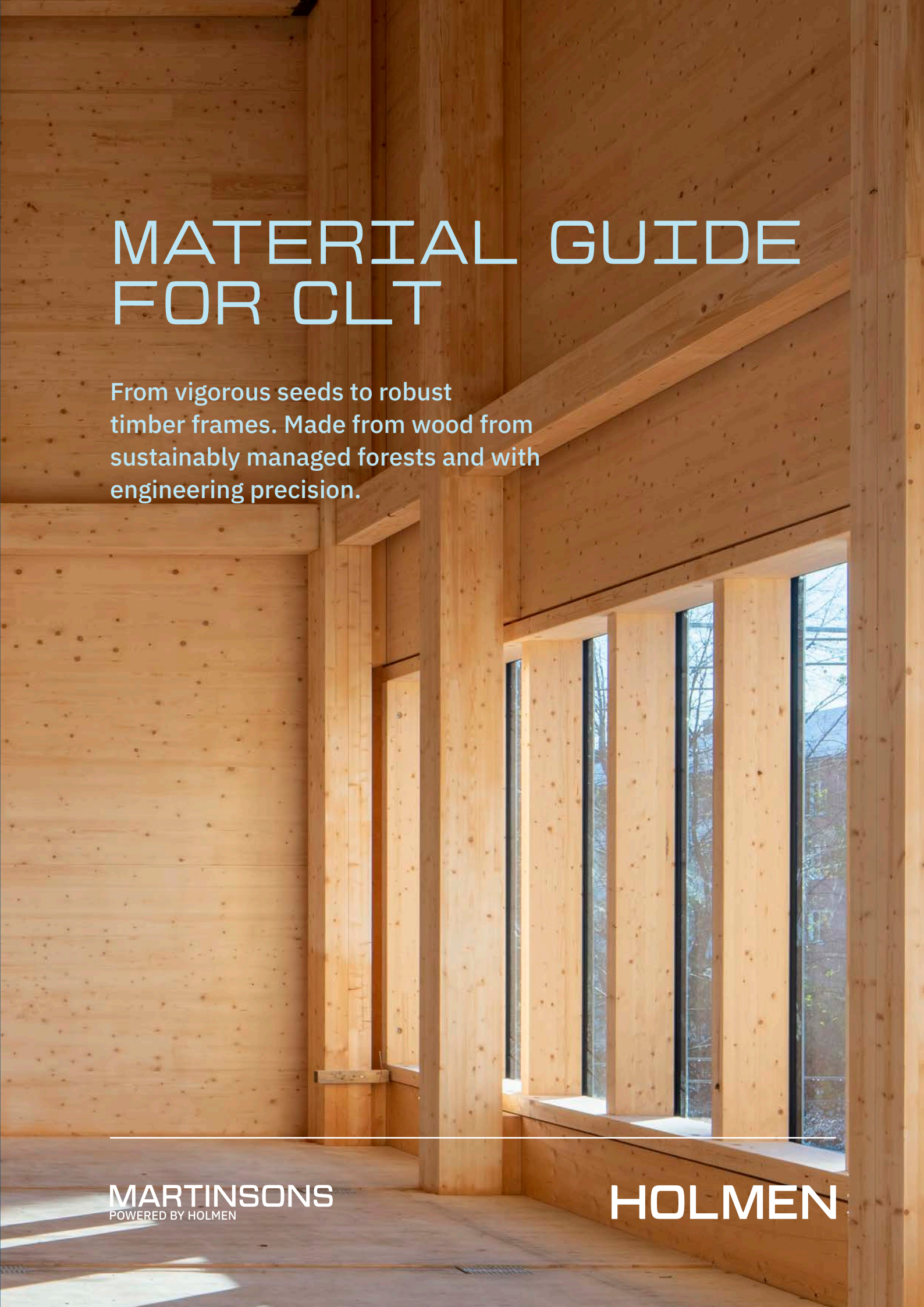


MATERIAL GUIDE FOR CLT

From vigorous seeds to robust timber frames. Made from wood from sustainably managed forests and with engineering precision.

MARTINSONS
POWERED BY HOLMEN

HOLMEN

HOLMEN & MARTINSONS

Martinsons is part of Holmen. Together we form a complete value chain, all the way from seed and sustainable forestry to finished timber frames.

CONTENTS

Holmen Wood Products

PRODUCTION OF CLT

Holmen Wood Products supplies high-quality wood products to the joinery and construction industry, builders' merchants and wood product importers. Holmen's high-tech sawmills are the hub of our circular business. All chain-of-custody certified, our sawmills are located in Linghem, Braviken, Iggesund, Kroksjön and Bygdsiljum in Sweden. Martinsons Building System has been part of the Holmen Group since 2020. Martinsons has accrued extensive experience as a leading player in the development, construction and delivery of glulam and CLT frame systems. Martinsons' offering in custom CLT is based on Holmen's range of products, manufactured in Bygdsiljum, with delivery tailored entirely to the needs and requirements of a specific structural object. As a customer, you simply contact Martinsons about what you require, and we then develop a proposal to meet your brief.

As part of the Holmen Group, we create a cohesive and secure value chain that stretches all the way from seed to fully assembled frame, in a close collaboration that allows us to ensure high quality and sustainability every step of the way. As responsible users of forest resources, we contribute to a more sustainable future for construction and urban development. We are proud to offer our customers a complete solution that always has a keen eye on quality, efficiency and sustainability.

CLT factory

Sara Kulturhus, Skellefteå
Architect: White Arkitekter
Client: Skellefteå Municipality
Contractor: Hent

CLT

General information on the composition, function and benefits of the material.

WHAT IS CLT?

Cross-laminated timber (CLT) is a solid wood panel made from planed timber that is glued and pressed together, with every other layer rotated 90 degrees for increased dimensional stability. The result is a structural element with high strength and transverse stiffness in relation to its low weight. CLT paves the way for a wealth of uses.

CLT floor systems can be supplied with large spans, giving plenty of layout options and the choice of large, open spaces. CLT is designed to allow for efficient assembly and can be put to good use in mezzanine or residential floor systems.

CLT walls are usually chosen for their considerable load-bearing and stabilising capacity. CLT also has other good physical properties that benefit any building, such as sound insulation and fire resistance. In addition, the wood's moisture buffering properties contribute towards a better, more consistent indoor climate.

CLT roof sheathing can be supplied as prefabricated elements that cover a large area and are finished with sheet metal or roof tiles.

BENEFITS OF CLT

CLT is easy to handle. Large elements and efficient joints enable rapid assembly, which is good for the overall economics of a project. The material can be worked on using traditional hand tools and is highly practical when it comes to fitting utilities. Electricians on site, for example, can drill the necessary holes in exactly the right place.

The material is lightweight. This low weight makes it simple to achieve efficient assembly with a relatively small crane. Wood is around five times lighter than concrete and therefore places much less of a load on the underlying structure, which is good news where ground conditions don't permit heavy weights and when adding new floors onto existing buildings.

Dimensionally stable material. With its cross-laminated structure, the panel keeps its shape and doesn't move due to moisture fluctuations the way solid timber does. The structural capacity of CLT is close to that of concrete in terms of material strength, with dimensionally stable and robust elements. **High load-bearing capacity and large spans.** The structure of CLT makes it a dimensionally stable material that offers flexible solutions, with few load-bearing walls and design freedom when it comes to the layout.

High degree of prefabrication. The panels are manufactured in units of up to 3 x 16 metres. Our CLT is made in a quality-assured factory environment, using CNC machining to ensure precision cutting and other types of finishing. This precision saves time and keeps every project running smoothly, without the delays caused by on-site adjustments.

No drying time. Since CLT requires no drying time, the material can be provided with its final finish immediately after assembly, giving a much better work flow on site and allowing other parts of the construction process to get started sooner.

Pleasant indoor environments. CLT can be ordered in a variety of surface qualities, offering huge scope to create attractive environments as required. The visual grade can also be sanded to achieve great aesthetic solutions. And thanks to its moisture buffering properties, CLT contributes to a good indoor climate at the same time.

High fire resistance. The solid CLT panel has extremely good properties when it comes to fire. A 5-layer sheet will usually meet class R60 (residential load) without the addition of plasterboard or other materials.

An eco-smart choice. CLT is produced from renewable raw material and manufactured in an energy-efficient process with minimal environmental impact. Wood is a natural part of the ecocycle, as it binds carbon dioxide for its entire lifetime.

Wuddhouse, Arlandastad
Architect: White Arkitekter
Client: WUDD Fastigheter
Contractor: Effective Solutions

Sara Kulturhus, Skellefteå
Architect: White Arkitekter
Client: Skellefteå Municipality
Contractor: Hent

PRODUCT RANGE

A summary of Holmen's CLT range, including the surface quality grades offered.

PRODUCT RANGE

CLT is made from planed timber and is available in various lengths up to 16 metres. The raw outer dimensions of the panel can be freely adjusted from 2 metres up to 3 metres. The top layer of CLT runs either lengthwise (L) or crosswise (C), with C-panels being suitable for use in walls. The board is not edge-glued as the lamellas then have room to move, minimising aesthetic splitting. CLT may be used in service classes 1 and 2.

Thickness (mm)	Self-weight for lifting and transport (kg/m²)	No. of layers	U-value*	Thickness per layer	Strength class per layer
60	28	3	1.49	20+20+20	C24-C24-C24
70	33	3	1.33	20+30+20	C24-C14-C24
80-00	37	3	1.20	30+20+30	C24-C14-C24
80-0B	38	3	1.20	20+40+20	C24-C14-C24
90	42	3	1.09	30+30+30	C24-C14-C24
100-00	47	3	1.00	30+40+30	C24-C14-C24
100-0B	46	3	1.00	40+20+40	C24-C14-C24
120	56	3	0.85	40+40+40	C24-C14-C24
140	65	3	0.75	46.5+46.5+46.5	C24-C14-C24
100	48	5	1.00	20+20+20+20+20	C24-C24-C24-C24-C24
120-00	58	5	0.85	20+30+20+30+20	C24-C14-C24-C14-C24
120-0B	57	5	0.85	30+20+20[1]+20+30	C24-C14-C24-C14-C24
130	62	5	0.80	30+20+30+20+30	C24-C14-C24-C14-C24
140-00	68	5	0.75	20+40+20+40+20	C24-C14-C24-C14-C24
140-0B	66	5	0.75	40+20+20[1]+20+40	C24-C14-C24-C14-C24
150	72	5	0.70	30+30+30+30+30	C24-C14-C24-C14-C24
160	76	5	0.67	40+20+40+20+40	C24-C14-C24-C14-C24
180-00	87	5	0.60	30+45+30+45+30	C24-C14-C24-C14-C24
180-0B	86	5	0.60	40+30+40+30+40	C24-C14-C24-C14-C24
200	96	5	0.54	40+40+40+40+40	C24-C14-C24-C14-C24
230	110	5	0.48	46+46+46+46+46	C24-C14-C24-C14-C24
170	83	7	0.63	20+30+20+30+20+30+20	C24-C14-C24-C14-C24-C14-C24
180-2S	87	7	0.60	(30+30[2])+20+20[1]+20+(30+30[2])	C24-C24-C14-C24-C14-C24-C24
200	98	7	0.54	20+40+20+40+20+40+20	C24-C14-C24-C14-C24-C14-C24
210	102	7	0.52	30+30+30+30+30+30+30	C24-C14-C24-C14-C24-C14-C24
220-2S	106	7	0.50	(40+40[2])+20+20[1]+20+(40+40[2])	C24-C24-C14-C14-C14-C24-C24
240-00	116	7	0.46	45+20+45+20+45+20+45	C24-C14-C24-C14-C24-C14-C24
240-2S	116	7	0.46	(45+45[2])+20+20[1]+20+(45+45[2])	C24-C24-C14-C24-C14-C24-C24
270-00	131	7	0.41	45+30+45+30+45+30+45	C24-C14-C24-C14-C24-C14-C24
270-2S	131	7	0.41	(45+45[2])+30+30[1])+30+(45+45[2])	C24-C24-C14-C24-C14-C24-C24
280	136	7	0.40	40+40+40+40+40+40+40	C24-C14-C24-C14-C24-C14-C24
300	146	7	0.37	45+40+45+40+45+40+45	C24-C14-C24-C14-C24-C14-C24

Strength code
00C24
0BC24
2SC24

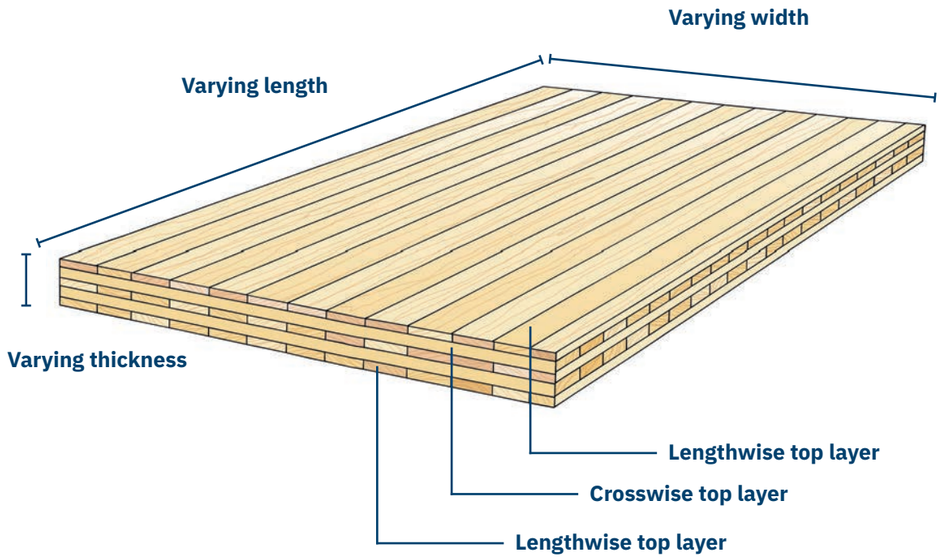
* Lambda = 0.12 according to tech. approval. $R_{si} + R_{se} = 0.17$.
[1] = Lengthwise lamellas of grade C14.
[2] = Double layer of lengthwise lamellas.

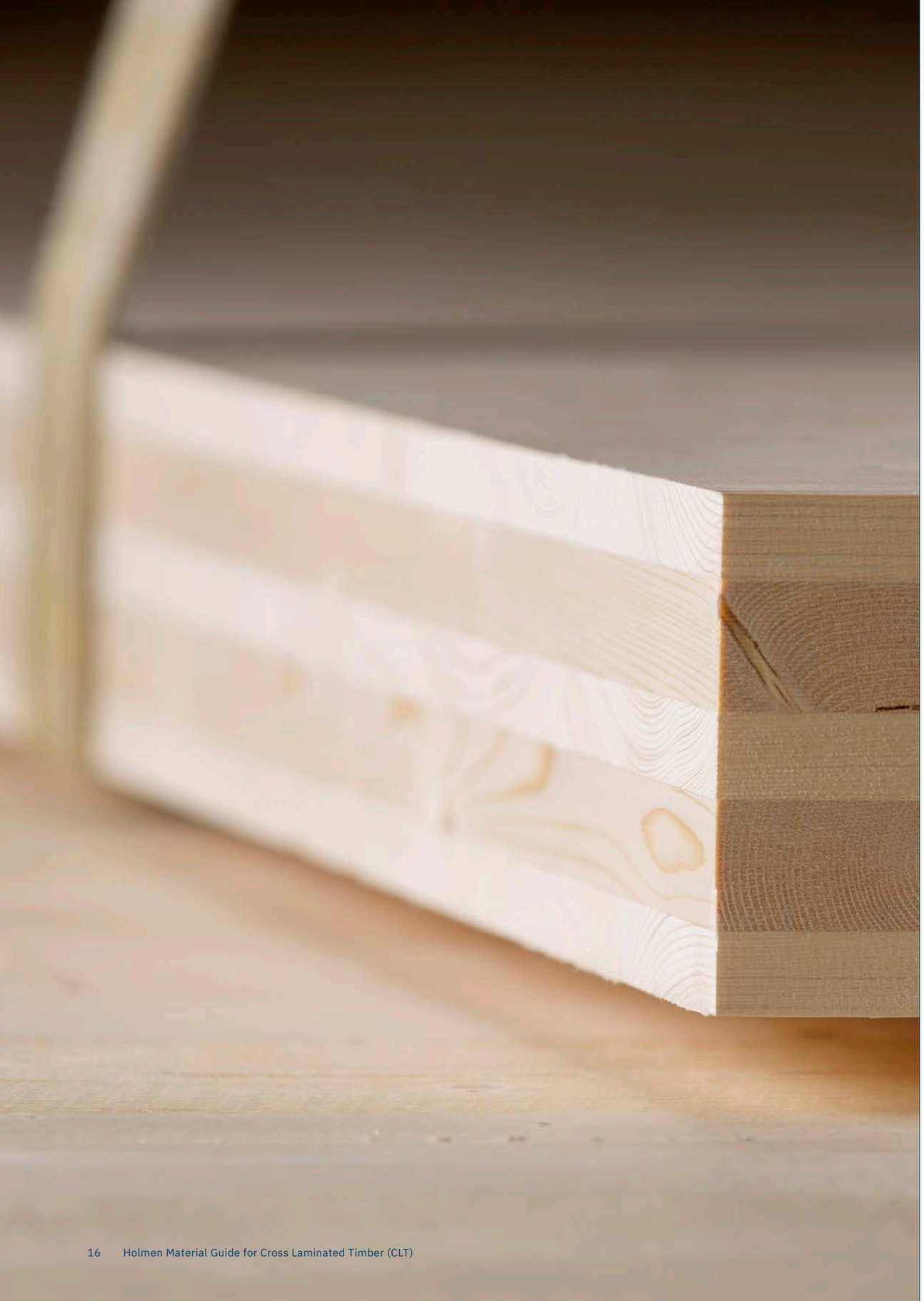
When dimensioning, values such as strength and density etc. normally follow the standard SS EN 338-2016, see page 24 of this guide. The CLT panels are manufactured in accordance with type approval SC0665-17 and are supplied with a target moisture content of 12 per cent.

For more information, visit **holmen.com/#Wood_Products**

Target tolerance for finished panels in line with type approval

Length and width	± 2 mm
Thickness	± 1 mm for 3-layer panels ± 1.5 mm for 5-layer panels ± 2 mm for 7-layer panels
Edge straightness	± 2 mm for measured length 1 200 mm ± 9 mm for measured length 6 000 mm
Squareness	± 1° deviation from 90°
Diagonal dimensions	± 3 mm



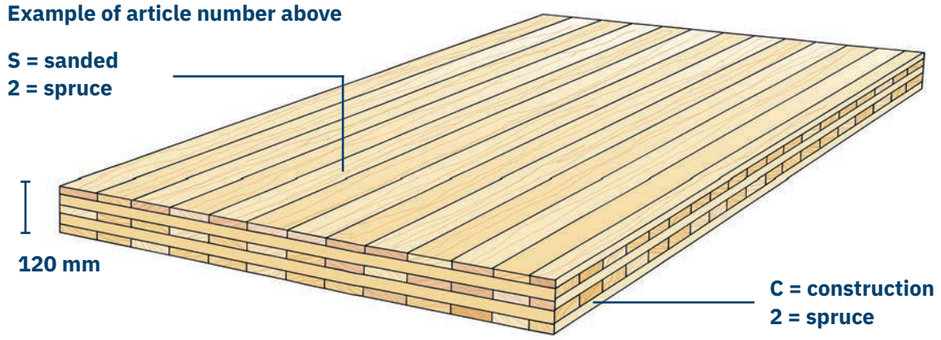


Article number for production

L-120-05-00C24-CS-22

Orientation top layer	**Thickness**	**No. of layers**	**Strength code**	**Surface quality per side**	**Wood species per side**
L = Lengthwise	060	3	00C24	C = Construction	1 = Pine
C = Crosswise	070	5	0BC24	I = Industry	2 = Spruce
	080	7	2SC24	S = Sanded	
	090				
	100				
	120				
	140				
	150				
	160				
	170				
	180				
	200				
	210				
	220				
	230				
	240				
	270				
	280				
	300				

Example of article number above



Article quality beyond CC includes the following categories: CI, CS, II, IS and SS.

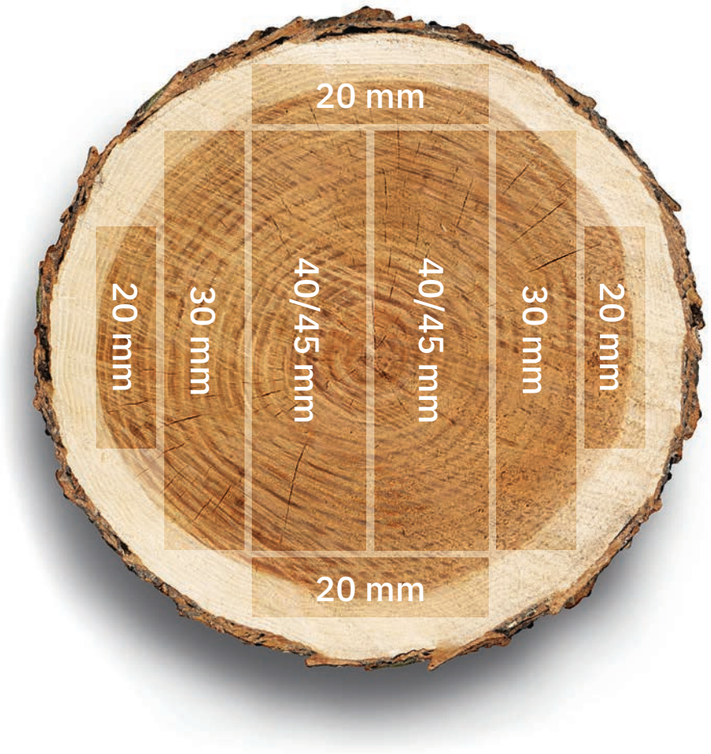
Example: A panel specified as SC is always glued as CS. This is because the highest quality is listed last.

SURFACE QUALITY GRADES

CLT can be supplied in three different surface qualities:

- **Construction (non-visual)**
- **Industry (industrial visual)**
- **Sanded (visual)**

End use and needs determine which surface quality is chosen. The different surface quality grades are based on SS-EN 13017-1. Different dimensions of wood are used depending on the composition of the panel. The visual impression can therefore vary depending on where on the log it comes from.



CONSTRUCTION (NON-VISUAL)

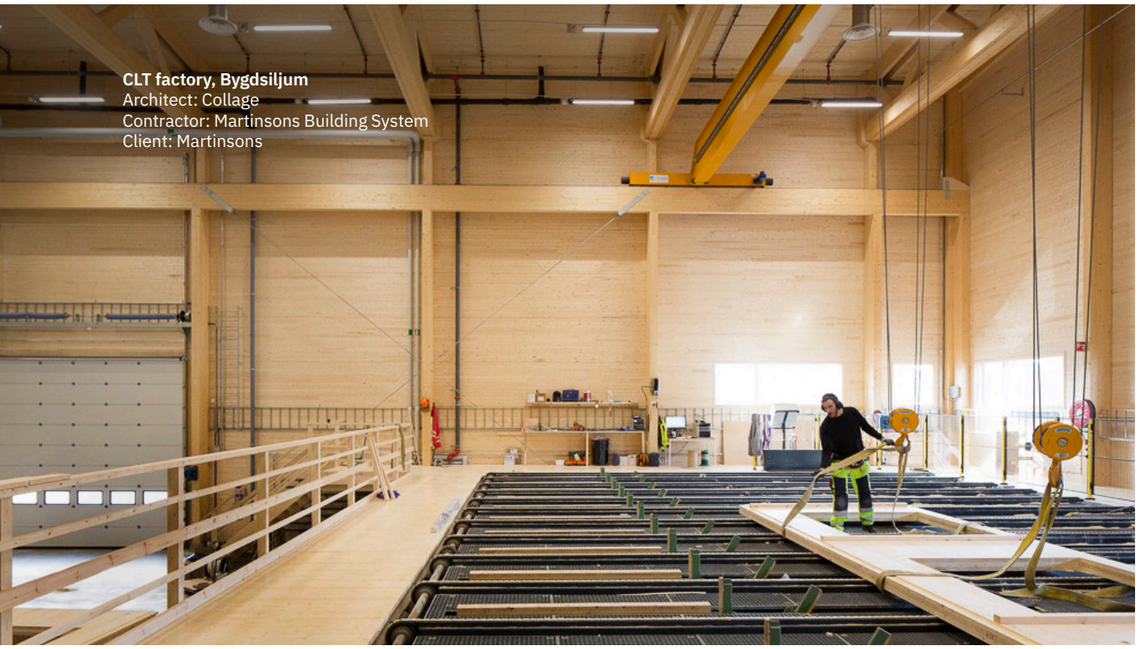
This surface quality is intended for CLT panels that will be encased and not visible in the finished building. No visual inspection for visible defects is carried out in the factory. This surface quality is standard unless otherwise specified when ordering.

Sports hall, Skellefteå
Architect: Collage
Contractor: PEAB
Client: Skellefteå Municipality

INDUSTRY (INDUSTRIAL VISUAL)

Industry grade uses the same raw material as for Construction grade, but with the most obvious visual defects removed. Some natural defects are allowed, but the panel undergoes a visual inspection and any repairs are carried out in the factory. This surface quality is recommended when the CLT board will be visible from a slight distance or in the type of space where more natural defects are acceptable. Examples include roofs, walls in industrial buildings and sports halls.

The panels may have adhesive residues on the surface after manufacture. If this is not desirable, they should be ordered as Sanded grade,

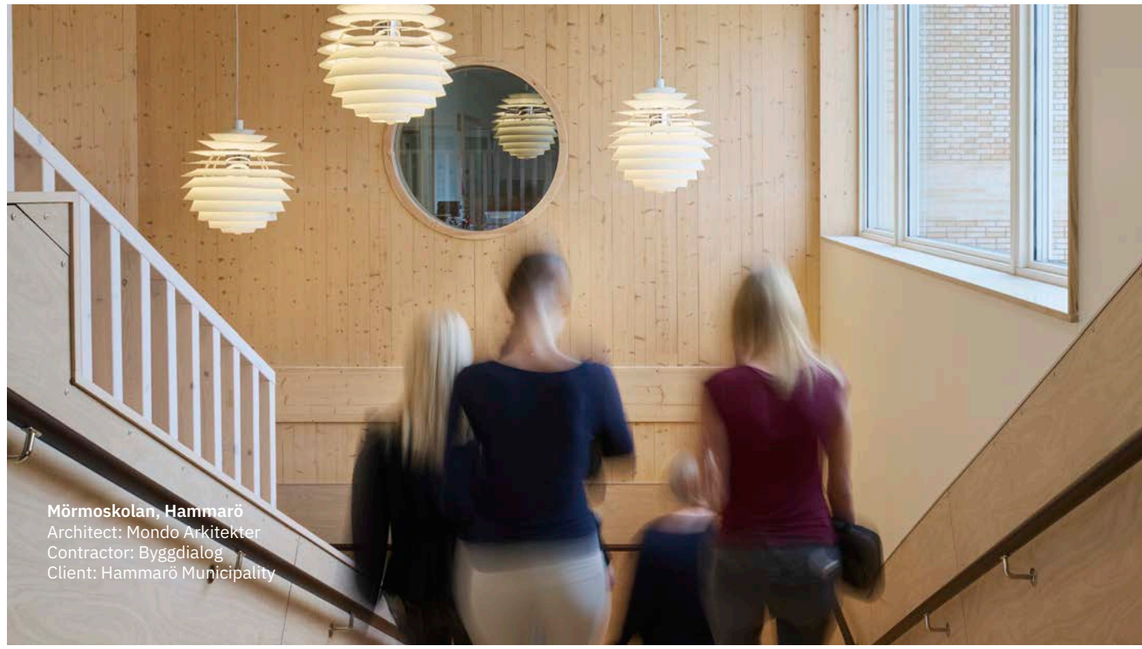


CLT factory, Bygdsiljum
Architect: Collage
Contractor: Martinsons Building System
Client: Martinsons

SANDED (VISUAL)

the finest grade available. To achieve this grade, a special raw material is used on the top layer, the surface is inspected visually and any defects are repaired. The panel is then finished in a sanding machine with 80 grit paper. This surface quality is recommended when the CLT panel will be visible in the finished structure and people will be close enough to touch it. Examples include walls for homes and offices.

For further information on surface quality, see Swedish Wood's "Guide to assessing CLT surface quality".



Mörmoskolan, Hammarö
Architect: Mondo Arkitekter
Contractor: Byggdialog
Client: Hammarö Municipality

Morö Backe Skola, Skellefteå
Architect: MAF Arkitektkontor
Client: Skellefteå Municipality
Contractor: Peab Sweden

PROCESSING

Information on how CLT can be processed to best meet your project's needs.

CNC MACHINING

Width

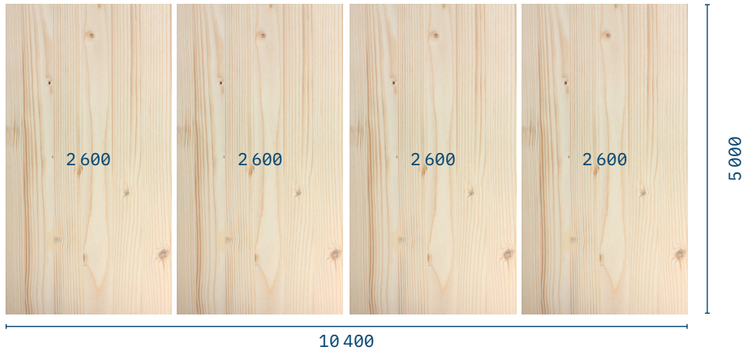
- **Min 2 005 mm**
- **Max 3 000 mm**

Length

- **Min 8 100 mm. Usually, this does not need to be taken into account, as several elements are taken from the same original panel.**
- **Max 16 000 mm**

If possible, all panels should be made the same width, as this will minimise waste. It also makes it easier to package the panels and put them in the right order for assembly. As such, both the maximum and minimum width of the panels should be taken into account.

Like this: Example floor 5 x 10.4 m (top view)



Not like this:

CLT factory, Bygdsiljum
CNC machine

CNC TOLERANCES

The CNC machine has a tolerance of ±2 mm, which means that there is some slight variation in the precision of the component manufacturing. To ensure the smooth functioning of the building system on site, it is important that this tolerance is taken into account during planning and construction.

SURFACE TREATMENTS

To ensure a surface finish that lasts, a surface treatment can be applied in the factory.

These treatments can be divided into the following categories:

- **Aesthetic**
- **Moisture-proofing**
- **Fireproofing**

Get in touch with your sales contact at Martinsons for more information on the various surface treatment options.

Brinkskolan, Täby
Architect: Link Architecture
Client: Täby Municipality
Contractor: Boetten Bygg AB

MATERIAL PROPERTIES

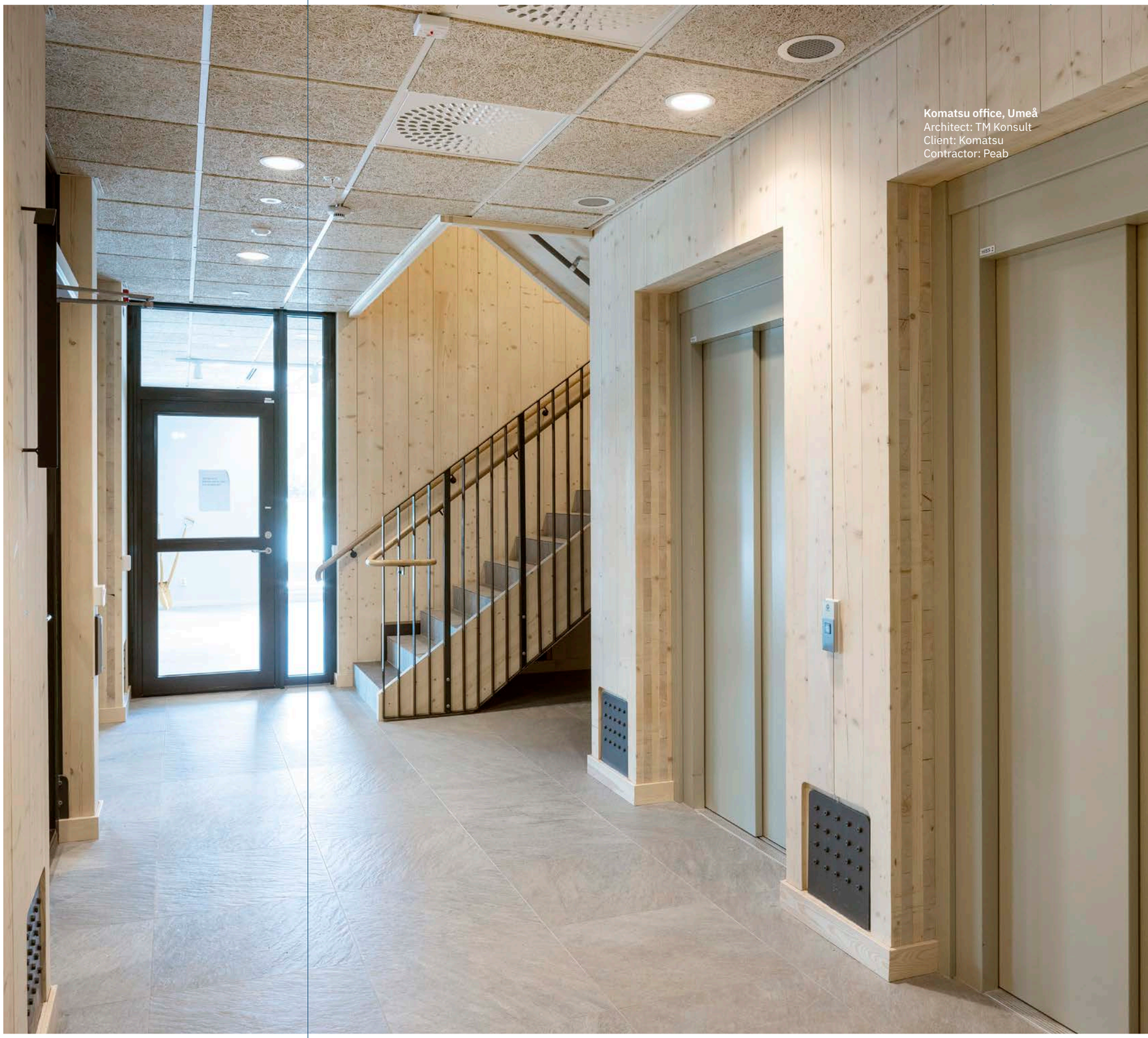
Facts about the properties of the layers, as well as information about acoustics, fire and certifications.

Material properties – input lamellas

Strength classes – characteristic values			
Softwoods	$f_{m,g,k}$	C14	C24
Strength properties (in N/mm²)			
Bending strength	$f_{m,k}$	14	24
Tensile strength along the grain	$f_{t.0.k}$	8	14
Tensile strength across the grain	$f_{t.90.k}$	0.4	0.4
Compressive strength along the grain	$f_{c.0.k}$	16	21
Compressive strength across the grain	$f_{c.90.k}$	2.0	2.5
Stiffness values for stability calculations and load-bearing capacity (in N/mm²)			
Modulus of elasticity	$E_{0.04}$	4.7	7.4
Stiffness values in serviceability limit state (in N/mm²)			
Modulus of elasticity along the grain	$E_{0,mean}$	7	11
Modulus of elasticity across the grain	$E_{90,mean}$	0.23	0.37
Shear modulus	E_{mean}	0.44	0.69
Density in kg/m³			
Characteristic density	P_k	290	350
Mean density	P_{mean}	350	420

Note: Values above follow SS EN 338-2016. Specified properties are compatible with wood of 12 per cent moisture content.

Read more about the strength and stiffness values of finished boards at www.martinsons.se



Komatsu office, Umeå
Architect: TM Konsult
Client: Komatsu
Contractor: Peab

AIR TIGHTNESS

CLT panels can usefully be incorporated into the building envelope, for example in external walls and/or roofs. A key factor for the building envelope is airtightness and a common question is whether CLT on its own has sufficient integrity on this score. Measurements of a limited sample of panels have shown airtightness far in excess of required levels, for both three- and five-layer panels. And this remains the case even after a few percentage points of drying from the delivery moisture content of 12 per cent.

Leakage levels at 50 Pa were so small as to be negligible, and at 100 Pa air leakage was measured at no more than 0.2 $m^3/(h*m^2)$. Compare this with the requirement for the Passive House standard of 1.08 $m^3/(h*m^2)$ at 50 Pa.

The recommendation is that the CLT should generally be placed on the warm side of the building envelope, primarily for reasons of comfort and thermal inertia. Joints between building elements do require sealing to meet the building's airtightness requirements. This can be done from the inside but also on the outside of the CLT. Depending on the structure of the wall, one may be easier than the other. The alternative is to work with a membrane on the outside of the CLT board to ensure airtightness. The benefits of this are that it can act as a moisture barrier for the facade during construction and it removes the need to seal joints.

BURGLARY RESISTANCE CLASS

The CLT from Holmen has undergone independent testing by RISE Research Institutes of Sweden for theft prevention certification. The tests demonstrated how well different dimensions of CLT can withstand attempted break-ins, with 60–100 mm CLT achieving SSF 1047 class 2, while panels of 120 mm and thicker SSF 1047 attain class 3.

Test methods The different classifications are based on the use of different tools.

Class 1: Getting through a class 1 barrier requires only a knife, hands and fingers, and very little time.

Class 2: The test for class 2 is whether a hole big enough for a person to get through can be cut using a one-handed axe and a crowbar in under five minutes. The 60 mm CLT held out for a time of 8 minutes and 27 seconds.

Class 3: To achieve class 3, it must take at least 10 minutes with a 1.2 kg two-handed axe to create a 300 x 600 mm hole, a standard the 120 mm CLT successfully achieved.

Applications In addition to walls, CLT can be used in roofs where the theft prevention classification also applies. This may be relevant for premises where the building also needs to withstand intrusion from above, for example.

Testing of CLT wall elements was performed according to SSF 1047 edition 2.

Thickness	Requirement fulfilled
60–100 mm	SSF 1047, class 2
>120 mm	SSF 1047, class 3

SOUND

CLT panels can, in principle, be used for the structural frame in buildings with the same spans and dimensions as concrete. However, the density of CLT is only a fifth of that of concrete and its elastic modulus is more than 10 times lower. This means that sound insulation is around 15 dB less effective for normal thicknesses within the range 100–250 mm.

Guided by particular acoustic requirements
In offices, for example, where the thresholds are low, it will often be sufficient to cover the CLT with some form of cladding (plasterboard, for example). In apartment blocks, where the acoustic standards are higher, supplementary cladding of some kind is usually required. This might, for example, mean having double walls separating apartments, and a flooring or ceiling layer that complements the CLT floor system.

The table shows examples of the frequency-weighted sound reduction index for pure CLT boards. The table also shows the results of applying one and two layers of plasterboard (9 kg/m^2) to CLT walls. The sound reduction index serves as an indication of the sound insulation achieved when measured in the lab on a real structure.
More information can be found in the CLT Handbook from Swedish Wood.

Quantities and terms used
Sound insulation is the collective name for airborne sound insulation and impact sound insulation. The purpose of airborne sound insulation requirements is to avoid disturbance and to ensure privacy.

Impact sound insulation requirements are applied to avoid disturbance.

Previously, airborne sound insulation was stated as R'w and specifically for dwellings as R'w + C 50-3150 and impact sound insulation as L'n,w or L'n,w + C CI 50-3150, all in decibels (dB). These metrics indicating the sound insulation of the structure are the focus of this section.

Summary of frequency-weighted sound reduction index for single walls

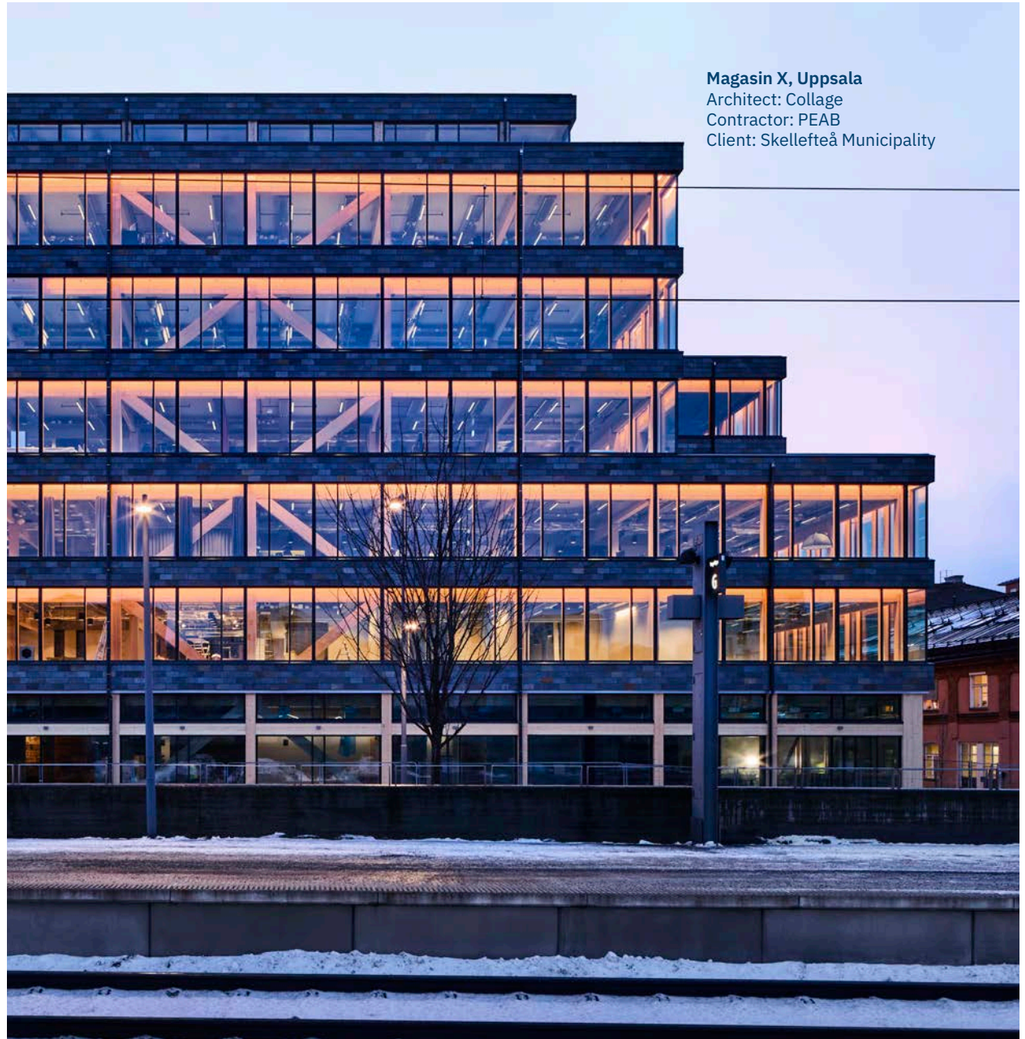
	CL		CL+1 plasterboard		CL+2 plasterboard	
Thickness	R_w	$R_{w,50}$	R_w	$R_{w,50}$	R_w	$R_{w,50}$
70	31	30	34	32	36	34
90	33	32	35	34	37	35
100	34	33	36	34	37	36
120	36	34	37	36	38	37
140	37	35	38	37	39	38
160	38	37	40	38	41	39
180	40	38	41	39	42	40
210	41	39	42	40	43	41
240	42	40	43	41	44	42

In practice, the anchoring of the structure and flanking transmission must also be taken into account.

Sound requirements Airborne sound insulation requirements range from R'w = 35 dB for offices up to R'w + C 50-3150 = 60 dB for residential buildings in sound insulation class A. Music rooms, cinemas or similar spaces are subject to even higher requirements. Sound requirements up to R'w + C 50-3150 = 60 dB can be achieved with CLT. The requirements for impact sound insulation vary from no requirement, for example between offices, down to L'n,w + CI 50-3150 = 48 dB for sound insulation class A.

In some cases, such as studios and auditoriums, higher requirements apply. Requirements for sound insulation between dwellings are given as a standardised sound level difference DnT, 50 for airborne and LnT, w, 50 for impact sound insulation. These quantities depend on factors such as the volume of the room, so the results cannot be used for generalised calculations.

We therefore report results as R'w + C 50-3150 and L'n + CI 50-3150. From these values, it is then possible to calculate DnT, w, 50 and LnT, w, 50.



Magasin X, Uppsala
Architect: Collage
Contractor: PEAB
Client: Skellefteå Municipality

FIRE

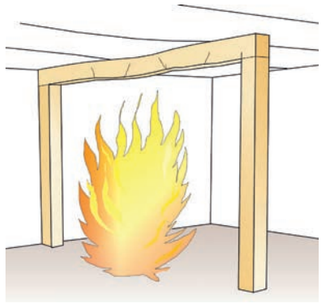
CLT is regularly used as a framing material even where fire safety requirements are particularly tough, such as for residential buildings over four storeys high. In the event of a fire, the wood material could certainly begin to burn, but the dimensioning takes into account the penetration that occurs and the penetration rate takes into account the charred layer of thermal insulation that forms.

Fire resistance The fire safety class for load-bearing and separating building components, whatever their material, is broken down according to the functions: load-bearing capacity (R), integrity (E, seal against fire gases and flames), and insulating capacity (I, insulation relating to temperature rises on the side not exposed to fire). A time element such as 15, 30, 45, 60 or 90 minutes is then added to fully describe the requirements that a building component must meet. The numbers state the time in minutes that the building component will resist the effects of a standard fire without losing its load-bearing or fire separation function.

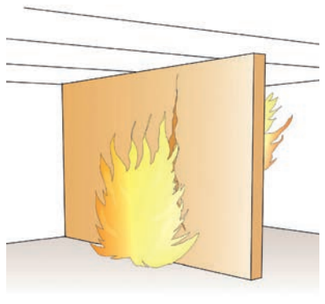
Fire safety class of surface materials A surface material is defined as the visible outer part of a building's structure that may be exposed in a fire's early phase, with the surface material class indicating the capacity to prevent or delay flashover and development of smoke.

An untreated CLT panel meets surface material class D-s2,d0. Where a higher class is required, there are various options, including finishing the CLT with a fireproofing paint or encasing it in a material of a higher surface material classification. Surface material class B-s1,d0 is a relatively common requirement, which is achieved via surface treatment or encasing with another material. Requirements concerning non-combustible finishes can be met using plasterboard or fireproofing paint. Apartment blocks of 5–8 storeys are usually classed as Br1 buildings and tend to fall into fire safety class EI60, as well as R90 for a vertical supporting structure and R60 for floor systems.

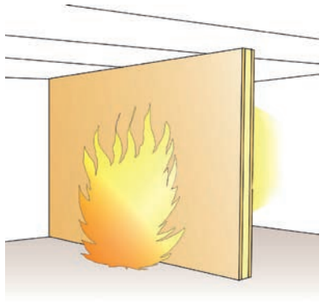
CLT panels in themselves are well able to perform a load-bearing and separating function, but to meet the requirements above and the requirements for surface materials in apartment blocks they are often clad in plasterboard. Integrity E is met if two glue lines remain intact after a fire. Insulation I is achieved with just a few cm of CLT, which means that all CLT panels fulfil the requirement.



Load-bearing capacity R



Integrity E



Insulation I

Swedish Wood has more information on CLT and its fire safety performance.

M-WALL

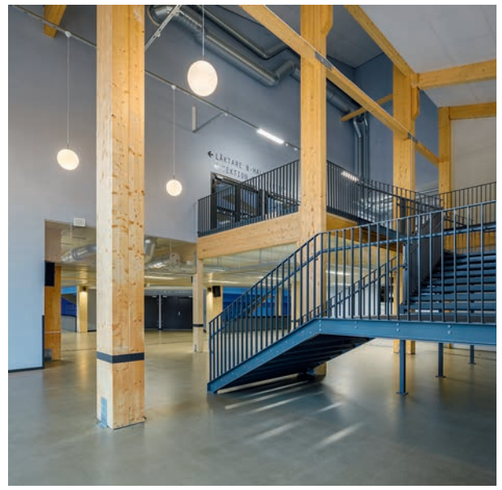
The Swedish National Board of Housing, Building and Planning's building regulations (BBR) require that a wall "shall withstand the mechanical impacts that are likely to occur in case of fire" and state "The firewall between buildings shall have sufficient stability and load-bearing capacity that it is possible for buildings on either side to collapse without an appreciable reduction in the properties of the firewall."

A common way of classifying an M-rated wall, regardless of material, is via testing to the EN 1363-2:1999 standard.

The table shows examples of the choice of panels according to the fire safety class. The ability of the panels to fulfil the mechanical impact requirement is based on calculations corresponding to the load in the wall test specified in standard EN 1363-2:1999. Note that the table is only indicative and that the design must always be carried out by a competent structural engineer.

The table is relatively independent of the actual wall height/width and refers to:

- **Walls without vertical load, although they may fulfil the function of an M-rated wall and of a frame-stabilising wall at the use stage.**
- **Fire on one side only.**
- **Application in load-bearing direction with greatest stiffness.**



Fire safety class	Cladding	Panel
R30-M	-	140-3s
R30-M	Fire-resistant plasterboard 15 mm	120-3s
R60-M	Fire-resistant plasterboard 15 mm	140-3s
R90-M	Fire-resistant plasterboard 15 mm	160-5s
R120-M	Fire-resistant plasterboard 15 mm	200-5s

There are many possible variants of the wall structure, and the examples in the table represent only some of the possibilities. If more sheets of plasterboard are added, thinner CLT can be used.

Martinsons' structural engineers can design solutions to meet specific needs regarding other fire safety classes or forms of cladding.

Martinsons Building System

VALUE-CREATING EXPERTISE

Martinsons develops and supplies timber framing systems for everything from industrial buildings, commercial premises and sports halls to high-rise apartment blocks and office buildings. As part of the Holmen Group, we offer a secure value chain with full control over the entire project process – from forest raw material to finished building.

The skillsets of our employees complement each other to create exactly the package we want to offer our customers and partners. We have expertise in everything from sales, consultancy and costing, to development, design, project management and installation.

Our ability to draw on the knowledge accumulated over the company's many years in the business – with thousands of projects completed – makes it only natural that we will continue to drive forward the development of new, more efficient and smart ways to build sustainably with wood.

We are more than happy to take the lead in project partnerships, to enable a green vision of the future through our value-adding expertise.

DELIVERY AND HANDLING

Information on delivery, handling on site and lifting methods during assembly.

Sara Kulturhus, Skellefteå
Architect: White Arkitekter
Client: Skellefteå Municipality
Contractor: Hent

SHIPPING AND PACKAGING

Early assembly planning
The project managers at Martinsons are keen to receive information about the order of assembly as early as possible, to aid in planning the factory work and to ensure the right wrapping and packing. The CLT is usually delivered horizontal on an open or covered truck.

Fully wrapped packages
If a covered truck is required, the panels are best designed with a maximum width of 2.4 m.

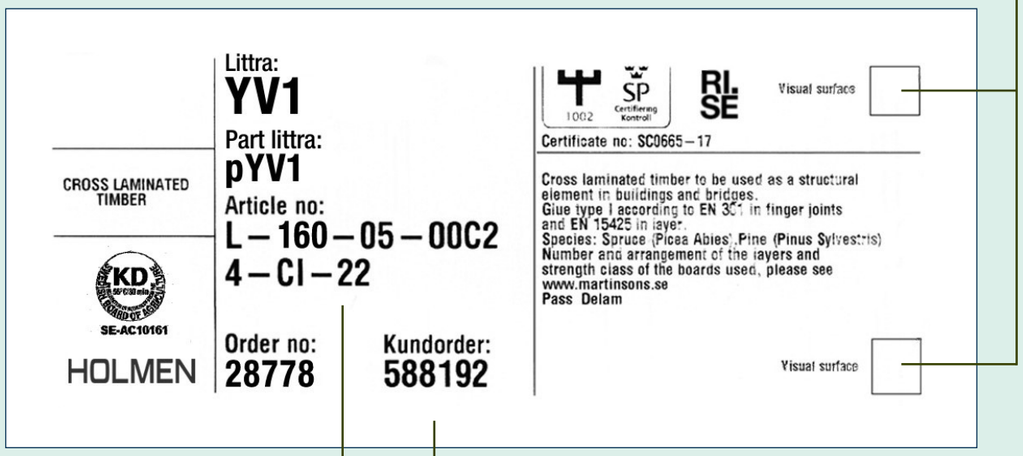
Whether delivered by open or covered truck, the panels are normally delivered fully wrapped, with several panels in each package according to the agreed packing list.

The target moisture content at delivery is 12 per cent.

Always DPU (Delivered at Place Unloaded)
As standard, Martinsons always requires site access for a 20-tonne trailer, unless otherwise agreed. Martinsons always delivers DPU unless otherwise agreed.

A coded product label is stuck on each individual panel.

A manual mark to show which side is a visual surface.



See page 17 for how to read the article number.

Internal order number

Coded components and subcomponents
As part of the project planning, we sometimes want certain components to be assembled in the factory. Two different designations are used for this purpose. The main component code (*Littra*) always refers to the prefabricated element to be delivered to the construction site and is the designation shown on the drawings. The subcomponent code (*Part littra*) represents each unique part manufactured. A component may therefore consist of several different subcomponents. To distinguish these parts, they are marked with a “p” at the beginning of the designation.

Shipping label
Adding several elements together creates a shipment/package. A shipping label is used to describe the contents, providing information such as package number, shipment number and delivery address.

Shipping label

Delivery address

RECEIPT AND DELIVERY

Like all construction products, careful storage and handling of CLT is essential, as it can impact not just on the durability and design of the structure, but also the economics and planning of the project. We have provided a checklist below to ensure a smooth construction process:

- **Plan the assembly well ahead of unloading to avoid time-consuming rearranging.**
- **Check that the packaging is intact.**
- **Check that the number of elements and the dimensions match the order and the delivery note.**
- **Check the delivery and note any visible damage. Check the strength and appearance class and the labelling against the order and the delivery note.**
- **Take random samples of the moisture content at a number of locations using an electrical resistance moisture meter with insulated hammer electrodes, to get an indication that the moisture content matches the order.**
- **Check that the CLT elements are clear of soil and dirt.**
- **Avoid temporary storage and, if possible, assemble directly from the truck.**
- **Do not place CLT elements where there is a risk of soiling and splashing from guttering or traffic, for example.**
- **Make sure the storage location is in the shade in spring, summer and autumn. Sunlight makes the surfaces of packaged CLT hotter than the ambient temperature, which can lead to splitting or condensation, which in turn increases the risk of microbial growth.**
- **Rest the components on clean supports, at least 300 mm off the ground or the floor, to provide good ventilation. Make sure you have enough supports to stop the CLT elements bending.**
- **The substrate should be dry and level, so the CLT elements are not subject to stresses that can cause lasting deformations.**

ASSEMBLY LIFTING

A system such as SIGHA PICK can be used when installing CLT. This method is based on an expanding lifting plug, fitted into holes pre-drilled in the factory, and can handle weights of around 500–1000 kg per lifting device, depending on the lifting angles. Using the SIHGA PICK system involves drilling 50 mm holes, which must be repaired with a wooden plug immediately after the lifting device is removed.

MOISTURE DURING CONSTRUCTION

Managing moisture in the erection of a CLT frame is a key factor that requires active cooperation with the main contractor, from the early stages of the construction project to the completion of the building.
The brief exposure of wood, in this case CLT, to rain does not damage the chances of a quality-assured end result.

But it is important to ensure that both the technical solutions for the frame and the moisture management procedures are designed to avoid unnecessary exposure to unfavourable weather conditions. It is also important that the wood is sufficiently dried out before being encased.

Proper moisture prevention measures during frame construction therefore serve two purposes:

- **To prevent the risk of prolonged exposure to moisture.**
- **To avoid the unnecessary time and cost of drying out the pre-assembled frame.**

Two main types of moisture protection are available when constructing a CLT frame. You can either choose a full temporary shelter or you could opt for multiple smaller interventions to limit the impact of any moisture. This might include anything from sealing holes and joints to using small mobile all-weather shelters. This latter option involves more active work throughout the construction process.

DIMENSIONING AND TECHNICAL SOLUTIONS

Span tables, joint types and
tips on where to find further information.

Åsveinen Skole, Trondheim, Norway
Architect: Eggen Arkitekter
Client: Trondheim Municipality
Contractor: Betonmast

Span table floor systems[1]

R0
R30
R60

Martinssons CLT Format: 3000 x length x thickness [mm]

Load type[2]	Category A (Residential) 2.0 kN/m²		Category B (Office) 2.5 kN/m²		Category C:3 3.0 kN/m²		Category C:4 4.0 kN/m²		Category C:5 5.0 kN/m²	
Panel[3]	**Max span[4]**	**Deformation[6]**	**Max span[4]**	**Deformation[6]**	**Max span[4]**	**Deformation[6]**	**Max span[4]**	**Deformation[6]**	**Max span[4]**	**Deformation[6]**
CL60-3s	2.3	L/315	2.2	L/306	2.4	L/209	2.2	L/214	2.1	L/204
CL70-3s	2.6	L/325	2.5	L/309	2.7	L/218	2.5	L/217	2.4	L/203
CL80-3s A	3.1	L/304	2.9	L/315	3.2	L/209	3.0	L/203	2.8	L/207
CL80-3s B	2.9	L/319	2.8	L/304	3.4	L/228	2.8	L/213	3.0	L/216
CL90-3s	3.4	L/312	3.2	L/317	3.5	L/217	3.3	L/208	3.1	L/207
CL100-3s A	3.7	L/314	3.5	L/315	3.9	L/205	3.6	L/208	3.4	L/205
CL100-3s B	3.8	L/314	3.6	L/319	4.0	L/206	3.7	L/210	3.5	L/206
CL120-3s	4.5	L/302	4.2	L/318	4.6	L/218	4.3	L/214	4.1	L/206
CL140-3s	5.1	L/313	4.9	L/306	5.3	L/217	5.0	L/209	4.6	L/204
CL100-5s	3.5	L/318	3.4	L/301	3.7	L/209	3.4	L/214	3.2	L/213
CL120-5s A	4.0	L/317	3.8	L/319	4.2	L/212	3.9	L/212	3.7	L/208
CL120-5s B	4.4	L/301	4.1	L/318	4.6	L/204	4.2	L/213	4.0	L/205
CL130-5s	4.6	L/319	4.4	L/317	4.9	L/205	4.6	L/201	4.3	L/205
CL140-5s A	4.5	L/308	4.3	L/305	4.7	L/211	4.4	L/208	4.1	L/214
CL140-5s B	5.1	L/311	4.8	L/322	5.3	L/214	4.9	L/220	4.6	L/221
CL150-5s	5.2	L/302	4.9	L/312	5.3	L/222	5.1	L/202	4.8	L/203
CL160-5s	5.7	L/311	5.5	L/302	5.7	L/244	5.6	L/210	5.3	L/208
CL180-5s A	5.7	L/335	5.6	L/309	5.7	L/263	5.6	L/227	5.5	L/202
CL180-5s B	6.0	L/343	5.9	L/317	6.0	L/269	6.0	L/221	5.7	L/218
CL200-5s	6.3	L/368	6.3	L/325	6.3	L/290	6.3	L/240	6.3	L/205
CL230-5s	6.8	L/422	6.8	L/374	6.8	L/335	6.8	L/279	6.8	L/239
CL170-7s	5.2	L/331	5.0	L/329	5.3	L/230	5.1	L/227	4.9	L/215
CL180-7s 2S	6.2	L/358	5.9	L/351	6.2	L/282	6.2	L/231	6.0	L/216
CL210-7s	6.3	L/380	6.3	L/335	6.3	L/300	6.3	L/248	6.3	L/211
CL220-7s 2S	7.0	L/422	7.0	L/376	6.9	L/361	7.0	L/288	7.0	L/246
CL240-7s	7.1	L/455	7.1	L/406	7.1	L/364	7.1	L/303	7.1	L/260
CL240-7s 2S	7.4	L/465	7.4	L/400	7.4	L/372	7.4	L/310	7.4	L/265
CL270-7s	7.4	L/493	7.4	L/446	7.4	L/404	7.4	L/338	7.4	L/290
CL270-7s 2S	7.8	L/520	7.8	L/454	7.8	L/419	7.8	L/350	7.8	L/301
CL280-7s	7.4	L/493	7.4	L/440	7.4	L/398	7.4	L/332	7.4	L/286
CL300-7s	7.7	L/538	7.7	L/481	7.7	L/438	7.7	L/367	7.7	L/317

Conditions:

[1] EKS 12, SS-EN1995-1-1, Safety class 3, Service class 1, Permanent load = panel self-weight + 50
[2] Imposed loads excluding movable partitions according to 6.3.1.2(8) of SS-EN 1991-1-1
[3] Fundamental frequency minimum requirement ≥ 8 Hz, Sagging ≤ 1.5 mm at floor system width of 3.0 m
[4] Fundamental frequency recommended for residential ≥ 10 Hz, Sagging ≤ 0.9 mm at floor system width of 3.0 m
[5] Quasi-permanent combination Eq. 6.16a & 6.16b (SS-EN 1990)
[6] Fire resistance is given for unprotected panel, fire on one side only. Higher fire resistance can be achieved using shorter spans than the maximum or encasing.

Roof span table

The general recommendation for compact roofs (low-pitch) is to always attach a bitumen-based roofing felt tightly onto the CLT boards before insulating the roof.

R0
R15
R30
R60

Panel type	Snow zone (kN/m²)							
	1.0	1.5	2.0	2.5	3.0	3.5	4.5	5.5
CL60-3s	3.6	3.6	3.3	3.3	3.2	3.1	3.0	2.9
CL70-3s	4.1	4.1	3.8	3.7	3.6	3.6	3.4	3.3
CL80-3s A	4.8	4.7	4.4	4.3	4.2	4.1	4.0	3.8
CL80-3s B	4.5	4.5	4.2	4.1	4.0	3.9	3.8	3.6
CL90-3s	5.2	5.2	4.9	4.7	4.6	4.6	4.4	4.3
CL100-3s A	5.7	5.6	5.3	5.2	5.1	5.0	4.8	4.7
CL100-3s B	5.8	5.7	5.4	5.3	5.2	5.1	4.9	4.7
CL120-3s	6.7	6.6	6.3	6.1	6.0	5.9	5.7	5.6
CL140-3s	7.6	7.5	7.2	7.0	6.9	6.8	6.6	6.4
CL100-5s	5.4	5.3	5.0	4.9	4.8	4.7	4.5	4.3
CL120-5s A	6.0	5.9	5.6	5.5	5.4	5.3	5.1	4.9
CL120-5s B	6.5	6.4	6.1	5.9	5.8	5.7	5.5	5.3
CL130-5s	6.9	6.8	6.5	6.3	6.2	6.1	5.9	5.8
CL140-5s A	6.7	6.6	6.3	6.1	6.0	5.9	5.8	5.6
CL140-5s B	7.5	7.4	7.1	6.9	6.8	6.7	6.5	6.3
CL150-5s	7.6	7.5	7.1	6.9	6.9	6.8	6.6	6.4
CL160-5s	8.3	8.2	7.8	7.6	7.6	7.5	7.2	7.0
CL180-5s A	8.5	8.4	8.1	8.1	7.8	7.7	7.5	7.3
CL180-5s B	9.0	8.9	8.5	8.3	8.2	8.1	7.8	7.6
CL200-5s	9.6	9.5	9.1	9.0	8.8	8.7	8.5	8.2
CL230-5s	10.8	10.7	10.3	10.1	10.0	9.8	9.6	9.3
CL170-7s	7.8	7.7	7.3	7.2	7.1	7.0	6.8	6.6
CL180-7s 2S	9.4	9.3	8.9	8.7	8.6	8.5	8.2	8.0
CL210-7s	9.7	9.6	9.2	9.0	8.9	8.8	8.5	8.3
CL220-7s 2S	11.1	11.0	10.6	10.4	10.3	10.1	9.8	9.6
CL240-7s	11.4	11.3	10.9	10.7	10.6	10.4	10.2	9.9
CL240-7s 2S	11.8	11.7	11.3	11.2	11.1	10.9	10.6	10.4
CL270-7s	12.2	12.1	11.7	11.4	11.4	11.2	11.0	10.7
CL270-7s 2S	12.9	12.8	12.4	12.2	12.1	11.9	11.6	11.4
CL280-7s	12.2	12.1	11.6	11.4	11.3	11.2	10.9	10.7
CL300 -7s	12.8	12.7	12.3	12.1	11.9	11.8	11.5	11.3

Conditions:
EKS 12
Safety classes 1, 2 & 3
Service class 1 or 2
Deformation max L/200 in quasi-permanent load combination (6.16)
Negative slope or absolute deformation not taken into account

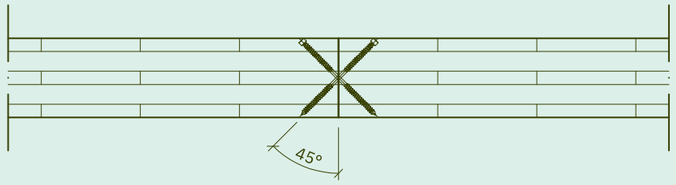
Self-weight of roof (excl. CLT) 50 kg/m².
Low-pitch roof, my = 0.8
Possible snow pockets not taken into account
Fire resistance as below, fire on one side only (higher resistance achievable with shorter span or encasing)

JOINT TYPES

There are several different types of joints that can be used when installing CLT panels.

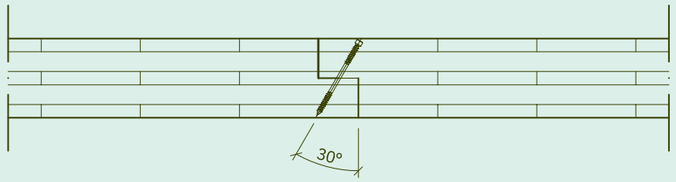
We describe some of the most common options below:

BUTT JOINT CONNECTION



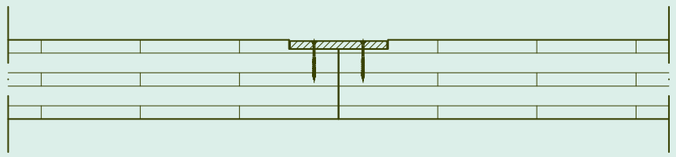
The butt joint is the most commonly used joint, as it is easy to create and simple to include in the project plans. The joint is fixed with the appropriate screws angled at less than 45 degrees.

LAP JOINT CONNECTION



The edge of each panel is mitred to half its thickness and the panel edges are overlapped. They are then screwed together at an angle of less than 45 degrees.

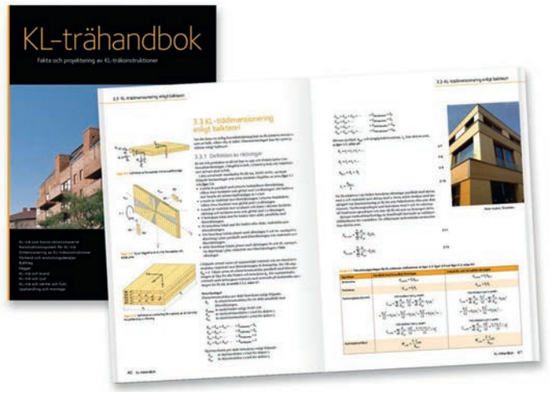
SURFACE SPLINE CONNECTION



A groove is cut into the edge of the board for the insertion of a plywood spline, which is then screwed to the next board.

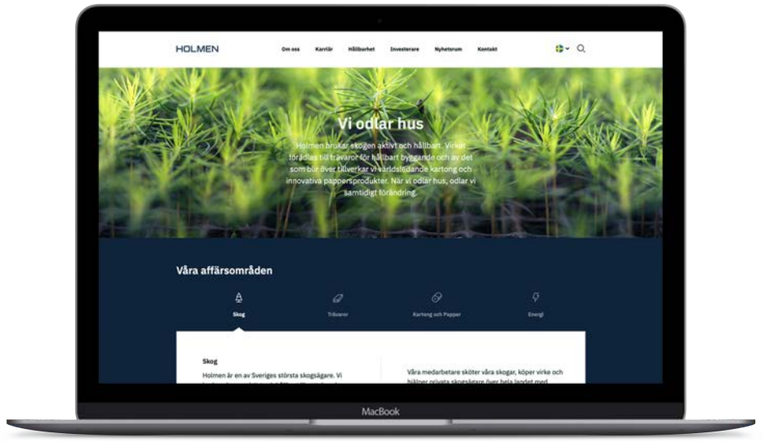
SOURCES FOR MORE DETAILED INFORMATION

This material guide contains information and technical facts related to our production of CLT. For further guidance on the calculation of mechanical properties and structural solutions for specific applications, we recommend the following sources of information:



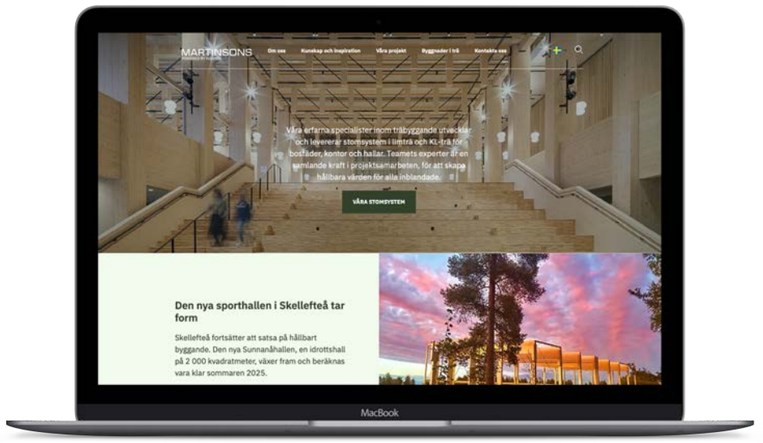
The CLT Handbook from Swedish Wood
This industry handbook helps construction planners to design and plan CLT structures. The information includes guidance on factors such as acoustics, fire safety and joints.

To download the CLT Handbook, go to Swedishwood.com



Holmen.com
Holmen's business concept is to own and add value to the forest. Our extensive forest holdings are thus the foundation of our business. Using our own production facilities, the growing trees are refined into everything from wood for climate-smart building to renewable packaging, magazines and books, while at the same time we generate hydro and wind power on our own land. A business that not only creates value for customers and shareholders, but also contributes to a better climate and thriving rural communities.

You can find out more about us and our contribution to a sustainable future on the Group's website!



Martinsons.se
Martinsons supplies construction systems in glulam and CLT for everything from sports halls, commercial premises, schools, industrial buildings and warehouses to high-rise apartment blocks and office buildings. The business covers both development and design, as well as sales, project management and assembly. Visit martinsons.se for some useful information to help you make decisions and discover the opportunities available. You can also draw inspiration from our previous projects and gain valuable knowledge about building in wood. Browse the content on the site or use the search function to quickly find what you are looking for.

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