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European Technical Assessment ETA 18/1132 of 26/4/2023

I General Part

Technical Assessment Body issuing the ETA	**Eurofins Expert Services Oy**
Trade name of the construction product	**Sylva™ LVL Rib by Stora Enso**
Product family to which the construction product belongs	Wood based composite slab element for structural purposes
Manufacturer	**Stora Enso Oyj** Salmisaarenaukio 2 FI-00180 Helsinki, Finland
Manufacturing plants	Annex N
This European Technical Assessment contains	30 pages including 3 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	EAD 140022-00-0304, Pre-fabricated wood-based loadbearing stressed skin panels
This version replaces	ETA 18/1132 issued on 21.12.2021

II Specific Part

1. Technical description of the product

Sylva™ LVL Rib by Stora Enso is a composite slab element made of X- and S-types structural laminated veneer lumber by Stora Enso according to EN 14374. The adhesive is of type EN 15425 polyurethane adhesive. Sylva™ LVL Rib may contain screws and nails, but they do not have an influence on the composite effect. They are only used to fix secondary construction elements; or to achieve the compression necessary for gluing. The materials, dimensions and tolerances are given in Annex 1.

Sylva™ LVL Rib is intended to be used as a structural or non-structural element in buildings and bridges. Sylva™ LVL Rib may function as directly load bearing.

The products have rectangular or trapezoid shape with parallel longitudinal edges and at maximum 30 degrees angle between the short ends. The maximum length of the elements is 24m and the typical height up to 1200mm. Typical lengths are from 6 m to 18 m and width up to 2,5m.

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

2.1. Intended uses

Sylva™ LVL Rib is intended to be used as directly load bearing elements.

With regard to moisture behaviour of the product, the product shall be used in service classes 1 and 2, according to EN 1995 1.1. If Sylva™ LVL Rib is intended to be a part of the external envelope of the building, it shall be protected adequately, e.g. by a roof or by cladding.

The Sylva™ LVL Rib elements are only intended to be used subject to static or quasi-static actions. In seismic areas the behaviour factor of Sylva™ LVL Rib elements 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 clauses 1.5.2 and 8.1.3 b).

2.2. Working life

The provisions made in this European Technical Assessment are based on an assumed intended working life of Sylva™ LVL Rib of 50 years when installed in the works, provided that the panels 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.

[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.

2.3. 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.

2.4. Manufacturing

Gluing of slabs to ribs shall be performed according to the ETA holder's instructions assessed by Eurofins Expert Services Oy. The gluing pressure can be applied by a hydraulic press or the applying screw/nail press-gluing as specified in detail in the instructions of the ETA holder's quality manual. When the instructions are updated by substantial changes which have major influence to the technology, the TAB Eurofins Expert Services Oy shall be informed about the changes before they are introduced.

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.

2.6. Installation

Sylva™ LVL Rib shall be installed by appropriately qualified personnel, following the installation plan for each project. The panels 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 Annex 1 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 Sylva™ LVL Rib 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, Annex 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, Annex 2
BWR 3. Hygiene, health and the environment	
Content, emission and/or release of dangerous substances	Clause 3.3.1
BWR 4 Safety and accessibility in use	
Impact resistance	No performance assessed
BWR 5 Protection against noise	
Airborne sound insulation	3.4.1, Annex 3
Impact sound insulation	3.4.2, Annex 3
Sound absorption	No performance assessed
BWR 6 Energy economy and heat retention	
Thermal resistance	Clause 3.5.1
Air permeability	Clause 3.5.2
Aspects of durability	
Natural durability	Clause 3.6.1

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 following possibilities have been considered in the assessment:

1. The manufacturer declares the performance of the product by referring to geometric details of the product and to the performance of the materials used. For this purpose, all building components are described with regard to their materials and their structure in Annex 1 and further specified in the production documentation of each Sylva™ LVL Rib element.

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

2. The manufacturer declares the performance of the product by referring to production documentation received from the client.

3. The manufacturer declares the performance of the product by referring to structural design calculations of the structural construction product prepared by him.

The structural performance of Sylva™ LVL Rib is considered in accordance with the limit state design principles specified in Eurocodes. Both ultimate limit state and serviceability limit state (comprising vibrations when relevant) are considered. Calculation methods follow EN 1995-1-1. Methods are described in Sylva™ LVL Rib design manual.

Structural design shall be documented. Strength values of LVL-S and LVL-X by Stora Enso to be used in design together with information of the dimensions of the components are given in Annex 1.

Eurofins Expert Services has assessed the design instructions of the manufacturer. In case of changes which have substantial influence to the structural design, the design instructions should be updated and the TAB Eurofins Expert Services Oy shall be informed about the changes before they are introduced.

3.1.2. Dimensional stability

In normal conditions, harmful deformations due to moisture changes of the Sylva™ LVL Rib are not expected. When necessary, the dimensional change ΔL of the 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

	LVL-S	LVL-X
Thickness	0.0030	0.0044
Width	0.0031	0.00033
Length	0.0001	0.0001

3.2. Safety in case of fire, BWR 2

3.2.1. Reaction to fire

Untreated X- and S-type LVL are classified to have reaction to fire class D-s1, d0. The classification is valid for the following end use applications: With or without an air gap between the product and a wood-based product or any substrate of classes A1 and A2-s1, d0 with density of at least 337.5 kg/m3.

If thermal insulation is used inside the elements, it shall be classified to have reaction to fire class A1 as a default. Sylva™ LVL Rib treated against fire is not covered by this ETA.

3.2.2. Resistance to fire

Structures with REI 30, REI 90 and REI 120 classifications are specified in Annex 2. However thermal insulation and gypsum plasterboards are installed normally at building site and therefore the stressed skin panel itself does not have the REI classification.

LVL X panel slab on the lower side of Sylva™ LVL Rib – closed type may be used as protection for the rest of the Sylva™ LVL Rib. This protective construction shall be designed and planned appropriately according to EN 1995 - 1 – 2:2004 and the relevant National Annex and together with the instruction given in Annex 2.

Sylva™ LVL Rib 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.

3.3. Hygiene, health and environment, BWR 3

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

Dangerous substances

The formaldehyde release class of the LVL used is E1 in accordance with EN 14374. The product does not contain pentachlorophenol, or recycled wood. LVL products by Stora Enso have formaldehyde releases less than E1 class requirement 0,10 ppm when determined in accordance with EN 717-1.

The manufacturer has not declared that the Sylva™ LVL Rib would contain other dangerous substances.

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. Protection against noise, BWR 5

3.4.1. Airborne sound insulation

Measured values for weighted sound reduction index R_w and spectrum adoption terms (C ; C_{tr} ; $C_{50\text{-}3150}$) of a range of Sylva™ LVL Rib, floor topping and ceiling combinations are given in Annex 3, figures 3-1a and 3-1b and in table 3-3.

3.4.2. Impact sound insulation

Measured values for weighted impact sound pressure level $L_{n,w}$ and spectrum adoption terms (C_I : $C_{I,50\text{-}2500}$) of a range of Sylva™ LVL Rib, floor topping and ceiling combinations are given in Annex 3, figures 3-1a and 3-1b and in table 3-3.

3.5. Energy economy and heat retention, BWR 6

3.5.1. Thermal resistance

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. *U*-values of some Sylva™ LVL Rib alternatives are given in Annex 3, figures 3-1a and 3-1b

3.5.2. Air permeability

A construction with Sylva™ LVL Rib, 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.

3.6. Aspects of durability

3.6.1. Natural durability

The adhesive of type I can be used in service classes 1, 2 and 3 but natural durability class of LVL is 5 according to EN 350-2. Thus, Sylva™ LVL Rib 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. 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, Sylva™ LVL Rib 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.

5.1. Tasks of the manufacturer

The manufacturer has 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.

5.1. 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 April 26, 2023
by Eurofins Expert Services Oy

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ANNEX 1
DESCRIPTION OF SYLVA™ LVL RIB

1. Cross sections and sizes

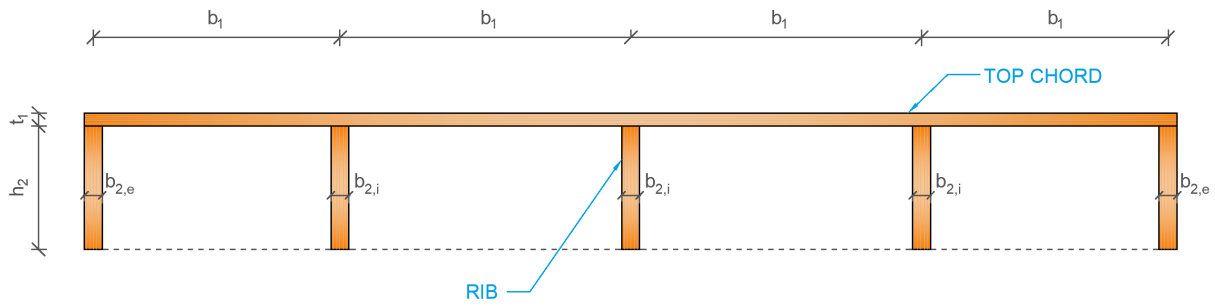


Figure 1-1. Sylva™ LVL Rib– *Open*

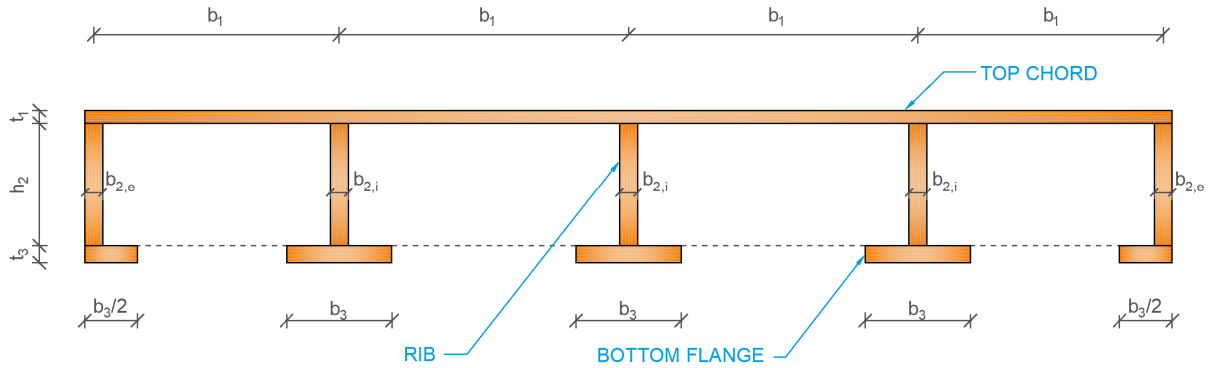


Figure 1-2. Sylva™ LVL Rib – *Semi Open*

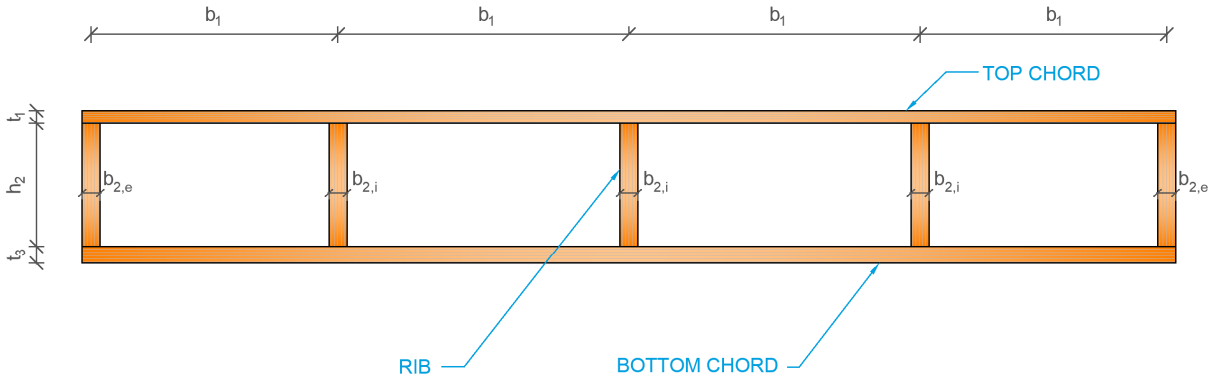


Figure 1-3. Sylva™ LVL Rib – *Closed*

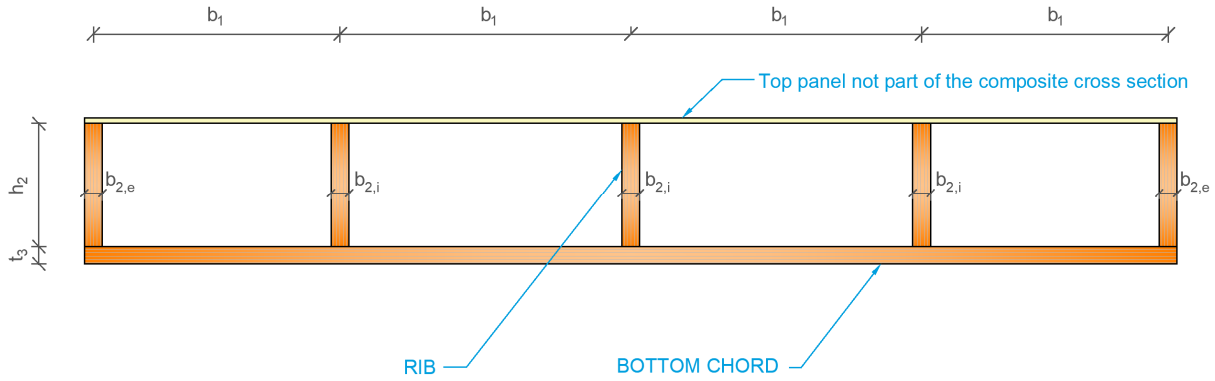


Figure 1-4. Sylva™ LVL Rib – *Inverted*

Typical dimensions of the members to be glued together are
b_2 = 39 to 75 mm
h_2 = 100 to 1150 mm (h_2 < 15,4 x thickness of rib b_2)
h_1 and h_3 = 22 to 73 mm

2. Tolerances of dimensions

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

Table 1-1. Tolerances of the Sylva™ LVL Rib.

Dimension		Tolerance [mm] or [%]
Depth of the Sylva™ LVL Rib	$h_{rib} \leq 300$mm	+/- 2 mm
	300mm < $h_{rib} \leq 600$mm	+/- 3 mm
	$h_{rib} > 600$mm	-0,5 %·h / +1 %·h
Width of the Sylva™ LVL Rib		± 2 mm or ± 0,5 %
Length of the Sylva™ LVL Rib		± 5 mm

All tolerances are based on standard LVL production with a moisture content of 10 ± 2%.

The thickness of sanded LVL slabs is the nominal thickness decreased by 1mm for each sanded surface. LVL slabs used in Sylva™ LVL Rib 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 Sylva™ LVL Rib.

3. Specifications of components

The components are made of LVL by Stora Enso. Orientation of the LVL material is given in Figure 1-2. The material properties comply with EN 14374. The characteristic strength values of the LVL by Stora Enso shall be at least as given in Table 1-2.

The adhesive used in manufacturing of Sylva™ LVL Rib glued components is of type I (full exposure to the weather) as defined in EN15425. The adhesives used shall be approved for gluing of load-bearing structures and suitable for gluing of LVL.

Other materials and components needed for the fire resistance class REI 30, REI90 and REI120 are specified in Annex 2.

Table 1-2. The characteristic values of LVL-S and LVL-X by Stora Enso to be used in the design of Sylva™ LVL Rib.

Property	Reference in Figure 1-5	**Symbol**	LVL- S N/mm² or kg/m³ Thickness 24-75 mm	LVL- X N/mm² or kg/m³ Thickness 24-75 mm
Bending strength:				
Parallel to grain, edgewise (reference depth 300 mm)	*A*	$f_{m,0,edge,k}$	44	32
Size effect parameter	*A*	*s*	0,12	0,12
Perpendicular to grain, edgewise	*A'*	$f_{m,90,edge,k}$	-	8,0
Parallel to grain, flatwise	*B*	$f_{m,0,flat,k}$	50	36
Perpendicular to grain, flatwise	*C*	$f_{m,90,flat,k}$	-	8,0
Tension strength:				
Parallel to grain (length 3000 mm)	*D*	$f_{t,0,k}$	35	26
Perpendicular to grain, edgewise	*E*	$f_{t,90,edge,k}$	0,8	6,0
Perpendicular to grain, flatwise	*F*	$f_{t,90,flat,k}$	0,35	-
Compression strength:				
Parallel to grain	*G*	$f_{c,0,k}$	35	26
Perpendicular to grain, edgewise	*H*	$f_{c,90,edge,k}$	6,0	9,0
Perpendicular to grain, flatwise	*I*	$f_{c,90,flat,k}$	2,2	2,2
Shear strength:				
Edgewise	*J*	$f_{v,edge,k}$	4,2	4,5
Parallel to grain, flatwise	*K*	$f_{v,0,flat,k}$	2,3	1,3
Perpendicular to grain, flatwise	*L*	$f_{v,90,flat,k}$	-	0,6
Modulus of elasticity:				
Parallel to grain, along, edge & flatwise (mean)	*A, D, G*	$E_{0,mean}$	13800	10500
Parallel to grain, along, edge & flatwise (5%-fractile)	*A, D, G*	$E_{0,k}$	11600	8800
Perpendicular to grain, edgewise (mean)	*H*	$E_{90,edge,mean}$	-	2400
Perpendicular to grain, edgewise (5%-fractile)	*H*	$E_{90,edge,k}$	-	2000
Bending perpendicular to grain, edgewise (mean)	*A'*	$E_{90,edgewise,mean}$	-	2400
Bending perpendicular to grain, edgewise(5% fractile)	*A'*	$E_{90,edgewise,k}$	-	1800
Bending perpendicular to grain, flatwise (mean)	*C*	$E_{90,flatwise,mean}$	-	2000
Bending perpendicular to grain, flatwise (5%-fractile)	*C*	$E_{90,flatwise,k}$	-	1700
Shear modulus:				
Edgewise (mean)	*J*	$G_{edge,mean}$	600	600
Edgewise (5%-fractile)	*J*	$G_{edge,k}$	400	400
Parallel to grain, flatwise, (mean)	*K*	$G_{0,flat,mean}$	460	120
Parallel to grain, flatwise, (5%-fractile)	*K*	$G_{0,flat,k}$	270	100
Perpendicular to grain, flatwise, (mean)	*L*	$G_{90,flat,mean}$	-	22
Perpendicular to grain, flatwise, (5%-fractile)	*L*	$G_{90,flat,k}$	-	16
Density				
Mean		ρ_{mean}	510	510
5%-fractile		ρ_{k}	480	480

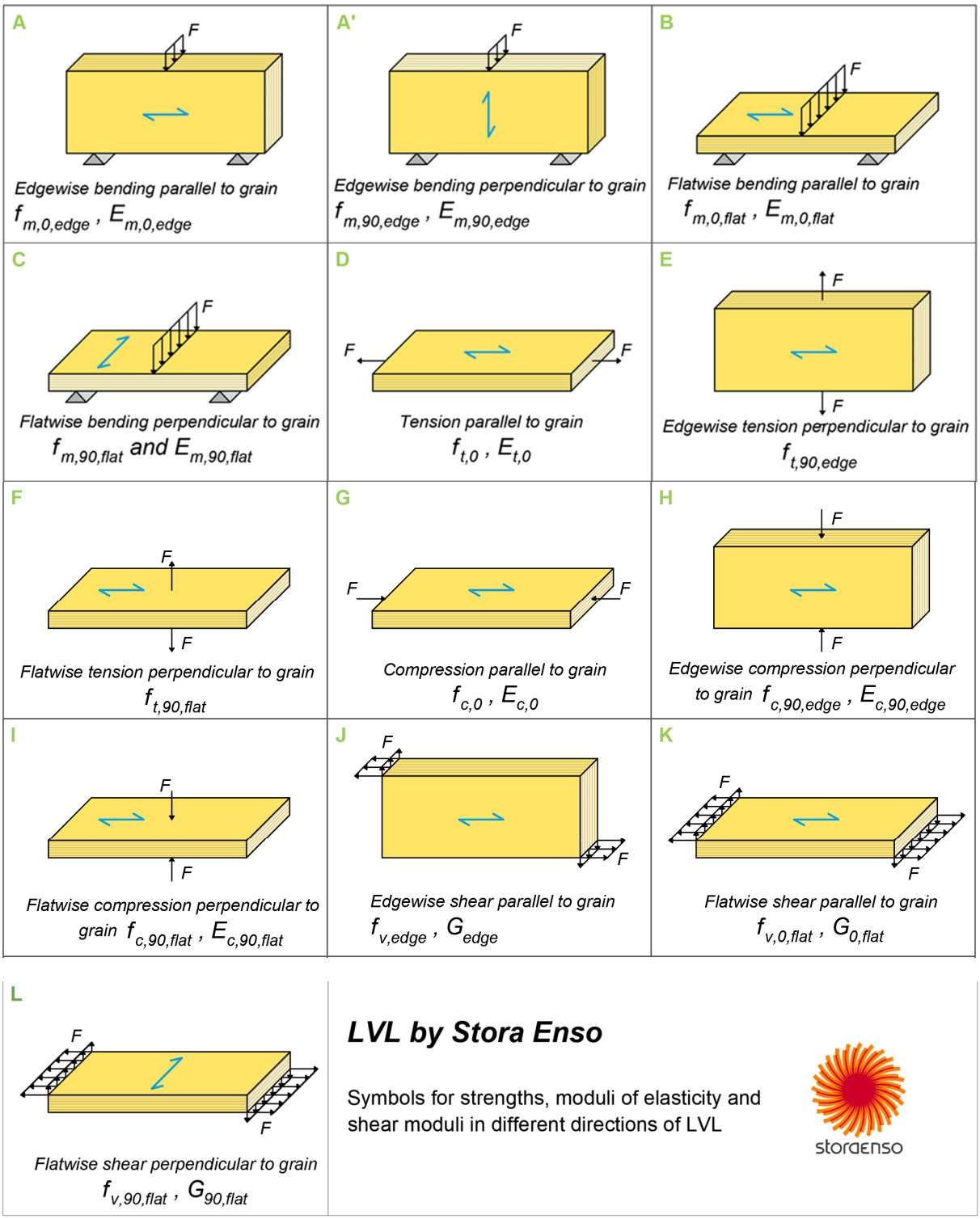


Figure 1-5. Definition of the strength and stiffness orientations.

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 Sylva™ LVL Rib. Partial safety factor γ_m is defined in National annex of 1995-1-1. γ_m for LVL shall be used for the composite cross section of the elements.

Since the dimensions of Sylva™ LVL Rib 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 Sylva™ LVL Rib element and support

Sylva™ LVL Rib may be simple supported, end beam supported or top slab supported (suspended support). Design guide for suspended support is provided by the ETA holder.

Table 1-6. Typical connections between Sylva™ LVL Rib and support.

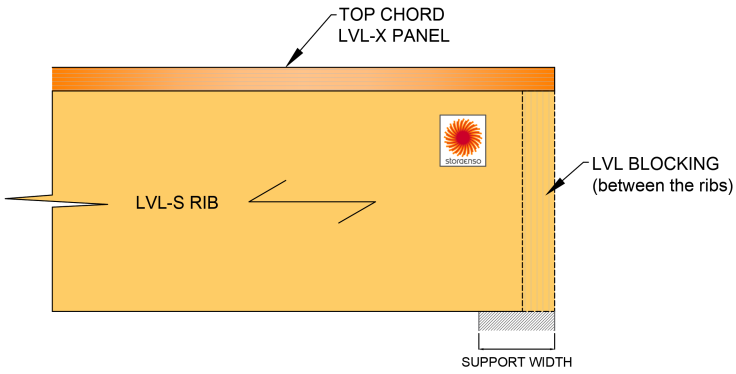
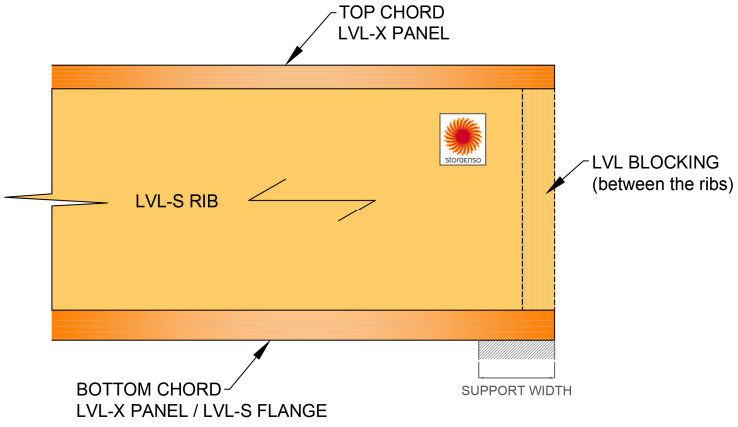
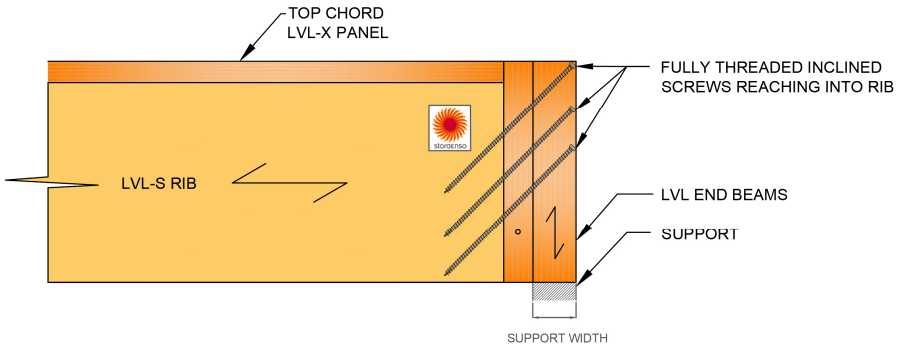
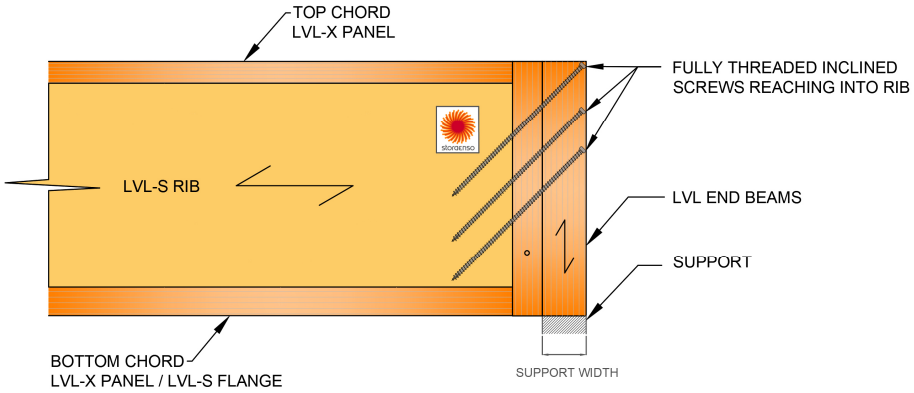
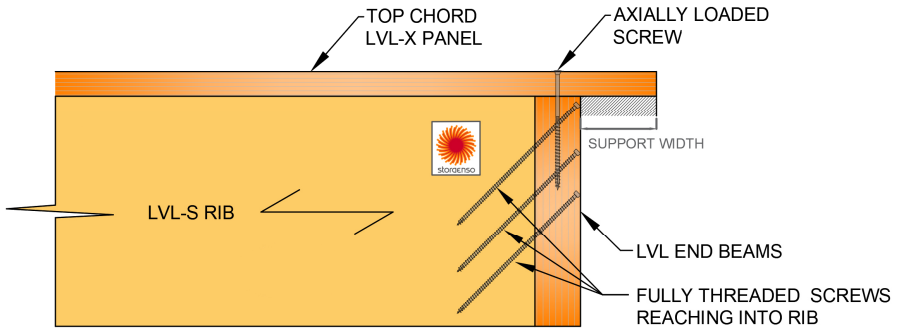
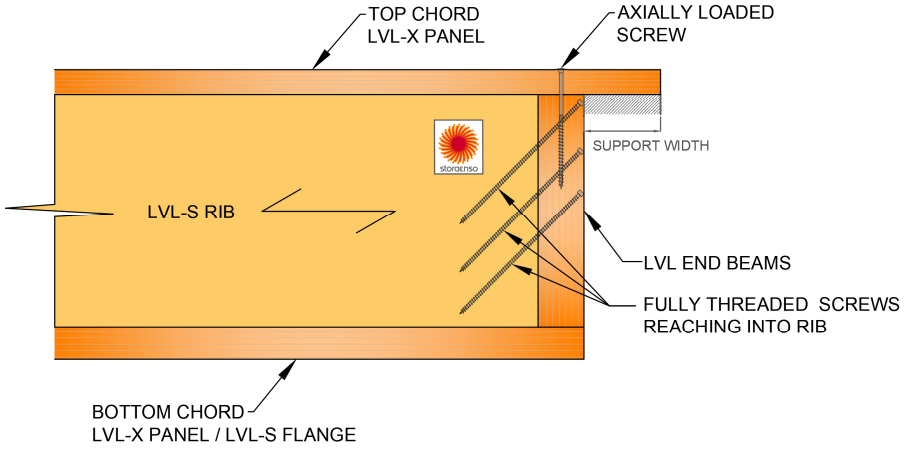
Simple support **Sylva™ LVL Rib Open type**	
Sylva™ LVL Rib Semi-Open/Closed type	

Table 1-6 continues. Typical connections between Sylva™ LVL Rib and support.

End beam support **Sylva™ LVL Rib Open type**	
Sylva™ LVL Rib Semi-Open/Closed type	
Suspended support **Sylva™ LVL Rib Open type**	
Sylva™ LVL Rib Semi-Open/Closed type	

Sylva™ LVL Rib elements are normally connected to each other with mechanical fasteners. Diagonal screwing is recommended. Sylva™ LVL Rib 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.

The connection between rib panels at the longitudinal joints must ensure:

- Transferring of vertical shear forces (differential distributed loads, point loads, etc.)
- Transferring of longitudinal shear forces (overall bracing of the building by panels, horizontal differential loads, etc.)
- Levelling (service)
- Sealing for fire safety, acoustic insulation, airtightness, etc.

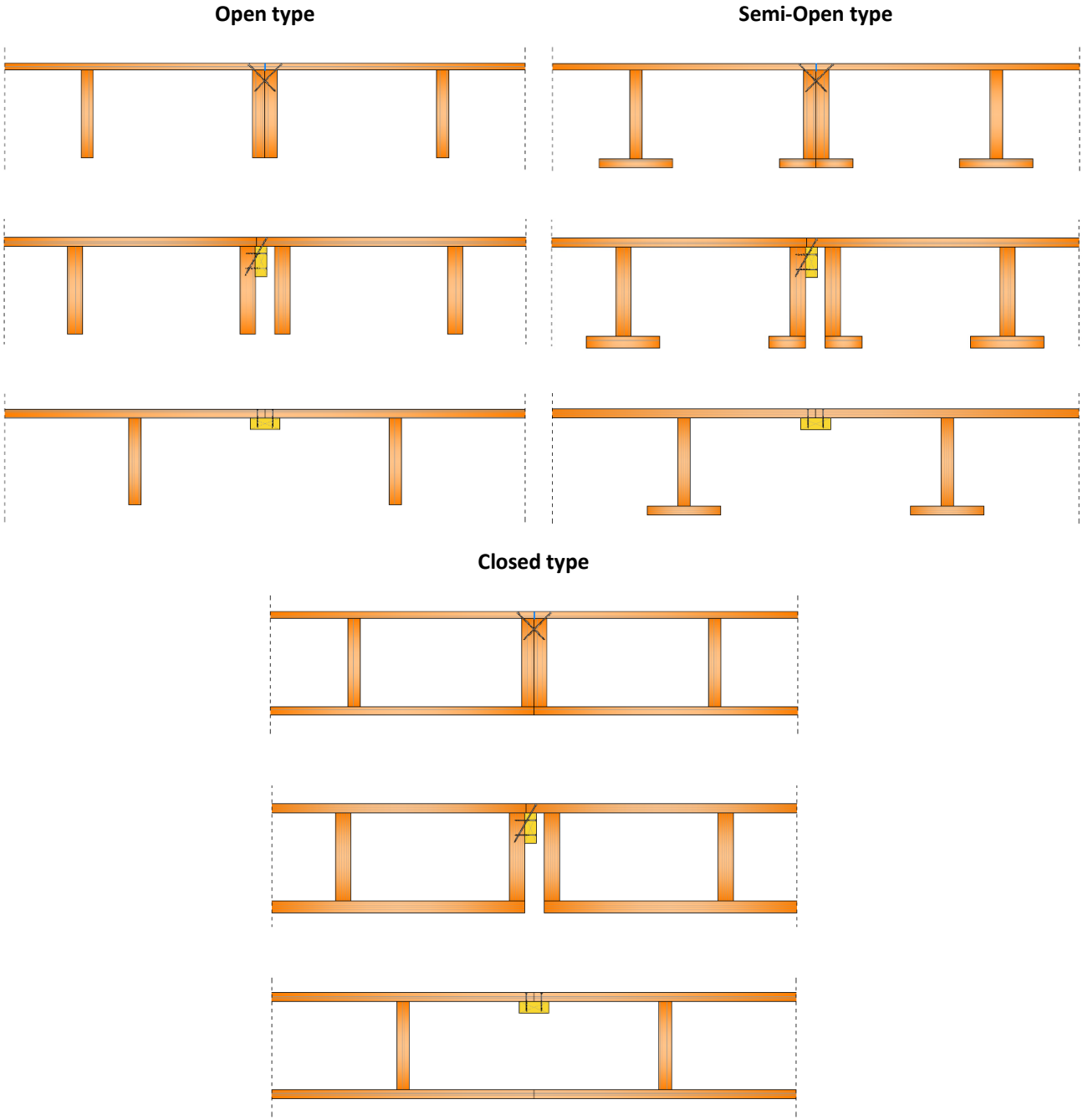


Figure 1-7: Alternative types of joints between Sylva™ LVL Rib elements.

ANNEX 2
FIRE RESISTANCE OF SYLVA™ LVL RIB FLOOR CONSTRUCTIONS

This Annex has information of the fire resistance classification of 4 alternative floor constructions of Sylva™ LVL Rib and complementary information for calculating the fire resistance of Sylva™ LVL Rib – closed type according to EN1995-1-2:2004.

Thermal insulation and gypsum plasterboards are installed normally at building site and therefore the Sylva™ LVL Rib itself does not have the REI classification. The fire performance of the following floor build-ups will be met with careful installation of the protecting elements composing the ceiling. The specifications in the section drawings of the construction in this annex shall be followed including: metal profile type, metal profile spacing, screw types and spacing, board thickness and board type, overlapping distance between the boards, insulation type and insulation thickness.

1. Sylva™ LVL Rib – Open type; with a gypsum board ceiling structure REI30

Fire resistance class of a wooden floor construction made of Sylva™ LVL Rib elements is REI 30, RE 30 and R 30 if the structure of the floor is according to figure 2-1 below and the maximum moment of 42,2 kNm/m is not exceeded. This classification is valid for the following end use applications:

- The maximum moments shall not be greater than 42,2 kNm/m. The shear forces shall not be greater than the shear force produced by the same loading as the moment 42,2 kNm/m.
- The panels consist of LVL S ribs with a minimum cross-section of 500 x 51 (*h* x *w*) arranged at a maximum centre-to-centre distance of 735mm. The spacing between the ribs is provided by closing beams (configuration 1) or blocking pieces (configuration 2), type X with a minimum cross-section of 497x51 (*h* x *w*). These are arranged at the floor ends and thus delimit the length of the ceiling surface. The panels can thus be closed at the ends in two types of configuration:
  - Configuration 1: a single continuous end beam (type X) is secured to the vertical edges of the ribs. The spacing between the ribs is then mechanically fixed by means of screws ø 6x140 from Würth which are centred in the thickness of the ribs. At the ends, the beam is levelled to the width of the finished rib panel.
  - Configuration 2: blocking pieces (type X) are inserted between the ribs and held in place by screws (ø 6x140 from Würth). The vertical edges of the blocking pieces are flush with the end faces of the ribs.
  - The closing elements, in particular the continuous end beam, do not form the support area of the floor; the ribs must always and in all cases overlap the support area.
- The dimensions of the top chord LVL X 27mm are strictly equal to the overall dimensions of the finished Sylva™ LVL Rib elements.
- The connection between the top chord and ribs is made by means of a gluing system. The pressure at the glue joint is applied by means screws according to the production manual of the manufacturer.
- The panels are held together with ROTHOBLAAS screws ø 7x160, diagonally placed at 45° on both sides of the connection joint. These fixings are arranged at a spacing of 300 mm.
- The ceiling consists of a metal framework, fixed directly under the ribs of the slab, and a facing and rock wool insulation resting on the framework elements and gypsum plaster board cladding:

- The metal frame consists of 1) 34 x 23 L-section edge runners mechanically fastened to the walls through their 23 mm leg using appropriate screws for the support. Their 34 mm leg is centred 30 mm from the base of the ribs. In the corners of the ceiling, a minimum clearance of 10 mm is provided at the ends of the runners. 2) "Hut Ferderschiene" omega support profiles from RIGIPS, positioned perpendicular to the flooring ribs at a maximum spacing of 400 mm. The profiles, inserted between the 34 mm leg of the edge rails and the underside of the ribs, are attached to the ribs with ø 4.5 x 35 screws from RIGIPS, one screw per flange and per rib. There is no mechanical connection between the edge runners and the support profiles.
- The thermal insulation consists of ROCKWOOL "DELTAROCK" rockwool panels with a maximum thickness of 80 [mm] and a maximum density of 50 [kg/m^3], inserted in each bay. These are supported on the ceiling grid.
- The cladding consists of a single skin of Placoflam® BA15 plasterboard panels. The panels are mechanically fastened to the support profiles and edge runners by means of TTPC 35 screws (spacing 170mm, edge distance 20mm).
- At the edges, the plasterboard panels are attached only to the edge runners at the fastener spacing stipulated in the previous point. If necessary, fasteners shall be placed on either side of and as close as possible to the support profiles (none of these edge fasteners are to be attached directly to the support profiles). After fastening the panels, the joints, the inside corners and the screw heads are treated with a "Placojoint® PR2" finishing coat applied with a spatula in two passes. In the second pass, a paper joint tape is pressed into the plaster at the joints and inside corners.
- The size of panels of the ceiling lining (gypsum boards) may be increased by a maximum of 5 % but limited to a maximum of 50 mm. The length of the grid members can be increased accordingly.

- The height of the cavity (420 mm) and the minimum distance (27 mm) between the ceiling and the structural members are equal to or greater.
- No material is added to the cavity.

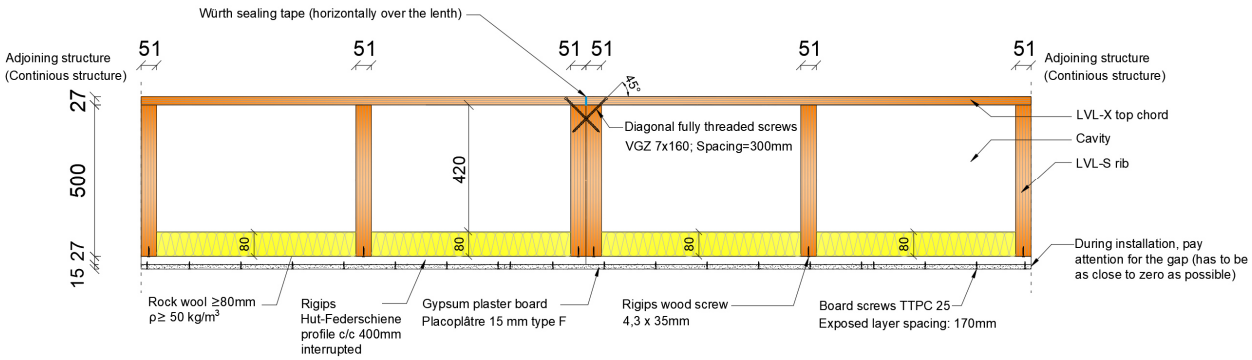


Figure 2-1: Sylva™ LVL Rib – Open type; with a gypsum board ceiling structure is classified as REI 30, RE 30 and R 30 in accordance with EN 13501-2.

2. Sylva™ LVL Rib – Semi-Open type; with a gypsum board ceiling structure REI90

Fire resistance class of a wooden floor construction made of Sylva™ LVL Rib elements is REI 90, RE 90 and R 90 if the structure of the floor is according to figures 2-2- below and the maximum moment of 40,8 kNm/m is not exceeded. This classification is valid for the following end use applications:

- The maximum moments shall not be greater than 40,8 kNm/m. The shear forces shall not be greater than the shear force produced by the same loading as the moment 40,8 kNm/m.
- The panels consist of LVL S ribs with a minimum cross-section of 360 x 51 (*h* x *w*) arranged at a maximum centre-to-centre distance of 735mm. The spacing between the ribs is provided by closing beams (configuration 1) or blocking pieces (configuration 2), type X with a minimum cross-section of 357x51mm (*h* x *w*). These are arranged at the floor ends and thus delimit the length of the ceiling surface. The panels can thus be closed at the ends in two types of configuration:
  - Configuration 1: a single continuous end beam (type X) is secured to the vertical edges of the ribs. The spacing between the ribs is then mechanically fixed by means of screws ø 6x140 from Würth which are centered in the thickness of the ribs. At the ends, the beam is levelled to the width of the finished rib panel.
  - Configuration 2: blocking pieces (type X) are inserted between the ribs and held in place by screws (ø 6x140 from Würth). The vertical edges of the blocking pieces are flush with the end faces of the ribs.
  - The closing elements, in particular the continuous end beam, do not form the support area of the floor; the ribs must always and in all cases overlap the support area.
- The dimensions of the top chord LVL X 27mm are strictly equal to the overall dimensions of the finished Sylva™ LVL Rib.
- LVL S flanges with a minimum cross-section of 300x36mm (*L* x *t*) for the inner flanges and 150x36mm (*L* x *t*) for the edge flanges are glued, screwed and centered on the underside of the ribs. At the outer ribs, these flanges are flush across the width of each Sylva™ LVL Rib element.
- The connection between the top chord and ribs is made by means of a gluing system. The pressure at the glue joint is applied by means screws according to the production manual of the manufacturer.
- The panels are held together with ROTHOBLAAS screws VGZ 7x160, diagonally placed at 45° on both sides of the connection joint. These fixings are arranged at a spacing of 300 mm.
- The ceiling consists of a metal framework, fixed directly under the LVL flanges of the supporting slab, and a facing (gypsum plaster board cladding) and rock wool insulation resting on the bottom flanges:
  - The metal frame consists of *1)* 34 x 23 L-section edge runners mechanically fastened to the walls through their 23 mm leg using appropriate screws for the support. Their 34 mm leg is centred 30 mm from the base of the ribs. In the corners of the ceiling, a minimum clearance of 10 mm is provided at the ends of the runners. *2)* "Hut Ferderschiene" omega support profiles from RIGIPS, positioned perpendicular to the flooring ribs at a maximum spacing of 400 mm. The profiles, inserted between the 34 mm leg of the edge rails and the underside of the LVL bottom flanges, are attached to the flanges with ø 4.5 x 35 screws from RIGIPS, 4 screws per LVL flange fixed two by two opposite from each other and on either side of each rib. There is no mechanical connection between the edge runners and the support profiles.

- The thermal insulation consists of ROCKWOOL "DELTAROCK" rockwool panels with a maximum thickness of 80 [mm] and a maximum density of 50 [kg/m^3], inserted in each bay. These are supported on the back of the LVL bottom flanges.
- The cladding consists of a double skin of Placoflam® BA15 plasterboard panels. The panels are mechanically fastened to the support profiles and edge runners by means of TTPC 35 screws (spacing 510mm, edge distance 40mm) at the 1st mounted skin and TTPC 55 screws (spacing 170mm, edge distance 20mm) at the 2nd mounted skin. The joints shall be staggered in both directions.
- At the edges, the plasterboard panels are attached only to the edge runners at the fastener spacing stipulated in the point above. If necessary, fasteners shall be placed on either side of and as close as possible to the support profiles (none of these edge fasteners are to be attached directly to the support profiles). After fastening the panels, the joints, the inside corners and the screw heads are treated with a "Placojoint® PR2" finishing coat applied with a spatula in two passes. In the second pass, a paper joint tape is pressed into the plaster at the joints and inside corners.
- The size of panels of the ceiling lining (gypsum boards) may be increased by a maximum of 5 % but limited to a maximum of 50 mm. The length of the grid members can be increased accordingly.

- The height of the cavity (280 mm) and the minimum distance (27 mm) between the ceiling and the structural members are equal to or greater.
- No material is added to the cavity.

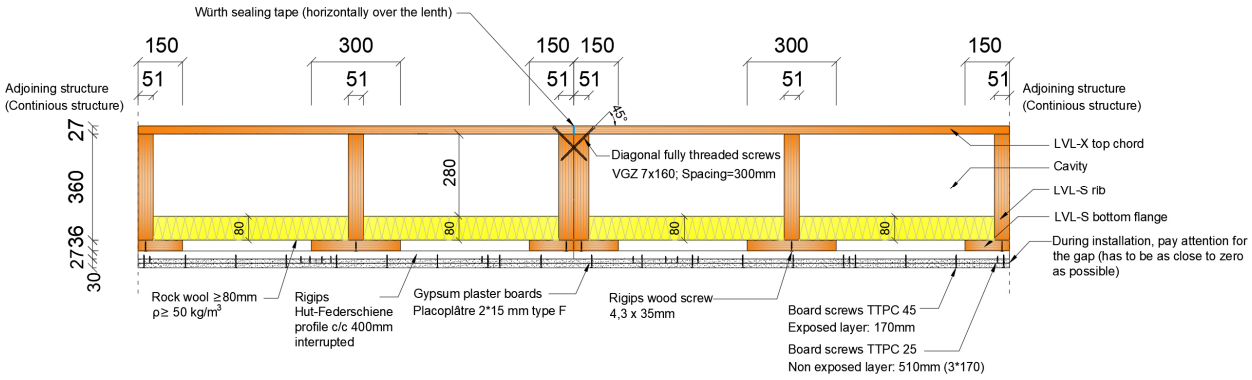


Figure 2-2: Sylva™ LVL Rib – Semi-Open type; with a gypsum board ceiling structure is classified as REI 90, RE 90 and R 90 in accordance with EN 13501-2.

3. Sylva™ LVL Rib – Semi-Open type; with a gypsum board ceiling structure REI120

Fire resistance class of a wooden floor construction made of Sylva™ LVL Rib elements is REI 120, RE 120 and R 120 if the structure of the floor is according to figures 2-3- below and the maximum moment of 40,8 kNm/m is not exceeded. This classification is valid for the following end use applications:

- The maximum moments shall not be greater than 40,8 kNm/m. The shear forces shall not be greater than the shear force produced by the same loading as the moment 40,8 kNm/m.
- The panels consist of LVL S ribs with a minimum cross-section of 360 x 51 (*h* x *w*) arranged at a maximum centre-to-centre distance of 735mm. The spacing between the ribs is provided by closing beams (configuration 1) or blocking pieces (configuration 2), type X with a minimum cross-section of 357x51mm (*h* x *w*). These are arranged at the floor ends and thus delimit the length of the ceiling surface. The panels can thus be closed at the ends in two types of configuration:
  - Configuration 1: a single continuous end beam (type X) is secured to the vertical edges of the ribs. The spacing between the ribs is then mechanically fixed by means of screws ø 6x140 from Würth which are centred in the thickness of the ribs. At the ends, the beam is levelled to the width of the finished rib panel.
  - Configuration 2: blocking pieces (type X) are inserted between the ribs and held in place by screws (ø 6x140 from Würth). The vertical edges of the blocking pieces are flush with the end faces of the ribs.
  - The closing elements, in particular the continuous end beam, do not form the support area of the floor; the ribs must always and in all cases overlap the support area.
- The dimensions of the top chord LVL X 27mm are strictly equal to the overall dimensions of the finished Sylva™ LVL Rib.
- LVL S flanges with a minimum cross-section of 300x36mm (*L* x *t*) for the inner flanges and 150x36mm (*L* x *t*) for the edge flanges are glued, screwed and centred on the underside of the ribs. At the outer ribs, these flanges are flush across the width of each Sylva™ LVL Rib element.
- The connection between the top chord and ribs is made by means of a gluing system. The pressure at the glue joint is applied by means of screws according to the production manual of the manufacturer.
- The panels are held together with ROTHOBLAAS screws VGZ 7x160, diagonally placed at 45° on both sides of the connection joint. These fixings are arranged at a spacing of 300 mm.
- The ceiling consists of a metal framework, fixed directly under the LVL flanges of the supporting slab, and a facing (gypsum plaster board cladding) and rock wool insulation resting on the bottom flanges:
  - The metal frame consists of *1)* 34 x 23 L-section edge runners mechanically fastened to the walls through their 23 mm leg using appropriate screws for the support. Their 34 mm leg is centred 30 mm from the base of the ribs. In the corners of the ceiling, a minimum clearance of 10 mm is provided at the ends of the runners. *2)* "Hut Ferderschiene" omega support profiles from RIGIPS, positioned perpendicular to the flooring ribs at a maximum spacing of 400 mm. The profiles, inserted between the 34 mm leg of the edge rails and the underside of the flanges, are attached to the flanges with ø 4.5 x 35 screws from RIGIPS, 4 screws per LVL flange fixed two by two opposite from each other and on either side of each rib. There is no mechanical connection between the edge runners and the support profiles.

- The thermal insulation consists of ROCKWOOL "DELTAROCK" rockwool panels with a maximum thickness of 80 [mm] and a maximum density of 50 [kg/m^3], inserted in each bay. These are supported on the LVL bottom flanges.
- The cladding consists of a triple skin of Placoflam® BA15 plasterboard panels. The panels are mechanically fastened to the support profiles and edge runners by means of TTPC 35 screws (spacing 510mm, edge distance 40mm) at the 1st mounted skin and TTPC 55 screws (spacing 370mm, edge distance 60mm) at the 2nd mounted skin and TTPC 70 screws (spacing 170mm, edge distance 20mm) at the 3rd mounted skin. The joints shall be staggered in both directions.
- At the edges, the plasterboard panels are attached only to the edge runners at the fastener spacing stipulated in the point above. If necessary, fasteners shall be placed on either side of and as close as possible to the support profiles (none of these edge fasteners are to be attached directly to the support profiles). After fastening the panels, the joints, the inside corners and the screw heads are treated with a "Placojoint® PR2" finishing coat applied with a spatula in two passes. In the second pass, a paper joint tape is pressed into the plaster at the joints and inside corners.
- The size of panels of the ceiling lining (gypsum boards) may be increased by a maximum of 5 % but limited to a maximum of 50 mm. The length of the grid members can be increased accordingly.

- The height of the cavity (280 mm) and the minimum distance (27 mm) between the ceiling and the structural members are equal to or greater.
- No material is added to the cavity.

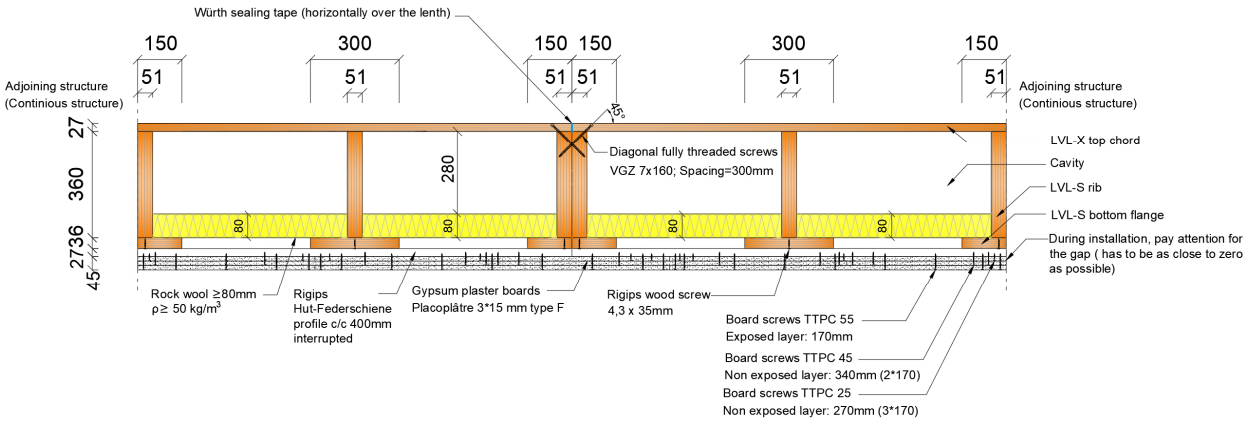


Figure 2-3: Sylva™ LVL Rib– Semi-Open type; with a gypsum board ceiling structure is classified as REI 120, RE 120 and R 120 in accordance with EN 13501-2.

4. Sylva™ LVL Rib – Semi-Open type; with a gypsum board ceiling structure REI120

Fire resistance class of a wooden floor construction made of Sylva™ LVL Rib elements is REI 120, RE 120 and R 120 if the structure of the floor is according to figures 6-8- below and the maximum moment of 21,6 kNm/m is not exceeded. This classification is valid for the following end use applications:

- The maximum moments shall not be greater than 21,6 kNm/m. The shear forces shall not be greater than the shear force produced by the same loading as the moment 21,6 kNm/m.
- The size of panels of the ceiling lining (gypsum boards) may be increased by a maximum of 5 % but limited to a maximum of 50 mm. The length of the grid members can be increased accordingly.
- The total area occupied by fixtures and fittings relative to the area of the ceiling lining (gypsum boards) is not increased and the maximum opening in the lining (gypsum boards) presented in this annex is not exceeded.
- The height of the cavity (250 mm) and the minimum distance (25 mm) between the ceiling and the structural members are equal to or greater.
- No material is added to the cavity.

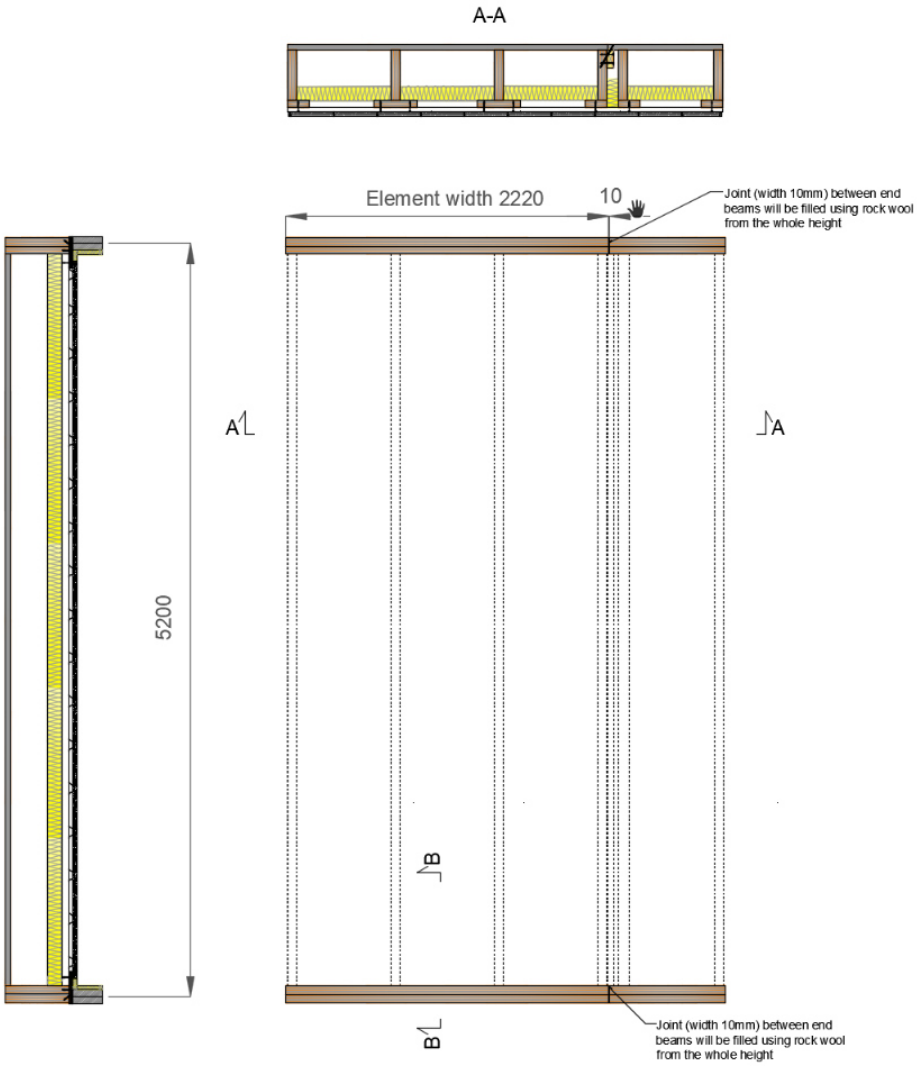
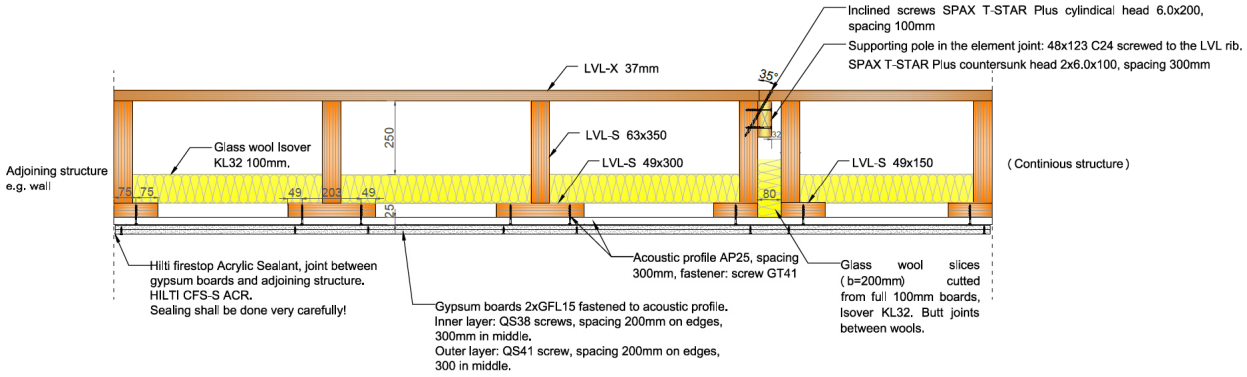


Figure 2-4. Fire resistance class REI 120, RE 120 and R 120 - wooden floor construction made of Sylva™ LVL Rib elements



Note: Tested with gypsum plaster board Gyproc GFL15. The joints shall be staggered in both directions.

Figure 2-5. Fire resistance class REI 120, RE 120 and R 120 - wooden floor construction made of Sylva™ LVL Rib

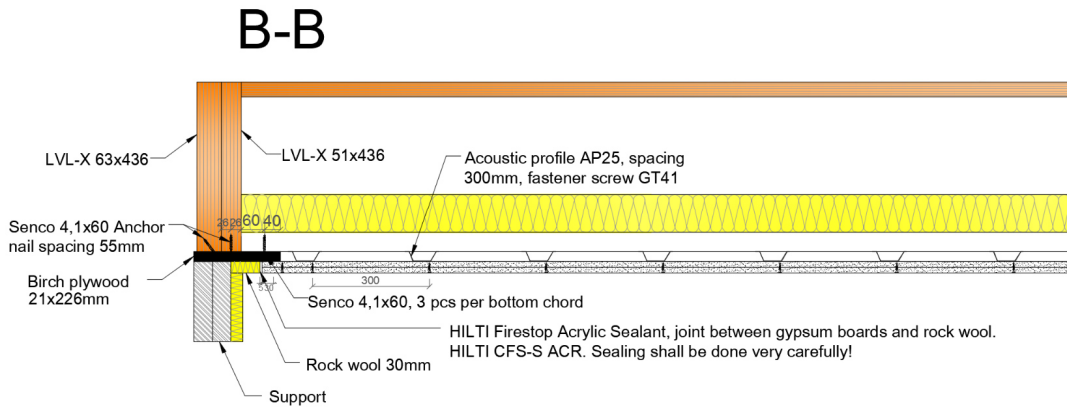


Figure 2-6. Fire resistance class REI 120, RE 120 and R 120 - wooden floor construction made of Sylva™ LVL Rib.

5. Sylva™ LVL Rib – Closed type

The resistance to fire of Sylva™ LVL Rib – closed type is designed according to EN1995-1-2:2004 and the relevant National Annex and together with the instruction given in this annex. The LVL X panel on the lower side of Sylva™ LVL Rib – closed type may be used as a non-loadbearing protection for the rest of the Sylva™ LVL Rib cross section or as a load bearing part of the structure in the design of the resistance to fire. When the LVL X panel is a non-loadbearing protection part, the minimum panel thickness $h_{p,1,min}$ [mm] including the zero strength layer (d_0 = 7mm) can be calculated for the required duration of fire exposure t_{req} based on EN1995-1-2:2004, equations (4.1) and (C.7) or (D.3) as follows:

$$\text{Minimum panel thickness } h_{p,1,min} = 0{,}65\ \text{mm/min} \cdot (t_{req} + 4\text{min}) + 7\text{mm} \quad \text{(A2.1)}$$

When the LVL X panel is a loadbearing part in the design of resistance to fire, it has to be ensured that the bond line between the rib and the bottom flange remains its loadbearing capacity. Therefore the minimum panel thickness $h_{p,2,min}$ [mm] shall be calculated for the required duration of fire exposure t_{req} as follows :

$$\text{Minimum panel thickness } h_{p,2,min} = 0{,}65\ \text{mm/min} \cdot t_{req} + 19\text{mm} \quad \text{(A2.2)}$$

In the table 2-1 are the minimum thicknesses $h_{p1,min}$ and $h_{p2,min}$ of the LVL X lower side panel for the certain duration of fire exposure times t [min]. When the thickness of the LVL X panel h_p is $h_{p,2,min}$, the effective thickness $h_{p,ef,fi}$ in the design of the resistance to fire is 9mm. When the thickness h_p of the LVL X bottom panel is larger, the effective thickness is $h_{p,ef,fi} = h_p - h_{p,2,min} + 9\text{mm}$.

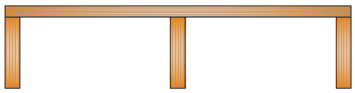
Table 2-1. Minimum sanded thickness of LVL X panel to protect the rest of the Sylva™ LVL Rib cross section for a duration of fire exposure t = 30 - 90 minutes.

Duration of fire exposure t	Minimum sanded thickness $h_{p1,min}$ of LVL X panel when not a loadbearing part protecting the rest of the Sylva™ LVL Rib cross section	Minimum sanded thickness $h_{p2,min}$ of LVL X panel when it is a loadbearing part of the structure of the Sylva™ LVL Rib, closed type
	$h_{p1,min}$	$h_{p2,min}$
30 min	29 mm	39 mm
45 min	39 mm	48 mm
60 min	49 mm	58 mm
75 min	58 mm	68 mm
90 min	68 mm	-

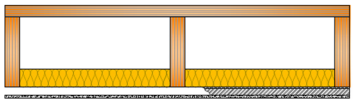
When the LVL X panel thickness h_p is according to the Table 2-1, other reductions of the rest of the Sylva™ LVL Rib cross section size or properties are not required in the design resistance in the fire situation $R_{d,t,fi}$ for the required duration of fire exposure t_{req}.

ANNEX 3
BUILDING PHYSICS PROPERTIES OF SYLVA™ LVL RIB

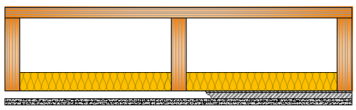
U-values based on calculations and airborne sound isolation R_w (C;C_{tr};C) and impact sound isolation Ln,w (CI;$C_{I,50\text{-}2150}$) of Sylva™ LVL Rib based on laboratory testing are given in figures 3-1a, 3-1b and in table 3-3. Floor topping and ceiling alternatives are specified in table 3-1 and table 3-2. For part of the alternatives, the acoustic properties based on simulation calculations can be found from a building physic document of the producer. The values of for Open type panels are also applicable for Semi open type panels.



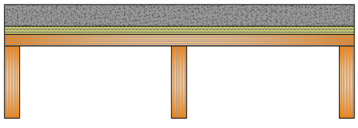
1.
U-value: 1.601 W/m^{2}K
Measured acoustic performance
R_w (C ; C_{tr} ; $C_{50\text{-}3150}$): 26 dB (-1 ;-3 ;-1)
$L_{n,w}$ (C_I : $C_{I,50\text{-}2500}$): 93 dB (-2 ; -2)



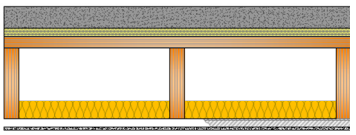
2.
U-value: 0.437 W/m^{2}K
Predicted acoustic performance
See Stora Enso building physics document



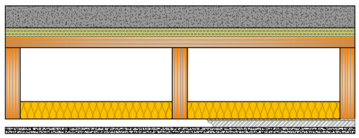
3.
U-value: 0.432 W/m^{2}K
Predicted acoustic values
See Stora Enso building physics document



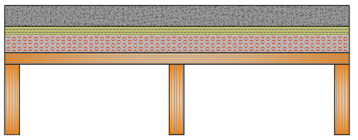
4.
U-value: 0.620 W/m^{2}K
Measured acoustic values
R_w (C ; C_{tr} ; $C_{50\text{-}3150}$): 50 dB (-1 ;-5 ;-2)
$L_{n.w}$ (C_I : $C_{I.50\text{-}2500}$): 71 dB (-1 ; -1)



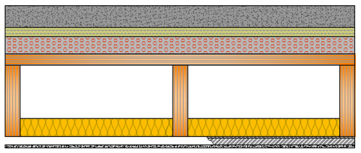
5.
U-value: 0.305 W/m^{2}K
Measured acoustic values
R_w (C ; C_{tr} ; $C_{50\text{-}3150}$): 71 dB (-3 ;-10 ;-12)
$L_{n,w}$ (C_I : $C_{I,50\text{-}2500}$): 50 dB (-1 ; 8)



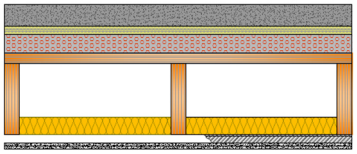
6.
U-value: 0.303 W/m^{2}K
Measured acoustic values
R_w (C ; C_{tr} ; $C_{50\text{-}3150}$): 75 dB (-2 ;-9 ;-11)
$L_{n,w}$ (C_I : $C_{I,50\text{-}2500}$): 46 dB (-2 ; 5)



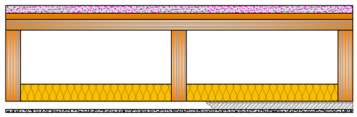
7.
U-value: 0.589 W/m2K
Measured acoustic values
R_w (C ; C_{tr} ; $C_{50\text{-}3150}$): 72 dB (-1 ;-6 ;-5)
$L_{n,w}$ (C_I : $C_{I,50\text{-}2500}$): 58 dB (-7 ; -3)



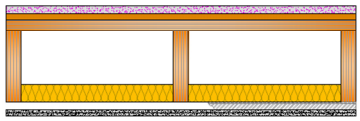
8.
U-value: 0.298 W/m^{2}K
Predicted acoustic values
See Stora Enso building physics document



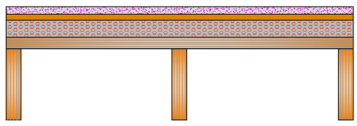
9.
U-value: 0.295 W/m^{2}K
Predicted acoustic values
See Stora Enso building physics document



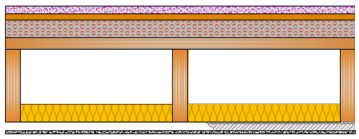
10.
U-value: 0.356 W/m^{2}K
Measured acoustic performance
R_w (C ; C_{tr} ; $C_{50\text{-}3150}$): 64 dB (-5 ;-12 ;-12)
$L_{n,w}$ (C_I : $C_{I,50\text{-}2500}$): 54 dB (0 ; 7)



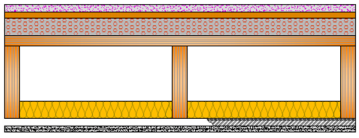
11.
U-value: 0.352 W/m^{2}K
Measured acoustic performance
R_w (C ; C_{tr} ; $C_{50\text{-}3150}$): 68 dB (-4 ;-11 ;-12)
$L_{n,w}$ (C_I : $C_{I,50}$): 52 dB (-1 ; 6)



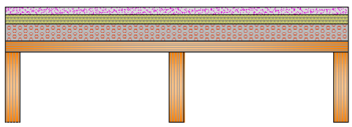
12.
U-value 0.812 W/m^{2}K
Measured acoustic values
R_w (C ; C_{tr} ; $C_{50\text{-}3150}$): 58 dB (-2 ;-7 ;-3)
$L_{n,w}$ (C_I : $C_{I,50\text{-}2500}$) 67 dB (-3 ; -2)



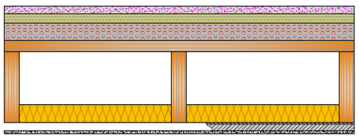
13.
U-value 0.346 W/m^{2}K
Measured acoustic values
R_w (C ; C_{tr} ; $C_{50\text{-}3150}$): 74 dB (-6 ;-13 ;-17)
$L_{n,w}$ (C_I : $C_{I,50\text{-}2500}$) 46 dB (2 ; 9)



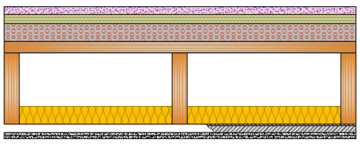
14.
U-value: 0.342 W/m^{2}K
Predicted acoustic values
See Stora Enso building physics document



15.
U-value: 0.599 W/m2K
Measured acoustic values
R_w (C ; C_{tr} ; $C_{50\text{-}3150}$): 61 dB (-4 ;-10 ;-5)
$L_{n,w}$ (C_I : $C_{I,50\text{-}2500}$): 60 dB (-1 ; 0)

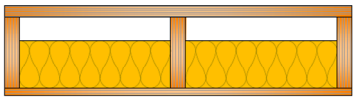


16.
U-value: 0.300 W/m^{2}K
Predicted acoustic values
See Stora Enso building physics document

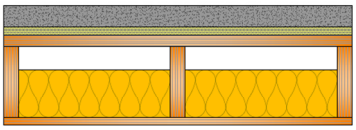


17.
U-value: 0.298 W/m^{2}K
Predicted acoustic values
See Stora Enso building physics document

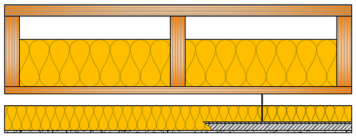
Figure 3-1a. U-values, airborne sound isolation R_w (C ;C_{tr} ;C) and impact sound isolation $L_{n,w}$ (C_I ;$C_{I,50\text{-}2150}$) of Sylva™ LVL Rib- Open, by Stora Enso. Floor topping and ceiling alternatives are specified in table 3-1.



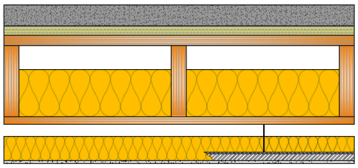
18.
U-value: 0.218 W/m^{2}K
Measured acoustic values
R_w (C ; C_{tr} ; $C_{50\text{-}3150}$): 37 dB (-2 ;-6 ;-2)
$L_{n,w}$ (C_I : $C_{I,50\text{-}2500}$): 81 dB (-1 ; -1)



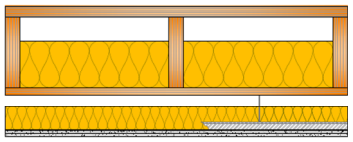
21.
U-value: 0.179 W/m^{2}K
Measured acoustic values
R_w (C ; C_{tr} ; $C_{50\text{-}3150}$): 58 dB (-3 ;-8 ;-4)
$L_{n,w}$ (C_I : $C_{I,50\text{-}2500}$): 63 dB (-2 ; 0)



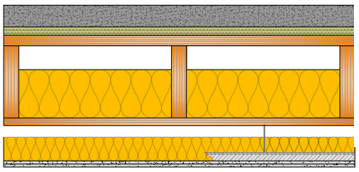
19.
U-value: 0.146 W/m^{2}K
Predicted acoustic values
See Stora Enso building physics document



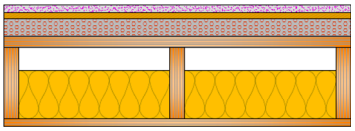
22.
U-value: 0.127 W/m^{2}K
Predicted acoustic values
See Stora Enso building physics document



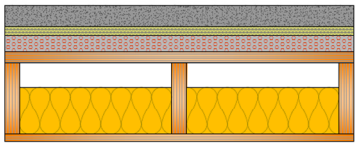
20.
U-value: 0.145 W/m^{2}K
Measured acoustic values
R_w (C ; C_{tr} ; $C_{50\text{-}3150}$): 64 dB (-3 ;-9 ;-7)
$L_{n,w}$ (C_I : $C_{I,50\text{-}2500}$): 56 dB (0 ; 4)



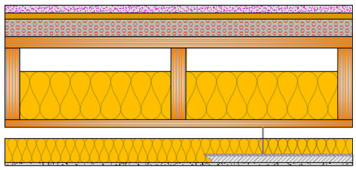
23.
U-value: 0.127 W/m^{2}K
Measured acoustic values
R_w (C ; C_{tr} ; $C_{50\text{-}3150}$): 78 dB (-3 ;-10 ;-10)
$L_{n,w}$ (C_I : $C_{I,50\text{-}2500}$): 42 dB (2 ; 8)



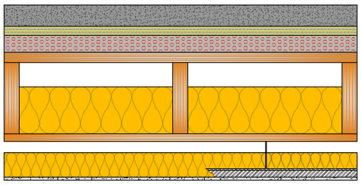
27.
U-value: 0.192 W/m^{2}K
Measured acoustic values
R_w (C ; C_{tr} ; $C_{50\text{-}3150}$): 56 dB (-5 ;-13 ;-6)
$L_{n,w}$ (C_I : $C_{I,50\text{-}2500}$): 64 dB (1 ; 1)



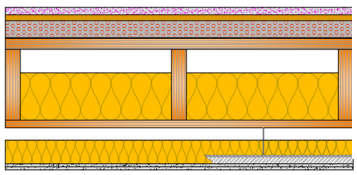
24.
U-value: 0.176 W/m^{2}K
Measured acoustic values
R_w (C ; C_{tr} ; $C_{50\text{-}3150}$): 71 dB (-3 ;-10 ;-7)
$L_{n,w}$ (C_I : $C_{I,50\text{-}2500}$): 53 dB (-2 ; 1)



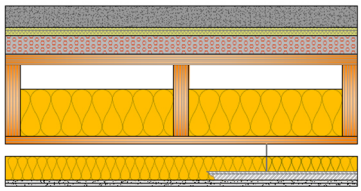
28.
U-value: 0.134 W/m^{2}K
Measured acoustic values
R_w (C ; C_{tr} ; $C_{50\text{-}3150}$): 76 dB (-6 ;-14 ;-16)
$L_{n,w}$ (C_I : $C_{I,50\text{-}2500}$): 46 dB (2 ; 9)



25.
U-value: 0.126 W/m^{2}K
Predicted acoustic values
See Stora Enso building physics document



29.
U-value: 0.133 W/m^{2}K
Measured acoustic values
R_w (C ; C_{tr} ; $C_{50\text{-}3150}$): 79 dB (-4 ;-11 ;-13)
$L_{n,w}$ (C_I : $C_{I,50\text{-}2500}$): 41 dB (2 ; 8)



26.
U-value: 0.126 W/m^{2}K
Measured acoustic values
R_w (C ; C_{tr} ; $C_{50\text{-}3150}$): 82 dB (-1 ;-7 ;-9)
$L_{n,w}$ (C_I : $C_{I,50\text{-}2500}$): 29 dB (3 ; 16)

Figure 3-1b. U-values, airborne sound isolation R_w (C; C_{tr}; C) values and impact sound isolation $L_{n,w}$ (C_I; $C_{I,50\text{-}2150}$) values of Sylva™ LVL Rib - Closed, by Stora Enso. Floor topping and ceiling alternatives are specified in table 3-2.

Table 3-1: Specifications of the floor topping and ceiling alternatives for Sylva™ LVL Rib - Open.

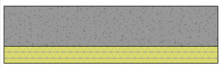
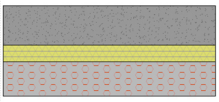
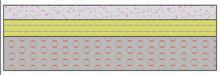
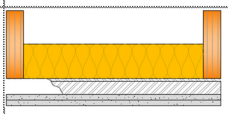
Open Sylva™ LVL Rib		
ID	**Short description**	**Drawing**
Bare panel	Top panel LVL X 37mm, LVL S ribs 240mm x 51mm in ~550mm centres, ~42 kg/m^2	
No floor topping	Bare panel - no additional floor topping	
Floor 1.1	70 mm Floating concrete slab ~175 kg/m^2 30 mm Impact sound insulation mineral wool s' = 6 MN/m^3	
Floor 1.2	70 mm Floating concrete slab ~175 kg/m^2 30 mm Impact sound insulation mineral wool s' = 6 MN/m^3 60 mm Gravel ballast	
Floor 1.3	25 mm Dry screed with gypsum fibre ~30 kg/m^2 20 mm Impact sound insulation with wood fibre ~4 kg/m^2	
Floor 1.4	25 mm Dry screed with gypsum fibre ~30 kg/m2 20 mm Impact sound insulation with wood fibre ~4 kg/m^2 60 mm Gravel ballast ~96 kg/m^2	
Floor 1.5	25 mm Dry screed with gypsum fibre ~30 kg/m^2 30 mm Impact sound insulation mineral wool s' = 6 MN/m^3 60 mm Gravel ballast ~96 kg/m^2	
No suspended ceiling	Bare panel - open ceiling cavities, no suspended ceiling, wood visible	
Ceiling 1.1	60 mm Insulation mineral wool 27 mm Air gap with resilient metal channels with c/c ~300mm spacing 10 mm Gypsum fibreboard ~12 kg/m^2	
Ceiling 1.2	60 mm Insulation mineral wool 27 mm Air gap with resilient metal channels with c/c ~300mm spacing 2 x 10 mm Gypsum fibreboard ~24 kg/m^2	

Table 3-2: Specifications of the Floor topping and ceiling alternatives for Sylva™ LVL Rib - Closed.

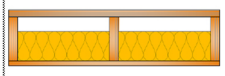
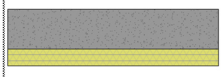
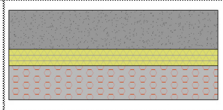
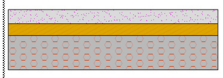
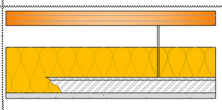
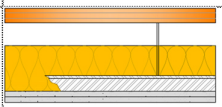
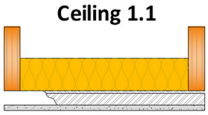
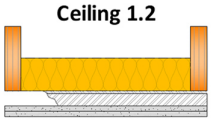
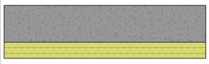
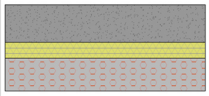
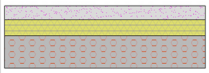
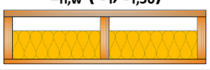
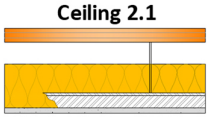
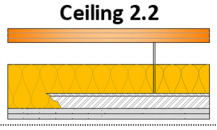
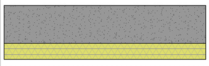
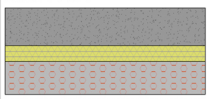
Closed Sylva™ LVL Rib		
ID	**Short description**	**Drawing**
Bare panel	Top panel LVL X 37mm, LVL S ribs 240mm x 51mm in ~550mm centres, cavity insulation 160mm mineral wool 20kg/m^3, bottom panel LVL X 25mm, ~62 kg/m^2	
No floor topping	Bare panel - no additional floor topping	
Floor 2.1	70 mm Floating concrete slab ~175 kg/m^2 30 mm Impact sound insulation mineral wool	
Floor 2.2	70 mm Floating concrete slab ~175 kg/m^2 30 mm Impact sound insulation mineral wool s' = 6 MN/m^3 60 mm Gravel ballast ~96 kg/m^2	
Floor 2.3	25 mm Dry screed with gypsum fibre ~30 kg/m^2 20 mm Impact sound insulation with wood fibre ~4 kg/m^2 60 mm Gravel ballast ~175 kg/m^2	
No suspended ceiling	Bare panel - no suspended ceiling, wood visible	
Ceiling 1.1	40 mm Air gap 80 mm Insulation mineral wool with 27 mm resilient metal channels with c/c ~300mm spacing 10 mm Gypsum fibreboard ~12 kg/m^2	
Ceiling 1.2	40 mm Air gap 80 mm Insulation mineral wool with 27 mm resilient metal channels with c/c ~300mm spacing 2 x 10 mm Gypsum fibreboard ~24 kg/m^2	

Table 3-3: Matrix of airborne sound isolation R_w ($C;C_{tr};C$) values and impact sound isolation $L_{n,w}$ ($C_I;C_{I,50\text{-}2150}$) values of Sylva™ LVL Rib - Open. (i) refer to drawings in Figure 3-1a and 3-1b.

OPEN MATRIX

R_w ($C;C_{tr};C_{50\text{-}3150}$) $L_{n,w}$ ($C_I;C_{I,50}$) 	Bare panel - open ceiling cavities, no suspended ceiling, wood visible	Ceiling 1.1 	Ceiling 1.2 
Bare panel - no additional floor topping	26 dB (-1 ;-3 ;-1) 93 dB (-2 ; -2) (1)	See Stora Enso building physics document (2)	See Stora Enso building physics document (3)
Floor 1.1 	50 dB (-1 ;-5 ;-2) 71 dB (-1 ; -1) (4)	71 dB (-3 ;-10 ;-12) 50 dB (-1 ; 8) (5)	75 dB (-2 ;-9 ;-11) 46 dB (-2 ; 5) (6)
Floor 1.2 	72 dB (-1 ;-6 ;-5) 58 dB (-7 ; -3) (7)	See Stora Enso building physics document (8)	See Stora Enso building physics document (9)
Floor 1.3 	See Stora Enso building physics document	64 dB (-5 ;-12 ;-12) 54 dB (0 ; 7) (10)	68 dB (-4 ;-11 ;-12) 52 dB (-1 ; 6) (11)
Floor 1.4 	58 dB (-2 ;-7 ;-3) 67 dB (-3 ; -2) (12)	74 dB (-6 ;-13 ;-17) 46 dB (2 ; 9) (13)	See Stora Enso building physics document (14)
Floor 1.5 	61 dB (-4 ;-10 ;-5) 60 dB (-1 ; 0) (15)	See Stora Enso building physics document (16)	See Stora Enso building physics document (17)

CLOSED MATRIX

R_w ($C;C_{tr};C_{50\text{-}3150}$) $L_{n,w}$ ($C_I;C_{I,50}$) 	Bare panel - open ceiling cavities, no suspended ceiling, wood visible	Ceiling 2.1 	Ceiling 2.2 
Bare panel - no additional floor topping	37 dB (-2 ;-6 ;-2) 81 dB (-1 ; -1) (18)	See Stora Enso building physics document (19)	64 dB (-3 ;-9 ;-7) 56 dB (0 ; 4) (20)
Floor 2.1 	58 dB (-3 ;-8 ;-4) 63 dB (-2 ; 0) (21)	See Stora Enso building physics document (22)	78 dB (-3 ;-10 ;-10) 42 dB (2 ; 8) (23)
Floor 2.2 	71 dB (-3 ;-10 ;-7) 53 dB (-2 ; 1) (24)	See Stora Enso building physics document (25)	82 dB (-1 ;-7 ;-9) 29 dB (3 ; 16) (26)
Floor 2.3 	56 dB (-5 ;-13 ;-6) 64 dB (1 ; 1) (27)	76 dB (-6 ;-14 ;-16) 46 dB (2 ; 9) (28)	79 dB (-4 ;-11 ;-13) 41 dB (2 ; 8) (29)