

# VGZ EVO



## FULLY THREADED SCREW WITH CYLINDRICAL HEAD

### C4 EVO COATING

Multilayer coating with a 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.

### AUTOCLAVE-TREATED TIMBER

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

### STRUCTURAL APPLICATIONS

Deep thread and high resistance steel for excellent tensile performance. Approved for structural applications subject to stresses in any direction vs the grain (0° - 90°). Reduced minimum distances.

### CYLINDRICAL HEAD

It allows the screw to penetrate and pass through the surface of the wood substrate. Ideal for concealed joints, timber couplings and structural reinforcements. It is the right choice for increased fire performance.

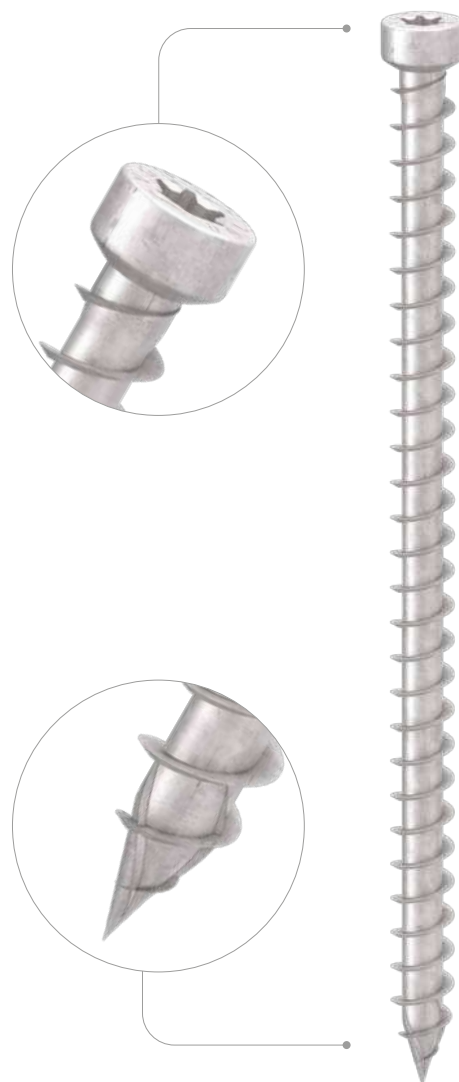


VIDEO



BIT INCLUDED

|                         |                                                            |
|-------------------------|------------------------------------------------------------|
| DIAMETER [mm]           | 5 <b>5</b> 11 11                                           |
| LENGTH [mm]             | 80 <b>80</b> 600 1000                                      |
| SERVICE CONDITION       | <b>EC1</b> <b>EC3</b>                                      |
| ATMOSPHERIC CORROSIVITY | <b>C1</b> <b>C2</b> <b>C3</b> <b>C4</b>                    |
| WOOD CORROSIVITY        | <b>T1</b> <b>T2</b> <b>T3</b>                              |
| MATERIAL                | <b>C4</b><br>EVO COATING carbon steel with C4 EVO coating  |
| CORE HARDNESS           | <b>&lt;390 HV</b> as required in CSA 086:24 <sup>(1)</sup> |



CANADIAN DESIGN VALUES

USA, EU and more design values available online.



### FIELDS OF USE

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

<sup>(1)</sup> Core hardness < 390 HV guaranteed for structural timber screws diameter 6 mm and above).



## TRUSS & RAFTER JOINTS

Ideal for joining small timber elements such as the crossbeams and uprights of light frame structures. Certified for application parallel to the grain and with reduced minimum distances.



Fastening Wood Trusses outdoors.



Fastening the uprights of light frame structures with VGZ EVO Ø5 mm.

## ■ GEOMETRY AND MECHANICAL CHARACTERISTICS



### GEOMETRY

| Nominal diameter                          | $d_1$     | [mm] | 5,3  | 5,6  | 7    | 9     | 11    |
|-------------------------------------------|-----------|------|------|------|------|-------|-------|
| Head diameter                             | $d_K$     | [mm] | 8,00 | 8,00 | 9,50 | 11,50 | 13,50 |
| Root diameter                             | $d_2$     | [mm] | 3,60 | 3,80 | 4,60 | 5,90  | 6,60  |
| Pre-drilling hole diameter <sup>(1)</sup> | $d_{V,S}$ | [mm] | 3,5  | 3,5  | 4,0  | 5,0   | 6,0   |
| Pre-drilling hole diameter <sup>(2)</sup> | $d_{V,H}$ | [mm] | 4,0  | 4,0  | 5,0  | 6,0   | 7,0   |

<sup>(1)</sup> Pre-drilling valid for softwood.

<sup>(2)</sup> Pre-drilling valid for hardwood and beech LVL.

### MECHANICAL PARAMETERS

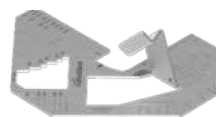
| Nominal diameter                                                                | d <sub>1</sub>  | [mm]   | 5,3    | 5,6   | 7     | 9     | 11    |       |
|---------------------------------------------------------------------------------|-----------------|--------|--------|-------|-------|-------|-------|-------|
| Factored tensile strength                                                       | Φf <sub>u</sub> | [kN]   | 7,49   | 8,08  | 10,64 | 17,84 | 23,17 |       |
| Bending yield strength                                                          | F <sub>yb</sub> | [MPa]  | 1021   | 1021  | 1111  | 1069  | 1026  |       |
| Factored shear strength of the screw                                            | Φv <sub>s</sub> | [kN]   | 3,91   | 4,36  | 6,38  | 10,50 | 13,14 |       |
| Specified withdrawal resistance per millimeter of threaded shank (tip included) | Y <sub>w</sub>  | [N/mm] | G=0.35 | 55,43 | 58,56 | 61,1  | 78,56 | 96,02 |
|                                                                                 |                 |        | G=0.42 | 64,13 | 67,76 | 70,7  | 90,9  | 111,1 |
|                                                                                 |                 |        | G=0.49 | 72,55 | 76,56 | 79,98 | 102,8 | 125,7 |
|                                                                                 |                 |        | G=0.55 | 79,57 | 84,07 | 87,72 | 112,8 | 137,9 |

## CODES AND DIMENSIONS

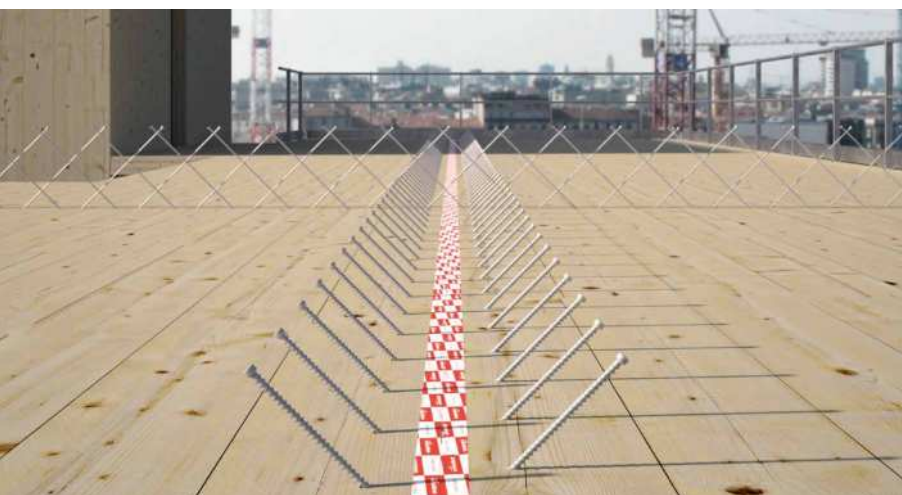
| d <sub>1</sub><br>[mm] | CODE       | L<br>[mm] | b<br>[mm] | pcs |
|------------------------|------------|-----------|-----------|-----|
| 5,3<br>TX 25           | VGZEVO580  | 80        | 70        | 50  |
|                        | VGZEVO5100 | 100       | 90        | 50  |
|                        | VGZEVO5120 | 120       | 110       | 50  |
| 5,6<br>TX 25           | VGZEVO5140 | 140       | 130       | 50  |
|                        | VGZEVO5150 | 150       | 140       | 50  |
|                        | VGZEVO5160 | 160       | 150       | 50  |
| 7<br>TX 30             | VGZEVO780  | 80        | 70        | 50  |
|                        | VGZEVO7100 | 100       | 90        | 50  |
|                        | VGZEVO7120 | 120       | 110       | 50  |
|                        | VGZEVO7140 | 140       | 130       | 50  |
|                        | VGZEVO7160 | 160       | 150       | 50  |
|                        | VGZEVO7180 | 180       | 170       | 50  |
|                        | VGZEVO7200 | 200       | 190       | 50  |
|                        | VGZEVO7220 | 220       | 210       | 50  |
|                        | VGZEVO7240 | 240       | 230       | 50  |
|                        | VGZEVO7260 | 260       | 250       | 50  |
|                        | VGZEVO7280 | 280       | 270       | 50  |
|                        | VGZEVO7300 | 300       | 290       | 50  |
|                        | VGZEVO7340 | 340       | 330       | 50  |
|                        | VGZEVO7380 | 380       | 370       | 50  |
| 9<br>TX 40             | VGZEVO9160 | 160       | 150       | 50  |
|                        | VGZEVO9180 | 180       | 170       | 50  |
|                        | VGZEVO9200 | 200       | 190       | 50  |
|                        | VGZEVO9220 | 220       | 210       | 50  |
|                        | VGZEVO9240 | 240       | 230       | 50  |
|                        | VGZEVO9260 | 260       | 250       | 50  |
|                        | VGZEVO9280 | 280       | 270       | 50  |
|                        | VGZEVO9300 | 300       | 290       | 50  |
|                        | VGZEVO9320 | 320       | 310       | 25  |
|                        | VGZEVO9340 | 340       | 330       | 25  |
|                        | VGZEVO9360 | 360       | 350       | 25  |
|                        | VGZEVO9380 | 380       | 370       | 25  |
|                        | VGZEVO9400 | 400       | 390       | 25  |
|                        | VGZEVO9440 | 440       | 430       | 25  |
|                        | VGZEVO9480 | 480       | 470       | 25  |
|                        | VGZEVO9520 | 520       | 510       | 25  |

| d <sub>1</sub><br>[mm] | CODE        | L<br>[mm] | b<br>[mm] | pcs |
|------------------------|-------------|-----------|-----------|-----|
| 11<br>TX 50            | VGZEVO11250 | 250       | 240       | 25  |
|                        | VGZEVO11300 | 300       | 290       | 25  |
|                        | VGZEVO11350 | 350       | 340       | 25  |
|                        | VGZEVO11400 | 400       | 390       | 25  |
|                        | VGZEVO11450 | 450       | 440       | 25  |
|                        | VGZEVO11500 | 500       | 490       | 25  |
|                        | VGZEVO11550 | 550       | 540       | 25  |
|                        | VGZEVO11600 | 600       | 590       | 25  |

## RELATED PRODUCTS



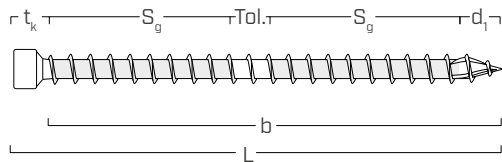
**JIG VGZ 4**  
TEMPLATE FOR 45° SCREWS



## OUTDOOR STRUCTURAL PERFORMANCE

Values also tested, certified and calculated for CLT and high density woods such as Microllam® LVL. Ideal for fastening timber-framed panels and lattice beams (Rafter, Truss).

## EFFECTIVE THREAD USED IN CALCULATION



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

represents the entire length of the threaded part (see table above)

$$S_g = (b - d_1 - Tol.) / 2$$

represents the partial length of the threaded part net of a laying tolerance (Tol.) of 10 mm

$t_k = 10$  mm or 20 mm depending on screw length.

### NOTES

- The length of the tip is equal to the nominal diameter of the respective fasteners,  $d_1$ , as specified in the ELC-4645 report.

## MINIMUM DISTANCES FOR AXIAL STRESSES | TIMBER

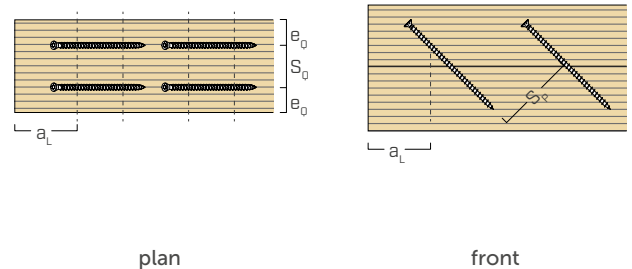
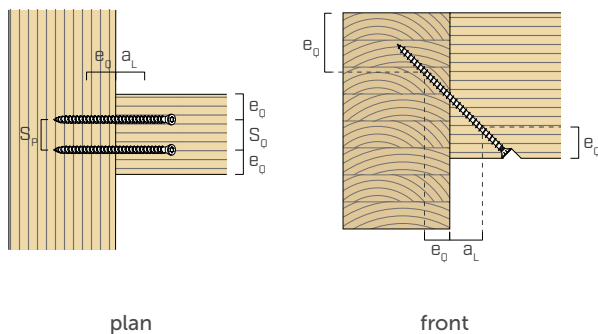


screws inserted **WITH and WITHOUT** pre-drilled hole

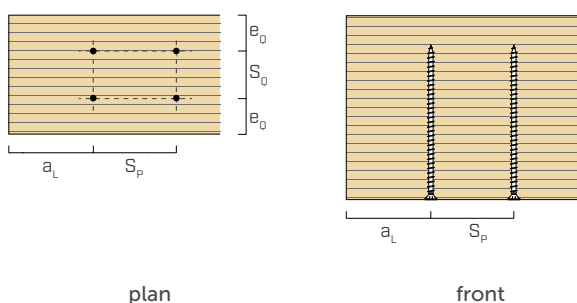
| $d_1$ |                         | <b>5,3</b><br>[mm] | <b>0.21</b><br>[in] | <b>5,6</b><br>[mm] | <b>0.23</b><br>[in] | <b>7</b><br>[mm] | <b>0.28</b><br>[in] | <b>9</b><br>[mm] | <b>0.36</b><br>[in] | <b>11</b><br>[mm] | <b>0.44</b><br>[in] |
|-------|-------------------------|--------------------|---------------------|--------------------|---------------------|------------------|---------------------|------------------|---------------------|-------------------|---------------------|
| $S_p$ | <b>7·d<sup>†</sup></b>  | 37                 | 1 7/16              | 40                 | 1 9/16              | 49               | 1 15/16             | 63               | 2 1/2               | 77                | 3 1/16              |
| $S_Q$ | <b>5·d</b>              | 27                 | 1 1/16              | 28                 | 1 1/8               | 35               | 1 3/8               | 45               | 1 3/4               | 55                | 2 3/16              |
| $a_L$ | <b>10·d<sup>†</sup></b> | 53                 | 2 1/16              | 56                 | 2 3/16              | 70               | 2 3/4               | 90               | 3 1/2               | 110               | 4 3/8               |
| $a$   | <b>7·d<sup>†</sup></b>  | 37                 | 1 7/16              | 40                 | 1 9/16              | 49               | 1 15/19             | 63               | 2 1/2               | 77                | 3 1/16              |
| $e_Q$ | <b>4·d</b>              | 22                 | 7/8                 | 23                 | 7/8                 | 28               | 1 1/8               | 36               | 1 7/16              | 44                | 1 3/4               |

† For Douglas Fir–Larch and Western Red Cedar, this minimum spacing shall be increased by 50%.

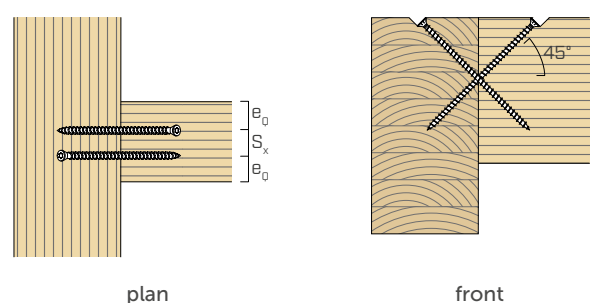
### SCREWS UNDER TENSION INSERTED WITH AN ANGLE $\alpha$ WITH RESPECT TO THE GRAIN



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

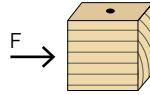


### CROSSED SCREWS INSERTED WITH AN ANGLE $\alpha$ WITH RESPECT TO THE GRAIN



## MINIMUM DISTANCES FOR SHEAR LOADS | TIMBER

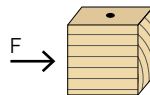
screws inserted **WITHOUT** pre-drilled hole  $G \leq 0.44$



| $d_1$ |                   | 5,3<br>[mm] | 0.21<br>[in] | 5,6<br>[mm] | 0.23<br>[in] | 7<br>[mm] | 0.28<br>[in] | 9<br>[mm] | 0.36<br>[in] | 11<br>[mm] | 0.44<br>[in] |
|-------|-------------------|-------------|--------------|-------------|--------------|-----------|--------------|-----------|--------------|------------|--------------|
| $S_p$ | 12·d <sup>†</sup> | 64          | 2 1/2        | 68          | 2 11/16      | 84        | 3 5/16       | 108       | 4 1/4        | 132        | 5 3/16       |
| $S_Q$ | 5·d               | 27          | 1 1/16       | 28          | 1 1/8        | 35        | 1 3/8        | 45        | 1 3/4        | 55         | 2 3/16       |
| $a_L$ | 15·d <sup>†</sup> | 80          | 3 1/8        | 84          | 3 5/16       | 105       | 4 1/8        | 135       | 5 5/16       | 165        | 6 1/2        |
| $a$   | 10·d <sup>†</sup> | 53          | 2 1/16       | 56          | 2 3/16       | 70        | 2 3/4        | 90        | 3 1/2        | 110        | 4 3/8        |
| $e_Q$ | 10·d              | 53          | 2 1/16       | 56          | 2 3/16       | 70        | 2 3/4        | 90        | 3 1/2        | 110        | 4 3/8        |
| $e_p$ | 5·d               | 27          | 1 1/16       | 28          | 1 1/8        | 35        | 1 3/8        | 45        | 1 3/4        | 55         | 2 3/16       |
| $S_x$ | 2·d               | 11          | 7/16         | 12          | 1/2          | 14        | 9/16         | 18        | 11/16        | 22         | 7/8          |

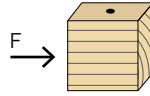
<sup>†</sup> For Western Red Cedar, this minimum spacing shall be increased by 50%.

screws inserted **WITHOUT** pre-drilled hole  $0.44 < G \leq 0.50$



| $d_1$ |      | 5,3<br>[mm] | 0.21<br>[in] | 5,6<br>[mm] | 0.23<br>[in] | 7<br>[mm] | 0.28<br>[in] | 9<br>[mm] | 0.36<br>[in] | 11<br>[mm] | 0.44<br>[in] |
|-------|------|-------------|--------------|-------------|--------------|-----------|--------------|-----------|--------------|------------|--------------|
| $S_p$ | 18·d | 96          | 3 3/4        | 101         | 4            | 126       | 4 15/16      | 162       | 6 3/8        | 198        | 7 13/16      |
| $S_Q$ | 7·d  | 37          | 1 7/16       | 40          | 1 9/16       | 49        | 1 15/16      | 63        | 2 1/2        | 77         | 3 1/16       |
| $a_L$ | 22·d | 117         | 4 5/8        | 124         | 4 7/8        | 154       | 6 1/16       | 198       | 7 13/16      | 242        | 9 1/2        |
| $a$   | 15·d | 80          | 3 1/8        | 84          | 3 5/16       | 105       | 4 1/8        | 135       | 5 5/16       | 165        | 6 1/2        |
| $e_Q$ | 12·d | 64          | 2 1/2        | 68          | 2 11/16      | 84        | 3 5/16       | 108       | 4 1/4        | 132        | 5 3/16       |
| $e_p$ | 7·d  | 37          | 1 7/16       | 40          | 1 9/16       | 49        | 1 15/16      | 63        | 2 1/2        | 77         | 3 1/16       |
| $S_x$ | 3·d  | 16          | 5/8          | 17          | 11/16        | 21        | 13/16        | 27        | 1 1/16       | 33         | 1 5/16       |

screws inserted **WITH** pre-drilled hole

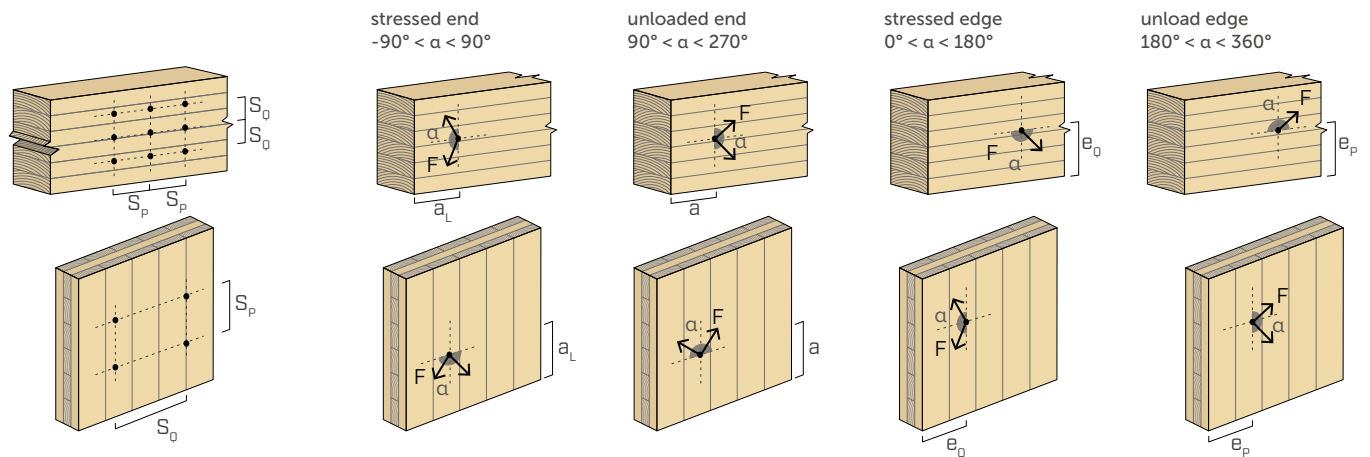


| $d_1$ |                   | 5,3<br>[mm] | 0.21<br>[in] | 5,6<br>[mm] | 0.23<br>[in] | 7<br>[mm] | 0.28<br>[in] | 9<br>[mm] | 0.36<br>[in] | 11<br>[mm] | 0.44<br>[in] |
|-------|-------------------|-------------|--------------|-------------|--------------|-----------|--------------|-----------|--------------|------------|--------------|
| $S_p$ | 5·d <sup>†</sup>  | 27          | 1 1/16       | 28          | 1 1/8        | 35        | 1 3/8        | 45        | 1 3/4        | 55         | 2 3/16       |
| $S_Q$ | 4·d               | 22          | 7/8          | 23          | 7/8          | 28        | 1 1/8        | 36        | 1 7/16       | 44         | 1 3/4        |
| $a_L$ | 12·d <sup>†</sup> | 64          | 2 1/2        | 68          | 2 11/16      | 84        | 3 5/16       | 108       | 4 1/4        | 132        | 5 3/16       |
| $a$   | 7·d <sup>†</sup>  | 37          | 1 7/16       | 40          | 1 9/16       | 49        | 1 15/16      | 63        | 2 1/2        | 77         | 3 1/16       |
| $e_Q$ | 7·d               | 37          | 1 7/16       | 40          | 1 9/16       | 49        | 1 15/16      | 63        | 2 1/2        | 77         | 3 1/16       |
| $e_p$ | 3·d               | 16          | 5/8          | 17          | 11/16        | 21        | 13/16        | 27        | 1 1/16       | 33         | 1 5/16       |
| $S_x$ | 1.5·d             | 8           | 5/16         | 9           | 3/8          | 11        | 7/6          | 14        | 9/16         | 17         | 11/16        |

<sup>†</sup> For Douglas Fir–Larch and Western Red Cedar, this minimum spacing shall be increased by 50%.

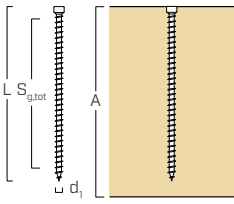
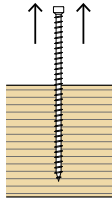
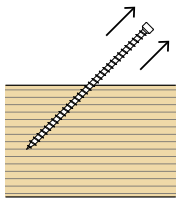
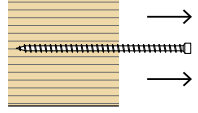
$d = d_1$  = nominal diameter of the screw

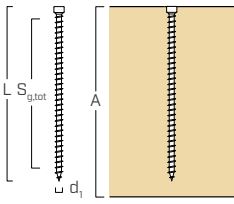
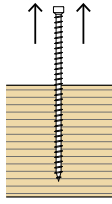
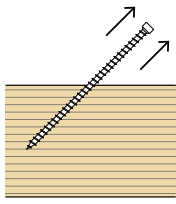
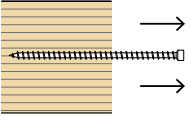
$\alpha$  = load-to-grain angle



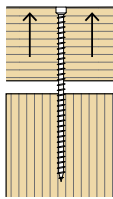
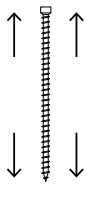
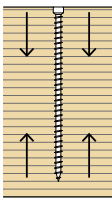
### NOTES

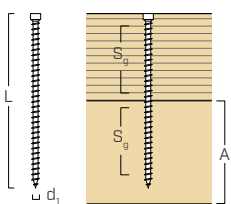
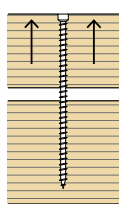
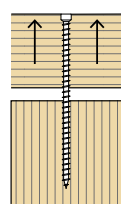
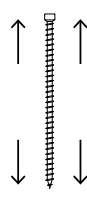
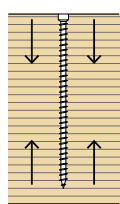
- The minimum spacing and distances comply with Clause 12.12.5 of CSA O86:24, where  $d_1$  refers to the nominal diameter of the self-tapping screw.
- The spacing, end, and edge distances for Rothoblaas screws installed in the narrow face of CLT panels shall comply with the specifications outlined in ETA-11/0030.
- The placement of fasteners subjected to axial loading shall be determined in accordance with Clause 12.12.5 of CSA O86:24.

| geometry                                                                          |      |        |             |           | TENSION/COMPRESSION <sup>(1)</sup>                                                |       |       |       |                                                                                    |       |       |       |                                                                                     |       |       |       |
|-----------------------------------------------------------------------------------|------|--------|-------------|-----------|-----------------------------------------------------------------------------------|-------|-------|-------|------------------------------------------------------------------------------------|-------|-------|-------|-------------------------------------------------------------------------------------|-------|-------|-------|
|                                                                                   |      |        |             |           | $\alpha = 90^\circ$                                                               |       |       |       | total thread withdrawal<br>$\alpha = 45^\circ$                                     |       |       |       | end grain $\alpha = 0^\circ$                                                        |       |       |       |
|  |      |        |             |           |  |       |       |       |  |       |       |       |  |       |       |       |
|                                                                                   |      |        |             |           | factored withdrawal resistance $P_{rw}$                                           |       |       |       | factored withdrawal resistance $P_{rw}$                                            |       |       |       | factored withdrawal resistance $P_{rw}^{(2)(3)}$                                    |       |       |       |
|                                                                                   |      |        |             |           | G                                                                                 |       |       |       | G                                                                                  |       |       |       | G                                                                                   |       |       |       |
| $d_1$                                                                             | L    |        | $S_{g,tot}$ | $A_{min}$ | 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]<br>[in]                                                                      | [mm] | [in]   | [mm]        | [mm]      | [kN]                                                                              | [kN]  | [kN]  | [kN]  | [kN]                                                                               | [kN]  | [kN]  | [kN]  | [kN]                                                                                | [kN]  | [kN]  | [kN]  |
| <b>5.3</b><br><b>0.21</b>                                                         | 80   | 3 1/8  | 65          | 90        | 2,52                                                                              | 2,92  | 3,30  | 3,62  | 2,29                                                                               | 2,65  | 3,00  | 3,29  | 1,26                                                                                | 1,46  | 1,65  | 1,81  |
|                                                                                   | 100  | 4      | 85          | 110       | 3,30                                                                              | 3,82  | 4,32  | 4,73  | 3,00                                                                               | 3,47  | 3,92  | 4,30  | 1,65                                                                                | 1,91  | 2,16  | 2,37  |
|                                                                                   | 120  | 4 3/4  | 105         | 130       | 4,07                                                                              | 4,71  | 5,33  | 5,85  | 3,70                                                                               | 4,29  | 4,85  | 5,32  | 2,04                                                                                | 2,36  | 2,67  | 2,92  |
| <b>5.6</b><br><b>0.23</b>                                                         | 140  | 5 1/2  | 125         | 150       | 5,12                                                                              | 5,93  | 6,70  | 7,36  | 4,66                                                                               | 5,39  | 6,09  | 6,69  | 2,56                                                                                | 2,96  | 3,35  | 3,68  |
|                                                                                   | 150  | 6      | 135         | 160       | 5,53                                                                              | 6,40  | 7,23  | 7,94  | 5,03                                                                               | 5,82  | 6,58  | 7,22  | 2,77                                                                                | 3,20  | 3,62  | 3,97  |
|                                                                                   | 160  | 6 1/4  | 145         | 170       | 5,94                                                                              | 6,88  | 7,77  | 8,53  | 5,40                                                                               | 6,25  | 7,06  | 7,76  | 2,97                                                                                | 3,44  | 3,89  | 4,27  |
| <b>7</b><br><b>0.28</b>                                                           | 80   | 3 1/8  | 63          | 90        | 2,69                                                                              | 3,12  | 3,53  | 3,87  | 2,45                                                                               | 2,83  | 3,21  | 3,52  | 1,35                                                                                | 1,56  | 1,76  | 1,93  |
|                                                                                   | 100  | 4      | 83          | 110       | 3,55                                                                              | 4,11  | 4,65  | 5,10  | 3,23                                                                               | 3,73  | 4,22  | 4,63  | 1,77                                                                                | 2,05  | 2,32  | 2,55  |
|                                                                                   | 120  | 4 3/4  | 103         | 130       | 4,41                                                                              | 5,10  | 5,77  | 6,32  | 4,00                                                                               | 4,63  | 5,24  | 5,75  | 2,20                                                                                | 2,55  | 2,88  | 3,16  |
|                                                                                   | 140  | 5 1/2  | 123         | 150       | 5,26                                                                              | 6,09  | 6,89  | 7,55  | 4,78                                                                               | 5,53  | 6,26  | 6,87  | 2,63                                                                                | 3,04  | 3,44  | 3,78  |
|                                                                                   | 160  | 6 1/4  | 143         | 170       | 6,12                                                                              | 7,08  | 8,01  | 8,78  | 5,56                                                                               | 6,43  | 7,28  | 7,98  | 3,06                                                                                | 3,54  | 4,00  | 4,39  |
|                                                                                   | 180  | 7 1/8  | 163         | 190       | 6,97                                                                              | 8,07  | 9,13  | 10,01 | 6,34                                                                               | 7,33  | 8,30  | 9,10  | 3,49                                                                                | 4,03  | 4,56  | 5,00  |
|                                                                                   | 200  | 8      | 183         | 210       | 7,83                                                                              | 9,06  | 10,25 | 11,24 | 7,12                                                                               | 8,23  | 9,31  | 10,22 | 3,91                                                                                | 4,53  | 5,12  | 5,62  |
|                                                                                   | 220  | 8 5/8  | 203         | 230       | 8,68                                                                              | 10,05 | 11,37 | 12,47 | 7,89                                                                               | 9,13  | 10,33 | 11,33 | 4,34                                                                                | 5,02  | 5,68  | 6,23  |
|                                                                                   | 240  | 9 1/2  | 223         | 250       | 9,54                                                                              | 11,04 | 12,48 | 13,69 | 8,67                                                                               | 10,03 | 11,35 | 12,45 | 4,77                                                                                | 5,52  | 6,24  | 6,85  |
|                                                                                   | 260  | 10 1/4 | 243         | 270       | 10,39                                                                             | 12,03 | 13,60 | 14,92 | 9,45                                                                               | 10,93 | 12,37 | 13,56 | 5,20                                                                                | 6,01  | 6,80  | 7,46  |
|                                                                                   | 280  | 11     | 263         | 290       | 11,25                                                                             | 13,02 | 14,72 | 16,15 | 10,23                                                                              | 11,83 | 13,39 | 14,68 | 5,62                                                                                | 6,51  | 7,36  | 8,07  |
|                                                                                   | 300  | 11 3/4 | 283         | 310       | 12,10                                                                             | 14,01 | 15,84 | 17,38 | 11,00                                                                              | 12,73 | 14,40 | 15,80 | 6,05                                                                                | 7,00  | 7,92  | 8,69  |
| <b>9</b><br><b>0.36</b>                                                           | 340  | 13 3/8 | 323         | 350       | 13,81                                                                             | 15,99 | 18,08 | 19,83 | 12,56                                                                              | 14,53 | 16,44 | 18,03 | 6,91                                                                                | 7,99  | 9,04  | 9,92  |
|                                                                                   | 380  | 15     | 363         | 390       | 15,53                                                                             | 17,96 | 20,32 | 22,29 | 14,11                                                                              | 16,33 | 18,48 | 20,26 | 7,76                                                                                | 8,98  | 10,16 | 11,14 |
|                                                                                   | 160  | 6 1/4  | 141         | 170       | 7,75                                                                              | 8,97  | 10,15 | 11,13 | 7,05                                                                               | 8,16  | 9,22  | 10,12 | 3,88                                                                                | 4,49  | 5,07  | 5,57  |
|                                                                                   | 180  | 7 1/8  | 161         | 190       | 8,85                                                                              | 10,24 | 11,59 | 12,71 | 8,05                                                                               | 9,31  | 10,53 | 11,56 | 4,43                                                                                | 5,12  | 5,79  | 6,36  |
|                                                                                   | 200  | 8      | 181         | 210       | 9,95                                                                              | 11,52 | 13,02 | 14,29 | 9,05                                                                               | 10,47 | 11,84 | 12,99 | 4,98                                                                                | 5,76  | 6,51  | 7,15  |
|                                                                                   | 220  | 8 5/8  | 201         | 230       | 11,05                                                                             | 12,79 | 14,46 | 15,87 | 10,05                                                                              | 11,63 | 13,15 | 14,43 | 5,53                                                                                | 6,39  | 7,23  | 7,94  |
|                                                                                   | 240  | 9 1/2  | 221         | 250       | 12,15                                                                             | 14,06 | 15,90 | 17,45 | 11,05                                                                              | 12,78 | 14,46 | 15,86 | 6,08                                                                                | 7,03  | 7,95  | 8,73  |
|                                                                                   | 260  | 10 1/4 | 241         | 270       | 13,25                                                                             | 15,33 | 17,34 | 19,03 | 12,05                                                                              | 13,94 | 15,77 | 17,30 | 6,63                                                                                | 7,67  | 8,67  | 9,51  |
|                                                                                   | 280  | 11     | 261         | 290       | 14,35                                                                             | 16,61 | 18,78 | 20,61 | 13,05                                                                              | 15,10 | 17,07 | 18,74 | 7,18                                                                                | 8,30  | 9,39  | 10,30 |
|                                                                                   | 300  | 11 3/4 | 281         | 310       | 15,45                                                                             | 17,88 | 20,22 | 22,19 | 14,05                                                                              | 16,25 | 18,38 | 20,17 | 7,73                                                                                | 8,94  | 10,11 | 11,09 |
|                                                                                   | 320  | 12 5/8 | 301         | 330       | 16,55                                                                             | 19,15 | 21,66 | 23,77 | 15,05                                                                              | 17,41 | 19,69 | 21,61 | 8,28                                                                                | 9,58  | 10,83 | 11,88 |
|                                                                                   | 340  | 13 3/8 | 321         | 350       | 17,65                                                                             | 20,43 | 23,10 | 25,35 | 16,05                                                                              | 18,57 | 21,00 | 23,04 | 8,83                                                                                | 10,21 | 11,55 | 12,67 |
|                                                                                   | 360  | 14 1/4 | 341         | 370       | 18,75                                                                             | 21,70 | 24,54 | 26,93 | 17,05                                                                              | 19,73 | 22,31 | 24,48 | 9,38                                                                                | 10,85 | 12,27 | 13,46 |
|                                                                                   | 380  | 15     | 361         | 390       | 19,85                                                                             | 22,97 | 25,98 | 28,50 | 18,05                                                                              | 20,88 | 23,62 | 25,91 | 9,93                                                                                | 11,49 | 12,99 | 14,25 |
|                                                                                   | 400  | 15 3/4 | 381         | 410       | 20,95                                                                             | 24,24 | 27,42 | 30,08 | 19,05                                                                              | 22,04 | 24,92 | 27,35 | 10,48                                                                               | 12,12 | 13,71 | 15,04 |
|                                                                                   | 440  | 17 1/4 | 421         | 450       | 23,15                                                                             | 26,79 | 30,30 | 33,24 | 21,05                                                                              | 24,35 | 27,54 | 30,22 | 11,58                                                                               | 13,39 | 15,15 | 16,62 |
|                                                                                   | 480  | 19     | 461         | 490       | 25,35                                                                             | 29,33 | 33,17 | 36,40 | 23,05                                                                              | 26,67 | 30,16 | 33,09 | 12,68                                                                               | 14,67 | 16,59 | 18,20 |
|                                                                                   | 520  | 20 1/2 | 501         | 530       | 27,55                                                                             | 31,88 | 36,05 | 39,56 | 25,05                                                                              | 28,98 | 32,77 | 35,96 | 13,78                                                                               | 15,94 | 18,03 | 19,78 |

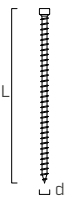
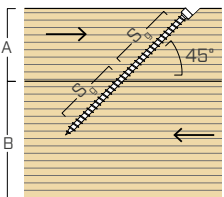
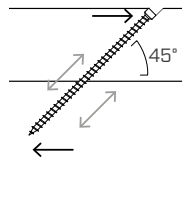
| geometry                                                                          |              |              |              |     | TENSION/COMPRESSION <sup>(1)</sup>                                                |       |       |       |                                                                                    |       |       |       |                                                                                     |       |       |       |
|-----------------------------------------------------------------------------------|--------------|--------------|--------------|-----|-----------------------------------------------------------------------------------|-------|-------|-------|------------------------------------------------------------------------------------|-------|-------|-------|-------------------------------------------------------------------------------------|-------|-------|-------|
|                                                                                   |              |              |              |     | $\alpha = 90^\circ$                                                               |       |       |       | total thread withdrawal<br>$\alpha = 45^\circ$                                     |       |       |       | end grain $\alpha = 0^\circ$                                                        |       |       |       |
|  |              |              |              |     |  |       |       |       |  |       |       |       |  |       |       |       |
|                                                                                   |              |              |              |     | factored withdrawal resistance $P_{rw}$                                           |       |       |       | factored withdrawal resistance $P_{rw}$                                            |       |       |       | factored withdrawal resistance $P_{rw}^{(2)(3)}$                                    |       |       |       |
|                                                                                   |              |              |              |     | G                                                                                 |       |       |       | G                                                                                  |       |       |       | G                                                                                   |       |       |       |
| $d_1$                                                                             | L            | $S_{g,tot}$  | $A_{min}$    |     | 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]<br>[in]                                                                      | [mm]<br>[in] | [mm]<br>[in] | [mm]<br>[in] |     | [kN]                                                                              | [kN]  | [kN]  | [kN]  | [kN]                                                                               | [kN]  | [kN]  | [kN]  | [kN]                                                                                | [kN]  | [kN]  | [kN]  |
| <b>11</b><br><b>0.44</b>                                                          | 250          | 10           | 229          | 260 | 15,39                                                                             | 17,81 | 20,15 | 22,11 | 13,99                                                                              | 16,19 | 18,32 | 20,10 | 7,70                                                                                | 8,90  | 10,07 | 11,05 |
|                                                                                   | 300          | 11 3/4       | 279          | 310 | 18,75                                                                             | 21,70 | 24,55 | 26,93 | 17,05                                                                              | 19,73 | 22,32 | 24,48 | 9,38                                                                                | 10,85 | 12,27 | 13,47 |
|                                                                                   | 350          | 13 3/4       | 329          | 360 | 22,11                                                                             | 25,59 | 28,95 | 31,76 | 20,10                                                                              | 23,26 | 26,32 | 28,87 | 11,06                                                                               | 12,79 | 14,47 | 15,88 |
|                                                                                   | 400          | 15 3/4       | 379          | 410 | 25,47                                                                             | 29,47 | 33,35 | 36,58 | 23,16                                                                              | 26,80 | 30,32 | 33,26 | 12,74                                                                               | 14,74 | 16,67 | 18,29 |
|                                                                                   | 450          | 17 3/4       | 429          | 460 | 28,83                                                                             | 33,36 | 37,75 | 41,41 | 26,21                                                                              | 30,33 | 34,32 | 37,65 | 14,42                                                                               | 16,68 | 18,87 | 20,71 |
|                                                                                   | 500          | 19 3/4       | 479          | 510 | 32,20                                                                             | 37,25 | 42,15 | 46,24 | 29,27                                                                              | 33,87 | 38,32 | 42,03 | 16,10                                                                               | 18,63 | 21,07 | 23,12 |
|                                                                                   | 550          | 21 5/8       | 529          | 560 | 35,56                                                                             | 41,14 | 46,55 | 51,06 | 32,32                                                                              | 37,40 | 42,32 | 46,42 | 17,78                                                                               | 20,57 | 23,27 | 25,53 |
|                                                                                   | 600          | 23 5/8       | 579          | 610 | 38,92                                                                             | 45,03 | 50,95 | 55,89 | 35,38                                                                              | 40,94 | 46,31 | 50,81 | 19,46                                                                               | 22,51 | 25,47 | 27,95 |

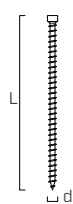
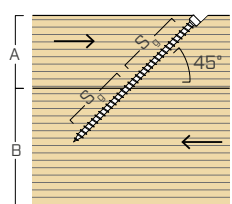
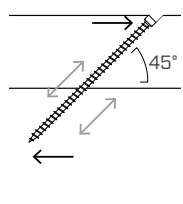
$\alpha$  = screw-to-grain angle

| geometry                  |      |        |               |                   | TENSION/COMPRESSION <sup>(1)</sup>                                                |       |       |       |                                                                                   |      |      |      |                                                                                     |                                                                                     |
|---------------------------|------|--------|---------------|-------------------|-----------------------------------------------------------------------------------|-------|-------|-------|-----------------------------------------------------------------------------------|------|------|------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|
|                           |      |        |               |                   | partial thread withdrawal<br>$\alpha = 90^\circ$                                  |       |       |       | end grain $\alpha = 0^\circ$                                                      |      |      |      | steel<br>tension                                                                    | buckling<br>$\alpha = 90^\circ$                                                     |
|                           |      |        |               |                   |  |       |       |       |  |      |      |      |  |  |
|                           |      |        |               |                   | factored withdrawal<br>resistance $P_{rw}$                                        |       |       |       | factored withdrawal<br>resistance $P_{rw}^{(2)(3)}$                               |      |      |      | factored tension<br>resistance $T_{rs}$                                             | factored buckling<br>resistance $P_{rb}$                                            |
| $d_1$<br>[mm]<br>[in]     | L    |        | $S_g$<br>[mm] | $A_{min}$<br>[mm] | G                                                                                 |       |       |       | G                                                                                 |      |      |      | [kN]                                                                                | [kN]                                                                                |
|                           | [mm] | [in]   |               |                   | 0.35                                                                              | 0.42  | 0.49  | 0.55  | 0.35                                                                              | 0.42 | 0.49 | 0.55 |                                                                                     |                                                                                     |
| <b>5.3</b><br><b>0.21</b> | 80   | 3 1/8  | 25            | 45                | 0,97                                                                              | 1,12  | 1,27  | 1,39  | 0,49                                                                              | 0,56 | 0,63 | 0,70 | 7,49                                                                                | 5,82                                                                                |
|                           | 100  | 4      | 35            | 55                | 1,36                                                                              | 1,57  | 1,78  | 1,95  | 0,68                                                                              | 0,79 | 0,89 | 0,97 |                                                                                     |                                                                                     |
|                           | 120  | 4 3/4  | 45            | 65                | 1,75                                                                              | 2,02  | 2,29  | 2,51  | 0,87                                                                              | 1,01 | 1,14 | 1,25 |                                                                                     |                                                                                     |
| <b>5.6</b><br><b>0.23</b> | 140  | 5 1/2  | 55            | 75                | 2,25                                                                              | 2,61  | 2,95  | 3,24  | 1,13                                                                              | 1,30 | 1,47 | 1,62 | 8,08                                                                                | 6,48                                                                                |
|                           | 150  | 6      | 60            | 80                | 2,46                                                                              | 2,85  | 3,22  | 3,53  | 1,23                                                                              | 1,42 | 1,61 | 1,77 |                                                                                     |                                                                                     |
|                           | 160  | 6 1/4  | 65            | 85                | 2,66                                                                              | 3,08  | 3,48  | 3,83  | 1,33                                                                              | 1,54 | 1,74 | 1,91 |                                                                                     |                                                                                     |
| <b>7</b><br><b>0.28</b>   | 80   | 3 1/8  | 25            | 45                | 1,07                                                                              | 1,24  | 1,40  | 1,54  | 0,53                                                                              | 0,62 | 0,70 | 0,77 | 10,64                                                                               | 10,34                                                                               |
|                           | 100  | 4      | 35            | 55                | 1,50                                                                              | 1,73  | 1,96  | 2,15  | 0,75                                                                              | 0,87 | 0,98 | 1,07 |                                                                                     |                                                                                     |
|                           | 120  | 4 3/4  | 45            | 65                | 1,92                                                                              | 2,23  | 2,52  | 2,76  | 0,96                                                                              | 1,11 | 1,26 | 1,38 |                                                                                     |                                                                                     |
|                           | 140  | 5 1/2  | 55            | 75                | 2,35                                                                              | 2,72  | 3,08  | 3,38  | 1,18                                                                              | 1,36 | 1,54 | 1,69 |                                                                                     |                                                                                     |
|                           | 160  | 6 1/4  | 65            | 85                | 2,78                                                                              | 3,22  | 3,64  | 3,99  | 1,39                                                                              | 1,61 | 1,82 | 2,00 |                                                                                     |                                                                                     |
|                           | 180  | 7 1/8  | 75            | 95                | 3,21                                                                              | 3,71  | 4,20  | 4,61  | 1,60                                                                              | 1,86 | 2,10 | 2,30 |                                                                                     |                                                                                     |
|                           | 200  | 8      | 85            | 105               | 3,64                                                                              | 4,21  | 4,76  | 5,22  | 1,82                                                                              | 2,10 | 2,38 | 2,61 |                                                                                     |                                                                                     |
|                           | 220  | 8 5/8  | 95            | 115               | 4,06                                                                              | 4,70  | 5,32  | 5,83  | 2,03                                                                              | 2,35 | 2,66 | 2,92 |                                                                                     |                                                                                     |
|                           | 240  | 9 1/2  | 105           | 125               | 4,49                                                                              | 5,20  | 5,88  | 6,45  | 2,25                                                                              | 2,60 | 2,94 | 3,22 |                                                                                     |                                                                                     |
|                           | 260  | 10 1/4 | 115           | 135               | 4,92                                                                              | 5,69  | 6,44  | 7,06  | 2,46                                                                              | 2,85 | 3,22 | 3,53 |                                                                                     |                                                                                     |
|                           | 280  | 11     | 125           | 145               | 5,35                                                                              | 6,19  | 7,00  | 7,68  | 2,67                                                                              | 3,09 | 3,50 | 3,84 |                                                                                     |                                                                                     |
|                           | 300  | 11 3/4 | 135           | 155               | 5,77                                                                              | 6,68  | 7,56  | 8,29  | 2,89                                                                              | 3,34 | 3,78 | 4,14 |                                                                                     |                                                                                     |
|                           | 340  | 13 3/8 | 155           | 175               | 6,63                                                                              | 7,67  | 8,68  | 9,52  | 3,31                                                                              | 3,84 | 4,34 | 4,76 |                                                                                     |                                                                                     |
|                           | 380  | 15     | 175           | 195               | 7,48                                                                              | 8,66  | 9,80  | 10,75 | 3,74                                                                              | 4,33 | 4,90 | 5,37 |                                                                                     |                                                                                     |
| <b>9</b><br><b>0.36</b>   | 160  | 6 1/4  | 65            | 85                | 3,57                                                                              | 4,14  | 4,68  | 5,13  | 1,79                                                                              | 2,07 | 2,34 | 2,57 | 17,84                                                                               | 16,37                                                                               |
|                           | 180  | 7 1/8  | 75            | 95                | 4,12                                                                              | 4,77  | 5,40  | 5,92  | 2,06                                                                              | 2,39 | 2,70 | 2,96 |                                                                                     |                                                                                     |
|                           | 200  | 8      | 85            | 105               | 4,67                                                                              | 5,41  | 6,12  | 6,71  | 2,34                                                                              | 2,70 | 3,06 | 3,36 |                                                                                     |                                                                                     |
|                           | 220  | 8 5/8  | 95            | 115               | 5,22                                                                              | 6,04  | 6,84  | 7,50  | 2,61                                                                              | 3,02 | 3,42 | 3,75 |                                                                                     |                                                                                     |
|                           | 240  | 9 1/2  | 105           | 125               | 5,77                                                                              | 6,68  | 7,56  | 8,29  | 2,89                                                                              | 3,34 | 3,78 | 4,15 |                                                                                     |                                                                                     |
|                           | 260  | 10 1/4 | 115           | 135               | 6,32                                                                              | 7,32  | 8,28  | 9,08  | 3,16                                                                              | 3,66 | 4,14 | 4,54 |                                                                                     |                                                                                     |
|                           | 280  | 11     | 125           | 145               | 6,87                                                                              | 7,95  | 9,00  | 9,87  | 3,44                                                                              | 3,98 | 4,50 | 4,94 |                                                                                     |                                                                                     |
|                           | 300  | 11 3/4 | 135           | 155               | 7,42                                                                              | 8,59  | 9,71  | 10,66 | 3,71                                                                              | 4,30 | 4,86 | 5,33 |                                                                                     |                                                                                     |
|                           | 320  | 12 5/8 | 145           | 165               | 7,97                                                                              | 9,23  | 10,43 | 11,45 | 3,99                                                                              | 4,61 | 5,22 | 5,72 |                                                                                     |                                                                                     |
|                           | 340  | 13 3/8 | 155           | 175               | 8,52                                                                              | 9,86  | 11,15 | 12,24 | 4,26                                                                              | 4,93 | 5,58 | 6,12 |                                                                                     |                                                                                     |
|                           | 360  | 14 1/4 | 165           | 185               | 9,07                                                                              | 10,50 | 11,87 | 13,03 | 4,54                                                                              | 5,25 | 5,94 | 6,51 |                                                                                     |                                                                                     |
|                           | 380  | 15     | 175           | 195               | 9,62                                                                              | 11,14 | 12,59 | 13,82 | 4,81                                                                              | 5,57 | 6,30 | 6,91 |                                                                                     |                                                                                     |
|                           | 400  | 15 3/4 | 185           | 205               | 10,17                                                                             | 11,77 | 13,31 | 14,61 | 5,09                                                                              | 5,89 | 6,66 | 7,30 |                                                                                     |                                                                                     |
|                           | 440  | 17 1/4 | 205           | 225               | 11,27                                                                             | 13,04 | 14,75 | 16,19 | 5,64                                                                              | 6,52 | 7,38 | 8,09 |                                                                                     |                                                                                     |
|                           | 480  | 19     | 225           | 245               | 12,37                                                                             | 14,32 | 16,19 | 17,77 | 6,19                                                                              | 7,16 | 8,10 | 8,88 |                                                                                     |                                                                                     |
|                           | 520  | 20 1/2 | 245           | 265               | 13,47                                                                             | 15,59 | 17,63 | 19,35 | 6,74                                                                              | 7,79 | 8,82 | 9,67 |                                                                                     |                                                                                     |

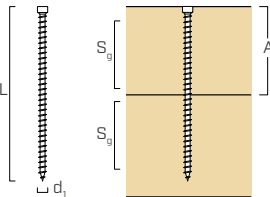
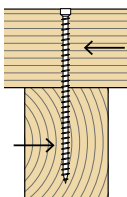
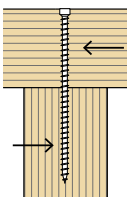
| geometry                                                                          |      |        |               |                   | TENSION/COMPRESSION <sup>(1)</sup>                                                |       |       |       |                                                                                   |       |       |       |                                                                                     |                                                                                     |
|-----------------------------------------------------------------------------------|------|--------|---------------|-------------------|-----------------------------------------------------------------------------------|-------|-------|-------|-----------------------------------------------------------------------------------|-------|-------|-------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|
|                                                                                   |      |        |               |                   | partial thread withdrawal<br>$\alpha = 90^\circ$                                  |       |       |       | end grain $\alpha = 0^\circ$                                                      |       |       |       | steel<br>tension                                                                    | buckling<br>$\alpha = 90^\circ$                                                     |
|  |      |        |               |                   |  |       |       |       |  |       |       |       |  |  |
|                                                                                   |      |        |               |                   | factored withdrawal<br>resistance $P_{rw}$                                        |       |       |       | factored withdrawal<br>resistance $P_{rw}^{(2)(3)}$                               |       |       |       | factored tension<br>resistance $T_{rs}$                                             | factored buckling<br>resistance $P_{rb}$                                            |
| $d_1$<br>[mm]<br>[in]                                                             | L    |        | $S_g$<br>[mm] | $A_{min}$<br>[mm] | G                                                                                 |       |       |       | G                                                                                 |       |       |       | [kN]                                                                                | [kN]                                                                                |
|                                                                                   | [mm] | [in]   |               |                   | 0.35                                                                              | 0.42  | 0.49  | 0.55  | 0.35                                                                              | 0.42  | 0.49  | 0.55  |                                                                                     |                                                                                     |
| <b>11</b><br><b>0.44</b>                                                          | 250  | 10     | 110           | 130               | 7,39                                                                              | 8,55  | 9,68  | 10,62 | 3,70                                                                              | 4,28  | 4,84  | 5,31  | 23,17                                                                               | 19,66                                                                               |
|                                                                                   | 300  | 11 3/4 | 135           | 155               | 9,07                                                                              | 10,50 | 11,88 | 13,03 | 4,54                                                                              | 5,25  | 5,94  | 6,52  |                                                                                     |                                                                                     |
|                                                                                   | 350  | 13 3/4 | 160           | 180               | 10,75                                                                             | 12,44 | 14,08 | 15,44 | 5,38                                                                              | 6,22  | 7,04  | 7,72  |                                                                                     |                                                                                     |
|                                                                                   | 400  | 15 3/4 | 185           | 205               | 12,43                                                                             | 14,39 | 16,28 | 17,86 | 6,22                                                                              | 7,19  | 8,14  | 8,93  |                                                                                     |                                                                                     |
|                                                                                   | 450  | 17 3/4 | 210           | 230               | 14,11                                                                             | 16,33 | 18,48 | 20,27 | 7,06                                                                              | 8,17  | 9,24  | 10,14 |                                                                                     |                                                                                     |
|                                                                                   | 500  | 19 3/4 | 235           | 255               | 15,80                                                                             | 18,28 | 20,68 | 22,68 | 7,90                                                                              | 9,14  | 10,34 | 11,34 |                                                                                     |                                                                                     |
|                                                                                   | 550  | 21 5/8 | 260           | 280               | 17,48                                                                             | 20,22 | 22,88 | 25,10 | 8,74                                                                              | 10,11 | 11,44 | 12,55 |                                                                                     |                                                                                     |
|                                                                                   | 600  | 23 5/8 | 285           | 305               | 19,16                                                                             | 22,16 | 25,08 | 27,51 | 9,58                                                                              | 11,08 | 12,54 | 13,76 |                                                                                     |                                                                                     |

$\alpha$  = screw-to-grain angle

|                                                                                   |      | SLIDING <sup>[4]</sup> |                                                                                   |      |                  |                                                           |       |       |                                                                                     |                                             |  |
|-----------------------------------------------------------------------------------|------|------------------------|-----------------------------------------------------------------------------------|------|------------------|-----------------------------------------------------------|-------|-------|-------------------------------------------------------------------------------------|---------------------------------------------|--|
| geometry                                                                          |      |                        | timber-to-timber                                                                  |      |                  |                                                           |       |       | steel tension                                                                       |                                             |  |
|  |      |                        |  |      |                  |                                                           |       |       |  |                                             |  |
|                                                                                   |      |                        |                                                                                   |      |                  | factored lateral resistance N <sub>r</sub> <sup>(5)</sup> |       |       |                                                                                     | factored tension resistance T <sub>rs</sub> |  |
| d <sub>1</sub>                                                                    | L    |                        | S <sub>g</sub>                                                                    | A    | B <sub>min</sub> | G                                                         |       |       |                                                                                     |                                             |  |
| <div>[mm]<br/>[in]</div>                                                          | [mm] | [in]                   | [mm]                                                                              | [mm] | [mm]             | 0.35                                                      | 0.42  | 0.49  | 0.55                                                                                | [kN]                                        |  |
|                                                                                   |      |                        |                                                                                   |      |                  | [kN]                                                      | [kN]  | [kN]  | [kN]                                                                                |                                             |  |
| <b>5.3</b><br><b>0.21</b>                                                         | 80   | 3 1/8                  | 25                                                                                | 35   | 50               | 0,75                                                      | 0,87  | 0,98  | 1,07                                                                                | 5,30                                        |  |
|                                                                                   | 100  | 4                      | 35                                                                                | 40   | 55               | 1,05                                                      | 1,21  | 1,37  | 1,50                                                                                |                                             |  |
|                                                                                   | 120  | 4 3/4                  | 45                                                                                | 45   | 60               | 1,35                                                      | 1,56  | 1,76  | 1,93                                                                                |                                             |  |
| <b>5.6</b><br><b>0.23</b>                                                         | 140  | 5 1/2                  | 55                                                                                | 55   | 70               | 1,74                                                      | 2,01  | 2,27  | 2,50                                                                                | 5,71                                        |  |
|                                                                                   | 150  | 6                      | 60                                                                                | 60   | 75               | 1,90                                                      | 2,20  | 2,48  | 2,72                                                                                |                                             |  |
|                                                                                   | 160  | 6 1/4                  | 65                                                                                | 60   | 75               | 2,06                                                      | 2,38  | 2,69  | 2,95                                                                                |                                             |  |
| <b>7</b><br><b>0.28</b>                                                           | 80   | 3 1/8                  | 25                                                                                | 35   | 50               | 0,82                                                      | 0,95  | 1,08  | 1,18                                                                                | 7,52                                        |  |
|                                                                                   | 100  | 4                      | 35                                                                                | 40   | 55               | 1,15                                                      | 1,34  | 1,51  | 1,66                                                                                |                                             |  |
|                                                                                   | 120  | 4 3/4                  | 45                                                                                | 45   | 60               | 1,48                                                      | 1,72  | 1,94  | 2,13                                                                                |                                             |  |
|                                                                                   | 140  | 5 1/2                  | 55                                                                                | 55   | 70               | 1,81                                                      | 2,10  | 2,38  | 2,61                                                                                |                                             |  |
|                                                                                   | 160  | 6 1/4                  | 65                                                                                | 60   | 75               | 2,14                                                      | 2,48  | 2,81  | 3,08                                                                                |                                             |  |
|                                                                                   | 180  | 7 1/8                  | 75                                                                                | 70   | 85               | 2,47                                                      | 2,86  | 3,24  | 3,55                                                                                |                                             |  |
|                                                                                   | 200  | 8                      | 85                                                                                | 75   | 90               | 2,80                                                      | 3,24  | 3,67  | 4,03                                                                                |                                             |  |
|                                                                                   | 220  | 8 5/8                  | 95                                                                                | 85   | 100              | 3,13                                                      | 3,63  | 4,10  | 4,50                                                                                |                                             |  |
|                                                                                   | 240  | 9 1/2                  | 105                                                                               | 90   | 105              | 3,46                                                      | 4,01  | 4,53  | 4,97                                                                                |                                             |  |
|                                                                                   | 260  | 10 1/4                 | 115                                                                               | 95   | 110              | 3,79                                                      | 4,39  | 4,97  | 5,45                                                                                |                                             |  |
|                                                                                   | 280  | 11                     | 125                                                                               | 105  | 120              | 4,12                                                      | 4,77  | 5,40  | 5,92                                                                                |                                             |  |
|                                                                                   | 300  | 11 3/4                 | 135                                                                               | 110  | 125              | 4,45                                                      | 5,15  | 5,83  | 6,39                                                                                |                                             |  |
| <b>9</b><br><b>0.36</b>                                                           | 340  | 13 3/8                 | 155                                                                               | 125  | 140              | 5,11                                                      | 5,92  | 6,69  | 7,34                                                                                | 12,61                                       |  |
|                                                                                   | 380  | 15                     | 175                                                                               | 140  | 155              | 5,77                                                      | 6,68  | 7,56  | 8,29                                                                                |                                             |  |
|                                                                                   | 160  | 6 1/4                  | 65                                                                                | 60   | 75               | 2,76                                                      | 3,19  | 3,61  | 3,96                                                                                |                                             |  |
|                                                                                   | 180  | 7 1/8                  | 75                                                                                | 70   | 85               | 3,18                                                      | 3,68  | 4,16  | 4,57                                                                                |                                             |  |
|                                                                                   | 200  | 8                      | 85                                                                                | 75   | 90               | 3,61                                                      | 4,17  | 4,72  | 5,18                                                                                |                                             |  |
|                                                                                   | 220  | 8 5/8                  | 95                                                                                | 85   | 100              | 4,03                                                      | 4,66  | 5,27  | 5,79                                                                                |                                             |  |
|                                                                                   | 240  | 9 1/2                  | 105                                                                               | 90   | 105              | 4,45                                                      | 5,15  | 5,83  | 6,40                                                                                |                                             |  |
|                                                                                   | 260  | 10 1/4                 | 115                                                                               | 95   | 110              | 4,88                                                      | 5,64  | 6,38  | 7,00                                                                                |                                             |  |
|                                                                                   | 280  | 11                     | 125                                                                               | 105  | 120              | 5,30                                                      | 6,14  | 6,94  | 7,61                                                                                |                                             |  |
|                                                                                   | 300  | 11 3/4                 | 135                                                                               | 110  | 125              | 5,73                                                      | 6,63  | 7,49  | 8,22                                                                                |                                             |  |
|                                                                                   | 320  | 12 5/8                 | 145                                                                               | 120  | 135              | 6,15                                                      | 7,12  | 8,05  | 8,83                                                                                |                                             |  |
|                                                                                   | 340  | 13 3/8                 | 155                                                                               | 125  | 140              | 6,58                                                      | 7,61  | 8,60  | 9,44                                                                                |                                             |  |
|                                                                                   | 360  | 14 1/4                 | 165                                                                               | 130  | 145              | 7,00                                                      | 8,10  | 9,16  | 10,05                                                                               |                                             |  |
|                                                                                   | 380  | 15                     | 175                                                                               | 140  | 155              | 7,42                                                      | 8,59  | 9,71  | 10,66                                                                               |                                             |  |
|                                                                                   | 400  | 15 3/4                 | 185                                                                               | 145  | 160              | 7,85                                                      | 9,08  | 10,27 | 11,27                                                                               |                                             |  |
|                                                                                   | 440  | 17 1/4                 | 205                                                                               | 160  | 175              | 8,70                                                      | 10,06 | 11,38 | 12,49                                                                               |                                             |  |
|                                                                                   | 480  | 19                     | 225                                                                               | 175  | 190              | 9,54                                                      | 11,04 | 12,49 | 13,70                                                                               |                                             |  |
|                                                                                   | 520  | 20 1/2                 | 245                                                                               | 190  | 205              | 10,39                                                     | 12,03 | 13,60 | 14,92                                                                               |                                             |  |

| SLIDING <sup>[4]</sup>                                                            |     |                   |                                                                                   |                        |           |                          |                                                           |              |              |                                                                                     |                                             |  |
|-----------------------------------------------------------------------------------|-----|-------------------|-----------------------------------------------------------------------------------|------------------------|-----------|--------------------------|-----------------------------------------------------------|--------------|--------------|-------------------------------------------------------------------------------------|---------------------------------------------|--|
| geometry                                                                          |     |                   | timber-to-timber                                                                  |                        |           |                          |                                                           |              |              | steel tension                                                                       |                                             |  |
|  |     |                   |  |                        |           |                          |                                                           |              |              |  |                                             |  |
| d <sub>1</sub><br>[mm]<br>[in]                                                    |     | L<br>[mm]<br>[in] |                                                                                   | S <sub>g</sub><br>[mm] | A<br>[mm] | B <sub>min</sub><br>[mm] | factored lateral resistance N <sub>r</sub> <sup>(5)</sup> |              |              |                                                                                     | factored tension resistance T <sub>rs</sub> |  |
|                                                                                   |     |                   |                                                                                   |                        |           |                          | G                                                         |              |              |                                                                                     | [kN]                                        |  |
|                                                                                   |     |                   |                                                                                   |                        |           |                          | 0.35<br>[kN]                                              | 0.42<br>[kN] | 0.49<br>[kN] | 0.55<br>[kN]                                                                        |                                             |  |
| 11<br>0.44                                                                        | 250 | 10                | 110                                                                               | 95                     | 110       | 5,70                     | 6,60                                                      | 7,47         | 8,19         | 16,38                                                                               |                                             |  |
|                                                                                   | 300 | 11 3/4            | 135                                                                               | 110                    | 125       | 7,00                     | 8,10                                                      | 9,16         | 10,05        |                                                                                     |                                             |  |
|                                                                                   | 350 | 13 3/4            | 160                                                                               | 130                    | 145       | 8,30                     | 9,60                                                      | 10,86        | 11,91        |                                                                                     |                                             |  |
|                                                                                   | 400 | 15 3/4            | 185                                                                               | 145                    | 160       | 9,59                     | 11,10                                                     | 12,56        | 13,78        |                                                                                     |                                             |  |
|                                                                                   | 450 | 17 3/4            | 210                                                                               | 165                    | 180       | 10,89                    | 12,60                                                     | 14,25        | 15,64        |                                                                                     |                                             |  |
|                                                                                   | 500 | 19 3/4            | 235                                                                               | 180                    | 195       | 12,18                    | 14,10                                                     | 15,95        | 17,50        |                                                                                     |                                             |  |
|                                                                                   | 550 | 21 5/8            | 260                                                                               | 200                    | 215       | 13,48                    | 15,60                                                     | 17,65        | 19,36        |                                                                                     |                                             |  |
|                                                                                   | 600 | 23 5/8            | 285                                                                               | 215                    | 230       | 14,78                    | 17,10                                                     | 19,34        | 21,22        |                                                                                     |                                             |  |

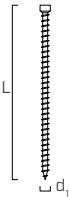
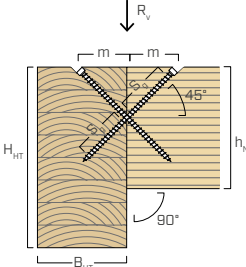
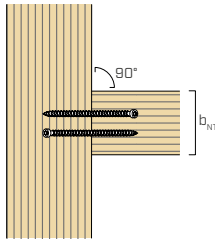
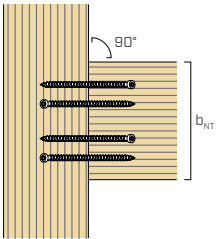
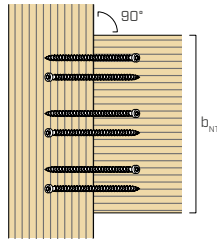
NOTES and GENERAL PRINCIPLES on page 26.

| geometry                                                                          |      |        |               |                   | SHEAR <sup>[6]</sup>                                                              |              |              |              |                                                                                     |              |              |              |
|-----------------------------------------------------------------------------------|------|--------|---------------|-------------------|-----------------------------------------------------------------------------------|--------------|--------------|--------------|-------------------------------------------------------------------------------------|--------------|--------------|--------------|
|                                                                                   |      |        |               |                   | timber-to-timber                                                                  |              |              |              |                                                                                     |              |              |              |
|                                                                                   |      |        |               |                   | $\alpha = 90^\circ$                                                               |              |              |              | $\alpha = 0^\circ$                                                                  |              |              |              |
|  |      |        |               |                   |  |              |              |              |  |              |              |              |
|                                                                                   |      |        |               |                   | factored lateral resistance $N_r$                                                 |              |              |              | factored lateral resistance $N_r^{(2)(3)}$                                          |              |              |              |
| $d_1$<br>[mm]<br>[in]                                                             | L    |        | $S_g$<br>[mm] | $A^{(7)}$<br>[mm] | G                                                                                 |              |              |              | G                                                                                   |              |              |              |
|                                                                                   | [mm] | [in]   |               |                   | 0.35<br>[kN]                                                                      | 0.42<br>[kN] | 0.49<br>[kN] | 0.55<br>[kN] | 0.35<br>[kN]                                                                        | 0.42<br>[kN] | 0.49<br>[kN] | 0.55<br>[kN] |
| <b>5.3</b><br><b>0.21</b>                                                         | 80   | 3 1/8  | 25            | 40                | 0,96                                                                              | 1,11         | 1,21         | 1,30         | 0,57                                                                                | 0,65         | 0,73         | 0,79         |
|                                                                                   | 100  | 4      | 35            | 50                | 1,10                                                                              | 1,22         | 1,34         | 1,44         | 0,66                                                                                | 0,75         | 0,84         | 0,92         |
|                                                                                   | 120  | 4 3/4  | 45            | 60                | 1,19                                                                              | 1,33         | 1,47         | 1,57         | 0,74                                                                                | 0,85         | 0,96         | 1,04         |
| <b>5.6</b><br><b>0.23</b>                                                         | 140  | 5 1/2  | 55            | 70                | 1,40                                                                              | 1,57         | 1,73         | 1,86         | 0,88                                                                                | 1,01         | 1,14         | 1,23         |
|                                                                                   | 150  | 6      | 60            | 75                | 1,45                                                                              | 1,63         | 1,79         | 1,93         | 0,93                                                                                | 1,06         | 1,18         | 1,27         |
|                                                                                   | 160  | 6 1/4  | 65            | 80                | 1,50                                                                              | 1,69         | 1,86         | 2,00         | 0,97                                                                                | 1,10         | 1,21         | 1,30         |
| <b>7</b><br><b>0.28</b>                                                           | 80   | 3 1/8  | 25            | 40                | 1,14                                                                              | 1,36         | 1,57         | 1,76         | 0,76                                                                                | 0,90         | 1,00         | 1,08         |
|                                                                                   | 100  | 4      | 35            | 50                | 1,47                                                                              | 1,74         | 1,98         | 2,11         | 0,90                                                                                | 1,02         | 1,13         | 1,23         |
|                                                                                   | 120  | 4 3/4  | 45            | 60                | 1,74                                                                              | 1,93         | 2,12         | 2,26         | 0,99                                                                                | 1,13         | 1,26         | 1,38         |
|                                                                                   | 140  | 5 1/2  | 55            | 70                | 1,84                                                                              | 2,06         | 2,26         | 2,42         | 1,09                                                                                | 1,25         | 1,40         | 1,52         |
|                                                                                   | 160  | 6 1/4  | 65            | 80                | 1,95                                                                              | 2,18         | 2,40         | 2,57         | 1,19                                                                                | 1,36         | 1,53         | 1,67         |
|                                                                                   | 180  | 7 1/8  | 75            | 90                | 2,06                                                                              | 2,30         | 2,54         | 2,73         | 1,29                                                                                | 1,47         | 1,66         | 1,79         |
|                                                                                   | 200  | 8      | 85            | 100               | 2,16                                                                              | 2,43         | 2,68         | 2,88         | 1,38                                                                                | 1,58         | 1,74         | 1,87         |
|                                                                                   | 220  | 8 5/8  | 95            | 110               | 2,27                                                                              | 2,55         | 2,82         | 3,03         | 1,47                                                                                | 1,65         | 1,81         | 1,94         |
|                                                                                   | 240  | 9 1/2  | 105           | 120               | 2,38                                                                              | 2,67         | 2,96         | 3,15         | 1,53                                                                                | 1,71         | 1,88         | 2,02         |
|                                                                                   | 260  | 10 1/4 | 115           | 130               | 2,49                                                                              | 2,75         | 2,97         | 3,15         | 1,58                                                                                | 1,77         | 1,95         | 2,10         |
|                                                                                   | 280  | 11     | 125           | 140               | 2,51                                                                              | 2,75         | 2,97         | 3,15         | 1,63                                                                                | 1,83         | 2,02         | 2,17         |
|                                                                                   | 300  | 11 3/4 | 135           | 150               | 2,51                                                                              | 2,75         | 2,97         | 3,15         | 1,69                                                                                | 1,89         | 2,09         | 2,25         |
| <b>9</b><br><b>0.36</b>                                                           | 340  | 13 3/8 | 155           | 170               | 2,51                                                                              | 2,75         | 2,97         | 3,15         | 1,79                                                                                | 2,02         | 2,23         | 2,38         |
|                                                                                   | 380  | 15     | 175           | 190               | 2,51                                                                              | 2,75         | 2,97         | 3,15         | 1,90                                                                                | 2,08         | 2,25         | 2,38         |
|                                                                                   | 160  | 6 1/4  | 65            | 80                | 2,85                                                                              | 3,17         | 3,48         | 3,73         | 1,61                                                                                | 1,83         | 2,05         | 2,23         |
|                                                                                   | 180  | 7 1/8  | 75            | 90                | 2,98                                                                              | 3,33         | 3,66         | 3,93         | 1,73                                                                                | 1,98         | 2,21         | 2,41         |
|                                                                                   | 200  | 8      | 85            | 100               | 3,12                                                                              | 3,49         | 3,84         | 4,13         | 1,85                                                                                | 2,12         | 2,38         | 2,59         |
|                                                                                   | 220  | 8 5/8  | 95            | 110               | 3,26                                                                              | 3,65         | 4,02         | 4,32         | 1,97                                                                                | 2,26         | 2,54         | 2,77         |
|                                                                                   | 240  | 9 1/2  | 105           | 120               | 3,40                                                                              | 3,81         | 4,20         | 4,52         | 2,09                                                                                | 2,40         | 2,70         | 2,90         |
|                                                                                   | 260  | 10 1/4 | 115           | 130               | 3,53                                                                              | 3,97         | 4,38         | 4,72         | 2,21                                                                                | 2,54         | 2,79         | 3,00         |
|                                                                                   | 280  | 11     | 125           | 140               | 3,67                                                                              | 4,13         | 4,56         | 4,90         | 2,33                                                                                | 2,62         | 2,88         | 3,09         |
|                                                                                   | 300  | 11 3/4 | 135           | 150               | 3,81                                                                              | 4,28         | 4,62         | 4,90         | 2,41                                                                                | 2,70         | 2,97         | 3,19         |
|                                                                                   | 320  | 12 5/8 | 145           | 160               | 3,91                                                                              | 4,28         | 4,62         | 4,90         | 2,48                                                                                | 2,78         | 3,06         | 3,29         |
|                                                                                   | 340  | 13 3/8 | 155           | 170               | 3,91                                                                              | 4,28         | 4,62         | 4,90         | 2,55                                                                                | 2,86         | 3,15         | 3,39         |
|                                                                                   | 360  | 14 1/4 | 165           | 180               | 3,91                                                                              | 4,28         | 4,62         | 4,90         | 2,62                                                                                | 2,94         | 3,24         | 3,49         |
|                                                                                   | 380  | 15     | 175           | 190               | 3,91                                                                              | 4,28         | 4,62         | 4,90         | 2,69                                                                                | 3,02         | 3,33         | 3,59         |
|                                                                                   | 400  | 15 3/4 | 185           | 200               | 3,91                                                                              | 4,28         | 4,62         | 4,90         | 2,76                                                                                | 3,10         | 3,42         | 3,69         |
|                                                                                   | 440  | 17 1/4 | 205           | 220               | 3,91                                                                              | 4,28         | 4,62         | 4,90         | 2,89                                                                                | 3,24         | 3,49         | 3,70         |
|                                                                                   | 480  | 19     | 225           | 240               | 3,91                                                                              | 4,28         | 4,62         | 4,90         | 2,95                                                                                | 3,24         | 3,49         | 3,70         |
|                                                                                   | 520  | 20 1/2 | 245           | 260               | 3,91                                                                              | 4,28         | 4,62         | 4,90         | 2,95                                                                                | 3,24         | 3,49         | 3,70         |

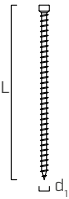
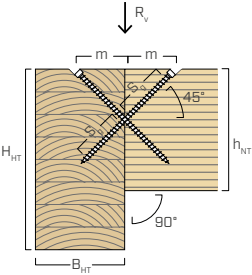
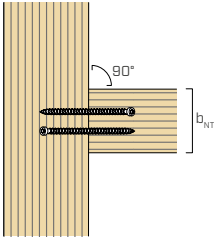
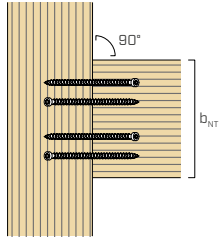
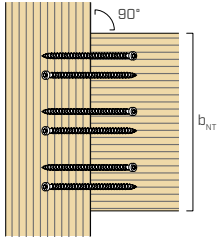
| geometry     |              |              |                  |     | SHEAR <sup>[6]</sup>              |      |      |      |                                            |      |      |      |
|--------------|--------------|--------------|------------------|-----|-----------------------------------|------|------|------|--------------------------------------------|------|------|------|
|              |              |              |                  |     | timber-to-timber                  |      |      |      |                                            |      |      |      |
|              |              |              |                  |     | $\alpha = 90^\circ$               |      |      |      | $\alpha = 0^\circ$                         |      |      |      |
|              |              |              |                  |     |                                   |      |      |      |                                            |      |      |      |
|              |              |              |                  |     | factored lateral resistance $N_r$ |      |      |      | factored lateral resistance $N_r^{(2)(3)}$ |      |      |      |
|              |              |              |                  |     | G                                 |      |      |      | G                                          |      |      |      |
| $d_1$        | L            | $S_g$        | A <sup>(7)</sup> |     | 0.35                              | 0.42 | 0.49 | 0.55 | 0.35                                       | 0.42 | 0.49 | 0.55 |
| [mm]<br>[in] | [mm]<br>[in] | [mm]<br>[in] | [mm]<br>[mm]     |     | [kN]                              | [kN] | [kN] | [kN] | [kN]                                       | [kN] | [kN] | [kN] |
| 11<br>0.44   | 250          | 10           | 110              | 125 | 4,26                              | 4,78 | 5,27 | 5,68 | 2,58                                       | 2,97 | 3,34 | 3,62 |
|              | 300          | 11 3/4       | 135              | 150 | 4,68                              | 5,27 | 5,75 | 6,09 | 2,94                                       | 3,31 | 3,65 | 3,92 |
|              | 350          | 13 3/4       | 160              | 175 | 4,86                              | 5,32 | 5,75 | 6,09 | 3,17                                       | 3,56 | 3,92 | 4,22 |
|              | 400          | 15 3/4       | 185              | 200 | 4,86                              | 5,32 | 5,75 | 6,09 | 3,38                                       | 3,80 | 4,20 | 4,52 |
|              | 450          | 17 3/4       | 210              | 225 | 4,86                              | 5,32 | 5,75 | 6,09 | 3,59                                       | 4,02 | 4,35 | 4,60 |
|              | 500          | 19 3/4       | 235              | 250 | 4,86                              | 5,32 | 5,75 | 6,09 | 3,67                                       | 4,02 | 4,35 | 4,60 |
|              | 550          | 21 5/8       | 260              | 275 | 4,86                              | 5,32 | 5,75 | 6,09 | 3,67                                       | 4,02 | 4,35 | 4,60 |
|              | 600          | 23 5/8       | 285              | 300 | 4,86                              | 5,32 | 5,75 | 6,09 | 3,67                                       | 4,02 | 4,35 | 4,60 |

$\alpha$  = screw-to-grain angle

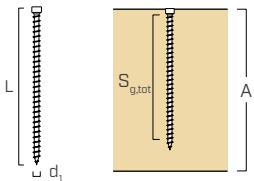
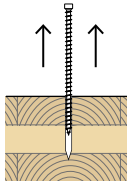
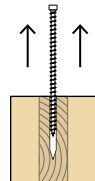
MAIN BEAM-SECONDARY BEAM SHEAR CONNECTION<sup>(8)</sup>

| geometry                                                                          |      |        | main beam<br>secondary beam                                                       |                                                    |                        |           | 1 pair                                                                            |                                                            |              | 2 pairs                                                                            |                                                            |              | 3 pairs                                                                             |                                                            |              |
|-----------------------------------------------------------------------------------|------|--------|-----------------------------------------------------------------------------------|----------------------------------------------------|------------------------|-----------|-----------------------------------------------------------------------------------|------------------------------------------------------------|--------------|------------------------------------------------------------------------------------|------------------------------------------------------------|--------------|-------------------------------------------------------------------------------------|------------------------------------------------------------|--------------|
|  |      |        |  |                                                    |                        |           |  |                                                            |              |  |                                                            |              |  |                                                            |              |
| d <sub>1</sub><br><br>[mm]<br>[in]                                                | L    |        | B <sub>HT,min</sub><br>[mm]                                                       | H <sub>HT,min</sub><br>h <sub>NT,min</sub><br>[mm] | S <sub>g</sub><br>[mm] | m<br>[mm] | b <sub>NT,min</sub><br>[mm]                                                       | factored shear<br>resistance R <sub>v</sub> <sup>(9)</sup> |              | b <sub>NT,min</sub><br>[mm]                                                        | factored shear<br>resistance R <sub>v</sub> <sup>(9)</sup> |              | b <sub>NT,min</sub><br>[mm]                                                         | factored shear<br>resistance R <sub>v</sub> <sup>(9)</sup> |              |
|                                                                                   | [mm] | [in]   |                                                                                   |                                                    |                        |           |                                                                                   | G                                                          |              |                                                                                    | G                                                          |              |                                                                                     | G                                                          |              |
|                                                                                   |      |        |                                                                                   |                                                    |                        |           |                                                                                   | 0.42<br>[kN]                                               | 0.49<br>[kN] |                                                                                    | 0.42<br>[kN]                                               | 0.49<br>[kN] |                                                                                     | 0.42<br>[kN]                                               | 0.49<br>[kN] |
| 5,3<br>0,21                                                                       | 80   | 3 1/8  | 45                                                                                | 70                                                 | 25                     | 31        | 53                                                                                | 1,44                                                       | 1,63         | 80                                                                                 | 2,89                                                       | 3,26         | 106                                                                                 | 4,33                                                       | 4,90         |
|                                                                                   | 100  | 4      | 55                                                                                | 85                                                 | 35                     | 38        |                                                                                   | 2,02                                                       | 2,29         |                                                                                    | 4,04                                                       | 4,57         |                                                                                     | 6,06                                                       | 6,86         |
|                                                                                   | 120  | 4 3/4  | 60                                                                                | 100                                                | 45                     | 45        |                                                                                   | 2,60                                                       | 2,94         |                                                                                    | 5,19                                                       | 5,88         |                                                                                     | 7,79                                                       | 8,81         |
| 5,6<br>0,23                                                                       | 140  | 5 1/2  | 70                                                                                | 115                                                | 55                     | 53        | 56                                                                                | 3,35                                                       | 3,79         | 84                                                                                 | 6,71                                                       | 7,58         | 112                                                                                 | 10,06                                                      | 11,37        |
|                                                                                   | 150  | 6      | 70                                                                                | 120                                                | 60                     | 56        |                                                                                   | 3,66                                                       | 4,13         |                                                                                    | 7,32                                                       | 8,27         |                                                                                     | 10,98                                                      | 12,40        |
|                                                                                   | 160  | 6 1/4  | 75                                                                                | 130                                                | 65                     | 60        |                                                                                   | 3,96                                                       | 4,48         |                                                                                    | 7,93                                                       | 8,96         |                                                                                     | 11,89                                                      | 13,44        |
| 7<br>0,28                                                                         | 80   | 3 1/8  | 45                                                                                | 70                                                 | 25                     | 31        | 70                                                                                | 1,59                                                       | 1,80         | 105                                                                                | 3,18                                                       | 3,60         | 140                                                                                 | 4,77                                                       | 5,40         |
|                                                                                   | 100  | 4      | 55                                                                                | 85                                                 | 35                     | 38        |                                                                                   | 2,23                                                       | 2,52         |                                                                                    | 4,45                                                       | 5,04         |                                                                                     | 6,68                                                       | 7,56         |
|                                                                                   | 120  | 4 3/4  | 60                                                                                | 100                                                | 45                     | 45        |                                                                                   | 2,86                                                       | 3,24         |                                                                                    | 5,73                                                       | 6,48         |                                                                                     | 8,59                                                       | 9,72         |
|                                                                                   | 140  | 5 1/2  | 70                                                                                | 115                                                | 55                     | 53        |                                                                                   | 3,50                                                       | 3,96         |                                                                                    | 7,00                                                       | 7,92         |                                                                                     | 10,50                                                      | 11,88        |
|                                                                                   | 160  | 6 1/4  | 75                                                                                | 130                                                | 65                     | 60        |                                                                                   | 4,14                                                       | 4,68         |                                                                                    | 8,27                                                       | 9,36         |                                                                                     | 12,41                                                      | 14,04        |
|                                                                                   | 180  | 7 1/8  | 80                                                                                | 140                                                | 75                     | 67        |                                                                                   | 4,77                                                       | 5,40         |                                                                                    | 9,54                                                       | 10,80        |                                                                                     | 14,32                                                      | 16,20        |
|                                                                                   | 200  | 8      | 90                                                                                | 155                                                | 85                     | 74        |                                                                                   | 5,41                                                       | 6,12         |                                                                                    | 10,82                                                      | 12,24        |                                                                                     | 16,22                                                      | 18,35        |
|                                                                                   | 220  | 8 5/8  | 95                                                                                | 170                                                | 95                     | 81        |                                                                                   | 6,04                                                       | 6,84         |                                                                                    | 12,09                                                      | 13,68        |                                                                                     | 18,13                                                      | 20,51        |
|                                                                                   | 240  | 9 1/2  | 105                                                                               | 185                                                | 105                    | 88        |                                                                                   | 6,68                                                       | 7,56         |                                                                                    | 13,36                                                      | 15,12        |                                                                                     | 20,04                                                      | 22,67        |
|                                                                                   | 260  | 10 1/4 | 110                                                                               | 200                                                | 115                    | 95        |                                                                                   | 7,32                                                       | 8,28         |                                                                                    | 14,63                                                      | 16,56        |                                                                                     | 21,95                                                      | 24,83        |
|                                                                                   | 280  | 11     | 120                                                                               | 215                                                | 125                    | 102       |                                                                                   | 7,95                                                       | 9,00         |                                                                                    | 15,91                                                      | 17,99        |                                                                                     | 23,86                                                      | 26,99        |
|                                                                                   | 300  | 11 3/4 | 125                                                                               | 225                                                | 135                    | 109       |                                                                                   | 8,59                                                       | 9,72         |                                                                                    | 17,18                                                      | 19,43        |                                                                                     | 25,77                                                      | 29,15        |
| 9<br>0,36                                                                         | 340  | 13 3/8 | 140                                                                               | 255                                                | 155                    | 123       | 90                                                                                | 9,86                                                       | 11,16        | 135                                                                                | 19,72                                                      | 22,31        | 180                                                                                 | 29,59                                                      | 33,47        |
|                                                                                   | 380  | 15     | 155                                                                               | 285                                                | 175                    | 137       |                                                                                   | 11,13                                                      | 12,60        |                                                                                    | 22,27                                                      | 25,19        |                                                                                     | 33,40                                                      | 37,79        |
|                                                                                   | 160  | 6 1/4  | 75                                                                                | 130                                                | 65                     | 60        |                                                                                   | 5,32                                                       | 6,01         |                                                                                    | 10,63                                                      | 12,03        |                                                                                     | 15,95                                                      | 18,04        |
|                                                                                   | 180  | 7 1/8  | 80                                                                                | 140                                                | 75                     | 67        |                                                                                   | 6,14                                                       | 6,94         |                                                                                    | 12,27                                                      | 13,88        |                                                                                     | 18,41                                                      | 20,82        |
|                                                                                   | 200  | 8      | 90                                                                                | 155                                                | 85                     | 74        |                                                                                   | 6,95                                                       | 7,86         |                                                                                    | 13,91                                                      | 15,73        |                                                                                     | 20,86                                                      | 23,59        |
|                                                                                   | 220  | 8 5/8  | 95                                                                                | 170                                                | 95                     | 81        |                                                                                   | 7,77                                                       | 8,79         |                                                                                    | 15,54                                                      | 17,58        |                                                                                     | 23,31                                                      | 26,37        |
|                                                                                   | 240  | 9 1/2  | 105                                                                               | 185                                                | 105                    | 88        |                                                                                   | 8,59                                                       | 9,71         |                                                                                    | 17,18                                                      | 19,43        |                                                                                     | 25,77                                                      | 29,14        |
|                                                                                   | 260  | 10 1/4 | 110                                                                               | 200                                                | 115                    | 95        |                                                                                   | 9,41                                                       | 10,64        |                                                                                    | 18,82                                                      | 21,28        |                                                                                     | 28,22                                                      | 31,92        |
|                                                                                   | 280  | 11     | 120                                                                               | 215                                                | 125                    | 102       |                                                                                   | 10,23                                                      | 11,56        |                                                                                    | 20,45                                                      | 23,13        |                                                                                     | 30,68                                                      | 34,69        |
|                                                                                   | 300  | 11 3/4 | 125                                                                               | 225                                                | 135                    | 109       |                                                                                   | 11,04                                                      | 12,49        |                                                                                    | 22,09                                                      | 24,98        |                                                                                     | 33,13                                                      | 37,47        |
|                                                                                   | 320  | 12 5/8 | 130                                                                               | 240                                                | 145                    | 116       |                                                                                   | 11,86                                                      | 13,41        |                                                                                    | 23,72                                                      | 26,83        |                                                                                     | 35,59                                                      | 40,24        |
|                                                                                   | 340  | 13 3/8 | 140                                                                               | 255                                                | 155                    | 123       |                                                                                   | 12,68                                                      | 14,34        |                                                                                    | 25,36                                                      | 28,68        |                                                                                     | 38,04                                                      | 43,02        |
|                                                                                   | 360  | 14 1/4 | 145                                                                               | 270                                                | 165                    | 130       |                                                                                   | 13,50                                                      | 15,27        |                                                                                    | 27,00                                                      | 30,53        |                                                                                     | 40,49                                                      | 45,80        |
|                                                                                   | 380  | 15     | 155                                                                               | 285                                                | 175                    | 137       |                                                                                   | 14,32                                                      | 16,19        |                                                                                    | 28,63                                                      | 32,38        |                                                                                     | 42,95                                                      | 48,57        |
|                                                                                   | 400  | 15 3/4 | 160                                                                               | 300                                                | 185                    | 144       |                                                                                   | 15,13                                                      | 17,12        |                                                                                    | 30,27                                                      | 34,23        |                                                                                     | 45,40                                                      | 51,35        |
|                                                                                   | 440  | 17 1/4 | 175                                                                               | 325                                                | 205                    | 159       |                                                                                   | 16,77                                                      | 18,97        |                                                                                    | 33,54                                                      | 37,93        |                                                                                     | 50,31                                                      | 56,90        |
|                                                                                   | 480  | 19     | 190                                                                               | 355                                                | 225                    | 173       |                                                                                   | 18,41                                                      | 20,82        |                                                                                    | 36,81                                                      | 41,63        |                                                                                     | 55,22                                                      | 62,45        |
|                                                                                   | 520  | 20 1/2 | 200                                                                               | 385                                                | 245                    | 187       |                                                                                   | 20,04                                                      | 21,49        |                                                                                    | 40,08                                                      | 42,99        |                                                                                     | 60,13                                                      | 64,48        |

MAIN BEAM-SECONDARY BEAM SHEAR CONNECTION<sup>(8)</sup>

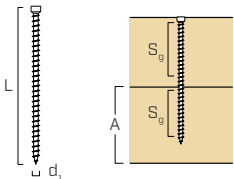
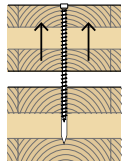
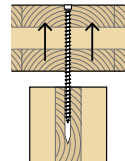
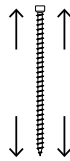
| geometry                                                                          |                |        | main beam<br>secondary beam                                                       |                                                    |                        |           | 1 pair                                                                            |                                                            | 2 pairs                                                                            |                             |                                                            | 3 pairs                                                                             |                             |                                                            |       |
|-----------------------------------------------------------------------------------|----------------|--------|-----------------------------------------------------------------------------------|----------------------------------------------------|------------------------|-----------|-----------------------------------------------------------------------------------|------------------------------------------------------------|------------------------------------------------------------------------------------|-----------------------------|------------------------------------------------------------|-------------------------------------------------------------------------------------|-----------------------------|------------------------------------------------------------|-------|
|  |                |        |  |                                                    |                        |           |  |                                                            |  |                             |                                                            |  |                             |                                                            |       |
| d <sub>1</sub><br>[mm]<br>[in]                                                    | L<br>[mm] [in] |        | B <sub>HT,min</sub><br>[mm]                                                       | H <sub>HT,min</sub><br>h <sub>NT,min</sub><br>[mm] | S <sub>g</sub><br>[mm] | m<br>[mm] | b <sub>NT,min</sub><br>[mm]                                                       | factored shear<br>resistance R <sub>v</sub> <sup>(9)</sup> |                                                                                    | b <sub>NT,min</sub><br>[mm] | factored shear<br>resistance R <sub>v</sub> <sup>(9)</sup> |                                                                                     | b <sub>NT,min</sub><br>[mm] | factored shear<br>resistance R <sub>v</sub> <sup>(9)</sup> |       |
|                                                                                   |                |        |                                                                                   |                                                    |                        |           |                                                                                   | G                                                          |                                                                                    |                             | G                                                          |                                                                                     |                             | G                                                          |       |
|                                                                                   |                |        |                                                                                   |                                                    |                        |           |                                                                                   | 0.42                                                       | 0.49                                                                               |                             | 0.42                                                       | 0.49                                                                                |                             | 0.42                                                       | 0.49  |
|                                                                                   |                |        |                                                                                   |                                                    |                        |           |                                                                                   | [kN]                                                       | [kN]                                                                               |                             | [kN]                                                       | [kN]                                                                                |                             | [kN]                                                       | [kN]  |
| 11<br>0.44                                                                        | 250            | 10     | 105                                                                               | 190                                                | 110                    | 91        | 110                                                                               | 11,00                                                      | 12,44                                                                              | 165                         | 22,00                                                      | 24,89                                                                               | 220                         | 33,00                                                      | 37,33 |
|                                                                                   | 300            | 11 3/4 | 125                                                                               | 225                                                | 135                    | 109       |                                                                                   | 13,50                                                      | 15,27                                                                              |                             | 27,00                                                      | 30,54                                                                               |                             | 40,49                                                      | 45,82 |
|                                                                                   | 350            | 13 3/4 | 140                                                                               | 260                                                | 160                    | 127       |                                                                                   | 16,00                                                      | 18,10                                                                              |                             | 32,00                                                      | 36,20                                                                               |                             | 47,99                                                      | 54,30 |
|                                                                                   | 400            | 15 3/4 | 160                                                                               | 300                                                | 185                    | 144       |                                                                                   | 18,50                                                      | 20,93                                                                              |                             | 36,99                                                      | 41,86                                                                               |                             | 55,49                                                      | 62,78 |
|                                                                                   | 450            | 17 3/4 | 180                                                                               | 335                                                | 210                    | 162       |                                                                                   | 21,00                                                      | 23,76                                                                              |                             | 41,99                                                      | 47,51                                                                               |                             | 62,99                                                      | 71,27 |
|                                                                                   | 500            | 19 3/4 | 195                                                                               | 370                                                | 235                    | 180       |                                                                                   | 23,50                                                      | 25,81                                                                              |                             | 46,99                                                      | 51,63                                                                               |                             | 70,49                                                      | 77,44 |
|                                                                                   | 550            | 21 5/8 | 215                                                                               | 405                                                | 260                    | 197       |                                                                                   | 25,81                                                      | 25,81                                                                              |                             | 51,63                                                      | 51,63                                                                               |                             | 77,44                                                      | 77,44 |
|                                                                                   | 600            | 23 5/8 | 230                                                                               | 440                                                | 285                    | 215       |                                                                                   | 25,81                                                      | 25,81                                                                              |                             | 51,63                                                      | 51,63                                                                               |                             | 77,44                                                      | 77,44 |

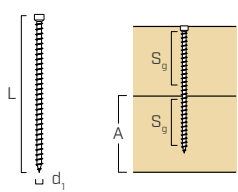
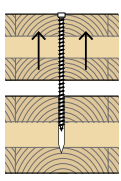
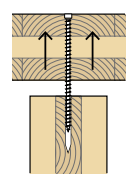
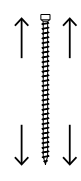
NOTES and GENERAL PRINCIPLES on page 26.

|                                                                                   |              |              |              |              | TENSION <sup>(1)</sup>                                                            |       |       |       |                                                                                     |       |       |       |
|-----------------------------------------------------------------------------------|--------------|--------------|--------------|--------------|-----------------------------------------------------------------------------------|-------|-------|-------|-------------------------------------------------------------------------------------|-------|-------|-------|
| geometry                                                                          |              |              |              |              | total thread withdrawal                                                           |       |       |       |                                                                                     |       |       |       |
|                                                                                   |              |              |              |              | lateral $\alpha=90^\circ$                                                         |       |       |       | narrow $\alpha=0^\circ$                                                             |       |       |       |
|  |              |              |              |              |  |       |       |       |  |       |       |       |
|                                                                                   |              |              |              |              | factored withdrawal resistance $P_{rw}$                                           |       |       |       | factored withdrawal resistance $P_{rw}^{(2)(3)}$                                    |       |       |       |
|                                                                                   |              |              |              |              | G                                                                                 |       |       |       | G                                                                                   |       |       |       |
| $d_1$                                                                             | L            | $S_{g,tot}$  | $A_{min}$    |              | 0.35                                                                              | 0.42  | 0.49  | 0.55  | 0.35                                                                                | 0.42  | 0.49  | 0.55  |
| [mm]<br>[in]                                                                      | [mm]<br>[in] | [mm]<br>[in] | [mm]<br>[in] | [mm]<br>[in] | [kN]                                                                              | [kN]  | [kN]  | [kN]  | [kN]                                                                                | [kN]  | [kN]  | [kN]  |
| 5.3<br>0.21                                                                       | 80           | 3 1/8        | 65           | 90           | 2,52                                                                              | 2,92  | 3,30  | 3,62  | 1,26                                                                                | 1,46  | 1,65  | 1,81  |
|                                                                                   | 100          | 4            | 85           | 110          | 3,30                                                                              | 3,82  | 4,32  | 4,73  | 1,65                                                                                | 1,91  | 2,16  | 2,37  |
|                                                                                   | 120          | 4 3/4        | 105          | 130          | 4,07                                                                              | 4,71  | 5,33  | 5,85  | 2,04                                                                                | 2,36  | 2,67  | 2,92  |
| 5.6<br>0.23                                                                       | 140          | 5 1/2        | 124          | 150          | 5,12                                                                              | 5,93  | 6,70  | 7,36  | 2,56                                                                                | 2,96  | 3,35  | 3,68  |
|                                                                                   | 150          | 6            | 134          | 160          | 5,53                                                                              | 6,40  | 7,23  | 7,94  | 2,77                                                                                | 3,20  | 3,62  | 3,97  |
|                                                                                   | 160          | 6 1/4        | 144          | 170          | 5,94                                                                              | 6,88  | 7,77  | 8,53  | 2,97                                                                                | 3,44  | 3,89  | 4,27  |
| 7<br>0.28                                                                         | 80           | 3 1/8        | 63           | 90           | 2,69                                                                              | 3,12  | 3,53  | 3,87  | 1,35                                                                                | 1,56  | 1,76  | 1,93  |
|                                                                                   | 100          | 4            | 83           | 110          | 3,55                                                                              | 4,11  | 4,65  | 5,10  | 1,77                                                                                | 2,05  | 2,32  | 2,55  |
|                                                                                   | 120          | 4 3/4        | 103          | 130          | 4,41                                                                              | 5,10  | 5,77  | 6,32  | 2,20                                                                                | 2,55  | 2,88  | 3,16  |
|                                                                                   | 140          | 5 1/2        | 123          | 150          | 5,26                                                                              | 6,09  | 6,89  | 7,55  | 2,63                                                                                | 3,04  | 3,44  | 3,78  |
|                                                                                   | 160          | 6 1/4        | 143          | 170          | 6,12                                                                              | 7,08  | 8,01  | 8,78  | 3,06                                                                                | 3,54  | 4,00  | 4,39  |
|                                                                                   | 180          | 7 1/8        | 163          | 190          | 6,97                                                                              | 8,07  | 9,13  | 10,01 | 3,49                                                                                | 4,03  | 4,56  | 5,00  |
|                                                                                   | 200          | 8            | 183          | 210          | 7,83                                                                              | 9,06  | 10,25 | 11,24 | 3,91                                                                                | 4,53  | 5,12  | 5,62  |
|                                                                                   | 220          | 8 5/8        | 203          | 230          | 8,68                                                                              | 10,05 | 11,37 | 12,47 | 4,34                                                                                | 5,02  | 5,68  | 6,23  |
|                                                                                   | 240          | 9 1/2        | 223          | 250          | 9,54                                                                              | 11,04 | 12,48 | 13,69 | 4,77                                                                                | 5,52  | 6,24  | 6,85  |
|                                                                                   | 260          | 10 1/4       | 243          | 270          | 10,39                                                                             | 12,03 | 13,60 | 14,92 | 5,20                                                                                | 6,01  | 6,80  | 7,46  |
|                                                                                   | 280          | 11           | 263          | 290          | 11,25                                                                             | 13,02 | 14,72 | 16,15 | 5,62                                                                                | 6,51  | 7,36  | 8,07  |
|                                                                                   | 300          | 11 3/4       | 283          | 310          | 12,10                                                                             | 14,01 | 15,84 | 17,38 | 6,05                                                                                | 7,00  | 7,92  | 8,69  |
|                                                                                   | 340          | 13 3/8       | 323          | 350          | 13,81                                                                             | 15,99 | 18,08 | 19,83 | 6,91                                                                                | 7,99  | 9,04  | 9,92  |
| 9<br>0.36                                                                         | 380          | 15           | 363          | 390          | 15,53                                                                             | 17,96 | 20,32 | 22,29 | 7,76                                                                                | 8,98  | 10,16 | 11,14 |
|                                                                                   | 160          | 6 1/4        | 141          | 170          | 7,75                                                                              | 8,97  | 10,15 | 11,13 | 3,88                                                                                | 4,49  | 5,07  | 5,57  |
|                                                                                   | 180          | 7 1/8        | 161          | 190          | 8,85                                                                              | 10,24 | 11,59 | 12,71 | 4,43                                                                                | 5,12  | 5,79  | 6,36  |
|                                                                                   | 200          | 8            | 181          | 210          | 9,95                                                                              | 11,52 | 13,02 | 14,29 | 4,98                                                                                | 5,76  | 6,51  | 7,15  |
|                                                                                   | 220          | 8 5/8        | 201          | 230          | 11,05                                                                             | 12,79 | 14,46 | 15,87 | 5,53                                                                                | 6,39  | 7,23  | 7,94  |
|                                                                                   | 240          | 9 1/2        | 221          | 250          | 12,15                                                                             | 14,06 | 15,90 | 17,45 | 6,08                                                                                | 7,03  | 7,95  | 8,73  |
|                                                                                   | 260          | 10 1/4       | 241          | 270          | 13,25                                                                             | 15,33 | 17,34 | 19,03 | 6,63                                                                                | 7,67  | 8,67  | 9,51  |
|                                                                                   | 280          | 11           | 261          | 290          | 14,35                                                                             | 16,61 | 18,78 | 20,61 | 7,18                                                                                | 8,30  | 9,39  | 10,30 |
|                                                                                   | 300          | 11 3/4       | 281          | 310          | 15,45                                                                             | 17,88 | 20,22 | 22,19 | 7,73                                                                                | 8,94  | 10,11 | 11,09 |
|                                                                                   | 320          | 12 5/8       | 301          | 330          | 16,55                                                                             | 19,15 | 21,66 | 23,77 | 8,28                                                                                | 9,58  | 10,83 | 11,88 |
|                                                                                   | 340          | 13 3/8       | 321          | 350          | 17,65                                                                             | 20,43 | 23,10 | 25,35 | 8,83                                                                                | 10,21 | 11,55 | 12,67 |
|                                                                                   | 360          | 14 1/4       | 341          | 370          | 18,75                                                                             | 21,70 | 24,54 | 26,93 | 9,38                                                                                | 10,85 | 12,27 | 13,46 |
|                                                                                   | 380          | 15           | 361          | 390          | 19,85                                                                             | 22,97 | 25,98 | 28,50 | 9,93                                                                                | 11,49 | 12,99 | 14,25 |
|                                                                                   | 400          | 15 3/4       | 381          | 410          | 20,95                                                                             | 24,24 | 27,42 | 30,08 | 10,48                                                                               | 12,12 | 13,71 | 15,04 |
|                                                                                   | 440          | 17 1/4       | 421          | 450          | 23,15                                                                             | 26,79 | 30,30 | 33,24 | 11,58                                                                               | 13,39 | 15,15 | 16,62 |
|                                                                                   | 480          | 19           | 461          | 490          | 25,35                                                                             | 29,33 | 33,17 | 36,40 | 12,68                                                                               | 14,67 | 16,59 | 18,20 |
|                                                                                   | 520          | 20 1/2       | 501          | 530          | 27,55                                                                             | 31,88 | 36,05 | 39,56 | 13,78                                                                               | 15,94 | 18,03 | 19,78 |

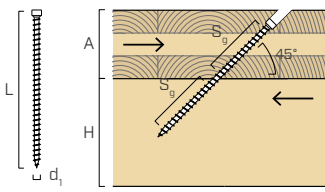
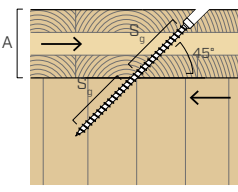
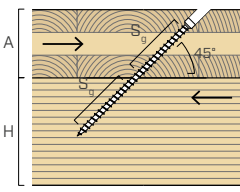
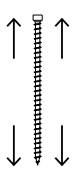
|                          |              |             |           |     | TENSION <sup>(1)</sup>                  |       |       |       |                                                  |       |       |       |
|--------------------------|--------------|-------------|-----------|-----|-----------------------------------------|-------|-------|-------|--------------------------------------------------|-------|-------|-------|
| geometry                 |              |             |           |     | total thread withdrawal                 |       |       |       |                                                  |       |       |       |
|                          |              |             |           |     | lateral $\alpha=90^\circ$               |       |       |       | narrow $\alpha=0^\circ$                          |       |       |       |
|                          |              |             |           |     |                                         |       |       |       |                                                  |       |       |       |
|                          |              |             |           |     | factored withdrawal resistance $P_{rw}$ |       |       |       | factored withdrawal resistance $P_{rw}^{(2)(3)}$ |       |       |       |
|                          |              |             |           |     | G                                       |       |       |       | G                                                |       |       |       |
| $d_1$                    | L            | $S_{g,tot}$ | $A_{min}$ |     | 0.35                                    | 0.42  | 0.49  | 0.55  | 0.35                                             | 0.42  | 0.49  | 0.55  |
| [mm]<br>[in]             | [mm]<br>[in] | [mm]        | [mm]      |     | [kN]                                    | [kN]  | [kN]  | [kN]  | [kN]                                             | [kN]  | [kN]  | [kN]  |
| <b>11</b><br><b>0.44</b> | 250          | 10          | 229       | 260 | 15,39                                   | 17,81 | 20,15 | 22,11 | 7,70                                             | 8,90  | 10,07 | 11,05 |
|                          | 300          | 11 3/4      | 279       | 310 | 18,75                                   | 21,70 | 24,55 | 26,93 | 9,38                                             | 10,85 | 12,27 | 13,47 |
|                          | 350          | 13 3/4      | 329       | 360 | 22,11                                   | 25,59 | 28,95 | 31,76 | 11,06                                            | 12,79 | 14,47 | 15,88 |
|                          | 400          | 15 3/4      | 379       | 410 | 25,47                                   | 29,47 | 33,35 | 36,58 | 12,74                                            | 14,74 | 16,67 | 18,29 |
|                          | 450          | 17 3/4      | 429       | 460 | 28,83                                   | 33,36 | 37,75 | 41,41 | 14,42                                            | 16,68 | 18,87 | 20,71 |
|                          | 500          | 19 3/4      | 479       | 510 | 32,20                                   | 37,25 | 42,15 | 46,24 | 16,10                                            | 18,63 | 21,07 | 23,12 |
|                          | 550          | 21 5/8      | 529       | 560 | 35,56                                   | 41,14 | 46,55 | 51,06 | 17,78                                            | 20,57 | 23,27 | 25,53 |
|                          | 600          | 23 5/8      | 579       | 610 | 38,92                                   | 45,03 | 50,95 | 55,89 | 19,46                                            | 22,51 | 25,47 | 27,95 |

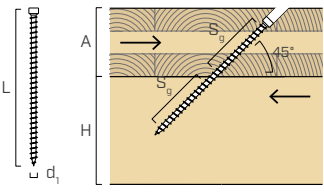
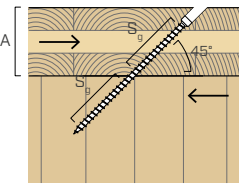
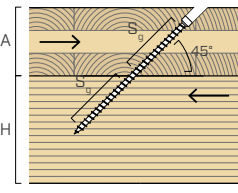
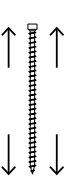
$\alpha$  = screw-to-grain angle

| geometry                                                                          |      |        |                        |                          | TENSION <sup>(1)</sup>                                                            |              |              |              |                                                                                    |              |              |              | steel tension                                                                       |
|-----------------------------------------------------------------------------------|------|--------|------------------------|--------------------------|-----------------------------------------------------------------------------------|--------------|--------------|--------------|------------------------------------------------------------------------------------|--------------|--------------|--------------|-------------------------------------------------------------------------------------|
|                                                                                   |      |        |                        |                          | partial thread withdrawal                                                         |              |              |              |                                                                                    |              |              |              |                                                                                     |
|                                                                                   |      |        |                        |                          | lateral α=90°                                                                     |              |              |              | narrow α=0°                                                                        |              |              |              |                                                                                     |
|  |      |        |                        |                          |  |              |              |              |  |              |              |              |  |
|                                                                                   |      |        |                        |                          | factored withdrawal resistance P <sub>rw</sub>                                    |              |              |              | factored withdrawal resistance P <sub>rw</sub> <sup>(2)(3)</sup>                   |              |              |              | factored tension resistance T <sub>rs</sub>                                         |
| d <sub>1</sub><br>[mm]<br>[in]                                                    | L    |        | S <sub>g</sub><br>[mm] | A <sub>min</sub><br>[mm] | G                                                                                 |              |              |              | G                                                                                  |              |              |              | [kN]                                                                                |
|                                                                                   | [mm] | [in]   |                        |                          | 0.35<br>[kN]                                                                      | 0.42<br>[kN] | 0.49<br>[kN] | 0.55<br>[kN] | 0.35<br>[kN]                                                                       | 0.42<br>[kN] | 0.49<br>[kN] | 0.55<br>[kN] |                                                                                     |
| 5.3<br>0.21                                                                       | 80   | 3 1/8  | 25                     | 45                       | 0,97                                                                              | 1,12         | 1,27         | 1,39         | 0,49                                                                               | 0,56         | 0,63         | 0,70         | 7,49                                                                                |
|                                                                                   | 100  | 4      | 35                     | 55                       | 1,36                                                                              | 1,57         | 1,78         | 1,95         | 0,68                                                                               | 0,79         | 0,89         | 0,97         |                                                                                     |
|                                                                                   | 120  | 4 3/4  | 45                     | 65                       | 1,75                                                                              | 2,02         | 2,29         | 2,51         | 0,87                                                                               | 1,01         | 1,14         | 1,25         |                                                                                     |
| 5.6<br>0.23                                                                       | 140  | 5 1/2  | 55                     | 75                       | 2,25                                                                              | 2,61         | 2,95         | 3,24         | 1,13                                                                               | 1,30         | 1,47         | 1,62         | 8,08                                                                                |
|                                                                                   | 150  | 6      | 60                     | 80                       | 2,46                                                                              | 2,85         | 3,22         | 3,53         | 1,23                                                                               | 1,42         | 1,61         | 1,77         |                                                                                     |
|                                                                                   | 160  | 6 1/4  | 65                     | 85                       | 2,66                                                                              | 3,08         | 3,48         | 3,83         | 1,33                                                                               | 1,54         | 1,74         | 1,91         |                                                                                     |
| 7<br>0.28                                                                         | 80   | 3 1/8  | 25                     | 45                       | 1,07                                                                              | 1,24         | 1,40         | 1,54         | 0,53                                                                               | 0,62         | 0,70         | 0,77         | 10,64                                                                               |
|                                                                                   | 100  | 4      | 35                     | 55                       | 1,50                                                                              | 1,73         | 1,96         | 2,15         | 0,75                                                                               | 0,87         | 0,98         | 1,07         |                                                                                     |
|                                                                                   | 120  | 4 3/4  | 45                     | 65                       | 1,92                                                                              | 2,23         | 2,52         | 2,76         | 0,96                                                                               | 1,11         | 1,26         | 1,38         |                                                                                     |
|                                                                                   | 140  | 5 1/2  | 55                     | 75                       | 2,35                                                                              | 2,72         | 3,08         | 3,38         | 1,18                                                                               | 1,36         | 1,54         | 1,69         |                                                                                     |
|                                                                                   | 160  | 6 1/4  | 65                     | 85                       | 2,78                                                                              | 3,22         | 3,64         | 3,99         | 1,39                                                                               | 1,61         | 1,82         | 2,00         |                                                                                     |
|                                                                                   | 180  | 7 1/8  | 75                     | 95                       | 3,21                                                                              | 3,71         | 4,20         | 4,61         | 1,60                                                                               | 1,86         | 2,10         | 2,30         |                                                                                     |
|                                                                                   | 200  | 8      | 85                     | 105                      | 3,64                                                                              | 4,21         | 4,76         | 5,22         | 1,82                                                                               | 2,10         | 2,38         | 2,61         |                                                                                     |
|                                                                                   | 220  | 8 5/8  | 95                     | 115                      | 4,06                                                                              | 4,70         | 5,32         | 5,83         | 2,03                                                                               | 2,35         | 2,66         | 2,92         |                                                                                     |
|                                                                                   | 240  | 9 1/2  | 105                    | 125                      | 4,49                                                                              | 5,20         | 5,88         | 6,45         | 2,25                                                                               | 2,60         | 2,94         | 3,22         |                                                                                     |
|                                                                                   | 260  | 10 1/4 | 115                    | 135                      | 4,92                                                                              | 5,69         | 6,44         | 7,06         | 2,46                                                                               | 2,85         | 3,22         | 3,53         |                                                                                     |
|                                                                                   | 280  | 11     | 125                    | 145                      | 5,35                                                                              | 6,19         | 7,00         | 7,68         | 2,67                                                                               | 3,09         | 3,50         | 3,84         |                                                                                     |
|                                                                                   | 300  | 11 3/4 | 135                    | 155                      | 5,77                                                                              | 6,68         | 7,56         | 8,29         | 2,89                                                                               | 3,34         | 3,78         | 4,14         |                                                                                     |
|                                                                                   | 340  | 13 3/8 | 155                    | 175                      | 6,63                                                                              | 7,67         | 8,68         | 9,52         | 3,31                                                                               | 3,84         | 4,34         | 4,76         |                                                                                     |
|                                                                                   | 380  | 15     | 175                    | 195                      | 7,48                                                                              | 8,66         | 9,80         | 10,75        | 3,74                                                                               | 4,33         | 4,90         | 5,37         |                                                                                     |
| 9<br>0.36                                                                         | 160  | 6 1/4  | 65                     | 85                       | 3,57                                                                              | 4,14         | 4,68         | 5,13         | 1,79                                                                               | 2,07         | 2,34         | 2,57         | 17,84                                                                               |
|                                                                                   | 180  | 7 1/8  | 75                     | 95                       | 4,12                                                                              | 4,77         | 5,40         | 5,92         | 2,06                                                                               | 2,39         | 2,70         | 2,96         |                                                                                     |
|                                                                                   | 200  | 8      | 85                     | 105                      | 4,67                                                                              | 5,41         | 6,12         | 6,71         | 2,34                                                                               | 2,70         | 3,06         | 3,36         |                                                                                     |
|                                                                                   | 220  | 8 5/8  | 95                     | 115                      | 5,22                                                                              | 6,04         | 6,84         | 7,50         | 2,61                                                                               | 3,02         | 3,42         | 3,75         |                                                                                     |
|                                                                                   | 240  | 9 1/2  | 105                    | 125                      | 5,77                                                                              | 6,68         | 7,56         | 8,29         | 2,89                                                                               | 3,34         | 3,78         | 4,15         |                                                                                     |
|                                                                                   | 260  | 10 1/4 | 115                    | 135                      | 6,32                                                                              | 7,32         | 8,28         | 9,08         | 3,16                                                                               | 3,66         | 4,14         | 4,54         |                                                                                     |
|                                                                                   | 280  | 11     | 125                    | 145                      | 6,87                                                                              | 7,95         | 9,00         | 9,87         | 3,44                                                                               | 3,98         | 4,50         | 4,94         |                                                                                     |
|                                                                                   | 300  | 11 3/4 | 135                    | 155                      | 7,42                                                                              | 8,59         | 9,71         | 10,66        | 3,71                                                                               | 4,30         | 4,86         | 5,33         |                                                                                     |
|                                                                                   | 320  | 12 5/8 | 145                    | 165                      | 7,97                                                                              | 9,23         | 10,43        | 11,45        | 3,99                                                                               | 4,61         | 5,22         | 5,72         |                                                                                     |
|                                                                                   | 340  | 13 3/8 | 155                    | 175                      | 8,52                                                                              | 9,86         | 11,15        | 12,24        | 4,26                                                                               | 4,93         | 5,58         | 6,12         |                                                                                     |
|                                                                                   | 360  | 14 1/4 | 165                    | 185                      | 9,07                                                                              | 10,50        | 11,87        | 13,03        | 4,54                                                                               | 5,25         | 5,94         | 6,51         |                                                                                     |
|                                                                                   | 380  | 15     | 175                    | 195                      | 9,62                                                                              | 11,14        | 12,59        | 13,82        | 4,81                                                                               | 5,57         | 6,30         | 6,91         |                                                                                     |
|                                                                                   | 400  | 15 3/4 | 185                    | 205                      | 10,17                                                                             | 11,77        | 13,31        | 14,61        | 5,09                                                                               | 5,89         | 6,66         | 7,30         |                                                                                     |
|                                                                                   | 440  | 17 1/4 | 205                    | 225                      | 11,27                                                                             | 13,04        | 14,75        | 16,19        | 5,64                                                                               | 6,52         | 7,38         | 8,09         |                                                                                     |
|                                                                                   | 480  | 19     | 225                    | 245                      | 12,37                                                                             | 14,32        | 16,19        | 17,77        | 6,19                                                                               | 7,16         | 8,10         | 8,88         |                                                                                     |
|                                                                                   | 520  | 20 1/2 | 245                    | 265                      | 13,47                                                                             | 15,59        | 17,63        | 19,35        | 6,74                                                                               | 7,79         | 8,82         | 9,67         |                                                                                     |

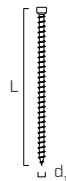
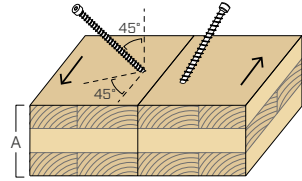
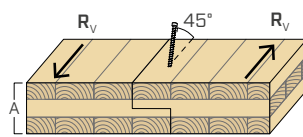
|                                                                                   |      |        |       |           | TENSION <sup>(1)</sup>                                                            |       |       |       |                                                                                    |       |       |       |                                                                                     |  |
|-----------------------------------------------------------------------------------|------|--------|-------|-----------|-----------------------------------------------------------------------------------|-------|-------|-------|------------------------------------------------------------------------------------|-------|-------|-------|-------------------------------------------------------------------------------------|--|
| geometry                                                                          |      |        |       |           | total thread withdrawal                                                           |       |       |       |                                                                                    |       |       |       | steel tension                                                                       |  |
|                                                                                   |      |        |       |           | lateral $\alpha=90^\circ$                                                         |       |       |       | narrow $\alpha=0^\circ$                                                            |       |       |       |                                                                                     |  |
|  |      |        |       |           |  |       |       |       |  |       |       |       |  |  |
|                                                                                   |      |        |       |           | factored withdrawal resistance $P_{rw}$                                           |       |       |       | factored withdrawal resistance $P_{rw}^{(2)(3)}$                                   |       |       |       | factored tension resistance $T_{rs}$                                                |  |
|                                                                                   |      |        |       |           | G                                                                                 |       |       |       | G                                                                                  |       |       |       |                                                                                     |  |
| $d_1$                                                                             | L    |        | $S_g$ | $A_{min}$ | 0.35                                                                              | 0.42  | 0.49  | 0.55  | 0.35                                                                               | 0.42  | 0.49  | 0.55  |                                                                                     |  |
| [mm]<br>[in]                                                                      | [mm] | [in]   | [mm]  | [mm]      | [kN]                                                                              | [kN]  | [kN]  | [kN]  | [kN]                                                                               | [kN]  | [kN]  | [kN]  | [kN]                                                                                |  |
| <b>11</b><br><b>0.44</b>                                                          | 250  | 10     | 110   | 130       | 7,39                                                                              | 8,55  | 9,68  | 10,62 | 3,70                                                                               | 4,28  | 4,84  | 5,31  | 23,17                                                                               |  |
|                                                                                   | 300  | 11 3/4 | 135   | 155       | 9,07                                                                              | 10,50 | 11,88 | 13,03 | 4,54                                                                               | 5,25  | 5,94  | 6,52  |                                                                                     |  |
|                                                                                   | 350  | 13 3/4 | 160   | 180       | 10,75                                                                             | 12,44 | 14,08 | 15,44 | 5,38                                                                               | 6,22  | 7,04  | 7,72  |                                                                                     |  |
|                                                                                   | 400  | 15 3/4 | 185   | 205       | 12,43                                                                             | 14,39 | 16,28 | 17,86 | 6,22                                                                               | 7,19  | 8,14  | 8,93  |                                                                                     |  |
|                                                                                   | 450  | 17 3/4 | 210   | 230       | 14,11                                                                             | 16,33 | 18,48 | 20,27 | 7,06                                                                               | 8,17  | 9,24  | 10,14 |                                                                                     |  |
|                                                                                   | 500  | 19 3/4 | 235   | 255       | 15,80                                                                             | 18,28 | 20,68 | 22,68 | 7,90                                                                               | 9,14  | 10,34 | 11,34 |                                                                                     |  |
|                                                                                   | 550  | 21 5/8 | 260   | 280       | 17,48                                                                             | 20,22 | 22,88 | 25,10 | 8,74                                                                               | 10,11 | 11,44 | 12,55 |                                                                                     |  |
|                                                                                   | 600  | 23 5/8 | 285   | 305       | 19,16                                                                             | 22,16 | 25,08 | 27,51 | 9,58                                                                               | 11,08 | 12,54 | 13,76 |                                                                                     |  |

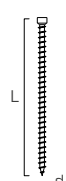
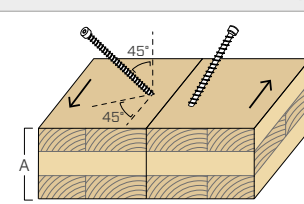
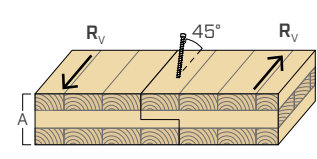
$\alpha$  = screw-to-grain angle

|                                                                                   |           |                        |           |                          |              | SLIDING <sup>[4]</sup>                                                            |              |                                                                                    |       |                                                                                     |
|-----------------------------------------------------------------------------------|-----------|------------------------|-----------|--------------------------|--------------|-----------------------------------------------------------------------------------|--------------|------------------------------------------------------------------------------------|-------|-------------------------------------------------------------------------------------|
| geometry                                                                          |           |                        |           |                          |              | CLT - CLT<br>α=0°                                                                 |              | CLT - timber<br>α=45°                                                              |       | steel tension                                                                       |
|  |           |                        |           |                          |              |  |              |  |       |  |
|                                                                                   |           |                        |           |                          |              | factored lateral resistance<br>N <sub>r</sub> <sup>(5)</sup>                      |              | factored lateral resistance<br>N <sub>r</sub> <sup>(5)</sup>                       |       | factored tension<br>resistance T <sub>rs</sub>                                      |
| d <sub>1</sub><br>[mm]<br>[in]                                                    | L<br>[mm] | S <sub>g</sub><br>[mm] | A<br>[mm] | H <sub>min</sub><br>[mm] | G            |                                                                                   | G            |                                                                                    | [kN]  |                                                                                     |
|                                                                                   |           |                        |           |                          | 0.42<br>[kN] | 0.49<br>[kN]                                                                      | 0.42<br>[kN] | 0.49<br>[kN]                                                                       |       |                                                                                     |
| 5.3<br>0.21                                                                       | 80        | 3 1/8                  | 25        | 35                       | 50           | 0,40                                                                              | 0,45         | 0,79                                                                               | 0,90  | 5,30                                                                                |
|                                                                                   | 100       | 4                      | 35        | 40                       | 55           | 0,56                                                                              | 0,63         | 1,11                                                                               | 1,26  |                                                                                     |
|                                                                                   | 120       | 4 3/4                  | 45        | 45                       | 60           | 0,71                                                                              | 0,81         | 1,43                                                                               | 1,62  |                                                                                     |
| 5.6<br>0.23                                                                       | 140       | 5 1/2                  | 55        | 55                       | 70           | 0,92                                                                              | 1,04         | 1,84                                                                               | 2,08  | 5,71                                                                                |
|                                                                                   | 150       | 6                      | 60        | 60                       | 75           | 1,01                                                                              | 1,14         | 2,01                                                                               | 2,27  |                                                                                     |
|                                                                                   | 160       | 6 1/4                  | 65        | 60                       | 75           | 1,09                                                                              | 1,23         | 2,18                                                                               | 2,46  |                                                                                     |
| 7<br>0.28                                                                         | 80        | 3 1/8                  | 25        | 35                       | 50           | 0,44                                                                              | 0,49         | 0,87                                                                               | 0,99  | 7,52                                                                                |
|                                                                                   | 100       | 4                      | 35        | 40                       | 55           | 0,61                                                                              | 0,69         | 1,22                                                                               | 1,39  |                                                                                     |
|                                                                                   | 120       | 4 3/4                  | 45        | 45                       | 60           | 0,79                                                                              | 0,89         | 1,57                                                                               | 1,78  |                                                                                     |
|                                                                                   | 140       | 5 1/2                  | 55        | 55                       | 70           | 0,96                                                                              | 1,09         | 1,92                                                                               | 2,18  |                                                                                     |
|                                                                                   | 160       | 6 1/4                  | 65        | 60                       | 75           | 1,14                                                                              | 1,29         | 2,27                                                                               | 2,57  |                                                                                     |
|                                                                                   | 180       | 7 1/8                  | 75        | 70                       | 85           | 1,31                                                                              | 1,48         | 2,62                                                                               | 2,97  |                                                                                     |
|                                                                                   | 200       | 8                      | 85        | 75                       | 90           | 1,49                                                                              | 1,68         | 2,97                                                                               | 3,36  |                                                                                     |
|                                                                                   | 220       | 8 5/8                  | 95        | 85                       | 100          | 1,66                                                                              | 1,88         | 3,32                                                                               | 3,76  |                                                                                     |
|                                                                                   | 240       | 9 1/2                  | 105       | 90                       | 105          | 1,84                                                                              | 2,08         | 3,67                                                                               | 4,16  |                                                                                     |
|                                                                                   | 260       | 10 1/4                 | 115       | 95                       | 110          | 2,01                                                                              | 2,28         | 4,02                                                                               | 4,55  |                                                                                     |
|                                                                                   | 280       | 11                     | 125       | 105                      | 120          | 2,19                                                                              | 2,47         | 4,37                                                                               | 4,95  |                                                                                     |
|                                                                                   | 300       | 11 3/4                 | 135       | 110                      | 125          | 2,36                                                                              | 2,67         | 4,72                                                                               | 5,34  |                                                                                     |
|                                                                                   | 340       | 13 3/8                 | 155       | 125                      | 140          | 2,71                                                                              | 3,07         | 5,42                                                                               | 6,14  |                                                                                     |
|                                                                                   | 380       | 15                     | 175       | 140                      | 155          | 3,06                                                                              | 3,46         | 6,12                                                                               | 6,93  |                                                                                     |
| 9<br>0.36                                                                         | 160       | 6 1/4                  | 65        | 60                       | 75           | 1,46                                                                              | 1,65         | 2,92                                                                               | 3,31  | 12,61                                                                               |
|                                                                                   | 180       | 7 1/8                  | 75        | 70                       | 85           | 1,69                                                                              | 1,91         | 3,37                                                                               | 3,82  |                                                                                     |
|                                                                                   | 200       | 8                      | 85        | 75                       | 90           | 1,91                                                                              | 2,16         | 3,82                                                                               | 4,33  |                                                                                     |
|                                                                                   | 220       | 8 5/8                  | 95        | 85                       | 100          | 2,14                                                                              | 2,42         | 4,27                                                                               | 4,83  |                                                                                     |
|                                                                                   | 240       | 9 1/2                  | 105       | 90                       | 105          | 2,36                                                                              | 2,67         | 4,72                                                                               | 5,34  |                                                                                     |
|                                                                                   | 260       | 10 1/4                 | 115       | 95                       | 110          | 2,59                                                                              | 2,93         | 5,17                                                                               | 5,85  |                                                                                     |
|                                                                                   | 280       | 11                     | 125       | 105                      | 120          | 2,81                                                                              | 3,18         | 5,62                                                                               | 6,36  |                                                                                     |
|                                                                                   | 300       | 11 3/4                 | 135       | 110                      | 125          | 3,04                                                                              | 3,43         | 6,07                                                                               | 6,87  |                                                                                     |
|                                                                                   | 320       | 12 5/8                 | 145       | 120                      | 135          | 3,26                                                                              | 3,69         | 6,52                                                                               | 7,38  |                                                                                     |
|                                                                                   | 340       | 13 3/8                 | 155       | 125                      | 140          | 3,49                                                                              | 3,94         | 6,97                                                                               | 7,89  |                                                                                     |
|                                                                                   | 360       | 14 1/4                 | 165       | 130                      | 145          | 3,71                                                                              | 4,20         | 7,42                                                                               | 8,40  |                                                                                     |
|                                                                                   | 380       | 15                     | 175       | 140                      | 155          | 3,94                                                                              | 4,45         | 7,87                                                                               | 8,90  |                                                                                     |
|                                                                                   | 400       | 15 3/4                 | 185       | 145                      | 160          | 4,16                                                                              | 4,71         | 8,32                                                                               | 9,41  |                                                                                     |
|                                                                                   | 440       | 17 1/4                 | 205       | 160                      | 175          | 4,61                                                                              | 5,22         | 9,22                                                                               | 10,43 |                                                                                     |
|                                                                                   | 480       | 19                     | 225       | 175                      | 190          | 5,06                                                                              | 5,72         | 10,12                                                                              | 11,45 |                                                                                     |
|                                                                                   | 520       | 20 1/2                 | 245       | 190                      | 205          | 5,51                                                                              | 6,23         | 11,02                                                                              | 12,47 |                                                                                     |

|                                                                                   |              |        |       |      |           | SLIDING <sup>[4]</sup>                                                            |                                                                                    |                                                                                     |       |                                         |
|-----------------------------------------------------------------------------------|--------------|--------|-------|------|-----------|-----------------------------------------------------------------------------------|------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------|-----------------------------------------|
| geometry                                                                          |              |        |       |      |           | CLT - CLT<br>$\alpha=0^\circ$                                                     | CLT - timber<br>$\alpha=45^\circ$                                                  | steel tension                                                                       |       |                                         |
|  |              |        |       |      |           |  |  |  |       |                                         |
|                                                                                   |              |        |       |      |           | factored lateral resistance<br>$N_r^{(5)}$                                        |                                                                                    | factored lateral resistance<br>$N_r^{(5)}$                                          |       | factored tension resistance<br>$T_{rs}$ |
|                                                                                   |              |        |       |      |           | G                                                                                 |                                                                                    | G                                                                                   |       |                                         |
| $d_1$                                                                             | L            |        | $S_g$ | A    | $H_{min}$ | 0.42                                                                              | 0.49                                                                               | 0.42                                                                                | 0.49  |                                         |
| [mm]<br>[in]                                                                      | [mm]<br>[in] |        | [mm]  | [mm] | [mm]      | [kN]                                                                              | [kN]                                                                               | [kN]                                                                                | [kN]  | [kN]                                    |
| <b>11</b><br><b>0.44</b>                                                          | 250          | 10     | 110   | 95   | 110       | 3,02                                                                              | 3,42                                                                               | 6,05                                                                                | 6,84  | 16,38                                   |
|                                                                                   | 300          | 11 3/4 | 135   | 110  | 125       | 3,71                                                                              | 4,20                                                                               | 7,42                                                                                | 8,40  |                                         |
|                                                                                   | 350          | 13 3/4 | 160   | 130  | 145       | 4,40                                                                              | 4,98                                                                               | 8,80                                                                                | 9,95  |                                         |
|                                                                                   | 400          | 15 3/4 | 185   | 145  | 160       | 5,09                                                                              | 5,76                                                                               | 10,17                                                                               | 11,51 |                                         |
|                                                                                   | 450          | 17 3/4 | 210   | 165  | 180       | 5,77                                                                              | 6,53                                                                               | 11,55                                                                               | 13,07 |                                         |
|                                                                                   | 500          | 19 3/4 | 235   | 180  | 195       | 6,46                                                                              | 7,31                                                                               | 12,92                                                                               | 14,62 |                                         |
|                                                                                   | 550          | 21 5/8 | 260   | 200  | 215       | 7,15                                                                              | 8,09                                                                               | 14,30                                                                               | 16,18 |                                         |
|                                                                                   | 600          | 23 5/8 | 285   | 215  | 230       | 7,84                                                                              | 8,87                                                                               | 15,67                                                                               | 17,73 |                                         |

$\alpha$  = screw-to-grain angle

| geometry                                                                          |                   |        |                |      | SLIDING <sup>(4)</sup>                                                            |             |                                                                                     |                                                              |             |                                                |
|-----------------------------------------------------------------------------------|-------------------|--------|----------------|------|-----------------------------------------------------------------------------------|-------------|-------------------------------------------------------------------------------------|--------------------------------------------------------------|-------------|------------------------------------------------|
|                                                                                   |                   |        |                |      | butt joint<br>(double inclination at 45° + 45°) <sup>(10)</sup>                   |             | half-lap joint<br>α=45°                                                             |                                                              |             |                                                |
|  |                   |        |                |      |  |             |  |                                                              |             |                                                |
|                                                                                   |                   |        |                |      | factored lateral<br>resistance N <sub>r</sub> <sup>(5)</sup>                      |             | factored tension<br>resistance T <sub>rs</sub>                                      | factored lateral<br>resistance N <sub>r</sub> <sup>(5)</sup> |             | factored tension<br>resistance T <sub>rs</sub> |
| d <sub>1</sub>                                                                    | L                 |        | S <sub>g</sub> | A    | G                                                                                 |             |                                                                                     | G                                                            |             |                                                |
| <b>[mm]<br/>[in]</b>                                                              | [mm]              | [in]   | [mm]           | [mm] | <b>0.42</b>                                                                       | <b>0.49</b> | [kN]                                                                                | <b>0.42</b>                                                  | <b>0.49</b> | [kN]                                           |
| <b>5.3<br/>0.21</b>                                                               | 80                | 3 1/8  | 25             | 65   | 0,69                                                                              | 0,79        | 3,75                                                                                | 0,87                                                         | 0,98        | 5,30                                           |
|                                                                                   | 100               | 4      | 35             | 80   | 0,97                                                                              | 1,10        |                                                                                     | 1,21                                                         | 1,37        |                                                |
|                                                                                   | 120               | 4 3/4  | 45             | 95   | 1,25                                                                              | 1,41        |                                                                                     | 1,56                                                         | 1,76        |                                                |
| <b>5.6<br/>0.23</b>                                                               | 140               | 5 1/2  | 55             | 110  | 1,61                                                                              | 1,82        | 4,04                                                                                | 2,01                                                         | 2,27        | 5,71                                           |
|                                                                                   | 150               | 6      | 60             | 115  | 1,76                                                                              | 1,99        |                                                                                     | 2,20                                                         | 2,48        |                                                |
|                                                                                   | 160               | 6 1/4  | 65             | 125  | 1,91                                                                              | 2,16        |                                                                                     | 2,38                                                         | 2,69        |                                                |
| <b>7<br/>0.28</b>                                                                 | 80 <sup>(3)</sup> | 3 1/8  | 25             | 65   | 0,77                                                                              | 0,87        | 5,32                                                                                | 0,95                                                         | 1,08        | 7,52                                           |
|                                                                                   | 100               | 4      | 35             | 80   | 1,07                                                                              | 1,21        |                                                                                     | 1,34                                                         | 1,51        |                                                |
|                                                                                   | 120               | 4 3/4  | 45             | 95   | 1,38                                                                              | 1,56        |                                                                                     | 1,72                                                         | 1,94        |                                                |
|                                                                                   | 140               | 5 1/2  | 55             | 110  | 1,69                                                                              | 1,91        |                                                                                     | 2,10                                                         | 2,38        |                                                |
|                                                                                   | 160               | 6 1/4  | 65             | 125  | 1,99                                                                              | 2,25        |                                                                                     | 2,48                                                         | 2,81        |                                                |
|                                                                                   | 180               | 7 1/8  | 75             | 135  | 2,30                                                                              | 2,60        |                                                                                     | 2,86                                                         | 3,24        |                                                |
|                                                                                   | 200               | 8      | 85             | 150  | 2,60                                                                              | 2,95        |                                                                                     | 3,24                                                         | 3,67        |                                                |
|                                                                                   | 220               | 8 5/8  | 95             | 165  | 2,91                                                                              | 3,29        |                                                                                     | 3,63                                                         | 4,10        |                                                |
|                                                                                   | 240               | 9 1/2  | 105            | 180  | 3,22                                                                              | 3,64        |                                                                                     | 4,01                                                         | 4,53        |                                                |
|                                                                                   | 260               | 10 1/4 | 115            | 195  | 3,52                                                                              | 3,99        |                                                                                     | 4,39                                                         | 4,97        |                                                |
|                                                                                   | 280               | 11     | 125            | 210  | 3,83                                                                              | 4,33        |                                                                                     | 4,77                                                         | 5,40        |                                                |
|                                                                                   | 300               | 11 3/4 | 135            | 220  | 4,14                                                                              | 4,68        |                                                                                     | 5,15                                                         | 5,83        |                                                |
|                                                                                   | 320               | 12 5/8 | 145            | 235  | 4,44                                                                              | 5,03        |                                                                                     | 5,54                                                         | 6,26        |                                                |
|                                                                                   | 340               | 13 3/8 | 155            | 250  | 4,75                                                                              | 5,37        |                                                                                     | 5,92                                                         | 6,69        |                                                |
|                                                                                   | 380               | 15     | 175            | 280  | 5,36                                                                              | 6,07        |                                                                                     | 6,68                                                         | 7,56        |                                                |
| <b>9<br/>0.36</b>                                                                 | 160               | 6 1/4  | 65             | 125  | 2,56                                                                              | 2,90        | 8,92                                                                                | 3,19                                                         | 3,61        | 12,61                                          |
|                                                                                   | 180               | 7 1/8  | 75             | 135  | 2,95                                                                              | 3,34        |                                                                                     | 3,68                                                         | 4,16        |                                                |
|                                                                                   | 200               | 8      | 85             | 150  | 3,35                                                                              | 3,79        |                                                                                     | 4,17                                                         | 4,72        |                                                |
|                                                                                   | 220               | 8 5/8  | 95             | 165  | 3,74                                                                              | 4,23        |                                                                                     | 4,66                                                         | 5,27        |                                                |
|                                                                                   | 240               | 9 1/2  | 105            | 180  | 4,14                                                                              | 4,68        |                                                                                     | 5,15                                                         | 5,83        |                                                |
|                                                                                   | 260               | 10 1/4 | 115            | 195  | 4,53                                                                              | 5,12        |                                                                                     | 5,64                                                         | 6,38        |                                                |
|                                                                                   | 280               | 11     | 125            | 210  | 4,92                                                                              | 5,57        |                                                                                     | 6,14                                                         | 6,94        |                                                |
|                                                                                   | 300               | 11 3/4 | 135            | 220  | 5,32                                                                              | 6,01        |                                                                                     | 6,63                                                         | 7,49        |                                                |
|                                                                                   | 320               | 12 5/8 | 145            | 235  | 5,71                                                                              | 6,46        |                                                                                     | 7,12                                                         | 8,05        |                                                |
|                                                                                   | 340               | 13 3/8 | 155            | 250  | 6,11                                                                              | 6,90        |                                                                                     | 7,61                                                         | 8,60        |                                                |
|                                                                                   | 360               | 14 1/4 | 165            | 265  | 6,50                                                                              | 7,35        |                                                                                     | 8,10                                                         | 9,16        |                                                |
|                                                                                   | 380               | 15     | 175            | 280  | 6,89                                                                              | 7,80        |                                                                                     | 8,59                                                         | 9,71        |                                                |
|                                                                                   | 400               | 15 3/4 | 185            | 295  | 7,29                                                                              | 8,24        |                                                                                     | 9,08                                                         | 10,27       |                                                |
|                                                                                   | 440               | 17 1/4 | 205            | 320  | 8,07                                                                              | 9,13        |                                                                                     | 10,06                                                        | 11,38       |                                                |
|                                                                                   | 480               | 19     | 225            | 350  | 8,86                                                                              | 10,02       |                                                                                     | 11,04                                                        | 12,49       |                                                |
|                                                                                   | 520               | 20 1/2 | 245            | 380  | 9,65                                                                              | 10,91       |                                                                                     | 12,03                                                        | 13,60       |                                                |

| geometry                                                                          |      |        |                |      | SLIDING <sup>(4)</sup>                                                            |       |                                                                                     |                                                              |       |                                                |
|-----------------------------------------------------------------------------------|------|--------|----------------|------|-----------------------------------------------------------------------------------|-------|-------------------------------------------------------------------------------------|--------------------------------------------------------------|-------|------------------------------------------------|
|                                                                                   |      |        |                |      | butt joint<br>(double inclination at 45° + 45°) <sup>(10)</sup>                   |       | half-lap joint<br>α=45°                                                             |                                                              |       |                                                |
|  |      |        |                |      |  |       |  |                                                              |       |                                                |
|                                                                                   |      |        |                |      | factored lateral<br>resistance N <sub>r</sub> <sup>(5)</sup>                      |       | factored tension<br>resistance T <sub>rs</sub>                                      | factored lateral<br>resistance N <sub>r</sub> <sup>(5)</sup> |       | factored tension<br>resistance T <sub>rs</sub> |
|                                                                                   |      |        |                |      | G                                                                                 |       |                                                                                     | G                                                            |       |                                                |
| d <sub>1</sub>                                                                    | L    |        | S <sub>g</sub> | A    | 0.42                                                                              | 0.49  |                                                                                     | 0.42                                                         | 0.49  |                                                |
| $\frac{[mm]}{[in]}$                                                               | [mm] | [in]   | [mm]           | [mm] | [kN]                                                                              | [kN]  | [kN]                                                                                | [kN]                                                         | [kN]  | [kN]                                           |
| 11<br>0.44                                                                        | 250  | 10     | 110            | 185  | 5,30                                                                              | 5,99  | 11,59                                                                               | 6,60                                                         | 7,47  | 16,38                                          |
|                                                                                   | 300  | 11 3/4 | 135            | 220  | 6,50                                                                              | 7,35  |                                                                                     | 8,10                                                         | 9,16  |                                                |
|                                                                                   | 350  | 13 3/4 | 160            | 255  | 7,70                                                                              | 8,72  |                                                                                     | 9,60                                                         | 10,86 |                                                |
|                                                                                   | 400  | 15 3/4 | 185            | 295  | 8,91                                                                              | 10,08 |                                                                                     | 11,10                                                        | 12,56 |                                                |
|                                                                                   | 450  | 17 3/4 | 210            | 330  | 10,11                                                                             | 11,44 |                                                                                     | 12,60                                                        | 14,25 |                                                |
|                                                                                   | 500  | 19 3/4 | 235            | 365  | 11,31                                                                             | 12,80 |                                                                                     | 14,10                                                        | 15,95 |                                                |
|                                                                                   | 550  | 21 5/8 | 260            | 400  | 12,52                                                                             | 14,16 |                                                                                     | 15,60                                                        | 17,65 |                                                |
|                                                                                   | 600  | 23 5/8 | 285            | 435  | 13,72                                                                             | 15,52 |                                                                                     | 17,10                                                        | 19,34 |                                                |

$\alpha$  = screw-to-grain angle

## STRUCTURAL VALUES

### GENERAL PRINCIPLES

- The reference factored lateral resistance for self-tapping screws has been determined following the guidelines in Clause 12.12 of the CSA O86:24 including the withdrawal restraint effect. Listed values are based on standard long term load duration factor ( $K_D = 1.0$ ), dry service condition factor ( $K_{SF} = 1.0$ ), and treatment factor ( $K_T = 1.0$ ).
- The factored thread withdrawal resistance were evaluated considering a penetration length of  $S_{g, tot}$  or  $S_g$ , as shown in the table. For intermediate values of  $S_g$  it is possible to linearly interpolate
- The reference lateral design values are calculated for screws inserted without pre-drilling as per CSA O86:24 Clause 12.12.10.5.3. The direction of the bearing-to-grain angle does not influence lateral resistance. In the case of screws inserted with pre-drilling, greater resistance values can be obtained.
- VGZ screws must be positioned in accordance with the minimum distances.
- G is the mean relative density according to CSA O86:24 Table A12. Most common wood species are assumed such as Northern species ( $G = 0.35$ ), Spruce-Pine-Fir ( $G = 0.42$ ), Douglas Fir ( $G = 0.49$ ), and Southern Pine ( $G = 0.55$ ).
- The tabulated lateral design values are based on both wood members having the same specific gravity  $G$ .
- As part of the connection design, the designer must size and verify both the structural wood members and the steel plates separately.
- Combined shear and tensile stresses shall comply with the interaction criteria outlined in CSA O86:24 Clause 12.12.11.

### NOTES

- (1) Factored withdrawal resistances were calculated with the entire threaded portion of the screw,  $b$  (in millimeters), minus the tip length,  $L_{tip}$ . The length of the tip is equal to the nominal diameter of the respective fasteners,  $d_1$ , as specified in the ELC-4645 report. Factor for fastener axis-to-grain angle,  $J_a$ , and the factor for dowel bearing effect for laterally loaded connections,  $J_w$ , varies according to connection geometry. The factored tensile resistance of the connector ( $P_{rt}$ ) is governed by the lower value between the withdrawal resistance ( $P_{rw}$ ) and the steel strength ( $T_{rs}$ ). Similarly, the factored compression resistance of the connector ( $P_{rc}$ ) is determined as the lower value between the withdrawal resistance ( $P_{rw}$ ) and the buckling capacity ( $P_{rb}$ ).
- (2) The angle between the fastener axis and the grain direction of the wood member,  $\alpha$ , is taken as zero for the end grain calculations. Self-tapping screws installed perpendicular to the panel edge of CLT are assumed to be installed in the end grain of member.
- (3) VGZ screws installed in the end grain may not meet the minimum penetration requirement for withdrawal ( $20 d_1$ ) specified in CSA O86:24 Clause 12.12.6.1. Discretion and engineering judgment must be exercised to evaluate the impact of reduced penetration on the connection's capacity.
- (4) For fully threaded screws, head pull-through does not govern the connection capacity, instead, thread withdrawal governs. The governing axial resistance is taken as the minimum of the screw's shear, thread withdrawal, and tensile resistances. In this case, the tensile resistance is always lower than the shear resistance, so the governing value is the minimum between thread withdrawal and tensile resistance.
- (5) 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.
- (6) Lateral resistances are factored and according to CSA O86:24 Clause 12.12.10. Values apply to dry service conditions and are representative of a single screw.
- (7) The fixable thickness ( $A$ ) is considered as half the length of the screw ( $L/2$ ).
- (8) The number of cross pairs,  $n_F$ , has been taken as 2.0 and 3.0 for configurations with two and three screw pairs, respectively, in accordance with CSA O86:24. However, when evaluating the effective number of screws in axially stressed connector pairs, Rothoblaas recommends using reduced values of 1.9 and 2.7 for two and three pairs, respectively. This recommendation accounts for the fact that the load-bearing capacity of a multi-screw connection—with screws of the same size and type—may be lower than the sum of the individual screw capacities, due to group effects and non-uniform load distribution within the connection. Discretion and engineering judgment must be exercised.
- (9) The factored shear resistance,  $R_v$ , of crossed screws is determined by taking the minimum of  $2 \cdot P_{rt} \cdot \cos(\beta)$ ,  $2 \cdot P_{rc} \cdot \cos(\beta)$ , and  $V_{rs/\sin(\beta)}$ , where  $P_{rt}$  represents the factored axial resistance of screws loaded in tension,  $P_{rc}$  represents the factored axial resistance of screws loaded in compression, and  $V_{rs}$  represents the factored shear resistance of screws. This approach accounts for the directional component of the axial forces relative to the shear plane and ensures a conservative estimate by considering the governing case among all conditions.
- (10) The sliding strengths of the connectors inserted with double inclination (45°-45°) were evaluated considering an  $\alpha$  angle of 60° between the grain and the connector; in fact, the geometry of the joint requires that the connectors have to 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. The use of the JIG VGZ 45 template is recommended for professional installation of the connectors in this application.

## ■ INSTALLATION SUGGESTIONS

### TIMBER-TO-TIMBER JOINT WITH CROSSED CONNECTORS

#### TIGHTENING THE JOINT



For correct installation of the joint, we recommend tightening the elements before inserting the connectors.



Insert a partially threaded screw (e.g. HBS680) to bring the elements closer together.



The HBS screw eliminated the initial gap between the elements. After positioning the VGZ connectors, it can be removed.

#### INSERTION OF CONNECTORS



To ensure the correct positioning and inclination of the VGZ screws, we recommend using the JIGVGZ45 template.



After tightening about one third of the screw, remove the JIGVGZ45 template and continue with the installation.



Repeat the procedure to install the inserted screw from the main beam to the secondary beam.

### JOINT BETWEEN CLT PANELS WITH CONNECTORS INCLINED IN BOTH DIRECTIONS [45°-45°]



To ensure the correct positioning and inclination of the VGZ screws, we recommend using the JIGVGZ45 template positioned at 45° to the panel head.



After tightening about one third of the screw, remove the JIGVGZ45 template and continue with the installation.



Repeat the procedure to install the screw in the adjoining panel and continue this alternating sequence according to the distances provided in the design.

## ■ RELATED PRODUCTS



HBS



CATCH



BIT



JIG VGZ 4