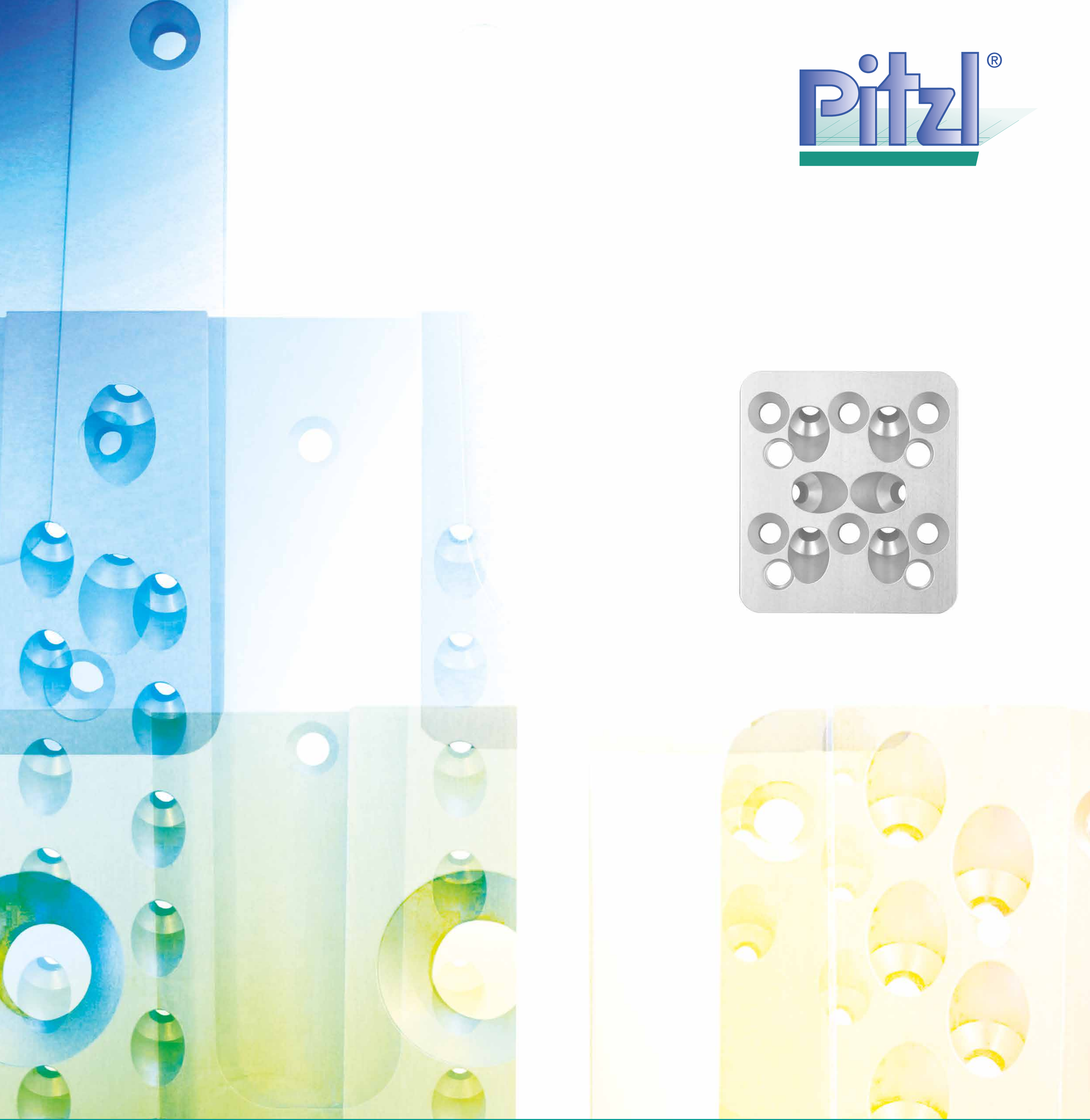


ISO-CONNECT

The connector for additional connections on thermally insulated timber facades.

Innovative timber connection systems for highest requirements.

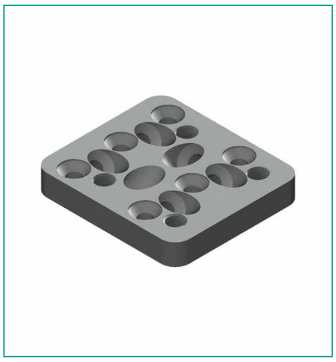
ETA-10/0413 ETA-15/0187

Pitzl Metallbau GmbH & Co. KG DIN EN 1090-2

ISO-CONNECT

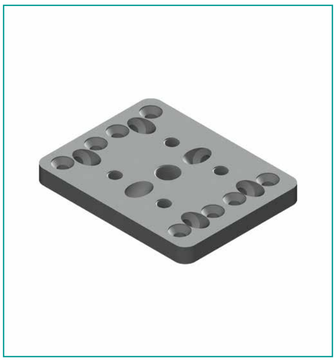
The ISO-CONNECT system offers, due to the combination of tension and compression screws perpendicular to the facade and inclined screws to transfer shear loads, a connection point on thermally insulated facades of timber constructions. Areas of application are for example purlins, rafters, french balconies etc. . The compatibility with the HVP connector system extends the applications of the ISO-CONNECT. So also a direct connection of beams to the facade is possible. As a further option, the connection concept offers the possibility to mount purlin with threaded rods directly to the ISO-CONNECT and the facade.

The ISO-CONNECT can be mounted on solid timber, glulam and cross laminated timber.



83100.0___

83200.0___



83300.0___

Item no.	Description	Dimension B x H x D [mm]	Threaded hole		
			M8	M12	M20
83100.0___	Connection to HVP 88210.3000	90 x 100 x 15	-	4	-
83200.0___	Connection to french balcony	Ø 80 x 15	4	1	-
83300.0___	Universal connection threaded rod M20	120 x 155 x 15	4	-	1

The ISO-CONNECT is only available as a set with the appropriate screws. The insulation thickness must be specified for this reason.
Example for insulation 160 mm: 83100.0160

Product information

The ISO-CONNECT connection plates may only be used in combination with the including screws with countersunk head.

The deformation of the rubber mat (3 mm thick) included in the scope of delivery indicates the contact pressure of the connection plate. In addition, this ensures a reliable effect of the seal, as three-flank adhesion of the adhesive and sealant is avoided.

Scope of delivery: Connection plate, rubber mat and suitable screws for your insulation.
Universal connection is supplied with matching steel pressure plate.

Assembling

1. Positioning of the connector and optionally the rubber mat
2. Fix the connector plate first with the screws perpendicular (horizontal) to the facade until contact to the facade surface is reached. If using the rubber mat screw in until low deformations are reached.
3. Screw in inclined screws.
4. Installation of the balcony railing, the HVP connector or the counter plate of the universal connector.
5. The gap between ISO-CONNECT and the facade should be filled with silicone (acetic-free).

Calculation

The acting forces are devided into tension and compression stresses, are transfered with screws through the insulation into the timber construction. The load distribution and the stress on the screws are shown below for each connector version.

The load carrying capacity depends first on the withdrawal parameter and the tensile strength of the Fischer Power-Fast screws. And second on the compression strength (=withdrawal parameter of the effective point side penetration length of the threaded part in timber) and the buckling load capacity in the area of the free screw length in the thermal insulation.

Provide evidence: Load carrying-capacity of the screws > stress of the screws

Load carrying-capacity of the tension screws

Withdrawal capacity for screws in solid timber according to ETA ETA-11/0027: $F_{ax,k} = n_{ef} \cdot k_{ax} \cdot f_{ax,k} \cdot d \cdot l_{ef,t} \cdot \left(\frac{\rho_k}{350}\right)^{0,8}$	Values for d = 8 mm : α: screw axis - grain direction $k_{ax} = 1,0$ $f_{ax,k} = 10\ N/mm^2$ l_{ef}: effective point side penetration length of the threaded part ρ_k: characteristic density of the timber $n_{ef} = n^{0,9}$
Characteristic tensile strength: $f_{\text{tens,k}}$	$f_{\text{tens,k}} = 19{,}1\ \text{kN}$ for stainless steel screws: $f_{\text{tens,k}} = 13{,}0\ \text{kN}$
Criterium: $F_{ax,t,Rd} = min\begin{cases} F_{ax,\text{a,Rk}} \cdot k_{mod}/\gamma_m \\ f_{tens,k}/\gamma_{m2} \end{cases}$	

Stability and load carrying capacity of the compression screws

Stability of the screw: $I_s = \pi/64 \cdot d_s^4$ $N_{pl,k} = \pi \cdot d_s^2/4 \cdot f_{yk}$ $s_k = \beta \cdot l_f$ $N_{ki,k} = \pi^2/(s_k^2) \cdot E_s \cdot I_s$ $\lambda'_k = \sqrt{N_{pl,k}/N_{ki,k}}$ $k = 0{,}5 \cdot (1 + \alpha \cdot (\lambda'_k - \lambda_0) + {\lambda'_k}^2$ $\kappa_c = \begin{cases} 1 & f\ddot{u}r\ \lambda'_k < 0{,}2 \\ 1/(k + \sqrt{k^2 - {\lambda'_k}^2} & f\ddot{u}r\ \lambda'_k \geq 0{,}2 \end{cases}$ $F_{ki,Rk} = \kappa_c \cdot N_{pl,k}$	$d_s = 5{,}9$ mm $f_{yk} = 1000\ N/mm^2$ for carbon steel $f_{yk} = 500\ N/mm^2$ for stainless steel $\beta = 0{,}7$ (Screw with fixed support at one end) l_f = free screw length (from the wood to the screw head) $E_s = 210000\ N/mm^2$ for screws made of carbon steel $E_s = 160000\ N/mm^2$ for screws made of stainless steel $\lambda_0 = 0{,}2$ $\alpha = 0{,}49$
Withdrawal parameter: See withdrawal capacity of the tension screw	
Criterium: $F_{ax,c,Rd} = min\begin{cases} F_{ax,k} \cdot k_{mod}/\gamma_m \\ n_{ef} \cdot F_{ki,Rk}/\gamma_{m1} \end{cases}$	n: number of compression screws $n_{ef} = n^{0,9}$

The tables below gives an overview about the load carrying capacity for single screws according to the given equations. Values for timber elements with an characteristic density of ρ_k = 350 kg/m³ an carbon steel screws.

Characteristic withdrawal parameter $F_{ax,k}$	
l_{ef}	α = 45° / 90°
mm	kN
40	3,20
45	3,60
50	4,00
55	4,40
60	4,80
65	5,20
70	5,60
75	6,00
80	6,40
85	6,80
90	7,20
95	7,60
100	8,00
$F_{ax,d} = k_{mod} \cdot F_{ax,k} / \gamma_m$	

Characteristic buckling capacity $F_{ki,k}$			
l_f	$F_{ki,k}$	l_f	$F_{ki,k}$
mm	kN	mm	kN
60	21,1	160	7,3
65	20,2	165	6,9
70	19,3	170	6,6
75	18,4	175	6,3
80	17,5	180	6,0
85	16,6	185	5,7
90	15,8	190	5,5
95	14,9	195	5,2
100	14,1	200	5,0
105	13,3	205	4,8
110	12,6	210	4,6
115	11,9	215	4,4
120	11,2	220	4,2
125	10,6	225	4,1
130	10,0	230	3,9
135	9,5	235	3,8
140	9,0	240	3,6
145	8,5	245	3,5
150	8,1	250	3,4
155	7,6		
l_f: free screw length			
$F_{ki,d} = F_{ax,k} / \gamma_{m1}$	$\gamma_{m1} = 1,1$		

Minimum edge and end distances for screws

Values for screws with d= 8mm

Solid timber and glulam:

Distance to the stressed end of the center of gravity of the threaded part of the screw in the timber: $a_{3,c} = 9 \cdot d = 72$ mm

Edge distance of the center of gravity of the threaded part of the screw in the timber: $a_{4,c} = 4 \cdot d = 32$ mm

Cross lamintated timber, screws used in the plane surface:

Distance to the unstressed end grain of the center of gravity of the threaded part of the screw in the timber: $a_{3,c} = 6 \cdot d = 48$ mm

Distance to the stressed end grain of the center of gravity of the threaded part of the screw in the timber: $a_{3,t} = 6 \cdot d = 48$ mm

Distance to the unstressed edge of the center of gravity of the threaded part of the screw in the timber: $a_{4,c} = 2,5 \cdot d = 20$ mm

Distance to the stressed edge of the center of gravity of the threaded part of the screw in the timber: $a_{4,t} = 6 \cdot d = 48$ mm

ISO-CONNECT - fixing french balcony

The french-balcony is fixed to the façade with a total of four ISO-CONNECT connections. Thereby the ISO-Connectors are situated left and right of the doorway and the french-balcony is fixed with M12 bolts.
Due to the support at four points, no eccentricity of the force F_1 must be taken into account.

Dimension of the coupling plate: Ø 80 x 15 mm
Inclined screws: 2 x Ø 8 mm
Horizontal screws: 2 x Ø 8 mm

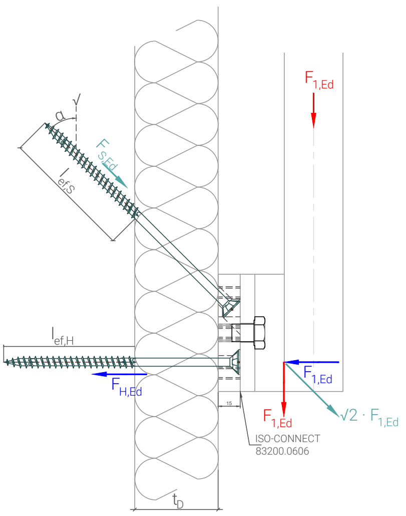
Note: The compression plate is already mounted at the french-balcony

Stress on the screws depending on the acting loads

$F_{s,Ed}$: Stress on the inclined screws

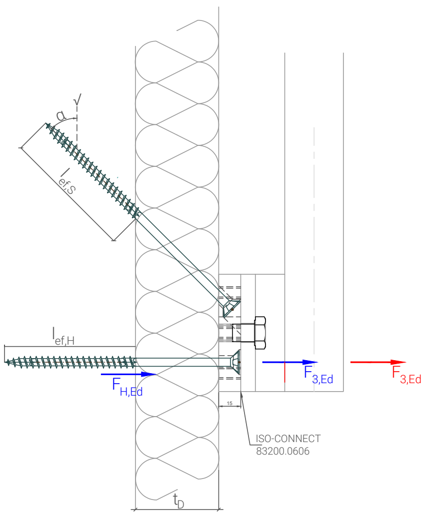
$F_{H,Ed}$: Stress on the horizontal screws

Direction F_1



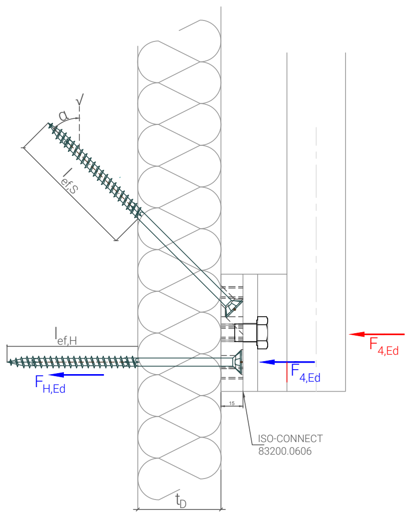
Stress on the screw
$F_{s,Ed} = \sqrt{2} \cdot F_{1,Ed}$ (Tension)
$F_{H,Ed} = F_{1,Ed}$ (Compression)

Direction F_3



Stress on the screw
$F_{H,Ed} = F_{3,Ed}$ (Tension)

Direction F_4



Stress on the screw
$F_{H,Ed} = F_{4,Ed}$ (Compression)

Design values of the load carrying-capacity

The tables are calculated with the given calculation model.

Version	Thickness of the insulation	Horizontal screw Ø 8		Inclined and sideward screws Ø 8		Design load carrying-capacity		
		Length	threaded part in timber	Length	threaded part in timber	k_{mod} = 0,9		
	t_D	l_h	$l_{ef,h}$	l_s	$l_{ef,s}$	$F_{1,Rd}$	$F_{3,Rd}$	$F_{4,Rd}$
	mm	mm	mm	mm	mm	kN	kN	kN
Insulation 60	60	160	75	220	100	7,3	7,8	7,8
Insulation 80	80	180	75	260	100	7,3	7,8	7,8
Insulation 100	100	220	95	280	100	5,7	5,7	5,7
Insulation 120	120	240	95	320	100	7,3	9,8	9,8
Insulation 140	140	260	95	340	100	7,3	9,8	9,8
Insulation 160	160	280	95	380	100	7,3	9,8	9,8
Insulation 180	180	300	95	400	100	7,3	9,8	8,7
Insulation 200	200	320	95	400	82	6,0	9,8	7,4
Insulation 220	220	340	95	400	54	3,9	9,8	6,3

The values are valid when using carbon screws and the following compostion: 15 mm Iso-Connect plate, 3 mm rubber panel, 5 mm plaster and thermal insulation

The penetration length of the threaded part of the horizontal partial threaded screw must be at least the effective threaded length but maximum 5 mm longer.

For combined stresses in direction F1 and F4 - direction, the forces resulting from the acting forces must be assigned to the screws and summed up.
The distribution of forces can be seen in the previous figures.

ISO CONNECT – fixing HVP 88210.3000

The HVP 88210.3000 is connected to the ISO-CONNECT with four M12. Due to the thickness of the HVP-connector the rafter has a distance of 18 mm to the ISO-CONNECT. This eccentricity must be taken into account.

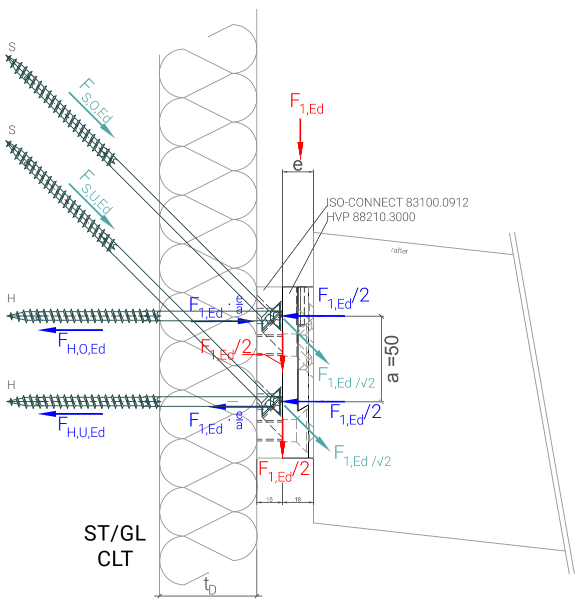
Dimension coupling plate: 90 x 100 x 15 mm
Inclined screws: 6 x Ø 8 mm
Horizontal screws: 6 x Ø 8 mm

Note: The HVP connector 88210.3000 is used as pressure plate.

Stress on the screws depending on the acting loads

$F_{s,o,Ed}$: Stress on the upper inclined screws
$F_{H,o,Ed}$: Stress on the upper horizontal screws
$F_{s,u,Ed}$: Stress on the bottom inclined screw
$F_{H,u,Ed}$: Stress on the bottom horizontal screw

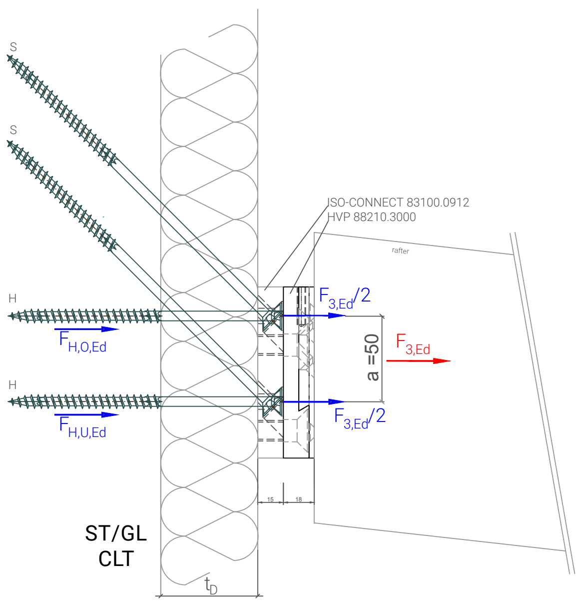
Direction F_1



Stress on the screw

$F_{S,O,Ed} = F_{S,U,Ed} = F_{1,Ed}/\sqrt{2}$ (Tension)
$F_{H,O,Ed} = F_{1,Ed}/2 - F_{1,Ed} \cdot \frac{e}{a}$ (Compression)
$F_{H,U,Ed} = F_{1,Ed}/2 + F_{1,Ed} \cdot \frac{e}{a}$ (Compression)

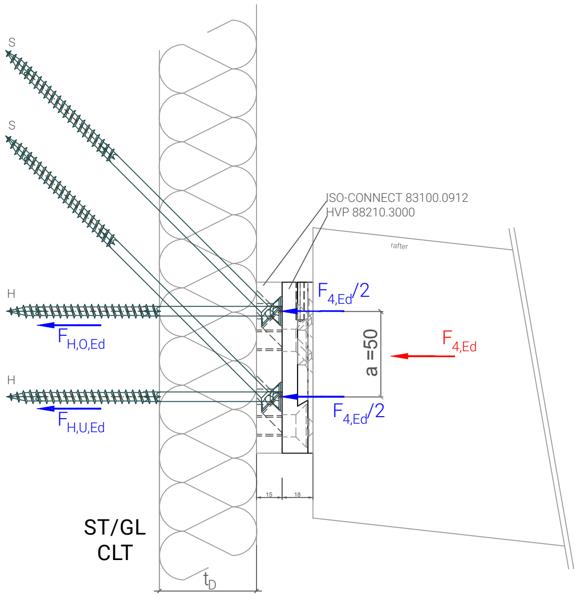
Direction F_3



Stress on the screw

$F_{H,O,Ed} = F_{H,U,Ed} = F_{3,Ed}/2$ (Tension)

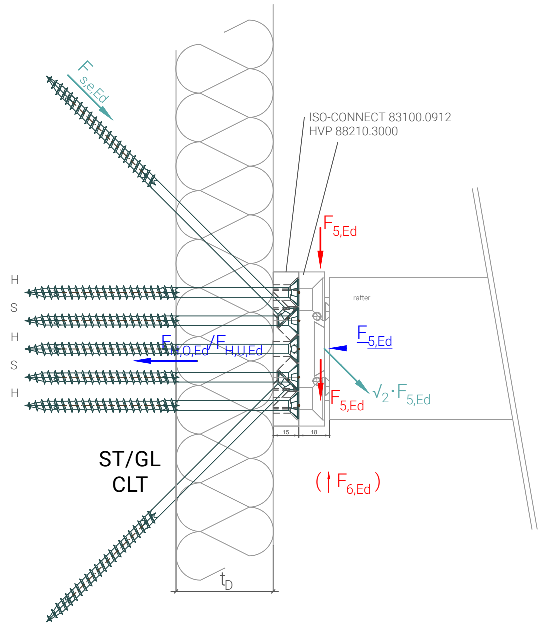
Direction F_4



Stress on the screw

$F_{H,O,Ed} = F_{H,U,Ed} = F_{4,Ed}/2$ (Compression)

Direction F_5 | F_6



Stress on the screw

$F_{se,Ed} = \sqrt{2} \cdot F_{5,Ed}$ (Tension)
$F_{H,O,Ed} = F_{H,U,Ed} = F_{5,Ed}/2$ (Compression)

Design values of the load carrying-capacity

The tables are calculated with the given calculation model.
The ccentricity is assumed with e = 18 mm.

Version	Thickness insulation	Horizontal screw Ø 8		Inclined and sideward screws Ø8		Design load carrying-capacity			
		length	threaded part in timber	length	threaded part in timber	k_{mod} = 0,9; e = 18 mm			
	t_D	l_h	$l_{ef,h}$	l_s	$l_{ef,s}$	$F_{1,Rd}$	$F_{3,Rd}$	$F_{4,Rd}$	$F_{5/6,Rd}$
	mm	mm	mm	mm	mm	kN	kN	kN	kN
Insulation 60	60	160	75	220	100	13,0	22,4	22,4	3,9
Insulation 80	80	180	75	260	100	13,0	22,4	22,4	3,9
Insulation 100	100	220	95	280	100	14,6	28,4	28,4	3,9
Insulation 120	120	240	95	320	100	14,6	28,4	28,4	3,9
Insulation 140	140	260	95	340	100	14,6	28,4	28,4	3,9
Insulation 160	160	280	95	380	100	14,6	28,4	28,4	3,9
Insulation 180	180	300	95	400	100	14,6	28,4	26,1	3,9
Insulation 200	200	320	95	400	82	12,0	28,4	22,1	3,2
Insulation 220	220	340	95	400	54	7,8	28,4	19,0	2,1

The values are only valid for carbon screws and the following compostion: 15 mm Iso-Connect plate, 3 mm rubber panel, 5 mm plaster and thermal insulation

If l_{ef} is greater than in the table, it is allowed to increase $F_{5/6,Rd}$ with the factor ($l_{ef,neu}/l_{ef}$).

The penetration length of the threaded part of the horizontal partial threaded screw must be at least the effective threaded length but maximum 20 mm longer.

For combined stresses in direction F_1 and F_4 - direction, the forces resulting from the acting forces must be assigned to the screws and summed up.
The distribution of forces can be seen in the previous figures.

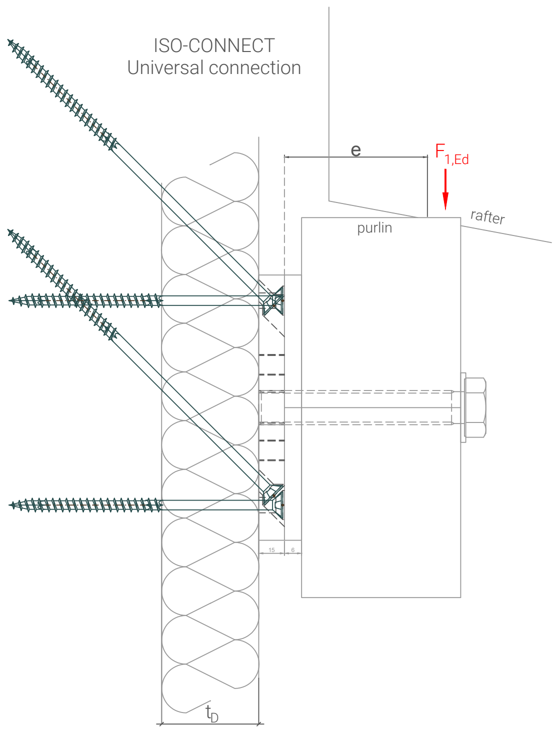
ISO-CONNECT - universal connection

The universal connection system with a greater height and additional compression screws is optimized for higher forces and eccentricity, to connect for example purlins. The connection is realized with a M20 bolt.

Dimension coupling plate: 120 x 155 x 15 mm
Inclined screws: 6 x Ø 8 mm
Horizontal screws: 8 x Ø 8 mm

Note: The compression plate is included in shipment.

Calculation
The load distribution is similar to the HVP connection. The additional eccentricity has to be taken into account.



Design values of the load carrying-capacity
The tables are calculated with the presented calculation model.
The maximum capacity is defined with the bolt-timber connection.
The load carrying-capacity are calculated for different purlin dimensions.

Bearing capacity M20 bolts - thick steel plate in single shear							
Thickness of the purlin	mm	60	80	100	120	140	160
Characteristic value	kN	9,05	12,06	15,08	18,09	21,11	22,41
Design value for k_{mod} = 0,9	kN	7,40	9,87	12,33	14,80	17,27	18,33

Version	Thickness insulation	Horizontal screw Ø 8		Inclined and side-ward screws Ø8		Design load carrying-capacity k_{mod} = 0,9						
		Length	threaded part in timber	Length	threaded part in timber	e = 40 mm	e = 60 mm	e = 80 mm	e = 100 mm	no influence of eccentricity		
	t_D	l_h	$l_{ef,h}$	l_s	$l_{ef,s}$	$F_{1,Rd}$	$F_{1,Rd}$	$F_{1,Rd}$	$F_{1,Rd}$	$F_{3,Rd}$	$F_{4,Rd}$	$F_{5/6,Rd}$
	mm	mm	mm	mm	mm	kN	kN	kN	kN	kN	kN	kN
Insulation 60	60	160	75	220	100	14,59	14,59	12,82	11,22	29,91	29,91	3,91
Insulation 80	80	180	75	260	100	15,62	14,62	12,82	11,22	29,91	29,91	3,92
Insulation 100	100	220	95	280	100	14,62	14,62	14,62	14,21	37,88	37,88	3,92
Insulation 120	120	240	95	320	100	14,62	14,62	14,62	14,21	37,88	37,88	3,92
Insulation 140	140	260	95	340	100	14,62	14,62	14,62	14,21	37,88	37,88	3,92
Insulation 160	160	280	95	380	100	14,62	14,62	14,62	14,21	37,88	37,88	3,92
Insulation 180	180	300	95	400	100	14,62	14,62	14,62	13,04	37,88	34,78	3,92
Insulation 200	200	320	95	400	82	11,96	11,96	11,96	11,07	37,88	29,52	3,20
Insulation 220	220	340	95	400	54	7,82	7,82	7,82	7,82	37,88	25,35	2,10

The values are only valid for carbon screws and the following compostion: 15 mm Iso-Connect plate, 3 mm rubber panel, 5 mm plaster and thermal insulation

If l_{ef} is greater than in the table, it is allowed to increase $F_{5/6,Rd}$ with the factor ($l_{ef,neu}/l_{ef}$).

The penetration length of the threaded part of the horizontal partial threaded screw must be at least the effective threaded length but maximum 5 mm longer.

For combined stresses in direction F_1 and F_4 - direction, the forces resulting from the acting forces must be assigned to the screws and summed up.
The distribution of forces can be seen in the previous figures.

Calculation

Proof of a french-balcony

Situation:
The french balcony is installed with two ISO CONNECTors on the left and right side of the doorway. Decisive for the evidence are the upper connectors, due to the horizontal railing forces. The screws are screwed in in a CLT-element with a thickness of 100 mm through the thermal insulation with 200 mm.

For the system solution the version "Insulation 200" is chosen. Horizontal screws: 8 x 300 partial threaded, threaded part 100 mm; Inclined screws: 8 x 380 partial threaded, threaded part 80 mm

Load assumption:
Death weight balcony : g_k = 0,4 kN/m
Horizontal load: h_k = 1,0 kN/m
Vertical load: v_k = 1,0 kN/m

Length of balcony railing: 1,00 m

Stresses on the connector:
$F_{1,Ed}$ = (1,35 * 0,4 + 1,5 * 1,0) * 1,0/2 = 1,02 kN
$F_{3,Ed}$ = $F_{4,Ed}$ = 1,5 * 1,0 *1,0/2 = 0,75 kN

Proof direction F_1 with table values:
Insulation 200: $F_{1,Rd}$ = 6,0 kN
Proof: 1,02/6,0 = 0,17 < 1,0

Proof direction F_3 and F_4 with table values:
Due to the low values the combined proof is not shown.
Insulation 200: $F_{4,Rd}$ = 7,4 kN
Proof: 0,75/7,4 = 0,10 < 1,0

Proof rafter connection with HVP

Situation:
Installation of a 5 m wide canopy (projecting roof) on an existing building with a CLT-wall structure with a thickness of 100 mm and a thermal insulation of 140 mm. The rafters have a center distance of 800 mm.

For the system solution the version "insulation 140" is selected. Horizontal screws: 8 x 240 partial threaded, threaded part 100 mm; Inclined and sideward screws: 8 x 320 partial threaded, threaded part 120 mm

Load assumption:
Death weight roof: g_k = 0,5 kN/m²
Snow load: s_k = 1,3 kN/m²
Wind load : w_k = (0,8 + 0,5) * 0,65 = 0,85 kN/m²

Stresses on the connector:
$F_{1,Ed}$ = (1,35 * 0,5 + 1,5 * 1,3) * 5/2 * 0,8 = 5,25 kN
$F_{5/6,Ed}$ = 0,85 * 0,4 * 5/2 = 0,85 kN

Proof direction F_1 with table values:
Insulation 140: $F_{1,Rd}$ = 14,6 kN
Proof: 5,25/14,6 = 0,36 < 1,0

Proof direction $F_{5/6}$ with table values:
Insulation 140: $F_{5/6,Rd}$ = 3,9 kN
Proof: 0,85/3,9 = 0,22 < 1,0

Proof purlin connection with universal connector

Situation:
Installation of a 5 m wide canopy (projecting roof) on an existing building with a CLT-wall structure with a thickness of 100 mm and a thermal insulation of 140 mm. The rafters are supported on a purlin with 120/160 mm, which is fixed with the universal connector to the facade.

Load assumption:
Dead weight roof: g_k = 0,5 kN/m²
Snow load: s_k = 1,3 kN/m²

Stress on the connector:
$F_{1,Ed}$ = (1,35 * 0,5 + 1,5 * 1,3) * 5/2 = 6,56 kN/m

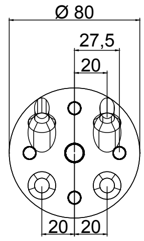
Bearing capacity of the connector with e = 80 mm:
Insulation 140: $F_{1,Rd}$ = 14,6 kN (maßgebend)
maximum load capacity due to bolts (s.table): $F_{1,Rd,max}$ = 14,8 kN

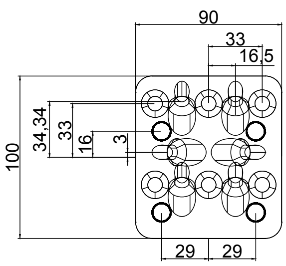
Maximum spacing of the ISO-CONNECT: e = 14,6/6,56 = 2,23 m

The distance is chosen with 2,0 m.

Drawings of the coupling plate

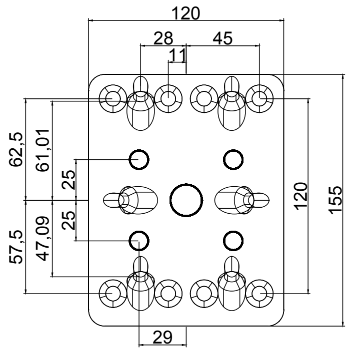
Coupling plate: 83200
Connection french balcony Ø 80 x 15 mm
- 2 bore holes 9 mm, counter-sunk
- 2 bore holes 9 mm, 45°, counter-sunk
- 1 threaded hole Ø 12 mm
- 4 threaded holes Ø 8 mm

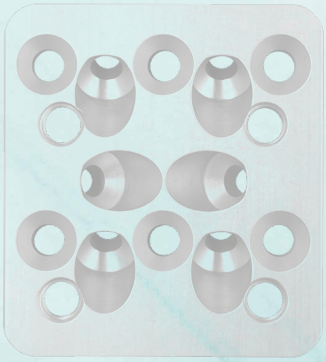




Coupling plate: 83100
Connection FL 90 x 100 x 15 mm, aluminium
- 6 bore holes 9 mm, counter-sunk
- 6 bore holes 9 mm, 45°, counter-sunk
- 4 threaded holes Ø 12 mm

Coupling plate: 83300
Universal connection 120 x 155 x 15 mm
- 8 bore holes 9 mm, counter-sunk
- 6 bore holes 9 mm, 45°, counter-sunk
- 1 threaded hole Ø 20 mm
- 4 threaded holes Ø 8 mm





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