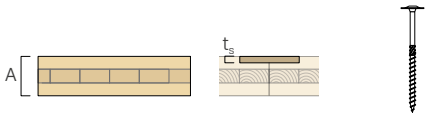
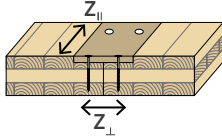
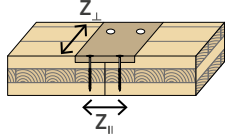
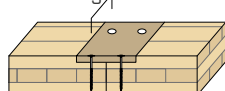


## CLT | FLOOR-TO-BEAM

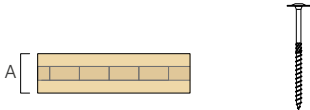
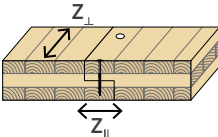
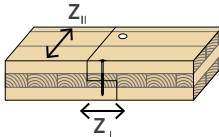
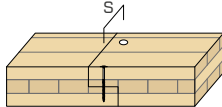
geometry				SHEAR								TENSION	SPACING	
				floor-to-beam orientation 1		floor-to-beam orientation 2		floor-to-double lumber 2" orientation 1		floor-to-double lumber 2" orientation 2		withdrawal / head pull-through	fastener in a row	
side member thickness (wall/floor) = A		suggested screw	Z <sub>⊥</sub>	Z <sub>∥</sub>	Z <sub>m⊥</sub>	Z <sub>s⊥</sub>	Z <sub>⊥</sub>	Z <sub>∥</sub>	Z <sub>m⊥</sub>	Z <sub>s⊥</sub>	W(*)	minimum	typical	
[mm]	[in]		CODE	[lb]	[lb]	[lb]	[lb]	[lb]	[lb]	[lb]	[lb]	[lb]	[in]	[in]
5 PLY	100	3 15/16	TBSMAX8200	196	245	131	196	196	245	131	196	484	3 1/8	6
			TBSMAX8220	196	245	131	196	-	-	-	-	484	3 1/8	6
	140	5 1/2	TBSMAX8240	196	245	131	196	196	245	131	196	484	3 1/8	6
			TBSMAX8280	196	245	131	196	-	-	-	-	484	3 1/8	6
	175	6 7/8	TBSMAX8240	196	245	131	196	196	245	131	196	484	3 1/8	6
			TBSMAX8320	196	245	131	196	-	-	-	-	484	3 1/8	6
	200	7 7/8	TBSMAX8280	196	245	131	196	196	245	131	196	484	3 1/8	6
			TBSMAX8320	196	245	131	196	-	-	-	-	484	3 1/8	6
7 PLY	140	5 1/2	TBSMAX8240	196	245	131	196	196	245	131	196	484	3 1/8	6
			TBSMAX8280	196	245	131	196	-	-	-	-	484	3 1/8	6
	191	7 1/2	TBSMAX8280	196	245	131	196	196	245	131	196	484	3 1/8	6
			TBSMAX8320	196	245	131	196	-	-	-	-	484	3 1/8	6
	244	9 5/8	TBSMAX8320	196	245	131	196	196	245	131	196	484	3 1/8	6
			TBSMAX8400	196	245	131	196	-	-	-	-	484	3 1/8	6
	280	11	TBSMAX8360	196	245	131	196	196	245	131	196	484	3 1/8	6
			TBSMAX8400	196	245	131	196	-	-	-	-	484	3 1/8	6
9 PLY	180	7 1/16	TBSMAX8240	196	245	131	196	196	245	131	196	484	3 1/8	6
			TBSMAX8320	196	245	131	196	-	-	-	-	484	3 1/8	6
	267	10 1/2	TBSMAX8320	185	231	124	185	185	231	124	185	484	3 1/8	6
			TBSMAX8400	196	245	131	196	-	-	-	-	484	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 <sub>s</sub>	suggested screw	Z <sub>  </sub>	Z <sub>⊥</sub>	Z <sub>  </sub>	Z <sub>⊥</sub>	minimum	typical
[mm]		[in]	[in]	CODE	[lbf]	[lbf]	[lbf]	[lbf]	[in]	[in]
5 PLY	130	5 1/8	3/4	TBSMAX8120	173	139	173	139	3 1/8	4
			1	TBSMAX8120	179	143	179	143	3 1/8	4
	140	5 1/2	3/4	TBSMAX8120	173	139	173	139	3 1/8	4
			1	TBSMAX8120	179	143	179	143	3 1/8	4
	175	6 7/8	3/4	TBSMAX8120	173	139	173	139	3 1/8	4
			1	TBSMAX8160	179	143	179	143	3 1/8	4
7 PLY	191	7 1/2	3/4	TBSMAX8120	173	139	173	139	3 1/8	4
			1	TBSMAX8160	179	143	179	143	3 1/8	4
	220	8 5/8	3/4	TBSMAX8160	173	139	173	139	3 1/8	4
			1	TBSMAX8160	179	143	179	143	3 1/8	4
	244	9 5/8	3/4	TBSMAX8180	173	139	173	139	3 1/8	4
			1	TBSMAX8180	179	143	179	143	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 <sub>⊥</sub>	Z <sub>  </sub>	Z <sub>⊥</sub>	Z <sub>  </sub>	minimum	typical
[mm]		[in]	CODE	[lbf]	[lbf]	[lbf]	[lbf]	[in]	[in]
5 PLY	140	5 1/2	TBSMAX8120	178	222	178	222	3 1/8	6
	175	6 7/8	TBSMAX8160	196	245	196	245	3 1/8	6
	200	7 7/8	TBSMAX8180	196	245	196	245	3 1/8	6
7 PLY	140	5 1/2	TBSMAX8120	178	222	178	222	3 1/8	6
	191	7 1/2	TBSMAX8180	196	245	196	245	3 1/8	6
	244	9 5/8	TBSMAX8220	196	245	196	245	3 1/8	6
	280	11	TBSMAX8240	196	245	196	245	3 1/8	6
9 PLY	180	7 1/16	TBSMAX8160	196	245	196	245	3 1/8	6
	267	10 1/2	TBSMAX8240	196	245	196	245	3 1/8	6
	314	12 3/8	TBSMAX8280	196	245	196	245	3 1/8	6
	360	14 3/16	TBSMAX8320	196	245	196	245	3 1/8	6

NOTES and GENERAL PRINCIPLES on page 112.

## 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.
- TBS MAX 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  $\alpha$  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  $k_\alpha$ :

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

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;
- $k_\alpha$  factor is calculated as:

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

- $\alpha$  is the angle between the grain direction and screw axis.  
Tabulated values at page 108 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

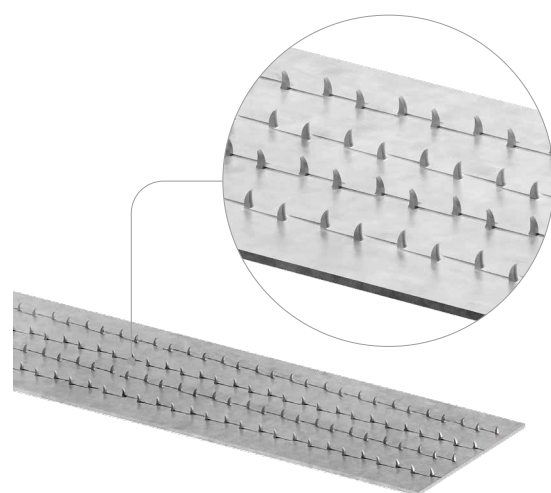
- The main grain direction of the CLT floor panel is considered both parallel and perpendicular to the machining's direction.
- The width of half-lap machining on CLT panel must comply with the minimum distance requirements.
- The proposed screw's length does not exceed the total thickness of the connection.



## A breakthrough in fast, reliable, glue-free timber connections

The SHARP METAL hooked plate revolutionises timber-to-timber connections with a simple but incredibly effective system. The multitude of small hooks distributed over the two surfaces of the plate allows for a secure joint that can be easily removed when necessary.

Ideal for ribbed or formwork floors: thanks to the SHARP METAL hooks and TBS MAX tightening, there is no need for glues, adhesives or presses.



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Solutions for Building Technology



# 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	<input checked="" type="radio"/> 0.32	0.63
LENGTH [in]	1 9/16	<input checked="" type="radio"/> 2 7/8	6 7/8
EXPOSURE CONDITION	<input checked="" type="radio"/> EC1	<input type="radio"/> DRY	
ATMOSPHERIC CORROSIVITY	<input checked="" type="radio"/> C1	<input type="radio"/> C2	
WOOD CORROSIVITY	<input checked="" type="radio"/> T1	<input type="radio"/> T2	
MATERIAL	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