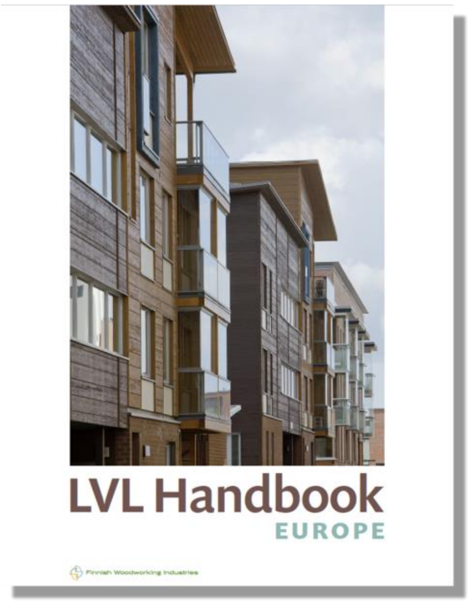
Finnish Woodworking Industries

20.10.2025



LVL Handbook Europe

Corrections for 2nd edition

Pages 19-20, Clause 1.4.1:

Revision: 3rd generation of the LVL Handbook Europe has updated information about global LVL production in Table 1.3 and Figures 1.14 and 1.15:

Table 1.3. Global LVL production. Active manufacturers of structural LVL have in total a production capacity of 4,8 million cubic meters per year [4,5].

Europe			North America			Asia & Oceania		
Manufacturer	**Mills**	**Capacity 1000 m³/year**	**Manufacturer**	**Mills**	**Capacity 1000 m³/year**	**Manufacturer**	**Mills**	**Capacity 1000 m³/year**
Metsä Wood	3	430	Boise Cascade	3	890	First plywood	1	180
Steico	1	160	Weyerhaeuser	4	710	Carter Holt Harvey	1	120
Pollmeier	1	130	PWT	3	520	Wesbeam	1	100
VMG Lignum Constructions	1	120	Roseburg	2	350	Nelson Pine	1	90
Stora Enso	1	100	Murphy	1	140	JNL	1	90
MLT	1	100	West Fraser	1	90	Keyteck	1	90
Groupe Thebault	1	70	RedBuilt	1	60	Taizhou Ke Mian Wood	1	60
LVL Ugra	1	40	Global LVL	1	30	Seihoku	1	50
						Nisshin Co	1	40
						Shin Yang	1	20
Total	**10**	**1150**		**16**	**2790**		**10**	**840**

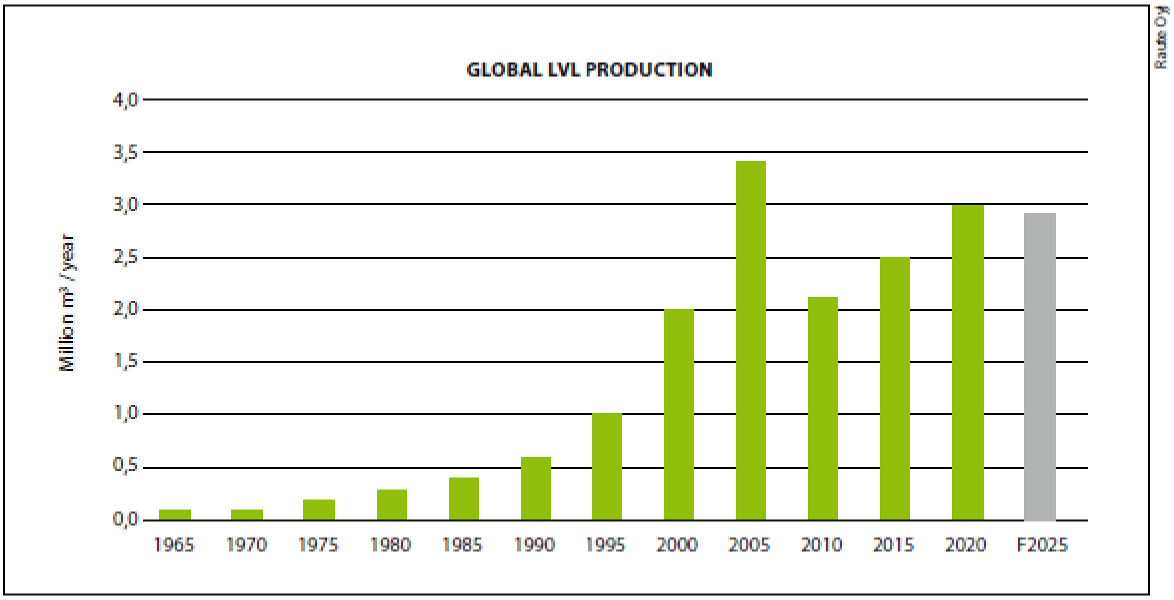


Figure 1.14. Development of structural LVL production volume globally 1965 – 2025 [5].

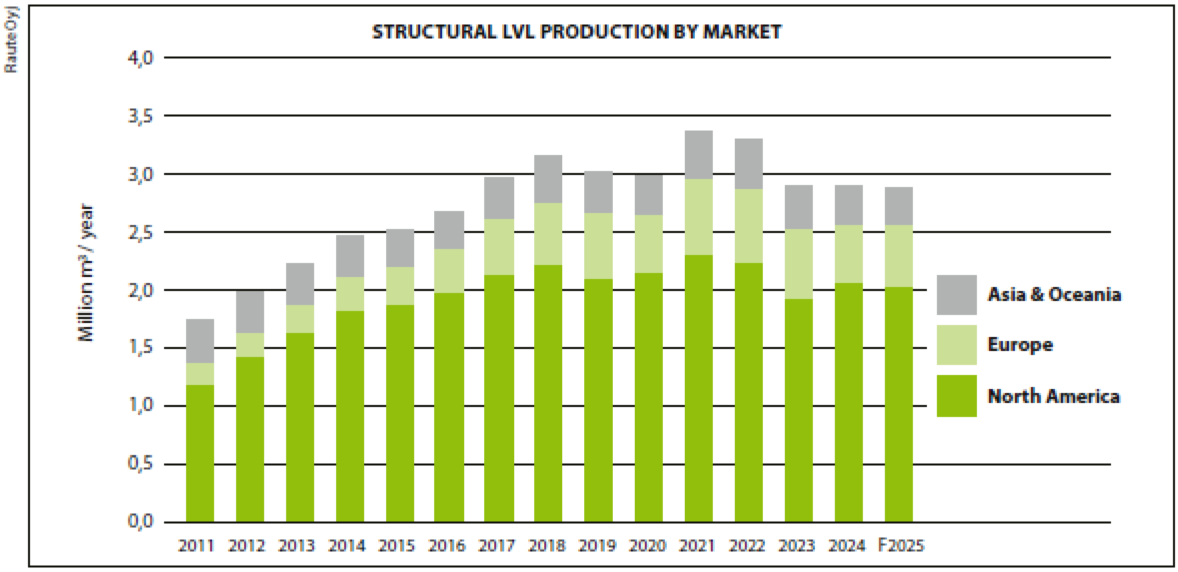


Figure 1.15. Structural LVL production volume by market 2011 – 2025 [5].

Page 45, Table 1.11.:

Revised value of LVL 36C characteristic shear flatwise parallel to grain
$f_{v,flat,0,k}$ = 1,3 → 1,1N/mm^2

Table 1.11. Basic mechanical properties of common LVL strength classes.

Typical use		LVL 48 P Beam	LVL 32 P Stud	LVL 36 C Panel	LVL 25 C Panel
Characteristic strength values, N/mm²					
Bending strength edgewise, *h* = 300 mm	$f_{m,0,edge,k}$	44	27	32	20
Bending strength flatwise	$f_{m,0,flat,k}$	48	32	36	25
Bending strength flatwise perpendicular to grain	$f_{m,90,flat,k}$	-	-	8	-
Compression parallel to grain	$f_{c,0,k}$	29	21	21	15
Compression perpendicular to grain edgewise	$f_{c,90,edge,k}$	6	4	9	8
Tension parallel to grain	$f_{t,0,k}$	35	22	22	15
Shear edgewise parallel to grain	$f_{v,edge,0,k}$	4,2	3,2	4,5	3,6
Shear flatwise parallel to grain	$f_{v,flat,0,k}$	2,3	2,0	1,1	1,1
Size effect parameter	*s*, [-]	0,15	0,15	0,15	0,15
Mean stiffness values, N/mm²					
Modulus of elasticity parallel to grain	$E_{0,mean}$	13800	9600	10500	7200
Modulus of elasticity perpendicular to grain in flatwise bending	$E_{m,90,mean}$	-	-	2000	-
Shear modulus edgewise	$G_{0,edge,mean}$	600	500	600	500
Density, kg/m³					
Mean value	ρ_{mean}	510	440	510	440
Characteristic value	ρ_k	480	410	480	410

Page 118-119, Tables 4.5 and 4.6:

- Revised value of LVL 32C and LVL 36C Characteristic compression strength perpendicular to grain $f_{c,90,flat,k}$ = 1,3 → 1,1N/mm^2
- Revised value of LVL 32C and LVL 36C Characteristic shear flatwise parallel to grain $f_{v,flat,0,k}$ = 3,5 → 3,3N/mm^2
- Revision: Modulus of elasticity parallel to grain, ~~edgewise~~ $E_{0,\cancel{edge},mean}$ and $E_{0,\cancel{edge},k}$
- Revision: ~~MVD~~ →DoP: Property is not expressed for the strength class but it may be given in the Declaration of Performance (DoP) of the LVL manufacturer

Table 4.6. Strength classes for structural LVL-C with crossband veneers [15].

Property [a]		Symbol	Unit	Strenght class					
				LVL 22 C	LVL 25 C	LVL 32 C	LVL 36 C	LVL 70 C	LVL 75 C
Bending strength	Edgewise, parallel to grain (depth 300 mm)	$f_{m,0,edge,k}$	N/mm²	19	20	28	32	54	60
	Flatwise, parallel to grain	$f_{m,0,flat,k}$	N/mm²	22	25	32	36	70	75
	Size effect parameter	s	-	0,15	0,15	0,15	0,15	0,15	0,15
	Flatwise, perpendicular to grain	$f_{m,90,flat,k}$	N/mm²	DoP [c]	DoP [c]	7	8	32	20
Tension strength	Parallel to grain (length 3 000 mm)	$f_{t,0,k}$	N/mm²	14	15	18	22	45	51
	Perpendicular to grain, edgewise	$f_{t,90,edge,k}$	N/mm²	4	4	5	5	16	8
Compression strength	Parallel to grain for service class 1	$f_{c,0,k}$	N/mm²	18	18	18	26	54	64
	For service class 2 according to EN 1995-1-1 [b]			15	15	15	21	45	53
	Perpendicular to grain, edgewise	$f_{c,90,edge,k}$	N/mm²	8	8	9	9	45	23
	Perpendicular to grain, flatwise (except pine)	$f_{c,90,flat,k}$	N/mm²	1,0	1,0	2,2	2,2	16	16
	Perpendicular to grain, flatwise, pine	$f_{c,90,flat,k,pine}$	N/mm²	DoP [c]	DoP [c]	3,3	3,3	- [d]	- [d]
Shear strength	Edgewise parallel to grain	$f_{v,0,edge,k}$	N/mm²	3,6	3,6	4,5	4,5	7,8	7,8
	Flatwise, parallel to grain	$f_{v,0,flat,k}$	N/mm²	1,1	1,1	1,1	1,1	3,8	3,8
	Flatwise, perpendicular to grain	$f_{v,90,flat,k}$	N/mm²	DoP [c]	DoP [c]	0,6	0,6	DoP [c]	DoP [c]
Modulus of elasticity	Parallel to grain	$E_{0,mean}$ [e]	N/mm²	6 700	7 200	10 000	10 500	11 800	13200
	Parallel to grain	$E_{0,k}$ [f]	N/mm²	5 500	6 000	8 300	8 800	10 900	12200
	Perpendicular to grain, edgewise	$E_{90,edge,mean}$ [g]	N/mm²	DoP [c]	DoP [c]	2 400	2 400	DoP [c]	DoP [c]
	Perpendicular to grain, edgewise	$E_{90,edge,k}$ [h]	N/mm²	DoP [c]	DoP [c]	2 000	2 000	DoP [c]	DoP [c]
	Perpendicular to grain, flatwise	$E_{m,90,flat,mean}$	N/mm²	DoP [c]	DoP [c]	1 200	2 000	DoP [c]	DoP [c]
	Perpendicular to grain, flatwise	$E_{m,90,flat,k}$	N/mm²	DoP [c]	DoP [c]	1 000	1 700	DoP [c]	DoP [c]
Shear modulus	Edgewise, parallel to grain	$G_{0,edge,mean}$	N/mm²	500 [i]	500 [i]	600	600	820	820
	Edgewise, parallel to grain	$G_{0,edge,k}$	N/mm²	300 [i]	300 [i]	400	400	660	660
	Flatwise, parallel to grain	$G_{0,flat,mean}$	N/mm²	70 [i]	70 [i]	80	120	430	430
	Flatwise, parallel to grain	$G_{0,flat,k}$	N/mm²	55 [i]	55 [i]	60	100	380	380
	Flatwise, perpendicular to grain	$G_{90,flat,mean}$	N/mm²	DoP [c]	DoP [c]	22	22	DoP [c]	DoP [c]
	Flatwise, perpendicular to grain	$G_{90,flat,k}$	N/mm²	DoP [c]	DoP [c]	16	16	DoP [c]	DoP [c]
Density		ρ_{mean}	kg/m³	440	440	510	510	800	800
		ρ_k	kg/m³	410	410	480	480	730	730

[a] Additional strength, stiffness and density properties not covered by the classes may be declared as individual values

[b] ~~Value may also be applied in Service Class 1 as a conservative value~~

[c] Property is not expressed for the strength class but it may be given in the Declaration of Performance (DoP) of the LVL manufacturer

[d] Class not produced from pine

[e] Covering $E_{m,0,edge,mean}$, $E_{t,0,mean}$, $E_{m,0,flat,mean}$, and $E_{c,0,mean}$

[f] Covering $E_{m,0,edge,k}$, $E_{t,0,k}$, $E_{m,0,flat,k}$ and $E_{c,0,k}$

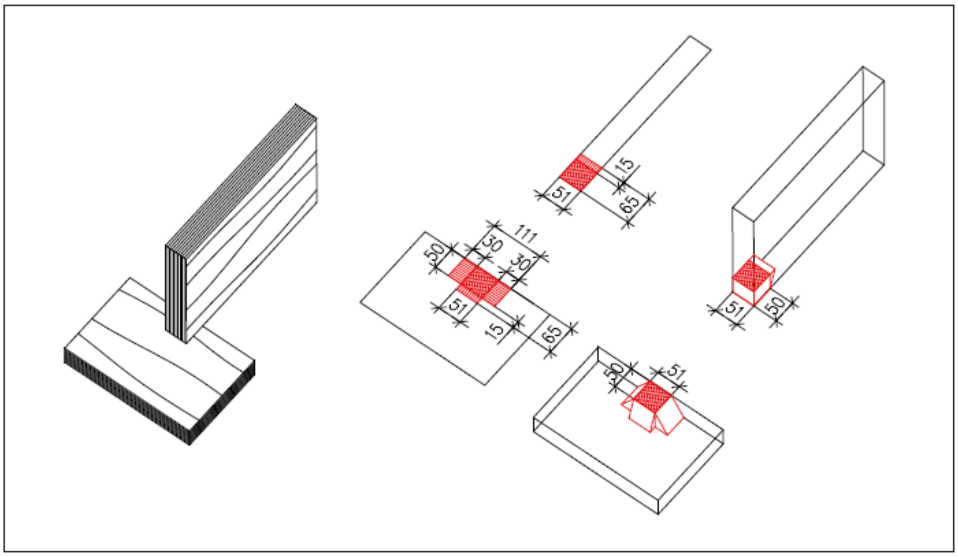
[g] Covering $E_{m,90,edge,mean}$, $E_{t,90,edge,mean}$ and $E_{c,90,edge,mean}$

[h] Covering $E_{m,90,edge,k}$, $E_{t,90,edge,k}$ and $E_{c,90,edge,k}$

[i] Property need not be tested if all other properties meet the minimum values for the strength class

Page 125, Figure 4.14, LVL or solid wood sole plate:

Correction: "Effective contact area $A_{ef} = b \cdot (l + l_1) + l \cdot 2 \cdot l_2$"



LVL beam							
Product type	Beam thickness b [mm]	Support length l [mm]	Increase in actual contact length l_1 [mm]	Effective contact area $A_{ef} = b \cdot (l + l_1)$ [mm²]	Compression strength $f_{c,90,edge,k}$ [N/mm²]	$k_{c,90}$ [-]	Characteristic bearing capacity $F_{c,k} = A_{ef} \cdot k_{c,90} \cdot f_{c,90,edge,k}$ [kN]
LVL 48 P	51	50	15	3 315	6,0	1,0	20
LVL 36 C	51	50	15	3 315	9,0	1,0	30

LVL or solid wood sole plate							
Product type	Contact width b [mm]	Contact length l [mm]	Increase in actual contact length parallel l_1 and perpendicular l_2 [mm]	Effective contact area $A_{ef} = b \cdot (l + l_1) + l \cdot 2 \cdot l_2$ [mm²]	Compression strength $f_{c,90,edge,k}$ [N/mm²]	$k_{c,90}$ [-]	Characteristic bearing capacity $F_{c,k} = A_{ef} \cdot k_{c,90} \cdot f_{c,90,edge,k}$ [kN]
LVL 48 P or 36 C	50	51	$l_1 = 30$, $l_2 = 15$	6 315	2,2	1,4	19,5
LVL 48 P or 36 C of pine	50	51	$l_1 = 30$, $l_2 = 15$	6 315	3,3	1,4	29
C24 solid wood	50	51	$l_1 = 30$, $l_2 = 0$	5 550	2,5	1,25	17,3

Figure 4.14. Example of an LVL beam supported on an LVL sole plate. Effective contact area is increased by 15 mm in the edgewise direction on the beam and separately by 60 mm (2x30 mm) in the length direction and 15mm in width direction on the sole plate.

Page 131, clause 4.3.10, Clarifications*:*

-Explanations of equation 4.46 are added

-k_n is 4,5 for LVL in general in edgewise direction

When the taper at the notch at tensile side is steeper than 1:10, it can be located only at the support.

For beams with rectangular cross sections and where the grain runs essentially parallel to the length of the member, the shear stress τ_d at the notched support should be calculated using the effective (reduced) depth h_{ef}, see Figure 4.20 b).

It should be verified that

$$\tau_d = \frac{1{,}5\,V_d}{b \cdot h_{ef}} \le k_v \cdot f_{v,d} \qquad (4.46)\ (\text{EC5 } 6.60)$$

where

V_d is design value of the shear force [N];
b is the beams thickness [mm];
h_{ef} is the effective beam depth [mm];
k_v is a reduction factor [-]; and
$f_{v,d}$ is the design value of the shear strength [N/mm$_2$].

The reduction factor k_v is defined as follows:

– For beams notched at the opposite side to the support, see Figure 4.20 B), $k_v = 1{,}0$.

– For beams notched on the same side as the support, see Figure 4.20 A)

$$k_v = \min\left(1\ ;\ \frac{k_n\left(1 + \frac{1{,}1\, i^{1{,}5}}{\sqrt{h}}\right)}{\sqrt{h}\left(\sqrt{\alpha\,(1-\alpha)} + 0{,}8\,\frac{x}{h}\sqrt{\frac{1}{\alpha} - \alpha^2}\right)}\right) \qquad (4.47)\ (\text{EC5 } 6.62)$$

where

i is the notch inclination, see Figure 4.20 a);
h is the beam depth in mm;
x is the distance from line of action of the support reaction to the corner of the notch, in mm; and

$$\alpha = \frac{h_{ef}}{h} \qquad (4.48)$$

k_n is 4,5 for LVL in general in edgewise direction. Note: manufacturers provide product-specific information on the k_n values of their products, especially where the advantages of LVL-C are evident.

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Page 134, clause 4.3.12 Holes:

Correction in equation (4.60)*: $h_{ro} \rightarrow h_{ru}$*

$$h_r = \begin{cases} \min(h_{ro};\, h_{ru}) \text{ for rectangular holes} & (4.60) \\ \min(h_{ro} + 0{,}15 \cdot d;\, \boxed{h_{ru}} + 0{,}15 \cdot d) \text{ for round holes} \end{cases}$$

Page 136, clause 4.3.13, 2nd column:

Correction: reference to EN1990:2002, clause 6.5.3(2)(c)*:*

Page 147, Table 5.1:

Spacing a_1 for LVL-C and GLVL-C wide face when points side penetrations length is at least 10*d*: ($5 + 2 \mid \cos \alpha \mid$) d

Table 5.1. Minimum spacings, end distances and edge distances for nails and screws with outer thread diameter <12 mm [32].
Note: EN 1995-1-1:2004 (Eurocode 5) has a limit of d_{ef}<6 mm which corresponds with 9 mm outer thread diameter.

Laterally loaded connections Spacing or distance, see Figures 5.4-5.5 and 5.7	Angle α	Minimum spacing or end/edge distance – without predrilled holes: LVL or GLVL wide face	without predrilled holes: LVL or GLVL edge face	without predrilled holes: LVL-C or GLVL-C wide face when pointside penetration length of at least 10*d* [a]	with predrilled holes
Spacing a_1 (parallel to grain)	$0° \le \alpha \le 360°$	$d < 5$ mm: $(5 + 5 \mid\cos\alpha\mid) d$ $d \ge 5$ mm: $(5 + 7 \mid\cos\alpha\mid) d$	$(7 + 8 \mid\cos\alpha\mid) d$	$(5 + 2 \mid\cos\alpha\mid) d$	$(4 + \mid\cos\alpha\mid) d$
Spacing a_2 (perpendicular to grain)	$0° \le \alpha \le 360°$	$5d$	$7d$	$5d$	$(3 + \mid\sin\alpha\mid) d$
Distance $a_{3,t}$ (loaded end)	$-90° \le \alpha \le 90°$	$(10 + 5\cos\alpha) d$	$(15 + 5\cos\alpha) d$	$(4 + 3\cos\alpha) d$	$(7 + 5\cos\alpha) d$ [b]
Distance $a_{3,c}$ (unloaded end)	$90° \le \alpha \le 270°$	$10d$	$15d$	$5d$	$7d$ [c]
Distance $a_{4,t}$ (loaded edge)	$0° \le \alpha \le 180°$	$d < 5$ mm: $(5 + 2\sin\alpha) d$ $d \ge 5$ mm: $(5 + 5\sin\alpha) d$	$d < 5$ mm: $(7 + 2\sin\alpha) d$ $d \ge 5$ mm: $(7 + 5\sin\alpha) d$	$(3 + 4\sin\alpha) d$	$d < 5$ mm: $(3 + 2\sin\alpha) d$ $d \ge 5$ mm: $(3 + 4\sin\alpha) d$
Distance $a_{4,c}$ (unloaded edge)	$180° \le \alpha \le 360°$	$5d$	$7d$	$3d$	$3d$
Axially loaded screws Spacing or distance, see Figures 5.7-5.8					
Spacing a_1 (parallel to grain)		$7d$	$10d$	$7d$	$7d$
Spacing a_2 (perpendicular to grain)		$5d$	$5d$	$5d$	$5d$
Minimum end distance of the centre of gravity of the threaded part of the screw in the member $a_{1,CG}$		$10d$	$12d$	$10d$	$10d$
Minimum edge distance of the centre of gravity of the threaded part of the screw in the member $a_{2,CG}$		$4d$	$4d$	$4d$	$4d$

[a] When pointside penetration length is less than 10d, the rules in the column LVL or GLVL wide face apply
[b] for LVL-C or GLVL-C wide face and pointside penetration length of at least 10*d*: $(4 + 3\cos\alpha) d$
[c] for LVL-C or GLVL-C wide face and pointside penetration length of at least 10*d*: $5d$

Page 148, Table 5.3:

Spacing $a_{3,c}$, *angle* 210°≤ α ≤ 270° for edge face: $(1 + 6\,|\sin\alpha|)\,d$

Table 5.3. Minimum spacings, end distances and edge distances for bolts and screws with max outer thread diameter >12 mm with predrilled holes [32]. Note: EN 1995-1-1:2004 (Eurocode 5) has a limit of d_{ef} < 6 mm which corresponds with 9 mm outer thread diameter.

Spacing or distance, see Figures 5.4-5.5 and 5.7	Angle α	Minimum spacing or end/edge distance	
		LVL-P / GLVL-P or LVL-C / GLVL-C edge face	LVL-C / GLVL-C wide face
Spacing a_1 (parallel to grain)	$0° \le \alpha \le 360°$	$(4 + 3\,|\cos\alpha|)\,d$ [a]	$4d$
Spacing a_2 (perpendicular to grain)	$0° \le \alpha \le 360°$	$4d$	$4d$
Distance $a_{3,t}$ (loaded end)	$-90° \le \alpha \le 90°$	max ($7d$; 105 mm) [b]	max ($4d$; 60 mm) [c]
Distance $a_{3,c}$ (unloaded end)	$90° \le \alpha < 150°$ $150° \le \alpha < 210°$ $210° \le \alpha \le 270°$	$(1 + 6 \sin\alpha)\,d$ $4d$ $(1 + 6\,|\sin\alpha|)\,d$	$4d$ $4d$ $4d$
Distance $a_{4,t}$ (loaded edge)	$0° \le \alpha \le 180°$	max $[(2 + 2 \sin\alpha)\,d;\ 3d]$	max $[(2 + 2 \sin\alpha)\,d;\ 3d]$
Distance $a_{4,c}$ (unloaded edge)	$180° \le \alpha \le 360°$	$3d$	$3d$

[a] minimum spacing a_1 may be reduced to $5d$ if $f_{h,0,k}$ is multiplied by $\sqrt{a_1 / (4 + 3\,|\cos\alpha|)\,d}$
[b] minimum end distance $a_{3,t}$ may be reduced to $7d$ for d < 15 mm if $f_{h,0,k}$ is multiplied by $a_{3,t}$ /105 mm
[c] minimum end distance $a_{3,t}$ may be reduced to $4d$ for d < 15 mm if $f_{h,0,k}$ is multiplied by $a_{3,t}$ / 60 mm

Spacing and end/edge distances on circular patterns for double shear moment-resisting connections, see Figure 5.6	Minimum spacing or distance		
	LVL-P, GLVL-P wide face	LVL-C / GLVL-C wide face	Side member LVL-C / GLVL-C wide face Middle member LVL-P, GLVL-P or LVL-C wide face
a_1 (spacing on circle)	$6d$	$4d$	$5d$
a_2 (spacing between circles)	$5d$	$4d$	$5d$
$a_{3,t}$ (loaded end)	$6d$	$4d$	$6d$ in middle member $4d$ in side member
$a_{4,t}$ (loaded edge)	$4d$	$3d$	$4d$ in middle member $3d$ in side member

Page 149, Table 5.4:

- Spacing $a_{3,c}$, *angle* 90°≤ α ≤ 150° for edge face: $a_{t,3}\,|\sin\alpha|$
- Spacing $a_{3,c}$, *angle* 210°≤ α ≤ 270° for edge face: $a_{t,3}\,|\sin\alpha|$
- Spacing $a_{3,c}$ for wide face: $(3+|\sin\alpha|)\,d$

Table 5.4. Minimum spacings, end distances and edge distances for 6-30 mm dowels [32].

Spacing or distance, see Figures 5.4-5.7	Angle α	Minimum spacing or end/edge distance	
		LVL-P / GLVL-P or LVL-C / GLVL-C edge face	LVL-C / GLVL-C wide face
Spacing a_1 (parallel to grain)	$0° \le \alpha \le 360°$	$(4 + 3\,|\cos\alpha|)\,d$ [a]	$(3 + |\cos\alpha|)\,d$
Spacing a_2 (perpendicular to grain)	$0° \le \alpha \le 360°$	$3d$	$3d$
Distance $a_{3,t}$ (loaded end)	$-90° \le \alpha \le 90°$	max ($7d$; 105 mm) [b]	max ($4d$; 60 mm) [c]
Distance $a_{3,c}$ (unloaded end)	$90° \le \alpha < 150°$ $150° \le \alpha < 210°$ $210° \le \alpha \le 270°$	$a_{3,t}\,|\sin\alpha|$ $3d$ $a_{3,t}\,|\sin\alpha|$	$(3 + |\sin\alpha|)\,d$
Distance $a_{4,t}$ (loaded edge)	$0° \le \alpha \le 180°$	max $[(2 + 2 \sin\alpha)\,d;\ 3d]$	max $[(2 + 2 \sin\alpha)\,d;\ 3d]$
Distance $a_{4,c}$ (unloaded edge)	$180° \le \alpha \le 360°$	$3d$	$3d$

[a] minimum spacing a_1 may be reduced to $5d$ if $f_{h,0,k}$ is multiplied by $\sqrt{a_1 / (4 + 3\,|\cos\alpha|)\,d}$
[b] minimum end distance $a_{3,t}$ may be reduced to $7d$ for d < 15 mm if $f_{h,0,k}$ is multiplied by $a_{3,t}$ /105 mm
[c] minimum end distance $a_{3,t}$ may be reduced to $4d$ for d < 15 mm if $f_{h,0,k}$ is multiplied by $a_{3,t}$ / 60 mm

Page 151, clause 5.3.3, 2nd column:

Correction to the equation (5.7): $F_{ps,k} = L_{net,t} \cdot (t_{ef} \cdot f_{t,0,k} + (a_3 + (n_1 - 1) \cdot a) \cdot f_{v,0,k})$

Page 153, clause 5.5.1:

Correction to the equation (5.23): k_{90} is 1,15 + 0,015d for softwood LVL/GLVL; and

Page 153, clause 5.6, 2nd column:

Correction: k_{90} is 1,15 + 0,015d for softwood LVL / GLVL; and

Page 173, clause 8.1.2, revision of the Note:

Examples of suitable moisture meters for measuring the moisture content of spruce LVL are:

- Delta 2000H (setup: H3 Spruce)

- Doser Messgerat HD5 (setup: material group3)

- Doser Messgerat DM4A (setup: A2)

- Esko 314 (setup: A2)

- Exotec (setup: 500)

- Merlin PM1-E (setup: 5)

- Orion 930 (setup: 0,55)

- Testo 616 (setup: F1)

Page 204, Example 9.8, Connection capacity, corrections:

- $d^{-0,3}$ and $d^{-2,6}$
- *Note: the angle β = 90° for the beam and 0° for the stud, so the simpler equation of embedment strength can be used.*

Connection capacity

The embedment strength of 3,1x90 mm round nail in LVL 48P and LVL 32P

$f_{h,LVL\,48P,k} = 0{,}082 \cdot \rho_k \cdot \boxed{d^{-0,3}} = 0{,}082 \cdot 480 \cdot \boxed{2{,}5^{-0,3}} = 28{,}0\ \text{N/mm}^2$

$f_{h,LVL32P,k} = 0{,}082 \cdot \rho_k \cdot \boxed{d^{-0,3}} = 0{,}082 \cdot 410 \cdot \boxed{2{,}5^{-0,3}} = 23{,}9\ \text{N/mm}^2$

Note: the angle $\boxed{\beta = 90°}$ *for the beam and* $\boxed{0°}$ *for the stud, so the simpler equation of embedment strength can be used.*

When the nails are produced from wire with tensile strength $f_u = 600$ N/mm², the characteristic value of the yield moment $M_{y,k}$ for round nails is

$M_{y,k} = 0{,}3 \cdot f_u \cdot \boxed{d^{2,6}} = 0{,}3 \cdot 600 \cdot \boxed{(2{,}5)^{2,6}} = 3410\ \text{Nmm}$