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Designated according to Article 29 of Regulation (EU) No 305/2011

Member of EOTA
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European Technical Assessment

ETA-11/0137 of 31.05.2021

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	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	34 pages including 6 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) 140022-00-0304 “Prefabricated wood-based loadbearing stressed skin panels”.
This European Technical Assessment replaces	European Technical Assessment ETA-11/0137 of 04.11.2019.

Remarks

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

Communication of this European Technical Assessment, including transmission by electronic means, shall be in full. However, partial reproduction may be made with the written consent of Austrian Institute of Construction Engineering. Any partial reproduction has to be identified as such.

Specific parts

1 Technical description of the product

1.1 General

This European Technical Assessment[1] (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 EAD 140022-00-0304[2], Clause 1.1:

- 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.

LIGNATUR-elements and the boards for its manufacturing correspond to the specifications given in the Annexes 1 and 2. The material characteristics, dimensions and tolerances of LIGNATUR-elements, not indicated in these Annexes, are given in the technical file[3] of the European Technical Assessment.

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 Components

1.2.1 Timber

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.

Solid wood shall be classified according to EN 338.

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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, amended and converted in 2014 to the European Technical Assessment ETA-11/0137 of 20.06.2014, 2019 amended to ETA-11/0137 of 04.11.2019 and 2021 amended to ETA-11/0137 of 31.05.2021.

2 Reference documents are listed in Annex 6.

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.

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.

1.2.2 Adhesive

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.

The adhesive for bonding the LIGNATUR-elements and finger joints conforms to EN 15425 or EN 301.

1.2.3 Thermal insulation products

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

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

1.2.4 Ballast weight

Ballast weight inserted into the box elements 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 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 given.

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 predominantly 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 design 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.

The following conditions shall be observed:

- Design of the LIGNATUR-elements is carried out 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 may be according to EN 1995-1-1 and EN 1995-1-2, taking into account of Annexes 2 to 5 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 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.

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 effect 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.

2.3 Assumed working life

The provisions made in the European Technical Assessment (ETA) are based on an assumed intended working life of the LIGNATUR-elements of 50 years, when installed in the works, provided that the cross laminated timber 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[4].

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 can also be shorter than the assumed working life.

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 of the product and assessment methods

№	Essential characteristic	Product performance
Basic requirement for construction works 1: Mechanical resistance and stability [1)]		
1	Bending strength and/or bending moment resistance perpendicular to the skin (flatwise bending of the product)	Annex 2
2	Compression strength and/or resistance parallel to the skin (parallel and perpendicular to the grain as applicable)	Annex 2
3	Compression strength and/or resistance perpendicular to the skin (support reaction)	Annex 2
4	Shear strength and/or resistance perpendicular to the skin (flatwise bending of the product)	Annex 2
5	Racking resistance	Not relevant for use in floors and roofs. No performance assessed.
6	Resistance to concentrated loads	Annex 2
7	Density	Annex 2
8	Creep and duration of the load	Annex 2
9	Dimensional stability	Annex 2
Basic requirement for construction works 2: Safety in case of fire		
10	Reaction to fire	Annex 2
11	Resistance to fire	Annex 2
Basic requirement for construction works 3: Hygiene, health and the environment		
12	Content, emission and/or release of dangerous substances	3.1.1 and Annex 2
13	Water vapour permeability and moisture resistance	Annex 2
Basic requirement for construction works 4: Safety and accessibility in use		
14	Impact/shock resistance	Annex 2
Basic requirement for construction works 5: Protection against noise		
15	Airborne sound insulation	Annex 2
16	Impact sound insulation	Annex 2
17	Sound absorption	Annex 2
Basic requirement for construction works 6: Energy economy and heat retention		
18	Thermal conductivity	Annex 2
19	Air permeability	Annex 2
20	Thermal inertia	Annex 2
Aspects of durability		
21	Natural durability	Annex 2
[1)] These characteristics also relate to basic requirement for construction works 4.		

3.1.1 Hygiene, health and the environment

The release of dangerous substances is determined according to European Assessment Document EAD 140022-00-0304 “Prefabricated wood-based loadbearing stressed skin panels”. No dangerous substances is the performance of LIGNATUR-elements 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 LIGNATUR-elements 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 European Assessment Document EAD 140022-00-0304 “Prefabricated wood-based loadbearing stressed skin panels”.

3.2.2 Identification

The European Technical Assessment for the LIGNATUR-elements 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 2000/447/EC the system of assessment and verification of constancy of performance to be applied to the LIGNATUR-elements 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[5];

(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;

[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.

(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 LIGNATUR-elements 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 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.

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 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 verify the ability of the manufacturer for a continuous and orderly manufacturing of the LIGNATUR-elements according to the European Technical Assessment. In particular the following items shall be appropriately considered

- Personnel and equipment
- The suitability of the factory production control established by the manufacturer
- Full implementation of the control plan

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 routine inspection. In particular the following items shall be appropriately considered

- The manufacturing process including personnel and equipment
- The factory production control
- The implementation of the control plan

The results of continuous surveillance are made available on demand by the notified product certification body to Österreichisches Institut für Bautechnik. When the provisions of the European Technical Assessment and the control plan are no longer fulfilled, the certificate of constancy of performance is withdrawn by the notified product certification body.

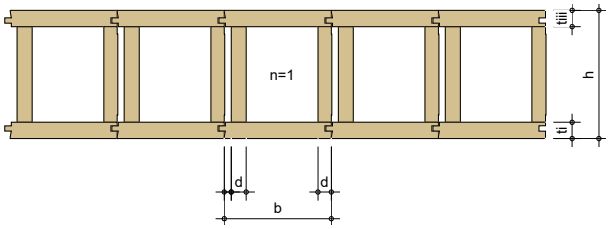
Issued in Vienna on 31.05.2021
by Österreichisches Institut für Bautechnik

The original document is signed by:

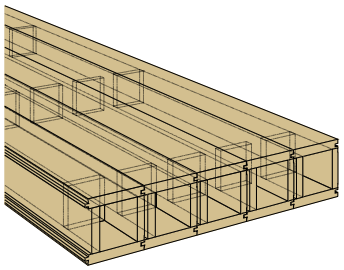
Rainer Mikulits

Managing Director

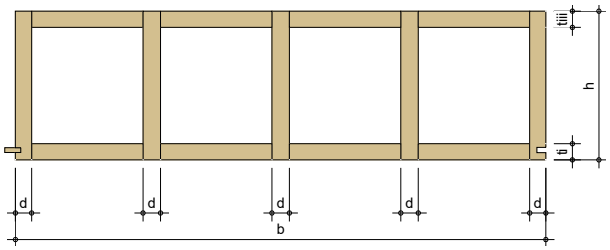
LIGNATUR – box element (LKE)



Height h	≤ 400 mm
Width b	≤ 250 mm
Thickness of ribs d	27 mm – 33 mm
Thickness skin ti	25 mm – 82 mm
Thickness skin tiii	25 mm – 82 mm
Number of boxes n	1
Length L	≤ 18 m
Spacing of stiffeners	≤ 1.2 m

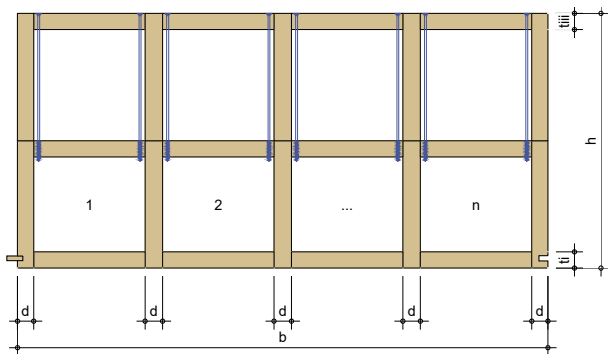


LIGNATUR – surface element (LFE)



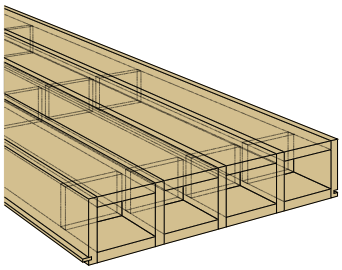
Height h	≤ 360 mm
Width b	≤ 1 000 mm
Thickness of ribs d	27 mm – 80 mm
Thickness skin ti	25 mm – 82 mm
Thickness skin tiii	25 mm – 82 mm
Number of boxes n	≤ 4
Length L	≤ 18 m
Spacing of stiffeners	≤ 1.2 m

or

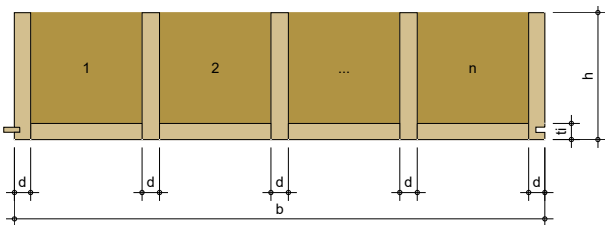


Height h	> 360 – 600 mm
Width b	≤ 1 000 mm
Thickness of ribs d	27 mm – 80 mm
Thickness skin ti	25 mm – 82 mm
Thickness skin tiii	25 mm – 82 mm
Number of boxes n	≤ 4
Length L	≤ 18 m
Spacing of stiffeners	≤ 1.2 m

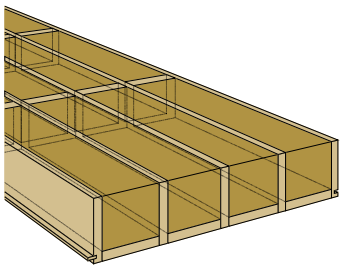
LIGNATUR-elements	Annex 1
Product specification	of European Technical Assessment ETA-11/0137 of 31.05.2021



LIGNATUR – shell element (LSE)



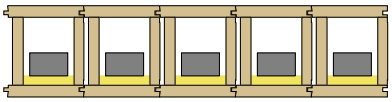
Height h	≤ 250 mm
Width b	≤ 1 000 mm
Thickness of ribs d	27 mm – 40 mm
Thickness skin ti	25 mm – 40 mm
Number of boxes n	≤ 4
Length L	≤ 18 m
Spacing of stiffeners	≤ 1.2 m



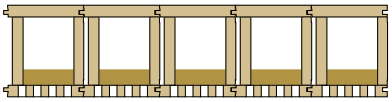
LIGNATUR-elements	Annex 1
Product specification	of European Technical Assessment ETA-11/0137 of 31.05.2021

Examples of assemblies of LIGNATUR – box elements (LKE)

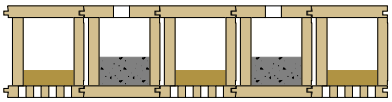
Airborne and impact sound insulation



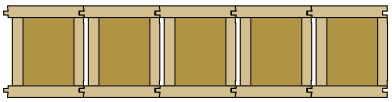
Sound absorption



Airborne and impact sound insulation and sound absorption

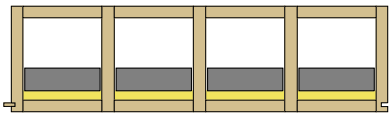


Thermal insulation

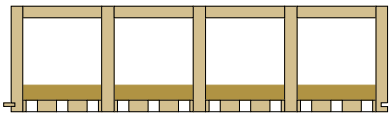


Examples of assemblies of LIGNATUR – surface elements (LFE)

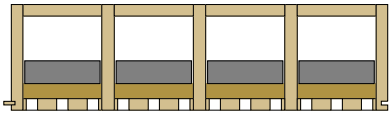
Airborne and impact sound insulation

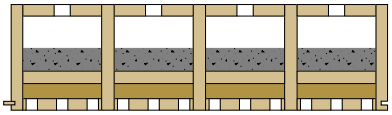


Sound absorption

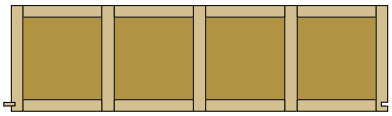


Airborne and impact sound insulation and sound absorption

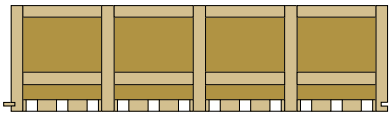




Thermal insulation

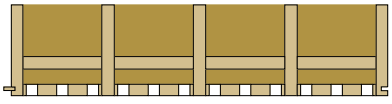


Thermal insulation and sound absorption



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 31.05.2021

Table 2: Product characteristics of LIGNATUR-elements

BWR	Essential characteristic	Assessment method	Level / Class / Description
1	**Mechanical resistance and stability**		
	Load bearing capacity and serviceability	EN 1995-1-1 (Eurocode 5) [1)]	
	– Exemplary load bearing capacity perpendicular to the skin (bending, shear)		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

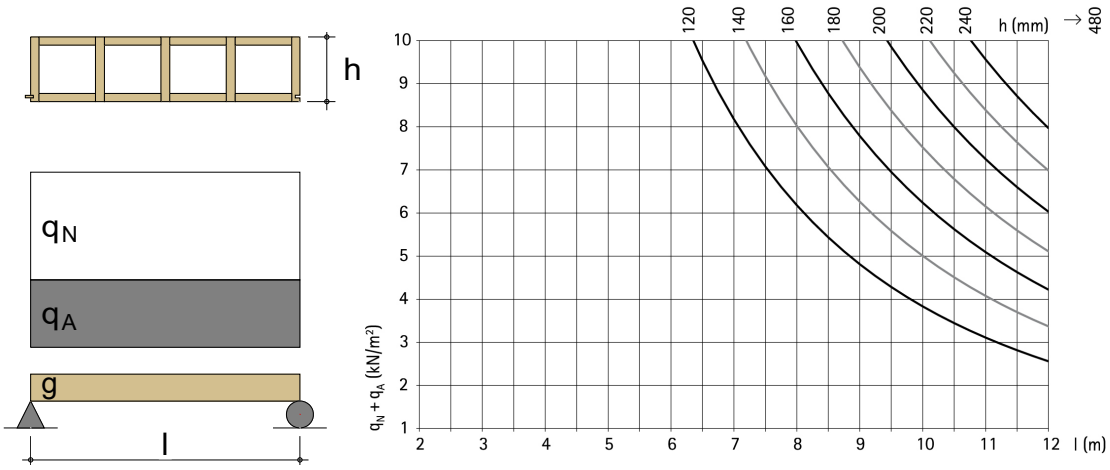


Figure 1: Exemplary load bearing capacity for bending and shear (t_i = 31 mm, t_{iii} = 31 mm, d = 31 mm)

LIGNATUR-elements	Annex 2
Characteristic data of LIGNATUR-elements	of European Technical Assessment ETA-11/0137 of 31.05.2021

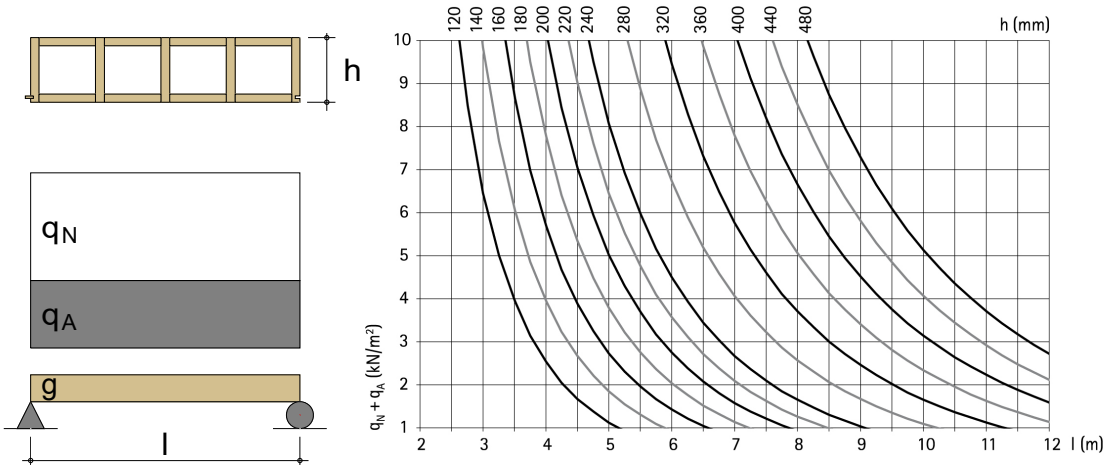


Figure 2: Floor, exemplary serviceability for deflection w = l / 600 (t_i = 31 mm, t_{iii} = 31 mm, d = 31 mm)

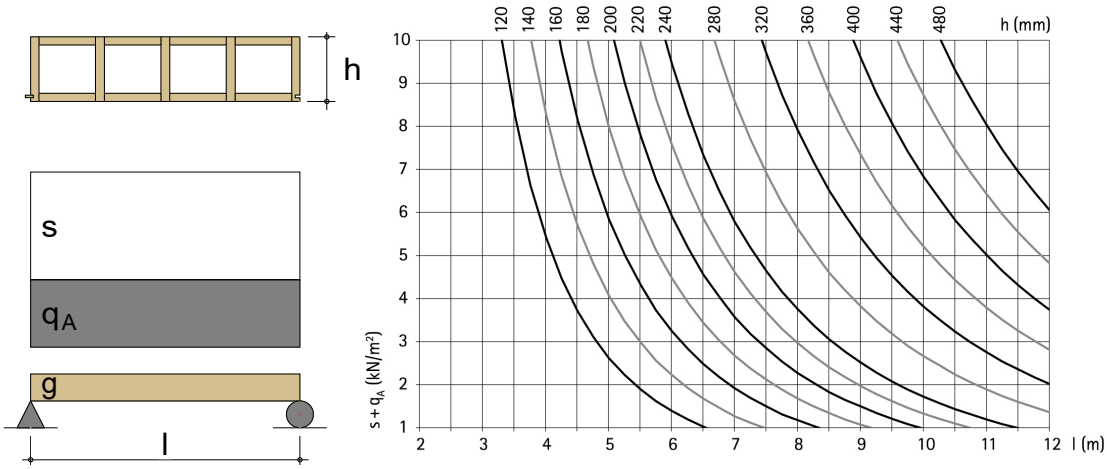


Figure 3: Roof, exemplary serviceability for deflection w = l / 300 (t_i = 31 mm, t_{iii} = 31 mm, d = 31 mm)

LIGNATUR-elements	Annex 2
Characteristic data of LIGNATUR-elements	of European Technical Assessment ETA-11/0137 of 31.05.2021

BWR	Essential characteristic	Assessment method	Level / Class / Description
1	**Mechanical resistance and stability**		
	Compression strength parallel to the skin (parallel and perpendicular to the grain)	Acc. to strength class C24 according to EN 338	
	Compression strength perpendicular to the skin (support reaction)	Calculation according to EN 1995-1-1 considering strength class C24 according to EN 338.	
	Resistance to concentrated loads		
	Density	Acc. to strength class C24 according to EN 338	
	Creep and duration of the load	k_{mod} and k_{def} for solid wood acc. to EN 1995-1-1	
	Dimensional stability Moisture content during service shall not change to such an extend that adverse deformation will occur. Dimensional changes in thickness and width of softwood according to EN 336: - increase of 0.25 % per 1 % moisture increase - decrease of 0.25 % per 1 % moisture decrease		
2	**Safety in case of fire**		
	<u>Reaction to fire of LIGNATUR-elements without perforation</u>		
	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.	
	<u>Reaction to fire of LIGNATUR-elements with perforation</u>		
	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, Type 8.1, Type 9 and Type 9.1, see Annex 5 Thickness of skins and ribs in planed spruce……..≥ 25 mm		
	<u>Resistance to fire</u> Charring rate for calculation of fire resistance		
	Standard elements	EN 1995-1-2	β_n = 0.8 mm/min
	Perforated elements	EN 1995-1-2	see Annex 3

LIGNATUR-elements	Annex 2
Characteristic data of LIGNATUR-elements	of European Technical Assessment ETA-11/0137 of 31.05.2021

BWR	Essential characteristic	Assessment method	Level / Class / Description
3	**Hygiene, health and environment**		
	Water vapour permeability μ of softwood	EN ISO 10456	50 (dry) to 20 (wet)
	Content, emission and/or release of dangerous substances – Formaldehyde	EN 717-1	E1
4	**Safety and accessibility in use**		
	Impact/shock resistance	EAD 140022-00-0304, Clause 2.2.15	Satisfactory
5	**Protection against noise**		
	<u>Airborne sound insulation</u> Exemplary performance of load bearing LIGNATUR-elements for floors and roofs		
	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
	<u>Impact sound insulation</u> Exemplary performance of load bearing LIGNATUR-elements for floors		
	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_I), see Annex 4
	<u>Sound absorption</u> Exemplary performance of load bearing LIGNATUR-elements for floors and roofs		
	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

LIGNATUR-elements	Annex 2
Characteristic data of LIGNATUR-elements	of European Technical Assessment ETA-11/0137 of 31.05.2021

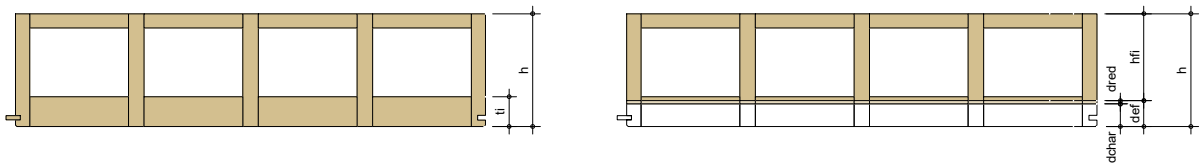
BWR	Essential characteristic	Assessment method	Level / Class / Description
6	**Energy economy and heat retention**		
	Air permeability	EAD 140022-00-0304, Clause 2.2.20	Satisfactory
	Thermal conductivity Input parameters for calculation of thermal resistance acc. to EN ISO 6946 and EN ISO 10211		
	– Thermal conductivity λ of spruce wood	EN 10456	0.12 W/(m·K)
	– Thermal conductivity of thermal insulation product	According to the specification of the product	
	Thermal inertia		
	– Char. density of spruce wood	EN 338	350 kg/m³
	– Heat capacity c_p of spruce wood	EN ISO 10456	1 600 J/(kg·K)
	– Thermal conductivity	See above	
-	**Aspects of durability**		
	Natural durability of European spruce – Wood destroying fungi – Insects – Termites	EN 350	 Class 4 SH S
	Service classes	EN 1995-1-1	1 and 2

LIGNATUR-elements	Annex 2
Characteristic data of LIGNATUR-elements	of European Technical Assessment ETA-11/0137 of 31.05.2021

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

Charring rate of LIGNATUR-elements without perforation

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

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

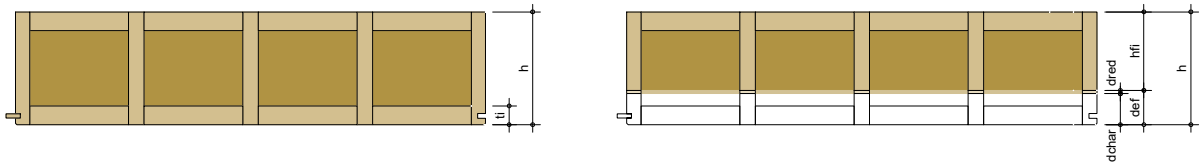
d_{ef} ..... effective charring depth for determination of residual cross section

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

t ..... required fire resistance time

β_1 = 0.8 mm/min charring rate

d_{red} = 7 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

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

β_1 = 0.8 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

β_2 = 1.6 mm/min charring rate for thermal insulation product of mineral fibre (reaction to fire class min. A2-s1, d0 and melting point ≥ 1 000°C)

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

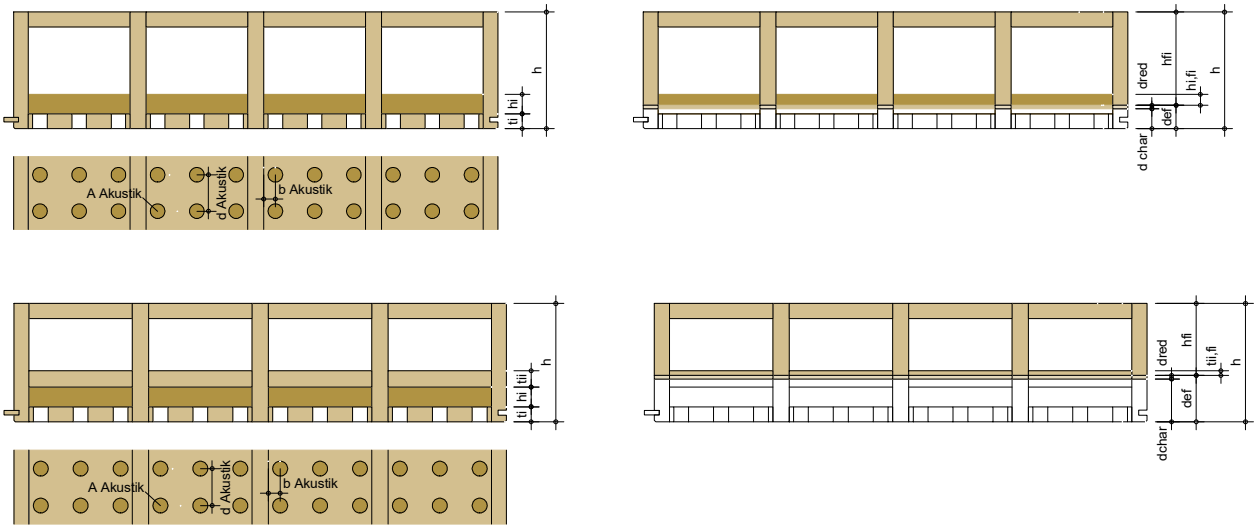
d_{red} = 7 mm ... depth of layer for consideration of strength loss in areas adjacent to the charred layer

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

LIGNATUR-elements	Annex 3
Resistance to fire – Charring rates	of European Technical Assessment ETA-11/0137 of 31.05.2021

Charring rate of LIGNATUR-elements with perforation

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:



$d_{ef} = d_{char} + d_{red} = t_1 \cdot \beta_1 + t_2 \cdot \beta_2 + t_3 \cdot \beta_3 + 7$ mm

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

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

$t = t_1 + t_2 + t_3$... required fire resistance time

t_1 ..... charring time in the area of the skin

t_2 ..... charring time in the area of wood fibre

t_3 ..... charring time in the area of wood

$\beta_1 = 0.22 \cdot k + 0.72$ mm/min charring rate

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

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

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

$\beta_3 = 0.8$ mm

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

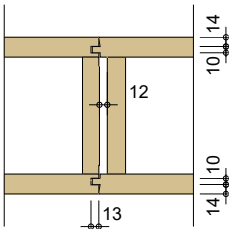
LIGNATUR-elements	Annex 3
Resistance to fire – Charring rates	of European Technical Assessment ETA-11/0137 of 31.05.2021

Joints 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

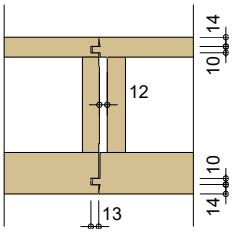
REI 30



Joint width 12 mm

Joint with groove and tongue

REI 60

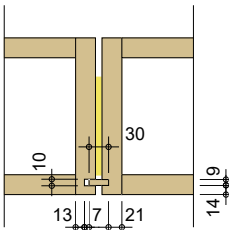


Joint width 12 mm

Joint with groove and tongue

LIGNATUR surface element

REI 30

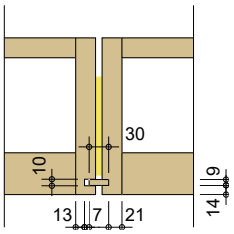


Joint width 10 mm

Joint with groove and separate tongue

Joint insulation [1)]

REI 60

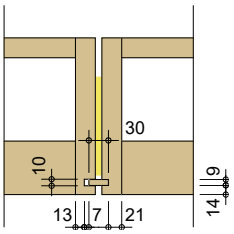


Joint width 10 mm

Joint with groove and separate tongue

Joint insulation [1)]

REI 90

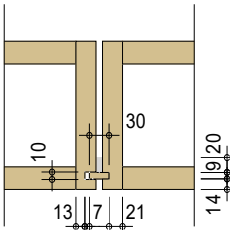


Joint width 10 mm

Joint with groove and separate tongue

Joint insulation [1)]

REI 30

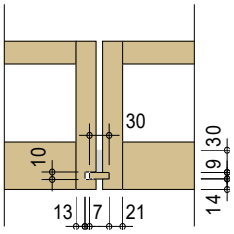


Joint width 10 mm

Joint with groove and separate tongue

Fire protection joint sealing tape, min. width 20 mm [2)]

REI 60

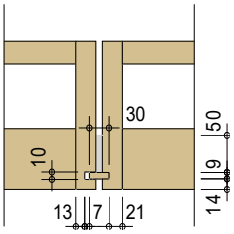


Joint width 10 mm

Joint with groove and separate tongue

Fire protection joint sealing tape, min. width 30 mm [2)]

REI 90



Joint width 10 mm

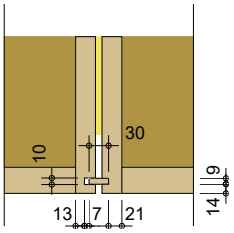
Joint with groove and separate tongue

Fire protection joint sealing tape, min width 50 mm [2)]

LIGNATUR-elements	Annex 3
Resistance to fire - Joints	of European Technical Assessment ETA-11/0137 of 31.05.2021

LIGNATUR shell element

REI 30



Joint width 10 mm

Joint with groove and separate tongue

Joint insulation[1)]

Dimensions in mm

1) Joint insulation with reaction to fire class at least A2-s1,d0 and melting point ≥ 1 000°C

2) Fire protection joint sealing tape ISO-FLAME KOMBI F120

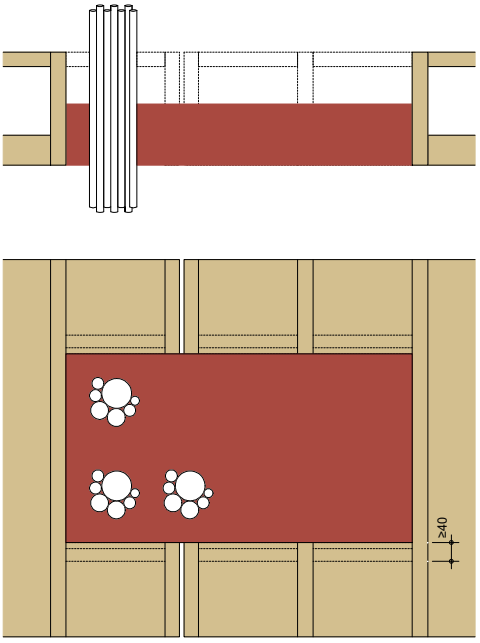
LIGNATUR-elements	Annex 3
Resistance to fire - Joints	of European Technical Assessment ETA-11/0137 of 31.05.2021

Preparation of LIGNATUR for Hilti-fire stopping according to ETA 18/1024

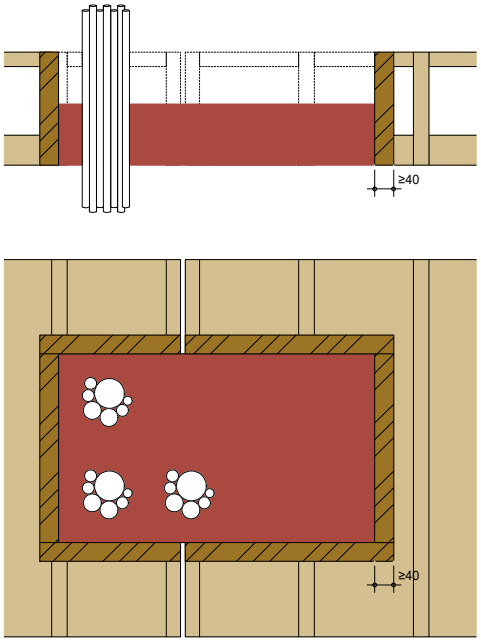
LIGNATUR-floors and –roofs of fire resistance class REI30, REI60 and REI90 are to be prepared accordingly in case of openings for fire stoppings.

Example: mixed penetration seal stone CFS-BL P according to ETA-18/1024

Edging with LIGNATUR-webs

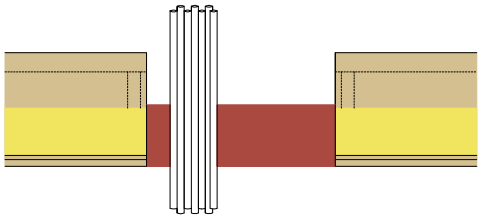


Edging with wooden reveal

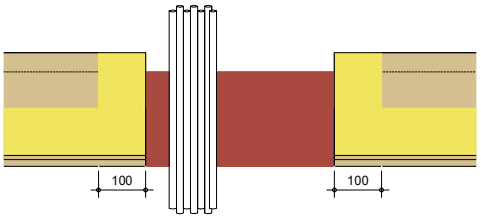


Dimension of the penetration seal according to European Technical Assessment for Hilti-fire stoppings.
The edging must be at least as high as the required height of the mixed penetration seal stone or the element height. If the element height is less than the required height of the mixed penetration seal stone, the element must be doubled locally.

Joint formation
Example EI30, EI60



Joint formation
Example EI 90



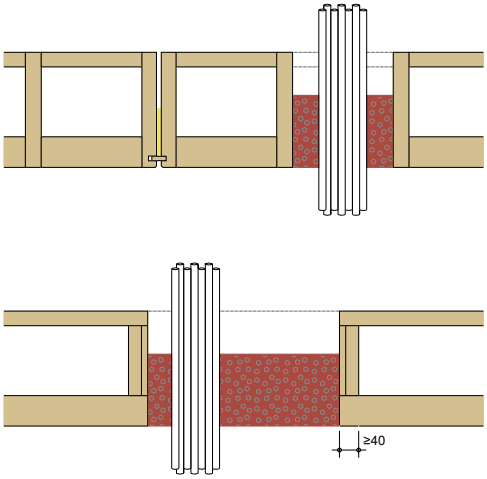
Joint insulation [1)]

[1)] Joint insulation with reaction to fire class at least A2-s1,d0 and melting point ≥ 1 000°C

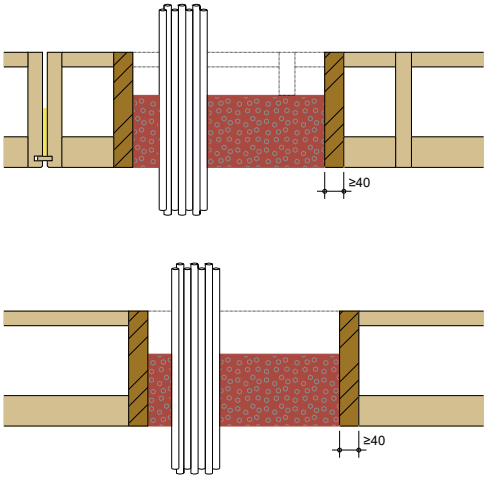
LIGNATUR-elements	Annex 3
Resistance to fire – Preparation for Hilti-fire stopping	of European Technical Assessment ETA-11/0137 of 31.05.2021

Examples: penetration seals for power devices with fire protection foam CFS-F FX according to ETA-10/0109

Edging with LIGNATUR-webs



Edging with wooden reveal



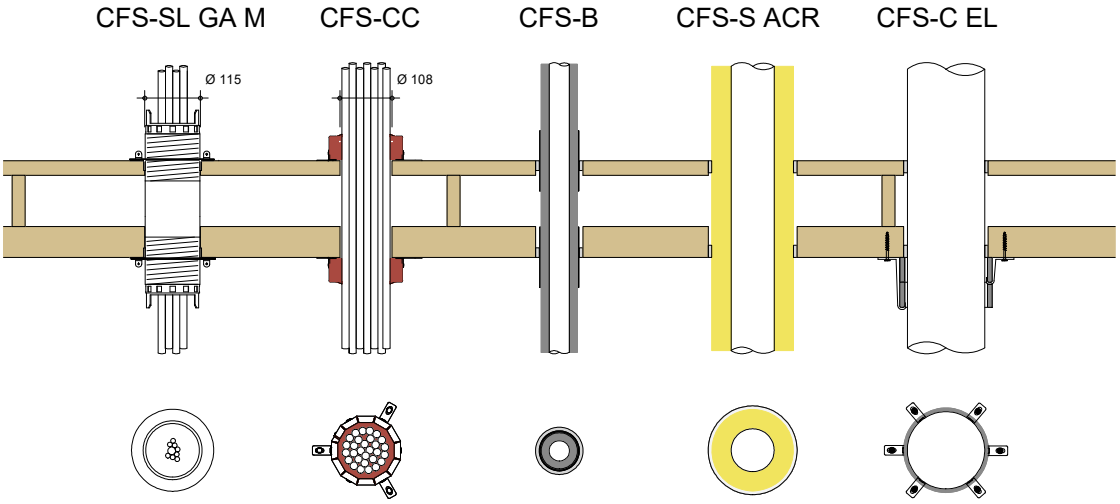
Dimension of the penetration seal according to European Technical Assessment for Hilti-fire stoppings.

The edging must be at least as high as the required height of the fire protection foam or the element height. If the element height is less than the required height of the fire protection foam, the element must be doubled locally.

LIGNATUR-elements	Annex 3
Resistance to fire – Preparation for Hilti-fire stopping	of European Technical Assessment ETA-11/0137 of 31.05.2021

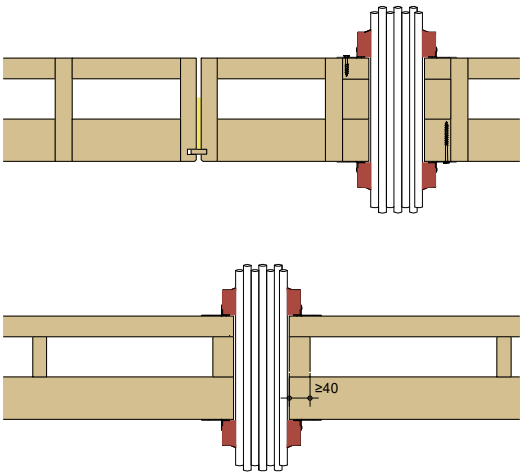
Examples for single openings

Fire protection sleeve CFS-SL GA M according to ETA-17/0081
fire protection cable collar CFS-CC according to ETA-13/0704
fire protection wrap CFS-B according to ETA-10/0212
acrylic fire protection sealant CFS-S ACR according to ETA-10/0292
fire protection collar CFS-C EL according to ETA-14/0085

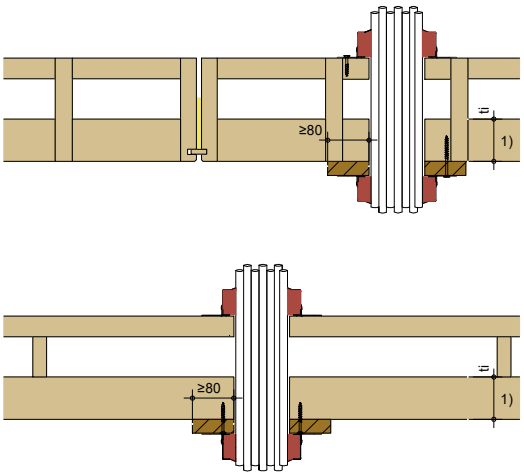


Standard example fire protection cable collar CFS-CC for the single openings shown above

Preparation for massive box



Preparation for empty box



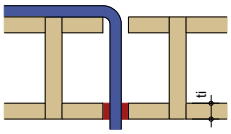
Design according to European Technical Assessment for Hilti-fire stoppings.

[1] If the lower skin t_i does not meet the requirements for the minimum thickness (58 mm for EI30, 64 mm for EI60 or 100 mm for EI90) it must be doubled with a wood-based panel.

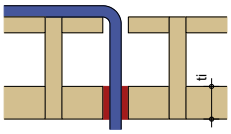
LIGNATUR-elements	Annex 3
Resistance to fire – Preparation for Hilti-fire stopping	of European Technical Assessment ETA-11/0137 of 31.05.2021

Examples for single power- and data cable fire protection sealant CFS-IS/CP611 A according to ETA-10/0406

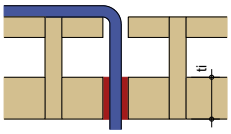
Example EI30



Example EI60



Example EI90



Dimension of the opening according to European Technical Assessment for Hilti-fire stoppings.
Design according to European Technical Assessment for Hilti-fire stoppings.

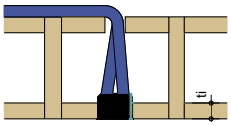
LIGNATUR-elements	Annex 3
Resistance to fire – Preparation for Hilti-fire stopping	of European Technical Assessment ETA-11/0137 of 31.05.2021

Preparation of LIGNATUR for f-tronic fire protection socket BS3700 according to ETA 18/0628

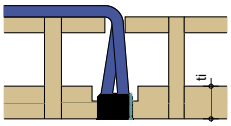
LIGNATUR-floors and –roofs of fire resistance class REI30, REI60 and REI90 are to be prepared accordingly in case of openings for fire protection sockets.

Examples for penetration seals for power devices with fire protection socket

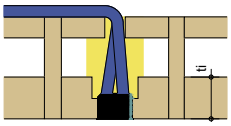
Example EI 30



Example EI60



Example EI90

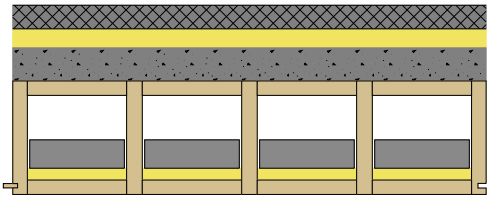


If the lower skin has a thickness $t_i \geq$ the max. clamping strength of the mounting, an undercut must be made to fix the socket.

Design according to European Technical Assessment for f-tronic fire protection socket.

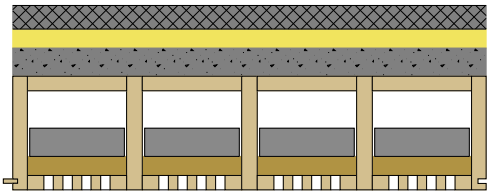
LIGNATUR-elements	Annex 3
Resistance to fire – Preparation for f-tronic fire protection socket	of European Technical Assessment ETA-11/0137 of 31.05.2021

Examples with improved airborne and impact sound performance



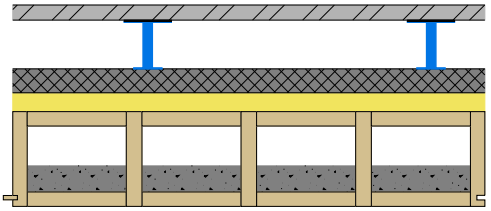
50 mm	Cement screed m' = 120 kg/m²
40 mm	Impact sound insulation board m' = 3.5 kg/m²,, s' = 6 MN/m³
70 mm	Ballast weight m' = 105 kg/m²
240 mm	LIGNATUR surface element silence12 m' = 71 kg/m² including ballast weight: concrete blocks[1)]

Mass per unit area of assembly: m' ≅ 301 kg/m²
$R_w(C; C_{tr})$ = 72 (-1; -5) dB
$L_{n,w}(C_I)$ = 45 (-2) dB



50 mm	Cement screed m' = 120 kg/m²
40 mm	Impact sound insulation board m' = 3.5 kg/m²,, s' = 6 MN/m³
60 mm	Ballast weight m' = 90 kg/m²
240 mm	LIGNATUR surface element silence12 with acoustics perforation m' = 74 kg/m² including ballast weight: concrete blocks[1)]

Mass per unit area of assembly: m' ≅ 288 kg/m²
$R_w(C; C_{tr})$ = 71 (-1; -6) dB
$L_{n,w}(C_I)$ = 43 (0) dB

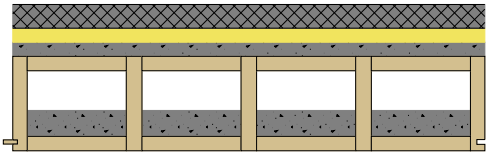


32 mm	Gypsum fiberboard m' = 52 kg/m², auf hollow floor columns 95 mm with 5 mm insulation sheets
50 mm	Cement screed m' = 120 kg/m²
40 mm	Impact sound insulation board m' = 3.5 kg/m², s' = 7 MN/m³
200 mm	LIGNATUR surface element m' = 89.6 kg/m² including ballast weight: aggregates m' = 50 kg/m²

Mass per unit area of assembly: m' ≅ 267 kg/m²
$R_w(C; C_{tr})$ = 74 (-4; -10) dB
$L_{n,w}(C_I)$ = 43 (1) dB

[1)] Concrete blocks, density ρ = 2 250 kg/m³

LIGNATUR-elements	Annex 4
Airborne and impact sound insulation	of European Technical Assessment ETA-11/0137 of 31.05.2021

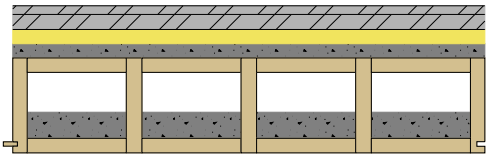


50 mm	Cement screed m' = 120 kg/m²
40 mm	Impact sound insulation board m' = 3.5 kg/m², s' = 7 MN/m³
30 mm	Ballast weight m' = 47.2 kg/m²
200 mm	LIGNATUR surface element m' = 89.6 kg/m² including ballast weight: aggregates m' = 50 kg/m²

Mass per unit area of assembly: m' ≅ 260 kg/m²

$R_w(C; C_{tr})$ = 76 (-4; -10) dB

$L_{n,w}(C_I)$ = 42 (1) dB

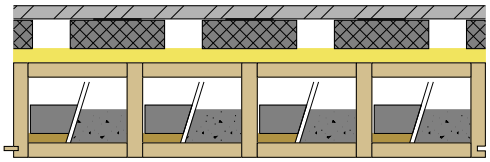


50 mm	Gypsum fiberboards m' = 81.3 kg/m²
30 mm	Impact sound insulation board m' = 2.7 kg/m², s' = 9 MN/m³
30 mm	Ballast weight m' = 47.2 kg/m²
200 mm	LIGNATUR surface element m' = 89.6 kg/m² including ballast weight: aggregates m' = 50 kg/m²

Mass per unit area of assembly: m' ≅ 221 kg/m²

$R_w(C; C_{tr})$ = 73 (-4; -10) dB

$L_{n,w}(C_I)$ = 47 (1) dB



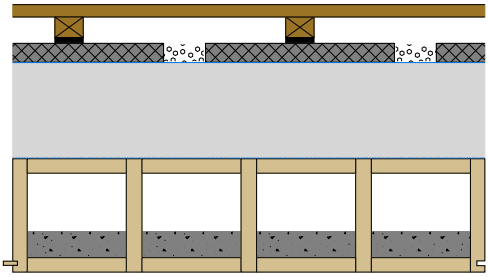
28 mm	Gypsum fiberboard m' = 45,4 kg/m²
2.8 mm	Impact sound insulation fleece m' = 2.4 kg/m²
60 mm	Concrete blocks in stripes m' = 89.4 kg/m²
30 mm	Impact sound insulation board m' = 4 kg/m², s' ≤ 15 MN/m³
200 mm	LIGNATUR surface element silence12 m' = 117 kg/m² including ballast weight: aggregates m' = 50 kg/m² and concrete blocks[1)]

Mass per unit area of assembly : m' ≅ 259 kg/m²

$R_w(C; C_{tr})$ = 72 (-2; -7) dB

$L_{n,w}(C_I)$ = 47 (-2) dB

LIGNATUR-elements	Annex 4
Airborne and impact sound insulation	of European Technical Assessment ETA-11/0137 of 31.05.2021

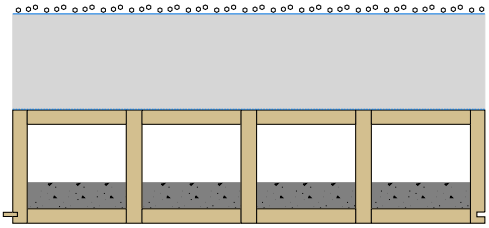


82 mm	Wooden grating (26 mm boards on 44 mm baulks) on 12 mm Sylomer-bearing m' = 15.8 kg/m²
40 mm	Concrete panels 400 x 400 mm, m' = 77 kg/m²
1.5 mm	Polymer roof sheeting m' = 2.1 kg/m²
200 mm	Expanded polystyrene m' = 3.6 kg/m²
240 mm	LIGNATUR surface element m' = 92.4 kg/m² including ballast weight: aggregates m' = 50 kg/m²

Mass per unit area of assembly: m' ≅ 191 kg/m²

$R_w(C; C_{tr})$ = 60 (-1; -5) dB

$L_{n,w}(C_I)$ = 37 (-2) dB



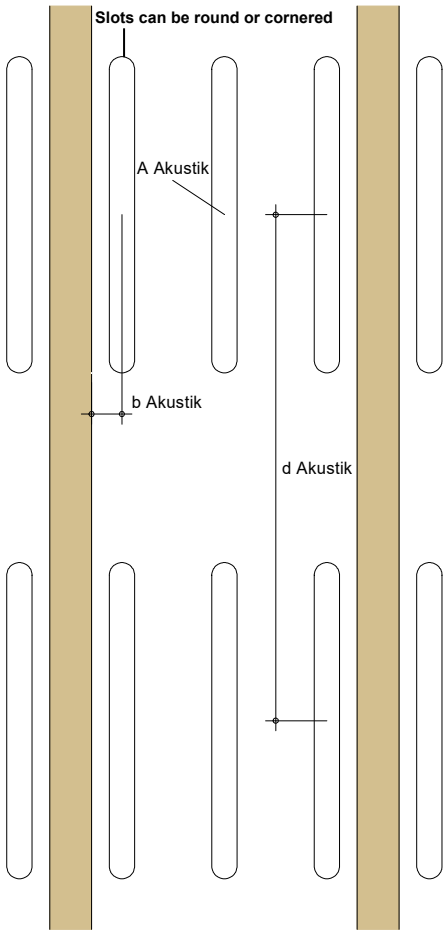
50 mm	Gravel m' = 87.3 kg/m²
1.5 mm	Polymer roof sheeting m' = 2.1 kg/m²
200 mm	Expanded polystyrene m' = 3.6 kg/m²
240 mm	LIGNATUR surface element m' = 92.4 kg/m² including ballast weight: aggregates m' = 50 kg/m²

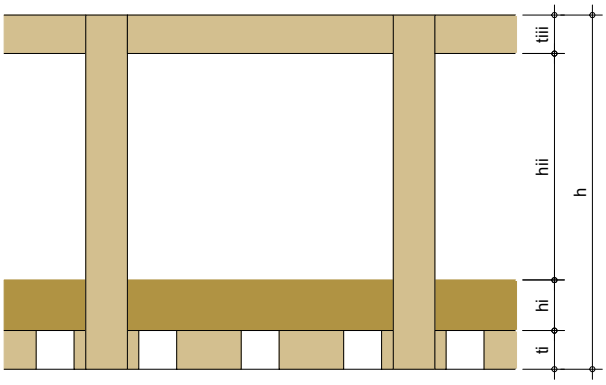
Mass per unit area of assembly: m' ≅ 186 kg/m²

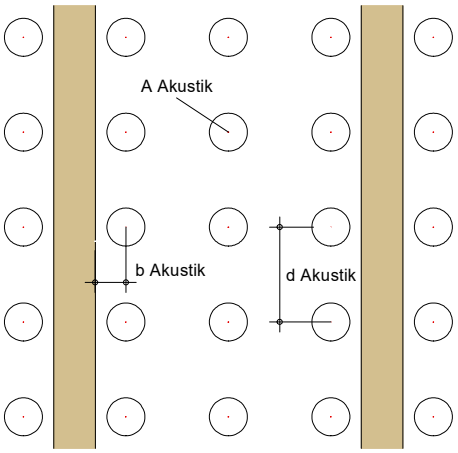
$R_w(C; C_{tr})$ = 64 (-2; -6) dB

LIGNATUR-elements	Annex 4
Airborne and impact sound insulation	of European Technical Assessment ETA-11/0137 of 31.05.2021

Perforated skins for acoustic elements







Example type 1

Example type 3

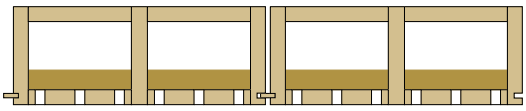
Type 1:	$A_{Akustik}$ = 5000 mm²	$d_{Akustik}$ = 400 mm	$b_{Akustik}$ = 24 mm
Type 2:	$A_{Akustik}$ = 707 mm²	$d_{Akustik}$ = 75 mm	$b_{Akustik}$ = 24 mm
Type 3:	$A_{Akustik}$ = 314 mm²	$d_{Akustik}$ = 40 mm	$b_{Akustik}$ = 5 mm
Type 3.1:	$A_{Akustik}$ = 314 mm²	$d_{Akustik}$ = 40 mm	$b_{Akustik}$ = 45 mm
Type 5:	$A_{Akustik}$ = 177 mm²	$d_{Akustik}$ = 40 mm	$b_{Akustik}$ = 5 mm
Type 5.1:	$A_{Akustik}$ = 177 mm²	$d_{Akustik}$ = 40 mm	$b_{Akustik}$ = 45 mm
Type 6:	$A_{Akustik}$ = 64 mm²	$d_{Akustik}$ = 20 mm	$b_{Akustik}$ = 15 mm
Type 6.1:	$A_{Akustik}$ = 64 mm²	$d_{Akustik}$ = 20 mm	$b_{Akustik}$ = 35 mm
Type 8:	$A_{Akustik}$ = 3420 mm²	$d_{Akustik}$ = 600 mm	$b_{Akustik}$ = 9 mm
Type 8.1:	$A_{Akustik}$ = 3420 mm²	$d_{Akustik}$ = 600 mm	$b_{Akustik}$ = 33 mm
Diverse:	A_{Slot} ≤ 5000 mm²	d_{Slot} ≤ 600 mm	b_{Slot} ≥ 1 mm
	A_{Hole} ≤ 707 mm²	d_{Hole} ≤ 75 mm	b_{Hole} ≥ 1 mm

LIGNATUR-elements	Annex 5
Sound absorption – Perforated skins	of European Technical Assessment ETA-11/0137 of 31.05.2021

Examples with improved sound absorption

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

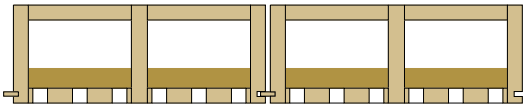
Dimensions: h = 200 mm, t_i = 31 mm, h_i = 40 mm



α_w = 0,55

Acoustics type 1 Class of absorber: D

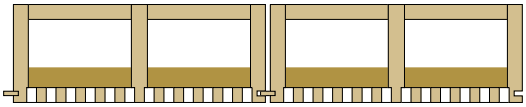
Slot dimension: 20 / 250 mm
Grid: 81 / 400 mm



α_w = 0,50

Acoustics type 2 Class of absorber: D

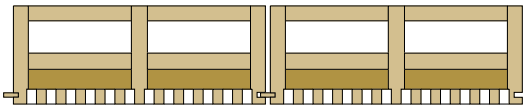
Hole diameter: 30 mm
Grid: 81/75 mm



α_w = 0,90

Acoustics type 3 Class of absorber: A

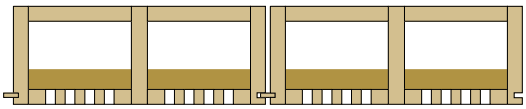
Hole diameter: 20 mm
Grid: 40 / 40 mm



α_w = 0,85

Acoustics type 3 ZL Class of absorber: B

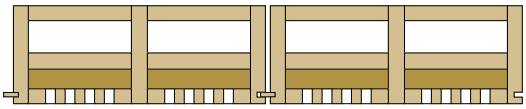
Hole diameter: 20 mm
Grid: 40 / 40 mm



α_w = 0,75

Acoustics type 3.1 Class of absorber: C

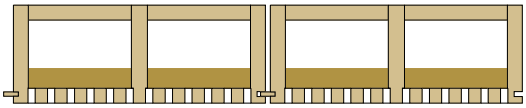
Hole diameter: 20 mm
Grid: 40 / 40 mm



α_w = 0,60

Acoustics type 3.1 ZL Class of absorber: C

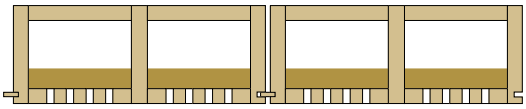
Hole diameter: 20 mm
Grid: 40 / 40 mm



α_w = 0,65 (L)

Acoustics type 5 Class of absorber: C

Hole diameter: 15 mm
Grid: 40 / 40 mm



α_w = 0,50 (L)

Acoustics type 5.1 Class of absorber: D

Hole diameter: 15 mm
Grid: 40 / 40 mm

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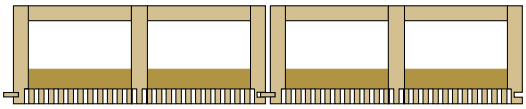
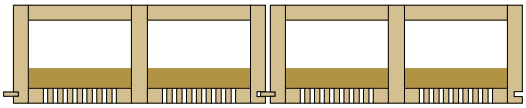
Sound absorption	of European Technical Assessment ETA-11/0137 of 31.05.2021



α_w = 0,80

Acoustics type 6 Class of absorber: B

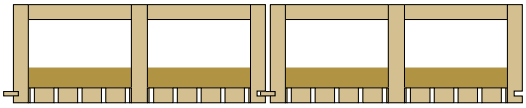
Hole diameter: 9 mm
Grid: 20 / 20 mm



α_w = 0,60

Acoustics type 6.1 Class of absorber: C

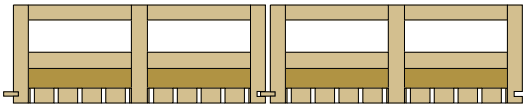
Hole diameter: 9 mm
Grid: 20 / 20 mm



α_w = 0,50

Acoustics type 8 Class of absorber: D

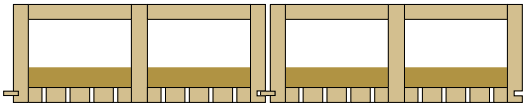
Slot dimension: 9 / 380 mm
Grid: 48 / 600 mm



α_w = 0,50

Acoustics type 8 ZL Class of absorber: D

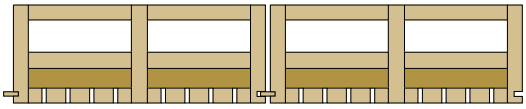
Slot dimension: 9 / 380 mm
Grid: 48 / 600 mm



α_w = 0,45

Acoustics type 8.1 Class of absorber: D

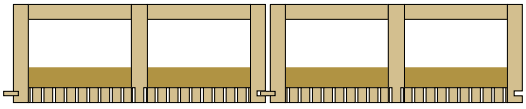
Slot dimension: 9 / 380 mm
Grid: 48 / 600 mm



α_w = 0,40

Acoustics type 8.1 ZL Class of absorber: D

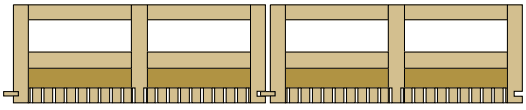
Slot dimension: 9 / 380 mm
Grid: 48 / 600 mm



α_w = 0,50

Acoustics type 9 Class of absorber: D

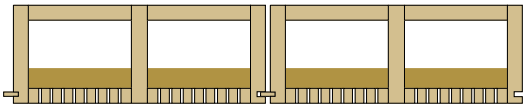
Slot dimension: 5.5 / 380 mm
Grid: 24 / 600 mm



α_w = 0,55

Acoustics type 9 ZL Class of absorber: D

Slot dimension: 5.5 / 380 mm
Grid: 24 / 600 mm



α_w = 0,50

Acoustics type 9.1 Class of absorber: D

Slot dimension: 5.5 / 380 mm
Grid: 24 / 600 mm

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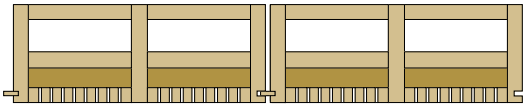
Sound absorption	of European Technical Assessment ETA-11/0137 of 31.05.2021



α_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
Sound absorption	of European Technical Assessment ETA-11/0137 of 31.05.2021

European Assessment Document (EAD) 140022-00-0304 “Prefabricated wood-based loadbearing stressed skin panels”

EN 301 (10.2017), Adhesives, phenolic and aminoplastic, for load-bearing timber structures – Classification and performance requirements

EN 336 (10.2013), Structural timber – Sizes, permitted deviations

EN 338 (04.2016), Structural timber – Strength classes

EN 350 (08.2016). Durability of wood and wood-based products – Testing and classification of the durability to biological agents of wood and wood-based materials

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

EN 13501-1 (12.2018), Fire classification of construction products and building elements – Part 1: Classification using data from reaction to fire tests

EN 15425 (01.2017), 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

EN ISO 6946 (07.2017), Building components and building elements – Thermal resistance and thermal transmittance - Calculation method

LIGNATUR-elements	Annex 6
Reference documents	of European Technical Assessment ETA-11/0137 of 31.05.2021

EN ISO 10211 (07.2017), Thermal bridges in building construction – Heat flows and surface temperatures - Detailed calculations

EN ISO 10456 (12.2007), +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