

# VGS EVO



## FULLY THREADED SCREW WITH COUNTERSUNK OR HEXAGONAL HEAD

### C4 EVO COATING

Surface treatment of epoxy resin and aluminium flakes. No rust after 1440 hours of salt spray exposure test, as per ISO 9227. Can be used in exposure condition 3 outdoor applications and under class C4 atmospheric corrosion conditions.

### STRUCTURAL APPLICATIONS

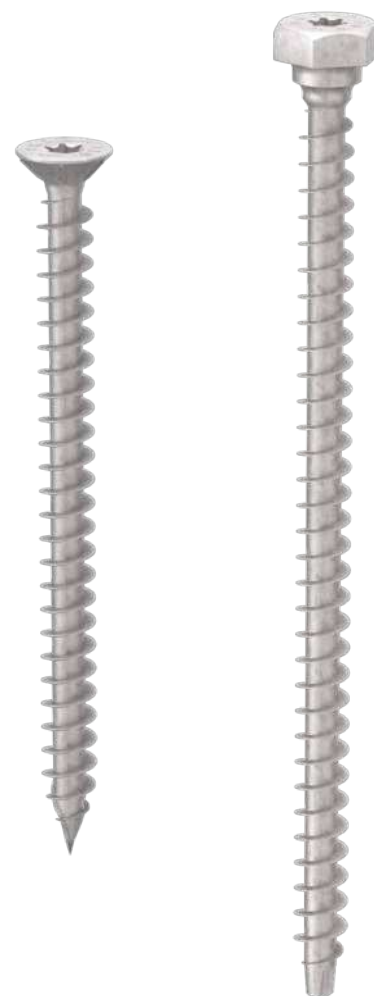
Approved for structural applications subject to stresses in any direction vs the grain (0° - 90°). Safety certified by numerous tests carried out for any direction of insertion. Cyclical SEISMIC-REV tests according to EN 12512. Countersunk head up to L = 23 5/8" (600 mm), ideal for use on plates or for concealed reinforcements.

### AUTOCLAVE-TREATED TIMBER

The C4 EVO coating has been certified according to US acceptance criteria AC257 for outdoor use with ACQ-treated timber.

### 3 THORNS TIP

Thanks to the 3 THORNS tip, minimum installation distances are reduced. More screws can be used in less space and larger screws in smaller elements.



MY PROJECT

SOFTWARE

VIDEO

MANUALS

BIT INCLUDED

DIAMETER [in]

0.36

0.36

0.52

0.60

LENGTH [in]

3 1/8

4

31 1/2

78 3/4

EXPOSURE CONDITION

EC1

EC3

ATMOSPHERIC CORROSIVITY

C1

C2

C3

C4

WOOD CORROSIVITY

T1

T2

T3

MATERIAL

C4 EVO COATING

carbon steel with C4 EVO coating

#### METAL-to-TIMBER recommended use:



### FIELDS OF USE

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



## OUTDOOR STRUCTURAL PERFORMANCE

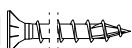
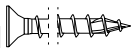
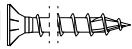
Ideal for fastening timber framed panels and trusses (Rafter, Truss). Values also tested, certified and calculated for high density woods. Ideal for fastening timber-framed panels and lattice beams (Rafter, Truss).

## CLT & LVL

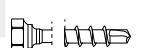
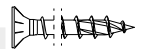
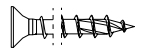
Values also tested, certified and calculated for CLT and high density woods such as LVL, Plywood or other laminated veneer products.

## CODES AND DIMENSIONS

| d <sub>1</sub>               | CODE        | L    |        | b    |         | pcs |
|------------------------------|-------------|------|--------|------|---------|-----|
| [mm]<br>[in]                 |             | [mm] | [in]   | [mm] | [in]    |     |
| 9<br>0.36<br>TX 40           | VGSEVO9120  | 120  | 4 3/4  | 110  | 4 3/8   | 50  |
|                              | VGSEVO9160  | 160  | 6 1/4  | 150  | 6       | 50  |
|                              | VGSEVO9200  | 200  | 8      | 190  | 7 1/2   | 50  |
|                              | VGSEVO9240  | 240  | 9 1/2  | 230  | 9 1/16  | 50  |
|                              | VGSEVO9280  | 280  | 11     | 270  | 10 5/8  | 50  |
|                              | VGSEVO9320  | 320  | 12 5/8 | 310  | 12 3/16 | 25  |
| 11<br>0.44<br>TX 50          | VGSEVO9360  | 360  | 14 1/4 | 350  | 13 3/4  | 25  |
|                              | VGSEVO11100 | 100  | 4      | 90   | 3 1/2   | 25  |
|                              | VGSEVO11150 | 150  | 6      | 140  | 5 1/2   | 25  |
|                              | VGSEVO11200 | 200  | 8      | 190  | 7 1/2   | 25  |
| 13<br>0.52<br>TX 50<br>SW 19 | VGSEVO11250 | 250  | 10     | 240  | 9 1/2   | 25  |
|                              | VGSEVO11300 | 300  | 11 3/4 | 290  | 11 7/16 | 25  |
|                              | VGSEVO11350 | 350  | 13 3/4 | 340  | 13 3/8  | 25  |
|                              | VGSEVO11400 | 400  | 15 3/4 | 390  | 15 3/8  | 25  |
|                              | VGSEVO11500 | 500  | 19 3/4 | 490  | 19 5/16 | 25  |
|                              | VGSEVO11600 | 600  | 23 5/8 | 590  | 23 1/4  | 25  |



| d <sub>1</sub>               | CODE        | L    |        | b    |          | pcs |
|------------------------------|-------------|------|--------|------|----------|-----|
| [mm]<br>[in]                 |             | [mm] | [in]   | [mm] | [in]     |     |
| 13<br>0.52<br>TX 50          | VGSEVO13200 | 200  | 8      | 190  | 7 1/2    | 25  |
|                              | VGSEVO13300 | 300  | 11 3/4 | 280  | 11       | 25  |
|                              | VGSEVO13400 | 400  | 15 3/4 | 380  | 15       | 25  |
|                              | VGSEVO13500 | 500  | 19 3/4 | 480  | 19       | 25  |
| 13<br>0.52<br>TX 50<br>SW 19 | VGSEVO13600 | 600  | 23 5/8 | 580  | 22 13/16 | 25  |
|                              | VGSEVO13700 | 700  | 27 1/2 | 680  | 26 3/4   | 25  |
|                              | VGSEVO13800 | 800  | 31 1/2 | 780  | 30 11/16 | 25  |



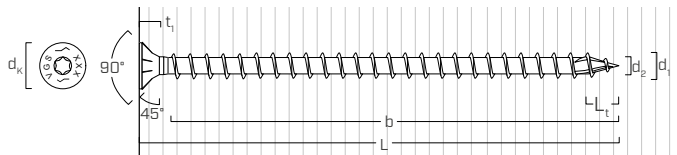
VGU EVO  
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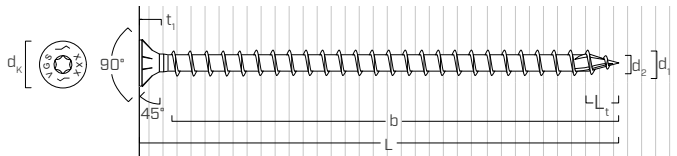
TORQUE LIMITER  
page 436

## GEOMETRY AND MECHANICAL CHARACTERISTICS

### VGS Ø0.36 in - Ø0.44 in

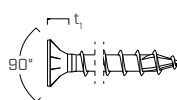


### VGS Ø0.52 in



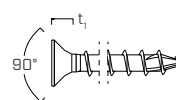
### VGS Ø0.36 in

4 3/4 in ≤ L ≤ 14 1/4 in



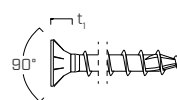
### VGS Ø0.44 in

L ≤ 10 in



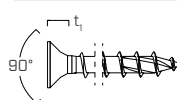
### VGS Ø0.44 in

10 in < L ≤ 23 5/8 in



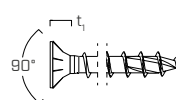
### VGS Ø0.52 in

L ≤ 10 in



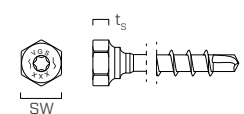
### VGS Ø0.52 in

10 in < L ≤ 23 5/8 in



### VGS Ø0.52 in

L > 23 5/8 in



## GEOMETRY

| Nominal diameter                          | d <sub>1</sub>           | [in] <sup>(1)</sup> | 0.36  | 0.44  | 0.52     | 0.52     |
|-------------------------------------------|--------------------------|---------------------|-------|-------|----------|----------|
|                                           |                          | [mm]                | 9     | 11    | 13       | 13       |
| Outer thread diameter                     | d <sub>1</sub>           | [in]                | 0.354 | 0.433 | 0.512    | 0.512    |
| Length                                    | L                        | [in]                | -     | -     | ≤ 23 5/8 | > 23 5/8 |
| Head diameter                             | d <sub>K</sub>           | [in]                | 0.630 | 0.760 | 0.866    | -        |
| Countersunk head thickness                | t <sub>s</sub>           | [in]                | 0.256 | 0.323 | 0.370    | -        |
| Wrench size                               | SW                       | -                   | -     | -     | -        | SW19     |
| Exagonal head thickness                   | t <sub>s</sub>           | [in]                | -     | -     | -        | 0.295    |
| Root diameter                             | d <sub>2</sub>           | [in]                | 0.232 | 0.260 | 0.315    | 0.315    |
| Tip Length                                | L <sub>t</sub>           | [in]                | 0.354 | 0.433 | 0.512    | 0.512    |
| Pre-drilling hole diameter <sup>(2)</sup> | d <sub>V,G≤0.55</sub>    | [in]                | 13/64 | 15/64 | 5/16     | 5/16     |
| Pre-drilling hole diameter <sup>(3)</sup> | d <sub>V,G&gt;0.55</sub> | [in]                | 15/64 | 9/32  | 23/64    | 23/64    |

<sup>(1)</sup> The nominal diameter of the screw is converted into imperial units and rounded up to the nearest decimal point.

<sup>(2)</sup> Pre-drilling applies to timber with G≤0.55 (optional).

<sup>(3)</sup> Pre-drilling applies to timber with G>0.55 (required).

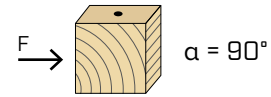
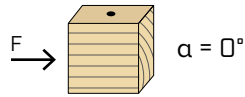
## MECHANICAL PARAMETERS

| Nominal diameter                   | d <sub>1</sub>    | [in]  | 0.36   | 0.44   | 0.52   | 0.52   |
|------------------------------------|-------------------|-------|--------|--------|--------|--------|
| Tensile strength (allowable)       | f <sub>tens</sub> | [lbf] | 2450   | 3200   | 4400   | 4400   |
| Bending yield strength (specified) | F <sub>y,b</sub>  | [psi] | 180000 | 170000 | 161000 | 161000 |

| Nominal diameter             | d <sub>1</sub>  | [in]     | 0.36     | 0.44  | 0.52   | 0.52   |
|------------------------------|-----------------|----------|----------|-------|--------|--------|
| Withdrawal<br>(design value) | W <sub>90</sub> | [lbf/in] | G = 0.35 | 192   | 207    | 235    |
|                              |                 |          | G = 0.42 | 220   | 240    | 272    |
|                              |                 |          | G = 0.49 | 255   | 272    | 308    |
|                              |                 |          | G = 0.55 | 280   | 298    | 338    |
| minimum embedded<br>length   |                 | [in]     | 2 1/8    | 2 5/8 | 3 1/16 | 3 1/16 |

## MINIMUM DISTANCES FOR SHEAR LOADS | TIMBER

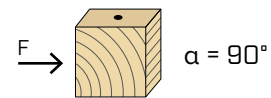
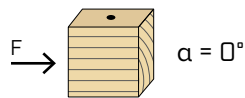
 screws inserted **WITHOUT** pre-drilled hole  $G \leq 0.50$



| $d_1$     | [in] | 0.36        | 0.44   | 0.52   |
|-----------|------|-------------|--------|--------|
|           | [mm] | 9           | 11     | 13     |
| $a_1$     | [in] | <b>15·d</b> | 5 5/16 | 6 1/2  |
| $a_2$     | [in] | <b>5·d</b>  | 1 3/4  | 2 3/16 |
| $a_{3,t}$ | [in] | <b>15·d</b> | 5 5/16 | 6 1/2  |
| $a_{3,c}$ | [in] | <b>10·d</b> | 3 1/2  | 4 3/8  |
| $a_{4,t}$ | [in] | <b>10·d</b> | 3 1/2  | 4 3/8  |
| $a_{4,c}$ | [in] | <b>5·d</b>  | 1 3/4  | 2 3/16 |

|             | 0.36   | 0.44   | 0.52    |
|-------------|--------|--------|---------|
|             | 9      | 11     | 13      |
| <b>10·d</b> | 3 1/2  | 4 3/8  | 5 1/8   |
| <b>5·d</b>  | 1 3/4  | 2 3/16 | 2 9/16  |
| <b>15·d</b> | 5 5/16 | 6 1/2  | 7 11/16 |
| <b>10·d</b> | 3 1/2  | 4 3/8  | 5 1/8   |
| <b>10·d</b> | 3 1/2  | 4 3/8  | 5 1/8   |
| <b>5·d</b>  | 1 3/4  | 2 3/16 | 2 9/16  |

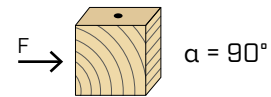
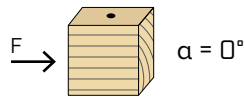
 screws inserted **WITHOUT** pre-drilled hole  $G > 0.50$



| $d_1$     | [in] | 0.36        | 0.44   | 0.52   |
|-----------|------|-------------|--------|--------|
|           | [mm] | 9           | 11     | 13     |
| $a_1$     | [in] | <b>15·d</b> | 5 5/16 | 6 1/2  |
| $a_2$     | [in] | <b>7·d</b>  | 2 1/2  | 3 1/16 |
| $a_{3,t}$ | [in] | <b>20·d</b> | 7 1/8  | 8 5/8  |
| $a_{3,c}$ | [in] | <b>15·d</b> | 5 5/16 | 6 1/2  |
| $a_{4,t}$ | [in] | <b>12·d</b> | 4 1/4  | 5 3/16 |
| $a_{4,c}$ | [in] | <b>7·d</b>  | 2 1/2  | 3 1/16 |

|             | 0.36   | 0.44   | 0.52    |
|-------------|--------|--------|---------|
|             | 9      | 11     | 13      |
| <b>10·d</b> | 3 1/2  | 4 3/8  | 5 1/8   |
| <b>7·d</b>  | 2 1/2  | 3 1/16 | 3 9/16  |
| <b>20·d</b> | 7 1/8  | 8 5/8  | 10 1/4  |
| <b>15·d</b> | 5 5/16 | 6 1/2  | 7 11/16 |
| <b>12·d</b> | 4 1/4  | 5 3/16 | 6 1/8   |
| <b>7·d</b>  | 2 1/2  | 3 1/16 | 3 9/16  |

 screws inserted **WITH** pre-drilled hole



| $d_1$     | [in] | 0.36        | 0.44   | 0.52       |
|-----------|------|-------------|--------|------------|
|           | [mm] | 9           | 11     | 13         |
| $a_1$     | [in] | <b>10·d</b> | 3 1/2  | <b>5·d</b> |
| $a_2$     | [in] | <b>4·d</b>  | 1 7/16 | <b>5·d</b> |
| $a_{3,t}$ | [in] | <b>12·d</b> | 4 1/4  | <b>7·d</b> |
| $a_{3,c}$ | [in] | <b>7·d</b>  | 2 1/2  | <b>4·d</b> |
| $a_{4,t}$ | [in] | <b>7·d</b>  | 2 1/2  | <b>4·d</b> |
| $a_{4,c}$ | [in] | <b>3·d</b>  | 1 1/16 | <b>3·d</b> |

|             | 0.36   | 0.44       | 0.52   |
|-------------|--------|------------|--------|
|             | 9      | 11         | 13     |
| <b>5·d</b>  | 1 3/4  | <b>5·d</b> | 2 3/16 |
| <b>4·d</b>  | 1 7/16 | <b>5·d</b> | 2 3/16 |
| <b>12·d</b> | 4 1/4  | <b>7·d</b> | 3 1/16 |
| <b>7·d</b>  | 2 1/2  | <b>4·d</b> | 1 3/4  |
| <b>7·d</b>  | 2 1/2  | <b>4·d</b> | 1 3/4  |
| <b>3·d</b>  | 1 1/16 | <b>3·d</b> | 1 5/16 |

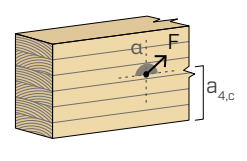
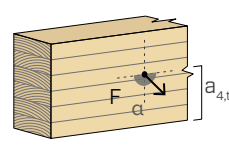
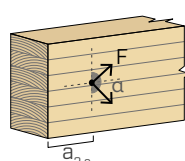
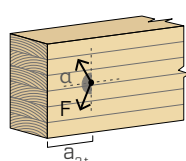
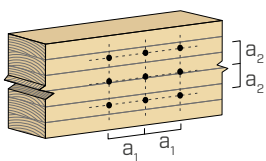
$\alpha$  = load-to-grain angle  
 $d$  =  $d_1$  = nominal diameter of the screw

stressed end  
 $-90^\circ < \alpha < 90^\circ$

unloaded end  
 $90^\circ < \alpha < 270^\circ$

stressed edge  
 $0^\circ < \alpha < 180^\circ$

unload edge  
 $180^\circ < \alpha < 360^\circ$



### NOTES

- 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.

## MINIMUM DISTANCES FOR AXIAL STRESSES | TIMBER



screws inserted **WITHOUT** pre-drilled hole

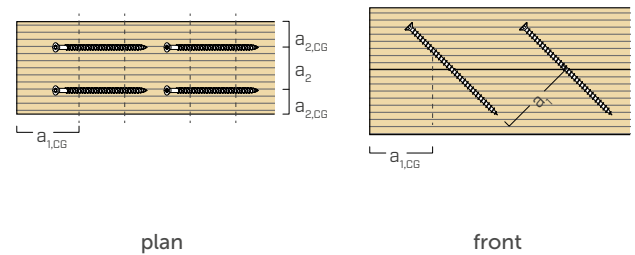
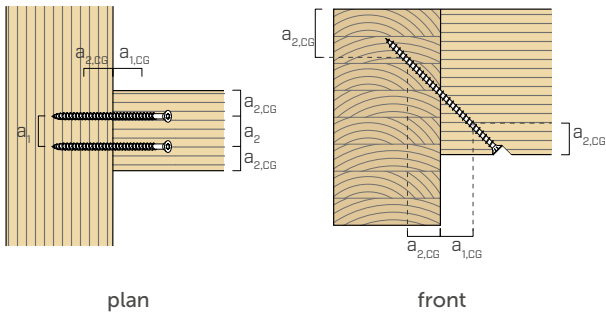


screws inserted **WITH** pre-drilled hole

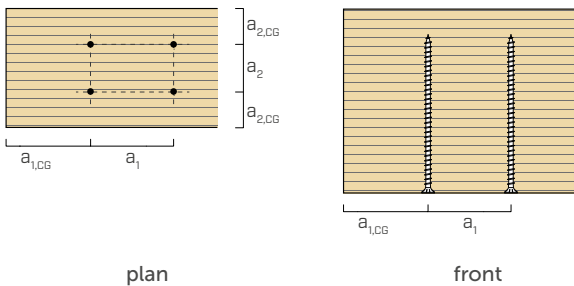
| d <sub>1</sub>     | [in] | 0.36  | 0.44   | 0.52  |        |        |
|--------------------|------|-------|--------|-------|--------|--------|
|                    | [mm] | 9     | 11     | 13    |        |        |
| a <sub>1</sub>     | [in] | 7·d   | 2 1/2  | 7·d   | 3 1/16 | 3 9/16 |
| a <sub>2</sub>     | [in] | 4·d   | 1 7/16 | 5·d   | 2 3/16 | 2 9/16 |
| a <sub>1,CG</sub>  | [in] | 10·d  | 3 1/2  | 10·d  | 4 3/8  | 5 1/8  |
| a <sub>2,CG</sub>  | [in] | 4·d   | 1 7/16 | 4·d   | 1 3/4  | 2 1/16 |
| a <sub>CROSS</sub> | [in] | 1,5·d | 9/16   | 1,5·d | 11/16  | 13/16  |

| d <sub>1</sub>     | [in] |       | 0.36   |       | 0.44   | 0.52   |
|--------------------|------|-------|--------|-------|--------|--------|
|                    | [mm] |       | 9      |       | 11     | 13     |
| a <sub>1</sub>     | [in] | 7·d   | 2 1/2  | 5·d   | 2 3/16 | 2 9/16 |
| a <sub>2</sub>     | [in] | 3·d   | 1 1/16 | 5·d   | 2 3/16 | 2 9/16 |
| a <sub>1,CG</sub>  | [in] | 7·d   | 2 1/2  | 4·d   | 1 3/4  | 2 1/16 |
| a <sub>2,CG</sub>  | [in] | 3·d   | 1 1/16 | 3·d   | 1 5/16 | 1 9/16 |
| a <sub>CROSS</sub> | [in] | 1,5·d | 9/16   | 1,5·d | 11/16  | 13/16  |

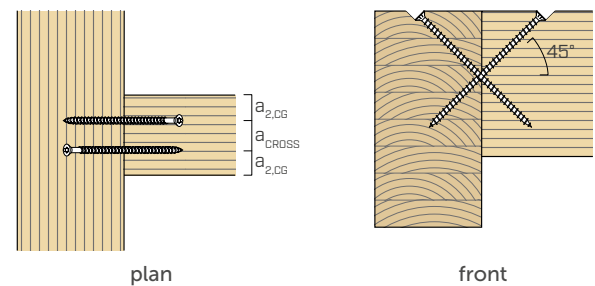
### SCREWS UNDER TENSION INSERTED WITH AN ANGLE $\alpha$ WITH RESPECT TO THE GRAIN



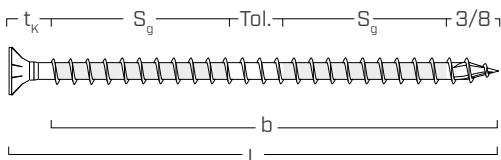
### SCREWS INSERTED WITH $\alpha = 90^\circ$ ANGLE WITH RESPECT TO THE GRAIN



### CROSS SCREWS INSERTED WITH AN ANGLE $\alpha$ WITH RESPECT TO THE GRAIN



## EFFECTIVE THREAD USED IN CALCULATION



$$b = S_{g,tot} = L - t_K$$

$$S_g = (L - t_K - 3/8" - Tol.) / 2$$

$$t_K = 3/8" \text{ (countersunk head)}$$

$$t_K = 3/4" \text{ (hexagonal head)}$$

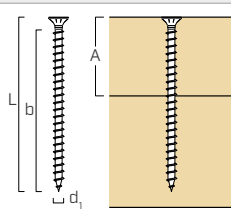
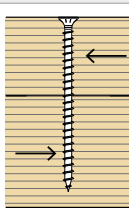
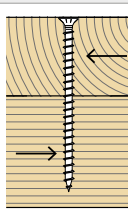
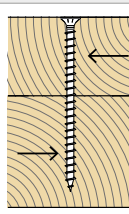
represents the entire length of the threaded part

represents the partial length of the threaded part net of a laying tolerance (Tol.) of 3/8"

### NOTES

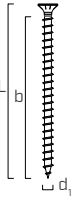
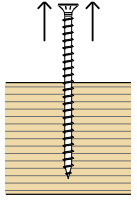
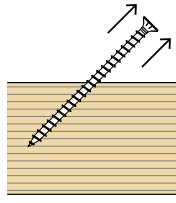
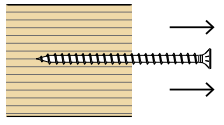
- The minimum spacing and distances comply with Table 8 of ESR-4645, where d refers to the nominal diameter of the screw;
- Wood member stresses must be checked in accordance with the corresponding Sections of the NDS; end distances, edge distances and fastener spacing may need to be increased accordingly.

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

| geometry                                                                          |                                                          |                                                          |                                                          |                                                          | $Z_{  }$                                                                          |               |               |               | $Z_{\perp/  }$                                                                     |               |               |               | $Z_{\perp}$                                                                         |               |               |               |
|-----------------------------------------------------------------------------------|----------------------------------------------------------|----------------------------------------------------------|----------------------------------------------------------|----------------------------------------------------------|-----------------------------------------------------------------------------------|---------------|---------------|---------------|------------------------------------------------------------------------------------|---------------|---------------|---------------|-------------------------------------------------------------------------------------|---------------|---------------|---------------|
|  |                                                          |                                                          |                                                          |                                                          |  |               |               |               |  |               |               |               |  |               |               |               |
| $d_1$                                                                             | L                                                        |                                                          | b                                                        | A                                                        | G                                                                                 |               |               |               | G                                                                                  |               |               |               | G                                                                                   |               |               |               |
| $\begin{matrix} [\text{mm}] \\ [\text{in}] \end{matrix}$                          | $\begin{matrix} [\text{mm}] \\ [\text{in}] \end{matrix}$ | $\begin{matrix} [\text{in}] \\ [\text{in}] \end{matrix}$ | $\begin{matrix} [\text{in}] \\ [\text{in}] \end{matrix}$ | $\begin{matrix} [\text{in}] \\ [\text{in}] \end{matrix}$ | 0.35<br>[lbf]                                                                     | 0.42<br>[lbf] | 0.49<br>[lbf] | 0.55<br>[lbf] | 0.35<br>[lbf]                                                                      | 0.42<br>[lbf] | 0.49<br>[lbf] | 0.55<br>[lbf] | 0.35<br>[lbf]                                                                       | 0.42<br>[lbf] | 0.49<br>[lbf] | 0.55<br>[lbf] |
| 9<br>0.36                                                                         | 120                                                      | 4 3/4                                                    | 4 3/8                                                    | 2 3/8                                                    | 187                                                                               | 258           | 313           | 348           | 149                                                                                | 206           | 250           | 278           | 149                                                                                 | 206           | 250           | 278           |
|                                                                                   | 160                                                      | 6 1/4                                                    | 6                                                        | 3 1/8                                                    | 230                                                                               | 272           | 313           | 348           | 184                                                                                | 217           | 250           | 278           | 184                                                                                 | 217           | 250           | 278           |
|                                                                                   | 200                                                      | 8                                                        | 7 1/2                                                    | 4                                                        | 230                                                                               | 272           | 313           | 348           | 184                                                                                | 217           | 250           | 278           | 184                                                                                 | 217           | 250           | 278           |
|                                                                                   | 240                                                      | 9 1/2                                                    | 9 1/16                                                   | 4 3/4                                                    | 230                                                                               | 272           | 313           | 348           | 184                                                                                | 217           | 250           | 278           | 184                                                                                 | 217           | 250           | 278           |
|                                                                                   | 280                                                      | 11                                                       | 10 5/8                                                   | 5 1/2                                                    | 230                                                                               | 272           | 313           | 348           | 184                                                                                | 217           | 250           | 278           | 184                                                                                 | 217           | 250           | 278           |
|                                                                                   | 320                                                      | 12 5/8                                                   | 12 3/16                                                  | 6 1/4                                                    | 230                                                                               | 272           | 313           | 348           | 184                                                                                | 217           | 250           | 278           | 184                                                                                 | 217           | 250           | 278           |
|                                                                                   | 360                                                      | 14 1/4                                                   | 13 3/4                                                   | 7 1/8                                                    | 230                                                                               | 272           | 313           | 348           | 184                                                                                | 217           | 250           | 278           | 184                                                                                 | 217           | 250           | 278           |
| 11<br>0.44                                                                        | 100                                                      | 4                                                        | 3 1/2                                                    | 1 15/16                                                  | 218                                                                               | 262           | 306           | 343           | 143                                                                                | 178           | 215           | 247           | 116                                                                                 | 152           | 190           | 224           |
|                                                                                   | 150                                                      | 6                                                        | 5 1/2                                                    | 2 15/16                                                  | 314                                                                               | 344           | 372           | 394           | 219                                                                                | 252           | 278           | 299           | 178                                                                                 | 232           | 262           | 285           |
|                                                                                   | 200                                                      | 8                                                        | 7 1/2                                                    | 4                                                        | 314                                                                               | 344           | 372           | 394           | 225                                                                                | 252           | 278           | 299           | 205                                                                                 | 234           | 262           | 285           |
|                                                                                   | 250                                                      | 10                                                       | 9 1/2                                                    | 4 15/16                                                  | 314                                                                               | 344           | 372           | 394           | 225                                                                                | 252           | 278           | 299           | 205                                                                                 | 234           | 262           | 285           |
|                                                                                   | 300                                                      | 11 3/4                                                   | 11 7/16                                                  | 6                                                        | 314                                                                               | 344           | 372           | 394           | 225                                                                                | 252           | 278           | 299           | 205                                                                                 | 234           | 262           | 285           |
|                                                                                   | 350                                                      | 13 3/4                                                   | 13 3/8                                                   | 6 7/8                                                    | 314                                                                               | 344           | 372           | 394           | 225                                                                                | 252           | 278           | 299           | 205                                                                                 | 234           | 262           | 285           |
|                                                                                   | 400                                                      | 15 3/4                                                   | 15 3/8                                                   | 8                                                        | 314                                                                               | 344           | 372           | 394           | 225                                                                                | 252           | 278           | 299           | 205                                                                                 | 234           | 262           | 285           |
|                                                                                   | 500                                                      | 19 3/4                                                   | 19 5/16                                                  | 10                                                       | 314                                                                               | 344           | 372           | 394           | 225                                                                                | 252           | 278           | 299           | 205                                                                                 | 234           | 262           | 285           |
| 13<br>0.52                                                                        | 600                                                      | 23 5/8                                                   | 23 1/4                                                   | 11 3/4                                                   | 314                                                                               | 344           | 372           | 394           | 225                                                                                | 252           | 278           | 299           | 205                                                                                 | 234           | 262           | 285           |
|                                                                                   | 200                                                      | 8                                                        | 7 1/2                                                    | 4                                                        | 450                                                                               | 493           | 532           | 564           | 312                                                                                | 351           | 387           | 416           | 262                                                                                 | 319           | 357           | 388           |
|                                                                                   | 300                                                      | 11 3/4                                                   | 11                                                       | 6                                                        | 450                                                                               | 493           | 532           | 564           | 312                                                                                | 351           | 387           | 416           | 280                                                                                 | 319           | 357           | 388           |
|                                                                                   | 400                                                      | 15 3/4                                                   | 15                                                       | 8                                                        | 450                                                                               | 493           | 532           | 564           | 312                                                                                | 351           | 387           | 416           | 280                                                                                 | 319           | 357           | 388           |
|                                                                                   | 500                                                      | 19 3/4                                                   | 19                                                       | 10                                                       | 450                                                                               | 493           | 532           | 564           | 312                                                                                | 351           | 387           | 416           | 280                                                                                 | 319           | 357           | 388           |
|                                                                                   | 600                                                      | 23 5/8                                                   | 22 13/16                                                 | 11 3/4                                                   | 450                                                                               | 493           | 532           | 564           | 312                                                                                | 351           | 387           | 416           | 280                                                                                 | 319           | 357           | 388           |
|                                                                                   | 700                                                      | 27 1/2                                                   | 26 3/4                                                   | 13 3/4                                                   | 450                                                                               | 493           | 532           | 564           | 312                                                                                | 351           | 387           | 416           | 280                                                                                 | 319           | 357           | 388           |
|                                                                                   | 800                                                      | 31 1/2                                                   | 30 11/16                                                 | 15 3/4                                                   | 450                                                                               | 493           | 532           | 564           | 312                                                                                | 351           | 387           | 416           | 280                                                                                 | 319           | 357           | 388           |

NOTES and GENERAL PRINCIPLES on page 219.

## ■ THREAD WITHDRAWAL (W) | WOOD

| geometry                                                                          |      |                  |          | thread withdrawal $\alpha = 90^\circ$                                             |       |       |       | thread withdrawal $\alpha = 45^\circ$                                              |       |       |       | thread withdrawal $\alpha = 0^\circ$                                                |       |       |       |
|-----------------------------------------------------------------------------------|------|------------------|----------|-----------------------------------------------------------------------------------|-------|-------|-------|------------------------------------------------------------------------------------|-------|-------|-------|-------------------------------------------------------------------------------------|-------|-------|-------|
|  |      |                  |          |  |       |       |       |  |       |       |       |  |       |       |       |
| d <sub>1</sub>                                                                    | L    |                  | b        | G                                                                                 |       |       |       | G                                                                                  |       |       |       | G                                                                                   |       |       |       |
|                                                                                   | [mm] | [in]             |          | 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] |                  |          | [lbf]                                                                             | [lbf] | [lbf] | [lbf] | [lbf]                                                                              | [lbf] | [lbf] | [lbf] | [lbf]                                                                               | [lbf] | [lbf] | [lbf] |
| 9<br>0.36                                                                         | 120  | 4 3/4            | 4 3/8    | 763                                                                               | 875   | 1014  | 1113  | 695                                                                                | 796   | 923   | 1013  | 229                                                                                 | 262   | 304   | 334   |
|                                                                                   | 160  | 6 1/4            | 6        | 1066                                                                              | 1221  | 1416  | 1554  | 970                                                                                | 1111  | 1288  | 1414  | 320                                                                                 | 366   | 425   | 466   |
|                                                                                   | 200  | 8                | 7 1/2    | 1368                                                                              | 1568  | 1817  | 1995  | 1245                                                                               | 1427  | 1654  | 1816  | 410                                                                                 | 470   | 545   | 599   |
|                                                                                   | 240  | 9 1/2            | 9 1/16   | 1671                                                                              | 1914  | 2219  | 2436  | 1520                                                                               | 1742  | 2019  | 2217  | 501                                                                                 | 574   | 666   | 731   |
|                                                                                   | 280  | 11               | 10 5/8   | 1973                                                                              | 2261  | 2620  | 2877  | 1795                                                                               | 2057  | 2384  | 2618  | 592                                                                                 | 678   | 786   | 863   |
|                                                                                   | 320  | 12 5/8           | 12 3/16  | 2275                                                                              | 2607  | 3022  | 3318  | 2071                                                                               | 2372  | 2750  | 3019  | 683                                                                                 | 782   | 907   | 995   |
|                                                                                   | 360  | 14 1/4           | 13 3/4   | 2578                                                                              | 2954  | 3423  | 3759  | 2346                                                                               | 2688  | 3115  | 3421  | 773                                                                                 | 886   | 1027  | 1128  |
| 11<br>0.44                                                                        | 100  | 4 <sup>(1)</sup> | 3 1/2    | 644                                                                               | 746   | 846   | 927   | 586                                                                                | 679   | 770   | 843   | 193                                                                                 | 224   | 254   | 278   |
|                                                                                   | 150  | 6                | 5 1/2    | 1051                                                                              | 1219  | 1381  | 1513  | 957                                                                                | 1109  | 1257  | 1377  | 315                                                                                 | 366   | 414   | 454   |
|                                                                                   | 200  | 8                | 7 1/2    | 1459                                                                              | 1691  | 1917  | 2100  | 1327                                                                               | 1539  | 1744  | 1911  | 438                                                                                 | 507   | 575   | 630   |
|                                                                                   | 250  | 10               | 9 1/2    | 1866                                                                              | 2164  | 2452  | 2687  | 1698                                                                               | 1969  | 2232  | 2445  | 560                                                                                 | 649   | 736   | 806   |
|                                                                                   | 300  | 11 3/4           | 11 7/16  | 2274                                                                              | 2636  | 2988  | 3273  | 2069                                                                               | 2399  | 2719  | 2979  | 682                                                                                 | 791   | 896   | 982   |
|                                                                                   | 350  | 13 3/4           | 13 3/8   | 2681                                                                              | 3109  | 3523  | 3860  | 2440                                                                               | 2829  | 3206  | 3513  | 804                                                                                 | 933   | 1057  | 1158  |
|                                                                                   | 400  | 15 3/4           | 15 3/8   | 3089                                                                              | 3581  | 4059  | 4447  | 2811                                                                               | 3259  | 3693  | 4046  | 927                                                                                 | 1074  | 1218  | 1334  |
|                                                                                   | 500  | 19 3/4           | 19 5/16  | 3904                                                                              | 4526  | 5129  | 5620  | 3552                                                                               | 4119  | 4668  | 5114  | 1171                                                                                | 1358  | 1539  | 1686  |
|                                                                                   | 600  | 23 5/8           | 23 1/4   | 4719                                                                              | 5471  | 6200  | 6793  | 4294                                                                               | 4978  | 5642  | 6182  | 1416                                                                                | 1641  | 1860  | 2038  |
| 13<br>0.52                                                                        | 200  | 8                | 7 1/2    | 1638                                                                              | 1895  | 2146  | 2355  | 1490                                                                               | 1725  | 1953  | 2143  | 491                                                                                 | 569   | 644   | 707   |
|                                                                                   | 300  | 11 3/4           | 11       | 2470                                                                              | 2859  | 3238  | 3553  | 2248                                                                               | 2602  | 2946  | 3233  | 741                                                                                 | 858   | 971   | 1066  |
|                                                                                   | 400  | 15 3/4           | 15       | 3395                                                                              | 3930  | 4450  | 4884  | 3090                                                                               | 3576  | 4050  | 4444  | 1019                                                                                | 1179  | 1335  | 1465  |
|                                                                                   | 500  | 19 3/4           | 19       | 4321                                                                              | 5001  | 5663  | 6214  | 3932                                                                               | 4551  | 5153  | 5655  | 1296                                                                                | 1500  | 1699  | 1864  |
|                                                                                   | 600  | 23 5/8           | 22 13/16 | 5246                                                                              | 6072  | 6875  | 7545  | 4774                                                                               | 5525  | 6257  | 6866  | 1574                                                                                | 1822  | 2063  | 2264  |
|                                                                                   | 700  | 27 1/2           | 26 3/4   | 6171                                                                              | 7143  | 8088  | 8876  | 5616                                                                               | 6500  | 7360  | 8077  | 1851                                                                                | 2143  | 2426  | 2663  |
|                                                                                   | 800  | 31 1/2           | 30 11/16 | 7096                                                                              | 8214  | 9301  | 10207 | 6458                                                                               | 7474  | 8464  | 9288  | 2129                                                                                | 2464  | 2790  | 3062  |

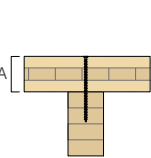
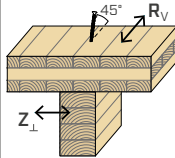
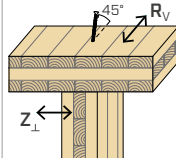
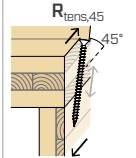
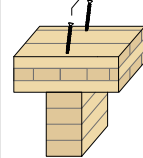
<sup>(1)</sup> The embedded thread length does not comply with the minimum requirement of ESR-4645 (8 times the outer thread diameter for screws installed at an angle  $0^\circ \leq \alpha < 90^\circ$  to the grain).

## SLIDING RESISTANCE ( $R_v$ ) | WOOD

| geometry       |      |                      |          | R <sub>v</sub> |         |                  |      |      |      |      |                    | R <sub>v</sub> |                  |      |      |      |      |  |  |
|----------------|------|----------------------|----------|----------------|---------|------------------|------|------|------|------|--------------------|----------------|------------------|------|------|------|------|--|--|
|                |      |                      |          |                |         |                  |      |      |      |      |                    |                |                  |      |      |      |      |  |  |
| d <sub>1</sub> | L    |                      | b        | S <sub>g</sub> | A       | B <sub>min</sub> | G    |      |      |      | S <sub>PLATE</sub> | S <sub>g</sub> | A <sub>min</sub> | G    |      |      |      |  |  |
| [mm]<br>[in]   | [mm] | [in]                 | [in]     | [in]           | [in]    | [in]             | 0.35 | 0.42 | 0.49 | 0.55 | [in]               | [in]           | [in]             | 0.35 | 0.42 | 0.49 | 0.55 |  |  |
| 9<br>0.36      | 120  | 4 3/4 <sup>(1)</sup> | 4 3/8    | 1 3/4          | 1 13/16 | 2 3/8            | 216  | 248  | 287  | 315  | 5/8                | 3 3/8          | 4 1/8            | 417  | 478  | 554  | 608  |  |  |
|                | 160  | 6 1/4 <sup>(1)</sup> | 6        | 2 9/16         | 2 3/8   | 3                | 317  | 363  | 420  | 462  |                    | 4 15/16        | 5 3/16           | 610  | 699  | 810  | 890  |  |  |
|                | 200  | 8                    | 7 1/2    | 3 3/8          | 2 15/16 | 3 1/2            | 417  | 478  | 554  | 608  |                    | 6 1/2          | 6 1/4            | 803  | 920  | 1067 | 1171 |  |  |
|                | 240  | 9 1/2                | 9 1/16   | 4 1/8          | 3 1/2   | 4 1/8            | 510  | 584  | 677  | 743  |                    | 8 1/16         | 7 7/16           | 996  | 1141 | 1323 | 1453 |  |  |
|                | 280  | 11                   | 10 5/8   | 4 15/16        | 4 1/16  | 4 5/8            | 610  | 699  | 810  | 890  |                    | 9 5/8          | 8 5/8            | 1189 | 1363 | 1579 | 1734 |  |  |
|                | 320  | 12 5/8               | 12 3/16  | 5 11/16        | 4 5/8   | 5 3/16           | 703  | 805  | 933  | 1025 |                    | 11 1/4         | 9 5/8            | 1390 | 1593 | 1846 | 2027 |  |  |
|                | 360  | 14 1/4               | 13 3/4   | 6 1/2          | 5 3/16  | 5 3/4            | 803  | 920  | 1067 | 1171 |                    | 12 3/4         | 10 7/8           | 1575 | 1805 | 2092 | 2297 |  |  |
| 11<br>0.44     | 100  | 4 <sup>(1)</sup>     | 3 1/2    | 1 3/8          | 1 9/16  | 2 1/8            | 183  | 212  | 241  | 264  | 3/4                | 2 3/8          | 3 1/2            | 316  | 367  | 416  | 455  |  |  |
|                | 150  | 6 <sup>(1)</sup>     | 5 1/2    | 2 3/8          | 2 1/4   | 2 13/16          | 316  | 367  | 416  | 455  |                    | 4 3/8          | 4 15/16          | 583  | 676  | 766  | 839  |  |  |
|                | 200  | 8 <sup>(1)</sup>     | 7 1/2    | 3 3/8          | 2 15/16 | 3 1/2            | 450  | 521  | 591  | 647  |                    | 6 1/4          | 6 1/4            | 832  | 965  | 1094 | 1198 |  |  |
|                | 250  | 10                   | 9 1/2    | 4 3/8          | 3 5/8   | 4 3/16           | 583  | 676  | 766  | 839  |                    | 8 1/4          | 7 11/16          | 1099 | 1274 | 1444 | 1582 |  |  |
|                | 300  | 11 3/4               | 11 7/16  | 5 5/16         | 4 3/8   | 4 15/16          | 708  | 820  | 930  | 1019 |                    | 10 1/4         | 9 1/4            | 1365 | 1583 | 1794 | 1965 |  |  |
|                | 350  | 13 3/4               | 13 3/8   | 6 1/4          | 5 1/16  | 5 5/8            | 832  | 965  | 1094 | 1198 |                    | 12 3/16        | 10 5/8           | 1623 | 1882 | 2133 | 2337 |  |  |
|                | 400  | 15 3/4               | 15 3/8   | 7 1/4          | 5 11/16 | 6 1/4            | 966  | 1120 | 1269 | 1390 |                    | 14 1/4         | 12               | 1898 | 2201 | 2494 | 2732 |  |  |
|                | 500  | 19 3/4               | 19 5/16  | 9 1/4          | 7 1/8   | 7 11/16          | 1232 | 1428 | 1619 | 1774 |                    | 18 1/8         | 14 3/4           | 2414 | 2799 | 3172 | 3476 |  |  |
|                | 600  | 23 5/8               | 23 1/4   | 11 1/4         | 8 5/8   | 9 1/4            | 1498 | 1737 | 1969 | 2157 |                    | 22             | 17 1/2           | 2930 | 3398 | 3851 | 4219 |  |  |
| 13<br>0.52     | 200  | 8 <sup>(1)</sup>     | 7 1/2    | 3 3/8          | 2 15/16 | 3 1/2            | 510  | 591  | 669  | 734  | 7/8                | 6 1/8          | 6 1/4            | 926  | 1072 | 1214 | 1332 |  |  |
|                | 300  | 11 3/4               | 11       | 5 5/16         | 4 3/8   | 4 15/16          | 803  | 930  | 1053 | 1155 |                    | 10 1/16        | 9 1/4            | 1522 | 1761 | 1994 | 2189 |  |  |
|                | 400  | 15 3/4               | 15       | 7 1/4          | 5 11/16 | 6 1/4            | 1096 | 1269 | 1437 | 1577 |                    | 14             | 12               | 2117 | 2450 | 2775 | 3045 |  |  |
|                | 500  | 19 3/4               | 19       | 9 1/4          | 7 1/8   | 7 11/16          | 1399 | 1619 | 1833 | 2012 |                    | 17 15/16       | 14 3/4           | 2712 | 3139 | 3555 | 3901 |  |  |
|                | 600  | 23 5/8               | 22 13/16 | 11 1/4         | 8 5/8   | 9 1/4            | 1701 | 1969 | 2230 | 2447 |                    | 21 7/8         | 17 1/2           | 3308 | 3829 | 4335 | 4758 |  |  |
|                | 700  | 27 1/2               | 26 3/4   | 12 3/4         | 10 1/16 | 10 5/8           | 1928 | 2232 | 2527 | 2773 |                    | -              | -                | -    | -    | -    | -    |  |  |
|                | 800  | 31 1/2               | 30 11/16 | 14 3/4         | 11 7/16 | 12               | 2230 | 2582 | 2923 | 3208 |                    | -              | -                | -    | -    | -    | -    |  |  |

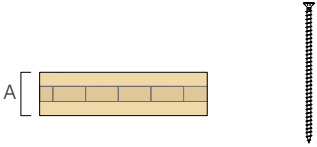
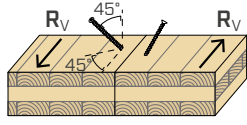
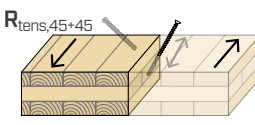
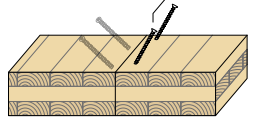
<sup>(1)</sup> The embedded thread length does not comply with the minimum requirement of ESR-4645 (8 times the outer thread diameter for screws installed at an angle  $0^\circ \leq \alpha < 90^\circ$  to the grain).

# CLT | FLOOR-TO-BEAM | FLOOR-TO-WALL

|                                                                                   |      |         |                 | SHEAR                                                                             |                |                |                 |                                                                                   |                |                |                 | SPACING                                                                             |                                                                                     |         |
|-----------------------------------------------------------------------------------|------|---------|-----------------|-----------------------------------------------------------------------------------|----------------|----------------|-----------------|-----------------------------------------------------------------------------------|----------------|----------------|-----------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|---------|
| geometry                                                                          |      |         |                 | CLT-to-wood                                                                       |                |                |                 | CLT-to-CLT                                                                        |                |                |                 | steel tension                                                                       | fastener in a row                                                                   |         |
|  |      |         |                 |  |                |                |                 |  |                |                |                 |  |  |         |
| side member thickness<br>(wall/floor) = A                                         |      |         | suggested screw | R <sub>v</sub>                                                                    | Z <sub>⊥</sub> | R <sub>v</sub> | Z <sub>m⊥</sub> | R <sub>v</sub>                                                                    | Z <sub>⊥</sub> | R <sub>v</sub> | Z <sub>m⊥</sub> | R <sub>tens,45</sub>                                                                | minimum                                                                             | typical |
| [mm]                                                                              | [in] | CODE    |                 | [lbf]                                                                             | [lbf]          | [lbf]          | [lbf]           | [lbf]                                                                             | [lbf]          | [lbf]          | [lbf]           | [lbf]                                                                               | [in]                                                                                | [in]    |
| 3 PLY                                                                             | 60   | 2 3/8   | VGSEVO9160      | 345                                                                               | 217            | 345            | 217             | 231                                                                               | 146            | 231            | 146             | 1732                                                                                | 5 5/16                                                                              | 7       |
|                                                                                   |      |         | VGSEVO11150     | 364                                                                               | 232            | 364            | 252             | 244                                                                               | 155            | 244            | 169             | 2263                                                                                | 6 1/2                                                                               | 9       |
|                                                                                   | 79   | 3 1/8   | VGSEVO9200      | 450                                                                               | 217            | 450            | 217             | 302                                                                               | 146            | 302            | 146             | 1732                                                                                | 5 5/16                                                                              | 7       |
|                                                                                   |      |         | VGSEVO11200     | 501                                                                               | 234            | 501            | 252             | 336                                                                               | 157            | 336            | 169             | 2263                                                                                | 6 1/2                                                                               | 9       |
|                                                                                   |      |         | VGSEVO13200     | 577                                                                               | 319            | 577            | 351             | 387                                                                               | 214            | 387            | 235             | 3111                                                                                | 7 11/16                                                                             | 11      |
|                                                                                   | 105  | 4 1/8   | VGSEVO9280      | 696                                                                               | 217            | 696            | 217             | 466                                                                               | 146            | 466            | 146             | 1732                                                                                | 5 5/16                                                                              | 7       |
|                                                                                   |      |         | VGSEVO11300     | 751                                                                               | 234            | 751            | 252             | 503                                                                               | 157            | 503            | 169             | 2263                                                                                | 6 1/2                                                                               | 9       |
|                                                                                   |      |         | VGSEVO13300     | 842                                                                               | 319            | 842            | 351             | 564                                                                               | 214            | 564            | 235             | 3111                                                                                | 7 11/16                                                                             | 11      |
|                                                                                   | 120  | 4 3/4   | VGSEVO9360      | 818                                                                               | 217            | 818            | 217             | 548                                                                               | 146            | 548            | 146             | 1732                                                                                | 5 5/16                                                                              | 7       |
|                                                                                   |      |         | VGSEVO11350     | 882                                                                               | 234            | 882            | 252             | 591                                                                               | 157            | 591            | 169             | 2263                                                                                | 6 1/2                                                                               | 9       |
| 5 PLY                                                                             | 100  | 3 15/16 | VGSEVO9280      | 660                                                                               | 217            | 660            | 217             | 442                                                                               | 146            | 442            | 146             | 1732                                                                                | 5 5/16                                                                              | 7       |
|                                                                                   |      |         | VGSEVO11300     | 710                                                                               | 234            | 710            | 252             | 476                                                                               | 157            | 476            | 169             | 2263                                                                                | 6 1/2                                                                               | 9       |
|                                                                                   |      |         | VGSEVO13300     | 795                                                                               | 319            | 795            | 351             | 533                                                                               | 214            | 533            | 235             | 3111                                                                                | 7 11/16                                                                             | 11      |
|                                                                                   | 140  | 5 1/2   | VGSEVO11400     | 1051                                                                              | 234            | 1051           | 252             | 704                                                                               | 157            | 704            | 169             | 2263                                                                                | 6 1/2                                                                               | 9       |
|                                                                                   |      |         | VGSEVO13400     | 1182                                                                              | 319            | 1182           | 351             | 792                                                                               | 214            | 792            | 235             | 3111                                                                                | 7 11/16                                                                             | 11      |
|                                                                                   | 175  | 6 7/8   | VGSEVO11500     | 1352                                                                              | 234            | 1352           | 252             | 906                                                                               | 157            | 906            | 169             | 2263                                                                                | 6 1/2                                                                               | 9       |
|                                                                                   |      |         | VGSEVO13500     | 1523                                                                              | 319            | 1523           | 351             | 1020                                                                              | 214            | 1020           | 235             | 3111                                                                                | 7 11/16                                                                             | 11      |
| 7 PLY                                                                             | 140  | 5 1/2   | VGSEVO11400     | 1054                                                                              | 234            | 1054           | 252             | 706                                                                               | 157            | 706            | 169             | 2263                                                                                | 6 1/2                                                                               | 9       |
|                                                                                   |      |         | VGSEVO13400     | 1185                                                                              | 319            | 1185           | 351             | 794                                                                               | 214            | 794            | 235             | 3111                                                                                | 7 11/16                                                                             | 11      |
|                                                                                   | 191  | 7 1/2   | VGSEVO11500     | 1369                                                                              | 234            | 1369           | 252             | 918                                                                               | 157            | 918            | 169             | 2263                                                                                | 6 1/2                                                                               | 9       |
|                                                                                   |      |         | VGSEVO13500     | 1561                                                                              | 319            | 1561           | 351             | 1046                                                                              | 214            | 1046           | 235             | 3111                                                                                | 7 11/16                                                                             | 11      |
|                                                                                   | 244  | 9 5/8   | VGSEVO13700     | 2134                                                                              | 319            | 2134           | 351             | 1430                                                                              | 214            | 1430           | 235             | 3111                                                                                | 7 11/16                                                                             | 11      |
| 9 PLY                                                                             | 280  | 11      | VGSEVO13800     | 2481                                                                              | 319            | 2481           | 351             | 1662                                                                              | 214            | 1662           | 235             | 3111                                                                                | 7 11/16                                                                             | 11      |
|                                                                                   |      |         | VGSEVO11500     | 1398                                                                              | 234            | 1398           | 252             | 937                                                                               | 157            | 937            | 169             | 2263                                                                                | 6 1/2                                                                               | 9       |
|                                                                                   | 267  | 10 1/2  | VGSEVO13500     | 1575                                                                              | 319            | 1575           | 351             | 1055                                                                              | 214            | 1055           | 235             | 3111                                                                                | 7 11/16                                                                             | 11      |
|                                                                                   |      |         | VGSEVO13800     | 2351                                                                              | 319            | 2351           | 351             | 1575                                                                              | 214            | 1575           | 235             | 3111                                                                                | 7 11/16                                                                             | 11      |

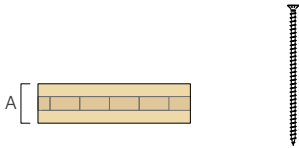
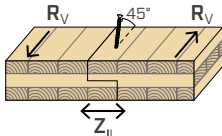
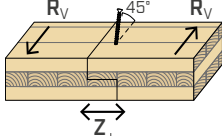
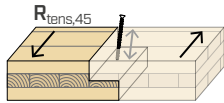
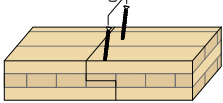
NOTES and GENERAL PRINCIPLES on page 219.

## CLT | BUTT JOINT (double 45° inclination)

|                                                                                   |             |         |                 | SHEAR                                                                             |                                                                                    | SPACING                                                                             |         |        |
|-----------------------------------------------------------------------------------|-------------|---------|-----------------|-----------------------------------------------------------------------------------|------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|---------|--------|
| geometry                                                                          |             |         |                 | butt joint                                                                        | steel tension                                                                      | fastener in a row                                                                   |         |        |
|  |             |         |                 |  |  |  |         |        |
| panel thickness = A                                                               |             |         | suggested screw | R <sub>V</sub>                                                                    | R <sub>tens,45+45</sub>                                                            | minimum                                                                             | typical |        |
| [mm]      [in]                                                                    |             | CODE    | [lbF]           | [lbF]                                                                             | [in]                                                                               | [in]                                                                                |         |        |
| 3 PLY                                                                             | 79          | 3 1/8   | VGSEVO11100     | 105                                                                               | 1600                                                                               | 6 1/2                                                                               | 9       |        |
|                                                                                   | 105         | 4 1/8   | VGSEVO9120      | 124                                                                               | 1225                                                                               | 5 5/16                                                                              | 7       |        |
|                                                                                   | 120         | 4 3/4   | VGSEVO9160      | 179                                                                               | 1225                                                                               | 5 5/16                                                                              | 7       |        |
|                                                                                   |             |         | VGSEVO11150     | 180                                                                               | 1600                                                                               | 6 1/2                                                                               | 9       |        |
| 5 PLY                                                                             | 100         | 3 15/16 | VGSEVO9120      | 124                                                                               | 1225                                                                               | 5 5/16                                                                              | 7       |        |
|                                                                                   | 140         | 5 1/2   | VGSEVO9160      | 179                                                                               | 1225                                                                               | 5 5/16                                                                              | 7       |        |
|                                                                                   |             |         | VGSEVO11150     | 180                                                                               | 1600                                                                               | 6 1/2                                                                               | 9       |        |
|                                                                                   |             |         | VGSEVO9200      | 234                                                                               | 1225                                                                               | 5 5/16                                                                              | 7       |        |
|                                                                                   | 175         | 6 7/8   | VGSEVO11200     | 256                                                                               | 1600                                                                               | 6 1/2                                                                               | 9       |        |
|                                                                                   |             |         | VGSEVO13200     | 290                                                                               | 2200                                                                               | 7 11/16                                                                             | 11      |        |
|                                                                                   |             |         | 200             | 7 7/8                                                                             | VGSEVO9240                                                                         | 289                                                                                 | 1225    | 5 5/16 |
|                                                                                   | VGSEVO11250 | 331     |                 |                                                                                   | 1600                                                                               | 6 1/2                                                                               | 9       |        |
|                                                                                   | 140         | 5 1/2   | VGSEVO9160      | 179                                                                               | 1225                                                                               | 5 5/16                                                                              | 7       |        |
|                                                                                   |             |         | VGSEVO11150     | 180                                                                               | 1600                                                                               | 6 1/2                                                                               | 9       |        |
|                                                                                   |             | 191     | 7 1/2           | VGSEVO9240                                                                        | 289                                                                                | 1225                                                                                | 5 5/16  | 7      |
|                                                                                   |             |         |                 | VGSEVO11250                                                                       | 331                                                                                | 1600                                                                                | 6 1/2   | 9      |
| 7 PLY                                                                             | 244         | 9 5/8   | VGSEVO9320      | 400                                                                               | 1225                                                                               | 5 5/16                                                                              | 7       |        |
|                                                                                   |             |         | VGSEVO11300     | 406                                                                               | 1600                                                                               | 6 1/2                                                                               | 9       |        |
|                                                                                   |             |         | VGSEVO13300     | 460                                                                               | 2200                                                                               | 7 11/16                                                                             | 11      |        |
|                                                                                   | 280         | 11      | VGSEVO9360      | 455                                                                               | 1225                                                                               | 5 5/16                                                                              | 7       |        |
|                                                                                   |             |         | VGSEVO11350     | 481                                                                               | 1600                                                                               | 6 1/2                                                                               | 9       |        |
|                                                                                   | 180         | 7 1/16  | VGSEVO9240      | 289                                                                               | 1225                                                                               | 5 5/16                                                                              | 7       |        |
| VGSEVO11250                                                                       |             |         | 331             | 1600                                                                              | 6 1/2                                                                              | 9                                                                                   |         |        |
| 9 PLY                                                                             | 267         | 10 1/2  | VGSEVO9360      | 455                                                                               | 1225                                                                               | 5 5/16                                                                              | 7       |        |
|                                                                                   |             |         | VGSEVO11350     | 481                                                                               | 1600                                                                               | 6 1/2                                                                               | 9       |        |
|                                                                                   | 314         | 12 3/8  | VGSEVO11400     | 556                                                                               | 1600                                                                               | 6 1/2                                                                               | 9       |        |
|                                                                                   |             |         | VGSEVO13400     | 630                                                                               | 2200                                                                               | 7 11/16                                                                             | 11      |        |
|                                                                                   | 360         | 14 3/16 | VGSEVO11500     | 707                                                                               | 1600                                                                               | 6 1/2                                                                               | 9       |        |
|                                                                                   |             |         | VGSEVO13500     | 801                                                                               | 2200                                                                               | 7 11/16                                                                             | 11      |        |

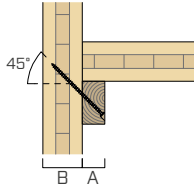
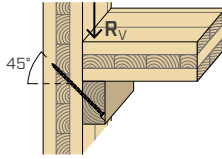
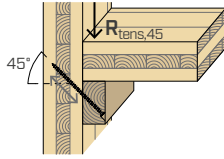
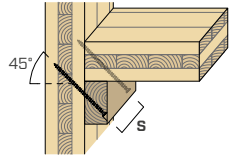
NOTES and GENERAL PRINCIPLES on page 219.

## CLT | HALF LAP

|                                                                                   |      |                    | SHEAR                                                                             |                 |                                                                                   |                |                                                                                     | SPACING                                                                             |         |    |
|-----------------------------------------------------------------------------------|------|--------------------|-----------------------------------------------------------------------------------|-----------------|-----------------------------------------------------------------------------------|----------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|---------|----|
| geometry                                                                          |      |                    | half lap<br>orientation 1                                                         |                 | half lap<br>orientation 2                                                         |                | steel tension                                                                       | fastener<br>in a row                                                                |         |    |
|  |      |                    |  |                 |  |                |  |  |         |    |
| panel thickness<br>(wall/floor) = A                                               |      | suggested<br>screw | R <sub>v</sub>                                                                    | Z <sub>II</sub> | R <sub>v</sub>                                                                    | Z <sub>⊥</sub> | R <sub>tens,45</sub>                                                                | minimum                                                                             | typical |    |
| [mm]                                                                              | [in] | CODE               | [lbf]                                                                             | [lbf]           | [lbf]                                                                             | [lbf]          | [lbf]                                                                               | [in]                                                                                | [in]    |    |
| 3 PLY                                                                             | 79   | 3 1/8              | VGSEVO11100                                                                       | 191             | 262                                                                               | 191            | 151                                                                                 | 2263                                                                                | 6 1/2   | 9  |
|                                                                                   | 105  | 4 1/8              | VGSEVO9120                                                                        | 217             | 242                                                                               | 217            | 194                                                                                 | 1732                                                                                | 5 5/16  | 7  |
|                                                                                   | 120  | 4 3/4              | VGSEVO9160                                                                        | 345             | 272                                                                               | 345            | 217                                                                                 | 1732                                                                                | 5 5/16  | 7  |
|                                                                                   |      |                    | VGSEVO11150                                                                       | 364             | 344                                                                               | 364            | 232                                                                                 | 2263                                                                                | 6 1/2   | 9  |
| 5 PLY                                                                             | 100  | 3 15/16            | VGSEVO9120                                                                        | 236             | 251                                                                               | 236            | 201                                                                                 | 1732                                                                                | 5 5/16  | 7  |
|                                                                                   | 140  | 5 1/2              | VGSEVO9160                                                                        | 302             | 272                                                                               | 302            | 217                                                                                 | 1732                                                                                | 5 5/16  | 7  |
|                                                                                   |      |                    | VGSEVO11150                                                                       | 279             | 344                                                                               | 279            | 213                                                                                 | 2263                                                                                | 6 1/2   | 9  |
|                                                                                   | 175  | 6 7/8              | VGSEVO9200                                                                        | 387             | 272                                                                               | 387            | 217                                                                                 | 1732                                                                                | 5 5/16  | 7  |
|                                                                                   |      |                    | VGSEVO11200                                                                       | 433             | 344                                                                               | 433            | 234                                                                                 | 2263                                                                                | 6 1/2   | 9  |
|                                                                                   |      |                    | VGSEVO13200                                                                       | 500             | 493                                                                               | 500            | 319                                                                                 | 3111                                                                                | 7 11/16 | 11 |
|                                                                                   | 200  | 7 7/8              | VGSEVO9240                                                                        | 510             | 272                                                                               | 510            | 217                                                                                 | 1732                                                                                | 5 5/16  | 7  |
|                                                                                   |      |                    | VGSEVO11250                                                                       | 628             | 344                                                                               | 628            | 234                                                                                 | 2263                                                                                | 6 1/2   | 9  |
| 7 PLY                                                                             | 140  | 5 1/2              | VGSEVO9160                                                                        | 301             | 272                                                                               | 301            | 217                                                                                 | 1732                                                                                | 5 5/16  | 7  |
|                                                                                   |      |                    | VGSEVO11150                                                                       | 278             | 344                                                                               | 278            | 213                                                                                 | 2263                                                                                | 6 1/2   | 9  |
|                                                                                   | 191  | 7 1/2              | VGSEVO9240                                                                        | 548             | 272                                                                               | 548            | 217                                                                                 | 1732                                                                                | 5 5/16  | 7  |
|                                                                                   |      |                    | VGSEVO11250                                                                       | 668             | 344                                                                               | 668            | 234                                                                                 | 2263                                                                                | 6 1/2   | 9  |
|                                                                                   | 244  | 9 5/8              | VGSEVO9320                                                                        | 781             | 272                                                                               | 781            | 217                                                                                 | 1732                                                                                | 5 5/16  | 7  |
|                                                                                   |      |                    | VGSEVO11300                                                                       | 740             | 344                                                                               | 740            | 234                                                                                 | 2263                                                                                | 6 1/2   | 9  |
|                                                                                   |      |                    | VGSEVO13300                                                                       | 848             | 493                                                                               | 848            | 319                                                                                 | 3111                                                                                | 7 11/16 | 11 |
|                                                                                   | 280  | 11                 | VGSEVO9360                                                                        | 864             | 272                                                                               | 864            | 217                                                                                 | 1732                                                                                | 5 5/16  | 7  |
| VGSEVO11350                                                                       |      |                    | 892                                                                               | 344             | 892                                                                               | 234            | 2263                                                                                | 6 1/2                                                                               | 9       |    |
| 9 PLY                                                                             | 180  | 7 1/16             | VGSEVO9240                                                                        | 581             | 272                                                                               | 581            | 217                                                                                 | 1732                                                                                | 5 5/16  | 7  |
|                                                                                   |      |                    | VGSEVO11250                                                                       | 624             | 344                                                                               | 624            | 234                                                                                 | 2263                                                                                | 6 1/2   | 9  |
|                                                                                   | 267  | 10 1/2             | VGSEVO9360                                                                        | 916             | 272                                                                               | 916            | 217                                                                                 | 1732                                                                                | 5 5/16  | 7  |
|                                                                                   |      |                    | VGSEVO11350                                                                       | 949             | 344                                                                               | 949            | 234                                                                                 | 2263                                                                                | 6 1/2   | 9  |
|                                                                                   | 314  | 12 3/8             | VGSEVO11400                                                                       | 1048            | 344                                                                               | 1048           | 234                                                                                 | 2263                                                                                | 6 1/2   | 9  |
|                                                                                   |      |                    | VGSEVO13400                                                                       | 1197            | 493                                                                               | 1197           | 319                                                                                 | 3111                                                                                | 7 11/16 | 11 |
|                                                                                   | 360  | 14 3/16            | VGSEVO11500                                                                       | 1398            | 344                                                                               | 1398           | 234                                                                                 | 2263                                                                                | 6 1/2   | 9  |
|                                                                                   |      |                    | VGSEVO13500                                                                       | 1575            | 493                                                                               | 1575           | 319                                                                                 | 3111                                                                                | 7 11/16 | 11 |

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## CLT | LEDGER CONNECTION

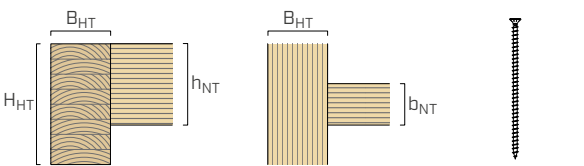
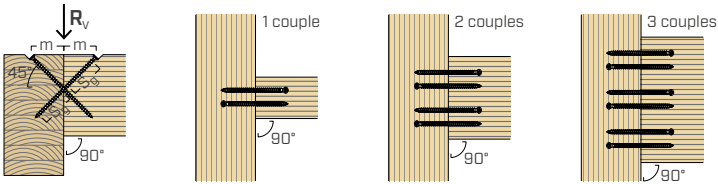
|                                                                                   |      |                                    |                 |                | SHEAR                                                                             |                                                                                    | SPACING                                                                             |    |
|-----------------------------------------------------------------------------------|------|------------------------------------|-----------------|----------------|-----------------------------------------------------------------------------------|------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|----|
| geometry                                                                          |      |                                    |                 |                | CLT-to-ledger                                                                     | steel tension                                                                      | fastener in a row                                                                   |    |
|  |      |                                    |                 |                |  |  |  |    |
| main member thickness (wall) = B                                                  |      | side member thickness (ledger) = A | suggested screw | R <sub>v</sub> | R <sub>tens,45</sub>                                                              | minimum                                                                            | typical                                                                             |    |
| [mm]                                                                              | [in] | [in]                               | CODE            | [lbf]          | [lbf]                                                                             | [in]                                                                               | [in]                                                                                |    |
| 3 PLY                                                                             | 60   | 2 3/8                              | 1 3/4           | VGSEVO9120     | 340                                                                               | 1732                                                                               | 1 3/4                                                                               | 7  |
|                                                                                   | 79   | 3 1/8                              | 1 3/4           | VGSEVO9120     | 340                                                                               | 1732                                                                               | 1 3/4                                                                               | 7  |
|                                                                                   | 105  | 4 1/8                              | 1 3/4           | VGSEVO9120     | 340                                                                               | 1732                                                                               | 1 3/4                                                                               | 7  |
|                                                                                   | 120  | 4 3/4                              | 1 3/4           | VGSEVO9160     | 340                                                                               | 1732                                                                               | 1 3/4                                                                               | 7  |
|                                                                                   |      |                                    | 1 3/4           | VGSEVO11150    | 362                                                                               | 2263                                                                               | 2 3/16                                                                              | 9  |
| 5 PLY                                                                             | 100  | 3 15/16                            | 1 3/4           | VGSEVO9120     | 340                                                                               | 1732                                                                               | 1 3/4                                                                               | 7  |
|                                                                                   |      |                                    | 1 3/4           | VGSEVO11150    | 362                                                                               | 2263                                                                               | 2 3/16                                                                              | 9  |
|                                                                                   | 140  | 5 1/2                              | 3 1/2           | VGSEVO9280     | 786                                                                               | 1732                                                                               | 1 3/4                                                                               | 7  |
|                                                                                   |      |                                    | 3 1/2           | VGSEVO11250    | 830                                                                               | 2263                                                                               | 2 3/16                                                                              | 9  |
|                                                                                   | 175  | 6 7/8                              | 5 1/4           | VGSEVO9360     | 1050                                                                              | 1732                                                                               | 1 3/4                                                                               | 7  |
|                                                                                   |      |                                    | 5 1/4           | VGSEVO11350    | 1078                                                                              | 2263                                                                               | 2 3/16                                                                              | 9  |
|                                                                                   |      |                                    | 5 1/4           | VGSEVO13400    | 1488                                                                              | 3111                                                                               | 2 9/16                                                                              | 11 |
|                                                                                   | 200  | 7 7/8                              | 5 1/4           | VGSEVO9360     | 1050                                                                              | 1732                                                                               | 1 3/4                                                                               | 7  |
|                                                                                   |      |                                    | 5 1/4           | VGSEVO11400    | 1314                                                                              | 2263                                                                               | 2 3/16                                                                              | 9  |
| 5 1/4                                                                             |      |                                    | VGSEVO13400     | 1488           | 3111                                                                              | 2 9/16                                                                             | 11                                                                                  |    |
| 7 PLY                                                                             | 140  | 5 1/2                              | 3 1/2           | VGSEVO9240     | 700                                                                               | 1732                                                                               | 1 3/4                                                                               | 7  |
|                                                                                   |      |                                    | 3 1/2           | VGSEVO11250    | 830                                                                               | 2263                                                                               | 2 3/16                                                                              | 9  |
|                                                                                   |      |                                    | 3 1/2           | VGSEVO13300    | 949                                                                               | 3111                                                                               | 2 9/16                                                                              | 11 |
|                                                                                   | 191  | 7 1/2                              | 5 1/4           | VGSEVO11400    | 1314                                                                              | 2263                                                                               | 2 3/16                                                                              | 9  |
|                                                                                   |      |                                    | 5 1/4           | VGSEVO13400    | 1488                                                                              | 3111                                                                               | 2 9/16                                                                              | 11 |
|                                                                                   | 244  | 9 5/8                              | 6 1/2           | VGSEVO11500    | 1654                                                                              | 2263                                                                               | 2 3/16                                                                              | 9  |
|                                                                                   |      |                                    | 6 1/2           | VGSEVO13500    | 1873                                                                              | 3111                                                                               | 2 9/16                                                                              | 11 |
| 280                                                                               | 11   | 6 1/2                              | VGSEVO11500     | 1654           | 2263                                                                              | 2 3/16                                                                             | 9                                                                                   |    |
|                                                                                   |      | 6 1/2                              | VGSEVO13500     | 1873           | 3111                                                                              | 2 9/16                                                                             | 11                                                                                  |    |

GENERAL PRINCIPLES and CONNECTIONS GENERAL NOTES on page 219.

### NOTES

- Ledger Specific Gravity is considered as  $G = 0.49$ .
- The thread axial resistance to withdrawal has been evaluated considering an effective thread length equal to  $S_g$ . The connectors must be inserted at  $45^\circ$  with respect to the shear plane.
- Force-to-fastener angle is considered as  $45^\circ$ .
- The use of the JIG VGZ 45 template is recommended for professional installation of the connectors in this application.

## WOOD | CROSSED SCREW CONNECTION

| geometry                                                                          |              |              |                 | crossed screws                                                                     |                   |              |                |               |
|-----------------------------------------------------------------------------------|--------------|--------------|-----------------|------------------------------------------------------------------------------------|-------------------|--------------|----------------|---------------|
|  |              |              |                 |  |                   |              |                |               |
| $H_{HT,min}$<br>$h_{NT,min}$                                                      | $B_{HT,min}$ | $b_{NT,min}$ | suggested screw | $m$                                                                                | number of couples | $R_v$        |                | $R_{tens,45}$ |
| [in]                                                                              | [in]         | [in]         | CODE            | [in]                                                                               |                   | SPF<br>[lbf] | D.Fir<br>[lbf] | [lbf]         |
| 6                                                                                 | 3 1/8        | 3 1/8        | VGSEVO9200      | 2 15/16                                                                            | 1                 | 956          | 1108           | 3465          |
|                                                                                   |              | 3 1/2        |                 |                                                                                    | 2                 | 1911         | 2215           | 6930          |
|                                                                                   |              | 5 1/8        |                 |                                                                                    | 3                 | 2867         | 3323           | 10394         |
|                                                                                   |              | 3 1/2        | VGSEVO11200     | 2 15/16                                                                            | 1                 | 1042         | 1181           | 4525          |
|                                                                                   |              | 5 1/8        |                 |                                                                                    | 2                 | 2085         | 2363           | 9051          |
|                                                                                   |              | 5 1/2        |                 |                                                                                    | 3                 | 3127         | 3544           | 13576         |
| 7 1/2                                                                             | 3 1/2        | 3 1/2        | VGSEVO9240      | 3 3/4                                                                              | 1                 | 1168         | 1354           | 3465          |
|                                                                                   |              | 5 1/8        |                 |                                                                                    | 2                 | 2336         | 2707           | 6930          |
|                                                                                   |              | 5 1/2        |                 |                                                                                    | 3                 | 3504         | 4061           | 10394         |
|                                                                                   |              | 5 1/8        | VGSEVO11250     | 3 9/16                                                                             | 1                 | 1351         | 1531           | 4525          |
|                                                                                   |              | 5 1/2        |                 |                                                                                    | 2                 | 2703         | 3063           | 9051          |
|                                                                                   |              | 6 3/4        |                 |                                                                                    | 3                 | 4054         | 4594           | 13576         |
| 9                                                                                 | 5 1/8        | 3 1/2        | VGSEVO9280      | 4 5/16                                                                             | 1                 | 1398         | 1620           | 3465          |
|                                                                                   |              | 5 1/8        |                 |                                                                                    | 2                 | 2796         | 3241           | 6930          |
|                                                                                   |              | 5 1/2        |                 |                                                                                    | 3                 | 4194         | 4861           | 10394         |
|                                                                                   |              | 5 1/8        | VGSEVO11300     | 4 5/16                                                                             | 1                 | 1641         | 1860           | 4525          |
|                                                                                   |              | 5 1/2        |                 |                                                                                    | 2                 | 3282         | 3719           | 9051          |
|                                                                                   |              | 6 3/4        |                 |                                                                                    | 3                 | 4923         | 5579           | 13576         |
| 10 1/2                                                                            | 5 1/2        | 3 1/2        | VGSEVO9360      | 5 1/8                                                                              | 1                 | 1840         | 2133           | 3465          |
|                                                                                   |              | 5 1/8        |                 |                                                                                    | 2                 | 3681         | 4266           | 6930          |
|                                                                                   |              | 5 1/2        |                 |                                                                                    | 3                 | 5521         | 6399           | 10394         |
|                                                                                   |              | 5 1/8        | VGSEVO11350     | 5                                                                                  | 1                 | 1930         | 2188           | 4525          |
|                                                                                   |              | 5 1/2        |                 |                                                                                    | 2                 | 3861         | 4376           | 9051          |
|                                                                                   |              | 6 3/4        |                 |                                                                                    | 3                 | 5791         | 6563           | 13576         |
| 12                                                                                | 6 3/4        | 5 1/8        | VGSEVO11400     | 5 11/16                                                                            | 1                 | 2239         | 2538           | 4525          |
|                                                                                   |              | 5 1/2        |                 |                                                                                    | 2                 | 4479         | 5076           | 9051          |
|                                                                                   |              | 6 3/4        |                 |                                                                                    | 3                 | 6718         | 7614           | 13576         |
| 13 1/2                                                                            | 6 3/4        | 5 1/8        | VGSEVO11500     | 6 13/16                                                                            | 1                 | 2857         | 3238           | 4525          |
|                                                                                   |              | 5 1/2        |                 |                                                                                    | 2                 | 5714         | 6476           | 9051          |
|                                                                                   |              | 6 3/4        |                 |                                                                                    | 3                 | 8571         | 9714           | 13576         |
| 15                                                                                | 7 1/2        | 5 1/8        | VGSEVO11500     | 7 1/2                                                                              | 1                 | 2857         | 3238           | 4525          |
|                                                                                   |              | 5 1/2        |                 |                                                                                    | 2                 | 5714         | 6476           | 9051          |
|                                                                                   |              | 6 3/4        |                 |                                                                                    | 3                 | 8571         | 9714           | 13576         |
| 16 1/2                                                                            | 9            | 5 1/8        | VGSEVO11500     | 8 3/16                                                                             | 1                 | 2857         | 3238           | 4525          |
|                                                                                   |              | 5 1/2        |                 |                                                                                    | 2                 | 5714         | 6476           | 9051          |
|                                                                                   |              | 6 3/4        |                 |                                                                                    | 3                 | 8571         | 9714           | 13576         |
| 18                                                                                | 9            | 5 1/8        | VGSEVO11600     | 8 7/16                                                                             | 1                 | 3475         | 3938           | 4525          |
|                                                                                   |              | 5 1/2        |                 |                                                                                    | 2                 | 6949         | 7876           | 9051          |
|                                                                                   |              | 6 3/4        |                 |                                                                                    | 3                 | 10424        | 11814          | 13576         |

GENERAL PRINCIPLES and CONNECTIONS GENERAL NOTES on page 219.

### NOTES

- The thread axial resistance to withdrawal has been evaluated considering an effective thread length equal to  $S_g$ . The connectors must be inserted at 45° with respect to the shear plane.
- The connector compression design strength is the lower between the withdrawal-side design strength and the instability design strength.
- Force-to-fastener angle is considered as 45°.
- The use of the JIG VGZ 45 template is recommended for professional installation of the connectors in this application.

## 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.
- VGZ screws must be installed and used in dry in-service conditions in accordance with the NDS (wet service factor for connection CM is 1.0).
- VGZ screws must be positioned in accordance with the minimum distances.
- In the case of combined axial and shear forces on a screw, for the determination of the load-bearing capacity refer to the Hankinson formula found in the NDS section 12.4.1.

## REFERENCE LATERAL DESIGN VALUES

- Tabulated values are determined from the yield model equations in the corresponding Section of the NDS.
- Unless otherwise noted, the screw is intended to be inserted half in the main member and half in the side 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  $k_a$ :

$$W_a = W_{ref} \cdot k_a \cdot L_{eff}$$

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;
- $k_a$  factor is calculated as:

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

- $\alpha$  is the angle between the grain direction and screw axis. Tabulated values at page 212 are valid for  $L_{eff}$  equal to the screw thread length  $b$  minus the tip length  $L_t$  and  $k_a = 1$  for  $\alpha = 90^\circ$ ,  $k_a = 0.91$  for  $\alpha = 45^\circ$ ,  $k_a = 0.3$  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  $\alpha < 15^\circ$ .
- The reference withdrawal design values must be inferior to  $f_{tens}$  of the screw.

## REFERENCE WITHDRAWAL DESIGN VALUES

For fully-threaded screws the head pull-through resistance is not relevant for the connection resistance, thread withdrawal is governing. These values must be compared with the tensile resistance of the screw; the lower value is the governing one.

## SLIDING RESISTANCE

- Unless otherwise noted, the screws are intended to be inserted half in the main member and half in the side member.
- The 45° inclined screw is intended to work in withdrawal and the resulting resistance of the connection is given by the projection of the withdrawal resistance (along screw axis) onto the shear plane.
- The design values must be inferior to  $f_{tens}$  of the screw projected onto the shear plane.

## CONNECTIONS

### GENERAL NOTES

- Designed connections must respect all requirements on general principles and minimum distances.
- Calculations comply with the NDS in accordance with ESR 4645.
- Tabulated values, that are referred to a single fastener, are valid for Allowable Stress Design (ASD) considering a standard loading ( $C_D = 1.0$ ).
- Timber element specific gravity is considered as  $G = 0.42$ , unless otherwise noted.
- $Z_{\parallel}$ : 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.
- $R_y$ : withdrawal resistance of the screws projected on the shear force axis.
- 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°.

## FLOOR-TO-BEAM | FLOOR-TO-WALL

- The main grain direction of the CLT floor panel is considered both parallel and perpendicular to the beam's axis or wall plane.
- The main grain direction of the CLT wall panel is always considered as vertical.
- The threaded part of the screw has been always considered inserted in the central layer of the CLT panel.
- 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 (FLOOR-TO-WALL).
- Beam element can be considered both solid wood or glulam.
- 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.
- The CLT side  $R_y$  resistance is calculated taking into account a screw-to-grain angle as the lowest between the involved layers. In this case the considered angle is 45°.

## BUTT JOINT

- Force-to-fastener angle is considered to be 60°. The geometry of the joint requires that the connectors be inserted at an angle of 45° with respect to the face of the CLT panel, and at an angle of 45° with respect to the shear plane between the two panels.
- An end grain coefficient  $C_{eg} = 0.67$  is considered for the withdrawal resistance calculation due to fastener in narrow edge of CLT.
- Reported values represent the shear resistance of the connection along the shear plane for a single fastener.
- The proposed screw's length does not exceed the total thickness of the connection.
- The use of the JIG VGZ 45 template is recommended to ensure precise installation of the connectors in this application.

## HALF LAP

- The main grain direction of the CLT floor panel is considered both parallel and perpendicular to the machining's direction.
- Force-to-fastener angle is considered as 45°. The screws are considered inserted at an angle of 45° with respect to the face of the CLT panel in the machining's direction. In this direction the screw is intended to work in withdrawal. In the opposite direction the screws are intended to work in shear.
- 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.
- $R_y$  resistance is calculated by taking into account the screw-to-grain angle as the lowest among the involved layers. In this case, the angle considered is 45°.