HBS PLATE EVO

PAN HEAD SCREW

ESR-4645 ETA-11/0030

C4 EVO COATING

HBS PLATE EVO version designed for steel-timber joints outdoors. Atmospheric corrosion resistance class (C4) tested by the Research Institutes of Sweden - RISE. Coating suitable for use in applications on wood with an acidity level (pH) greater than 4, such as spruce, larch and pine (see page 354).

NEW GEOMETRY

The inner core diameter of the Ø0.32, Ø0.40 and Ø0.48 inch screws has been increased to ensure higher performance in thick plate applications. In steel-timber connections, the new geometry achieves a strength increase of more than 15%.

PLATE FASTENING

The under-head shoulder achieves an interlocking effect with the circular hole in the plate, thus guaranteeing excellent static performance. The edgeless geometry of the head reduces stress concentration points and gives the screw strength.

HBS P EVO
0.20 | 0.24 inch

HBS PLATE EVO
0.32 | 0.40 | 0.48 inch

MY PROJECT SOFTWARE

MANUALS

BIT INCLUDED

DIAMETER [in]

0.14 | **0.20** — **0.48** | 0.48

LENGTH [in]

1 | **1 15/16** — **8** | 8

EXPOSURE CONDITION

EC1 EC3

ATMOSPHERIC CORROSIVITY

C1 C2 C3 C4

WOOD CORROSIVITY

T1 T2 T3

MATERIAL

C4 EVO COATING — carbon steel with C4 EVO coating

FIELDS OF USE

- timber based panels
- solid timber and glulam
- CLT and LVL
- high density woods
- ACQ, CCA treated timber

CODES AND DIMENSIONS

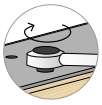
HBS P EVO

d_1 [mm] [in]	CODE	L [mm]	L [in]	b [mm]	b [in]	A [in]	pcs
5 **0.20** #11 TX 25	**HBSPEVO550**	50	1 15/16	30	1 3/16	1/32 - 3/8	200
	HBSPEVO560	60	2 3/8	35	1 3/8	1/32 - 3/8	200
	HBSPEVO570	70	2 3/4	40	1 9/16	1/32 - 3/8	100
	HBSPEVO580	80	3 1/8	50	1 15/16	1/32 - 3/8	100
6 **0.24** #14 TX 30	**HBSPEVO680**	80	3 1/8	50	1 15/16	1/32 - 3/8	100
	HBSPEVO690	90	3 1/2	55	2 3/16	1/32 - 3/8	100

RAPTOR
TRANSPORT PLATE FOR TIMBER ELEMENTS

page 441

METAL-to-TIMBER recommended use:

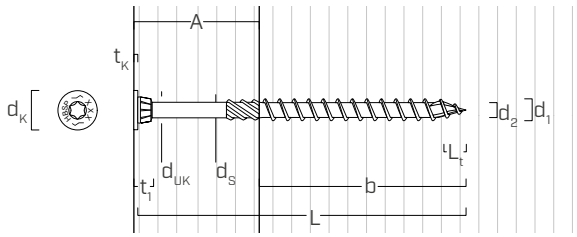


HBS PLATE EVO

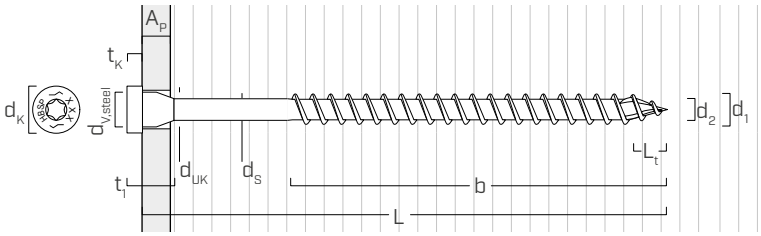
d_1 [mm] [in]	CODE	L [mm]	L [in]	b [mm]	b [in]	A_P [in]	pcs
8 **0.32** TX 40	**HBSPLEVO840**	40	1 9/16	32	1 1/4	1/32 - 3/8	100
	HBSPLEVO860	60	2 3/8	52	2 1/16	1/32 - 3/8	100
	HBSPLEVO880	80	3 1/8	55	2 3/16	1/32 - 9/16	100
	HBSPLEVO8100	100	4	75	2 15/16	1/32 - 9/16	100
	HBSPLEVO8120	120	4 3/4	95	3 3/4	1/32 - 9/16	100
	HBSPLEVO8140	140	5 1/2	110	4 3/8	1/32 - 13/16	100
	HBSPLEVO8160	160	6 1/4	130	5 1/8	1/32 - 13/16	100
10 **0.40** TX 40	**HBSPLEVO1060**	60	2 3/8	52	2 1/16	1/3 2- 3/8	50
	HBSPLEVO1080	80	3 1/8	60	2 3/8	1/32 - 3/8	50
	HBSPLEVO10100	100	4	75	2 15/16	1/32 - 9/16	50
	HBSPLEVO10120	120	4 3/4	95	3 3/4	1/32 - 9/16	50
	HBSPLEVO10140	140	5 1/2	110	4 3/8	1/32 - 13/16	50
	HBSPLEVO10160	160	6 1/4	130	5 1/8	1/32 - 13/16	50
	HBSPLEVO10180	180	7 1/8	150	6	1/32 - 13/16	50
12 **0.48** TX 50	**HBSPLEVO12120**	120	4 3/4	90	3 1/2	1/32 - 13/16	25
	HBSPLEVO12140	140	5 1/2	110	4 3/8	1/32 - 13/16	25
	HBSPLEVO12160	160	6 1/4	120	4 3/4	1/32 -1 3/16	25
	HBSPLEVO12180	180	7 1/8	140	5 1/2	1/32 -1 3/16	25
	HBSPLEVO12200	200	8	160	6 1/4	1/32 -1 3/16	25

GEOMETRY AND MECHANICAL CHARACTERISTICS

HBS P EVO - 0.20 | 0.24 inch



HBS PLATE EVO - 0.32 | 0.40 | 0.48 inch



A = side memeber thickness

Nominal diameter	**d_1**	**[in](1)**	**0.20**	**0.24**	**0.32**	**0.40**	**0.48**
Outer thread diameter	**d_1**	[mm]	5	6	8	10	12
		[in]	**0.197**	**0.236**	**0.315**	**0.394**	**0.472**
Head diameter	d_K	[in]	0.380	0.472	0.531	0.650	0.728
Root diameter	d_2	[in]	0.134	0.156	0.232	0.260	0.287
Shank diameter	d_S	[in]	0.144	0.169	0.248	0.283	0.337
Head thickness	t_1	[in]	0.217	0.256	0.531	0.650	0.768
Washer thickness	t_k	[in]	0.039	0.059	0.177	0.197	0.217
Underhead diameter	d_{UK}	[in]	0.236	0.315	0.394	0.472	0.512
Tip Lenght	L_t	[in]	0.197	0.236	0.315	0.394	0.472
Recommended hole diameter on steel plate	$d_{V,steel}$	[in]	1/4	3/8	7/16	1/2	9/16
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).

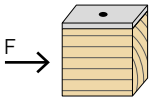
CHARACTERISTIC MECHANICAL PARAMETERS

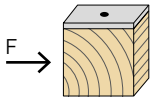
Nominal diameter	**d_1**	**[in]**	**0.20**	**0.24**	**0.32**	**0.40**	**0.48**
Bending yield strength (specified)	$F_{y,b}$	[psi]	220000	200000	172000	168000	178000
Tensile strength (allowable)	f_{tens}	[lbf]	690	1180	2660	3350	4310

Nominal diameter	d_1	[in]		**0.20**	**0.24**	**0.32**	**0.40**	**0.48**
Withdrawal	W_{90}	[lbf/in]	G = 0.35	103	131	141	186	222
			G = 0.42	119	151	162	214	256
			G = 0.49	133	171	183	241	288
			G = 0.55	146	188	200	263	314
minimum embedded length		[in]		1 7/8	1 7/8	1 7/8	2 3/8	2 13/16

MINIMUM DISTANCES FOR SHEAR LOADS | TIMBER

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

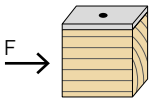


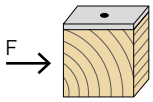


d_1	[in]		0.20	0.24	0.32	0.40	0.48
	[mm]		5	6	8	10	12
a_1	[in]	**15·d**	2 15/16	3 1/2	4 3/4	6	7 1/8
a_2	[in]	**5·d**	1	1 3/16	1 9/16	1 15/16	2 3/8
$a_{3,t}$	[in]	**15·d**	2 15/16	3 1/2	4 3/4	6	7 1/8
$a_{3,c}$	[in]	**10·d**	1 15/16	2 3/8	3 1/8	4	4 3/4
$a_{4,t}$	[in]	**10·d**	1 15/16	2 3/8	3 1/8	4	4 3/4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

	0.20	0.24	0.32	0.40	0.48
	5	6	8	10	12
10·d	1 15/16	2 3/8	3 1/8	4	4 3/4
5·d	1	1 3/16	1 9/16	1 15/16	2 3/8
15·d	2 15/16	3 1/2	4 3/4	6	7 1/8
10·d	1 15/16	2 3/8	3 1/8	4	4 3/4
10·d	1 15/16	2 3/8	3 1/8	4	4 3/4
5·d	1	1 3/16	1 9/16	1 15/16	2 3/8

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

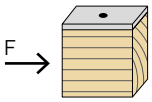


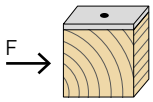


d_1	[in]		0.20	0.24	0.32	0.40	0.48
	[mm]		5	6	8	10	12
a_1	[in]	**15·d**	2 15/16	3 1/2	4 3/4	6	7 1/8
a_2	[in]	**7·d**	1 3/8	1 5/8	2 3/16	2 3/4	3 5/16
$a_{3,t}$	[in]	**20·d**	4	4 3/4	6 1/4	8	9 1/2
$a_{3,c}$	[in]	**15·d**	2 15/16	3 1/2	4 3/4	6	7 1/8
$a_{4,t}$	[in]	**12·d**	2 3/8	2 13/16	3 3/4	4 3/4	5 11/16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

	0.20	0.24	0.32	0.40	0.48
	5	6	8	10	12
10·d	1 15/16	2 3/8	3 1/8	4	4 3/4
7·d	1 3/8	1 5/8	2 3/16	2 3/4	3 5/16
20·d	4	4 3/4	6 1/4	8	9 1/2
15·d	2 15/16	3 1/2	4 3/4	6	7 1/8
12·d	2 3/8	2 13/16	3 3/4	4 3/4	5 11/16
7·d	1 3/8	1 5/8	2 3/16	2 3/4	3 5/16

screws inserted **WITH pre-drilled hole**

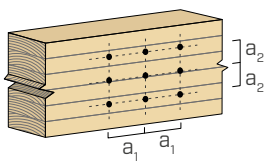




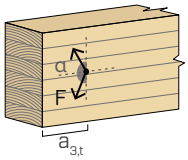
d_1	[in]		0.20	0.24	0.32		0.40	0.48
	[mm]		5	6	8		10	12
a_1	[in]	**10·d**	1 15/16	2 3/8	3 1/8	**5·d**	1 15/16	2 3/8
a_2	[in]	**4·d**	13/16	15/16	1 1/4	**5·d**	1 15/16	2 3/8
$a_{3,t}$	[in]	**12·d**	2 3/8	2 13/16	3 3/4	**7·d**	2 3/4	3 5/16
$a_{3,c}$	[in]	**7·d**	1 3/8	1 5/8	2 3/16	**4·d**	1 9/16	1 7/8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

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

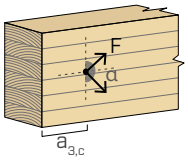
α = load-to-grain angle
d = d_1 = nominal diameter of the screw



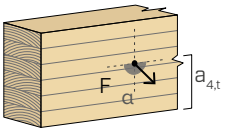
stressed end
-90° < α < 90°



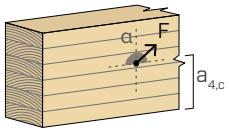
unloaded end
90° < α < 270°



stressed edge
0° < α < 180°



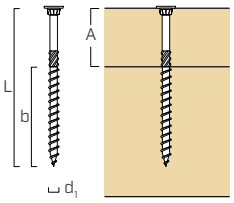
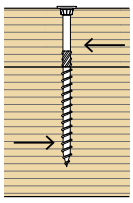
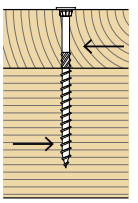
unload edge
180° < α < 360°

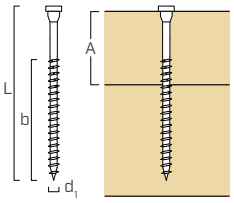
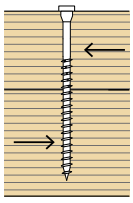
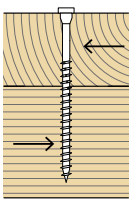


NOTES

- 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.

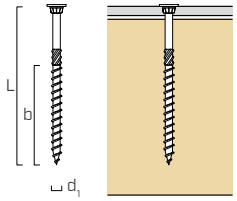
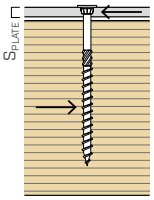
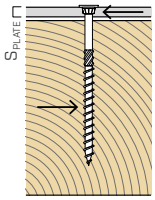
REFERENCE LATERAL DESIGN VALUES (Z) | WOOD-TO-WOOD

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]
5 **0.20**	50	1 15/16	1 3/16	1	57	80	106	131	57	80	106	131	57	80	106	131
	60	2 3/8	1 3/8	1 3/16	69	96	128	155	69	96	128	155	69	96	128	155
	70	2 3/4	1 9/16	1 3/8	81	113	146	164	81	113	146	164	81	113	146	164
	80	3 1/8	1 15/16	1 9/16	93	127	147	164	93	127	147	164	93	127	147	164
6 **0.24**	80	3 1/8	1 15/16	1 9/16	107	149	190	211	107	149	190	211	107	149	190	211
	90	3 1/2	2 3/16	1 3/4	121	165	190	211	121	165	190	211	121	165	190	211

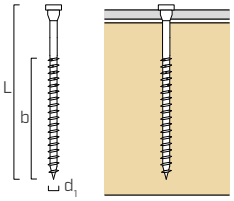
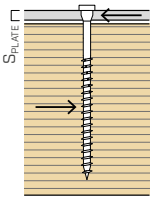
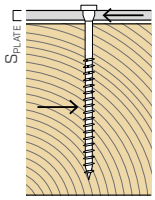
geometry					$Z_{\parallel}$				$Z_{\perp/\parallel}$				$Z_{\perp}$			
																
d_1	L		b	A	G				G				G			
					0.35	0.42	0.49	0.55	0.35	0.42	0.49	0.55	0.35	0.42	0.49	0.55
[mm] [in]	[mm]	[in]	[in]	[in]	[lbf]	[lbf]	[lbf]	[lbf]	[lbf]	[lbf]	[lbf]	[lbf]	[lbf]	[lbf]	[lbf]	[lbf]
8 **0.32**	40	1 9/16	1 1/4	13/16	59	83	110	136	47	66	88	109	47	66	88	109
	60	2 3/8	2 1/16	1 3/16	91	127	169	209	73	102	135	167	73	102	135	167
	80	3 1/8	2 3/16	1 9/16	123	172	228	282	98	137	183	226	98	137	183	226
	100	4	2 15/16	1 15/16	155	217	288	340	124	173	230	272	124	173	230	272
	120	4 3/4	3 3/4	2 3/8	187	257	306	340	150	205	245	272	150	205	245	272
	140	5 1/2	4 3/8	2 3/4	218	265	306	340	174	212	245	272	174	212	245	272
	160	6 1/4	5 1/8	3 1/8	224	265	306	340	180	212	245	272	180	212	245	272
10 **0.40**	60	2 3/8	2 1/16	1 3/16	128	153	179	201	82	103	124	143	68	89	111	131
	80	3 1/8	2 3/8	1 9/16	174	208	243	273	113	141	170	196	92	120	151	178
	100	4	2 15/16	1 15/16	219	263	307	345	144	179	216	249	117	152	190	225
	120	4 3/4	3 3/4	2 3/8	266	319	370	392	173	216	261	297	142	185	231	273
	140	5 1/2	4 3/8	2 3/4	312	342	370	392	204	251	277	297	166	216	261	283
	160	6 1/4	5 1/8	3 1/8	313	342	370	392	224	251	277	297	191	233	261	283
	180	7 1/8	6	3 1/2	313	342	370	392	224	251	277	297	204	233	261	283
12 **0.48**	120	4 3/4	3 1/2	2 3/8	292	350	408	458	185	231	279	321	148	193	241	285
	140	5 1/2	4 3/8	2 3/4	342	411	466	493	218	272	328	369	174	226	283	334
	160	6 1/4	4 3/4	3 1/8	393	431	466	493	252	311	343	369	199	260	320	348
	180	7 1/8	5 1/2	3 1/2	394	431	466	493	275	311	343	369	225	286	320	348
	200	8	6 1/4	4	394	431	466	493	277	311	343	369	251	286	320	348

NOTES and GENERAL PRINCIPLES on page 270.

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

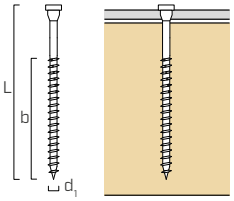
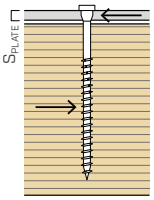
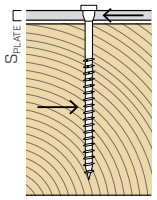
geometry				$Z_{\parallel}$ (1)					$Z_{\perp}$ (2)				
													
d_1	L		b	S_{PLATE}	G				S_{PLATE}	G			
					0.35	0.42	0.49	0.55		0.35	0.42	0.49	0.55
[mm] [in]	[mm]	[in]	[in]	[in]	[lbf]	[lbf]	[lbf]	[lbf]	[in]	[lbf]	[lbf]	[lbf]	[lbf]
5 **0.20**	50	1 15/16	1 3/16	1/8	116	144	163	179	1/8	116	144	163	179
	60	2 3/8	1 3/8		124	144	163	179		124	144	163	179
	70	2 3/4	1 9/16		124	144	163	179		124	144	163	179
	80	3 1/8	1 15/16		124	144	163	179		124	144	163	179
6 **0.24**	80	3 1/8	1 15/16	1/8	155	180	205	225	1/8	155	180	205	225
	90	3 1/2	2 3/16		155	180	205	225		155	180	205	225
5 **0.20**	50	1 15/16	1 3/16	1/4	130	169	203	225	1/4	130	169	203	225
	60	2 3/8	1 3/8		148	178	203	225		148	178	203	225
	70	2 3/4	1 9/16		151	178	203	225		151	178	203	225
	80	3 1/8	1 15/16		151	178	203	225		151	178	203	225
6 **0.24**	80	3 1/8	1 15/16	1/4	194	228	262	289	1/4	194	228	262	289
	90	3 1/2	2 3/16		194	228	262	289		194	228	262	289
5 **0.20**	50	1 15/16	1 3/16	3/8	125	161	202	225	3/8	125	161	202	225
	60	2 3/8	1 3/8		142	178	203	225		142	178	203	225
	70	2 3/4	1 9/16		151	178	203	225		151	178	203	225
	80	3 1/8	1 15/16		151	178	203	225		151	178	203	225
6 **0.24**	80	3 1/8	1 15/16	3/8	194	228	262	289	3/8	194	228	262	289
	90	3 1/2	2 3/16		194	228	262	289		194	228	262	289
5 **0.20**	50	1 15/16	1 3/16	1/2	120	153	191	225	1/2	120	153	191	225
	60	2 3/8	1 3/8		136	178	203	225		136	178	203	225
	70	2 3/4	1 9/16		151	178	203	225		151	178	203	225
	80	3 1/8	1 15/16		151	178	203	225		151	178	203	225
6 **0.24**	80	3 1/8	1 15/16	1/2	194	228	262	289	1/2	194	228	262	289
	90	3 1/2	2 3/16		194	228	262	289		194	228	262	289

NOTES and **GENERAL PRINCIPLES** on page 270.

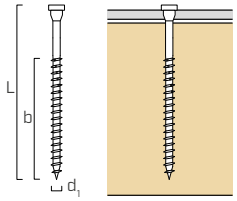
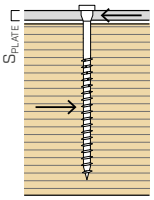
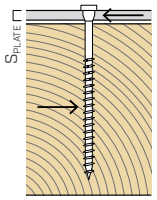
geometry				$Z_{\parallel}$ (1)				$Z_{\perp}$ (2)				
												
d_1	L		b	S_{PLATE}	G				S_{PLATE}	G		
					0.35	0.42	0.49	0.55		0.35	0.42	0.49	0.55
[mm] [in]	[mm]	[in]	[in]	[in]	[lbf]	[lbf]	[lbf]	[lbf]	[in]	[lbf]	[lbf]	[lbf]	[lbf]
8 **0.32**	40	1 9/16	1 1/4	1/8	127	166	211	254	1/8	101	133	169	203
	60	2 3/8	2 1/16		181	246	312	343		145	196	250	275
	80	3 1/8	2 3/16		234	274	312	343		187	219	250	275
	100	4	2 15/16		234	274	312	343		187	219	250	275
	120	4 3/4	3 3/4		234	274	312	343		187	219	250	275
	140	5 1/2	4 3/8		234	274	312	343		187	219	250	275
	160	6 1/4	5 1/8		234	274	312	343		187	219	250	275
10 **0.40**	60	2 3/8	2 1/16	1/8	244	289	334	373	1/8	135	171	211	246
	80	3 1/8	2 3/8		317	345	369	389		180	231	263	284
	100	4	2 15/16		317	345	369	389		210	237	263	284
	120	4 3/4	3 3/4		317	345	369	389		210	237	263	284
	140	5 1/2	4 3/8		317	345	369	389		210	237	263	284
	160	6 1/4	5 1/8		317	345	369	389		210	237	263	284
	180	7 1/8	6		317	345	369	389		210	237	263	284
12 **0.48**	120	4 3/4	3 1/2	1/8	394	429	460	485	1/8	255	289	320	346
	140	5 1/2	4 3/8		394	429	460	485		255	289	320	346
	160	6 1/4	4 3/4		394	429	460	485		255	289	320	346
	180	7 1/8	5 1/2		394	429	460	485		255	289	320	346
	200	8	6 1/4		394	429	460	485		255	289	320	346
8 **0.32**	40	1 9/16	1 1/4	1/4	188	224	264	301	1/4	151	179	211	241
	60	2 3/8	2 1/16		217	276	344	407		174	221	275	326
	80	3 1/8	2 3/16		263	328	372	407		211	262	297	326
	100	4	2 15/16		282	328	372	407		226	262	297	326
	120	4 3/4	3 3/4		282	328	372	407		226	262	297	326
	140	5 1/2	4 3/8		282	328	372	407		226	262	297	326
	160	6 1/4	5 1/8		282	328	372	407		226	262	297	326
10 **0.40**	60	2 3/8	2 1/16	1/4	269	310	350	385	1/4	160	193	229	261
	80	3 1/8	2 3/8		343	399	427	448		195	243	294	329
	100	4	2 15/16		368	399	427	448		236	277	305	329
	120	4 3/4	3 3/4		368	399	427	448		246	277	305	329
	140	5 1/2	4 3/8		368	399	427	448		246	277	305	329
	160	6 1/4	5 1/8		368	399	427	448		246	277	305	329
	180	7 1/8	6		368	399	427	448		246	277	305	329
12 **0.48**	120	4 3/4	3 1/2	1/4	444	482	515	542	1/4	289	326	360	388
	140	5 1/2	4 3/8		444	482	515	542		289	326	360	388
	160	6 1/4	4 3/4		444	482	515	542		289	326	360	388
	180	7 1/8	5 1/2		444	482	515	542		289	326	360	388
	200	8	6 1/4		444	482	515	542		289	326	360	388

NOTES and **GENERAL PRINCIPLES** on page 270.

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

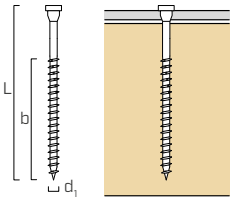
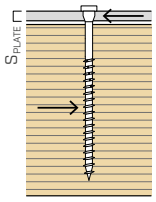
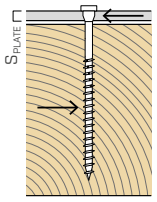
geometry				$Z_{\parallel}$ (1)				$Z_{\perp}$ (2)				
												
d_1	L		b	S_{PLATE}	G				S_{PLATE}	G		
					0.35	0.42	0.49	0.55		0.35	0.42	0.49	0.55
[mm] [in]	[mm]	[in]	[in]	[in]	[lbf]	[lbf]	[lbf]	[lbf]	[in]	[lbf]	[lbf]	[lbf]	[lbf]
8 **0.32**	40	1 9/16	1 1/4	3/8	206	261	303	342	3/8	165	209	243	274
	60	2 3/8	2 1/16		238	298	366	430		190	238	293	344
	80	3 1/8	2 3/16		278	362	422	467		222	290	338	373
	100	4	2 15/16		313	368	422	467		251	295	338	373
	120	4 3/4	3 3/4		313	368	422	467		251	295	338	373
	140	5 1/2	4 3/8		313	368	422	467		251	295	338	373
	160	6 1/4	5 1/8		313	368	422	467		251	295	338	373
10 **0.40**	60	2 3/8	2 1/16	3/8	324	362	399	430	3/8	207	239	272	302
	80	3 1/8	2 3/8		378	433	487	534		229	274	321	364
	100	4	2 15/16		432	472	507	536		261	320	360	390
	120	4 3/4	3 3/4		432	472	507	536		284	323	360	390
	140	5 1/2	4 3/8		432	472	507	536		284	323	360	390
	160	6 1/4	5 1/8		432	472	507	536		284	323	360	390
	180	7 1/8	6		432	472	507	536		284	323	360	390
12 **0.48**	120	4 3/4	3 1/2	3/8	523	566	604	634	3/8	314	384	424	456
	140	5 1/2	4 3/8		523	566	604	634		342	384	424	456
	160	6 1/4	4 3/4		523	566	604	634		342	384	424	456
	180	7 1/8	5 1/2		523	566	604	634		342	384	424	456
	200	8	6 1/4		523	566	604	634		342	384	424	456
8 **0.32**	40	1 9/16	1 1/4	1/2	182	254	299	335	1/2	145	203	240	268
	60	2 3/8	2 1/16		233	290	353	413		186	232	282	330
	80	3 1/8	2 3/16		271	351	422	467		216	281	338	373
	100	4	2 15/16		313	368	422	467		251	295	338	373
	120	4 3/4	3 3/4		313	368	422	467		251	295	338	373
	140	5 1/2	4 3/8		313	368	422	467		251	295	338	373
	160	6 1/4	5 1/8		313	368	422	467		251	295	338	373
10 **0.40**	60	2 3/8	2 1/16	1/2	334	378	421	457	1/2	208	244	282	317
	80	3 1/8	2 3/8		402	465	507	536		237	288	343	390
	100	4	2 15/16		432	472	507	536		277	323	360	390
	120	4 3/4	3 3/4		432	472	507	536		284	323	360	390
	140	5 1/2	4 3/8		432	472	507	536		284	323	360	390
	160	6 1/4	5 1/8		432	472	507	536		284	323	360	390
	180	7 1/8	6		432	472	507	536		284	323	360	390
12 **0.48**	120	4 3/4	3 1/2	1/2	545	594	639	674	1/2	348	397	442	479
	140	5 1/2	4 3/8		545	594	639	674		350	397	442	479
	160	6 1/4	4 3/4		545	594	639	674		350	397	442	479
	180	7 1/8	5 1/2		545	594	639	674		350	397	442	479
	200	8	6 1/4		545	594	639	674		350	397	442	479

NOTES and **GENERAL PRINCIPLES** on page 270.

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]
8 **0.32**	40	1 9/16	1 1/4	5/8	157	219	291	331	5/8	125	175	233	264
	60	2 3/8	2 1/16		229	282	341	397		183	226	273	317
	80	3 1/8	2 3/16		264	340	422	467		211	272	338	373
	100	4	2 15/16		311	368	422	467		249	295	338	373
	120	4 3/4	3 3/4		313	368	422	467		251	295	338	373
	140	5 1/2	4 3/8		313	368	422	467		251	295	338	373
	160	6 1/4	5 1/8		313	368	422	467		251	295	338	373
10 **0.40**	60	2 3/8	2 1/16	5/8	326	367	407	441	5/8	205	239	275	307
	80	3 1/8	2 3/8		390	450	507	536		231	280	333	380
	100	4	2 15/16		432	472	507	536		270	323	360	390
	120	4 3/4	3 3/4		432	472	507	536		284	323	360	390
	140	5 1/2	4 3/8		432	472	507	536		284	323	360	390
	160	6 1/4	5 1/8		432	472	507	536		284	323	360	390
	180	7 1/8	6		432	472	507	536		284	323	360	390
12 **0.48**	120	4 3/4	3 1/2	5/8	545	594	639	674	5/8	345	397	442	479
	140	5 1/2	4 3/8		545	594	639	674		350	397	442	479
	160	6 1/4	4 3/4		545	594	639	674		350	397	442	479
	180	7 1/8	5 1/2		545	594	639	674		350	397	442	479
	200	8	6 1/4		545	594	639	674		350	397	442	479
8 **0.32**	40	1 9/16	1 1/4	3/4	132	185	245	303	3/4	106	148	196	243
	60	2 3/8	2 1/16		226	275	330	382		181	220	264	305
	80	3 1/8	2 3/16		257	330	412	467		206	264	330	373
	100	4	2 15/16		303	368	422	467		242	295	338	373
	120	4 3/4	3 3/4		313	368	422	467		251	295	338	373
	140	5 1/2	4 3/8		313	368	422	467		251	295	338	373
	160	6 1/4	5 1/8		313	368	422	467		251	295	338	373
10 **0.40**	60	2 3/8	2 1/16	3/4	319	357	394	425	3/4	192	235	268	298
	80	3 1/8	2 3/8		379	435	492	536		226	273	322	367
	100	4	2 15/16		432	472	507	536		263	323	360	390
	120	4 3/4	3 3/4		432	472	507	536		284	323	360	390
	140	5 1/2	4 3/8		432	472	507	536		284	323	360	390
	160	6 1/4	5 1/8		432	472	507	536		284	323	360	390
	180	7 1/8	6		432	472	507	536		284	323	360	390
12 **0.48**	120	4 3/4	3 1/2	3/4	545	594	639	674	3/4	337	397	442	479
	140	5 1/2	4 3/8		545	594	639	674		350	397	442	479
	160	6 1/4	4 3/4		545	594	639	674		350	397	442	479
	180	7 1/8	5 1/2		545	594	639	674		350	397	442	479
	200	8	6 1/4		545	594	639	674		350	397	442	479

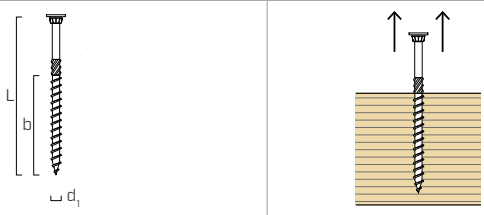
NOTES and **GENERAL PRINCIPLES** on page 270.

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

geometry				Z_{II} (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]
8 **0.32**	40	1 9/16	1 1/4	7/8	107	150	199	247	7/8	86	120	159	197
	60	2 3/8	2 1/16		223	269	320	368		179	215	256	294
	80	3 1/8	2 3/16		251	319	397	467		201	256	318	373
	100	4	2 15/16		295	368	422	467		236	295	338	373
	120	4 3/4	3 3/4		313	368	422	467		251	295	338	373
	140	5 1/2	4 3/8		313	368	422	467		251	295	338	373
	160	6 1/4	5 1/8		313	368	422	467		251	295	338	373
10 **0.40**	60	2 3/8	2 1/16	7/8	313	348	382	411	7/8	175	228	263	290
	80	3 1/8	2 3/8		367	421	474	519		221	265	312	354
	100	4	2 15/16		432	472	507	536		257	317	360	390
	120	4 3/4	3 3/4		432	472	507	536		284	323	360	390
	140	5 1/2	4 3/8		432	472	507	536		284	323	360	390
	160	6 1/4	5 1/8		432	472	507	536		284	323	360	390
	180	7 1/8	6		432	472	507	536		284	323	360	390
12 **0.48**	120	4 3/4	3 1/2	7/8	545	594	639	674	7/8	330	397	442	479
	140	5 1/2	4 3/8		545	594	639	674		350	397	442	479
	160	6 1/4	4 3/4		545	594	639	674		350	397	442	479
	180	7 1/8	5 1/2		545	594	639	674		350	397	442	479
	200	8	6 1/4		545	594	639	674		350	397	442	479

NOTES and **GENERAL PRINCIPLES** on page 270.

THREAD WITHDRAWAL (W) | WOOD

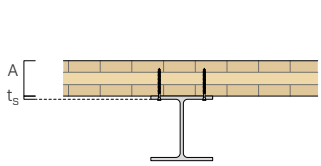
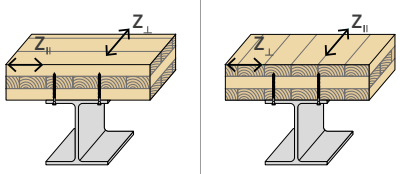
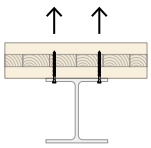
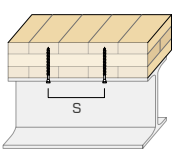
geometry				thread withdrawal α = 90°				thread withdrawal α = 45°				thread withdrawal α = 0°			
															
d_1	L		b	G				G				G			
				0.35	0.42	0.49	0.55	0.35	0.42	0.49	0.55	0.35	0.42	0.49	0.55
[mm] [in]	[mm]	[in]	[in]	[lbf]	[lbf]	[lbf]	[lbf]	[lbf]	[lbf]	[lbf]	[lbf]	[lbf]	[lbf]	[lbf]	[lbf]
5 **0.20**	50	1 15/16(1)	1 3/16	101	117	131	144	92	107	119	131	30	35	39	43
	60	2 3/8(1)	1 3/8	122	141	157	172	111	128	143	157	36	42	47	52
	70	2 3/4(2)	1 9/16	142	164	183	201	129	149	167	183	43	49	55	60
	80	3 1/8	1 15/16	182	211	236	259	166	192	214	235	55	63	71	78
6 **0.24**	80	3 1/8(2)	1 15/16	227	262	296	326	207	238	270	296	68	78	89	98
	90	3 1/2	2 3/16	253	291	330	363	230	265	300	330	76	87	99	109

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]
8 **0.32**	40	1 9/16(1)	1 1/4	133	153	173	189	121	139	157	172	40	46	52	57
	60	2 3/8(1)	2 1/16	244	281	317	346	222	255	288	315	73	84	95	104
	80	3 1/8(1)	2 3/16	261	300	339	370	237	273	308	337	78	90	102	111
	100	4	2 15/16	372	427	483	528	338	389	439	480	112	128	145	158
	120	4 3/4	3 3/4	483	555	627	685	439	505	570	623	145	166	188	206
	140	5 1/2	4 3/8	566	651	735	803	515	592	669	731	170	195	220	241
	160	6 1/4	5 1/8	677	778	879	961	616	708	800	874	203	233	264	288
10 **0.40**	60	2 3/8(1)	2 1/16	308	354	399	435	280	322	363	396	92	106	120	130
	80	3 1/8(1)	2 3/8	366	421	474	518	333	383	432	471	110	126	142	155
	100	4(2)	2 15/16	476	548	617	673	433	498	561	612	143	164	185	202
	120	4 3/4	3 3/4	622	716	806	880	566	652	734	801	187	215	242	264
	140	5 1/2	4 3/8	732	843	949	1035	666	767	863	942	220	253	285	311
	160	6 1/4	5 1/8	879	1011	1139	1243	800	920	1036	1131	264	303	342	373
	180	7 1/8	6	1025	1180	1328	1450	933	1073	1209	1319	308	354	399	435
10 **0.40**	120	4 3/4(2)	3 1/2	682	786	884	964	620	715	805	877	205	236	265	289
	140	5 1/2	4 3/8	857	988	1111	1211	779	899	1011	1102	257	296	333	363
	160	6 1/4	4 3/4	944	1089	1225	1335	859	991	1114	1215	283	327	367	401
	180	7 1/8	5 1/2	1119	1290	1451	1582	1018	1174	1321	1440	336	387	435	475
	200	8	6 1/4	1294	1492	1678	1830	1177	1357	1527	1665	388	447	503	549

(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).

NOTES and GENERAL PRINCIPLES on page 270.

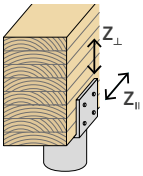
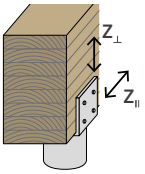
STEEL-TO-WOOD | CLT FLOOR-TO-STEEL BEAM

					SHEAR				TENSION	SPACING	
geometry					floor-to-beam orientation 1		floor-to-beam orientation 2		withdrawal / tensile	fastener in a row	
											
	main member thickness (wall/floor) = A		steel beam flange thickness = t_s	suggested screw	$Z_{\parallel}$	$Z_{\perp}$	$Z_{\parallel}$	$Z_{\perp}$	$W^{(*)}$	minimum	typical
	[mm]	[in]	[in]	CODE	[lbf]	[lbf]	[lbf]	[lbf]	[lbf]	[in]	[in]
3 PLY	79	3 1/8	3/16	HBSPLEVO860	257	205	257	205	281	3 1/8	6
			3/16	HBSPLEVO1080	367	235	367	235	421	4	8
	105	4 1/8	1/4	HBSPLEVO880	328	262	328	262	300	3 1/8	6
			1/4	HBSPLEVO1080	399	243	399	243	421	4	8
	120	4 3/4	5/16	HBSPLEVO8100	365	292	365	292	427	3 1/8	6
			5/16	HBSPLEVO10100	438	304	438	304	548	4	8
5 PLY	100	3 15/16	3/16	HBSPLEVO880	297	238	297	238	300	3 1/8	6
			3/16	HBSPLEVO1080	367	235	367	235	421	4	8
	140	5 1/2	1/4	HBSPLEVO8120	328	262	328	262	555	3 1/8	6
			1/4	HBSPLEVO10120	399	277	399	277	716	4	8
			1/4	HBSPLEVO12120	482	326	482	326	786	4 3/4	10
	175	6 7/8	5/16	HBSPLEVO8140	365	292	365	292	651	3 1/8	6
			5/16	HBSPLEVO10140	438	304	438	304	843	4	8
			5/16	HBSPLEVO12140	521	353	521	353	988	4 3/4	10
	200	7 7/8	3/8	HBSPLEVO8160	368	295	368	295	778	3 1/8	6
			3/8	HBSPLEVO10160	472	323	472	323	1011	4	8
			3/8	HBSPLEVO12160	566	384	566	384	1089	4 3/4	10
7 PLY	140	5 1/2	3/16	HBSPLEVO8120	297	238	297	238	555	3 1/8	6
			3/16	HBSPLEVO10120	367	254	367	254	716	4	8
			3/16	HBSPLEVO12120	450	304	450	304	786	4 3/4	10
	191	7 1/2	1/4	HBSPLEVO8140	328	262	328	262	651	3 1/8	6
			1/4	HBSPLEVO10140	399	277	399	277	843	4	8
			1/4	HBSPLEVO12140	482	326	482	326	988	4 3/4	10
	244	9 5/8	3/8	HBSPLEVO8160	368	295	368	295	778	3 1/8	6
			3/8	HBSPLEVO10160	472	323	472	323	1011	4	8
			3/8	HBSPLEVO12160	566	384	566	384	1089	4 3/4	10
	280	11	1/2	HBSPLEVO8160	368	295	368	295	778	3 1/8	6
			1/2	HBSPLEVO10180	472	323	472	323	1180	4	8
			1/2	HBSPLEVO12180	594	397	594	397	1290	4 3/4	10
9 PLY	180	7 1/16	5/16	HBSPLEVO8140	365	292	365	292	651	3 1/8	6
			5/16	HBSPLEVO10140	438	304	438	304	843	4	8
			5/16	HBSPLEVO12140	521	353	521	353	988	4 3/4	10
	267	10 1/2	7/16	HBSPLEVO8160	368	295	368	295	778	3 1/8	6
			7/16	HBSPLEVO10160	472	323	472	323	1011	4	8
			7/16	HBSPLEVO12160	594	397	594	397	1089	4 3/4	10
	314	12 3/8	9/16	HBSPLEVO8160	368	295	368	295	778	3 1/8	6
			9/16	HBSPLEVO10180	472	323	472	323	1180	4	8
			9/16	HBSPLEVO12180	594	397	594	397	1290	4 3/4	10
	360	14 3/16	5/8	HBSPLEVO8160	368	295	368	295	778	3 1/8	6
			5/8	HBSPLEVO10180	472	323	472	323	1180	4	8
			5/8	HBSPLEVO12200	594	397	594	397	1492	4 3/4	10

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

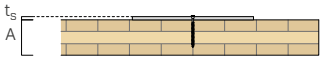
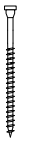
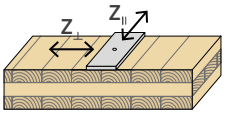
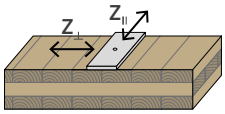
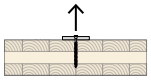
NOTES and GENERAL PRINCIPLES on page 270.

STEEL-TO-WOOD | STEEL COLUMN-TO-WOOD BEAM

geometry				SHEAR			
				wood beam (SPF) - steel side plate		wood beam (D.Fir) - steel side plate	
							
main member thickness (beam width) = A		steel beam flange thickness = t_s	suggested screw	Z_{II}	$Z_\perp$	Z_{II}	$Z_\perp$
[mm]	[in]	[in]	CODE	[lbf]	[lbf]	[lbf]	[lbf]
79	3 1/8	1/8	**HBSPLEVO860**	246	196	312	250
		1/8	**HBSPLEVO1080**	345	231	369	263
		1/4	**HBSPLEVO880**	328	262	372	297
		1/4	**HBSPLEVO1080**	399	243	427	294
130	5 1/8	1/4	**HBSPLEVO8100**	328	262	372	297
		1/4	**HBSPLEVO10100**	399	277	427	305
		3/8	**HBSPLEVO8120**	368	295	422	338
		3/8	**HBSPLEVO10120**	472	323	507	360
		3/8	**HBSPLEVO12120**	566	384	604	424
171	6 3/4	3/8	**HBSPLEVO8100**	368	295	422	338
		3/8	**HBSPLEVO10100**	472	320	507	360
		1/2	**HBSPLEVO8120**	368	295	422	338
		1/2	**HBSPLEVO10120**	472	323	507	360
		1/2	**HBSPLEVO12120**	594	397	639	442
222	8 3/4	1/2	**HBSPLEVO8120**	368	295	422	338
		1/2	**HBSPLEVO10140**	472	323	507	360
		1/2	**HBSPLEVO12140**	594	397	639	442
		5/8	**HBSPLEVO8140**	368	295	422	338
		5/8	**HBSPLEVO10160**	472	323	507	360
		5/8	**HBSPLEVO12160**	594	397	639	442
		3/4	**HBSPLEVO8160**	368	295	422	338
		3/4	**HBSPLEVO10180**	472	323	507	360
		3/4	**HBSPLEVO12180**	594	397	639	442
273	10 3/4	5/8	**HBSPLEVO8120**	368	295	422	338
		5/8	**HBSPLEVO10140**	472	323	507	360
		5/8	**HBSPLEVO12160**	594	397	639	442
		3/4	**HBSPLEVO8140**	368	295	422	338
		3/4	**HBSPLEVO10160**	472	323	507	360
		3/4	**HBSPLEVO12180**	594	397	639	442
		7/8	**HBSPLEVO8160**	368	295	422	338
		7/8	**HBSPLEVO10180**	472	323	507	360
		7/8	**HBSPLEVO12200**	594	397	639	442

NOTES and GENERAL PRINCIPLES on page 270.

STEEL-TO-WOOD | STEEL SIDE PLATE CLT CONNECTION

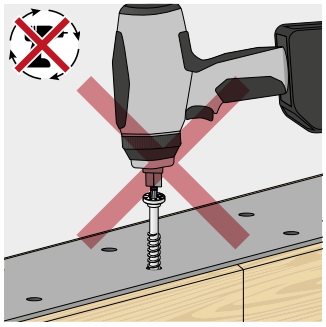
					SHEAR				TENSION
	geometry				CLT (SPF) - steel side plate		CLT (D.Fir) - steel side plate		withdrawal / tensile
									
	main member thickness (wall/floor) = A		steel beam flange thickness = t_s	suggested screw	$Z_\parallel$	$Z_\perp$	$Z_\parallel$	$Z_\perp$	$W^{(*)}$
	[mm]	[in]	[in]	CODE	[lbf]	[lbf]	[lbf]	[lbf]	[lbf]
3 PLY	79	3 1/8	3/16	HBSPLEVO860	257	205	327	262	281
			3/16	HBSPLEVO1080	367	235	393	281	421
	105	4 1/8	1/4	HBSPLEVO880	328	262	372	297	300
			1/4	HBSPLEVO1080	399	243	427	294	421
	120	4 3/4	5/16	HBSPLEVO8100	365	292	413	330	427
			5/16	HBSPLEVO10100	438	304	467	335	548
5 PLY	100	3 15/16	3/16	HBSPLEVO880	297	238	337	270	300
			3/16	HBSPLEVO1080	367	235	393	281	421
	140	5 1/2	1/4	HBSPLEVO8120	328	262	372	297	555
			1/4	HBSPLEVO10120	399	277	427	305	716
			1/4	HBSPLEVO12120	482	326	515	360	786
	175	6 7/8	5/16	HBSPLEVO8140	365	292	413	330	651
			5/16	HBSPLEVO10140	438	304	467	335	843
			5/16	HBSPLEVO12140	521	353	556	390	988
	200	7 7/8	3/8	HBSPLEVO8160	368	295	422	338	778
			3/8	HBSPLEVO10160	472	323	507	360	1011
			3/8	HBSPLEVO12160	566	384	604	424	1089
7 PLY	140	5 1/2	3/16	HBSPLEVO8120	297	238	337	270	555
			3/16	HBSPLEVO10120	367	254	393	281	716
			3/16	HBSPLEVO12120	450	304	482	337	786
	191	7 1/2	1/4	HBSPLEVO8140	328	262	372	297	651
			1/4	HBSPLEVO10140	399	277	427	305	843
			1/4	HBSPLEVO12140	482	326	515	360	988
	244	9 5/8	3/8	HBSPLEVO8160	368	295	422	338	778
			3/8	HBSPLEVO10160	472	323	507	360	1011
			3/8	HBSPLEVO12160	566	384	604	424	1089
	280	11	1/2	HBSPLEVO8160	368	295	422	338	778
			1/2	HBSPLEVO10180	472	323	507	360	1180
			1/2	HBSPLEVO12180	594	397	639	442	1290
9 PLY	180	7 1/16	5/16	HBSPLEVO8140	365	292	413	330	651
			5/16	HBSPLEVO10140	438	304	467	335	843
			5/16	HBSPLEVO12140	521	353	556	390	988
	267	10 1/2	7/16	HBSPLEVO8160	368	295	422	338	778
			7/16	HBSPLEVO10160	472	323	507	360	1011
			7/16	HBSPLEVO12160	594	397	639	442	1089
	314	12 3/8	9/16	HBSPLEVO8160	368	295	422	338	778
			9/16	HBSPLEVO10180	472	323	507	360	1180
			9/16	HBSPLEVO12180	594	397	639	442	1290
	360	14 3/16	5/8	HBSPLEVO8160	368	295	422	338	778
			5/8	HBSPLEVO10180	472	323	507	360	1180
			5/8	HBSPLEVO12200	594	397	639	442	1492

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

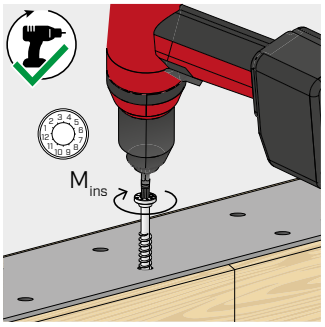
NOTES and GENERAL PRINCIPLES on page 270.

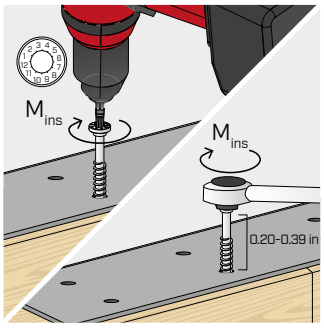
INSTALLATION

MANUALS



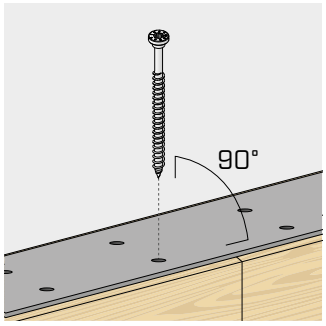
The use of pulse screw guns/impact wrenches is not permitted.



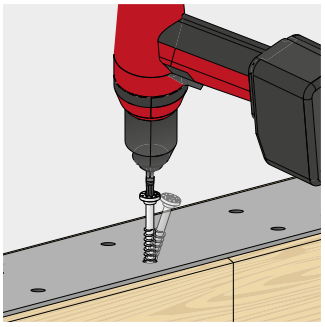


HBSPL HBSPL EVO	d_1 [in]	$M_{ins,max}$ [ft·lbs]
Ø0.32	0.32	18
Ø0.40	0.40	25
Ø0.48	0.48	36

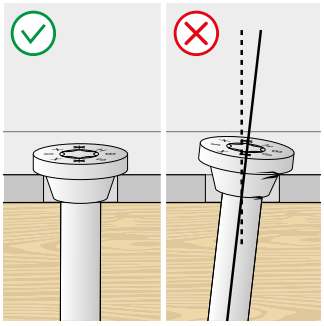
Ensure tightening torque is less than or equal to the maximum tightening torque ($M_{ins,max}$).
We recommend the use of torque-controlled screwdrivers, e.g. with TORQUE LIMITER. Alternatively, tighten with a torque wrench.



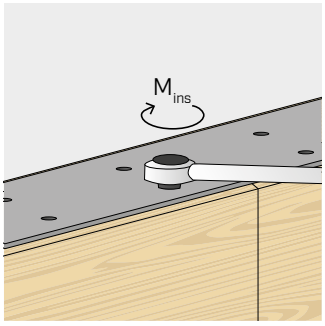
Respect the insertion angle. For very precise inclinations, the use of guide holes or pre-drilling is recommended.



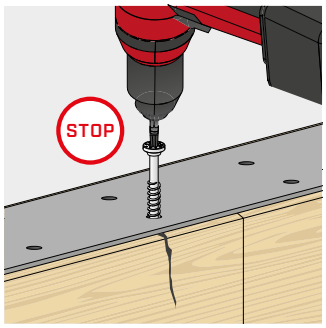
Avoid bending.



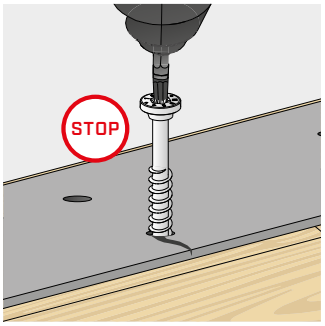
Ensure full contact between the entire surface of the screw head and the metal element



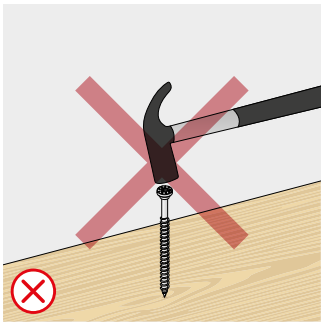
After installation, the fasteners can be inspected using a torque wrench.



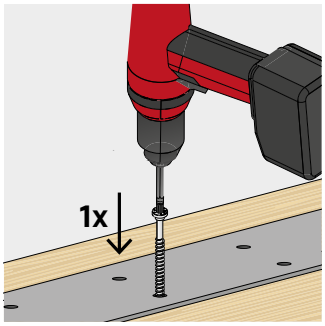
Stop installation if damage to the fastener or timber is noticed.



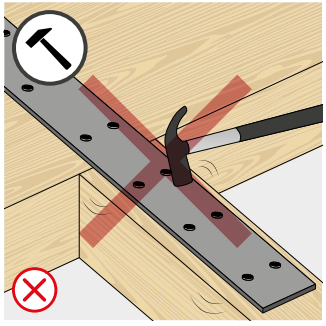
Stop installation if damage to the fastener or metal plates is noticed.



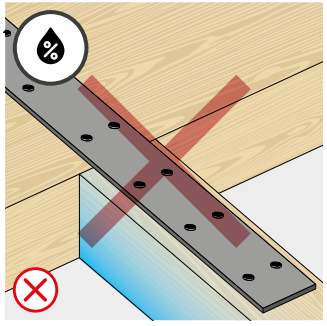
Do not hammer the screw tips into the timber.



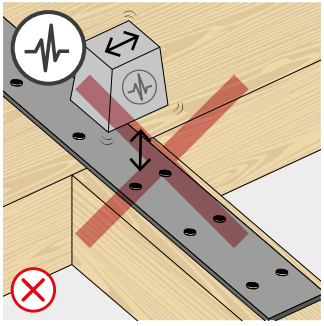
Install screws in one continuous stroke and stop when the screw head makes contact with the metal element..



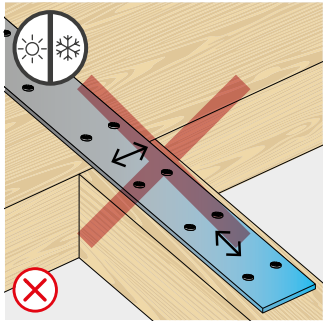
Avoid accidental stress during installation.



Protect the connection and avoid moisture changes and shrinkage and swelling of the timber.



Use not permitted for dynamic loads.



Avoid dimensional changes to the metal.

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.
- 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 PLATE EVO screws must be installed and used in dry in-service conditions in accordance with the NDS (wet service factor for connection CM is 1.0).
- HBS PLATE EVO screws must be positioned in accordance with the minimum distances.

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 265 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.

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, unless otherwisee noted.
- $Z_{||}$: 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°.
- 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°.

STEEL-TO-WOOD | CLT FLOOR-TO-STEEL BEAM

- Steel side member must be pre-drilled in accordance with the indications provided in this technical data sheet and installation instructions.
- A dowel bearing strength of F_e = 87,000 psi is used in the yield limit equations for the steel side member, in accordance with the NDS.
- The main grain direction of the CLT floor panel is considered both parallel and perpendicular to the beam direction.
- The withdrawal capacity has been considered as the minimum between thread withdrawal and tensile strength of the screw.

STEEL-TO-WOOD | STEEL SIDE PLATE CLT CONNECTION

- Steel side member must be pre-drilled according to the information reported in these tecnical datasheet and installation instructions.
- Beam element can be considered both solid wood or glulam.
- The proposed screw length does not exceed the total thickness of the connection. In the case of steel plates on both sides of the beam, the geometry of the connection must be designed to avoid collisions between screws inserted from opposite sides.
- A dowel bearing strength of F_e = 87,000 psi is used in the yield limit equations for the steel side member, in accordance with the NDS.

STEEL-TO-WOOD | STEEL SIDE PLATE CLT CONNECTION

- Steel side member must be pre-drilled according to the information reported in these tecnical datasheet and installation instructions.
- A dowel bearing strength of F_e = 87,000 psi is used in the yield limit equations for the steel side member, in accordance with the NDS.
- The main grain direction of the CLT floor panel is considered both parallel and perpendicular to the beam direction.
- The withdrawal capacity has been considered as the minimum between thread withdrawal and tensile strength of the screw.