HBS

COUNTERSUNK SCREW

ELC-4645 ESR-4645 UKTA-0836 22/6195 ETA-11/0030

3 THORNS TIP

Thanks to the 3 THORNS tip, minimum installation distances are reduced. More screws can be used in less space and larger screws in smaller elements. Costs and time for project implementation are reduced.

FAST

With the 3 THORNS tip, screw grip becomes more reliable and faster, while maintaining the usual mechanical performance.
More speed, less effort.

JOINTS WITH SOUNDPROOFING PROFILES

The screw has been tested and characterised in applications with sound-proofing layers (XYLOFON) interposed on the shear plane.
The impact of acoustic profiles on the mechanical performance of the HBS screw is described on page 86.

NEW-GENERATION TIMBER PRODUCTS

Tested and certified for use on a wide variety of engineered timbers such as CLT, GL, LVL, OSB and beech LVL.
Extremely versatile, the HBS screw guarantees the use of new-generation woods for the creation of increasingly innovative and sustainable structures.

MY PROJECT SOFTWARE

BIT INCLUDED

DIAMETER [in]	0.12 **0.14** — **0.48** 0.48
LENGTH [in]	1/2 **1 3/16** — **39 3/8** 39 3/8
EXPOSURE CONDITION	EC1 DRY
ATMOSPHERIC CORROSIVITY	C1 C2
WOOD CORROSIVITY	T1 T2
MATERIAL	Zn ELECTRO PLATED electrogalvanized carbon steel

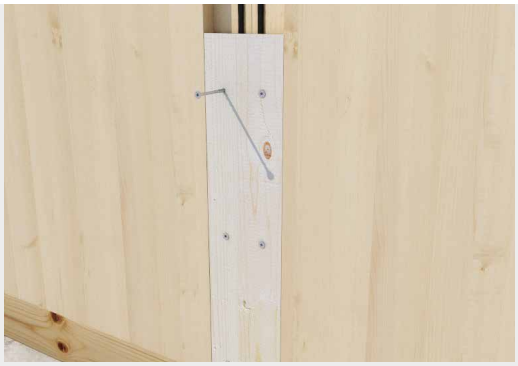
FIELDS OF USE

- timber based panels
- fibreboard, MDF, HDF and LDF
- plated and melamine faced panels
- glulam (Glued Laminated Timber)
- CLT and LVL
- soft woods (e.g. Spruce, Pine, Western red cedar)
- hard woods (e.g. Douglas Fir, Oak)

CLT, LVL AND HARDWOOD

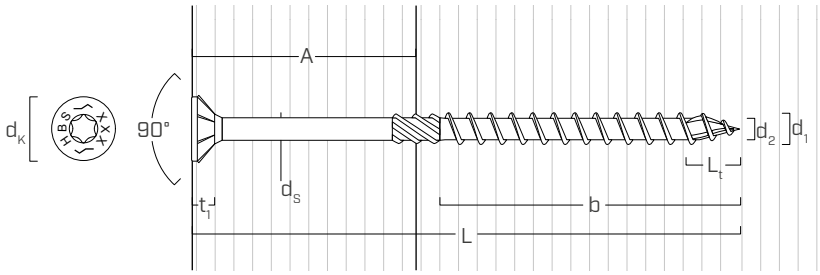
Values also tested, certified and calculated for CLT, LVL and high density woods such as beech LVL.

Wall insulation boards fastening with THERMOWASHER and HBS 0.32 inch (8 mm) diameter.



Fastening CLT walls with 0.24 inch (6 mm) diameter HBS screws.

GEOMETRY AND MECHANICAL CHARACTERISTICS



GEOMETRY

Nominal diameter	d_1	**[in]**(1)	**0.14**	**0.16**	**0.18**	**0.20**	**0.24**	**0.32**	**0.40**	**0.48**
Outer thread diameter	d_1	[mm]	3,5	4	4,5	5	6	8	10	12
		[in]	**0.138**	**0.157**	**0.177**	**0.197**	**0.236**	**0.315**	**0.394**	**0.472**
Head diameter	d_K	[in]	0.276	0.315	0.354	0.394	0.472	0.571	0.719	0.817
Root diameter	d_2	[in]	0.089	0.100	0.110	0.134	0.156	0.213	0.252	0.268
Shank diameter	d_S	[in]	0.096	0.108	0.124	0.144	0.169	0.228	0.276	0.315
Head thickness	t_1	[in]	0.087	0.110	0.110	0.122	0.177	0.177	0.228	0.283
Tip Length	L_t	[in]	0.138	0.157	0.177	0.197	0.236	0.315	0.394	0.472
Pre-drilling hole diameter(2)	$d_{V,G\leq0.55}$	[in]	-	-	-	1/8	5/32	13/64	15/64	9/32
Pre-drilling hole diameter(3)	$d_{V,G>0.55}$	[in]	-	-	-	9/64	5/32	15/64	9/32	5/16

(1) The nominal diameter of the screw is converted into imperial units and rounded up to the nearest decimal point.
(2) Pre-drilling applies to timber with G≤0.55 (optional).
(3) Pre-drilling applies to timber with G>0.55 (required).

MECHANICAL PARAMETERS

Nominal diameter	d_1	[in]	0.14	0.16	0.18	0.20	0.24	0.32	0.40	0.48
Tensile strength (allowable)	f_{tens}	[lbf]	320	430	540	680	1180	2040	2700	3060
Bending yield strength (specified)	$F_{y,b}$	[psi]	257000	248000	253500	220000	200000	180000	185000	190000

Nominal diameter	d_1	[in]		0.14	0.16	0.18	0.20	0.24	0.32	0.40	0.48
Withdrawal (design value)	W_{90}	[lbf/in]	G = 0.35	86	86	86	103	131	172	206	220
			G = 0.42	99	99	99	119	151	199	239	255
			G = 0.49	111	111	111	133	171	225	270	288
			G = 0.55	121	121	121	146	188	247	296	316
minimum embedded length		[in]		13/16	15/16	1 1/16	1 3/16	1 7/16	1 7/8	2 3/8	2 13/16
Head pull-through (design value)	W_H	[lbf]	G = 0.35	51	75	95	117	142	220	273	392
			G = 0.42	59	87	110	136	165	264	316	453
			G = 0.49	67	98	124	153	186	298	357	513
			G = 0.55	73	108	136	168	204	327	392	562
minimum side member thickness		[in]		1	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2

CODES AND DIMENSIONS

d_1 [mm] [in]	CODE	L [mm]	L [in]	b [mm]	b [in]	A [in]	pcs
3,5 **0.14** #6 TX 15	**HBS3540**	40	1 9/16	18	11/16	3/4	500
	HBS3545	45	1 3/4	24	15/16	3/4	400
	HBS3550	50	1 15/16	24	15/16	1	400
4 **0.16** #7 TX 20	**HBS430**	30	1 3/16	18	11/16	1/4	500
	HBS435	35	1 3/8	18	11/16	1/4	500
	HBS440	40	1 9/16	24	15/16	1/4	500
	HBS445	45	1 3/4	30	1 3/16	1/2	400
	HBS450	50	1 15/16	30	1 3/16	3/4	400
	HBS460	60	2 3/8	35	1 3/8	3/4	200
	HBS470	70	2 3/4	40	1 9/16	1	200
	HBS480	80	3 1/8	40	1 9/16	1 1/2	200
4,5 **0.18** #9 TX 20	**HBS4540**	40	1 9/16	24	15/16	1/2	400
	HBS4545	45	1 3/4	30	1 3/16	1/2	400
	HBS4550	50	1 15/16	30	1 3/16	3/4	200
	HBS4560	60	2 3/8	35	1 3/8	3/4	200
	HBS4570	70	2 3/4	40	1 9/16	1	200
	HBS4580	80	3 1/8	40	1 9/16	1 1/2	200
5 **0.20** #11 TX 25	**HBS540**	40	1 9/16	24	15/16	1/2	200
	HBS545	45	1 3/4	24	15/16	3/4	200
	HBS550	50	1 15/16	24	15/16	1	200
	HBS560	60	2 3/8	30	1 3/16	1	200
	HBS570	70	2 3/4	35	1 3/8	1 1/4	100
	HBS580	80	3 1/8	40	1 9/16	1 1/2	100
	HBS590	90	3 1/2	45	1 3/4	1 3/4	100
	HBS5100	100	4	50	1 15/16	1 3/4	100
	HBS5120	120	4 3/4	60	2 3/8	2 1/4	100
6 **0.24** #14 TX 30	**HBS640**	40	1 9/16	35	1 3/8	1/16	100
	HBS650	50	1 15/16	35	1 3/8	3/8	100
	HBS660	60	2 3/8	30	1 3/16	3/4	100
	HBS670	70	2 3/4	40	1 9/16	1	100
	HBS680	80	3 1/8	40	1 9/16	1 1/2	100
	HBS690	90	3 1/2	50	1 15/16	1 1/2	100
	HBS6100	100	4	50	1 15/16	1 3/4	100
	HBS6110	110	4 3/8	60	2 3/8	1 3/4	100
	HBS6120	120	4 3/4	60	2 3/8	2	100
	HBS6130	130	5 1/8	60	2 3/8	2 1/2	100
	HBS6140	140	5 1/2	75	2 15/16	2 1/2	100
	HBS6150	150	6	75	2 15/16	2 3/4	100
	HBS6160	160	6 1/4	75	2 15/16	3 1/4	100
	HBS6180	180	7 1/8	75	2 15/16	4	100
	HBS6200	200	8	75	2 15/16	4 3/4	100
	HBS6220	220	8 5/8	75	2 15/16	5 1/2	100
	HBS6240	240	9 1/2	75	2 15/16	6 1/4	100
	HBS6260	260	10 1/4	75	2 15/16	7	100
	HBS6280	280	11	75	2 15/16	8	100
	HBS6300	300	11 3/4	75	2 15/16	8 3/4	100
	HBS6320	320	12 5/8	75	2 15/16	9 1/2	100
	HBS6340	340	13 3/8	75	2 15/16	10 1/4	100
	HBS6360	360	14 1/4	75	2 15/16	11	100
	HBS6380	380	15	75	2 15/16	12	100
	HBS6400	400	15 3/4	75	2 15/16	12 3/4	100

d_1 [mm] [in]	CODE	L [mm]	L [in]	b [mm]	b [in]	A [in]	pcs
8 **0.32** TX 40	**HBS880**	80	3 1/8	52	2 1/16	1	100
	HBS8100	100	4	52	2 1/16	1 3/4	100
	HBS8120	120	4 3/4	60	2 3/8	2 1/4	100
	HBS8140	140	5 1/2	60	2 3/8	3	100
	HBS8160	160	6 1/4	80	3 1/8	3	100
	HBS8180	180	7 1/8	80	3 1/8	3 3/4	100
	HBS8200	200	8	80	3 1/8	4 1/2	100
	HBS8220	220	8 5/8	80	3 1/8	5 1/2	100
	HBS8240	240	9 1/2	80	3 1/8	6 1/4	100
	HBS8260	260	10 1/4	80	3 1/8	7	100
	HBS8280	280	11	80	3 1/8	7 3/4	100
	HBS8300	300	11 3/4	100	4	7 3/4	100
	HBS8320	320	12 5/8	100	4	8 1/2	100
	HBS8340	340	13 3/8	100	4	9 1/4	100
	HBS8360	360	14 1/4	100	4	10	100
	HBS8380	380	15	100	4	11	100
	HBS8400	400	15 3/4	100	4	11 1/2	100
	HBS8440	440	17 1/4	100	4	13 1/4	100
	HBS8480	480	19	100	4	14 3/4	100
	HBS8520	520	20 1/2	100	4	16 1/2	100
	HBS8560	560	22	100	4	18	100
	HBS8580	580	22 13/16	100	4	18 3/4	100
	HBS8600	600	23 5/8	100	4	19 1/2	100
10 **0.40** TX 40	**HBS1080**	80	3 1/8	52	2 1/16	1/2	50
	HBS10100	100	4	52	2 1/16	1	50
	HBS10120	120	4 3/4	60	2 3/8	2 1/8	50
	HBS10140	140	5 1/2	60	2 3/8	2 3/4	50
	HBS10160	160	6 1/4	80	3 1/8	3	50
	HBS10180	180	7 1/8	80	3 1/8	3 3/4	50
	HBS10200	200	8	80	3 1/8	4 1/2	50
	HBS10220	220	8 5/8	80	3 1/8	5 1/2	50
	HBS10240	240	9 1/2	80	3 1/8	6 1/4	50
	HBS10260	260	10 1/4	80	3 1/8	7	50
	HBS10280	280	11	80	3 1/8	7 3/4	50
	HBS10300	300	11 3/4	100	4	7 3/4	50
	HBS10320	320	12 5/8	100	4	8 1/2	50
	HBS10340	340	13 3/8	100	4	9 1/4	50
	HBS10360	360	14 1/4	100	4	10	50
	HBS10380	380	15	100	4	11	50
	HBS10400	400	15 3/4	100	4	11 1/2	50
	HBS10440	440	17 1/4	100	4	13 1/4	50
	HBS10480	480	19	100	4	14 3/4	50
	HBS10520	520	20 1/2	100	4	16 1/2	50
	HBS10560	560	22	100	4	18	50
	HBS10600	600	23 5/8	100	4	19 1/2	50
12 **0.48** TX 50	**HBS12120**	120	4 3/4	80	3 1/8	1 1/2	25
	HBS12160	160	6 1/4	80	3 1/8	3	25
	HBS12200	200	8	80	3 1/8	4 1/2	25
	HBS12240	240	9 1/2	80	3 1/8	6 1/4	25
	HBS12280	280	11	80	3 1/8	7 3/4	25
	HBS12320	320	12 5/8	120	4 3/4	7 3/4	25
	HBS12360	360	14 1/4	120	4 3/4	9 1/4	25
	HBS12400	400	15 3/4	120	4 3/4	11	25
	HBS12440	440	17 1/4	120	4 3/4	12 1/2	25
	HBS12480	480	19	120	4 3/4	14	25
	HBS12520	520	20 1/2	120	4 3/4	15 1/2	25
	HBS12560	560	22	120	4 3/4	17	25
	HBS12600	600	23 5/8	120	4 3/4	18 1/2	25
	HBS12700	700	27 1/2	120	4 3/4	22 3/4	25
	HBS12800	800	31 1/2	120	4 3/4	26 3/4	25
	HBS12900	900	35 1/2	120	4 3/4	30 1/2	25
	HBS121000	1000	39 3/8	120	4 3/4	34 1/2	25

RELATED PRODUCTS

HUS
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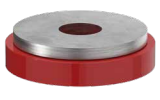
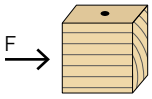


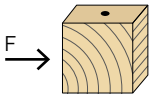
XYLOFON WASHER
page 84

THERMOWASHER
page 425

MINIMUM DISTANCES FOR SHEAR LOADS | TIMBER

screws inserted **WITHOUT pre-drilled hole** — G ≤ 0.48

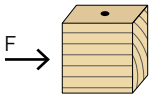


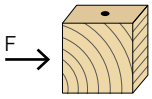


d_1	[in]		0.14	0.16	0.18	0.20	0.24	0.32	0.40	0.48
	[mm]		3,5	4	4,5	5	6	8	10	12
a_1	[in]	**15·d**	2 1/16	2 3/8	2 11/16	2 15/16	3 1/2	**3 1/8**	**4**	**4 3/4**
a_2	[in]	**5·d**	11/16	13/16	7/8	1	1 3/16	1 9/16	1 15/16	2 3/8
$a_{3,t}$	[in]	**15·d**	2 1/16	2 3/8	2 11/16	2 15/16	3 1/2	4 3/4	6	7 1/8
$a_{3,c}$	[in]	**10·d**	1 3/8	1 9/16	1 3/4	1 15/16	2 3/8	3 1/8	4	4 3/4
$a_{4,t}$	[in]	**10·d**	1 3/8	1 9/16	1 3/4	1 15/16	2 3/8	3 1/8	4	4 3/4
$a_{4,c}$	[in]	**5·d**	11/16	13/16	7/8	1	1 3/16	1 9/16	1 15/16	2 3/8

	0.14	0.16	0.18	0.20	0.24	0.32	0.40	0.48
	3,5	4	4,5	5	6	8	10	12
10·d	1 3/8	1 9/16	1 3/4	1 15/16	2 3/8	**1 9/16**	**1 15/16**	**2 3/8**
5·d	11/16	13/16	7/8	1	1 3/16	1 9/16	1 15/16	2 3/8
15·d	2 1/16	2 3/8	2 11/16	2 15/16	3 1/2	4 3/4	6	7 1/8
10·d	1 3/8	1 9/16	1 3/4	1 15/16	2 3/8	3 1/8	4	4 3/4
10·d	1 3/8	1 9/16	1 3/4	1 15/16	2 3/8	3 1/8	4	4 3/4
5·d	11/16	13/16	7/8	1	1 3/16	1 9/16	1 15/16	2 3/8

screws inserted **WITHOUT pre-drilled hole** — 0.48 < G ≤ 0.50

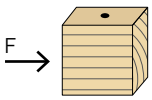


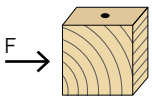


d_1	[in]		0.14	0.16	0.18	0.20	0.24	0.32	0.40	0.48
	[mm]		3,5	4	4,5	5	6	8	10	12
a_1	[in]	**15·d**	2 1/16	2 3/8	2 11/16	2 15/16	3 1/2	4 3/4	6	7 1/8
a_2	[in]	**5·d**	11/16	13/16	7/8	1	1 3/16	1 9/16	1 15/16	2 3/8
$a_{3,t}$	[in]	**15·d**	2 1/16	2 3/8	2 11/16	2 15/16	3 1/2	4 3/4	6	7 1/8
$a_{3,c}$	[in]	**10·d**	1 3/8	1 9/16	1 3/4	1 15/16	2 3/8	3 1/8	4	4 3/4
$a_{4,t}$	[in]	**10·d**	1 3/8	1 9/16	1 3/4	1 15/16	2 3/8	3 1/8	4	4 3/4
$a_{4,c}$	[in]	**5·d**	11/16	13/16	7/8	1	1 3/16	1 9/16	1 15/16	2 3/8

	0.14	0.16	0.18	0.20	0.24	0.32	0.40	0.48
	3,5	4	4,5	5	6	8	10	12
10·d	1 3/8	1 9/16	1 3/4	1 15/16	2 3/8	**2 3/16**	**2 3/4**	**3 5/16**
5·d	11/16	13/16	7/8	1	1 3/16	1 9/16	1 15/16	2 3/8
15·d	2 1/16	2 3/8	2 11/16	2 15/16	3 1/2	4 3/4	6	7 1/8
10·d	1 3/8	1 9/16	1 3/4	1 15/16	2 3/8	3 1/8	4	4 3/4
10·d	1 3/8	1 9/16	1 3/4	1 15/16	2 3/8	3 1/8	4	4 3/4
5·d	11/16	13/16	7/8	1	1 3/16	1 9/16	1 15/16	2 3/8

screws inserted **WITHOUT pre-drilled hole** — G > 0.50

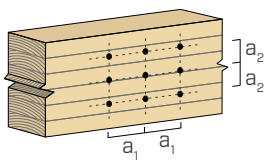




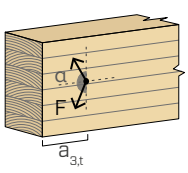
d_1	[in]		0.14	0.16	0.18	0.20	0.24	0.32	0.40	0.48
	[mm]		3,5	4	4,5	5	6	8	10	12
a_1	[in]	**15·d**	2 1/16	2 3/8	2 11/16	2 15/16	3 1/2	4 3/4	6	7 1/8
a_2	[in]	**7·d**	1	1 1/8	1 1/4	1 3/8	1 5/8	2 3/16	2 3/4	3 5/16
$a_{3,t}$	[in]	**20·d**	2 3/4	3 1/8	3 1/2	4	4 3/4	6 1/4	8	9 1/2
$a_{3,c}$	[in]	**15·d**	2 1/16	2 3/8	2 11/16	2 15/16	3 1/2	4 3/4	6	7 1/8
$a_{4,t}$	[in]	**12·d**	1 5/8	1 7/8	2 1/8	2 3/8	2 13/16	3 3/4	4 3/4	5 11/16
$a_{4,c}$	[in]	**7·d**	1	1 1/8	1 1/4	1 3/8	1 5/8	2 3/16	2 3/4	3 5/16

	0.14	0.16	0.18	0.20	0,24	0.32	0.40	0.48
	3,5	4	4,5	5	6	8	10	12
10·d	1 3/8	1 9/16	1 3/4	1 15/16	2 3/8	3 1/8	4	4 3/4
7·d	1	1 1/8	1 1/4	1 3/8	1 5/8	2 3/16	2 3/4	3 5/16
20·d	2 3/4	3 1/8	3 1/2	4	4 3/4	6 1/4	8	9 1/2
15·d	2 1/16	2 3/8	2 11/16	2 15/16	3 1/2	4 3/4	6	7 1/8
12·d	1 5/8	1 7/8	2 1/8	2 3/8	2 13/16	3 3/4	4 3/4	5 11/16
7·d	1	1 1/8	1 1/4	1 3/8	1 5/8	2 3/16	2 3/4	3 5/16

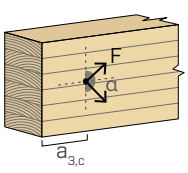
α = load-to-grain angle
d = d_1 = nominal diameter of the screw



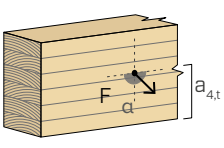
stressed end
-90° < α < 90°



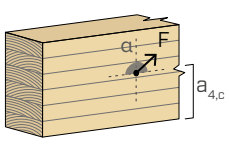
unloaded end
90° < α < 270°



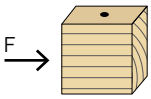
stressed edge
0° < α < 180°

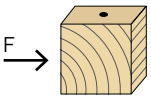


unload edge
180° < α < 360°



screws inserted **WITH pre-drilled hole**

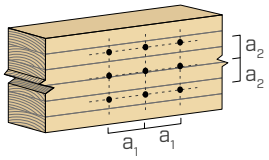




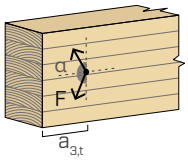
d_1	[in]		0.14	0.16	0.18	0.20	0.24	0.32		0.40	0.48
	[mm]		3,5	4	4,5	5	6	8		10	12
a_1	[in]	**10·d**	1 3/8	1 9/16	1 3/4	1 15/16	2 3/8	3 1/8	**5·d**	1 15/16	2 3/8
a_2	[in]	**4·d**	9/16	5/8	11/16	13/16	15/16	1 1/4	**5·d**	1 15/16	2 3/8
$a_{3,t}$	[in]	**12·d**	1 5/8	1 7/8	2 1/8	2 3/8	2 13/16	3 3/4	**7·d**	2 3/4	3 5/16
$a_{3,c}$	[in]	**7·d**	1	1 1/8	1 1/4	1 3/8	1 5/8	2 3/16	**4·d**	1 9/16	1 7/8
$a_{4,t}$	[in]	**7·d**	1	1 1/8	1 1/4	1 3/8	1 5/8	2 3/16	**4·d**	1 9/16	1 7/8
$a_{4,c}$	[in]	**3·d**	7/16	1/2	9/16	9/16	11/16	15/16	**3·d**	1 3/16	1 7/16

d_1	[in]		0.14	0.16	0.18	0.20	0.24	0.32		0.40	0.48
	[mm]		3,5	4	4,5	5	6	8		10	12
a_1	[in]	**5·d**	11/16	13/16	7/8	1	1 3/13	1 9/16	**5·d**	1 15/16	2 3/8
a_2	[in]	**4·d**	9/16	5/8	11/16	13/16	15/16	1 1/4	**5·d**	1 15/16	2 3/8
$a_{3,t}$	[in]	**12·d**	1 5/8	1 7/8	2 1/8	2 3/8	2 13/16	3 3/4	**7·d**	2 3/4	3 5/16
$a_{3,c}$	[in]	**7·d**	1	1 1/8	1 1/4	1 3/8	1 5/8	2 3/16	**4·d**	1 9/16	1 7/8
$a_{4,t}$	[in]	**7·d**	1	1 1/8	1 1/4	1 3/8	1 5/8	2 3/16	**4·d**	1 9/16	1 7/8
$a_{4,c}$	[in]	**3·d**	7/16	1/2	9/16	9/16	11/16	15/16	**3·d**	1 3/16	1 7/16

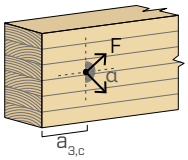
α = load-to-grain angle
d = d_1 = nominal diameter of the screw



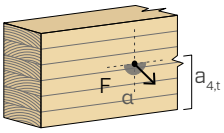
stressed end
-90° < α < 90°



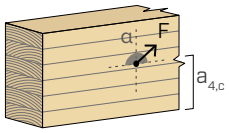
unloaded end
90° < α < 270°



stressed edge
0° < α < 180°



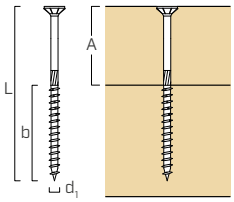
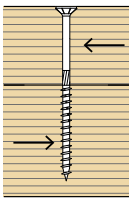
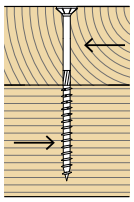
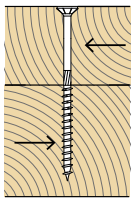
unload edge
180° < α < 360°



NOTES

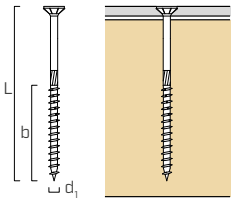
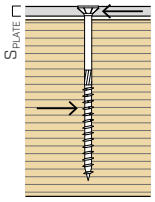
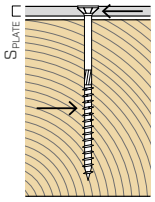
- Values in blue are from Table 10 of ESR-4645 (REDUCED CONNECTION GEOMETRY REQUIREMENTS BASED ON TESTING);
- The minimum spacing and distances comply with ESR-4645, where d refers to the nominal diameter of the screw, and are valid for screw installed into sawn lumber, structural glued laminated timber and cross laminated timber;
- Wood member stresses must be checked in accordance with the corresponding Sections of the NDS; end distances, edge distances and fastener spacing may need to be increased accordingly.

REFERENCE LATERAL DESIGN VALUES (Z) | WOOD-TO-WOOD

geometry				$Z_{\parallel}$				$Z_{\perp/\parallel}$				$Z_{\perp}$			
															
d_1	L		b	A	G				G				G			
					0.35	0.42	0.49	0.55	0.35	0.42	0.49	0.55	0.35	0.42	0.49	0.55
[mm] [in]	[mm]	[in]	[in]	[in]	[lbf]	[lbf]	[lbf]	[lbf]	[lbf]	[lbf]	[lbf]	[lbf]	[lbf]	[lbf]	[lbf]	[lbf]
3,5 **0.14**	40	1 9/16	11/16	3/4	30	42	56	69	30	42	56	69	30	42	56	69
	45	1 3/4	15/16	3/4	34	48	61	72	34	48	61	72	34	48	61	72
	50	1 15/16	15/16	1	38	53	67	78	38	53	67	78	38	53	67	78
4 **0.16**	30	1 3/16	11/16	1/4	27	38	51	63	27	38	51	63	27	38	51	63
	35	1 3/8	11/16	1/4	31	43	57	71	31	43	57	71	31	43	57	71
	40	1 9/16	15/16	1/4	37	51	65	74	37	51	65	74	37	51	65	74
	45	1 3/4	1 3/16	1/2	43	55	65	74	43	55	65	74	43	55	65	74
	50	1 15/16	1 3/16	3/4	44	61	74	86	44	61	74	86	44	61	74	86
	60	2 3/8	1 3/8	3/4	49	61	74	86	49	61	74	86	49	61	74	86
	70	2 3/4	1 9/16	1	54	69	86	98	54	69	86	98	54	69	86	98
	80	3 1/8	1 9/16	1 1/2	65	76	88	98	65	76	88	98	65	76	88	98
4,5 **0.18**	40	1 9/16	15/16	1/2	40	56	74	88	40	56	74	88	40	56	74	88
	45	1 3/4	1 3/16	1/2	47	66	78	88	47	66	78	88	47	66	78	88
	50	1 15/16	1 3/16	3/4	48	67	86	100	48	67	86	100	48	67	86	100
	60	2 3/8	1 3/8	3/4	58	71	86	100	58	71	86	100	58	71	86	100
	70	2 3/4	1 9/16	1	63	80	98	116	63	80	98	116	63	80	98	116
	80	3 1/8	1 9/16	1 1/2	76	93	107	119	76	93	107	119	76	93	107	119
5 **0.20**	40	1 9/16	15/16	1/2	48	67	89	111	48	67	89	111	48	67	89	111
	45	1 3/4	15/16	3/4	50	71	94	116	50	71	94	116	50	71	94	116
	50	1 15/16	15/16	1	56	78	104	129	56	78	104	129	56	78	104	129
	60	2 3/8	1 3/16	1	70	98	127	149	70	98	127	149	70	98	127	149
	70	2 3/4	1 3/8	1 1/4	81	113	143	164	81	113	143	164	81	113	143	164
	80	3 1/8	1 9/16	1 1/2	92	127	147	164	92	127	147	164	92	127	147	164
	90	3 1/2	1 3/4	1 3/4	103	128	147	164	103	128	147	164	103	128	147	164
	100	4	1 15/16	1 3/4	107	128	147	164	107	128	147	164	107	128	147	164
	120	4 3/4	2 3/8	2 1/4	108	128	147	164	108	128	147	164	108	128	147	164
6 **0.24**	40	1 9/16	1 3/8	1/16	21	30	39	49	21	30	39	49	21	30	39	49
	50	1 15/16	1 3/8	3/8	75	105	135	151	75	105	135	151	75	105	135	151
	60	2 3/8	1 3/16	3/4	80	112	149	182	80	112	149	182	80	112	149	182
	70	2 3/4	1 9/16	1	97	129	156	182	97	129	156	182	97	129	156	182
	80	3 1/8	1 9/16	1 1/2	106	148	190	211	106	148	190	211	106	148	190	211
	90	3 1/2	1 15/16	1 1/2	120	154	190	211	120	154	190	211	120	154	190	211
	100	4	1 15/16	1 3/4	129	165	190	211	129	165	190	211	129	165	190	211
	110	4 3/8	2 3/8	1 3/4	129	165	190	211	129	165	190	211	129	165	190	211
	120	4 3/4	2 3/8	2	139	165	190	211	139	165	190	211	139	165	190	211
	130	5 1/8	2 3/8	2 1/2	139	165	190	211	139	165	190	211	139	165	190	211
	140-400	5 1/2 - 15 3/4	2 15/16	≥ 2 1/2	139	165	190	211	139	165	190	211	139	165	190	211
8 **0.32**	80	3 1/8	2 1/16	1	130	179	213	244	104	143	170	195	104	143	170	195
	100	4	2 1/16	1 3/4	156	216	270	313	125	173	216	251	125	173	216	251
	120	4 3/4	2 3/8	2 1/4	185	245	282	313	148	196	225	251	148	196	225	251
	140	5 1/2	2 3/8	3	196	245	282	313	157	196	225	251	157	196	225	251
	160-280	6 1/4-11	3 1/8	≥ 3	207	245	282	313	165	196	225	251	165	196	225	251
	300-600	11 3/4 - 23 5/8	4	≥ 7 3/4	207	245	282	313	165	196	225	251	165	196	225	251
10 **0.40**	80	3 1/8	2 1/16	1/2	180	217	253	284	131	161	191	216	98	127	159	188
	100	4	2 1/16	1	217	261	304	341	149	184	220	253	118	153	192	226
	120	4 3/4	2 3/8	2 1/8	259	311	362	387	173	215	259	295	140	182	228	270
	140	5 1/2	2 3/8	2 3/4	300	338	365	387	195	245	274	295	165	216	259	282
	160-280	6 1/4 - 11	3 1/8	≥ 2 7/8	308	338	365	387	220	249	274	295	186	232	259	282
	300-600	11 3/4 - 23 5/8	4	≥ 7 3/4	308	338	365	387	222	249	274	295	203	232	259	282
12 **0.48**	120	4 3/4	3 1/8	1 1/2	273	308	342	372	183	211	240	266	157	197	228	255
	160-280	6 1/4-11	3 1/8	≥ 3	353	387	418	442	235	282	311	334	191	248	292	317
	320-1000	12 5/8 - 39 3/8	4 3/4	≥ 7 3/4	353	387	418	442	251	282	311	334	229	261	292	317

NOTES and **GENERAL PRINCIPLES** on page 50.

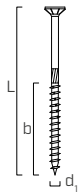
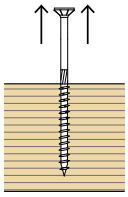
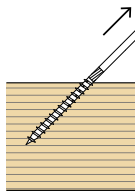
REFERENCE LATERAL DESIGN VALUES (Z) | STEEL-TO-WOOD

geometry				$Z_{\parallel}$ [1]					$Z_{\perp}$ [2]				
													
d_1	L		b	S_{PLATE}	G				S_{PLATE}	G			
					0.35	0.42	0.49	0.55		0.35	0.42	0.49	0.55
[mm] [in]	[mm]	[in]	[in]	[in]	[lbf]	[lbf]	[lbf]	[lbf]	[in]	[lbf]	[lbf]	[lbf]	[lbf]
3,5 **0.14**	40	1 9/16	11/16	1/16	54	63	72	79	1/16	54	63	72	79
	45-50	1 3/4 - 1 15/16	15/16		54	63	72	79		54	63	72	79
4 **0.16**	30	1 3/16	11/16	1/16	50	68	89	98	1/16	50	68	89	98
	35	1 3/8	11/16		58	78	89	98		58	78	89	98
	40	1 9/16	15/16		66	78	89	98		66	78	89	98
	45-50	1 3/4 - 1 15/16	1 3/16		67	78	89	98		67	78	89	98
	60	2 3/8	1 3/8		67	78	89	98		67	78	89	98
	70-80	2 3/4 - 3 1/8	1 9/16		67	78	89	98		67	78	89	98
4,5 **0.18**	40	1 9/16	15/16	1/16	72	95	108	119	1/16	72	95	108	119
	45-50	1 3/4 - 1 15/16	1 3/16		81	95	108	119		81	95	108	119
	60	2 3/8	1 3/8		81	95	108	119		81	95	108	119
	70-80	2 3/4 - 3 1/8	1 9/16		81	95	108	119		81	95	108	119
5 **0.20**	40	1 9/16	15/16	1/16	87	120	147	162	1/16	87	120	147	162
	45	1 3/4	15/16		98	129	147	162		98	129	147	162
	50	1 15/16	15/16		109	129	147	162		109	129	147	162
	60	2 3/8	1 3/16		110	129	147	162		110	129	147	162
	70	2 3/4	1 3/8		110	129	147	162		110	129	147	162
	80	3 1/8	1 9/16		110	129	147	162		110	129	147	162
	90	3 1/2	1 3/4		110	129	147	162		110	129	147	162
	100	4	1 15/16		110	129	147	162		110	129	147	162
	120	4 3/4	2 3/8		110	129	147	162		110	129	147	162
6 **0.24**	40	1 9/16	1 3/8	1/8	110	145	184	222	1/8	110	145	184	222
	50	1 15/16	1 3/8		132	177	205	225		132	177	205	225
	60	2 3/8	1 3/16		155	180	205	225		155	180	205	225
	70-80	2 3/4 - 3 1/8	1 9/16		155	180	205	225		155	180	205	225
	90-100	3 1/2 - 4	1 15/16		155	180	205	225		155	180	205	225
	110-130	4 3/8 - 5 1/8	2 3/8		155	180	205	225		155	180	205	225
	140-300	5 1/2 - 11 3/4	2 15/16		155	180	205	225		155	180	205	225
	320-400	12 5/8 - 15 3/4	2 15/16		180	210	238	262		180	210	238	262
8 **0.32**	80-100	3 1/8 - 4	2 1/16	1/8	218	255	290	319	1/8	174	204	232	255
	120-140	4 3/4 - 5 1/2	2 3/8		218	255	290	319		174	204	232	255
	160-280	6 1/4 - 11	3 1/8		218	255	290	319		174	204	232	255
	300-400	11 3/4 - 15 3/4	4		218	255	290	319		174	204	232	255
	440-600	17 1/4 - 23 5/8	4		235	274	313	344		188	220	250	275
10 **0.40**	80	3 1/8	2 1/16	1/4	330	387	418	440	1/4	191	237	287	324
	100	4	2 1/16		361	391	418	440		236	273	302	324
	120-140	4 3/4 - 5 1/2	2 3/8		361	391	418	440		242	273	302	324
	160-280	6 1/4 - 11	3 1/8		361	391	418	440		242	273	302	324
	300-400	11 3/4 - 15 3/4	4		361	391	418	440		242	273	302	324
	440-600	17 1/4 - 23 5/8	4		419	455	486	511		276	311	343	370
12 **0.48**	120-280	4 3/4 - 11	3 1/8	1/4	403	437	467	491	1/4	267	301	332	358
	320-480	12 5/8 - 19	4 3/4		403	437	467	491		267	301	332	358
	520-1000	20 1/2 - 39 3/8	4 3/4		533	578	619	651		339	383	424	457

[1] Main member loaded parallel to the grain.
[2] Main member loaded perpendicular to the grain.

NOTES and **GENERAL PRINCIPLES** on page 50.

THREAD WITHDRAWAL (W) | WOOD

geometry				thread withdrawal α = 90°				thread withdrawal α = 45°				thread withdrawal α = 0°			
															
d_1	L		b	G				G				G			
				0.35	0.42	0.49	0.55	0.35	0.42	0.49	0.55	0.35	0.42	0.49	0.55
[mm] [in]	[mm]	[in]	[in]	[lbf]	[lbf]	[lbf]	[lbf]	[lbf]	[lbf]	[lbf]	[lbf]	[lbf]	[lbf]	[lbf]	[lbf]
3,5 **0.14**	40	1 9/16(1)	11/16	49	57	63	69	45	51	58	63	15	17	19	21
	45-50	1 3/4 - 1 15/16(1)	15/16	69	80	90	98	63	73	82	89	21	24	27	29
4 **0.16**	30-35	1 3/16 - 1 3/8(1)	11/16	47	55	61	67	43	50	56	61	14	16	18	20
	40	1 9/16(1)	15/16	68	78	87	95	62	71	80	87	20	23	26	29
	45-50	1 3/4 - 1 15/16(2)	1 3/16	88	101	114	124	80	92	103	113	26	30	34	37
	60	2 3/8(2)	1 3/8	105	121	135	148	96	110	123	134	31	36	41	44
	70-80	2 3/4 - 3 1/8	1 9/16	122	140	157	171	111	128	143	156	37	42	47	51
4,5 **0.18**	40	1 9/16(1)	15/16	66	76	85	93	60	69	78	85	20	23	26	28
	45-50	1 3/4 - 1 15/16(1)	1 3/16	86	99	111	121	79	90	101	111	26	30	33	36
	60	2 3/8(2)	1 3/8	103	119	133	145	94	108	121	132	31	36	40	44
	70-80	2 3/4 - 3 1/8(2)	1 9/16	120	138	155	169	109	126	141	154	36	42	47	51
5 **0.20**	40-50	1 9/16 - 1 15/16(1)	15/16	77	89	99	109	70	81	91	99	23	27	30	33
	60	2 3/8(1)	1 3/16	101	117	131	144	92	107	119	131	30	35	39	43
	70	2 3/4(1)	1 3/8	122	141	157	172	111	128	143	157	36	42	47	52
	80	3 1/8(2)	1 9/16	142	164	183	201	129	149	167	183	43	49	55	60
	90	3 1/2(2)	1 3/4	162	187	209	230	148	171	191	209	49	56	63	69
	100	4	1 15/16	182	211	236	259	166	192	214	235	55	63	71	78
	120	4 3/4	2 3/8	223	258	288	316	203	234	262	288	67	77	86	95
6 **0.24**	40-50	1 9/16 - 1 15/16(1)	1 3/8	150	172	195	215	136	157	178	195	45	52	59	64
	60	2 3/8(1)	1 3/16	124	143	162	178	113	130	147	162	37	43	48	53
	70-80	2 3/4 - 3 1/8(1)	1 9/16	175	202	229	252	160	184	208	229	53	61	69	75
	90-100	3 1/2 - 4(2)	1 15/16	227	262	296	326	207	238	270	296	68	78	89	98
	110-130	4 3/8 - 5 1/8	2 3/8	279	321	364	400	253	292	331	364	84	96	109	120
	140-400	5 1/2 - 15 3/4	2 15/16	356	410	465	511	324	373	423	465	107	123	139	153
8 **0.32**	80-100	3 1/8 - 4(1)	2 1/16	298	345	390	428	271	314	355	389	89	103	117	128
	120-140	4 3/4 - 5 1/2(2)	2 3/8	352	407	461	506	320	371	419	460	106	122	138	152
	160-280	6 1/4 - 11	3 1/8	488	564	638	700	444	513	580	637	146	169	191	210
	300-600	11 3/4 - 23 5/8	4	623	721	815	895	567	656	742	814	187	216	244	268
10 **0.40**	80-100	3 1/8 - 4(1)	2 1/16	341	395	446	489	310	360	406	445	102	119	134	147
	120-140	4 3/4 - 5 1/2(1)	2 3/8	406	470	531	583	369	428	484	530	122	141	159	175
	160-280	6 1/4 - 11(2)	3 1/8	568	659	744	816	517	599	677	742	170	198	223	245
	300-600	11 3/4 - 23 5/8	4	730	847	957	1049	664	771	871	954	219	254	287	315
12 **0.48**	120-280	4 3/4 - 11(1)	3 1/8	589	683	771	846	536	621	702	770	177	205	231	254
	320-1000	12 5/8 - 39 3/8	4 3/4	935	1084	1225	1344	851	987	1114	1223	281	325	367	403

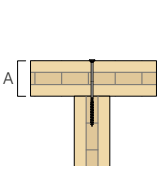
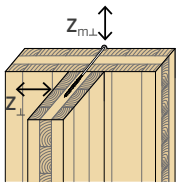
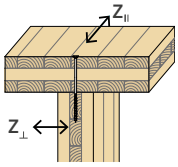
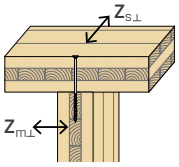
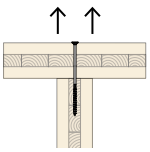
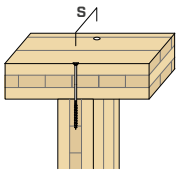
(1) The embedded thread length does not comply with the minimum requirement of ESR-4645 (6 times the outer thread diameter for screws installed at 90° to the grain and 8 times the outer thread diameter for screws installed at an angle 0°≤ α <90° to the grain).
(2) The embedded thread length does not comply with the minimum requirement of ESR-4645 (8 times the outer thread diameter for screws installed at an angle 0°≤ α <90° to the grain).

HEAD PULL-THROUGH (W_H) | WOOD

geometry			head pull through 90° ≤ α ≤ 30°			
d_1		d_k	G			
			0.35	0.42	0.49	0.55
[mm]	[in]	[in]	[lbf]	[lbf]	[lbf]	[lbf]
3,5	0.14	0.28	51	59	67	73
4	0.16	0.31	75	87	98	108
4,5	0.18	0.35	95	110	124	136
5	0.20	0.39	117	136	153	168
6	0.24	0.47	142	165	186	204
8	0.32	0.57	220	264	298	327
10	0.40	0.72	273	316	357	392
12	0.48	0.82	392	453	513	562

NOTES and GENERAL PRINCIPLES on page 50.

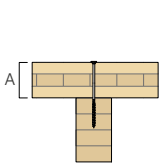
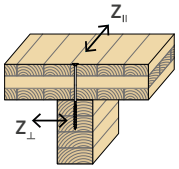
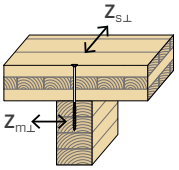
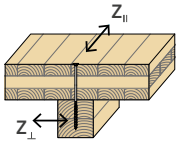
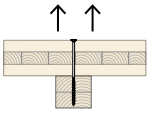
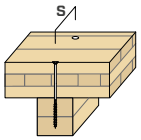
CLT | WALL-TO-WALL | FLOOR-TO-WALL

					SHEAR						TENSION	SPACING	
geometry					wall-to-wall		floor-to-wall orientation 1		floor-to-wall orientation 2		withdrawal / head pull-through	fastener in a row	
													
side member thickness (wall/floor) = A		suggested screw			$Z_{\perp}$	$Z_{m\perp}$	$Z_{\perp}$	$Z_{\parallel}$	$Z_{m\perp}$	$Z_{s\perp}$	W(*)	minimum	typical
[mm]	[in]	CODE			[lbf]	[lbf]	[lbf]	[lbf]	[lbf]	[lbf]	[lbf]	[in]	[in]
3 PLY	60	2 3/8	HBS6120	or longer	110	110	110	110	110	110	165	3 1/2	6
			HBS8120		131	131	131	164	131	131	264	3 1/8	6
			HBS10120		122	145	122	208	145	143	316	4	8
			HBS12160		158	189	158	258	189	168	453	4 3/4	10
	79	3 1/8	HBS6160		110	110	110	110	110	110	165	3 1/2	6
			HBS8160		131	131	131	164	131	131	264	3 1/8	6
			HBS10160		155	167	155	226	167	167	316	4	8
			HBS12160		167	188	167	259	188	189	453	4 3/4	10
	105	4 1/8	HBS6180		110	110	110	110	110	110	165	3 1/2	6
			HBS8200		131	131	131	164	131	131	264	3 1/8	6
			HBS10200		155	167	155	226	167	167	316	4	8
			HBS12200		175	189	175	259	189	189	453	4 3/4	10
	120	4 3/4	HBS6200		110	110	110	110	110	110	165	3 1/2	6
			HBS8200		131	131	131	164	131	131	264	3 1/8	6
			HBS10200		155	167	155	226	167	167	316	4	8
			HBS12200		175	189	175	259	189	189	453	4 3/4	10
5 PLY	100	3 15/16	HBS6180		110	110	110	110	110	110	165	3 1/2	6
			HBS8180		131	131	131	164	131	131	264	3 1/8	6
			HBS10180		155	167	155	226	167	167	316	4	8
			HBS12200		175	189	175	259	189	189	453	4 3/4	10
	140	5 1/2	HBS6220		110	110	110	110	110	110	165	3 1/2	6
			HBS8220		131	131	131	164	131	131	264	3 1/8	6
			HBS10220		155	167	155	226	167	167	316	4	8
			HBS12240		175	189	175	259	189	189	453	4 3/4	10
	175	6 7/8	HBS6260		110	110	110	110	110	110	165	3 1/2	6
			HBS8260		131	131	131	164	131	131	264	3 1/8	6
			HBS10260		155	167	155	226	167	167	316	4	8
			HBS12280		175	189	175	259	189	189	453	4 3/4	10
	200	7 7/8	HBS6280		110	110	110	110	110	110	165	3 1/2	6
			HBS8280		131	131	131	164	131	131	264	3 1/8	6
			HBS10280		155	167	155	226	167	167	316	4	8
			HBS12280		175	188	175	259	188	189	453	4 3/4	10
7 PLY	140	5 1/2	HBS6220		110	110	110	110	110	110	165	3 1/2	6
			HBS8220		131	131	131	164	131	131	264	3 1/8	6
			HBS10220		155	167	155	226	167	167	316	4	8
			HBS12240		175	189	175	259	189	189	453	4 3/4	10
	191	7 1/2	HBS6280		110	110	110	110	110	110	165	3 1/2	6
			HBS8280		131	131	131	164	131	131	264	3 1/8	6
			HBS10280		155	167	155	226	167	167	316	4	8
			HBS12280		175	189	175	259	189	189	453	4 3/4	10
	244	9 5/8	HBS6320		110	110	110	110	110	110	165	3 1/2	6
			HBS8360		131	131	131	164	131	131	264	3 1/8	6
			HBS10360		155	167	155	226	167	167	316	4	8
			HBS12400		175	189	175	259	189	189	453	4 3/4	10
	280	11	HBS6360		110	110	110	110	110	110	165	3 1/2	6
			HBS8380		131	131	131	164	131	131	264	3 1/8	6
			HBS10380		155	167	155	226	167	167	316	4	8
			HBS12400		175	189	175	259	189	189	453	4 3/4	10

(*) Minimum between head pull-through and withdrawal resistance

NOTES and GENERAL PRINCIPLES on page 50.

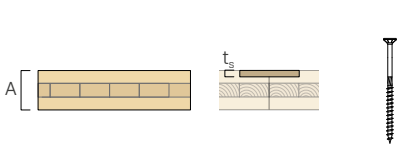
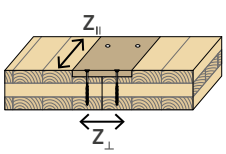
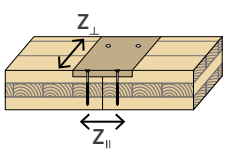
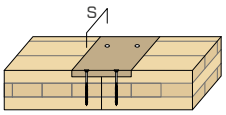
CLT | FLOOR-TO-BEAM

geometry			SHEAR								TENSION	SPACING	
			floor-to-beam orientation 1		floor-to-beam orientation 2		floor-to-double lumber 2" orientation 1		floor-to-double lumber 2" orientation 2		withdrawal / head pull-through	fastener in a row	
													
side member thickness (wall/floor) = A		suggested screw	$Z_{\perp}$	$Z_{\parallel}$	$Z_{m\perp}$	$Z_{s\perp}$	$Z_{\perp}$	$Z_{\parallel}$	$Z_{m\perp}$	$Z_{s\perp}$	W(*)	minimum	typical
[mm]	[in]	CODE	[lbf]	[lbf]	[lbf]	[lbf]	[lbf]	[lbf]	[lbf]	[lbf]	[lbf]	[in]	[in]
5 PLY													
100	3 15/16	HBS6180	165	165	165	165	165	165	165	165	165	3 1/2	6
		HBS8180	196	245	196	196	196	245	196	196	264	3 1/8	6
		HBS10180	232	338	249	249	232	338	167	249	316	4	8
		HBS12200	261	387	282	282	261	387	282	282	453	4 3/4	10
140	5 1/2	HBS6220	165	165	165	165	165	165	165	165	165	3 1/2	6
		HBS8220	196	245	196	196	196	245	196	196	264	3 1/8	6
		HBS10220	232	338	249	249	232	338	249	249	316	4	8
		HBS12240	261	387	282	282	261	387	282	282	453	4 3/4	10
175	6 7/8	HBS6260	165	165	165	165	165	165	165	165	165	3 1/2	6
		HBS8260	196	245	196	196	196	245	196	196	264	3 1/8	6
		HBS10260	232	338	167	249	232	338	167	249	316	4	8
		HBS12240	237	387	252	282	237	387	252	282	453	4 3/4	10
		HBS12280	261	387	282	282	-	-	-	-	453	4 3/4	10
200	7 7/8	HBS6280	165	165	165	165	165	165	165	165	165	3 1/2	6
		HBS8280	196	245	196	196	196	245	196	196	264	3 1/8	6
		HBS10280	232	338	249	249	232	338	249	249	316	4	8
		HBS12280	261	387	281	282	261	387	281	282	453	4 3/4	10
7 PLY													
140	5 1/2	HBS6220	165	165	165	165	165	165	165	165	165	3 1/2	6
		HBS8220	196	245	196	196	196	245	196	196	264	3 1/8	6
		HBS10220	232	338	249	249	232	338	249	249	316	4	8
		HBS12240	261	387	282	282	261	387	282	282	453	4 3/4	10
191	7 1/2	HBS6280	165	165	165	165	165	165	165	165	165	3 1/2	6
		HBS8280	196	245	196	196	196	245	196	196	264	3 1/8	6
		HBS10280	232	338	249	249	232	338	249	249	316	4	8
		HBS12280	261	387	282	282	261	387	282	282	453	4 3/4	10
244	9 5/8	HBS6320	165	165	110	165	165	165	110	165	165	3 1/2	6
		HBS8340	196	245	196	196	196	245	196	196	264	3 1/8	6
		HBS8360	196	245	131	196	-	-	-	-	264	3 1/8	6
		HBS10340	232	338	249	249	232	338	249	249	316	4	8
		HBS10360	232	338	249	249	-	-	-	-	316	4	8
		HBS12320	258	387	183	282	258	387	183	282	453	4 3/4	10
		HBS12400	261	387	282	282	-	-	-	-	453	4 3/4	10
280	11	HBS6360	165	165	165	165	165	165	165	165	165	3 1/2	6
		HBS8380	196	245	196	196	196	245	196	196	264	3 1/8	6
		HBS10380	232	338	167	249	232	338	167	249	316	4	8
		HBS12360	261	387	282	282	261	387	282	282	453	4 3/4	10
		HBS12400	261	387	282	282	-	-	-	-	453	4 3/4	10
9 PLY													
180	7 1/16	HBS6260	165	165	165	165	165	165	165	165	165	3 1/2	6
		HBS8260	196	245	196	196	196	245	196	196	264	3 1/8	6
		HBS10260	232	338	249	249	232	338	249	249	316	4	8
		HBS12280	261	387	282	282	261	387	282	282	453	4 3/4	10
267	10 1/2	HBS6360	165	165	165	165	165	165	165	165	165	3 1/2	6
		HBS8360	196	245	196	196	196	245	196	196	264	3 1/8	6
		HBS8380	196	245	196	196	-	-	-	-	264	3 1/8	6
		HBS10360	232	338	249	249	232	338	249	249	316	4	8
		HBS10380	232	338	249	249	-	-	-	-	316	4	8
		HBS12360	261	387	282	282	261	387	282	282	453	4 3/4	10
		HBS12400	261	387	189	282	-	-	-	-	453	4 3/4	10

(*)Minumum between head pull-through and withdrawal resistance

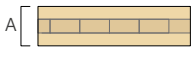
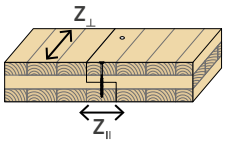
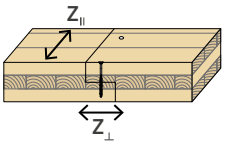
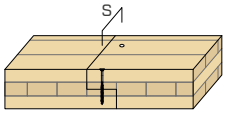
NOTES and GENERAL PRINCIPLES on page 50.

CLT | SPLINE JOINT

				SHEAR				SPACING	
geometry				spline joint orientation 1		spline joint orientation 2		fastener in a row	
									
panel thickness (wall/floor) = A		spline thickness = t_s	suggested screw	$Z_{\parallel}$	$Z_{\perp}$	$Z_{\parallel}$	$Z_{\perp}$	minimum	typical
[mm]	[in]	[in]	CODE	[lbf]	[lbf]	[lbf]	[lbf]	[in]	[in]
3 PLY	79	3 1/8	1/2	HBS550	91	91	91	91	2 15/16	3
				HBS650	107	107	107	107	3 1/2	4
			3/4	HBS560	95	95	95	95	2 15/16	3
				HBS660	120	120	120	120	3 1/2	4
			1	HBS570	103	103	103	103	2 15/16	3
				HBS670	128	128	128	128	3 1/2	4
	86	3 3/8	1/2	HBS560	91	91	91	91	2 15/16	3
				HBS660	116	116	116	116	3 1/2	4
			3/4	HBS570	95	95	95	95	2 15/16	3
				HBS670	120	120	120	120	3 1/2	4
			1	HBS680	128	128	128	128	3 1/2	4
				HBS880	179	143	179	143	3 1/8	4
	105	4 1/8	1/2	HBS670	91	91	91	91	2 15/16	3
				HBS870	116	116	116	116	3 1/2	4
			3/4	HBS680	120	120	120	120	3 1/2	4
				HBS880	173	139	173	139	3 1/8	4
			1	HBS690	128	128	128	128	3 1/2	4
				HBS890	179	143	179	143	3 1/8	4
5 PLY	130	5 1/8	3/4	HBS680	120	120	120	120	3 1/2	4
				HBS880	173	139	173	139	3 1/8	4
			1	HBS690	128	128	128	128	3 1/2	4
				HBS880	179	143	179	143	3 1/8	4
				HBS1080	202	128	202	128	4	6
	140	5 1/2	3/4	HBS690	120	120	120	120	3 1/2	4
				HBS8100	173	139	173	139	3 1/8	4
			1	HBS6100	128	128	128	128	3 1/2	4
				HBS8100	179	143	179	143	3 1/8	4
				HBS10100	211	164	211	164	4	6
	175	6 7/8	3/4	HBS6100	120	120	120	120	3 1/2	4
				HBS8100	173	139	173	139	3 1/8	4
			1	HBS6120	128	128	128	128	3 1/2	4
				HBS8120	179	143	179	143	3 1/8	4
				HBS10120	211	164	211	164	4	6
7 PLY	191	7 1/2	3/4	HBS690	120	120	120	120	3 1/2	4
				HBS890	173	139	173	139	3 1/8	4
			1	HBS6100	128	128	128	128	3 1/2	4
				HBS8100	179	143	179	143	3 1/8	4
				HBS10120	211	164	211	164	4	6
	220	8 5/8	3/4	HBS6100	120	120	120	120	3 1/2	4
				HBS8100	173	139	173	139	3 1/8	4
			1	HBS6120	128	128	128	128	3 1/2	4
				HBS8120	179	143	179	143	3 1/8	4
				HBS10140	211	164	211	164	4	6
	244	9 5/8	3/4	HBS6120	120	120	120	120	3 1/2	4
				HBS8120	173	139	173	139	3 1/8	4
			1	HBS6140	128	128	128	128	3 1/2	4
				HBS8140	179	143	179	143	3 1/8	4
				HBS10140	211	164	211	164	4	6

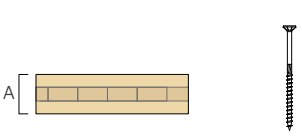
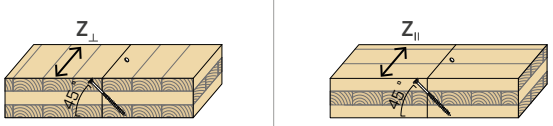
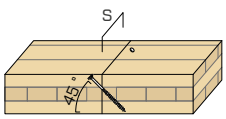
NOTES and GENERAL PRINCIPLES on page 50.

CLT | HALF LAP

				SHEAR				SPACING	
			geometry	half lap orientation 1		half lap orientation 2		fastener in a row	
			 						
	panel thickness (wall/floor) = A		suggested screw	$Z_{\perp}$	$Z_{\parallel}$	$Z_{\perp}$	$Z_{\parallel}$	minimum	typical
	[mm]	[in]	CODE	[lbf]	[lbf]	[lbf]	[lbf]	[in]	[in]
3 PLY	105	4 1/8	HBS690	144	144	144	144	3 1/2	6
			HBS8100	174	218	174	218	3 1/8	6
			HBS10100	153	261	153	261	4	8
	120	4 3/4	HBS6110	165	165	165	165	3 1/2	6
			HBS8100	160	200	160	200	3 1/8	6
			HBS10100	160	272	160	272	4	8
5 PLY	100	3 15/16	HBS690	149	149	149	149	3 1/2	6
			HBS880	143	179	143	179	3 1/8	6
			HBS1080	129	220	129	220	4	8
	140	5 1/2	HBS6130	165	165	165	165	3 1/2	6
			HBS8120	178	222	178	222	3 1/8	6
			HBS10120	189	301	189	301	4	8
			HBS12120	194	329	194	329	4 3/4	10
	175	6 7/8	HBS6160	165	165	165	165	3 1/2	6
			HBS8160	196	245	196	245	3 1/8	6
			HBS10160	232	338	232	338	4	8
			HBS12160	248	387	248	387	4 3/4	10
	200	7 7/8	HBS6180	165	165	165	165	3 1/2	6
			HBS8180	196	245	196	245	3 1/8	6
			HBS10180	232	338	232	338	4	8
			HBS12160	221	357	221	357	4 3/4	10
7 PLY	140	5 1/2	HBS6130	165	165	165	165	3 1/2	6
			HBS8120	178	222	178	222	3 1/8	6
			HBS10120	189	301	189	301	4	8
			HBS12120	194	328	194	328	4 3/4	10
	191	7 1/2	HBS8180	196	245	196	245	3 1/8	6
			HBS10180	232	338	232	338	4	8
			HBS12160	231	376	231	376	4 3/4	10
	244	9 5/8	HBS8220	196	245	196	245	3 1/8	6
			HBS10220	232	338	232	338	4	8
			HBS12240	261	387	261	387	4 3/4	10
	280	11	HBS8260	196	245	196	245	3 1/8	6
			HBS10260	232	338	232	338	4	8
			HBS12240	261	387	261	387	4 3/4	10
9 PLY	180	7 1/16	HBS6160	165	165	165	165	3 1/2	6
			HBS8160	196	245	196	245	3 1/8	6
			HBS10160	228	338	228	338	4	8
			HBS12160	242	387	242	387	4 3/4	10
	267	10 1/2	HBS8260	196	245	196	245	3 1/8	6
			HBS10260	232	338	232	338	4	8
			HBS12240	261	387	261	387	4 3/4	10
	314	12 3/8	HBS8300	196	245	196	245	3 1/8	6
			HBS10300	232	338	232	338	4	8
			HBS12280	261	387	261	387	4 3/4	10
	360	14 3/16	HBS8340	196	245	196	245	3 1/8	6
			HBS10340	232	338	232	338	4	8
			HBS12320	261	387	261	387	4 3/4	10

NOTES and GENERAL PRINCIPLES on page 50.

CLT | BUTT JOINT

				SHEAR		SPACING	
geometry				butt joint orientation 1	butt joint orientation 2	fastener in a row	
							
	panel thickness (wall/floor) = A		suggested screw	$Z_\perp$	$Z_\parallel$	minimum	typical
	[mm]	[in]	CODE	[lbf]	[lbf]	[in]	[in]
3 PLY	105	4 1/8	HBS6120	110	110	3 1/2	6
			HBS8120	131	164	3 1/8	6
			HBS10120	122	208	4	8
			HBS12120	125	220	4 3/4	10
	120	4 3/4	HBS6150	110	110	3 1/2	6
			HBS8140	131	164	3 1/8	6
			HBS10140	143	226	4	8
			HBS12160	167	259	4 3/4	10
5 PLY	100	3 15/16	HBS6120	110	110	3 1/2	6
			HBS8120	131	164	3 1/8	6
			HBS10120	122	208	4	8
			HBS12120	125	220	4 3/4	10
	140	5 1/2	HBS6180	110	110	3 1/2	6
			HBS8180	131	164	3 1/8	6
			HBS10180	155	226	4	8
			HBS12160	167	259	4 3/4	10
	175	6 7/8	HBS6220	110	110	3 1/2	6
			HBS8220	131	164	3 1/8	6
			HBS10220	155	226	4	8
			HBS12200	175	259	4 3/4	10
	200	7 7/8	HBS6260	110	110	3 1/2	6
			HBS8260	131	164	3 1/8	6
			HBS10260	155	226	4	8
			HBS12240	175	259	4 3/4	10
7 PLY	140	5 1/2	HBS6180	110	110	3 1/2	6
			HBS8180	131	164	3 1/8	6
			HBS10180	155	226	4	8
			HBS12160	167	259	4 3/4	10
	191	7 1/2	HBS6240	110	110	3 1/2	6
			HBS8240	131	164	3 1/8	6
			HBS10240	155	226	4	8
			HBS12240	175	259	4 3/4	10
	244	9 5/8	HBS8320	131	164	3 1/8	6
			HBS10320	155	226	4	8
			HBS12320	175	259	4 3/4	10
	280	11	HBS8380	131	164	3 1/8	6
			HBS10380	155	226	4	8
			HBS12360	175	259	4 3/4	10
9 PLY	180	7 1/16	HBS6240	110	110	3 1/2	6
			HBS8240	131	164	3 1/8	6
			HBS10240	155	226	4	8
			HBS12240	175	259	4 3/4	10
	267	10 1/2	HBS8360	131	164	3 1/8	6
			HBS10360	155	226	4	8
			HBS12360	175	259	4 3/4	10
	314	12 3/8	HBS6400	110	110	3 1/2	6
			HBS8400	131	164	3 1/8	6
			HBS10400	155	226	4	8
			HBS12400	175	259	4 3/4	10

GENERAL PRINCIPLES

- Tabulated values comply with NATIONAL DESIGN SPECIFICATION FOR WOOD CONSTRUCTION in accordance with ESR-4645.
- To determine allowable loads for use with ASD, design loads for use with LRFD or both, tabulated values must be multiplied by all adjustment factors included in the NDS for dowel-type fasteners. The design of connection with steel side plate must comply with Section 11.2.3 of the NDS.
- As part of the connection design, the structural wood members, the steel plates must be sized and verified in accordance with the corresponding Section of the NDS and must be done separately by the designer.
- Connections with multiple screws must be designed in accordance with the corresponding Sections of the NDS and ESR-4645.
- HBS screws must be positioned in accordance with the minimum distances.
- In case of combined axial and shear forces, the designer shall refer to the Hankinson formula, as specified in section 12.4.1 of the NDS, to evaluate the load-bearing capacity.

REFERENCE LATERAL DESIGN VALUES

- Tabulated values are determined from the yield model equations in the corresponding Section of the NDS.
- Unless otherwise noted, the threaded part of the screw is fully inserted in the main member.
- The screw penetration into the main member is minimum 6 times the outer thread diameter unless otherwise noted.
- The reference lateral design values may be determined for other connection configurations in accordance with the corresponding Section of NDS and ESR-4645.
- The reference lateral design values are calculated for screws inserted without pre-drilling hole. In the case of screws inserted with pre-drilling hole, greater resistance values can be obtained.

WOOD-TO-WOOD

- The wood main member thickness must be greater than the screw length minus the thickness of the wood side member.
- The tabulated lateral design values are based on both wood members having the same specific gravity G.

STEEL-TO-WOOD

- The steel side member must have a minimum tensile strength equal to 58 ksi (400 MPa) and comply with the minimum requirements of ASTM A36.
- The wood main member thickness must be greater than the screw length minus the thickness of the steel side member.
- In case of steel-to-wood connection with a thick plate, it is necessary to assess the effects of wood deformations and install the connectors according to the assembly instructions.

REFERENCE WITHDRAWAL DESIGN VALUES

- The reference withdrawal design values (W_{ref}) expressed in pounds-force per inch of thread penetration into the main member for screws installed at an angle of 90° to the grain can be found in the ESR-4645.
- The values for screws installed at an angle α to the grain are determined by multiplying the reference withdrawal design values with the effective thread penetration L_{eff} of the screw in the wood member and with the factor k_α:

  $W_\alpha = W_{ref} \cdot k_\alpha \cdot L_{eff}$

  Where:

  - W_{ref} is the reference withdrawal design value for screws installed at an angle of 90° to the grain, as shown in the table on the left;
  - k_α factor is calculated as:

$$k_\alpha = \begin{cases} 35^\circ < \alpha \leq 90^\circ & \dfrac{1}{1.2 \cdot \cos^2(\alpha) + \sin^2(\alpha)} \\ 0^\circ \leq \alpha \leq 35^\circ & 0.3 + 0.7\dfrac{\alpha}{45} \end{cases}$$

  - α is the angle between the grain direction and screw axis.

  Tabulated values at page 44 are valid for L_{eff} equal to the screw thread length b minus the tip length L_t and k_α = 1 for α=90°, k_α = 0.91 for α= 45°, k_α = 0.3 for α = 0°.
- The minimum embedded thread length is 6 times the outer thread diameter for screws installed at 90° to the grain, unless otherwise noted.
- The minimum embedded thread length for screws installed at an angle 0° ≤ α < 90° to the grain is 8 times the outer thread diameter, unless otherwise noted.
- At least four screws must be used in a connection with screws installed in the wood member with an angle between the grain direction and screw axis α ≤ 15°.
- The reference withdrawal design values must be inferior to f_{tens} of the screw.

REFERENCE HEAD PULL-THROUGH DESIGN VALUES

While designing a connection the head pull-through values must be compared with the tensile resistance of the screw and, if necessary, thread withdrawal. The lower value is the governing one.

CONNECTIONS

GENERAL NOTES

- Designed connections must respect all requirements on general principles and minimum distances.
- Calculations comply with the NDS in accordance with ESR 4645.
- Tabulated values, that are referred to a single fastener, are valid for Allowable Stress Design (ASD) considering a standard loading (C_D = 1.0).
- Timber element specific gravity is considered as G = 0.42.
- $Z_{||}$: Force-to-grain angle in the shear plane is considered as 0°.
- $Z_\perp$: Force-to-grain angle in the shear plane is considered as 90°.
- $Z_{m\perp}$: Force-to-grain angle in the shear plane is considered as 0° for side member and as 90° for main member.
- $Z_{s\perp}$: Force-to-grain angle in the shear plane is considered as 90° for side member and as 0° for main member.
- For the connectors inserted in the panel's face, it has been considered the same grain direction as the layer in the shear plane. For the connectors inserted in the panel's narrow edge, it has been considered the same grain direction as the layer in which the connector is installed.
- For lateral design values the force-to-fastener angle is always considered 90°.
- Typical fastener spacings are declared considering a generic load condition; spacings should be verified and defined according to the real load conditions.

CLT | WALL-TO-WALL | FLOOR-TO-WALL

- The main grain direction of the CLT wall panel is always considered as vertical.
- The main grain direction of the CLT floor panel is considered both parallel and perpendicular to the wall plane.
- The threaded part of the screw has been always considered inserted in the central layer of the CLT panel.
- The withdrawal capacity has been considered as the minimum between thread withdrawal, head-pull through and tensile strenght of the screw.
- According to NDS, an end grain coefficient C_{eg}=0.67 is considered for the lateral resistance calculation due to fastener in narrow edge of CLT.

CLT | FLOOR-TO-WOOD BEAM

- The main grain direction of the CLT floor panel is considered both parallel and perpendicular to the beam's axis.
- The threaded part of the screw has been always considered inserted in the central layer of the CLT panel.
- The withdrawal capacity has been considered as the minimum between thread withdrawal, head-pull through and tensile strength of the screw.
- According to NDS, an end grain coefficient C_{eg}=0.67 is considered for the lateral resistance calculation due to fastener in narrow edge of CLT.
- Beam element can be considered both solid wood or glulam.
- Double lumber is considered as two coupled element of 2 inches thick.
- The width of the beams must comply with the minimum distance requirements.
- The proposed screw's length does not exceed the total thickness of the connection. In configurations with no declared value (-) the fastener exceeds the main member depth.

SPLINE JOINT

- Spline thickness is considered to be thinner than the top CLT layer.
- For Root Diameter d_2>0.25 inch, the bearing strength of the spline is conservatively considered as 3350 psi according to NDS.
- The main grain direction of the CLT floor panel is considered both parallel and perpendicular to the spline's direction.
- The width of the spline and consequent machining on CLT panel must comply with the minimum distance requirements.

HALF LAP

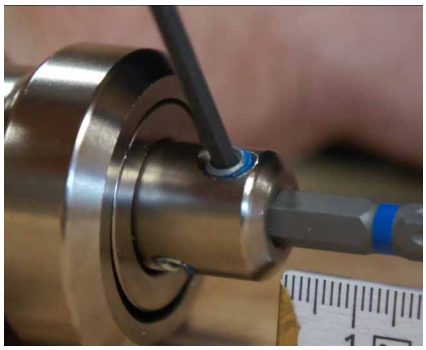
- The main grain direction of the CLT floor panel is considered both parallel and perpendicular to the machining's direction.
- The width of half-lap machining on CLT panel must comply with the minimum distance requirements.
- The proposed screw's lenghth does not exceed the total thickness of the connection.

BUTT JOINT

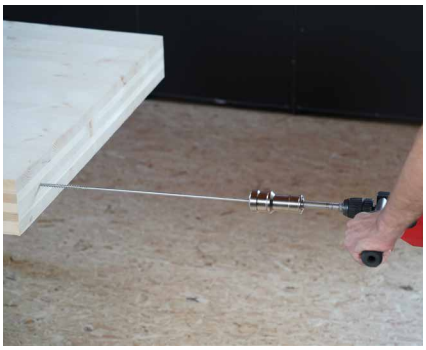
- The screw is considered inserted with an angle of 45° between the screw's axis and CLT plane face.
- According to NDS, an end grain coefficient C_{eg}=0.67 is considered for the lateral resistance calculation due to fastener in narrow edge of CLT.
- The axis of the connector on the shear plane is considered to run through the central layer of the panel.

INSTALLATION SUGGESTIONS

SCREWING USING CATCH



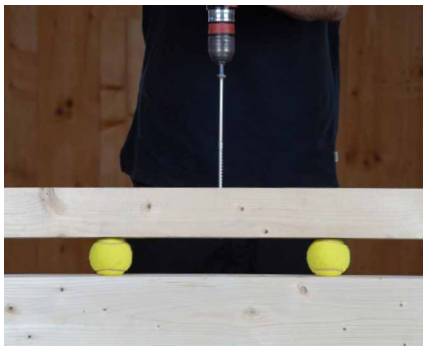
Place the bit inside the CATCH screwing device and fasten it to the correct depth depending on the chosen connector.



CATCH is suitable with long connectors where the insert would otherwise tend to come out of the screw head space.

Useful in case of screwing in corners, which usually do not allow exerting a great screwing force.

PARTIALLY THREADED SCREWS vs FULLY THREADED SCREW



Compressible elements are interposed between two timber beams and a screw is screwed centrally to evaluate its effect on the connection.

The partial thread screw (e.g. HBS) allows the joint to be closed. The threaded portion, inserted all the way inside the second element, allows the first element to slide on the smooth shank.

The fully threaded screw (e.g. VGZ) transfers the force by exploiting its axial strength and penetrates inside the timber elements without moving.

APPLICATION ON HARDWOODS

Pre-drill a hole of the required diameter ($d_{V,H}$) and length equal to the chosen connector size using the SNAIL tip.

Install the screw (e.g. HBS).

Alternatively, specific screws for hardwood applications (e.g. HBSH) can be used, which can be inserted without the aid of pre-drill hole

RELATED PRODUCTS

CATCH
page 436

LEWIS
page 442

SNAIL
page 444

A 18 | ASB 18
page 430