

Patent glazing and sloping glazing for buildings —

Part 1: Code of practice for design and installation of sloping and vertical patent glazing

ICS 81.040.20; 91.060.50

Committees responsible for this British Standard

The preparation of this British Standard was entrusted by Technical Committee B/520, Glass and glazing in building, to Subcommittee B/520/5, Patent glazing and non-vertical glazing, upon which the following bodies were represented:

- Association of Building Engineers
- Consumer Policy Committee of BSI
- Council for Aluminium in Building
- Flat Glass Manufacturers' Association
- Glass and Glazing Federation
- Institution of Structural Engineers
- Office of the Deputy Prime Minister – represented by BRE
- Co-opted members

This British Standard was published under the authority of the Standards Policy and Strategy Committee on 26 November 2004

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- First published, as CP145.101, April 1951
- Second edition, as CP145-1, January 1969
- Third edition, as BS 5516, December 1977
- Fourth edition, as BS 5516, April 1991
- Fifth edition, as BS 5516-1, November 2004

Amendments issued since publication

Amd. No.	Date	Comments

The following BSI references relate to the work on this British Standard:

- Committee reference B/520/5
- Draft for comment 03/111701 DC

ISBN 0 580 44711 1

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Foreword

This part of BS 5516 has been prepared by Technical Committee B/520. This part of BS 5516, together with BS 5516-2:2004, supersedes BS 5516:1991, which is withdrawn. It revises all or part of Clauses **1 to 3, 5 to 9, 10.3 to 10.5, 10.6.2, 10.6.3, 10.8, 11 to 14, 19, 20.1, 20.3, 20.4, 21 to 24, 25.1, 25.2, 25.4, 25.6, 25.8, 25.9, 26 to 29** and Annex A to Annex F and Annex J to Annex K of BS 5516:1991.

BS 5516:1991 has been revised and restructured to simplify its use and will be published in three parts covering the following areas:

- *Part 1: Code of practice for design and installation of sloping and vertical patent glazing;*
- *Part 2: Code of practice for sloping glazing;*
- *Part 3: Special applications.*

Requirements for standards of workmanship for glazing have been published separately as BS 8000-7 and, therefore, this subject is not dealt with in this standard.

Since the correct selection of materials to be used in glazing for buildings depends on many factors, attention is drawn to the recommendations in the other parts of this standard.

As a code of practice, this British Standard takes the form of guidance and recommendations. It should not be quoted as if it were a specification and particular care should be taken to ensure that claims of compliance are not misleading.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

Compliance with a British Standard does not of itself confer immunity from legal obligations.

Summary of pages

This document comprises a front cover, an inside front cover, pages i and ii, pages 1 to 63 and a back cover.

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Introduction

Patent glazing is the term applied to a self-draining and ventilated system of dry glazing that does not rely entirely for its watertightness upon external glazing seals. It consists essentially of a series of longitudinal glazing bars, i.e. patent glazing bars, and an infilling of glass or other suitable infill material. Patent glazing bars are attached to and supported by structural members, either directly or indirectly.

Patent glazing systems are described by the number of edges by which the infilling is supported. They are generally unsealed, at the interface with the building substrate relying on flashings and/or formed weatherings for weathertightness. They differ from sloping curtain wall systems which form sealed airtight constructions. Curtain wall systems designed for vertical application might not be suitable for sloping application, unless they incorporate a sloping application drainage facility or are face sealed to exclude water from the glazing rebates.

- a) *Two-edge systems* are those in which the infilling is fully supported by patent glazing bars on two opposite longitudinal edges only. Horizontal flashings or other weatherings are normally provided at the top and bottom edges of single tier glazing and at junctions of glazing of more than one tier.
- b) *Four-edge systems* are those in which the infilling is fully supported by patent glazing bars on two opposite longitudinal edges and additionally on the other two edges by transom members.

1 Scope

This British Standard gives recommendations for the design, manufacture, installation and maintenance of sloping and vertical patent glazing systems attached to and supported by structural members of adequate strength, stiffness and stability. All recommendations apply to flat, including faceted, patent glazing and infilling. They may also apply to curved patent glazing and infilling except for the structural design where specialist advice is needed.

The patent glazing systems included in this standard comprise glazing bars of aluminium or steel, which can be clad totally or partially clad with lead or PVC-U, for two-edge support and four-edge support systems for single and double glazing or other infill. A range of transparent and opaque infillings of glass, plastics glazing sheet materials and other infill materials are included; specific information on plastics glazing sheet materials is given in BS 5516-2:2004, Annex A.

This standard covers the use of patent glazing in permanent buildings and structures, including conservatories but excludes greenhouses. Clauses that are relevant also apply to the use of patent glazing inside buildings.

This standard does not include recommendations for the design of the supporting structure to which the patent glazing is attached.

Requirements for standards of workmanship for glazing have been published separately as BS 8000-7 and, therefore, this subject is not within the scope of this standard.

Since the correct selection of materials to be used in glazing for buildings depends on many factors, attention is drawn to the recommendations in the other parts of this standard.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the reference cited applies. For undated references, the latest edition of the referenced document (including any amendments).

BS 476-20, *Fire tests on building materials and structures — Part 20: Method for determination of the fire resistance of elements of construction (general principles)*.

BS 476-22, *Fire tests on building materials and structures — Part 22: Methods for determination of the fire resistance of non-loadbearing elements of construction*.

BS 1449-1, *Steel plate, sheet and strip — Part 1: Carbon and carbon-manganese plate, sheet and strip*.

BS 1473, *Specification for wrought aluminium and aluminium alloys for general engineering purposes — Rivet, bolt and screw stock*.

BS 3382, *Specification for electroplated coatings on threaded components*.

BS 3987, *Specification for anodic oxidation coatings on wrought aluminium for external architectural applications*.

BS 4254, *Specification for two-part polysulphide-based sealants*.

BS 4842, *Specification for liquid organic coatings for application to aluminium alloy extrusions, sheet and preformed sections for external architectural purposes, and for the finish on aluminium alloy extrusions, sheet and preformed sections coated with liquid organic coatings*.

BS 4921, *Specification for sherardized coatings on iron or steel*.

BS 5215, *Specification for one-part gun grade polysulphide-based sealants*.

BS 5268, *Structural use of timber — Code of practice for permissible stress design, materials and workmanship*.

BS 5516-2:2004, *Patent glazing and sloping glazing for buildings — Part 2: Code of practice for design and installation of sloping and vertical patent glazing*.

BS 5889, *Specification for one-part gun grade silicone-based sealants*.

BS 5950, *Structural use of steelwork in building*.

BS 6180, *Barriers in and about buildings — Code of practice*.

BS 6262 (all parts), *Code of practice for glazing for buildings*.

- BS 6270-3, *Code of practice for cleaning and surface repair of buildings — Part 3: Metals (cleaning only)*.
- BS 6338, *Specification for chromate conversion coatings on electroplated zinc and cadmium coatings*. (ISO 4520)
- BS 6399-2:1997, *Loading for buildings — Part 2: Code of practice for wind loads*.
- BS 6399-3, *Loading for buildings — Part 3: Code of practice for imposed roof loads*.
- BS 6496, *Specification for powder organic coatings for application and stoving to aluminium alloy extrusions, sheet and preformed sections for external architectural purposes, and for the finish on aluminium alloy extrusions, sheet and preformed sections coated with powder organic coatings*.
- BS 6497, *Specification for powder organic coatings for application and stoving to hot-dip galvanized hot-rolled steel sections and preformed steel sheet for windows and associated external architectural purposes, and for the finish on galvanized steel sections and preformed sheet coated with powder organic coatings*.
- BS 7412, *Plastics windows made from unplasticized polyvinyl chloride (PVC-U) extruded hollow profiles — Specification*.
- BS 8118-1:1991, *Structural use of aluminium — Structural use of aluminium — Part 1: Code of practice for design*.
- BS EN 477, *Unplasticized polyvinylchloride (PVC-U) profiles for the fabrication of windows and doors — Determination of the resistance to impact of main profiles by falling mass*.
- BS EN 478, *Unplasticized polyvinylchloride (PVC-U) profiles for the fabrication of windows and doors — Appearance after exposure at 150 °C — Test method*.
- BS EN 479, *Unplasticized polyvinylchloride (PVC-U) profiles for the fabrication of windows and doors — Determination of heat reversion*.
- BS EN 485, *Aluminium and aluminium alloys — Sheet, strip and plate*.
- BS EN 755, *Aluminium and aluminium alloys — Extruded rod/bar, tube and profiles*.
- BS EN 1363-1, *Fire resistance tests — Part 1: General requirements*.
- BS EN 1364-1, *Fire resistance tests for non-loadbearing elements — Part 1: Walls*.
- BS EN 1364-2, *Fire resistance tests for non-loadbearing elements — Part 2: Ceilings*.
- BS EN 3506 (all parts), *Mechanical properties of corrosion resistant stainless steel fasteners*.
- BS EN 10002-1, *Tensile testing of metallic materials — Part 1: Method of test at ambient temperature*.
- BS EN 10143, *Continuously hot-dip metal coated steel sheet and strip — Tolerances on dimensions and shape*.
- BS EN 12056-3, *Gravity drainage systems inside buildings — Part 3: Roof drainage, layout and calculation*.
- BS EN 12588, *Lead and lead alloys — Rolled lead sheet for building purposes*.
- BS EN 22063, *Metallic and other inorganic coatings — Thermal spraying — Zinc, aluminium and their alloys*.
- BS EN ISO 1461, *Hot dip galvanized coatings on fabricated iron and steel articles — Specifications and test methods*.

3 Terms and definitions

For the purposes of this British Standard, the following terms and definitions apply.

3.1

butt joint

joint between edges of adjacent panes of infilling, usually horizontal and weathered by a came or sealant

3.2

came

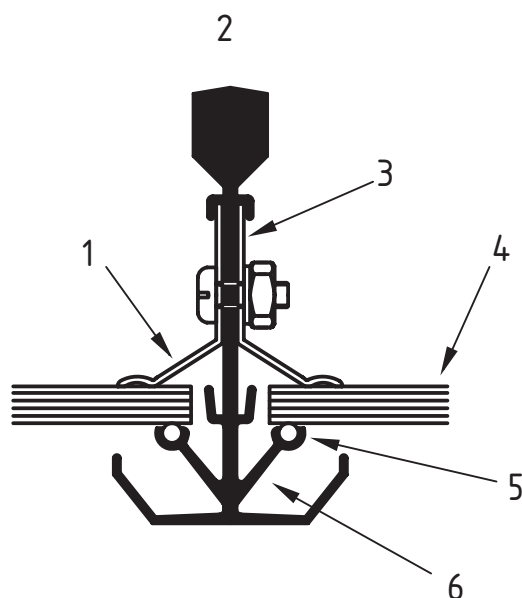
non-load-bearing member used to weather a horizontal butt joint in a two-edge system of patent glazing

3.3

cap

profile, fitted over a patent glazing bar or pressure plate, to retain infilling and impede direct water penetration

NOTE See Figure 1.

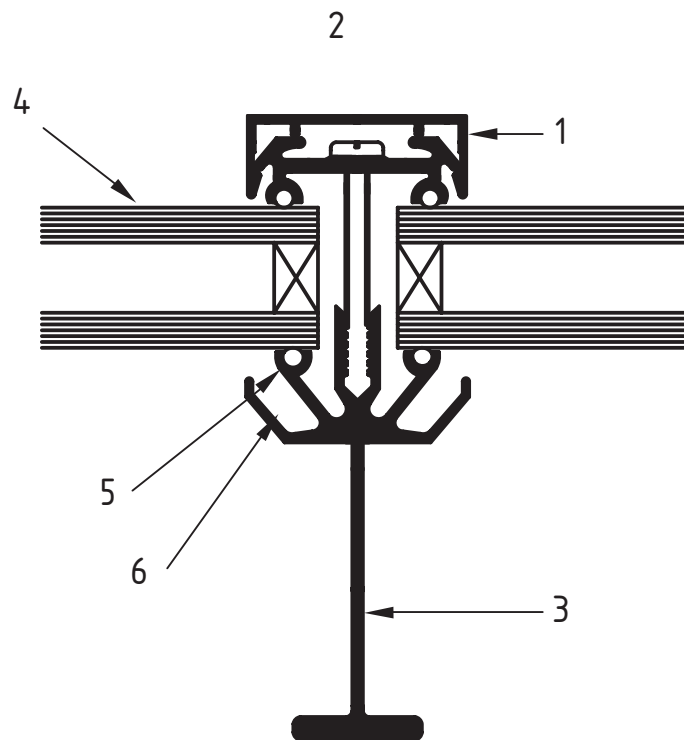


Key

- | | |
|---|------------------|
| 1 | Wing |
| 2 | Outside |
| 3 | Stalk |
| 4 | Glass or infill |
| 5 | Glazing seal |
| 6 | Drainage channel |

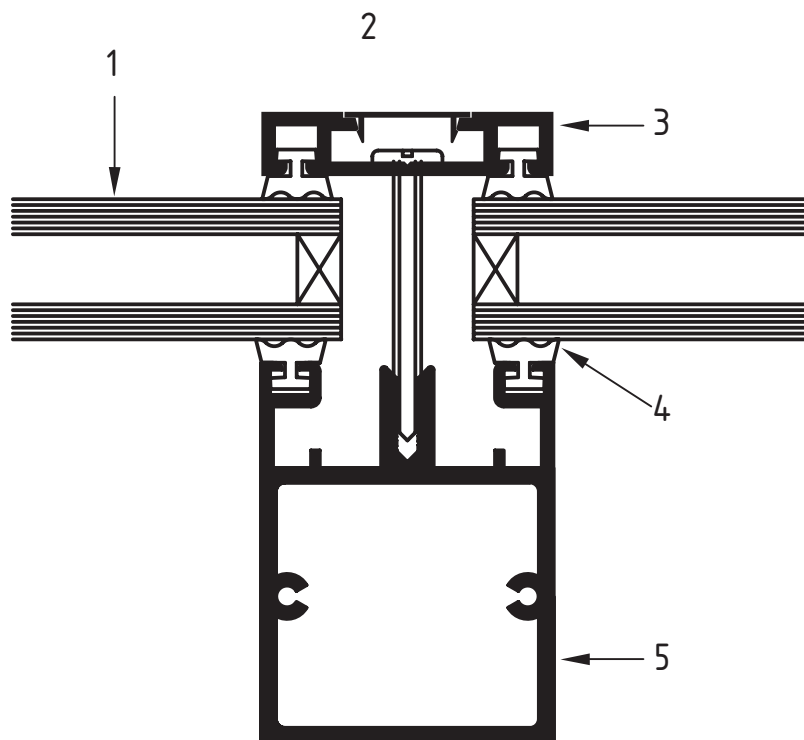
a) Traditional bar

Figure 1 — Typical examples of patent glazing bars

**Key**

- 1 Cap
 - 2 Outside
 - 3 Stalk
 - 4 Glass or infill
 - 5 Glazing seal
 - 6 Drainage channel
- b) Inverted bar

Figure 1 — Typical examples of patent glazing bars *(continued)*

**Key**

- 1 Glass or infill
- 2 Outside
- 3 Cap
- 4 Gasket
- 5 Box
- c) Box bar

Figure 1 — Typical examples of patent glazing bars *(continued)***3.4****conservatory**

construction which has not less than three-quarters of the area of its roof and not less than one half of the area of its external walls made of translucent material, and which is attached to and has direct access from a building

3.5**coupled glazing**

two panes of infilling spaced apart in an opening, either in the same frame or glazed separately, to form an unsealed cavity

3.6**drainage channel**

groove formed within the section profile of a glazing bar to collect and drain water to the outside of the building, either directly or indirectly

NOTE See Figure 1.

3.7**fastener**

mechanical device for securing patent glazing to the supporting structure, or for connecting or fastening one part to another

3.8**fixing**

item or assembly of items which forms the attachment of patent glazing to the supporting structure

3.9**fixing bracket**

fitting attached to a patent glazing bar and secured to a structural member by fasteners

NOTE Cleat, plate, shoe and slipper are deprecated terms for fixing brackets.

3.10**flashing**

strip of impervious material dressed or fitted in order to exclude water from the junction between patent glazing and adjacent material or between joints in patent glazing

NOTE It is usually metal.

3.11**four-edge system**

patent glazing with infilling fully supported on four edges

3.12**glazing bar**

member, incorporating drainage channels, that supports and retains the edge of infilling. The longitudinal bars span between structural member supports

NOTE Examples of glazing bars are shown in Figure 1.

3.13**glazing seal**

gasket or seating material fitted between the glazing bar, cap or wing and the infilling

3.14**glazing stop**

fitting attached to the lower end of a patent glazing bar to prevent the infilling from sliding

3.15**head**

top member in patent glazing, usually horizontal

3.16**infilling**

material that occupies the space between glazing bars

3.17**pane**

infilling cut to size and shape

3.18**setting blocks**

pieces of resilient material used at the bottom edge of infilling

3.19**sloping patent glazing**

patent glazing having a slope of 75° or less from horizontal

3.20**spacing**

bar centres

perpendicular distance between the centres of two adjacent glazing bars, measured in the plane of the glazing

3.21

span of glazing bar

fixing centres

distance between the centres of attachment points of a glazing bar to a structural member

3.22

storm clip

fitting attached to a patent glazing bar to restrain the infilling against negative wind pressure, mainly used on vertical patent glazing

3.23

thermal barrier

material of low conductivity between the exterior and interior surfaces of a metal profile or an air gap to prevent cold bridging and improve the thermal conductivity of the profile or framing

3.24

transom

intermediate transverse glazing section, spanning between patent glazing bars and incorporating a drainage channel

3.25

two-edge system

patent glazing with infilling fully supported on two opposite longitudinal edges

3.26

vertical patent glazing

patent glazing which is vertical or within 15° of vertical

3.27

weatherings

closure material to control the passage of water and/or air through a joint at eaves or tiered glazing junctions in patent glazing

3.28

wing

metal strip fitted to the side of a patent glazing bar to retain infilling and impede direct water penetration

NOTE See Figure 1.

4 Provision of information

4.1 General

To ensure that the intentions of the building designer and the requirements of the patent glazing contractor are clearly understood, consultation is recommended at both the initial design and tender stages. Consideration should be given to positioning and size of supporting structure; location of adjacent materials in relation to the patent glazing; requirements for movement joints; preparation of building work by the main contractor to receive perimeter flashings, etc. See also Clause 15.

Information normally required by the patent glazing contractor is given in 4.2 and is usually best provided in the form of drawings, specifications, bills of quantities or other related documents.

4.2 Design and performance criteria

The following information should be provided by the building designer, where appropriate:

a) the design wind pressure based on BS 6399-2:1997 assessed by the building engineer or the following information:

- 1) the building location and distance from sea;
- 2) the altitude of the site;
- 3) the building length width and height;
- 4) the height of surrounding buildings;
- 5) the distance from surrounding buildings;
- 6) site category town or country or distance from the edge of town;
- 7) the surrounding topography;

b) the design snow load based on BS 6399-3, assessed by the building engineer or the following information:

- 1) the building location;
- 2) the altitude of the site;
- 3) the building dimensions;
- 4) the position of the glazing in relation to the rest of the building, particularly any features likely to give rise to snow drifts on the glazing;

c) the intended use and occupancy of the building together with any specific performance criteria should be considered and may include the following:

- 1) mechanical design (see Clause 6);
- 2) safety (see Clause 7);
- 3) fire (see Clause 8);
- 4) ventilation (see Clause 9);
- 5) heat conservation (see Clause 10);
- 6) solar heat gain (see Clause 10);
- 7) thermal safety (see Clause 10);
- 8) condensation (see Clause 10);
- 9) acoustics (see Clause 11);
- 10) security (see Clause 12);
- 11) durability (see Clause 13);
- 12) weather resistance (see Clause 14);
- 13) maintenance and cleaning (see Clause 15);
- 14) transmission of light (see BS 5516-2:2004);

d) details of any environmental factors or atmospheric conditions which can have an adverse effect on the patent glazing, especially any corrosive conditions;

e) detail of any adjacent building material, e.g. copper sheet, which might contaminate rainwater run-off, onto the patent glazing;

f) position of the patent glazing on the building, the external dimensions of the building and details of any features which can affect the distribution of wind or snow;

g) design loads for the particular situation of the patent glazing;

h) details of supporting structure including the size, spacing, nature and dimensional and positional tolerances of structural members, surrounding construction and adjacent materials;

- i) dimensions of the patent glazing including angle of glazing to the horizontal and preferred spacing of patent glazing bars;
- j) type(s) of patent glazing bar, type(s) of infilling, type(s) of flashing and any decorative or protective finish(s) required;
- k) details of any ventilation or other openings required and their method of operation;
- l) details of any access equipment to be provided for cleaning/maintenance.

5 Materials, components and finishes

5.1 General

All components of a patent glazing system should be manufactured from materials or be protected by finishes which are compatible, durable and capable of resistance to corrosion and degradation in the environmental and service conditions in which they are expected to be used. The compatibility of components within patent glazing systems should also be considered. Highly corrosive conditions need attention and the patent glazing contractor should be provided with the necessary information at the initial design stage (see Clause 4).

The selection of suitable materials and finishes should take into account performance criteria, visual considerations and the economic factors involved.

5.2 Patent glazing bars

5.2.1 Types of patent glazing bars

Patent glazing bars should be one of the following types.

a) *Aluminium bars*:

- 1) *traditional bars* in which the stalk projects to the outside and the infilling is retained either by wings of aluminium, lead or plastics, or by caps of aluminium or plastics [see Figure 1a)];
- 2) *inverted bars* in which the stalk does not project to the outside and the infilling is retained by caps of aluminium or plastics [see Figure 1b)], which generally provide a thermal barrier by nature of the air gap;

b) *Lead-sheathed steel bars*. These bars have a steel core encased in an extruded lead sheath with integral lead wings. Sheaths are sealed at their ends by lead burning or soldering.

c) *Plastics-sheathed steel bars*. These bars have a steel core encased in an extruded plastics sheath, which is sealed at the ends. The infilling is retained in position by an extruded plastics cap.

d) *Composite bars*. A glazing bar produced from more than one material, e.g. a bar formed from a PVC-U profile, to provide weathering and drainage with steel or aluminium reinforcement to provide adequate stiffness.

e) Glazing bars of other materials that provide the necessary structural integrity and durability to conform to this Code of Practice.

5.2.2 Materials for patent glazing bars, caps, wings and sheaths

Materials for patent glazing bars, caps, wings and sheaths should be as follows.

- a) *Aluminium profiles*. These should be extruded from designated treated alloy 6060 or 6063 in temper T6 of BS EN 755. Other alloys and tempers might be suitable and the patent glazing contractor should be consulted as to their use.
- b) *Steel bars*. These should be manufactured from hot rolled steel sections that, when tested in accordance with BS EN 10002-1, have a minimum ultimate tensile strength of 355 N/mm². Rust and mill-scale should be removed before fabrication (cutting to length, drilling, notching, etc.). After fabrication, prior to lead or plastics sheathing, steel cores should be protected by the application of a suitable rust inhibiting material or inert coating.
- c) *Aluminium caps and wings*. These should be extruded from designated treated alloy 6060 or 6063 in temper T6 of BS EN 755, or formed from sheet or strip aluminium conforming to designation 1200 or from alloys designated 3103, 5005 or 5251 of BS EN 485, in a temper suitable for the particular type of application and degree of forming to be adopted. Other alloys might be suitable and the patent glazing contractor should be consulted as to their use.
- d) *Lead wings and sheaths*. These should be extruded from lead showing a medium grain size. Lead sheaths should be not less than 0.8 mm thick.
- e) *Plastics caps, wings and sheaths*. These should be extruded from unplasticized polyvinyl chloride, conforming to BS EN 477, BS EN 478 and BS EN 479. Plastic sheaths should be not less than 0.75 mm thick.
- f) *Reinforcement of PVC-U*. These should conform to the requirements of BS 7412.
- g) *Other materials*. These should provide the necessary structural integrity and durability to conform to the recommendations of this Code of Practice.

5.3 Flashings

Flashing materials should conform to one of the following specifications.

- a) *Lead*: milled lead sheet conforming to BS EN 12588 with a minimum thickness of 1.8-mm (code No. 4).
- b) *Aluminium*:
 - 1) *site formed flashings*: sheet or strip aluminium conforming to designation 1050 O/H111 of BS EN 485 and not less than 0.8 mm thick;
 - 2) *preformed flashings*: sheet or strip aluminium conforming to designation 1200 or alloys designated 3103, 5005 or 5251 of BS EN 485 in a temper suitable for the particular type of application and degree of forming to be adopted and not less than 0.9 mm thick.
- c) *Steel*: steel sheet conforming to BS 1449-1 or galvanized steel sheet conforming to BS EN 10143 and not less than 0.7 mm thick.
- d) Other suitable flashing materials. Their suitability should be checked with the patent glazing contractor.

5.4 Ancillary components

5.4.1 Weatherings

Weatherings such as comes, weather bars, closures and fillers, if made from one of the materials described in 5.2.2 and 5.3, should conform to the relevant specification. Other materials should be compatible with other components of the patent glazing. Where wood is used, it should be of a durable type and, if necessary, treated with preservative of a type compatible with the other components of the patent glazing and adjacent materials.

5.4.2 Fittings

Fixing brackets, glazing stops, storm clips, etc. should be of materials, shapes and thickness adequate to withstand the loads imposed upon them and any likely movements.

NOTE A large variety of fittings may be used and it is not practicable to give detailed recommendations.

5.4.3 Fasteners

Bolts, screws, studs, nuts, rivets and other mechanical fasteners should have adequate strength for the particular condition in which they are to be used and should be made from one of the following materials.

- a) *Aluminium*: bolt or screw stock alloy conforming to designation 5056A, temper H4, of BS 1473 or other suitable alloy of a composition not likely to show stress corrosion tendencies.
- b) *Brass*: alloy of a composition not likely to show stress corrosion tendencies. Brass fasteners should not be used where directly in contact with aluminium.
- c) *Stainless steel*: austenitic steel conforming to grades A2 or A4 of BS EN 3506.
- d) *Steel*: mild steel protected either by electroplating with zinc or cadmium conforming to BS 3382 and chromate passivated and sealed in accordance with BS 6338, or by sherardizing to class 1 in accordance with BS 4921. Other protective treatments might be suitable and the patent glazing contractor should be consulted as to their use.

Where patent glazing is to be subjected to vibration, fasteners of a type that resist slackening, should be used.

5.5 Finishes

NOTE The selection of suitable finishes for aluminium and steel will depend on the degree of protection and/or decorative effect required.

5.5.1 Finishes for aluminium

Aluminium components should have one of the following types of finish:

- a) *mill*. This is applicable to untreated aluminium surfaces;

NOTE The rate at which the original bright, metallic appearance will become dull as the surface oxidizes and develops a roughened texture depends upon environmental conditions. Mill finish might not be suitable where long-term appearance is important or where close fitting, moving parts are involved.

- b) *anodized*, conforming to BS 3987;
- c) *liquid organic coated*, conforming to BS 4842;
- d) *polyester powder coating*, conforming to BS 6496.

5.5.2 Finishes for steel

Components made from steel (except stainless steel), which are not otherwise protected against corrosion, should be protected by one of the following types of finish:

- a) *hot-dip galvanized*, conforming to BS EN ISO 1461;
- b) *zinc sprayed*, conforming to BS EN 22063;
- c) *organic coated*, conforming to BS 6497.

5.6 Infillings

5.6.1 Maximum size

Maximum size limits are determined more often by design considerations than by availability. Important design factors influencing size limits are loadings (e.g. wind, snow), safety, fire and security considerations. Ease of handling and means of access to vertical or sloping patent glazing are further considerations, which relate to both the weight and dimensions of the infilling.

The patent glazing contractor should be consulted about the suitability of the size of panes, shapes other than rectangles, or panes of unusual dimensions.

5.6.2 Glass and plastics glazing sheet materials

Glass for glazing is classified in BS 952-1. Selection of glass and plastics glazing sheet material should be according to the recommendations of BS 5516-2:2004 for sloping glazing and BS 6262 for vertical glazing.

5.6.3 Other materials

Infillings made from other materials should be compatible with all adjacent components of the patent glazing and be designed to resist the applied loads.

A wide range of materials, with or without insulating backings, may be used as infillings. These include:

- a) aluminium sheet;
- b) coated metal sheet;
- c) flat or profiled plastics sheet material;
- d) composite panels.

For full technical information of these and other types of infill material, reference should be made to the manufacturer of the infilling material.

5.7 Sealing and glazing materials

5.7.1 General

There is a wide range of materials available for the seating of infilling and the weather sealing of joints in patent glazing and between patent glazing and adjacent materials. These materials should be of a resilient nature, capable of accommodating any likely movements, and be compatible with the substrates to which they are applied or with which they are in contact. Care should be taken in the selection of sealing and glazing materials to ensure that they are sufficiently resistant to climatic effects, especially ultraviolet light and atmospheric pollution in the conditions in which they are to be used (see also BS 5516-2:2004, Annex A)

Correctly positioned setting blocks of adequate size, with or without glazing materials, should be used to prevent direct contact between the bottom edge of the glass and any metal component, continuous or otherwise. Suitable materials for use as setting blocks in patent glazing include plasticized polyvinyl chloride (with a softness no. of 35 to 45; see BS 2571) and extruded unplasticized polyvinyl chloride. However, plasticized polyvinyl chloride setting blocks are not recommended for use with plastics glazing sheet materials.

5.7.2 Types

5.7.2.1 Preformed materials

Preformed types are usually of substantially dry, non-viscous materials, commonly in reel or strip form, and include mastic tapes, greased cords synthetic rubbers and plastics sections and gaskets, either solid or cellular. Such materials, which do not normally undergo a physical or chemical change, might require to be used under pressure.

Typical material types include the following:

- a) polychloroprene (CR); or
- b) ethylene propylene diene monomer (EPDM); or
- c) silicone (Si);
- d) thermoplastic rubber (TPR); or
- e) plasticized PVC (PVC-P).

NOTE Non-cellular forms of material a), b) or c) are covered by BS 4255-1. Cellular materials with open cell structure might not be suitable for use as a glazing material.

5.7.2.2 Formed-in-place materials

Formed-in-place types, are those at interface with building substrate or flashings, transverse butt joints between glass panes and/or used as a glazing material. They are usually of viscous material for application by hand, knife or gun and include bulk mastics, glazing compounds and sealants. Such materials may undergo a physical or chemical change after initial placing and may also have adhesive properties. Such materials should be used so as to conform to the manufacturers recommendations for joint size.

Commonly used sealants are:

- one-part gun-grade polysulfide-based sealants, which should conform to BS 5215;
- two-part polysulfide-based sealants, which should conform to BS 4254;
- silicone-based sealants, which should conform to BS 5889.

6 Mechanical design

6.1 Structural support

Patent glazing should be attached to, and supported by, structural members of adequate strength, stiffness and stability. Deflection of a structural member should be limited to 1/360 of its span unless otherwise recommended in an appropriate British Standard code of practice, e.g. BS 5950, BS 5268 or BS 8118. A patent glazing contractor should be consulted with regard to those features of members affecting the accommodation of the patent glazing.

NOTE Self-supporting glazed structures are not covered by this code of practice.

6.2 Structural function

The patent glazing system should be capable of sustaining and transmitting to the structure at its points of support the most adverse combination of loads likely to be encountered in service without damage or permanent deterioration of its performance. There should be no significant, irreversible deformation or excessive deflection of any of its parts resulting from the design loads.

The principle structural requirements of the longitudinal patent glazing bars is to resist the loads acting on the surface of the glazing in addition to its own weight and that of the infilling and to provide continuous support and retention to the longitudinal edges of the infilling against positive and negative pressure. Patent glazing bars might also be required to resist other specified loads such as those incidental to maintenance.

Transoms are intermediate, transverse secondary glazing bars in four-edge systems of patent glazing. The principal structural requirements of a transom are to act in conjunction with the patent glazing bars in resisting the loads acting on the surface of the glazing in addition to its own weight and that of the infilling and to provide continuous support and retention to the transverse edges of the infilling against positive and negative pressure. Transoms have also to resist the dead load acting downwards in the plane of the glazing.

NOTE Came joints do not provide structural support for the glass edge.

The infilling should be capable of sustaining the loads acting on the surface of the glazing in addition to its own weight and of transferring them to the glazing bars.

Fixings should be capable of withstanding the maximum support and restraint loads to which they might be subjected and of resisting any likely movements.

6.3 Loading

Patent glazing should not be subjected to loads imposed by the structure to which it is attached.

Patent glazing should be designed to resist combinations of loads due to the following.

- Wind exerted on the surface of the patent glazing, which can act either inwards (positive pressure) or outwards (negative pressure or suction) or both: negative and positive pressures are not necessarily equal in magnitude.
- Snow acting inwards on the surface of the patent glazing.
- Self-weight, usually acting inwards: the weight should also be considered as a load acting downwards in the plane of the glazing.
- Maintenance, if required, which should be taken as acting inwards on sloping patent glazing but which can act either inwards or outwards on vertical patent glazing.

6.4 Assessment of design loads

6.4.1 Wind load

The design wind loads, both positive and negative, for the particular situation of the patent glazing should be determined at the initial design stage (see Clause 4).

Wind loads for external walls and roofs of normal, rectangular, clad buildings and for canopy roofs should be determined by the method described in BS 6399-2:1997. A summary of this procedure is given in Annex A.

For buildings of unusual geometric shape or site location not covered by BS 6399-2:1997 and for problems involving consideration of the excess pressure near ground level that can, in some circumstances, be generated by down-draught from tall buildings or high speed air currents such as can occur in narrow paths between buildings, the building designer should seek expert advice.

6.4.2 Snow load

The design snow loads on roofs for the particular situation of the patent glazing should be determined at the initial design stage (see Clause 4).

Snow loads on roofs should be determined by the method described in BS 6399-3. A summary of this procedure is given in Annex B.

Exceptional local effects such as shelter from the wind or local configurations, which funnel the snow, can give rise to increased loading. If the building designer thinks that there might be unusual local conditions that might need to be taken into account then the nearest meteorological office or informed local sources should be consulted.

Where there is a risk of damage by impact from large masses of snow sliding off an adjoining roof at higher level, snow-guards should be fitted. The building designer should refer to BS EN 12056-3 for detailed advice.

6.4.3 Dead load (self-weight)

Dead loads for glazing bars and for the infilling should be calculated from the actual known mass of the materials.

When considering the dead load for glazing bars, the weight taken should be that of the glazing bar, together with that of the infill material. When considering the dead load for the infilling alone, the weight taken should be that of the infill material only (see Annex C).

Self-weight should also be considered as a dead load acting downwards in the plane of the glazing.

6.4.4 Maintenance load

Safe and efficient means of access for the maintenance including cleaning of patent glazing, both inside and outside, should be considered (see Clause 15). It is essential that account should be taken of any loading on the patent glazing that might arise, incidental to maintenance, at the initial design stage (see Clause 4).

NOTE 1 Attention is drawn to the requirements of the Construction Design and Management (CDM) regulations and the National Building Specification (NBS) *Access for cleaning and maintenance* [1] at this initial stage.

For patent glazing at low level and certain forms of patent glazing at roof level, maintenance may be carried out from the ground or adjacent areas of solid, weight-bearing roof without the need to impose any maintenance load on the patent glazing itself.

Those responsible for the maintenance of patent glazing should be made aware of any load limits on which a particular design is based so that they can ensure that such limitations are not exceeded (see Clause 15).

NOTE 2 For glass replacement each contract needs to be individually assessed, as replacement might not be possible from a cleaning gantry.

Recommendations for maintenance loads are given in Annex D.

6.4.5 Other loads

Where loads other than those mentioned in 6.4.1, 6.4.2, 6.4.3 and 6.4.4 are anticipated, for example any permanent imposed loads or suspended loads, due allowance should be made and the patent glazing contractor should be provided with the necessary information at the initial design stage (see Clause 4). Permanent imposed loads should never be carried directly by the infilling.

6.5 Determination of working pressures

6.5.1 General

In determining working pressures for patent glazing, account should be taken of the most adverse combination of design loads that is likely to occur in service in the particular location of the patent glazing.

6.5.2 Glazing bars

Working pressures for glazing bars should be determined from the recommendations in Annex E.

6.5.3 Infilling

6.5.3.1 Glass and plastics glazing sheet materials

Glass and plastics glazing sheet materials should be selected according to the recommendations of BS 5516-2:2004 for sloping applications and BS 6262 for vertical applications.

6.5.3.2 Other infill materials

For the determination of appropriate working pressures for other infill materials the manufacturer should be consulted.

6.6 Strength and stiffness of glazing bars

6.6.1 General

Glazing bars should be strong enough to withstand the working pressure without permanent bending or yielding of their material. They should also be stiff enough to restrict deflection to an amount likely to be visually acceptable and prevent damage to, or displacement of, the infilling and other adjacent materials and components, or cause impairment to the functional performance of the patent glazing system.

Formulae for determining the required properties of section in a direction of bending normal to the plane of the glazing for straight glazing bars in two-edge and four-edge systems of patent glazing should be based on uniformly loaded simply supported beams, using the deflection limitations given in **6.6.3**.

The required properties of section for transverse glazing bars in four-edge systems of patent glazing should also take into account the dead load acting downwards in the plane of the glazing; usually this will be transmitted by setting blocks as two equal and symmetrically placed point loads.

These loads might not be directed through an axis of symmetry of the section and the required geometric properties about the neutral axis in a direction of bending parallel to the plane of the glazing should be determined from appropriate engineering formulae.

Example calculations for patent glazing bars are given in Annex F.

6.6.2 Strength

The glazing bars of a patent glazing systems, which are principally uniformly loaded and simply supported, should be designed to conform to the limit state design requirements of BS 8118.

NOTE 1 Glazing bars designed for integration or replacement of existing systems may be designed to resist bending stresses to conform to the obsolete BS CP 118, which will usually be satisfactory in respect of other mechanical stresses.

When patent glazing is used in self supporting roof lights, e.g. skylights and lantern lights, the structural element of the framing should be designed in accordance with BS 8118, BS 5950, BS 5268 and suitable stresses adopted. The design of the infilling should be in accordance with this standard, however.

NOTE 2 In the context of this code, glazing bars should not be considered as structural members. Lateral instability of patent glazing bars is not a criterion due to the restraint provided by the infilling.

6.6.3 Stiffness

For glazing bars carrying glass and other similar infill material, the maximum allowable deflection normal to the plane of the glazing is usually determined by considerations of appearance as well as the flexibility of the infilling. To restrict stresses in the infill material, the following deflection limits (in millimetres) should not be exceeded.

a) For two-edge systems:

1) for single glazing and for coupled glazing:

$$d_{\text{all}} = \frac{S^2}{180} \times 10^3$$

$$\text{or } d_{\text{all}} = 50 \text{ mm}$$

whichever is the less;

where S is the span of the glazing bar; and

d_{all} is the maximum deflection;

2) for hermetically sealed insulating glass units:

$$d_{\text{all}} = \frac{S^2}{540} \times 10^3$$

$$\text{or } d_{\text{all}} = 20 \text{ mm}$$

whichever is the less.

b) For four-edge systems:

1) for single glazing and coupled glazing when the span is less than or equal to three metres:

$$d_{\text{all}} = \frac{S}{125} \times 10^3$$

2) for single glazing and coupled glazing when the span is greater than three metres:

$$d_{\text{all}} = \left[\frac{S}{250} \times 10^3 \right] + 12$$

$$\text{or } d_{\text{all}} = 40 \text{ mm}$$

whichever is the less;

3) for hermetically sealed insulating glass units:

$$d_{\text{all}} = \frac{S}{175} \times 10^3$$

$$\text{or } d_{\text{all}} = 20 \text{ mm}$$

whichever is the less.

When designing to these maximum values, account should be taken of the magnitude of deflection under sustained loading and of the possible effect on adjacent materials and finishes. If lower deflection limits are required, the building designer should specify them and the patent glazing contractor should be provided with the necessary information at the initial design stage (see Clause 4).

For other infilling materials, especially those with inflexible coverings, the amount of deflection might need to be reduced and the manufacturer should be consulted.