Deutsches Institut für Bautechnik

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Approval body for construction products and types of construction

Bautechnisches Prüfamt

An institution established by the Federal and Laender Governments

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European Technical Assessment

ETA-22/0339 of 12 January 2023

English translation prepared by DIBt - Original version in German language

General Part

Technical Assessment Body issuing the European Technical Assessment:	Deutsches Institut für Bautechnik
Trade name of the construction product	Trigon FS SG
Product family to which the construction product belongs	Insulated glass unit with structural sealant punctually anchored
Manufacturer	HUECK System GmbH & Co. KG Loher Straße 9 58511 Lüdenscheid DEUTSCHLAND
Manufacturing plant	HUECK System GmbH & Co. KG Loher Straße 9 58511 Lüdenscheid DEUTSCHLAND
This European Technical Assessment contains	38 pages including 33 annexes which form an integral part of this assessment
This European Technical Assessment is issued in accordance with Regulation (EU) No 305/2011, on the basis of	EAD 090035-00-0404

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Specific Part

1 Technical description of the product

The product is a system for glass façades with the trade name "Trigon FS SG", consisting of insulating glass elements with structural sealant in the insulating glass edge seal and point-supported fastening. The insulating glass units are fastened punctually to a mullion-transom system. For that purpose, retaining devices (*toggles*), are screwed into the screwing channel of the mullion-transom construction. These toggles grip into a U-profile which is glued into the insulating glass edge. The U-profiles made of stainless steel or aluminium are installed continuously or in pieces with a length of 100 mm in the insulating glass edge towards the inner pane. The outer panes are borne via the structural sealant of the insulating glass edge, the inner pane is held mechanically via retaining devices (Annex 1 to 10).

For the self-weight of the insulating glass unit, aluminium glass supports are fixed to the mullion-transom construction. If necessary, wind protection devices (emergency retainers) made of stainless steel or aluminium may be used.

The insulating glass units may consist of two or three glass panes. The insulating glass units are fixed on at least two opposite sides by the retaining devices. The maximum dimensions of the insulating glass units are 3000 mm x 5000 mm. For the use as barrier against falling down, the insulating glass units are limited to 2500 mm x 3300 mm.

2 Specification of the intended use in accordance with the applicable European Assessment Document

The performances given in Section 3 are only valid if the system "Trigon FS SG" is used in compliance with the manufacturer's specifications and conditions as well as the details specified in the Annexes A to D.

The insulating glass units of the system "Trigon FS SG" are installed in mullion-transom façades. The vertical glazing of the system "Trigon FS SG" may have an inclination of 0° up to 10° from the vertical in direction of the supporting structure (mullion/transom profiles). As horizontal glazing, the insulating glass units of the system "Trigon FS SG" can be executed with angles from more than 10° up to 83° with respect to the vertical.

By using special toggles, polygonal façades can be executed.

The structural bond shall not be permanently subjected to tension.

The use of insulating glass units for the stiffening of other building elements is not intended. The application of insulating glazing with protection against falling down is only suitable for vertical facades.

The mullion and transom profiles as well as the T-connectors and their connection elements are not covered by this European Technical Assessment (ETA).

For use in structures, the following types are differentiated in accordance with EAD 090035-00-0404:

- Type I: Mechanical transfer of the self-weight of the façade element to the glass support and thence to the sub-construction. The structural sealant transfers wind suction loads. Devices (emergency retainers) are used to reduce danger in the event of bond failure.
- Type II: Mechanical transfer of the self-weight of the façade element to the glass support and thence to the sub-construction. The structural sealant transfers wind suction loads. No emergency retainers are used.

The verification and assessment methods on which this ETA is based lead to the assumption of a working life of the system "Trigon FS SG" of at least 25 years. The indications given on the working life cannot be interpreted as a guarantee given by the producer, 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

3.1 Mechanical resistance and stability (BWR 1)

Essential characteristic	Assessment method	Performance
Characteristics of the different glass products	EAD, 2.2.1.1	See Annex A
Structural bonding	EAD, 2.2.1.3	See Annex B
Load-bearing capacity of the glass supports	EAD, 2.2.1.2	See Annex C.1
Load-bearing capacity of the retaining devices (toggles)	EAD, 2.2.1.2	See Annex C.2
Load-bearing capacity of the wind protection devices (emergency retainers)	EAD, 2.2.1.2	See Annex C.3
Impact resistance: Formats and setting of insulating glass units for the use as barrier against falling down	EAD, 2.2.1.4	See Annex D

3.2 Safety in case of fire (BWR 2)

Essential characteristic	Assessment method	Performance
Reaction to fire	EAD, 2.2.1.1	Class A1

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

In accordance with EAD No. EAD 090035-00-0404 the applicable European legal act is: 1996/582/EC[1].

The systems to be applied are:

- System 1 for Type II
- System 2+ for Type I.

In addition, the European legal act is: 2003/656/EC[2] is valid for the reaction to fire of products according to this European Assessment Document.

The systems to be applied are:

- System 1, 3, 4

[1] Official Journal of the European Communities no L 254/62 of 8.10.1996
[2] Official Journal of the European Communities no L 231/15 of 17.9.2003

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 with Deutsches Institut für Bautechnik.

Issued in Berlin on 12 January 2023 by Deutsches Institut für Bautechnik

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beglaubigt:
Dr.-Ing. Häßler

Annex A Characteristics of the different glass products

For the system "Trigon FS SG", double or triple insulating glass units according to EN 1279-5[3] can be used. The basic glass type of all glass products is float glass in accordance with EN 572-2[4] made of soda lime silicate glass (float glass). The individual panes of the insulating glass units can consist of monolithic float glass in accordance with EN 572-2[4], monolithic heat strengthened soda lime silicate glass (TVG) in accordance with EN 1863-1[5], monolithic thermally toughened soda lime silicate safety glass (ESG) in accordance with EN 12150-1[6], monolithic heat soaked thermally toughened soda lime silicate safety glass in accordance with EN 14179-2[7] or laminated safety glass (VSG) in accordance with EN 14449[8] with an interlayer made of polyvinyl butyral (PVB).

The PVB-interlayer has to feature the following properties in a test in accordance with EN ISO 527-3[9] (test speed: 50 mm/min, test temperature: 23 °C):

- Tear strength: > 20 N/mm²
- Elongation at rupture: > 250 %.

The two individual panes of the laminated safety glass can consist of float glass in accordance with EN 572-2[4], heat strengthened soda lime silicate glass (TVG) in accordance with EN 1863-1[5], monolithic thermally toughened soda lime silicate safety glass (ESG) in accordance with EN 12150-1[6] or heat soaked thermally toughened soda lime silicate safety glass in accordance with EN 14179-2[7].

The glass panes coated or entirely or partially enamelled may only be used if the adhesive behaviour of the surfaces with the adhesives has been verified in accordance with the applicable regulations. The specification of the enamel or coating shall be defined in the respective European Technical Assessment (ETA) of the sealant or in another ETA or in national regulations. If other enamels or coatings of the glass panes are used, the bonded area of the glass pane shall be left out from this enamel or coating.

When using coated glass in accordance with EN 1096-4[10] in laminated safety glass, the coated glass surface may not be oriented towards the PVB-interlayer.

In the case of overhead glazing, the lower glass pane of the insulating glass units is made of laminated safety glass.

The settings of the insulating glass panes are given in Table 1. If the insulating glazing is used as barrier against falling down, the provisions and setting of the glass panes according to Annex D shall apply.

Table 1: Setting of the panes of the insulating glass units

Insulating glass units	**Setting of the glass panes** (from inside to outside)
Two panes	4 – 24 mm monolithic or VSG glazing / 20 mm air space (SZR) / 6 – 20 mm monolithic or VSG glazing
Three panes	4 – 24 mm monolithic or VSG glazing / 20 mm SZR / 4 – 12 mm monolithic or VSG glazing / 8 – 20 mm SZR / 6 – 20 mm monolithic or VSG glazing

3	EN 1279-5	Glass in building - Insulating glass units - Part 5: Product standard
4	EN 572-2	Glass in building - Basic soda lime silicate glass products - Part 2: Float glass
5	EN 1863-1	Glass in building - Heat strengthened soda lime silicate glass - Part 1: Definition and description
6	EN 12150-1	Glass in building - Thermally toughened soda lime silicate safety glass - Part 1: Definition and description
7	EN 14179-2	Heat soaked thermally toughened soda lime silicate safety glass - Part 2: Evaluation of conformity/Product standard
8	EN 14449	Glass in building - Laminated glass and laminated safety glass - Evaluation of conformity/Product standard
9	EN ISO 527-3	Plastics - Determination of tensile properties - Part 3: Test conditions for films and sheets
10	EN 1096-4	Glass in building - Coated glass - Part 4: Product standard

Annex B Structural bonding

Adhesives

Two-component silicone adhesives are to be used for the structural bonding considering the following detailed specifications. The properties of the structural sealant, such as the load-bearing capacity of the bonding, are given in the associated ETA for the structural sealant listed in Table 2. For all parts of load transmission by bonding – glass to glass and glass to the U-profile - the adhesives and surfaces according to the respective ETA of the silicone shall be respected.

Only surfaces for which compatibility or sufficient adhesion has been proven may be used with the adhesives. Only compatible materials may be installed adjacent to the structural sealant.

Table 2: Structural sealants

Adhesive	Manufacturer	Associated ETA
DOWSIL™ 993	DOW Europe GmbH	ETA 01/0005[11]
Sikasil®SG 500	SIKA SERVICES AG	ETA 03/0038[12]

Bonding profiles

U-profiles are inserted and bonded in the load-bearing insulating glass edge next to the inner pane. The products in Table 3 are to be used as U-profiles into which the retaining devices (toggles) are inserted. The U-profiles are inserted continuously or in pieces of the length of 100 mm along the supported edges of the pane. The minimum thickness of the U-profiles is 1.0 mm. The U-profiles may be used in combination with the adhesives listed in Table 3.

Bonding process

The load-bearing bonding of “Trigon FS SG” is performed at the manufacturing plants that are instructed by HUECK System GmbH & Co. KG. The processing guidelines of the companies HUECK System GmbH & Co. KG and of the manufacturer of the silicone sealant are to be respected.

The surfaces to be sealed may only be prepared in conformity with the manufacturing directives given by the sealant manufacturer. Bubbles, holes or inclusions in the structural sealant are not permissible.

11 ETA 01/0005 from 22/06/2018 DOWSIL™ 993N, DOWSIL™ 993 and DOWSIL™ 895
12 ETA 03/0038 from 16/03/2014 Sikasil®SG 500

Table 3: U-profiles for insulating glass units (Annex 13)

Product	**Art. No.***	**Surface condition**	**Adhesives that may be used**
Stainless steel 1.4301 with strength class S275	Z 917109	plate rolled blank, classified by either 2B (0.3 µm < R_a < 0.5 µm) or 2R, according to EN 10088-2[13]	DOWSIL™ 993 according to ETA 01/0005[11]
Stainless steel 1.4301 with strength class S275	Z 917109	classified by either 2B (0.3 µm < R_a < 0.5 µm) or 2R, according to EN 10088-2[13]	Sikasil®SG 500 according to ETA 03/0038[12]
EN AW 6060 aluminium as per EN 573-3[14], state T66 as per EN 755-2[15]	P 499633	Anodised aluminium**: – Colours E6/C0 und E6/C35, Fa. König Metallveredelung GmbH, Lauchringen, Germany – Colours E6/C0 und E6/C35, Fa. HD Wahl GmbH, Jettingen-Scheppach, Germany – Colours E6-C0 und E6-C35, Fa. Königsdorf Oberflächentechnik GmbH & Co. KG, Wolfhagen, Germany	DOWSIL™ 993 according to ETA 01/0005[11]
EN AW 6060 aluminium as per EN 573-3[14], state T66 as per EN 755-2[15]	P 499633	Anodised aluminium**: – Colours E6-C0 und E6-C35, Fa. König Metallveredelung GmbH, Lauchringen, Germany – Colours E6-EV1 und E6-C35, Fa. HD Wahl GmbH, Jettingen-Scheppach, Germany	Sikasil®SG 500 according to ETA 03/0038[12]

* Concerning the U-profiles, the article numbers are the same for continuous devices and devices in pieces.

** The anodising process is to be conform to the specifications described in the test reports respectively deposited in Deutsches Institut für Bautechnik.

[13] EN 10088-2 Stainless steels - Part 2: Technical delivery conditions for sheet/plate and strip of corrosion resisting steels for general purposes

[14] EN 573-3 Aluminium and aluminium alloys - Chemical composition and form of wrought products - Part 3: Chemical composition and form of products

[15] EN 755-2 Aluminium and aluminium alloys - Extruded rod/bar, tube and profiles - Part 2: Mechanical properties

Annex C.1 Characteristics and load-bearing capacities of the glass supports

The glass supports (Annexes 14 and 15) with a width of 100 mm support the self-weight of the glass panes. The glass supports are made of aluminium EN AW 6005A T6 according to EN 573-3[14] and EN 755-2[15].

The length of the glass supports depends on the total thickness of the insulating glass units.

The characteristic load-bearing capacity of the different glass supports is given in Table 4 to Table 8. For the load-bearing capacity, a maximum glass support deformation of 3 mm and a relative deformation of two glass panes of 0.5 mm are respected.

Table 4: Characteristic load-bearing capacity of standard glass supports without reinforcing profile (full element)

System	Art. No. transom	Art. No. glass support	F_{Rk} [kN]
Trigon FS SG 50	P585306	Z 923682	4.00
Trigon FS SG 60	P586306	Z 923694	3.10
		Z 923697	2.70
		Z 923700	1.26
	P586353	Z 923697	2.60

Table 5: Characteristic load-bearing capacity of standard glass supports with reinforcing profile (full element)

System	Art. No. transom	Art. No. glass support	F_{Rk} [kN]
Trigon FS SG 50	P585306	Z 923682 / Z 923704	5.10
Trigon FS SG 60	P586306	Z 923694 / Z 923704	4.00
		Z 923697 / Z 923704	3.00
		Z 923700 / Z 923704	1.40
	P586353	Z 923697 / Z 923704	2.77

Table 6: Characteristic load-bearing capacity of the overlapping (reinforced) glass supports (full element)

System	Art. No. glass support	Eccentricity e [mm]	F_{Rk} [kN]
Trigon FS SG 50	P 499914	up to 31	1.70
		up to 40	1.70
Trigon FS SG 60	P 499916	up to 31	1.89
		up to 40	1.42

Table 7: Characteristic load-bearing capacity of the light cross glass supports (full element)

System	Cross glass support type	Service load factor f* [kN x mm]	F_{Rk} [kN]
Trigon FS SG 50	Type 1a – with c-brackets	255	4.39
Trigon FS SG 60		230	3.95
Trigon FS SG 50	Type 1b – with c-brackets and standard glass supports	258	4.87
Trigon FS SG 60		232	4.38
Trigon FS SG 50	Type 2a – with t-bracket with spring pin	255	3.95
Trigon FS SG 60		207	3.55
Trigon FS SG 50	Type 2b – with t-bracket with spring pin and standard glass supports	232	4.38
Trigon FS SG 60		209	3.94
Trigon FS SG 50	Type 3a – without bracket	204	3.51
Trigon FS SG 60		184	3.16
Trigon FS SG 50	Type 2a – without t-bracket with standard glass supports	206	3.89
Trigon FS SG 60		185	3.51
* to determine the service load of the cross glass supports			

Table 8: Characteristic load-bearing capacity of heavy (HD) cross glass supports (full element)

System	Cross glass support type	Service load factor f* [kN x mm]	F_{Rk} [kN]
Trigon FS SG 50	Type 1 – with c-brackets	778	11.23
Trigon FS SG 60		701	10.11
Trigon FS SG 50	Type 2 – with t-bracket with spring pin	701	10.11
Trigon FS SG 60		631	9.10
* to determine the service load of the cross glass supports			

Annex C.2 Characteristics and load-bearing capacities of the retaining devices (toggles)

The toggles are made of aluminium EN AW 6063 T66 according to EN 573-3[14] and EN 755-2[15] (Annexes 11 and 12). For the positioning of the toggles, the distance "e" between two toggles is limited to 150 mm < e ≤ 400 mm. The first toggle is situated at a minimum of 50 mm and a maximum of 200 mm from the corner in the case of the horizontal pane edge or at a minimum of 50 mm and a maximum of 150 mm in the case of the vertical pane edge.

The minimum embedment depth of the toggles into the U-profiles is to be 8 mm.

If the glass pane is supported at two sides, two toggles must be placed right next to each other in each corner. They are to be regarded as one.

For polygonal façades, special toggles (polygonal toggles) are to be used in accordance with Table 9.

The toggles can be fixed in two different ways, "V1" with the fixing screw in the screwing channel only and "V2" being screwed into the screwing channel and through its web into the profile (Annex 17). The toggles are fixed to the screwing channel of the frame profile using stainless steel façade fixing screws group A4L. Detailed information for the screws is deposited at Deutsches Institut für Bautechnik.

The characteristic pull-out load capacity of the screw connection from the screwing channel is 3 kN.

The toggles shall be verified for the effects of actions in each individual case. A distinction is to be made between the load-bearing capacity of the toggles for use in infields where two insert elements of the same size (same span for the load bearing surface) are installed next to each other and for use in endfields or infields with insert elements of different sizes (in relation to the load bearing surface).

The characteristic load-bearing capacity of the different toggles is given in tables 9 and 10.

Table 9: Characteristic load-bearing capacity of toggles

Designation	Type	Angle	Art. No.	$F_{Rk,V1}$ [kN]	$F_{Rk,V2}$ [kN]
Standard holder, two-sided	-	180°	Z981746	2.66	2.77
	-		Z981793		
	-		Z981748		
Standard holder, one-sided	-	180°	Z981745	0.68	1.37
	-		Z981792		
	-		Z981747		
	-		Z981794		
Polygonal toggle A-D, one-sided	A	171° - 176°	Z981752	0.68	1.37
	B	166° - 171°	Z981753		
	C	161° - 166°	Z981754		
	D	156° - 161°	Z981755		
Polygonal toggle E/EL-N/NL, one-sided	E / EL	151°- 156°	Z981756 / Z981776	1.95	3.82
	F / FL	146°- 151°	Z981757 / Z981777		
	G / GL	141°- 146°	Z981758 / Z981778		
	H / HL	136°- 141°	Z981759 / Z981779		
	I / IL	131°- 136°	Z981760 / Z981780		
	J / JL	126°- 131°	Z981761 / Z981781		
	K / KL	121°- 126°	Z981762 / Z981782		
	L / LL	116°- 121°	Z981763 / Z981783		
	M / ML	111°- 116°	Z981764 / Z981784		
	N / NL	106°- 111°	Z981765 / Z981785		
Polygonal toggle O/OL-T/TL, one-sided	O / OL	101°- 106°	Z981766 / Z981786	6.37	3.30
	P / PL	96°- 101°	Z981767 / Z981787		
	Q / QL	91°- 96°	Z981768 / Z981788		
	R / RL	86°- 91°	Z981769 / Z981789		
	S / SL	81°- 86°	Z981770 / Z981790		
	T / TL	76°- 81°	Z981771 / Z981791		

Table 10: Characteristic load-bearing capacity of aluminium toggles with stainless steel fixing

Designation	Art. No.	$F_{Rk,V1}$ [kN]	$F_{Rk,V2}$ [kN]
Aluminium toggles with stainless steel fixing, one-sided	Z982121	0.61	0.50
	Z982123	0.58	0.50
	Z982125	0.53	0.50
	Z982127	0.51	0.51
Aluminium toggles with stainless steel fixing, two-sided	Z982122, Z982124, Z982126, Z982128	1.12	1.12

Annex C.3 Characteristics and load-bearing capacities of the mechanical safety devices (emergency retainers)

For the loading case of bond failure, the horizontal wind suction loads are absorbed and passed on by emergency retainers. Two types of emergency retainers are used. The "plate" type is made of stainless steel 1.4310 and is flat, the "hat-shaped" type is made of aluminium EN AW 6063 T66 according to EN 573-3[14] and EN 755-2[15] (Annex 13). The emergency retainers are loaded on one side (endfield) or both sides (infield), depending on their position in the façade.

The emergency retainers type "plate" are fixed with one screw. The emergency retainers type "hat" are fixed with two screws. The emergency retainers are fixed using stainless steel façade fixing screws group A4L. The screws are identical to those that are used to fix the toggles (Annex C.2). Detailed information for the screws is deposited at Deutsches Institut für Bautechnik.

The minimum distance between two emergency retainers is 500 mm. Emergency retainers must be arranged on at least two opposite sides.

The necessity to use such emergency retainers is regulated by the respective Member States.

The characteristic load bearing capacity of the emergency retainers are given in Table 11.

Table 11: Characteristic load-bearing capacity of emergency retainers

Emergency retainer	Article No.	Load	F_{Rk} [kN]
Type "Hat"	997260	one-sided	3.17
		two-sided	5.84
Type "Plate"	997259	one-sided	2.54
		two-sided	3.62

Annex D Formats and setting of insulating glass units used as barrier against falling down

For the dimensions and compositions of insulating glass units with structural bonding shown in Table 12, impact tests with the impact body according to EN 12600[16] and a drop height of 900 mm are passed (Annexes 20, 22 and 24). The setting of the glass panes according to Table 12 may be supplemented by a middle pane of nominal thickness 4, 6 or 8 mm made of float glass in accordance with EN 572-2[4], heat strengthened soda lime silicate glass (TVG) in accordance with EN 1863-1[5], monolithic thermally toughened soda lime silicate safety glass (ESG) in accordance with EN 12150-1[6] or heat soaked thermally toughened soda lime silicate safety glass in accordance with EN 14179-2[7].to form triple insulating glass units.

The verification of static actions for the use as barrier against falling down is additionally required in accordance with the respective requirements of the Member State.

Retaining devices (toggles) are used according to Table 9. For insulating glazing used as barrier against falling down, two directly adjacent toggles of the "V2" fastening variant are to be arranged between two toggles of the "V1" fastening variant. The distance "e" between one toggle "V1" and two toggles "V2" is 200 mm. For fastening variants "V1" and "V2" see Annexes C.2 and 17.

Toggles at the pane's corners must be at a minimum of 50 mm and a maximum of 200 mm horizontally or a minimum of 50 mm and a maximum of 150 mm vertically from the edge of the pane.

Table 12: Tested dimensions and setting of the insulating glass panes for the use as barrier against falling down

Insulating glass units	**Drop height of the pendulum***	**Dimension**				**Setting of the glass panes**** (from inside to outside)
		Width [mm]		**Height [mm]**		
		min.	**max.**	**min.**	**max.**	
Two panes	900 mm	600	2500	1000	3300	66.2 mm VSG made of float glass / 20 mm air space / 8 mm ESG
		500	3300	300	2500	

* Drop height of the pendulum and impact body in accordance with EN 12600[16].

** VSG - Laminated safety glass in accordance with EN 14449[8] made of float glass in accordance with EN 572-2[4] with an interlayer made of PVB according to Annex A. The nominal thickness of the PVB-interlayer must be at least 0.76 mm.

ESG - Thermally toughened soda lime silicate safety glass (ESG) in accordance with EN 12150-1[6] or heat soaked thermally toughened soda lime silicate safety glass in accordance with EN 14179-2[7].

16 EN 12600 Glass in building - Pendulum test - Impact test method and classification for flat glass

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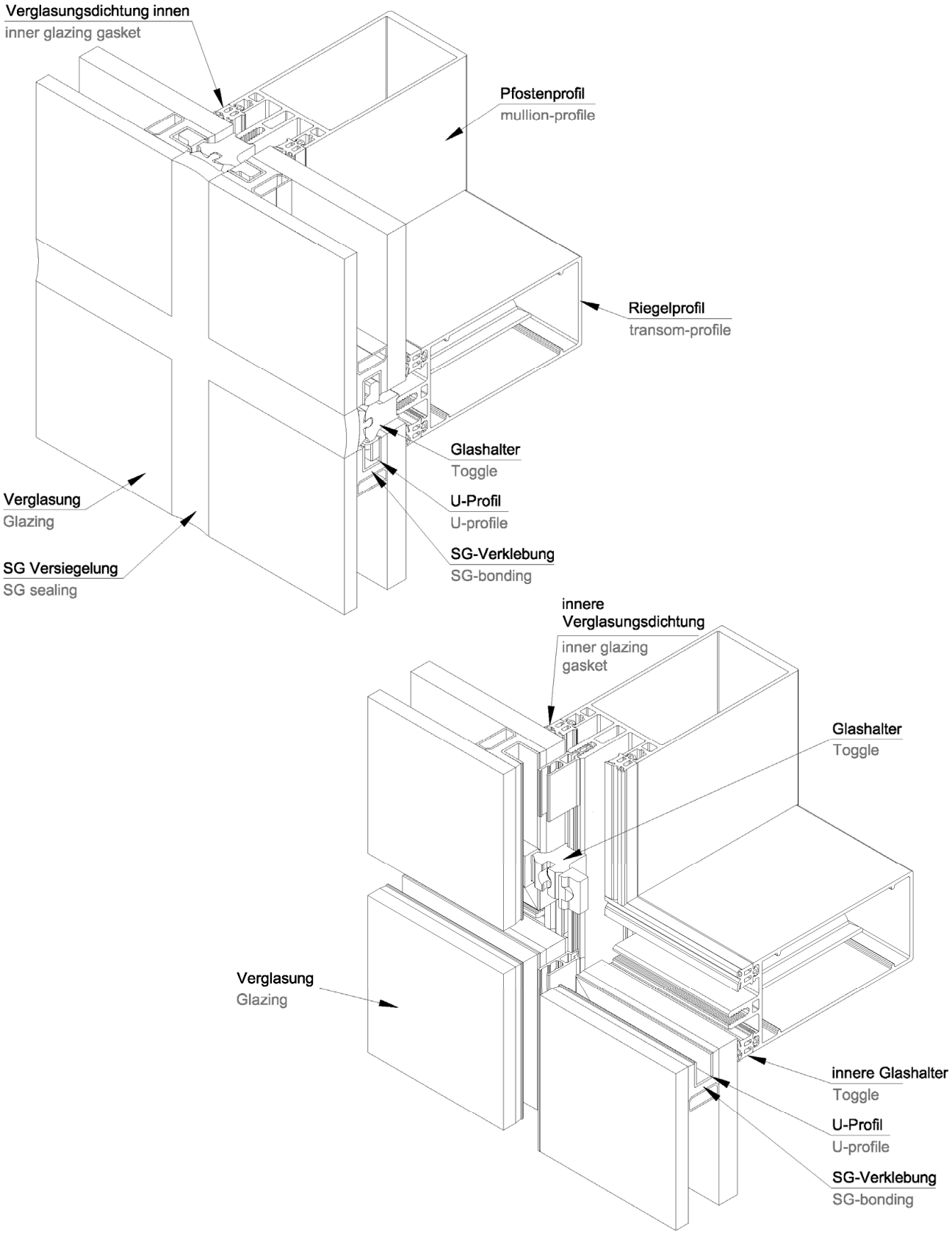
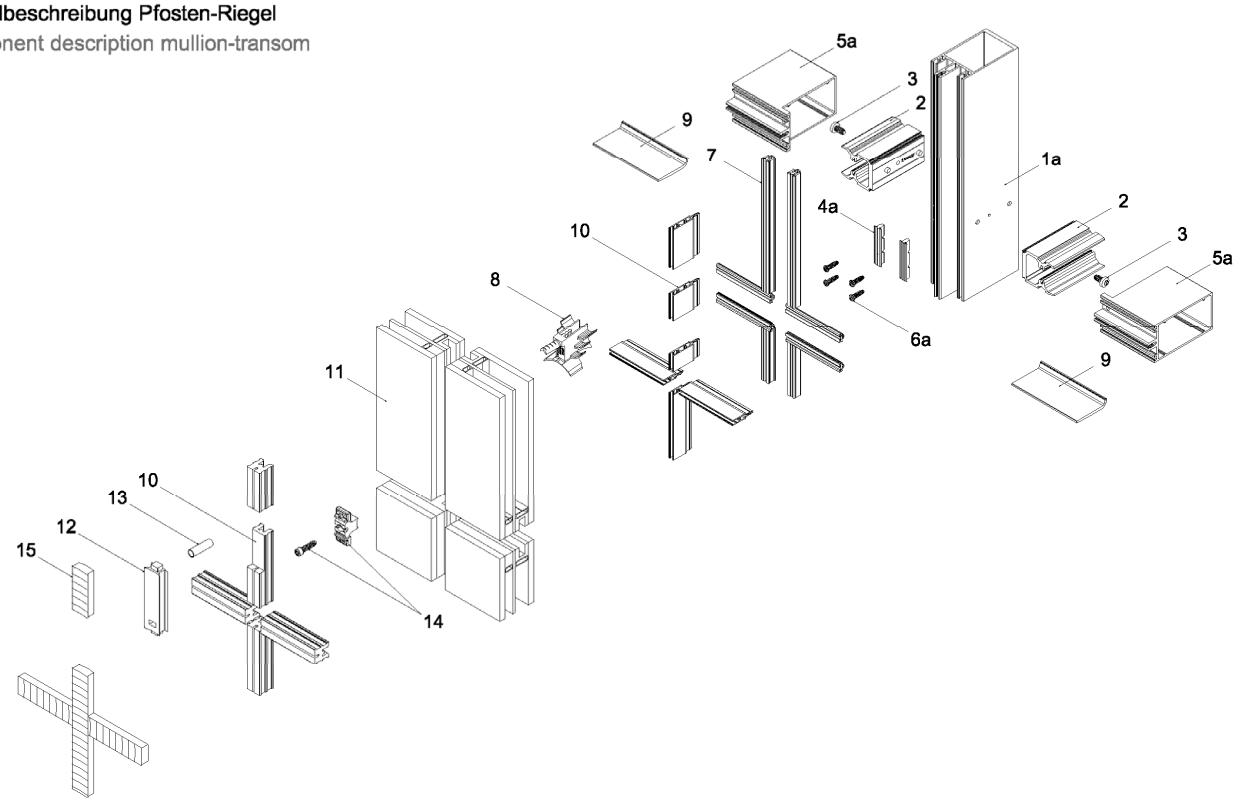


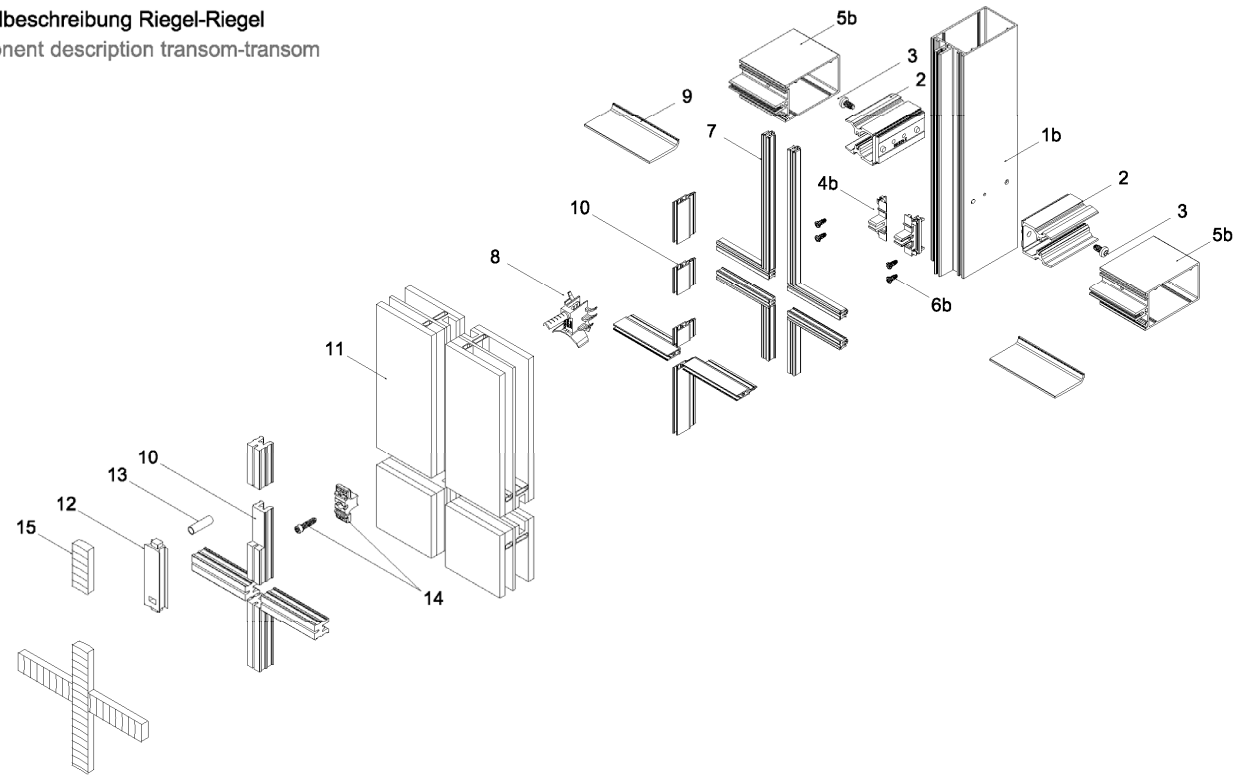
Trigon FS SG	Annex 1
System overview	

Deutsches Institut für Bautechnik DIBt

Bauteilbeschreibung Pfosten-Riegel
component description mullion-transom



Bauteilbeschreibung Riegel-Riegel
component description transom-transom



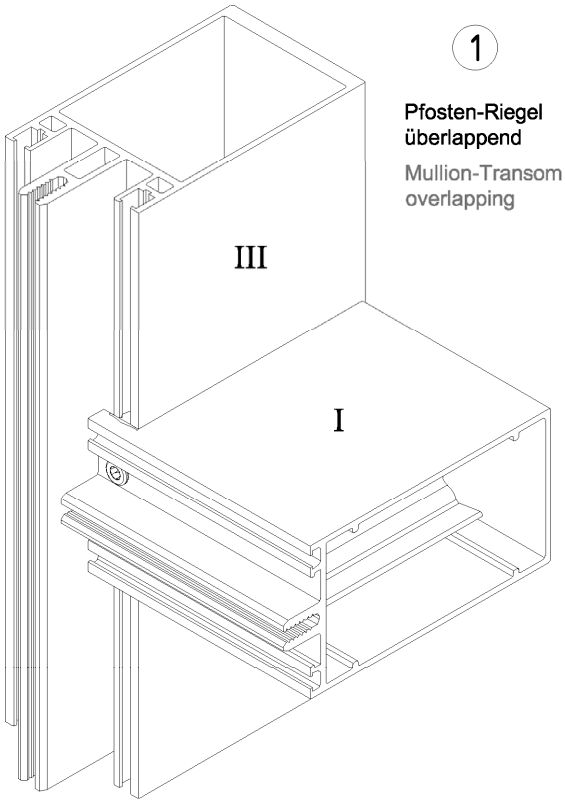
Trigon FS SG	Annex 2
System overview	

Deutsches Institut für Bautechnik DIBt

1 Pfosten a) Profile der Ebene III b) Profile der Ebene II Eine Vielzahl an Profilen mit Bautiefen von 50 mm bis 250 mm steht, je nach statischer Anforderung, zur Auswahl. Diese werden im Bedarfsfall durch Einschubprofile verstärkt. Montageprofile für elementierte Bauweise runden das Profil-Portfolio ab.	**1 Mullion** a) Level III profiles b) Level II profiles A large number of profiles with profile depths from 50 mm to 250 mm are available, depending on the static requirements. If required, these can be reinforced with slide-in profiles. Split profiles for elementary construction complement the profile portfolio.
2 T-Verbinder Verschiedene Verbinder ermöglichen unterschiedliche Montagearten, so stehen neben dem Standard-Verbinder auch Federstiftstoßverbinder zur Auswahl, diese ermöglichen den nachträglichen Einbau der Riegel bei bereits montierten Pfosten.	**2 T-bracket** Different types of connectors allow different types of assembly, so in addition to the standard connector, t-brackets with spring pin are also available. These allow the subsequent installation of the transoms with already mounted mullions.
3 Schraube Schraube zur Befestigung des Verbinders am Pfosten	**3 Screw** Srew for fixing the connector to the mullion
4 Dichtmanschette a) Formteil zur Abdichtung der Pfosten-Riegel Verbindung b) Formteil zur Abdichtung der Riegel-Riegel Verbindung	**4 Sealing sleeve** a) Shaped piece for sealing the mullion-transom connection b) Shaped piece for sealing the transom-transom connection
5 Riegel a) Profile der Ebene I und Profile der Ebene II b) Profile der Ebene II Eine Vielzahl an Profilen mit auf die Pfostengeometrie abgestimmten Bautiefen stehen zur Auswahl, dies ermöglicht einen bündigen Abschluss bei Decken- und Bodenanschlüssen.	**5 Transom** a) Level I profiles and level II profiles b) Level II profiles A large number of profiles with profile depths matched to the mullion geometry are available, allowing a flush finish for ceiling and floor connenctions.
6 Schraube a) Schrauben zur Befestigung des Riegels am Pfosten b) Schrauben zur Befestigung des Riegels am Verbinder	**6 Screw** a) Screws for fixing the transom to the mullion b) Screws for fixing the transom to the connector
7 innere Verglasungsdichtung	**7 Internal glazing gasket**
8 SG Belüftungsformteil Formteil zur Belüftung und Entwässerung der Vertikalen Profile	**8 SG Ventilation shaped pieces** Shaped piece for ventilation and drainage of vertival profiles
9 Glasträger	**9 Glass support**
10 Isolator eco einteiliger Isolator plus zweiteiliger Isolator	**10 Insulator** eco single-piece insulator plus two-piece insulator
11 Verglasung / Füllung Füllungsstärken von 32 mm bis 68 mm können in das System integriert werden. Somit können neben klassischen Verglasungen auch Einsatzelemente der HUECK Lambda 110 sowie Türen der HUECK Lambda DS 075 und 090 mit dem System kombiniert werden.	**11 Glazing / Filling** Filling thicknesses from 32 mm to 68 mm can be included in the system. Thus, in addition to classic glazing, insert elements of the HUECK Lambda 110 and also doors of the HUECK Lambda DS 075 and 090 can be combined with the system.
12 SG Belüftungsformteil Gegenstück	**12 SG Ventilation shaped piece counterpart**
13 Hülse	**13 Sleeve**
14 Toggle & Fassadenschraube	**14 Toggle & Facade screw**
15 SG Versiegelung	**15 SG Sealing**

Trigon FS SG	Annex 3
System overview	

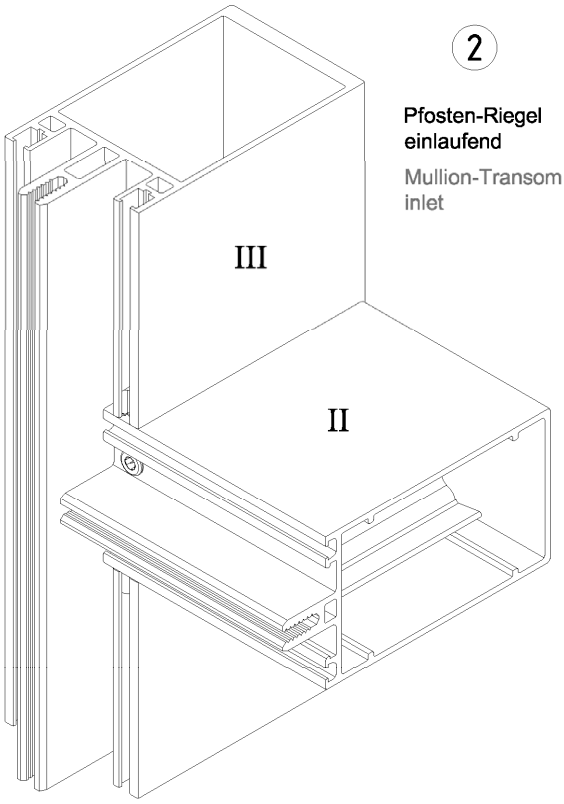
Deutsches Institut für Bautechnik DIBt



1

Pfosten-Riegel
überlappend

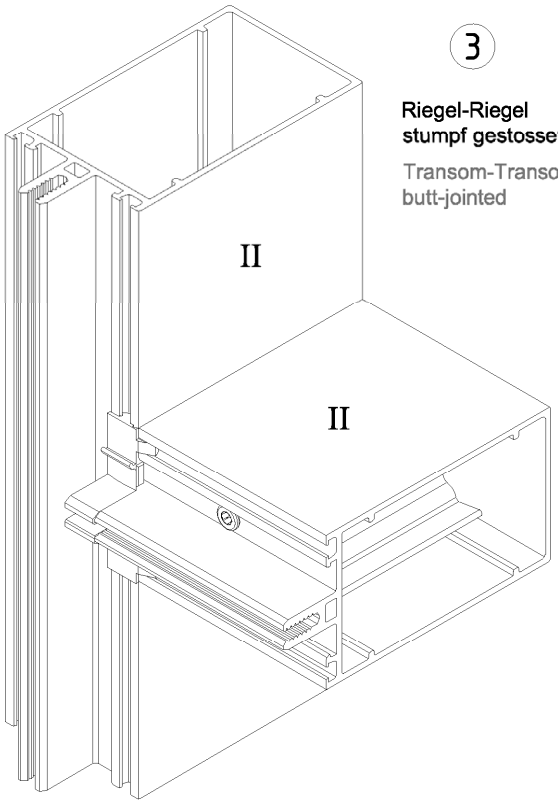
Mullion-Transom
overlapping



2

Pfosten-Riegel
einlaufend

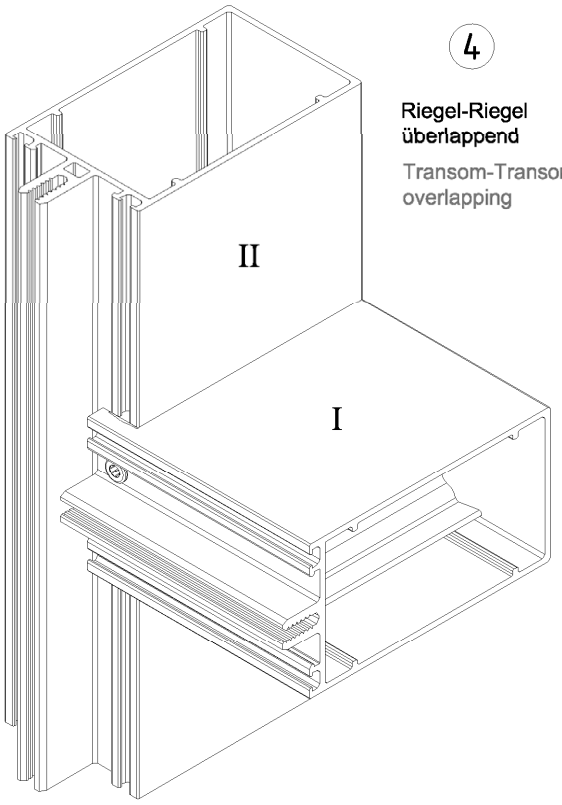
Mullion-Transom
inlet



3

Riegel-Riegel
stumpf gestossen

Transom-Transom
butt-jointed



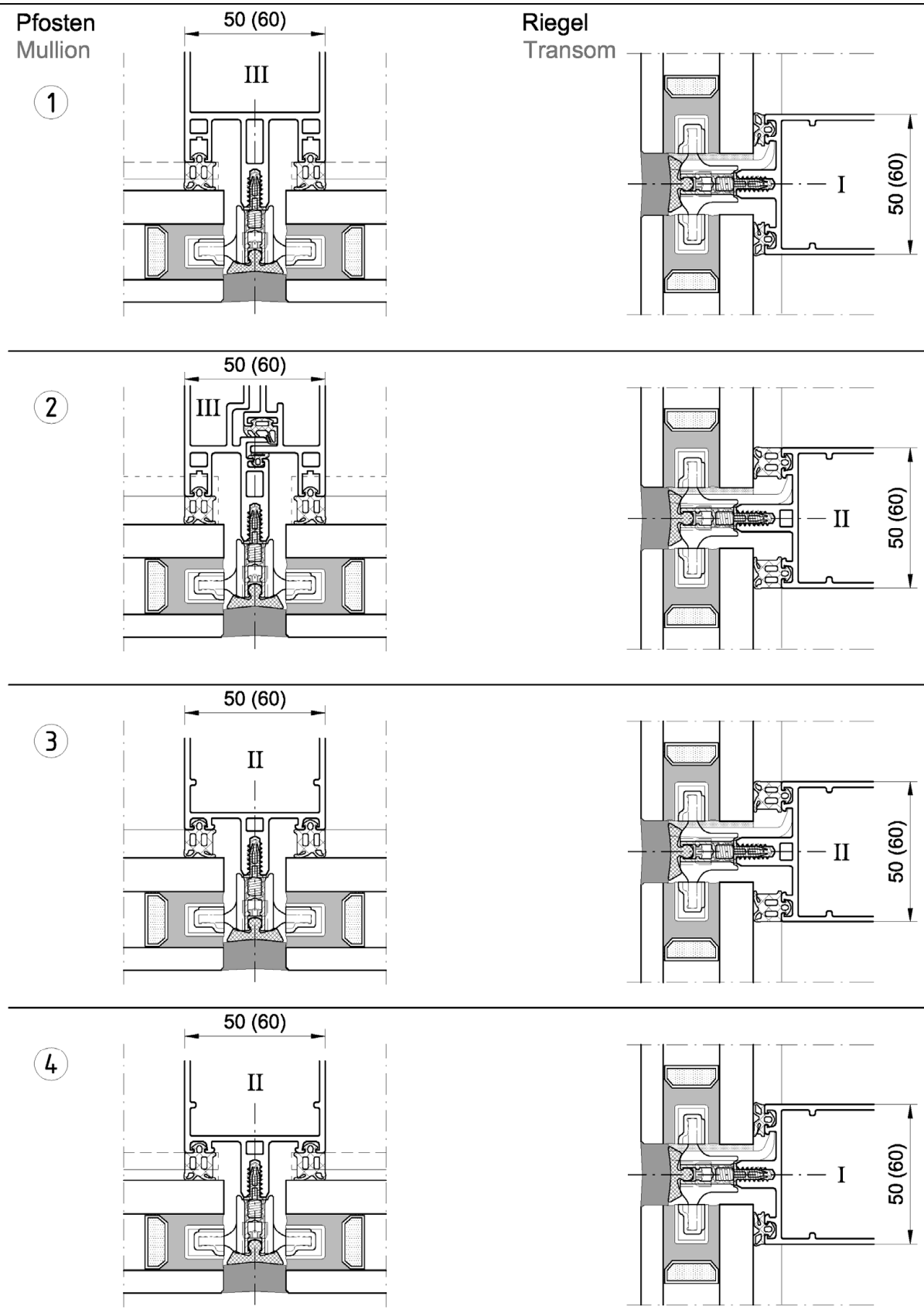
4

Riegel-Riegel
überlappend

Transom-Transom
overlapping

Trigon FS SG	Annex 4
Versions of profile-connections	

Deutsches Institut für Bautechnik DIBt

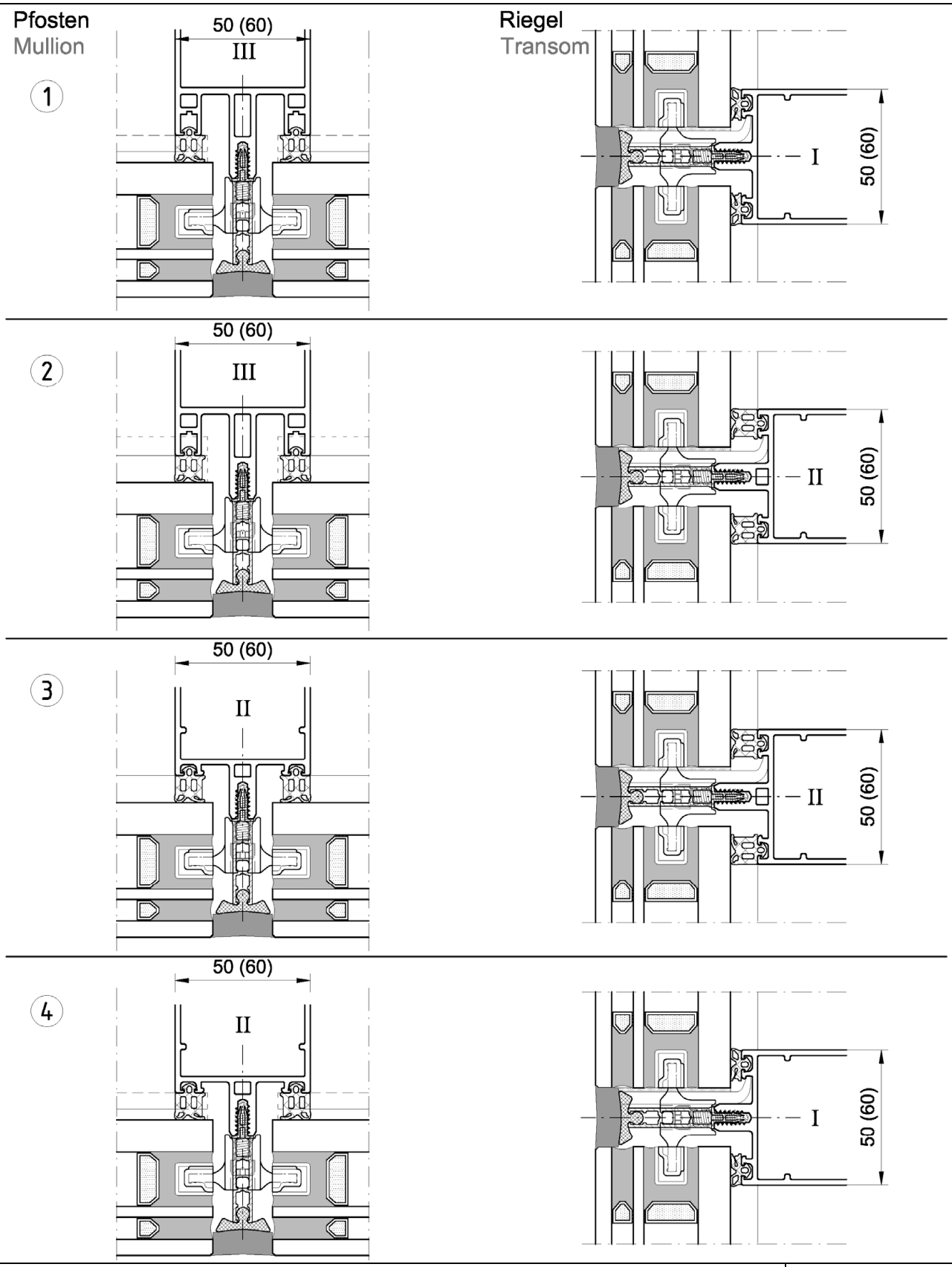


Trigon FS SG

Profile-versions – double glazing

Annex 5

Deutsches Institut für Bautechnik DIBt



Trigon FS SG

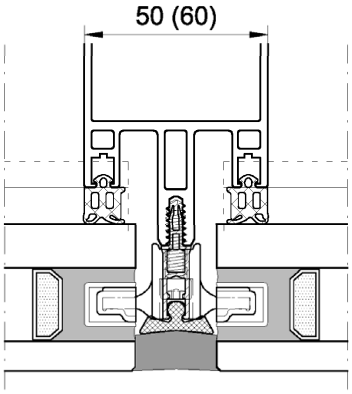
Profile-versions – triple glazing

Annex 6

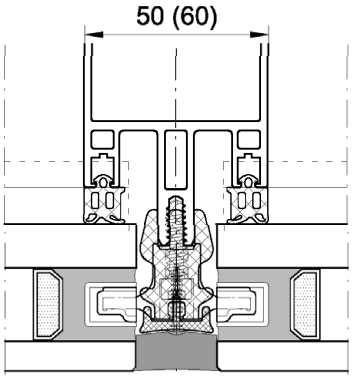
Deutsches Institut für Bautechnik DIBt

Pfosten
Mullion

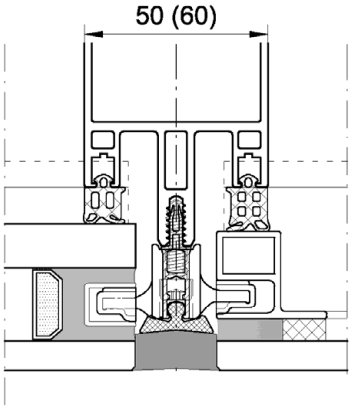
Schnitt mit Isolator aus ABS
section with insulator made of ABS



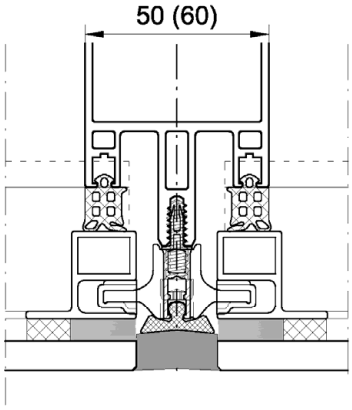
Schnitt mit Isolator aus PE
section with insulator made of PE



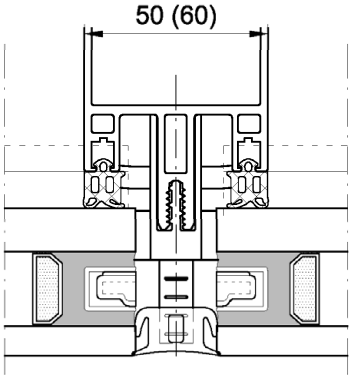
Schnitt mit Aluminiumprofil für Einfachverglasung
section with Aluminium profile for single galzing



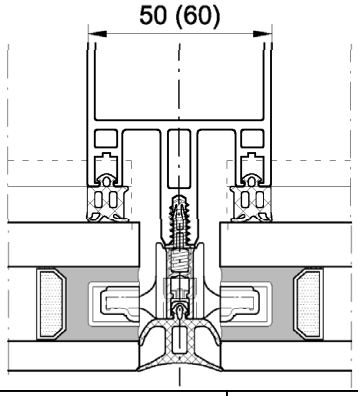
Schnitt mit Aluminiumprofil für Einfachverglasung
section with Aluminium profile for single galzing



Schnitt mit Belüftungsformteilen
section with shaped pieces for ventilation



Schnitt mit Silikondichtung zur Trockenverglasung außen
section with silicone gasket for outer dry glazing

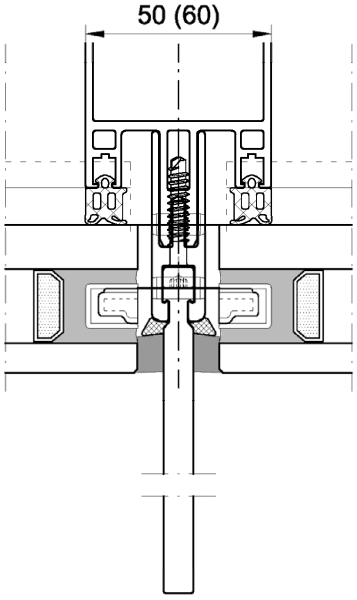


Trigon FS SG	Annex 7
Sections	

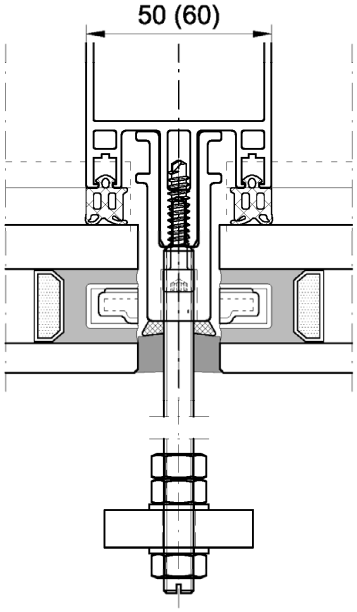
Deutsches Institut für Bautechnik DIBt

Pfosten
Mullion

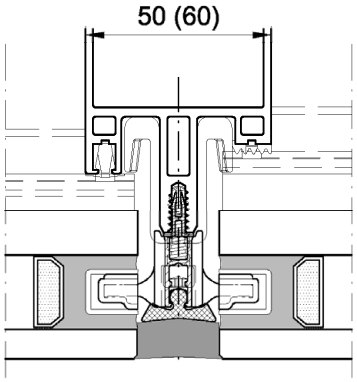
Schnitt mit Fassadenschwert zur Sonnenschutzbefestigung
section with facade bracket for fastening of sun protection



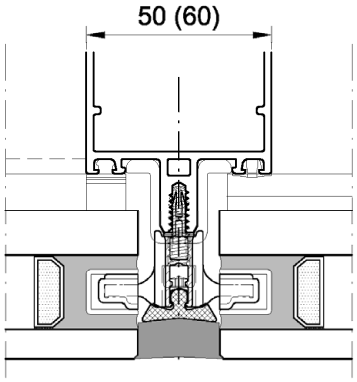
Schnitt mit Stehbolzen zur Sonnenschutzbefestigung
section with stud bolt for fastening of sun protection



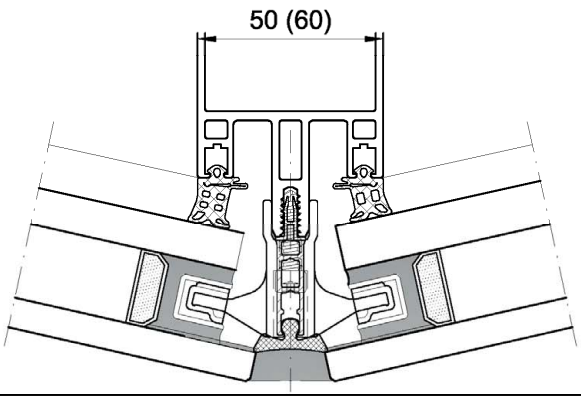
Schnitt mit Formteil für Pfostenlängsstoß und Dichtmanschette
section with shaped piece for mullion joint and sealing sleeve



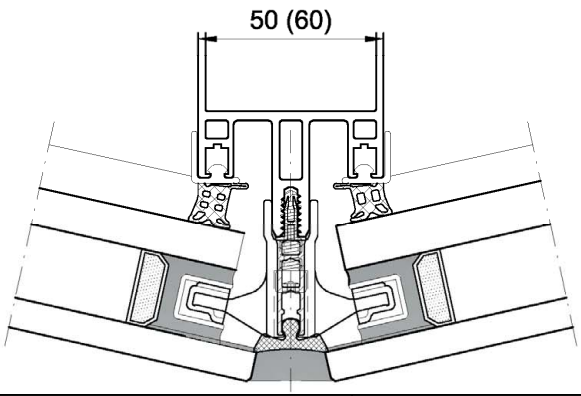
Schnitt mit Formteil zum Pfostenlängsstoß und Dichtmanschetten
section with shaped piece for mullion joint and sealing sleeve



Schnitt Polygonverglasung
section with polygonal glazing



Schnitt mit Dichtmanschette und polygonale Verglasung
section with shaped piece and polygonal glazing



Trigon FS SG

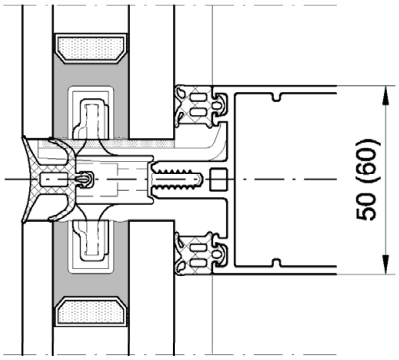
Sections

Annex 8

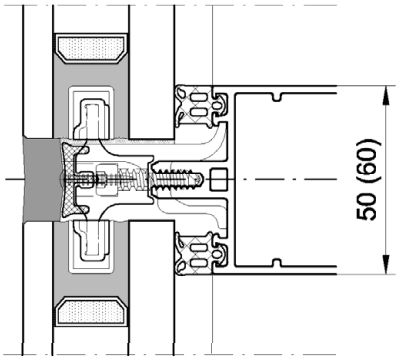
Deutsches Institut für Bautechnik DIBt

Riegel
Transom

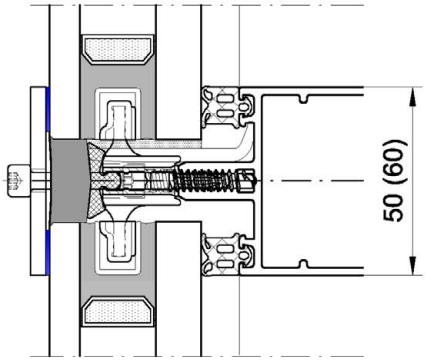
Schnitt mit Silikondichtung zur Trockenverglasung außen und Aluminium Glasträger
Section with silicone gasket for dry glazing outside and Aluminium glass support



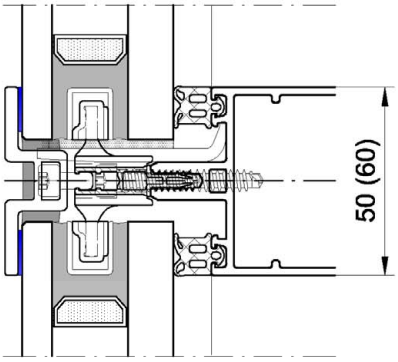
Schnitt mit Nassversiegelung außen, verstärktem Aluminium Glasträger
Section with wet sealing outside and reinforced Aluminium glass support



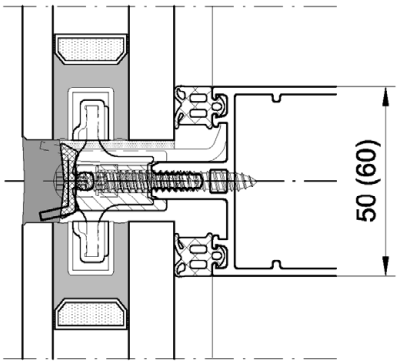
Schnitt mit Glassicherung aus Edelstahl
Section with security cover plate made of stainless steel



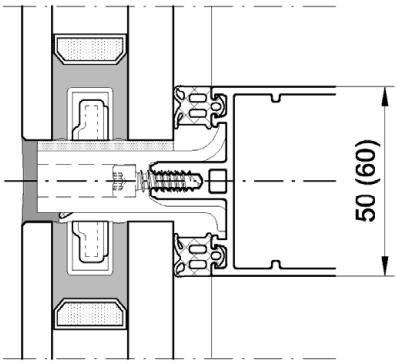
Schnitt mit Glassicherung aus Aluminium
Section with security cover plate made of Aluminium



Schnitt mit Sicherungsleiste und Hinterlage für RC3
Section with secure slat and protection profile for RC3



Schnitt mit Aluminiumglasträger für hohe Glaslasten
Section with Aluminium glass support for high filling loads

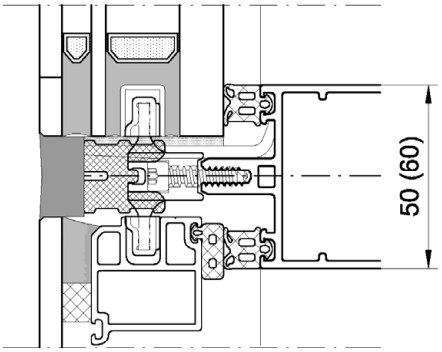


Trigon FS SG	Annex 9
Sections	

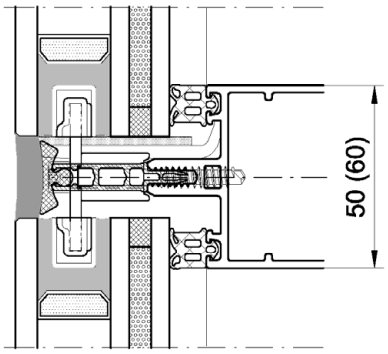
Deutsches Institut für Bautechnik DIBt

Riegel / Transom

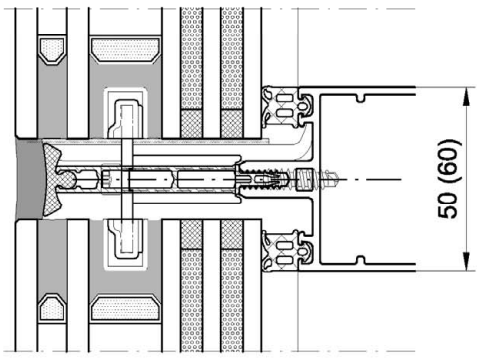
Schnitt mit Aluminiumprofil für Glaspaneel
Section with Aluminium profile for glass panel



Schnitt mit Nassversiegelung außen,
Glashalter aus Aluminium mit Edelstahlbefestigung
Section with wet sealing outside, toggle made of Aluminium
with stainless steel fastening

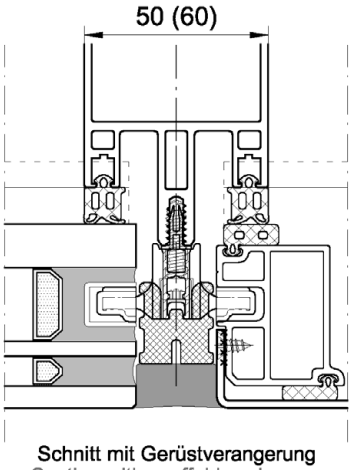


Schnitt mit Nassversiegelung außen,
Glashalter aus Aluminium mit Edelstahlbefestigung
Section with wet sealing outside, toggle made of Aluminium
with stainless steel fastening

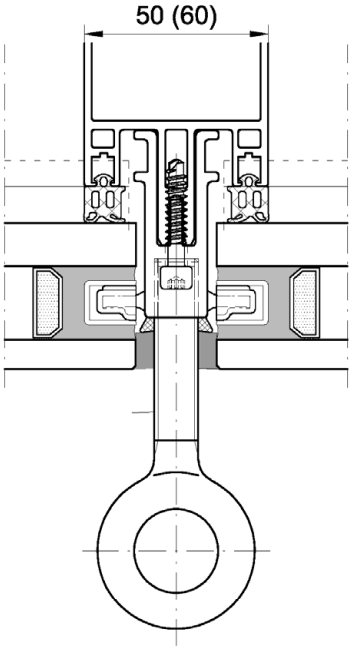


Pfosten / Mullion

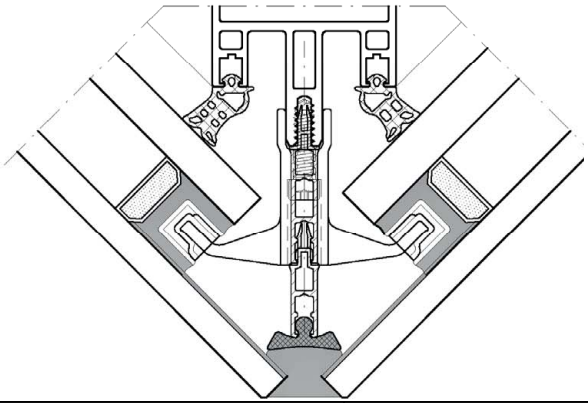
Schnitt mit Aluminiumprofil für Blechpaneel
Section with Aluminium profile for metal sheet panel



Schnitt mit Gerüstverangerung
Section with scaffold anchorage



Schnitt 90° Ganzglasecke
Section 90° structural glazing corner

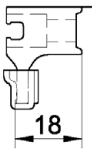


Trigon FS SG	Annex 10
Sections	

Deutsches Institut für Bautechnik DIBt

Glashalter
Toggle

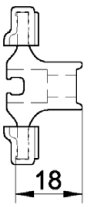
Z 981745



System-Glas-/ Paneelhalter asymmetrisch

system-glass-/ and panel holder asymmetrical

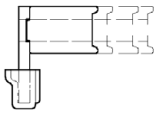
Z 981746



System-Glas-/ Paneelhalter symmetrisch

system-glass-/ and panel holder symmetrical

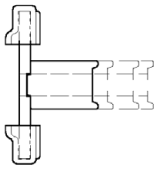
Z 982121 / Z 982123
Z 982125 / Z 982127



Glashalter asymmetrisch, aus Aluminium mit Edelstahlbefestigung

glass holder asymmetrical, made of Aluminium with stainless steel fastening

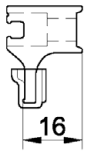
Z 982122 / Z 982124
Z 982126 / Z 982128



Glashalter symmetrisch, aus Aluminium mit Edelstahlbefestigung

glass holder symmetrical, made of Aluminium with stainless steel fastening

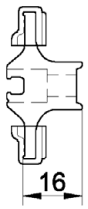
Z 981747



System-Glas-/ Paneelhalter asymmetrisch (Nur bei Verwendung von P 519903)

system-glass-/ and panel holder asymmetrical (use only with P 519903)

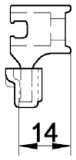
Z 981748



System-Glas-/ Paneelhalter symmetrisch (Nur bei Verwendung von P 519903)

system-glass-/ and panel holder symmetrical (use only with P 519903)

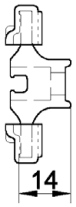
Z 981792



System-Glas-/ Paneelhalter asymmetrisch

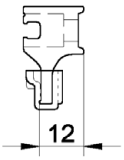
system-glass-/ and panel holder asymmetrical

Z 981793



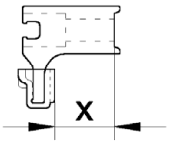
System-Glas-/ Paneelhalter symmetrisch

Z 981794



System-Glas-/ Paneelhalter asymmetrisch

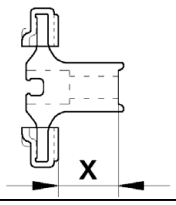
system-glass-/ and panel holder asymmetrical



Projekt-Glashalter asymmetrisch für Sonderverglasungen -Höhe siehe Tabelle-

Project-glass holder asymmetrical for special glazings -high find schedule-

Höhe X	Artikel-Nr. Article No.
14,3	Z 996395
16,3	Z 993945
18,3	Z 939184
22,3	Z 993974



Projekt-Glashalter symmetrisch für Sonderverglasungen -Höhe siehe Tabelle-

Project-glass holder symmetrical for special glazings -high find schedule-

Höhe X	Artikel-Nr. Article No.
14,3	Z 996396
16,3	Z 993946
22,3	Z 993975

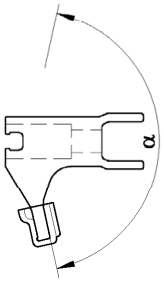
Trigon FS SG

Toggles

Annex 11

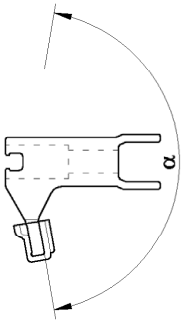
Deutsches Institut für Bautechnik DIBt

Glashalter
Toggle



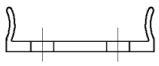
System-Glashalter-Polygon, asymmetrisch
System-glass holder-polygon, asymmetrical

Winkelbereich α Angle area α	Artikel-Nr. Article No.	Winkelbereich α Angle area α	Artikel-Nr. Article No.
171° - 176°	Z 981752	121° - 126°	Z 981762 Z 981782
166° - 171°	Z 981753	116° - 121°	Z 981763 Z 981783
161° - 166°	Z 981754	111° - 116°	Z 981764 Z 981784
156° - 161°	Z 981755	106° - 111°	Z 981765 Z 981785
151° - 156°	Z 981756 Z 981776	101° - 106°	Z 981766 Z 981786
146° - 151°	Z 981757 Z 981777	96° - 101°	Z 981767 Z 981787
141° - 146°	Z 981758 Z 981778	91° - 96°	Z 981768 Z 981788
136° - 141°	Z 981759 Z 981779	86° - 91°	Z 981769 Z 981789
131° - 136°	Z 981760 Z 981780	81° - 86°	Z 981770 Z 981790
126° - 131°	Z 981761 Z 981781	76° - 81°	Z 981771 Z 981791



Projekt-Glashalter-Polygon, asymmetrisch
Project-glass holder-polygon, asymmetrical

Winkelbereich α Angle area α	Artikel-Nr. Article No.	Winkelbereich α Angle area α	Artikel-Nr. Article No.
171° - 176°	Z 993976	121° - 126°	Z 993278
166° - 171°	Z 993977	116° - 121°	Z 996277
161° - 166°	Z 993978	111° - 116°	Z 996276
156° - 161°	Z 993979	106° - 111°	Z 996275
151° - 156°	Z 993980	101° - 106°	Z 996255
146° - 151°	Z 993981	96° - 101°	Z 996256
141° - 146°	Z 993982	91° - 96°	Z 996257
136° - 141°	Z 993983	86° - 91°	Z 996258
131° - 136°	Z 993984	81° - 86°	Z 938086
126° - 131°	Z 996279	76° - 81°	Z 938087



Z 918070

Distanzclip für Glashalter Polygonal
Distance clip for glass holder polygonal

Z 911945

Fassadenschraube aus Edelstahl zur Befestigung der Glashalter
Facade screw made of Stainless steel for fastening Toggles

Trigon FS SG	Annex 12
Toggles and façade fixing screw	

Deutsches Institut für Bautechnik DIBt

U-Profile
U-Profiles

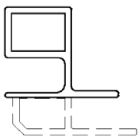
P 499633

U-Profil Aluminium
U-profile made of Aluminium

Z 917109

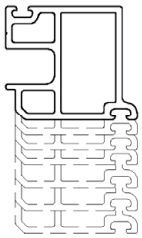
U-Profil Edelstahl
U-profile made of Stainless steel

Rahmenprofile Paneel
Frame profiles panel



P 519903 / P 519904

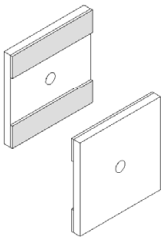
Rahmenprofil Paneel
Frame profile panel



P 585915 / P 585916 bis P 585925

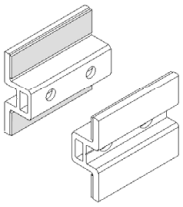
Rahmenprofil Paneel
Frame profile panel

Glassicherungen
Glassretainer



Z 997259

Nothalter aus Edelstahl
Cross fitting made of Stainless steel



Z 997260

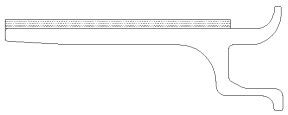
Nothalter aus Aluminium
Cross fitting made of Aluminium

Trigon FS SG	Annex 13
U-profiles and emergency retainer (cross fitting)	

Deutsches Institut für Bautechnik DIBt

Glasträger
glass support

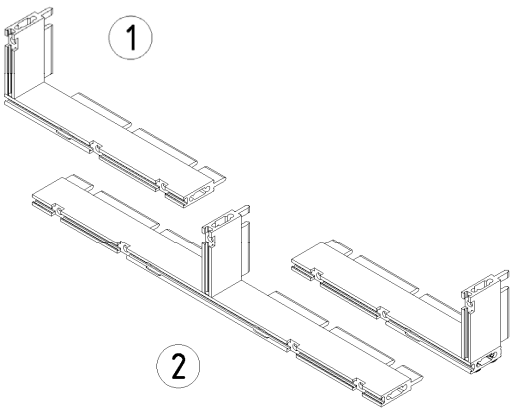
Glasträger aus Aluminium glass support made of Aluminium		aus Profil made of *Profile*	aus Profil made of *Profile*
FS 050 SG	FS 060 SG	FS 050 SG	FS 060 SG
Z 923680	Z 923692	P 499891	P 499898
Z 923681	Z 923693		
Z 923682	Z 923694		
Z 923683	Z 923695	P 499890	P 499897
Z 923684	Z 923696	P 499889	P 499896
Z 923685 / Z 923775	Z 923697 / Z 923780	P 499888	P 499895
Z 923686 / Z 923776	Z 923698 / Z 923781	P 499887	P 499894
Z 923687 / Z 923777	Z 923699 / Z 923782	P 499886	P 499893
Z 923688	Z 923700	P 499885	P 499892
Z 923689 / Z 923778	Z 923701 / Z 923783	P 499885	P 499892
Z 923690	Z 923702	P 499880	P 499881
Z 923691 / Z 923779	Z 923703 / Z 923784		



übergreifender (verstärkter) Glasträger aus Aluminium overarching (reinforced) glass support		aus Profil made of Profile	aus Profil made of Profile
FS 050 SG	FS 060 SG	FS 050 SG	FS 060 SG
Z 924035	Z 924043	P 499915	P 499917
Z 924036	Z 924044		
Z 924037 / Z 924292	Z 924045 / Z 924296		
Z 924038 / Z 924293	Z 924046 / Z 924297		
Z 924039	Z 924047		
Z 924040 / Z 924294	Z 924048 / Z 924298		
Z 924041	Z 924049		
Z 924042 / Z 924295	Z 924050 / Z 924299		
Z 924051	Z 924058	P 499914	P 499916
Z 924052 / Z 924276	Z 924059 / Z 924281		
Z 924053 / Z 924277	Z 924060 / Z 924282		
Z 924054 / Z 924278	Z 924061 / Z 924283		
Z 924055	Z 924062		
Z 924056 / Z 924279	Z 924063 / Z 924284		
Z 924057 / Z 924280	Z 924064 / Z 924285		

Z 923704

Verstärkungsprofil für Standardglasträger
reinforced profile for standard glass support



leichter Kreuzglasträger Glasträger aus Aluminium light cross glass support made of Aluminium	FS 050 / 060 SG aus Profil made of Profile	FS 050 SG Artikel-Nr Article-No	FS 060 SG Artikel-Nr Article-No
① Endfeld links, Endjamb left	P 599673	Z 981915	
② Kreuz Mitte, Cross middle		Z 981913	
③ Endfeld rechts, Endjamb right		Z 981914	

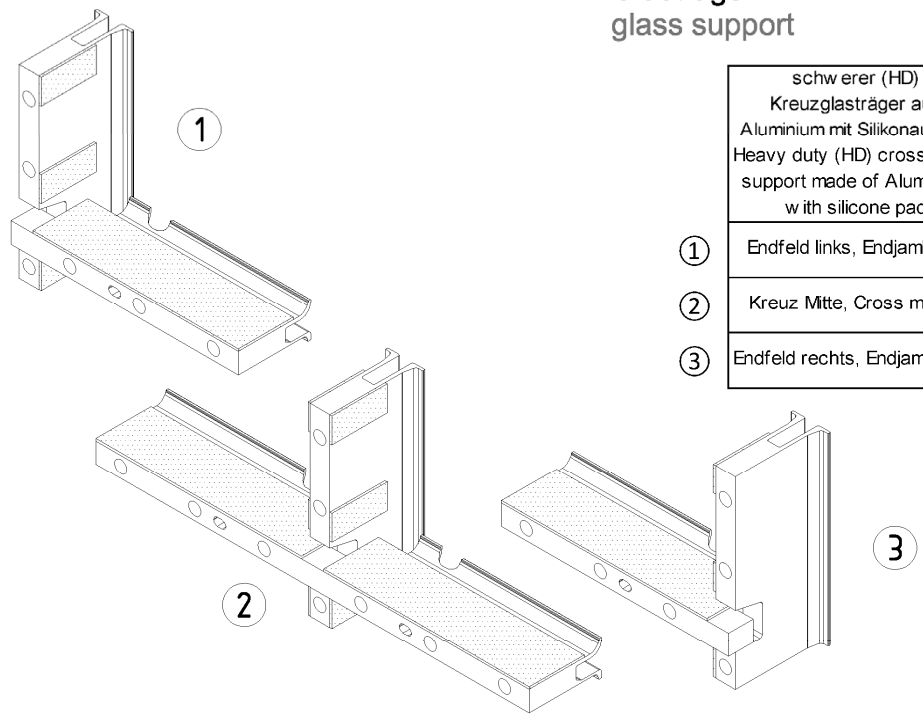
Trigon FS SG

Glass supports

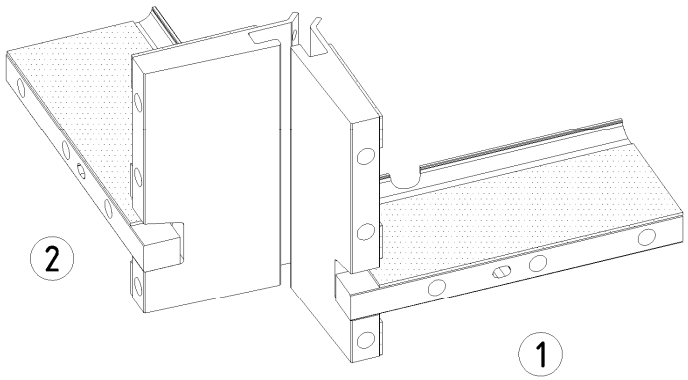
Annex 14

Deutsches Institut für Bautechnik DIBt

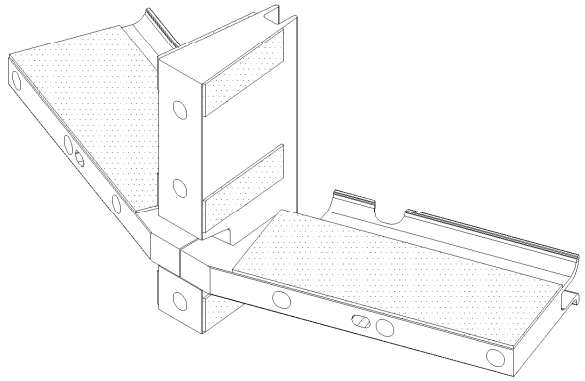
Glasträger
glass support



	schwerer (HD) Kreuzglasträger aus Aluminium mit Silikonauflage Heavy duty (HD) cross glass support made of Aluminium with silicone pad	FS 050 SG aus Profil made of Profile	FS 060 SG aus Profil made of Profile
①	Endfeld links, Endjamb left	P 499909 P 499910 P 499925 P 499926 P 499934 P 499942	P 499909 P 499910 P 499927 P 499928 P 499934 P 499943
②	Kreuz Mitte, Cross middle		
③	Endfeld rechts, Endjamb right		



	Schwerlastglasträger 90°-Ecke aus Aluminium mit Silikonauflage Heavy duty glass support 90°-corner made of Aluminium with silicone pad	FS 050 SG aus Profil made of Profile	FS 060 SG aus Profil made of Profile
①	Feld links, jamb left	P 499926 P 499930	P 499927 P 499931
②	Feld rechts, jamb right		

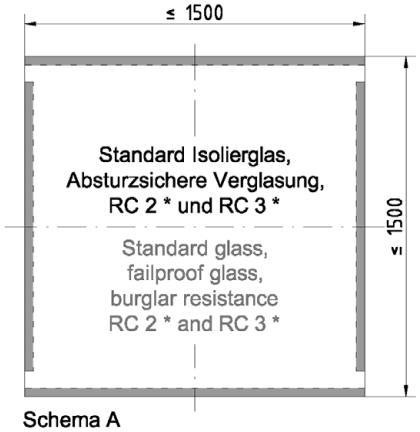


Schwerlastglasträger Polygon aus Aluminium mit Silikonauflage Heavy duty glass support polygone made of Aluminium with silicone pad	FS 050 SG aus Profil made of Profile	FS 060 SG aus Profil made of Profile
Polygon	P 499932 P 499926	P 499927 P 499933

Trigon FS SG	Annex 15
Glass supports	

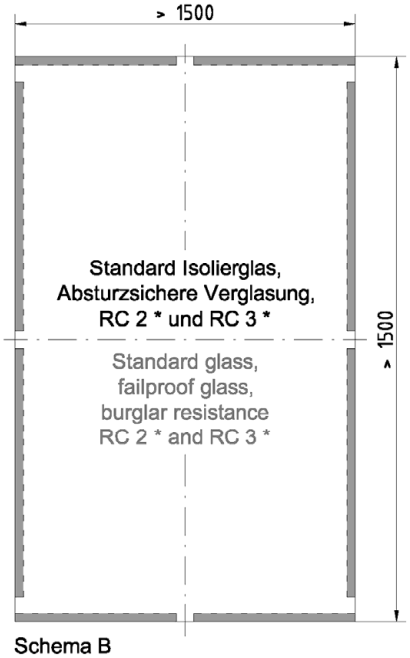
Deutsches Institut für Bautechnik DIBt

U-Profil durchlaufend aus Aluminium oder Edelstahl
U-Profile continously of aluminium or Inox



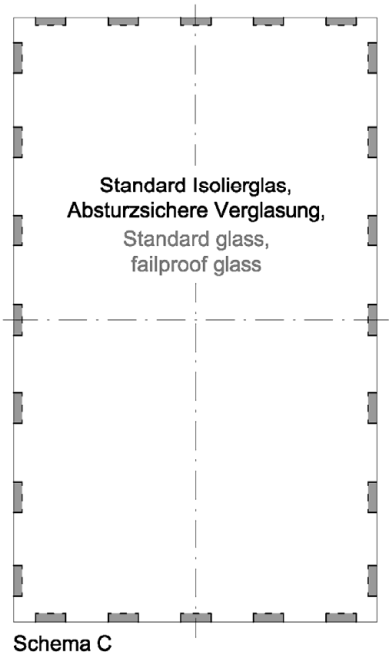
Schema A
scheme A

* Nur mit Z 917109 ausführbar.
* Approved only with Z 917109.

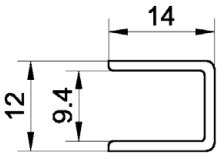


Schema B
scheme B

U-Profil Kurzstücke aus Aluminium oder Edelstahl
U-Profile in short pieces made of aluminium or Inox

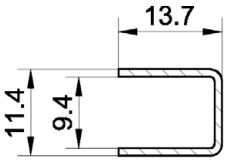


Schema C
scheme C



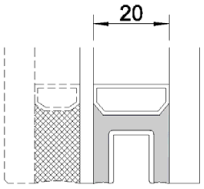
P 499633

U-Profil
Aluminium EN-AW 6060, SG-Eloxal,
Farbtöne: E6-C0, E6-C35
(DC993, SG 500)

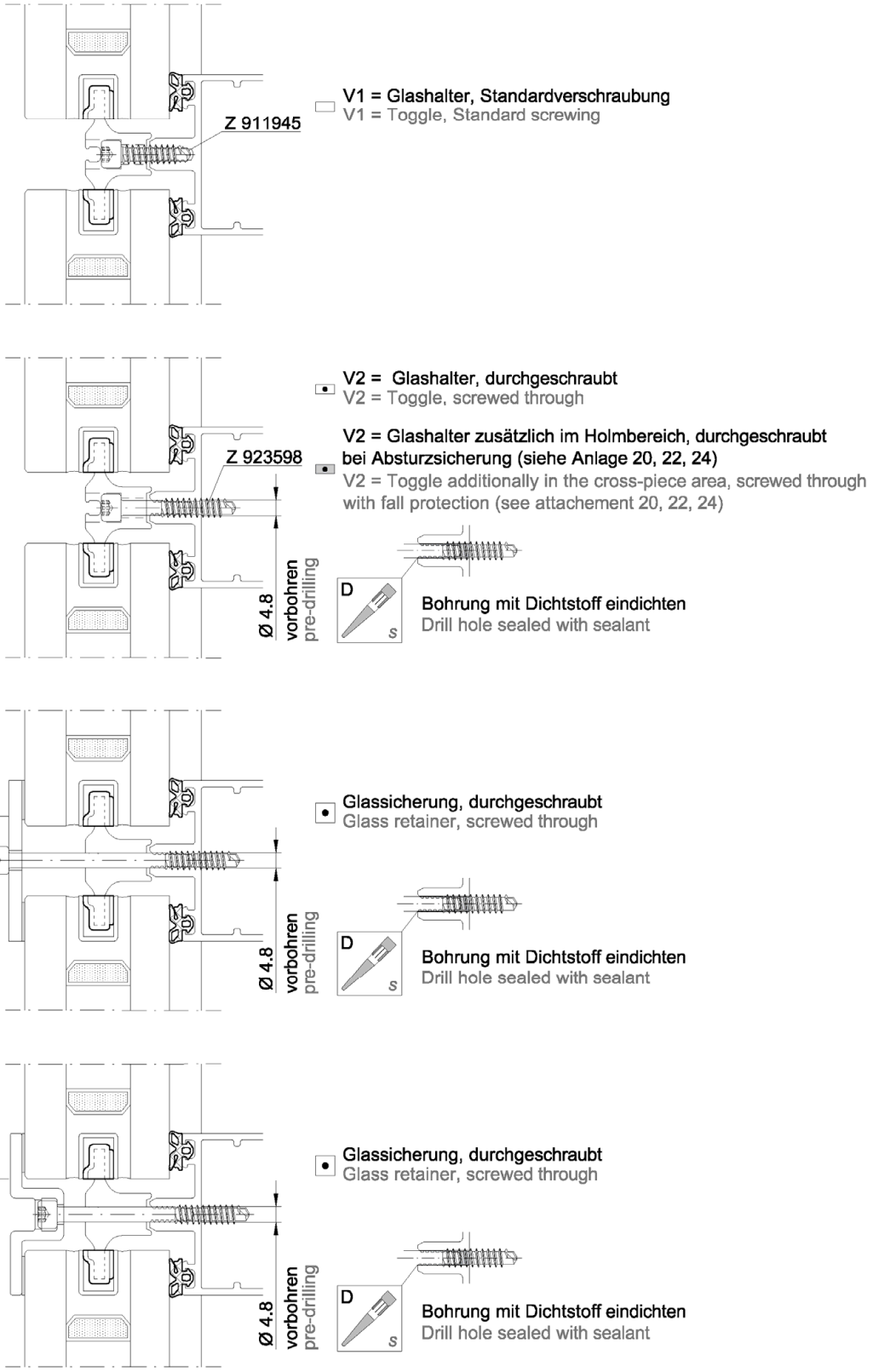


Z 917109

U-Profil
Edelstahl,
Oberflächenbeschaffenheit gemäß
ETA-01/0005 (DC993),
ETA-03/0038 (SG 500)

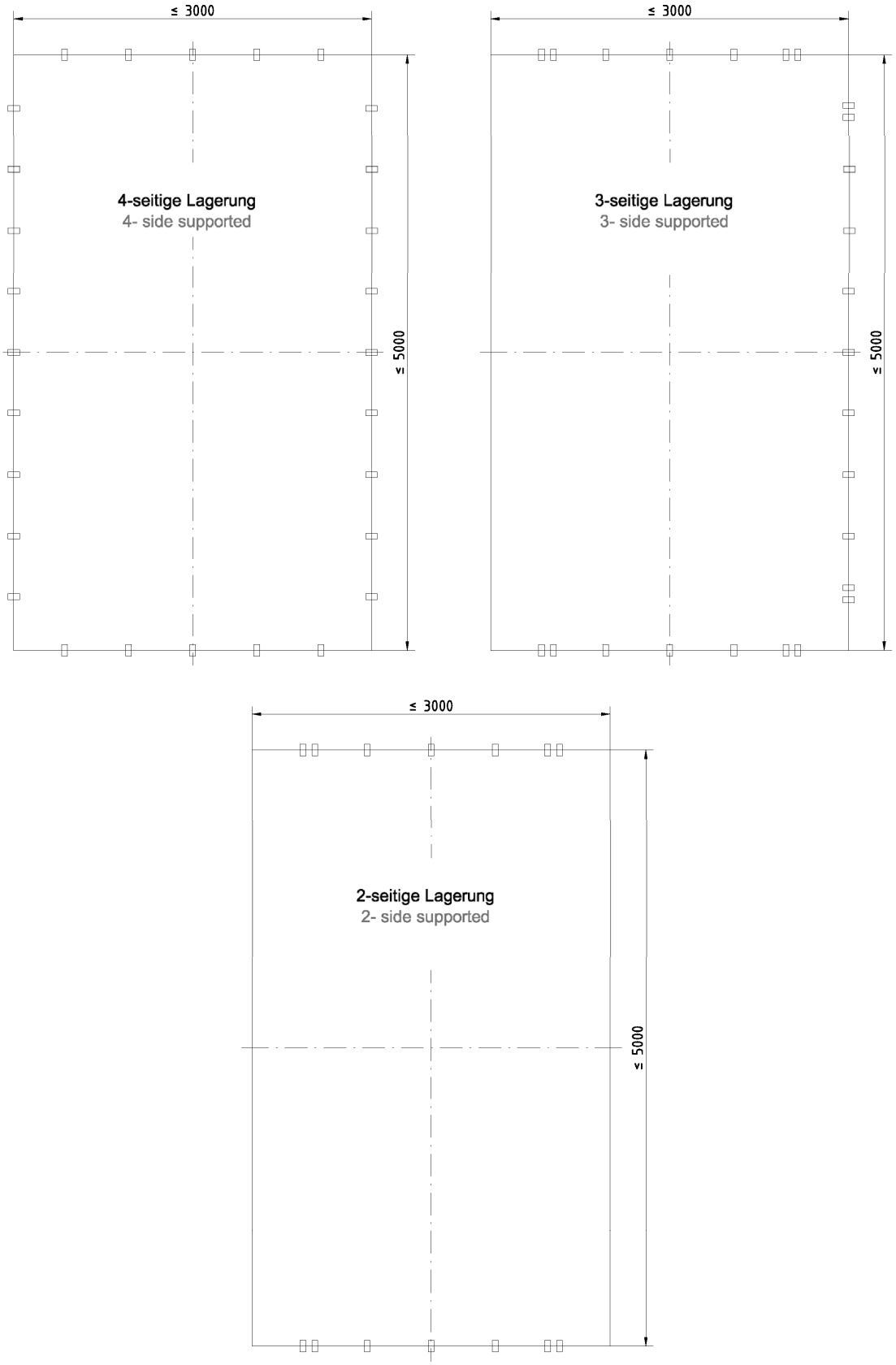


Trigon FS SG	Annex 16
Variants of U-profile arrangements	



Trigon FS SG	Annex 17
Toggles and emergency retainer (glass retainer)	

Deutsches Institut für Bautechnik DIBt



Trigon FS SG	Annex 18
Arrangement toggles	

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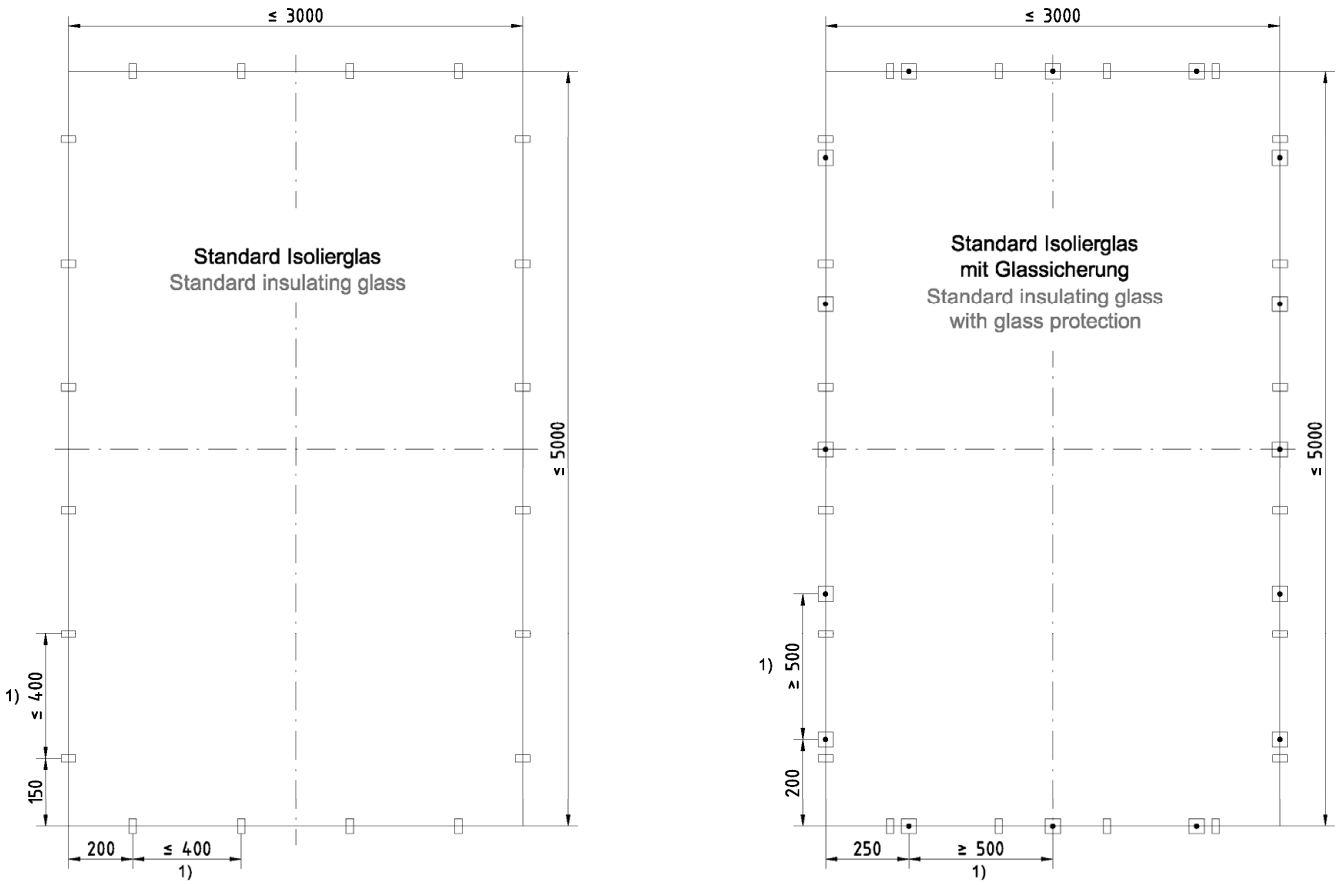


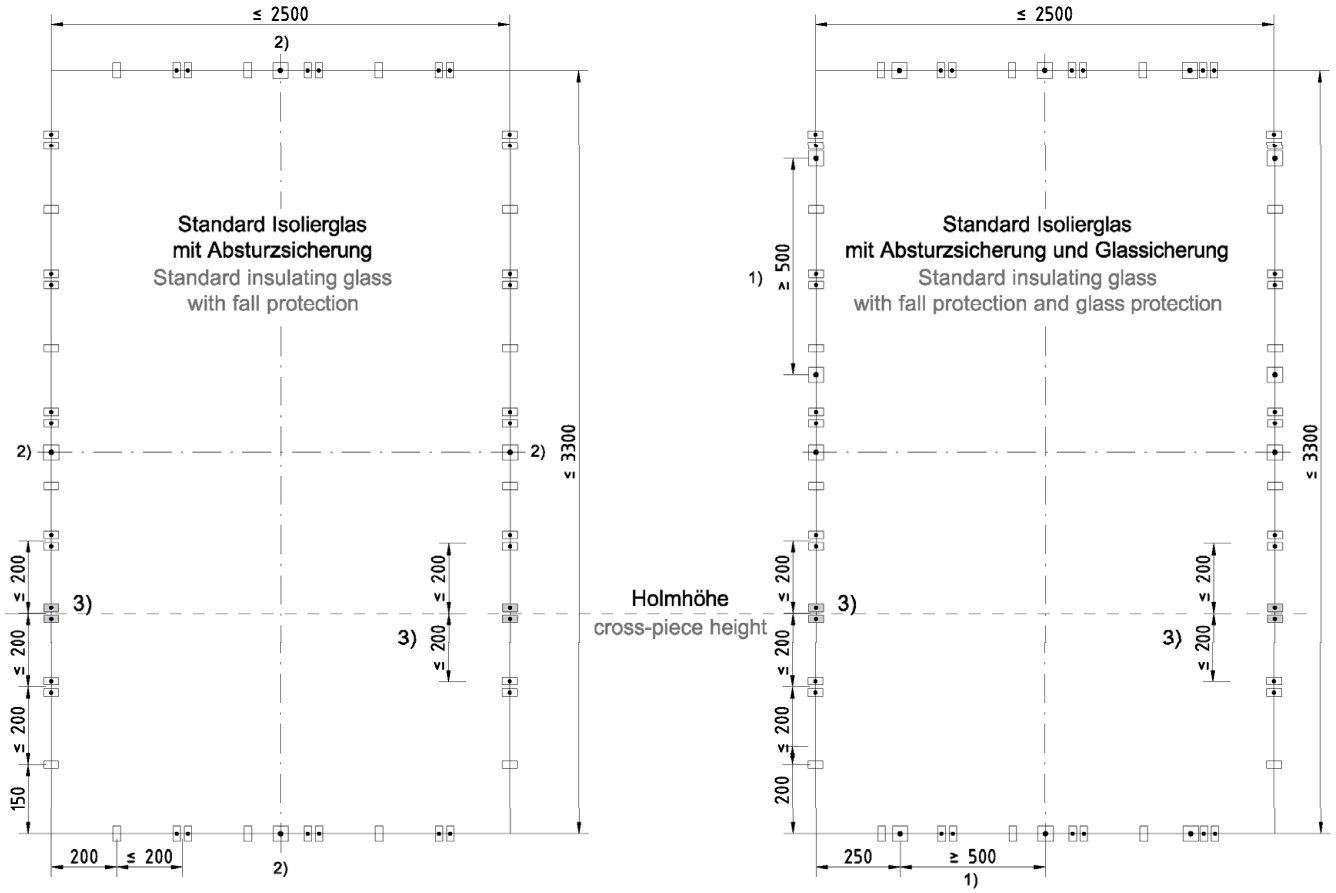
V1 = Glashalter, Standardverschraubung
V1 = Toggle, Standard screwing

Glassicherung, durchgeschraubt
Glass retainer, screwed through

1) Abstandsmaße abhängig von Windlast, siehe Tabellen auf den folgenden Seiten
Distance measurements depending on wind load, see tables on following pages

Trigon FS SG	Annex 19
Arrangement toggles standard	

Deutsches Institut für Bautechnik DIBt



V1 = Glashalter, Standardverschraubung
V1 = Toggle, Standard screwing

V2 = Glashalter, durchgeschraubt
V2 = Toggle, screwed through

V2 = Glashalter zusätzlich im Holmbereich, durchgeschraubt
V2 = Toggle additionally in the cross-piece area, screwed through

Glassicherung, durchgeschraubt
Glass retainer, screwed through

1) Abstandsmaße abhängig von Windlast, siehe Tabellen auf den folgenden Seiten
Distance measurements depending on wind load, see tables on following pages

2) Es ist an mindestens zwei gegenüberliegenden Seiten je eine Glassicherung anzuordnen
Glass retainer shall be fitted on at least two opposite sides

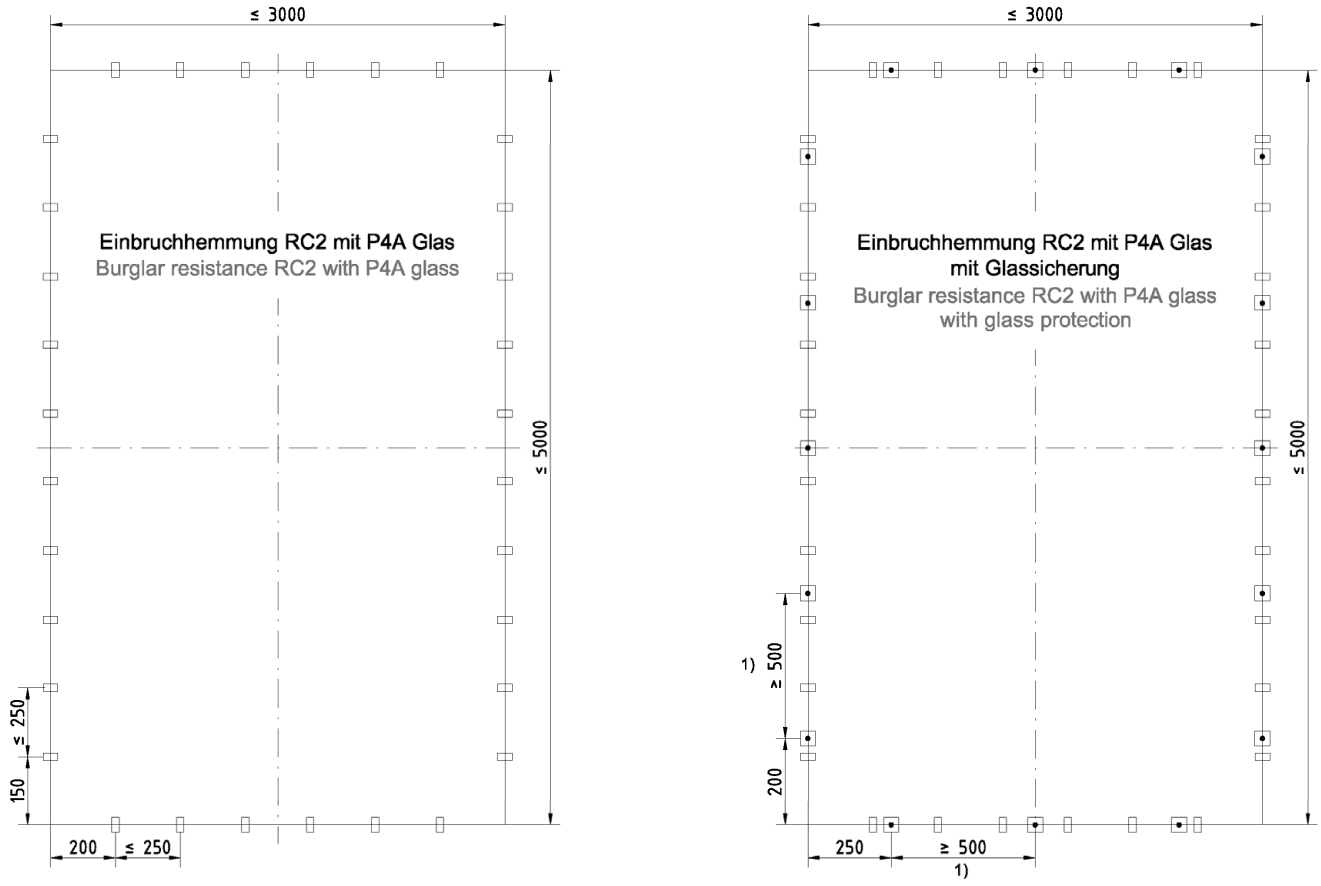
3) Im Bereich von 200 mm über und unter der bauaufsichtlich geforderten Holmhöhe sind im Abstand von 200 mm statt der Standardhalter jeweils 2 Glashalter der Variante V2 einzubauen.
In the range of 200 mm above and below the cross-piece height required by the building authorities, additionally 2 toggles of the V2 variant must be installed together at a distance of 200 mm instead the toggles with standard screwing.

- Verringerter Montageabstand und zusätzliche Glashalter

- Reduced mounting distance and additional toggles

Trigon FS SG	Annex 20
Arrangement toggles with fall protection	

Deutsches Institut für Bautechnik DIBt



V1 = Glashalter, Standardverschraubung
V1 = Toggle, Standard screwing

Glassicherung, durchgeschraubt
Glass protection, screwed through

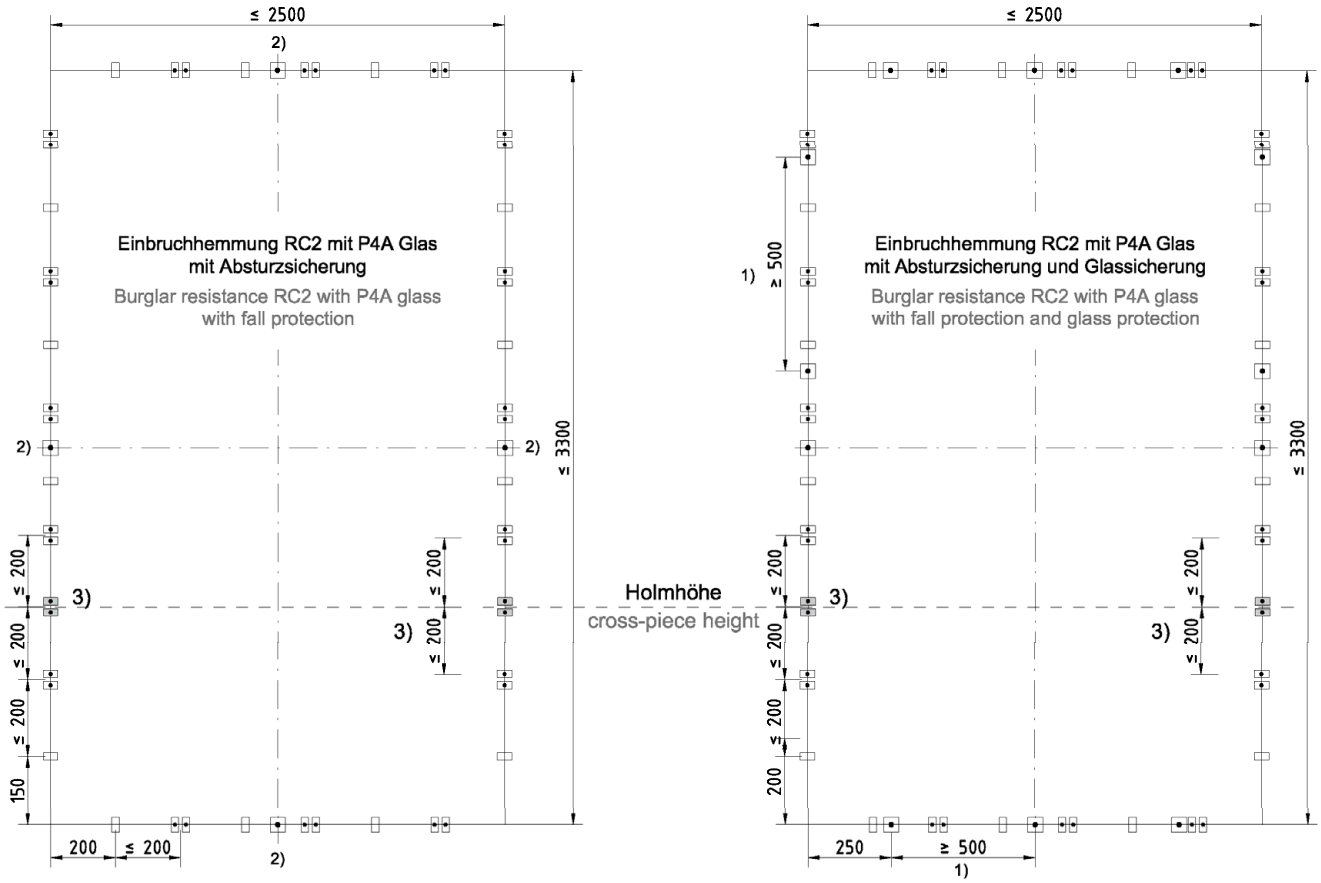
1) Abstandsmaße abhängig von Windlast, siehe Tabellen im Kapitel B4 Verglasung
Distance measurements depending on wind load, see tables in chapter B4 Glazing

RC2
- Verringerter Montageabstand und zusätzliche Glashalter

RC2
- Reduced mounting distance and additional toggles

Trigon FS SG	Annex 21
Arrangement toggles with burglar resistance RC2	

Deutsches Institut für Bautechnik DIBt



V1 = Glashalter, Standardverschraubung
V1 = Toggle, Standard screwing

V2 = Glashalter, durchgeschraubt
V2 = Toggle, screwed through

V2 = Glashalter zusätzlich im Holmbereich, durchgeschraubt
V2 = Toggle additionally in the cross-piece area, screwed through

Glassicherung, durchgeschraubt
Glass protection, screwed through

1) Abstandsmaße abhängig von Windlast, siehe Tabellen im Kapitel B4 Verglasung
Distance measurements depending on wind load, see tables in chapter B4 Glazing

2) Es ist an mindestens zwei gegenüberliegenden Seiten je eine Glassicherung anzuordnen
Glass protection shall be fitted on at least two opposite sides

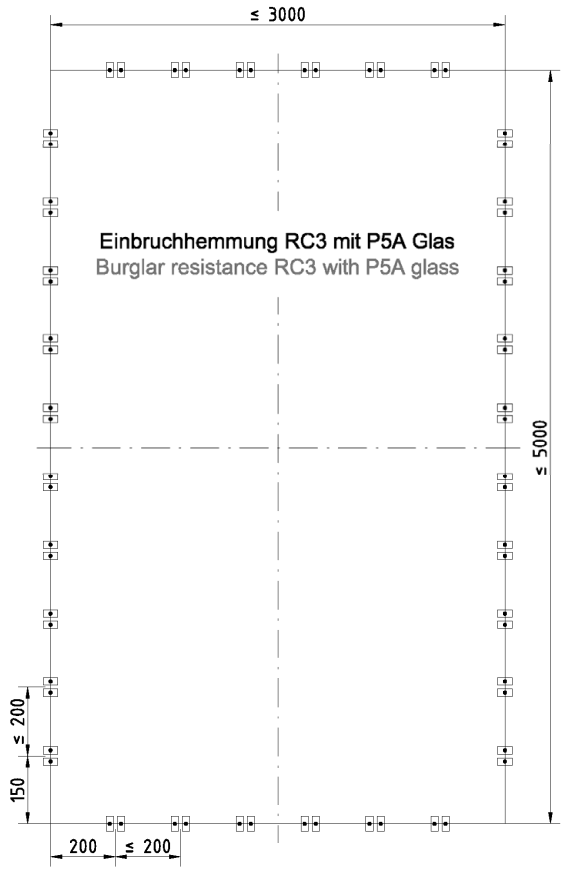
3) Im Bereich von 200 mm über und unter der bauaufsichtlich geforderten Holmhöhe sind im Abstand von 200 mm statt der Standardhalter jeweils 2 Glashalter der Variante V2 einzubauen.
In the range of 200 mm above and below the cross-piece height required by the building authorities, additionally 2 toggles of the V2 variant must be installed together at a distance of 200 mm instead the toggles with standard screwing.

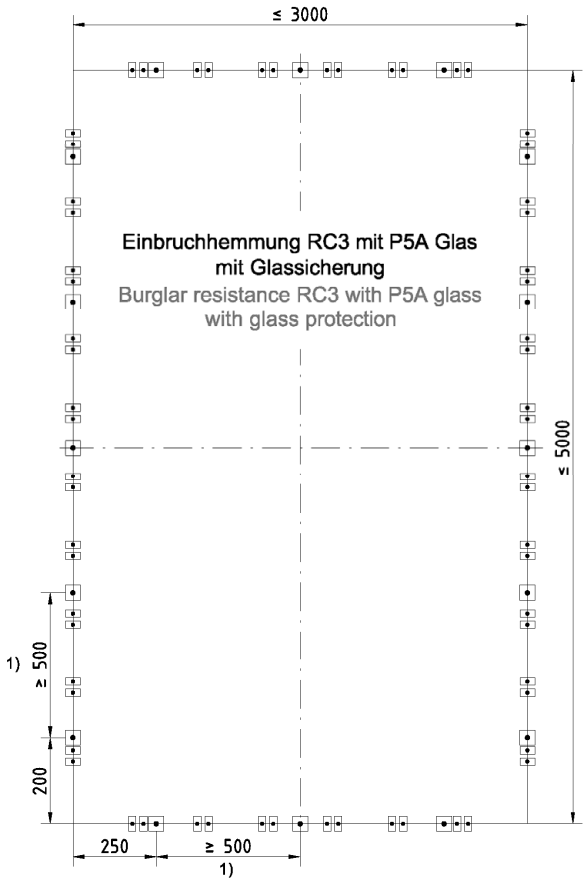
RC2
- Verringerter Montageabstand und zusätzliche Glashalter

RC2
- Reduced mounting distance and additional toggles

Trigon FS SG	Annex 22
Arrangement toggles with burglar resistance RC2 and fall protection	

Deutsches Institut für Bautechnik DIBt





V2 = Glashalter, durchgeschraubt
V2 = Toggle, screwed through

Glassicherung, durchgeschraubt
Glass protection, screwed through

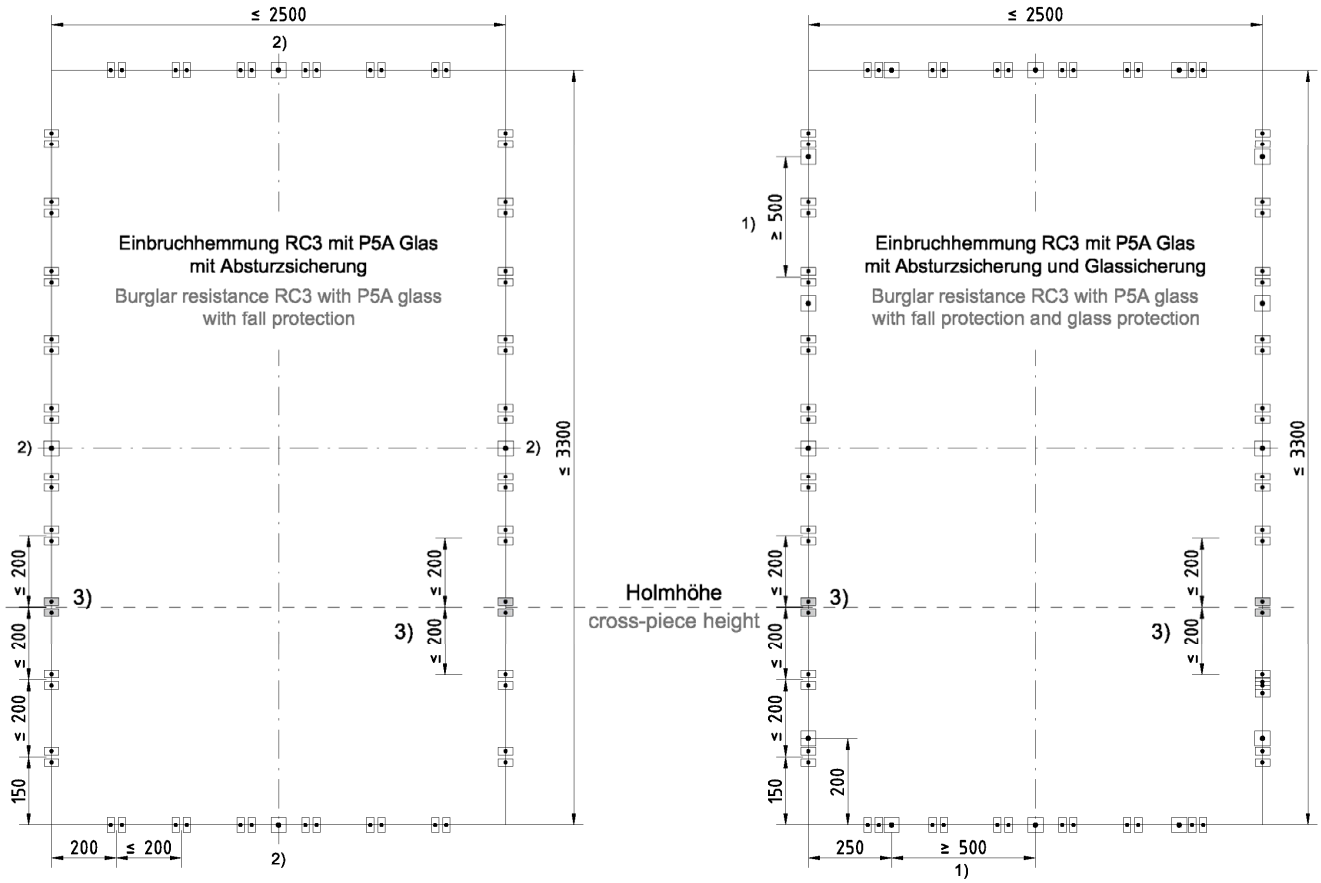
1) Abstandsmaße abhängig von Windlast, siehe Tabellen im Kapitel B4 Verglasung
Distance measurements depending on wind load, see tables in chapter B4 Glazing

RC3
- Verringerter Montageabstand und zusätzliche Glashalter
- Ausschließlich Kreuzglasträger leicht und HD verwenden

RC3
- Reduced mounting distance and additional toggles
- Only use cross glass support light and HD

Trigon FS SG	Annex 23
Arrangement toggles with burglar resistance RC3	

Deutsches Institut für Bautechnik DIBt



V2 = Glashalter, durchgeschraubt
V2 = Toggle, screwed through

V2 = Glashalter zusätzlich im Holmbereich, durchgeschraubt
V2 = Toggle additionally in the cross-piece area, screwed through

Glassicherung, durchgeschraubt
Glass protection, screwed through

1) Abstandsmaße abhängig von Windlast, siehe Tabellen im Kapitel B4 Verglasung
Distance measurements depending on wind load, see tables in chapter B4 Glazing

2) Es ist an mindestens zwei gegenüberliegenden Seiten je eine Glassicherung anzuordnen
Glass protection shall be fitted on at least two opposite sides

3) Im Bereich von 200 mm über und unter der bauaufsichtlich geforderten Holmhöhe sind im Abstand von 200 mm statt der Standardhalter jeweils 2 Glashalter der Variante V2 einzubauen.
In the range of 200 mm above and below the cross-piece height required by the building authorities, additionally 2 toggles of the V2 variant must be installed together at a distance of 200 mm instead the toggles with standard screwing.

RC3
- Verringerter Montageabstand und zusätzliche Glashalter
- Ausschließlich Kreuzglasträger leicht und HD verwenden

RC3
- Reduced mounting distance and additional toggles
- Only use cross glass support light and HD

Trigon FS SG	Annex 24
Arrangement toggles with burglar resistance RC3 and fall protection	