

## COUNTERSUNK SCREW

### SUPERIOR STRENGTH

Steel with superb bending yield strength (minimum of  $F_{yb} = 180,000 \text{ psi} \mid 1000 \text{ N/mm}^2$  according to ESR-4645). Very high torsional strength  $f_{tor,k}$  for safer screwing.

### STRUCTURAL APPLICATIONS

Evaluated by ICC-ES according to Acceptance Criteria AC 233. Withdrawal values for any angle between the screw axis and the grain (including end-grain). Asymmetric "umbrella" shape thread for improved penetration capacity into the wood member.

### DUCTILITY

The bending angle is  $20^\circ$  greater than the minimum required by the standard, and certified according to ETA-11/0030. Cyclical SEISMIC-REV tests according to EN 12512. Seismic performance tested according to EN 14592.

### CHROMIUM (VI) FREE

Total absence of hexavalent chromium. Compliance with the strictest regulations governing chemical substances (SVHC). REACH information available.

## CHARACTERISTICS

|          |                                  |                         |
|----------|----------------------------------|-------------------------|
| FOCUS    | extremely complete range         |                         |
| HEAD     | countersunk with under-head ribs |                         |
| DIAMETER | from 3,5 to 12,0 mm              | 0.14 to 0.48 inches     |
| LENGTH   | from 30 to 600 mm                | 1 3/16 to 23 5/8 inches |



## MATERIAL

Bright zinc plated carbon steel.

## FIELDS OF USE

- sawn lumber and timber
  - Glued Laminated Timber
  - CLT and other mass timber products
  - high density woods
- Dry in-service conditions.

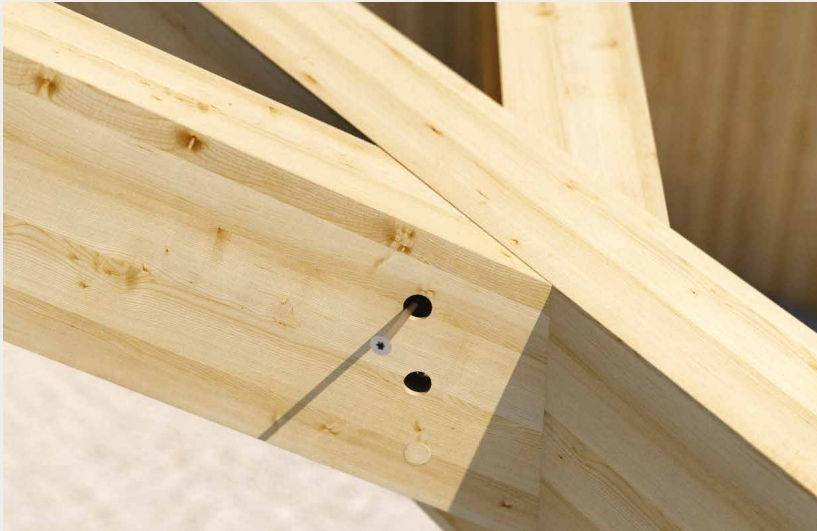


## CLT

ESR-4645 values applicable to connections with Cross Laminated Timber (CLT).

## END-GRAIN

Approved ICC-ES values for application in the end-grain of timber member.

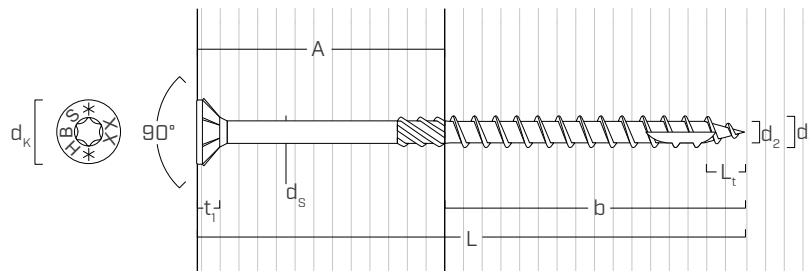


Valley jack rafter joint with HBS screws,  
diameter 8 mm | 0.32 inch.



Fastening CLT walls  
with 6 mm | 0.24 inch diameter HBS screws.

## ■ GEOMETRY AND MECHANICAL CHARACTERISTICS



| Nominal diameter                          | $d_1$      | [in] <sup>(1)</sup> | 0.14 <sup>(*)</sup> | 0.16 <sup>(*)</sup> | 0.18 <sup>(*)</sup> | 0.20 <sup>(*)</sup> | 0.24    | 0.32    | 0.40    | 0.48    |
|-------------------------------------------|------------|---------------------|---------------------|---------------------|---------------------|---------------------|---------|---------|---------|---------|
| Outer thread diameter                     | $d_1$      | [mm]                | 3,5                 | 4,0                 | 4,5                 | 5,0                 | 6,0     | 8,0     | 10,0    | 12,0    |
|                                           | $d_1$      | [in]                | 0.138               | 0.157               | 0.177               | 0.197               | 0.236   | 0.315   | 0.394   | 0.472   |
| Head diameter                             | $d_K$      | [in]                | 0.276               | 0.315               | 0.354               | 0.394               | 0.472   | 0.571   | 0.719   | 0.817   |
| Root diameter                             | $d_2$      | [in]                | 0.089               | 0.100               | 0.110               | 0.134               | 0.156   | 0.213   | 0.252   | 0.268   |
| Shank diameter                            | $d_s$      | [in]                | 0.096               | 0.108               | 0.124               | 0.144               | 0.169   | 0.228   | 0.276   | 0.315   |
| Head thickness                            | $t_1$      | [in]                | 0.087               | 0.110               | 0.110               | 0.122               | 0.177   | 0.177   | 0.228   | 0.283   |
| Tip length                                | $L_t$      | [in]                | 0.138               | 0.157               | 0.177               | 0.197               | 0.236   | 0.315   | 0.394   | 0.472   |
| Pre-drilling hole diameter <sup>(2)</sup> | $d_v$      | [in]                | 0.08                | 0.10                | 0.10                | 0.12                | 0.16    | 0.20    | 0.24    | 0.27    |
| Bending yield strength <sup>(3)</sup>     | $F_{y,b}$  | [psi]               | 145,000             | 145,000             | 145,000             | 145,000             | 200,000 | 180,000 | 185,000 | 190,000 |
| Tensile strength                          | $f_{tens}$ | [lbf]               | 320                 | 430                 | 540                 | 680                 | 1180    | 2040    | 2700    | 3060    |

(\*) Not evaluated in ESR-4645.

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

(2) Pre-drilling applies to softwood timber.

(3) Bending yield strengths for HBS screws with nominal diameters of 0.24, 0.32, 0.40 and 0.48 inches are determined in accordance with ASTM F1575 using the root diameter  $d_2$ . Bending yield strengths for HBS screws with nominal diameters of 0.14, 0.16, 0.18 and 0.20 inches are based on experimental tests according to ETA-11/0030.

## CODES AND DIMENSIONS

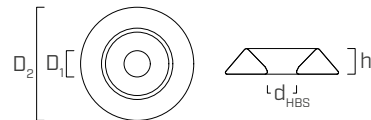
| d <sub>1</sub><br>[mm]<br>[in] | CODE       | L<br>[mm] [in] |         | b<br>[mm] [in] |         | A<br>[mm] [in] |       | pcs |
|--------------------------------|------------|----------------|---------|----------------|---------|----------------|-------|-----|
| 3,5<br>0.14<br>TX 15           | HBS3540(*) | 40             | 1 9/16  | 18             | 11/16   | 19             | 3/4   | 500 |
|                                | HBS3545(*) | 45             | 1 3/4   | 24             | 15/16   | 19             | 3/4   | 400 |
|                                | HBS3550(*) | 50             | 1 15/16 | 24             | 15/16   | 25             | 1     | 400 |
| 4<br>0.16<br>TX 20             | HBS430(*)  | 30             | 1 3/16  | 18             | 11/16   | 6              | 1/4   | 500 |
|                                | HBS435(*)  | 35             | 1 3/8   | 18             | 11/16   | 6              | 1/4   | 500 |
|                                | HBS440(*)  | 40             | 1 9/16  | 24             | 15/16   | 6              | 1/4   | 500 |
|                                | HBS445(*)  | 45             | 1 3/4   | 30             | 1 3/16  | 13             | 1/2   | 400 |
|                                | HBS450(*)  | 50             | 1 15/16 | 30             | 1 3/16  | 19             | 3/4   | 400 |
|                                | HBS460(*)  | 60             | 2 3/8   | 35             | 1 3/8   | 19             | 3/4   | 200 |
|                                | HBS470(*)  | 70             | 2 3/4   | 40             | 1 9/16  | 25             | 1     | 200 |
|                                | HBS480(*)  | 80             | 3 1/8   | 40             | 1 9/16  | 38             | 1 1/2 | 200 |
| 4,5<br>0.18<br>TX 20           | HBS4540(*) | 40             | 1 9/16  | 24             | 15/16   | 13             | 1/2   | 400 |
|                                | HBS4545(*) | 45             | 1 3/4   | 30             | 1 3/16  | 13             | 1/2   | 400 |
|                                | HBS4550(*) | 50             | 1 15/16 | 30             | 1 3/16  | 19             | 3/4   | 200 |
|                                | HBS4560(*) | 60             | 2 3/8   | 35             | 1 3/8   | 19             | 3/4   | 200 |
|                                | HBS4570(*) | 70             | 2 3/4   | 40             | 1 9/16  | 25             | 1     | 200 |
|                                | HBS4580(*) | 80             | 3 1/8   | 40             | 1 9/16  | 38             | 1 1/2 | 200 |
| 5<br>0.20<br>TX 25             | HBS540(*)  | 40             | 1 9/16  | 24             | 15/16   | 13             | 1/2   | 200 |
|                                | HBS545(*)  | 45             | 1 3/4   | 24             | 15/16   | 19             | 3/4   | 200 |
|                                | HBS550(*)  | 50             | 1 15/16 | 24             | 15/16   | 25             | 1     | 200 |
|                                | HBS560(*)  | 60             | 2 3/8   | 30             | 1 3/16  | 25             | 1     | 200 |
|                                | HBS570(*)  | 70             | 2 3/4   | 35             | 1 3/8   | 32             | 1 1/4 | 100 |
|                                | HBS580(*)  | 80             | 3 1/8   | 40             | 1 9/16  | 38             | 1 1/2 | 100 |
|                                | HBS590(*)  | 90             | 3 1/2   | 45             | 1 3/4   | 44             | 1 3/4 | 100 |
|                                | HBS5100(*) | 100            | 4       | 50             | 1 15/16 | 44             | 1 3/4 | 100 |
| 6<br>0.24<br>TX 30             | HBS5120(*) | 120            | 4 3/4   | 60             | 2 3/8   | 57             | 2 1/4 | 100 |
|                                | HBS640     | 40             | 1 9/16  | 35             | 1 3/8   | 3              | 1/8   | 100 |
|                                | HBS650     | 50             | 1 15/16 | 35             | 1 3/8   | 10             | 3/8   | 100 |
|                                | HBS660     | 60             | 2 3/8   | 30             | 1 3/16  | 19             | 3/4   | 100 |
|                                | HBS670     | 70             | 2 3/4   | 40             | 1 9/16  | 25             | 1     | 100 |
|                                | HBS680     | 80             | 3 1/8   | 40             | 1 9/16  | 38             | 1 1/2 | 100 |
|                                | HBS690     | 90             | 3 1/2   | 50             | 1 15/16 | 38             | 1 1/2 | 100 |
|                                | HBS6100    | 100            | 4       | 50             | 1 15/16 | 44             | 1 3/4 | 100 |
|                                | HBS6110    | 110            | 4 3/8   | 60             | 2 3/8   | 44             | 1 3/4 | 100 |
|                                | HBS6120    | 120            | 4 3/4   | 60             | 2 3/8   | 51             | 2     | 100 |
|                                | HBS6130    | 130            | 5 1/8   | 60             | 2 3/8   | 64             | 2 1/2 | 100 |
|                                | HBS6140    | 140            | 5 1/2   | 75             | 2 15/16 | 64             | 2 1/2 | 100 |
|                                | HBS6150    | 150            | 6       | 75             | 2 15/16 | 70             | 2 3/4 | 100 |
|                                | HBS6160    | 160            | 6 1/4   | 75             | 2 15/16 | 83             | 3 1/4 | 100 |
|                                | HBS6180    | 180            | 7 1/8   | 75             | 2 15/16 | 102            | 4     | 100 |
|                                | HBS6200    | 200            | 8       | 75             | 2 15/16 | 121            | 4 3/4 | 100 |
|                                | HBS6220    | 220            | 8 5/8   | 75             | 2 15/16 | 140            | 5 1/2 | 100 |
|                                | HBS6240    | 240            | 9 1/2   | 75             | 2 15/16 | 159            | 6 1/4 | 100 |
|                                | HBS6260    | 260            | 10 1/4  | 75             | 2 15/16 | 178            | 7     | 100 |
|                                | HBS6280    | 280            | 11      | 75             | 2 15/16 | 203            | 8     | 100 |
|                                | HBS6300    | 300            | 11 3/4  | 75             | 2 15/16 | 222            | 8 3/4 | 100 |

(\*) Not evaluated in ESR-4645.

### HUS COUNTERSUNK WASHER

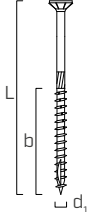
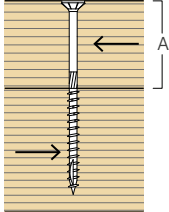
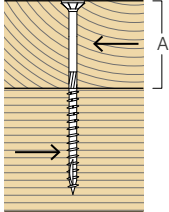
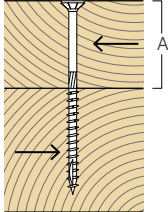
| d <sub>HBS</sub><br>[mm]<br>[in] | CODE  | D <sub>1</sub><br>[in] | D <sub>2</sub><br>[in] | h<br>[in] | pcs |
|----------------------------------|-------|------------------------|------------------------|-----------|-----|
| 6<br>0.24                        | HUS6  | 0.295                  | 0.787                  | 0.181     | 100 |
| 8<br>0.32                        | HUS8  | 0.335                  | 0.984                  | 0.213     | 50  |
| 10<br>0.40                       | HUS10 | 0.425                  | 1.181                  | 0.252     | 50  |
| 12<br>0.48                       | HUS12 | 0.551                  | 1.457                  | 0.335     | 25  |

| d <sub>1</sub><br>[mm]<br>[in] | CODE     | L<br>[mm] [in] |        | b<br>[mm] [in] |        | A<br>[mm] [in] |        | pcs |
|--------------------------------|----------|----------------|--------|----------------|--------|----------------|--------|-----|
| 8<br>0.32<br>TX 40             | HBS880   | 80             | 3 1/8  | 52             | 2 1/16 | 25             | 1      | 100 |
|                                | HBS8100  | 100            | 4      | 52             | 2 1/16 | 44             | 1 3/4  | 100 |
|                                | HBS8120  | 120            | 4 3/4  | 60             | 2 3/8  | 57             | 2 1/4  | 100 |
|                                | HBS8140  | 140            | 5 1/2  | 60             | 2 3/8  | 76             | 3      | 100 |
|                                | HBS8160  | 160            | 6 1/4  | 80             | 3 1/8  | 76             | 3      | 100 |
|                                | HBS8180  | 180            | 7 1/8  | 80             | 3 1/8  | 95             | 3 3/4  | 100 |
|                                | HBS8200  | 200            | 8      | 80             | 3 1/8  | 114            | 4 1/2  | 100 |
|                                | HBS8220  | 220            | 8 5/8  | 80             | 3 1/8  | 140            | 5 1/2  | 100 |
|                                | HBS8240  | 240            | 9 1/2  | 80             | 3 1/8  | 159            | 6 1/4  | 100 |
|                                | HBS8260  | 260            | 10 1/4 | 80             | 3 1/8  | 178            | 7      | 100 |
|                                | HBS8280  | 280            | 11     | 80             | 3 1/8  | 197            | 7 3/4  | 100 |
|                                | HBS8300  | 300            | 11 3/4 | 100            | 4      | 197            | 7 3/4  | 100 |
|                                | HBS8320  | 320            | 12 5/8 | 100            | 4      | 216            | 8 1/2  | 100 |
|                                | HBS8340  | 340            | 13 3/8 | 100            | 4      | 235            | 9 1/4  | 100 |
|                                | HBS8360  | 360            | 14 1/4 | 100            | 4      | 254            | 10     | 100 |
|                                | HBS8380  | 380            | 15     | 100            | 4      | 279            | 11     | 100 |
|                                | HBS8400  | 400            | 15 3/4 | 100            | 4      | 292            | 11 1/2 | 100 |
|                                | HBS8440  | 440            | 17 1/4 | 100            | 4      | 337            | 13 1/4 | 100 |
|                                | HBS8480  | 480            | 19     | 100            | 4      | 375            | 14 3/4 | 100 |
|                                | HBS8520  | 520            | 20 1/2 | 100            | 4      | 419            | 16 1/2 | 100 |
| 10<br>0.40<br>TX 40            | HBS1080  | 80             | 3 1/8  | 52             | 2 1/16 | 13             | 1/2    | 50  |
|                                | HBS10100 | 100            | 4      | 52             | 2 1/16 | 25             | 1      | 50  |
|                                | HBS10120 | 120            | 4 3/4  | 60             | 2 3/8  | 54             | 2 1/8  | 50  |
|                                | HBS10140 | 140            | 5 1/2  | 60             | 2 3/8  | 70             | 2 3/4  | 50  |
|                                | HBS10160 | 160            | 6 1/4  | 80             | 3 1/8  | 76             | 3      | 50  |
|                                | HBS10180 | 180            | 7 1/8  | 80             | 3 1/8  | 95             | 3 3/4  | 50  |
|                                | HBS10200 | 200            | 8      | 80             | 3 1/8  | 114            | 4 1/2  | 50  |
|                                | HBS10220 | 220            | 8 5/8  | 80             | 3 1/8  | 140            | 5 1/2  | 50  |
|                                | HBS10240 | 240            | 9 1/2  | 80             | 3 1/8  | 159            | 6 1/4  | 50  |
|                                | HBS10260 | 260            | 10 1/4 | 80             | 3 1/8  | 178            | 7      | 50  |
|                                | HBS10280 | 280            | 11     | 80             | 3 1/8  | 197            | 7 3/4  | 50  |
|                                | HBS10300 | 300            | 11 3/4 | 100            | 4      | 197            | 7 3/4  | 50  |
|                                | HBS10320 | 320            | 12 5/8 | 100            | 4      | 216            | 8 1/2  | 50  |
|                                | HBS10340 | 340            | 13 3/8 | 100            | 4      | 235            | 9 1/4  | 50  |
|                                | HBS10360 | 360            | 14 1/4 | 100            | 4      | 254            | 10     | 50  |
|                                | HBS10380 | 380            | 15     | 100            | 4      | 279            | 11     | 50  |
|                                | HBS10400 | 400            | 15 3/4 | 100            | 4      | 292            | 11 1/2 | 50  |
| 12<br>0.48<br>TX 50            | HBS12120 | 120            | 4 3/4  | 80             | 3 1/8  | 38             | 1 1/2  | 25  |
|                                | HBS12160 | 160            | 6 1/4  | 80             | 3 1/8  | 76             | 3      | 25  |
|                                | HBS12200 | 200            | 8      | 80             | 3 1/8  | 114            | 4 1/2  | 25  |
|                                | HBS12240 | 240            | 9 1/2  | 80             | 3 1/8  | 159            | 6 1/4  | 25  |
|                                | HBS12280 | 280            | 11     | 80             | 3 1/8  | 197            | 7 3/4  | 25  |
|                                | HBS12320 | 320            | 12 5/8 | 120            | 4 3/4  | 197            | 7 3/4  | 25  |
|                                | HBS12360 | 360            | 14 1/4 | 120            | 4 3/4  | 235            | 9 1/4  | 25  |
|                                | HBS12400 | 400            | 15 3/4 | 120            | 4 3/4  | 279            | 11     | 25  |
|                                | HBS12440 | 440            | 17 1/4 | 120            | 4 3/4  | 318            | 12 1/2 | 25  |
|                                | HBS12480 | 480            | 19     | 120            | 4 3/4  | 356            | 14     | 25  |
|                                | HBS12520 | 520            | 20 1/2 | 120            | 4 3/4  | 394            | 15 1/2 | 25  |
|                                | HBS12560 | 560            | 22     | 120            | 4 3/4  | 432            | 17     | 25  |
|                                | HBS12600 | 600            | 23 5/8 | 120            | 4 3/4  | 470            | 18 1/2 | 25  |



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

HBS Ø6 | 0.24 inch - HBS Ø8 | 0.32 inch

| geometry                                                                          |                   |         |         |        | Z <sub>  </sub> (1)                                                               |        |        |        | Z <sub>⊥/  </sub> (2)                                                              |        |        |        | Z <sub>⊥</sub> (3)                                                                  |        |        |        |
|-----------------------------------------------------------------------------------|-------------------|---------|---------|--------|-----------------------------------------------------------------------------------|--------|--------|--------|------------------------------------------------------------------------------------|--------|--------|--------|-------------------------------------------------------------------------------------|--------|--------|--------|
|  |                   |         |         |        |  |        |        |        |  |        |        |        |  |        |        |        |
| d <sub>1</sub>                                                                    | L                 | b       | A       |        | G=0.35                                                                            | G=0.42 | G=0.49 | G=0.55 | G=0.35                                                                             | G=0.42 | G=0.49 | G=0.55 | G=0.35                                                                              | G=0.42 | G=0.49 | G=0.55 |
| [mm]<br>[in]                                                                      | [mm]<br>[in]      | [in]    | [in]    | [in]   | [lbf]                                                                             | [lbf]  | [lbf]  | [lbf]  | [lbf]                                                                              | [lbf]  | [lbf]  | [lbf]  | [lbf]                                                                               | [lbf]  | [lbf]  | [lbf]  |
| 6<br>0.24                                                                         | 40 <sup>(4)</sup> | 1 9/16  | 1 3/8   | 1/8    | 21                                                                                | 30     | 39     | 49     | 21                                                                                 | 30     | 39     | 49     | 21                                                                                  | 30     | 39     | 49     |
|                                                                                   | 50                | 1 15/16 | 1 3/8   | 3/8    | 64                                                                                | 89     | 118    | 146    | 64                                                                                 | 89     | 118    | 146    | 64                                                                                  | 89     | 118    | 146    |
|                                                                                   | 60                | 2 3/8   | 1 3/16  | 3/4    | 86                                                                                | 120    | 142    | 163    | 86                                                                                 | 120    | 142    | 163    | 86                                                                                  | 120    | 142    | 163    |
|                                                                                   | 70                | 2 3/4   | 1 9/16  | 1      | 97                                                                                | 129    | 156    | 182    | 97                                                                                 | 129    | 156    | 182    | 97                                                                                  | 129    | 156    | 182    |
|                                                                                   | 80                | 3 1/8   | 1 9/16  | 1 1/2  | 107                                                                               | 149    | 190    | 211    | 107                                                                                | 149    | 190    | 211    | 107                                                                                 | 149    | 190    | 211    |
|                                                                                   | 90                | 3 1/2   | 1 15/16 | 1 1/2  | 120                                                                               | 154    | 190    | 211    | 120                                                                                | 154    | 190    | 211    | 120                                                                                 | 154    | 190    | 211    |
|                                                                                   | 100               | 4       | 1 15/16 | 1 3/4  | 129                                                                               | 165    | 190    | 211    | 129                                                                                | 165    | 190    | 211    | 129                                                                                 | 165    | 190    | 211    |
|                                                                                   | 110               | 4 3/8   | 2 3/8   | 1 3/4  | 129                                                                               | 165    | 190    | 211    | 129                                                                                | 165    | 190    | 211    | 129                                                                                 | 165    | 190    | 211    |
|                                                                                   | 120               | 4 3/4   | 2 3/8   | 2      | 139                                                                               | 165    | 190    | 211    | 139                                                                                | 165    | 190    | 211    | 139                                                                                 | 165    | 190    | 211    |
|                                                                                   | 130               | 5 1/8   | 2 3/8   | 2 1/2  | 139                                                                               | 165    | 190    | 211    | 139                                                                                | 165    | 190    | 211    | 139                                                                                 | 165    | 190    | 211    |
|                                                                                   | 140               | 5 1/2   | 2 15/16 | 2 1/2  | 139                                                                               | 165    | 190    | 211    | 139                                                                                | 165    | 190    | 211    | 139                                                                                 | 165    | 190    | 211    |
|                                                                                   | 150               | 6       | 2 15/16 | 2 3/4  | 139                                                                               | 165    | 190    | 211    | 139                                                                                | 165    | 190    | 211    | 139                                                                                 | 165    | 190    | 211    |
|                                                                                   | 160               | 6 1/4   | 2 15/16 | 3 1/4  | 139                                                                               | 165    | 190    | 211    | 139                                                                                | 165    | 190    | 211    | 139                                                                                 | 165    | 190    | 211    |
|                                                                                   | 180               | 7 1/8   | 2 15/16 | 4      | 139                                                                               | 165    | 190    | 211    | 139                                                                                | 165    | 190    | 211    | 139                                                                                 | 165    | 190    | 211    |
|                                                                                   | 200               | 8       | 2 15/16 | 4 3/4  | 139                                                                               | 165    | 190    | 211    | 139                                                                                | 165    | 190    | 211    | 139                                                                                 | 165    | 190    | 211    |
|                                                                                   | 220               | 8 5/8   | 2 15/16 | 5 1/2  | 139                                                                               | 165    | 190    | 211    | 139                                                                                | 165    | 190    | 211    | 139                                                                                 | 165    | 190    | 211    |
|                                                                                   | 240               | 9 1/2   | 2 15/16 | 6 1/4  | 139                                                                               | 165    | 190    | 211    | 139                                                                                | 165    | 190    | 211    | 139                                                                                 | 165    | 190    | 211    |
|                                                                                   | 260               | 10 1/4  | 2 15/16 | 7      | 139                                                                               | 165    | 190    | 211    | 139                                                                                | 165    | 190    | 211    | 139                                                                                 | 165    | 190    | 211    |
| 8<br>0.32                                                                         | 280               | 11      | 2 15/16 | 8      | 139                                                                               | 165    | 190    | 211    | 139                                                                                | 165    | 190    | 211    | 139                                                                                 | 165    | 190    | 211    |
|                                                                                   | 300               | 11 3/4  | 2 15/16 | 8 3/4  | 139                                                                               | 165    | 190    | 211    | 139                                                                                | 165    | 190    | 211    | 139                                                                                 | 165    | 190    | 211    |
|                                                                                   | 80                | 3 1/8   | 2 1/16  | 1      | 132                                                                               | 179    | 213    | 244    | 105                                                                                | 143    | 170    | 195    | 105                                                                                 | 143    | 170    | 195    |
|                                                                                   | 100               | 4       | 2 1/16  | 1 3/4  | 153                                                                               | 214    | 270    | 313    | 123                                                                                | 171    | 216    | 251    | 123                                                                                 | 171    | 216    | 251    |
|                                                                                   | 120               | 4 3/4   | 2 3/8   | 2 1/4  | 184                                                                               | 245    | 282    | 313    | 147                                                                                | 196    | 225    | 251    | 147                                                                                 | 196    | 225    | 251    |
|                                                                                   | 140               | 5 1/2   | 2 3/8   | 3      | 196                                                                               | 245    | 282    | 313    | 157                                                                                | 196    | 225    | 251    | 157                                                                                 | 196    | 225    | 251    |
|                                                                                   | 160               | 6 1/4   | 3 1/8   | 3      | 207                                                                               | 245    | 282    | 313    | 165                                                                                | 196    | 225    | 251    | 165                                                                                 | 196    | 225    | 251    |
|                                                                                   | 180               | 7 1/8   | 3 1/8   | 3 3/4  | 207                                                                               | 245    | 282    | 313    | 165                                                                                | 196    | 225    | 251    | 165                                                                                 | 196    | 225    | 251    |
|                                                                                   | 200               | 8       | 3 1/8   | 4 1/2  | 207                                                                               | 245    | 282    | 313    | 165                                                                                | 196    | 225    | 251    | 165                                                                                 | 196    | 225    | 251    |
|                                                                                   | 220               | 8 5/8   | 3 1/8   | 5 1/2  | 207                                                                               | 245    | 282    | 313    | 165                                                                                | 196    | 225    | 251    | 165                                                                                 | 196    | 225    | 251    |
|                                                                                   | 240               | 9 1/2   | 3 1/8   | 6 1/4  | 207                                                                               | 245    | 282    | 313    | 165                                                                                | 196    | 225    | 251    | 165                                                                                 | 196    | 225    | 251    |
|                                                                                   | 260               | 10 1/4  | 3 1/8   | 7      | 207                                                                               | 245    | 282    | 313    | 165                                                                                | 196    | 225    | 251    | 165                                                                                 | 196    | 225    | 251    |
|                                                                                   | 280               | 11      | 3 1/8   | 7 3/4  | 207                                                                               | 245    | 282    | 313    | 165                                                                                | 196    | 225    | 251    | 165                                                                                 | 196    | 225    | 251    |
|                                                                                   | 300               | 11 3/4  | 4       | 7 3/4  | 207                                                                               | 245    | 282    | 313    | 165                                                                                | 196    | 225    | 251    | 165                                                                                 | 196    | 225    | 251    |
|                                                                                   | 320               | 12 5/8  | 4       | 8 1/2  | 207                                                                               | 245    | 282    | 313    | 165                                                                                | 196    | 225    | 251    | 165                                                                                 | 196    | 225    | 251    |
|                                                                                   | 340               | 13 3/8  | 4       | 9 1/4  | 207                                                                               | 245    | 282    | 313    | 165                                                                                | 196    | 225    | 251    | 165                                                                                 | 196    | 225    | 251    |
|                                                                                   | 360               | 14 1/4  | 4       | 10     | 207                                                                               | 245    | 282    | 313    | 165                                                                                | 196    | 225    | 251    | 165                                                                                 | 196    | 225    | 251    |
|                                                                                   | 380               | 15      | 4       | 11     | 207                                                                               | 245    | 282    | 313    | 165                                                                                | 196    | 225    | 251    | 165                                                                                 | 196    | 225    | 251    |
|                                                                                   | 400               | 15 3/4  | 4       | 11 1/2 | 207                                                                               | 245    | 282    | 313    | 165                                                                                | 196    | 225    | 251    | 165                                                                                 | 196    | 225    | 251    |
|                                                                                   | 440               | 17 1/4  | 4       | 13 1/4 | 207                                                                               | 245    | 282    | 313    | 165                                                                                | 196    | 225    | 251    | 165                                                                                 | 196    | 225    | 251    |
|                                                                                   | 480               | 19      | 4       | 14 3/4 | 207                                                                               | 245    | 282    | 313    | 165                                                                                | 196    | 225    | 251    | 165                                                                                 | 196    | 225    | 251    |
|                                                                                   | 520               | 20 1/2  | 4       | 16 1/2 | 207                                                                               | 245    | 282    | 313    | 165                                                                                | 196    | 225    | 251    | 165                                                                                 | 196    | 225    | 251    |

## NOTES:

Tabulated reference lateral design values (Z) are applicable to screws installed perpendicular to the faces of the wood members and loaded as follows:

(1) Z<sub>||</sub> both side and main members loaded parallel to the grain.

(2) Z<sub>⊥/||</sub> side member loaded perpendicular to the grain; main member loaded parallel to the grain.

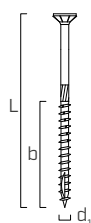
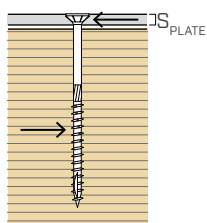
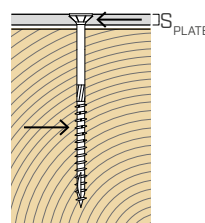
(3) Z<sub>⊥</sub> both side and main members loaded perpendicular to the grain.

(4) The screw penetration in the main member is lower than 6 times the outer thread diameter as specified in ESR-4645.

Refer to page 17 for the general calculation principles.

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

HBS Ø6 | 0.24 inch - HBS Ø8 | 0.32 inch

| geometry                                                                          |                                            |                                            |                       | Z <sub>  </sub> (1)                                                               |                      |                      |                      |                       | Z <sub>⊥</sub> (2)                                                                  |                      |                      |                      |     |
|-----------------------------------------------------------------------------------|--------------------------------------------|--------------------------------------------|-----------------------|-----------------------------------------------------------------------------------|----------------------|----------------------|----------------------|-----------------------|-------------------------------------------------------------------------------------|----------------------|----------------------|----------------------|-----|
|  |                                            |                                            |                       |  |                      |                      |                      |                       |  |                      |                      |                      |     |
| d <sub>1</sub>                                                                    | L                                          | b                                          | steel plate thickness | G=0.35                                                                            | G=0.42               | G=0.49               | G=0.55               | steel plate thickness | G=0.35                                                                              | G=0.42               | G=0.49               | G=0.55               |     |
| <small>[mm]</small><br><small>[in]</small>                                        | <small>[mm]</small><br><small>[in]</small> | <small>[in]</small><br><small>[in]</small> | <small>[in]</small>   | <small>[lbf]</small>                                                              | <small>[lbf]</small> | <small>[lbf]</small> | <small>[lbf]</small> | <small>[in]</small>   | <small>[lbf]</small>                                                                | <small>[lbf]</small> | <small>[lbf]</small> | <small>[lbf]</small> |     |
| 6<br>0.24                                                                         | 40                                         | 1 9/16                                     | 1 3/8                 | S <sub>PLATE</sub> = 1/8"                                                         | 111                  | 146                  | 186                  | 224                   | S <sub>PLATE</sub> = 1/8"                                                           | 111                  | 146                  | 186                  | 224 |
|                                                                                   | 50                                         | 1 15/16                                    | 1 3/8                 |                                                                                   | 134                  | 179                  | 205                  | 225                   |                                                                                     | 134                  | 179                  | 205                  | 225 |
|                                                                                   | 60                                         | 2 3/8                                      | 1 3/16                |                                                                                   | 155                  | 180                  | 205                  | 225                   |                                                                                     | 155                  | 180                  | 205                  | 225 |
|                                                                                   | 70                                         | 2 3/4                                      | 1 9/16                |                                                                                   | 155                  | 180                  | 205                  | 225                   |                                                                                     | 155                  | 180                  | 205                  | 225 |
|                                                                                   | 80                                         | 3 1/8                                      | 1 9/16                |                                                                                   | 155                  | 180                  | 205                  | 225                   |                                                                                     | 155                  | 180                  | 205                  | 225 |
|                                                                                   | 90                                         | 3 1/2                                      | 1 15/16               |                                                                                   | 155                  | 180                  | 205                  | 225                   |                                                                                     | 155                  | 180                  | 205                  | 225 |
|                                                                                   | 100                                        | 4                                          | 1 15/16               |                                                                                   | 155                  | 180                  | 205                  | 225                   |                                                                                     | 155                  | 180                  | 205                  | 225 |
|                                                                                   | 110                                        | 4 3/8                                      | 2 3/8                 |                                                                                   | 155                  | 180                  | 205                  | 225                   |                                                                                     | 155                  | 180                  | 205                  | 225 |
|                                                                                   | 120                                        | 4 3/4                                      | 2 3/8                 |                                                                                   | 155                  | 180                  | 205                  | 225                   |                                                                                     | 155                  | 180                  | 205                  | 225 |
|                                                                                   | 130                                        | 5 1/8                                      | 2 3/8                 |                                                                                   | 155                  | 180                  | 205                  | 225                   |                                                                                     | 155                  | 180                  | 205                  | 225 |
|                                                                                   | 140                                        | 5 1/2                                      | 2 15/16               |                                                                                   | 155                  | 180                  | 205                  | 225                   |                                                                                     | 155                  | 180                  | 205                  | 225 |
|                                                                                   | 150                                        | 6                                          | 2 15/16               |                                                                                   | 155                  | 180                  | 205                  | 225                   |                                                                                     | 155                  | 180                  | 205                  | 225 |
|                                                                                   | 160                                        | 6 1/4                                      | 2 15/16               |                                                                                   | 155                  | 180                  | 205                  | 225                   |                                                                                     | 155                  | 180                  | 205                  | 225 |
|                                                                                   | 180                                        | 7 1/8                                      | 2 15/16               |                                                                                   | 155                  | 180                  | 205                  | 225                   |                                                                                     | 155                  | 180                  | 205                  | 225 |
|                                                                                   | 200                                        | 8                                          | 2 15/16               |                                                                                   | 155                  | 180                  | 205                  | 225                   |                                                                                     | 155                  | 180                  | 205                  | 225 |
|                                                                                   | 220                                        | 8 5/8                                      | 2 15/16               |                                                                                   | 155                  | 180                  | 205                  | 225                   |                                                                                     | 155                  | 180                  | 205                  | 225 |
|                                                                                   | 240                                        | 9 1/2                                      | 2 15/16               |                                                                                   | 155                  | 180                  | 205                  | 225                   |                                                                                     | 155                  | 180                  | 205                  | 225 |
|                                                                                   | 260                                        | 10 1/4                                     | 2 15/16               |                                                                                   | 155                  | 180                  | 205                  | 225                   |                                                                                     | 155                  | 180                  | 205                  | 225 |
| 280                                                                               | 11                                         | 2 15/16                                    | 155                   | 180                                                                               | 205                  | 225                  | 155                  | 180                   | 205                                                                                 | 225                  |                      |                      |     |
| 300                                                                               | 11 3/4                                     | 2 15/16                                    | 155                   | 180                                                                               | 205                  | 225                  | 155                  | 180                   | 205                                                                                 | 225                  |                      |                      |     |
| 8<br>0.32                                                                         | 80                                         | 3 1/8                                      | 2 1/16                | S <sub>PLATE</sub> = 1/8"                                                         | 218                  | 255                  | 290                  | 319                   | S <sub>PLATE</sub> = 1/8"                                                           | 174                  | 204                  | 232                  | 255 |
|                                                                                   | 100                                        | 4                                          | 2 1/16                |                                                                                   | 218                  | 255                  | 290                  | 319                   |                                                                                     | 174                  | 204                  | 232                  | 255 |
|                                                                                   | 120                                        | 4 3/4                                      | 2 3/8                 |                                                                                   | 218                  | 255                  | 290                  | 319                   |                                                                                     | 174                  | 204                  | 232                  | 255 |
|                                                                                   | 140                                        | 5 1/2                                      | 2 3/8                 |                                                                                   | 218                  | 255                  | 290                  | 319                   |                                                                                     | 174                  | 204                  | 232                  | 255 |
|                                                                                   | 160                                        | 6 1/4                                      | 3 1/8                 |                                                                                   | 218                  | 255                  | 290                  | 319                   |                                                                                     | 174                  | 204                  | 232                  | 255 |
|                                                                                   | 180                                        | 7 1/8                                      | 3 1/8                 |                                                                                   | 218                  | 255                  | 290                  | 319                   |                                                                                     | 174                  | 204                  | 232                  | 255 |
|                                                                                   | 200                                        | 8                                          | 3 1/8                 |                                                                                   | 218                  | 255                  | 290                  | 319                   |                                                                                     | 174                  | 204                  | 232                  | 255 |
|                                                                                   | 220                                        | 8 5/8                                      | 3 1/8                 |                                                                                   | 218                  | 255                  | 290                  | 319                   |                                                                                     | 174                  | 204                  | 232                  | 255 |
|                                                                                   | 240                                        | 9 1/2                                      | 3 1/8                 |                                                                                   | 218                  | 255                  | 290                  | 319                   |                                                                                     | 174                  | 204                  | 232                  | 255 |
|                                                                                   | 260                                        | 10 1/4                                     | 3 1/8                 |                                                                                   | 218                  | 255                  | 290                  | 319                   |                                                                                     | 174                  | 204                  | 232                  | 255 |
|                                                                                   | 280                                        | 11                                         | 3 1/8                 |                                                                                   | 218                  | 255                  | 290                  | 319                   |                                                                                     | 174                  | 204                  | 232                  | 255 |
|                                                                                   | 300                                        | 11 3/4                                     | 4                     |                                                                                   | 218                  | 255                  | 290                  | 319                   |                                                                                     | 174                  | 204                  | 232                  | 255 |
|                                                                                   | 320                                        | 12 5/8                                     | 4                     |                                                                                   | 218                  | 255                  | 290                  | 319                   |                                                                                     | 174                  | 204                  | 232                  | 255 |
|                                                                                   | 340                                        | 13 3/8                                     | 4                     |                                                                                   | 218                  | 255                  | 290                  | 319                   |                                                                                     | 174                  | 204                  | 232                  | 255 |
|                                                                                   | 360                                        | 14 1/4                                     | 4                     |                                                                                   | 218                  | 255                  | 290                  | 319                   |                                                                                     | 174                  | 204                  | 232                  | 255 |
|                                                                                   | 380                                        | 15                                         | 4                     |                                                                                   | 218                  | 255                  | 290                  | 319                   |                                                                                     | 174                  | 204                  | 232                  | 255 |
|                                                                                   | 400                                        | 15 3/4                                     | 4                     |                                                                                   | 218                  | 255                  | 290                  | 319                   |                                                                                     | 174                  | 204                  | 232                  | 255 |
|                                                                                   | 440                                        | 17 1/4                                     | 4                     |                                                                                   | 235                  | 274                  | 313                  | 344                   |                                                                                     | 188                  | 220                  | 250                  | 275 |
|                                                                                   | 480                                        | 19                                         | 4                     |                                                                                   | 235                  | 274                  | 313                  | 344                   |                                                                                     | 188                  | 220                  | 250                  | 275 |
|                                                                                   | 520                                        | 20 1/2                                     | 4                     |                                                                                   | 235                  | 274                  | 313                  | 344                   |                                                                                     | 188                  | 220                  | 250                  | 275 |

## NOTES:

Tabulated reference lateral design values (Z) are applicable to screws installed perpendicular to the faces of the wood members and loaded as follows:

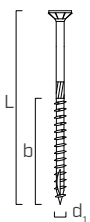
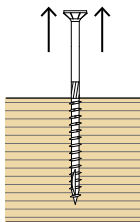
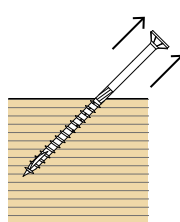
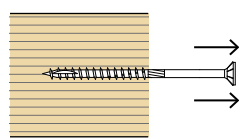
(1) Z<sub>||</sub> main member loaded parallel to the grain.

(2) Z<sub>⊥</sub> main member loaded perpendicular to the grain.

Refer to page 17 for the general calculation principles.

## STRUCTURAL VALUES | THREAD WITHDRAWAL [W]

HBS Ø6 | 0.24 inch - HBS Ø8 | 0.32 inch

| geometry                                                                          |                    |         |         | thread withdrawal $\alpha = 90^\circ$                                             |        |        |        | thread withdrawal $\alpha = 45^\circ$                                              |        |        |        | thread withdrawal $\alpha = 0^\circ$                                                |        |        |        |
|-----------------------------------------------------------------------------------|--------------------|---------|---------|-----------------------------------------------------------------------------------|--------|--------|--------|------------------------------------------------------------------------------------|--------|--------|--------|-------------------------------------------------------------------------------------|--------|--------|--------|
|  |                    |         |         |  |        |        |        |  |        |        |        |  |        |        |        |
| $d_1$                                                                             | L                  | b       |         | G=0.35                                                                            | G=0.42 | G=0.49 | G=0.55 | G=0.35                                                                             | G=0.42 | G=0.49 | G=0.55 | G=0.35                                                                              | G=0.42 | G=0.49 | G=0.55 |
| [mm]<br>[in]                                                                      | [mm]<br>[in]       | [in]    | [in]    | [lbf]                                                                             | [lbf]  | [lbf]  | [lbf]  | [lbf]                                                                              | [lbf]  | [lbf]  | [lbf]  | [lbf]                                                                               | [lbf]  | [lbf]  | [lbf]  |
| 6<br>0.24                                                                         | 40 <sup>(1)</sup>  | 1 9/16  | 1 3/8   | 106                                                                               | 122    | 180    | 197    | 96                                                                                 | 111    | 164    | 179    | 32                                                                                  | 37     | 54     | 59     |
|                                                                                   | 50 <sup>(1)</sup>  | 1 15/16 | 1 3/8   | 106                                                                               | 122    | 180    | 197    | 96                                                                                 | 111    | 164    | 179    | 32                                                                                  | 37     | 54     | 59     |
|                                                                                   | 60 <sup>(1)</sup>  | 2 3/8   | 1 3/16  | 91                                                                                | 106    | 156    | 170    | 83                                                                                 | 96     | 142    | 155    | 27                                                                                  | 32     | 47     | 51     |
|                                                                                   | 70 <sup>(2)</sup>  | 2 3/4   | 1 9/16  | 120                                                                               | 139    | 205    | 223    | 109                                                                                | 127    | 186    | 203    | 36                                                                                  | 42     | 61     | 67     |
|                                                                                   | 80 <sup>(2)</sup>  | 3 1/8   | 1 9/16  | 120                                                                               | 139    | 205    | 223    | 109                                                                                | 127    | 186    | 203    | 36                                                                                  | 42     | 61     | 67     |
|                                                                                   | 90                 | 3 1/2   | 1 15/16 | 149                                                                               | 172    | 254    | 277    | 136                                                                                | 157    | 231    | 252    | 45                                                                                  | 52     | 76     | 83     |
|                                                                                   | 100                | 4       | 1 15/16 | 149                                                                               | 172    | 254    | 277    | 136                                                                                | 157    | 231    | 252    | 45                                                                                  | 52     | 76     | 83     |
|                                                                                   | 110                | 4 3/8   | 2 3/8   | 183                                                                               | 211    | 311    | 340    | 166                                                                                | 192    | 283    | 309    | 55                                                                                  | 63     | 93     | 102    |
|                                                                                   | 120                | 4 3/4   | 2 3/8   | 183                                                                               | 211    | 311    | 340    | 166                                                                                | 192    | 283    | 309    | 55                                                                                  | 63     | 93     | 102    |
|                                                                                   | 130                | 5 1/8   | 2 3/8   | 183                                                                               | 211    | 311    | 340    | 166                                                                                | 192    | 283    | 309    | 55                                                                                  | 63     | 93     | 102    |
|                                                                                   | 140                | 5 1/2   | 2 15/16 | 226                                                                               | 261    | 385    | 420    | 206                                                                                | 238    | 350    | 382    | 68                                                                                  | 78     | 115    | 126    |
|                                                                                   | 150                | 6       | 2 15/16 | 226                                                                               | 261    | 385    | 420    | 206                                                                                | 238    | 350    | 382    | 68                                                                                  | 78     | 115    | 126    |
|                                                                                   | 160                | 6 1/4   | 2 15/16 | 226                                                                               | 261    | 385    | 420    | 206                                                                                | 238    | 350    | 382    | 68                                                                                  | 78     | 115    | 126    |
|                                                                                   | 180                | 7 1/8   | 2 15/16 | 226                                                                               | 261    | 385    | 420    | 206                                                                                | 238    | 350    | 382    | 68                                                                                  | 78     | 115    | 126    |
|                                                                                   | 200                | 8       | 2 15/16 | 226                                                                               | 261    | 385    | 420    | 206                                                                                | 238    | 350    | 382    | 68                                                                                  | 78     | 115    | 126    |
|                                                                                   | 220                | 8 5/8   | 2 15/16 | 226                                                                               | 261    | 385    | 420    | 206                                                                                | 238    | 350    | 382    | 68                                                                                  | 78     | 115    | 126    |
|                                                                                   | 240                | 9 1/2   | 2 15/16 | 226                                                                               | 261    | 385    | 420    | 206                                                                                | 238    | 350    | 382    | 68                                                                                  | 78     | 115    | 126    |
|                                                                                   | 260                | 10 1/4  | 2 15/16 | 226                                                                               | 261    | 385    | 420    | 206                                                                                | 238    | 350    | 382    | 68                                                                                  | 78     | 115    | 126    |
|                                                                                   | 280                | 11      | 2 15/16 | 226                                                                               | 261    | 385    | 420    | 206                                                                                | 238    | 350    | 382    | 68                                                                                  | 78     | 115    | 126    |
|                                                                                   | 300                | 11 3/4  | 2 15/16 | 226                                                                               | 261    | 385    | 420    | 206                                                                                | 238    | 350    | 382    | 68                                                                                  | 78     | 115    | 126    |
| 8<br>0.32                                                                         | 80 <sup>(2)</sup>  | 3 1/8   | 2 1/16  | 225                                                                               | 258    | 285    | 359    | 205                                                                                | 235    | 259    | 327    | 67                                                                                  | 77     | 85     | 108    |
|                                                                                   | 100 <sup>(2)</sup> | 4       | 2 1/16  | 225                                                                               | 258    | 285    | 359    | 205                                                                                | 235    | 259    | 327    | 67                                                                                  | 77     | 85     | 108    |
|                                                                                   | 120 <sup>(2)</sup> | 4 3/4   | 2 3/8   | 259                                                                               | 297    | 328    | 413    | 236                                                                                | 270    | 298    | 376    | 78                                                                                  | 89     | 98     | 124    |
|                                                                                   | 140 <sup>(2)</sup> | 5 1/2   | 2 3/8   | 259                                                                               | 297    | 328    | 413    | 236                                                                                | 270    | 298    | 376    | 78                                                                                  | 89     | 98     | 124    |
|                                                                                   | 160                | 6 1/4   | 3 1/8   | 341                                                                               | 391    | 431    | 544    | 310                                                                                | 355    | 392    | 495    | 102                                                                                 | 117    | 129    | 163    |
|                                                                                   | 180                | 7 1/8   | 3 1/8   | 341                                                                               | 391    | 431    | 544    | 310                                                                                | 355    | 392    | 495    | 102                                                                                 | 117    | 129    | 163    |
|                                                                                   | 200                | 8       | 3 1/8   | 341                                                                               | 391    | 431    | 544    | 310                                                                                | 355    | 392    | 495    | 102                                                                                 | 117    | 129    | 163    |
|                                                                                   | 220                | 8 5/8   | 3 1/8   | 341                                                                               | 391    | 431    | 544    | 310                                                                                | 355    | 392    | 495    | 102                                                                                 | 117    | 129    | 163    |
|                                                                                   | 240                | 9 1/2   | 3 1/8   | 341                                                                               | 391    | 431    | 544    | 310                                                                                | 355    | 392    | 495    | 102                                                                                 | 117    | 129    | 163    |
|                                                                                   | 260                | 10 1/4  | 3 1/8   | 341                                                                               | 391    | 431    | 544    | 310                                                                                | 355    | 392    | 495    | 102                                                                                 | 117    | 129    | 163    |
|                                                                                   | 280                | 11      | 3 1/8   | 341                                                                               | 391    | 431    | 544    | 310                                                                                | 355    | 392    | 495    | 102                                                                                 | 117    | 129    | 163    |
|                                                                                   | 300                | 11 3/4  | 4       | 436                                                                               | 500    | 552    | 696    | 397                                                                                | 455    | 502    | 633    | 131                                                                                 | 150    | 166    | 209    |
|                                                                                   | 320                | 12 5/8  | 4       | 436                                                                               | 500    | 552    | 696    | 397                                                                                | 455    | 502    | 633    | 131                                                                                 | 150    | 166    | 209    |
|                                                                                   | 340                | 13 3/8  | 4       | 436                                                                               | 500    | 552    | 696    | 397                                                                                | 455    | 502    | 633    | 131                                                                                 | 150    | 166    | 209    |
|                                                                                   | 360                | 14 1/4  | 4       | 436                                                                               | 500    | 552    | 696    | 397                                                                                | 455    | 502    | 633    | 131                                                                                 | 150    | 166    | 209    |
|                                                                                   | 380                | 15      | 4       | 436                                                                               | 500    | 552    | 696    | 397                                                                                | 455    | 502    | 633    | 131                                                                                 | 150    | 166    | 209    |
|                                                                                   | 400                | 15 3/4  | 4       | 436                                                                               | 500    | 552    | 696    | 397                                                                                | 455    | 502    | 633    | 131                                                                                 | 150    | 166    | 209    |
|                                                                                   | 440                | 17 1/4  | 4       | 436                                                                               | 500    | 552    | 696    | 397                                                                                | 455    | 502    | 633    | 131                                                                                 | 150    | 166    | 209    |
|                                                                                   | 480                | 19      | 4       | 436                                                                               | 500    | 552    | 696    | 397                                                                                | 455    | 502    | 633    | 131                                                                                 | 150    | 166    | 209    |
|                                                                                   | 520                | 20 1/2  | 4       | 436                                                                               | 500    | 552    | 696    | 397                                                                                | 455    | 502    | 633    | 131                                                                                 | 150    | 166    | 209    |

### NOTES:

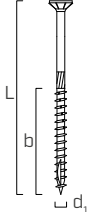
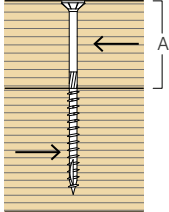
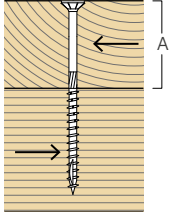
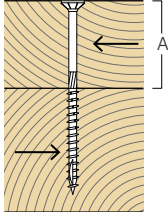
<sup>(1)</sup> The embedded thread length does not comply with the minimum requirement of ESR-4645 (6 times the outer thread diameter for screws installed at  $90^\circ$  to the grain and 8 times the outer thread diameter for screws installed at an angle  $0^\circ \leq \alpha < 90^\circ$  to the grain).

<sup>(2)</sup> The embedded thread length does not comply with the minimum requirement of ESR-4645 (8 times the outer thread diameter for screws installed at an angle  $0^\circ \leq \alpha < 90^\circ$  to the grain).

Refer to page 17 for the general calculation principles.

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

HBS Ø10 | 0.40 inch - HBS Ø12 | 0.48 inch

| geometry                                                                          |              |        |        |        | $Z_{  }^{(1)}$                                                                    |        |        |        | $Z_{\perp/  }^{(2)}$                                                               |        |        |        | $Z_{\perp}^{(3)}$                                                                   |        |        |        |
|-----------------------------------------------------------------------------------|--------------|--------|--------|--------|-----------------------------------------------------------------------------------|--------|--------|--------|------------------------------------------------------------------------------------|--------|--------|--------|-------------------------------------------------------------------------------------|--------|--------|--------|
|  |              |        |        |        |  |        |        |        |  |        |        |        |  |        |        |        |
| $d_1$                                                                             | L            | b      | A      |        | G=0.35                                                                            | G=0.42 | G=0.49 | G=0.55 | G=0.35                                                                             | G=0.42 | G=0.49 | G=0.55 | G=0.35                                                                              | G=0.42 | G=0.49 | G=0.55 |
| [mm]<br>[in]                                                                      | [mm]<br>[in] | [in]   | [in]   | [in]   | [lbf]                                                                             | [lbf]  | [lbf]  | [lbf]  | [lbf]                                                                              | [lbf]  | [lbf]  | [lbf]  | [lbf]                                                                               | [lbf]  | [lbf]  | [lbf]  |
| 10<br>0.40                                                                        | 80           | 3 1/8  | 2 1/16 | 1/2    | 123                                                                               | 148    | 173    | 194    | 67                                                                                 | 87     | 109    | 129    | 67                                                                                  | 87     | 109    | 129    |
|                                                                                   | 100          | 4      | 2 1/16 | 1      | 222                                                                               | 247    | 270    | 290    | 134                                                                                | 174    | 198    | 216    | 134                                                                                 | 166    | 188    | 207    |
|                                                                                   | 120          | 4 3/4  | 2 3/8  | 2 1/8  | 258                                                                               | 310    | 361    | 387    | 176                                                                                | 218    | 258    | 292    | 140                                                                                 | 182    | 228    | 269    |
|                                                                                   | 140          | 5 1/2  | 2 3/8  | 2 3/4  | 302                                                                               | 338    | 365    | 387    | 199                                                                                | 249    | 274    | 295    | 164                                                                                 | 213    | 259    | 282    |
|                                                                                   | 160          | 6 1/4  | 3 1/8  | 3      | 308                                                                               | 338    | 365    | 387    | 220                                                                                | 249    | 274    | 295    | 188                                                                                 | 232    | 259    | 282    |
|                                                                                   | 180          | 7 1/8  | 3 1/8  | 3 3/4  | 308                                                                               | 338    | 365    | 387    | 222                                                                                | 249    | 274    | 295    | 203                                                                                 | 232    | 259    | 282    |
|                                                                                   | 200          | 8      | 3 1/8  | 4 1/2  | 308                                                                               | 338    | 365    | 387    | 222                                                                                | 249    | 274    | 295    | 203                                                                                 | 232    | 259    | 282    |
|                                                                                   | 220          | 8 5/8  | 3 1/8  | 5 1/2  | 308                                                                               | 338    | 365    | 387    | 222                                                                                | 249    | 274    | 295    | 203                                                                                 | 232    | 259    | 282    |
|                                                                                   | 240          | 9 1/2  | 3 1/8  | 6 1/4  | 308                                                                               | 338    | 365    | 387    | 222                                                                                | 249    | 274    | 295    | 203                                                                                 | 232    | 259    | 282    |
|                                                                                   | 260          | 10 1/4 | 3 1/8  | 7      | 308                                                                               | 338    | 365    | 387    | 222                                                                                | 249    | 274    | 295    | 203                                                                                 | 232    | 259    | 282    |
|                                                                                   | 280          | 11     | 3 1/8  | 7 3/4  | 308                                                                               | 338    | 365    | 387    | 222                                                                                | 249    | 274    | 295    | 203                                                                                 | 232    | 259    | 282    |
|                                                                                   | 300          | 11 3/4 | 4      | 7 3/4  | 308                                                                               | 338    | 365    | 387    | 222                                                                                | 249    | 274    | 295    | 203                                                                                 | 232    | 259    | 282    |
|                                                                                   | 320          | 12 5/8 | 4      | 8 1/2  | 308                                                                               | 338    | 365    | 387    | 222                                                                                | 249    | 274    | 295    | 203                                                                                 | 232    | 259    | 282    |
|                                                                                   | 340          | 13 3/8 | 4      | 9 1/4  | 308                                                                               | 338    | 365    | 387    | 222                                                                                | 249    | 274    | 295    | 203                                                                                 | 232    | 259    | 282    |
|                                                                                   | 360          | 14 1/4 | 4      | 10     | 308                                                                               | 338    | 365    | 387    | 222                                                                                | 249    | 274    | 295    | 203                                                                                 | 232    | 259    | 282    |
|                                                                                   | 380          | 15     | 4      | 11     | 308                                                                               | 338    | 365    | 387    | 222                                                                                | 249    | 274    | 295    | 203                                                                                 | 232    | 259    | 282    |
|                                                                                   | 400          | 15 3/4 | 4      | 11 1/2 | 308                                                                               | 338    | 365    | 387    | 222                                                                                | 249    | 274    | 295    | 203                                                                                 | 232    | 259    | 282    |
| 12<br>0.48                                                                        | 120          | 4 3/4  | 3 1/8  | 1 1/2  | 273                                                                               | 308    | 342    | 372    | 183                                                                                | 211    | 240    | 266    | 155                                                                                 | 197    | 228    | 255    |
|                                                                                   | 160          | 6 1/4  | 3 1/8  | 3      | 353                                                                               | 387    | 418    | 442    | 235                                                                                | 282    | 311    | 334    | 192                                                                                 | 250    | 292    | 317    |
|                                                                                   | 200          | 8      | 3 1/8  | 4 1/2  | 353                                                                               | 387    | 418    | 442    | 251                                                                                | 282    | 311    | 334    | 226                                                                                 | 261    | 292    | 317    |
|                                                                                   | 240          | 9 1/2  | 3 1/8  | 6 1/4  | 353                                                                               | 387    | 418    | 442    | 251                                                                                | 282    | 311    | 334    | 218                                                                                 | 261    | 292    | 317    |
|                                                                                   | 280          | 11     | 3 1/8  | 7 3/4  | 353                                                                               | 387    | 418    | 442    | 251                                                                                | 282    | 311    | 334    | 221                                                                                 | 261    | 292    | 317    |
|                                                                                   | 320          | 12 5/8 | 4 3/4  | 7 3/4  | 353                                                                               | 387    | 418    | 442    | 251                                                                                | 282    | 311    | 334    | 229                                                                                 | 261    | 292    | 317    |
|                                                                                   | 360          | 14 1/4 | 4 3/4  | 9 1/4  | 353                                                                               | 387    | 418    | 442    | 251                                                                                | 282    | 311    | 334    | 229                                                                                 | 261    | 292    | 317    |
|                                                                                   | 400          | 15 3/4 | 4 3/4  | 11     | 353                                                                               | 387    | 418    | 442    | 251                                                                                | 282    | 311    | 334    | 229                                                                                 | 261    | 292    | 317    |
|                                                                                   | 440          | 17 1/4 | 4 3/4  | 12 1/2 | 353                                                                               | 387    | 418    | 442    | 251                                                                                | 282    | 311    | 334    | 229                                                                                 | 261    | 292    | 317    |
|                                                                                   | 480          | 19     | 4 3/4  | 14     | 353                                                                               | 387    | 418    | 442    | 251                                                                                | 282    | 311    | 334    | 229                                                                                 | 261    | 292    | 317    |
|                                                                                   | 520          | 20 1/2 | 4 3/4  | 15 1/2 | 353                                                                               | 387    | 418    | 442    | 251                                                                                | 282    | 311    | 334    | 229                                                                                 | 261    | 292    | 317    |
|                                                                                   | 560          | 22     | 4 3/4  | 17     | 353                                                                               | 387    | 418    | 442    | 251                                                                                | 282    | 311    | 334    | 229                                                                                 | 261    | 292    | 317    |
|                                                                                   | 600          | 23 5/8 | 4 3/4  | 18 1/2 | 353                                                                               | 387    | 418    | 442    | 251                                                                                | 282    | 311    | 334    | 229                                                                                 | 261    | 292    | 317    |

### NOTES:

Tabulated reference lateral design values (Z) are applicable to screws installed perpendicular to the faces of the wood members and loaded as follows:

(1)  $Z_{||}$  both side and main members loaded parallel to the grain.

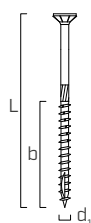
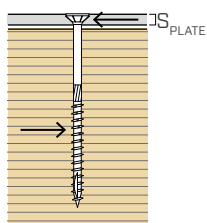
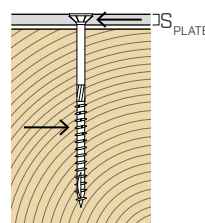
(2)  $Z_{\perp/||}$  side member loaded perpendicular to the grain; main member loaded parallel to the grain.

(3)  $Z_{\perp}$  both side and main members loaded perpendicular to the grain.

Refer to page 17 for the general calculation principles.

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

HBS Ø10 | 0.40 inch - HBS Ø12 | 0.48 inch

| geometry                                                                          |      |        |                       | Z <sub>  </sub> (1)                                                               |        |        |        |                       | Z <sub>⊥</sub> (2)                                                                  |        |        |        |       |
|-----------------------------------------------------------------------------------|------|--------|-----------------------|-----------------------------------------------------------------------------------|--------|--------|--------|-----------------------|-------------------------------------------------------------------------------------|--------|--------|--------|-------|
|  |      |        |                       |  |        |        |        |                       |  |        |        |        |       |
| d <sub>1</sub>                                                                    | L    | b      | steel plate thickness | G=0.35                                                                            | G=0.42 | G=0.49 | G=0.55 | steel plate thickness | G=0.35                                                                              | G=0.42 | G=0.49 | G=0.55 |       |
| [mm]                                                                              | [mm] | [in]   | [in]                  | [in]                                                                              | [lbf]  | [lbf]  | [lbf]  | [lbf]                 | [in]                                                                                | [lbf]  | [lbf]  | [lbf]  | [lbf] |
| [in]                                                                              |      |        |                       |                                                                                   |        |        |        |                       |                                                                                     |        |        |        |       |
| 10<br>0.40                                                                        | 80   | 3 1/8  | 2 1/16                | S <sub>PLATE</sub> = 1/4"                                                         | 333    | 389    | 418    | 440                   | S <sub>PLATE</sub> = 1/4"                                                           | 192    | 239    | 289    | 324   |
|                                                                                   | 100  | 4      | 2 1/16                |                                                                                   | 361    | 391    | 418    | 440                   |                                                                                     | 232    | 273    | 302    | 324   |
|                                                                                   | 120  | 4 3/4  | 2 3/8                 |                                                                                   | 361    | 391    | 418    | 440                   |                                                                                     | 242    | 273    | 302    | 324   |
|                                                                                   | 140  | 5 1/2  | 2 3/8                 |                                                                                   | 361    | 391    | 418    | 440                   |                                                                                     | 242    | 273    | 302    | 324   |
|                                                                                   | 160  | 6 1/4  | 3 1/8                 |                                                                                   | 361    | 391    | 418    | 440                   |                                                                                     | 242    | 273    | 302    | 324   |
|                                                                                   | 180  | 7 1/8  | 3 1/8                 |                                                                                   | 361    | 391    | 418    | 440                   |                                                                                     | 242    | 273    | 302    | 324   |
|                                                                                   | 200  | 8      | 3 1/8                 |                                                                                   | 361    | 391    | 418    | 440                   |                                                                                     | 242    | 273    | 302    | 324   |
|                                                                                   | 220  | 8 5/8  | 3 1/8                 |                                                                                   | 361    | 391    | 418    | 440                   |                                                                                     | 242    | 273    | 302    | 324   |
|                                                                                   | 240  | 9 1/2  | 3 1/8                 |                                                                                   | 361    | 391    | 418    | 440                   |                                                                                     | 242    | 273    | 302    | 324   |
|                                                                                   | 260  | 10 1/4 | 3 1/8                 |                                                                                   | 361    | 391    | 418    | 440                   |                                                                                     | 242    | 273    | 302    | 324   |
|                                                                                   | 280  | 11     | 3 1/8                 |                                                                                   | 361    | 391    | 418    | 440                   |                                                                                     | 242    | 273    | 302    | 324   |
|                                                                                   | 300  | 11 3/4 | 4                     |                                                                                   | 361    | 391    | 418    | 440                   |                                                                                     | 242    | 273    | 302    | 324   |
|                                                                                   | 320  | 12 5/8 | 4                     |                                                                                   | 361    | 391    | 418    | 440                   |                                                                                     | 242    | 273    | 302    | 324   |
|                                                                                   | 340  | 13 3/8 | 4                     |                                                                                   | 361    | 391    | 418    | 440                   |                                                                                     | 242    | 273    | 302    | 324   |
|                                                                                   | 360  | 14 1/4 | 4                     |                                                                                   | 361    | 391    | 418    | 440                   |                                                                                     | 242    | 273    | 302    | 324   |
|                                                                                   | 380  | 15     | 4                     |                                                                                   | 361    | 391    | 418    | 440                   |                                                                                     | 242    | 273    | 302    | 324   |
|                                                                                   | 400  | 15 3/4 | 4                     |                                                                                   | 361    | 391    | 418    | 440                   |                                                                                     | 242    | 273    | 302    | 324   |
| 12<br>0.48                                                                        | 120  | 4 3/4  | 3 1/8                 | S <sub>PLATE</sub> = 1/4"                                                         | 403    | 437    | 467    | 491                   | S <sub>PLATE</sub> = 1/4"                                                           | 267    | 301    | 332    | 358   |
|                                                                                   | 160  | 6 1/4  | 3 1/8                 |                                                                                   | 403    | 437    | 467    | 491                   |                                                                                     | 267    | 301    | 332    | 358   |
|                                                                                   | 200  | 8      | 3 1/8                 |                                                                                   | 403    | 437    | 467    | 491                   |                                                                                     | 267    | 301    | 332    | 358   |
|                                                                                   | 240  | 9 1/2  | 3 1/8                 |                                                                                   | 403    | 437    | 467    | 491                   |                                                                                     | 267    | 301    | 332    | 358   |
|                                                                                   | 280  | 11     | 3 1/8                 |                                                                                   | 403    | 437    | 467    | 491                   |                                                                                     | 267    | 301    | 332    | 358   |
|                                                                                   | 320  | 12 5/8 | 4 3/4                 |                                                                                   | 403    | 437    | 467    | 491                   |                                                                                     | 267    | 301    | 332    | 358   |
|                                                                                   | 360  | 14 1/4 | 4 3/4                 |                                                                                   | 403    | 437    | 467    | 491                   |                                                                                     | 267    | 301    | 332    | 358   |
|                                                                                   | 400  | 15 3/4 | 4 3/4                 |                                                                                   | 403    | 437    | 467    | 491                   |                                                                                     | 267    | 301    | 332    | 358   |
|                                                                                   | 440  | 17 1/4 | 4 3/4                 |                                                                                   | 403    | 437    | 467    | 491                   |                                                                                     | 267    | 301    | 332    | 358   |
|                                                                                   | 480  | 19     | 4 3/4                 |                                                                                   | 403    | 437    | 467    | 491                   |                                                                                     | 267    | 301    | 332    | 358   |
|                                                                                   | 520  | 20 1/2 | 4 3/4                 |                                                                                   | 533    | 578    | 619    | 651                   |                                                                                     | 339    | 383    | 424    | 457   |
|                                                                                   | 560  | 22     | 4 3/4                 |                                                                                   | 533    | 578    | 619    | 651                   |                                                                                     | 339    | 383    | 424    | 457   |
|                                                                                   | 600  | 23 5/8 | 4 3/4                 |                                                                                   | 533    | 578    | 619    | 651                   |                                                                                     | 339    | 383    | 424    | 457   |

### NOTES:

Tabulated reference lateral design values (Z) are applicable to screws installed perpendicular to the faces of the wood members and loaded as follows:

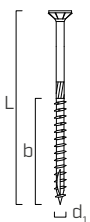
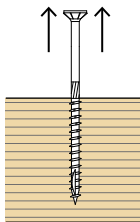
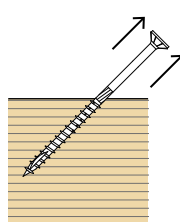
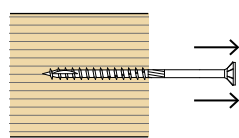
(1)  $Z_{||}$  main member loaded parallel to the grain.

(2)  $Z_{\perp}$  main member loaded perpendicular to the grain.

Refer to page 17 for the general calculation principles.

## STRUCTURAL VALUES | THREAD WITHDRAWAL (W)

HBS Ø10 | 0.40 inch - HBS Ø12 | 0.48 inch

| geometry                                                                          |                    |        |        | thread withdrawal $\alpha = 90^\circ$                                             |        |        |        | thread withdrawal $\alpha = 45^\circ$                                              |        |        |        | thread withdrawal $\alpha = 0^\circ$                                                |        |        |        |
|-----------------------------------------------------------------------------------|--------------------|--------|--------|-----------------------------------------------------------------------------------|--------|--------|--------|------------------------------------------------------------------------------------|--------|--------|--------|-------------------------------------------------------------------------------------|--------|--------|--------|
|  |                    |        |        |  |        |        |        |  |        |        |        |  |        |        |        |
| $d_1$                                                                             | L                  | b      |        | G=0.35                                                                            | G=0.42 | G=0.49 | G=0.55 | G=0.35                                                                             | G=0.42 | G=0.49 | G=0.55 | G=0.35                                                                              | G=0.42 | G=0.49 | G=0.55 |
| [mm]                                                                              | [mm]               | [in]   | [in]   | [lbf]                                                                             | [lbf]  | [lbf]  | [lbf]  | [lbf]                                                                              | [lbf]  | [lbf]  | [lbf]  | [lbf]                                                                               | [lbf]  | [lbf]  | [lbf]  |
| 10<br>0.40                                                                        | 80 <sup>(1)</sup>  | 3 1/8  | 2 1/16 | 289                                                                               | 332    | 388    | 423    | 263                                                                                | 302    | 353    | 385    | 87                                                                                  | 100    | 116    | 127    |
|                                                                                   | 100 <sup>(1)</sup> | 4      | 2 1/16 | 289                                                                               | 332    | 388    | 423    | 263                                                                                | 302    | 353    | 385    | 87                                                                                  | 100    | 116    | 127    |
|                                                                                   | 120 <sup>(2)</sup> | 4 3/4  | 2 3/8  | 333                                                                               | 382    | 447    | 487    | 303                                                                                | 348    | 406    | 443    | 100                                                                                 | 115    | 134    | 146    |
|                                                                                   | 140 <sup>(2)</sup> | 5 1/2  | 2 3/8  | 333                                                                               | 382    | 447    | 487    | 303                                                                                | 348    | 406    | 443    | 100                                                                                 | 115    | 134    | 146    |
|                                                                                   | 160                | 6 1/4  | 3 1/8  | 438                                                                               | 503    | 588    | 641    | 398                                                                                | 458    | 535    | 583    | 131                                                                                 | 151    | 176    | 192    |
|                                                                                   | 180                | 7 1/8  | 3 1/8  | 438                                                                               | 503    | 588    | 641    | 398                                                                                | 458    | 535    | 583    | 131                                                                                 | 151    | 176    | 192    |
|                                                                                   | 200                | 8      | 3 1/8  | 438                                                                               | 503    | 588    | 641    | 398                                                                                | 458    | 535    | 583    | 131                                                                                 | 151    | 176    | 192    |
|                                                                                   | 220                | 8 5/8  | 3 1/8  | 438                                                                               | 503    | 588    | 641    | 398                                                                                | 458    | 535    | 583    | 131                                                                                 | 151    | 176    | 192    |
|                                                                                   | 240                | 9 1/2  | 3 1/8  | 438                                                                               | 503    | 588    | 641    | 398                                                                                | 458    | 535    | 583    | 131                                                                                 | 151    | 176    | 192    |
|                                                                                   | 260                | 10 1/4 | 3 1/8  | 438                                                                               | 503    | 588    | 641    | 398                                                                                | 458    | 535    | 583    | 131                                                                                 | 151    | 176    | 192    |
|                                                                                   | 280                | 11     | 3 1/8  | 438                                                                               | 503    | 588    | 641    | 398                                                                                | 458    | 535    | 583    | 131                                                                                 | 151    | 176    | 192    |
|                                                                                   | 300                | 11 3/4 | 4      | 560                                                                               | 644    | 752    | 820    | 510                                                                                | 586    | 684    | 746    | 168                                                                                 | 193    | 226    | 246    |
|                                                                                   | 320                | 12 5/8 | 4      | 560                                                                               | 644    | 752    | 820    | 510                                                                                | 586    | 684    | 746    | 168                                                                                 | 193    | 226    | 246    |
|                                                                                   | 340                | 13 3/8 | 4      | 560                                                                               | 644    | 752    | 820    | 510                                                                                | 586    | 684    | 746    | 168                                                                                 | 193    | 226    | 246    |
|                                                                                   | 360                | 14 1/4 | 4      | 560                                                                               | 644    | 752    | 820    | 510                                                                                | 586    | 684    | 746    | 168                                                                                 | 193    | 226    | 246    |
|                                                                                   | 380                | 15     | 4      | 560                                                                               | 644    | 752    | 820    | 510                                                                                | 586    | 684    | 746    | 168                                                                                 | 193    | 226    | 246    |
|                                                                                   | 400                | 15 3/4 | 4      | 560                                                                               | 644    | 752    | 820    | 510                                                                                | 586    | 684    | 746    | 168                                                                                 | 193    | 226    | 246    |
|                                                                                   | 120 <sup>(2)</sup> | 4 3/4  | 3 1/8  | 644                                                                               | 738    | 831    | 906    | 586                                                                                | 671    | 756    | 825    | 193                                                                                 | 221    | 249    | 272    |
|                                                                                   | 160 <sup>(2)</sup> | 6 1/4  | 3 1/8  | 644                                                                               | 738    | 831    | 906    | 586                                                                                | 671    | 756    | 825    | 193                                                                                 | 221    | 249    | 272    |
|                                                                                   | 200 <sup>(2)</sup> | 8      | 3 1/8  | 644                                                                               | 738    | 831    | 906    | 586                                                                                | 671    | 756    | 825    | 193                                                                                 | 221    | 249    | 272    |
|                                                                                   | 240 <sup>(2)</sup> | 9 1/2  | 3 1/8  | 644                                                                               | 738    | 831    | 906    | 586                                                                                | 671    | 756    | 825    | 193                                                                                 | 221    | 249    | 272    |
|                                                                                   | 280 <sup>(2)</sup> | 11     | 3 1/8  | 644                                                                               | 738    | 831    | 906    | 586                                                                                | 671    | 756    | 825    | 193                                                                                 | 221    | 249    | 272    |
| 12<br>0.48                                                                        | 320                | 12 5/8 | 4 3/4  | 979                                                                               | 1121   | 1264   | 1378   | 890                                                                                | 1020   | 1150   | 1254   | 294                                                                                 | 336    | 379    | 413    |
|                                                                                   | 360                | 14 1/4 | 4 3/4  | 979                                                                               | 1121   | 1264   | 1378   | 890                                                                                | 1020   | 1150   | 1254   | 294                                                                                 | 336    | 379    | 413    |
|                                                                                   | 400                | 15 3/4 | 4 3/4  | 979                                                                               | 1121   | 1264   | 1378   | 890                                                                                | 1020   | 1150   | 1254   | 294                                                                                 | 336    | 379    | 413    |
|                                                                                   | 440                | 17 1/4 | 4 3/4  | 979                                                                               | 1121   | 1264   | 1378   | 890                                                                                | 1020   | 1150   | 1254   | 294                                                                                 | 336    | 379    | 413    |
|                                                                                   | 480                | 19     | 4 3/4  | 979                                                                               | 1121   | 1264   | 1378   | 890                                                                                | 1020   | 1150   | 1254   | 294                                                                                 | 336    | 379    | 413    |
|                                                                                   | 520                | 20 1/2 | 4 3/4  | 979                                                                               | 1121   | 1264   | 1378   | 890                                                                                | 1020   | 1150   | 1254   | 294                                                                                 | 336    | 379    | 413    |
|                                                                                   | 560                | 22     | 4 3/4  | 979                                                                               | 1121   | 1264   | 1378   | 890                                                                                | 1020   | 1150   | 1254   | 294                                                                                 | 336    | 379    | 413    |
|                                                                                   | 600                | 23 5/8 | 4 3/4  | 979                                                                               | 1121   | 1264   | 1378   | 890                                                                                | 1020   | 1150   | 1254   | 294                                                                                 | 336    | 379    | 413    |

### NOTES:

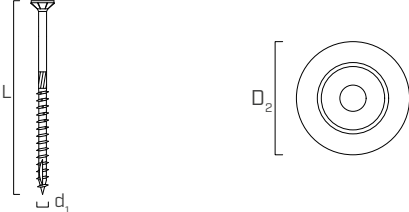
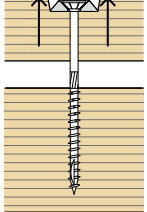
(1) The embedded thread length does not comply with the minimum requirement of ESR-4645 (6 times the outer thread diameter for screws installed at  $90^\circ$  to the grain and 8 times the outer thread diameter for screws installed at an angle  $0^\circ \leq \alpha < 90^\circ$  to the grain).

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

Refer to page 17 for the general calculation principles.

## STRUCTURAL VALUES | HEAD PULL-THROUGH ( $W_H$ )

HBS Ø6 | 0.24 inch - HBS Ø8 | 0.32 inch - HBS Ø10 | 0.40 inch - HBS Ø12 | 0.48 inch

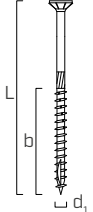
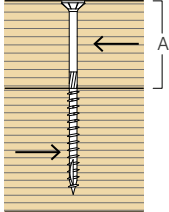
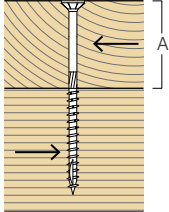
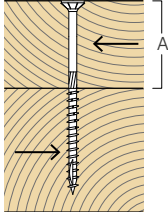
| geometry                                                                          |                   |                       |                       |                                        |                                          | head pull-through                                                                   |                 |                 |                 |
|-----------------------------------------------------------------------------------|-------------------|-----------------------|-----------------------|----------------------------------------|------------------------------------------|-------------------------------------------------------------------------------------|-----------------|-----------------|-----------------|
|  |                   |                       |                       |                                        |                                          |  |                 |                 |                 |
| $d_1$<br>[mm]<br>[in]                                                             | L<br>[mm]<br>[in] |                       | countersunk<br>washer | washer outer<br>diameter $D_2$<br>[in] | minimum side<br>member thickness<br>[in] | G=0.35<br>[lbf]                                                                     | G=0.42<br>[lbf] | G=0.49<br>[lbf] | G=0.55<br>[lbf] |
| <b>6</b><br><b>0.24</b>                                                           | from 40 to 300    | from 1 9/16 to 11 3/4 | <b>HUS6</b>           | 0.787                                  | 1 1/2                                    | 166                                                                                 | 239             | 270             | 294             |
| <b>8</b><br><b>0.32</b>                                                           | from 80 to 520    | from 3 1/8 to 20 1/2  | <b>HUS8</b>           | 0.984                                  | 1 1/2                                    | 166                                                                                 | 239             | 325             | 410             |
| <b>10</b><br><b>0.40</b>                                                          | from 80 to 400    | from 3 1/8 to 15 3/4  | <b>HUS10</b>          | 1.181                                  | 1 1/2                                    | 166                                                                                 | 239             | 325             | 410             |
| <b>12</b><br><b>0.48</b>                                                          | from 120 to 600   | from 4 3/4 to 23 5/8  | <b>HUS12</b>          | 1.457                                  | 1 1/2                                    | 166                                                                                 | 239             | 325             | 410             |

### NOTES:

Refer to page 17 for the general calculation principles.

## STRUCTURAL VALUES | REFERENCE LATERAL DESIGN VALUES (Z) | WOOD-TO-WOOD<sup>[\*]</sup>

HBS Ø3,5 | 0.14 inch - HBS Ø4 | 0.16 inch - HBS Ø4,5 | 0.18 inch - HBS Ø5 | 0.20 inch

| geometry                                                                          |                                            |                     |                     |                     | $Z_{  }^{(1)}$                                                                    |                      |                      |                      | $Z_{\perp/  }^{(2)}$                                                               |                      |                      |                      | $Z_{\perp}^{(3)}$                                                                   |                      |                      |                      |
|-----------------------------------------------------------------------------------|--------------------------------------------|---------------------|---------------------|---------------------|-----------------------------------------------------------------------------------|----------------------|----------------------|----------------------|------------------------------------------------------------------------------------|----------------------|----------------------|----------------------|-------------------------------------------------------------------------------------|----------------------|----------------------|----------------------|
|  |                                            |                     |                     |                     |  |                      |                      |                      |  |                      |                      |                      |  |                      |                      |                      |
| $d_1$                                                                             | L                                          | b                   | A                   |                     | G=0.35                                                                            | G=0.42               | G=0.49               | G=0.55               | G=0.35                                                                             | G=0.42               | G=0.49               | G=0.55               | G=0.35                                                                              | G=0.42               | G=0.49               | G=0.55               |
| <small>[mm]</small><br><small>[in]</small>                                        | <small>[mm]</small><br><small>[in]</small> | <small>[in]</small> | <small>[in]</small> | <small>[in]</small> | <small>[lbf]</small>                                                              | <small>[lbf]</small> | <small>[lbf]</small> | <small>[lbf]</small> | <small>[lbf]</small>                                                               | <small>[lbf]</small> | <small>[lbf]</small> | <small>[lbf]</small> | <small>[lbf]</small>                                                                | <small>[lbf]</small> | <small>[lbf]</small> | <small>[lbf]</small> |
| <b>3,5</b><br><b>0.14</b>                                                         | 40 <sup>(4)</sup>                          | 1 9/16              | 11/16               | 3/4                 | 30                                                                                | 42                   | 52                   | 58                   | 30                                                                                 | 42                   | 52                   | 58                   | 30                                                                                  | 42                   | 52                   | 58                   |
|                                                                                   | 45                                         | 1 3/4               | 15/16               | 3/4                 | 34                                                                                | 43                   | 52                   | 58                   | 34                                                                                 | 43                   | 52                   | 58                   | 34                                                                                  | 43                   | 52                   | 58                   |
|                                                                                   | 50                                         | 1 15/16             | 15/16               | 1                   | 37                                                                                | 45                   | 52                   | 58                   | 37                                                                                 | 45                   | 52                   | 58                   | 37                                                                                  | 45                   | 52                   | 58                   |
| <b>4</b><br><b>0.16</b>                                                           | 30 <sup>(4)</sup>                          | 1 3/16              | 11/16               | 1/4                 | 27                                                                                | 38                   | 48                   | 53                   | 27                                                                                 | 38                   | 48                   | 53                   | 27                                                                                  | 38                   | 48                   | 53                   |
|                                                                                   | 35                                         | 1 3/8               | 11/16               | 1/4                 | 27                                                                                | 38                   | 48                   | 53                   | 27                                                                                 | 38                   | 48                   | 53                   | 27                                                                                  | 38                   | 48                   | 53                   |
|                                                                                   | 40                                         | 1 9/16              | 15/16               | 1/4                 | 27                                                                                | 38                   | 48                   | 53                   | 27                                                                                 | 38                   | 48                   | 53                   | 27                                                                                  | 38                   | 48                   | 53                   |
|                                                                                   | 45                                         | 1 3/4               | 1 3/16              | 1/2                 | 36                                                                                | 44                   | 53                   | 62                   | 36                                                                                 | 44                   | 53                   | 62                   | 36                                                                                  | 44                   | 53                   | 62                   |
|                                                                                   | 50                                         | 1 15/16             | 1 3/16              | 3/4                 | 41                                                                                | 52                   | 65                   | 75                   | 41                                                                                 | 52                   | 65                   | 75                   | 41                                                                                  | 52                   | 65                   | 75                   |
|                                                                                   | 60                                         | 2 3/8               | 1 3/8               | 3/4                 | 41                                                                                | 52                   | 65                   | 75                   | 41                                                                                 | 52                   | 65                   | 75                   | 41                                                                                  | 52                   | 65                   | 75                   |
|                                                                                   | 70                                         | 2 3/4               | 1 9/16              | 1                   | 47                                                                                | 58                   | 67                   | 75                   | 47                                                                                 | 58                   | 67                   | 75                   | 47                                                                                  | 58                   | 67                   | 75                   |
| <b>4,5</b><br><b>0.18</b>                                                         | 80                                         | 3 1/8               | 1 9/16              | 1 1/2               | 49                                                                                | 58                   | 67                   | 75                   | 49                                                                                 | 58                   | 67                   | 75                   | 49                                                                                  | 58                   | 67                   | 75                   |
|                                                                                   | 40 <sup>(4)</sup>                          | 1 9/16              | 15/16               | 1/2                 | 40                                                                                | 52                   | 62                   | 72                   | 40                                                                                 | 52                   | 62                   | 72                   | 40                                                                                  | 52                   | 62                   | 72                   |
|                                                                                   | 45                                         | 1 3/4               | 1 3/16              | 1/2                 | 43                                                                                | 52                   | 62                   | 72                   | 43                                                                                 | 52                   | 62                   | 72                   | 43                                                                                  | 52                   | 62                   | 72                   |
|                                                                                   | 50                                         | 1 15/16             | 1 3/16              | 3/4                 | 47                                                                                | 60                   | 74                   | 88                   | 47                                                                                 | 60                   | 74                   | 88                   | 47                                                                                  | 60                   | 74                   | 88                   |
|                                                                                   | 60                                         | 2 3/8               | 1 3/8               | 3/4                 | 47                                                                                | 60                   | 74                   | 88                   | 47                                                                                 | 60                   | 74                   | 88                   | 47                                                                                  | 60                   | 74                   | 88                   |
|                                                                                   | 70                                         | 2 3/4               | 1 9/16              | 1                   | 54                                                                                | 70                   | 81                   | 90                   | 54                                                                                 | 70                   | 81                   | 90                   | 54                                                                                  | 70                   | 81                   | 90                   |
| <b>5</b><br><b>0.20</b>                                                           | 80                                         | 3 1/8               | 1 9/16              | 1 1/2               | 60                                                                                | 70                   | 81                   | 90                   | 60                                                                                 | 70                   | 81                   | 90                   | 60                                                                                  | 70                   | 81                   | 90                   |
|                                                                                   | 40 <sup>(4)</sup>                          | 1 9/16              | 15/16               | 1/2                 | 49                                                                                | 68                   | 88                   | 100                  | 49                                                                                 | 68                   | 88                   | 100                  | 49                                                                                  | 68                   | 88                   | 100                  |
|                                                                                   | 45 <sup>(4)</sup>                          | 1 3/4               | 15/16               | 3/4                 | 51                                                                                | 72                   | 95                   | 116                  | 51                                                                                 | 72                   | 95                   | 116                  | 51                                                                                  | 72                   | 95                   | 116                  |
|                                                                                   | 50 <sup>(4)</sup>                          | 1 15/16             | 15/16               | 1                   | 57                                                                                | 80                   | 106                  | 126                  | 57                                                                                 | 80                   | 106                  | 126                  | 57                                                                                  | 80                   | 106                  | 126                  |
|                                                                                   | 60                                         | 2 3/8               | 1 3/16              | 1                   | 69                                                                                | 92                   | 115                  | 133                  | 69                                                                                 | 92                   | 115                  | 133                  | 69                                                                                  | 92                   | 115                  | 133                  |
|                                                                                   | 70                                         | 2 3/4               | 1 3/8               | 1 1/4               | 80                                                                                | 104                  | 120                  | 133                  | 80                                                                                 | 104                  | 120                  | 133                  | 80                                                                                  | 104                  | 120                  | 133                  |
|                                                                                   | 80                                         | 3 1/8               | 1 9/16              | 1 1/2               | 88                                                                                | 104                  | 120                  | 133                  | 88                                                                                 | 104                  | 120                  | 133                  | 88                                                                                  | 104                  | 120                  | 133                  |
|                                                                                   | 90                                         | 3 1/2               | 1 3/4               | 1 3/4               | 88                                                                                | 104                  | 120                  | 133                  | 88                                                                                 | 104                  | 120                  | 133                  | 88                                                                                  | 104                  | 120                  | 133                  |
|                                                                                   | 100                                        | 4                   | 1 15/16             | 1 3/4               | 88                                                                                | 104                  | 120                  | 133                  | 88                                                                                 | 104                  | 120                  | 133                  | 88                                                                                  | 104                  | 120                  | 133                  |
|                                                                                   | 120                                        | 4 3/4               | 2 3/8               | 2 1/4               | 88                                                                                | 104                  | 120                  | 133                  | 88                                                                                 | 104                  | 120                  | 133                  | 88                                                                                  | 104                  | 120                  | 133                  |

### NOTES:

(\*) The screws are not evaluated in ESR-4645.

Tabulated reference lateral design values (Z) are applicable to screws installed perpendicular to the faces of the wood members and loaded as follows:

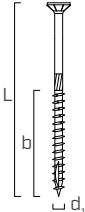
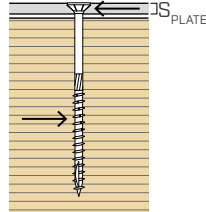
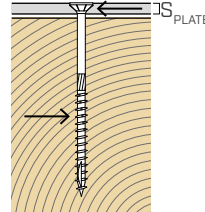
- (1)  $Z_{||}$  both side and main members loaded parallel to the grain.
- (2)  $Z_{\perp/||}$  side member loaded perpendicular to the grain; main member loaded parallel to the grain.
- (3)  $Z_{\perp}$  both side and main members loaded perpendicular to the grain.

(4) The screw penetration in the main member is lower than 6 times the outer thread diameter.

Refer to page 17 for the general calculation principles.

## STRUCTURAL VALUES | REFERENCE LATERAL DESIGN VALUES (Z) | STEEL-TO-WOOD<sup>[\*]</sup>

HBS Ø3,5 | 0.14 inch - HBS Ø4 | 0.16 inch - HBS Ø4,5 | 0.18 inch - HBS Ø5 | 0.20 inch

| geometry                                                                          |                                            |                                            |                                            | Z <sub>  </sub> (1)                                                               |                                              |                                              |                                              |                                              | Z <sub>⊥</sub> (2)                                                                  |                                              |                                              |                                              |                                              |
|-----------------------------------------------------------------------------------|--------------------------------------------|--------------------------------------------|--------------------------------------------|-----------------------------------------------------------------------------------|----------------------------------------------|----------------------------------------------|----------------------------------------------|----------------------------------------------|-------------------------------------------------------------------------------------|----------------------------------------------|----------------------------------------------|----------------------------------------------|----------------------------------------------|
|  |                                            |                                            |                                            |  |                                              |                                              |                                              |                                              |  |                                              |                                              |                                              |                                              |
| d <sub>1</sub>                                                                    | L                                          |                                            | b                                          | steel plate thickness                                                             | G=0.35                                       | G=0.42                                       | G=0.49                                       | G=0.55                                       | steel plate thickness                                                               | G=0.35                                       | G=0.42                                       | G=0.49                                       | G=0.55                                       |
| <small>[mm]</small><br><small>[in]</small>                                        | <small>[mm]</small><br><small>[in]</small> | <small>[in]</small><br><small>[in]</small> | <small>[in]</small><br><small>[in]</small> | <small>[in]</small><br><small>[in]</small>                                        | <small>[lbf]</small><br><small>[lbf]</small> | <small>[lbf]</small><br><small>[lbf]</small> | <small>[lbf]</small><br><small>[lbf]</small> | <small>[lbf]</small><br><small>[lbf]</small> | <small>[in]</small><br><small>[in]</small>                                          | <small>[lbf]</small><br><small>[lbf]</small> | <small>[lbf]</small><br><small>[lbf]</small> | <small>[lbf]</small><br><small>[lbf]</small> | <small>[lbf]</small><br><small>[lbf]</small> |
| <b>3,5</b><br><b>0.14</b>                                                         | 40                                         | 1 9/16                                     | 11/16                                      | S <sub>PLATE</sub> = 1/16"                                                        | 43                                           | 50                                           | 57                                           | 63                                           | S <sub>PLATE</sub> = 1/16"                                                          | 43                                           | 50                                           | 57                                           | 63                                           |
|                                                                                   | 45                                         | 1 3/4                                      | 15/16                                      |                                                                                   | 43                                           | 50                                           | 57                                           | 63                                           |                                                                                     | 43                                           | 50                                           | 57                                           | 63                                           |
|                                                                                   | 50                                         | 1 15/16                                    | 15/16                                      |                                                                                   | 43                                           | 50                                           | 57                                           | 63                                           |                                                                                     | 43                                           | 50                                           | 57                                           | 63                                           |
| <b>4</b><br><b>0.16</b>                                                           | 30                                         | 1 3/16                                     | 11/16                                      | S <sub>PLATE</sub> = 1/16"                                                        | 50                                           | 63                                           | 71                                           | 78                                           | S <sub>PLATE</sub> = 1/16"                                                          | 50                                           | 63                                           | 71                                           | 78                                           |
|                                                                                   | 35                                         | 1 3/8                                      | 11/16                                      |                                                                                   | 54                                           | 63                                           | 71                                           | 78                                           |                                                                                     | 54                                           | 63                                           | 71                                           | 78                                           |
|                                                                                   | 40                                         | 1 9/16                                     | 15/16                                      |                                                                                   | 54                                           | 63                                           | 71                                           | 78                                           |                                                                                     | 54                                           | 63                                           | 71                                           | 78                                           |
|                                                                                   | 45                                         | 1 3/4                                      | 1 3/16                                     |                                                                                   | 54                                           | 63                                           | 71                                           | 78                                           |                                                                                     | 54                                           | 63                                           | 71                                           | 78                                           |
|                                                                                   | 50                                         | 1 15/16                                    | 1 3/16                                     |                                                                                   | 54                                           | 63                                           | 71                                           | 78                                           |                                                                                     | 54                                           | 63                                           | 71                                           | 78                                           |
|                                                                                   | 60                                         | 2 3/8                                      | 1 3/8                                      |                                                                                   | 54                                           | 63                                           | 71                                           | 78                                           |                                                                                     | 54                                           | 63                                           | 71                                           | 78                                           |
|                                                                                   | 70                                         | 2 3/4                                      | 1 9/16                                     |                                                                                   | 54                                           | 63                                           | 71                                           | 78                                           |                                                                                     | 54                                           | 63                                           | 71                                           | 78                                           |
| <b>4,5</b><br><b>0.18</b>                                                         | 80                                         | 3 1/8                                      | 1 9/16                                     | S <sub>PLATE</sub> = 1/16"                                                        | 54                                           | 63                                           | 71                                           | 78                                           | S <sub>PLATE</sub> = 1/16"                                                          | 54                                           | 63                                           | 71                                           | 78                                           |
|                                                                                   | 40                                         | 1 9/16                                     | 15/16                                      |                                                                                   | 64                                           | 74                                           | 84                                           | 93                                           |                                                                                     | 64                                           | 74                                           | 84                                           | 93                                           |
|                                                                                   | 45                                         | 1 3/4                                      | 1 3/16                                     |                                                                                   | 64                                           | 74                                           | 84                                           | 93                                           |                                                                                     | 64                                           | 74                                           | 84                                           | 93                                           |
|                                                                                   | 50                                         | 1 15/16                                    | 1 3/16                                     |                                                                                   | 64                                           | 74                                           | 84                                           | 93                                           |                                                                                     | 64                                           | 74                                           | 84                                           | 93                                           |
|                                                                                   | 60                                         | 2 3/8                                      | 1 3/8                                      |                                                                                   | 64                                           | 74                                           | 84                                           | 93                                           |                                                                                     | 64                                           | 74                                           | 84                                           | 93                                           |
|                                                                                   | 70                                         | 2 3/4                                      | 1 9/16                                     |                                                                                   | 64                                           | 74                                           | 84                                           | 93                                           |                                                                                     | 64                                           | 74                                           | 84                                           | 93                                           |
| <b>5</b><br><b>0.20</b>                                                           | 80                                         | 3 1/8                                      | 1 9/16                                     | S <sub>PLATE</sub> = 1/16"                                                        | 64                                           | 74                                           | 84                                           | 93                                           | S <sub>PLATE</sub> = 1/16"                                                          | 64                                           | 74                                           | 84                                           | 93                                           |
|                                                                                   | 40                                         | 1 9/16                                     | 15/16                                      |                                                                                   | 88                                           | 106                                          | 121                                          | 133                                          |                                                                                     | 88                                           | 106                                          | 121                                          | 133                                          |
|                                                                                   | 45                                         | 1 3/4                                      | 15/16                                      |                                                                                   | 91                                           | 106                                          | 121                                          | 133                                          |                                                                                     | 91                                           | 106                                          | 121                                          | 133                                          |
|                                                                                   | 50                                         | 1 15/16                                    | 15/16                                      |                                                                                   | 91                                           | 106                                          | 121                                          | 133                                          |                                                                                     | 91                                           | 106                                          | 121                                          | 133                                          |
|                                                                                   | 60                                         | 2 3/8                                      | 1 3/16                                     |                                                                                   | 91                                           | 106                                          | 121                                          | 133                                          |                                                                                     | 91                                           | 106                                          | 121                                          | 133                                          |
|                                                                                   | 70                                         | 2 3/4                                      | 1 3/8                                      |                                                                                   | 91                                           | 106                                          | 121                                          | 133                                          |                                                                                     | 91                                           | 106                                          | 121                                          | 133                                          |
|                                                                                   | 80                                         | 3 1/8                                      | 1 9/16                                     |                                                                                   | 91                                           | 106                                          | 121                                          | 133                                          |                                                                                     | 91                                           | 106                                          | 121                                          | 133                                          |
|                                                                                   | 90                                         | 3 1/2                                      | 1 3/4                                      |                                                                                   | 91                                           | 106                                          | 121                                          | 133                                          |                                                                                     | 91                                           | 106                                          | 121                                          | 133                                          |
|                                                                                   | 100                                        | 4                                          | 1 15/16                                    |                                                                                   | 91                                           | 106                                          | 121                                          | 133                                          |                                                                                     | 91                                           | 106                                          | 121                                          | 133                                          |
|                                                                                   | 120                                        | 4 3/4                                      | 2 3/8                                      |                                                                                   | 91                                           | 106                                          | 121                                          | 133                                          |                                                                                     | 91                                           | 106                                          | 121                                          | 133                                          |

### NOTES:

[\*]The screws are not evaluated in ESR-4645.

Refer to page 17 for the general calculation principles.

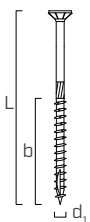
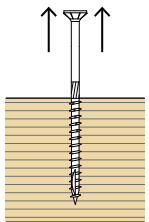
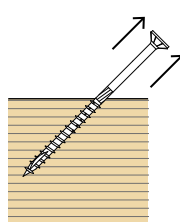
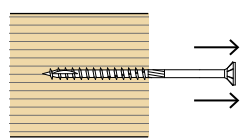
Tabulated reference lateral design values (Z) are applicable to screws installed perpendicular to the faces of the wood members and loaded as follows:

(1) Z<sub>||</sub> main member loaded parallel to the grain.

(2) Z<sub>⊥</sub> main member loaded perpendicular to the grain.

## STRUCTURAL VALUES | THREAD WITHDRAWAL<sup>[\*]</sup>

HBS Ø3,5 | 0.14 inch - HBS Ø4 | 0.16 inch - HBS Ø4,5 | 0.18 inch - HBS Ø5 | 0.20 inch

| geometry                                                                          |                   |         |         | thread withdrawal $\alpha = 90^\circ$                                             |        |        |        | thread withdrawal $\alpha = 45^\circ$                                              |        |        |        | thread withdrawal $\alpha = 0^\circ$                                                |        |        |        |
|-----------------------------------------------------------------------------------|-------------------|---------|---------|-----------------------------------------------------------------------------------|--------|--------|--------|------------------------------------------------------------------------------------|--------|--------|--------|-------------------------------------------------------------------------------------|--------|--------|--------|
|  |                   |         |         |  |        |        |        |  |        |        |        |  |        |        |        |
| $d_1$                                                                             | L                 | b       |         | G=0.35                                                                            | G=0.42 | G=0.49 | G=0.55 | G=0.35                                                                             | G=0.42 | G=0.49 | G=0.55 | G=0.35                                                                              | G=0.42 | G=0.49 | G=0.55 |
| [mm]<br>[in]                                                                      | [mm]<br>[in]      | [in]    | [in]    | [lbf]                                                                             | [lbf]  | [lbf]  | [lbf]  | [lbf]                                                                              | [lbf]  | [lbf]  | [lbf]  | [lbf]                                                                               | [lbf]  | [lbf]  | [lbf]  |
| <b>3,5</b><br><b>0.14</b>                                                         | 40 <sup>(1)</sup> | 1 9/16  | 11/16   | 31                                                                                | 36     | 52     | 57     | 28                                                                                 | 33     | 48     | 52     | 9                                                                                   | 11     | 16     | 17     |
|                                                                                   | 45 <sup>(2)</sup> | 1 3/4   | 15/16   | 42                                                                                | 49     | 71     | 78     | 38                                                                                 | 44     | 65     | 71     | 13                                                                                  | 15     | 21     | 23     |
|                                                                                   | 50 <sup>(2)</sup> | 1 15/16 | 15/16   | 42                                                                                | 49     | 71     | 78     | 38                                                                                 | 44     | 65     | 71     | 13                                                                                  | 15     | 21     | 23     |
| <b>4</b><br><b>0.16</b>                                                           | 30 <sup>(1)</sup> | 1 3/16  | 11/16   | 35                                                                                | 41     | 39     | 65     | 32                                                                                 | 37     | 36     | 59     | 11                                                                                  | 12     | 12     | 20     |
|                                                                                   | 35 <sup>(1)</sup> | 1 3/8   | 11/16   | 35                                                                                | 41     | 39     | 65     | 32                                                                                 | 37     | 36     | 59     | 11                                                                                  | 12     | 12     | 20     |
|                                                                                   | 40 <sup>(2)</sup> | 1 9/16  | 15/16   | 48                                                                                | 55     | 53     | 89     | 44                                                                                 | 50     | 49     | 81     | 14                                                                                  | 17     | 16     | 27     |
|                                                                                   | 45 <sup>(2)</sup> | 1 3/4   | 1 3/16  | 61                                                                                | 70     | 68     | 113    | 55                                                                                 | 64     | 62     | 103    | 18                                                                                  | 21     | 20     | 34     |
|                                                                                   | 50 <sup>(2)</sup> | 1 15/16 | 1 3/16  | 61                                                                                | 70     | 68     | 113    | 55                                                                                 | 64     | 62     | 103    | 18                                                                                  | 21     | 20     | 34     |
|                                                                                   | 60                | 2 3/8   | 1 3/8   | 70                                                                                | 81     | 78     | 131    | 64                                                                                 | 74     | 71     | 119    | 21                                                                                  | 24     | 24     | 39     |
|                                                                                   | 70                | 2 3/4   | 1 9/16  | 80                                                                                | 92     | 89     | 148    | 73                                                                                 | 84     | 81     | 135    | 24                                                                                  | 28     | 27     | 45     |
| <b>4,5</b><br><b>0.18</b>                                                         | 80                | 3 1/8   | 1 9/16  | 80                                                                                | 92     | 89     | 148    | 73                                                                                 | 84     | 81     | 135    | 24                                                                                  | 28     | 27     | 45     |
|                                                                                   | 40 <sup>(1)</sup> | 1 9/16  | 15/16   | 54                                                                                | 63     | 92     | 100    | 49                                                                                 | 57     | 84     | 91     | 16                                                                                  | 19     | 28     | 30     |
|                                                                                   | 45 <sup>(2)</sup> | 1 3/4   | 1 3/16  | 69                                                                                | 80     | 116    | 127    | 63                                                                                 | 72     | 106    | 116    | 21                                                                                  | 24     | 35     | 38     |
|                                                                                   | 50 <sup>(2)</sup> | 1 15/16 | 1 3/16  | 69                                                                                | 80     | 116    | 127    | 63                                                                                 | 72     | 106    | 116    | 21                                                                                  | 24     | 35     | 38     |
|                                                                                   | 60 <sup>(2)</sup> | 2 3/8   | 1 3/8   | 80                                                                                | 92     | 135    | 147    | 73                                                                                 | 84     | 123    | 134    | 24                                                                                  | 28     | 40     | 44     |
|                                                                                   | 70                | 2 3/4   | 1 9/16  | 91                                                                                | 105    | 153    | 167    | 82                                                                                 | 95     | 139    | 152    | 27                                                                                  | 31     | 46     | 50     |
| <b>5</b><br><b>0.20</b>                                                           | 80                | 3 1/8   | 1 9/16  | 91                                                                                | 105    | 153    | 167    | 82                                                                                 | 95     | 139    | 152    | 27                                                                                  | 31     | 46     | 50     |
|                                                                                   | 40 <sup>(1)</sup> | 1 9/16  | 15/16   | 60                                                                                | 69     | 102    | 112    | 55                                                                                 | 63     | 93     | 102    | 18                                                                                  | 21     | 31     | 33     |
|                                                                                   | 45 <sup>(1)</sup> | 1 3/4   | 15/16   | 60                                                                                | 69     | 102    | 112    | 55                                                                                 | 63     | 93     | 102    | 18                                                                                  | 21     | 31     | 33     |
|                                                                                   | 50 <sup>(1)</sup> | 1 15/16 | 15/16   | 60                                                                                | 69     | 102    | 112    | 55                                                                                 | 63     | 93     | 102    | 18                                                                                  | 21     | 31     | 33     |
|                                                                                   | 60 <sup>(2)</sup> | 2 3/8   | 1 3/16  | 76                                                                                | 88     | 129    | 141    | 69                                                                                 | 80     | 118    | 129    | 23                                                                                  | 26     | 39     | 42     |
|                                                                                   | 70 <sup>(2)</sup> | 2 3/4   | 1 3/8   | 88                                                                                | 102    | 150    | 164    | 80                                                                                 | 93     | 136    | 149    | 26                                                                                  | 31     | 45     | 49     |
|                                                                                   | 80                | 3 1/8   | 1 9/16  | 100                                                                               | 116    | 170    | 186    | 91                                                                                 | 105    | 155    | 169    | 30                                                                                  | 35     | 51     | 56     |
|                                                                                   | 90                | 3 1/2   | 1 3/4   | 112                                                                               | 130    | 191    | 208    | 102                                                                                | 118    | 174    | 190    | 34                                                                                  | 39     | 57     | 62     |
|                                                                                   | 100               | 4       | 1 15/16 | 124                                                                               | 143    | 211    | 231    | 113                                                                                | 130    | 192    | 210    | 37                                                                                  | 43     | 63     | 69     |
|                                                                                   | 120               | 4 3/4   | 2 3/8   | 152                                                                               | 176    | 259    | 283    | 138                                                                                | 160    | 236    | 257    | 46                                                                                  | 53     | 78     | 85     |

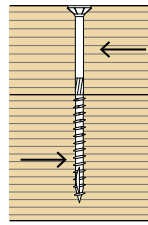
### NOTES:

(\*) The screws are not evaluated in ESR-4645.

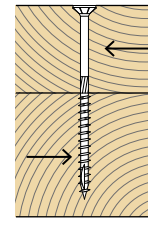
(1) The embedded thread length is lower than 6 times the outer thread diameter.

(2) The embedded thread length is lower than 8 times the outer thread diameter.

Refer to page 17 for the general calculation principles.



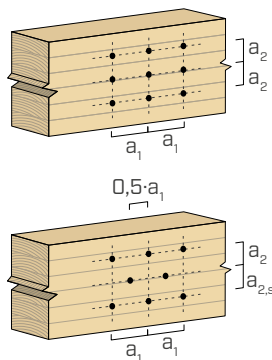
Load-to-grain angle  $\alpha = 0^\circ$



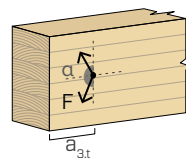
Load-to-grain angle  $\alpha = 90^\circ$

|                        |      | Screws inserted without pre-drilling hole <b>G &lt; 0.50</b> |                  |                    |                  |         |        |        |             |        | Screws inserted without pre-drilling hole <b>G &lt; 0.50</b> |                  |                    |                  |         |         |         |        |             |        |         |
|------------------------|------|--------------------------------------------------------------|------------------|--------------------|------------------|---------|--------|--------|-------------|--------|--------------------------------------------------------------|------------------|--------------------|------------------|---------|---------|---------|--------|-------------|--------|---------|
| <b>d<sub>1</sub></b>   | [mm] | 3,5 <sup>(*)</sup>                                           | 4 <sup>(*)</sup> | 4,5 <sup>(*)</sup> | 5 <sup>(*)</sup> | 6       | 8      | 10     |             | 12     | 3,5 <sup>(*)</sup>                                           | 4 <sup>(*)</sup> | 4,5 <sup>(*)</sup> | 5 <sup>(*)</sup> | 6       | 8       | 10      |        | 12          |        |         |
|                        | [in] | 0.14                                                         | 0.16             | 0.18               | 0.20             | 0.24    | 0.32   | 0.40   |             | 0.48   | 0.14                                                         | 0.16             | 0.18               | 0.20             | 0.24    | 0.32    | 0.40    |        | 0.48        |        |         |
| <b>a<sub>1</sub></b>   | [in] | <b>15·d</b>                                                  | 2 1/16           | 2 3/8              | 2 11/16          | 2 15/16 | 3 1/2  | 4 3/4  | <b>15·d</b> | 6      | 7 1/8                                                        | <b>12·d</b>      | 15/8               | 17/8             | 2 1/8   | 2 3/8   | 2 13/16 | 3 3/4  | <b>12·d</b> | 4 3/4  | 5 11/16 |
| <b>a<sub>2</sub></b>   | [in] | <b>5·d</b>                                                   | 11/16            | 13/16              | 7/8              | 1       | 1 3/16 | 19/16  | <b>5·d</b>  | 115/16 | 2 3/8                                                        | <b>5·d</b>       | 11/16              | 13/16            | 7/8     | 1       | 1 3/16  | 19/16  | <b>5·d</b>  | 115/16 | 2 3/8   |
| <b>a<sub>2,s</sub></b> | [in] | <b>2.5·d</b>                                                 | 3/8              | 3/8                | 1/2              | 1/2     | 9/16   | 13/16  | <b>5·d</b>  | 115/16 | 2 3/8                                                        | <b>2.5·d</b>     | 3/8                | 3/8              | 1/2     | 1/2     | 9/16    | 13/16  | <b>5·d</b>  | 115/16 | 2 3/8   |
| <b>a<sub>3,t</sub></b> | [in] | <b>15·d</b>                                                  | 2 1/16           | 2 3/8              | 2 11/16          | 2 15/16 | 3 1/2  | 4 3/4  | <b>15·d</b> | 6      | 7 1/8                                                        | <b>10·d</b>      | 13/8               | 19/16            | 1 3/4   | 115/16  | 2 3/8   | 3 1/8  | <b>10·d</b> | 4      | 4 3/4   |
| <b>a<sub>3,c</sub></b> | [in] | <b>10·d</b>                                                  | 13/8             | 19/16              | 1 3/4            | 115/16  | 2 3/8  | 3 1/8  | <b>10·d</b> | 4      | 4 3/4                                                        | <b>10·d</b>      | 13/8               | 19/16            | 1 3/4   | 115/16  | 2 3/8   | 3 1/8  | <b>10·d</b> | 4      | 4 3/4   |
| <b>a<sub>4,t</sub></b> | [in] | <b>5·d</b>                                                   | 11/16            | 13/16              | 7/8              | 1       | 1 3/16 | 19/16  | <b>5·d</b>  | 115/16 | 2 3/8                                                        | <b>10·d</b>      | 13/8               | 19/16            | 1 3/4   | 115/16  | 2 3/8   | 3 1/8  | <b>10·d</b> | 4      | 4 3/4   |
| <b>a<sub>4,c</sub></b> | [in] | <b>5·d</b>                                                   | 11/16            | 13/16              | 7/8              | 1       | 1 3/16 | 19/16  | <b>5·d</b>  | 115/16 | 2 3/8                                                        | <b>5·d</b>       | 11/16              | 13/16            | 7/8     | 1       | 1 3/16  | 19/16  | <b>5·d</b>  | 115/16 | 2 3/8   |
|                        |      |                                                              |                  |                    |                  |         |        |        |             |        |                                                              |                  |                    |                  |         |         |         |        |             |        |         |
|                        |      | Screws inserted without pre-drilling hole <b>G ≥ 0.50</b>    |                  |                    |                  |         |        |        |             |        | Screws inserted without pre-drilling hole <b>G ≥ 0.50</b>    |                  |                    |                  |         |         |         |        |             |        |         |
| <b>d<sub>1</sub></b>   | [mm] | 3,5 <sup>(*)</sup>                                           | 4 <sup>(*)</sup> | 4,5 <sup>(*)</sup> | 5 <sup>(*)</sup> | 6       | 8      | 10     |             | 12     | 3,5 <sup>(*)</sup>                                           | 4 <sup>(*)</sup> | 4,5 <sup>(*)</sup> | 5 <sup>(*)</sup> | 6       | 8       | 10      |        | 12          |        |         |
|                        | [in] | 0.14                                                         | 0.16             | 0.18               | 0.20             | 0.24    | 0.32   | 0.40   |             | 0.48   | 0.14                                                         | 0.16             | 0.18               | 0.20             | 0.24    | 0.32    | 0.40    |        | 0.48        |        |         |
| <b>a<sub>1</sub></b>   | [in] | <b>15·d</b>                                                  | 2 1/16           | 2 3/8              | 2 11/16          | 2 15/16 | 3 1/2  | 4 3/4  | <b>15·d</b> | 6      | 7 1/8                                                        | <b>15·d</b>      | 2 1/16             | 2 3/8            | 2 11/16 | 2 15/16 | 3 1/2   | 4 3/4  | <b>15·d</b> | 6      | 7 1/8   |
| <b>a<sub>2</sub></b>   | [in] | <b>7·d</b>                                                   | 1                | 1 1/8              | 1 1/4            | 1 3/8   | 1 5/8  | 2 3/16 | <b>7·d</b>  | 2 3/4  | 3 5/16                                                       | <b>7·d</b>       | 1                  | 1 1/8            | 1 1/4   | 1 3/8   | 1 5/8   | 2 3/16 | <b>7·d</b>  | 2 3/4  | 3 5/16  |
| <b>a<sub>2,s</sub></b> | [in] | <b>3·d</b>                                                   | 7/16             | 1/2                | 9/16             | 9/16    | 11/16  | 15/16  | <b>5·d</b>  | 115/16 | 2 3/8                                                        | <b>3·d</b>       | 7/16               | 1/2              | 9/16    | 9/16    | 11/16   | 15/16  | <b>5·d</b>  | 115/16 | 2 3/8   |
| <b>a<sub>3,t</sub></b> | [in] | <b>20·d</b>                                                  | 2 3/4            | 3 1/8              | 3 1/2            | 4       | 4 3/4  | 6 1/4  | <b>20·d</b> | 8      | 9 1/2                                                        | <b>15·d</b>      | 2 1/16             | 2 3/8            | 2 11/16 | 2 15/16 | 3 1/2   | 4 3/4  | <b>15·d</b> | 6      | 7 1/8   |
| <b>a<sub>3,c</sub></b> | [in] | <b>15·d</b>                                                  | 2 1/16           | 2 3/8              | 2 11/16          | 2 15/16 | 3 1/2  | 4 3/4  | <b>15·d</b> | 6      | 7 1/8                                                        | <b>15·d</b>      | 2 1/16             | 2 3/8            | 2 11/16 | 2 15/16 | 3 1/2   | 4 3/4  | <b>15·d</b> | 6      | 7 1/8   |
| <b>a<sub>4,t</sub></b> | [in] | <b>7·d</b>                                                   | 1                | 1 1/8              | 1 1/4            | 1 3/8   | 1 5/8  | 2 3/16 | <b>7·d</b>  | 2 3/4  | 3 5/16                                                       | <b>12·d</b>      | 15/8               | 17/8             | 2 1/8   | 2 3/8   | 2 13/16 | 3 3/4  | <b>12·d</b> | 4 3/4  | 5 11/16 |
| <b>a<sub>4,c</sub></b> | [in] | <b>7·d</b>                                                   | 1                | 1 1/8              | 1 1/4            | 1 3/8   | 1 5/8  | 2 3/16 | <b>7·d</b>  | 2 3/4  | 3 5/16                                                       | <b>7·d</b>       | 1                  | 1 1/8            | 1 1/4   | 1 3/8   | 1 5/8   | 2 3/16 | <b>7·d</b>  | 2 3/4  | 3 5/16  |

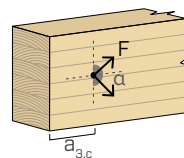
$d$  = nominal screw diameter



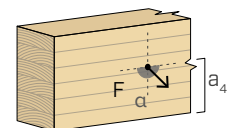
stressed end  
 $-90^\circ < \alpha < 90^\circ$



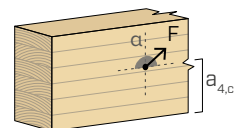
unloaded end  
 $90^\circ < \alpha < 270^\circ$



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



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

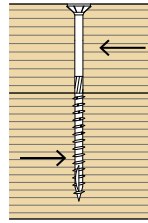


## NOTES:

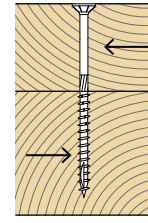
(\*) Not evaluated in ESR-4645.

- The minimum spacing and distances comply with Table 9 of ESR-4645, where  $d$  refers to the nominal diameter of the screw.
- Values for spacing between staggered rows  $a_{2,s}$  apply where fasteners in adjacent rows are offset by half of the spacing between fasteners in a row ( $0.5 \cdot a_1$ ).

- Wood member stresses must be checked in accordance with Section 11.1.2 and Appendix E of the NDS, and end distances, edge distances and fastener spacing may need to be increased accordingly.



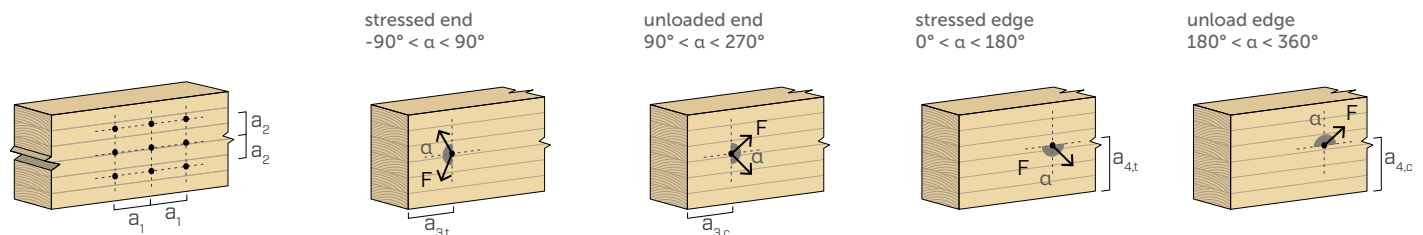
Load-to-grain angle  $\alpha = 0^\circ$



Load-to-grain angle  $\alpha = 90^\circ$

|           |      | Screws inserted without pre-drilling hole $G \leq 0.47$ |        |       |         |      |         |         |        |        |         | Screws inserted without pre-drilling hole $G \leq 0.47$ |        |        |         |      |         |         |        |        |         |
|-----------|------|---------------------------------------------------------|--------|-------|---------|------|---------|---------|--------|--------|---------|---------------------------------------------------------|--------|--------|---------|------|---------|---------|--------|--------|---------|
| $d_1$     | [mm] | 3,5                                                     | 4      | 4,5   | 5       |      | 6       | 8       | 10     | 12     | 3,5     |                                                         | 4      | 4,5    | 5       |      | 6       | 8       | 10     | 12     |         |
|           | [in] | 0.14                                                    | 0.16   | 0.18  | 0.20    |      | 0.24    | 0.32    | 0.40   | 0.48   | 0.14    |                                                         | 0.16   | 0.18   | 0.20    |      | 0.24    | 0.32    | 0.40   | 0.48   |         |
| $a_1$     | [in] | 10·d                                                    | 13/8   | 19/16 | 13/4    | 12·d | 2 3/8   | 2 13/16 | 3 3/4  | 4 3/4  | 5 11/16 | 5·d                                                     | 11/16  | 13/16  | 7/8     | 5·d  | 1       | 13/16   | 19/16  | 115/16 | 2 3/8   |
| $a_2$     | [in] | 5·d                                                     | 11/16  | 13/16 | 7/8     | 5·d  | 1       | 1 3/16  | 19/16  | 115/16 | 2 3/8   | 5·d                                                     | 11/16  | 13/16  | 7/8     | 5·d  | 1       | 13/16   | 19/16  | 115/16 | 2 3/8   |
| $a_{3,t}$ | [in] | 15·d                                                    | 2 1/16 | 2 3/8 | 2 11/16 | 15·d | 2 15/16 | 3 1/2   | 4 3/4  | 6      | 7 1/8   | 10·d                                                    | 13/8   | 19/16  | 13/4    | 10·d | 115/16  | 2 3/8   | 3 1/8  | 4      | 4 3/4   |
| $a_{3,c}$ | [in] | 10·d                                                    | 13/8   | 19/16 | 13/4    | 10·d | 115/16  | 2 3/8   | 3 1/8  | 4      | 4 3/4   | 10·d                                                    | 13/8   | 19/16  | 13/4    | 10·d | 115/16  | 2 3/8   | 3 1/8  | 4      | 4 3/4   |
| $a_{4,t}$ | [in] | 5·d                                                     | 11/16  | 13/16 | 7/8     | 5·d  | 1       | 1 3/16  | 19/16  | 115/16 | 2 3/8   | 7·d                                                     | 1      | 11/8   | 11/4    | 10·d | 115/16  | 2 3/8   | 3 1/8  | 4      | 4 3/4   |
| $a_{4,c}$ | [in] | 5·d                                                     | 11/16  | 13/16 | 7/8     | 5·d  | 1       | 1 3/16  | 19/16  | 115/16 | 2 3/8   | 5·d                                                     | 11/16  | 13/16  | 7/8     | 5·d  | 1       | 13/16   | 19/16  | 115/16 | 2 3/8   |
|           |      |                                                         |        |       |         |      |         |         |        |        |         |                                                         |        |        |         |      |         |         |        |        |         |
|           |      | Screws inserted without pre-drilling hole $G > 0.47$    |        |       |         |      |         |         |        |        |         | Screws inserted without pre-drilling hole $G > 0.47$    |        |        |         |      |         |         |        |        |         |
| $d_1$     | [mm] | 3,5                                                     | 4      | 4,5   | 5       |      | 6       | 8       | 10     | 12     | 3,5     |                                                         | 4      | 4,5    | 5       |      | 6       | 8       | 10     | 12     |         |
|           | [in] | 0.14                                                    | 0.16   | 0.18  | 0.20    |      | 0.24    | 0.32    | 0.40   | 0.48   | 0.14    |                                                         | 0.16   | 0.18   | 0.20    |      | 0.24    | 0.32    | 0.40   | 0.48   |         |
| $a_1$     | [in] | 15·d                                                    | 2 1/16 | 2 3/8 | 2 11/16 | 15·d | 2 15/16 | 3 1/2   | 4 3/4  | 6      | 7 1/8   | 7·d                                                     | 1      | 11/8   | 11/4    | 7·d  | 13/8    | 15/8    | 2 3/16 | 2 3/4  | 3 5/16  |
| $a_2$     | [in] | 7·d                                                     | 1      | 1 1/8 | 1 1/4   | 7·d  | 1 3/8   | 1 5/8   | 2 3/16 | 2 3/4  | 3 5/16  | 7·d                                                     | 1      | 1 1/8  | 1 1/4   | 7·d  | 13/8    | 15/8    | 2 3/16 | 2 3/4  | 3 5/16  |
| $a_{3,t}$ | [in] | 20·d                                                    | 2 3/4  | 3 1/8 | 3 1/2   | 20·d | 4       | 4 3/4   | 6 1/4  | 8      | 9 1/2   | 15·d                                                    | 2 1/16 | 2 3/8  | 2 11/16 | 15·d | 2 15/16 | 3 1/2   | 4 3/4  | 6      | 7 1/8   |
| $a_{3,c}$ | [in] | 15·d                                                    | 2 1/16 | 2 3/8 | 2 11/16 | 15·d | 2 15/16 | 3 1/2   | 4 3/4  | 6      | 7 1/8   | 15·d                                                    | 2 1/16 | 2 3/8  | 2 11/16 | 15·d | 2 15/16 | 3 1/2   | 4 3/4  | 6      | 7 1/8   |
| $a_{4,t}$ | [in] | 7·d                                                     | 1      | 1 1/8 | 1 1/4   | 7·d  | 1 3/8   | 1 5/8   | 2 3/16 | 2 3/4  | 3 5/16  | 9·d                                                     | 11/4   | 1 7/16 | 1 5/8   | 12·d | 2 3/8   | 2 13/16 | 3 3/4  | 4 3/4  | 5 11/16 |
| $a_{4,c}$ | [in] | 7·d                                                     | 1      | 1 1/8 | 1 1/4   | 7·d  | 1 3/8   | 1 5/8   | 2 3/16 | 2 3/4  | 3 5/16  | 7·d                                                     | 1      | 1 1/8  | 1 1/4   | 7·d  | 13/8    | 15/8    | 2 3/16 | 2 3/4  | 3 5/16  |
|           |      |                                                         |        |       |         |      |         |         |        |        |         |                                                         |        |        |         |      |         |         |        |        |         |
|           |      | Screws inserted with pre-drilling hole                  |        |       |         |      |         |         |        |        |         | Screws inserted with pre-drilling hole                  |        |        |         |      |         |         |        |        |         |
| $d_1$     | [mm] | 3,5                                                     | 4      | 4,5   | 5       |      | 6       | 8       | 10     | 12     | 3,5     |                                                         | 4      | 4,5    | 5       |      | 6       | 8       | 10     | 12     |         |
|           | [in] | 0.14                                                    | 0.16   | 0.18  | 0.20    |      | 0.24    | 0.32    | 0.40   | 0.48   | 0.14    |                                                         | 0.16   | 0.18   | 0.20    |      | 0.24    | 0.32    | 0.40   | 0.48   |         |
| $a_1$     | [in] | 5·d                                                     | 11/16  | 13/16 | 7/8     | 5·d  | 1       | 1 3/16  | 19/16  | 115/16 | 2 3/8   | 4·d                                                     | 9/16   | 5/8    | 11/16   | 4·d  | 13/16   | 15/16   | 1 1/4  | 19/16  | 17/8    |
| $a_2$     | [in] | 3·d                                                     | 7/16   | 1/2   | 9/16    | 3·d  | 9/16    | 11/16   | 15/16  | 13/16  | 17/16   | 4·d                                                     | 9/16   | 5/8    | 11/16   | 4·d  | 13/16   | 15/16   | 1 1/4  | 19/16  | 17/8    |
| $a_{3,t}$ | [in] | 12·d                                                    | 15/8   | 17/8  | 2 1/8   | 12·d | 2 3/8   | 2 13/16 | 3 3/4  | 4 3/4  | 5 11/16 | 7·d                                                     | 1      | 1 1/8  | 1 1/4   | 7·d  | 13/8    | 15/8    | 2 3/16 | 2 3/4  | 3 5/16  |
| $a_{3,c}$ | [in] | 7·d                                                     | 1      | 1 1/8 | 1 1/4   | 7·d  | 1 3/8   | 1 5/8   | 2 3/16 | 2 3/4  | 3 5/16  | 7·d                                                     | 1      | 1 1/8  | 1 1/4   | 7·d  | 13/8    | 15/8    | 2 3/16 | 2 3/4  | 3 5/16  |
| $a_{4,t}$ | [in] | 3·d                                                     | 7/16   | 1/2   | 9/16    | 3·d  | 9/16    | 11/16   | 15/16  | 13/16  | 17/16   | 5·d                                                     | 11/16  | 13/16  | 7/8     | 7·d  | 13/8    | 15/8    | 2 3/16 | 2 3/4  | 3 5/16  |
| $a_{4,c}$ | [in] | 3·d                                                     | 7/16   | 1/2   | 9/16    | 3·d  | 9/16    | 11/16   | 15/16  | 13/16  | 17/16   | 3·d                                                     | 7/16   | 1/2    | 9/16    | 3·d  | 9/16    | 11/16   | 15/16  | 13/16  | 17/16   |

d = nominal screw diameter



#### NOTES:

- The tabulated values for the minimum spacing and distances are according to the European Technical Assessment ETA-11/0030. The values from ETA-11/0030 are based on extensive research studies carried out in Europe and are according to the well-established provisions from EN 1995:2014 (Eurocode 5). Designers may adopt, under their responsibility, the minimum spacing and distances from ETA-11/0030.
- Specific gravity of  $G = 0.47$  is equivalent to a characteristic density of  $\rho_k = 420 \text{ kg/m}^3$ .
- The minimum spacing for all steel-to-timber connections ( $a_1$  and  $a_2$ ) can be multiplied by a coefficient of 0.7.

## GENERAL PRINCIPLES:

- Tabulated values must be multiplied by all adjustment factors included in the NDS for dowel-type fasteners to determine allowable loads for use with ASD, design loads for use with LRFD or both.
- As part of the connection design, the structural wood members must be checked for load-carrying capacity in accordance with Section 11.1.2 of the NDS and local stresses within multiple-fastener connections must be checked against Appendix E of the NDS to ensure the capacity of the connection and fastener group.
- The design of connection with steel side plate must comply with Section 11.2.3 of the NDS.
- Connections with multiple screws must be designed in accordance with Sections 11.2.2 and 12.6 of the NDS and the requirements in Section 4.1.7.3.1 of ESR-4645.
- HBS screws must be installed and used in dry in-service conditions in accordance with the NDS (wet service factor for connection CM is 1.0)
- Sizing and verification of the timber elements and steel plates must be done separately by the designer.

## REFERENCE LATERAL DESIGN VALUES:

- Tabulated values are determined from the yield model equations in Section 12.3 and Table 12.3.1A of the NDS.
- The screw penetration into the main member is minimum 6 times the outer thread diameter unless otherwise noted.
- The reference lateral design values may be determined for other connection configurations in accordance with the NDS and Section 4.1.6.2 of ESR-4645.
- The reference lateral design values are calculated for screws inserted without pre-drilling hole. In the case of screws inserted with pre-drilling hole, greater resistance values can be obtained.

### WOOD-TO-WOOD

- The wood main member thickness must be greater than the screw length less the thickness of the wood side member.
- The tabulated lateral design values are based on both wood members having the same specific gravity G.

### STEEL-TO-WOOD

- The steel side member must have a minimum tensile strength equal to 58 ksi (400 MPa) and comply with the minimum requirements of ASTM A36.
- The wood main member thickness must be greater than the screw length less the thickness of the steel side member.

## REFERENCE WITHDRAWAL DESIGN VALUES:

The reference withdrawal design values ( $W_{ref}$ ) expressed in pounds-force per inch of thread penetration into the main member for screws installed at an angle of 90° to the grain can be found in Table 7 of ESR-4645 and are reported below.

| $d_1$<br>[mm]<br>[in] | Reference withdrawal design values $W_{ref}$ |                    |                    |                    |
|-----------------------|----------------------------------------------|--------------------|--------------------|--------------------|
|                       | G=0.35<br>[lbf/in]                           | G=0.42<br>[lbf/in] | G=0.49<br>[lbf/in] | G=0.55<br>[lbf/in] |
| 3.5<br>0.14(*)        | 45                                           | 52                 | 76                 | 83                 |
| 4<br>0.16(*)          | 51                                           | 59                 | 87                 | 95                 |
| 4.5<br>0.18(*)        | 58                                           | 67                 | 98                 | 107                |
| 5<br>0.20(*)          | 64                                           | 74                 | 109                | 119                |
| 6<br>0.24             | 77                                           | 89                 | 131                | 143                |
| 8<br>0.32             | 109                                          | 125                | 138                | 174                |
| 10<br>0.40            | 140                                          | 161                | 188                | 205                |
| 12<br>0.48            | 206                                          | 236                | 266                | 290                |

(\*) Not evaluated in ESR-4645.

- The values for screws installed at an angle  $\alpha$  to the grain are determined by multiplying the reference withdrawal design values with the effective thread penetration  $L_{eff}$  of the screw in the wood member and with the factor  $k_\alpha$ :

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

Where:

- $W_{ref}$  is the reference withdrawal design value for screws installed at an angle of 90° to the grain, as shown in the table on the left;

- $k_\alpha$  factor is calculated as:

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

- $\alpha$  is the angle between the grain direction and screw axis.

Tabulated values at page 7, 10 and 14 are valid for  $L_{eff}$  equal to the screw thread length  $b$  and  $k_\alpha = 1$  for  $\alpha = 90^\circ$ ,  $k_\alpha = 0.91$  for  $\alpha = 45^\circ$ ,  $k_\alpha = 0.3$  for  $\alpha = 0^\circ$ .

- The minimum embedded thread length is 6 times the outer thread diameter for screws installed at 90° to the grain, unless otherwise noted.
- The minimum embedded thread length for screws installed at an angle  $0^\circ \leq \alpha < 90^\circ$  to the grain is 8 times the outer thread diameter, unless otherwise noted.
- At least four screws must be used in a connection with screws installed in the wood member with an angle between the grain direction and screw axis  $\alpha \leq 15^\circ$ .
- The reference withdrawal design values must be less than  $f_{tens}$  of the screw.

## REFERENCE HEAD-PULL THROUGH DESIGN VALUES:

- Tabulated values are valid for HBS screws in combination with HUS counter-sunk washers installed perpendicular to the faces of the wood members.
- The reference head pull-through values must be less than  $f_{tens}$  of the screw.
- The head pull-through design values for HBS screws with diameter 3,5 mm | 0.14 inch, 4,0 mm | 0.16 inch, 4,5 mm | 0.18 inch and 5,0 mm | 0.20 inch screws can be determined according to the NDS.