



## EUROPEAN ASSESSMENT DOCUMENT

EAD 130197-00-0304

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# GLUED LAMINATED TIMBER MADE OF STEAM-CURED SOLID TIMBER WITH RECTANGULAR CROSS SECTION – SOFTWOOD

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## 1 SCOPE OF THE EAD

### 1.1 Description of the construction product

The product, "Glued laminated timber made of steam-cured solid timber with rectangular cross section – softwood", is composed of lamellae according to EAD 130166-00-0304. The cross section is identical to standardized glued laminated timber made of softwood laminations according to EN 14080.

The dimensions for the lamellae and glued laminated timber are given in Table 1.

**Table 1: Minimum and maximum dimensions for the lamellae and for glued laminated timber made of laminated veneer lumber**

Dimensions of lamellae and GLT	mm
Thickness of lamellae	6 to 45
Width of lamellae	80 to 260
Height of GLT	120 to 1000
Width of GLT	80 to 260

Wood species is European spruce, fir and larch.

The following structural adhesives are used for finger joints as well as surface gluing:

- Adhesives type I according to EN 301
- Adhesives type I according to EN 15425 and EN 14080, Annex B.2.

The product is not fully covered by the following harmonised technical specifications:

- hEN 14080 2013-06 due to steam-cured lamellae
- EAD 130166-00-0304 2016-08 due to deviating product type

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.

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.

Relevant manufacturer's stipulations having influence on the performance of the product covered by this European Assessment Document shall be considered for the determination of the performance and detailed in the ETA.

### 1.2 Information on the intended use(s) of the construction product

#### 1.2.1 Intended use(s)

Glued laminated timber made of steam-cured solid timber with rectangular cross section – softwood is intended to be used as a structural element for load bearing applications in buildings and civil engineering structures.

The product is subjected to static and quasi static actions only.

The product is intended to be used in service class 1 and 2 according to EN 1995-1-1.

### 1.2.2 Working life/Durability

The assessment methods included or referred to in this EAD have been written based on the manufacturer's request to take into account a working life of the glued laminated timber made of steam-cured solid timber for the intended use of 50 years when installed in the works. These provisions are based upon the current state of the art and the available knowledge and experience.

When assessing the product the intended use as foreseen by the manufacturer shall be taken into account. The real working life may be, in normal use conditions, considerably longer without major degradation affecting the basic requirements for works<sup>1</sup>.

The indications given as to the working life of the construction product cannot be interpreted as a guarantee neither given by the product manufacturer or his representative nor by EOTA when drafting this EAD nor by the Technical Assessment Body issuing an ETA based on this EAD, but are regarded only as a means for expressing the expected economically reasonable working life of the product.

## 1.3 Specific terms used in this EAD (if necessary in addition to the definitions in CPR, Art 2)

### 1.3.1 Steam-curing

special kind of thermal modification. In contrast to conventional thermal modification procedures for wood the temperature is lower whereas the exposure time is extended. The wood is exposed to a maximum temperature of 120°C and defined humidity conditions for a predefined time range. The required time depends on wood species, size and initial moisture content.

### 1.3.2 Population

timber for which the characteristic values are relevant.

### 1.3.3 Timber source

identifiable geographical origin of a species or species combination from which timber is, or is intended to be, strength graded.

### 1.3.4 Sample

a number of ungraded specimens of one timber species or species combination, one source, with sizes and quality representative of the timber population.

### 1.3.5 Specimen

piece of timber from which the test piece is taken.

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<sup>1</sup> The real working life of a product incorporated in a specific works depends on the environmental conditions to which that works is subject, as well as on the particular conditions of the design, execution, use and maintenance of that works. Therefore, it cannot be excluded that in certain cases the real working life of the product may also be shorter than referred to above.

## 2 ESSENTIAL CHARACTERISTICS AND RELEVANT ASSESSMENT METHODS AND CRITERIA

### 2.1 Essential characteristics of the product

Table 2 shows how the performance of the glued laminated timber made of steam-cured solid timber is assessed in relation to the essential characteristics.

**Table 2 Essential characteristics of the product and methods and criteria for assessing the performance of the product in relation to those essential characteristics**

No	Essential characteristic	Method of assessment	Type of expression of product performance
<b>Basic Works Requirement 1: Mechanical resistance and stability <sup>1)</sup></b>			
1	Bending strength	2.2.1	Level
2	Tension strength in direction of grain	2.2.2	Level
3	Tension strength perpendicular to direction of grain	2.2.3	Level
4	Compression strength in direction of grain	2.2.4	Level
5	Compression strength perpendicular to direction of grain	2.2.5	Level
6	Shear strength	2.2.6	Level
7	Bending modulus of elasticity in direction of grain	2.2.7	Level
8	Modulus of elasticity perpendicular to direction of grain	2.2.8	Level
9	Shear modulus	2.2.9	Level
10	Density	2.2.10	Level
11	Bond integrity of finger joints	2.2.11	Description
12	Bonding quality	2.2.12	Description
13	Dimensional stability	2.2.13	Description, level
14	Durability	2.2.14	Description
15	Creep and duration of the load	2.2.15	Description, level
16	pH-value	2.2.16	Level
<b>Basic Works Requirement 2: Safety in case of fire</b>			
17	Reaction to fire	2.2.17	Class
18	Resistance to fire	2.2.18	Class
<b>Basic Works Requirement 4: Safety and accessibility in use</b>			
–	Same as BWR 1		
<sup>1)</sup>	This characteristic also relates to BWR 4.		

## **2.2 Methods and criteria for assessing the performance of the product in relation to essential characteristics of the product**

Samples shall be produced from lamellae according to EAD 130166-00-0304.

The samples shall represent the timber source, sizes and grade that will be used in production. Each sample shall be from one source.

Glued laminated timber samples (GLT) shall be tested at least in the available dimension limits (depths and widths).

The reference moisture content of wood shall follow the conditions under service class 1 (20°C, 65 % rel. humidity) when not stated otherwise in the following. This corresponds to a moisture content of approx. 12 %.

The test results for each individual test specimen are based on the standardized reference conditions according to 5.3

For each individual test specimen the performance established under given conditions should be calculated for the reference conditions in Clause 5.3 of EN 384. Hereby, the conversion factors given in Clause 5.4 of EN 384 shall be used.

### **2.2.1 Bending strength**

Testing according to Clause 19 of EN 408 with measurement of global and local deformations. A minimum of 15 samples shall be tested per dimension.

The bending strength shall be calculated from the results of the bending tests according to the equations given in EN 408. The characteristic values shall be determined in accordance with EN 384.

The characteristic bending strength in MPa shall be given in the ETA.

### **2.2.2 Tension strength in direction of grain**

Testing according to Clause 13 of EN 408 with at least 15 samples per dimension.

The tensile strength in direction of grain shall be calculated according to the equations given in EN 408. The characteristic values shall be determined in accordance with EN 384.

Alternatively, the tensile strength in direction of grain may be estimated by the characteristic value of strength parallel to the grain of the lamellae.

The characteristic tensile strength in direction of grain of glued laminated timber in MPa shall be given in the ETA.

### **2.2.3 Tension strength perpendicular to direction of grain**

Testing according to Clause 16 of EN 408 with at least 15 samples per dimension.

The tensile strength perpendicular to the grain shall be calculated according to the equations given in EN 408. The characteristic values shall be determined in accordance with EN 384.

The characteristic tensile strength perpendicular to the grain of glued laminated timber in MPa shall be given in the ETA.

### **2.2.4 Compression strength in direction of grain**

Testing according to Clause 15 of EN 408. A minimum of 15 samples shall be tested per dimension. Tests shall be conducted with the highest possible moisture content according to the desired service class.

The compressive strength in direction of grain shall be calculated according to the equations given in EN 408. The characteristic values shall be determined in accordance with EN 384.

Alternatively, the compressive strength in direction of grain may be estimated by the characteristic value of strength in direction of grain of the lamellae.

The characteristic compression strength in direction of grain of glued laminated timber in MPa shall be given in the ETA.

### **2.2.5 Compression strength perpendicular to direction of grain**

Testing according to Clause 16 of EN 408. A minimum of 15 samples shall be tested per dimension. Tests shall be conducted with the highest possible moisture content according to the desired service class.

The compressive strength perpendicular to the grain shall be calculated according to the equations given in EN 408. The characteristic values shall be determined in accordance with EN 384.

Alternatively, the compressive strength perpendicular to the grain may be estimated by the characteristic value of strength perpendicular to the grain of the lamellae.

The characteristic compression strength perpendicular to the grain of glued laminated timber in MPa shall be given in the ETA.

### **2.2.6 Shear strength in direction of grain**

Shear tests shall be performed according to Clause 18 of EN 408. A minimum of 15 samples shall be tested per dimension.

The shear strength shall be calculated according to the equations given in EN 408. The characteristic values shall be determined in accordance with EN 384.

The characteristic shear strength of glued laminated timber in MPa shall be given in the ETA.

### **2.2.7 Bending modulus of elasticity in direction of grain**

Testing according to Clause 9 and 10 of EN 408 with measurement of global and local deformations. A minimum of 15 samples shall be tested per dimension.

The bending modulus of elasticity in direction of grain shall be calculated from the results of the tests according to the equations given in EN 408. The characteristic values shall be determined in accordance with EN 384.

The mean and characteristic value of the local bending modulus of elasticity in direction of grain in MPa shall be given in the ETA.

### **2.2.8 Modulus of elasticity perpendicular to direction of grain**

Testing according to Clause 17 of EN 408 with measurement of global and local deformations. A minimum of 15 samples shall be tested per dimension.

The modulus of elasticity perpendicular to the grain shall be calculated according to the equations given in EN 408. The mean and characteristic values shall be determined in accordance with EN 384.

Alternatively, the modulus of elasticity perpendicular to the grain may be estimated by the value of modulus of elasticity perpendicular to the grain of the lamellae.

The mean and characteristic value of the modulus of elasticity perpendicular to the grain in MPa shall be given in the ETA.

### **2.2.9 Shear modulus**

Testing according to Clause 11.2 of EN 408. A minimum of 15 samples shall be tested per dimension.

The shear modulus shall be calculated by the corrected Equation according to EN 408:



$$G_{tor,s} = \frac{\alpha}{2} \frac{h_0}{b \cdot h} \frac{V_{s,2} - V_{s,1}}{w_2 - w_1}$$

The characteristic values shall be determined in accordance with EN 384.

The mean and characteristic value of shear modulus in MPa shall be given in the ETA.

### 2.2.10 Density

The test shall be carried out in accordance with Clause 7 of EN 408.

Calculation of the mean value shall be performed with the densities of the individual specimens determined according to EN 408.

Calculation of the characteristic value of density as 5 % percentile shall be performed according to EN 384.

### 2.2.11 Bond integrity of finger joints

The tests shall be carried out in accordance with EN 15497. For durability see 2.2.14.

### 2.2.12 Bonding quality

Delamination tests shall be carried out in accordance with EN 14080, Annex C, Method A.

The provisions stated in EN 14080, Clause 5.5.5.2.2 shall be met. The maximum delamination percentage of a single glue line shall be given in the ETA.

### 2.2.13 Dimensional stability

Dimensional stability shall be considered as swelling and shrinkage of structural timber due to changes of its moisture content.

Shrinkage as well as swelling tests shall be performed on steam-cured as well as untreated wood on samples according to ISO 4469.

The linear shrinkage shall be determined according to ISO 4469.

For determination of the maximum amount of radial and tangential swelling  $\alpha_{max,r}$  and  $\alpha_{max,t}$  the samples shall be dried till weight constancy according to ISO 4469, measured, and stored in standardized climate (20°C, 65% relative humidity) for 3 to 5 days. Afterwards, the samples are stored in a water bath till saturation according to ISO 4469.  $\alpha_{max} = 100 (l_w - l_0) / l_0$  with  $l_w$  as dimension of the saturated sample and  $l_0$  as the dimension of the dried sample.

Linear shrinkage as well as the maximum amount of swelling shall be given in the ETA.

### 2.2.14 Durability

For the following wood species the natural durability of wood can be given according to EN 350: European spruce (*Picea abies* (L.) Karst.), fir (*Abies alba* Mill.) and larch (*Larix decidua* Mill.)

If the wood species is not given in EN 350, it shall be tested according to CEN/TS 15083-1 and CEN/TS 15083-2.

Durability of finger joints shall be evaluated according to EN 14080, Annex B.3.

### 2.2.15 Creep and duration of load

Evaluation of the deformation and modification values according to EN 1156, Clause 6 and 7. However, the span of the samples is  $L \geq 10 h$ . The samples shall be loaded under the conditions of the respective service class by a constant load in the third points following EN 1156.

For evaluation of  $k_{\text{mod}}$  testing of at least 5 different load levels (e.g. 90, 80, 70, 50, 30 %) below the maximum load is required according to EN 1156. At least 6 specimen shall be tested per load level. The time-deformation plot till rupture shall be recorded. Calculation of modification values shall be performed from the logarithmic approximation of the duration till rupture, see Figure 4 in Clause 7.1 of EN 1156, for the respective service class and load duration classes according to Table 2.1 of EN 1995-1-1 (5 minutes = instantaneous, 1 week = short-term, 6 months = medium-term, 10 years = long term, 50 years = permanent).

Evaluation of  $k_{\text{def}}$  is performed using Equation (4) in Clause 7.2.1 of EN 1156 to determine the creep factor  $k_c$ . Therefore, the total deflection  $a_T$  is calculated for each service class from the approximated time-deformation plots at a load level of 30 % evaluated after 50 years time. From this creep factor  $k_{\text{def}}$  can be determined as  $k_{\text{def}} = k_c - 1$ .

The numeric value for  $k_{\text{mod}}$  and  $k_{\text{def}}$  shall be given in the ETA for the relevant service class and duration of load.

#### **2.2.16 pH-value**

Determination of the pH-value shall be carried out with an electrode on a suspension of 2 g wood powder in 20 ml distilled water after a reaction time of two hours. The minimum number of samples is 3.

The pH-value of the steam-cured timber shall be given in the ETA.

#### **2.2.17 Reaction to fire**

The glued laminated timber made of steam-cured solid timber shall be tested, using the test method(s) relevant for the corresponding reaction to fire class, in order to be classified according to EN 13501-1 and Commission delegated regulation (EU) 2016/364.

Testing shall be performed according to EN 13823. For assembly of the specimen see Clause 5.8 of EN 14080.

#### **2.2.18 Resistance to fire**

Testing shall be performed according to EN 1365-3. The classification according to EN 13501-2 shall be given in the ETA.

### 3 ASSESSMENT AND VERIFICATION OF CONSTANCY OF PERFORMANCE

#### 3.1 System(s) of assessment and verification of constancy of performance to be applied

For the products covered by this EAD the applicable European legal act is: Decision 97/176/EC

The system is: 1

#### 3.2 Tasks of the manufacturer

The cornerstones of the actions to be undertaken by the manufacturer of the product in the procedure of assessment and verification of constancy of performance are laid down in Table 3.

**Table 3 Control plan for the manufacturer; cornerstones**

No	Subject/type of control	Test or control method	Criteria, if any	Minimum number of samples	Minimum frequency of control
<b>Factory production control (FPC)</b> [including testing of samples taken at the factory in accordance with a prescribed test plan]*					
1	The factory production control shall be performed in accordance with the provisions in EN 14080 if not stated differently in No. 2 to 3.				
2	Grading of lamellae	EAD 130166-00-0304	EAD 130166-00-0304	EAD 130166-00-0304	EAD 130166-00-0304
3	Bonding quality	EN 14080	EN 14080	2	per 20 m <sup>3</sup> or (minimum) per shift, adhesive system, press and species

### 3.3 Tasks of the notified body

The cornerstones of the actions to be undertaken by the notified body in the procedure of assessment and verification of constancy of performance for strength graded and steam-cured structural timber are laid down in Table 4.

**Table 4 Control plan for the notified body; cornerstones**

No	Subject/type of control	Test or control method	Criteria, if any	Minimum number of samples	Minimum frequency of control
<b>Initial inspection of the manufacturing plant and of factory production control</b>					
1	<p>The notified product certification body shall verify the ability of the manufacturer for a continuous and orderly manufacturing of the product according to the control plan. In particular the following items shall be appropriately considered</p> <ul style="list-style-type: none"> <li>– personnel and equipment</li> <li>– the suitability of the factory production control established by the manufacturer</li> <li>– full implementation of the control plan</li> </ul>				—
<b>Continuous surveillance, assessment and evaluation of factory production control</b>					
2	<p>The notified product certification body shall verify that</p> <ul style="list-style-type: none"> <li>– the manufacturing process</li> <li>– the system of factory production control</li> <li>– the implementation of the control plan</li> </ul> <p>are maintained.</p>				2/year

## 4 REFERENCE DOCUMENTS

As far as no edition date is given in the list of standards thereafter, the standard in its current version at the time of issuing the European Technical Assessment, is of relevance.

EAD 130166-00-0304 (07.2016): Strength graded structural timber – steam-cured solid timber with rectangular cross section which may be finger jointed or not – softwood

EN 301: Adhesives, phenolic and aminoplastic, for load-bearing timber structures — Classification and performance requirements

EN 350: Durability of wood and wood-based products – Testing and classification of the durability to biological agents of wood and wood-based materials

EN 384 (11.2016): Structural timber – Determination of characteristic values of mechanical properties and density

EN 408 (07.2012): Timber structures – Structural timber and glued laminated timber – Determination of some physical and mechanical properties

EN 1365-3: Fire resistance tests for loadbearing elements – Part 3: Beams

EN 1995-1-1 (11.2004) +AC (06.2006) +A1 (06.2008) +A2 (05.2014): Eurocode 5 – Design of timber structures — Part 1-1: General – Common rules and rules for buildings

EN 13501-1: Fire classification of construction products and building elements – Part 1: Classification using data from reaction to fire tests

EN 13501-2: Fire classification of construction products and building elements – Part 2: Classification using data from fire resistance tests, excluding ventilation services

EN 13823: Reaction to fire tests for building products – Building products excluding floorings exposed to the thermal attack by a single burning item

EN 14080 (06.2013): Timber structures – Glued laminated timber and glued solid timber – Requirements

EN 15425: Adhesives – One component polyurethane for load bearing timber structures – Classification and performance requirements

CEN/TS 15083-1: Durability of wood and wood-based products – Determination of the natural durability of solid wood against wood-destroying fungi, test methods – Part 1: Basidiomycetes

CEN/TS 15083-2: Durability of wood and wood-based products – Determination of the natural durability of solid wood against wood-destroying fungi, test methods – Part 2: Soft rotting micro-fungi

ISO 4469 (01.1995): Wood – Determination of radial and tangential shrinkage