



European Technical Approval ETA-12/0327

English translation prepared by DIBt - Original version in German language

Handelsbezeichnung
Trade name

ED-BSP Elemente
ED-BSP elements

Zulassungsinhaber
Holder of approval

EUGEN DECKER
Holzindustrie KG
Hochwaldstraße 31
54497 Morbach
DEUTSCHLAND

Zulassungsgegenstand
und Verwendungszweck
*Generic type and use
of construction product*

Massives plattenförmiges Holzbauelement zur Verwendung als
tragendes Bauteil in Bauwerken
Solid wood slab element to be used as a structural element in buildings

Geltungsdauer:
Validity: vom
from
bis
to

5 September 2012
5 September 2017

Herstellwerk
Manufacturing plant

EUGEN DECKER
Holzindustrie KG
Hochwaldstraße 31
54497 Morbach
DEUTSCHLAND

Diese Zulassung umfasst
This Approval contains

15 Seiten einschließlich 5 Anhänge
15 pages including 5 annexes

I LEGAL BASES AND GENERAL CONDITIONS

- 1 This European technical approval is issued by Deutsches Institut für Bautechnik in accordance with:
 - Council Directive 89/106/EEC of 21 December 1988 on the approximation of laws, regulations and administrative provisions of Member States relating to construction products¹, modified by Council Directive 93/68/EEC² and Regulation (EC) N° 1882/2003 of the European Parliament and of the Council³;
 - *Gesetz über das In-Verkehr-Bringen von und den freien Warenverkehr mit Bauprodukten zur Umsetzung der Richtlinie 89/106/EWG des Rates vom 21. Dezember 1988 zur Angleichung der Rechts- und Verwaltungsvorschriften der Mitgliedstaaten über Bauprodukte und anderer Rechtsakte der Europäischen Gemeinschaften (Bauproduktengesetz - BauPG) vom 28. April 1998⁴, as amended by Article 2 of the law of 8 November 2011⁵;*
 - Common Procedural Rules for Requesting, Preparing and the Granting of European technical approvals set out in the Annex to Commission Decision 94/23/EC⁶.
- 2 Deutsches Institut für Bautechnik is authorized to check whether the provisions of this European technical approval are met. Checking may take place in the manufacturing plant. Nevertheless, the responsibility for the conformity of the products to the European technical approval and for their fitness for the intended use remains with the holder of the European technical approval.
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- 6 The European technical approval is issued by the approval body in its official language. This version corresponds fully to the version circulated within EOTA. Translations into other languages have to be designated as such.

¹ Official Journal of the European Communities L 40, 11 February 1989, p. 12

² Official Journal of the European Communities L 220, 30 August 1993, p. 1

³ Official Journal of the European Union L 284, 31 October 2003, p. 25

⁴ *Bundesgesetzblatt Teil I 1998*, p. 812

⁵ *Bundesgesetzblatt Teil I 2011*, p. 2178

⁶ Official Journal of the European Communities L 17, 20 January 1994, p. 34

II SPECIFIC CONDITIONS OF THE EUROPEAN TECHNICAL APPROVAL

1 Definition of the product and intended use

1.1 Definition of the construction product

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

Surfaces of the *ED-BSP elements* are planed.

The use of chemical substances (wood preservatives and/or flame retardants) is not subject of this European technical approval.

1.2 Intended use

The timber construction elements are intended to be used as a load-bearing, bracing or non structural element in buildings or timber structures. It shall be subjected to static and quasi static actions only.

The elements are intended to be used in service classes 1 and 2 according to EN 1995-1-1⁷.

The provisions made in this European technical approval are based on an assumed working life of the cross laminated timber elements of 50 years, provided that the conditions laid down in sections 4.2, 5.2 and 5.3 for the installation, packaging, transport, storage, use, maintenance and repair are met. 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.

2 Characteristics of the product and methods of verification

2.1 Characteristics of the product

2.1.1 General

The cross laminated timber elements and their boards correspond to the information given in the annexes 1 to 3. Details about the elements are deposited with Deutsches Institut für Bautechnik.

2.1.2 Construction of the cross laminated timber elements

A specification of the composition of the elements and the boards to be used is given in Annex 1 and 2.

Boards are visually or machine graded. Only technically dried wood shall be used.

⁷ EN 1995-1-1:2004 + AC2005 + A1:2008 Eurocode 5: Design of timber structures – Part 1-1: General - Common rules and rules for buildings

The single boards of the top layers meet at least strength class C24 according to EN 338⁸ resp EN 14081-1⁹, the single boards of the middle layers are to comply strength class C16 at least.

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

The boards of the longitudinal layers have 2 grooves for load relieving (width of the groove 4 mm) in the third points parallel to the grain. The depth of the groove must be half of the thickness of the board at least. The remaining thickness of the board under the groove must be 5 mm at least.

The ratio width to thickness of the boards of the cross layers must fulfil the condition $\geq 4 : 1$. Surfaces are planed on both sides.

The boards of the single layers shall be connected by finger joints according to EN 385¹⁰ in longitudinal direction. Butt joints are not permissible.

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

The acceptable width of gaps between the single boards of a layer is 6 mm. The narrow sides of the boards are not glued. The cross-section of the cross laminated timber elements shall be symmetrically.

2.1.3 Adhesive

Details on the adhesives used are deposited with Deutsches Institut für Bautechnik.

2.2 Mechanical resistance and stability

The specifications regarding mechanical resistance and stability are given in annexes 2 to 5. Design of the cross laminated timber elements can be carried out according to EN 1995-1-1. Design also may be carried out according to national provisions that apply at the installation site of the certified object.

2.3 Behaviour in case of fire

2.3.1 Reaction to fire

In accordance with Commission Decision 2003/43/EC¹¹ the cross laminated timber elements covered by this European technical approval for use as wall, roof, ceiling and special construction components comply with Euroclass D-s2, d0 according to EN 13501-1¹². For the use as floor construction components they comply with Euroclass D_{fl}-s1. The boundary conditions stated in the commission decision have to be attended for this classification.

The Decision of the European Commission might not apply if wood-based panels or other coverings are part of the element, depending on the coverings used and the boundary conditions affected.

8	EN 338:2003	Structural timber – Strength classes
9	EN 14081-1:2005+A1:2011	Timber structures – Strength graded structural timber with rectangular cross section – Part 1: General requirements
10	EN 385:2001	Finger jointed structural timber - Performance requirements and minimum production requirements
11	Official Journal of the European Communities L 13, 18 January 2003, p.35	
12	EN 13501-1:2007+A1:2009	Fire classification of construction products and building elements – Part 1: Classification using data from reaction to fire tests

Note:

A European reference fire scenario for façades has not been laid down. In some Member States, the classification of the cross laminated timber elements according to EN 13501-1¹² might not be sufficient for the use in façades. An additional assessment of the cross laminated timber elements 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.

2.4 Hygiene, health and the environment

A manufacturer's declaration has been submitted at Deutsches Institut für Bautechnik that no dangerous substances are used in the cross laminated timber elements.

Cross laminated timber elements with wood preservatives and/or flame retardants are not subject of this European technical approval.

The class of formaldehyde is E1 according to EN 13986¹³ with respect to solid wood slab elements.

Note:

In addition to the specific clauses relating to dangerous substances contained in this European technical approval, 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 Construction Products Directive, these requirements need also to be complied with, when and where they apply.

2.5 Methods of verification

The assessment of the fitness of the building product for the intended use in relation to the essential requirements for mechanical resistance and stability, for safety in case of fire, for hygiene, health and the environment, for protection against noise, for energy economy and heat retention, as well as for durability in the sense of these essential has been made in compliance with the assessment rules for these cross laminated timber elements agreed upon within EOTA.

3 Evaluation and attestation of conformity and CE marking

3.1 System of attestation of conformity

According to the Decision 97/176/EC¹⁴ of the European Commission for the product family system 1 of the attestation of conformity applies.

This system of attestation of conformity is defined as follows:

System 1: Certification of the conformity of the product by an approved certification body on the basis of:

- (a) Tasks for the manufacturer:
 - (1) factory production control;
 - (2) further testing of samples taken at the factory by the manufacturer in accordance with a prescribed test plan.

¹³ EN 13986:2004 Wood-based panels for use in construction - Characteristics, evaluation of conformity and marking

¹⁴ Official Journal of the European Communities L 73/19, 14 March 1997

- (b) Tasks for the approved body:
- (3) initial type-testing of the product;
 - (4) initial inspection of factory and of factory production control;
 - (5) continuous surveillance, assessment and approval of factory production control.

Note: Approved bodies are also referred to as "notified bodies".

3.2 Responsibilities

3.2.1 Tasks for the manufacturer

3.2.1.1 Factory production control

The manufacturer shall exercise permanent internal control of production. All the elements, requirements and provisions adopted by the manufacturer shall be documented in a systematic manner in the form of written policies and procedures, including records of results performed. This production control system shall insure that the product is in conformity with this European technical approval.

The manufacturer may only use raw materials stated in the technical documentation of this European technical approval.

The factory production control shall be in accordance with the "Control plan relating to the European technical approval ETA-12/0327 issued on 5 September 2012" which is part of the technical documentation of this European technical approval. The control plan is laid down in the context of the factory production control system operated by the manufacturer and deposited with Deutsches Institut für Bautechnik.¹⁵

The results of factory production control shall be recorded and evaluated in accordance with the provisions of the control plan.

The records include at least:

- Designation of the product, basic materials and components;
- Type of control or testing;
- Date of manufacture of the product and date of testing of the product or basic materials or components;
- Results of control and testing and, if appropriate, comparison with requirements;
- Name and signature of person responsible for factory production control.

3.2.1.2 Other tasks for the manufacturer

The manufacturer shall, on the basis of a contract, involve a body which is approved for the tasks referred to in section 3.1 in order to undertake the actions laid down in section 3.2.2. For this purpose, the control plan referred to in sections 3.2.1.1 and 3.2.2 shall be handed over by the manufacturer to the approved body involved.

The manufacturer shall make a declaration of conformity, stating that the construction product is in conformity with the provisions of the European technical approval ETA-12/0327 issued on 5 September 2012. The declaration of conformity can only be given if the provisions of this ETA are met and the control plan is being followed.

¹⁵ The "Control plan" is a confidential part of the European technical approval and only handed over to the approved body involved in the procedure of attestation of conformity. See section 3.2.2.

3.2.2 Tasks for the approved body

The approved body shall perform the

- initial type-testing of the product,
- initial inspection of factory and of factory production control,
- continuous surveillance, assessment and approval of factory production

in accordance with the provisions laid down in the control plan.

The initial inspection of the factory shall include the inspection of the factory plant, the technical equipment of the plant and the qualification of the staff.

The approved body shall retain the essential points of its actions referred to above and state the results obtained and conclusions drawn in a written report.

The approved certification body involved by the manufacturer shall issue an EC certificate of conformity of the product stating the conformity with the provisions of this European technical approval. The certificate of conformity can only be given if the provisions of this ETA are met and the control plan is being followed.

In cases where the provisions of the European technical approval and its control plan are no longer fulfilled the certification body shall withdraw the certificate of conformity and inform Deutsches Institut für Bautechnik without delay.

3.3 CE marking

The CE marking shall be affixed on the product itself, a label attached to it, the packaging or the accompanying commercial document.

The letters "CE" shall be followed by the identification number of the approved certification body and be accompanied by the following additional information:

- the name and address of the producer (legal entity responsible for the manufacture),
- the last two digits of the year in which the CE marking was affixed,
- the number of the EC certificate of conformity for the product,
- the number of the European technical approval,
- description of the element, showing its intended use,
- species of the wood used,
- number and arrangement plus thickness of the layers,
- nominal thickness of the timber element,
- strength class of the wood of each layer,
- class of formaldehyde,
- type and classification of the adhesive used.

4 Assumptions under which the fitness of the product for the intended use was favourably assessed

4.1 Manufacturing

The cross laminated timber elements are manufactured in accordance with the provisions of this European technical approval 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.

The layers shall be glued together to the required thickness of the element.

Pressing of the elements is executed with a hydraulic press with a flat pressure of 0.5 up to 0.8 MPa. Details of the manufacturing process are deposited with Deutsches Institut für Bautechnik.

The European technical approval is issued for the product on the basis of agreed data/information, deposited with Deutsches Institut für Bautechnik, which identifies the product that has been assessed and judged. Changes to the product or production process, which could result in this deposited data/information being incorrect, should be notified to Deutsches Institut für Bautechnik before the changes are introduced. Deutsches Institut für Bautechnik will decide whether or not such changes affect the approval and consequently the validity of the CE marking on the basis of the approval and if so whether further assessment or alterations to the approval shall be necessary.

4.2 Installation

4.2.1 Design of the cross laminated timber elements

The European technical approval only applies to the manufacture and use of the cross laminated timber elements regulated here. Verification of stability of the buildings while using these cross laminated timber elements is not subject of this European technical approval.

Fitness for the intended use of the elements is given under the following conditions:

- Design of the cross laminated timber elements is carried out under the responsibility of an engineer experienced in design of these elements.
- Design of the works provides a sufficient protection of the cross laminated timber elements.
- The cross laminated timber elements are installed correctly.

Design of the cross laminated timber elements can be performed according to EN 1995-1-1 taking into account the Annexes 2 to 5 of this European technical approval. Standards and regulations valid in the place of use shall be considered.

4.2.2 Installation of cross laminated timber elements

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 cross laminated timber elements in accordance with this European technical approval shall be carried out by appropriately qualified personnel.

Cross laminated timber elements shall be protected against detrimental changes of moisture.

5 Recommendations to the manufacturer

5.1 General

The manufacturer shall ensure that the requirements stated in the clauses 1, 2 and 4 and the Annexes of this European technical approval are made known to those who are concerned during planning and execution of the works.

5.2 Recommendations for packaging, transport and storage

The cross laminated timber elements shall be protected during transport and storage against any damage and detrimental moisture effects. The manufacturer's instruction for packaging, transport and storage shall be observed.

European technical approval

ETA-12/0327

English translation prepared by DIBt

Page 9 of 15 | 5 September 2012

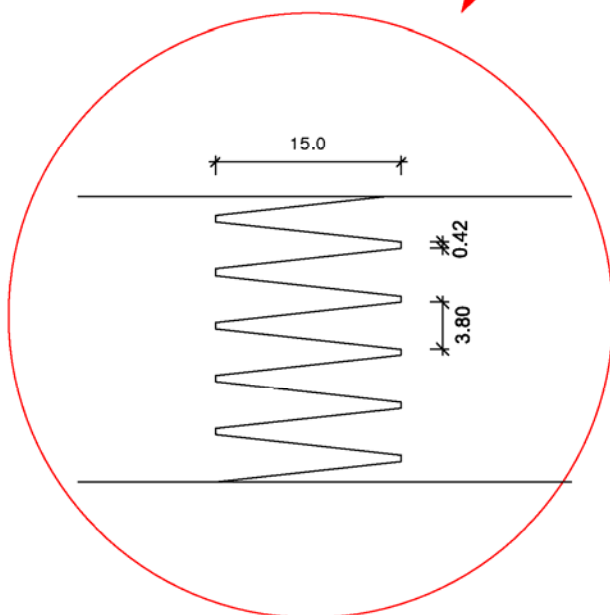
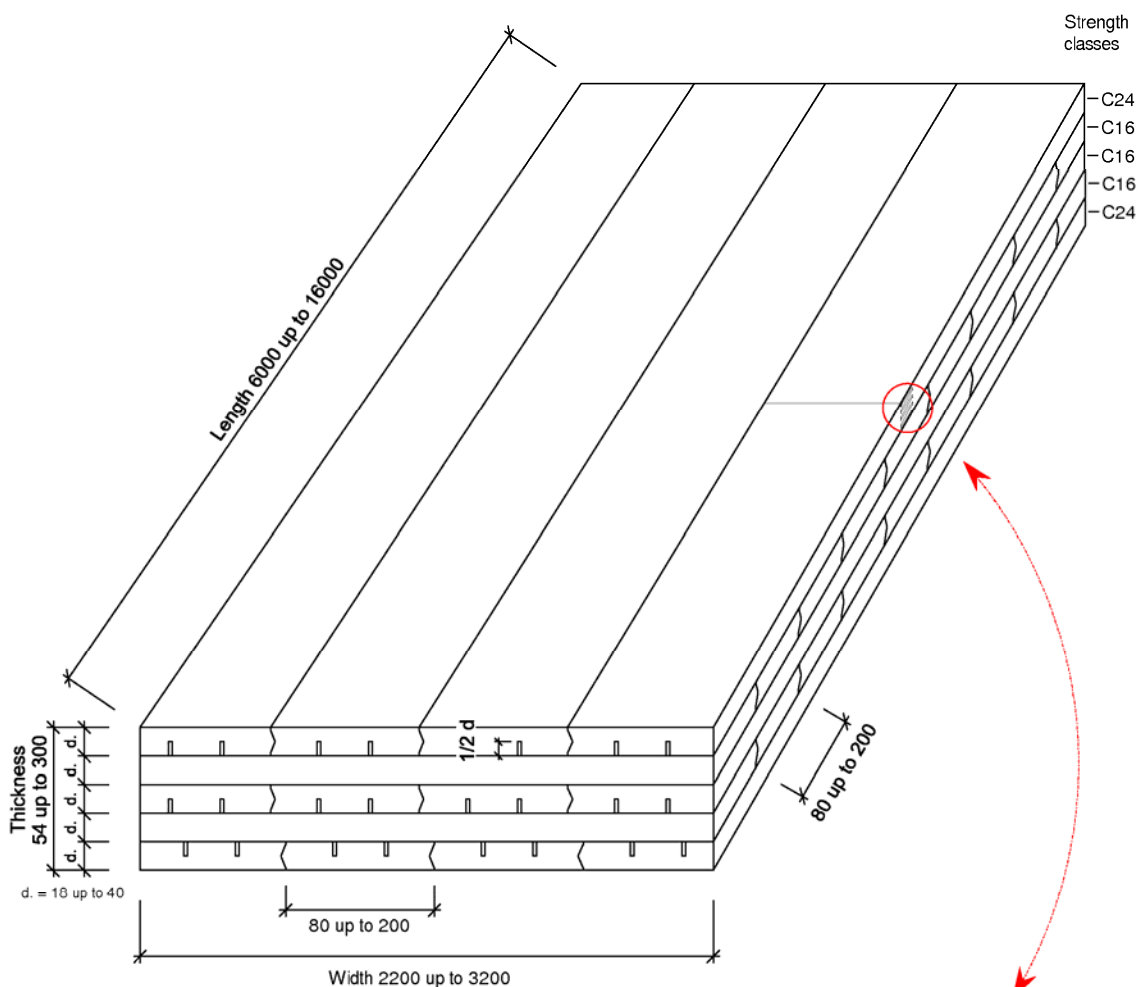
5.3 Recommendations for use, maintenance and repair

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 cross laminated timber 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.

Georg Feistel
Head of Department

beglaubigt
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all dimensions in mm



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

Tabelle 1

Characteristic	Specification
Elements	
Thickness	54 to 300 mm
Tolerance in thickness	± 0.5 mm
Width	≤ 3.20 m
Tolerance in width	± 1 mm
Length	≤ 16.00 m
Tolerance in length	± 2.0 mm
Number of layers	3 ≤ n ≤ 9
Number of consecutive layers having the same direction	≤ 2 for n > 5
Maximum width of gaps between the single boards	6 mm
Boards	
Material	Spruce, pine, Douglas fir
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	C24
Strength class according to EN 338 resp. EN 14081-1 of the middle layers	≥ C16
Thickness	18 to 48 mm
Width	80 to 200 mm
Ratio width to thickness of the cross layers	≥ 4 : 1
Moisture of wood according to EN 13183-2 ¹⁶	12 ± 2 %
Finger joints	according to EN 385

¹⁶ EN 13183-2:2002 Moisture content of a piece of sawn timber - Part 2: Estimation by electrical resistance method

ED-BSP elements	Annex 2
Specifications and dimensions of the cross laminated timber elements	

Table 2

ER	Requirement	Verification method	Class / Use category / Value		
Mechanical resistance and stability					
1	Panel shear strength	For the calculation of the single layers the characteristic strength and stiffness values of softwood of the corresponding strength classes according to EN 338 resp EN 14081-1 shall be used taking into consideration the definitions in Annex 2. In addition the following values apply:			
	Bending strength				
			Rolling shear strength (5% - fractile)	$f_{R,k}$	0.90 N/mm ²
			Rolling shear modulus (mean value)	$G_{R,mean}$	50 N/mm ²
			For references regarding the calculation see Annexes 4 and 5. National regulations might have to be followed.		
		Use of fasteners	according to EN 1995-1-1, for further details see Annex 4		
	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 clause 6.1.7: $k_{cr} = 1.0$			
Behaviour in case of fire					
Reaction to fire					
2	Timber elements except for floorings	Commission Decision 2003/43/EC	Euroclass D-s2, d0		
	Floorings		Euroclass D _{fl} -s1		
Resistance to fire					
	Charring rate	EN 1995-1-2 ¹⁷	no performance determined		
Hygiene, health and the environment					
3	Vapour permeability μ	EN 12524 ¹⁸	no performance determined		
	Release of formaldehyde	EN 13986 with respect to the solid wood slab elements	Class E1		
Safety in use					
4	Slipperiness		no performance determined		
	Impact resistance		no performance determined		
Protection against noise					
5	Airbourne sound insulation		no performance determined		
	Impact sound insulation		no performance determined		
	Sound absorption		no performance determined		
Energy economy and heat retention					
6	Thermal conductivity λ	EN 12524	no performance determined		
	Air tightness		no performance determined		
	Thermal inertia c_p	EN 12524	no performance determined		

¹⁷ EN 1995-1-2:2004 + AC:2009
¹⁸ EN ISO 10456:2007 + AC:2009

Eurocode 5: Design of timber structures – Part 1-2: General – Structural fire design
Building materials and products – Hygrothermal properties – Tabulated design values and procedures for determining declared and design values

ED-BSP elements	Annex 3
Essential requirements of the cross laminated timber elements	

1 Notes on the calculation of the elements

1.1 General

Design, calculation and realization can be done 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 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 $G = 60 \text{ N/mm}^2$ 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 5, only the boards, which are oriented parallel to the span direction, might be considered.

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

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

with n = number of boards lying side by side.

1.3.2 Tension and compression perpendicular to the grain

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 the element should be avoided.

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

If forces between adjacent boards of a layer are transmitted only by means of using the next layer glued crosswise, the shear stresses in the crossing surfaces have to be calculated as follows:

$$\tau_{T,d} = \frac{F_d \cdot h}{\sum I_p} \cdot \frac{a}{2} \leq f_{v,d}$$

ED-BSP elements	Annex 4/1
Recommendations for the design of the elements and the fastener	

with

F_d = external load on a wall element (N)

h = height of the wall (mm)

a = largest side length of the crossing area (mm)

I_p = polar moment of inertia of a certain crossing area i (mm⁴)

$\sum I_p$ = sum of all polar moments of inertia of the crossing areas in the element

$f_{v,d}$ = design value of the torsional shear strength; the characteristic value shall be set to $f_{v,k} = 2.5$ N/mm² for this calculation

$\tau_{T,d}$ = design value of the torsional stresses occurring if boards of one layer are not glued on their lateral sides

In addition it has to be verified that the layers can bear the stresses falling upon them.

1.4.2 Tension and compression

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

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 a European technical approval 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.

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

Lateral surfaces are the surfaces perpendicular to the plane of the element, consisting of the lateral surfaces and the cross grain of the boards.

As fasteners nails, wood screws, bolts, dowels and dowels type fasteners according to EN 1995-1-1 or a European technical approval may be used.

Gaps are regarded as edges of the building component.

ED-BSP elements	Annex 4/2
Recommendations for the design of the elements and the fastener	

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 $\bar{h}_i/(G_R \cdot b)$.

The effective moment of inertia is calculated by:

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

$$\gamma_1 = \frac{1}{1 + \frac{\pi^2 \cdot E_0 \cdot A_1 \cdot \bar{h}_1}{G_R \cdot b \cdot l^2}}; \quad \gamma_2 = 1; \quad \gamma_3 = \frac{1}{1 + \frac{\pi^2 \cdot E_0 \cdot A_3 \cdot \bar{h}_2}{G_R \cdot b \cdot l^2}}$$

$$a_1 = \left(\frac{h_1}{2} + \bar{h}_1 + \frac{h_2}{2} \right) - a_2; \quad a_3 = \left(\frac{h_2}{2} + \bar{h}_2 + \frac{h_3}{2} \right) + a_2$$

$$a_2 = \frac{\gamma_1 \cdot A_1 \cdot \left(\frac{h_1}{2} + \bar{h}_1 + \frac{h_2}{2} \right) - \gamma_3 \cdot A_3 \cdot \left(\frac{h_2}{2} + \bar{h}_2 + \frac{h_3}{2} \right)}{\sum_{i=1}^3 (\gamma_i \cdot A_i)}$$

The verification of the bending performance is done by determination of the bending stress at the boundary of the boards. The bending stress in the middle of the boards may remain unconsidered.

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

The verification of the shear performance is done by determination of the shear stress in the decisive plane:

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

Legend:

- h_{tot} = thickness of the whole element [mm]
- h_i = thickness of the layer i parallel to the direction of load transfer [mm]
- \bar{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 5
Recommendations for the design of the element under bending load	