



BS 6262 : 1982

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British Standard Code of practice for **Glazing for buildings**

(Formerly CP 152)

Vitrages de bâtiments - Code de bonne pratique

Leitfaden für das Verglasen von Gebäuden

British Standards Institution

BS 6262 : 1982

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This code of practice represents a standard of good practice and takes the form of recommendations. Compliance with it does not confer immunity from relevant legal obligations.

Foreword

This code of practice was first published, as BS 973, in 1941 and revised under the same number in 1945. A second revision was published in 1960 as CP 152 and this was subsequently revised in 1966 and 1972.

This present code, prepared under the direction of the Elements and Components (of Diverse Materials) for Buildings Standards Committee, now supersedes that last revision, which is withdrawn.

Since the 1972 edition of the code was only a partial revision of the 1966 issue, the alterations necessary to bring this edition up to date in respect of new glass, plastics materials and methods have been very considerable. This, and the inclusion of plastics glazing sheet materials, structural glass assemblies and frameless doors and entrances, has consequently enlarged the code, although this has been mitigated to some extent by the omission of items such as glass domes and facings. This code now only covers vertically glazed materials and attention is drawn to the list of exclusions in the scope.

One aspect of this revision that received particular attention was the recommendations related to safety (see 4.7, 5.7 and 6.7). These have been appraised in the light of both current accident information and the increased use of large panes of glass in risk areas, and the recommendations are now more stringent than the 1972 code as amended in 1976.

These recommendations are a consensus of varying shades of opinion, taking all factors into consideration. These recommendations will be reviewed during the currency of this code should any further accident information show this to be desirable. The recommendations on safety take into account the new standard BS 6206. Because the recommendations in this edition of the code are more complex, appendix A has been added to give guidance on their application in some commonly occurring situations.

This code now covers plastics glazing sheet materials in the form of flat sheets. Because these plastics may be formulated to meet a wide range of requirements, individual manufacturers have hitherto preferred to make their own recommendations on the grade of material to be used to meet a specific requirement and on the fixing method to be employed. Although this practice will continue and manufacturers should be consulted about the suitability of the use of their materials for a particular glazing application, there is now sufficient similarity between manufacturers' data on fixing techniques and general properties to present them as a code of good practice related to general building uses.

The drawings contained in this code are diagrammatic, their purpose being only to complement the text and indicate design principles.

British Standard Code of practice for

Glazing for buildings

1. Scope

This code of practice gives recommendations for the design, installation and maintenance of vertically glazed (see 3.40) glass and plastics glazing sheet materials for the external walls and interiors of buildings.

The recommendations in this code do not apply to:

- (a) patent glazing (see BS 5516);
- (b) glazing of furniture and fittings;
- (c) glazing of barriers and balustrades (see BS 6180);
- (d) glazing of commercial greenhouses (see BS 5502);
- (e) glazing of domestic greenhouses;
- (f) bent, profiled and corrugated glass;
- (g) glass blocks;
- (h) glass lens lights (precast and cast in situ);
- (i) glass and plastics bullions;
- (j) thermoformed plastics panels;
- (k) corrugated plastics sheeting (reinforced and unreinforced).

NOTE 1. All dimensions given in this code for thickness are nominal. Tolerances on glass thicknesses should be in accordance with BS 952 : Part 1.

NOTE 2. It is not possible to state individual tolerances on all the installation dimensions contained in this code. These dimensions, which are based on considered good practice in the glazing industry and assume skilled workmanship, should be reasonably applied.

2. References

The titles of the standards publications referred to in this code are listed on the inside back cover.

3. Definitions

For the purposes of this code the following definitions apply.

3.1 aspect ratio. The ratio of the longer side of a pane to its shorter side.

3.2 back bedding. That portion of the glazing material between the face of the glass or plastics and the rebate upstand after the glass or plastics has been pushed into position.

NOTE. See 3.4.

3.3 bead or glazing bead. A strip of wood, metal or other suitable rigid material attached to the surround to retain the glass or plastics.

3.4 bedding. The glazing material placed in the rebate, into which the glass or plastics is bedded.

3.5 blocks

(a) **location blocks.** Pieces of resilient material used between the edges of the glass or plastics (other than the bottom edge) and the surround to prevent relative movement between the pane and the surround.

(b) **setting blocks.** Pieces of resilient material used between the bottom edge of the glass or plastics and the surround to support and centralize the pane in the surround.

NOTE. See also 3.11.

3.6 butt jointing. The positioning of the edges of panes close together and the filling of the space between them.

3.7 capping. A sealant applied to fill the space remaining above a strip glazing material positioned between the glass or plastics and the rebate and/or bead.

NOTE. See 9.3.3.4.

3.8 clearance (see figure 1)

(a) **back clearance.** The distance between the face of the glass or plastics and the upstand face of a rebate or groove.

(b) **edge clearance.** The distance between the edge of the glass or plastics and the rebate.

(c) **front clearance.** The distance between the face of the glass or plastics and the upstand face of a bead or groove.

NOTE. The back clearance and front clearance are sometimes called the 'face clearance' or, collectively, the 'face clearances'.

3.9 cleat. A small, non-corrodible metal component, usually right-angled in section, secured to the surround to hold the glass or plastics in position, in conjunction with distance pieces when necessary.

3.10 coupled windows. One single-glazed frame with another glazed frame hinged or fastened to it, so that both open together for ventilation and can be separated for cleaning purposes.

3.11 distance pieces. Pieces of resilient material used between the glass or plastics and rebate upstand and bead to constrain movement of the glass under wind load.

3.12 double glazing. Glazing that incorporates two panes, separated for the purposes of sound and/or thermal insulation.

3.13 double-glazing unit. Two panes of glass or plastics spaced apart and hermetically sealed in a factory.

NOTE. A double-glazing unit is often referred to as an insulating glazing unit, but this latter term also caters for any number of panes and spaces (see 3.24).

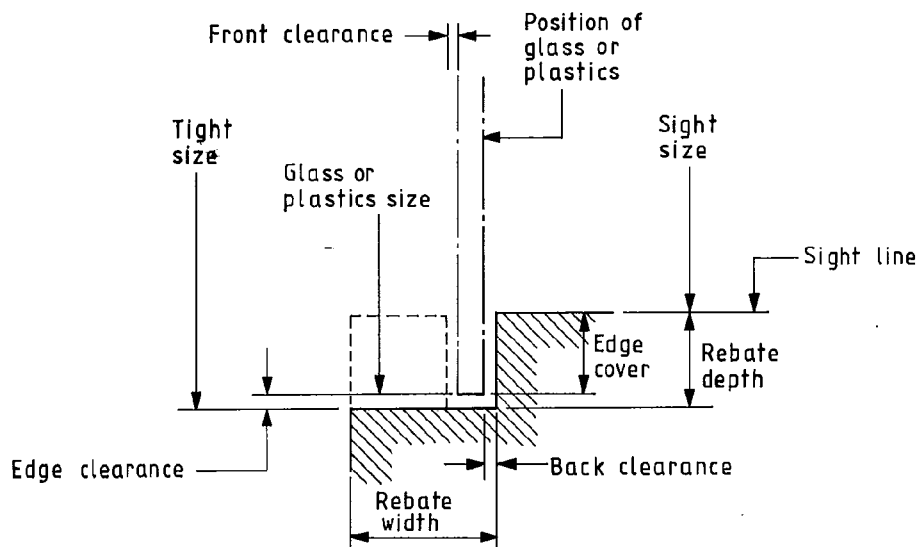


Figure 1. Glass, plastics and rebate dimension definitions

3.14 double windows. Two separate glazed frames superimposed in the same wall opening.

3.15 edge cover. The distance between the edge of the glass or plastics and the sight line (see figure 1).

3.16 factory glazing. Glazing into surrounds (usually in a factory) prior to the surround being installed in the building.

3.17 fixing. The securing of glass or plastics to surfaces (e.g. walls).

3.18 fronting. A triangular fillet of glazing material on the rebate platform between the surface of the glass or plastics and the front edge of the rebate.

3.19 gasket. A specially profiled material for bedding or securing the glass or plastics.

3.20 glass assembly. A matrix of glass panels connected together by mechanical or adhesive means and supported against wind loading by the use of glass stiffeners (e.g. fins).

3.21 glazing. The securing of glass or plastics in prepared openings in, for example, windows, door panels, screens and partitions.

(a) **external glazing.** Glass or plastics where one or both faces are exposed outside the building.

(1) **inside glazing.** External glazing in which the glass or plastics is inserted from inside the building.

(2) **outside glazing.** External glazing in which the glass or plastics is inserted from the outside.

(b) **internal glazing.** Glass or plastics where neither face is exposed outside the building.

3.22 glazing material. A material that provides a bedding for the glass or plastics and produces a joint between them and the surround.

3.23 location blocks. See 3.5.

3.24 multiple glazing. A form of glazing incorporating two or more panes spaced apart for the purposes of sound and/or thermal insulation.

3.25 pane. A piece of glass or plastics glazing sheet material cut to size and shape ready for glazing.

NOTE. A less preferred term for this definition is 'square'.

3.26 peg. A metal pin used to hold the glass or plastics in a metal surround.

3.27 plastics material. A material based on an organic polymeric substance of high molecular weight that may be used either in its raw material state or in combination with other chemical additives to modify the properties of the raw material to suit particular applications.

3.28 plastics film. Any plastics material less than 1 mm in thickness.

3.29 plastics glazing sheet material. Plastics materials consisting of a single sheet or a combination of sheets laminated together or as profiled extruded double skin sheet.

3.30 plastics sheet. Any plastics material 1 mm or greater in thickness.

3.31 primer. A coating applied to a surface to improve the adhesion of compounds or sealants subsequently applied to that surface.

3.32 primer/sealer. A coating applied to a porous substrate to prevent migration from compounds or sealants subsequently applied to that surface and at the same time to improve the adhesion of compounds or sealants to the substrate.

3.33 rebate. That part of a surround, the cross section of which forms an angle into which the edge of the glass or plastics is placed (see figure 1).

3.34 sealer. A coating applied to a porous substrate to prevent migration from compounds or sealants subsequently applied to that surface.

3.35 secondary sashes. The addition of a second glazed frame either to an existing window or fixed to the reveals.

3.36 size (see figure 1)

(a) **glass size or plastics size.** The actual size of a pane.

(b) **sight size or daylight size.** The actual size of the opening that admits light.

(c) **tight size or rebate size.** The actual size of the rebate opening.

NOTE. Size dimensions should be given as width (measured horizontally as used) followed by height (measured vertically as used).

3.37 sprig. A small headless nail or triangular piece of metal used for securing panes in wood surrounds while the glazing material hardens.

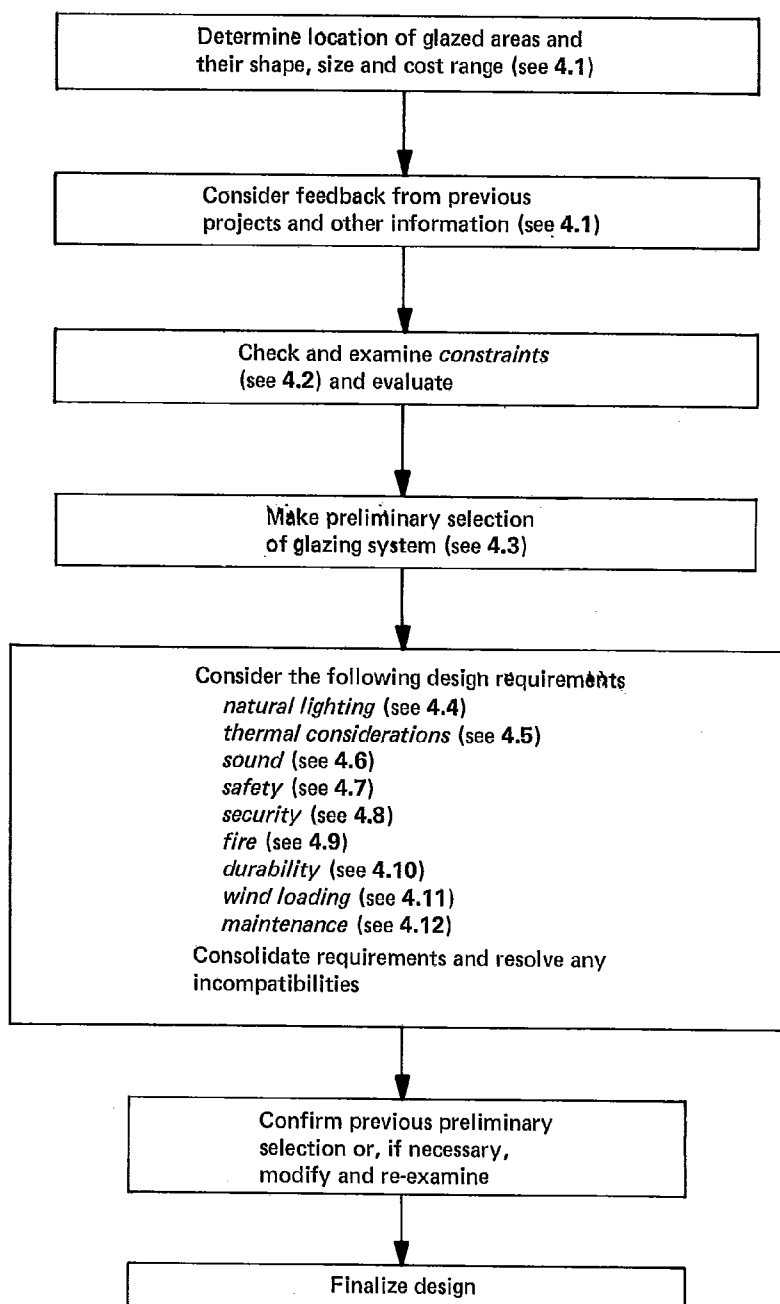
3.38 spring clip. A small metal component used for securing panes in metal frames while the glazing material hardens.

3.39 surround. Any frame or building element designed to be glazed.

3.40 vertically glazed. Glass or plastics glazing sheet material glazed either truly vertical or sloping at up to 15° either side of true vertical.

4. Design and performance

4.1 Introduction. This clause provides a methodology to arrive at an appropriate choice of glass, plastics and methods of glazing (see figure 2).



NOTE. Reference should be made to clause 5, which deals with the performance of glass and glazing systems, to clause 6 for plastics glazing sheet materials and systems to satisfy the evaluated design requirements, and to clause 15 which sets out essential information needed for installation.

Figure 2. Sequence of design evaluation for glazed areas

In recent years the design and performance requirements for glass and plastics have become more demanding, particularly in terms of energy conservation. It is important at the initial project evaluation stage that sufficient note is taken of the implications of using glass and plastics that are adequate. 4.2 to 4.12 are directly related to the sequence shown in figure 2. It has been assumed that:

- (a) the locations of the glazed areas, their shapes and preliminary sizes have been decided as part of the normal building design process;
- (b) the designer will have acquired information on glass and plastics used in similar circumstances;
- (c) the designer is aware of the implications of any innovative design.

4.2 Initial constraints

4.2.1 General. Before making any selection, the factors given in 4.2.2 to 4.2.4 should be considered.

4.2.2 Design requirements. Design requirements include aesthetic considerations, psychological factors (e.g. view) and any specific client requirements, such as security and maintenance considerations.

The desire to provide a visual link from the inside of the building to the outside (and in some cases vice versa) may determine the size, proportion and type of windows and the positioning of intermediate frame members, all of which is beyond the scope of this code, but could determine the size and type of the glass or plastics glazing sheet material.

4.2.3 Legislative requirements. The size and type of the glass or plastics, and in some cases the surrounds, may be restricted by legislation.

4.2.4 Effect of design on cost. This involves consideration of:

- (a) not only the initial cost of the glazing system but the effect of the glass and plastics on the capital and running costs related to the building and its heating, lighting and ventilation; factors affecting the initial glazing cost include:
 - (1) type, size and thickness of glass or plastics;
 - (2) method and materials for glazing;
 - (3) access for initial glazing;
 - (4) continuity of work schedule;
 - (5) possible need for protection during construction and its removal on hand-over;
- (b) the maintenance of the glazed areas, the factors most likely to affect maintenance costs being:
 - (1) the glazing materials used;
 - (2) access for cleaning and reglazing;
 - (3) ease of reglazing.

The use of more expensive glass and plastics should take into account the possibility of reduced fuel consumption and lower running costs.

The comparative costs of glazing materials should be considered in conjunction with their life expectancy and probability of need for maintenance. (For guidance, see table 5.)

4.3 Glazing system. When the designer has evaluated the effect of the constraints given in 4.2, a preliminary selection of a system of glazing can be made. The design requirements in 4.4 to 4.12 can be considered in detail in order to check the validity of the initial selection.

4.4 Natural lighting

4.4.1 Design information. For design guidance relating to the assessment and provision of natural lighting, reference should be made to DD 67 for sunlight, and DD 73 and for daylight. Further references will be found in the bibliographies included in these standards. Consideration of natural lighting should be related to the provision for artificial lighting. Recommendations for artificial lighting are given in CP 3 : Chapter 1 : Part 2.

4.4.2 Glare. The following four manifestations of glare from glass and plastics should be considered:

- (a) direct glare from the sun;
- (b) glare from the sky, excluding direct sunlight;
- (c) glare resulting from diffracting or diffusing glass and plastics of high surface luminance;
- (d) glare resulting from reflection of sunlight or skylight.

It is generally accepted that direct glare from the sun can be controlled only by design to prevent the sun from entering the window aperture. In relation to glare from the sky, or reflected glare, it is possible to use special glass and plastics with reduced light transmissions in order to produce satisfactory lighting. Methods exist for the prediction of glare indices when direct sunlight is excluded, and these relate the size and shape of the glazed area, the luminance of the relevant part of the field of view and the light transmission characteristics of the glass and plastics. As a general rule it is more rewarding to maintain the size and reduce the light transmission of the glass or plastics material than it is to maintain a high light transmission and reduce the area. This is because the contrast between the glazed area and its surrounding opaque walls, etc., has to be minimized if glare is to be reduced to an acceptable level.

4.4.3 Fading. When sunlight or skylight is received by an object, fading can occur. The rate of fading depends on the nature of the object, the duration and intensity of the exposure and the type of radiation. Fading is generally associated with ultraviolet radiation, which comprises about 3 % of the sun's energy received at the earth's surface. It should, however, be borne in mind when assessing the performance of glass or plastics in reducing fading, that fading can result from exposure not only to ultraviolet radiation but also to some part of the visible radiation in sunlight and skylight.

4.4.4 Privacy. The required degree of obscuration should be considered in respect of the privacy needed, from either side of the glass or plastics and under the difference between internal and external lighting conditions.

4.5 Thermal considerations

4.5.1 General. The total annual energy implications of solar gain and heat loss should be considered in relation to the total heat balance of the building and the glazed areas should be chosen accordingly.

4.5.2 Solar transmission. The effects of solar transmission can be considered in two ways:

- (a) solar gains that occur during the summer months;
- (b) solar gains that occur during the normal heating season of September to May.

Unwanted summertime solar gains can be dealt with by means of window design and orientation, and various forms of shading.



Solar gains that occur during the heating season can be used to advantage by the consideration of window geometry and orientation and the use of suitable controls on the heating and lighting systems. Effective use can mean that the net energy balance of windows facing south of the east/west axis can be positive, i.e. the useful solar gains can more than equal the conduction losses due to the glazed area.

4.5.3 Thermal insulation. The thermal insulation of a building material such as glass or plastics is conveniently expressed by its thermal transmittance (U -value). To determine the total heat loss for a particular type of glass or plastics, single or multiple, it is simply a matter of multiplying the U -value (expressed in $W/(m^2 \cdot K)$) by the area of the glass or plastics and by the temperature difference between the environments, usually indoors and outdoors, on each side of the glazed area.

Glazed areas enable daylight to be admitted to a building, but at the expense of a comparatively high heat loss. Multiple glazing has a reduced heat loss (lower U -value) compared with single glazing because of the additional thermal insulation provided by the cavity(ies) separating the individual panes. Glass and plastics can also be used in conjunction with insulating materials to reduce the heat loss through an opaque building element.

The risk of condensation on the indoor surface of glass or plastics is reduced by using multiple glazing. The risk of condensation in the cavities of such glazing systems is minimized by sealing and dehydrating these (see 5.3.1.3.3) or by venting them to the outside air.

4.5.4 Heat absorption. The effects of the window design on the creation of excessive thermal stresses resulting from the heat absorbed by the glass and plastics should be considered.

4.6 Sound. The reduction of transmitted noise requires an appraisal of the following three elements, each of which is frequency dependent.

(a) *The noise source.* Most noises are complex in that they include sounds of different frequencies and amplitudes. The method of sound determination described in BS 2750 is the one normally used in the UK construction industry, but it is necessary for the designers to be aware that other methods of determination (e.g. ISO) are widely used in the USA and Europe. Further information on external noise climates is given in CP 153 : Part 3.

(b) *The human response.* The range of sound energy to which the ear responds is very large. A logarithmic scale is more in accord with the ear's response and is therefore used to measure sound levels (decibels).

(c) *The glass or plastics and its surround*

(1) *Sound insulation of windows: effects of mass.* The mean sound insulation value of glazing may be predicted with reasonable accuracy from its mass. However, it is not this mean sound insulation value that is important in practice but the sound insulation at the dominant frequencies of the relevant noise spectrum. High insulation values at other frequencies in no way compensate for a deficiency in these bands.

(2) *Differences in pane thickness.* Where two parallel panes are of equal thickness, a drop in sound insulation will occur at the coincidence frequency of the individual panes. By employing panes of different

thicknesses, this loss will not occur at the same frequency and thus an improved sound insulation performance will result.

(3) *Physical separation of panes.* Glass and plastics separated by an air space or a plastics interlayer can provide increased sound insulation. However, the vibrations of the first pane can be transmitted to the second pane and also via the surround.

(4) *Non-parallel panes.* Theoretically, non-parallel panes should provide better acoustic insulation than parallel panes. However, unless the angle of incidence of the noise is well defined, this improvement is negligible in practice.

For further design guidance reference should also be made to CP 3 : Chapter III and CP 153 : Part 3.

4.7 Safety

4.7.1 General. Glass and plastics of suitable type, thickness and size should be selected to provide an appropriate degree of safety, taking into account the intended use. In addition to considering the risks of accidental impact, or where activities generate a special risk, the following criteria should also be taken into account:

- (a) wind loading (see 4.11);
- (b) fire (see 4.9);
- (c) criminal attack (see 4.8).

In the case of internal doors the wind loading is negligible, but the possible risk of accidental human impact could be appreciable.

The recommendations in this subclause are based on the best informed opinion available. The main criteria are:

(1) *The characteristics of the glass and plastics glazing sheet material under impact and the mode of fracture.* Dependent on the location, the glass and plastics need to have different properties. These are:

no break. The glass and plastics remain undamaged and serviceable.

'break safe'. Fracture of the glass and plastics gives either relatively harmless pieces or insufficient penetration to allow serious injury.

containment. Fracture of the glass and plastics gives no significant penetration.

These three characteristics should be determined for single panes of glass or plastics or for the individual panes of double glazing, by testing in accordance with BS 6206. When it is required that the glass or plastics, on impact, should remain in position and be unbroken, the specifier should consult with the manufacturer.

(2) *The building and its use, particularly the number and likely behaviour pattern of the people expected to be in close proximity to the glazed area.*

The assessment of these criteria, and the subsequent glass and plastics specification, is the responsibility of the designer or other specifier. 4.7.2 to 4.7.5 give guidance on the minimum standards that should be accepted. It is for the specifier to consider whether, in a particular case, these standards are sufficient.

4.7.2 Risk areas

4.7.2.1 General. The situations in which risks can exist, being dependent on the criteria described in 4.7.1, can be described in general terms only.

Not every accident is avoidable but many injuries are due to failure to observe a reasonable standard of safety and the failure to provide protection of the glazed area at vulnerable points. Standards of safety assume reasonable standards of human behaviour for appropriate age groups. In most buildings, glass and plastics in areas not defined in 4.7.2.2 to 4.7.2.6 do not usually give a significant risk, neither are these recommendations intended to apply to internal display fitments or display windows to shopfronts.

Leaded lights and copper lights, made in the traditional form which comprises small panes of varying thicknesses (usually of antique glass) glazed into a framework of lead or copper comes, are deemed to be acceptable for use in the areas defined in 4.7.2.2 and 4.7.2.3.

4.7.2.2 Doors, and side panels that may be mistaken for doors. These have been identified as the major risk area. As designs of door may lead to a different type and risk of injury, these are differentiated and defined as follows.

(a) *Frameless doors and side panels*

(1) When the overall width is 900 mm or greater, the pane should comply with class B of BS 6206.

(2) When the overall width is less than 900 mm, the pane should comply with class C of BS 6206.

(b) *Framed fully glazed doors and side panels containing a single pane of glass or plastics*

(1) Where one pane of glass or plastics comes to within 150 mm of both vertical edges and the top, and to within 300 mm of the bottom of the door or side panel (measured from the sight line), then

(i) when the overall width of the door or side panel is 900 mm or greater, the glass or plastics should comply with class B of BS 6206;

(ii) when the overall width of the door or side panel is less than 900 mm, the glass or plastics should comply with class C of BS 6206;

(iii) when the glass or plastics is less than 300 mm in width, the glass should be in accordance with 5.7.2 (table 11), but never less than 6 mm thick, and plastics glazing sheet materials should be in accordance with 6.7;

(iv) when the overall door or side panel width is any size, but the glass or plastics is protected on both sides in a zone between 800 mm and 1100 mm from the finished floor level by protective rails or decorative assembly (see 4.7.3), the glass should be in accordance with 5.7.2 (table 11), but never less than 6 mm thick, and plastics glazing sheet materials should be in accordance with 6.7.

If the protective rails or decorative assembly do not meet the criteria of 4.7.3, the glass and plastics should be in accordance with (i) and (ii).

(2) Where one pane of glass or plastics comes to within 150 mm of one vertical edge and the top, and to within 300 mm of the bottom of the door or side panel (measured from the sight line), then

(i) when the overall door or side panel width is 900 mm or greater and the width of the glass or plastics is 300 mm or greater, the pane should comply with class B of BS 6206;

(ii) when the overall door or side panel width is less than 900 mm and the width of the glass or plastics is 300 mm or greater, the pane should comply with class C of BS 6206;

(iii) when the overall door or side panel width is any size but the glass or plastics is less than

300 mm in width, the glass should be in accordance with 5.7.2 (table 11), but never less than 6 mm

thick, and plastics glazing sheet materials should be in accordance with 6.7;

(iv) when the pane of glass or plastics is protected as described in (b) (1) (iv) and 4.7.3, the glass should be in accordance with 5.7.2 (table 11), but never less than 6 mm thick, and plastics glazing sheet materials should be in accordance with 6.7.

(3) Where one pane of glass or plastics is other than as defined in (b) (1) and (b) (2), i.e. it comes to within 150 mm of one vertical edge or the top, or to within 300 mm of the bottom of the overall door size but is outside these limits on one or more of the other sides, glass should be in accordance with 5.7.2 (table 11), but never less than 6 mm thick (unless the area of glass is less than 0.02 m², in which case 4 mm thick annealed glass can be used) and plastics glazing sheet materials should be in accordance with 6.7.

(c) *Framed and glazed doors and side panels containing more than one pane of glass or plastics.* Where doors and side panels of any size contain two or more panes of glass or plastics either

(1) divided by substantial intermediate rails or glazing bars that are part of the framing, or

(2) protected by protective rails as defined in 4.7.3, the glass should be in accordance with 5.7.2 (table 11), but never less than 6 mm thick, and plastics glazing sheet materials should be in accordance with 6.7.

4.7.2.3 Glass or plastics wholly or partially within 800 mm from floor level (excluding doors, side panels and balustrades)

4.7.2.3.1 In areas subject to the movement of many people there is an appreciable risk of glass and plastics breakages by accidental human impact. Such areas include:

(a) corridors and assembly areas where the glass and plastics are not protected by a protective rail or by being recessed;

(b) areas where there are added risks to children whose more active behaviour may lead to more frequent accidents;

(c) vulnerable situations, e.g. landings, balconies, stairways, and at the bottom of stairs.

4.7.2.3.2 Glass or plastics wholly or partially within 800 mm from floor level should be considered in the following six categories (a) to (f); these recommendations need to be considered for every floor where any glazed area is common to two or more storeys.

(a) Where the glass or plastics is within 300 mm of floor level, or comes from a lower floor to within 300 mm of the floor level, it should satisfy the wind loading recommendations of 4.11.

(b) Where the glass or plastics is entirely within a zone between 300 mm and 800 mm above floor level, then

(1) in areas where many people are likely to be gathering, circulating or passing, it should comply with class C of BS 6206;

(2) in other situations, the glass should be in accordance with 5.7.2 (table 11) and plastics glazing sheet material should be in accordance with 6.7.

(c) Where the glass or plastics is entirely within a zone between floor level and 800 mm above floor level, it should be in accordance with (b).

(d) Where the glass or plastics extends from within 300 mm from floor level to over 800 mm above floor level, it should be in accordance with (b).

(e) Where the glass or plastics extends from above 300 mm from floor level but less than 800 mm from floor level, to over 800 mm from floor level, it should be in accordance with (b).

(f) Where the glass or plastics in any of the above categories (b) to (e) is suitably protected in accordance with 4.7.3, the glass should be in accordance with 5.7.2 (table 11) and plastics glazing sheet material should be in accordance with 6.7.

4.7.2.4 Glass and plastics in balustrades. Glass and plastics in balustrades should comply with BS 6180.

4.7.2.5 Glass and plastics in bathing areas. Any glass or plastics used in domestic type bathrooms for bath or shower screens, or adjacent to, or surrounding, private or public swimming pools or baths, is an inherent risk because of the possibility of slipping on wet surfaces. Such glass and plastics should comply with class C of BS 6206 unless this code recommends a higher class to be used.

NOTE. A British Standard for prefabricated shower enclosures and shower cabinets for domestic dwellings, which will include requirements for their glazed areas, is in course of preparation.

4.7.2.6 Areas of special risk. In buildings, or those parts of buildings, where the planned activity generates a special risk, the glass and plastics should, at least, comply with class C of BS 6206. The specifier should consider if a higher class is appropriate and if any other safeguards (protective rails or screens) are necessary.

4.7.3 Protective systems. When guarded by a suitably designed protective system (e.g. protective rails, decorative assemblies) independent of the glass or plastics, glass should be in accordance with 5.7.2 (table 11) and plastics glazing sheet materials should be in accordance with 6.7.

The protective system should satisfy the following criteria.

(a) The overall face width should be 75 mm minimum.

(b) If 900 mm or over in length, the protective system should sustain at least a centrally applied force of 1350 N*, or 1100 N* if under 900 mm in length, without:

- (1) fracturing;
- (2) deflecting so as to impact the glass;
- (3) permanently distorting;
- (4) displacing.

If the protective system is multi-railed, each rail should satisfy this recommendation.

(c) If vertical, the protective system should be towards the centre of the glazed area or, if horizontal, be between 800 mm and 1100 mm from the finished floor level. †



4.7.4 Manifestation. There are certain situations, particularly under some conditions of daylighting, or artificial illumination, where the presence of transparent glass and plastics may not be readily evident. This applies particularly to buildings that the public visit only infrequently (e.g. airports). Risk of human impact may be further reduced if a means of indicating the presence of glass or plastics (e.g. a company logo) is used. The mode

employed should be of a size, and so positioned, as to make it immediately obvious; it should also be permanent.

4.7.5 Fixing. The fixing of glass and plastics in risk areas should at least satisfy the recommendations of clause 9 or 10 for the particular method chosen.

4.8 Security. Security glazing is used in situations where a high degree of protection either to persons or property is required. The basic considerations are:

- (a) protection against violent, malicious manual attack;
- (b) protection against the use of firearms;
- (c) protection against the effect of explosions.

For design guidance relating to security glazing reference should be made to BS 5051 : Parts 1 and 2, BS 5357 and BS 5544.

4.9 Fire

4.9.1 Regulations and test standards. Structural fire precautions, in which the performance of glass and plastics may need to be considered, are controlled by Building Regulations and bye-laws for new building work and by the Fire Precautions Act 1971 and other legislation for occupied premises.

For new buildings, control is exercised separately in England (excluding Inner London) and Wales, Inner London, Scotland and Northern Ireland. The extent of control depends on the type of glass or plastics and the method of specification, the particular location and the regulations applicable thereto.

In determining the appropriate fire properties of materials, the following tests apply.

(a) **BS 476 : Part 4 : 1970.** This test determines whether building materials are non-combustible within the meaning of the definition. Determination of combustibility is made by reference to the duration of any flaming or the increase in the temperature of the sample or furnace above a defined limit.

(b) **BS 476 : Part 6 : 1968.** This test provides a means of comparing the contribution of building materials to the growth of a fire by measuring the rate of heat evolution. The performance is expressed as a numerical index from 0 to 100 or more, low values indicating a low rate of heat release.

(c) **BS 476 : Part 7 : 1971.** The standard is used to determine the tendency of materials to support the spread of flame across their surfaces and specifies a method of classification appropriate for wall and ceiling linings.

The performances are expressed as four classes, class 1 representing the best performance.

NOTE. For class 0 see the appropriate Building Regulations.

(d) **BS 476 : Part 8 : 1972.** These tests determine whether elements of construction retain their stability, resistance to the passage of flame and hot gases and provide, where necessary, resistance to heat transmission. Performances are expressed in minutes to failure by the appropriate criteria.

(e) **BS 2782 : 1970 : Method 102C.** Test to determine softening point of thermoplastics. Used for categorization of materials for certain regulations.

* These forces ensure the rail(s) has an impact energy absorption level approximately equivalent to classes B and C of BS 6206.

† The Building Standards (Scotland) Regulations specify minimum heights in particular situations and should be referred to for detailed requirements.



(f) *BS 2782 : 1970 : Method 508A*. Laboratory test method to determine the rate of burning of a plastics or duration of flame or after-glow.

Generally, regulations are written in terms of performance under the standard fire tests but CP 3 : Chapter IV* and other codes of practice dealing with means of escape in case of fire make specific mention in connection with the use of glass when fire resistance is required.

Glass and plastics installed vertically may need to satisfy requirements in connection with the control of:

- (1) surface spread of flame over room linings; and
- (2) the fire performance of external cladding.

Where glass and plastics are to be incorporated within doors, walls or partitions forming elements of construction or enclosures forming protected escape routes, etc., the glazed installation should satisfy the necessary period of fire resistance in terms of BS 476 : Part 8 : 1972.

The ability of elements to comply with fire resistance requirements will depend on the type of material, its thickness, size, height to width ratio of pane, type of frame, method of fixing, the form of construction surrounding the glazed area, and whether or not the element consists of a single pane.

Only certain types of glazed installations are able to satisfy fire resistance ratings specified in terms of BS 476 : Part 8 : 1972. Although periods in excess of 1 h are obtainable for stability and integrity, as most glazed elements transmit radiant heat, the insulation criterion cannot normally be met for more than a few minutes. However, in such circumstances, waivers or relaxations may need to be obtained. No restrictions are made on the use of glazed systems meeting the full fire resistance performance in terms of stability, integrity and insulation, but those systems not providing adequate insulation will be limited under codes of practice dealing with the protection of escape routes, etc.

There may be situations in which a designer needs to take account of both legislative fire requirements and the safety considerations in 4.7.

4.9.2 Information. Information on the fire performance of glass and plastics and on glazed systems (e.g. fire-resisting doors and partitions) should be obtained from the manufacturers of the material, component or system. Further information will be found in CP 153 : Part 4.

4.10 Durability. The designer should consider the durability of the glass, plastics and the glazing materials and should consult the system manufacturer and the relevant codes of practice, e.g. CP 153 : Part 2.

The expected performance of glazing materials is described in 5.3.

It is important to consider the possibility of interactions between adjacent materials both in the glazing system and between it and the surround.

4.11 Wind loading

4.11.1 General method of determination. The design wind pressure should be determined by the method described in CP 3 : Chapter V : Part 2. If the complexities are obviously beyond the scope of that code, the Building Research

Establishment† or the National Maritime Institute‡ should be consulted.

4.11.2 Abbreviated method of determination for low rise buildings. For low rise buildings (i.e. up to 10 m high) an abbreviated method of determining the design wind pressure may be used, employing figure 3 and tables 1 and 2. Although the wind loading so determined may not be identical with a loading derived from CP 3 : Chapter V : Part 2 it should be sufficiently accurate to be used for most low rise buildings.

This abbreviated method assumes a combined pressure coefficient of 1.4, which takes into account that the glazed area may be exposed to pressure on one side and suction on the other. There may be instances when a coefficient higher than 1.4 should be used, e.g.:

- (a) near to the corners of some buildings;
- (b) where eddies or downdraughts are likely to occur;
- (c) in areas of particular local topography and/or building configuration.

It is therefore recommended that if, having found the required glass and plastics thickness for a wind load using this abbreviated method, the required glazed area is close to the maximum area suitable for the exposure, then the exposure should be reassessed using CP 3 : Chapter V : Part 2.

This abbreviated method is not suitable for any buildings higher than 10 m from ground level or where the basic wind speed is higher than 52 m/s nor should it be used for buildings on cliff tops. In all such cases the method described in CP 3 : Chapter V : Part 2 should be used.

To find the design wind pressure, select

- (1) the basic wind speed (3 s gust) from figure 3,
- (2) the ground roughness category from table 1,

then use these to obtain the design wind pressure from table 2.

Table 1. Ground roughness categories

Ground description	Category
Long fetches of open, level or nearly level country and all coastal situations	1
Open country with scattered windbreaks	2
Country with many windbreaks; small towns; outskirts of large cities	3
Surfaces with large and frequent obstructions, e.g. city centres	4

4.12 Maintenance (including reglazing after occupation)

4.12.1 Design. Adequate provision for cleaning, care and replacement should be incorporated in the design of the building.

* At present under revision. To be superseded by BS 5588.

† Building Research Establishment, Building Research Station, Garston, Watford, WD2 7JR.

‡ National Maritime Institute, Faggs Road, Feltham, Middlesex.

Table 2. Design wind pressures

Basic wind speed (from figure 3)	Height to eaves	Design wind pressure for a ground roughness category (see table 1) of:			
		cat. 1	cat. 2	cat. 3	cat. 4
m/s	m	N/m ²	N/m ²	N/m ²	N/m ²
52	3	1600	1200	950	750
	5	1800	1450	1150	850
	10	2350	2000	1450	1050
50	3	1500	1150	900	700
	5	1700	1350	1050	800
	10	2150	1850	1300	1000
48	3	1400	1050	850	650
	5	1550	1250	1000	750
	10	2000	1750	1200	900
46	3	1250	950	750	600
	5	1400	1150	900	650
	10	1850	1600	1100	850
44	3	1150	900	700	550*
	5	1300	1050	850	600
	10	1650	1450	1050	750
42	3	1050	800	650	500*
	5	1200	950	750	550*
	10	1550	1350	950	700
40	3	950	750	600	450*
	5	1100	850	700	500*
	10	1400	1200	850	650
38	3	850	650	550*	400*
	5	1000	800	600	450*
	10	1250	1100	750	550*

* In order to avoid excessive deflection, it is recommended that a minimum design wind pressure of 600 N/m² is used in these cases (see 5.11.2).

NOTE 1. The values have been rounded.

NOTE 2. 1 N/m² = 1 Pa.

NOTE 3. This table is based on CP 3 : Chapter V : Part 2 using the following:

- (a) topography factor (i.e. the natural shape of the ground) $S_1 = 1.0$;
- (b) building life factor equivalent to a wind exposure of 50 years, i.e. $S_3 = 1.0$;
- (c) total pressure coefficient (difference between external pressure coefficient, C_{pe} , and internal pressure coefficient, C_{pi}), $C_p = 1.4$.

The selection of glazing systems (including materials and surrounds) should be influenced by:

- (a) the provision of suitable and safe access for cleaning and maintenance, including consideration of any possible inconvenience to the building occupants;
- (b) the ease and cost of replacement of materials;
- (c) the cleaning costs.

4.12.2 Instructions. The requirements for maintenance should be handed over on completion of the glazing, thus ensuring awareness of the need to comply with the maintenance procedure for the satisfactory performance of the glazing system in the years to follow.

5. Performance of glass and sealing materials

5.1 Introduction. The properties of the glass are described in this clause for each of the performance requirements listed in clause 4. Sophisticated techniques to predict the performance of glass are also available. The appropriate manufacturers should be consulted.

5.2 Constraints. Not every manufacturer offers every glass type described in BS 952 : Part 1. Where British Standard test methods are available it is recommended that, where appropriate, glass known to pass BS test methods should be specified. Table 3 gives availability of glass types and processes.

BS 6262 : 1982

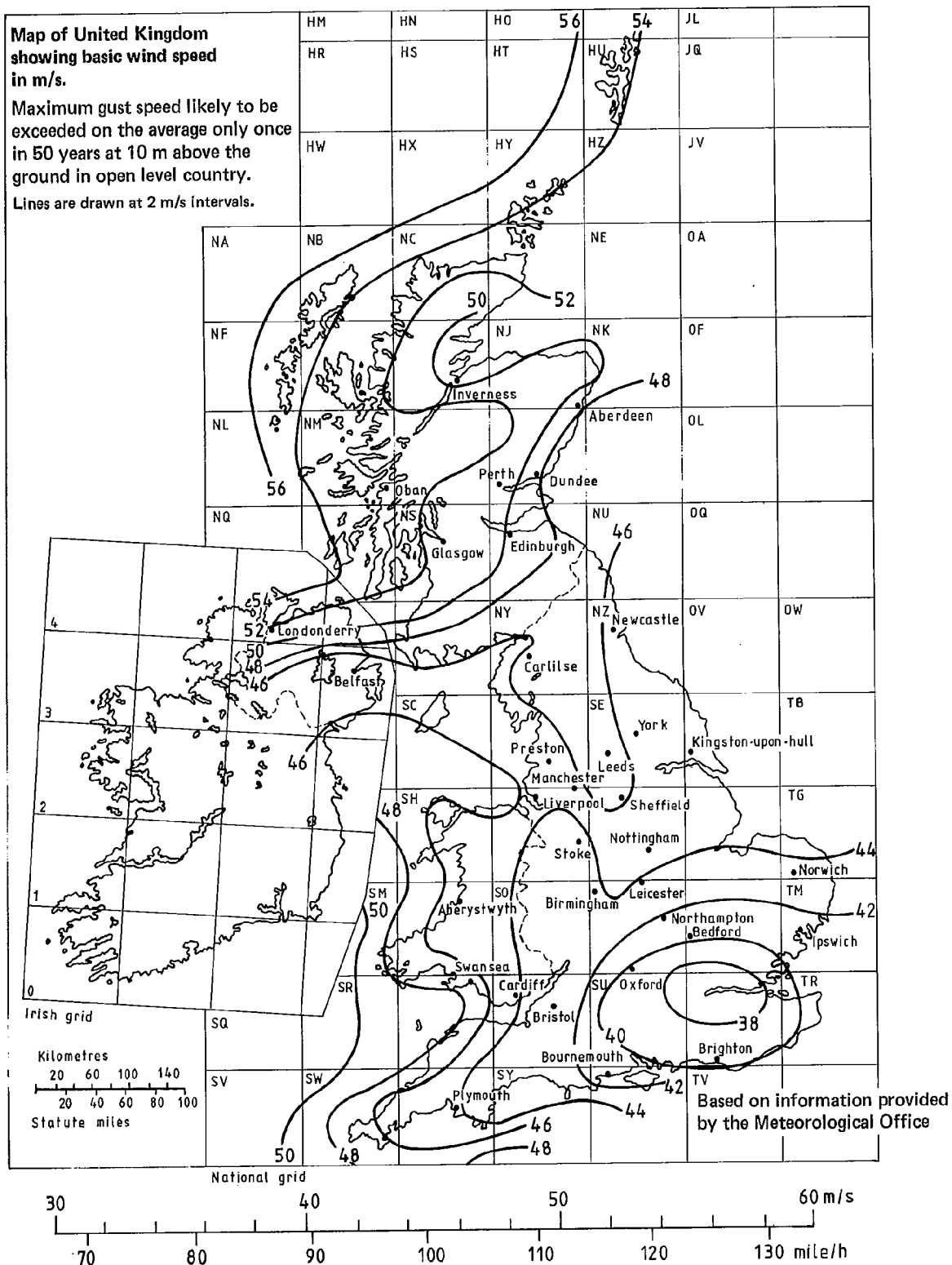


Figure 3. Distribution of basic wind speed over the United Kingdom

Table 3. Summary of availability of glass types and processes

Processes	Glass types (see BS 952 : Part 1)										
	Clear float	Body tinted float	Surface modified float	Surface coated float	Clear sheet	Body tinted sheet	Clear rough cast	Body tinted rough cast	Clear part-earned	Body tinted part-earned	Clear rough cast wired
Toughened (tempered)	X	X	X*	X*	X	X	X	X	X	X	—
Laminated safety	X	X	X	X	X	X	X*	X*	X*	X*	X
Multiple glass units	X	X	X	X	X	X	X	X	X	X	X
Surface treatment	X	X	X*	X*	X	X	X	X	X	X	X
Edge treatment	X	X	X*	X*	X	X	X	X	X	X	X

NOTE:

X denotes technically feasible;

X* denotes technically feasible but check viability;

— denotes not technically feasible.

5.3 Descriptions of materials and systems

5.3.1 Glass

5.3.1.1 General. 5.3.1.2 and 5.3.1.3 list those types of annealed and processed flat glasses it is technically feasible to manufacture. However, the designer is recommended to check the availability/viability of some of the types of processed flat glasses listed in 5.3.1.3 as indicated in table 3. For a description of the various glass types see BS 952 : Part 1.

5.3.1.2 Annealed flat glass

5.3.1.2.1 Transparent glass. Transparent glass comprises the following types:

- (a) float glass:
 - (1) clear;
 - (2) body tinted (e.g. for solar control);
 - (3) surface modified tinted (e.g. for solar control);
 - (4) surface coated (e.g. for solar control);
- (b) polished wired glass;
- (c) sheet glass:
 - (1) clear;
 - (2) body tinted (e.g. for solar control);
 - (3) flashed or pot coloured.

5.3.1.2.2 Translucent glass. Translucent glass comprises the following rolled and cast types:

- (a) patterned;
- (b) tinted patterned;
- (c) wired patterned;
- (d) rough cast;
- (e) tinted rough cast;
- (f) rough cast wired.

5.3.1.3 Processed flat glasses

5.3.1.3.1 Toughened (tempered) glass

5.3.1.3.1.1 Transparent glass. Transparent glass comprises the following types:

- (a) float glass:
 - (1) clear;
 - (2) body tinted (e.g. for solar control);
 - (3) surface modified tinted (e.g. for solar control);
 - (4) surface coated (e.g. for solar control);
- (b) sheet glass:
 - (1) clear;
 - (2) body tinted (e.g. for solar control).

5.3.1.3.1.2 Translucent glass. Translucent glass comprises the following rolled and cast types:

- (a) patterned;
- (b) tinted patterned (e.g. for solar control);
- (c) rough cast;
- (d) tinted rough cast (e.g. for solar control).

5.3.1.3.1.3 Opaque glass. Opaque glass comprises the following types:

- (a) enamelled glass;
- (b) insulating infill panels.

5.3.1.3.2 Laminated glass. Laminated glass is a manufactured product consisting of any of the annealed and/or toughened flat glasses incorporating interlayer(s) appropriate to the design function (i.e. ultraviolet absorption, colour, penetration resistance, decoration, solar and/or sound control) and, where required, wire (e.g. for alarm circuits, decoration, security).

5.3.1.3.3 Multiple glass units. Multiple glass units are manufactured products consisting of any of the annealed, toughened or laminated flat glass (or any combination thereof), the panes of glass being separated by one or more hermetically sealed spaces of dehydrated air or special gas mixture appropriate to the design function (e.g. thermal or acoustic insulation).

NOTE. Surface coatings not suitable for single glazing can be incorporated on the internal surfaces of multiple glass units.

5.3.1.3.4 Surface treated glass. For decorative and/or functional effect, different methods of surface treatments are available as follows (see also BS 952 : Part 2):

- (a) obscuring (sandblasting, grinding and acid embossing);
- (b) brilliant cutting;
- (c) engraving;
- (d) enamelling, staining or painting and firing;
- (e) stoving;
- (f) gilding;
- (g) silvering;
- (h) striped silvering;
- (i) metallic coating.

For further details manufacturers and processors should be consulted.

5.3.1.3.5 Edge treated glass. Edge treatments may be divided into three categories:

- (a) arrissing;
- (b) grinding, smoothing and polishing;
- (c) mitreing and bevelling.

These various types of edge finishing are described in BS 952 : Part 2.

5.3.1.3.6 Holes and notches. Most glasses can be drilled and/or notched but in all cases specialist advice should be sought. In the case of toughened glass and insulating glass units, such work has to be executed as part of the manufacturing process.

5.3.1.4 Plastics covered annealed glass. In order to meet certain needs for thermal properties, safety and security, a plastic film may be applied to one or both surfaces of glass already glazed in buildings, or prior to glazing for glass intended for glazing in new buildings.

Where the plastic film or organic coating is applied to the glass prior to glazing, a margin of untreated glass may be left at the perimeter of the glass so that the plastic film or coating does not extend into the rebate when the glass is glazed. Where the plastic film or organic coating extends to the edge of the glass before glazing, advice should be sought from the manufacturer on the glazing method and materials to be used.

5.3.2 Glazing materials and components

5.3.2.1 Putties

5.3.2.1.1 Linseed oil putty. Linseed oil putty is a glazing putty traditionally manufactured from linseed oil and fillers and complying with BS 544. It is used for glazing into softwood and absorbent hardwood frames. Linseed oil putty should not be used on dense, non-absorbent hardwood, such as teak, because initial setting of linseed oil putty is controlled by the absorption of some of the oil into the frame, which is facilitated by primers complying with BS 2521 & BS 2523, or primers having equivalent properties. Varnish, gloss paint and some acrylic primers are not suitable for use as primers because they seal the timber surface. Some combinations of preservative and decorative

treatments, primers and timber may reduce the porosity of the frame to an unacceptable level and so prevent setting of linseed oil putty. In most cases, the keg life is in the order of three months, after which there may be some separation of oil. The oil should be mixed back into the putty before use to restore the original characteristics.

When it has firmed off sufficiently, normally within 7 days to 21 days, linseed oil putty needs to be protected by paint, full protection being given only by the finishing coats, which should be applied within 28 days of glazing. Failure to provide this protection will lead to early deterioration of the putty, i.e. loss of adhesion and cracking.

5.3.2.1.2 Metal casement putty. Metal casement putty is formulated to set hard and adhere to non-porous surfaces. The putty needs to be painted as soon as it has hardened (normally within 7 days to 14 days) and the finishing coat should be applied within 28 days of glazing. If painting is not carried out or maintained within the specified time, loss of adhesion or cracking can occur.

5.3.2.2 Flexible compounds

5.3.2.2.1 Non-setting glazing compounds. Non-setting glazing compounds are manufactured for use in conjunction with beads or in grooves where glass is subject to structural or thermal movement that cannot be accommodated by putties. Solar control glasses, insulating glass units and glass faced infill panels can be glazed using such compounds. They form a dust-resistant skin on the surface in 5 days to 7 days, yet remain flexible underneath. The protective skin does not require further protection by painting.

The maintenance of the non-setting property of these compounds is dependent on the volume of compound employed. A thin layer of these compounds will harden quickly. A minimum thickness of 3 mm, and generally a maximum of 5 mm, is therefore recommended for both sides of the glass, and the compound should be continuous around the edge of the glass, forming a solid bedding from sight line to sight line without voids. Owing to the non-setting properties of these compounds, it is important that distance pieces are used to prevent displacement under wind loading;

5.3.2.2.2 Two-part rubberizing compounds. These are hand- or gun-applied flexible glazing compounds, comprising two parts that, when mixed, cure to form a rubbery material. Suitable for glazing with beads in exposed situations and for frames subject to movement or distortion, they can be used with glass types as listed in summary table 4. They can also be used for presite glazing since, when fully cured, they are not subject to displacement in transit.

Two-part rubberizing compounds are normally used with primers on both glass and frame. They are capable of withstanding high wind loads or other pressures when cured.

Two-part rubberizing compounds are normally used in a similar fashion to non-setting compounds (see 5.3.2.2.1), using a minimum 3 mm thickness of compound, and incorporating distance pieces and setting blocks in order to withstand wind loading until the compound has cured. These materials cannot be painted except with the use of special primers.

5.3.2.3 Sealants

5.3.2.3.1 General. Sealants are gun-applied materials generally used for capping and bedding applications.

Such sealants, together with their primers and cleaning fluids, often contain hazardous or toxic materials and in this connection, manufacturers' handling recommendations should be strictly observed.

5.3.2.3.2 One-part sealant: curing types. One-part sealants, of polysulphide, silicone or urethane base, undergo, at normal temperatures, a chemical reaction to form a firm resilient seal. They are capable of tolerating much greater movement over all climatic temperature variations, but vary considerably in their rate and degree of cure. It is important that selection should therefore be made to ensure that a slow curing type does not have to withstand excessive movement during the early stages of the cure. Generally speaking, the silicones and urethanes cure quickly, while one-part polysulphides have a slow curing action that is accelerated by high temperatures and high relative humidity.

To obtain optimum adhesion these materials may require the use of primers or similar surface conditioners. They generally provide flexibility, elongation, resilience and similar rubber-like characteristics.

(a) Polysulphides exhibit good resilience to direct sunlight, water and many organic salt solutions, mild acids and alkalis, solvents and oil-based fuels. Fresh sealant will bond to existing sealant, thus facilitating repair or remedial work. Curing time is approximately 14 days to 21 days under normal site conditions, but it can be as long as 4 months.

(b) Silicones exhibit rubber-like properties and can have various degrees of stiffness. Water resistance is good and the sealant may be used in joints subject to permanent immersion in water. Resistance is also good to salt solutions, mild acids and alkalis, and to directly transmitted or reflected sunlight.

Surface primers are not usually necessary on glass, ceramics, aluminium and stainless steel. Porous surfaces should be primed. Other surfaces, e.g. plastics, glass-fibre reinforced plastics (GRP) and some metals, may require special primers. Fresh sealant does not readily bond to aged sealant. Curing time is normally of the order of 5 days to 7 days under normal site conditions. Paint will not adhere to silicone sealant.

(c) Polyurethane sealants have excellent abrasion, adhesion and long-term weathering resistance coupled with good chemical resistance. Primers may be required to ensure optimum adhesion to both glass and surround. Flexibility is maintained at temperatures from -40°C to 80°C . Curing time is of the order of 5 days to 10 days under normal site conditions.

5.3.2.3.3 One-part sealant: solvent release types. Sealants of the solvent release type have butyl or acrylic bases, and are essentially non-curing in the sense that no extensive chemical change takes place. They should remain soft and pliable but are subject to a degree of solvent loss that may cause some shrinkage.

(a) Butyl-based sealants set to form a rubbery compound, adhering readily to most surfaces without the need for primers. Some grades may be degraded by ultraviolet light, producing a tacky surface that collects dirt progressively. These grades are best suited to concealed positions, such as bedding beads to frames or filling perimeter voids around glass.

Grades susceptible to ultraviolet light are not suitable for use in exposed situations.

(b) Acrylic-based sealants set to a tough plastic material that adheres well to most surfaces without the use of primers and is not affected by ultraviolet light. Some, however, are not recommended for use in permanently wet conditions or where they are liable to attack by alkaline water.

5.3.2.3.4 Two-part sealant: curing types. Sealants of the curing type are supplied as two component materials that, when mixed, react to form a rubbery material. Excessive mixing speed or mixing time can reduce the working life of the sealant. The working life and curing time may also be affected by temperature and humidity.

(a) Two-part polysulphide sealants (see BS 4254) cure to form a tough rubbery material, remaining flexible in service. They exhibit good resistance to direct sunlight, water and many inorganic salts, mild acids and alkali solutions, and oil-based fuels. Adhesion is good to most surfaces, including aluminium, stainless steel, galvanized steel and ceramic materials. Bricks, concrete and other porous surfaces normally require primers. Primers are required on glass, especially where the bond is subject to transmitted or reflected sunlight.

Fresh sealant bonds readily to clean existing sealant. Curing times vary with individual products, normally taking between 10 days and 14 days under normal site conditions.

(b) Two-part polyurethane based sealants cure to form a tough, rubbery material. Water resistance of the cured sealant is good and sealants may be used in joints subject to permanent immersion in water. The resistance of these sealants to ultraviolet light varies and some surface degradation or discoloration may occur. Primers are usually required to ensure optimum adhesive strength to glass and other surfaces. Fresh sealant does not bond readily to existing sealant without special preparation.

Curing time is normally of the order of 7 days to 14 days under normal site conditions.

5.3.2.4 Preformed strip materials. Various forms of preformed tape materials and extruded sections may be used in certain glazing applications. Specific types are as follows.

(a) *Preformed mastic tapes.* These are usually based on butyl or polyisobutene polymers, most grades being available in various widths and thicknesses. Where softer, non-load bearing types are used, distance pieces are required but some grades are load bearing and may be used without distance pieces.

(b) *Extruded solid sections.* These are of PVC or synthetic rubbers. They may be used under compression on both sides of the glass, or as insert wedges in conjunction with strip sealant or compound, either as an internal trim or as part of external weather protection in a drained system. Such insert sections usually have a means of locating on the bead or surround, and provide a water-shedding cap to the glazing line. Other extruded solid sections of PVC or synthetic rubber may be used as a continuous distance piece and be capped with a sealant. Extruded sections may also be used for internal glazing (doors, partitions, etc.) without sealant or compound.

(c) *Cellular strips.* Generally these are made of self-adhesive synthetic rubber that may be used on either side of the glass, alone or in conjunction with sealants, and that need to be compressed sufficiently to ensure adequate load bearing ability to withstand wind pressures.

When used externally it is normally necessary to cap the strip with sealant, except in very sheltered situations, or where the strip forms part of a drained glazing system.

If a capping sealant is to be used, care should be taken to ensure that the materials are compatible.

5.3.2.5 Preformed compression type gaskets. Gaskets have several advantages over conventional glazing materials. They are easy to install, involve no waste and in general need no maintenance.

Gaskets should remain flexible under load and have dimensional stability (see BS 4255 : Part 1).

The successful application of gasket glazing depends on careful cooperation between gasket manufacturer, window frame designer and the glazing contractor.

There are two types.

(a) *Structural gaskets.* These products are usually made from vulcanized polychloroprene-based rubber compounds, but other synthetic rubbers may be used. They should comply with BS 4255 : Part 1. Good weather resistance and resistance to permanent deformation are essential. Integral locking strips or 'zipper' type insertions produce a compression grip on the frame structure and the glass. The dimensions of opening, glass and gasket are critical and manufacturers should be consulted for guidance regarding allowable tolerances.

Corners of gaskets should be factory moulded and where possible should incorporate a secondary pressure seal to ensure weather-tightness between frame and gasket.

Standard H and Y sections are available for most glass thicknesses but special purpose-made gaskets can be provided when necessary.

Ladder gaskets are structural gaskets designed to receive two or more pieces of glass in one structural opening.

(b) *Non-structural gaskets.* These products may be of synthetic rubber or plastics and are supplied in solid, tubular or dense sponge form. They should comply with BS 4255 : Part 2. They are extruded into many shapes, mainly channel and wedge. They may be used as primary seals where they can be maintained under positive and specified compression. If compression is not provided the gaskets should be mechanically retained in the rebate and top sealed with one- or two-part sealant.

5.3.2.6 Glazing materials for internal glazing. In addition to the materials described for external glazing (see 5.3.2.1 to 5.3.2.5), the following are suitable for internal glazing only.

(a) *Self-adhesive glazing tapes.* These comprise treated cotton-based tapes and black velvet ribbons treated with an adhesive coating on one side.

(b) *Simulated washleather and black velvet tapes*

(c) *Extruded mastic tapes.* These can also be satisfactory for external glazing of small panes of glass, up to 600 mm major dimension, in sheltered locations.

5.3.2.7 Asbestos-based materials. Woven asbestos fabric tape or channels of soft asbestos material can be used in fire resistant glazing. They should never be used externally unless capped. In addition, a fire resistant adhesive can be used. Any health hazard of these materials should be considered.

5.3.2.8 *Non-asbestos based fire-protecting materials.*

Intumescent glazing materials are available for incorporation in glass surrounds. Such materials, when subjected to fire, expand and fill adjacent gaps and voids. The manufacturers should be consulted.

5.3.3 *Selection of glazing materials.* General guidance on the selection of suitable glazing materials for any particular glass type is given in table 4. To assist the designer in further narrowing the choice of glazing materials, information on their properties and use is given in table 5. Of necessity, tables 4 and 5 can only give general guidance. Therefore, in addition to these specific uses where consultation with the manufacturer is advised, such action is also recommended in those cases where the use of the tables results in the selection of a material with which the designer is unfamiliar in that application.

5.4 Natural lighting

5.4.1 *Light transmission.* The admission of daylight into buildings is affected by a number of factors, one of which is the light transmittance of the window glass and its variation with the angle of the incident light. Daylighting calculation aids generally include a detailed allowance for this variation for clear transparent glass.

For some purposes, it is sufficient to assume a single value for the light transmittance, corresponding to that due to a diffuse source representing the sky. The light transmittance of multiple glazing is similarly given by the product of the diffuse light transmittances of the individual panes of glass. The diffuse light transmittance frequently forms the basis for corrections to the calculation aids for other types of glass.

The manufacturer should be consulted on appropriate values of light transmittance for specific glasses.

Dirt on the glazing reduces the light transmittance, often by an appreciable extent before becoming noticeable to a building's occupants. Nonetheless, to ensure daylighting levels are adequate for the visual tasks being performed, an allowance for the reduced light transmittance is usually made in daylighting calculations. The glass should also be cleaned regularly (see 5.12.1).

In most instances the tinted appearance of solar control glasses, whilst reducing the light transmission, has little or no effect on colour discrimination or on the colour appearance of the interior of buildings. It is, however, desirable to take precautions in situations where critical colour judgement will occur.

Attention is drawn to the variation in appearance from both inside and outside that may occur if glasses of different types or thickness are used in a single facade.

5.4.2 *Glare.* The light transmission of the glass is usually required to be at least as low as 50 % before a perceptible degree of control for sky or reflected glare is achieved.

5.4.3 *Obscuration and diffusion.* Obscuration and diffusion are controlled mainly by surface treatment of the glass or by the incorporation of a diffusing layer (insulating glazing and laminated glass only).

If the window is outside the normal field of view, diffusing glazing can be used to ease the problems of glare from bright sunlight. However, for glazing installations within the normal field of view, diffusing glazing should be used with extreme caution. Instead of one shaft of bright

sunlight entering via, say, one corner of a window, the whole window becomes an extremely uniform bright light source and in many circumstances is totally unacceptable. Samples of glass and manufacturers' literature should be consulted before specifying obscuring and diffusing glasses.

5.4.4 *Fading.* Clear monolithic window glass rejects approximately half of the ultraviolet content of natural light. This proportion can be increased to about 99 % by using an appropriate interlayer in the construction of laminated glasses. Some tinted solar control glasses have greater rejection properties in the ultraviolet region than clear glass.

The degree of protection afforded by any type of glass will depend on the type of material receiving the radiation. Materials claimed to be fade-resistant will have their life extended by the use of ultraviolet rejecting glasses, whilst those materials not generally regarded as fade-resistant will benefit simply because of the overall reduction in radiation falling upon them whatever its spectral composition.

5.5 Thermal considerations

5.5.1 *Solar transmission.* When solar radiation is received on a piece of glass, some is reflected, some is absorbed and some is transmitted. The absorbed component is re-emitted, partly inwards and partly outwards, by the process of radiation and convection. The relative magnitudes of each component will depend on the composition of the glass, its surface treatment and whether the glazing is single or multiple, as follows.

(a) *Clear glass.* Gives high solar transmittance together with low solar absorptance* and reflectance. As the angle of the radiation increases to glazing incidence, reflectance increases and transmittance progressively decreases to zero (a feature not specific to clear glass).

(b) *Clear multiple glazing.* Gives slightly lower solar transmittance than (a), owing to the additional pane(s) of glass.

(c) *Solar control glasses.* Used singly or as the outer pane of multiple glazing. Solar absorptance and/or reflectance is higher than for clear glass, with consequent lower solar transmittance.

(d) *Shading devices.* These are generally used in situations where direct or reflected glare or the thermal discomfort of direct sunshine are likely to be a problem.

(1) Internal shading devices either between two panes or on the room side of the glass are in general less efficient than external devices, and allow different solar heat gains dependent on their position in relation to the glass and their properties.

(2) External shading devices give more efficient reduction of solar heat gain. They will reduce instantaneous heat gain by ensuring that heat is dissipated externally. When external shading devices are to be used they will need to be considered as a major element in the aesthetic design of the building facade.

(e) *Solar control plastic films.* These are normally coloured and/or reflective and may be applied to glass to produce reflecting/absorbing surfaces, the exact performance depending on the construction of the film.

* absorptance. The ratio of the solar radiation absorbed by a surface to that falling on the surface.

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Table 4. Summary of usage of glazing materials for various glass types

Clause	Glass type	Glazing material		Non-setting glazing compounds	Two-part rubberizing compounds	One-part sealant: curing types	One-part sealant: solvent release types	Two-part sealant: curing types	Preformed mastic tapes	Extruded solid sections	Cellular strips	Structural gaskets	Non-structural gaskets
		Clause											
				5.3.2.1.1	5.3.2.1.2	5.3.2.2.1	5.3.2.2.2	5.3.2.3.2	5.3.2.3.3	5.3.2.3.4	5.3.2.4(a)	5.3.2.5(a)	(b)
				Linseed oil putty	Metal casement putty	Non-setting glazing compounds	Two-part rubberizing compounds	One-part sealant: curing types	One-part sealant: solvent release types	Two-part sealant: curing types	Preformed mastic tapes	Extruded solid sections	Cellular strips
5.3.1.2.1	<i>Transparent glass</i>												
	(a) Float glass												
	(1) Clear			X	X	X	X	X	X	X	X	X	X
	(2) Body tinted			C	C	X	X	X	X	X	X	X	X
	(3) Surface modified tinted			—	—	X	X	X	X	X	X	X	X
	(4) Surface coated			—	—	X	X	X	X	X	X	X	X
	(b) Polished wired glass			X	X	X	X	X	X	X	X	X	X
	(c) Sheet glass												
	(1) Clear			X	X	X	X	X	X	X	X	X	X
	(2) Body tinted			C	C	X	X	X	X	X	X	X	X
	(3) Flashed or pot coloured			C	C	X	X	X	X	X	X	X	X
5.3.1.2.2	<i>Translucent rolled and cast glass</i>												
	(a) Patterned			X	X	X	X	X	X	X	X	X	X
	(b) Tinted patterned			C	C	X	X	X	X	X	X	X	X
	(c) Wired patterned			X	X	X	X	X	X	X	X	X	X
	(d) Rough cast			X	X	X	X	X	X	X	X	X	X
	(e) Tinted rough cast			C	C	X	X	X	X	X	X	X	X
	(f) Rough cast wired			X	X	X	X	X	X	X	X	X	X
5.3.1.3.1	<i>Toughened (tempered) glass</i>												
	Clear rolled, cast			X	X	X	X	X	X	X	X	X	X
	Enamelled, tinted			—	—	X	X	X	X	X	X	X	X
	Insulating infill panels			—	—	X	X	X	X	X	X	X	X
5.3.1.3.2	<i>Laminated glass (all types)</i>			—	—	C	C	C	C	X	C	C	X
5.3.1.3.3	<i>Multiple glass units</i>												
	Hermetically sealed units			—	C	C	C	C	C	C	C	C	X
	Stepped hermetically sealed units			C	C	C	C	C	C	C	C	C	X

Key

X denotes suitable;

— denotes not suitable;

C denotes consider, but dependent on precise details of compound constituents; consult the manufacturers involved.

Table 5. Glazing materials

Type	Basic components	Typical life expectancy*	Form	Uses	Wind pressure resistance †	Comments
0. Linseed oil putty	Linseed oil	See comments column	Bulk	Bedding and fronting	Up to 900 N/m ²	Paint protection essential. Life dependent on paint maintenance. Inspect annually.
1. Metal casement putty	Drying oils	See comments column	Bulk	Bedding and fronting	Up to 900 N/m ²	Paint protection essential. Life dependent on paint maintenance. Inspect annually.
2a. Non-setting compound	Oils, plasticizers, polymers	See comments column	Bulk	Bedding glass and beads	Up to 1500 N/m ²	Paint protection not essential, but painting prolongs life. Inspect every year and maintain as necessary. Sealer required for porous surround.
2b. Preformed mastic tape (non-load bearing)	Oils, plasticizers, polymers	Over 15 years	Reels	Bedding	Up to 1500 N/m ²	Limited load-bearing capability. Use with distance pieces.
3. Gun grade sealant, solvent release type	Synthetic rubber or acrylic polymers and plasticizers	Over 15 years	Bulk or gun packs	Heel bead or bedding beads	Up to 1500 N/m ²	
4a. Preformed mastic tape, load bearing	Synthetic rubber and plasticizers	See comments column	Reels	Bedding glass	Exceeding 1500 N/m ²	Drainage is essential.
4b. Solid sections	Vulcanized synthetic rubber or PVC	See comments column	Coils	Bedding glass	Varies according to design and materials	Drainage is essential.
4c. Expanded sections	Cross-linked synthetic polymer or PVC	Over 10 years	Rolls	Bedding glass	Up to 1000 N/m ²	Drainage should be provided. Resistance to wind pressure can be improved by capping or heel beading with sealant.
5a. Curing gun grade sealant, one-part	Solvent release acrylic sealants, polysulphide, silicone, polyurethane	Over 20 years	Gun packs or bulk	Heel bead and capping	Exceeding 1500 N/m ²	Cure may be slow owing to concealed position of sealant.
5b. Curing gun grade sealant, two-part	Polyurethane, polysulphide, flexibilized epoxide	Over 20 years	Proportioned packs for on-site mixing	Heel bead and capping	Exceeding 1500 N/m ²	Cure is unaffected by being in concealed positions.
6. Two-part rubberizing compound	Synthetic rubber, plasticizers	Over 20 years	Bulk	Bedding glass and beads	Exceeding 1500 N/m ²	Compound is load bearing when cured.
7. Reinforced mastic tape	Foil or fabric, coated or impregnated with mastic compound	2 years to 10 years	Rolls	Covering joints	Up to 1000 N/m ²	Generally used as a repair system, lapped over glass and frame.
8a. Extruded sections structural gaskets	Vulcanized synthetic rubber	Over 20 years	Factory moulded	Bedding glass	Exceeding 1500 N/m ²	Drainage essential.
8b. Extruded sections, non-structural gaskets	Vulcanized synthetic rubber or PVC	Over 20 years	Rolls or factory moulded	Bedding glass	Exceeding 1500 N/m ²	Drainage essential. Joints should be sealed.
9a. Self-adhesive fabric tape	Cotton or other fibre	Over 20 years	Rolls	Bedding glass	Internal use only	
9b. Self-adhesive velvet tape	Velvet	Over 20 years	Rolls	Bedding glass	Internal use only	
9c. Extruded mastic tape	Vegetable oils	Over 20 years	Reels	Bedding glass	Internal use only	
9d. Asbestos tape	Asbestos fibre	Over 20 years	Rolls	Bedding	Normally internal use only	Used in glazing of fire doors and partitions usually incorporating a suitable mastic sealant.
10. Asbestos channel	Asbestos fibre	Over 20 years	Strip	Bedding	Normally internal use only	Used in glazing of fire doors and partitions usually incorporating a suitable mastic sealant.

* Typical life expectancy is defined as the number of years during which the compound or sealant can be expected to perform its intended function satisfactorily under normal conditions of weather and exposure when used in accordance with the manufacturer's instructions.

† These figures should be taken as a comparative guide only, and may be exceeded or attained according to the pane size, the particular material or the glazing system used.

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Figure 4 shows examples of the mechanism of solar radiation transfer for:

- (1) 6 mm clear single glass;
- (2) 6 mm body tinted glass, 75/61 (green);
- (3) 6 mm clear double-glazing unit;
- (4) reflective double-glazing unit, 34/25.

The total solar transmittance for a particular glazing configuration comprises the transmitted component together with those parts of the absorbed components re-emitted inwards, for example:

$$(61 + 10) / 100 = 0.71$$

in the case of figure 4(c).

For convenience in calculating the solar loads to a building, the solar performance characteristics of particular glazing configurations are identified by one or other of the following concepts, depending on the method of calculation being used:

- (i) **shading coefficient.** The ratio of the total solar transmittance of the glazing configuration to 0.87, 0.87 being the total solar transmittance of a notional 3 mm to 4 mm thick clear glass*.

Example. The shading coefficient of the clear double-glazing unit figure 4(c) is given by:

$$0.71/0.87 = 0.82$$

- (ii) **solar gain factor †**

solar gain factor. The quotient of the daily mean solar cooling load due to the glazing configuration and the daily mean solar irradiance received on the glazing.

alternating solar gain factor. The quotient of the instantaneous cyclic cooling load due to the glazing configuration and the instantaneous cyclic solar irradiance received on the glazing.

The manufacturer should be consulted on appropriate values of shading coefficient or solar gain factor for specific glasses. Shading coefficients for a selection of clear and solar control glasses used singly are given in table 5 of DD 67 : 1980. Solar gain factors for a similar selection of glasses used either singly, as the outer pane of double glazing or in conjunction with internal, mid-pane or external shading devices are given in tables A5.3 and A5.4 of the CIBS Guide, Section A5 (see footnote †). However, for convenience, typical transmittance characteristics for a selection of glass types are given in table 6. Similarly, tables 7 and 8 give an indication of the influence of different arrangements of louvred blinds used in conjunction with various types of glass.

5.5.2 Thermal insulation. Table 9 gives typical *U*-values for various glazing configurations and different degrees of site exposure. Site exposure is conventionally divided into three categories: sheltered, normal, and severe, as specified in CIBS Guide, Section A3 (Thermal properties of building structures), 1980.

5.5.3 Energy balance of windows. The final energy balance of the glazed area will be a combination of the solar gains and the losses due to conduction, convection and radiation, and these can be calculated, but close cooperation between

the supplier, the glass manufacturer and the building designer is required because many of the modes of heat transfer through windows are complex.

5.5.4 Assessment of thermal safety of glass. Although thermal stress in glass and the need for its assessment is described below, the question of thermal safety related to particular circumstances is not considered, such detail being the subject of glass manufacturers' literature.

Knowledge of the radiation to which the glass is to be subjected and the thermal capabilities of the glass are necessary for the assessment of the thermal safety of glass. One method of assessment is by determining the solar radiation intensity on the glass surface and the air temperature range applicable to the location of the building. These, together with the heat transfer coefficients and the glass absorption allow determination of the appropriate basic temperature difference between the central area of the glass and its edge. This difference is related to the thermal stress and then modified for the type of glazing system, taking account of extraneous effects resulting from curtains, blinds, back-up walls, close proximity to heaters and the like, to derive a stress for actual service conditions. High air temperatures, low rates of air movement, and the insulation provided by curtains, blinds, back-up walls and multiple glazing tend to reduce the loss of heat and uphold the centre temperature. Low temperatures at the edges are maintained by conduction from the glass through the frame to a cold building structure with a large thermal capacity.

The resultant service stress should then be compared with the design stress for the glass. If on comparison the service stress is less than or equal to the design stress, the glass and glazing system can be accepted as thermally safe provided that the edges of the glass are of sufficient quality.

Insulating glass systems have different temperature distribution patterns from those of single glazing because each glass, having absorbed its share of solar energy, transfers some of its heat to other glasses in the system. Where the application of a solar control film is being considered to a glass already glazed in a building, advice should be sought from the manufacturer on the effect of any additional thermal stress likely to be induced in the glass.

The materials used in framing the glass vary widely in their thermal properties and the details of the frame design are therefore important in determining the temperature gradients near the edges of the glass.

If the frame is in good thermal contact with a heavy masonry structure it will lose heat rapidly to the masonry and stay relatively cool. Blinds and other shading devices interfere with the free movement of air over the glass and they reflect, absorb and reradiate solar radiation. Edge cover is instrumental in causing stress in the edge of sunlit glass but, within the practicable limits consistent with the safe retention of the glass in conventional glazing, changes in the width of edge cover alter the edge stress so little that their effect on the thermal safety of the glass is negligible.

* Definition taken from American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE) Handbook, *Fundamentals*, 1981.

† Definitions taken from Chartered Institution of Building Services (CIBS) Guide, Section A5, *Thermal Response of buildings*, 1979.

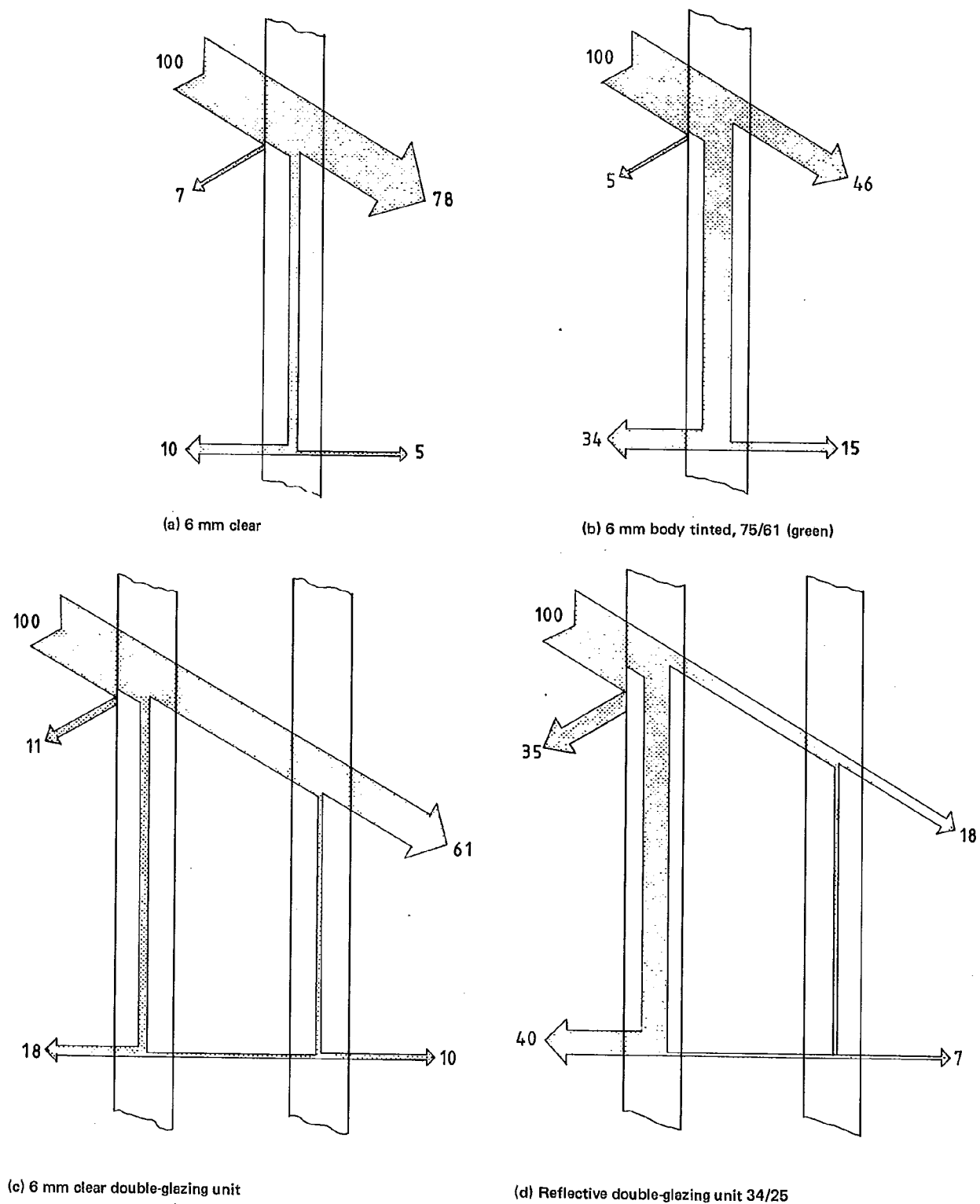


Figure 4. Examples of typical total transmission characteristics

Table 6. Typical solar radiant heat properties for glasses

Glass type	Reflectance	Absorptance	Direct transmittance	Total transmittance	Shading coefficient
Single clear glass, 4 mm	0.08	0.08	0.84	0.86	0.99
Single or laminated clear glass, 6 mm	0.07	0.15	0.78	0.83	0.95
Body tinted, solar control	0.05 to 0.06	0.49 to 0.51	0.44 to 0.45	0.59 to 0.62	0.69 to 0.72
Laminated tinted inter-layer, solar control	0.04 to 0.07	0.21 to 0.81	0.15 to 0.72	0.36 to 0.77	0.41 to 0.88
Surface coated or modified, solar control	0.09 to 0.10	0.34 to 0.43	0.48 to 0.56	0.51 to 0.66	0.70 to 0.76
Laminated solar reflecting	0.12 to 0.48	0.35 to 0.55	0.09 to 0.50	0.22 to 0.62	0.26 to 0.71
Solar control double-glazing unit incorporating one 6 mm pane surface-coated glass	0.12 to 0.49	0.31 to 0.62	0.08 to 0.40	0.16 to 0.52	0.19 to 0.59
Clear double-glazing units having two panes, 6 mm	0.11 to 0.12	0.24 to 0.33	0.56 to 0.64	0.66 to 0.73	0.76 to 0.84
Solar control films applied to single 6 mm clear glass	0.14 to 0.50	0.30 to 0.66	0.14 to 0.50	0.22 to 0.60	0.22 to 0.70

Because the normal mode of thermal breakage of glass is by the action of tensile stress located in and parallel to an edge, the breaking stress of the glass is mainly dependent on the extent and position of flaws in the edges. The condition of the glass edge is therefore extremely important.

Solar control glasses should not be nipped to size and any squares with shelled or vented edges should not be accepted for glazing in orientations subject to direct sunlight. Although a wheel-cut edge is the most satisfactory, laminated glasses may be supplied with worked edges. Where clean cut edges are not permitted, arrises should be created by a wet process, working parallel to the edge and not across the thickness, and the design implications of such an action should be examined.

Some solar control glasses can be toughened and this gives a means of raising the design stress and ensuring safety from thermal fracture. Where solar control glasses are to be used in sliding doors and windows there is always the possibility that, when opened during sunny periods, the overlapping will function as double glazing with little ventilation in the air space, and it is this condition that should be assumed in assessing the thermal safety of glass.

It is important to remember that the thermal safety assessment is based on the behaviour of glass in good condition and properly glazed. Even if the glass is shown to be thermally safe, that safety depends on close adherence to the recommended glazing procedures. All necessary precautions should be taken to see that only glass with edges of an acceptable condition is glazed. The glass should be stored and handled so that no contact with hard bodies can damage the edges and each square should be carefully examined immediately before glazing.

5.5.5 Thermal expansion. The coefficient of linear expansion of all the glasses referred to in this code, whether clear or deeply tinted, annealed, laminated or toughened, is approximately $8.0 \times 10^{-6} \text{ K}^{-1}$. Thus an increase of 60 K in the temperature of the glass (feasible with tinted glass) would cause a pane 2.5 m long to expand by 1.2 mm. A similar length of clear glass would only expand by 0.4 mm as its maximum service temperature increase would only be about 20 K. This difference in expansion has been accounted for in arriving at the recommended minimum glass clearances of table 20.

Table 7. Shading coefficients for a selection of 6 mm glasses with various arrangements of louvred blinds

Window design	Shading coefficient				
	No blinds	Opaque materials: medium performance blind		Translucent materials: medium performance blinds	
		Louvres at 45° to plane of glass	Louvres closed	Louvres at 45° to plane of glass	Louvres closed
Clear single glass	0.97	0.62	0.50	0.62	0.63
Heat-absorbing glass	0.69	0.50	0.46	0.50	0.52
Double-glazing units, 12 mm air space, both panes clear glass	0.84	0.58	0.50	0.58	0.60
Double-glazing units, 12 mm air space, inner pane clear glass, outer pane heat-absorbing glass	0.55	0.40	0.37	0.40	0.42
Double glazing with 20 mm or greater air space, louvres between panes, both panes clear glass	—	0.29	0.21	0.41	0.45
Double glazing with 20 mm or greater air space, louvres between panes, inner pane clear glass, outer pane heat-absorbing glass	—	0.25	0.21	0.31	0.34

Table 8. Solar optical properties of glass and blinds materials considered in table 7

	Reflectance	Absorptance	Direct transmittance
<i>Solar radiation at normal incidence</i>			
Clear glass	0.07	0.13	0.80
Heat-absorbing glass	0.05	0.51	0.44
Opaque material blind	0.55	0.45	0.00
Translucent material blind	0.40	0.20	0.40
<i>Solar radiation at 45°</i>			
Clear glass	0.09	0.13	0.78
Heat-absorbing glass	0.07	0.53	0.40
Opaque material blind	0.40	0.53	0.07
Translucent material blind	0.40	0.27	0.33

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Table 9. Thermal insulation properties of glass, excluding frame

Glass type	Air space width	Thermal insulation for degree of site exposure		
		Sheltered	Normal	Severe
	mm	W/(m ² ·K)	W/(m ² ·K)	W/(m ² ·K)
Single glazing		5.0	5.6	6.7
Double glazing	3	3.6	4.0	4.4
	6	3.2	3.4	3.8
	12	2.8	3.0	3.3
	25 or more	2.8	2.9	3.2
Triple glazing	3	2.8	3.0	3.3
	6	2.3	2.5	2.6
	12	2.0	2.1	2.2
	25 or more	1.9	2.0	2.1
Double glazing with one pane surface coated adjacent to the air space with a low emissivity coating	6	2.4	2.5	2.7
	12	1.7	1.8	1.9

5.6 Sound

5.6.1 Introduction. Glass has a very low sound absorption coefficient. However, with regard to the acoustic use of glass in buildings, sound transmission is by far the most significant and quantifies how much of the incident sound energy appears on the opposite side of the glass or window. Among the factors that affect the overall acoustic performance, which are not all independent, are the following.

(a) Single glazing:

- (1) glass thickness, or mass per unit area;
- (2) coincidence effect;
- (3) closure or sealing;
- (4) edge conditions;
- (5) lamination;
- (6) pane dimensions.

(b) Multiple glazing. Factors are as for single glazing, plus:

- (1) amount of pane separation;
- (2) lining the reveals;
- (3) difference in thicknesses of panes;
- (4) non-parallel panes;
- (5) mechanical separation.

These effects are not all of the same magnitude, and some are operative only over a narrow band of frequencies, whilst others can affect the whole of the frequency range.

5.6.2 Single glazing. Theoretically, sound insulation should increase by 6 dB per doubling of glass thickness, but this is not achieved in practice owing to interference by resonance effects. As the mass increases, the frequency at which coincidence effects manifest themselves will be lower. The average sound insulation for different glass thicknesses is given in table 10. Values for specific frequencies, in general, can be obtained from the manufacturers.

The benefits of sound damping can be obtained by the use of laminated glass, which improves the insulation at the coincidence frequency and at higher frequencies. At other

frequencies, there is little improvement over ordinary, monolithic glass of the same thickness (see figure 5).

5.6.3 Double glazing. Sound insulation increases with increase in pane separation, but, in general, beyond 200 mm the incremental increase is small.

The sound insulation of a few glass configurations is given in table 10.

5.7 Safety

5.7.1 Fracture characteristics of glasses

5.7.1.1 General. The energy requirement to cause fracture and penetration will vary with the type and particular composition of the glass.

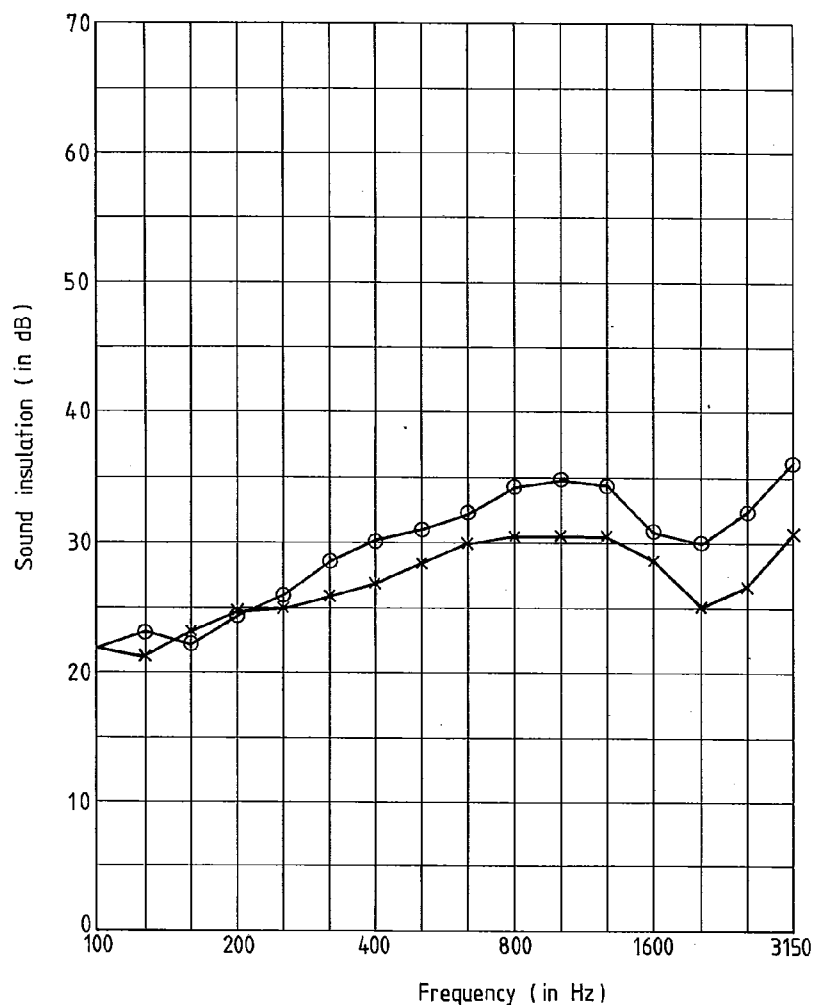
The safety characteristics of glasses can be identified using the classification in BS 6206.

5.7.1.2 Annealed glass (i.e. float glass, sheet glass, patterned glass, tinted float glass). If annealed glass is broken and penetrated and pieces are dislodged, the resulting glass edges will be sharp. The risk of breakage under human impact is reduced where annealed glass is used in accordance with table 11.

5.7.1.3 Wired glass. Wired glass, if broken after impact, will be held together by the wires and penetration is unlikely except under higher impacts, where the wires are broken. If penetrated, the characteristics of the edges are similar to those of annealed glass.

5.7.1.4 Laminated glass. The fracture characteristics will be similar to those of the basic types of glass used but the pieces will substantially remain adhered to the plastics interlayer. The broken glass, when containing an interlayer, such as 0.38 mm thick PVB, is unlikely to be penetrated. Much greater penetration resistance is given with thicker PVB interlayers.

5.7.1.5 Toughened (tempered) glass. Thermally toughened soda-lime glass is difficult to penetrate, but if broken it fragments into small, relatively harmless pieces.



Key

- 6 mm laminated (0.75 mm poly(vinyl butyral) (PVB))
- ×—× 6 mm monolithic

Figure 5. Variation in sound insulation of monolithic and laminated glass with frequency

5.7.1.6 Plastics covered annealed glass. Annealed glass coated with a film or covered with specially formulated organic materials intended to hold the glass together after breakage, will, when broken, be difficult to penetrate providing the coating or covering is applied in accordance with the manufacturer's recommendations.

5.7.2 Glass selection

5.7.2.1 General. The glass selection, made by the specifier, should be guided by the requirements of the design under consideration and satisfy the recommendations of 4.7.

5.7.2.2 Non-fully glazed doors and side panels that may be mistaken for doors. Table 11 should be used for determining the necessary thickness of glass for non-fully glazed doors and side panels, except that glass less than 6 mm thickness should not be used (see 4.7.2.2(c)). However, doors containing no more than a small vision panel not exceeding 0.02 m² in area can be glazed with 4 mm glass.

5.7.2.3 Glass, any part of which is within 800 mm from the floor (excluding balustrades). For areas where the risks of injury are not sufficient to necessitate the use of a safety glass (see 4.7.2.3), the glass should be specified in accordance with table 11.

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Table 10. Sound insulation of glass*

Table 10A. Single glass performance

Centre frequency of third-octave band	Sound insulation for a glass thickness of:						
	4 mm	6 mm	6 mm laminated	8 mm	10 mm	12 mm	12/14 mm nominal (laminated)
Hz	dB	dB	dB	dB	dB	dB	dB
100	20	22	22	23	24	25	25
125	20	22	23	24	25	26	27
160	21	23	22	25	26	27	27
200	22	24	23	26	27	28	29
250	23	25	26	27	28	29	32
315	24	26	28	28	29	31	32
400	25	27	30	29	30	32	33
500	26	29	31	30	31	33	34
630	27	30	32	31	32	33	34
800	28	31	34	32	32	32	33
1000	29	31	35	32	31	29	33
1250	30	31	34	29	27	26	32
1600	31	28	32	26	27	30	36
2000	29	25	30	28	31	34	40
2500	26	27	32	32	35	37	43
3150	23	31	37	35	37	40	46
Mean (100 Hz to 3150 Hz)	25	27	29	29	30	31	34

Table 10B. Double glass performance

Centre frequency of third-octave band	Sound insulation for a thickness of glass/air space/glass (mm) of:							
	6/12/6	10/12/6	7 nominal (laminated) /12/4	6/100/4	10/100/6	10/200/6	6/200/6	6/200/6
	Sound absorbent in reveals							
	no †	no †	no †	yes	yes	yes	yes	no
Hz	dB	dB	dB	dB	dB	dB	dB	dB
100	21	22	23	23	26	33	32	32
125	27	28	25	27	29	37	35	35
160	27	28	23	30	32	39	38	37
200	23	24	22	33	34	41	40	38
250	25	25	23	35	36	42	42	39
315	28	29	27	37	38	44	43	41
400	29	30	29	39	40	45	45	43
500	31	31	32	41	42	47	46	44
630	32	32	35	43	44	48	47	45
800	33	33	38	45	45	49	48	46
1000	34	34	40	46	47	50	49	46
1250	33	34	41	48	47	50	50	46
1600	31	33	40	49	48	50	49	44
2000	27	34	39	49	50	51	44	39
2500	29	35	39	50	52	52	47	41
3150	34	36	43	50	54	54	52	46
Mean (100 Hz to 3150 Hz)	29	31	32	40	42	46	44	41

* The values given in these tables have been correlated from many results.

† Double-glazing units.

Table 11. Nominal thickness and maximum area of glass* not complying with BS 6206 when used in risk areas with four edges supported

Single glazing		Hermetically sealed, factory made double-glazing units	
Nominal thickness	Maximum area	Nominal thickness	Maximum area
mm	m ²	mm	m ²
4	0.2	4 + 4	0.6
5	0.8	5 + 5	1.2
6	1.8	6 + 6	2.5
10	3.3	10 + 10	5.0 †
12	5.0 †	—	—

* Includes float, polished plate, sheet and cast (patterned) glasses.

† Areas of glass greater than 5 m² and supported on four sides require special consideration and the manufacturer should be consulted.

5.7.2.4 Exposed edges. Wherever glass with an exposed edge is used in a risk area, it should be edge treated as appropriate and should comply with BS 6206.

5.7.3 Fixing of glass in risk areas. The fixing of glass in risk areas should satisfy the recommendations of clause 9.

5.8 Security

5.8.1 General. Laminated glasses can be designed to provide any specified degree of resistance to penetration. The precise constituents of the laminated glass will depend on the particular purpose and the specification will require detailed discussion with the supplier, who should also be able to advise on the correct manner of glazing.

5.8.2 Manual attack. BS 5544 specifies requirements and test methods for glass resistant to manual attack and BS 5357 gives recommendations for its glazing for internal applications. Advice on glazing such security materials in external applications should be sought from the manufacturers.

5.8.3 Firearm attack. Special glazing systems and materials will be required for security glazing and the glass supplier should be consulted for an appropriate specification (see BS 5051).

5.8.4 Explosion resistance. Special glass types and fixing systems are available and specialist advice should be obtained.

5.9 Fire

5.9.1 Soda-lime silica glass can be considered non-combustible in terms of BS 476 : Part 4. Hence, laminated products in which the outer layers comprise soda-lime silica glass will have non-combustible exposed surfaces, and as such should be acceptable in any wall lining or cladding.

5.9.2 Because ordinary annealed glass will crack and fall away from its frame when exposed to high temperatures, only certain types of glazed installations have performed adequately under BS 476 : Part 8 test conditions or have been permitted under deemed-to-satisfy provisions in codes of practice and bye-laws.

Failure of integrity under BS 476 : Part 8 generally occurs when the pane becomes sufficiently plastic for it to no longer support itself within the frame, and also where

combustible beads, glazing materials or frames ignite on the face remote from the furnace even though the glass is still in position. Some new glass types and glazing techniques enable longer test performances to be achieved.

5.9.3 The following types of glass have been shown to be suitable for fire-resistant glazing by the test conditions described in BS 476 : Part 8.

(a) *Wired glass.* A period of fire resistance of up to 90 min can be achieved with wired glass at least 6 mm thick in panes of up to 1.6 m² in area, depending on the design and materials of the glazed installation.

(b) *Copper-light glazing in unwired glass panes 6 mm thick with individual panes not exceeding 0.015 m² in area.* Panels of copper-lights should not exceed 0.4 m² in area, but composite panels may be assembled using metal dividing bars that have appropriate melting-points to give up to 60 min fire resistance.

(c) *Laminated glass.* A period of fire resistance of up to 90 min can be achieved with laminated glass (containing wired glass) at least 6 mm thick in panes of up to 1.6 m² in area, depending on the design and materials of the glazed installation.

NOTE. At the present time, much research is being carried out into improved fire performances for glass and further information can be anticipated.

5.10 Durability. Glass should be adequately protected on site to ensure that no damage occurs prior to installation.

Glass may require special protection both externally and internally, from the effects of plastering, welding spatter, special adhesives, alkaline paint removers, stone-cleaning chemicals, etc. It is recommended that anything deposited on unprotected glass be removed immediately to avoid damage (see 5.12).

Although the durability of glass used in buildings today is excellent under ordinary conditions, all glasses are subject to chemical deterioration by the action of water-borne or deposited materials or permanent condensation within unventilated spaces behind glass cladding. Where rainwater is allowed to collect alkalis from surrounding construction and run down the surface of the glass, the glass can be subject to chemical attack or staining.

Air and water penetration between glass and glazing may effect the durability of the glazing system, except in a specifically designed drained system.

Water penetration may occur and glass may break if neglected metalwork corrodes, if timber warps, or if the glazing deteriorates. Guidance on maintenance is given in CP 153 : Part 2.

Where glass treated with a transparent organic material, e.g. adhesive-coated plastics film, is used, the durability of the system will depend on the durability of the organic material applied to the glass and advice should be sought from the manufacturer.

5.11 Strength of glass to withstand uniform loading

5.11.1 General. The procedure given in 5.11.2 is for windows vertically glazed (see 3.40) with four-edge fully supported glass as described in BS 952 : Part 1.

The procedure applies to single glazing, to insulating glass units and to all other forms of double glazing, whether sealed, openable or permanently ventilated.

For glass to be considered as four-edge fully supported, the deflection of each edge of the glass should be limited to glass span/125 for single glazing and glass span/175 for insulating glass units.

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'Four-edge fully supported' refers to a pane supported on all edges and having an aspect ratio, i.e. length/breadth ratio, not greater than 3 : 1. If the aspect ratio is greater than this, the pane is considered as two-edge supported and the glass manufacturer should be consulted. Where the glass is not four-edge fully supported, and for non-rectangular panes, the glass manufacturer should be consulted.

5.11.2 Use of wind loading graphs to determine thickness of glass. The design wind loadings, on a 3 s gust basis, for pressure and suction, should be determined from either 4.11 or CP 3 : Chapter V : Part 2. Glass having to withstand only low wind loadings, or glass used internally, may require to be increased in thickness to keep its deflection within acceptable limits. Detailed design consideration will be needed.

NOTE 1. CP 3 : Chapter V : Part 2 is based on a 3 s gust wind loading. The strength of glass is lower for sustained loading. When sustained loading is liable to occur, detailed advice should be obtained from the glass manufacturer.

For four-edge fully supported panes, figures 7 to 13 should be used for the appropriate glass type, and the procedure should be as follows.

NOTE 2. For information relating to figures 7 to 13, see 5.11.3.

- Calculate the area of pane, axb , and the aspect ratio, a/b , where a is the longer dimension and b is the shorter.
- On the appropriate graph from figure 7 to 13, determine the point where the vertical line for the required wind loading intersects the horizontal line for the required area.
- If the point of intersection is in the unshaded area, the next thicker glass is required. Should the intersection point be within a shaded band, determine the aspect ratio to which this point corresponds by interpolation between aspect ratios of 1 : 1 (lower limit) and 3 : 1

(upper limit of band).

(d) If the value of the calculated aspect ratio is nearer to the thick black line (i.e. for a square pane) than the interpolated value, the next glass thickness should be used. If the value of the calculated aspect ratio is farther away from this line then the glass thickness corresponding to that band can be used. Figure 6 gives a visual interpretation of this procedure.

5.11.3 Information relating to wind loading graphs.

The following information relates to the wind loading graphs, figures 7 to 13.

- For other glass thicknesses and for other glass combinations in insulation glazing, reference should be made to the glass manufacturer for recommendations.
- In preparing the graphs, the minimum tolerance on the glass thickness specified in BS 952 : Part 1 has been used.
- The design stress has been based on experience, experimental knowledge and statistical methods of analysis.
- The design stress used for figure 12 is based on fully toughened glass.
- Compliance of a glass design with the wind loading graphs does not imply suitability of use. Other recommendations of this code also need to be satisfied.
- Double glazing units should be in accordance with figure 10 or 11.

Stepped units should be treated as though they are single glazing of the thickness of the larger pane.

Coupled and double windows and secondary sashes should be designed on the basis that each glass is required to carry the full wind loading. This will be the case if the cavity between the glasses is ventilated, or if either of the two windows can be opened.

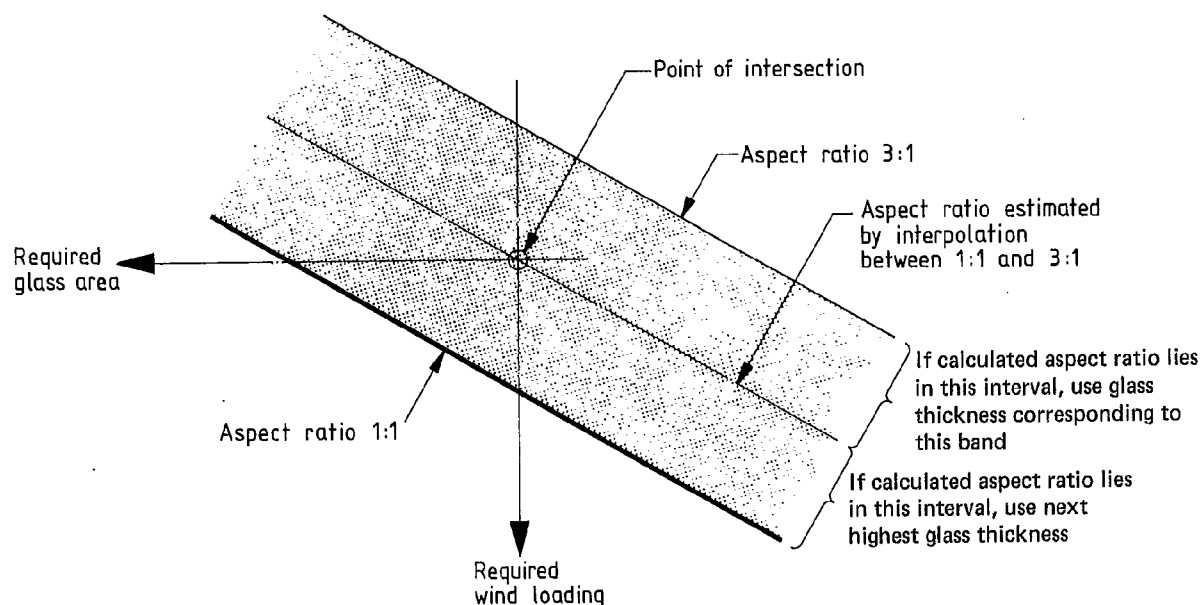


Figure 6. Visual explanation of procedure described in 5.11.2(c) and (d)

5.11.4 Examples

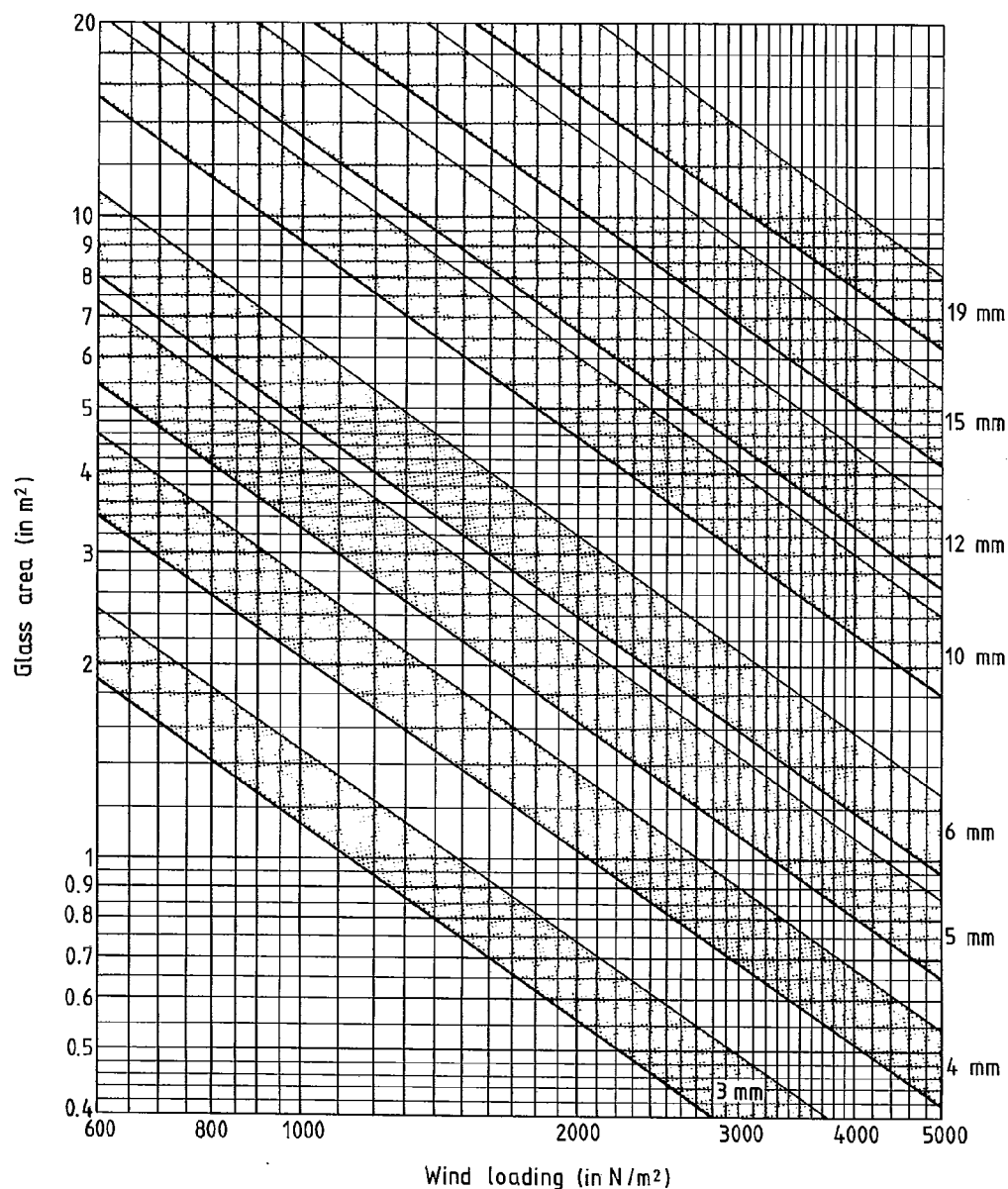
5.11.4.1 Example 1. *What is the thinnest glass recommended?* It is required to glaze an opening 1200 mm x 900 mm (aspect ratio 1.3 : 1) to withstand a 3 s wind load of 1500 N/m².

(a) Refer to clear glass (except laminated) graph (figure 7).

(b) Calculate the area of the opening, in this case 1200 mm x 900 mm = 1.08 m².

(c) Find the point at which the horizontal line representing 1.08 m² intersects with the vertical line representing 1500 N/m².

(d) The point lies in the unshaded area between the 3 mm and 4 mm diagonal bands. The thicker 4 mm glass should therefore be used.



NOTE. For notes, see 5.11.3.

Figure 7. Transparent annealed glass (except laminated): 3 s mean wind loadings

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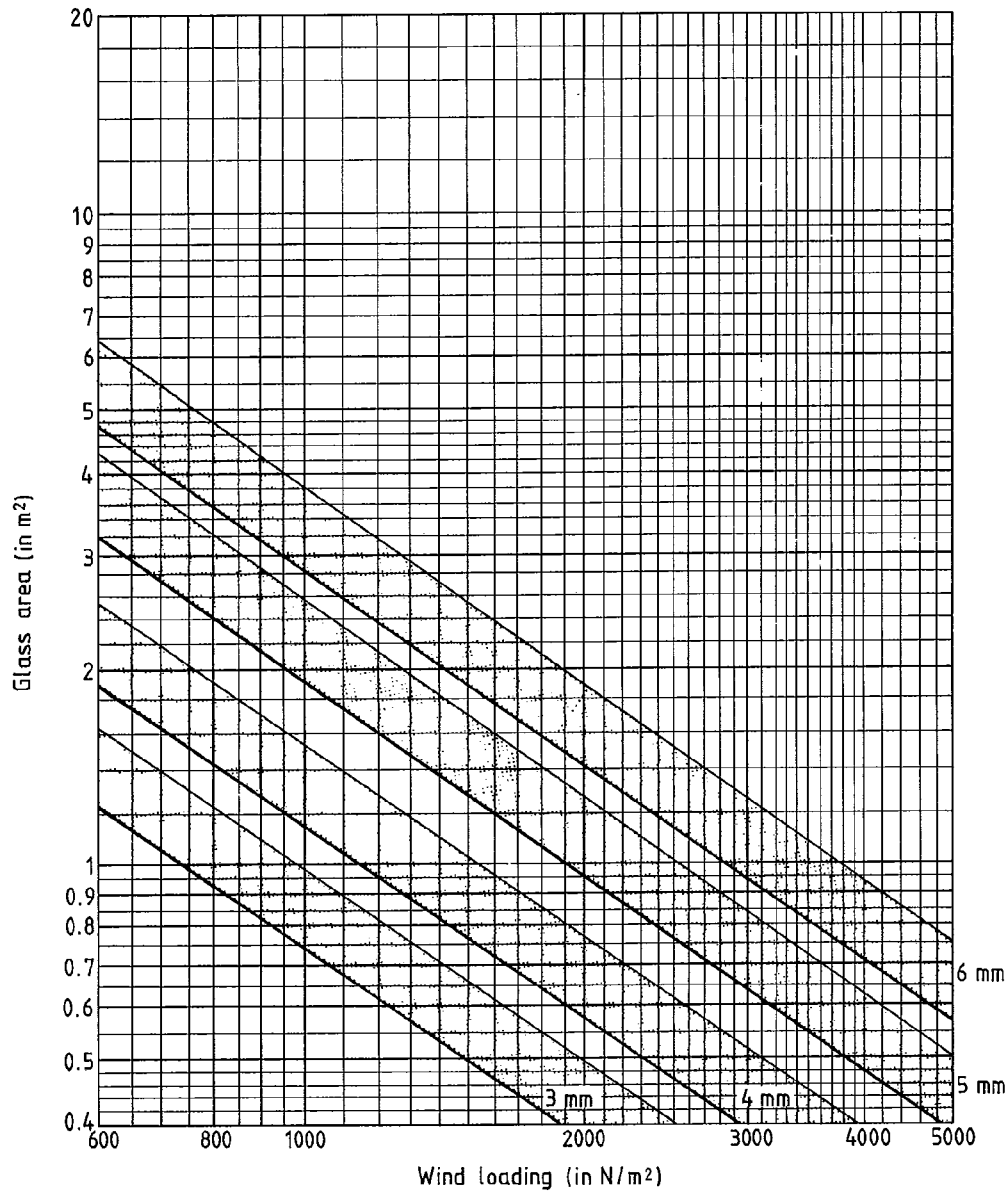
5.11.4.2 Example 2. What is the maximum area for a given wind loading? What is the maximum size of 5 mm patterned glass with an aspect ratio of 2 : 1 that will withstand a 3 s wind load of 1300 N/m²?

(a) Refer to rough cast and patterned glass graph (figure 8).

(b) Draw a vertical line from the 1300 N/m² wind loading to meet a point midway between the dark black 5 mm diagonal line and the edge of its shaded area.

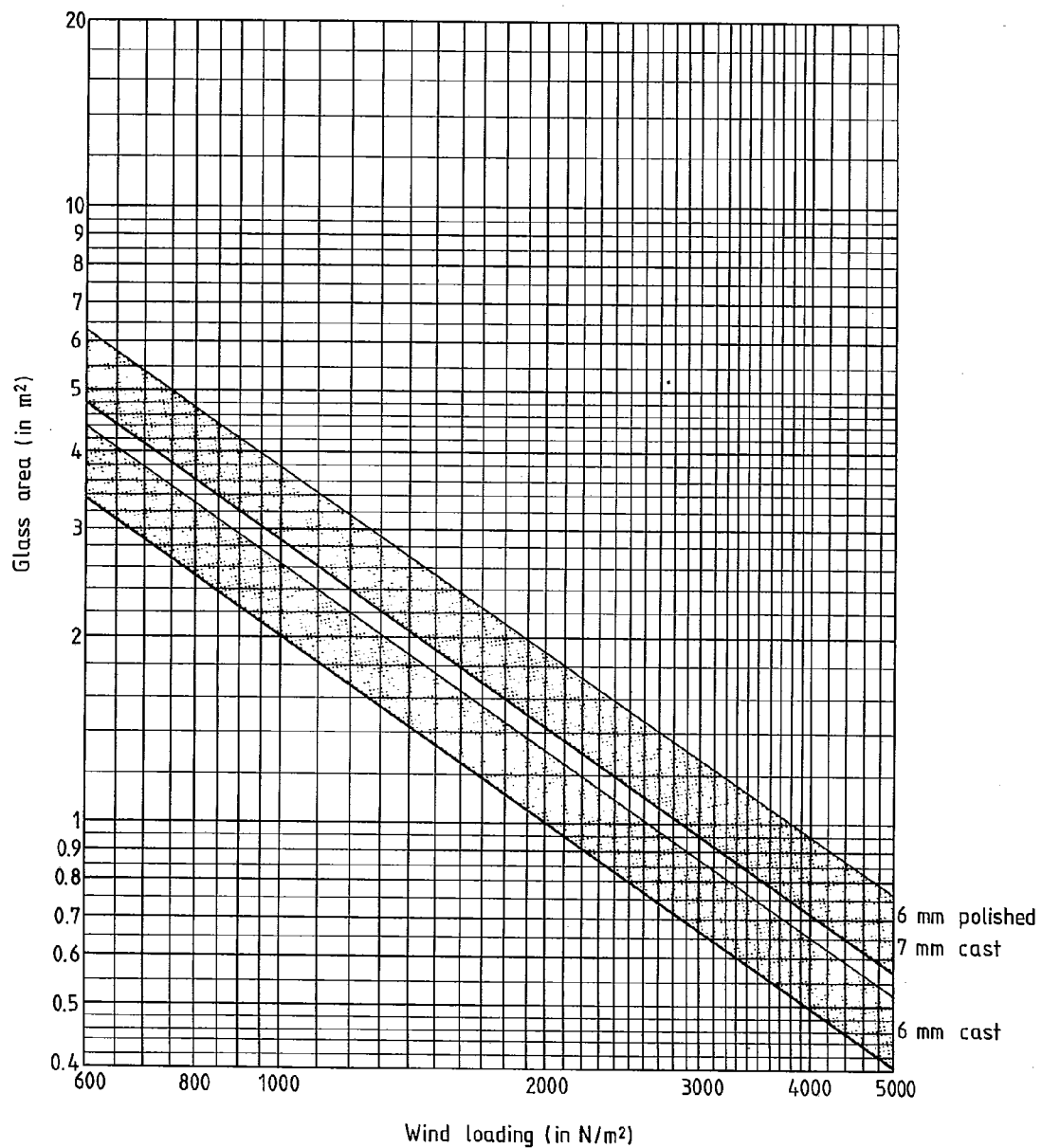
(c) Draw a horizontal line from this point to the glass area shown at the left of the graph, this is at 1.7 m².

(d) 1.7 m² is therefore the maximum area.



NOTE. For notes, see 5.11.3.

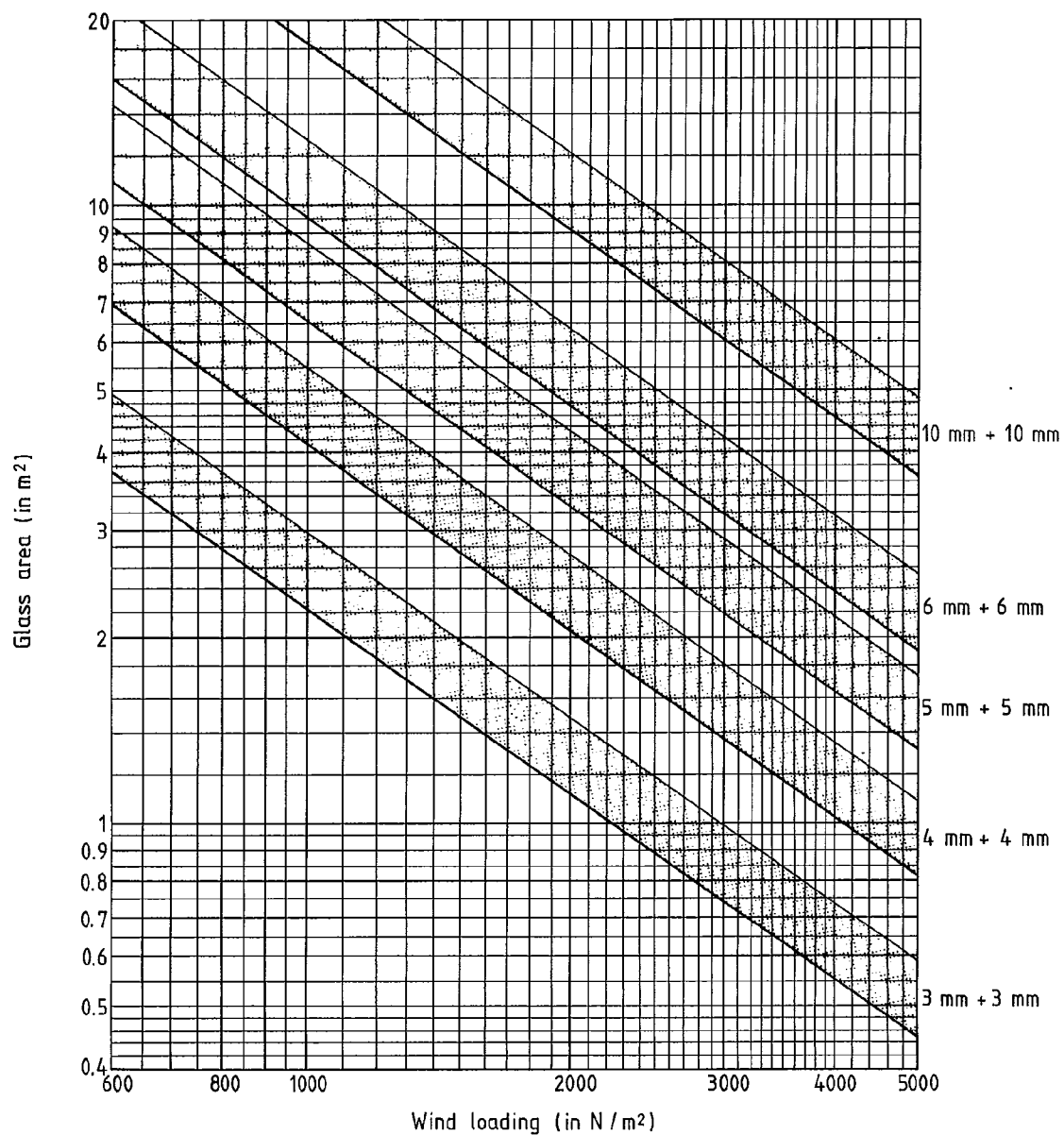
Figure 8. Rough cast and patterned glass: 3 s mean wind loadings



NOTE. For notes, see 5.11.3.

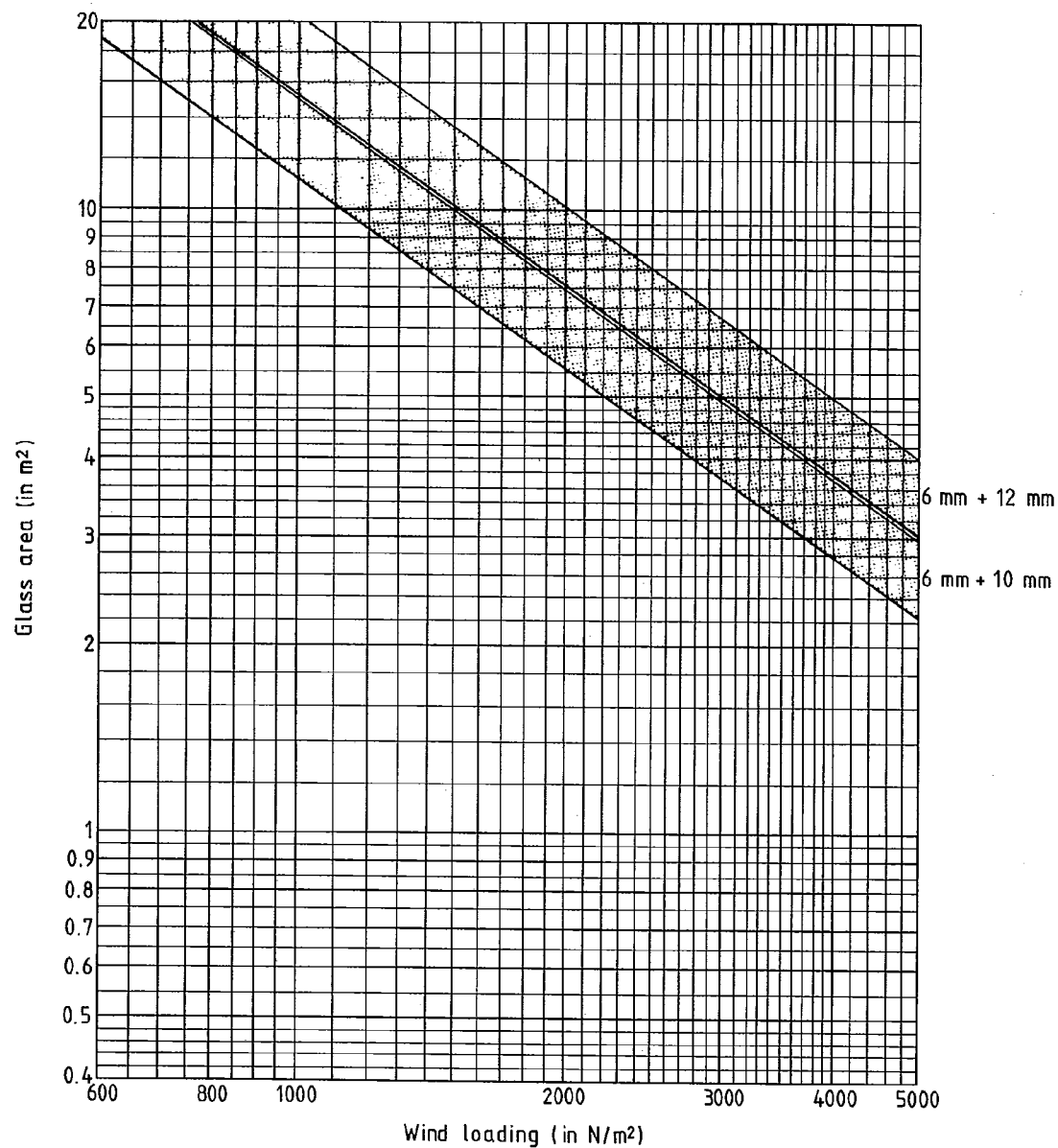
Figure 9. Wired glass: 3 s mean wind loadings

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NOTE. For notes, see 5.11.3.

Figure 10. Transparent double-glazing unit (symmetrical): 3 s mean wind loadings



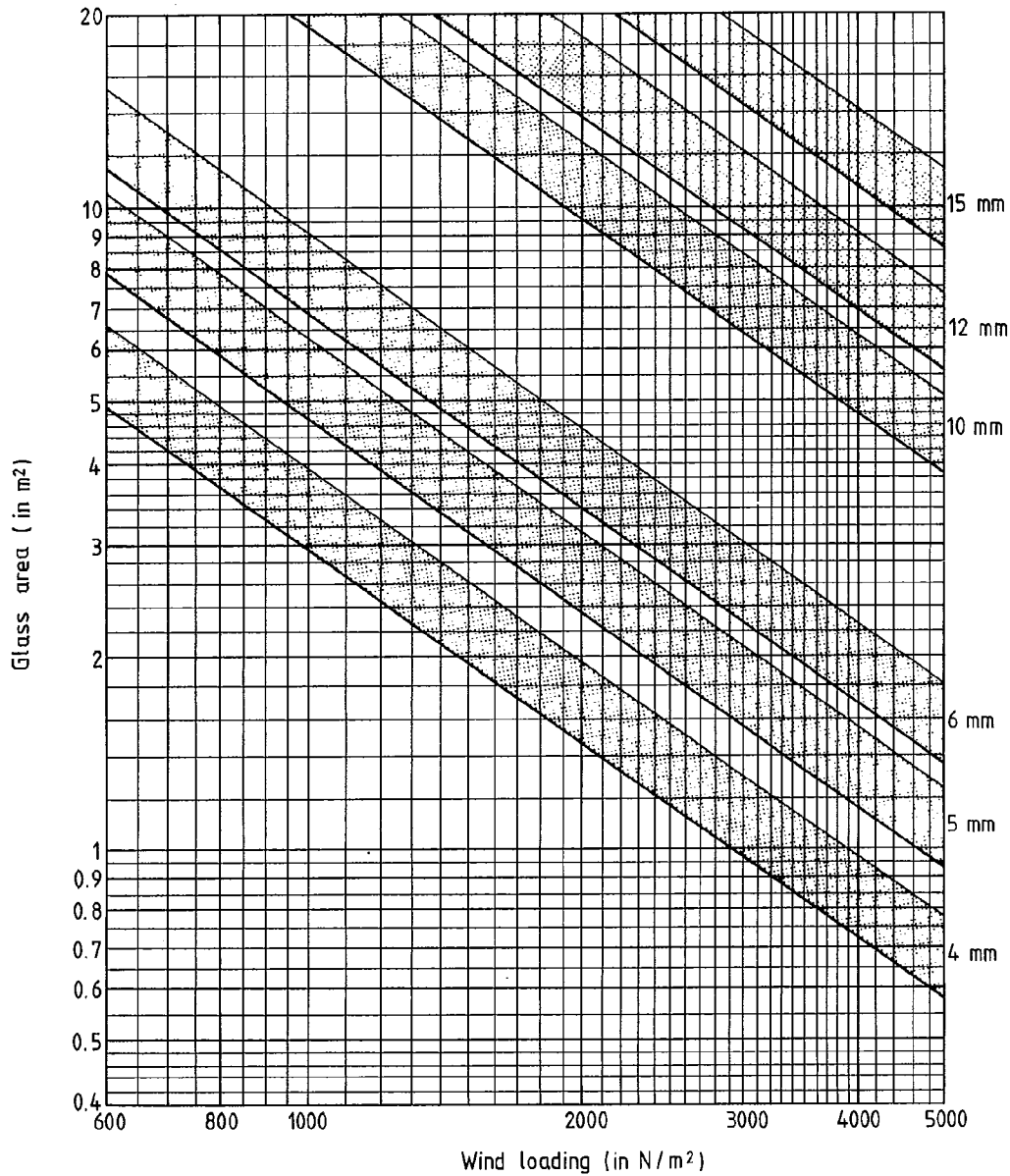
NOTE. For notes, see 5.11.3.

Figure 11. Transparent double-glazing unit (asymmetrical): 3 s mean wind loadings

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2

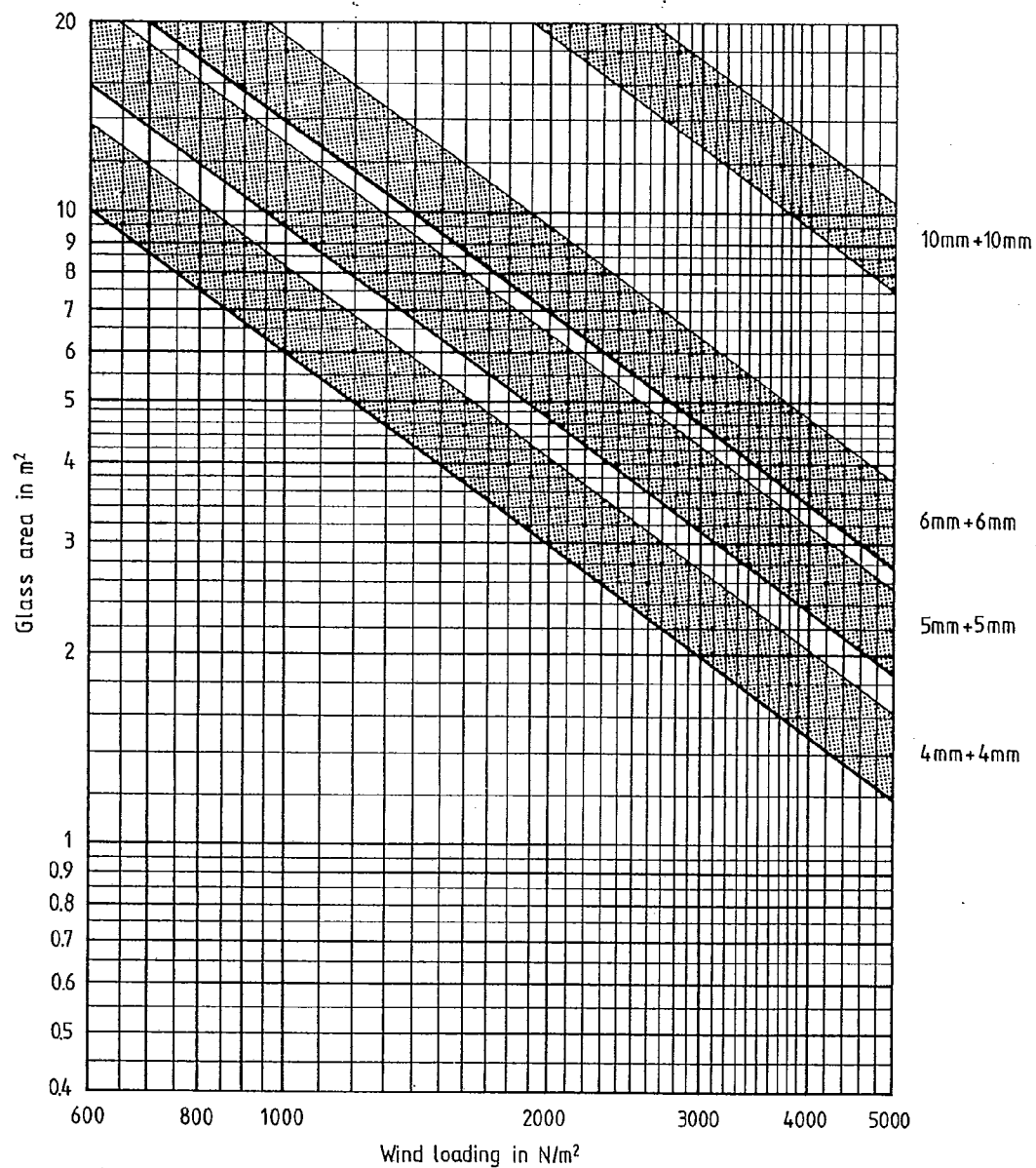
(a) Single glazing.



NOTE. For notes, see 5.11.3.

Figure 12. Toughened glass: 3 s mean wind loadings

2

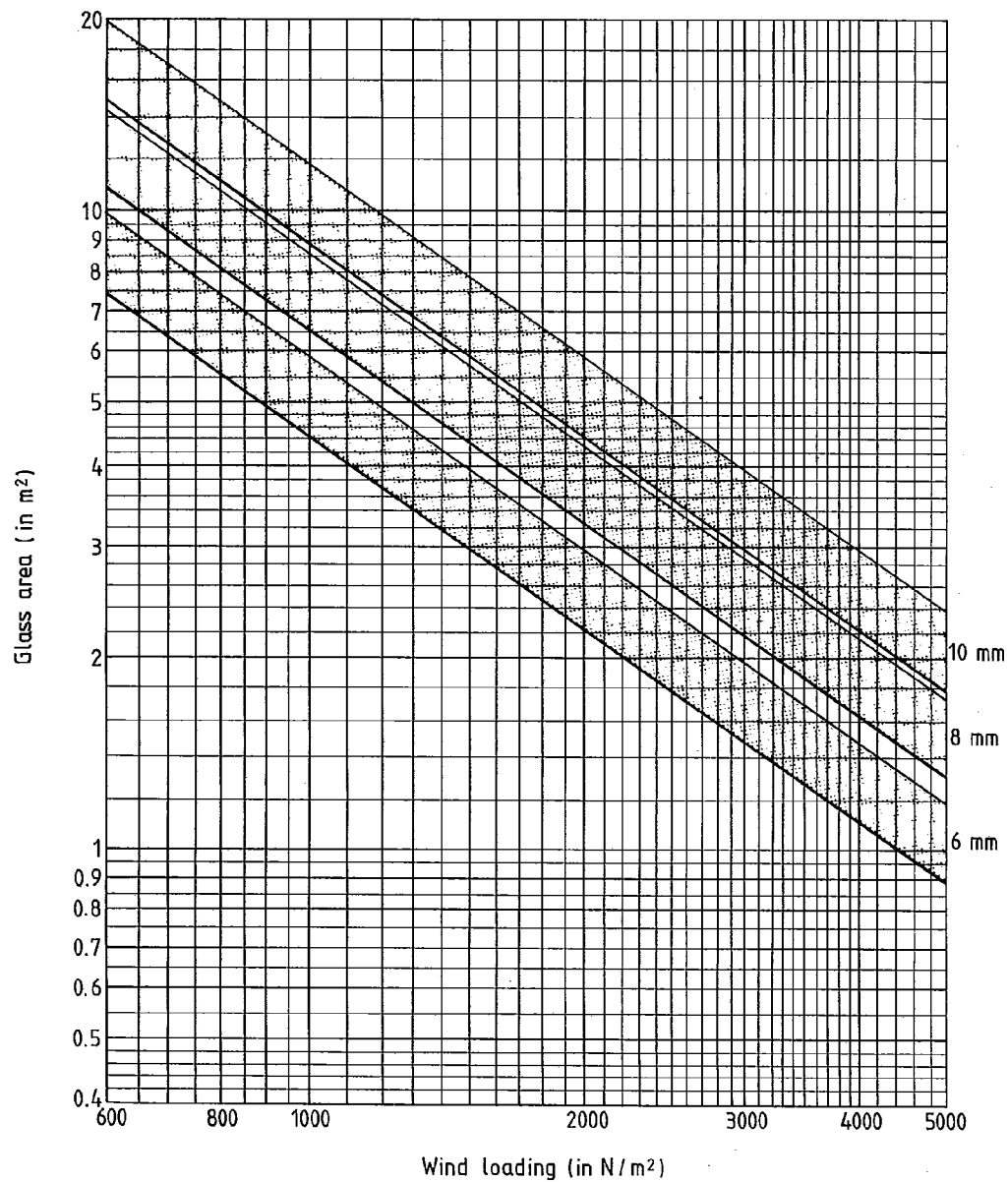


(b) Double-glazing unit, both panes toughened glass

Figure 12 contd

34a

[AMD 4582]



NOTE. For notes, see 5.11.3.

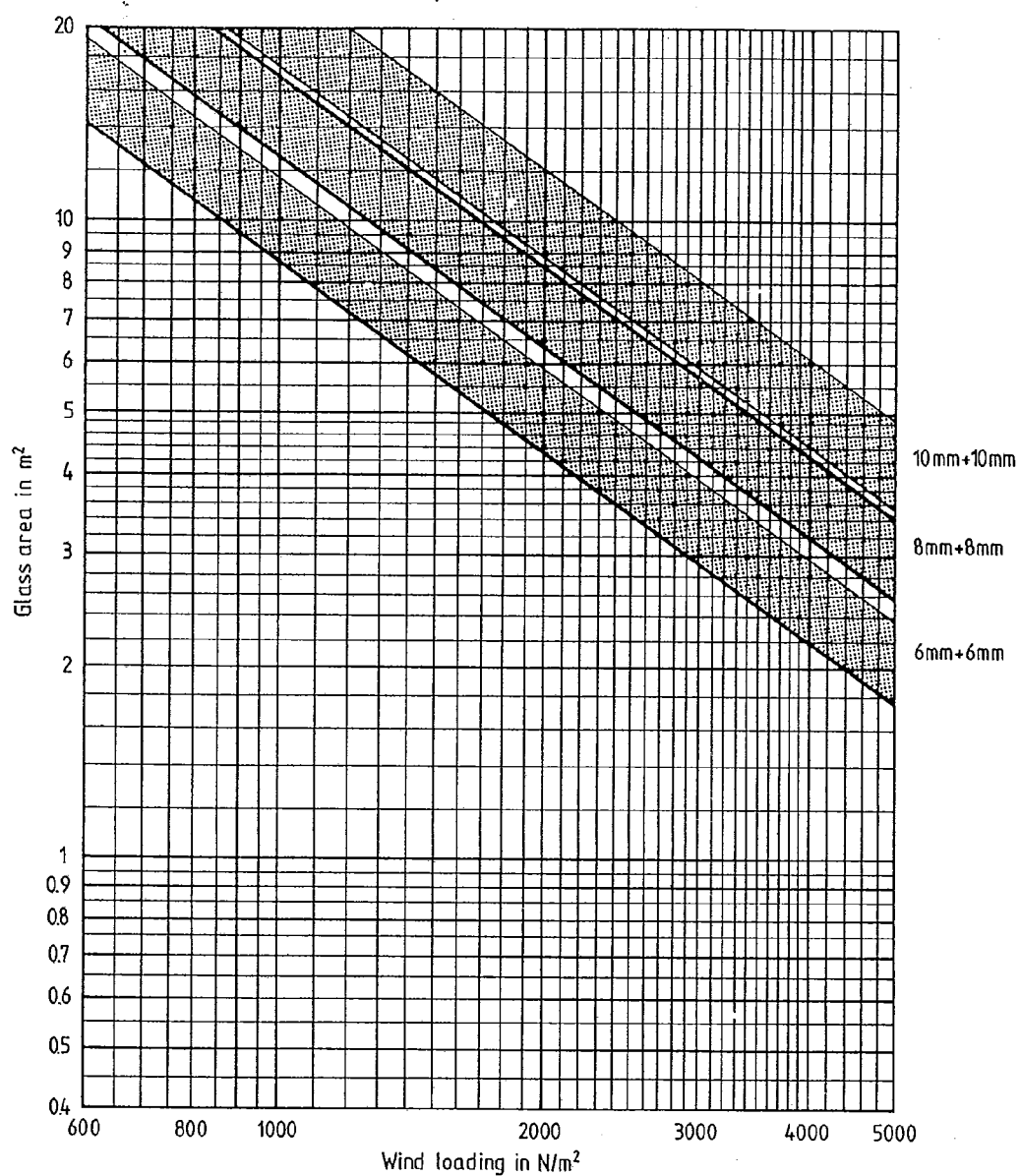
2

Figure 13. Transparent laminated glass: (symmetrical) 3 s mean wind loadings

2

(a) Single glazing

2



(b) Double-glazing unit, both panes laminated glass

Figure 13 *contd*

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5.11.5 Rebate size and edge cover

5.11.5.1 Rebates should be not less than 8 mm deep, except for very small panes up to 0.1 m² in area, where 6 mm depth is adequate. For larger sizes and depending on the exposure conditions, table 12 should be used as a general guide to good practice.

For glass sizes larger than those given in table 12, detailed design consideration is necessary but, in general, the rebate depth should be equal to the recommended edge cover plus the edge clearance conforming to the glazing method being used.

5.11.5.2 The recommended minimum edge cover for single glass glazed in putty or non-setting compound is given in tables 13 and 14.

5.11.5.3 Putty fronting of flush-edged insulating glass units has a limited application (see 9.3.2.4.2) and should only be considered for use where the wind loading does not exceed 1000 N/m² and where the units do not exceed 1.5 m² in area.

Frames, to be suitable for putty front glazing, should have adequate mechanical means, such as clips or sprigs, to retain the unit in position and should also have the minimum dimensions given in table 15.

5.11.6 Weight of glass. When considering dead loading (e.g. for assessing the characteristics of setting block materials not covered in 7.4.1 or for calculating the deflection of horizontal surround members), the weights of glass shown in table 16 should be used.

The weights given in table 16 apply to all types of monolithic glass, transparent and translucent. The weight of an insulating glass unit or laminated glass is taken as the sum of the weights of the individual glasses.

5.12 Cleaning and maintenance

5.12.1 Cleaning. Glass should be cleaned regularly. Failure to do this may result in discoloration and deterioration of the surface. Warm water with soap or a mild domestic detergent, followed by a clean water rinse, is generally adequate for routine cleaning. For transparent glass, polishing with whiting in water or methylated spirits may be found to be successful. Corrosive cleaning liquids are also sometimes employed, but care should be taken to ensure proper protection of the operative, and they should be sluiced away with an excess of clean water as soon as possible after use to avoid damage to the glass or fixing materials and window frames. Organic solvents are also useful for special purposes, e.g. for removing tar, paint that has not dried hard, or grease. However, any organic solvent is likely to have toxic properties and the operative should be suitably protected particularly against inhalation and skin contact. In some instances the fire risk may need to be guarded against during use. The solvents should always be carefully cleaned off the glass afterwards. Plaster or mortar splashed on to the glass may be removed with a thin razor blade.

Table 12. Minimum rebate depths**Table 12A. Putty fronting**

Maximum wind loading	Nominal glass thickness	Maximum glass area	Minimum rebate depth
N/m ²	mm	m ²	mm
Up to 1000	3	0.1	6
	3	1.0	8
	4	2.0	8
1000 to 1500	3	0.1	6
	3	0.7	8
	4	1.25	8
Greater than 1500	Bead glazing required for all sizes of glass (see table 12B)		

Table 12B. Bead glazing

Maximum wind loading	Nominal glass thickness	Maximum glass area	Minimum rebate depth
N/m ²	mm	m ²	mm
1000	3	1.0	9
	4	2.0	9
	5	3.2	11
	6	4.6	11
	10	9.0	13
	12	12.0	14
1500	3	0.7	9
	4	1.2	9
	5	2.1	11
	6	3.0	11
	10	6.1	13
	12	8.7	14
2000	3	0.5	10
	4	1.0	10
	5	1.5	12
	6	2.3	12
	10	4.4	15
	12	6.5	15
2500	3	0.4	10
	4	0.75	10
	5	1.2	12
	6	1.8	15
	10	3.6	18
	12	5.3	18
3000	6	1.5	15
	10	3.0	18
	12	4.4	18

Table 13. Minimum edge cover for single glass up to and including 6 mm thickness

Glazing material	Frame or surround	Glass area	Edge cover			
			Internal glazing	External glazing with a wind loading of:		
				Up to 1000 N/m ²	Up to 1500 N/m ²	Over 1500 N/m ²
Putty	Timber, galvanized steel	m ²	mm	mm	mm	mm
		Up to 0.1	4	4	6	—
		Up to 0.4	4	6	6	—
		Over 0.4	6	6	6	—
Non-setting compound	Timber, metal, plastics	Up to 1.2	6	6	6	7
		Up to 2.0	6	6	6	7
		Up to 3.0	6	7	7	7
		Up to 4.6	6	7	—	—
Non-setting compound	Stone, concrete	Up to 1.2	8	8	8	9
		Up to 2.0	8	8	9	9
		Up to 3.0	8	8	9	9
		Up to 4.6	8	9	—	—

2

Table 14. Minimum edge cover for single glass exceeding 6 mm thickness

Glass thickness	Edge cover
mm	mm
10	8
12	9
15	10
19	12
25	15

Table 15. Minimum rebate dimensions for flush-edged insulating glass units with putty fronting

Unit thickness	Minimum width		Minimum depth of rebate and front putty
	Rebate	Front putty	
mm	mm	mm	mm
11	22	8	12
14	25	8	12

Table 16. Weight of glass for setting block assessment

Nominal glass thickness	Nominal glass weight
mm	kg/m ²
3	7.5
4	10.0
5	12.5
6	15.0
10	25.0
12	30.0
15	37.5
19	47.5
25	63.5

2

Where glass treated with a transparent organic material, e.g. adhesive-coated plastics film, is used, advice on cleaning methods and maintenance generally should be sought from the plastics film manufacturer. Organic materials applied to glass should be cleaned by non-abrasive cleaning methods.

5.12.2 Need for replacement. Broken or cracked panes, which may lead to damage of the building by allowing rain to penetrate, should be made waterproof at once with suitable material and replacement should be undertaken with new glass as soon as is practical. If wired glass is broken and allowed to remain exposed to weather conditions, moisture will penetrate to the wire, which will rust.

If laminated glass is broken and allowed to remain in place, the interlayer adjacent to the exposed edge may discolour, owing to water absorption.

5.12.3 Periodic inspection and maintenance. All glazing is subject to some degradation by the action of weather and building movement. Periodic inspection and maintenance may be required, the frequency depending on the nature of the materials, their exposure and the situation of the building.

Where major maintenance or remedial work is necessary, the designers and suppliers of all components should be consulted to agree a suitable procedure.

Minor maintenance, such as repainting (particularly of putty glazing, see 9.3.2.1 and 9.3.2.4), refilling cracks, reapplying cappings, and checking that drainage ways in drained glazing systems are unobstructed, will be necessary periodically. Regular inspection and, where necessary, maintenance of the glazing system is therefore essential.

Water constantly lodged in the neighbourhood of an insulating glass unit's seal will shorten the life of that seal. In addition to the maintenance necessary for single glazing, it is important to examine drainage holes or slots periodically, to ensure that they are completely free of obstruction. Any obstruction found should be freed, removing the bead if necessary, and the full drainage system should be cleaned out. If a serious fault is found, i.e. one necessitating the temporary removal of the unit from the frame, the unit manufacturer should be notified.

6. Performance of plastics glazing sheet materials, frames and sealing materials

6.1 Introduction. The properties of plastics glazing sheet materials are described for the appropriate performance recommendations given in clause 4. As plastics technology develops, further products may become available that are not described in this code. In addition, other techniques to predict the performance of plastics glazing sheet materials are also available and the appropriate manufacturers should be consulted.

6.2 Constraints. Not every manufacturer offers every type of plastics glazing sheet material. Where British Standards test methods are available it is recommended that, when appropriate, materials complying with such tests should be specified.

6.3 Description of materials

6.3.1 General

6.3.1.1 General. This code covers plastics materials in the form of flat or flat profiled sheet. These materials may be of a composition giving a high level of resistance to breakage making them suitable for use in areas where the risk of injury when broken by human contact is an essential consideration or where resistance to breakage from vandalism is required. They may also be of a composition suitable for general purpose glazing only. Plastics materials may be formulated to meet a range of special requirements, such as the protection of art objects when on display from harmful ultraviolet radiation.

Because plastics materials may be formulated to meet a wide range of requirements, individual manufacturers have hitherto preferred to make their own recommendations on the grade of material to be used to meet a specific requirement and on the fixing method to be employed. Although this practice will continue and manufacturers should be consulted about the suitability of the use of their materials for a particular glazing application, there is now sufficient similarity between manufacturers' data on fixing techniques and general properties to present them as a code of good practice related to general building uses.

Glazing with coloured plastics sheet should always be regarded as a special case and the manufacturers consulted.

Plastics glazing sheet materials are light in weight, the relative density* for typical ones being 1.2. Therefore, in a thickness of 3 mm, such a material would weigh approximately 3.6 kg/m².

6.3.1.2 Classification of plastics glazing sheet materials.

Plastics glazing sheet materials are of various basic 'types'. The types marketed vary because of a difference in their chemical composition and structure or they may be a combination of two or more different types. Whilst different types are normally available under their proprietary brand names, the three basic types most commonly used for both exterior and interior flat glazing applications are generically:

- (a) polycarbonate (PC);
- (b) polymethyl methacrylate, commonly referred to as 'acrylic' (PMMA);
- (c) polyvinyl chloride, commonly referred to as 'rigid PVC' (unplasticized PVC or 'UPVC').

Other plastics materials or profiles suitable for specialized glazing applications include:

- (d) glass-fibre reinforced plastics (GRP) flat sheet;
- (e) hollow section extruded profiles in polycarbonate, polymethyl methacrylate and polyvinyl chloride;
- (f) cellulose acetate butyrate (CAB) sheet for heavy duty and industrial glazing;
- (g) plain or decorative polystyrene sheet for interior use.

NOTE. The recommendations on wind loading in 6.11 do not necessarily apply to the products listed in items (d) and (g). In all cases the manufacturer should be consulted.

* Formerly known as 'specific gravity' (sp. gr.).

6.3.1.3 Surface treatment. For decorative and for functional effects, similar to those described in 5.3.1.3.4, surface treatments are available and the manufacturers and processors should be consulted.

6.3.1.4 Edge treatment. Where required, the edges of plastics glazing sheet materials can be ground, smoothed, polished, mitred or bevelled.

6.3.1.5 Holes and slots. Holes and slots can be easily machined in plastics glazing sheet materials. Manufacturers and processors should be consulted.

6.3.2 Glazing materials and components

6.3.2.1 General. Sealing compounds, tapes and gaskets should be sufficiently flexible to permit expansion and contraction of the plastics glazing sheet materials. Hard setting sealant should be avoided. Where there is direct contact between the sealant, tape, or gasket and the plastics glazing sheet material, it is important that all materials used are compatible. Full details of compatibility are available from sealant manufacturers.

6.3.2.2 Putty. Linseed oil putty is not recommended for thermoplastics materials.

Metal casement putty may be used for glazing small panes of acrylic or rigid PVC.

6.3.2.3 Other glazing materials. The majority of glazing materials and compounds, described in 5.3.2.2 to 5.3.2.8, can be used with plastics glazing sheet materials, provided

that they and their associated systems are chemically compatible. It is imperative that the glazing materials manufacturer should always be consulted on this aspect.

6.4 Natural lighting. In general terms the text of 5.4 is applicable to plastics glazing sheet materials but for specific detail the manufacturer should be consulted.

6.5 Thermal considerations

6.5.1 Thermal expansion and contraction. It is important that movement caused by temperature changes is allowed for when cutting the plastics glazing sheet material pane to size to fit into its frame. The coefficient of linear expansion for most plastics sheet materials is in the order of $6.0 \times 10^{-5} \text{ K}^{-1}$ to $8.0 \times 10^{-5} \text{ K}^{-1}$. Thus with a temperature change from 0°C to 60°C the plastics material will expand by approximately 5 mm for every 1000 mm length.

6.5.2 Thermal insulation. Table 17 gives typical values for single and double-glazing units constructed from plastics glazing sheet materials.

6.5.3 Solar transmission. Various plastics glazing sheet materials are available that reduce the transmission of solar radiation. Manufacturers should be consulted for specific details.

6.6 Sound. For general information reference should be made to CP 3 : Chapter III and CP 153 : Part 3.

Table 17. Thermal transmittances (*U*-values) of single and double plastics glazing sheet materials

Sheet or unit	Airspace width	Thermal transmittance for degree of site exposure		
		Sheltered	Normal	Severe
	mm	$\text{W}/(\text{m}^2 \cdot \text{K})$	$\text{W}/(\text{m}^2 \cdot \text{K})$	$\text{W}/(\text{m}^2 \cdot \text{K})$
Single 3 mm 5 mm	—	4.6	5.1	5.9
	—	4.3	4.9	5.6
Double 3 mm + 3 mm	3	3.2	3.5	3.9
	6	2.9	3.1	3.4
	9	2.7	2.9	3.1
	12	2.6	2.7	2.9
	16	2.5	2.7	2.9
	20	2.5	2.6	2.8
Double 3 mm + 2 mm or 2.5 mm + 2.5 mm	3	3.3	3.6	3.9
	6	2.9	3.1	3.4
	9	2.7	2.9	3.2
	12	2.6	2.8	3.0
	16	2.5	2.7	2.9
	20	2.5	2.7	2.9

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The sound insulation properties of plastics glazing sheet materials relate to mass. Table 18 gives the mean sound reduction index for various thicknesses of plastics glazing sheet materials. Details of insulation at various frequencies of different types and grades of plastics glazing sheet materials may be available from the manufacturers of the materials.

Table 19 gives an estimation only of the probable mean sound reduction index for double glazing with plastics glazing sheet materials.

Table 18. Mean sound reduction index: single glazing

Thickness	Mean sound reduction index
mm	dB
3	18
4	20
5	22
6	23
8	25
10	26
13	28

6.7 Safety. Plastics glazing sheet materials classified as safety plastics complying with BS 6206 are suitable for use in risk areas as defined in 4.7.

When cutting and glazing plastics panes for safety applications it is essential that, in order to obtain the maximum breakage resistance, no small chips or cracks are present at the edges (see 10.6).

6.8 Security

6.8.1 General. Plastics glazing sheet materials can provide varying degrees of resistance to breakage and penetration. The precise materials will depend on the particular purpose and the specification will require detailed discussion with the supplier who will also be able to advise on the correct manner of glazing.

6.8.2 Manual attack. BS 5544 specifies requirements and test methods for plastics glazing sheet materials resistant to manual attack and BS 5357 gives recommendations for their glazing for internal applications.

Advice on glazing such security materials in external applications should be sought from the manufacturers.

6.8.3 Firearm attack. Special glazing systems and materials will be required for security glazing and the supplier should be consulted for an appropriate specification (see BS 5051).

6.8.4 Explosion resistance. Special materials and glazing systems are available and specialist advice should be obtained.

6.9 Fire

6.9.1 Where regulations and requirements specify materials used for glazing in terms of their fire performance designers should take careful note of the following points when using plastics glazing sheet materials.

(a) Different plastics glazing sheet materials (see 6.3.1.2) may have different properties. The basic types of plastics glazing sheet materials (see 6.3.1.2(a) to (c)) can have a surface spread-of-flame classification under BS 476 : Part 7 : 1971 between 1 and 3, according to their nature and composition.

(b) Some regulations have specific and arbitrary systems of classification of thermoplastics materials that may not correlate with the classifications given in 6.3.1.2. Under these circumstances the mandatory (i.e. legislative) requirements should be carefully followed.

(c) Where regulations have as part of their requirements reference to BS 476 : Part 4 : 1970 for non-combustibility, designers should note that thermoplastics glazing sheet materials do not meet this requirement (see also 6.9.3).

6.9.2 It is essential that fire test information be obtained from manufacturers of plastics glazing sheet material in a form and type compatible with any mandatory regulations for plastics glazing sheet materials.

6.9.3 Where plastics glazing sheet materials are specified by a designer because of other design parameters described in this code, authorization for its use may require waivers or relaxations in respect of fire performance.

Table 19. Mean sound reduction index: double glazing, both panels same thickness

Thickness	Mean estimated sound reduction index for an air space of:										
	0 mm	10 mm	20 mm	30 mm	40 mm	50 mm	75 mm	100 mm	150 mm	200 mm	250 mm
mm	dB	dB	dB	dB	dB	dB	dB	dB	dB	dB	dB
3	23	24	25	26	27	27	28	30	31	32	33
4	25	26	28	28	29	30	31	32	34	35	36
5	26	28	29	30	31	31	33	35	36	37	38
6	27	29	31	32	32	33	35	36	38	39	40
8	29	31	33	34	35	35	37	39	41	42	44
10	31	33	34	36	37	37	39	41	43	45	46
13	32	35	37	38	39	40	42	44	46	48	49

6.10 Durability. The durability, scratch and abrasion resistance of plastics glazing sheet materials will depend on their chemical nature, added constituents or surface coating. Manufacturers should be consulted on the suitability of use. The presence of unnatural atmospheric conditions where certain chemicals are present, or the use of certain chemicals for cleaning, or incorrect installation, may cause severe adverse effects to some plastics glazing sheet materials. These factors should be checked with the manufacturer before installation.

6.11 Strength to withstand uniform loading

6.11.1 General. The recommendations given in 6.11 are for flat, plane, solid plastics glazing sheet materials of uniform thickness and as classified in 6.3.1.2(a), (b) and (c). For design recommendations for other forms, e.g. patterned, reference should be made to the manufacturers (see also 6.3.1.2(d) to (g)).

6.11.2 Design considerations

6.11.2.1 These design considerations are based on the fact that the failure of a pane of plastics glazing sheet material under load is most likely to be by displacement of the pane rather than by breakage.

The procedure in 6.11.2.2 to 6.11.4 is for vertical (see 3.40) four-edge fully supported glazing.

For panes having an aspect ratio greater than 3.5 : 1, or where they are not four-edge fully supported, or are non-rectangular, the manufacturer should be consulted.

6.11.2.2 The design wind loadings, on a 3 s gust basis, for pressure and suction, should be determined from either 4.11 or CP 3 : Chapter V : Part 2.

The values given in the sets of wind loading graphs, figures 14 to 19, have been derived from trade practice proven to be satisfactory over many years experience and experimental knowledge.

The aspect ratio of a pane has an effect on the thickness required to limit deflection under uniform load. The higher the aspect ratio the greater the resistance to deflection.

In order to limit the deflection for larger panes, the manufacturer should be consulted where areas of individual panes exceed 2 m².

6.11.2.3 The thermal expansion of plastics glazing sheet materials (see 6.5.1) should be allowed for in the rebate size (see 8.3) if the absence of bowing under large increases in ambient temperature is an important aesthetic design consideration.

The recommendations on thickness for plastics glazing sheet material is related to a minimum size of edge cover (see 8.4) to prevent a pane of specified thickness from springing out under loading in normal glazing conditions.

For plastics glazing sheet materials, a minimum edge cover of 15 mm is normally recommended (see figures 14 to 16). To accommodate a smaller edge cover arising from small existing rebate depths, the designer should consider the

possible following options:

- (a) use of an increased thickness of glazing: figures 17 to 19 give thickness recommendations for 5 mm edge cover; for edge covers not stated in figures 14 to 19, the manufacturer should be consulted;
- (b) use of tight glazing by sacrificing edge clearance and accepting the possibility of bowing at elevated temperatures;
- (c) use of higher quality sealants to increase edge restraint (see 8.4);
- (d) use of mechanical fixing (see 10.7).

These options frequently arise in reglazing situations where plastics glazing sheet materials are used with existing rebates designed for glass, which are often inadequate for ideal glazing with these materials.

For glazing systems designed specifically for plastics glazing sheet materials, the use of an edge cover greater than 15 mm may allow the use of materials thinner than those derived from figures 14 to 16, but the manufacturer should always be consulted.

6.11.3 Use of wind loading graphs to determine thickness of plastics glazing sheet materials. The following procedure should be used to determine the thickness of the plastics glazing sheet materials, in conjunction with the wind loading graphs, figures 14 to 19.

NOTE. Figures 14 to 16 are used for the normally recommended edge cover of 15 mm. Figures 17 to 19 are used for a reduced edge cover of 5 mm (see 6.11.2.3).

- (a) Calculate the area of the pane, $a \times b$ and the aspect ratio, a/b , where a is the longer dimension and b is the shorter.
- (b) Select the figure appropriate to the aspect ratio and edge cover.
- (c) Determine the point where the vertical line for the required wind loading intersects with the horizontal line for the required area.
- (d) If the point of intersection coincides with a thickness line, this thickness should be used for this corresponding size of edge cover. If the point of intersection does not coincide with a thickness line, the recommended thickness for use with the corresponding size of edge cover is indicated by the line above or by the thickness indication for that area of the graph.

The minimum pane thickness for wind loading should be derived from figures 14 to 19 using the appropriate design wind speed as given in CP 3 : Chapter V : Part 2. If the pane is situated where it may be subject to accidental breakage or is intended to be of a thickness to withstand vandal attack, the thickness may need to be increased or the method of glazing modified to allow for this additional loading.

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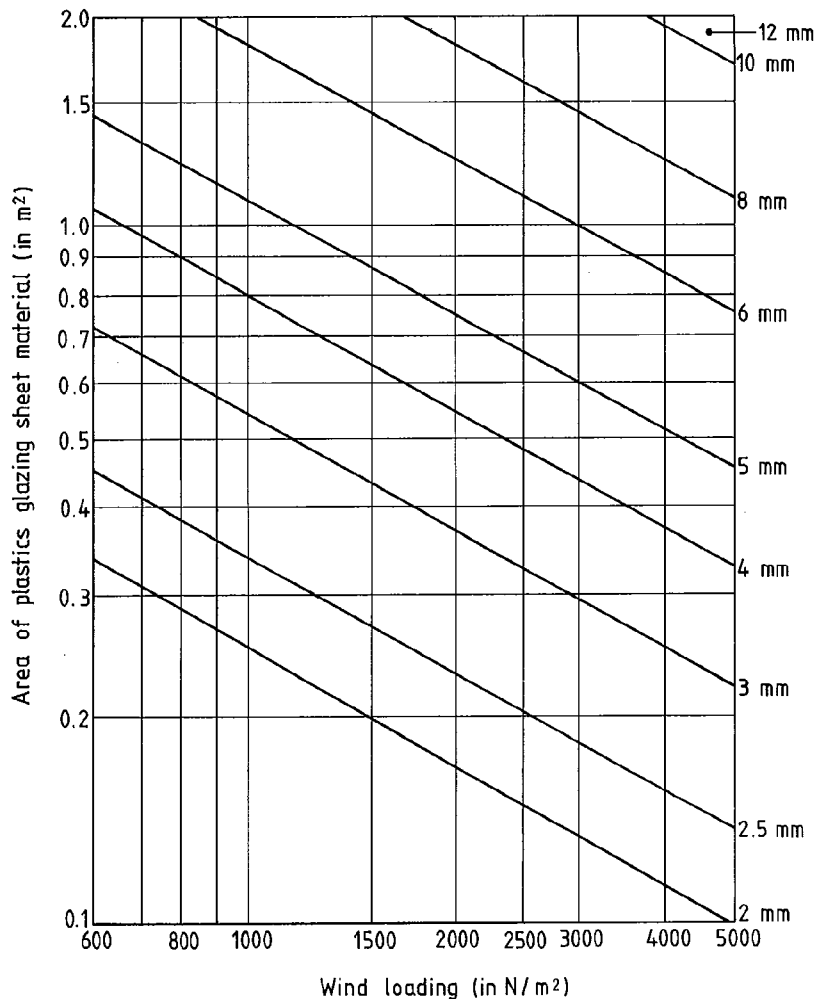


Figure 14. Wind loading graph for plastics glazing sheet materials (3 s mean wind loadings), 15 mm edge cover, aspect ratio of 1 : 1 to 1.5 : 1

6.11.4 Examples of use of wind loading graphs

6.11.4.1 Example 1. What is the thinnest plastics glazing sheet material recommended? It is required to glaze an opening 1800 mm × 900 mm to withstand a 3 s wind load of 1500 N/m² with a 15 mm edge cover.

- Calculate the area of pane (in this case 1.62 m²) and aspect ratio (in this case 2.0 : 1).
- Select figure 15 (appropriate for edge cover and aspect ratio).
- Find the point at which the horizontal line representing 1.62 m² intersects with the vertical line representing 1500 N/m².
- The point lies just below the 6 mm thickness line. The recommended thickness is therefore 6 mm.

6.11.4.2 Example 2. What is the thinnest plastics glazing sheet material recommended? It is required to glaze an opening the same as example 1 above but with a 5 mm edge cover.

- Calculate area of pane (1.62 m²) and aspect ratio (2.0 : 1).
- Select figure 18 (appropriate for edge cover and aspect ratio).
- Find the point at which the horizontal line representing 1.62 m² intersects with the vertical line representing 1500 N/m².
- The point lies between the 6 mm and 8 mm thickness lines. The recommended thickness is therefore 8 mm.

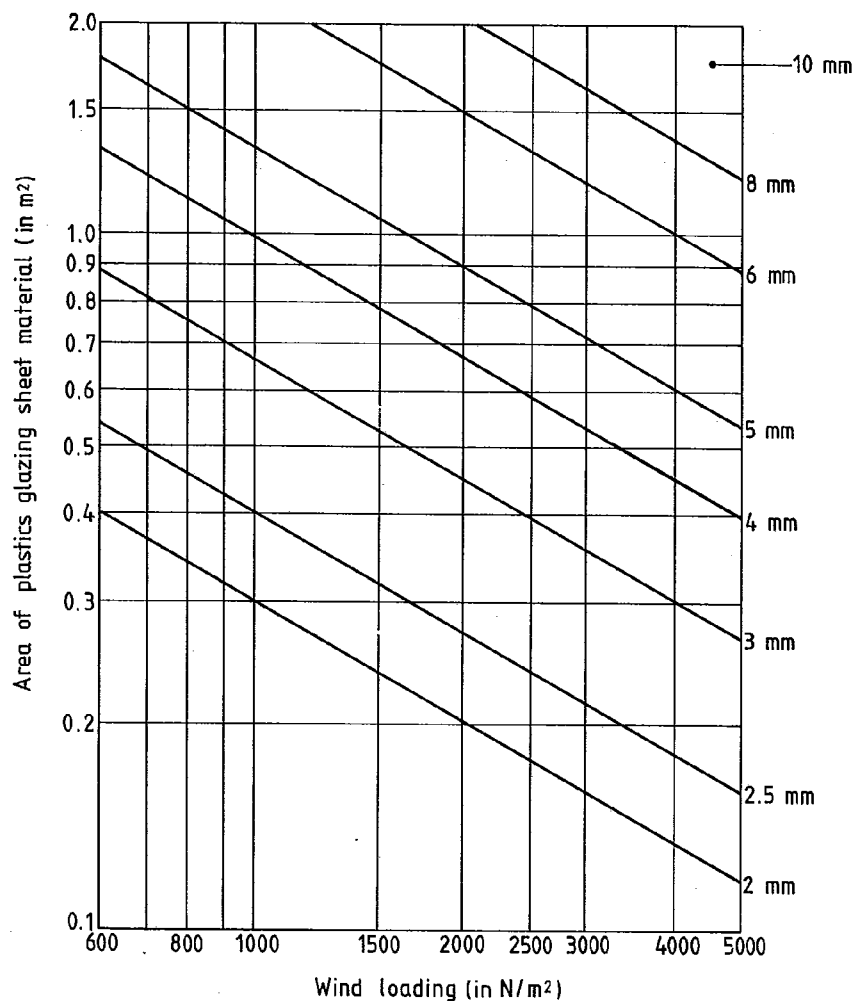


Figure 15. Wind loading graph for plastics glazing sheet materials (3 s mean wind loadings), 15 mm edge cover, aspect ratio greater than 1.5 : 1 up to and including 2.5 : 1

6.12 Cleaning and maintenance

6.12.1 General. Cleaning should normally be carried out using liquid detergents mixed with water (preferably warm). The solution should be applied liberally with a clean grit-free cloth or sponge using only light pressure. When dirt has been removed, the panel should be rinsed with clean water and wiped dry using a soft clean cloth or flannel. If a dirty window is rubbed with a dry cloth, scratching may occur.

6.12.2 Removal of foreign matter other than dirt.

Fresh paint, grease, and smeared glazing compound can be removed by using solvents. Because some cleaning solvents attack some types of plastics glazing sheet materials, it is

advisable to seek the plastics manufacturer's advice on the use of solvents and cleaning agents. A soft cloth dipped in white spirit, followed immediately by clean soapy water to prevent smearing, will remove most foreign matter. Scouring compounds and other abrasive materials should never be used.

6.12.3 Removal of scratches. Hairline scratches can be removed by gently polishing with proprietary brands of polish as recommended by the manufacturer of the plastics glazing sheet material.

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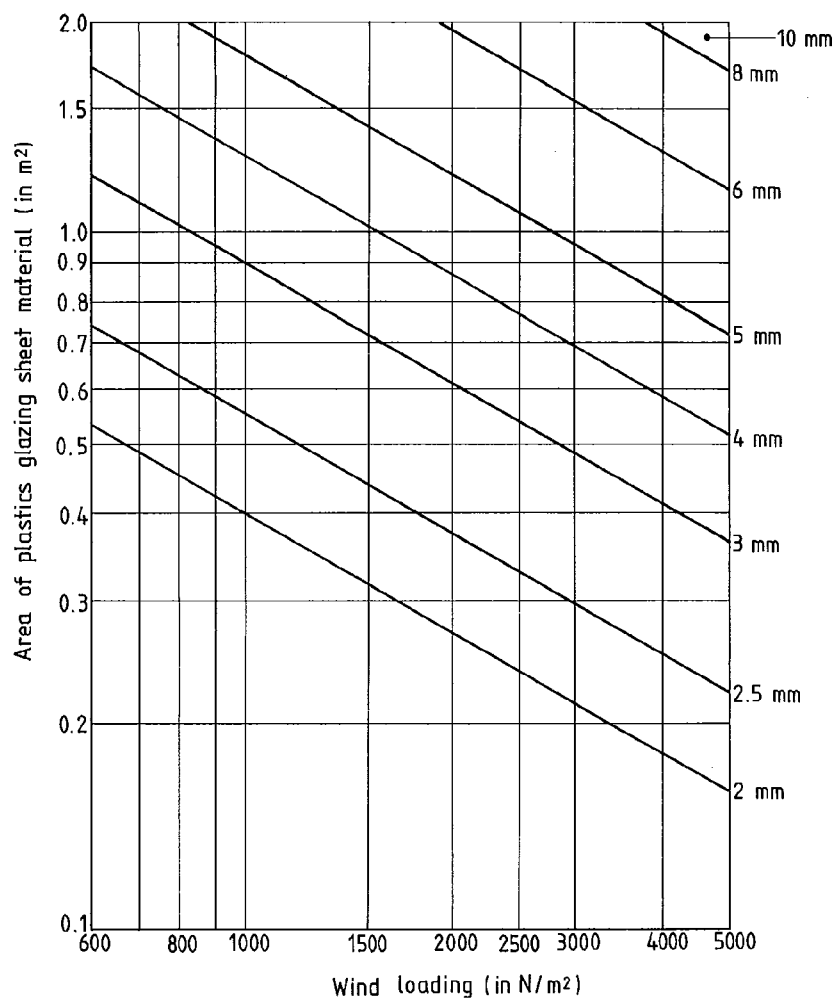


Figure 16. Wind loading graph for plastics glazing sheet materials (3 s mean wind loadings), 15 mm edge cover, aspect ratio greater than 2.5 : 1 up to and including 3.5 : 1

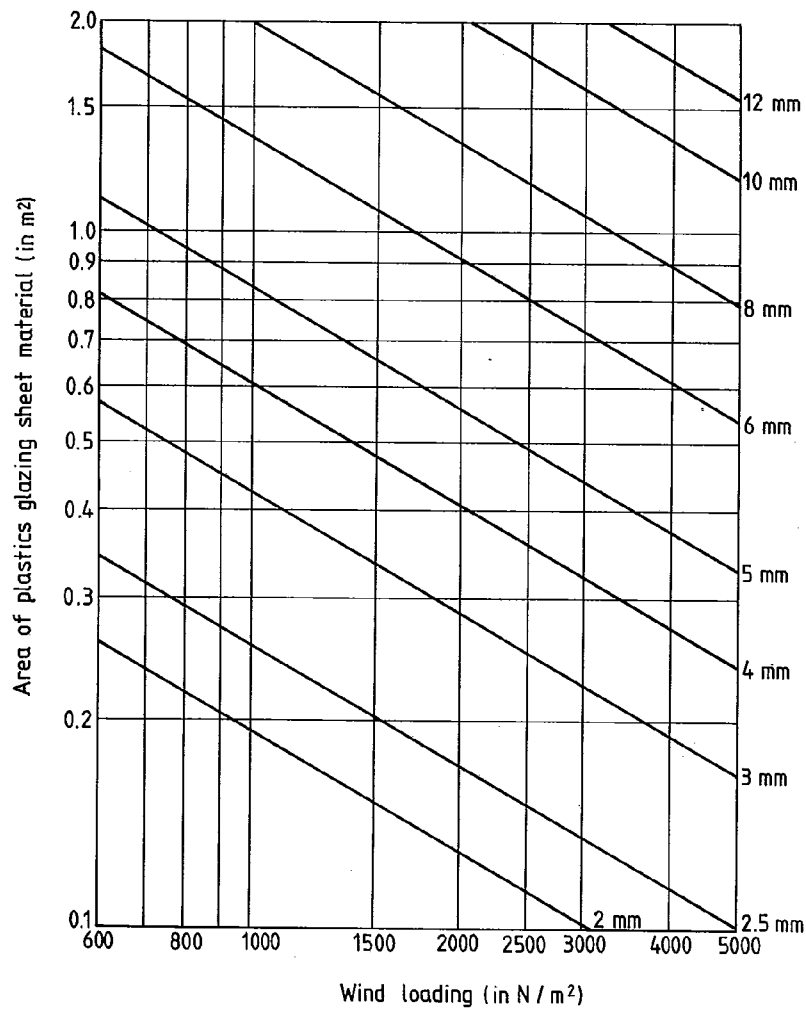


Figure 17. Wind loading graph for plastics glazing sheet materials (3 s mean wind loadings), 5 mm edge cover, aspect ratio of 1 : 1 to 1.5 : 1

BS 6262 : 1982

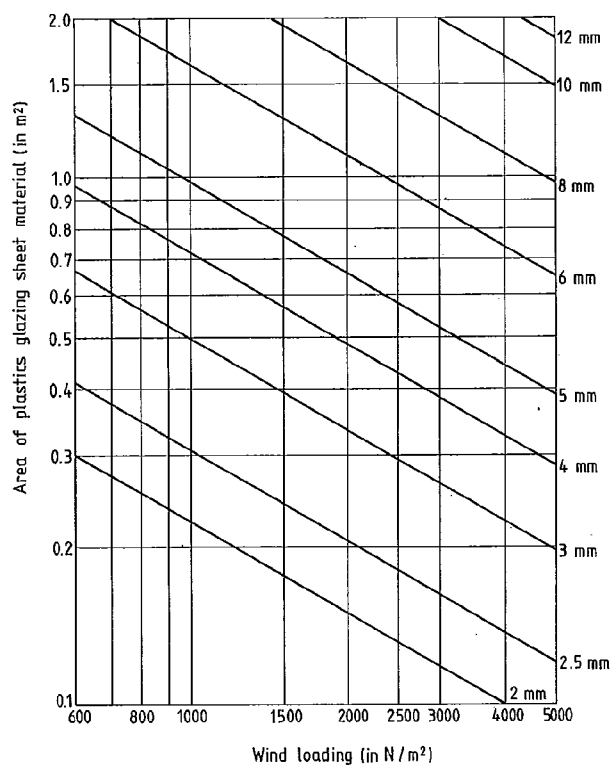


Figure 18. Wind loading graph for plastics glazing sheet materials (3 s mean wind loadings), 5 mm edge cover, aspect ratio greater than 1.5 : 1 up to and including 2.5 : 1

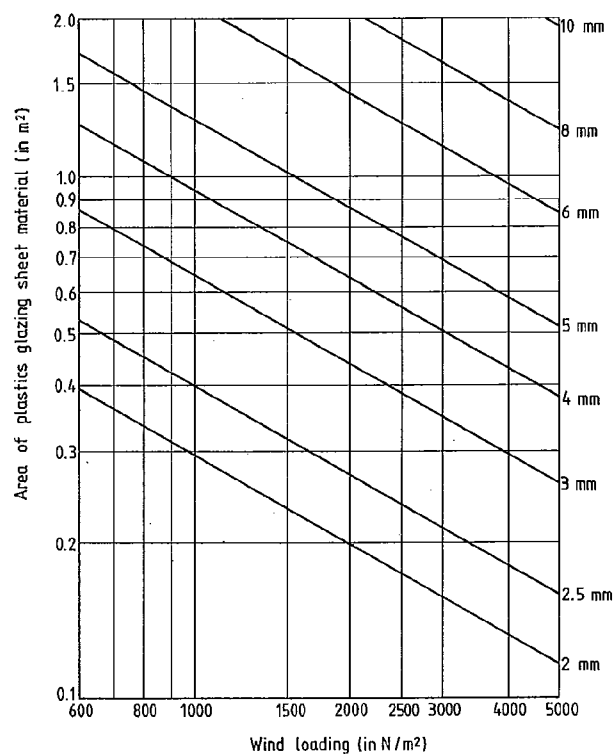


Figure 19. Wind loading graph for plastics glazing sheet materials (3 s mean wind loadings), 5 mm edge cover, aspect ratio greater than 2.5 : 1 up to and including 3.5 : 1

7. Dimensional recommendations for glazing with glass

7.1 Width of rebate or groove

7.1.1 The minimum width of rebate is governed by the thickness of glass, the glazing method and the materials used.

- (a) For glazing without beads it is the sum of:
 - (1) the width of back clearance;
 - (2) the nominal glass thickness;
 - (3) the width of the front putty, or the width required for a single sided gasket or for an internal trim.
- (b) For glazing with beads it is the sum of:
 - (1) the widths of the front and back clearances;
 - (2) the nominal glass thickness;
 - (3) the width required to provide a platform and fixing for the bead (except when the bead is fixed to the face of the surround).
- (c) For glazing into grooves, it is the sum of:
 - (1) the widths of the front and back clearances;
 - (2) the nominal glass thickness.

Where the glass has to be inserted into the groove diagonally to the plane of the groove (e.g. as in shuffle glazing), the groove width may need to be wider than indicated above to allow room to manoeuvre the glass into the groove.

(d) For very large panes (as in some shop fronts) and thick glass, allowance should be made for the wider tolerances in total thickness and flatness. The manufacturer's advice should be sought.

7.1.2 The minimum width of materials for the back and front clearances for glazing with or without beads should be as follows.

(a) *Linseed oil and metal casement putties*: 2.0 mm. Experience has shown that when bedding into these putties, they offer substantial resistance to displacement when pressed back to a thickness of nearly 2 mm. Used in this way, there is no need to incorporate distance pieces. If a thicker bedding is used it will not be load bearing and it will be necessary to use distance pieces to resist wind loading during the setting period of the putty.

(b) *Non-setting glazing compounds, plastic glazing compounds, two-part rubberizing compounds, sealants and preformed strip material*: 3.0 mm. Generally, these materials are not load bearing and distance pieces are required to ensure that there is no displacement due to wind loading.

NOTE. Some materials however are specially designed for use in a thickness of less than 3 mm.

(c) *Preformed compression-type gaskets and non-structural gaskets*: 2 mm. The back clearance depends on the design of the gasket but generally 2 mm should be allowed for or the minimum clearance that will ensure that under loading there will not be glass-to-metal contact.

7.1.3 The minimum width of materials for putty fronting without beads should be 8 mm. The fronting should be a triangular fillet angled at about 45°. Angled at less than 45° or having less than 8 mm on the glazing platform could result in deterioration of the putty and cracking, thereby needing greater attention to maintenance.

7.1.4 Tolerances in the plane of bead fixings should not allow the bead to encroach into the glazing space. This is particularly important when surrounds are assembled on site from separate bars and their rebates may be out of alignment.

7.2 Depth of rebate or groove

7.2.1 *General*. The minimum depth of rebate or groove is governed by the depth of the edge clearance and edge cover necessary according to the type, size and thickness of glass, the glazing method and materials used. The edge cover is also determined by the severity of the exposure conditions. The minimum rebate or grooved depths for different glass sizes and types to suit various wind loadings are given in 5.11.5. This subclause, therefore, deals only with the minimum dimensions of the edge clearances and edge cover that determine these depths.

7.2.2 Edge clearance. The minimum design edge clearances (i.e. based on the nominal glass cutting size) to allow glazing and to prevent direct contact between the edge of the glass and the surround should be as given in table 20.

Table 20. Minimum edge clearance for glass

Glass type	Edge clearance for a length or breadth (see notes 1 and 2) of:	
	Up to and including 2 m	Over 2 m
Float, sheet, cast, patterned and wired glass up to and including 12 mm nominal thickness	3	5
Toughened glass up to and including 12 mm nominal thickness		
Laminated glass up to and including 12 mm overall thickness		
Insulating glass units up to and including 18 mm overall thickness	5	5
Float, sheet, cast, patterned and wired glass over 12 mm nominal thickness		
Toughened glass over 12 mm nominal thickness		
Laminated glass exceeding 12 mm but not exceeding 30 mm overall thickness		
Insulating glass units exceeding 18 mm overall thickness	10	10
Laminated glass exceeding 30 mm overall thickness		

NOTE 1. Based on nominal glass cutting size.

NOTE 2. Edge clearance may need to be greater for some glazing systems, e.g. some gaskets, drained glazing.

7.2.3 Edge cover. The edge cover should be of sufficient depth to provide support for the glass against wind loading (see 5.11.2). Where this support is by means of distance pieces, the edge cover should be of a depth to allow the distance pieces to be covered by a suitable volume of compound sealant capping. For certain glass the edge cover may need to be greater:

- to give adequate protection to the edge seal of insulating glass units;
- for aesthetic reasons;
- for safety;
- for security.

7.3 Nibs for H-type structural gaskets

7.3.1 General. Dimensions of the nib should be in accordance with the gasket manufacturer's instructions and 7.3.2 and 7.3.3 are given only as an approximate guide.

7.3.2 Depth of nib. The nib should project approximately 16 mm from the surround and be of sufficient depth to allow 3 mm clearance between the outer edge of the gasket and the base of the nib.

7.3.3 Thickness of nib. Gaskets are available for nibs of thicknesses ranging from 3 mm to 25 mm and to suit various glass thicknesses. Wood nibs should be at least 6 mm thick.

7.4 Setting and location blocks

7.4.1 Setting blocks. Setting blocks are used between the bottom edge of the glass and the frame or surround to support and centralize the glass in the opening (see figure 20). They should be rot-proof, non-absorbent and load bearing, capable of maintaining the requisite edge clearance without presenting local areas of stress to the glass through being non-compressible or non-resilient. Suitable materials and lengths are given in table 21.

Table 21. Setting block materials and lengths

Material	Minimum length of each block per square metre of glass area
	mm
Sealed hard wood, e.g. teak, mahogany	10
Hammered lead (not to be used in metal frames with drained glazing systems), or extruded unplasticized PVC	25
Plasticized PVC (complying with BS 2571 softness nos. 35 to 45), or neoprene (complying with Shore A hardness nos. 80 to 90)	30

NOTE 1. The length of any block should not be less than 12 mm.

NOTE 2. The length of setting block in the case of vertically pivoted windows may need to be longer than the length prescribed in table 21.

NOTE 3. For stepped insulating glass units the minimum lengths given in table 21 should be doubled.

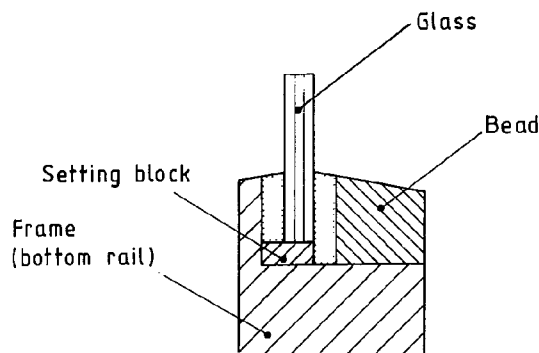


Figure 20. Setting block position

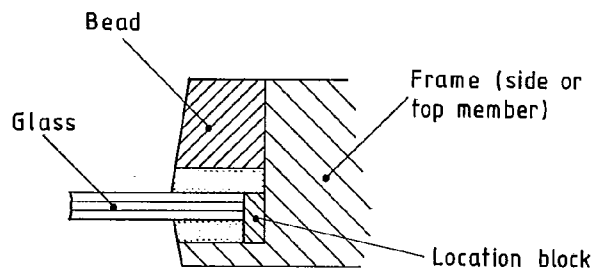


Figure 21. Location block position

The width of the blocks should be at least equal to the thickness of the glass (or insulating glass unit). To assist correct positioning, blocks are often used equal to the glass thickness plus the back clearance so that they locate against the rebate upstand.

7.4.2 Location blocks. Location blocks are used between the edges of the glass, other than at the bottom edge, to prevent movement of the glass within the frame as the window or door is opened or closed and to prevent the weight of the glass causing the frame to become out of square (see figure 21). Location blocks should be of resilient non-absorbent material, generally of plasticized PVC complying with a BS 2571 softness number of 35 to 45, and should be at least 25 mm long for all opening windows except reversible horizontally pivoted windows, in which case those on the top edge should be treated as setting blocks.

Location blocks should be of a thickness to suit the edge clearance and at least as wide as the glass thickness.

7.4.3 Position of setting and location blocks. For fixed windows, setting blocks should usually be positioned as near to the quarter points as possible. Where it is necessary to avoid undue deflection of the frame, the window manufacturer should specify the position of the setting blocks as being either:

- (a) not less than 30 mm from the corner of the glass; or
- (b) in positions to coincide with the window fixing points, if these are between 30 mm from the corner and the quarter points.

The positions of setting and location blocks should be as shown in figure 22.

7.4.4 Distance pieces. Distance pieces are used to locate the glass in the glazing rebate (see figure 23). They are necessary with non-setting glazing compounds to prevent displacement of the compound under loading and with curing type compounds to prevent displacement during the curing process. They should be of resilient, non-absorbent material, generally of plasticized PVC complying with a BS 2571 softness number of 35 to 45.

Distance pieces should be 25 mm long and of a height to suit the depth of the rebate and the method of glazing. It is important to use the correct height of distance pieces so that they can be covered by at least 3 mm of compound. Their thickness should be equal to the front and back clearances, thus retaining the glass firmly in the frame so that it cannot be displaced in service conditions.

7.4.5 Position of distance pieces. Distance pieces should be used on both sides of the glass opposite each other, except in the case of front putty glazing of flush-edged double-glazing units where they should be used only between the unit and the rebate upstand.

Where beads are fixed by screws or over studs, distance pieces should coincide with the bead fixing points.

Where beads fit into continuous grooves, the first distance piece should be at approximately 50 mm from the corner and the remainder should be located at approximately 300 mm centres or less.

A distance piece should never coincide with a setting or location block position.

8. Dimensional recommendations for glazing with plastics glazing sheet materials

8.1 Width of rebate or groove

8.1.1 The minimum width of rebate is governed by the thickness of the plastics glazing sheet material, the glazing method and the materials used.

(a) For glazing without beads it is the sum of:

- (1) the width of the back clearance;
- (2) the nominal plastics glazing sheet material thickness;
- (3) the width of the compound fronting, the width required for a single-sided gasket or the width required for an internal trim.

(b) For glazing with beads it is the sum of:

- (1) the width of the front and back clearances;
- (2) the nominal plastics glazing sheet material thickness;
- (3) the width required to provide a platform and fixing for the bead (except when the bead is fixed to the face of the surround).

(c) For glazing into grooves it is the sum of:

- (1) the widths of the front and back clearances;
- (2) the nominal plastics glazing sheet material thickness.

For shuffle glazing systems the minimum size may be as given in items (c) (1) and (2) or it may be dictated by the space needed to allow the sheet to be inserted into the groove diagonally to the plane of the groove.

For very large sheets, thick, or cold bent sheets, greater clearances may be required. The tolerance in curvature, total thickness and flatness should be taken into account and the manufacturer's guidance should be sought.

8.1.2 The minimum width of materials for glazing without beads should be

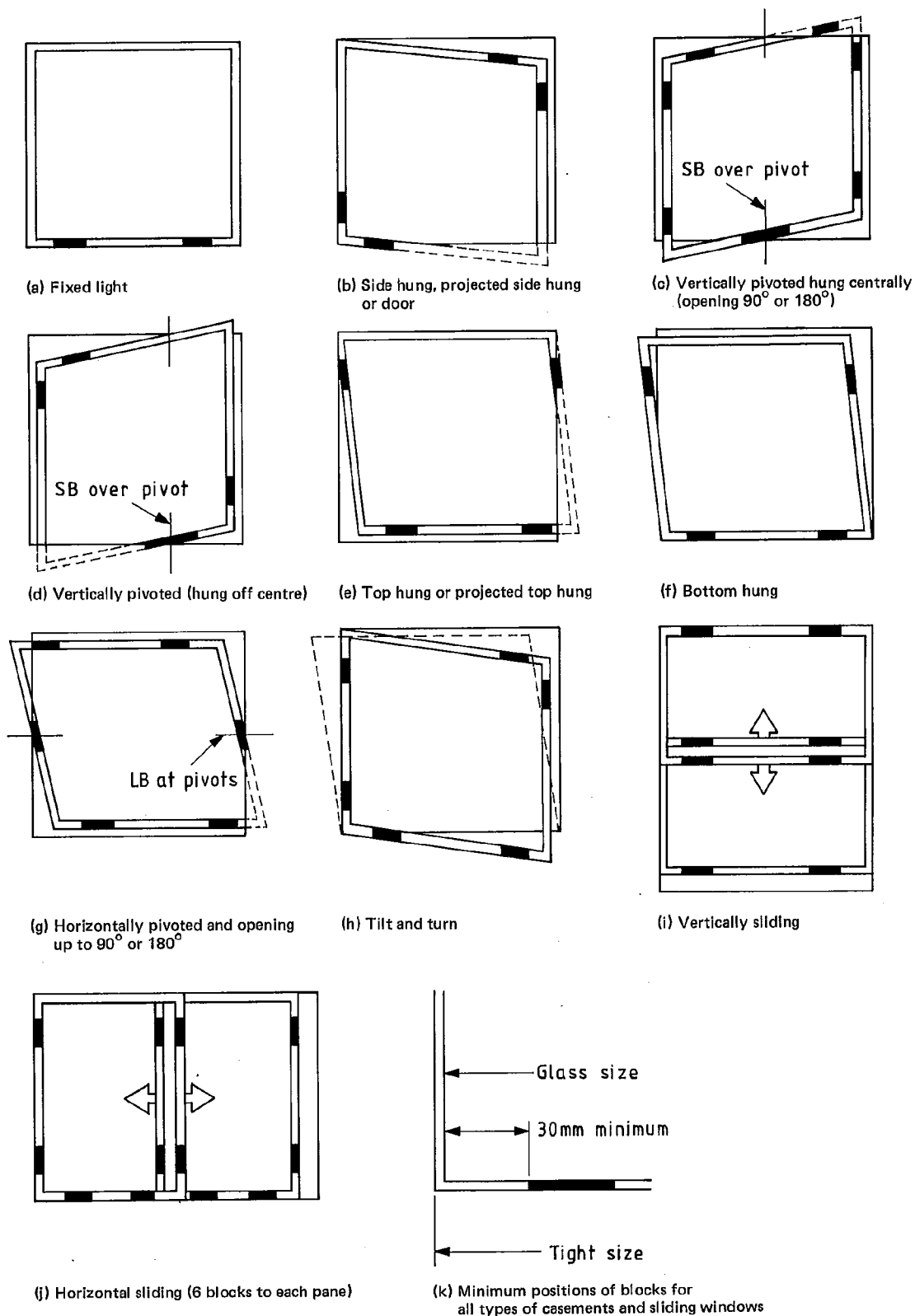
(a) *For the back clearance:*

- (1) non-setting glazing compounds: 3.0 mm;
- (2) preformed strip materials: 2.0 mm;
- (3) sealants: 1.0 mm.

(b) *For fronting:*

- (1) non-setting glazing compounds: 12 mm;
- (2) sealants not less than 6 mm: preferably such that a 45° fillet of sealant will lap at least 6 mm on to the face of the plastics glazing sheet material.

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NOTE 1. Setting blocks for fixed lights should preferably be at the quarter points, but can be positioned as shown above if necessary.

NOTE 2. For designs where the actual positions are critical, block positions should be stated by the window manufacturers.

NOTE 3. The design of sliding windows may affect the position of the blocks and the manufacturers should be consulted.

Figure 22. Recommended positions of setting and location blocks for the site glazing of some types of surrounds

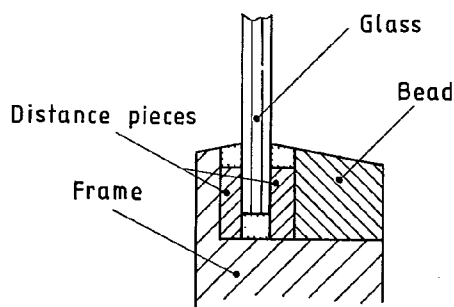


Figure 23. Distance piece position

8.1.3 The minimum width of materials for both front and back clearances for glazing with beads should be:

- (a) non-setting compounds: not less than 3.0 mm;
- (b) preformed strip materials: not less than 2.0 mm;
- (c) for sealants applied as capping: not less than 3.0 mm;
- (d) for sealants applied as bedding: not less than 2.0 mm.

8.1.4 Tolerances in the plane of the bead fixings should not allow the bead to encroach into the glazing space. This is particularly important when surrounds are assembled on site from separate bars and their rebates may be out of alignment.

8.2 Depth of rebate or groove. The minimum rebate or groove depth for different plastics glazing sheet materials will depend on the edge cover required (see 8.4) and the allowance for thermal expansion (see 10.8.2). The edge cover is also determined by the severity of the exposure conditions.

The high coefficient of thermal expansion of plastics glazing sheet materials as compared with glass may make it necessary to provide, ideally, comparatively large clearances between them and the surround. If this overall allowance is not practical, particularly under reglazing conditions, attention should be focused on the edge cover necessary for retention of the pane within the surround, and thus glazing to a tighter size can be considered, providing it is accepted that there can be the possibility of bowing of the plastics glazing sheet material under high ambient temperature conditions because the necessary allowance for thermal expansion of the pane has not been possible.

Where small panes having an edge length of not greater than 500 mm are being glazed, reference should be made to 10.9 and 10.9.3 in particular.

8.3 Edge clearance. A minimum edge clearance is required to accommodate clearances in cutting and frame tolerances to allow for the insertion of the plastics glazing sheet material into the frame. Such tolerances will normally be adequately accommodated by the allowances made for thermal expansion (see table 23). Where these allowances are reduced (see 8.2), the minimum clearance will still be essential in order to accommodate tolerances to ensure an adequate fit.

The allowances shown in table 23 are calculated for clear plastics glazing sheet materials. Where coloured or tinted sheets are used, higher temperatures in the sheets are likely to be achieved and these allowances will need to be increased. The manufacturer's guidance should be sought.

8.4 Edge cover. The edge cover should be of sufficient depth to provide support for the plastics glazing sheet material in order to prevent 'spring out' under load.

The design recommendations in 6.11 allow for the selection of different thicknesses of plastics glazing sheet material, under specified wind loading conditions, with varying edge cover requirements.

In many cases there will be no choice of edge cover. Where there can be a choice, the option for the designer would be:

- (a) a small edge cover using thicker plastics glazing sheet material and lower quality sealants; or
- (b) a large edge cover using thinner plastics glazing sheet material, but in this case higher quality sealants will be necessary; however, the use of this option may give rise to aesthetically unacceptable bowing of the plastics glazing sheet material, particularly with larger panes.

Some proprietary brands of glazing materials are capable of bonding the plastics glazing sheet material to the rebate and beading face thus allowing smaller edge cover dimensions to be used. Information on suitable sealants and their application should be obtained from sealant manufacturers. Such sealants can be employed in reglazing situations where the existing rebate depth is inadequate for the edge cover requirements for the replacement plastics glazing sheet material.

For anti-vandal glazing, heavy-duty industrial glazing or security glazing, it may be advisable to use an increased size of edge cover and the manufacturers of the plastics glazing sheet material should be consulted.

8.5 Nibs for H-type structural gaskets. The dimensions of the nib should be in accordance with the gasket manufacturer's instructions.

8.6 Setting and location blocks. Setting blocks may be used but are not essential. The normal practice is to allow the pane to rest on the sill and glaze in the conventional way. If setting blocks are used, the height of the pane should be further reduced to allow space for the blocks.

8.7 Distance pieces. Distance pieces are necessary with non-setting glazing compounds and with curing type compounds. The recommendations in 7.4.4 and 7.4.5 should be followed.

9. Glazing and fixing techniques for glass

9.1 General

9.1.1 Whilst most glass types can be fixed according to the general glazing advice given in 9.2 to 9.5, some special glasses may require special glazing systems because of the function of the glass or the glass construction. Individual manufacturers may differ in their requirements and should be consulted.

Attention is drawn to the additional requirements for:

- (a) laminated glasses (see key (8), table 22);
- (b) security glasses (see 5.8);
- (c) insulating glass units (see 9.3.2.4.2);
- (d) plastics covered annealed glass (see 5.3.1.4).

A summary of the external glazing systems and their suitability or otherwise for use with various glass types is shown in table 22.

Table 22. Summary of external glazing systems

Glass types	External glazing systems	On to nibs	Into grooves
5.3.1.2 Annealed flat glass			
5.3.1.2.1 Transparent glass			
(a) Float glass			
(1) Clear	✓	✓	✓
(2) Body tinted	—	✓	✓
(3) Surface modified tinted	—	✓	✓
(4) Surface coated	—	✓	✓
(b) Polished wired glass	1	2	2
(c) Sheet glass			
(1) Clear	✓	✓	✓
(2) Body tinted	—	✓	✓
(3) Flashed or pot coloured	—	✓	✓
5.3.1.2.2 Translucent rolled and cast glass			
(a) Patterned	✓	5	5
(b) Tinted patterned	7	5	5
(c) Wired patterned	1	1/5	1/5
(d) Rough cast	✓	✓	✓
(e) Tinted rough cast	7	✓	✓
(f) Rough cast wired	1	2	2

5.3.1.3.1.3 Processed flat glasses

5.3.1.3.1.3.1 Toughened (tempered) glass

5.3.1.3.1.1 Transparent glass

5.3.1.3.1.2 Translucent glass

5.3.1.3.1.3 Opaque glass

5.3.1.1.3 Processed flat glasses
5.3.1.1.3.1 Toughened (tempered) glass
5.3.1.1.3.1.1 Transparent glass
5.3.1.1.3.1.2 Translucent glass
5.3.1.1.3.1.3 Opaque glass
(a) Enamelled
(b) Insulating infill panels
5.3.1.1.3.2 Laminated glass
Transparent glass
Translucent glass
Anti-bandit glass
Bullet-resistant glass
5.3.1.1.3 Multiple glass units
Normal
Stepped
5.3.1.1.3.4 Surface treated glass

✓ denotes suitable for general use;

- 1 denotes not suitable for fire-resisting glazing;
- 2 denotes if fire-resisting glazing, see special recommendations for beads and surrounds;
- 3 denotes hardware may encroach into space required for the stepped unit;
- 4 denotes may not be suitable for inside glazing, depending on design of beads;
- 5 denotes may not be suitable for some patterned glasses;
- 6 denotes panel thickness and flatness tolerance may preclude its use in some designs;
- 7 denotes tinted patterned areas less than 0.2 m²;
- 8 denotes dependent on whether compound is compatible with edge seal of units or interlayers.

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9.1.2 The glazing systems described in 9.2 to 9.5 are applicable to surrounds of the following materials.

(a) *Softwood to be protected by a paint or other protective system, or durable hardwoods with appropriate protective treatments.* The nature of the timber, pretreatment and finish will influence the choice of glazing system.

(b) *Metal.* Where the term 'metal' is used in the description of glazing systems, it applies to any of the following materials:

(1) *protected mild steel*, rustproofed (older surrounds may not have been rustproofed);

(2) *stainless steel*;

(3) *aluminium alloys*, either as extruded (i.e. mill finish), or with anodized or stoved organic finishes;

(4) *bronze*, either bronze, or brass with a bronze finish.

(c) *Plastics*, most commonly, unplasticized PVC or glass-fibre reinforced polyester.

(d) *Stone, concrete and similar materials.*

9.1.3 For systems that employ beads, they may be of wood, metal or plastics. Wood beads should be secured by screws, preferably with cups, or by panel pins. Screws are desirable

2 when glazing large and/or heavy panes of glass

Metal or plastics beads may be secured by screws or be designed to fit over studs or fit into grooves in the surround.

9.1.4 The use of protective capping is normally recommended where a high performance glazing system is required, together with long life expectancy and the minimum of maintenance.

Typical applications are:

(a) the glazing of solar control panes and insulation units;

(b) metal and plastic frames;

(c) wooden frames treated with preservative stains.

In these applications, considerably more movement takes place compared to conventional glazing situations and the flexible glazing system is much more able to accept the greater degree of movement.

Suitable materials for capping are:

(1) one- and two-part silicone sealants;

(2) one- and two-part polysulphide sealants;

(3) some acrylic sealants;

(4) one- and two-part polyurethane sealants.

These highly flexible and weather resistant sealants are normally used in combination with preformed mastic or foam tapes, these being positioned at least 3 mm below the sight line of the outside upstand. An example of such a system is shown in figure 29.

Before glazing, it is advisable to obtain advice from the sealant manufacturer concerning the compatibility of the sealant and tape to be used.

9.2 Rebate preparation

9.2.1 General. Non-setting compounds require clean frames; sealants can usually be used without primers (but see 5.3.2.3) with clean, grease-free and uncontaminated frames.

If primers are required they should be applied and allowed to dry before glazing commences, but if the application of the sealant is likely to be delayed, the requirements for priming should be agreed with the manufacturer.

The manufacturer's specific recommendations for primers

and sealants should be followed. In some instances it may be necessary to mask the surrounds or other adjacent areas to prevent accidental contact of either the sealer or glazing compound, as these may be difficult to remove otherwise. In addition to the above general recommendations, which are applicable to beads and rebates acting as glass surrounds in all the glazing systems described, the recommendations in 9.2.2 to 9.2.6 for specific surround materials should also be followed.

9.2.2 Timber

9.2.2.1 Surrounds to be painted and glazed with putty (with or without beads)

9.2.2.1.1 Softwood. Painted softwood is normally supplied already primed. Where this has not been done, or the primer has deteriorated, a coat of priming paint complying with BS 5358 or equivalent should be applied to reduce the porosity of the timber surface when putty is used either with or without beads.

9.2.2.1.2 Absorbent hardwood. Absorbent hardwood to be painted should have two coats of the glazing material manufacturer's recommended sealer applied to the rebate area, be allowed to dry between coats, and glazing should be carried out using metal casement putty.

9.2.2.1.3 Non-absorbent hardwood. Non-absorbent hardwood, and softwood that has been treated with certain types of primer or preservative, should receive at least one coat of the glazing material manufacturer's recommended sealer to ensure minimum absorption, and glazing should be carried out using metal casement putty.

9.2.2.2 Surrounds and beads to be painted and glazed with non-setting compound or plastic glazing compound.

The surfaces of the rebate and bead to which the glazing compound is to be applied should be sealed with two coats of the sealer recommended by the compound manufacturer. The sealer should be allowed to dry between coatings and before glazing commences. If the frames are already primed and subject to chalking, they should be brushed vigorously to remove dust and chalky material before applying the sealer.

9.2.2.3 Surrounds and beads to be painted and glazed with sealants or rubberizing compounds. Sealants and rubberizing compounds will, in general, require the use of special primer that can normally be used as a sealer for the entire rebate without causing any problem of non-compatibility in the system. Where separate primers and sealers are recommended for the different portions of the rebate, care should be taken that they are correctly used in order to avoid interactions that may be detrimental.

9.2.2.4 Surrounds to be finished with decorative stain.

Unless the frame is correctly pretreated there are likely to be serious difficulties in glazing. Stain should be applied to all surfaces, including all sides of the bead and rebate. However, frames so treated do not provide a satisfactory base for putty. Frames should be bead glazed using a flexible compound, a strip sealant with capping or other flexible system able to accommodate the movement of the timber and maintain an effective seal.

9.2.2.5 Surrounds which are to be finished with other materials. Owing to the wide variety, both in type and formulation, of finish that may be encountered, no general advice to cover all cases can be given. In each case, specific advice should be sought from both the manufacturer of the finish and the manufacturer of the glazing material.

9.2.3 Galvanized steel. Galvanized steel normally requires no priming for metal casement putty and non-setting compounds provided the galvanizing has been passivated or weathered naturally. If the surrounds have been primed with calcium plumbate or zinc chromate, these should be checked by gentle rubbing with white spirit to ensure that they are fully hardened before glazing takes place. It is essential when using sealants that particular attention is paid to providing frames that are free from grease, moisture and other contamination. If surrounds are primed and there is doubt over adhesion or hardness of the primers, they should be completely removed from the rebate.

9.2.4 Aluminium, bronze and stainless steel. Some sealants may promote attack on some aluminium and bronze.

9.2.5 Plastics. Plastics are normally glazed with gaskets but if sealants are to be used, the glazing surfaces should receive one coat of recommended primer for the particular sealant. The primer should be allowed to dry before the sealant is applied.

9.2.6 Concrete and stone. Before glazing, any blow holes or similar damage to the rebate should be made good and allowed to dry thoroughly and harden. The rebates should be thoroughly cleaned and wire-brushed to remove contamination and laitance. Normally, one coat of primer should be applied over the entire rebate and bead to provide a seal for the other materials of the glazing system.

Some stonework is porous and staining may be caused by the glazing materials; in such instances it may be necessary to mask the areas adjacent to the glazing.

9.3 Glazing into rebates and grooves

9.3.1 General. Care should be taken to ensure the compatibility of any glazing sealant in contact with the constructional sealant of an insulating glass unit or the interlay material in laminated glass.

Water should not be allowed to collect near the edge seal of insulating glass units or the edge of laminated glass. This can be achieved either by drained glazing or solid bedding.

9.3.2 Rebates without beads

9.3.2.1 Putty (see figure 24)

9.3.2.1.1 General. The glass is bedded and fronted in putty and is secured with clips, sprigs, pegs or cleats. Putty is suitable for glazing certain glass types (see table 4) into rebates of wood and galvanized steel surrounds, for panes within the size and wind loading limits shown in figures 7 to 13.

Setting and location blocks may be required. Linseed oil putty is normally suitable for wood surrounds that are to be painted. Metal casement putty should be used for steel surrounds (excluding stainless steel), for sealed concrete surrounds, and may be necessary for some wood surrounds, depending on the species of timber and/or its protective treatment. In this latter respect the putty manufacturer's advice should be sought.

Putty glazing is suitable for outside or inside glazing on site, the former generally being preferred for aesthetic reasons. Putty should be adequately protected with paint as its continuing effectiveness depends on the paint-to-glass seal.

All putties should be finished with a light brushing in order to seal the putty to the glass. The putty should be allowed to firm for not less than 7 days before being painted.

Painting, including the finishing coat, should be carried out within the required time laid down by the putty manufacturer in order to provide the protection necessary to ensure

satisfactory weathering of the putty. Paint should be cut in approximately 2 mm above the sight line to ensure a seal between the putty and the glass. In the case of stepped insulating glass units, the paint should be cut in approximately 4 mm above the top edge of the putty (the actual sight line, being formed by the edge spacers of the unit, usually being higher).

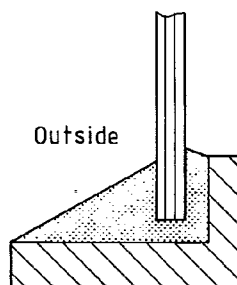


Figure 24. Glazing with putty without beads

9.3.2.1.2 Stepped insulating glass units. For stepped insulating glass units it should be noted that whilst the unit can be glazed as if it were single glass:

- (a) the smaller pane should always be to the inside;
- (b) no attempt should be made to alter the size by nipping or cutting;
- (c) setting blocks should always be used to provide a clearance between the larger pane and bottom of the rebate, and should also maintain a clearance between the smaller pane and the top of the rebate upstand;
- (d) the smaller pane should not foul fittings such as handles, hinges or locking devices and, to avoid this, it may be necessary to insert distance pieces between the larger pane and the rebate upstand;
- (e) the space between the smaller pane and the top of the rebate can be filled with the same putty as is used for the glazing; alternatively, a non-setting glazing compound with internal beads can be used;
- (f) compatibility of the putty/non-setting compound and the construction sealant of the unit should be checked.

Where the face of the smaller pane projects beyond the inside face of a metal frame, the inside putty and between the edge of the unit and the frame should be suitably finished. Where a timber frame extends beyond the unit, the inside putty should be finished with a chamfer, preferably with an internal head.

NOTE. Stepped insulating glass units can also be glazed with any of the glazing systems suitable for single glazing as long as the glazing compounds used are compatible with the unit seal.

9.3.2.2 Extruded compound and internal trim (see figure 25). An extruded compound strip is placed on to the rebate and the glass is pressed on to the compound.

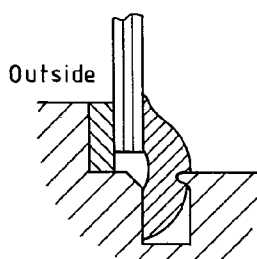


Figure 25. Glazing with extruded compound and internal trim

An internal trim, usually of extruded plasticized PVC, is inserted into a groove in the surround. Setting and location blocks may be necessary.

This system is normally used for preglazing into aluminium frames for inside glazing. The trim may not accommodate some patterned glasses but, if drained, may be suitable for insulating glass units and laminated glass.

Designs vary and size limits should therefore be obtained from the surround manufacturer.

This system of glazing is normally carried out in the factory. Where it needs to be done on site or if reglazing is necessary, the window manufacturer should provide full glazing instructions.

9.3.2.3 Single-sided gaskets (see figure 26)

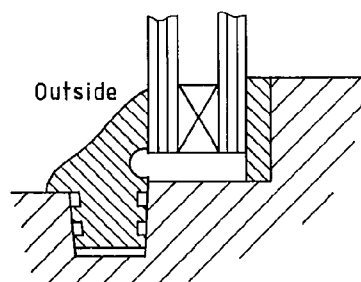


Figure 26. Glazing with single-sided gaskets

9.3.2.3.1 Description of system. An extruded cellular backing strip is placed against the rebate and the glass is held under pressure by a continuous synthetic rubber gasket forced into a groove in the surround. Setting and location blocks may be required. The system is normally used for outside glazing, either in the factory or on site. The gasket may not accommodate some patterned glasses. This system can be used in surrounds of any material in which an accurate groove can be formed. Advice on performance limitations should be obtained from the gasket manufacturers. It is good practice for the space around the glazing material to be drained and ventilated.

9.3.2.3.2 Glazing procedure. A load bearing strip material should be applied to the upstand of the rebate using butt joints at the corners.

The glass should be lifted into the frame and supported in place on conventional setting blocks.

The gasket, cut overlength, should be pushed into the groove, at the corners first and then gradually eased into the frame, working from the centre out towards the corners.

To ensure that the gasket is properly fitted, it should be forced down into the groove, since adequate sealing pressure will only be exerted if the gasket is properly located in the groove.

9.3.2.4 Metal casement putty and non-setting compound (see figure 27)

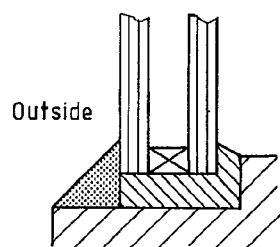


Figure 27. Glazing with putty and non-setting compound

9.3.2.4.1 General. This system is similar to that described in 9.3.2.3 except that the glass is bedded in non-setting compound, using distance pieces between the glass and rebate, and is fronted with metal casement putty.

The surround should be sealed before the non-setting compound is applied. This system is used for the site glazing of insulating glass units (within the limits shown in 5.11.5.3 and minimum rebate dimensions recommended in 7.1) into wood or metal surrounds. The putty should be adequately protected with paint as its continuing effectiveness depends on the paint-to-glass seal.

9.3.2.4.2 Flush-edged insulating glass units. The following applies to flush-edged insulating glass units only, and not to stepped units.

Putty fronting of flush-edged units is an acceptable system of glazing only where rebates are too narrow to allow bead glazing. Stepped units are a more acceptable alternative.

NOTE. Linseed oil putty should never be used for glazing flush-edged insulating glass units.

Even where rebates are too narrow to allow bead glazing, putty fronting has a limited application (see 5.11.5.3) and has the following restrictions:

- (a) the area of units so glazed should not exceed 1.5 m^2 ;
- (b) it should not be used for glazing into stain finished timber frames (or plastics frames);
- (c) its use should only be considered where the wind loading is less than 1000 N/m^2 .

As with all glazing systems, successful protection of the unit during its lifetime can only be achieved by regular inspection and proper maintenance of the glazed area; this is particularly important in maintaining the performance of putty fronting systems. It is essential that the putty should be painted within 28 days of installation. Experience has shown that failure of units with putty fronting is often attributable to not observing this recommendation.

The glazing should be inspected annually and made good where necessary. The paint protection (including the overlap on to the glass faces) should be kept in good order at all times. Complete repainting at least once every three years is considered the minimum protection of the putty by the paint, but more frequent 'spot painting' may be necessary to maintain the required standard of protection.

It is vital for the successful performance of putty fronting that all the parties involved in its choice, application and use, e.g. architect, builder, glazing contractor, householder or other client, are made aware of the important influence that inspection and maintenance can have on the system's performance.

The above comments provide general advice and guidelines. It should be noted that some manufacturers of insulating glass units will not provide a warranty for putty fronting with their products, or may not provide a full warranty where this method is used. Consultation with the unit manufacturer before specification is therefore recommended.

9.3.3 Rebates with beads

9.3.3.1 General. Regardless of the actual type of fixing employed (see 9.3.3.2 to 9.3.3.8), the following general preparatory procedures should be used.

- (a) Check all glass and rebate sizes. With solar control glasses it is particularly important that the design edge clearance should not be less than the manufacturer's recommendation.

(b) Clean and dry all rebates to remove all dust, dirt, spillage and accidental contamination. Where necessary, degrease the surfaces with a solvent compatible with both frame material and compound.

In drained glazing systems the drainage outlets should be cleaned to ensure they are not blocked. The frames should also be examined at corner joints to make sure there are no holes that could allow water to bypass the glazing system. If such holes occur they should be made good before glazing proceeds.

(c) Setting blocks should be pushed into the glazing material on the rebate platform as required (see figure 22). A smear of the material should be placed over the blocks prior to the glass being positioned. Except for small single panes not exceeding 0.2 m² in area, the glass should rest centrally on the setting blocks.

(d) Position any necessary location blocks required for opening windows and doors (see figure 22).

9.3.3.2 With hand grade non-setting or plastics glazing compounds (see figure 28)

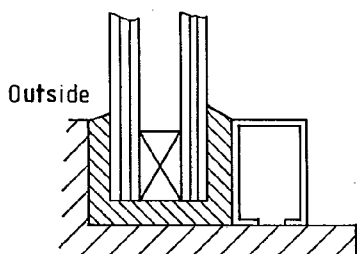


Figure 28. Glazing with beads and hand grade non-setting or plastics glazing compound

9.3.3.2.1 Description of system. This method of glazing with non-setting compounds is normally restricted to moderately exposed situations as it is dependent on the presence of correctly placed distance pieces to withstand wind pressure (see figure 22).

The method is suitable for glazing to frames with minimal movement characteristics, such as timber, metal, and possibly certain types of plastics.

Location blocks may be required. Setting blocks and distance pieces are necessary if non-setting compound is used.

The system need not be protected with paint.

Non-setting compounds are suitable for site glazing of wood or metal surrounds. This system may also be used for glazing to concrete or masonry, normally using aluminium beads.

Some materials do not readily allow for a chamfer to be formed to the glass to assist in drainage of moisture and in such cases it is necessary to provide a capping compound in which this chamfer can be formed or to seek advice on technique from the manufacturer.

9.3.3.2.2 Glazing procedure. The glazing procedure, in addition to that given in 9.3.3.1, should be as follows:

(a) Sufficient compound should be applied to the rebate so that, when the glass is pressed into the rebate, a bed of compound not less than 3 mm thick will remain between glass and rebate.

(b) Setting blocks and distance pieces should be pushed into position on the rebate platform and against the

rebate upstand respectively. Distance pieces are required on all four sides of the frame and, where possible, they should be located at the fixing points of the beads.

The glass should be offered to the surround, placed on the setting blocks, centralized, and pushed back into the glazing compound, care being taken to ensure that no voids or spaces are left. This action squeezes the surplus glazing compound out of the rebate, and should leave a back bedding of not less than 3 mm thickness, or equal to the thickness of the distance pieces, which should be held firmly between the glass and rebate. Location blocks should then be inserted as necessary.

(c) Make a further application of compound to the glass or glazing face of the bead using sufficient compound to form the bedding between bead and glass.

Further distance pieces should be located in the compound opposite to those against the rebate upstand.

(d) All beads should be bedded against the glass. Where the bead is outside, it should also be bedded with the same or a compatible compound against the rebate platform unless designed not to be so bedded (see note). A gun grade compound is recommended for bedding solid rectangular or angle beads. A substantial bedding of hand grade compound is recommended for bedding channel beads to the rebate. With channel or hollow rectangular beads, care should be taken to ensure that the ends of the beads are filled with compound.

NOTE. Some bead and rebate designs may provide a water barrier without the bead being bedded to the surround.

Where the bead is inside, it should be bedded against the glass, but it is not normally necessary to bed it to the surround.

For external beads, if water entering the stud fixing holes could lead to its penetration into the building, the thread of the studs should first be dipped in, or smeared with, a suitable sealant.

When bedding the beads to the glass, and rebate (where necessary), ensure that the distance pieces are firmly held between the glass and bead. Then fix the bead in position, securing with an adequate number of pins, screws or clips to prevent distortion.

(e) When the beads are in position, the compound should be chamfered on both sides of the glass to shed water (see also 9.3.3.2.1).

9.3.3.3 With two-part rubberizing compounds. This method is similar to that used when glazing with beads with hand grade non-setting glazing compounds (see 9.3.3.2), except that it is necessary to prime all the contact surfaces of the frame, bead and glass with a suitable primer (and allow to dry) prior to glazing, in order to obtain satisfactory adhesion to these surfaces.

Two-part compounds should be thoroughly mixed before application. The compounds should be applied in a similar manner to non-setting compounds, incorporating distance pieces, setting and location blocks at the normal spacings to ensure an adequate bed of compound around the perimeter of the glass. The compounds require 7 days to 14 days to cure.

It is advisable to trim off the majority of the compound at the time of glazing, but to leave final cleaning until the compound has cured.

9.3.3.4 With mastic strips and sealant capping

9.3.3.4.1 Description of system. This method, involving two mastic strips, one to each surface of the glass, and external capping, is suitable for glazed frames with screw-on beads or beads that can be clipped into position without disturbing the strip mastic. It is suitable for glazing in severely exposed situations and for large sizes of glass.

Where protection is required against internal conditions in addition to external ones, e.g. swimming pools, the capping should be on both sides of the glass.

These systems are suitable for outside or inside glazing on site and, depending on the materials used, may also be suitable for presite glazing.

They can be used with wood, metal, concrete, stone and similar surrounds. The frame manufacturer should be consulted regarding the use of this system with plastics surrounds. Variations of this system are the heel bead methods where a sealant is gun-applied to the rebate instead of (or in addition to) being used as an external capping. Figure 29 shows a typical system suitable for thicker glass or insulating glass units where the edge would be difficult to fill with sealant, and a foam strip has been utilized as a filling material.

A wide range of materials is available and the systems vary according to the materials selected. These include load bearing and non-load bearing mastic strips, and synthetic rubber or PVC strips or extrusions and PVC closed cell tapes, generally in conjunction with bedding compounds and/or sealants.

For insulating glass and laminated glass, the edge of the unit or glass should be bedded in a suitable compound unless provision is made to drain any moisture away from the edge. If the strips are not in compression, an external capping of sealant is necessary. It is essential that this sealant is compatible with the mastic strip. Setting and location blocks are required and distance pieces may be necessary, e.g. with non-load bearing mastic strips.

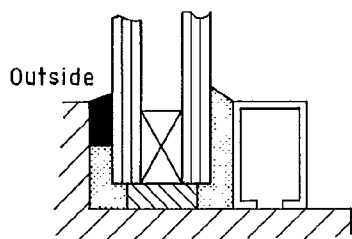


Figure 29. Glazing with beads, mastic strip and sealant capping

9.3.3.4.2 Glazing procedure. The glazing procedure, in addition to that given in 9.3.3.1, should be as follows.

(a) Inside glazing

(1) Apply the preformed load bearing mastic strip to the rebate upstand, the strip being of such a section that after compression it will be 3 mm thick and will finish approximately 6 mm below the sight line of the window or, in the case of silicone capping, not less than 3 mm. It should be applied on all four sides of the frame, taking care to ensure that the butt joints at the corners are securely formed to avoid overlapping or leaving a gap.

(2) Place setting blocks in appropriate positions on the rebate platform.

(3) Offer the glass centrally into the surround, placing it on the setting and pressing it back into position against the preformed mastic strip, compressing the strip as required.

(4) For insulating glass and laminated glass, the void around the unit should be filled with non-setting compound before applying the second preformed mastic strip to the inside face around the perimeter so that the strip, when compressed, will be 3 mm thick and to the full height of the glazing bead.

(5) Press the beads against the strips, compressing them and bedding the bead to the glass. Trim back the excess preformed mastic to provide a smooth chamfer to shed water.

(6) Clean and prime the glass surface where it is to receive the sealant capping, and allow to dry.

(7) Apply the sealant capping, filling the void between the rebate upstand and the glass, finishing to a smooth chamfer to shed water.

(b) *Outside glazing.* The procedure is similar to that for inside glazing, but the strips are reversed, thus allowing the sealant capping to be applied between the bead and the glass. In addition, the bead may need to be bedded to the frame (see 9.3.3.2(d)).

Where clip-on beads are used for inside glazing, it is possible to use a combination method, using strip and capping sealant for the exterior with a non-setting compound for the interior. Similarly, where the rebate is of a complex profile and a suitable bead is used, it is possible to glaze with an external bead using strip and capping with a bedding of non-setting compound. Distance pieces should be used with non-setting compounds. These variations are normally used in cases where the bead is unsuitable for mating with a strip form mastic, or where the bead is uneven, or has a grooved surface and cannot therefore completely receive the strip form mastic.

9.3.3.5 Heel bead systems

NOTE. These systems are usually used for inside glazing only.

9.3.3.5.1 Normal heel bead system (see figure 30).

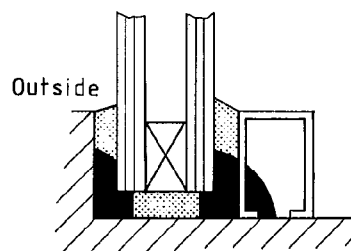


Figure 30. Glazing with normal heel bead system

The glazing procedure, in addition to that given in 9.3.3.1, should be as follows.

(a) A strip of appropriately sized load bearing mastic is applied to the rebate upstand so that when compressed the strip will be to the full height of the rebate. The degree of compression is normally controlled either by the inherent stiffness of the mastic strip or by a built-in spacer within the strip.

(b) Setting blocks are appropriately placed on the rebate platform and the glass is then bedded against the mastic strip on the setting blocks, centralized in the opening, and pressed firmly back until the strip is compressed. Care should be taken to ensure that no voids or spaces are left between the strip and the glass and between adjoining strips at corners.

(c) Location blocks should be inserted when necessary.

(d) The perimeter face of the glass should be carefully cleaned and dried to remove all contamination.

(e) After cleaning, the perimeter face of the glass should be primed, with the appropriate primer as necessary for the heel bead sealant, and allowed to dry.

(f) A generous heel bead of sealant should be applied between the edge of the glass and the surround to form a triangular fillet. The heel bead should overlap the face of the glass by not less than 3 mm, and should also provide a bedding for the bead when fixed in position. For insulating glass, closed cell foam strip can be inserted into the heel bead to fill the void around the unit completely without the need to use excessive sealant, and then a further bead of sealant should be applied.

(g) The glazing bead should be fixed into position and firmly secured to the surround forming a complete seal at the base of the glass.

(h) An internal trim of PVC, synthetic rubber or similar materials, normally wedge shaped, should be driven down between glass and the bead. The trim length should normally be cut oversize in accordance with the manufacturer's instructions. The trim is inserted first at the corners, then at the centre, and the two loops thus formed are driven in between the glass and bead, working from the centre towards the corners. By this means the section is placed in position and the slight compression will reduce the risks of gaps from shrinkage. Sections are normally inserted at the head, sill and jambs (in that order) and finally pressed home.

(j) As an alternative to the use of plastics insert strip, it is possible to use conventional distance pieces in the compound, the distance pieces being inserted after the bead has been fixed. They should be slightly oversized so that they are forced between bead and glass, applying pressure to the external glazing strip. Having driven the distance pieces into position, non-setting glazing compound is then caulked in, filling the space between glass and bead, and finished to a smooth chamfer to shed water.

9.3.3.5.2 Heel bead and capping system. This method is suitable where:

- (a) there is a radius arris to the rebate upstand;
- (b) the material of the surround has a rough surface;
- (c) additional protection is required.

The glazing procedure, in addition to that given in 9.3.3.1, should follow 9.3.3.5.1(a) to (h) with the exception that in (a) the mastic strip should finish approximately 6 mm below the sight line of the window.

The groove between glass and rebate should be carefully cleaned out, using dry brushes and compressed air to remove all dust and dirt and a cloth to remove grease. The glass and rebate should then be primed as required, or the primer on the rebate reactivated with solvent, in preparation for the sealant application.

The sealant should be applied into the groove, filling the groove and finished to a neat smooth chamfer to shed water.

9.3.3.5.3 Heel bead system using curing compounds with insert strip. This method is suitable for all exposure conditions and areas of glass, and particularly suitable for glazing into uneven rebates, such as concrete or stone, where the face glazing tolerances may be considerable. The glazing compounds used are normally curing one-part or two-part sealants or two-part rubberizing compound. These systems can be used for inside glazing where external access is delayed, as they can be allowed to cure before being trimmed on the external face. When trimming, care should be taken not to damage the frame finish.

The glazing procedure, in addition to that given in 9.3.3.1, should be as follows.

(a) The rebate should be sealed and then brushed free of loose material that may have collected since sealing. It should be primed with the primer recommended by the compound manufacturer, and allowed to dry.

(b) Sufficient glazing compound or sealant should be applied to the rebate so that when the glass is pressed into position an adequate bed of compound will remain between the glass and rebate. If the compound is of a type such that new compound does not readily adhere to cured compound, it is essential that the bed should be in excess and will extrude over the top of the rebate as the glass is bedded, i.e. overfill rather than attempt to top up.

(c) The perimeter face of the glass, which will be in contact with the glazing compound or sealant, should be cleaned and primed with the appropriate primer, as recommended by the compound manufacturer, and allowed to dry.

(d) Setting blocks should be pressed into position on the rebate platform. As this technique is normally used only with concrete surrounds, and rebates may be subject to appreciable tolerances, extra care should be taken with the selection of the blocks to ensure that the positioned glass is centralized in the opening. In cases where the glazing platform is not at right angles to the upstand, it is important to use tapered blocks to accommodate the slope and to ensure that the glass is evenly supported.

(e) Distance pieces should be bedded into the compound against the rebate upstand.

(f) The glass should be offered to the surround, placed on the setting blocks and pushed back into the glazing compound or sealant until it is bearing on the distance pieces ensuring that they are firmly held between the glass and the upstand. There should be no voids between the glass and compound or sealant. If voids are observed, additional sealant should be injected around the edge of the glass to make up the deficiency.

(g) Sealant or glazing compound should be applied to fill around the perimeter of the glass and to form a substantial heel bead between the internal face of the glass and the rebate, preferably using a gun to fill around the glass perimeter.

(h) The retainer beads should be fixed securely in position, ensuring correct spacing from the glass. Any internal cappings to the bead should then be applied.

(i) As soon as the bead is in position and firmly fixed, an internal trim of PVC or similar material, normally wedge shaped, should be driven down between the bead and the glass. It is important that this section should be cut oversize as advised by the manufacturer, the trim inserted first at the corners, then at the centre, and the two loops so formed driven in between bead and glass, working from the centre towards the corners. In this way the section is placed in position and the slight compression will reduce the risk of gaps forming in the corner. Sections should be normally inserted at the head, sill and jams (in that order) and finally pressed home using a roller tool to ensure a neat, smooth finish.

(j) When external access becomes available, excess glazing compound can be trimmed from the rebate, leaving a neat chamfer. Any further excess on the glass can be carefully removed and followed by a final cleaning. If sealant has been left below the sight line, the surfaces should be thoroughly cleaned with a suitable solvent and a further application of sealant made, ensuring filling of the void and finishing to a smooth water-shedding chamfer. The sealant should finally be smoothed off.

9.3.3.6 Compression glazing with beads (see figure 31).

Where compression is provided by beads designed to apply pressure mechanically to the glazing system, methods similar to those described in 9.3.3.4 can be used, but the external capping of sealant may be omitted, depending on the exposure conditions and the nature of the external face seal. In such cases the external face seal should be taken to the full height of the bead or rebate.

The glazing procedure is similar to that given in 9.3.3.4 except that the mastic strips should be extended to the full height of the rebate, because capping is unnecessary.

It is essential when glazing by this method that sufficient pressure is applied to the glazing strip to ensure complete bedding of the glass but prevent exudation of the strip under wind pressure.

Alternatively, gaskets may be used in conjunction with compression beads. If the gaskets have moulded corners, they should be simply fitted around the glass. Otherwise they should first be cut to size and fitted in accordance with the gasket designer's instructions. The beads should be tightened to the recommended torque.

Compression bead systems can be designed for inside or outside glazing either in preglazing or on site.

The systems are generally designed for metal surrounds.

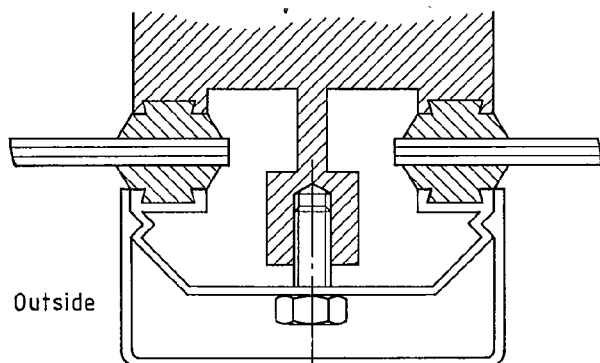


Figure 31. Compression glazing

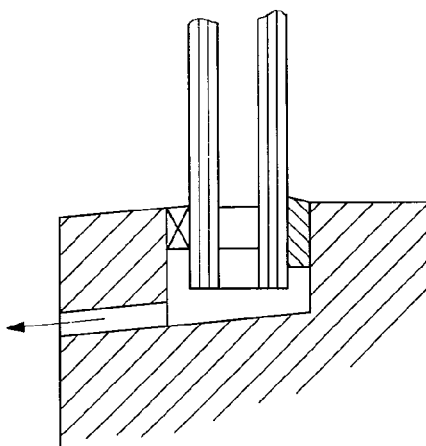
9.3.3.7 Drained and ventilated glazing (see figure 32)

9.3.3.7.1 General. As the designs of these systems vary considerably, the information and illustrations in 9.3.3.7.2 to 9.3.3.7.4 should be considered only as indicative of the principles. The glazier should obtain full instructions from the window manufacturer.

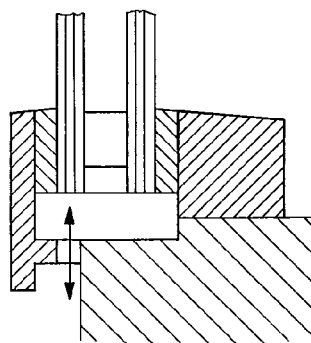
It should not be assumed that holes in frames are intended for drainage or ventilation. They may, for example, be surplus fixing holes. If in doubt, consult the window manufacturer.

9.3.3.7.2 Drained glazing systems. These systems are designed so that any water penetrating the glazing rebate is drained from that area to the outside of the building. Care should be taken to ensure that the internal sealing of the glass to the frame is complete, using high quality materials. The external treatment need only act as a means of retaining the glass in position and as protection to the edge of an insulating glass unit. In some cases the external system may be required to compress the internal seal and in most cases it is also required to limit the amount of water penetrating the glazing area.

In all cases it is essential to ensure that the frame itself is completely weathertight and that a suitable seal is used internally to ensure that, under wind pressure, water cannot be forced through to the interior of the building.



(a) Drained system



(b) Ventilated and drained system

Figure 32. Drained glazing

9.3.3.7.3 Ventilated and drained glazing systems. Where there is no compound edge filling and there is no means of providing positive drainage, e.g. there is a non-sloping platform at the sill, both seals should be effective in preventing water penetration but the cavity below the edge of an insulating glass unit or laminated glass should be ventilated to the outside to eliminate the risk of condensation in that area, or rain penetrating through slight defects in the outer seal. The ventilation slots should be at least 25 mm x 5 mm and should be positioned so as to allow drainage of most of the moisture to the outside. Perimeter clearance at the sill should be at least 5 mm, and setting blocks should be placed so as not to prevent ventilation and drainage.

9.3.3.7.4 Glazing procedure. In addition to that given in 9.3.3.1, in all cases glazing should follow the procedure laid down by the window manufacturer.

9.3.3.8 Glazing with putty (see figure 33)

9.3.3.8.1 Description of system. This method is suitable for glazing in sheltered localities and for glass areas up to 2 m². The method is only suitable for use in frames where the frame and putty can be painted and where there is minimal movement between the glass and the frame. Weather-proofing is achieved by paint and putty, the layer of putty being sufficiently thin to be load bearing.

This system is suitable for outside or inside glazing on site of clear transparent glass and patterned glasses.

The glass is bedded in metal casement putty or linseed oil putty as appropriate for the surround (see 9.3.2.4) and is secured by beads.

Beads for outside glazing should be bedded against the rebate platform. Setting and location blocks may be required.

Putty should be allowed to firm for not less than 7 days before being painted. Painting, including the finishing coat, should be carried out within the required time as laid down by the putty manufacturer in order to provide the protection necessary to ensure satisfactory weathering of the putty. The paint should be cut approximately 2 mm above the sight line to ensure a seal between putty and glass.

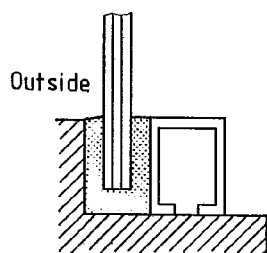


Figure 33. Glazing with beads and putty

9.3.3.8.2 Glazing procedure. The glazing procedure, in addition to that given in 9.3.3.1, should be as follows.

(a) Sufficient putty of the appropriate type should be applied to the rebate so that when the glass is pressed into the rebate a bed of compound, back putty, approximately 1.5 mm thick, will remain between glass and rebate.

(b) Setting blocks should be pushed into the putty on the rebate platform where necessary.

(c) The glass should be placed on the setting blocks and pushed well back into the putty, taking care to ensure that there are no voids or spaces. Location blocks should be inserted as necessary (see figure 25).

(d) Where the bead is outside, it should be bedded with putty against the glass and to the rebate platform. If the bead is to the inside, it is not necessary to bed the platform where the bead is to be fixed.

(e) The beads should be fixed sufficiently to ensure they do not distort.

(f) The putty should be made up to the sight line and chamfered to shed water.

(g) All putties should be finished with a light brushing in order to seal the putty to the glass.

9.3.4 Grooves

9.3.4.1 General. The surround usually has a groove at the head and jambs and a bead at the sill. Extruded seals are provided on either side of the glass.

The glazing grooves need to be of sufficient depth (at least on one side) to allow the glass to be shuffled into the groove on the opposite side.

The height of the setting blocks should be sufficient to support and locate the glass after it has been lifted into the head groove.

Location blocks cannot be inserted and the system is therefore only suitable for the glazing of fixed lights.

Regardless of the actual type of fixing employed, the following general preparatory procedures should be used:

- (a) check all glass and rebate sizes;
- (b) clean and dry all grooves and rebates to remove all dust, dirt, spillage and accidental contamination; where necessary, degrease the surfaces with a solvent compatible with both frame material and compound;
- (c) ensure any drainage holes are clear.

9.3.4.2 With extruded section (see figure 34). The system is commonly used in metal entrance screens and in shop fronts. Higher performance versions are used in curtain walling systems.

Similar systems may be used for glazing to concrete and to masonry surrounds, generally using an elastomeric glazing compound or using cellular strips and a capping of sealant.

The glazing procedure, in addition to that given in 9.3.4.1, should be as follows.

The back bedding inserts (including profiled strip gaskets) should be positioned at this stage, unless they are of the type that may be rolled into place after the glass has been put into the groove. Setting blocks appropriate to the size of glass should be put into position and the glass placed on them after observing the shuffle procedure. In cases where one bead only is used at the bottom edge, the setting blocks will require to be of suitable built-up height to support the glass after being lifted into the top groove. The beads having been fixed, the glazing inserts should be rolled into position externally and internally, if not previously positioned. If the insert strip continues around the corners it is usual to ensure that the joint occurs on the top edge.

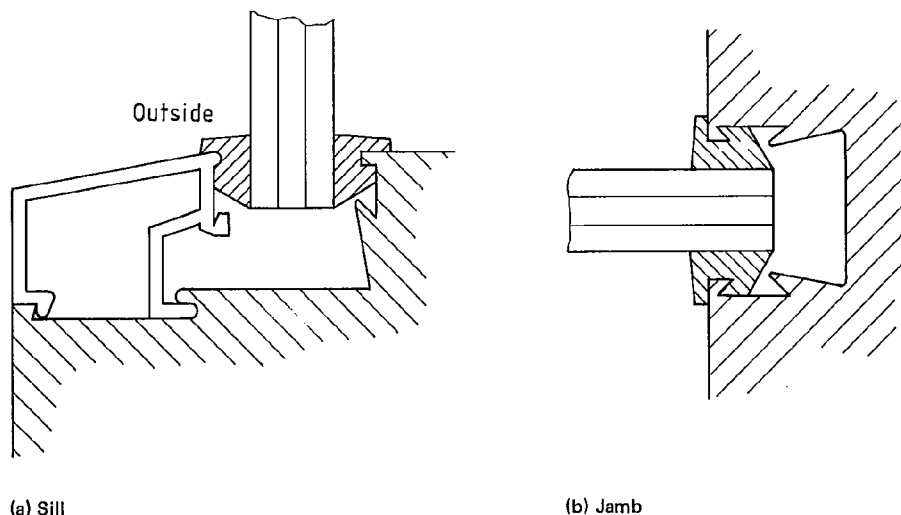


Figure 34. Glazing into grooves with extruded section

9.3.4.3 With non-setting compound. The glazing procedure, in addition to that given in 9.3.4.1, should be as follows.

- (a) Sufficient non-setting compound should be applied to the rebate upstand and on that side of the groove all round the opening, so that an adequate bedding of compound will remain when the glass is in position.
- (b) Setting blocks should be placed in position at the bottom of the frame.
- (c) The glass should be offered to the surround, placed on the setting blocks and pushed into the deep groove, so that it can then clear the inside face of the opposing side, be shuffled back into the shallow groove and centralized in the opening relative to the sight line of the window, and then be bedded back against the compound. If a deep bead is used at the sill, the glass should be lifted on to thick setting blocks, in order to obtain the necessary edge cover at the head and to ensure that the distance is correctly centralized.
- Distance pieces should be inserted into the compound against the back upstand of the rebate and the back face of the grooves. The glass should be bedded back on to the compound and pressed home until firmly in contact with the distance pieces on all four sides.
- (d) A further application of compound should be made into the grooves to fill the void around the perimeter of the glass and to provide a bedding at the internal face, and similarly applied around the glass in the beaded areas to provide a bedding for the beads. Distance pieces of sufficient thickness to fill the face clearance should be inserted into the grooves opposite the distance pieces inserted previously. Similarly, distance pieces should be placed on the surface of the glass at the bead side and the beads fixed into position. Additional compound should be knifed into place to fill the groove and voids around the glass and finally finished to a smooth chamfer inside and out.
- (e) Any masking tape should be removed immediately after the glazing has been completed and before the glazing compound forms a skin. After removal of the masking tape, the glazing line should be brushed to smooth down any torn edges produced by its removal.

9.3.4.4 With sealant capping systems. The glazing procedure, in addition to that given in 9.3.4.1, should be as follows.

- (a) If glazing into concrete or stone openings, closed cell expanded polyethylene sections should be inserted into the grooves to act as cushions, in order to prevent chipping of the edges of the glass when it is being positioned.
- (b) Setting blocks should be placed into position.
- (c) One edge of the glass should be placed into the deep groove, then shuffled back into the opposite groove and centralized in the opening.
- (d) The height of the setting blocks should be increased to centralize the glass in the opening.
- (e) Distance pieces should be inserted back and front of the glass on all four sides. Distance pieces used at the beaded surface of the glass may require to be of a different section from those used in the grooves.
- (f) The beads should be fixed to the rebates, ensuring that the beads are firmly held in position using screws.
- (g) Polyethylene cellular strip 25 % to 40 % thicker than the face clearance between the glass and surround should be inserted into the spaces between the distance pieces, leaving a groove not less than 6 mm deep to receive the sealant.
- (h) The exposed faces of the glass within the groove should be carefully cleaned.
- (i) If recommended by the sealant manufacturer, the appropriate primer should be applied to the glass faces, within the groove and up to the sight line, and allowed to dry.
- (j) The recommended sealant should be gunned on both sides of the glass and finally be pressed into position, using a suitable tool moistened with a dilute detergent solution in order to ensure that it is compacted into the groove. The sealant should be finished to a smooth chamfer to shed water. Depending upon the application, it may be necessary to use a masking tape to achieve this, as described in 9.3.4.3(e).

9.3.4.5 With channel gaskets (see figure 35). This system differs from all the others in that the glazing and surround assembly are carried out simultaneously. A channel-shaped synthetic rubber or PVC extrusion or strip is wrapped round the edge of the glass and the members forming the surround are forced on to the gasket. The system is therefore particularly applicable to the opening lights of presite glazed metal windows that can be readily removed and dismantled for reglazing, and is most commonly used in aluminium sliding windows and doors. This system is also used where the glass is not framed on all four sides.

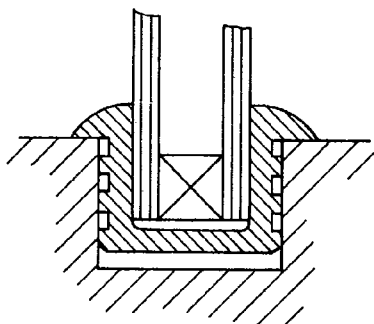


Figure 35. Glazing into grooves with channel gaskets

Channel gaskets rely on a rigid member of the frame for supplying sealing pressure. Pressure may be derived by forcing the gasket and glass into a single piece channel, or by application of a second rigid member, which when in place exerts pressure at one side of the channel.

9.3.4.6 With structural gaskets (see figure 36)

9.3.4.6.1 General. Structural gaskets not only have to provide an effective seal against the weather but also have to support the glass structurally.

Y-sectioned gaskets are designed to fit into a groove in the surround. The sealing pressure on the periphery of the glass and on the surround is derived from a 'zipper' strip of a harder synthetic rubber than that used for the main gasket. It is important that the gasket provides a continuous seal and the gaskets are, therefore, usually made with moulded right-angled corners. They can also be made to suit radiused cornered surrounds.

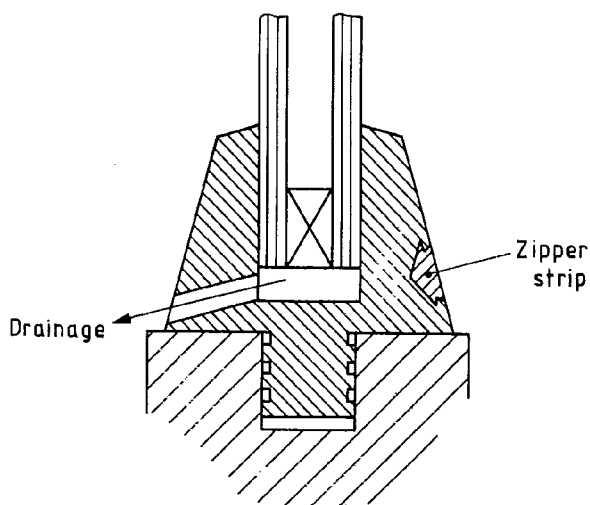


Figure 36. Glazing into grooves with structural gaskets

Glazing on site or presite glazing can be carried out from the inside or outside.

These gaskets can be used in surrounds of any material in which a suitable groove can be formed.

When glass is to be inserted into Y-section structural gaskets, the edges of the glass should be abraded or covered with self-adhesive tape to avoid the gasket being cut.

The gaskets are required to perform two tasks: they should form an effective seal against the weather and they should support the glass structurally within the frame. Factory fabricated structural gaskets are made slightly larger than the frame into which they fit; this allows them to seat correctly ready for glazing and ensures compression against the frame. When gaskets are received on site they should be laid out flat in a dry and preferably warm area for 24 h to allow them to relax before they are used.

Variation will undoubtedly occur in the actual procedure adopted for glazing with structural gaskets but the following general points, in addition to those given in 9.3.4.1, should be noted.

- (a) The gasket should first be fitted to the surround at the four corners and gradually eased on to or into the surround, working from the centres out towards the corners. This causes the gasket to be put into slight compression even before the glass is inserted. The portion of the gasket to receive the glass should be lubricated with water or liquid paraffin at this stage. The glass should be entered into the gasket about 50 mm above each of the two bottom corners and gradually into the bottom of the gasket, which can be carefully lipped over the bottom edge of the glass by inserting hardwood, plastics or similar spatulas. The glass should be kept tilted back towards the operatives at an angle of about 15°.
- (b) Spatulas should be inserted in each of the two vertical lips of the gasket and simultaneous upward progress made, at the same time gradually reducing the angle of tilt until the glass is virtually upright. Both sides of one top corner should be raised with spatulas and the glass pressed in. This procedure should be repeated on the other top corner.
- (c) Before the zipper strip is inserted, it is recommended that the glass edge clearances are equalized, inserting setting blocks of appropriate size if necessary in the bottom channel of the gasket.
- (d) The zipper groove should be lubricated thoroughly with water or liquid paraffin applied with a cloth. The zipper should be cut oversize by 50 mm to 75 mm and inserted, using a zipper tool, up to the corners and left hanging out at the ends. After a minimum period of 4 h (preferably overnight) for retraction, the corners should be cut to a mitre and pushed into position.

9.3.4.6.2 Ladder gaskets. Glazing into ladder gaskets is essentially as given in 9.3.4.6.1. Zipper strips should be continuous on the long sides of each gasket. When the second piece of glass is installed, the first transom/mullion should be fitted with a zipper. The gasket and glass should be centralized for each pane using setting blocks (where necessary) to ensure correct alignment. Before the zipper strip is inserted it is recommended that the glass edge clearances are equalized, inserting setting blocks of appropriate size if necessary in the bottom channel of the gasket.

The zipper groove should be thoroughly lubricated with water or liquid paraffin applied with a cloth. The zipper should be cut oversize by 50 mm to 75 mm, and inserted using a zipper tool up to the corners and left hanging out of the ends. After a minimum period of 4 h (preferably overnight) for retraction, the corners should be cut to a mitre and pushed into position.

9.4 Glazing over a nib with structural gaskets (see figure 37). Structural gaskets similar to those described in 9.3.4.6 but of H-section profile are designed to fit over a projecting nib in the surround. The zipper strip provides compression on the periphery of the glass and the surrounding nib. For suitability of use see 9.3.4.6.

The glazing procedure is similar to that described in 9.3.4.6 for Y-section gaskets and ladder gaskets.

9.5 Internal glazing. Many of the systems described in 9.3 may be modified if used internally as the glazing does not need to be weathertight. They merely consist of a means of providing a spacer between the glass and the surround and support for the glass against internal pressures and sometimes against body impact.

Self-adhesive glazing tapes (see 5.3.2.6), plastics or synthetic rubber gaskets or strips, or asbestos-based materials may be used.

In situations where excessive condensation may occur, e.g. in bathrooms and kitchens, the materials used should be as for external glazing.

Special recommendations for the glazing of anti-bandit and bullet resistant glass are given in 4.8.

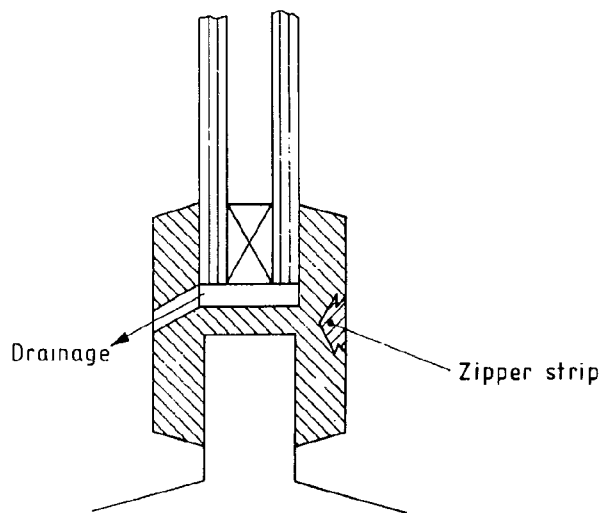


Figure 37. Glazing over a nib with structural gaskets

10. Glazing and fixing techniques for plastics glazing sheet materials

10.1 General. The properties of plastics materials are different from those of glass and it is important that the user of plastics glazing sheet materials is aware of how the

difference in properties requires certain principles to be observed, particularly when fixing.

10.2 Rebate preparation. The recommendations in 9.2 should be followed.

10.3 Glazing into rebates (without beads).

The recommendations in 9.3 should be followed.

10.4 Glazing into rebates (with beads). Glazing beads may be of metal or wood combined with a suitable sealant as described in 10.5. The sealant may be backed up with a butyl or neoprene section applied in strip form. After tooling, excess sealant should be carefully removed from the surface of the pane as quickly as possible. Sharp tools, which may scratch the plastics pane, should not be used. Typical details of the fixing method are given in figure 38.

10.5 Sealants. Silicone and polysulphide mastics have superior properties and should be used with panes having edges longer than 500 mm. For edge lengths greater than 2000 mm, silicone sealants should be used. Panes with an edge length of 500 mm or less may be sealed with butyl compounds. Some sealants require the use of a surface priming agent. The compatibility of the sealant, compound or primer with the particular plastics glazing sheet material should be established; this is of additional importance if the panes are to be cold bent.

10.6 Cutting of plastics glazing sheet materials.

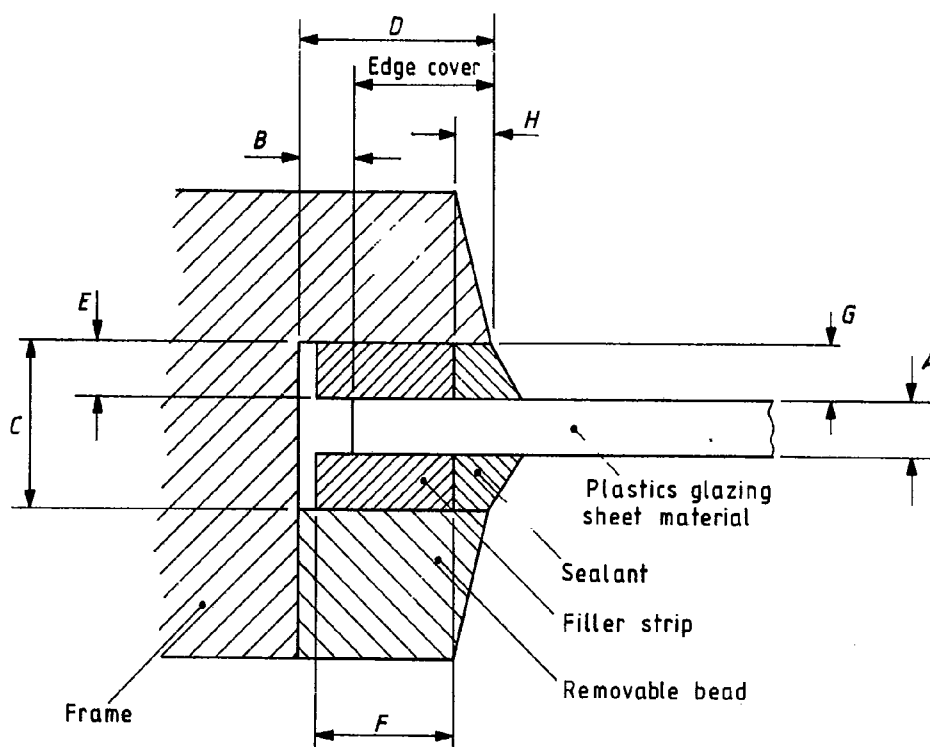
The maximum breakage resistance will be obtained if panes have smooth chip-free edges. The best results are usually obtained using circular saws or fine tooth band saws specially designed to cut plastics. Maximum breakage and impact resistance may be obtained by smoothing, chamfering or rounding the edges of the pane immediately after cutting. Information on cutting and finishing techniques should be obtained from the manufacturers of the plastics glazing sheet material.

10.7 Fixing with bolts and screws to non-plastics materials.

Because panes of plastics glazing sheet materials have to be free to expand or contract without restraint after installation, the use of tightened bolts or screws should be avoided. In some instances, bolts or screws may be used provided this is in conjunction with rubber grommets, oversize clearance holes or elongated slots cut into the pane. It is essential that the tightness of the bolts or screws is such that the pane can expand or contract freely.

10.8 Fixing large panes

10.8.1 General. Large panes of plastics glazing sheet materials are those having an edge length of 500 mm or greater. Large panes used for external glazing require detailed consideration of rigidity and the effect of wind loading to ensure the appropriate thickness of the pane. With an increased size of the pane, thermal expansion, coupled with adequate edge support, becomes more important. Panes used for internal glazing require less consideration and are dealt with in 10.10.



Key

Dimension	Designation	Notes												
A	Plastics glazing sheet material thickness	The pane thickness should be derived from requirements for deflection under load, breakage resistance and/or wind loading												
B	Edge clearance	Table 23 gives the thermal expansion allowance for horizontal and vertical dimensions												
C	Glazing space	$C = A + 2G$												
D	Rebate depth	$D = \text{edge cover} + \text{edge clearance}$												
E	Filler strip thickness	The thickness of the filler strip is determined by the recommended width of sealant G												
F	Filler strip width	The width of the filler strip should be at least 6 mm less than the rebate depth D												
G	Sealant width	Although the minimum recommended width for a sealant capping is 3 mm, a greater width should be provided for larger panes. Presuming clear plastics glazing sheet materials, the recommended widths are as follows: <table><tr><th>Maximum longest edge dimension</th><th>Sealant width</th></tr><tr><td>mm</td><td>mm</td></tr><tr><td>600</td><td>3</td></tr><tr><td>1000</td><td>5</td></tr><tr><td>2000</td><td>6</td></tr><tr><td>3000</td><td>8</td></tr></table> For coloured or opaque glazing sheet material, a greater temperature increase can be expected and therefore greater expansion. The sealant width should be modified accordingly and the manufacturer's guidance sought.	Maximum longest edge dimension	Sealant width	mm	mm	600	3	1000	5	2000	6	3000	8
Maximum longest edge dimension	Sealant width													
mm	mm													
600	3													
1000	5													
2000	6													
3000	8													
H	Sealant depth	The depth of a capping sealant should not be less than 6 mm.												

Figure 38. Typical fixing details: section through vertical frame member

10.8.2 Allowance for thermal expansion. For cutting at 18 °C to 20 °C and use in ambient temperatures up to 35 °C, to accommodate thermal movement the pane should be cut smaller than the tight rebate size by the amounts shown in table 23.

Table 23. Pane size reduction to allow for thermal expansion

Length of side	Reduction
mm	mm
Up to 1000	3
1000 to 2000	5
2000 to 3000	7

If the temperature of the material, when cut, is appreciably lower than 18 °C to 20 °C, for example if cutting on site in winter conditions or where stored in a cold warehouse, an additional allowance for thermal expansion should be made on the basis of 1 mm per 1000 mm length and width for every 12 °C of variation between the temperature of the material when cut and the maximum ambient temperature anticipated.

10.9 Fixing small panes

10.9.1 Thickness. For panes with a maximum edge length not greater than 500 mm and glazed into a wood or metal sash, the thickness of the pane may be 2.5 mm to 3 mm. Where resistance to breakage is of particular importance, as in anti-vandal glazing, the thickness may have to be increased depending on the type of plastics glazing sheet material being used.

10.9.2 Clearance. The pane should be cut 3 mm shorter than the width and the length of the sash.

10.9.3 Rebate depth. The recommended rebate depth should not be less than 12 mm. Where the proprietary brands of sealants are used this depth may be reduced. The sealant manufacturers should be consulted.

10.9.4 Glazing. Where beads are used they should be bedded and attached in the conventional way. If pins or sprigs are used, it is essential that care is taken to ensure that they do not prevent the pane from expanding. The flexible sealant thickness between the face of the pane and the rebate should be maintained at 3 mm by the use of distance pieces set at not more than 300 mm spacing. The outer fronting should be finished as in conventional glazing.

10.10 Internal glazing

10.10.1 General. Where interior applications are not subjected to large temperature variations or wind loading, thinner panes may be used and less clearance made for thermal expansion. Many indoor applications are designed to fulfil a particular function, such as high resistance to breakage. In such cases the manufacturer should be consulted.

10.10.2 Thickness. For general purpose internal glazing a pane thickness of 3 mm should be adequate if the size of the pane is not greater than 1000 mm at its longest edge. To give increased rigidity, panes with an edge length greater than 1000 mm should be increased to 5 mm thickness.

10.10.3 Clearance. Recommendations for the clearance for thermal expansion are given in 10.8.2.

10.10.4 Rebate depth. The minimum rebate depth should be 12 mm. See also 10.9.3 for reference to sealants.

10.10.5 Glazing. A sealant or gasket need not be used if a bead forms the retaining rebate. However, in order to reduce vibrations and noise, a small amount of permanently flexible sealant may be used in conjunction with the bead.

11. Handling, storage and care on site

11.1 General. Acceptable conditions for the delivery and receipt of glass and plastics, the provision of suitable storage facilities and the availability of adequate handling equipment should be arranged by mutual agreement with the main contractor, so that every care is taken to ensure the safety of personnel and the best protection for materials on site. These considerations should relate to the particular aspects of each site and not be agreed on a general basis applicable to any site condition.

11.2 Safety on site

11.2.1 Safe conditions and methods of glazing operations on sites involve statutory responsibilities that embrace the main contractor, subcontractors and persons working on sites.

All building sites are subject to statutory regulations and possibly additional local regulations. On some sites it is likely that there are specific regulations in force to facilitate safe conditions at work. Matters relating to safe methods of working should form an integral part of discussions with the main contractor, prior to the commencement of work. It is essential that any such rules and any notices displayed are strictly observed.

11.2.2 The glazing contractor should decide upon the safe system of work to be used and this should be agreed with the main contractor prior to the commencement of glazing.

11.2.3 Account should always be taken of adverse weather conditions, e.g. strong winds, ice, whenever glazing is to be done, particularly when operating above ground level. In adverse conditions the fixing and handling of glass and plastics should proceed only if it is safe to do so.

11.3 Storage and care of glass on site

11.3.1 Predelivery. Wherever possible, a predelivery survey should be carried out to ascertain where the glass will be stored. The location and facilities should be based on the following.

- (a) There should be adequate access to the site;
- (b) The storage area should be level and adequate to support the total weight to be stored.
- (c) The storage area should be sheltered and dry and the glass should be protected from dirt and accidental damage. Glass in storage should always be in shaded and ventilated areas. On no account should glass be allowed to stand on or lean against materials that may damage the edges and surfaces.

11.3.2 In transit and storage. When glass is stacked, care should be taken to prevent the accumulation of water between the sheets; this can arise because of inadequate protection in transit or unsuitable storage conditions. Moisture formed by condensation can also collect between sheets. This very thin film of water, entrapped between sheets of glass, cannot readily dry out and soon, by leaching soda from the glass, becomes alkaline and thereby attacks

the glass. The damage can be a discoloration or degradation of the surface. Since this action can take place in a period of weeks, any glass stock that shows signs of dampness should be separated and dried. The action cannot occur under normal conditions of use provided the composition of the glass is in accordance with BS 952 : Part 1.

11.3.3 During glazing. Traditional white blobs, which indicate that the opening has been glazed, and advertising emblems, stencilled on the glass by the main contractor, are not detrimental to ordinary glass provided whitening is used. On no account should alkaline materials, e.g. lime, be used as they can cause surface attack of the glass. If advertising labels are attached to the glass, the adhesive used should not attack the glass and should be easy to remove without scraping or scratching.

Any form of indicator or advertisement on heat-absorbing glass, e.g. annealed solar control glasses, should be removed during glazing otherwise local heating in the areas of blobs or labels may cause thermal breakage.

11.3.4 After glazing. Damage to glass after glazing can also be caused when attempting to remove plaster, mortar or concrete spillage. These materials should be removed when wet because once they become hard they are virtually impossible to remove without damaging the glass surface. To avoid the risk of spillage or damage from welding splatter, appropriate protective sheeting is often the only answer. Another form of damage to the surface which can appear as staining or discoloration after the glass has been glazed is caused by alkalis, from concrete or cement above the glass being released by water, which runs down the glass surface, the free alkali remaining on the glass and chemically attacking it. The problem can be avoided if the concrete members at window heads are designed so that they shed any rainwater away from the glass surface.

11.4 Handling and storage of plastics glazing sheet materials on site. Plastics glazing sheets should be stored vertically or at an angle not greater than 10° to the vertical. They should be supported to prevent sag and kept away from radiators or other heat-emitting appliances; the heat from such appliances will increase the tendency of the panels to sag and deform.

Plastics glazing sheet materials are supplied by the manufacturer protected by a masking material. Sheets masked with paper should not be exposed to rain, sunlight or excessive dry heat, or placed on rough or dirty work benches where sharp pieces of swarf may pierce the masking paper and scratch the surface of the plastics. The masking paper should be removed only after the sheet has been cut to size and all machining operations completed. It is recommended that the edges only of any cut-to-size pane are exposed by bending back the masking sufficiently to allow fixing to take place. This will provide protection to the surface of the pane from scratching and finger marking, thus reducing the cleaning operation after installation.

12. Large openings with structural glass assemblies

12.1 Glazing of display windows using glass fins

12.1.1 General. The procedures set out in clause 4 should be followed. 12.1.2 and 12.1.3 supplement the recommendations given in clauses 4, 5 and 9.

12.1.2 Design. Display windows should be designed to resist the expected design wind load (see 4.11 and 5.11), but as they may only be subjected to low wind loads the

psychological effects of possible deflections should also be assessed.

Where panes in the same plane are butt-jointed without fins they will not be so strong as a single pane of the same overall size and thickness. Their thickness should be calculated by assuming that they are two- or three-edge supported, i.e. supported by the surround only.

Depending on the span and wind exposure, glass fins of 12 mm thickness minimum may be necessary, secured to the building structure and bonded to the glazing with a suitable sealant. The adhesive sealant should therefore have sufficient bond to resist wind suction whilst allowing for movement.

The stability and robustness of the rebates and their ability to withstand the effects of wind and glass weight are particularly important in large openings.

Where frames are cantilevered they should be designed to take the weight of the glass when installed. With very large panes it may be necessary to introduce rigid frame supports below the setting block positions to support the weight of the glass. The normal studding type of stallriser framework may be inadequate for this purpose.

12.1.3 Performance of glass with fin supports. Figures 39, 40 and 41 are a guide to the selection of the thickness of glass for main panes, taking account of wind loading, and of the width and thickness of supporting fins; they are based on a design stress for the sealant of 0.3 MN/m^2 .

The recommendations of the sealant manufacturer should be followed at all times. Figures 39, 40 and 41 are applicable to installations up to 5 m in height. Above 5 m, glass suppliers should be consulted to determine the suitability of proposals.

To facilitate application of the sealant in a joint, a filler of, for example, self-adhesive polyethylene foam strip may be used. It is important to ensure a minimum sealant contact to the fin of 4.5 mm each side and the gap between panes should not be less than 3 mm (i.e. a minimum fin thickness of 12 mm).

Figure 39 shows the recommended thickness of main panes of annealed monolithic glass for fin assemblies.

The heavy diagonal lines in figure 39 represent recommended glass thicknesses for square panes. The upper limit of each shaded area shows the recommended thickness where the longer dimension of rectangular panes is three times the shorter dimension. The thickness of panes of intermediate proportions can be obtained by interpolation.

The following example illustrates the use of figures 39 to 41.

Design brief. A pane 2000 mm long x 4000 mm high has an area of 8 m^2 , an aspect ratio of 2 : 1, and a fin height of 4000 mm. The pane has to withstand a wind loading of 1000 N/m^2 .

Determination of pane thickness. For an area of 8 m^2 , to withstand a wind loading of 1000 N/m^2 , figure 39 shows that 10 mm glass is recommended.

Determination of fin thickness. In figure 40, the strength of an adhesive sealant joint depends on the width (and hence area) of the fin edge fixed to the glass it is required to support (dimension c). The minimum fin thickness is given by the diagonal line to the right of the intersection of the horizontal line representing fin height and the vertical line representing wind loading. In this example, a fin 4000 mm high to withstand a wind loading of 1000 N/m^2 requires a thickness of 19 mm.

Determination of fin width. Referring to figure 41 and knowing the height of the fin, the wind loading, the ratio between the height of the fin and the width of the glass which it is to support and the fin thickness, the width of the fin can be determined. For a fin 4000 mm high having to withstand a wind loading of 1000 N/m^2 , where the aspect ratio is 2 : 1 and a fin thickness of 19 mm, the width of the fin is found to be 250 mm (see broken lines on figure 41).

Where a glazed area, without mullions, includes right-angled returns or has butting panes with the internal angle not exceeding 135° , panes may be mitre bevelled and joined by a suitable adhesive sealant without the need for additional support, provided the size of the join is similar to that shown in figure 40. Each of the two panes meeting at the angle should also satisfy the wind loading recommendations of figure 39.

12.1.4 Fixing. Any of the glazing methods described in clause 9 employing beads or structural gaskets can be applied.

12.2 Suspended glazing with annealed glass. When glazed conventionally, glass has to support its own weight, and for very tall panes this can result in considerable stress being induced. By suspending the glass from above, such stress can be eliminated and settlement or other movement of the

main structure of a building can be accommodated.

Annealed glass can be suspended by two sets of clamps attached to the glass by a combination of a suitable adhesive and mechanical pressure, thus avoiding drilling or notching, which would considerably weaken the annealed glass.

This system of suspended glazing should be carefully designed to ensure optimum performance and it is essential that the specialist glazier is consulted at an early stage in the development.

The vertical edges of such suspended glass should be supported against wind loading. This can be achieved by a conventional mullion system provided that the glass is allowed to 'ride' in the rebates when deflection takes place, or by the use of glass fins mechanically joined to the panes. In certain conditions this may be achieved by joining with sealant, but for exposed situations, particularly where a high degree of movement may be expected, a combined glass and metal bar may be necessary.

12.3 Toughened glass suspended assemblies

12.3.1 General. The procedures set out in clause 4 should be followed. 12.3.2 and 12.3.3 supplement the recommendations given in clauses 4 and 5.

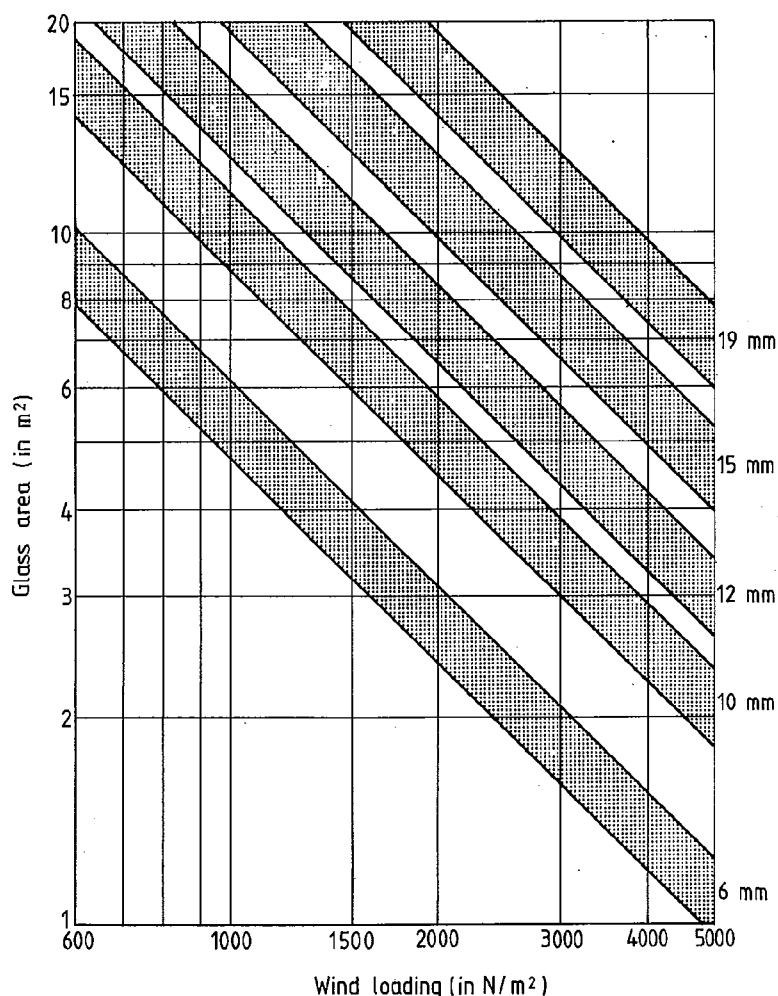
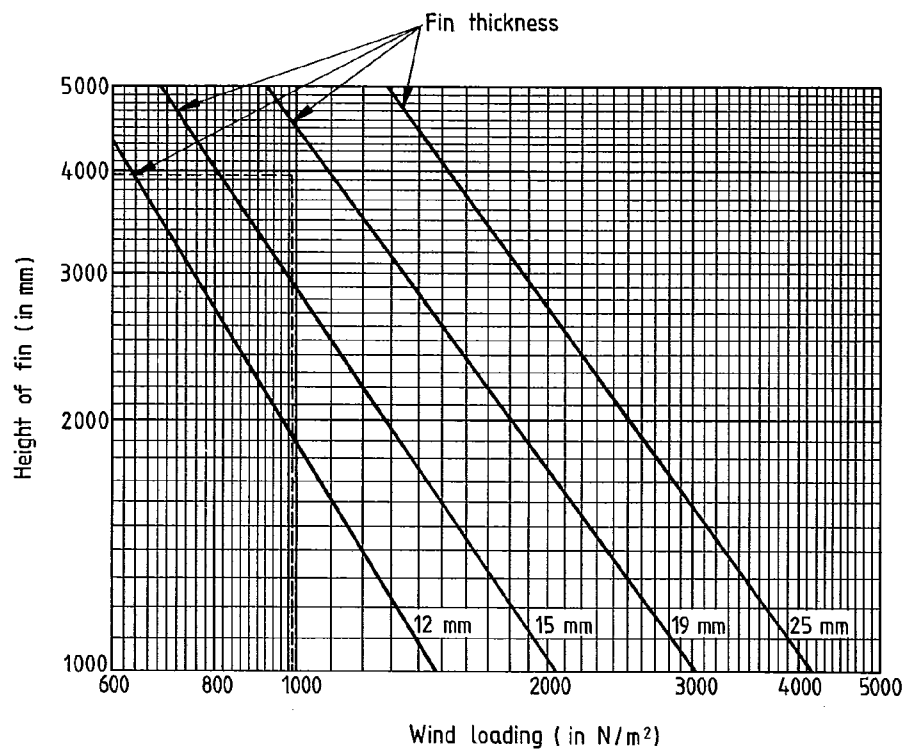


Figure 39. Wind loading on glass fin assemblies: recommended thickness for main panes of annealed monolithic glass



----- Indicates example in 12.1.3

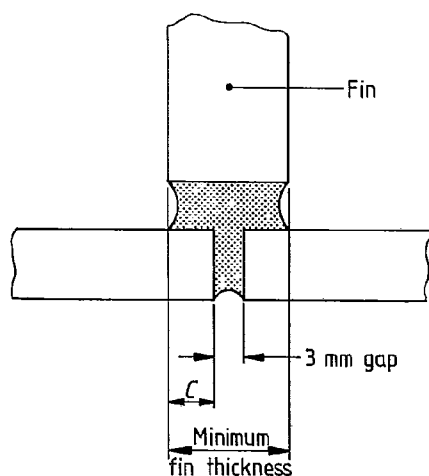


Figure 40. Determination of glass fin thickness

12.3.2 Design. Suspended glass assemblies consist of a series of toughened glass panes secured together at their corners and can be designed to provide a method of glazing large openings in buildings without the use of mullions. The facade so produced is hung from the building structure by its top edge and sealed to the building. The gaps between panes can be sealed.

Support against wind loads is provided by toughened glass fins fixed at vertical joints on the facade and are secured to the building fabric and to each pane corner fitting. The fins may be cantilevered or continuous, according to design and aesthetic considerations.

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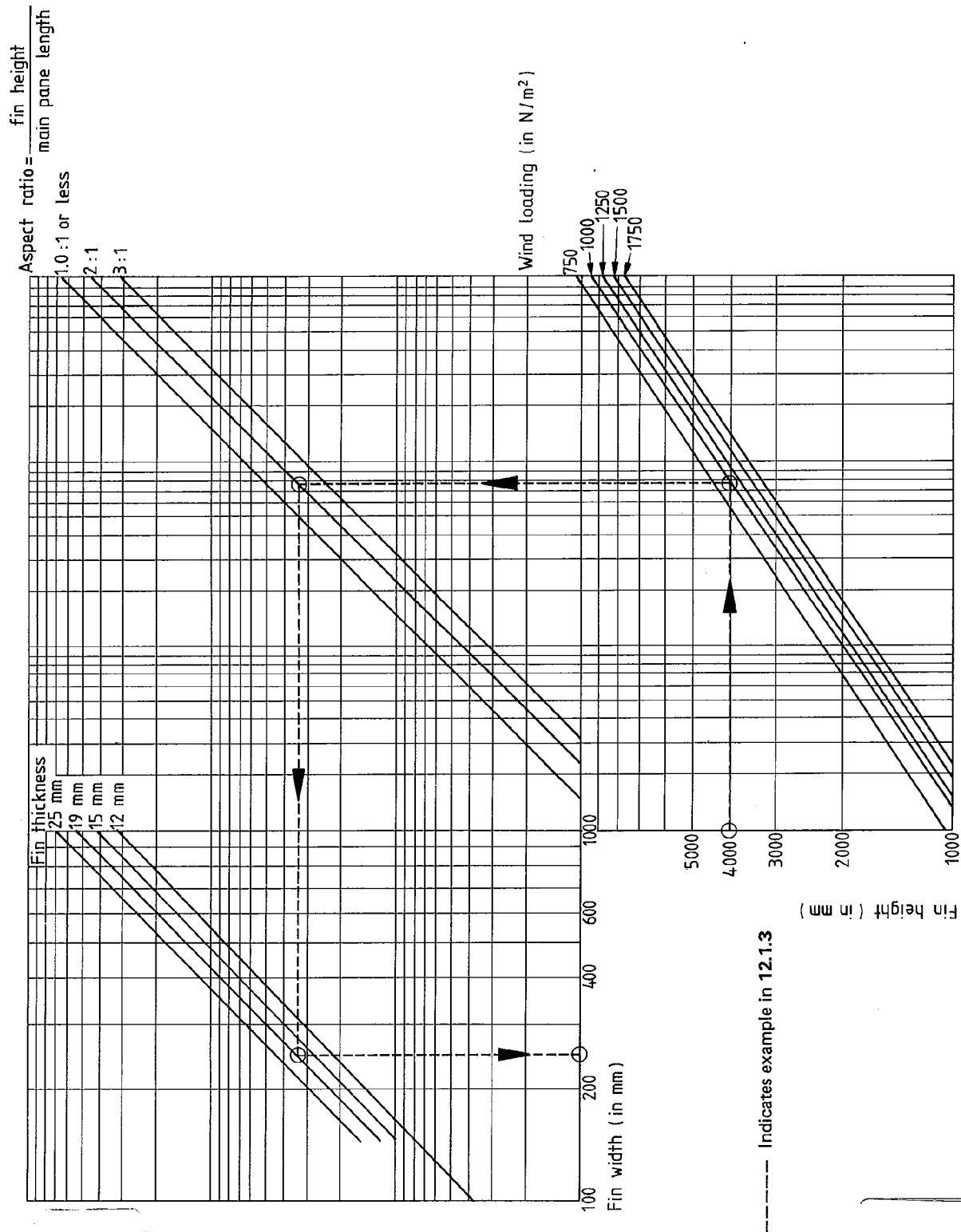


Figure 41. Determination of glass fin width

12.3.3 Performance. It is the responsibility of the architect and/or structural engineer for a project to ensure that the building structure is capable of supporting the load of the suspended glass. The glass designers need to know a number of relevant facts prior to a project study being undertaken, e.g.:

- (a) opening size;
- (b) design wind loading;
- (c) deflections.

13. Frameless doors and entrances

13.1 Toughened glass

13.1.1 General. The procedures set out in clause 4 should be followed. **13.1.2** and **13.1.3** supplement the recommendations given in clauses 5 and 9.

Toughened glass doors are usually specially designed for a particular location and the manufacturer should be consulted.

Full details of all aspects of toughened glass door installations and assemblies need to be considered at an early design stage.

13.1.2 Exterior doors. Transparent and translucent glass doors for exterior use are normally fitted with rails and/or patch fittings at the top and/or bottom edges. Matching side panels and transoms may be used to fill the entire opening in an assembly securely fixed with patch fittings and toughened glass supporting fins.

13.1.3 Interior doors. Transparent and translucent glass doors for interior use are normally fitted with patches at top and bottom corners, from which the doors are pivoted, or with hinges. Pivoted doors may be provided with matching side and transom panels as for exterior doors, thereby filling an opening in an assembly fixed with patch fittings and toughened glass supporting fins.

Hinged doors are generally provided for hanging in frames.

13.2 Frameless plastics doors

13.2.1 General. The procedures set out in clause 4 should be followed. **13.2.2** supplements the recommendations given in clauses 6 and 10.

13.2.2 Design. Frameless plastics doors may have panels fitted to the bottom edge and, where handles are not used, over the area contacted by the hand. Corners and exposed edges of doors should be rounded.

Hinges and locks should not be attached by systems that require screw threads to be tapped in the plastics sheet material. Should bolts be used, the perimeter of the clearance holes should be at least 35 mm from any edge. The bolts should not be over-tightened and the recommendations of the plastics materials manufacturer on hole drilling and bolt assembly should be followed.

14. Mirrors

14.1 Glass mirrors

14.1.1 General. Mirrors should be in accordance with BS 952 : Part 1.

14.1.2 Precautions to take when fixing mirrors

14.1.2.1 Mechanical damage. Mirrors can be distorted or even broken by being forced into clips or screwed down too tightly. Where local irregularities occur in a wall, they should be overcome by the use of compensating washers, and for large areas of irregularity the mirror should be bedded on to a minimum thickness of 5 mm of fixing compound.

It is also important, where fixing is by means of screws, that the screws are prevented from coming into contact with the glass by sleeves and washers. The holes in the glass should therefore be large enough to accommodate both sleeves and screws.

14.1.2.2 Damage by sulphur. Some building materials, e.g. clinker blocks, and certain fixing media, such as latex cement, contain sulphur. Care should be taken to ensure that the sleeve and washer materials do not contain sulphur compounds, as these can migrate through the protective mirror backing and attack the silver film. One of the most satisfactory barrier materials for this purpose is polyethylene.

14.1.2.3 Damage by alkali. Where a mirror is to be in contact with mortar, concrete or plaster, it may be liable to damage by alkali. The alkali can attack any unprotected backing paint of a mirror. Alternatively, the risk of alkali attack can be largely avoided by spacing the mirror from the wall, leaving a gap of at least 3 mm, or by applying additional backing protection, e.g. lead or aluminium foil.

14.1.2.4 Damage by excessive exposure to water. In places where a high humidity occurs, as in bathrooms or kitchens, provision should be made for the free circulation of air behind the mirror, to prevent deterioration from protracted exposure to water vapour. This can be achieved by the use of distance pieces (washers where screws are used, and packing pieces behind clips) to leave a gap of not less than 3 mm.

14.1.2.5 Miscellaneous factors. Mirrors to be fixed with mastic should be fixed with suitable mastic to avoid attack of the backing paint and the silver. The wall surface should also be sealed to prevent oil absorption from the mastic.

For all mirrors over 1 m² in area and fixed by clips or screws, additional support adequate to carry the weight of the mirror should be provided at the bottom edge by, for example, supplementary clips, anchors or a fixing bead.

14.1.3 Fixing methods. Mirrors can be fixed in any one of the following ways.

- (a) Directly to a permanently dry background, as in a living room, or to an independently fixed backboard using clips or screws with decorative covers.
- (b) With a freely ventilated airspace between the mirror and the wall, using clips or screws with spacing washers or packing pieces.
- (c) With edge beads, either to a flat surface or on battens spaced not more than 400 mm apart. The battens should be sealed and fixing compound used as a bedding.
- (d) To a backboard using an adhesive. (The manufacturer should be consulted.) To protect the backing paint, silver and adhesive from timber movement, protection should be first applied to the backboard and then the mirror fixed.
- (e) To a flat background using foam self-adhesive strips or pads applied directly to the backing paint. In all cases, the mirror manufacturers should be consulted and their instructions followed. This method of fixing should be limited to mirrors up to 1 m² in area.

14.2 Plastics mirrors

14.2.1 General. Plastics sheet mirrors are subject to dimensional changes caused by variations in moisture content or the ambient temperature.

Fixing systems should be capable of accommodating any dimensional change that may occur after installation.

Most plastics sheet mirrors are coated on the rear surface with a lacquer to protect the mirrored finish. It is important that adhesives used for attachment do not contain solvents that could damage the protective coating.

Plastics sheet mirrors are frequently used in areas where impact resistant properties are of importance or in those situations where a material is required that can be easily cut and drilled.

14.2.2 Fixing. Plastics sheet mirrors can be fixed directly to a wall or ceiling by screws. To allow for dimensional changes, screw holes should be oversize. Minimum pressure should be used when tightening screws to prevent optical distortion of the mirror.

A frame may be used to hold a mirror but it should be capable of accommodating dimensional changes.

A third method of fixing plastics sheet mirrors to walls or ceilings is by double-sided adhesive foam tape. For ceiling fixtures it is recommended that at least 30 % of the sheet area is covered by tape.

15. Information

15.1 Provision of information. Difficulties and abortive work occur when the designer's intentions are not made clear to the glazier. Ideally, there should be the fullest cooperation between the two at an early stage in the design process, but this is not always possible. Therefore, it is essential that adequate and clearly-worded information and instructions are given by the designer in the contract documentation. This clause suggests the stages at which information is needed, and the type of information that should be provided at each stage; this is outlined in the information given in 15.4, 15.5 and 15.6. The checklists are intended only as basic annotated checklists for the designer and the glazier.

The designer should consult the manufacturer to acquaint himself fully with the behaviour in service of a plastics glazing sheet material before specifying it for a glazing application to ensure that, when specified, it meets the user's requirements and the requirements of statutory regulations. The designer or specifier should provide the glazier or installer with full instructions as to the type of plastics glazing sheet material and glazing techniques, including any pretreatment. While this code describes all the work connected with glazing, all the work may not be carried out by the glazier. The designer should therefore satisfy himself that the whole of the work has been carried out satisfactorily and in accordance with the recommendations of this code.

15.2 The information stages. It is not feasible to attempt to assess the information needs over the whole range of possible contracts and circumstances. The following stages could relate to the medium project range; some modifications may be needed to suit other projects. The stages are based on the logical sequence of action given in figure 42. Ultimately, success will depend on all concerned giving the required information at the correct time. The stages are.

(a) *Tender stage*, when the glazier is to be nominated as a specialist subcontractor, or when action is to be taken under (b) (2).

(b) *Contract (order) stage*, when the main contractor either:

(1) confirms, or agrees variations to, the tender of the

nominated subcontractor; or

(2) selects the glazier by the normal tender and selection procedure; and agrees a subcontract.

(c) *Contract (glazing) stage*, when variations may occur to the subcontract works.

15.3 Specification of requirements. Subject to any special contract requirements, the information to be given at each of the stages given in 15.2 should be as follows.

(a) *Tender stage.* The information should be in the following three basic sections.

(1) *Contract conditions.* This section should define the type of contract, and give full details of any variations therefrom, as well as any special legal or other requirements.

(2) *Building site conditions.* This section should adequately describe the location of the building; its environment and exposure; the storage and other facilities to be made available on site; and any special conditions to be taken into account by the glazier (see 15.4).

(3) *Materials and labour.* This section should give a full description of the materials, systems and surrounds including their finish and workmanship. Except in the simplest of specifications, the descriptions should usually comply with the Standard Method of Measurement of Building Works*. Any items not covered in this document should be described in a similar manner (see 15.5).

(b) *Contract stages.* Information should be exchanged in accordance with standard procedure and as provided for under the terms of the contract. During this stage, the glazier may be asked to assist in the provision of information for incorporation into the Building owner's manual (see 15.6).

15.4 Building site conditions

NOTE. See 15.3(a) (2).

15.4.1 It is not feasible to attempt a detailed checklist to cover all sites and conditions. The designer should err on the generous side with information, particularly on difficult sites. In most cases it will be of benefit for the glazier to visit the site.

15.4.2 The areas of information fall into the following three parts.

(a) *Location.* Items should include the address of the site, the name and details of the contractor (if known at this stage), and the nature of any difficulty in access.

(b) *Working environment.* It is suggested that these details, such as the height of the building, exposure rating, etc., ascertained from location and elevational drawings, should accompany the other tender requirements for all except the simplest situation.

(c) *Site conditions.* The following information should be made available.

(1) *Site storage:* site storage facilities and whether these are to be external or internal; the degree of security.

(2) *Scaffolding hoisting facilities:* the type of scaffolding; any need to work from cradles, etc.

(3) *Notification of any special conditions:* details of any site restriction and conditions.

*Standard Method of Measurement of Building Works, published jointly by the Royal Institute of Chartered Surveyors, 12 Great George Street, London SW1, and the National Federation of Building Trades Employers, 82 New Cavendish Street, London W1.

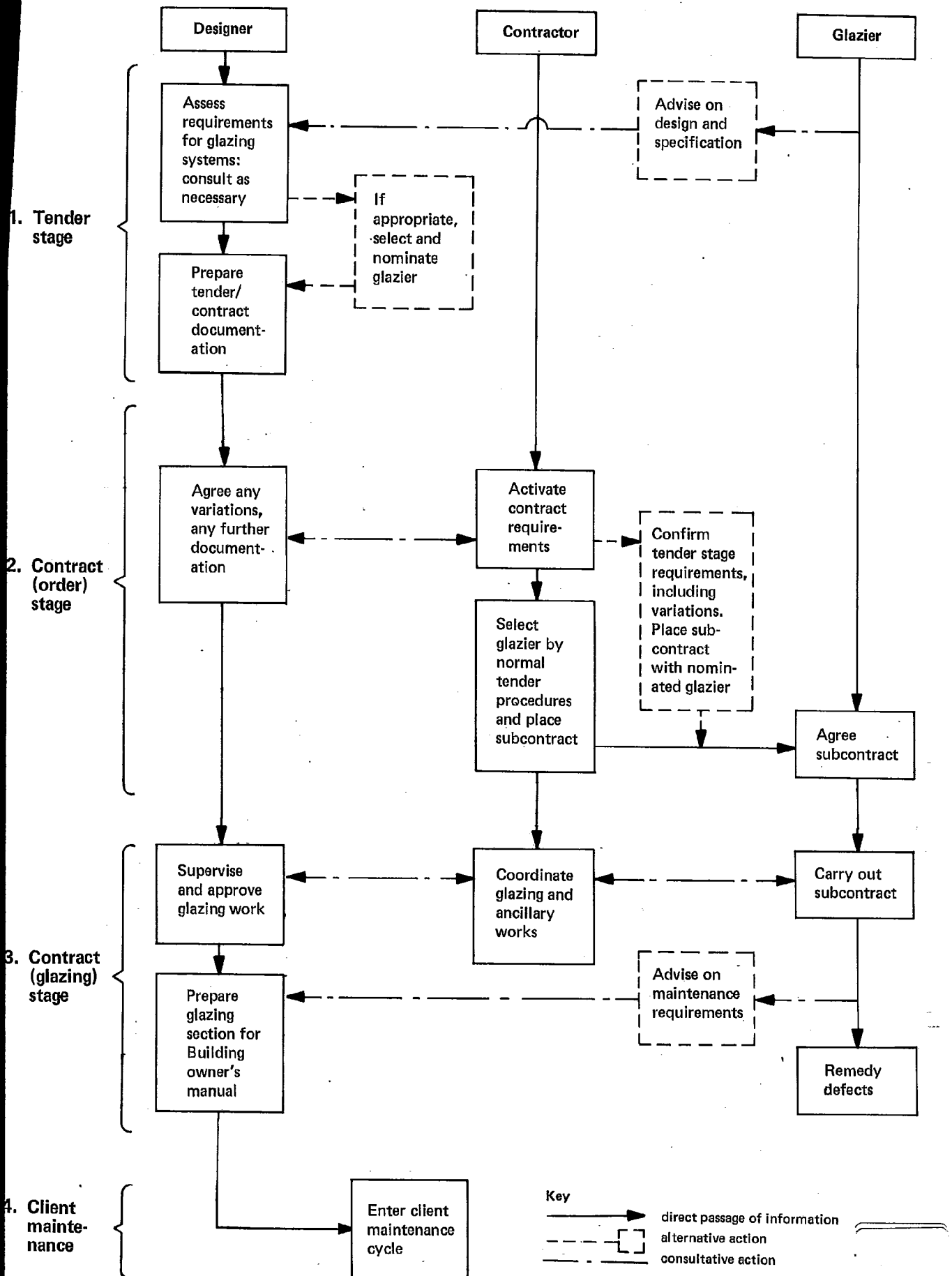


Figure 42. Information stages and workflow diagram

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15.5 Materials and processes

NOTE. See 15.3(a)(3).

15.5.1 General. Before preparing a specification, the manufacturer's literature should always be consulted and any case of doubt referred to the manufacturer.

15.5.2 Information to be given when ordering glass.

The following information should be given as appropriate.

- (a) General description and intended purposes of the work.
- (b) Description of materials
 - (1) Type, quality and substance (for glass this is described in BS 952 : Part 1), and combinations of materials: specified in accordance with manufacturer's literature, giving description and overall thickness.
 - (2) Pattern, including the direction of the pattern when the pane is installed, and any need for alignment.
 - (3) Size: give the width of the pane as installed as the first dimension.
 - (4) Quantity, of each type and size.
- (c) Special requirements
 - (1) Edge condition, to be suitable for particular application.
 - (2) Edgework: smoothing, chamfering, bevelling, etc.
 - (3) Shaping: if the shape cannot be simply described, a drawing or template should be provided.
 - (4) Holes: position and sizes; for complex patterns a rigid template should be provided.
 - (5) Decoration and surface work: describe nature and technique to be used, and size of pane. In most cases a design drawing (preferably fullsize) should be provided.
 - (6) Stepped insulating glass units: specify the size of any step and overall size of both panes.

15.5.3 Information to be given when ordering plastics glazing sheet materials. It is assumed that all glazing allowances have been made in accordance with this code and it is fully understood that the performance of most plastics glazing sheet materials can be modified by the inclusion of additives to enhance a specific property, e.g. behaviour under conditions of fire testing, impact properties, weathering.

The following information should be given to the manufacturer or supplier when ordering:

- (a) the purpose for which the plastics glazing sheet materials is required to enable the manufacturer or supplier to supply the correct type;

- (b) in specifying the size, the first dimension should be the horizontal length (often known as the width);

- (c) in specifying the size or preparing templates for shaped plastics glazing sheet materials, the face side should be specified;

- (d) in specifying the size of directional patterned panes, the direction of the pattern should be stated;

- (e) in specifying factory-made double-glazing units or thermoformed units, both the tight size and the sight size should be given.

15.5.4 Measurement. Except in a simple specification, the descriptions and measurements should conform to the Standard Method of Measurement and the Code of Measurement Practice. Items not covered in these documents should be described in a similar manner.

15.6 Building owner's manual

NOTE. See 15.3(b).

15.6.1 It is not feasible to attempt a detailed checklist for every contingency over the whole possible range of contracts and circumstances. Any full list of requirements needs to be a matter for cooperation and agreement between the designer and the glazier.

15.6.2 The areas of information fall, logically, into the following three parts.

- (a) *General information.* This should give the name, addresses, and other details of the glazier and the material suppliers, together with copies of drawings showing the glass and plastics, glazing materials and system used, reports, technical literature, catalogues, etc.
- (b) *Maintenance instructions*
 - (1) *Glass and plastics.* This should include: frequency of cleaning; techniques and materials to be used; any cautionary or advisory notes.
 - (2) *Glazing system.* This should include: frequency of regular inspections and points to look for; general maintenance techniques and materials to be used; any cautionary or advisory notes.
- (c) *Repair and replacement*
 - (1) *General.* This should detail the methods of inspection and the criteria for repair or replacement.
 - (2) *Glass and plastics and glazing system.* This should include: purchasing and replacement instructions; when specialist work rather than normal maintenance work is necessary; any advisory or cautionary notes.

Appendix A

Guidance on the application of the recommendations of this code in some commonly occurring situations

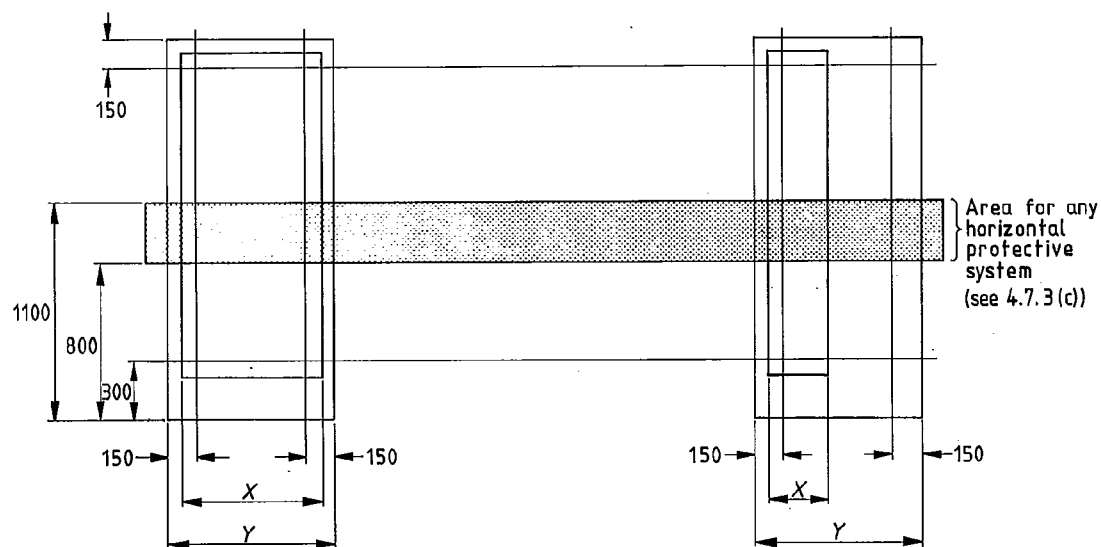
NOTE. This appendix is not part of the main body of this standard and is referred to only in the foreword.

A.1 Selection of glass and plastics for doors and side panels that can be mistaken for doors. Figure 43 indicates the application of 4.7, 5.7 and 6.7 in some commonly occurring designs of glazed doors and side panels. This figure is only for general guidance and indicates minimum recommend-

ations. It is essential for the designer/specifier to consider all aspects of any particular case (see 4.7.1).

A.2 Glass or plastics wholly or partially within 800 mm of the floor. Figure 44 gives visual guidance on the application of 4.7, 5.7 and 6.7 in respect of glazing within 800 mm of the floor. This figure is only for general guidance and indicates minimum recommendations. It is essential for the designer/specifier to consider all aspects of any particular case (see 4.7.1).

BS 6262 : 1982



Either:

(a) glass or plastics complying with class B of BS 6206 should be used if Y is greater than or equal to 900 mm; or

(b) glass or plastics complying with class C of BS 6206 should be used if Y is less than 900 mm;

unless, either:

(1) X is less than 300 mm, or

(2) Y is any dimension and X is greater than 300 mm and the glazing is protected as recommended in 4.7.2(b)(1)(iv) and 4.7.3, in which case annealed glass of the thickness given in table 11 should be used (with a minimum nominal thickness of 6 mm), or plastics as recommended in 6.7.

Either:

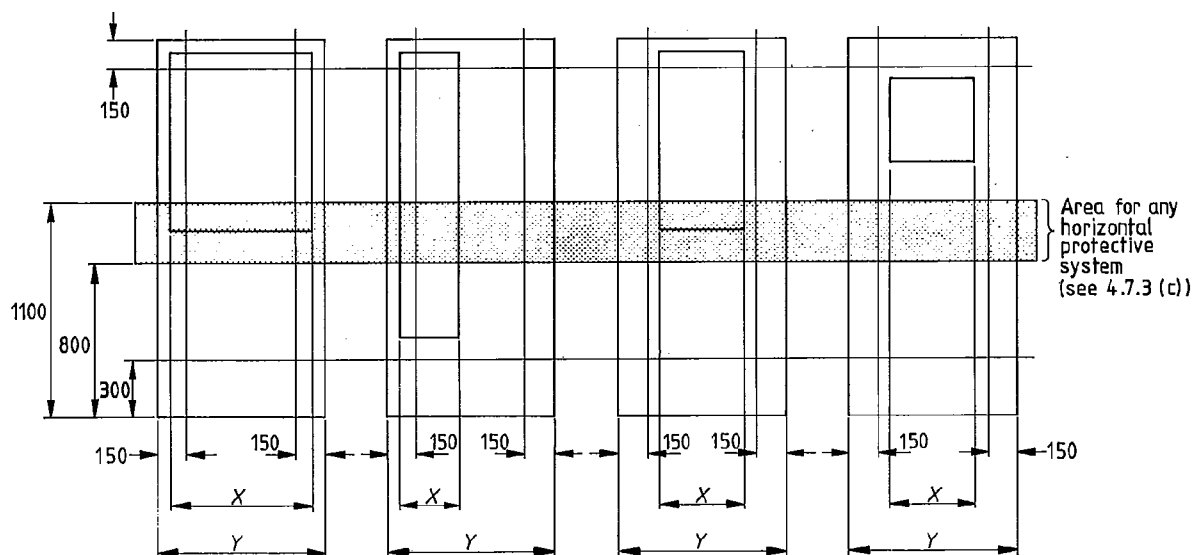
(a) glass or plastics complying with class B of BS 6206 should be used if Y is greater than or equal to 900 mm and X is greater than 300 mm; or

(b) glass or plastics complying with class C of BS 6206 should be used if Y is less than 900 mm and X is greater than 300 mm;

unless, either:

(1) Y is any dimension and X is less than 300 mm, or

(2) Y is any dimension and X is greater than 300 mm and the glazing is protected as recommended in 4.7.2(b)(1)(iv) and 4.7.3, in which case annealed glass of the thickness given in table 11 should be used (with a minimum nominal thickness of 6 mm), or plastics as recommended in 6.7.



Y is the width of the glazed door or side panel and X is the width of the glazed area.

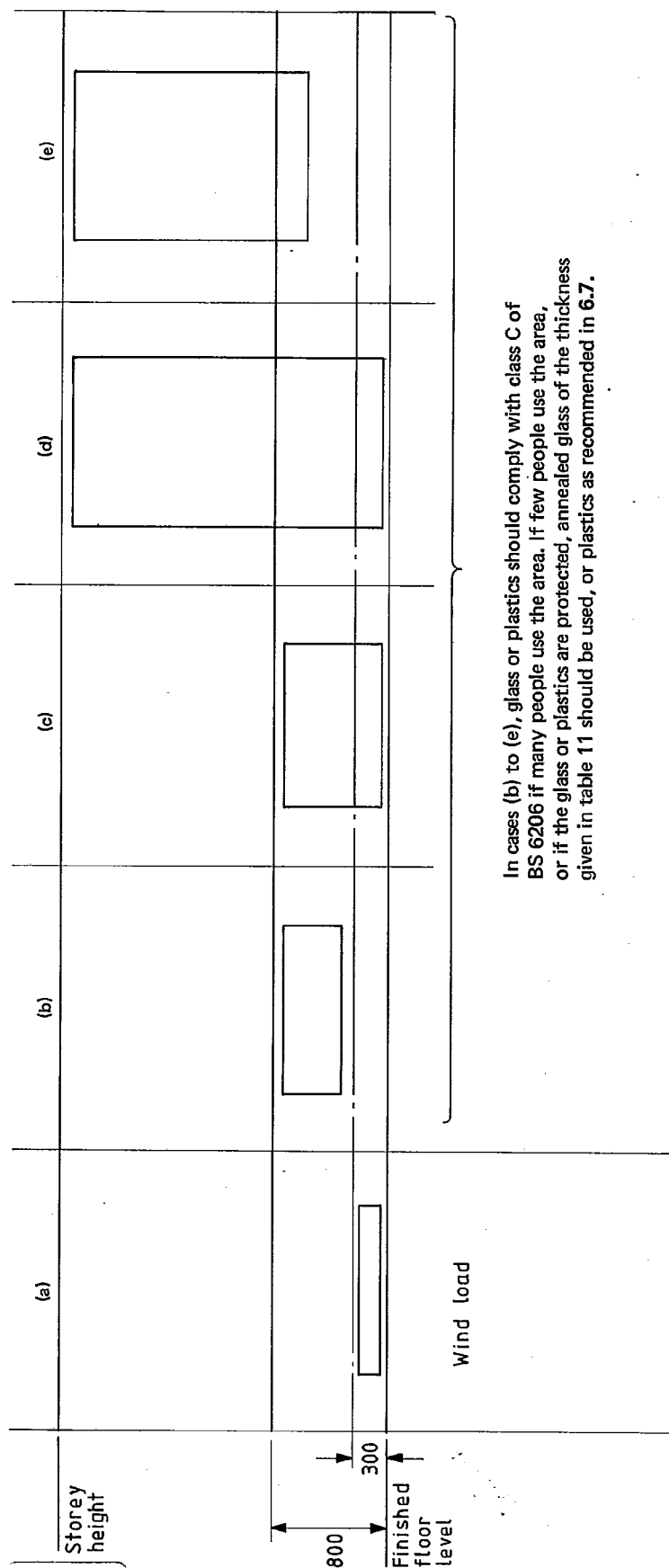
If Y is any dimension and X is any dimension, annealed glass of the thickness given in table 11 should be used (with a minimum nominal thickness of 6 mm), or plastics as recommended in 6.7,

unless

the area of the door or panel is less than 0.02 m^2 , in which case annealed glass of the thickness given in table 11 should be used (with a minimum nominal thickness of 4 mm), or plastics as recommended in 6.7.

All dimensions are in millimetres.

Figure 43. Framed glazed doors or side panels



In cases (b) to (e), glass or plastics should comply with class C of BS 6206 if many people use the area. If few people use the area, or if the glass or plastics are protected, annealed glass of the thickness given in table 11 should be used, or plastics as recommended in 6.7.

NOTE 1. For situations other than those shown in (a) to (e), the specifier should consider the type of glazing most appropriate for the purpose.

NOTE 2. Where a pane of glass or plastics extends from one storey height to another (e.g. past the edge of a floor slab), it should be considered in relation to both floors and the most onerous requirements should be satisfied.

All dimensions in millimetres.

Figure 44. Glass or plastics wholly or partially within 800 mm of floor (excluding doors and side panels)

Standards publications referred to

BS 476	Fire tests on building materials and structures Part 4 : 1970 Non-combustibility test for materials Part 6 : 1968 Fire propagation test for materials Part 7 : 1971 Surface spread of flame tests for materials Part 8 : 1972 Test methods and criteria for the fire resistance of elements of building construction
BS 544	Linseed oil putty for use in wooden frames
BS 952	Glass for glazing Part 1 Classification Part 2 Terminology for work on glass
BS 2521 & 2523	Lead-based priming paints
BS 2571	Flexible PVC compounds
BS 2750	Methods of measurement of sound insulation in buildings and of building elements
BS 2782	Methods of testing plastics Method 102C : 1970 Softening point of thermoplastic moulding material (bending test) Method 508A : 1970 Rate of burning
BS 4254	Two-part polysulphide-based sealants for the building industry
BS 4255	Preformed rubber gaskets for weather exclusion from buildings Part 1 Non-cellular gaskets Part 2 Cellular gaskets
BS 5051	Security glazing Part 1 Bullet-resistant glazing for interior use Part 2 Specification for bullet-resistant glazing for exterior use
BS 5357	Code of practice for the installation of security glazing
BS 5358	Specification for low-lead solvent-thinned priming paint for woodwork
BS 5502	Code of practice for the design of buildings and structures for agriculture
BS 5516	Code of practice for patent glazing
BS 5544	Specification for anti-bandit glazing (glazing resistant to manual attack)
BS 6180	Code of practice for protective barriers in and about buildings
BS 6206	Specification for impact performance requirements for flat safety glass and safety plastics for use in buildings
CP 3	Code of basic data for the design of buildings Chapter I Lighting
	Chapter I : Part 2 Artificial lighting
	Chapter III Sound insulation and noise reduction
	*Chapter IV Precautions against fire
	Chapter V Loading
	Chapter V : Part 2 Wind loads
CP 153	Windows and rooflights Part 2 Durability and maintenance Part 3 Sound insulation Part 4 Fire hazards associated with glazing in buildings
DD 67	Basic data for the design of buildings: sunlight
DD 73	Basic data for the design of buildings: daylight

* In course of revision. Will be superseded by BS 5588.

This British Standard, having been prepared under the direction of the Elements and Components (of Diverse Materials) for Buildings Standards Committee, was published under the authority of the Board of BSI and comes into effect on 30 June 1982.

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- Brick Development Association
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- *British Woodworking Federation
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- Department of the Environment (Building Research Establishment, Princes Risborough Laboratory)
- *Department of the Environment (Housing and Construction)
- *Department of the Environment (PSA)
- *Flat Glass Manufacturers' Association
- *Glass and Glazing Federation
- *Health and Safety Executive
- *Incorporated Association of Architects and Surveyors
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- *Institution of Municipal Engineers
- Institution of Structural Engineers

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- National Federation of Building Trades Employers
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- Department of Trade (Metrology, Quality Assurance, Safety and Standards Division)
- Greater London Council
- Metal Window Federation of Great Britain
- National Association of Shopfitters
- National House-building Council
- Patent Glazing Conference
- Sealant Manufacturers' Conference
- Union of Construction, Allied Trades and Technicians

Amendments issued since publication

Amd. No.	Date of issue	Text affected
4063	June 1982	Indicated by a line in the margin

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AMD 4582

Amendment No. 2
published and effective from 29 June 1984
to BS 6262 : 1982

Code of practice for glazing for buildings

Revised text

AMD 4582
June 1984

Clause 4.4.1 Design information

In line 3, delete 'and CP 3 : Chapter 1(B)' and in line 4 delete 'and CP 3 : Chapter 1 : Part 1'.

AMD 4582
June 1984

Clause 4.7.2.1 General

At the end of the clause insert the following new paragraph.

'Leaded lights and copper lights, made in the traditional form which comprises small panes of varying thicknesses (usually of antique glass) glazed into a framework of lead or copper comes, are deemed to be acceptable for use in the areas defined in 4.7.2.2 and 4.7.2.3.'

AMD 4582
June 1984

Clause 4.7.3 Protective systems

In paragraph 2, item (c), at the end of the text, insert '†', and insert the following footnote at the bottom of page 9.

†The Building Standards (Scotland) Regulations specify minimum heights in particular situations and should be referred to for detailed requirements.'

AMD 4582
June 1984

Table 2. Design wind pressures

In 'cat. 1' column, 44 m/s basic wind speed, 10 m height to eaves, delete '1200' and substitute '1650'.

AMD 4582
June 1984

Figure 12. Toughened glass : 3 s mean wind loadings

Sub-title the existing graph '(a) Single glazing'.

Insert new graph (as attached) sub-titled '(b) Double-glazing unit, both panes toughened glass'.

AMD 4582
June 1984

Figure 13. Transparent laminated glass : 3 s mean wind loadings

In the title, after 'glass' add '(symmetrical)'.

Subtitle the existing graph '(a) Single glazing'.

Insert new graph (as attached) sub-titled '(b) Double-glazing unit, both panes laminated glass'.

AMD 4582
June 1984

Table 13. Minimum edge cover for single glass up to and including 6 mm thickness

In 'Glazing material' column insert 'Non-setting compound' in blank space at the bottom.

AMD 4582
June 1984

Table 16. Weight of glass for setting block assessment

After line 6 insert a new line as follows.

'15 | 37.5'

AMD 4582
June 1984

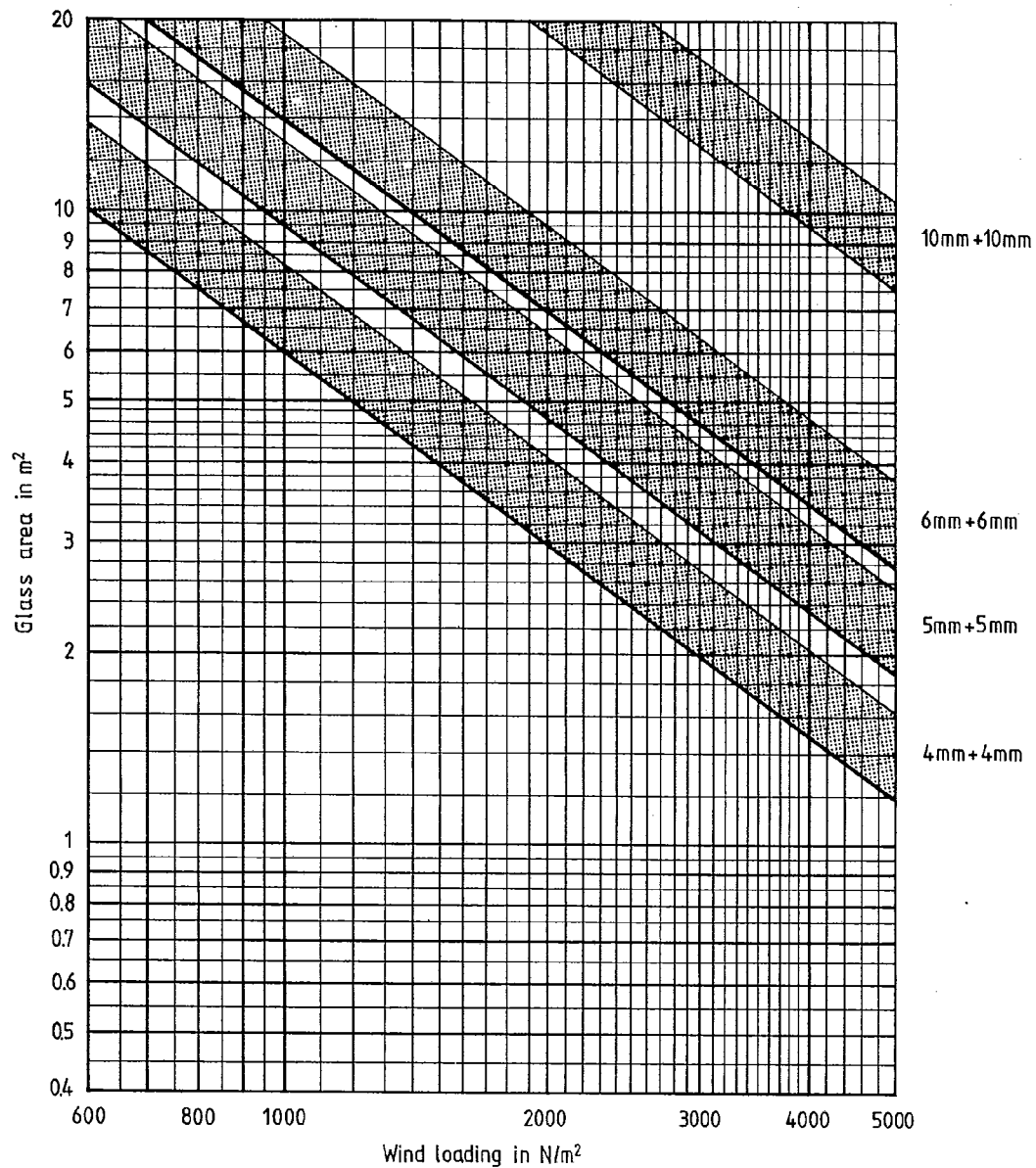
Clause 9.1.3

In paragraph 1, delete the last sentence and substitute 'Screws are desirable when glazing large and/or heavy panes of glass.'

AMD 4582
June 1984

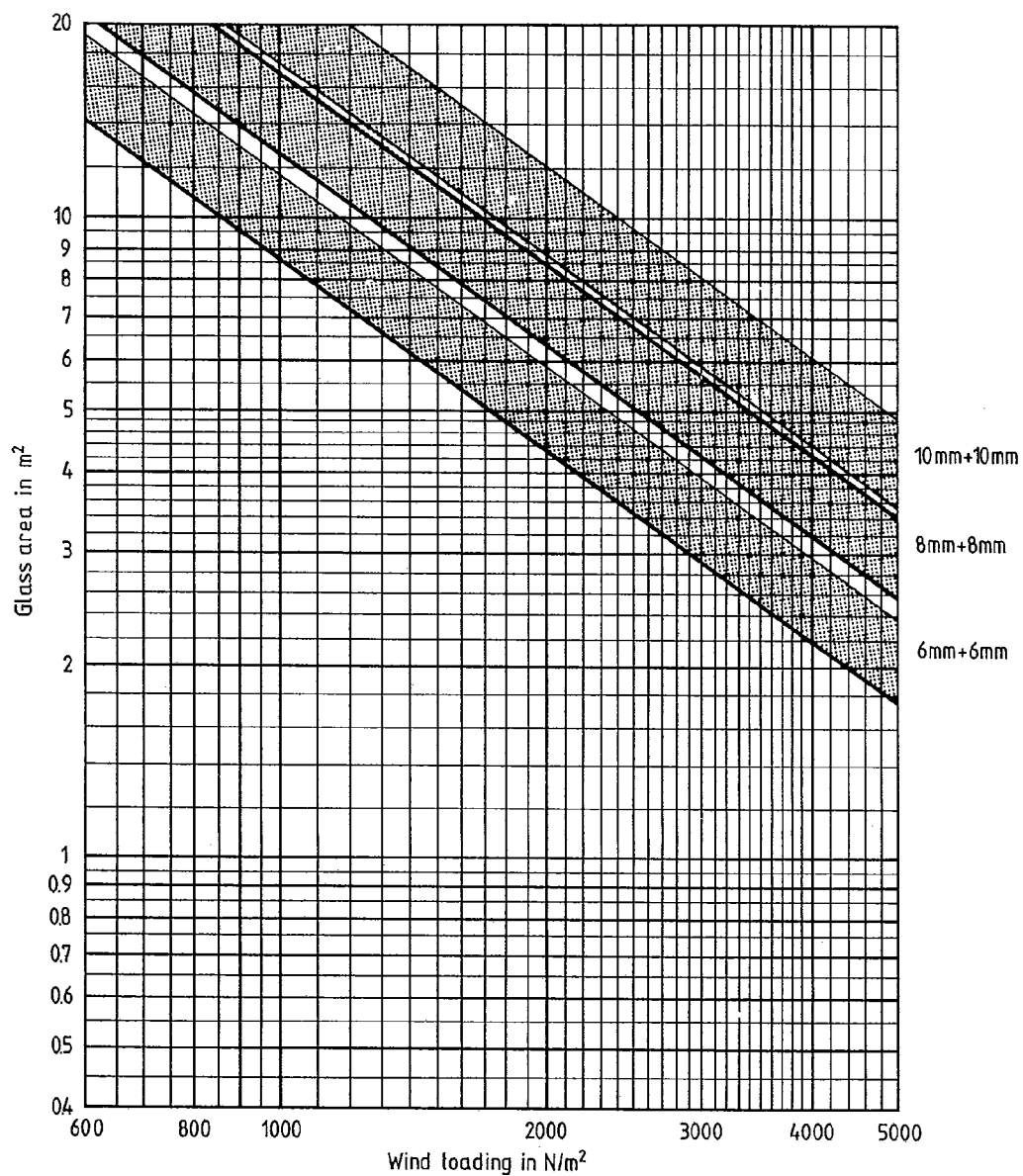
Standards publications referred to

Delete references to CP 3 : Chapter 1 : Part 1 and CP 3 : Chapter 1(B).



(b) Double-glazing unit, both panes toughened glass

Figure 12 contd



(b) Double-glazing unit, both panes laminated glass

Figure 13 *contd*