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European Technical Assessment

ETA-09/0036 of 30.06.2015

GENERAL PART

Technical Assessment Body issuing the European Technical Assessment

Österreichisches Institut für Bautechnik
 Austrian Institute of Construction Engineering

Trade name of the construction product

MM - crosslam

Product family to which the construction product belongs

Solid wood slab elements to be used as structural elements in buildings

Manufacturer

Mayr-Melnhof Holz Holding AG
 Turmgasse 67
 8700 Leoben
 Austria

Manufacturing plant

Mayr-Melnhof Holz Gaishorn GmbH
 8783 Gaishorn am See
 Austria

This European Technical Assessment contains

16 Pages including 4 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

European Assessment Document EAD 130005-00-0304 "Solid wood slab element to be used as a structural element in buildings", Edition March 2015.

This European Technical Assessment replaces

European technical approval ETA-09/0036 with validity from 17.06.2013 to 16.06.2018

Remarks

Translations of this European Technical Assessment in other languages shall fully correspond to the original issued document and should be identified as such.

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SPECIFIC PARTS

1 Technical description of the product

1.1 General

This European Technical Assessment¹ (ETA) applies to the cross laminated timber “MM – crosslam”. MM – crosslam is made of softwood boards which are bonded together in order to form cross laminated timber (solid wood slab elements). Generally, adjacent layers of the softwood boards are arranged perpendicular (angle of 90 °) to each other, see Annex 1, Figure 1.

In multilayer elements with at least five layers, a maximum of two consecutive board layers may be arranged in the same direction if their all over thickness does not exceed 90 mm.

Single board layers (maximum 50 % of the cross section) may be replaced by one- and multilayer solid wood panels. The solid wood panels shall be suitable for structural use.

The surfaces of the solid wood slabs may be provided with wood based panels.

The principle structure of the cross laminated timber is shown in Annex 1, Figure 2 and Figure 3. Surfaces are planed.

The solid wood slab elements consist of at least three and up to thirteen adjacent layers which are arranged perpendicular to each other. With regard to the thickness of the solid wood slab element, thickness and orientation of individual layers are symmetrically assembled. In case of serious deviations from symmetry potential effects should be investigated.

The application of wood preservatives and flame retardants is not subject of the European Technical Assessment.

1.2 Wood

Wood species is European spruce or equivalent softwood.

1.3 Wood-based panels

Wood-based panels are in accordance with EN 13986 or a European Technical Assessment.

2 Specification of the intended use(s) in accordance with the applicable European Assessment Document (thereafter EAD)

2.1 Intended use

The solid wood slab is intended to be used as a structural or non-structural element in buildings and timber structures.

The solid wood slab shall be subjected to static and quasi-static actions only.

¹ The ETA-09/0036 was firstly issued in 2009 as European technical approval with validity from 23.03.2009, extended in 2013 with validity from 17.06.2013 and amended and converted in 2015 to the European Technical Assessment ETA-09/0036 of 30.06.2015.

The solid wood slab is intended to be used in service classes 1 and 2 according to EN 1995-1-1². Members which are directly exposed to the weather shall be provided with an effective protection for the solid wood slab element in service.

2.2 General assumptions

The solid wood slab element is manufactured in accordance with the provisions of the European Technical Assessment using the manufacturing process as identified in the inspection of the manufacturing plant by Österreichisches Institut für Bautechnik and laid down in the technical file³.

The manufacturer shall ensure that the requirements in accordance with the Clauses 1, 2 and 3 as well as with the Annexes of the European Technical Assessment are made known to those who are concerned with planning and execution of the works.

Layers of planed boards shall be bonded together to the required thickness of the cross laminated timber. The individual boards shall be jointed in longitudinal direction by means of finger joints according to EN 14080, there shall be no butt joints.

Adhesive shall be applied on one face of each board. The edges of the boards need not to be bonded.

Design

The European Technical Assessment only applies to the manufacture and use of solid wood slab element. Verification of stability of the works including application of loads on the product is not subject of the European Technical Assessment.

The following conditions shall be observed:

- Design of the solid wood slab element 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 element.
- The solid wood slab element is installed correctly.

Design of the solid wood slab element can be according to EN 1995-1-1 and EN 1995-1-2, taking into account of Annexes 2 and 3 of the European Technical Assessment.

Standards and regulations in force at the place of use shall be considered.

Packaging, transport and storage

The manufacturer's instruction for packaging, transport and storage shall be observed.

The following aspects shall be considered:

- protection against unfavourable environmental effects
- protection against external damage, that may affect the proper assembling of the solid wood slab element
- intermediate storage at the construction site.

Installation

The manufacturer shall prepare installation instructions in which the product-specific characteristics and the most important measures to be taken into consideration for installation are described. The installation instructions shall be available at every construction site and shall be deposited at Österreichisches Institut für Bautechnik.

² Reference documents are listed in Annex 4.

³ The technical file of the European Technical Assessment is deposited at Österreichisches Institut für Bautechnik and, in so far as is relevant to the tasks of the notified product certification body involved in the assessment and verification of constancy of performance procedure, is handed over to the notified product certification body.

Installation of solid wood slab element shall be carried out by appropriately qualified personnel under the supervision of the person responsible for technical matters on site. An assembly plan shall be prepared for each structure, which contains the sequence in which the individual solid wood slab element shall be installed and their designation. The assembly plan shall be available at the construction site.

Relevant items to be considered are e.g.

- definition and verification of the size, spacing and minimum length of support, and demands of serviceability
- fastening of components and eventual restrictions on the application of fixings to the product
- temporary bracing for temporary loads on the construction site during erection.

Damaged products shall not be installed.

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

Use, maintenance and repair

The assessment of the product is based on the assumption that maintenance is not required during the assumed intended working life.

Should repair prove necessary this is treated on an individual basis relative to the specific application and/or damage.

2.3 Assumed working life

The provisions made in the European Technical Assessment (ETA) are based on an assumed intended working life of MM – crosslam of 50 years, when installed in the works, provided that the solid wood slab element is subject to appropriate installation, use and maintenance (see Clause 2.2). These provisions are based upon the current state of the art and the available knowledge and experience⁴.

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 nor by the Technical Assessment Body, but are regarded only as a means for choosing the appropriate products in relation to the expected economically reasonable working life of the works.

⁴ 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.

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

Table 1: Essential characteristics of the product and methods of assessment

No	Essential characteristic	Method of assessment	Expression of product performance
Basic Works Requirement 1: Mechanical resistance and stability ¹⁾			
1	Bending ²⁾	3.2	Annex 2
2	Tension and compression ²⁾	3.2	Annex 2
3	Shear ³⁾	3.2	Annex 2
4	Embedment strength	3.2	Annex 2
5	Creep and duration of the load	3.2	Annex 2
6	Dimensional stability	3.2	Annex 2
7	In-service environment	3.2	Annex 2
8	Bond integrity	3.2	Annex 2
Basic Works Requirement 2: Safety in case of fire			
9	Reaction to fire	3.2	Annex 2
10	Resistance to fire	3.2	Annex 2
Basic Works Requirement 3: Hygiene, health and the environment			
11	Content, emission and/or release of dangerous substances	3.2	Annex 2
12	Water vapour permeability – Water vapour transmission	3.2	Annex 2
Basic Works Requirement 4: Safety and accessibility in use			
13	Impact resistance	3.2	Annex 2
Basic Works Requirement 5: Protection against noise			
14	Airborne sound insulation	3.2	Annex 2
15	Impact sound insulation	3.2	Annex 2
16	Sound absorption	3.2	Annex 2
Basic Works Requirement 6: Energy economy and heat retention			
17	Thermal conductivity	3.2	Annex 2
18	Air permeability	3.2	Annex 2
19	Thermal inertia	3.2	Annex 2
1)	These characteristics also relate to BWR 4.		
2)	Load bearing capacity and stiffness regarding mechanical actions perpendicular to and in plane of the solid wood slab element.		

3.1 Essential characteristics of the product

3.1.1 MM – crosslam element

3.1.1.1 General

MM – crosslam and the boards for its manufacturing correspond to the specifications given in the Annexes 1 and 2. The material characteristics, dimensions and tolerances of MM – crosslam, not indicated in these Annexes, are given in the technical file of the European Technical Assessment.

3.1.1.2 Hygiene, health and the environment

The release of dangerous substances is determined according to European Assessment Document EAD 130005-00-0304 “Solid wood slab element to be used as a structural element in buildings”, Edition March 2015. A manufacturer’s declaration to this effect has been submitted.

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

3.1.2 Components

3.1.2.1 Boards, wood-based panels

The specification of the boards is given in Annex 2, Table 2. Boards are visually or machine strength graded. Only technically dried wood shall be used.

If wood-based panels are used, these shall conform to EN 13986 or a European Technical Assessment.

3.1.2.2 Adhesive

The adhesive for bonding of the cross laminated timber and the finger joints of the individual boards shall conform to EN 301 or EN 15425.

3.2 Assessment methods

3.2.1 General

The assessment of the solid wood slab element for the intended use in relation to the requirements for mechanical resistance and stability, for safety in case of fire, for hygiene, health and the environment, for safety and accessibility in use, for protection against noise and for energy economy and heat retention in the sense of the Basic Requirements 1 to 6 of Regulation (EU) № 305/2011 has been made in accordance with *European Assessment Document EAD 130005-00-03.04 “Solid wood slab element to be used as a structural element in buildings”*.

3.2.2 Identification

The European Technical Assessment for MM – crosslam is issued on the basis of agreed data, deposited with Österreichisches Institut für Bautechnik, which identifies the product that has been assessed. Changes to materials, to the composition or to characteristics of the product, or to the production process, which could result in this deposited data being incorrect, should be immediately notified to Österreichisches Institut für Bautechnik before the changes are introduced. Österreichisches Institut für Bautechnik will decide whether or not such changes affect the European Technical Assessment, and, if so, whether further assessment or alterations to the European Technical Assessment are considered necessary.

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

4.1 System of assessment and verification of constancy of performance

The manufacturer shall draw up the declaration of performance and determine the product-type on the basis of the assessments and verifications of constancy of performance carried out under the following system as laid down in the Commission Delegated Regulation (EU) № 568/2014 of 18 February 2014, Annex V, 1.2, referred to as System 1. This System provides for:

- (a) the manufacturer shall carry out:
 - (i) factory production control;
 - (ii) further testing of samples taken at the manufacturing plant by the manufacturer in accordance with a prescribed test plan⁵;
- (b) the notified product certification body shall decide on the issuing, restriction, suspension or withdrawal of the certificate of constancy of performance of the construction product on the basis of the outcome of the following assessments and verifications carried out by that body:
 - (i) an assessment of the performance of the construction product carried out on the basis of testing (including sampling), calculation, tabulated values or descriptive documentation of the product;
 - (ii) initial inspection of the manufacturing plant and of factory production control;
 - (iii) continuous surveillance, assessment and evaluation of factory production control.

4.2 AVCP for construction products for which a European Technical Assessment has been issued

Notified bodies undertaking tasks under System 1 shall consider the European Technical Assessment issued for the construction product in question as the assessment of the performance of that product. Notified bodies shall therefore not undertake the tasks referred to in point 4.1 (b)(i).

5 Technical details necessary for the implementation of the AVCP system, as provided for in the applicable European Assessment Document

5.1 Tasks for the manufacturer

5.1.1 Factory production control

At the manufacturing plant the manufacturer has implemented and continuously maintains a factory production control system. All the elements, requirements and provisions adopted by the manufacturer are documented in a systematic manner in the form of written policies and procedures. The factory production control system ensures that the performance of the solid wood slab elements is in conformity with the European Technical Assessment.

The manufacturer shall only use raw materials supplied with the relevant inspection documents as laid down in the prescribed test plan. The incoming raw materials shall be subject to controls and tests by the manufacturer before acceptance. Check of incoming materials shall include control of inspection documents (comparison with nominal values) presented by the manufacturer of the raw materials by verifying the dimensions and determining the material properties.

The frequencies of controls and tests conducted during manufacturing and on the assembled product are defined by taking account of the manufacturing process of the product and are laid down in the prescribed test plan.

⁵ The prescribed test plan has been deposited with Österreichisches Institut für Bautechnik and is handed over only to the notified product certification body involved in the procedure for the assessment and verification of constancy of performance. The prescribed test plan is also referred to as control plan.

The results of factory production control are recorded and evaluated. The records include at least the following data:

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

The records shall be kept at least for ten years time after the construction product has been placed on the market and shall be presented to the notified product certification body involved in continuous surveillance. On request they shall be presented to Österreichisches Institut für Bautechnik.

5.1.2 Declaration of performance

The manufacturer is responsible for preparing the declaration of performance. When all the criteria of the assessment and verification of constancy of performance are met, including the certificate of conformity of the factory production control issued by the notified product certification body, the manufacturer shall draw up a declaration of performance.

5.2 Tasks for the notified product certification body

5.2.1 Initial inspection of the manufacturing plant and of factory production control

The notified product certification body shall ascertain that, in accordance with the prescribed test plan, the factory, in particular personnel and equipment, and the factory production control, are suitable to ensure a continuously and orderly manufacturing of MM – crosslam with the specifications given in the specific parts as well as in the Annexes of the European Technical Assessment.

5.2.2 Continuous surveillance, assessment and evaluation of factory production control

The notified product certification body shall visit the factory at least once a year for surveillance. It shall be verified that the system of factory production control and the specified manufacturing process are maintained, taking account of the prescribed test plan. On demand the results of continuous surveillance shall be made available by the notified product certification body to Österreichisches Institut für Bautechnik. When the provisions of the European Technical Assessment and the prescribed test plan are no longer fulfilled, the certificate of constancy of performance shall be withdrawn by the notified product certification body.

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by Österreichisches Institut für Bautechnik

The original document is signed by:

Rainer Mikulits
Managing Director

Figure 1: Principle structure of the solid wood slab

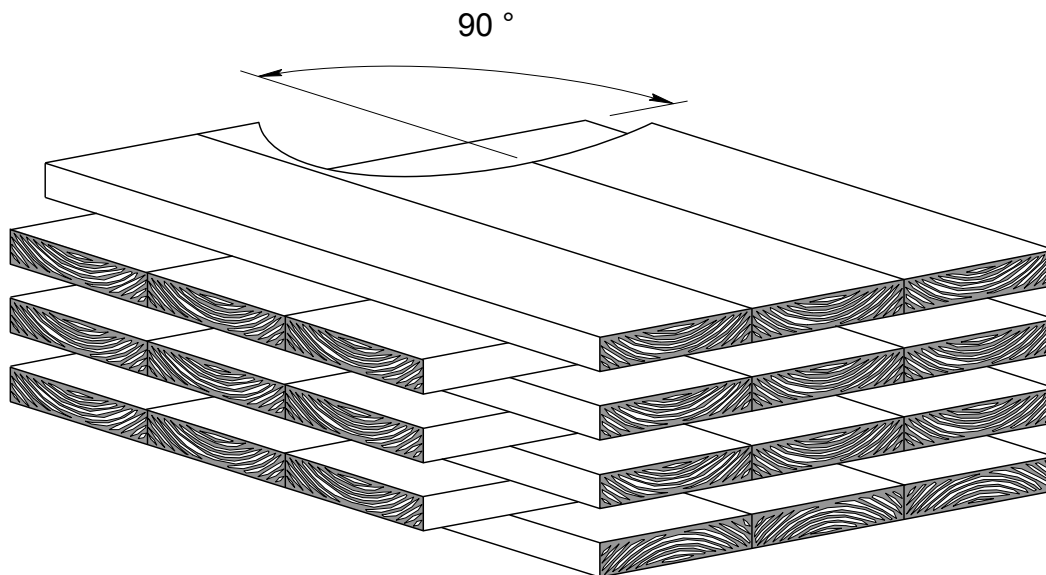


Figure 2: Principle structure of cross laminated timber with 3 layers

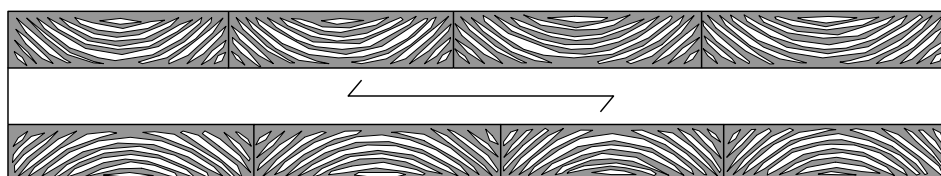
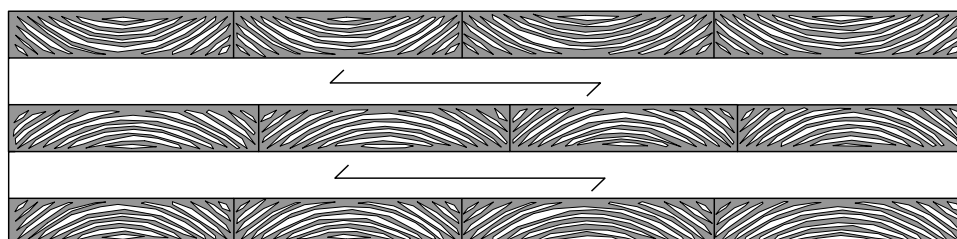


Figure 3: Principle structure of cross laminated timber with 5 layers



MM – crosslam	Annex 1
Structure of cross laminated timber	of European Technical Assessment ETA-10/0036 of 30.06.2015

Table 2: Dimensions and specifications

Characteristic		Dimension / Specification				
Cross laminated timber						
Thickness	mm	36 to 280				
Width	m	≤ 4.0				
Length	m	≤ 18				
Number of layers	—	3 to 13 symmetric assembly				
Maximum width of joints between boards within one layer	mm	3 max. 10 % ≤ 4 mm				
Board						
Surface	—	planed				
Thickness (planed dimension)	mm	12 to 45				
Width	mm	70 to 280				
Ratio width to thickness	—	≥ 4 : 1				
Boards shall be graded with suitable visual and/or machine procedures to be able to assign them to a strength class according to EN 338.	—					
Cover layer	—	C16 / L17 to C35 / L36 ¹⁾				
Inner layer	—	<table border="0" style="width: 100%;"> <tr> <td style="width: 50%; border-right: 1px solid black;">≤ 10 % C16 / L17 ²⁾</td> <td style="width: 50%;">≤ 10 % C24 / L25 ⁴⁾</td> </tr> <tr> <td style="border-right: 1px solid black;">≥ 90 % C_{DI} ^{3), 2)}</td> <td>≥ 90 % C35 / L36 ⁴⁾</td> </tr> </table>	≤ 10 % C16 / L17 ²⁾	≤ 10 % C24 / L25 ⁴⁾	≥ 90 % C _{DI} ^{3), 2)}	≥ 90 % C35 / L36 ⁴⁾
≤ 10 % C16 / L17 ²⁾	≤ 10 % C24 / L25 ⁴⁾					
≥ 90 % C _{DI} ^{3), 2)}	≥ 90 % C35 / L36 ⁴⁾					
Moisture of wood according to EN 13183-2	%	10 ± 2 or 12 ± 2 Within one member of cross laminated timber only one of the specified moisture ranges shall be applied.				
Finger joints	—	EN 14080				

- 1) Grading classes L17 to L36 according to EN 14081-4 or equivalent T-classes according to EN 14080.
 2) If the boards of the cover layer confirm to a strength class of C18 / L17 to C24 / L25.
 3) Strength class of the cover layer.
 4) If the boards of the cover layer confirm to the strength class C35 / L36.

MM – crosslam	Annex 2 of European Technical Assessment ETA-10/0036 of 30.06.2015
Characteristic data of cross laminated timber	

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Table 3: Product characteristics of the solid wood slab

BWR	Essential characteristic	Method of assessment	Level / Class / Description
1	Mechanical resistance and stability		
	1. Mechanical actions perpendicular to cross laminated timber		
	Strength class of boards	EN 338	C16 / L17 to C35 / L36
	Modulus of elasticity – parallel to the grain of the boards $E_{0, mean}$ – perpendicular to the grain of the boards $E_{90, mean}$	I_{eff} , Annex 3 EAD 130005-00-0304, 2.2.1.1 EN 338	C16 / L17 8.000 MPa C18 / L17 9.000 MPa C24 / L25 11.600 MPa C30 / L30 12.600 MPa C35 / L36 13.700 MPa according to EN 338
	Shear modulus – parallel to the grain of the boards $G_{090, mean}$ – perpendicular to the grain of the boards (rolling shear modulus) $G_{9090, mean}$	EN 338 EAD 130005-00-0304, 2.2.1.1	650 MPa 50 MPa
	Bending strength – parallel to the grain of the boards $f_{m, k}$	W_{eff} , Annex 3 EAD 130005-00-0304, 2.2.1.1	according to EN 338
	Tensile strength – perpendicular to the grain of the boards $f_{t, 90, k}$	EN 338, reduced	0.12 MPa
	Compressive strength – perpendicular to the grain of the boards $f_{c, 90, k}$	EN 338	according to EN 338
	Shear strength – parallel to the grain of the boards $f_{v, 090, k}$ – perpendicular to the grain of the boards (rolling shear strength) $f_{v, 9090, k}$	EN 338 A_{gross} , Annex 3 EAD 130005-00-0304, 2.2.1.3	according to EN 338 1.10 MPa

MM – crosslam

Annex 2

Characteristic data of cross laminated timber

of European Technical Assessment
ETA-10/0036 of 30.06.2015

BWR	Essential characteristic	Method of verification	Level / Class / Description
1	Mechanical resistance and stability		
	2. Mechanical actions in plane of cross laminated timber		
	Strength class of boards	EN 338	C16 / L17 to C35 / L36
	Modulus of elasticity – parallel to the grain of the boards $E_{0, mean}$	A_{net}, I_{net} , Annex 3 EAD 130005-00-0304, 2.2.1.1	C16 / L17 8.000 MPa C18 / L17 9.000 MPa C24 / L25 11.600 MPa C30 / L30 12.600 MPa C35 / L36 13.700 MPa
	Shear modulus – parallel to the grain of the boards $G_{090, mean}$	A_{net} , Annex 3 EAD 130005-00-0304, 2.2.1.3	250 MPa
	Bending strength – parallel to the grain of the boards $f_{m, k}$	W_{net} , Annex 3 EAD 130005-00-0304, 2.2.1.1	according to EN 338
	Tensile strength – parallel to the grain of the boards $f_{t, 0, k}$	EN 338	according to EN 338
	Compressive strength – parallel to the grain of the boards $f_{c, 0, k}$	EN 338	according to EN 338
	Shear strength – parallel to the grain of the boards $f_{v, 090, k}$	A_{net} , Annex 3 EAD 130005-00-0304, 2.2.1.3	5.0 MPa
	3. Other mechanical actions		
	Creep and duration of load	k_{mod} and k_{def} according to EN 1995-1-1 for glued laminated timber	
	Dimensional stability Moisture content during service shall not change to such an extent that adverse deformation will occur.		
	Fasteners	EN 1995-1-1, the direction of grain of the cover layer shall be taken as reference	

MM – crosslam

Annex 2

Characteristic data of cross laminated timber

of European Technical Assessment
ETA-10/0036 of 30.06.2015

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BWR	Essential characteristic	Method of verification	Level / Class / Description
	In-service environment		
	Durability of timber	EN 1995-1-1	
	Service classes		1 and 2
	Bond integrity	EAD 130005-00-0304	Pass
2	Reaction to fire		
	Glued laminated timber products	Commission Decision 2005/610/EC	Mean density of wood $\geq 380 \text{ kg/m}^3$ Euroclass D-s2, d0
	Resistance to fire		
	No characteristic assessed		
3	Hygiene, health and environment		
	Content, emission and/or release of dangerous substances	EAD 130005-00-0304	No dangerous substances
	Vapour permeability, μ , including joints within the layers	EN ISO 10456	50 (dry) to 20 (wet)
4	Safety and accessibility 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		
	Airborne sound insulation	No performance assessed.	
	Impact sound insulation	No performance assessed.	
	Sound absorption	Not relevant. No performance assessed.	
6	Energy economy and heat retention		
	Thermal conductivity, λ	EN ISO 10456	0.13 W/(m·K)
	Air permeability	No performance assessed.	
	Thermal inertia, specific heat capacity c_p	EN ISO 10456	1 600 J/(kg·K)
MM – crosslam		Annex 2	
Characteristic data of cross laminated timber		of European Technical Assessment ETA-10/0036 of 30.06.2015	

Mechanical actions perpendicular to plane and in plane of cross laminated timber

General

Due to the perpendicular orientation of the boards, cross laminated timber is able to transfer loads in all directions according to its condition of support.

For calculation of characteristic values of cross-section, only boards which are oriented in direction of the mechanical action may be employed.

For design of cross laminated timber according to EN 1995-1-1, characteristic strength and stiffness of solid wood according to Annex 2 shall be taken. If the cross laminated timber is comprised of visually graded boards, the characteristic bending strength parallel to the grain may be determined with the following equation:

$$f_{m, CLT, k} = \text{Minimum} \begin{cases} a_{CLT} \cdot f_{t, 0, k}^{0,8} \\ 1,2 \cdot f_{m, k} \end{cases}$$

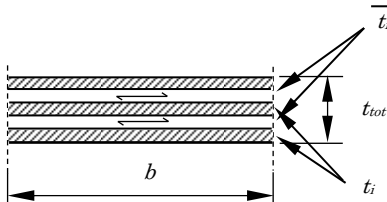
$$b \geq 1 \text{ m}$$

Where

- $f_{m, CLT, k}$ MPa characteristic bending strength of cross laminated timber
- $f_{m, k}$ MPa characteristic bending strength according to EN 338
- $a_{CLT} = 3.5$ - for visually graded timber
- $f_{t, 0, k}$ MPa characteristic tensile strength of board according to EN 338
- b mm width of the member of cross laminated timber

For cross laminated timber multi-axle stressed in both principal directions, different stiffness for the two principal directions shall be considered.

Mechanical actions perpendicular to cross laminated timber



Where

- t_i Thickness of board layers in direction of mechanical actions
- \bar{t}_i Thickness of board layers perpendicular to direction of mechanical actions

The bending stiffness is specified in relation to the effective moment of inertia I_{eff} . The calculation of the effective moment of inertia and therewith of the effective bending stiffness is according to EN 1995-1-1.

MM – crosslam	Annex 3
Design considerations for cross laminated timber	of European Technical Assessment ETA-10/0036 of 30.06.2015

For I_{eff} see clause 9.1.3 and Annex B of EN 1995-1-1.

The term $\frac{S_i}{K_i}$ of EN 1995-1-1 should be substituted by $\frac{\bar{t}_i}{G_{9090} \cdot b}$.

$$I_i = \frac{b \cdot t_i^3}{12}$$

$$W_{eff} = \frac{2 \cdot I_{eff}}{t_{tot}}$$

$$A_i = b \cdot t_i$$

$$h_{tot} = \sum_i (t_i + \bar{t}_i)$$

$$\tau_{v,d} = \frac{1,5 \cdot V_d}{A_{gross}}$$

$$A_{gross} = b \cdot t_{tot}$$

Where

I moment of inertia

I_{eff} effective moment of inertia

S spacing of fasteners according to EN 1995-1-1 (*not relevant for solid wood slab*)

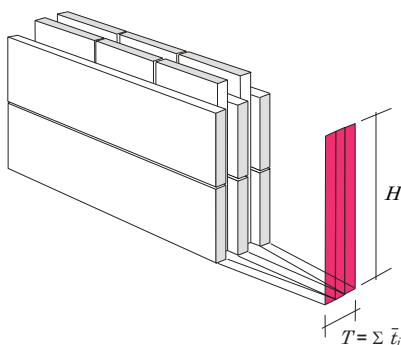
K slip modulus according to EN 1995-1-1 (*not relevant for solid wood slab*)

G_{9090} shear modulus of the board perpendicular to grain (*rolling shear modulus*);

$$G_{9090} = 50 \text{ MPa}$$

b width of the member of cross laminated timber

Mechanical actions in plane of the solid wood slab



Where

$$H \leq 400 \text{ mm}$$

t_i Thickness of board layers in direction of mechanical actions

\bar{t}_i Thickness of board layers perpendicular to direction of mechanical actions

V Shear force

Under the terms of the technical beam theory the following equations may be used.

Moment of inertia

$$I_{net} = \frac{T \cdot H^3}{12}$$

Section modulus

$$W_{net} = \frac{T \cdot H^2}{6}$$

Shear strength

$$\tau_{v,d} = \text{Maximum} \begin{cases} \frac{3}{2} \cdot \frac{V_d}{A_{x,net}} \\ \frac{3}{2} \cdot \frac{V_d}{A_{z,net}} \end{cases}$$

$$A_{x,net} = H \cdot \sum_i \bar{t}_i$$

$$A_{z,net} = H \cdot \sum_i t_i$$

MM – crosslam	Annex 3
Design considerations for cross laminated timber	of European Technical Assessment ETA-10/0036 of 30.06.2015

EAD 130005-00-0304, European Assessment Document for “Solid wood slab element to be used as a structural element in buildings”, Edition March 2015

EN 301 (10.2013), Adhesives, phenolic and aminoplastic, for load-bearing timber structures – Classification and performance requirements

EN 338 (10.2009), Structural timber – Strength classes

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 1995-1-2 (11.2004), +AC (06.2006), +AC (03.2009), Eurocode 5 – Design of timber structures – Part 1-2: General – Structural fire design

EN 13183-2 (04.2002) and AC (09.2003), Moisture content of a piece of sawn timber – Part 2: Estimation by electrical resistance method

EN 13986 (10.2004) Wood-based panels for use in construction - Characteristics, evaluation of conformity and marking

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MM – crosslam	Annex 4 of European Technical Assessment ETA-09/0036 of 30.06.2015
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