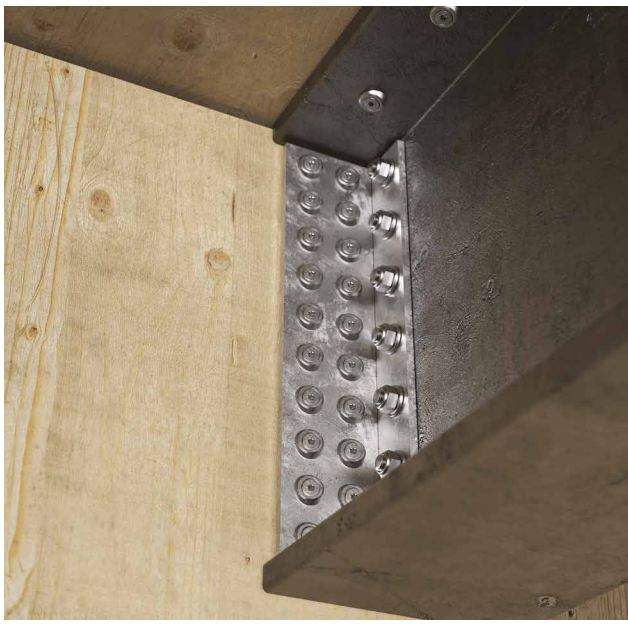
HUS

TURNED WASHER

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



COMPATIBILITY
It is the ideal coupling for countersunk-head screws (HBS, VGS, SBS-SPP, SCI, etc.) when the axial strength of the connection is to be increased.

TIMBER-TO-METAL
It is the optimal choice for connections on metal plates with cylindrical holes.

HUS EVO
The HUS EVO version increases the washer's corrosion resistance due to the special surface treatment. This allows it to be used in exposure condition 3 and atmospheric corrosion class C4.

HUS 15°
The 15° angled washer is specifically designed for particular wood-to-metal applications where just a small angle is needed for screw insertion. The HUS BAND double-sided adhesive tape holds the washer in place during over-head applications.

MY PROJECT SOFTWARE

MATERIAL

HUS 15°

alu — aluminium alloy EN AW 6082-T6

EC1 or WET, C2, T3

HUS

Zn ELECTRO PLATED — electrogalvanized carbon steel

EC1 DRY, C2, T2

HUS EVO

C4 EVO COATING — carbon steel with C4 EVO coating

EC1 EC3, C4, T3

HUS A4

A4 AISI 316 — A4 | AISI316 austenitic stainless steel

EC1 EC2 EC3 EC4 WET, C5, T5

HUS

HUS 15°

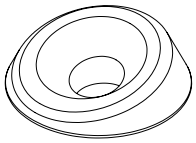
HUS EVO

HUS A4

FIELDS OF USE

- thin or thick metal plates with cylindrical holes
- timber based panels
- solid timber and glulam
- CLT and LVL
- high density woods

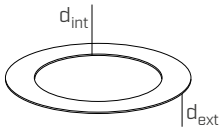
CODES AND DIMENSIONS



alu

HUS 15° - 15° angled washer

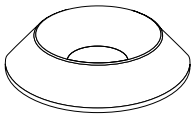
CODE	d_{HBS}		d_{VGS}		pcs
	[mm]	[in]	[mm]	[in]	
HUS815	8	0.32	9	0.36	50



HUS BAND - double-sided adhesive for HUS washers

CODE	d_{int}		d_{ext}		pcs
	[mm]	[in]	[mm]	[in]	
HUSBAND	22	7/8	30	1 3/16	50

Compatible with HUS815, HUS10, HUS12, HUS10A4.



Zn ELECTRO PLATED

HUS - turned washer

CODE	d_{HBS}		d_{VGS}		pcs
	[mm]	[in]	[mm]	[in]	
HUS6	6	0.24	-	-	100
HUS8	8	0.32	9	0.36	50
HUS10	10	0.40	11	0.44	50
HUS12	12	0.48	13	0.52	25

C4 EVO COATING

HUS EVO - turned washer

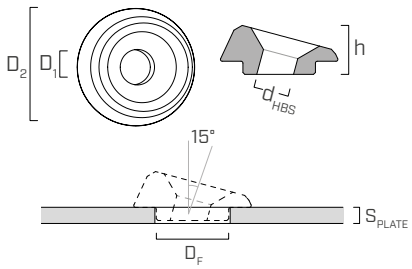
CODE	$d_{HBS\ EVO}$		$d_{VGS\ EVO}$		pcs
	[mm]	[in]	[mm]	[in]	
HUSEVO6	6	0.24	-	-	50
HUSEVO8	8	0.32	9	0.36	50

A4 AISI 316

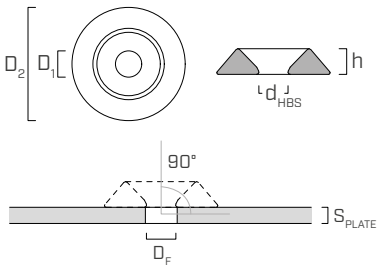
HUS A4 - turned washer

CODE	d_{SCI}		$d_{VGS\ A4}$		pcs
	[mm]	[in]	[mm]	[in]	
HUS6A4	6	0.24	-	-	100
HUS8A4	8	0.32	9	0.36	100
HUS10A4	-	-	11	0.44	50

GEOMETRY AND MECHANICAL PARAMETERS



HUS 15°



HUS - HUS EVO - HUS A4

GEOMETRY

Washer			HUS815	HUS6 HUSEVO6 HUS6A4	HUS8 HUSEVO8 HUS8A4	HUS10 HUS10A4	HUS12
Internal diameter	D_1	[in]	0.374	0.295	0.335	0.425	0.551
External diameter	D_2	[in]	1.236	0.787	0.984	1.181	1.457
Height	h	[in]	0.535	0.177	0.217	0.256	0.335
Plate hole diameter(1)	D_F	[in]	25/32 - 7/8	17/64 - 5/16	21/64 - 25/64	27/64 - 15/32	1/2 - 35/64
Steel plate thickness	S_{PLATE}	[in]	3/16 - 11/16	-	-	-	-

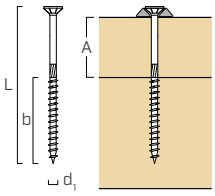
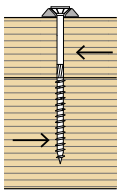
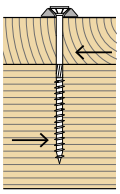
(1) The choice of diameter is also linked to the diamter of the screw used.

MECHANICAL PARAMETERS

Nominal diameter	d_1	[in]		0.24	0.32	0.40	0.48
Head pull-through (design value)	W_H(*)	[lbf]	G = 0.35	235	339	461	581
			G = 0.42	294	423	576	726
			G = 0.49	353	508	692	871
			G = 0.55	412	593	807	1017
minimum side member thickness		[in]		1 1/2	1 1/2	1 1/2	1 1/2

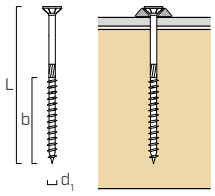
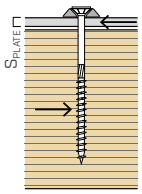
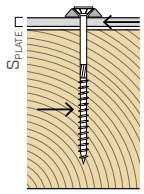
(*)Head pull-trough values are calculated according to NDS Equation 12.2-6 without the 1/2" upper limit on head diameter, a 0.75 safety factor has been considered.

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

geometry						$Z_{\parallel}$				$Z_{\perp/\parallel}$				$Z_{\perp}$			
																	
						G				G				G			
	$d_{1,HBS}$	L		b	A	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]
HUS HUS EVO	6 **0.24**	50	1 15/16	1 3/8	3/8	64	89	118	146	64	89	118	146	64	89	118	146
		60	2 3/8	1 3/16	1	80	112	148	182	80	112	148	182	80	112	148	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 1/4	110	140	174	206	110	140	174	206	110	140	174	206
		90	3 1/2	1 15/16	1 1/4	111	140	174	206	111	140	174	206	111	140	174	206
		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
		120-130	4 3/4-5 1/8	2 3/8	≥ 2	139	165	190	211	139	165	190	211	139	165	190	211
		140-300	5 1/2-11 3/4	2 15/16	≥ 2 1/4	139	165	190	211	139	165	190	211	139	165	190	211
		320-400	12 5/8-15 3/4	2 15/16	≥ 9 1/4	165	195	225	250	165	195	225	250	165	195	225	250
HUS HUS EVO	8 **0.32**	80	3 1/8	2 1/16	3/4	146	174	202	228	116	139	162	182	116	139	162	182
		100	4	2 1/16	1 1/2	158	202	248	292	126	161	198	233	126	161	198	233
		120	4 3/4	2 3/8	2	180	233	282	313	144	186	225	251	144	186	225	251
		140	5 1/2	2 3/8	2 3/4	207	245	282	313	165	196	225	251	165	196	225	251
		160-280	6 1/4-11	3 1/8	≥ 2 3/4	207	245	282	313	165	196	225	251	165	196	225	251
		300-400	11 3/4-15 3/4	4	≥ 7 1/2	207	245	282	313	165	196	225	251	165	196	225	251
		440-600	17 1/4-23 5/8	4	≥ 13	225	266	307	341	180	213	245	273	180	213	245	273
HUS	10 **0.40**	80	3 1/8	2 1/16	3/4	185	222	259	277	100	131	163	193	100	131	163	193
		100	4	2 1/16	1 1/2	220	264	307	336	155	190	218	243	119	155	194	229
		120	4 3/4	2 3/8	2	260	312	361	387	178	213	249	281	141	183	229	271
		140	5 1/2	2 3/8	2 3/4	302	338	365	387	199	249	274	295	164	213	259	282
		160-280	6 1/4-11	3 1/8	≥ 2 3/4	308	338	365	387	208	249	274	295	189	232	259	282
		300-400	11 3/4-15 3/4	4	≥ 7 1/2	308	338	365	387	222	249	274	295	203	232	259	282
		440-600	17 1/4-23 5/8	4	≥ 13	369	404	437	463	265	298	328	352	243	277	310	337
HUS	12 **0.48**	120	4 3/4	3 1/8	1	252	279	305	327	138	179	222	241	138	179	209	230
		160-280	6 1/4-11	3 1/8	≥ 2 3/4	353	387	418	442	224	273	311	334	194	252	292	317
		320-480	12 5/8-19	4 3/4	≥ 7 1/2	353	387	418	442	251	282	311	334	229	261	292	317
		520-1000	20 1/2-39 3/8	4 3/4	≥ 15 1/4	488	535	578	612	348	390	430	463	317	361	404	439

NOTES and **GENERAL PRINCIPLES** on page 83.

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

geometry					$Z_{\parallel}$ (1)				$Z_{\perp}$ (2)				
													
	$d_{1,HBS}$	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]
HUS HUS EVO	6 **0.24**	40	1 9/16	1 3/8	1/8	102	132	166	199	1/8	102	132	166	199
		50	1 15/16	1 3/8		123	164	205	225		123	164	205	225
		60	2 3/8	1 3/16		147	180	205	225		147	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		155	180	205	225		155	180	205	225
HUS HUS EVO	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 1/4-5 1/2	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
HUS	10 **0.40**	80	3 1/8	2 1/16	1/8	293	339	364	383	1/8	162	208	257	282
		100	4	2 1/16		312	339	364	383		208	236	261	282
		120-140	4 3/4-5 1/2	2 3/8		312	339	364	383		208	236	261	282
		160-280	6 1/4-11	3 1/8		312	339	364	383		208	236	261	282
		300-400	11 3/4-15 3/4	4		312	339	364	383		208	236	261	282
		440-600	17 1/4-23 5/8	4		370	403	432	456		247	279	310	335
HUS	12 **0.48**	120-280	4 3/4-11	3 1/8	1/8	355	386	414	436	1/8	233	264	293	316
		320-480	12 5/8-19	4 3/4		355	386	414	436		233	264	293	316
		520-1000	20 1/2-39 3/8	4 3/4		485	528	567	598		319	361	401	433

(1) Main member loaded parallel to the grain.
(2) Main member loaded perpendicular to the grain.

NOTES and GENERAL PRINCIPLES on page 83.

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

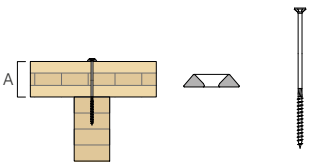
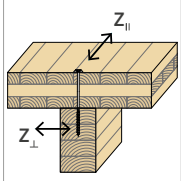
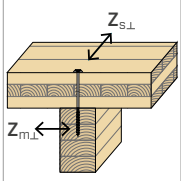
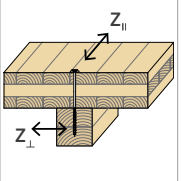
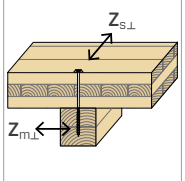
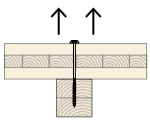
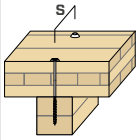
geometry				SHEAR						TENSION	SPACING	
				wall-to-wall		floor-to-wall orientation 1		floor-to-wall orientation 2		withdrawal / head pull-through	fastener in a row	
				$Z_{\perp}$	$Z_{m\perp}$	$Z_{\perp}$	$Z_{\parallel}$	$Z_{m\perp}$	$Z_{s\perp}$	W(*)	minimum	typical
side member thickness (wall/floor) = A			suggested washer and screw									
	[mm]	[in]	CODE	[lbf]	[lbf]	[lbf]	[lbf]	[lbf]	[lbf]	[lbf]	[in]	[in]
3 PLY	60	2 3/8	HUS6 + HBS6120	110	110	110	110	110	110	294	3 1/2	6
			HUS8 + HBS8120	124	124	124	155	124	124	423	3 1/8	6
			HUS10 + HBS10120	116	139	116	197	139	132	576	4	8
			HUS12 + HBS12160	158	185	158	258	185	168	726	4 3/4	10
	79	3 1/8	HUS6 + HBS6160	110	110	110	110	110	110	294	3 1/2	6
			HUS8 + HBS8160	131	131	131	164	131	131	423	3 1/8	6
			HUS10 + HBS10160	155	167	155	226	167	167	576	4	8
			HUS12 + HBS12160	160	177	160	259	177	186	726	4 3/4	10
	105	4 1/8	HUS6 + HBS6180	110	110	110	110	110	110	294	3 1/2	6
			HUS8 + HBS8200	131	131	131	164	131	131	423	3 1/8	6
			HUS10 + HBS10200	155	167	155	226	167	167	576	4	8
			HUS12 + HBS12200	175	189	175	259	189	189	726	4 3/4	10
	120	4 3/4	HUS6 + HBS6200	110	110	110	110	110	110	294	3 1/2	6
			HUS8 + HBS8200	131	131	131	164	131	131	423	3 1/8	6
			HUS10 + HBS10200	155	167	155	226	167	167	576	4	8
			HUS12 + HBS12200	166	176	166	259	176	189	726	4 3/4	10
5 PLY	100	3 15/16	HUS6 + HBS6180	110	110	110	110	110	110	294	3 1/2	6
			HUS8 + HBS8180	131	131	131	164	131	131	423	3 1/8	6
			HUS10 + HBS10180	155	167	155	226	167	167	576	4	8
			HUS12 + HBS12200	175	189	175	259	189	189	726	4 3/4	10
	140	5 1/2	HUS6 + HBS6220	110	110	110	110	110	110	294	3 1/2	6
			HUS8 + HBS8220	131	131	131	164	131	131	423	3 1/8	6
			HUS10 + HBS10220	155	167	155	226	167	167	576	4	8
			HUS12 + HBS12240	175	189	175	259	189	189	726	4 3/4	10
	175	6 7/8	HUS6 + HBS6260	110	110	110	110	110	110	294	3 1/2	6
			HUS8 + HBS8260	131	131	131	164	131	131	423	3 1/8	6
			HUS10 + HBS10260	155	167	155	226	167	167	576	4	8
			HUS12 + HBS12280	175	189	175	259	189	189	726	4 3/4	10
	200	7 7/8	HUS6 + HBS6280	110	110	110	110	110	110	294	3 1/2	6
			HUS8 + HBS8280	131	131	131	164	131	131	423	3 1/8	6
			HUS10 + HBS10280	155	167	155	226	167	167	576	4	8
			HUS12 + HBS12280	166	176	166	259	176	189	726	4 3/4	10
7 PLY	140	5 1/2	HUS6 + HBS6220	110	110	110	110	110	110	294	3 1/2	6
			HUS8 + HBS8220	131	131	131	164	131	131	423	3 1/8	6
			HUS10 + HBS10220	155	167	155	226	167	167	576	4	8
			HUS12 + HBS12240	175	189	175	259	189	189	726	4 3/4	10
	191	7 1/2	HUS6 + HBS6280	110	110	110	110	110	110	294	3 1/2	6
			HUS8 + HBS8280	131	131	131	164	131	131	423	3 1/8	6
			HUS10 + HBS10280	155	167	155	226	167	167	576	4	8
			HUS12 + HBS12280	175	189	175	259	189	189	726	4 3/4	10
	244	9 5/8	HUS6 + HBS6320	110	110	110	110	110	110	294	3 1/2	6
			HUS8 + HBS8360	131	131	131	164	131	131	423	3 1/8	6
			HUS10 + HBS10360	155	167	155	226	167	167	576	4	8
			HUS12 + HBS12400	175	189	175	259	189	189	726	4 3/4	10
	280	11	HUS6 + HBS6360	110	110	110	110	110	110	294	3 1/2	6
			HUS8 + HBS8380	131	131	131	164	131	131	423	3 1/8	6
			HUS10 + HBS10380	155	167	155	226	167	167	576	4	8
			HUS12 + HBS12400	175	189	175	259	189	189	726	4 3/4	10

or longer

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

NOTES and GENERAL PRINCIPLES on page 83.

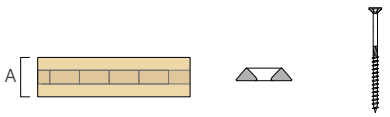
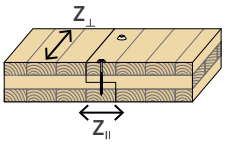
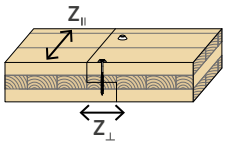
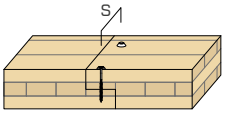
CLT | FLOOR-TO-BEAM

				SHEAR								TENSION	SPACING	
geometry				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 washer and 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	HUS6 + HBS6180	165	165	165	165	165	165	165	165	294	3 1/2	6
			HUS8 + HBS8180	196	245	196	196	196	245	196	196	423	3 1/8	6
			HUS10 + HBS10180	232	338	249	249	232	338	249	249	576	4	8
			HUS12 + HBS12200	261	387	282	282	261	387	282	282	726	4 3/4	10
	140	5 1/2	HUS6 + HBS6220	165	165	165	165	165	165	165	165	294	3 1/2	6
			HUS8 + HBS8220	196	245	196	196	196	245	196	196	423	3 1/8	6
			HUS10 + HBS10220	232	338	249	249	232	338	249	249	576	4	8
			HUS12 + HBS12240	261	387	282	282	261	387	282	282	726	4 3/4	10
	175	6 7/8	HUS6 + HBS6260	165	165	165	165	165	165	165	165	294	3 1/2	6
			HUS8 + HBS8260	196	245	196	196	196	245	196	196	423	3 1/8	6
			HUS10 + HBS10260	232	338	249	249	232	338	249	249	576	4	8
			HUS12 + HBS12240	218	350	232	261	218	350	232	261	726	4 3/4	10
			HUS12 + HBS12280	261	387	282	282	-	-	-	-	726	4 3/4	10
	200	7 7/8	HUS6 + HBS6280	165	165	165	165	165	165	165	165	294	3 1/2	6
			HUS8 + HBS8280	196	245	196	196	196	245	196	196	423	3 1/8	6
			HUS10 + HBS10280	232	338	249	249	232	338	249	249	576	4	8
			HUS12 + HBS12280	248	387	263	282	248	387	263	282	726	4 3/4	10
7 PLY	140	5 1/2	HUS6 + HBS6220	165	165	165	165	165	165	165	165	294	3 1/2	6
			HUS8 + HBS8220	196	245	196	196	196	245	196	196	423	3 1/8	6
			HUS10 + HBS10220	232	338	249	249	232	338	249	249	576	4	8
			HUS12 + HBS12240	261	387	282	282	261	387	282	282	726	4 3/4	10
	191	7 1/2	HUS6 + HBS6280	165	165	165	165	165	165	165	165	294	3 1/2	6
			HUS8 + HBS8280	196	245	196	196	196	245	196	196	423	3 1/8	6
			HUS10 + HBS10280	232	338	249	249	232	338	249	249	576	4	8
			HUS12 + HBS12280	261	387	282	282	261	387	282	282	726	4 3/4	10
	244	9 5/8	HUS6 + HBS6320	165	165	165	165	165	165	165	165	294	3 1/2	6
			HUS8 + HBS8340	196	245	196	196	196	245	196	196	423	3 1/8	6
			HUS8 + HBS8360	196	245	196	196	-	-	-	-	423	3 1/8	6
			HUS10 + HBS10340	232	338	249	249	232	338	249	249	576	4	8
			HUS10 + HBS10360	232	338	249	249	-	-	-	-	576	4	8
			HUS12 + HBS12320	238	387	252	282	238	387	252	282	726	4 3/4	10
			HUS12 + HBS12400	261	387	282	282	-	-	-	-	726	4 3/4	10
	280	11	HUS6 + HBS6360	165	165	165	165	165	165	165	165	294	3 1/2	6
			HUS8 + HBS8380	196	245	196	196	196	245	196	196	423	3 1/8	6
			HUS10 + HBS10380	232	338	249	249	232	338	249	249	576	4	8
			HUS12 + HBS12360	248	387	263	282	248	387	263	282	726	4 3/4	10
			HUS12 + HBS12400	261	387	282	282	-	-	-	-	726	4 3/4	10
9 PLY	180	7 1/16	HUS6 + HBS6260	165	165	165	165	165	165	165	165	294	3 1/2	6
			HUS8 + HBS8260	196	245	196	196	196	245	196	196	423	3 1/8	6
			HUS10 + HBS10260	232	338	249	249	232	338	249	249	576	4	8
			HUS12 + HBS12280	261	387	282	282	261	387	282	282	726	4 3/4	10
	267	10 1/2	HUS6 + HBS6360	165	165	165	165	165	165	165	165	294	3 1/2	6
			HUS8 + HBS8360	196	245	196	196	196	245	196	196	423	3 1/8	6
			HUS8 + HBS8380	196	245	196	196	-	-	-	-	423	3 1/8	6
			HUS10 + HBS10360	232	338	249	249	232	338	249	249	576	4	8
			HUS10 + HBS10380	232	338	249	249	-	-	-	-	576	4	8
			HUS12 + HBS12360	261	387	282	282	261	387	282	282	726	4 3/4	10
			HUS12 + HBS12400	261	387	282	282	-	-	-	-	726	4 3/4	10

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

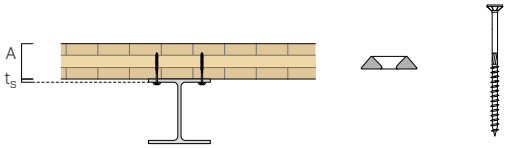
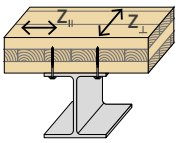
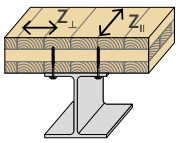
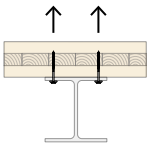
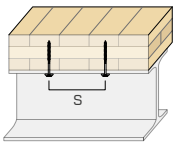
NOTES and GENERAL PRINCIPLES on page 83.

CLT | HALF LAP

				SHEAR				SPACING	
geometry				half lap orientation 1		half lap orientation 2		fastener in a row	
									
panel thickness (wall/floor) = A		suggested washer and 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	HUS6 + HBS690	137	137	137	137	3 1/2	6
			HUS8 + HBS8100	161	202	161	202	3 1/8	6
			HUS10 + HBS10100	144	244	144	244	4	8
	120	4 3/4	HUS6 + HBS6110	165	165	165	165	3 1/2	6
			HUS8 + HBS8100	149	187	149	187	3 1/8	6
			HUS10 + HBS10100	154	252	154	252	4	8
5 PLY	100	3 15/16	HUS6 + HBS690	142	142	142	142	3 1/2	6
			HUS8 + HBS880	140	174	140	174	3 1/8	6
			HUS10 + HBS1080	127	216	127	216	4	8
	140	5 1/2	HUS6 + HBS6130	165	165	165	165	3 1/2	6
			HUS8 + HBS8120	166	207	166	207	3 1/8	6
			HUS10 + HBS10120	180	278	180	278	4	8
			HUS12 + HBS12120	187	301	187	301	4 3/4	10
	175	6 7/8	HUS6 + HBS6160	165	165	165	165	3 1/2	6
			HUS8 + HBS8160	196	245	196	245	3 1/8	6
			HUS10 + HBS10160	223	338	223	338	4	8
			HUS12 + HBS12160	232	378	232	378	4 3/4	10
	200	7 7/8	HUS6 + HBS6180	165	165	165	165	3 1/2	6
			HUS8 + HBS8180	196	245	196	245	3 1/8	6
			HUS10 + HBS10180	232	338	232	338	4	8
			HUS12 + HBS12160	208	331	208	331	4 3/4	10
7 PLY	140	5 1/2	HUS6 + HBS6130	165	165	165	165	3 1/2	6
			HUS8 + HBS8120	166	207	166	207	3 1/8	6
			HUS10 + HBS10120	180	278	180	278	4	8
			HUS12 + HBS12120	187	300	187	300	4 3/4	10
	191	7 1/2	HUS8 + HBS8180	196	245	196	245	3 1/8	6
			HUS10 + HBS10180	232	338	232	338	4	8
			HUS12 + HBS12160	217	348	217	348	4 3/4	10
	244	9 5/8	HUS8 + HBS8220	196	245	196	245	3 1/8	6
			HUS10 + HBS10220	232	338	232	338	4	8
			HUS12 + HBS12200	243	387	243	387	4 3/4	10
	280	11	HUS8 + HBS8260	196	245	196	245	3 1/8	6
			HUS10 + HBS10260	232	338	232	338	4	8
			HUS12 + HBS12240	261	387	261	387	4 3/4	10
9 PLY	180	7 1/16	HUS6 + HBS6160	165	165	165	165	3 1/2	6
			HUS8 + HBS8160	196	245	196	245	3 1/8	6
			HUS10 + HBS10160	217	338	217	338	4	8
			HUS12 + HBS12160	227	368	227	368	4 3/4	10
	267	10 1/2	HUS8 + HBS8260	196	245	196	245	3 1/8	6
			HUS10 + HBS10260	232	338	232	338	4	8
			HUS12 + HBS12240	261	387	261	387	4 3/4	10
	314	12 3/8	HUS8 + HBS8300	196	245	196	245	3 1/8	6
			HUS10 + HBS10300	232	338	232	338	4	8
			HUS12 + HBS12280	261	387	261	387	4 3/4	10
	360	14 3/16	HUS8 + HBS8340	196	245	196	245	3 1/8	6
			HUS10 + HBS10340	232	338	232	338	4	8
			HUS12 + HBS12320	261	387	261	387	4 3/4	10

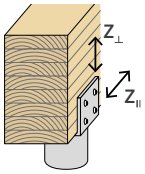
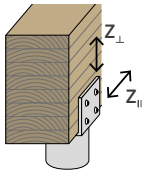
NOTES and GENERAL PRINCIPLES on page 83.

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 washer and 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	HUS6 + HBS680	207	207	207	207	926	3 1/2	6
			3/16	HUS8 + HBS880	279	223	279	223	1198	3 1/8	6
			3/16	HUS10 + HBS1080	351	213	351	213	1144	4	8
	105	4 1/8	1/4	HUS6 + HBS6100	228	228	228	228	1198	3 1/2	6
			1/4	HUS8 + HBS8100	311	249	311	249	1198	3 1/8	6
			1/4	HUS10 + HBS10100	391	273	391	273	1144	4	8
	120	4 3/4	5/16	HUS6 + HBS6120	228	228	228	228	1470	3 1/2	6
			5/16	HUS8 + HBS8120	339	271	339	271	1416	3 1/8	6
			5/16	HUS10 + HBS10120	428	300	428	300	1361	4	8
5 PLY	100	3 15/16	3/16	HUS6 + HBS6100	207	207	207	207	1198	3 1/2	6
			3/16	HUS8 + HBS8100	279	223	279	223	1198	3 1/8	6
			3/16	HUS10 + HBS10100	361	251	361	251	1144	4	8
	140	5 1/2	1/4	HUS6 + HBS6130	228	228	228	228	1470	3 1/2	6
			1/4	HUS8 + HBS8140	311	249	311	249	1416	3 1/8	6
			1/4	HUS10 + HBS10140	391	273	391	273	1361	4	8
	175	6 7/8	5/16	HUS6 + HBS6180	228	228	228	228	1879	3 1/2	6
			5/16	HUS8 + HBS8180	339	271	339	271	1960	3 1/8	6
			5/16	HUS10 + HBS10180	428	300	428	300	1906	4	8
	200	7 7/8	3/8	HUS8 + HBS8200	339	271	339	271	1960	3 1/8	6
			3/8	HUS10 + HBS10200	465	321	465	321	1906	4	8
			3/8	HUS12 + HBS12200	517	357	517	357	1851	4 3/4	10
7 PLY	140	5 1/2	3/16	HUS8 + HBS8140	279	223	279	223	1416	3 1/8	6
			3/16	HUS10 + HBS10140	361	251	361	251	1361	4	8
			3/16	HUS12 + HBS12120	407	279	407	279	1851	4 3/4	10
	191	7 1/2	1/4	HUS8 + HBS8180	311	249	311	249	1960	3 1/8	6
			1/4	HUS10 + HBS10180	391	273	391	273	1906	4	8
			1/4	HUS12 + HBS12160	437	301	437	301	1851	4 3/4	10
	244	9 5/8	3/8	HUS8 + HBS8240	339	271	339	271	1960	3 1/8	6
			3/8	HUS10 + HBS10240	465	321	465	321	1906	4	8
			3/8	HUS12 + HBS12240	517	357	517	357	1851	4 3/4	10
	280	11	1/2	HUS8 + HBS8280	339	271	339	271	1960	3 1/8	6
			1/2	HUS10 + HBS10280	465	321	465	321	1906	4	8
			1/2	HUS12 + HBS12280	533	362	533	362	1851	4 3/4	10
9 PLY	180	7 1/16	5/16	HUS8 + HBS8160	339	271	339	271	1960	3 1/8	6
			5/16	HUS10 + HBS10160	428	300	428	300	1906	4	8
			5/16	HUS12 + HBS12160	474	327	474	327	1851	4 3/4	10
	267	10 1/2	7/16	HUS8 + HBS8260	339	271	339	271	1960	3 1/8	6
			7/16	HUS10 + HBS10260	465	321	465	321	1906	4	8
			7/16	HUS12 + HBS12240	533	362	533	362	1851	4 3/4	10
	314	12 3/8	9/16	HUS8 + HBS8300	339	271	339	271	2505	3 1/8	6
			9/16	HUS10 + HBS10300	465	321	465	321	2450	4	8
			9/16	HUS12 + HBS12280	533	362	533	362	1851	4 3/4	10
	360	14 3/16	5/8	HUS8 + HBS8320	339	271	339	271	2505	3 1/8	6
			5/8	HUS10 + HBS10320	465	321	465	321	2450	4	8
			5/8	HUS12 + HBS12320	533	362	533	362	2941	4 3/4	10

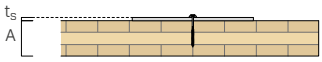
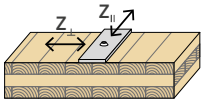
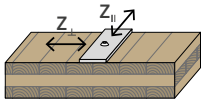
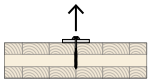
NOTES and GENERAL PRINCIPLES on page 83.

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 washer and screw	$Z_{\parallel}$	$Z_{\perp}$	$Z_{\parallel}$	$Z_{\perp}$
[mm]	[in]	[in]	CODE	[lbf]	[lbf]	[lbf]	[lbf]
79	3 1/8	1/8	HUS6 + HBS640	132	132	166	166
		1/8	HUS8 + HBS880	255	204	290	232
		1/8	HUS10 + HBS1080	339	208	364	257
		1/4	HUS6 + HBS650	191	191	236	236
		1/4	HUS8 + HBS880	311	249	352	282
		1/4	HUS10 + HBS1080	359	222	410	267
130	5 1/8	1/4	HUS6 + HBS660	219	219	262	262
		1/4	HUS8 + HBS8100	311	249	352	282
		1/4	HUS10 + HBS10100	391	273	418	302
		3/8	HUS6 + HBS670	228	228	262	262
		3/8	HUS8 + HBS8100	339	271	389	311
		3/8	HUS10 + HBS10100	465	298	501	355
171	6 3/4	3/8	HUS6 + HBS680	228	228	262	262
		3/8	HUS8 + HBS8120	339	271	389	311
		3/8	HUS10 + HBS10120	465	321	501	358
		1/2	HUS6 + HBS690	228	228	262	262
		1/2	HUS8 + HBS8120	339	271	389	311
		1/2	HUS10 + HBS10120	465	321	501	358
222	8 3/4	1/2	HUS8 + HBS8140	339	271	389	311
		1/2	HUS10 + HBS10140	465	321	501	358
		1/2	HUS12 + HBS12120	533	362	573	403
		5/8	HUS8 + HBS8160	339	271	389	311
		5/8	HUS10 + HBS10160	465	321	501	358
		5/8	HUS12 + HBS12160	533	362	573	403
		3/4	HUS8 + HBS8180	339	271	389	311
		3/4	HUS10 + HBS10180	465	321	501	358
		3/4	HUS12 + HBS12200	533	362	573	403
273	10 3/4	5/8	HUS8 + HBS8140	339	271	389	311
		5/8	HUS10 + HBS10140	465	321	501	358
		5/8	HUS12 + HBS12120	533	362	573	403
		3/4	HUS8 + HBS8160	339	271	389	311
		3/4	HUS10 + HBS10160	465	321	501	358
		3/4	HUS12 + HBS12160	533	362	573	403
		7/8	HUS8 + HBS8180	339	271	389	311
		7/8	HUS10 + HBS10180	465	321	501	358
		7/8	HUS12 + HBS12200	533	362	573	403

NOTES and GENERAL PRINCIPLES on page 83.

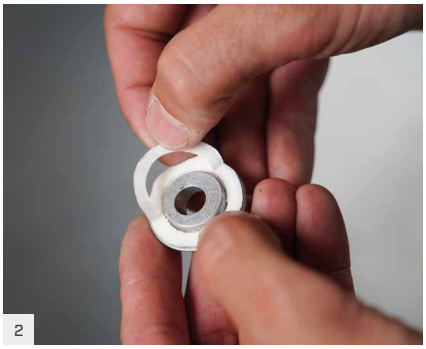
STEEL-TO-WOOD | STEEL SIDE PLATE CLT CONNECTION

					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 washer and screw	Z_{II}	$Z_{\perp}$	Z_{II}	$Z_{\perp}$	W
	[mm]	[in]	[in]	CODE	[lbf]	[lbf]	[lbf]	[lbf]	[lbf]
3 PLY	79	3 1/8	3/16	HUS6 + HBS680	207	207	234	234	926
			3/16	HUS8 + HBS880	279	223	316	253	1198
			3/16	HUS10 + HBS1080	351	213	386	260	1144
	105	4 1/8	1/4	HUS6 + HBS6100	228	228	262	262	1198
			1/4	HUS8 + HBS8100	311	249	352	282	1198
			1/4	HUS10 + HBS10100	391	273	418	302	1144
	120	4 3/4	5/16	HUS6 + HBS6120	228	228	262	262	1470
			5/16	HUS8 + HBS8120	339	271	389	311	1416
			5/16	HUS10 + HBS10120	428	300	458	330	1361
5 PLY	100	3 15/16	3/16	HUS6 + HBS6100	207	207	234	234	1198
			3/16	HUS8 + HBS8100	279	223	316	253	1198
			3/16	HUS10 + HBS10100	361	251	386	278	1144
	140	5 1/2	1/4	HUS6 + HBS6130	228	228	262	262	1470
			1/4	HUS8 + HBS8140	311	249	352	282	1416
			1/4	HUS10 + HBS10140	391	273	418	302	1361
	175	6 7/8	5/16	HUS6 + HBS6180	228	228	262	262	1879
			5/16	HUS8 + HBS8180	339	271	389	311	1960
			5/16	HUS10 + HBS10180	428	300	458	330	1906
	200	7 7/8	3/8	HUS8 + HBS8200	339	271	389	311	1960
			3/8	HUS10 + HBS10200	465	321	501	358	1906
			3/8	HUS12 + HBS12200	517	357	552	394	1851
7 PLY	140	5 1/2	3/16	HUS8 + HBS8140	279	223	316	253	1416
			3/16	HUS10 + HBS10140	361	251	386	278	1361
			3/16	HUS12 + HBS12120	407	279	435	309	1851
	191	7 1/2	1/4	HUS8 + HBS8180	311	249	352	282	1960
			1/4	HUS10 + HBS10180	391	273	418	302	1906
			1/4	HUS12 + HBS12160	437	301	467	332	1851
	244	9 5/8	3/8	HUS8 + HBS8240	339	271	389	311	1960
			3/8	HUS10 + HBS10240	465	321	501	358	1906
			3/8	HUS12 + HBS12240	517	357	552	394	1851
	280	11	1/2	HUS8 + HBS8280	339	271	389	311	1960
			1/2	HUS10 + HBS10280	465	321	501	358	1906
			1/2	HUS12 + HBS12280	533	362	573	403	1851
9 PLY	180	7 1/16	5/16	HUS8 + HBS8160	339	271	389	311	1960
			5/16	HUS10 + HBS10160	428	300	458	330	1906
			5/16	HUS12 + HBS12160	474	327	507	361	1851
	267	10 1/2	7/16	HUS8 + HBS8260	339	271	389	311	1960
			7/16	HUS10 + HBS10260	465	321	501	358	1906
			7/16	HUS12 + HBS12240	533	362	573	403	1851
	314	12 3/8	9/16	HUS8 + HBS8300	339	271	389	311	2505
			9/16	HUS10 + HBS10300	465	321	501	358	2450
			9/16	HUS12 + HBS12280	533	362	573	403	1851
	360	14 3/16	5/8	HUS8 + HBS8320	339	271	389	311	2505
			5/8	HUS10 + HBS10320	465	321	501	358	2450
			5/8	HUS12 + HBS12320	533	362	573	403	2941

NOTES and GENERAL PRINCIPLES on page 83.

HUS 15° INSTALLATION

Drill a D_F = 7/8 inch diameter hole in the metal plate at the insertion point of the HUS815 washer.



We recommend applying HUSBAND adhesive underneath the HUS815 washer to facilitate application.

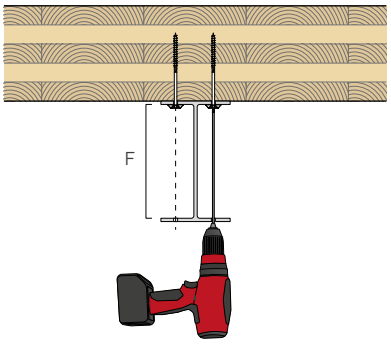
Remove the liner and apply the washer at the hole, paying attention to the insertion direction.

Drill a guide hole with a diameter of 13/64 inch and a minimum length of 1 inch, preferably using the JIGVGU945 template to ensure the correct installation direction.

Install the HBS screw of the desired length. Do not use pulse screw guns.
Pay attention when tightening the connection.

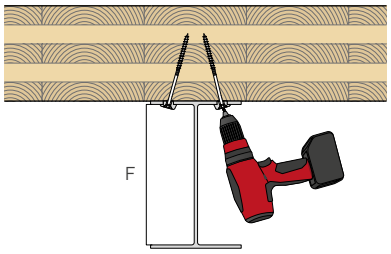
Installation completed.
The 15° screw angle ensures that the distance to the head of the panel (or beam) is maintained.

STEEL-TIMBER INSTALLATION FROM BELOW



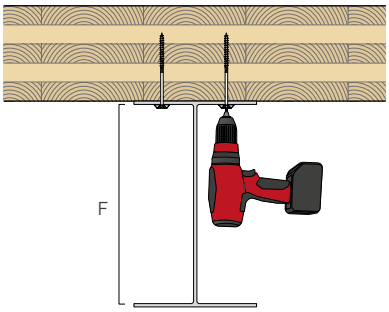
F < 8 1/4"

If the clearance (F) is small, the screws are installed using a long insert; both flanges must be drilled.



F = 8 1/4" - 11 5/8"

In this F range, there are not enough long bits and not enough free space for the operator to manoeuvre. The slight inclination of the HUS 15° allows for easy fastening.

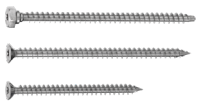


F > 11 5/8"

When sufficient free space is available for installation, a HUS washer can also be used, within the minimum distances.

RELATED PRODUCTS

HBS
page 36



VGS
page 144

CATCH
page 436

TORQUE LIMITER
page 436

JIG VGU
page 437

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 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:

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

  - 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 LATERAL 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°.
- Resistance values are calculated considering one single screw.

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 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.

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.

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 length does not exceed the total thickness of the connection.

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.