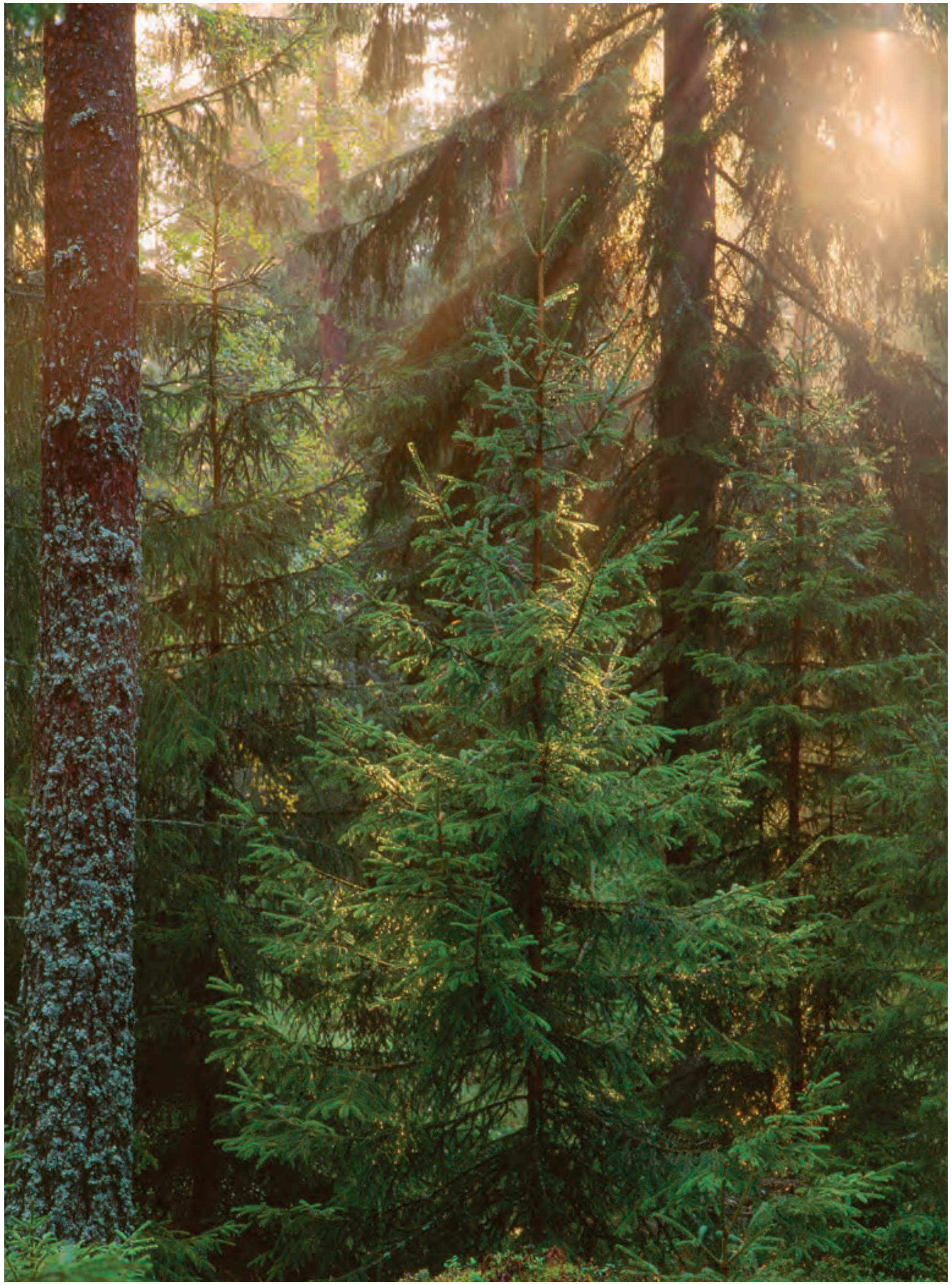
LVL by Stora Enso

Technical brochure

THE RENEWABLE MATERIALS COMPANY

storaenso



Stora Enso
The renewable materials company

Stora Enso is a leading provider of renewable solutions in packaging, biomaterials, wooden constructions and paper on global markets.

We believe that everything that is made from fossil-based materials today can be made from a tree tomorrow. Our materials are renewable, reusable and recyclable, and form the building blocks for a range of innovative solutions that can help replace products based on fossil fuels and other non-renewable materials.

With carbon captured in the wood, the products offer a truly sustainable means of combating climate change.

Stora Enso products are manufactured from responsibly sourced wood. The wood supply chains to Stora Enso's Wood Products units are covered by a wood traceability system, which is third-party certified according to PEFC™ or FSC® Chain of Custody system, or according to both systems.

Contents

This brochure is a summarised version of the technical LVL folder.
Please refer to the folder for more information about the references to sources.

See also: **storaenso.com/lvl**

Key data

Laminated Veneer Lumber (LVL) is an advanced wood product consisting of 3 mm spruce veneers glued together. It is suitable for a wide range of structural applications, from new build to repair. Being one of the strongest wood-based construction materials relative to its weight, LVL provides an ideal solution when strength, dimensional stability and high load-bearing capacity are essential. Not forgetting the consistent quality and excellent workability. LVL is CE-marked.

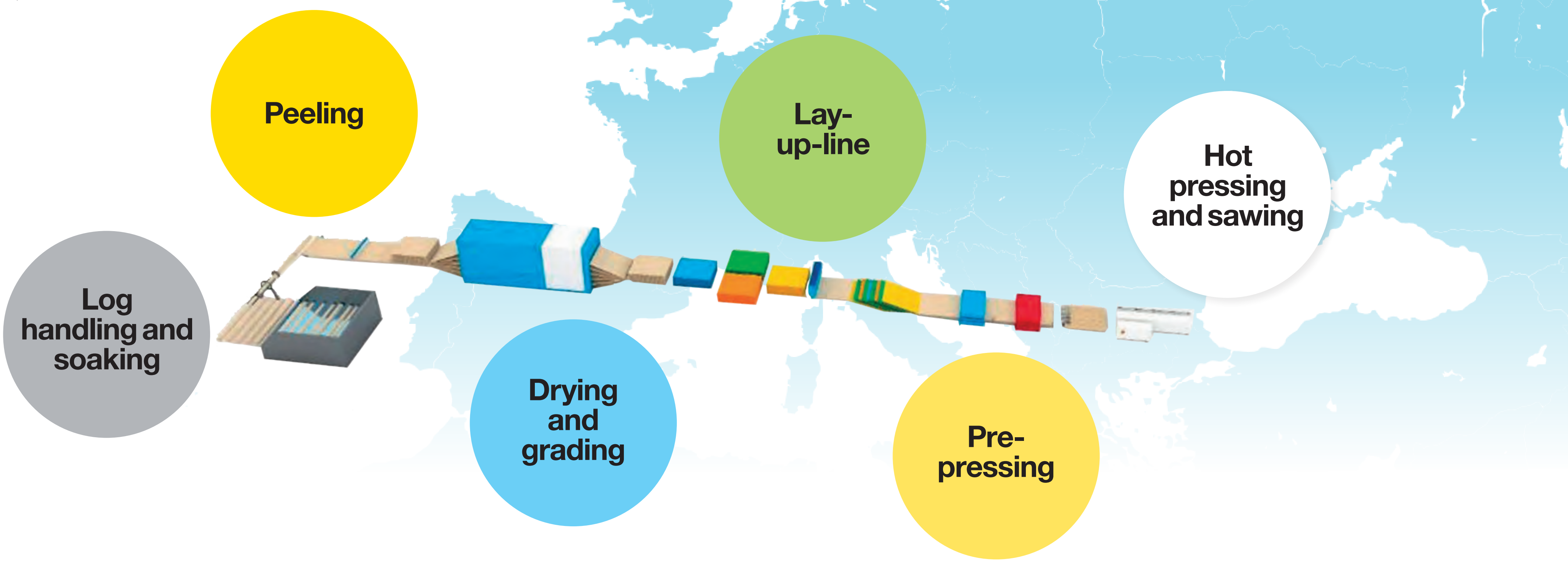
Use	**Structural applications: post and beam, framing, wall floor and roof panels**
Product certification	CE marked according EN 14374
Wood species	Spruce (Picea Abies)
Wood certification	PEFC (FSC available upon request)
Maximum width	2400 mm
Maximum thickness	75 mm
Maximum length	24.5 m
Adhesive	Phenolic on all layers; MUF (clear) on top surface
Emissions	E1 – classification (EN 717-1), formaldehyde <0.01 ppm
Moisture content	8–10 % when leaving mill
Surface quality	Intended for non-visual or industrial-visual applications.
Density	510 kg/m^3 (LVL S & X)
Thermal conductivity	0.13 W(mK)
Specific heat capacity	c = 1800 J/(kg K)
Service class	1 and 2
Reaction to fire	D-s1, d0 (EN 13501-1)
Charring rate	β_0 = 0.65 mm/min (one-dimensional charring) β_n = 0.70 mm/min (notional charring) (EN 1995-1-2)
Water vapor resistance factor	Wet cup μ = 70 Dry cup μ = 200 (EN 13986)

LVL production

Using the latest technology Stora Enso is producing LVL at the Varkaus site in Finland.

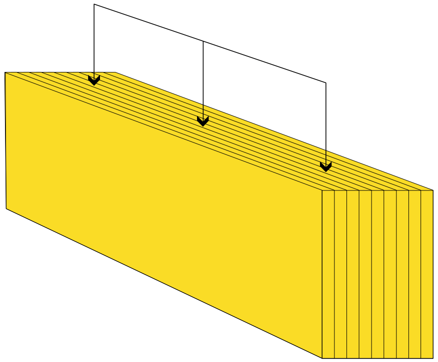
High quality spruce logs are harvested locally and delivered to Varkaus mill for LVL production in accordance with EN14374.

Primary production is of 3 main grades of LVL: S, X and T.



Three grades S, X and T

The layering of the veneers affects the strength, properties and capabilities of a grade and makes it most suitable for a particular use. Each grade of LVL has key properties and benefits like strength, span or straightness.



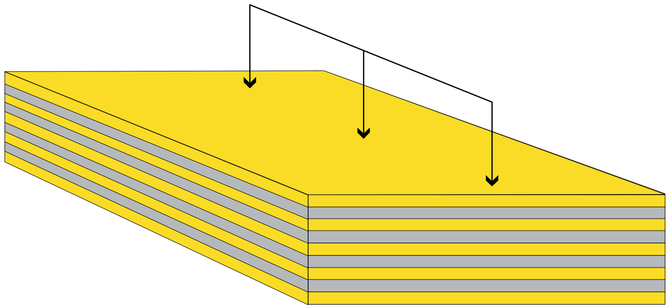
S grade – precision beams

With S grade all the veneers run in the same direction enhancing the strength properties of the material.

This feature, along with its light weight and ease of re-working, makes it the ideal choice for the construction industry in a wide range of applications – from framing to beams and roof components to formwork.

Available dimensions*

- Thicknesses (mm): 27 / 30 / 33 / 39 / 45 / 51 / 57 / 63 / 69 / 75
- Widths (mm): 200 / 220 / 240 / 250 / 260 / 300 / 350 / 360 / 400 / 450 / 500 / 600
- Max length (m): 24.5

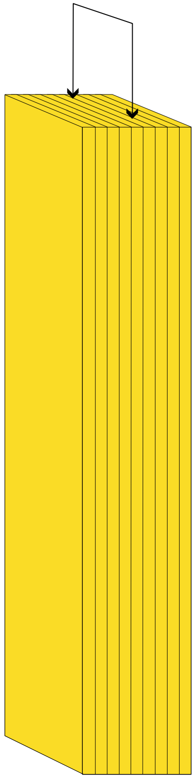


X grade – precision panels

Veneers regularly spaced crosswise through the element makes this ideal for construction panels and boards. The X grade has superior inherent dimensional stability which opens up a host of possibilities for how it can be used – especially where shear strength is a design driver.

Available dimensions*

- Thicknesses (mm): 27 / 30 / 33 / 39 / 45 / 51 / 57 / 63 / 69 / 75
- Widths (mm): 200 / 220 / 240 / 250 / 260 / 300 / 350 / 360 /400 / 450 / 500 / 600
- Panels width (mm): 1200–2400
- Max length (m): 24



T grade – precision studs

All the veneers in T grade run in the same direction, however these are lighter veneers. As such it has all the qualities exhibited by LVL in terms of dimensional accuracy, structural rigidity and lack of twisting.

Therefore, the T grade is suitable for structures requiring dimensional stability and straightness as well as light weight.

A typical application is wall studs for internal walls.

Available dimensions (mm)*

- 39 x 66, lengths 2550–6000
- 39 x 92, length 6000

*Other dimensions available upon request.

Sustainability

Environmental Product Declaration

Environmental product declarations have been issued by EPD International AB, Sweden. These are in accordance with ISO 14025 and EN 15804 for LVL, covering S, X- and T. The declaration number is:
S-P-01730 LVL (Laminated Veneer Lumber)

Product features

LVL cross-sections

In table below are standard thicknesses for LVL-X. These thicknesses are possible with the following veneer structure compilation.

Nominal thicknesses and lay-ups for LVL X

Thickness [mm]	Number of plies	Veneer structure
24	8	II-II-II
27	9	II-III-II
30	10	II-IIII-II
33	11	II-IIIII-II
39	13	II-III-III-II
45	15	II-IIII-IIII-II
51	17	II-IIIII-IIIII-II
57	19	II-III-IIIII-III-II
63	21	II-III-III-III-III-II
69	23	II-IIII-III-III-IIII-II
75	25	II-IIIII-III-III-IIIII-II

After production nominal thickness of veneers is 3 mm. LVL S and LVL T products all layers are parallel to length.

Tolerances

Thickness tolerance variation comes from combination of veneer density affecting hot pressing and after pressing thickness “recovery”. Whilst both are minimized in the production process there can be thickness variation.

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

LVL material thickness	Thickness	Length
27 mm	± 1 mm	± 5 mm
27–57 mm	± 2 mm	± 5 mm
57–75 mm	± 3 mm	± 5 mm

Product width	Width tolerance
400 mm or less	± 2 mm
>400 mm	± 0.5 %

For more accurate tolerances further processed products are available.

Sanding

Standard LVL by Stora Enso is delivered unsanded and product grading is based on strength properties, not visual appearance. In order to obtain more accurate thicknesses and for more demanding tolerances, LVL can be calibrated or optically sanded. Please note that neither sanding nor calibration will remove any visual imperfections that may appear on the product surface.

Optical sanding (OPT1 and OPT2)

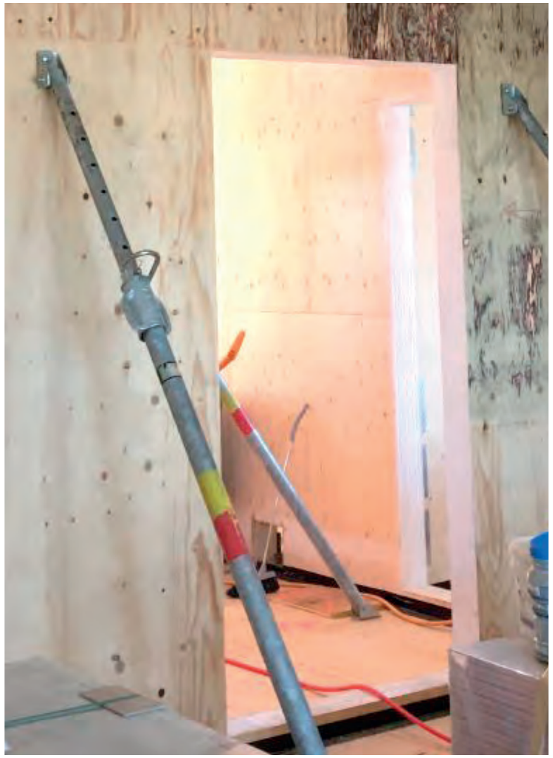
- For smooth surface
- Thickness reduced approx, 1 mm per face
- Available on one side (OPT1) or both sides (OPT2)
- Thickness tolerace according to standard LVL
- No higher surface grade

Calibration sanding (CAL)

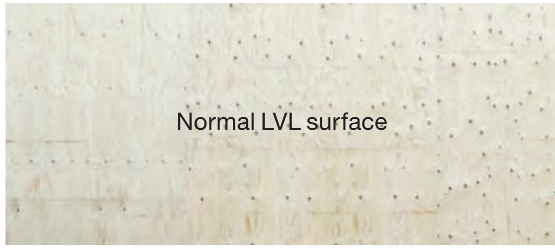
- For improved thickness tolerance
- Thickness reduced approx, 3 mm (1.5 mm per face)
- Both sides are sanded
- Thickness tolerance ± 0.5 mm
- No higher surface grade

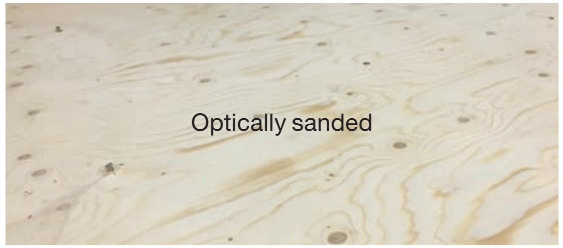
Sanding options and thickness tolerance

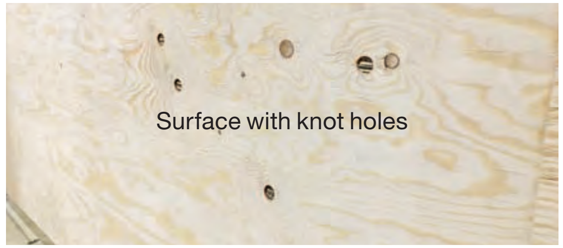
LVL thickness	Unsanded	Optical sanding (OPT1 and OPT2)	Calibration sanding (CAL)
27 mm	± 1 mm	± 1 mm	± 0.5 mm
27–57 mm	± 2 mm	± 2 mm	± 0.5 mm
57–75 mm	± 3 mm	± 3 mm	± 0.5 mm

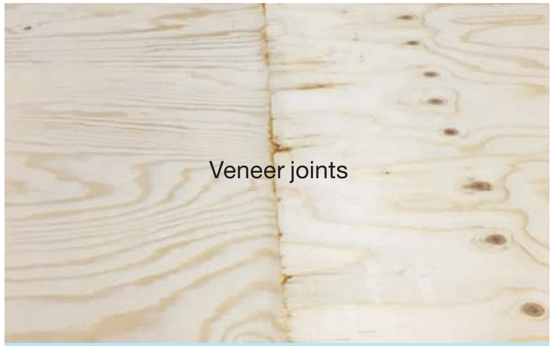


With calibration sanding it is possible that the glue line becomes partially visible.









The top face of LVL uses a clear color glue (MF) and it is recommended to use as face side where needed.

The bottom side veneer joint is also visible and the resorcinol glue line is visible.

Veneer joints are approximately with 2.5 m interval.

Tolerances for further processed products – CNC machining tolerances

	Nominal size	Tolerance
Thickness*	27 mm	± 1 mm
	27–57 mm	± 2 mm
	57–75 mm	± 3 mm
Width	-	± 2 mm
Length	-	± 2 mm

*Thickness tolerance according to LVL production.

Adhesive and emissions

Veneers are glued together with weather resistance phenolic resin. Phenolic resin component is in cured/solid state in the LVL product. This means glue is not reacting any more. LVL by Stora Enso fulfills requirements of class E1 (EN 717-1) with formaldehyde emissions <0.1 ppm.

Material / chemical substances	kg	%	Notes
Wood (Picea Abies)	478.3	93.8	Water content 8–10 %
Phenolic resin	27.3	5.3	Veneer layers gluing
Hardener	4.5	0.9	Veneer layers gluing
Melamine-formaldehyde resin		<0.1	Top veneer layer gluing

Technical properties

Dimensional stability

Swelling and shrinkage is determined using the α_H factor. This factor indicates the dimensional change in % per 1 % change in moisture content. The factor is valid below fiber saturation point which is about 30 %.

The swelling and shrinkage behavior due to change in moisture content of LVL panels relates to the swelling and shrinkage behavior of the base material.

When necessary, the dimensional change ΔL of the product due to change of moisture content can be calculated as follows:
$\Delta L = \Delta\omega \cdot \alpha_H \cdot L$

Type of timber and species	Swelling and shrinkage in percent per percent change of moisture content		
	In the direction of the thickness	In the direction of the length	In the direction of the width
LVL-S (spruce)	0.30	0.006	0.31
LVL-X (spruce)	0.44	0.009	0.033

Dimensional variation coefficients 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 above and practical example in table to the right.

Product	Direction	Original dimension	Dimension after +7 % increase of MC	Difference
LVL S or LVL X	Length, l	4200 mm	4200 + (7 x 0.01/100 x 4200) = 4203 mm	+3.0 mm
LVL S	Thickness, t	57 mm	57 + (7 x 0.3/100 x 57) = 58.2 mm	+1.2 mm
LVL X	Thickness, t	57 mm	57 + (7 x 0.44/100 x 57) = 58.8 mm	+1.8 mm
LVL S	Height, h	260 mm	260 + (7 x 0.31/100 x 260) = 265.6 mm	+5.6 mm
LVL X	Height, h	260 mm	260 + (7 x 0.033/100 x 260) = 260.6 mm	+0.6 mm

Water vapour resistance

Water vapour resistance is a measure of the extent to which a material prevents the passage of water vapour through it.

The water vapour resistance factor μ and water vapour diffusion coefficient in air δ_p defined in EN ISO 10456 may be used for LVL products in their thickness direction. Due to the wood cell structure, water vapour resistance in the length direction is only 5 % of the water vapour resistance in the thickness direction. For LVL S and T water vapour resistance in the same in width and thickness direction but for LVL X it is about 15 % of the resistance in the thickness direction.

	Water vapour resistance factor μ		Water vapour diffusion coefficient in air δ_p (kg/Pa·s·m)	
Density ρ mean	**Dry cup**	**Wet cup**	**Dry cup**	**Wet cup**
440 kg/m³ (LVL T)	180	65	$0.73 \cdot 10^{-12}$	$2.3 \cdot 10^{-12}$
510 kg/m³	200	70	$0.96 \cdot 10^{-12}$	$2.7 \cdot 10^{-12}$

Water vapour resistance factor μ and water vapour diffusion coefficient in air δ_p of softwood LVL.

Reaction to fire

Reaction to fire requirements are specified for wood surfaces to control the risk of flame spread in buildings. They set boundary conditions for the use of visible wood in claddings and structures. In some cases, fire retardant treatments or sprinkler systems can allow more visible wood structures to be used in architectural design.

LVL by Stora Enso in relation to its reaction to fire behaviour is classified as D-s1, d0 according to the European classification system defined in EN 13501-1:2018.

The format of the reaction to fire classification is:

Fire behavior		Smoke production			Flaming droplets	
D	-	S	1	.	d	0

This classification (18) 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.

Fire resistance

The temperature at which LVL ignites when it is exposed to a flame is about 270 °C.

The reaction to fire performance of LVL is classified as class D-s1, d0.

According to EN 1995-1-2 the one-dimensional charring rate for LVL is given as 0.65 mm/min, and the notional charring rate as 0.70 mm/min.

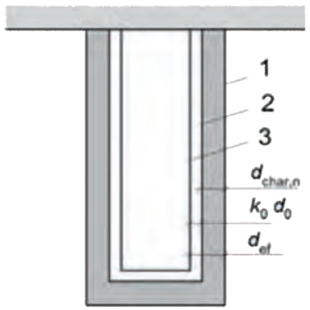
Determination of the effective cross section:
Due to the increased temperature, the mechanical properties of wood reduce which is taken into consideration by a zero strength layer d_0.

The remaining residual cross section beneath the zero strength layer on exposed sides is defined as the effective cross section.

The effective cross section is calculated by subtracting the effective charring depth d_{ef} from the initial cross section.

$$d_{ef} = d_{char,n} + k_0 \cdot d_0$$

Where d_0 is the depth of a layer with assumed zero strength and stiffness.
$d_0 = 7$ mm
$d_{char,n}$ is the notional design charring depth
k_0 is in the case of unprotected surfaces t/20, when t< 20 min and 1.0 when t>20 min.



1. Initial surface of member
2. Border of residual cross section
3. Border of effective cross section

Thermal properties

The thermal conductivity of LVL depends on its moisture content. In RH 47 % the moisture content is 9.3 % and the thermal conductivity coefficient λ = 0.110 M/(m·K).

The design thermal conductivity λ of LVL products is 0.13 W/(m·K) according to EN ISO 10456 for a product density of 500 kg/m^3 in 20 °C RH 65 % conditions. If the density decreases the thermal conductivity decreases and if the moisture content increases the thermal conductivity increases.

LVL can be used at a temperature up to 100 °C, temporarily 120 °C. Wood products resist cold better than heat and can be used at a temperature of -200 °C. The dimensions are very stable under heat and the thermal deformation can generally be disregarded.

Biological and chemical durability

The biological durability of the material is as good as the wood it came from. The glue is weather resistant. It is not recommended to use untreated LVL in use class 3. Avoid permanent contact with water.

Decay in wood is caused by fungal attack that may cause the wood to soften and lose strength. Fungi need moisture above 20 % and a temperature between +3 °C and +40 °C to develop and grow. We recommend that the wood surface should be treated when used in exterior conditions. LVL has good resistance to mild acids and acid salt solutions.

Alkalis cause softening of wood. Direct contact with oxidizing agents such as chlorine, hypochlorites and nitrates should be avoided. Alcohols and som organic liquids cause similar effects to wates i.e. producing swelling and slight loss of strength. Petrolium oils have no effect to strength properties but causes discolouration. The chemical resistance can be improved with various types of coatings.

Characteristic strength, stiffness and density values

Characteristic values (N/mm²)	Symbol	Figure	LVL-S 24–75 mm	LVL-X 24–75 mm
Bending strength: Edgewise (depth 300 mm)	$f_{m,0,edge,k}$	A	44	32
Bending strength: Size effect parameter	s	A	0.12	0.12
Bending strength: Flatwise, parallel to grain	$f_{m,0,flat,k}$	B	50	36
Bending strength: Flatwise, perpendicular to grain	$f_{m,90,flat,k}$	C	-	8
Tensile strength: Parallel to grain (length 3.000 mm)	$f_{t,0,k}$	D	35	26
Tensile strength: Perpendicular to grain, edgewise	$f_{t,90,edge,k\ (1)}$	E	0.8	6
Tensile strength: Perpendicular to grain, flatwise	$f_{t,90,flat,k}$	F	-	-
Compressive strength: Parallel to grain	$f_{c,0,k}$	G	35	26
Compressive strength: Perpendicular to grain, edgewise	$f_{c,90,edge,k}$	H	6	9
Compressive strength: Perpendicular to grain, flatwise	$f_{c,90,flat,k}$	I	2.2	2.2
Shear strength: Edgewise	$f_{v,0/90,edge,k}$	J	4.2	4.5
Shear strength: Flatwise, parallel to grain	$f_{v,0,flat,k}$	K	2.3	1.3
Shear strength: Flatwise, perpendicular to grain	$f_{v,90,flat,k}$	L	-	0.6
Modulus of elasticity: Parallel to grain	$E_{0,k}$	ABDG	11 600	8 800
Modulus of elasticity: Compression perpendicular to grain, edgewise	$E_{c,90,edge,k}$	H	-	2 000
Modulus of elasticity: Compression perpendicular to grain, flatwise	$E_{c,90,flat,k}$	I	-	-
Modulus of elasticity: Bending perpendicular to face veneer grain	$E_{m,90,k}$	C	-	1700
Shear modulus: Edgewise	$G_{0/90,edge,k}$	J	400	400
Shear modulus: Flatwise, parallel to grain	$G_{0,flat,k}$	K	250	100
Shear modulus: Flatwise, perpendicular to grain	$G_{90,flat,k}$	L	-	16
Characteristic density [kg/m³]	ρ_k	-	480	480

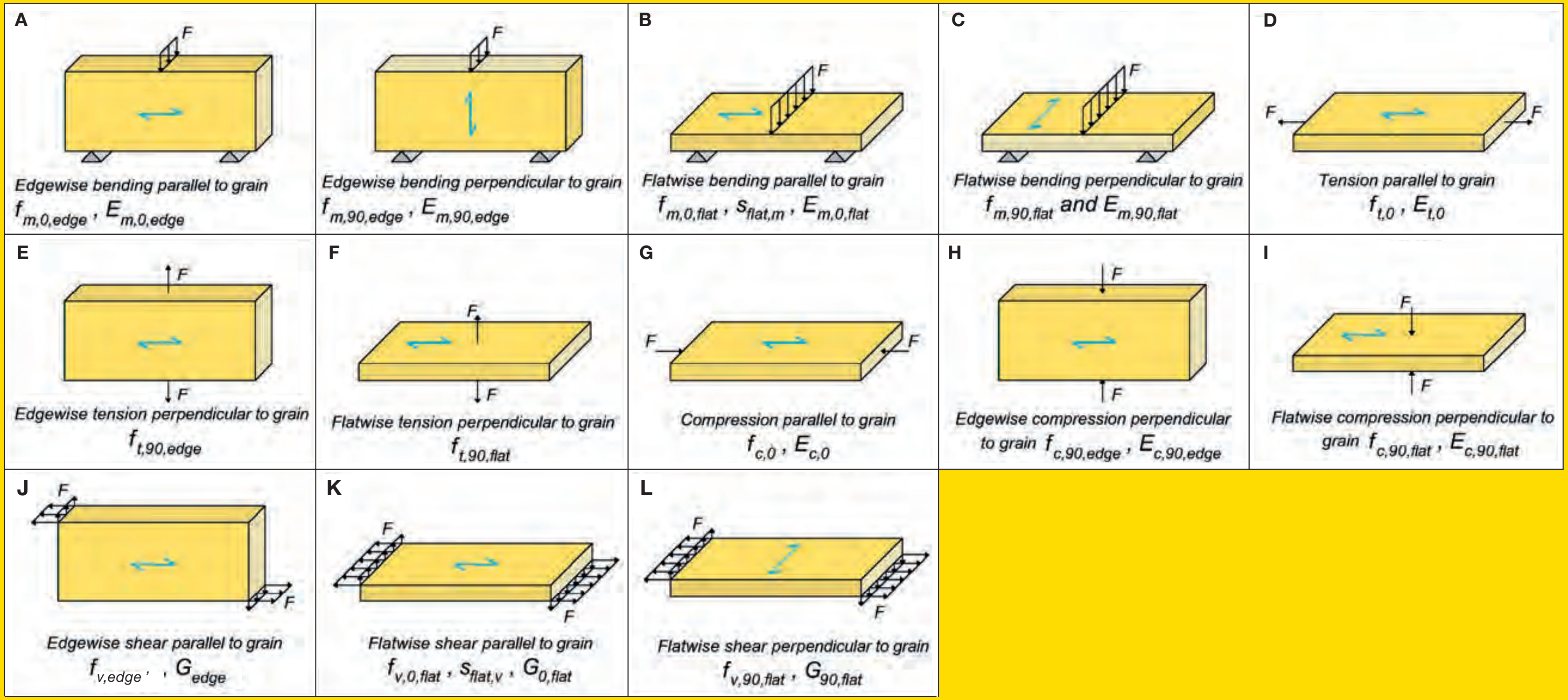
When edgewise bending property in 90° direction is not defined, *ft, 90, edge, k* value should be used as *fm, 90, edge, k*.

Mean stiffness and density values

Mean values (N/mm²)	**Symbol**	**Figure**	**LVL-S** 24–75 mm	**LVL-X** 24–75 mm
Modulus of elasticity: Parallel to grain	$E_{0,mean}$	ABDG	13 800	10 500
Modulus of elasticity: Compression perpendicular to grain, edgewise	$E_{c,90,edge,mean}$	H	-	2400
Modulus of elasticity: Compression perpendicular to grain, flatwise	$E_{c,90,flat,mean}$	I	-	-
Modulus of elasticity: Bending perpendicular to face veneer grain	$E_{m,90,mean}$	C	-	2000
Shear modulus: Edgewise	$G_{0/90,edge,mean}$	J	600	600
Shear modulus: Flatwise, parallel to grain	$G_{0,flat,mean}$	K	460	120
Shear modulus: Flatwise, perpendicular to grain	$G_{90,flat,mean}$	L	-	22
Mean density [kg/m³]	ρ_{mean}	-	510	510

When edgewise bending property in 90° direction is not defined, *ft, 90, edge, k* value should be used as *fm, 90, edge, k*.

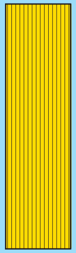
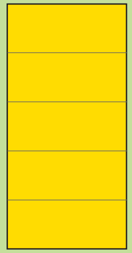
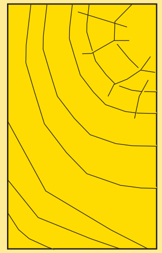
Definition of the strength and stiffness orientations




TEGERA
FESTOOL
5,2 Ah Li-Ion

LVL compared to other wood products

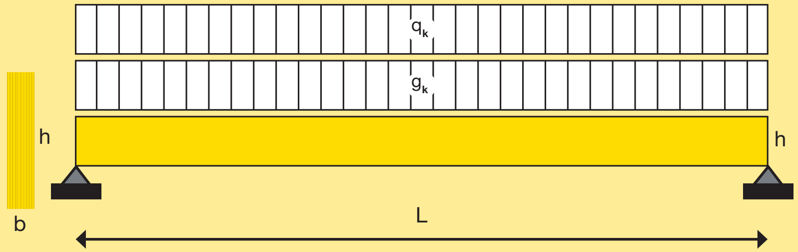
Compared to GL24h or C24 sawn timber, LVL has strength properties that provide designers with greater flexibility and allow for the potential for material savings to be made.

H =	LVL S by Stora Enso 300 mm 			Glulam GL 24h 300 mm 			Sawn Timber C24 300 mm 		
	Property N/mm²	**Width mm**	**Material saving**	**Property N/mm²**	**Width mm**	**Material increase**	**Property N/mm²**	**Property N/mm²**	**Material increase**
Bending edgewise $f_{m,0,edge,k}$	44.0	39	0 %	24.0	69	78 %	24.0	89	128 %
	44.0	45	0 %	24.0	80	78 %	24.0	103	128 %
	44.0	51	0 %	24.0	90	78 %	24.0	115	128 %
	44.0	75	0 %	24.0	134	78 %	24.0	171	128 %
Shear edgewise $f_{v,0,edge,k}$	4.1	39	0 %	3.5	48	22 %	4.0	65	66 %
	4.1	45	0 %	3.5	55	22 %	4.0	75	66 %
	4.1	51	0 %	3.5	62	22 %	4.0	84	66 %
	4.1	75	0 %	3.5	92	22 %	4.0	125	66 %
Compression // $f_{c,0,k}$	35.0	39	0 %	24.0	59	52 %	21.0	70	81 %
	35.0	45	0 %	24.0	68	52 %	21.0	80	81 %
	35.0	51	0 %	24.0	78	52 %	21.0	93	81 %
	35.0	75	0 %	24.0	114	52 %	21.0	135	81 %
Compression $f_{c,90,edge,k}$	6.0	39	0 %	2.5	98	150 %	2.5	101	160 %
	6.0	45	0 %	2.5	112	150 %	2.5	116	160 %
	6.0	51	0 %	2.5	127	150 %	2.5	132	160 %
	6.0	75	0 %	2.5	186	150 %	2.5	194	160 %
Tension // $f_{t,0,k}$	35.0	39	0 %	19.2	76	95 %	14.0	133	242 %
	35.0	45	0 %	19.2	88	95 %	14.0	154	242 %
	35.0	51	0 %	19.2	100	95 %	14.0	175	242 %
	35.0	75	0 %	19.2	145	95 %	14.0	255	242 %
Modulus of elasticity $E_{0,mean}$	13 800	39	0 %	11 500	47	20 %	11 000	49	25 %
	13 800	45	0 %	11 500	54	20 %	11 000	56	25 %
	13 800	51	0 %	11 500	61	20 %	11 000	64	25 %
	13 800	75	0 %	11 500	90	20 %	11 000	94	25 %
Characteristic density ρ_k	510 kg/m³			385 kg/m³			350 kg/m³		
Mean density ρ_{mean}	480 kg/m³			420 kg/m³			420 kg/m³		

Floor beams

In producing these tables the beam spacing has been set at 1.0 m for all design checks. The floor loads are given in kN/m². In determing the bending strength, the design table assumes that the beam is fully restrained to prevent laberal torsional buckling.

Beam spacing	1.00 m
Floor deck material	22 mm P5 particleboard 3000 N/mm²
Ceiling material	12.5 mm plasterboard 2000 N/mm²
Floor joist	C16 38 x 200 @ 600 c/c (secondary framing)



LVL S – single span beam

Char. permanent load g_k		1.0 kN/m²	1.5 kN/m²	2.0 kN/m²	1.0 kN/m²	1.5 kN/m²	2.0 kN/m²	1.0 kN/m²	1.5 kN/m²	2.0 kN/m²
Char. live load q_k		**1.5 kN/m²**			**2.5 kN/m²**			**5.0 kN/m²**		
		Category A1 Single occupancy residential			**Category B1** Office building			**Category C** Public building		
b (mm)	**h (mm)**	**Clear span (m)**								
39	195	2.98	2.76	2.59	2.68	2.52	2.40	2.23	2.14	2.07
39	220	3.37	3.12	2.93	3.03	2.85	2.71	2.52	2.42	2.34
39	240	3.68	3.41	3.20	3.31	3.12	2.96	2.75	2.65	2.56
39	245	3.76	3.48	3.27	3.38	3.18	3.02	2.81	2.70	2.61
39	300	4.60	4.15	3.86	4.14	3.91	3.71	3.45	3.32	3.21
39	360	5.28	4.77	4.44	4.98	4.70	4.44	4.15	4.00	3.86
39	400	5.72	5.17	4.80	5.54	5.17	4.80	4.62	4.44	4.29
45	195	3.14	2.91	2.73	2.82	2.66	2.53	2.35	2.26	2.19
45	220	3.55	3.29	3.09	3.19	3.01	2.86	2.66	2.56	2.47
45	240	3.87	3.59	3.37	3.48	3.28	3.12	2.90	2.79	2.70
45	245	3.96	3.67	3.43	3.55	3.35	3.19	2.96	2.85	2.76
45	300	4.77	4.31	4.01	4.36	4.11	3.91	3.64	3.50	3.39
45	360	5.48	4.95	4.60	5.24	4.95	4.60	4.37	4.21	4.07
45	400	5.93	5.36	4.98	5.83	5.36	4.98	4.87	4.69	4.53
75	195	3.76	3.49	3.28	3.38	3.19	3.04	2.83	2.73	2.64
75	220	4.25	3.87	3.60	3.82	3.61	3.44	3.20	3.08	2.98
75	240	4.58	4.14	3.85	4.17	3.94	3.75	3.49	3.37	3.26
75	245	4.66	4.20	3.91	4.26	4.03	3.83	3.57	3.44	3.33
75	300	5.43	4.90	4.56	5.23	4.90	4.56	4.38	4.22	4.08
75	360	6.23	5.63	5.23	6.23	5.63	5.23	5.26	5.08	4.91
75	400	6.75	6.09	5.67	6.75	6.09	5.67	5.85	5.65	5.46

● Vibration is design governing.

NOTE: The table does not replace the requirement to carry out a full, project specific structural design. The bearing support length should be calculated on a project specific basis appropriate to the proposed connection detail.

The following EN 1995-1-1-2004+A1:2008 design parameters have been used to produce these tables for service class 1 environments.

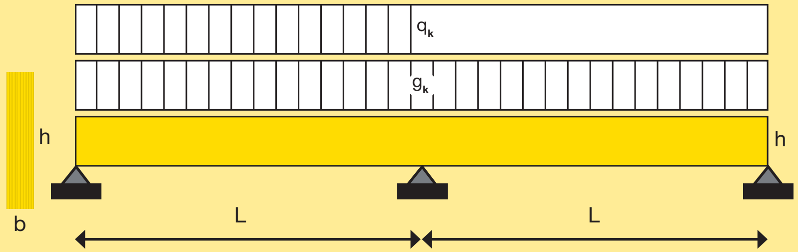
Design limits to control floor vibration are taken from the UK National Annex to BS EN 1995-1-1-2004+A1:2008: f1 ≥ 8 Hz.

The flexural rigidity of the supported floor (EI)b is set at 340765 N.m²/m.

$k_{mod.perm}$	0.6	f_1	8
$k_{mod.med}$	0.8	γ_m	1.2
k_{def}	0.6	$\gamma_{F.g}$	1.35
$k_{mod.short}$	0.9	$\gamma_{F.q}$	1.5
k_{amp}	1.05	Ψ_2	0.3
k_{dist}	1.36		
w_{inst}	L/300		
$w_{net.fin}$	L/250		

In producing these tables the beam spacing has been set at 1.0 m for all design checks. The floor loads are given in kN/m². Pattern imposed loading is applied to the multi-span floor beam table. The multispan beam tables are based on multiple equal spans. In determining the bending strength, the design table assumes that the beam is fully restrained to prevent lateral torsional buckling.

Beam spacing	1.00 m
Floor deck material	22 mm P5 particleboard 3000 N/mm²
Ceiling material	12.5 mm plasterboard 2000 N/mm²
Floor joist	C16 38 x 200 @ 600 c/c (secondary framing)



LVL S – 2 bay continuous beam

Char. permanent load g_k		1.0 kN/m²	1.5 kN/m²	2.0 kN/m²	1.0 kN/m²	1.5 kN/m²	2.0 kN/m²	1.0 kN/m²	1.5 kN/m²	2.0 kN/m²
Char. live load q_k		**1.5 kN/m²**			**2.5 kN/m²**			**5.0 kN/m²**		
		Category A1 Single occupancy residential			**Category B1** Office building			**Category C** Public building		
b (mm)	**h (mm)**	**Clear span (m)**								
39	195	3.47	3.26	3.08	3.07	2.93	2.81	2.52	2.45	2.32
39	220	3.92	3.68	3.48	3.47	3.31	3.17	2.85	2.77	2.63
39	240	4.28	4.02	3.73	3.79	3.62	3.47	3.11	3.02	2.87
39	245	4.37	4.08	3.79	3.87	3.69	3.54	3.18	3.09	2.93
39	300	5.27	4.75	4.42	4.75	4.53	4.35	3.90	3.79	3.60
39	360	6.05	5.46	5.08	5.71	5.45	5.08	4.69	4.56	4.33
39	400	6.55	5.91	5.50	6.35	5.91	5.50	5.21	5.07	4.82
45	195	3.65	3.43	3.25	3.23	3.08	2.96	2.66	2.58	2.51
45	220	4.12	3.87	3.62	3.65	3.49	3.34	3.00	2.92	2.84
45	240	4.50	4.16	3.87	3.99	3.81	3.65	3.28	3.19	3.10
45	245	4.60	4.23	3.93	4.07	3.89	3.73	3.35	3.25	3.17
45	300	5.46	4.93	4.58	5.00	4.77	4.58	4.11	3.99	3.89
45	360	6.27	5.66	5.26	6.00	5.66	5.26	4.94	4.80	4.67
45	400	6.79	6.13	5.70	6.68	6.13	5.70	5.49	5.34	5.20
75	195	4.37	4.05	3.76	3.87	3.70	3.55	3.19	3.11	3.03
75	220	4.91	4.43	4.12	4.38	4.16	4.02	3.61	3.51	3.42
75	240	5.25	4.74	4.40	4.78	4.57	4.38	3.94	3.83	3.74
75	245	5.33	4.81	4.47	4.88	4.66	4.47	4.02	3.91	3.81
75	300	6.21	5.61	5.22	5.98	5.61	5.22	4.94	4.80	4.68
75	360	7.13	6.44	5.99	7.13	6.44	5.99	5.93	5.77	5.63
75	400	7.72	6.97	6.48	7.72	6.97	6.48	6.60	6.42	6.26

● Vibration is design governing.

NOTE: The table does not replace the requirement to carry out a full, project specific structural design. The bearing support length should be calculated on a project specific basis appropriate to the proposed connection detail.

The following EN 1995-1-1-2004+A1:2008 design parameters have been used to produce these tables for service class 1 environments.

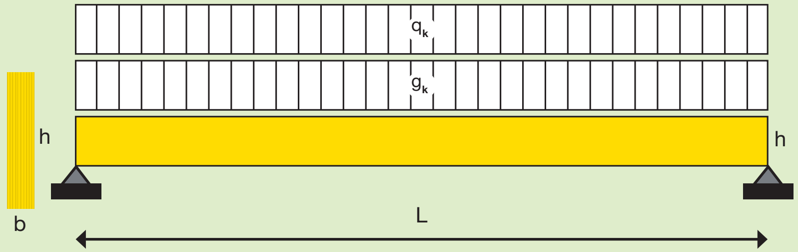
Design limits to control floor vibration are taken from the UK National Annex to BS EN 1995-1-1-2004+A1:2008: f1 ≥ 8 Hz.

The flexural rigidity of the supported floor (EI)b is set at 340765 N.m²/m.

$k_{mod.perm}$	0.6	f_1	8
$k_{mod.med}$	0.8	γ_m	1.2
k_{def}	0.6	$\gamma_{F.g}$	1.35
$k_{mod.short}$	0.9	$\gamma_{F.q}$	1.5
k_{amp}	1.05	Ψ_2	0.3
k_{dist}	1.36		
w_{inst}	L/300		
$w_{net.fin}$	L/250		

Roof purlins

In determining the bending strength, the design table assumes that the beam is fully restrained to prevent lateral torsional buckling.



LVL S – single span beam

Char. permanent load g_k		1.0 kN/m²	1.5 kN/m²	2.0 kN/m²	1.0 kN/m²	1.5 kN/m²	2.0 kN/m²	1.0 kN/m²	1.5 kN/m²	2.0 kN/m²
Char. live load qk		1.5 kN/m²			2.5 kN/m²			5.0 kN/m²		
		Category A1 Single occupancy residential			**Category B1** Office building			**Category C** Public building		
b (mm)	**h (mm)**	**Clear span (m)**								
39	195	2.91	2.71	2.55	2.42	2.34	2.26	2.13	2.08	2.03
39	220	3.29	3.06	2.88	2.74	2.64	2.56	2.41	2.35	2.29
39	240	3.60	3.35	3.15	2.99	2.88	2.79	2.64	2.57	2.51
39	245	3.67	3.42	3.22	3.05	2.95	2.85	2.69	2.62	2.56
39	300	4.51	4.19	3.95	3.75	3.62	3.50	3.31	3.22	3.15
39	360	5.42	5.04	4.75	4.50	4.35	4.21	3.98	3.88	3.78
39	400	6.02	5.61	5.28	5.01	4.84	4.69	4.42	4.31	4.21
45	195	3.07	2.85	2.69	2.55	2.46	2.38	2.25	2.19	2.14
45	220	3.47	3.23	3.04	2.88	2.78	2.70	2.55	2.48	2.42
45	240	3.78	3.52	3.32	3.15	3.04	2.95	2.78	2.71	2.65
45	245	3.86	3.60	3.39	3.22	3.11	3.01	2.84	2.77	2.70
45	300	4.74	4.41	4.16	3.95	3.81	3.69	3.49	3.40	3.32
45	360	5.70	5.31	5.00	4.75	4.58	4.44	4.20	4.09	3.99
45	400	6.34	5.90	5.56	5.28	5.10	4.94	4.67	4.55	4.44
75	195	3.67	3.42	3.23	3.07	2.96	2.87	2.72	2.65	2.59
75	220	4.15	3.87	3.65	3.47	3.35	3.25	3.07	3.00	2.93
75	240	4.53	4.22	3.98	3.78	3.66	3.55	3.35	3.27	3.20
75	245	4.63	4.31	4.07	3.86	3.74	3.62	3.43	3.34	3.26
75	300	5.68	5.29	4.99	4.74	4.58	4.44	4.20	4.10	4.01
75	360	6.82	6.36	6.00	5.70	5.51	5.34	5.05	4.93	4.82
75	400	7.58	7.07	6.67	6.34	6.13	5.94	5.62	5.48	5.36

The following EN 1995-1-1-2004+A1:2008 design parameters have been used to produce these tables for service class 1 environments.

Design limits to control floor vibration are taken from the UK National Annex to BS EN 1995-1-1-2004+A1:2008: f1 ≥ 8 Hz.

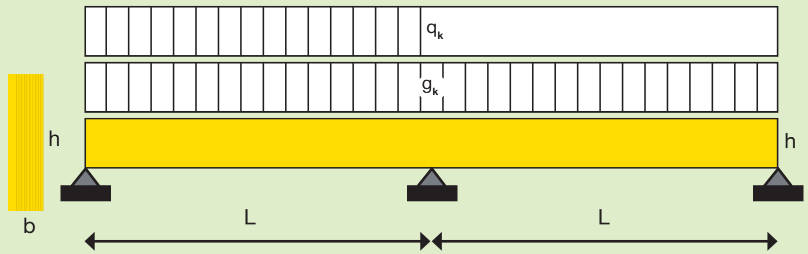
The flexural rigidity of the supported floor (EI)b is set at 340765 N.m²/m.

$k_{mod.perm}$	0.6	f_1	8
$k_{mod.med}$	0.8	γ_m	1.2
k_{def}	0.6	$\gamma_{F.g}$	1.35
$k_{mod.short}$	0.9	$\gamma_{F.q}$	1.5
k_{amp}	1.05	Ψ_2	0.0 (snow)
k_{dist}	1.36		
w_{inst}	L/300		
$w_{net.fin}$	L/250		

NOTE: The table does not replace the requirement to carry out a full, project specific structural design. The bearing support length should be calculated on a project specific basis appropriate to the proposed connection detail.

In producing these tables the beam spacing has been set at 1.0 m for all design checks. The floor loads are given in kN/m². Pattern imposed loading is applied to the multi-span floor beam table. The multispan beam tables are based on multiple equal spans. In determining the bending strength, the design table assumes that the beam is fully restrained to prevent lateral torsional buckling.

Beam spacing	1.00 m
Floor deck material	22 mm P5 particleboard 3000 N/mm²
Ceiling material	12.5 mm plasterboard 2000 N/mm²
Floor joist	C16 38 x 200 @ 600 c/c (secondary framing)



LVL S – 2 bay continuous beam

Char. permanent load g_k		1.0 kN/m²	1.5 kN/m²	2.0 kN/m²	1.0 kN/m²	1.5 kN/m²	2.0 kN/m²	1.0 kN/m²	1.5 kN/m²	2.0 kN/m²
Char. live load q_k		**1.5 kN/m²**			**2.5 kN/m²**			**5.0 kN/m²**		
		Category A1 Single occupancy residential			**Category B1** Office building			**Category C** Public building		
b (mm)	**h (mm)**	**Clear span (m)**								
39	195	3.64	3.39	3.19	3.03	2.90	2.78	2.55	2.41	2.28
39	220	4.11	3.83	3.60	3.42	3.30	3.20	2.89	2.73	2.58
39	240	4.49	4.18	3.93	3.73	3.61	3.49	3.16	2.98	2.82
39	245	4.58	4.27	4.02	3.81	3.68	3.57	3.23	3.04	2.88
39	300	5.62	5.23	4.93	4.68	4.52	4.38	3.96	3.74	3.54
39	360	6.76	6.29	5.92	5.62	5.43	5.26	4.77	4.49	4.25
39	400	7.51	6.99	6.59	6.25	6.04	5.85	5.30	5.00	4.73
45	195	3.83	3.57	3.36	3.19	3.08	2.98	2.82	2.75	2.61
45	220	4.33	4.03	3.79	3.60	3.48	3.37	3.18	3.10	2.95
45	240	4.72	4.40	4.14	3.93	3.80	3.68	3.48	3.39	3.22
45	245	4.82	4.49	4.23	4.02	3.88	3.76	3.55	3.46	3.29
45	300	5.92	5.51	5.19	4.93	4.76	4.61	4.36	4.25	4.04
45	360	7.11	6.62	6.24	5.92	5.72	5.54	5.24	5.11	4.86
45	400	7.90	7.36	6.93	6.59	6.36	6.16	5.83	5.68	5.40
75	195	4.58	4.27	4.03	3.83	3.70	3.59	3.40	3.31	3.24
75	220	5.18	4.83	4.55	4.33	4.18	4.05	3.84	3.74	3.66
75	240	5.65	5.27	4.97	4.72	4.57	4.43	4.19	4.09	3.99
75	245	5.77	5.38	5.07	4.82	4.66	4.52	4.28	4.17	4.08
75	300	7.08	6.60	6.22	5.92	5.72	5.55	5.25	5.12	5.00
75	360	8.50	7.93	7.48	7.11	6.87	6.66	6.31	6.15	6.01
75	400	9.45	8.81	8.31	7.90	7.64	7.41	7.01	6.84	6.68

The following EN 1995-1-1-2004+A1:2008 design parameters have been used to produce these tables for service class 1 environments.

The following EN 1995-1-1-2004+A1:2008 design parameters have been used to produce these tables for service class 1 environments.

Design limits to control floor vibration are taken from the UK National Annex to BS EN 1995-1-1-2004+A1:2008: f1 ≥ 8 Hz.

The flexural rigidity of the supported floor (EI)b is set at 340765 N.m²/m.

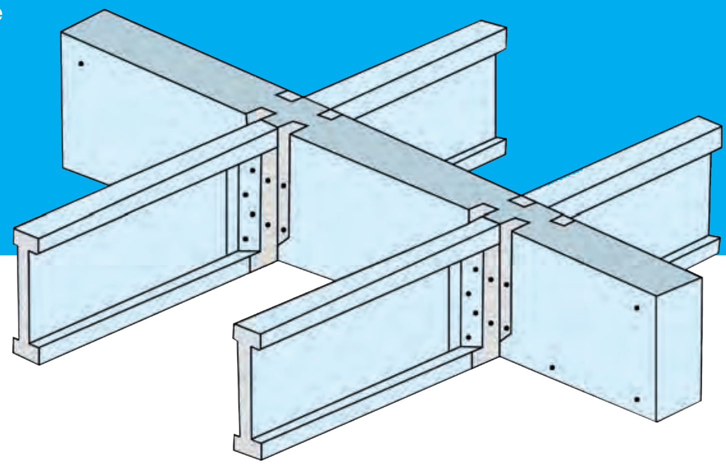
$k_{mod.perm}$	0.6	f_1	8
$k_{mod.med}$	0.8	γ_m	1.2
k_{def}	0.6	$\gamma_{F.g}$	1.35
$k_{mod.short}$	0.9	$\gamma_{F.q}$	1.5
k_{amp}	1.05	Ψ_2	0.0 (snow)
k_{dist}	1.36		
w_{inst}	L/300		
$w_{net.fin}$	L/250		

NOTE: The table does not replace the requirement to carry out a full, project specific structural design. The bearing support length should be calculated on a project specific basis appropriate to the proposed connection detail.

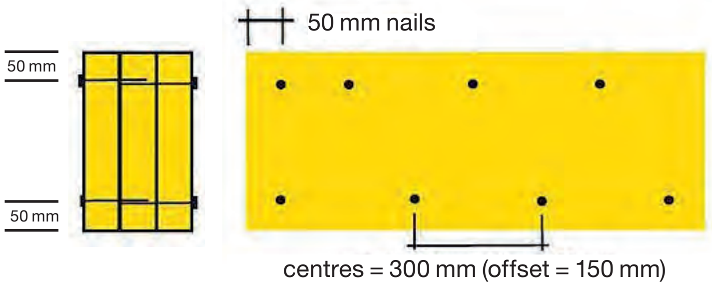
Multiple ply beams

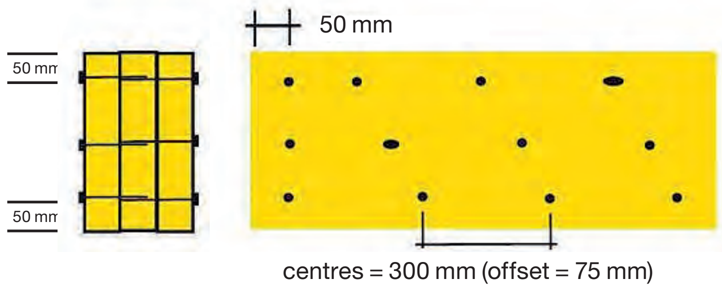
Joist applied to one or both sides of the beam.

Side loads are not recommended for 180 mm wide beams unless applied to both beam faces.

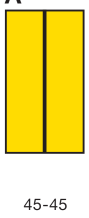


Medium term loading kmod = 0.8 γm = 1.3

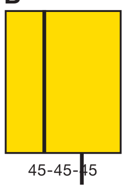




A

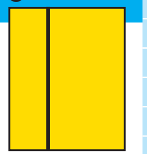


B



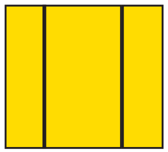
Connections	Shear plane resistance	EC5 Mode	Maximum side load[1)]
Ø 3.35 x 90 smooth nail 2 rows @ 300	4.75 kN/m	f	9.50 kN/m
Ø 3.35 x 90 smooth nail 3 rows @ 300	7.12 kN/m	f	14.20 kN/m
Ø 3.75 x 90 smooth nail 2 rows @ 300	5.72 kN/m	f	11.40 kN/m
Ø 3.75 x 90 smooth nail 3 rows @ 300	8.58 kN/m	f	17.20 kN/m
Partially threaded screw Ø 10 x 80 2 rows @ 600	6.79 kN/m	c	6.79 kN/m
Partially threaded screw Ø 10 x 80 2 rows @ 300	13.59 kN/m	c	13.59 kN/m
Fully threaded screw Ø 8 x 80 2 rows @ 600	7.67 kN/m	c	7.67 kN/m
Fully threaded screw Ø 8 x 80 2 rows @ 300	15.34 kN/m	c	15.34 kN/m
Fully threaded screw Ø 8 x 80 3 rows @ 600	11.50 kN/m	c	11.50 kN/m
Fully threaded screw Ø 8 x 80 3 rows @ 300	23.00 kN/m	c	23.00 kN/m
Fully threaded screw Ø 10 x 80 2 rows @ 600	9.38 kN/m	c	9.38 kN/m
Fully threaded screw Ø 10 x 80 2 rows @ 300	18.75 kN/m	c	18.75 kN/m
Ø 3.35 x 90 smooth nail 2 rows @ 300	4.75 kN/m	f	7.1 kN/m
Ø 3.35 x 90 smooth nail 3 rows @ 300	7.12 kN/m	f	10.7 kN/m
Ø 3.75 x 90 smooth nail 2 rows @ 300	5.72 kN/m	f	8.6 kN/m
Ø 3.75 x 90 smooth nail 3 rows @ 300	8.58 kN/m	f	12.9 kN/m
Partially threaded screw Ø 10 x 120 2 rows @ 600	9.10 kN/m	h	18.21 kN/m
Partially threaded screw Ø 10 x 120 2 rows @ 300	18.21 kN/m	h	36.42 kN/m
Fully threaded screw Ø 8 x 130 2 rows @ 600	10.28 kN/m	h	20.55 kN/m
Fully threaded screw Ø 8 x 130 2 rows @ 300	20.55 kN/m	h	41.10 kN/m
Fully threaded screw Ø 8 x 130 3 rows @ 600	15.41 kN/m	h	30.83 kN/m
Fully threaded screw Ø 8 x 130 3 rows @ 300	30.83 kN/m	h	61.65 kN/m
Fully threaded screw Ø 10 x 130 2 rows @ 600	12.57 kN/m	h	25.13 kN/m
Fully threaded screw Ø 10 x 130 2 rows @ 300	25.13 kN/m	h	50.26 kN/m

C



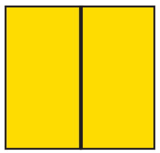
45-90

D



45-90-45

E

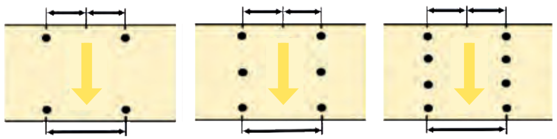


90-90

Connections	Shear plane resistance	EC5 Mode	Maximum side load[1]
Ø 3.35 x 90 smooth nail 2 rows @ 300	4.75 kN/m	f	7.10 kN/m
Ø 3.35 x 90 smooth nail 3 rows @ 300	7.12 kN/m	f	10.70 kN/m
Ø 3.75 x 90 smooth nail 2 rows @ 300	5.72 kN/m	f	8.60 kN/m
Ø 3.75 x 90 smooth nail 3 rows @ 300	8.58 kN/m	f	12.90 kN/m
Partially threaded screw Ø 10 x 80 2 rows @ 600	10.59 kN/m	c	10.59 kN/m
Partially threaded screw Ø 10 x 80 2 rows @ 300	21.18 kN/m	c	21.18 kN/m
Fully threaded screw Ø 8 x 80 2 rows @ 600	13.28 kN/m	c	13.28 kN/m
Fully threaded screw Ø 8 x 80 2 rows @ 300	26.56 kN/m	c	26.56 kN/m
Fully threaded screw Ø 8 x 80 3 rows @ 600	19.92 kN/m	c	19.92 kN/m
Fully threaded screw Ø 8 x 80 3 rows @ 300	39.83 kN/m	c	39.83 kN/m
Fully threaded screw Ø 10 x 80 2 rows @ 600	16.24 kN/m	c	16.24 kN/m
Fully threaded screw Ø 10 x 80 2 rows @ 300	32.47 kN/m	c	32.47 kN/m
Ø 3.35 x 90 smooth nail 2 rows @ 300	4.75 kN/m	f	6.30 kN/m
Ø 3.35 x 90 smooth nail 3 rows @ 300	7.12 kN/m	f	9.50 kN/m
Ø 3.75 x 90 smooth nail 2 rows @ 300	5.72 kN/m	f	7.60 kN/m
Ø 3.75 x 90 smooth nail 3 rows @ 300	8.58 kN/m	f	11.40 kN/m
Partially threaded screw Ø 10 x 120 2 rows @ 600	13.18 kN/m	d	26.37 kN/m
Partially threaded screw Ø 10 x 120 2 rows @ 300	26.37 kN/m	d	52.74 kN/m
Fully threaded screw Ø 8 x 130 2 rows @ 600	17.03 kN/m	f	34.07 kN/m
Fully threaded screw Ø 8 x 130 2 rows @ 300	34.07 kN/m	f	68.13 kN/m
Fully threaded screw Ø 8 x 130 3 rows @ 600	25.55 kN/m	f	51.10 kN/m
Fully threaded screw Ø 8 x 130 3 rows @ 300	51.10 kN/m	f	102.20kN/m
Fully threaded screw Ø 10 x 130 2 rows @ 600	21.67 kN/m	d	43.33 kN/m
Fully threaded screw Ø 10 x 130 2 rows @ 300	43.33 kN/m	d	86.66 kN/m
Ø 3.35 x 90 smooth nail 2 rows @ 300	N/A	N/A	N/A
Ø 3.35 x 90 smooth nail 3 rows @ 300	N/A	N/A	N/A
Ø 3.75 x 90 smooth nail 2 rows @ 300	N/A	N/A	N/A
Ø 3.75 x 90 smooth nail 3 rows @ 300	N/A	N/A	N/A
Partially threaded screw Ø 10 x 180 2 rows @ 600	14.07 kN/m	f	14.07 kN/m
Partially threaded screw Ø 10 x 180 2 rows @ 300	28.14 kN/m	f	28.14 kN/m
Fully threaded screw Ø 8 x 180 2 rows @ 600	17.03 kN/m	c	17.03 kN/m
Fully threaded screw Ø 8 x 180 2 rows @ 300	34.05 kN/m	c	34.05 kN/m
Fully threaded screw Ø 8 x 180 3 rows @ 600	25.54 kN/m	c	25.54 kN/m
Fully threaded screw Ø 8 x 180 3 rows @ 300	51.08 kN/m	c	51.08 kN/m
Fully threaded screw Ø 10 x 180 2 rows @ 600	20.82 kN/m	c	20.82 kN/m
Fully threaded screw Ø 10 x 180 2 rows @ 300	41.64 kN/m	c	41.64 kN/m

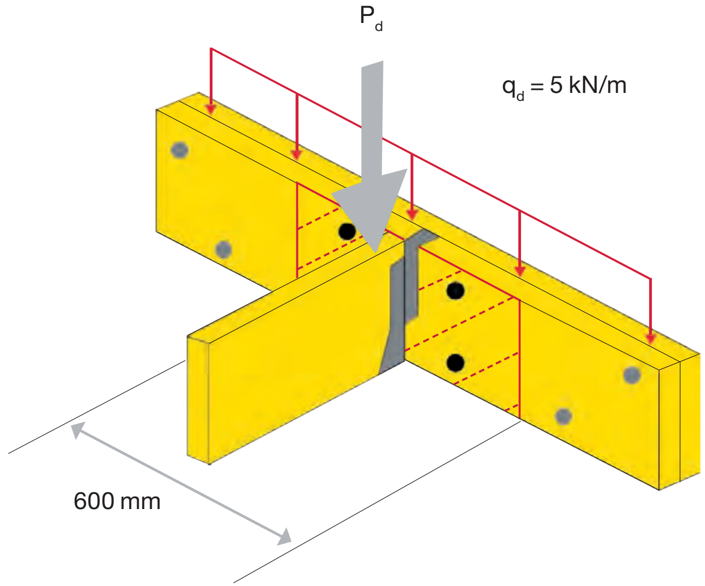
1) The values given in this table are maximum medium term design side loads meeting the the capacities of the fixing details. The Engineer should also check that all other strength and stiffness design criteria are met (e.g. moment, shear, bearing and deflection).

Point loads



“A” is not greater than 300 mm.

		“A”	“A”	“A”
A	Ø 3.35 x 90 smooth nail 2 rows @ 300	6.84 kN	10.26 kN	13.68 kN
	Ø 3.75 x 90 smooth nail 2 rows @ 300	8.21 kN	12.31 kN	16.42 kN
	Partially threaded screw Ø 10 x 80 2 rows @ 300	9.78 kN	14.67 kN	19.57 kN
	Fully threaded screw Ø 8 x 80 2 rows @ 300	11.04 kN	16.56 kN	22.08 kN
	Fully threaded screw Ø 10 x 80 2 rows @ 300	13.50 kN	20.25 kN	27.00 kN
B	Ø 3.35 x 90 smooth nail 2 rows @ 300	5.11 kN	7.67 kN	10.22 kN
	Ø 3.75 x 90 smooth nail 2 rows @ 300	6.19 kN	9.29 kN	12.38 kN
	Partially threaded screw Ø 10 x 120 2 rows @ 300	26.22 kN	39.33 kN	52.44 kN
	Fully threaded screw Ø 8 x 130 2 rows @ 300	29.59 kN	44.39 kN	59.19 kN
	Fully threaded screw Ø 10 x 130 2 rows @ 300	36.19 kN	54.28 kN	72.38 kN
C	Ø 3.35 x 90 smooth nail 2 rows @ 300	5.11 kN	7.67 kN	10.22 kN
	Ø 3.75 x 90 smooth nail 2 rows @ 300	6.19 kN	9.29 kN	12.38 kN
	Partially threaded screw Ø 10 x 120 2 rows @ 300	15.25 kN	22.87 kN	30.50 kN
	Fully threaded screw Ø 8 x 130 2 rows @ 300	19.12 kN	28.68 kN	38.24 kN
	Fully threaded screw Ø 10 x 130 2 rows @ 300	23.38 kN	35.07 kN	46.76 kN
D	Ø 3.35 x 90 smooth nail 2 rows @ 300	4.54 kN	6.80 kN	9.07 kN
	Ø 3.75 x 90 smooth nail 2 rows @ 300	5.47 kN	8.21 kN	10.94 kN
	Partially threaded screw Ø 10 x 180 2 rows @ 300	37.97 kN	56.96 kN	75.94 kN
	Fully threaded screw Ø 8 x 180 2 rows @ 300	49.06 kN	73.58 kN	98.11 kN
	Fully threaded screw Ø 10 x 180 2 rows @ 300	62.40 kN	93.60 kN	124.80 kN
E	Ø 3.35 x 90 smooth nail 2 rows @ 300	0.00 kN	0.00 kN	0.00 kN
	Ø 3.75 x 90 smooth nail 2 rows @ 300	0.00 kN	0.00 kN	0.00 kN
	Partially threaded screw Ø 10 x 180 2 rows @ 300	20.26 kN	30.39 kN	40.52 kN
	Fully threaded screw Ø 8 x 180 2 rows @ 300	24.52 kN	36.77 kN	49.03 kN
	Fully threaded screw Ø 10 x 180 2 rows @ 300	29.98 kN	44.97 kN	59.96 kN



The values given in this table are maximum medium term design side loads meeting the the capacities of the fixing details. The Engineer should also check that all other strength and stiffness design criteria are met (e.g. moment, shear, bearing and deflection). The values given in this table include any design UDL load adjacent to, and supported by, the fixings. The design UDL must be subtracted from the table value in order to determine the maximum point load, for example:

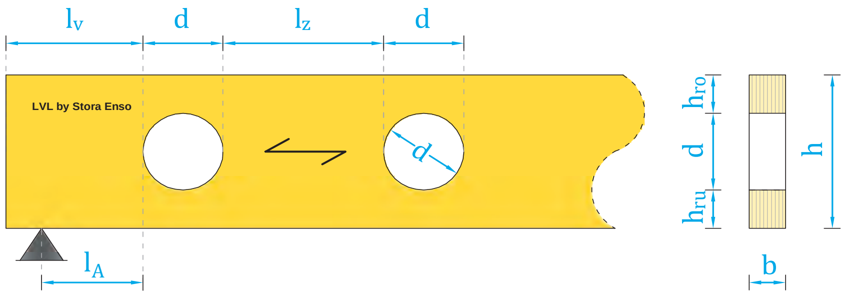
- 2No 45 x 360 LVL-S connected by 2 rows of Fully threaded screw Ø 10 with a spacing of 600 mm
- The incoming beam is supported by 4 Fully threaded screw Ø 10 x 80
- The multiple ply beam also supports a uniformly distributed side load qd of 5 kN/m
- The maximum design load from the incoming beam:
- $P_{d.max}$ = 11.25 – 0.6 x 5 = 8.25 kN*

***Subject to the additional design checks described in note 1.**

Holes in edgewise LVL beams

In the figures below the geometric boundary conditions regarding holes in beams are shown. The rules given in the further sections of this chapter are only valid, for unreinforced holes and if the following geometric boundary conditions are respected.

General boundary condition: $l_V \geq h$ and $l_A \geq 0.5 \cdot h$



Definition of geometric dimension related to circular holes.

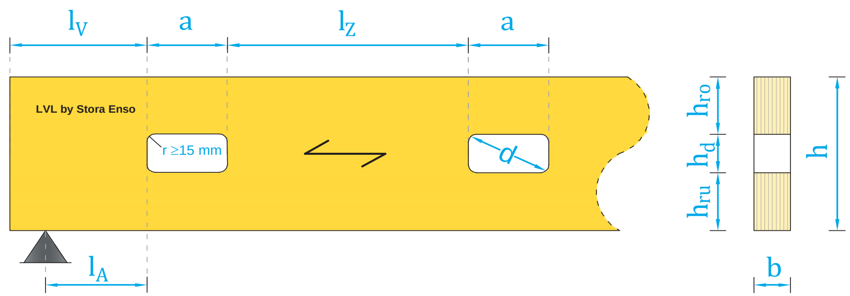
Additionally. for circular holes:

$h_d = d \leq 0.7 \cdot h$

When the hole center is situated at neutral axis:
$h_{ro} \geq 0.15 \cdot h$ and $h_{ru} \geq 0.15 \cdot h$

When opening is not placed at the neutral axis (eccentricity):
$h_{ro} \geq 0.25 \cdot h$ and $h_{ru} \geq 0.25 \cdot h$

$$l_z \geq max \begin{cases} 0.50 \cdot h \\ 2.0 \cdot d \end{cases}$$



Definition of geometric dimensions related to rectangular holes.

Additionally for rectangular holes:
The radius of curvature at each corner shall be at least 15 mm.

$h_d \leq 0.3 \cdot h$

$a \leq 1.5 \cdot h$

$h_{ro} \geq 0.35 \cdot h$ and $h_{ru} \geq 0.35 \cdot h$

$l_z \geq 1.5 \cdot h$

With:

h Depth of the LVL beam [mm]

l_z Distance between two holes [mm]

h_d Diameter or height of the circular opening [mm]

a Length of the rectangular opening [mm]

Size and location of the holes

(LVL-S and LVL-X)

Beams with circular holes loaded in bending

Geometrical limitations for circular holes in LVL-S and LVL-X by Stora Enso beams.

				Center of the hole on neutral axis		Center of the hole on neutral axis	
BEAM HEIGHT	MIN DISTANCE FROM THE BEAM END	MIN DISTANCE FROM THE SUPPORT	MIN DISTANCE BETWEEN HOLES	MAXIMUM DIAMETER OF THE HOLE	DISTANCE FROM THE EDGES OF THE BEAM	MAXIMUM DIAMETER OF THE HOLE	DISTANCE FROM THE EDGES OF THE BEAM
h [mm]	L_V min [mm]	L_A min [mm]	L_Z min [mm]	d [mm]	h_{ro} and h_u min [mm]	d [mm]	h_{ro} and h_u [mm]
200	200	100	280	140	30	100	50
240	240	120	336	168	36	120	60
300	300	150	420	210	45	150	75
350	350	175	490	245	52.5	175	87.5
400	400	200	560	280	60	200	100
450	450	225	630	315	67.5	225	112.5
500	500	250	700	350	75	250	125
600	600	300	840	420	90	300	150

(LVL-S and LVL-X)

Beams with rectangular holes loaded in bending

Geometrical limitations for rectangular holes in LVL-S and LVL-X by Stora Enso beams.

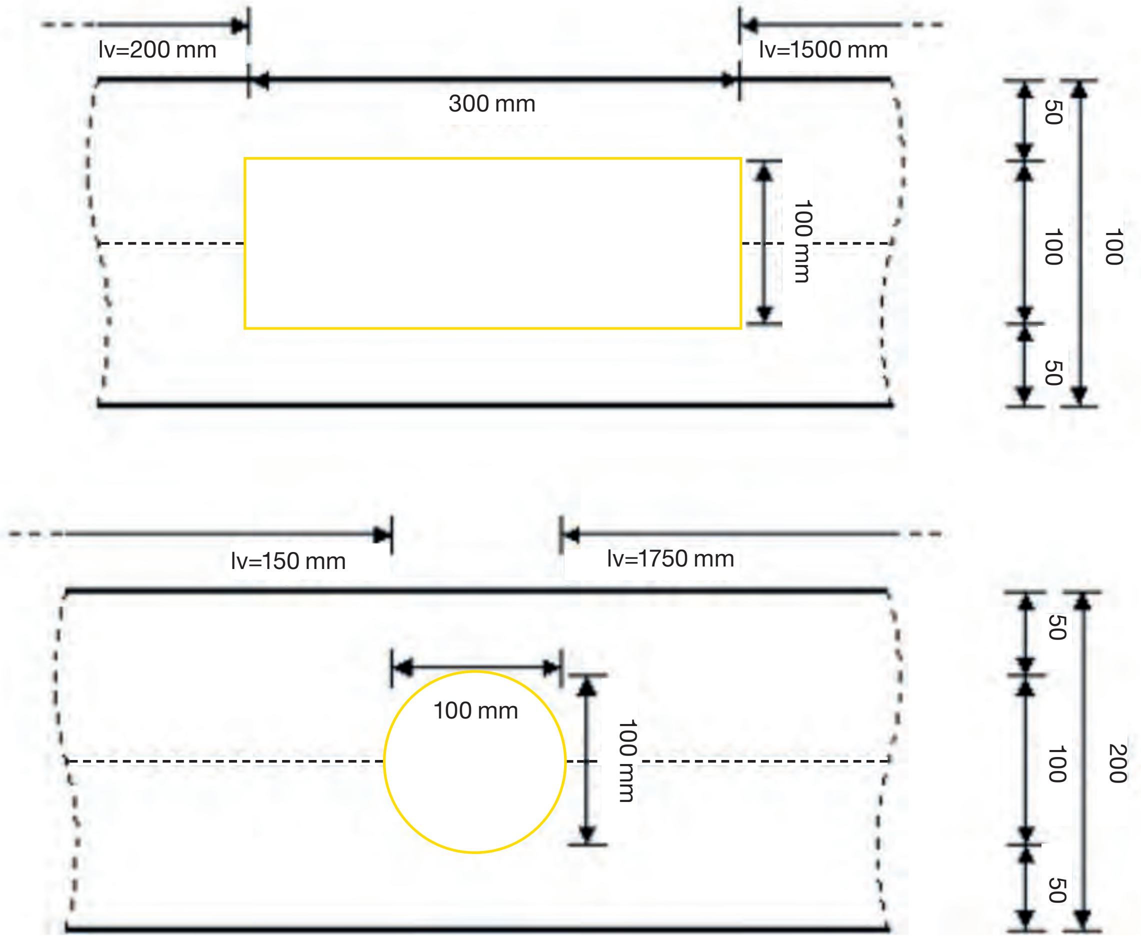
BEAM HEIGHT	MIN DISTANCE FROM THE BEAM END	MIN DISTANCE FROM THE SUPPORT	MIN DISTANCE BETWEEN HOLES	MAXIMUM LENGTH OF TWO HOLE	MAXIMUM HEIGHT OF THE HOLE	DISTANCE FROM THE EDGES OF THE BEAM
h [mm]	L_V min [mm]	L_A min [mm]	L_Z min [mm]	a max [mm]	h_d max [mm]	h_{ro} and h_u min [mm]
200	200	100	300	300	60	70
240	240	120	360	360	72	84
300	300	150	450	450	90	105
350	350	175	525	525	105	122.5
400	400	200	600	600	120	140
450	450	225	675	675	135	157.5
500	500	250	750	750	150	175
600	600	300	900	900	180	210

NOTE: For more detailed guidance to design holes in LVL beams, the document “LVL by Stora Enso Holes and notches in beams” is available.

Design software

Calculatis
by Stora Enso

The software Calculatis by Stora Enso also support the design of LVL beams, plates and holes according to Stora Enso design rules.



LVL rim board for timber frames

RIM boards are used as edge binders and load transfer members for timber floor assemblies, and also serve a purpose as fire separating components. The rim board is continuous and not broken by I-joists.

LVL rim boards by Stora Enso are manufactured using the cross-laminated structure that has inherent dimensional stability built in as well being easy to handle, work and nail.

They are available in 30 mm thickness and depts from 195 to 400 mm to suit all I-joists and in 254 mm especially for metal web joist products. Where web-fillers/ blocking is used then this must form an intimate fit between the i-joist flanges. For further guidance please refer to engineered joist producer.

The applications have been tested by International Fire Consultants Ltd (IFC) and satisfy the integrity and insulation performance criteria to BS476: Parts 21 and 22: 1987, for the relevant fire resistance for standard domestic dwellings and structures up to 4 storeys. Following table and illustrations are based on the IFC assessments report.

Minimum rim board and blocking thickness for LVL

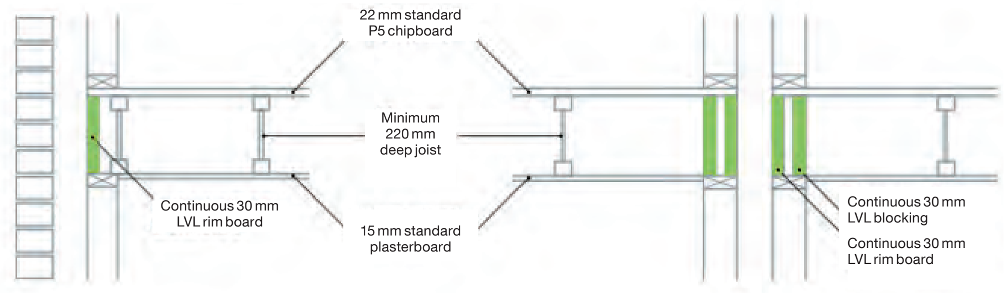
	30 min fire resistance	30 min fire resistance
Blocking type / minimum LVL thickne	-	30 min*
Rim board type / minimum LVL thickness	30 min*	30 min*

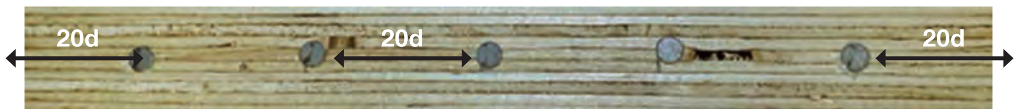
*The LVL rim board system thickness may need to be increased for buildings requiring a greater loadbearing capability than 2.5 kN/m².

NOTE: For more details about fasteners spacing, edge and end distances in LVL, Chapter 5.2 of the LVL handbook Europe should be consulted.

Floor joists perpendicular to wall 30 minutes

Floor joists parallel to wall 30 minutes





According to experimental testing, nailed connections with 3.1 x 90 mm nail gun nailing may be done to the edge face of Stora Enso LVL 30 mm product, when the end distance $a_{3,c}$ to an unloaded end is at least 20d (62 mm) and the nails spacing a_1 is at least 20d (62 mm).

Storage and handling

Careful and proper handling and storing of the materials is essential to avoid defects on product's surfaces, edges or corners. Furthermore, the dimensional stability of the product may suffer as a result of incorrect handling.

Transportation

While you transport or store LVL, avoid increase moisture caused by rain or splashing. When using a forklift truck, make sure the forks are wide enough to prevent damage. The width of the forks is also important when lifting several packs of LVL at the same time.

Unloading

When you handle packs of LVL with a forklift truck or crane, our recommedation is to use web slings of proper condition and strength. Avoid using chains or wires since they may cause damage to the surface, edge and the dimensional stability.

Do not drop packs from trucks or push with the fork tips. When you use a forklift truck, please make sure proper stability is maintained.

Storing

Packs of LVL should be stored covered and protected from the weather. Make sure they are placed on wooden skids at least 30 cm of the ground on a flat and dry surface. The skids must be of suitable size, amount and should be spread evenly to prevent the material from twisting or cracking. If you need to store packs of LVL over a week, please cut the plastic open from the bottom to enable air circulation.

Stora Enso
Division Wood Products

Head Office Helsinki
Kanavaranta 1
P.O. Box 309
FI-00101 Helsinki, Finland

storaenso.com
storaenso.com/lvl

THE RENEWABLE MATERIALS COMPANY