



Austrian Institute of Construction Engineering
 Schenkenstrasse 4 | T+43 1 533 65 50
 1010 Vienna | Austria | F+43 1 533 64 23
 www.oib.or.at | mail@oib.or.at



European Technical Assessment

ETA-11/0137 of 20.06.2014

GENERAL PART

Technical Assessment Body
 issuing the ETA

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

Trade name of the construction product

**LIGNATUR-box element (LKE), -surface element (LFE)
 and -shell element (LSE)**

Product family to which the construction
 product belongs

**Prefabricated wood-based loadbearing stressed skin
 panels**

Manufacturer

Lignatur AG
Herisauerstraße 30
9104 Waldstatt
Switzerland

Manufacturing plant

Lignatur AG
Herisauerstraße 30
9104 Waldstatt
Switzerland

This European Technical Assessment
 contains

**27 Pages including 6 Annexes which form an integral
 part of this assessment**

This European Technical Assessment
 is issued in accordance with
 Regulation (EU) № 305/2011, on the
 basis of

Guideline for European Technical Approval ETAG 019
“Prefabricated wood-based loadbearing stressed skin
panels”, Edition November 2004, used as European
Assessment Document

This European Technical Assessment
 replaces

European technical approval ETA-11/0137 with validity
from 19.11.2012 to 18.11.2017

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 open and closed box load bearing stressed skin panels

LIGNATUR-box element (LKE) LIGNATUR-surface element (LFE) LIGNATUR-shell element (LSE)

LIGNATUR-elements are factory made large-size floor and roof elements in softwood. The LIGNATUR-elements have parallel skins and ribs at regular distances.

Type according to ETAG 019², Clause 2.1:

- Open or closed box type with skins rigidly bonded to the entire length of the ribs with an adhesive
- Without or with thermal insulation products not contributing to the structural characteristics of the stressed skin panels

Beside thermal insulation products the boxes can be provided with ballast weight. The ballast weight does not contribute to the structural characteristics of the stressed skin panels.

Cladding, covering, rain and snow protection and connection to the structure as well as application of wood preservatives and flame retardants are not subject to the European Technical Assessment.

1.2 Skins and ribs

Skins and ribs are made of softwood boards or softwood of rectangular cross section, i.e. visually or machine strength graded timber. Only technically dried wood is used. In longitudinal direction the softwood boards are jointed with finger joints, there are no butt joints. Between the ribs stiffeners are arranged at regular distances for stabilisation.

To improve the acoustic performance of the LIGNATUR-elements, the skin can be provided with a grid of holes or slots.

The skins and ribs are bonded by means of an adhesive to open or closed boxes. Directions of grain of skins and ribs are parallel.

1.3 Thermal insulation products

Thermal insulation products such as mineral wool, wood fibre etc. conform to a harmonised European standard or a European Technical Assessment and do not contribute to the load bearing characteristics of the LIGNATUR-elements.

¹ The ETA-11/0137 was firstly issued in 2011 as European technical approval with validity from 28.04.2011, amended in 2012 with validity from 19.11.2012 and amended and converted in 2014 to the European Technical Assessment ETA-11/0137 of 20.06.2014.

² Reference documents are listed in Annex 6.

The thermal insulation products are not subject to the European Technical Assessment.

1.4 Ballast weight

Ballast weight such as concrete blocks, aggregates etc. does not contribute to the load bearing characteristics of the LIGNATUR-elements. Concrete blocks and aggregates conform to a harmonised European standard or a European Technical Assessment. For ballast weight with aggregates from calcium carbonate, see Clause 3.1.2.4.

The ballast weight is not subject to the 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 LIGNATUR-elements are intended to be used as load bearing or non load bearing elements in floors and roofs. They may be used in a load bearing function or for load transmission stressed perpendicular as well as in plane of the element.

The product shall be subjected to static and quasi static actions only.

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

2.2 General assumptions

The LIGNATUR-elements are 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 planning and execution of the works.

Design

The European Technical Assessment only applies to the manufacture and use of the LIGNATUR-elements. Verification of stability of the works including application of loads on the products is not subject to the European Technical Assessment.

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

- Design of the LIGNATUR-elements is carried under the responsibility of an engineer experienced in such products.
- Design of the works shall account for the protection of the LIGNATUR-elements.
- In service, the LIGNATUR-elements are not exposed to detrimental moisture. The definitions of service classes 1 and 2 according to EN 1995-1-1 apply.
- The LIGNATUR-elements are installed correctly.

Design of the products can be according to EN 1995-1-1 and EN 1995-1-2, taking into account of Clause 3.1 of the European Technical Assessment. Standards and regulations in force at the place of use shall be considered.

Packaging, transport and storage

The LIGNATUR-elements shall be protected during transport and storage against any damage and detrimental moisture effects. Storage shall at all time be clear from the ground. Damaged products shall not be installed. The manufacturer's instruction for packaging, transport and storage shall be observed.

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.

Installation of LIGNATUR–elements 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 LIGNATUR–elements shall be installed and their designation. The assembly plan shall be available at the construction site.

Damaged products shall not be installed.

Ducts and services shall as far as possible be arranged not to affect the performances of the LIGNATUR–elements. If there are ducts or services between the skins or passing through the product, their affect on the stability, the safety in case of fire and the building physics characteristics shall be taken into consideration. The same principles apply to holes cut for another purpose.

Cutting of ribs and cutting of slots in the skins shall be avoided as much as possible and always requires special attention and assessment.

Use, maintenance and repair

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

Should repair prove necessary, an assessment shall be made in each case. Severe damage of a LIGNATUR–element requires immediate actions regarding the mechanical resistance and stability of the works.

2.3 Assumed working life

The provisions made in the European Technical Assessment (ETA) are based on an assumed intended working life for the LIGNATUR–elements of 50 years, when installed in the works, provided that the LIGNATUR–elements are 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.

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

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

No	Essential characteristic	Method of verification and assessment	Expression of product performance
Basic Requirement 1: Mechanical resistance and stability ¹			
1	Load bearing capacity	3.2	Annex 2
2	Serviceability		
3	Moisture content		
Basic Requirement 2: Safety in case of fire			
4	Reaction to fire	3.2	Annex 2
5	Resistance to fire		
Basic Requirement 3: Hygiene, health and environment			
6	Water vapour permeability and moisture resistance	3.2	Annex 2
7	Water tightness		
8	Content and/or release of dangerous substances		
Basic requirement 4: Safety and accessibility in use			
9	Slipperiness of floors	3.2	Annex 2
10	Impact resistance		
Basic requirement 5: Protection against noise			
11	Airborne sound insulation	3.2	Annex 2
12	Impact sound insulation		
13	Sound absorption		
Basic requirement 6: Energy economy and heat retention			
14	Thermal resistance	3.2	Annex 2
15	Air permeability		
16	Thermal inertia		
¹ This characteristic also relates to BWR 4.			

3.1 Essential characteristics of the product

3.1.1 LIGNATUR-elements

3.1.1.1 General

The load bearing LIGNATUR-elements correspond to the information and drawings given in Annex 1. The performance characteristics data of the product are given in Annex 2, Table 1.

The dimensions of the product are specific to the project. Maximum dimensions as given in Annex 1 shall be considered.

The material characteristics, dimensions, and tolerances of the product and its components not indicated in Annex 1 are given in the technical file³ of the European Technical Assessment.

3.1.1.2 Safety in case of fire

The classifications of the LIGNATUR-elements regarding reaction to fire and resistance to fire are given in Annex 2, Table 1.

3.1.1.3 Hygiene, health and environment

On dangerous substances the LIGNATUR-elements comply with Guideline for European Technical Approval ETAG 019 "Prefabricated wood-based loadbearing stressed skin panels", Edition November 2004, used as European Assessment Document. A manufacturer's declaration to this effect has been submitted. The performance of the product regarding release of dangerous substances is given in Annex 2, Table 1.

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.

3.1.1.4 Durability and serviceability

Durability and serviceability, including dimensional stability of the LIGNATUR-elements are given under the conditions of Clause 2.2.

The LIGNATUR-elements can be used in service classes 1 and 2 according to EN 1995-1-1

3.1.2 Components

3.1.2.1 Timber

Solid timber for skins and ribs shall be visually or machine strength graded. Only technically dried wood shall be used.

Solid wood shall be classified according to EN 338.

3.1.2.2 Adhesive

The adhesive for bonding the LIGNATUR-elements shall conform to EN 15425 or EN 301.

3.1.2.3 Thermal insulation products

Thermal insulation products are not subject to the European Technical Assessment. Thermal insulation products inserted into the box elements shall conform to a harmonised European standard or a European Technical Assessment and shall be CE marked.

3.1.2.4 Ballast weight

The ballast weight is not subject to the European Technical Assessment. Concrete blocks and aggregates inserted into the box elements shall conform to a harmonised European standard or a European Technical Assessment and shall be CE marked.

For ballast weight with aggregates from calcium carbonate at least mineralogy, grain category, density as well as content of fines shall be declared.

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.

3.2 Methods of verification

3.2.1 General

The assessment of fitness of the LIGNATUR-elements 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 *Guideline for European Technical Approval ETAG № 019 "Prefabricated wood-based loadbearing stressed skin panels" used as European Assessment Document*.

3.2.2 Identification

The European Technical Assessment for the LIGNATUR-elements is issued on the basis of agreed data, deposited with Österreichisches Institut für Bautechnik, which identifies the product that has been assessed and judged. 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.

By the accompanying documentation the LIGNATUR-elements shall be clearly identifiable at delivery.

Thermal insulation products inserted into the LIGNATUR-elements shall conform to a harmonised European standard or a European Technical Assessment. At least density, mass per unit area and reaction to fire classification of the respective materials shall be specified. These materials are not subject to the European Technical Assessment. Standards and regulations in force at the place of use should be observed.

Ballast weight of concrete blocks and aggregates inserted into the LIGNATUR-elements shall conform to a harmonised European standard or a European Technical Assessment. The grain size of ballast weight made of CCN chalk may vary in between 2 and 3 mm. At least density, mass per unit area and reaction to fire classification of the respective materials shall be specified. These materials are not subject to the European Technical Assessment. Standards and regulations in force at the place of use should be observed.

The specifications of the inserted materials together with their essential performances have to be provided by the manufacturer of the LIGNATUR-elements.

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 plan⁴;
- (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.

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 LIGNATUR–elements is in conformity with the European Technical Assessment.

The factory production control shall address at least:

- Specifications of all materials and components incorporated in the LIGNATUR–elements
- Positions of structural members
- Overall dimensions of LIGNATUR–elements
- Installation of thermal insulation products and ballast weight
- Tolerances of dimensions, squareness and flatness
- Markings for correct position and installation in the works, and special handling
- Packaging and protection during transport
- Ensure that specified moisture content levels are maintained during manufacture, storage at the factory, and during delivery and on site

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.

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

⁴ 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.

- 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 including certification are met, the manufacturer shall issue a declaration of performance.

5.2 Tasks for the notified product certification body

5.2.1 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

For assessment of the performance of the construction product, the results of the tests performed as part of the assessment for the European Technical Assessment may be used unless there are changes in the manufacturing process or manufacturing plant. In the case of changes, the necessary assessment of the performance of the construction product shall be agreed between Österreichisches Institut für Bautechnik and the notified product certification body involved.

5.2.2 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 the LIGNATUR–elements with the specifications given in the specific parts as well as in the Annexes of the European Technical Assessment.

5.2.3 Continuous surveillance, assessment and evaluation of factory production control

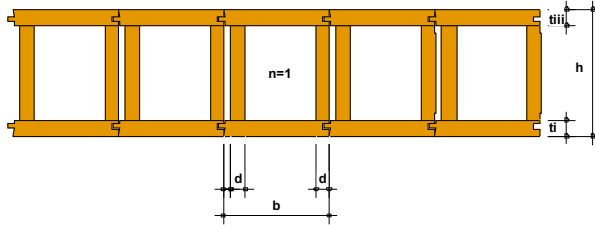
The notified product certification body shall visit the factory at least twice a year for routine inspection. It shall be verified that the system of factory production control and the specified manufacturing process are maintained, taking account of the prescribed test plan. On demand the results of 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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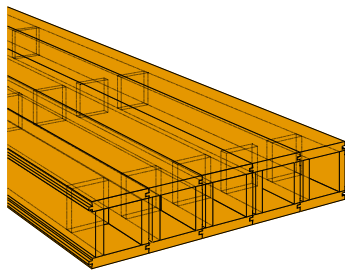
The original document is signed by:

Rainer Mikulits
Managing Director

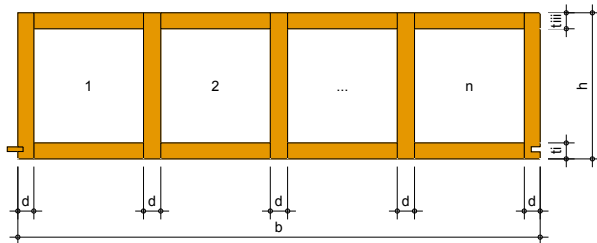
LIGNATUR – box element (LKE)



Height h	≤ 400 mm
Width b	≤ 250 mm
Thickness of ribs d	27 mm – 33 mm
Thickness skin t _i	25 mm – 82 mm
Thickness skin t _{iii}	25 mm – 82 mm
Number of boxes n	1
Length L	≤ 18 m
Spacing of stiffeners	≤ 1,2 m

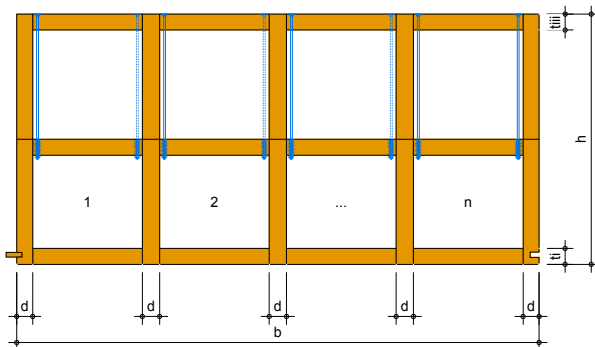


LIGNATUR – surface element (LFE)



Height h	≤ 320 mm
Width b	≤ 1 000 mm
Thickness of ribs d	27 mm – 80 mm
Thickness skin t _i	25 mm – 82 mm
Thickness skin t _{iii}	25 mm – 82 mm
Number of boxes n	≤ 4
Length L	≤ 18 m
Spacing of stiffeners	≤ 1,2 m

or



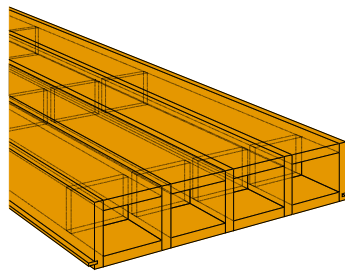
Height h	> 320 – 480 mm
Width b	≤ 1 000 mm
Thickness of ribs d	27 mm – 80 mm
Thickness skin t _i	25 mm – 82 mm
Thickness skin t _{iii}	25 mm – 82 mm
Number of boxes n	≤ 4
Length L	≤ 18 m
Spacing of stiffeners	≤ 1,2 m

LIGNATUR-elements

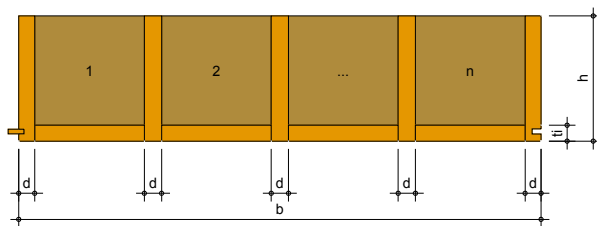
Annex 1

Product specification

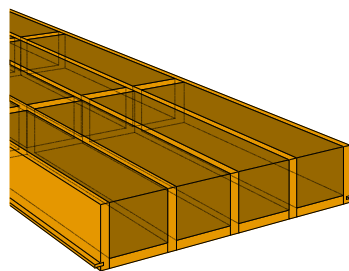
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LIGNATUR – shell element (LSE)



- Height h ≤ 250 mm
- Width b $\leq 1\,000$ mm
- Thickness of ribs d 27 mm – 40 mm
- Thickness skin t_i 25 mm – 40 mm
- Number of boxes n ≤ 4
- Length L ≤ 18 m
- Spacing of stiffeners $\leq 1,2$ m



LIGNATUR-elements

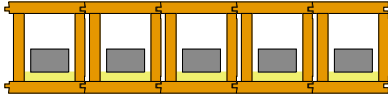
Annex 1

Product specification

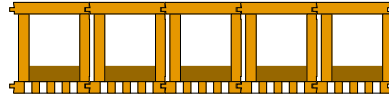
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Examples of assemblies of LIGNATUR – box elements (LKE)

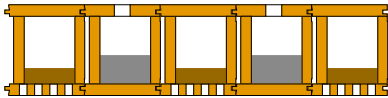
Airborne and impact sound insulation



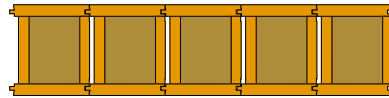
Sound absorption



Airborne and impact sound insulation and sound absorption

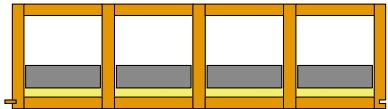


Thermal insulation

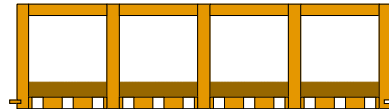


Examples of assemblies of LIGNATUR – surface elements (LFE)

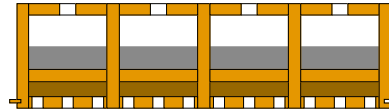
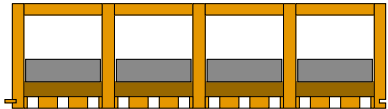
Airborne and impact sound insulation



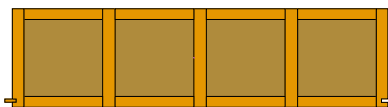
Sound absorption



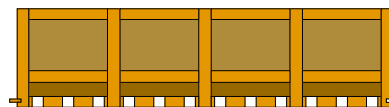
Airborne and impact sound insulation and sound absorption



Thermal insulation



Thermal insulation and sound absorption



Example of an assembly of LIGNATUR – shell elements (LSE)

Sound absorption



LIGNATUR-elements

Annex 1

Product specification

of European Technical Assessment
ETA-11/0137 of 20.06.2014

Tabelle 1: Product characteristics and evaluation according to ETAG 019

Basic requirements for construction works	Essential characteristic	Verification procedure	Level / Class / Description / NPD
1	Exemplary load bearing capacity (bending, shear)	EN 1995-1-1 ¹⁾ (Eurocode 5)	Example, see Figure 1
	Floor, exemplary serviceability for deflection $w = l / 600$		Example, see Figure 2
	Roof, exemplary serviceability for deflection $w = l / 300$		Example, see Figure 3
	Moisture content	EN 13183-1	10 %

¹⁾ The load bearing capacity is determined by calculation according to EN 1995-1-1, applying the characteristic values of softwood strength class C24 according to EN 338.

- g Permanent load (self-weight of LIGNATUR-element considered in calculation)
- q_N, q_A Imposed loads
- s Snow load
- $\gamma = 1$ Partial safety coefficient for serviceability

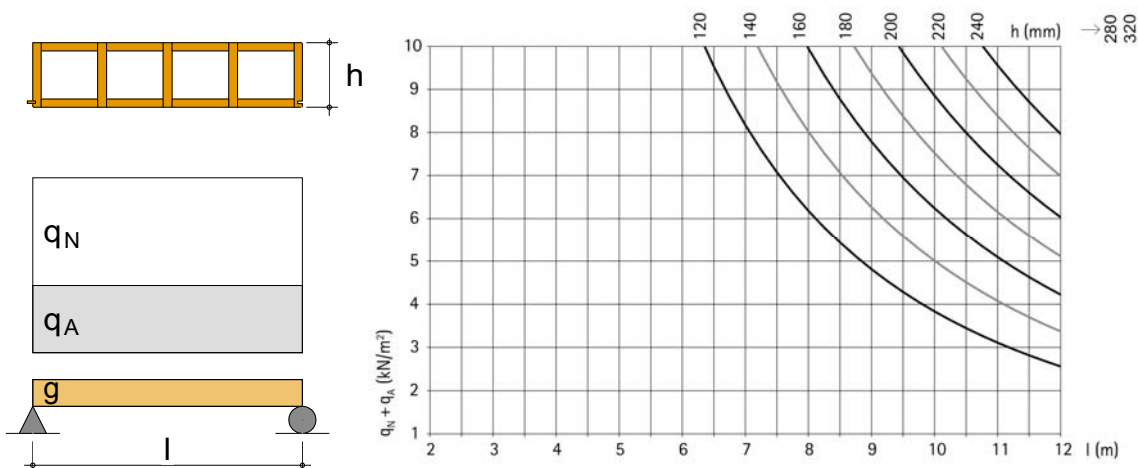


Figure 1: Exemplary load bearing capacity for bending and shear ($t_i = 31 \text{ mm}$, $t_{iii} = 31 \text{ mm}$, $d = 31 \text{ mm}$)

LIGNATUR-elements	Annex 2 of European Technical Assessment ETA-11/0137 of 20.06.2014
Performance characteristics	

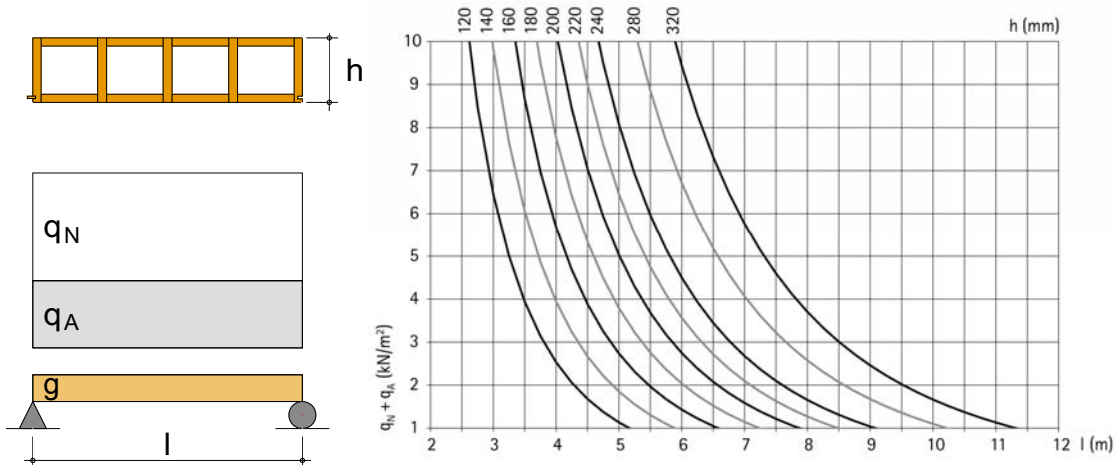


Figure 2: Floor, exemplary serviceability for deflection $w = l / 600$ ($t_i = 31$ mm, $t_{iii} = 31$ mm, $d = 31$ mm)

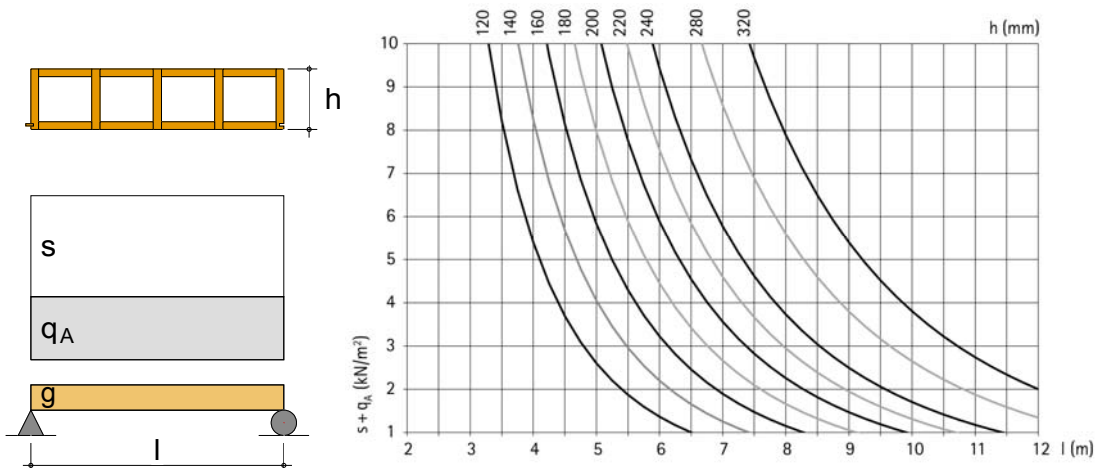


Figure 3: Roof, exemplary serviceability for deflection $w = l / 300$ ($t_i = 31$ mm, $t_{iii} = 31$ mm, $d = 31$ mm)

LIGNATUR-elements	Annex 2 of European Technical Assessment ETA-11/0137 of 20.06.2014
Performance characteristics	

Basic requirements for construction works	Essential characteristic	Verification procedure	Level / Class / Description / NPD
2	Reaction to fire of LIGNATUR-elements without perforation		
	Floors, roofs	EN 13501-1	D-s1, d0
	LIGNATUR-elements: box element, surface element, shell element Overall thickness of load bearing LIGNATUR elements.....≥ 120 mm Thickness of skins and ribs in planed spruce≥ 25 mm		
	Floorings	The product does not include floorings.	
	Reaction to fire of LIGNATUR-elements with perforation		
	Floors, roofs	EN 13501-1	D-s1, d0
	LIGNATUR-elements with perforation: Type 1, Type 2, Type 3, Type 3.1, Type 5, Type 5.1, Type 6, Type 6.1, Type 8 and Type 8.1, see Annex 5 Thickness of skins and ribs in planed spruce≥ 25 mm		
	Resistance to fire		
	<u>Charring rate for calculation of fire resistance</u>		
	Standard elements	EN 1995-1-2	β = 0,8 mm/min
	Perforated elements	EN 1995-1-2	see Annex 3
3	Water vapour permeability and moisture resistance		
	Softwood	EN ISO 10456	μ = 20 - 50
	Water tightness		
	External envelope	No performance determined The product does not include external finishes.	
	Internal surfaces	No performance determined	
	Release of dangerous substances		
	Formaldehyde	EN 717-1	E1
	Other dangerous substances	ETAG 019, Clause 5.3.3	No other dangerous substances
4	Slipperiness of floors		
	No performance determined The product does not include floorings.		
	Impact resistance	ETAG 019, Clause 5.4.2	Satisfactory

LIGNATUR-elements	Annex 2 of European Technical Assessment ETA-11/0137 of 20.06.2014
Performance characteristics	

Basic requirements for construction works	Essential characteristic	Verification procedure	Level / Class / Description / NPD
5	Airborne sound insulation		
	<u>Exemplary performance of load bearing LIGNATUR-elements for floors and roofs</u>		
	Examples of LIGNATUR-elements as given in Annex 4	EN ISO 10140-2, EN ISO 717-1	For weighted sound reduction index, R_w (C; C_{tr}), see Annex 4
	Impact sound insulation		
	<u>Exemplary performance of load bearing LIGNATUR-elements for floors</u>		
	Examples of LIGNATUR-elements as given in Annex 4	EN ISO 10140-3, EN ISO 717-2	For weighted normalised impact sound pressure level, $L_{n,w}$ (C), see Annex 4
	Sound absorption		
	<u>Exemplary performance of load bearing LIGNATUR-elements for floors and roofs</u>		
	Examples of LIGNATUR-elements as given in Annex 5	EN ISO 354 EN ISO 11654	For weighted sound absorption coefficient, α_w , and class of sound absorber see Annex 5
	6	Thermal resistance	
<u>Input parameters for calculation of thermal resistance</u> EN ISO 6946, EN ISO 10211			
<u>Thermal conductivity</u>			
Spruce wood		EN ISO 10456	$\lambda = 0,13 \text{ W/(m} \cdot \text{K)}$
Thermal insulation product		According to the specification of the product	
Air permeability		ETAG 019, Clause 5.6.2	Satisfactory
Thermal inertia			
<u>Characteristic density</u>			
Spruce wood		EN 338	350 kg/m^3
<u>Heat capacity</u>			
Spruce wood		EN ISO 10456	$1\,600 \text{ J/(kg} \cdot \text{K)}$
<u>Thermal conductivity see above</u>			

LIGNATUR-elements

Annex 2

Performance characteristics

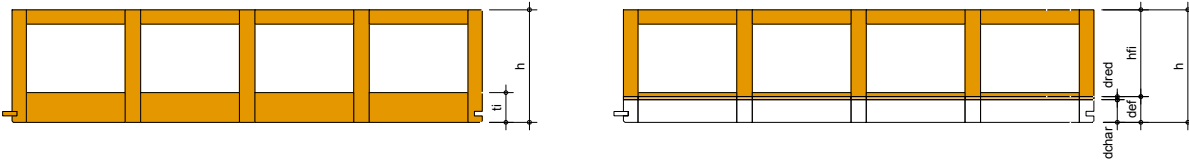
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Resistance to fire is calculated with the residual cross section according to EC 5.

Charring rate of standard LIGNATUR-elements

The charring rate for elements made of spruce wood is 0,8 mm/min. The effective charring depths for determination of the residual cross section are:



Standard element

$$d_{ef} = d_{char} + d_{red} = t \cdot \beta_1 + 7 \text{ mm}$$

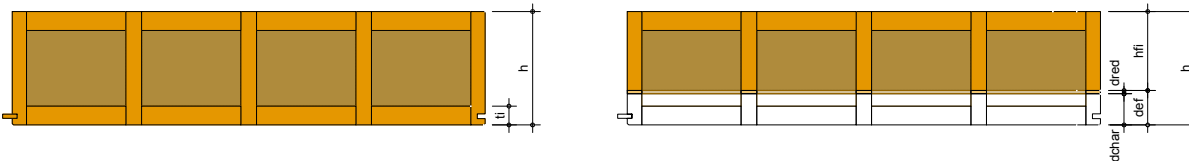
d_{ef} effective charring depth for determination of residual cross section

d_{char} depth of charred layer after required fire resistance time

t required fire resistance time

$\beta_1 = 0.8 \text{ mm/min}$ charring rate

$d_{red} = 7 \text{ mm}$... depth of layer for consideration of strength loss in areas adjacent to the charred layer



Standard elements with thermal insulation product of wood fibre

$$d_{ef} = d_{char} + d_{red} = t_1 \cdot \beta_1 + t_2 \cdot \beta_2 + 7 \text{ mm}$$

d_{ef} effective charring depth for determination of residual cross section

d_{char} depth of charred layer after required fire resistance time

$t = t_1 + t_2$ required fire resistance time

t_1 charring time in the area of the skin

t_2 charring time in the area of the thermal insulation product of wood fibre

$\beta_1 = 0.8 \text{ mm/min}$ charring rate

$\beta_2 = 0.9 \cdot \sqrt{\frac{450}{\rho_{iso}}}$ mm/min charring rate for thermal insulation product of wood fibre or

$\beta_2 = 1.6 \text{ mm/min}$ charring rate for thermal insulation product of mineral fibre (reaction to fire class A2-s1, d0 or better)

ρ_{iso} density of thermal insulation product of wood fibre

$d_{red} = 7 \text{ mm}$... depth of layer for consideration of strength loss in areas adjacent to the charred layer

Dimensions in mm
Time in minutes
Density in kg/m^3

LIGNATUR-elements

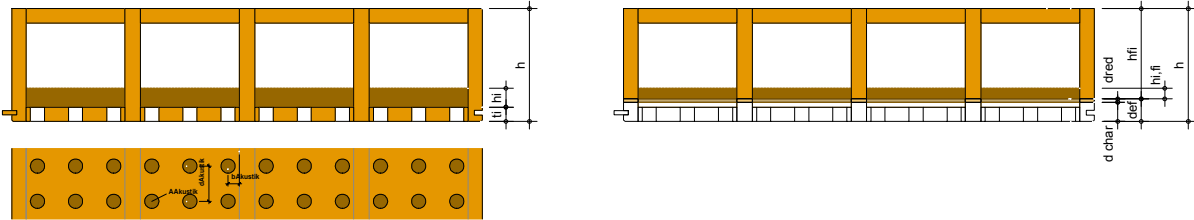
Annex 3

Resistance to fire – Charring rates

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Charring rate of LIGNATUR acoustics elements

To improve the acoustic performance, the lower skin can be perforated with holes or slots. Annex 5 shows the usual types of perforation. The charring rate of perforated skins can be determined by:



$$d_{ef} = d_{char} + d_{red} = t_1 \cdot \beta_1 + t_2 \cdot \beta_2 + 7 \text{ mm}$$

d_{ef} effective charring depth for determination of residual cross section

d_{char} depth of charred layer after required fire resistance time

$t = t_1 + t_2$ required fire resistance time

t_1 charring time in the area of the skin

t_2 charring time in the area of wood fibre

$\beta_1 = 0,22 \cdot k + 0,72$ mm/min charring rate

$$k = \frac{A_{Akustik}}{b_{Akustik}^{1,5} \cdot t_i} \cdot 10^3$$

For $A_{Akustik}$, $b_{Akustik}$, $d_{Akustik}$ and t_i see Annex 5.

$$\beta_2 = 0,9 \cdot \sqrt{\frac{450}{\rho_{iso}}} \text{ mm/min charring rate for thermal insulation product of wood fibre}$$

ρ_{iso} density of thermal insulation product of wood fibre

$d_{red} = 7$ mm ... depth of layer for consideration of strength loss in areas adjacent to the charred layer

Dimensions in mm
Time in minutes
Density in kg/m³

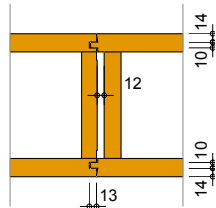
LIGNATUR-elements	Annex 3 of European Technical Assessment ETA-11/0137 of 20.06.2014
Resistance to fire – Charring rates	

Joins between the LIGNATUR-elements

LIGNATUR floors and roofs of fire resistance classes REI30, REI60 and REI90 shall be provided with appropriate joints between the LIGNATUR-elements.

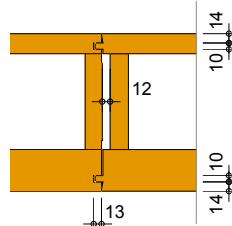
LIGNATUR box element

REI 30



Joint width 12 mm
 Joint with groove and tongue

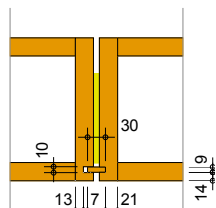
REI 60



Joint width 12 mm
 Joint with groove and tongue

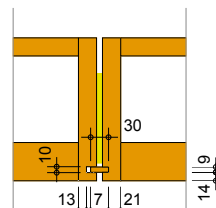
LIGNATUR surface element

REI 30



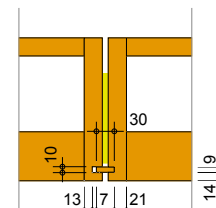
Joint width 10 mm
 Joint with groove and separate tongue
 Joint insulation¹⁾

REI 60



Joint width 10 mm
 Joint with groove and separate tongue
 Joint insulation¹⁾

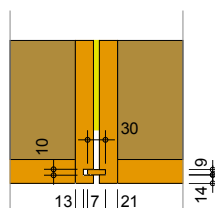
REI 90



Joint width 10 mm
 Joint with groove and separate tongue
 Joint insulation¹⁾

LIGNATUR shell element

REI 30



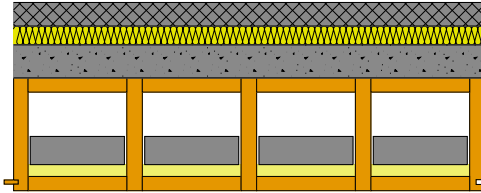
Joint width 10 mm
 Joint with groove and separate tongue
 Joint insulation¹⁾

Dimensions in mm

¹⁾ Joint insulation with reaction to fire class at least A2-s1, d0

LIGNATUR-elements	Annex 3 of European Technical Assessment ETA-11/0137 of 20.06.2014
Resistance to fire - Joints	

Examples with improved airborne and impact sound performance

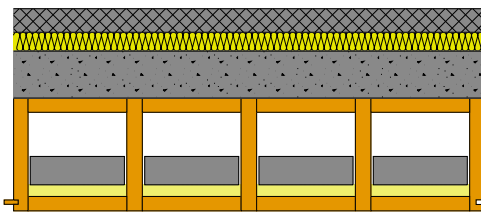


50 mm Cement screed $m' = 120 \text{ kg/m}^2$
40 mm Impact sound insulation board
 $\rho = 59,4 \text{ kg/m}^3$, $s' = 6 \text{ MN/m}^3$
70 mm Ballast weight $m' = 105 \text{ kg/m}^2$
240 mm LIGNATUR surface element silence12
 $m' = 71 \text{ kg/m}^2$ including ballast
weight: concrete blocks¹⁾

Mass per unit area of assembly: $m' \cong 301 \text{ kg/m}^2$

$R_w(\text{C}; \text{C}_{tr}) = 72 \text{ (-1; -5) dB}$

$L_{n,w}(\text{C}_I) = 45 \text{ (-2) dB}$

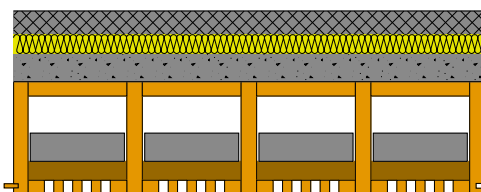


50 mm Cement screed $m' = 120 \text{ kg/m}^2$
40 mm Impact sound insulation board
 $\rho = 59,4 \text{ kg/m}^3$, $s' = 6 \text{ MN/m}^3$
100 mm Ballast weight $m' = 150 \text{ kg/m}^2$
240 mm LIGNATUR surface element silence12
 $m' = 71 \text{ kg/m}^2$ including ballast
weight: concrete blocks¹⁾

Mass per unit area of assembly: $m' \cong 345 \text{ kg/m}^2$

$R_w(\text{C}; \text{C}_{tr}) = 72 \text{ (-1; -5) dB}$

$L_{n,w}(\text{C}_I) = 44 \text{ (-2) dB}$



50 mm Cement screed $m' = 120 \text{ kg/m}^2$
40 mm Impact sound insulation board
 $\rho = 59,4 \text{ kg/m}^3$, $s' = 6 \text{ MN/m}^3$
60 mm Ballast weight $m' = 90 \text{ kg/m}^2$
240 mm LIGNATUR surface element silence12
with acoustics perforation
 $m' = 74 \text{ kg/m}^2$ including ballast
weight: concrete blocks¹⁾

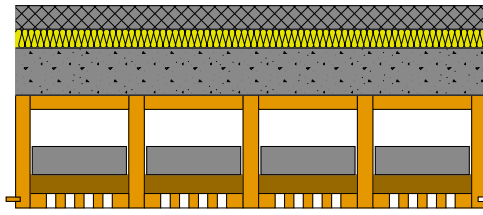
Mass per unit area of assembly: $m' \cong 288 \text{ kg/m}^2$

$R_w(\text{C}; \text{C}_{tr}) = 71 \text{ (-1; -6) dB}$

$L_{n,w}(\text{C}_I) = 43 \text{ (0) dB}$

¹⁾ Concrete blocks, density $\rho = 2\,250 \text{ kg/m}^3$

LIGNATUR-elements	Annex 4 of European Technical Assessment ETA-11/0137 of 20.06.2014
Airborne and impact sound insulation	



50 mm	Cement screed $m' = 120 \text{ kg/m}^2$
40 mm	Impact sound insulation board $\rho = 59,4 \text{ kg/m}^3$, $s' = 6 \text{ MN/m}^3$
100 mm	Ballast weight $m' = 150 \text{ kg/m}^2$
240 mm	LIGNATUR surface element silence12 with acoustics perforation $m' = 74 \text{ kg/m}^2$ including ballast weight: concrete blocks ¹⁾

Mass per unit area of assembly : $m' \cong 348 \text{ kg/m}^2$

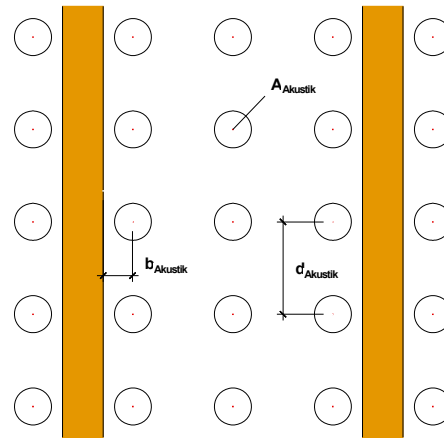
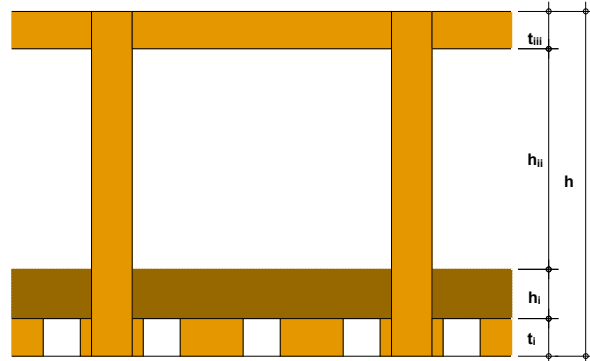
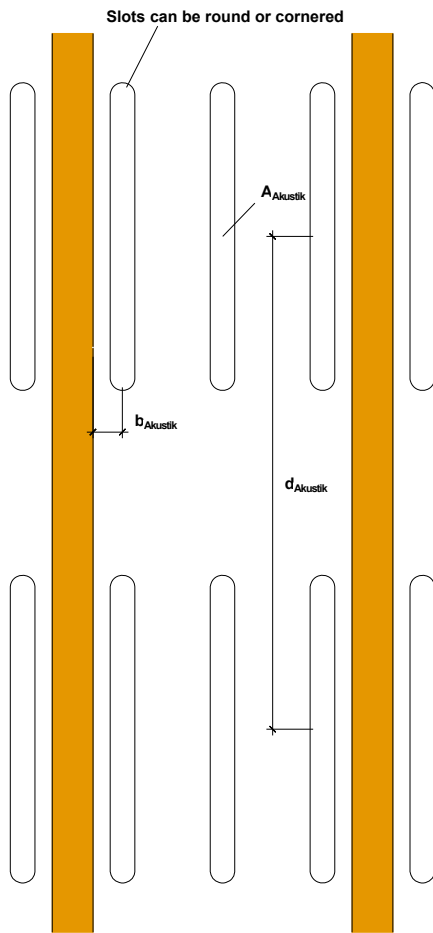
$R_w(\text{C}; \text{C}_{tr}) = 71 \text{ (-2; -5) dB}$

$L_{n,w}(\text{C}_l) = 41 \text{ (0) dB}$

1) Concrete blocks, density $\rho = 2\,250 \text{ kg/m}^3$

LIGNATUR-elements	Annex 4
Airborne and impact sound insulation	of European Technical Assessment ETA-11/0137 of 20.06.2014

Perforated skins for acoustic elements



Example type 1

Example type 3

Type 1:	$A_{Akustik} = 5000 \text{ mm}^2$	$d_{Akustik} = 400 \text{ mm}$	$b_{Akustik} = 24 \text{ mm}$
Type 2:	$A_{Akustik} = 707 \text{ mm}^2$	$d_{Akustik} = 75 \text{ mm}$	$b_{Akustik} = 24 \text{ mm}$
Type 3:	$A_{Akustik} = 314 \text{ mm}^2$	$d_{Akustik} = 40 \text{ mm}$	$b_{Akustik} = 5 \text{ mm}$
Type 3.1:	$A_{Akustik} = 314 \text{ mm}^2$	$d_{Akustik} = 40 \text{ mm}$	$b_{Akustik} = 45 \text{ mm}$
Type 5:	$A_{Akustik} = 177 \text{ mm}^2$	$d_{Akustik} = 40 \text{ mm}$	$b_{Akustik} = 5 \text{ mm}$
Type 5.1:	$A_{Akustik} = 177 \text{ mm}^2$	$d_{Akustik} = 40 \text{ mm}$	$b_{Akustik} = 45 \text{ mm}$
Type 6:	$A_{Akustik} = 64 \text{ mm}^2$	$d_{Akustik} = 20 \text{ mm}$	$b_{Akustik} = 15 \text{ mm}$
Type 6.1:	$A_{Akustik} = 64 \text{ mm}^2$	$d_{Akustik} = 20 \text{ mm}$	$b_{Akustik} = 35 \text{ mm}$
Type 8:	$A_{Akustik} = 3040 \text{ mm}^2$	$d_{Akustik} = 600 \text{ mm}$	$b_{Akustik} = 9 \text{ mm}$
Type 8.1:	$A_{Akustik} = 3040 \text{ mm}^2$	$d_{Akustik} = 600 \text{ mm}$	$b_{Akustik} = 33 \text{ mm}$
Diverse:	$A_{Slot} \leq 5000 \text{ mm}^2$	$d_{Slot} \leq 600 \text{ mm}$	$b_{Slot} \geq 1 \text{ mm}$
	$A_{Hole} \leq 707 \text{ mm}^2$	$d_{Hole} \leq 75 \text{ mm}$	$b_{Hole} \geq 1 \text{ mm}$

LIGNATUR-elements

Annex 5

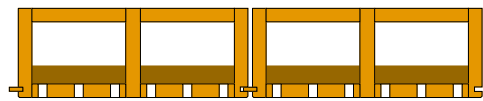
Sound absorption – Perforated skins

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 ETA-11/0137 of 20.06.2014

Examples with improved sound absorption

Absorber material: thermal insulation product of wood fibre, density $\rho < 110 \text{ kg/m}^3$

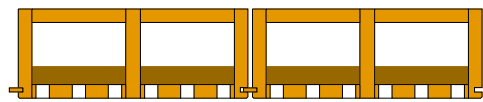
Dimensions: $h = 200 \text{ mm}$, $t_i = 31 \text{ mm}$, $h_i = 40 \text{ mm}$



$\alpha_w = 0,55$

Acoustics type 1 Class of absorber: D

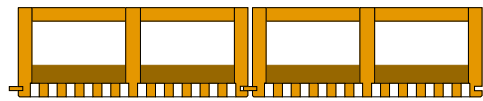
Slot dimension: 20 / 250 mm
 Grid: 81 / 400 mm



$\alpha_w = 0,50$

Acoustics type 2 Class of absorber: D

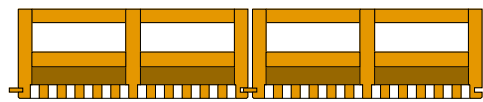
Hole diameter: 30 mm
 Grid: 81/75 mm



$\alpha_w = 0,90$

Acoustics type 3 Class of absorber: A

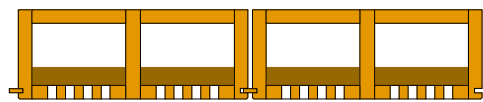
Hole diameter: 20 mm
 Grid: 40 / 40 mm



$\alpha_w = 0,85$

Acoustics type 3 ZL Class of absorber: B

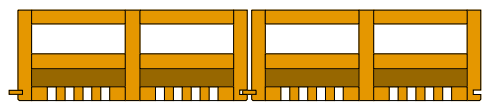
Hole diameter: 20 mm
 Grid: 40 / 40 mm



$\alpha_w = 0,75$

Acoustics type 3.1 Class of absorber: C

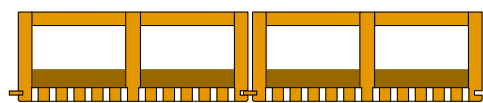
Hole diameter: 20 mm
 Grid: 40 / 40 mm



$\alpha_w = 0,60$

Acoustics type 3.1 ZL Class of absorber: C

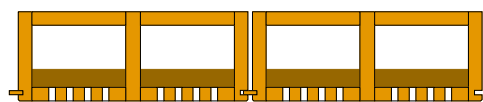
Hole diameter: 20 mm
 Grid: 40 / 40 mm



$\alpha_w = 0,65 \text{ (L)}$

Acoustics type 5 Class of absorber: C

Hole diameter: 15 mm
 Grid: 40 / 40 mm

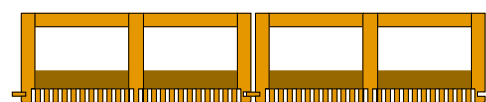


$\alpha_w = 0,50 \text{ (L)}$

Acoustics type 5.1 Class of absorber: D

Hole diameter: 15 mm
 Grid: 40 / 40 mm

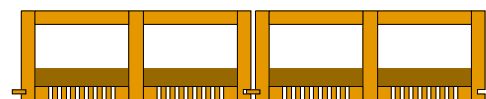
LIGNATUR-elements	Annex 5
Sound absorption	of European Technical Assessment ETA-11/0137 of 20.06.2014



$\alpha_w = 0,80$

Acoustics type 6 Class of absorber: B

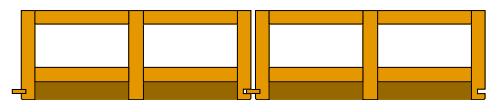
Hole diameter: 9 mm
 Grid: 20 / 20 mm



$\alpha_w = 0,60$

Acoustics type 6.1 Class of absorber: C

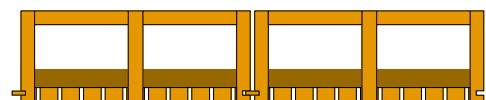
Hole diameter: 9 mm
 Grid: 20 / 20 mm



$\alpha_w = 0,80$ (H)

Acoustics type 7 Class of absorber: B

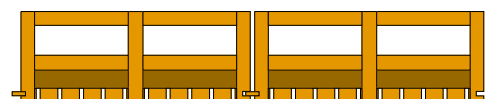
Visible wood fibre



$\alpha_w = 0,50$

Acoustics type 8 Class of absorber: D

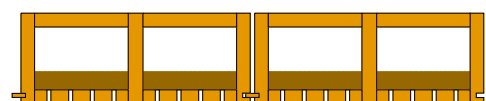
Slot dimension: 9 / 380 mm
 Grid: 48 / 600 mm



$\alpha_w = 0,50$

Acoustics type 8 ZL Class of absorber: D

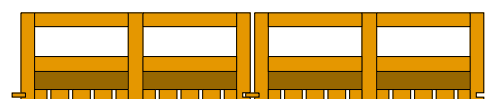
Slot dimension: 9 / 380 mm
 Grid: 48 / 600 mm



$\alpha_w = 0,45$

Acoustics type 8.1 Class of absorber: D

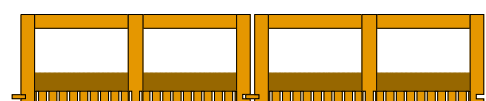
Slot dimension: 9 / 380 mm
 Grid: 48 / 600 mm



$\alpha_w = 0,40$

Acoustics type 8.1 ZL Class of absorber: D

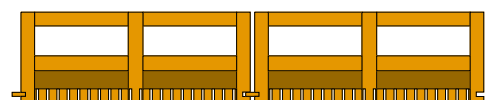
Slot dimension: 9 / 380 mm
 Grid: 48 / 600 mm



$\alpha_w = 0,50$

Acoustics type 9 Class of absorber: D

Slot dimension: 5,5 / 380 mm
 Grid: 24 / 600 mm



$\alpha_w = 0,55$

Acoustics type 9 ZL Class of absorber: D

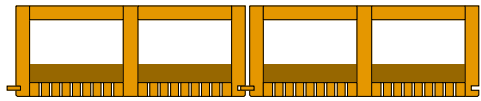
Slot dimension: 5,5 / 380 mm
 Grid: 24 / 600 mm

LIGNATUR-elements

Annex 5

Sound absorption

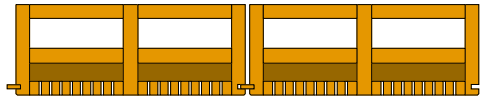
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$\alpha_w = 0,50$

Acoustics type 9.1 Class of absorber: D

Slot dimension: 5,5 / 380 mm
Grid: 24 / 600 mm



$\alpha_w = 0,50$

Acoustics type 9.1 ZL Class of absorber: D

Slot dimension: 5,5 / 380 mm
Grid: 24 / 600 mm

LIGNATUR-elements	Annex 5 of European Technical Assessment ETA-11/0137 of 20.06.2014
Sound absorption	

Reference documents

Guideline for European Technical Approval ETAG 019 “Prefabricated wood-based loadbearing stressed skin panels”, Edition November 2004, used as European Assessment Document

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 717-1 (10.2004), Wood-based panels - Determination of formaldehyde release - Part 1: Formaldehyde emission by the chamber method

EN 1995-1-1 (11.2004), EN 1995-1-1/AC (06.2006), EN 1995-1-1/A1 (06.2008), Eurocode 5 - Design of timber structures - Part 1-1: General - Common rules and rules for buildings

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

EN 13183-1 (04.2002), Moisture content of a piece of sawn timber - Part 1: Determination by oven dry method

EN 13501-1+A1 (09.2009), Fire classification of construction products and building elements - Part 1: Classification using data from reaction to fire tests

EN 15425 (02.2008), Adhesives – One component polyurethane for load bearing timber structures - Classification and performance requirements

EN ISO 10140-2 (09.2010), Acoustics — Laboratory measurement of sound insulation of building elements — Part 2: Measurement of airborne sound insulation

EN ISO 10140-3 (09.2010), Acoustics — Laboratory measurement of sound insulation of building elements — Part 3: Measurement of impact sound insulation

EN ISO 354 (05.2003), Acoustics - Measurement of sound absorption in a reverberation room

EN ISO 717-1 (03.2013), Acoustics - Rating of sound insulation in buildings and of building elements - Part 1: Airborne sound insulation

EN ISO 717-2 (03.2013), Acoustics - Rating of sound insulation in buildings and of building elements - Part 2: Impact sound insulation

LIGNATUR-elements	Annex 6 of European Technical Assessment ETA-11/0137 of 20.06.2014
Reference documents	

EN ISO 6946 (12.2007), Building components and building elements - Thermal resistance and thermal transmittance - Calculation method

EN ISO 10211 (12.2007), Thermal bridges in building construction - Heat flows and surface temperatures - Detailed calculations

EN ISO 10456 (12.2007), EN ISO 10456/AC (12.2009), Building materials and products - Hygrothermal properties - Tabulated design values and procedures for determining declared and design thermal values

EN ISO 11654 (04.1997), Acoustics - Sound absorbers for use in buildings - Rating of sound absorption

LIGNATUR-elements	Annex 6
Reference documents	of European Technical Assessment ETA-11/0137 of 20.06.2014