eurofins | Expert Services

Kivimiehentie 4,
FI-02150 Espoo, FINLAND

Designated according to Article 29 of Regulation (EU) No 305/2011

Member of EOTA
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European Technical Assessment ETA 18/0621 of 10/07/2018

I General Part

Technical Assessment Body issuing the ETA and designated according to Article 29 of the Regulation (EU) No 305/2011:	**Eurofins Expert Services LTD**
Trade name of the construction product	**Hoisko CLT**
Product family to which the construction product belongs	Solid wood slab elements to be used as structural elements in buildings
Manufacturer	**CLT Finland Oy** Sahapolku 49 FI-62940 Hoisko Finland www.hoisko.fi
Manufacturing plant	CLT Finland Oy Sahapolku 49 FI-62940 Hoisko Finland
This European Technical Assessment contains	18 pages including 3 Annexes which form an integral part of this assessment.
This European Technical Assessment is issued in accordance with regulation (EU) No 305/2011, on the basis of	EAD 130005-00-0304, Solid wood slab element to be used as structural element in buildings.

II Specific Part

1 Technical description of the product

Hoisko CLT is manufactured of softwood timber grown in the Nordic growth region, from spruce (Picea abies) or pine (Pinus sylvestries).

Hoisko CLT is a cross laminated timber element made of layers of spruce or pine boards that are glued together. Number of layers is 3, 5, 7, 8 or 10. In 3-layer elements the adjacent layers are arranged perpendicular (angle of 90°) to each other. In 5- and 7-layer products the two outer layers may be also parallel to each other. The 8-layer elements have parallel double layers in middle and on the both surfaces. The 10-layer products have a parallel double layer in middle, but the other adjacent layers are perpendicular to each other. The lay-up of the element is symmetric with respect to the plane defined by the centre line.

Each layer of laminations is comprised of strength graded planed sawn timber boards laid side by side. The thickness of the layer is 20, 30, 40 or 60 mm. The minimum width dimensions of the laminations are as follows for each thickness: 20 x 90 mm, 30 x 115 mm, 40 x 140 mm and 60 x 190 mm. The sides of adjacent laminations are not structurally glued together. The strength of the timber shall fulfil the requirements for class C24 according to EN 338. Lengthwise boards may be finger jointed according to the requirements of standard EN 16351:2015.

The maximum dimensions of the cross laminated timber element that can be manufactured are width 3,50 m and length 12,00 m. Thickness of the element is at least 60 mm and at maximum 400 mm. The application of wood preservatives and flame retardants is not subject to the European Technical Assessment.

2 Specification of the intended uses in accordance with the applicable European Assessment Document, EAD

2.1 Intended uses and in-service environment

Hoisko CLT is intended to be used as a structural or non-structural element in buildings and timber structures. The solid wood slab shall be subjected to static and quasi static actions only.

Hoisko CLT is made of *Picea abies* and *Pinus sylvestris.* Durability against fungi of these species is of class 3 (pine heartwood) and 5 according to EN 350-2. Durability may be reduced by attack from insects such as long horn beetle, dry wood termites and anobium in regions where these may be found.

The solid wood slab is intended to be used in service classes 1 and 2 according to EN 1995-1-1. Members which are directly exposed to the weather shall be provided with an effective protection for the solid wood slab element in service.

2.2 Working life

The provisions made in this European Technical Assessment are based on an assumed intended working life of the solid wood slab of 50 years[1].

2.3 Design

The European Technical Assessment only applies to the manufacture and use of the solid wood slabs. Verification of stability of the works including application of loads on the solid wood slab is not subject of this European Technical Assessment. Fitness for the intended use of the solid wood slab is given under the following conditions:

- Design of the solid wood slabs shall follow the Eurocodes system (EN 1990, adequate parts of EN 1991, EN 1995-1-1 and EN 1995-1-2) and this ETA.
- Especially, the mechanical properties of Hoisko CLT cross laminated timber elements as given in Annex 2 and design principles given in Annex 3 shall be used.
- Design of the cross laminated timber elements is carried under the responsibility of an engineer experienced in solid wood slab elements
- cross laminated timber elements are protected adequately against weather so that the conditions correspond to service classes 1 and 2
- cross laminated timber elements are installed correctly.

This European technical assessment is based on the assumption that all plans needed have been made correctly according to the regulations valid on the building site.

2.4 Execution of construction works

Concerning product packaging, transport, storage, maintenance, replacement and repair it is the responsibility of the manufacturer to undertake the appropriate measures and to advise his clients on the transport, storage, maintenance, replacement and repair of the product as he considers necessary. This advice should be followed by the user of the product.

It is assumed that the product will be installed according to the manufacturer's instructions or (in absence of such instructions) according to the usual practice of the building professionals.

The completed building (the works) shall comply with the building regulations (regulations on the works) applicable in the Member States in which the building is to be constructed. The procedures foreseen in the Member State for demonstrating compliance with the building regulations shall also be followed by the entity held responsible for this act. An ETA for a solid wood slab element does not amend this process in any way.

[1] This means that it is expected that when this working life has elapsed, the real working life may be, in normal use conditions, considerably longer without major degradation affecting the essential requirements of the works. The indications given as to the working life of the solid wood slab cannot be interpreted as a guarantee given by the producer or the assessment body. They should only be regarded as a means for the specifiers to choose the appropriate criteria for the solid wood slabs in relation to the expected, economically reasonable working life of the works.

3 Performance of the product and references to the methods used for its assessment

Table 1. Basic requirements for construction works and essential characteristics

Basic requirement and essential characteristics	Performance
BWR 1. Mechanical resistance and stability[1)]	
Bending[2)]	3.1 Description, level
Tension and compression[2)]	3.1 Description, level
Shear[2)]	3.1 Description, level
Embedment strength	3.1 Description, level
Creep and duration of the load	3.1 Description, level
Dimensional stability	3.1 Description, level
In-service environment	3.1 Description
Bond integrity	3.1 Description
BWR 2. Safety in case of fire	
Reaction to fire	3.2 Class
Resistance to fire	No performance assessed
BWR 3. Hygiene, health and the environment	
Content, emission and/or release of dangerous substances	3.3 Description, class
Water vapour permeability – Water vapour transmission	3.3 Level
BWR 4. Safety and accessibility in use	
Impact resistance	3.4 Description
BWR 5. Protection against noise	
Airborne sound insulation	No performance assessed
Impact sound insulation of floors	No performance assessed
Sound absorption	No performance assessed
BWR 6. Energy economy and heat retention	
Thermal conductivity	3.5 Level
Air permeability	No performance assessed
Thermal inertia	3.5 Level

1) This characteristic also relates to BWR4

2) Load bearing capacity and stiffness regarding mechanical actions perpendicular to and in plane of the solid wood slab element.

3.1 Mechanical resistance and stability, BWR 1

Mechanical properties of Hoisko CLT are given in Annexes 2 to 3.

Resistances and stiffness values shall be calculated according to EN 1995-1-1, the design principles given in Annex 3 shall be taken into account. Joint design and embedding strength values given in EN 1995-1-1 for solid timber shall be used. Tension perpendicular to the solid wood slab shall be avoided.

Dimensional stability

Tolerances of dimensions

Tolerances of dimensions are as follows:

Dimension	Symbol	Tolerances
Thickness (depth)	h	± 1 mm
Width	b	± 3 mm
Length	l	± 3 mm

Stability of dimensions

Three moisture content ranges at the time of shipping are possible; 10±2 %, 11±2 % or 12±2 %. Within one solid wood slab element only one of the specified moisture content ranges shall be applied. Tolerances are given in the specified mean moisture content, 10, 11 or 12 %.

Moisture content range shall be chosen according to the intended use so that inadmissible effects on performance and stability are avoided.

Thermal expansion

Normally, thermal expansion is not relevant for timber structures. Thermal expansion coefficients as given in EN 1991-1-5, Annex C Table C1, shall be used when needed.

In-service environment

See 2.1 of this ETA.

Bond integrity

Bond integrity fulfils the requirements of the EAD 130005-00-0304.

3.2 Safety in case of fire, BWR 2

3.2.1 Reaction to fire

In accordance with Commission Decision 2003/43/EC the solid wood slab elements covered by this European technical assessment for use as wall, roof, ceiling and special construction components comply with Euroclass D-s2,d0 according to EN 13501-1. The boundary conditions stated in the commission decision have to be attended for this classification. Provision for this classification is that possible surface treatments do not essentially change the behaviour in fire.

Note: A European reference fire scenario for façades has not been laid down. In some Member States, the classification of the solid wood slabs according to EN 13501-1 might not be sufficient for the use in façades. An additional assessment of the solid wood slabs according to national provisions (e.g. on the basis of a large scale test) might be necessary to comply with Member State regulations, until the existing European classification system has been completed.

3.3 Hygiene, health and environment, BWR 3

3.3.1 Content, emission and/or release of dangerous substances

No recycled wood has been used in the manufacturing of the solid wood slab. The product does not contain added formaldehyde. The manufacturer has not declared that Hoisko CLT would contain other dangerous substances.

In addition to the specific clauses relating to dangerous substances contained in this European Technical Assessment, there may be other requirements applicable to the products falling within its scope (e.g. transposed European legislation and national laws, regulations and administrative provisions). In order to meet the provisions of the EU Construction Products Directive, these requirements need also to be complied with, when and where they apply.

3.3.2 Vapour permeability – Water vapour transmission

Water vapour resistance factor μ for solid wood slab is 50.

3.4 Safety and accessibility in use, BWR 4

3.4.1 Impact resistance

Soft body resistance is assumed to be fulfilled for walls with a minimum of 3 layers and minimum thickness of 60 mm.

3.5 Energy economy and heat retention, BWR 6

3.5.1 Thermal conductivity

The design value of thermal conductivity to be used in design calculations of the solid wood slab is λ = 0,12 W/(mK). This value can be used in thermal resistance calculations according to EN ISO 6946.

3.5.2 Thermal inertia

The design value of thermal inertia to be used in design calculations of the solid wood slab is c_p = 1600 J/(kg K).

4 Assessment and verification of constancy of performance (hereinafter AVCP) system applied, with reference to its legal base

According to the Decision 97/176/EC of the European Commission[2], as amended by 2001/596/EC[3], the system of assessment and verification of constancy of performance (see Annex V to the regulation (EU) No 305/2011) is System 1.

5 Technical details necessary for the implementation of the AVCP system, as provided for in the applicable EAD.

Technical details necessary for the implementation of the AVCP system are laid down in the control plan deposited at Eurofins Expert Services Ltd.

Issued in Espoo on July 10, 2018
by Eurofins Expert Services Ltd

Tiina Ala-Outinen
Business Manager

Pertti Jokinen
Product Manager

[2] Official Journal of the European Communities L 73/19 of 14 March 1997

[3] Official Journal of the European Communities L 209/33 of 2 August 2011

ANNEX 1
DESCRIPTION AND PERFORMANCE OF HOISKO CLT SOLID WOOD SLAB

1 Standard lay-ups of the solid wood slab

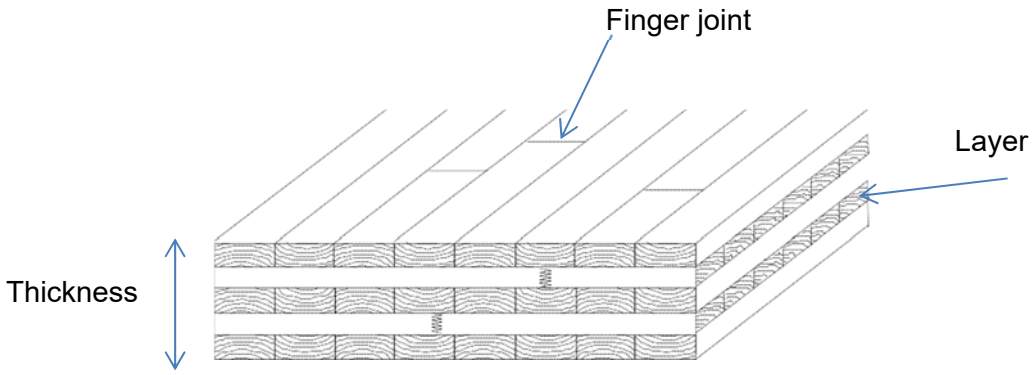

Figure 1: Principle structure of the solid wood slab (five layers)

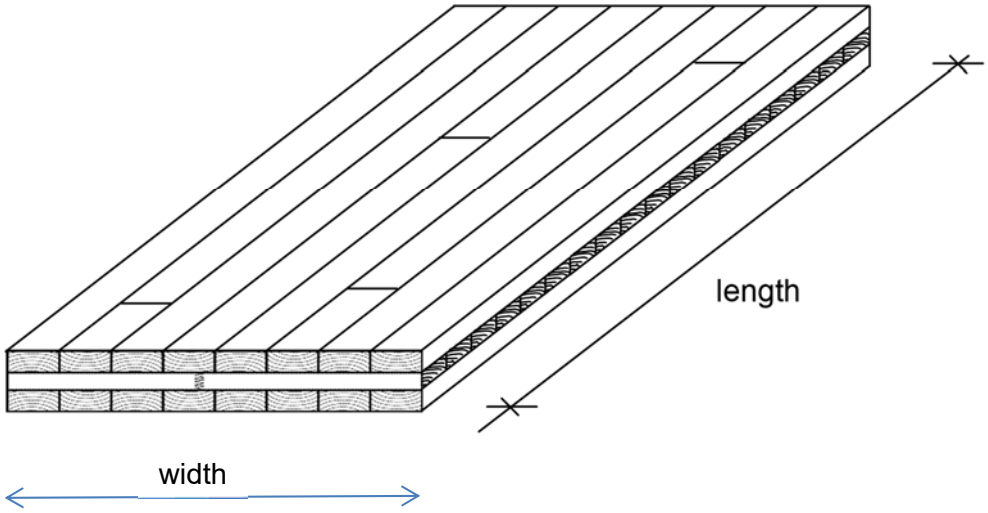

Figure 2: Solid wood slab element (three layers)

2 Dimensions and specifications

Table 1. Dimensions and specifications

Hoisko CLT solid wood slab element		
Thickness	mm	60 – 400
Width	m	≤ 3,50
Length	m	≤ 12,00
Number of layers	-	3, 5, 7, 8 or 10
Boards (spruce or pine)		
Surface	-	Planed
Thickness *t*	mm	20, 30, 40 or 60
Minimum dimensions	mm	20x90, 30x115, 40x140 and 60x190
Gaps between adjacent boards • between every second board • 10 % of gaps	 mm mm	 max 2 max 5
Strength class of boards		C24
Finger joints		EN 16351
Adhesive		EN 154257

3 Mechanical properties of the solid wood slabs

Table 2. Mechanical properties of the solid wood slabs

1. Actions perpendicular to the solid wood slab		
	Standard	**Charasteristic value N/mm² for C 24**
Bending strength $f_{m,k}$ - if number of adjacent longitudinal boards ≥ 8	EN 408	24 28
Compression strength $f_{c,90,k}$	EN 338	2,5
Shear strength perpendicular to the grain of the boards $f_{R,k}$	EN 408	1,2
Modulus of elasticity parallel to the grain of the boards $E_{0,mean}$	EN 408	12500
Modulus of elasticity perpendicular to the grain of the longitudinal boards $E_{90,mean}$	EN 338	370
Shear modulus parallel to the grain of the boards G_{mean}	EN 338	690
Shear modulus perpendicular to the grain of the boards $G_{R,mean}$	EN 408	50
2. Actions in plane of the solid wood slab		
Bending strength $f_{m,k}$	EN 408	24
Compression strength $f_{c,0,k}$	EN 338	21
Tension strength $f_{t,0,k}$	EN 338	14,5
Tension strength $f_{t,90,k}$	EN 338	0,4
Shear strength parallel to the grain of the boards $f_{v,k}$ calculated with the gross cross section	EN 408	as given in Table 3a and 3b
Modulus of elasticity parallel to the grain of the longitudinal boards $E_{0,mean}$	EN 408	12500
Shear modulus parallel to the grain of the boards G_{mean}	EN 408	500
3. Actions generally		
For references regarding the calculation see Annexes 2 and 3 National regulations shall be followed.		
Use of fasteners	According to EN 1995-1-1, for further details see Annex 3	

Table 3a. Characteristic shear strength values for edgewise loading of Hoisko CLT H-panels. In manufacturing of H-panels, the lamellas of cover layers are parallel to the length direction of the production line.

Product No.	*H*	*V*	*H*	*V*	*H*	*V*	*H*	*V*	*H*	b_H	b_V	$f_{v,k}$
	(mm)									(mm)	(mm)	(N/mm²)
60-H3	20	20	20							90	90	2,67
70-H3	20	30	20							90	115	3,43
80-H3	30	20	30							115	90	2,00
90-H3	30	30	30							115	115	2,67
100-H3	30	40	30							115	140	3,20
110-H3	40	30	40							140	115	2,18
120-H3	40	40	40							140	140	2,67
140-H3	40	60	40							140	190	3,43
160-H5-2	60	40	60							115	140	2,00
200-H5-2	80	40	80							140	140	1,60
100-H5	20	20	20	20	20					90	90	3,20
120-H5	30	20	20	20	30					90	90	2,67
140-H5	30	30	20	30	30					90	115	3,43
150-H5	30	30	30	30	30					115	115	3,20
160-H5	40	20	40	20	40					140	90	2,00
180-H5	40	30	40	30	40					140	115	2,67
200-H5	40	40	40	40	40					140	140	3,20
210-H7-2	30+30	30	30	30	30+30					115	115	2,29
220-H7-2	30+30	30	40	30	30+30					115	115	2,18
240-H7-2	40+40	20	40	20	40+40					140	90	1,33
260-H7-2	40+40	30	40	30	40+40					140	115	1,85
280-H7-2	40+40	40	40	40	40+40					140	140	2,29
300-H8-2	40+40	30	40+40	30	40+40					140	115	1,60
320-H8-2	40+40	40	40+40	40	40+40					140	140	2,00
180-H7	30	20	30	20	30	20	30			90	90	2,67
200-H7	30	30	30	20	30	30	30			90	115	3,48
210-H7	30	30	30	30	30	30	30			115	115	3,43
220-H7	30	30	30	40	30	30	30			115	115	3,27
240-H7	30	40	30	40	30	40	30			115	140	3,50
280-H7	40	40	40	40	40	40	40			140	140	3,43
400-H10-2	40	40	40	40	40+40	40	40	40	40	140	140	3,20

Table 3b: Characteristic shear strength values for edgewise loading of Hoisko CLT V-panels. In manufacturing of V-panels, the lamellas of cover layers are perpendicular to the length direction of the production line.

Product No.	*V*	*H*	*V*	*H*	*V*	b_H	b_V	$f_{v,k}$
			(mm)			(mm)	(mm)	(N/mm²)
60-V3	20	20	20			90	90	2,67
70-V3	20	30	20			115	90	3,31
80-V3	20	40	20			140	90	3,09
90-V3	30	30	30			115	115	2,67
100-V3	30	40	30			140	115	2,93
110-V3	40	30	40			115	140	2,18
120-V3	40	40	40			140	140	2,67
140-V3	40	60	40			190	140	2,62
100-V5	20	20	20	20	20	90	90	3,20
120-V5	20	30	20	30	20	115	90	3,50
140-V5	30	30	20	30	30	115	90	3,31
150-V5	30	30	30	30	30	115	115	3,20
160-V5	30	30	40	30	30	115	115	3,00
180-V5	40	30	40	30	40	115	140	2,67
200-V5	40	40	40	40	40	140	140	3,20
220-V5	40	40	60	40	40	140	140	2,91

ANNEX 2
DESIGN OF THE HOISKO CLT SOLID WOOD SLAB

1. Mechanical actions perpendicular to the solid wood slab

Stress distribution within the solid wood slab shall be calculated so that the shear deformation of the cross layers is taken into account.

For simply supported solid wood slabs with up to 5 layers the stress distribution may be calculated according to EN 1995-1-1 as mechanically jointed beam where the value s_i/K_i is substituted by $h_i/(G\ b)$ with h_i = thickness of the cross layer, G = shear modulus of the cross layer (50 N/mm^2) and b = width of the cross layer.

For solid wood slabs with more than 5 layers numerical solutions shall be used offered by computer programs taking into account the shear deformation of the cross layers.

For the design of solid wood slabs the characteristic strength and stiffness values shall be taken from Annex 1.

For the bending design only the stresses at the edges of the boards are decisive, axial stresses in the centre of the boards are not considered in the bending design.

In bending design the characteristic bending strength properties may be multiplied by a system strength factor k

$$k_\ell = \min \begin{cases} 1+0{,}025 \cdot n \\ 1{,}2 \end{cases}$$

where n = number of boards within a layer.

Tension loads perpendicular to the element shall be avoided.

2. Mechanical actions in plane of the solid wood slab

Stress distribution within the solid wood slab shall be calculated by taking into account only the boards which are oriented in the direction of the actions.

Shear stresses may be calculated with the total width of the solid wood slab.

For the design of solid wood slabs the characteristic strength and stiffness shall be taken from Annex 1.

In bending design the characteristic bending strength properties may be multiplied by a system strength factor k

$$k_\ell = \min \begin{cases} 1+0{,}025 \cdot n \\ 1{,}2 \end{cases}$$

where n = number of longitudinal layers.

ANNEX 3
DESIGN OF CONNECTIONS WITH METAL FASTENERS

1. Design of connections with metal fasteners

1.1 General

The design rules given in this section amend the design rules for connections given in EN 1995-1-1. Plane sides are the surfaces of the element parallel to the plane of element, narrow sides are the surfaces perpendicular to the plane sides of the element.

1.2 Laterally loaded dowel type fasteners

Joints in the plane side of cross laminated timber

Embedment strength:

For nails, self-tapping screws, dowels and bolts in the plane side of cross laminated timber the embedment strength of solid timber may be used, depending on the characteristic density of the laminations of the cross laminated timber and on the angle between force and grain direction of the outer layer.

The following conditions should be fulfilled:

- diameter of nails $d \geq 4$ mm
- diameter of self-tapping screws $d \geq 6$ mm

Effective number of fasteners:

If the thickness of the outer layers exceeds 40 m, the effective number of fasteners is determined as for sawn timber. Otherwise n_{ef} shall be taken from equation (1)

$$n_{ef} = n \quad (1)$$

where n is the actual number of fasteners.

Minimum spacings, edge and end distances:

Minimum spacings, edge and end distances and angle α between the force and the grain direction of the outer layers as defined in Figure 4 are given in Table 4.

Table 4: Definition of minimum spacings, edge and end distances in the plane side of Hoisko CLT cross laminated timber

	a_1	$a_{1,t}$	$a_{1,c}$	a_2	$a_{2,t}$	$a_{2,c}$
Nails	$(3+3\cos\alpha)d$	$(7+3\cos\alpha)d$	6 d	3 d	$(3+4\sin\alpha)\ d$	3 d
Self-tapping screws	4 d	6 d	6 d	2,5 d	6 d	2,5 d
Dowels	$(3+2\cos\alpha)\ d$	5 d	$\max\begin{cases}4d\cdot\sin\alpha\\3d\end{cases}$	3 d	3 d	3 d
Bolts	$\max\begin{cases}(3+2\cos\alpha)d\\4d\end{cases}$	5 d	4 d	4 d	3 d	3 d

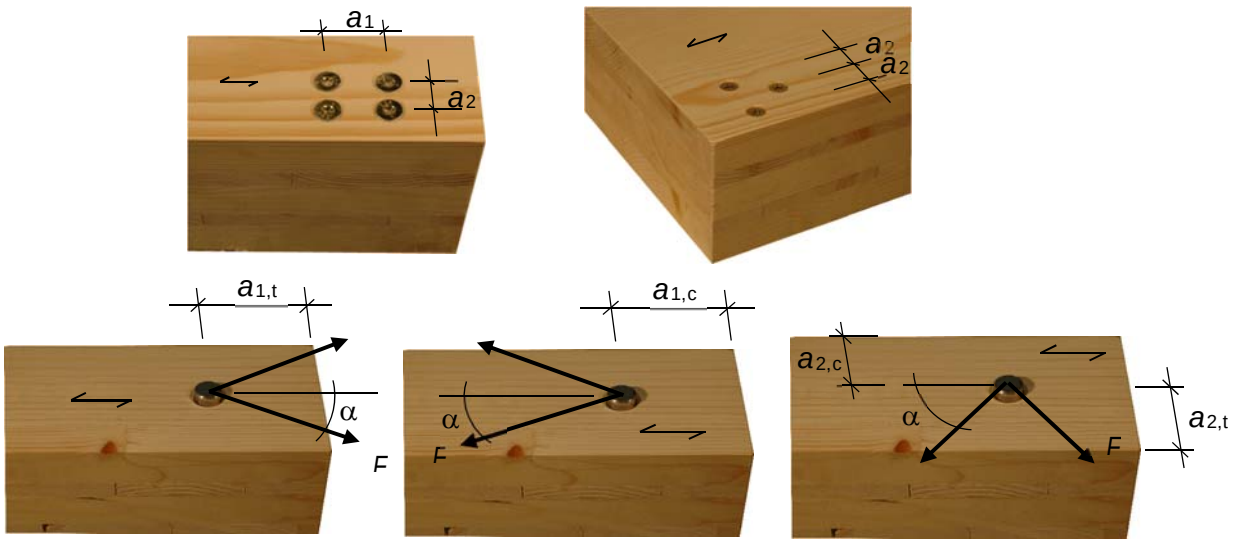

Figure 4: Definition of minimum spacings, edge and end distances for laterally loaded dowel- type fasteners in the plane side of cross laminated timber.

Joints in the narrow side of cross laminated timber

Only self-tapping screws may be used in the narrow side connections.

Embedment strength

The characteristic embedment strength for self-tapping screws with a diameter $d \geq 8$ mm in the narrow sides of cross laminated timber may be calculated according to equation (2).

$$f_{h,k} = 20\,d^{-0,5} \quad \text{in N/mm}^2 \qquad (2)$$

where d is the nominal diameter of the self-tapping screws in mm.

For actions perpendicular to the plane side of the cross laminated timber the possibility of splitting caused by the tension force component perpendicular to the grain, shall be taken into account. Connections with ratios he/h < 0,7 should be reinforced with fully threaded screws, when he is the loaded edge distance to the centre of the most distant fastener and h is the thickness of the cross laminated timber (see example in Figure 5).

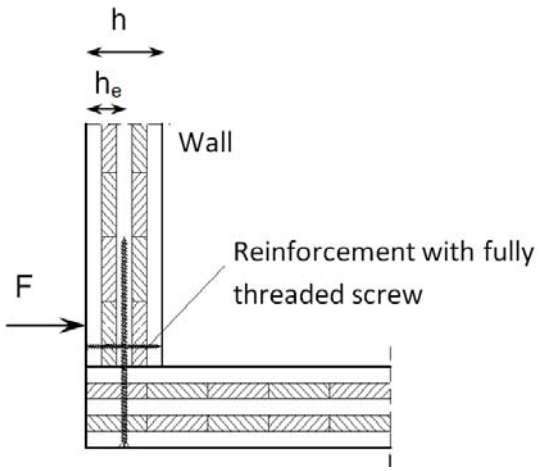

Figure 5: Reinforcement of a cross laminated timber wall with fully threaded screws.

Effective number of fasteners:

The effective number of fasteners n_{ef} for solid timber may be used.

Minimum spacings, edge and end distances:

Minimum spacings, edge and end distances as defined in Figure 6 and further requirements for connections with self-tapping screws in the narrow side of cross laminated timber are given in Tables 5 and 6.

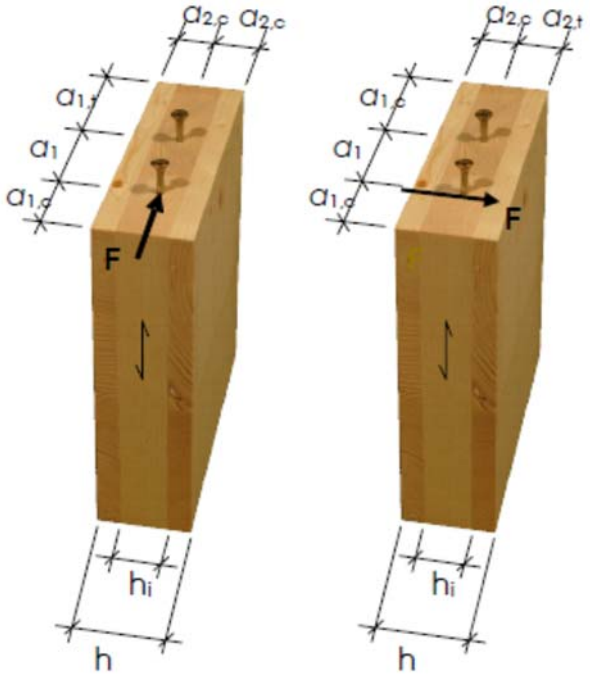

Figure 6: Definition of minimum spacings, edge and end distances for laterally loaded dowel- type fasteners in the narrow side of cross laminated timber

Table 5: Minimum spacings, edge and end distances in the narrow side of cross laminated timber

	a_1	$a_{1,t}$	$a_{1,c}$	a_2	$a_{2,t}$	$a_{2,c}$
Self-tapping screws	10 d	12 d	7 d	3 d	6 d	3 d

Table 6: Requirements for joints in the narrow side of cross laminated timber

	Minimum thickness of the relevant layer h_i in mm	Minimum thickness of the solid wood slab h in mm	Minimum penetration length of the fastener t_1 or t_2 in mm [a)]
Self-tapping screws	d > 8 mm: 3 · d $d \leq$ 8 mm: 2 · d	10 · d	10 · d
[a)] t_1 Minimum penetration length of the fastener in side members t_2 Minimum penetration length of the fastener in middle members			

1.3 **Axially loaded dowel type fasteners**

Threaded nails

The characteristic withdrawal capacity for threaded nails in the plane sides of Hoisko CLT cross laminated timber elements may be calculated according equation (3).

$$R_{ax,k} = 14\ d^{0,6}\ L_{ef} \quad \text{in N} \tag{3}$$

where d = outer diameter of the threaded part
L_{ef} = penetration length of the threaded part.

The following conditions should be fulfilled:

- at least two nails in a connection
- diameter of the threaded part $d \geq 4$ mm
- penetration length of the threaded part $L_{ef} \geq 8\ d$
- characteristic point side withdrawal parameter $f_{ax.k} \geq 6$ N/mm², for sawn timber of strength class C24.

Self tapping screws

Withdrawal resistance:

The characteristic withdrawal capacity for self tapping screws in the plane sides or in the narrow sides of cross laminated timber may be calculated according equation (4).

$$R_{ax,k} = \sum_{i=1}^{n} f_{ax,i,k} \cdot \ell_{ef,i} \cdot d \quad \text{in N} \qquad (4)$$

where d = outer diameter of the threaded part, with $d \geq 6$ mm for screws in the plane sides of cross laminated timber and $d \geq 8$ mm for screws in the narrow sides of cross laminated timber

$f_{ax,i,k}$ = characteristic withdrawal strength of strength class C24 depending on the angle αi between screw axis and grain direction of layer i

$\ell_{ef,i}$ = penetration length of the threaded part in layer i

n = number of penetrated layers.

The following conditions should be fulfilled:

- penetration length of the threaded part $L_{ef,I} \geq 4$ d.

For the design of axially loaded screws in cross laminated timber only threaded parts with an angle $\alpha \geq 30°$ between screw axis and grain direction may be taken into account.

Screws oriented parallel to the plane side of the cross laminated timber should be completely arranged within one layer. The outer diameter of the threaded part should not exceed the thickness of the layer the screw is arranged in.

The characteristic pull-through strength of the screw head for solid timber of strength class C24 may be used.