

Construction guide for CLT buildings



Possibilities and limitations in the design
and production of CLT panels



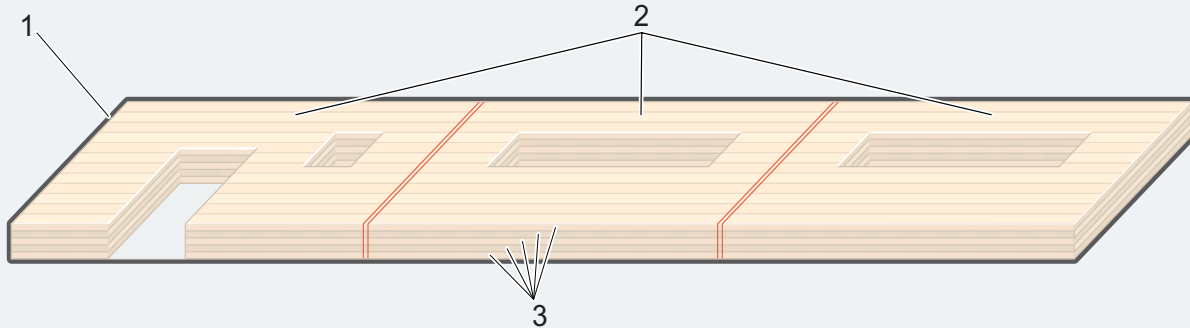


This construction guide is mainly intended for designers and those involved in project planning. The guide provides information about possibilities and limitations when designing and producing with CLT panels. Carefully considering the design of CLT panels in construction can save both time and costs in the planning process. The production of CLT panels is optimized on the basis of different conditions and simple adjustments in the construction process can lead to major gains in subsequent stages.

Nomenclature of CLT panels

CLT panel

A CLT panel is made from layers of lamellas that are stacked crosswise and lengthwise and glued together. A CLT panel can be a master panel (1) or a child panel (2).



Master panel (1)

A large CLT panel that is processed into one or more child panels.

Largest possible dimension: 16 x 3.5 meters.

Smallest possible dimension: 8 x 2.2 meters.

Child panel (2)

A finished CLT panel that is ready for assembly on-site.

Largest possible dimension: 16 x 3.5 meters.

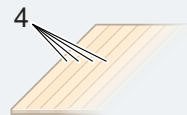
Smallest possible dimension: 4 x 0.8 m, smaller panels are available upon request.

Lamella layer (3)

A layer of the CLT panel, made from glued lamellas.

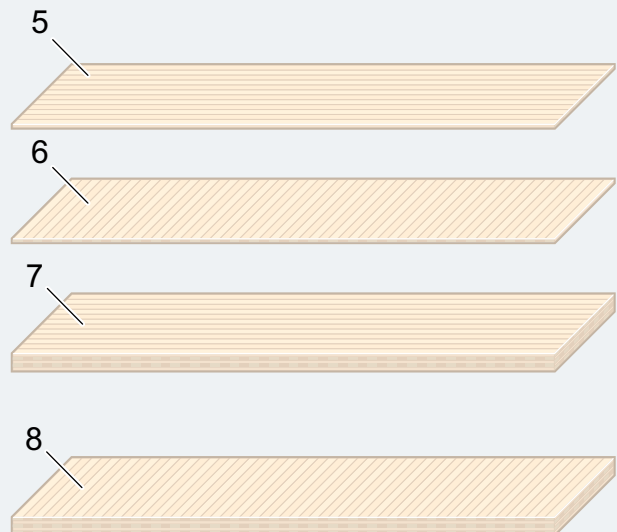
Lamella (4)

A planed board that forms part of a lamella layer.



Lamella direction

The direction of the wood fibers in relation to the longitudinal direction of the CLT panel in the production line. The direction of the lamellas can be longitudinal (5) or transverse (6).



L panel (7)

CLT panel where the outer lamella layers are longitudinal in the production line. L panels are mainly considered for horizontal usage, such as slab- and roof elements.

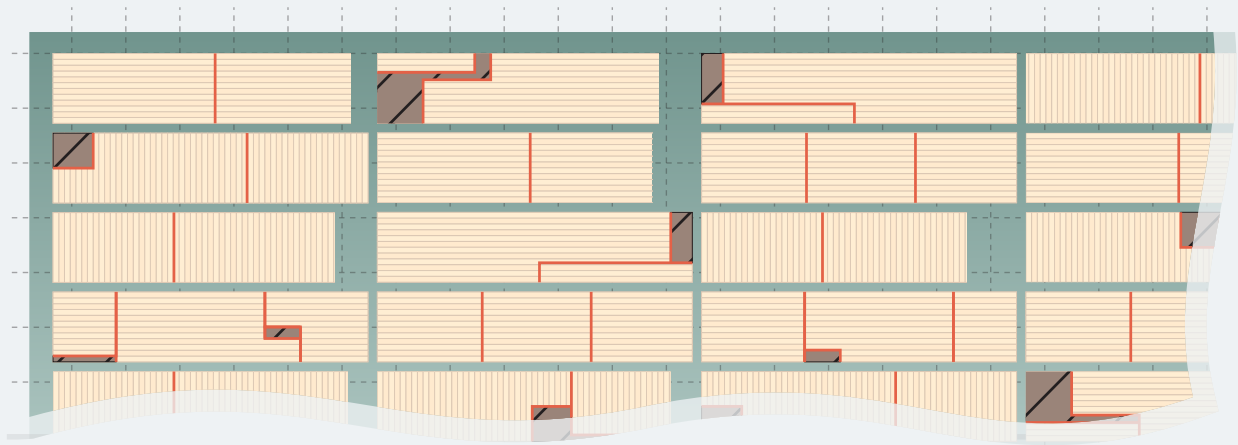
C panel (8)

CLT panel where the outer lamella layers are transverse in the production line. C panels are mainly used as wall elements.

Nesting

Nesting refers to the optimized arrangement of master panels in order to maximize the extraction of child panels and to minimize waste.

Examples of nesting with the placement of child panels on master panels:



Manufacturing drawing

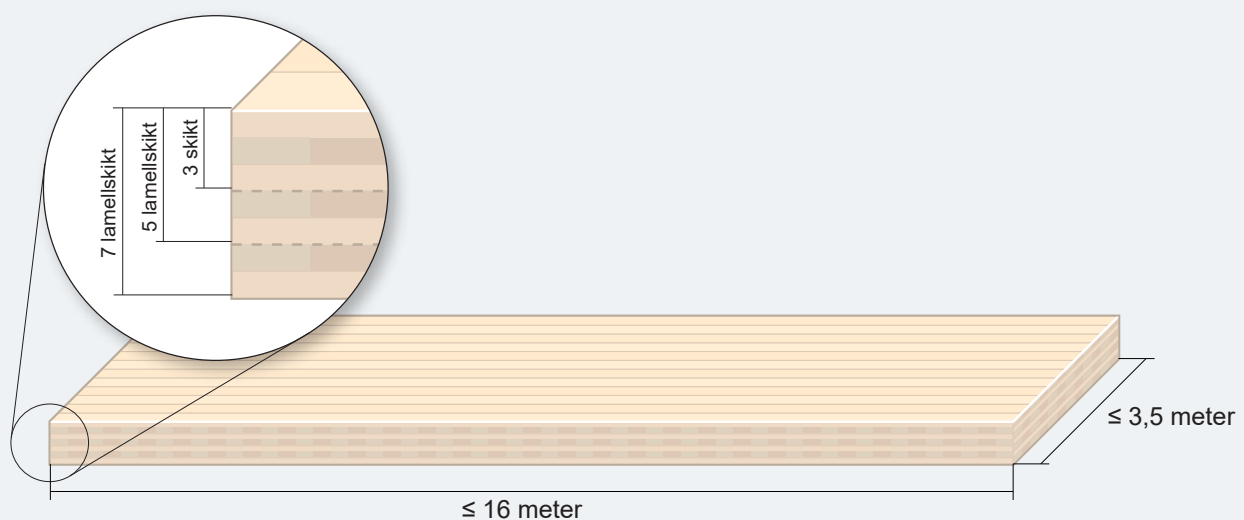
Drawing of child panels showing the structure, outer dimensions and measurements of processings.

Panel list

A list of the master panels and child panels included, with selected information. The panel list comprises the main data for business systems and the production of master and child panels.

Technical specifications

Södra's CLT panels consist of 3, 5 or 7 layers. The dimensions and buildup of the CLT panels depend on their intended use, such as slab, roof, load-bearing or separating wall. We work continuously to improve and broaden the range of our standard panels. Read more about panel structure and the technical specifications for our entire range of panels here*.



* <https://www.sodra.com/en/global/building-systems/our-products/cross-laminated-timber/>

Nesting

The size of the master panels is optimized in order to minimize the amount of waste from child panels. The shape of the child panels is crucial for minimizing the amount of waste.

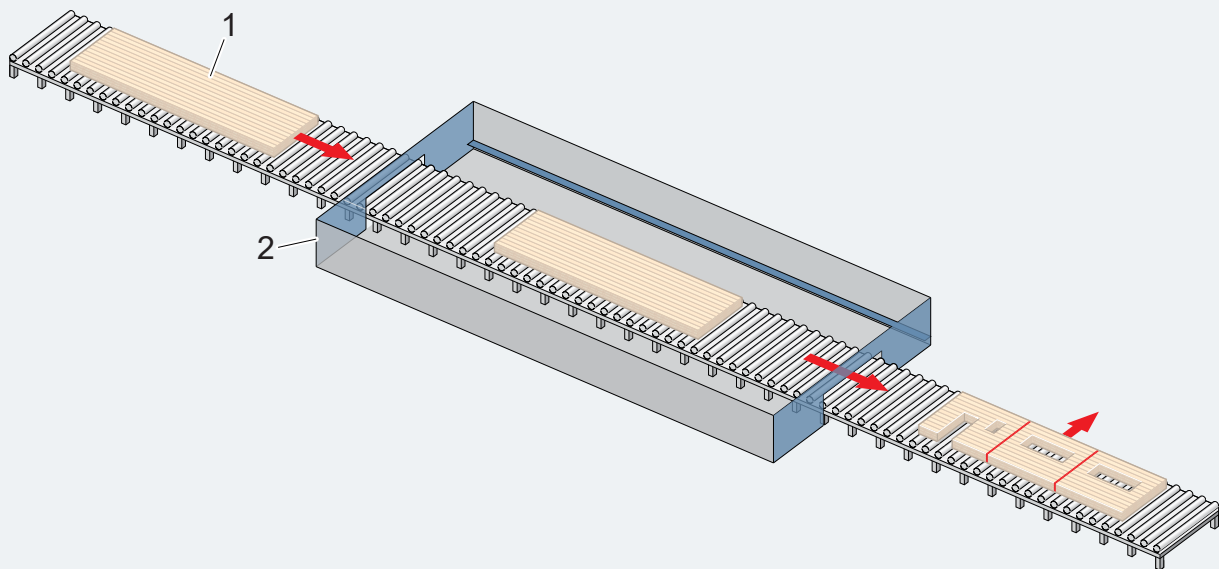
Södra performs the nesting prior to production. To create good conditions for efficient nesting, we offer a tool that optimizes the selection and design of panels. For more information, visit our website, where we also provide the product library via ProdLib.

Guidelines for designing child panels:

- Child panels are produced as far as possible in the same order as they are mounted at the construction site. Factors such as safe loading and transportation may affect the order of production.
- It's better to work with fewer but larger child panels than several smaller ones.
- If the child panels are too big, they may be difficult to transport.
- The dimensions of the child panels should ideally be evenly divisible by the largest possible dimension of the master panel (16 x 3.5 meters).
- Deduct material waste for sawing or milling when sawing out the child panels. More information can be found under Circular sawing and End milling.

Processing CLT panels

All processing of the CLT panels (1) is done in our CNC machines (2). The CLT panel is laid down and fed into the CNC machine with the short side first. We can also turn the CLT panel over outside the CNC machine so that processing can be carried out from both sides.



* <https://www.sodra.com/en/global/building-systems/think-wood/construction-in-wood/>

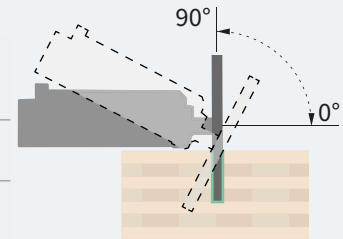
Circular sawing

The circular saw is used for sawing out child panels, and for larger recesses such as doors and windows openings.

Possibilities and limitations of the saw:

Saw blade	Diameter (mm)	Saw blade thickness (mm)	Maximum cutting depth (mm)	Cutting angle (°)
Small blade	800	7,5	270*	0-90
Large blade	1000	8,5	400*	0-90

* depending on the cutting angle.



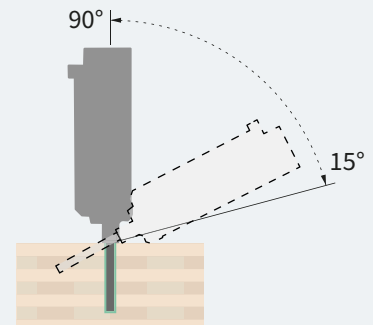
End milling

The end mill is used for cutting the edges of the master panel, milling small areas and grooves such as cable ducts and larger holes, and for contouring corners when sawing out recesses for doors and windows openings, for example.

Possibilities and limitations of the end mill:

End mill	Radius (mm)	Panel thickness (mm)	Maximum milling depth (mm)	Milling angle (°)
D20	10	60-70	74*	15-90
D40	20	80-150	160*	15-90
D60	30	160-230	235*	15-90
D80	40	240-280	290*	15-90

* depending on the milling angle.



When processing holes with the end milling tool, the smallest possible diameter of the hole depends on the thickness of the child panel:

Panel thickness (mm)	Hole diameter (mm)
60-70	≥20
70-160	≥43
160-230	≥63
230-280	≥83

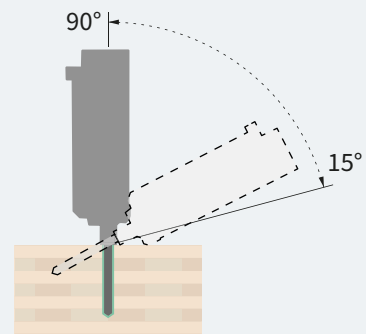
Drilling

The drill is used to create holes that are 8–30 mm.

Possibilities and limitations of the drill:

Drill	Radius (mm)	Maximum drilling depth (mm)	Drilling angle (°)
D8	4	190*	15-90
D10	5	190*	15-90
D20	10	400*	15-90
D30	15	280*	15-90

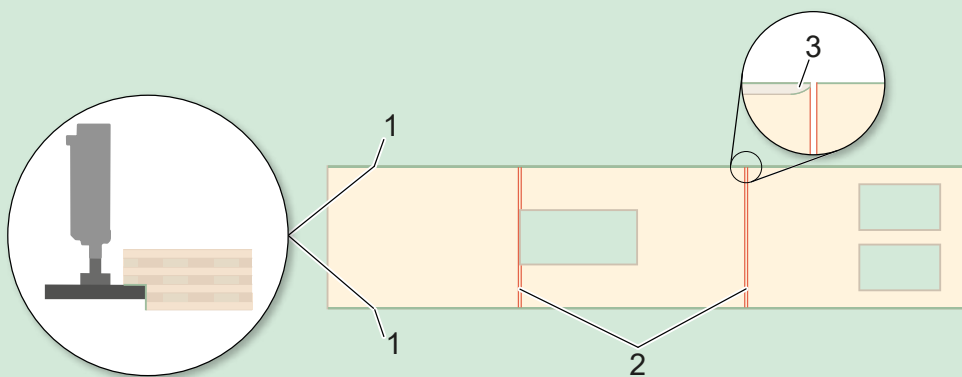
* beroende på borrhinkel.



Disc milling

The disc milling tool is used for processing underneath the outer edges of the child panel, which facilitates effective handling because the panel does not need to be turned over.

Guidelines when nesting for disc milling:



- The outer edges of the child panel which are supposed to be processed must match the outer edges of the master panel, preferably along the long sides of the master panel (1). It is not possible to disc mill edges that are the cut edges between two child panels (2).
- If there is an adjacent child panel that doesn't have a recess, a radius (3) will occur at the end of the recess.

Possibilities and limitations of the disc milling tool:

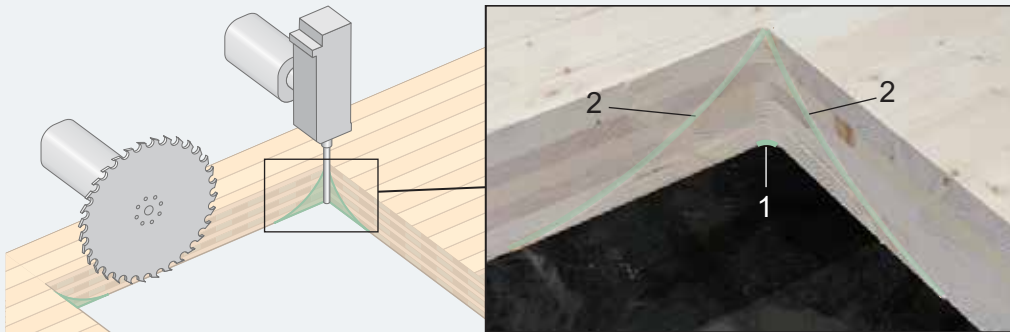
Disc mill	Radius (mm)	Minimum height (mm)	Maximum milling depth (mm)
D400	200	30	100
D500	250	100	175

Methods and solutions

Recess

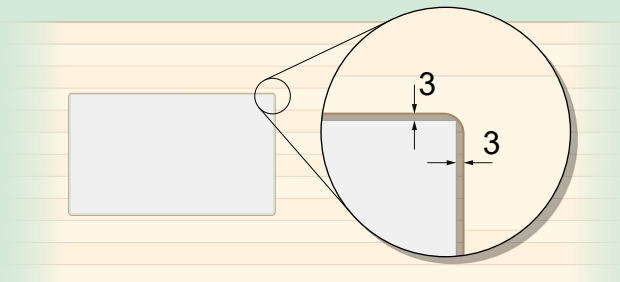
For larger recesses such as window and door openings, the processing methods we use depend on the thickness of the child panel. For thin child panels, only the end mill should be used, which means that the inner corners of the recess have a radius (1) corresponding to the radius of the end mill.

For thick child panels, the circular saw should be used to saw straight cuts and the end mill to process inner corners. This means that the inner corners will have a radius (1) that corresponds to the radius of the end mill and there will be a slight difference in height (2) in the transition between the working surfaces of the circular saw and the end mill.

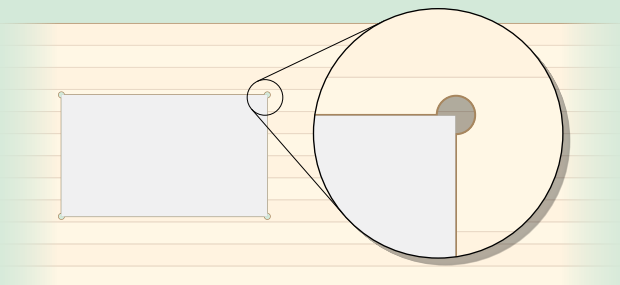


Recommended solutions for installation in recesses with rounded inner corners:

Alternative 1: Use sufficient reveal (3), taking into account the rounded corners in order to fit a window frame or door frame for example.



Alternative 2: Use a recess with drilled out inner corners.



Alternative 3: Post-process at the construction site.

Note: Draw inner corners without any radius in the construction drawings. However, any requests for drilled out corners must be specified.

Contact Södra if other solutions are required.

Tolerances and surface quality

The tolerances below apply when processing in our CNC machines:

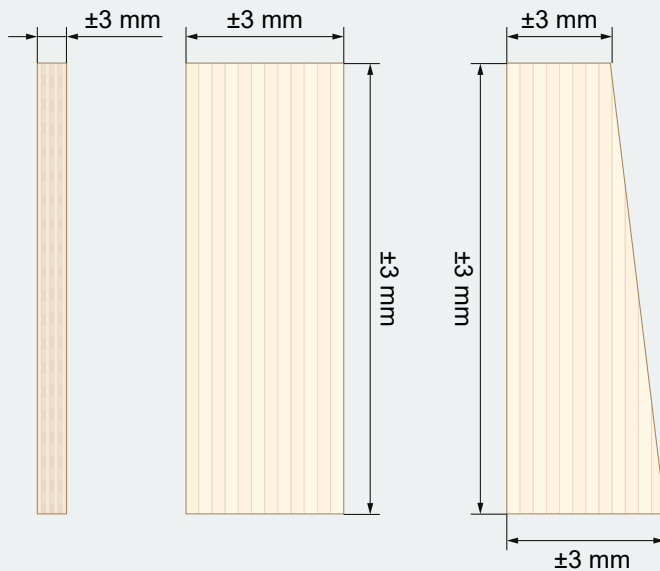
Child panels

Length: ± 3 mm

Width: ± 3 mm

Thickness: ± 2 mm, or 2% of panel thickness.

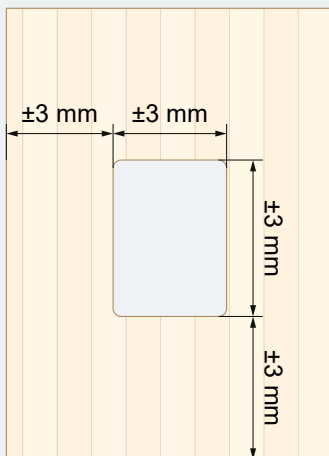
The largest value applies.



Recess

Position: ± 3 mm

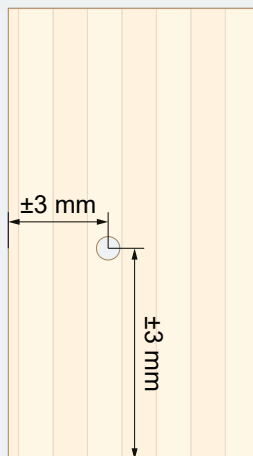
Size: ± 3 mm



Drill hole

Position: ± 3 mm

Depth: ± 3 mm

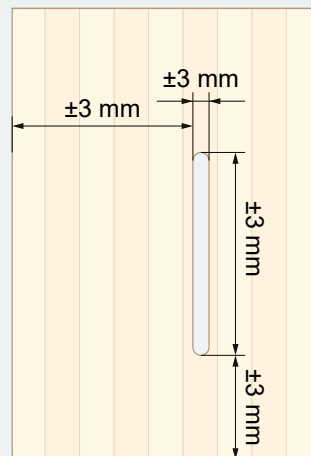


Milling

Position: ± 3 mm

Size: ± 3 mm

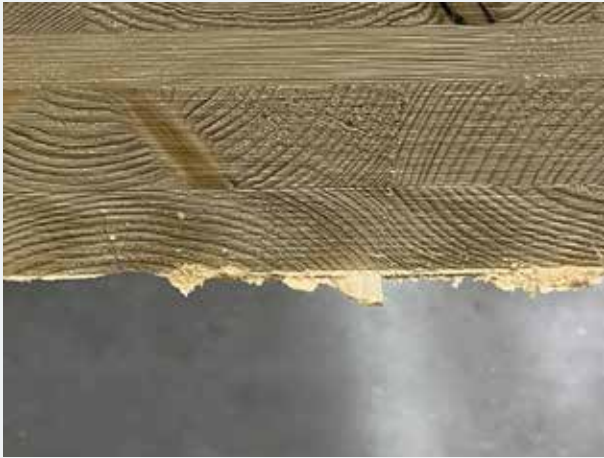
Depth: ± 3 mm



Surface quality

When processing CLT panels, some chipping and bearding occurs. We follow Swedish Wood's standard for assessing surface quality and offer different surface qualities depending on your specifications.

We always consider the edges of the child panel and other machined surfaces as non-visible surfaces. Examples of surface quality:



The surface quality of the outer lamella layer of the child panel is available with a 'visible surface quality' or a 'non-visible surface quality:'



'Visible surface quality'.



Example of a 'non-visible surface quality' where pressure marks may occur.

Guidelines

In the construction drawings, define the surfaces that should have 'visible surface quality'.

Transport conditions

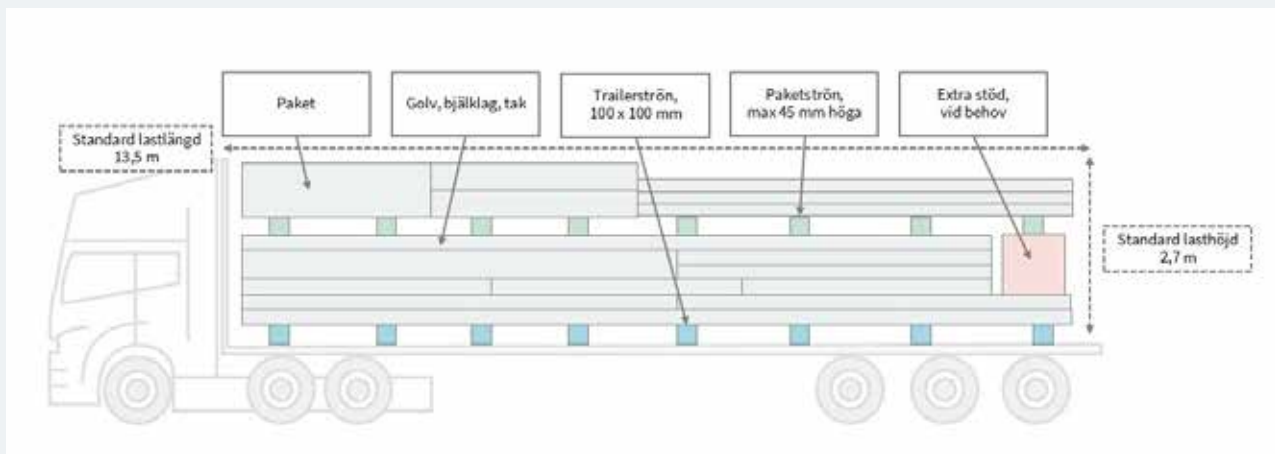
Basic conditions

Södra's CLT elements are loaded flat on semi-trailers with a load capacity of 30 tons. The maximum load length is 13.5 m, load width 3.1 m and load height 2.7 m.

When calculating the weight, a density of 500 kg/m³ is used. Before the exact number of deliveries are stated in a project, Södra assumes 40 m³ CLT per delivery. The volume per delivery can vary greatly between projects. We reserve the right to change the conditions for transportation depending on the accessibility of the construction site, such as bridges, tunnels or bearing capacity classes.

Basic design

- Heaviest and widest panels at the bottom for safe loading.
- Slab and roof elements, i.e. panels that are lifted horizontally, are laid flush in the delivery.
- Walls, i.e. panels that are lifted vertically, are laid in packages of about 700 mm high and weigh about 5 tons.
- Wood blocking is placed between all packages, with a maximum height of 45 mm.
- Wood blocking 100 x 100 mm is placed on the trailer platform.
- The entire load is covered.
- Corner protectors under the packaging to protect against sharp corners on panels.
- Extra support if needed for safe and stable loading.



Width

General limits for the width of panels for transportation are as follows:

- | | |
|-------------|--|
| ≤ 2,4 m | standard covered semi-trailer without packaging, must be unloaded from the side with forklift/wheel loader. |
| 2,4 - 3,1 m | flatbed trailer without escort vehicle, packed cargo, can be unloaded vertically by crane. |
| 3,1 - 3,5 m | flatbed trailer with escort, packed cargo, can be unloaded vertically by crane. |
| > 3,5 m | flatbed trailer, transportation permit and escort required, packaged cargo, can be unloaded vertically by crane. |

Please note that trailers wider than 3.1 m are not operated during weekends or at night.

Length

General limits on the length of panels for transportation are as follows:

- | | |
|----------|---|
| < 14,5 m | maximum length of divisible load for standard semi-trailer, e.g. two packages of 7.25 m = 14.5 m. |
| ≤ 15 m | maximum length of indivisible load for standard semi-trailer, 15 m. |
| > 15 m | requires a special trailer with special loading and unloading requirements. |

Höjd

General limits on height for transportation are as follows:

- | | |
|---------|--|
| < 4,5 m | the overall height of the vehicle must not exceed 4.5 m. |
| < 2,7 m | the maximum standard loading height should not exceed 2.7 m. |



About Södra

Södra was founded in 1938 on the idea that we are stronger together. Södra is now the largest forest-owner association in Sweden, with more than 50,000 family forest owners as members. Together, the members of Södra own a world-leading industrial operation that processes forest raw material into renewable products such as pulp, timber, building systems, liquid bioproducts and energy.

Rooted in the forest, we grow the future.

sodra.com/buildingsystems

