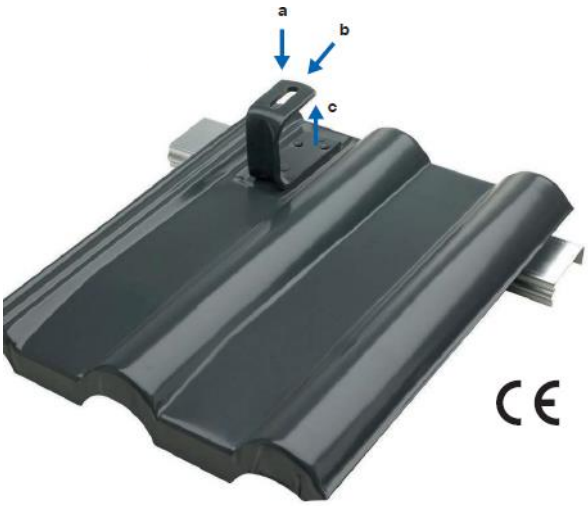
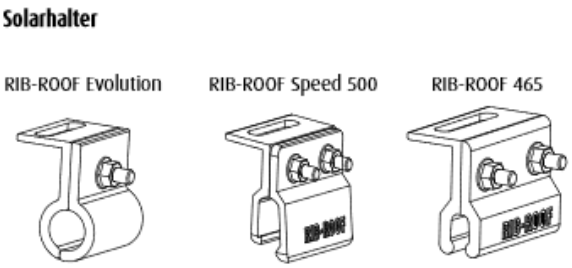
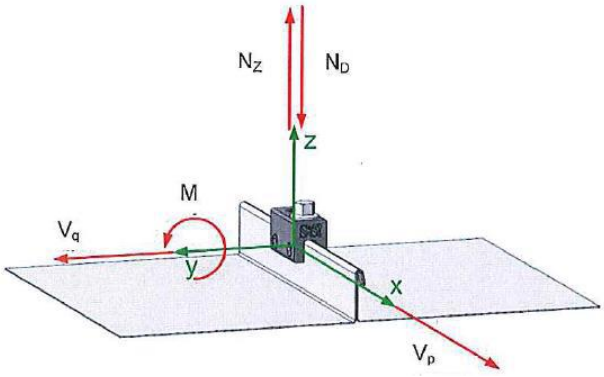
Solar systems of Schweizer:

Planning of PV pitched roof systems with customer delivered fasteners and components of the PV mounting system MSP with SPT from Schweizer.







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Planning of PV pitched roof systems with customer delivered fasteners and components of the PV mounting system MSP with SPT from Schweizer.

Content

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1 PV mounting system MSP-PR from Schweizer

The PV mounting system MSP-PR is designed for use on pitched roofs. A roof hook system made of aluminium with a sophisticated click fastening, supplemented by classic roof hooks made of stainless steel and hanger bolts, which secure the anchoring of the support structure in the roof. The supporting profiles are fastened with the prefabricated clamps in a single layer or in a cross connection.

Combination of MSP-PR with customer delivered fasteners

The MSP-PR-HBP adapter plate (Art. No. 2065896) is available for combining customer delivered fasteners with the MSP mounting system. Depending on the customer delivered fastener, the additional fasteners (e.g. screws, nuts) must also be provided by the customer.

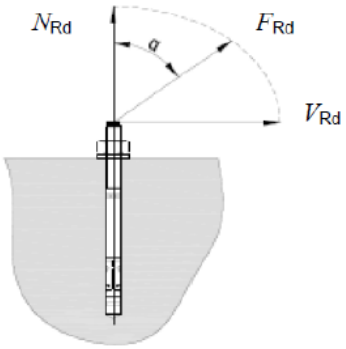
Information on strength values of customer delivered fasteners

In admissions, characteristic values are usually given, which are converted to design values via a partial safety factor γ_M.

Suppliers' data sheets often contain incomplete information that cannot be used for structural calculations.

Data referring to pressure under an angle must be converted into the components pressure and shear force. Example according to ÖNORM M 7778.

$$F_{Rd} = \left[\left(\frac{\cos a}{N_{Rd}} \right)^{1,5} + \left(\frac{\sin a}{V_{Rd}} \right)^{1,5} \right]^{-\frac{2}{3}}$$



In the following catalogue, tables with load-bearing capacity values are provided and instructions on how to handle the values are given.

Interaction with simultaneously acting load directions

1. As standard in SPT, no interaction is calculated, i.e. pressure and shear force may be fully utilised at the same time.
2. With some fasteners, the "linear interaction" between pressure and shear force is applied, i.e. (utilisation of pressure) + (utilisation of shear force) ≤ 100%.
3. Another variant is the quadratic interaction: (utilisation pressure)^2 + (utilisation shear force)^2 ≤ 100%.

With the SPT in-house licence at Schweizer, these interaction conditions can be applied. With the standard SPT customer licence, calculations are always made without interaction. Accordingly only load capacities may be used which are valid independently of other force directions acting simultaneously.

Note: If interaction is required, please contact the indoor service for the design (msp@ernstschweizer.solar).

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2 Planning in SPT from Schweizer

1. Selection of roof covering and substructure according to local conditions.
2. Selection of fastening system: "roof hooks / fastening element on site - without interaction" *
3. Connection components: "Adapter plate MSP-PR-HBP" or "without connection".
4. Installation system: All options are available. The planner must assess what is technically possible.
5. Enter the design values for pressure, tension and shear force according to the supplier's specifications or table values. The values listed below are taken from the data sheets or approvals of the respective manufacturers and are not guaranteed to be correct or applicable.

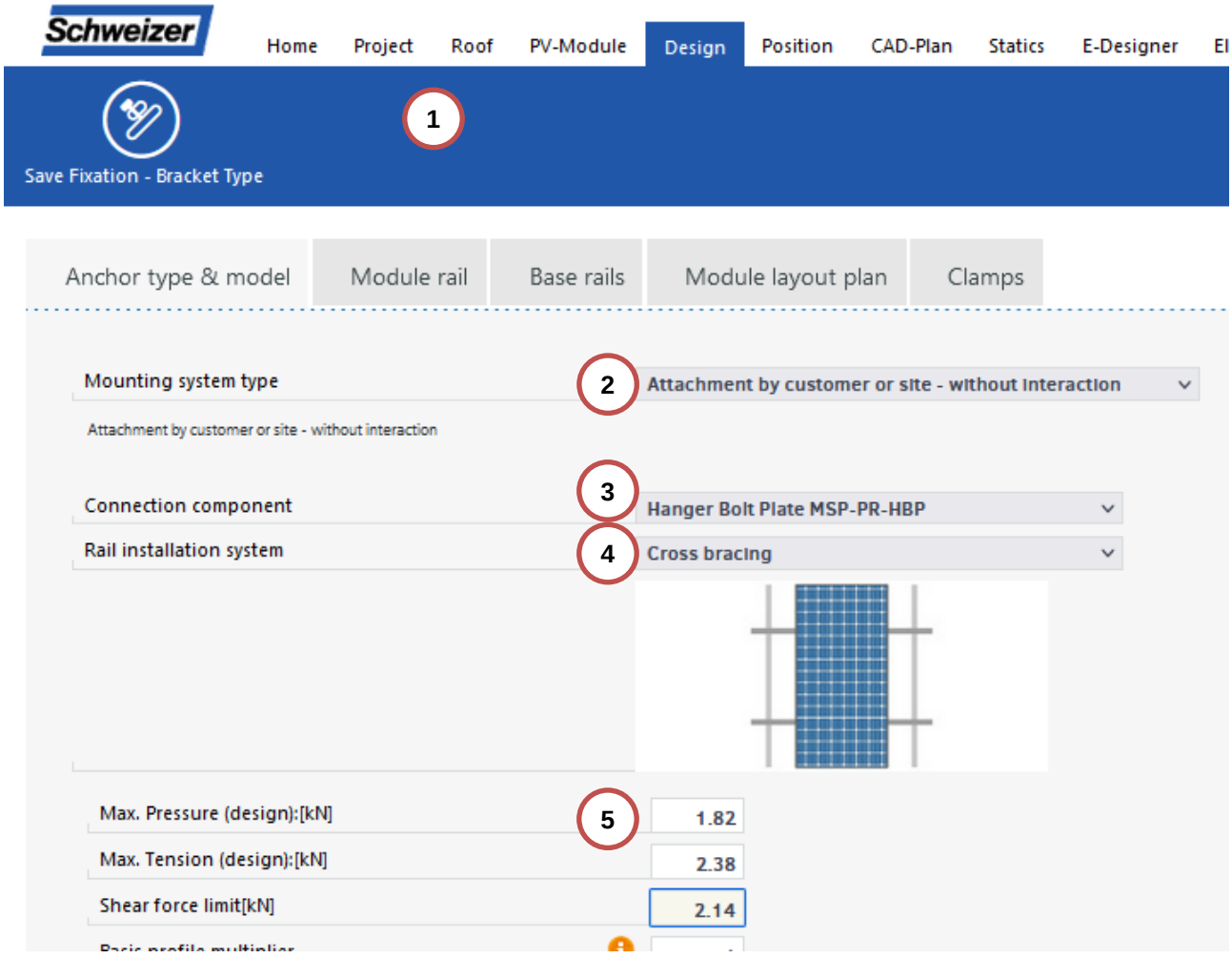

Figure 1: Selection of parameters for customer delivered fasteners

*) "without interaction": for the load-bearing capacity pressure and shear force, limit values are to be entered which may act fully at the same time.

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3 Products

3.1 Manufacturer / supplier: Otto Lehmann GmbH, D-93070 Neutraubling

Product name: Lehmann **“**Aufdachmodulhalter 7300” riveted to metal roof tiles

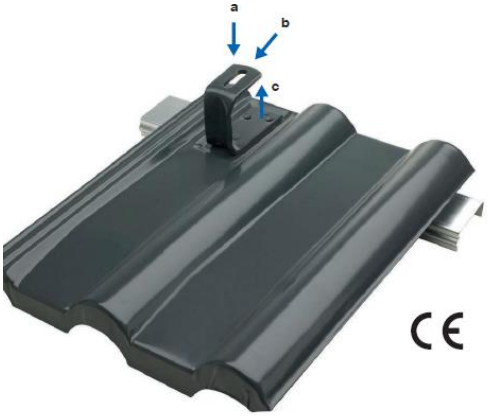

Figure 2: Lehmann «Aufdachmodulhalter»

Utilisation in SPT: Select the design values from Table 1 according to the roof pitch.
Interaction condition: "without interaction”.

Table 1: Design values of the load-bearing capacity

Force angle	Pressure	Suction	Shear force
0°	3.61 kN	2.16 kN	0.00 kN
5°	3.35 kN	2.16 kN	0.29 kN
10°	2.97 kN	2.16 kN	0.52 kN
15°	2.59 kN	2.16 kN	0.70 kN
20°	2.26 kN	2.16 kN	0.82 kN
25°	1.97 kN	2.16 kN	0.92 kN
30°	1.72 kN	2.16 kN	1.00 kN
35°	1.51 kN	2.16 kN	1.05 kN
40°	1.31 kN	2.16 kN	1.10 kN
45°	1.14 kN	2.16 kN	1.14 kN
50°	0.98 kN	2.16 kN	1.17 kN
55°	0.84 kN	2.16 kN	1.20 kN
60°	0.71 kN	2.16 kN	1.22 kN
65°	0.58 kN	2.16 kN	1.24 kN
70°	0.46 kN	2.16 kN	1.26 kN
75°	0.34 kN	2.16 kN	1.27 kN

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3.2 Manufacturer / supplier: Zambelli RIB-ROOF GmbH & Co. KG, Hans-Sachs-Straße 3 + 5, D-94569 Stephansposching

Product name: Standard Solar bracket RIB-ROOF

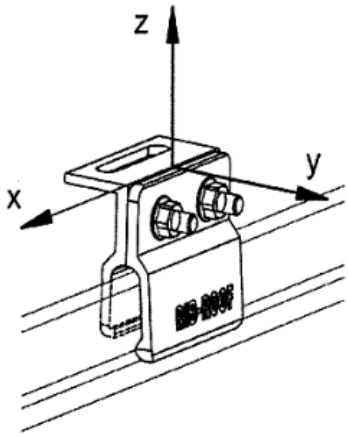

Figure 3: Standard Solar bracket RIB-ROOF

Utilisation in SPT: Determine the design values by dividing the characteristic values for suction, pressure and roof-parallel force (shear force) by partial safety factor $\gamma_M = 1.33$.
The approval Z-14.4-774 contains different characteristic values for different RIB-ROOF systems as well as additional specifications, boundary conditions and interaction formulae. After rough planning, compliance with these must be checked and, if necessary, recalculated with new values.
Interaction condition: "without interaction".

Table 2: Design values of the load-bearing capacity in compliance with all boundary conditions

	Pressure	Suction	Shear force
RIB-ROOF 465 steel 0.63 mm	2.68 kN	1.47 kN	1.18 kN
RIB-ROOF 465 alu 0.70 mm	1.86 kN	1.17 kN	1.12 kN
RIB-ROOF Speed 500 steel 0.63 mm	2.50 kN	1.33 kN	1.18 kN
RIB-ROOF Speed 500 alu 0.70 mm	1.41 kN	0.89 kN	1.67 kN
RIB-ROOF Evolution steel 0.63 mm	2.93 kN	3.32 kN	0.80 kN
RIB-ROOF Evolution alu 0.70 mm	1.56 kN	2.11 kN	0.80 kN

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3.3 Manufacturer / supplier: RoofTech GmbH, Merklinger Straße 30, D-71263 Weil der Stadt

Product name: "S-5! E-Klemme"

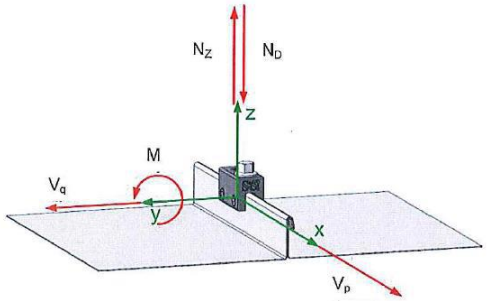

Figure 4: "S-5! E-Klemme"

Utilisation in SPT: Determine the design values by dividing the characteristic values for suction, pressure and roof-parallel force (shear force) by partial safety factor $\gamma_M = 1.33$.
The approval Z-14.4-719 contains different characteristic values for different clamps as well as additional specifications, boundary conditions and interaction formulae. After rough planning, compliance with these must be checked and, if necessary, re-calculated with new values.
In addition, the standing seam profile must be verified according to the respective approvals.
Interaction condition: "without interaction".

Table 3: Design values of the load-bearing capacity under optimal conditions

	Pressure	Suction	Shear force
S-5-E, S-5-E Mini and S-5-E Mini FL	1.17 kN	1.42 kN	0.95 kN
S-5-Z, S-5-Z Mini and S-5-Z Mini FL	1.02 kN	0.86 kN	1.28 kN

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3.4 Manufacturer / supplier: Kalzip GmbH, August-Horch-Straße 20–22, D-56070 Koblenz

Product name: Kalzip mounting clamp type FA and type FS

Figure 5: Kalzip mounting clamp type F

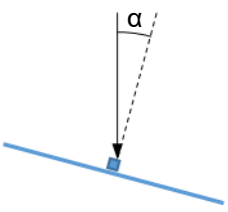
Utilisation in SPT: Determine the design values by dividing the characteristic value of the load-bearing capacity by the partial safety factor $\gamma_M = 1.1$. The same value applies in all directions (suction, pressure, shear force), a linear interaction check is required between simultaneously acting forces.
The approval Z-14.4-560 contains further characteristic values for various clamps as well as numerous specifications, boundary conditions and interaction formulae.
Interaction condition: "linear interaction" (a more detailed procedure is described in the approval).

The load capacity can be determined from Table 4 depending on the sheet thickness t and the clipping distance (distance between the fixing points of the metal sheeting). With this value for the load capacity, the input values can then be determined as a function of the force angle from the tables for the input values. The input values must be interpolated manually depending on the load capacity value.

Table 4: Characteristic values of load-bearing capacity according to Kalzip data sheet

Sheet thickness t	Clipping distance Lk [m]										
[mm]	1.00	1.10	1.20	1.30	1.40	1.50	1.60	1.70	1.80	1.90	2.00
0.80	1.12	1.06	1.02	0.96	0.92	0.86	0.81	0.76	0.71	0.66	0.61
0.90	1.25	1.21	1.16	1.11	1.06	1.02	0.97	0.92	0.87	0.83	0.78
1.00	1.40	1.35	1.29	1.24	1.18	1.13	1.07	1.03	0.97	0.92	0.86
1.20	1.67	1.61	1.55	1.48	1.42	1.35	1.29	1.23	1.16	1.10	1.02

Design values (Input values in SPT)
Pressure = $R_d * \cos(\alpha)$
Suction = R_d
Shere force = $R_d * \sin(\alpha)$



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3.5 Manufacturer / supplier: Ernst Schweizer GmbH. Sonnenstrasse 1. AT-6822 Satteins

Product name: ex Hilti Sheet metal seam clamp

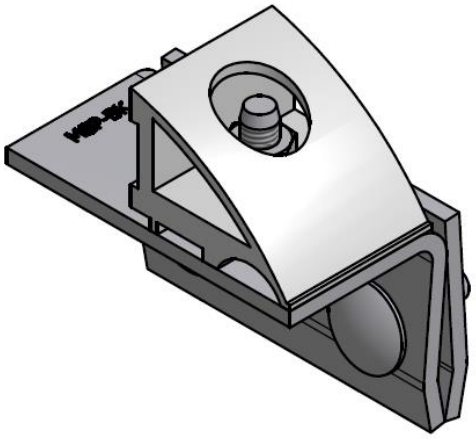

Figure 6: ex Hilti Sheet metal seam clamp

Utilisation in SPT: The tensile tests show that the weak point is in the sheet metal and not in the clamp (test with tensile force > 3 kN). For a design. the values from the approval of comparable sheet metal seam clamps can be used. However. this does not provide a binding static proof; the responsibility lies with the person carrying out the work.

Typical design values for an optimally fastened sheet metal seam roof:

- Max. Max. pressure: 1.0 kN
- Max. Suction: 1.4 kN
- Max. Shear force: 0.9 kN

Interaction condition: "without interaction”.

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