

## FULL THREADED SCREW WITH CYLINDRICAL HEAD

### 3 THORNS TIP

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

### STRUCTURAL APPLICATIONS

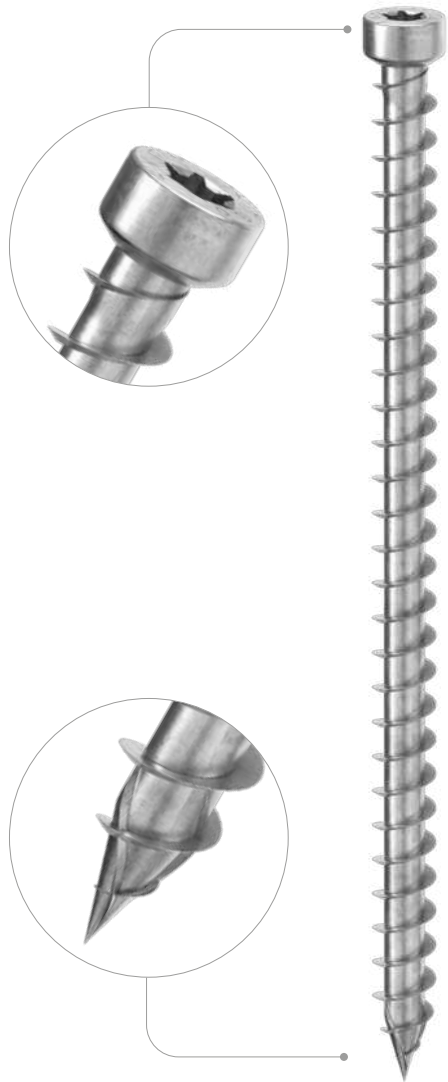
Structural connector approved for timber applications subjected to stresses in any direction according to ICC ELC-4645 listing report in Canada. Cyclical SEISMIC-REV tests according to EN 12512.

### 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 re-inforcements. It is the right choice to ensure strength in fire conditions.

### TIMBER FRAME

Also ideal for joining small timber elements such as the crossbeams and uprights of light frame structures.



VIDEO



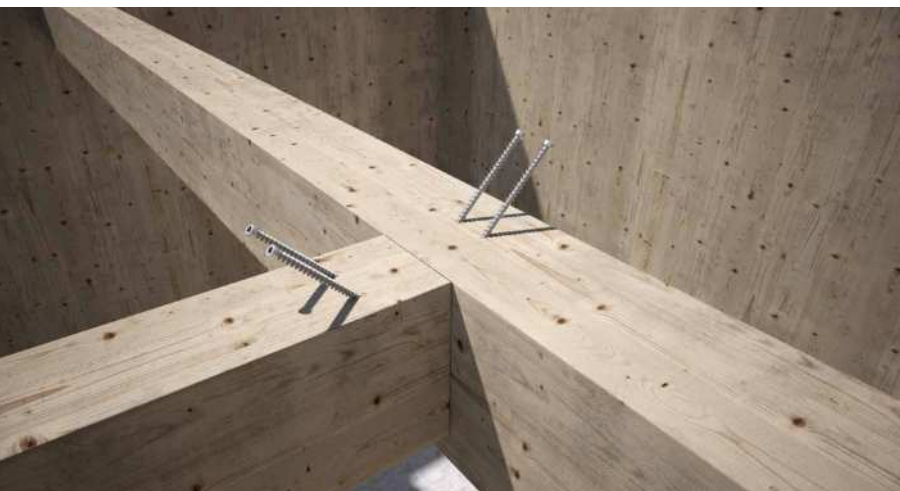
BIT INCLUDED

|                         |                   |                                          |      |      |
|-------------------------|-------------------|------------------------------------------|------|------|
| DIAMETER [mm]           | 5                 | 7                                        | 11   | 11   |
| LENGTH [mm]             | 80                | 80                                       | 1000 | 1000 |
| SERVICE CONDITION       | EC1               | DRY                                      |      |      |
| ATMOSPHERIC CORROSIVITY | C1                | C2                                       |      |      |
| WOOD CORROSIVITY        | T1                | T2                                       |      |      |
| MATERIAL                | Zn ELECTRO PLATED | electrogalvanized carbon steel           |      |      |
| CORE HARDNESS           | <390 HV           | 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
- glulam (Glued Laminated Timber)
- CLT and LVL
- high density woods

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

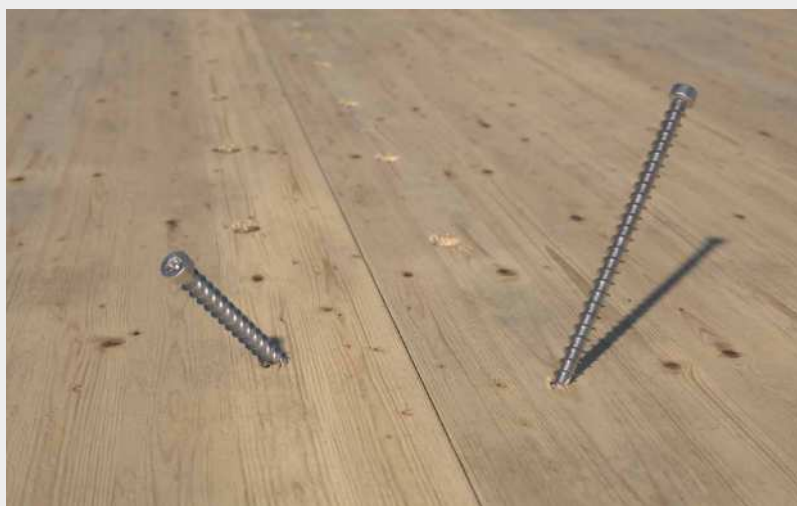


## STRUCTURAL RESTORATION

Ideal for coupling beams in structural renovations and new works. Can also be used parallel to the grain thanks to the special approval.

### CLT, LVL

Values also tested, certified and calculated for CLT and high density woods such as LVL.

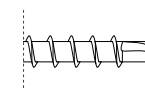
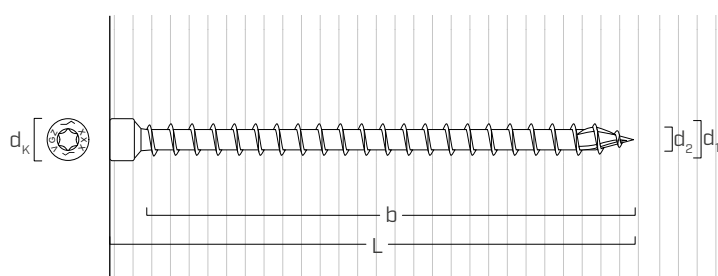


Very high stiffness in side-by-side joining of CLT floors.  
Application with double inclination at 45°, perfect combined with the JIG VGZ template.



Reinforcement orthogonal to grain for hanging load due to joining of main-secondary beams.

## GEOMETRY AND MECHANICAL CHARACTERISTICS



Ø9 | L > 520 mm  
Ø11 | L > 600 mm

### GEOMETRY

| Nominal diameter                          | d <sub>1</sub>   | [mm] | 7    | 9     | 11    |
|-------------------------------------------|------------------|------|------|-------|-------|
| Head diameter                             | d <sub>K</sub>   | [mm] | 9,50 | 11,50 | 13,50 |
| Root diameter                             | d <sub>2</sub>   | [mm] | 4,60 | 5,90  | 6,60  |
| Pre-drilling hole diameter <sup>(1)</sup> | d <sub>V,S</sub> | [mm] | 4,0  | 5,0   | 6,0   |
| Pre-drilling hole diameter <sup>(2)</sup> | d <sub>V,H</sub> | [mm] | 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]   | 7      | 9     | 11    |       |
|---------------------------------------------------------------------------------|-----------------|--------|--------|-------|-------|-------|
| Factored tensile strength                                                       | Φf <sub>u</sub> | [kN]   | 10,64  | 17,84 | 23,17 |       |
| Bending yield strength                                                          | F <sub>yb</sub> | [MPa]  | 1111   | 1069  | 1026  |       |
| Factored shear strength of the screw                                            | Φv <sub>s</sub> | [kN]   | 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 | 61,1  | 78,56 | 96,02 |
|                                                                                 |                 |        | G=0.42 | 70,7  | 90,9  | 111,1 |
|                                                                                 |                 |        | G=0.49 | 79,98 | 102,8 | 125,7 |
|                                                                                 |                 |        | G=0.55 | 87,72 | 112,8 | 137,9 |

## CODES AND DIMENSIONS

| d <sub>1</sub><br>[mm] | CODE    | L<br>[mm] | b<br>[mm] | pcs |
|------------------------|---------|-----------|-----------|-----|
| 7<br>TX 30             | VGZ780  | 80        | 70        | 50  |
|                        | VGZ7100 | 100       | 90        | 50  |
|                        | VGZ7120 | 120       | 110       | 50  |
|                        | VGZ7140 | 140       | 130       | 50  |
|                        | VGZ7160 | 160       | 150       | 50  |
|                        | VGZ7180 | 180       | 170       | 50  |
|                        | VGZ7200 | 200       | 190       | 50  |
|                        | VGZ7220 | 220       | 210       | 50  |
|                        | VGZ7240 | 240       | 230       | 50  |
|                        | VGZ7260 | 260       | 250       | 50  |
|                        | VGZ7280 | 280       | 270       | 50  |
|                        | VGZ7300 | 300       | 290       | 50  |
|                        | VGZ7320 | 320       | 310       | 50  |
|                        | VGZ7340 | 340       | 330       | 50  |
|                        | VGZ7360 | 360       | 350       | 50  |
|                        | VGZ7380 | 380       | 370       | 50  |
|                        | VGZ7400 | 400       | 390       | 50  |
|                        | VGZ9160 | 160       | 150       | 50  |
|                        | VGZ9180 | 180       | 170       | 50  |
|                        | VGZ9200 | 200       | 190       | 50  |
| 9<br>TX 40             | VGZ9220 | 220       | 210       | 50  |
|                        | VGZ9240 | 240       | 230       | 50  |
|                        | VGZ9260 | 260       | 250       | 25  |
|                        | VGZ9280 | 280       | 270       | 50  |
|                        | VGZ9300 | 300       | 290       | 50  |
|                        | VGZ9320 | 320       | 310       | 50  |
|                        | VGZ9340 | 340       | 330       | 50  |
|                        | VGZ9360 | 360       | 350       | 50  |
|                        | VGZ9380 | 380       | 370       | 50  |
|                        | VGZ9400 | 400       | 390       | 50  |
|                        | VGZ9440 | 440       | 430       | 25  |
|                        | VGZ9480 | 480       | 470       | 25  |
|                        | VGZ9520 | 520       | 510       | 25  |
|                        | VGZ9560 | 560       | 550       | 25  |
|                        | VGZ9600 | 600       | 590       | 25  |

| d <sub>1</sub><br>[mm] | CODE      | L<br>[mm] | b<br>[mm] | pcs |
|------------------------|-----------|-----------|-----------|-----|
| 11<br>TX 50            | VGZ11150  | 150       | 140       | 25  |
|                        | VGZ11200  | 200       | 190       | 25  |
|                        | VGZ11250  | 250       | 240       | 25  |
|                        | VGZ11275  | 275       | 265       | 25  |
|                        | VGZ11300  | 300       | 290       | 25  |
|                        | VGZ11325  | 325       | 315       | 25  |
|                        | VGZ11350  | 350       | 340       | 25  |
|                        | VGZ11375  | 375       | 365       | 25  |
|                        | VGZ11400  | 400       | 390       | 25  |
|                        | VGZ11425  | 425       | 415       | 25  |
|                        | VGZ11450  | 450       | 440       | 25  |
|                        | VGZ11475  | 475       | 465       | 25  |
|                        | VGZ11500  | 500       | 490       | 25  |
|                        | VGZ11525  | 525       | 515       | 25  |
|                        | VGZ11550  | 550       | 540       | 25  |
|                        | VGZ11575  | 575       | 565       | 25  |
|                        | VGZ11600  | 600       | 590       | 25  |
|                        | VGZ11650  | 650       | 630       | 25  |
|                        | VGZ11700  | 700       | 680       | 25  |
|                        | VGZ11750  | 750       | 730       | 25  |
|                        | VGZ11800  | 800       | 780       | 25  |
|                        | VGZ11850  | 850       | 830       | 25  |
|                        | VGZ11900  | 900       | 880       | 25  |
|                        | VGZ11950  | 950       | 930       | 25  |
|                        | VGZ111000 | 1000      | 980       | 25  |

## RELATED PRODUCTS



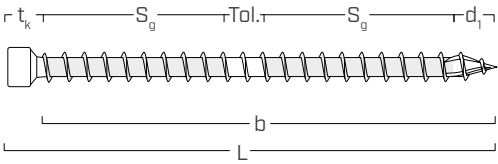
**JIG VGZ 4**  
TEMPLATE FOR 45° SCREWS



### JIG VGZ 45° TEMPLATE

Installation at 45° using the JIG VGZ steel template.

EFFECTIVE THREAD USED IN CALCULATION



b = S<sub>g,tot</sub> = L - t<sub>k</sub>

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

S<sub>g</sub> = (b - d<sub>1</sub> - Tol.)/2

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

t<sub>k</sub> = 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<sub>1</sub>, as specified in the ELC-4645 report.

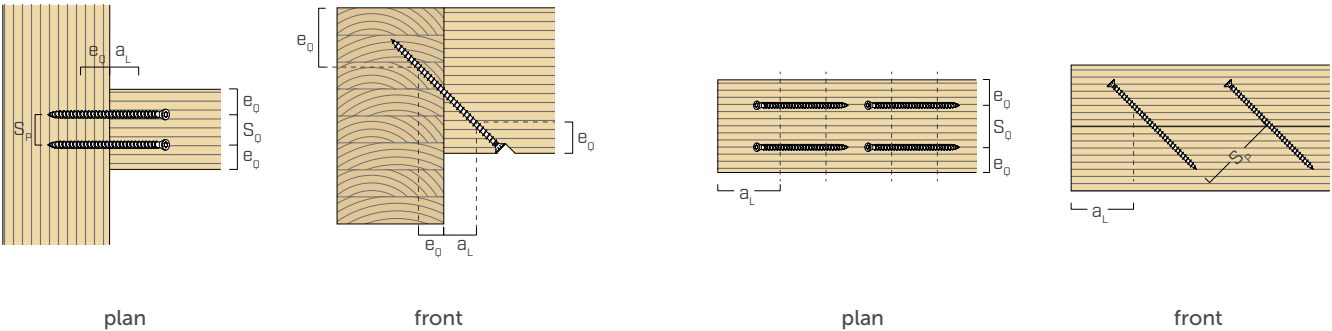
MINIMUM DISTANCES FOR AXIAL STRESSES | TIMBER

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

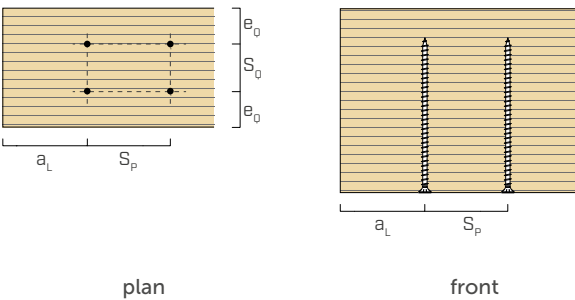
| d <sub>1</sub> |                   | 7<br>[mm] | 0.28<br>[in] | 9<br>[mm] | 0.36<br>[in] | 11<br>[mm] | 0.44<br>[in] |
|----------------|-------------------|-----------|--------------|-----------|--------------|------------|--------------|
| S <sub>p</sub> | 7·d <sup>†</sup>  | 49        | 1 15/16      | 63        | 2 1/2        | 77         | 3 1/16       |
| S <sub>Q</sub> | 5·d               | 35        | 1 3/8        | 45        | 1 3/4        | 55         | 2 3/16       |
| a <sub>L</sub> | 10·d <sup>†</sup> | 70        | 2 3/4        | 90        | 3 1/2        | 110        | 4 3/8        |
| a              | 7·d <sup>†</sup>  | 49        | 1 15/16      | 63        | 2 1/2        | 77         | 3 1/16       |
| e <sub>Q</sub> | 4·d               | 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%.

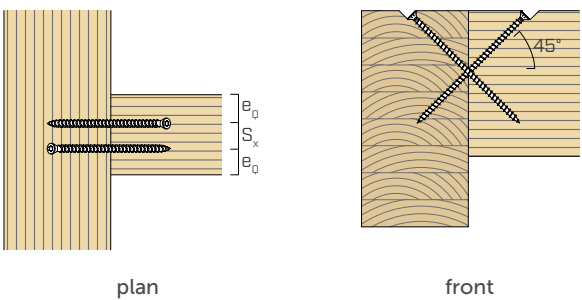
SCREWS UNDER TENSION INSERTED WITH AN ANGLE α WITH RESPECT TO THE GRAIN



SCREWS INSERTED WITH α = 90° ANGLE WITH RESPECT TO THE GRAIN

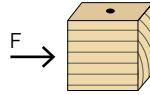


CROSSED SCREWS INSERTED WITH AN ANGLE α WITH RESPECT TO THE GRAIN



## MINIMUM DISTANCES FOR SHEAR LOADS | TIMBER

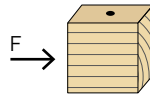
screws inserted **WITHOUT** pre-drilled hole  $G \leq 0.44$



| $d_1$ |                   | 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> | 84        | 3 5/16       | 108       | 4 1/4        | 132        | 5 3/16       |
| $S_Q$ | 5·d               | 35        | 1 3/8        | 45        | 1 3/4        | 55         | 2 3/16       |
| $a_L$ | 15·d <sup>‡</sup> | 105       | 4 1/8        | 135       | 5 5/16       | 165        | 6 1/2        |
| $a$   | 10·d <sup>‡</sup> | 70        | 2 3/4        | 90        | 3 1/2        | 110        | 4 3/8        |
| $e_Q$ | 10·d              | 70        | 2 3/4        | 90        | 3 1/2        | 110        | 4 3/8        |
| $e_P$ | 5·d               | 35        | 1 3/8        | 45        | 1 3/4        | 55         | 2 3/16       |
| $S_x$ | 2·d               | 14        | 9/16         | 18        | 11/16        | 22         | 7/8          |

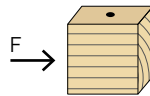
<sup>‡</sup> For Western Red Cedar, this minimum spacing shall be increased by 50%.

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



| $d_1$ |      | 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 | 126       | 4 15/16      | 162       | 6 3/8        | 198        | 7 13/16      |
| $S_Q$ | 7·d  | 49        | 1 15/16      | 63        | 2 1/2        | 77         | 3 1/16       |
| $a_L$ | 22·d | 154       | 6 1/16       | 198       | 7 13/16      | 242        | 9 1/2        |
| $a$   | 15·d | 105       | 4 1/8        | 135       | 5 5/16       | 165        | 6 1/2        |
| $e_Q$ | 12·d | 84        | 3 5/16       | 108       | 4 1/4        | 132        | 5 3/16       |
| $e_P$ | 7·d  | 49        | 1 15/16      | 63        | 2 1/2        | 77         | 3 1/16       |
| $S_x$ | 3·d  | 21        | 13/16        | 27        | 1 1/16       | 33         | 1 5/16       |

screws inserted **WITH** pre-drilled hole

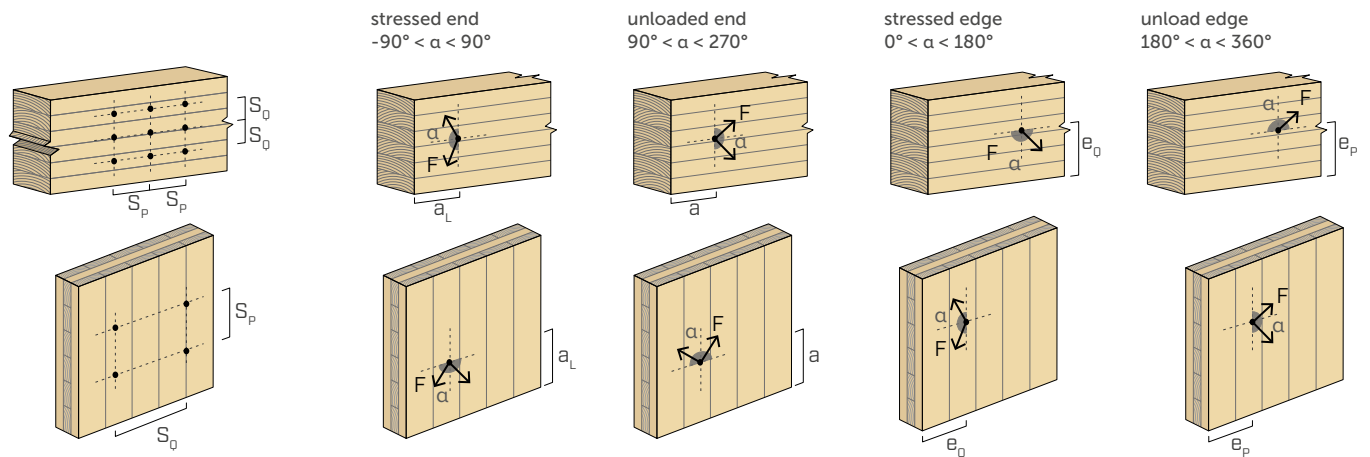


| $d_1$ |                   | 7<br>[mm] | 0.28<br>[in] | 9<br>[mm] | 0.36<br>[in] | 11<br>[mm] | 0.44<br>[in] |
|-------|-------------------|-----------|--------------|-----------|--------------|------------|--------------|
| $S_P$ | 5·d <sup>†</sup>  | 35        | 1 3/8        | 45        | 1 3/4        | 55         | 2 3/16       |
| $S_Q$ | 4·d               | 28        | 1 1/8        | 36        | 1 7/16       | 44         | 1 3/4        |
| $a_L$ | 12·d <sup>†</sup> | 84        | 3 5/16       | 108       | 4 1/4        | 132        | 5 3/16       |
| $a$   | 7·d <sup>†</sup>  | 49        | 1 15/16      | 63        | 2 1/2        | 77         | 3 1/16       |
| $e_Q$ | 7·d               | 49        | 1 15/16      | 63        | 2 1/2        | 77         | 3 1/16       |
| $e_P$ | 3·d               | 21        | 13/16        | 27        | 1 1/16       | 33         | 1 5/16       |
| $S_x$ | 1.5·d             | 11        | 7/16         | 14        | 9/16         | 17         | 11/16        |

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

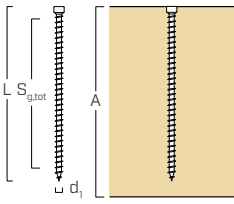
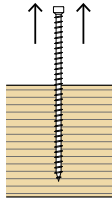
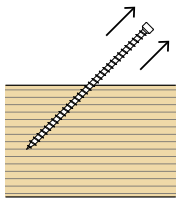
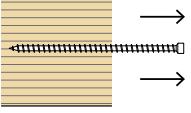
$d = d_1$  = nominal diameter of the screw

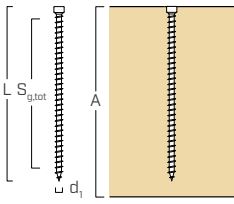
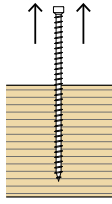
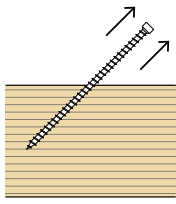
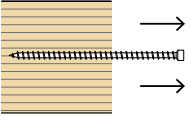
$\alpha$  = load-to-grain angle



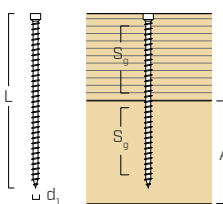
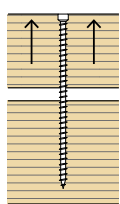
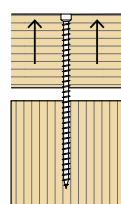
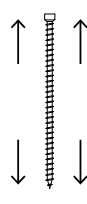
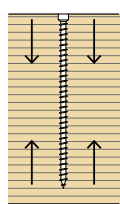
### NOTES

- 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]<br>[in] | [mm]<br>[in] | [mm]<br>[in] |     | [kN]                                                                              | [kN]  | [kN]  | [kN]  | [kN]                                                                               | [kN]  | [kN]  | [kN]  | [kN]                                                                                | [kN]  | [kN]  | [kN]  |
| 7<br>0.28                                                                         | 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  |
|                                                                                   | 320          | 12 5/8       | 303          | 330 | 12,96                                                                             | 15,00 | 16,96 | 18,61 | 11,78                                                                              | 13,63 | 15,42 | 16,91 | 6,48                                                                                | 7,50  | 8,48  | 9,30  |
|                                                                                   | 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  |
|                                                                                   | 360          | 14 1/4       | 343          | 370 | 14,67                                                                             | 16,98 | 19,20 | 21,06 | 13,34                                                                              | 15,43 | 17,46 | 19,15 | 7,34                                                                                | 8,49  | 9,60  | 10,53 |
|                                                                                   | 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 |
| 9<br>0.36                                                                         | 400          | 15 3/4       | 383          | 410 | 16,38                                                                             | 18,95 | 21,44 | 23,52 | 14,89                                                                              | 17,23 | 19,49 | 21,38 | 8,19                                                                                | 9,48  | 10,72 | 11,76 |
|                                                                                   | 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 |
|                                                                                   | 560          | 22           | 541          | 570 | 29,75                                                                             | 34,42 | 38,93 | 42,72 | 27,05                                                                              | 31,29 | 35,39 | 38,83 | 14,88                                                                               | 17,21 | 19,47 | 21,36 |
|                                                                                   | 600          | 23 5/8       | 581          | 610 | 31,95                                                                             | 36,97 | 41,81 | 45,88 | 29,05                                                                              | 33,61 | 38,01 | 41,71 | 15,98                                                                               | 18,48 | 20,90 | 22,94 |

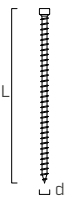
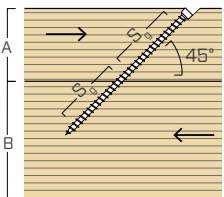
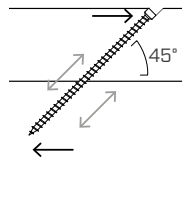
| geometry                                                                          |              |              |              |      | TENSION/COMPRESSION <sup>(1)</sup>                                                |       |       |       |                                                                                    |       |       |       |                                                                                     |       |       |       |
|-----------------------------------------------------------------------------------|--------------|--------------|--------------|------|-----------------------------------------------------------------------------------|-------|-------|-------|------------------------------------------------------------------------------------|-------|-------|-------|-------------------------------------------------------------------------------------|-------|-------|-------|
|                                                                                   |              |              |              |      | $\alpha = 90^\circ$                                                               |       |       |       | 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]  |
| 11<br>0.44                                                                        | 150          | 6            | 129          | 160  | 8,67                                                                              | 10,03 | 11,35 | 12,45 | 7,88                                                                               | 9,12  | 10,32 | 11,32 | 4,34                                                                                | 5,02  | 5,68  | 6,23  |
|                                                                                   | 200          | 8            | 179          | 210  | 12,03                                                                             | 13,92 | 15,75 | 17,28 | 10,94                                                                              | 12,66 | 14,32 | 15,71 | 6,02                                                                                | 6,96  | 7,88  | 8,64  |
|                                                                                   | 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 |
|                                                                                   | 275          | 10 7/8       | 254          | 285  | 17,07                                                                             | 19,75 | 22,35 | 24,52 | 15,52                                                                              | 17,96 | 20,32 | 22,29 | 8,54                                                                                | 9,88  | 11,17 | 12,26 |
|                                                                                   | 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 |
|                                                                                   | 325          | 12 3/4       | 304          | 335  | 20,43                                                                             | 23,64 | 26,75 | 29,35 | 18,58                                                                              | 21,49 | 24,32 | 26,68 | 10,22                                                                               | 11,82 | 13,37 | 14,67 |
|                                                                                   | 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 |
|                                                                                   | 375          | 14 3/4       | 354          | 385  | 23,79                                                                             | 27,53 | 31,15 | 34,17 | 21,63                                                                              | 25,03 | 28,32 | 31,07 | 11,90                                                                               | 13,77 | 15,57 | 17,09 |
|                                                                                   | 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 |
|                                                                                   | 425          | 16 3/4       | 404          | 435  | 27,15                                                                             | 31,42 | 35,55 | 39,00 | 24,69                                                                              | 28,56 | 32,32 | 35,45 | 13,58                                                                               | 15,71 | 17,77 | 19,50 |
|                                                                                   | 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 |
|                                                                                   | 475          | 18 11/16     | 454          | 485  | 30,52                                                                             | 35,31 | 39,95 | 43,82 | 27,74                                                                              | 32,10 | 36,32 | 39,84 | 15,26                                                                               | 17,65 | 19,97 | 21,91 |
|                                                                                   | 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 |
|                                                                                   | 525          | 20 11/16     | 504          | 535  | 33,88                                                                             | 39,20 | 44,35 | 48,65 | 30,80                                                                              | 35,63 | 40,32 | 44,23 | 16,94                                                                               | 19,60 | 22,17 | 24,33 |
|                                                                                   | 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 |
|                                                                                   | 575          | 22 5/8       | 554          | 585  | 37,24                                                                             | 43,08 | 48,75 | 53,48 | 33,85                                                                              | 39,17 | 44,31 | 48,62 | 18,62                                                                               | 21,54 | 24,37 | 26,74 |
|                                                                                   | 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 |
|                                                                                   | 650          | 25 9/16      | 619          | 660  | 41,61                                                                             | 48,14 | 54,47 | 59,75 | 37,82                                                                              | 43,76 | 49,51 | 54,32 | 20,80                                                                               | 24,07 | 27,23 | 29,88 |
|                                                                                   | 700          | 27 1/2       | 669          | 710  | 44,97                                                                             | 52,03 | 58,87 | 64,58 | 40,88                                                                              | 47,30 | 53,51 | 58,71 | 22,48                                                                               | 26,01 | 29,43 | 32,29 |
|                                                                                   | 750          | 29 1/2       | 719          | 760  | 48,33                                                                             | 55,92 | 63,26 | 69,41 | 43,93                                                                              | 50,83 | 57,51 | 63,10 | 24,16                                                                               | 27,96 | 31,63 | 34,70 |
|                                                                                   | 800          | 31 1/2       | 769          | 810  | 51,69                                                                             | 59,81 | 67,66 | 74,23 | 46,99                                                                              | 54,37 | 61,51 | 67,48 | 25,84                                                                               | 29,90 | 33,83 | 37,12 |
|                                                                                   | 850          | 33 7/16      | 819          | 860  | 55,05                                                                             | 63,69 | 72,06 | 79,06 | 50,04                                                                              | 57,90 | 65,51 | 71,87 | 27,52                                                                               | 31,85 | 36,03 | 39,53 |
|                                                                                   | 900          | 35 1/2       | 869          | 910  | 58,41                                                                             | 67,58 | 76,46 | 83,88 | 53,10                                                                              | 61,44 | 69,51 | 76,26 | 29,20                                                                               | 33,79 | 38,23 | 41,94 |
|                                                                                   | 950          | 37 3/8       | 919          | 960  | 61,77                                                                             | 71,47 | 80,86 | 88,71 | 56,15                                                                              | 64,97 | 73,51 | 80,65 | 30,88                                                                               | 35,74 | 40,43 | 44,36 |
|                                                                                   | 1000         | 39 3/8       | 969          | 1010 | 65,13                                                                             | 75,36 | 85,26 | 93,54 | 59,21                                                                              | 68,51 | 77,51 | 85,03 | 32,57                                                                               | 37,68 | 42,63 | 46,77 |

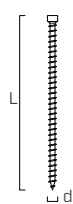
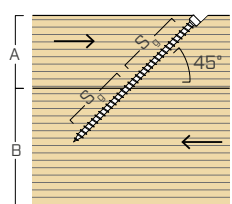
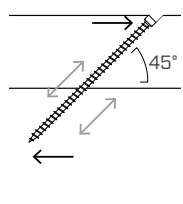
$\alpha$  = screw-to-grain angle

|                                                                                   |      |        |               |                   | TENSION/COMPRESSION <sup>(1)</sup>                                                |       |       |       |                                                                                   |      |       |       |                                                                                     |                                                                                     |
|-----------------------------------------------------------------------------------|------|--------|---------------|-------------------|-----------------------------------------------------------------------------------|-------|-------|-------|-----------------------------------------------------------------------------------|------|-------|-------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|
| geometry                                                                          |      |        |               |                   | 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  |                                                                                     |                                                                                     |
| 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                                                                               | 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  |                                                                                     |                                                                                     |
|                                                                                   | 320  | 12 5/8 | 145           | 165               | 6,20                                                                              | 7,18  | 8,12  | 8,90  | 3,10                                                                              | 3,59 | 4,06  | 4,45  |                                                                                     |                                                                                     |
|                                                                                   | 340  | 13 3/8 | 155           | 175               | 6,63                                                                              | 7,67  | 8,68  | 9,52  | 3,31                                                                              | 3,84 | 4,34  | 4,76  |                                                                                     |                                                                                     |
|                                                                                   | 360  | 14 1/4 | 165           | 185               | 7,06                                                                              | 8,17  | 9,24  | 10,13 | 3,53                                                                              | 4,08 | 4,62  | 5,07  |                                                                                     |                                                                                     |
|                                                                                   | 380  | 15     | 175           | 195               | 7,48                                                                              | 8,66  | 9,80  | 10,75 | 3,74                                                                              | 4,33 | 4,90  | 5,37  |                                                                                     |                                                                                     |
|                                                                                   | 400  | 15 3/4 | 185           | 205               | 7,91                                                                              | 9,16  | 10,36 | 11,36 | 3,96                                                                              | 4,58 | 5,18  | 5,68  |                                                                                     |                                                                                     |
| 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                                                                               | 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  |                                                                                     |                                                                                     |
|                                                                                   | 560  | 22     | 265           | 285               | 14,57                                                                             | 16,86 | 19,07 | 20,92 | 7,29                                                                              | 8,43 | 9,53  | 10,46 |                                                                                     |                                                                                     |
|                                                                                   | 600  | 23 5/8 | 285           | 305               | 15,67                                                                             | 18,13 | 20,51 | 22,50 | 7,84                                                                              | 9,07 | 10,25 | 11,25 |                                                                                     |                                                                                     |

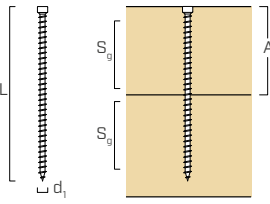
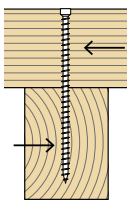
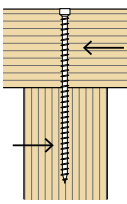
|              |              |              |              |     | TENSION/COMPRESSION <sup>(1)</sup>               |       |       |       |                                                  |       |       |       |
|--------------|--------------|--------------|--------------|-----|--------------------------------------------------|-------|-------|-------|--------------------------------------------------|-------|-------|-------|
| geometry     |              |              |              |     | partial thread withdrawal<br>$\alpha = 90^\circ$ |       |       |       | end grain $\alpha = 0^\circ$                     |       |       |       |
|              |              |              |              |     |                                                  |       |       |       |                                                  |       |       |       |
|              |              |              |              |     | factored withdrawal resistance $P_{rw}$          |       |       |       | factored withdrawal resistance $P_{rw}^{(2)(3)}$ |       |       |       |
|              |              |              |              |     | 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]<br>[in] | [mm]<br>[in] | [mm]<br>[in] |     | [kN]                                             | [kN]  | [kN]  | [kN]  | [kN]                                             | [kN]  | [kN]  | [kN]  |
| 11<br>0.44   | 150          | 6            | 60           | 80  | 4,03                                             | 4,67  | 5,28  | 5,79  | 2,02                                             | 2,33  | 2,64  | 2,90  |
|              | 200          | 8            | 85           | 105 | 5,71                                             | 6,61  | 7,48  | 8,21  | 2,86                                             | 3,31  | 3,74  | 4,10  |
|              | 250          | 10           | 110          | 130 | 7,39                                             | 8,55  | 9,68  | 10,62 | 3,70                                             | 4,28  | 4,84  | 5,31  |
|              | 275          | 10 7/8       | 120          | 143 | 8,07                                             | 9,33  | 10,56 | 11,58 | 4,03                                             | 4,67  | 5,28  | 5,79  |
|              | 300          | 11 3/4       | 135          | 155 | 9,07                                             | 10,50 | 11,88 | 13,03 | 4,54                                             | 5,25  | 5,94  | 6,52  |
|              | 325          | 12 3/4       | 145          | 168 | 9,75                                             | 11,28 | 12,76 | 14,00 | 4,87                                             | 5,64  | 6,38  | 7,00  |
|              | 350          | 13 3/4       | 160          | 180 | 10,75                                            | 12,44 | 14,08 | 15,44 | 5,38                                             | 6,22  | 7,04  | 7,72  |
|              | 375          | 14 3/4       | 170          | 193 | 11,43                                            | 13,22 | 14,96 | 16,41 | 5,71                                             | 6,61  | 7,48  | 8,21  |
|              | 400          | 15 3/4       | 185          | 205 | 12,43                                            | 14,39 | 16,28 | 17,86 | 6,22                                             | 7,19  | 8,14  | 8,93  |
|              | 425          | 16 3/4       | 195          | 218 | 13,11                                            | 15,17 | 17,16 | 18,82 | 6,55                                             | 7,58  | 8,58  | 9,41  |
|              | 450          | 17 3/4       | 210          | 230 | 14,11                                            | 16,33 | 18,48 | 20,27 | 7,06                                             | 8,17  | 9,24  | 10,14 |
|              | 475          | 18 11/16     | 220          | 243 | 14,79                                            | 17,11 | 19,36 | 21,24 | 7,39                                             | 8,55  | 9,68  | 10,62 |
|              | 500          | 19 3/4       | 235          | 255 | 15,80                                            | 18,28 | 20,68 | 22,68 | 7,90                                             | 9,14  | 10,34 | 11,34 |
|              | 525          | 20 11/16     | 245          | 268 | 16,47                                            | 19,05 | 21,56 | 23,65 | 8,23                                             | 9,53  | 10,78 | 11,82 |
|              | 550          | 21 5/8       | 260          | 280 | 17,48                                            | 20,22 | 22,88 | 25,10 | 8,74                                             | 10,11 | 11,44 | 12,55 |
|              | 575          | 22 5/8       | 270          | 293 | 18,15                                            | 21,00 | 23,76 | 26,06 | 9,07                                             | 10,50 | 11,88 | 13,03 |
|              | 600          | 23 5/8       | 285          | 305 | 19,16                                            | 22,16 | 25,08 | 27,51 | 9,58                                             | 11,08 | 12,54 | 13,76 |
|              | 650          | 25 9/16      | 305          | 330 | 20,50                                            | 23,72 | 26,84 | 29,44 | 10,25                                            | 11,86 | 13,42 | 14,72 |
|              | 700          | 27 1/2       | 330          | 355 | 22,18                                            | 25,66 | 29,04 | 31,85 | 11,09                                            | 12,83 | 14,52 | 15,93 |
|              | 750          | 29 1/2       | 355          | 380 | 23,86                                            | 27,61 | 31,24 | 34,27 | 11,93                                            | 13,80 | 15,62 | 17,13 |
|              | 800          | 31 1/2       | 380          | 405 | 25,54                                            | 29,55 | 33,44 | 36,68 | 12,77                                            | 14,78 | 16,72 | 18,34 |
|              | 850          | 33 7/16      | 405          | 430 | 27,22                                            | 31,50 | 35,64 | 39,09 | 13,61                                            | 15,75 | 17,82 | 19,55 |
|              | 900          | 35 1/2       | 430          | 455 | 28,90                                            | 33,44 | 37,84 | 41,51 | 14,45                                            | 16,72 | 18,92 | 20,75 |
|              | 950          | 37 3/8       | 455          | 480 | 30,58                                            | 35,39 | 40,04 | 43,92 | 15,29                                            | 17,69 | 20,02 | 21,96 |
|              | 1000         | 39 3/8       | 480          | 505 | 32,26                                            | 37,33 | 42,24 | 46,33 | 16,13                                            | 18,66 | 21,12 | 23,17 |

$\alpha$  = screw-to-grain angle

| 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                                                      |  |  |  | 0.42                                        |  | 0.49 |  | 0.55 |  |  |  |
|                                                                                   |     |        |                                                                                   |     |     |                        |       |       |           |                                                                                     |  |                          |  |  | [kN]                                                      |  |  |  | [kN]                                        |  |      |  |      |  |  |  |
| 7<br>0.28                                                                         | 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      |                                                                                     |  |                          |  |  |                                                           |  |  |  |                                             |  |      |  |      |  |  |  |
|                                                                                   | 320 | 12 5/8 | 145                                                                               | 120 | 135 | 4,78                   | 5,54  | 6,26  | 6,87      |                                                                                     |  |                          |  |  |                                                           |  |  |  |                                             |  |      |  |      |  |  |  |
|                                                                                   | 340 | 13 3/8 | 155                                                                               | 125 | 140 | 5,11                   | 5,92  | 6,69  | 7,34      |                                                                                     |  |                          |  |  |                                                           |  |  |  |                                             |  |      |  |      |  |  |  |
|                                                                                   | 360 | 14 1/4 | 165                                                                               | 130 | 145 | 5,44                   | 6,30  | 7,13  | 7,82      |                                                                                     |  |                          |  |  |                                                           |  |  |  |                                             |  |      |  |      |  |  |  |
|                                                                                   | 380 | 15     | 175                                                                               | 140 | 155 | 5,77                   | 6,68  | 7,56  | 8,29      |                                                                                     |  |                          |  |  |                                                           |  |  |  |                                             |  |      |  |      |  |  |  |
|                                                                                   | 400 | 15 3/4 | 185                                                                               | 145 | 160 | 6,10                   | 7,06  | 7,99  | 8,76      |                                                                                     |  |                          |  |  |                                                           |  |  |  |                                             |  |      |  |      |  |  |  |
| 9<br>0.36                                                                         | 160 | 6 1/4  | 65                                                                                | 60  | 75  | 2,76                   | 3,19  | 3,61  | 3,96      | 12,61                                                                               |  |                          |  |  |                                                           |  |  |  |                                             |  |      |  |      |  |  |  |
|                                                                                   | 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     |                                                                                     |  |                          |  |  |                                                           |  |  |  |                                             |  |      |  |      |  |  |  |
|                                                                                   | 560 | 22     | 265                                                                               | 205 | 220 | 11,24                  | 13,01 | 14,71 | 16,14     |                                                                                     |  |                          |  |  |                                                           |  |  |  |                                             |  |      |  |      |  |  |  |
|                                                                                   | 600 | 23 5/8 | 285                                                                               | 215 | 230 | 12,09                  | 13,99 | 15,82 | 17,36     |                                                                                     |  |                          |  |  |                                                           |  |  |  |                                             |  |      |  |      |  |  |  |

|                                                                                   |      | SLIDING <sup>[4]</sup> |                                                                                   |           |                          |                                                           |              |                   |                                                                                     |                                             |
|-----------------------------------------------------------------------------------|------|------------------------|-----------------------------------------------------------------------------------|-----------|--------------------------|-----------------------------------------------------------|--------------|-------------------|-------------------------------------------------------------------------------------|---------------------------------------------|
| geometry                                                                          |      |                        | timber-to-timber                                                                  |           |                          |                                                           |              |                   | steel tension                                                                       |                                             |
|  |      |                        |  |           |                          |                                                           |              |                   |  |                                             |
| d <sub>1</sub><br>[mm]<br>[in]                                                    | L    |                        | 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> |
|                                                                                   | [mm] | [in]                   |                                                                                   |           |                          | 0.35<br>[kN]                                              | 0.42<br>[kN] | G<br>0.49<br>[kN] | 0.55<br>[kN]                                                                        | [kN]                                        |
| 11<br>0.44                                                                        | 150  | 6                      | 60                                                                                | 60        | 75                       | 3,11                                                      | 3,60         | 4,07              | 4,47                                                                                | 16,38                                       |
|                                                                                   | 200  | 8                      | 85                                                                                | 75        | 90                       | 4,41                                                      | 5,10         | 5,77              | 6,33                                                                                |                                             |
|                                                                                   | 250  | 10                     | 110                                                                               | 95        | 110                      | 5,70                                                      | 6,60         | 7,47              | 8,19                                                                                |                                             |
|                                                                                   | 275  | 10 7/8                 | 120                                                                               | 100       | 115                      | 6,22                                                      | 7,20         | 8,14              | 8,94                                                                                |                                             |
|                                                                                   | 300  | 11 3/4                 | 135                                                                               | 110       | 125                      | 7,00                                                      | 8,10         | 9,16              | 10,05                                                                               |                                             |
|                                                                                   | 325  | 12 3/4                 | 145                                                                               | 120       | 135                      | 7,52                                                      | 8,70         | 9,84              | 10,80                                                                               |                                             |
|                                                                                   | 350  | 13 3/4                 | 160                                                                               | 130       | 145                      | 8,30                                                      | 9,60         | 10,86             | 11,91                                                                               |                                             |
|                                                                                   | 375  | 14 3/4                 | 170                                                                               | 135       | 150                      | 8,81                                                      | 10,20        | 11,54             | 12,66                                                                               |                                             |
|                                                                                   | 400  | 15 3/4                 | 185                                                                               | 145       | 160                      | 9,59                                                      | 11,10        | 12,56             | 13,78                                                                               |                                             |
|                                                                                   | 425  | 16 3/4                 | 195                                                                               | 155       | 170                      | 10,11                                                     | 11,70        | 13,24             | 14,52                                                                               |                                             |
|                                                                                   | 450  | 17 3/4                 | 210                                                                               | 165       | 180                      | 10,89                                                     | 12,60        | 14,25             | 15,64                                                                               |                                             |
|                                                                                   | 475  | 18 11/16               | 220                                                                               | 170       | 185                      | 11,41                                                     | 13,20        | 14,93             | 16,38                                                                               |                                             |
|                                                                                   | 500  | 19 3/4                 | 235                                                                               | 180       | 195                      | 12,18                                                     | 14,10        | 15,95             | 17,50                                                                               |                                             |
|                                                                                   | 525  | 20 11/16               | 245                                                                               | 190       | 205                      | 12,70                                                     | 14,70        | 16,63             | 18,24                                                                               |                                             |
|                                                                                   | 550  | 21 5/8                 | 260                                                                               | 200       | 215                      | 13,48                                                     | 15,60        | 17,65             | 19,36                                                                               |                                             |
|                                                                                   | 575  | 22 5/8                 | 270                                                                               | 205       | 220                      | 14,00                                                     | 16,20        | 18,33             | 20,10                                                                               |                                             |
|                                                                                   | 600  | 23 5/8                 | 285                                                                               | 215       | 230                      | 14,78                                                     | 17,10        | 19,34             | 21,22                                                                               |                                             |
|                                                                                   | 650  | 25 9/16                | 305                                                                               | 240       | 255                      | 15,81                                                     | 18,30        | 20,70             | 22,71                                                                               |                                             |
|                                                                                   | 700  | 27 1/2                 | 330                                                                               | 255       | 270                      | 17,11                                                     | 19,80        | 22,40             | 24,57                                                                               |                                             |
|                                                                                   | 750  | 29 1/2                 | 355                                                                               | 275       | 290                      | 18,41                                                     | 21,30        | 24,10             | 26,43                                                                               |                                             |
|                                                                                   | 800  | 31 1/2                 | 380                                                                               | 290       | 305                      | 19,70                                                     | 22,80        | 25,79             | 28,30                                                                               |                                             |
|                                                                                   | 850  | 33 7/16                | 405                                                                               | 310       | 325                      | 21,00                                                     | 24,30        | 27,49             | 30,16                                                                               |                                             |
|                                                                                   | 900  | 35 1/2                 | 430                                                                               | 325       | 340                      | 22,29                                                     | 25,80        | 29,19             | 32,02                                                                               |                                             |
|                                                                                   | 950  | 37 3/8                 | 455                                                                               | 345       | 360                      | 23,59                                                     | 27,30        | 30,88             | 33,88                                                                               |                                             |
|                                                                                   | 1000 | 39 3/8                 | 480                                                                               | 360       | 375                      | 24,89                                                     | 28,80        | 32,58             | 35,74                                                                               |                                             |

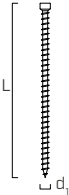
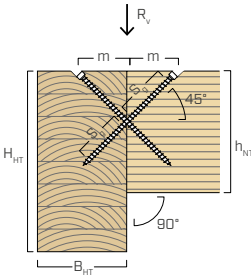
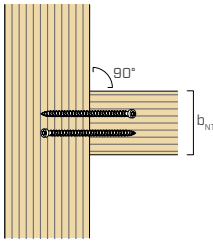
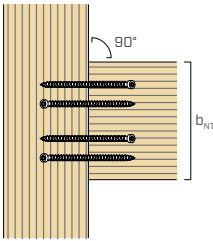
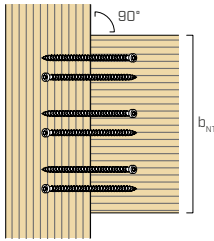
NOTES and GENERAL PRINCIPLES on page 26.

| geometry                                                                          |              |              |                  |              | SHEAR <sup>[6]</sup>                                                              |      |      |      |                                                                                     |      |      |      |
|-----------------------------------------------------------------------------------|--------------|--------------|------------------|--------------|-----------------------------------------------------------------------------------|------|------|------|-------------------------------------------------------------------------------------|------|------|------|
|                                                                                   |              |              |                  |              | timber-to-timber                                                                  |      |      |      |                                                                                     |      |      |      |
|                                                                                   |              |              |                  |              | $\alpha = 90^\circ$                                                               |      |      |      | $\alpha = 0^\circ$                                                                  |      |      |      |
|  |              |              |                  |              |  |      |      |      |  |      |      |      |
|                                                                                   |              |              |                  |              | factored lateral resistance $N_r$                                                 |      |      |      | factored lateral resistance $N_r^{(2)(3)}$                                          |      |      |      |
|                                                                                   |              |              |                  |              | 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>[in]     | [mm]<br>[in] | [kN]                                                                              | [kN] | [kN] | [kN] | [kN]                                                                                | [kN] | [kN] | [kN] |
| 7<br>0.28                                                                         | 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 |
|                                                                                   | 320          | 12 5/8       | 145              | 160          | 2,51                                                                              | 2,75 | 2,97 | 3,15 | 1,74                                                                                | 1,96 | 2,16 | 2,33 |
|                                                                                   | 340          | 13 3/8       | 155              | 170          | 2,51                                                                              | 2,75 | 2,97 | 3,15 | 1,79                                                                                | 2,02 | 2,23 | 2,38 |
|                                                                                   | 360          | 14 1/4       | 165              | 180          | 2,51                                                                              | 2,75 | 2,97 | 3,15 | 1,85                                                                                | 2,08 | 2,25 | 2,38 |
|                                                                                   | 380          | 15           | 175              | 190          | 2,51                                                                              | 2,75 | 2,97 | 3,15 | 1,90                                                                                | 2,08 | 2,25 | 2,38 |
|                                                                                   | 400          | 15 3/4       | 185              | 200          | 2,51                                                                              | 2,75 | 2,97 | 3,15 | 1,90                                                                                | 2,08 | 2,25 | 2,38 |
| 9<br>0.36                                                                         | 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 |
|                                                                                   | 560          | 22           | 265              | 280          | 3,91                                                                              | 4,28 | 4,62 | 4,90 | 2,95                                                                                | 3,24 | 3,49 | 3,70 |
|                                                                                   | 600          | 23 5/8       | 285              | 300          | 3,91                                                                              | 4,28 | 4,62 | 4,90 | 2,95                                                                                | 3,24 | 3,49 | 3,70 |

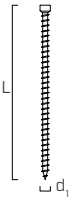
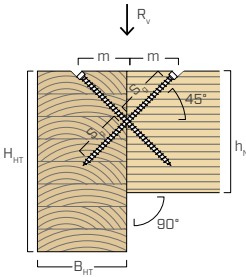
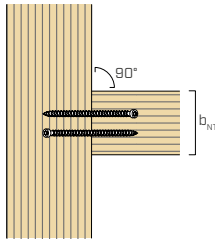
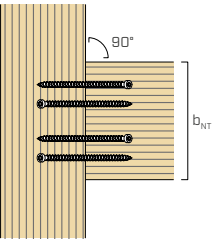
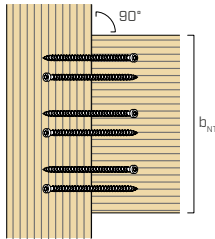
| geometry     |              |              |                  |     | SHEAR <sup>[6]</sup>              |      |      |      |                                            |      |      |      |
|--------------|--------------|--------------|------------------|-----|-----------------------------------|------|------|------|--------------------------------------------|------|------|------|
|              |              |              |                  |     | 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>[in]     |     | [kN]                              | [kN] | [kN] | [kN] | [kN]                                       | [kN] | [kN] | [kN] |
| 11<br>0.44   | 150          | 6            | 60               | 75  | 3,24                              | 3,81 | 4,17 | 4,47 | 1,86                                       | 2,12 | 2,37 | 2,57 |
|              | 200          | 8            | 85               | 100 | 3,84                              | 4,29 | 4,72 | 5,07 | 2,22                                       | 2,54 | 2,85 | 3,11 |
|              | 250          | 10           | 110              | 125 | 4,26                              | 4,78 | 5,27 | 5,68 | 2,58                                       | 2,97 | 3,34 | 3,62 |
|              | 275          | 10 7/8       | 120              | 138 | 4,47                              | 5,02 | 5,55 | 5,98 | 2,76                                       | 3,18 | 3,51 | 3,77 |
|              | 300          | 11 3/4       | 135              | 150 | 4,68                              | 5,27 | 5,75 | 6,09 | 2,94                                       | 3,31 | 3,65 | 3,92 |
|              | 325          | 12 3/4       | 145              | 163 | 4,86                              | 5,32 | 5,75 | 6,09 | 3,07                                       | 3,44 | 3,78 | 4,07 |
|              | 350          | 13 3/4       | 160              | 175 | 4,86                              | 5,32 | 5,75 | 6,09 | 3,17                                       | 3,56 | 3,92 | 4,22 |
|              | 375          | 14 3/4       | 170              | 188 | 4,86                              | 5,32 | 5,75 | 6,09 | 3,28                                       | 3,68 | 4,06 | 4,37 |
|              | 400          | 15 3/4       | 185              | 200 | 4,86                              | 5,32 | 5,75 | 6,09 | 3,38                                       | 3,80 | 4,20 | 4,52 |
|              | 425          | 16 3/4       | 195              | 213 | 4,86                              | 5,32 | 5,75 | 6,09 | 3,49                                       | 3,92 | 4,33 | 4,60 |
|              | 450          | 17 3/4       | 210              | 225 | 4,86                              | 5,32 | 5,75 | 6,09 | 3,59                                       | 4,02 | 4,35 | 4,60 |
|              | 475          | 18 11/16     | 220              | 238 | 4,86                              | 5,32 | 5,75 | 6,09 | 3,67                                       | 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 |
|              | 525          | 20 11/16     | 245              | 263 | 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 |
|              | 575          | 22 5/8       | 270              | 288 | 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 |
|              | 650          | 25 9/16      | 300              | 325 | 4,86                              | 5,32 | 5,75 | 6,09 | 3,67                                       | 4,02 | 4,35 | 4,60 |
|              | 700          | 27 1/2       | 325              | 350 | 4,86                              | 5,32 | 5,75 | 6,09 | 3,67                                       | 4,02 | 4,35 | 4,60 |
|              | 750          | 29 1/2       | 350              | 375 | 4,86                              | 5,32 | 5,75 | 6,09 | 3,67                                       | 4,02 | 4,35 | 4,60 |
|              | 800          | 31 1/2       | 375              | 400 | 4,86                              | 5,32 | 5,75 | 6,09 | 3,67                                       | 4,02 | 4,35 | 4,60 |
|              | 850          | 33 7/16      | 400              | 425 | 4,86                              | 5,32 | 5,75 | 6,09 | 3,67                                       | 4,02 | 4,35 | 4,60 |
|              | 900          | 35 1/2       | 425              | 450 | 4,86                              | 5,32 | 5,75 | 6,09 | 3,67                                       | 4,02 | 4,35 | 4,60 |
|              | 950          | 37 3/8       | 450              | 475 | 4,86                              | 5,32 | 5,75 | 6,09 | 3,67                                       | 4,02 | 4,35 | 4,60 |
|              | 1000         | 39 3/8       | 475              | 500 | 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>

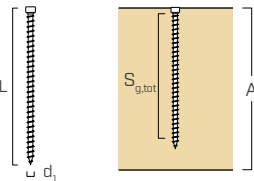
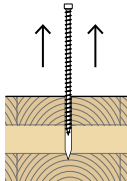
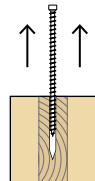
| geometry                                                                          |              |              | main beam<br>secondary beam                                                       |                                            |                |       | 1 pair                                                                            |                                                            |       | 2 pairs                                                                            |                                                            |       | 3 pairs                                                                             |                                                            |       |
|-----------------------------------------------------------------------------------|--------------|--------------|-----------------------------------------------------------------------------------|--------------------------------------------|----------------|-------|-----------------------------------------------------------------------------------|------------------------------------------------------------|-------|------------------------------------------------------------------------------------|------------------------------------------------------------|-------|-------------------------------------------------------------------------------------|------------------------------------------------------------|-------|
|  |              |              |  |                                            |                |       |  |                                                            |       |  |                                                            |       |  |                                                            |       |
| d <sub>1</sub>                                                                    | L            |              | B <sub>HT,min</sub>                                                               | H <sub>HT,min</sub><br>h <sub>NT,min</sub> | S <sub>g</sub> | m     | b <sub>NT,min</sub>                                                               | factored shear<br>resistance R <sub>v</sub> <sup>(9)</sup> |       | b <sub>NT,min</sub>                                                                | factored shear<br>resistance R <sub>v</sub> <sup>(9)</sup> |       | b <sub>NT,min</sub>                                                                 | factored shear<br>resistance R <sub>v</sub> <sup>(9)</sup> |       |
|                                                                                   | [mm]<br>[in] | [mm]<br>[in] |                                                                                   |                                            |                |       |                                                                                   | G                                                          | G     |                                                                                    | G                                                          | G     |                                                                                     |                                                            |       |
| 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 |
|                                                                                   | 320          | 12 5/8       | 130                                                                               | 240                                        | 145            | 116   |                                                                                   | 9,23                                                       | 10,44 |                                                                                    | 18,45                                                      | 20,87 |                                                                                     | 27,68                                                      | 31,31 |
|                                                                                   | 340          | 13 3/8       | 140                                                                               | 255                                        | 155            | 123   |                                                                                   | 9,86                                                       | 11,16 |                                                                                    | 19,72                                                      | 22,31 |                                                                                     | 29,59                                                      | 33,47 |
|                                                                                   | 360          | 14 1/4       | 145                                                                               | 270                                        | 165            | 130   |                                                                                   | 10,50                                                      | 11,88 |                                                                                    | 21,00                                                      | 23,75 |                                                                                     | 31,50                                                      | 35,63 |
|                                                                                   | 380          | 15           | 155                                                                               | 285                                        | 175            | 137   |                                                                                   | 11,13                                                      | 12,60 |                                                                                    | 22,27                                                      | 25,19 |                                                                                     | 33,40                                                      | 37,79 |
|                                                                                   | 400          | 15 3/4       | 160                                                                               | 300                                        | 185            | 144   |                                                                                   | 11,77                                                      | 13,32 |                                                                                    | 23,54                                                      | 26,63 |                                                                                     | 35,31                                                      | 39,95 |
| 9<br>0.36                                                                         | 160          | 6 1/4        | 75                                                                                | 130                                        | 65             | 60    | 90                                                                                | 5,32                                                       | 6,01  | 135                                                                                | 10,63                                                      | 12,03 | 180                                                                                 | 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 |
|                                                                                   | 560          | 22           | 215                                                                               | 410                                        | 265            | 201   |                                                                                   | 21,49                                                      | 21,49 |                                                                                    | 42,99                                                      | 42,99 |                                                                                     | 64,48                                                      | 64,48 |
| 600                                                                               | 23 5/8       | 230          | 440                                                                               | 285                                        | 215            | 21,49 | 21,49                                                                             | 42,99                                                      | 42,99 | 64,48                                                                              | 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>                                                                    | L                   |                     | B <sub>HT,min</sub>                                                               | H <sub>HT,min</sub><br>h <sub>NT,min</sub> | S <sub>g</sub> | m    | b <sub>NT,min</sub>                                                               | factored shear<br>resistance R <sub>v</sub> <sup>(9)</sup> |       | b <sub>NT,min</sub>                                                                | factored shear<br>resistance R <sub>v</sub> <sup>(9)</sup> |       | b <sub>NT,min</sub>                                                                 | factored shear<br>resistance R <sub>v</sub> <sup>(9)</sup> |       |
|                                                                                   | [mm]<br><i>[in]</i> | [mm]<br><i>[in]</i> |                                                                                   |                                            |                |      |                                                                                   | G                                                          |       |                                                                                    | G                                                          |       |                                                                                     | G                                                          |       |
|                                                                                   | [mm]                | <i>[in]</i>         | [mm]                                                                              | [mm]                                       | [mm]           | [mm] | [mm]                                                                              | 0.42                                                       | 0.49  | [mm]                                                                               | 0.42                                                       | 0.49  | [mm]                                                                                | 0.42                                                       | 0.49  |
| 11<br>0.44                                                                        | 150                 | 6                   | 70                                                                                | 120                                        | 60             | 56   | 110                                                                               | 6,00                                                       | 6,79  | 165                                                                                | 12,00                                                      | 13,57 | 220                                                                                 | 18,00                                                      | 20,36 |
|                                                                                   | 200                 | 8                   | 90                                                                                | 155                                        | 85             | 74   |                                                                                   | 8,50                                                       | 9,62  |                                                                                    | 17,00                                                      | 19,23 |                                                                                     | 25,50                                                      | 28,85 |
|                                                                                   | 250                 | 10                  | 105                                                                               | 190                                        | 110            | 91   |                                                                                   | 11,00                                                      | 12,44 |                                                                                    | 22,00                                                      | 24,89 |                                                                                     | 33,00                                                      | 37,33 |
|                                                                                   | 275                 | 10 7/8              | 115                                                                               | 210                                        | 120            | 98   |                                                                                   | 12,00                                                      | 13,57 |                                                                                    | 24,00                                                      | 27,15 |                                                                                     | 35,99                                                      | 40,72 |
|                                                                                   | 300                 | 11 3/4              | 125                                                                               | 225                                        | 135            | 109  |                                                                                   | 13,50                                                      | 15,27 |                                                                                    | 27,00                                                      | 30,54 |                                                                                     | 40,49                                                      | 45,82 |
|                                                                                   | 325                 | 12 3/4              | 130                                                                               | 245                                        | 145            | 116  |                                                                                   | 14,50                                                      | 16,40 |                                                                                    | 29,00                                                      | 32,81 |                                                                                     | 43,49                                                      | 49,21 |
|                                                                                   | 350                 | 13 3/4              | 140                                                                               | 260                                        | 160            | 127  |                                                                                   | 16,00                                                      | 18,10 |                                                                                    | 32,00                                                      | 36,20 |                                                                                     | 47,99                                                      | 54,30 |
|                                                                                   | 375                 | 14 3/4              | 150                                                                               | 280                                        | 170            | 134  |                                                                                   | 17,00                                                      | 19,23 |                                                                                    | 33,99                                                      | 38,46 |                                                                                     | 50,99                                                      | 57,69 |
|                                                                                   | 400                 | 15 3/4              | 160                                                                               | 300                                        | 185            | 144  |                                                                                   | 18,50                                                      | 20,93 |                                                                                    | 36,99                                                      | 41,86 |                                                                                     | 55,49                                                      | 62,78 |
|                                                                                   | 425                 | 16 3/4              | 165                                                                               | 315                                        | 195            | 152  |                                                                                   | 19,50                                                      | 22,06 |                                                                                    | 38,99                                                      | 44,12 |                                                                                     | 58,49                                                      | 66,18 |
|                                                                                   | 450                 | 17 3/4              | 180                                                                               | 335                                        | 210            | 162  |                                                                                   | 21,00                                                      | 23,76 |                                                                                    | 41,99                                                      | 47,51 |                                                                                     | 62,99                                                      | 71,27 |
|                                                                                   | 475                 | 18 11/16            | 185                                                                               | 350                                        | 220            | 169  |                                                                                   | 22,00                                                      | 24,89 |                                                                                    | 43,99                                                      | 49,77 |                                                                                     | 65,99                                                      | 74,66 |
|                                                                                   | 500                 | 19 3/4              | 195                                                                               | 370                                        | 235            | 180  |                                                                                   | 23,50                                                      | 25,81 |                                                                                    | 46,99                                                      | 51,63 |                                                                                     | 70,49                                                      | 77,44 |
|                                                                                   | 525                 | 20 11/16            | 200                                                                               | 385                                        | 245            | 187  |                                                                                   | 24,50                                                      | 25,81 |                                                                                    | 48,99                                                      | 51,63 |                                                                                     | 73,49                                                      | 77,44 |
|                                                                                   | 550                 | 21 5/8              | 215                                                                               | 405                                        | 260            | 197  |                                                                                   | 25,81                                                      | 25,81 |                                                                                    | 51,63                                                      | 51,63 |                                                                                     | 77,44                                                      | 77,44 |
|                                                                                   | 575                 | 22 5/8              | 220                                                                               | 420                                        | 270            | 205  |                                                                                   | 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 |
|                                                                                   | 650                 | 25 9/16             | 245                                                                               | 475                                        | 305            | 229  |                                                                                   | 25,81                                                      | 25,81 |                                                                                    | 51,63                                                      | 51,63 |                                                                                     | 77,44                                                      | 77,44 |
|                                                                                   | 700                 | 27 1/2              | 260                                                                               | 510                                        | 330            | 247  |                                                                                   | 25,81                                                      | 25,81 |                                                                                    | 51,63                                                      | 51,63 |                                                                                     | 77,44                                                      | 77,44 |
|                                                                                   | 750                 | 29 1/2              | 280                                                                               | 545                                        | 355            | 265  |                                                                                   | 25,81                                                      | 25,81 |                                                                                    | 51,63                                                      | 51,63 |                                                                                     | 77,44                                                      | 77,44 |
|                                                                                   | 800                 | 31 1/2              | 300                                                                               | 580                                        | 380            | 282  |                                                                                   | 25,81                                                      | 25,81 |                                                                                    | 51,63                                                      | 51,63 |                                                                                     | 77,44                                                      | 77,44 |
|                                                                                   | 850                 | 33 7/16             | 315                                                                               | 615                                        | 405            | 300  |                                                                                   | 25,81                                                      | 25,81 |                                                                                    | 51,63                                                      | 51,63 |                                                                                     | 77,44                                                      | 77,44 |
|                                                                                   | 900                 | 35 1/2              | 335                                                                               | 650                                        | 430            | 318  |                                                                                   | 25,81                                                      | 25,81 |                                                                                    | 51,63                                                      | 51,63 |                                                                                     | 77,44                                                      | 77,44 |
|                                                                                   | 950                 | 37 3/8              | 350                                                                               | 685                                        | 455            | 335  |                                                                                   | 25,81                                                      | 25,81 |                                                                                    | 51,63                                                      | 51,63 |                                                                                     | 77,44                                                      | 77,44 |
|                                                                                   | 1000                | 39 3/8              | 370                                                                               | 720                                        | 480            | 353  |                                                                                   | 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 $P_{rw}^{(2)(3)}$ |              |              |              |
| $d_1$<br>[mm]<br>[in] | L    |        | $S_{g,tot}$<br>[mm] | $A_{min}$<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] |
| 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         |
|                       | 320  | 12 5/8 | 303                 | 330               | 12,96                                   | 15,00        | 16,96        | 18,61        | 6,48                                             | 7,50         | 8,48         | 9,30         |
|                       | 340  | 13 3/8 | 323                 | 350               | 13,81                                   | 15,99        | 18,08        | 19,83        | 6,91                                             | 7,99         | 9,04         | 9,92         |
|                       | 360  | 14 1/4 | 343                 | 370               | 14,67                                   | 16,98        | 19,20        | 21,06        | 7,34                                             | 8,49         | 9,60         | 10,53        |
|                       | 380  | 15     | 363                 | 390               | 15,53                                   | 17,96        | 20,32        | 22,29        | 7,76                                             | 8,98         | 10,16        | 11,14        |
| 9<br>0.36             | 400  | 15 3/4 | 383                 | 410               | 16,38                                   | 18,95        | 21,44        | 23,52        | 8,19                                             | 9,48         | 10,72        | 11,76        |
|                       | 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        |
|                       | 560  | 22     | 541                 | 570               | 29,75                                   | 34,42        | 38,93        | 42,72        | 14,88                                            | 17,21        | 19,47        | 21,36        |
|                       | 600  | 23 5/8 | 581                 | 610               | 31,95                                   | 36,97        | 41,81        | 45,88        | 15,98                                            | 18,48        | 20,90        | 22,94        |

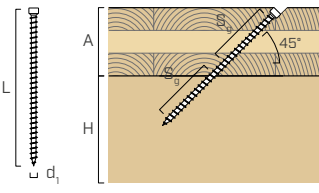
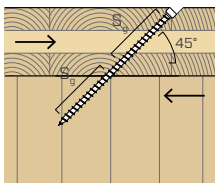
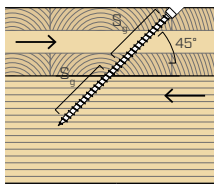
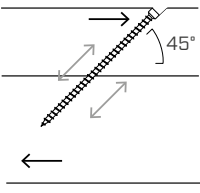
|                                                                                   |              |             |           |      | TENSION <sup>(1)</sup>                                                            |       |       |       |                                                                                     |       |       |       |
|-----------------------------------------------------------------------------------|--------------|-------------|-----------|------|-----------------------------------------------------------------------------------|-------|-------|-------|-------------------------------------------------------------------------------------|-------|-------|-------|
| 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]  |
| 11<br>0.44                                                                        | 150          | 6           | 129       | 160  | 8,67                                                                              | 10,03 | 11,35 | 12,45 | 4,34                                                                                | 5,02  | 5,68  | 6,23  |
|                                                                                   | 200          | 8           | 179       | 210  | 12,03                                                                             | 13,92 | 15,75 | 17,28 | 6,02                                                                                | 6,96  | 7,88  | 8,64  |
|                                                                                   | 250          | 10          | 229       | 260  | 15,39                                                                             | 17,81 | 20,15 | 22,11 | 7,70                                                                                | 8,90  | 10,07 | 11,05 |
|                                                                                   | 275          | 10 7/8      | 254       | 285  | 17,07                                                                             | 19,75 | 22,35 | 24,52 | 8,54                                                                                | 9,88  | 11,17 | 12,26 |
|                                                                                   | 300          | 11 3/4      | 279       | 310  | 18,75                                                                             | 21,70 | 24,55 | 26,93 | 9,38                                                                                | 10,85 | 12,27 | 13,47 |
|                                                                                   | 325          | 12 3/4      | 304       | 335  | 20,43                                                                             | 23,64 | 26,75 | 29,35 | 10,22                                                                               | 11,82 | 13,37 | 14,67 |
|                                                                                   | 350          | 13 3/4      | 329       | 360  | 22,11                                                                             | 25,59 | 28,95 | 31,76 | 11,06                                                                               | 12,79 | 14,47 | 15,88 |
|                                                                                   | 375          | 14 3/4      | 354       | 385  | 23,79                                                                             | 27,53 | 31,15 | 34,17 | 11,90                                                                               | 13,77 | 15,57 | 17,09 |
|                                                                                   | 400          | 15 3/4      | 379       | 410  | 25,47                                                                             | 29,47 | 33,35 | 36,58 | 12,74                                                                               | 14,74 | 16,67 | 18,29 |
|                                                                                   | 425          | 16 3/4      | 404       | 435  | 27,15                                                                             | 31,42 | 35,55 | 39,00 | 13,58                                                                               | 15,71 | 17,77 | 19,50 |
|                                                                                   | 450          | 17 3/4      | 429       | 460  | 28,83                                                                             | 33,36 | 37,75 | 41,41 | 14,42                                                                               | 16,68 | 18,87 | 20,71 |
|                                                                                   | 475          | 18 11/16    | 454       | 485  | 30,52                                                                             | 35,31 | 39,95 | 43,82 | 15,26                                                                               | 17,65 | 19,97 | 21,91 |
|                                                                                   | 500          | 19 3/4      | 479       | 510  | 32,20                                                                             | 37,25 | 42,15 | 46,24 | 16,10                                                                               | 18,63 | 21,07 | 23,12 |
|                                                                                   | 525          | 20 11/16    | 504       | 535  | 33,88                                                                             | 39,20 | 44,35 | 48,65 | 16,94                                                                               | 19,60 | 22,17 | 24,33 |
|                                                                                   | 550          | 21 5/8      | 529       | 560  | 35,56                                                                             | 41,14 | 46,55 | 51,06 | 17,78                                                                               | 20,57 | 23,27 | 25,53 |
|                                                                                   | 575          | 22 5/8      | 554       | 585  | 37,24                                                                             | 43,08 | 48,75 | 53,48 | 18,62                                                                               | 21,54 | 24,37 | 26,74 |
|                                                                                   | 600          | 23 5/8      | 579       | 610  | 38,92                                                                             | 45,03 | 50,95 | 55,89 | 19,46                                                                               | 22,51 | 25,47 | 27,95 |
|                                                                                   | 650          | 25 9/16     | 619       | 660  | 41,61                                                                             | 48,14 | 54,47 | 59,75 | 20,80                                                                               | 24,07 | 27,23 | 29,88 |
|                                                                                   | 700          | 27 1/2      | 669       | 710  | 44,97                                                                             | 52,03 | 58,87 | 64,58 | 22,48                                                                               | 26,01 | 29,43 | 32,29 |
|                                                                                   | 750          | 29 1/2      | 719       | 760  | 48,33                                                                             | 55,92 | 63,26 | 69,41 | 24,16                                                                               | 27,96 | 31,63 | 34,70 |
|                                                                                   | 800          | 31 1/2      | 769       | 810  | 51,69                                                                             | 59,81 | 67,66 | 74,23 | 25,84                                                                               | 29,90 | 33,83 | 37,12 |
|                                                                                   | 850          | 33 7/16     | 819       | 860  | 55,05                                                                             | 63,69 | 72,06 | 79,06 | 27,52                                                                               | 31,85 | 36,03 | 39,53 |
|                                                                                   | 900          | 35 1/2      | 869       | 910  | 58,41                                                                             | 67,58 | 76,46 | 83,88 | 29,20                                                                               | 33,79 | 38,23 | 41,94 |
|                                                                                   | 950          | 37 3/8      | 919       | 960  | 61,77                                                                             | 71,47 | 80,86 | 88,71 | 30,88                                                                               | 35,74 | 40,43 | 44,36 |
|                                                                                   | 1000         | 39 3/8      | 969       | 1010 | 65,13                                                                             | 75,36 | 85,26 | 93,54 | 32,57                                                                               | 37,68 | 42,63 | 46,77 |

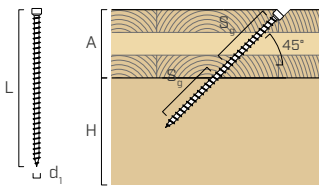
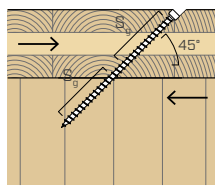
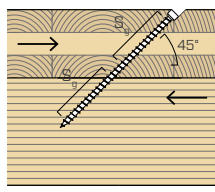
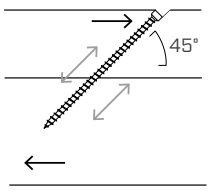
$\alpha$  = screw-to-grain angle

|                       |      |        |       |           | TENSION <sup>(1)</sup>                  |       |       |       |                                                  |      |       |       |                                      |  |
|-----------------------|------|--------|-------|-----------|-----------------------------------------|-------|-------|-------|--------------------------------------------------|------|-------|-------|--------------------------------------|--|
| geometry              |      |        |       |           | partial 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 $T_{rs}$ |  |
| $d_1$<br>[mm]<br>[in] | L    |        | $S_g$ | $A_{min}$ | G                                       |       |       |       | G                                                |      |       |       | [kN]                                 |  |
|                       | [mm] | [in]   | [mm]  | [mm]      | 0.35                                    | 0.42  | 0.49  | 0.55  | 0.35                                             | 0.42 | 0.49  | 0.55  |                                      |  |
| 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  |                                      |  |
|                       | 320  | 12 5/8 | 145   | 165       | 6,20                                    | 7,18  | 8,12  | 8,90  | 3,10                                             | 3,59 | 4,06  | 4,45  |                                      |  |
|                       | 340  | 13 3/8 | 155   | 175       | 6,63                                    | 7,67  | 8,68  | 9,52  | 3,31                                             | 3,84 | 4,34  | 4,76  |                                      |  |
|                       | 360  | 14 1/4 | 165   | 185       | 7,06                                    | 8,17  | 9,24  | 10,13 | 3,53                                             | 4,08 | 4,62  | 5,07  |                                      |  |
|                       | 380  | 15     | 175   | 195       | 7,48                                    | 8,66  | 9,80  | 10,75 | 3,74                                             | 4,33 | 4,90  | 5,37  |                                      |  |
|                       | 400  | 15 3/4 | 185   | 205       | 7,91                                    | 9,16  | 10,36 | 11,36 | 3,96                                             | 4,58 | 5,18  | 5,68  |                                      |  |
| 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  |                                      |  |
|                       | 560  | 22     | 265   | 285       | 14,57                                   | 16,86 | 19,07 | 20,92 | 7,29                                             | 8,43 | 9,53  | 10,46 |                                      |  |
|                       | 600  | 23 5/8 | 285   | 305       | 15,67                                   | 18,13 | 20,51 | 22,50 | 7,84                                             | 9,07 | 10,25 | 11,25 |                                      |  |

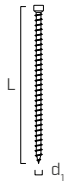
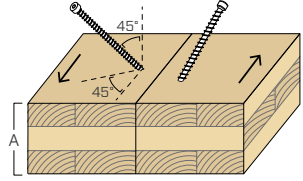
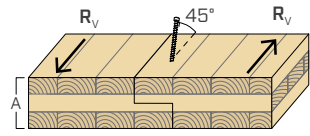
|              |              |          |           | TENSION <sup>(1)</sup>                  |       |       |       |                                                  |       |       |       |                                      |       |
|--------------|--------------|----------|-----------|-----------------------------------------|-------|-------|-------|--------------------------------------------------|-------|-------|-------|--------------------------------------|-------|
| 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]<br>[in] | [mm]     | [mm]      | [kN]                                    | [kN]  | [kN]  | [kN]  | [kN]                                             | [kN]  | [kN]  | [kN]  | [kN]                                 |       |
| 11<br>0.44   | 150          | 6        | 60        | 80                                      | 4,03  | 4,67  | 5,28  | 5,79                                             | 2,02  | 2,33  | 2,64  | 2,90                                 | 23,17 |
|              | 200          | 8        | 85        | 105                                     | 5,71  | 6,61  | 7,48  | 8,21                                             | 2,86  | 3,31  | 3,74  | 4,10                                 |       |
|              | 250          | 10       | 110       | 130                                     | 7,39  | 8,55  | 9,68  | 10,62                                            | 3,70  | 4,28  | 4,84  | 5,31                                 |       |
|              | 275          | 10 7/8   | 120       | 143                                     | 8,07  | 9,33  | 10,56 | 11,58                                            | 4,03  | 4,67  | 5,28  | 5,79                                 |       |
|              | 300          | 11 3/4   | 135       | 155                                     | 9,07  | 10,50 | 11,88 | 13,03                                            | 4,54  | 5,25  | 5,94  | 6,52                                 |       |
|              | 325          | 12 3/4   | 145       | 168                                     | 9,75  | 11,28 | 12,76 | 14,00                                            | 4,87  | 5,64  | 6,38  | 7,00                                 |       |
|              | 350          | 13 3/4   | 160       | 180                                     | 10,75 | 12,44 | 14,08 | 15,44                                            | 5,38  | 6,22  | 7,04  | 7,72                                 |       |
|              | 375          | 14 3/4   | 170       | 193                                     | 11,43 | 13,22 | 14,96 | 16,41                                            | 5,71  | 6,61  | 7,48  | 8,21                                 |       |
|              | 400          | 15 3/4   | 185       | 205                                     | 12,43 | 14,39 | 16,28 | 17,86                                            | 6,22  | 7,19  | 8,14  | 8,93                                 |       |
|              | 425          | 16 3/4   | 195       | 218                                     | 13,11 | 15,17 | 17,16 | 18,82                                            | 6,55  | 7,58  | 8,58  | 9,41                                 |       |
|              | 450          | 17 3/4   | 210       | 230                                     | 14,11 | 16,33 | 18,48 | 20,27                                            | 7,06  | 8,17  | 9,24  | 10,14                                |       |
|              | 475          | 18 11/16 | 220       | 243                                     | 14,79 | 17,11 | 19,36 | 21,24                                            | 7,39  | 8,55  | 9,68  | 10,62                                |       |
|              | 500          | 19 3/4   | 235       | 255                                     | 15,80 | 18,28 | 20,68 | 22,68                                            | 7,90  | 9,14  | 10,34 | 11,34                                |       |
|              | 525          | 20 11/16 | 245       | 268                                     | 16,47 | 19,05 | 21,56 | 23,65                                            | 8,23  | 9,53  | 10,78 | 11,82                                |       |
|              | 550          | 21 5/8   | 260       | 280                                     | 17,48 | 20,22 | 22,88 | 25,10                                            | 8,74  | 10,11 | 11,44 | 12,55                                |       |
|              | 575          | 22 5/8   | 270       | 293                                     | 18,15 | 21,00 | 23,76 | 26,06                                            | 9,07  | 10,50 | 11,88 | 13,03                                |       |
|              | 600          | 23 5/8   | 285       | 305                                     | 19,16 | 22,16 | 25,08 | 27,51                                            | 9,58  | 11,08 | 12,54 | 13,76                                |       |
|              | 650          | 25 9/16  | 305       | 330                                     | 20,50 | 23,72 | 26,84 | 29,44                                            | 10,25 | 11,86 | 13,42 | 14,72                                |       |
|              | 700          | 27 1/2   | 330       | 355                                     | 22,18 | 25,66 | 29,04 | 31,85                                            | 11,09 | 12,83 | 14,52 | 15,93                                |       |
|              | 750          | 29 1/2   | 355       | 380                                     | 23,86 | 27,61 | 31,24 | 34,27                                            | 11,93 | 13,80 | 15,62 | 17,13                                |       |
|              | 800          | 31 1/2   | 380       | 405                                     | 25,54 | 29,55 | 33,44 | 36,68                                            | 12,77 | 14,78 | 16,72 | 18,34                                |       |
|              | 850          | 33 7/16  | 405       | 430                                     | 27,22 | 31,50 | 35,64 | 39,09                                            | 13,61 | 15,75 | 17,82 | 19,55                                |       |
|              | 900          | 35 1/2   | 430       | 455                                     | 28,90 | 33,44 | 37,84 | 41,51                                            | 14,45 | 16,72 | 18,92 | 20,75                                |       |
|              | 950          | 37 3/8   | 455       | 480                                     | 30,58 | 35,39 | 40,04 | 43,92                                            | 15,29 | 17,69 | 20,02 | 21,96                                |       |
|              | 1000         | 39 3/8   | 480       | 505                                     | 32,26 | 37,33 | 42,24 | 46,33                                            | 16,13 | 18,66 | 21,12 | 23,17                                |       |

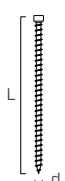
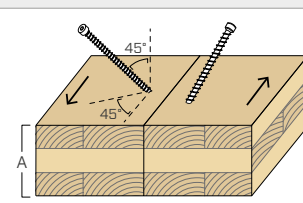
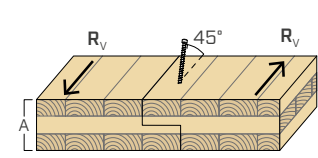
$\alpha$  = screw-to-grain angle

|                                                                                   |              |        |      |           |     | 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]                                    |
| 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  |                                         |
|                                                                                   | 320          | 12 5/8 | 145  | 120       | 135 | 2,54                                                                              | 2,87                                                                               | 5,07                                                                                | 5,74  |                                         |
|                                                                                   | 340          | 13 3/8 | 155  | 125       | 140 | 2,71                                                                              | 3,07                                                                               | 5,42                                                                                | 6,14  |                                         |
|                                                                                   | 360          | 14 1/4 | 165  | 130       | 145 | 2,89                                                                              | 3,27                                                                               | 5,77                                                                                | 6,53  |                                         |
|                                                                                   | 380          | 15     | 175  | 140       | 155 | 3,06                                                                              | 3,46                                                                               | 6,12                                                                                | 6,93  |                                         |
|                                                                                   | 400          | 15 3/4 | 185  | 145       | 160 | 3,24                                                                              | 3,66                                                                               | 6,47                                                                                | 7,32  |                                         |
| 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 |                                         |
|                                                                                   | 560          | 22     | 265  | 205       | 220 | 5,96                                                                              | 6,74                                                                               | 11,92                                                                               | 13,48 |                                         |
|                                                                                   | 600          | 23 5/8 | 285  | 215       | 230 | 6,41                                                                              | 7,25                                                                               | 12,82                                                                               | 14,50 |                                         |

|                                                                                   |              |                |      |                  |     | 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>                                                                    | L            | S <sub>g</sub> | A    | H <sub>min</sub> |     | G                                                                                 |       | G                                                                                  |       |                                                                                     |
|                                                                                   |              |                |      |                  |     | 0.42                                                                              | 0.49  | 0.42                                                                               | 0.49  |                                                                                     |
| [mm]<br>[in]                                                                      | [mm]<br>[in] | [mm]           | [mm] | [mm]             |     | [kN]                                                                              | [kN]  | [kN]                                                                               | [kN]  | [kN]                                                                                |
| 11<br>0.44                                                                        | 150          | 6              | 60   | 60               | 75  | 1,65                                                                              | 1,87  | 3,30                                                                               | 3,73  | 16,38                                                                               |
|                                                                                   | 200          | 8              | 85   | 75               | 90  | 2,34                                                                              | 2,64  | 4,67                                                                               | 5,29  |                                                                                     |
|                                                                                   | 250          | 10             | 110  | 95               | 110 | 3,02                                                                              | 3,42  | 6,05                                                                               | 6,84  |                                                                                     |
|                                                                                   | 275          | 10 7/8         | 120  | 100              | 115 | 3,30                                                                              | 3,73  | 6,60                                                                               | 7,47  |                                                                                     |
|                                                                                   | 300          | 11 3/4         | 135  | 110              | 125 | 3,71                                                                              | 4,20  | 7,42                                                                               | 8,40  |                                                                                     |
|                                                                                   | 325          | 12 3/4         | 145  | 120              | 135 | 3,99                                                                              | 4,51  | 7,97                                                                               | 9,02  |                                                                                     |
|                                                                                   | 350          | 13 3/4         | 160  | 130              | 145 | 4,40                                                                              | 4,98  | 8,80                                                                               | 9,95  |                                                                                     |
|                                                                                   | 375          | 14 3/4         | 170  | 135              | 150 | 4,67                                                                              | 5,29  | 9,35                                                                               | 10,58 |                                                                                     |
|                                                                                   | 400          | 15 3/4         | 185  | 145              | 160 | 5,09                                                                              | 5,76  | 10,17                                                                              | 11,51 |                                                                                     |
|                                                                                   | 425          | 16 3/4         | 195  | 155              | 170 | 5,36                                                                              | 6,07  | 10,72                                                                              | 12,13 |                                                                                     |
|                                                                                   | 450          | 17 3/4         | 210  | 165              | 180 | 5,77                                                                              | 6,53  | 11,55                                                                              | 13,07 |                                                                                     |
|                                                                                   | 475          | 18 11/16       | 220  | 170              | 185 | 6,05                                                                              | 6,84  | 12,10                                                                              | 13,69 |                                                                                     |
|                                                                                   | 500          | 19 3/4         | 235  | 180              | 195 | 6,46                                                                              | 7,31  | 12,92                                                                              | 14,62 |                                                                                     |
|                                                                                   | 525          | 20 11/16       | 245  | 190              | 205 | 6,74                                                                              | 7,62  | 13,47                                                                              | 15,24 |                                                                                     |
|                                                                                   | 550          | 21 5/8         | 260  | 200              | 215 | 7,15                                                                              | 8,09  | 14,30                                                                              | 16,18 |                                                                                     |
|                                                                                   | 575          | 22 5/8         | 270  | 205              | 220 | 7,42                                                                              | 8,40  | 14,85                                                                              | 16,80 |                                                                                     |
|                                                                                   | 600          | 23 5/8         | 285  | 215              | 230 | 7,84                                                                              | 8,87  | 15,67                                                                              | 17,73 |                                                                                     |
|                                                                                   | 650          | 25 9/16        | 305  | 240              | 255 | 8,39                                                                              | 9,49  | 16,77                                                                              | 18,98 |                                                                                     |
|                                                                                   | 700          | 27 1/2         | 330  | 255              | 270 | 9,07                                                                              | 10,27 | 18,15                                                                              | 20,53 |                                                                                     |
|                                                                                   | 750          | 29 1/2         | 355  | 275              | 290 | 9,76                                                                              | 11,04 | 19,52                                                                              | 22,09 |                                                                                     |
|                                                                                   | 800          | 31 1/2         | 380  | 290              | 305 | 10,45                                                                             | 11,82 | 20,90                                                                              | 23,64 |                                                                                     |
|                                                                                   | 850          | 33 7/16        | 405  | 310              | 325 | 11,14                                                                             | 12,60 | 22,27                                                                              | 25,20 |                                                                                     |
|                                                                                   | 900          | 35 1/2         | 430  | 325              | 340 | 11,82                                                                             | 13,38 | 23,65                                                                              | 26,75 |                                                                                     |
|                                                                                   | 950          | 37 3/8         | 455  | 345              | 360 | 12,51                                                                             | 14,15 | 25,02                                                                              | 28,31 |                                                                                     |
|                                                                                   | 1000         | 39 3/8         | 480  | 360              | 375 | 13,20                                                                             | 14,93 | 26,40                                                                              | 29,86 |                                                                                     |

$\alpha$  = screw-to-grain angle

|                                                                                   |      |        |       |      | SLIDING <sup>(4)</sup>                                                            |       |                                                                                     |                                            |                                         |
|-----------------------------------------------------------------------------------|------|--------|-------|------|-----------------------------------------------------------------------------------|-------|-------------------------------------------------------------------------------------|--------------------------------------------|-----------------------------------------|
| geometry                                                                          |      |        |       |      | butt joint<br>(double inclination at 45° + 45°) <sup>(10)</sup>                   |       | half-lap joint<br>$\alpha=45^\circ$                                                 |                                            |                                         |
|  |      |        |       |      |  |       |  |                                            |                                         |
|                                                                                   |      |        |       |      | factored lateral<br>resistance $N_r^{(5)}$                                        |       | factored tension<br>resistance $T_{rs}$                                             | factored lateral<br>resistance $N_r^{(5)}$ | factored tension<br>resistance $T_{rs}$ |
|                                                                                   |      |        |       |      | G                                                                                 |       |                                                                                     | G                                          |                                         |
| $d_1$                                                                             | L    |        | $S_g$ | A    | 0.42                                                                              | 0.49  |                                                                                     | 0.42                                       | 0.49                                    |
| $\frac{[mm]}{[in]}$                                                               | [mm] | [in]   | [mm]  | [mm] | [kN]                                                                              | [kN]  | [kN]                                                                                | [kN]                                       | [kN]                                    |
| 7<br>0.28                                                                         | 80   | 3 1/8  | 25    | 65   | 0,77                                                                              | 0,87  | 5,32                                                                                | 0,95                                       | 1,08                                    |
|                                                                                   | 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                                    |
|                                                                                   | 360  | 14 1/4 | 165   | 265  | 5,06                                                                              | 5,72  |                                                                                     | 6,30                                       | 7,13                                    |
|                                                                                   | 380  | 15     | 175   | 280  | 5,36                                                                              | 6,07  |                                                                                     | 6,68                                       | 7,56                                    |
|                                                                                   | 400  | 15 3/4 | 185   | 295  | 5,67                                                                              | 6,41  |                                                                                     | 7,06                                       | 7,99                                    |
| 9<br>0.36                                                                         | 160  | 6 1/4  | 65    | 125  | 2,56                                                                              | 2,90  | 8,92                                                                                | 3,19                                       | 3,61                                    |
|                                                                                   | 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                                   |
|                                                                                   | 560  | 22     | 265   | 405  | 10,44                                                                             | 11,80 |                                                                                     | 13,01                                      | 14,71                                   |
|                                                                                   | 600  | 23 5/8 | 285   | 435  | 11,23                                                                             | 12,70 |                                                                                     | 13,99                                      | 15,82                                   |

| geometry                                                                          |      |          |       |      | SLIDING <sup>(4)</sup>                                                            |       |                                                                                     |                                            |                                         |
|-----------------------------------------------------------------------------------|------|----------|-------|------|-----------------------------------------------------------------------------------|-------|-------------------------------------------------------------------------------------|--------------------------------------------|-----------------------------------------|
|                                                                                   |      |          |       |      | butt joint<br>(double inclination at 45° + 45°) <sup>(10)</sup>                   |       | half-lap joint<br>$\alpha=45^\circ$                                                 |                                            |                                         |
|  |      |          |       |      |  |       |  |                                            |                                         |
|                                                                                   |      |          |       |      | factored lateral<br>resistance $N_r^{(5)}$                                        |       | factored tension<br>resistance $T_{rs}$                                             | factored lateral<br>resistance $N_r^{(5)}$ | factored tension<br>resistance $T_{rs}$ |
|                                                                                   |      |          |       |      | G                                                                                 |       |                                                                                     | G                                          |                                         |
| $d_1$                                                                             | L    |          | $S_g$ | A    | 0.42                                                                              | 0.49  |                                                                                     | 0.42                                       | 0.49                                    |
| $\frac{[mm]}{[in]}$                                                               | [mm] | [in]     | [mm]  | [mm] | [kN]                                                                              | [kN]  | [kN]                                                                                | [kN]                                       | [kN]                                    |
| <b>11</b><br>0.44                                                                 | 150  | 6        | 60    | 115  | 2,89                                                                              | 3,27  | 11,59                                                                               | 3,60                                       | 4,07                                    |
|                                                                                   | 200  | 8        | 85    | 150  | 4,09                                                                              | 4,63  |                                                                                     | 5,10                                       | 5,77                                    |
|                                                                                   | 250  | 10       | 110   | 185  | 5,30                                                                              | 5,99  |                                                                                     | 6,60                                       | 7,47                                    |
|                                                                                   | 275  | 10 7/8   | 120   | 205  | 5,78                                                                              | 6,54  |                                                                                     | 7,20                                       | 8,14                                    |
|                                                                                   | 300  | 11 3/4   | 135   | 220  | 6,50                                                                              | 7,35  |                                                                                     | 8,10                                       | 9,16                                    |
|                                                                                   | 325  | 12 3/4   | 145   | 240  | 6,98                                                                              | 7,90  |                                                                                     | 8,70                                       | 9,84                                    |
|                                                                                   | 350  | 13 3/4   | 160   | 255  | 7,70                                                                              | 8,72  |                                                                                     | 9,60                                       | 10,86                                   |
|                                                                                   | 375  | 14 3/4   | 170   | 275  | 8,18                                                                              | 9,26  |                                                                                     | 10,20                                      | 11,54                                   |
|                                                                                   | 400  | 15 3/4   | 185   | 295  | 8,91                                                                              | 10,08 |                                                                                     | 11,10                                      | 12,56                                   |
|                                                                                   | 425  | 16 3/4   | 195   | 310  | 9,39                                                                              | 10,62 |                                                                                     | 11,70                                      | 13,24                                   |
|                                                                                   | 450  | 17 3/4   | 210   | 330  | 10,11                                                                             | 11,44 |                                                                                     | 12,60                                      | 14,25                                   |
|                                                                                   | 475  | 18 11/16 | 220   | 345  | 10,59                                                                             | 11,98 |                                                                                     | 13,20                                      | 14,93                                   |
|                                                                                   | 500  | 19 3/4   | 235   | 365  | 11,31                                                                             | 12,80 |                                                                                     | 14,10                                      | 15,95                                   |
|                                                                                   | 525  | 20 11/16 | 245   | 380  | 11,80                                                                             | 13,35 |                                                                                     | 14,70                                      | 16,63                                   |
|                                                                                   | 550  | 21 5/8   | 260   | 400  | 12,52                                                                             | 14,16 |                                                                                     | 15,60                                      | 17,65                                   |
|                                                                                   | 575  | 22 5/8   | 270   | 415  | 13,00                                                                             | 14,71 |                                                                                     | 16,20                                      | 18,33                                   |
|                                                                                   | 600  | 23 5/8   | 285   | 435  | 13,72                                                                             | 15,52 |                                                                                     | 17,10                                      | 19,34                                   |
|                                                                                   | 650  | 25 9/16  | 305   | 470  | 14,68                                                                             | 16,61 |                                                                                     | 18,30                                      | 20,70                                   |
|                                                                                   | 700  | 27 1/2   | 330   | 505  | 15,89                                                                             | 17,98 |                                                                                     | 19,80                                      | 22,40                                   |
|                                                                                   | 750  | 29 1/2   | 355   | 540  | 17,09                                                                             | 19,34 |                                                                                     | 21,30                                      | 24,10                                   |
|                                                                                   | 800  | 31 1/2   | 380   | 575  | 18,29                                                                             | 20,70 |                                                                                     | 22,80                                      | 25,79                                   |
|                                                                                   | 850  | 33 7/16  | 405   | 610  | 19,50                                                                             | 22,06 |                                                                                     | 24,30                                      | 27,49                                   |
|                                                                                   | 900  | 35 1/2   | 430   | 645  | 20,70                                                                             | 23,42 |                                                                                     | 25,80                                      | 29,19                                   |
|                                                                                   | 950  | 37 3/8   | 455   | 680  | 21,91                                                                             | 24,78 |                                                                                     | 27,30                                      | 30,88                                   |
|                                                                                   | 1000 | 39 3/8   | 480   | 715  | 23,11                                                                             | 26,15 |                                                                                     | 28,80                                      | 32,58                                   |

$\alpha$  = screw-to-grain angle

NOTES and GENERAL PRINCIPLES on page 26.

## 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



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JIG VGZ 4