

Special Design Provisions

CLT Panel to Panel Connections



August 22, 2018

Subject: CLT panel to panel connections

To Whom It May Concern;

The National Design Standard (NDS) has been providing a calculation approach to determine the reference design values for laterally loaded fasteners in timber for a long time. Recently, with the rise in interest in mass timber product, the NDS has issued a special calculation provision allowing a general calculation approach to determine the reference lateral design values (Z_{calc}) of common fasteners in CLT.

However, it is well known that a general calculation approach will lead to conservative reference design values, due to the number of variables in the connection design. Therefore, it is possible to use an alternative approach, by determining a reference design value based on test data instead. Approval bodies, such as ICC-ES are providing guidelines to extract reference design values based on an exhaustive database with controlled design parameters.

This CLT Special Provisions guide contains reference lateral design values (Z_{test}) derived from testing of the configurations illustrated herein. Reference lateral design values are based on a minimum factor of safety of 5.0, and a slip modulus (k) is included for the purpose of estimating joint displacement. Reference lateral design values in this guide apply to the specific configurations tested and for configurations where any change in parameters will result in increased connection strength.

By using the design values in this guide, designers can gain approximately 50% to 150% in capacity over the corresponding calculated reference lateral design values. This can increase cost efficiency tremendously for large projects that call for a large number of screws.

Mass timber construction continues to gain momentum. The degree to which it is adopted on a wide scale will no doubt heavily depend on viability from a cost perspective. This CLT Special Provisions document is offered to you, the designer, with the intention of adding value to your work and to move the mass timber movement forward.

Sincerely,
MyTiCon Timber Connectors

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General Notes

1. Reference lateral design values in this guide apply to the specific configurations tested and for configurations where any change in parameters will increase connection strength. To illustrate, reference lateral design values may be applied to configurations where the thread penetration length in the main member and the secondary member, the screw diameter and the wood specific gravity are all greater than or equal to the parameters given.
2. Parallel-to-grain loading at the shear plane is assumed in listed design value to yield higher strength and stiffness.
3. Decreasing screw spacing is assumed to introduce the possibility of strength reduction per screw.
4. A minimum of 24 ICC-approved ASSY fasteners replicate were tested for each configuration.
5. All design values apply to respective ASSY self-tapping screws only.
6. Assigned Specific Gravities (G)
 - CLT member:
 - S-P-F, G= 0.42
 - D.fir, G= 0.49
 - Plywood member
 - Structural grade, G=0.50

Adjusted Design Value Calculation

Adjusted design value calculation (Z'):

$$Z' = Z \cdot n_F \cdot C'$$

- | | |
|-------|---|
| Z | Reference design value given in the provided design tables |
| n_F | Number of effective fasteners in a connection: $n_F = 0.9 \cdot n$ |
| n | Number of screws acting together in a connection. |
| C' | <p>The adjustment factors for the connection, composed of:</p> <p>$C_D ; C_M ; C_t ; C_{\Delta} ; C_{eg} ; C_{di} ; C_{tn}$</p> <p>$C_g$ may be ignored when calculating with n_F.</p> |

Surface Splines

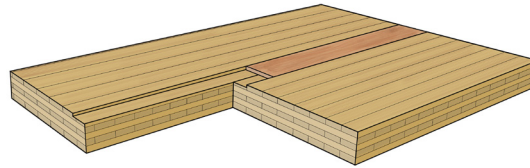


Table 1. Surface Spline Reference Design Values

CLT Details	Spline Thickness	Dimensions			Screws Details (For ASSY Ecofast or ASSY SK)	Reference Design Values		
		e	S _q	S _p		Z _{calc} [lbs]	k [in/kip]	Z _{test} [lbs]
3-Ply S-P-F	3/4"	13/16"	1 - 9/16"	4 - 3/4"	5/16" x 3 - 1/8"	172	0.2	288
3-Ply D. Fir	1"	2 - 1/4"	4 - 1/2"	6"	5/16" x 4"	189	0.2	288
3-Ply D. Fir	1"	2 - 3/4"	5 - 1/2"	6"	3/8" x 4"	-	0.2	387
5-Ply S-P-F	11/16"	1 - 3/8"	2 - 3/4"	6"	1/4" x 6 - 1/4"	172	0.3	198
5-Ply S-P-F	1"	1 - 3/8"	2 - 3/4"	6"	5/16" x 6 - 1/4"	243	0.2	444

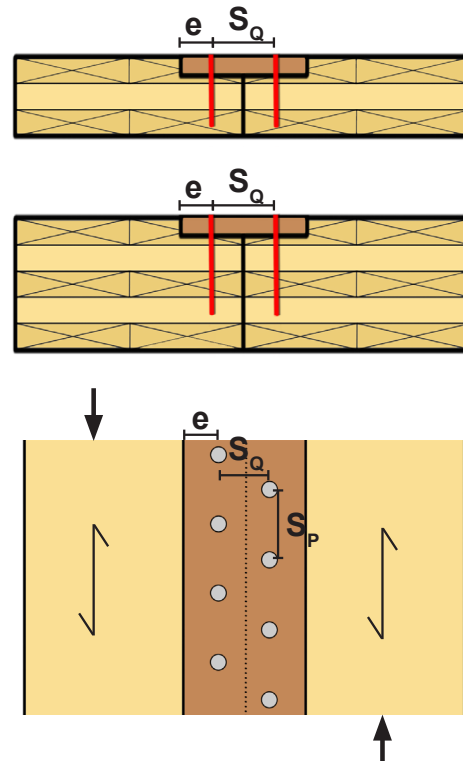
Notes:

1. Table 1 lists reference design values valid for allowable stress design in the USA for a single ASSY fastener conforming to the connection geometry and loading condition described on this page.
2. It is recommended to stagger the screws across the line of the joint, as illustrated to the left.
3. Listed reference lateral design values are only valid for ASSY Ecofast and ASSY SK.
4. Fastener must be installed in pair, one screw in each panel in order to transmit the load through the spline connection.
5. CLT panels ply thickness are assumed to be 1-3/8" [35 mm].
6. Listed reference lateral design values given correspond to load duration factor $C_D = 1.0$. Reference design value may be adjusted for a different load duration factor C_D .
7. Listed reference lateral design values are valid for dry service conditions, $C_M = 1.0$.

Screw Size Color Coding

1/4"
 5/16"
 3/8"

Connection Geometry Requirements



Half Lap Joints

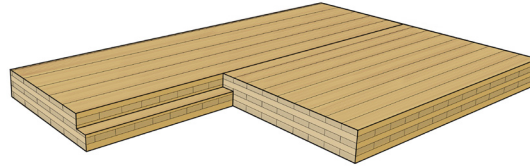


Table 2. Half Lap Joints Reference Design Values

CLT Details	Dimensions			Screws Details (For ASSY Ecofast or ASSY SK)	Reference Design Values		
	e	b _{spline}	S _p		Z _{calc} [lbs]	k [in/kip]	Z _{test} [lbs]
3-Ply S-P-F	1 - 5/8"	3 - 1/8"	2 - 1/2"	5/16" x 3 - 1/2"	209	0.15	288
5-Ply S-P-F	1 - 1/4"	2 - 5/8"	6"	1/4" x 6 - 1/4"	185	0.15	341
5-Ply S-P-F	1 - 5/8"	3 - 1/8"	2 - 1/2"	5/16" x 6 - 1/4"	243	0.15	486

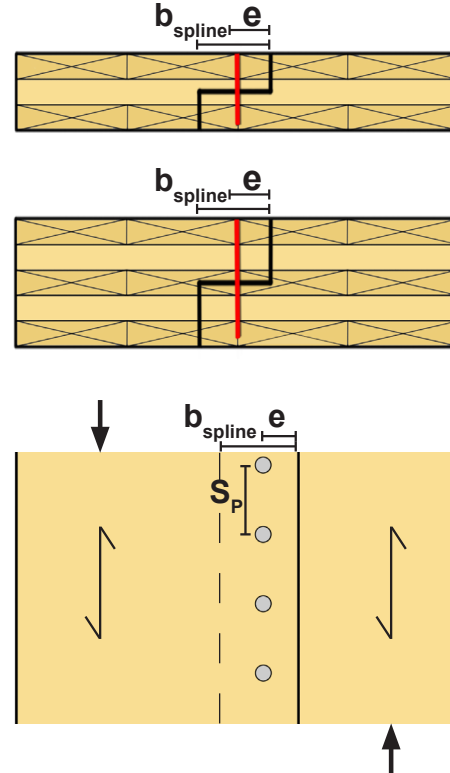
Notes:

- Table 2 lists reference design values valid for allowable stress design in the USA for a single ASSY fastener conforming to the connection geometry and loading condition described on this page.
- Listed reference lateral design values are only valid for ASSY Ecofast and ASSY SK.
- Reference lateral design values apply to single screws.
- CLT panels ply thickness are assumed to be 1-3/8" [35 mm].
- Listed reference lateral design values given correspond to load duration factor $C_D = 1.0$. Reference design value may be adjusted for a different load duration factor C_D .
- Listed reference lateral design values are valid for dry service condition, $C_M = 1.0$.
- Lap joint notch reinforcement may be required.

Screw Size Color Coding

1/4"
 5/16"
 3/8"

Connection Geometry Requirements



Butt Joints

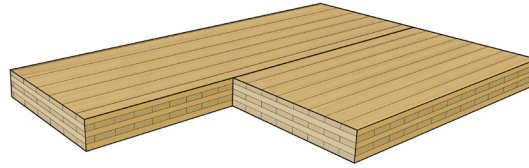


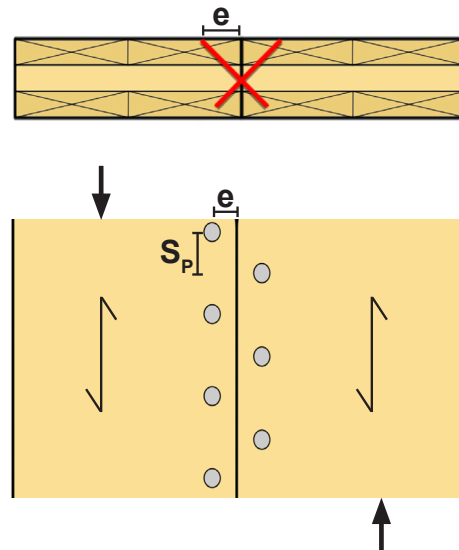
Table 3. Butt Joints Reference Design Values

CLT Details	Dimensions		Screws Details (For ASSY VG CSK)	Reference Design Values		
	e	S _p		Z _{calc} [lbs]	k [in/kip]	Z _{test} [lbs]
3-Ply S-P-F	2"	2 - 1/2"	5/16" x 5 - 1/2"	123	0.26	306

Notes:

1. Table 3 lists reference design values valid for allowable stress design in the USA for a single ASSY fastener conforming to the connection geometry and loading condition described on this page.
2. Screws are installed at a 45° angle to the surface of the panel, intersecting the joint at 1/2 the panel thickness, such that the screws are loaded perpendicular to the axis.
3. Listed reference lateral design values are only valid for ASSY VG CSK.
4. Reference lateral design values apply to single screws.
5. CLT panels ply thickness are assumed to be 1-3/8" [35 mm].
6. Listed reference lateral design values given correspond to load duration factor $C_D = 1.0$. Reference design value may be adjusted for a different load duration factor C_D .
7. Listed reference lateral design values are valid for dry service conditions, $C_M = 1.0$.

Connection Geometry Requirements

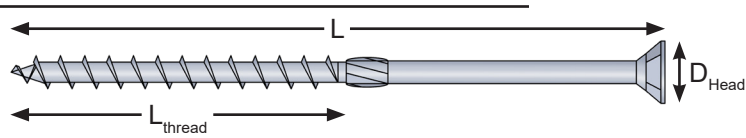


Screw Size Color Coding



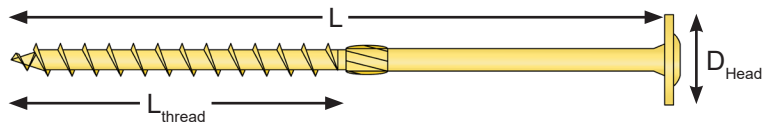
Screw Selection Guide

ASSY® Ecofast



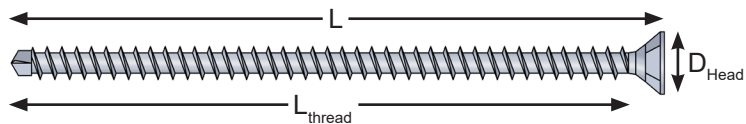
Item #	Box Size pieces	D in. [mm]	L in. [mm]	L _{Thread} in. [mm]	D _{Head} in. [mm]	Bit
11060160000	100	1/4 [6]	6-1/4 [160]	2-3/4 [70]	0.472 [12]	AW 30
11080080000	50	5/16 [8]	3-1/8 [80]	2 [50]	0.591 [15]	AW 40
11080100000	50		4 [100]	2-3/8 [60]		
11080160000	50		6-1/4 [160]	3-1/8 [80]		
11100100000	50	3/8 [10]	4 [100]	2-3/8 [60]	0.728 [18.5]	AW 50

ASSY® SK



Item #	Box Size pieces	D in. [mm]	L in. [mm]	L _{Thread} in. [mm]	D _{Head} in. [mm]	Bit
12060160000	100	1/4 [6]	6-1/4 [160]	2-3/4 [70]	0.551 [14]	AW 30
12080080000	50	5/16 [8]	3-1/8 [80]	2 [50]	0.870 [22.1]	AW 40
12080100000	50		4 [100]	2-3/8 [60]		
12080160000	50		6-1/4 [160]	3-1/8 [80]		
12100100000	50	3/8 [10]	4 [100]	2-3/8 [60]	0.992 [25.2]	AW 50

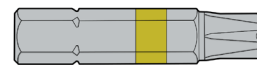
ASSY® VG CSK



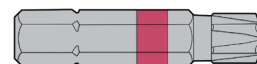
Item #	Box Size pieces	D in. [mm]	L in. [mm]	L _{Thread} in. [mm]	D _{Head} in. [mm]	Bit
14080140000	75	5/16 [8]	5-1/2 [140]	4-7/8 [123]	0.591 [15]	AW 40

Bits - AW® Drive

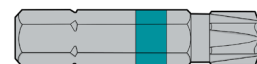
The AW® Bits are engineered and patented for proper installation of all ASSY® screws and offer exceptional fit and durability. They are available in three standard sizes.



AW® 30



AW® 40



AW® 50