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**SANS 10137:2011**

Edition 4

# SOUTH AFRICAN NATIONAL STANDARD

# The installation of glazing in buildings

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**Table of changes**

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## Foreword

This South African standard was approved by National Committee SABS TC 59C, *Construction standards – Glazing in buildings*, in accordance with procedures of the SABS Standards Division, in compliance with annex 3 of the WTO/TBT agreement.

This document was published in December 2011.

This document supersedes SABS 0137:2002 (edition 3.1).

**This document is referenced in the National Building Regulations and Building Standards Act, 1977 (Act No. 103 of 1977), and the National Road Traffic Act, 1996 (Act No. 93 of 1996).**

Reference is made in note 1 to clause 1 to the "relevant national legislation". In South Africa this means the National Building Regulations and Building Standards Act, 1977 (Act No. 103 of 1977).

Annex A is for information only.

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# The installation of glazing in buildings

## 1 Scope

This standard covers the design and installation of glazing and glazing materials used in buildings and is for applications described in SANS 10400-N, and for use by a competent person (glazing).

NOTE 1 Compliance with this standard does not necessarily grant exemption from the need for compliance with the relevant national legislation (see foreword).

NOTE 2 The design methods described in this standard may represent only one of many methods of determining glass thickness and strength requirements for a given situation. A competent person (glazing) may use any method of calculation they deem fit for purpose provided such method represents good engineering design practice, acceptable safety factors and deflections, and can be backed up by reference to reference material or test data.

## 2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies. Information on currently valid national and international standards can be obtained from the SABS Standards Division.

ASTM C 1087, Standard *test method for determining compatibility of liquid-applied sealants with accessories used in structural glazing systems.*

ASTM E 1300a, *Standard practice for determining load resistance of glass in buildings.*

BS 952-1, *Glass for glazing – Classification.*

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

BS EN 572-1, *Glass in building – Basic soda lime silicate glass products – Definitions and general physical and mechanical properties.*

BS EN 673, *Glass in building – Determination of thermal transmittance (U-value) – Calculation method.*

DIN 32622, *Aquariums of glass – Safety requirements and testing.*

ISO 48, *Rubber, vulcanized or thermoplastic – Determination of hardness (hardness between 10 IRHD and 100 IRHD).*

ISO 7391-2, *Plastics – Polycarbonate (PC) moulding and extrusion materials – Part 2: Preparation of test specimens and determination of properties.*

SANS 17, *Glass and plastics in furniture.*

SANS 110, *Sealing compounds for the building industry, two-component, polysulphide base.*

SANS 204, *Energy efficiency in buildings.*

SANS 635, *Elastomeric structural glazing and panel gaskets.*

SANS 678, *Primers for wood.*

SANS 680, *Glazing putty for wooden and metal window frames.*

SANS 727, *Windows and doors made from rolled mild steel sections.*

SANS 935, *Hot-dip (galvanized) zinc coatings on steel wire.*

SANS 999, *Anodized coatings on aluminium (for architectural applications).*

SANS 1077, *Sealing compounds for the building and construction industry, two-component, polyurethane-base.*

SANS 1236, *Silvered glass mirror for general use.*

SANS 1263-1, *Safety and security glazing materials for buildings – Part 1: Safety performance of glazing materials under human impact.*

SANS 1263-2, *Safety and security glazing materials for buildings – Part 2: Burglar-resistant and vandal-resistant glazing materials.*

SANS 1263-3, *Safety and security glazing materials for buildings – Part 3: Bullet-resistant glazing materials.*

SANS 1274, *Coatings applied by the powder-coating process.*

SANS 1305, *Sealing compounds for the building industry, one-component, silicone-rubber-base.*

SANS 1578, *Durable organic powders for coating of external architectural aluminium.*

SANS 1796, *Application of durable organic powder coatings for architectural aluminium.*

SANS 5146, *Paints and varnishes – Resistance to impact of paint films.*

SANS 10160-1, *Basis of structural design and actions for buildings and industrial structures – Part 1: Basis of structural design.*

SANS 10160-2, *Basis of structural design and actions for buildings and industrial structures – Part 2: Self-weight and imposed loads.*

SANS 10160-3, *Basis of structural design and actions for buildings and industrial structures – Part 3: Wind actions.*

SANS 10177-5, *Fire-testing of materials, components and elements used in buildings – Part 5: Non-combustibility at 750 °C of building materials.*

SANS 10400-A, *The application of the National Building Regulations – Part A: General principles and requirements.*

SANS 10400-N, *The application of the National Building Regulations – Part N: Glazing.*

SANS 50572-1/EN 572-1, *Glass in building – Basic soda lime silicate glass products – Part 1: Definitions and general physical and mechanical properties.*

## 3 Definitions

For the purpose of this document, the following definitions apply.

**3.1**
**acceptable**
acceptable to the authority administering this standard or to the parties concluding the purchase contract, as relevant

**3.2**
**absorption**
fraction of solar radiant heat at normal incidence that is absorbed by the glazing

**3.3**
**anchor**
-shaped metal strip used in the fixing of glazing materials, the longer leg of which is secured to he background while the shorter leg supports the glazing material (with insulation) without protruding beyond the face of the glazing material

**.4**
**nnealed**
escriptive of glass that during manufacture, is subjected to controlled cooling to remove stresses rom the glass so that it can be cut or worked without breaking

**.5**
**rris**
escriptive of the edge of a surface that has a bevel of width not exceeding 1,6 mm at an angle of pproximately 45° to the surface

**6**
**spect ratio**
ng dimension divided by the short dimension expressed as a ratio

**7**
**ck clearance**
ace between the surface of the pane and the back of the rebate (see figure 1)

**ad**
p of wood, metal or other suitable material secured to the platform of the rebate to retain the zing material

**3.9**
**bevel**
edge of the glazing material that is finished at an angle to the face of the material

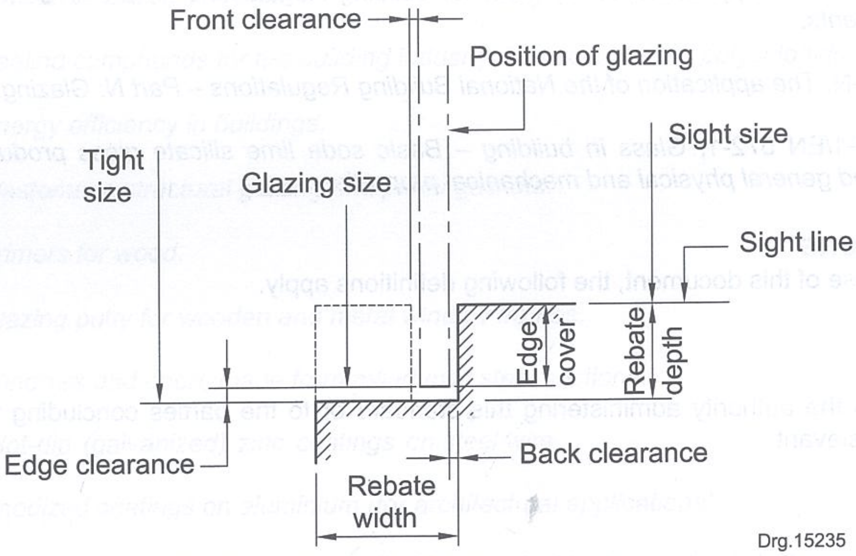



**Figure 1 — Details of glazing rebate**

**3.10**
**blocks**

**3.10.1**
**location blocks**
pieces of resilient non-absorbent inert material used between the top and side edges of glazing material and the surround to position the glazing material in the surround as required

**3.10.2**
**setting blocks**
pieces of resilient non-absorbent inert material used between the bottom edge of glazing material and a surround to support the glazing material in the surround and to prevent direct contact between the glazing material and the surround

**3.11**
**butt jointing**
close positioning of the edges of glazing material during glazing

NOTE The space between the butting edges is normally filled with silicone of appropriate strength.

**3.12**
**capping**
material used to fill the space remaining between the pane and a rebate and between the glazing pane and a bead

**3.13**
**cleat**
small corrosion-resistant metal component (usually right-angled in section) that is secured to the frame to hold the glazing pane in position and that is used in conjunction with location blocks when necessary

**3.14**
**competent person (glazing)**
person who is recognized by an institute, who has specialist expertise in the field of glazing, as generally having the necessary experience and training to determine glazing requirements in accordance with the provisions of this standard

**3.15**
**direct transmittance**
fraction of solar radiant heat at normal incidence that is transmitted directly through the glazing without change in wavelength

**3.16**
**edge clearance**
space between the edge of the glazing pane and the platform of the rebate

**3.17**
**edge cover**
distance between the edge of the pane and the sight line (see figure 1)

**3.18**
**fin**
transparent structural stabilizing member

**3.19**
**fixing**
securing of glazing panes in surrounds and to surfaces such as walls, shelves, floors and ceilings

**3.20**
**gasket**
preformed resilient inert section that is non-absorbent and provides a continuous weathertight surround for glazing panes

**3.21**
**glazing**

**3.21.1**
**double glazing**
glazing that for the purpose of sound insulation or thermal insulation or fire protection, utilizes two panes of glass or plastics separated by substantially stationary air or inert gas

**3.21.2**
**internal glazing**
glazing, neither side of which is exposed to the outside environment

NOTE This term is used for glazing other than inside glazing.

**3.21.3**
**multiple glazing**
glazing based on the same principle as double glazing, but incorporating three or more panes

**3.22**
**glazing compound**
fixing compound
setting or non-setting material applied by hand, knife or gun or in a pre-shaped form to provide a bedding for the glazing pane and a weather tight joint between the pane and the surround

**3.23**
**glazing material**
materials used for the installation of glazing

**3.24**
**glazing pane**
piece of flat pane glass or rigid plastics, cut to the size and shape required and intended for glazing into a surround or onto a backing

**3.25**
**heat-reflecting glass**
glass that reflects a portion of radiant heat owing to its metallic coating

**3.26**
**heat-absorbing glass**
glass that resists the passage of radiant heat by absorption and re-radiation, with a resultant increase in the temperature of the glass

**3.27**
**heat transfer**

**3.27.1**
**conduction**
movement of heat through a solid body, for example, along a metal bar one end of which is inserted in a fire

**3.27.2**
**convection**
movement of heat by the actual movement of a fluid medium, for example, heated air from a convection heater

**3.27.3**
**direct solar radiation**
radiation that is emitted by the sun and reaches an object directly

NOTE The amount of direct radiation that reaches an object depends on the solar altitude and atmospheric conditions.

**3.27.4**
**radiation**
emission or transfer of energy, including radiant heat, in the form of electromagnetic waves or particles

**3.28**
**load-bearing element**
that portion of a glazing pane that supports a load

**3.29**
**low emissivity**
low-E
coatings which have surface emissivities of less than 0,2 (see BS 952-1)

NOTE The use of such coating on glass improves the thermal insulation. They are most efficient when used on the cavity surfaces of insulating glass units.

**3.30**
**mastic**
material used to fix glazing panes to solid backgrounds and to fill joints at edges of panes

**3.31**
**primer**
coating material that promotes the adhesion of sealants or, in the case of paints, a preparatory coat of paint

**3.32**
**putty**

**3.32.1**
**back putty**
portion of the glazing compound that remains between the back of the rebate and the glazing pane after the pane has been bedded into position

**3.32.2**
**bedding putty**
bedding
glazing compound in the rebate into which the glazing pane is bedded

**3.32.3**
**front putty**
fillet of glazing compound formed in front of and in contact with the glazing pane

**3.33**
**rebate**
part of a surround, the cross section of which forms an angle into which the edge of the glazing pane is secured

**3.34**
**rebate platform**
part of the rebate perpendicular to the pane (see figure 1)

**3.35**
**reflectance**
fraction of solar radiant heat at normal incidence that is reflected from all surfaces of glazing

**3.36**
**safety glazing material**
glazing material constructed, combined or treated with the intention of minimizing the likelihood of breakage caused by human impact that could result in injuries in the form of cuts or punctures, and which meets the requirements of SANS 1236

**3.37**
**sealant**
jointing compound that, when cured, has adhesive and elastic properties

NOTE Sealant is often used as a capping on joints filled mainly with other materials.

**3.38**
**sealer**
liquid compound of brushing consistency applied to a surface to prevent

a) the absorption of oils from fixing compounds, and

b) attack on the oils of the fixing compounds by alkalis from within the surface

**3.39**
**shading coefficient**
number used to compare the solar radiant heat transmittance properties of different glazing systems and obtained by dividing the total solar transmittance of each system by 0,87, which is the total solar transmittance of a notional clear single glazing pane of thickness between 3 mm and 4 mm

**3.40**
**shelf life**
length of time that a material can be stored without deterioration

**3.41**
**silvering**
process by which a metal film is deposited on glass and the film is then covered or coated with a protective medium as in the manufacture of a mirror

**3.42**
**sizes**
(see figure 1)

**3.42.1**
**glazing size**
dimensions of a pane of flat glass or plastics ready for glazing after allowance has been made for edge clearances

**3.42.2**
**sight size**
dimensions of the glazed area through which light such as daylight is admitted

**3.42.3**
**tight size**
rebate size
dimensions of the rebate opening from rebate platform to rebate platform

**3.43**
**solar radiant heat**
radiation that has the spectral distribution (i.e. the energy available at each wavelength, for air mass equal to two)

NOTE The term "air mass" describes the length and density of the path of the radiation through the atmosphere; air mass equal to one being applied to the vertical path and air mass equal to two being applied to a solar heat of 30 °C.

**3.44**
**sprig**
small headless nail or triangular piece of metal used to secure a glazing pane in wood frames while the glazing compound hardens

**3.45**
**structural glazing**
glazing panes fixed to the substrate by the use of structural sealants or bolted structural assemblies

**3.46**
**structural sealants**
any sealant that is used in any manner to structurally bond the glazing pane to a substrate

**3.47**
**total transmittance**
fraction of solar radiant heat at normal incidence that is transmitted through the glazing pane directly and by re-radiation

**3.48**
**translucent**
descriptive of a glazing material or sealant that permits light to pass through but with a degree of obscuration and diffusion

**3.49**
**transparent**
descriptive of a glazing material that permits light to pass through with clear vision

**3.50**
***U*-value**
amount of heat transmitted, expressed in watts per square metre per degree Celsius ($W/m^2/°C$)

NOTE The difference in temperature between the air on one side of the glazing and the air, or inert gas, on the other side, depends on the thermal resistance of both surfaces of the material as well as the thermal resistance of individual layers and air spaces contained between individual panes.

**3.51**
**ultraviolet light**
light in the range of wavelengths immediately shorter than the wavelengths of visible light

**3.52**
**visible light**
light at normal incidence that is reflected from all the surfaces of the glazing material

# 4 Materials and components

## 4.1 Dimensions

The dimensions of stock sheet sizes shall be obtained from the supplier.

## 4.2 Glass

### 4.2.1 General

Window glass will not deteriorate under normal circumstances. Stains can develop if the glass is not cleaned at reasonable intervals. Further detailed information can to be obtained from the manufacturer.

### 4.2.2 Types

The following types of flat glass are normally suitable for glazing purposes and have adequate durability:

a) ordinary clear flat glass;

b) patterned or obscure glass; and

c) special glass of the following types:

1) fire-retardant glass;

2) glare-reducing glass;

3) heat-absorbing glass;

4) heat-reflecting glass;

5) safety glass; and

6) wired glass.

### 4.2.3 Characteristics of certain types of glass

#### 4.2.3.1 Float glass

Float glass is transparent glass that is manufactured by allowing the glass from the tank furnace to flow across molten metal (usually tin). The surfaces of the glass are flat and parallel so that the glass provides undistorted vision and reflection.

The mass of glass, $m$, can be calculated as follows:

$$m = 2,5 \times A \times t$$

where

$m$ is the mass of glass, expressed in kilograms (kg);

$A$ is the area of glass, expressed in square metres ($m^2$);

$t$ is the minimum thickness of the glass, expressed in millimetres (mm).

**4.2.3.2 Sheet glass** (drawn glass)

Sheet glass is transparent glass that is manufactured by the vertical drawing process, giving natural fire-finished surfaces. Because of the method of manufacture some degree of line distortion is inevitable.

**4.2.3.3 Patterned or obscure glass**

Patterned or obscure glass covers a large range of translucent and tinted textured glass. It is supplied in several thicknesses and sizes, depending on the country of origin.

**4.2.3.4 Wired glass**

Wired glass is annealed glass that contains a wire mesh that is completely embedded in the body of the glass during manufacture. When wired glass is broken, the fragments tend to remain mechanically attached to the wire mesh.

Wired glass is manufactured in both obscure and clear form.

**4.2.3.5 Environmental glass**

The specific applications of glass for environmental control are dealt with in clause 5 and only the different types are described here. Consult the literature of the individual manufacturer for details of the product range.

The different types of environmental glass are as follows:

a) Glare-reducing glass: Glass that is designed to cut down the transmission of visible light and so reduce light intensity. It can be either integrally tinted glass or clear glass coated with a strongly tinted film, or glass that is laminated. Grey and bronze are the most suitable tints as they do not distort colour values to a substantial degree.

b) Solar-heat-absorbing glass: Glass that is designed to restrict, by preferential absorption, the transmission of radiant heat. It is available in obscure and in clear and tinted form.

   NOTE Clause 5 provides information on solar radiation and the precautions to be taken when glazing with solar-heat-absorbing glass.

c) Solar-heat-reflecting glass: Glass that is designed to restrict, by preferential reflection, the transmission of radiant heat.

   NOTE Clause 5 provides information on solar radiation and the precautions to be taken when glazing with solar-heat-reflecting glass.

d) Sealed insulating glass units: Hermetically sealed, factory-made window units that consist of two or more parallel glazing panes with dehydrated air on glass spaces between the panes. They are used to provide sound insulation or thermal insulation (or both).

e) Composite in-fill panels: Factory-made panels that comprise a glazing pane to the back of which are attached layers of insulating material (fibreglass or other material) and finishing material (such as decorative sheet material).

f) Multiple glazing: Factory-made window units that consist of two or more glazing panes with airspaces between the panes. They are used to provide sound insulation or thermal insulation (or both).

#### 4.2.3.6 Toughened safety glass

Toughened glass is produced by subjecting annealed glass to a process of controlled heating and cooling, which produces high compression in the surface and compensating tension in the centre. For this reason toughened glass cannot be cut, drilled, surface-worked or edge-worked.

The process gives the glass greatly increased resistance to impact, loading and thermal shock. When thermally toughened safety glass breaks it is reduced to comparatively small harmless pieces. For precise information regarding various properties of toughened glass, consult the literature of the relevant manufacturer. Sizes depend on the facilities of the individual manufacturer.

Most types of flat glass can be toughened, but information shall be obtained from the manufacturer.

Thermally toughened glass that complies with the requirements of all the parts of SANS 1263 may be regarded as safety glazing.

#### 4.2.3.7 Laminated safety glass

The following types of laminated glass are available:

a) Ordinary laminated glass: Glazing pane that comprises two sheets of glass bonded by a shear-resistant and impact-resistant interlayer. When laminated glass is fractured, the glass pieces adhere to the interlayer and their sharp cutting edges are held in contact with one another and are thus prevented from causing lacerations.

b) Multi-laminated glass: Similar to ordinary laminated glass but consisting of three or more sheets of glass bonded by a series of interlayers; it provides greater impact resistance and therefore, greater security than does ordinary laminated glass.

c) Bullet-resistant glass: A purpose-made, multi-laminated glass designed to the precise specification of the purchaser. In all cases consult the manufacturer of the laminate and state the degree of protection required (see SANS 1263-3).

d) Safety and security laminated glass (also safety mirrors): Laminated glazing pane available with interlayers and different combinations of glass types and thicknesses, depending on the performance required to meet the requirements of SANS 1263-1 and SANS 1263-2.

e) Functional laminated glass: Glazing pane intended for the control of aspects such as transmitted solar radiation, sound and glare reduction.

NOTE It might be possible, by arrangement with the manufacturer, to have combinations of certain features embodied in a laminated glass.

## 4.3 Plastics

### 4.3.1 General

The operational area of glazing in a building will be decisive for the type of plastics to be used. The manufacturer shall recommend the correct plastics material.

Basic information about specific plastics is given in 5.8.6. Any additional details shall be obtained from the manufacturer.

### 4.3.2 Types

The following types of plastic glazing materials are available:

a) polycarbonate;

b) polyethylene terephthalate (PET);

c) polymethyl methacrylate (PMMA), also known as "acrylic";

d) polyethylene terephthalate, glycol modified (PETG); and

e) poly(vinyl chloride) (PVC).

### 4.3.3 Characteristics of certain types of plastics

#### 4.3.3.1 Polycarbonate

The characteristics of the different grades of polycarbonate are as follows:

a) Standard glazing grade is transparent and recommended for interior use or secondary glazing. It provides protection against vandalism and forced entry.

b) Improved fire-resistant grade is transparent and provides balanced combustion characteristics, including low flammability, low smoke evolution and low toxicity. It is designed to anticipate additional combustion standards.

c) Optical improved-grade polycarbonates are extensively used for lamination with glass.

d) UV-improved grade has an ultraviolet-protected surface on both sides and is intended for use outdoors.

e) Polycarbonate resin incorporating proprietary additives that block infrared and near infrared heat from the sun while letting in high levels of light. Because this technology is inherent in the material, solar control properties are permanent.

f) Abrasion-resistant grade polycarbonate glazing panes have on either one or both sides, surfaces that are both abrasion-resistant and UV-resistant to combine high-impact strength with improved long-term performance and durability. The surface coating provides protection against scratching and hazing caused by regular contact and cleaning.

   The surface coating is immune to many chemicals and provides protection against the yellowing effect. The fire-resistance performance is also superior.

g) Textured glazing grade has a textured surface, giving excellent light diffusion without transparency. It is used for interior and exterior glazing applications. The textured surface hides scratching and scuffing marks.

h) Multi-walled grades are impact-resistant energy-saving sheets available in multi-layer wall construction that provide varying degrees of thermal insulation. Their lightness and rigidity reduces the need for supporting structures.

i) Multi-laminates are constructed with two to four bonded layers of different gauges. They conform to specific international safety and security standards (for example ISO 7391-2), offer protection from manual attack, and are bullet-resistant.

#### 4.3.3.2 Polyethylenterephthalate (PET)

PET has excellent transparency, high impact resistance, excellent chemical resistance, and excellent fire resistance, and is suitable for outdoor use.

#### 4.3.3.3 Polymethyl methacrylate (PMMA)

PMMA (also known as acrylic), has the following characteristics:

a) Cell-cast acrylic has superior optical properties, high-notched impact strength and high crazing resistance. Its resistance to weathering and to outdoor exposure is also excellent.

b) Extruded acrylic has good weathering and optical properties but its susceptibility to failure on exposure to high stresses shall be considered.

c) Ultra-high-impact acrylic offers improved impact resistance but its weathering and mechanical properties shall be considered before use.

d) Multi-laminates are constructed from specially bonded layers of cast acrylic to offer improved human impact and bullet-resistant glazing.

e) Similar to PET, PMMA has excellent transparency, high impact resistance, excellent chemical resistance, and excellent fire resistance, and is suitable for outdoor use.

#### 4.3.3.4 Polyethylene-1, 4-cyclohexanaldimethylene-terephthalate (PETG)

PETG offers a combination of clear optical transparency with good impact resistance properties. It is not suitable for outdoor use, is flammable and is not resistant to many chemicals.

## 4.4 Special glazing materials

### 4.4.1 Cladding glass

Most types of flat glass (such as in-fill panel glass and spandrel glass) can be used in cladding, but generally a coloured panel is desired. The principal types are:

a) toughened ceramic-coated glass;

b) coated reflective glass; and

c) back painted glass.

Due to the heat-absorption properties of reflective and back painted glass, the manufacturer shall be consulted before the glass is used.

### 4.4.2 Leaded lights

Leaded lights are panels consisting of small pieces of glass held together by lead sections.

#### 4.4.3 Copper lights

Copper lights are panels consisting of small pieces of glass held together by copper sections.

#### 4.4.4 Lead glass

Lead glass (for example, X-ray glass or radiation shielding) contains a large percentage of lead oxide, which imparts a high degree of opacity to X-rays. The opacity is usually expressed in terms of the equivalent thickness of metallic lead (the thickness of lead that has the same ability to absorb X-rays). Consult the manufacturer for performance details.

Lead glass is available in blocks of thickness up to 150 mm, depending on the radiation shielding required.

#### 4.4.5 Glass bricks

Glass bricks are manufactured by a pressing process in the form of two shallow dishes that are subsequently fused together to form a hollow hermetically sealed brick. There are a number of sizes available, both square and rectangular, having a variety of different surface patterns and a limited range of colours.

### 4.5 Fixing materials

#### 4.5.1 General-purpose putty

General-purpose putty is used to secure glazing in softwood and absorbent hardwood frames as well as in metal frames. For these applications, use only putties that comply with SANS 680. (This standard covers two types of putty, namely, a self-setting (one-pack) type that is usually used only on timber frames, and a reaction or catalyst type that is used mainly on metal frames.)

Always paint metal frames with a good anti-corrosive primer before they are glazed. In all cases paint the putty within 7 d to prevent cracking and loss of adhesion. Do not use general purpose putty on dense, non-absorbent hard timber (such as teak) without priming the timber with a primer recommended by the manufacturer of the frame. On timber frames, use only primers that comply with SANS 678.

Generally, putty is without added colour and adheres well to both glazing pane and frame, but not excessively to the putty knife or to the glazier's hands. It possesses good knifing and handling characteristics throughout its shelf life. In most cases, the shelf life is in the order of three months, after which there might be some separation of oil. If separation of oil has occurred, thoroughly mix the oil back into the putty before use to restore the original characteristics of the putty.

#### 4.5.2 Sealants

##### 4.5.2.1 General

Sealants are caulking-gun-applied materials generally used for capping and bedding applications. Care shall be taken with their use as sealants since their primers and cleaning fluids often contain hazardous or toxic materials. Always strictly observe the manufacturer's recommendations as regards the use and application of a sealant.

**4.5.2.2 Single-component sealants** (curing type)

Single-component sealants that have a polysulphide, silicone or urethane base undergo a chemical reaction at normal temperatures to form a firm resilient seal. They can tolerate much greater movement over wider temperature ranges than other compounds, but vary considerably in their rate and degree of cure. Ensure that a slow curing type is not used where the sealant has to withstand excessive movement during the early stages of curing. In general, the silicones and urethanes cure quickly, while single-component polysulphides have a slower curing action, which is accelerated by high temperatures and high relative humidity.

To obtain optimum adhesion these sealants might require the use of primers or similar surface conditioners. They generally provide flexibility, elongation, resilience and similar rubber-like characteristics. The following are several specific properties of single-component sealants of the curing type:

a) Polysulphide sealants which exhibit good resistance to direct sunlight, water and many organic salt solutions, mild acids and alkalis, solvents and oil-based fuels. Where sunlight is transmitted through or reflected from the glazing material, primers are essential to give optimum durability of seal. Fresh sealant will bond to existing sealant, thus facilitating repair or remedial work. Curing time is approximately 14 d to 21 d under normal site conditions, depending on the thickness of the sealant and humidity.

b) Silicone sealants (see SANS 1305) which cure by a variety of chemical mechanisms, each type being suitable for specific end uses. Guidance from the manufacturer is essential. These sealants exhibit rubber-like properties in service over a temperature range of –60 °C to 200 °C. Their water resistance is good and some can be used in joints that are subjected to permanent immersion in water. Resistance to salt solutions, mild acids and alkalis and to directly transmitted or reflected sunlight is also good.

   When silicone sealants are used, surface primers first have to be applied to porous surfaces, but primers are not usually necessary on glass, ceramics, aluminium and stainless steel. Some non-porous surfaces, for example, plastics, glass-reinforced plastics and certain metals might require special primers. Under normal site conditions curing time is 21 d. The curing reaction sometimes produces volatile products that can attack laminated glass or metallic film, (or both). Consultation with silicone suppliers or manufacturers, (or both) regarding compatibility with laminated glass is essential.

c) Urethane sealants, which have excellent abrasion resistance and good chemical resistance. Primers are necessary to ensure optimum adhesion to both glass and frame. Fresh urethane sealant does not readily bond to an aged sealant. Under normal site conditions curing time is 7 d to 14 d.

**4.5.2.3 Single-component sealants** (solvent-release type)

Single-component sealants of the solvent release type have acrylic, chlorosulphonated polyethylene, polychloroprene or vinyl acrylic bases, and are essentially non-curing in the sense that no extensive chemical change takes place during setting. Although some forms might achieve a partial state of polymerization, these sealants generally set as a result of solvent release when exposed to the atmosphere.

They normally remain fairly soft and flexible but are subject to a degree of solvent loss, which can cause some shrinkage. These sealants are subject to degradation over time and are therefore not recommended for use where long-term durability is required. The following are several specific properties of single component sealants (solvent-release type):

a) Butyl-based sealants which set to form rubbery compounds that adhere readily to most surfaces without the need for primers. They are best suited for concealed applications such as the bedding of beads to frames or the filling of perimeter voids around the glazing material. They can be degraded by ultraviolet light, producing a tacky surface that collects dirt progressively, and so they are not generally recommended for use in exposed situations.

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

c) Chloroprene-based sealants are not freely available and little is currently known about their performance.

#### 4.5.2.4 Two-component sealants

Two-component sealants (curing type) are supplied in two parts that when mixed, react to form a solid rubbery material. The curing cycle starts when the mixing begins. Take care during the mixing process to avoid the entrapment of air, and preferably use specially designed mechanical devices or slow-speed drills with suitably designed paddles. Excessive mixing speed or mixing time can reduce the period of workability of the sealant.

The period of workability and curing time can also be affected by temperature and humidity. In general, warm humid weather shortens the period of workability whereas cool dry weather extends it. Use the sealant within its period of workability, and to avoid wastage do not mix excessive quantities. The following are several specific properties of two-component sealants (curing type):

a) Polysulphide-based sealants (see also SANS 110) which cure to form a tough rubber-like substance that remains flexible in service at temperatures ranging from −40 °C to 100 °C. They exhibit good resistance to direct sunlight, water and many inorganic salt solutions, mild acids, alkalis and oil based fuels. Adhesion is good to most clean, dry surfaces, including aluminium, stainless steel, galvanized steel and ceramic materials but bricks, concrete and other porous surfaces normally require primers. Primers are also required on glass and plastics, especially where the bond will be subject to transmitted or reflected sunlight. Apply the sealants preferably at temperatures between 4 °C and 35 °C. The curing time is approximately 7 d depending on the prevailing temperature and humidity.

b) Polyurethane-based sealants which cure to form a tough, rubber-like material. The water resistance of the cured sealants is good and they can 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 can occur. Primers are usually required to ensure optimum adhesive strength when these sealants are applied to glass and other surfaces. A fresh sealant of this type does not bond readily to a cured sealant without special preparation. Curing time is approximately 7 d under normal site conditions.

## 4.5.3 Preformed strip materials

### 4.5.3.1 Preformed mastic tapes

Preformed mastic tapes are usually based on butyl or isobutylene polymers and tapes of most grades are available on reels in various widths and thicknesses. Some grades are load bearing, either by virtue of their formulation or by the incorporation of a load-bearing core, and may be used without location blocks. Where non-load bearing types are used, incorporate location blocks.

### 4.5.3.2 Extruded solid sections

Extruded solid sections are made of PVC or synthetic rubbers and, when in use, are under compression on both sides of the glazing pane. They are also used as insert wedges in conjunction with strip sealant or compound, either as internal trim or as part of the external weather protection in a drain glazing system. An insert section usually has a means of locating it on the bead or surround and provides a water-shedding cap to the glazing line.

Extruded solid section capped with a sealant may also be used as a continuous location block or, without sealant or compound, for internal glazing (such as doors and partitions).

### 4.5.3.3 Cellular strips

Cellular strips are generally of self-adhesive synthetic rubber and are used on either side of the glazing pane, alone or in conjunction with sealants. To ensure adequate load-bearing ability they have to be compressed sufficiently to withstand wind pressures. When they are used externally, except in very sheltered situations or where the strip forms part of a drained glazing system, it is normally necessary to cap the strip with a sealant. If a capping sealant is used, ensure that the materials are compatible.

## 4.5.4 Preformed compression-type gaskets

### 4.5.4.1 General

Gaskets have several advantages over conventional glazing compounds, such as ease of installation, no wastage and no maintenance. They can be used in most weather conditions but at extremely low temperatures they can stiffen.

Ensure that gaskets do not deform permanently under load and that in order to minimize stiffening at low temperatures and to avoid staining of adjacent surfaces, they are formulated to withstand stretching, compression, aging and ozone attack. Ensure also that gaskets conform to the required dimensions and are such that they exhibit dimensional stability in use.

The hardness of gaskets is expressed in international rubber hardness degrees (IRHD) as defined in ISO 48 and varies between 45 IRHD and 70 IRHD, according to the indicated use.

Successful glazing with gaskets depends on careful co-operation between the gasket manufacturer, the window-frame designer and the glazing contractor. Use only gaskets that comply with the relevant requirements of SANS 635.

#### 4.5.4.2 Structural gaskets

Structural gaskets are usually made from vulcanised polychloroprene-based rubber compounds, but other synthetic rubbers may be used, provided that they also have good weather resistance and resistance to permanent deformation. Integral locking strips produce a compression grip on the frame and the glass. Consult the gasket manufacturer as regards the dimensions of the gaskets required.

Where possible, incorporate a second pressure seal to ensure weather tightness between frame and gasket.

Standard H-section and Y-section gaskets are available for most thicknesses of glazing panes, but special purpose-made gaskets are obtainable.

Ladder gaskets are designed to receive two or more glazing panes in one structural opening and are used either vertically or horizontally. As the transoms or mullions are not rigid enough to resist wind loading, ensure at the design stage that the glazing pane, when supported along only two or three edges, is capable of resisting the design wind pressure.

#### 4.5.4.3 Non-structural gaskets

Non-structural gaskets are made of synthetic rubber or a plastics material and are available in solid, tubular or dense sponge form. They are extruded into various shapes, mainly channel and wedge, and are used as primary seals where they can be maintained under the required compression. If compression is not provided mechanically, apply a top seal with a single-component or two- component sealant to retain the gaskets in the rebate.

### 4.5.5 Fixing materials for internal work

The following tapes, ribbons and channels are used for internal glazing:

a) adhesive glazing tape, consisting of tape based on treated cotton (or similar material) with a self-adhesive coating on one side or on both sides;

b) extruded mastic tapes; and

c) UV bonding as described in SANS 17 for furniture and artwork.

NOTE UV bonding is currently not suitable for external applications. Consult the manufacturer of UV adhesive for the latest information.

### 4.5.6 Fire-resistant compounds

Glazing compounds that become intumescent when heated and have a degree of fire resistance are available. Such materials, when subjected to fire, expand and fill adjacent gaps and voids.

# 5 Design and performance

## 5.1 Heat

### 5.1.1 General

Glazed areas in buildings shall be designed so that account is taken of the overall heat balance in relation to the effects of the thermal comfort of occupants and the total annual energy implications of solar gain and heat loss. These need to be examined separately, since factors affecting one aspect of performance may have no effect on the other.

Heat gain is due to transmission of solar radiant energy through the glass into the building. Solar energy is all at relatively short wavelengths and is controlled by using the glass to absorb or reflect the energy. Heat loss is due to the transfer of low-grade heat, by conduction, conversion and long wavelength radiation and is controlled by incorporating air cavities and using low emissivity (low-E) glass.

### 5.1.2 Thermal comfort

Heat transmission through glazing can significantly influence occupier comfort by raising or lowering room air temperatures. For example, sunny weather can give rise to excessive heat gains even if the air temperature is low and heat losses can occur through the glazing during cold weather, or at night. Thermal comfort shall be used as the most important criterion for choice of performance glazing. Determination of thermal comfort is a particularly complex problem and can be affected by factors such as individual preference, geographic location and time of year. However glazing materials can substantially change the amount of heat entering and leaving a building and recommendations based on the change of energy can be made.

### 5.1.3 Solar heat gain

Factors that can influence the amount of solar gain through the glazing include

a) orientation,

b) window area,

c) shading devices, both internal and external, and

d) properties of the glazing.

### 5.1.4 Total solar energy transmittance

The solar energy transmittance is the proportion of solar radiation at normal incidence transferred through the glazing. It is composed of the direct transmittance, (short wave component) and the part of the solar absorptance dissipated inwards by long wave radiation and convection (long wave component).

The total solar energy transmission properties of solar control glazing can be described by their shading coefficients. The shading coefficient is derived by comparing the properties of the solar control glazing with a clear float glass having a total solar energy transmittance of 0,87 (i.e. clear glass of between 3 mm and 4 mm thick).

### 5.1.5 Thermal performance

#### 5.1.5.1 Heat transmission

Heat can pass through a glazing pane

a) by radiation, because the material is partly transparent to direct or reflected solar energy, and

b) by conduction, because of the air-to air- temperature difference across the pane.

#### 5.1.5.2 Radiant heat gains (solar heat gains)

**5.1.5.2.1** Solar radiation that falls on a glazing pane is partly reflected, partly absorbed and partly transmitted. The component that is absorbed is re-emitted, partly inwards, and partly outwards, through radiation and conduction. The magnitude of each component will depend on the composition of the glazing pane, its surface treatment and whether the glazing is single or multiple. Clear single glazing gives a high solar transmittance and a low solar absorptance and reflectance. Clear multiple glazing has a slightly lower transmittance than clear single glazing, owing to multiple reflection and increased thickness of material. The solar absorptance or reflectance (or both) of solar control material exceeds that for clear glazing, and the transmittance is lower.

Where it is necessary to minimize glare or reduce solar radiation, use may be made of shading devices. External shading devices are more effective than internal devices in reducing solar heat gains because they either limit the amount of direct solar radiation that reaches the surface of the glazing pane or block it out altogether.

**5.1.5.2.2** Another way of reducing solar gains and glare of clear glazing panes is by the application of coloured or reflective plastics film to the surface of the glazing pane. However, it shall also be noted that the use of heat-controlling types of glazing pane and plastics film reduces the amount of daylight entering a building and this shall be taken into account in the overall design. Light transmission values for specific heat controlling materials are obtainable from the manufacturer's data sheets.

Figures 2, 3 and 4 illustrate the solar transmittance for a number of typical glazing situations. They show that the total transmittance consists of the initial transmitted component plus the part of the absorbed component that is reradiated inwards. For example, in figure 2, the total solar transmittance of clear glazing pane consists of the initial transmitted component of 80 % plus the part of the absorbed component reradiated inwards, which is 5 %, giving a total of 85 %.

**5.1.5.2.3** When calculating the instantaneous solar heat gain through the glazed areas of a building, use can be made of the shading coefficient or the solar-heat-gain factor (*SHGF*), depending on the method of calculation used. For example, the total shading coefficient for the glazing pane in figure 2 is

$$\frac{0,85}{0,87} = 0,98$$

The mean solar heat gain into a room is a function of the mean incident radiation intensity, the appropriate *SHGF* for the type of glazing pane and solar protection, and the sunlit area of the glazing. The mean solar heat gain is expressed using the following equation:

$$Q_s = \frac{SHGF}{A_g}$$

where

$Q_s$ is the mean solar heat gain, expressed in watts (W);

*SHGF* is the solar-heat-gain factor (shading coefficient);

$A_g$ is the sunlit area of glazing, expressed in square metres ($m^2$).

Where solar protection can vary during the day, for example through the manipulation of shading devices, allowance shall be made for this in the application of the *SHGF*, and guidance on the allowance necessary shall be obtained from the relevant glazing pane manufacturer.

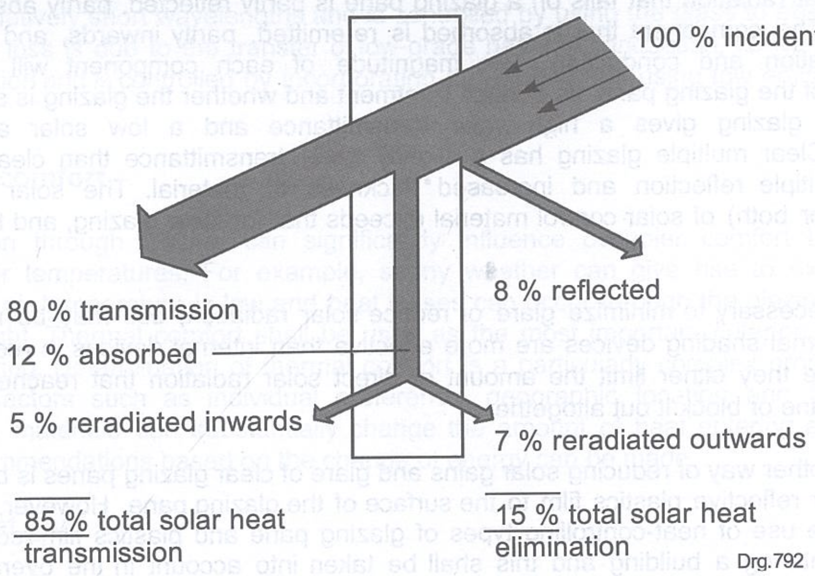



**Figure 2 — Typical thermal transmittance of clear glass**

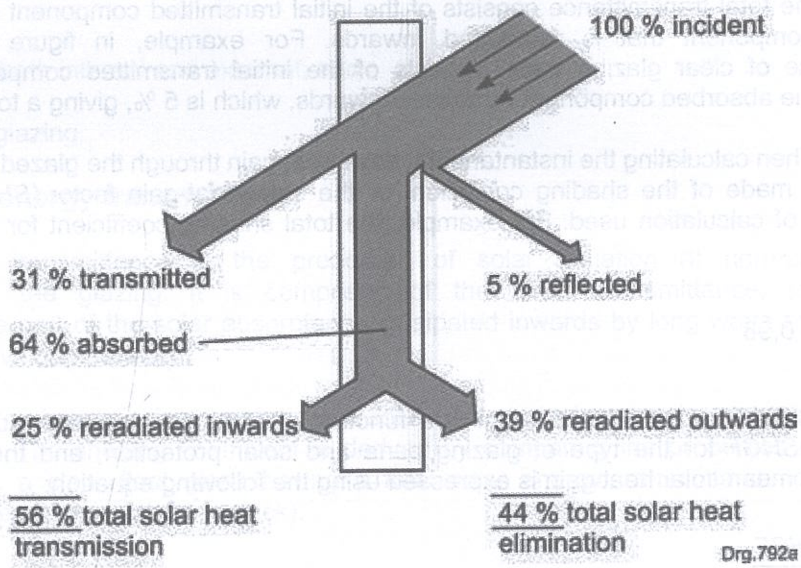



**Figure 3 — Typical thermal transmittance of solar-heat-absorbing glazing pane**

**5.1.5.3 Body tinted glass** (increased absorption)

Solar control properties and colour vary with the thickness of the glass. When used in insulating glass units, body tinted glass shall be positioned as the outer pane because the heat due to the absorbed radiation is more easily dissipated to the outside.

Performances of a typical range of body tinted glass products are shown in table 1, with the properties of clear float for comparison. Actual values shall be obtained from individual manufacturers and confirmed by the competent person (glazing).

**5.1.5.4 Reflective coated glass**

**5.1.5.4.1** Reflective coated glass uses the principle of increasing the direct reflection to maximize solar heat attenuation. In comparison with clear glass its absorption of solar energy is also increased.

The advantages of such glass types are

a) greater performance range than body tinted glass,

b) higher performances (greater solar heat attenuation),

c) light/heat ratios nearer to the theoretical limit, and

d) a range of colour appearances in transmission and reflection.

**5.1.5.4.2** Performance data in comparison to clear glass is shown in table 2. Actual values shall be obtained from individual manufacturers and confirmed by a competent person (glazing).

**Table 1 — Performance of typical body tinted glass products**

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|
| **Glass thickness and type** | **Light** | | **Solar radiant energy** | | | | **Shading coefficients** | | |
| **mm** | **Reflec-tance** | **Trans-mittance** | **Reflec-tance** | **Absorp-tance** | **Trans-mittance** | **Total transmittance** | **Short wave** | **Long wave** | **Total** |
| 4 clear | 0,08 | 0,89 | 0,07 | 0,11 | 0,82 | 0,85 | 0,94 | 0,04 | 0,98 |
| 4 green | 0,07 | 0,78 | 0,05 | 0,37 | 0,58 | 0,68 | 0,67 | 0,11 | 0,78 |
| 4 bronze | 0,06 | 0,61 | 0,05 | 0,37 | 0,58 | 0,68 | 0,67 | 0,11 | 0,78 |
| 4 grey | 0,05 | 0,55 | 0,05 | 0,40 | 0,55 | 0,65 | 0,63 | 0,12 | 0,75 |
| 6 clear | 0,08 | 0,87 | 0,07 | 0,15 | 0,78 | 0,82 | 0,90 | 0,04 | 0,94 |
| 6 green | 0,06 | 0,72 | 0,05 | 0,49 | 0,46 | 0,59 | 0,53 | 0,14 | 0,67 |
| 6 blue | 0,05 | 0,54 | 0,05 | 0,49 | 0,46 | 0,59 | 0,53 | 0,14 | 0,67 |
| 6 bronze | 0,05 | 0,50 | 0,05 | 0,49 | 0,46 | 0,59 | 0,53 | 0,14 | 0,67 |
| 6 grey | 0,05 | 0,42 | 0,05 | 0,53 | 0,42 | 0,56 | 0,48 | 0,16 | 0,64 |
| 10 clear | 0,07 | 0,84 | 0,07 | 0,23 | 0,70 | 0,76 | 0,80 | 0,07 | 0,87 |
| 10 green | 0,06 | 0,61 | 0,04 | 0,67 | 0,29 | 0,46 | 0,33 | 0,20 | 0,53 |
| 10 bronze | 0,04 | 0,33 | 0,04 | 0,67 | 0,29 | 0,46 | 0,33 | 0,20 | 0,53 |
| 10 grey | 0,04 | 0,25 | 0,04 | 0,71 | 0,43 | 0,43 | 0,29 | 0,21 | 0,50 |

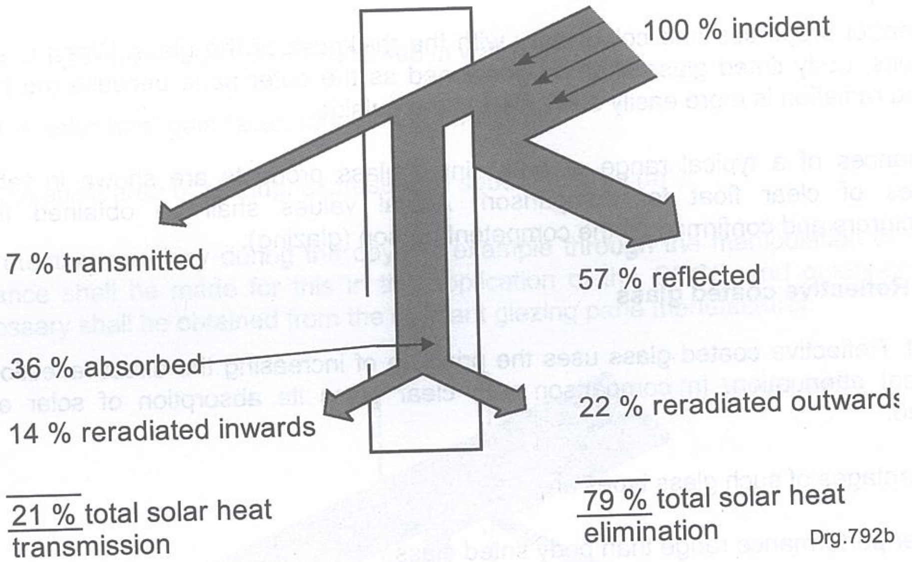



**Figure 4 — Typical thermal transmittance of solar-heat-reflecting glazing pane**

**Table 2 — Properties of a typical range of reflective coated glass products**

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|
| **Glass thickness and type** | **Light** | | **Solar radiant energy** | | | | **Shading coefficients** | | |
| | **Reflec-tance** | **Trans-mittance** | **Reflec-tance** | **Absorp-tance** | **Trans-mittance** | **Total transmittance** | **Short wave** | **Long wave** | **Total** |
| mm | | | | | | | | | |
| 6 clear | 0,08 | 0,87 | 0,07 | 0,15 | 0,82 | 0,85 | 0,94 | 0,04 | 0,94 |
| 6 silver | 0,13 | 0,32 | 0,11 | 0,60 | 0,58 | 0,68 | 0,67 | 0,11 | 0,49 |
| 6 silver | 0,23 | 0,20 | 0,18 | 0,66 | 0,58 | 0,68 | 0,67 | 0,11 | 0,35 |
| 6 silver | 0,38 | 0,10 | 0,32 | 0,58 | 0,55 | 0,65 | 0,63 | 0,12 | 0,23 |
| 6 clear | 0,10 | 0,40 | 0,10 | 0,61 | 0,78 | 0,82 | 0,90 | 0,04 | 0,53 |
| 6 blue | 0,16 | 0,30 | 0,18 | 0,64 | 0,46 | 0,59 | 0,53 | 0,14 | 0,41 |
| 6 blue | 0,16 | 0,20 | 0,21 | 0,66 | 0,46 | 0,59 | 0,53 | 0,14 | 0,34 |
| 6 blue | 0,20 | 0,26 | 0,14 | 0.73 | 0,46 | 0,59 | 0,53 | 0,14 | 0,41 |
| 6 bronze | 0,17 | 0,10 | 0,21 | 0,66 | 0,42 | 0,56 | 0,48 | 0,16 | 0,24 |
| 10 bronze | 0,19 | 0,10 | 0,10 | 0,73 | 0,70 | 0,76 | 0,80 | 0,07 | 0,51 |
| 10 grey | 0,12 | 0,32 | 0,10 | 0,69 | 0,29 | 0,46 | 0,33 | 0,20 | |

NOTE The coatings may be placed onto body-tinted glass to extend the range of performances.

#### 5.1.5.5 Laminated glass

Laminated glass is commonly constructed with clear glass and clear interlayers, but solar control properties can be incorporated into laminated glass by including either solar control glass or tinted interlayers, or both.

Laminated glass with clear interlayers and solar control glass exhibits similar properties to the solar control glass from which it is made.

Laminated glass with a tinted interlayer acts in a similar manner to body tinted glass, by absorbing the solar radiation, but with a different range of colours and performances.

Performances of a typical range of laminated glass products with clear glass and tinted interlayers are shown in table 3, with the properties of clear laminated glass for comparison. Actual values shall be confirmed by a competent person (glazing).

### 5.1.6 Solar control plastics glazing sheet materials

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

### 5.1.7 Blinds and louvers

The use of blinds or louvers in windows affects the window-shading coefficient and depends upon the solar optical properties of the glazing and the material of the blind, the coefficients of heat transfer at the window surfaces, the geometry and location of the blind, and the angular position of the sun. The manufacturer shall be consulted for specific advice.

**Table 3 — Properties of a typical range of laminated glass products with tinted interlayers and clear glass**

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|
| **Glass thickness and type** | **Light** | | **Solar radiant energy** | | | | **Shading coefficients** | | |
| mm | **Reflec-tance** | **Trans-mittance** | **Reflec-tance** | **Absorp-tance** | **Trans-mittance** | **Total transmittance** | **Short wave** | **Long wave** | **Total** |
| 6,4 clear | 0,08 | 0,87 | 0,07 | 0,16 | 0,77 | 0,81 | 0,89 | 0,04 | 0,93 |
| 6,4 brown | 0,04 | 0,28 | 0,04 | 0,64 | 0,32 | 0,49 | 0,03 | 0,19 | 0,56 |
| 6,4 bronze | 0,05 | 0,52 | 0,05 | 0,41 | 0,54 | 0,65 | 0,62 | 0,12 | 0,74 |
| 6,4 grey | 0,05 | 0,44 | 0,05 | 0,44 | 0,51 | 0,62 | 0,59 | 0,13 | 0,72 |
| 6,4 marine | 0,06 | 0,60 | 0,06 | 0,31 | 0,63 | 0,71 | 0,72 | 0,10 | 0,82 |
| 6,4 blue-grey | 0,05 | 0,37 | 0,05 | 0,52 | 0,43 | 0,56 | 0,49 | 0,16 | 0,65 |
| 6,4 blue-grey | 0,07 | 0,73 | 0,07 | 0,24 | 0,69 | 0,75 | 0,79 | 0,07 | 0,86 |
| 6,4 white translucent | 0,05 | 0,57 | 0,05 | 0,41 | 0,54 | 0,65 | 0,62 | 0,12 | 0,74 |

## 5.2 Heat Loss

### 5.2.1 General

Heat loss is quantified by the thermal transmittance or *U*-values. (For a full definition of thermal transmittance and its method of calculation see BS EN 673.) Glass and thin plastics glazing sheet materials readily conduct heat and so are poor insulators. To improve resistance to heat loss, insulation sealed insulated glass units or coupled windows shall be used, since the air cavities provide extra thermal resistance.

### 5.2.2 Methods for improving thermal insulation

#### 5.2.2.1 Use of low emissivity (low-E) coatings

Low-E coatings have surface emissivities of less than 0,2 (see BS 952-1). The use of such a coating on glass improves the thermal insulation. They are most efficient when used on the cavity surfaces of insulating glass units.

#### 5.2.2.2 Increasing the width of the air space

Enhanced thermal insulation can be achieved by increasing the width of the airspace. However, there is a practical upper limit of approximately 25 mm; above this width no extra thermal benefit is obtained due to convection of the air in the cavity.

#### 5.2.2.3 Using gases of lower thermal conductivity

Replacing the air in the cavity with, for example, argon, can improve the thermal insulation. If gases other than air are used the manufacturer shall be consulted for the *U*-value.

#### 5.2.2.4 Inhibiting convection within the air space

Filling the cavity with cellular material reduces convection and makes the cavity a more efficient insulator. However, this usually results in loss of vision, since the materials are, at best, translucent.

#### 5.2.2.5 Evacuation of the air space

In theory, a vacuum will eliminate heat transfer by conduction and convection. However, a vacuum puts high demands on the glass from the external air pressure.

### 5.2.3 Energy efficient glazing

A competent person (glazing) may use the design guidelines as given in SANS 204 to calculate the glazing required for energy efficiency. Alternatively a competent person (glazing) will use good engineering practice or experience (or both) in the design of energy efficient glazing systems and shall document and maintain documentation of each project so designed.

## 5.3 Condensation

### 5.3.1 Room side condensation

As thermal insulation of the glazing improves, the susceptibility to condensation on the room face of the glazing is reduced.

### 5.3.2 Interstitial condensation

In insulating glass units, condensation in the cavities is minimized by sealing and dehydrating the cavity. In coupled windows, interstitial condensation problems can be reduced by venting the cavity to the outside. However dust control and contamination of the interstitial space becomes a problem.

### 5.3.3 Exterior condensation

On rare occasions, condensation may occur on the outermost glass surface of highly insulating glazing, for example low-E glass, as a result of the reduction of heat conduction to the outside. This effect will only be prevalent at low sky temperature, i.e. clear sky, when there is heavy dew or due to the events of air-conditioning and very hot humid conditions.

## 5.4 Thermal safety of glass

The thermal safety of glass shall be assessed considering the amount of radiation incident on the surface and the thermal capabilities of the glass.

For example, the solar radiation intensity on the glass surface shall be determined along with the air temperature range applicable to the location of the building. These measurements, 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. The difference is related to the thermal stress and then modified for the type of glazing system, taking into account extraneous effects resulting from for example, curtains, blinds, back-up walls and proximity to heaters/air conditioners, to derive a stress for actual service conditions.

NOTE High air temperatures, incident solar radiation, 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 shall 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 adequate quality.

NOTE Where the application of a solar control film is being considered to existent glazing, advice shall be sought from the manufacturer on the effect of any additional thermal stress likely to be induced in the glass.

The mode of thermal breakage of glass is by the action of tensile stress located in and parallel to an edge, and so 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 shall not be nipped to size and any panes with shelled or vented edges shall not be accepted for glazing in orientations subject to direct sunlight. Where clean-cut edges are not permitted, arrisses shall be created by a wet process, working parallel to the edge and not across the thickness, and the design implications of such an action shall be examined.

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 shall be assumed in assessing the thermal safety of glass.

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, this depends on close adherence to the recommended glazing procedures. All necessary precautions shall be taken to see that only glass with edges of an acceptable condition is used. The glass shall be stored and handled so that no contact with hard bodies can damage the edges and each square shall be carefully examined immediately before glazing.

Some solar control glasses can be toughened or heat strengthened and this gives a means of raising the design stress and ensuring safety from thermal fracture. The manufacturer or competent person (glazing) (or both), shall provide relevant thermal stress evaluation.

## 5.5 Prevention of thermal cracks of glass

Numerous construction arbitration cases in South Africa have ruled that it is the responsibility of the persons installing the glass (i.e. sub-contractor or glazier (or both)) to ensure that the glass does not crack due to thermal or other causes.

This is even upheld in cases where the specifier specified without the apparent option for alternatives, the trade name, type and thickness of the heat absorbing or heat reflecting glasses.

The introduction of structural glazing usually solves the thermal crack factor, however, many applications are still executed in more conventional methods making a request by the sub-contractor or glazier (or both) for thermal stress evaluation by the glass manufacturer or competent person (glazing) essential to protect the interest of all parties concerned.

Always polish the glass edges of heat absorbing or heat reflecting glasses, and always obtain a thermal stress evaluation from the glass manufacturer or competent person (glazing).

## 5.6 Breakage evaluation

Thermal breaks can be identified by the following characteristics (see figure 5):

a) The break line always makes a right angle with edge of glass at or near the origin.

b) If the break line does not separate into two or more lines within 50 mm from the edge and the origin, a low stress caused the failure. This indicates that the glass edge was damaged.

c) If the break line separates into two or more lines within 50 mm of the edge (more lines mean higher breaking stress), it indicates that surrounding conditions are causing high temperature difference between centre portion and edge of glass.

d) If the break line does not make a right angle with the edge of the glass at or near the origin, this indicates a low stress below 10 343 kPa tension break from bending.

e) Impact damage either to the edge of the glass or to the face of the glass is very easy to determine, as the point of impact is normally clearly visible from which cracks radiate in several directions.

## 5.7 Thermal expansion

### 5.7.1 ass

The coefficient of linear expansion of all the soda-lime silicate glass types referred to in BS EN 572-1, whether clear or tinted, annealed, laminated or toughened, is approximately

$8,3 \times 10^{-6}\ K^{-1}$

### 5.7.2 astics glazing sheet materials

Movement caused by temperature changes shall be allowed for when cutting plastics glazing sheet material to fit into a frame. The coefficient of linear expansion for most plastics sheet materials is approximately

$6,0 \times 10^{-5}\ K^{-1}$ to $8,0 \times 10^{-5}\ K^{-1}$

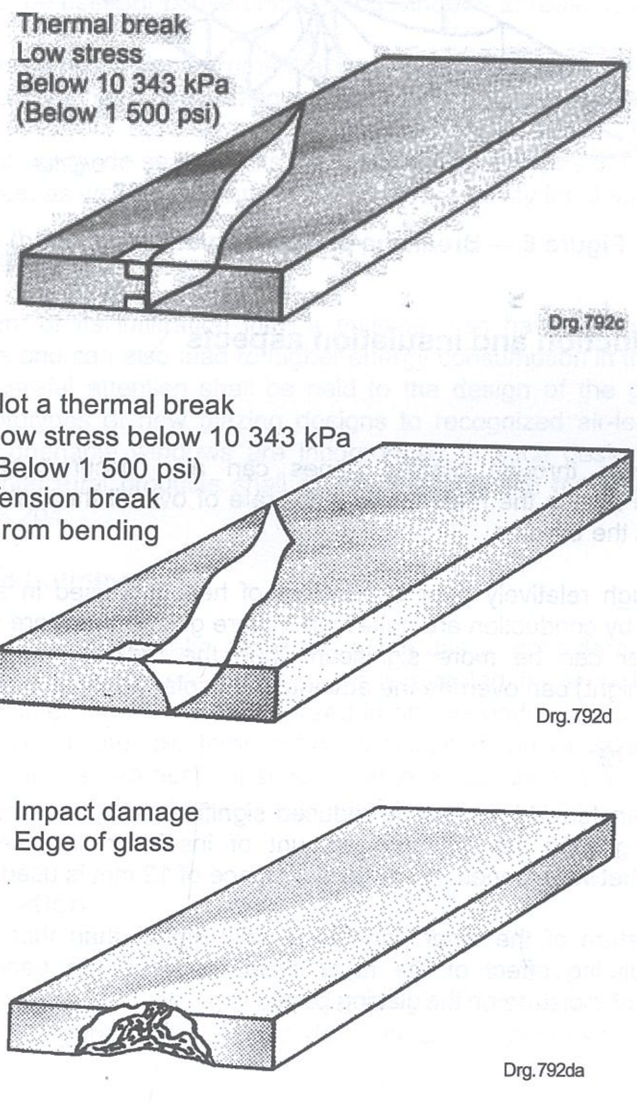
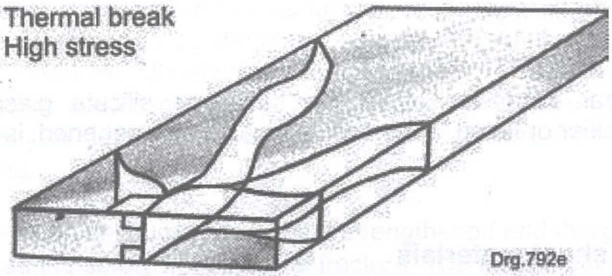



**Figure 5 — Breakage pattern of glass**



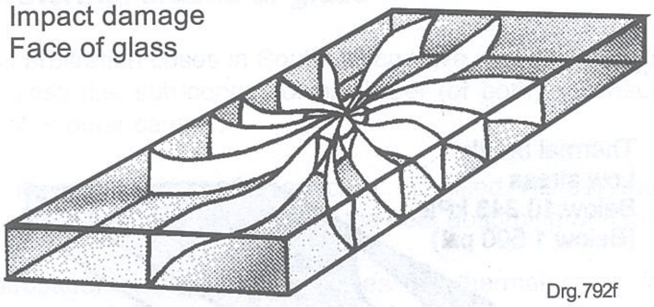




**Figure 5 — Breakage pattern of glass** (*concluded*)

## 5.8 Thermal conduction and insulation aspects

### 5.8.1 General

Heat gains and losses through glazing panes can also occur because of the air-to-air temperature difference across the material, and the rate of overall thermal transmittance owing to this effect is known as the *U*-value.

Glazing panes, although relatively poor conductors of heat are used in such thin sections that heat gains and losses by conduction are quite high. Where glazed areas are shaded, the conductive heat gains in summer can be more significant than the radiant heat gains. In winter, heat losses (particularly at night) can override the advantage of solar heat gains by day.

### 5.8.2 Multiple glazing

**5.8.2.1** The rate of transferred loss can be reduced significantly by the use of multiple glazing. In the case of vertical glazing the optimum amount of insulation is obtained with a space of approximately 19 mm between panes. (In general, a space of 12 mm is used.)

In winter the temperature of the inner pane is usually higher than that of the outside surface (because of the insulating effect of the layer of air between the panes), and this helps to prevent condensation of moisture on the glazing pane.

**5.8.2.2** The following are forms of multiple glazing from which a choice can be made to suit the particular requirements:

a) Factory-made hermetically sealed units (sealed insulating glass units (SIGU), or double glazing): These units have a carefully constructed seal between the panes so that condensation on the inner surfaces is eliminated and these surfaces need never be cleaned (see also 4.2.3.5(d)). These units may require some form of pressure equalisation between manufacture and installation to eliminate altitude induced atmospheric pressure changes. This will normally take the form of a breather tube which shall be sealed at installation.

b) Double windows: This form of glazing consists of two separate frames, each single glazed and fixed in the same wall opening. It provides good sound insulation because of the wide spacing and the separate surrounds (see also 5.2).

c) Auxiliary frames: This is a form of coupled window in which an additional surround with a single glazing pane is fixed to the main window surround. Such a window opens as a single unit for ventilation purposes but the auxiliary frame is removable to provide access for cleaning. (This method of glazing can be used for converting existing windows at reasonable cost.)

d) Dual glazing: This constitutes a single frame that carries two panes individually glazed, the panes being separated either by a bead or by being fixed in separate rebates.

Except in the case of factory-made sealed units (see (a) above), all types of multiple glazing require ventilation of the air space, as well as a means of access to the cavity for cleaning purposes.

### 5.8.3 Air-sealing of glazing

The leakage of air from, or its infiltration into, a building, can have a significant effect on the comfort of the occupants and can also lead to higher energy consumption in the building. In order to minimize air leakage, careful attention shall be paid to the design of the glazing as well as its installation. Subject prototypes of new glazing designs to recognized air-leakage and infiltration tests, especially where openable windows are incorporated in such designs. Reference to test methods for glazed architectural products shall be made along with the requirements for energy efficiency made in SANS 204.

### 5.8.4 Air-conditioned buildings

If a building is to be air-conditioned, take into account the design considerations given in 5.1.2 to 5.1.4 because the load on the air-conditioning plant is affected by solar heat gains. Optimum comfort conditions in summer are also better realized in an air-conditioned building in the absence of both direct solar radiation and low temperature radiation to un-insulated elements. Building design that takes these factors into account shall result in a reduction in equipment requirements and running costs. It is also important to minimize heat losses in winter via the glazing of such a building.

### 5.8.5 Energy conservation

In the design of a major building project such as an office or residential block, calculate the expected heat gains and losses, taking into consideration the functional properties of the glazing materials, and prepare a total energy budget in order to obtain the best use of the available energy resources.

## 5.8.6 Thermal movement of plastics glazing panes

### 5.8.6.1 General

Plastics materials expand and contract much more than glass. To accommodate thermal expansion, cut clear plastics panes smaller than the tight size (see 3.42.3) by the appropriate amount given in table 4.

Coloured plastics sheet might require even greater allowances because of increased solar-energy absorption. Consult the relevant manufacturer in this regard.

### 5.8.6.2 Depth of rebate

To accommodate thermal movement and to avoid pop-out situations, a minimum rebate depth of 20 mm shall be used for the provision of sufficient cover of the edges irrespective of the thickness of the pane. Where a smaller rebate is necessary the supplier shall be consulted for special glazing instructions (see figure 1).

**Table 4 — Reduction in size of plastics sheet to accommodate thermal expansion**

| 1 | 2 |
|---|---|
| **Length of side** | **Reduction**[a] |
| Up to 1 000 | 3 |
| 1 001 – 2 000 | 5 |
| 2 001 – 3 000 | 7 |
| [a] The reductions apply to sheets that are cut under factory conditions at a temperature of approximately 20 °C. If the sheets are cut on site in winter, allow a further reduction of 1 mm/1 000 mm of length of side for every 10 °C below 20 °C. | |

## 5.9 Sound insulation

### 5.9.1 Factors affecting sound transmission

The main factors that affect the transmission of sound through a closed (sealed) window are

a) the size of the window,

b) the thickness and type of the glazing pane, and

c) in the case of a multiple window, the width of the air space(s).

### 5.9.2 Window size

Doubling the window area doubles the amount of energy admitted; it increases the level of transmitted sound by 3 dB (decibel). Similarly, halving the window area reduces sound levels by 3 dB. Clearly a major change in window area is necessary before sound levels are affected to any noticeable degree and reducing the window area is therefore not an important factor in improving sound insulation.

### 5.9.3 Material thickness

The following effects depend on the thickness of the glazing pane:

a) Mass effect: For a given window area and sound frequency, doubling the thickness, and therefore the mass of the glazing pane theoretically increases the sound insulation by 6 dB.

b) Resonance effect: A glazing pane can resonate at certain frequencies depending on its size, stiffness, fixing and mass. The resonance impairs sound insulation at the resonant frequencies; the thinner the pane, the lower the frequency at which fundamental resonance occurs.

c) Coincidence effect: At a certain frequency the wavelength of sound is the same as that of the natural oscillation of the glazing pane and consequently the transmission loss through the material is reduced. This gives a characteristic "coincidence dip" in the insulation spectrum. The greater the thickness of the pane, the lower the frequency at which the coincidence dip occurs. Laminated materials minimize the effect of coincidence and the overall sound insulation of a laminated material is therefore better than that of an unlaminated one of similar thickness since most of the improvement occurs in the coincidence region.

### 5.9.4 Air space

**5.9.4.1** In multiple glazing systems the width of the air space between panes is an important factor in the reduction of sound. In general, the reduction increases with width and a separation of at least 100 mm, with the panes in separate frames, is usually required when insulating against severe noise.

Additional benefit can be obtained by lining the reveals with an acoustically absorbent material.

Tight fitting windows are essential, small gaps having a marked influence on the overall sound reduction. Therefore, where possible, obtain the necessary ventilation of rooms by means other than opening windows.

**5.9.4.2** The sound insulation of a particular window is often given as a single value (expressed in decibels).

The arithmetic mean of the insulation values measured in each of 16 third-octave bands was previously used as a single rating value. However, this meant that various substances with different insulation spectra could have the same single insulation value. Since approximately 1968 a single value, standardized by the International Organization for Standardization (ISO) and called the insulation index, $I_a$ (almost identical to the American sound transmission class (STC)), has been used. It is obtained by comparing the measured values with a prescribed rating curve that takes into account the spectra of domestic sounds and the properties of the ear.

A more satisfactory way of describing the same sound reducing properties of the glazing pane is to list the complete insulation spectrum of the sound source. In this way, and by knowing the spectrum of the sound source, it is possible to select the types of material that will be most effective. It is also possible to ensure that the coincidence dip does not occur at the dominating frequencies of the sound source.

**5.9.4.3** A number of different types of glazing materials are available and details about the sound insulation properties of the individual pane shall be obtained from the relevant manufacturer.

## 5.10 Resistance to wind loads

### 5.10.1 General

Except for accidental loading, the most important force that glazing will be subjected to is wind load. The term "wind load" indicates the force generated by a gust of wind for a maximum of 3 s that the glazing will have to withstand. It takes into account the fact that the glazing can be subjected simultaneously to a positive load on one side and a negative load on the other.

It is the responsibility of the designer in conjunction with consultants to determine the expected wind load in terms of SANS 10160-3, taking into account whether or not the window is permanently sealed, capable of being opened, or permanently open.

The resistance of the glazing to wind load depends to a great extent on the surrounds and fixings and careful attention has to be given to the design and installation of the glazing. The design tables (tables 5 to 19) that follow consider glazing materials simply supported in frames. Only two conditions are considered, namely, supported all around and supported on two opposite edges.

A competent person (glazing) shall be required to design glass for installations using other support methods such as bolted, clamped, and cantilevered and any other method of transferring design loads from the glazing material to the superstructure.

A competent person (glazing) shall use good engineering practice or experience (or both) in the design of the glazing system to resist wind load (and any other required loads such as impact) and shall document and maintain documentation of each project so designed.

The design graphs (see figures 6 to 11, 12 to 17 and 6.9.4) represent a conservative condition for general use with, in some cases, deflection limits as the design criterion. A competent person (glazing) may decide to design glazing using stress limits which may be outside these graph designs provided the competent person (glazing) has considered all implications of such a design (including testing and design calculations) and deemed them acceptable for the particular application.

The architect or structural engineer (or both) shall specify the design wind pressure for a particular building at the time of tender. The specifier (i.e. architect, quantity surveyor, developer or owner) is to supply the manufacturer with the design wind pressure for a particular building as the manufacturer has no access to the owner's requirements in respect of the life expectancy of the building; this together with the engineer's interpretation of building configuration and location in terms of SANS 10160-3. The general procedures and loadings to be adopted in the design of buildings, will determine the required design wind pressure.

The declaration of the design wind pressure at the time of tender also enables the specifier to compare like-for-like during adjudication and circumvents that (sub) contractors select unsuitable glazed architectural products for the project at hand.

If a design wind pressure is not available guidance for its determination shall be obtained from SANS 10160-3. This wind pressure shall be stated on all design documentation.

### 5.10.2 Determination of pane dimensions

#### 5.10.2.1 Specified wind load

Use the wind load specified or determined by the competent person (glazing) to establish pane dimensions from the graphs and figures 6 to 11 for the type of glazing material specified.

NOTE For internal applications a method of determining glazing thickness would be to use the minimum wind load on the design graph or higher wind load if appropriate. However, lower wind loads may be used as determined by the competent person (glazing).

#### 5.10.2.2 Wind load graphs

Wind load graphs are based on

a) non-factored wind load (3 s mean gust) (see table 5 for equally distributed loads of longer duration),

b) a maximum frame deflection of 1/175$^{th}$,

c) a probability of breakage equal to 8/1 000 L,

d) vertical glazing only where self weight has not been considered, and

e) an aspect ratio of one-to-one (refer to table 6 for aspect ratio factors).

Table 5 provides factors to be applied to load resistance of longer duration.

**Table 5 — Load duration factors**

| 1 | 2 |
|---|---|
| **Duration** | **Factor** |
| 3 s | 1,00 |
| 10 s | 0,93 |
| 1 min | 0,83 |
| 10 min | 0,72 |
| 60 min | 0,64 |
| 12 h | 0,55 |
| 24 h | 0,53 |
| 1 week | 0,47 |
| 1 month | 0,43 |
| 1 year | 0,36 |
| Beyond 1 year | 0,31 |
| NOTE 1 Calculated to 8/1 000 L probability of breakage. | |
| NOTE 2 This table is taken from ASTM E 1300a. | |

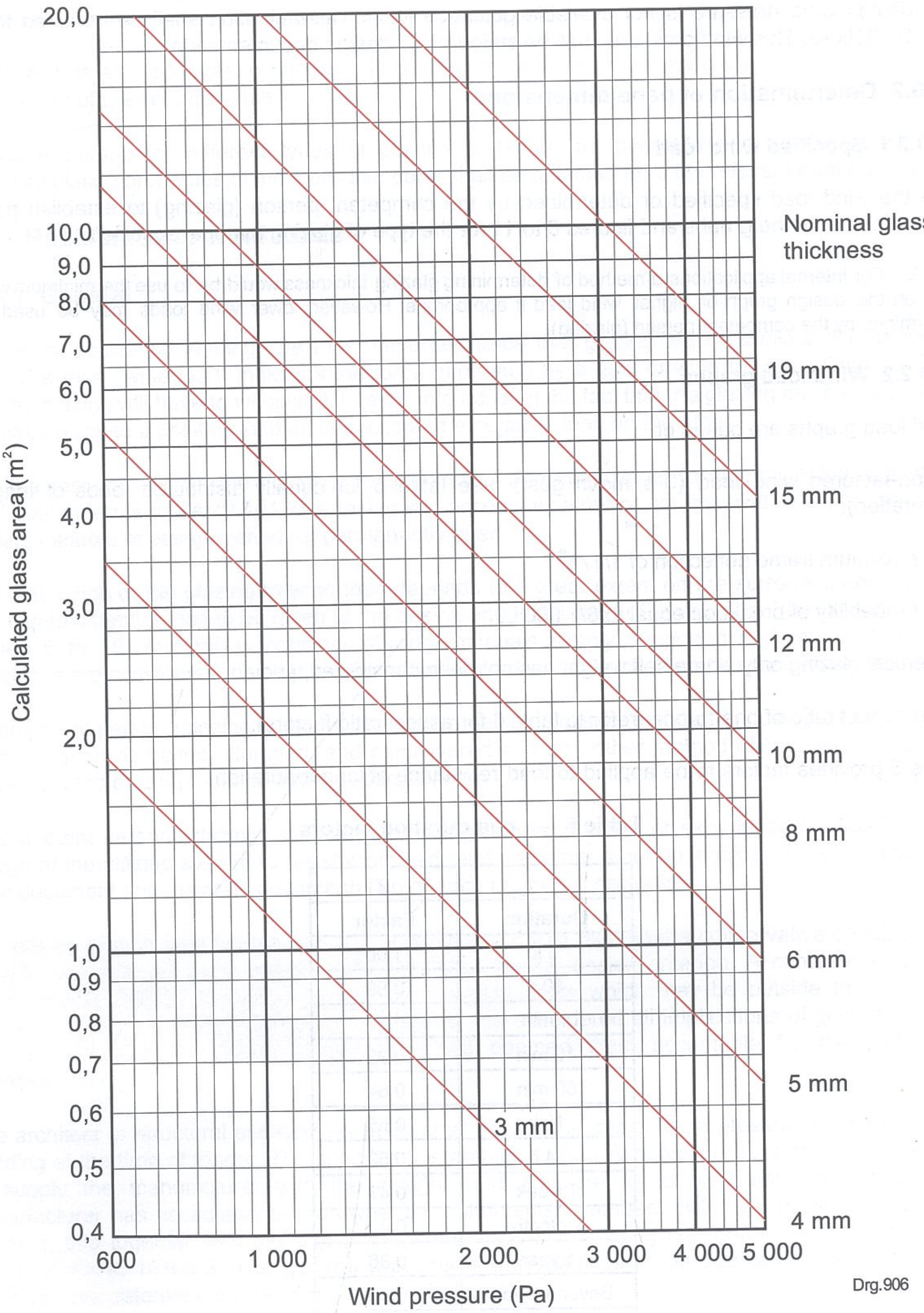



**Figure 6 — Wind load on monolithic annealed glass supported all around (3 s mean wind load)**

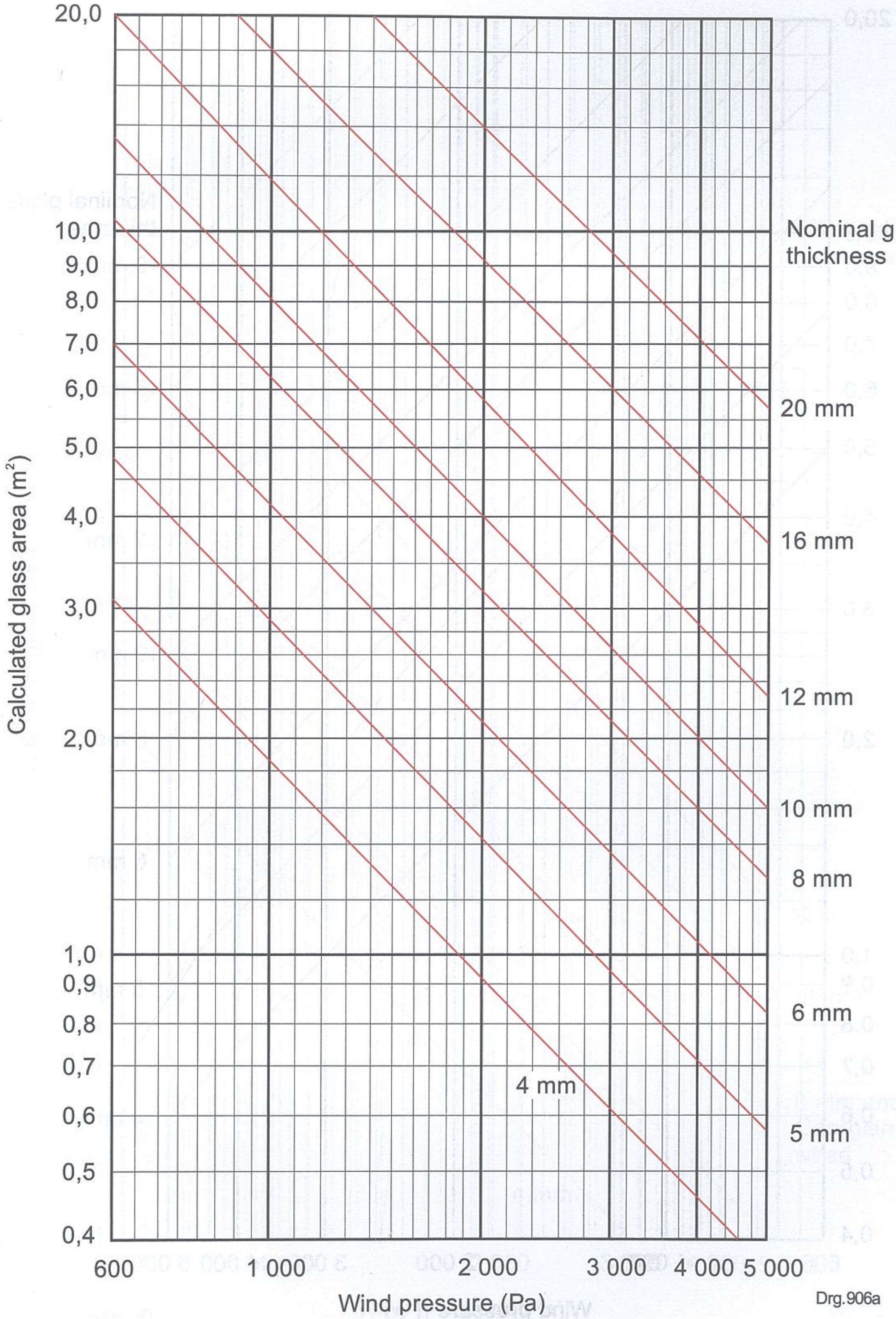



**Figure 7 — Wind load on laminated annealed safety glass support all around (3 s mean wind load)**

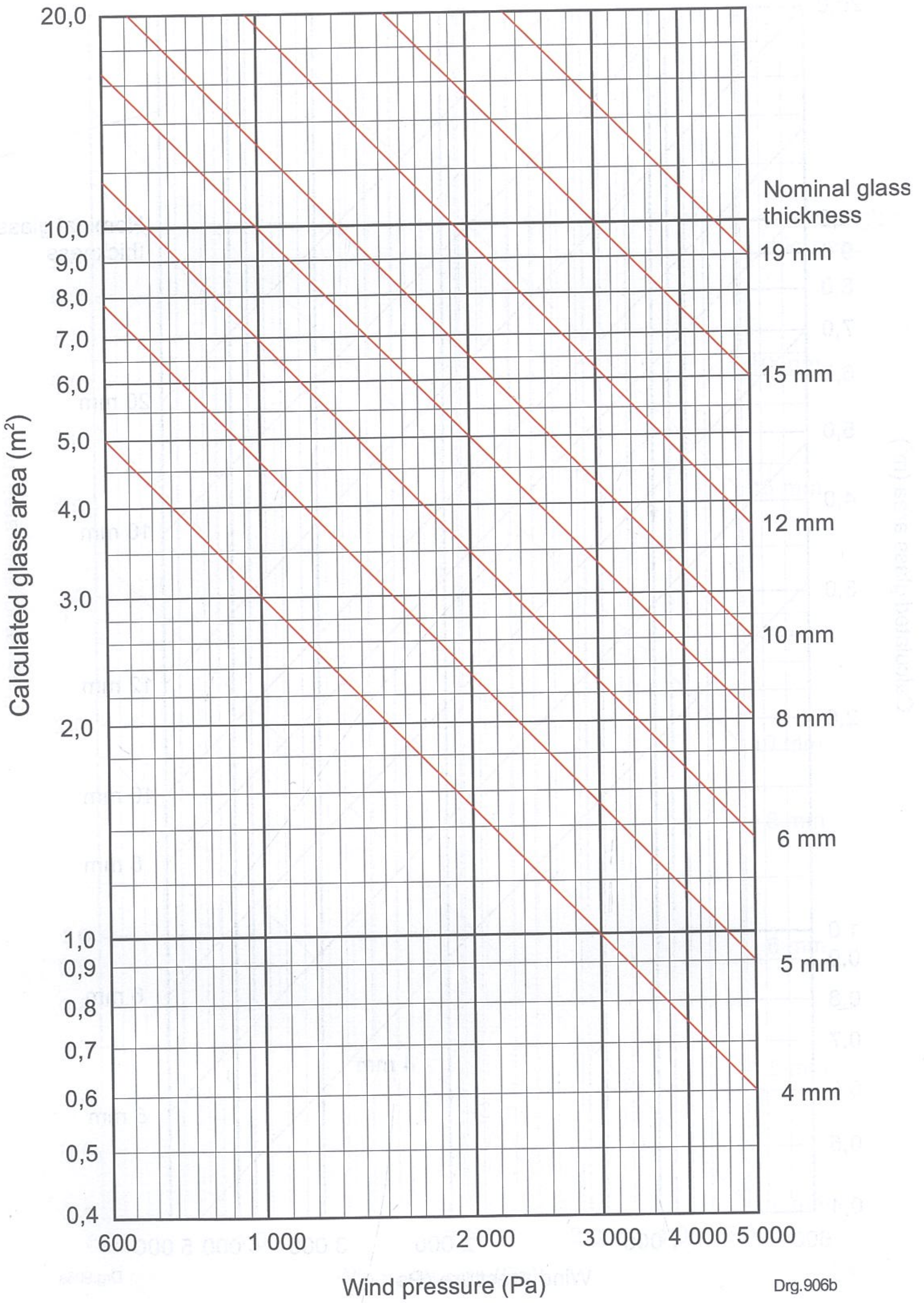



**Figure 8 — Wind load on toughened safety glass supported all around (3 s mean wind load)**

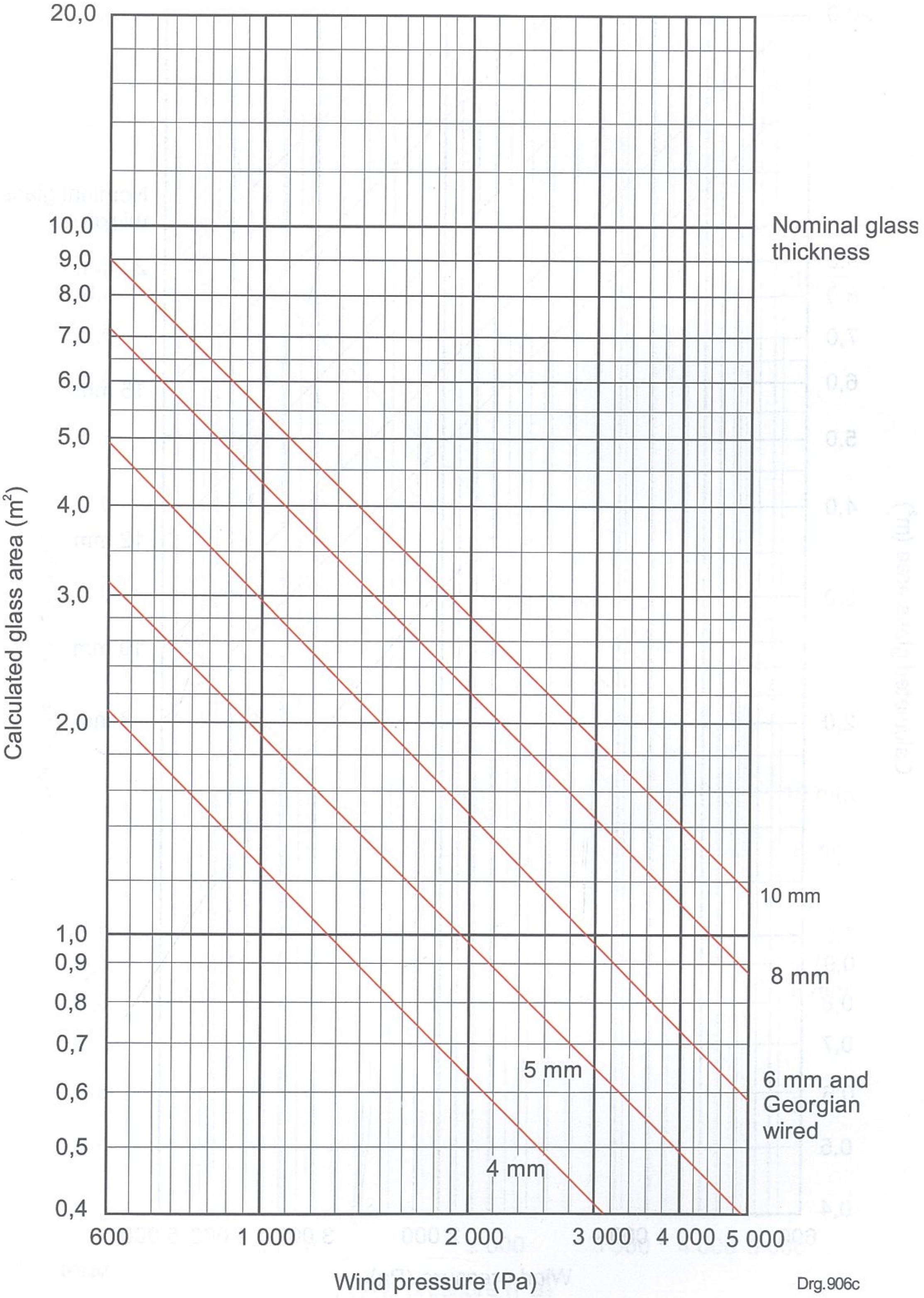



**Figure 9 — Wind load on patterned and wired annealed glass supported all around (3 s mean wind load)**

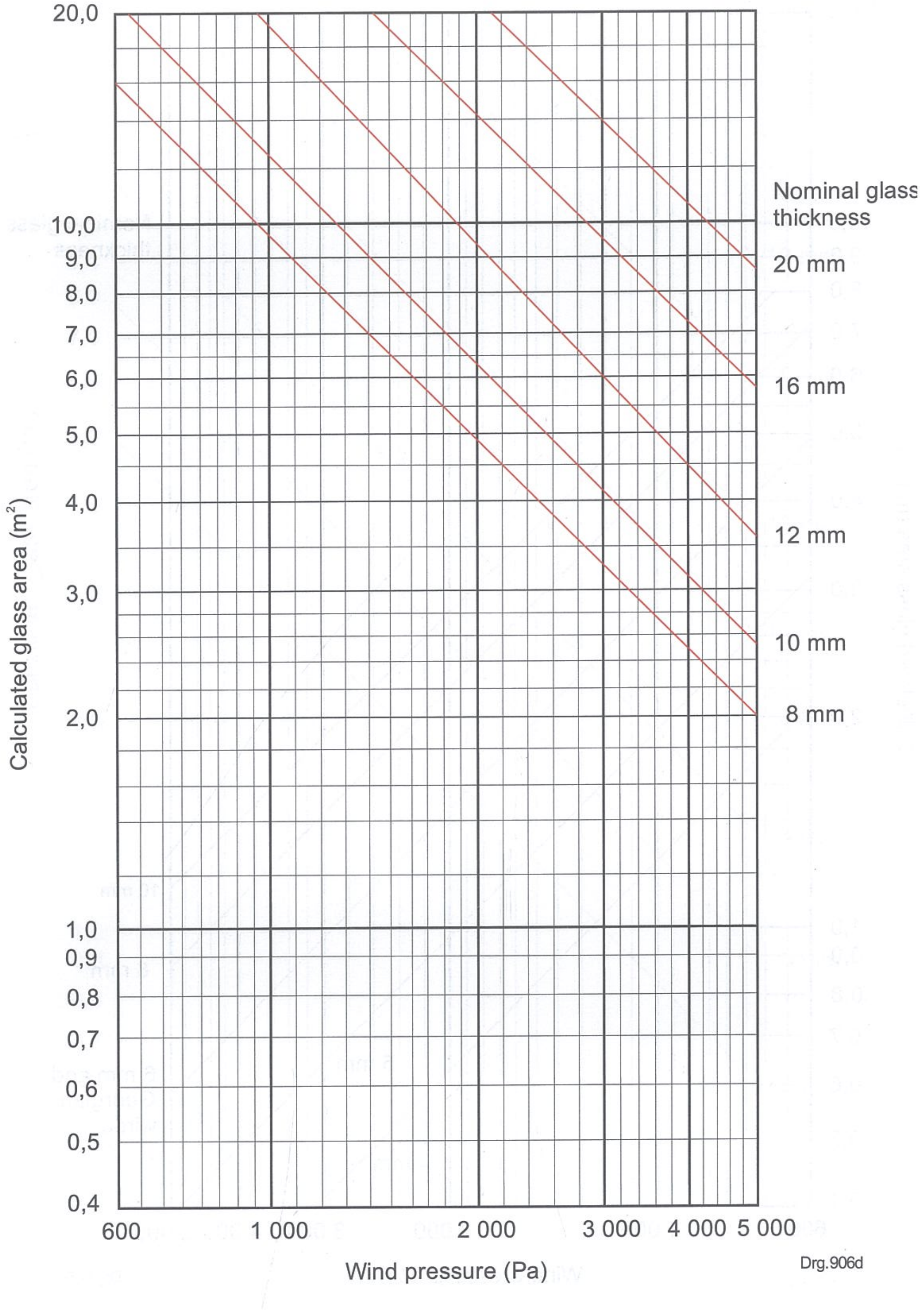



**Figure 10 — Wind load on laminated toughened safety glass supported all around (3 s mean wind load)**

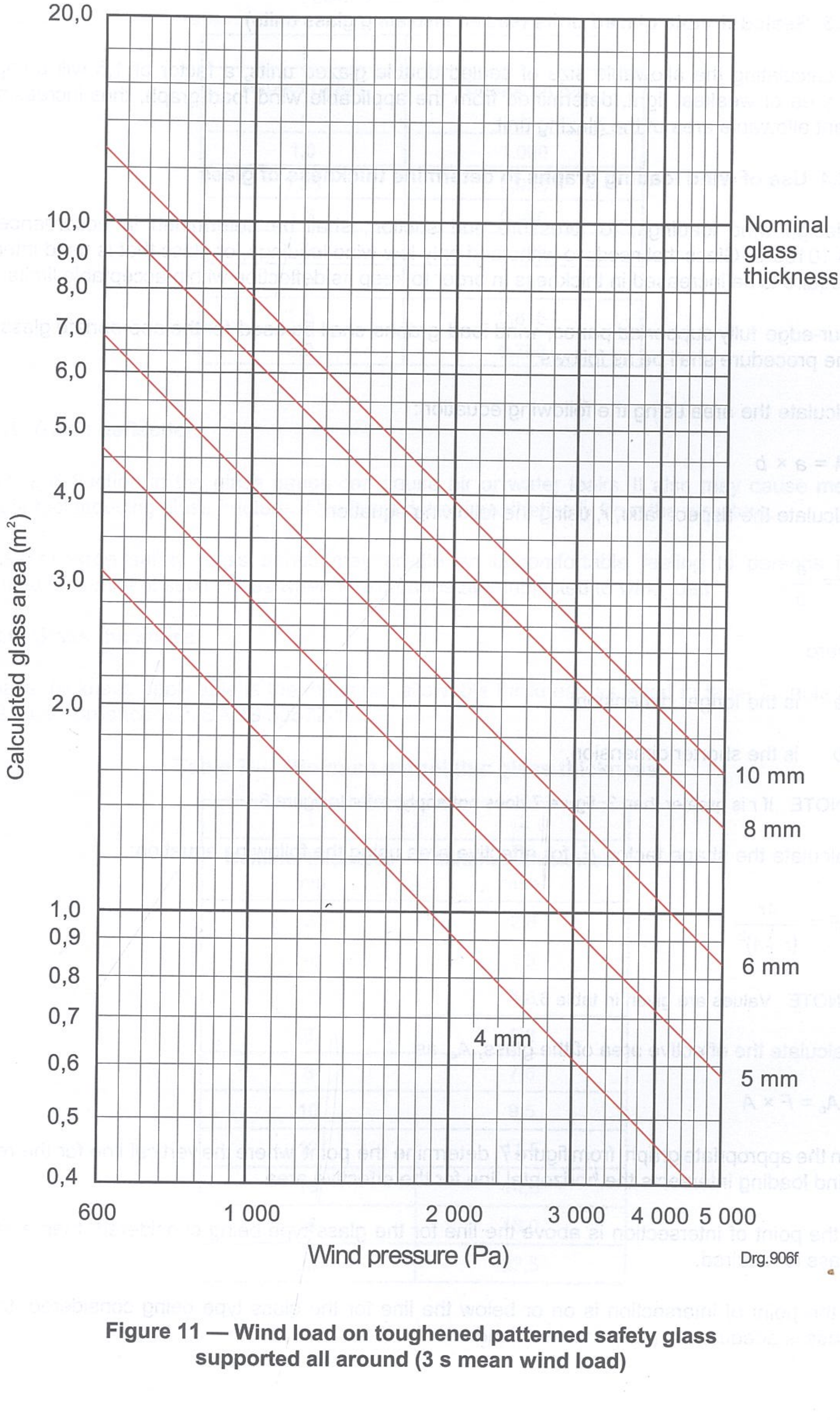



**Figure 11 — Wind load on toughened patterned safety glass supported all around (3 s mean wind load)**

**5.10.2.3 Sealed double glazed units** (sealed insulating glass units)

When calculating the allowable size of sealed double glazed units, a factor of 1,5 will be applied to the area of weakest light, determined from the applicable wind load graph, thus increasing the resultant allowable area of the glazing unit.

**5.10.2.4 Use of wind loading graphs to determine thickness of glass**

The design wind loadings, for pressure and suction, shall be determined in accordance with SANS 10160-3. Glass that needs to withstand only low wind loadings, or glass that is used internally, may require to be increased in thickness in order to keep its deflection within acceptable limits.

For four-edge fully supported panes, wind load graphs shall be used for the appropriate glass type, and the procedure shall be as follows:

a) Calculate the area using the following equation:

$$A = a \times b$$

b) Calculate the aspect ratio, *r*, using the following equation:

$$r = \frac{a}{b}$$

where

*a* is the longer dimension;

*b* is the shorter dimension.

NOTE If *r* is greater than 3, figure 7 does not apply; refer to figure 8.

c) Calculate the shape factor, *F*, for effective area using the following equation:

$$F = \frac{4r}{(r+1)^2}$$

NOTE Values are given in table 6.

d) Calculate the effective area of the glass, $A_e$, as

$$A_e = F \times A$$

e) On the appropriate graph from figure 7, determine the point where the vertical line for the required wind loading intersects the horizontal line for the effective area.

f) If the point of intersection is above the line for the glass type being considered, then a stronger glass is required.

g) If the point of intersection is on or below the line for the glass type being considered, then the glass is adequate to resist the wind load.

**Table 6 — Shape factors**

| 1 | 2 |
|---|---|
| **Aspect ration** $r$ | **Shape factor** $F$ |
| 1,0 | 1,000 |
| 1,25 | 0,988 |
| 1,5 | 0,960 |
| 1,75 | 0,926 |
| 2,0 | 0,989 |
| 2,5 | 0,816 |
| 3,0 | 0,750 |

### 5.10.2.5 Glass deflection

Excessive deflection in the glass panes can cause air or water leaks. It also may cause metal to glass contact inducing glass fracture. Also it will detract aesthetically from the structure.

The use of large safety glass panes may create an uncomfortable feeling to persons in the immediate proximity of such panes when these panes are subjected to wind load.

### 5.10.2.6 Glass thickness

The glass thickness applicable is the minimum allowable thickness as listed in table 7, table 8 and table 9, in accordance with SANS 50572-1.

**Table 7 — Minimum monolithic glass thickness**

| 1 | 2 |
|---|---|
| **Nominal thickness** mm | **Minimum thickness** mm |
| 3 | 2,8 |
| 4 | 3,8 |
| 5 | 4,8 |
| 6 | 5,8 |
| 8 | 7,5 |
| 10 | 9,5 |
| 12 | 11,5 |
| 15 | 14,5 |
| 19 | 18,0 |
| 25 | 23,5 |

**Table 8 — Minimum laminated glass thickness**[a]

| 1 | 2 |
|---|---|
| **Nominal thickness** mm | **Minimum thickness** mm |
| 6 | 5,6 |
| 8 | 7,6 |
| 10 | 9,6 |
| 12 | 11,6 |
| 16 | 15,0 |
| 20 | 19,0 |
| 24 | 23,0 |
| [a] Thickness shown does not include thickness of interlayer, for example, 6 mm may apply to 6,38 mm, 6,76 mm or 7,52 mm. | |

**Table 9 — Minimum monolithic glass thickness**

| 1 | 2 |
|---|---|
| **Nominal thickness** mm | **Minimum thickness** mm |
| 3 | 2,8 |
| 4 | 3,8 |
| 5 | 4,8 |
| 6 | 5,8 |
| 8 | 7,5 |
| 10 | 9,5 |
| 12 | 11,5 |

**5.10.2.7 Glass supported on two opposite edges only**

Figures 12 to 18 are applicable to glass supported on two opposite edges only.

**5.10.2.8 Wind load graphs**

The wind graphs (see figures 6 to 11, 12 to 17 and 6.9.4) are based on the following:

a) non-factored wind load (3 s mean gust) (see table 5 for equally distributed loads of longer duration);

b) a maximum frame deflection of 1/175$^{th}$;

c) a probability of breakage equal to 8/1 000 L; and

d) vertical glazing only where self weight has not been considered.

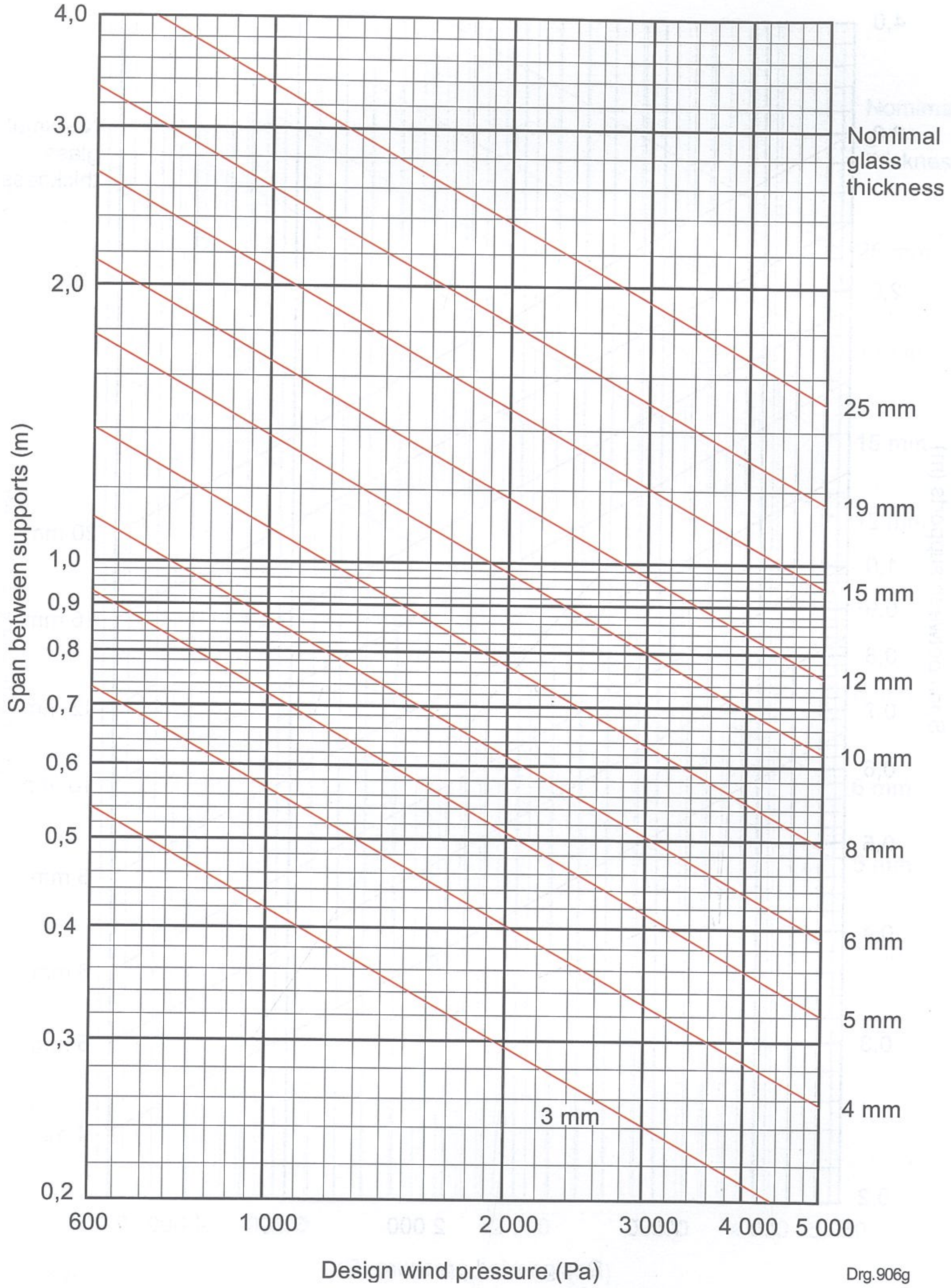



**Figure 12 — Wind load on monolithic annealed glass supported on two opposite sides (3 s mean wind load)**

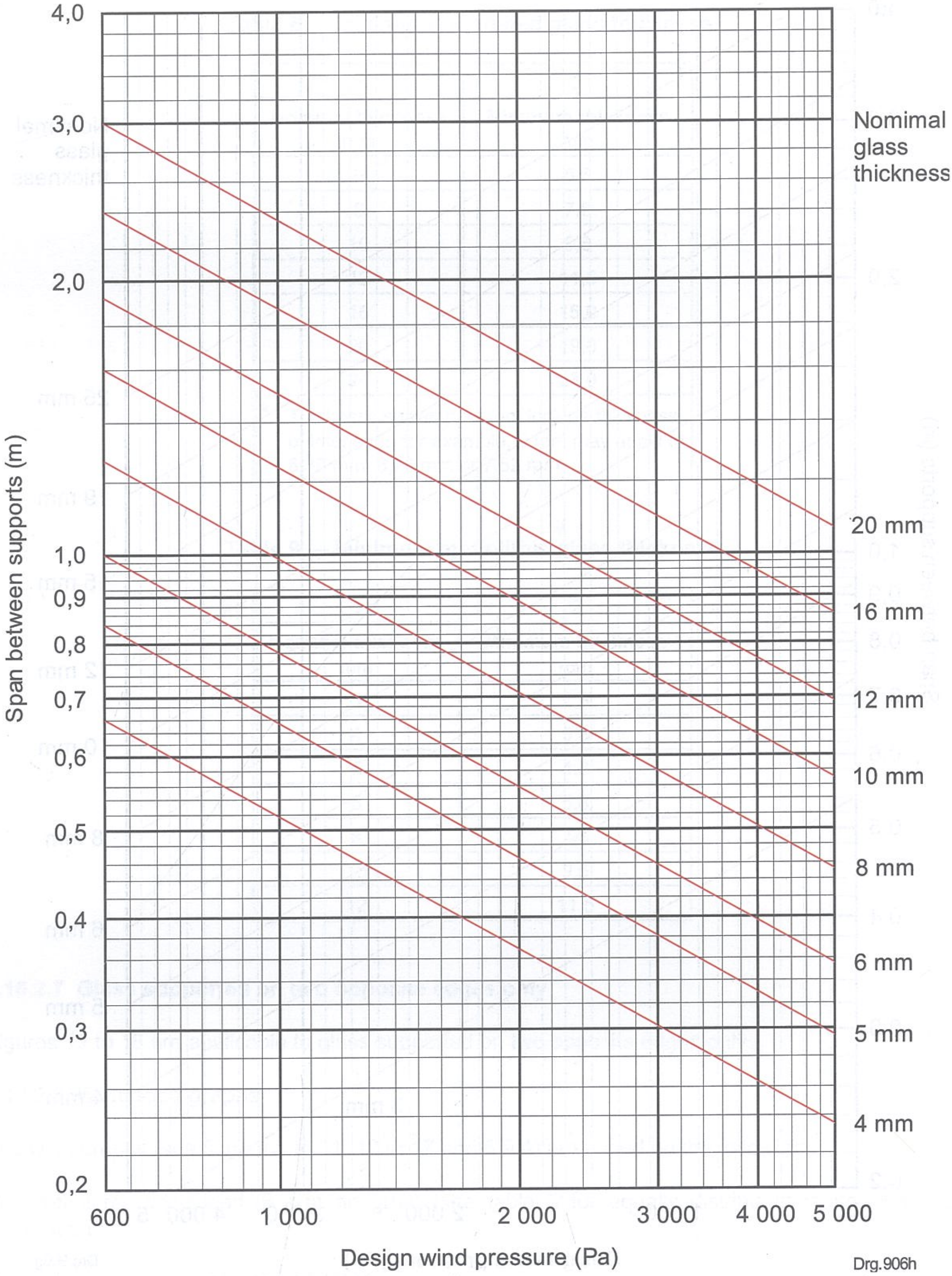



**Figure 13 — Wind load on laminated annealed safety glass supported on two opposite sides (3 s wind load)**

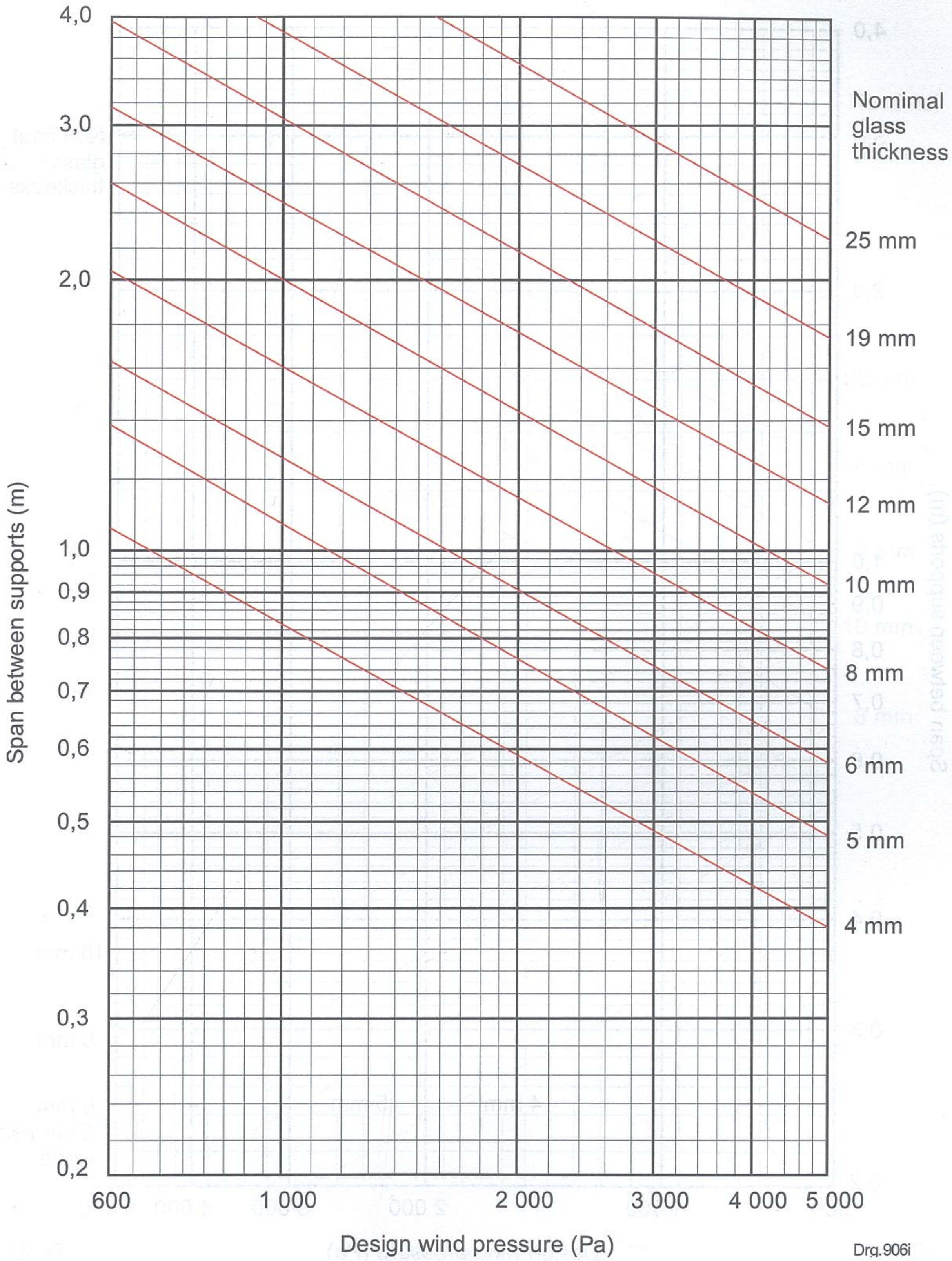



**Figure 14 — Wind load on toughened safety glass supported on two opposite sides (3 s wind load)**

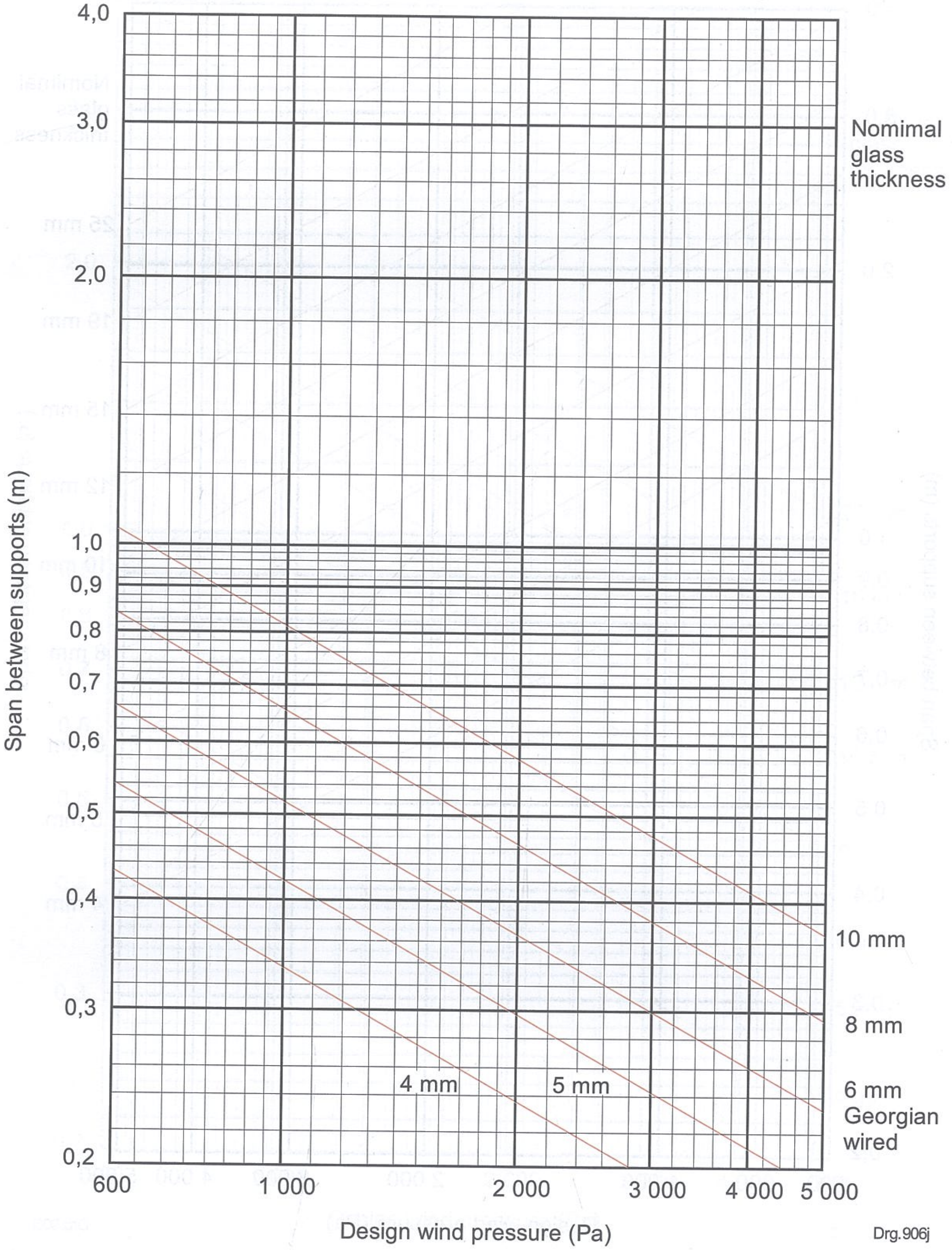



**Figure 15 — Wind load on patterned annealed safety glass supported on two opposite sides (3 s wind load)**

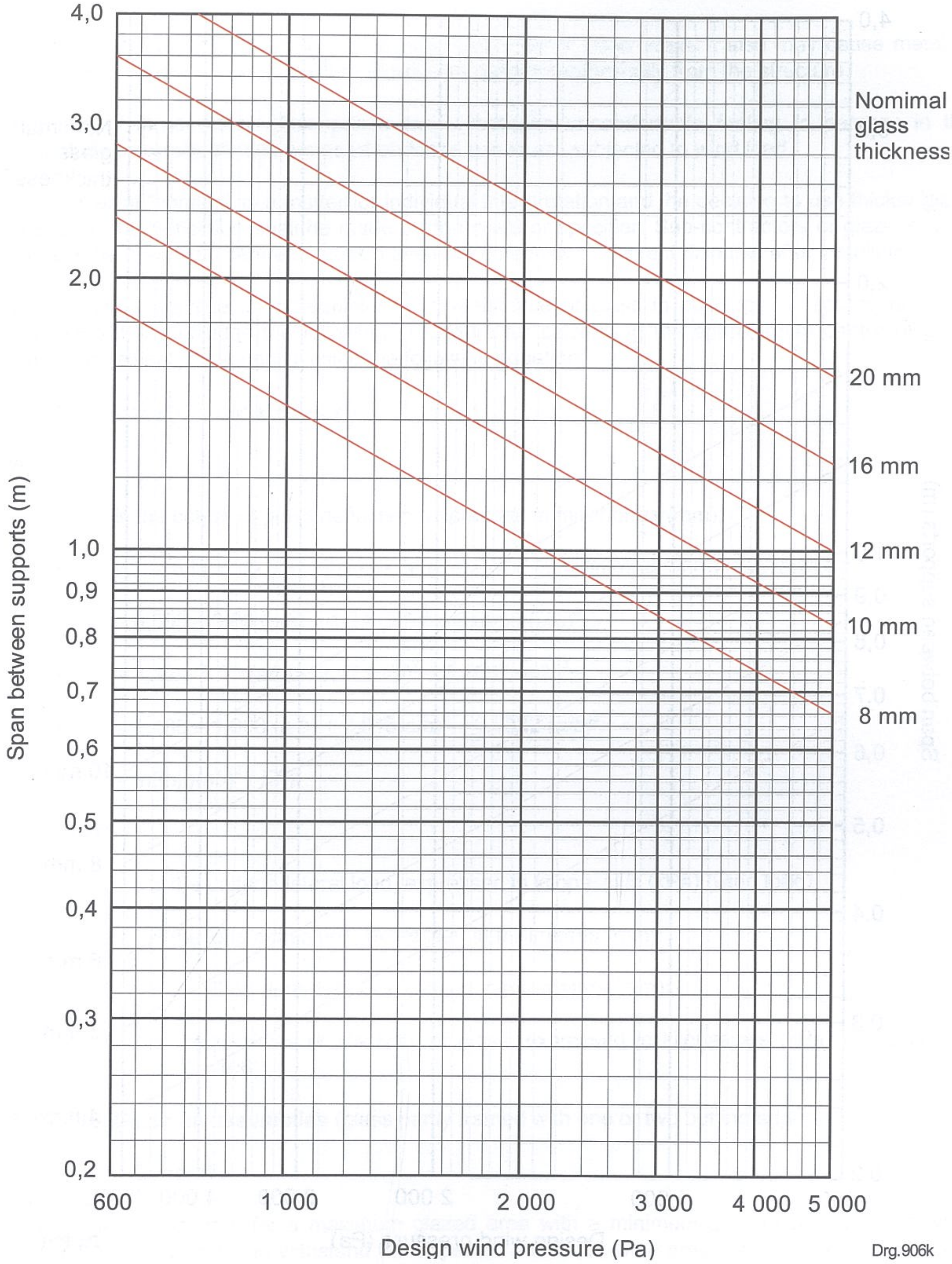



**Figure 16 — Wind load on laminated toughened safety glass supported on two opposite sides (3 s wind load)**

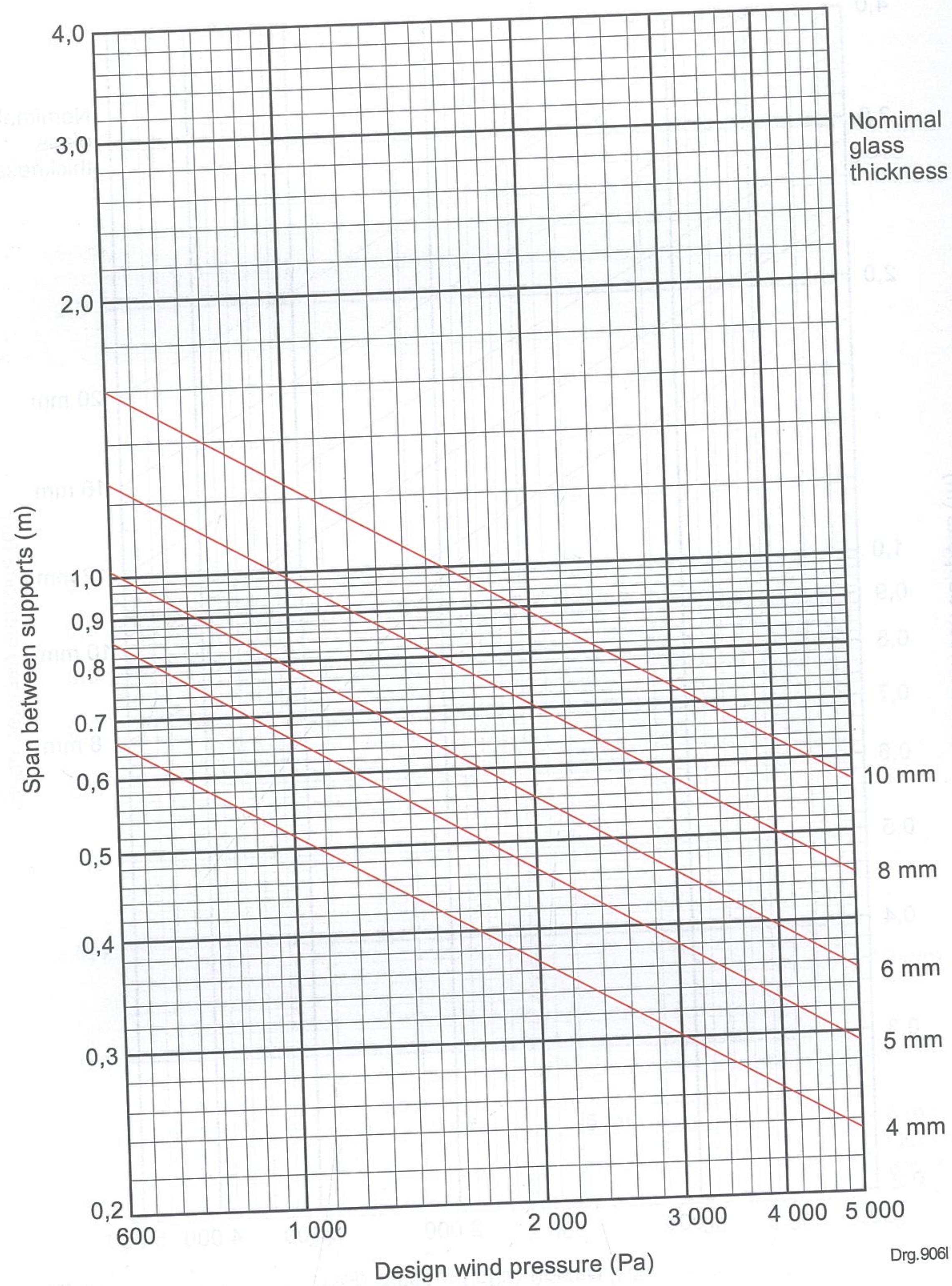



**Figure 17 — Wind load on toughened patterned safety glass supported on two opposite sides (3 s wind load)**

#### 5.10.2.9 Glass deflection

Excessive deflection in the glass panes can cause air or water leaks. It also may cause metal to glass contact inducing glass fracture. It will also detract aesthetically from the structure.

The use of large safety glass panes may create an uncomfortable feeling to persons in the immediate proximity of such panes when these panes are subjected to wind load.

The matter of "comfort" is a matter for individual interpretation and the decision to use thicker glass to reduce the deflection shall be made by the client or specifier. Sub-contractors or glaziers shall declare the maximum centre of glass movement timeously to prevent disputes after installation.

The standard practice for determining load resistance of glass in buildings, in accordance with ASTM E 1300a, includes the following procedure for calculating the approximate centre of glass deflection (all around support), using the following equation:

$$w = t \times \exp(r_0 + r_1 \times x + r_2 \times x^2)$$

where

$w$ is the centre of glass deflection, expressed in millimetres (mm);

$t$ is the minimum glass thickness, expressed in millimetres (mm) (see table 3);

$r_0$ $= 0{,}553 - 3{,}83\,(a/b) + 1{,}11\,(a/b)^2 - 0{,}0969\,(a/b)^3$;

$r_1$ $= 2{,}29 - 5{,}83\,(a/b) + 2{,}17\,(a/b)^2 - 0{,}2067\,(a/b)^3$;

$r_2$ $= 1{,}485 - 1{,}908\,(a/b) + 0{,}815(a/b)^2 - 0{,}0822\,(a/b)^3$;

$x^2$ $= \ln\{\ln[q(ab)^2 / Et^4]\}$

where

$q$ is the uniform lateral load, expressed in kilopascals (kPa) (wind load);

$a$ is the long dimension, expressed in millimetres (mm);

$b$ is the short dimension, expressed in millimetres (mm);

$E$ is the modulus of elasticity of glass, expressed in kilopascals (kPa) (for example, 71,7 × 106).

#### 5.10.2.10 Glass fin assemblies (glass partly framed with one or two butting edges)

#### 5.10.2.10.1 General

Where the design calls for a maximum glazed area with a minimum amount of framing, ensure that the glazing panes can withstand the expected maximum wind pressure. If adjacent panes are joined together with suitable adhesive sealants, note that the use of such sealants will not necessarily produce glazing of the same strength as that of a solid pane of the same dimensions (see figures 7, 8 and 10).

**5.10.2.10.2 Butt jointing edges**

Where glass panes in the same plane are butt-jointed without fins, they will not have the same wind resistance characteristics as a single pane of the same overall size and thickness. The thickness of such glass shall be calculated on the assumption that the butt joint does not have any structural effect, i.e. the surround will be the only support.

If reinforcing is unavoidable due to the span and wind loading, it might be necessary to install fins attached to the structure at the butt joints as indicated in figure 18. A suitable adhesive sealant with sufficient bonding strength to allow movement due to wind loading shall be used.

Silicone sealants used shall be chosen to be compatible with laminated glass (if used) and shall be classified by the sealant manufacturer as having a high modulus of elasticity. Fins would normally be installed on the inside of the building where there is likely to be less pedestrian traffic. Fin selection is covered in figures 19, 20 and 21.

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 high modulus silicone sealant without the need for additional support, provided the size of the joint is similar to that shown in figure 22. Each of the two panes meeting at the angle can be considered as fully supported along that edge and shall also satisfy the wind loading recommendations of SANS 10160-3.

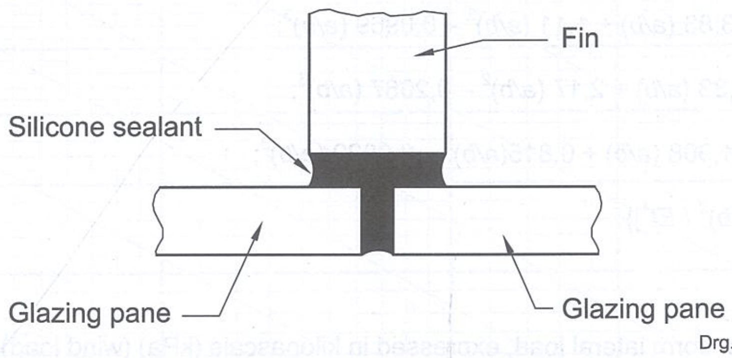



**Figure 18 — Detail of fin assembly**

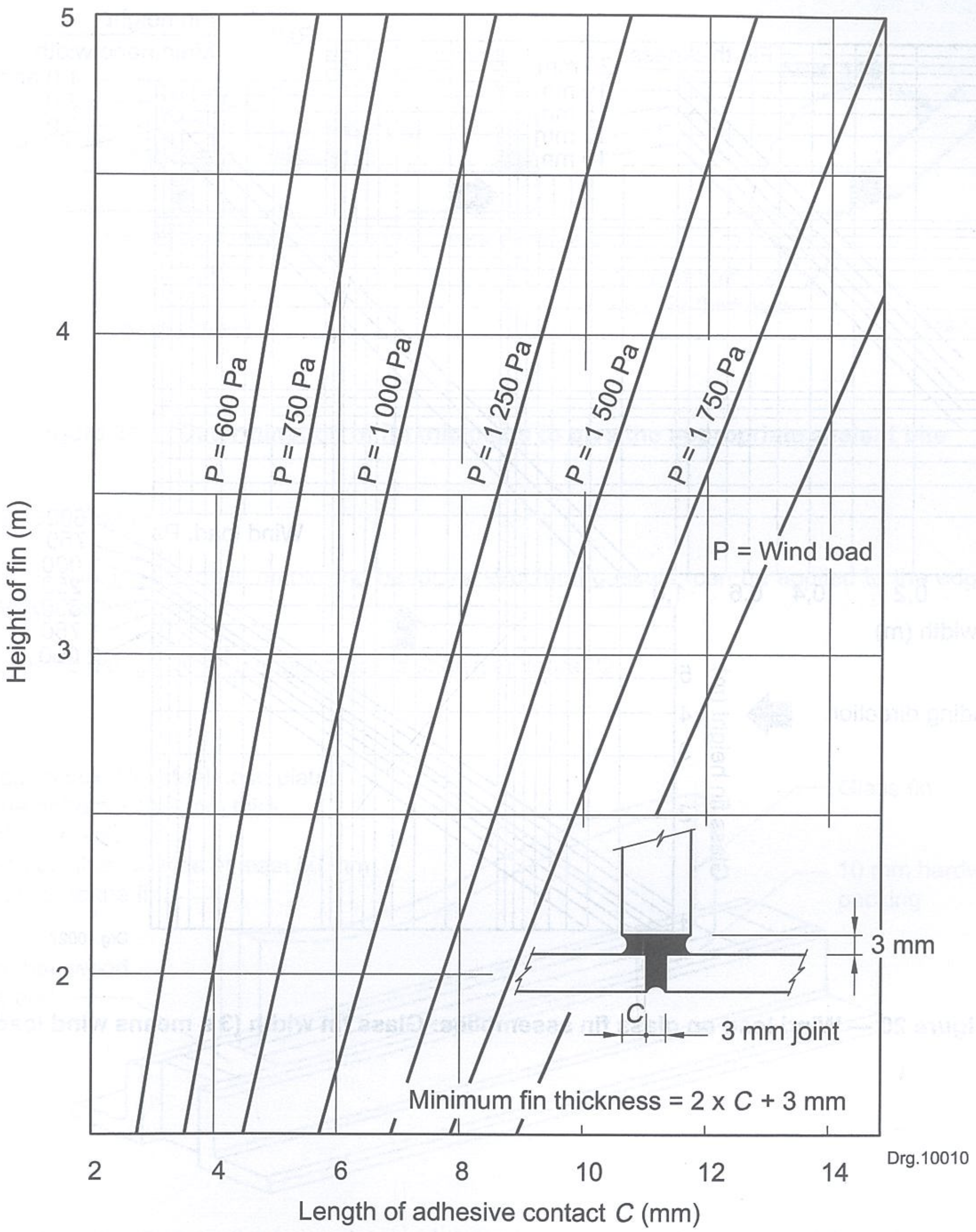



**Figure 19 — Wind load on glass fin assemblies: Size of adhesive joint**

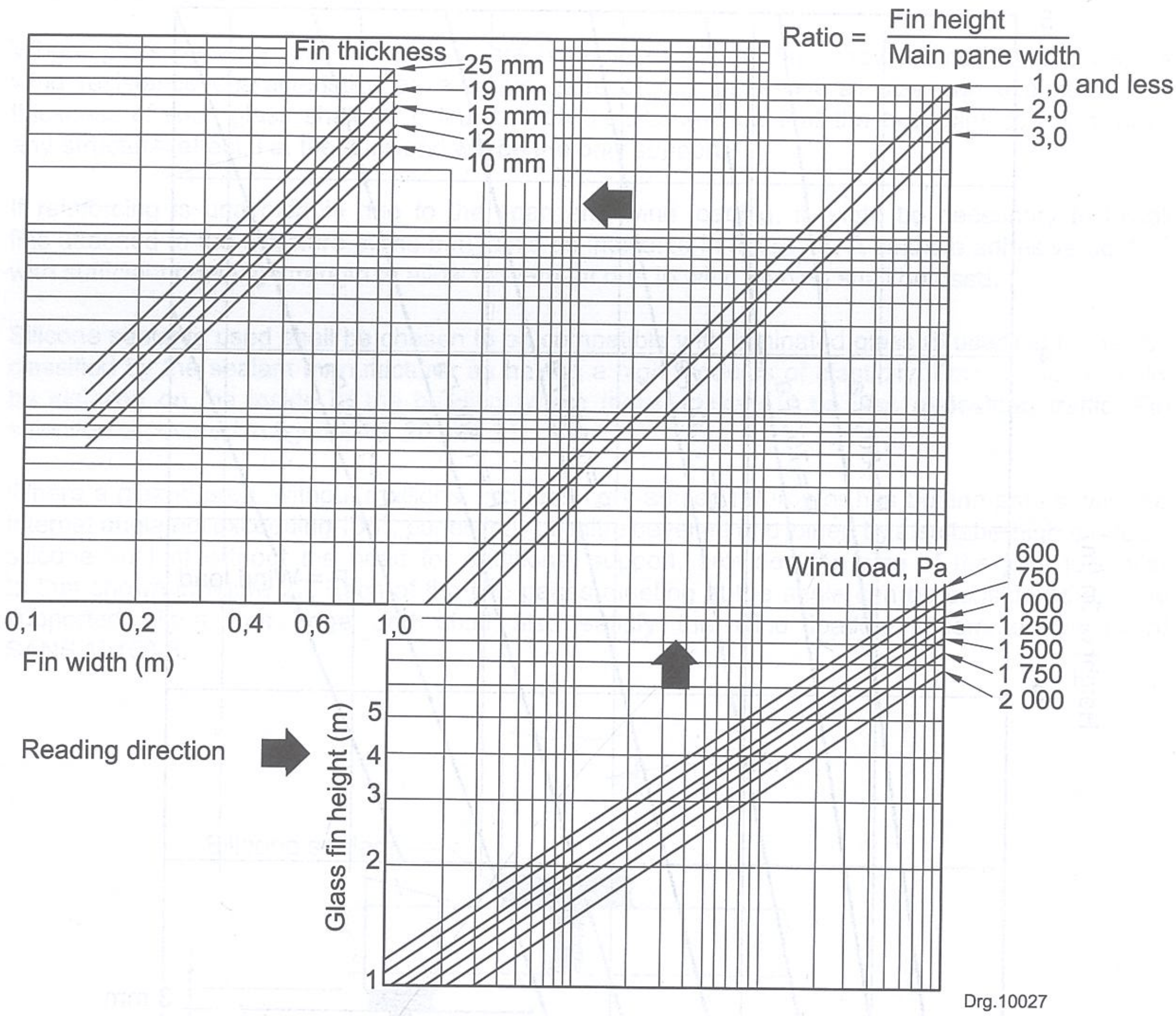



**Figure 20 — Wind load on glass fin assemblies: Glass fin width (3 s means wind load)**

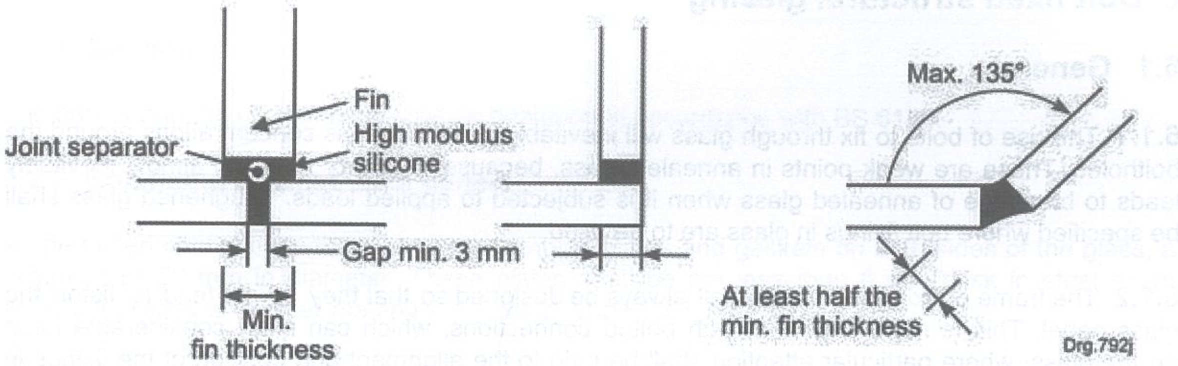
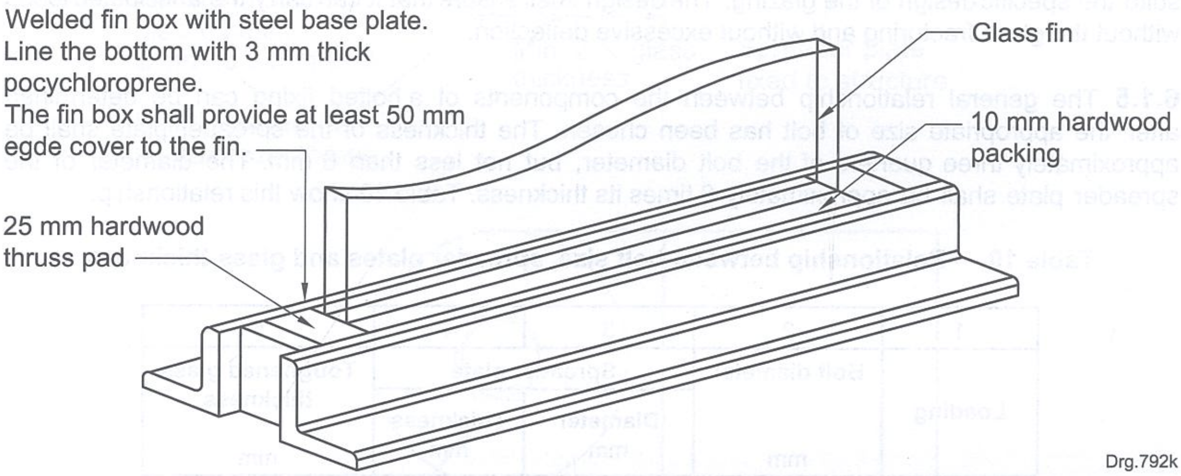



**Figure 21 — Determination of fin thickness to give the appropriate sealant bite**

#### 5.10.2.10.3 Fixing

Any of the glazing methods employing beads or structural gaskets, can be applied to the edges of the façade panes.

A suggested design for a fin support box is shown in figure 22.




NOTE For a tap fin box, the base plate and the chloroprene can be omitted. Adequate clearance should be provided above the top edge of the glass fin.

**Figure 22 — Fin support box**

# 6 Bolt fixed structural glazing

## 6.1 General

**6.1.1** The use of bolts to fix through glass will inevitably result in stress concentrations around the boltholes. These are weak points in annealed glass, because drilling or notching almost inevitably leads to breakage of annealed glass when it is subjected to applied loads. Toughened glass shall be specified where bolt fixings in glass are to be used.

**6.1.2** The frame or fixing (or both) shall always be designed so that they do not tend to distort the glass panel. This is more important with bolted connections, which can exert considerable force on the glass, where particular attention shall be paid to the alignment and position of the fixings in order to avoid unnecessary stresses being developed.

**6.1.3** A bolted fixing will generally consist of two metal spreader plates, one of which is attached to the structure, with one or more bolts passing through the glass and clamping it between the spreader plates. The spreader plates shall be separated from the glass by a gasket that shall preferably be not more than 1 mm thick and incompressible (for example, a vulcanized fibre gasket but not a chloroprene gasket). A nylon or similar, incompressible bush 2 mm to 3 mm thick shall be used to prevent the bolt from contacting the edge of the hole. The hole in the glass shall be at least 10 mm larger in diameter than the bolt passing through it, to allow for tolerance adjustment and the presence of a bush. The spreader plate shall give a minimum of 15 mm cover to the glass around the hole when the bolt is centrally positioned in the hole.

**6.1.4** The bolt size, spreader plate diameter and spreader plate thickness shall be chosen to suite the specific design of the glazing. The design shall ensure that it can carry the anticipated loads without the glass fracturing and without excessive deflection.

**6.1.5** The general relationship between the components of a bolted fixing can be determined after the appropriate size of bolt has been chosen. The thickness of the spreader plate shall be approximately three quarters of the bolt diameter, but not less than 6 mm. The diameter of the spreader plate shall be approximately 8 times its thickness. Table 10 show this relationship.

**Table 10 — Relationship between bolt size, spreader plates and glass thickness**

| 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|
| **Loading** | **Bolt diameter** mm | **Spreader plate** | | **Toughened glass thickness** mm |
| | | **Diameter** mm | **Thickness** mm | |
| Light | M6 | 50 | 6 | 8 |
| Normal | M8, M10 | 50 | 6 | 8,10 |
| Heavy | M10 | 60 | 8 | 10,12 |
| | M12 | 75 | 10 | 12,15 |
| | M16 | 100 | 12 | 15, 19, 25 |

NOTE For bolted fixings used simply to locate a pane in position, not intended to form a clamp and able to resist applied bending moments the fixing for normal loading should be appropriate for all thicknesses of toughened glass.

## 6.2 Bolt fixing of glass in barriers

### 6.2.1 General

The barrier and the glass panels shall be designed in accordance with BS 6180.

### 6.2.2 Bolt fixing of glass infill panels

At the bolted connections there shall be clamping plates and gaskets on both sides of the glass, a minimum of 50 mm in diameter. These plates shall be not less than 6 mm thick in steel or an equivalent stiffness in other materials. Figure 23 shows a typical fixing.

Where the length of a glass pane is much greater than the span between the bolted connectors, giving rise to a cantilevered portion of the pane, the cantilevered portion shall be less than one quarter of the span between the bolted connectors.

Under the design loads, the barriers shall be designed such that the relative in-plane movement of the bolted connections in the same panel is not greater than 2 mm.

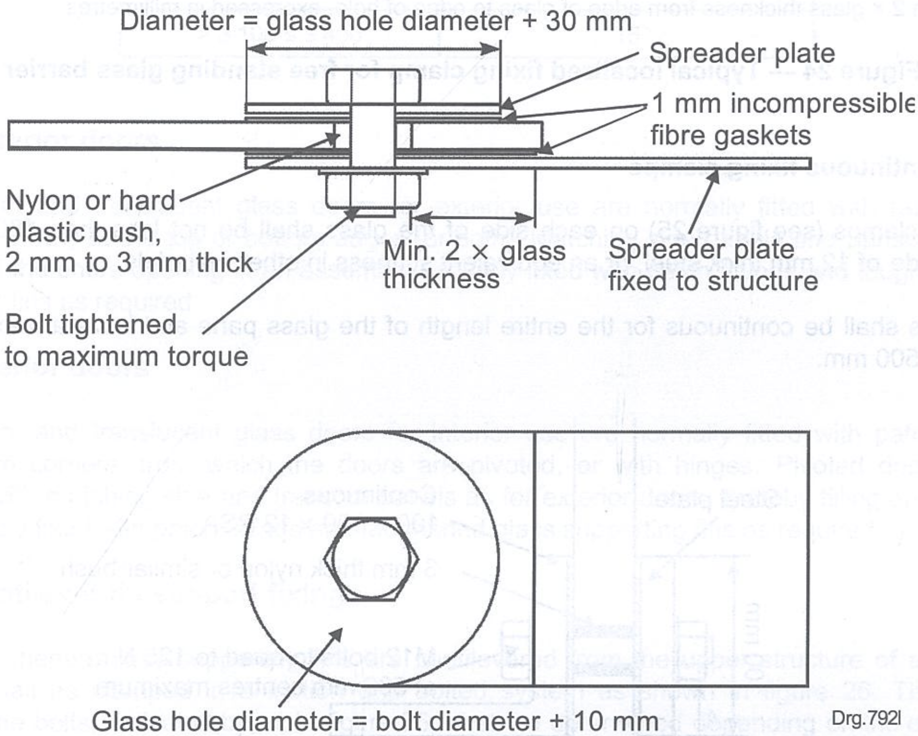
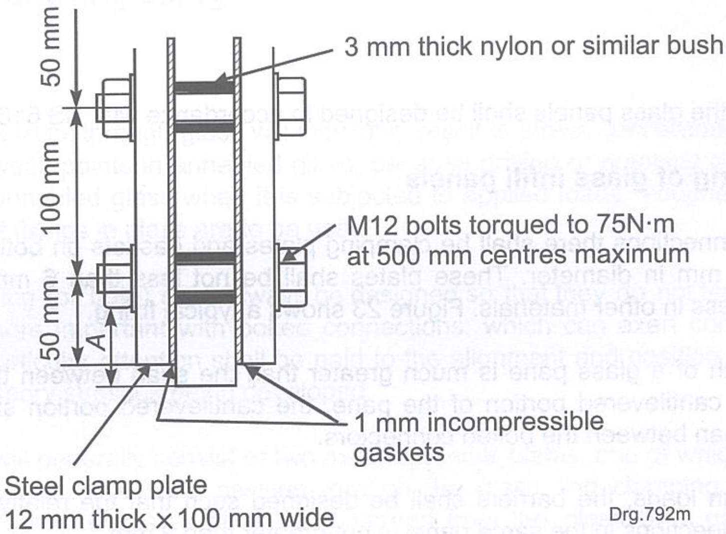



**Figure 23 — Bolting of toughened glass**

### 6.2.3 Base fixing of free standing glass barriers

#### 6.2.3.1 Localized fixing clamps

The fixing clamps (see figure 24) on each side of the glass shall be not less than 100 mm × 150 mm, and be made of 12 mm thick steel, or an equivalent stiffness in other materials. There shall be not less than two fixing clamps for every 1 000 mm length of barrier.




**Key**

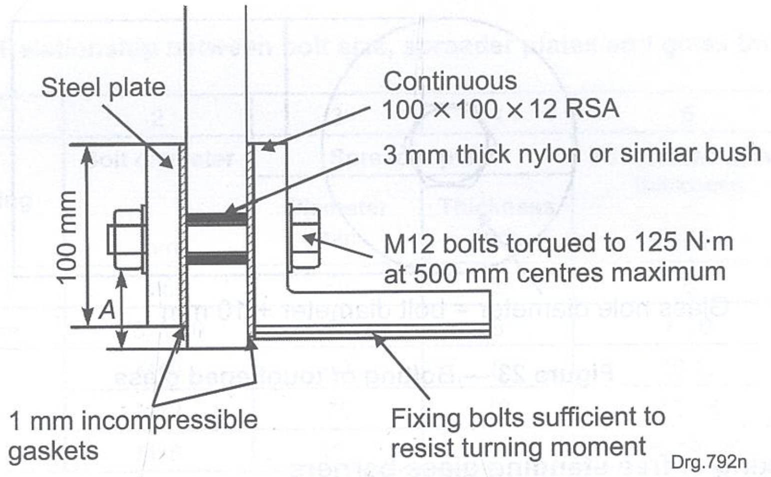
*A* Minimum 2 × glass thickness from edge of glass to edge of hole, expressed in millimetres

**Figure 24 — Typical localized fixing clamp for free standing glass barrier**

### 6.2.3.2 Continuous fixing clamps

The fixing clamps (see figure 25) on each side of the glass shall be not less than 100 mm wide and be made of 12 mm thick steel, or an equivalent stiffness in other materials.

The clamps shall be continuous for the entire length of the glass pane and have a maximum bolt spacing of 500 mm.




**Key**

*A* Minimum 2 × glass thickness from edge of glass to edge of hole, expressed in millimetres

**Figure 25 — Typical continuous fixing clamp for free standing glass barrier**

## 6.3 Toughened glass frameless doors and door assemblies

### 6.3.1 General

Toughened glass doors are usually specially designed for a particular location and the manufacturer shall be consulted.

Table 11 gives guidance on appropriate toughened glass thicknesses for recommended frameless toughened safety door thicknesses.

**Table 11 — Recommended frames toughened door thicknesses**

| 1 | 2 |
|---|---|
| **Length of door diagonal** mm | **Thickness of toughened glass** mm |
| ≤ 2 000 | 8 |
| > 2 000 ≤ 2 600 | 10 |
| > 2 600 ≤ 3 100 | 12 |
| > 3 100 ≤ 3 400 | 15 |

### 6.3.2 Exterior doors

Transparent and translucent glass doors for exterior use are normally fitted with rails or patch fittings (or both) at the top or bottom edges (or both). 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 as required.

### 6.3.3 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 as required.

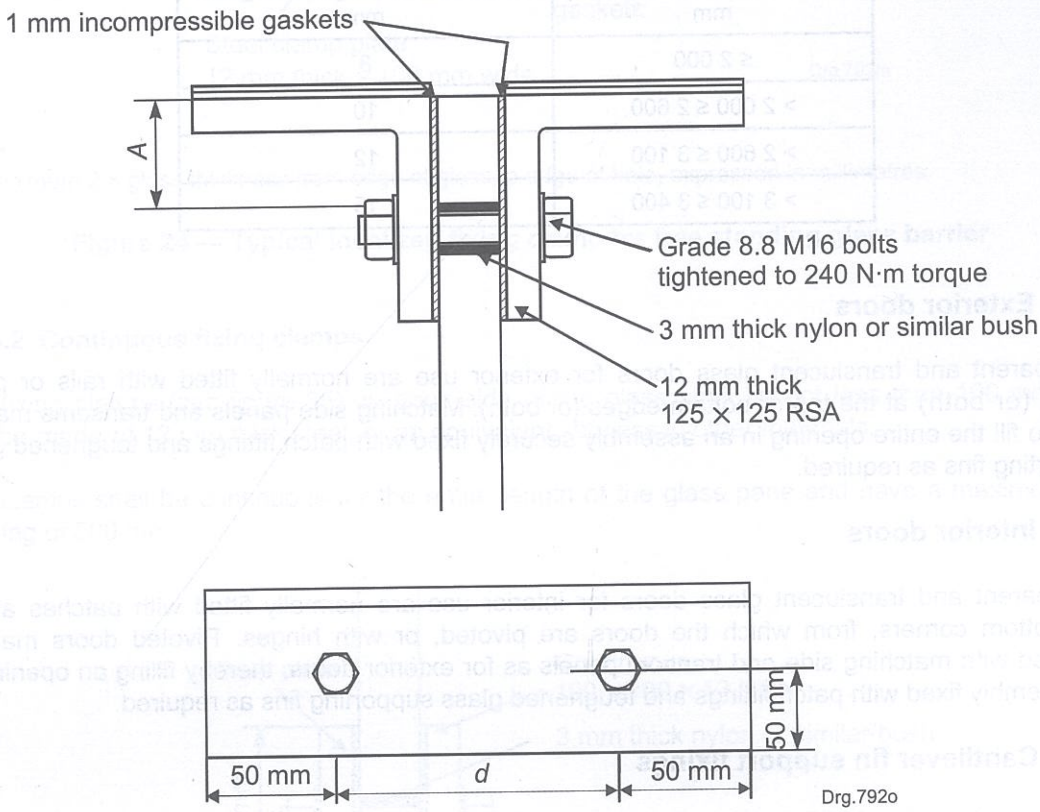
### 6.3.4 Cantilever fin support fixings

Where toughened glass supporting fins are cantilevered from the upper structure of an opening, the fins shall be clamped in a friction grip bolted system as shown in figure 26. The distance between the bolts, indicated by, *d*, in figure 26, shall be determined depending on the door height, the spacing of the fins, the length of the fins and the applied loadings but shall be not less than 100 mm.

Table 12 gives the suggested bolt separation for a standard width and height double door configuration (2 × 900 mm × 2 100 mm), with a cantilevered fin supporting the upper corners of the door opening, when the design wind load does not exceed 1 000 N/m$^2$.

**Table 12 — Spacing of bolt in cantilevered fin support systems**

| 1 | 2 |
|---|---|
| **Length of door diagonal** mm | **Thickness of toughened glass** mm |
| ≤ 2 000 | 8 |
| >2 000 ≤ 2 600 | 10 |
| >2 600 ≤ 3 100 | 12 |
| >3 100 ≤ 3 400 | 15 |




*A* Minimum 2 × glass thickness from edge of glass to edge of hole, expressed in millimetres
*d* Distance between the bolts

**Figure 26 — Principle of a cantilever fin support**

## 6.4 Toughened glass suspended assemblies

### 6.4.1 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 façade so produced is hung from the building structure by its top edge and sealed to the building. The gaps between the panes can be sealed.

Support against wind loads is provided by toughened glass fins fixed at vertical joints on the façade 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.

### 6.4.2 Performance

It is the responsibility of the architect or structural engineer (or both) of a project to ensure that the building structure is able to support the load of a suspended glass. The following shall be determined prior to a project study being undertaken:

a) opening size;

b) design wind loading; and

c) deflections of the structure under wind, live and dead loads.

## 6.5 Balustrades

### 6.5.1 General

Balustrades are defined as being a device that guards and protect a drop of 750 mm or more (see SANS 10160-2).

Refer to the relevant sections in SANS 10160-2 for the design loads on balustrading. Ensure that the impact load requirement as described in SANS 10160-1 for glazed panels within 500 mm of finished floor is also applied.

Due to the various types of glazed panels, fixing methods, site conditions and workmanship of the installer all balustrades shall be tested to prove their design capability and shall also be tested on site to further ensure consistency of workmanship and installation detail. It is therefore not possible to describe "rule of thumb" glass thickness for generic installation methods.

NOTE The tests required by SANS 10160-2 can be exceeded in their magnitude to give some idea of the safety factor in these installations.

### 6.5.2 Two-edge support — Mechanical fixings

Toughened safety glass, laminated heat-strengthened safety glass, or laminated toughened safety glass shall be used in accordance with table 12. There shall be a minimum of four fixings per pane. The panes shall be positioned not more than *X*74 from the corner, where *X* is the span between fixings.

## 6.6 Glass floors

**6.6.1** Generally there are two types of glass floor, namely

a) a floor that has artificial lighting underneath (for example a dance floor), and

b) a floor that allows light to pass through to the space below.

**6.6.2** Imposed loads (for example, distributed load and point load) shall be in accordance with SANS 10160-2 which determines that a glass floor for a building classified in accordance with SANS 10400-A, as residential, will not necessarily use the same design floor load as an office.

Design shall take into account the post fracture behaviour of the glass and that the design stress for glass declines with an increase in the time that the load is applied (see table 5).

## 6.7 Glass in furniture

For guidelines on glass furniture refer to SANS 17.

## 6.8 Fish tanks or underwater observation panels

### 6.8.1 Resistance to water loading

When glass is used in aquaria or as observation panels in swimming pools and large fish tanks, it can be subjected to high pressure by the water. If the glass should break the results will be catastrophic, therefore it is very important to design the glass and glazing system carefully.

### 6.8.2 Loads produced by water

**6.8.2.1** Water exerts a pressure in all directions, which is directly dependent upon the depth of the water. The total volume of water, for example in an aquarium, is not relevant.

The pressure at any depth in water, $P$, or any liquid, is given by the following equation:

$$P = pgh$$

where

$P$ is the pressure at any depth in water, expressed in newtons per square metre ($N/m^2$);

$p$ is the density of the liquid, expressed in kilograms per cubic metre ($kg/m^3$);

$g$ is the acceleration due to gravity ($9.81 m/s^2$);

$h$ is the depth, expressed in metres (m).

NOTE The pressure increases linearly with depth.

**6.8.2.2** The density of water is 1 000 $kg/m^3$ (1 040 $kg/m^3$ for sea water). At a depth of 600 mm, typical of the bottom of a domestic fish tank, the pressure is approximately 6 000 $N/m^2$. In comparison with pressures generated by wind (1 000 $N/m^2$ to 2 000 $N/m^2$, and up to 8 000 $N/m^2$ for hurricanes), those generated by water are high. For large aquaria of 4 m deep, the pressure generated at the bottom is nearly 40 $kN/m^2$; a pressure comparable in size with that from an explosion.

**6.8.2.3** Water pressure is a sustained pressure. Unlike wind pressure, it is not transitory. Since glass suffers from static fatigue the design stresses appropriate for designing against water pressure will therefore be much lower than those for wind pressure, resulting in (very) thick glass being required.

Whereas wind pressure could be considered as loading the glass uniformly, the pressure exerted by water varies with the depth. For example, in a 600 mm deep domestic fish tank, there will be zero pressure at and above the water level, and a gradually increasing pressure with depth on the sides of the tank to approximately 6 000 N/m$^2$ at the base. This is a triangularly distributed load. These triangular loads take various forms (see figure 27).

### 6.8.3 Glass thickness selection

#### 6.8.3.1 Frameless fish tanks

Small domestic frameless fish tanks having a silicone sealant shall be constructed with a type of silicone having a tensile strength of not less than 1 MPa and have glass thickness selected in accordance with tables 13 and 14, which are based on DIN 32622.

#### 6.8.3.2 Underwater observation panels

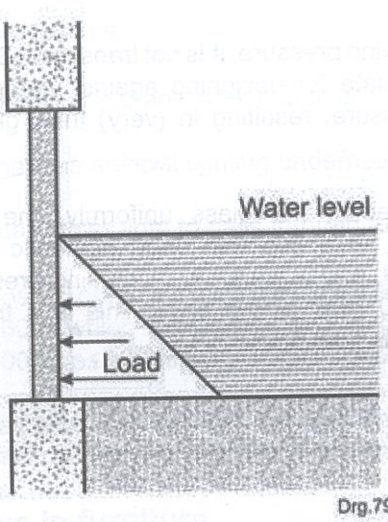
For applications of this nature all calculations shall allow for water pressure and possible impact forces. Also consult the glass manufacturer for advice on design and installation recommendations. Thickness depends on the relationship of the glass size, the manner of support, and the pressure to be exerted by the water. Glass strength varies according to the duration of the load applied, with a proportional reduction in strength as the loading duration is increased.

To determine the thickness of vertical glass supported on four edges, provided the head of water does not exceed the height of the glass, and the only applicable loading is the water pressure, the chart in figure 28 may be used. This chart may also be used where the water level is below the top edge of the glass and it is reasonable to expect that a thinner glass may be adequate. First select the thickness from figure 28, then, according to the actual head of water under consideration, make an allowance on glass thickness shown on the chart by the appropriate factor found in table 14. The glass thickness to use is the next thickness of glass available.

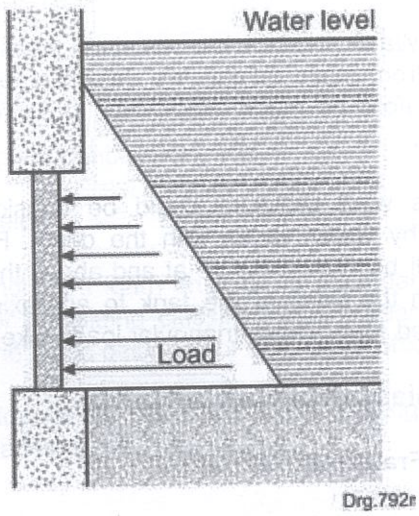
Water pressure is determined by the head of water, which for vertical glazing is measured from the water level to the bottom edge of the glass (see figure 29) and, for horizontal glazing (base plate), from the water level to the surface of the glass.

The chart for recommended glass thicknesses applies only to vertically glazed glass supported on all four edges. The chart shall not be used in the determination of glass thickness for observation panels of swimming pools and large scale aquaria that have the glass top edge below the water line because, in those applications, additional pressure will be afforded by the extra head of water by the use of the glass to give increased impetus to swimmers, or by the impact of large sea creatures. Applications not within the limits of the chart shall be referred to the glass manufacturers so that due allowance may be made of any possible increase in stressing.

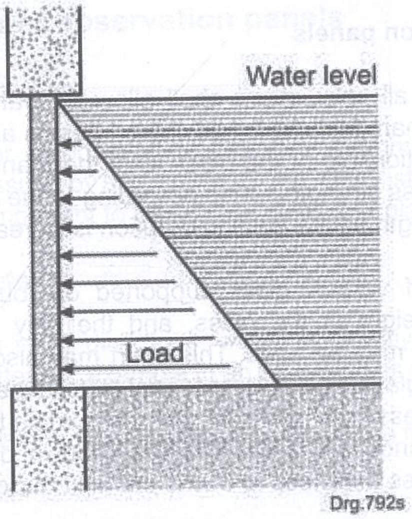
For large scale aquaria it is not recommended that silicone be used as structural supports, and it is recommended that rigid steel frames capable of withstanding the specific load shall be used.




**a) Form of triangular distributed load with a low water level**




**b) Form of triangular distributed load with a high water level**




**c) Form of triangular distributed load with a medium water level**

NOTE 1 Water loading on a glass aquarium window may not be over the full depth (a reptile tank may have only the bottom portion in water).

NOTE 2 There is already a significant pressure at the top edge of the window and this increases over its depth.

NOTE 3 More commonly, the water can be considered to be loading the window over its full depth, since the amount of unloaded window at the top edge is relatively small.

**Figure 27 — Forms of triangular distributed loads**

**Table 13 — Thickness of monolithic annealed glass bases for frameless fish tanks**

Dimensions in millimetres

<table>
<tr><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td><td>8</td><td>9</td><td>10</td><td>11</td><td>12</td><td>13</td><td>14</td><td>15</td><td>16</td><td>17</td><td>18</td></tr>
<tr><td rowspan="2">Water height</td><td rowspan="2">Width</td><td colspan="16">Length</td></tr>
<tr><td>400</td><td>500</td><td>600</td><td>700</td><td>800</td><td>900</td><td>1 000</td><td>1 100</td><td>1 200</td><td>1 300</td><td>1 400</td><td>1 500</td><td>1 600</td><td>1 700</td><td>1 800</td><td>2 000</td></tr>
<tr><td rowspan="2">300</td><td>200</td><td colspan="3">4</td><td colspan="6">6</td><td colspan="7">8</td></tr>
<tr><td>300</td><td colspan="3">4</td><td colspan="2">5</td><td colspan="4">6</td><td colspan="7">8</td></tr>
<tr><td rowspan="4">400</td><td>200</td><td colspan="3">4</td><td colspan="6">6</td><td colspan="7">8</td></tr>
<tr><td>300</td><td colspan="2">4</td><td colspan="3">5</td><td colspan="4">6</td><td colspan="7">8</td></tr>
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<tr><td>400</td><td colspan="3">5</td><td colspan="4">6</td><td colspan="9">8</td></tr>
<tr><td rowspan="2">500</td><td>450</td><td colspan="3">6</td><td colspan="7">8</td><td colspan="6">10</td></tr>
<tr><td>500</td><td colspan="3">6</td><td colspan="5">8</td><td colspan="8">10</td></tr>
<tr><td rowspan="2">600</td><td>500</td><td colspan="4">8</td><td colspan="5">10</td><td colspan="7">12</td></tr>
<tr><td>600</td><td colspan="4">8</td><td colspan="5">10</td><td colspan="7">12</td></tr>
</table>

**Table 14 — Thickness of monolithic annealed glass sides for frameless fish tanks**

Dimensions in millimetres

<table>
<tr><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td><td>8</td><td>9</td><td>10</td><td>11</td><td>12</td><td>13</td><td>14</td><td>15</td><td>15</td><td>17</td></tr>
<tr><td rowspan="2">At water height</td><td colspan="16">Length</td></tr>
<tr><td>400</td><td>500</td><td>600</td><td>700</td><td>800</td><td>900</td><td>1000</td><td>1100</td><td>1 200</td><td>1 300</td><td>1 400</td><td>1 500</td><td>1 600</td><td>1 700</td><td>1 800</td><td>2 000</td></tr>
<tr><td>300</td><td colspan="3">4</td><td colspan="2">5</td><td colspan="4">6</td><td colspan="7">8</td></tr>
<tr><td>350</td><td colspan="2">4</td><td colspan="3">5</td><td colspan="4">6</td><td colspan="7">8</td></tr>
<tr><td>400</td><td colspan="4">5</td><td colspan="3">6</td><td colspan="9">8</td></tr>
<tr><td>450</td><td>5</td><td colspan="6">6</td><td colspan="9">8</td></tr>
<tr><td>500</td><td colspan="4">5</td><td colspan="5">8</td><td colspan="7">10</td></tr>
<tr><td>600</td><td>6</td><td colspan="3">8</td><td colspan="5">10</td><td colspan="7">12</td></tr>
</table>

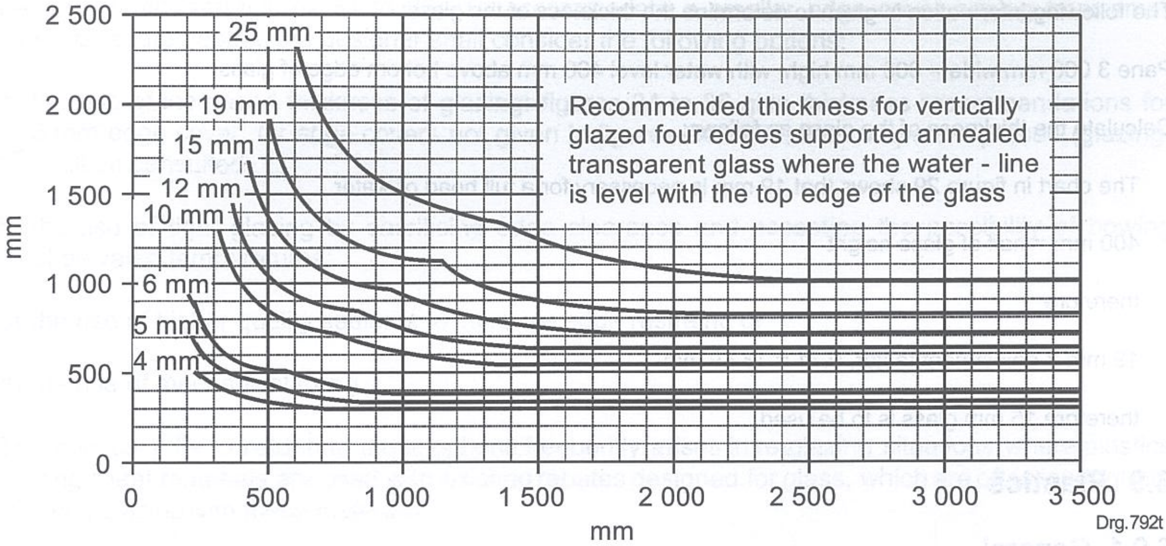



**Figure 28 — Underwater observation panels**

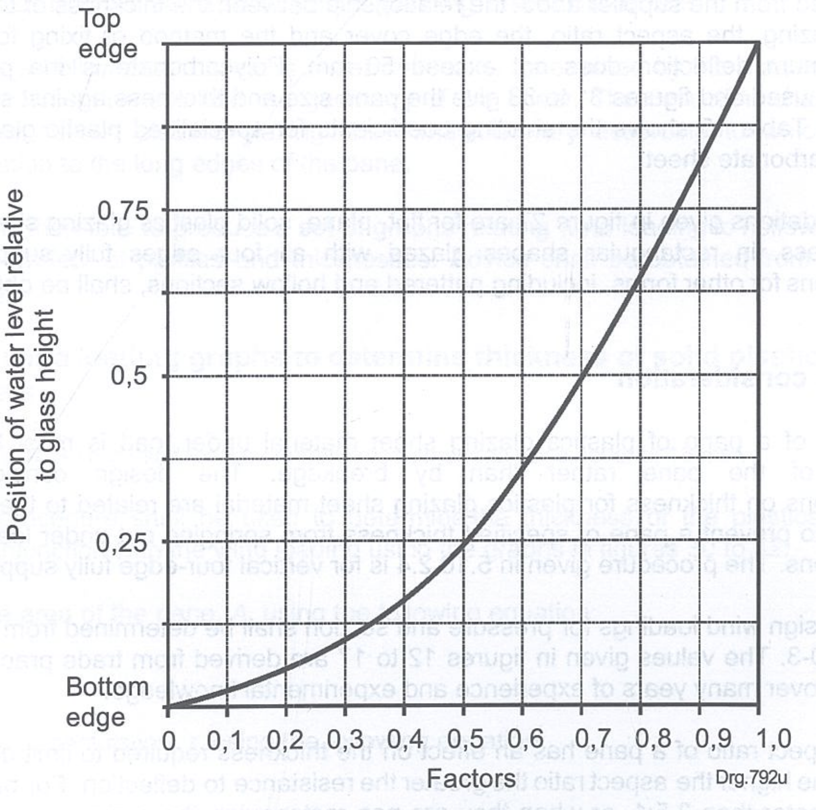



**Figure 29 — Adjustment factors accordance to water level**

**Example**

The following information is given to determine the thickness of the glass:

Pane 3 000 mm wide × 800 mm high, with water level 400 mm above bottom edge of glass.

Calculate the thickness of the glass as follows:

The chart in figure 29 shows that 19 mm is necessary for a full head of water

400 mm = half of glass height

therefore

19 mm × adjustment factor, 0,71 = 13,49 mm

therefore 15 mm glass is to be used.

## 6.9 Plastics

### 6.9.1 General

Design considerations as regards wind load on plastics materials shall be based on the fact that, under load (positive or negative), a pane is more likely to be displaced from its frame than to be fractured. When it is necessary to design for an anticipated wind load, relevant material information shall be obtained from the supplier about the relationship between the thickness of the material, the area of the glazing, the aspect ratio, the edge cover and the method of fixing for normal use, provided maximum deflection does not exceed 50 mm. Polycarbonate is the plastics glazing material mostly used and figures 31 to 33 give the pane size and thickness against short dimension and wind load. Table 15 shows the shading coefficients for specialised plastic glazing materials, including polycarbonate sheet.

The recommendations given in figure 27 are for flat, plane, solid plastics glazing sheet materials of uniform thickness, in rectangular shapes glazed with all four edges fully supported. Design recommendations for other forms, including pattered and hollow sections, shall be obtained from the manufacturers.

### 6.9.2 Design consideration

**6.9.2.1** 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 design considerations and recommendations on thickness for plastics glazing sheet material are related to the minimum size of edge cover to prevent a pane of specified thickness from springing out under loading in normal glazing conditions. The procedure given in 5.10.2.4 is for vertical four-edge fully supported glazing.

**6.9.2.2** The design wind loadings for pressure and suction shall be determined from either 5.10.2.4 or SANS 10160-3. The values given in figures 12 to 17 are derived from trade practices proven to be satisfactory over many years of experience and experimental knowledge.

**6.9.2.3** 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. For panes having an aspect ratio greater than 3,5:1, or when they are non-rectangular, the competent person (glazing) shall be consulted. In order to limit the deflection for larger panes, the competent person (glazing) shall be consulted where areas of individual panes exceed 2 $m^2$. If the absence of bowing under large increases in ambient temperature is an important aesthetic consideration, then the thermal expansion of plastics glazing sheet materials shall be allowed for in the rebate size.

**6.9.2.4** For plastics glazing sheet materials, a minimum edge cover of 15 mm is normally recommended (see figures 31 to 33). To accommodate a smaller edge cover arising from small existing rebate depths, the designer shall consider the following options:

a) the use of increased thickness of glazing: figures 34 to 36 give thickness recommendations for 5 mm edge cover; for edge covers not given in figures 34 to 36, the competent person (glazing) shall be consulted;

b) the use of tight glazing by sacrificing edge clearance and accepting the possibility of bowing at elevated temperatures;

c) the use of higher quality sealants to increase edge restraint; or

d) the use of mechanical fixing.

The necessity for considering these options frequently arises in re-glazing 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 for the use of materials thinner than those given in figures 31 to 33, however, the competent person (glazing) shall be consulted.

### 6.9.3 Design of hollow section plastics glazing sheet materials

The stiffness of a hollow plastic glazing sheet material is determined by the material from which it is made, the overall thickness and the geometry of the sheet. The deflection characteristics of a particular hollow section plastics glazing sheet material vary according to which direction the webs run in relation to the long edges of the pane.

It is not practical, therefore to produce a set of graphs relating wind loading to hollow section sheets because of the variety of profiles and thicknesses. Advice shall be obtained from the competent person (glazing).

### 6.9.4 Use of wind loading graphs to determine thickness of solid plastics glazing sheet materials

NOTE Figures 30 to 32 are used for the normally recommended edge cover of 15 mm.

The following procedure shall be used to determine the thickness of the plastics glazing sheet materials, in conjunction with the wind loading using the graphs in figures 30 to 32:

a) Calculate the area of the pane, *A*, using the following equation:

$$A = a \times b$$

Calculate the aspect ration, *r*, using the following equation:

$$r = \frac{a}{b}$$

where

*a* is the longer dimension;

*b* is the shorter dimension.

b) On the appropriate graph for the aspect ratio and edge cover from figures 31 to 33, determine the point where the vertical line for the required wind loading intersects the horizontal line for the required area.

c) 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.

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.

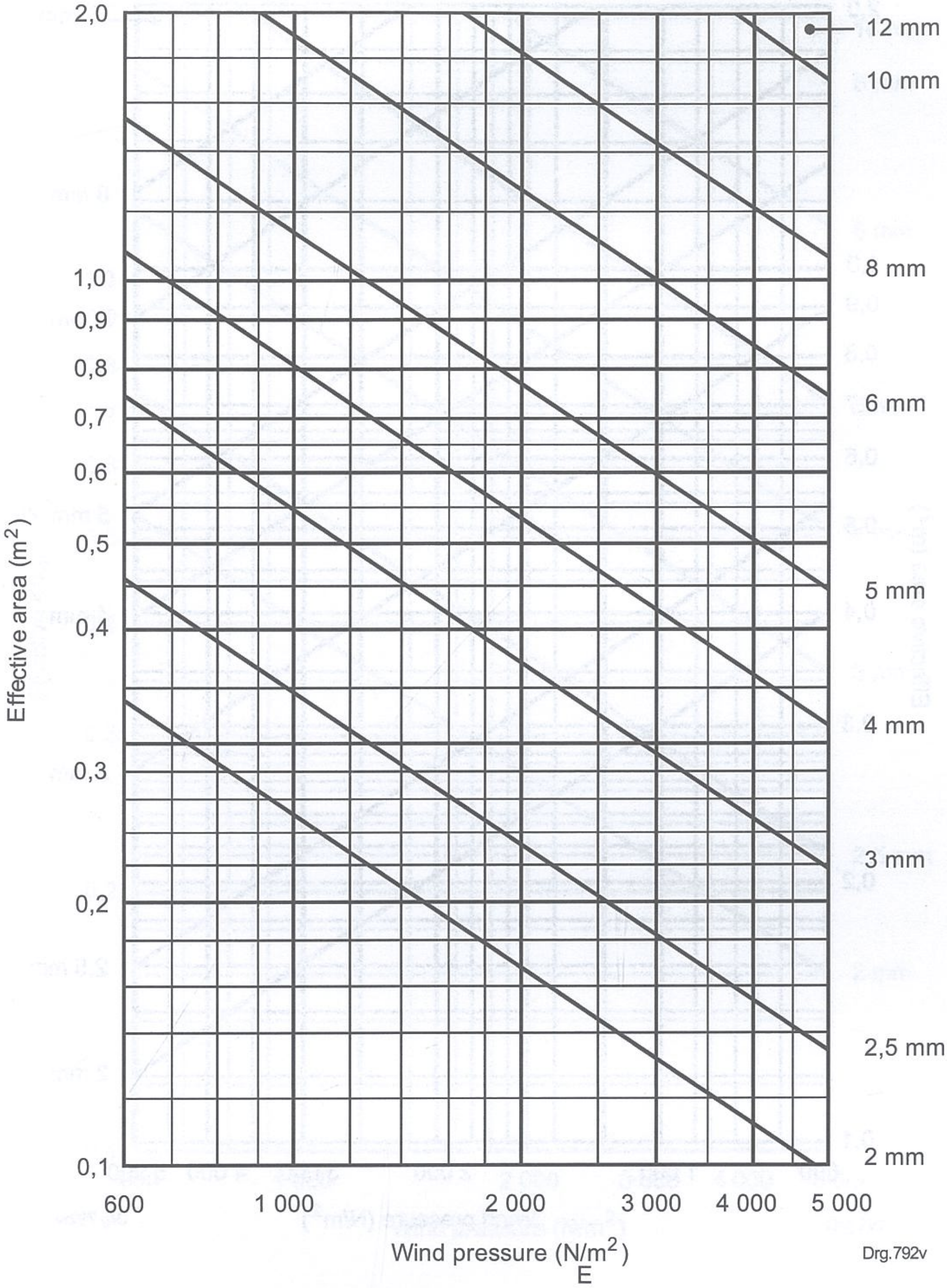



**Figure 30 — Wind loading graph for plastics glazing sheet materials, 15 mm edge cover, and aspect ratio 1,0 to 1,5**

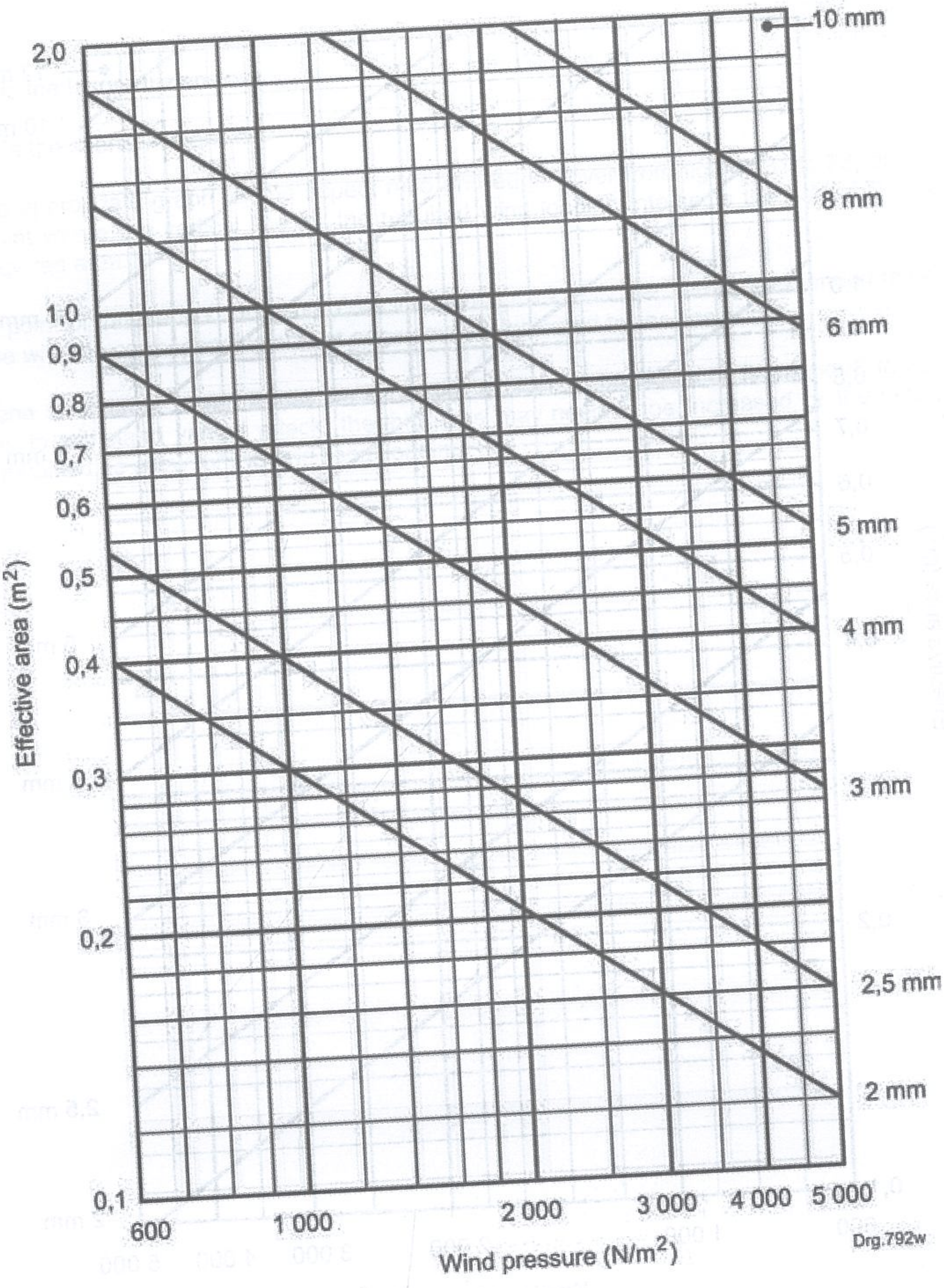



Figure 31 — Wind loading graph for plastics glazing sheet materials, 15 mm edge cover, aspect ratio greater than 1,5 up to and including 2,5

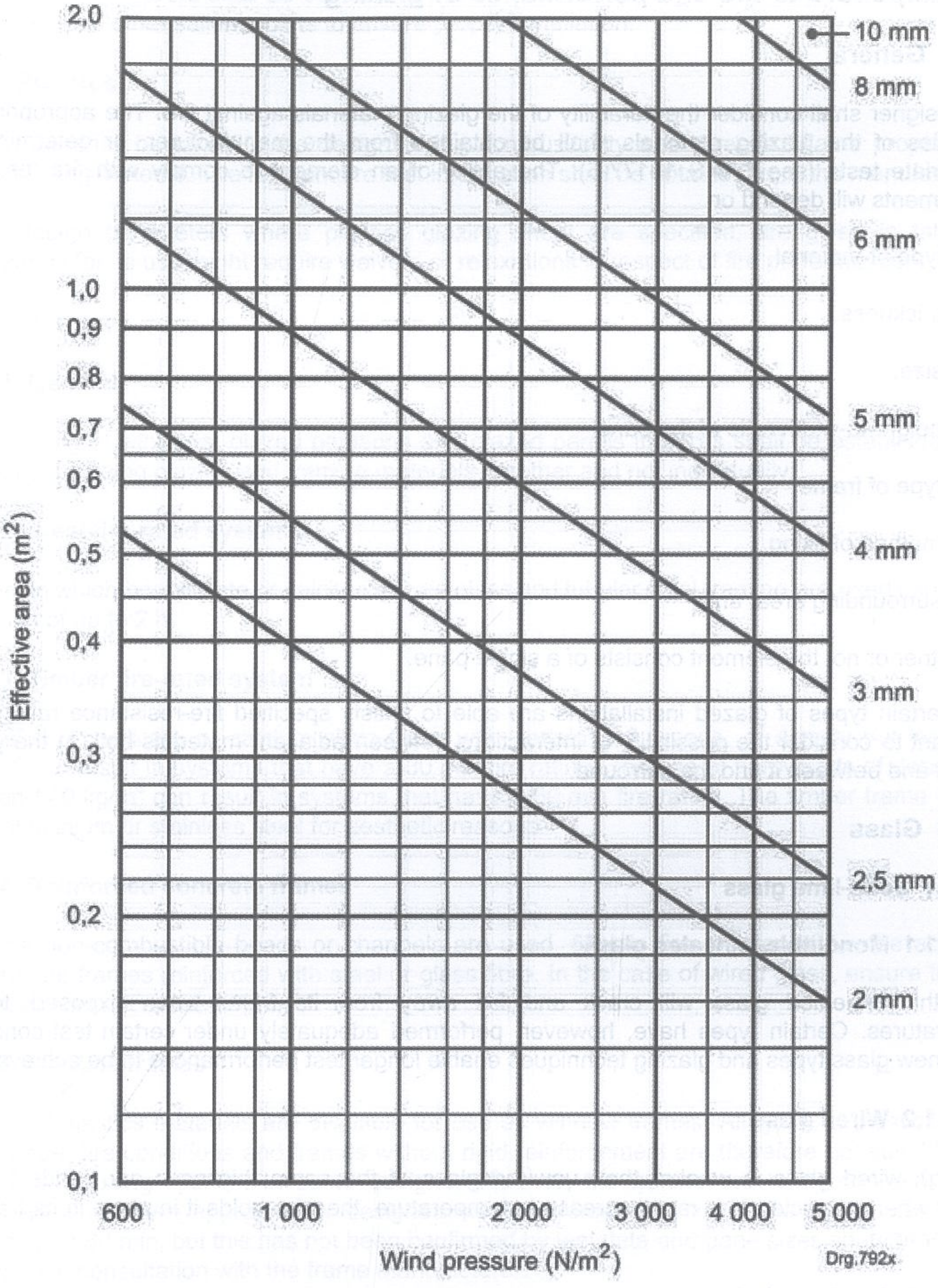



**Figure 32 — Wind loading graph for plastics glazing sheet materials, 15 mm edge cover, aspect ration greater than 2,5 up to include 3,5**

## 6.10 Exposure to fire and performance of glazing

### 6.10.1 General

The designer shall consider the durability of the glazing materials against fire. The appropriate fire properties of the glazing materials shall be obtained from the manufacturer, or determined by appropriate tests (see SANS 10177-5). The ability of an element to comply with fire resistance requirements will depend on

a) the type of material,

b) the thickness,

c) the size,

d) the height-to-width ratio of the pane,

e) the type of frame,

f) the method of fixing,

g) the surrounding area, and

h) whether or not the element consists of a single pane.

Only certain types of glazed installations are able to satisfy specified fire-resistance ratings. It is important to consider the possibility of interactions between adjacent materials both in the glazing system and between it and the surround.

### 6.10.2 Glass

#### 6.10.2.1 Soda-lime glass

##### 6.10.2.1.1 Monolithic annealed glass

Monolithic annealed glass will crack and fall away from its frame when exposed to high temperatures. Certain types have, however, performed adequately under certain test conditions. Some new glass types and glazing techniques enable longer test performances to be achieved.

##### 6.10.2.1.2 Wired glass

Although wired glass is weaker than unwired glass of the same thickness and tends to crack sooner when subjected to a rapid increase in temperature, the wire holds it in place in its frame for a longer time.

##### 6.10.2.1.3 Laminated glass

Laminated glass cracks when subjected to rapid and uneven heating but is held in place by the plastics interlayer until this layer melts or chars and the glass fragments gradually fall away.

#### 6.10.2.2 Borosilicate glass and calcium silicate glass

Borosilicate glass and calcium silicate glass are fire-resistant and are not wired or laminated. When used in appropriate framing, fire ratings of up to 2 h can be obtained.

The glass manufacturers shall be consulted to obtain information regarding intumescent materials, bead fixings and other salient points to ensure proper installation.

### 6.10.3 Plastics

Careful note shall be taken in the design of the combustibility and spread-of-flame properties of plastics glazing material. The relevant fire test information shall be obtained from the manufacturer.

Certain design parameters where plastics glazing sheet are specified, are given in table 18. Authorization for its use might require waivers or relaxations in respect of fire performance.

### 6.10.4 Frames

#### 6.10.4.1 General

The fire rating of windows, glazed partitions and glazed panels in doors shall be established as a system, i.e. by using glazing and framing materials together and not individually.

#### 6.10.4.2 Steel fire-rated systems

A system in which borosilicate or calcium silicate glass and tubular steel framing are used can obtain fire ratings of up to 2 h.

#### 6.10.4.3 Timber fire-rated system

The use of borosilicate or calcium silica glass with certain soft woods, of density not less than 490 g/m$^3$ can result in systems that have a 30 min fire rating. The use of hardwoods of density not less than 540 kg/m$^3$ can result in systems that have a 60 min fire rating. The timber frame can be clad in aluminium or stainless steel for aesthetic reasons.

#### 6.10.4.4 Reinforced concrete frames

If suitable non-combustible beads or channels are used, 60 min fire resistance can be achieved with concrete frames reinforced with steel or glass fibre. In the case of wired glass, ensure that the pane area does not exceed 1,2 m$^2$.

#### 6.10.4.5 Plastics frames

A variety of plastics materials are available for use as window frames. All types of plastics soften or char under fire conditions and frames without rigid reinforcement are therefore not suitable for a fire resistant glazing system. In some designs, however, the frames are reinforced with wood, steel or aluminium. An appropriately designed steel-reinforced plastics frame can achieve a fire rating of up to 60 min, but this has not been confirmed by test data and pane sizes shall be carefully considered in consultation with the frame manufacturer.

### 6.10.5 Requirements for roof lights

Normally there is no need for roof lights to have fire-resistance properties in relation to internal fire, but where they form part of the ceiling, ensure that their internal surfaces have an acceptable flame- spread classification (see SANS 10177-5) and that their number, area and positions are restricted.

With suitable fixings, supports and joints, all types of glass of nominal thickness exceeding 4 mm and some plastics materials can qualify, but consider, preferably, the use of glass with good holding properties such as wired or laminated glass.

### 6.10.6 Roof glazing

Although there is usually no need for roof glazing to have fire-resistance properties in relation to an internal fire, give consideration to both the type of occupancy and the contribution to the spread of fire that a collapse of the glazing material can cause.

## 6.11 Safety and security

### 6.11.1 General

The safety and security of people and property are of prime importance and, in addition to wind loads and fire protection, the following factors shall be considered when selecting glazing materials:

a) human impact;

b) burglary and vandalism; and

c) armed attack.

Glass for protection against factors (a) to (c) is given in SANS 1263-1, SANS 1263-2 and SANS 1263-3, respectively.

Risk situations can be described in general terms only. However, while accidents are not always avoidable, injuries are often due to failure by designers to observe an acceptable standard of safety in vulnerable areas.

It is not a requirement that the glazing remains unbroken, but it is a requirement that the risk be minimized by virtue of the strength and fracture characteristics of the glazing material selected.

Security glazing often has to be specially made to suit a particular situation and data contained in this clause is intended to serve as a guide only. Consult the individual manufacturer or supplier for guidance in the use of particular products.

### 6.11.2 Identification of safety and security glazing material

All safety glazing material (individual panes) shall be permanently marked. Such marking shall be visible after installation (glazing).

NOTE The onus rests with the installer of the safety glazing material to ensure that the permanent mark is applied.

### 6.11.3 Glazing material for resistance to human impact

#### 6.11.3.1 Transparent Glazing

Where transparent glazing is used and is not likely to be apparent to, or suspected by, any person approaching it, such glazing shall bear markings that shall render such glazing apparent to such person.

**6.11.3.2 Safety glazing**

**6.11.3.2.1** The panes of all safety glazing material shall be permanently marked by the installer in such a manner that the markings are visible in individual panes after installation.

**6.11.3.2.2** Safety glazing material that complies with the requirements of SANS 1263 shall be used where

a) the occupancy or building classification is A3: places of instruction, E1: places of detention, E2: hospitals, and E3: other institutional: residential buildings (see SANS 10400-A);

b) doors and sidelights form part of any entrance up to 2 100 mm from finished floor level;

c) a window has a sill height of less than 500 mm from the floor and is not guarded by a barrier that prevents a person from coming into contact with the glass panel;

NOTE A barrier could be any feature, i.e. a heavy bar across a window or a flower box placed in front of the window that will provide a physical or visual barrier between the glass and a person.

d) a window has a sill height of less than 800 mm from the floor and in the opinion of the local authority, is so placed that persons are likely, on normal traffic routes, to move directly towards such window;

e) a bath enclosure or shower cubicle is glazed or where glazing occurs immediately above a bath;

f) glazing is used in any shop front or display window within 2 100 mm from the finished floor level;

g) glazing is used in any wall or balustrade to a stairway, ramp, landing or balcony;

h) glazing is used within 1 800 mm of the pitch of a stairway or the surface of a ramp, landing or balcony;

i) glazing applications are sloped or are horizontal;

j) a mirror is installed as a facing to a cupboard door less than 800 mm above floor level and there is no solid backing;

k) glazing is used around areas such as swimming pools and ice rinks; and

l) glazing is used in internal partitions, within 2 100 mm of floor level, forming escape routes in buildings.

**6.11.3.2.3** Glass in balustrades shall be toughened safety glass unless rigidly supported all round. Specialized plastic glazing materials i.e. polycarbonate may be used for glazing in balustrades.

**6.11.3.2.4** Glass in horizontal or sloping applications shall be laminated safety glass or toughened glass. Toughened safety glass shall only be used where individual panes are framed all round. Specialized plastic glazing materials such as polycarbonate and acrylic may be used in sloped glazing applications provided they meet the requirements of all parts of SANS 1263.

**6.11.3.2.5** Wired glass having two-edge support may be used in vertical glazing in saw tooth roofs.

NOTE Figures 33 to 36 illustrate the conditions where safety-glazing materials are required in terms of 6.11.3.2.2.

**6.11.3.2.6** All repair and renovation glazing shall comply with the provisions of SANS 10400-N, irrespective of the type of glazing used originally.

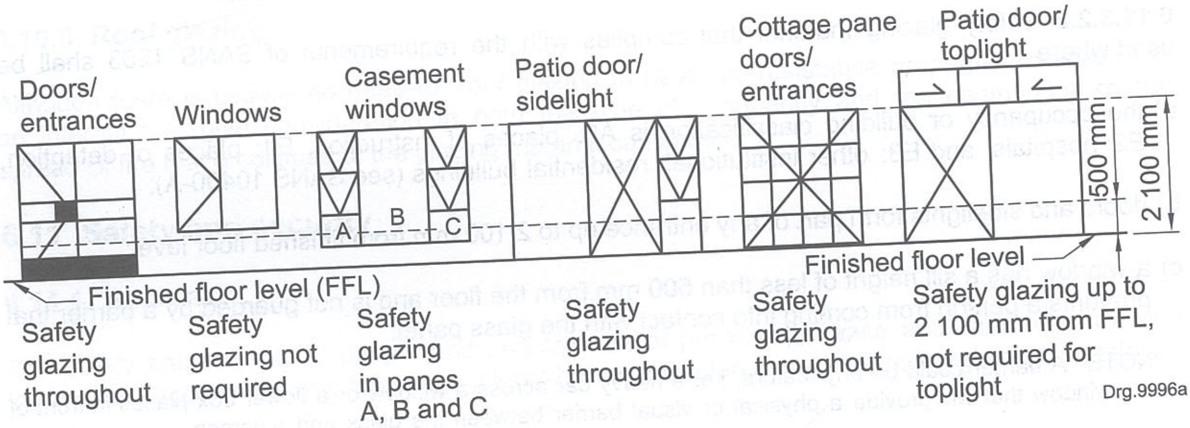



**Figure 33 — Examples of safety glazing requirements in doors and windows**

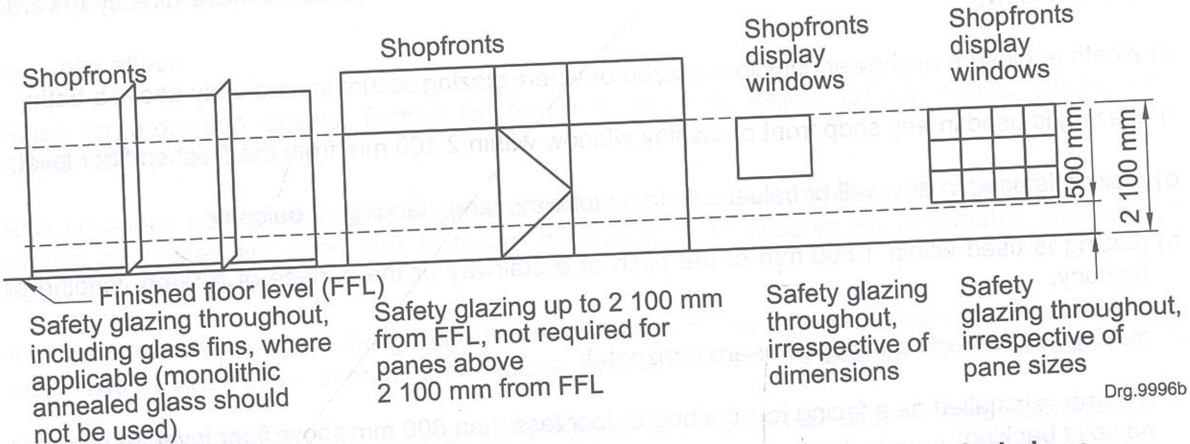



**Figure 34 — Examples of safety glazing requirements in doors and windows**

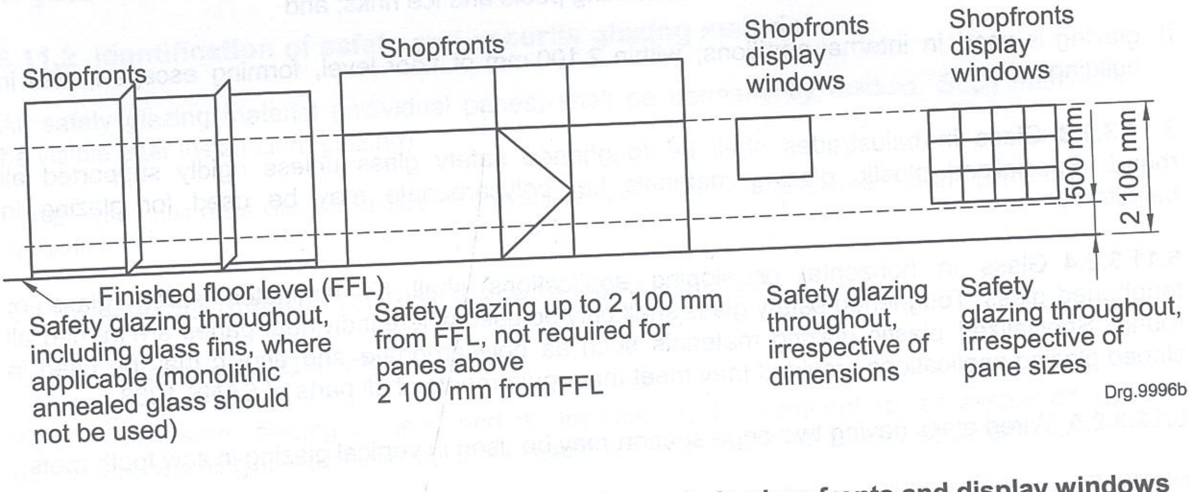
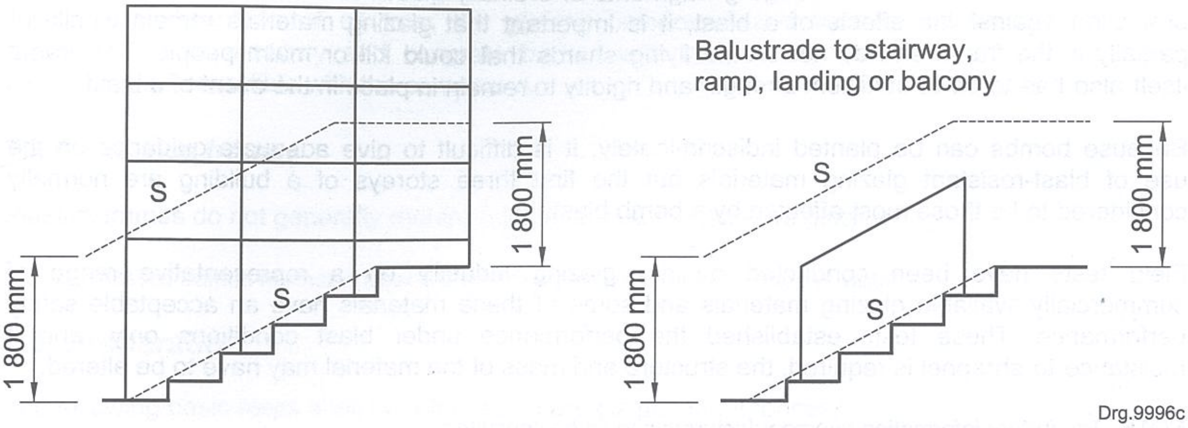



**Figure 35 — Examples of safety glazing requirements in shop fronts and display windows**




**Key**
S Safety glazing

**Figure 36 — Examples of safety glazing requirements around staircases and landings**

### 6.11.4 Other safety glazing material

Where the use of safety glass is required, such requirements shall not be construed as meaning that other safety glazing materials that comply with the requirements of all parts of SANS 1263 may not be used (see figure 37).

### 6.11.5 Bullet-resistant glazing material

**6.11.5.1** Armed attack means attack with the use of firearms, such as handguns, rifles or shotguns. The glazing material used to resist such attack may be one of the following:

a) multiple laminated glass;

b) glass and sheet plastics composites;

c) certain sheet plastics; or

d) laminated plastics.

**6.11.5.2** Bullet-resistant materials vary in composition and thickness to meet the anticipated level of attack. In the case of laminated materials, the number of layers is determined by the mass of the bullet and the muzzle velocity of the firearm envisaged. Each layer contributes in slowing down a bullet by absorbing some of its energy to such an extent that the bullet does not penetrate the material and that it does not generate flying fragments that could cause injury to a person immediately behind the material. Install bullet-resistant glazing materials in strict accordance with the recommendations of the manufacturer.

When resistance to armed attack is required; use glazing materials that comply with the relevant requirements of SANS 1263-3.

**6.11.5.3** Experience has shown that approximately 85 % of the injuries caused by urban bomb blasts or other blasts result from flying fragments of ordinary glass. Therefore, in order to provide protection against the effects of a blast, it is important that glazing materials remain wholly or partially in the frame and do not create flying shards that could kill or maim people. The frame itself also has to be of sufficient strength and rigidity to remain in place in the event of a blast.

Because bombs can be planted indiscriminately, it is difficult to give adequate guidance on the use of blast-resistant glazing materials but the first three storeys of a building are normally considered to be those most affected by a bomb blast.

Field tests have been conducted by the glazing industry on a representative range of commercially available glazing materials and some of these materials have an acceptable safety performance. These tests established the performance under blast conditions only, and if resistance to shrapnel is required, the structure and mass of the material may have to be altered.

NOTE For further information the manufacturers should be consulted.

# 7 Frames

## 7.1 General

The frames used for glazing may be timber, metal, plastics, concrete or stone frames. The nature of the frame has a considerable influence on the choice of the glazing method and material and the success or failure of the method depends to a large extent on the preparation of the frame.

## 7.2 Types

### 7.2.1 Timber frames

Treat the rebates (including beads, when used) with a primer that complies with the requirements of SANS 678. This reduces the porosity of the timber surfaces, prevents excessive absorption of oil from the glazing compound and provides a degree of protection for the timber.

Ensure that the primer is compatible with the glazing compound to be used.

### 7.2.2 Metal frames

**7.2.2.1** Ensure that steel frames comply with the relevant requirements of SANS 727. They shall be either

a) coated with an anti-corrosive primer,

b) powder-coated with a coating complying with SANS 1274, or

c) hot-dip galvanized, in accordance with the requirements of SANS 935.

**7.2.2.2** Aluminium frames shall either be

a) anodized for exterior use in accordance with the requirements of SANS 999, or

b) powder-coated for exterior use in accordance with the requirements of SANS 1578 and SANS 1796.

#### 7.2.3 Masonry and concrete frames

To prevent absorption of oil from the glazing compound and consequent staining, seal the relative areas of masonry and concrete frames with at least two coats of an alkali-resistant sealer that is compatible with the compound.

#### 7.2.4 Plastics frames

Plastics frames do not generally require additional treatment before glazing.

NOTE Plastics frames normally require beads that provide for the drainage of water.

### 7.3 Preparation

The following basic steps shall be followed before glazing commences:

a) Ensure that the frames are free from moisture before glazing is started.

b) Remove dust and other foreign matter from the rebates.

c) Ensure that frames are true and square.

d) Ensure that rebates of metal frames are free from projecting weld seams, screws and other fixings.

e) Carry out adjustments to the frames before glazing starts.

f) Where glazing beads are used, ensure that the beads are fixed to the frames with screws, where necessary, and that allowance is made for the thickness of the glazing material plus at least 3 mm of glazing compound on each face.

## 8 Glazing methods and systems

### 8.1 General

The methods described in this clause are those most commonly used in practice. Only the basic principles are given and variations may be used in certain circumstances when so agreed by the parties concerned. It is assumed that the preparatory steps detailed in 7.3 have already been taken.

### 8.2 Precautions

For a pane of thickness up to 6 mm provide an edge clearance of at least 3 mm all around. For a thicker pane that has a minor dimension exceeding 1 m, increase the edge clearance to provide for reasonable tolerances in the cutting of the pane and to facilitate the fitting of the pane.

### 8.3 Setting and location blocks

Before placing the glazing pane in the surround, where necessary, push setting blocks into position (when applicable, in the glazing compound) on the rebate platform. With the exception of panes of area not exceeding 0,3 m$^2$, rest the glazing pane on setting blocks to centralize it within the surround. Use blocks of length 25 mm to 75 mm, except at the bottom bar of vertically pivoted windows, where a single block of length at least 150 mm is sufficient.

Use location blocks also in openable windows to prevent distortion of the frame. Position setting and location blocks for glazing are as shown in figure 37. Setting and location blocks shall be of a material that is compatible with the glazing materials and sealants used shall be of hardness 50° Shore A durometer to 90° Shore A durometer.

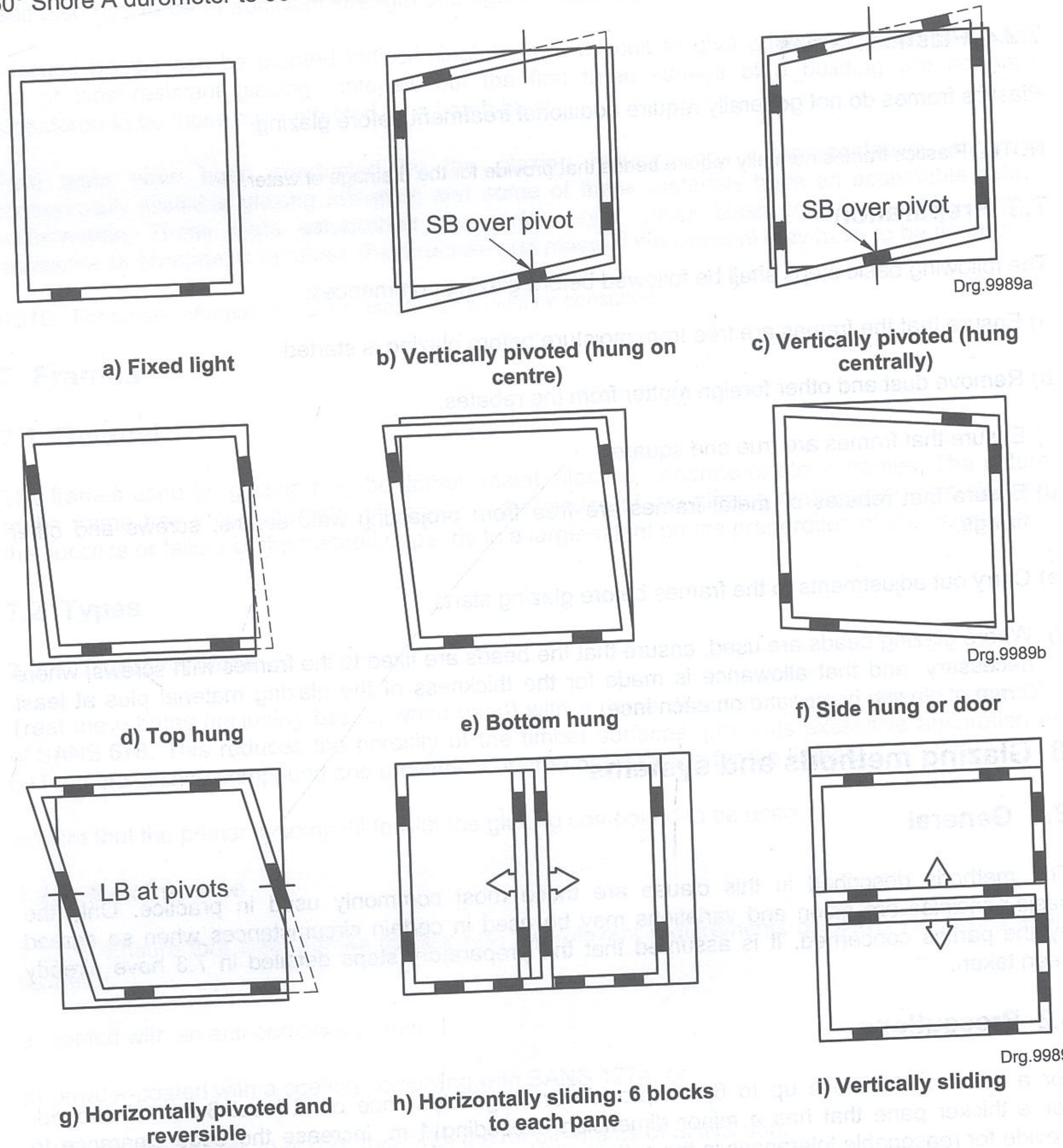



**Figure 37 — Approximate positions of setting blocks and location blocks**

## 8.4 Putty

**8.4.1** Apply enough bedding putty to the rebate to ensure that when the glazing pane is pressed into position, the putty is squeezed out around the entire perimeter of the glazing rebate (see figure 38).

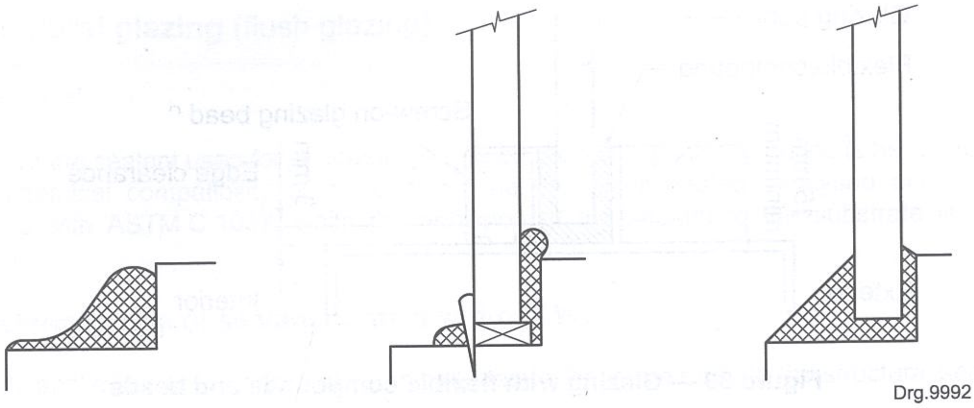



**Figure 38 — Glazing with putty**

**8.4.2** Where applicable, place the glazing pane on one or two (as appropriate) setting blocks placed at the required point(s) along the bottom edge. So position the glazing pane that an even bearing is obtained and edge clearances are equal all around. Then press the pane into the bedding putty until it is at least 2 mm from the back surface of the rebate.

**8.4.3** In timber surrounds, secure sprigs in the frame against the face of the glazing pane at approximately 30 mm centres. When the glazing pane of large area or thickness (or both) is used in a metal frame, secure the pane in the surround by the use of either clips or cleats. These accessories hold the glazing pane in position until the front putty has hardened, and thereafter act as a safeguard in case the putty deteriorates.

**8.4.4** Apply the front putty and finish it off to a splayed finish.

**8.4.5** Trim off excess back putty and finish it to a smooth fillet.

**8.4.6** Finish the front putty approximately 2 mm below the sight line (to allow for sealing of the edge of the putty to the glazing pane by overlapping of the paint) and then intercut the corners neatly.

**8.4.7** Lightly brush over the glazing with a small brush to seal the edges of the putty against the glazing panel and the surround.

NOTE Putty glazing is not recommended for large glazing panes, or for buildings of height exceeding five storeys.

## 8.5 Flexible compounds

Use flexible glazing compounds in conjunction with beads (see figure 39), as the compounds alone do not generally offer sufficient resistance to displacement. In order to maintain a weather tight seal, use correctly placed setting blocks and location blocks to support the glazing pane and to limit the movement caused by pressures imposed on the glazing system.

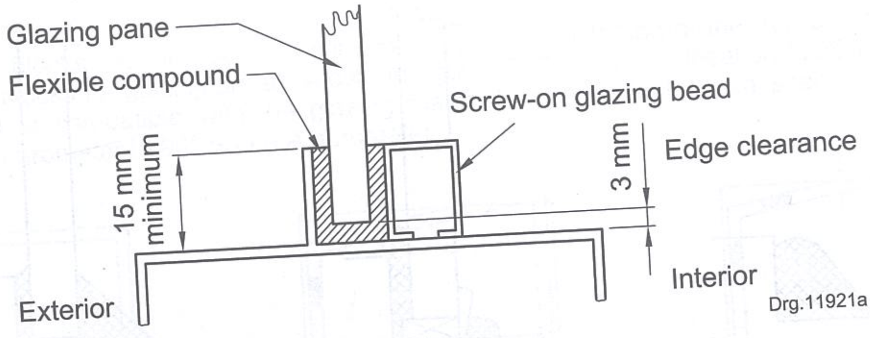



**Figure 39 — Glazing with flexible compounds and beads**

## 8.6 Sealants

Sealants ensure a satisfactory weather tight seal by providing maximum flexibility and adhesion between the glazing pane and the frame, and are generally used as bedding or capping (or both).

Use a sealant in conjunction with a flexible compound and beads as illustrated in figure 40 and also use setting blocks and location blocks (see figure 41).

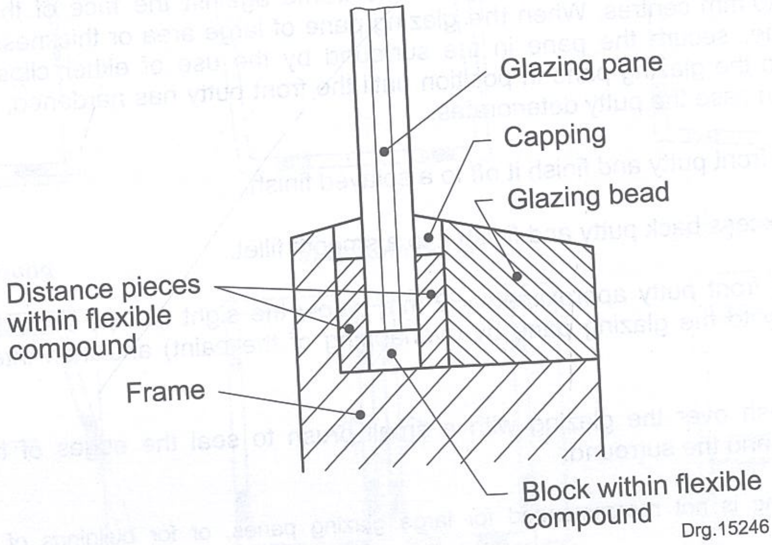



**Figure 40 — Glazing with sealants in conjunction with compounds and beads**

## 8.7 Preformed adhesive strip material

In glazing with preformed adhesive strip material, use the strip material in conjunction with beads as illustrated in figures 41, 42 and 43. Use setting blocks and location blocks as required (see figure 41).

## 8.8 Structural glazing (flush glazing)

### 8.8.1 General

It is vital that the sealant used for structural glazing be properly specified, the joints be well designed and the chemical compatibility of all elements be thoroughly tested, analysed and verified in accordance with ASTM C 1087, while the adhesion of the sealant to the substrate is of prime importance.

### 8.8.2 Determination of sealant contact width (CW)

Wind loads applied to the glazing area are distributed to the frame through the structural sealant.

The sealant shall be capable of maintaining an ultimate adhesive bond strength with the frame structure of 0,83 MPa and the maximum design stress on the sealant shall not exceed 0,14 MPa. Calculate the contact width using the following equation:

$$CW = \frac{S \times D}{200 \times 14}$$

where

$CW$ is the contact width, expressed in centimetres (cm);

$S$ is the short pane dimensions, expressed in metres (m);

$D$ is the design wind loading, expressed in pascals (Pa).

For geometric variations of pattern the above equation might require modification. If necessary, consult the manufacturer. For the determination of the adhesion of structural sealants refer to SANS 110, SANS 1077 and SANS 1305.

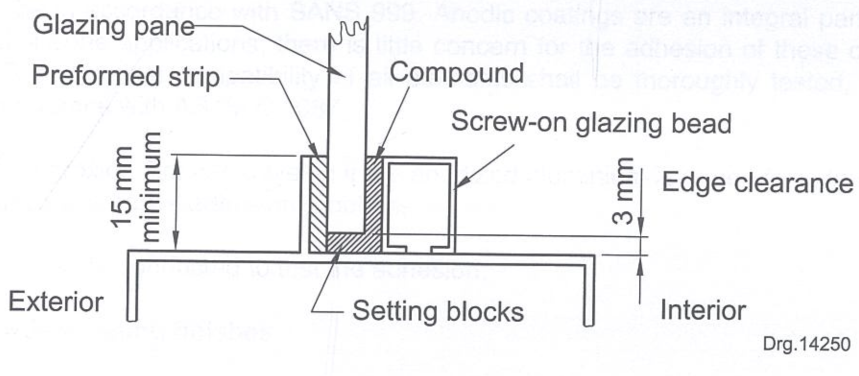
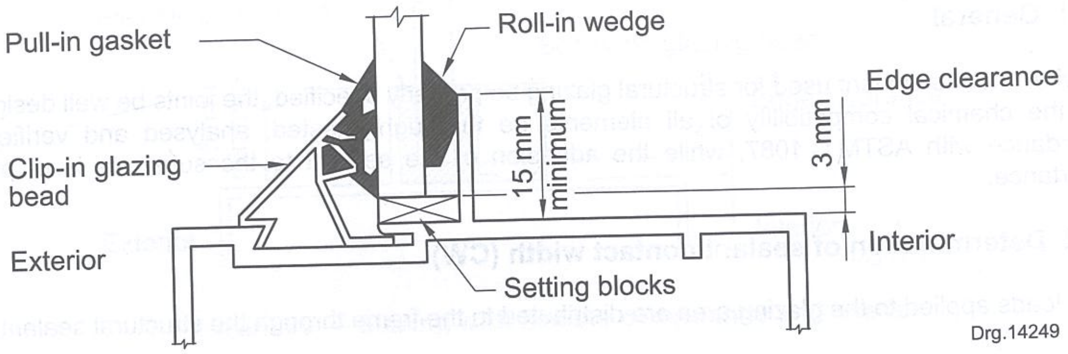
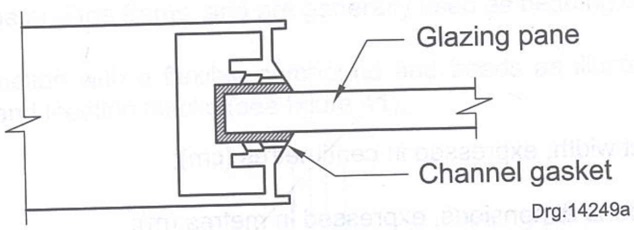



**Figure 41 — Glazing with preformed adhesive strip material in conjunction with beads and capping**




**a) Gasket glazing**




**b) Channel glazing**

**Figure 42 — Glazing with beads and preformed compression gaskets**

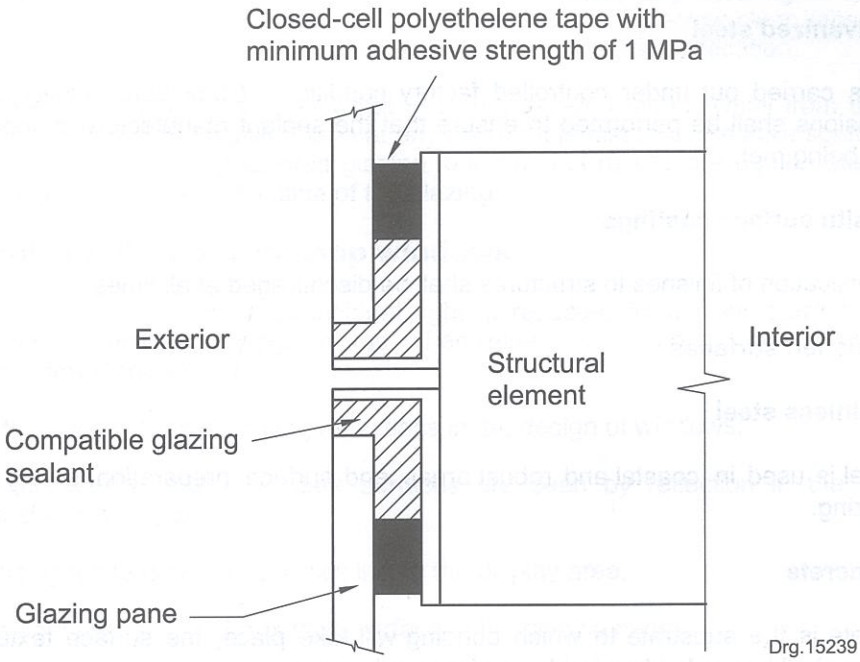



**Figure 43 — Structural glazing**

### 8.8.3 Surfaces

#### 8.8.3.1 Finished surfaces

##### 8.8.3.1.1 Anodic finishes

Only aluminium is anodized. The process is conducted under strict factory conditions and shall in every aspect be in accordance with SANS 999. Anodic coatings are an integral part of the metal. For structural silicone applications, there is little concern for the adhesion of these coatings to the metal itself. The chemical compatibility of all elements shall be thoroughly tested, analysed and verified in accordance with ASTM C 1087.

An aluminium hydroxide film can develop if the anodized aluminium is stored for a long period. This can go unnoticed and cause adhesion problems.

Random tests shall be conducted to test the adhesion.

##### 8.8.3.1.2 Powder-coating finishes

Powder coatings shall be factory-applied by applicators approved by the manufacturers of the coatings. Adhesion of organic coatings to substrates is developed by proper treatment. To minimize potential problems, continuous quality control before and after application of the coating is essential.

The sealant adhesion contact area shall be clearly shown and noted on the fabrication.

Proof shall be furnished that the requirements for the paints, given in SANS 5146, have been met and the compatibility shall be tested.

**8.8.3.1.3 Galvanized steel**

Galvanizing is carried out under controlled factory conditions. Continuous quality control of the finished extrusions shall be performed to ensure that the sealant manufacturer's specifications for adhesion are being met.

**8.8.3.1.4 In-situ surface coatings**

The in-situ application of finishes to structures shall be discouraged at all times.

**8.8.3.2 Unfinished surfaces**

**8.8.3.2.1 Stainless steel**

Stainless steel is used in coastal and robust areas and surface preparation is very important for structural glazing.

**8.8.3.2.2 Concrete**

Where concrete is the substrate to which bonding will take place, the surface texture is vital. A porous surface shall be sealed to provide maximum adhesion.

**8.8.3.2.3 Other materials**

Where materials other than those mentioned above are used the designer and manufacturers shall be consulted.

### 8.8.4 Surface preparation

**8.8.4.1 Solvent cleaning**

Clean dirty pane edges and oily surfaces with approved solvents.

**8.8.4.2 Priming**

Priming is not a substitute for solvent cleaning. Apply an appropriate primer within its shelf life. Over-priming can cause loss of sealant adhesion. Allow the primer to dry completely. The silicone sealant shall be applied as soon as possible.

**8.8.4.3 Sealing of porous surface**

A sealer that is totally compatible with the substrate and the sealant to be used shall be used to provide a smooth surface.

## 8.9 One-way vision

One-way vision can be provided where a considerable difference in the lighting intensities on the inside and outside of a window can be tolerated as, for example, in a security observation room, where the fitting of dark-tinted or reflective glazing will permit outward vision while obstructing any view inwards. The conditions will be reversed at night if the lighting in the observation room is switched on.

Another application of the one-way mirror technique is Venetian strip silvering in which a film is applied to glazing in vertically running broad strips alternating with narrow clear lines. The relative widths of the strips and lines can be varied according to the particular application.

From one side the appearance is almost that of a fully silvered mirror, while from the other side vision is achieved through the glazing pane at any reasonable distance. Relative lighting intensities are of less importance with strip-silvered glazing, but the best results are again obtained with the higher lighting intensity on the mirror side of the glazing.

## 8.10 Control of reflections in shop windows

Although only a small percentage of incident light is reflected from clear glazing panes, there are circumstances, particularly during daytime, when reflections from bright objects prevent a clear view of shop window displays.

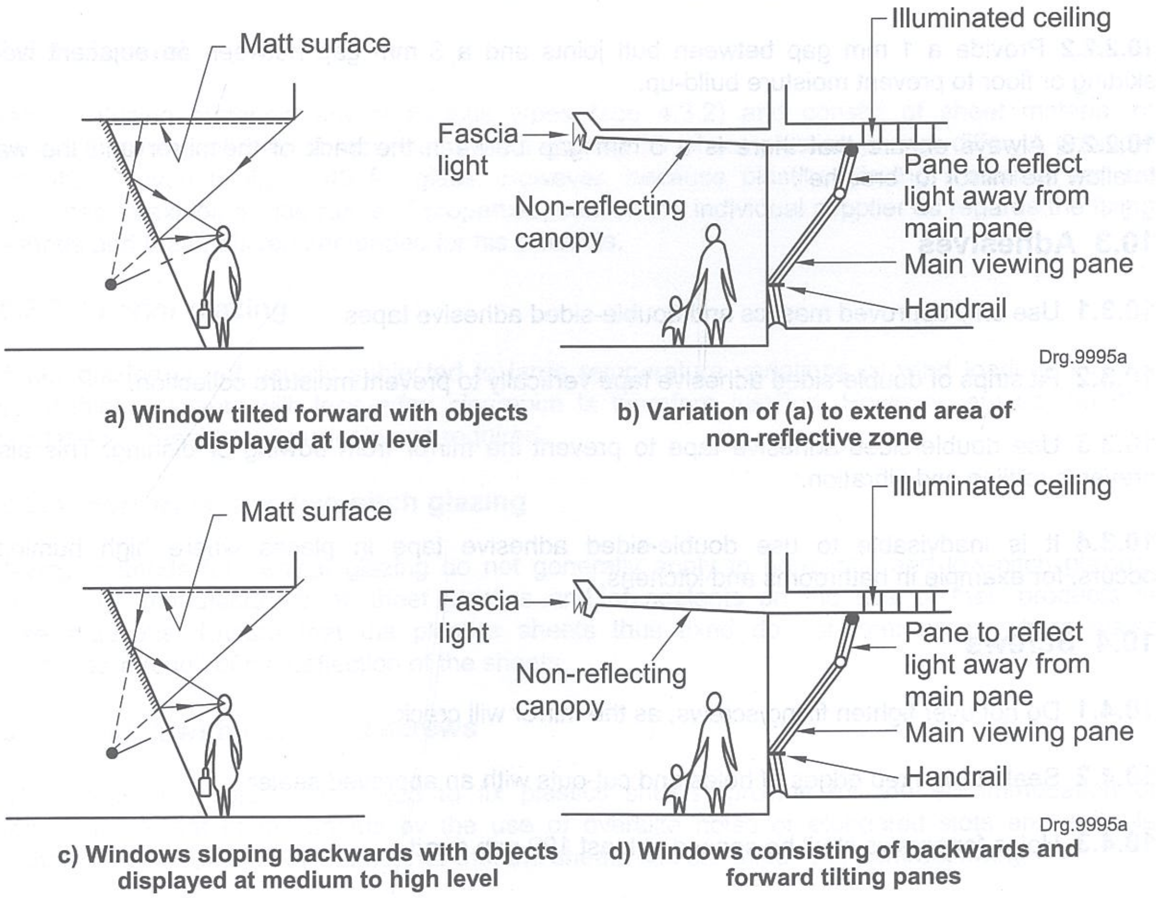
Consider the following means of limiting reflections in the design of windows:

a) So locate the window that only dark surfaces are seen by reflection in the window from normal outside viewing positions.

b) Augment the light intensity from sources inside the display area.

c) Reduce the light intensity on the outside surface of the glazing pane.

Various combinations of tilted flat panes or curved glazing panes in conjunction with different light intensities and finishes can be used to improve the view through the windows (see figure 44).




**a) Window tilted forward with objects displayed at low level**

**b) Variation of (a) to extend area of non-reflective zone**

**c) Windows sloping backwards with objects displayed at medium to high level**

**d) Windows consisting of backwards and forward tilting panes**

**Figure 44 —Various methods of glazing shop windows to control reflections**

## 9 Marking of safety glazing

All safety-glazing materials shall be permanently marked. Such marking shall be visible after installation in accordance with SANS 1263-1.

## 10 Fixing of mirrors

### 10.1 Thickness

A mirror of minimum thickness of at least 5 mm is recommended for mirror walls, as thinner mirrors tend to bow and distort.

### 10.2 Environment

#### 10.2.1 General

Do not rest mirrors on the backsplash of sinks or basins. Use a suitable anchor or spacers.

#### 10.2.2 Gaps

**10.2.2.1** Always provide expansion gaps, particularly when mirrors are mounted on walls that receive direct sunlight or that are situated next to a fireplace.

**10.2.2.2** Provide a 1 mm gap between butt joints and a 3 mm gap between an adjacent wall, skirting or floor to prevent moisture build-up.

**10.2.2.3** Always ensure that there is a 5 mm gap between the back of the mirror and the wall to allow the mirror to "breathe".

### 10.3 Adhesives

**10.3.1** Use only approved mastics and double-sided adhesive tapes.

**10.3.2** Fit strips of double-sided adhesive tape vertically to prevent moisture collection.

**10.3.3** Use double-sided adhesive tape to prevent the mirror from bowing or dishing. This also prevents rattling and vibration.

**10.3.4** It is inadvisable to use double-sided adhesive tape in places where high humidity occurs, for example in bathrooms and kitchens.

### 10.4 Screws

**10.4.1** Do not over tighten fixing screws, as the mirror will crack.

**10.4.2** Seal the worked edges of holes and cut-outs with an approved sealer.

**10.4.3** Holes for screws shall be spaced at least 100 mm apart.

## 10.5 Surface

Do not fit a mirror flush against any surface as this could cause problems due to factors such as stress, abrasion and collection of moisture.

## 10.6 Finishing

Do not seal edges of mirror with tile grouting, cement, silicone or other similar material.

## 10.7 Cleaning and maintenance

**10.7.1** Ensure that all the joints and edges are thoroughly dry.

**10.7.2** Use methylated spirits to clean the mirror.

**10.7.3** Do not use acidic or alkaline (ammonia-based) cleaners as they attack the backing paint.

**10.7.4** Do not use any abrasive cleaner such as steel wool, which scratches the glass.

**10.7.5** Do not apply cleaning fluid directly onto the face of the mirror as it could spill over the edge and onto the back.

## 10.8 Sheet plastics material

### 10.8.1 General

Plastics glazing materials are of various types (see 4.3.2) and consist of sheet material of nominal thickness at least 3 mm. Methods of glazing for sheet plastics do not differ in principle from those given in figure 43 for glass. However, because plastics glazing materials can be formulated to exhibit a wide range of properties, consult the individual supplier as regards the fixing methods and materials recommended for his products.

### 10.8.2 Interior glazing

Interior glazing is not usually subjected to large temperature variations or wind loading and the use of thinner sheets with less edge clearance is therefore justified. However, ensure that the installation is capable of functioning as required.

### 10.8.3 Horizontal and low-pitch glazing

Glazing methods for vertical glazing do not generally apply to horizontal and low-pitch glazing. Consult the manufacturers of sheet plastics and of sealants on the use of their products in these situations. Ensure that the plastics sheets thus fixed do not form areas where water collects as a result of the deflection of the sheets.

### 10.8.4 Fixing with bolts and screws

Where bolts and screws are used to fix plastics sheets, provide for the accommodation of thermal movement of the sheets by the use of oversize holes or elongated slots and suitable washers. So tighten the bolts or screws that the sheets can still expand or contract freely.

### 10.8.5 Properties of specialized plastic glazing materials

Table 15 gives the shading coefficients for specialised plastic glazing materials, table 16 gives acoustical insulation, table 17 gives heat loss properties and table 18 gives edge clearance and rebate depth.

## 10.9 Installation of unframed glass doors

Install unframed glass doors of toughened glass in accordance with the manufacturer's instructions, on either hinges sliders or pivots.

## 10.10 Glazing of buildings prone to high wind loads

Where a building is expected to be subjected to exceptional wind loads because of its height, shape or environment (or a combination of these factors), adhere to the following recommendations for glazing (see table 19):

a) Glaze the building from the inside, wherever possible.

b) Do not use front putty at a height of more than 15 m above ground level as the sole means of retaining the glazing in place.

c) Ensure that the glazing system (including fixing) is suitable for the wind loading conditions.

**Table 15 — Shading coefficients[a] for specialised plastic glazing materials**

| 1<br>**Materials** | 2<br>**Shading coefficients** | 3 |
|---|---|---|
| **Cast acrylic sheet** | | |
| Clear | 1,0 | |
| Bronze | 0,78 | |
| Opal | 0,47 | |
| **Polycarbonate sheet** | | |
| Clear | 0,97 | |
| Bronze | 0,75 | |
| Opal | 0,67 | |
| **Multi-walled polycarbonate sheet** | **6 mm** | **10 mm** |
| Clear | 0,99 | 0,98 |
| Bronze | 0,63 | 0,63 |
| Grey | 0,58 | 0,58 |
| Blue | 0,81 | 0,76 |
| Green | 0,59 | 0,59 |
| Opal | 0,87 | 0,82 |

[a] Due to the vast range of available products the specifier is advised to consult with manufacturers/suppliers to obtain/confirm relevant data.

**Table 16 — Acoustical insulation solid polycarbonate sheet**

| 1 | 2 |
|---|---|
| **Thickness** mm | **75 RW**[a] db |
| 4 | 27 |
| 5 | 28 |
| 6 | 29 |
| 8 | 31 |
| 9,5 | 32 |
| 12 | 34 |

[a] RW is the weighted sound reduction index.

**Table 17 — Heat loss properties solid polycarbonate[a] sheets**

| 1 | 2 |
|---|---|
| **Thickness** mm | ***U*-value** $W/m^2$ K |
| 4 | 5,33 |
| 5 | 5,21 |
| 6 | 5,09 |
| 8 | 4,84 |
| 9,5 | 4,69 |
| 12 | 4,35 |

[a] Due to the vast range of available products the specifier is advised to consult with manufacturers/suppliers to obtain/confirm relevant data.

**Table 18 — Edge clearance, (sheet edge engagement) and rebate depth for specialized plastic glazing materials**

| 1 | 2 | 3 | 4 |
|---|---|---|---|
| **Width or height**<br>mm | **Edge engagement "bite"** | **Edge clearance**<br>mm | **Rebate depth min.**<br>mm |
| 300 | 6 | 1 | 7 |
| 300 – 600 | 9 | 2 | 11 |
| 600 – 900 | 12 | 3 | 15 |
| 900 – 1 200 | 15 | 4 | 19 |
| 1 200 – 1 500 | 18 | 5 | 23 |
| 1 500 – 1 800 | 20 | 6 | 26 |
| 1800 – 2 100 | 20 | 7 | 27 |
| 2100 – 2 400 | 20 | 8 | 28 |
| 2 400 – 2 700 | 20 | 9 | 29 |
| 2 700 – 3 000 | 20 | 10 | 30 |

## 10.11 Glazing for special environmental conditions

### 10.11.1 Swimming-pool areas

Glazing in swimming-pool areas is subject to chemical attack on the fixing materials by both condensation and pool water. Chlorine or sodium hypochlorite is used in most swimming pools to maintain the water in a satisfactory condition for safe bathing and the condensate from such pools contains a substantial amount of chlorine, which can attack some fixing materials. It is also common practice at some pools to wash windows with pool water, which might contain chlorine, sodium hypochlorite or other harmful additives.

In general, silicone sealants, some polysulphide sealants and two-component (curing type) sealants are resistant to such types of attack and are suitable to use as glazing materials in swimming pool areas.

### 10.11.2 Underwater areas

Where the glazing will be permanently under water, such as in aquarium tanks and viewing windows of pools, obtain expert advice from the manufacturers of the relevant glazing materials about the suitability and use of the materials in such an environment.

### 10.11.3 High-humidity areas

In areas that are subject to both humidity and heat, mould growth on fixing materials and on surfaces adjacent to these materials might be promoted. In such areas, improve the ventilation in order to reduce the level of humidity. In addition, finish the fixing materials with a smooth chamfer to enable them to shed water and, where practicable, paint such materials with a gloss paint to minimize the collection of moisture and other contamination that is liable to promote mould growth.

### 10.11.4 Clinical areas

In areas where aseptic conditions are required, such as operating theatres and medical laboratories, it is normal practice to wash all surfaces regularly with strong detergents and bactericides. Fixing materials used in such areas have to be resistant to this type of treatment and also to the growth of bacteria. Materials generally selected for such applications are silicone sealants that incorporate fungicides, or some harder types of polysulphide sealants that include epoxy polysulphide sealants.

### 10.11.5 Areas subject to vandalism and security areas

When glazing has to withstand acts of vandalism and attempts at forced entry, use glazing materials that comply with the requirements of SANS 1263-2. Ensure that the area of exposed glazing panes is reduced to the minimum practicable. Also select glazing compounds or sealants that are difficult to damage or remove, such as some of the elastomeric types. Where possible, make use of bead glazing systems.

### 10.11.6 Heat-prone areas

Where glazing will be subjected to high temperatures use heat-resistant glazing materials in conjunction with beads and frames that will withstand the expected temperatures.

NOTE An illustration of the mean annual rainfall in Southern Africa is given in annex A.

# 11 Care of glazing materials

## 11.1 Before installation

Between the delivery of glazing materials to a building site and the completion of the building, they are vulnerable to the following types of damage:

a) Damage caused by moisture: Moist or wet conditions in storage can cause moisture penetration between the sheets, with consequent alkaline attack on the surface of the sheets. To prevent this, stack the sheets in a dry, protected place.

b) Impact and abrasion damage: Protect all glazing panes against impact, scratching and excessive pressure that could cause edge or surface damage. In the case of sheet plastics materials that are protected by a masking material, remove the masking only after the sheet has been cut to size and machining operations have been completed.

c) Thermal fracture or distortion: Do not store glazing materials in areas that are exposed to direct sunlight or to heat from appliances such as radiators.

## 11.2 During progress of work

During construction work, carry out the following recommendations, as appropriate:

a) Clean the glazing material as soon as practicable after installation.

b) In normal cleaning, use a soft clean cloth with water and a mild soap or mild liquid detergent, rinse with clean water and then remove excess water with a clean squeegee or wash leather. In exceptional circumstances remove grease and the like from the glazing pane by means of commercial solvents, followed by a normal wash and rinse. In the case of sheet plastics material ensure that the solvents are not detrimental to the material. Take care to avoid damage to glazing compounds.

c) To remove putty smears and similar marks, dust chalk powder lightly onto the surface of the glazing material and then rub it off.

d) Remove stains resistant to normal cleaning methods and light scratches on glass with the use of powdered pumice, cerium oxide or rouge. Do not use these abrasive-cleaning materials on surface-coated glazing panes.

e) Ensure that the cleaning agents used do not damage the glazing panes or surrounding elements.

f) It is advisable for the main contractor to protect all glazing materials from plaster droppings and mortar splashings by means of removable plastics coatings until completion of the building operations.

## 11.3 Cleaning and maintenance

During cleaning and maintenance work

a) prevent the entry of moisture that might be detrimental to timber and metal surrounds by the regular application of a protective coating, such as paint, lacquer or wax,

b) renew glazing compounds that have loosened or cracked,

c) replace other faulty or damaged fixing materials,

d) replace cracked and broken glazing panes,

e) wash the glazing panes and surrounds regularly with warm water and soap (or equivalent) to remove dirt, grit and other atmospheric pollutants that can cause deterioration of the glazing,

f) use acid cleaners, however diluted, only as a last resort for cleaning the glazing materials, and carefully follow the manufacturer's instructions for their use, particularly with regard to safety precautions, and

g) where difficult cleaning operations have to be performed, call upon specialists to do it.

(26) For Class H, C or S "normal construction foundations" are recomended. What is the minimum width of normal strip foundations for load bearing/external walls in single storey housing units with concrete roofs?
A: 400mm on rock or 600 if on soil
Ref: SANS 10400-H:2012 / Table 3 p17.

(27) Where shall vertical control joint be provided?
A: Where there is a storey height change in the height of the external walling and where set-backs produce a return on a plan of less than 800mm
Ref: SANS 10400-K:2015 / Section ~~4.3.3.2 p21~~. 4.2.6.2 p47

**Table 19 — Ultimate limit state design stresses for glass subjected to wind loading**

| 1 | 2 | 3 | 4 |
|---|---|---|---|
| **Glass type** | **Nominal thickness** mm | **Ultimate limit state design stress at locations shown** | |
| | | **Away from edge** MPa | **At edge** MPa |
| Annealed | 3 | 41,00 | 32,80 |
| | 4 | 38,99 | 31,19 |
| | 5 | 37,45 | 29,96 |
| | 6 | 36,20 | 28,96 |
| | 8 | 34,33 | 27,46 |
| | 10 | 32,80 | 26,24 |
| | 12 | 31,57 | 25,25 |
| | 15 | 30,15 | 24,12 |
| | 19 | 28,72 | 22,98 |
| | 25 | 26,96 | 21,57 |
| Toughened | 4 | 97,47 | 77,97 |
| | 5 | 93,61 | 74,89 |
| | 6 | 90,49 | 72,39 |
| | 8 | 85,82 | 68,65 |
| | 10 | 82,01 | 65,61 |
| | 12 | 78,91 | 63,13 |
| | 15 | 75,37 | 60,30 |
| | 19 | 71,81 | 57,45 |
| | 25 | 67,41 | 53,93 |
| Annealed laminated | 5 | 37,73 | 30,18 |
| | 6 | 36,43 | 29,14 |
| | 8 | 34,41 | 27,53 |
| | 10 | 32,87 | 26,30 |
| | 12 | 31,62 | 25,30 |
| | 16 | 29,75 | 23,80 |
| | 20 | 28,23 | 22,58 |
| | 24 | 26,99 | 21,59 |

NOTE 1 The surface of the glass within a distance equal to the glass thickness is considered to be the edge.

NOTE 2 3 mm toughened glass is not included in this table as it is not generally available in toughened form.

# Annex A
(informative)

## Illustration of the mean annual rainfall in Southern Africa

A map of the mean annual rainfall in Southern Africa is given in figure A.1.

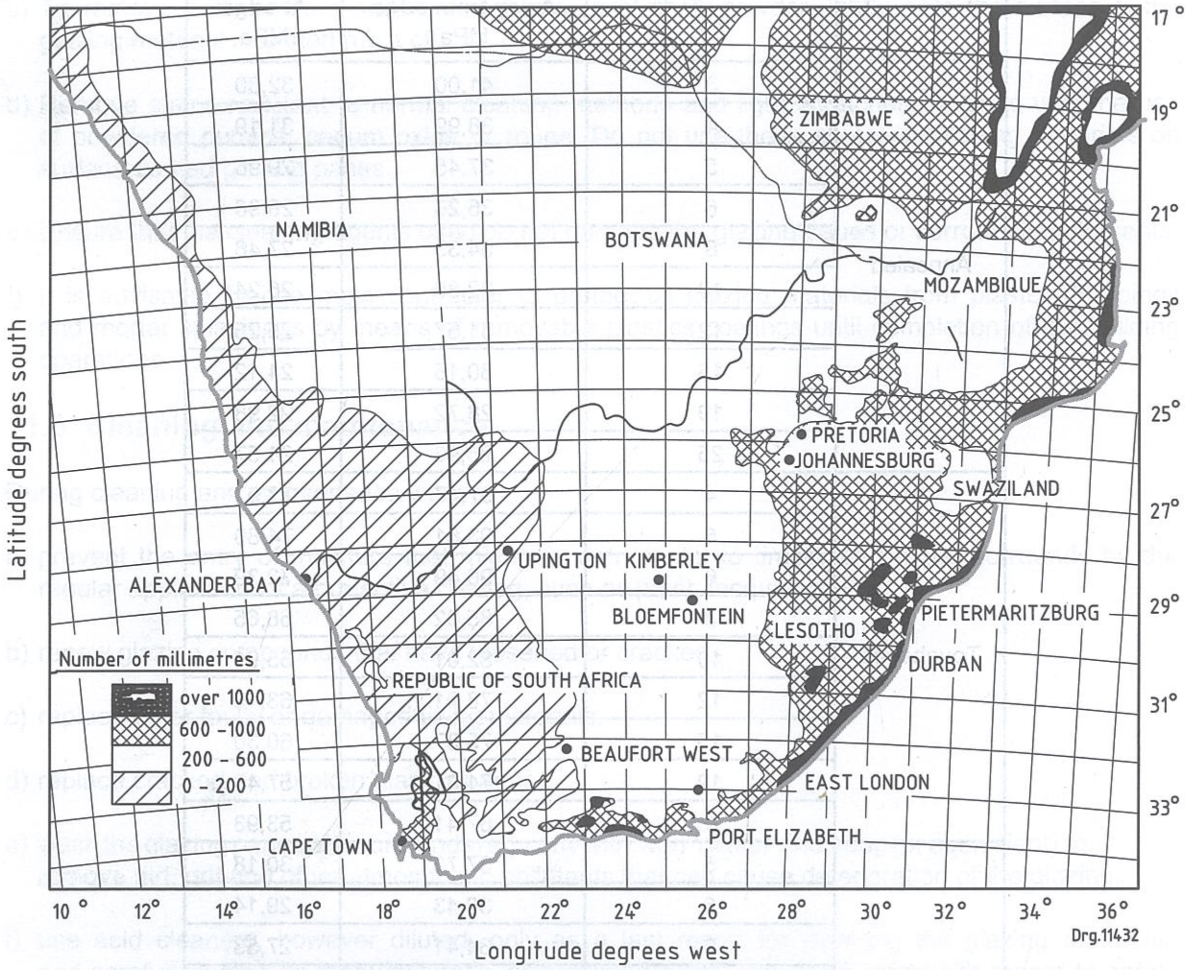
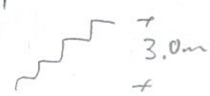



**Figure A.1 — Mean annual rainfall**

(22) What is the minimum bearing for a lintol with a span equal or greater than 2,5
A: 350mm
Ref: SANS 10400 - K: 2015 / Section 4.2.9.3.5 (b-1) p67

(23) What is the maximum rise of a staircase




A: 3m
Ref: SANS 10400 - M: 2011 / Section 4.2.3. p6

(24) What is the minimum headspace above a staircase?
A: 2.1m measures vertically from pitch line
Ref: SANS 10400 - M: 2011 / Section 4.2.1 p6.

(25) How deep is a drip beneath roof overhang?
A: 12mm
Ref: SANS 10400 - L: 2011 / Section 4.3.3.3. p14 / figure 5 p17