EDITION 1:2024

Guide to CLT in the early stages

SWEDISH WOOD


Assembly of the CLT frame.

Introduction

A publication
The publication you have in your hand will guide you in words and pictures through the key considerations in the early stages of designing and constructing a CLT building.

It gives you an insight into different building systems, their advantages and disadvantages, and when they are most appropriate. The publication gives you rules of thumb for dimensions and thicknesses and for the construction of walls, ceilings and floors. It also provides tips on what to consider for water, heating and sanitary piping, stabilisation against horizontal wind loads, ground floor design and foundation design. In addition, the publication gives examples of possibilities and limitations in terms of construction, architecture and production.

The publication has been produced jointly by the industry organisation Swedish Wood, the architectural firm Arkemi and the Swedish CLT manufacturers Martinsons, Setra and Södra.

A configurator
Spans and wall, roof and floor thicknesses are entered in the parametric design tool Grasshopper, which is a plug-in for the Rhinoceros CAD software. Based on a simple 2D plan, the configurator allows you to make your first analyses. Modifying the plan and parameters such as number of floors, room height and acoustic class allows you to see early on how different options affect the construction of building components, spans, material consumption, climate footprint and so on.

A Revit library
The third helping hand is offered by the Revit library, which gives you access to Revit families of different building components, solutions and structures. Using the pre-programmed tables, you can also estimate the consumption of different materials, carbon footprint, costs, etc.

The Revit files are not intended for modelling, but should primarily be used as a library from which families and tables can easily be copied to other design files. This makes them readily available to support the ongoing design work.

The configurator and Revit library are available via **www.arkemi.se**.

Further knowledge, information and practical instructions on wood, glulam, CLT and wood construction are available on Wood Campus, **woodcampus.co.uk**, which is constantly updated with new knowledge and practical experiences. Wood Campus is an extensive resource with tables, drawings and illustrations.

Welcome to **woodcampus.co.uk**.

Information on glulam, CLT and wood construction can also be found at **www.swedishwood.com**.

Stockholm, September 2023
Tomas Alsmarker

CLT allows for larger openings.

Contents


Installation of CLT wall panels.

Ten reasons for CLT

CLT is a prefabricated building component manufactured by gluing sawn boards together in several layers to form large flat wall and floor elements. Since the boards are laid in two perpendicular directions, the CLT elements are able to take up loads in two directions. Another major advantage of the alternating layers is that they make CLT more dimensionally stable. The boards lock each other into place, combating movements in different directions. CLT can be compared to a large sheet of plywood. It can also be likened to reinforced concrete. However, a CLT element weighs only a fifth as much as the corresponding concrete element — while still carrying around the same load!

Since its introduction in the early 1990s in Austria and Germany, its use has spread steadily across much of the world. While there are numerous advantages to choosing CLT, we are going to mention just ten of them:

- CLT is a renewable material.
- CLT reduces carbon emissions from the construction sector.
- CLT has a high load-bearing capacity in relation to its weight.
- CLT requires simpler foundations and less transport.
- CLT shortens the construction time.
- CLT reduces construction costs.
- CLT means a quiet and pleasant workplace.
- CLT provides good fire safety and acoustic performance.
- CLT stores heat.
- CLT is attractive.

CLT can be used as a frame system in everything from ordinary houses to the spectacular Sara Kulturhus complex, from schools to high-rise residential buildings, from halls to office buildings.

Storey-high CLT walls can be used as tall beams, giving the freedom to bridge differences in floor plans between a concrete ground floor or garage and the CLT structure above.

The CLT frame might also be used to bridge foundation variations or to bridge differences in floor plans between an existing building and an upward extension.

Installing a CLT floor slab.


Six-storey apartment block with CLT frame.

CLT in building systems

CLT can be used for both load-bearing and non-load-bearing elements in a building. A non-load-bearing application does not utilise the material's full potential but can still make use of valuable properties, such as thermal inertia, how CLT can contribute to a good indoor climate and, not least, the experience and feeling that CLT can create in different rooms. However, this publication focuses on applications where CLT forms part of the load-bearing structure.

The most common way of building a CLT frame is to use vertical surface units as walls and horizontal surface units for the floor system. These two components are prefabricated industrially by the CLT manufacturer. The walls, floors and roof are then assembled into a complete frame on the construction site. In this publication, we will refer to this system as surface units. It is worth noting that horizontal wall elements can sometimes lead to cost savings compared to vertical ones.

Another approach is for the prefabricated surface units to be assembled into finished volumes. These building blocks are then transported to the construction site where they are lifted into place like large Lego. In this publication, we will use the term volumetric units when referring to this frame system.

Right from the sketching phase, a carefully considered decision should be taken on whether the frame system will be constructed from surface or volumetric units, or a combination of the two. Since each volumetric unit is delivered with its floor, walls and roof, the structure is doubled up where two units meet. The height of the building or the number of floors permitted in the detailed development plan becomes an important parameter to take into account when choosing between volumetric and surface units.

CLT can also be combined with a frame system of columns and beams in glulam or other construction materials, or with a regular timber frame.

This publication focuses on pure CLT frame systems. This is the most common way of working with CLT today and is more or less synonymous with what we commonly call a mass timber building.

Surface units


CLT elements offer great flexibility.

Building up a CLT frame using individual surface units offers a relatively large degree of freedom. The wall elements can be used to handle both vertical and horizontal loads in different directions. They can also be used as tall beams to bridge larger openings, manage differences in floor plans, enable openings over corners, act as cantilevered panels, etc.

Moreover, the floor elements carry loads in two perpendicular directions, which makes it easier to create holes and handle more unusual geometries, among other things.

The wall panels can be placed in a more or less pronounced grid system. The more it resembles a grid, the more structurally effective the construction, although this limits the freedom to design different types of floor plans. However, an internal grid of load-bearing walls creates more freedom in terms of façade design.

A building has to deal not just with vertical loads, but also horizontal loads, which in the Nordic region mainly means wind loads. In other parts of the world, horizontal loads may also be caused by earthquakes. The structure of CLT elements, with their boards in perpendicular directions and in several layers, provides considerable stiffness. Together, CLT walls and floors create a highly efficient system for transferring horizontal loads down to the foundations. Try to avoid using short walls or walls with large openings for stabilisation, as these are subject to the greatest lifting forces.

The load-bearing walls of the CLT frame should be placed on top of each other, not just for the load-bearing function but also to create robust solutions for acoustics and fire safety.

Volumetric units

Building a CLT frame with volumetric units can have several advantages. Time on site can be minimised because the volumetric units can be more or less finished and completed in the factory. This makes the build less susceptible to weather conditions. The time saving can also be advantageous for sites in dense urban areas, which may be more difficult to keep operating for a prolonged period of time. However, a high degree of repetition is required for volumetric unit construction to be cost-effective.

There is also a risk that flexibility will suffer and that the design will be governed more by production and transport considerations than by the dimensions needed to create a good building to be in.

It is worth bearing in mind that volumetric units are often long and narrow, leading to rather deep apartments, with the risk of a dark inner core that natural daylight struggles to reach.

Hybrid construction systems

Combining different wood-based frame systems can be a way to achieve greater material and resource efficiency. For example, the stiffness and strength of CLT can be used in lift shafts, stairwells and stabilising walls, while other parts of the frame use a grid of columns and beams. CLT can also be used to simplify and streamline the manufacture of small buildings with a timber frame. Use the right frame system in the right place.

Also consider CLT in combination with other construction materials. This may involve using different construction materials in different parts of the load-bearing structure, but also interaction between different construction materials in individual building components. In a floor system, for example, a structural interaction between CLT and a concrete casting can enable longer spans. A floating concrete floor can also contribute to better acoustic performance at low frequencies.

However, combining wood with other materials risks reducing the climate benefits that can be achieved by building more purely in wood.

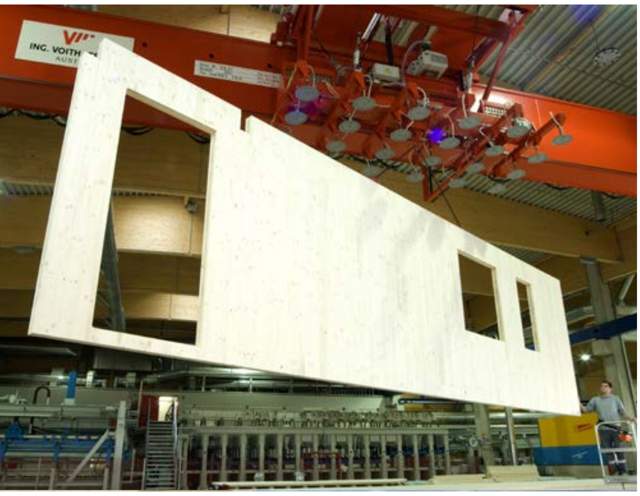
A dry construction system

CLT is delivered to the construction site dry and ready for encasing. Maintaining this low moisture content saves time and money. You should therefore also think about installation at the sketching stage. To get the roof on quickly, it is often preferable to install the CLT frame in vertical sections, rather than floor by floor. The question of whether to use some kind of weather protection is another production issue to consider early on. The basic rule is to keep standing water from accumulating on horizontal surfaces or in joints and connections. Any water that gets in must be able to get out, and wood that has become damp must be able to dry out. Think about moisture-proofing right from the earliest design stages.

Volumetric units in CLT.

CLT and glulam working together.

Prefabricated wall elements being unwrapped.



Stabilising wall elements with openings.

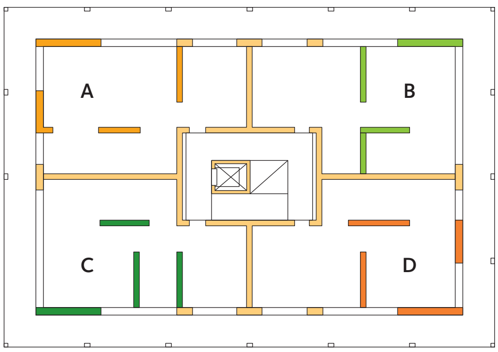


Figure 1 Example of placement of stabilising walls

Stabilising system

In the first instance, use the party walls and the walls around lifts and stairwells as stabilisers. These walls are usually long and fairly free of major openings, meaning that they work well as stabilising elements. External walls, on the other hand, feature both doors and windows. For such a wall to function as a stabilising panel, there must be enough of the CLT panel left both above and on both sides of the opening. As a rule of thumb, there should be around 400 mm or more both above the opening and to the side. Too low a construction height and too narrow a wall width will make a CLT element non-functional as a structural panel. The 400 mm width is also the dimension most often required for the remaining wall section to function as a so-called wall column with sufficient load capacity to handle vertical loads.

Consider at an early stage:

- **The inner core:** The walls that are usually found in the core of the building can usefully be employed as parts of the building's stabilising system, together with other CLT walls and/or stabilising diagonals.
- **Symmetrical layouts:** It is worth aiming for symmetrical layouts, as the wind blows from many directions. A balanced distribution of the stabilising walls in each direction also creates a torsionally rigid structure.
- **Prioritise the longer walls:** Try to create and make use of as many long wall sections as possible. A wooden building has a low self-weight, which means that lifting forces can occur at the ends of the walls. The longer and more numerous the active walls, the lower the local lifting forces will be. Use walls that are reasonably evenly spaced.

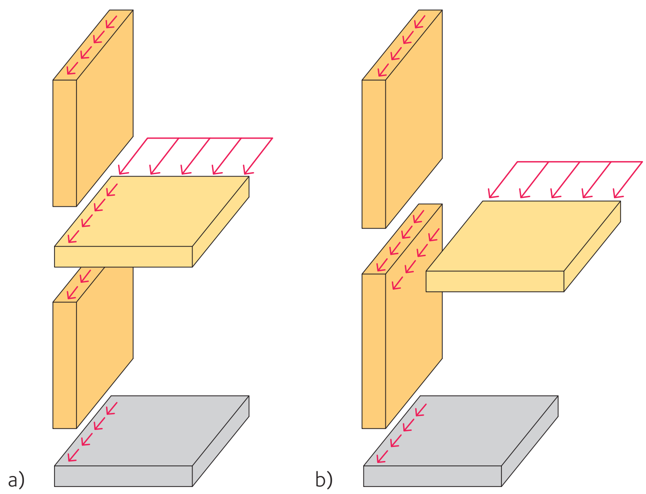


Figure 2 Transfer of horizontal forces between floor slabs and wall elements

- **Openings:** CLT offers relatively good freedom to locate openings even in the stabilising walls. In order to determine the appropriate size and location and the need for any reinforcement measures, structural calculations regarding stiffness and load-bearing capacity are required.
- **Lifting forces:** The vertical lifting forces resulting from the horizontal loads must be transferred floor by floor. One way to do this is to use round bars that are spliced together at each floor level to form a continuous tension rod. Another way is to transfer the lifting forces through brackets or fittings.
- **Compressive forces:** Deformation occurs when compressive forces are applied to wood perpendicular to the grain. Wood also shrinks most in this direction. As far as possible, solutions where end wood meets end wood should therefore be favoured.
- **Foundation structure:** The lightweight CLT frame generally only requires simple foundations with smaller footings and lower costs. However, the lifting forces resulting from the horizontal loads may mean that parts of the foundation structure must be given more weight and perhaps also deeper footings. Piles that take up tensile forces may be an option.

Ground floor and basement

It is not uncommon for the layout of the ground floor to be different from the floor above. This may be a reason to build the ground floor in concrete. The ground floor can then function as a kind of "podium" on which a light CLT building can be placed with some freedom, without being completely locked in by the layout of the floor below. A concrete ground floor combined with a lightweight CLT frame makes it easier to provide suitable spaces for entrances, communal spaces, retail or parking at street level or in basements. It is also beneficial from a moisture point of view to raise the CLT frame up from ground level a little.

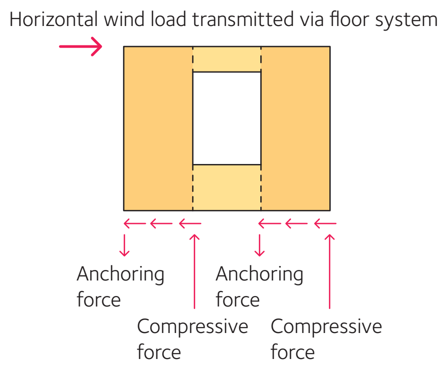


Figure 3 **Force equilibrium for CLT wall with opening**

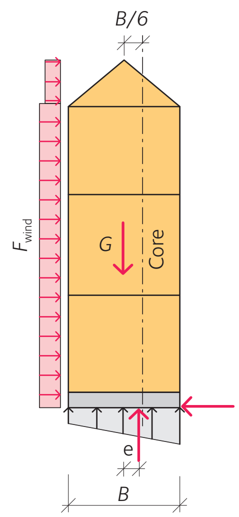


Figure 4 **Control against overturning**

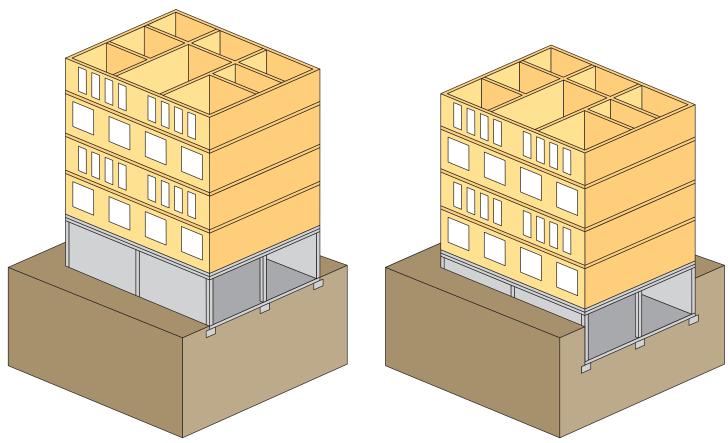


Figure 5 **CLT frame on concrete ground floor or basement**

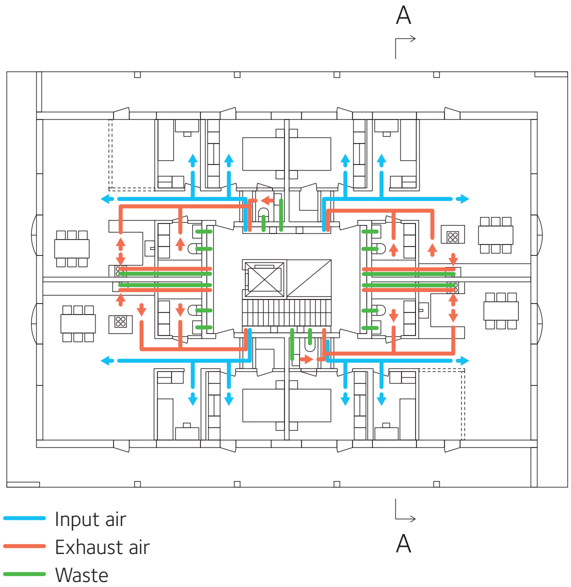


Figure 6 Example of horizontal distribution of input air, exhaust air and waste

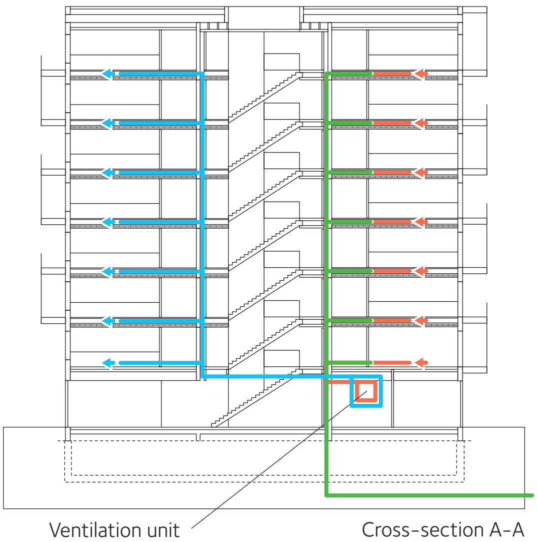


Figure 7 Example of vertical distribution of input air, exhaust air and waste

Water, heating and sanitation

When sketching out floor plans in the early stages based around water, heating and sanitation systems, the factors that need to be considered are quite similar to those for frames made of other materials, for example:

Location of wet zones and vertical shafts. Vertical shafts should, as far as possible, be located close to bathrooms, kitchens and other wet areas. It is also beneficial to locate them in the core of the building. Horizontal piping in floors and through walls can then be minimised, and the fewer the actions that need to be carried out in the CLT frame, the more robust the construction system will be overall. Thinking through the location of wet zones and vertical shafts at an early stage can also help to facilitate future maintenance of the plumbing system.

Location of the different parts of the plumbing system. The size and location of ducts, pipes, air handling units, etc. must be taken into account in the early layout sketches. Considering the plumbing system and the CLT frame together, even in early sketches, ensures that many unnecessary "clashes" and extra costs can be avoided.

Ventilation ducts. In the floor system, ventilation ducts can be installed in the space between CLT elements and a suspended ceiling or cavity floor. Ducting in suspended ceilings is preferable in corridors and similar spaces where there is usually a greater acceptance of lower ceilings, but also of possible noise from pipes and ducts.

Settling and movement

Wood moves differently in different directions, and minor settling cannot be avoided. Most commonly, the floor system is laid on the walls, which means that at this node the floor is loaded perpendicular to the grain. Some deformation thus occurs on each storey.

In vertical installation shafts, stairwells and lifts, it is often more natural to have continuous walls and for the floors to connect to them. At these nodes, end wood meets end wood and the vertical deformations are virtually zero. Different designs and different loads produce different vertical movements, something that needs to be considered when it comes to the detailed design.

CLT in different building components

Walls

CLT walls are available in different strength classes and surface qualities. Quite often, there will be a desire to expose the genuine and completely untreated CLT surface. The wood surface can also be treated with various pigments, paints, waxes or oils. In multi-family buildings, fire safety and acoustic requirements may mean that the CLT wall must be clad with one or more layers of panelling. Read more about surface qualities in Swedish Wood's *Guide to assessing CLT surface quality*.

Openings for doors and windows are milled out of the CLT element using modern Computer Numerical Control (CNC) technology. The structure with boards in two perpendicular directions and in several layers means that the CLT element works structurally in much the same way as a reinforced concrete element. Like the cross-linked reinforcement, the alternating boards allow forces and stresses to pass through openings without compromising the stiffness or load-bearing capacity of the wall panel. Obviously, the openings should be placed where most appropriate, based on the flow of stresses in the wall element in question.

CLT can also be used to good effect for non-load-bearing internal walls, although the most common application is in load-bearing and party walls.


External wall made of CLT.

Lift shafts and stairs

CLT can also be used for more specialised structural elements, such as lift shafts and stairs. The machinability of the wood material, combined with high manufacturing precision, creates favourable conditions for


Lift shaft in CLT.


Stair carcass in CLT.

Car park in glulam with a CLT floor system.

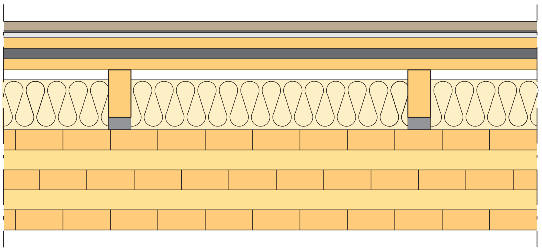


Figure 8 **CLT cavity floor**

fast and accurate assembly. There is usually no problem meeting the requirements set, for example, by lift suppliers regarding permissible deformations. Horizontally, it is a matter of minimising the deflections caused by the horizontal loads that occur in the guide rail attachments when the lift stops at different floors. In the vertical direction, deformations can be reduced almost to zero by avoiding loading wooden beams or CLT elements perpendicular to the direction of the grain. Wall to wall, end wood to end wood, is always preferable.

The walls around the lift shaft can be linked together structurally to form stabilising towers. The lift shafts then also function perfectly as part of the building's stabilising system.

Stair carcasses can also be made from CLT, giving a frame that weighs only one fifth as much as a concrete staircase. CLT stairs are fairly easy to customise for a specific stairwell. The CLT staircase is often a logical and cost-effective alternative to staircases made of other materials, especially if you can reuse materials cut for windows and doors in other CLT elements.

Floor system

CLT can be used in many different ways in floors, ranging from fully solid to semi-solid, or in structural interaction with concrete.

The simplest form of CLT flooring consists of a mass timber panel of sufficient thickness to withstand the applied load and to minimise the feeling of sagging and vibrations. In order to meet acoustic and fire safety requirements, the CLT element is supplemented with various board materials, a suspended ceiling or a cavity floor, the latter of which is the most common approach nowadays. Utilities are also installed in the cavity between the lower and upper floor layers.

CLT floor systems are usually supported on longitudinal walls, which are often also made of CLT. The floor elements may also be supported on longitudinal beams that in turn rest on columns, usually in glulam but also in other construction materials.

As previously stated, CLT elements are constructed from strength graded boards or planks in two perpendicular directions. Consequently, they also carry the external load in these two directions. The CLT floor works much like a reinforced concrete floor, which means, among other things, that holes for stairs and shafts, for example, can be handled in a similar way to a concrete floor, i.e. often without the need for extra reinforcement.

Since CLT has excellent thermal mass and low thermal conductivity, a CLT surface feels warmer to the touch than materials such as concrete. CLT has an inherent capacity to positively influence the thermal feel of a room, in both the colder and warmer months.

Roof

The roof can be seen as a building element that functionally falls somewhere between a wall and a floor — it could be viewed as a sloping wall, or a sloping floor. The roof needs to transfer vertical loads such as snow and self-weight. It can also act as a rigid sheet that can transfer horizontal loads in its own plane to neighbouring structural elements. In other words, the functionality and possibilities of a CLT roof structure are similar to those of CLT floors and walls, and openings can be made in the same way as in a wall or a floor. There is also little difference in the free span that can be achieved with a CLT roof and a CLT floor system.

For buildings that require particularly long spans, it is often more economical to support the roof elements on an underlying system of beams. The most cost-effective option is to combine the beam system with a system of columns, which allows the structural height of both the CLT panel and the beams to be reduced for more efficient use of the wood.

CLT tends to be a rational and economical solution for both flat roofs and pitched roofs, whether monopitch or gable. With a pitched gable roof, the fact that CLT elements carry loads in both directions can be utilised in an interesting way. CLT elements can of course be used to carry loads from eaves to ridge, but also in the opposite direction, from gable to gable. In the long direction, CLT elements can be designed to function as tall inclined beams, which creates a self-supporting roof structure in both directions that combines function, economy, looks and technology into an elegant whole.

Summer cottage roof.

Glulam and CLT roof structure.

Table 1 Common dimensions of boards and planks used in the manufacture of CLT

Parameter	Commonplace	Available
Thickness, *t*	20 – 45 mm	20 – 60 mm
Width, *b*	80 – 200 mm	40 – 300 mm
Width to thickness ratio	4:1	–

Table 2 Common dimensions of CLT elements

Parameter	Commonplace	Available
Thickness, *t*	80 – 300 mm	60 – 500 mm
Width, *b*	1.20 – 3.00 m	up to 4.80 m
Length, *l*	16 m	up to 30 m
No. of layers	3, 5, 7, 9	up to 25

Rules of thumb

Master panel

Specific wall and floor elements are sawn or milled out of a larger CLT element called the master panel. This is made up of an odd number of layers of strength graded boards or planks laid in two perpendicular directions. The top layer runs in the same direction as the bottom layer, and this is the direction that constitutes the primary load-bearing direction of the element.

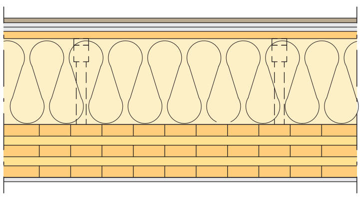
It is desirable to aim for the largest master panel that is possible in the CLT manufacturer's glue press. It is also preferable for the customised and sawn or milled CLT elements to fill the master panel as much as possible. This minimises material waste and facilitates transport and assembly, which is good for both material and cost efficiency. It is therefore well worth thinking systematically about the thickness, width and length of the wooden elements at an early stage.

Larger CLT elements and fewer joints are preferable because they create a more coherent structure with fewer critical element joints. Fewer pieces also mean less lifting and usually faster assembly.

Floor systems

The thickness of a CLT element in a floor is mainly determined by span, sagging, vibrations and acoustics. A CLT floor can normally cope with spans of up to 6 metres, usually with deformations and vibrations as the determining factors. In residential buildings, spans are mostly below 5 metres, which means CLT elements with thicknesses between 160 and 200 mm.

Larger spans can be achieved by having underlying beams of glulam, for example, that structurally interact with the CLT slab like a cassette floor.



14 wood flooring
2 x 13 plasterboard floor panels
22 fibreboard floor panels
Cavity floor support system
260 insulation
160 CLT slab
15 fire-resistant plasterboard

Figure 9 Structure and dimensions of CLT cavity floor

Walls

The thickness of the CLT wall is primarily determined by the number of storeys and the fire safety class.

In 3 – 8 storey residential buildings, the thickness of the CLT elements in the walls is normally 100 – 180 mm.

The width of the master panel is usually adapted to the height of the wall elements. However, with walls in buildings of two or more storeys, it is more natural to cut the wall elements in the longitudinal direction of the master panel.

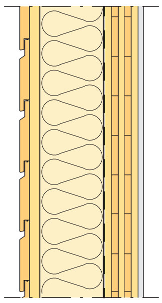


Figure 10 Example of an external wall

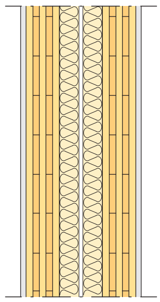
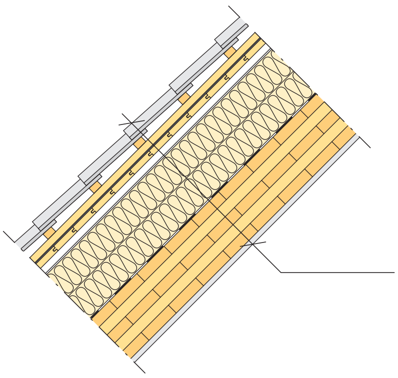


Figure 11 Example of a party wall

Roof

The thickness of the roof element is mainly determined by the span of the roof and the snow loads for which the roof is designed. Approximately 7 m is a normal span for a flat roof, a monopitch roof or from eaves to ridge in a gable roof. As with a floor, the roof can be reinforced with an underlying system of beams, such as glulam, to further increase the spans. The normal thickness of CLT elements in roofs is usually 140 – 180 mm.



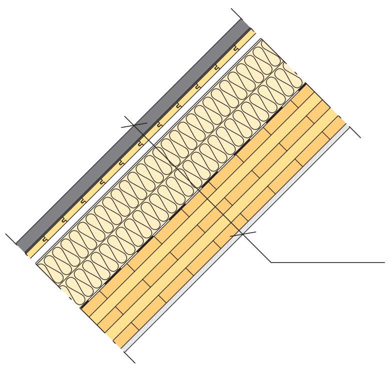


Figure 12 Examples of CLT roof structures

Volumetric units in CLT.

Volumetric units

The dimensions of the volumetric units are determined by the production facilities of the CLT manufacturer and the restrictions on transport. The production units of different manufacturers are fitted out slightly differently. The construction site in question may also impose restrictions, for example when located in a dense urban area.

With regard to transport, the width of the volumes can be up to 4.5 m without a road transport manager. The height of the volumes should be kept below 3.4 m. The maximum length of a trailer and truck is 30 m. Authorisation to transport larger modules can be obtained if measures such as escort vehicles and approval of the transport route are in place.

Transport

The dimensions of surface and volumetric units are often determined by transport limitations rather than the capabilities of the factory. As such, transport options may put a limit on storey heights and layouts. The width of the wooden elements often determines when an escort or specialised transport is required.

When transporting between different countries, bear in mind that regulations differ between countries to varying degrees. Special authorisation may be required, which adds complexity and costs.

A rule of thumb is to stay within the limits of the fairly universal standards for the two most common forms of trailers — the semi-trailer which measures 13.6 × 2.45 × 2.7 metres and the mega trailer which measures 13.6 × 2.45 × 3.0 metres. These dimensions refer to covered trailers. Slightly larger elements can be transported on open trailers.

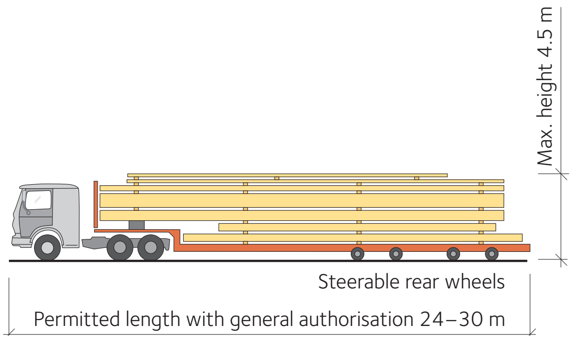


Figure 13 **Dimensional limits for heavy goods vehicles in Sweden**

About dimensions and rules of thumb

This publication provides rules of thumb for the dimensions and construction of the key components in a pure CLT frame. The rules of thumb can also be used where CLT is combined with column and beam frame systems.

These rules mainly relate to residential buildings in Sweden with 3—8 storeys, and are based on Boverket's Building Regulations and the CLT products available on the Swedish market when this publication was produced. These conditions also apply to the Grasshopper script and Revit families that have been developed in order to model and obtain preliminary dimensions in a CLT project at an early stage.

There is currently no common standard for metrics and dimensions in the CLT industry. CLT is mainly manufactured in accordance with the requirements of standard SS-EN 16351 and must fulfil the product properties declared by the CLT manufacturers in their European Technical Approval (ETA). Each CLT manufacturer provides various forms of guidance explaining the possibilities and limitations of their products. This should be kept in mind when preparing the first preliminary measurements and dimensions. The choice of CLT supplier is a decision that is often made at a later stage.

For this publication, the products of different CLT manufacturers have been compared and weighed up against each other, producing a library of the most common building components and their various limitations.

It is important to recognise that the choice of one component can affect the design of another. The whole picture must always be taken into account.

Note that the rules of thumb regarding dimensions are only intended to support and assist in the initial stages and do not replace a full static calculation.

References

Bahari Narges, Elangovan Emiline, Moattar Kayrokh, Orth Frantisek, Pettersson Sandmark Niels, Sarrafzadeh Sepideh & Tjernberg Frida: How to CLT — architectural guidelines for early stages. Arkemi AB, 2022.

Gustavsson Anders & Crocetti Roberto, Just Alar, Landel Pierre, Olsson Jörgen, Pousette Anna, Silfverhielm Magnus, Östman Birgit: The CLT Handbook: CLT structures — facts and planning. Swedish Wood, 2019.

Höfferl Bernd, Isopp Anne, Pirchner Esther, Elmecker Christoph, Druck Marcel: Mehrgeschossiger Wohnbau — Planen und Bauen. pro:Holz Fokus, 2021.

Stora Enso, Division Wood Products: Building Systems by Stora Enso — Residential multi-storey buildings. Stora Enso, version 1.4, 2016.

Disclaimer

By using the content of the *Guide to CLT in the early stages*, you agree to the terms of use set out below. Everything in the *Guide to CLT in the early stages* is provided for informational purposes only and should not be seen as entering into an advisory or professional relationship with the reader.

All information is provided in its present state and without any form of guarantee, to the extent permitted by prevailing legislation. Although the publisher has taken all reasonable steps to provide reliable information in the *Guide to CLT in the early stages*, the publisher does not guarantee that the content is free from errors, mistakes and/or omissions, or that the content is up to date and relevant to the user's needs.

The publisher, The Swedish Forest Industries Federation, also provides no guarantees for any outcomes arising from the use of the information contained in the *Guide to CLT in the early stages*. All use of the information in the *Guide to CLT in the early stages* is the user's own responsibility and is done at the user's risk.

The Swedish Forest Industries Federation accepts no liability for any damage or injury that may arise due to the content of the *Guide to CLT in the early stages*.

Guide to CLT in the early stages

First edition

Publisher

Swedish Forest Industries Federation
Swedish Wood
P.O Box 55525
SE-102 04 STOCKHOLM
Sweden
Tel: +46 8 762 72 60
E-mail: info@swedishwood.com
www.swedishwood.com

Editor
Tomas Alsmarker — Swedish Wood

Author
Tomas Alsmarker — Swedish Wood

Co-authors
Arkemi AB

Reference group
Urban Blomster — Södra Skogsägarna ekonomisk förening
Erik Dicander — Setra Trävaror AB
Gabriel Eriksson — Swedish Wood
Björn Kjellberg — Setra Trävaror AB
Gunnar Lundmark — Martinsons Byggsystem AB
Kayrokh Moattar — Arkemi AB
Frantisek Orth — Arkemi AB

Fact checkers
Daniel Anderson — Södra Skogsägarna Ekonomisk Förening
Ellen Andreasson — Setra Trävaror AB
Narges Bahari — Arkemi AB
Emiline Elangovan — Arkemi AB
Martin Eveborn — Södra Skogsägarna ekonomisk förening
Johan Fröbel — Swedish Wood
Peter Jacobsson — Martinsons Byggsystem AB
Niels Pettersson Sandmark — Arkemi AB
Frida Tjernberg — Sitowise Sverige AB

Illustrations
Vendela Martinac — Thelander Arkitektur & Design AB
Charlotta Olsson — Formigo AB
Cornelia Thelander — Thelander Arkitektur & Design AB

Photography
Adobe Stock, page 1
Tomas Alsmarker, page 13 bottom right
Patrick Degerman, pages 14, 15 top, 23
Anders Gustafsson, page 9 bottom
Fredrik Hjerling, pages 2, 4, 7, 8 bottom
Pierre Landel, page 8 top
Åke E:son Lindman, page 13 top
Skanska, page 9 centre
Stora Enso, pages 6, 9 top, 10, 15 bottom
Jonas Westling, pages 13 lower left, 18

Graphic production
Charlotta Olsson — Formigo AB

ISBN 978-91-985920-0-9

CLT manufacturers who participate in industry initiatives for information sharing and technical development within Swedish Wood and who are responsible for the content of this publication:

Holmen/Martinsons
Burträskvägen 53
SE-937 80 Bygdsiljum
Sweden
Tel: +46 914 207 00
www.martinsons.se

Setra Trävaror AB
Amungsvägen 17
SE-770 70 Långshyttan
Sweden
Tel: +46 225 635 00
www.setragroup.com

Södra Skogsägarna ekonomisk förening
SE-432 86 Väröbacka
Sweden
Tel: +46 340 628 000
www.sodra.com

SWEDISH WOOD

Swedish Wood disseminates knowledge about wood, wood products and wood in construction, contributing towards a sustainable society and a thriving sawmill industry. We achieve this by inspiring, educating and driving technical advances.

Swedish Wood represents the Swedish sawmill industry and is part of the Swedish Forest Industries Federation. Swedish Wood represents the Swedish glulam, CLT and packaging industries, and collaborates closely with Swedish builders' merchants and wholesalers of wood products.

P.O Box 55525
SE-102 04 Stockholm
Sweden
Tel: +46 8 762 72 60
info@swedishwood.com
swedishwood.com

7 350009 431361 >

ISBN 978-91-985920-0-9

2024-04