

# HBS PLATE

## PAN HEAD SCREW FOR PLATES

ICC  
ES  
AC233  
ESR-4645

CE  
ETA-11/0030

### NEW GEOMETRY

The inner core diameter of the Ø8, Ø10 and Ø12 mm screws has been increased to ensure higher performance in thick plate applications. In steel-timber connections, the new geometry achieves a strength increase of more than 15%.

### PLATE FASTENING

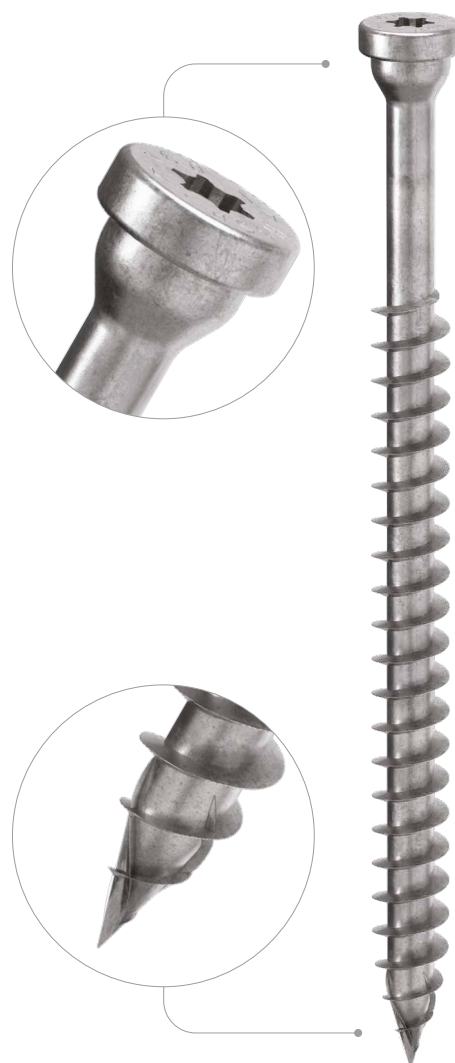
The under-head shoulder achieves an interlocking effect with the circular hole in the plate, thus guaranteeing excellent static performance. The edgeless geometry of the head reduces stress concentration points and gives the screw strength.

### 3 THORNS TIP

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



|                         |                                                               |     |     |     |
|-------------------------|---------------------------------------------------------------|-----|-----|-----|
| DIAMETER [mm]           | 3                                                             | 8   | 12  | 12  |
| LENGTH [mm]             | 25                                                            | 60  | 200 | 200 |
| SERVICE CLASS           | SC1                                                           | SC2 |     |     |
| ATMOSPHERIC CORROSIVITY | C1                                                            | C2  |     |     |
| WOOD CORROSIVITY        | T1                                                            | T2  |     |     |
| MATERIAL                | <b>Zn</b><br>ELECTRO PLATED<br>electrogalvanized carbon steel |     |     |     |

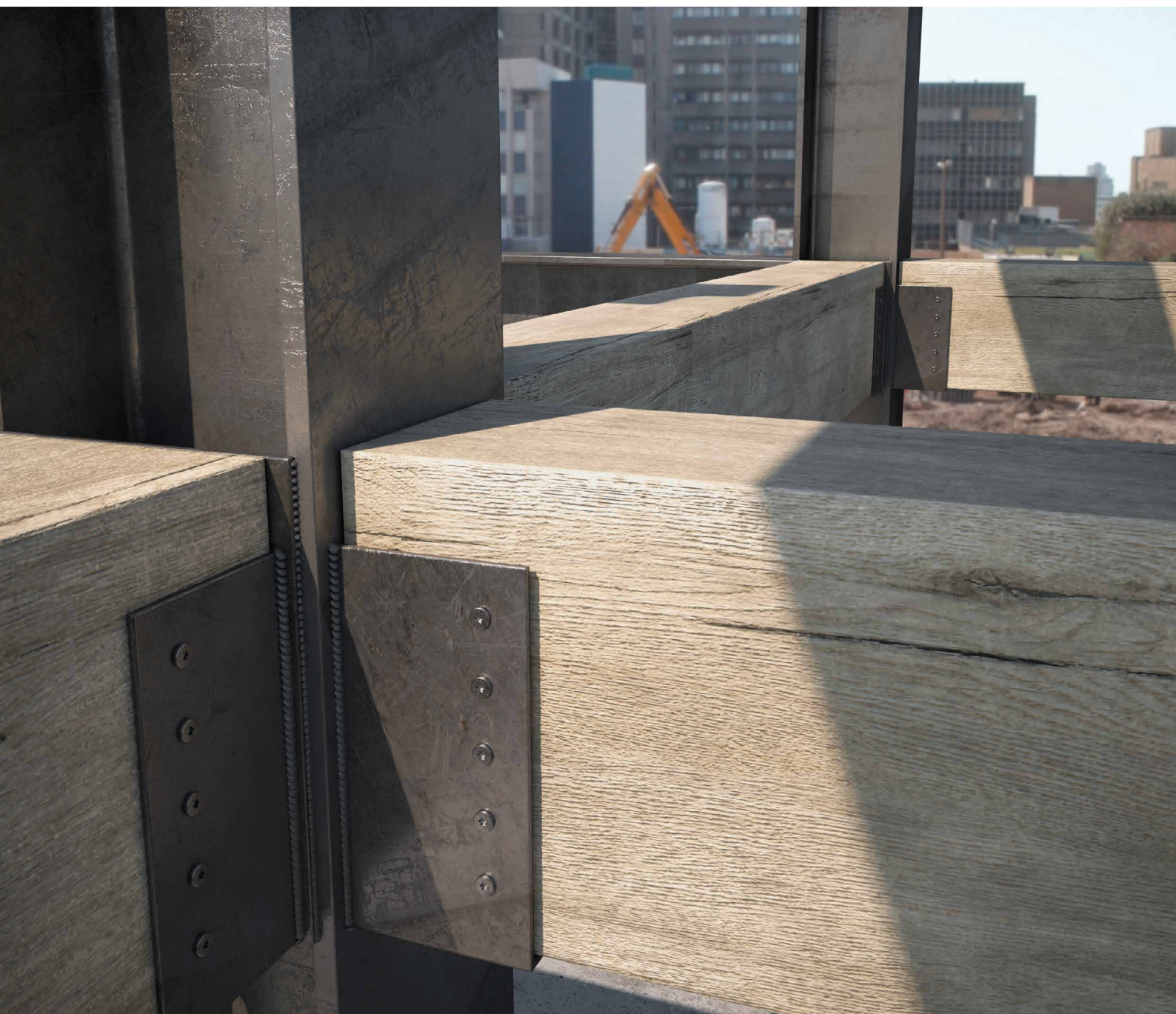


### METAL-to-TIMBER recommended use:



### FIELDS OF USE

- timber based panels
- solid timber
- glulam (Glued Laminated Timber)
- CLT and LVL
- high density woods



## MULTISTOREY

Ideal for steel-to-timber joints with large customized plates, designed for multi-story timber buildings.

## TITAN

Values also tested, certified and calculated for fastening standard Rothoblaas plates.

## CODES AND DIMENSIONS

| $d_1$<br>[mm] | CODE      | L<br>[mm] | b<br>[mm] | $A_p$<br>[mm] | pcs |
|---------------|-----------|-----------|-----------|---------------|-----|
| 8<br>TX 40    | HBSP860   | 60        | 52        | 1÷10          | 100 |
|               | HBSP880   | 80        | 55        | 1÷15          | 100 |
|               | HBSP8100  | 100       | 75        | 1÷15          | 100 |
|               | HBSP8120  | 120       | 95        | 1÷15          | 100 |
|               | HBSP8140  | 140       | 110       | 1÷20          | 100 |
|               | HBSP8160  | 160       | 130       | 1÷20          | 100 |
| 10<br>TX 40   | HBSP1080  | 80        | 60        | 1÷10          | 50  |
|               | HBSP10100 | 100       | 75        | 1÷15          | 50  |
|               | HBSP10120 | 120       | 95        | 1÷15          | 50  |
|               | HBSP10140 | 140       | 110       | 1÷20          | 50  |
|               | HBSP10160 | 160       | 130       | 1÷20          | 50  |
|               | HBSP10180 | 180       | 150       | 1÷20          | 50  |

| $d_1$<br>[mm] | CODE      | L<br>[mm] | b<br>[mm] | $A_p$<br>[mm] | pcs |
|---------------|-----------|-----------|-----------|---------------|-----|
| 12<br>TX 50   | HBSP12100 | 100       | 75        | 1÷15          | 25  |
|               | HBSP12120 | 120       | 90        | 1÷20          | 25  |
|               | HBSP12140 | 140       | 110       | 1÷20          | 25  |
|               | HBSP12160 | 160       | 120       | 1÷30          | 25  |
|               | HBSP12180 | 180       | 140       | 1÷30          | 25  |
|               | HBSP12200 | 200       | 160       | 1÷30          | 25  |

## RELATED PRODUCTS

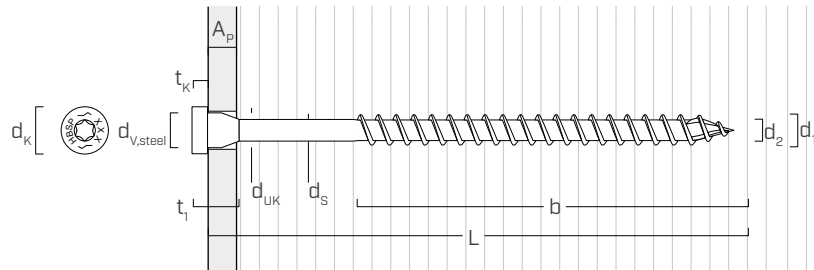


### TORQUE LIMITER

TORQUE LIMITER

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## GEOMETRY AND MECHANICAL CHARACTERISTICS



### GEOMETRY

| Nominal diameter                          | $d_1$         | [mm] | 8     | 10    | 12    |
|-------------------------------------------|---------------|------|-------|-------|-------|
| Head diameter                             | $d_K$         | [mm] | 13,50 | 16,50 | 18,50 |
| Thread diameter                           | $d_2$         | [mm] | 5,90  | 6,60  | 7,30  |
| Shank diameter                            | $d_S$         | [mm] | 6,30  | 7,20  | 8,55  |
| Head thickness                            | $t_1$         | [mm] | 13,50 | 16,50 | 19,50 |
| Washer thickness                          | $t_K$         | [mm] | 4,50  | 5,00  | 5,50  |
| Underhead diameter                        | $d_{UK}$      | [mm] | 10,00 | 12,00 | 13,00 |
| Hole diameter on steel plate              | $d_{V,steel}$ | [mm] | 11,0  | 13,0  | 14,0  |
| Pre-drilling hole diameter <sup>(1)</sup> | $d_{V,S}$     | [mm] | 5,0   | 6,0   | 7,0   |
| Pre-drilling hole diameter <sup>(2)</sup> | $d_{V,H}$     | [mm] | 6,0   | 7,0   | 8,0   |

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

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

### CHARACTERISTIC MECHANICAL PARAMETERS

| Nominal diameter | $d_1$        | [mm] | 8    | 10   | 12   |
|------------------|--------------|------|------|------|------|
| Tensile strength | $f_{tens,k}$ | [kN] | 32,0 | 40,0 | 48,0 |
| Yield moment     | $M_{y,k}$    | [Nm] | 33,4 | 45,0 | 55,0 |

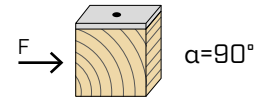
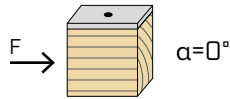
The mechanical parameters are obtained analytically and validated by experimental tests (HBS PLATE Ø10 and Ø12).

|                                 |              |                      | softwood<br>(softwood) | LVL softwood<br>(LVL softwood) | pre-drilled beech LVL<br>(beech LVL predrilled) |
|---------------------------------|--------------|----------------------|------------------------|--------------------------------|-------------------------------------------------|
| Withdrawal resistance parameter | $f_{ax,k}$   | [N/mm <sup>2</sup> ] | 11,7                   | 15,0                           | 29,0                                            |
| Head-pull-through parameter     | $f_{head,k}$ | [N/mm <sup>2</sup> ] | 10,5                   | 20,0                           | -                                               |
| Associated density              | $\rho_a$     | [kg/m <sup>3</sup> ] | 350                    | 500                            | 730                                             |
| Calculation density             | $\rho_k$     | [kg/m <sup>3</sup> ] | ≤ 440                  | 410 ÷ 550                      | 590 ÷ 750                                       |

For applications with different materials please see ETA-11/0030.

## MINIMUM DISTANCES FOR SHEAR LOADS | STEEL-TO-TIMBER

screws inserted **WITHOUT** pre-drilled hole  $\rho_k \leq 420 \text{ kg/m}^3$

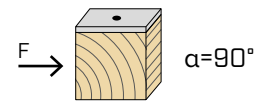
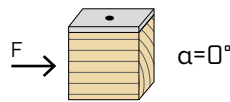


| $d_1$ [mm]     |                        | 8   | 10  | 12  |
|----------------|------------------------|-----|-----|-----|
| $a_1$ [mm]     | $10 \cdot d \cdot 0,7$ | 56  | 70  | 84  |
| $a_2$ [mm]     | $5 \cdot d \cdot 0,7$  | 28  | 35  | 42  |
| $a_{3,t}$ [mm] | $15 \cdot d$           | 120 | 150 | 180 |
| $a_{3,c}$ [mm] | $10 \cdot d$           | 80  | 100 | 120 |
| $a_{4,t}$ [mm] | $5 \cdot d$            | 40  | 50  | 60  |
| $a_{4,c}$ [mm] | $5 \cdot d$            | 40  | 50  | 60  |

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

| $d_1$ [mm]     |                       | 8  | 10  | 12  |
|----------------|-----------------------|----|-----|-----|
| $a_1$ [mm]     | $5 \cdot d \cdot 0,7$ | 28 | 35  | 42  |
| $a_2$ [mm]     | $5 \cdot d \cdot 0,7$ | 28 | 35  | 42  |
| $a_{3,t}$ [mm] | $10 \cdot d$          | 80 | 100 | 120 |
| $a_{3,c}$ [mm] | $10 \cdot d$          | 80 | 100 | 120 |
| $a_{4,t}$ [mm] | $10 \cdot d$          | 80 | 100 | 120 |
| $a_{4,c}$ [mm] | $5 \cdot d$           | 40 | 50  | 60  |

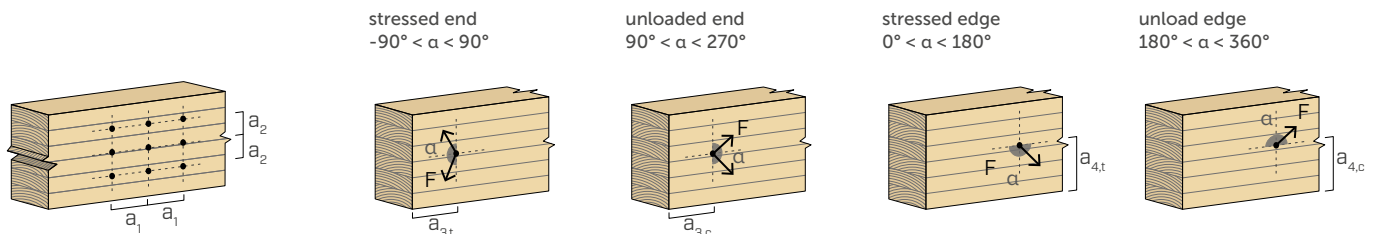
screws inserted **WITH** pre-drilled hole



| $d_1$ [mm]     |                       | 8  | 10  | 12  |
|----------------|-----------------------|----|-----|-----|
| $a_1$ [mm]     | $5 \cdot d \cdot 0,7$ | 28 | 35  | 42  |
| $a_2$ [mm]     | $3 \cdot d \cdot 0,7$ | 17 | 21  | 25  |
| $a_{3,t}$ [mm] | $12 \cdot d$          | 96 | 120 | 144 |
| $a_{3,c}$ [mm] | $7 \cdot d$           | 56 | 70  | 84  |
| $a_{4,t}$ [mm] | $3 \cdot d$           | 24 | 30  | 36  |
| $a_{4,c}$ [mm] | $3 \cdot d$           | 24 | 30  | 36  |

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

| $d_1$ [mm]     |                       | 8  | 10 | 12 |
|----------------|-----------------------|----|----|----|
| $a_1$ [mm]     | $4 \cdot d \cdot 0,7$ | 22 | 28 | 34 |
| $a_2$ [mm]     | $4 \cdot d \cdot 0,7$ | 22 | 28 | 34 |
| $a_{3,t}$ [mm] | $7 \cdot d$           | 56 | 70 | 84 |
| $a_{3,c}$ [mm] | $7 \cdot d$           | 56 | 70 | 84 |
| $a_{4,t}$ [mm] | $7 \cdot d$           | 56 | 70 | 84 |
| $a_{4,c}$ [mm] | $3 \cdot d$           | 24 | 30 | 36 |

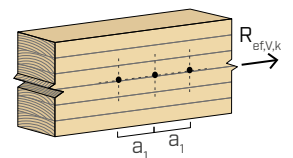


NOTE on page 221.

## EFFECTIVE NUMBER FOR SHEAR LOADS

The load-bearing capacity of a connection made with several screws, all of the same type and size, may be lower than the sum of the load-bearing capacities of the individual connection system. For a row of  $n$  screws arranged parallel to the direction of the grain at a distance  $a_1$ , the characteristic effective load-bearing capacity is equal to:

$$R_{ef,V,k} = n_{ef} \cdot R_{V,k}$$



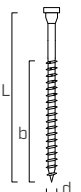
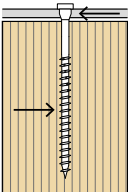
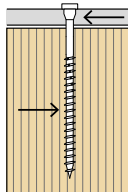
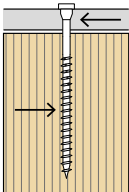
The  $n_{ef}$  value is given in the table below as a function of  $n$  and  $a_1$ .

| $n$ |   | $a_1^{(*)}$ |      |      |      |      |      |      |      |      |        |
|-----|---|-------------|------|------|------|------|------|------|------|------|--------|
|     |   | 4·d         | 5·d  | 6·d  | 7·d  | 8·d  | 9·d  | 10·d | 11·d | 12·d | ≥ 14·d |
| 2   | 2 | 1,41        | 1,48 | 1,55 | 1,62 | 1,68 | 1,74 | 1,80 | 1,85 | 1,90 | 2,00   |
|     | 3 | 1,73        | 1,86 | 2,01 | 2,16 | 2,28 | 2,41 | 2,54 | 2,65 | 2,76 | 3,00   |
|     | 4 | 2,00        | 2,19 | 2,41 | 2,64 | 2,83 | 3,03 | 3,25 | 3,42 | 3,61 | 4,00   |
|     | 5 | 2,24        | 2,49 | 2,77 | 3,09 | 3,34 | 3,62 | 3,93 | 4,17 | 4,43 | 5,00   |

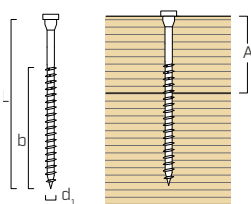
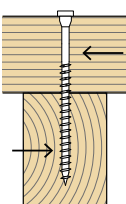
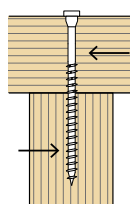
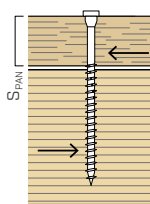
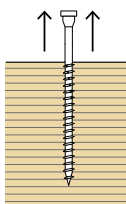
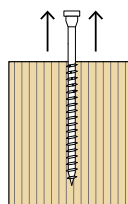
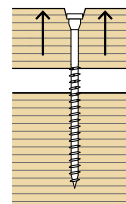
(\*)For intermediate  $a_1$  values a linear interpolation is possible.

| geometry      |           |           | SHEAR                                                   |       |       |                                                                 |       |                                                          |       |       |  |
|---------------|-----------|-----------|---------------------------------------------------------|-------|-------|-----------------------------------------------------------------|-------|----------------------------------------------------------|-------|-------|--|
|               |           |           | steel-to-timber<br>thin plate<br>$\varepsilon=90^\circ$ |       |       | steel-to-timber<br>intermediate plate<br>$\varepsilon=90^\circ$ |       | steel-to-timber<br>thick plate<br>$\varepsilon=90^\circ$ |       |       |  |
|               |           |           |                                                         |       |       |                                                                 |       |                                                          |       |       |  |
| $d_1$<br>[mm] | L<br>[mm] | b<br>[mm] | $R_{V,90,k}$<br>[kN]                                    |       |       | $R_{V,90,k}$<br>[kN]                                            |       | $R_{V,90,k}$<br>[kN]                                     |       |       |  |
| $S_{PLATE}$   |           |           | 2 mm                                                    | 3 mm  | 4 mm  | 5 mm                                                            | 6 mm  | 8 mm                                                     | 10 mm | 12 mm |  |
| 8             | 60        | 52        | 3,14                                                    | 3,09  | 3,03  | 3,64                                                            | 4,13  | 5,12                                                     | 5,12  | 5,12  |  |
|               | 80        | 55        | 4,22                                                    | 4,17  | 4,11  | 4,72                                                            | 5,22  | 6,21                                                     | 6,21  | 6,21  |  |
|               | 100       | 75        | 5,31                                                    | 5,25  | 5,20  | 5,68                                                            | 6,04  | 6,78                                                     | 6,78  | 6,78  |  |
|               | 120       | 95        | 5,86                                                    | 5,86  | 5,86  | 6,22                                                            | 6,57  | 7,29                                                     | 7,29  | 7,29  |  |
|               | 140       | 110       | 6,24                                                    | 6,24  | 6,24  | 6,59                                                            | 6,95  | 7,67                                                     | 7,67  | 7,67  |  |
|               | 160       | 130       | 6,74                                                    | 6,74  | 6,74  | 7,10                                                            | 7,46  | 8,17                                                     | 8,17  | 8,17  |  |
| $S_{PLATE}$   |           |           | 3 mm                                                    | 4 mm  | 5 mm  | 6 mm                                                            | 8 mm  | 10 mm                                                    | 12 mm | 16 mm |  |
| 10            | 80        | 60        | 4,87                                                    | 4,81  | 4,75  | 5,42                                                            | 6,50  | 7,58                                                     | 7,58  | 7,58  |  |
|               | 100       | 75        | 6,14                                                    | 6,08  | 6,01  | 6,61                                                            | 7,56  | 8,50                                                     | 8,50  | 8,50  |  |
|               | 120       | 95        | 7,34                                                    | 7,34  | 7,28  | 7,70                                                            | 8,42  | 9,14                                                     | 9,14  | 9,14  |  |
|               | 140       | 110       | 7,81                                                    | 7,81  | 7,81  | 8,17                                                            | 8,89  | 9,61                                                     | 9,61  | 9,61  |  |
|               | 160       | 130       | 8,44                                                    | 8,44  | 8,44  | 8,80                                                            | 9,52  | 10,24                                                    | 10,24 | 10,24 |  |
|               | 180       | 150       | 8,68                                                    | 8,68  | 8,68  | 9,12                                                            | 10,00 | 10,87                                                    | 10,87 | 10,87 |  |
| $S_{PLATE}$   |           |           | 4 mm                                                    | 5 mm  | 6 mm  | 8 mm                                                            | 10 mm | 12 mm                                                    | 16 mm | 20 mm |  |
| 12            | 100       | 75        | 6,90                                                    | 6,83  | 6,76  | 7,96                                                            | 9,02  | 10,07                                                    | 10,07 | 10,07 |  |
|               | 120       | 90        | 8,34                                                    | 8,27  | 8,20  | 9,11                                                            | 9,87  | 10,64                                                    | 10,64 | 10,64 |  |
|               | 140       | 110       | 9,28                                                    | 9,28  | 9,28  | 9,99                                                            | 10,69 | 11,40                                                    | 11,40 | 11,40 |  |
|               | 160       | 120       | 9,66                                                    | 9,66  | 9,66  | 10,37                                                           | 11,07 | 11,78                                                    | 11,78 | 11,78 |  |
|               | 180       | 140       | 10,23                                                   | 10,23 | 10,23 | 11,00                                                           | 11,77 | 12,54                                                    | 12,54 | 12,54 |  |
|               | 200       | 160       | 10,23                                                   | 10,23 | 10,23 | 11,25                                                           | 12,27 | 13,29                                                    | 13,29 | 13,29 |  |

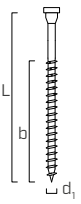
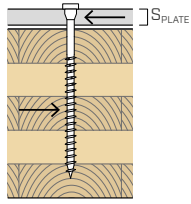
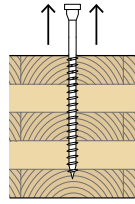
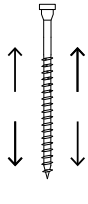
$\varepsilon$  = screw-to-grain angle

| geometry                                                                          |           |           | SHEAR                                                                             |      |      |                                                                                    |       |                                                                                     |       |       |  |
|-----------------------------------------------------------------------------------|-----------|-----------|-----------------------------------------------------------------------------------|------|------|------------------------------------------------------------------------------------|-------|-------------------------------------------------------------------------------------|-------|-------|--|
|                                                                                   |           |           | steel-to-timber<br>thin plate<br>$\varepsilon=0^\circ$                            |      |      | steel-to-timber<br>intermediate plate<br>$\varepsilon=0^\circ$                     |       | steel-to-timber<br>thick plate<br>$\varepsilon=0^\circ$                             |       |       |  |
|  |           |           |  |      |      |  |       |  |       |       |  |
| $d_1$<br>[mm]                                                                     | L<br>[mm] | b<br>[mm] | $R_{V,0,k}$<br>[kN]                                                               |      |      | $R_{V,0,k}$<br>[kN]                                                                |       | $R_{V,0,k}$<br>[kN]                                                                 |       |       |  |
| $S_{PLATE}$                                                                       |           |           | 2 mm                                                                              | 3 mm | 4 mm | 5 mm                                                                               | 6 mm  | 8 mm                                                                                | 10 mm | 12 mm |  |
| 8                                                                                 | 60        | 52        | 1,26                                                                              | 1,23 | 1,21 | 1,54                                                                               | 1,82  | 2,38                                                                                | 2,38  | 2,38  |  |
|                                                                                   | 80        | 55        | 1,69                                                                              | 1,67 | 1,65 | 1,94                                                                               | 2,19  | 2,70                                                                                | 2,70  | 2,70  |  |
|                                                                                   | 100       | 75        | 2,12                                                                              | 2,10 | 2,08 | 2,39                                                                               | 2,65  | 3,18                                                                                | 3,18  | 3,18  |  |
|                                                                                   | 120       | 95        | 2,56                                                                              | 2,53 | 2,51 | 2,84                                                                               | 3,13  | 3,70                                                                                | 3,70  | 3,70  |  |
|                                                                                   | 140       | 110       | 2,99                                                                              | 2,97 | 2,95 | 3,22                                                                               | 3,46  | 3,93                                                                                | 3,93  | 3,93  |  |
|                                                                                   | 160       | 130       | 3,17                                                                              | 3,17 | 3,17 | 3,40                                                                               | 3,62  | 4,08                                                                                | 4,08  | 4,08  |  |
| $S_{PLATE}$                                                                       |           |           | 3 mm                                                                              | 4 mm | 5 mm | 6 mm                                                                               | 8 mm  | 10 mm                                                                               | 12 mm | 16 mm |  |
| 10                                                                                | 80        | 60        | 1,95                                                                              | 1,92 | 1,90 | 2,22                                                                               | 2,77  | 3,32                                                                                | 3,32  | 3,32  |  |
|                                                                                   | 100       | 75        | 2,46                                                                              | 2,43 | 2,41 | 2,73                                                                               | 3,28  | 3,83                                                                                | 3,83  | 3,83  |  |
|                                                                                   | 120       | 95        | 2,96                                                                              | 2,94 | 2,91 | 3,26                                                                               | 3,84  | 4,43                                                                                | 4,43  | 4,43  |  |
|                                                                                   | 140       | 110       | 3,47                                                                              | 3,44 | 3,42 | 3,76                                                                               | 4,34  | 4,92                                                                                | 4,92  | 4,92  |  |
|                                                                                   | 160       | 130       | 3,97                                                                              | 3,95 | 3,92 | 4,20                                                                               | 4,66  | 5,11                                                                                | 5,11  | 5,11  |  |
|                                                                                   | 180       | 150       | 4,17                                                                              | 4,17 | 4,17 | 4,39                                                                               | 4,85  | 5,30                                                                                | 5,30  | 5,30  |  |
| $S_{PLATE}$                                                                       |           |           | 4 mm                                                                              | 5 mm | 6 mm | 8 mm                                                                               | 10 mm | 12 mm                                                                               | 16 mm | 20 mm |  |
| 12                                                                                | 100       | 75        | 2,76                                                                              | 2,73 | 2,70 | 3,31                                                                               | 3,86  | 4,40                                                                                | 4,40  | 4,40  |  |
|                                                                                   | 120       | 90        | 3,34                                                                              | 3,31 | 3,28 | 3,90                                                                               | 4,47  | 5,03                                                                                | 5,03  | 5,03  |  |
|                                                                                   | 140       | 110       | 3,91                                                                              | 3,88 | 3,85 | 4,53                                                                               | 5,14  | 5,76                                                                                | 5,76  | 5,76  |  |
|                                                                                   | 160       | 120       | 4,49                                                                              | 4,46 | 4,43 | 4,97                                                                               | 5,45  | 5,94                                                                                | 5,94  | 5,94  |  |
|                                                                                   | 180       | 140       | 4,83                                                                              | 4,83 | 4,83 | 5,27                                                                               | 5,72  | 6,16                                                                                | 6,16  | 6,16  |  |
|                                                                                   | 200       | 160       | 5,05                                                                              | 5,05 | 5,05 | 5,50                                                                               | 5,95  | 6,39                                                                                | 6,39  | 6,39  |  |

$\varepsilon$  = screw-to-grain angle

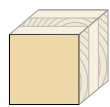
|                                                                                   |      |      |      | SHEAR                                                                             |                                                                                   |                                                                                   |                  | TENSION                                                                            |                                                                                     |                                                                                     |                                                                                     |
|-----------------------------------------------------------------------------------|------|------|------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|------------------|------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|
| geometry                                                                          |      |      |      | timber-to-timber<br>ε=90°                                                         | timber-to-timber<br>ε=0°                                                          | panel-to-timber                                                                   |                  | thread<br>withdrawal<br>ε=90°                                                      | thread<br>withdrawal<br>ε=0°                                                        | head<br>pull-through                                                                | steel tension                                                                       |
|  |      |      |      |  |  |  |                  |  |  |  |  |
| d <sub>1</sub>                                                                    | L    | b    | A    | R <sub>V,90,k</sub>                                                               | R <sub>V,0,k</sub>                                                                | S <sub>PAN</sub>                                                                  | R <sub>V,k</sub> | R <sub>ax,90,k</sub>                                                               | R <sub>ax,0,k</sub>                                                                 | R <sub>head,k</sub>                                                                 | R <sub>tens,k</sub>                                                                 |
| [mm]                                                                              | [mm] | [mm] | [mm] | [kN]                                                                              | [kN]                                                                              | [mm]                                                                              | [kN]             | [kN]                                                                               | [kN]                                                                                | [kN]                                                                                | [kN]                                                                                |
| 8                                                                                 | 60   | 52   | 8    | 1,62                                                                              | 1,35                                                                              | 22                                                                                | 2,40             | 4,85                                                                               | 1,45                                                                                | 2,07                                                                                | 32,00                                                                               |
|                                                                                   | 80   | 55   | 25   | 2,83                                                                              | 1,70                                                                              |                                                                                   | 2,94             | 5,56                                                                               | 1,67                                                                                | 2,07                                                                                |                                                                                     |
|                                                                                   | 100  | 75   | 25   | 2,83                                                                              | 2,13                                                                              |                                                                                   | 2,94             | 7,58                                                                               | 2,27                                                                                | 2,07                                                                                |                                                                                     |
|                                                                                   | 120  | 95   | 25   | 2,83                                                                              | 2,33                                                                              |                                                                                   | 2,94             | 9,60                                                                               | 2,88                                                                                | 2,07                                                                                |                                                                                     |
|                                                                                   | 140  | 110  | 30   | 2,93                                                                              | 2,42                                                                              |                                                                                   | 2,94             | 11,11                                                                              | 3,33                                                                                | 2,07                                                                                |                                                                                     |
|                                                                                   | 160  | 130  | 30   | 2,93                                                                              | 2,42                                                                              |                                                                                   | 2,94             | 13,13                                                                              | 3,94                                                                                | 2,07                                                                                |                                                                                     |
| 10                                                                                | 80   | 60   | 20   | 3,16                                                                              | 2,07                                                                              | 25                                                                                | 3,76             | 7,58                                                                               | 2,27                                                                                | 3,09                                                                                | 40,00                                                                               |
|                                                                                   | 100  | 75   | 25   | 3,65                                                                              | 2,59                                                                              |                                                                                   | 3,76             | 9,47                                                                               | 2,84                                                                                | 3,09                                                                                |                                                                                     |
|                                                                                   | 120  | 95   | 25   | 3,65                                                                              | 3,01                                                                              |                                                                                   | 3,76             | 12,00                                                                              | 3,60                                                                                | 3,09                                                                                |                                                                                     |
|                                                                                   | 140  | 110  | 30   | 3,75                                                                              | 3,11                                                                              |                                                                                   | 3,76             | 13,89                                                                              | 4,17                                                                                | 3,09                                                                                |                                                                                     |
|                                                                                   | 160  | 130  | 30   | 3,75                                                                              | 3,11                                                                              |                                                                                   | 3,76             | 16,42                                                                              | 4,92                                                                                | 3,09                                                                                |                                                                                     |
|                                                                                   | 180  | 150  | 30   | 3,75                                                                              | 3,11                                                                              |                                                                                   | 3,76             | 18,94                                                                              | 5,68                                                                                | 3,09                                                                                |                                                                                     |
| 12                                                                                | 100  | 75   | 25   | 4,34                                                                              | 2,99                                                                              | 25                                                                                | 4,39             | 11,36                                                                              | 3,41                                                                                | 3,88                                                                                | 48,00                                                                               |
|                                                                                   | 120  | 90   | 30   | 4,45                                                                              | 3,54                                                                              |                                                                                   | 4,39             | 13,64                                                                              | 4,09                                                                                | 3,88                                                                                |                                                                                     |
|                                                                                   | 140  | 110  | 30   | 4,45                                                                              | 3,70                                                                              |                                                                                   | 4,39             | 16,67                                                                              | 5,00                                                                                | 3,88                                                                                |                                                                                     |
|                                                                                   | 160  | 120  | 40   | 4,77                                                                              | 4,00                                                                              |                                                                                   | 4,39             | 18,18                                                                              | 5,45                                                                                | 3,88                                                                                |                                                                                     |
|                                                                                   | 180  | 140  | 40   | 4,77                                                                              | 4,00                                                                              |                                                                                   | 4,39             | 21,21                                                                              | 6,36                                                                                | 3,88                                                                                |                                                                                     |
|                                                                                   | 200  | 160  | 40   | 4,77                                                                              | 4,00                                                                              |                                                                                   | 4,39             | 24,24                                                                              | 7,27                                                                                | 3,88                                                                                |                                                                                     |

$\varepsilon$  = screw-to-grain angle

|                                                                                   |           |           | SHEAR                                                                             |      |      |       |       |       |       |       | TENSION                                                                             |                                                                                     |
|-----------------------------------------------------------------------------------|-----------|-----------|-----------------------------------------------------------------------------------|------|------|-------|-------|-------|-------|-------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|
| geometry                                                                          |           |           | steel-to-CLT<br>lateral face                                                      |      |      |       |       |       |       |       | thread withdrawal<br>lateral face                                                   | steel tension                                                                       |
|  |           |           |  |      |      |       |       |       |       |       |  |  |
| d <sub>1</sub><br>[mm]                                                            | L<br>[mm] | b<br>[mm] | R <sub>V,90,k</sub><br>[kN]                                                       |      |      |       |       |       |       |       | R <sub>ax,90,k</sub><br>[kN]                                                        | R <sub>tens,k</sub><br>[kN]                                                         |
| S <sub>PLATE</sub>                                                                |           |           | 2 mm                                                                              | 3 mm | 4 mm | 5 mm  | 6 mm  | 8 mm  | 10 mm | 12 mm | -                                                                                   | -                                                                                   |
| 8                                                                                 | 60        | 52        | 2,85                                                                              | 2,81 | 2,76 | 3,33  | 3,80  | 4,75  | 4,75  | 4,75  | 4,49                                                                                | 32,00                                                                               |
|                                                                                   | 80        | 55        | 3,84                                                                              | 3,79 | 3,74 | 4,31  | 4,78  | 5,72  | 5,72  | 5,72  | 5,15                                                                                |                                                                                     |
|                                                                                   | 100       | 75        | 4,82                                                                              | 4,77 | 4,72 | 5,22  | 5,62  | 6,42  | 6,42  | 6,42  | 7,02                                                                                |                                                                                     |
|                                                                                   | 120       | 95        | 5,52                                                                              | 5,52 | 5,52 | 5,86  | 6,20  | 6,89  | 6,89  | 6,89  | 8,89                                                                                |                                                                                     |
|                                                                                   | 140       | 110       | 5,87                                                                              | 5,87 | 5,87 | 6,21  | 6,55  | 7,24  | 7,24  | 7,24  | 10,30                                                                               |                                                                                     |
|                                                                                   | 160       | 130       | 6,34                                                                              | 6,34 | 6,34 | 6,68  | 7,02  | 7,70  | 7,70  | 7,70  | 12,17                                                                               |                                                                                     |
| S <sub>PLATE</sub>                                                                |           |           | 3 mm                                                                              | 4 mm | 5 mm | 6 mm  | 8 mm  | 10 mm | 12 mm | 16 mm | -                                                                                   | -                                                                                   |
| 10                                                                                | 80        | 60        | 4,43                                                                              | 4,37 | 4,32 | 4,94  | 5,97  | 7,00  | 7,00  | 7,00  | 7,02                                                                                | 40,00                                                                               |
|                                                                                   | 100       | 75        | 5,58                                                                              | 5,52 | 5,47 | 6,07  | 7,06  | 8,05  | 8,05  | 8,05  | 8,78                                                                                |                                                                                     |
|                                                                                   | 120       | 95        | 6,73                                                                              | 6,67 | 6,62 | 7,11  | 7,87  | 8,63  | 8,63  | 8,63  | 11,12                                                                               |                                                                                     |
|                                                                                   | 140       | 110       | 7,36                                                                              | 7,36 | 7,36 | 7,70  | 8,38  | 9,07  | 9,07  | 9,07  | 12,87                                                                               |                                                                                     |
|                                                                                   | 160       | 130       | 7,94                                                                              | 7,94 | 7,94 | 8,28  | 8,97  | 9,65  | 9,65  | 9,65  | 15,21                                                                               |                                                                                     |
|                                                                                   | 180       | 150       | 8,28                                                                              | 8,28 | 8,28 | 8,67  | 9,45  | 10,24 | 10,24 | 10,24 | 17,55                                                                               |                                                                                     |
| S <sub>PLATE</sub>                                                                |           |           | 4 mm                                                                              | 5 mm | 6 mm | 8 mm  | 10 mm | 12 mm | 16 mm | 20 mm | -                                                                                   | -                                                                                   |
| 12                                                                                | 100       | 75        | 6,28                                                                              | 6,21 | 6,14 | 7,36  | 8,44  | 9,53  | 9,53  | 9,53  | 10,53                                                                               | 48,00                                                                               |
|                                                                                   | 120       | 90        | 7,58                                                                              | 7,52 | 7,45 | 8,41  | 9,23  | 10,05 | 10,05 | 10,05 | 12,64                                                                               |                                                                                     |
|                                                                                   | 140       | 110       | 8,74                                                                              | 8,74 | 8,74 | 9,41  | 10,08 | 10,76 | 10,76 | 10,76 | 15,44                                                                               |                                                                                     |
|                                                                                   | 160       | 120       | 9,09                                                                              | 9,09 | 9,09 | 9,76  | 10,43 | 11,11 | 11,11 | 11,11 | 16,85                                                                               |                                                                                     |
|                                                                                   | 180       | 140       | 9,75                                                                              | 9,75 | 9,75 | 10,44 | 11,12 | 11,81 | 11,81 | 11,81 | 19,66                                                                               |                                                                                     |
|                                                                                   | 200       | 160       | 9,75                                                                              | 9,75 | 9,75 | 10,67 | 11,59 | 12,51 | 12,51 | 12,51 | 22,46                                                                               |                                                                                     |

■ MINIMUM DISTANCES FOR SHEAR AND AXIAL LOADS | CLT

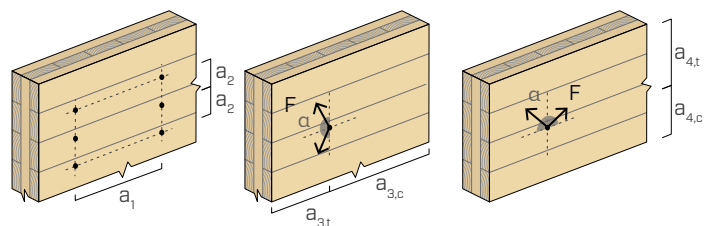
● screws inserted **WITHOUT** pre-drilled hole



lateral face

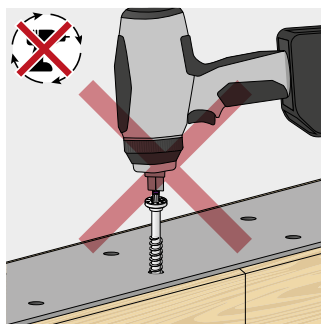
| d <sub>1</sub>   | [mm] | 8       | 10 | 12 |
|------------------|------|---------|----|----|
| a <sub>1</sub>   | [mm] | 4 · d   | 32 | 40 |
| a <sub>2</sub>   | [mm] | 2,5 · d | 20 | 25 |
| a <sub>3,t</sub> | [mm] | 6 · d   | 48 | 60 |
| a <sub>3,c</sub> | [mm] | 6 · d   | 48 | 60 |
| a <sub>4,t</sub> | [mm] | 6 · d   | 48 | 60 |
| a <sub>4,c</sub> | [mm] | 2,5 · d | 20 | 25 |

d = d<sub>1</sub> = nominal screw diameter

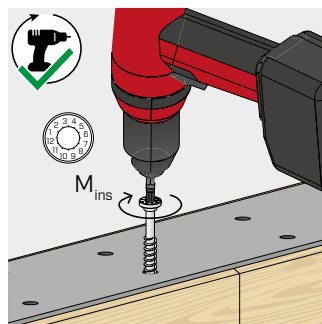


NOTES and GENERAL PRINCIPLES on page 221.

## ■ INSTALLATION

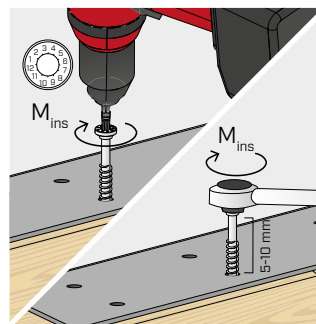


The use of pulse screw guns/impact wrenches is not permitted.

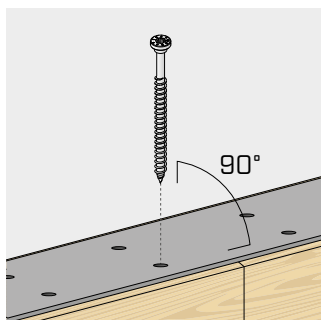


Ensure correct tightening.

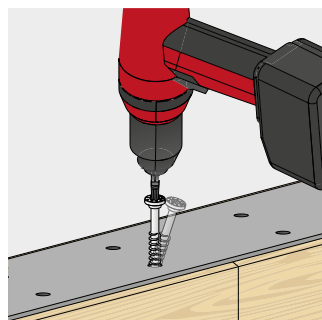
We recommend the use of torque-controlled screwdrivers, e.g. with TORQUE LIMITER. Alternatively, tighten with a torque wrench.



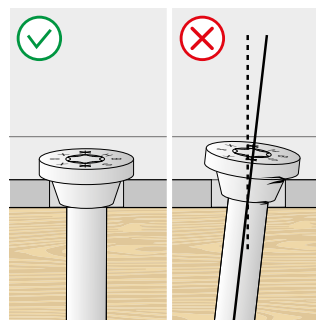
| HB SPL | $d_1$<br>[mm] | $M_{ins,rec}$<br>[Nm] |
|--------|---------------|-----------------------|
| Ø8     | 8             | 18                    |
| Ø10    | 10            | 25                    |
| Ø12    | 12            | 40                    |



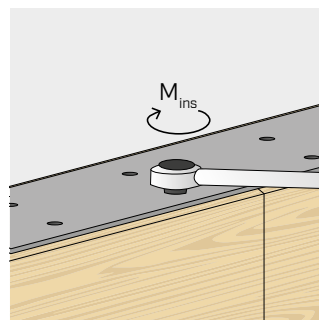
Respect the insertion angle. For very precise inclinations, the use of guide holes or pre-drilling is recommended.



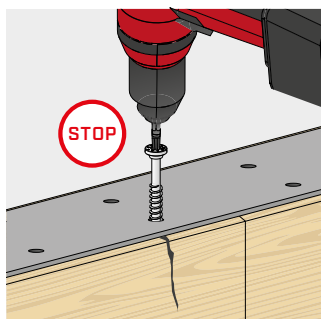
Avoid bending.



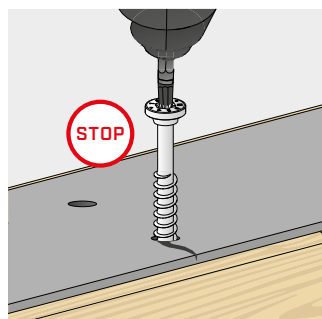
Ensure full contact between the entire surface of the screw head and the metal element



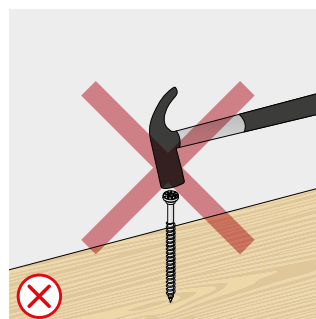
After installation, the fasteners can be inspected using a torque wrench.



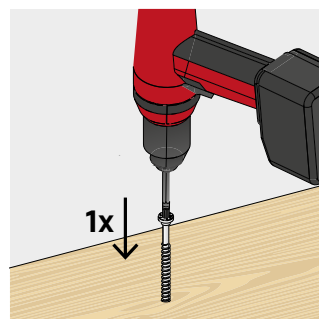
Stop installation if damage to the fastener or timber is noticed.



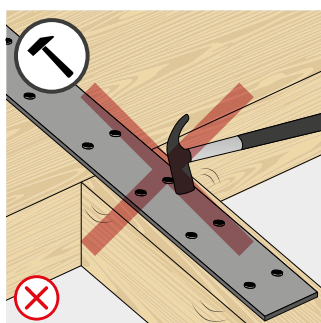
Stop installation if damage to the fastener or metal plates is noticed.



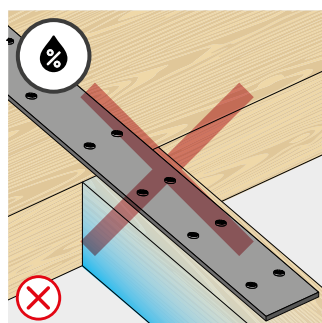
Do not hammer the screw tips into the timber.



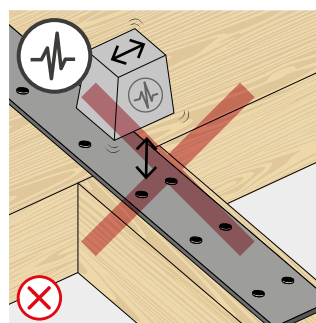
Install screws in one continuous stroke.



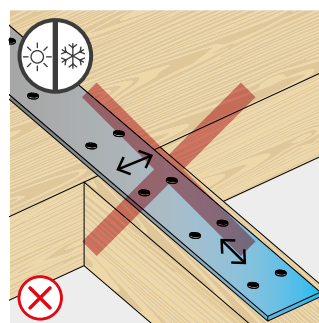
Avoid accidental stress during installation.



Protect the connection and avoid moisture changes and shrinkage and swelling of the timber.



Use not permitted for dynamic loads.



Avoid dimensional changes to the metal.

## STRUCTURAL VALUES

### GENERAL PRINCIPLES

- Characteristic values comply with the EN 1995:2014 standard in accordance with ETA-11/0030.
- Design values can be obtained from characteristic values as follows:

$$R_d = \frac{R_k \cdot k_{mod}}{\gamma_M}$$

The coefficients  $\gamma_M$  and  $k_{mod}$  should be taken according to the current regulations used for the calculation.

- The tensile design strength of the connector is the lower between the timber-side design strength ( $R_{ax,d}$ ) and the steel-side design strength ( $R_{tens,d}$ ).

$$R_{ax,d} = \min \left\{ \begin{array}{l} \frac{R_{ax,k} \cdot k_{mod}}{\gamma_M} \\ \frac{R_{tens,k}}{\gamma_{M2}} \end{array} \right.$$

- For the mechanical resistance values and the geometry of the screws, reference was made to ETA-11/0030.
- Sizing and verification of the timber elements and metal plates must be done separately.
- The screws must be positioned in accordance with the minimum distances.
- The characteristic shear resistances 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.
- Shear strengths were calculated considering the threaded part fully inserted in the second element.
- The characteristic shear-strength value has been evaluated for plates with thickness =  $S_{PLATE}$ , and considering the thin ( $S_{PLATE} \leq 0,5 d_1$ ), intermediate ( $0,5 d_1 < S_{PLATE} < d_1$ ) or thick ( $S_{PLATE} \geq d_1$ ) plate case scenario.
- In the case of combined shear and tensile stress, the following verification must be satisfied:

$$\left( \frac{F_{v,d}}{R_{v,d}} \right)^2 + \left( \frac{F_{ax,d}}{R_{ax,d}} \right)^2 \leq 1$$

- In the case of steel-to-timber connections, generally the steel tensile strength is binding with respect to head separation or pull-through.
- The thread withdrawal characteristic strength has been evaluated considering a fixing length equal to  $b$ .
- In the case of steel-to-timber connections with a thick plate, it is necessary to assess the effects of timber deformation and install the connectors according to the assembly instructions.
- The values in the table are evaluated considering mechanical strength parameters of the Ø10 and Ø12 HBS PLATE screws obtained analytically and validated by experimental tests.
- For different calculation configurations, the MyProject software is available ([www.rothoblaas.com](http://www.rothoblaas.com)).

### NOTES | TIMBER

- The characteristic timber-to-timber shear strengths were evaluated considering both an  $\epsilon$  angle of 90° ( $R_{V,90,k}$ ) and 0° ( $R_{V,0,k}$ ) between the grains of the second element and the connector.
- The characteristic thread withdrawal resistances were evaluated considering both an  $\epsilon$  angle of 90° ( $R_{ax,90,k}$ ) and of 0° ( $R_{ax,0,k}$ ) between the grains and the connector.
- For the calculation process a timber characteristic density  $\rho_k = 385 \text{ kg/m}^3$  has been considered. For different  $\rho_k$  values, the strength values in the table can be converted by the  $k_{dens}$  coefficient.

$$R'_{V,k} = k_{dens,v} \cdot R_{V,k}$$

$$R'_{ax,k} = k_{dens,ax} \cdot R_{ax,k}$$

$$R'_{head,k} = k_{dens,ax} \cdot R_{head,k}$$

| $\rho_k$<br>[kg/m <sup>3</sup> ] | 350  | 380  | 385   | 405   | 425   | 430   | 440   |
|----------------------------------|------|------|-------|-------|-------|-------|-------|
| C-GL                             | C24  | C30  | GL24h | GL26h | GL28h | GL30h | GL32h |
| $k_{dens,v}$                     | 0,90 | 0,98 | 1,00  | 1,02  | 1,05  | 1,05  | 1,07  |
| $k_{dens,ax}$                    | 0,92 | 0,98 | 1,00  | 1,04  | 1,08  | 1,09  | 1,11  |

Strength values thus determined may differ, for higher safety standards, from those resulting from an exact calculation.

### NOTES | CLT

- The characteristic values are according to the national specifications ÖNORM EN 1995 - Annex K.
- For the calculation process a mass density  $\rho_k = 350 \text{ kg/m}^3$  has been considered for CLT elements.
- The characteristics shear resistance are calculated considering a minimum fixing length of 4  $d_1$ .
- The characteristic shear strength is independent from the direction of the grain of the CLT panels outer layer.

## MINIMUM DISTANCES

### NOTES | TIMBER

- The minimum distances comply with the EN 1995:2014 standard in accordance with ETA-11/0030.
- In the case of timber-to-timber joints, the minimum spacing ( $a_1$ ,  $a_2$ ) can be multiplied by a coefficient of 1,5.
- In the case of joints with elements in Douglas fir (*Pseudotsuga menziesii*), the minimum spacing and distances parallel to the grain must be multiplied by a coefficient of 1,5.
- The spacing  $a_1$  in the table for screws with 3 THORNS tip inserted without pre-drilling hole in timber elements with density  $\rho_k \leq 420 \text{ kg/m}^3$  and load-to-grain angle  $\alpha=0^\circ$  was assumed to be 10·d based on experimental tests; alternatively, adopt 12·d in accordance with EN 1995:2014.

### NOTES | CLT

- The minimum distances are compliant with ETA-11/0030 and are to be considered valid unless otherwise specified in the technical documents for the CLT panels.
- Minimum distances are valid for minimum CLT thickness  $t_{CLT,min} = 10 \cdot d_1$ .
- Minimum distances for narrow face application can be found on page 39.

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