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Subject of the approval:  
UNIGLAS I FACADE Timber-Glass-Composite

The aforementioned subject of the approval is hereby granted general building approval.  
This general building approval covers 19 pages and four annexes.

**Disclaimer:**

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## I. GENERAL PROVISIONS

1. General building approval serves as evidence for the applicability of the approved subject matter in sense of regional building regulations.
2. If the general building approval has requirements for any specific expertise and experience of persons involved in the production of building products and types in accordance with Article 17 (5) of Model Building Code of the corresponding regional regulations, it shall be ensured that this expertise and experience can also be proven through other similar or equivalent proofs from other member states of the European Union. This is also applicable for other equivalent proofs submitted as part of European Economic Community (EEC) treaty and other bilateral treaties.
3. The general building approval does not replace the approvals, consents and certifications legally prescribed for the implementation of the construction project.
4. The general building approval is granted irrespective of the rights of Third Parties, especially privacy protection rights.
5. The fabricator and the distributor of the approved product must provide copies of the general building approval to the users of the approved product irrespective of any other regulations/conditions in "Special provisions" and they shall also emphasise that the general building approval must be available at the place of use. Copies of the general building approval must be provided to the relevant authorities if requested.
6. The general building approval must be reproduced only in full. Any partial publication of the approval requires consent from the German Institute for Structural Engineering. Texts and drawings of brochures should not contradict the general building approval. Translation of the general building approval must include the note "Translation of the original German version not checked by the German Institute of Structural Engineering".
7. The general building approval is granted on a revocable basis. The provisions of the general building approval may be amended or supplemented later, especially if it is required by new technical knowledge.

## II. SPECIAL PROVISIONS

### 1 Approved product and scope

#### 1.1 Approved product

UNIGLAS I FACADE Timber-Glass-Composites with maximum dimensions of 2.50 m x 3.50 m (W x H and H x W) consisting of multiple panes insulated glass or single glass, which is factory fitted with a coupling strip around all four sides (Annex 1) are the approved products here. The multiple pane insulation glass is made of two or three glass panes with supporting insulating glass edge seal. The coupling strip is made of birch veneer laminated wood. A silicone adhesive is used as adhesive for the supporting insulation glass edge seal and for adhesion between glass and coupling strip. Wind loads and stresses, which result from the requirements for fall protection of glass construction, are cleared away over adhesive joints. The dead weight of the elements is cascaded mechanically and transferred to substructure. For any installations exceeding a height of 8 m, mechanical glass pane safety device is used in case adhesive joint fails. The timber-glass-composites are fastened on site with the mullion and transom substructure made of timber materials.

#### 1.2 Scope

The UNIGLAS I FACADE timber-glass-composite is used in a mullion and transom façade vertically and horizontally. When using it as horizontal glazing in accordance with the system description of UNIGLAS GmbH & Co. KG<sup>1</sup>, only inclines, wherein the glass panes are on the top and apply pressure on the adhesive joint, are permitted. For vertical glazing, outward inclines are limited to 5% against the vertical glazing and inward inclines are limited to 10%. In case of an outward incline, a mechanical glass pane safety device according to Section 2.1.5 must be provided. In addition, the overhang of the upper edge under the assumption of aforementioned inclines can be maximum 30 cm over the lowermost edge of the façade.

Use in extremely moist environment (e.g. swimming pools, sauna and wellness areas) is not permitted. The timber-glass-composites must be used only under the climatic conditions of utilization class 1 and 2 in accordance with DIN EN 1995-1-1<sup>2</sup>.

In accordance with DIN 68800-1<sup>3</sup> and DIN 68800-2<sup>4</sup>, the design is classified as use class UC 0. In installed condition, the wood moisture of the coupling strip should not exceed 17%. This value can be exceeded only for a short duration.

For usage in conjunction with corrosion protection, the technical building regulations shall be applicable, especially DIN EN 1995-1-1 in conjunction with DIN EN 1995-1-1/NA and provisions of the general building approval No. Z-30.3.-6<sup>5</sup>. Any ingress of moisture from outside and regular condensation formation must be ruled out.

<sup>1</sup> UNIGLAS GmbH & Co. KG: System description for planning, production and assembly, Version 004 October 2015

<sup>2</sup> DIN EN 1995-1-1:2010-12+A2:2014-07 Eurocode 5: Dimensioning and design of wooden structures - Part 1-1: General - common rules and rules for buildings

<sup>3</sup> DIN 68800-1:2011-10 Wood preservation General

<sup>4</sup> DIN 68800-2:2012-02 Wood preservation - Part 2: Preventive construction measures in buildings

<sup>5</sup> Z-30.3-6 Products, connecting devices and structural components made of stainless steel

The adhesive design of this general building approval corresponds to Type I or Type II based on ETAG 002-1<sup>6</sup>. A mechanical support of the glass dead weight is required for Type I and additionally a mechanical safeguard is required to account for wind loads if adhesion fails. Only a mechanical support and no mechanical safeguard are required for Type II. In Germany, Type II can be used up to an installation height of 8 m.

The timber-glass-composites in accordance with Section 3.1.4 can be used for fall protection corresponding to Category A or C in accordance with DIN 18008-4<sup>7</sup>.

The bracing of other components with UNIGLASS | FACADE timber-glass-composites is not governed by this general building approval.

## 2 Provisions for the building product

### 2.1 Properties and composition

#### 2.1.1 Glass panes

As glass types for single glazing and multiple pane insulation glass thermally pre-stretched - in accordance with the requirements of float glass according to building rule list (BRL) A Part 1 S. No. 11.0 - soda lime single pane safety glass (ESG) according to BRL A Part 1 S. No 11.12 or heat soaked soda lime single pane safety glass (ESG-H) according to BRL A Part 1 S. no. 11.13, composite safety glass (VSG) according to BRL A Part 1 S. NO. 11.14 or partially pre-stretched soda lime glass (TVG) in accordance with general building approval should be used.

For horizontal glazing, composite safety glass is required as lower pane of the insulation glass and it is also required in single glazing.

It should be ensured that above four meter installation height, ESG-H (single pane safety glass - heat soak tested) is always used instead of monolithic ESG as outer pane of the multiple pane insulation glazing. In addition, requirements for fall protection in accordance with Section 3.1.4 shall apply. The multiple pane insulation glass is made of two or three panes, whereby the edge compound has load supporting design. Adhesive Sikasil IG-25 HM Plus in accordance with ETA-11/0391 or Sikasil SG 500 in accordance with ETA-03/0038 is used for this purpose. In the area of the edge compound, only such coatings or enamelling, which are tested as part of the existing ETA [European Technical Approval] for adhesives and listed there.

The maximum possible weight of the multiple pane insulation glass is 525 kg.

On the coupling strip side, only uncoated glass panes should be used in the area of the adhesive joint between glass and wood.

For glazing with requirements for fall protection, only formats and structures according to Section 3.1.4 should be used.

The area of the glass to be glued must be cleaned up and dried immediately before gluing. The specifications of the adhesive manufacturer must be followed.

#### 2.1.2 Coupling strip

The coupling strips must be made of plywood panels made of beech EN 636-3 S in accordance with DIN EN 13986<sup>8</sup> (DIN EN 636<sup>9</sup>) of appearance class S(II) in accordance with DIN EN 635-2<sup>10</sup>. The plywood panels must be at least 12 mm thick. The raw density must be at least 420 kg/m<sup>3</sup>.

<sup>6</sup> ETAG-002-1: Guideline for European technical approval of Structure Sealing Glazing Kits (SSGK); Part 1: Supported and unsupported systems

<sup>7</sup> DIN 18008-4:2013-07 Glass in building - Design and construction rules - Part 4: Additional requirements for barrier glazing

<sup>8</sup> DIN 13986:2015-06 Wood-based panels for use in construction- Characteristics, evaluation of conformity and marking

<sup>9</sup> DIN EN 636:2015-05 Plywood requirements

<sup>10</sup> DIN EN 635-2:1995-08 Plywood - classification based on surface appearance - Part 2: Hardwood

The wood moisture content of the coupling strip must be  $\leq 17\%$ . The coupling strips are coated on all sides, whereby the area remains free for adhesives, i.e. it is free of coating or the coating is removed later. The boundary between coated and uncoated areas is below the distance adhesive tape as planned (Section 2.1.3). The structure of coating is defined by the German Institute for Structural Engineering.

The geometry of the coupling strips is given in Annex 2. To fix the coupling strips to the substructure, holes with a diameter of 3.5 mm are provided at a distance of 120 mm - in addition there is countersunk hole for wooden screws with countersunk screw. The coupling strips are fixed to the substructure with wood screws Würth ASSY 5x70 in accordance with ETA-11/0190 or Spax 5x70 in accordance with ETA-12/0114 with countersunk head and partial thread.

The coupling strips of the adjacent façade elements are offset around grid dimension of 60 mm. The trapezoid geometry of the strips enables interlocking of the adjacent strips and a screw connection in the axis grid (Annex 2).

### 2.1.3 Adhesive

The multiple pane insulation glass is glued with the coupling strip in factory with two-component silicon adhesive OTTOCOLLS660 manufactured by Hermann Otto GmbH, Fridolfing. The adhesive joint thickness is 3.2 mm, width 12 mm or 6.4 mm and 14 mm. To guarantee the adhesive joint, the distance adhesive tape Thermalbond V 2100 made by Saint-Gobain Plastics S.A. is used.

Adhesive properties for identification

Test	ET AG 002-1 Reference	Result
Specific weight (mixing ratio based on volume 10:1 based on weight 11:1)	5.2.1.1	$V_{\text{mean}} = 1.33 \text{ g/cm}^3$
Shore hardness scale A	5.2.1.2	Mean: 39
Thermogravimetric analysis	5.2.1.3	The curve is defined in DIBt.
Colour	5.2.1.4	Black

Important characteristics for adhesive joints

Important characteristic	Performance
Characteristic breaking stress - Pull $R_{q,5}$	0.772 MPa
Characteristic breaking stress - Thrust diagonal to the adhesive joint $R_{q,u,5}$	0.605 MPa
Characteristic breaking stress - Thrust longitudinal to the adhesive joint $R_{q,u,5}$	0.814 MPa
Elasticity module pull or pressure (initial status) $E_0$	1.6 MPa
Elasticity module thrust (initial status) $G_0$	0.37 MPa
Processing time (at 23°C, 50 % r.F.)	$\leq 10$ minutes
Time till adhesive free condition (at 23°C, 50 % r.F.)	90 to 150 minutes
Minimum time till the transport of a glued element	2 days

The regulations on adhesive OTTOCOLL S 660 are provided based on the agreed data and information, which were filed with DIBt. DIBt should be informed about any changes to the product and to the manufacturing process, which may lead to a situation that the data and information do not match, before implementing such changes. DIBt shall decide whether the changes may have an influence on this general building approval and if any change to the general building approval may be required.

#### 2.1.4 Glass support

To spread the dead weight of UNIGLAS | FACADE timber-glass-composites, glass support in accordance with Annex 3 are provided in the lower edges of a element on the left and right side, which is then anchored into the transoms of the substructure.

The glass support consists of a minimum of two and a maximum of six rod dowels and a polyamide block. Rod dowels in accordance with DIN EN 14592<sup>11</sup> in conjunction with DIN 20000-6<sup>12</sup> should be used. The rod dowels have a diameter of 8 mm. The length varies depending on the thickness of the glass panes, the bonding depth in wood is 80 mm. The rod dowels are made of stainless steel based on general building approval Z-30.3-6 with a tensile strength of  $700 \text{ N/mm}^2 \leq f_{u,d,k} \leq 800 \text{ N/mm}^2$ . The characteristic value of the yield moment of the rod dowel  $M_{y,k}$  must be at least 46.8 Nm.

To avoid glass-metal contact, a load bearing block made of polyamide PA6 is placed on the rod dowel, which bear the dead weight loads of the glazing.

#### 2.1.5 Mechanical pane safety device (MPS)

At installation of greater than 8 m, mechanical pane safety devices must be installed for bearing wind suction loads if adhesion fails. The mechanical pane safety device is available in two variants, one with ventilation and one without ventilation. It is made of formed stainless steel sheet, a polyamide insert (PA6) to prevent glass-metal contact and a stainless steel wood screw (Annex 4).

Stainless steel sheet is 2 mm thick and is made of stainless steel with material number 1.4301 or 1.4401 with minimum yield strength of 320 N/mm<sup>2</sup>.

Würth ASSY 3.0 A2 Ø.5 x 80 mm in accordance with ETA-11/0190 made of unhardened stainless steel is used as wood screws. The screw depth in 50 mm. If the minimum screw depth 50 mm cannot be achieved due thickness of the glass design, wood screws Spax HI Force 6 x 120 in accordance with ETA-12/0114 made of unhardened stainless steel should be used.

#### 2.1.6 Sealings

For insulating insulation glazing of UNIGLAS | FACADE timber-glass-composites, only such materials should be used in adhesive area, which have compatibility with the adhesives used (Section 3.1.3). Ottoseal S7 is used for external joint sealing. The material specification is defined by German Institute of Structural Engineering.

#### 2.1.7 Substructure

The substructure is a mullion and transom design made of wood, which be based on applicable technical building regulations. The mullion and transom design may consist of following timber materials:

- Laminated timber in accordance with DIN EN 14080<sup>13</sup> in conjunction with DIN 20000-3<sup>14</sup>,

<sup>11</sup> DIN EN 14592:2012-07 Timber structures - Dowel type fasteners - Requirements

<sup>12</sup> DIN 20000-6:2015-02 application of building products in construction - Part 6: Dowel type and non-dowel type fasteners in accordance with DIN EN 14592 and DIN EN 14545

<sup>13</sup> DIN EN 14080: 2013-09 Timber structures - glued laminated timber and glued solid timber - requirements

<sup>14</sup> DIN 20000-3:2015-02 application of building products in construction - Part 3: Glued laminated timber and glued solid timber in accordance with DIN EN 14080

- Glued laminated timber made of beech or oak in accordance with general building approval or European Technical Approval / Assessment,
  - Structural laminated veneer lumber in accordance with DIN EN 14374<sup>15</sup>.
- The mullion and transom must be at least 60 mm wide.

## **2.2 Production, packaging, transport, storage and labelling**

### **2.2.1 Production**

The UNIGLAS | FACADE timber-glass-composites must be manufactured only in plants and that too only in plants that are approved by the applicant with regard to technical expertise and experience required for the manufacturing of adhesives.. The adhesive plants must be sufficiently trained by the manufacturer of adhesive in accordance with Section 2.1.3. UNIGLAS GmbH maintains a constantly updated list, which lists authorised adhesive plants. This list should be submitted to German Institute for Structural Engineering if requested. The adhesive plants are subject to the corresponding requirements in accordance with Section 2.3.

The wood moisture content must be at least 11% and maximum of 15% before gluing.

The preparation of surfaces to be glued should be done only in accordance with the working instructions defined by the German Institute for Structural Engineering. The adhesive joints in the intermediate area between glass and coupling strip must be filled completely. The thickness of silicone adhesive joints is 3.2 mm and 6.4 mm and width is 12 mm and 14 mm. The exact dimensions should be determined based on calculations.

Bubbles, holes or inclusions in the adhesive are not permitted.

### **2.2.2 Packaging, transport and storage**

Packaging, production and storage should be such that a longer impact of moisture, especially in the adhesive area, can be safely ruled out.

### **2.2.3 Labelling**

The delivery note for UNIGLAS | FACADE timber-glass-composites must be labelled by the manufacturer with a certificate of conformity (C-symbol) in accordance with the certificate of conformity regulations of the countries. The labelling must be done only if the requirements according to Section 2.3 are met.

## **2.3 Certificate of conformity**

### **2.3.1 General**

(1) The certificate of conformity for the glass panes used as well as insulation glazing with the regulations in accordance with Section 2.1.1 should be provided corresponding to the referenced section of the Building Rules List A Part 1 along with the certificate of conformity defined therein. The requirements with regard to in-house production control, external monitoring and certification should be adhered.

(2) The confirmation of conformity of UNIGLAS | FACADE timber-glass-composites with the provisions of this general building approval must be provided for each plant with a certificate of conformity based on in-house production control and in case adhesive designs, this should be augmented with a regular external monitoring of adhesive plants including an initial inspection of UNIGLAS | FACADE timber-glass-composites based on the following provisions.

The manufacturer of the building product should appoint a recognized certification body as well as a monitoring body for the issue of certification of conformity and external monitoring of adhesive constructions including the production test to be implemented as part of this.

<sup>15</sup> DIN EN 14374:2005-02 Timber structures - Structural laminated veneer lumber - requirements



The certification body should submit a copy of the certification of conformity granted by them to the German Institute for Structural Engineering.

## 2.3.2 In-house production control

### 2.3.2.1 General

An in-house production control should be established and implemented in each plant of UNIGLAS | FACADE timber-glass-composites. In-house production control means continuous monitoring of the production to be done by the manufacturer, and this will ensure that the building products manufactured by the manufacturer correspond to the provisions of this general building approval.

To guarantee continuous operation, a person should be appointed who will be responsible to carry out tasks mentioned below. Depending on the respective product, in-house production control should include measures listed in Sections 2.3.2.2 to 2.3.2.5.

If the test results obtained in accordance with Sections 2.3.2.2, 2.3.2.3 and 2.3.2.4 do not meet the requirements, then the manufacturer should take immediate measures to remedy the defects. Insert elements, which do not meet the requirements, should not be used and they should be handled such that any confusion with elements used is safely ruled out. After fixing the defect - to the extent it is technically possible and as proof of remedy of defects - the concerned test must be repeated immediately.

### 2.3.2.2 Description and testing of the raw materials and components

Before processing the required raw materials and components, it is necessary to establish conformity of the relevant product characteristics with the corresponding standards as well as regulations in this general building approval. At least the following should be checked for this purpose:

- For glass panes according to Section 2.1.1, proper labelling in accordance with conformity regulations of the countries should be verified.
- The conformity of coupling strip in accordance with Section 2.1.2 and the applicable European standards should be provided through the proof of conformity defined therein. Proper labelling should be checked. The surface quality of the parts, which are glued for load bearing, must be polished twice (grain 120 and grain 180) and evidence for the same should be provided through an acceptance test certificate "3.1" in accordance with DIN EN 10204<sup>16</sup>. The minimum raw density of 420 kg/m<sup>3</sup> for the raw materials used in coupling strips should be confirmed on delivery.
- Likewise, confirmation should be provided for the conformity of rod dowels of the glass support with the provisions of Section 2.1.4.
- The conformity of the cladding material made of polyamide PA6 according to Section 2.1.4 should be checked for each delivery.
- The conformity of sealings according to Section 2.1.6. with the specification defined by the German Institute for Structural Engineering should be checked for each delivery.
- The conformity of the silicone adhesive according to Section 2.1.1 with the provisions of the relevant ETA should be checked based on CE marking. The batch number should be specified as part of certificate of compliance "2.1" in accordance with DIN EN 10204.
- The conformity of the silicone adhesive according to 2.1.3 should be ensured for each delivery with a certificate of compliance "2.1" in accordance with DIN EN 10204.

<sup>16</sup> DIN EN 10204:2005-01 Metallic products - types of inspection documents



- The conformity of the mechanical pane safety device according to Section 2.1.5 with the provisions mentioned therein should be confirmed through an acceptance test certificate "3.1" in accordance with DIN EN 10204.

2.3.2.3 Controls and tests of the coupling strip before gluing

The wood moisture content of the coupling strip should be determined before gluing. The following condition should be complied with:  $\leq 11\%$  to  $\leq 15\%$ .

It should be checked whether the area of adhesive joint is free of coatings.

2.3.2.4 Controls and tests, which should be carried out during gluing process are the substrate (glass pane and coupling strip) for the samples, which must be done for the below points a., b., and c., must be identical with the materials used in the system produced. The surfaces of glass and coupling strips should be cleaned and pre-treated like glass panes and coupling strips of the current production and this should be done in accordance with the specifications of the adhesive manufacturer.

a. Daily tests of the adhesive

Following tests must be carried out on production days thrice a day in accordance with the specifications of the adhesive manufacturer:

- Homogeneity (free of streaks)
- Pot life
- Shore A hardness

b. Daily adhesion tests samples Type A

On each production day three samples for glass and three samples for birch veneer plywood according to Section 2.1.2 are manufactured, i.e. at the start of production, during production and at the end of production. The samples should be labelled with date and time.

Following materials and tools are required for manufacturing the samples:

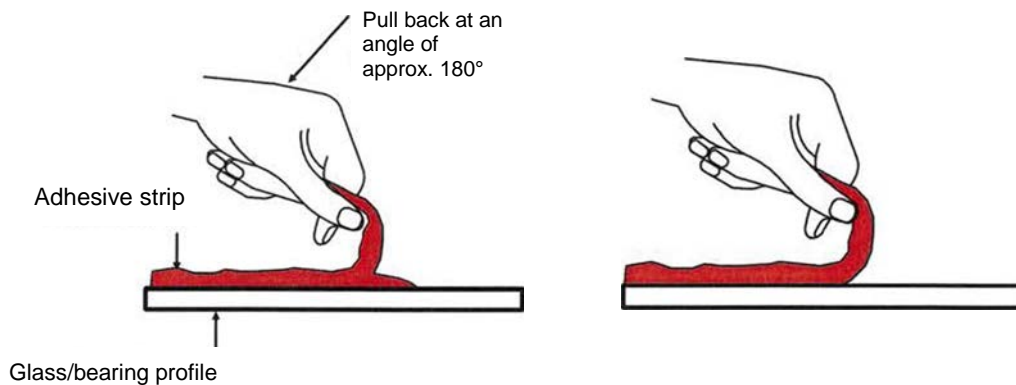
For float glass the minimum size should be approx. 35 mm x 250 mm and for coated ESG the samples must be used in dimension that can be manufactured. The samples should be requested from the suppliers of the coupling strip for each delivery.

- Adhesive from current production.
- Masking tape with a width of approx. 25 mm.
- Trowel with rectangular section 25 mm x 6 mm for creating a defined adhesive strip or smooth trowel and two spacers for limiting adhesive,
- sharp knife or one-sided razor blade.

At a distance of approx. 200 mm, two short pieces of masking tape are glued and an adhesive strip with the dimensions of 25 mm x 6 mm with approx. 250 mm length is placed. This adhesive strip covers the first masking tape, lies approx. 200 mm on the prepared substrate and covers the second masking tape after another 25 mm.

The Type A sample manufactured this way is stored under the same environmental conditions like in the production of elements. After a hardening time of at least 24 hours, following test should be conducted. The adhesive strip is loosened from one end of the substrate, turned and pulled one to two cm under as flat an angle as possible (see image 1). Then the part of adhesive strip remaining on the substrate is cut at the end point of the joint with the knife till the boundary surface of adhesive/substrate and the pull out process as stated above is continued. The process is ended only if the adhesive strip is completely loosened. Tearing must always be done in the adhesive (cohesion fracture). If the adhesive strip tears off completely, test can be continued on other strip ends.

The fracture pattern will be evaluated. Differentiation is made between adhesive (in the separation level of adhesive - substrate) and cohesion fracture (in volume of the adhesive, see image 1). Only cohesion fracture is permitted in adhesive. The results should be logged in the log of in-house production control. All samples manufactured daily should be retained till the next external monitoring.

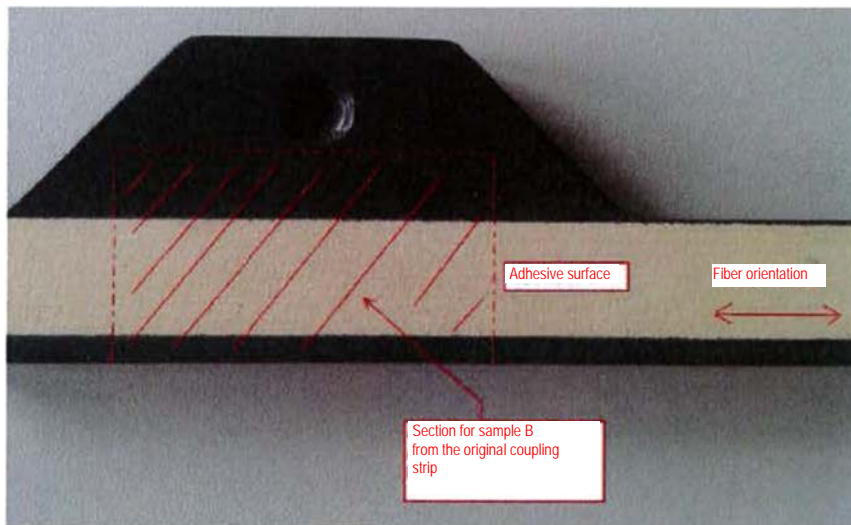


**Image 1** Adhesion test of type A samples (left: example for cohesion fracture, evaluation positive, right: example for cohesion fracture, evaluation negative)

c. Object-related tests of Type B samples

In accordance with the agreements with the approval holder from the original profile of the coupling strip, the "adhesive plant" must cut out short pieces in the length of 50 mm and width of 27.5 mm in the corresponding quantity for manufacturing Type B samples (see Image 2). The adhesive surface must be free of top layer glazing over the entire length of sample of 50 mm. Type B samples for tensile tests are produced from short piece, silicone and substrate glass. If the "adhesive plant" cannot carry tensile tests for Type B samples as part of in-house control, then such tests must be carried out by the adhesive manufacturer or by a recognized material testing body.

Three samples should be produced after opening each new adhesive bonding and at least twice in a week. Type B samples should be tested in tensile test at a right angle to the adhesive joint. The smallest value of breaking stress must be at least 0.76 N/mm<sup>2</sup>. The proportion of cohesion fracture must be at least 90% of the fractured surface.



**Image 2** Short piece made of coupling strip

An extensive description of the test is provided in Annex 3 of the system description of the applicant, which is filed with DIBt. The specifications mentioned therein should be followed.

2.3.2.5 Test, which must be carried out on completed UNIGLAS | FACADE timber-glass-composites

During the gluing process, all the UNIGLAS | FACADE timber-glass-composites to be manufactured must be checked for cavities or bubbles in the adhesive joint by means of a visual inspection. The results of the visual inspection must be documented.

2.3.2.6 Object documentation

The results of the in-house production control should be logged and evaluated in the form of an object documentation. The logs must include at least the following information:

- Description of the construction product and the raw material and the components
- Object-related data on quantity, dimensions, superstructures, representation of adhesion, delivery date, special characteristics during production
- Type of control or test
- Date of production and the testing of the building product or the raw material or the component
- Result of the controls and tests and comparison with the requirements if needed
- Signature of the person responsible for in-house production control

The object documentation must be retained for at least ten years and submitted to the monitoring body commissioned for external monitoring purposes. The documentation should also be submitted to the German Institute for Structural Engineering and relevant higher supervisory authorities on request.

### **2.3.3 External monitoring of the adhesive plants and manufacturer of the coupling strip**

In each plant for adhesives and coupling strips, the in-house production control must be audited by an external monitoring authority at least twice a year.

As part of this external monitoring, an initial test of UNIGLAS | FACADE timber-glass-composites must be carried out. Further specifications should be implemented in accordance with directives from external monitoring authority. The sampling and tests are the responsibility of the recognized monitoring authority. The results of the certification and external monitoring should be retained at least for a period of ten years. They should be submitted by the certification body or the monitoring authority to the respective higher building approval authority and the German Institute for Structural Engineering on request.

In case of negative tests, the monitoring authority should carry out special tests. Building products, which do not meet the requirements, should not be use and they should be handled such that any confusion with compliant product is safely ruled out. After fixing the defect - to the extent it is technically possible and as proof of remedy of defects - the concerned test must be repeated immediately.

If the production has been stopped for more than 12 months, a special test should be carried out when intended restart of production is notified. Type and scope of special test should be determined by the monitoring authority for individual cases in line with the purpose of the tests.

## **3 Provisions for design and dimensioning**

### **3.1 Design**

#### **3.1.1 UNIGLAS | FACADE Timber-Glass-Composites**

The UNIGLAS | FACADE timber-glass-composites can be used up to an installation height of 8 m without any mechanical pane safety device. This is also applicable for anti-fall glazings.

In case of installation heights exceeding 8 m, mechanical pane safety devices according to Section 2.1.5 should be provided.

#### **3.1.2 Glass support**

In all UNIGLAS | FACADE timber-glass-composites, the dead weight should be transferred mechanically. The glass supports must be arranged in such a way that evens the outer panel of the insulation glazing is sufficiently supported.

#### **3.1.3 Adjacent materials in glued UNIGLAS | FACADE timber-glass-composites**

The adhesives should be used only with surfaces for which there is proof of sufficient compatibility and adhesion. Adjacent materials can be used in combinations according to the following table.

Combinability of load bearing adhesive and adjacent materials								
Manufacturer	Load bearing Adhesive	Inner sealing / Butyl				Spacing strip Covering profile Sealing		Glass support Blocking
		BU-S, Fa. Kömmerling	Butylver, Fa. Fenzi SA	Basic Polyisobutylene, GD 115, Fa.	Sika Glaze IG-5, SIKA SERVICES	Ottoseal S7	Thermalbond V2100 by Saint-Gobain Performance Plastics Chainex S.A.	
Sika AG	Sikasil SG 500	X	X		X	X		X
	Sikasil IG25 HM Plus		X	X		X		X
Hermann Otto GmbH	OTTOCOLL S 660						X	X

### 3.1.4 Anti-fall glazings

For UNIGLAS | FACADE timber-glass-composites, evidence under impact-type influences for anti-fall mechanism is provided in the approval process for the formats and structures listed below.

Irrespective of the proven shock resistance, even static evidence with capping loads for closed elements should also be provided for fall safety in accordance with DIN 18008-4.

Multiple pane insulation glass made of two panes:

Glass pane facing shock: 8 mm single pane safety glass (ESG or ESG-H)

Pane intermediate space 16 mm

Glass pane facing away from shock: 8 mm composite safety glass made of 2x4 mm float glass with 0.76 mm PVB foil

Multiple pane insulation glass made of three panes:

Glass pane facing shock: 8 mm single pane safety glass (ESG or ESG-H)

Pane intermediate space 16 mm

Middle glass pane: 6 mm single pane safety glass (ESG or ESG-H)

Pane intermediate space 16 mm

Glass pane facing away from shock: 8 mm composite safety glass made of 2x4 mm float glass with 0.76 mm PVB foil

Following dimensions for two different categories are permissible for the glass structures listed above:

Category A - pendulum drop height 900 mm  
Minimum / maximum width = 540 mm / 2340 mm  
Minimum / maximum height = 1200 mm / 3540 mm

Category C - pendulum drop height 450 mm  
Minimum / maximum width = 540 mm / 2340 mm  
Minimum / maximum height = 540mm / 1100 mm

### 3.2 Proof of structural stability and sag

#### 3.2.1 General

Proof should be provided for the structural stability of UNIGLAS | FACADE timber-glass-composites and their fixing in support structure. At least the following should be taken into consideration:

- Dead weight
- Wind loads (pressure and suction)
- Temperature
- Wood moisture change
- Climatic requirements in accordance with DIN 18008-1:
- Capping loads for Category A anti-fall glazings

The evidence for load bearing capacity of anti-fall designs under static influence should be provided for intact adhesive joints.

In case of "failure of adhesion, the complete wind load should be proven under assumption of extraordinary load.

With regard to the dimensioning of timber-glass-composites and their fixing to the substructure, the technical building rules shall be applicable if it is not agreed otherwise in the following.

#### 3.2.2 Proof for glass panes

The proof for structural stability and deflection of glass panes of UNIGLAS | FACADE timber-glass-composites should be provided in accordance with DIN 18008-1<sup>17</sup> and DIN 18008-4. For use at an installation height exceeding 8 m, proof for the glass panes for load bearing over adhesive joint as well only over mechanical pane safety devices should be provided (Section 3.2.3).

With regard to proof of glass panes in accordance with DIN 18008, the failure of adhesion and bearing of the panes over mechanical panel safety devices should be treated as extraordinary load condition with corresponding part safety co-efficient.

#### 3.2.3 Proof of mechanical pane safety device (MSS)

When using timber-glass-composites at an installation height of more than 8 m, the structural stability should be also be proven under the assumption that the adhesion is no longer effective and thus the external glass pane is held over the mechanical pane safety device (MSS) in accordance with Annex 4.

<sup>17</sup> DIN 18008-2:2010-12 Glass in building - Design and construction rules - Part 1: Concepts and general principles: Part 2: Linearly supported glazings Correction to DIN 18008-2:2010-12 Edition 2011-04

The load bearing capacity of the mechanical pane safety device is calculated from the characteristic pull out load capacity of the screw in accordance with Section 2.1.5, which is calculated based on the following equation.

$$R_{ax,Rk} = \min \{12.0 \cdot d \cdot l_{ef} \cdot (p_k / 350)^{0.8}; 3910 \text{ N}\}$$

Here:

- d Outer diameter of thread screw in mm  
Screws in accordance with ETA-11/0190 d = 5.0 mm  
Screws in accordance with ETA-12/0114 d = 6.0 mm
- l<sub>ef</sub> Effective binding length of the screws in the substructure in mm  
l<sub>ef</sub> ≥ 50 mm
- PK Characteristic raw density of the substructure according to Section 2.1.7 in kg/m<sup>3</sup>  
The raw density of 500 kg/m<sup>3</sup> can be used for glued laminated timber and veneer laminates made of softwood 590 kg/m<sup>3</sup> is allowed for glued laminated timber and veneer laminate made of hardwood.

### 3.2.4 Proof for adhesive joints

For UNIGLAS | FACADE timber-glass-composites proof should be provided that the adhesive joints do not experience any pulling or pushing load higher than the ones permitted in Section 2.1.3 under the conditions mentioned in Section 3.2.1. The proof can be provided based on Annex 2 of ETAG 002-1. The influence of angular adjustment between glazing and coupling strip on the load bearing capacity of adhesion was tested as part of the approval process and is of lower importance.

Due to different thermal expansions between glass and coupling strip and the expansion and contraction behaviour of wood, there will be induced stresses in the adhesive joints. This should be taken into consideration when providing proof for adhesive joints. The length of the coupling strip should be limited accordingly.

Following proofs should be provided based on ETAG 002-1 in accordance with global safety concept v<sub>tot</sub> = 6:

The permissible tensile and shear stress of the adhesive due to wind and capping load factors as well as interaction of entire tensile stress and shear stress between adhesive joint and coupling strip should be strictly adhered. Different length changes between the coupling strip and glass from temperature factors and expansion and contraction factors due to wood moisture contents limited to 6% should be considered. The interaction proof should be provided as follows through linear overlay of both loads.

$$\frac{S_{d, \text{Overall tensile stress}}}{R_{d, \text{tensile stress}}} + \frac{S_{d, \text{stress, shearing stress}}}{R_{d, \text{shearing stress}}} \leq 1$$

Aforementioned proofs result in maximum length of individual coupling strip pieces depending on influencing factors and glass dimensions.

To consider deformations and plasticisation in adhesive, the length change due to contraction and expansion for glued laminated wood should be calculated with an expansion and contraction factor of 0.01% for each 1% change in wood moisture content.

### 3.2.5 Sag

The specifications for limiting sagging as provided by the manufacturer of insulating glass should be followed.



### 3.2.6 Proof for glass support

Proof should be provided for the glass support according to Section 2.1.4 for dead weight loads of UNIGLAS | FACADE timber-glass-composites applicable for each use case. Proofs in threshold conditions of load bearing capacity (GZT) as well as threshold condition of usability (GZG) should be provided.

Here the resistance values should be calculated based on following equation:

$$R_{v,k,GZT} = 1.15 \cdot f_{h,k} \cdot d \cdot \left( -a + \sqrt{a^2 + \frac{2 \cdot M_{y,k}}{f_{h,k} \cdot d}} \right) \text{ for each rod dowel}$$

$$R_{v,k,GZG,1mm} = \left( \frac{\rho_{mean}}{500} \right)^{1.5} \cdot \frac{85}{a^{1.5}} \text{ for each rod dowel}$$

with:

$f_{hk}$  Characteristic bearing stress of the substructure in accordance with Section 2.1.7 in  $N/mm^2$

$$f_{h,k} = 0.082 (1 - 0.10 d) \cdot p_k$$

$P_k$  Characteristic raw density of the substructure according to Section 2.1.7 in  $kg/m^3$

The raw density of  $500 kg/m^3$  can be used for glued laminated timber and veneer laminates made of softwood  $590 kg/m^3$  is allowed for glued laminated timber and veneer laminate made of hardwood.

$P_{mean}$  Mean raw density of substructure according to Section 2.1.7 in  $kg/m^3$

$d$  Nominal diameter of the rod dowel in mm

$$d = 8 \text{ mm}$$

$a$  Adhesive joint thickness + distance of centre of gravity of glazing in mm (according to Annex 3)

$M_{y,k}$  Characteristics yield moment of the rod dowel

$$M_{y,k} = 46800 \text{ Nmm}$$

Proofs in threshold condition of load bearing capacity (GZT) and in threshold condition of usability (GZG) should be provided for each glass support as follows:

$$\text{GZT: } n = \frac{\gamma_F \cdot F_{E,k}}{k_{mod} \cdot \frac{n \cdot R_{v,k,GZT}}{\gamma_M}} \leq 1.0 \text{ with: } \gamma_M = 1.3 ; k_{mod} = 0.6 \text{ for KLED constant}$$

$$\text{GZG: } n = \frac{F_{E,k}}{n \cdot R_{v,k,GZG,1mm}} \leq 1.0$$

with:

n Number of rod dowels for each glass support  $2 \leq n \leq 6$

If more than two rod dowels are used per side, proof should be provided for sufficient stiffness of the substructure considering uniform load distribution. Deformation limit of  $l/500$  should be followed for transom. If required a cross pass proof should be provided for the transom. Proof should be provided in accordance with DIN EN 1995-1-1/NA:2013-08 Section NCI for 8.1.4 and NCI NA.6.8.2.

### 3.2.7 Proof for mounting on the substructure

The characteristic value of load bearing capacity of a screw  $R_{ax,k}$  for load during pulling out process is:  $R_{ax,k} = 366 \text{ N}$ .

As the varying stiffness with increased load on screws can be expected on the impact side due to positioning, following method should be followed for calculating screw load.

The calculation of screw load  $F_{ax,Ed}$  is done by using a single span girder and cutting a panel strip with a width of the screw distance of 0.12 m.

$$F_{ax,Ed} = Y_F q_p C_{pe} b/2 \cdot 0.12$$

$Y_F$  Part safety co-efficient for impact, which considers possibility of unfavourable size deviations of impact

$b$  smaller dimension of the timber-glass-composite (W or H) [m]

$C_{pe}$  External pressure co-efficient in accordance with DIN EN 1991-1-4:2010-12 in conjunction with DIN EN 1991 -1 -4/NA:2010-12

$q_p$  Peak velocity pressure in accordance with DIN EN 1991-1-4:2010-12 in conjunction with DIN EN 1991-1-4/NA:2010-12 [kN/m<sup>2</sup>]

Adherence to the follow equation should be proven:

$$\eta = F_{ax,Ed} / R_{ax,d} \leq 1.0.$$

### 3.3 Fire safety

**3.3.1** The regulations of regional building laws should be strictly followed for fire safety. Accordingly the materials used must have normal inflammability - material class DIN 4102-B2.

**3.3.2** The fire resistance can be evaluated only for the entire construction and separate proof for the same should be provided if required, e.g. as part of general building approval or based on agreement in individual cases.

## 4 Provisions for design

It should be noted that the weight of UNIGLAS | FACADE timber-glass-composites is limited to 525 kg and dimensions to 2.50 m x 3.50 m.

For transferring dead weight loads of the elements to the transom, holes should be provided for the rod dowel in accordance with Section 2.1.4 by means of a drilling jig. This will ensure that the tolerances remain in acceptable range. During assembly, the panes are first placed on glass support. The glass supports are fixed to the substructure with rod dowels. The distance of the rod dowel to each other is always 30 mm. The rod dowel penetrates 80 mm into the timber construction. Then the coupling strip is screwed to the substructure.

For fixing the rod dowel to the glass support and screws of the mechanical pane safety device in the substructure, the values in accordance with DIN EN 1995-1-1 in conjunction with DIN EN 1995-1-1/NA or European Technical Approval/Evaluation should be followed as minimum distances.

The UNIGLAS | FACADE timber-glass-composites should be used in load bearing constructions in such a way that there is no bending in the elements. The adhesion process and assembly should be carried out only by trained professionals, who have been trained by Hermann Otto GmbH or UNIGLAS GmbH & Co. KG for such tasks. UNIGLAS GmbH & Co. KG maintains a constantly updated list, which lists authorised adhesive and assembly companies. This list should be submitted to German Institute for Structural Engineering if requested. The adhesive plants are subject to the corresponding requirements in accordance with Section 2.3.

Stricter requirements than the ones specified by DIN 18202 or DIN 18203 are stipulated for substructure with regard to tolerance to be followed. These were calculated from planned joint between coupling strip of two adjacent façade elements, which are on 5 mm joint width. The requirements can be taken from the following figure.

The offset of mullions against transoms in the façade level can be a maximum of  $\pm 0.5$  mm.

For fixing the UNIGLAS | FACADE timber-glass-composites to the substructure, screwdrivers with torque limiter should be used for applying screws to fix the coupling strips. The screw depth into the substructure must be at least 50 mm. The torque should be set such that the screws are aligned perfectly in the coupling strips. In case of very deeply placed screws (more than 1 mm), it may lead to reduced loading bearing capacity of the coupling strips due to damages.

The screws for fixing the coupling strips can be used in substructures made of softwood without pre-drilling or pre-drilled wood parts, whereby the diameter of pre-drilled hole must correspond to the values of the following table. In the substructures made of beech or oak wood, the screws can be placed only in the pre-drilled holes. The diameter of the pre-drilled holes must correspond to the values listed in the following table.

Thread external diameter	Diameter of the holes to be drilled with a tolerance of $\pm 0.1$ mm [mm]	
	Substructure made of softwood	Substructure made of beech or oak wood
5.0	3.0	3.5
6.0	4.0	4.0

The coupling strips should be installed with a moisture content that can be expected during normal use. The wood moisture content of the coupling strips must be at least 11% and maximum of 15% before assembly.

## 5 Provisions for maintenance

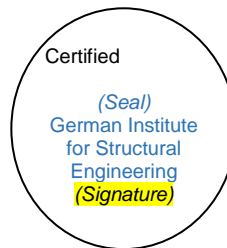
### 5.1 Cleaning

The cleaning of the facade should be done only with water plus maximum 1% of tensides without any other chemical additives.

### 5.2 Replacement of components

When replacing damaged or destroyed panes, it should be ensured that the panes, which correspond to the general building approval, are used. The installation should be done such that the holding of the pane in the frame is done in a specific sequence.

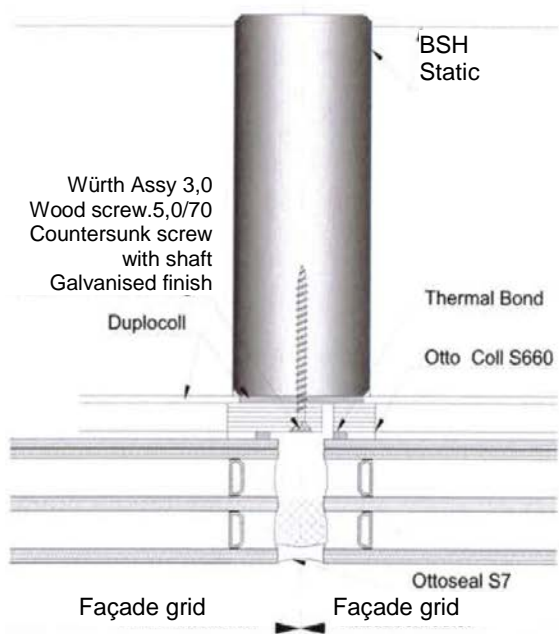
Andreas Schult  
Head of Department



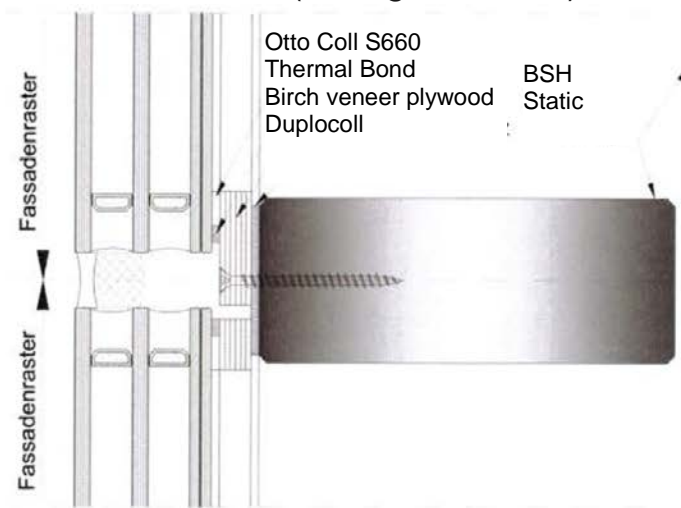
**Isometric view of the locking bolts to the mullion**



**Horizontal view (through mullion)**



**Vertical view (through transom)**



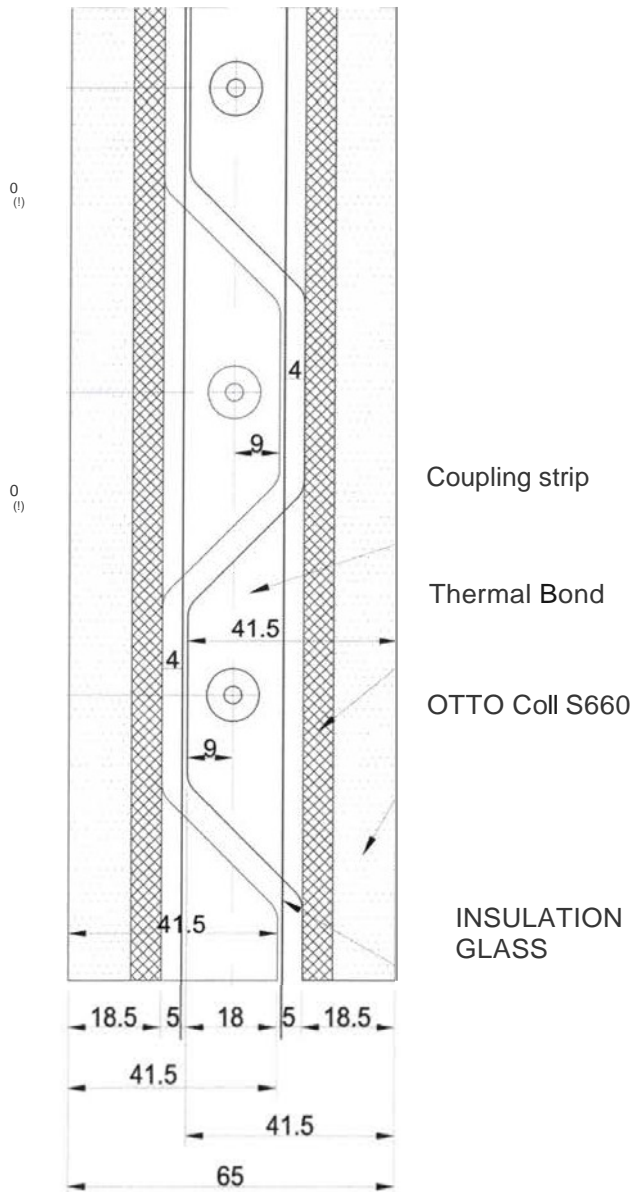
**(View without scale)**

UNIGLAS I FACADE Timber-Glass-Composite

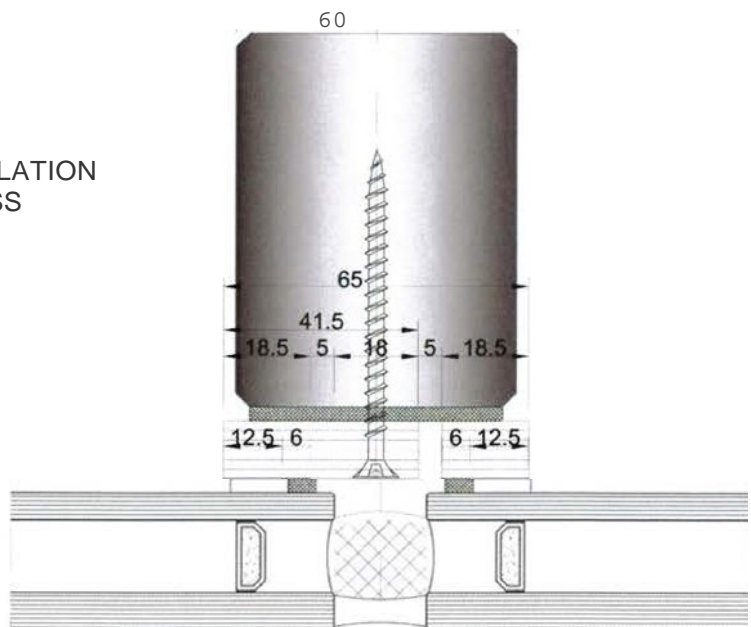
System

Annex 1

**Coupling strip (birch veneer plywood)**  
 Top view (without scale)



**Connection of the coupling strip**  
 (without scale)

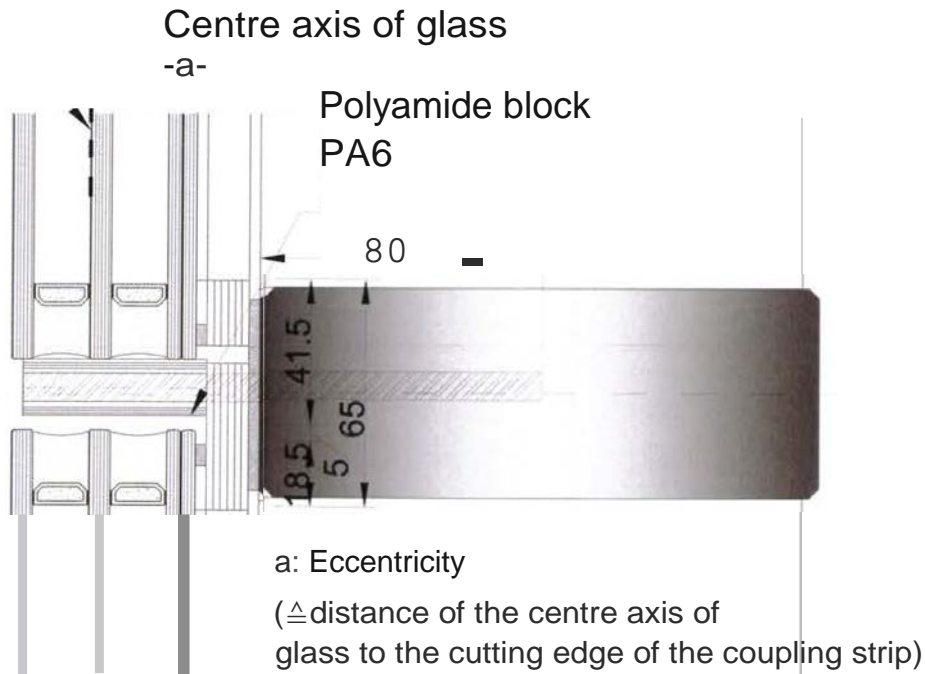


UNIGLAS I FACADE Timber-Glass-Composite

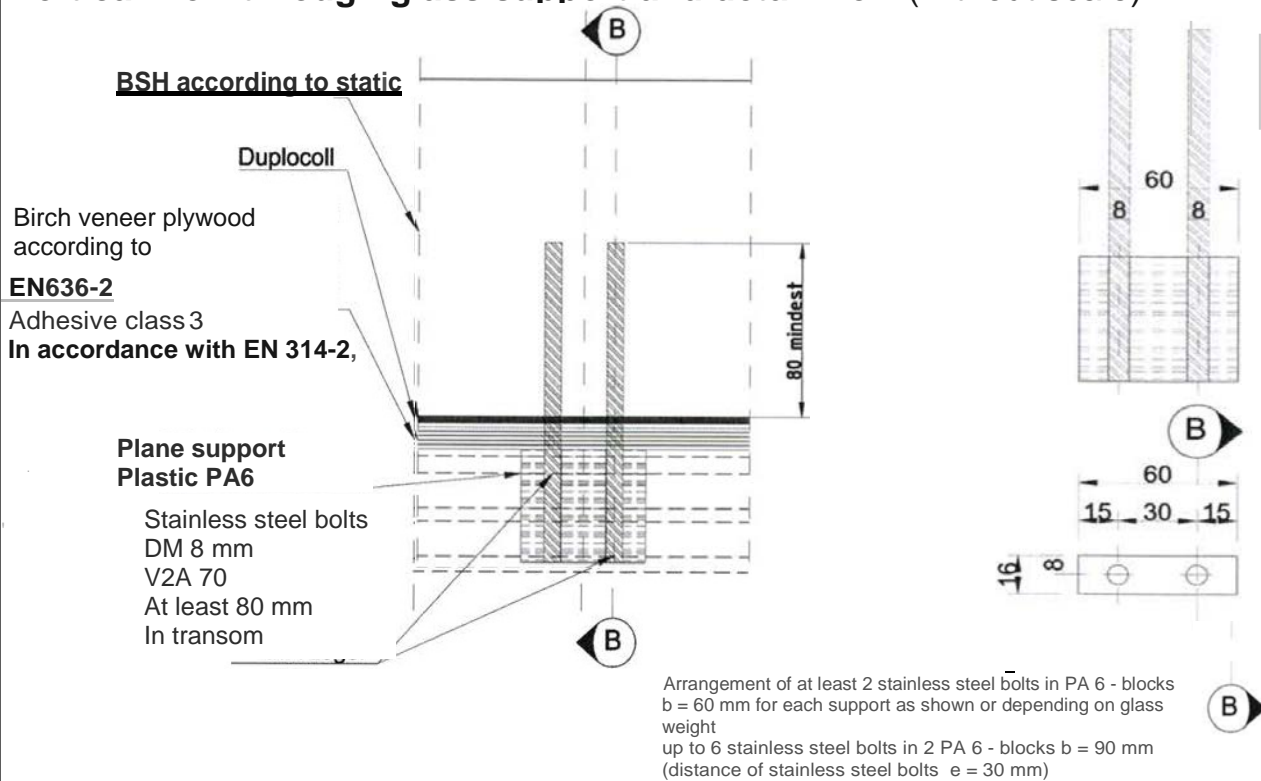
Coupling strip

Annex 2

### Horizontal view through glass support (without scale)



### Vertical view through glass support and detail view (without scale)

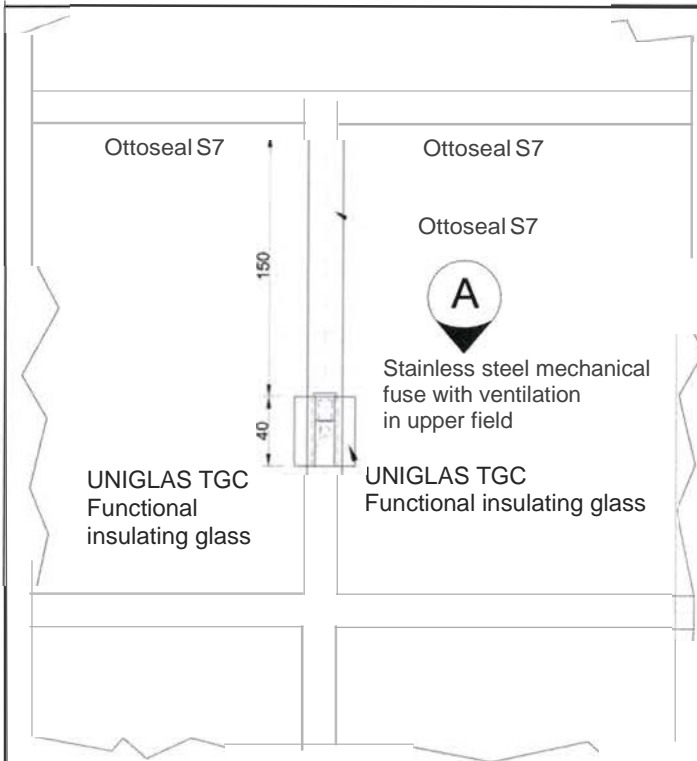


UNIGLAS I FACADE Timber-Glass-Composite

Glass support

Annex 3

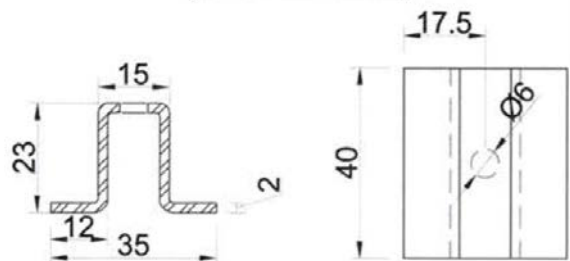




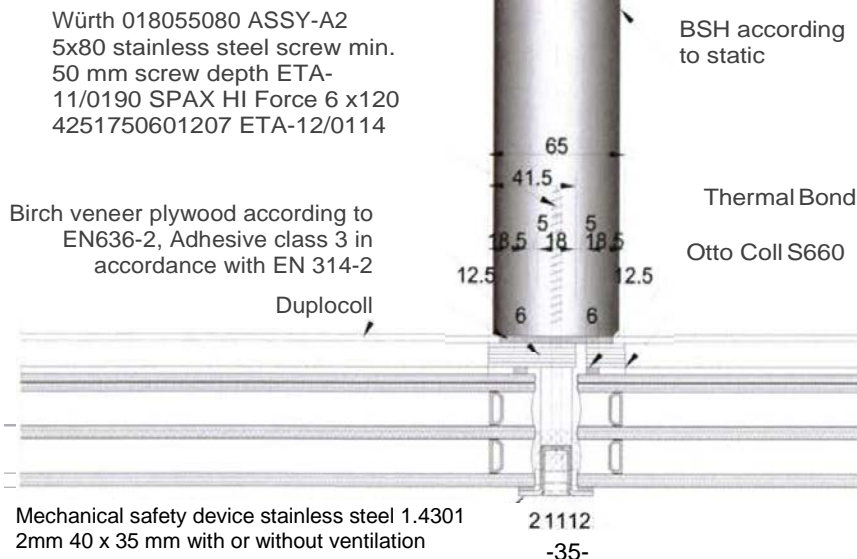
### Mechanical pane safety device MSS

(at installation height above 8.00 m over ground upper MSS of upper most pane with ventilation)

### MSS without ventilation (without scale)

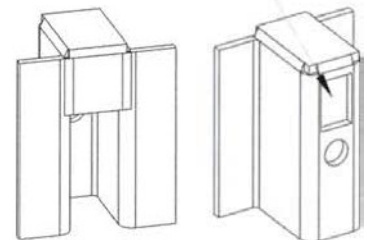


### Horizontal section through MSS (without scale)



### MSS with ventilation (Isometric)

Ventilation opening



UNIGLAS I FACADE Timber-Glass-Composite	Annex 4
Mechanical pane safety device MSS	