ETA-Danmark A/S
Göteborg Plads 1
DK-2150 Nordhavn
Tel. +45 72 24 59 00
Internet ww.etadanmark.dk

Authorised and notified according to Article 29 of the Regulation (EU) No 305/2011 of the European Parliament and of the Council of 9 March 2011

MEMBER OF EOTA

European Technical Assessment ETA-26/0028 of 2026/03/11

General Part

Technical Assessment Body issuing the ETA and designated according to Article 29 of the Regulation (EU) No 305/2011: ETA-Danmark A/S

Trade name of the construction product:	Hübscher SUPER TROUPER connector
Product family to which the above construction product belongs:	Three-dimensional nailing plate
Manufacturer:	Hübscher Holzbau AG Guntmadingerstr. 14 8222 Beringen SWIZERLAND Tel. +41 52 687 40 00 Internet www.huebscher.net
Manufacturing plant:	Hübscher Holzbau AG
This European Technical Assessment contains:	31 pages including 3 annexes which form an integral part of the document
This European Technical Assessment is issued in accordance with Article 95(4) of Regulation (EU) 2024/3110, on the basis of:	EAD 130186-00-0603, Three Dimensional Nailing Plates

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II SPECIFIC PART OF THE EUROPEAN TECHNICAL ASSESSMENT

1 Technical description of product

Hübscher SUPER TROUPER connectors are one-piece, face-fixed connectors to be used in timber-to-timber, timber-to-concrete or timber-to-steel connections.

SUPER TROUPER connectors are made of steel grade S355J2 according to EN 10025-2 or stainless steel 1.4301 according to EN 10088 with Rp ≥ 210 N/mm² and Rm ≥ 520 N/mm². Dimensions, hole positions and typical installations are shown in Annex A.

2 Specification of the intended use in accordance with the applicable European Assessment Document (hereinafter EAD)

SUPER TROUPER connectors are intended for use in connections in load bearing timber structures, as a connection between a timber member and a timber, concrete or steel member, where requirements for mechanical resistance and stability and safety in use in the sense of the Basic Works Requirements 1 of Regulation (EU) 305/2011 shall be fulfilled.

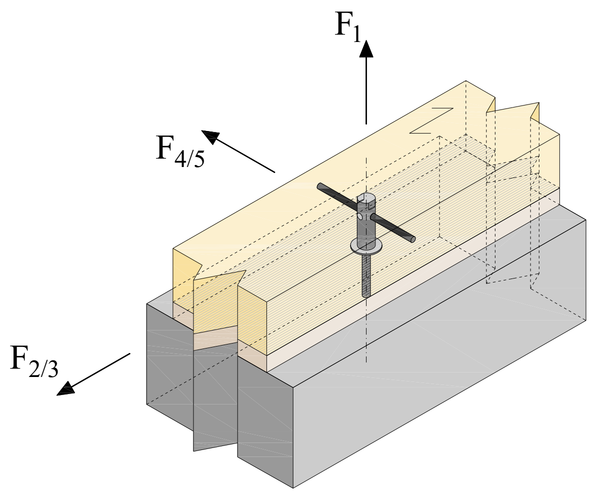
SUPER TROUPER connectors can be installed as connections between wood-based members such as:

- Structural solid timber according to EN 14081,
- Glued solid timber according to EN 14080,
- Glulam according to EN 14080 or ETA,
- Cross-laminated timber according to ETA,
- LVL according to EN 14374 or ETA,
- Engineered wood products with certified mechanical resistances for connections with dowel-type fasteners.

However, the calculation methods are only allowed for a characteristic wood density of up to 480 kg/m^3. Even though the wood-based material may have a larger density, this must not be used in the formulas for the load-carrying capacities of the fasteners.

Annex B states the formulas for the characteristic load-carrying capacities of the connections with SUPER TROUPER connectors. The design of the connections shall be in accordance with Eurocode 5 or a similar national Timber Code.

It is assumed that the forces acting on the SUPER TROUPER connector are F_1 in direction of the connector axis or F_{23} and F_{45} perpendicular to the connector axis. The forces shall act in the shear plane between a timber member and a concrete or steel member.



SUPER TROUPER connectors are intended for use for connections subject to static or quasi static loading. This includes seismic actions.

The SUPER TROUPER connectors are for use in timber structures subject to service classes 1, 2 and 3 of Eurocode 5. In service classes 1 and 2 the corrosion protection is given according to EN1995-1-1, or by equivalent measures.

In service class 3 the corrosion protection is given according to EN1995-1-1 or by stainless steel or zinc coating with minimum thickness of 55 µm according to EN ISO 1461, or by equivalent measures. The steel dowels must also be stainless steel or have a coating for the intended use in service class 3 of EN 1995-1-1.

The scope of the connectors regarding resistance to corrosion shall be defined according to national provisions that apply at the installation site considering environmental conditions and in conjunction with the admissible service conditions according to EN 1995-1-1 and the admissible corrosivity category as described and defined in EN ISO 12944-2.

The provisions made in this European Technical Assessment are based on an assumed intended working life of the connectors of 50 years.

The indications given on the working life cannot be interpreted as a guarantee given by the producer or Assessment Body but are to be regarded only as a means for choosing the right products in relation to the expected economically reasonable working life of the works.

3 Performance of the product and references to the methods used for its assessment

Characteristic	Assessment of characteristic
3.1 Mechanical resistance and stability*) (BWR1)	
Joint Strength - Characteristic load-carrying capacity	See Annex B
Joint Stiffness	No performance assessed
Joint ductility	No performance assessed
Resistance to seismic actions	No performance assessed
Resistance to corrosion and deterioration	See section 3.5
3.2 Safety in case of fire (BWR2)	
Reaction to fire	The dowels are made from steel classified as **Euroclass A1** in accordance with EN 13501-1 and Commission Delegated Regulation 2016/364
Resistance to fire	No performance assessed

*) See additional information in section 3.3 – 3.6.

3.3 Methods of verification

Safety principles and partial factors

The characteristic load-carrying capacities are based on the characteristic values of the steel connectors and steel dowels. To obtain design values the capacities must be divided by different partial factors for the material properties, in case of timber failure in addition multiplied with the coefficient k_{mod}.

According to EN 1990:2002+A1:2005 (Eurocode – Basis of design) paragraph 6.3.5 the design value of load-carrying capacity may be determined by reducing the characteristic values of the load-carrying capacity with different partial factors γ_M.

For timber failure the load duration class and the service class shall be considered by multiplication with modification factors k_{mod}.

3.4 Mechanical resistance and stability

See Annex B for characteristic load-carrying capacities of the connectors.

The characteristic capacities of the connectors are determined by calculation as described in the EAD 130186-00-0603 clause 2.2.1. They should be used for designs in accordance with Eurocode 5 or a similar national Timber Code.

The design models allow the use of fasteners described in the table in Annex A:

- Steel dowels according to EN 14592
- Mechanical fastener for use in concrete according to an ETA
- Bolts in accordance with ISO 4017 or ISO 4762
- Threaded rods in accordance with ISO 965-1 or equivalent

No performance has been determined in relation to ductility of a joint under cyclic testing. The contribution to the performance of structures in seismic zones, therefore, has not been assessed.

3.5 Aspects related to the performance of the product

Corrosion protection in service class 1 and 2.
In accordance with Eurocode 5 the SUPER TROUPER connectors are made from galvanized steel. The steel employed is grade S355J2 according to EN 10025-2 with a zink layer of 6-10 µm.

Corrosion protection in service class 3
In accordance with Eurocode 5 the SUPER TROUPER connectors are made from stainless steel. The stainless steel employed is 1.4301 according to EN 10088 with $R_p \geq 220$ N/mm² and $R_m \geq 500$ N/mm².

3.6 General aspects related to the use of the product

Hübscher SUPER TROUPER connectors are manufactured in accordance with the provisions of this European Technical Assessment using the manufacturing processes as identified in the inspection of the plant by the notified inspection body and laid down in the technical documentation.

SUPER TROUPER connections

The SUPER TROUPER connection is assessed under the following assumptions.

- Connectors are fastened to wood-based members by steel dowels.
- The characteristic capacity of the SUPER TROUPER connection is calculated according to Annex B.
- The SUPER TROUPER connection is designed in accordance with Eurocode 5 or an appropriate national code.
- The dimensions of the timber member fulfil the requirements given in Annex B.
- The thickness of intermediate layers between a timber member and a steel or concrete member is limited to 25 mm

4 Assessment and verification of constancy of performance (hereinafter AVCP) system applied, with reference to its legal base

4.1 AVCP system

According to the decision 97/638/EC of the European Commission1, as amended, the system(s) of assessment and verification of constancy of performance (see Annex V to Regulation (EU) No 305/2011) is **2+**.

5 Technical details necessary for the implementation of the AVCP system, as provided for in the applicable EAD

Technical details necessary for the implementation of the AVCP system are laid down in the control plan deposited at ETA-Danmark prior to CE marking.

Issued in Copenhagen on 2026-03-11 by

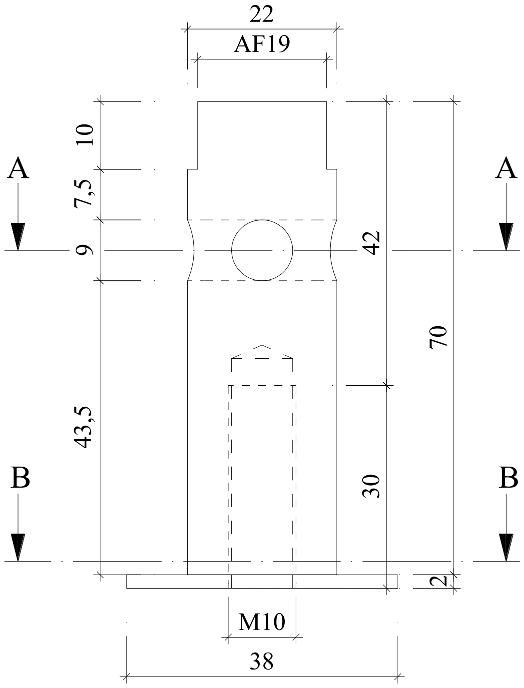
Thomas Bruun
Managing Director, ETA-Danmark

Annex A
Product Dimensions and Example Applications

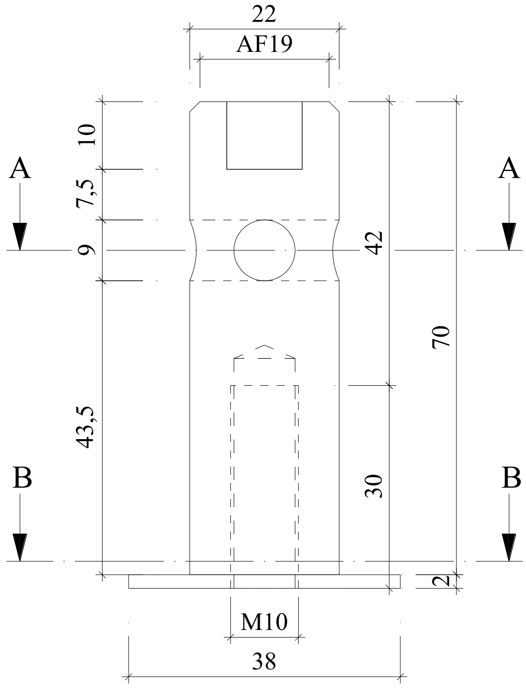
A.1 Dimensions of the SUPER TROUPER M10 connector

Material: steel grade S355 according to EN 10025-2 or an equivalent or better carbon steel or an equivalent or better stainless steel.

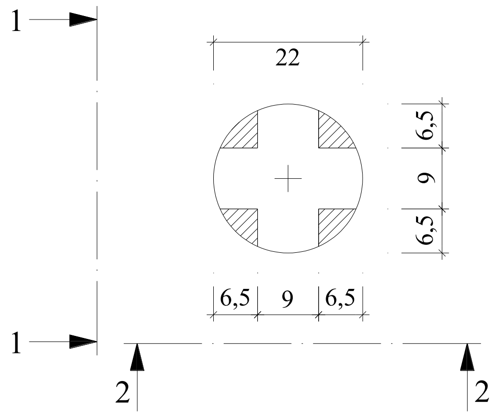
SIDE VIEW: 2-2



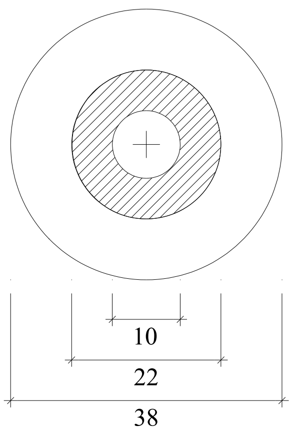
SIDE VIEW: 1-1



SECTION: A-A



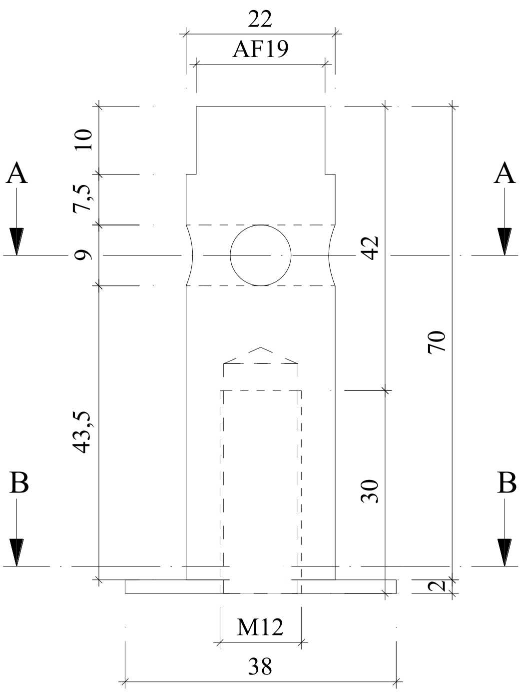
SECTION: B-B



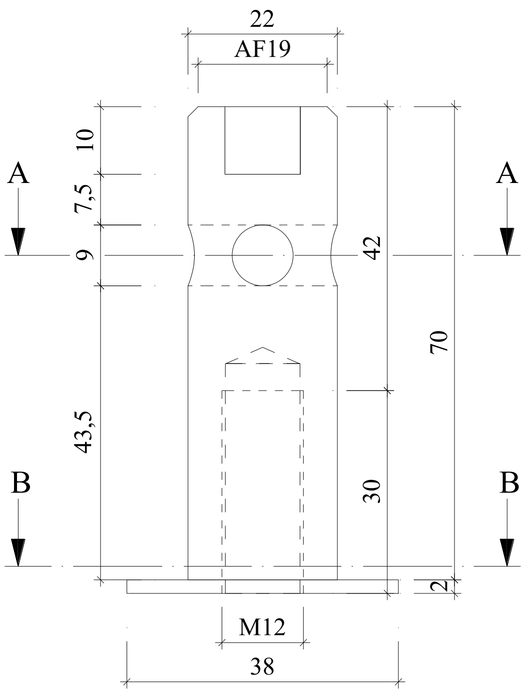
A.2 Dimensions of the SUPER TROUPER M12 Connector

Material: steel grade S355 according to EN 10025-2 or an equivalent or better carbon steel or an equivalent or better stainless steel.

SIDE VIEW: 2-2



SIDE VIEW: 1-1



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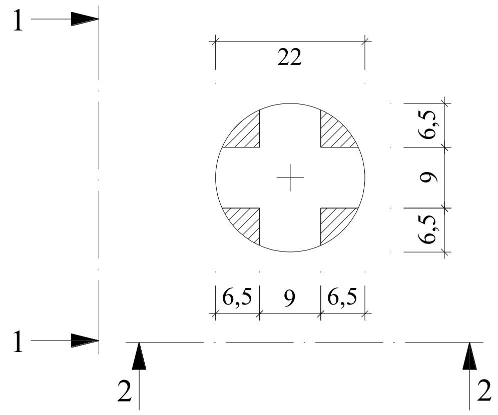

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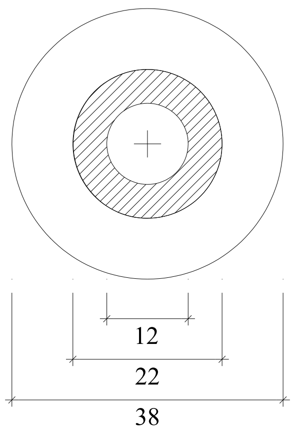
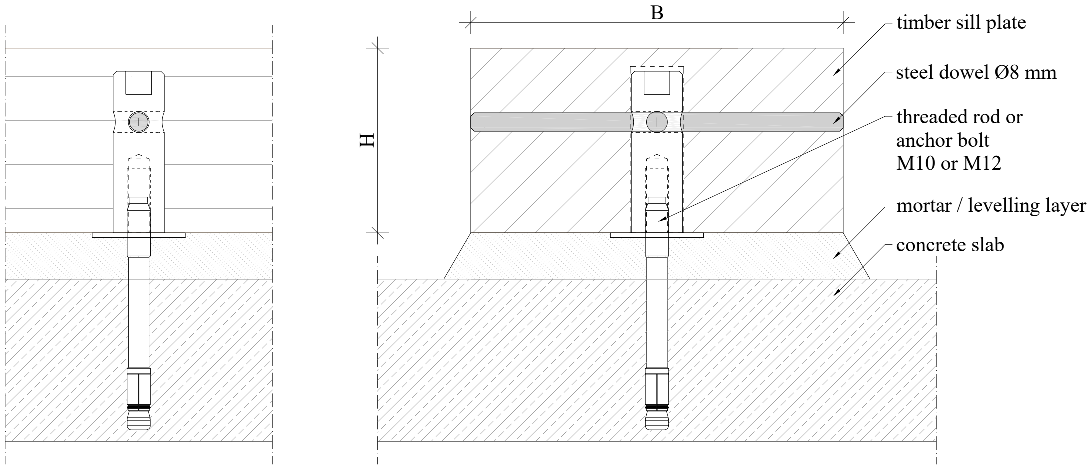
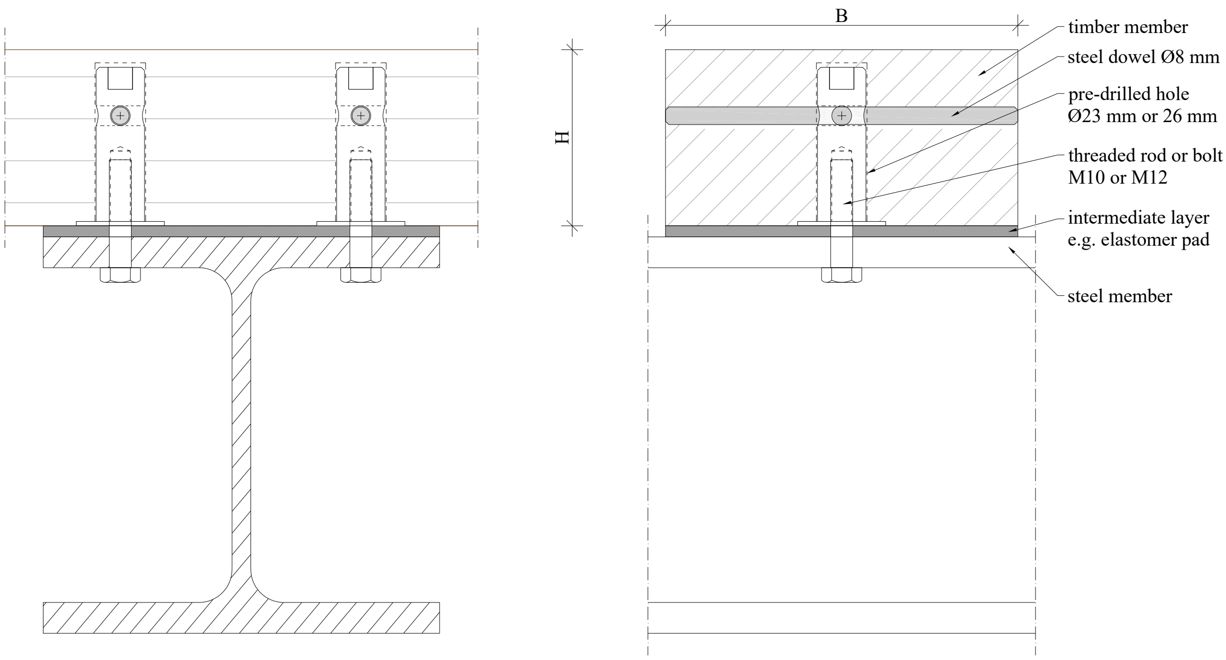


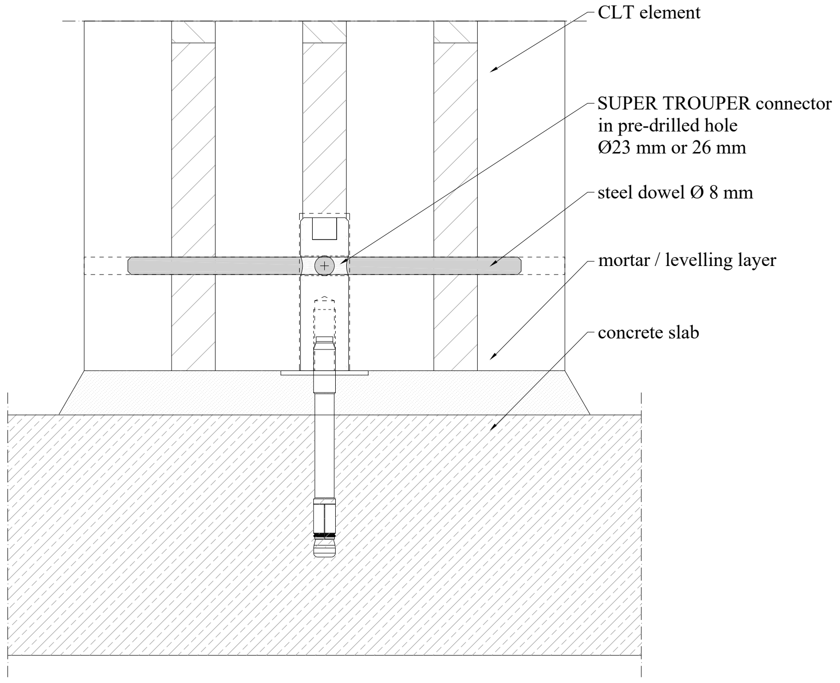
A.3 Example of a Timber-to-Concrete Connection



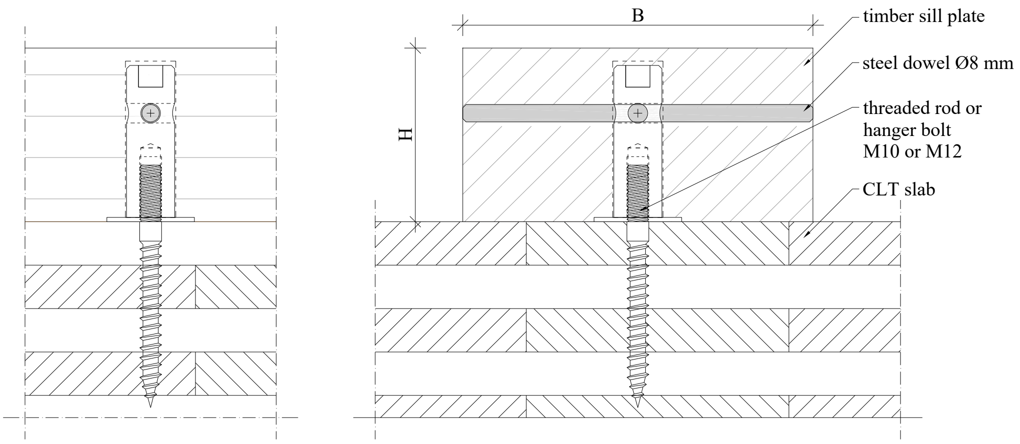
A.4 Example of a Timber-to-Steel Connection



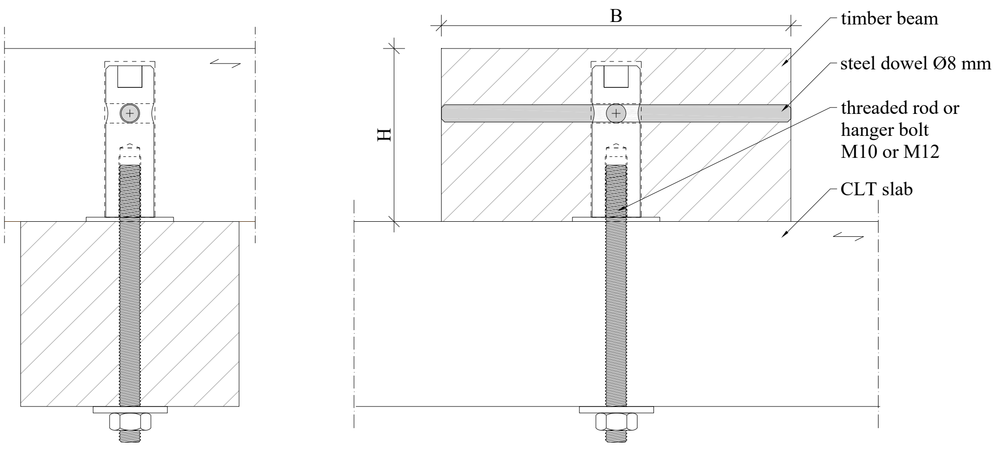
A.5 Example of a CLT-to-Concrete Connection



A.6 Example of a Timber-to-CLT Connection



A.7 Example of a Timber-to-Timber Connection



Annex B
Characteristic load-carrying capacities

The SUPER TROUPER connector consists of a 70 mm long circular steel mandrel with an outer diameter of 22 mm, and a 2 mm thick circular base plate with an outer diameter of 38 mm. At the top, the connector features two 9 mm bores perpendicular to the mandrel axis and to each other, designed for inserting an 8 mm steel dowel to fix the connector within the timber member. The bottom of the connector contains a hole with an internal M10 or M12 thread, allowing it to be fastened to metric threaded screws.

In Annex A side and sectional views of the connector and the relevant dimensions are given.

The forces are assumed to act in the shear plane between a timber member and a concrete or steel member.

For a row of SUPER TROUPER connectors arranged parallel to the grain direction of the timber member the load-carrying capacity of the connection is calculated with the effective number of SUPER TROUPER connectors.

The calculation methods are only allowed for a characteristic wood density of up to 480 kg/m³. Even though the wood-based material may have a larger density, this must not be used in the formulas for the load-carrying capacities of the fasteners.

B.1 Characteristic load-carrying capacity of timber-to-concrete and timber-to-steel connections

B.1.1 Loading in load direction F_1 for SUPER TROUPER connectors in 23 mm drill holes

$$F_{1,Rk} = 4{,}6 \cdot \sqrt{M_{y,k,s} \cdot f_{h,\alpha,k,s} \cdot d_s} \cdot k_{ts} \qquad \text{in N}$$

with
$$f_{h,\alpha,k,s} = \begin{cases} \dfrac{0{,}082 \cdot \rho_k \cdot (1 - 0{,}01 \cdot d_s)}{k_{90} \cdot \sin^2\alpha + \cos^2\alpha} & \text{for softwood and LVL} \\ 32 \cdot (1 - 0{,}015 \cdot d_s) & \text{for CLT} \end{cases} \qquad \text{in N/mm}^2$$

$$k_{90} = \begin{cases} 1{,}35 + 0{,}015\, d_s & \text{for softwood} \\ 1{,}30 + 0{,}015\, d_s & \text{for LVL} \\ 1{,}1 & \text{for CLT} \end{cases}$$

d_s diameter of the steel dowel = 8 mm

ρ_k characteristic density of the timber member in kg/m³

α angle between force and grain direction

$$k_{ts} = \frac{t_s}{t_{s,req}} \leq 1{,}0$$

t_s embedment length of the steel dowel in mm

$$t_{s,req} = 2{,}3 \sqrt{\frac{4 \cdot M_{y,k,s}}{f_{h,\alpha,k,s} \cdot d_s}} \qquad \text{in mm}$$

d_s diameter of the steel dowel = 8 mm

$M_{y,k,s}$ yield moment of the steel dowel in Nmm

$$M_{y,k,s} = 0{,}3 \cdot f_{u,k,s} \cdot d_s^{2,6}$$

$f_{u,k,s}$ characteristic tensile strength of the steel dowel in N/mm²

B.1.2 Loading in load direction F_1 for SUPER TROUPER connectors in 26 mm drill holes

$$F_{1,Rk} = 2 \cdot \left(\sqrt{t_{i,s}^2 + 4 \cdot M_{y,k,s} \cdot f_{h,\alpha,k,s} \cdot d_s} - t_{i,s} \cdot f_{h,\alpha,k,s} \cdot d_s \right) \qquad \text{in N}$$

with

$$f_{h,\alpha,k,s} = \begin{cases} \dfrac{0,082 \cdot \rho_k \cdot (1 - 0,01 \cdot d_s)}{k_{90} \cdot \sin^2\alpha + \cos^2\alpha} & \text{for softwood and LVL} \\ 32 \cdot (1 - 0,015 \cdot d_s) & \text{for CLT} \end{cases} \qquad \text{in N/mm}^2$$

$$k_{90} = \begin{cases} 1,35 + 0,015\, d_s & \text{for softwood} \\ 1,30 + 0,015\, d_s & \text{for LVL} \\ 1,1 & \text{for CLT} \end{cases}$$

d_s diameter of the steel dowel = 8 mm

ρ_k characteristic density of the timber member in kg/m³

α angle between force and grain direction

t_s embedment length of the steel dowel in mm

$$t_s \geq t_{s,req}$$

$$t_{s,req} = \sqrt{\frac{f_{h,\alpha,k,s} \cdot d_s \cdot t_{i,s}^2 + 4 \cdot M_{y,k,s}}{f_{h,\alpha,k,s} \cdot d_s}} + \sqrt{\frac{f_{h,\alpha,k,s} \cdot d_s \cdot t_{i,s}^2 + 4 \cdot M_{y,k,s}}{f_{h,\alpha,k,s} \cdot d_s} - t_{i,s}^2} - t_{i,s}$$

$t_{i,s}$ average hole clearance of the SUPER TROUPER connector = 2 mm

d_s diameter of the steel dowel = 8 mm

$M_{y,k,s}$ yield moment of the steel dowel in Nmm

$$M_{y,k,s} = 67 \cdot f_{u,k,s}$$

$f_{u,k,s}$ characteristic tensile strength of the steel dowel in N/mm²

B.1.3 Loading in load direction $F_{2/3}$ and $F_{4/5}$ for SUPER TROUPER connectors in 23 mm drill holes

$$F_{2/3(4/5),Rk} = \min \begin{cases} f_{h,\alpha,k,c} \cdot t_c \cdot d_c & \text{mode (a)} \\ 2 \cdot f_{h,\alpha,k,c} \cdot x_b \cdot d_c - f_{h,\alpha,k,c} \cdot t_c \cdot d_c & \text{mode (b)} \\ f_{h,\alpha,k,c} \cdot x_c \cdot d_c & \text{mode (c)} \end{cases} \qquad \text{in N}$$

with

$$x_b = \sqrt{t_{i,eff}^2 + t_c \cdot t_{i,eff} + \frac{t_c^2}{2} + \frac{M_{y,k,r}}{f_{h,\alpha,k,c} \cdot d_c}} - t_{i,eff}$$

$$x_c = \sqrt{t_{i,eff}^2 + \frac{2 \cdot (M_{y,k,c} + M_{y,k,r})}{f_{h,\alpha,k,c} \cdot d_c}} - t_{i,eff}$$

$$f_{h,\alpha,k,c} = \begin{cases} \dfrac{0,082 \cdot \rho_k \cdot (1 - 0,01 \cdot d_c)}{k_{90} \cdot \sin^2\alpha + \cos^2\alpha} & \text{for softwood and LVL} \\ 9 \cdot (1\text{-}0,017 \cdot d_c) & \text{for CLT} \end{cases} \qquad \text{in N/mm}^2$$

$$k_{90} = \begin{cases} 1,35 + 0,015\, d_c & \text{for softwood} \\ 1,30 + 0,015\, d_c & \text{for LVL} \end{cases}$$

d_c diameter of the SUPER TROUPER connector = 22mm

ρ_k characteristic density of the timber member in kg/m³

α angle between force and grain direction

$\alpha = 0°$ for load direction $F_{2/3}$

$\alpha = 90°$ for load direction $F_{4/5}$

t_c length of the SUPER TROUPER connector t_c = 70 mm

$t_{i,eff}$ effective thickness of intermediate layer in mm

$t_{i,eff} = t_i$ for timber-to-steel connections

$t_{i,eff} = 0{,}5d_r + t_i$ for timber-to-concrete connections

t_i = thickness of intermediate layer

d_r diameter of the threaded rod or anchor bolt = 10 mm

$M_{y,k,c}$ yield moment of the SUPER TROUPER connector

$M_{y,k,c} = 178.210\,\text{Nmm}$

$M_{y,k,r}$ yield moment of the threaded rod

$M_{y,k,r} = 97{,}5 \cdot f_{u,k,r}$ for M10

$M_{y,k,r} = 157 \cdot f_{u,k,r}$ for M12

$f_{u,k,r}$ characteristic tensile strength of the threaded rod in N/mm²

B.1.4 Loading in load direction $F_{2/3}$ for SUPER TROUPER connectors in 26 mm drill holes

$$F_{2/3,Rk} = \frac{M_{y,k,r}}{e_{eff}} \quad \text{in N}$$

with $M_{y,k,r,}$ yield moment of the threaded rod in N/mm

e_{eff} effective lever arm in mm

$$e_{eff} = \begin{cases} 50\text{ mm} + t_i + 0{,}5 \cdot d_r & \text{for timber-to-concrete connections} \\ 50\text{ mm} + t_i & \text{for timber-to-steel connections} \end{cases}$$

t_i thickness of intermediate layer in mm

d_r diameter of threaded rod

B.2 Characteristic load-carrying capacity of timber-to-concrete and timber-to-steel connections

B.2.1 Loading in load direction F_1 for SUPER TROUPER connectors in 23 mm drill holes

$$F_{1,Rk} = \min \begin{cases} F_{c,1,Rk} \\ F_{ax,1,Rk} \\ F_{c90,1,Rk} \end{cases}$$

where

$F_{c,1,Rk} = F_{1,Rk}$ according to B.1.1

$$F_{ax,1,Rk} = \frac{0,52 \cdot d_r^{0,5} \cdot \ell_{ef}^{0,9} \cdot \rho_{k,r}^{0,8}}{1,15}$$

with d_r diameter of the hanger bolt

l_{ef} penetration length of the threaded part of the hanger bolt

$\rho_{k,r}$ characteristic density of the timber member containing the hanger bolt

$$F_{c90,1,Rk} = 3 \cdot f_{c,90,k} \cdot A_{c,90}$$

with $f_{c,90,k}$ compressive strength of the timber member

$A_{c,90}$ contact area between washer and timber surface

B.2.2 Loading in load direction F_1 for SUPER TROUPER connectors in 26 mm drill holes

$$F_{1,Rk} = \min \begin{cases} F_{c,1,Rk} \\ F_{ax,1,Rk} \\ F_{c90,1,Rk} \end{cases}$$

where

$F_{c,1,Rk} = F_{1,Rk}$ according to B.1.2

$F_{ax,1,Rk}$ according to B.2.1

$F_{c90,1,Rk}$ according to B.2.1

B.2.3 Loading in load direction $F_{2/3}$ and $F_{4/5}$ for SUPER TROUPER connectors in 23 mm drill holes

$$F_{Rk}=\min\begin{cases} f_{h,\alpha,k,c}\cdot t_c\cdot d_c & \text{mode (a)}\\ f_{h,\alpha,k,r}\cdot t_r\cdot d_r & \text{mode (b)}\\ \dfrac{f_{h,\alpha,k,c}\cdot t_c\cdot d_c}{1+\beta}\cdot\left[\sqrt{\beta+2\beta^2\left[1+\dfrac{t_r}{t_c}+\left(\dfrac{t_r}{t_c}\right)^2\right]+\beta^3\left(\dfrac{t_r}{t_c}\right)^2}-\beta\left(1+\dfrac{t_r}{t_c}\right)\right] & \text{mode (c)}\\ 1{,}05\cdot\dfrac{f_{h,\alpha,k,c}\cdot t_c\cdot d_c}{2+\beta}\cdot\left[\sqrt{2\beta(1+\beta)+\dfrac{4\beta(2+\beta)M_{y,k,c}}{f_{h,\alpha,k,c}\cdot t_c^2\cdot d_c}}-\beta\right] & \text{mode (d)}\\ 1{,}05\cdot\dfrac{f_{h,\alpha,k,c}\cdot t_r\cdot d_c}{1+2\beta}\cdot\left[\sqrt{2\beta^2(1+\beta)+\dfrac{4\beta(1+2\beta)M_{y,k,r}}{f_{h,\alpha,k,c}\cdot t_r^2\cdot d_c}}-\beta\right] & \text{mode (e)}\\ 1{,}15\cdot\sqrt{\dfrac{2\beta}{1+\beta}}\cdot\sqrt{\left(M_{y,k,c}+M_{y,k,r}\right)f_{h,\alpha,k,c}\cdot d_c} & \text{mode (f)} \end{cases}\quad \text{in N}$$

with

$$\beta=\frac{d_r\cdot f_{h,\alpha,k,r}}{d_c\cdot f_{h,\alpha,k,c}}$$

$$x_b=\sqrt{t_i^2+\frac{2\cdot M_{y,k,r}}{f_{h,\alpha,k,r}\cdot d_r}}-t_i$$

$f_{h,\alpha,k,c}$ embedment strength for the SUPER TROUPER connector

$f_{h,\alpha,k,r}$ embedment strength for the hanger bolt / threaded rod

$$f_{h,\alpha,k,c/r}=\begin{cases}\dfrac{f_{h,0,k,c/r}}{k_{90}\cdot\sin^2\alpha+\cos^2\alpha} & \text{for softwood and LVL}\\ 9\cdot(1\text{-}0{,}017\cdot d_c) & \text{for CLT}\end{cases}$$

with $f_{h,0,k,c}=0{,}082\cdot\rho_k\cdot(1-0{,}01\cdot d_c)$

$$k_{90}=\begin{cases}1{,}35+0{,}015\,d_c & \text{for softwood}\\ 1{,}30+0{,}015d_c & \text{for LVL}\end{cases}$$

$\rho_{k,c/r}$ characteristic density of the timber member containing the SUPER TROUPER connector / the threaded rod / the hanger bolt

α angle between force and grain direction, $\alpha_{2/3}=0°,\alpha_{4/5}=90°$

t_c length of the SUPER TROUPER connector = 70 mm

t_r embedment depth of the hanger bolt / threaded rod $\geq 5\cdot dr$

d_c diameter of the SUPER TROUPER connector = 22 mm

d_r diameter of the hanger bolt / threaded rod = 10 mm or 12 mm

$M_{y,k,c}$ yield moment of the SUPER TROUPER connector =178.210 Nmm

$M_{y,k,r}$ yield moment of the hanger bolt / threaded rod

$$M_{y,k,r}=0{,}3\cdot f_{u,k,r}\cdot\left(\frac{d_r+d_{r,net}}{2}\right)^{2{,}6}$$

with $f_{u,k,r}$ characteristic tensile strength of the threaded rod in N/mm²

B2.4 Loading in load direction $F_{2/3}$ for SUPER TROUPER connectors in 26 mm drill holes

$$F_{2/3,Rk} = \min \begin{cases} f_{h,\alpha,k,r} \cdot d_r \cdot (2 \cdot x_a - t_r) & \text{mode (a)} \\ f_{h,\alpha,k,r} \cdot d_r \cdot x_b & \text{mode (b)} \\ F_{v,Rk,s} & \text{steel dowel} \end{cases} \quad \text{in N}$$

with

$$x_a = \sqrt{t_i^2 + t_i t_r + \frac{t_r^2}{2}} - t_i$$

$$x_b = \sqrt{t_i^2 + \frac{2 \cdot M_{y,k,r}}{f_{h,\alpha,k,r} \cdot d_r}} - t_i$$

t_r embedment depth of the hanger bolt $\geq 5 \cdot dr$

t_i distance between the axis of the steel dowel and the shear plane = 50 mm

d_r diameter of the SUPER TROUPER connector = 22 mm

$M_{y,k,r}$ yield moment of the hanger bolt

$f_{h,\alpha,k,r}$ embedment strength for the hanger bolt

$F_{v,Rk,s}$ lateral capacity $F_{1,Rk}$ of the steel dowel calculated according to B.1.2 with $\alpha = 0°$

B.3 Effective number of fasteners

For a row of SUPER TROUPER connectors subject to forces $F_{2/3}$ the effective number of connectors n_{ef} should be taken as follows:

$$n_{ef} = \min \begin{cases} n \\ n^{0,9} \sqrt[4]{\dfrac{a_1}{13 d_c}} \end{cases}$$

with n number of SUPER TROUPER connectors in a row parallel to grain

a_1 spacing parallel to grain in mm

d_c diameter of the SUPER TROUPER connector = 22 mm

For SUPER TROUPER connectors in 26 mm drill holes in CLT the effective number of connectors may be assumed as $n_{ef} = n$.

B.4 Verification of load-carrying capacities for SUPER TROUPER connectors in 23 mm drill holes

$$\frac{F_{1,Ed}}{F_{1,Rd}} \leq 1 \quad \text{and} \quad \frac{F_{2/3,Ed}}{F_{2/3,Rd}} \leq 1 \quad \text{and} \quad \frac{F_{4/5,Ed}}{F_{4/5,Rd}} \leq 1 \quad \text{and} \quad \left(\frac{F_{2/3,Ed}}{F_{2/3,Rd}}\right)^2 + \left(\frac{F_{4/5,Ed}}{F_{4/5,Rd}}\right)^2 \leq 1$$

with

$$F_{1,Rd} = F_{1,Rk} \cdot \frac{k_{mod}}{\gamma_{M,timber}}$$

$$F_{2/3,Rd} = F_{2/3,Rk} \cdot \frac{k_{mod}}{\gamma_{M,timber}}$$

$$F_{4/5,Rd} = F_{4/5,Rk} \cdot \frac{k_{mod}}{\gamma_{M,timber}}$$

B.5 Verification of load-carrying capacities for SUPER TROUPER connectors in 26 mm drill holes

$$\frac{F_{1,Ed}}{F_{1,Rd}} \leq 1 \quad \text{and} \quad \frac{F_{2/3,Ed}}{F_{2/3,Rd}} \leq 1 \quad \text{and} \quad \left(\frac{F_{2/3,Ed}}{F_{2/3,Rd}}\right)^2 + \left(\frac{F_{4/5,Ed}}{F_{4/5,Rd}}\right)^2 \leq 1$$

with $F_{1,Rd} = F_{1,Rk} \cdot \frac{k_{mod}}{\gamma_{M,timber}}$;

$F_{2/3,Rd} = F_{2/3,Rk} \cdot \frac{1}{\gamma_{M,steel}}$ for timber-to-steel and timber-to-concrete connections

$F_{2/3,Rd} = F_{2/3,Rk} \cdot \frac{k_{mod}}{\gamma_{M,timber}}$ for timber-to-timber- connections

B.6 Minimum spacings, edge and end distances

Spacings, edge and end distances shall fulfil the requirements given in EN 1995-1-1:2004, Table 8.4.
In addition the following minimum dimensions of the timber members apply:

Minimum dimensions for **solid timber, glulam, LVL and CLT**
for SUPER TROUPER connectors in drill holes with **D = 23 mm**

load direction	F_1	$F_{2/3}$	$F_{4/5}$
min H in mm	80	80	80
min B in mm	140	140	220

Minimum dimensions for **solid timber, glulam, LVL and CLT**
for SUPER TROUPER connectors in drill holes with **D = 26 mm**

load direction	F_1	$F_{2/3}$
min H in mm	80	60
min B in mm	100	100

In CLT elements subject to forces in the 4/5 direction, splitting of the CLT elements shall be prevented by appropriate reinforcements, e.g., fully-thread screws arranged parallel to the edge face. If loads in the 4/5 direction can be excluded the minimum thickness may be reduced to 140 mm.

ANNEX C
Characteristic Load-Carrying Capacities

C.1 Characteristic load-carrying capacities of Hübscher SUPER TROUPER connectors in timber-to-steel and timber-to-concrete connections

Characteristic load-carrying capacities $\mathbf{F_{1,Rk}}$ in kN for SUPER TROUPER connectors in **softwood, LVL and CLT** with drill hole diameters **D = 23 mm**

steel grade of dowel	ρ_k in kg/m³	$F_{1,Rk}$ in kN	B_{req} in mm
S235	350 (C24)	8,55	142
	380 (C30)	8,91	137
	365 (GL24c)	8,74	140
	390 (GL28c)	9,03	136
	420 (GL24h)	9,37	132
	460 (GL28h)	9,81	127
	480 (LVL)	12,0	108
S355	350 (C24)	9,98	162
	380 (C30)	10,4	156
	365 (GL24c)	10,2	159
	390 (GL28c)	10,5	155
	420 (GL24h)	10,9	150
	460 (GL28h)	11,4	144
	480 (LVL)	14,0	122

For timber members with $B < B_{req}$ the load-carrying capacity $F_{1,Rk}$ shall be reduced by the factor $k_b = \frac{B-26}{B_{req}-26}$

Characteristic load-carrying capacities $\mathbf{F_{2/3,Rk}}$ in kN for SUPER TROUPER connectors **M10** in **softwood and LVL** with drill hole diameter **D = 23 mm**

timber density ρ_k in kg/m³	strength class of threaded rod	$\mathbf{F_{2/3,Rk}}$ in kN					
		effective thickness of interlayer $t_{i,eff}$ in mm					
		0	5	10	15	20	25
350 (C24)	4.6	14,6	12,4	10,5	9,00	7,79	6,81
	5.6	15,0	12,7	10,8	9,29	8,06	7,06
	8.8	15,8	13,6	11,7	10,1	8,84	7,79
	10.9	16,2	14,2	12,3	10,7	9,35	8,26
380 (C30)	4.6	15,2	12,8	10,8	9,20	7,93	6,91
	5.6	15,6	13,1	11,1	9,50	8,20	7,16
	8.8	16,6	14,1	12,1	10,4	9,01	7,91
	10.9	17,2	14,7	12,6	10,9	9,54	8,40
365 (GL24c)	4.6	14,9	12,6	10,7	9,10	7,86	6,86
	5.6	15,3	12,9	11,0	9,40	8,13	7,11
	8.8	16,2	13,9	11,9	10,3	8,93	7,85
	10.9	16,8	14,5	12,5	10,8	9,45	8,33
390 (GL28c)	4.6	15,4	12,9	10,9	9,27	7,97	6,94
	5.6	15,8	13,3	11,2	9,57	8,25	7,19
	8.8	16,8	14,3	12,2	10,5	9,07	7,95
	10.9	17,4	14,9	12,8	11,0	9,59	8,44
420 (GL24h)	4.6	16,0	13,3	11,2	9,45	8,09	7,02
	5.6	16,4	13,7	11,5	9,76	8,38	7,29
	8.8	17,4	14,7	12,5	10,7	9,22	8,06
	10.9	18,1	15,3	13,1	11,2	9,76	8,55
460 (GL28h)	4.6	16,8	13,8	11,5	9,67	8,24	7,12
	5.6	17,1	14,2	11,9	9,99	8,54	7,39
	8.8	18,2	15,3	12,9	10,9	9,40	8,18
	10.9	18,9	15,9	13,5	11,5	9,96	8,70
480 (LVL)	4.6	17,1	14,1	11,7	9,77	8,31	7,17
	5.6	17,5	14,5	12,0	10,1	8,61	7,44
	8.8	18,6	15,5	13,0	11,1	9,48	8,24
	10.9	19,3	16,2	13,7	11,7	10,1	8,76

Characteristic load-carrying capacities $F_{2/3,Rk}$ in kN for SUPER TROUPER connectors **M12** in **softwood and LVL** with drill hole diameter **D = 23 mm**

timber density ρ_k in kg/m³	strength class of threaded rod	$F_{2/3,Rk}$ in kN					
		effective thickness of interlayer $t_{i,eff}$ in mm					
		0	6	10	15	20	25
350 (C24)	4.6	15,4	12,7	11,3	9,70	8,44	7,41
	5.6	15,8	13,2	11,7	10,1	8,86	7,80
	8.8	16,8	14,6	13,1	11,4	10,1	8,92
	10.9	17,4	15,5	13,9	12,2	10,8	9,64
380 (C30)	4.6	16,1	13,2	11,6	9,93	8,60	7,53
	5.6	16,6	13,7	12,1	10,4	9,03	7,92
	8.8	18,0	15,1	13,5	11,7	10,3	9,07
	10.9	18,6	16,0	14,3	12,5	11,1	9,81
365 (GL24c)	4.6	15,7	13,0	11,4	9,82	8,52	7,47
	5.6	16,2	13,4	11,9	10,3	8,94	7,86
	8.8	17,4	14,9	13,3	11,6	10,2	9,00
	10.9	18,0	15,7	14,1	12,4	10,9	9,73
390 (GL28c)	4.6	16,3	13,3	11,7	10,0	8,65	7,56
	5.6	16,8	13,8	12,2	10,5	9,08	7,96
	8.8	18,3	15,3	13,6	11,8	10,3	9,12
	10.9	19,0	16,2	14,5	12,6	11,1	9,86
420 (GL24h)	4.6	16,9	13,7	12,0	10,2	8,79	7,66
	5.6	17,4	14,2	12,5	10,7	9,23	8,07
	8.8	19,0	15,7	13,9	12,1	10,5	9,26
	10.9	19,9	16,7	14,9	12,9	11,3	10,0
460 (GL28h)	4.6	17,7	14,2	12,3	10,4	8,96	7,78
	5.6	18,2	14,8	12,9	10,9	9,42	8,20
	8.8	19,8	16,3	14,4	12,4	10,7	9,42
	10.9	20,8	17,3	15,3	13,3	11,6	10,2
480 (LVL)	4.6	18,0	14,4	12,5	10,6	9,03	7,83
	5.6	18,6	15,0	13,1	11,1	9,50	8,25
	8.8	20,3	16,6	14,6	12,5	10,8	9,49
	10.9	21,3	17,6	15,6	13,4	11,7	10,3

Characteristic load-carrying capacities $\mathbf{F_{2/3,Rk}}$ and $\mathbf{F_{4/5,Rk}}$ in kN for SUPER TROUPER connectors **M10** in **CLT** with drill hole diameter **D = 23 mm**

timber density ρk in kg/m³	strength class of threaded rod	$\mathbf{F_{2/3,Rk}}$ and $\mathbf{F_{4/5,Rk}}$ in kN					
		effective thickness of interlayer $t_{i,eff}$ in mm					
		0	5	10	15	20	25
350 (C24) Or 380 (C30)	4.6	4,36	3,97	3,65	3,36	3,11	2,90
	5.6	4,54	4,15	3,81	3,51	3,26	3,03
	8.8	5,08	4,65	4,28	3,96	3,68	3,43
	10.9	5,43	4,98	4,59	4,26	3,96	3,70

Characteristic load-carrying capacities $\mathbf{F_{2/3,Rk}}$ and $\mathbf{F_{4/5,Rk}}$ in kN for SUPER TROUPER connectors **M12** in **CLT** with drill hole diameter **D = 23 mm**

timber density ρk in kg/m³	strength class of threaded rod	$\mathbf{F_{2/3,Rk}}$ and $\mathbf{F_{4/5,Rk}}$ in kN					
		effective thickness of interlayer $t_{i,eff}$ in mm					
		0	6	10	15	20	25
350 (C24) Or 380 (C30)	4.6	4,80	4,32	4,04	3,73	3,46	3,23
	5.6	5,09	4,58	4,29	3,97	3,69	3,44
	8.8	5,91	5,36	5,03	4,67	4,35	4,07
	10.9	6,44	5,85	5,50	5,12	4,78	4,47

Characteristic load-carrying capacities $\mathbf{F_{4/5,Rk}}$ in kN for SUPER TROUPER connectors **M10** in softwood and LVL with drill hole diameter **D = 23 mm**

timber density ρk in kg/m³	strength class of threaded rod	$\mathbf{F_{4/5,Rk}}$ in kN					
		effective thickness of interlayer $t_{i,eff}$ in mm					
		0	5	10	15	20	25
350 (C24)	4.6	9,28	8,44	7,72	7,10	6,57	6,11
	5.6	9,47	8,61	7,89	7,26	6,72	6,24
	8.8	10,0	9,14	8,38	7,72	7,15	6,66
	10.9	10,4	9,49	8,71	8,03	7,44	6,93
380 (C30)	4.6	10,0	9,10	8,32	7,66	7,01	6,24
	5.6	10,2	9,28	8,49	7,81	7,23	6,46
	8.8	10,8	9,81	8,99	8,28	7,67	7,09
	10.9	11,1	10,2	9,32	8,59	7,96	7,41
365 (GL24c)	4.6	9,64	8,77	8,02	7,38	6,83	6,19
	5.6	9,83	8,95	8,19	7,54	6,97	6,40
	8.8	10,4	9,48	8,68	8,00	7,41	6,89
	10.9	10,8	9,83	9,01	8,31	7,70	7,17
390 (GL28c)	4.6	10,2	9,32	8,52	7,84	7,05	6,28
	5.6	10,4	9,50	8,69	8,00	7,29	6,50
	8.8	11,0	10,0	9,19	8,47	7,84	7,13
	10.9	11,4	10,4	9,52	8,77	8,13	7,55
420 (GL24h)	4.6	11,0	9,98	9,13	8,17	7,19	6,38
	5.6	11,2	10,2	9,30	8,42	7,43	6,60
	8.8	11,7	10,7	9,79	9,02	8,12	7,26
	10.9	12,1	11,0	10,1	9,33	8,57	7,68
460 (GL28h)	4.6	12,0	10,9	9,65	8,39	7,35	6,50
	5.6	12,1	11,0	9,92	8,65	7,60	6,73
	8.8	12,7	11,6	10,6	9,42	8,32	7,40
	10.9	13,1	11,9	10,9	9,90	8,78	7,84
480 (LVL)	4.6	15,4	12,9	10,9	9,27	7,97	6,94
	5.6	15,8	13,3	11,2	9,57	8,25	7,20
	8.8	16,8	14,3	12,2	10,5	9,07	7,95
	10.9	17,4	14,9	12,8	11,0	9,60	8,44

Characteristic load-carrying capacities $\mathbf{F_{4/5,Rk}}$ in kN for SUPER TROUPER connectors **M12** in softwood and LVL with drill hole diameter **D = 23 mm**

timber density ρk in kg/m³	strength class of threaded rod	$F_{4/5,Rk}$ in kN					
		effective thickness of interlayer $t_{i,eff}$ in mm					
		0	6	10	15	20	25
350 (C24)	4.6	9,74	8,71	8,12	7,48	6,93	6,44
	5.6	10,0	8,99	8,39	7,73	7,16	6,66
	8.8	10,9	9,82	9,18	8,47	7,86	7,32
	10.9	11,5	10,4	9,69	8,95	8,31	7,75
380 (C30)	4.6	10,5	9,36	8,73	8,04	7,44	6,77
	5.6	10,8	9,64	9,00	8,29	7,67	7,10
	8.8	11,7	10,5	9,78	9,03	8,37	7,80
	10.9	12,3	11,0	10,3	9,52	8,83	8,23
365 (GL24c)	4.6	10,1	9,04	8,43	7,76	7,18	6,68
	5.6	10,4	9,32	8,69	8,01	7,42	6,90
	8.8	11,3	10,1	9,48	8,75	8,11	7,56
	10.9	11,9	10,7	10,0	9,24	8,57	7,99
390 (GL28c)	4.6	10,7	9,58	8,93	8,22	7,61	6,81
	5.6	11,0	9,9	9,20	8,47	7,85	7,15
	8.8	11,9	10,7	9,99	9,22	8,54	7,96
	10.9	12,5	11,2	10,5	9,70	9,00	8,39
420 (GL24h)	4.6	11,4	10,2	9,54	8,78	7,77	6,92
	5.6	11,8	10,5	9,80	9,03	8,14	7,27
	8.8	12,7	11,3	10,6	9,77	9,06	8,27
	10.9	13,2	11,9	11,1	10,3	9,52	8,87
460 (GL28h)	4.6	12,4	11,1	10,3	9,03	7,95	7,06
	5.6	12,7	11,4	10,6	9,43	8,33	7,42
	8.8	13,6	12,2	11,4	10,5	9,43	8,45
	10.9	14,2	12,8	11,9	11,0	10,1	9,11
480 (LVL)	4.6	16,3	13,3	11,7	10,0	8,65	7,56
	5.6	16,8	13,8	12,2	10,5	9,08	7,96
	8.8	18,3	15,3	13,6	11,8	10,3	9,12
	10.9	19,0	16,2	14,5	12,6	11,1	9,87

Characteristic load-carrying capacities $\mathbf{F_{1,Rk}}$ in kN for SUPER TROUPER connectors
in **softwood, LVL and CLT** with drill hole diameters **D = 26 mm**

steel grade of dowel	ρ_k in kg/m³	$F_{1,Rk}$ in kN	B_{req} in mm
S235	350 (C24)	6,89	126
	380 (C30)	7,15	122
	365 (GL24c)	7,02	124
	390 (GL28c)	7,24	120
	420 (GL24h)	7,49	117
	460 (GL28h)	7,81	112
	480 (LVL)	9,38	96
S355	350 (C24)	8,12	143
	380 (C30)	8,44	138
	365 (GL24c)	8,28	140
	390 (GL28c)	8,54	137
	420 (GL24h)	8,84	132
	460 (GL28h)	9,22	128
	480 (LVL)	11,1	108

For timber members with $B < B_{req}$ the load-carrying capacity $F_{1,Rk}$ shall be reduced by the factor $k_b = \frac{B - 26}{B_{req} - 26}$

Characteristic load-carrying capacities $\mathbf{F_{2/3,Rk}}$ in kN for SUPER TROUPER connectors **M10**
in softwood, LVL and CLT with drill hole diameter **D = 26 mm**

strength class of threaded rod	ρ_k in kg/m³	$\mathbf{F_{2/3,Rk}}$ **in kN**					
		effective lever arm e_{eff} =					
		50 mm	55 mm	60 mm	65 mm	70 mm	75 mm
4.6	350 - 480	0,78	0,71	0,65	0,60	0,56	0,52
5.6		0,98	0,89	0,81	0,75	0,70	0,65
8.8		1,56	1,42	1,30	1,20	1,11	1,04
10.9		1,95	1,77	1,63	1,50	1,39	1,30

Characteristic load-carrying capacities $\mathbf{F_{2/3,Rk}}$ in kN for SUPER TROUPER connectors **M12**
in softwood, LVL and CLT with drill hole diameter **D = 26 mm**

strength class of threaded rod	ρ_k in kg/m³	$\mathbf{F_{2/3,Rk}}$ **in kN**					
		effective lever arm e_{eff} =					
		50 mm	55 mm	60 mm	65 mm	70 mm	75 mm
4.6	350 - 480	1,26	1,14	1,05	0,97	0,90	0,84
5.6		1,57	1,43	1,31	1,21	1,12	1,05
8.8		2,51	2,28	2,09	1,93	1,79	1,67
10.9		3,14	2,85	2,62	2,42	2,24	2,09

C.2 Characteristic load-carrying capacities of Hübscher SUPER TROUPER connectors in timber-to-timber connections

Characteristic load-carrying capacities $\mathbf{F_{1,Rk}}$ in kN for SUPER TROUPER connectors **M10** and **M12** in **softwood, LVL and CLT** with drill hole diameters **D = 23 mm**

SUPER TROUPER connector				hanger bolt		washer	
steel grade of dowel	timber density $\rho_{k,c} = \rho_{k,r}$ in kg/m³	$F_{1,Rk}$ in kN	B_{req} in mm	M10 $\ell_{ef,req}$ in mm	M12 $\ell_{ef,req}$ in mm	34-11-3 $R_{c,90k}$ in kN	44-13,5-4 $R_{c,90k}$ in kN
S235	350 (C24)	8,55	142	86	78	6,09	10,3
	380 (C30)	8,91	137	84	76		
	365 (GL24c)	8,74	140	85	77		
	390 (GL28c)	9,03	136	83	75		
	420 (GL24h)	9,37	132	81	73		
	460 (GL28h)	9,81	127	79	71		
	480 (LVL)	12,0	108	95	86		
S355	350 (C24)	9,98	162	102	92		
	380 (C30)	10,4	156	99	90		
	365 (GL24c)	10,2	159	101	91		
	390 (GL28c)	10,5	155	99	89		
	420 (GL24h)	10,9	150	96	87		
	460 (GL28h)	11,4	144	93	84		
	480 (LVL)	14,0	122	113	102		

For timber members with $B < B_{req}$ the load-carrying capacity $F_{1,Rk}$ shall be reduced by the factor $k_b = \frac{B-26}{B_{req}-26}$.

For SUPER TROUPER connectors with hanger bolt and penetration lengths $\ell_{ef} \le \ell_{ef,req}$ the load-carrying capacity $F_{1,Rk}$ shall be reduced by the factor $k_\ell = \left(\frac{\ell_{ef}}{\ell_{ef,req}}\right)^{0,9} \le 1,0$.

For densities $\rho_{k,r} \le \rho_{k,c}$ the load-carrying capacity $F_{1,Rk}$ shall be reduced by the factor $k_\rho = \left(\frac{\rho_{k,r}}{\rho_{k,c}}\right)^{0,9} \le 1,0$.

For SUPER TROUPER connectors with threaded rod and washer the capacity $F_{1,Rk}$ is limited by the capacity of the washer:

$$F_{1,Rk,red} = F_{1,Rk} \cdot k_b \cdot k_\rho \le F_{c,90,Rk}$$

Characteristic load-carrying capacities $\mathbf{F_{2/3,Rk}}$ and $\mathbf{F_{4/5,Rk}}$ for SUPER TROUPER connectors **M10** in **softwood and LVL** and drill holes with diameter **D = 23 mm**

timber density $\rho_{k,c} = \rho_{k,r}$ in kg/m³	strength class of threaded rod	t_r in mm	$F_{2/3,Rk}$ in kN ($\alpha_c = \alpha_r = 0°$)	$F_{4/5,Rk}$ in kN ($\alpha_c = \alpha_r = 90°$)
350 (C24)	4.6 to 10.9	50	8,63	6,27
380 (C30)		50	9,09	6,81
365 (GL24c)		50	8,86	6,54
390 (GL28c)		50	9,25	6,99
420 (GL24h)		50	9,70	7,41
460 (GL28h)		50	10,3	7,82
480 (LVL)		50	10,6	10,0

For connections with ($\alpha_c = 0°$ and $\alpha_r = 90°$) and for connections with ($\alpha_c = 90°$ and $\alpha_r = 0°$) the load-carrying capacities $F_{4/5,Rk}$ shall be applied.

Characteristic load-carrying capacities $\mathbf{F_{2/3,Rk}}$ and $\mathbf{F_{4/5,Rk}}$ for SUPER TROUPER connectors **M12** in **softwood and LVL** and drill holes with diameter **D = 23 mm**

timber density $\rho_{k,c} = \rho_{k,r}$ in kg/m³	strength class of threaded rod	t_r in mm	$F_{2/3,Rk}$ in kN	$F_{4/5,Rk}$ in kN
350 (C24)	4.6 to 10.9	60	10,0	6,77
380 (C30)		60	10,6	7,35
365 (GL24c)		60	10,3	7,06
390 (GL28c)		60	10,8	7,55
420 (GL24h)		60	11,4	8,13
460 (GL28h)		60	12,2	8,84
480 (LVL)		60	12,6	11,6

For connections with ($\alpha_c = 0°$ and $\alpha_r = 90°$) and for connections with ($\alpha_c = 90°$ and $\alpha_r = 0°$) the load-carrying capacities $F_{4/5,Rk}$ shall be applied.

Characteristic load-carrying capacities $\mathbf{F_{2/3,Rk}}$ and $\mathbf{F_{4/5,Rk}}$ for SUPER TROUPER connectors **M10** in **CLT** and drill holes with diameter **D = 23 mm**

timber density $\rho_{k,c} = \rho_{k,r}$ in kg/m³	strength class of threaded rod	t_r in mm	$F_{2/3,Rk}$ in kN ($\alpha_c = \alpha_r = 0°$)	$F_{4/5,Rk}$ in kN ($\alpha_c = \alpha_r = 90°$)
350 (C24)	4.6 to 10.9	50	4,00	3,58
380 (C30)		50	4,04	3,71
365 (GL24c)		50	4,02	3,65
390 (GL28c)		50	4,05	3,75
420 (GL24h)		50	4,08	3,88
460 (GL28h)		50	4,12	3,94
480 (LVL)		50	4,13	4,11

For connections with ($\alpha_c = 0°$ and $\alpha_r = 90°$) and for connections with ($\alpha_c = 90°$ and $\alpha_r = 0°$) the load-carrying capacities $F_{4/5,Rk}$ shall be applied.

Characteristic load-carrying capacities $\mathbf{F_{2/3,Rk}}$ and $\mathbf{F_{4/5,Rk}}$ for SUPER TROUPER connectors **M12** in **CLT** and drill holes with diameter **D = 23 mm**

timber density $\rho_{k,c} = \rho_{k,r}$ in kg/m³	strength class of threaded rod	t_r in mm	$F_{2/3,Rk}$ in kN	$F_{4/5,Rk}$ in kN
350 (C24)	4.6 to 10.9	60	4,46	4,19
380 (C30)		60	4,49	4,28
365 (GL24c)		60	4,48	4,25
390 (GL28c)		60	4,51	4,29
420 (GL24h)		60	4,54	4,33
460 (GL28h)		60	4,58	4,38
480 (LVL)		60	4,59	4,56

For connections with ($\alpha_c = 0°$ and $\alpha_r = 90°$) and for connections with ($\alpha_c = 90°$ and $\alpha_r = 0°$) the load-carrying capacities $F_{4/5,Rk}$ shall be applied.

Characteristic load-carrying capacities $\mathbf{F_{1,Rk}}$ in kN for SUPER TROUPER connectors **M10** and **M12** in **softwood, LVL and CLT** with drill hole diameters **D = 26 mm**

SUPER TROUPER connector				hanger bolt		washer	
				M10	M12	34-11-3	44-13,5-4
steel grade of dowel	timber density $\rho_{k,c} = \rho_{k,r}$ in kg/m³	$F_{1,Rk}$ in kN	B_{req} in mm	$\ell_{ef,req}$ in mm	$\ell_{ef,req}$ in mm	$F_{c,90,Rk}$ in kN	$F_{c,90,Rk}$ in kN
S235	350 (C24)	6,89	126	68	61	6,09	10,3
	380 (C30)	7,15	122	66	59		
	365 (GL24c)	7,02	124	67	60		
	390 (GL28c)	7,24	120	65	59		
	420 (GL24h)	7,49	117	63	57		
	460 (GL28h)	7,81	112	61	55		
	480 (LVL)	9,38	96	72	65		
S355	350 (C24)	8,12	143	81	73		
	380 (C30)	8,44	138	79	71		
	365 (GL24c)	8,28	140	80	72		
	390 (GL28c)	8,54	137	78	71		
	420 (GL24h)	8,84	132	76	69		
	460 (GL28h)	9,22	128	73	66		
	480 (LVL)	11,1	108	87	79		

For timber members with $B < B_{req}$ the load-carrying capacity $F_{1,Rk}$ shall be reduced by the factor $k_b = \frac{B-26}{B_{req}-26}$.

For SUPER TROUPER connectors with hanger bolt and penetration lengths $\ell_{ef} \leq \ell_{ef,req}$ the load-carrying capacity $F_{1,Rk}$ shall be reduced by the factor $k_\ell = \left(\frac{\ell_{ef}}{\ell_{ef,req}}\right)^{0,9} \leq 1,0$.

For densities $\rho_{k,r} \leq \rho_{k,c}$ the load-carrying capacity $F_{1,Rk}$ shall be reduced by the factor $k_\rho = \left(\frac{\rho_{k,r}}{\rho_{k,c}}\right)^{0,9} \leq 1,0$.

For SUPER TROUPER connectors with threaded rod and washer the capacity $F_{1,Rk}$ is limited by the capacity of the washer:

$$F_{1,Rk,red} = F_{1,Rk} \cdot k_b \cdot k_\rho \leq F_{c,90,Rk}$$

Characteristic load-carrying capacities $\mathbf{F_{2/3,Rk}}$ for SUPER TROUPER connectors **M10** in **softwood, LVL and CLT** and drill holes with diameter **D = 26 mm**

timber density $\rho_{k,c}$ in kg/m³	strength class of threaded rod	$F_{2/3,Rk}$ in kN
350 (C24)	4.6	0,76
	5.6	0,94
	8.8	1,48
	10.9	1,82
380 (C30)	4.6	0,76
	5.6	0,94
	8.8	1,48
	10.9	1,83
365 (GL24c)	4.6	0,76
	5.6	0,94
	8.8	1,48
	10.9	1,83
390 (GL28c)	4.6	0,76
	5.6	0,94
	8.8	1,48
	10.9	1,83
420 (GL24h)	4.6	0,76
	5.6	0,95
	8.8	1,49
	10.9	1,84
460 (GL28h)	4.6	0,76
	5.6	0,95
	8.8	1,49
	10.9	1,85
480 (LVL)	4.6	0,76
	5.6	0,95
	8.8	1,50
	10.9	1,85

Characteristic load-carrying capacities $\mathbf{F_{2/3,Rk}}$ for SUPER TROUPER connectors **M12** in **softwood, LVL and CLT** and drill holes with diameter **D = 26 mm**

timber density $\rho_{k,c}$ in kg/m³	strength class of threaded rod	$F_{2/3,Rk}$ in kN
350 (C24)	4.6	1,21
	5.6	1,50
	8.8	2,33
	10.9	2,87
380 (C30)	4.6	1,21
	5.6	1,50
	8.8	2,34
	10.9	2,89
365 (GL24c)	4.6	1,21
	5.6	1,50
	8.8	2,34
	10.9	2,88
390 (GL28c)	4.6	1,21
	5.6	1,50
	8.8	2,35
	10.9	2,89
420 (GL24h)	4.6	1,22
	5.6	1,51
	8.8	2,36
	10.9	2,91
460 (GL28h)	4.6	1,22
	5.6	1,51
	8.8	2,37
	10.9	2,93
480 (LVL)	4.6	1,22
	5.6	1,51
	8.8	2,38
	10.9	2,93