SHARP METAL

STEEL HOOKED PLATES

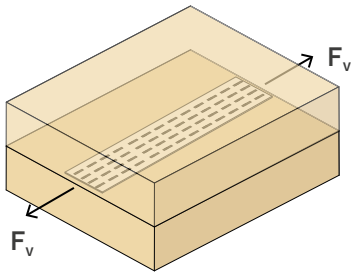
VIDEO | CALCULATION TOOL | PATENTED | ETA-24/0058

SERVICE CLASS SC1 SC2

MATERIAL

410 AISI martensitic stainless steel AISI 410

EXTERNAL LOADS



REVOLUTIONARY TECHNOLOGY

The plates have a multitude of small hooks spread over the two surfaces. The joint is made by mechanically inserting the hooks into the timber.

DRY GLUING

Ideal for transmitting shear forces in a diffuse way between two timber components. The high stiffness of the system places it as an intermediate solution between a glueing and a joint with cylindrical shank connectors.

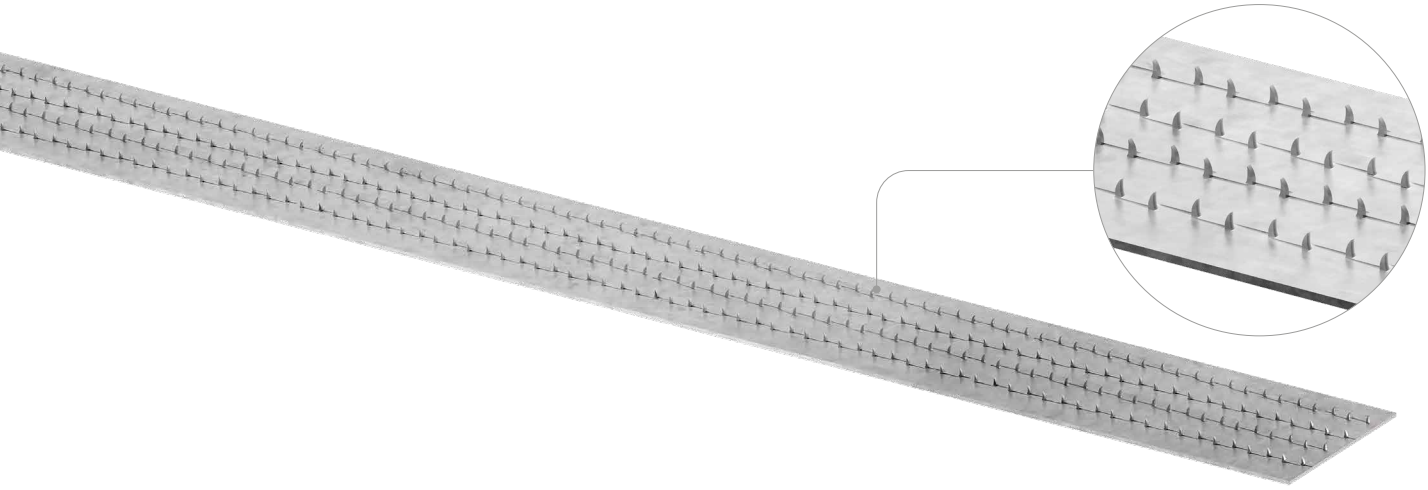
TBS MAX SCREWS

The hooks pull-through into the timber can be achieved by the compression generated by the TBS MAX flange head screws. A mechanical or vacuum press can be used for industrialised applications.

CERTIFIED

The new technology is certified according to ETA-24/0058 as a guarantee of the reliability of the research and testing carried out.

VIDEO
Scan the QR Code and watch the video on our YouTube channel



FIELDS OF USE

Shear strength timber-to-timber connections with high stiffness.
It can be used as an additional connection to limit the sliding of the connection to the Serviceability Limit State.

Can be applied to:

- solid timber or glulam
- CLT or LVL softwood panels

RIBBED FLOOR WITHOUT GLUE

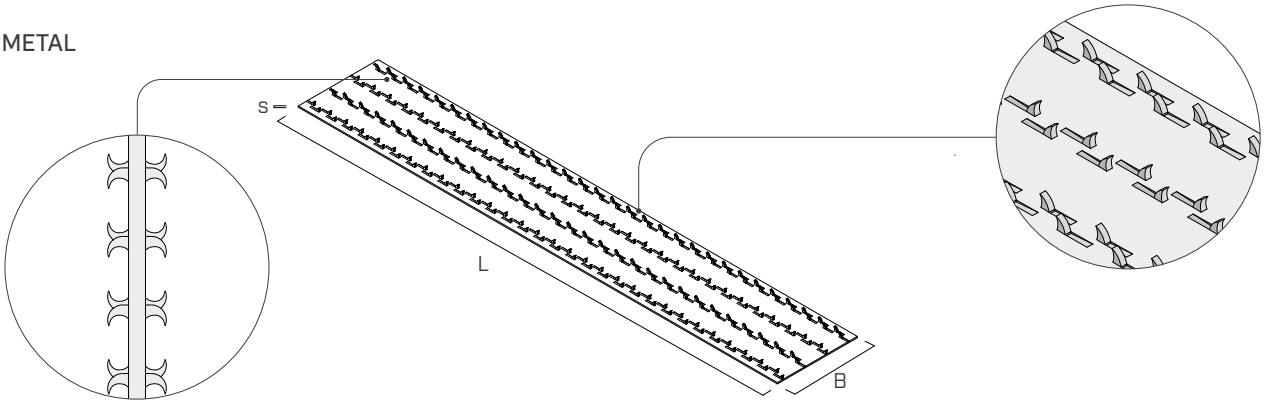
Thanks to the hook technology, it is ideal for the production of ribbed or formwork floors without the use of glues, adhesives and presses. It eliminates the waiting times for glue curing. Possibility of transporting disassembled floors to the construction site.

STRUCTURAL REINFORCEMENT

Ideal for structural reinforcement of beams by dry glueing of additional timber elements.

CODES AND DIMENSIONS

SHARP METAL

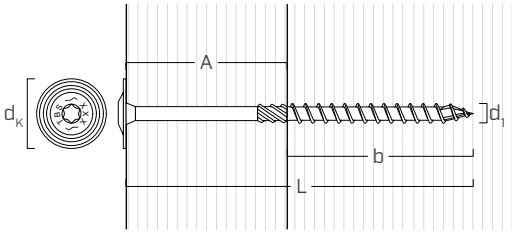


CODE	B [mm]	L [mm]	s [mm]		pcs
SHARP501200	50	1200	0,75	●	10

FASTENERS

TBS MAX - XL flange head screw

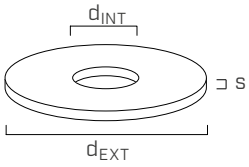
d_1 [mm]	d_K [mm]	CODE	L [mm]	b [mm]	A [mm]	pcs
8 TX 40	24,5	**TBSMAX8120**	120	100	20	50
		TBSMAX8160	160	120	40	50
		TBSMAX8180	180	120	60	50
		TBSMAX8200	200	120	80	50
		TBSMAX8220	220	120	100	50
		TBSMAX8240	240	120	120	50
		TBSMAX8280	280	120	160	50
		TBSMAX8320	320	120	200	50
		TBSMAX8360	360	120	240	50
		TBSMAX8400	400	120	280	50



For further details please see the **"TIMBER SCREWS AND DECK FASTENING"** catalogue.

WASHER

CODE	rod	d_{INT} [mm]	d_{EXT} [mm]	s [mm]	pcs
ULS13373	**M12**	13,0	37,0	3,0	100



RELATED PRODUCTS

TUCAN - shears for long, straight through cuts

CODE	length [mm]	pcs
TUC350	350	1

rothoblaas

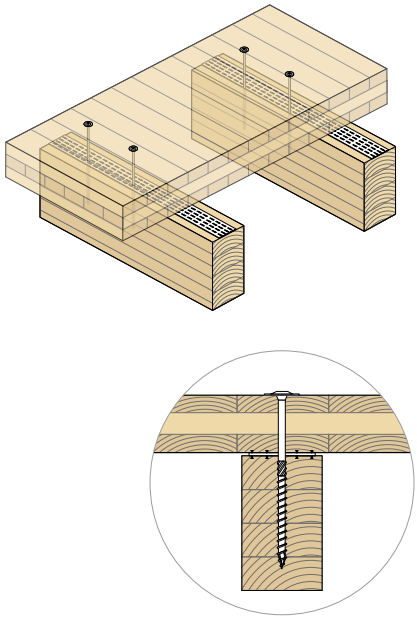
FIELDS OF APPLICATION

The SHARP METAL dry connection system can be used both in new constructions and in structural upgrading and reinforcement.

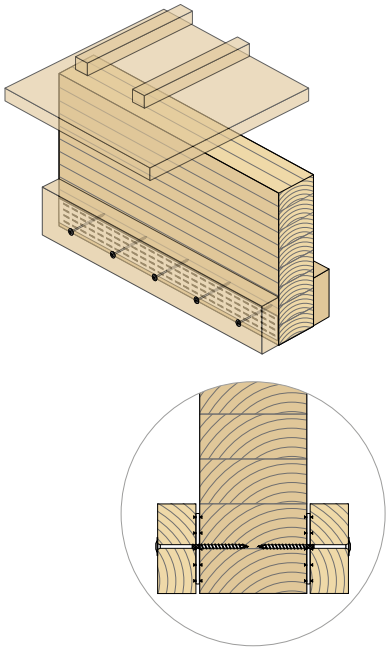
Due to the high stiffness and the absence of construction tolerances, the coupling of additional sections is immediately active and allows the construction of composite sections without complicated preparation operations (A), or by working on the sides of existing beams, it is possible to use clamping systems with mechanical clamps and ensure a high speed of intervention (B).

Another area of application is in the reduction of sliding at low force levels, to reduce the effect of free sliding in bolt and dowel connections (C). This aspect, for large span truss structures, can be a great advantage in reducing displacements.

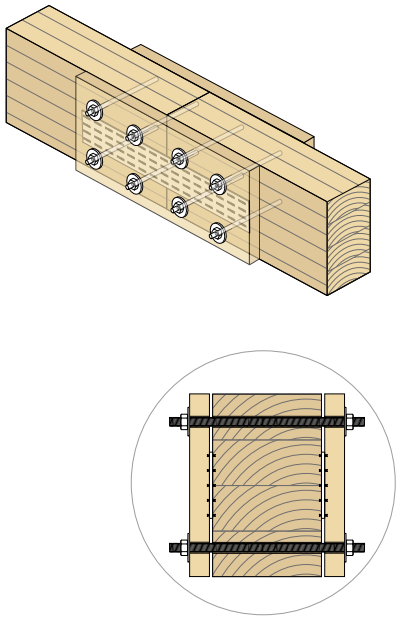
(A) COMPOSITE SECTIONS



(B) STRUCTURAL REINFORCEMENT



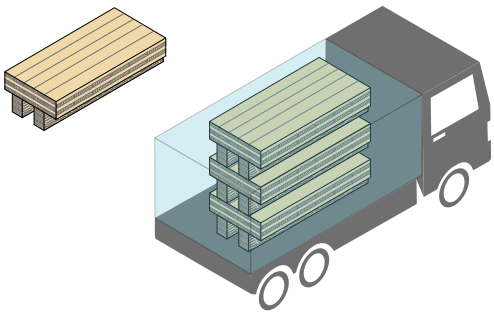
(C) LOCAL JOINT STIFFENERS



PRODUCTION AND TRANSPORT

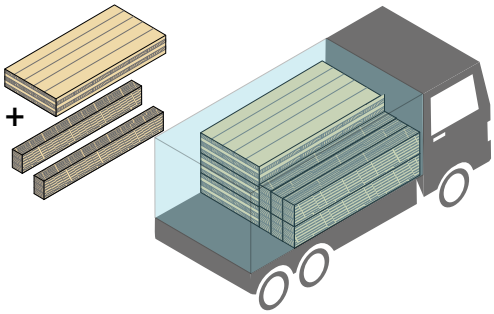
ASSEMBLY IN THE FACTORY

The effectiveness of SHARP METAL plates can be maximised if the components are connected in an installation equipped with press systems or similar, e.g. for series prefabrication. This reduces assembly time, as there is no need to wait for glues or resins to harden.
In this case, a minimum number of screws must be inserted to maintain contact of the elements for tensile forces orthogonal to the plate.



ASSEMBLY ON SITE

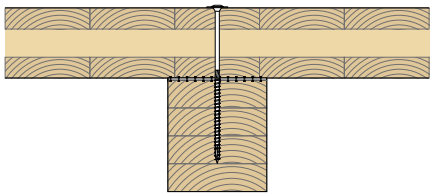
If the components are assembled on site, pressure to ensure hook pull-through can be achieved with TBS MAX screws. With this methodology, it is possible to substantially reduce the transport costs of compound "T" elements and to exploit the potential of assembling components from different manufacturers (e.g. CLT and glulam). Thanks to the performance of the screws and the reduced thickness of the SHARP metal plate, no pre-drilling is necessary in SHARP METAL plates, and cutting to length can easily be done with TUCAN shears.



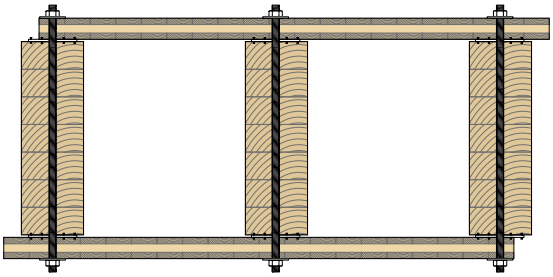
MOUNTING

The connection with SHARP METAL requires a minimum application pressure of 1.15 MPa, assuming an average density of 480 kg/m^3, to ensure correct hook pull-through.
This pressure value can be applied using different technologies depending on specific requirements and production. Two prevailing types can be identified: fastening with presses or by means of cylindrical shank connectors such as flange head screws or threaded rods.

fastening through screws

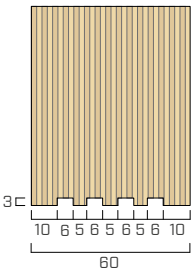


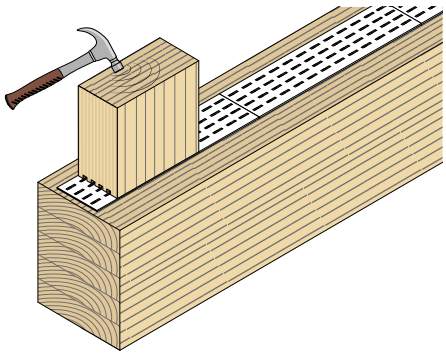
fastening with threaded rods or bolts



PRE-INSTALLATION ON THE FIRST COMPONENT

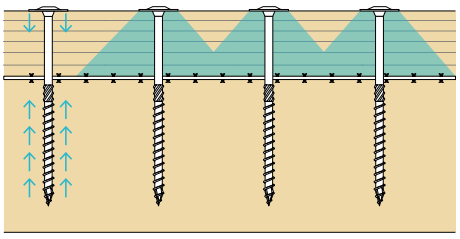
In order to facilitate installation, a finger joint template made from a milled hardwood element can be used on one side of the connection, as shown in the figure. Using a hammer, it is possible to pull-through the teeth of SHARP METAL strips without damaging them.

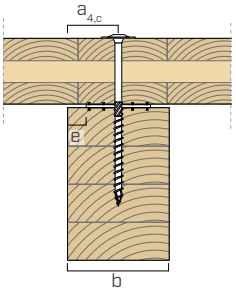




SECOND COMPONENT ASSEMBLY

The force required to close the joint can be applied by means of flange head screws. To achieve this, it is necessary that the threaded portion of the screw falls entirely into one of the two connected elements. The efficiency of the screws is influenced by the stiffness of the connected components. The average spacing suggested in the table derive from practical applications on site.
Due to the very low plate thickness, "discontinuous" configurations, i.e. with plate portions at intervals, can be used to optimise system effectiveness. If the capacity of the screws used to close the joint is to be increased, additional washers ULS13373 can be used to enlarge the force diffusion area and increase the strength of the screw head pull-through.





SUGGESTED SPACING

fastening	average spacing
TBS	8·d/10·d=64/80 mm
TBS MAX	15·d/20·d=120/160 mm
TBS MAX + ULS13373	20·d/25·d = 160/200 mm

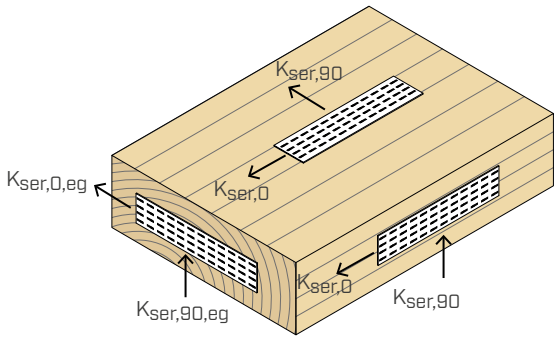
MINIMUM DISTANCES

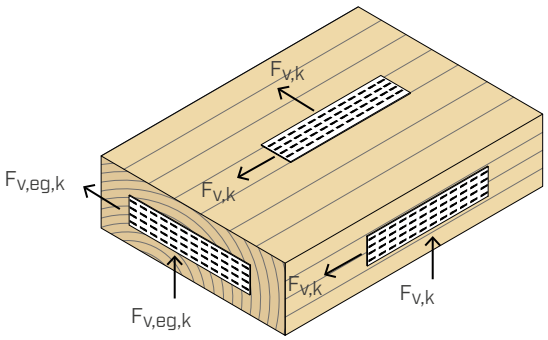
fastening	description				
TBS/TBS MAX	minimum distance from the unloaded edge	$a_{4,c}$	[mm]	5·d	
SHARP METAL	minimum distance from the edge to the outside of the plate	e	[mm]	b<150 b>150	25 b/6

where d is the screw diameter and b is the width of the timber element.

The use of SHARP METAL in combination with screws allows a practical and safe installation. The hooked plate provides considerable confinement to the wood, increasing its strength against splitting failure due to loads parallel to the fiber acting on the screws.

STRUCTURAL VALUES | F_v





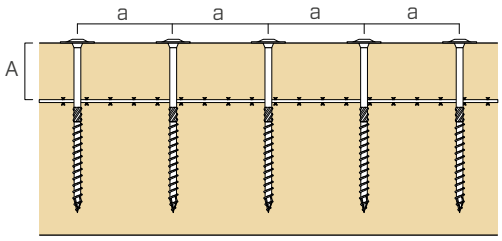
Characteristic strength values - lateral grain

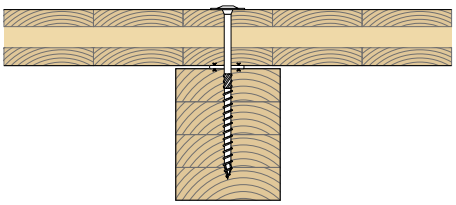
TBS/TBSMAX screws spacing	SOLID TIMBER, GLULAM and CLT		
	$F_{v,k}$ [MPa]	$k_{ser,0}$ [N/mm^3]	$k_{ser,90}$ [N/mm^3]
a ≤ 100mm	1,72	3,05	1,01
≤ 175mm	1,02	2,47	0,87
without screws(*)	0,81	1,76	0,72

(*)Minimum screws must be inserted to ensure that contact is maintained, the minimum spacing must be 250 mm.

Characteristic strength values - head grain

TBS/TBSMAX screws spacing	SOLID TIMBER AND GLULAM			CLT		
	$F_{v,eg,k}$ [MPa]	$k_{ser,0,eg}$ [N/mm^3]	$k_{ser,90,eg}$ [N/mm^3]	$F_{v,eg,k}$ [MPa]	$k_{ser,0,eg}$ [N/mm^3]	$k_{ser,90,eg}$ [N/mm^3]
≤ 175mm	0,86	1,40	0,85	1,11	1,40	0,85





GENERAL PRINCIPLES

- Characteristic values are consistent with EN 1995-1-1 and in accordance with ETA-24/0058.
- Dimensioning and verification of the timber elements must be carried out separately.
- To reduce distortions caused by hygrometric variations, it is possible to use staggered screw positioning along the SHARP METAL axis.
- The minimum thickness of the element to be connected (A) is 60 mm. The length of the screw must allow the threaded part to penetrate completely into the second connected element.
- When using SHARP METAL on medium density wood-based materials ρ_m>480 kg/m^3, particular attention should be paid to checking that the hooks penetrate correctly.
- The design strengths are obtained from the characteristic values as follows:

$$F_{v,Rk} = \begin{cases} B \cdot l_{eff} \cdot F_{v,k} \cdot k_{dens} & \text{for lateral grain applications} \\ B \cdot l_{eff} \cdot F_{v,eg,k} \cdot k_{dens} & \text{for head grain applications} \end{cases}$$

where B represents the width of the strips used. The strengths values are obtained experimentally on wooden specimens with a density of 385 kg/m^3.

If timbers with different characteristic densities are used, the strength value must be multiplied by:

$$K_{dens} = \left(\frac{\rho_k}{385}\right)^{0.5}$$

The effective length that must be considered in calculating the connections is equal to:

$l_{eff} = min\ (0,9;l - 10\ mm)$

where l represents the width of the strips used.

- Design stiffness can be obtained from values in the table as follows:

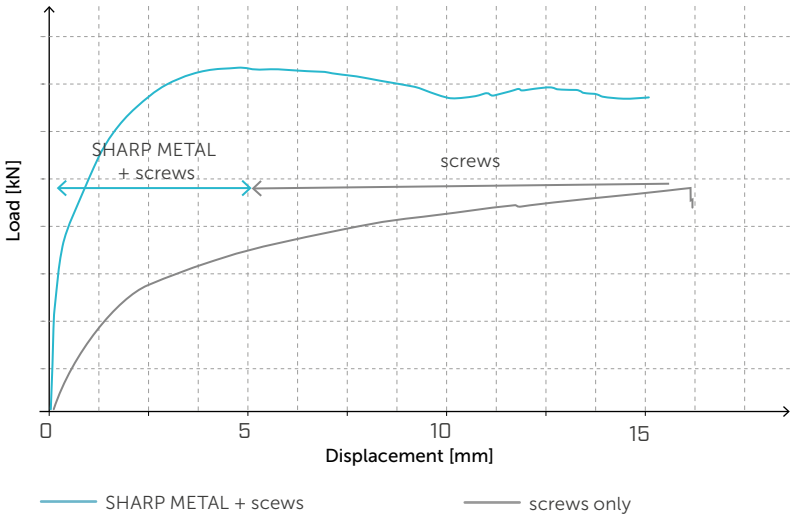
$$k_{v,ser} = \begin{cases} B \cdot l_{eff} \cdot k_{ser,\alpha} & \text{for lateral grain applications} \\ B \cdot l_{eff} \cdot k_{ser,eg,\alpha} & \text{for head grain applications} \end{cases}$$

INTELLECTUAL PROPERTY

- SHARP METAL is protected by the following patent: IT102020000025540.
- SHARP METAL is developed by Rothoblaas based on technology from Nucap Industries Inc.

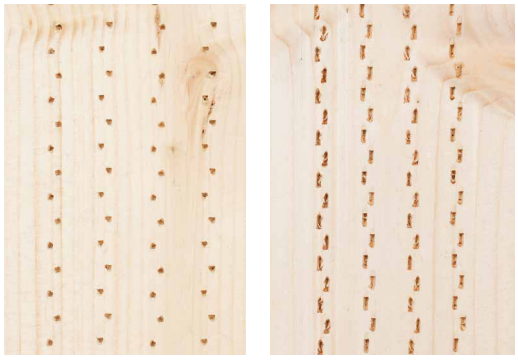
MECHANICAL BEHAVIOUR

Timber-to-timber connections made with SHARP METAL and screws allow an intermediate structural behaviour between connections with cylindrical shank means and gluing.
This peculiar behaviour ensures the reduction of displacements due to assembly tolerances and, at the same time, allows good ductility for large displacements in boundary conditions.
These properties can be effectively modulated through careful design of service limit state (SLS) and ultimate limit state (ULS) conditions.



The study of the system must consider, in the case of advanced analyses, different fields of use in terms of displacement. The performance of SHARP METAL plates at low levels of displacement allows for high strength and stiffness. These features make it a good solution for coupling elements in composite sections where very high connection efficiency is desired.

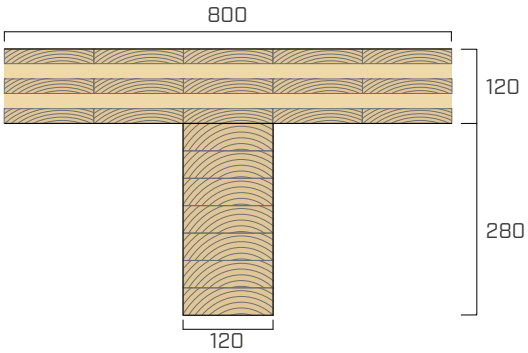
In the high-displacement range, the screws provide satisfactory post-elastic behaviour due to their high ductility and strength.

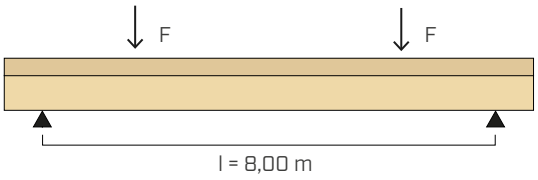


EXPERIMENTATION

The use of the SHARP METAL shear connection showed advantages during comparative experimental tests carried out on full-scale specimens under real-world conditions, both in terms of size and installation.
Tests on composite sections, where a high stiffness of the connection between the elements is usually required, showed a significant gain in terms of reduced displacements and deformations. A comparison of the results in terms of stiffness is shown in the table.

CASE STUDY: COMPARISON WITH GLUED CONNECTION





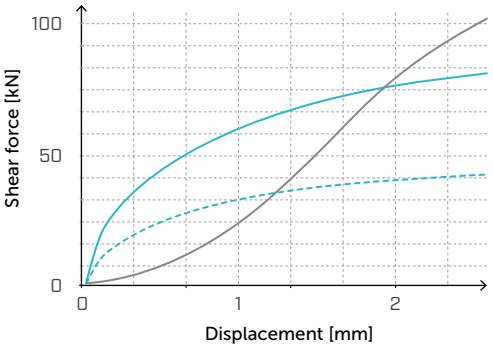
DATA	
beam length	8 m
CLT panel thickness	120 mm (5 layers)
beam	GL24h 120 x 280 mm

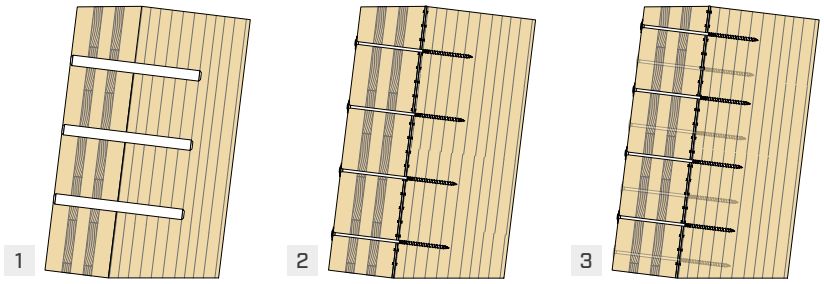
description	connection system	flexural rigidity $E_{I,ef}$	arrow v
reference test-only screws	TBS Ø8x220 mm, a = 100 mm	100%	100%
connection with screw and SHARP METAL	SHARP METAL TBS Ø8x220 mm, a = 100 mm	204%	49%
rigid connection	glueing with XEPOX	239%	42%

CASE STUDY: COMPARISON WITH CYLINDRICAL SHANK CONNECTORS

When using connectors with large diameters, extremely small spacings and minimal tolerances must often be used to ensure sufficient connection efficiency. SHARP METAL plates ensure excellent performance with small displacements, small diameters and self-drilling connectors. Below are the results of tests carried out on shear and full-scale samples.

SHEAR TESTS

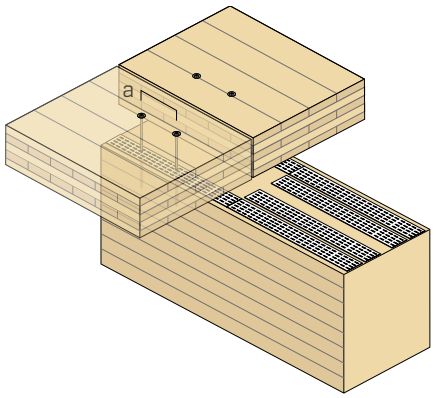


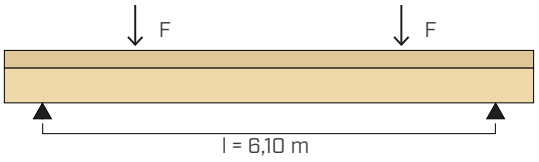


STA — SHARP METAL + TBS — **2x** SHARP METAL + TBS

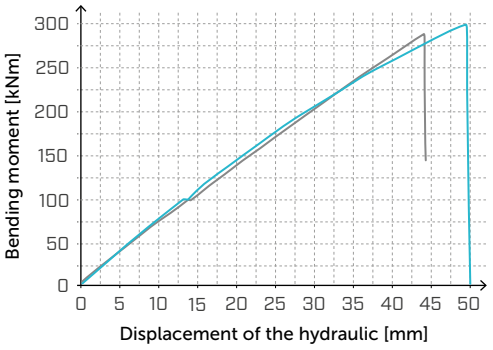
	description	connection system	stiffness $E_{I,ef}$
1	**STA dowels**	6 - STA Ø20x300 mm	100%
2	**SHARP METAL + screws TBS**	SHARP METAL (1 strip l=500 mm) 4 - TBS Ø8x260 mm	75%
3	**SHARP METAL + screws TBS**	SHARP METAL (2 strips l=500 mm) 8 - TBS Ø8x260 mm	144%

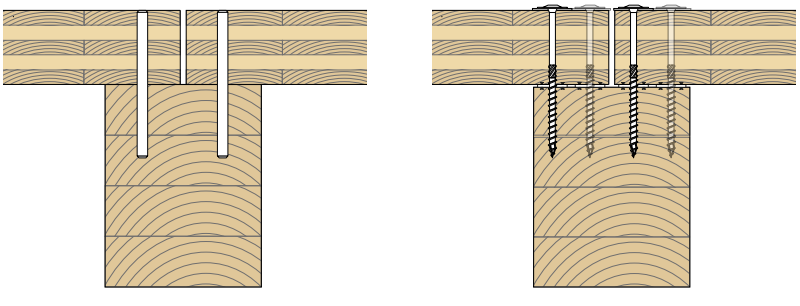
BENDING TESTS





DATA	
beam length	6,10 m
CLT panel thickness	140 mm (5 layers)
beam	GL28h 240 x 400 mm





1 STA — 2 SHARP METAL + TBS

	description	connection system	flexural rigidity $E_{I,ef}$	arrow v
1	**STA dowels**	STA dowels Ø20x300 (a=120 mm/240 mm)	100%	100%
2	**SHARP METAL + screws TBS**	SHARP METAL (4 strips/2 strips) TBS Ø8x260 mm, s=150 mm	102%	97%