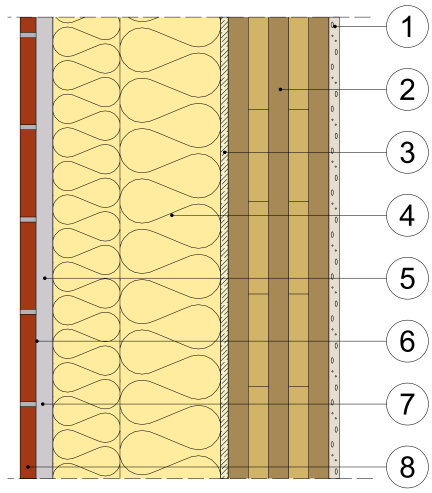
PERFORMANCE [2] BASED ON THE SELECTED THICKNESS

Properties and definitions			Thickness webertherm 371 (mm)			
			120	150	180	200
	Sound reduction	R_w	52 [3]	52 [3]	52 [3]	52 [3]
		R_wC	51 [3]	51 [3]	51 [3]	51 [3]
		R_w+C_{tr}	50	50	50	50
	U-value	W/m^2K	0.21 [4]	0.17 [4]	0.15 [4]	0.14 [4]
	Carbon footprint	kg CO_2 per m^2	26.9	28.4	30.0	31.0
	Weight	kg/m^2	118	120	122	123
	Structural thickness	mm	281	311	341	361

[1] Utilisation rate in accidental limit state relative to ultimate limit state. 5-layer CLT (20-40-20-40-20).
[2] The structure works for CLT with a thickness of 60-150 mm: min. 50 mm and max. 200 mm webertherm 371.
[3] In accordance with calculations.
[4] Calculation in accordance with the ISOVER U-value calculator.

WEBER SERPOROC PREMIUM 32 AND WEBER DESIGN BRICKS

Fire resistance [1] (inside and out)	REI	REI 60 (µfi=60%) REI 90 (µfi=40%)



1. 12.5 mm Gyproc GNE 13 Normal
2. 120 mm CLT element
3. 9.5 mm webertherm 500
4. 120+80 mm webertherm 371
5. 20 mm webertherm 344
6. 3 mm weber flex fix
7. – weber coloured masonry mortar M2.5
8. 14 mm weber design bricks

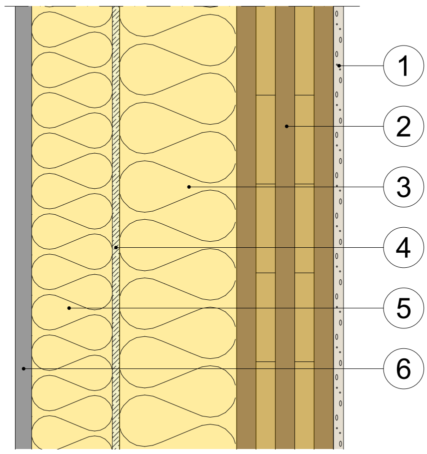
PERFORMANCE [4] BASED ON THE SELECTED THICKNESS

Properties and definitions		Thickness webertherm 371 (mm)			
		120	150	180	200
Sound reduction	R_w	54 [2]	54 [2]	54 [2]	54 [2]
	R_wC	53 [2]	53 [2]	53 [2]	53 [2]
	R_w+C_{tr}	52	52	52	52
U-value	W/m²K	0.21 [3]	0.17 [3]	0.15 [3]	0.14 [3]
Carbon footprint	kg CO_2 per m²	35	36	38	39
Weight	kg/m²	151	153	155	157
Structural thickness	mm	302	332	362	382

[1] Utilisation rate in accidental limit state relative to ultimate limit state. 5-layer CLT (20-40-20-40-20).
[2] In accordance with calculation from LTH.
[3] Calculation in accordance with the ISOVER U-value calculator.
[4] The structure works for CLT with a thickness of 60-150 mm: min. 50 mm and max. 200 mm webertherm 371.

WEBER SERPOROC PREMIUM 32 AND ISOVER PLUS^{+}

Fire resistance [1] (inside and out)	REI	REI 60 (µfi=60%) REI 90 (µfi=40%)



1. 12.5 mm Gyproc GNE 13 Normal
2. 120 mm CLT element
3. 145 mm ISOVER PLUS^{+} board 32 between 145 mm ISOVER PLUS^{+} stud 1
4. 9.5 mm webertherm 500
5. 100 mm webertherm 371
6. 20 mm webertherm 340 substrate mortar webertherm 323 mesh webertherm 342 façade mortar

PERFORMANCE BASED ON THE SELECTED THICKNESS

Properties and definitions			Thickness ISOVER PLUS^{+} (mm) / Thickness webertherm 371 (mm)							
			145/80	145/100	195/50	195/80	195/100	245/50	245/80	245/100
	Sound reduction	R_w	56 [2]	56 [2]	56 [2]	56 [2]	56 [2]	56 [2]	56 [2]	56 [2]
		R_wC	54 [2]	54 [2]	54 [2]	54 [2]	54 [2]	54 [2]	54 [2]	54 [2]
		R_w+C_{tr}	50 [2]	50 [2]	50 [2]	50 [2]	50 [2]	50 [2]	50 [2]	50 [2]
	U-value	W/m^2K	0.13 [3]	0.12 [3]	0.13 [3]	0.11 [3]	0.10 [3]	0.11 [3]	0.10 [3]	0.09 [3]
	Carbon footprint	kg CO_2 per m^2	29.8 [3]	30.8 [3]	29.7 [3]	31.2 [3]	32.2 [3]	31.2 [3]	32.8 [3]	33.8 [3]
	Weight	kg/m^2	122	124	122	124	126	124	126	127
	Structural thick-ness	mm	387	407	397	437	457	457	487	507

[1] Utilisation rate in accidental limit state relative to ultimate limit state. 5-layer CLT (20-40-20-40-20).

[2] In accordance with calculations.

[3] Calculation in accordance with the ISOVER U-value calculator with ISOVER PLUS^{+} studs, centre distance 600. Biogenic carbon not included in the carbon footprint calculation.

YT2

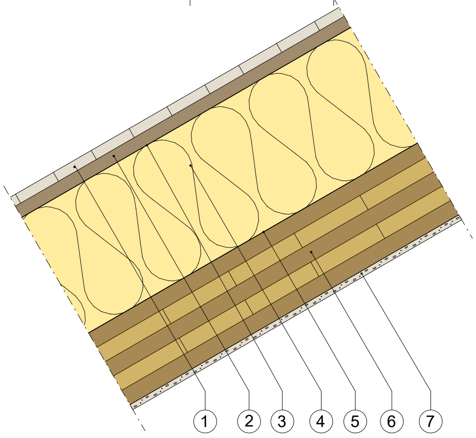
Roofs and wind joists

Sloping roofs

Ventilated sloping roof with diffusion-open suspended ceiling and load-bearing insulation system

ISOVER PLUS+

Fire resistance (inside and out)	REI CLT180 (5 layers)	REI 90 Load 6 kN/m² at a span width of 5 metres



1. 20 mm Tongue-in-groove board
2. 28 mm Ventilated air gap built on wooden lath
3. 0.4 mm ISOVER Vempro® underlay
4. 290 mm ISOVER PLUS+ Board 32 between
   290 mm ISOVER PLUS+ Stud 1
   (centre distance 1000)
5. 0.1 mm ISOVER Vario® Xtra
6. 180 mm CLT element
7. 12.5 mm Gyproc GNE 13 Normal

PERFORMANCE BASED ON THE SELECTED THICKNESS

Properties and definitions		Thickness, ISOVER PLUS+ / Board 32 (mm)			
		145/145	195/195	245/245	290/290
U-value	W/m²K	0.17 [1]	0.14 [1]	0.12 [1]	0.10 [1]
Carbon footprint	kg CO_2 per m²	19.4 [2]	20.7 [2]	22.1 [2]	23.5 [2]
Weight	kg/m²	106	108	109	111
Structural thickness	mm	386	436	486	531

[1] Calculation in accordance with the ISOVER U-value calculator with ISOVER PLUS+ studs, centre distance 1000 mm.

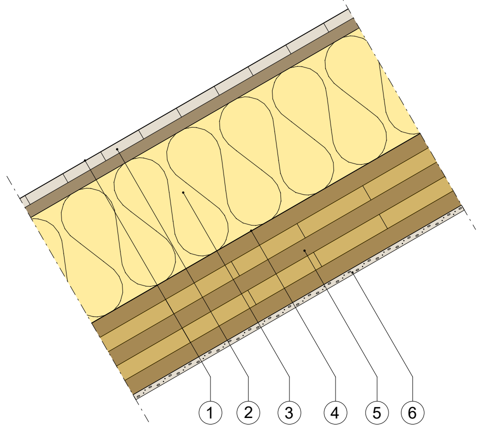
[2] Calculation with ISOVER U-value calculator for ISOVER PLUS+ studs. Biogenic carbon not included in the carbon footprint calculation.

Ventilated sloping roof on load-bearing insulation systems

YT2A

ISOVER PLUS+

Fire resistance (inside and out)	REI CLT180 (5 layers)	REI 90 Load 6 kN/m² at a span width of 5 metres



1. 2 mm Roof covering/roofing felt
2. 20 mm Tongue-in-groove board
3. 290 mm
   120+145 mm ISOVER PLUS+ Board 32 between
   290 mm ISOVER PLUS+ Stud 1 (centre distance 1000)
4. 0.1 mm ISOVER Vario® Xtra
5. 180 mm CLT element
6. 12.5 mm Gyproc GNE 13 Normal

PERFORMANCE BASED ON THE SELECTED THICKNESS

Properties and definitions			Thickness, ISOVER PLUS+ / Board 32 (mm)			
			120/145	170/195	220/245	265/290
	U-value	W/m²K	0.19 [1]	0.15 [1]	0.13 [1]	0.11 [1]
	Carbon footprint	kg CO_2 per m²	20 [2]	21 [2]	23 [2]	24 [2]
	Weight	kg/m²	104	106	108	109
	Structural thick-ness	mm	358	408	458	503

[1] Calculation in accordance with the ISOVER U-value calculator with ISOVER PLUS+ studs, centre distance 1000 mm.

[2] Calculation with ISOVER U-value calculator for ISOVER PLUS+ studs. Biogenic carbon not included in the carbon footprint calculation.

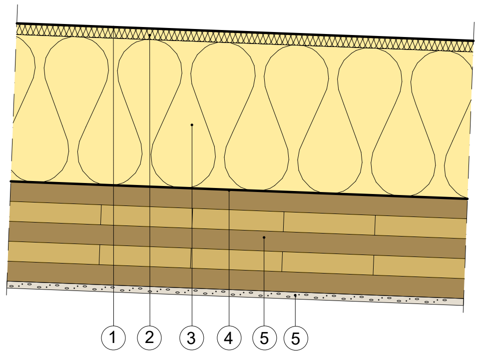
Low-pitched roofs

Exterior insulation for low-pitched roofs

YT3

ISOVER ROBUST CEILING PANEL

Fire resistance (inside and out)	REI CLT180 (5 layers)	REI 90 Load 6 kN/m² at a span width of 5 metres



1. 6 mm Waterproofing
2. 20 mm ISOVER ROBUST Ceiling Board
3. 380 mm ISOVER ROBUST Ceiling Panel
4. 2 mm Underlay felt
5. 180 mm CLT element
6. 12.5 mm Gyproc GNE 13 Normal

PERFORMANCE BASED ON THE SELECTED THICKNESS

Properties and definitions		**Thickness (mm) ISOVER ROBUST Ceiling Board / ROBUST Ceiling Board**								
		180/20	200/20	220/20	250/20	280/20	300/20	330/20	350/20	380/20
U-value	W/m²K	0.15 [1]	0.14 [1]	0.13 [1]	0.12 [1]	0.11 [1]	0.10 [1]	0.10 [1]	0.09 [1]	0.08 [1]
Carbon footprint	kg CO_2 per m²	34	35	36	38	40	41	43	44	46
Weight	kg/m²	113	114	115	116	118	119	120	121	123
Structural thick-ness	mm	401	421	441	471	501	521	551	571	601

[1] Calculation in accordance with the ISOVER U-value calculator.

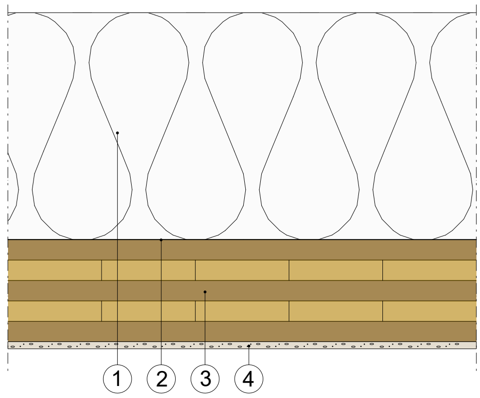
Open wind joists

Loose wool installation on CLT wind joists

YT1

INSULSAFE®

Fire resistance (bottom to top)	REI CLT180 (5 layers)	REI 60 [2] Load 6 kN/m² at a span width of 5 metres



1. 400 mm ISOVER InsulSafe®
2. 0.2 mm ISOVER Vario® Xtra
3. 120 mm CLT element
4. 15.4 mm Gyproc GFE 15 Protect F®

PERFORMANCE BASED ON THE SELECTED THICKNESS

Properties and definitions			Thickness, InsulSafe Wind (mm)				
			300	350	400	450	500
	U-value	W/m²K	0.13 [1]	0.12 [1]	0.10 [1]	0.09 [1]	0.08 [1]
	Carbon footprint	kg CO_2 per m²	15.1	15.9	16.6	17.4	18.1
	Weight	kg/m²	71	72	73	73	74
	Structural thick-ness	mm	435	485	535	585	635

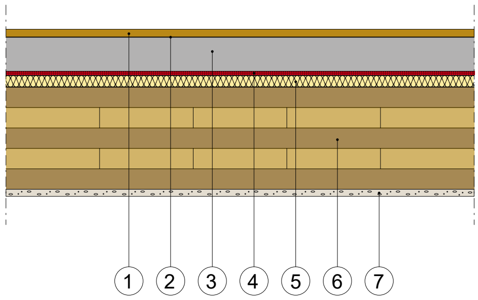
[1] Calculation in accordance with the ISOVER U-value calculator with ISOVER PLUS⁺ studs, centre distance 1000 mm.
[2] REI30 with Gyproc GNE 13 Normal.

Intermediate joists

MBL3A

SAINT-GOBAIN SILENT FLOOR®
WEBER FLOOR SCREED, APROBO DECIBEL AND SAINT-GOBAIN GLASS WOOL

Fire resistance (bottom to top)	REI CLT180 (5 layers)	REI 90 Load 6 kN/m² at a span width of 5 metres



1. 14 mm Parquet
2. 2 mm Foam
3. 60 mm weberfloor 150 dura
4. 12 mm Aprobo Decibel 4
5. 20 mm Glava footstep impact sound board
6. 180 mm CLT element
7. 12.5 mm Gyproc GNE 13 Normal

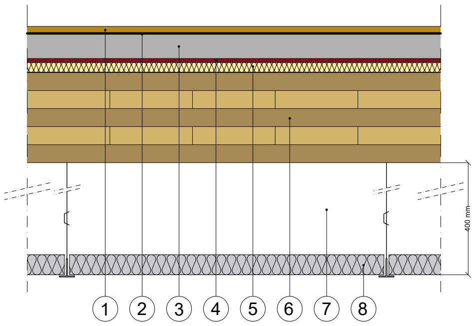
Properties and definitions			
	Sound reduction		
	Footstep impact sound	$L_{n,w}$ (dB)	54 [1]
		$L_{n,w}+C_{I,50\text{-}2500}$ (dB)	58 [1]
	Airborne sound	R_w (dB)	54 [1]
		$R_w+C_{50\text{-}3150}$ (dB)	52 [1]
	Carbon footprint	kg CO_2 per m²	34
	Weight	kg/m²	234
	Structural thick-ness	mm	301

[1] Laboratory value, without underlying plasterboard installed.

MBL5A

SAINT-GOBAIN SILENT FLOOR® WEBER FLOOR SCREED, APROBO DECIBEL 4, SAINT-GOBAIN GLASS WOOL AND ECOPHON MASTER A

Fire resistance (bottom to top)	REI CLT180 (5 layers)	REI 90 Load 6 kN/m² at a span width of 5 metres



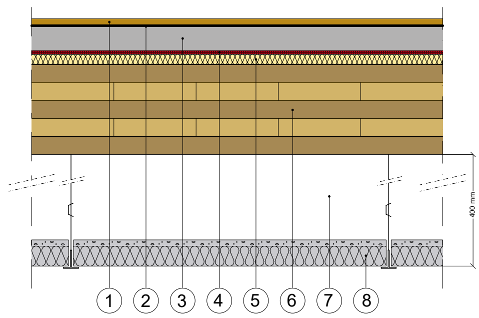
1. 14 mm Parquet
2. 2 mm Foam
3. 30–60 mm weberfloor 150 dura
4. 12 mm Aprobo Decibel 4
5. 20 mm Glava footstep impact sound board
6. 180 mm CLT element
7. 360 mm Air gap
8. 40 mm Ecophon Master™ A

Properties and definitions				
	Thickness, weber-floor	mm	30	60
	Sound reduction			
	Footstep impact sound	$L_{n,w}$ (dB)	51 [1]	47 [1]
		$L_{n,w}+C_{I,50-2500}$ (dB)	57 [1]	55 [1]
	Airborne sound	R_w (dB)	59 [1]	60 [1]
		$R_w+C_{50-3150}$ (dB)	56 [1]	57 [1]
	Carbon footprint	kg CO_2 per m²	38 [2]	45 [2]
	Weight	kg/m²	167	232
	Structural thick-ness	mm	658	688
Sound absorption class		A		

[1] Laboratory value.
[2] Estimation based on EPDs with similar content.

SAINT-GOBAIN SILENT FLOOR® WEBER FLOOR SCREED, APROBO DECIBEL 4, SAINT-GOBAIN GLASS WOOL AND ECOPHON COMBISON DUO A

Fire resistance (bottom to top)	REI CLT180 (5 layers)	REI 90 Load 6 kN/m² at a span width of 5 metres



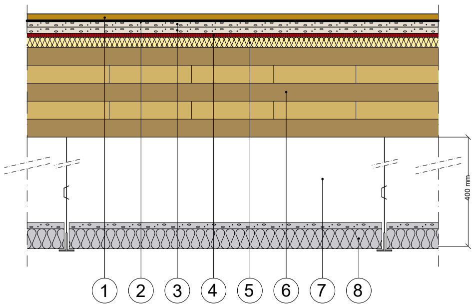
1. 14 mm Parquet
2. 2 mm Foam
3. 30–60 mm weberfloor 150 dura
4. 12 mm Aprobo Decibel 4
5. 20 mm Glava footstep impact sound board
6. 180 mm CLT element
7. 345 mm Air gap
8. 55 mm Ecophon Combison™ DUO A

Properties and definitions				
	Thickness, weber-floor	mm	30	60
	Sound reduction			
	Footstep impact sound	$L_{n,w}$ (dB)	47 [1]	44 [1]
		$L_{n,w}+C_{I,50-2500}$ (dB)	54 [1]	50 [1]
	Airborne sound	R_w (dB)	62 [1]	63 [1]
		$R_w+C_{50-3150}$ (dB)	57 [1]	59 [1]
	Carbon footprint	kg CO_2 per m²	40 [2]	48 [2]
	Weight	kg/m²	176	241
	Structural thick-ness	mm	658	688
Sound absorption class			A	

[1] Laboratory value.
[2] Estimation based on EPDs with similar content.

SAINT-GOBAIN SILENT FLOOR® GYPROC FLOOR PLASTERBOARD, APROBO DECIBEL 4, SAINT-GOBAIN GLASS WOOL AND ECOPHON COMBISON DUO A

Fire resistance (bottom to top)	REI CLT180 (5 layers)	REI 90 Load 6 kN/m² at a span width of 5 metres



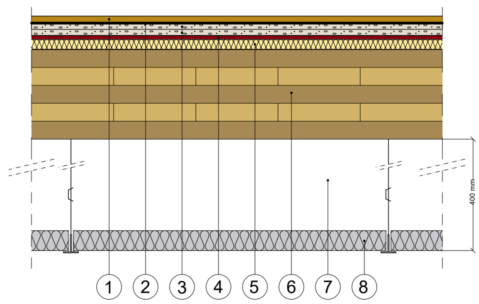
1. 14 mm Parquet
2. 2 mm Foam
3. 2x12.5 mm Gyproc GG 13 Floor plasterboard
4. 12 mm Aprobo Decibel 4
5. 20 mm Glava footstep impact sound board
6. 180 mm CLT element
7. 345 mm Air gap
8. 55 mm Ecophon Combison™ DUO A

Properties and definitions				
	Number of GG on top		1	2
	Sound reduction			
	Footstep impact sound	$L_{n,w}$ (dB)	50 [3]	48 [1]
	Footstep impact sound	$L_{n,w}+C_{I,50-2500}$ (dB)	57 [3]	54 [1]
	Airborne sound	R_w (dB)	60 [3]	62 [1]
	Airborne sound	$R_w+C_{50-3150}$ (dB)	52 [3]	56 [1]
	Carbon footprint	kg CO_2 per m²	37 [2]	41 [2]
	Weight	kg/m²	126	140
	Structural thickness	mm	640	653
Sound absorption class			A	

[1] Laboratory value.
[2] Estimation based on EPDs with similar content.
[3] Calculated value.

SAINT-GOBAIN SILENT FLOOR® GYPROC FLOOR PLASTERBOARD, APROBO DECIBEL 4, SAINT-GOBAIN GLASS WOOL AND ECOPHON MASTER A

Fire resistance (bottom to top)	REI	REI 90
	CLT180 (5 layers)	Load 6 kN/m² at a span width of 5 metres



1. 14 mm Parquet
2. 2 mm Foam
3. 2x12.5 mm Gyproc GG 13 Floor plasterboard
4. 12 mm Aprobo Decibel 4
5. 20 mm Glava footstep impact sound board
6. 180 mm CLT element
7. 360 mm Air gap Suspended ceiling
8. 40 mm Ecophon Master™ A

Properties and definitions				
	Number of GG on top		1	2
	Sound reduction			
	Footstep impact sound	$L_{n,w}$ (dB)	54 [3]	52 [1]
		$L_{n,w}+C_{I,50-2500}$ (dB)	60 [3]	57 [1]
	Airborne sound	R_w (dB)	56 [3]	58 [1]
		$R_w+C_{50-3150}$ (dB)	49 [3]	53 [1]
	Carbon footprint	kg CO_2 per m²	35 [2]	39 [2]
	Weight	kg/m²	117	131
	Structural thickness	mm	640	653
Sound absorption class			A	

[1] Laboratory value.
[2] Estimation based on EPDs with similar content.
[3] Calculated value.

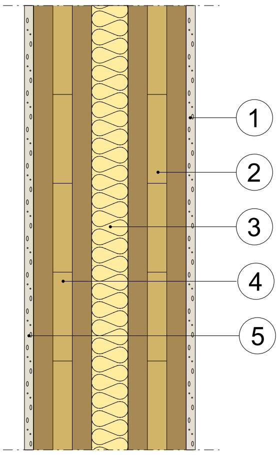
Partition walls

Apartment partitioning

IV1

GYPROC GNE AND ISOVER CAVITY WALL BOARD CLT 80 MM

Fire resistance & load utilisation	REI / µfi (%) (3 layers)	REI 60 / µfi 10% [2]



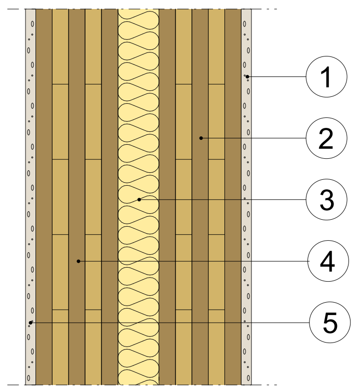
1. 12.5 mm Gyproc GNE 13 Normal
2. 80 mm CLT element
3. 50 mm ISOVER Cavity Wall Board 32
4. 80 mm CLT element
5. 12.5 mm Gyproc GNE 13 Normal

Properties and definitions		
Sound reduction	R_w (dB)	64 [1]
	$R_w+C_{50\text{-}3150}$ (dB)	57 [1]
Carbon footprint	kg CO_2 per m²	15
Weight	kg/m²	91
Structural thick-ness	mm	235

[1] Calculated value.
[2] REI 60 / µfi 60% can be achieved using Gyproc GNE 13 Normal.

GYPROC GFE AND ISOVER CAVITY WALL BOARD CLT 100 MM

Fire resistance & load utilisation	REI / µfi (%) (3 layers)	REI 60 / µfi 60%



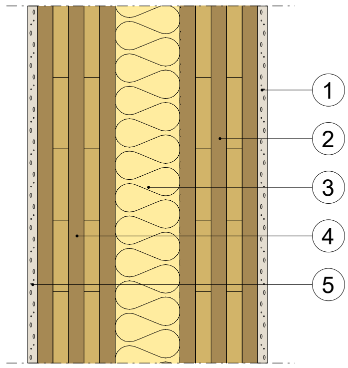
1. 15.4 mm Gyproc GFE 15 Protect F®
2. 100 mm CLT element
3. 100 mm ISOVER Cavity Wall Board 32
4. 100 mm CLT element
5. 15.4 mm Gyproc GFE 15 Protect F®

Properties and definitions			
Sound reduction	R_w (dB)	67 [1]
	$R_w+C_{50\text{-}3150}$ (dB)	64 [1]
Carbon footprint	kg CO_2 per m^2	20
Weight	kg/m^2	118
Structural thickness	mm	330

[1] Calculated value.

GYPROC GFE AND ISOVER CAVITY WALL BOARD CLT 120 MM

Fire resistance & load utilisation	REI / µfi (%)	**3-layer CLT:** REI 60/µfi=60% REI 90 /µfi=10% **5-layer CL timber[2]:** REI 60/µfi=40% REI 90/µfi=30%



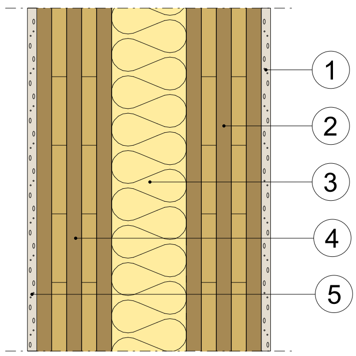
1. 15.4 mm Gyproc GFE 15 Protect F®
2. 120 mm CLT element
3. 100 mm ISOVER Cavity Wall Board 32
4. 120 mm CLT element
5. 15.4 mm Gyproc GFE 15 Protect F®

Properties and definitions			
Sound reduction	R_w (dB)	70 [1]
	$R_w+C_{50\text{-}3150}$ (dB)	67 [1]
Carbon footprint	kg CO_2 per m²	22
Weight	kg/m²	135
Structural thickness	mm	370

[1] Calculated value.
[2] CLT (20-30-20-30-20).

GYPROC GNE AND ISOVER CAVITY WALL BOARD CLT 100 MM

Fire resistance & load utilisation	REI / µfi (%)	**5 layers:** REI 60 /µfi=50%



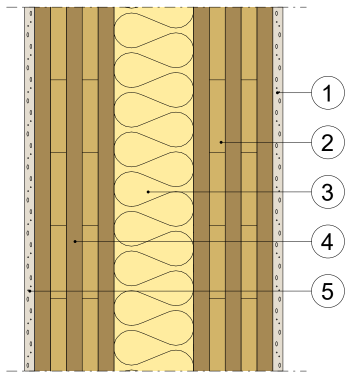
1. 12.5 mm Gyproc GNE 13 Normal
2. 100 mm CLT element
3. 100 mm ISOVER Cavity Wall Board 32
4. 100 mm CLT element
5. 12.5 mm Gyproc GNE 13 Normal

Properties and definitions		
Sound reduction	R_w (dB)	65 [1]
	$R_w+C_{50-3150}$ (dB)	63 [1]
Carbon footprint	kg CO_2 per m²	18
Weight	kg/m²	110
Structural thickness	mm	326

[1] Calculated value.

GYPROC GNE AND ISOVER CAVITY WALL BOARD CLT 120 MM

Fire resistance & load utilisation	REI / µfi (%)	**5 layers [2]:** REI 60/µfi=60% REI 90/µfi=40%



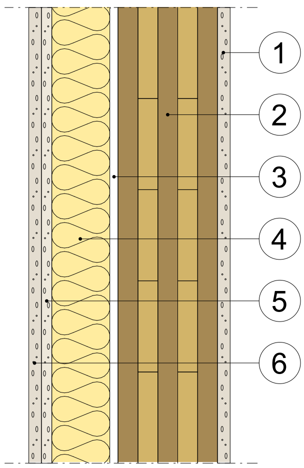
1. 12.5 mm Gyproc GNE 13 Normal
2. 120 mm CLT element
3. 120 mm ISOVER Cavity Wall Board 32
4. 120 mm CLT element
5. 12.5 mm Gyproc GNE 13 Normal

Properties and definitions			
Sound reduction	R_w (dB)	70 [1]
	$R_w+C_{50-3150}$ (dB)	67 [1]
Carbon footprint	kg CO_2 per m²	21
Weight	kg/m²	129
Structural thick-ness	mm	386

[1] Calculated value.
[2] CLT (20-30-20-30-20).

GYPROC GFE, GYPROC GHE, GYPROC ER WITH ISOVER PIANO CLT 120 MM

Fire resistance & load utilisation	REI / µfi (%)	**3 layers:** REI 60 (µfi=60%) / REI 60 (µfi=60%) REI 90 (µfi=10%) / REI 90 (µfi=60%) **5 layers [2]:** **REI 60 (µfi=60%) / REI 60 (µfi=60%)** REI 90 (µfi=30%) / REI 90 (µfi=40%)



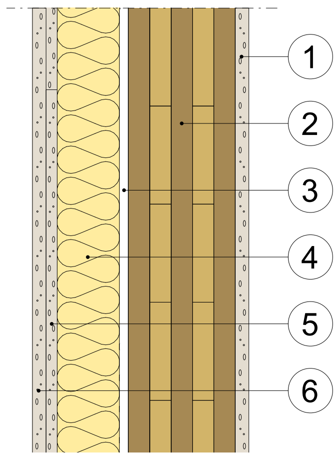
1. 15.4 mm Gyproc GFE 15 Protect F®
2. 120 mm CLT element
3. ≥10 mm Air gap
4. 70 mm Gyproc ER 70 with
   70 mm ISOVER Piano® Sound Board, centre distance 450
5. 12.5 mm Gyproc GHE 13 Habito®
6. 15.4 mm Gyproc GFE 15 Protect F®

Properties and definitions			
Sound reduction	R_w (dB)	68 [1]
	$R_w+C_{50-3150}$ (dB)	58 [1]
Carbon footprint	kg CO_2 per m²	21
Weight	kg/m²	94
Structural thickness	mm	243

[1] Calculated value.
[2] CLT (20-30-20-30-20).

GYPROC GFE, GYPROC GNE, GYPROC ER WITH ISOVER PIANO CLT 120 MM

Fire resistance & load utilisation	REI / μfi (%)	**3 layers:** REI 60 (μfi=60%) / REI 60 (μfi=60%) REI 90 (μfi=10%) / REI 90 (μfi=10%) **5 layers [2]:** REI 60 (μfi=60%) / REI 60 (μfi=60%) REI 90 (μfi=30%) / REI 90 (μfi=40%)



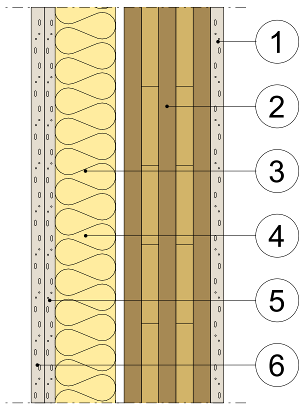
1. 15.4 mm Gyproc GFE 15 Protect F®
2. 120 mm CLT element
3. ≥10 mm Air gap
4. 70 mm Gyproc ER 70 with
   70 mm ISOVER Piano® Sound Board, centre distance 450
5. 12.5 mm Gyproc GNE 13 Normal
6. 15.4 mm Gyproc GFE 15 Protect F®

Properties and definitions		
Sound reduction	R_w (dB)	68 [1]
	$R_w+C_{50\text{-}3150}$ (dB)	58 [1]
Carbon footprint	kg CO_2 per m²	21
Weight	kg/m²	91
Structural thickness	mm	243

[1] Calculated value.
[2] CLT (20-30-20-30-20).

GYPROC GFE, GYPROC GHE, GYPROC ER WITH ISOVER PIANO CLT 100 MM

Fire resistance & load utilisation	REI / µfi (%)	**3 layers [2]:** REI 60 (µfi=60%) / REI 60 (µfi=60%) REI 90 (µfi=60%) **5 layers:** REI 60 (µfi=50%) / REI 60 (µfi=60%)



1. 15.4 mm Gyproc GFE 15 Protect F®
2. 100 mm CLT element
3. ≥10 mm Air gap
4. 70 mm Gyproc ER 70 with
   70 mm ISOVER Piano® Sound Board, centre distance 450
5. 12.5 mm Gyproc GHE 13 Habito®
6. 15.4 mm Gyproc GFE 15 Protect F®

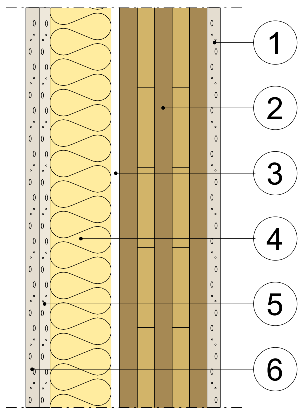
Properties and definitions			
	Sound reduction	R_w (dB)	68 [1]
		$R_w+C_{50-3150}$ (dB)	58 [1]
	Carbon footprint	kg CO_2 per m²	20
	Weight	kg/m²	85
	Structural thick-ness	mm	223

[1] Calculated value.

[2] CLT, 3 layers (40-20-40). REI 90 can be achieved using one additional layer of Gyproc GHE 13 Habito® on the inside against the CLT.

GYPROC GFE, GYPROC GNE, GYPROC ER WITH ISOVER PIANO CLT 100 MM

Fire resistance & load utilisation	REI / µfi (%)	**3 layers (40-20-40):** REI 60 (µfi=60%) / REI 60 (µfi=60%) **5 layers:** REI 60 (µfi=50%) / REI 60 (µfi=50%)



1. 15.4 mm Gyproc GFE 15 Protect F®
2. 100 mm CLT element
3. ≥10 mm Air gap
4. 70 mm Gyproc ER 70 with
   70 mm ISOVER Piano® Sound Board, centre distance 450
5. 12.5 mm Gyproc GNE 13 Normal
6. 15.4 mm Gyproc GFE 15 Protect F®

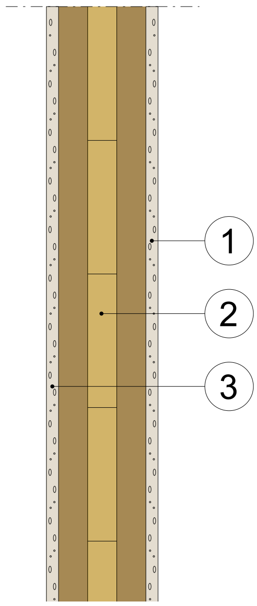
Properties and definitions			
	Sound reduction	R_w (dB)	67 [1]
		$R_w+C_{50\text{-}3150}$ (dB)	56 [1]
	Carbon footprint	kg CO_2 per m²	20
	Weight	kg/m²	82
	Structural thick-ness	mm	223

[1] Calculated value.

IV8

GYPROC GNE NORMAL
CLT 90 MM

	Fire resistance & load utilisation	REI / µfi (%)	REI 30 / µfi=50%



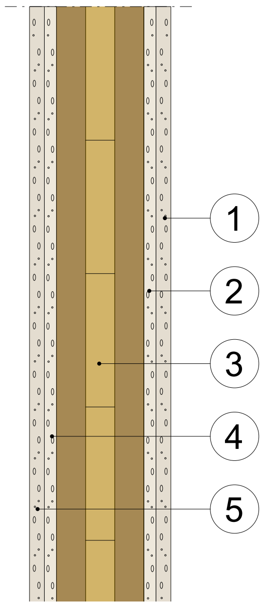
1. 12.5 mm Gyproc GNE 13 Normal
2. 90 mm CLT element
3. 12.5 mm Gyproc GNE 13 Normal

Properties and definitions			
	Sound reduction	R_w (dB)	38 [1]
		$R_w+C_{50-3150}$ (dB)	37 [1]
	Carbon footprint	kg CO_2 per m^2	10
	Weight	kg/m^2	59
	Structural thick-ness	mm	116

[1] Calculated value.

GYPROC GFE AND GYPROC GNE CLT 90 MM

Fire resistance & load utilisation	REI / µfi (%)	REI 60 / µfi=60%



1. 15.4 mm Gyproc GFE 15 Protect F®
2. 12.5 mm Gyproc GNE 13 Normal
3. 90 mm CLT element
4. 12.5 mm Gyproc GNE 13 Normal
5. 15.4 mm Gyproc GFE 15 Protect F®

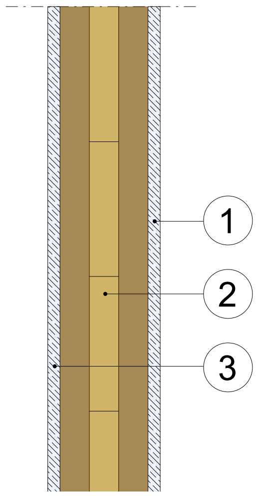
Properties and definitions			
	Sound reduction	R_w (dB)	42 [1]
		$R_w+C_{50\text{-}3150}$ (dB)	42 [1]
	Carbon footprint	kg CO_2 per m²	16
	Weight	kg/m²	84
	Structural thickness	mm	146

[1] Calculated value.

Wet rooms

GLASROC H OCEAN
CLT 90 MM

	Fire resistance & load utilisation	REI / µfi (%)	REI 30 / µfi=50%



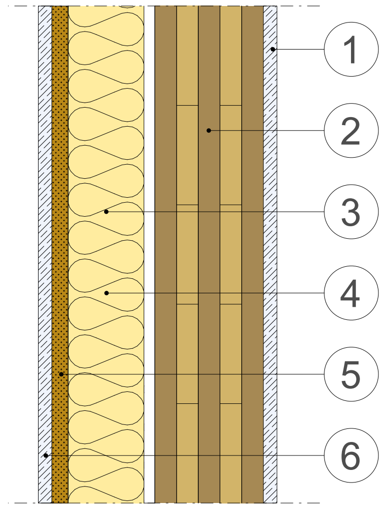
1. 12.5 mm Glasroc H GHO 13 Ocean®
2. 90 mm CLT element
3. 12.5 mm Glasroc H GHO 13 Ocean®

Properties and definitions			
	Sound reduction	R_w (dB)	39 [1]
		$R_w+C_{50-3150}$ (dB)	39 [1]
	Carbon footprint	kg CO_2 per m²	11
	Weight	kg/m²	60
	Structural thickness	mm	116

[1] Calculated value.

GLASROC H OCEAN, PLYWOOD, GYPROC ER WITH ISOVER PIANO CLT 100 MM

Fire resistance & load utilisation	REI / µfi (%)	**5 Layers:** REI 60/µfi=50% / REI 60 (µfi=50%)



1. 12.5 mm Glasroc H GHO 13 Ocean®
2. 100 mm CLT element
3. ≥10 mm Air gap
4. 70 mm Gyproc ER 70 with
   70 mm ISOVER Piano® Sound Board, centre distance 450
5. 15 mm Structural plywood
6. 12.5 mm Glasroc H GHO 13 Ocean®

Properties and definitions			
Sound reduction	R_w (dB)	66 [1]
	$R_w+C_{50\text{-}3150}$ (dB)	58 [1]
Carbon footprint	kg CO_2 per m²	20
Weight	kg/m²	75
Structural thickness	mm	221

[1] Calculated value.

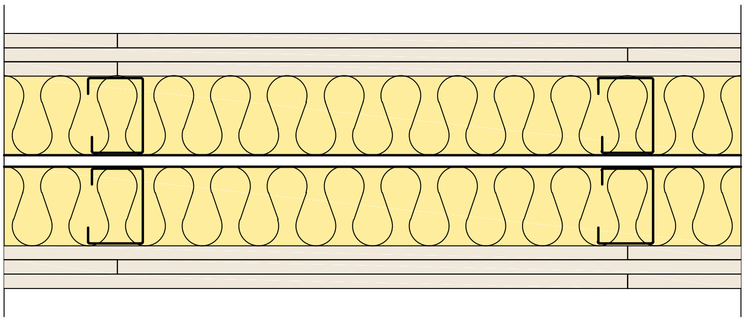
Non-load-bearing partition walls

Apartment partitioning

IV12

GYPROC GHE, GYPROC GNE AND GYPROC GD WITH ISOVER PIANO

Fire resistance	EI	EI 90



1. 12.5 mm Gyproc GHE 13 Habito®
2. 2x12.5 mm Gyproc GNE 13 Normal
3. 45 mm Reinforcement stud, Gyproc GFR DUROnomic® and
   45 mm Reinforcement channel, Gyproc GFS DUROnomic® with
4. 45 mm ISOVER Piano® Sound Board, centre distance 450
5. 10 mm Air gap
6. 45 mm Reinforcement stud, Gyproc GFR DUROnomic® and
   45 mm Reinforcement channel, Gyproc GFS DUROnomic® with
7. 45 mm ISOVER Piano® Sound Board, centre distance 450
8. 2x12.5 mm Gyproc GNE 13 Normal
9. 12.5 mm Gyproc GHE 13 Habito®

Properties and definitions			
Sound reduction	R_w (dB)	69 [1]
	$R_w+C_{50-3150}$ (dB)	64 [1]
Carbon footprint	kg CO_2 per m²	41
Weight	kg/m²	70
Structural thick-ness	mm	175

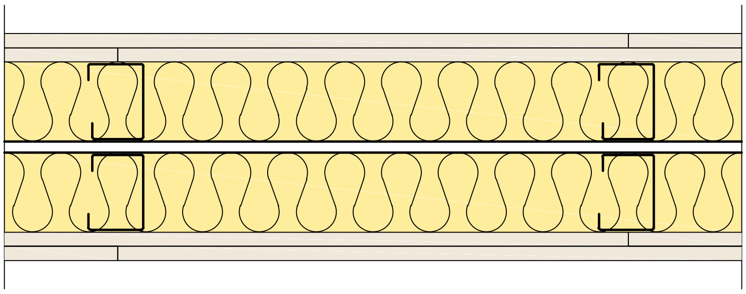
[1] Laboratory value.

Apartment partitioning

IV13

GYPROC GHE, GYPROC GNE AND GYPROC GD WITH ISOVER PIANO

Fire resistance	EI	EI 90



1. 12.5 mm Gyproc GHE 13 Habito®
2. 12.5 mm Gyproc GNE 13 Normal
3. 45 mm Reinforcement stud, Gyproc GFR DUROnomic® and
   45 mm Reinforcement channel, Gyproc GFS DUROnomic® with
4. 45 mm ISOVER Piano® Sound Board, centre distance 450
5. 10 mm Air gap
6. 45 mm Reinforcement stud, Gyproc GFR DUROnomic® and
   45 mm Reinforcement channel, Gyproc GFS DUROnomic® with
7. 45 mm ISOVER Piano® Sound Board, centre distance 450
8. 12.5 mm Gyproc GNE 13 Normal
9. 12.5 mm Gyproc GHE 13 Habito®

Properties and definitions			
	Sound reduction	R_w (dB)	64 [1]
		$R_w + C_{50-3150}$ (dB)	57 [1]
	Carbon footprint	kg CO_2 per m^2	36
	Weight	kg/m^2	52
	Structural thick-ness	mm	150

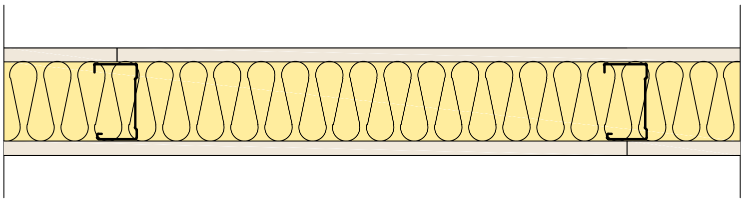
[1] Laboratory value.

Dividing wall

IV16

GYPROC GNE AND GYPROC ER WITH ISOVER PIANO

Fire resistance	EI	EI 30



1. 12.5 mm Gyproc GNE 13 Normal
2. 70 mm Gyproc ER 450 with
3. 70 mm ISOVER Piano® Sound Board, centre distance 450
4. 12.5 mm Gyproc GNE 13 Normal

Properties and definitions			
	Sound reduction	R_w (dB)	42 [1]
	Carbon footprint	kg CO_2 per m^2	10
	Weight	kg/m^2	21
	Structural thick-ness	mm	95

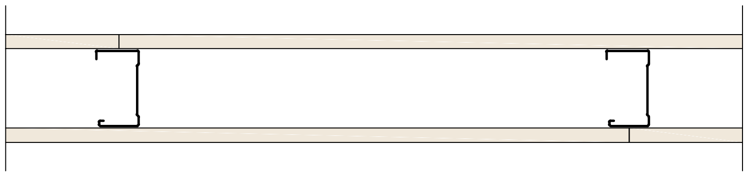
[1] Laboratory value.

Dividing wall

IV17

GYPROC GHE AND GYPROC ER

Fire resistance	EI	EI 30



1. 12.5 mm Gyproc GHE 13 Habito®
2. 70 mm Gyproc ER 450
3. 12.5 mm Gyproc GHE 13 Habito®

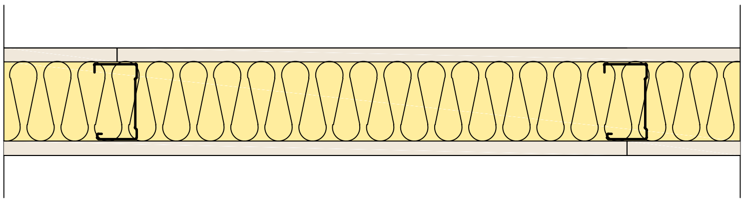
Properties and definitions			
	Sound reduction	R_w (dB)	37 [1]
	Carbon footprint	kg CO_2 per m^2	9
	Weight	kg/m^2	25
	Structural thickness	mm	95

[1] Laboratory value.

Dividing wall

GYPROC GHE AND GYPROC ER WITH ISOVER PIANO

Fire resistance	EI	EI 30



1. 12.5 mm Gyproc GHE 13 Habito®
2. 70 mm Gyproc ER 450 with
3. 70 mm ISOVER Piano® Sound Board, centre distance 450
4. 12.5 mm Gyproc GHE 13 Habito®

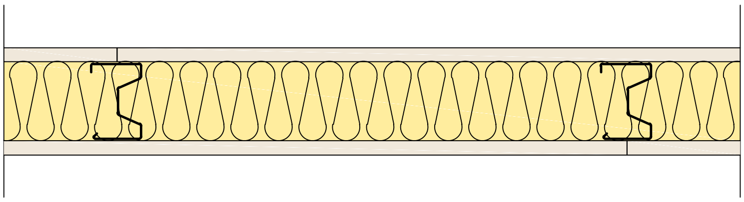
Properties and definitions			
	Sound reduction	R_w (dB)	47 [1]
	Carbon footprint	kg CO_2 per m^2	10
	Weight	kg/m^2	27
	Structural thickness	mm	95

[1] Laboratory value.

Dividing wall

GYPROC GHE AND GYPROC XR WITH ISOVER PIANO

Fire resistance	EI	EI 30



1. 12.5 mm Gyproc GHE 13 Habito®
2. 70 mm Gyproc XR 450 with
3. 70 mm ISOVER Piano® Sound Board, centre distance 450
4. 12.5 mm Gyproc GHE 13 Habito®

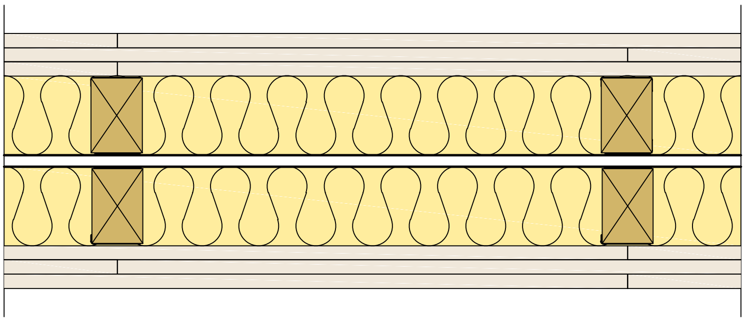
Properties and definitions			
	Sound reduction	R_w (dB)	49 [1]
	Carbon footprint	kg CO_2 per m^2	12
	Weight	kg/m^2	27
	Structural thick-ness	mm	95

[1] Laboratory value.

Apartment partitioning

GYPROC GHE, GYPROC GNE AND GYPROC GT WITH ISOVER WOODEN STUD BOARD

Fire resistance	REI / µfi (%)	REI 60 / EI 60 [2]



1. 12.5 mm Gyproc GHE 13 Habito®
2. 2x12.5 mm Gyproc GNE 13 Normal
3. 70 mm Wooden stud with
4. 70 mm ISOVER Wooden stud board 35, centre distance 450
5. 20 mm Air gap
6. 70 mm Wooden stud with
7. 70 mm ISOVER Wooden stud board 35, centre distance 450
8. 2x12.5 mm Gyproc GNE 13 Normal
9. 12.5 mm Gyproc GHE 13 Habito®

Properties and definitions		
Sound reduction	R_w (dB)	73 [1]
	$R_w+C_{50-3150}$ (dB)	68 [1]
Carbon footprint	kg CO_2 per m²	17
Weight	kg/m²	71
Structural thickness	mm	235

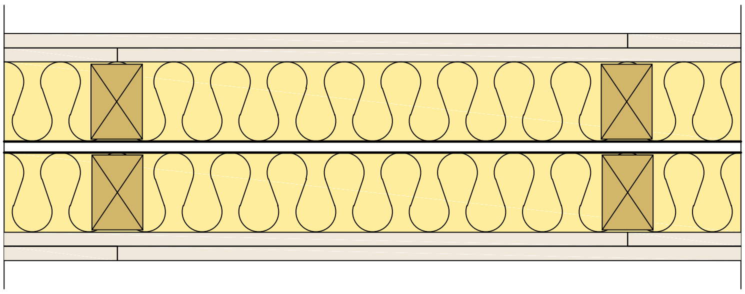
[1] Laboratory value.

[2] Nogging piece recommended for articulated bracing. Capacity in fire limit state must be calculated by the constructor responsible.

Apartment partitioning

GYPROC GHE, GYPROC GNE AND GYPROC GT WITH ISOVER WOODEN STUD BOARD

	Fire resistance	REI / µfi (%)	REI 30 [2] / EI 60



1. 12.5 mm Gyproc GHE 13 Habito®
2. 12.5 mm Gyproc GNE 13 Normal
3. 70 mm Wooden stud with
4. 70 mm ISOVER Wooden stud board 35, centre distance 450
5. 20 mm Air gap
6. 70 mm Wooden stud with
7. 70 mm ISOVER Wooden stud board 35, centre distance 450
8. 12.5 mm Gyproc GNE 13 Normal
9. 12.5 mm Gyproc GHE 13 Habito®

Properties and definitions			
	Sound reduction	R_w (dB)	68 [1]
		$R_w+C_{50-3150}$ (dB)	62 [1]
	Carbon footprint	kg CO_2 per m^2	13
	Weight	kg/m^2	53
	Structural thickness	mm	210

[1] Laboratory value.

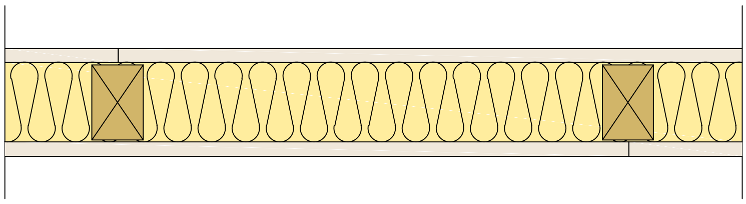
[2] Nogging piece recommended for articulated bracing. Capacity in fire limit state must be calculated by the constructor responsible.

Dividing wall

IV22

GYPROC GHE AND GYPROC GT WITH ISOVER WOODEN STUD BOARD

Fire resistance	EI	REI 15 / EI 30



1. 12.5 mm Gyproc GHE 13 Habito®
2. 70 mm Wooden stud, 45x70 with
3. 70 mm ISOVER Wooden stud board 35, centre distance 450
4. 12.5 Gyproc GHE 13 Habito®

Properties and definitions			
Sound reduction	R_w (dB)	38 [1]
Carbon footprint	kg CO_2 per m^2	8
Weight	kg/m^2	35
Structural thickness	mm	95

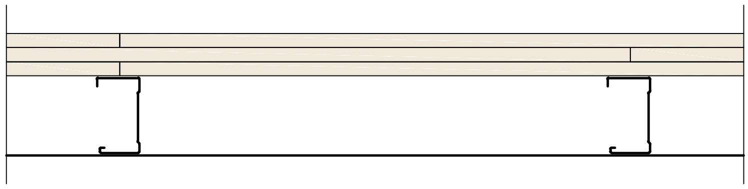
[1] Laboratory value.

Shaft wall

IV23

GYPROC GNE AND GYPROC ER

Fire resistance	EI	EI 60



1. 12.5 mm Gyproc GNE 13 Normal
2. 12.5 mm Gyproc GNE 13 Normal
3. 12.5 mm Gyproc GNE 13 Normal
4. 70 mm Gyproc ER 450

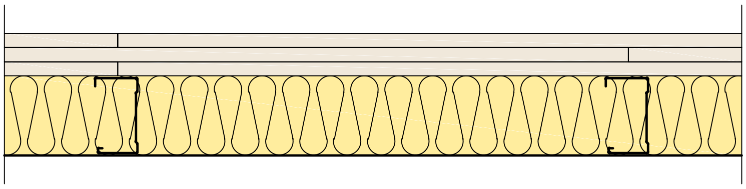
Properties and definitions			
	Sound reduction	R_w (dB)	34 [1]
	Carbon footprint	kg CO_2 per m^2	11
	Weight	kg/m^2	29
	Structural thickness	mm	108

[1] Laboratory value.

Shaft wall

GYPROC GNE AND GYPROC ER WITH ISOVER PIANO

Fire resistance	EI	EI 60



1. 12.5 mm Gyproc GNE 13 Normal
2. 12.5 mm Gyproc GNE 13 Normal
3. 12.5 mm Gyproc GNE 13 Normal
4. 70 mm Gyproc ER 450
5. 70 mm ISOVER Piano® Sound Board, centre distance 450

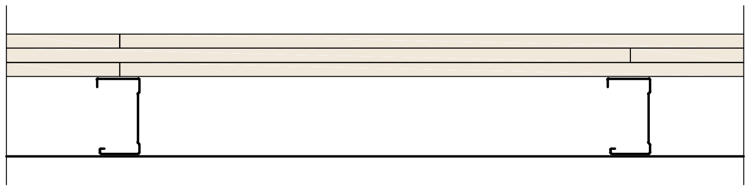
Properties and definitions			
	Sound reduction	R_w (dB)	39 [1]
	Carbon footprint	kg CO_2 per m^2	12
	Weight	kg/m^2	30
	Structural thickness	mm	108

[1] Laboratory value.

Shaft wall

GYPROC GHE, GYPROC GNE AND GYPROC ER

	Fire resistance	EI	EI 60



1. 12.5 mm Gyproc GHE 13 Habito®
2. 12.5 mm Gyproc GNE 13 Normal
3. 12.5 mm Gyproc GNE 13 Normal
4. 70 mm Gyproc ER 450

Properties and definitions			
	Sound reduction	R_w (dB)	34 [1]
	Carbon footprint	kg CO_2 per m²	11
	Weight	kg/m²	32
	Structural thick-ness	mm	108

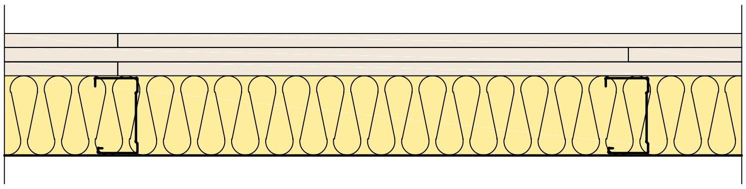
[1] Laboratory value.

IV26

Shaft wall

GYPROC GHE, GYPROC GNE AND GYPROC ER WITH ISOVER PIANO

	Fire resistance	EI	EI 60



1. 12.5 mm Gyproc GHE 13 Habito®
2. 12.5 mm Gyproc GNE 13 Normal
3. 12.5 mm Gyproc GNE 13 Normal
4. 70 mm Gyproc ER 450
5. 70 mm ISOVER Piano® Sound Board, centre distance 450

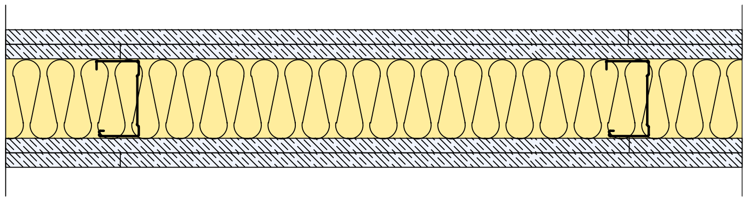
Properties and definitions			
	Sound reduction	R_w (dB)	39 [1]
	Carbon footprint	kg CO_2 per m^2	11
	Weight	kg/m^2	33
	Structural thickness	mm	108

[1] Laboratory value.

Wet room wall

GLASROC H OCEAN AND GYPROC ER WITH ISOVER PIANO

Fire resistance	EI	EI 60



1. 12.5 mm Glasroc H GHO 13 Ocean®
2. 12.5 mm Glasroc H GHO 13 Ocean®
3. 70 mm Gyproc ER 450 with
4. 70 mm ISOVER Piano® Sound Board, centre distance 450
5. 12.5 mm Glasroc H GHO 13 Ocean®
6. 12.5 mm Glasroc H GHO 13 Ocean®

Properties and definitions			
	Sound reduction	R_w (dB)	50 [1]
	Carbon footprint	kg CO_2 per m^2	17
	Weight	kg/m^2	42
	Structural thick-ness	mm	120

[1] Laboratory value.

For details relating to each solution:

ISOVER PLUS+:
www.isover.se/kl-tra

Weber Serporoc
www.se.weber/kl-tra

Saint-Gobain Silent Floor Weber:
www.se.weber/kl-tra

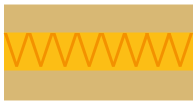
Gyproc dividing walls:
www.gyproc.se/kl-tra

Ecophon acoustic ceiling:
www.ecophon.com/sv/

Fire-proofing between modules

ISOVER's joint sealing products, such as caulk, joint fibre and sealing fibre, are certified by Rise as complete joint sealing systems for caulking around doors and windows in fire cell separating structural elements and caulking between fire cell separating structural elements. The tables below show the tested conditions for each fire class and adjacent materials. Joints may be covered with wooden lining or the joint compound Bostik Build & Sanitary Sealants.

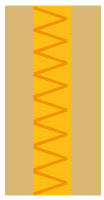
HORIZONTAL FIRE DEVELOPMENT



Adjacent materials	EI 30	EI 60	EI 90	Dimensions (mm)	Quantity (pcs)	Minimum joint depth (mm)	Maximum joint width (mm)	Caulk product
Wood – Wood				30 x 95	2	95	20	ISOVER sealing fibre – glass wool
	[1]			20 x 60	2	70	20	ISOVER Non-plasticised caulk – glass wool
				30 x 100	2	95	20	ISOVER Non-plasticised caulk – glass wool
	[1]			20 x 60	2	95	20	ISOVER Joint fibre – glass wool
				40 x 95	2	95	40	ISOVER ULTIMATE Caulk
				30 x 95	2	95	40	ISOVER ULTIMATE Sealing fibre
				40 x 95	2	95	40	ISOVER ULTIMATE Sealing fibre

[1] The joint is caulked and covered with wooden lining 12 x 44 mm on both sides or a different wood-based material with at least the same fire resistance properties.

VERTICAL FIRE DEVELOPMENT



Adjacent materials	EI 30	EI 60	EI 90	Dimensions (mm)	Quantity (pcs)	Minimum joint depth (mm)	Maximum joint width (mm)	Caulk product
Wood – Wood				30 x 95	2	95	20	ISOVER sealing fibre – glass wool
	[2]			20 x 60	2	70	20	ISOVER Non-plasticised caulk – glass wool
				40 x 95	2	95	20	ISOVER ULTIMATE Sealing fibre
				40 x 95	2	95	20	ISOVER ULTIMATE Sealing fibre
				40 x 95	2	95	40	
	[3]			40 x 95	2	95	40	

[2] The joint is caulked and covered with at least a 10 mm thick silicone bead, BOSTIK Build & Sanitary Sealants, on one side (fire).
[3] The joint is caulked and covered with at least a 10 mm silicone bead, BOSTIK Build & Sanitary Sealants, on both sides.

Detailed information/presentation of strategic products and solutions for CLT

GYPROC PLASTERBOARD

One of the unique properties of plasterboard is its fire resistance. Plasterboard contains a relatively large volume of chemically-bound water. This water is released from the board in case of fire, cooling it down through a process called calcination. This means that plaster is not only incombustible but also helps dampen fire development. The temperature on the side of the board that is not exposed to fire will not exceed 100°C as long as the calcination process is ongoing! In this way, plasterboard protects the underlying materials (CLT) against temperature rises.

GYPROC GG 13 FLOOR PLASTERBOARD

Gyproc floor plasterboard allows for “dry” solutions with good airborne and footstep impact sound insulation on top of a subfloor. The board consists of a core made from high-density fibreglass-reinforced plaster and a cardboard surface layer. The board thickness is 13 mm. The boards can be supplied in accordance with Saint-Gobain’s Construction optimization concept.

GYPROC GHE 13 HABITO®

Gyproc Habito® is an extra-hard plasterboard with high anchoring strength and impact resistance. It is easier to hang heavier objects using an ordinary wood screw without using expanders. In many cases, the board can replace OSB and plywood, with better fire protection and extra-good sound insulation as a result. Habito® has a high-density fibreglass-reinforced plaster core with a cardboard surface layer. The board thickness is 13 mm. Recommended for preschools, schools, hospitals and residential homes.

GYPROC GFE 15 PROTECT F®

Gyproc Protect F® is a fire-resistant plasterboard with significantly better fire resistance properties than ordinary plasterboard. The desired fire class can therefore be achieved using fewer board layers compared to standard plaster. The board consists of a core made from high-density fibreglass-reinforced plaster with dimension-stabilising mineral additives and a cardboard surface layer. The board thickness is 15 mm.

ISOVER PLUS+

ISOVER PLUS+ is an innovative, façade-bearing insulation system made from non-combustible glass wool for exterior wall structures in CLT. The system is efficient with excellent LCA properties and has been tested in accordance with SP Fire 105, with approved results.

The low weight and few components ensure a very efficient installation. The system is quick and easy to install using ordinary manual tools and without the need for separate attachment of insulation. Any recesses and adjustments necessary in order to align a façade can easily be made using a handsaw or circular saw. More information for the design, as well as work instructions, can be found at www.isover.se

ISOVER PLUS+ is particularly suitable for projects in which all or parts of the exterior walls' thermal insulation will be covered from the outside, which is a highly efficient way of avoiding large cold bridges. Even though ISOVER PLUS+ is primarily intended for façades, there are several interesting applications and uses for this flexible system, for example exterior roof insulation where the system carries tongue-in-groove boards and roofing instead.

ISOVER VARIO® XTRA

ISOVER Vario® Xtra is a non-woven reinforced variable vapour retarder. The product is used for air sealing and moisture protection in walls, floors and roofs. Unlike ordinary PE film, it adapts to the relative humidity (RH) of the retarder:

- During winter, when there is low relative humidity indoors, ISOVER Vario® Xtra increases its resistance to vapour penetration to a high level. The moisture migration that takes place from the inside out into the structures is therefore reduced to negligible levels.
- In summer, the situation is the opposite. The heat from the outside means that moisture is driven inwards in the house and the RH increases. The variable vapour barrier then reduces its resistance to vapour penetration so that moisture can migrate through the next layer of the structure and moisture is diverted through the ventilation in the house.

The above means that the product is suitable for use in combination with wooden structures, since moisture can dry out in both directions. More information about the ISOVER air sealing system can be found at www.isover.se

ISOVER FIRE SEAL MADE FROM GLASS WOOL AND ULTIMATE

In order to comply with modern performance requirements, there is an increased focus on all aspects of the climate envelope's contributions to e.g. fire resistance, sound reduction and energy requirements.

It has become increasingly important to gain knowledge of detailed solutions and for this reason we have had the performance of our caulking systems verified by RISE (formerly SP). We have chosen to have a series of measurements performed at RISE Byggteknik – Sound and Vibration showing the acoustic performance of different caulking systems. Here, we have looked at how the acoustic performance is affected by joints sealed using joint sealant or caulk covered by wooden strips, as well as various different combinations. This means that you have adequate fire protection between modules or structural elements, provided that the products are used correctly in accordance with the information available at www.isover.se

WEBER SERPOROC® PREMIUM 32

Serporoc Premium 32 Façade system is a thick mineral stucco system on glass wool plaster carriers with insulation thicknesses of 30-120 mm. With its strong stucco structure, the Serporoc system is highly suitable for environments where the façades are exposed to great stress.

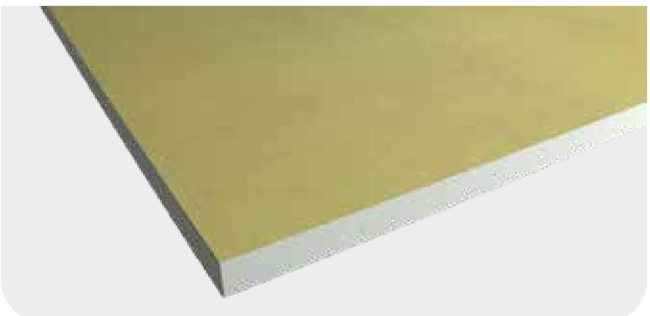
Insulation can also be installed in double layers to achieve the best possible energy performance. The Weber Serporoc façade system is two-step sealed and the SC0283-10 certificate applies to installation on stud framework/CLT.

The lambda value of the glass wool insulation is 0.032 W/m·K, which, in combination with ISOVER PLUS+ allows for passive house structures. To help with the design, all structural details are available at www.se.weber

The installation of Serporoc on stud framework must be performed and documented by a Certified Weber Façade Contractor, CWF.

To help with the design, structural details and work instructions are available at www.se.weber

WEBERTHERM 500 WIND BARRIER BOARD

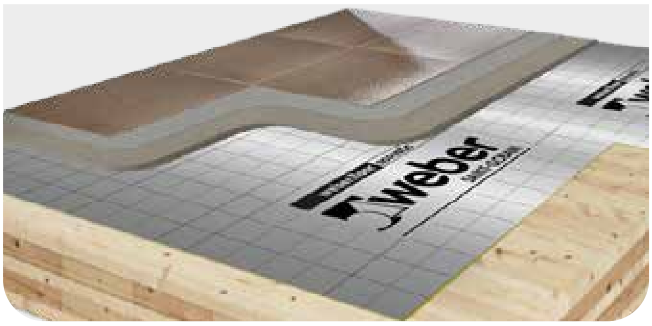


webertherm 500 is a wind barrier board developed by Gyproc specifically for Weber's Serporoc façade system for stud framework in accordance with the P-marking procedures. The unique characteristics of the board ensure effective protection against wind and moisture. The board can withstand exposure to the weather for a prolonged period of time, providing great flexibility during the construction phase. The board is moisture and water-repellent and has excellent mould resistance. The board thickness is 9.5 mm.

WEBER SERPOROC® PREMIUM 32 WITH DESIGN BRICKS

Weber design bricks are thin bricks that are increasingly used in combination with stucco and have been frequently used across Europe for a long period of time with very good results. Weber design bricks are available in five different formats and more than 135 different colours, with a multitude of surface structure variations. There are endless combinations and the design can sometimes be made easier since these system combinations do not require girders or supports in the same way as traditional brick. The combination of weber design bricks and stucco contributes to excellent sound reduction.

WEBER FLOOR SCREED AND ACOUSTIC FLOORS



Weber floor solutions are characterised by high quality and a broad range, including everything from manual filler to advanced pump systems. The environmental properties of floor screed are important, including moisture stability and low emission values. Two or more weber floor products create a system, and a system, together with additional services, creates a concept. Weber's concept floors are design floors, comfort floors, acoustic floors and industrial floors. Several of Weber's floor products are certified and fall within the certification rules for P-marking according to RISE. Installation must be performed by a Certified Weber Floor Contractor (CWG). CWGs have undergone special training provided by Weber and all work is carried out in accordance with Weber's quality assurance programme.

SAINT-GOBAIN SILENT FLOOR®

Saint-Gobain has developed several intermediate joist systems that we collectively refer to under the name Saint-Gobain Silent Floor. With our combinations of products based on the requirements of the project, you have the opportunity to resolve airborne and footstep impact sound issues in different ways, whether from above or below or both.

Saint-Gobain can provide all products (except CLT) included in the solutions within the Silent Floor family and can help optimise the structure based on the customer's needs by also coordinating deliveries and customising solutions for minimal wastage and the shortest possible installation time.

The system has been tested at LTH in accordance with ISO 10140-3 and ISO 717-2 standards.

SAINT-GOBAIN SILENT FLOOR® WITH WEBER FLOOR SCREED

Aprobos Decibel Concept is an important part of the Saint-Gobain Silent Floor system. The Decibel mat is a sound-absorbing mat protected by an outer layer that can be combined with a variety of floor materials or integrated in the joists below screed for a permanent structure, called Decibel SoundSeal. The SoundSeal structure provides excellent footstep impact and airborne sound properties for wood and concrete structures alike. The concept includes Decibel 4, which has been specially designed for lightweight structures such as CLT joists, and in which the acoustic properties help meet the acoustic requirements for residential homes, offices and schools.

The Decibel products have a long service life and are therefore suitable for inclusion in permanent joist structures. All products within the Decibel Concept meet all applicable requirements in the market from e.g. Byggvarubedömningen, BASTA, Healthy Homes (Sunda Hus) and Nordic "Svanen" Ecolabel.

ECOPHON ACOUSTIC CEILING

Saint-Gobain Ecophon develops, manufactures and markets acoustic systems that contribute to a positive working environment and to the wellbeing and performance of people. Our promise “A sound effect on people” permeates everything that we do.

Ecophon provides acoustic ceilings and wall absorbers to help you create excellent room acoustics for most indoor environments.

Ecophon Master™ A

The product is suitable for premises for which there are high requirements concerning room acoustics and where there is an essential need to be able to remove individual ceiling panels with ease.

Ecophon Combison™ Duo A

The product is intended for use as a suspended ceiling with excellent sound absorption and sound insulation properties. The product is also suitable for use in reducing noise from ventilation ducts in intermediate joists and reducing the footstep impact sound from the floor above.

For further information, please see
www.gyproc.se/kl-tra
www.isover.se/kl-tra
www.se.weber/kl-tra
www.ecophon.com/sv

SAINT-GOBAIN CONSTRUCTION OPTIMIZATION

Construction costs (SEK/m² living area) have increased drastically in recent years and we believe that one of the reasons is that the construction industry has not yet decided to digitise and rationalise its processes for construction and production.

In order to resolve this issue, Saint-Gobain has developed a Construction optimization concept, in which we optimise:

- Structures – by reducing the number of variants for e.g. walls.
- Products – by customising them to reduce cutting and adaptations required at the workplace.
- Processes in the workplace – by delivering the correct materials at the right time and place. Products (plaster, steel studs, insulation, etc.) are clearly labelled for each apartment to reduce installation time.
- Last but not least, we can also offer a recycling system to simplify waste management at the workplace.

The result of this is:

1. Reduced costs for the actual execution, which becomes more efficient (less time spent on cutting and handling products and better order in the workplace).
2. Reduced waste levels and lower costs for waste management.
3. Reduced carbon footprint since fewer m² of materials can de facto be ordered (due to less wastage), while still being able to meet the net requirements in the workplace

References from projects using Saint-Gobain solutions can be found on our website www.saint-gobain.se

SAINT-GOBAIN

Saint-Gobain Sweden AB
P.O Box 415, Norra Malmvägen 76
SE-191 24 Sollentuna, Sweden
Telephone: +46 (0)8-625 61 00
www.saint-gobain.se