Timber Design Guide

HTP and WR Technical Handbook
Canada

Revision	Date	Changes
V1.01	March 2024	Initial Release

Contents

1. Overview

SFS HTP and WR are high-strength, self-tapping structural fasteners designed for use in wood-to-wood and steel-to-wood applications in heavy-timber (HTP), mass-timber (MT), and conventional light-frame wood construction. HTP and WR fasteners are available in varying diameters and lengths, partial thread (PT) and full thread (FT) configurations, and varying head configurations (Figures 1.3.A and 1.3.B). Partial thread HTP fasteners are equipped with shank ribs (knurl) near the bottom of the unthreaded shank. The shank ribs reduce the drive-in resistance and ensure a tight fit between the two connecting members.

1.1 Reference documents

SFS HTP and WR fasteners have been evaluated by the International Code Council Evaluation Services (ICC ES) and the European Technical Assessment (ETA-12/0062, April 15, 2019) and conform to all applicable provisions of the International Building Code (IBC), International Residential Code (IRC), and the governing Eurocodes. The design method and presentation in this guide is to be used with the following editions of the standard CSAO86 Engineering Design in Wood and the National Building Code of Canada.

- Current section of National Building Code of Canada
- CSA O86-19 Engineering design in wood

See section 1.4 for more details.

1.2 Design overview

The factored lateral resistance, N_r, the factored withdrawal resistance P_{rw} and the factored head pull-through resistance, P_{rh}, provided in this guide assume standard-term loading (Kd=1.00), dry service condition (K_{SF} = 1.00), untreated wood (K_T = 1.00), and for wood members other than CLT
(J_x = 1.0). For other conditions, these factored values should be adjusted accordingly by all applicable modification factors outlined in CSA O86 and described below:

Kd = load duration factor (CSA 086 Clause 12.2.1.7.1 & Clause 5.3.2)
= 1.15 (short-term load duration)
= 1.00 (standard term load duration)
= 0.65 (long-term load duration)

K_{SF} = service condition factor for connections (CSA 086 Clause 12.2.1.7.2 & Table 12.1)
= 1.00 (moisture content of wood is dry (less than 19%) at time of fabrication and in-service)
= N/A (not allowed/applicable for service conditions other than dry conditions)

K_t = treatment factor (CSA 086 Clause 12.2.1.7.3 & Clause 5.3.4)
= 1.0 (for connections that are untreated)
= N/A (not allowed/applicable for treated wood)

J_x = connection resistance factor (CSA 086 Clause 12.6.5.1.2 & Clause 12.6.6.1)
= 1.0 (for all wood members other than CLT)
= 0.9 (for CLT)

J_E = end grain factor (CSA 086 Clause 12.6.6.1) (applicable for withdrawal only)
= 1.00 (for all other cases)
= 0.67 (in panel edge of CLT)
= 0.75 (in end grain)

Table 1.3: Wood species vs relative density cross-reference

	Usage				
Wood species	**Mean oven-dry relative density**	**Visually stress-graded lumber**	**Glue-laminated timber**	**"MSR or MEL E Grades of S-P-F"**	**CLT**
Southern Pine	0.55	x	x	x	x
D Fir-Larch, Hem-Fir	0.49		x		x
D Fir-Larch	0.47			x	
Spruce-Pine	0.44		x		
Spruce-Pine-Fir	0.42			x	x
Northern Species	0.35				x

1.4 Commentary on presented values:

1.4.1

The following characteristic values for physical properties presented in Table 2.1 and referenced elsewhere herein were derived from characteristic values established from European Technical Assessments (ETAs):

- Torsion
- Tensile, f_u
- Yield, f_y

1.4.2

The following factored resistance values represented herein were derived from characteristic values established in ETAs:

- Factored head pull-through resistance, P_{rh}
- Factored withdrawal resistance, P_{rw}

1.4.2.1

First, the characteristic values were converted to equivalent specified strengths (standard term adjustment) to be used in conjunction with CSA O86 as follows:

Specified strength = characteristic value × 0.8 (Eq. 1-1)

1.4.2.2

In accordance with Eurocode 5 (EC5), characteristic values are converted to design values via the equation:

characteristic value × K_{mod} / γ_m (Eq. 1-2)

where:

K_{mod} = modification factor for duration of load and moisture content per EC5, and

γ_m = material factor

An adjustment value was derived for the specified strengths to be used in conjunction with CSA 086 in wood connections, as follows:

ϕ_{equiv} = 1 / γ_m (Eq. 1-3)
= 1/1.3
= 0.77

This was established as an equivalence value for the factored values represented herein.

Factored values presented herein are represented in standard term load duration (Kd = 1.0), which can be adjusted to other load durations. The values presented in the tables may be used in conjunction with CSA 086 using the following basic calculation:

Other load durations = factored value × Kd (Eq. 1-4)
= factored value × 1.15 for wind and seismic, for example

1.4.3

Factored tensile resistance, T_r, presented in physical property tables 2.8 - 2.10 represent the factored tensile strength of the steel fastener. Factored tensile strength is represented as follows herein are derived directly from the ETA with a ϕ of 0.8 as per CSA S16 for steel.

1.4.4

Factored lateral resistance calculated in accordance with CSA 086, section 12.6

Connection geometry requirements presented per ICC AC233

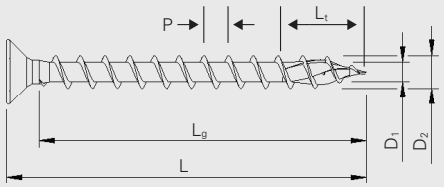
1. Overview

1.5 Geometry and material properties

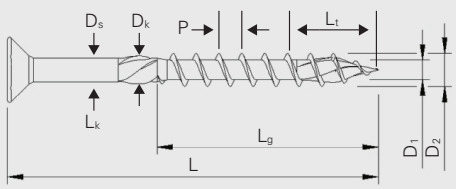
The geometry of SFS HTP and WR fasteners is shown in Figures 1.5.A and 1.5.B and Table 1.5.A. The material properties are provided in Table 1.5.B.

Figure 1.5.A: HTP thread design and head styles

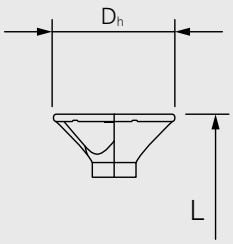
HTP–FT (full thread)



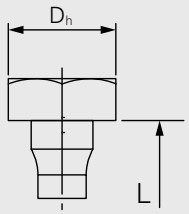
HTP–PT (partial thread)



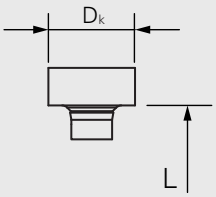
Flat Countersunk Head–CS
with milling pockets



Hexagon Head–H13 or H15
with internal T-drive



Cylinder Head–CH



Raised Flange Head–FH

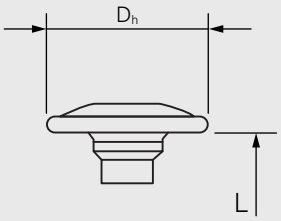


Figure 1.5.B: WR thread design and head styles

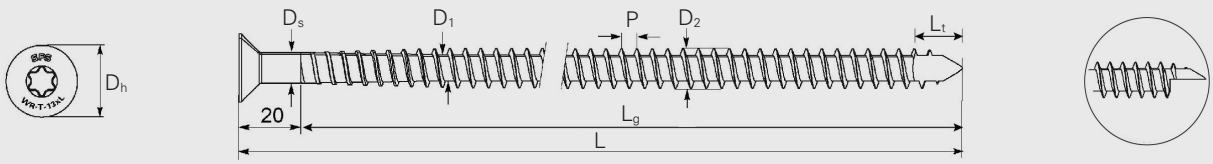


Table 1.5.A: HTP and WR dimensions

	Product feature	Fastener diameter							
		HTP (PT and FT)						WR	
		6	1/4	8	5/16	10	3/8	13	1/2
		mm	in	mm	in	mm	in	mm	in
	Minimum Length, L	50	2"	40	1-5/8"	80	3-1/8"	400	15-3/4"
	Max. Length, L	300	11-3/4"	500	19-5/8"	500	19-5/8"	1000	39-3/8"
	Thread Length, LThread, L_g	See Product Catalog							
	Tip Length, LTip, L_t	9.70	0.382	13.40	0.528	16.10	0.634	16.50	0.650
	Minor Diameter, DRoot, D_1	3.75	0.148	5.20	0.205	6.25	0.246	8.50	0.335
	Major Diameter, DThread, D_2	6.00	0.236	8.20	0.315	10.00	0.394	13.00	0.512
	Shank Diameter, DShank, D_s	4.45	0.175	5.80	0.228	7.00	0.276	10.00	0.394
	Thread Pitch, P	4.50	0.177	6.00	0.236	7.50	0.295	3.20	0.126
	Knurl Diameter, DKnurl[2], D_k	4.90	0.193	6.30	0.248	8.00	0.315	n/a	n/a
	Knurl Length, LKnurl[2], L_k	8.00	0.315	12.0	0.472	12.00	0.472		
	Fastener Drive	T30					T40*	T50	
Head diameter, D_{Head}	Flat Countersunk Head (CS)	11.7	0.465	14.8	0.583	18.5	0.728	22.0	0.866
	Raised Flange Head (FH)	14.0	0.551	18.0	0.709	22.5	0.886	n/a	n/a
	Cylinder Head (CH)	9.0	0.315	12.0	0.472	14.0	0.551		
	Hexagon Head (H13 & H15)[1]	n/a	n/a	13.0	0.512	15.0	0.591		

[1] Hexagon head has 13 mm hex drive with T40 internal drive and 15 mm hex drive with T40 internal drive for diameters 5/16" (8 mm) and 3/8" (10 mm), respectively.
[2] Only applies to partial thread (PT) screws.

1.6 Product code

Type | **D (mm)** | **L (mm)**

HTP-T-CS-PT-8,0x220

Nominal length

Diameter - outer thread

Thread
PT = **P**artial **t**hread
FT = **F**ull **t**hread
DT = **D**ouble **t**hread
VFT = **V**ariable **f**ull **t**hread with "magic close effect"

Head Style
CS = **C**ounter**s**unk
FH = **F**lange **h**ead
CH = **C**ylinder **h**ead
H = Combination **h**exagon head

Material
T = **T**empered carbon steel

Product family
WR = **W**ood **r**einforcement: special large diameter, full thread
HTP = **H**eavy **t**imber: core products for variety of timber connections

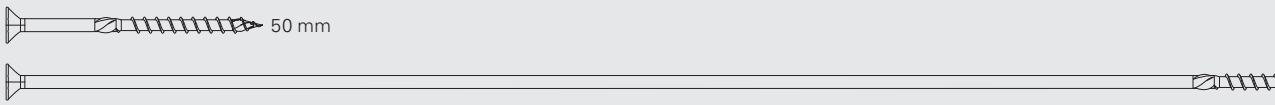
1.7 Connection matrix

		CLT		Glulam or timber		Concrete		Structural Steel		Wood Framing		Light Guage Steel Framing	
		V	H	V	H	V	H	V	H	V		V	
Glulam or timber	H	•	•	•	•	•	•	•	•	—	—	—	—
	V	•	•	•	—	•	•	•	•	—	—	—	—
CLT	H	•	•	•	•	•	•	•	•	•	—	•	—
	V	•	—	•	•	•	•	•	•	—	—	—	—

1. Overview

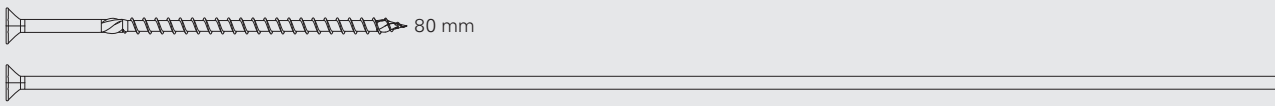
1.8 Fastener matrix

HTP-T-CS-PT-6xL
6 mm countersunk partial thread



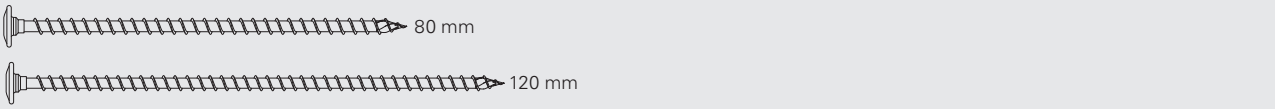
HTP-T-CS-PT-8xL
8 mm countersunk partial thread

HTP-T-CS-PT-10xL
10 mm countersunk partial thread



HTP-T-FH-PT-6xL
6 mm flange head partial thread

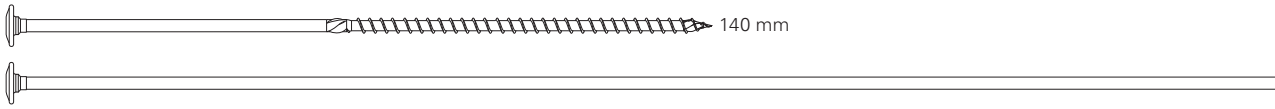
HTP-T-FH-FT-8xL
8 mm flange head full thread



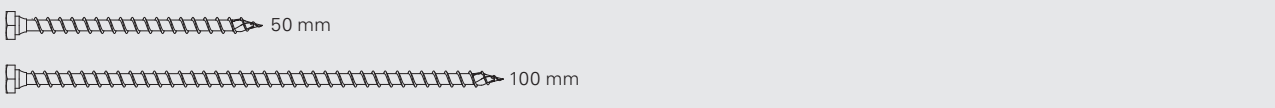
HTP-T-FH-PT-8xL
8 mm flange head partial thread

HTP-T-FH-FT-10xL
10 mm flange head full thread

HTP-T-FH-PT-10xL
10 mm flange head partial thread

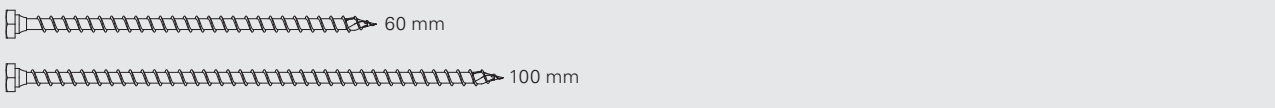


HTP-T-H-FT-8xL
8 mm hex head full thread

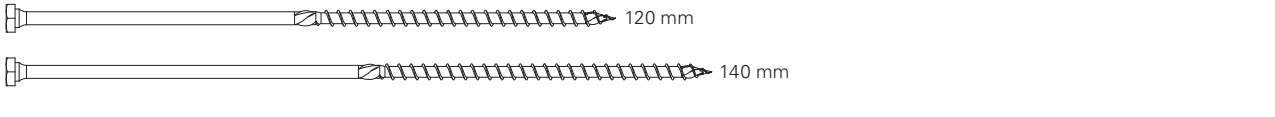


HTP-T-H-PT-8xL
8 mm hex head partial thread

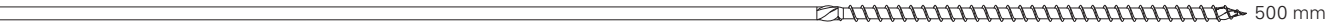
HTP-T-H-FT-10xL
10 mm hex head full thread

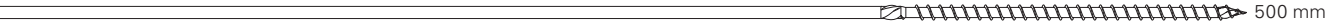


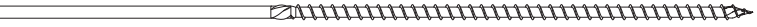
HTP-T-H-PT-10xL
10 mm hex head partial thread



	0 mm	25 mm	50 mm	75 mm	100 mm	125 mm	150 mm	175 mm	200 mm	225 mm

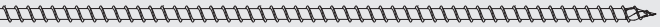


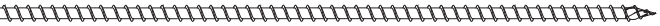


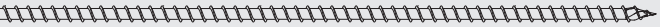


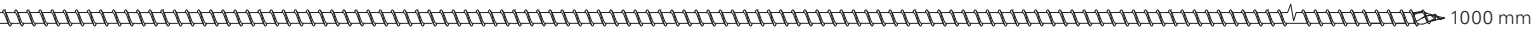
250 mm	275 mm	300 mm	325 mm	350 mm	375 mm	400 mm	425 mm	450 mm	475 mm	975 mm	1000 mm

1.8 Fastener matrix continued









250 mm	275 mm	300 mm	325 mm	350 mm	375 mm	400 mm	425 mm	450 mm	475 mm	975 mm	1000 mm

2. Reference design values

Table 2.1: HTP and WR material properties

Screw	d (mm)	Torsion (Nm)	Tensile, f_u (MPa)	Yield, f_y (MPa)	f_y[1] (MPa)
HTP 6 mm, partial thread	6.0	11	1018	1073	1045
HTP 6 mm, full thread				802	910
HTP 8 mm, partial and full thread	8.0	25	920	826	873
HTP 10 mm, partial and full thread	10.0	42	978	885	932
WR 13 mm, full thread	13.0	100	967	779	873

[1] Average of f_u and f_y per CSA O86:19, 12.4.4.3.3.3. This is the rule used to calculate tables 2.2–2.7.

The reference lateral design values for SFS HTP and WR are provided in Tables 2.2–2.7. The factored withdrawal and factored head pull-through values are provided in Tables 2.8, 2.9 and 2.10 respectively. The appropriate modification factors shall be used as described in Section 1.2 of this design guide.

Figure 2.1

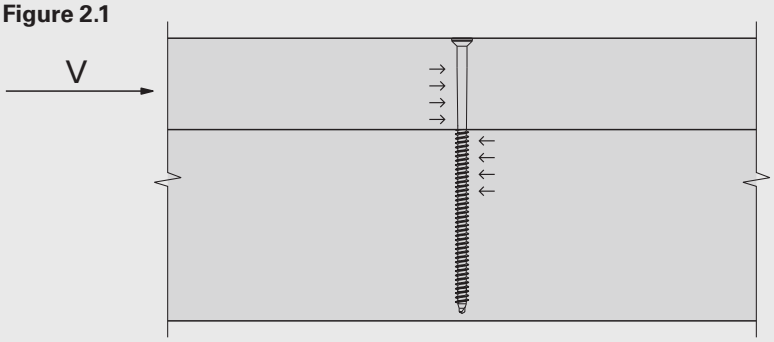


Table 2.2: Reference lateral design values—single shear wood-to-wood connection, partial thread

Fastener Designation Diameter × Length (mm)	Side Member Thickness, t_1 (mm)	Main Member Dowel Bearing Length[5], t_2 (mm)	Factored Lateral Resistance (kN) for Partial Thread Screws in Wood-Wood Connections for Specific Gravities of [1, 2, 3, 4]											
			0.35				0.42				0.44			
			$Nr_{,\parallel}$	$Nr_{,\parallel/\perp}$	$Nr_{,\perp/\parallel}$	$Nr_{,\perp}$	$Nr_{,\parallel}$	$Nr_{,\parallel/\perp}$	$Nr_{,\perp/\parallel}$	$Nr_{,\perp}$	$Nr_{,\parallel}$	$Nr_{,\parallel/\perp}$	$Nr_{,\perp/\parallel}$	$Nr_{,\perp}$
6.0 × 60	13	38	0.444	0.246	0.258	0.195	0.532	0.296	0.309	0.234	0.558	0.310	0.324	0.245
6.0 × 70	19	41	0.532	0.369	0.328	0.234	0.638	0.443	0.394	0.281	0.668	0.464	0.412	0.294
6.0 × 80		51	0.609		0.367	0.273	0.685		0.440	0.327	0.706		0.461	0.343
6.0 × 90	25	55	0.665	0.444	0.437	0.312	0.752	0.496	0.524	0.374	0.776	0.511	0.549	0.392
6.0 × 100		65			0.476	0.350			0.571	0.420			0.598	0.440
6.0 × 110		75			0.514	0.389			0.617	0.439			0.647	0.452
6.0 × 120	38	72	0.777	0.493	0.616	0.428	0.887	0.555	0.739	0.498	0.917	0.573	0.774	0.514
6.0 × 140	51	80	0.883	0.542	0.690	0.490	0.967	0.614	0.756	0.557	0.990	0.635		0.576
6.0 × 150	64	77		0.591		0.539		0.674		0.616		0.696		0.638
6.0 × 160	76	74		0.633		0.580		0.723		0.641		0.748		0.657
6.0 × 180	89	81		0.661		0.586		0.756				0.774		
6.0 × 200	114	76		0.640				0.732				0.758		
6.0 × 220	140	71		0.619		0.567		0.707				0.731		
6.0 × 240	152	78		0.647		0.586		0.741				0.767		
6.0 × 260	178	73		0.626		0.574		0.715				0.740		
6.0 × 280	191	80		0.655		0.586		0.749				0.774		
6.0 × 300	216	74		0.634		0.581		0.724				0.750		
8.0 × 90	19	58	0.878	0.480	0.508	0.386	1.025	0.576	0.610	0.463	1.055	0.604	0.639	0.485
8.0 × 100	25	61	0.988	0.640	0.599	0.437	1.112	0.750	0.719	0.524	1.147	0.772	0.754	0.549
8.0 × 120	38	69	1.133	0.737	0.782	0.537	1.287	0.827	0.938	0.645	1.330	0.852	0.983	0.676
8.0 × 140	51	76	1.279	0.801	0.964	0.638	1.461	0.904	1.157	0.766	1.513	0.932	1.212	0.802

2. Reference design values

Table 2.2: Continued

Fastener Designation Diameter × Length (mm)	Side Member Thickness, t_1 (mm)	Main Member Dowel Bearing Length[5], t_2 (mm)	Factored Lateral Resistance (kN) for Partial Thread Screws in Wood-Wood Connections for Specific Gravities of[1, 2, 3, 4]											
			0.35				0.42				0.44			
			$Nr_{r,\|\|}$	$Nr_{r,\|\|/\perp}$	$Nr_{r,\perp/\|\|}$	$Nr_{r,\perp}$	$Nr_{r,\|\|}$	$Nr_{r,\|\|/\perp}$	$Nr_{r,\perp/\|\|}$	$Nr_{r,\perp}$	$Nr_{r,\|\|}$	$Nr_{r,\|\|/\perp}$	$Nr_{r,\perp/\|\|}$	$Nr_{r,\perp}$
8.0 × 160	51	96	1.279	0.801	1.065	0.718	1.461	0.904	1.193	0.813	1.513	0.932	1.221	0.840
8.0 × 180	64	103	1.393	0.865	1.089	0.782	1.526	0.981		0.890	1.562	1.013		0.920
8.0 × 200	89	98		0.993		0.910		1.134		1.012		1.174		1.036
8.0 × 220	102	105		1.057		0.924		1.193				1.221		
8.0 × 240	127	100		1.047										
8.0 × 260	152	94		1.019								1.208		
8.0 × 280	165	102		1.056								1.221		
8.0 × 300	191	96		1.029								1.220		
8.0 × 320	203	103		1.066								1.221		
8.0 × 340	229	98		1.039										
8.0 × 360	241	105		1.075										
8.0 × 380	267	100		1.048										
8.0 × 400	292	95		1.021										
8.0 × 420	305	102		1.058										
8.0 × 460	343	104		1.067										
8.0 × 500	381	106		1.077										
10.0 × 120	25	79	1.423	0.773	0.829	0.633	1.596	0.928	0.995	0.759	1.643	0.972	1.043	0.795
10.0 × 140	38	86	1.599	1.070	1.049	0.754	1.807	1.196	1.259	0.905	1.864	1.231	1.319	0.948
10.0 × 160	51	93	1.775	1.147	1.270	0.876	2.017	1.289	1.523	1.051	2.085	1.328	1.596	1.101
10.0 × 180	64	100	1.950	1.224	1.490	0.998	2.228	1.382	1.788	1.197	2.306	1.425	1.873	1.254
10.0 × 200	89	95	2.144	1.379	1.676	1.119	2.348	1.567	1.836	1.343	2.403	1.620	1.879	1.407
10.0 × 220	102	102		1.456		1.241		1.660		1.489		1.717		1.560
10.0 × 240	127	97		1.428		1.301		1.626		1.487		1.681		1.539
10.0 × 260	152	92		1.395		1.268		1.586		1.447		1.640		1.497
10.0 × 280	165	99		1.439		1.312		1.640		1.501		1.696		1.553
10.0 × 300	191	93		1.406		1.280		1.600		1.461		1.654		1.512
10.0 × 320	203	101		1.451		1.324		1.654		1.514		1.710		1.568
10.0 × 340	229	95		1.418		1.291		1.614		1.475		1.669		1.527
10.0 × 360	241	103		1.462		1.336		1.667		1.528		1.725		1.582
10.0 × 380	267	97		1.430		1.303		1.628		1.489		1.683		1.541
10.0 × 400	292	92		1.397		1.270		1.588		1.449		1.642		1.500
10.0 × 420	305	99		1.441		1.314		1.642		1.503		1.698		1.556
10.0 × 460	343	101		1.453		1.326		1.656		1.517		1.712		1.570
10.0 × 480	381	83		1.343		1.216		1.523		1.384		1.574		1.432

Notes:

[1] Values must be multiplied by all applicable adjustment factors, in accordance with CSA 086:19. For use in dry conditions only.

[2] Tabulated reference lateral design values, N_r apply to screws driven into the side grain of the main member, such that the screws are oriented perpendicular to the grain and loaded as follows:

- $N_{r,\|}$ both side and main member are loaded parallel to the grain.
- $N_{r,\|/\perp}$ side member loaded perpendicular to the grain and main member loaded parallel to the grain.
- $N_{r,\perp/\|}$ side member loaded parallel to the grain and main member loaded perpendicular to the grain.
- $N_{r,\perp}$ both side and main member are loaded perpendicular to the grain.

[3] Tabulated lateral design values are based on both wood members having the same specific gravity, G.

[4] The value f_y used in calculating tables 2.2–2.7 is the value f_y^1 from Table 2.1

[5] Main member dowel bearing length, t_2 is defined as fastener penetration into the main member minus the length of the tapered tip of the screw.

2. Reference design values

Table 2.2: Continued

Fastener Designation Diameter × Length (mm)	Side Member Thickness, t_1 (mm)	Main Member Dowel Bearing Length[5], t_2 (mm)	Factored Lateral Resistance (kN) for Partial Thread Screws in Wood-Wood Connections for Specific Gravities of[1, 2, 3, 4]											
			0.47				0.49				0.55			
			$Nr_{,\parallel}$	$Nr_{,\parallel/\perp}$	$Nr_{,\perp/\parallel}$	$Nr_{,\perp}$	$Nr_{,\parallel}$	$Nr_{,\parallel/\perp}$	$Nr_{,\perp/\parallel}$	$Nr_{,\perp}$	$Nr_{,\parallel}$	$Nr_{,\parallel/\perp}$	$Nr_{,\perp/\parallel}$	$Nr_{,\perp}$
6.0 × 60	13	38	0.596	0.331	0.346	0.262	0.621	0.345	0.361	0.273	0.697	0.387	0.405	0.307
6.0 × 70	19	41	0.714	0.496	0.440	0.314	0.744	0.512	0.459	0.328	0.817	0.549	0.515	0.368
6.0 × 80		51	0.737		0.493	0.366	0.757		0.513	0.382			0.576	0.429
6.0 × 90	25	55	0.812	0.532	0.587	0.418	0.836	0.546	0.612	0.436	0.905	0.587	0.687	0.490
6.0 × 100		65			0.639	0.470			0.666	0.484			0.747	0.522
6.0 × 110		75			0.691	0.472			0.720				0.784	
6.0 × 120	38	72	0.962	0.598	0.800	0.538	0.992	0.615	0.817	0.553	1.081	0.665	0.865	0.599
6.0 × 140	51	80	1.023	0.664		0.604	1.045	0.684		0.622	1.107	0.742		0.677
6.0 × 150	64	77		0.731		0.670		0.753		0.691		0.820		0.734
6.0 × 160	76	74		0.786		0.679		0.811		0.693		0.865		
6.0 × 180	89	81		0.800				0.817						
6.0 × 200	114	76		0.796										
6.0 × 220	140	71		0.768				0.792						
6.0 × 240	152	78		0.800				0.817						
6.0 × 260	178	73		0.778				0.802						
6.0 × 280	191	80		0.800				0.817						
6.0 × 300	216	74		0.787				0.812						
8.0 × 90	19	58	1.100	0.645	0.683	0.519	1.130	0.672	0.712	0.541	1.216	0.754	0.799	0.607
8.0 × 100	25	61	1.198	0.803	0.805	0.586	1.232	0.824	0.839	0.611	1.330	0.884	0.942	0.686
8.0 × 120	38	69	1.393	0.889	1.050	0.722	1.435	0.913	1.094	0.752	1.559	0.984	1.228	0.844
8.0 × 140	51	76	1.589	0.975	1.262	0.857	1.639	1.003	1.289	0.893	1.747	1.085	1.365	0.982
8.0 × 160		96				0.879				0.905				
8.0 × 180	64	103	1.614	1.061		0.965	1.648	1.092		0.995		1.186		1.082
8.0 × 200	89	98		1.233		1.071		1.272		1.093		1.365		1.159
8.0 × 220	102	105		1.262				1.289						
8.0 × 240	127	100												
8.0 × 260	152	94												
8.0 × 280	165	102												
8.0 × 300	191	96												
8.0 × 320	203	103												
8.0 × 340	229	98												
8.0 × 360	241	105												
8.0 × 380	267	100												
8.0 × 400	292	95												
8.0 × 420	305	102												
8.0 × 460	343	104												
8.0 × 500	381	106												
10.0 × 120	25	79	1.714	1.038	1.114	0.849	1.760	1.082	1.161	0.886	1.896	1.215	1.303	0.994
10.0 × 140	38	86	1.950	1.282	1.409	1.013	2.006	1.316	1.469	1.056	2.172	1.415	1.649	1.185
10.0 × 160	51	93	2.186	1.386	1.705	1.176	2.252	1.424	1.777	1.226	2.448	1.536	1.995	1.377
10.0 × 180	64	100	2.422	1.490	1.942	1.340	2.498	1.532	1.983	1.382	2.687	1.658	2.101	1.499
10.0 × 200	89	95	2.484	1.698		1.503	2.536	1.749		1.567		1.901		1.742
10.0 × 220	102	102		1.801		1.648		1.857		1.682		2.022		1.782

2. Reference design values

Table 2.2: Continued

Fastener Designation Diameter × Length (mm)	Side Member Thickness, t_1 (mm)	Main Member Dowel Bearing Length[5], t_2 (mm)	Factored Lateral Resistance (kN) for Partial Thread Screws in Wood-Wood Connections for Specific Gravities of[1, 2, 3, 4]											
			0.47				0.49				0.55			
			$Nr_{r,\parallel}$	$Nr_{r,\parallel/\perp}$	$Nr_{r,\perp/\parallel}$	$Nr_{r,\perp}$	$Nr_{r,\parallel}$	$Nr_{r,\parallel/\perp}$	$Nr_{r,\perp/\parallel}$	$Nr_{r,\perp}$	$Nr_{r,\parallel}$	$Nr_{r,\parallel/\perp}$	$Nr_{r,\perp/\parallel}$	$Nr_{r,\perp}$
10.0 × 240	127	97	2.484	1.763	1.942	1.616	2.536	1.817	1.983	1.667	2.687	1.977	2.101	1.782
10.0 × 260	152	92		1.719		1.572		1.771		1.621		1.926		1.767
10.0 × 280	165	99		1.779		1.632		1.833		1.682		1.996		1.782
10.0 × 300	191	93		1.735		1.587		1.787		1.637		1.944		
10.0 × 320	203	101		1.794		1.647		1.850		1.682		2.014		
10.0 × 340	229	95		1.750		1.603		1.804		1.653		1.962		
10.0 × 360	241	103		1.810		1.648		1.866		1.682		2.032		
10.0 × 380	267	97		1.766		1.619		1.820		1.670		1.980		
10.0 × 400	292	92		1.721		1.574		1.774		1.624		1.929		1.769
10.0 × 420	305	99		1.781		1.634		1.836		1.682		1.998		1.782
10.0 × 460	343	101		1.797		1.648		1.852				2.017		
10.0 × 480	381	83		1.649		1.502		1.698		1.548		1.843		1.684

Notes:

[1] Values must be multiplied by all applicable adjustment factors, in accordance with CSA 086:19. For use in dry conditions only.

[2] Tabulated reference lateral design values, N_r apply to screws driven into the side grain of the main member, such that the screws are oriented perpendicular to the grain and loaded as follows:

- $N_{r,\parallel}$ both side and main member are loaded parallel to the grain.
- $N_{r,\parallel/\perp}$ side member loaded perpendicular to the grain and main member loaded parallel to the grain.
- $N_{r,\perp/\parallel}$ side member loaded parallel to the grain and main member loaded perpendicular to the grain.
- $N_{r,\perp}$ both side and main member are loaded perpendicular to the grain.

[3] Tabulated lateral design values are based on both wood members having the same specific gravity, G.

[4] The value f_y used in calculating tables 2.2–2.7 is the value f_y[1] from Table 2.1

[5] Main member dowel bearing length,t_2 is defined as fastener penetration into the main member minus the length of the tapered tip of the screw.

2. Reference design values

The reference lateral design values for SFS HTP and WR are provided in Tables 2.2–2.7. The factored withdrawal and factored head pull-through values are provided in Tables 2.8, 2.9 and 2.10 respectively. The appropriate modification values shall be used as described in Section 1.2 of this design guide.

Figure 2.2

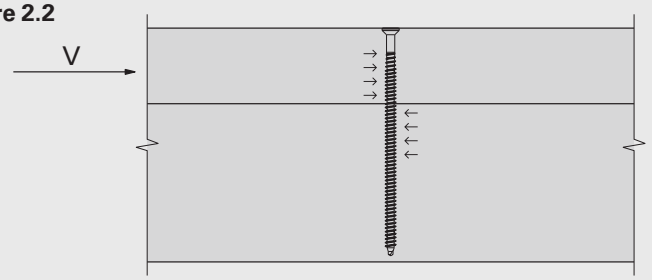


Table 2.3: Reference lateral design values—single shear wood-to-wood connection, full thread

Fastener Designation Diameter × Length (mm)	Side Member Thickness, t_1 (mm)	Main Member Dowel Bearing Length[5], t_2 (mm)	Factored Lateral Resistance (kN) for Full thread Screws in Wood-Wood Connections for Specific Gravities of [1, 2, 3, 4]											
			0.35				0.42				0.44			
			$Nr_{,\|\|}$	$Nr_{,\|\|/\perp}$	$Nr_{,\perp/\|\|}$	$Nr_{,\perp}$	$Nr_{,\|\|}$	$Nr_{,\|\|/\perp}$	$Nr_{,\perp/\|\|}$	$Nr_{,\perp}$	$Nr_{,\|\|}$	$Nr_{,\|\|/\perp}$	$Nr_{,\perp/\|\|}$	$Nr_{,\perp}$
6.0 × 60	25	25	0.380	0.274	0.274	0.167	0.456	0.328	0.328	0.201	0.478	0.344	0.344	0.210
6.0 × 80		45	0.493	0.321	0.340	0.234	0.560	0.360	0.409	0.281	0.579	0.371	0.428	0.294
6.0 × 100	38	52	0.592	0.364	0.463	0.301	0.664	0.412	0.519	0.361	0.680	0.425	0.531	0.378
6.0 × 120		72			0.474	0.328				0.373				0.385
6.0 × 140		92												
6.0 × 160	50	100	0.606	0.404				0.460		0.421		0.476		0.436
8.0 × 100	38	49	0.910	0.626	0.623	0.401	1.093	0.704	0.748	0.481	1.145	0.725	0.784	0.504
8.0 × 120	50	57	1.100	0.681	0.786	0.493	1.259	0.770	0.943	0.591	1.293	0.795	0.988	0.619
8.0 × 160	60	87	1.153	0.727	0.901	0.659	1.263	0.825	0.987	0.750		0.853	1.011	0.776
8.0 × 180		107												
8.0 × 200	76	111		0.801		0.732		0.914		0.838		0.945		0.858
8.0 × 220	100	107		0.901		0.765		0.987				1.011		
8.0 × 240	114	113												
8.0 × 260	120	127												
8.0 × 280	138	129												
8.0 × 300		149												
8.0 × 340	152	175												
8.0 × 380	175	192												
10.0 × 120	38	66	1.280	0.860	0.825	0.563	1.478	0.963	0.990	0.676	1.526	0.992	1.037	0.708
10.0 × 160	50	94	1.452	0.925	1.124	0.780	1.655	1.041	1.349	0.933	1.711	1.074	1.413	0.963
10.0 × 200	76	108	1.673	1.065	1.308	0.966	1.833	1.210	1.433	1.102	1.876	1.251	1.467	1.140
10.0 × 220	100	104		1.195		1.096		1.366		1.216		1.414		1.244
10.0 × 240	114	110		1.250		1.110		1.431				1.467		
10.0 × 260	120	124		1.304				1.433						
10.0 × 280		144												
10.0 × 300	138	146		1.308										
10.0 × 340	152	172												
10.0 × 380	165	199												
13.0 × 400	190	193	2.966	2.319	2.319	1.967	3.249	2.540	2.540	2.155	3.325	2.600	2.600	2.206
13.0 × 500	215	268												
13.0 × 600	228	355												
13.0 × 700	240	443												

2. Reference design values

Table 2.3 Continued

Fastener Designation Diameter × Length (mm)	Side Member Thickness, t_1 (mm)	Main Member Dowel Bearing Length[5], t_2 (mm)	Factored Lateral Resistance (kN) for Full Thread Screws in Wood-Wood Connections for Specific Gravities of [1, 2, 3, 4]											
			0.35				0.42				0.44			
			$Nr_{,\parallel}$	$Nr_{,\parallel/\perp}$	$Nr_{,\perp/\parallel}$	$Nr_{,\perp}$	$Nr_{,\parallel}$	$Nr_{,\parallel/\perp}$	$Nr_{,\perp/\parallel}$	$Nr_{,\perp}$	$Nr_{,\parallel}$	$Nr_{,\parallel/\perp}$	$Nr_{,\perp/\parallel}$	$Nr_{,\perp}$
13.0 × 800	260	523	2.966	2.319	2.319	1.967	3.249	2.540	2.540	2.155	3.325	2.600	2.600	2.206
13.0 × 900	292	591												
13.0 × 1000	330	653												

Notes:
[1] Values must be multiplied by all applicable adjustment factors, in accordance with CSA 086:19. For use in dry conditions only.
[2] Tabulated reference lateral design values, N_r apply to screws driven into the side grain of the main member, such that the screws are oriented perpendicular to the grain and loaded as follows:
- $N_{r,\parallel}$ both side and main member are loaded parallel to the grain.
- $N_{r,\parallel/\perp}$ side member loaded perpendicular to the grain and main member loaded parallel to the grain.
- $N_{r,\perp/\parallel}$ side member loaded parallel to the grain and main member loaded perpendicular to the grain.
- $N_{r,\perp}$ both side and main member are loaded perpendicular to the grain.

[3] Tabulated lateral design values are based on both wood members having the same specific gravity, G.
[4] The value f_y used in calculating tables 2.2–2.7 is the value f_y[1] from Table 2.1
[5] Main member dowel bearing length,t_2 is defined as fastener penetration into the main member minus the length of the tapered tip of the screw.

Table 2.3 Continued

Fastener Designation Diameter × Length (mm)	Side Member Thickness, t_1 (mm)	Main Member Dowel Bearing Length[5], t_2 (mm)	Factored Lateral Resistance (kN) for Full Thread Screws in Wood-Wood Connections for Specific Gravities of [1, 2, 3, 4]											
			0.47				0.49				0.55			
			$Nr_{,\parallel}$	$Nr_{,\parallel/\perp}$	$Nr_{,\perp/\parallel}$	$Nr_{,\perp}$	$Nr_{,\parallel}$	$Nr_{,\parallel/\perp}$	$Nr_{,\perp/\parallel}$	$Nr_{,\perp}$	$Nr_{,\parallel}$	$Nr_{,\parallel/\perp}$	$Nr_{,\perp/\parallel}$	$Nr_{,\perp}$
6.0 × 60	25	25	0.510	0.367	0.367	0.224	0.532	0.383	0.383	0.234	0.597	0.428	0.430	0.263
6.0 × 80		45	0.606	0.387	0.457	0.314	0.625	0.397	0.477	0.328	0.679		0.535	0.368
6.0 × 100	38	52	0.703	0.445	0.549	0.404	0.717	0.458	0.561	0.416	0.760	0.497	0.594	0.452
6.0 × 120		72												
6.0 × 140		92												
6.0 × 160	50	100		0.499		0.458		0.514		0.472		0.560		0.504
8.0 × 100	38	49	1.202	0.757	0.837	0.538	1.239	0.778	0.873	0.561	1.348	0.840	0.979	0.630
8.0 × 120	50	57	1.336	0.831	1.045	0.662	1.364	0.856	1.067	0.690	1.445	0.927	1.130	0.774
8.0 × 160	60	87		0.893		0.814		0.920		0.839		0.999		0.914
8.0 × 180		107												
8.0 × 200	76	111		0.992		0.886		1.023		0.905		1.115		0.959
8.0 × 220	100	107		1.045				1.067				1.130		
8.0 × 240	114	113												
8.0 × 260	120	127												
8.0 × 280	138	129												
8.0 × 300		149												
8.0 × 340	152	175												
8.0 × 380	175	192												
10.0 × 120	38	66	1.597	1.034	1.108	0.756	1.645	1.062	1.155	0.788	1.784	1.143	1.296	0.885
10.0 × 160	50	94	1.796	1.121	1.510	1.007	1.851	1.153	1.548	1.036	2.016	1.245	1.640	1.121
10.0 × 200	76	108	1.939	1.310	1.516	1.196	1.980	1.350		1.233	2.098	1.466		1.342
10.0 × 220	100	104		1.485		1.286		1.532		1.313		1.640		1.391
10.0 × 240	114	110		1.516				1.548						
10.0 × 260	120	124												
10.0 × 280		144												
10.0 × 300	138	146												

2. Reference design values

Table 2.3 Continued

Fastener Designation Diameter × Length (mm)	Side Member Thickness, t_1 (mm)	Main Member Dowel Bearing Length[5], t_2 (mm)	Factored Lateral Resistance (kN) for Full Thread Screws in Wood-Wood Connections for Specific Gravities of[1, 2, 3, 4]											
			0.47				0.49				0.55			
			$Nr_{,\parallel}$	$Nr_{,\parallel/\perp}$	$Nr_{,\perp/\parallel}$	$Nr_{,\perp}$	$Nr_{,\parallel}$	$Nr_{,\parallel/\perp}$	$Nr_{,\perp/\parallel}$	$Nr_{,\perp}$	$Nr_{,\parallel}$	$Nr_{,\parallel/\perp}$	$Nr_{,\perp/\parallel}$	$Nr_{,\perp}$
10.0 × 340	152	172	1.939	1.516	1.516	1.286	1.980	1.548	1.548	1.313	2.098	1.640	1.640	1.391
10.0 × 380	165	199												
13.0 × 400	190	193	3.437	2.687	2.687	2.280	3.509	2.743	2.743	2.328	3.718	2.906	2.906	2.466
13.0 × 500	215	268												
13.0 × 600	228	355												
13.0 × 700	240	443												
13.0 × 800	260	523												
13.0 × 900	292	591												
13.0 × 1000	330	653												

Notes:

[1] Values must be multiplied by all applicable adjustment factors, in accordance with CSA 086:19. For use in dry conditions only.

[2] Tabulated reference lateral design values, N_r apply to screws driven into the side grain of the main member, such that the screws are oriented perpendicular to the grain and loaded as follows:

- $N_{r,\parallel}$ both side and main member are loaded parallel to the grain.
- $N_{r,\parallel/\perp}$ side member loaded perpendicular to the grain and main member loaded parallel to the grain.
- $N_{r,\perp/\parallel}$ side member loaded parallel to the grain and main member loaded perpendicular to the grain.
- $N_{r,\perp}$ both side and main member are loaded perpendicular to the grain.

[3] Tabulated lateral design values are based on both wood members having the same specific gravity, G.

[4] The value f_y used in calculating tables 2.2–2.7 is the value f_y[1] from Table 2.1

[5] Main member dowel bearing length,t_2 is defined as fastener penetration into the main member minus the length of the tapered tip of the screw.

2. Reference design values

The reference lateral design values for SFS HTP and WR are provided in Tables 2.2–2.7. The factored withdrawal and factored head pull-through values are provided in Tables 2.8, 2.9 and 2.10 respectively. The appropriate modification values shall be used as described in Section 1.2 of this design guide.

Figure 2.3

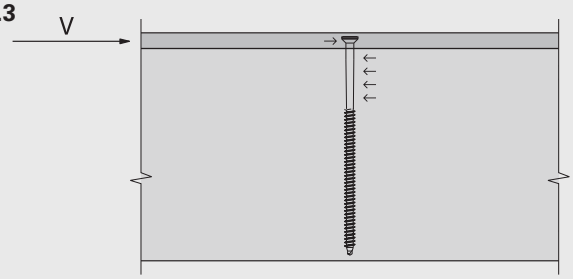


Table 2.4: Reference lateral design values—single shear steel-to-wood connection, partial thread

Fastener Designation Diameter × Length (mm)	Side Member Thickness, t_1 (mm)	Main Member Dowel Bearing Length[5], t_2 (mm)	Factored Lateral Resistance (kN) for Partial Thread Screws in Steel-Wood Connections for Specific Gravities of[1, 2, 3, 4]											
			0.35		0.42		0.44		0.47		0.49		0.55	
			$Nr_{,\parallel}$	$Nr_{,\perp}$	$Nr_{,\parallel}$	$Nr_{,\perp}$	$Nr_{,\parallel}$	$Nr_{,\perp}$	$Nr_{,\parallel}$	$Nr_{,\perp}$	$Nr_{,\parallel}$	$Nr_{,\perp}$	$Nr_{,\parallel}$	$Nr_{,\perp}$
6.0 × 60	6	44	1.243	0.826	1.360	0.905	1.392	0.926	1.438	0.957	1.468	0.977	1.554	1.035
6.0 × 70		54												
6.0 × 80		64												
6.0 × 90		74												
6.0 × 100		84												
6.0 × 110		94												
6.0 × 120		104												
6.0 × 140		124												
6.0 × 150		134												
6.0 × 160		144												
6.0 × 180		164												
6.0 × 200		184												
6.0 × 220		204												
6.0 × 240		224												
6.0 × 260		244												
6.0 × 280		264												
6.0 × 300		284												
8.0 × 80		60	1.961	1.304	2.147	1.428	2.197	1.462	2.269	1.510	2.317	1.542	2.452	1.633
8.0 × 90		70												
8.0 × 100		80												
8.0 × 120		100												
8.0 × 140		120												
8.0 × 160		140												
8.0 × 180		160												
8.0 × 200		180												
8.0 × 220		200												
8.0 × 240		220												
8.0 × 260		240												
8.0 × 280		260												
8.0 × 300		280												
8.0 × 320		300												
8.0 × 340		320												

2. Reference design values

Table 2.4: Continued

Fastener Designation Diameter × Length (mm)	Side Member Thickness, t_1 (mm)	Main Member Dowel Bearing Length[5], t_2 (mm)	Factored Lateral Resistance (kN) for Partial Thread Screws in Steel-Wood Connections for Specific Gravities of[1, 2, 3, 4]											
			0.35		0.42		0.44		0.47		0.49		0.55	
			$Nr_{,\parallel}$	$Nr_{,\perp}$	$Nr_{,\parallel}$	$Nr_{,\perp}$	$Nr_{,\parallel}$	$Nr_{,\perp}$	$Nr_{,\parallel}$	$Nr_{,\perp}$	$Nr_{,\parallel}$	$Nr_{,\perp}$	$Nr_{,\parallel}$	$Nr_{,\perp}$
8 × 360	6	340	1.961	1.304	2.147	1.428	2.197	1.462	2.269	1.510	2.317	1.542	2.452	1.633
8 × 380		360												
8 × 400		380												
8 × 420		400												
8 × 460		440												
8 × 500		480												
10 × 80		58	3.018	1.765	3.303	2.118	3.380	2.219	3.492	2.324	3.564	2.373	3.773	2.513
10 × 100		78		2.007		2.198		2.249						
10 × 120		98												
10 × 140		118												
10 × 160		138												
10 × 180		158												
10 × 200		178												
10 × 220		198												
10 × 240		218												
10 × 260		238												
10 × 280		258												
10 × 300		278												
10 × 320		298												
10 × 340		318												
10 × 360		338												
10 × 380		358												
10 × 400		378												
10 × 420		398												
10 × 460		438												
10 × 480		458												

Notes:

[1] Values must be multiplied by all applicable adjustment factors, in accordance with CSA 086:19. For use in dry conditions only.

[2] Tabulated reference lateral design values, N_r apply to screws driven into the side grain of the main member, such that the screws are oriented perpendicular to the grain and loaded as follows:

- $N_{r,\parallel}$ main member is loaded parallel to the grain.
- $N_{r,\perp}$ main member is loaded perpendicular to the grain.

[3] Tabulated lateral design values are based on side member dowel bearing strength of 450 MPa for ASTM A36 steel.

[4] The value f_y used in calculating tables 2.2–2.7 is the value f_y[1] from Table 2.1

[5] Main member dowel bearing length, t_2 is defined as fastener penetration into the main member minus the length of the tapered tip of the screw.

2. Reference design values

The reference lateral design values for SFS HTP and WR are provided in Tables 2.2–2.7. The factored withdrawal and factored head pull-through values are provided in Tables 2.8, 2.9 and 2.10 respectively. The appropriate modification values shall be used as described in Section 1.2 of this design guide.

Figure 2.4

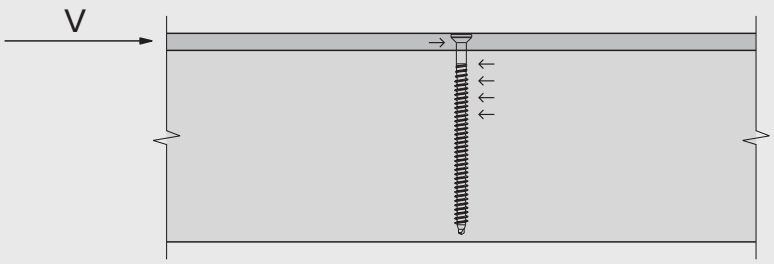


Table 2.5: Reference lateral design values—single shear steel-to-wood connection, full thread

Fastener Designation Diameter × Length (mm)	Side Member Thickness, t_1 (mm)	Main Member Dowel Bearing Length[5], t_2 (mm)	Factored Lateral Resistance (kN) for Full Thread Screws in Steel-Wood Connections for Specific Gravities of [1, 2, 3, 4]											
			0.35		0.42		0.44		0.47		0.49		0.55	
			$Nr_{,\parallel}$	$Nr_{,\perp}$	$Nr_{,\parallel}$	$Nr_{,\perp}$	$Nr_{,\parallel}$	$Nr_{,\perp}$	$Nr_{,\parallel}$	$Nr_{,\perp}$	$Nr_{,\parallel}$	$Nr_{,\perp}$	$Nr_{,\parallel}$	$Nr_{,\perp}$
6.0 × 40	6	24	0.853	0.401	0.934	0.481	0.956	0.504	0.987	0.539	1.008	0.562	1.067	0.631
6.0 × 60		44		0.568		0.622		0.636		0.657		0.671		0.711
6.0 × 80		64												
6.0 × 100		84												
6.0 × 120		104												
6.0 × 140		124												
6.0 × 160		144												
8.0 × 60		40	1.623	0.921	1.777	1.105	1.818	1.158	1.878	1.237	1.917	1.276	2.030	1.352
8.0 × 80		60		1.079		1.182		1.210		1.250				
8.0 × 100		80												
8.0 × 120		100												
8.0 × 160		140												
8.0 × 180		160												
8.0 × 200		180												
8.0 × 220		200												
8.0 × 240		220												
8.0 × 260		240												
8.0 × 280		260												
8.0 × 300		280												
8.0 × 340		320												
8.0 × 380		360												
10.0 × 120		98	2.356	1.567	2.578	1.715	2.638	1.756	2.726	1.814	2.782	1.852	2.945	1.961
10.0 × 160		138												
10.0 × 200		178												
10.0 × 220		198												
10.0 × 240		218												
10.0 × 260		238												
10.0 × 280		258												
10.0 × 300		278												
10.0 × 340		318												
10.0 × 380		358												

2. Reference design values

Table 2.5: Continued

Fastener Designation Diameter × Length (mm)	Side Member Thickness, t_1 (mm)	Main Member Dowel Bearing Length[5], t_2 (mm)	Factored Lateral Resistance (kN) for Full Thread Screws in Steel-Wood Connections for Specific Gravities of[1, 2, 3, 4]											
			0.35		0.42		0.44		0.47		0.49		0.55	
			$Nr_{,\parallel}$	$Nr_{,\perp}$	$Nr_{,\parallel}$	$Nr_{,\perp}$	$Nr_{,\parallel}$	$Nr_{,\perp}$	$Nr_{,\parallel}$	$Nr_{,\perp}$	$Nr_{,\parallel}$	$Nr_{,\perp}$	$Nr_{,\parallel}$	$Nr_{,\perp}$
13.0 × 400	6	377	4.176	2.777	4.570	3.041	4.677	3.112	4.832	3.216	4.932	3.283	5.222	3.477
13.0 × 500		477												
13.0 × 600		577												
13.0 × 700		677												
13.0 × 800		777												
13.0 × 900		877												
13.0 × 1000		977												

Notes:
[1] Values must be multiplied by all applicable adjustment factors, in accordance with CSA 086:19. For use in dry conditions only.
[2] Tabulated reference lateral design values, N_r apply to screws driven into the side grain of the main member, such that the screws are oriented perpendicular to the grain and loaded as follows:
- $N_{r,\parallel}$ main member is loaded parallel to the grain.
- $N_{r,\perp}$ main member is loaded perpendicular to the grain.

[3] Tabulated lateral design values are based on side member dowel bearing strength of 450 MPa for ASTM A36 steel.
[4] The value f_y used in calculating tables 2.2–2.7 is the value f_y^1 from Table 2.1
[5] Main member dowel bearing length,t_2 is defined as fastener penetration into the main member minus the length of the tapered tip of the screw.

2. Reference design values

The reference lateral design values for SFS HTP and WR are provided in Tables 2.2–2.7. The factored withdrawal and factored head pull-through values are provided in Tables 2.8, 2.9 and 2.10 respectively. The appropriate modification values shall be used as described in Section 1.2 of this design guide.

Figure 2.5

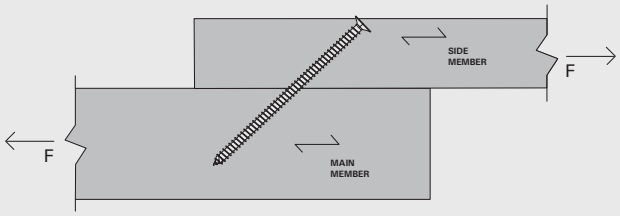


Table 2.6: Reference lateral design values—wood-to-wood connection, 45° angle to grain, full thread

Fastener Designation Diameter × Length (mm)	Side Member Thickness, t_1 (mm)	Main Member Embed-ment Length[4], t_2 (mm)	Factored Lateral Resistance (kN) for Full Thread Screws in Wood-Wood Connections, 45 degree angle to grain for Specific Gravities of [1,2,3]											
			0.35				0.42				0.44			
			$Nr_{r\|\|,45}$	$Nr_{r\|\|/\perp,45}$	$Nr_{r\perp/\|\|,45}$	$Nr_{r\perp,45}$	$Nr_{r\|\|,45}$	$Nr_{r\|\|/\perp,45}$	$Nr_{r\perp/\|\|,45}$	$Nr_{r\perp,45}$	$Nr_{r\|\|,45}$	$Nr_{r\|\|/\perp,45}$	$Nr_{r\perp/\|\|,45}$	$Nr_{r\perp,45}$
6.0 × 80	25	45	1.00	1.00	1.00	1.00	1.15	1.15	1.15	1.15	1.19	1.19	1.19	1.19
6.0 × 100	38	46	1.31	1.31	1.31	1.31	1.51	1.51	1.51	1.51	1.55	1.55	1.55	1.55
6.0 × 120		66	1.52	1.52	1.52	1.52	1.75	1.75	1.75	1.75	1.81	1.81	1.81	1.81
6.0 × 140	50	69	1.96	1.96	1.96	1.96	2.26	2.26	2.26	2.26	2.33	2.33	2.33	2.33
6.0 × 160		89	2.00	2.00	2.00	2.00	2.30	2.30	2.30	2.30	2.38	2.38	2.38	2.38
8.0 × 100	38	46	1.75	1.75	1.75	1.75	2.01	2.01	2.01	2.01	2.07	2.07	2.07	2.07
8.0 × 120		66	2.03	2.03	2.03	2.03	2.33	2.33	2.33	2.33	2.41	2.41	2.41	2.41
8.0 × 160	60	75	2.84	2.84	2.84	2.84	3.26	3.26	3.26	3.26	3.37	3.37	3.37	3.37
8.0 × 180		95	3.20	3.20	3.20	3.20	3.68	3.68	3.68	3.68	3.80	3.80	3.80	3.80
8.0 × 200	76	93	3.49	3.49	3.49	3.49	4.02	4.02	4.02	4.02	4.15	4.15	4.15	4.15
8.0 × 220		113	4.06	4.06	4.06	4.06	4.67	4.67	4.67	4.67	4.81	4.81	4.81	4.81
8.0 × 240	85	120	4.52	4.52	4.52	4.52	5.20	5.20	5.20	5.20	5.37	5.37	5.37	5.37
8.0 × 260		140	4.54	4.54	4.54	4.54	5.22	5.22	5.22	5.22	5.38	5.38	5.38	5.38
8.0 × 280	100	139	5.23	5.23	5.23	5.23	6.02	6.02	6.02	6.02	6.21	6.21	6.21	6.21
8.0 × 300		159	5.34	5.34	5.34	5.34	6.14	6.14	6.14	6.14	6.33	6.33	6.33	6.33
8.0 × 340	114	179	6.09	6.09	6.09	6.09	7.00	7.00	7.00	7.00	7.22	7.22	7.22	7.22
8.0 × 380	138	185	6.98	6.98	6.98	6.98	8.03	8.03	8.03	8.03	8.28	8.28	8.28	8.28
10.0 × 120	38	66	2.54	2.54	2.54	2.54	2.92	2.92	2.92	2.92	3.01	3.01	3.01	3.01
10.0 × 160	50	89	3.34	3.34	3.34	3.34	3.84	3.84	3.84	3.84	3.96	3.96	3.96	3.96
10.0 × 200	76	93	4.37	4.37	4.37	4.37	5.02	5.02	5.02	5.02	5.18	5.18	5.18	5.18
10.0 × 220		113	5.07	5.07	5.07	5.07	5.83	5.83	5.83	5.83	6.02	6.02	6.02	6.02
10.0 × 240	85	120	5.66	5.66	5.66	5.66	6.50	6.50	6.50	6.50	6.71	6.71	6.71	6.71
10.0 × 260		140	5.67	5.67	5.67	5.67	6.52	6.52	6.52	6.52	6.73	6.73	6.73	6.73
10.0 × 280	100	139	6.54	6.54	6.54	6.54	7.52	7.52	7.52	7.52	7.76	7.76	7.76	7.76
10.0 × 300		159	6.67	6.67	6.67	6.67	7.67	7.67	7.67	7.67	7.92	7.92	7.92	7.92
10.0 × 340	120	170	8.01	8.01	8.01	8.01	9.21	9.21	9.21	9.21	9.50	9.50	9.50	9.50
10.0 × 380	138	185	8.73	8.73	8.73	8.73	10.03	10.03	10.03	10.03	10.35	10.35	10.35	10.35
13.0 × 400		205	11.97	11.97	11.97	11.97	13.77	13.77	13.77	13.77	14.21	14.21	14.21	14.21
13.0 × 500	175	253	15.18	15.18	15.18	15.18	17.46	17.46	17.46	17.46	18.01	18.01	18.01	18.01
13.0 × 600	215	296	18.16	18.16	18.16	18.16	20.88	20.88	20.88	20.88	21.55	21.55	21.55	21.55
13.0 × 700	252	344	21.09	21.09	21.09	21.09	24.25	24.25	24.25	24.25	25.02	25.02	25.02	25.02
13.0 × 800	275	411	23.86	23.86	23.86	23.86	27.43	27.43	27.43	27.43	28.31	28.31	28.31	28.31
13.0 × 900	330	433	26.59	26.59	26.59	26.59	30.57	30.57	30.57	30.57	31.12	31.12	31.12	31.12
13.0 × 1000	350	505	30.37	30.37	30.37	30.37	31.12	31.12	31.12	31.12				

2. Reference design values

Table 2.6: Continued

Fastener Designation Diameter × Length (mm)	Side Member Thickness, t_1 (mm)	Main Member Embedment Length[4], t_2 (mm)	Factored Lateral Resistance (kN) for Full Thread Screws in Wood-Wood Connections, 45 degree angle to grain for Specific Gravities of [1, 2, 3]											
			0.47				0.49				0.55			
			$Nr_{r\|\|r45}$	$Nr_{r\|\|/\perp r45}$	$Nr_{r\perp/\|\|r45}$	$Nr_{r\perp r45}$	$Nr_{r\|\|r45}$	$Nr_{r\|\|/\perp r45}$	$Nr_{r\perp/\|\|r45}$	$Nr_{r\perp r45}$	$Nr_{r\|\|r45}$	$Nr_{r\|\|/\perp r45}$	$Nr_{r\perp/\|\|r45}$	$Nr_{r\perp r45}$
6.0 × 80	25	45	1.25	1.25	1.25	1.25	1.30	1.30	1.30	1.30	1.41	1.41	1.41	1.41
6.0 × 100	38	46	1.63	1.63	1.63	1.63	1.70	1.70	1.70	1.70	1.85	1.85	1.85	1.85
6.0 × 120		66	1.90	1.90	1.90	1.90	1.97	1.97	1.97	1.97	2.15	2.15	2.15	2.15
6.0 × 140	50	69	2.45	2.45	2.45	2.45	2.54	2.54	2.54	2.54	2.77	2.77	2.77	2.77
6.0 × 160		89	2.50	2.50	2.50	2.50	2.59	2.59	2.59	2.59	2.83	2.83	2.83	2.83
8.0 × 100	38	46	2.18	2.18	2.18	2.18	2.26	2.26	2.26	2.26	2.47	2.47	2.47	2.47
8.0 × 120		66	2.53	2.53	2.53	2.53	2.63	2.63	2.63	2.63	2.87	2.87	2.87	2.87
8.0 × 160	60	75	3.54	3.54	3.54	3.54	3.67	3.67	3.67	3.67	4.01	4.01	4.01	4.01
8.0 × 180		95	3.99	3.99	3.99	3.99	4.15	4.15	4.15	4.15	4.52	4.52	4.52	4.52
8.0 × 200	76	93	4.36	4.36	4.36	4.36	4.52	4.52	4.52	4.52	4.94	4.94	4.94	4.94
8.0 × 220		113	5.06	5.06	5.06	5.06	5.25	5.25	5.25	5.25	5.73	5.73	5.73	5.73
8.0 × 240	85	120	5.64	5.64	5.64	5.64	5.86	5.86	5.86	5.86	6.39	6.39	6.39	6.39
8.0 × 260		140	5.66	5.66	5.66	5.66	5.88	5.88	5.88	5.88	6.41	6.41	6.41	6.41
8.0 × 280	100	139	6.53	6.53	6.53	6.53	6.78	6.78	6.78	6.78	7.39	7.39	7.39	7.39
8.0 × 300		159	6.66	6.66	6.66	6.66	6.91	6.91	6.91	6.91	7.54	7.54	7.54	7.54
8.0 × 340	114	179	7.59	7.59	7.59	7.59	7.88	7.88	7.88	7.88	8.60	8.60	8.60	8.60
8.0 × 380	138	185	8.70	8.70	8.70	8.70	9.04	9.04	9.04	9.04	9.86	9.86	9.86	9.86
10.0 × 120	38	66	3.16	3.16	3.16	3.16	3.28	3.28	3.28	3.28	3.58	3.58	3.58	3.58
10.0 × 160	50	89	4.16	4.16	4.16	4.16	4.32	4.32	4.32	4.32	4.71	4.71	4.71	4.71
10.0 × 200	76	93	5.45	5.45	5.45	5.45	5.65	5.65	5.65	5.65	6.17	6.17	6.17	6.17
10.0 × 220		113	6.32	6.32	6.32	6.32	6.57	6.57	6.57	6.57	7.16	7.16	7.16	7.16
10.0 × 240	85	120	7.05	7.05	7.05	7.05	7.32	7.32	7.32	7.32	7.99	7.99	7.99	7.99
10.0 × 260		140	7.07	7.07	7.07	7.07	7.34	7.34	7.34	7.34	8.01	8.01	8.01	8.01
10.0 × 280	100	139	8.16	8.16	8.16	8.16	8.47	8.47	8.47	8.47	9.24	9.24	9.24	9.24
10.0 × 300		159	8.32	8.32	8.32	8.32	8.64	8.64	8.64	8.64	9.43	9.43	9.43	9.43
10.0 × 340	120	170	9.99	9.99	9.99	9.99	10.37	10.37	10.37	10.37	11.31	11.31	11.31	11.31
10.0 × 380	138	185	10.88	10.88	10.88	10.88	11.30	11.30	11.30	11.30	12.32	12.32	12.32	12.32
13.0 × 400		205	14.93	14.93	14.93	14.93	15.50	15.50	15.50	15.50	16.91	16.91	16.91	16.91
13.0 × 500	175	253	18.93	18.93	18.93	18.93	19.66	19.66	19.66	19.66	21.45	21.45	21.45	21.45
13.0 × 600	215	296	22.65	22.65	22.65	22.65	23.51	23.51	23.51	23.51	25.65	25.65	25.65	25.65
13.0 × 700	252	344	26.29	26.29	26.29	26.29	27.30	27.30	27.30	27.30	29.79	29.79	29.79	29.79
13.0 × 800	275	411	29.75	29.75	29.75	29.75	30.89	30.89	30.89	30.89	31.12	31.12	31.12	31.12
13.0 × 900	330	433	31.12	31.12	31.12	31.12	31.12	31.12	31.12	31.12				
13.0 × 1000	350	505												

Notes:

[1] Values must be multiplied by all applicable adjustment factors, in accordance with CSA 086:19. For use in dry conditions only.

[2] Tabulated reference lateral design values, N_r apply to screws driven into the side grain of the main member, such that the screws are oriented 45 degrees to the grain.

- $N_{r,||,45}$ both side and main member are loaded parallel to the grain.
- $N_{r,||/\perp,45}$ side member loaded perpendicular to the grain and main member loaded parallel to the grain.
- $N_{r,\perp/||,45}$ side member loaded parallel to the grain and main member loaded perpendicular to the grain.
- $N_{r,\perp,45}$ both side and main member are loaded perpendicular to the grain.

[3] The value f_y used in calculating tables 2.2–2.7 is the value f_y[1] from Table 2.1

[4] Main member embedment length,t_2 is defined as fastener penetration into the main member minus the length of the tapered tip of the screw (measured along actual length of screw).

2. Reference design values

The reference lateral design values for SFS HTP and WR are provided in Tables 2.2–2.7. The factored withdrawal and factored head pull-through values are provided in Tables 2.8, 2.9 and 2.10 respectively. The appropriate modification values shall be used as described in Section 1.2 of this design guide

Figure 2.6

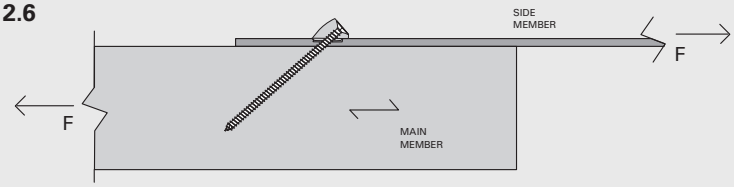


Table 2.7: Reference lateral design values—steel-to-wood connection, 45° angle to grain, full thread

Fastener Designation Diameter × Length (mm)	Side Member Thickness, t_1 (mm)	Main Member Embedment Depth[4], t_2 (mm)	Factored Lateral Resistance (kN) for Full Thread Screws in Steel-Wood Connections for Specific Gravities of [1, 2, 3]					
			0.35	0.42	0.44	0.47	0.49	0.55
			$Nr_{r\|\|,45}$	$Nr_{r\|\|,45}$	$Nr_{r\|\|,45}$	$Nr_{r\|\|,45}$	$Nr_{r\|\|,45}$	$Nr_{r\|\|,45}$
6.0 × 40	6	31	0.88	1.01	1.04	1.10	1.14	1.24
6.0 × 60		51	1.45	1.66	1.71	1.80	1.87	2.04
6.0 × 80		71	2.01	2.31	2.39	2.51	2.60	2.84
6.0 × 100		91	2.58	2.96	3.06	3.21	3.34	3.64
6.0 × 120		111	3.14	3.61	3.73	3.92	4.07	4.44
6.0 × 140		131	3.71	4.27	4.40	4.63	4.80	5.24
6.0 × 160		151	4.28	4.92	5.07	5.33	5.54	6.04
8.0 × 60		51	1.93	2.22	2.29	2.40	2.49	2.72
8.0 × 80		71	2.68	3.08	3.18	3.34	3.47	3.79
8.0 × 100		91	3.44	3.95	4.08	4.29	4.45	4.85
8.0 × 120		111	4.19	4.82	4.97	5.23	5.43	5.92
8.0 × 160		151	5.70	6.56	6.77	7.11	7.38	8.05
8.0 × 180		171	6.46	7.42	7.66	8.05	8.36	9.12
8.0 × 200		191	7.21	8.29	8.56	8.99	9.34	10.19
8.0 × 220		211	7.97	9.16	9.45	9.94	10.32	11.25
8.0 × 240		231	8.72	10.03	10.35	10.88	11.29	11.32
8.0 × 260		251	9.48	10.90	11.25	11.32	11.32	
8.0 × 280		271	10.23	11.32	11.32			
8.0 × 300		291	10.99					
8.0 × 340		331	11.32					
8.0 × 380		371						
10.0 × 120		111	5.24	6.02	6.22	6.53	6.78	7.40
10.0 × 160		151	7.13	8.20	8.46	8.89	9.23	10.07
10.0 × 200		191	9.02	10.37	10.70	11.24	11.67	12.74
10.0 × 220		211	9.96	11.45	11.82	12.42	12.90	14.07
10.0 × 240		231	10.90	12.54	12.94	13.60	14.12	15.40
10.0 × 260		251	11.85	13.62	14.06	14.77	15.34	16.74
10.0 × 280		271	12.79	14.71	15.18	15.95	16.56	16.97
10.0 × 300		291	13.74	15.79	16.30	16.97	16.97	
10.0 × 340		331	15.63	16.97	16.97			
10.0 × 380		371	16.97					
13.0 × 400		391	26.03	29.92	30.88	31.12	31.12	31.12
13.0 × 500		491	30.12	31.12	31.12			
13.0 × 600		591	31.12					
13.0 × 700		691						

Table 2.7: Continued

Fastener Designation Diameter × Length (mm)	Side Member Thickness, t_1 (mm)	Main Member Embedment Depth[4], t_2 (mm)	Factored Lateral Resistance (kN) for Full Thread Screws in Steel-Wood Connections for Specific Gravities of [1, 2, 3]					
			0.35	0.42	0.44	0.47	0.49	0.55
			$Nr_{r\|\|r45}$	$Nr_{r\|\|r45}$	$Nr_{r\|\|r45}$	$Nr_{r\|\|r45}$	$Nr_{r\|\|r45}$	$Nr_{r\|\|r45}$
13.0 × 800	6	791	31.12	31.12	31.12	31.12	31.12	31.12
13.0 × 900		891						
13.0 × 1000		991						

Notes:
[1] Values must be multiplied by all applicable adjustment factors, in accordance with CSA 086:19. For use in dry conditions only.
[2] Tabulated lateral design values are based on side member dowel bearing strength of 450 MPa for ASTM A36 steel.
[3] The value f_y used in calculating tables 2.2–2.7 is the value f_y[1] from Table 2.1
[4] Main member embedment length, t_2 is defined as fastener penetration into the main member including the length of the tapered tip of the screw (measured along actual length of screw).

2. Reference design values

Figure 2.7.1

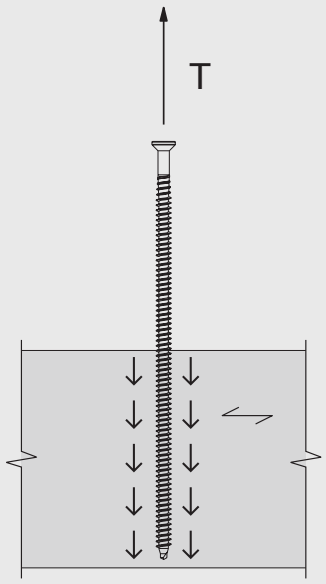


Figure 2.7.2

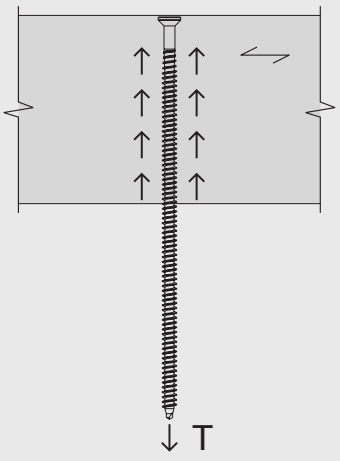


Table 2.8: Factored withdrawal resistance, P_{rw} (kN/20 mm) and factored tensile resistance, T_r[1, 2, 3, 4]

	Factored withdrawal resistance, P_{rw} (kN/20 mm embedment) for G								Factored tensile resistance, T_r
Screw	**d (mm)**	**0.35**	**0.42**	**0.44**	**0.46**	**0.47**	**0.49**	**0.50**	**0.55**	**(kN)**
HTP 6 mm	6.0	0.80	0.92	0.95	0.99	1.00	1.04	1.06	1.13	9.04
HTP 8 mm	8.0	1.07	1.23	1.27	1.32	1.33	1.38	1.41	1.51	16.00
HTP 10 mm	10.0	1.34	1.54	1.59	1.65	1.67	1.73	1.76	1.89	24.00
WR	13.0	1.74	2.00	2.06	2.14	2.17	2.25	2.29	2.45	44.00

[1] Factored withdrawal per 20 mm embedment and using Kd = 1, Φequiv (standard adjustment factor) = 0.77
[2] Calculated withdrawal value must not exceed factored tensile resistance, T_r of the screw
[3] Factored withdrawal, P_{rw}, includes the length of the tapered tip of the self-tapping screws when considering the embedment depth.
[4] n_{ef}, the effective number of screws in the connection, may be taken to be 1.0; however, a more conservative value can be applied as follows:

$n_{ef} = \max\{n^{0.9}; 0.9 \cdot n\}$ (Eq. 2-1)

Table 2.9: Alternate reference table for factored withdrawal resistance, P_{rw} (kN/mm) for G[1, 2, 3, 4]

	Factored withdrawal resistance, P_{rw} (kN/mm embedment) for G								Factored tensile resistance, T_r
Screw	**d (mm)**	**0.35**	**0.42**	**0.44**	**0.46**	**0.47**	**0.49**	**0.50**	**0.55**	**(kN)**
HTP 6 mm	6.0	0.040	0.046	0.048	0.050	0.050	0.052	0.053	0.057	9.04
HTP 8 mm	8.0	1.054	0.062	0.064	0.066	0.067	0.069	0.071	0.076	16.00
HTP 10 mm	10.0	0.067	0.077	0.080	0.083	0.084	0.087	0.088	0.095	24.00
WR	13.0	0.087	0.100	0.103	0.107	0.109	0.113	0.115	0.123	44.00

[1] Factored withdrawal per 20 mm embedment and using Kd = 1, Φequiv (standard adjustment factor) = 0.77
[2] Calculated withdrawal value must not exceed factored tensile resistance, T_r of the screw
[3] Factored withdrawal, P_{rw}, includes the length of the tapered tip of the self-tapping screws when considering the embedment depth.
[4] n_{ef}, the effective number of screws in the connection, may be taken to be 1.0; however, a more conservative value can be applied as follows:

$n_{ef} = \max\{n^{0.9}; 0.9 \cdot n\}$ (Eq. 2-1)

2. Reference design values

Figure 2.8

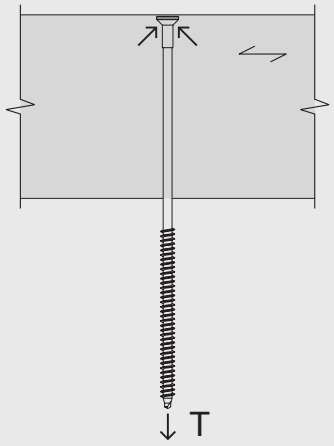


Table 2.10: Factored head pull through resistance, P_{rh} (kN) and factored tensile resistance, T_r[1]

		Factored head pull-through resistance, P_{rh} (kN) for G								Factored tensile resistance, T_r
Screw	**d_h[2] (mm)**	**0.35**	**0.42**	**0.44**	**0.46**	**0.47**	**0.49**	**0.50**	**0.55**	**(kN)**
HTP 6 mm countersunk	11.7	1.09	1.25	1.29	1.34	1.35	1.40	1.43	1.53	9.04
HTP 8 mm countersunk	14.8	1.74	2.00	2.06	2.14	2.16	2.25	2.29	2.45	16.00
HTP 10 mm countersunk	18.5	2.71	3.12	3.22	3.35	3.38	3.51	3.58	3.83	24.00
HTP 8mm hex	13.0	1.34	1.54	1.59	1.65	1.67	1.73	1.77	1.89	16.00
HTP 10 mm hex	15.0	1.78	2.05	2.12	2.20	2.22	2.31	2.35	2.52	24.00
HTP 6 mm flange	14.0	1.55	1.79	1.84	1.92	1.94	2.01	2.05	2.19	9.04
HTP 8 mm flange	18.0	2.57	2.95	3.05	3.17	3.20	3.32	3.39	3.63	16.00
HTP 10 mm flange	22.5	4.01	4.61	4.76	4.96	5.00	5.20	5.29	5.67	24.00
WR 13 mm countersunk	22.0	3.84	4.41	4.55	4.74	4.78	4.97	5.06	5.42	44.00

[1] Factored pull-through resistance based on minimum member thickness of 20 mm and using Kd = 1, Φequiv (standard adjustment factor) = 0.77
[2] d_h refers to screw head diameter.
[3] Calculated withdrawal value must not exceed factored tensile resistance, T_r of the screw

3. Connection geometry requirements

3.1: Connection geometry requirements without pre-drill

3.1.1: Lateral loading—in-line rows

Figure 3.1: Tension loading—parallel to grain

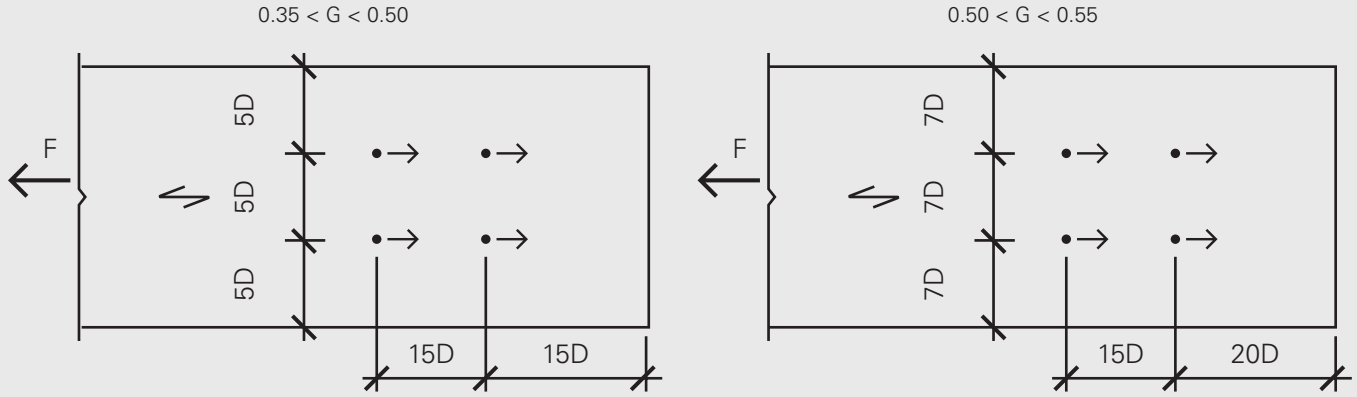
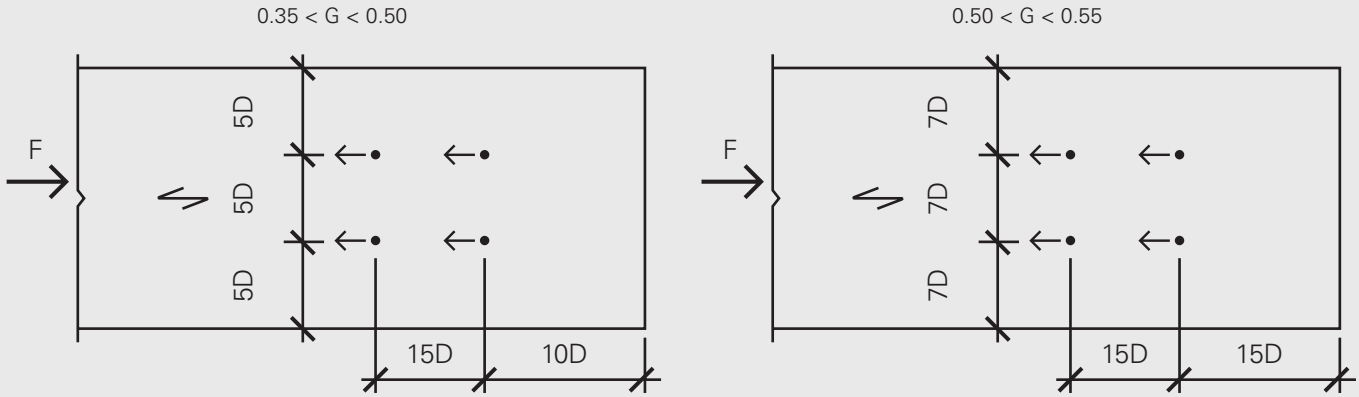
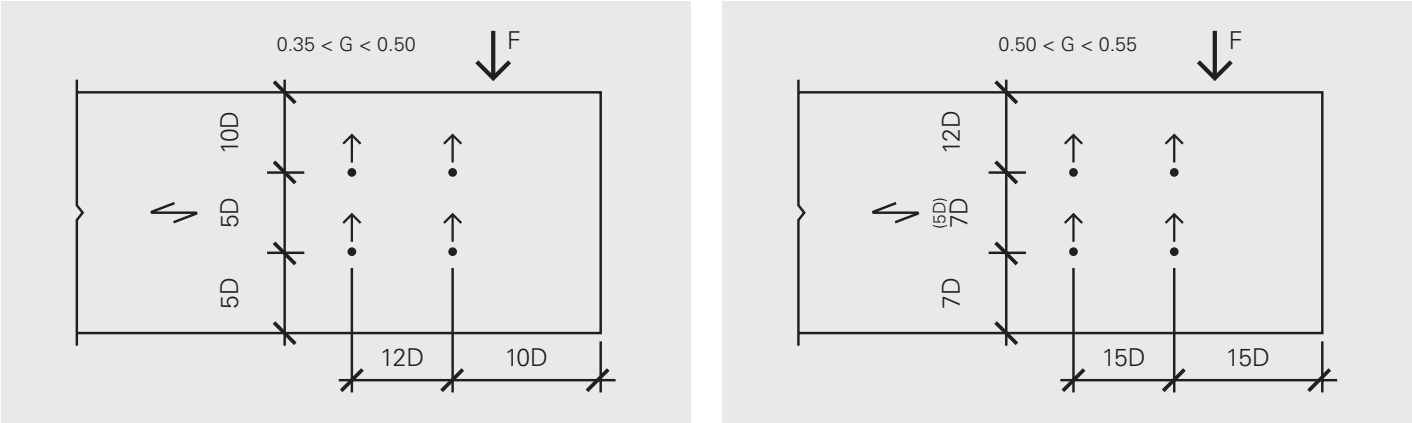


Figure 3.2: Compression loading—parallel to grain



3. Connection geometry requirements

Figure 3.3: Lateral loading—perpendicular to grain
Note: Values in parenthesis( ) apply to 10 mm and 13 mm screws only



3.1.2: Lateral loading—staggered rows
Note: Values apply to 6 mm and 8 mm screws

Figure 3.4: Tension loading—parallel to grain

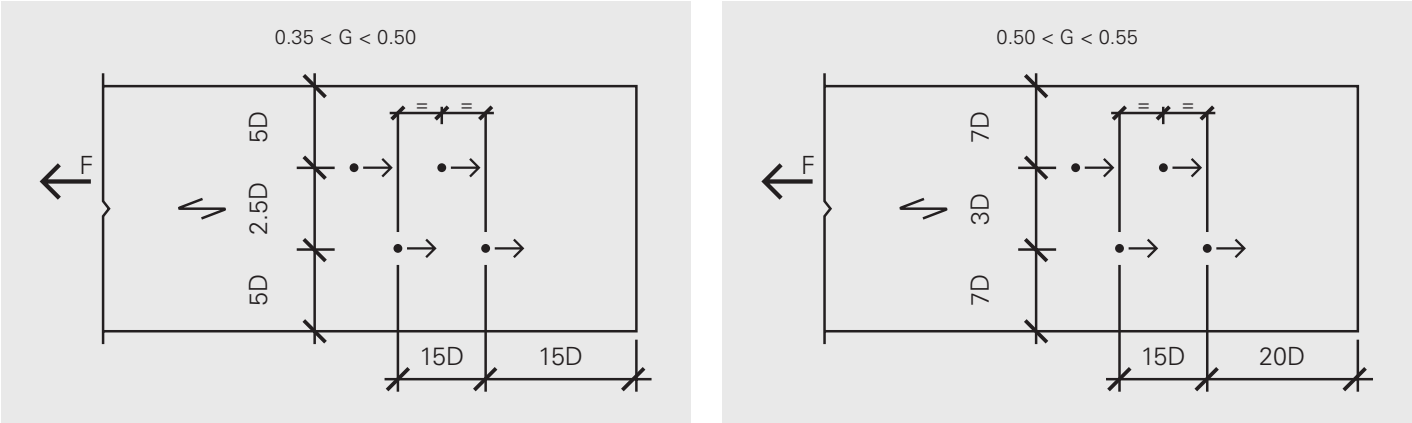
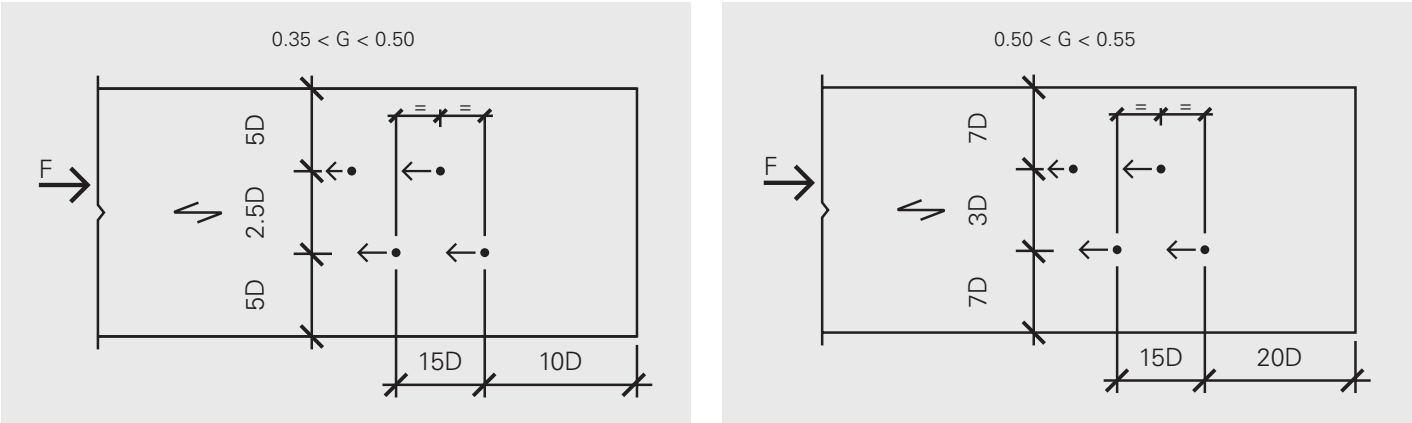
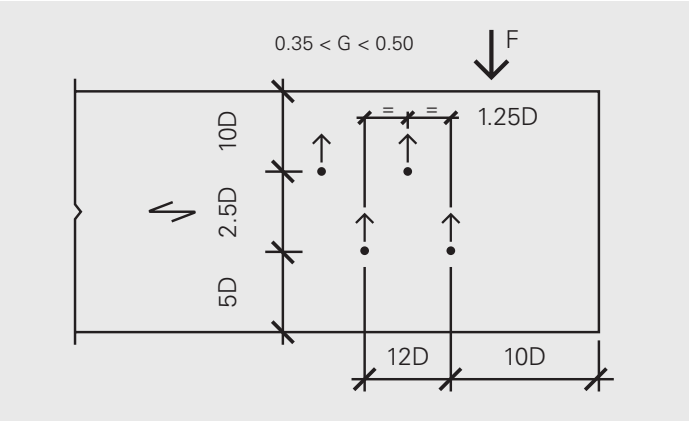


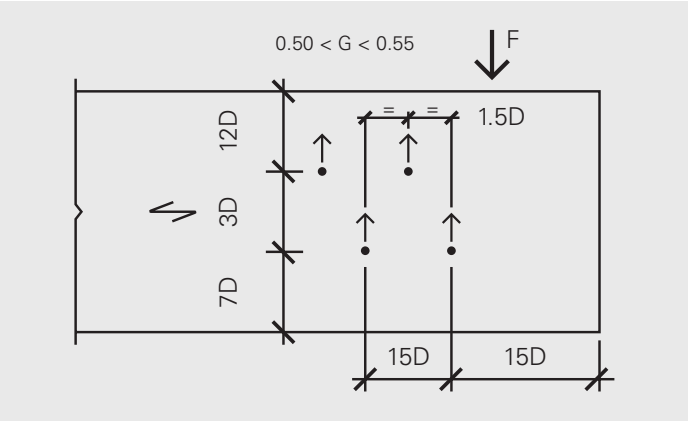
Figure 3.5: Compression loading—parallel to grain



3. Connection geometry requirements

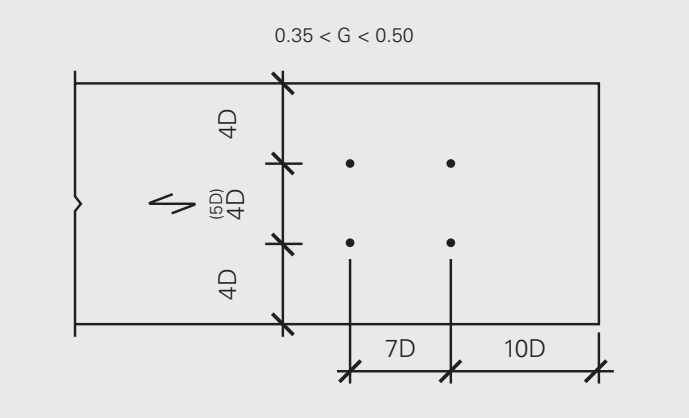
Figure 3.6: Lateral loading—perpendicular to grain





3.1.3: Axial loading

Figure 3.7: Axial loading (for all values of G)
Note: Values in parenthesis( ) apply to 10 mm and 13 mm screws only



3.1.4: Reference spacing

Table 3.1: Spacing table

	Screw diameter (mm)			
	6	**8**	**10**	**13**
2.5D	3	4	5	6.5
3D	18	24	30	39
4D	24	32	40	52
5D	30	40	50	65
7D	42	56	70	91
10D	60	80	100	130
12D	72	96	120	156
15D	190	120	150	195
20D	120	160	200	260

3. Connection geometry requirements

3.2: Connection geometry requirements with pre-drill (for all values of G)

3.2.1: Lateral loading—in-line rows

Values in parenthesis ( ) apply to 10 mm and 13 mm screws only

Figure 3.8: Tension loading—parallel to grain

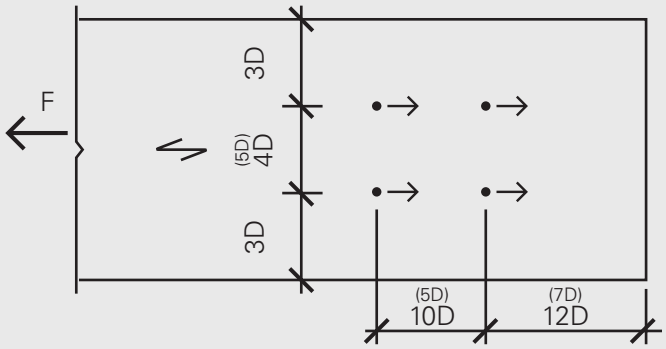


Figure 3.9: Compression loading—parallel to grain

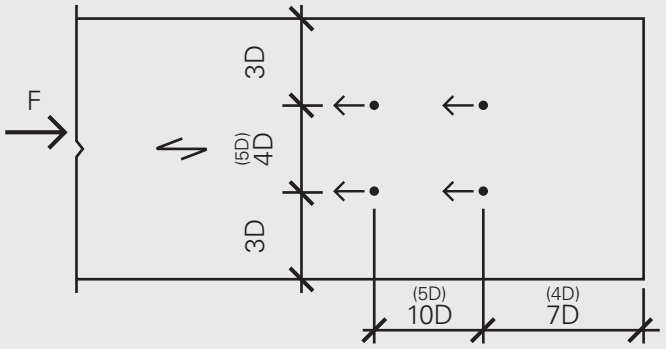
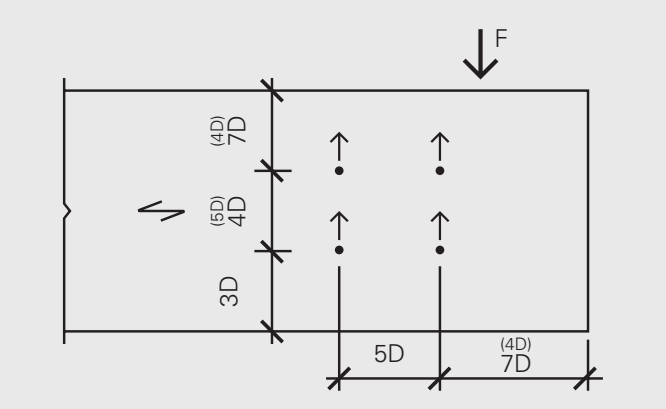


Figure 3.10: Lateral loading—perpendicular to grain

Values in parenthesis ( ) apply to 10 mm and 13 mm screws only



3. Connection geometry requirements

3.2.2: Lateral loading—staggered rows

Values only apply for 6 mm and 8 mm screws

Figure 3.11: Tension loading—parallel to grain

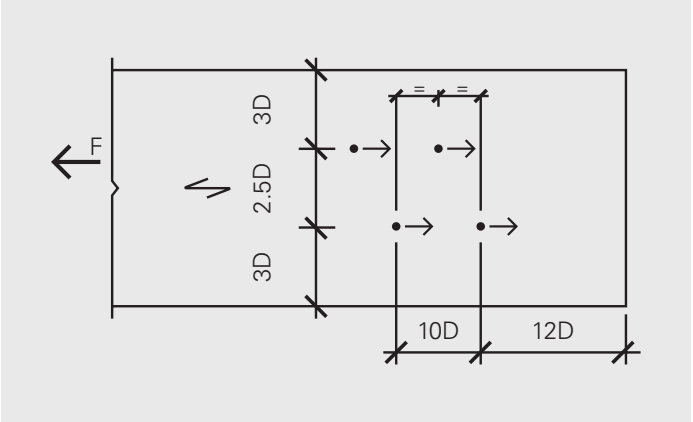


Figure 3.12: Compression loading—parallel to grain

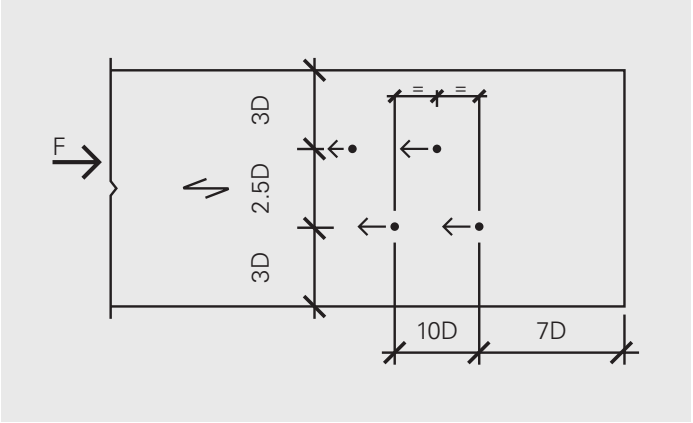
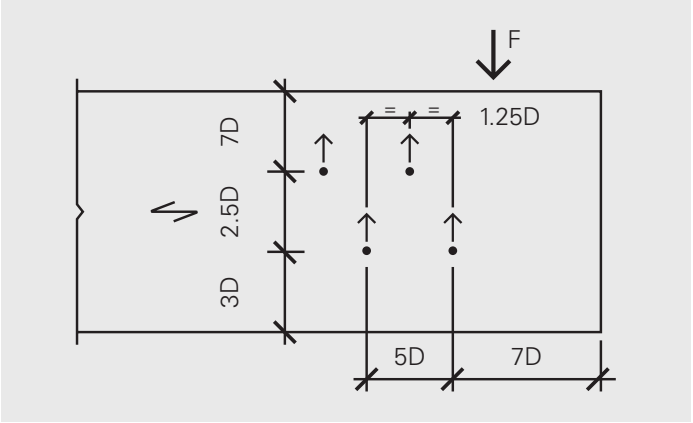


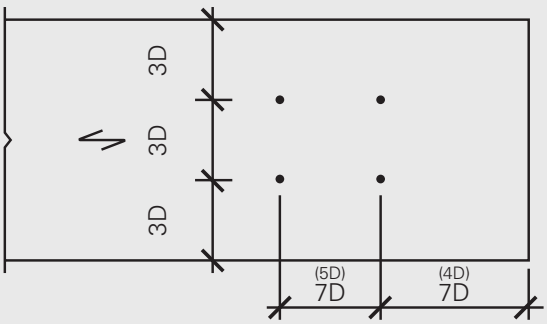
Figure 3.13: Lateral loading—perpendicular to grain



3. Connection geometry requirements

3.2.3: Axial loading

Figure 3.14: Axial loading
Values in parenthesis ( ) apply to 10 mm and 13 mm screws only



3.2.4: Reference spacing

Table 3.2: Spacing table

	Screw diameter (mm)			
	6	**8**	**10**	**13**
2.5D	3	4	5	6.5
3D	18	24	30	39
4D	24	32	40	52
5D	30	40	50	65
7D	42	56	70	91
10D	60	80	100	130
12D	72	96	120	156
15D	190	120	150	195
20D	120	160	200	260

4. Withdrawal at an angle to grain

Apply the following equation to reduce the reference withdrawal design value when screws are inserted at an angle to grain.

Reference withdrawal design value adjustments

Reference withdrawal design values ($P_{rw,\alpha}$) in kN/mm of thread penetration for screws installed at an angle α (in degrees) to the grain of the wood member must be determined as follows:

$$P_{rw,\alpha} = P_{rw} \cdot k_{\alpha}$$

Where:

P_{rw} = The reference withdrawal design value for α = 90° determined in accordance with Table 2.8.

k_{α} = Value from table 4.1

Table 4.1

Values of k_{α} for standard angles:

α	k_{α}	α	k_{α}
90	1.00	40	0.89
85		35	0.84
80		30	0.77
75		25	0.69
70		20	0.61
65		15	0.53
60		14*	0.52
55		10*	0.46
50		5*	0.38
45		0*	0.30

* At least four (4) screws required for structural connections with α <15°

Figure 4.1

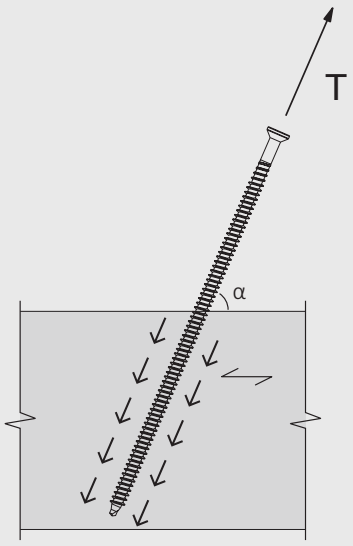
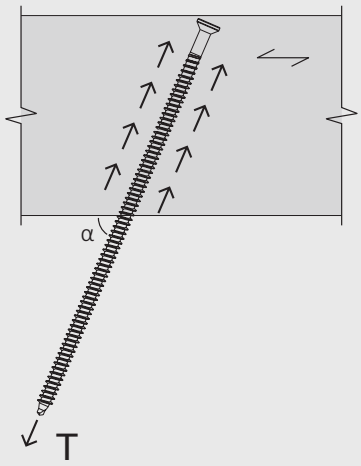


Figure 4.2



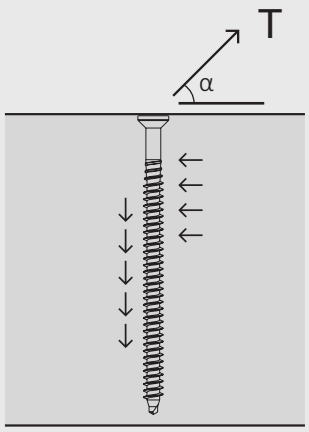
5. Combined lateral and withdrawal loading

For cases of combined lateral and withdrawal loading, the following expression should be satisfied:

$(P_{ax}/ P_{rw})^2+(P_v/N_r)^2 \leq 1$ (Eq. 5-1)

Where:
$P_{f,ax}$ = factored axial force on fastener
P_{rw} = factored withdrawal resistance of fastener (See Table 2.8)
$P_{f,v}$ = factored lateral force on fastener
N_r = factored lateral resistance of fastener (See Tables 2.2–2.7)

Figure 5.1



6. Compressive capacity for fully threaded screws

For screws in compression the following must be satisfied:

C_r = min {P_{rw}, C_{rb}}(Eq. 6-1)

Where:

P_{rw} = Factored withdrawal resistance (kN) from Table 2.8

C_{rb} = Factored compression (buckling) resistance (kN) from Table 6.1

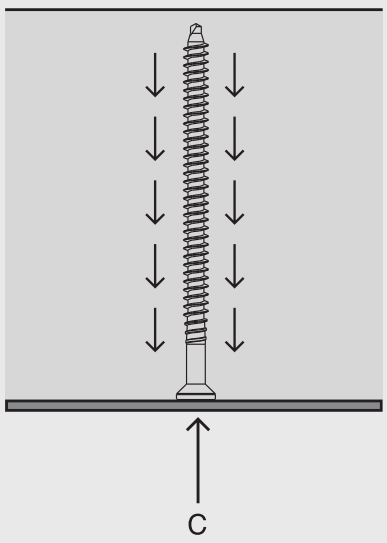
Table 6.1

Factored Compression (Buckling) Resistance (C_{rb}) in kN

d							**G**
(mm)	**0.35**	**0.42**	**0.44**	**0.46**	**0.47**	**0.49**	**0.55**
6	6.0	6.3	6.4	6.5	6.5	6.6	6.8
8	11.1	11.6	11.7	11.8	11.9	12.0	12.3
10	15.4	16.0	16.2	16.3	16.4	16.6	16.9
13	30.1	31.4	31.6	32.0	32.1	32.4	33.2

Note: Compression (buckling) resistance for self-tapping screws in timber assemblies is expressed as a single value, independent of the length of the screw.

Figure 6.1



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