CONTENTS

1. SCOPE OF APPLICABILITY
2. DEFINITIONS AND CLARIFICATIONS
  2.1 Types of supports
  2.2 Types of glass and acrylic glass
  2.3 Design calculation standards
  2.4 Material properties of glass products
3. STAND DESIGN, CONSTRUCTION AND LOADS
  3.1 Vertical glazing not intended to prevent falling
    3.1.1 Vertical glazing of a height h ≤ 4 meters above hall floor level
    3.1.2 Vertical glazing of height h > 4 meters above hall floor level
  3.2 Vertical glazing intended to prevent falls
    3.2.1 Category A – vertical glass wall
    3.2.2 Category B – clamped glass balustrade with continuous handrail
    3.2.3 Category C – Railing and balustrade infills and glass walls with load-distributing cross-bar fitted in front of it
  3.3 Horizontal glazing
    3.3.1 Overhead glazing
    3.3.2 Glazing designed to support human loads
4. APPROVAL PROCEDURES
  4.1 Basics
  4.2 Installation approval for a specific case
5. NOTES ON DESIGN AND DESIGN CALCULATIONS
6. EXAMPLES OF STRUCTURES (BARRIERS) DESIGNED TO PREVENT FALLS
  6.1 Category B
  6.2 Category C1
    6.2.1 Railing infills secured vertically on 2 sides
    6.2.2 Railing infills secured horizontally on 2 edges
    6.2.3 Railing infills secured on 4 sides
    6.2.4 Glazing secured at individual points by means of drilled anchorage points (design specifications in accordance with TRAV and/or DIN 18008-4)
    6.2.5 Point mounting with lateral clamps and anti-slip grips
    6.2.6 Point mounting with clamps at top and bottom
  6.3 Balustrade with horizontal bars (protection against falling is provided solely by sufficiently strong handrails and knee-height bars)
7. CONSTRUCTION ENGINEERING REGULATIONS, GENERALLY ACCEPTED RULES OF ENGINEERING AND REFERENCES
8. ABBREVIATIONS
9. KEYWORD INDEX
10. TABLES CONTAINING INFORMATION FOR STAND BUILDERS
1. Scope of applicability
This information sheet discusses the regulations concerning the use of glass and acrylic glass in stand construction and design in trade fair halls. It does not apply to stand construction and design outside trade fair halls.

Designing, dimension calculations and assembly of glass components for use inside trade fair halls require that the design, planning and assembly personnel involved is adequately qualified for glass construction projects. Glass structures which have received general construction approval (including European Technical Approval ETA) may be used in all cases in trade fair halls in accordance with the wording of the approval. This information sheet does not impose restrictions on the use of such structures.

2. Definitions and explanations
2.1 Types of supports
- Glazing secured by linear supports: secured by linear supports on at least two opposite edges over the full length of each edge of the glass plate.
- Glazing secured at individual points: glazing anchored through drilled holes or by a clamping system.

2.2 Types of glass and acrylic glass
Types of glass granted statutory construction approval in Building Regulation List A:
- Float glass (polished plate glass – PPG) as specified in DIN EN 572-2: Also called flat or plate glass. It is characterised by relatively low ultimate flexural strength, and when destroyed, it fragments into large sharp-edged shards. Its use as single sheet glazing in trade fair construction is prohibited. If used in LSG, it is permitted in trade-fair construction.
- Tempered safety glass (TSG) as specified in DIN 12150-1: TSG is a fully thermically pre-stressed type of glass. It has internal residual stress characteristics: core tensile stress and surface compression stress. It has high ultimate flexural strength and when broken, it shatters into crumb-like fragments. Where TSG is referred to in this information sheet, TSG made of float glass is always meant.
- Laminated safety glass (LSG): LSG consists of at least two sheets of PPG, TSG or HSG glass. The individual thicknesses of these are not permitted to differ from each other by a factor of more than 1.5. The sheets of glass are laminated together by intermediate film layers (PVB or SGP films). If a sheet is broken, then the film prevents the fragments from being scattered, thus providing residual load-bearing capacities and reducing the risk of injury from cuts.
- Heat-strengthened glass (HSG) as specified in DIN EN 1863-1 or with other general approvals by building authorities (German: allgemeine bauaufsichtliche Zulassung – abZ); HSG is a type of glass that is only partially thermally pre-stressed. Its ultimate flexural strength is lower than that of TSG (tempered safety glass). When broken, HSG fragments into shards which are larger than those of broken TSG. Therefore LSG sheets made of HSG have higher residual load-bearing capacities than LSG sheets made of TSG. HSG laminated with PVB film is included in Building Regulation List A. A general construction approval by building authorities (German allgemeine bauaufsichtliche Zulassung – abZ) for the SGP film is required for HSG laminated with SGP.
- Types of glass for which no statutory construction approval has been granted:
  - Acrylic glass: Acrylic glass is a transparent thermoplastic product marketed under the brand names Plexiglas® and Perspex®, for example. At present no recognised technical regulations are available for the use of acrylic glass.
  - Polycarbonate products: e.g. Makrolon
Acrylic glass and polycarbonate may only be used for non-load-bearing, decorative infill components.

2.3 Design calculation standards
The static strength proof calculations for glass components can be carried out in accordance with the following design calculation concepts and structural design standards:

**Design concept**
- A: comprehensive safety concept
- B: load factor concept

**Proof concept**
- Calculation based on capacity proof (allowable stress)
- Calculation based on deformation proof (allowable strains)

**Determination of action effects and stresses**
- Own weight: permanent (k_mod = 0.25)
- Working loads: medium (k_mod = 0.4)
- Horizontal substitute load: short (k_mod = 0.7)
- Cross-bar pressure: short (k_mod = 0.7)

**Deformation checks**
- For static load calculations, either concept A, comprehensive safety, or concept B, load factor, shall be used as a basis. The two concepts must not be mixed (used together). After the design dimension calculation concept A or B has been chosen, all design requirement specifications (e.g. flexing limits, glass clamping depth etc.) given in the set of standards chosen for the design concept only partially to be applied. The verbal description and the symbols and abbreviations used in equations must make it absolutely clear which concept is being applied. Supporting forces transmitted by glass components must always be stated for the SLS (GZG) and the ULS (GZT) so that the loads of the connected force-transmitting components of concrete, steel or wood can be calculated using the load-factor concept without transmission errors.

**Dimension calculation rules, dimension calculation standards**

**Standards applying to loads and actions**
- DIN EN 1991-1-1
- DIN EN 1991-1-1/NA: (2010-12)
- DIN 1953-2
- DIN 1953-3
- DIN 18008-5
- DIN 18008-6
- TRPV [17]

**Serviceability limit state SLS**
- (forces due to characteristic loads, without γ)
- (ULS) or $F_d = 16 \text{kN}$
- (GZG)
- (GZT)
- at SLS (GZG)
- at ULS (GZT)
- with the number or index k after formula symbol e. g. supporting force = 12 kN (LS) or $f_r = 12 \text{kN}$
- at SLS (GZG)

**Ultimate limit state ULS**
- (forces due to characteristic loads, multiplied by γ)
- (ULS) or $F_d = 16 \text{kN}$
- at SLS (GZG)
- at ULS (GZT)
- with the number or index d after formula symbol e. g. supporting force = 12 kN (LS) or $f_r = 16 \text{kN}$

<table>
<thead>
<tr>
<th>Type of Glass</th>
<th>Symbol</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Float Glass</td>
<td>PPG</td>
<td>Polished plate glass</td>
</tr>
<tr>
<td>Tempered Safety Glass</td>
<td>TSG</td>
<td>Fully thermally pre-stressed</td>
</tr>
<tr>
<td>Laminated Safety Glass</td>
<td>LSG</td>
<td>At least two sheets</td>
</tr>
<tr>
<td>Heat-Strengthened Glass</td>
<td>HSG</td>
<td>Partially thermally pre-stressed</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Type of Support</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Linear Supports</td>
<td>Secured by linear supports</td>
</tr>
<tr>
<td>Individual Points</td>
<td>Anchored through drilled holes</td>
</tr>
</tbody>
</table>

**Designation of forces / stresses in the serviceability limit state SLS**
- (forces due to characteristic loads)

**Designation of forces / stresses in the ultimate limit state ULS**
- (forces due to characteristic loads)

**Designation of the allowable material stress**
- $f_r$ (allowable stress)
- $f_t$ (allowable strain)

**Designation of the limit state**
- SLS (GZG)
- ULS (GZT)

**Dimension calculation rules, dimension calculation standards**
- DIN 18008-1
- DIN 18008-2
- DIN 18008-3
- DIN 18008-4
- DIN 18008-5

**Standards applying to loads and actions**
- DIN EN 1991-1-1
- DIN EN 1991-1-1/NA: (2010-12)

**Design concept**
- A: comprehensive safety concept
  - $f_r < \text{allow.}$ $\sigma$
  - $f_t < \text{allow.}$ $\gamma_b$ at SLS (GZG)
  - $f_t < \text{allow.}$ $\gamma_b$ at ULS (GZT)
- B: load factor concept
  - $\sigma = \gamma_f \cdot f$ for permanent loads
  - $\sigma = \gamma_m \cdot F$ for variable loads
  - $\sigma = \gamma_p \cdot P$ for actions (e.g. dynamic pressure, imposed loads, dead loads)

**Proof concept**
- Calculation based on capacity proof (allowable stress)
- Calculation based on deformation proof (allowable strains)

**Deformation checks**
- For static load calculations, either concept A, comprehensive safety, or concept B, load factor, shall be used as a basis. The two concepts must not be mixed (used together). After the design dimension calculation concept A or B has been chosen, all design requirement specifications (e.g. flexing limits, glass clamping depth etc.) given in the set of standards chosen for the design concept only partially to be applied. The verbal description and the symbols and abbreviations used in equations must make it absolutely clear which concept is being applied. Supporting forces transmitted by glass components must always be stated for the SLS (GZG) and the ULS (GZT) so that the loads of the connected force-transmitting components of concrete, steel or wood can be calculated using the load-factor concept without transmission errors.

**Design concept**
- A: comprehensive safety concept
  - $f_r < \text{allow.}$ $\sigma$
  - $f_t < \text{allow.}$ $\gamma_b$ at SLS (GZG)
  - $f_t < \text{allow.}$ $\gamma_b$ at ULS (GZT)
- B: load factor concept
  - $\sigma = \gamma_f \cdot f$ for permanent loads
  - $\sigma = \gamma_m \cdot F$ for variable loads
  - $\sigma = \gamma_p \cdot P$ for actions (e.g. dynamic pressure, imposed loads, dead loads)

**Proof concept**
- Calculation based on capacity proof (allowable stress)
- Calculation based on deformation proof (allowable strains)

**Determination of action effects and stresses**
- Own weight: permanent ($k_{mod} = 0.25$)
- Working loads: medium ($k_{mod} = 0.4$)
- Horizontal substitute load: short ($k_{mod} = 0.7$)
- Cross-bar pressure: short ($k_{mod} = 0.7$)

**Deformation checks**
- For static load calculations, either concept A, comprehensive safety, or concept B, load factor, shall be used as a basis. The two concepts must not be mixed (used together). After the design dimension calculation concept A or B has been chosen, all design requirement specifications (e.g. flexing limits, glass clamping depth etc.) given in the set of standards chosen for the design concept only partially to be applied. The verbal description and the symbols and abbreviations used in equations must make it absolutely clear which concept is being applied. Supporting forces transmitted by glass components must always be stated for the SLS (GZG) and the ULS (GZT) so that the loads of the connected force-transmitting components of concrete, steel or wood can be calculated using the load-factor concept without transmission errors.
3. Stand design, construction and loads

3.1 Vertical glazing not intended to prevent falling

3.1.1 Vertical glazing of a height h ≤ 4 metres above hall floor level

Neither static proof of structural characteristics in accordance with the regulations specified in chapter 2.3 is required, nor is it necessary to submit documentation of testing. In this case the exhibitor alone is responsible for ensuring that the construction/design is technically safe for general use and that it meets current and accepted technical standards. Table A provides an overview of the types of structural designs that are possible.

- Either TSG or LSG must be used.
- The glass sheets may be secured by linear supports or at individual points.
- Glass walls tilting at an angle of more than 10° from the vertical are considered to be overhead glazing for which the provisions of chapter 3.3 shall apply.
- Additional measures, e.g. provision of static proof calculations similar to those described in chapter 3.1.2, may be required to ensure protection of neighbouring walkways, or to be able to bear the loads of persons leaning against or bumping into the glass.

3.1.2 Vertical glazing of a height h > 4 metres above hall floor level

Vertical glazing not intended to prevent falling and whose uppermost edges are higher than 4 metres above hall floor level does not require installation approval for a specific case (c.f. 4.2) provided that the type of glass used, structural design details and the type of supports securing the glass comply with the regulations specified in chapter 2.3. In addition, the following provisions shall be observed.

- Verified structural calculations or structural calculations suitable for verification and the corresponding construction plans must be submitted.
- In addition to the load of its own weight, the material must be capable of resisting horizontal forces, i.e. a pressure corresponding to at least h1 = 0.125 kN/m² for visible surfaces of up 4 m above hall floor level and at least h2 = 0.063 kN/m² for visible surfaces at more than 4 m above hall floor level.
- Wherever there is a high risk of impact, e.g. where there is a descending ramp leading towards the glazing, additional measures are required.
- Proof of structural characteristics is not required if the area of each individual sheets is less than 1.6 m² and TSG with a thickness of at least 4 mm is used, and the sheet(s) is (are) held on four sides by linear supports.

3.2 Vertical glazing intended to prevent falls

In all three of the following categories, A, B and C, static load proof calculations for the glass and the supporting structures and proof of the load-bearing capacity under impact-like conditions are required. The static structural design calculations for the glass and the supporting structure shall be based on an assumed cross-bar pressure load and as an additional load case, a horizontal assumed surface load of h1 = 0.125 kN/m² for all visible surfaces at up to 4 m above the hall floor level and of h2 = 0.063 kN/m² for surfaces located at more than 4 m above hall floor level.

The load-bearing capacity of the structure under impact action can be verified as follows:

- a pendulum impact test in accordance with DIN EN 12600 if design calculation concept A is used, or in accordance with DIN 18008-4 if design calculation concept B is used, or
- the relevant design specifications, glass dimensions and thicknesses as stated in Table B of this information sheet are adhered to, or
- by providing proof calculations in accordance with the rules described in chapter 2.3.

4. Installation of glazing not intended to prevent falling

Installation approval for a specific case is required for all other designs. If the use of TSG glazing is planned, a heat soak test certificate must be submitted. If design calculation concept B is used, or in accordance with DIN 18008-4 or Table B are adhered to, then installation approval for a specific case is not required for all other designs.

The intermediate films in LSG shall be made of PVB or SGP (SentryGlas® plus). Films made of PVB must have tear strength of at least 20 N/mm². SGP films shall have general approval by building authorities (including European Technical Approval ETA) and shall be processed in accordance with this approval.

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Information sheet “Glass and acrylic glass” 2017 (continued)
### 3.2.3 Category A – vertical glass wall

**Definition:** Linearly-supported vertical glazing that does not contain any load-bearing bars at capping height and is not protected by a rail or cross-bar located in front of it, making it suitable for the direct action of rail or cross-bar load-bearing handrail (see example in chapter 6.1) attached to the top of the structure.

- **Only LSG shall be used.**
- **Verified proof of structural characteristics or static structural calculations suitable for verification, as well as a pendulum impact test (test in accordance with DIN EN 12 600 or DIN 18008-4) are required.**
- **The pendulum impact test is not required for glass with linear support on all sides, provided that the appropriate dimensions and glass thickness conform to Table B or (TRAIV or DIN 18008-4) are required.**
- **The glazing supports must provide adequate protection to the edges of the glass sheets.**

### 3.2.2 Category B – clamped glass balustrade with continuous handrail

**Definition:** Load-bearing glass balustrades held by linear supports secured by clamp-type base mountings, the individual glazing elements of which are connected by a continuous, load-bearing handrail (see example in chapter 6.1) attached to the top of the structure.

- **Only LSG shall be used.**
- **Verified proof of structural characteristics or static structural calculations suitable for verification, as well as a pendulum impact test (test in accordance with DIN EN 12 600 or DIN 18008-4) are required.**
- **If LSG made of 2 x 10 mm TSG (or 2 x 10 mm HSG) is used, no pendulum impact test is required, provided that the dimensions as stated in Table B are adhered to (design in accordance with TRAV or DIN18008-4).**
- **The thickness of the intermediate PVB/SGP film must be at least 1.52 mm.**
- **The securing clamps must be at least 100 mm above floor level.**
- **Calculations shall be provided proving that the loads will be distributed with the capping of the glass sheets as stated in Table B and the working loads into account. In addition, proof of impact resistance and residual load-bearing capacity shall be provided.**

### 3.2.1 Category C – railing and balustrade infills and glass walls with load-distributing cross-bar fitted in front of it

**Definition:** Accident-prevention (barrier) glazing which is not intended to distribute capping loads and which corresponds to one of the following groups:

C1: Railing/balustrade infills secured by linear supports and/or at individual points on at least two opposing sides.

C2: Vertical glazing beneath a crosswise load-distributing spanning member located at capping level and secured by linear supports on at least two opposing sides.

C3: Category A type glazing with a load-distributing cross-bar placed in front of it.

- **For category C1 and C2 type glazing, the use of TSG is allowed if the sheets are secured by linear supports on all sides. For all other types of supports and for category C3, only LSG may be used unless other statutory construction approval exists.**
- **Table B contains an overview of possible designs and the proofs required.**
- **The pendulum impact test is not required if the relevant design specifications and the dimensions and thickness of the glass as stated in Table B or TRAV or in DIN 18008-4 are adhered to.**

### 3.3 Glazing designed to support human loads

This kind of glazing is specifically intended to be subjected to persons walking over it, e.g. stairs, platforms, landings and cat-walks. The design and proof calculations shall take both dead loads (own weight) and the working loads into account. In addition, proof of impact resistance and residual load-bearing capacity shall be provided.

### 3.3.2 Calculation of the working loads and the design loads

The design loads to be assumed are the sheet’s own weight and a horizontal pressure corresponding to at least h1 = 0.125 kN/m² for visible surfaces of up 4 m above hall floor level or h2 = 0.063 kN/m² for vertical visible surfaces at more than 4 m above hall floor level.

The sheets must secure in such a way as to properly safeguard against them slipping out of the mounting and forces which may lift them off the mounts.

The design dimensions of glass sheets mounted at individual points and LSG sheets shall either be calculated according to the rules outlined in chapter 2.3 or they must have general construction approval (abZ).

If, for cleaning purposes, overhead glazing periodically has to support human loads, then such additional loads must be taken into consideration and experimental proof of residual load-bearing capacities must be provided [8]. In such cases a special individual construction approval is always required.

- **LSG sheets with an effective span exceeding 1.20 m shall be supported on all sides. The ratio between length and width may not exceed 3 to 1. The overall thickness of the intermediate PVB/SGP films must be at least 0.76 mm. If a sheet is supported on all sides, then a thickness of 0.38 mm is allowed under the condition that the length-to-width ratio is not greater than 3 to 1 and that the effective span in the direction bearing the main load is not greater than 0.8 m.**
- **The effective span of a wire glass sheet may not exceed 0.7 m, and the glass shall protrude into the supports by at least 15 mm.**
- **Cutting of recesses or notches in the glass sheets is not allowed.**
- **Only holes conforming to TRPV and/or DIN 18008-3 are allowed.**
- **The maximum permissible sag shall not exceed 1/100 of the effective span between the closest supports of the sheet above floor level.**

### Table 3: Glazing mounted in linear supports at all four edges and intended to support human loads, with proven impact resistance and residual load-bearing capacity.

<table>
<thead>
<tr>
<th>Max. max.</th>
<th>Max. max.</th>
<th>LSG structure</th>
<th>Min. supporting</th>
<th>Max. max.</th>
<th>Max. max.</th>
<th>LSG structure</th>
<th>Min. supporting</th>
</tr>
</thead>
<tbody>
<tr>
<td>Max. length</td>
<td>Max. width</td>
<td>[mm]</td>
<td>[mm]</td>
<td>[mm]</td>
<td>[mm]</td>
<td>[mm]</td>
<td>[mm]</td>
</tr>
<tr>
<td>400</td>
<td>8 HSG *// 10 Float *// 10 Float</td>
<td>30</td>
<td>30</td>
<td>30</td>
<td>30</td>
<td>30</td>
<td>30</td>
</tr>
<tr>
<td>1500</td>
<td>750</td>
<td>8 HSG *// 12 Float *// 12 Float</td>
<td>35</td>
<td>35</td>
<td>35</td>
<td>35</td>
<td>35</td>
</tr>
<tr>
<td>1500</td>
<td>1250</td>
<td>8 HSG *// 10 HSG *// 10 HSG</td>
<td>35</td>
<td>35</td>
<td>35</td>
<td>35</td>
<td>35</td>
</tr>
<tr>
<td>1250</td>
<td>1500</td>
<td>8 HSG *// 12 HSG *// 12 HSG</td>
<td>35</td>
<td>35</td>
<td>35</td>
<td>35</td>
<td>35</td>
</tr>
<tr>
<td>1500</td>
<td>1400</td>
<td>8 HSG *// 15 Float *// 15 Float</td>
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<tr>
<td>2000</td>
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<td></td>
</tr>
</tbody>
</table>
Glazing designed to support human loads may be secured by linear supports or at individual points. It must be made of LSG consisting of at least three layers of TSG and/or HSG/float glass. From the point of view of impact resistance, the use of TSG or HSG for the top layer is recommended. This surface must possess non-slip characteristics in accordance with DIN 51097. In order to achieve the required residual load-bearing capacity, the two lower layers must normally be made of float glass or HSG.

Glazing, mountings and supporting structure must be designed and their dimensions calculated to withstand the load of their own combined weight (dead load) as well as intended human (working) loads in accordance with the chosen design calculation concept and all relevant and applicable standards.

### Design calculation concept

- **Working surface load** $q$, depending on usage category
- **Point load** $Q$, as an additional changing load parameter to be investigated
- **Application area** of point load
- **Inclusion of top sheet in structural static calculations allowed?**
- **Proof calculation for situation with broken top sheet** (i.e. only the two lower sheets still bear the load)
- **Standards relating to the action of loads**
- **Max. sag / flexure with 3 load-bearing sheets**
- **DMax. sag / flexure with 2 load-bearing sheets**

### Installation Approval for a Specific Case

The installation approval will be granted instead of the individual construction approval if glass is used only within the rules and limitations described in this information sheet.

### Approval procedures

#### 4.1 Basics

If a glass component and its glass products conform to the technical building regulations outlined in chapter 2.3 and to generally accepted technical principles, then it shall be sufficient to submit the verified structural calculations and the verified plans, following which construction approval will be granted. In addition, the construction work on site will be checked and the results subjected to an approval inspection. If additional components are installed for which statutory construction approval, a statutory construction test report or type approval are required, then these documents are to be submitted together with the structural calculations.

If a glass component or parts of this component do not conform to the construction engineering regulations and generally accepted technical principles outlined in chapter 2.3, and if no statutory construction approval or statutory construction test certificate can be produced, then an individual construction approval (Zustimmung im Einzelfall – ZE) shall be required. An Installation Approval for a Specific Case may be granted instead of the individual construction approval if glass is used only within the rules and limitations described in this information sheet.

#### 4.2 Installation approval for a specific case

This approval procedure is similar to the procedure for obtaining individual construction approval. If an Installation Approval for a Specific Case has been granted once for a particular construction/design and type of usage, then the trade fair companies in question will accept this for an identical design serving an identical purpose. Nevertheless, a new application for construction work approval and approval inspection shall be submitted for each repeated case. The test report, all certificates and approvals, design details, as well as glass dimensions and thicknesses must be submitted with the application.

Glass components requiring approval and which require type 3 proof documentation are listed in column A of Tables A, B and C. Installation approvals for specific cases cannot be granted at short notice, as they require a considerable period of time for processing. Applications for these should therefore be submitted at least 6 weeks before the commencement of construction.

Prior to conducting component tests, it is advisable to contact the relevant trade fair company in good time in order to coordinate procedures and intended testing methods. Normally, component testing requirements stipulate inclusion of parts of the glass component’s actual substructure in order to simulate realistic loads.

The procedure for obtaining an Installation Approval for a Specific Case is as follows:

- The structural calculations and the required certificates confirming the identity of the product(s) (glass manufacturer/processing company’s factory certificates) must be verified and checked by a publicly certified structural building surveyor and tester (in the field of steel, concrete and brick construction/engineering).
6. Notes on design and design calculations
- Glass is a brittle material, any failure of which will occur spontaneously and without warning.
- Glass is sensitive to blows with hard, pointed objects.

These properties lead to the following guideline notes:
- Proof calculations for the load-bearing capacity of structural glass not only take into consideration the unbroken glass but always include an investigation of the broken or partially broken glass (proof of residual load-bearing capacity).
- The support design must ensure that glass sheets are not subjected to pressure or stresses by the supports.
- Direct glass-to-glass contact and contact between glasses and other hard materials (e.g. metal) shall be prevented at all times, whereby the effects of load and temperature fluctuations have to be taken into account.
- The minimum supporting depths of glass sheets ("glass insertion depth") on their respective support sections as well as the allowable sheet and supporting beam sections as specified in the standards listed in chapter 2.3 for the selected design calculation concept must be adhered to.
- After glazing has been installed, the markings identifying the individual type of glass sheet used (e.g. TSG, HSG) must be durable and legible at all times. In the case of LSG glazing, a section of the edge must be left free for inspection purposes (to check the number of glass sheets, thickness, interlayer films) until the construction has been approved. If required, a manufacturer’s certificate shall be submitted as well.
- The edges of glass sheets must be finished or protected in such a way as to exclude any possibility of injury.
- In the case of TSG, HSG, or LSG glazing manufactured from sheets of TSG or HSG, subsequent reworking of the finished product such as cutting out sections or drilling holes is not possible.
- Sheets intended to bear human loads must have a durable non-slip surface finish.
- Load-bearing adhesive joints may only be used if a general construction approval (abZ) has been granted for the entire adhesive system (i.e. the glass, adhesive and metal combination), and under the condition that the joint is made exactly as described in the approval documents.
- The rules described in chapter 2.3 do not yet make allowance for applying more favourable assumptions of the joint effect of the intermediate film layers in LSG and therefore an Installation Approval for the Specific Case has to be applied for if these assumptions are used in calculations. Trade publications [18] contain information on suitable calculation assumptions to account for the joint effects in LSG. This may possibly be useful for LSG in which SGP is used.

5. Notes on design and design calculations
- Glass is a brittle material, any failure of which will occur spontaneously and without warning.
- Glass is sensitive to blows with hard, pointed objects.

These properties lead to the following guideline notes:
- Proof calculations for the load-bearing capacity of structural glass not only take into consideration the unbroken glass but always include an investigation of the broken or partially broken glass (proof of residual load-bearing capacity).
- The support design must ensure that glass sheets are not subjected to pressure or stresses by the supports.
- Direct glass-to-glass contact and contact between glasses and other hard materials (e.g. metal) shall be prevented at all times, whereby the effects of load and temperature fluctuations have to be taken into account.
- The minimum supporting depths of glass sheets ("glass insertion depth") on their respective support sections as well as the allowable sheet and supporting beam sections as specified in the standards listed in chapter 2.3 for the selected design calculation concept must be adhered to.
- After glazing has been installed, the markings identifying the individual type of glass sheet used (e.g. TSG, HSG) must be durable and legible at all times. In the case of LSG glazing, a section of the edge must be left free for inspection purposes (to check the number of glass sheets, thickness, interlayer films) until the construction has been approved. If required, a manufacturer’s certificate shall be submitted as well.
- The edges of glass sheets must be finished or protected in such a way as to exclude any possibility of injury.
- In the case of TSG, HSG, or LSG glazing manufactured from sheets of TSG or HSG, subsequent reworking of the finished product such as cutting out sections or drilling holes is not possible.
- Sheets intended to bear human loads must have a durable non-slip surface finish.
- Load-bearing adhesive joints may only be used if a general construction approval (abZ) has been granted for the entire adhesive system (i.e. the glass, adhesive and metal combination), and under the condition that the joint is made exactly as described in the approval documents.
- The rules described in chapter 2.3 do not yet make allowance for applying more favourable assumptions of the joint effect of the intermediate film layers in LSG and therefore an Installation Approval for the Specific Case has to be applied for if these assumptions are used in calculations. Trade publications [18] contain information on suitable calculation assumptions to account for the joint effects in LSG. This may possibly be useful for LSG in which SGP is used.

6. Examples of structures (barriers) designed to prevent falls
All possible dimensions, types of glass, thicknesses and the necessary proof documents are summarised in Table B.

6.1 Category B

Note: If LSG made of 10 mm TSG + 1.52 mm PVBSGP + 10 mm TSG or of 10 mm HSG + 1.52 mm PVBSGP + 10 mm HSG in the dimensions as stated in Table B is used, only static structural proof calculations are required.
6.2.5 Point mounting with lateral clamps and anti-slip grips
- Designs that have a general construction approval (abZ) shall be used in accordance with.
- For all systems that have not been granted general construction approval, a pendulum impact test is required. Minimum requirement: LSG comprising 6 mm TSG + 1.52 mm PVB + 6 mm TSG or 6mm HSG + 1.52 mm PVB + 6 mm HSG shall be used.

6.2.6 Point mounting with clamps at top and bottom
- System designs that have a general construction approval (abZ) shall be used in accordance with the specifications in the approval documents.
- For all systems that have not been granted general building approval, a pendulum impact test is required. Minimum require- ment: LSG comprising 6 mm TSG + 1.52 mm PVB + 6 mm TSG or 6mm HSG + 1.52 mm PVB + 6 mm HSG shall be used.

6.3 Balustrade with horizontal bars (protection against falling is provided solely by sufficiently strong handrails and knee-height bars)

The type of glass used shall be selected from Table A, glazing not intended to protect against falls. The spacing between horizontal bars should not exceed approx. 35 cm.

7. Construction engineering regulations, generally accepted rules of engineering and references
[8] Communications (Mitteilungen) of DIBt no. 2 / 2001: Anforde rungen an begehbar Verglasungen; Empfehlungen für das Zustimmungs-verfahren - Fassung März 2000 –, Berlin (Requirements on glazing intended to be walked on, recommendations for approval procedures - Version of March 2000 –)
[9] Wörner, J.-D.; Schneider J.: Closing report on experiments and calculations to determine the dynamic stresses on glass as a result of a light impact, Fraunhofer IRB Verlag Stuttgart 2000, Booklet T 2935
[17] Technische Regeln für die Bemessung und die Ausführung punktförmig gelagerter Verglasung [Technical rules for the use of glazing with supports at individual points] (TRPV), (final version August 2006), DIBT.
[19] Building rules list (see www.dibt.de )
[20] ETB-Richtlinie: Bauteile, die gegen Absturz sichern (June 1985) (ETB guideline: Building components designed to prevent falls)

8. Abbreviations
abZ German: Allgemeine bauaufsichtliche Zulassung (general construction approval)
C1, C3 Categories for vertically acting working loads on floors of public meeting spaces in buildings as specified in DIN EN 1991-1-1 / NA
DIBT Deutsches Institut für Bautechnik (German civil engineering institute)
ESG German: Einscheiben-Sicherheitsglas (fully-tempered glass / toughened safety glass)
HSG Heat-strengthened glass
LSG Laminated safety glass
PPG Polished plate glass
PVB polyvinyl butyric (intermediate film material for LSG)
SGP SentryGlas® plus (intermediate film material for LSG)
SLS Serviceability limit state
SLL Serviceability limit state
SPG German: Spiegelglas (float glass or PPG)
T2 Category for vertically acting working loads on stairs / staircase landings for large traffic loads and escape staircases as specified in DIN EN 1991-1-1 / NA
TRAV Technische Regeln für die Verwendung von aburstzsichernden Verglasungen [Technical rules for the use of accident-prevention (barrier) glazing]
TRLV Technische Regeln für die Verwendung von lineinförmi g gelagerten Verglasungen [Technical rules for the use of glazing with linear supports]
TRPV Technische Regeln für die Bemessung und die Ausführung punktförmig gelagertem Verglasung [Technical rules for the use of glazing with supports with individual points]
TSG Toughened safety glass
TVG German: Teilvorgespanntes Glas (heat-strengthened glass)
ULS Ultimate limit state
VSG German: Verbund-Sicherheitsglas (laminated safety glass)
ZIE German: Zustimmung im Einzelfall (individual construction approval)
### Table A: Vertical glazing, not intended to prevent falls

<table>
<thead>
<tr>
<th>Structure type</th>
<th>Characteristic</th>
<th>Structure</th>
<th>Sheet support</th>
<th>Glass type</th>
<th>Allowed, yes/no</th>
<th>Glass thickness in mm</th>
<th>SGP/PVB film thickness</th>
<th>Width in mm</th>
<th>Height in mm</th>
<th>Min. glass insertion depth in mm</th>
<th>Type of proof required</th>
<th>Civil engineering rules</th>
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</thead>
<tbody>
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<td>6: Residual load-bearing cap. test</td>
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<td>7: Shock impact resistance test</td>
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<td>1) Proof type 2 (verified static design calculations) are not required for sheet areas A ≤ 1.6 m² and d ≥ 4 mm</td>
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</tbody>
</table>


1: No specific proof A: TRLV or DIN 18008-1/2
2: Verified static calculations B: TRAV or DIN 18008-1/2
3: Installation appr. for spec. case C: TRPV or DIN 18008-3
4: Pendulum impact test
5: Heat soak test
6: Residual load-bearing cap. test
7: Shock impact resistance test
### Table B: Vertical glazing, intended to prevent falls (barrier glazing)

<table>
<thead>
<tr>
<th>Structure type</th>
<th>Characteristic</th>
<th>Structure</th>
<th>Sheet support</th>
<th>Glass type</th>
<th>Allowed, yes/no</th>
<th>Glass thickness in mm</th>
<th>SG/PVB film thickness</th>
<th>Width in mm min.</th>
<th>Width in mm max.</th>
<th>Height in mm min.</th>
<th>Height in mm max.</th>
<th>Min. glass insertion depth in mm</th>
<th>Type of proof required</th>
<th>Designation</th>
<th>Civil engineering rules</th>
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<tbody>
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<td>Fall-prevention, barrier (Dh &gt; 1 m)</td>
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<td>0.76</td>
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<tr>
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<td>Linear support at top and bottom</td>
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<td>0.76</td>
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<td>Linear support at left and right</td>
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<td>0.76</td>
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<td>A, B</td>
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</tr>
</tbody>
</table>

**Proof by:**
1. No specific proof
2. Verified static calculations
3. Installation appr. for spec. case
4. Pendulum impact test
5. Heat soak test
6. Residual load-bearing cap. test
7. Shock impact resistance test

**Civil engineering rules:**
A: TRLV or DIN 18008-1/2
B: TRAV or DIN 18008-4
C: TRPV or DIN 18008-3

**As of:** 1.12.2012

Note: where decimal fractions are listed in the table, a comma is used instead of a decimal point to permit the same table contents to be used for all language versions.

“If a pendulum impact test, proof type “4”, is not specified in column 14, then this advantage is subject to adherence to the limit values stated in columns 7 to 13. Structural designs not listed here will require an Installation Approval for the Specific Case.”

2) In systems having a valid general statutory construction approval, LSG may be used in accordance with the text of the approval documents.
3) The distance between neighbouring point supports in x-direction and in y-direction, respectively.
4) Clamped on both faces by circular plates with diameter d ≥ 50 mm, if spacing is greater than 1200 mm, plate diameter shall be d ≥ 70 mm, see DIN 18008-3/4

The use of acrylic glass and wire glass is not allowed for vertical glazing intended to prevent falls (barrier glazing). If the sheets are held in linear supports, LSG made of HSG and with the same specified thicknesses may be used instead of LSG made of float glass.
<table>
<thead>
<tr>
<th>Structure type</th>
<th>Characteristic</th>
<th>Structure</th>
<th>Sheet support</th>
<th>Glass type</th>
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<td>Wire glass</td>
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</tbody>
</table>

Proof by:

1. No specific proof
2. Verified static calculations
3. Installation appr. for spec. case
4. Pendulum impact test
5. Heat soak test
6. Residual load-bearing cap. test

As of: 1.12.2012

Note: where decimal fractions are listed in the table, a comma is used instead of a decimal point to permit the same table contents to be used for all language versions.

3) Overhead glazing that has to be capable of supporting human loads to permit cleaning is subject to a special approval procedure.

4) The data apply to the smaller distance between supports (support direction).

5) If HSG which has not received general statutory construction approval (abZ) is used, an additional Installation Approval for the Specific Case is required.

6) If glass type/support type combination systems which have been granted a general statutory construction approval (abZ) are used, the Installation Approval for the Specific Case is not required.

The use of acrylic glass for horizontal glazing is not allowed. However, exceptions may be possible if the trade-fair company has no objections with regard to fire prevention/protection and structural stability.