Deutsches Institut für Bautechnik

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Approval body for construction products and types of construction

Bautechnisches Prüfamt

An institution established by the Federal and Laender Governments

Designated according to Article 29 of Regulation (EU) No 305/2011 and member of EOTA (European Organisation for Technical Assessment)

European Technical Assessment ETA-12/0327 of 28 August 2017

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General Part

Technical Assessment Body issuing the European Technical Assessment:	Deutsches Institut für Bautechnik
Trade name of the construction product	ED-BSP elements
Product family to which the construction product belongs	Solid wood slab element to be used as a structural element in buildings
Manufacturer	EUGEN DECKER Holzindustrie KG Hochwaldstraße 31 54497 Morbach DEUTSCHLAND
Manufacturing plant	EUGEN DECKER Holzindustrie KG Hochwaldstraße 31 54497 Morbach DEUTSCHLAND
This European Technical Assessment contains	19 pages including 6 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
This version replaces	ETA-12/0327 issued on 5 September 2012

Deutsches Institut für Bautechnik
Kolonnenstraße 30 B | 10829 Berlin | GERMANY | Phone: +49 30 78730-0 | Fax: +49 30 78730-320 | Email: dibt@dibt.de | www.dibt.de

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Specific Part

1 Technical description of the product

ED-BSP elements are plane cross laminated timber elements made of at least 3 crosswise (perpendicular) glued boards out of spruce, pine, Douglas fir or larch. The principle structure of the element is shown in Annex 1 and 2. Surfaces of the *ED-BSP elements* are planed. The cross-section of the elements is symmetric.

The layers are bonded together to the required thickness of the cross laminated timber.

Specifications of the used boards are given in Annex 2. Boards are visually or machine strength graded. Only technically dried wood is used.

The single boards of the cover layers meet at least strength class C24 according to EN 338[1] resp EN 14081-1[2], the single boards of the middle layers are to comply strength class C16 at least.

The thickness is 18 to 40 mm and the broadness 80 to 200 mm. For elements with ≥ 7 layers the cover layer and adjacent layer with the same grain direction meet at least strength class C24.

The boards have no grooves for load relieving.

Only boards which are planed on both sides of the outer layer are used. The boards may be connected by finger joints in longitudinal direction according to EN 14080. There are no butt joints.

In elements adjacent layers may be arranged in the same direction as long as a symmetric, crosswise jointed cross-section remains.

The max. width of gaps between the single boards is given in Annex 2. The narrow sides of the boards are not glued.

The cross laminated timber elements are manufactured in accordance with the provisions of this European technical assessment using the automated manufacturing process as identified in the inspection of the plant by the Deutsches Institut für Bautechnik and laid down in the technical documentation.

2 Specification of the intended use in accordance with the applicable European Assessment Document

The elements are intended to be used as load-bearing and/or stiffening or not load-bearing wall, ceiling/floor, roof and special construction components for timber structures. The solid wood slab element shall be subjected to static and quasi-static actions only.

The solid wood slab element is intended to be used in service classes 1 and 2 according to EN 1995-1-1.

Members shall be provided with an effective protection for the solid wood slab elements in service.

[1] EN 338:2003 Structural timber – Strength classes
[2] EN 14081-1:2005+A1:2011 Timber structures – Strength graded structural timber with rectangular cross section – Part 1: General requirements

The performances given in Section 3 are only valid if the solid wood slab elements are used in compliance with the specifications and conditions given in Annex 1 to 5.

The verifications and assessment methods on which this European Technical Assessment is based lead to the assumption of a working life of the solid wood slab element of at least 50 years. The indications given on the working life cannot be interpreted as a guarantee given by the producer, but are to be regarded only as a means for choosing the right products in relation to the expected economically reasonable working life of the works.

Design

The suitability of the solid wood slab elements for the specified purpose is given under the following conditions:

- Design of the solid wood slab elements is carried out under the responsibility of an engineer experienced in such products.
- Design of the works shall account for the protection of the solid wood slab elements.
- The solid wood slab elements are installed correctly.

The design of the solid wood slab element can be performed according to EN 1995-1-1, taking into account Annexes 2 to 5 of the European Technical Assessment. Standards and regulations valid in the place of use shall be considered.

Packaging, transport, storage, maintenance and repair

The solid wood slab elements shall be protected during transport and storage against any damage and detrimental moisture effects. The manufacturer's instructions for packaging, transport and storage shall be observed.

The assessment of the fitness for use is based on the assumption that maintenance is not required during the assumed intended working life. In case of a severe damage of a solid wood slab element immediate actions regarding the mechanical resistance and stability of the works shall be initiated. Should this situation arise replacement of the elements can be necessary.

Installation

The manufacturer shall prepare assembling instructions in which the product-specific characteristics and important measures to be taken into consideration for assembling are described. The assembling instructions shall be available at every construction site.

The assembling of the solid wood slab elements according to this European Technical Assessment shall be carried out by appropriately qualified personnel.

Elements which are directly exposed to the weather shall be provided with an effective protection for the cross laminated timber element during assembling and service.

The safety-at-work and health protection regulations have to be observed.

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

3.1 Mechanical resistance and stability [1)] (BWR 1)

Essential characteristic	Performance
Bending [2)]	Annex 3
Tension and compression [2)]	Annex 3
Shear [2)]	Annex 3
Embedment strength	Annex 3
Creep and duration of the load	Annex 3
Dimensional stability	Annex 3
In-service environment	Annex 3
Bond integrity	Annex 3

[1)] This characteristic also relates to BWR 4.

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

The adhesive for gluing the board layers and the finger joint connection of the individual boards fulfills the requirements for adhesive type I according to EN 15425[3].

Regarding the applicable type of adhesive national regulations apply.[3]

Details on the adhesives and the bonding process are deposited with Deutsches Institut für Bautechnik.

3.2 Safety in case of fire (BWR 2)

Essential characteristic	Performance
Reaction to fire	Annex 3
Resistance to fire	Annex 3

[3] In Germany adhesives of the type I are to be used.

3.3 Hygiene, health and the environment (BWR 3)

Essential characteristic	**Performance**
Content, emission and/or release of dangerous substances	
Substance/s classified as EU-cat. Carc. 1A and/or 1B in accordance with Regulation (EC) No 1272/2008.	The product does not contain these dangerous substances.[a)]
Substance/s classified as EU-cat. Muta. 1A and/or 1B in accordance with Regulation (EC) No 1272/2008.	
Substance(s) classified as EU-cat. Acute Tox. 1, 2 and/or 3; substance(s) classified as EU-cat. Repr. 1A/1B; substance(s) classified as EU-cat. STOT SE 1 and/or STOT RE 1, in accordance with Regulation (EC) No 1272/2008.	
Formaldehyde emission	Formaldehyde class E1 in accordance with EN 13986
Water vapour permeability - Water vapour transmission	Annex 3
Use scenarios regarding BWR 3 in accordance with EOTA TR 034: IA 1, IA 2	

[a)] Assessment based on a detailed manufacturer's product declaration.

3.4 Safety and accessibility in use (BWR 4)

Essential characteristic	**Performance**
Impact resistance	Annex 3

3.5 Protection against noise (BWR 5)

Essential characteristic	**Performance**
Airborne sound insulation	no performance assessed
Impact sound insulation	no performance assessed
Sound absorption	no performance assessed

3.6 Energy economy and heat retention (BWR 6)

Essential characteristic	Performance
Thermal conductivity	Annex 3
Air permeability	no performance assessed
Thermal inertia	Annex 3

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

In accordance with EAD No. 130005-00-0304 the applicable European legal act is: 1997/176/EC amended by 2001/596/EC

The system to be applied is: 1

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

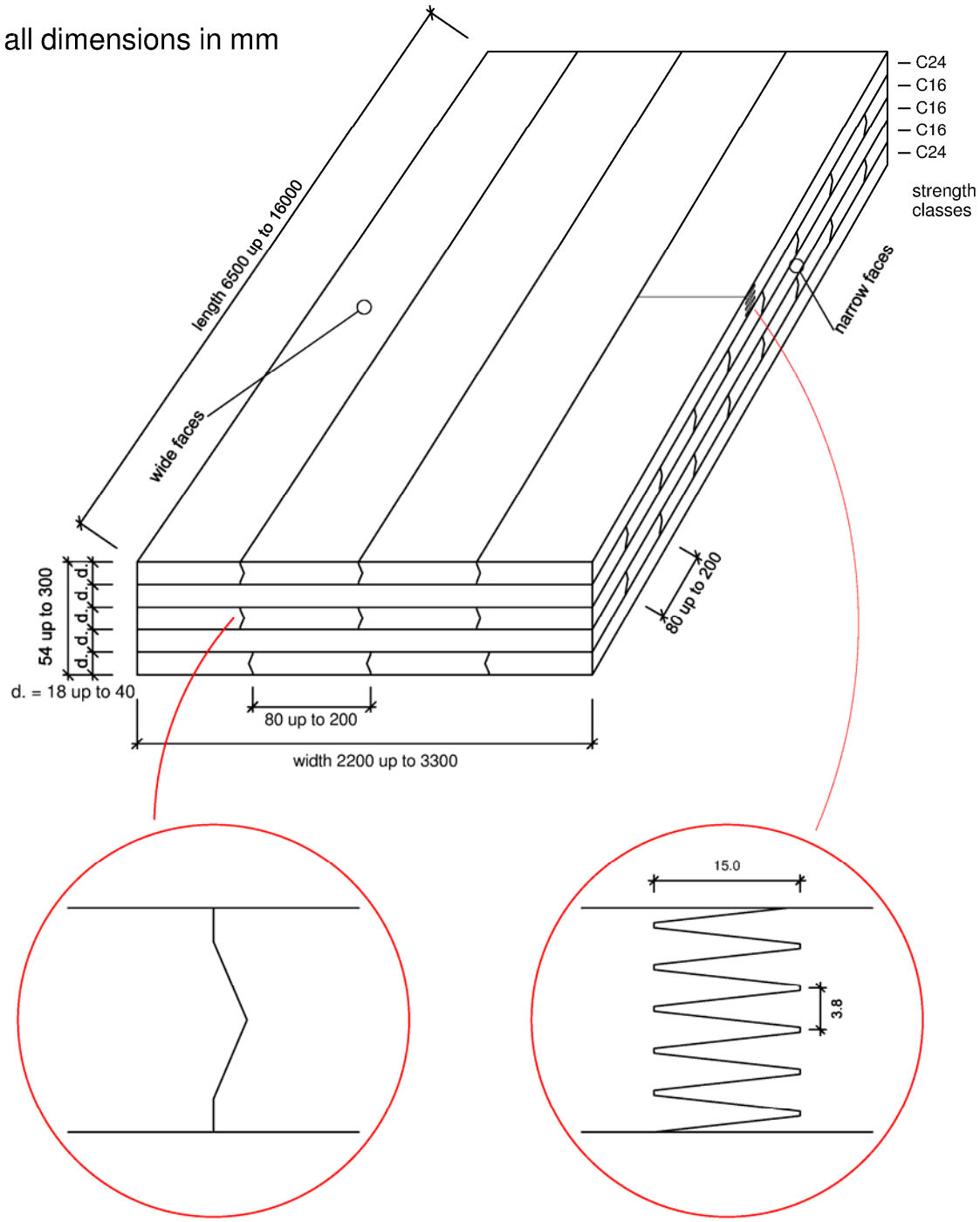
Technical details necessary for the implementation of the AVCP system are laid down in the control plan deposited with Deutsches Institut für Bautechnik.

Issued in Berlin on 28 August 2017 by Deutsches Institut für Bautechnik

Dr.-Ing. Lars Eckfeldt
p. p. Head of Department

beglaubigt:
Deniz

Deutsches Institut für Bautechnik



ED-BSP elements	Annex 1
Construction of a cross laminated timber element (Example)	

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Table 1: Dimensions and specifications of the elements

Characteristic	Specification
Elements	
Thickness	54 to 300 mm
Tolerance in thickness	± 1.0 mm
Width	≤ 3.30 m
Tolerance in width	± 3.0 mm
Length	≤ 16.00 m
Tolerance in length	± 3.0 mm
Number of layers	$3 \leq n \leq 9$
Number of consecutive layers having the same direction	≤ 2 for n > 5
Maximum width of gaps between the single boards	4 mm
Boards	
Material	Spruce, pine, Douglas fir, larch
Strength class according to EN 338 resp. EN 14081-1 - of the top layer and adjacent layer with the same grain direction with a number n ≥ 7 - of the middle layers	 C24 ≥ C16
Thickness	18 to 40 mm
Width	80 to 200 mm
Ratio width to thickness of the cross layers	≥ 4 : 1
Moisture of wood according to EN 13183-2	12 ± 2 %
Finger joints	acc. to EN 14080

ED-BSP elements	Annex 2
Dimensions and specifications of the cross laminated timber	

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Table 2: Essential requirements of the elements

BWR	Requirement	Verification method	Class / Use category / Value
1	**Mechanical resistance and stability**		
	For the calculation of the individual layers the characteristic strength and stiffness values of softwood of the corresponding strength classes acc. to EN 338 shall be used taking into consideration the definitions in Annex 2. In addition the following values apply:		
	Mechanical actions in plane of cross laminated timber	Shear strength (5%-fractile)	$f_{v,k}$	See Annex 4, clause 1.4.1
	Mechanical actions perpendicular to the plane of cross laminated timber	Rolling shear strength (5%-fractile)	$f_{v,9090,k}$	1.0 N/mm²
		Rolling shear modulus (mean value)	$G_{9090,mean}$	50 N/mm²
	For references regarding the calculation see annex 4 and 5. National regulations might have to be followed.		
	Creep and duration of load	according to EN 1995-1-1	
	Dimensional stability	Moisture content during use shall not change to such extent that adverse deformations can occur.	
	Crack factor	according to EN 1995-1-1, 6.1.7: k_{cr} = 1.0	
	In-service environment	EN 1995-1-1	1 and 2
	Bond integrity	EAD 130005-00-0304	Passed
2	**Safety in case of fire**		
	Reaction to fire		
	Timber elements except for floorings	Commission Decision 2005/610/EC	Euroclass D-s2, d0
	Resistance to fire		
	Charring rate	EN 1995-1-2	no performance assessed
3	**Hygiene, health and the environment**		
	Water vapour permeability μ	EN ISO 10456	50 (dry) to 20 (wet)
	Content of dangerous substances	EAD 130005-00-0304	See clause 3
4	**Safety in use**		
	Impact resistance	Soft body resistance is assumed to be fulfilled for walls with a minimum of 3 layers and minimum thickness of 60 mm.	
5	**Protection against noise**		
	Airbourne sound insulation	no performance assessed	
	Impact sound insulation	no performance assessed	
	Sound absorption	no performance assessed	
6	**Energy economy and heat retention**		
	Thermal conductivity λ	EN ISO 10456	0.12 W/(m·K)
	Air tightness	no performance assessed	
	Thermal inertia c_p	EN ISO 10456	1600 J/(kg ·K)

ED-BSP elements	Annex 3
Essential requirements of the multilayered timber elements	

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1 Recommendations for the design of the elements

1.1 General

Design, calculation and realization may be performed according to EN 1995-1-1 taking into account the following provisions. For the calculation according to EN 1995-1-1 national regulations may have to be followed.

The determination of the distribution of stresses and internal forces must consider the influence of shear deformations of the cross layers. In Annex 5 advice is given on how to perform the calculation of the elements.

If using panels as cover, the deformation of the covers might have to be taken into account. These cover layers may not be used for calculation of the bearing capacity of the cross laminated timber elements.

For cross laminated timber elements under bending load with more than 5 layers it is necessary to use numerical solutions taking into account the shear deformation of the cross layers.

1.2 Characteristic values

The characteristic strength and stiffness values can be taken from Annex 2 and 3. In addition the following applies:

While calculating the part of the deformation due to shear forces, the element's thickness D regardless of the configuration and a shear modulus of G = 60 N/mm² may be used.

1.3 Mechanical actions perpendicular to the element`s plane

1.3.1 Bending and shear

For the calculation of the characteristic values of the element according to Annex 4, only the boards, which are oriented parallel to the span direction, may be considered.

For the verification of the bending strength of a layer the design value of the bending strength may be multiplied with a system factor k_ℓ:

$$k_\ell = \min \begin{cases} 1 + 0.025\ n \\ 1.1 \end{cases}$$

where n = number of adjacent boards

1.3.2 Tension and compression

The behaviour in bearing and deformation against compression perpendicular to the element's plane can be calculated according to EN 1995-1-1 using the strength and stiffness values given in chapter 1.2.

Tension loads perpendicular to plane of the element should be avoided.

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1.4 Mechanical actions in plane of the element

For loads in plane of the element only layers can be taken into account, where the direction of the grain is parallel to the stresses occurring from external loads.

1.4.1 Shear

Shear stresses may be calculated with the gross cross section. These shear stresses are to be compared with an effective characteristic shear strength $f_{v,k}$ according to the following equation:

$$f_{v,k} = \min \begin{cases} 3.5 \\ 8.0 \dfrac{D_{net}}{D} \\ 2.5 \dfrac{(n-1)\left(a^2+b^2\right)}{6\,D\,b} \end{cases} \quad \text{in } [N/mm^2]$$

where

D element thickness (see Annex 1)

D_{net} total thickness of longitudinal or cross layers within the element; the smaller value applies

n number of layers within the element, adjacent layers with parallel lamellae shall be considered as one layer and

a, b width of the boards in the longitudinal or cross layers, where b > a
(If a and b is unknown, the minimum value acc. to Table 1 must be applied.)

1.4.2 Tension and compression

The load-bearing and deformation behaviour in the element plane can be calculated according to EN 1995-1-1 using the strength and stiffness values given in chapter 1.2.

Design according to the theory of flexible bonded beams

The calculation of elements with up to five layers can be performed using the theory of flexible bonded beams as described in EN 1995-1-1.

To consider deformations due to shear the factor s_i/K_i according to the standard is substituted by the factor $\overline{h_i}/(G_R \cdot b)$.

The effective moment of inertia is calculated by:

$$I_{ef} = \sum_{i=1}^{3} (I_i \cdot + \gamma_i \cdot A_i \cdot a_i^2) \qquad \text{where} \quad A_i = b_i \cdot h_i ; \qquad I_i = \frac{b_i \cdot h_i^3}{12}$$

$$\gamma_1 = \frac{1}{1 + \frac{\pi^2 \cdot E_0 \cdot A_1 \cdot \overline{h_1}}{G_R \cdot b \cdot l^2}} ; \qquad \gamma_2 = 1 ; \qquad \gamma_3 = \frac{1}{1 + \frac{\pi^2 \cdot E_0 \cdot A_3 \cdot \overline{h_2}}{G_R \cdot b \cdot l^2}}$$

$$a_1 = \left(\frac{h_1}{2} + \overline{h_1} + \frac{h_2}{2} \right) - a_2 ; \qquad a_3 = \left(\frac{h_2}{2} + \overline{h_2} + \frac{h_3}{2} \right) + a_2$$

$$a_2 = \frac{\gamma_1 \cdot A_1 \cdot \left(\frac{h_1}{2} + \overline{h_1} + \frac{h_2}{2} \right) - \gamma_3 \cdot A_3 \cdot \left(\frac{h_2}{2} + \overline{h_2} + \frac{h_3}{2} \right)}{\sum_{i=1}^{3} (\gamma_i \cdot A_i)}$$

The bending stress in the centre of the boards may be disregarded.

The governing bending stress in the outermost fibre of the boards:

$$\sigma_{m,r,i,d} = \pm \frac{M_d}{I_{ef}} \cdot \left(\gamma_i \cdot a_i + \frac{h_i}{2} \right) \le f_{m,d}$$

Shear design is in the governing plane:

$$\tau_{v,d} = \frac{V_d \cdot \gamma_i \cdot S_i}{I_{ef} \cdot b} \le f_{R,d}$$

Notation:

h_{tot} = thickness of the whole element [mm]

h_i = thickness of the layer i parallel to the direction of load transfer [mm]

$\overline{h_i}$ = thickness of the layer i perpendicular to the direction of load transfer [mm]

b = width of the element [mm]

n = number of layers

l = span width [mm]

I_{ef} = effective moment of inertia [Nmm²]

G_R = rolling shear modulus [N/mm²]

E_0 = modulus of elasticity parallel to the grain of the boards [N/mm²]

ED-BSP elements	Annex 4
Design considerations	

2 Recommendations for the design of the fasteners

2.1 General

The determination of characteristic values of the load-bearing capacity of fasteners in the element shall be carried out according to EN 1995-1-1 or acc. to an European Technical Approval or Assessment which has been granted for the relevant fastener as for softwood or for glued laminated timber. For the calculation according to European regulations national provisions may apply.

Wide faces are the surfaces of the element parallel to the plane of the element consisting of the surface of the outer layers.

Narrow faces are the lateral and the cross grain board surfaces perpendicular to the plane of the element.

Only fasteners according to EN 1995-1-1 or a European Technical Approval or Assessment or according to national regulations may be used.

If the position of the fasteners in the narrow faces is not clearly defined (end grain, gaps between the single boards, etc.), then the most unfavorable case is to be assumed.

The grain direction of the cover layers governs the minimum spacings of the fasteners as well as the embedding strength is.

For the minimum spacings, minimum thicknesses, minimum layer thicknesses and minimum penetration length of fasteners, see Appendix 5.

Additional please note the following:

2.2 Nails

The nails must be at least 2.8 mm in diameter.

Wide faces

The characteristic load-carrying capacity of laterally loaded nails in the wide faces is to be determined according to EN 1995-1-1. Decisive for the minimum spacings is the grain direction of the cover layers. The characteristic density of the cover layers is decisive for the density.

The effective number of nails n_{ef} may be set equal to the actual number n.

Narrow faces

Nails in the narrow faces of the elements shall not be considered as load-bearing.

2.3 Screws

The outer thread diameter shall be used as the relevant diameter d of the screw. Penetration lengths $l_{ef} < 4$ d should not be considered as load-carrying.

The minimum diameter for screws in the wide faces is 4 mm and in the narrow faces 6 mm.

Wide faces

The load direction must be perpendicular to the screw axis and parallel to the wide face of the cross laminated timber.

The embedding strength may be determined as for nails in solid timber according to DIN EN 1995-1-1 where the characteristic density of the cover layers is to be used.

Decisive for the minimum spacings is the grain direction of the cover layers.

The effective number of screws n_{ef} may be set equal to the actual number n.

Narrow faces

The load direction must be perpendicular to the screw axis and parallel to the narrow face of the cross laminated timber.

Regardless of the arrangement of the screw in the narrow face (e.g. for angles between screw axis and grain direction of $0° \le \alpha < 90°$), the characteristic value of the embedding strength, when using screws without predrilling, shall be calculated as follows:

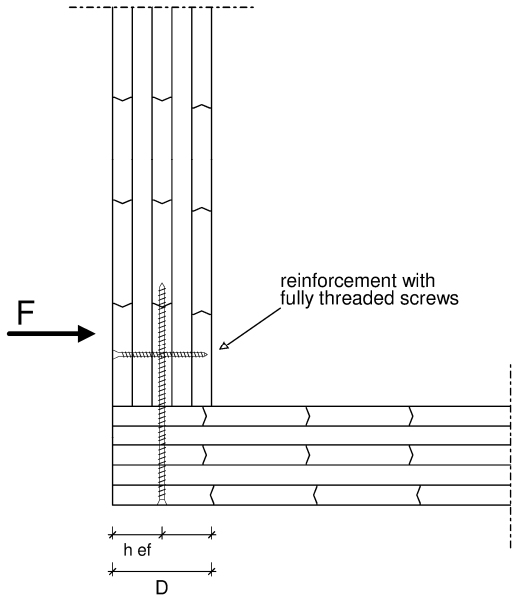
$$f_{h,k} = 20 \cdot d^{-0,5} \qquad \text{in N/mm}^2$$

where

d nominal diameter of the screw in mm

The effective number of screws n_{ef} may be set as for bolts in solid timber according to DIN EN 1995-1-1.

Note: For actions perpendicular to the plane 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 $h_{ef}/D \le 0.7$ should be reinforced with fully threaded screws (see Figure).



Axially loaded screws (pull-out)

The characteristic withdrawal capacity of a fastener in the wide face shall be carried out according to EN 1995-1-1 or acc. to a European Technical Approval or Assessment of the fastener.

Screws with an angles α <15 ° between the screw axis and the grain direction may be loaded only in the load duration classes "short" and "very short". This only applies to screws for which this direction of load is regulated in the European Technical Approval or Assessment of the screw.

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

The characteristic pull-through strength of the screw head is to be determined as for solid timber, depending on the characteristic density of the corresponding layer in the head area of the screw.

ED-BSP elements	Annex 5
Fasteners	

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2.4 Split ring, shear plate and toothed-plate connectors

Wide faces

The characteristic load-carrying capacity of split ring, shear plate and toothed-plate connectors in the wide faces of cross laminated timber may be calculated according to EN 1995-1-1 for an angle between force and grain direction of α = 0° regardless of the actual angle between the force and grain direction of the cover layers.

When inserting in the wide faces a minimum layer thickness of 18 mm must be maintained .

Narrow faces

For split ring and shear plate connectors in the narrow faces of the cross laminated timber the regulations for connections with split ring connectors in the end grain of timber members may be applied.

2.5 Connections with dowels and bolts

Wide faces

The characteristic load-carrying capacity of dowelled or bolted connections in the wide faces is to be determined with the embedding strength according to the following equation:

$$f_{h,\alpha,k} = \frac{32 \cdot (1 - 0.015 \cdot d)}{1.1 \cdot \sin^2 \alpha + \cos^2 \alpha} \qquad \text{in N/mm}^2$$

where

d fastener diameter in mm

α angle between force and grain direction of the cover layer

Decisive for the calculation of the embedding strength is the grain direction of the cover layers.

For dowels and bolts connections with a diameter ≥ 10 mm, $n_{ef} = n$ may be assumed.

Narrow faces

The characteristic load-carrying capacity of dowelled or bolted connections in the narrow faces is to be determined with the embedding strength according to the following equation:

$$f_{h,k} = 9 \cdot (1 - 0.017 \cdot d) \qquad \text{in N/mm}^2$$

where

d fastener diameter in mm

Note: For actions perpendicular to the plane 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 $h_{ef}/D \leq 0.7$ should be reinforced with fully threaded screws.

ED-BSP elements	Annex 5
Fasteners	

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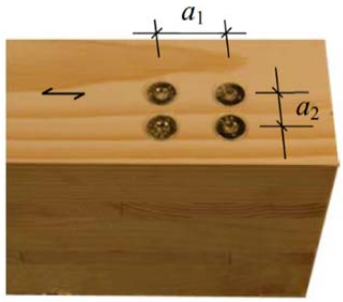
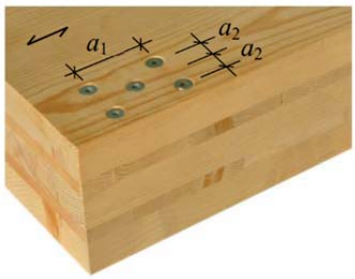
3. Minimum spacings of fasteners

3.1 Minimum spacings of fasteners in the wide faces

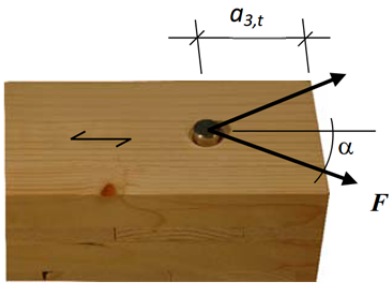
Minimum spacings – parallel and perpenticular to grain



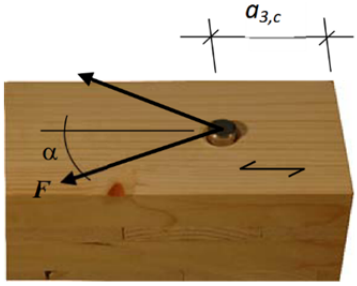


Edge and end distances

loaded end $a_{3,t}$



unloaded end $a_{3,c}$



unloaded edge $a_{4,c}$
loaded edge $a_{4,t}$

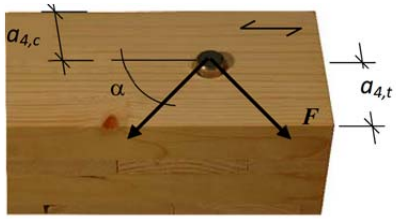


Table 4a: Minimum spacings of fasteners in the wide faces

fastener	a_1	a_2	$a_{3,t}$	$a_{3,c}$	$a_{4,t}$	$a_{4,c}$
screws [1)]	4·d	2.5·d	6·d	6·d	6·d	2.5·d
nails	(3+3·cosα)·d	3·d	(7+3·cosα)·d	6·d	(3+4·sinα)·d	3·d
dowels	(3+2·cosα)·d	3·d	5·d	4·d·sinα min. 3·d	3·d	3·d
bolts	(3+2·cosα)·d min. 4·d	4·d	5·d	4·d·sinα min. 4·d	3·d	3·d
α angle between force and grain direction of the cover layer 1) self-tapping screws						

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3.2 Minimum spacings, minimum thicknesses, minimum layer thicknesses und minimum penetration lengths of fasteners in the narrow faces

The minimum spacings in the narrow faces are independent of the angle between fastener axis and grain direction.

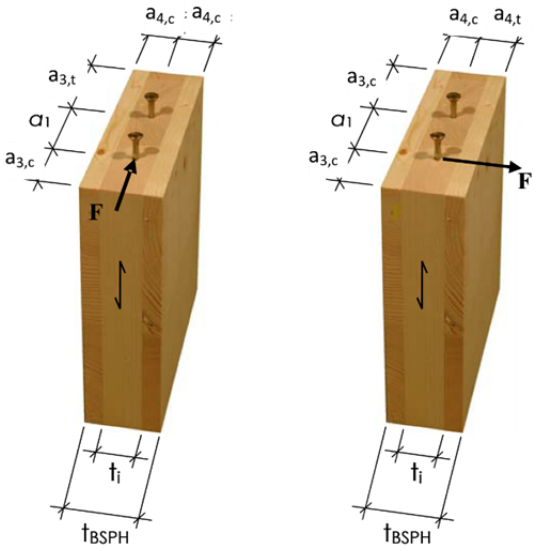

Table 4b: Minimum spacings of fasteners in the narrow faces

	a_1	a_2	$a_{3,t}$	$a_{3,c}$	$a_{4,t}$	$a_{4,c}$
screws [1)]	10·d	3·d	12·d	7·d	6·d	5·d
dowels	4·d	3·d	5·d	3·d	5·d	3·d
bolts	4·d	4·d	5·d	4·d	5·d	3·d
[1)] self-tapping screws						

Table 4c: Requirements for fasteners in the narrow faces of cross laminated timber

fastener	Minimum thickness of the cross laminated timber	Minimum thickness of the relevant layer	Minimum penetration length of the fastener t_1 oder t_2 *)
	t_{BSPH} in mm	t_i in mm	in mm
screws	10·d	d > 8 mm: 3·d d ≤ 8 mm: 2·d	10·d
dowels bolts	6·d	d	5·d
*) t_1 Minimum penetration length of the fastener in side members (member to be connected) t_2 Minimum penetration length of the fastener in middle members (cross laminated timber element)			

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