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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 23/0478 of 29/06/2023

I General Part

Technical Assessment Body issuing the ETA	**Eurofins Expert Services Oy**
Trade name of the construction product	**EGO RIPA Elements**
Product family to which the construction product belongs	Wood based panels and elements
Manufacturer	**Egoin S.A.** Barrio Olagorta S/N CP 48311 Natxitua (Vizcaya) Spain
Manufacturing plant	**Egoin S.A.** Barrio Olagorta S/N CP 48311 Natxitua Vizcaya) Spain
This European Technical Assessment contains	25 pages including 2 Annexes
This European Technical Assessment is issued in accordance with regulation (EU) No 305/2011, on the basis of	EAD 140022-00-0304

II Specific Part

1. Technical description of the product

EGO RIPA Elements are composite slab elements made of Kerto structural laminated veneer lumber. The adhesive is of type I (full exposure to the weather) as defined in EN 301, or polyurethane adhesive as defined in EN 15425. EGO RIPA Elements may contain thermal or acoustic insulation inside the cavities, additional fire protective gypsum plasterboards and roofing for watertightness. EGO RIPA element may, or may not, have a bottom slab. Some materials may be added at the building site to elements without a bottom slab. The materials, dimensions and tolerances are given in Annex 1.

EGO RIPA Elements are intended to be used as structural or non-structural elements in buildings and bridges. EGO RIPA Elements may function as directly load bearing as well as structural stiffening members.

The products are shaped according to the customer's specification. The maximum length of the elements is 25 m and the height varies from 150 to 1300 mm. Top and bottom slabs may be jointed at a rib. Typical lengths are from 4 to 24 m and widths 2 to 4 m. The panels may have one-sided tapered ribs; maximum taper is 10°.

EGO RIPA Elements can be painted or stained. The suitability of the treatment shall be checked with the manufacturer of it. Surface treatments of the elements are not covered by this ETA.

2. Specification of the intended uses in accordance with the applicable EAD

2.1. Intended uses

EGO RIPA Elements are intended to be used as directly load bearing parts of building constructions. They may also function as structural bracing members. EGO RIPA Elements can be supported either below the ribs or via the upper slab by the means of inclined screws.

With regard to moisture behaviour of the product, the use is limited to service classes 1 and 2 as defined in EN 1995-1-1. The product shall not be used in service class 3 / use class 3 (3.1 exterior, above ground, protected; occasionally wet). If EGO RIPA Elements are intended to be a part of the external envelope of the building, they shall be protected adequately, e.g. by a roof or by cladding.

EGO RIPA Elements can be used in seismic areas, when designed adequately. The panels are intended to be used subject to static or quasi-static actions only. In seismic areas the behavior factor of LVL rib panels used for the design is limited to non-dissipative or low-dissipative structures ($q \leq 1,5$), defined according to Eurocode 8 (EN 1998-1:2004 clauses 1.5.2 and 8.1.3 b) and applicable national rules on construction works of the Member States (MS).

If the elements are intended to be covered by flooring, it is recommended that the moisture content of the top slab is checked by a moisture meter calibrated for Kerto LVL; moisture content of the slab should not exceed the value recommended by the manufacturer of the flooring material.

Holes in EGO RIPA Elements to provide openings for ducts, pipes etc. or modification or repair of the construction may only be made after consultation with the person responsible for the design as described in 2.3.

2.2. Working life

The provisions made in this European Technical Assessment are based on an assumed intended working life of EGO RIPA Elements of 50 years when installed in the works, provided that the elements are subjected to appropriate installation, use and maintenance. These provisions are based upon the current state of the art and the available knowledge and experience. The real working life may be, in normal use conditions, considerably longer without major degradation affecting the basic requirements for works[1].

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 expressing the expected economically reasonable working life of the product.

2.3. Design of works

For each individual building project, a specific structural design shall be made according to the instructions of the ETA holder by a person responsible for the task according to the laws of the Member States (MS). The design also shall take into account any aspects regarding installation of the elements, as any temporary bracing and supporting.

Metsä Wood provides design instructions of the EGO RIPA Elements. When the instructions are updated, the updated version shall be assessed by Eurofins Expert Services Oy.

2.4. Manufacturing

Gluing of slabs to ribs shall be performed according to the ETA holder's instructions assessed by Eurofins Expert Services Oy. Gluing pressure may be achieved by screws or nails as specified in detail in the instructions of the ETA holder. When the instructions are updated, the updated version shall be approved by Eurofins Expert Services Oy

2.5. 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.

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[1] The real working life of a product incorporated in a specific works depends on the environmental conditions to which that works is subject, as well as on the particular conditions of the design, execution, use and maintenance of that works. Therefore, it cannot be excluded that in certain cases the real working life of the product may also be shorter than referred to above.

2.6. Installation

EGO RIPA Elements shall be installed by appropriately qualified personnel, following the installation plan. EGO RIPA Elements shall be protected against moisture from the supporting main structure by a damp-proof membrane, when relevant. In case of elements without a bottom slab, only those components specified in this ETA shall be used when there are requirements for resistance to fire.

The completed building (the works) shall comply with the building regulations (regulations on the works) applicable in the Member States in which the building is to be constructed. The procedures foreseen in the Member State for demonstrating compliance with the building regulations shall also be followed by the entity held responsible for this act. An ETA for EGO RIPA Elements does not amend this process in any way.

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

Table 1. Basic requirements for construction works and essential characteristics

Basic requirement and essential characteristics	Performance
BWR 1. Mechanical resistance and stability	
Mechanical resistance and stiffness	Clause 3.1.1
Dimensional stability	Clause 3.1.2
BWR 2. Safety in case of fire	
Reaction to fire	Clause 3.2.1
Resistance to fire	Clause 3.2.2
BWR 3. Hygiene, health and the environment	
Water vapour permeability and moisture resistance	Clause 3.3.1
Content, emission and/or release of dangerous substances	Clause 3.3.2
BWR 4 Safety and accessibility in use	
Impact resistance	Clause 3.4.1
BWR 5 Protection against noise	
Airborne sound insulation	Clause 3.5.1
Impact sound insulation	Clause 3.5.1
BWR 6 Energy economy and heat retention	
Thermal conductivity	Clause 3.6.1
Air permeability	Clause 3.6.2
Aspects of durability	
Natural durability	Clause 3.7.1

3.1. Mechanical resistance and stability, BWR 1

3.1.1. Mechanical resistance and stiffness as well as serviceability

The intention of the manufacturer is to declare the performance of the kit by reference to the production documents[2]. Thus, the mechanical resistance and deformations for EGO RIPA Elements is given by one of the following methods:

Method 3a: Reference to design documents of the purchaser
Method 3b: Reference to design documents produced and held by the manufacturer according to the order for the works

The structural performance of EGO RIPA Elements is considered in accordance with the limit state design principles specified in Eurocodes and is described in detail in the manufacturer's instructions for design. Both ultimate limit state and serviceability limit state (comprising vibrations when relevant) are considered. Calculation methods follow EN 1995-1-1:2004.

[2] This is specified in Delegated Regulation (EU) No 574/2014 of 21 February 2014 amending Annex III to Regulation (EU) No 305/2011.

Structural design shall be documented. Strength values of Kerto LVL to be used in design together with information of the dimensions of the components are given in Annex 1.

Eurofins Expert Services Oy has assessed the design instructions of the manufacturer. In case of updating, the new versions shall be assessed by Eurofins Expert Services Oy.

3.1.2. Dimensional stability

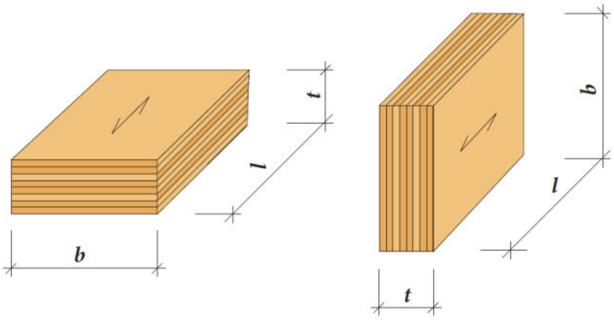
In normal conditions, harmful deformations due to moisture changes of the EGO RIPA Elements are not expected. When necessary, the dimensional change ΔL of a Kerto LVL product due to change of moisture content can be calculated as follows:

$$\Delta L = \Delta\omega \cdot \alpha_H \cdot L$$

where $\Delta\omega$ is change of moisture content [%] from the equilibrium moisture content, α_H dimensional variation coefficient and L dimension [mm]. The dimensional variation coefficients are presented in Table 2.

Table 2. Dimensional variation coefficients.

Dimension	Kerto LVL S-beam	Kerto LVL Q-panel
Thickness *t*	0.0024	0.0024
Width *b*	0.0032	0.0003
Length *l*	0.0001	0.0001



3.2. Safety in case of fire, BWR 2

3.2.1. Reaction to fire

Untreated Kerto LVL is classified to have reaction to fire class D-s1, d0. If thermal insulation is used inside the elements, it shall be classified to have reaction to fire class A1 as a default. Other options for completing materials are specified in Annex 2.

Reaction to fire class of EGO RIPA Elements can be improved by chemical treatments or other protective means designed appropriately. These kinds of improvements are not covered by this ETA.

For roofing, reaction to fire is NPD.[3]

[3] Reaction of fire of the roofing shall meet the requirements set in the place of use.

3.2.2. Resistance to fire

EGO RIPA Elements have been tested according to relevant standards to be classified according to EN 13501-2. Annex 2 (informative) is based on these tests and the calculation methods in EN 1995-1-2:2004. A floor or roof construction made of EGO RIPA Elements may have resistance to fire class REI 30, REI 60 or REI 90 provided that the conditions in Annex 2 are fulfilled. Load-bearing performance (class R) can be determined as a part of design of works (see also clause 2.3 – Design of works) taking into account the charring rates and limitations given in Annex 2. Resistance to fire is strongly influenced by the structure of the element, insulation in the cavities and optional use of gypsum plasterboards, see Annex 2.

EGO RIPA Elements without any slab on the lower side of the element may be protected by a gypsum plasterboard construction suspended below the element. This protective construction shall be designed and planned appropriately according to EN 1995-1-2:2004 and the relevant National Annex and its performance is not covered by this ETA.

Passage of fire to the gap between the end of the element and a supporting edge has to be prevented. Neither may the bottom slab have such holes that might act as passages for fire to the cavity inside the EGO RIPA Element.

3.3. Hygiene, health and environment, BWR 3

3.3.1. Water vapour permeability and moisture resistance

EGO RIPA Elements may contain thermal insulation in the cavities. The construction resembles a timber frame construction where any moisture possibly coming into the cavities is ventilated or will be removed by diffusion. In cases where resistance to fire is required, ventilation cavities may require fire stops according to separate design.

In special cases when the performance shall be calculated, e.g. when there is a separate ceiling construction that is not part of the EGO RIPA Element, the water vapour resistance factors μ given in Table 3 may be used.

Table 3. Water vapour resistance factors μ and diffusion coefficients δ_p

	Conditions	μ (-)		δ_p (kg/Pa s m)	
		Kerto LVL S-beam	Kerto LVL Q-panel	Kerto LVL S-beam	Kerto LVL Q-panel
Thickness direction	Dry Cup[1]	200	200	$1{,}0 \cdot 10^{-12}$	$1{,}0 \cdot 10^{-12}$
	Wet Cup[2]	70	70	$2{,}7 \cdot 10^{-12}$	$2{,}7 \cdot 10^{-12}$
	20°C-50/75RH%	80	62	$2{,}4 \cdot 10^{-12}$	$3{,}0 \cdot 10^{-12}$
Width direction	20°C-50/75RH%	82	9,5	$2{,}3 \cdot 10^{-12}$	$20 \cdot 10^{-12}$
Length direction	20°C-50/75RH%	3,9	4,7	$49 \cdot 10^{-12}$	$40 \cdot 10^{-12}$

[1] Dry cup values tested in 23°C - 0/50 RH% conditions.
[2] Wet cup values tested in 23°C - 50/93 RH% conditions.

3.3.2. Content, emission and/or release of dangerous substances

Dangerous substances

Based on the declaration of the manufacturer and the assessment of the Assessment Body, EGO RIPA Elements do not contain harmful or dangerous substances as defined in the EU database, with exception of formaldehyde. The formaldehyde release class of the LVL is E1 in accordance with EN 14374. The product does not contain pentachlorophenol, or recycled wood. Kerto LVL products manufactured by Metsä Wood have formaldehyde releases less than 0,030 ppm which is 30% of E1 class requirement 0,10 ppm when determined in accordance with EN 717-1.

High relative humidity conditions may cause mould growth on the surface of EGO RIPA Elements. If these kinds of conditions are expected during erection, a brushable or sprayable surface treatment should be used. These kinds of treatment have no adverse effects to the structural properties of EGO RIPA Elements. If, due to excessive wetting, there is mould growth on the surface of EGO RIPA Elements, this can be removed by sanding.

EGO RIPA Elements treated against biological attack are not covered by this ETA.

In addition to the specific clauses relating to dangerous substances contained in this 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 EU Construction Products Directive, these requirements need to also be complied with, when and where they apply.

3.4. Safety in use, BWR 4

3.4.1. Impact resistance

EGO RIPA Elements are assessed to have acceptable impact resistance for the intended uses.

3.5. Protection against noise, BWR 5

3.5.1. Airborne sound insulation and impact sound insulation

Measured value for weighted sound reduction index R_w and weighted impact sound pressure level $L_{n,w}$ of a typical EGO RIPA Element are given in Table 4. The thickness of the top slab of the basic EGO RIPA Element (EGO RIPA Element 1) was 25 mm while the thickness of the bottom slab was 37 mm. Measured values for some typical flooring constructions are also given.

Table 4 The acoustical performance of EGO RIPA Elements.

Measured construction	**Airborne sound insulation (dB)**		**Impact sound insulation (dB)**	
	R_w	C	$L_{n,w}$	C_I
EGO RIPA Element 1: Basic EGO RIPA Element with bottom slab 37 mm	31	0	86	-3
EGO RIPA Element 1 topped with 60 mm concrete slab	43	-1	78	-7
EGO RIPA Element 1 topped with 60 mm concrete slab floating on 30 mm of mineral wool	54	-1	66	-2
EGO RIPA Element 1 topped with floating screed on 30 mm of mineral wool, ΔL_w for floor covering ≥18 dB	48	-1	65 … 70	0 …-2

Acoustical performance of EGO RIPA Elements that do not have the slab on the lower side of the element may be improved by a gypsum plasterboard construction suspended below the element. The performance of this kind of construction is outside of this ETA. Also in this case, the performance is strongly influenced by the flooring construction used.

3.6. Energy economy and heat retention, BWR 6

3.6.1. Thermal conductivity

The thermal conductivity λ for both web and flange material is 0.13 W/(m K) according to EN ISO 10456. The natural density variation of the materials is taken into account in this value.

3.6.2. Air permeability

A construction with EGO RIPA Elements, including the joints between the elements, will provide adequate airtightness in relation to the intended use, taking into account both energy economy and heat retention, risk of cold draughts and risk of condensation within the construction.

3.7. Aspects of durability

3.7.1. Natural durability

The adhesive of type I can also be used in service class 3 but natural durability class of LVL is 5 according to EN 350-2. Thus, EGO RIPA Elements can be used in service classes 1 and 2 according to EN 1995-1-1, and hazard classes 1 and 2 as specified in EN 335. The designer shall pay attention to the details of the construction and to ensure that no water pockets will be formed. During the erection of the building, EGO RIPA Elements have good resistance to temporary exposure to water without decay, provided that they are allowed to dry afterwards. Integrity of the bond is maintained in the assigned service classes throughout the expected life of the structure.

Durability may be reduced by attack from insects such as long horn beetle, dry wood termites and anobium in regions where these may be found.

When necessary and required by the local authorities, EGO RIPA Elements may be treated against biological attack according to the rules valid within the region. Any adverse effects of the treatment on other properties shall be taken into account. These kinds of treatments are not covered by this ETA.

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

According to the Decision 2000/447/EC of the European Commission, the system of assessment and verification of constancy of performance (see Annex V to the regulation (EU) No 305/2011) is System 1.

5. Technical details necessary for the implementation of the AVCP system, as provided for in the applicable EAD.

Assessment and verification of constancy of performance shall focus on glue bond quality that is provision for the performances given in the ETA. Technical details necessary for the implementation of the AVCP system are laid down in the control plan deposited at Eurofins Expert Services Oy.

5.1. Tasks of the manufacturer

The manufacturer has approved instructions for manufacturing and factory production control for each type of manufacturing method. Integrity of the glue bond shall be tested, as specified in the instructions, with a shear test according to the clause 3.4.1 of the EAD 140022-00-0304.

5.2. Tasks of the notified body

Under continuous production, the notified body shall visit the factory twice a year. Products may not be manufactured continuously. Only one yearly inspection visit may be carried out in case of production stop longer than half a year.

Issued in Espoo on June 29, 2023[4]
by Eurofins Expert Services Oy

Katja Vahtikari
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[4] This ETA is a reproduction of ETA 07/0029 issued 31/08/2021.

ANNEX 1
DESCRIPTION OF EGO RIPA ELEMENTS

1. Cross sections and sizes

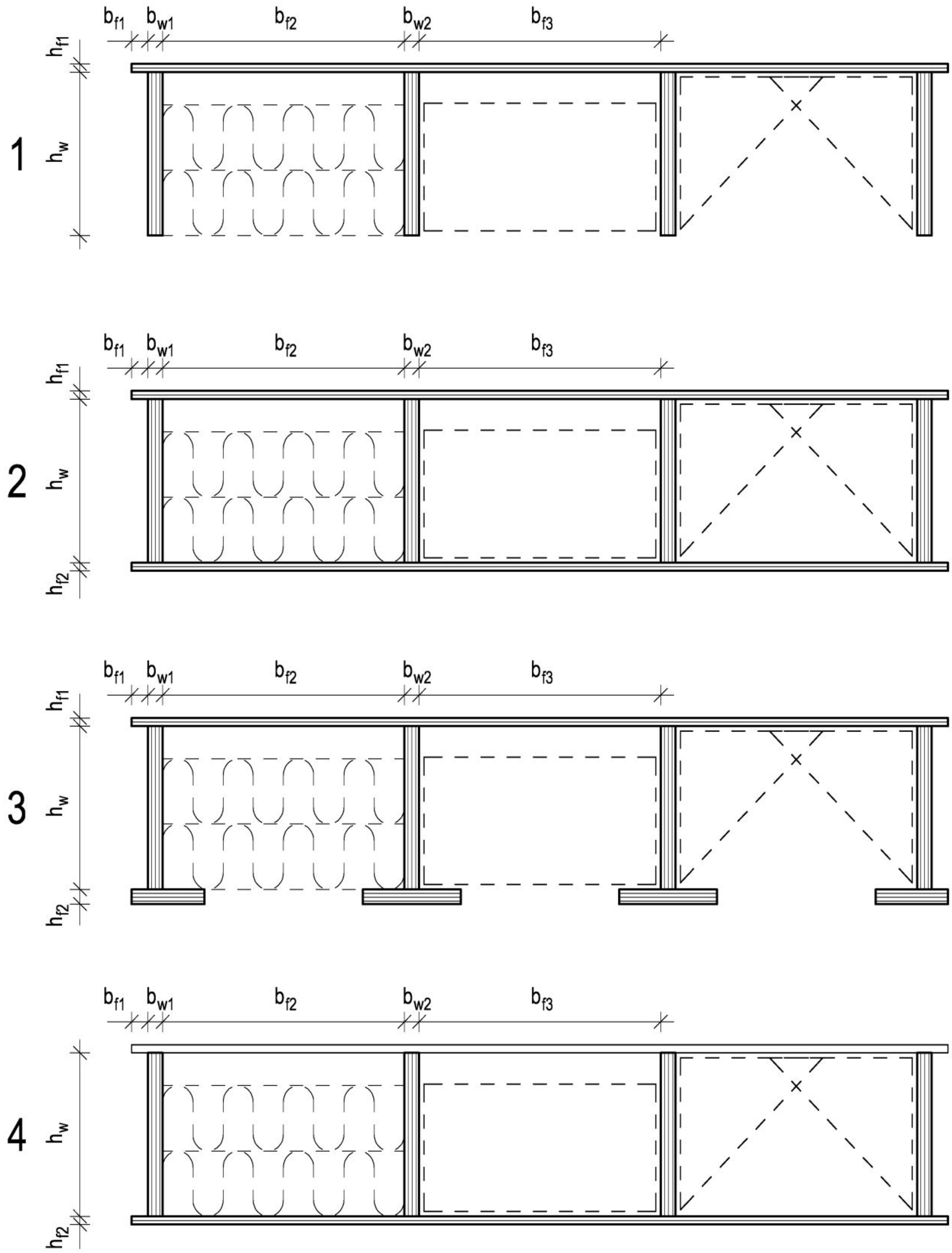


Figure1-1: Cross sections of EGO RIPA Elements: 1 Ribbed slab, 2 Box slab, 3 Open box slab with Kerto LVL S-beam or Kerto LVL Q-panel bottom flanges (depending on the design), may contain optional fire protective bottom courses, and 4 Box slab where top panel is not a part of the composite cross section. Cross bracing and insulation are optional.

Typical cross sections and symbols used are illustrated in Figure 1-1. The products are individually designed based on the specification of the customer. The maximum length of the elements is 25 m and the height varies from 150 to 1300 mm. Top and bottom slabs may be jointed at a rib. If the length of the element is more than 12 m, the handling of the element shall be considered by the designer. The panels may have one-sided tapered ribs; maximum taper is 10°.The ribs may be stiffened, when necessary, with additional stiffeners made of Kerto LVL. EGO RIPA Elements may contain insulation in the cavities.

Typical dimensions of the members to be glued together are
b_w = 39 to 75 mm
h_w = 100 to 900 mm (h_w< 15.4x thickness of rib b_w)
h_f = 19 to 73 mm

2. Tolerances of dimensions

Tolerances of dimensions at the reference moisture content of 10 ± 2% are presented in Table 1-1.

Table 1-1. Tolerances of EGO RIPA Elements.

Dimension	Tolerance, mm or %
Depth of the EGO RIPA Element	± 5,0 mm or 1,5 %**
Width of the EGO RIPA Element	± 0,5 %
Length of the EGO RIPA Element	± 5,0 mm

** which one is smaller

The thickness of sanded Kerto LVL slabs is the nominal thickness decreased by 1mm for each sanded surface. Kerto LVL slabs used in EGO RIPA Elements shall be sanded at least from that side which is glued to the ribs. The effect of sanding to the thickness shall be taken into account in the structural calculations of EGO RIPA Elements.

3. Specifications of components

The components are made of Kerto LVL produced by Metsä Wood Lohja LVL Mill or Punkaharju LVL Mill or corresponding Kerto LVL mill. Orientation of the Kerto LVL material is given in Figure 1-2. The material properties comply with EN 14374. The characteristic strength values of the Kerto LVL shall be at least as given in Table 1-2.

The adhesive used in manufacturing of EGO RIPA Elements is of type I (full exposure to the weather) as defined in EN 301, or polyurethane adhesive as defined in EN 15425. The adhesives used shall be approved for gluing of load-bearing structures and suitable for gluing of Kerto LVL.

Table 1-2 The characteristic values of Kerto LVL S-beam and Kerto LVL Q-panel to be used in the design of EGO RIPA Elements.

Property	Symbol	Figure 1-2	Characteristic value, N/mm² or kg/m³			
			Kerto LVL S-beam thickness	Kerto LVL Q-panel thickness		
			27 – 75 mm	19-20 mm*	19 - 23 mm**	25 – 73 mm**
Characteristic values						
Bending strength:						
Edgewise (depth 300 mm)	$f_{m,0,edge,k}$	A	44.0	28.0	28.0	32.0
Size effect parameter	s	-	0.12	0.12	0.12	0.12
Flatwise, parallel to grain	$f_{m,0,flat,k}$	B	50.0	28.0	32.0	36.0
Flatwise, perpendicular to grain	$f_{m,90,flat,k}$	C	-	14,0	7.0	8.0
Tensile strength:						
Parallel to grain (length 3000 mm)	$f_{t,0,k}$	D	35.0	19.0	19.0	26.0
Perpendicular to grain, edgewise	$f_{t,90,edge,k}$	E	0.8	6.0	6.0	6.0
Perpendicular to grain, flatwise	$f_{t,90,flat,k}$	F	-	-	-	-
Compressive strength:						
Parallel to grain	$f_{c,0,k}$	G	35.0	19.0	19.0	26.0
Perpendicular to grain, edgewise	$f_{c,90,edge,k}$	H	6.0	9.0	9.0	9.0
Perpendicular to grain, flatwise	$f_{c,90,flat,k}$	I	2,2	2,2	2,2	2,2
Shear strength:						
Edgewise	$f_{v,0,edge,k}$	J	4.2	4.5	4.5	4.5
Flatwise, parallel to grain	$f_{v,0,flat,k}$	K	2.3	1.3	1.3	1.3
Flatwise, perpendicular to grain	$f_{v,90,flat,k}$	L	-	0.6	0.6	0.6
Modulus of elasticity:						
Parallel to grain, along	$E_{0,k}$	ABDG	11600	8300	8300	8800
Parallel to grain, across	$E_{90,k}$	C	-	2900	1000	1700
Perpendicular to grain, edgewise	$E_{90,edge,k}$	H	350	2000	2000	2000
Perpendicular to grain, flatwise	$E_{90,flat,k}$	I	100	100	100	100
Shear modulus:						
Edgewise	$G_{0,edge,k}$	J	400	400	400	400
Flatwise, parallel to grain	$G_{0,flat,k}$	K	270	60	60	100
Flatwise, perpendicular to grain	$G_{90,flat,k}$	L	-	16	16	16
Density	ρ_k	-	480	480	480	480
Mean values						
Modulus of elasticity:						
Parallel to grain, along	$E_{0,mean/}$	ABDG	13800	10000	10000	10500
Parallel to grain, across	$E_{90,mean}$	C	-	3300	1200	2000
Perpendicular to grain, edgewise	$E_{90,edge,mean}$	H	430	2400	2400	2400
Perpendicular to grain, flatwise	$E_{90,flat,mean}$	I	130	130	130	130
Shear modulus:						
Edgewise	$G_{0,edge,mean}$	J	600	600	600	600
Flatwise, parallel to grain	$G_{0,flat,mean}$	K	380	80	80	120
Flatwise, perpendicular to grain	$G_{90,flat,mean}$	L	-	22	22	22
Density	ρ_{mean}	-	510	510	510	510

* For Kerto LVL Q-panel with lay-up |—| | |—|

** For Kerto LVL Q-panel with two parallel surface veneers

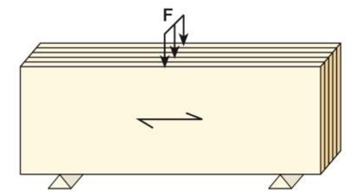
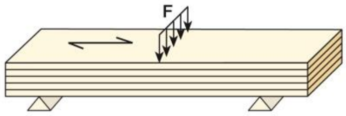
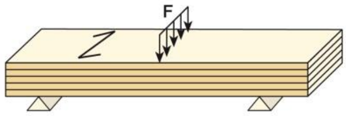
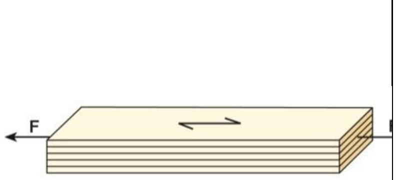
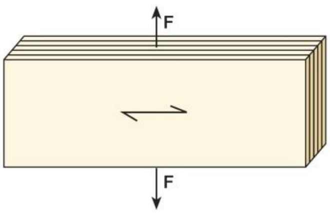
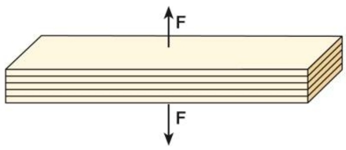
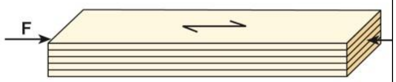
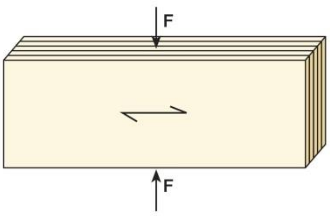
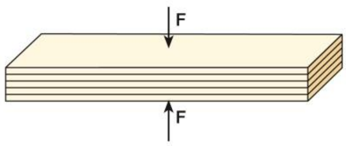
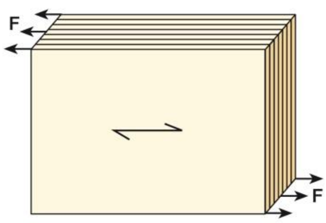
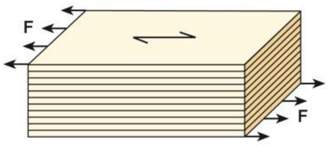
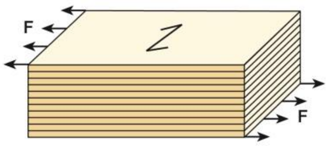
 A. Edgewise bending, parallel to grain (m,0,edge)	 B. Flatwise bending, parallel to grain (m,0,flat)	 C. Flatwise bending, perpendicular to grain (m,90,flat)
 D. Tension, parallel to grain (t,0)	 E. Edgewise tension, perpendicular to grain (t,90, edge)	 F. Flatwise tension, perpendicular to grain (t,90,flat)
 G. Compression, parallel to grain (c,0)	 H. Edgewise compression, perpendicular to grain (c,90,edge)	 I. Flatwise compression, perpendicular to grain (c,90,flat)
 J. Edgewise shear, parallel to grain (v,0,edge)	 K. Flatwise shear, parallel to grain (v,0,flat)	 L. Flatwise shear, perpendicular to grain (v,90,flat)

Figure 1-2. Definitions of the strength and stiffness properties in different orientations.

The characteristic strength values are given at an equilibrium moisture content resulting from a temperature of 20 °C and a relative humidity of 65 % exposed to duration of load of 5 minutes. The characteristic values given in Table 1-2 can be used without any modifications for temperatures below or equal to 50 °C for a prolonged period of time.

Furthermore, the reference width (depth of the beam) in edgewise bending is 300 while the reference length in tensile parallel to grain is 3000 mm. The effect of member size on edgewise bending and tensile strength values shall be taken into account. This is made by the factors k_h and k_l given in Eurocode 5 for which the *s*-values are given in Table 1-2. This also applies for the effective width of the tension flange.

The modification factors k_{mod} and k_{def} for LVL, as defined in Eurocode 5, shall be used in the design of EGO RIPA Elements. Partial safety factor γ_m is defined in National annex of 1995-1-1:2004. γ_m for LVL shall be used for the composite cross section of the elements.

Since the dimensions of EGO RIPA Elements remain quite stable during temperature changes, it is not usually necessary to consider any effects of temperature variations on the structural design.

4. Typical connections between EGO RIPA Elements

EGO RIPA Elements are normally connected to each other with mechanical fasteners. Diagonal screwing is recommended. EGO RIPA Elements shall be designed in such a way that width and thickness changes due to moisture content variation do not cause harmful stresses in the structures. Special attention shall be paid to the design of joints.

EGO RIPA Elements may be top slab supported. Design guide for top slab supported EGO RIPA Elements is provided by the ETA holder.

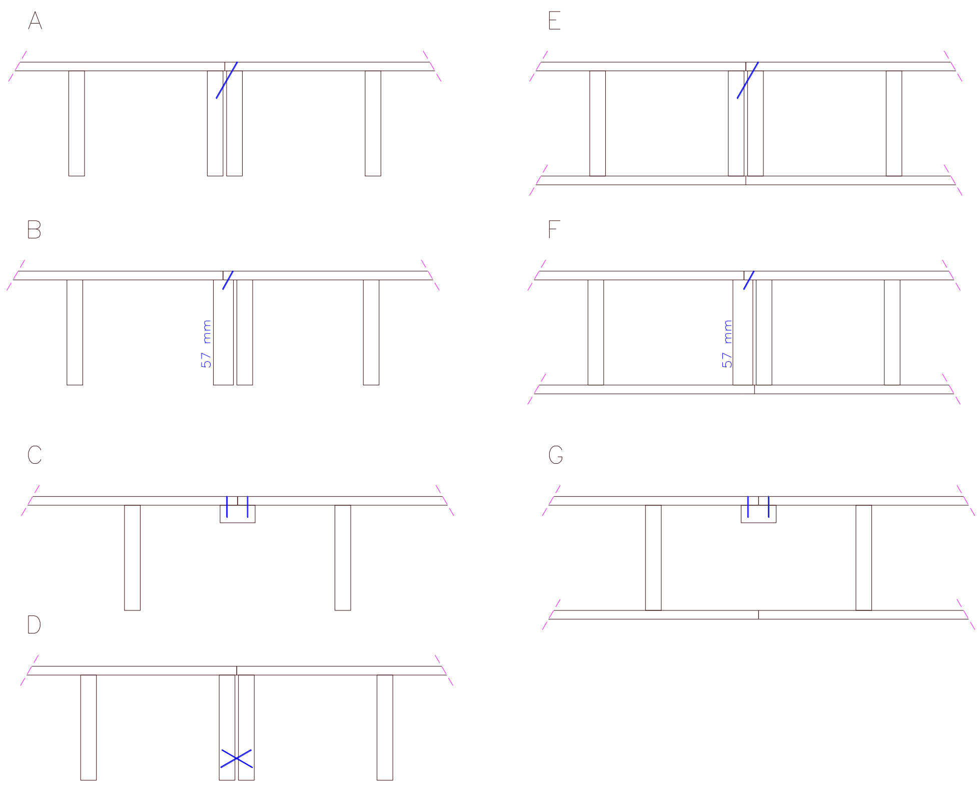


Figure1-3: Principal drawing of connections between EGO RIPA Elements.

ANNEX 2 (INFORMATIVE)
RESISTANCE TO FIRE OF EGO RIPA ELEMENTS

1. EGO RIPA Elements, type closed box element

Structure of EGO RIPA Element in case of closed box element is presented in Annex 1, Figure 1-1, type 2. A floor or roof construction made of EGO RIPA Elements with a continuous bottom slab may have resistance to fire class REI 30, REI 60 or REI 90 if the thickness of the bottom slab is at least 22 mm, 37 mm or 61 mm, respectively.

In fire resistance class REI 30, the bottom slab may also be comprised of at least 19 mm thick Kerto LVL Q-panel and one layer of gypsum plasterboard of type A or type F. In fire class REI 60 or REI 90, the bottom slab may be comprised of at least 25 mm thick Kerto LVL Q-panel and one or two layers of gypsum plasterboard of type A or type F or a combination of them. The thickness of board type A[5] is at least 13 mm and weight 8.2 kg/m^2 and of type F at least 15 mm and weight 12.5 kg/m^2. Gypsum plasterboards type A and F are defined in product standard EN 520.

Further provisions for the classification above:

The thickness of the ribs shall be at least 39 mm and the spacing of the ribs shall not exceed 1250 mm. The cavities may contain insulation or not. The height of the ribs shall not exceed 350 mm added by the height of the insulation layer when the whole bottom slab is charring during the required fire resistance time. When the fire does not proceed into the cavity of the insulated closed box element, or the closed box element is uninsulated, the height of the ribs is not restricted. The elements shall be glued with polyurethane glue Purbond HB 110 or other glue with corresponding strength properties at elevated temperatures.

To have an effect on resistance to fire, insulation in the cavities shall be rock wool installed tightly against the ribs and the thickness of it shall be at least 100 mm and the density of it at least 27 kg/m^3. If the thickness exceeds 100 mm, rock wool shall be fixed in the ribs so that it remains at place during the fire or if rock wool is not fixed it has to be supported with the bottom slab during the whole fire resistance time.

If the spacing of the ribs exceeds 600 mm (600 mm < spacing ≤ 900 mm), the insulation has to be supported with longitudinal timber battens 2 x 22 x 100 mm^2 or Kerto LVL S-beam 39 x 100 mm^2. The battens shall be fixed to the stiffeners of the ribs (maximum c/c 5300 mm) with 4 nails 2.9 x 90 and the bottom slab of the element to the battens or Kerto LVL S-beam with nails 2.9 x 90 c/c 400 mm. If the spacing of the ribs exceeds 900 mm (900 mm < spacing ≤ 1250 mm), start of charring of the ribs shall be at least the required fire resistance time R.

Insulation in the cavities may also be glass wool or insulation of class B - F. If the insulation is glass wool, then fire design may be performed as fire design of the open box element without insulation. If the insulation is of class B – F, then residual thickness of the bottom slab should be at least 10 mm at the time of required fire resistance time R. The values of Tables 2-1 and 2-2 may be used to calculate loadbearing capacity and deflection of the EGO RIPA Element construction with insulation materials specified above.

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[5] Nominal board thickness of type A is 13 mm which corresponds real thickness of 12,5 mm.

Gypsum plasterboards, if any, shall be fixed to the bottom slab of the element at least with 32 mm long gypsum plasterboard screws for one layer and 52 mm long screws for two layers. Maximum spacing of the screws is c/c 200 mm at the edge and end of the board and 300 x 400 mm^2 squares at the centre of the board. In case of two layers of gypsum plasterboards, the joints of the boards shall be staggered.

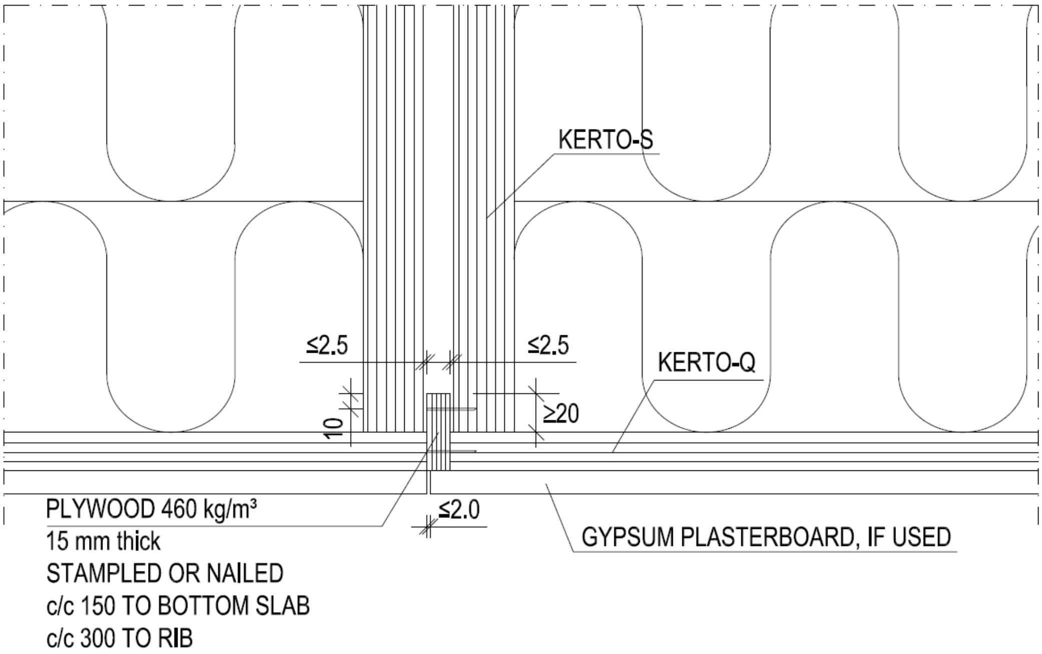


Figure 2-1a. The joint between the elements sealed with a wooden batten or plywood at the bottom of the rib.

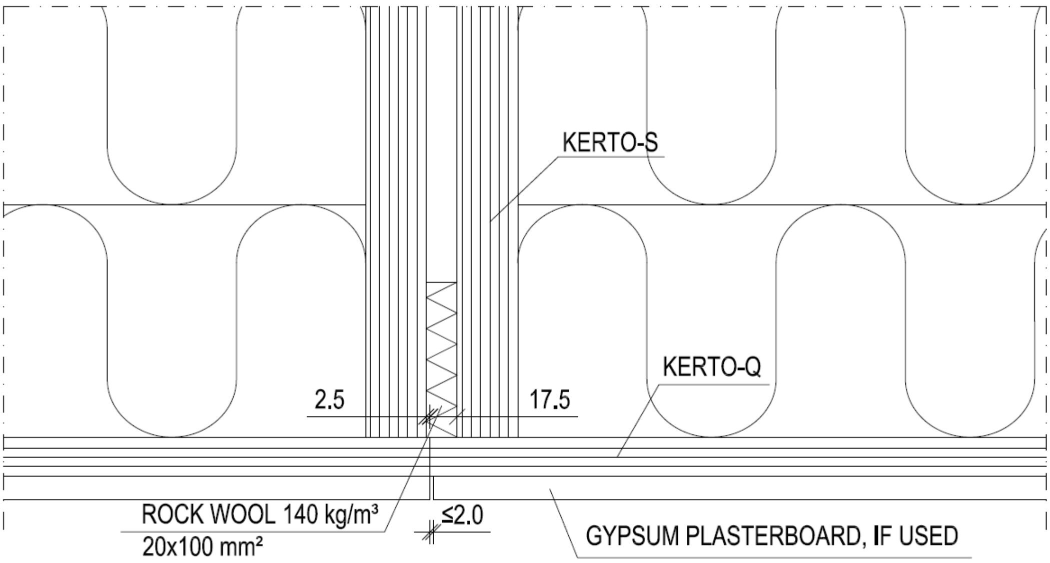


Figure 2-1b. The joint between the elements sealed with rock wool insulation at the bottom of the rib.

The elements shall be fixed together by joint types E and F presented in Figure 1-3 of Annex 1. When using joint type E between the elements they shall be fixed together with two cross screwed, diagonal screws, e.g. ASSY (or comparable), Ø = 6 mm c/c 300 mm (c/c 600 mm / c/c 600 mm) from the top slab, the penetration length of the screw tip in the Kerto LVL rib member shall be at least 50 mm.

When using joint type F between the elements they shall be fixed together with diagonal screws, e.g. ASSY (or comparable), Ø = 5 mm c/c 300 from the top slab, the penetration length of the screw tip in the Kerto LVL rib member shall be at least 50 mm.

The ribs begin to char in the joint between the elements after 40 min unless the butt joint between the bottom slabs is sealed with a wooden batten, plywood or rock wool insulation installed inside the joint, joint types a and b in Figure 2-1. The wooden batten or plywood shall be 15 mm wide and at least 20 mm of the height of the batten or plywood shall be uncharred after the fire. Density of the rock wool insulation shall be 140 kg/m^3 and size of the insulation width x height = 20 x 100 mm^2. If the density of rock wool is less than 140 kg/m^3, the width and thickness of insulation should be increased in such a manner that the amount (kg/m) of compressed insulation is the same as when the insulation with density 140 kg/m^3 is used.

EGO RIPA Elements may be supported so that whole bottom slab rests on the underlay, or by the top slab of the elements, or by metal suspensions attached to every rib. The metal suspensions must be tightly protected in joints between elements with rock wool (thickness 30 mm, density 140 kg/m^3). When designing the suspensions for the fire exposure of 60 min their temperature has to be taken into account: 500 °C at the bottom and 300 °C at the top of the suspension. Protection for the centre suspensions inside the element is not necessary. Metal suspensions are not allowed to be used when fire resistance class REI 90 is required.

A top slab of EGO RIPA Element may be substituted for plywood, but then fire design of the composite structure shall be performed without the top slab, which is only used as stiffening, see structure in Figure 1-1, type 4 of Annex 1.

Loadbearing capacity (for class R) and deflection of the EGO RIPA Element construction in case of fire may be calculated according to EN 1995-1-2:2004/AC Annex C (insulation in the cavity) or D (no insulation in the cavity) taking into account the charring rates, factors and notes given in Tables 2-1 and 2-2. Notional charring rate β_n or β_{n3} of the ribs and top slab shall be determined according to expressions in Tables 2-1 and 2-2 when required fire resistance time $t \geq t_f$ where t_f is failure time of cladding.

Table 2-1. Factors and expressions used in fire design according to EN 1995-1-2:2004/AC Annex C for floors and roofs with rock wool insulation in the cavities.

EGO RIPA Element with continuous bottom slab with rock wool insulation in the cavities						
Bottom slab	Kerto LVL Q-panel	Kerto LVL Q-panel and gypsum plasterboard type A	Kerto LVL Q-panel and gypsum plasterboard type F	Kerto LVL Q-panel and gypsum plasterboards type 2 x A	Kerto LVL Q-panel and gypsum plasterboards type A + F	Kerto LVL Q-panel and gypsum plasterboards type 2 x F
Charring rate of the bottom slab β_0	β_0 = 0.75 mm/min	-	-	-	-	-
Start of charring t_{ch} of the bottom edge of the ribs and failure time of cladding t_f	$t_{ch} = t_f = h_p/\beta_0$-4	$t_{ch} = t_f$ = 50 min when h_{f2} = 25 mm[2)]	$t_{ch} = t_f$ = 60 min when h_{f2} = 25 mm[3)]	$t_{ch} = t_f$ = 60 min when h_{f2} = 25 mm[3)]	$t_{ch} = t_f$ = 70 min when h_{f2} = 25 mm[4)]	$t_{ch} = t_f$ = 75 min when h_{f2} = 25 mm[5)]
Notional charring rate β_n of the bottom edge of the ribs	$\beta_n = k_s\, k_3\, k_n\, \beta_0$ k_s = [1)] k_3 = 3.5 k_n = 1.5 β_0 = 0.65 mm/min	$\beta_n = k_s\, k_3\, k_n\, \beta_0$ k_s = [1)] k_3 = 3.5 k_n = 1.5 β_0 = 0.65 mm/min	$\beta_n = k_s\, k_3\, k_n\, \beta_0$ k_s = [1)] k_3 = 3.5 k_n = 1.5 β_0 = 0.65 mm/min	$\beta_n = k_s\, k_3\, k_n\, \beta_0$ k_s = [1)] k_3 = 3.5 k_n = 1.5 β_0 = 0.65 mm/min	$\beta_n = k_s\, k_3\, k_n\, \beta_0$ k_s = [1)] k_3 = 3.5 k_n = 1.5 β_0 = 0.65 mm/min	$\beta_n = k_s\, k_3\, k_n\, \beta_0$ k_s = [1)] k_3 = 3.5 k_n = 1.5 β_0 = 0.65 mm/min
Start of charring of the vertical edges of the ribs $t_{ch,vertical}$ and the top slab $t_{ch,top}$	$t_{ch,vertical} = t_{ch,top}$ = t_{ch} + 10 min	$t_{ch,vertical} = t_{ch,top}$ = t_{ch} + 10 min	$t_{ch,vertical} = t_{ch,top}$ = t_{ch} + 10 min	$t_{ch,vertical} = t_{ch,top}$ = t_{ch} + 10 min	$t_{ch,vertical} = t_{ch,top}$ = t_{ch} + 10 min	$t_{ch,vertical} = t_{ch,top}$ = t_{ch} + 10 min
Notional charring rate β_n of the vertical edges of the ribs and the top slab	$\beta_n = k_s\, k_3\, k_n\, \beta_0$ k_s = [1)] k_3 = 3.5 k_n = 1.0 β_0 = 0.65 mm/min	$\beta_n = k_s\, k_3\, k_n\, \beta_0$ k_s = [1)] k_3 = 3.5 k_n = 1.0 β_0 = 0.65 mm/min	$\beta_n = k_s\, k_3\, k_n\, \beta_0$ k_s = [1)] k_3 = 3.5 k_n = 1.0 β_0 = 0.65 mm/min	$\beta_n = k_s\, k_3\, k_n\, \beta_0$ k_s = [1)] k_3 = 3.5 k_n = 1.0 β_0 = 0.65 mm/min	$\beta_n = k_s\, k_3\, k_n\, \beta_0$ k_s = [1)] k_3 = 3.5 k_n = 1.0 β_0 = 0.65 mm/min	$\beta_n = k_s\, k_3\, k_n\, \beta_0$ k_s = [1)] k_3 = 3.5 k_n = 1.0 β_0 = 0.65 mm/min
Design of the residual cross section as a composite structure after charring of the bottom slab	always	always	always	always	always	always

[1)] according to EN 1995-1-2:2004 Table C1 for the bottom and vertical edges of the ribs and k_s = 1.0 for the bottom slab
[2)] if $h_{f2} \neq$ 25 mm t_{ch} = 50 + (h_{f2} - 25)/0.65 [min] when charring rate of the bottom slab β_0 = 0.65 mm/min
[3)] if $h_{f2} \neq$ 25 mm t_{ch} = 60 + (h_{f2} - 25)/0.65 [min] when charring rate of the bottom slab β_0 = 0.65 mm/min
[4)] if $h_{f2} \neq$ 25 mm t_{ch} = 70 + (h_{f2} - 25)/0.65 [min] when charring rate of the bottom slab β_0 = 0.65 mm/min
[5)] if $h_{f2} \neq$ 25 mm t_{ch} = 75 + (h_{f2} - 25)/0.65 [min] when charring rate of the bottom slab β_0 = 0.65 mm/min

Required thickness of the bottom slab h_{f2} may be calculated as follows:

$h_{f2} \geq (t_{req} - t_{ch,25})*0.65 + 25 + h_{B\text{-}F}$ [mm]

where
t_{req} is the required fire resistance time [min]
$t_{ch,25}$ is the time of start of charring for the ribs when 25 mm thick board as the bottom flange (according to Table 1) [min]
$h_{B\text{-}F}$ is required residual thickness of the bottom slab [mm]

The nominal board thickness of type A is at least 13 mm which corresponds real thickness of 12,5 mm and the nominal board thickness of type F is at least 15mm.

Table 2-2. Factors and expressions used in fire design according to EN 1995-1-2:2004/AC Annex D for floors and roofs without insulation in the cavities.

EGO RIPA Element with continuous bottom slab without rock wool insulation in the cavities						
Bottom slab	Kerto LVL Q-panel	Kerto LVL Q-panel and gypsum plasterboard type A	Kerto LVL Q-panel and gypsum plasterboard type F	Kerto LVL Q-panel and gypsum plasterboards type 2 x A	Kerto LVL Q-panel and gypsum plasterboards type A + F	Kerto LVL Q-panel and gypsum plasterboards type 2 x F
Charring rate of the bottom slab β_0	$\beta_0 = 0.65$ mm/min	-	-	-	-	-
Start of charring t_{ch} of the bottom edge of the ribs and failure time of cladding t_f	$t_{ch} = t_f = h_p/\beta_0 - 4$	$t_{ch} = t_f = 50$ min when $h_{f2} = 25$ mm[1)]	$t_{ch} = t_f$ = 60 min when $h_{f2} = 25$ mm[2)]	$t_{ch} = t_f$ = 60 min when $h_{f2} = 25$ mm[2)]	$t_{ch} = t_f$ = 70 min when $h_{f2} = 25$ mm[3)]	$t_{ch} = t_f$ = 75 min when $h_{f2} = 25$ mm[4)]
Notional charring rate β_{n3} of the bottom edge of the ribs	$\beta_{n3} = k_3\,\beta_n$ $k_3 = 2.0$ $\beta n = 0.7$ mm/min	$\beta_{n3} = k_3\,\beta_n$ $k_3 = 2.0$ $\beta n = 0.7$ mm/min	$\beta_{n3} = k_3\,\beta_n$ $k_3 = 2.0$ $\beta n = 0.7$ mm/min	$\beta_{n3} = k_3\,\beta_n$ $k_3 = 2.0$ $\beta n = 0.7$ mm/min	$\beta_{n3} = k_3\,\beta_n$ $k_3 = 2.0$ $\beta n = 0.7$ mm/min	$\beta_{n3} = k_3\,\beta_n$ $k_3 = 2.0$ $\beta n = 0.7$ mm/min
Start of charring of the vertical edges of the ribs $t_{ch,vertical}$ and the top slab $t_{ch,top}$	$t_{ch,vertical} = t_{ch,top} = t_{ch}$	$t_{ch,vertical} = t_{ch,top} = t_{ch}$	$t_{ch,vertical} = t_{ch,top} = t_{ch}$	$t_{ch,vertical} = t_{ch,top} = t_{ch}$	$t_{ch,vertical} = t_{ch,top} = t_{ch}$	$t_{ch,vertical} = t_{ch,top} = t_{ch}$
Notional charring rate β_{n3} of the vertical edges of the ribs and the top slab	$\beta_{n3} = k_3\,\beta_n$ $k_3 = 2.0$ $\beta n = 0.7$ mm/min	$\beta_{n3} = k_3\,\beta_n$ $k_3 = 2.0$ $\beta n = 0.7$ mm/min	$\beta_{n3} = k_3\,\beta_n$ $k_3 = 2.0$ $\beta n = 0.7$ mm/min	$\beta_{n3} = k_3\,\beta_n$ $k_3 = 2.0$ $\beta n = 0.7$ mm/min	$\beta_{n3} = k_3\,\beta_n$ $k_3 = 2.0$ $\beta n = 0.7$ mm/min	$\beta_{n3} = k_3\,\beta_n$ $k_3 = 2.0$ $\beta n = 0.7$ mm/min
Design of the residual cross section as a composite structure after charring of the bottom slab	if shear stress between the rib and the bottom slab ≤ 1.5 N/mm^2	if shear stress between the rib and the bottom slab ≤ 1.5 N/mm^2	if shear stress between the rib and the bottom slab ≤ 1.5 N/mm^2	if shear stress between the rib and the bottom slab ≤ 1.5 N/mm^2	if shear stress between the rib and the bottom slab ≤ 1.5 N/mm^2	if shear stress between the rib and the bottom slab ≤ 1.5 N/mm^2

[1)] if $h_{f2} \neq 25$ mm $t_{ch} = 50 + (h_{f2} - 25)/0.65$ [min] when charring rate of the bottom slab $\beta_0 = 0.65$ mm/min
[2)] if $h_{f2} \neq 25$ mm $t_{ch} = 60 + (h_{f2} - 25)/0.65$ [min] when charring rate of the bottom slab $\beta_0 = 0.65$ mm/min
[3)] if $h_{f2} \neq 25$ mm $t_{ch} = 70 + (h_{f2} - 25)/0.65$ [min] when charring rate of the bottom slab $\beta_0 = 0.65$ mm/min
[4)] if $h_{f2} \neq 25$ mm $t_{ch} = 75 + (h_{f2} - 25)/0.65$ [min] when charring rate of the bottom slab $\beta_0 = 0.65$ mm/min

Required thickness of the bottom slab h_{f2} may be calculated as follows:

$h_{f2} \geq (t_{req} - t_{ch,25})*0.65 + 25 + h_{B\text{-}F}$ [mm]

where

t_{req} is the required fire resistance time [min]
$t_{ch,25}$ is the time of start of charring for the ribs when 25 mm thick board as the bottom flange (according to Table 1) [min]
$h_{B\text{-}F}$ is required residual thickness of the bottom slab [mm]

The nominal board thickness of type A is at least 13 mm which corresponds real thickness of 12,5 mm and the nominal board thickness of type F is at least 15mm.

Modification factor $k_{mod,fm,fi}$ values for bending and axial strength of LVL are given in Table 2-3 *(exposed side in tension)* and Table 2-4 (*exposed side in compression)* when the structure includes insulation in the cavities. $k_{mod,fm,fi}$ value is 1.0 when the structure does not include insulation in the cavities.

In d_{char} / h for the modification factor $k_{mod,fm,fi}$, the depth h is the total depth of the element as the sum of the thicknesses of the bottom and top slab and the height of the rib. Charring depth d_{char} is charring depth of the bottom slab and the bottom edge of the rib added together. Height in case of fire h_{fi} may be used in calculation of the factor k_h (given in EN 1995-1-1 equation (3.3)) for characteristic value for bending strength $f_{m,k}$.

Table 2-3. Modification factor $k_{mod,fm,fi}$ for bending and axial strength of LVL with exposed side in tension when the floor or roof construction includes insulation. Interpolation can be used for the intermediate values.

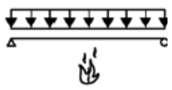
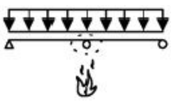
	$k_{mod,fm,fi}$, **when** d_{char} / h							
	h [mm]	**0**	**0,1**	**0,2**	**0,3**	**0,4**	**0,5**	**0,9**
	95	0.6	0.55	0.51	0.46	0.42	0.37	0.19
	145	0.68	0.63	0.58	0.53	0.48	0.43	0.24
	**195**	0.73	0.68	0.63	0.58	0.53	0.48	0.27
Bending strength with exposed side in tension	**220**	0.76	0.71	0.66	0.61	0.56	0.51	0.3
	300	0.84	0.79	0.74	0.69	0.64	0.59	0.38
	400	0.94	0.89	0.84	0.79	0.74	0.69	0.48
	500	1	0.95	0.9	0.85	0.8	0.75	0.54
	600	1.00	1.00	0.96	0.91	0.86	0.81	0.60
	1200	1.00	1.00	1.00				

Table 2-4. Modification factor $k_{mod,fm,fi}$ for bending and axial strength of LVL with exposed side in compression when the floor or roof construction includes insulation. Interpolation can be used for the intermediate values.

	$k_{mod,fm,fi}$, **when** d_{char} / h							
	h [mm]	**0**	**0,1**	**0,2**	**0,3**	**0,4**	**0,5**	**0,9**
	95	0.46	0.42	0.39	0.35	0.31	0.28	0.13
	145	0.55	0.51	0.47	0.43	0.39	0.35	0.19
	**195**	0.65	0.60	0.55	0.51	0.46	0.41	0.22
Bending strength with exposed side in compression	**220**	0.67	0.62	0.58	0.53	0.48	0.44	0.25
	300	0.73	0.68	0.64	0.59	0.55	0.50	0.32
	400	0.81	0.76	0.72	0.67	0.63	0.58	0.40
	500	0.89	0.84	0.80	0.75	0.71	0.66	0.48
	600	0.97	0.92	0.88	0.83	0.79	0.74	0.56
	1200	1.00	1.00	1.00				

Alternatively modification factor $k_{mod,fm,fi}$ for bending and axial strength of LVL until element height of 500 mm may be calculated as

$k_{mod,fm,fi} = a_0 - a_1(d_{char,n}/h)$

where

a_0 and a_1 are values given in Table 2-5.

When element height > 500 mm the modification factor $k_{mod,fm,fi}$ increases with the same slope a_3 as for element height ≤ 500 mm until the modification factor $k_{mod,fm,fi}$ achieves the value of 1. Thus modification factor $k_{mod,fm,fi}$ for bending and axial strength of LVL when element height > 500 mm may be calculated as

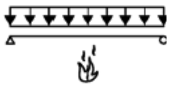
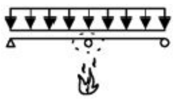
$k_{mod,fm,fi} = k_{mod,fm,fi,500} + a_3(h\text{-}500)$

where

$k_{mod,fm,fi,500}$ is modification factor with element height of 500 mm,

a_3 is 0.0006 when exposed side is in tension and 0.0008 when exposed side is in compression.

Table 2-5. Values of a_0 and a_1 for calculation of modification factor $k_{mod,fm,fi}$ when exposed side in tension or exposed side in compression.

<table>
<tr><td rowspan="8">
Bending strength with exposed side in tension</td><td>h [mm]</td><td>a_0</td><td>a_1</td></tr>
<tr><td>95</td><td>0.60</td><td>0.46</td></tr>
<tr><td>145</td><td>0.68</td><td>0.49</td></tr>
<tr><td>195</td><td>0.73</td><td>0.51</td></tr>
<tr><td>220</td><td>0.76</td><td>0.51</td></tr>
<tr><td>300</td><td>0.84</td><td>0.51</td></tr>
<tr><td>400</td><td>0.94</td><td>0.51</td></tr>
<tr><td>500</td><td>1.00</td><td>0.51</td></tr>
<tr><td rowspan="8">
Bending strength with exposed side in compression</td><td>h [mm]</td><td>a_0</td><td>a_1</td></tr>
<tr><td>95</td><td>0.46</td><td>0.37</td></tr>
<tr><td>145</td><td>0.55</td><td>0.40</td></tr>
<tr><td>195</td><td>0.65</td><td>0.48</td></tr>
<tr><td>220</td><td>0.67</td><td>0.47</td></tr>
<tr><td>300</td><td>0.725</td><td>0.45</td></tr>
<tr><td>400</td><td>0.805</td><td>0.45</td></tr>
<tr><td>500</td><td>0.885</td><td>0.45</td></tr>
</table>

If Kerto LVL Q-panel is only partially charred, loadbearing capacity of the element in case of fire may be calculated according to EN 1995-1-2:2004/AC Annex D. Charring rate of the bottom slab β_0 = 0.65 mm/min shall be used together with the values of Table 2-6 for start of charring t_{ch}, failure time of cladding t_f, insulation factor k_2 and post-protection factor k_3 of gypsum plaster boards.

The deflection in the fire situation should not exceed $D = L^2/(2600*d)$ [mm] where L = the span of the element [mm] and $d = h_{f1} + h_w + h_{f2}$ [mm]. Modulus of elasticity at normal temperature may be used when calculating the deflection.

2. EGO RIPA Elements, type open box element

Structure of EGO RIPA Element in case of open box element is presented in Annex 1, Figure 1-1, type 3. A floor or roof construction made of EGO RIPA Elements without a continuous bottom slab may have resistance to fire class REI 30 or REI 60 or REI 90 if the thickness of the bottom flange (Kerto LVL S-beam or Kerto LVL Q-panel) is at least 43 mm and the width 300 mm in the middle and 150 mm at the edge.

Further provisions for the classification above:

The bottom surface of the element shall be covered with gypsum plasterboards type 2 x A, A + F, 2 x F, F or A in fire resistance class REI 30; type 2 x A, A + F, 2 x F or F in class REI 60 and type A + F or 2 x F in class REI 90. The thickness of board type A is at least 13 mm and weight 8.2 kg/m^2 and type F at least 15 mm and weight 12.5 kg/m^2. The board types A and F are defined in product standard EN 520.

The thickness of the ribs shall be at least 45 mm and the spacing of the ribs must not exceed 585 mm for claddings type A or F and 833 mm for claddings type 2 x A, A + F or 2 x F. The height of the ribs must not exceed 350 mm added by the height of the rock wool layer. The elements shall be glued with polyurethane glue Purbond HB 110 or other glue with corresponding strength properties at elevated temperatures.

To have an effect on resistance to fire, insulation in the cavities shall be rock wool slabs installed tightly against the ribs and the thickness of it shall be at least 100 mm and the density of it at least 30 kg/m3. If the thickness exceeds 100 mm and it consists of two layers of insulation, the joints of the insulation slabs shall be overlapped and residual thickness of the bottom flange (Kerto LVL S-beam or Kerto LVL Q-panel) shall be at least 10 mm at the time of the required fire resistance time R.

Insulation in the cavities may also be glass wool (density 15 kg/m^3) in fire class REI 30 if the element is covered with gypsum plasterboards type 2 x A, A + F or 2 x F and in fire class REI 60 if the element is covered with gypsum plasterboards type 2 x F. Table 2-4 may be used to calculate the start of charring.

Gypsum plasterboards are fixed to the bottom flanges of the slab by the aid of acoustic battens AP 25 c/c 400 mm. The first layer of gypsum plasterboards shall be fixed to acoustic battens with screws 3.5 x 25 c/c 300 mm and the second layer with screws 3.5 x 35 c/c 300 mm. The acoustic battens shall be fixed to the bottom flanges of the slab with screws 4.2 x 55, 1 pc / bottom flange and the minimum penetration length of the screw into unburnt wood shall be at least 10 mm.

The elements shall be fixed together by joint types E and F shown in Figure 1-2 of Annex 1. When using joint type E the elements shall be fixed together with two cross screwed, diagonal screws, e.g. ASSY (or comparable), Ø = 6 mm c/c 300 mm (c/c 600 mm / c/c 600 mm) from the top slab, the penetration length of the screw tip in the Kerto LVL member shall be at least 50 mm.

When using joint type F the elements shall be fixed together with diagonal screws, e.g. ASSY (or comparable), Ø = 6 mm c/c 300 mm from the top slab, the penetration length of the screw tip in the Kerto LVL member shall be at least 50 mm.

A gap between elements shall not exceed 20 mm and it shall be sealed with plywood installed between the elements at the bottom and 40 x 25 EPDM-gasket or polyurethane foam, Figure 2-2. The plywood shall be 15 mm wide and at least 20 mm of the height of the plywood shall be uncharred after the fire. Instead of EPDM-gasket other materials with similar fire properties may be used. EPDM-gasket and polyurethane foam may also be substituted for rock wool insulation with the density of 140 kg/m^3 and size of 20 x 100 mm^2 (width x height). If the density of rock wool is less than 140 kg/m^3 the width and thickness of insulation should be increased in such a manner that the amount (kg/m) of compressed insulation is the same as when the insulation with density 140 kg/m^3 is used.

A gap between elements may also be sealed only with plywood installed between the elements at the bottom if there is a leak-proof layer (euroclass A1) like stone wool with high density of 120 kg/m^3 at the top of the joint. Then plywood shall be 15 mm wide and at least 40 mm of the height of the plywood shall be uncharred after the fire.

In case of fire, EGO RIPA Elements may be supported so that whole bottom slab rests on the underlay or by the top slab of the elements.

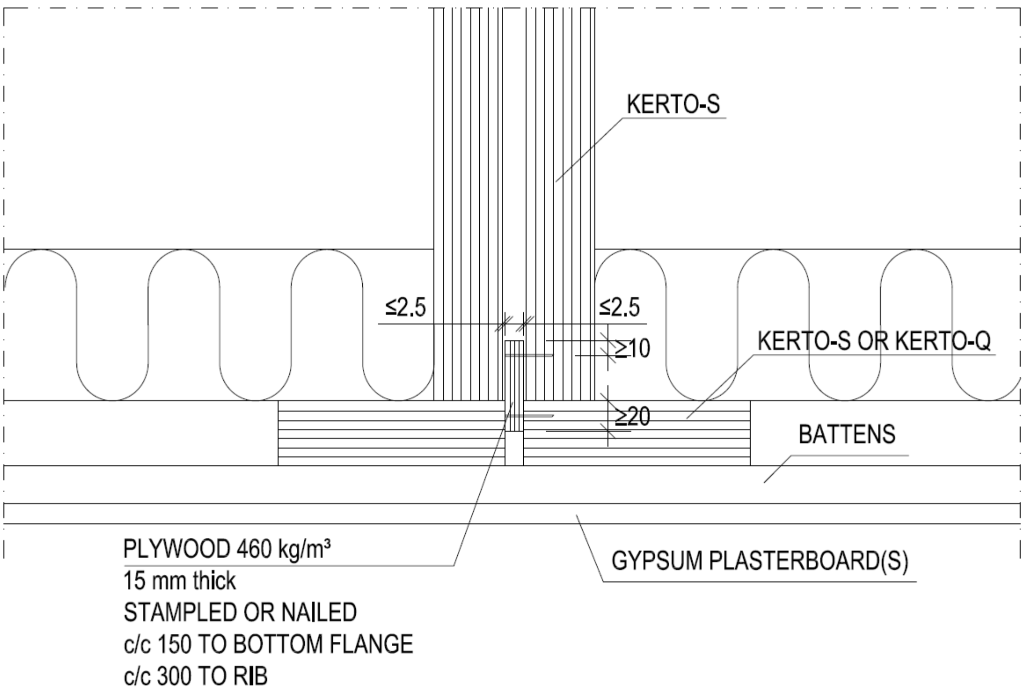


Figure 2-2. The joint between the elements sealed with plywood at the bottom of the rib.

Loadbearing capacity and deflection of EGO RIPA Element construction without a continuous bottom slab can be fire calculated for maximum fire resistance time of 90 minutes (R) according to EN 1995-1-2:2004/AC Annex C taking into account the factors and notes given in Table 2-6. Notional charring rate β_n is determined according to following expressions:

$\beta_n = k_s\, k_2\, k_n\, \beta_0$ for $t_{ch} \leq t \leq t_f$

$\beta_n = k_s\, k_3\, k_n\, \beta_0$ for $t > t_f$

where

β_0 = 0.65 mm/min, one-dimensional charring rate

k_s = 1 cross-section factor for the top slab and bottom flange

k_n = 1 factor to convert the irregular residual cross-section into a notional rectangular cross-section

Three edges of the bottom flange are exposed to fire after the failure of cladding.

Table 2-6. Factors used in fire design according to EN 1995-1-2:2004 Annex C.

EGO RIPA Element with rock wool insulation in the cavities and covered with gypsum plasterboard					
	type 2 x A	**type A + F**	**type 2 x F**	**type F**	**type A**
Start of charring t_{ch}	30 min	40 min	60 min	20 min	10 min
Failure time of cladding t_f	30 min	45 min	65 min	30 min	10 min
Insulation factor k_2	-	0.85	0.85	0.85	-
Post-protection factor k_3	3	3	3	3	3
Start of charring of the vertical edges of the ribs and the top slab	75 min	85 min	> 90 min	> 60 min	> 30 min
Design of the residual cross section as a composite structure after charring of the bottom flange					

As modification factor $k_{mod,fm,fi}$ for bending and axial strength of LVL can be used the values given in Table 2-3 and 2-4. In d_{char} / h for modification factor $k_{mod,fm,fi}$, depth h of the element is sum of the thicknesses of the bottom flange and top slab and the height of the rib. Charring depth d_{char} is charring depth of the bottom flange and the rib added together. Height in case of fire h_{fi} may be used when defining the factor k_h (given in EN 1995-1-1 equation (3.3)) for characteristic value for bending strength $f_{m,k}$.

The deflection in the fire situation is not allowed to exceed $D = L^2/(1600 \cdot d)$ [mm] where L = the span of the element [mm] and $d = h_{f1} + h_w + h_{f2}$ [mm]. Modulus of elasticity at normal temperature can be used when calculating the deflection.

3. EGO RIPA Elements, type ribbed element

Fire design of the elements in case of ribbed element in Annex 1, Figure 1-1, type 1 shall be performed according to EN 1995-1-2:2004 and relevant National Annex.