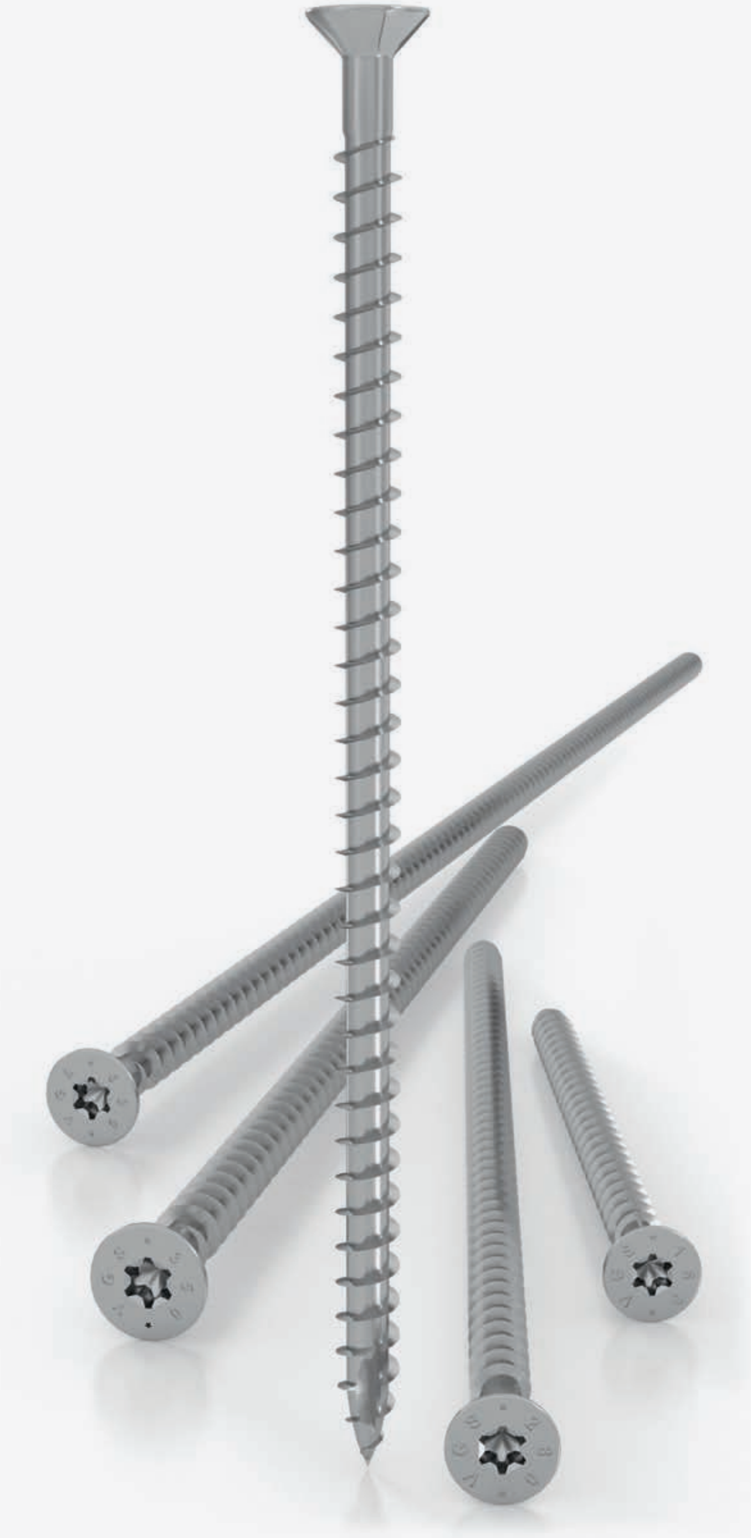
VGS

ETA 11/0030

Total thread connector with countersunk head

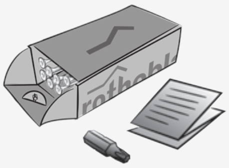
Carbon steel with white galvanic zinc coating

software myProject



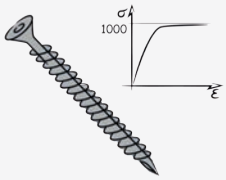
PACKAGING

Box + CE paper + BIT



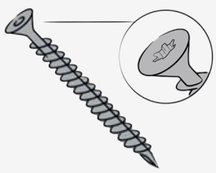
SPECIAL STEEL

Deep thread and high-resistance steel ($f_{y,k}$ = 1000 N/mm^2) for excellent tensile performance



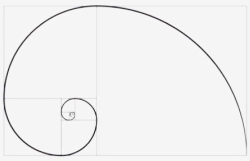
COUNTERSUNK HEAD

Countersunk head for use on steel plates



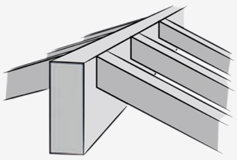
DIAMETERS Ø9 and Ø11

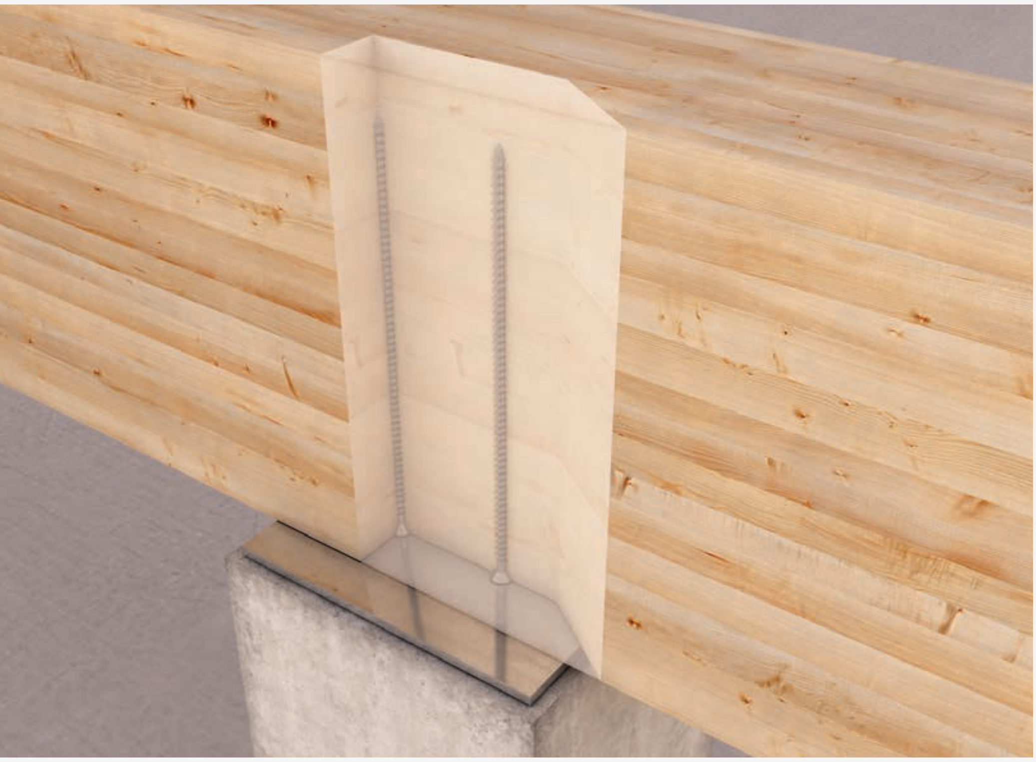
Optimise the minimum dimensions of the beams to be joined



FIELDS OF USE

Solid-wood, glulam, X-Lam, LVL, wood-based-panel joints, reinforcements and couplings. Service classes 1 and 2





STEEL – WOOD

The use of the connector inclined at 45° in combination with a steel plate guarantees high sliding resistance and rigidity of the joint

LIFTING

The connector is ideal for lifting and transporting wood elements, thanks to the geometry of the head and the high-performance thread with excellent tensile strength

REINFORCEMENT

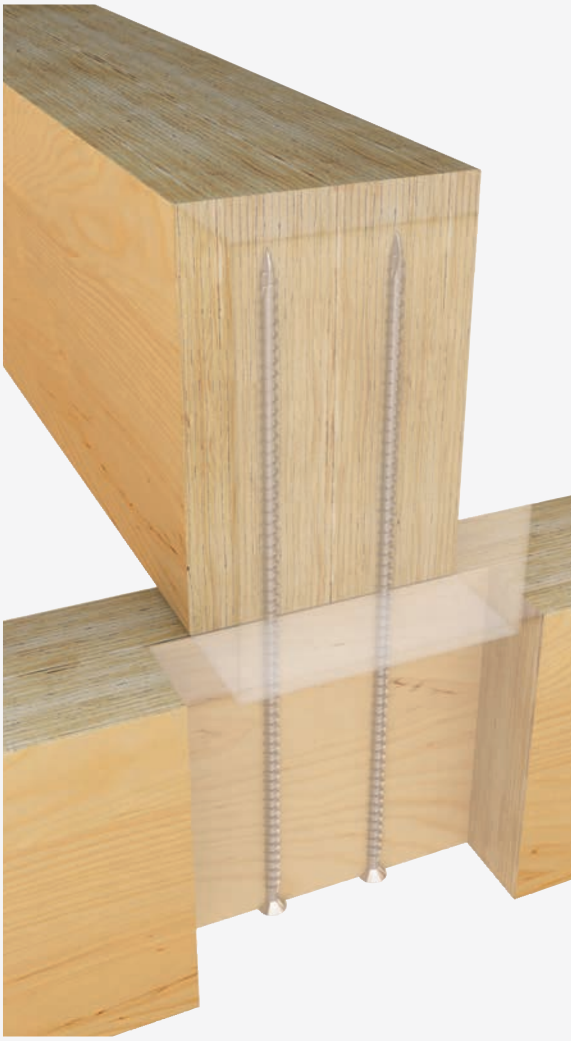
The total thread and head geometry, in combination with a steel plate, make it possible to avoid crushing the wood grain due to perpendicular compres-sion

Applications

Fastening of wood beams hanging from a steel beam

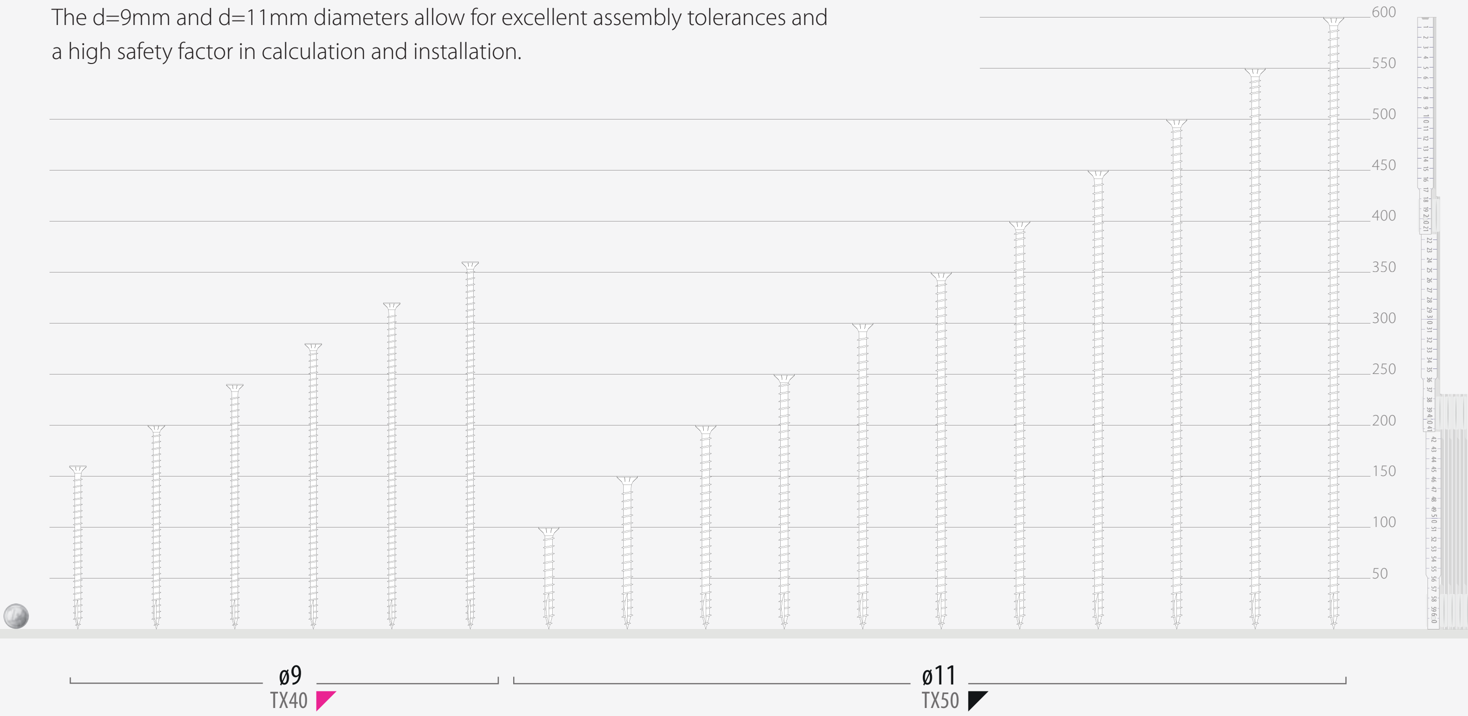
Fastening of LVL wood beams

Retractable junction for large beams with 11 mm diameter connectors

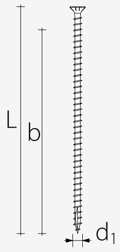


Range

The countersunk head allows for fastenings coupled with steel plates or hooks. The d=9mm and d=11mm diameters allow for excellent assembly tolerances and a high safety factor in calculation and installation.

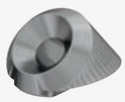


Codes and dimensions



d_1 [mm]	code	L [mm]	b [mm]	pcs/pckg
9 *TX40*	**VGS9160**	160	150	25
	VGS9200	200	190	
	VGS9240	240	230	
	VGS9280	280	270	
	VGS9320	320	310	
	VGS9360	360	350	
11 *TX50*	**VGS11100**	100	90	25
	VGS11150	150	140	
	VGS11200	200	190	
	VGS11250	250	240	
	VGS11300	300	290	
	VGS11350	350	340	
	VGS11400	400	390	
	VGS11450	450	440	
	VGS11500	500	490	
	VGS11550	550	540	
	VGS11600	600	590	

Upon request, the nanocoating version is also available for corrosion class C5.

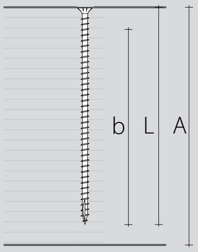


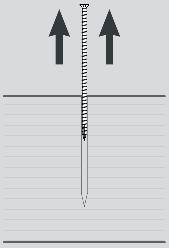
d_1 VGS	code	d_1 [mm]	d_K [mm]	D [mm]	L [mm]	H [mm]	h_1 [mm]	pcs/pckg
9	**HUS945**	9,5	18	25	35	20	3	25

Carpenter statics

ALLOWABLE VALUES
DIN 1052:1988

THREAD WITHDRAWAL N_{adm}

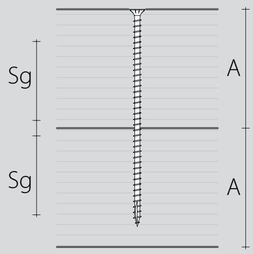


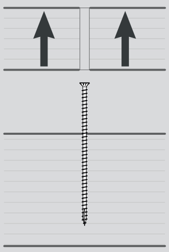


TOTAL THREAD WITHDRAWAL N_{adm}

d_1 [mm]	L [mm]	b [mm]	A_{min} [mm]	N_{adm}
9	**160**	150	170	675 kg
	200	190	210	855 kg
	240	230	250	1035 kg
	280	270	290	1215 kg
	320	310	330	1277 kg (1)
	360	350	370	1277 kg (1)

d_1 [mm]	L [mm]	b [mm]	A_{min} [mm]	N_{adm}
11	**100**	90	110	495 kg
	150	140	160	770 kg
	200	190	210	1045 kg
	250	240	260	1320 kg
	300	290	310	1595 kg
	350	340	360	1598 kg (1)
	400	390	410	1598 kg (1)
	450	440	460	1598 kg (1)
	500	490	510	1598 kg (1)
	550	540	560	1598 kg (1)
	600	590	610	1598 kg (1)





PARTIAL THREAD WITHDRAWAL N_{adm}

d_1 [mm]	L [mm]	s_g [mm]	A_{min} [mm]	N_{adm}
9	**160**	65	85	293 kg
	200	85	105	383 kg
	240	105	125	473 kg
	280	125	145	563 kg
	320	145	165	653 kg
	360	165	185	743 kg

d_1 [mm]	L [mm]	b [mm]	A_{min} [mm]	N_{adm}
11	**100**	35	55	193 kg
	150	60	80	330 kg
	200	85	105	468 kg
	250	110	130	605 kg
	300	135	155	743 kg
	350	160	180	880 kg
	400	185	205	1018 kg
	450	210	230	1155 kg
	500	235	255	1293 kg
	550	260	280	1430 kg
	600	285	305	1568 kg

CALCULATION FORMULAS - EXTRACTION DIN 1052-2:1988

WOOD-WOOD

$N_{adm} = 0{,}5 \cdot s_g \cdot d_1$

d_1 [mm]
s_g [mm]
N_{adm} [kg]

EXAMPLE WOOD-WOOD

VGS 11 x 400 mm

$d_1 = 11$ mm
$s_g = 185$ mm

$N_{adm} = 0{,}5 \cdot s_g \cdot d_1$
$N_{adm} = 0{,}5 \cdot 185 \cdot 11 = 1018$ kg

NOTE

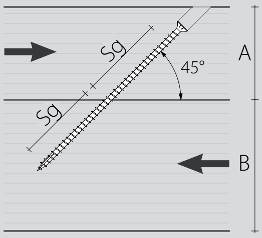
- Allowable values in accordance with DIN 1052:1988.
- The allowable shear values are calculated considering a fixing length of 8 d_1 with the exception of (*).
- The allowable extraction values are calculated considering the threaded part (b or s_g) as being completely inserted into the wood.

(1) Reaching tensile strength for steel failure.
(2) To properly create the joint, the head of the connector must be completely inserted in the steel plate.

Carpenter statics

ALLOWABLE VALUES
DIN 1052:1988

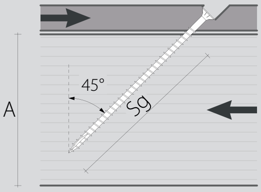
SLIDING V_{adm}



WOOD - WOOD

d_1 [mm]	L [mm]	s_g [mm]	A_{min} [mm]	B_{min} [mm]	V_{adm}
9	**160**	65	60	75	207 kg
	200	85	75	90	270 kg
	240	105	90	105	334 kg
	280	125	105	120	398 kg
	320	145	120	135	461 kg
	360	165	135	145	525 kg

d_1 [mm]	L [mm]	s_g [mm]	A_{min} [mm]	B_{min} [mm]	V_{adm}
11	**100**	35	40	55	136 kg
	150	60	60	75	233 kg
	200	85	80	90	331 kg
	250	110	95	110	428 kg
	300	135	115	125	525 kg
	350	160	130	145	622 kg
	400	185	150	160	719 kg
	450	210	165	180	817 kg
	500	235	185	195	914 kg
	550	260	200	215	1011 kg
	600	285	220	230	1108 kg

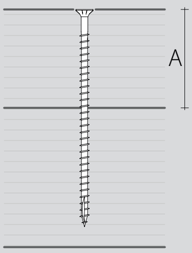


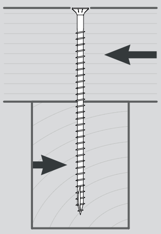
STEEL - WOOD (2)

d_1 [mm]	L [mm]	s_g [mm]	A_{min} [mm]	V_{adm}
9	**160**	140	120	445 kg
	200	180	145	573 kg
	240	220	175	700 kg
	280	260	205	827 kg
	320	300	230	903 kg (1)
	360	340	260	903 kg (1)

d_1 [mm]	L [mm]	s_g [mm]	A_{min} [mm]	V_{adm}
11	**100**	80	75	311 kg
	150	130	110	506 kg
	200	180	145	700 kg
	250	230	185	894 kg
	300	280	220	1089 kg
	350	330	255	1130 kg (1)
	400	380	290	1130 kg (1)
	450	430	325	1130 kg (1)
	500	480	360	1130 kg (1)
	550	530	395	1130 kg (1)
	600	580	430	1130 kg (1)

SHEAR V_{adm}





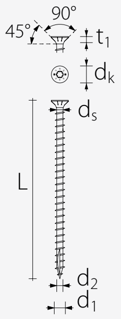
WOOD - WOOD

d_1 [mm]	L [mm]	s_g [mm]	A [mm]	V_{adm}
9	**160**	65*	80	138 kg
	200	85	100	138 kg
	240	105	120	138 kg
	280	125	140	138 kg
	320	145	160	138 kg
	360	165	180	138 kg

d_1 [mm]	L [mm]	s_g [mm]	A [mm]	V_{adm}
11	**100**	35*	50	206 kg
	150	60*	75	206 kg
	200	85*	100	206 kg
	250	110	125	206 kg
	300	135	150	206 kg
	350	160	175	206 kg
	400	185	200	206 kg
	450	210	225	206 kg
	500	235	250	206 kg
	550	260	275	206 kg
	600	285	300	206 kg

Geometry and minimum distances

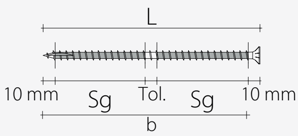
GEOMETRY AND MECHANICAL CHARACTERISTICS



VGS CONNECTOR			
Nominal diameter	**d_1 [mm]**	**9**	**11**
Head diameter	d_K [mm]	16,00	19,30
Tip diameter	d_2 [mm]	5,90	6,60
Shank diameter	d_S [mm]	6,50	7,70
Head thickness	t_1 [mm]	6,50	8,20
Pre-bored hole diameter *	d_V [mm]	5,0	6,0
Characteristic yield moment	$M_{y,k}$ [Nmm]	27244,1	45905,4
Characteristic extraction-resistance parameter	$f_{ax,k}$ [N/mm^2]	11,7	11,7
Characteristic tensile strength	$f_{tens,k}$ [kN]	25,4	38,0
Characteristic yield strength	$f_{y,k}$ [N/mm^2]	1000	1000

(*) Pre-bored hole required for connectors with Ø11 ≥ 400 mm

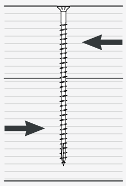
EFFECTIVE THREAD USED IN CALCULATION



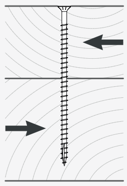
b = L - 10 mm represents the entire length of the threaded part.
$\mathbf{s_g}$ = (L - 10 mm - 10 mm - Tol.) / 2 represents the partial length of the threaded part net of a laying tolerance (Tol.) of 10 mm.

The wood-wood 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.

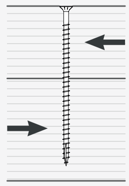
MINIMUM DISTANCES FOR SHEAR LOADS [(1)]



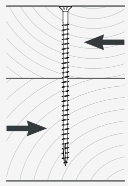
Angle between strength and grain α = 0°



Angle between strength and grain α = 90°

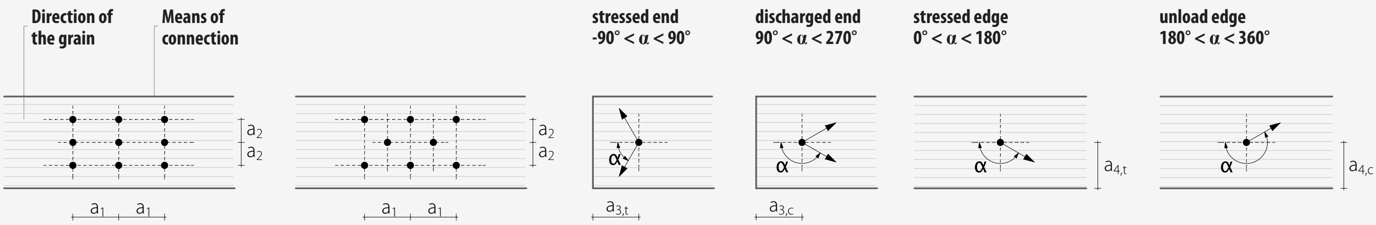


Angle between strength and grain α = 0°



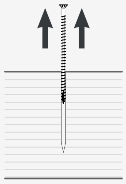
Angle between strength and grain α = 90°

		SCREWS INSERTED WITHOUT PRE-BORED HOLES				SCREWS INSERTED WITH PRE-BORED HOLES			
		Angle between strength and grain α = 0°		Angle between strength and grain α = 90°		Angle between strength and grain α = 0°		Angle between strength and grain α = 90°	
		9	**11**	**9**	**11**	**9**	**11**	**9**	**11**
a_1	[mm]	108	132	45	55	45	55	36	44
a_2	[mm]	45	55	45	55	27	33	36	44
$a_{3,t}$	[mm]	135	165	90	110	108	132	63	77
$a_{3,c}$	[mm]	90	110	90	110	63	77	63	77
$a_{4,t}$	[mm]	45	55	90	110	27	33	63	77
$a_{4,c}$	[mm]	45	55	45	55	27	33	27	33



Geometry and minimum distances

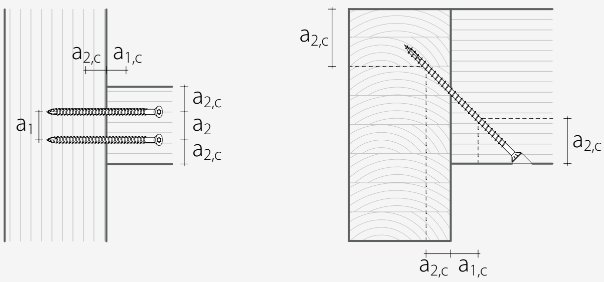
MINIMUM DISTANCES FOR AXIAL STRESSES (2)



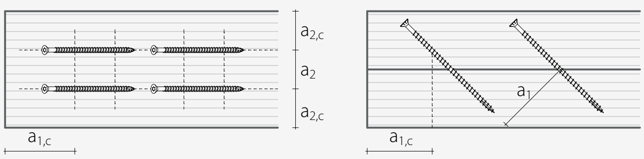
		SCREWS INSERTED WITHOUT PRE-BORED HOLES		SCREWS INSERTED WITH PRE-BORED HOLES	
		9	**11**	**9**	**11**
a_1	[mm]	45	55	45	55
a_2	[mm]	45	55	45	55
$a_{2,LIM}$ (3)	[mm]	23	28	23	28
$a_{1,C}$	[mm]	90	110	90	110
$a_{2,C}$	[mm]	36	44	27	33
a_{CROSS}	[mm]	14	17	14	17

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

Plan **Front**

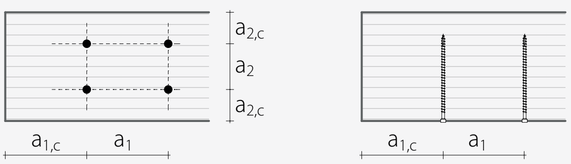


Plan **Front**



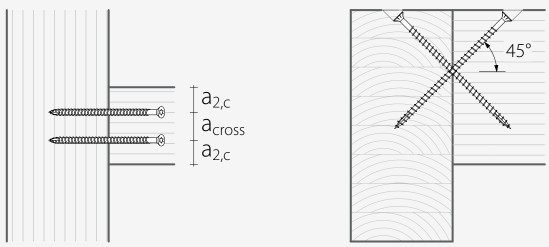
SCREWS INSERTED WITH A 90° ANGLE WITH RESPECT TO THE GRAIN

Plan **Front**



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

Plan **Front**



NOTE

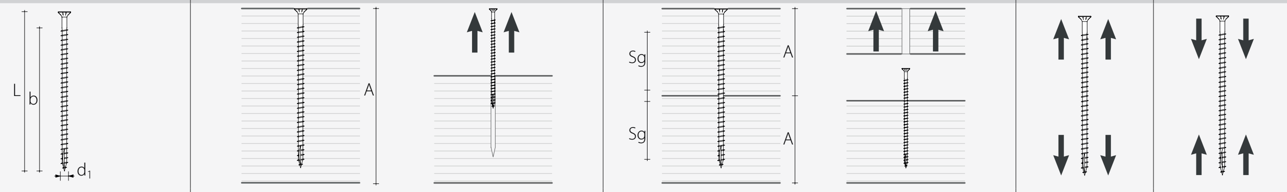
(1) The minimum distances are in accordance with EN 1995:2008, according to ETA-11/0030, considering a mass density of the wood elements of $\rho_k \leq 420$ kg/m³.

(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 $2.5 \cdot d_1$ if for each connector a "joint surface" $a_1 \cdot a_2 = 25 \cdot d_1^2$ is maintained.

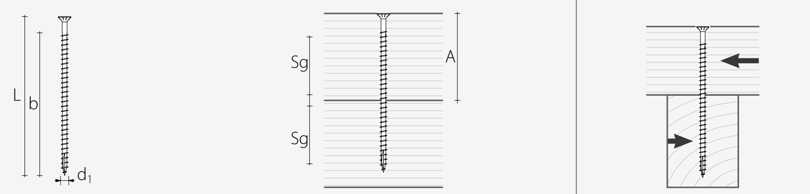
Designer statics

TRACTION (1) / COMPRESSION (2)



geometry		total thread withdrawal (3)			partial thread withdrawal (3)			steel traction	instability
				wood			wood	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]
9	160	150	170	16,87	65	85	7,31	25,40	17,20
	200	190	210	21,37	85	105	9,56		
	240	230	250	25,87	105	125	11,81		
	280	270	290	30,36	125	145	14,06		
	320	310	330	34,86	145	165	16,31		
	360	350	370	39,36	165	185	18,56		
11	100	90	110	12,37	35	55	4,81	38,00	21,88
	150	140	160	19,24	60	80	8,25		
	200	190	210	26,12	85	105	11,68		
	250	240	260	32,99	110	130	15,12		
	300	290	310	39,86	135	155	18,56		
	350	340	360	46,73	160	180	21,99		
	400	390	410	53,61	185	205	25,43		
	450	440	460	60,48	210	230	28,86		
	500	490	510	67,35	235	255	32,30		
	550	540	560	74,22	260	280	35,74		
	600	590	610	81,10	285	305	39,17		

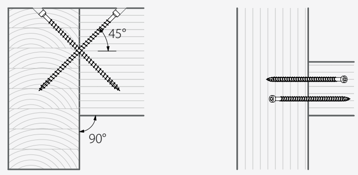
SHEAR



geometry				wood-wood
d_1 [mm]	L [mm]	s_g [mm]	A_{MIN} [mm]	$R_{V,k}$ [kN]
9	160	65	80	5,06
	200	85	100	5,62
	240	105	120	6,19
	280	125	140	6,47
	320	145	160	6,47
	360	165	180	6,47
11	100	35	50	4,22
	150	60	75	6,33
	200	85	100	7,42
	250	110	125	8,28
	300	135	150	9,00
	350	160	175	9,00
	400	185	200	9,00
	450	210	225	9,00
	500	235	250	9,00
	550	260	275	9,00
	600	285	300	9,00

CROSSED CONNECTORS

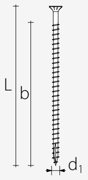
right-angle joint

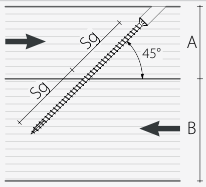


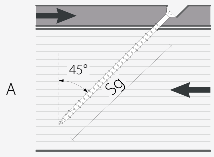
The shear connection of the main/secondary beam with crossed VGS connectors is shown on page 110.

Designer statics

SLIDING (4)







geometry		wood - wood				steel - wood (5)			
								wood	steel
d_1 [mm]	L [mm]	s_g [mm]	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]
9	160	65	60	75	4,70	140	120	10,12	17,96
	200	85	75	90	6,14	180	145	13,01	
	240	105	90	105	7,59	220	175	15,90	
	280	125	105	120	9,04	260	205	18,80	
	320	145	120	135	10,48	300	230	21,69	
	360	165	135	145	11,93	340	260	24,58	
11	100	35	40	55	3,09	80	75	7,07	26,87
	150	60	60	75	5,30	130	110	11,49	
	200	85	80	90	7,51	180	145	15,90	
	250	110	95	110	9,72	230	185	20,32	
	300	135	115	125	11,93	280	220	24,74	
	350	160	130	145	14,14	330	255	29,16	
	400	185	150	160	16,35	380	290	33,58	
	450	210	165	180	18,56	430	325	37,99	
	500	235	185	195	20,76	480	360	42,41	
	550	260	200	215	22,97	530	395	46,83	
	600	285	220	230	25,18	580	430	51,25	

GENERAL PRINCIPLES

- Characteristic values comply with the EN 1995:2008 standard in accordance with ETA-11/0030.
- Design values are obtained from the following characteristic values:

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

  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.
- In the calculations, the density of the wood elements was considered equal to $\rho_k = 380\ kg/m^3$. Characteristic resistances can also be considered as valid for larger densities, for the purposes of safety.
- 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.
- The wood-wood extraction, shear and sliding values were calculated considering the centre of gravity of the connector placed in correspondence with the shear plane.
- The characteristic resistances were calculated using solid wood or glulam. In the case of joints with X-Lam elements, the resistance values may be different and should be calculated on the basis of the characteristics of the panel and the connection configuration.

NOTE

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

$$R_{ax,d} = min \begin{cases} R_{ax,k} \cdot k_{mod} / \gamma_m \\ R_{tens,k} / \gamma_{m2} \end{cases}$$

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

$$R_{ax,d} = \min \begin{cases} R_{ax,k} \cdot k_{mod} / \gamma_m \\ R_{ki,k} / \gamma_{m1} \end{cases}$$

(3) 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 s_g. For intermediate s_g values it is possible to interpolate linearly.

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

(5) The sliding design strength of the connector is the lower between the wood-side design strength ($R_{V,d}$) and the steel-side design strength ($R_{tens,d\ 45°}$).

$$R_{V,d} = min \begin{cases} R_{V,k} \cdot k_{mod} / \gamma_m \\ R_{tens,k\ 45°} / \gamma_{m2} \end{cases}$$

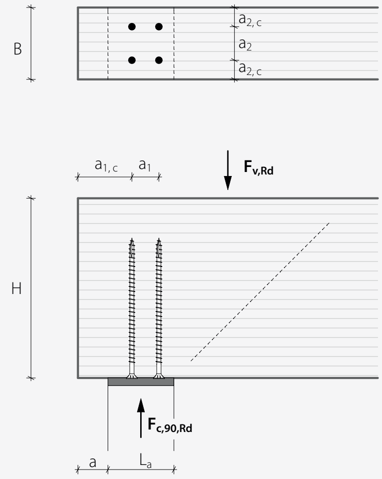
To properly create the joint, the head of the connector must be completely inserted in the steel plate.

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

Calculation example: reinforcement of beam with compression perpendicular to the fibres

PROJECT DATA

B = 200 mm	$F_{v,Rd}$ = 98,3 kN
H = 520 mm	$F_{c,90,Rd}$ = 98,3 kN
a = 25 mm	Service class = 1
L_a = 200 mm	Load duration = medium
Wood GL24h (ρ_k = 380 kg/m³)	



SHEAR VERIFICATION OF SUPPORT (EN 1995:2008): $\tau_d \le f_{v,d}$

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

τ_d = 1,42 N/mm²
$f_{v,k}$ = 2,70 N/mm²

EN 1995:2008

k_{mod} = 0,8
γ_m = 1,25
$f_{v,d}$ = 1,73 N/mm²

$\tau_d \le f_{v,d}$ → 1,42 < 1,73 N/mm² Verification passed

Italia - NTC 2008

k_{mod} = 0,8
γ_m = 1,45
$f_{v,d}$ = 1,49 N/mm²

$\tau_d \le f_{v,d}$ → 1,42 < 1,49 N/mm² Verification passed

PERPENDICULAR COMPRESSION VERIFICATION OF SUPPORT - BEAM WITHOUT REINFORCEMENT (EN 1995:2008): $\sigma_{c,90,d} \le k_{c,90} \cdot f_{c,90,d}$

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

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

$l_{ef,1}$ = 255 mm
$\sigma_{c,90,d}$ = 1,93 N/mm²
$k_{c,90}$ = 1,00
$f_{c,90,k}$ = 2,70 N/mm²

EN 1995:2008

k_{mod} = 0,8
γ_m = 1,25
$f_{c,90,d}$ = 1,73 N/mm²

$\sigma_{c,90,d} \le k_{c,90} \cdot f_{c,90,d}$ → 1,93 > 1,73 N/mm² Verification not passed
Requires reinforcement

Italia - NTC 2008

k_{mod} = 0,8
γ_m = 1,45
$f_{c,90,d}$ = 1,49 N/mm²

$\sigma_{c,90,d} \le k_{c,90} \cdot f_{c,90,d}$ → 1,93 > 1,49 N/mm² Verification not passed
Requires reinforcement

PERPENDICULAR COMPRESSION VERIFICATION OF SUPPORT - BEAM WITH REINFORCEMENT (EN 1995:2008 and ETA-11/0030): $F_{c,90,Rd} \leq R_{c,90,Rd}$

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

REINFORCEMENT CONNECTOR SELECTION

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

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

$$l_{ef,2} = L + (n_0 - 1) \cdot a_1 + min(a_{1,CG}; L) \qquad l_{ef,2} = 495 \text{ mm}$$

The minimum distances for placement of the connectors are found in the table on pg. 143.

$$R_{ax,Rd} = min \begin{cases} R_{ax,d} = \dfrac{R_{ax,a,Rk} \cdot k_{mod}}{\gamma_m} \\ R_{ki,d} = \dfrac{R_{ki,k}}{\gamma_{m1}} \end{cases}$$

$R_{ax,90°,Rk} = 39{,}36$ kN
$R_{ki,k} = 17{,}20$ kN

The compression resistance of the connectors calculated here is shown in the table on pg. 144.

EN 1995:2008
$k_{mod} = 0{,}8$
$\gamma_m = 1{,}3$
$\gamma_{m1} = 1{,}00$
$R_{ax,90°,Rd} = 24{,}22$ kN
$R_{ki,d} = 17{,}20$ kN
$R_{ax,Rd} = 17{,}20$ kN

Italia - NTC 2008
$k_{mod} = 0{,}8$
$\gamma_m = 1{,}5$
$\gamma_{m1} = 1{,}05$
$R_{ax,90°,Rd} = 20{,}99$ kN
$R_{ki,d} = 16{,}38$ kN
$R_{ax,Rd} = 16{,}38$ kN

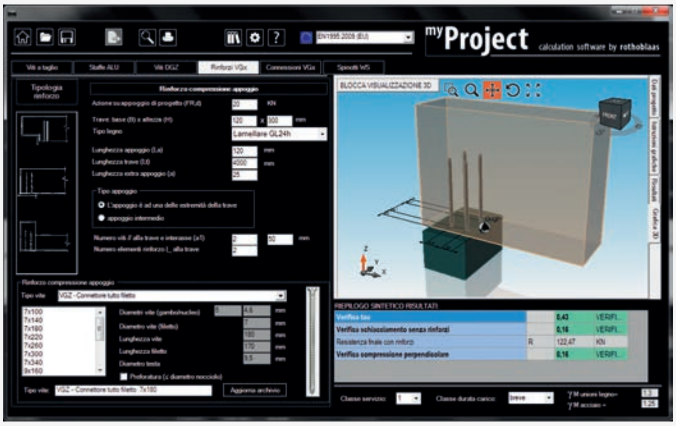
$$R_{c,90,Rd} = min \begin{cases} k_{c,90} \cdot B \cdot l_{ef,1} \cdot f_{c,90,d} + n \cdot R_{ax,Rd} \\ B \cdot l_{ef,2} \cdot f_{c,90,d} \end{cases}$$

EN 1995:2008: **$R_{c,90,Rd} = 156{,}93$ kN**

$F_{c,90,Rd} \leq R_{c,90,Rd} \rightarrow 98{,}3 < 156{,}93$ kN   Verification passed

Italia - NTC 2008: **$R_{c,90,Rd} = 141{,}50$ kN**

$F_{c,90,Rd} \leq R_{c,90,Rd} \rightarrow 98{,}3 < 141{,}50$ kN   Verification passed



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