



EUROPEAN ASSESSMENT DOCUMENT

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**GLUED LAMINATED TIMBER MADE OF
HARDWOOD – STRUCTURAL
LAMINATED VENEER LUMBER MADE
OF BEECH**

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1 SCOPE OF THE EAD

1.1 Description of the construction product

The product is comprised of structural laminated veneer lumber made of beech (*Fagus sylvatica*). Lamellae conform to EN 14374. The thickness of the veneers and the assembly of the LVL and, if necessary, information on the veneer joint formation and arrangements shall be given in the European Technical Assessment.

The properties of the tested glued laminated timber made from LVL shall be included in the ETA as minimum requirements.

The cross section is identical to standardised glued laminated timber made of softwood laminations according to EN 14080. Lamellae shall be bonded at the faces. Minimum and maximum dimensions for the lamellae and glued laminated timber of laminated veneer lumber are given in Table 1.

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

Type of GLT made of LVL from Beech <i>Fagus sylvatica</i>	
Min. and max. dimensions	mm
Max. width of lamellae	300
Max. thickness of lamellae	50
Max. depth of GLT	600
Min. width of GLT	80
Max. width of GLT	300
Max. length of GLT	18 000
Service class	1 and 2
Moisture content	5 – 10 %
Min. number of lamellae	3

Only phenolic resorcinol (PRF) adhesives may be used for glued laminated timber of LVL. Adhesives used for glued laminated timber beams and lamellae of laminated veneer lumber shall fulfil the provisions given in Clause 2.2.1.13.

The moisture content in the glued laminated timber shall conform to Table 1.

Lamellae for the product are

- in conformity with EN 14374,
- without preservative treatment,
- without flame retardant and
- exclusively made in virgin wood; no recycled wood is used.

European Technical Assessments should contain provisions pertaining to the fasteners means to be used in glued laminated timber made from LVL.

Manufacture shall be in accordance with EN 14080 if not specified in the ETA. Adhesives according to Clause 2.2.1.13.

Holes in glued laminated timber made from LVL are excluded from the scope of the EAD.

The application of wood preservatives and flame retardants is not subject of the EAD.

Finger joints as well as large finger joints are excluded from the scope of the EAD.

The product is not covered by a harmonised European standard (hEN).

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 of laminated veneer lumber is intended to be used as a structural element for load bearing applications in buildings and civil engineering structures, in service classes 1 and 2 according to EN 1995-1-1.

The application range for the glued laminated timber made of LVL may be limited further in terms of service classes by national requirements.

The product is only intended to be used subject to static or quasi-static actions.

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 LVL for the intended use of 50 years when installed in the works provided that the product is subject to appropriate installation (see 1.1). 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 works¹.

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 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 laminated veneer lumber 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
Basic Works Requirement 1: Mechanical resistance and stability ¹⁾			
1	Bending strength	2.2.1.2	Description, level
2	Tensile strength parallel to the grain	2.2.1.3	Description, level
3	Tensile strength perpendicular to the grain	2.2.1.4	Description, level
4	Compression strength parallel to the grain	2.2.1.5	Description, level
5	Compression strength perpendicular to the grain	2.2.1.6	Description, level
6	Shear strength	2.2.1.7	Description, level
7	Modulus of elasticity parallel to the grain	2.2.1.8	Description, level
8	Modulus of elasticity perpendicular to the grain	2.2.1.9	Description, level
9	Shear modulus	2.2.1.10	Description, level
10	Creep and duration of the load	2.2.1.11	Description, level
11	Dimensional stability	2.2.1.12	Description, level
12	Adhesive characteristics	2.2.1.13	Description, level
13	Bonding quality	2.2.1.14	Description
14	In-service environment	2.2.1.15	Description
15	Density	2.2.1.16	Description, level
Basic Works Requirement 2: Safety in case of fire			
16	Reaction to fire	2.2.2.1	Class
17	Resistance to fire	2.2.2.2	Description, level
Basic Works Requirement 3: Hygiene, health and the environment			
18	Content, emission and/or release of dangerous substances	2.2.3.1	Description

Basic Works Requirement 4: Safety and accessibility in use			
19	Same as BWR 1		
Basic Works Requirement 6: Energy economy and heat retention			
20	Thermal conductivity	2.2.5.1	Description, level
21	Thermal inertia	2.2.5.2	Description, level
1) 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

2.2.1 Mechanical resistance and stability

2.2.1.1 General

Samples shall be produced from lamellae according to EN 14374.

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

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

2.2.1.2 Bending strength

The test shall be carried out in accordance with Clause 19 as well as Clause 9 and 10 of EN 408, 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 14358.

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

2.2.1.3 Tensile strength parallel to the grain

The tensile strength parallel to the grain shall be tested according to Clause 13 of EN 408 with at least 15 samples per dimension.

The tensile strength parallel to the grain shall be calculated according to the equations given in EN 408. The characteristic values shall be determined in accordance with EN 14358.

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

The characteristic tensile strength parallel to the grain of GLT in MPa shall be declared in the ETA.

2.2.1.4 Tensile strength perpendicular to the grain

The tensile strength perpendicular to the grain shall be tested according to Clause 16 of EN 408 with at least 15 samples per dimension. Structures composed of different grading classes are to be tested separately.

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 14358.

Alternatively, the tensile strength perpendicular to the grain can be determined according to EN 384, clause 6, if appropriate.

The characteristic tensile strength perpendicular to the grain of GLT in MPa shall be declared in the ETA.

2.2.1.5 Compression strength parallel to the grain

The compressive strength parallel to the grain shall be tested according to Clause 15 of EN 408. A minimum of 15 samples shall be tested per dimension.

The compressive strength parallel to the grain shall be calculated according to the equations given in EN 408. The characteristic values shall be determined in accordance with EN 14358.

For glued laminated timber made from LVL, used in the environmental conditions specified by service class 2, tests to determine the compressive strength parallel to the grain can be performed on specimens that were air-conditioned according to the environmental conditions of service class 2.

Without further testing the compressive strength parallel to the grain shall be reduced by 1/6 for glued laminated timber made from LVL used in the environmental conditions specified by service class 2.

The characteristic compression strength parallel to the grain of GLT in MPa shall be declared in the ETA.

2.2.1.6 Compression strength perpendicular to the grain

The compressive strength perpendicular to the grain shall be tested according to Clause 16 of EN 408. A minimum of 15 samples shall be tested per dimension.

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 14358.

For glued laminated timber made from LVL, used in the environmental conditions specified by service class 2, tests to determine the compressive strength perpendicular to the grain may be performed on specimens that were air-conditioned according to the environmental conditions of service class 2.

Without further testing the compressive strength perpendicular to the grain shall be reduced by 1/6 for glued laminated timber made from LVL used in the environmental conditions specified by service class 2.

Alternatively, the compressive strength perpendicular to the grain can be determined according to EN 384, clause 6, if appropriate.

The characteristic compression strength perpendicular to the grain of GLT in MPa shall be declared in the ETA.

2.2.1.7 Shear strength

Shear tests shall be performed on samples, simply supported on both ends with a ratio length/height = 8. The forces shall be imposed sufficient close to the supports to result in shear failure. The principles of EN 408 shall be followed. A minimum of 15 samples shall be tested per dimension.

The shear strength shall be calculated according to $\tau_v = \frac{1,5 \cdot V}{A}$

τ_v ... shear strength

V ... shear force

A ... cross sectional area

The characteristic values shall be determined in accordance with EN 14358.

The characteristic shear strength of GLT in MPa shall be declared in the ETA.

2.2.1.8 Modulus of elasticity parallel to the grain

The modulus of elasticity parallel to the grain shall be tested according to Clause 2.2.1.2.

The modulus of elasticity parallel to the 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 14358.

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

2.2.1.9 Modulus of elasticity perpendicular to the grain

The modulus of elasticity perpendicular to the grain shall be tested according to Clause 17 of EN 408, 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 14358.

Alternatively, the modulus of elasticity perpendicular to the grain can be determined according to EN 384, clause 6, if appropriate. Hereby, the characteristic modulus of elasticity perpendicular to the grain shall be determined by

$$E_{90,05} = 0,84 \cdot E_{90,mean}$$

$E_{90,05}$... characteristic modulus of elasticity perpendicular to the grain

$E_{90,mean}$... mean modulus of elasticity perpendicular to the grain

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

2.2.1.10 Shear modulus

The shear modulus shall be tested according to Clause 2.2.1.2. In addition some samples shall be tested according to Clause 11.2 of EN 408.

The shear modulus shall be calculated according to the equations given in EN 408 and from the measured global and local deformations. The characteristic values shall be determined in accordance with EN 14358.

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

2.2.1.11 Creep and duration of load

Factors k_{mod} and k_{def} as specified in EN 1995-1-1, Table 3.1 and Table 3.2, for laminated veneer lumber and glued laminated timber shall be used.

The numeric value for k_{mod} and k_{def} shall be given in the ETA for the relevant service class and duration of load as defined in EN 1995-1-1.

2.2.1.12 Dimensional stability

Dimensions of cross section shall be measured according to EN 1309-1.

Tolerances of dimensions

The dimensions of the beams are to be checked and the measured values assessed for compliance with specifications supplied by the manufacturer with the specific tolerances.

The glued laminated timber beams shall have manufacturing tolerances within such limits, so that its performance and stability will be maintained.

Tolerances of cross section shall be at least according to EN 14080.

Stability of dimensions

An assessment shall be made of the effect on the beam dimensions of variations in moisture content between installation and service as well as during the beam's service life.

Dimensional stability shall be considered as swelling and shrinkage of laminated veneer lumber due to changes of its moisture content. Hence the swelling and shrinkage value can be regarded as constant values in the perpendicular to grain and parallel to grain directions of the laminated veneer lumber as given in EN 14080.

The moisture content at delivery and the nominal dimensions shall be given in the ETA.

2.2.1.13 Adhesive characteristics

Only phenolic resorcinol (PRF) adhesives may be used which conform to EN 301, type I. In addition, the adhesive shall be tested according to EN 302-5, EN 302-6 and EN 302-7. Verification of applicability for beech is required.

The adhesive use properties such as minimum pressure time, bonding pressure and minimum spread rate shall be determined by an independent test institute under the responsibility of the TAB in the assessment procedure.

The suitability of the adhesives for special application processes shall be considered.

The minimum value of bonding pressure, minimum and maximum values of open and closed assembly time and minimum spread rate shall be declared in the ETA.

2.2.1.14 Bonding quality

Determination of bonding quality in accordance with EN 14374, Annex B.

The percentage of wood failure (determined in accordance with EN 314-1) shall meet the requirements given in EN 14374.

Additional testing of glued laminated timber made from LVL by the manufacturer under actual industry conditions in accordance with EN 302-2.

The requirements of the standard EN 301 shall be fulfilled.

2.2.1.15 In-service environment

Durability of timber shall be assessed according to EN 350-2, Table 2.

Timber species and the service classes as defined in EN 1995-1-1, Clause 2.3.1.3 shall be declared. National provisions at the building site may apply.

2.2.1.16 Density

Measurement of density of lamellae in accordance with EN 323. A minimum of 50 samples shall be tested. The characteristic values shall be determined in accordance with EN 14358.

The mean and characteristic density in kg/m³ shall be declared in the ETA.

2.2.2 Safety in case of fire

2.2.2.1 Reaction to fire

The beams are considered to satisfy the requirements for performance class D-s2,d0 of the characteristic reaction to fire in accordance with the EC Decision 2005/610/EC without the need for testing on the basis of it fulfilling the conditions set out in that Decision and its intended use being covered by that Decision.

Therefore the performance of the product is D-s2,d0.

When the product does not meet the provisions of EC Decision 2005/610/EC, the beams 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.

2.2.2.2 Resistance to fire

The charring rate of the glued laminated timber made of laminated veneer lumber shall be assessed in accordance with EN 1995-1-2.

The part of the works or assembled system in which the glued laminated timber made of LVL is intended to be incorporated, installed or applied shall be tested, using the test method relevant for the corresponding fire resistance class, in order to be classified according to EN 13501-2.

2.2.3 Hygiene, health and environment

2.2.3.1 Content, emission and/or release of dangerous substances

The performance of the product related to the emissions and/or release and, where appropriate, the content of dangerous substances will be assessed on the basis of the information provided by the manufacturer using the following methods and criteria:

- EOTA TR034: "General Checklist for EADs/ETAs - Content and/or release of dangerous substances in products".

Formaldehyde

If for bonding the glued laminated timber made of laminated veneer lumber an adhesive which contains formaldehyde is applied the formaldehyde emission of the glued laminated timber shall be determined.

Testing shall be according to EN 717-1 with

- a test chamber of 1 m³ in volume
- a loading factor of 0,3 m² / m³

- specimens with dimensions of
- width · depth · length = 90 · 200 · 517 mm³
- the end grain surfaces of the specimen shall be sealed

If the manufacturer of the adhesive can provide an equivalent test report with glued laminated timber made of laminated veneer lumber, this report can be adopted.

Table 3: Classification criteria for the class E1 and E2 for the emission of formaldehyde

Class	Classification criteria
E1	Equilibrium concentration of formaldehyde in the air of a test chamber: $\leq 0.1 \text{ ml/m}^3$ ($\leq 0.12 \text{ mg/m}^3$).
E2	Equilibrium concentration of formaldehyde in the air of a test chamber: $> 0.1 \text{ ml/m}^3$ (0.12 mg/m^3)

Glued laminated timber made of laminated veneer lumber with an adhesive free from formaldehyde can be classified as E1 without testing.

2.2.4 Safety and accessibility in use

Same as BWR 1.

2.2.5 Energy economy and heat retention

2.2.5.1 Thermal conductivity

Declaration of design values according to EN ISO 10456.

2.2.5.2 Thermal inertia

Declaration of design values according to EN ISO 10456.

3 ASSESSMENT AND VERIFICATION OF CONSTANCY OF PERFORMANCE

3.1 System(s) of assessment and verification of constancy of performance

For the product covered by this EAD the applicable European legal act is: 1997/176/EC of the European Commission² as amended by 2001/596/EC³

The system to be applied 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 4.

² OJEU L 73 of 14 March 1997

³ OJEU L 209/33 of 2 August 2011

Table 4 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
Factory production control (FPC) [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 5.				
2	Grading of lamellae	Grading acc. to EN 14374	EN 14374	acc. to EN 14374	acc. to EN 14374
3	Bonding quality	EN 14374, Annex B	EN 14374	2	per 20 m ³ or (minimum) per shift, adhesive system, press and species
4	Density of laminated veneer lumber	EN 323	1)	2	per shift, timber source and species
5	Flatwise bending strength of laminated veneer lumber	EN 408	2)	2	per shift, timber source and species

¹⁾ declared 5%-quantile value, not more than 5 out of 100 subsequent test results shall be below that value

²⁾ declared value according to EN 14374, not more than 5 out of 100 subsequent test results shall be below that value

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 the glued laminated timber made of laminated veneer lumber are laid down in Table 5.

Table 5 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
Initial inspection of the manufacturing plant and of factory production control					
1	The notified body shall ascertain that, in accordance with the test plan, the manufacturing plant of the single product manufacturer, in particular personnel and equipment, and the factory production control are suitable to ensure a continuous and orderly manufacturing of the glued laminated timber made of LVL according the European Technical Assessment. The provisions in EN 14080 shall be taken into account.				—
Continuous surveillance, assessment and evaluation of factory production control					
2	It shall be verified that the system of factory production control and the specified manufacturing process are maintained taking account of the test plan. In addition EN 14080 shall be taken into account.				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.

EOTA TR001 (2003-02): EOTA Technical Report for Determination of impact resistance of panels and panel assemblies

EOTA TR034 (2012-03): EOTA Technical Report for General ER 3 Checklist for ETAGs/CUPAs/ETAs-Content and/or release of dangerous substances in products/kits

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

EN 302-2: Adhesives for load-bearing timber structures – Test methods – Part 2: Determination of resistance to delamination

EN 302-5: Adhesives for load-bearing structures — Test methods — Part 5: Determination of maximum assembly time under referenced conditions

EN 302-6: Adhesives for load-bearing timber structures - Test methods – Part 6: Determination of the minimum pressing time under reference conditions

EN 302-7: Adhesives for load-bearing timber structures — Test methods — Part 7: Determination of the working life under referenced conditions

EN 314-1: Plywood – Bonding quality – Part 1: Test methods

EN 323: Wood-based panels – Determination of density

EN 350-2: Durability of wood and wood-based products — Natural durability of solid wood — Part 2: Guide to natural durability and treatability of selected wood species of importance in Europe

EN 384: Structural timber - Determination of characteristic values of mechanical properties and density

EN 408: Timber structures — Structural timber and glued laminated timber — Determination of some physical and mechanical properties

EN 717-1: Wood-based panels - Determination of formaldehyde release – Part 1: Formaldehyde emission by the chamber method

EN 1309-1: Round and sawn timber — Method of measurement of dimensions — Part 1: Sawn timber

EN 1995-1-1: Eurocode 5 — Design of timber structures — Part 1 1: General – Common rules and rules for buildings

EN 1995-1-2: Eurocode 5 — Design of timber structures — Part 1 2: General — Structural fire design

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 14080: Timber structures — Glued laminated timber and glued solid timber — Requirements

EN 14374: Timber structures – Structural laminated veneer lumber - Requirements

EN 14358: Timber structures — Calculation of characteristic 5-percentile values and acceptance criteria for a sample

EN ISO 10456: Building materials and products — Hygrothermal properties — Tabulated design values and procedures for determining declared and design thermal values