VGZ

BIT INCLUDED | MY PROJECT SOFTWARE | CE ETA-11/0030

FULL THREADED SCREW WITH CYLINDRICAL HEAD

TENSION
Deep thread and high resistance steel ($f_{y,k}$ = 1000 N/mm² | *145,038 psi*) for excellent tensile performance. Very broad range of measurements.

STRUCTURAL APPLICATIONS
Approved for structural applications subject to stresses in any direction vs. the grain (α = 0° - 90°). Reduced minimum distances.

CYLINDRICAL HEAD
Ideal for concealed joints, timber couplings and structural reinforcements. Guarantees fire protection and earthquake suitability. Cyclical SEISMIC-REV tests according to EN 12512.

CHROMIUM (VI) FREE
Total absence of hexavalent chromium. Compliance with the strictest regulations governing chemical substances (SVHC).
REACH information available.

CHARACTERISTICS

FOCUS	45° connections, reinforcements and couplings	
HEAD	cylindrical, countersunk	
DIAMETER	5,3 | 5,6 | 7,0 | 9,0 | 11,0 mm	*0.21 to 0.44 inch*
LENGTH	from 80 mm to 600 mm	*3 1/8 to 23 5/8 inch*

MATERIAL
Carbon steel with bright zinc plated.

FIELDS OF USE
- wood based panels
- solid timber
- glulam (Glued Laminated Timber)
- CLT, LVL
- high density woods

Service classes 1 and 2.

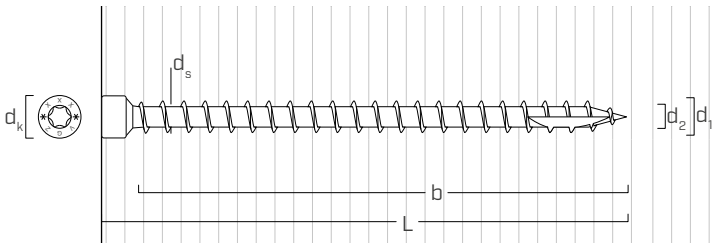
STRUCTURAL RESTORATION

Ideal for coupling beams in structural renovations and new works. Can also be used parallel to the grain thanks to the special approval.

CLT, LVL

Values also tested, certified and calculated for CLT and high density woods such as Microllam® LVL.

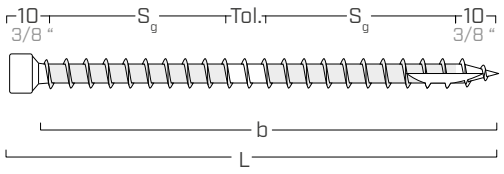
GEOMETRY AND MECHANICAL CHARACTERISTICS



Nominal diameter	d_1	**[mm]** ***[in]*** *[in]*[(1)]	**5.3** ***0.21*** *7/32*	**5.6** ***0.23*** *7/32*	**7** ***0.28*** *1/4*	**9** ***0.36*** *3/8*	**11** ***0.44*** *7/16*
Head diameter	d_k	[mm] *[in]*	8.00 *0.315*	8.00 *0.315*	9.50 *0.374*	11.50 *0.453*	13.50 *0.531*
Tip diameter	d_2	[mm] *[in]*	3.60 *0.142*	3.80 *0.150*	4.60 *0.181*	5.90 *0.232*	6.60 *0.260*
Shank diameter	d_s	[mm] *[in]*	3.95 *0.156*	4.15 *0.163*	5.00 *0.197*	6.50 *0.256*	7.70 *0.303*
Pre-drilling diameter	d_v	[mm] *[in]*	3.50 *0.138*	3.50 *0.138*	4.00 *0.157*	5.00 *0.197*	6.00 *0.236*
Characteristic yield moment	$M_{y,k}$	[Nm] *[lbf.in]*	9.2 *81.4*	10.6 *93.8*	14.2 *125.7*	27.2 *240.7*	45.9 *406.2*
Characteristic withdrawal-resistance parameter [(2)]	$f_{ax,k}$	[N/mm^2] *[psi]*	11.7 *1,697*	11.7 *1,697*	11.7 *1,697*	11.7 *1,697*	11.7 *1,697*
Associated density	ρ_a	[kg/m^3]	350	350	350	350	350
Characteristic tensile strength	$f_{tens,k}$	[kN] *[lbf]*	11 *2,473*	12.3 *2,765*	15.4 *3,462*	25.4 *5,710*	38.0 *8,543*
Associated density	ρ_a	[kg/m^3]	350	350	350	350	350
Characteristic yield strength	$f_{y,k}$	[N/mm^2] *[psi]*	1000 *145,038*	1000 *145,038*	1000 *145,038*	1000 *145,038*	1000 *145,038*

[(1)] The value in fractional inches is rounded to the closest fraction for simplicity of use. For the precise value of the nominal diameter d_1, see the value in decimal inches.
[(2)] Valid for softwood - maximum density 440 kg/m^3.
For applications on different timber types (e.g. LVL) or with a high density please check on the ETA-11/0030.

EFFECTIVE THREAD USED IN CALCULATION



b = L - 10 mm
L - *3/8 inch*
represents the entire length of the threaded part

S_g = (L - 10 mm - 10 mm - Tol.)/ 2
(L - *3/8 inch* - *3/8 inch* - Tol.)/ 2
represents the partial length of the threaded part net of a laying tolerance (Tol.) of 10 mm (*3/8 inch*)

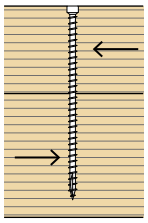
The extraction, shear and sliding values were calculated placing the centre of gravity of the connector in correspondence with the shear plane and considering an effective thread of S_g.

CODES AND DIMENSIONS

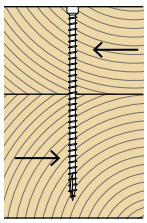
d_1 [mm] *[in]*	CODE	L [mm]	L *[in]*	b [mm]	b *[in]*	pcs
5.3 *0.21* TX 25	VGZ580	80	*3 1/8*	70	*2 3/4*	50
	VGZ5100	100	*4*	90	*3 1/2*	50
	VGZ5120	120	*4 3/4*	110	*4 3/8*	50
5.6 *0.23* TX 25	VGZ5140	140	*5 1/2*	130	*5 1/8*	50
	VGZ5160	160	*6 1/4*	150	*6*	50
7 *0.28* TX 30	VGZ780	80	*3 1/8*	70	*2 3/4*	25
	VGZ7100	100	*4*	90	*3 1/2*	25
	VGZ7120	120	*4 3/4*	110	*4 3/8*	25
	VGZ7140	140	*5 1/2*	130	*5 1/8*	25
	VGZ7160	160	*6 1/4*	150	*6*	25
	VGZ7180	180	*7 1/8*	170	*6 3/4*	25
	VGZ7200	200	*8*	190	*7 1/2*	25
	VGZ7220	220	*8 5/8*	210	*8 1/4*	25
	VGZ7240	240	*9 1/2*	230	*9 1/16*	25
	VGZ7260	260	*10 1/4*	250	*10*	25
	VGZ7280	280	*11*	270	*10 5/8*	25
	VGZ7300	300	*11 3/4*	290	*11 7/16*	25
	VGZ7340	340	*13 3/8*	330	*13*	25
	VGZ7380	380	*15*	370	*14 9/16*	25

d_1 [mm] *[in]*	CODE	L [mm]	L *[in]*	b [mm]	b *[in]*	pcs
9 *0.36* TX 40	VGZ9160	160	*6 1/4*	150	*6*	25
	VGZ9180	180	*7 1/8*	170	*6 3/4*	25
	VGZ9200	200	*8*	190	*7 1/2*	25
	VGZ9220	220	*8 5/8*	210	*8 1/4*	25
	VGZ9240	240	*9 1/2*	230	*9 1/16*	25
	VGZ9260	260	*10 1/4*	250	*10*	25
	VGZ9280	280	*11*	270	*10 5/8*	25
	VGZ9300	300	*11 3/4*	290	*11 7/16*	25
	VGZ9320	320	*12 5/8*	310	*12 3/16*	25
	VGZ9340	340	*13 3/8*	330	*13*	25
	VGZ9360	360	*14 1/4*	350	*13 3/4*	25
	VGZ9380	380	*15*	370	*14 9/16*	25
	VGZ9400	400	*15 3/4*	390	*15 3/8*	25
	VGZ9440	440	*17 1/4*	430	*16 15/16*	25
	VGZ9480	480	*19*	470	*18 1/2*	25
	VGZ9520	520	*20 1/2*	510	*20 1/16*	25
11 *0.44* TX 50	VGZ11250	250	*10*	240	*9 1/2*	25
	VGZ11300	300	*11 3/4*	290	*11 7/16*	25
	VGZ11350	350	*13 3/4*	340	*13 3/8*	25
	VGZ11400	400	*15 3/4*	390	*15 3/8*	25
	VGZ11450	450	*17 3/4*	440	*17 1/4*	25
	VGZ11500	500	*19 3/4*	490	*19 5/16*	25
	VGZ11550	550	*21 5/8*	540	*21 1/4*	25
	VGZ11600	600	*23 5/8*	590	*23 1/4*	25

MINIMUM DISTANCES FOR SHEAR LOADS | WOOD ELEMENTS



Load-to-grain angle α = 0°



Load-to-grain angle α = 90°

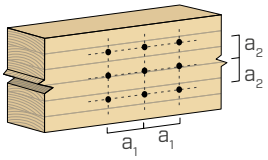
SCREWS INSERTED WITH PREDRILL

			α = 0°						α = 90°					
d_1	[mm]		5.3	5.6	7	9	11		5.3	5.6	7	9	11	
	[in]		*0.21*	*0.23*	*0.28*	*0.36*	*0.44*		*0.21*	*0.23*	*0.28*	*0.36*	*0.44*	
a_1	[mm]	5·d (1)	27	28	35	45	55	4·d (1)	21	22	28	36	44	
	[in]		*1.043*	*1.102*	*1.378*	*1.772*	*2.165*		*0.835*	*0.882*	*1.102*	*1.417*	*1.732*	
a_2	[mm]	3·d	16	17	21	27	33	4·d	21	22	28	36	44	
	[in]		*0.626*	*0.661*	*0.827*	*1.063*	*1.299*		*0.835*	*0.882*	*1.102*	*1.417*	*1.732*	
$a_{3,t}$	[mm]	12·d (1)	64	67	84	108	132	7·d (1)	37	39	49	63	77	
	[in]		*2.504*	*2.646*	*3.307*	*4.252*	*5.197*		*1.461*	*1.543*	*1.929*	*2.480*	*3.031*	
$a_{3,c}$	[mm]	7·d (1)	37	39	49	63	77	7·d (1)	37	39	49	63	77	
	[in]		*1.461*	*1.543*	*1.929*	*2.480*	*3.031*		*1.461*	*1.543*	*1.929*	*2.480*	*3.031*	
$a_{4,t}$	[mm]	3·d	16	17	21	27	33	7·d	37	39	49	63	77	
	[in]		*0.626*	*0.661*	*0.827*	*1.063*	*1.299*		*1.461*	*1.543*	*1.929*	*2.480*	*3.031*	
$a_{4,c}$	[mm]	3·d	16	17	21	27	33	3·d	16	17	21	27	33	
	[in]		*0.626*	*0.661*	*0.827*	*1.063*	*1.299*		*0.626*	*0.661*	*0.827*	*1.063*	*1.299*	

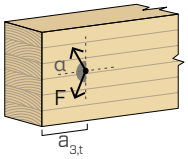
SCREWS INSERTED WITHOUT PREDRILL

			α = 0°						α = 90°					
d_1	[mm]		5.3	5.6	7	9	11		5.3	5.6	7	9	11	
	[in]		*0.21*	*0.23*	*0.28*	*0.36*	*0.44*		*0.21*	*0.23*	*0.28*	*0.36*	*0.44*	
a_1	[mm]	12·d (1)	64	67	84	108	132	5·d (1)	27	28	35	45	55	
	[in]		*2.504*	*2.646*	*3.307*	*4.252*	*5.197*		*1.043*	*1.102*	*1.378*	*1.772*	*2.165*	
a_2	[mm]	5·d	27	28	35	45	55	5·d	27	28	35	45	55	
	[in]		*1.043*	*1.102*	*1.378*	*1.772*	*2.165*		*1.043*	*1.102*	*1.378*	*1.772*	*2.165*	
$a_{3,t}$	[mm]	15·d (1)	80	84	105	135	165	10·d (1)	53	56	70	90	110	
	[in]		*3.130*	*3.307*	*4.134*	*5.315*	*6.496*		*2.087*	*2.205*	*2.756*	*3.543*	*4.331*	
$a_{3,c}$	[mm]	10·d (1)	53	56	70	90	110	10·d (1)	53	56	70	90	110	
	[in]		*2.087*	*2.205*	*2.756*	*3.543*	*4.331*		*2.087*	*2.205*	*2.756*	*3.543*	*4.331*	
$a_{4,t}$	[mm]	5·d	27	28	35	45	55	10·d	53	56	70	90	110	
	[in]		*1.043*	*1.102*	*1.378*	*1.772*	*2.165*		*2.087*	*2.205*	*2.756*	*3.543*	*4.331*	
$a_{4,c}$	[mm]	5·d	27	28	35	45	55	5·d	27	28	35	45	55	
	[in]		*1.043*	*1.102*	*1.378*	*1.772*	*2.165*		*1.043*	*1.102*	*1.378*	*1.772*	*2.165*	

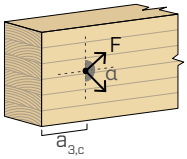
d = nominal screw diameter



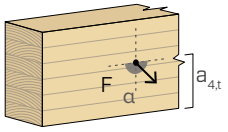
stressed end
-90° < α < 90°



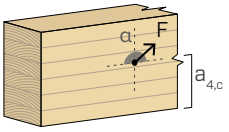
unloaded end
90° < α < 270°



stressed edge
0° < α < 180°



unload edge
180° < α < 360°

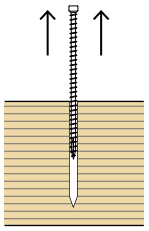


NOTES:

- The minimum distances are in accordance with the EN 1995:2014 standard, according to ETA-11/0030, considering a density of the wood elements $\rho_k \leq 420$ kg/m^3.
- For wood densities conversion (mean oven-dry relative density to 5th-percentile density 12% MC wt & vol) see "Background document" available at Rothoblaas.
- In the case of OSB-wood joints, the minimum spacings (a_1, a_2) can be multiplied by a coefficient of 0.85.
- In the case of steel-wood joints, the minimum spacings (a_1, a_2) can be multiplied by a coefficient of 0.7.

(1) For Douglas fir members minimum spacing and distances parallel to the grain shall be increased by 50%.

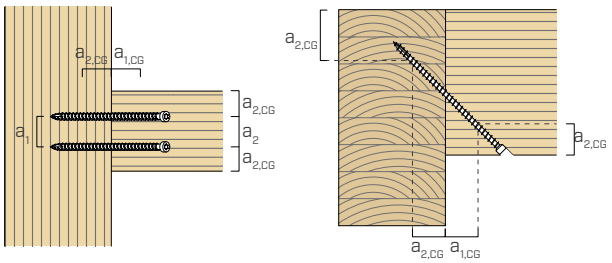
MINIMUM DISTANCES FOR AXIAL LOADS [2]



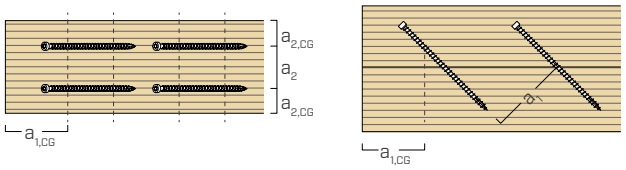
			SCREWS INSERTED WITH AND WITHOUT PREDRILL				
d_1	[mm] *[in]*		**5.3** ***0.21***	**5.6** ***0.23***	**7** ***0.28***	**9** ***0.36***	**11** ***0.44***
a_1	[mm] *[in]*	**5·d**	27 *1.043*	28 *1.102*	35 *1.378*	45 *1.772*	55 *2.165*
a_2	[mm] *[in]*	**5·d**	27 *1.043*	28 *1.102*	35 *1.378*	45 *1.772*	55 *2.165*
$a_{2,LIM}$ [3]	[mm] *[in]*	**2.5·d**	13 *0.522*	14 *0.551*	18 *0.689*	23 *0.886*	28 *1.083*
$a_{1,CG}$	[mm] *[in]*	**8·d**	42 *1.669*	45 *1.764*	56 *2.205*	72 *2.835*	88 *3.465*
$a_{2,CG}$	[mm] *[in]*	**3·d**	16 *0.626*	17 *0.661*	21 *0.827*	27 *1.063*	33 *1.299*
a_{CROSS}	[mm] *[in]*	**1.5·d**	8 *0.313*	8 *0.331*	11 *0.413*	14 *0.531*	17 *0.650*

d = nominal screw diameter

SCREWS UNDER TENSION INSERTED WITH AN ANGLE α WITH RESPECT TO THE GRAIN

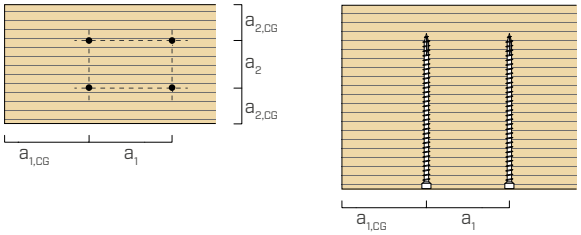


plan front



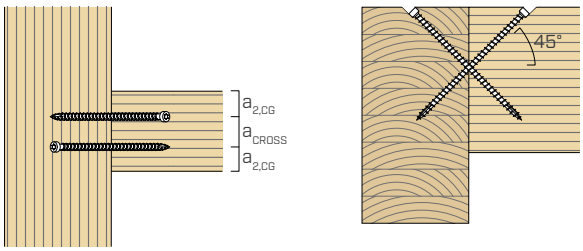
plan front

SCREWS INSERTED WITH α 90° ANGLE WITH RESPECT TO THE GRAIN



plan front

CROSS SCREWS INSERTED WITH AN ANGLE α WITH RESPECT TO THE GRAIN



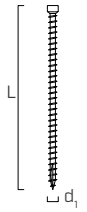
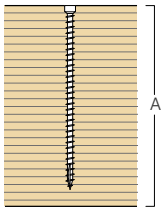
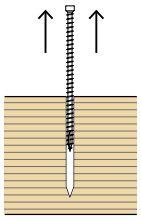
plan front

NOTES:

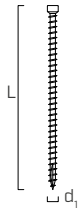
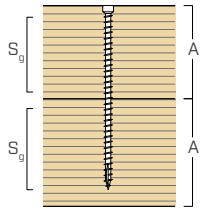
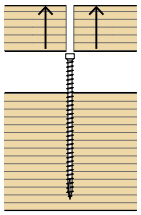
[2] The minimum distances for connectors stressed axially are independent of the insertion angle of the connector and the angle of the force with respect to the grain, in accordance with ETA-11/0030.

[3] The axial distance a_2 can be reduced down to 2,5 d_1 if for each connector a "joint surface" a_1 a_2 = 25 d_1^2 is maintained.

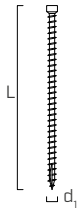
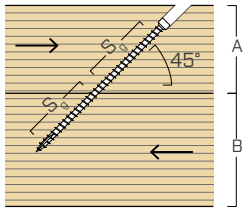
STATIC VALUES | TRACTION [1]

geometry			total thread withdrawal [2]											
														
d_1		L	b		A_{MIN}		characteristic values				design values (factored resistance)			
							timber		steel		$R_{ax,d}$		$R_{ax,d}$		$R_{ax,d}$	
							$R_{ax,k}$		$R_{tens,k}$		Load Case 1		Load Case 2&3		Load Case 4&5	
[mm] *[in]*		[mm]	*[in]*	[mm]	*[in]*	[mm]	*[in]*	[kN]	*[lbf]*	[kN]	*[lbf]*	[kN]	*[lbf]*	[kN]	*[lbf]*	[kN]	*[lbf]*
5.3 *0.21*		80	*3 1/8*	70	*2 3/4*	90	*3 1/2*	4.54	*1,020*	11.00	*2,473*	2.09	*471*	2.79	*628*	3.14	*706*
		100	*4*	90	*3 1/2*	110	*4 3/8*	5.83	*1,312*			2.69	*605*	3.59	*807*	4.04	*908*
		120	*4 3/4*	110	*4 3/8*	130	*5 1/8*	7.13	*1,603*			3.29	*740*	4.39	*987*	4.94	*1,110*
5.6 *0.23*		140	*5 1/2*	130	*5 1/8*	150	*6*	8.90	*2,002*	12.30	*2,765*	4.11	*924*	5.48	*1,232*	6.16	*1,386*
		160	*6 1/4*	150	*6*	170	*6 3/4*	10.27	*2,310*			4.74	*1,066*	6.32	*1,421*	7.11	*1,599*
7 *0.28*		80	*3 1/8*	70	*2 3/4*	90	*3 1/2*	5.99		15.40	*3,462*	2.77	*622*	3.69	*829*	4.15	*933*
		100	*4*	90	*3 1/2*	110	*4 3/8*	7.71	*1,732*			3.56	*800*	4.74	*1,066*	5.33	*1,199*
		120	*4 3/4*	110	*4 3/8*	130	*5 1/8*	9.42	*2,117*			4.35	*977*	5.80	*1,303*	6.52	*1,466*
		140	*5 1/2*	130	*5 1/8*	150	*6*	11.13	*2,502*			5.14	*1,155*	6.85	*1,540*	7.71	*1,732*
		160	*6 1/4*	150	*6*	170	*6 3/4*	12.84	*2,887*			5.93	*1,333*	7.90	*1,777*	8.89	*1,999*
		180	*7 1/8*	170	*6 3/4*	190	*7 1/2*	14.56	*3,272*			6.72	*1,510*	8.96	*2,014*	10.08	*2,265*
		200	*8*	190	*7 1/2*	210	*8 1/4*	16.27	*3,657*			7.51	*1,688*	10.01	*2,251*	11.26	*2,532*
		220	*8 5/8*	210	*8 1/4*	230	*9 1/16*	17.98	*4,042*			8.30	*1,866*	11.07	*2,488*	12.32	*2,770*
		240	*9 1/2*	230	*9 1/16*	250	*10*	19.69	*4,427*			9.09	*2,043*	12.12	*2,724*	12.32	*2,770*
		260	*10 1/4*	250	*10*	270	*10 5/8*	21.41	*4,812*			9.88	*2,221*	12.32	*2,770*	12.32	*2,770*
		280	*11*	270	*10 5/8*	290	*11 7/16*	23.12	*5,197*			10.67	*2,399*	12.32	*2,770*	12.32	*2,770*
		300	*11 3/4*	290	*11 7/16*	310	*12 3/16*	24.83	*5,582*			11.46	*2,576*	12.32	*2,770*	12.32	*2,770*
		340	*13 3/8*	330	*13*	350	*13 3/4*	28.26	*6,352*			12.32	*2,770*	12.32	*2,770*	12.32	*2,770*
		380	*15*	370	*14 9/16*	390	*15 3/8*	31.68	*7,122*			12.32	*2,770*	12.32	*2,770*	12.32	*2,770*
9 *0.36*		160	*6 1/4*	150	*6*	170	*6 3/4*	16.51	*3,712*	25.40	*5,710*	7.62	*1,713*	10.16	*2,284*	11.43	*2,570*
		180	*7 1/8*	170	*6 3/4*	190	*7 1/2*	18.71	*4,207*			8.64	*1,942*	11.52	*2,589*	12.96	*2,913*
		200	*8*	190	*7 1/2*	210	*8 1/4*	20.92	*4,702*			9.65	*2,170*	12.87	*2,894*	14.48	*3,255*
		220	*8 5/8*	210	*8 1/4*	230	*9 1/16*	23.12	*5,197*			10.67	*2,399*	14.23	*3,198*	16.00	*3,598*
		240	*9 1/2*	230	*9 1/16*	250	*10*	25.32	*5,692*			11.69	*2,627*	15.58	*3,503*	17.53	*3,941*
		260	*10 1/4*	250	*10*	270	*10 5/8*	27.52	*6,187*			12.70	*2,856*	16.94	*3,807*	19.05	*4,283*
		280	*11*	270	*10 5/8*	290	*11 7/16*	29.72	*6,682*			13.72	*3,084*	18.29	*4,112*	20.32	*4,568*
		300	*11 3/4*	290	*11 7/16*	310	*12 3/16*	31.93	*7,177*			14.73	*3,312*	19.65	*4,417*	20.32	*4,568*
		320	*12 5/8*	310	*12 3/16*	330	*13*	34.13	*7,672*			15.75	*3,541*	20.32	*4,568*	20.32	*4,568*
		340	*13 3/8*	330	*13*	350	*13 3/4*	36.33	*8,167*			16.77	*3,769*	20.32	*4,568*	20.32	*4,568*
		360	*14 1/4*	350	*13 3/4*	370	*14 9/16*	38.53	*8,662*			17.78	*3,998*	20.32	*4,568*	20.32	*4,568*
		380	*15*	370	*14 9/16*	390	*15 3/8*	40.73	*9,157*			18.80	*4,226*	20.32	*4,568*	20.32	*4,568*
		400	*15 3/4*	390	*15 3/8*	410	*16 1/8*	42.93	*9,652*			19.82	*4,455*	20.32	*4,568*	20.32	*4,568*
		440	*17 1/4*	430	*16 15/16*	450	*17 3/4*	47.34	*10,642*			20.32	*4,568*	20.32	*4,568*	20.32	*4,568*
		480	*19*	470	*18 1/2*	490	*19 5/16*	51.74	*11,632*			20.32	*4,568*	20.32	*4,568*	20.32	*4,568*
		520	*20 1/2*	510	*20 1/16*	530	*20 7/8*	56.14	*12,622*			20.32	*4,568*	20.32	*4,568*	20.32	*4,568*

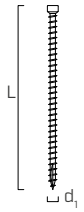
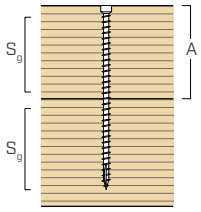
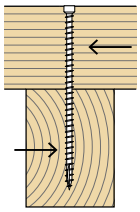
STATIC VALUES | TRACTION [1]

geometry			partial thread withdrawal [2]											
														
d_1		L	S_g		A_{MIN}		characteristic values				design values (factored resistance)			
							timber		steel		$R_{ax,d}$		$R_{ax,d}$		$R_{ax,d}$	
							$R_{ax,k}$		$R_{tens,k}$		Load Case 1		Load Case 2&3		Load Case 4&5	
[mm]	*[in]*	[mm]	*[in]*	[mm]	*[in]*	[mm]	*[in]*	[kN]	*[lbf]*	[kN]	*[lbf]*	[kN]	*[lbf]*	[kN]	*[lbf]*	[kN]	*[lbf]*
5.3	*0.21*	80	*3 1/8*	25	*1*	45	*1 3/4*	1.62	*364*	11.00	*2,473*	0.75	*168*	1.00	*224*	1.12	*252*
		100	*4*	35	*1 3/8*	55	*2 3/16*	2.27	*510*			1.05	*235*	1.40	*314*	1.57	*353*
		120	*4 3/4*	45	*1 3/4*	65	*2 9/16*	2.92	*656*			1.35	*303*	1.80	*404*	2.02	*454*
5.6	*0.23*	140	*5 1/2*	55	*2 3/16*	75	*2 15/16*	3.77	*847*	12.30	*2,765*	1.74	*391*	2.32	*521*	2.61	*586*
		160	*6 1/4*	65	*2 9/16*	85	*3 3/8*	4.45	*1,001*			2.05	*462*	2.74	*616*	3.08	*693*
7	*0.28*	80	*3 1/8*	25	*1*	45	*1 3/4*	2.14	*481*	15.40	*3,462*	0.99	*222*	1.32	*296*	1.48	*333*
		100	*4*	35	*1 3/8*	55	*2 3/16*	3.00	*674*			1.38	*311*	1.84	*415*	2.07	*466*
		120	*4 3/4*	45	*1 3/4*	65	*2 9/16*	3.85	*866*			1.78	*400*	2.37	*533*	2.67	*600*
		140	*5 1/2*	55	*2 3/16*	75	*2 15/16*	4.71	*1,059*			2.17	*489*	2.90	*651*	3.26	*733*
		160	*6 1/4*	65	*2 9/16*	85	*3 3/8*	5.57	*1,251*			2.57	*577*	3.42	*770*	3.85	*866*
		180	*7 1/8*	75	*2 15/16*	95	*3 3/4*	6.42	*1,444*			2.96	*666*	3.95	*888*	4.45	*999*
		200	*8*	85	*3 3/8*	105	*4 1/8*	7.28	*1,636*			3.36	*755*	4.48	*1,007*	5.04	*1,133*
		220	*8 5/8*	95	*3 3/4*	115	*4 1/2*	8.13	*1,829*			3.75	*844*	5.01	*1,125*	5.63	*1,266*
		240	*9 1/2*	105	*4 1/8*	125	*4 15/16*	8.99	*2,021*			4.15	*933*	5.53	*1,244*	6.22	*1,399*
		260	*10 1/4*	115	*4 1/2*	135	*5 5/16*	9.85	*2,214*			4.54	*1,022*	6.06	*1,362*	6.82	*1,533*
		280	*11*	125	*4 15/16*	145	*5 11/16*	10.70	*2,406*			4.94	*1,111*	6.59	*1,481*	7.41	*1,666*
		300	*11 3/4*	135	*5 5/16*	155	*6 1/8*	11.56	*2,599*			5.33	*1,199*	7.11	*1,599*	8.00	*1,799*
		340	*13 3/8*	155	*6 1/8*	175	*6 7/8*	13.27	*2,984*			6.13	*1,377*	8.17	*1,836*	9.19	*2,066*
		380	*15*	175	*6 7/8*	195	*7 11/16*	14.98	*3,369*			6.92	*1,555*	9.22	*2,073*	10.37	*2,332*
9	*0.36*	160	*6 1/4*	65	*2 9/16*	85	*3 3/8*	7.16	*1,609*	25.40	*5,710*	3.30	*742*	4.40	*990*	4.95	*1,114*
		180	*7 1/8*	75	*2 15/16*	95	*3 3/4*	8.26	*1,856*			3.81	*857*	5.08	*1,142*	5.72	*1,285*
		200	*8*	85	*3 3/8*	105	*4 1/8*	9.36	*2,104*			4.32	*971*	5.76	*1,295*	6.48	*1,456*
		220	*8 5/8*	95	*3 3/4*	115	*4 1/2*	10.46	*2,351*			4.83	*1,085*	6.44	*1,447*	7.24	*1,628*
		240	*9 1/2*	105	*4 1/8*	125	*4 15/16*	11.56	*2,599*			5.33	*1,199*	7.11	*1,599*	8.00	*1,799*
		260	*10 1/4*	115	*4 1/2*	135	*5 5/16*	12.66	*2,846*			5.84	*1,314*	7.79	*1,751*	8.76	*1,970*
		280	*11*	125	*4 15/16*	145	*5 11/16*	13.76	*3,094*			6.35	*1,428*	8.47	*1,904*	9.53	*2,142*
		300	*11 3/4*	135	*5 5/16*	155	*6 1/8*	14.86	*3,341*			6.86	*1,542*	9.15	*2,056*	10.29	*2,313*
		320	*12 5/8*	145	*5 11/16*	165	*6 1/2*	15.96	*3,589*			7.37	*1,656*	9.82	*2,208*	11.05	*2,484*
		340	*13 3/8*	155	*6 1/8*	175	*6 7/8*	17.06	*3,836*			7.88	*1,770*	10.50	*2,361*	11.81	*2,656*
		360	*14 1/4*	165	*6 1/2*	185	*7 1/4*	18.16	*4,084*			8.38	*1,885*	11.18	*2,513*	12.58	*2,827*
		380	*15*	175	*6 7/8*	195	*7 11/16*	19.27	*4,331*			8.89	*1,999*	11.86	*2,665*	13.34	*2,998*
		400	*15 3/4*	185	*7 1/4*	205	*8 1/16*	20.37	*4,578*			9.40	*2,113*	12.53	*2,818*	14.10	*3,170*
		440	*17 1/4*	205	*8 1/16*	225	*8 7/8*	22.57	*5,073*			10.42	*2,342*	13.89	*3,122*	15.62	*3,512*
		480	*19*	225	*8 7/8*	245	*9 5/8*	24.77	*5,568*				*2,570*	15.24	*3,427*	17.15	*3,855*
		520	*20 1/2*	245	*9 5/8*	265	*10 7/16*	26.97	*6,063*			12.45	*2,798*	16.60	*3,731*	18.67	*4,198*

STATIC VALUES | SLIDING TIMBER-TO-TIMBER

geometry			timber-to-timber[3]													
																
d_1		L	S_g		A_{MIN}		B_{MIN}		characteristic values		design values (factored resistance)					
									$R_{V,k}$		$R_{V,d}$ Load Case 1		$R_{V,d}$ Load Case 2&3		$R_{V,d}$ Load Case 4&5	
[mm] *[in]*	[mm]	*[in]*	[mm]	*[in]*	[mm]	*[in]*	[mm]	*[in]*	[kN]	*[lbf]*	[kN]	*[lbf]*	[kN]	*[lbf]*	[kN]	*[lbf]*
5.3 *0.21*	80	*3 1/8*	25	*1*	30	*1 3/16*	50	*1 15/16*	1.15	*258*	0.53	*119*	0.71	*159*	0.79	*178*
	100	*4*	35	*1 3/8*	40	*1 9/16*	55	*2 3/16*	1.60	*361*	0.74	*166*	0.99	*222*	1.11	*250*
	120	*4 3/4*	45	*1 3/4*	45	*1 3/4*	60	*2 3/8*	2.06	*464*	0.95	*214*	1.27	*285*	1.43	*321*
5.6 *0.23*	140	*5 1/2*	55	*2 3/16*	50	*1 15/16*	70	*2 3/4*	2.66	*599*	1.23	*276*	1.64	*369*	1.84	*415*
	160	*6 1/4*	65	*2 9/16*	60	*2 3/8*	75	*2 15/16*	3.15	*708*	1.45	*327*	1.94	*436*	2.18	*490*
7 *0.28*	80	*3 1/8*	25	*1*	30	*1 3/16*	50	*1 15/16*	1.51	*340*	0.70	*157*	0.93	*209*	1.05	*236*
	100	*4*	35	*1 3/8*	40	*1 9/16*	55	*2 3/16*	2.12	*476*	0.98	*220*	1.30	*293*	1.47	*330*
	120	*4 3/4*	45	*1 3/4*	45	*1 3/4*	60	*2 3/8*	2.72	*612*	1.26	*283*	1.68	*377*	1.89	*424*
	140	*5 1/2*	55	*2 3/16*	55	*2 3/16*	70	*2 3/4*	3.33	*749*	1.54	*346*	2.05	*461*	2.31	*518*
	160	*6 1/4*	65	*2 9/16*	60	*2 3/8*	75	*2 15/16*	3.94	*885*	1.82	*408*	2.42	*544*	2.72	*612*
	180	*7 1/8*	75	*2 15/16*	65	*2 9/16*	85	*3 3/8*	4.54	*1,021*	2.10	*471*	2.79	*628*	3.14	*707*
	200	*8*	85	*3 3/8*	75	*2 15/16*	90	*3 1/2*	5.15	*1,157*	2.38	*534*	3.17	*712*	3.56	*801*
	220	*8 5/8*	95	*3 3/4*	80	*3 1/8*	100	*4*	5.75	*1,293*	2.65	*597*	3.54	*796*	3.98	*895*
	240	*9 1/2*	105	*4 1/8*	90	*3 1/2*	105	*4 1/8*	6.36	*1,429*	2.93	*660*	3.91	*879*	4.40	*989*
	260	*10 1/4*	115	*4 1/2*	95	*3 3/4*	110	*4 3/8*	6.96	*1,565*	3.21	*722*	4.28	*963*	4.82	*1,084*
	280	*11*	125	*4 15/16*	100	*4*	120	*4 3/4*	7.57	*1,701*	3.49	*785*	4.66	*1,047*	5.24	*1,178*
	300	*11 3/4*	135	*5 5/16*	110	*4 3/8*	125	*4 15/16*	8.17	*1,837*	3.77	*848*	5.03	*1,131*	5.66	*1,272*
	340	*13 3/8*	155	*6 1/8*	125	*4 15/16*	140	*5 1/2*	9.38	*2,110*	4.33	*974*	5.78	*1,298*	6.50	*1,461*
	380	*15*	175	*6 7/8*	140	*5 1/2*	155	*6 1/8*	10.60	*2,382*	4.89	*1,099*	6.52	*1,466*	7.34	*1,649*
9 *0.36*	160	*6 1/4*	65	*2 9/16*	60	*2 3/8*	75	*2 15/16*	5.06	*1,137*	2.34	*525*	3.11	*700*	3.50	*787*
	180	*7 1/8*	75	*2 15/16*	70	*2 3/4*	85	*3 3/8*	5.84	*1,312*	2.69	*606*	3.59	*808*	4.04	*909*
	200	*8*	85	*3 3/8*	75	*2 15/16*	90	*3 1/2*	6.62	*1,487*	3.05	*687*	4.07	*915*	4.58	*1,030*
	220	*8 5/8*	95	*3 3/4*	80	*3 1/8*	100	*4*	7.40	*1,662*	3.41	*767*	4.55	*1,023*	5.12	*1,151*
	240	*9 1/2*	105	*4 1/8*	90	*3 1/2*	105	*4 1/8*	8.17	*1,837*	3.77	*848*	5.03	*1,131*	5.66	*1,272*
	260	*10 1/4*	115	*4 1/2*	95	*3 3/4*	110	*4 3/8*	8.95	*2,012*	4.13	*929*	5.51	*1,238*	6.20	*1,393*
	280	*11*	125	*4 15/16*	105	*4 1/8*	120	*4 3/4*	9.73	*2,187*	4.49	*1,010*	5.99	*1,346*	6.74	*1,514*
	300	*11 3/4*	135	*5 5/16*	110	*4 3/8*	125	*4 15/16*	10.51	*2,362*	4.85	*1,090*	6.47	*1,454*	7.28	*1,636*
	320	*12 5/8*	145	*5 11/16*	115	*4 1/2*	135	*5 5/16*	11.29	*2,537*	5.21	*1,171*	6.95	*1,562*	7.81	*1,757*
	340	*13 3/8*	155	*6 1/8*	125	*4 15/16*	140	*5 1/2*	12.07	*2,712*	5.57	*1,252*	7.43	*1,669*	8.35	*1,878*
	360	*14 1/4*	165	*6 1/2*	130	*5 1/8*	145	*5 11/16*	12.84	*2,887*	5.93	*1,333*	7.90	*1,777*	8.89	*1,999*
	380	*15*	175	*6 7/8*	140	*5 1/2*	155	*6 1/8*	13.62	*3,062*	6.29	*1,413*	8.38	*1,885*	9.43	*2,120*
	400	*15 3/4*	185	*7 1/4*	145	*5 11/16*	160	*6 1/4*	14.40	*3,237*	6.65	*1,494*	8.86	*1,992*	9.97	*2,241*
	440	*17 1/4*	205	*8 1/16*	160	*6 1/4*	175	*6 7/8*	15.96	*3,587*	7.37	*1,656*	9.82	*2,208*	11.05	*2,484*
	480	*19*	225	*8 7/8*	175	*6 7/8*	190	*7 1/2*	17.51	*3,937*	8.08	*1,817*	10.78	*2,423*	12.13	*2,726*
	520	*20 1/2*	245	*9 5/8*	190	*7 1/2*	205	*8 1/16*	17.96	*4,038*	8.29	*1,864*	11.05	*2,485*	12.43	*2,795*

STATIC VALUES | SHEAR TIMBER-TO-TIMBER

geometry			timber-to-timber									
												
d_1		L	S_g		A_{MIN}		characteristic values		design values (factored resistance)			
							$R_{V,k}$		$R_{V,d}$ Load Case 1		$R_{V,d}$ Load Case 2&3		$R_{V,d}$ Load Case 4&5	
[mm] *[in]*	[mm]	*[in]*	[mm]	*[in]*	[mm]	*[in]*	[kN]	*[lbf]*	[kN]	*[lbf]*	[kN]	*[lbf]*	[kN]	*[lbf]*
5.3 *0.21*	80	*3 1/8*	25	*1*	40	*1 9/16*	1.61	*362*	0.74	*167*	0.99	*223*	1.11	*250*
	100	*4*	35	*1 3/8*	50	*1 15/16*	2.02	*455*	0.93	*210*	1.25	*280*	1.40	*315*
	120	*4 3/4*	45	*1 3/4*	60	*2 3/8*	2.27	*510*	1.05	*235*	1.40	*314*	1.57	*353*
5.6 *0.23*	140	*5 1/2*	55	*2 3/16*	70	*2 3/4*	2.63	*591*	1.21	*273*	1.62	*363*	1.82	*409*
	160	*6 1/4*	65	*2 9/16*	80	*3 1/8*	2.80	*629*	1.29	*290*	1.72	*387*	1.94	*436*
7 *0.28*	80	*3 1/8*	25	*1*	40	*1 9/16*	2.10	*472*	0.97	*218*	1.29	*291*	1.45	*327*
	100	*4*	35	*1 3/8*	50	*1 15/16*	2.60	*584*	1.20	*270*	1.60	*360*	1.80	*405*
	120	*4 3/4*	45	*1 3/4*	60	*2 3/8*	3.07	*691*	1.42	*319*	1.89	*425*	2.13	*478*
	140	*5 1/2*	55	*2 3/16*	70	*2 3/4*	3.29	*739*	1.52	*341*	2.02	*455*	2.28	*512*
	160	*6 1/4*	65	*2 9/16*	80	*3 1/8*	3.50	*787*	1.62	*363*	2.15	*484*	2.42	*545*
	180	*7 1/8*	75	*2 15/16*	90	*3 1/2*	3.71	*835*	1.71	*385*	2.29	*514*	2.57	*578*
	200	*8*	85	*3 3/8*	100	*4*	3.93	*883*	1.81	*408*	2.42	*544*	2.72	*611*
	220	*8 5/8*	95	*3 3/4*	110	*4 3/8*	4.14	*931*	1.91	*430*	2.55	*573*	2.87	*645*
	240	*9 1/2*	105	*4 1/8*	120	*4 3/4*	4.22	*948*	1.95	*438*	2.60	*584*	2.92	*657*
	260	*10 1/4*	115	*4 1/2*	130	*5 1/8*	4.22	*948*	1.95	*438*	2.60	*584*	2.92	*657*
	280	*11*	125	*4 15/16*	140	*5 1/2*	4.22	*948*	1.95	*438*	2.60	*584*	2.92	*657*
	300	*11 3/4*	135	*5 5/16*	150	*6*	4.22	*948*	1.95	*438*	2.60	*584*	2.92	*657*
	340	*13 3/8*	155	*6 1/8*	170	*6 3/4*	4.22	*948*	1.95	*438*	2.60	*584*	2.92	*657*
	380	*15*	175	*6 7/8*	190	*7 1/2*	4.22	*948*	1.95	*438*	2.60	*584*	2.92	*657*
9 *0.36*	160	*6 1/4*	65	*2 9/16*	80	*3 1/8*	4.98	*1,119*	2.30	*516*	3.06	*688*	3.45	*775*
	180	*7 1/8*	75	*2 15/16*	90	*3 1/2*	5.25	*1,181*	2.42	*545*	3.23	*727*	3.64	*817*
	200	*8*	85	*3 3/8*	100	*4*	5.53	*1,243*	2.55	*573*	3.40	*765*	3.83	*860*
	220	*8 5/8*	95	*3 3/4*	110	*4 3/8*	5.80	*1,304*	2.68	*602*	3.57	*803*	4.02	*903*
	240	*9 1/2*	105	*4 1/8*	120	*4 3/4*	6.08	*1,366*	2.81	*631*	3.74	*841*	4.21	*946*
	260	*10 1/4*	115	*4 1/2*	130	*5 1/8*	6.35	*1,428*	2.93	*659*	3.91	*879*	4.40	*989*
	280	*11*	125	*4 15/16*	140	*5 1/2*	6.38	*1,433*	2.94	*662*	3.92	*882*	4.41	*992*
	300	*11 3/4*	135	*5 5/16*	150	*6*	6.38	*1,433*	2.94	*662*	3.92	*882*	4.41	*992*
	320	*12 5/8*	145	*5 11/16*	160	*6 1/4*	6.38	*1,433*	2.94	*662*	3.92	*882*	4.41	*992*
	340	*13 3/8*	155	*6 1/8*	170	*6 3/4*	6.38	*1,433*	2.94	*662*	3.92	*882*	4.41	*992*
	360	*14 1/4*	165	*6 1/2*	180	*7 1/8*	6.38	*1,433*	2.94	*662*	3.92	*882*	4.41	*992*
	380	*15*	175	*6 7/8*	190	*7 1/2*	6.38	*1,433*	2.94	*662*	3.92	*882*	4.41	*992*
	400	*15 3/4*	185	*7 1/4*	200	*8*	6.38	*1,433*	2.94	*662*	3.92	*882*	4.41	*992*
	440	*17 1/4*	205	*8 1/16*	220	*8 5/8*	6.38	*1,433*	2.94	*662*	3.92	*882*	4.41	*992*
	480	*19*	225	*8 7/8*	240	*9 1/2*	6.38	*1,433*	2.94	*662*	3.92	*882*	4.41	*992*
	520	*20 1/2*	245	*9 5/8*	260	*10 1/4*	6.38	*1,433*	2.94	*662*	3.92	*882*	4.41	*992*

STATIC VALUES | SHEAR CONNECTION WITH CROSSED CONNECTORS

RIGHT ANGLE JOINT - MAIN BEAM / SECONDARY BEAM

d_1	L		$S_{g\,HT}$		$S_{g\,NT}$		$B_{HT\,min}$		$H_{HT\,min} = h_{NT\,min}$		$b_{NT\,min}$	
[mm] *[in]*	[mm]	*[in]*	[mm]	*[in]*	[mm]	*[in]*	[mm]	*[in]*	[mm]	*[in]*	[mm]	*[in]*
5.3 *0.21*	120	*4 3/4*	30	*1 3/16*	60	*2 3/8*	45	*1 3/4*	105	*4 1/8*	50 77 103	*1 15/16* *3 1/16* *4 1/16*
5.6 *0.23*	140	*5 1/2*	45	*1 3/4*	65	*2 9/16*	55	*2 3/16*	120	*4 3/4*	53 81 109	*2 1/16* *3 3/16* *4 5/16*
	160	*6 1/4*	65	*2 9/16*	65	*2 9/16*	65	*2 9/16*	135	*5 5/16*	53 81 109	*2 1/16* *3 3/16* *4 5/16*
7 *0.28*	180	*7 1/8*	65	*2 9/16*	85	*3 3/8*	80	*3 1/8*	160	*6 1/4*	53 88 123	*2 1/16* *3 7/16* *4 13/16*
	220	*8 5/8*	95	*3 3/4*	95	*3 3/4*	95	*3 3/4*	170	*6 3/4*	53 88 123	*2 1/16* *3 7/16* *4 13/16*
	260	*10 1/4*	115	*4 1/2*	115	*4 1/2*	110	*4 3/8*	200	*8*	53 88 123	*2 1/16* *3 7/16* *4 13/16*
	300	*11 3/4*	135	*5 5/16*	135	*5 5/16*	125	*4 15/16*	230	*9 1/16*	53 88 123	*2 1/16* *3 7/16* *4 13/16*
	340	*13 3/8*	155	*6 1/8*	155	*6 1/8*	140	*5 1/2*	255	*10 1/16*	53 88 123	*2 1/16* *3 7/16* *4 13/16*
9 *0.36*	200	*8*	85	*3 3/8*	85	*3 3/8*	90	*3 1/2*	200	*8*	86 131 176	*3 3/8* *5 3/16* *6 15/16*
	240	*9 1/2*	105	*4 1/8*	105	*4 1/8*	100	*4*	200	*8*	86 131 176	*3 3/8* *5 3/16* *6 15/16*
	280	*11*	125	*4 15/16*	125	*4 15/16*	115	*4 1/2*	215	*8 7/16*	86 131 176	*3 3/8* *5 3/16* *6 15/16*
	320	*12 5/8*	145	*5 11/16*	145	*5 11/16*	130	*5 1/8*	245	*9 5/8*	86 131 176	*3 3/8* *5 3/16* *6 15/16*
	360	*14 1/4*	165	*6 1/2*	165	*6 1/2*	145	*5 11/16*	270	*10 5/8*	86 131 176	*3 3/8* *5 3/16* *6 15/16*
	400	*15 3/4*	185	*7 1/4*	185	*7 1/4*	160	*6 1/4*	300	*11 3/4*	86 131 176	*3 3/8* *5 3/16* *6 15/16*
	480	*19*	225	*8 7/8*	225	*8 7/8*	185	*7 1/4*	355	*14*	86 131 176	*3 3/8* *5 3/16* *6 15/16*
	520	*20 1/2*	245	*9 5/8*	245	*9 5/8*	200	*8*	385	*15 3/16*	86 131 176	*3 3/8* *5 3/16* *6 15/16*

No. pairs	$R_{1\,V,k}$ [4] extraction [6]		$R_{2\,V,k}$ [4] instability		$R_{V,d}$ Load Case 1		$R_{V,d}$ Load Case 2&3		$R_{V,d}$ Load Case 4&5		m [5]	
	[kN]	*[lbf]*	[kN]	*[lbf]*	[kN]	*[lbf]*	[kN]	*[lbf]*	[kN]	*[lbf]*	[mm]	*[in]*
1	2,8	*618*	8.1	*1,823*	1.3	*285*	1.7	*381*	1.9	*428*		
2	5,1	*1.154*	15.1	*3,402*	2.4	*533*	3.2	*710*	3.6	*799*	45	*1,772*
3	7,4	*1.662*	21.8	*4,900*	3.4	*767*	4.5	*1,023*	5.1	*1,151*		
1	4,4	*980*	9.1	*2,038*	2.0	*452*	2.7	*603*	3.0	*678*		
2	8,1	*1.829*	16.9	*3,804*	3.8	*844*	5.0	*1,125*	5.6	*1,266*	52	*2,047*
3	11,7	*2.634*	24.4	*5,479*	5.4	*1,216*	7.2	*1,621*	8.1	*1,824*		
1	6,3	*1.416*	9.1	*2,038*	2.9	*653*	3.9	*871*	4.4	*980*		
2	11,7	*2.641*	16.9	*3,804*	5.4	*1,219*	7.2	*1,626*	8.1	*1,829*	59	*2,323*
3	16,9	*3.805*	24.4	*5,479*	7.8	*1,756*	10.4	*2,341*	11.7	*2,634*		
1	7,9	*1.769*	13.5	*3,035*	3.6	*817*	4.8	*1,089*	5.4	*1,225*		
2	14,7	*3.302*	25.2	*5,663*	6.8	*1,524*	9.0	*2,032*	10.2	*2,286*	67	*2,638*
3	21,2	*4.756*	36.3	*8,157*	9.8	*2,195*	13.0	*2,927*	14.6	*3,293*		
1	11,5	*2.586*	13.5	*3,035*	5.3	*1,194*	7.1	*1,591*	8.0	*1,790*		
2	21,5	*4.826*	25.2	*5,663*	9.9	*2,227*	13.2	*2,970*	14.9	*3,341*	81	*3,189*
3	30,9	*6.951*	36.3	*8,157*	14.3	*3,208*	19.0	*4,278*	21.4	*4,812*		
1	13,9	*3.131*	13.5	*3,035*	6.4	*1,445*	8.6	*1,926*	9.6	*2,167*		
2	26,0	*5.842*	25.2	*5,663*	12.0	*2,696*	16.0	*3,595*	18.0	*4,044*	95	*3,740*
3	37,4	*8.414*	36.3	*8,157*	17.3	*3,884*	23.0	*5,178*	25.9	*5,825*		
1	16,3	*3.675*	13.5	*3,035*	7.5	*1,696*	10.1	*2,262*	11.3	*2,544*		
2	30,5	*6.858*	25.2	*5,663*	14.1	*3,165*	18.8	*4,220*	21.1	*4,748*	109	*4,291*
3	43,9	*9.878*	36.3	*8,157*	20.3	*4,559*	27.0	*6,079*	30.4	*6,839*		
1	18,8	*4.219*	13.5	*3,035*	8.7	*1,947*	11.6	*2,597*	13.0	*2,921*		
2	35,0	*7.874*	25.2	*5,663*	16.2	*3,634*	21.6	*4,845*	24.2	*5,451*	124	*4,882*
3	50,4	*11.341*	36.3	*8,157*	23.3	*5,234*	31.0	*6,979*	34.9	*7,852*		
1	13,2	*2.975*	22.7	*5,095*	6.1	*1,373*	8.1	*1,831*	9.2	*2,060*		
2	24,7	*5.551*	42.3	*9,508*	11.4	*2,562*	15.2	*3,416*	17.1	*3,843*	75	*2,953*
3	35,6	*7.996*	60.9	*13,695*	16.4	*3,691*	21.9	*4,921*	24.6	*5,536*		
1	16,3	*3.675*	22.7	*5,095*	7.5	*1,696*	10.1	*2,262*	11.3	*2,544*		
2	30,5	*6.858*	42.3	*9,508*	14.1	*3,165*	18.8	*4,220*	21.1	*4,748*	89	*3,504*
3	43,9	*9.878*	60.9	*13,695*	20.3	*4,559*	27.0	*6,079*	30.4	*6,839*		
1	19,5	*4.375*	22.7	*5,095*	9.0	*2,019*	12.0	*2,692*	13.5	*3,029*		
2	36,3	*8.164*	42.3	*9,508*	16.8	*3,768*	22.3	*5,024*	25.1	*5,652*	103	*4,055*
3	52,3	*11.759*	60.9	*13,695*	24.1	*5,427*	32.2	*7,237*	36.2	*8,141*		
1	22,6	*5.075*	22.7	*5,095*	10.4	*2,342*	13.9	*3,123*	15.6	*3,513*		
2	42,1	*9.470*	42.3	*9,508*	19.4	*4,371*	25.9	*5,828*	29.2	*6,556*	117	*4,606*
3	60,7	*13.641*	60.9	*13,695*	28.0	*6,296*	37.3	*8,394*	42.0	*9,444*		
1	25,7	*5.775*	22.7	*5,095*	11.9	*2,665*	15.8	*3,554*	17.8	*3,998*		
2	47,9	*10.776*	42.3	*9,508*	22.1	*4,974*	29.5	*6,632*	33.2	*7,461*	131	*5,157*
3	69,0	*15.522*	60.9	*13,695*	31.9	*7,164*	42.5	*9,552*	47.8	*10,746*		
1	28,8	*6.475*	22.7	*5,095*	13.3	*2,988*	17.7	*3,985*	19.9	*4,483*		
2	53,7	*12.083*	42.3	*9,508*	24.8	*5,577*	33.1	*7,435*	37.2	*8,365*	145	*5,709*
3	77,4	*17.404*	60.9	*13,695*	35.7	*8,033*	47.6	*10,710*	53.6	*12,049*		
1	35,0	*7.875*	22.7	*5,095*	16.2	*3,635*	21.6	*4,846*	22.7	*5,095*		
2	65,4	*14.695*	42.3	*9,508*	30.2	*6,782*	40.2	*9,043*	42.3	*9,508*	163	*6,417*
3	94,2	*21.167*	60.9	*13,695*	43.5	*9,769*	57.9	*13,026*	60.9	*13,695*		
1	35,9	*8.075*	22.7	*5,095*	16.6	*3,727*	22.1	*4,969*	22.7	*5,095*		
2	67,0	*15.069*	42.3	*9,508*	30.9	*6,955*	41.2	*9,273*	42.3	*9,508*	181	*7,126*
3	96,6	*21.706*	60.9	*13,695*	44.6	*10,018*	59.4	*13,357*	60.9	*13,695*		

STATIC VALUES | SHEAR CONNECTION WITH CROSSED CONNECTORS

RIGHT ANGLE JOINT - MAIN BEAM / SECONDARY BEAM

d_1		L	$S_{g\,HT}$		$S_{g\,NT}$		$B_{HT\,min}$		$H_{HT\,min} = h_{NT\,min}$		$b_{NT\,min}$	
[mm]	*[in]*	[mm]	*[in]*	[mm]	*[in]*	[mm]	*[in]*	[mm]	*[in]*	[mm]	*[in]*	[mm]	*[in]*
11	*0.44*	250	*10*	110	*4 3/8*	110	*4 3/8*	105	*4 1/8*	245	*9 5/8*	105 160 215	*4 1/8* *6 1/4* *8 7/16*
		300	*11 3/4*	135	*5 5/16*	135	*5 5/16*	125	*4 15/16*	245	*9 5/8*	105 160 215	*4 1/8* *6 1/4* *8 7/16*
		350	*13 3/4*	160	*6 1/4*	160	*6 1/4*	140	*5 1/2*	265	*10 7/16*	105 160 215	*4 1/8* *6 1/4* *8 7/16*
		400	*15 3/4*	185	*7 1/4*	185	*7 1/4*	160	*6 1/4*	300	*11 3/4*	105 160 215	*4 1/8* *6 1/4* *8 7/16*
		450	*17 3/4*	210	*8 1/4*	210	*8 1/4*	175	*6 7/8*	340	*13 3/8*	105 160 215	*4 1/8* *6 1/4* *8 7/16*
		500	*19 3/4*	235	*9 1/4*	235	*9 1/4*	195	*7 11/16*	370	*14 9/16*	105 160 215	*4 1/8* *6 1/4* *8 7/16*
		550	*21 5/8*	260	*10 1/4*	260	*10 1/4*	210	*8 1/4*	405	*15 15/16*	105 160 215	*4 1/8* *6 1/4* *8 7/16*
		600	*23 5/8*	285	*11 1/4*	285	*11 1/4*	230	*9 1/16*	445	*17 1/2*	105 160 215	*4 1/8* *6 1/4* *8 7/16*

NOTES:

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

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

γ_{M2}: partial factor for resistance of cross-sections in tension to fracture according to EN 1993-1-1. Please see "Background document" available at Rothoblaas.

(2) The axial resistance of the thread to extraction was calculated considering a 90° angle between the fibres and the connector and for a effective thread length of b or sg. For intermediate sg values it is possible to interpolate linearly.

(3) The axial resistance of the thread to extraction was calculated considering a 45° angle between the fibres and the connector and for an effective thread length of S_g.

(4) The design strength of the connector is the lower between the extraction-side design strength($R_{1\,V,d}$) and the instability design strength ($R_{2\,V,d}$).

$$R_{ax,d} = min\begin{cases} R_{1V,k} \cdot DMF \\ \dfrac{R_{2V,k}}{\gamma_{M1}} \end{cases}$$

γ_{M1}: partial factor for resistance of cross-sections in tension to fracture according to EN 1993-1-1. Please see "Background document" available at Rothoblaas.

(5) The assembly figure (m) is valid in the case of laying of the connectors flush over the elements.

(6) The axial resistance of the thread to extraction was calculated considering an effective thread length equal to sg. The connectors must be inserted at 45° with respect to the shear plane. The centre of gravity of the connectors must be placed in correspondence with the shear plane.

For different calculation methods, the MyProject software is available (www.rothoblaas.com).

No. pairs	$R_{1\,V,k}$ [4] extraction [6]		$R_{2\,V,k}$ [4] instability		$R_{V,d}$ Load Case 1		$R_{V,d}$ Load Case 2&3		$R_{V,d}$ Load Case 4&5		m [5]	
	[kN]	*[lbf]*	[kN]	*[lbf]*	[kN]	*[lbf]*	[kN]	*[lbf]*	[kN]	*[lbf]*	[mm]	*[in]*
1	20,9	*4.706*	28.9	*6,493*	9.7	*2,172*	12.9	*2,896*	14.5	*3,258*		
2	39,1	*8.781*	53.9	*12,117*	18.0	*4,053*	24.0	*5,404*	27.0	*6,079*	95	*3,740*
3	56,3	*12.648*	77.6	*17,454*	26.0	*5,837*	34.6	*7,783*	38.9	*8,756*		
1	25,7	*5.775*	28.9	*6,493*	11.9	*2,665*	15.8	*3,554*	17.8	*3,998*		
2	47,9	*10.776*	53.9	*12,117*	22.1	*4,974*	29.5	*6,632*	33.2	*7,461*	113	*4,449*
3	69,0	*15.522*	77.6	*17,454*	31.9	*7,164*	42.5	*9,552*	47.8	*10,746*		
1	30,4	*6.844*	28.9	*6,493*	14.1	*3,159*	18.7	*4,212*	21.1	*4,738*		
2	56,8	*12.772*	53.9	*12,117*	26.2	*5,895*	35.0	*7,860*	39.3	*8,842*	131	*5,157*
3	81,8	*18.397*	77.6	*17,454*	37.8	*8,491*	50.4	*11,321*	56.7	*12,736*		
1	35,2	*7.914*	28.9	*6,493*	16.2	*3,653*	21.7	*4,870*	24.4	*5,479*		
2	65,7	*14.768*	53.9	*12,117*	30.3	*6,816*	40.4	*9,088*	45.5	*10,224*	148	*5,827*
3	94,6	*21.271*	77.6	*17,454*	43.7	*9,818*	58.2	*13,090*	65.5	*14,726*		
1	40,0	*8.983*	28.9	*6,493*	18.4	*4,146*	24.6	*5,528*	27.7	*6,219*		
2	74,6	*16.763*	53.9	*12,117*	34.4	*7,737*	45.9	*10,316*	51.6	*11,605*	166	*6,535*
3	107,4	*24.146*	77.6	*17,454*	49.6	*11,144*	66.1	*14,859*	74.4	*16,716*		
1	44,7	*10.053*	28.9	*6,493*	20.6	*4,640*	27.5	*6,186*	28.9	*6,493*		
2	83,4	*18.759*	53.9	*12,117*	38.5	*8,658*	51.4	*11,544*	53.9	*12,117*	184	*7,244*
3	120,2	*27.020*	77.6	*17,454*	55.5	*12,471*	74.0	*16,628*	77.6	*17,454*		
1	49,5	*11.122*	28.9	*6,493*	22.8	*5,133*	28.9	*6,493*	28.9	*6,493*		
2	92,3	*20.755*	53.9	*12,117*	42.6	*9,579*	53.9	*12,117*	53.9	*12,117*	201	*7,913*
3	133,0	*29.895*	77.6	*17,454*	61.4	*13,798*	77.6	*17,454*	77.6	*17,454*		
1	53,7	*12.081*	28.9	*6,493*	24.8	*5,576*	28.9	*6,493*	28.9	*6,493*		
2	100,3	*22.544*	53.9	*12,117*	46.3	*10,405*	53.9	*12,117*	53.9	*12,117*	219	*8,622*
3	144,4	*32.473*	77.6	*17,454*	66.7	*14,988*	77.6	*17,454*	77.6	*17,454*		

GENERAL PRINCIPLES:

- Characteristic values comply with the EN 1995:2014 standard in accordance with ETA-11/0030.
- According to EN 1995:2014 for shear characteristic values the contribution from the rope effect ($F_{ax,Rk}$ / 4) is considered. This is resulting in higher shear resistances compared to shear resistances calculated in accordance with CSA O86-14.
- Design values for wood-side are obtained from the following characteristic values:

$$R_d = R_k \cdot \text{DMF}$$

DMF: design modification factor based on k_{mod} as per Table 10 and for γ_M as per Table 11 (γ_M = 1.3). See "Background document" available at Rothoblaas.

Load case	Load Combination Principal Load	Load Combination Companion Load	Design Modification Factor DMF
1	1.4D	-	0.46
2	(1.25D or 0.9D) + 1.5L	1.0S or 0.4W	0.62 [1]
3	(1.25D or 0.9D) + 1.5S	1.0L or 0.4W	0.62
4	(1.25D or 0.9D) + 1.4W	0.5L or 0.5S	0.69
5	1.0D + 1.0E	0.5L or 0.25S	0.69

[1] If Live Load L is associated with long term loads such as storage, equipment areas etc., use 0,54.

- For the mechanical resistance values and the geometry of the screws, reference was made to ETA-11/0030.
- In the calculations, the density of the wood elements was considered equal to ρ_k = 370 kg/m^3 (S-P-F sawn lumber). For wood densities conversion (mean ovendry relative density to 5th-percentile density 12% MC wt & vol) see "Background document" available at Rothoblaas .
  Characteristic resistances can also be considered as valid for higher densities, for the purposes of safety.
- Values were calculated considering the threaded part as being completely inserted into the wood.
- Sizing and verification of the wooden elements and steel plates must be done separately.
- The shear characteristic resistances are calculated for screws inserted without pre-bored holes. In the case of screws inserted with pre-bored holes, greater resistance values can be obtained.
- For different calculation methods, the MyProject software is available free of charge (www.rothoblaas.com).
- The characteristic resistances were calculated using solid wood or glulam. In the case of joints with CLT elements, the resistance values may be different and should be calculated on the basis of the characteristics of the panel and the connection configuration.

Packaged quantities may vary.
Original text: Italian.
Reference unit of measurement: metric.

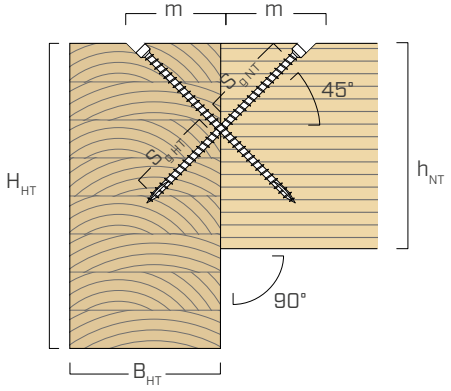
MINIMUM DISTANCES FOR CROSS SCREWS

			SCREWS INSERTED WITH AND WITHOUT PREDRILL				
d_1	**[mm]**		**5.3**	**5.6**	**7**(1)	**9**	**11**
	[in]		***0.21***	***0.23***	***0.28***	***0.36***	***0.44***
$a_{2,C}$	[mm]	**4·d**	22	23	21	36	44
	[in]		*0.866*	*0.906*	*0.827*	*1.417*	*1.732*
a_{CROSS}	[mm]	**1.5·d**	8	8	11	14	17
	[in]		*0.315*	*0.354*	*0.433*	*0.551*	*0.669*
e(2)	[mm]	**3.5 ·d**	19	20	25	32	39
	[in]		*0.748*	*0.787*	*0.984*	*1.260*	*1.535*

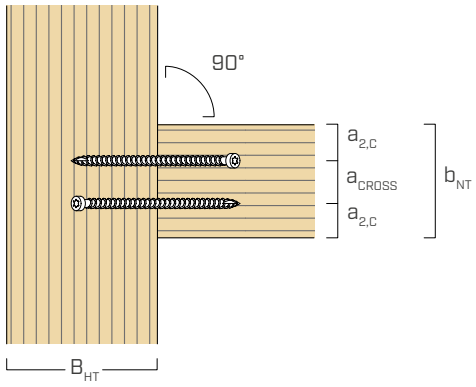
d_1		**[mm]**	**5.3**	**5.6**	**7**(1)	**9**	**11**
		[in]	***0.21***	***0.23***	***0.28***	***0.36***	***0.44***
d_v **(pre-drill)**		[mm]	3.5	3.5	4.0	5.0	6.0
		[in]	*0.138*	*0.138*	*0.157*	*0.197*	*0.236*

Recommended pre-drilling hole for connectors Ø11 L ≥ 400 mm.
(1) Minimum distance for a screw with diameter 7 is 3d instead of 4d in accordance with ETA-11/0030.
(2) The minimum distance "e" between two couples of connectors is equal to $e = a_2 - a_{2,CROSS}$ (5d - 1.5d = 3.5d)

SHEAR CONNECTION WITH CROSSED CONNECTORS - 1 PAIR

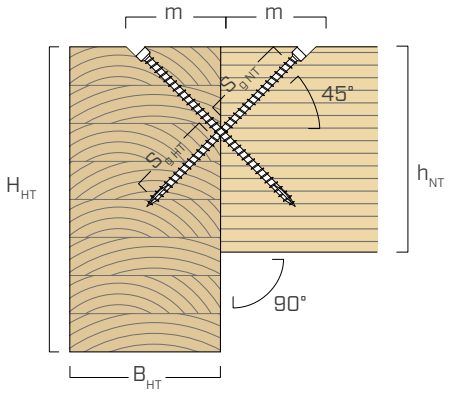


section

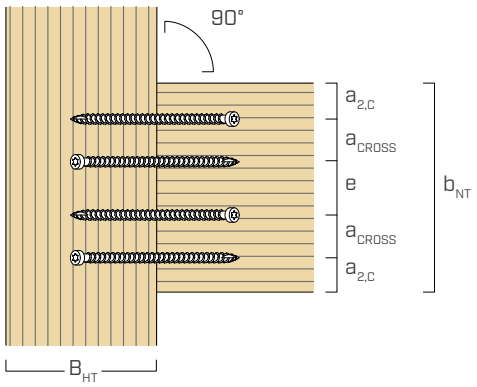


plan

SHEAR CONNECTION WITH CROSSED CONNECTORS - 2 OR MORE PAIRS



section



plan