VGS

FULLY THREADED SCREW WITH COUNTERSUNK OR HEXAGONAL HEAD

AC233
ESR-4645

BIT INCLUDED

MY PROJECT SOFTWARE

ETA-11/0030

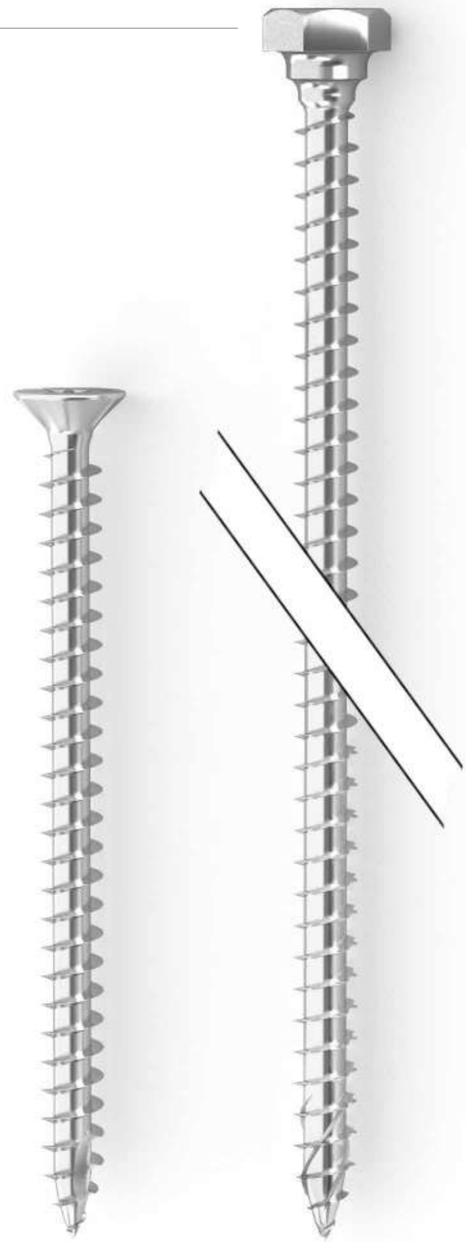
TENSION
Deep thread and high resistance steel ($f_{y,k}$ = 1000 N/mm^2) for excellent tensile performance. Approved for structural applications subject to stresses in any direction vs. the grain (α = 0° - 90°).

COUNTERSUNK OR HEXAGONAL HEAD
Countersunk head up to L = 600 mm, ideal for use on plates or for concealed reinforcements. Hexagonal head L > 600 mm to facilitate gripping with screwdriver.

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

9,0 | 11,0 | 13,0 mm L ≤ 600 mm

11,0 | 13,0 mm L > 600 mm



CHARACTERISTICS

FOCUS	45° connections, lifting and reinforcements
HEAD	countersunk with ribs for L ≤ 600 mm hexagonal for L > 600 mm
DIAMETER	9,0 | 11,0 | 13,0 mm
LENGTH	from 100 to 1200 mm

MATERIAL
Galvanized carbon steel.

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

Service classes 1 and 2.

TENSILE STRENGTH

Ideal for joints requiring high tensile or sliding strength. Can be used on steel plates in combination with the VGU washer.

TITAN V

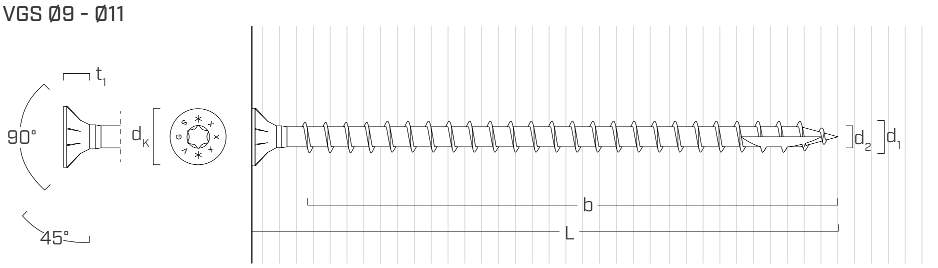
Values also tested, certified and calculated for fastening standard Rothoblaas plates.

Reinforcement perpendicular to the grain of a large glulam beam.

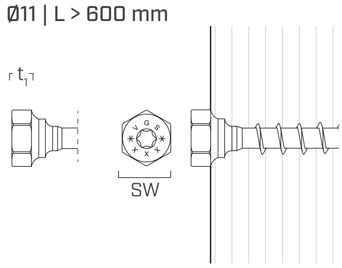
System for lifting and transport using WASP hook and VGS screw.

GEOMETRY AND MECHANICAL CHARACTERISTICS

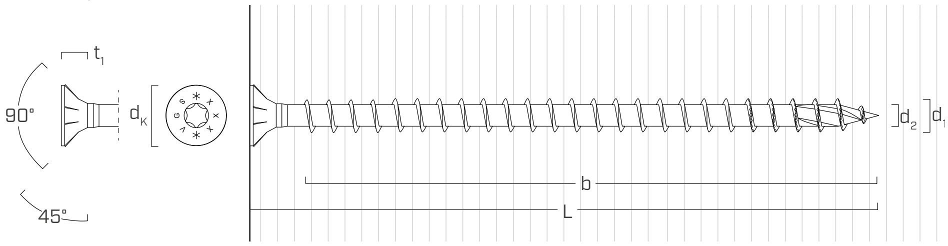
VGS Ø9 - Ø11



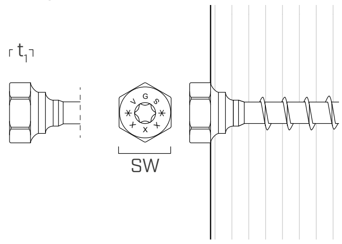
VGS Ø11 | L > 600 mm



VGS Ø13 | L ≤ 600 mm



VGS Ø13 | L > 600 mm



Nominal diameter	**d_1**	**[mm]**	**9**	**11** [L ≤ 600 mm]	**11** [L > 600 mm]	**13** [L ≤ 600 mm]	**13** [L > 600 mm]
Head diameter	d_K	[mm]	16,00	19,30	-	22,00	-
Wrench size	SW		-	-	SW17	-	SW19
Head thickness	t_1	[mm]	6,50	8,20	6,40	9,40	7,50
Tip diameter	d_2	[mm]	5,90	6,60		8,00	
Pre-drilling hole diameter(1)	d_V	[mm]	5,0	6,0		8,0	
Characteristic yield moment	$M_{y,k}$	[Nm]	27,2	45,9		70,9	
Characteristic withdrawal-resistance parameter(2)	$f_{ax,k}$	[N/mm²]	11,7	11,7		11,7	
Associated density	ρ_a	[kg/m³]	350	350		350,0	
Characteristic tensile strength	$f_{tens,k}$	[kN]	25,4	38,0		53,0	
Characteristic yield strength	$f_{y,k}$	[N/mm²]	1000	1000		1000	

(1) Pre-drilling valid for softwood.
(2) Valid for softwood - maximum density 440 kg/m³.
For applications with different materials or with high density please see ETA-11/0030.

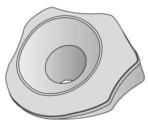
For VGS Ø13 screw a Ø8x80 predrill is recommended.

CODES AND DIMENSIONS

d1 [mm] [in]	CODE	L [mm]	L [in]	b [mm]	pcs
9 0.36 TX 40	VGS9100	100	4	90	25
	VGS9120	120	4 3/4	110	25
	VGS9140	140	5 1/2	130	25
	VGS9160	160	6 1/4	150	25
	VGS9180	180	7 1/8	170	25
	VGS9200	200	8	190	25
	VGS9220	220	8 5/8	210	25
	VGS9240	240	9 1/2	230	25
	VGS9260	260	10 1/4	250	25
	VGS9280	280	11	270	25
	VGS9300	300	11 3/4	290	25
	VGS9320	320	12 5/8	310	25
	VGS9340	340	13 3/8	330	25
	VGS9360	360	14 1/4	350	25
	VGS9380	380	15	370	25
	VGS9400	400	15 3/4	390	25
	VGS9440	440	17 1/4	430	25
	VGS9480	480	19	470	25
	VGS9520	520	20 1/2	510	25
11 0.44 TX 50	VGS11100	100	4	90	25
	VGS11125	125	4 15/16	115	25
	VGS11150	150	6	140	25
	VGS11175	175	6 7/8	165	25
	VGS11200	200	8	190	25
	VGS11225	225	8 7/8	215	25
	VGS11250	250	10	240	25
	VGS11275	275	10 7/8	265	25
	VGS11300	300	11 3/4	290	25
	VGS11325	325	12 3/4	315	25
	VGS11350	350	13 3/4	340	25
	VGS11375	375	14 3/4	365	25
	VGS11400	400	15 3/4	390	25
	VGS11450	450	17 3/4	440	25
	VGS11500	500	19 3/4	490	25
	VGS11550	550	21 5/8	540	25
	VGS11600	600	23 5/8	590	25
11 0.44 SW17 TX 50	VGS11700	700	27 1/2	680	25
	VGS11800	800	31 1/2	780	25

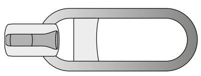
d1 [mm] [in]	CODE	L [mm]	L [in]	b [mm]	pcs
13 0.52 TX 50	VGS13100	100	4	90	25
	VGS13150	150	6	140	25
	VGS13200	200	8	190	25
	VGS13300	300	11 3/4	280	25
	VGS13400	400	15 3/4	380	25
	VGS13500	500	19 3/4	480	25
	VGS13600	600	23 5/8	580	25
13 0.52 SW 19 TX 50	VGS13700	700	27 1/2	680	25
	VGS13800	800	31 1/2	780	25
	VGS13900	900	35 1/2	880	25
	VGS131000	1000	39 3/8	980	25
	VGS131100	1100	43 5/16	1080	25
	VGS131200	1200	47 1/4	1180	25

VGU WASHER

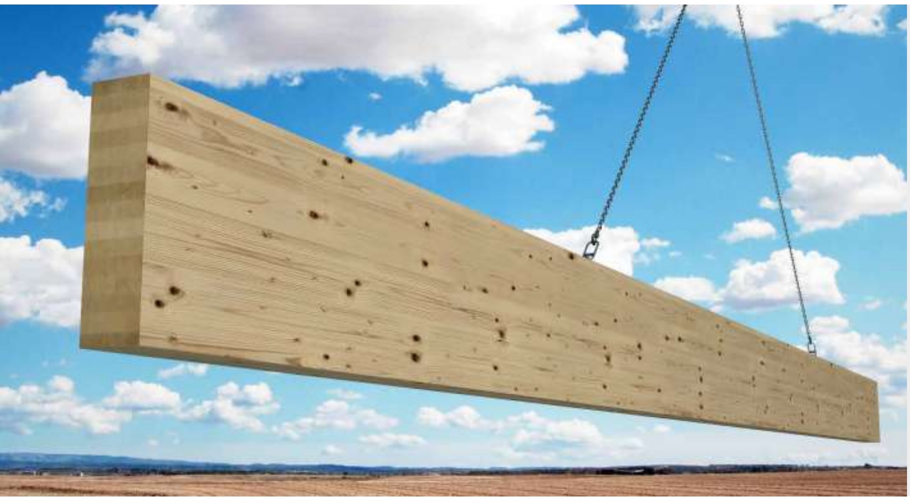


CODE	screw [mm]	pcs
VGU945	VGS Ø9	25
VGU1145	VGS Ø11	25
VGU1345	VGS Ø13	25

WASP HOOK



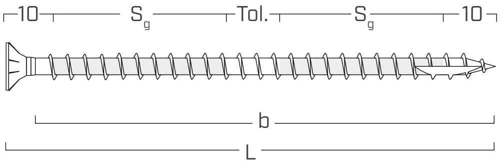
CODE	screw [mm]	max. capacity [kg]	pcs
WASP	VGS Ø11	1300	2
WASPL	VGS Ø13	5000	2



WASP

Various installation options with more types of screws for load conditions and different material.

EFFECTIVE THREAD USED IN CALCULATION

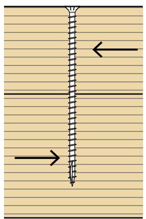


b = L - 10 mm — represents the entire length of the threaded part

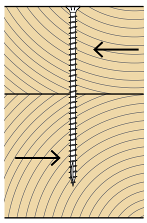
S_g = (L - 10 mm - 10 mm - Tol.)/ 2 — represents the partial length of the threaded part net of a laying tolerance (Tol.) of 10 mm

The timber to timber withdrawal, shear and sliding values were calculated considering the centre of gravity of the connector placed in correspondence with the shear plane.

MINIMUM DISTANCES FOR SHEAR LOADS [1]



Load-to-grain angle α = 0°

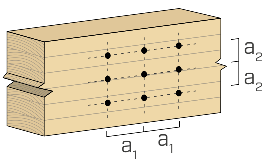


Load-to-grain angle α = 90°

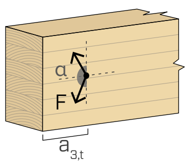
		α = 0°				α = 90°			
		SCREWS INSERTED WITH PRE-DRILLING HOLE				SCREWS INSERTED WITH PRE-DRILLING HOLE			
d_1	**[mm]**		**9**	**11**	**13**		**9**	**11**	**13**
a_1	[mm]	**5·d**	45	55	65	**4·d**	36	44	52
a_2	[mm]	**3·d**	27	33	39	**4·d**	36	44	52
$a_{3,t}$	[mm]	**12·d**	108	132	156	**7·d**	63	77	91
$a_{3,c}$	[mm]	**7·d**	63	77	91	**7·d**	63	77	91
$a_{4,t}$	[mm]	**3·d**	27	33	39	**7·d**	63	77	91
$a_{4,c}$	[mm]	**3·d**	27	33	39	**3·d**	27	33	39

		α = 0°				α = 90°			
		SCREWS INSERTED WITHOUT PRE-DRILLING HOLE				SCREWS INSERTED WITHOUT PRE-DRILLING HOLE			
d_1	**[mm]**		**9**	**11**	**13**		**9**	**11**	**13**
a_1	[mm]	**12·d**	108	132	156	**5·d**	45	55	65
a_2	[mm]	**5·d**	45	55	65	**5·d**	45	55	65
$a_{3,t}$	[mm]	**15·d**	135	165	195	**10·d**	90	110	130
$a_{3,c}$	[mm]	**10·d**	90	110	130	**10·d**	90	110	130
$a_{4,t}$	[mm]	**5·d**	45	55	65	**10·d**	90	110	130
$a_{4,c}$	[mm]	**5·d**	45	55	65	**5·d**	45	55	65

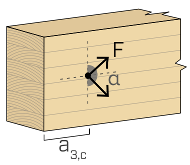
d = nominal screw diameter



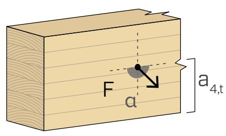
stressed end
-90° < α < 90°



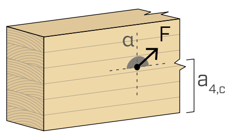
unloaded end
90° < α < 270°



stressed edge
0° < α < 180°



unload edge
180° < α < 360°

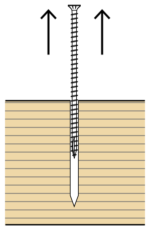


NOTES:

[1] Minimum distances are in accordance with EN 1995:2014 as per ETA-11/0030 considering a timber characteristic density of$\rho_k \leq 420$ kg/m^3.

- The minimum spacing for all steel-to-timber connections (a_1, a_2) can be multiplied by a coefficient of 0,7.
- The minimum spacing for all panel-to-timber connections(a_1, a_2) can be multiplied by a coefficient of 0,85.

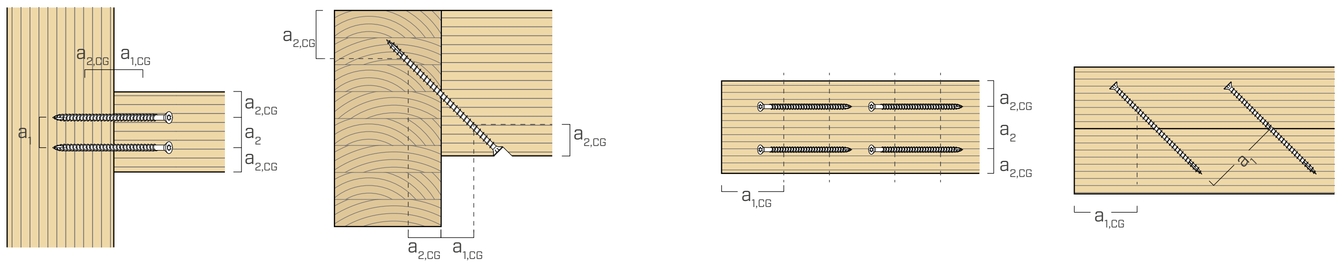
MINIMUM DISTANCES FOR AXIAL STRESSES [2]



			SCREWS INSERTED WITH AND WITHOUT PRE-DRILLING HOLE		
d_1	[mm]		9	11	13
a_1	[mm]	5·d	45	55	65
a_2	[mm]	5·d	45	55	65
$a_{2,LIM}$ (3)	[mm]	2.5·d	23	28	33
$a_{1,CG}$	[mm]	10·d	90	110	130
$a_{2,CG}$	[mm]	4·d	36	44	52
a_{CROSS}	[mm]	1.5·d	14	17	20

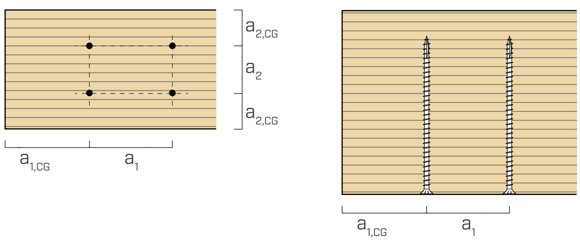
d = nominal screw diameter

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



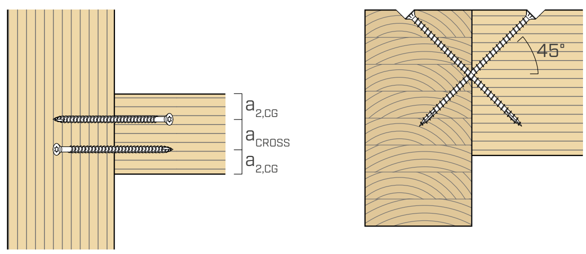
plan front plan front

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



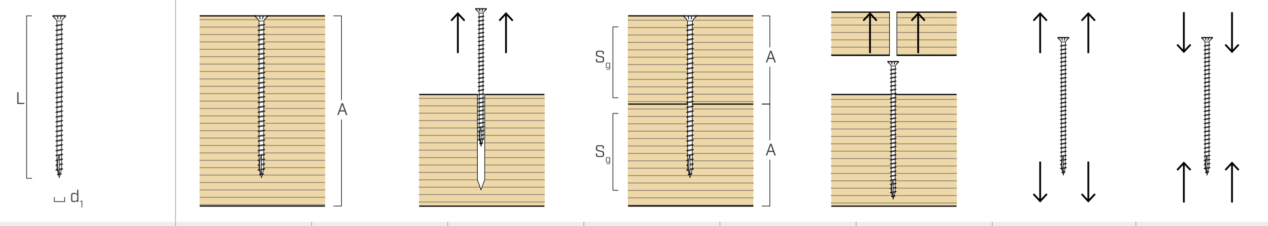
plan front

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.

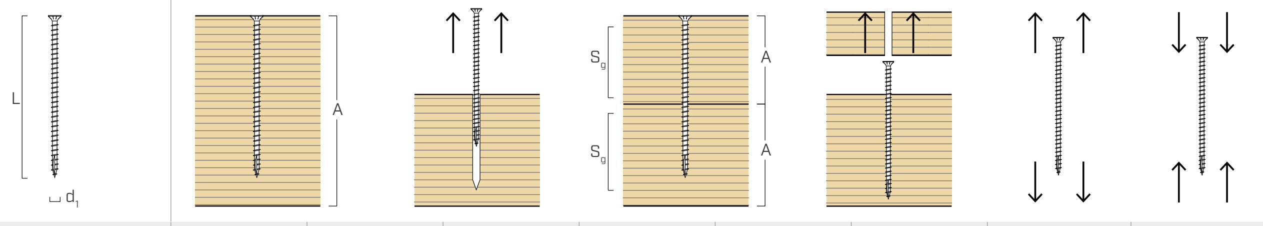
(3) The axial distance a_2 can be reduced down to 2,5 d_1 if for each connector a "joint surface" $a_1 \cdot a_2 = 25 \cdot d_1^2$ is maintained.

TENSION[1]/COMPRESSION[2]



geometry		total thread withdrawal[3]			partial thread withdrawal[3]			steel tension	instability
				timber			timber	steel	steel
d_1 [mm]	L [mm]	b [mm]	A_{min} [mm]	$R_{ax,k}$ [kN]	S_g [mm]	A_{min} [mm]	$R_{ax,k}$ [kN]	$R_{tens,k}$ [kN]	$R_{ki,k}$ [kN]
	100	90	110	10,23	35	55	3,98		
	120	110	130	12,50	45	65	5,11		
	140	130	150	14,77	55	75	6,25		
	160	150	170	17,05	65	85	7,39		
	180	170	190	19,32	75	95	8,52		
	200	190	210	21,59	85	105	9,66		
	220	210	230	23,87	95	115	10,80		
	240	230	250	26,14	105	125	11,93		
	260	250	270	28,41	115	135	13,07		
9	280	270	290	30,68	125	145	14,21	25,40	17,25
	300	290	310	32,96	135	155	15,34		
	320	310	330	35,23	145	165	16,48		
	340	330	350	37,50	155	175	17,61		
	360	350	370	39,78	165	185	18,75		
	380	370	390	42,05	175	195	19,89		
	400	390	410	44,32	185	205	21,02		
	440	430	450	48,87	205	225	23,30		
	480	470	490	53,41	225	245	25,57		
	520	510	530	57,96	245	265	27,84		
	100	90	110	12,50	35	55	4,86		
	125	115	135	15,97	48	68	6,60		
	150	140	160	19,45	60	80	8,33		
	175	165	185	22,92	73	93	10,07		
	200	190	210	26,39	85	105	11,81		
	225	215	235	29,86	98	118	13,54		
	250	240	260	33,34	110	130	15,28		
	275	265	285	36,81	123	143	17,01		
	300	290	310	40,28	135	155	18,75		
11	325	315	335	43,75	148	168	20,49	38,00	21,93
	350	340	360	47,22	160	180	22,22		
	375	365	385	50,70	173	193	23,96		
	400	390	410	54,17	185	205	25,70		
	450	440	460	61,11	210	230	29,17		
	500	490	510	68,06	235	255	32,64		
	550	540	560	75,00	260	280	36,11		
	600	590	610	81,95	285	305	39,59		
	700	680	710	94,45	335	355	46,53		
	800	780	810	108,34	385	405	53,48		

STATIC VALUES



geometry		TENSION[1]/COMPRESSION[2] total thread withdrawal[3]			partial thread withdrawal[3]			steel tension	instability
				timber			timber	steel	steel
d_1 [mm]	L [mm]	b [mm]	A_{min} [mm]	$R_{ax,k}$ [kN]	S_g [mm]	A_{min} [mm]	$R_{ax,k}$ [kN]	$R_{tens,k}$ [kN]	$R_{ki,k}$ [kN]
13	100	90	110	14,77	35	55	5,75	53,00	32,69
	150	140	160	22,98	60	80	9,85		
	200	190	210	31,19	85	105	13,95		
	300	280	310	45,96	135	155	22,16		
	400	380	410	62,38	185	205	30,37		
	500	480	510	78,79	235	255	38,58		
	600	580	610	95,21	285	305	46,78		
	700	680	710	111,62	335	355	54,99		
	800	780	810	128,04	385	405	63,20		
	900	880	910	144,45	435	455	71,41		
	1000	980	1010	160,87	485	505	79,61		
	1100	1080	1110	177,28	535	555	87,82		
	1200	1180	1210	193,70	585	605	96,03		

NOTES:

(1) 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 ($R_{tens,d}$).

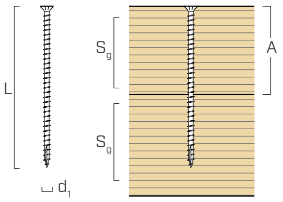
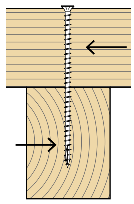
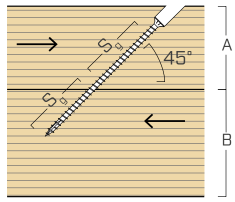
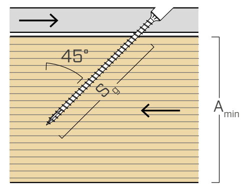
$$R_{ax,d} = min \begin{cases} \dfrac{R_{ax,k} \cdot k_{mod}}{\gamma_M} \\ \dfrac{R_{tens,k}}{\gamma_{M2}} \end{cases}$$

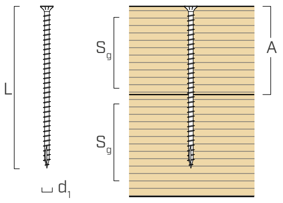
(2) The compression design strength of the connector is the lower between the timber-side design strength ($R_{ax,d}$) and the instability design strength ($R_{ki,k}$).

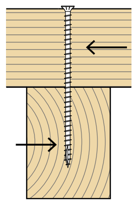
$$R_{ax,d} = min \begin{cases} \dfrac{R_{ax,k} \cdot k_{mod}}{\gamma_M} \\ \dfrac{R_{ki,k}}{\gamma_{M1}} \end{cases}$$

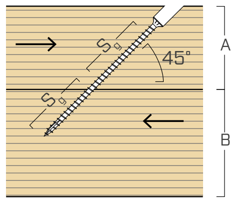
(3) The axial resistance of the thread to withdrawal was calculated considering a 90° angle between the fibres and the connector and for a effective thread length of b or S_g.

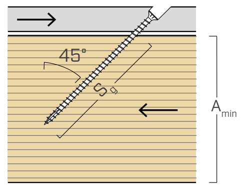
For intermediate values of S_g it is possible to linearly interpolate.

			SHEAR		SLIDING[4]						
geometry			timber-to-timber		timber-to-timber[5]			steel-to-timber[5]			
											
							timber			timber	steel
d_1 [mm]	L [mm]	S_g [mm]	A_{min} [mm]	$R_{V,k}$ [kN]	A_{min} [mm]	B_{min} [mm]	$R_{V,k}$ [kN]	S_g [mm]	A_{min} [mm]	$R_{V,k}$ [kN]	$R_{tens,k\ 45°}$[6] [kN]
	100	35	50	3,53	40	55	2,81	80	75	6,43	
	120	45	60	4,19	50	60	3,62	100	90	8,04	
	140	55	70	4,81	55	70	4,42	120	105	9,64	
	160	65	80	5,10	60	75	5,22	140	120	11,25	
	180	75	90	5,38	70	85	6,03	160	135	12,86	
	200	85	100	5,67	75	90	6,83	180	145	14,46	
	220	95	110	5,95	85	100	7,63	200	160	16,07	
	240	105	120	6,23	90	105	8,44	220	175	17,68	
	260	115	130	6,50	100	110	9,24	240	190	19,29	
9	280	125	140	6,50	105	120	10,04	260	205	20,89	17,96
	300	135	150	6,50	110	125	10,85	280	220	22,50	
	320	145	160	6,50	120	135	11,65	300	230	24,11	
	340	155	170	6,50	125	140	12,46	320	245	25,71	
	360	165	180	6,50	135	145	13,26	340	260	27,32	
	380	175	190	6,50	140	155	14,06	360	275	28,93	
	400	185	200	6,50	145	160	14,87	380	290	30,54	
	440	205	220	6,50	160	175	16,47	420	315	33,75	
	480	225	240	6,50	175	190	18,08	460	345	36,96	
	520	245	260	6,50	190	205	19,69	500	375	40,18	
	100	35	50	4,27	40	55	3,44	80	75	7,86	
	125	48	63	5,40	50	65	4,67	105	95	10,31	
	150	60	75	6,40	60	75	5,89	130	110	12,77	
	175	73	88	7,05	70	80	7,12	155	130	15,22	
	200	85	100	7,48	80	90	8,35	180	145	17,68	
	225	98	113	7,92	85	100	9,58	205	165	20,13	
	250	110	125	8,35	95	110	10,80	230	185	22,59	
	275	123	138	8,79	105	115	12,03	255	200	25,04	
	300	135	150	9,06	115	125	13,26	280	220	27,50	
11	325	148	163	9,06	120	135	14,49	305	235	29,96	26,87
	350	160	175	9,06	130	145	15,71	330	255	32,41	
	375	173	188	9,06	140	155	16,94	355	270	34,87	
	400	185	200	9,06	150	160	18,17	380	290	37,32	
	450	210	225	9,06	165	180	20,63	430	325	42,23	
	500	235	250	9,06	185	195	23,08	480	360	47,14	
	550	260	275	9,06	200	215	25,54	530	395	52,05	
	600	285	300	9,06	220	230	27,99	580	430	56,96	
	700	335	350	9,06	255	265	32,90	-	-	-	
	800	385	400	9,06	290	305	37,81	-	-	-	









			SHEAR		SLIDING[4]						
geometry			timber-to-timber		timber-to-timber[5]			steel-to-timber[5]			
							timber			timber	steel
d_1 [mm]	L [mm]	S_g [mm]	A_{min} [mm]	$R_{V,k}$ [kN]	A_{min} [mm]	B_{min} [mm]	$R_{V,k}$ [kN]	S_g [mm]	A_{min} [mm]	$R_{V,k}$ [kN]	$R_{tens,k\ 45°}$[6] [kN]
	100	35	50	4,87	45	55	4,06	80	75	9,29	
	150	60	75	7,61	60	75	6,96	130	110	15,09	
	200	85	100	9,46	80	90	9,87	180	145	20,89	
	300	135	150	11,51	115	125	15,67	280	220	32,50	
	400	185	200	11,94	150	160	21,47	380	290	44,11	
	500	235	250	11,94	185	195	27,28	480	360	55,71	
13	600	285	300	11,94	220	230	33,08	580	430	67,32	37,48
	700	335	350	11,94	255	265	38,88	-	-	-	
	800	385	400	11,94	290	305	44,69	-	-	-	
	900	435	450	11,94	325	340	50,49	-	-	-	
	1000	485	500	11,94	360	375	56,30	-	-	-	
	1100	535	550	11,94	395	410	62,10	-	-	-	
	1200	585	600	11,94	430	445	67,90	-	-	-	

NOTES:

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

(5) The design sliding resistance of the connector is either the timber-side design resistance ($R_{V,d}$) and the steel design resistance ($R_{tens,d\ 45°}$), whichever is lower.

$$R_{V,d} = min \begin{cases} \dfrac{R_{V,k} \cdot k_{mod}}{\gamma_M} \\ \dfrac{R_{tens,k\ 45°}}{\gamma_{M2}} \end{cases}$$

To properly create the joint, the head of the connector must be completely inserted in the steel plate.

(6) The connector tensile strength was calculated considering a 45° angle between the fibres and the connector.

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:

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

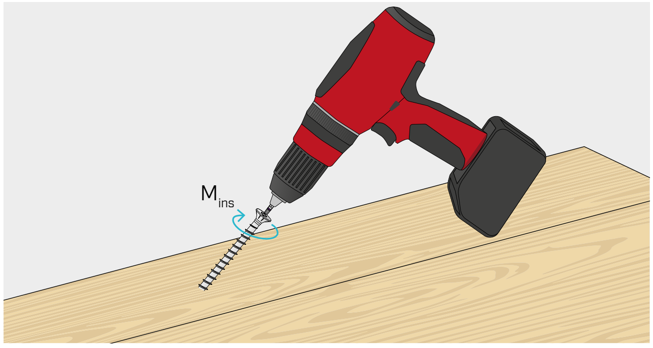
The coefficients γ_M and k_{mod} should be taken according to the current regulations used for the calculation.

- For the mechanical resistance values and the geometry of the screws, reference was made to ETA-11/0030.
- For the calculation process a timber characteristic density ρ_k = 385 kg/m^3 has been considered.
- Dimensioning and verification of timber elements and steel plates must be carried out separately.
- The characteristic shear resistances are calculated for screws inserted without pre-drilling hole. In the case of screws inserted with pre-drilling hole, greater resistance values can be obtained.
- The timber to timber withdrawal, shear and sliding values were calculated considering the centre of gravity of the connector placed in correspondence with the shear plane.

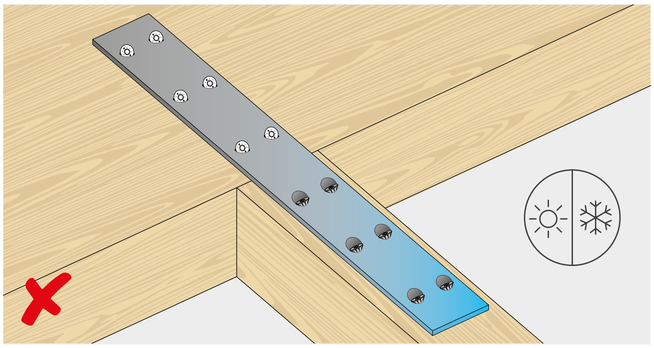
TIMBER-TO-TIMBER APPLICATION

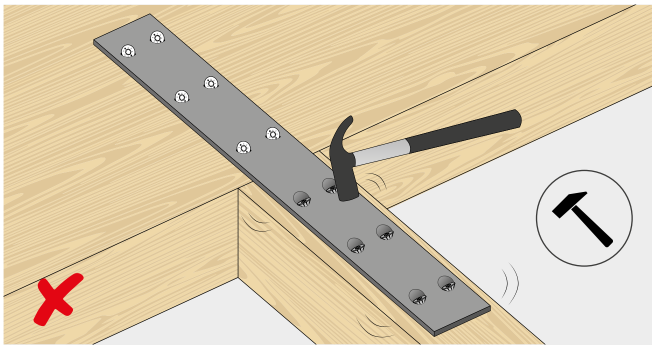
RECOMMENDED INSERTION MOMENT: M_{ins}

VGS Ø9	M_{ins} = 20 Nm
VGS Ø11 L < 400 mm	M_{ins} = 30 Nm
VGS Ø11 L ≥ 400 mm	M_{ins} = 40 Nm
VGS Ø13	M_{ins} = 50 Nm

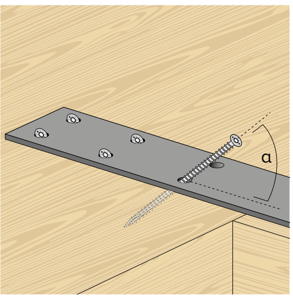


STEEL-TO-TIMBER APPLICATION

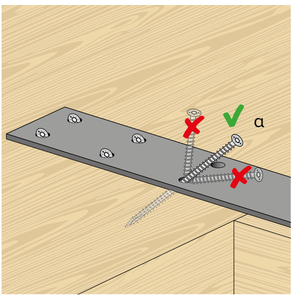

Avoid dimensional changes to the metal.


Avoid accidental stress during installation.

A. SHAPED PLATE WITH COUNTERSUNK HOLES

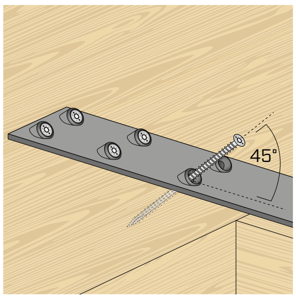


Respect the insertion angle (e.g. adopting a template).

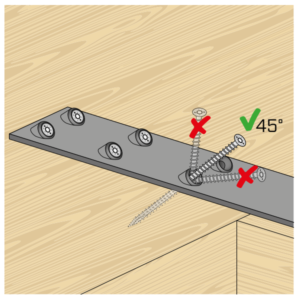


Avoid bending.

B. VGU WASHER

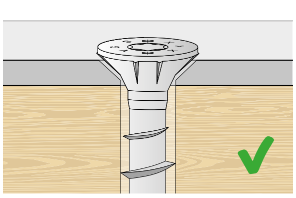


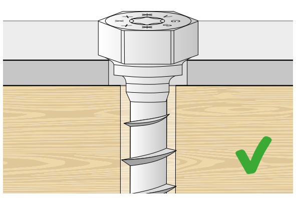
Respect the 45° insertion angle.



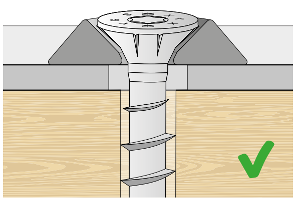
Avoid bending.

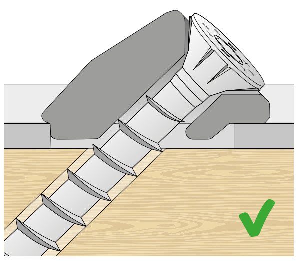
A. SHAPED PLATE


Countersunk hole.

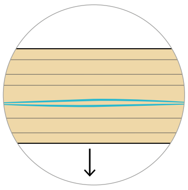

Cylindrical hole.

B. WASHERS

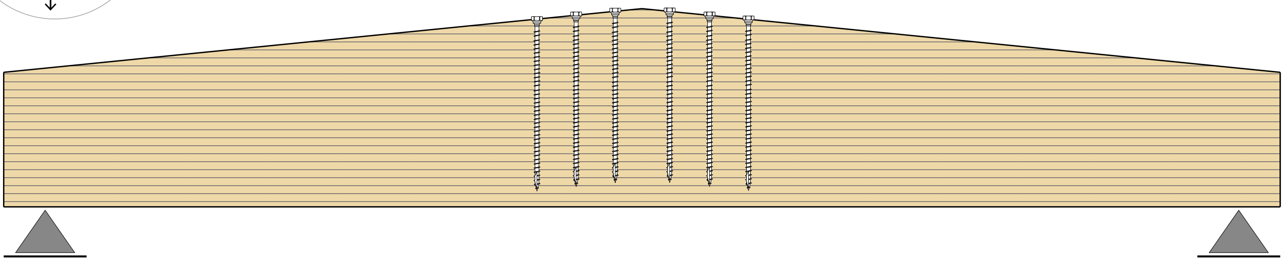

Flared washer.

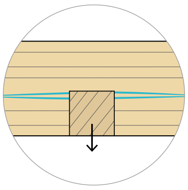

VGU washer.

APPLICATION EXAMPLES

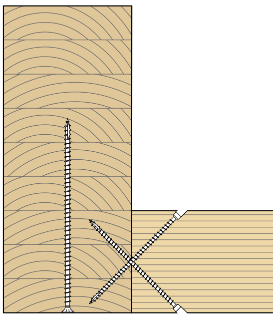


TAPERED BEAMS
apex tension reinforcement perpendicular to grain

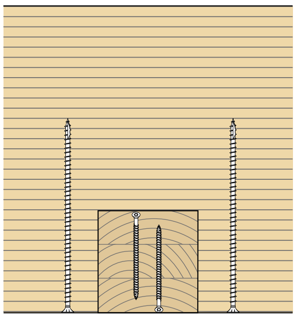




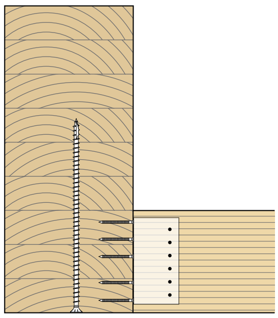
HANGING LOAD
tension reinforcement perpendicular to grain



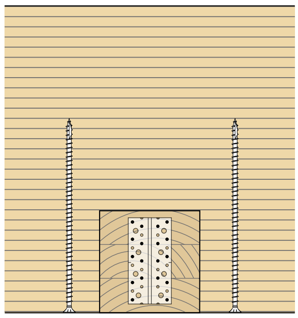
section



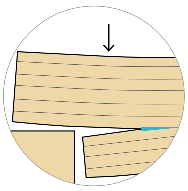
front



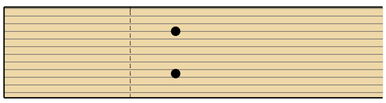
section



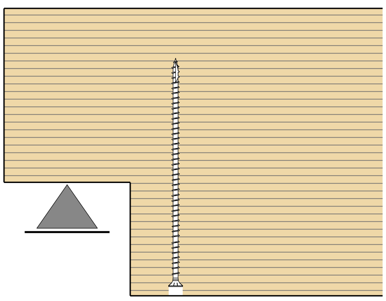
front



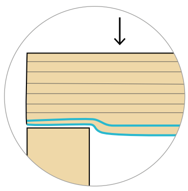
NOTCH
tension reinforcement perpendicular to grain



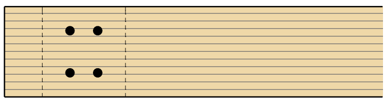
plan



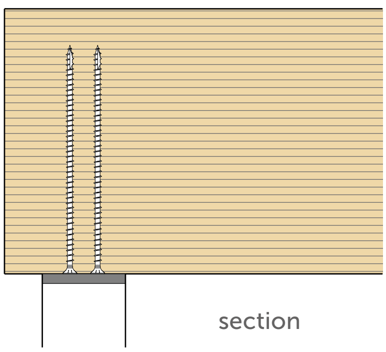
section



SUPPORT
compression reinforcement perpendicular to grain



plan

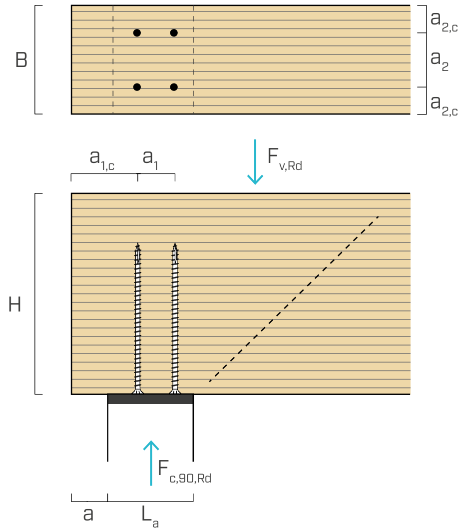


section

CALCULATION EXAMPLES: REINFORCEMENT OF BEAM WITH COMPRESSION PERPENDICULAR TO THE FIBRES

MY PROJECT SOFTWARE

PROJECT DATA	
B = 220 mm	$F_{v,Rd}$ = 158 kN
H = 560 mm	$F_{c,90,Rd}$ = 158 kN
a = 25 mm	Service class = 1
L_a = 200 mm	Load duration = medium
GL24h Glulam (ρ_k = 385 kg/m^3)	



SHEAR VERIFICATION OF SUPPORT (EN 1995:2014) : $\tau_d \leq f_{v,d}$

$$\tau_d = \frac{1{,}5 \cdot F_{v,Rd}}{B \cdot H}$$

τ_d = 1,92 N/mm^2
$f_{v,k}$ = 3,50 N/mm^2

EN 1995:2014
k_{mod} = 0,8
γ_M = 1,25
$f_{v,d}$ = 2,24 N/mm^2

$\tau_d \leq f_{v,d}$ 1,92 < 2,24 N/mm^2
verification passed

Italy - NTC 2018
k_{mod} = 0,8
γ_M = 1,45
$f_{v,d}$ = 1,93 N/mm^2

$\tau_d \leq f_{v,d}$ 1,92 < 1,93 N/mm^2
verification passed

PERPENDICULAR COMPRESSION VERIFICATION OF SUPPORT-BEAM WITHOUT REINFORCEMENT (EN 1995:2014) : $\sigma_{c,90,d} \leq k_{c,90} \cdot f_{c,90,d}$

$$l_{ef,1} = L_a + a + 30$$

$$\sigma_{c,90,d} = \frac{F_{v,Rd}}{B \cdot l_{ef,1}}$$

$l_{ef,1}$ = 255 mm
$\sigma_{c,90,d}$ = 2,82 N/mm^2
$k_{c,90}$ = 1,75
$f_{c,90,k}$ = 2,50 N/mm^2

EN 1995:2014
k_{mod} = 0,8
γ_M = 1,25
$f_{c,90,d}$ = 1,60 N/mm^2

$\sigma_{c,90,d} \leq k_{c,90} \cdot f_{c,90,d}$ 2,82 < 2,80 N/mm^2
verification not passed
REQUIRES REINFORCEMENT

Italy - NTC 2018
k_{mod} = 0,8
γ_M = 1,45
$f_{c,90,d}$ = 1,38 N/mm^2

$\sigma_{c,90,d} \leq k_{c,90} \cdot f_{c,90,d}$ 2,82 < 2,41 N/mm^2
verification not passed
REQUIRES REINFORCEMENT

PERPENDICULAR COMPRESSION VERIFICATION OF SUPPORT - BEAM WITH REINFORCEMENT (EN 1995:2014 and ETA-11/0030) : $F_{c,90,Rd} \leq R_{c,90,Rd}$

$$R_{c,90,Rd} = min \begin{cases} k_{c,90} \cdot B \cdot l_{ef,1} \cdot f_{c,90d} + n \cdot R_{ax,Rd} \\ B \cdot l_{ef,2} \cdot f_{c,90d} \end{cases}$$

REINFORCEMENT CONNECTOR SELECTION

VGS 9 x 360 mm
L = 360 mm
b = 350 mm

$n_0 = 2$
$n_{90} = 2$
$n = n_0 \cdot n_{90} = 4$

$$l_{ef,2} = L + (n_0 - 1) \cdot a_1 + min\ (a_{1,CG}; L)$$

$l_{ef,2}$ = 555 mm

The minimum distances for placement of the connectors are found in the table on p.191.
In this example it is assumed a_1 = 50 mm and $a_{1,CG}$ = 145 mm.

$$R_{ax,Rd} = min \begin{cases} R_{ax,d} = \dfrac{R_{ax,\alpha,Rk} \cdot k_{mod}}{\gamma_M} \\ R_{ki,d} = \dfrac{R_{ki,k}}{\gamma_{M1}} \end{cases}$$

$R_{ax,90°,Rk}$ = 39,78 kN
$R_{ki,k}$ = 17,25 kN

The compression resistance of the connectors calculated here is shown in the table on p.192.

EN 1995:2014
k_{mod} = 0,8
γ_M = 1,3
γ_{M1} = 1,00
$R_{ax,90°,Rd}$ = 24,48 kN
$R_{ki,d}$ = 17,25 kN
$R_{ax,Rd}$ = 17,25 kN

Italy - NTC 2018
k_{mod} = 0,8
γ_M = 1,5
γ_{M1} = 1,05
$R_{ax,90°,Rd}$ = 21,22 kN
$R_{ki,d}$ = 16,43 kN
$R_{ax,Rd}$ = 16,43 kN

$$R_{c,90,Rd} = min \begin{cases} k_{c,90} \cdot B \cdot l_{ef,1} \cdot f_{c,90d} + n \cdot R_{ax,Rd} \\ B \cdot l_{ef,2} \cdot f_{c,90d} \end{cases}$$

EN 1995:2014:

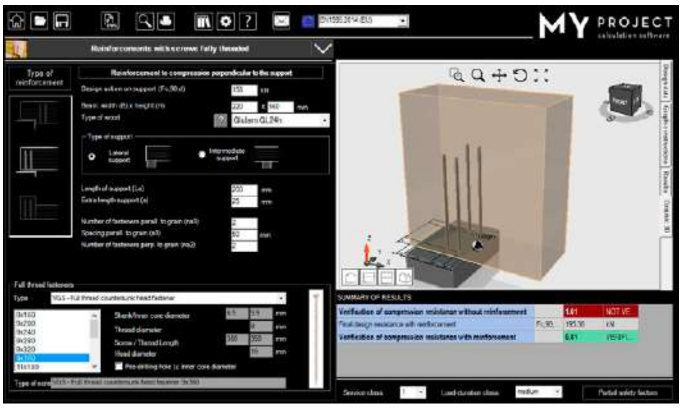
$R_{c,90,Rd}$ = 195,36 kN

$F_{c,90,Rd} \leq R_{c,90,Rd}$ — 158 < 195,36 kN
verification passed

Italy - NTC 2018:

$R_{c,90,Rd}$ = 168,41 kN

$F_{c,90,Rd} \leq R_{c,90,Rd}$ — 158 < 168,41 kN
verification passed



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