

TBS FRAME

FLAT FLANGE HEAD SCREW



FLAT FLANGE HEAD

The flange head ensures excellent tightening capacity of the joint; the flat shape allows a joint without additional thickness on the wooden surface, thus enabling the fixing of plates on the same element without interference.

SHORT THREAD

The short, fixed-length thread at 1 5/16" (34 mm) is optimised for fastening multi-layer elements (Multi-ply) for lightweight frame construction.

BLACK E-COATING

Coated with black E-coating for easy recognition on site and increased corrosion resistance.

3 THORNS TIP

TBSF is easily installed without pre-drilling hole. More screws can be used in less space and larger screws in smaller elements.



BIT INCLUDED

DIAMETER [in]	0.24	☒ 0.32	0.63
LENGTH [in]	1 9/16	☒ 2 7/8	6 7/8 39 3/8
EXPOSURE CONDITION	☒ EC1	☐ DRY	
ATMOSPHERIC CORROSIVITY	☒ C1	☐ C2	
WOOD CORROSIVITY	☒ T1	☐ T2	
MATERIAL	Zn E-COATING electrogalvanised carbon steel with black E-Coating		



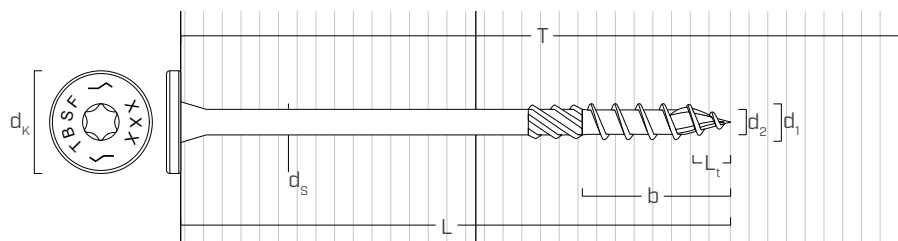
FIELDS OF USE

- timber based panels
- solid timber and glulam
- CLT and LVL
- high density woods
- multi-ply trusses

CODES AND DIMENSIONS

d ₁ [mm] [in]	CODE	L		b		A	pcs
		[mm]	[in]	[mm]	[in]	[in]	
8 0.32 TX 40	TBSF873	73	2 7/8	34	1 5/16	3	100
	TBSF886	86	3 3/8	34	1 5/16	3 1/2	100
	TBSF898	98	3 7/8	34	1 5/16	4	50
	TBSF8111	111	4 3/8	34	1 5/16	4 1/2	50
	TBSF8130	130	5 1/8	34	1 5/16	5 1/4	50
	TBSF8149	149	5 7/8	34	1 5/16	6	50
	TBSF8175	175	6 7/8	34	1 5/16	7	50

GEOMETRY AND MECHANICAL CHARACTERISTICS



Nominal diameter	d ₁	[in] ⁽¹⁾	0.32
Outer thread diameter	d ₁	[mm]	8
		[in]	0.315
Head diameter	d _k	[in]	0.748
Root diameter	d ₂	[in]	0.213
Shank diameter	d _s	[in]	0.228
Tip Length	L _t	[in]	0.315
Pre-drilling hole diameter ⁽²⁾	d _{V,G≤0.55}	[in]	13/64
Pre-drilling hole diameter ⁽³⁾	d _{V,G>0.55}	[in]	15/64

⁽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).

Nominal diameter	d ₁	[in]	0.32
Tensile strength (allowable)	f _{tens}	[lbf]	2040
Bending yield strength (specified)	F _{y,b}	[psi]	180000

Nominal diameter	d ₁	[in]	0.32
Withdrawal (design value)	W ₉₀	[lbf/in]	G = 0.35
			G = 0.42
			G = 0.49
			G = 0.55
minimum embedded length		[in]	1 7/8
Head pull-through (design value)	W _H	[lbf]	G = 0.35
			G = 0.42
			G = 0.49
			G = 0.55
minimum side member thickness		[in]	1 1/2

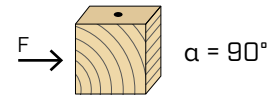
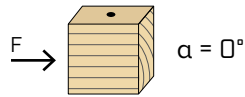


MULTI-PLY TRUSSES

It is available in optimised lengths for fastening 2-, 3- and 4-ply truss elements of the most common solid timber and LVL dimensions.

MINIMUM DISTANCES FOR SHEAR LOADS | TIMBER

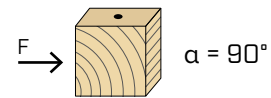
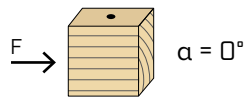
screws inserted **WITHOUT** pre-drilled hole $G \leq 0.48$



d_1	[in]	0.32
	[mm]	8
a_1	[in]	15·d
		3 1/8
a_2	[in]	5·d
		1 9/16
$a_{3,t}$	[in]	15·d
		4 3/4
$a_{3,c}$	[in]	10·d
		3 1/8
$a_{4,t}$	[in]	10·d
		3 1/8
$a_{4,c}$	[in]	5·d
		1 9/16

		0.32
		8
		10·d
		1 9/16
		5·d
		1 9/16
		15·d
		4 3/4
		10·d
		3 1/8
		10·d
		3 1/8
		5·d
		1 9/16

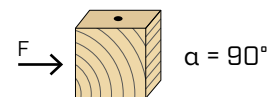
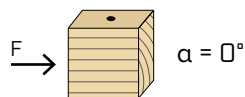
screws inserted **WITHOUT** pre-drilled hole $0.48 < G \leq 0.50$



d_1	[in]	0.32
	[mm]	8
a_1	[in]	15·d
		4 3/4
a_2	[in]	5·d
		1 9/16
$a_{3,t}$	[in]	15·d
		4 3/4
$a_{3,c}$	[in]	10·d
		3 1/8
$a_{4,t}$	[in]	10·d
		3 1/8
$a_{4,c}$	[in]	5·d
		1 9/16

		0.32
		8
		10·d
		2 3/16
		5·d
		1 9/16
		15·d
		4 3/4
		10·d
		3 1/8
		10·d
		3 1/8
		5·d
		1 9/16

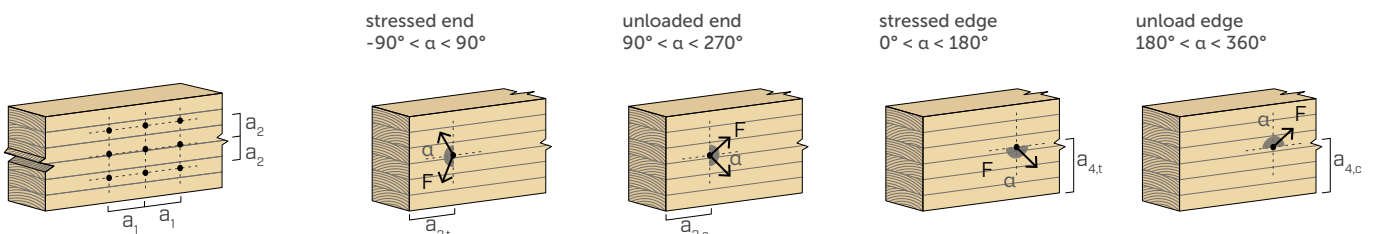
screws inserted **WITHOUT** pre-drilled hole $G > 0.50$



d_1	[in]	0.32
	[mm]	8
a_1	[in]	15·d
		4 3/4
a_2	[in]	7·d
		2 3/16
$a_{3,t}$	[in]	20·d
		6 1/4
$a_{3,c}$	[in]	15·d
		4 3/4
$a_{4,t}$	[in]	12·d
		3 3/4
$a_{4,c}$	[in]	7·d
		2 3/16

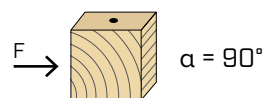
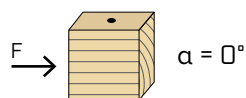
		0.32
		8
		10·d
		3 1/8
		7·d
		2 3/16
		20·d
		6 1/4
		15·d
		4 3/4
		12·d
		3 3/4
		7·d
		2 3/16

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





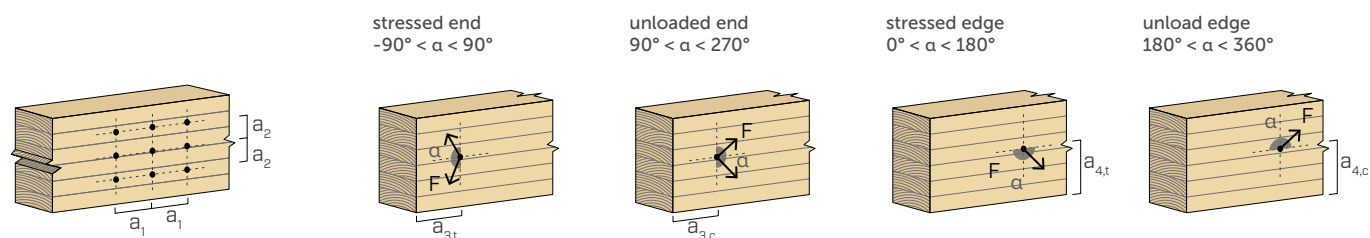
screws inserted **WITH pre-drilled hole**



d_1	[in]	0.32
	[mm]	8
a_1	[in]	$10 \cdot d$ 3 1/8
a_2	[in]	$4 \cdot d$ 1 1/4
$a_{3,t}$	[in]	$12 \cdot d$ 3 3/4
$a_{3,c}$	[in]	$7 \cdot d$ 2 3/16
$a_{4,t}$	[in]	$7 \cdot d$ 2 3/16
$a_{4,c}$	[in]	$3 \cdot d$ 15/16

	0.32
	8
$5 \cdot d$	1 9/16
$4 \cdot d$	1 1/4
$12 \cdot d$	3 3/4
$7 \cdot d$	2 3/16
$7 \cdot d$	2 3/16
$3 \cdot d$	15/16

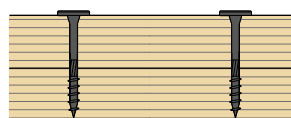
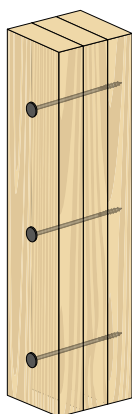
α = load-to-grain angle
 $d = d_1$ = nominal diameter of the screw



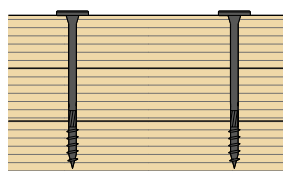
NOTES

- Values in blue are from Table 10 of ESR-4645 (REDUCED CONNECTION GEOMETRY REQUIREMENTS BASED ON TESTING);
- The minimum spacing and distances comply with Table 8 of ESR-4645, where d refers to the nominal diameter of the screw;
- 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.

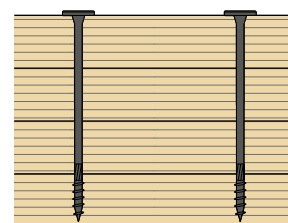
APPLICATION EXAMPLES: MULTI-PLY FASTENINGS



screw: TBSF873
 timber element:
 2 x 1 1/2" (38 mm)
 total thickness:
 3" (76 mm)



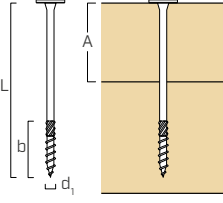
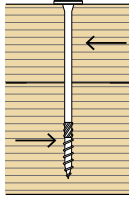
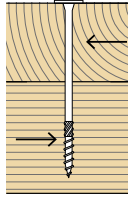
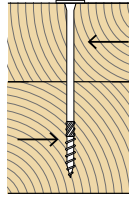
screw: TBSF8111
 timber element:
 3 x 1 1/2" (38 mm)
 total thickness:
 4 1/2" (114 mm)



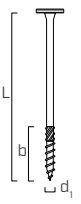
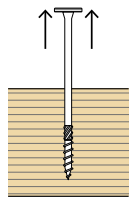
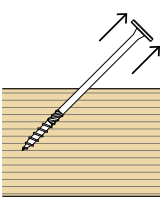
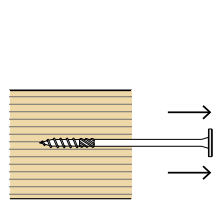
screw: TBSF8149
 timber element:
 4 x 1 1/2" (38 mm)
 total thickness:
 6" (152 mm)

NOTES and GENERAL PRINCIPLES on page 123.

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

geometry					$Z_{ }$				$Z_{\perp/ }$				$Z_{\perp}$			
																
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	73	2 7/8	1 5/16	3	111	155	205	254	88	124	164	203	88	124	164	203
	86	3 3/8	1 5/16	3 1/2	136	187	226	263	109	150	181	210	109	150	181	210
	98	3 7/8	1 5/16	4	152	187	226	263	122	150	181	210	122	150	181	210
	111	4 3/8	1 5/16	4 1/2	152	187	226	263	122	150	181	210	122	150	181	210
	130	5 1/8	1 5/16	5 1/4	152	187	226	263	122	150	181	210	122	150	181	210
	149	5 7/8	1 5/16	6	152	187	226	263	122	150	181	210	122	150	181	210
	175	6 7/8	1 5/16	7	152	187	226	263	122	150	181	210	122	150	181	210

THREAD WITHDRAWAL (W) | WOOD

geometry					thread withdrawal $\alpha = 90^\circ$				thread withdrawal $\alpha = 45^\circ$				thread withdrawal $\alpha = 0^\circ$			
																
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	73	2 7/8 ⁽¹⁾	1 5/16		176	204	230	253	160	185	210	230	53	61	69	76
	86	3 3/8 ⁽¹⁾	1 5/16		176	204	230	253	160	185	210	230	53	61	69	76
	98	3 7/8 ⁽¹⁾	1 5/16		176	204	230	253	160	185	210	230	53	61	69	76
	111	4 3/8 ⁽¹⁾	1 5/16		176	204	230	253	160	185	210	230	53	61	69	76
	130	5 1/8 ⁽¹⁾	1 5/16		176	204	230	253	160	185	210	230	53	61	69	76
	149	5 7/8 ⁽¹⁾	1 5/16		176	204	230	253	160	185	210	230	53	61	69	76
	175	6 7/8 ⁽¹⁾	1 5/16		176	204	230	253	160	185	210	230	53	61	69	76

⁽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 $0^\circ \leq \alpha < 90^\circ$ to the grain).

HEAD PULL-THROUGH (W_H) | WOOD

geometry			head pull through $90^\circ \leq \alpha \leq 30^\circ$			
d_1		d_k	G			
			0.35	0.42	0.49	0.55
[mm]	[in]	[in]	[lbf]	[lbf]	[lbf]	[lbf]
8	0.32	0.75	223	322	438	552

NOTES and GENERAL PRINCIPLES on page 123.

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									
side member thickness (wall/floor) = A		suggested screw		Z_perp		Z_m_perp		Z_perp		Z_parallel		Z_m_perp		Z_s_perp		W(*)		minimum		typical	
[mm]		[in]		CODE		[lbf]		[lbf]		[lbf]		[lbf]		[lbf]		[lbf]		[in]		[in]	
3 PLY	60	2 3/8	TBSF898	or longer	104	104	104	130	104	104	322	3 1/8	6								
	79	3 1/8	TBSF8130		119	119	119	149	119	119	322	3 1/8	6								
	105	4 1/8	TBSF8149		111	111	111	139	111	111	322	3 1/8	6								
	120	4 3/4	TBSF8175		125	125	125	156	125	125	322	3 1/8	6								
5 PLY	100	3 15/16	TBSF8149	or longer	117	117	117	146	117	117	322	3 1/8	6								
	140	5 1/2	TBSF8175		100	100	100	126	100	100	322	3 1/8	6								
7 PLY	140	5 1/2	TBSF8175	or longer	100	100	100	125	100	100	322	3 1/8	6								

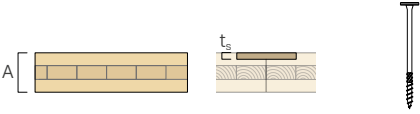
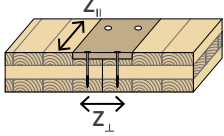
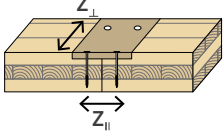
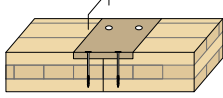
(*) Minimum between head pull-through and withdrawal resistance

CLT | FLOOR-TO-BEAM

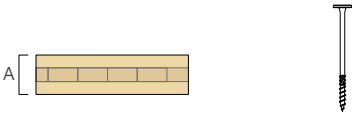
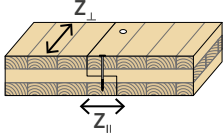
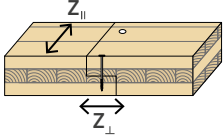
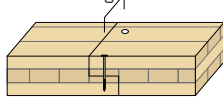
				SHEAR								TENSION		SPACING	
geometry				floor-to-beam orientation 1		floor-to-beam orientation 2		floor-to-double lumber 2" orientation 1		floor-to-double lumber 2" orientation 2		withdrawal / head pull-through		fastener in a row	
side member thickness (wall/floor) = A		suggested screw		Z _⊥	Z	Z _{m⊥}	Z _{s⊥}	Z _⊥	Z	Z _{m⊥}	Z _{s⊥}	W(*)	minimum	typical	
[mm]	[in]	CODE		[lbf]	[lbf]	[lbf]	[lbf]	[lbf]	[lbf]	[lbf]	[lbf]	[lbf]	[in]	[in]	
3 PLY	60	2 3/8	TBSF898	155	194	104	155	155	194	104	155	322	3 1/8	6	
	79	3 1/8	TBSF8130	178	222	119	178	178	222	119	178	322	3 1/8	6	
	105	4 1/8	TBSF8149	165	207	111	165	165	207	111	165	322	3 1/8	6	
	120	4 3/4	TBSF8175	186	232	125	186	186	232	125	186	322	3 1/8	6	
5 PLY	100	3 15/16	TBSF8149	175	218	117	175	175	218	117	175	322	3 1/8	6	
	140	5 1/2	TBSF8175	150	187	100	150	150	187	100	150	322	3 1/8	6	
7 PLY	140	5 1/2	TBSF8175	149	187	100	149	149	187	100	149	322	3 1/8	6	

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

CLT | SPLINE JOINT

				SHEAR				SPACING	
geometry				spline joint orientation 1		spline joint orientation 2		fastener in a row	
									
panel thickness (wall/floor) = A		spline thickness = t_s	suggested screw	$Z_{ }$	$Z_{\perp}$	$Z_{ }$	$Z_{\perp}$	minimum	typical
[mm]	[in]	[in]	CODE	[lbf]	[lbf]	[lbf]	[lbf]	[in]	[in]
3 PLY	79	3 1/8	1/2 TBSF873	136	108	136	108	3 1/8	4
			3/4 TBSF873	173	139	173	139	3 1/8	4
			1 TBSF886	179	143	179	143	3 1/8	4
	86	3 3/8	1/2 TBSF873	136	108	136	108	3 1/8	4
			3/4 TBSF886	173	139	173	139	3 1/8	4
			1 TBSF8111	179	143	179	143	3 1/8	4
	105	4 1/8	1/2 TBSF886	136	108	136	108	3 1/8	4
			3/4 TBSF898	173	139	173	139	3 1/8	4
			1 TBSF8111	179	143	179	143	3 1/8	4
5 PLY	130	5 1/8	3/4 TBSF886	173	139	173	139	3 1/8	4
			1 TBSF898	179	143	179	143	3 1/8	4
	140	5 1/2	3/4 TBSF8111	173	139	173	139	3 1/8	4
			1 TBSF8130	179	143	179	143	3 1/8	4
	175	6 7/8	3/4 TBSF8130	173	139	173	139	3 1/8	4
			1 TBSF8149	179	143	179	143	3 1/8	4
7 PLY	191	7 1/2	3/4 TBSF898	173	139	173	139	3 1/8	4
			1 TBSF8111	179	143	179	143	3 1/8	4
	220	8 5/8	3/4 TBSF8111	173	139	173	139	3 1/8	4
			1 TBSF8149	179	143	179	143	3 1/8	4
	244	9 5/8	3/4 TBSF8149	173	139	173	139	3 1/8	4
			1 TBSF8175	192	154	192	154	3 1/8	4

CLT | HALF LAP

				SHEAR				SPACING	
geometry				half lap orientation 1		half lap orientation 2		fastener in a row	
									
panel thickness (wall/floor) = A		suggested screw		$Z_{\perp}$	$Z_{ }$	$Z_{\perp}$	$Z_{ }$	minimum	typical
[mm]	[in]	CODE		[lbf]	[lbf]	[lbf]	[lbf]	[in]	[in]
3 PLY	79	3 1/8	TBSF873	125	156	125	156	3 1/8	6
	105	4 1/8	TBSF886	148	185	148	185	3 1/8	6
	120	4 3/4	TBSF898	155	194	155	194	3 1/8	6
5 PLY	100	3 15/16	TBSF886	151	189	151	189	3 1/8	6
	140	5 1/2	TBSF8130	196	245	196	245	3 1/8	6
	175	6 7/8	TBSF8149	196	245	196	245	3 1/8	6
	200	7 7/8	TBSF8175	196	245	196	245	3 1/8	6
7 PLY	140	5 1/2	TBSF8130	196	245	196	245	3 1/8	6
	191	7 1/2	TBSF8175	196	245	196	245	3 1/8	6
9 PLY	180	7 1/16	TBSF8175	196	245	196	245	3 1/8	6

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, 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.
- TBS FRAME screws must be positioned in accordance with the minimum distances.
- In case of combined axial and shear forces, the designer shall refer to the Hankinson formula, as specified in section 12.4.1 of the NDS, to evaluate the load-bearing capacity.

REFERENCE LATERAL DESIGN VALUES

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

WOOD-TO-WOOD

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

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:

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

- α is the angle between the grain direction and screw axis.
Tabulated values at page 120 are valid for L_{eff} equal to the screw thread length b minus the tip length L_t and $k_\alpha = 1$ for $\alpha = 90^\circ$, $k_\alpha = 0.91$ for $\alpha = 45^\circ$, $k_\alpha = 0.3$ for $\alpha = 0^\circ$.
- 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 $0^\circ \leq \alpha < 90^\circ$ 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 $\alpha \leq 15^\circ$.
- The reference withdrawal design values must be inferior to f_{tens} of the screw.

REFERENCE HEAD PULL-THROUGH DESIGN VALUES

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

CONNECTIONS

GENERAL NOTES

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

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

- The main grain direction of the CLT wall panel is always considered as vertical.
- The main grain direction of the CLT floor panel is considered both parallel and perpendicular to the wall plane.
- The threaded part of the screw has been always considered inserted in the central layer of the CLT panel.
- The withdrawal capacity has been considered as the minimum between thread withdrawal, head-pull through and tensile 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.

SPLINE JOINT

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

HALF LAP

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