LBS HARDWOOD EVO

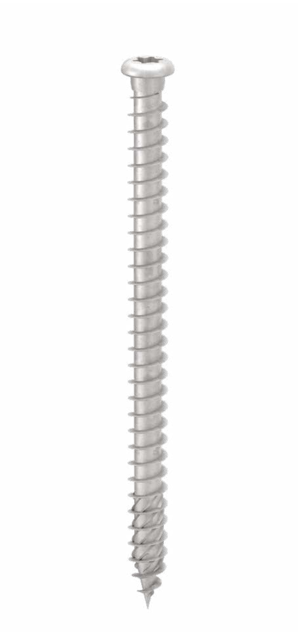
ICC ES ELC-4645 | ICC ES ESR-4645 | CE ETA-11/0030

ROUND HEAD SCREW FOR PLATES ON HARDWOODS

C4 EVO COATING
The atmospheric corrosion strength class (C4) of the C4 EVO coating was tested by the Research Institutes of Sweden - RISE. Coating suitable for use in applications on wood with an acidity level (pH) greater than 4, such as spruce, larch and pine (see page 314).

HARDWOOD CERTIFICATION
Special tip with embossed slit elements. ETA-11/0030 certification allows for use with high density timber without any pre-drill.
Approved for structural applications subject to stresses in any direction vs the grain.

ROBUSTNESS
The inner core diameter of the screw has been enlarged compared to the LBS version to ensure screwing in higher density woods. The cylindrical under head is designed for fastening mechanical elements and producing an interlocking effect with the plate hole that provides excellent static performances.



MANUALS

BIT INCLUDED

DIAMETER [mm]

3,5 — 5 – 7 — 12

LENGTH [mm]

25 — 60 – 200 — 200

SERVICE CLASS

SC1 SC2 SC3

ATMOSPHERIC CORROSIVITY

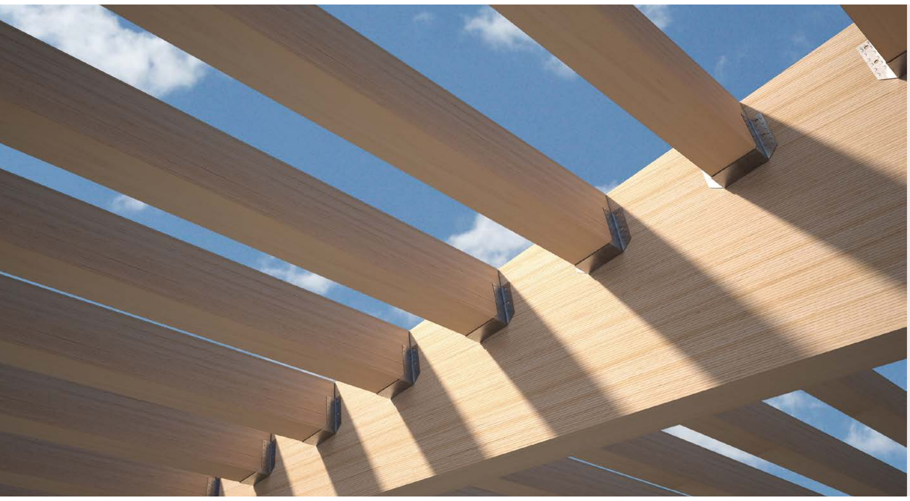
C1 C2 C3 C4

WOOD CORROSIVITY

T1 T2 T3

MATERIAL

C4 EVO COATING — carbon steel with C4 EVO coating



FIELDS OF USE

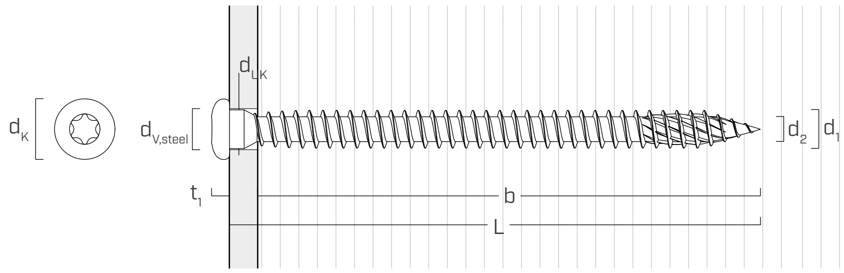
- timber based panels
- solid timber and glulam
- CLT and LVL
- high density woods
- ACQ, CCA treated timber

CODES AND DIMENSIONS

d_1 [mm]	CODE	L [mm]	b [mm]	pcs
5 TX 20	**LBSHEVO580**	80	76	200
	LBSHEVO5100	100	96	200
	LBSHEVO5120	120	116	200

d_1 [mm]	CODE	L [mm]	b [mm]	pcs
7 TX 30	**LBSHEVO760**	60	55	100
	LBSHEVO780	80	75	100
	LBSHEVO7100	100	95	100
	LBSHEVO7120	120	115	100
	LBSHEVO7160	160	155	100
	LBSHEVO7200	200	195	100

GEOMETRY AND MECHANICAL CHARACTERISTICS

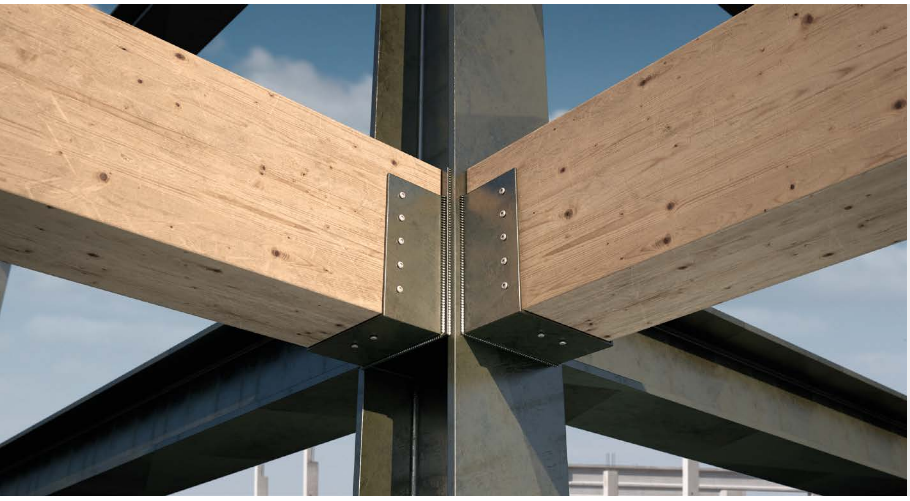


Nominal diameter	d_1	**[mm]**	**5**	**7**
Head diameter	d_K	[mm]	7,80	11,00
Thread diameter	d_2	[mm]	3,48	4,85
Underhead diameter	d_{UK}	[mm]	4,90	7,00
Head thickness	t_1	[mm]	2,45	3,50
Hole diameter on steel plate	$d_{V,steel}$	[mm]	5,0÷5,5	7,5÷8,0
Pre-drilling hole diameter(1)	$d_{V,S}$	[mm]	3,0	4,0
Pre-drilling hole diameter(2)	$d_{V,H}$	[mm]	3,5	5,0
Characteristic tensile strength	$f_{tens,k}$	[kN]	11,5	21,5
Characteristic yield moment	$M_{y,k}$	[Nm]	9,0	21,5

(1) Pre-drilling valid for softwood.
(2) Pre-drilling valid for hardwood and beech LVL.
The mechanical parameters are obtained analytically and validated by experimental tests (LBS H EVO Ø7) .

			softwood *(softwood)*	**oak, beech** *(hardwood)*	**ash** *(hardwood)*	**beech LVL** *(Beech LVL)*
Withdrawal resistance parameter	$f_{ax,k}$	[N/mm^2]	11,7	22,0	30,0	42,0
Head-pull-through parameter	$f_{head,k}$	[N/mm^2]	10,5	-	-	-
Associated density	ρ_a	[kg/m^3]	350	530	530	730
Calculation density	ρ_k	*[kg/m^3]*	*≤ 440*	*≤ 590*	*≤ 590*	*590 ÷ 750*

For applications with different materials please see ETA-11/0030.



HYBRID STEEL-TIMBER STRUCTURES

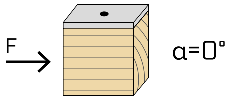
The LBSHEVO Ø7 mm screws are suitable for custom-designed connections, which are characteristic of steel structures. Maximum performance in hardwoods combined with the strengths of steel plates.

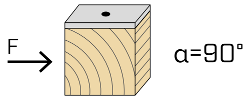
T3 TIMBER CORROSIVITY

Coating suitable for use in applications on wood with an acidity level (pH) greater than 4, such as spruce, larch, pine, ash and birch (see page 314).

MINIMUM DISTANCES FOR SHEAR LOADS | STEEL-TO-TIMBER

screws inserted **WITHOUT pre-drilled hole** $\rho_k > 420\ kg/m^3$

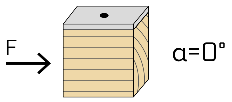


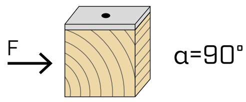


d_1	[mm]		5	7
a_1	[mm]	15·d·0,7	53	74
a_2	[mm]	7·d·0,7	25	34
$a_{3,t}$	[mm]	20·d	100	140
$a_{3,c}$	[mm]	15·d	75	105
$a_{4,t}$	[mm]	7·d	35	49
$a_{4,c}$	[mm]	7·d	35	49

d_1	[mm]		5	7
a_1	[mm]	7·d·0,7	25	34
a_2	[mm]	7·d·0,7	25	34
$a_{3,t}$	[mm]	15·d	75	105
$a_{3,c}$	[mm]	15·d	75	105
$a_{4,t}$	[mm]	12·d	60	84
$a_{4,c}$	[mm]	7·d	35	49

screws inserted **WITH pre-drilled hole**

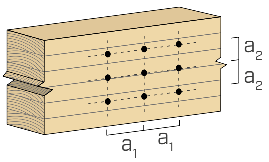




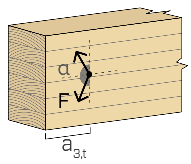
d_1	[mm]		5	7
a_1	[mm]	5·d·0,7	18	25
a_2	[mm]	3·d·0,7	11	15
$a_{3,t}$	[mm]	12·d	60	84
$a_{3,c}$	[mm]	7·d	35	49
$a_{4,t}$	[mm]	3·d	15	21
$a_{4,c}$	[mm]	3·d	15	21

d_1	[mm]		5	7
a_1	[mm]	4·d·0,7	14	20
a_2	[mm]	4·d·0,7	14	20
$a_{3,t}$	[mm]	7·d	35	49
$a_{3,c}$	[mm]	7·d	35	49
$a_{4,t}$	[mm]	7·d	35	49
$a_{4,c}$	[mm]	3·d	15	21

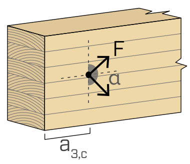
α = load-to-grain angle
d = d_1 = nominal screw diameter



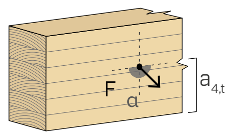
stressed end
-90° < α < 90°



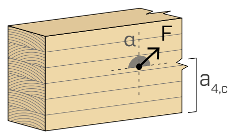
unloaded end
90° < α < 270°



stressed edge
0° < α < 180°



unload edge
180° < α < 360°

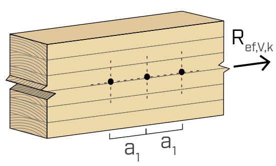


NOTES

- The minimum distances comply with EN 1995:2014, according to ETA-11/0030, considering a timber element mass density of 420 kg/m³ < $\rho_k \leq$ 500 kg/m³.
- In the case of timber-to-timber joints, the minimum spacing (a_1, a_2) can be multiplied by a coefficient of 1,5.
- In the case of joints with elements in Douglas fir (Pseudotsuga menziesii), the minimum spacing and distances parallel to the grain must be multiplied by a coefficient of 1.5.

EFFECTIVE NUMBER FOR SHEAR LOADS

The load-bearing capacity of a connection made with several screws, all of the same type and size, may be lower than the sum of the load-bearing capacities of the individual connection system.
For a row of n screws arranged parallel to the direction of the grain at a distance a_1, the characteristic effective load-bearing capacity is equal to:

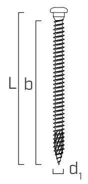
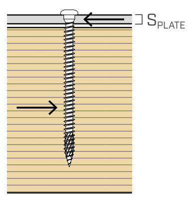
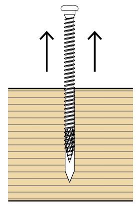
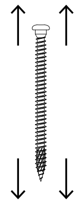


$$R_{ef,V,k} = n_{ef} \cdot R_{V,k}$$

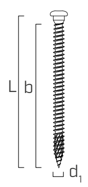
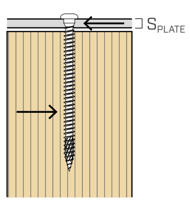
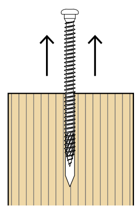
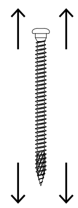
The n_{ef} value is given in the table below as a function of n and a_1.

		a_1(*)										
		4·d	5·d	6·d	7·d	8·d	9·d	10·d	11·d	12·d	13·d	≥ 14·d
n	2	1,41	1,48	1,55	1,62	1,68	1,74	1,80	1,85	1,90	1,95	2,00
	3	1,73	1,86	2,01	2,16	2,28	2,41	2,54	2,65	2,76	2,88	3,00
	4	2,00	2,19	2,41	2,64	2,83	3,03	3,25	3,42	3,61	3,80	4,00
	5	2,24	2,49	2,77	3,09	3,34	3,62	3,93	4,17	4,43	4,71	5,00

(*) For intermediate a_1 values a linear interpolation is possible.

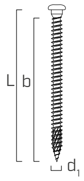
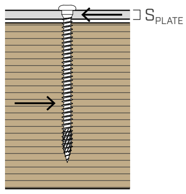
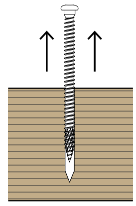
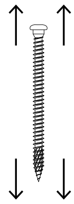
			SHEAR							TENSION	
geometry			**steel-to-timber** ε=90°							**thread withdrawal** ε=90°	**steel tension**
											
d_1 [mm]	L [mm]	b [mm]	$R_{V,90,k}$ [kN]							$R_{ax,90,k}$ [kN]	$R_{tens,k}$ [kN]
	S_{PLATE}		1,5 mm	2,0 mm	2,5 mm	3,0 mm	4,0 mm	5,0 mm	6,0 mm	-	-
5	80	76	3,35	3,35	3,35	3,35	3,35	3,34	3,32	4,80	11,50
	100	96	3,67	3,67	3,67	3,67	3,67	3,65	3,64	6,06	
	120	116	3,98	3,98	3,98	3,98	3,98	3,97	3,95	7,32	
	S_{PLATE}		3,0 mm	4,0 mm	5,0 mm	6,0 mm	8,0 mm	10,0 mm	12,0 mm	-	-
7	60	55	2,81	3,02	3,50	3,99	4,37	4,25	4,12	4,86	21,50
	80	75	3,80	3,98	4,43	4,90	5,34	5,29	5,25	6,63	
	100	95	4,75	4,89	5,18	5,50	5,78	5,73	5,69	8,40	
	120	115	5,19	5,35	5,66	5,96	6,22	6,17	6,13	10,16	
	160	155	5,30	5,56	6,10	6,62	7,10	7,06	7,01	13,70	
	200	195	5,30	5,61	6,24	6,86	7,49	7,49	7,49	17,24	

ε = screw-to-grain angle

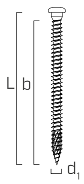
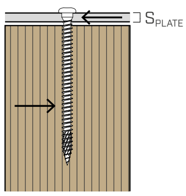
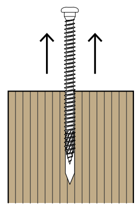
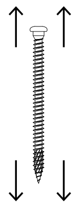
			SHEAR							TENSION	
geometry			**steel-to-timber** ε=0°							**thread withdrawal** ε=0°	**steel tension**
											
d_1 [mm]	L [mm]	b [mm]	$R_{V,90,k}$ [kN]							$R_{ax,90,k}$ [kN]	$R_{tens,k}$ [kN]
	S_{PLATE}		1,5 mm	2,0 mm	2,5 mm	3,0 mm	4,0 mm	5,0 mm	6,0 mm	-	-
5	80	76	1,72	1,72	1,72	1,72	1,72	1,72	1,71	1,44	11,50
	100	96	1,82	1,82	1,82	1,82	1,82	1,81	1,81	1,82	
	120	116	1,91	1,91	1,91	1,91	1,91	1,91	1,90	2,20	
	S_{PLATE}		3,0 mm	4,0 mm	5,0 mm	6,0 mm	8,0 mm	10,0 mm	12,0 mm	-	-
7	60	55	1,12	1,23	1,48	1,73	1,95	1,92	1,88	1,46	21,50
	80	75	1,52	1,63	1,88	2,14	2,35	2,31	2,27	1,99	
	100	95	1,91	2,04	2,31	2,58	2,81	2,76	2,72	2,52	
	120	115	2,31	2,41	2,64	2,88	3,11	3,10	3,08	3,05	
	160	155	2,70	2,80	3,00	3,19	3,38	3,36	3,35	4,11	
	200	195	2,97	3,07	3,26	3,46	3,64	3,63	3,61	5,17	

ε = screw-to-grain angle

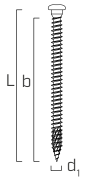
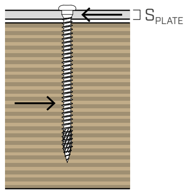
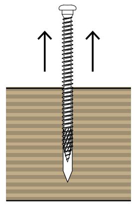
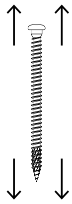
NOTES and GENERAL PRINCIPLES on page 249.

			SHEAR							TENSION	
geometry			steel-to-timber ε=90°							thread withdrawal ε=90°	steel tension
											
d_1 [mm]	L [mm]	b [mm]	$R_{V,90,k}$ [kN]							$R_{ax,90,k}$ [kN]	$R_{tens,k}$ [kN]
	S_{PLATE}		1,5 mm	2,0 mm	2,5 mm	3,0 mm	4,0 mm	5,0 mm	6,0 mm	-	-
5	80	76	4,73	4,73	4,73	4,73	4,73	4,70	4,67	8,61	11,50
	100	96	5,15	5,15	5,15	5,15	5,15	5,15	5,15	10,88	
	120	116	5,15	5,15	5,15	5,15	5,15	5,15	5,15	13,14	
	S_{PLATE}		3,0 mm	4,0 mm	5,0 mm	6,0 mm	8,0 mm	10,0 mm	12,0 mm	-	-
7	60	55	4,01	4,33	5,07	5,83	6,43	6,22	6,02	8,72	21,50
	80	75	5,42	5,65	6,21	6,80	7,33	7,25	7,17	11,90	
	100	95	6,33	6,60	7,15	7,67	8,12	8,04	7,97	15,07	
	120	115	6,33	6,70	7,45	8,20	8,92	8,84	8,76	18,24	
	160	155	6,33	6,70	7,45	8,20	8,95	8,95	8,95	24,59	
	200	195	6,33	6,70	7,45	8,20	8,95	8,95	8,95	30,93	

ε = screw-to-grain angle

			SHEAR							TENSION	
geometry			steel-to-timber ε=0°							thread withdrawal ε=0°	steel tension
											
d_1 [mm]	L [mm]	b [mm]	$R_{V,90,k}$ [kN]							$R_{ax,90,k}$ [kN]	$R_{tens,k}$ [kN]
	S_{PLATE}		1,5 mm	2,0 mm	2,5 mm	3,0 mm	4,0 mm	5,0 mm	6,0 mm	-	-
5	80	76	2,27	2,27	2,27	2,27	2,27	2,27	2,26	2,58	11,50
	100	96	2,44	2,44	2,44	2,44	2,44	2,44	2,43	3,26	
	120	116	2,61	2,61	2,61	2,61	2,61	2,61	2,60	3,94	
	S_{PLATE}		3,0 mm	4,0 mm	5,0 mm	6,0 mm	8,0 mm	10,0 mm	12,0 mm	-	-
7	60	55	1,61	1,75	2,08	2,41	2,69	2,63	2,57	2,62	21,50
	80	75	2,17	2,34	2,70	3,06	3,37	3,30	3,23	3,57	
	100	95	2,73	2,88	3,23	3,59	3,92	3,90	3,88	4,52	
	120	115	3,30	3,40	3,65	3,92	4,16	4,14	4,12	5,47	
	160	155	3,85	3,96	4,20	4,43	4,64	4,62	4,59	7,38	
	200	195	4,00	4,17	4,49	4,81	5,11	5,09	5,07	9,28	

ε = screw-to-grain angle

			SHEAR							TENSION	
geometry			steel-beech LVL							thread withdrawal flat	steel tension
											
d_1 [mm]	L [mm]	b [mm]	$R_{V,90,k}$ [kN]							$R_{ax,90,k}$ [kN]	$R_{tens,k}$ [kN]
	S_{PLATE}		1,5 mm	2,0 mm	2,5 mm	3,0 mm	4,0 mm	5,0 mm	6,0 mm	-	-
5	80	76	6,22	6,22	6,22	6,22	6,22	6,22	6,22	15,96	11,50
	100	96	6,22	6,22	6,22	6,22	6,22	6,22	6,22	20,16	
	120	116	6,22	6,22	6,22	6,22	6,22	6,22	6,22	24,36	
	S_{PLATE}		3,0 mm	4,0 mm	5,0 mm	6,0 mm	8,0 mm	10,0 mm	12,0 mm	-	-
7	60	55	7,14	7,44	8,22	9,06	9,79	9,64	9,49	16,17	21,50
	80	75	8,44	8,85	9,68	10,51	11,26	11,11	10,96	22,05	
	100	95	8,44	8,85	9,68	10,51	11,34	11,93	11,93	27,93	
	120	115	8,44	8,85	9,68	10,51	11,34	11,93	11,93	33,81	
	160	155	8,44	8,85	9,68	10,51	11,34	11,93	11,93	45,57	
	200	195	8,44	8,85	9,68	10,51	11,34	11,93	11,93	57,33	

ε = screw-to-grain angle

STRUCTURAL VALUES

GENERAL PRINCIPLES

- Characteristic values comply with the EN 1995:2014 standard in accordance with ETA-11/0030.
- Design values can be obtained from characteristic values as follows:

$$R_d = \frac{R_k \cdot k_{mod}}{\gamma_M}$$

The coefficients γ_M and k_{mod} should be taken according to the current regulations used for the calculation.

- The tensile design strength of the connector is the lower between the timber-side design strength ($R_{ax,d}$) and the steel-side design strength ($R_{tens,d}$).

$$R_{ax,d} = min \begin{cases} \dfrac{R_{ax,k} \cdot k_{mod}}{\gamma_M} \\ \dfrac{R_{tens,k}}{\gamma_{M2}} \end{cases}$$

- For the mechanical resistance values and the geometry of the screws, reference was made to ETA-11/0030.
- Sizing and verification of the timber elements and metal plates must be done separately.
- The characteristic shear strength are calculated for screws inserted without pre-drilling hole.
- The screws must be positioned in accordance with the minimum distances.
- The thread withdrawal characteristic strength has been evaluated considering a fixing length equal to b.
- The characteristic shear-strength value for LBSH EVO Ø5 nails has been evaluated assuming a plate thickness = S_{PLATE}, always considering the case of thick plates according to ETA-11/0030 ($S_{PLATE} \geq 1,5$ mm).
- The characteristic shear-strength value for LBSH EVO Ø7 screws has been evaluated assuming a plate thickness = S_{PLATE}, and considering the thin ($S_{PLATE} \leq 3,5$ mm) intermediate (3,5 mm < S_{PLATE} < 7,0 mm) or thick ($S_{PLATE} \geq 7$ mm) plate case.
- In the case of combined shear and tensile stress, the following verification must be satisfied:

$$\left(\frac{F_{v,d}}{R_{v,d}}\right)^2 + \left(\frac{F_{ax,d}}{R_{ax,d}}\right)^2 \leq 1$$

- In the case of steel-to-timber connections with a thick plate, it is necessary to assess the effects of timber deformation and install the connectors according to the assembly instructions.
- The values in the table are evaluated considering mechanical strength parameters of the Ø7 EVO screws obtained analytically and validated by experimental tests.

NOTES | TIMBER

- The characteristic timber-to-timber shear strengths were evaluated considering both an ε angle of 90° ($R_{V,90,k}$) and 0° ($R_{V,0,k}$) between the grains of the second element and the connector.
- In the case of screws inserted with pre-drilling hole, higher strength values can be achieved.
- The characteristic thread withdrawal resistances were evaluated considering both an ε angle of 90° ($R_{ax,90,k}$) and of 0° ($R_{ax,0,k}$) between the grains and the connector.
- For the calculation process a timber characteristic density ρ_k = 385 kg/m^3 has been considered.

  For different values of ρ_k, the strength values in the table (timber-to-timber shear, steel-to-timber shear and tensile) can be converted by means of the coefficient k_{dens} (see page 243).

NOTES | HARDWOOD

- For the calculation process a mass density equal to ρ_k = 550 kg/m^3 has been considered for hardwood (oak) elements.

NOTES | BEECH LVL

- For the calculation process a mass density equal to ρ_k = 730 kg/m^3 has been considered for LVL beech elements.
- A 90° angle between the connector and the fiber, a 90° angle between the connector and the side face of the LVL element, and a 0° angle between the force and the fiber were considered for individual timber elements in the calculation.