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## European Technical Assessment

**ETA-15/0760**  
of 30.06.2017

General part

### Technical Assessment Body issuing the European Technical Assessment

Österreichisches Institut für Bautechnik (OIB)  
Austrian Institute of Construction Engineering

### Trade name of the construction product

MHM – wall element  
MHM – Wandelement

### Product family to which the construction product belongs

Solid wood slab element – Element of mechanically jointed timber boards to be used as a structural element in buildings

### Manufacturer

Massiv-Holz-Mauer (MHM) Entwicklungs GmbH  
Auf der Geigerhalde 41  
87459 Pfronten-Weißbach  
Germany

### Manufacturing plants

See Annex 1

### This European Technical Assessment contains

24 pages including 8 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 130002-00-0304 “Solid wood slab element - element of dowel jointed timber boards to be used as a structural element in buildings”, Edition July 2015

## 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 Assessment (ETA)<sup>1</sup> applies to the element of mechanically jointed timber boards "MHM – wall element". The MHM – wall element is made of softwood boards which are bonded together with fluted aluminium nails 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 2, Figure 1.

The principle structure of the MHM – wall element is shown in Annex 2, Figure 1 and Figure 2. Surfaces can be rough. The boards may be grooved in longitudinal direction on one side until a maximum depth of 3 mm, see Annex 2, Figure 3. Outer surface of cover layers may be planed. The boards may be provided with a rabbet joint.

The solid wood slab element consists of at least five adjacent layers and up to fifteen adjacent layers which are arranged perpendicular to each other. With regard to the thickness of the solid wood slab element, thicknesses and orientations of individual layers are symmetrically assembled. In case of serious deviations from symmetry potential effects should be investigated.

The MHM – wall element and the boards for its manufacturing correspond to the specifications given in the Annexes 2 and 4. The material characteristics, dimensions and tolerances of the MHM – wall element, not indicated in these Annexes, are given in the technical file<sup>2</sup> of the European Technical Assessment.

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

#### 1.2 Components

##### 1.2.1 Boards

The specification of the boards is given in Annex 4, Table 3. Boards are visually or machine strength graded. Only technically dried wood shall be used. The boards may be grooved in longitudinal direction on one side until a maximum depth of 3 mm see Annex 2, Figure 3.

The boards may be provided with a rabbet joint.

Wood species is European spruce or equivalent softwood.

##### 1.2.2 Fluted aluminium nails

For mechanically jointing the single boards, fluted aluminium nails according to Annex 3 shall be used. The dimension of the fluted aluminium nails is 2.5 x 50 mm. They are made of aluminium. The fluted aluminium nails may be CE-marked according to a European Technical Assessment.

<sup>1</sup> In 2016 ETA-15/0760 was firstly issued as European Technical Assessment ETA-15/0760 of 24.05.2016 and amended to ETA-15/0760 of 30.06.2017.

<sup>2</sup> 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.

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

### 2.1 Intended use

The MHM – wall element is intended to be used as a structural or non-structural wall element in buildings and timber structures.

The MHM – wall element is subjected to static and quasi static actions.

The MHM – wall element is intended to be used in service classes 1 and 2 according to EN 1995-1-1<sup>3</sup> at low and moderate exposure to corrosion (corrosive categories C1, C2 and C3 according to EN 12944-2). Members which are directly exposed to the weather shall be provided with an effective protection for the MHM – wall element in service.

### 2.2 General assumptions

The MHM – wall 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 file.

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 design and execution of the works.

Layers of rough boards shall be jointed together to the required thickness of the element of mechanically jointed timber boards. The individual boards may be jointed in longitudinal direction by means of finger joints according to EN 14080, there shall be no butt joints.

Minimum width of the load bearing element is 3 board widths.

Nailing of the single boards must be performed by an automatic nail device type “Wandmaster” of company Hans Hundegger AG.

Edge distance between nailed boards is  $30 \pm 5$  mm according to Annex 3, Figure 5. This excludes the nailing between the first and the second layer of boards where a fixed nailing pattern according to Annex 3, Figure 6, with  $e_{fix} \leq 0.8 \times b_{min}$  is possible.

The edges of the boards need not to be jointed. The boards may be provided with a rabbet joint.

#### Design

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

The following conditions shall be observed:

- Design of the MHM – wall 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 MHM – wall element.
- The MHM – wall element is installed correctly.

Design of the element of mechanically jointed timber boards may be according to EN 1995-1-1 and EN 1995-1-2, taking into account the Annexes 4 and 7 of the European Technical Assessment.

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

#### Packaging, transport, storage, maintenance, replacement and repair

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

<sup>3</sup> Reference documents are listed in Annex 8.

on the transport, storage, maintenance, replacement and repair of the product as he considers necessary.

#### Installation

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.

#### Fixing of objects

All fixed objects that are subject to tensile forces shall in any case be anchored in MHM – wall element with an anchoring depth of at least 3 layers. For heavy weight objects a deeper anchorage has to be provided. This refers in particular to kitchen cabinets, hot water boilers, handrails, etc..

The specifications of the installation instructions shall be observed.

### 2.3 Working life/Durability

The provisions made in the European Technical Assessment (ETA) are based on an assumed intended working life of the MHM – wall element of 50 years, when installed in the works, provided that the 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 experience<sup>4</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 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.

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

### 3.1 Essential characteristics of the product

**Table 1: Essential characteristics and product performance**

No	Essential characteristic	Product performance
Basic requirement for construction works 1: Mechanical resistance and stability <sup>1)</sup>		
1	Load-bearing capacity and stiffness regarding mechanical actions perpendicular to the solid wood slab element	Annex 4
2	Load-bearing capacity and stiffness regarding mechanical actions in plane of the solid wood slab element	Annex 4
3	Embedding strength / Withdrawal strength	Annex 4
4	Creep and duration of the load	Annex 4
5	Dimensional stability	Annex 4
6	Aspects of durability	Annex 4
Basic requirement for construction works 2: Safety in case of fire		
7	Reaction to fire	Annex 4
8	Resistance to fire	Annex 4

<sup>4</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.

Basic requirement for construction works 3: Hygiene, health and the environment		
9	Content, emission and/or release of dangerous substances	3.1.1
10	Water vapour permeability	Annex 4
Basic requirement for construction works 4: Safety and accessibility in use		
11	Same as BWR 1	Annex 4
Basic requirement for construction works 5: Protection against noise		
12	Airborne sound insulation	Annex 4
13	Impact sound insulation	No performance assessed.
14	Sound absorption	No performance assessed.
Basic requirement for construction works 6: Energy economy and heat retention		
15	Thermal resistance	Annex 4
16	Air permeability	Annex 4
17	Thermal inertia	Annex 4
1) These characteristics also relate to BWR 4.		

### 3.1.1 Hygiene, health and the environment

The release of dangerous substances is determined according to EAD 130002-00-0304, "Solid wood slab element – Element of dowel jointed timber boards to be used as a structural element in buildings", Edition July 2015. No dangerous substances is the performance of the MHM – wall element in this respect.

**NOTE** 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.

## 3.2 Assessment methods

### 3.2.1 General

The assessment of the essential characteristics in Clause 3.1 of the MHM – wall element for the intended use, and 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 use in the sense of the basic requirements for construction works № 1 to 6 of Regulation (EU) № 305/2011 has been made in accordance with the European Assessment Document EAD 130002-00-0304, Solid wood slab element – Element of dowel jointed timber boards to be used as a structural element in buildings, edition July 2015.

### 3.2.2 Identification

The European Technical Assessment for the MHM – wall element is issued on the basis of agreed data that identify the assessed product. Changes to materials, to composition, to characteristics of the product, or to the production process could result in these deposited data being incorrect. Österreichisches Institut für Bautechnik should be notified before the changes are implemented, as an amendment of the European Technical Assessment is possibly 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**

According to Commission Decision 97/176/EC the system of assessment and verification of constancy of performance to be applied to the MHM – wall element is System 1. System 1 is detailed in Commission Delegated Regulation (EU) № 568/2014 of 18 February 2014, Annex, 1.2., and provides for the following items

- (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 plan<sup>5</sup>;
- (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**

In the manufacturing plant the manufacturer shall establish and continuously maintain a factory production control. All procedures and specification adopted by the manufacturer shall be documented in a systematic manner. The factory production control shall ensure the constancy of performances of the element of mechanically jointed timber boards with regard to the essential characteristics.

The manufacturer shall only use raw materials supplied with the relevant inspection documents as laid down in the control plan. The incoming raw materials shall be subject to controls by the manufacturer before acceptance. Check of incoming materials shall include control of inspection documents presented by the manufacturer of the raw materials.

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 control plan.

<sup>5</sup> 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.





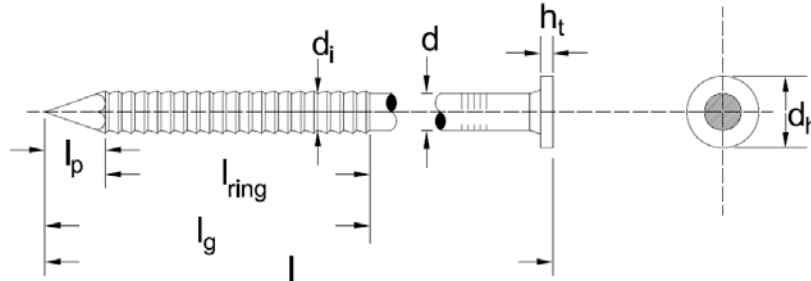








**Figure 4: Geometry of fluted aluminium nail**



- $l$  length
- $l_{ring}$  threaded length
- $l_p$  length of the tip
- $l_g$  length of tip and thread
- $d_i$  inner thread diameter
- $d$  diameter
- $d_h$  head diameter
- $h_t$  thickness of the head

**Table 2: Specification of fluted aluminium nail**

Nail characteristics		Unit	Value
Nominal diameter	$d$	mm	2.5
Nominal length	$l$	mm	50
Characteristic tensile strength	$F_{tens,k}$	N	1400
Characteristic yield moment	$M_{y,k}$	N	800
Characteristic withdrawal capacity of the shaft	$F_{ax,k,Shaft}$	N	610
Characteristic withdrawal capacity of the nail	$F_{ax,k}$	N	485
Slip modulus (serviceability limit state)	$K_{ser}$	N/mm	300

**MHM – wall element**

Annex 3

Fluted aluminium nail

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**Table 3: Dimensions and specifications**

Item	Dimension / Specification	
<b>MHM – wall element</b>		
Thickness	mm	115 to 345
Width	m	≤ 4.0
Length	m	≤ 6.0
Number of layers	—	5 to 15 symmetric assembly
Maximum width of joints between boards within one layer: Regions with applied fasteners Other regions	mm	3 6
<b>Board</b>		
Surface	—	rough
Thickness (planed dimension)	mm	23 ± 2
Width	mm	140 to 260
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 and inner layer	—	C16 or better With additional requirements of C24 regarding bow
Moisture of wood according to EN 13183-2	%	15 ± 3
Finger joints	—	EN 14080

**MHM – wall element**

Annex 4

Characteristic data of MHM – wall element

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**Table 4: Product characteristics of the MHM – wall element**

BWR	Essential characteristic	Method of verification	Level / Class / Description
1	<b>Mechanical resistance and stability</b>		
	<b>1. Load bearing capacity and stiffness regarding mechanical actions perpendicular to the solid wood slab element</b>		
	Strength class of boards	EN 338	C16 or better With additional requirements of C24 regarding bow
	Modulus of elasticity	Annex 7	See Annex 7
	– parallel to the grain of the boards $E_{0, mean}$		
	– perpendicular to the grain of the boards $E_{90, mean}$	EN 338	370 MPa <sup>1)</sup>
	Shear modulus	EN 338	690 MPa
	– parallel to the grain of the boards $G_{090, mean}$		
	Bending strength	Annex 7	See Annex 7
	– parallel to the grain of the boards $f_{m, k}$		
Tensile strength			
In general mechanically jointed solid wood slab element elements are unsuitable for tension perpendicular to the plane of the slab. Fasteners shall be applied to overcome such design situations.			
Compressive strength	EN 338	2.5 MPa	
– perpendicular to the grain of the boards $f_{c, 90, k}$			
Shear strength	Annex 7	See Annex 7	
– parallel to the grain of the boards $f_{v, 090, k}$			

<sup>1)</sup> 1 MPa = 1 N/mm<sup>2</sup>**MHM – wall element**

Annex 4

Characteristic data of MHM – wall element

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BWR	Essential characteristic	Method of verification	Level / Class / Description
1	<b>Mechanical resistance and stability</b>		
	<b>2. Load bearing capacity and stiffness regarding mechanical actions in plane of the solid wood slab element</b>		
	Strength class of boards	EN 338	C16 or better With additional requirements of C24 regarding bow
	Modulus of elasticity – parallel to the grain of the boards $E_{0, mean}$	Annex 7	See Annex 7
	Bending strength – parallel to the grain of the boards $f_{m, k}$	Annex 7	See Annex 7
	Tensile strength – parallel to the grain of the boards $f_{t, 0, k}$	EN 338	14 MPa
	Compressive strength – parallel to the grain of the boards $f_{c, 0, k}$	EN 338	21 MPa
	Shear strength – parallel to the grain of the boards $f_{v, 090, k}$	Annex 7	See Annex 7
	<b>3. Other mechanical actions</b>		
	Fasteners: Embedding strength and withdrawal strength	EN 1995-1-1 and Annex 7	
	Creep and duration of load	EN 1995-1-1	
	Dimensional stability Moisture content during service shall not change to such an extend that adverse deformation will occur.		
	Aspects of durability – Service classes	EN 1995-1-1	1 and 2

**MHM – wall element**

Annex 4

Characteristic data of MHM – wall element

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BWR	Essential characteristic	Method of verification	Level / Class / Description
<b>2</b>	<b>Reaction to fire</b>		
	Solid wood panels excluding floorings ( $\rho_{\min}=400\text{kg/m}^3$ )	Commission Decision 2003/43/EC as amended	Euroclass D-s2, d0
	Floorings of solid wood panels ( $\rho_{\min}=400\text{kg/m}^3$ )		Euroclass D <sub>fl</sub> -s1
	<b>Resistance to fire</b>		
Charring rate – Charring of more layers than the cover layer	EN 1365-1	1.15 mm/min	
<b>3</b>	<b>Hygiene, health and environment</b>		
	Vapour permeability, $\mu$ , for the timber  The elements are open for water vapour diffusion. Harmful condensation within the element shall be avoided in intended use conditions. This can be proven case by case by a calculation according to EN ISO 13788, when needed.	EN ISO 10456	50 (dry) to 20 (wet)
<b>4</b>	<b>Safety and accessibility in use</b>		
	Same as BWR 1.		
<b>5</b>	<b>Protection against noise</b>		
	Airborne sound insulation	EN ISO 10140-2, EN ISO 717-1	For $R_w$ (C; C <sub>tr</sub> ), see Annex 6
<b>6</b>	<b>Energy economy and heat retention</b>		
	Thermal resistance $\lambda_D$	EAD 130002-00-0304	0.11 W/(m·K)
	Air tightness	Wind tightness is required in particular if dry lining is used. Adequate air tightness has to be provided by the manufacturer.	
	Thermal inertia, specific heat capacity $c_p$	EN ISO 10456	1 600 J/(kg·K)

**MHM – wall element**

Annex 4


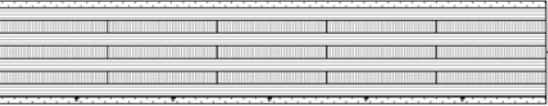
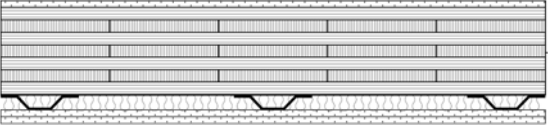
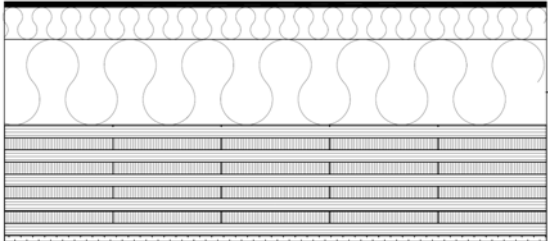
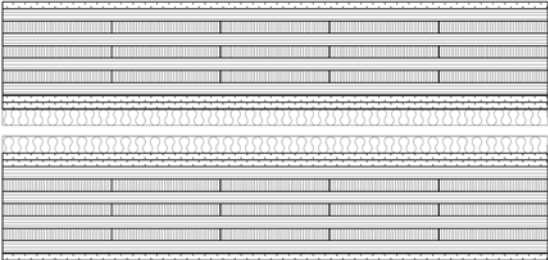
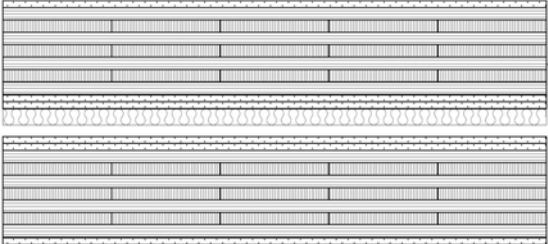
Characteristic data of MHM – wall element

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### Examples for airborne sound insulation

№	Wall elements		
<b>W 1</b>	115 mm	MHM – wall element, $m' = 45.7 \text{ kg/m}^2$	$R_w(C; C_{tr}) = 32 \text{ (-1; -3) dB}$ 
<b>W 2</b>	12.5 mm 160 mm 12.5 mm	Gypsum fibre board, $m' = 15.3 \text{ kg/m}^2$ MHM – wall element, $m' = 63.4 \text{ kg/m}^2$ Gypsum fibre board, $m' = 15.3 \text{ kg/m}^2$	$R_w(C; C_{tr}) = 42 \text{ (-1; -4) dB}$ 
<b>W 3</b>	12.5 mm 12.5 mm 27 mm 20 mm  160 mm 12.5 mm	Gypsum fibre board, $m' = 15.3 \text{ kg/m}^2$ Gypsum fibre board, $m' = 15.3 \text{ kg/m}^2$ Hat-shaped spring strip, $e = 690 \text{ mm}$ Stone wool insulation board, $\rho = 40.2 \text{ kg/m}^3$ MHM – wall element, $m' = 63.7 \text{ kg/m}^2$ Gypsum fibre board, $m' = 15.3 \text{ kg/m}^2$	$R_w(C; C_{tr}) = 61 \text{ (-4; -11) dB}$ 
<b>W 4</b>	6 mm 60 mm  160 mm  0.45 mm 205 mm 12.5 mm	Plaster, $m' = 9.6 \text{ kg/m}^2$ Wood fiber insulation board, $m' = 15 \text{ kg/m}^2$ Structural timber, $e = 625 \text{ mm}$ , and blow-in insulation of wood fiber, $\rho = 38.9 \text{ kg/m}^3$ Facing sheet, $m' = 0.145 \text{ kg/m}^2$ MHM – wall element, $m' = 81.6 \text{ kg/m}^2$ Gypsum fibre board, $m' = 15.3 \text{ kg/m}^2$	$R_w(C; C_{tr}) = 46 \text{ (-2; -7) dB}$ 
<b>W 5</b>	12.5 mm 160 mm 2 x 12.5 mm 30 mm  20 mm 30 mm  2 x 12.5 mm 160 mm 12.5 mm	Gypsum fibre board, $m' = 15.3 \text{ kg/m}^2$ MHM – wall element, $m' = 64.9 \text{ kg/m}^2$ Gypsum fibre board, $m' = 15.3 \text{ kg/m}^2$ Stone wool insulation board, $\rho = 40.9 \text{ kg/m}^3$ Joint/air Stone wool insulation board, $\rho = 40.9 \text{ kg/m}^3$ Gypsum fibre board, $m' = 15.3 \text{ kg/m}^2$ MHM – wall element, $m' = 64.9 \text{ kg/m}^2$ Gypsum fibre board, $m' = 15.3 \text{ kg/m}^2$	$R_w(C; C_{tr}) = 78 \text{ (-2; -7) dB}$ 
<b>W 6</b>	12.5 mm 160 mm 2 x 12.5 mm 20 mm 30 mm  2 x 12.5 mm 160 mm 12.5 mm	Gypsum fibre board, $m' = 15.3 \text{ kg/m}^2$ MHM – wall element, $m' = 64.9 \text{ kg/m}^2$ Gypsum fibre board, $m' = 15.3 \text{ kg/m}^2$ Air Stone wool insulation board, $\rho = 40.9 \text{ kg/m}^3$ Gypsum fibre board, $m' = 15.3 \text{ kg/m}^2$ MHM – wall element, $m' = 64.9 \text{ kg/m}^2$ Gypsum fibre board, $m' = 15.3 \text{ kg/m}^2$	$R_w(C; C_{tr}) = 74 \text{ (-2; -8) dB}$ 
<b>MHM – wall element</b>			Annex 6
Airborne sound insulation			of European Technical Assessment ETA-15/0760 of 30.06.2017

## Mechanical actions perpendicular to plane and in plane of the MHM – wall element

### General

Due to the perpendicular orientation of the boards, the MHM – wall element is able to transfer loads in all directions according to its condition of support. For mechanically jointed cross laminated timber multi-axle stressed in both principal directions, different stiffness for the two principal directions shall be considered.

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 mechanically jointed cross laminated timber according to shear analogy method (TR019, C.1.2) and EN 1995-1-1, characteristic strength and stiffness of solid wood according to Annex 4 shall be taken.

### Mechanical actions perpendicular to the MHM – wall element

Design with maximum board width  $b_{\max} = 260$  mm in both directions. If the board width is defined and marked accordingly, the marked board width may be used.

If the maximum deformation in the serviceability limit state does not exceed  $h / 300$ , the following provisions may be considered:

- Design for wall elements with two nails per crossing point with 2/3 of the calculated shear flow. Design for wall elements with four nails per crossing point with 4/5 of the calculated shear flow.
- Consideration of factor  $f$  for rise in stiffness

For design of mechanically jointed cross laminated timber according to shear analogy method (TR019, C.1.2) and EN 1995-1-1, characteristic strength and stiffness of solid wood according to Annex 4 shall be taken.

$$EI_{eff} = EI_A + EI_B \cdot \frac{1}{1 + \frac{EI_B \cdot \pi^2}{S \cdot l^2}} \quad [\text{Nmm}^2] \quad \text{Effective bending stiffness}$$

With

$$\frac{1}{S} = \left[ \frac{1}{((n-1) \cdot d)^2} \sum_{i=1}^{n-1} \frac{1}{m \cdot \left( \frac{k_{nail}}{b_x \cdot b_y} \right)} \right] \cdot \frac{1}{f} \quad [\text{Nmm}^2] \quad \text{Substitute shear stiffness}$$

$n$	[-]	Number of layers
$d$	[mm]	Thickness of one layer
$m$	[-]	Number of nails per cross point
$b_x$	[mm]	Width of boards in x-direction
$b_y$	[mm]	Width of boards in y-direction
$k_{nail}$	[N/mm]	Slip modulus of single nail

<b>MHM – wall element</b>	Annex 7
Design considerations for the MHM – wall element	of European Technical Assessment ETA-15/0760 of 30.06.2017

$f$	[-]	Factor considering rise in stiffness (only for serviceability limit state): $f = 1.5$ for $m = 2$ and $f = 1.25$ for $m = 4$
$l$	[mm]	Length of element
$EI_A$	[Nmm <sup>2</sup> ]	Sum of own bending stiffnesses (layers in longitudinal direction)
$EI_B$	[Nmm <sup>2</sup> ]	Sum of Steiner parts (layers in longitudinal direction)

The bending stiffness is specified in relation to the effective moment of inertia  $I_{eff}$ .

#### Mechanical actions in plane of the MHM – wall element

For assessment of wall elements loaded in tension or compression the net cross section (without transverse layers) in direction of loading has to be considered.

For compressive stress in plane of the MHM – wall element verification according to second order theory with equivalent imperfections according to EN 1995-1-1 under consideration of shear deformations or shear buckling, respectively. Assessment of stability with maximum board width  $b_{max} = 260$  mm in both directions. If the board width is defined and marked accordingly, the marked board width may be used.

For horizontal stress in plane of MHM – wall elements verification according to second order theory with equivalent imperfections according to EN 1995-1-1 under consideration of shear deformations or shear buckling, respectively. Hereby, serviceability will be decisive. For shear stress in plane of the MHM – wall element assessment with minimum board width  $b_{min} = 140$  mm in both directions. If the board width is defined and marked accordingly, the marked board width may be used.

Design according to EN 1995-1-1, with characteristic strength and stiffness of solid wood according to Annex 4 and

$$EI_{eff} = EI_A + \gamma \cdot EI_B \quad [\text{Nmm}^2] \quad \text{Effective bending stiffness}$$

With

$$\gamma = 7.5\% \quad [\%] \quad \text{Ratio according to EN 1995-1-1, Annex B}$$

$$EI_A \quad [\text{Nmm}^2] \quad \text{Sum of own bending stiffnesses (layers in longitudinal direction)}$$

$$EI_B \quad [\text{Nmm}^2] \quad \text{Sum of Steiner parts (layers in longitudinal direction)}$$

For elements above openings the number of horizontal, statically active, board layers is restricted to five boards lying upon each other.

#### Racking strength – shear wall

Without further verification, the racking strength for an element with minimum 9 layers may be taken by

$$R_{v,k} = 2.75 \text{ kN/m.}$$

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Verification by calculation shall follow the shear analogy method, with

$$\frac{1}{D_{xy}} = \frac{b_x \cdot b_y}{\sum K_{\varphi,i}} \quad [\text{mm/N}] \quad \text{Shear stiffness}$$

With

$$K_{\varphi,i} = \sum r_i^2 \cdot k_{nail} \quad [\text{Nmm}] \quad \text{Torsion spring stiffness}$$

$$r_i \quad [\text{mm}] \quad \text{Distance of nails to the centre of rotation}$$

$$k_{nail} \quad [\text{N/mm}] \quad \text{Slip modulus of single nail}$$

$$b_x \quad [\text{mm}] \quad \text{Width of boards in x-direction}$$

$$b_y \quad [\text{mm}] \quad \text{Width of boards in y-direction}$$

$$M_{\varphi} = \frac{n_{xy} \cdot e_x \cdot e_y}{\sum K_{\varphi,i}} \cdot K_{\varphi,i} \quad [\text{Nmm}] \quad \text{Moment for design of connection in joint}$$

$$n_{xy} \quad [\text{N/mm}] \quad \text{Shear force}$$

$$e_x \quad [\text{mm}] \quad \text{Distance between centre of boards in x-direction}$$

$$e_y \quad [\text{mm}] \quad \text{Distance between centre of boards in y-direction}$$

### Fasteners

Load transfer through fluted aluminium nails shall be verified.

Design of fasteners for connection of two MHM – wall elements or MHM – wall elements and solid timber, glued laminated timber or steel sheets with a minimum penetration depth of  $12 \times d$ , may follow EN 1995-1-1 under consideration of:

- For connections between MHM – wall elements and solid timber or glued laminated timber loaded in shear with the screw head on solid timber or glued laminated timber side reduction of load bearing capacity  $F_{v,Rk}$  by factor  $\delta_1 = 0.95$ .
- For connections between two MHM – wall elements and MHM – wall elements and solid timber or glued laminated timber loaded in shear with the screw head on MHM – wall element side reduction of load bearing capacity  $F_{v,Rk}$  by factor  $\delta_2 = 0.75$ .

No reduction for nail-connections loaded in shear as well as axially loaded screw connections.

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