Required rafter cross-sections for winter garden constructions

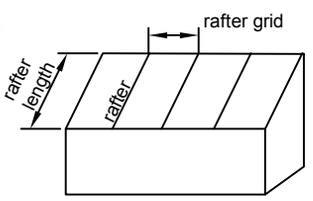
(in accordance with the new DIN 1055, valid for German planning and building laws since January 2007)

The tables are only suitable for preliminary static computations. They do not replace static calculations from a structural engineer.

Prerequisites for using the tables:

- The assumed loads and field of application are checked, followed, or undercut by the handler.
- The winter garden is considered a closed structure because open structures may be subject to higher wind loads.
- Height offsets and superstructural parts, which cause snow drifts and slides from a higher roof, must be accounted for separately. The maximum ridge height is 6 m from ground level.
- The roof structure may only be treaded on for cleaning purposes.
- The tables are based on the following values:

Maximum deflection:	lower than l/300 or a maximum of 8 mm
Glass load:	35 kg/m² for 14 mm total glass thickness
Roof incline:	15° to 30°
Wood quality:	GL 24 (E-module = 11600 N/mm²)
Snow load “si” on the roof: si =	sk x 0.8 (indicated in standard snow load = "sk“)
	The local building authorities will provide the snow load “sk” values if necessary.
Wind load	q = 0.65 kN/m²
	= wind zones 1, 2
	(installation under 10 m)



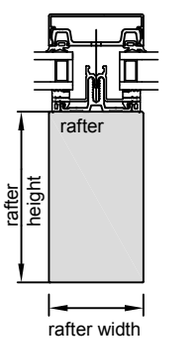


Table 1: “required rafter height for snow loads si = 0.75 kN/m², sk = 0.9375 kN/m²“
valid in: Zone 1 up to 550 m above NN, zone 1a up to 450 m above NN. Zone 2 up to 310 m above NN

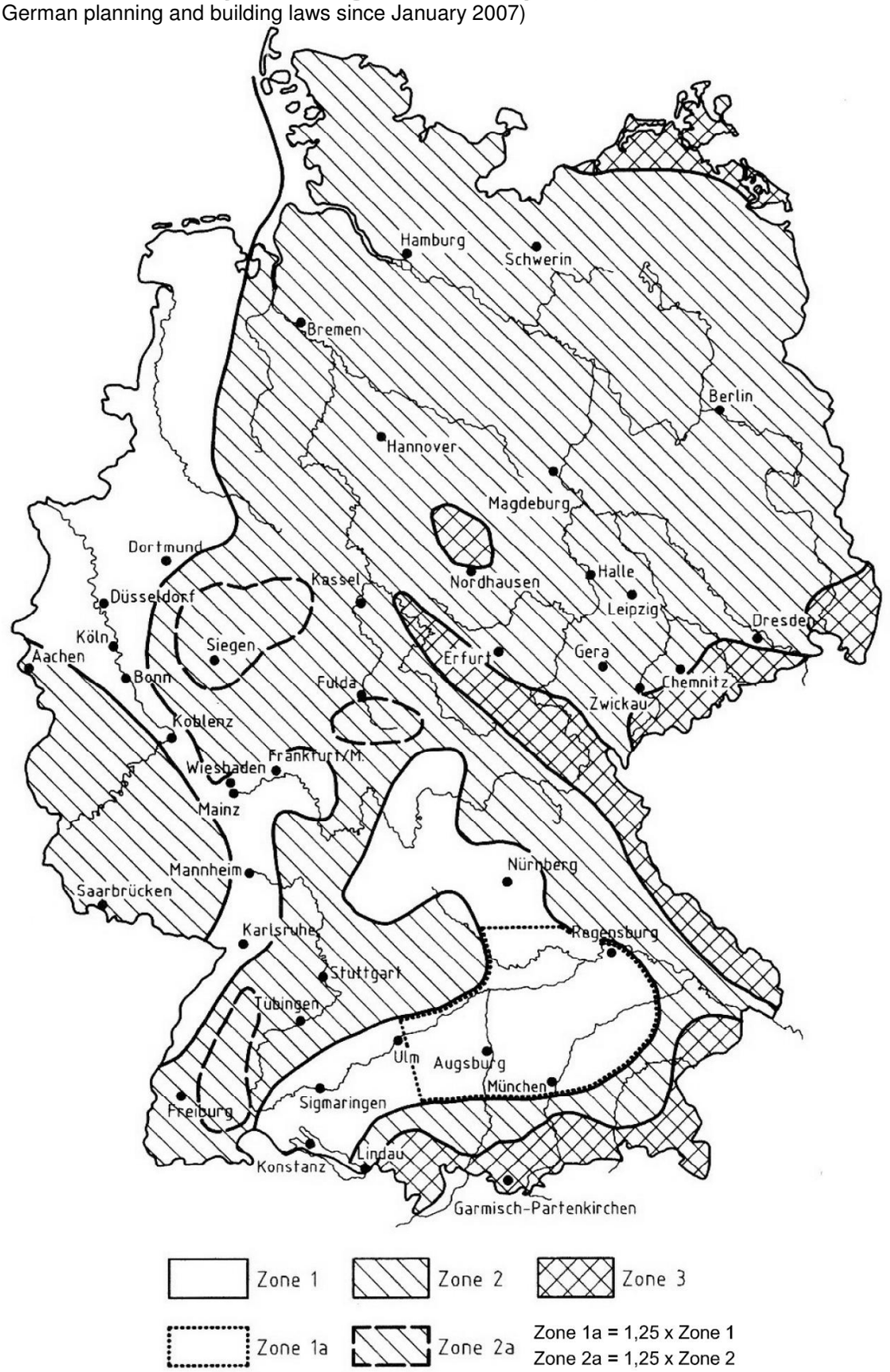
Rafter grid	Rafter width	"Required rafter height (mm) for snow loads si = 75 kN/m²" **rafter length (cm)**							
		150 cm	200 cm	250 cm	300 cm	350 cm	400 cm	450 cm	500 cm
60 cm	60 mm	60 mm	80 mm	100 mm	120 mm	150 mm	180 mm	210 mm	240 mm
	80 mm	60 mm	70 mm	90 mm	110 mm	140 mm	160 mm	190 mm	220 mm
	100 mm	50 mm	70 mm	80 mm	110 mm	130 mm	150 mm	180 mm	200 mm
80 cm	60 mm	70 mm	90 mm	110 mm	140 mm	170 mm	200 mm	230 mm	260 mm
	80 mm	60 mm	80 mm	100 mm	120 mm	150 mm	180 mm	210 mm	240 mm
	100 mm	60 mm	70 mm	90 mm	120 mm	140 mm	170 mm	200 mm	220 mm
100 cm	60 mm	70 mm	90 mm	120 mm	150 mm	180 mm	220 mm	250 mm	290 mm
	80 mm	60 mm	80 mm	110 mm	120 mm	160 mm	190 mm	230 mm	260 mm
	100 mm	60 mm	80 mm	100 mm	120 mm	150 mm	180 mm	210 mm	240 mm

Table 2: “required rafter height for snow loads si = 1.25 kN/m², sk = 1.56 kN/m²“
Valid in: Zone 1 up to 795 m above NN, zone 1a up to 680 m above NN, zone 2 up to 490 m above NN
Zone 2a up to 405 m above NN, zone 3 up to 360 m above NN.

Rafter grid	Rafter width	"required rafter height (mm) for snow loads si = 1.25 kN/m² **rafter length (cm)**							
		150 cm	200 cm	250 cm	300 cm	350 cm	400 cm	450 cm	500 cm
60 cm	60 mm	70 mm	90 mm	110 mm	140 mm	170 mm	200 mm	230 mm	270 mm
	80 mm	60 mm	80 mm	100 mm	130 mm	150 mm	180 mm	210 mm	240 mm
	100 mm	60 mm	70 mm	90 mm	120 mm	140 mm	140 mm	170 mm	230 mm
80 cm	60 mm	70 mm	100 mm	120 mm	150 mm	180 mm	220 mm	250 mm	290 mm
	80 mm	70 mm	90 mm	110 mm	140 mm	170 mm	200 mm	230 mm	270 mm
	100 mm	60 mm	80 mm	100 mm	130 mm	160 mm	190 mm	220 mm	250 mm
100 cm	60 mm	80 mm	100 mm	130 mm	160 mm	200 mm	240 mm	270 mm	310 mm
	80 mm	70 mm	90 mm	120 mm	150 mm	180 mm	210 mm	250 mm	290 mm
	100 mm	70 mm	90 mm	110 mm	140 mm	170 mm	200 mm	230 mm	270 mm

Snow load zones Germany according to DIN 1055, part 5, 2005-07

(valid for German planning and building laws since January 2007)



GUTMANN TWINLOC

GUTMANN TWINLOC is designed for the connection of mullions and transoms in vertical curtain walls or purlins and rafters in wood roof structures with wood face widths of 50 - 80 mm. See the special technical information for the precise specifications for wood roof structures.
The connection must be able to safely and verifiably transfer all loads that arise from the individual supporting structural components. Due to the eccentric applied load, torsion forces act on the transom in wood-aluminium curtain walls, which places high demands on the load-bearing capacity of the connection.
Furthermore, high visual demands are placed on wood-aluminium curtain walls with the expectation that the transom to mullion connection will remain permanently closed without any gap.
GUTMANN TWINLOC satisfies these requirements perfectly and remains, in design and assembly, "brilliantly simple - simply brilliant!"

Technical Properties

►Great stability due to perfect form and force closure

►Increase in load-bearing capacity by simple means

►Easy assembly: lateral transom mounting or insertion from the rear

►Fast connection: central connection bolt locks in all three axes

►Versatile: different connection lengths are available, depending on transom depth

►Easy assembly with drill and router template

►Precise installation: transom milling creates depth stop

►Perfect appearance: installation concealed on three sides

►Closed joints thanks to only one bolt in the entire length of the connector

►Simple design: two identical connector components

►Same design for single and double connections

►Shear plates prevent rotation caused by eccentric glass loads

►Guaranteed stability

►**GUTMANN TWINLOC** is patented

Building Inspectorate Requirements

In Germany, the suitability of mullion - transom connectors that are used in curtain walls must be proved with a building inspectorate approval (abZ).
Building inspectorate approval no. 9.1-682 was awarded to the GUTMANN TWINLOC in January 2007. Manufacture of the connectors is subject to third party monitoring by TÜV Rheinland. See the current GUTMANN Technical Information: Structural Values or the building inspectorate approval for detailed connector structural values.

TWINLOC Connectors for vertical curtain walls

GUTMANN TWINLOC connects mullion and transom wood structures with a wood face width of 50-80 mm. Technical Information: Structural values or the general building inspectorate approval should be used as a basis for checking load-bearing capacity and structural analysis.

Mullion assembly

Transom assembly

Connection

TWINLOC connector

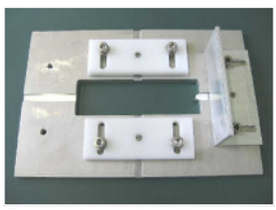
TWINLOC: Connector selection for vertical curtain walls

	Connector Type	Transom depth (mm) (1)	max. weight of glass (2)	
			Standard	Heavy duty
	TL 41	59-76	170 kg	170 kg
	TL 59	77-94	226 kg	226 kg
	TL 77	95-112	234 kg	234 kg
	TL 95	113-148	250 kg	250 kg
	TL 131	149-189	316 kg	326 kg
	TL 221	239 -280	316 kg	326 kg

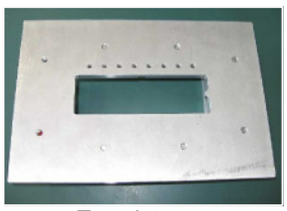
(1) Larger transom depths are achieved by coupling the connectors. The higher stress levels that this permits are not taken into account in the maximum loads shown.
(2) The maximum glass loads are specified as the max. load capacity of a continuous transom with 2 identical connectors, expressed as the overall weight of glass. See Technical Information: Structural Values for additional possibilities for increasing load capacities.

Milling the Transom Face

A 12 - 12.5 mm deep recess is milled in the transom (on the abutting part) using a standard router (bit Ø 14 mm, bushing Ø 24 mm) and the TWINLOC template.



Template underside



Template top

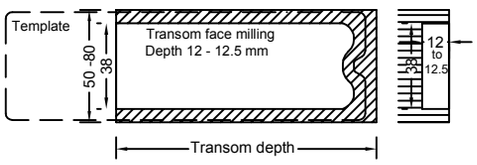
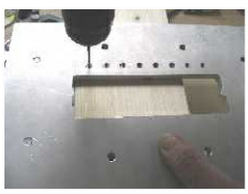


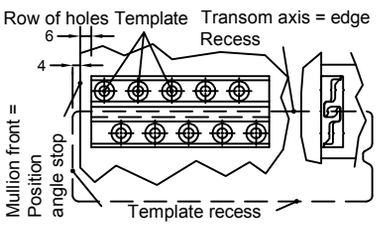
Table: Milling dimensions

	Connector type	Milling dimension	Transom depth
Standard	TL 41	47	59-76
	TL 59	65	77-94
	TL 77	83	95-112
	TL 95	101	113-148
	TL 131	137	149-189
	TL 221	227	239-280
Variant 1 Connector combinations	TL 131 + TL 41	178	190-207
	TL 131 + TL 59	196	208-225
	TL 131 + TL 77	214	226-243
	TL 131 + TL 95	232	244-279
	TL 131 + TL 131	268	280-300
Variant 2 Layout	TL 221 - 72	155	167-184
	TL 221 - 54	173	185-202

Drilling Mullions

To precisely position the mullion screw connections, Ø 3 mm pilot holes are drilled using the template drill bushings. The transom axis is laid out on the edge of the milled recess on the template. The depth position of the screw connection is adjusted with the angle stop so that the front edge of the connector is 6 mm behind the front edge of the wood structure.

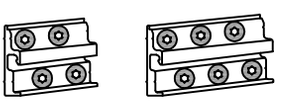




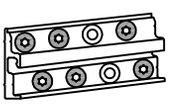
Fastening the Connector

Basically, the 5/80 long screws are used for fastening to the long grain of wood and the 5/50 long screws are used for fastening to end grain. In hard woods or close to the edge of wood, Ø 3 mm pilot holes should be drilled. All of the connector holes are used in the heavy duty screw connection. In the standard screw connection, fastening is carried out in accordance with the sketch.

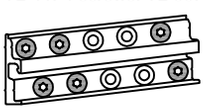
Sketch: Standard Screw Connection



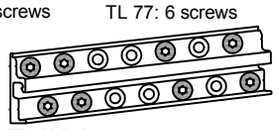
TL 41: 4 screws. TL 59: 6 screws



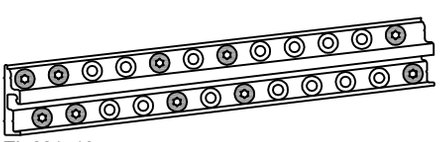
TL 77: 6 screws



TL 95: 6 screws



TL 131: 8 screws



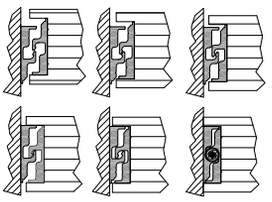
TL 221: 10 screws

A group of 4 screws is always placed at the end with the glass load (= face of wood or mullion).
One pair of screws is always placed at the inner end.

Wood Connection Assembly

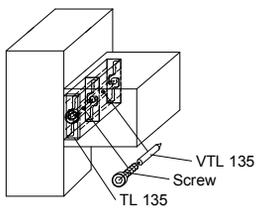
The transom can either be pushed in from the rear or mounted from the side as shown in the sketch.

Sketch: Assembly by mounting from the side



By screwing the greased connection screw (cordless screwdriver with T25 Torx bit) into the screw channel formed by both connector components, tightening of the connector on all three axes takes place and can be undone if needed. This presses the transom against the mullion with uniform pressure across its entire depth.

Sketch: closed connector

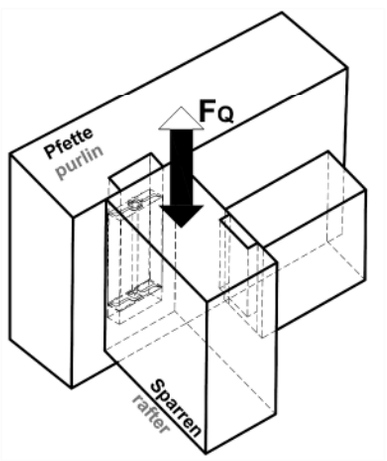


Variant 1 Combination
With large transom depths over 190 mm, the required connector (with standard fastening) is coupled to the inner end of connector TL 131. The VTL 135 pin, adapted to the length of the coupled connector, is hammered into a depth of approx. 2 cm and pushed into its final position by the connection screw.

Variant 2 Shortening TL 221
Additional lengths can be produced by shortening the TL 221 in increments of 18 mm. The screw connection is the same as in variant 1.

TWINLOC connector for wooden roof constructions

GUTMANN TWINLOC may be used for wooden roof constructions as well: TWINLOC connects rafters and purlins with a wood face width of 50 to 80 mm. Please consult the “Technical Datasheet Statics” or the General Building Inspectorate Approval for load-bearing capacities and statical testing.

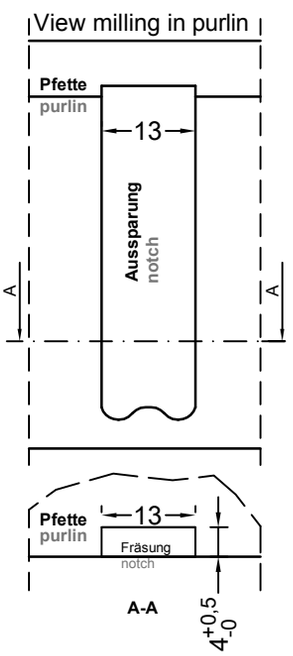


TWINLOC: Selection of connectors for wooden roof constructions

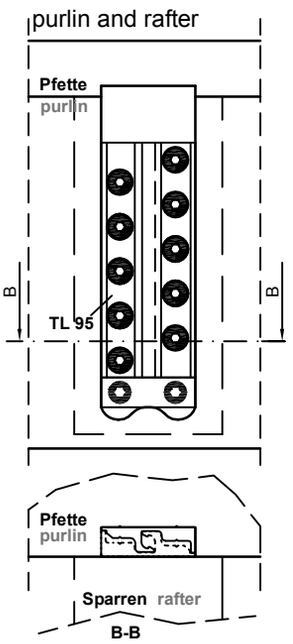
	Connector type	Min. rafter height for 20° roof incline, approx.: (1)	Load bearing capacity FQ (2)	
			Standard	Heavy-duty
	TL 41	80 mm	342 kg	342 kg
	TL 59	100 mm	514 kg	514 kg
	TL 77	120 mm	514 kg	686 kg
	TL 95	135 mm	514 kg	858 kg
	TL 131	170 mm	686 kg	1202 kg
	TL 221	170 mm	686 kg	1202 kg

(1) Larger rafter heights are obtained by linking connectors (see information about vertical curtain walls). The rafter must be dimensioned separately depending on the load.
(2) Maximum load-bearing capacity Fq is specified as maximum bearing capacity of a rafter with two identical connectors for the load direction along the connector axis for apparent wood densities.
>= 430 kg/m³

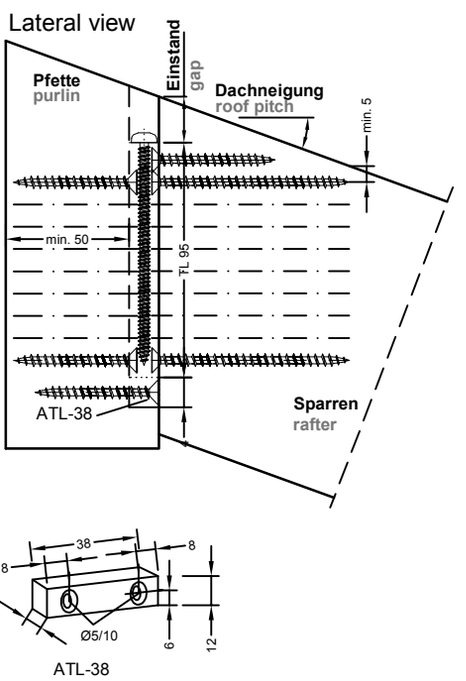
View milling in purlin



View connector in purlin and rafter



Lateral view



ATL-38

Milling

Use a commercial hand router (cutter diameter 14 mm, guide ring diameter 24 mm) and the TWINLOC template to mill a recess 12 to 12.5 mm deep. Angle and flat stoppers can be replaced as required on the base plate. Usually, a recess is created in the purlin (the continuous part).

Rafter drilling

The screw positions are predrilled using a template with ø 3 mm at the end of the rafter to facilitate exact positioning of the connectors.

Screwing the connectors together

The connectors are screwed together either as standard or heavy-duty screw joints exactly as described for vertical curtain walls.

Assembly of the wood joint

After fastening the bracket ATL-38, the rafter (trimming) is pushed in from the top or hooked in from the side and then driven in with a greased connecting bolt. This creates a highly stressable connection, which may be disconnected again if necessary.

Determining the required TWINLOC connectors for application in wooden roof structures

(in accordance with the new DIN 1055, valid for German planning and building laws since January 2007)

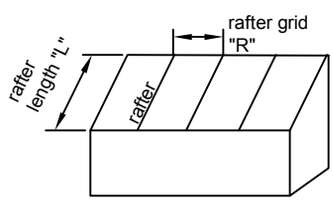
The tables are only suitable for preliminary static computations. They do not replace static calculations from a structural engineer.

Prerequisites for using the tables:

- Connectors are installed in accordance with manufacturer specifications and approval.
- There is a distinction between standard and heavy-duty screws joints (S-TL).
- The assumed loads and field of application are checked and followed or undercut by the handler.
- The winter garden is considered a closed structure because open structures may be subject to higher wind loads.
- Height offsets and superstructural parts, which cause snow drifts and slides from a higher roof, must be accounted for separately. The maximum ridge height is 6 m from ground level.
- The roof structure may only be treaded on for cleaning purposes.
- The tables are based on the following values:

Maximum load-bearing capacity:	based on TWINLOC Approval no. 9.1-682
Glass load:	35 kg/m² for 14 mm total glass thickness
Roof incline:	15° to 30°
Wood quality:	GL 24 (E-module = 11600 N/mm²)
Snow load “si” on the roof:	si = sk x 0.8 (indicated in standard snow load = "sk“) The local building authorities will provide the snow load “sk” values if necessary.
Wind load:	q = 0.65 kN/m² - wind zones (installation under 10 m)

- The minimum rafter width is 50 mm.
- In addition, the connector length must be adapted to the rafter height for construction. This often leads to different solutions because the tables only indicate the smallest admissible connector.



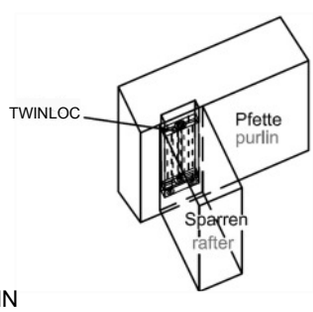


Table 1: “Selection of TWINLOC connectors for snow loads si = 0.75 kN/m², sk = 0.9375 kN/m²“
valid in: Zone 1 up to 550 m above NN, zone 1a up to 450 m above NN, zone 2 up to 310 m above NN
“S-TL” - heavy-duty screw joint, “TL” - standard screw joint

Rafter grid "R"	Smallest connector for snow load si = 0.75 kN/m² for rafter length "L" (cm):							
	150 cm	200 cm	250 cm	300 cm	350 cm	400 cm	450 cm	500 cm
60 cm	TL 41	TL 41	TL 41	TL 41	TL 41	TL 59	TL 59	TL 59
80 cm	TL 41	TL 41	TL 41	TL 59	TL 59	TL 59	TL 131 S-TL 77	TL 131 S-TL 77
100 cm	TL 41	TL 41	TL 59	TL 59	TL 131 S-TL 77	TL 131 S-TL 77	S-TL 95 S-TL 131	S-TL 95 S-TL 131

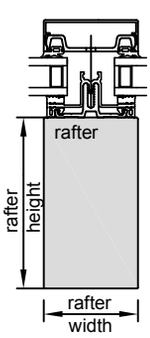


Table 2: “Selection of TWINLOC connectors for snow loads si = 1.25 kN/m², sk = 1.56 kN/m²“
valid in: Zone 1 up to 795 m above NN, zone 1a up to 680 m above NN, zone 2 up to 490 m above NN
Zone 2a up to 405 m above NN, zone 3 up to 360 m above NN.
“S-TL” - heavy-duty screw joint, “TL” - standard screw joint

Rafter grid "R"	Smallest connector for snow load si = 1.25 kN/m² for rafter length "L" (cm):							
	150 cm	200 cm	250 cm	300 cm	350 cm	400 cm	450 cm	500 cm
60 cm	TL 41	TL 41	TL 41	TL 59	TL 59	TL 59	TL 131 S-TL 77	TL 131 S-TL 77
80 cm	TL 41	TL 41	TL 59	TL 59	TL 131 S-TL77	TL 131 S-TL 77	TL 95 S-TL 77	TL 95 S-TL 77
100 cm	TL 41	TL 59	TL 131 S-TL 77	TL 131 S-TL 77	TL 95 S-TL 131	TL 95 S-TL 131	S-TL 131	S-TL 131