

# WT

## Double thread connector

Carbon steel with durocoat

CE  
ETA 12/0063

**SFS** intec

### TECHNICAL ASSISTANCE

Complete documentation  
and software available online  
free of charge



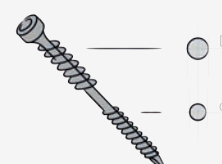
### APPROVAL PLUS

Reduced minimum distances and  
use also allowed in directions parallel  
to the grain



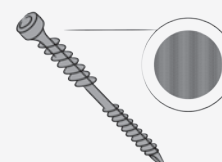
### OPTIMISED GEOMETRY

Diameter and thread distances  
differentiated between the two  
threads, generating a pulling effect  
in the joint



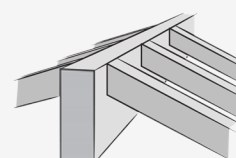
### DUROCOAT

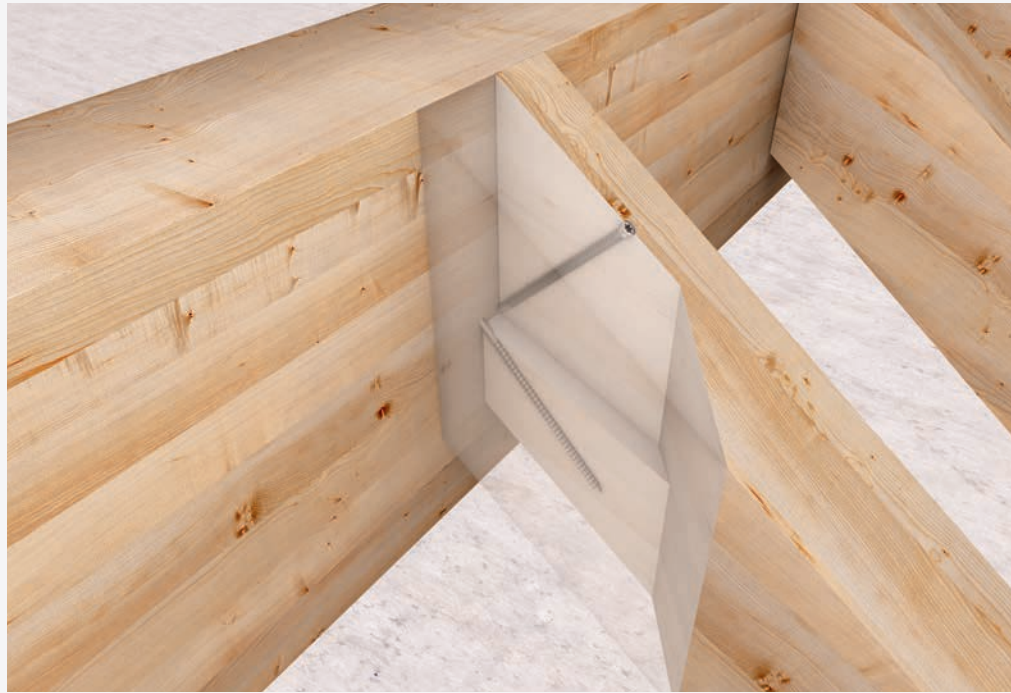
Surface durocoat treatment,  
for excellent corrosion resistance



### APPLICATIONS

Solid-wood, glulam, X-Lam,  
LVL, wood-based-panel joints,  
reinforcements and couplings.  
Service classes 1 and 2





### MINIMUM DISTANCES

Special approval for use of the connector with reduced minimum distances and hence on smaller beam widths



### HIGH SLOPES

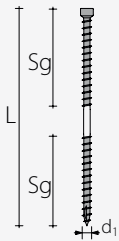
Special approval for use of the connector parallel to the grain and hence with any roof slope



### STRUCTURAL RESTORATION

The double thread with differentiated geometry creates a pulling and closing effect on the joint, ideal for use in structural restoration

# Codes and dimensions



| d <sub>1</sub> [mm] | code     | L [mm] | s <sub>g</sub> [mm] | pcs/pkg |
|---------------------|----------|--------|---------------------|---------|
| 6,5<br>TX30         | CS100150 | 65*    | 28                  | 100     |
|                     | CS100145 | 90*    | 40                  |         |
|                     | CS100115 | 130*   | 55                  |         |
|                     | CS100155 | 160    | 65                  |         |
|                     | CS100170 | 190    | 80                  |         |
|                     | CS100175 | 220    | 95                  |         |
| 8,2<br>TX40         | CS100120 | 160    | 65                  | 100     |
|                     | CS100125 | 190    | 80                  |         |
|                     | CS100130 | 220    | 95                  |         |
|                     | CS100135 | 245    | 107                 |         |
|                     | CS100105 | 275    | 122                 | 50      |
|                     | CS100140 | 300    | 135                 |         |
|                     | CS100100 | 330    | 135                 |         |
|                     |          |        |                     |         |

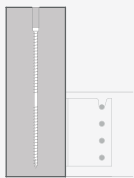
\* Items in stainless steel available upon request (see also the OUTDOOR chapter)

## Template WT

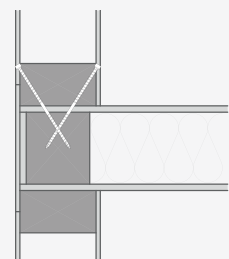
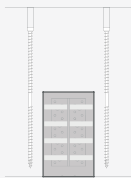


| code        | description                                     | for WT Ø | pcs/pkg |
|-------------|-------------------------------------------------|----------|---------|
| ATWTXAMK    | TEMPLATE FOR WT                                 |          | 1       |
| ATCS003     | universal tilting template with 2 guiding slots | 6,5/8,2  | 1       |
| ATINTX30200 | bit length 200, TX30                            | 6,5      | 1       |
| ATINTX30350 | bit length 350, TX30                            | 6,5      | 1       |
| ATINTX40152 | bit length 152, TX40                            | 8,2      | 1       |
| ATINTX40200 | bit length 200, TX40                            | 8,2      | 1       |
| ATINTX40350 | bit length 350, TX40                            | 8,2      | 1       |
| ATINTX40520 | bit length 520, TX40                            | 8,2      | 1       |

## Application examples



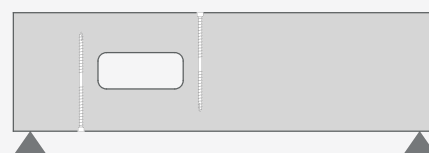
1 Reinforcement of main beam for hanging load (ALU)



3 Wall / floor joint in frame structure

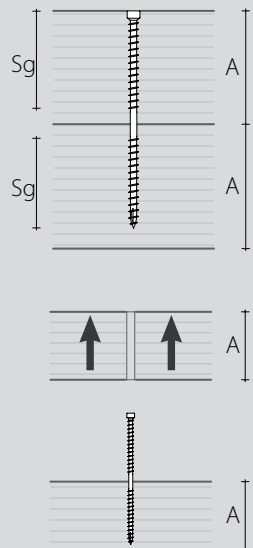


2 Lateral coupling



4 Beam reinforcement with openings

## THREAD WITHDRAWAL $N_{adm}$

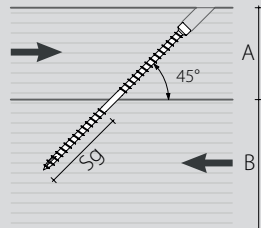


| $d_1$<br>[mm] | L<br>[mm] | $s_g$<br>[mm] | $A_{min}$<br>[mm] | $N_{adm}$ |
|---------------|-----------|---------------|-------------------|-----------|
| <b>6,5</b>    | 65        | 28            | 35                | 109 kg    |
|               | 90        | 40            | 50                | 156 kg    |
|               | 130       | 55            | 70                | 215 kg    |
|               | 160       | 65            | 85                | 254 kg    |
|               | 190       | 80            | 100               | 312 kg    |
|               | 220       | 95            | 115               | 371 kg    |

| $d_1$<br>[mm] | L<br>[mm] | $s_g$<br>[mm] | $A_{min}$<br>[mm] | $N_{adm}$ |
|---------------|-----------|---------------|-------------------|-----------|
| <b>8,2</b>    | 160       | 65            | 85                | 320 kg    |
|               | 190       | 80            | 100               | 394 kg    |
|               | 220       | 95            | 115               | 467 kg    |
|               | 245       | 107           | 125               | 526 kg    |
|               | 275       | 122           | 140               | 600 kg    |
|               | 300       | 135           | 155               | 664 kg    |
|               | 330       | 135           | 170               | 664 kg    |

## SLIDING $V_{adm}$

### WOOD - WOOD

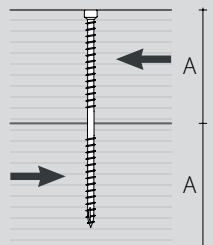


| $d_1$<br>[mm] | L<br>[mm] | $s_g$<br>[mm] | $A_{min}$<br>[mm] | $B_{min}$<br>[mm] | $V_{adm}$ |
|---------------|-----------|---------------|-------------------|-------------------|-----------|
| <b>6,5</b>    | 65        | 28            | 25                | 25                | 77 kg     |
|               | 90        | 40            | 35                | 35                | 110 kg    |
|               | 130       | 55            | 50                | 50                | 152 kg    |
|               | 160       | 65            | 60                | 60                | 179 kg    |
|               | 190       | 80            | 70                | 70                | 221 kg    |
|               | 220       | 95            | 80                | 80                | 262 kg    |

| $d_1$<br>[mm] | L<br>[mm] | $s_g$<br>[mm] | $A_{min}$<br>[mm] | $B_{min}$<br>[mm] | $V_{adm}$ |
|---------------|-----------|---------------|-------------------|-------------------|-----------|
| <b>8,2</b>    | 160       | 65            | 60                | 60                | 226 kg    |
|               | 190       | 80            | 70                | 70                | 278 kg    |
|               | 220       | 95            | 80                | 80                | 331 kg    |
|               | 245       | 107           | 90                | 90                | 372 kg    |
|               | 275       | 122           | 100               | 100               | 424 kg    |
|               | 300       | 135           | 110               | 110               | 470 kg    |
|               | 330       | 135           | 120               | 120               | 470 kg    |

## SHEAR $V_{adm}$

### WOOD - WOOD



| $d_1$<br>[mm] | L<br>[mm] | $s_g$<br>[mm] | A<br>[mm] | $V_{adm}$ |
|---------------|-----------|---------------|-----------|-----------|
| <b>6,5</b>    | 65        | 28            | 35        | 45 kg     |
|               | 90        | 40            | 50        | 62 kg     |
|               | 130       | 55            | 70        | 72 kg     |
|               | 160       | 65            | 85        | 72 kg     |
|               | 190       | 80            | 100       | 72 kg     |
|               | 220       | 95            | 115       | 72 kg     |

| $d_1$<br>[mm] | L<br>[mm] | $s_g$<br>[mm] | A<br>[mm] | $V_{adm}$ |
|---------------|-----------|---------------|-----------|-----------|
| <b>8,2</b>    | 160       | 65            | 85        | 114 kg    |
|               | 190       | 80            | 100       | 114 kg    |
|               | 220       | 95            | 115       | 114 kg    |
|               | 245       | 107           | 125       | 114 kg    |
|               | 275       | 122           | 140       | 114 kg    |
|               | 300       | 135           | 155       | 114 kg    |
|               | 330       | 135           | 170       | 114 kg    |

## NOTE

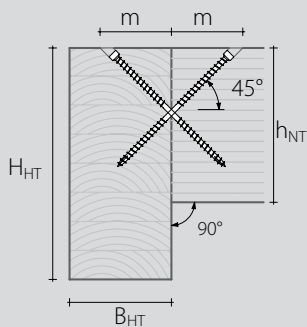
- Allowable values in accordance with DIN 1052:1988.
- The values are valid for connections in which the connectors are inserted with half in each of the components.
- The allowable extraction values are calculated considering the threaded part ( $s_g$ ) as being completely inserted into the wood.

## SHEAR CONNECTION WITH CROSSED CONNECTORS

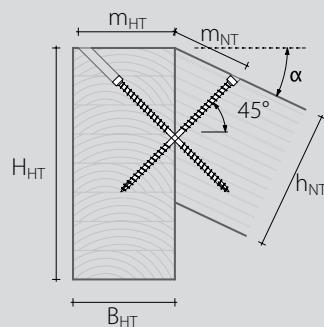
### RIGHT-ANGLE JOINT - MAIN BEAM / SECONDARY BEAM

| $d_1$<br>[mm] | L<br>[mm] | $s_g$<br>[mm] | $B_{HT \min}$<br>[mm] | $H_{HT \min}$<br>[mm] | $h_{NT \min}$<br>[mm] | $b_{NT \min}$<br>[mm] | No. pairs | $V_{adm}^{(1)}$<br>[kg] | $m^{(2)}$<br>[mm] |
|---------------|-----------|---------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------|-------------------------|-------------------|
| 6,5           | 130       | 55            | 60                    | 110                   | 110                   | 50                    | 1         | 249 kg                  | 55                |
|               |           |               |                       |                       |                       | 80                    | 2         | 497 kg                  |                   |
|               |           |               |                       |                       |                       | 115                   | 3         | 746 kg                  |                   |
|               | 160       | 65            | 70                    | 130                   | 130                   | 50                    | 1         | 294 kg                  | 65                |
|               |           |               |                       |                       |                       | 80                    | 2         | 588 kg                  |                   |
|               |           |               |                       |                       |                       | 115                   | 3         | 882 kg                  |                   |
|               | 190       | 80            | 80                    | 150                   | 150                   | 50                    | 1         | 362 kg                  | 75                |
|               |           |               |                       |                       |                       | 80                    | 2         | 724 kg                  |                   |
|               |           |               |                       |                       |                       | 115                   | 3         | 1085 kg                 |                   |
|               | 220       | 95            | 90                    | 170                   | 170                   | 50                    | 1         | 430 kg                  | 85                |
|               |           |               |                       |                       |                       | 80                    | 2         | 859 kg                  |                   |
|               |           |               |                       |                       |                       | 115                   | 3         | 1289 kg                 |                   |
| 8,2           | 160       | 65            | 70                    | 130                   | 130                   | 70                    | 1         | 371 kg                  | 65                |
|               |           |               |                       |                       |                       | 110                   | 2         | 742 kg                  |                   |
|               |           |               |                       |                       |                       | 150                   | 3         | 1113 kg                 |                   |
|               | 190       | 80            | 80                    | 150                   | 150                   | 70                    | 1         | 456 kg                  | 75                |
|               |           |               |                       |                       |                       | 110                   | 2         | 913 kg                  |                   |
|               |           |               |                       |                       |                       | 150                   | 3         | 1369 kg                 |                   |
|               | 220       | 95            | 90                    | 170                   | 170                   | 70                    | 1         | 542 kg                  | 85                |
|               |           |               |                       |                       |                       | 110                   | 2         | 1084 kg                 |                   |
|               |           |               |                       |                       |                       | 150                   | 3         | 1626 kg                 |                   |
|               | 245       | 107           | 100                   | 190                   | 190                   | 70                    | 1         | 610 kg                  | 95                |
|               |           |               |                       |                       |                       | 110                   | 2         | 1221 kg                 |                   |
|               |           |               |                       |                       |                       | 150                   | 3         | 1831 kg                 |                   |
|               | 275       | 122           | 110                   | 210                   | 210                   | 70                    | 1         | 696 kg                  | 105               |
|               |           |               |                       |                       |                       | 110                   | 2         | 1392 kg                 |                   |
|               |           |               |                       |                       |                       | 150                   | 3         | 2088 kg                 |                   |
|               | 300       | 135           | 120                   | 230                   | 230                   | 70                    | 1         | 770 kg                  | 115               |
|               |           |               |                       |                       |                       | 110                   | 2         | 1540 kg                 |                   |
|               |           |               |                       |                       |                       | 150                   | 3         | 2311 kg                 |                   |
|               | 330       | 135           | 130                   | 250                   | 250                   | 70                    | 1         | 770 kg                  | 125               |
|               |           |               |                       |                       |                       | 110                   | 2         | 1540 kg                 |                   |
|               |           |               |                       |                       |                       | 150                   | 3         | 2311 kg                 |                   |

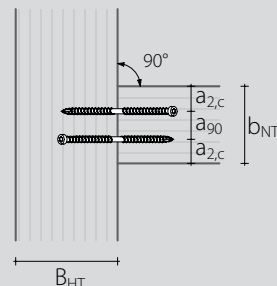
Right-angle joint



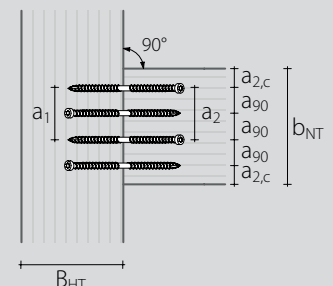
Inclined joint



Plan - 1 pair



Plan - 2 or more pairs



## SHEAR CONNECTION WITH CROSSED CONNECTORS

### INCLINED JOINT - MAIN BEAM / SECONDARY BEAM

| d <sub>i</sub><br>[mm] | L<br>[mm] | s <sub>g</sub><br>[mm] | B <sub>HT min</sub><br>[mm] | H <sub>HT min</sub><br>[mm]                        | h <sub>NT min</sub><br>[mm]                         | b <sub>NT min</sub><br>[mm] | No. pairs | V <sub>adm</sub> <sup>(1)</sup> [kg]                   |         |         |         |         | m <sub>HT</sub> <sup>(2)</sup><br>[mm] | m <sub>NT</sub> <sup>(2)</sup><br>[mm] |
|------------------------|-----------|------------------------|-----------------------------|----------------------------------------------------|-----------------------------------------------------|-----------------------------|-----------|--------------------------------------------------------|---------|---------|---------|---------|----------------------------------------|----------------------------------------|
|                        |           |                        |                             |                                                    |                                                     |                             |           | Inclination angle α for secondary beams <sup>(3)</sup> |         |         |         |         |                                        |                                        |
|                        |           |                        |                             |                                                    |                                                     |                             |           | α = 10°                                                | α = 20° | α = 30° | α = 40° | α = 45° |                                        |                                        |
| 6,5                    | 130       | 55                     | 60                          | $(L + 20) \cdot 0,707 + m_{NT} \cdot \tan(\alpha)$ | $(L + 20) \cdot 0,707 \cdot \cos(\alpha) + a_{2,c}$ | 50                          | 1         | 249 kg                                                 | 198 kg  | 149 kg  | 105 kg  | 84 kg   | m <sub>NT</sub> · [1 + tan(α)]         | 55 / cos(α)                            |
|                        |           |                        |                             |                                                    |                                                     | 80                          | 2         | 497 kg                                                 | 396 kg  | 299 kg  | 210 kg  | 169 kg  |                                        |                                        |
|                        |           |                        |                             |                                                    |                                                     | 115                         | 3         | 746 kg                                                 | 593 kg  | 448 kg  | 316 kg  | 253 kg  |                                        |                                        |
|                        | 160       | 65                     | 70                          |                                                    |                                                     | 50                          | 1         | 294 kg                                                 | 234 kg  | 177 kg  | 124 kg  | 100 kg  |                                        | 65 / cos(α)                            |
|                        |           |                        |                             |                                                    |                                                     | 80                          | 2         | 588 kg                                                 | 467 kg  | 353 kg  | 249 kg  | 199 kg  |                                        |                                        |
|                        |           |                        |                             |                                                    |                                                     | 115                         | 3         | 882 kg                                                 | 701 kg  | 530 kg  | 373 kg  | 299 kg  |                                        |                                        |
|                        | 190       | 80                     | 80                          |                                                    |                                                     | 50                          | 1         | 362 kg                                                 | 288 kg  | 217 kg  | 153 kg  | 123 kg  |                                        | 75 / cos(α)                            |
|                        |           |                        |                             |                                                    |                                                     | 80                          | 2         | 724 kg                                                 | 575 kg  | 435 kg  | 306 kg  | 245 kg  |                                        |                                        |
|                        |           |                        |                             |                                                    |                                                     | 115                         | 3         | 1085 kg                                                | 863 kg  | 652 kg  | 459 kg  | 368 kg  |                                        |                                        |
|                        | 220       | 95                     | 90                          |                                                    |                                                     | 50                          | 1         | 430 kg                                                 | 342 kg  | 258 kg  | 182 kg  | 146 kg  |                                        | 85 / cos(α)                            |
|                        |           |                        |                             |                                                    |                                                     | 80                          | 2         | 859 kg                                                 | 683 kg  | 516 kg  | 363 kg  | 291 kg  |                                        |                                        |
|                        |           |                        |                             |                                                    |                                                     | 115                         | 3         | 1289 kg                                                | 1025 kg | 775 kg  | 545 kg  | 437 kg  |                                        |                                        |
| 8,2                    | 160       | 65                     | 70                          |                                                    |                                                     | 70                          | 1         | 371 kg                                                 | 295 kg  | 223 kg  | 157 kg  | 126 kg  |                                        | 65 / cos(α)                            |
|                        |           |                        |                             |                                                    |                                                     | 110                         | 2         | 742 kg                                                 | 590 kg  | 446 kg  | 314 kg  | 251 kg  |                                        |                                        |
|                        |           |                        |                             |                                                    |                                                     | 150                         | 3         | 1113 kg                                                | 884 kg  | 669 kg  | 471 kg  | 377 kg  |                                        |                                        |
|                        | 190       | 80                     | 80                          |                                                    |                                                     | 70                          | 1         | 456 kg                                                 | 363 kg  | 274 kg  | 193 kg  | 155 kg  |                                        | 75 / cos(α)                            |
|                        |           |                        |                             |                                                    |                                                     | 110                         | 2         | 913 kg                                                 | 726 kg  | 549 kg  | 386 kg  | 309 kg  |                                        |                                        |
|                        |           |                        |                             |                                                    |                                                     | 150                         | 3         | 1369 kg                                                | 1089 kg | 823 kg  | 579 kg  | 464 kg  |                                        |                                        |
|                        | 220       | 95                     | 90                          |                                                    |                                                     | 70                          | 1         | 542 kg                                                 | 431 kg  | 326 kg  | 229 kg  | 184 kg  |                                        | 85 / cos(α)                            |
|                        |           |                        |                             |                                                    |                                                     | 110                         | 2         | 1084 kg                                                | 862 kg  | 652 kg  | 459 kg  | 367 kg  |                                        |                                        |
|                        |           |                        |                             |                                                    |                                                     | 150                         | 3         | 1626 kg                                                | 1293 kg | 977 kg  | 688 kg  | 551 kg  |                                        |                                        |
|                        | 245       | 107                    | 100                         |                                                    |                                                     | 70                          | 1         | 610 kg                                                 | 485 kg  | 367 kg  | 258 kg  | 207 kg  |                                        | 95 / cos(α)                            |
|                        |           |                        |                             |                                                    |                                                     | 110                         | 2         | 1221 kg                                                | 971 kg  | 734 kg  | 516 kg  | 414 kg  |                                        |                                        |
|                        |           |                        |                             |                                                    |                                                     | 150                         | 3         | 1831 kg                                                | 1456 kg | 1101 kg | 775 kg  | 621 kg  |                                        |                                        |
|                        | 275       | 122                    | 110                         |                                                    |                                                     | 70                          | 1         | 696 kg                                                 | 553 kg  | 418 kg  | 294 kg  | 236 kg  |                                        | 105 / cos(α)                           |
|                        |           |                        |                             |                                                    |                                                     | 110                         | 2         | 1392 kg                                                | 1107 kg | 837 kg  | 589 kg  | 472 kg  |                                        |                                        |
|                        |           |                        |                             |                                                    |                                                     | 150                         | 3         | 2088 kg                                                | 1660 kg | 1255 kg | 883 kg  | 708 kg  |                                        |                                        |
|                        | 300       | 135                    | 120                         |                                                    |                                                     | 70                          | 1         | 770 kg                                                 | 612 kg  | 463 kg  | 326 kg  | 261 kg  |                                        | 115 / cos(α)                           |
|                        |           |                        |                             |                                                    |                                                     | 110                         | 2         | 1540 kg                                                | 1225 kg | 926 kg  | 652 kg  | 522 kg  |                                        |                                        |
|                        |           |                        |                             |                                                    |                                                     | 150                         | 3         | 2311 kg                                                | 1837 kg | 1389 kg | 977 kg  | 783 kg  |                                        |                                        |
|                        | 330       | 135                    | 130                         |                                                    |                                                     | 70                          | 1         | 770 kg                                                 | 612 kg  | 463 kg  | 326 kg  | 261 kg  |                                        | 125 / cos(α)                           |
|                        |           |                        |                             |                                                    |                                                     | 110                         | 2         | 1540 kg                                                | 1225 kg | 926 kg  | 652 kg  | 522 kg  |                                        |                                        |
|                        |           |                        |                             |                                                    |                                                     | 150                         | 3         | 2311 kg                                                | 1837 kg | 1389 kg | 977 kg  | 783 kg  |                                        |                                        |

### MINIMUM RECOMMENDED DISTANCES [mm]

|     | a <sub>2,c</sub> | a <sub>cross</sub> = a <sub>90</sub> | a <sub>2</sub> | a <sub>i</sub> |
|-----|------------------|--------------------------------------|----------------|----------------|
| 6,5 | 15               | 10                                   | 33             | 33             |
| 8,2 | 24               | 12                                   | 40             | 40             |

### NOTE

<sup>(1)</sup> The axial resistance of the thread to extraction was calculated considering an effective thread length equal to s<sub>g</sub>.  
The connectors must be inserted at 45° with respect to the shear plane.  
The centre of gravity of the connectors must be placed in correspondence with the shear plane.

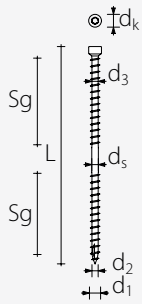
<sup>(2)</sup> The assembly figure (m) is valid in the case of laying of the connectors flush over the secondary beam.

<sup>(3)</sup> In the case of intermediate values of the secondary beam inclination angle (α) it is possible to carry out a linear interpolation.

• Allowable values in accordance with DIN 1052:1988.

# Geometry and minimum distances

## GEOMETRY AND MECHANICAL CHARACTERISTICS

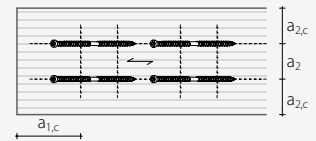
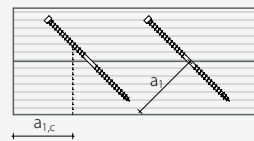
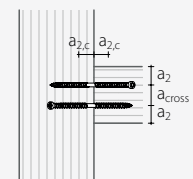
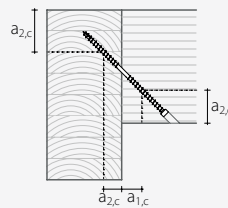


### WT CONNECTOR

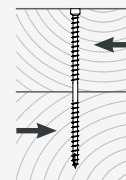
|                                                |                                 | 6,5   | 8,2   |
|------------------------------------------------|---------------------------------|-------|-------|
| Nominal diameter                               | $d_1$ [mm]                      |       |       |
| Locking thread diameter                        | $d_3$ [mm]                      | 6,50  | 8,90  |
| Head diameter                                  | $d_k$ [mm]                      | 8,00  | 10,00 |
| Tip diameter                                   | $d_2$ [mm]                      | 4,00  | 5,40  |
| Shank diameter                                 | $d_s$ [mm]                      | 4,60  | 6,30  |
| Characteristic yield moment                    | $M_{y,k}$ [Nmm]                 | 12700 | 19500 |
| Characteristic extraction-resistance parameter | $f_{ax,k}$ [N/mm <sup>2</sup> ] | 12,9  | 13,35 |
| Characteristic tensile strength                | $f_{tens,k}$ [kN]               | 14,4  | 28,6  |
| Characteristic yield strength                  | $f_{y,k}$ [N/mm <sup>2</sup> ]  | 990   | 870   |

## MINIMUM DISTANCES FOR AXIAL STRESSES <sup>(1)</sup>

|                        | 6,5 | 8,2 |
|------------------------|-----|-----|
| $a_1$ [mm]             | 33  | 40  |
| $a_2$ [mm]             | 33  | 40  |
| $a_{2,LIM}^{(2)}$ [mm] | 16  | 20  |
| $a_{1,c}$ [mm]         | 33  | 40  |
| $a_{2,c}$ [mm]         | 15  | 24  |
| $a_{cross}$ [mm]       | 10  | 12  |



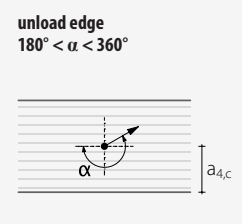
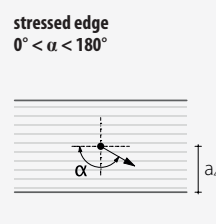
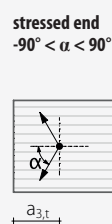
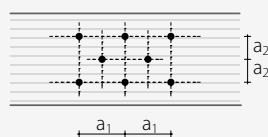
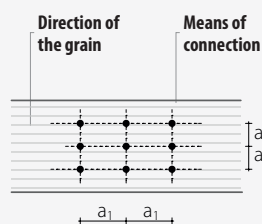
## MINIMUM DISTANCES FOR SHEAR LOADS <sup>(3)</sup>



Angle between strength and grain  $\alpha = 0^\circ$

Angle between strength and grain  $\alpha = 90^\circ$

|                | 6,5 | 8,2 | 6,5 | 8,2 |
|----------------|-----|-----|-----|-----|
| $a_1$ [mm]     | 33  | 40  | 26  | 32  |
| $a_2$ [mm]     | 26  | 32  | 26  | 32  |
| $a_{3,t}$ [mm] | 80  | 80  | 80  | 80  |
| $a_{3,c}$ [mm] | 26  | 32  | 46  | 56  |
| $a_{4,t}$ [mm] | 20  | 24  | 26  | 32  |
| $a_{4,c}$ [mm] | 20  | 24  | 20  | 24  |



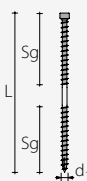
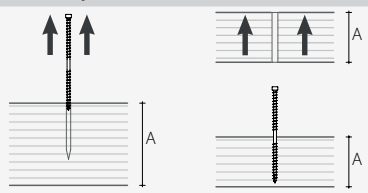
### NOTE

<sup>(1)</sup> The minimum distances for connectors stressed axially are independent of the insertion angle of the connector and the angle of the force with respect to the grain, in accordance with ETA-12/0063.

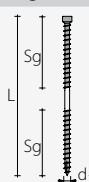
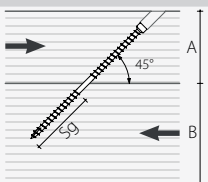
<sup>(2)</sup> The axial distance  $a_2$  can be reduced down to  $2.5 \cdot d_1$  if for each connector a "joint surface"  $a_1 \cdot a_2 = 25 \cdot d_1^2$  is maintained.

<sup>(3)</sup> The minimum distances are in accordance with the EN 1995:2008 standard in accordance with ETA-12/0063.

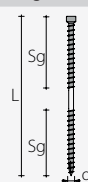
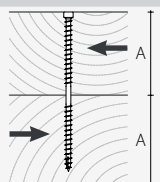
## TRACTION <sup>(1)</sup>

| geometry                                                                          |           |                        | partial thread withdrawal <sup>(2)</sup>                                           |                           | steel traction                                                                      |
|-----------------------------------------------------------------------------------|-----------|------------------------|------------------------------------------------------------------------------------|---------------------------|-------------------------------------------------------------------------------------|
|  |           |                        |  |                           |  |
| d <sub>1</sub><br>[mm]                                                            | L<br>[mm] | s <sub>g</sub><br>[mm] | A <sub>min</sub><br>[mm]                                                           | R <sub>ax,k</sub><br>[kN] | R <sub>tens,k</sub><br>[kN]                                                         |
| 6,5                                                                               | 65        | 28                     | 35                                                                                 | 2,51                      | 14,40                                                                               |
|                                                                                   | 90        | 40                     | 50                                                                                 | 3,58                      |                                                                                     |
|                                                                                   | 130       | 55                     | 70                                                                                 | 4,93                      |                                                                                     |
|                                                                                   | 160       | 65                     | 85                                                                                 | 5,82                      |                                                                                     |
|                                                                                   | 190       | 80                     | 100                                                                                | 7,16                      |                                                                                     |
| 8,2                                                                               | 220       | 95                     | 115                                                                                | 8,51                      |                                                                                     |
|                                                                                   | 160       | 65                     | 85                                                                                 | 7,60                      | 28,60                                                                               |
|                                                                                   | 190       | 80                     | 100                                                                                | 9,35                      |                                                                                     |
|                                                                                   | 220       | 95                     | 115                                                                                | 11,11                     |                                                                                     |
|                                                                                   | 245       | 107                    | 125                                                                                | 12,51                     |                                                                                     |
|                                                                                   | 275       | 122                    | 140                                                                                | 14,26                     |                                                                                     |
|                                                                                   | 300       | 135                    | 155                                                                                | 15,78                     |                                                                                     |
|                                                                                   | 330       | 135                    | 170                                                                                | 15,78                     |                                                                                     |

## SLIDING

| geometry                                                                            |           |                        | wood - wood <sup>(3)</sup>                                                          |                          |                         |
|-------------------------------------------------------------------------------------|-----------|------------------------|-------------------------------------------------------------------------------------|--------------------------|-------------------------|
|  |           |                        |  |                          |                         |
| d <sub>1</sub><br>[mm]                                                              | L<br>[mm] | S <sub>g</sub><br>[mm] | A <sub>MIN</sub><br>[mm]                                                            | B <sub>MIN</sub><br>[mm] | R <sub>yk</sub><br>[kN] |
| 6,5                                                                                 | 65        | 28                     | 25                                                                                  | 25                       | 1,77                    |
|                                                                                     | 90        | 40                     | 35                                                                                  | 35                       | 2,53                    |
|                                                                                     | 130       | 55                     | 50                                                                                  | 50                       | 3,48                    |
|                                                                                     | 160       | 65                     | 60                                                                                  | 60                       | 4,12                    |
|                                                                                     | 190       | 80                     | 70                                                                                  | 70                       | 5,07                    |
| 8,2                                                                                 | 220       | 95                     | 80                                                                                  | 80                       | 6,02                    |
|                                                                                     | 160       | 65                     | 60                                                                                  | 60                       | 5,37                    |
|                                                                                     | 190       | 80                     | 70                                                                                  | 70                       | 6,61                    |
|                                                                                     | 220       | 95                     | 80                                                                                  | 80                       | 7,85                    |
|                                                                                     | 245       | 107                    | 90                                                                                  | 90                       | 8,85                    |
|                                                                                     | 275       | 122                    | 100                                                                                 | 100                      | 10,09                   |
|                                                                                     | 300       | 135                    | 110                                                                                 | 110                      | 11,16                   |
|                                                                                     | 330       | 135                    | 120                                                                                 | 120                      | 11,16                   |

## SHEAR <sup>(4)</sup>

| geometry                                                                             |           |                        | wood-wood                                                                             |                         |
|--------------------------------------------------------------------------------------|-----------|------------------------|---------------------------------------------------------------------------------------|-------------------------|
|  |           |                        |  |                         |
| d <sub>1</sub><br>[mm]                                                               | L<br>[mm] | s <sub>g</sub><br>[mm] | A <sub>MIN</sub><br>[mm]                                                              | R <sub>yk</sub><br>[kN] |
| 6,5                                                                                  | 65        | 28                     | 35                                                                                    | 2,39                    |
|                                                                                      | 90        | 40                     | 50                                                                                    | 2,99                    |
|                                                                                      | 130       | 55                     | 70                                                                                    | 3,33                    |
|                                                                                      | 160       | 65                     | 85                                                                                    | 3,55                    |
|                                                                                      | 190       | 80                     | 100                                                                                   | 3,89                    |
| 8,2                                                                                  | 220       | 95                     | 115                                                                                   | 4,19                    |
|                                                                                      | 160       | 65                     | 85                                                                                    | 4,77                    |
|                                                                                      | 190       | 80                     | 100                                                                                   | 5,20                    |
|                                                                                      | 220       | 95                     | 115                                                                                   | 5,64                    |
|                                                                                      | 245       | 107                    | 125                                                                                   | 5,73                    |
|                                                                                      | 275       | 122                    | 140                                                                                   | 5,73                    |
|                                                                                      | 300       | 135                    | 155                                                                                   | 5,73                    |
|                                                                                      | 330       | 135                    | 170                                                                                   | 5,73                    |

## GENERAL PRINCIPLES

- Characteristic values comply with the EN 1995:2008 standard in accordance with ETA-12/0063.
- Design values are obtained from the following characteristic values:

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

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

- For the mechanical resistance values and the geometry of the connectors, reference was made to ETA-12/0063.
- In the calculations, the density of the wood elements was considered equal to  $\rho_k = 380 \text{ kg/m}^3$ .
- Sizing and verification of the wooden elements must be done separately.
- The extraction, shear and sliding values were calculated considering the centre of gravity of the connector placed in correspondence with the shear plane.

## NOTE

- <sup>(1)</sup> The design strength of the connector is the lower between the wood-side design strength ( $R_{ax,d}$ ) and the steel-side design strength ( $R_{tens,d}$ ).

$$R_{ax,d} = \min \left\{ \begin{array}{l} R_{ax,k} \cdot k_{mod} / \gamma_m \\ R_{tens,k} / \gamma_{m2} \end{array} \right.$$

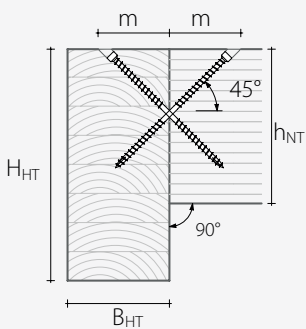
- <sup>(2)</sup> The axial resistance of the thread to extraction was calculated for an effective thread length of  $s_g$  and is constant for an angle between the fibres and the connector of between  $45^\circ$  and  $90^\circ$ .
- <sup>(3)</sup> The axial resistance of the thread to extraction was calculated considering a  $45^\circ$  angle between the fibres and the connector and for an effective thread length of  $s_g$ .
- <sup>(4)</sup> The characteristic shear resistance values were calculated using an angle  $\alpha$  between the force and the grain of  $90^\circ$ .

## SHEAR CONNECTION WITH CROSSED CONNECTORS

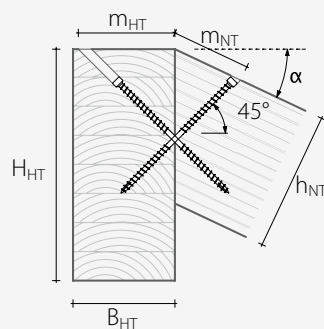
RIGHT-ANGLE JOINT - MAIN BEAM / SECONDARY BEAM

| $d_1$<br>[mm] | L<br>[mm] | $s_g$<br>[mm] | $B_{HTmin}$<br>[mm] | $H_{HTmin}$<br>[mm] | $h_{NTmin}$<br>[mm] | $b_{NTmin}$<br>[mm] | No. pairs | $R_{1VK}^{(1)}$<br>[kN]   | $R_{2VK}^{(1)}$<br>[kN] | m <sup>(2)</sup><br>[mm] |
|---------------|-----------|---------------|---------------------|---------------------|---------------------|---------------------|-----------|---------------------------|-------------------------|--------------------------|
|               |           |               |                     |                     |                     |                     |           | extraction <sup>(4)</sup> | instability             |                          |
| 6,5           | 130       | 55            | 60                  | 110                 | 110                 | 50                  | 1         | 6,3                       | 9,9                     | 55                       |
|               |           |               |                     |                     |                     | 80                  | 2         | 11,8                      | 19,7                    |                          |
|               |           |               |                     |                     |                     | 115                 | 3         | 17,0                      | 29,6                    |                          |
|               | 160       | 65            | 70                  | 130                 | 130                 | 50                  | 1         | 7,6                       | 9,9                     | 65                       |
|               |           |               |                     |                     |                     | 80                  | 2         | 14,1                      | 19,7                    |                          |
|               |           |               |                     |                     |                     | 115                 | 3         | 20,4                      | 29,6                    |                          |
|               | 190       | 80            | 80                  | 150                 | 150                 | 50                  | 1         | 9,5                       | 9,9                     | 75                       |
|               |           |               |                     |                     |                     | 80                  | 2         | 17,7                      | 19,7                    |                          |
|               |           |               |                     |                     |                     | 115                 | 3         | 25,5                      | 29,6                    |                          |
|               | 220       | 95            | 90                  | 170                 | 170                 | 50                  | 1         | 11,4                      | 9,9                     | 85                       |
|               |           |               |                     |                     |                     | 80                  | 2         | 21,2                      | 19,7                    |                          |
|               |           |               |                     |                     |                     | 115                 | 3         | 30,6                      | 29,6                    |                          |
| 8,2           | 160       | 65            | 70                  | 130                 | 130                 | 70                  | 1         | 9,9                       | 17,1                    | 65                       |
|               |           |               |                     |                     |                     | 110                 | 2         | 18,5                      | 34,2                    |                          |
|               |           |               |                     |                     |                     | 150                 | 3         | 26,6                      | 51,3                    |                          |
|               | 190       | 80            | 80                  | 150                 | 150                 | 70                  | 1         | 12,4                      | 17,1                    | 75                       |
|               |           |               |                     |                     |                     | 110                 | 2         | 23,1                      | 34,2                    |                          |
|               |           |               |                     |                     |                     | 150                 | 3         | 33,2                      | 51,3                    |                          |
|               | 220       | 95            | 90                  | 170                 | 170                 | 70                  | 1         | 14,8                      | 17,1                    | 85                       |
|               |           |               |                     |                     |                     | 110                 | 2         | 27,7                      | 34,2                    |                          |
|               |           |               |                     |                     |                     | 150                 | 3         | 39,9                      | 51,3                    |                          |
|               | 245       | 107           | 100                 | 190                 | 190                 | 70                  | 1         | 16,8                      | 17,1                    | 95                       |
|               |           |               |                     |                     |                     | 110                 | 2         | 31,4                      | 34,2                    |                          |
|               |           |               |                     |                     |                     | 150                 | 3         | 45,2                      | 51,3                    |                          |
|               | 275       | 122           | 110                 | 210                 | 210                 | 70                  | 1         | 19,3                      | 17,1                    | 105                      |
|               |           |               |                     |                     |                     | 110                 | 2         | 36,0                      | 34,2                    |                          |
|               |           |               |                     |                     |                     | 150                 | 3         | 51,9                      | 51,3                    |                          |
|               | 300       | 135           | 120                 | 230                 | 230                 | 70                  | 1         | 21,5                      | 17,1                    | 115                      |
|               |           |               |                     |                     |                     | 110                 | 2         | 40,0                      | 34,2                    |                          |
|               |           |               |                     |                     |                     | 150                 | 3         | 57,7                      | 51,3                    |                          |
|               | 330       | 135           | 130                 | 250                 | 250                 | 70                  | 1         | 21,5                      | 17,1                    | 125                      |
|               |           |               |                     |                     |                     | 110                 | 2         | 40,0                      | 34,2                    |                          |
|               |           |               |                     |                     |                     | 150                 | 3         | 57,7                      | 51,3                    |                          |

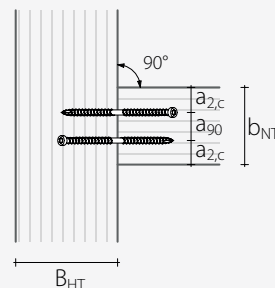
Right-angle joint



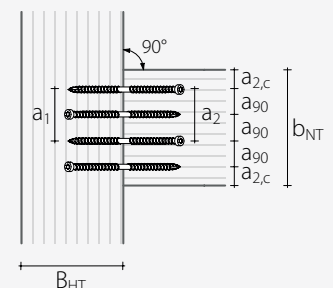
Inclined joint



Plan - 1 pair



Plan - 2 or more pairs



## SHEAR CONNECTION WITH CROSSED CONNECTORS

INCLINED JOINT - MAIN BEAM / SECONDARY BEAM

| d <sub>1</sub><br>[mm] | L<br>[mm] | s <sub>g</sub><br>[mm] | B <sub>HT min</sub><br>[mm] | H <sub>HT min</sub><br>[mm]                  | h <sub>NT min</sub><br>[mm]                  | b <sub>NT min</sub><br>[mm] | No. pairs | R <sub>Vk</sub> <sup>(1)</sup> [kN]                    |                  |                  |                  |                  |                  |                  |                  |                  |                  | m <sub>HT</sub> <sup>(2)</sup><br>[mm] | m <sub>NT</sub> <sup>(2)</sup><br>[mm] |
|------------------------|-----------|------------------------|-----------------------------|----------------------------------------------|----------------------------------------------|-----------------------------|-----------|--------------------------------------------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|----------------------------------------|----------------------------------------|
|                        |           |                        |                             |                                              |                                              |                             |           | Inclination angle α for secondary beams <sup>(3)</sup> |                  |                  |                  |                  |                  |                  |                  |                  |                  |                                        |                                        |
|                        |           |                        |                             |                                              |                                              |                             |           | α = 10°                                                |                  | α = 20°          |                  | α = 30°          |                  | α = 40°          |                  | α = 45°          |                  |                                        |                                        |
|                        |           |                        |                             |                                              |                                              |                             |           | R <sub>1Vk</sub>                                       | R <sub>2Vk</sub> | R <sub>1Vk</sub> | R <sub>2Vk</sub> | R <sub>1Vk</sub> | R <sub>2Vk</sub> | R <sub>1Vk</sub> | R <sub>2Vk</sub> | R <sub>1Vk</sub> | R <sub>2Vk</sub> |                                        |                                        |
| 6,5                    | 130       | 55                     | 60                          | (L + 20) · 0,707 + m <sub>NT</sub> · tan (α) | (L + 20) · 0,707 · cos (α) + a <sub>2c</sub> | 50                          | 1         | 5,3                                                    | 9,7              | 4,3              | 9,5              | 3,4              | 9,2              | 2,4              | 9,0              | 1,9              | 8,8              | 55 / cos (α)                           |                                        |
|                        |           |                        |                             |                                              |                                              | 80                          | 2         | 9,9                                                    | 19,4             | 8,0              | 19,0             | 6,3              | 18,4             | 4,5              | 18,0             | 3,5              | 17,6             |                                        |                                        |
|                        |           |                        |                             |                                              |                                              | 115                         | 3         | 14,2                                                   | 29,1             | 11,6             | 28,5             | 9,1              | 27,6             | 6,5              | 27,0             | 5,1              | 26,4             |                                        |                                        |
|                        | 160       | 65                     | 70                          |                                              |                                              | 50                          | 1         | 6,4                                                    | 9,7              | 5,2              | 9,5              | 4,0              | 9,2              | 2,9              | 9,0              | 2,3              | 8,8              | 65 / cos (α)                           |                                        |
|                        |           |                        |                             |                                              |                                              | 80                          | 2         | 11,9                                                   | 19,4             | 9,7              | 19,0             | 7,5              | 18,4             | 5,4              | 18,0             | 4,3              | 17,6             |                                        |                                        |
|                        |           |                        |                             |                                              |                                              | 115                         | 3         | 17,2                                                   | 29,1             | 14,0             | 28,5             | 10,8             | 27,6             | 7,8              | 27,0             | 6,2              | 26,4             |                                        |                                        |
|                        | 190       | 80                     | 80                          |                                              |                                              | 50                          | 1         | 8,0                                                    | 9,7              | 6,5              | 9,5              | 5,1              | 9,2              | 3,6              | 9,0              | 2,8              | 8,8              | 75 / cos (α)                           |                                        |
|                        |           |                        |                             |                                              |                                              | 80                          | 2         | 14,9                                                   | 19,4             | 12,1             | 19,0             | 9,5              | 18,4             | 6,7              | 18,0             | 5,2              | 17,6             |                                        |                                        |
|                        |           |                        |                             |                                              |                                              | 115                         | 3         | 21,5                                                   | 29,1             | 17,5             | 28,5             | 13,7             | 27,6             | 9,7              | 27,0             | 7,5              | 26,4             |                                        |                                        |
|                        | 220       | 95                     | 90                          |                                              |                                              | 50                          | 1         | 9,6                                                    | 9,7              | 7,8              | 9,5              | 6,1              | 9,2              | 4,3              | 9,0              | 3,4              | 8,8              | 85 / cos (α)                           |                                        |
|                        |           |                        |                             |                                              |                                              | 80                          | 2         | 17,9                                                   | 19,4             | 14,6             | 19,0             | 11,4             | 18,4             | 8,0              | 18,0             | 6,3              | 17,6             |                                        |                                        |
|                        |           |                        |                             |                                              |                                              | 115                         | 3         | 25,8                                                   | 29,1             | 21,0             | 28,5             | 16,4             | 27,6             | 11,6             | 27,0             | 9,1              | 26,4             |                                        |                                        |
| 8,2                    | 160       | 65                     | 70                          |                                              |                                              | 70                          | 1         | 8,3                                                    | 16,8             | 6,8              | 16,5             | 5,3              | 16,1             | 3,7              | 15,7             | 3,0              | 15,5             | 65 / cos (α)                           | m <sub>NT</sub> · [1 + tan (α)]        |
|                        |           |                        |                             |                                              |                                              | 110                         | 2         | 15,5                                                   | 33,6             | 12,7             | 33,0             | 9,9              | 32,2             | 6,9              | 31,4             | 5,6              | 31,0             |                                        |                                        |
|                        |           |                        |                             |                                              |                                              | 150                         | 3         | 22,3                                                   | 50,4             | 18,3             | 49,5             | 14,2             | 48,3             | 9,9              | 47,1             | 8,1              | 46,5             |                                        |                                        |
|                        | 190       | 80                     | 80                          |                                              |                                              | 70                          | 1         | 10,4                                                   | 16,8             | 8,5              | 16,5             | 6,6              | 16,1             | 4,7              | 15,7             | 3,7              | 15,5             | 75 / cos (α)                           |                                        |
|                        |           |                        |                             |                                              |                                              | 110                         | 2         | 19,4                                                   | 33,6             | 15,9             | 33,0             | 12,3             | 32,2             | 8,8              | 31,4             | 6,9              | 31,0             |                                        |                                        |
|                        |           |                        |                             |                                              |                                              | 150                         | 3         | 28,0                                                   | 50,4             | 22,8             | 49,5             | 17,7             | 48,3             | 12,6             | 47,1             | 9,9              | 46,5             |                                        |                                        |
|                        | 220       | 95                     | 90                          |                                              |                                              | 70                          | 1         | 12,5                                                   | 16,8             | 10,2             | 16,5             | 7,9              | 16,1             | 5,6              | 15,7             | 4,5              | 15,5             | 85 / cos (α)                           |                                        |
|                        |           |                        |                             |                                              |                                              | 110                         | 2         | 23,3                                                   | 33,6             | 19,0             | 33,0             | 14,7             | 32,2             | 10,4             | 31,4             | 8,4              | 31,0             |                                        |                                        |
|                        |           |                        |                             |                                              |                                              | 150                         | 3         | 33,6                                                   | 50,4             | 27,4             | 49,5             | 21,2             | 48,3             | 15,1             | 47,1             | 12,1             | 46,5             |                                        |                                        |
|                        | 245       | 107                    | 100                         |                                              |                                              | 70                          | 1         | 14,2                                                   | 16,8             | 11,6             | 16,5             | 9,0              | 16,1             | 6,4              | 15,7             | 5,0              | 15,5             | 95 / cos (α)                           |                                        |
|                        |           |                        |                             |                                              |                                              | 110                         | 2         | 26,5                                                   | 33,6             | 21,6             | 33,0             | 16,8             | 32,2             | 11,9             | 31,4             | 9,3              | 31,0             |                                        |                                        |
|                        |           |                        |                             |                                              |                                              | 150                         | 3         | 38,2                                                   | 50,4             | 31,2             | 49,5             | 24,2             | 48,3             | 17,2             | 47,1             | 13,4             | 46,5             |                                        |                                        |
|                        | 275       | 122                    | 110                         | 70                                           | 1                                            | 16,3                        | 16,8      | 13,3                                                   | 16,5             | 10,3             | 16,1             | 7,3              | 15,7             | 5,8              | 15,5             | 105 / cos (α)    |                  |                                        |                                        |
|                        |           |                        |                             | 110                                          | 2                                            | 30,4                        | 33,6      | 24,8                                                   | 33,0             | 19,2             | 32,2             | 13,6             | 31,4             | 10,8             | 31,0             |                  |                  |                                        |                                        |
|                        |           |                        |                             | 150                                          | 3                                            | 43,8                        | 50,4      | 35,7                                                   | 49,5             | 27,7             | 48,3             | 19,6             | 47,1             | 15,6             | 46,5             |                  |                  |                                        |                                        |
|                        | 300       | 135                    | 120                         | 70                                           | 1                                            | 18,1                        | 16,8      | 14,8                                                   | 16,5             | 11,4             | 16,1             | 8,1              | 15,7             | 6,4              | 15,5             | 115 / cos (α)    |                  |                                        |                                        |
|                        |           |                        |                             | 110                                          | 2                                            | 33,8                        | 33,6      | 27,6                                                   | 33,0             | 21,3             | 32,2             | 15,1             | 31,4             | 11,9             | 31,0             |                  |                  |                                        |                                        |
|                        |           |                        |                             | 150                                          | 3                                            | 48,7                        | 50,4      | 39,8                                                   | 49,5             | 30,6             | 48,3             | 21,8             | 47,1             | 17,2             | 46,5             |                  |                  |                                        |                                        |
|                        | 330       | 135                    | 130                         | 70                                           | 1                                            | 18,1                        | 16,8      | 14,8                                                   | 16,5             | 11,4             | 16,1             | 8,1              | 15,7             | 6,4              | 15,5             | 125 / cos (α)    |                  |                                        |                                        |
|                        |           |                        |                             | 110                                          | 2                                            | 33,8                        | 33,6      | 27,6                                                   | 33,0             | 21,3             | 32,2             | 15,1             | 31,4             | 11,9             | 31,0             |                  |                  |                                        |                                        |
|                        |           |                        |                             | 150                                          | 3                                            | 48,7                        | 50,4      | 39,8                                                   | 49,5             | 30,6             | 48,3             | 21,8             | 47,1             | 17,2             | 46,5             |                  |                  |                                        |                                        |

### MINIMUM RECOMMENDED DISTANCES [mm]

|     | a <sub>2,c</sub> | a <sub>cross</sub> = a <sub>90</sub> | a <sub>2</sub> | a <sub>1</sub> |
|-----|------------------|--------------------------------------|----------------|----------------|
| 6,5 | 15               | 10                                   | 33             | 33             |
| 8,2 | 24               | 12                                   | 40             | 40             |

### GENERAL PRINCIPLES

- Characteristic values comply with the EN 1995:2008 standard in accordance with ETA-12/0063.
- In the calculations, the density of the wood elements was considered equal to ρ<sub>k</sub> = 380 kg/m<sup>3</sup>.
- Sizing and verification of the wooden elements must be done separately.

### NOTE

- <sup>(1)</sup> The design strength of the connector is the lower between the extraction-side design strength (R<sub>1,V,d</sub>) and the instability design strength (R<sub>2,V,d</sub>).

$$R_{V,d} = \min \left\{ \frac{R_{1,V,k} \cdot k_{mod}}{\gamma_m}, \frac{R_{2,V,k}}{\gamma_m} \right\}$$

- <sup>(2)</sup> The assembly figure (m) is valid in the case of laying of the connectors flush over the secondary beam.

- <sup>(3)</sup> In the case of intermediate values of the secondary beam inclination angle (α) it is possible to carry out a linear interpolation.

- <sup>(4)</sup> The axial resistance of the thread to extraction was calculated considering an effective thread length equal to s<sub>g</sub>. The connectors must be inserted at 45° with respect to the shear plane. The centre of gravity of the connectors must be placed in correspondence with the shear plane.

- For different calculation methods, the online software is available ([www.rothoblaas.com](http://www.rothoblaas.com)).

# Calculation example: purlin joint / main beam

## PROJECT DATA

$$b = 160 \text{ mm}$$

$$h = 240 \text{ mm}$$

$$\alpha = 20^\circ$$

$$\text{Wood GL24h } (\rho_k = 380 \text{ kg/m}^3)$$

For the size of the purlin joints, stresses are projected to the components parallel ( $F_{II}$ ) and perpendicular to the covering ( $F_D$  o  $F_Z$ ).

$$F_{v,Rd} = 8,43 \text{ kN}$$

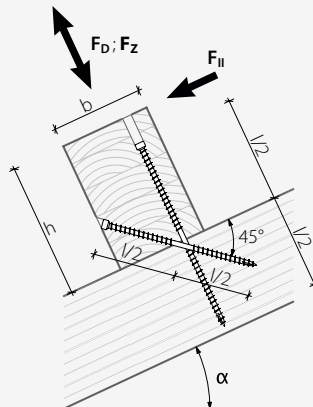
$$F_{II,Rd} = F_{v,Rd} \cdot \sin(\alpha) = 2,88 \text{ kN}$$

$$F_{D,Rd} = F_{v,Rd} \cdot \cos(\alpha) = 7,92 \text{ kN}$$

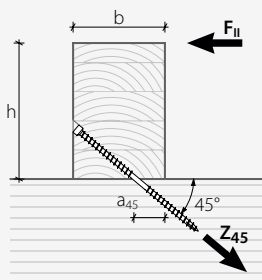
$$F_{Z,Rd} = 0 \text{ kN (es. vento)}$$

Service class = 1

Load duration = short



## 1) PARALLEL STRESS VERIFICATION: $R_{ax,45,Rd} > Z_{45,Rd}$



$$Z_{45} = F_{II} \cdot \sqrt{2}$$

$$F_{II,Rd} = 2,88 \text{ kN}$$

$$Z_{45,Rd} = 4,08 \text{ kN}$$

## CHOICE OF CONNECTOR INSERTED AT 45°

WT 8,2 x 245 mm

$$s_{g \text{ sup}} = 107 \text{ mm}$$

$$s_{g \text{ inf}} = 107 \text{ mm}$$

$$a_{45} = 65 \text{ mm}$$

The minimum distances for placement of the connectors are found in the table on pg. 120.

## CONNECTOR TENSILE STRENGTH CALCULATION (EN 1995:2008 and ETA-12/0063)

$$R_{ax,45,Rd} = \frac{R_{ax,45,Rk} \cdot k_{mod}}{\gamma_m}$$

$$R_{ax,45,Rk} = 12,51 \text{ kN}$$

The tensile strength of the connectors calculated here is shown in the table on pg. 121.

EN 1995:2008

$$k_{mod} = 0,9$$

$$\gamma_m = 1,3$$

$$R_{ax,45,Rd} = 8,66 \text{ kN}$$

$$R_{ax,45,Rd} > Z_{45,Rd} \rightarrow 8,66 > 4,08 \text{ kN} \quad \text{Verification passed}$$

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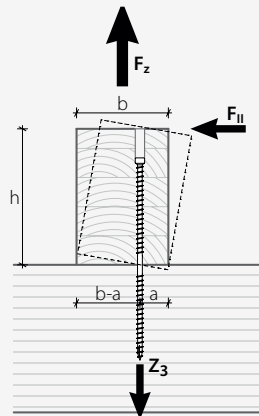
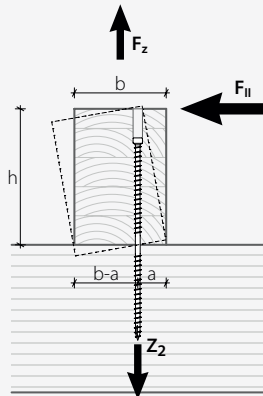
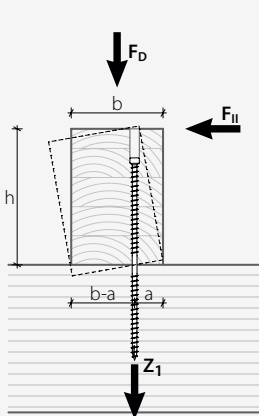
$$k_{mod} = 0,9$$

$$\gamma_m = 1,5$$

$$R_{ax,45,Rd} = 7,51 \text{ kN}$$

$$R_{ax,45,Rd} > Z_{45,Rd} \rightarrow 7,51 > 4,08 \text{ kN} \quad \text{Verification passed}$$

## 2) PERPENDICULAR STRESS VERIFICATION: $R_{ax,90,Rd} > Z_{Rd}$



$$\begin{aligned} F_{II,Rd} &= 2,88 \text{ kN} \\ F_{D,Rd} &= 7,92 \text{ kN} \\ F_{Z,Rd} (\text{VENTO}) &= 0 \text{ kN} \end{aligned}$$

$$a = 40 \text{ mm}$$

$$Z_{Rd} = \max \begin{cases} Z_{1,Rd} = \frac{3}{2 \cdot (b-a)} \cdot \left[ F_{II,Rd} \cdot h - F_{D,Rd} \cdot \left( \frac{b}{6} + \frac{a}{3} \right) \right] \\ Z_{2,Rd} = \frac{3}{2 \cdot (b-a)} \cdot \left[ F_{II,Rd} \cdot h - F_{Z,Rd} \cdot \left( \frac{b}{2} - a \right) \right] + F_{Z,Rd} \\ Z_{3,Rd} = \frac{3}{2 \cdot a} \cdot \left[ -F_{II,Rd} \cdot h + F_{Z,Rd} \cdot \left( \frac{b}{2} - a \right) \right] + F_{Z,Rd} \end{cases}$$

$$Z_{1,Rd} = 4,69 \text{ kN}$$

$$Z_{2,Rd} = 8,65 \text{ kN}$$

$$Z_{3,Rd} = -25,95 \text{ kN}$$

$$Z_{Rd} = 8,65 \text{ kN}$$

### CHOICE OF CONNECTOR INSERTED AT 90°

WT 8,2 x 330 mm

$s_{g \text{ sup}} = 135 \text{ mm}$

$s_{g \text{ inf}} = 135 \text{ mm}$

### CONNECTOR TENSILE STRENGTH CALCULATION (EN 1995:2008 and ETA-12/0063)

$$R_{ax,90,Rd} = \frac{R_{ax,90,Rk} \cdot k_{mod}}{\gamma_m}$$

$$R_{ax,90,Rk} = 15,78 \text{ kN}$$

The tensile strength of the connectors calculated here is shown in the table on pg. 121.

EN 1995:2008

$k_{mod} = 0,9$

$\gamma_m = 1,3$

$R_{ax,90,Rd} = 10,92 \text{ kN}$

$R_{ax,90,Rd} > Z_{Rd} \rightarrow 10,92 > 8,65 \text{ kN}$  Verification passed

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$k_{mod} = 0,9$

$\gamma_m = 1,5$

$R_{ax,90,Rd} = 9,47 \text{ kN}$

$R_{ax,90,Rd} > Z_{Rd} \rightarrow 9,47 > 8,65 \text{ kN}$  Verification passed