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Glass in buildings — Selection and installation



AS 1288:2021

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Preface

This Standard was prepared by the Joint Standards Australia/Standards New Zealand Committee BD-007, Glazing and Fixing of Glass, to supersede AS 1288—2006.

The objective of this document is to provide uniform direction for the use and installation of glazing throughout Australia to allow its use in legislation, and to clarify technical definitions.

This document will be referenced in the Building Code of Australia 2022; thereby superseding AS 1288—2006.

The most significant changes of this revision include the following:

- (a) Update [Section 1](#) to reflect introduction of new material.
- (b) Expand [Section 6](#) provisions to include three-sided support.
- (c) Include new charts and tables for [Section 6](#) to assist interpretation for users.
- (d) Assess/resolve loading requirements for glass balustrades and overhead glazing.
- (e) Inclusion of informative information in respect to post-breakage performance of materials involved.
- (f) Resolve ambiguity and clarify requirements for loading requirements to interlinking handrails in glass balustrades.
- (g) New test method for glass barriers in [Appendix H](#) and [I](#).
- (h) New imposed load table in [Appendix J](#).
- (i) Update changed sections to adhere to NCC drafting protocols (i.e. [Sections 1](#), [6](#) and [7](#) only).

This document makes recommendations for design and installation practice based on proven techniques.

Notes to the text contain information and guidance. They are not an integral part of the Standard.

The terms “normative” and “informative” are used in Standards to define the application of the appendix to which they apply. A “normative” appendix is an integral part of a Standard, whereas an “informative” appendix is only for information and guidance.

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Australian Standard®

Glass in buildings — Selection and installation

Section 1 Scope and general

1.1 Scope

This document sets out procedures for the selection and installation of glass in buildings, subject to wind loading, human impact, and special applications, such as overhead glazing, barriers and glass assemblies.

Glass strength requirements are given for glazing, based on the tensile stresses developed on the surface of the glass.

This document does not cover the following:

- (a) Glazing in lift cars and lift wells.
- (b) Furniture glass, cabinet glass, vanities, glass basins, refrigeration units, internal glass fitments and internal wall mirrors not specifically covered by [Section 5](#).
- (c) Buildings and structures with no public access intended for horticultural or agricultural use.

NOTE 1 The traditional use of these buildings suggests their current construction and glazing practices are acceptable. However, consideration should always be given to the brittle nature of glass and the consequences of its breakage.
- (d) Windows and doors in heritage buildings as defined by the relevant State or Territorial authority.
- (e) Restoration and or repairs to existing leadlights.
- (f) Special glazing applications which might fail due to the stresses other than tensile stresses, such as shear stresses.
- (g) Glass blocks, bricks or pavers.

NOTE 2 In Australia, legislation requires products to be “fit for purpose”. Where glazing is replaced because of breakage or any other reason, it is recommended that the replacement glass conform to the requirements of the relevant sections of this document, unless otherwise permitted by the relevant legislation.

1.2 Application

The criteria for the selection of thickness and type of glass for particular applications shall be as specified in separate sections of this document as follows:

- (a) For installations subject to wind loading, glass to be selected using either first principles as set out in [Section 3](#), or using the simplified design as set out in [Section 4](#).

NOTE 1 [Section 4](#) may give a more conservative design solution.
- (b) For human impact considerations, glass to be selected according to [Section 5](#).
- (c) For overhead glazing, glass to be selected according to [Section 6](#).
- (d) For barriers, glass to be selected according to [Section 7](#).
- (e) For framed, unframed, and partly framed glass assemblies glass to be selected in accordance with [Section 9](#).

Glass shall be installed in accordance with [Section 8](#).

For a given application, the type and thickness of glass selected shall be in accordance with the most stringent relevant requirements of [Sections 3](#) to [9](#) as applicable.

NOTE 2 For guidance on the use of this document for glass selection, see the flow charts in [Appendix G](#), [Figures G.1](#) to [G.5](#).

1.3 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document.

NOTE Documents referenced for informative purposes are listed in the Bibliography.

AS 1170.4, *Structural design actions, Part 4: Earthquake actions in Australia*

AS 1428.1, *Design for access and mobility, Part 1: General requirements for access — New building work*

AS 1926.1, *Swimming pool safety, Part 1: Safety barriers for swimming pools*

AS 2047, *Windows and external glazed doors in buildings*

AS 4055, *Wind loads for housing*

AS 4285, *Rooflights*

AS/NZS 1170.0, *Structural design actions, Part 0: General principles*

AS/NZS 1170.1, *Structural design actions, Part 1: Permanent, imposed and other actions*

AS/NZS 1170.2, *Structural design actions, Part 2: Wind actions*

AS/NZS 1170.3, *Structural design actions, Part 3: Snow and ice actions*

AS/NZS 2208, *Safety glazing materials in buildings*

AS/NZS 4666, *Insulating glass units*

AS/NZS 4667, *Quality requirements for cut-to-size and processed glass*

AS/NZS 4668, *Glossary of terms used in the glass and glazing industry*

ASTM C669, *Standard specification for glazing compounds for back bedding and face glazing of metal sash*

ASTM C1184, *Standard specification for structural silicone sealants*

ASTM C1279, *Standard test method for non-destructive photoelastic measurement of edge and surface stresses in annealed, heat-strengthened, and fully tempered flat glass*

ASTM C1281 *Standard specification for preformed tape sealants for glazing applications*

ASTM E1300, *Standard practice for determining load resistance of glass in buildings*

BS 544, *Specification for linseed oil putty for use in wooden frames*

BS 952-1, *Glass for glazing, Part 1: Classification*

BS 4255-1, *Rubber used in preformed gaskets for weather exclusion from buildings, Part 1: Specification for non-cellular gasket*

BS 6262 (all parts), *Glazing for buildings*

EN 14179-1, *Glass in buildings — Heat soaked thermally toughened soda lime silicate safety glass, Part 1: Definition and description*

1.4 Terms and definitions

For the purpose of this document, the definitions in AS/NZS 4668 and those below apply.

1.4.1

area

area of the panel between sightlines after glazing, calculated using the sight size

1.4.2

arrised edge

result of removing sharp edges

1.4.3

aspect ratio

<panels being supported on all 4 sides> ratio of the longer side of a panel to its shorter side

<panels supported on 3 sides or 2 opposite sides> ratio of the length of the supported side to its unsupported sides perpendicular to the supported side

1.4.4

barrier

balustrade

low wall to a stair, ramp, balcony, raised level, or a change in levels to prevent falls from height or to restrict access

Note 1 to entry: The term “balustrade” is used in [Sections 1, 6 and 7](#).

1.4.4.1

point-fixed barrier

point-fixed balustrade

glass barrier or balustrade which uses point-fixed standoff fittings to anchor or bolt through the face of the glass to the structure

Note 1 to entry: This type of barrier may or may not have a handrail.

Note 2 to entry: For an illustration, see [Figure 7.8](#).

1.4.4.2

spigot-fixed barrier

spigot-fixed balustrade

glass barrier or balustrade which is secured to the structure with spigot or peg fittings that clamp or restrain the glass on the bottom edge

Note 1 to entry: This type of barrier may or may not have a handrail.

Note 2 to entry: For an illustration, see [Figure 7.7](#).

1.4.5

barrier infill panel

balustrade infill panel

glass panel which serves as a component to fill a space or opening and is supported by posts, rails or other structural elements of the barrier system and resists an infill pressure and/or point load applied to the glass panel

1.4.6

bead

strip of wood, metal, sealant or other suitable material secured to the rebate to retain the glass

Note 1 to entry: Also known as “glazing bead” or “sealant bead”.

1.4.7**bite**

width of silicone used to bond the fin or frame member to the edge of the glass panel

1.4.8**block**

small piece of lead, rubber or other suitable material used to position the glass in the frame

1.4.9**buildings****1.4.9.1****residential**

buildings and such portions of buildings used as separate dwelling houses and flats, but not incorporating common circulation areas in blocks of two or more flats

1.4.9.2**non-residential**

buildings other than residential buildings ([1.4.9.1](#))

Note 1 to entry: Examples include hotels, hostels, motels, shops, offices, schools, public assembly buildings, and factories, and those parts of residential buildings common to a group of dwellings, such as common circulation areas in blocks of two or more flats.

1.4.10**chair rail**

fixed glazing bar, or rigid push-bar, that provides protection from human impact

1.4.11**crash rail**

rail, together with its fixings, capable of withstanding a load of 750 N/m length, acting in any direction without contact with the glazing material

1.4.12**daylight size**

clear unsupported opening size that admits light

1.4.13**decorated glass**

clear or patterned glass processed by craftsmen for decorative effect

Note 1 to entry: Stained glass, leadlights and sandblasted, acid-etched, embossed and printed glass fall into this category.

Note 2 to entry: Decorative interlayers may also be incorporated in laminated glass

1.4.14**distance piece**

small blocks of resilient, non-absorbent material (such as extruded rubber) used to prevent the displacement of glazing compound or sealant by external loading. They are positioned opposite each other between the glass and rebate, and glass and bead

1.4.15**door**

hinged, sliding, or otherwise supported openable framed or unframed barrier providing entrance to and exit from a building, corridor or room

1.4.16**double glazing**

glazing that incorporates two panels, separated with an airspace, for the purpose of sound insulation or thermal insulation, or both

1.4.17**edge blocks**

rubber blocks that prevent glass from moving sideways in the glazing rebate from thermal effects or vibration

1.4.18**edge clearance**

space between the edge of the glass and frame rebate

1.4.19**edge cover**

distance between the edge of the glass and the sightline

1.4.20**edge working**

process of removing sharp edges from the surface and/or cut edges of glass by grinding, smoothing, bevelling and/or polishing

Note 1 to entry: For different edge finish requirements for specific applications, see AS/NZS 4668.

1.4.21**exposed edge**

glass edge that is not covered

Note 1 to entry: Glass with exposed edges has no protection from damage and may cause injury to those who come in contact with it.

1.4.22**faceted glazing**

flat panes of glass installed vertically at an angle to each other, to form a faceted curve

1.4.23**fin**

piece of glass positioned and fastened to provide lateral support

1.4.24**frame**

structure manufactured from timber, metal, glass, or other durable material or combinations of materials supporting the full length of a glazed panel edge

Note 1 to entry: An example of a combination of materials is glass fins and structural sealant.

1.4.25**frameless glazing**

see *unframed glazing*

1.4.26**fully framed glazing**

panels that have all edges framed

1.4.27**glazing**

<verb> securing glass in prepared openings in windows, door panels, partitions, and the like

<noun> glass or plastics glazing sheet material for installation into a building

1.4.28 handrail

railing which forms part of a barrier or balustrade for people to hold onto for support and to prevent people from falling

Note 1 to entry: For the purposes of this document, the definition of handrail, may differ from other standards such as AS 1428.

1.4.28.1 load-supporting handrail

railing which supports the loads and is mechanically fixed to the structure or stanchions

Note 1 to entry: The handrail may or may not be connected to the glass.

1.4.28.2 non-load-supporting handrail

railing that is fixed to glass and relies on the glass for structural support

1.4.28.3 interlinking handrail

variation of load supporting handrail ([1.4.28.1](#)) which is connected to adjacent glass panels, the building, or both and relies on the glass for structural support

1.4.29 heat-strengthened laminated safety glass

laminated safety glass utilizing two or more panels of heat-strengthened glass in the make-up

1.4.30 insulating glass unit

IGU

two or more panels of glass spaced apart and factory sealed with dry air (hermetically) or special gases in the unit cavity

Note 1 to entry: Often abbreviated to IGU or referred to as the unit.

1.4.31 internal partition

interior dividing wall or such portion of an interior dividing wall that is not a door, side panel, shopfront, or atrium wall

1.4.32 laminated glass

composite material consisting of two or more sheets of glass permanently bonded together by a plastic interlayer material

1.4.33 laminated safety glass

laminated glass that satisfies the relevant requirements for a safety glazing material

Note 1 to entry: For the requirements for safety glazing materials, see [Clause 2.1.4](#).

1.4.34 leadlight

panel of individual glass pieces within a framework of lead, copper, zinc or brass comes, made in the traditional manner of small panes

1.4.35 maximum thickness

thickness of a panel of glass at the maximum thickness tolerance

1.4.36**minimum thickness**

thickness of a panel of glass at the minimum thickness tolerance

1.4.37**mirror**

piece of glass silvered on one side

1.4.38**nominal thickness**

numeric designation, used for reference purposes, that indicates the approximate thickness of glass

Note 1 to entry: Nominal thickness is used for description convenience only and not as an exact manufacture size.

1.4.39**pane**

single piece of glass cut to size for glazing

1.4.40**panel**

assembly containing one or more panes

Note 1 to entry: Panels may be fully framed, partly framed or fully unframed.

1.4.41**partly framed glazing**

panels that have one or more edges unframed

1.4.42**patterned glass**

glass having a pattern impressed on one side or both sides

1.4.43**rebate**

part of a frame into which the edge of glass is installed

1.4.44**organic-backed safety mirror**

glazing material consisting of a pane of glass mirror with a sheet of tear-resistant organic material permanently bonded to one side, which satisfies the relevant requirements for a safety glazing material

Note 1 to entry: For the requirements for safety glazing materials, see [Clause 2.1.4](#).

1.4.45**safety organic-coated glass**

glazing material consisting of a piece of glass coated and permanently bonded on one or both sides with a continuous polymeric coating, sheet or film, which meets the test requirements of the safety glazing materials

Note 1 to entry: For the requirements for safety glazing materials, see [Clause 2.1.4](#).

1.4.46**setting block**

block of resilient non-absorbent material used to support the dead load of the glass on the rebate and prevent glass-to-frame contact

Note 1 to entry: Normally used in pairs located at quarter points of the glass width.

1.4.47**shopfront**

glazed or partly glazed wall at public access level with or without a stall board suitable or intended, or both, for the display of products or services

Note 1 to entry: Locations include shopping malls, arcades and similar public areas of non-residential buildings,

1.4.48**side panel**

panel (operable or inoperable) located adjacent to a doorway, which may or may not be in the same plane as the doorway

1.4.49**sightline**

perimeter of the opening that admits daylight

Note 1 to entry: Also known as “glazing line”.

1.4.50**sight size**

clear unsupported opening size that admits light

Note 1 to entry: Also known as “daylight”.

1.4.51**sloped overhead glazing**

glazing that is inclined at less than 75° to the horizontal and located, wholly or partially, directly above an area that may be occupied by people

1.4.52**slenderness factor**

span to thickness ratio for all panels supported on four edges

1.4.53**span**

dimension between supports

Note 1 to entry: For panels supported on all four edges, this corresponds to the smaller of the sight size dimensions.

1.4.54**street awning**

overhead glazing where it is practical for limited numbers of people to gain access from either adjacent open windows, awnings, balconies or roofs or from the ground

1.4.55**structural barrier panel**

barrier in which the glass panel forms the structural element

1.4.56**structural silicone glazing**

use of silicone sealant not only as a weather seal but also for the structural transfer of loads from the glazing panel to its perimeter support system

1.4.57**toughened laminated safety glass**

laminated safety glass utilizing two or more panes of toughened safety glass in the construction

Note 1 to entry: Toughened laminated safety glass is more correctly referred to as “laminated toughened safety glass”.

1.4.58**unframed glazing**

panels without framed edges

1.4.59**wardrobe doors**

doors that provide access to built-in storage areas, excluding those fitted to pieces of furniture that are not built into the building

Note 1 to entry: Doors providing access to walk-in wardrobes are defined as doors ([1.4.15](#)).

1.5 Notation

Symbols used in this document are listed below.

The dimensional units for length and stress, in all expressions or equations, shall be taken as millimetres (mm) and megapascals (MPa), respectively, unless specified otherwise.

A	=	area of glass ($H \times W$)
AR	=	aspect ratio
B	=	span (distance between two supports) <i>or</i> width of each faceted panel
B/t	=	slenderness factor
b	=	width of glass pane or breadth of fin
$C_{p,n}$	=	net pressure coefficient
c_1	=	glass type factor
c_2	=	surface type factor
c_3	=	load duration factor
d	=	depth of fin <i>or</i> load duration
E	=	effective width <i>or</i> linear elastic modulus
$(EI)_y$	=	effective rigidity for bending about the minor y-axis
F	=	factor for facet angle
FFL	=	finished floor level
f'_t	=	characteristic tensile strength of the glass
G	=	gap between façade panels or torsional elastic modulus
G_j	=	effective torsional rigidity
g_1, g_2, g_3, g_4	=	slenderness factor
H	=	effective height of glass
i	=	total number of sheets or panes within the assembly
J	=	torsional moment of inertia

K_A	=	restraint stiffness
k_{pane}	=	load-sharing factor of pane
k_{sheet}	=	load-sharing factor of sheet
L_{ay}	=	distance between effectively rigid buckling restraints
M	=	bending moment
M_a	=	applied bending moment on the beam
M_{CR}	=	critical elastic buckling moment
M_t	=	topographic multiplier
m	=	number of members supported by each restraint system
n	=	number of equally spaced intermediate restraints
P_R	=	restraint force
P_s	=	serviceability limit state design wind pressure
P_u	=	ultimate limit state design wind pressure
P_z	=	ultimate limit state design wind pressure at a reference location, z , from ground level
R_u	=	nominal capacity at ultimate state
SLS	=	serviceability limit state
S^*	=	design action effect
T	=	thickness of the fin or tension load
TC	=	terrain category
t	=	minimum thickness of glass or minimum structural silicone bite
t_i	=	thickness of each sheet or pane of glass within the assembly
t_{pane}	=	thickness of pane
t_{sheet}	=	thickness of each sheet of glass
ULS	=	ultimate limit state
$V_{h,u}$	=	ultimate limit state design gust wind speed
$V_{h,s}$	=	serviceability limit state design gust wind speed
W	=	width of glass or width of the façade panel
X	=	geometric factor
y_h	=	height above centroid of the point of load application
β	=	moment parameter
Δ_A	=	beam displacement

φ	=	capacity reduction factor
γ	=	obtuse angle between adjacent façade panels
σ_G	=	ultimate limit edge strength of glass
σ_s	=	ultimate limit stress in silicone

Section 2 Materials

2.1 Glass

2.1.1 General

Clear ordinary annealed glass, tinted heat-absorbing glass, patterned, wired, processed, laminated and toughened glass shall be classified in accordance with AS/NZS 4667.

Glass types not otherwise specified in AS/NZS 4667, AS/NZS 4668 or this Standard, which are used in buildings, shall be classified in accordance with BS 952-1.

2.1.2 Heat-strengthened glass

When tested in accordance with ASTM C1279, heat-strengthened glass shall have a surface compression of 24–52 MPa unless heat strengthened glass having a surface compression stress > 52 MPa and < 69 MPa is glazed in accordance with [Clause 3.8.2](#).

NOTE Heat strengthening associated with relatively high surface compressive stresses > 52 MPa can lead to an increased risk of spontaneous glass fracture (associated with nickel sulphide). Refer to [Clause 3.8](#) for the requirements to minimize the risk.

2.1.3 Toughened glass

Toughened glass shall have a surface compression of not less than 69 MPa.

NOTE 1 The process of toughening is used to increase the strength of glass and to produce fracture characteristics that are desirable in many situations; however, the process of toughening can also lead to an increased risk of spontaneous glass fracture (associated with nickel sulphide). Refer to [Clause 3.8](#) for the requirements to minimize the risk.

NOTE 2 For determining surface compressive stress, see ASTM C1279.

2.1.4 Safety glazing material

Safety glazing materials shall comply with AS/NZS 2208.

Where safety glazing materials comply with the relevant requirements of AS/NZS 2208, except that they are of non-standard thickness, they may be used provided the minimum thickness is marked on the glass in addition to the other marking requirements of AS/NZS 2208 and the relevant requirements of this Standard.

When applied to glazing, safety organic coatings shall extend to the edge of the glass or within 3 mm of the sightline and shall be permanently bonded to the glass.

2.1.5 Insulating glass units

Insulating glass units shall comply with AS/NZS 4666.

2.1.6 Glass material properties

For the purpose of this Standard, whether the glass is annealed, heat strengthened or toughened, the glass material properties shall be based on reliable test data. In the absence of test data, the following material properties shall be used:

- (a) Density = 2 500 kg/m³.
- (b) Poisson's ratio = 0.22.

- (c) Linear elastic modulus (E) = 70.0 GPa.
- (d) Torsional elastic modulus (G) = 28.7 GPa.

2.2 Other glazing materials

2.2.1 General

Glazing materials, not otherwise specified in this Standard, shall be in accordance with the relevant requirements of BS 6262.

2.2.2 Structural sealant

The structural sealant shall be silicone complying with ASTM C1184.

The characteristic strength of the silicone shall be greater than 0.21 MPa.

2.2.3 Linseed oil putty

Linseed oil putty shall comply with BS 544 or equivalent.

2.2.4 Steel sash putty

Steel sash putty shall comply with ASTM C669 or equivalent.

2.2.5 Gaskets

Gaskets shall comply with BS 4255-1 or equivalent.

2.2.6 Preformed tape

Preformed butyl and foam tapes shall comply with ASTM C1281 or equivalent.

2.2.7 Setting blocks, location blocks, and distance pieces

Setting blocks, location blocks, and distance pieces shall be —

- (a) of resilient, load-bearing, non-absorbent and rot-proof materials;
- (b) compatible with all other materials that may come in contact with them; and
- (c) of shore-A hardness of 80 to 90 for setting blocks and 55 to 65 for location and distance pieces.

NOTE Specific design, sizing and installation details are critical for the performance and details for insulating glass units are given in [Section 9](#) and AS/NZS 4666.

Section 3 General design criteria

3.1 General

Glazing shall satisfy the design requirements for ultimate and serviceability limit states in accordance with the procedures given in this Standard, as appropriate.

NOTE For the construction and installation of windows, sliding doors, adjustable louvres, shopfronts and window walls, refer to AS 2047.

3.2 Loads and other actions

3.2.1 Loads

The design of a structure for strength and serviceability limit states shall account for the action effects directly arising from the following loads:

- (a) Permanent and imposed, live, wind, snow actions specified in AS/NZS 1170.1, AS/NZS 1170.2, AS/NZS 1170.3 or AS 1170.3 and AS 1170.4.
- (b) Other specific loads, as required.

3.2.2 Load combinations

The design load combinations for strength and serviceability limit states shall be as specified in AS/NZS 1170.0.

3.3 Limit states

3.3.1 General

The glazing and its component members (e.g. including each sheet for laminated glass) and connections shall be designed for the strength limit states as follows:

- (a) The loads and actions shall be determined in accordance with [Clause 3.2.1](#).
- (b) The design action effect (S^*) resulting from the strength limit state design loads shall be determined by elastic structural analysis.

NOTE 1 Where membrane action will occur (for example, glass plates supported on all edges with deflections greater than 75 % of the plate thickness), geometric nonlinear analysis is required to predict peak stress magnitude and location.

- (c) The ultimate design capacity (ϕR_u) shall be determined from the nominal capacity (R_u) determined from [Clause 3.3.2](#), where the capacity factor (ϕ) shall be taken as 0.67.

NOTE 2 A lower capacity reduction factor may be used where a higher safety factor is required for specific applications where the direct consequences of failure may be severe and as deemed necessary by the designer.

- (d) The characteristic capacity in regions where the distance from any edge or opening is less than the thickness of the glass shall be taken to be the characteristic capacity of the glass at the edge (see [Clause 3.3.2](#)).
- (e) All members and connections shall be proportioned so that the ultimate design capacity (ϕR_u) is not less than the design action effect (S^*), i.e. $S^* \leq \phi R_u$

3.3.2 Ultimate design strength

The ultimate design capacity shall be calculated as follows:

$$\text{Ultimate design capacity} = \phi R_u = \phi c_1 c_2 c_3 \left[f'_t X \right]$$

where

ϕ = capacity reduction factor

R_u = nominal capacity

$$= \phi R_u = \phi c_1 c_2 c_3 \left[f'_t X \right]$$

$$= c_1 c_2 c_3 \left[f'_t X \right]$$

c_1 = glass type factor (see [Table 3.1](#))

c_2 = surface type factor (see [Table 3.2](#))

c_3 = load duration factor (see [Table 3.3](#))

$f'_t X$ = characteristic capacity

f'_t = characteristic tensile strength of the glass, in megapascals

$$= -9.85 \ln t + 71.34 \text{ MPa away from the edge of glass panes}$$

Or

$$= -7.88 \ln t + 57.07 \text{ MPa at the edge of glass panes (including at the edges of holes in glass panes)}$$

where

t = minimum thickness of glass, in millimetres; for example, for 3 mm nominal thickness glass, having a minimum thickness of 2.8 mm then $f'_t = 61.2$ MPa away from the edge of glass panes and $f'_t = 49.0$ MPa at the edge of glass panes

X = geometric factor (based on the size, shape and support conditions of the glass) that relates the characteristic capacity of the glazing to the characteristic strength of the glass; for example, for bending of two-edge supported glass $X = \frac{bt^2}{6}$

where

b = width of the glass pane, in millimetres

The bending moment shall be calculated in Nmm (newton millimetres) in order to be consistent with the MPa (megapascals) unit used for the characteristic tensile strength of the glass f'_t .

Table 3.1 — Glass type factor c_1

Glass type	c_1
Ordinary annealed	1.0
Heat-strengthened	1.6 ^a
Toughened	2.5 ^a
Wired	0.5

^a The glass type factors for heat-strengthened and for toughened glass are based on the minimum stresses specified in [Clauses 2.1.2](#) and [2.1.3](#). For higher induced stress, correspondingly higher glass type factors may be used provided the level of safety is not reduced. The glass type factor may be determined from:

$$c_1 = (f'_t + \text{minimum induced surface compression stress}) / f'_t$$
Table 3.2 — Surface type factor c_2

Type	c_2
Untreated (flat or curved)	1.0
Sand-blasted or etched ^a	0.4
Acid etched ^a	1.0
Patterned ^a	1.0

^a Use actual minimum thickness of glass at the deepest trough of the pattern (refer to AS/NZS 4667)

Table 3.3 — Load duration factor (c_3)

Load combination	c_3
Short-term load duration (e.g. wind) for all glass types	1.0
Medium-term load duration (e.g. access-imposed actions on roof lights and actions on balustrades) on heat-strengthened and toughened glass (monolithic or laminated)	1.0
Medium-term load duration (e.g. access-imposed actions on roofs lights and actions on balustrades) on annealed glass (monolithic or laminated)	0.72
Long-term load duration (e.g. dead, some components of live) on heat-strengthened and toughened glass (monolithic or laminated)	0.5
Long-term load duration (e.g. dead, hydrostatic, some components of live) on annealed glass (monolithic or laminated)	0.31

NOTE 1 Short-term load duration is any duration ≤ 3 s.

NOTE 2 Medium-term load duration is any duration > 3 s and ≤ 10 min.

NOTE 3 Long-term load duration is any duration > 10 min.

NOTE 4 Where the load duration (d seconds) is accurately known then the load duration factor c_3 can be determined for annealed glass using $c_3 = (3/d)^{1/16}$.

3.3.3 Serviceability limit states

Glass shall be designed for the serviceability limit states by controlling or limiting deflection.

The maximum deflection for all glass under serviceability limit state actions shall be limited to —

- (a) span/60 for two-, three- or four- edge supported panels; or
- (b) height/30 (or cantilever length/30) for cantilevered panels such as cantilevered structural glass balustrade.

Glass designed in accordance with [Section 4](#) and other relevant sections, as appropriate, is deemed to comply with the requirements of this Clause.

For the purpose of this Clause, the serviceability loading for wind loading shall be based on a 25-year return period.

3.4 Laminated glass and insulating glass units

3.4.1 Laminated glass

The following applies:

- (a) For short-term and medium-term load durations, the actual total minimum glass thickness, given in [Table 4.1](#), shall be used.

NOTE 1 [Table 4.1](#) is applicable to both symmetrical and non-symmetrical laminates.

NOTE 2 Wind is considered to be a short-term load duration.

NOTE 3 Access-imposed actions on roof lights and actions on balustrades are considered to be of medium-term load duration.

NOTE 4 Dead, hydrostatic and some components of live load are considered to be of long-term load duration.

- (b) For long-term load durations, the strength of each sheet shall be checked where the proportion of the total load to be resisted by each sheet is k_{sheet} , taken as the larger of the following:

$$k_{\text{sheet}} = \left[\frac{t_{\text{sheet}}^3}{\sum_i t_i^3} \right]$$

or

$$k_{\text{sheet}} = \left[\frac{t_{\text{sheet}}^2}{\sum_i t_i^2} \right]$$

where

k_{sheet} = load-sharing factor of sheet being checked

t_{sheet} = thickness of sheet being checked. Unless known, minimum glass thickness, as per [Clause 3.6](#), shall be used

t_i = thickness of each sheet of glass within the assembly. Unless known, minimum glass thickness, as per [Clause 3.6](#), shall be used

i = total number of sheets within the assembly

NOTE 5 For laminated glass with two sheets of equal thickness, $k_{\text{sheet}} = 0.5$.

Alternatively, a full nonlinear analysis, modelling the glass-interlayer sheets behaviour, may be undertaken, or the “effective thickness method” adopted in ASTM E1300 may be used.

3.4.2 Insulating glass units (IGU)

For insulating glass units, each pane shall be checked for both the ultimate strength and serviceability limit state conditions with the load contribution to the pane determined from k_{pane} , as follows:

$$k_{\text{pane}} = \frac{1.25t_{\text{pane}}^3}{\sum_i t_i^3} \leq 1$$

where

k_{pane} = load-sharing factor of pane being checked

t_{pane} = thickness of pane being checked (including laminated glass as per [Clause 3.4.1](#) and glass thickness as per [Clause 3.6](#) or [Table 4.1](#))

t_i = thickness of each pane of glass within the assembly (see [Clause 3.6](#))

i = total number of panes within the assembly

NOTE For insulating glass units with two panes of equal thickness $k_{\text{pane}} = 0.625$.

3.5 Frames

3.5.1 General

When completely assembled and glazed, the secondary design action effects due to deflection of the frame member supporting the edge of the glass shall be allowed for.

3.5.2 Deflection limits

The following frame deflection limits under serviceability loading satisfy or are an acceptable alternative to [Clause 3.5.1](#):

- (a) Single glazing or insulating glass units, as specified in AS 2047, complying with the deflection limits of that Standard.
- (b) Span/150 for all other applications.

3.5.3 Panels glazed into the building structure

A panel glazed directly into a building structure by means of appropriate beads or stops shall be considered to be framed, provided the assembly complies with the deflection requirements of [Clause 3.5.2](#).

3.5.4 Mixed framing

Glass supported along the top and bottom edges by one means and along the vertical edges by another means shall be considered to be framed provided each frame member of the assembly complies with the deflection requirements of [Clause 3.5.2](#).

3.6 Design thickness of glass

3.6.1 Glass of standard nominal thickness

Limits on the standard nominal thickness of various types of glass are given in AS/NZS 4667 and [Table 4.1](#). The design calculations shall be based on the actual glass thickness or, if that is not known, the minimum thickness of the range for the standard nominal thickness.

3.6.2 Glass of non-standard nominal thickness

Glass of any of the types listed in AS/NZS 4667, which has thickness limits falling outside the ranges given in AS/NZS 4667, shall be deemed to be of a non-standard thickness and the requirements of this Standard shall be interpolated from the appropriate tables of [Sections 4, 5, 6 and 8](#), based on the minimum thickness.

3.6.3 Maximum area for 3 mm annealed glass

For 3 mm annealed glass the allowable area shall be not greater than —

- (a) 0.85 m² for monolithic annealed glass; or
- (b) 1.36 m² for IGUs.

NOTE This allowable area is calculated based on an unfactored concentrated incidental load of 0.25 kN as specified in AS/NZS 1170.1 for minimum imposed actions for barriers.

3.7 Structural silicone

3.7.1 General

Where the tensile adhesion of a sealant is the mechanism for fixing the glazing to its supports and where failure of the sealant will cause the glazing to become overstressed or fall out, structural silicone in accordance with [Clause 2.2.2](#) shall be used.

3.7.2 Strength limit state

The design action effect (except for silicone sealants immersed in water) shall be limited to a maximum of —

- (a) 0.011 MPa for dead and live long-term loads; or
- (b) 0.210 MPa for ultimate limit wind loads only.

NOTE 1 For structural silicone design example, see [Appendix F](#).

NOTE 2 The above values may not apply to structural silicones immersed in water.

3.7.3 Serviceability limit state

Structural silicone movements under all loads shall be limited so that —

- (a) glazing is not displaced from setting blocks; and
- (b) for butt glazing with glass fins, combined joint and frame movements meet the deflection limit requirements of [Clause 3.5.2](#).

NOTE For structural silicone design example, see [Appendix F](#).

3.8 Selection of glass for minimizing the risk due to glass spontaneous fracture

3.8.1 General

The use of toughened glass and some heat treated glasses may involve a relatively small risk of breakage resulting from nickel sulphide. In addition to the other requirements of this document, such glass shall be selected to minimize the risk in accordance with [Clause 3.8.2](#).

Class 1 and Class 10 buildings are exempt from the requirements of this Clause.

3.8.2 Requirements to minimize the risk

All monolithic toughened glass and heat strengthened glass, (with a surface compression greater than 52 MPa), shall be heat soaked in accordance with Clauses 3, 5, 6 and 12 and Annex A of European Standard EN 14179-1:2016. The heat soaked glass shall be marked in compliance with EN 14179-1. A certificate supplied by the manufacturer providing verification that the toughened glass has been heat soaked in accordance with this Clause shall be a suitable alternative to marking in compliance with EN 14179-1.

Heat soaking in accordance with this Clause is not required in glazing that conforms to any one of the following:

- (a) No part of the glass is glazed more than 5 m from the finished floor or ground level.
- (b) Suitable protection by a balcony, awning or the like is provided such that, in the event of glass fracturing, the risk of injury or property damage is minimized.
- (c) Laminated glass, (including toughened laminated and heat strengthened laminated) is used.

NOTE 1 For insulating glass units glazed vertically, greater than 5 m from the ground level, a laminated, monolithic annealed or monolithic heat strengthened outer or inner pane as appropriate may be considered to provide suitable protection.

NOTE 2 For insulating glass units glazed in sloped overhead glazing greater than 3 m from the finished floor or ground level a laminated inner (lower) pane may be considered to provide suitable protection.

NOTE 3 A balcony that extends from the building a minimum 2/3 of the height of the adjacent panel may be considered to be suitable to minimize the risk. For example, for a 2 700 mm high panel, the balcony or protection should extend a minimum of 1 800 mm from the building.

NOTE 4 Heat soaking will significantly reduce but not totally eliminate the small risk of fracture due to nickel sulphide.

Section 4 Design for wind loading

4.1 General

This Section sets out a deemed-to-comply methodology for determining the minimum glass thickness to be used to resist the ultimate limit state design wind pressures. However, the location of the glass within the building may require additional considerations, such as human impact, which may impose either a minimum glass thickness above the basic calculation of this Section or a provision for a specific glass type or both (see [Clause 1.2](#)).

Compliance with this Section is deemed to meet, or be an acceptable solution to, the strength limit state requirements of [Clause 3.3](#) for the ultimate wind loads determined in accordance with AS/NZS 1170.2 and the serviceability limit state deflection limit requirements of [Clause 3.3.3](#). The limitation of area for monolithic annealed glass shall also be applicable (see [Clause 3](#)).

The simplified provisions of this Section are applicable provided the following limiting parameters are satisfied:

- (a) Ultimate limit state wind pressure or other loads are of 3 s duration or less and not greater than 10.0 kPa.
- (b) For laminated glass, the two sheets are of equal thickness and the interlayer material is either polyvinyl butyral (pvb) or an equivalent type of interlayer with a modulus of elasticity of 24.1 MPa and a Poisson's ratio of 0.50 at 20 °C.

For laminated glass with unequal thicknesses sheets, see [Section 3](#).

4.2 Design wind pressure

The design wind pressures shall be the ultimate and serviceability limit state design wind pressures determined in accordance with the NCC for the importance level of the building and the annual probability of exceedance in accordance with AS/NZS 1170.2 or AS 4055.

NOTE [Appendix A](#) provides guidance on determining the ultimate and serviceability limit state design wind pressures from the procedures given in AS 4055 and AS/NZS 1170.2. It should be ensured that the assumptions used in these simplified determinations are applicable for the glass being designed.

4.3 Insulating glass units

When loads are shared between panes of glass within an insulating glass unit, each pane of glass shall be checked individually for the limit state design wind pressures multiplied by the relative load-sharing factor, in accordance with [Clause 3.4.2](#).

For 3 mm annealed glass used in IGUs, the maximum area shall not exceed 1.36 m².

NOTE For insulating glass units with two panes of equal thickness, $k_{\text{pane}} = 0.625$.

4.4 Maximum span for glass panels subjected to wind loading

4.4.1 General

The maximum span for a given standard nominal thickness of ordinary annealed, laminated, heat-strengthened, and toughened glass for a given panel size shall be determined in accordance with [Clauses 4.4.2](#), [4.4.3](#) or [4.4.4](#), as applicable for the relevant support conditions. For heat-strengthened laminated and toughened laminated glass, the maximum allowable span shall be determined in accordance with [Clause 4.4.5](#). For 3 mm monolithic annealed glass, the maximum area shall not exceed 0.85 m².

For the purpose of this Section, the minimum thickness of the nominal glass size shall be as given in AS/NZS 4667 or [Table 4.1](#). For non-standard glass thicknesses, the maximum allowable span (B), shall be the value determined from the nearest standard nominal thickness, as given in [Figures 4.1](#) to [4.34](#) as appropriate, multiplied by a reduction factor, which shall be taken as the ratio of the actual minimum thickness of the glass to the minimum thickness (t), as given in [Table 4.1](#).

For laminated glass composites, the combined minimum thickness of the glass sheets shall be used excluding the interlayer thickness.

4.4.2 Rectangles of glass supported along all four edges

For rectangles of glass supported along all four edges, the span (B) for the selected standard nominal thickness shall be determined either graphically from [Figures 4.1](#) to [4.34](#) or using the formula and the corresponding constants provided below the graph for each type of glass and thickness, where B is the smaller rectangular glass panel dimension.

Linear interpolation is permitted between the lines for each aspect ratio. The curve for aspect ratio 5 is applicable for rectangular glass panels having an aspect ratio of 5 or greater.

Alternatively, the span B may be determined from the tables in AS 1288 Supp 1. It should be noted that a more economical design might be obtained by following the design procedures given in [Section 3](#) of this Standard.

NOTE For an example calculation, see [Appendix B](#).

4.4.3 Rectangles of glass supported on two opposite edges

For rectangles of glass supported on two opposite edges, the minimum glass thickness for a span and a specific ultimate limit state design wind pressure shall be determined from [Figures 4.1](#) to [4.34](#) for ordinary annealed, laminated, heat-strengthened, and toughened glass respectively.

Alternatively, the span B may be determined from the tables in AS 1288 Supp 1. It should be noted that a more economical design might be obtained by following the design procedures given in [Section 3](#) of this Standard.

4.4.4 Rectangles of glass supported on three edges

For rectangles of glass supported on three edges, the minimum glass thickness shall be determined as for two-edge support spanning along the unsupported edge.

Alternatively, basic engineering principles in accordance with [Section 3](#) shall be adopted in determining the glass thickness for all applications where only three edges of the panel are supported.

NOTE Butt glazing of adjacent panels in the same plane should not be considered as a support when using [Figures 4.1](#) to [4.34](#).

4.4.5 Heat-strengthened laminated and toughened laminated glass

For heat-strengthened laminated and toughened laminated glass, the maximum span for a given standard nominal thickness for a given panel size shall be determined from [Figures 4.27](#) to [4.34](#) respectively with the design wind pressure being divided by the appropriate glass type factor, c_1 (see [Table 3.1](#)), as applicable for the relevant support conditions.

4.4.6 Serviceability checks

Glass complying with [Figure 4.35](#) is deemed to meet, or be an acceptable solution satisfying, the serviceability deflection limits specified in [Clause 3.3.3](#). The slenderness factor (B/t) for the selected standard nominal thickness shall be determined either graphically or using the formula and the corresponding constants provided below the graph for the appropriate aspect ratio. Linear interpolation

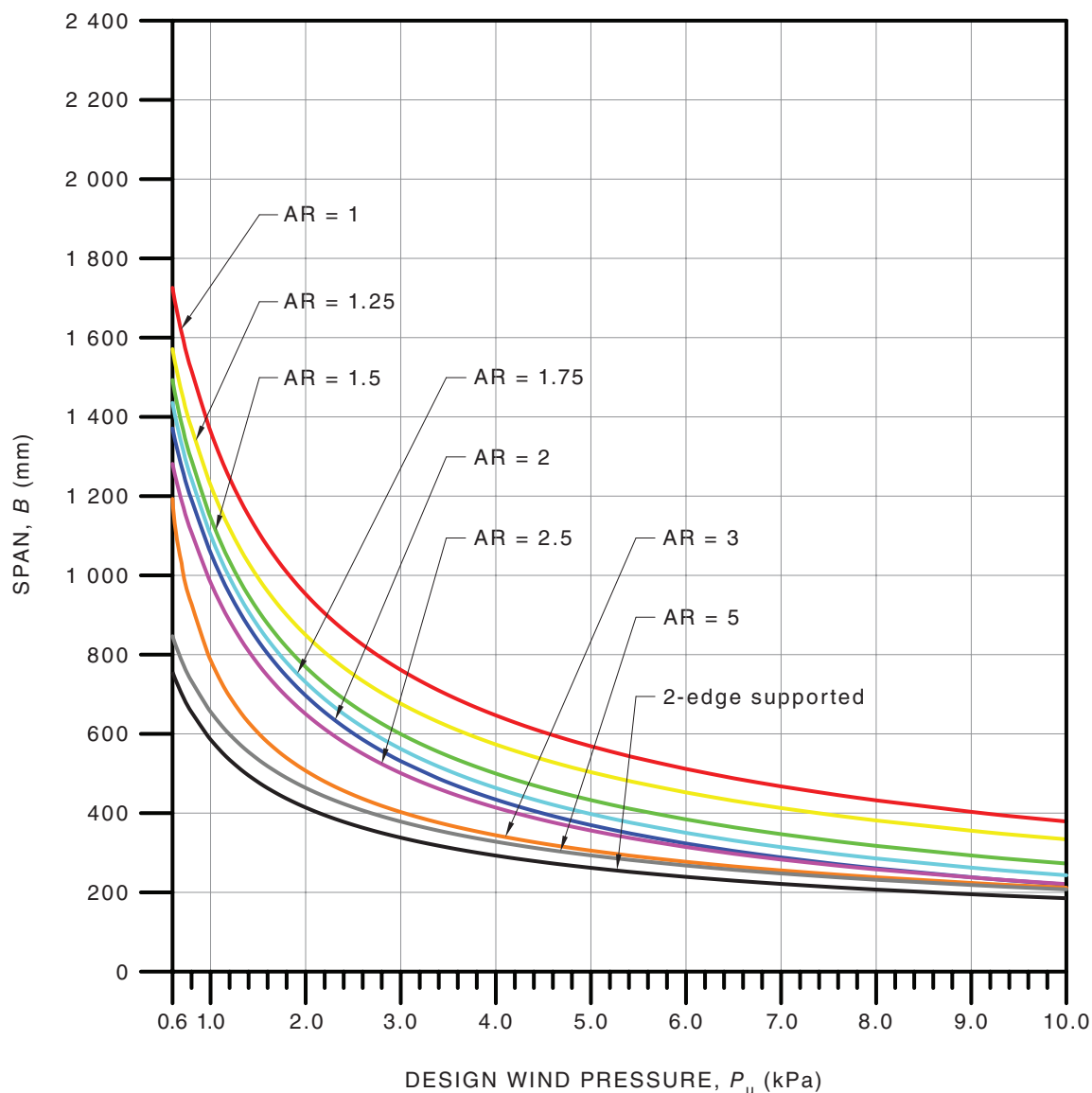
is permitted between the lines for each aspect ratio. For rectangular glass panels having aspect ratio greater than 5, the two-edge support line shall be used.

Table 4.1 — Minimum glass thickness

Nominal thickness mm	Minimum thickness mm
Monolithic glass	
3	2.8
4	3.8
5	4.8
6	5.8
8	7.7
10	9.7
12	11.7
15	14.5
19	18
25	23.5
Laminated glass	
5	4.6
6	5.6
8	7.6
10	9.6
12	11.6
16	15.4
20	19.4
24	23.4
Wired glass	
6	5
NOTE 1 For laminated glass, the thickness of glass shown above in the Table does not include the thickness of interlayer, e.g. 6 mm may apply to 6.38 mm, 6.76 mm or 7.52 mm, etc. An explanation of the methodology used in this Section is given in Appendix B. NOTE 2 This Table applies to symmetrical and non-symmetrical glass.	

4.5 Organic safety films and other glass coatings

The structural effects of an organic safety film or other glass coatings shall be ignored in the design of glass. Organic safety film or other coated glass shall be designed as monolithic glass units.



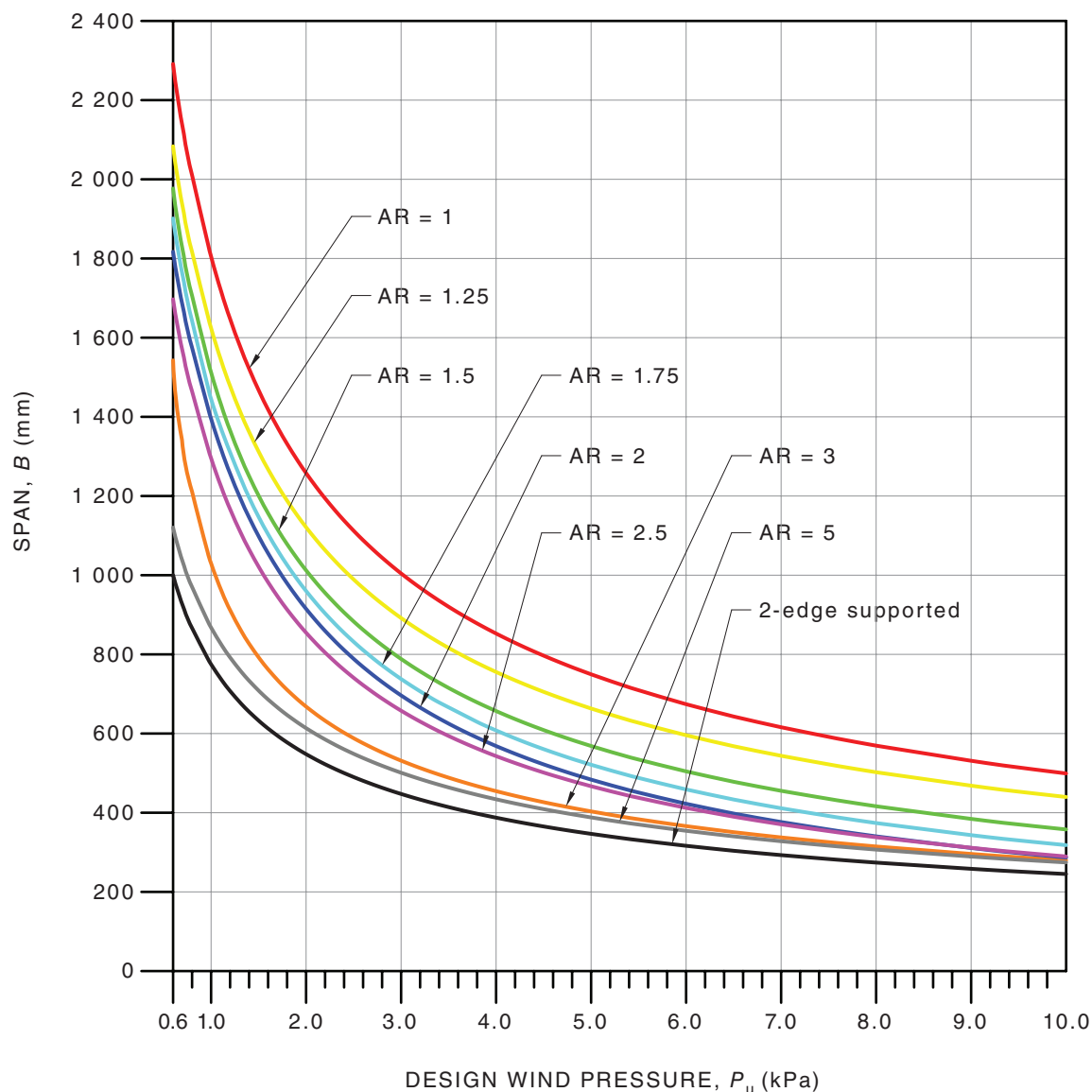
The allowable span B is given by: $B = k_1 \times (P_u + k_2)^{k_3} + k_4$

Constant	Four-edge supported annealed glass parameters for each aspect ratio								Two-edge supported
	AR = 1	AR = 1.25	AR = 1.5	AR = 1.75	AR = 2	AR = 2.5	AR = 3	AR = 5	
k_1	1558.4	1373.2	1313.4	1343.4	1381.9	1184.5	667.6	655.7	585.6
k_2	0.25	0.2	0.2	0.3	0.4	0.3	-0.3	0	0
k_3	-0.6124	-0.6071	-0.6423	-0.7112	-0.7642	-0.7255	-0.4881	-0.5	-0.5
k_4	4.2	-1.4	-22.68	-12.6	-11.2	2.8	-8.4	0	0

NOTE 1 Maximum allowable area is 0.85 m² (see [Clause 4.4.1](#)).

NOTE 2 Curves for AR = 1 to AR = 5 are to be used for four-edge supported glazing only.

Figure 4.1 — Maximum span for monolithic 3 mm annealed glass

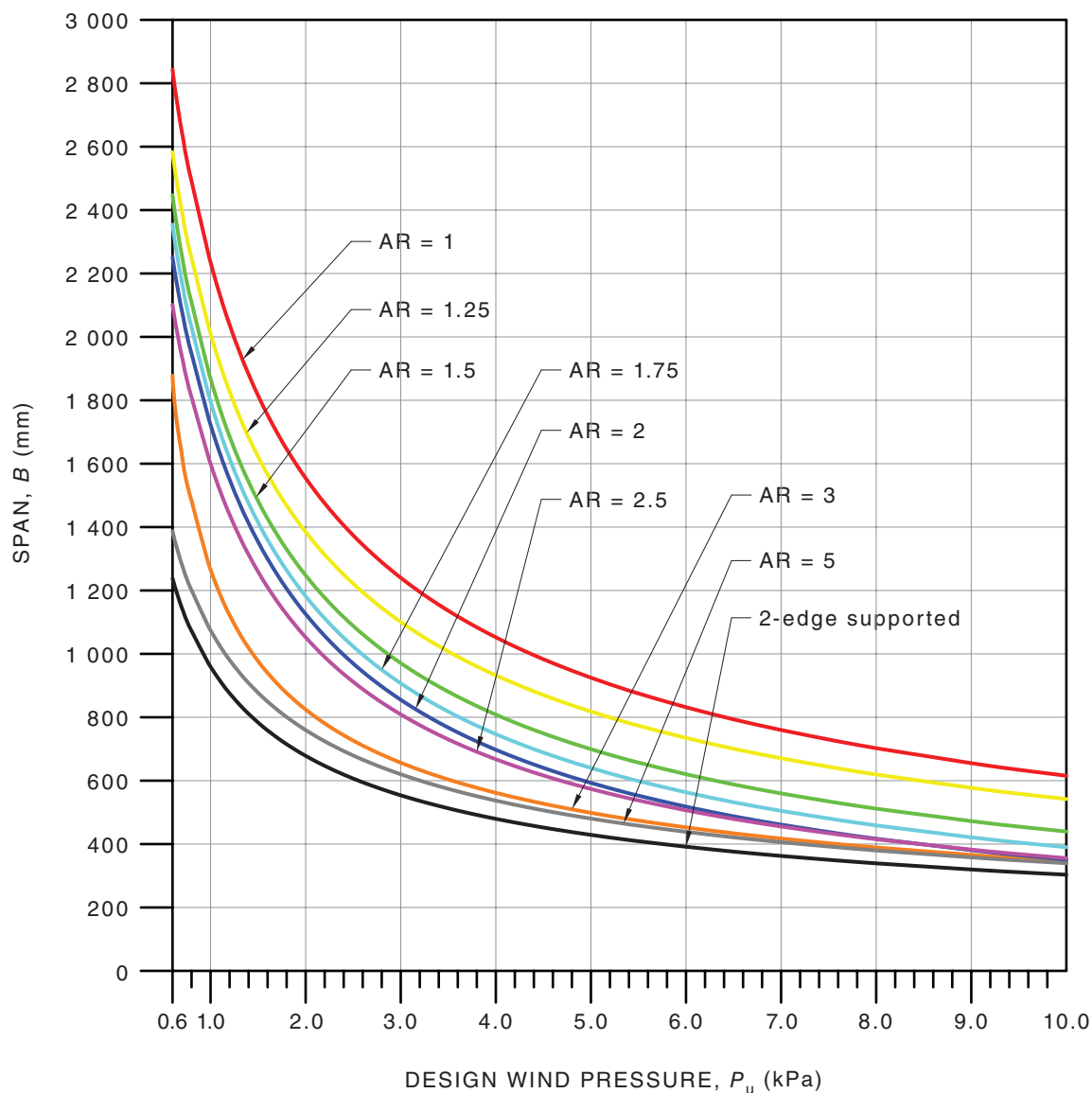


The allowable span B is given by: $B = k_1 \times (P_u + k_2)^{k_3} + k_4$

Constant	Four-edge supported annealed glass parameters for each aspect ratio								Two-edge supported
	AR = 1	AR = 1.25	AR = 1.5	AR = 1.75	AR = 2	AR = 2.5	AR = 3	AR = 5	
k_1	2050.7	1807.5	1725.7	1758.9	1804.6	1549.8	884.0	867.8	774.9
k_2	0.237712	0.19017	0.19017	0.285254	0.380339	0.285254	-0.28525	0	0
k_3	-0.6124	-0.6071	-0.6423	-0.7112	-0.7642	-0.7255	-0.4881	-0.5	-0.5
k_4	5.7	-1.9	-30.78	-17.1	-15.2	3.8	-11.4	0	0

NOTE Curves for AR = 1 to AR = 5 are to be used for four-edge supported glazing only.

Figure 4.2 — Maximum span for monolithic 4 mm annealed glass

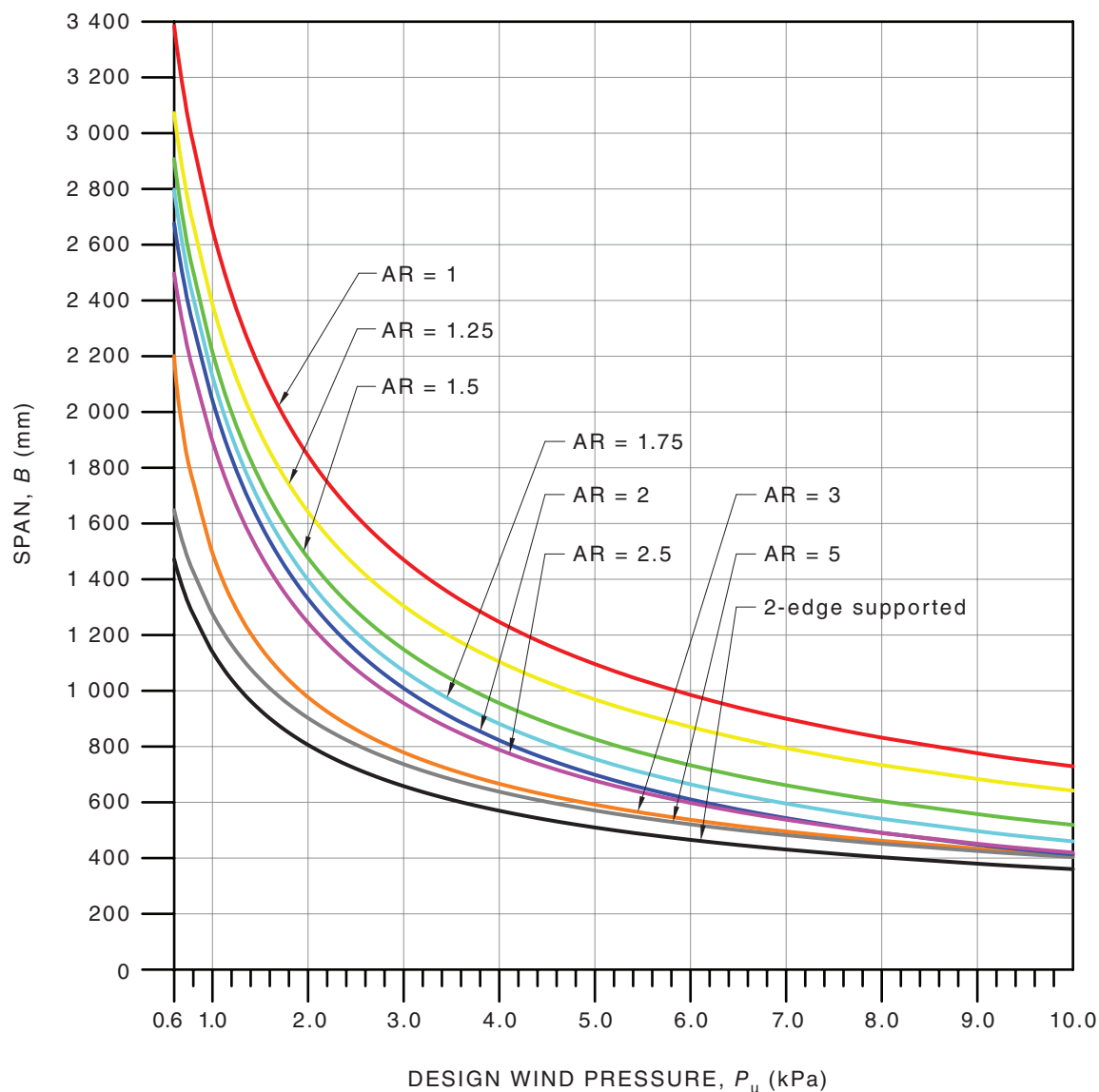


The allowable span B is given by: $B = k_1 \times (P_u + k_2)^{k_3} + k_4$

Constant	Four-edge supported annealed glass parameters for each aspect ratio								Two-edge supported
	AR = 1	AR = 1.25	AR = 1.5	AR = 1.75	AR = 2	AR = 2.5	AR = 3	AR = 5	
k_1	2527.1	2227.9	2124.1	2159.0	2210.3	1901.2	1094.8	1074.2	959.3
k_2	0.228312	0.182649	0.182649	0.273974	0.365299	0.273974	-0.27397	0	0
k_3	-0.6124	-0.6071	-0.6423	-0.7112	-0.7642	-0.7255	-0.4881	-0.5	-0.5
k_4	7.2	-2.4	-38.88	-21.6	-19.2	4.8	-14.4	0	0

NOTE Curves for AR = 1 to AR = 5 are to be used for four-edge supported glazing only.

Figure 4.3 — Maximum span for monolithic 5 mm annealed glass

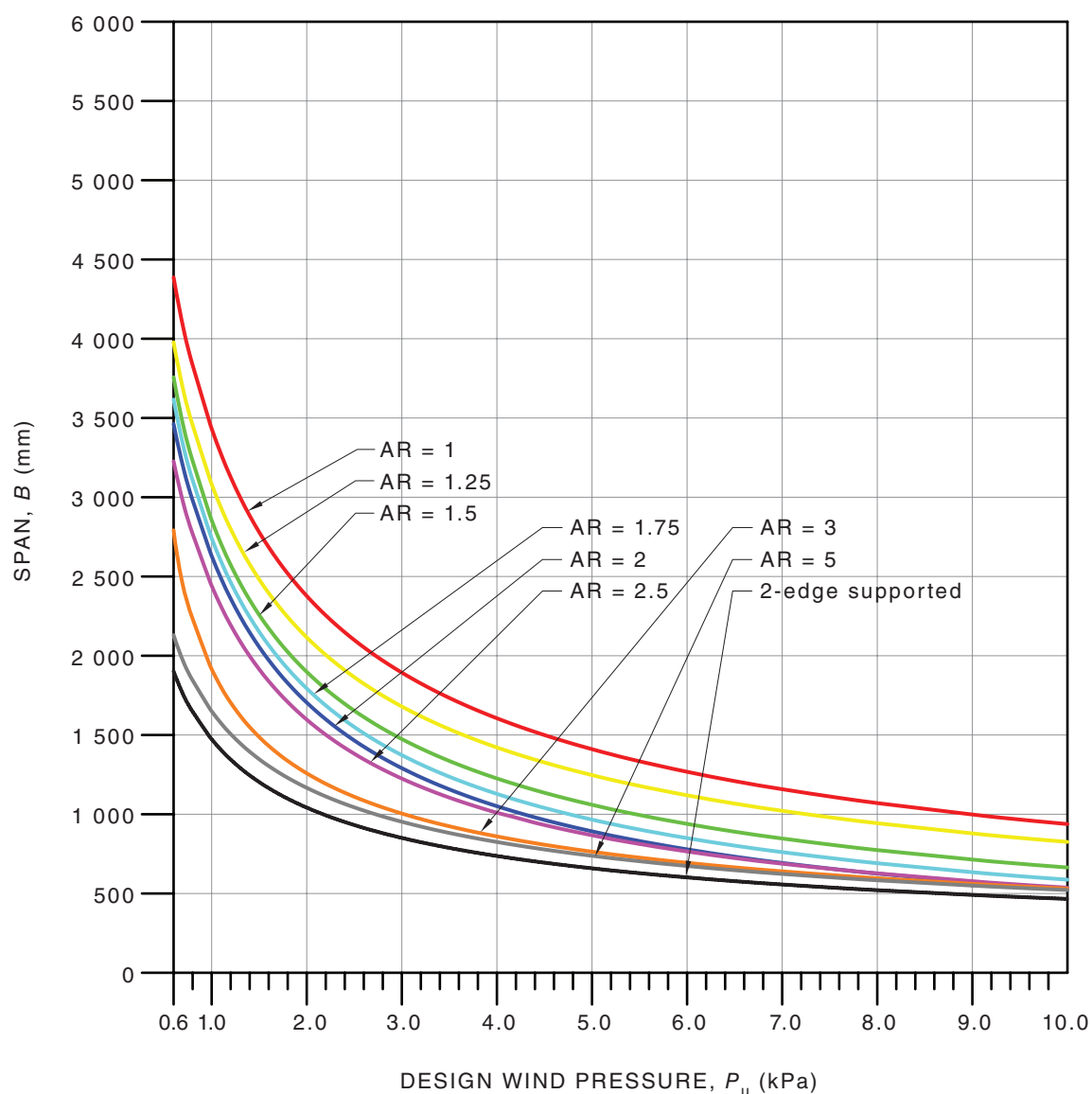


The allowable span B is given by: $B = k_1 \times (P_u + k_2)^{k_3} + k_4$

Constant	Four-edge supported annealed glass parameters for each aspect ratio								Two-edge supported
	AR = 1	AR = 1.25	AR = 1.5	AR = 1.75	AR = 2	AR = 2.5	AR = 3	AR = 5	
k_1	2990.8	2637.2	2511.3	2546.6	2602.4	2241.4	1301.2	1276.2	1139.7
k_2	0.220697	0.176558	0.176558	0.264836	0.353115	0.264836	-0.26484	0	0
k_3	-0.6124	-0.6071	-0.6423	-0.7112	-0.7642	-0.7255	-0.4881	-0.5	-0.5
k_4	8.7	-2.9	-46.98	-26.1	-23.2	5.8	-17.4	0	0

NOTE Curves for AR = 1 to AR = 5 are to be used for four-edge supported glazing only.

Figure 4.4 — Maximum span for monolithic 6 mm annealed glass

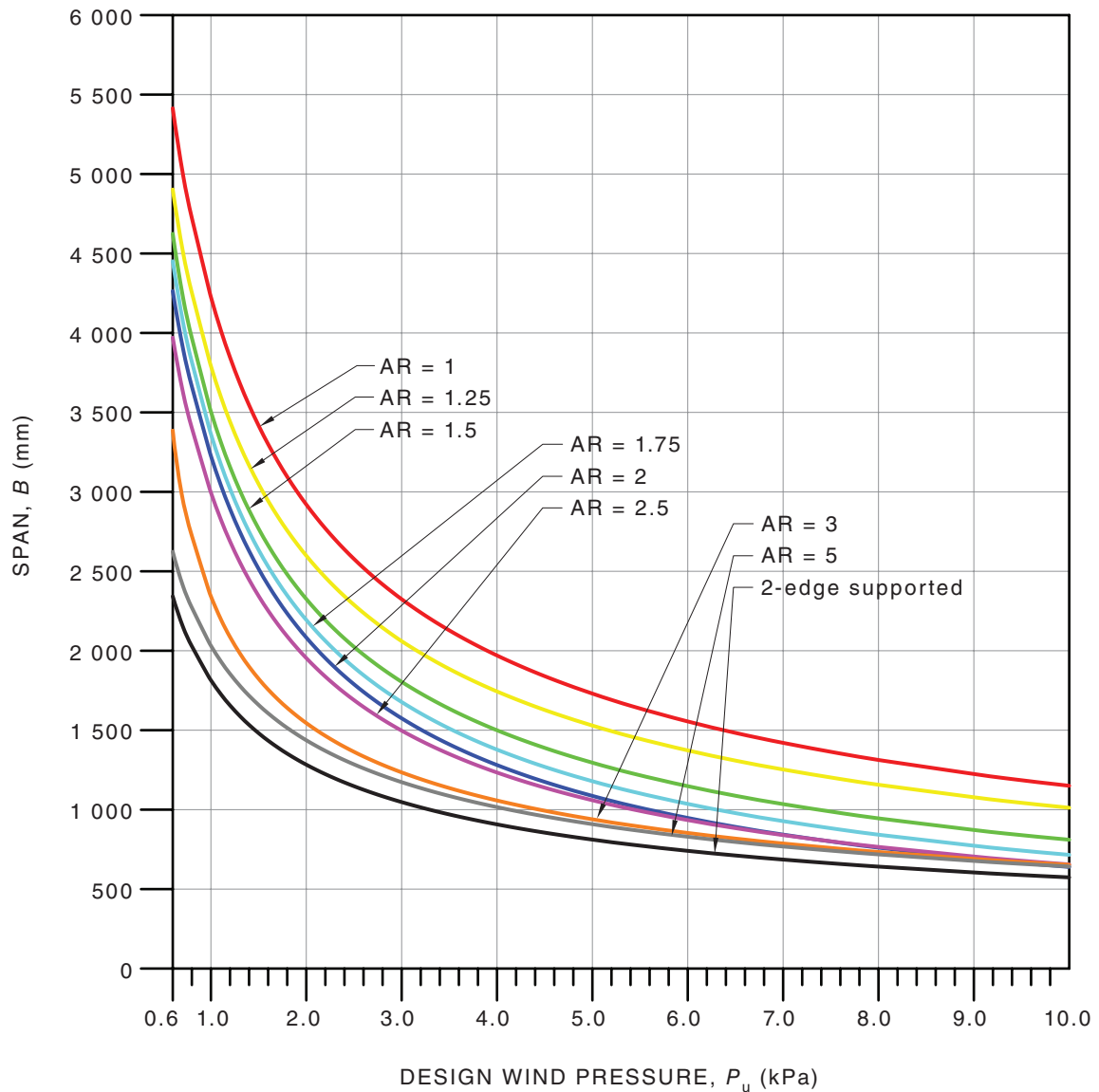


The allowable span B is given by: $B = k_1 \times (P_u + k_2)^{k_3} + k_4$

Constant	Four-edge supported annealed glass parameters for each aspect ratio								Two-edge supported
	AR = 1	AR = 1.25	AR = 1.5	AR = 1.75	AR = 2	AR = 2.5	AR = 3	AR = 5	
k_1	3843.7	3390.2	3222.3	3255.6	3317.7	2863.4	1683.3	1649.9	1473.4
k_2	0.209295	0.167436	0.167436	0.251154	0.334872	0.251154	-0.25115	0	0
k_3	-0.6124	-0.6071	-0.6423	-0.7112	-0.7642	-0.7255	-0.4881	-0.5	-0.5
k_4	11.55	-3.85	-62.37	-34.65	-30.8	7.7	-23.1	0	0

NOTE Curves for AR = 1 to AR = 5 are to be used for four-edge supported glazing only.

Figure 4.5 — Maximum span for monolithic 8 mm annealed glass

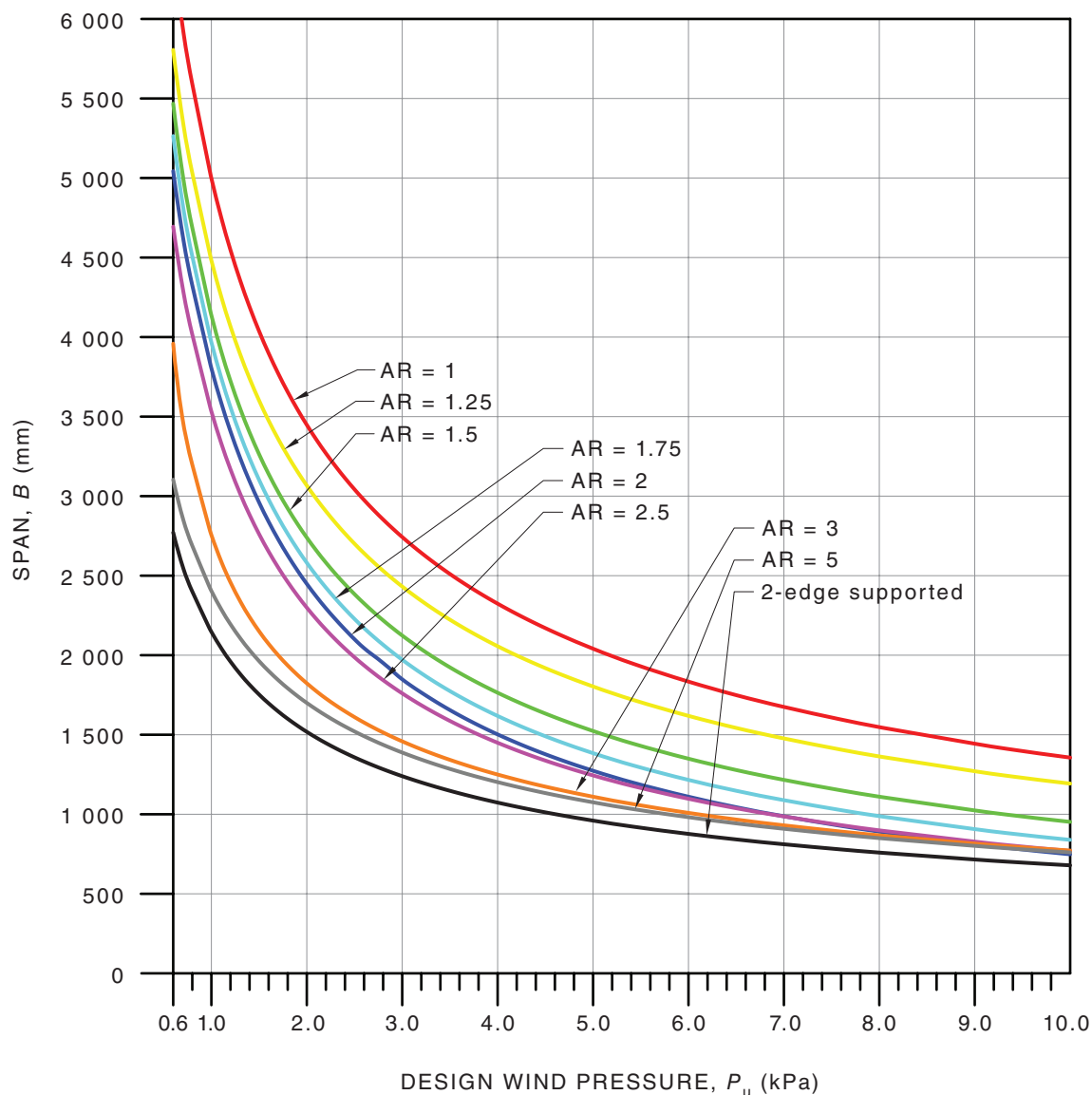


The allowable span B is given by: $B = k_1 \times (P_u + k_2)^{k_3} + k_4$

Constant	Four-edge supported annealed glass parameters for each aspect ratio								Two-edge supported
	AR = 1	AR = 1.25	AR = 1.5	AR = 1.75	AR = 2	AR = 2.5	AR = 3	AR = 5	
k_1	4709.2	4154.6	3942.6	3970.9	4036.8	3490.2	2074.0	2031.8	1814.4
k_2	0.200004	0.160003	0.160003	0.240005	0.320006	0.240005	-0.24	0	0
k_3	-0.6124	-0.6071	-0.6423	-0.7112	-0.7642	-0.7255	-0.4881	-0.5	-0.5
k_4	14.55	-4.85	-78.57	-43.65	-38.8	9.7	-29.1	0	0

NOTE Curves for AR = 1 to AR = 5 are to be used for four-edge supported glazing only.

Figure 4.6 — Maximum span for monolithic 10 mm annealed glass

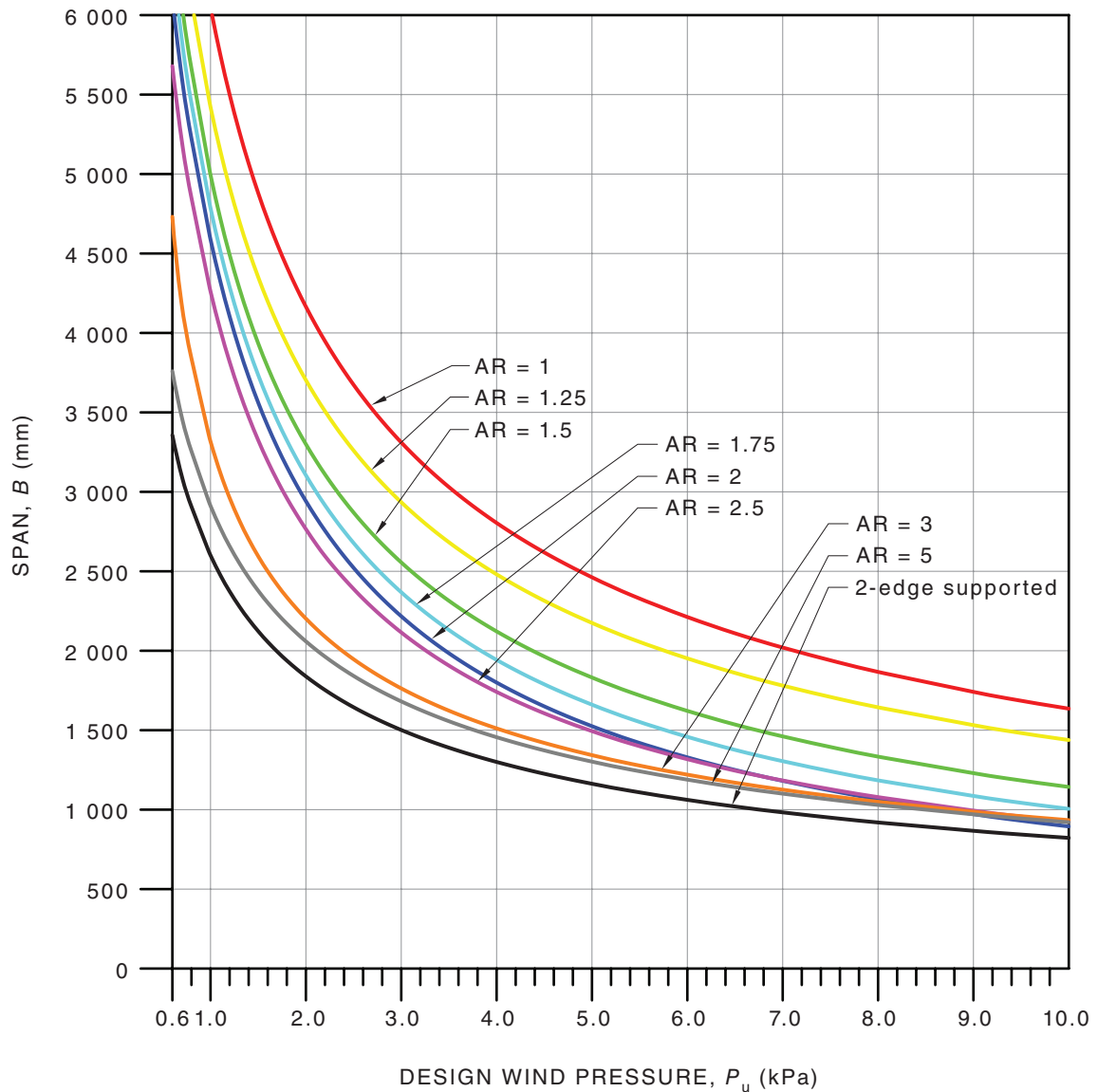


The allowable span B is given by: $B = k_1 \times (P_u + k_2)^{k_3} + k_4$

Constant	Four-edge supported annealed glass parameters for each aspect ratio								Two-edge supported
	AR = 1	AR = 1.25	AR = 1.5	AR = 1.75	AR = 2	AR = 2.5	AR = 3	AR = 5	
k_1	5548.0	4895.6	4639.5	4660.5	4728.2	4094.0	2455.2	2404.1	2146.9
k_2	0.192461	0.153969	0.153969	0.230953	0.307937	0.230953	-0.23095	0	0
k_3	-0.6124	-0.6071	-0.6423	-0.7112	-0.7642	-0.7255	-0.4881	-0.5	-0.5
k_4	17.55	-5.85	-94.77	-52.65	-46.8	11.7	-35.1	0	0

NOTE Curves for AR = 1 to AR = 5 are to be used for four-edge supported glazing only.

Figure 4.7 — Maximum span for monolithic 12 mm annealed glass

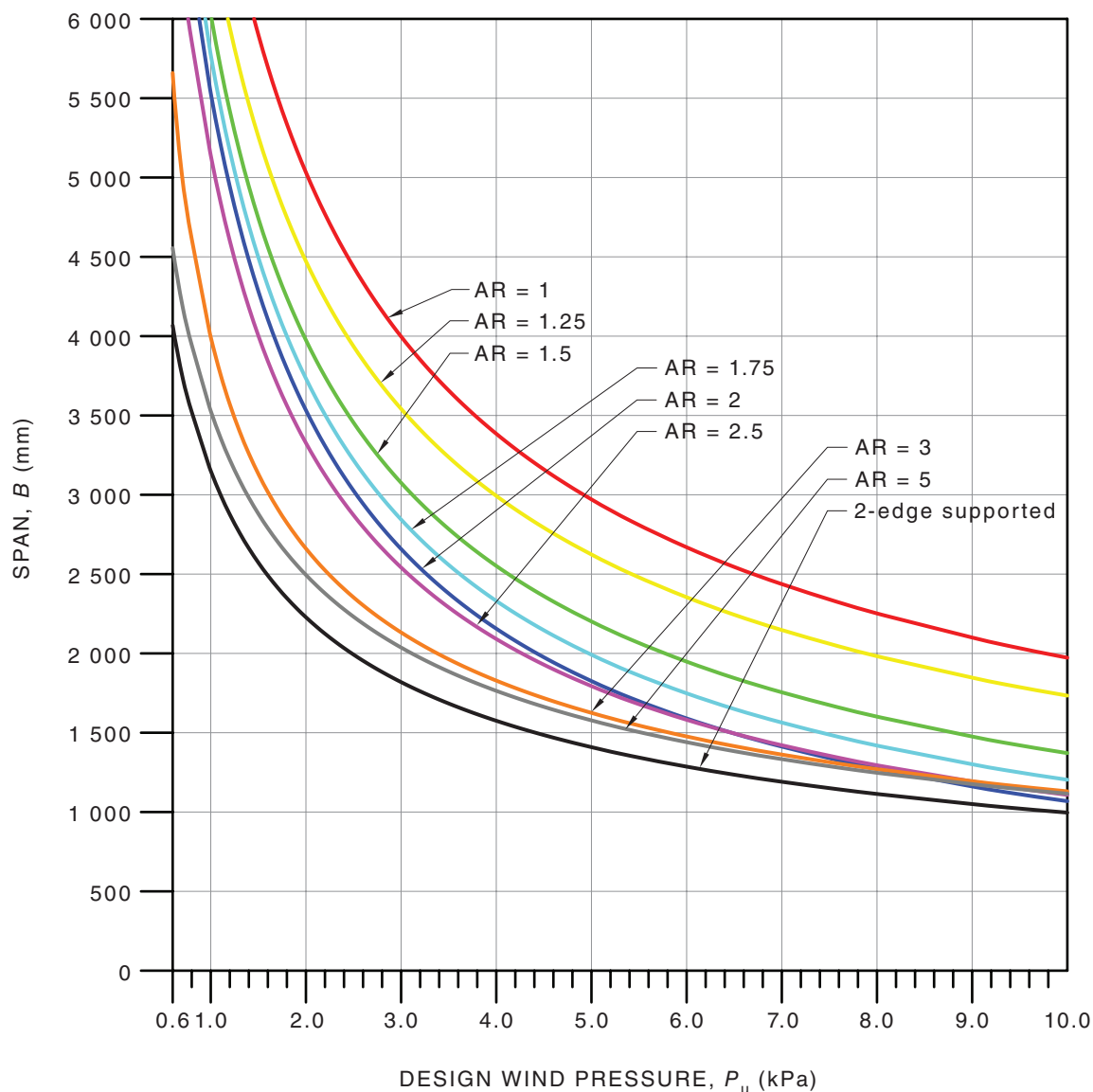


The allowable span B is given by: $B = k_1 \times (P_u + k_2)^{k_3} + k_4$

Constant	Four-edge supported annealed glass parameters for each aspect ratio								Two-edge supported
	AR = 1	AR = 1.25	AR = 1.5	AR = 1.75	AR = 2	AR = 2.5	AR = 3	AR = 5	
k_1	6685.2	5900.5	5582.8	5590.3	5657.8	4907.6	2975.3	2911.9	2600.3
k_2	0.183827	0.147062	0.147062	0.220593	0.294124	0.220593	-0.22059	0	0
k_3	-0.6124	-0.6071	-0.6423	-0.7112	-0.7642	-0.7255	-0.4881	-0.5	-0.5
k_4	21.75	-7.25	-117.45	-65.25	-58	14.5	-43.5	0	0

NOTE Curves for AR = 1 to AR = 5 are to be used for four-edge supported glazing only.

Figure 4.8 — Maximum span for monolithic 15 mm annealed glass

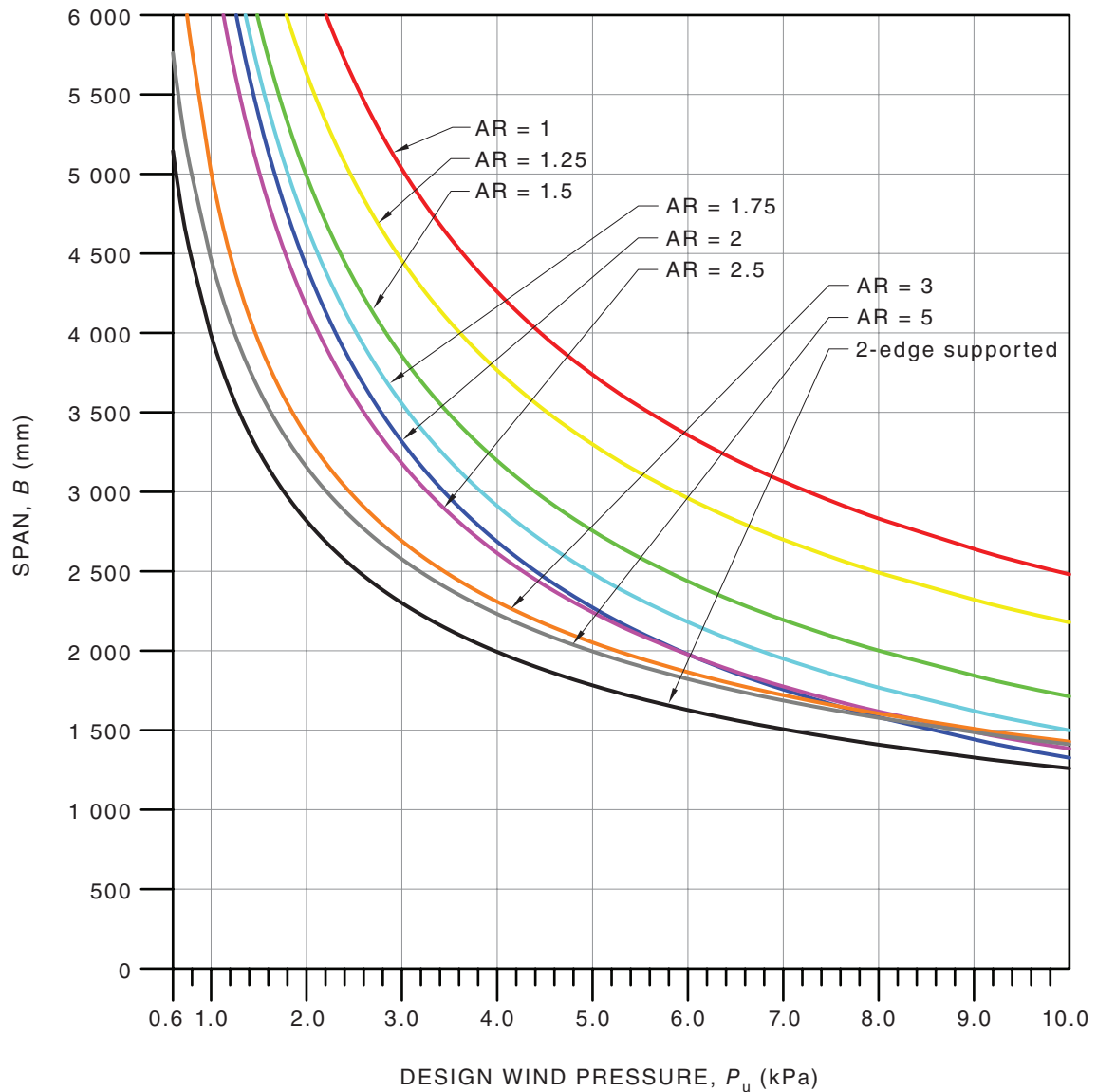


The allowable span B is given by: $B = k_1 \times (P_u + k_2)^{k_3} + k_4$

Constant	Four-edge supported annealed glass parameters for each aspect ratio								Two-edge supported
	AR = 1	AR = 1.25	AR = 1.5	AR = 1.75	AR = 2	AR = 2.5	AR = 3	AR = 5	
k_1	8056.1	7112.3	6717.8	6704.5	6768.0	5881.7	3607.1	3528.2	3150.6
k_2	0.175127	0.140102	0.140102	0.210152	0.280203	0.210152	-0.21015	0	0
k_3	-0.6124	-0.6071	-0.6423	-0.7112	-0.7642	-0.7255	-0.4881	-0.5	-0.5
k_4	27	-9	-145.8	-81	-72	18	-54	0	0

NOTE Curves for AR = 1 to AR = 5 are to be used for four-edge supported glazing only.

Figure 4.9 — Maximum span for monolithic 19 mm annealed glass

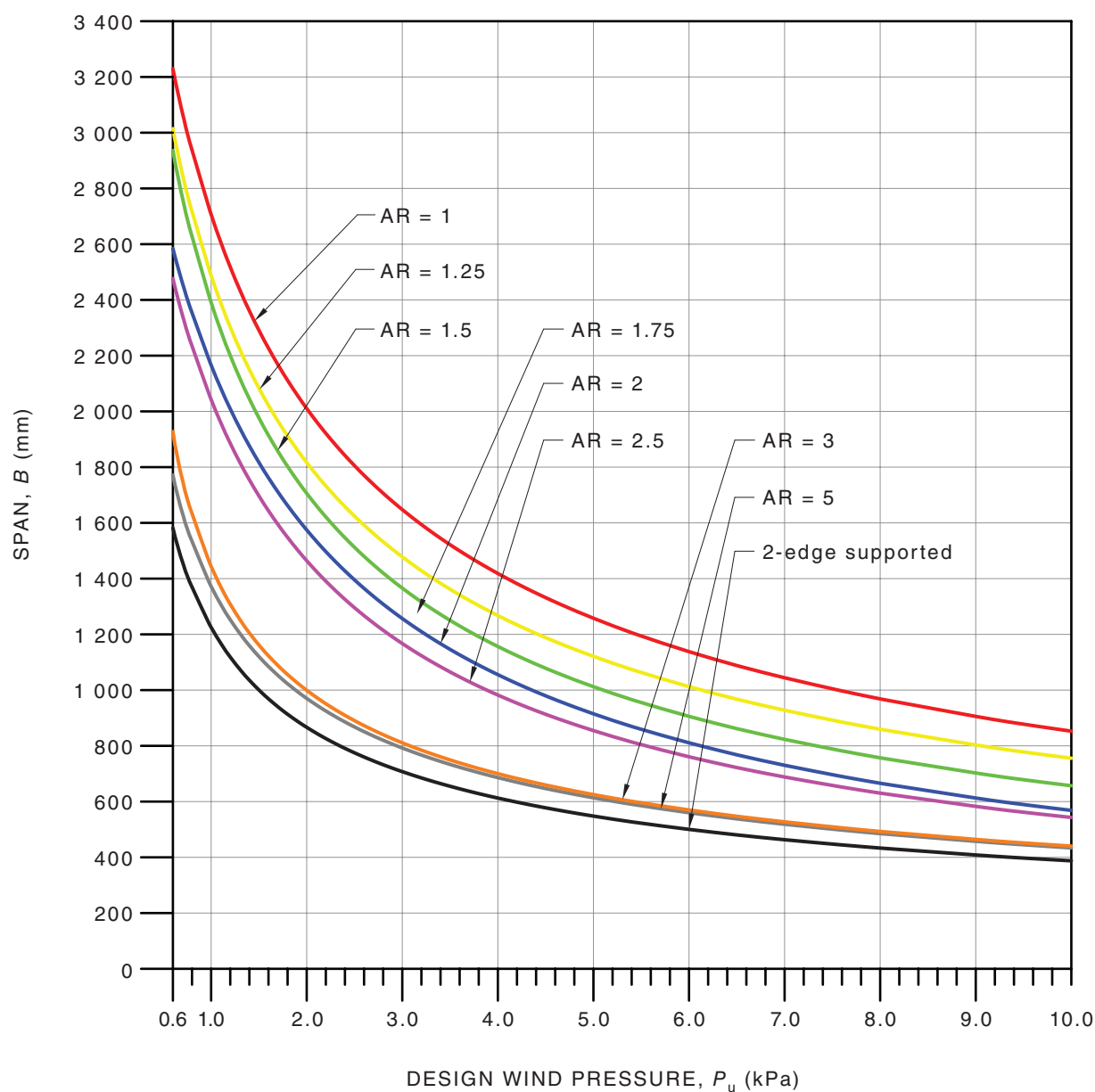


The allowable span B is given by: $B = k_1 \times (P_u + k_2)^{k_3} + k_4$

Constant	Four-edge supported annealed glass parameters for each aspect ratio								Two-edge supported
	AR = 1	AR = 1.25	AR = 1.5	AR = 1.75	AR = 2	AR = 2.5	AR = 3	AR = 5	
k_1	10118.2	8935.8	8421.5	8368.2	8419.2	7334.6	4566.2	4462.9	3985.3
k_2	0.164398	0.131519	0.131519	0.197278	0.263037	0.197278	-0.19728	0	0
k_3	-0.6124	-0.6071	-0.6423	-0.7112	-0.7642	-0.7255	-0.4881	-0.5	-0.5
k_4	35.25	-11.75	-190.35	-105.75	-94	23.5	-70.5	0	0

NOTE Curves for AR = 1 to AR = 5 are to be used for four-edge supported glazing only.

Figure 4.10 — Maximum span for monolithic 25 mm annealed glass

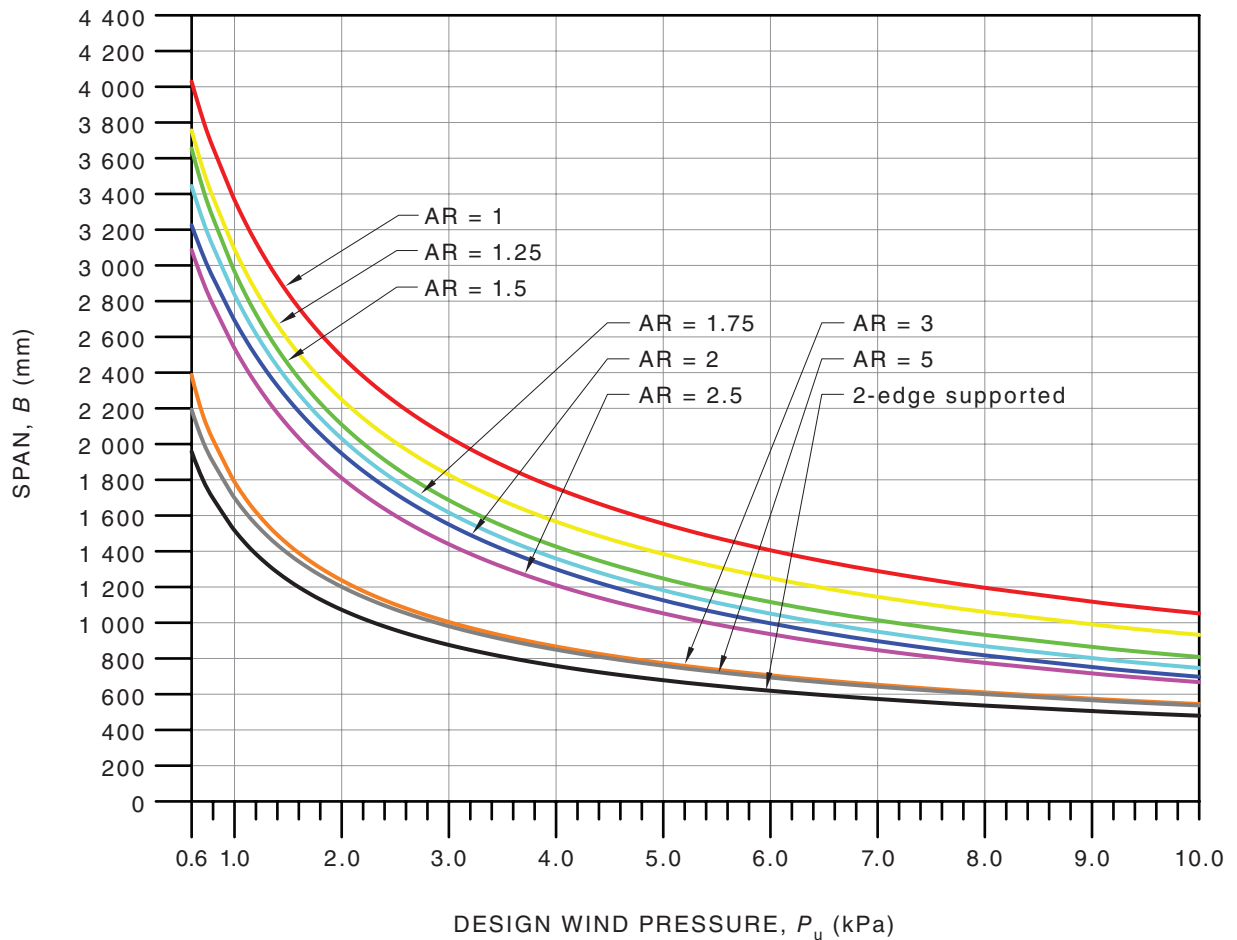


The allowable span B is given by: $B = k_1 \times (P_u + k_2)^{k_3} + k_4$

Constant	Four-edge supported annealed glass parameters for each aspect ratio								Two-edge supported
	AR = 1	AR = 1.25	AR = 1.5	AR = 1.75	AR = 2	AR = 2.5	AR = 3	AR = 5	
k_1	3594.2	3152.6	3108.6	3374.9	3634.8	3012.9	1382.5	1372.1	1225.3
k_2	0.59428	0.475424	0.475424	0.713136	0.950848	0.713136	-0.1	0	0
k_3	-0.6124	-0.6071	-0.6423	-0.7112	-0.7642	-0.7255	-0.4881	-0.5	-0.5
k_4	5.7	-1.9	-30.78	-17.1	-15.2	3.8	-11.4	0	0

NOTE Curves for AR = 1 to AR = 5 are to be used for four-edge supported glazing only.

Figure 4.11 — Maximum span for monolithic 4 mm toughened glass

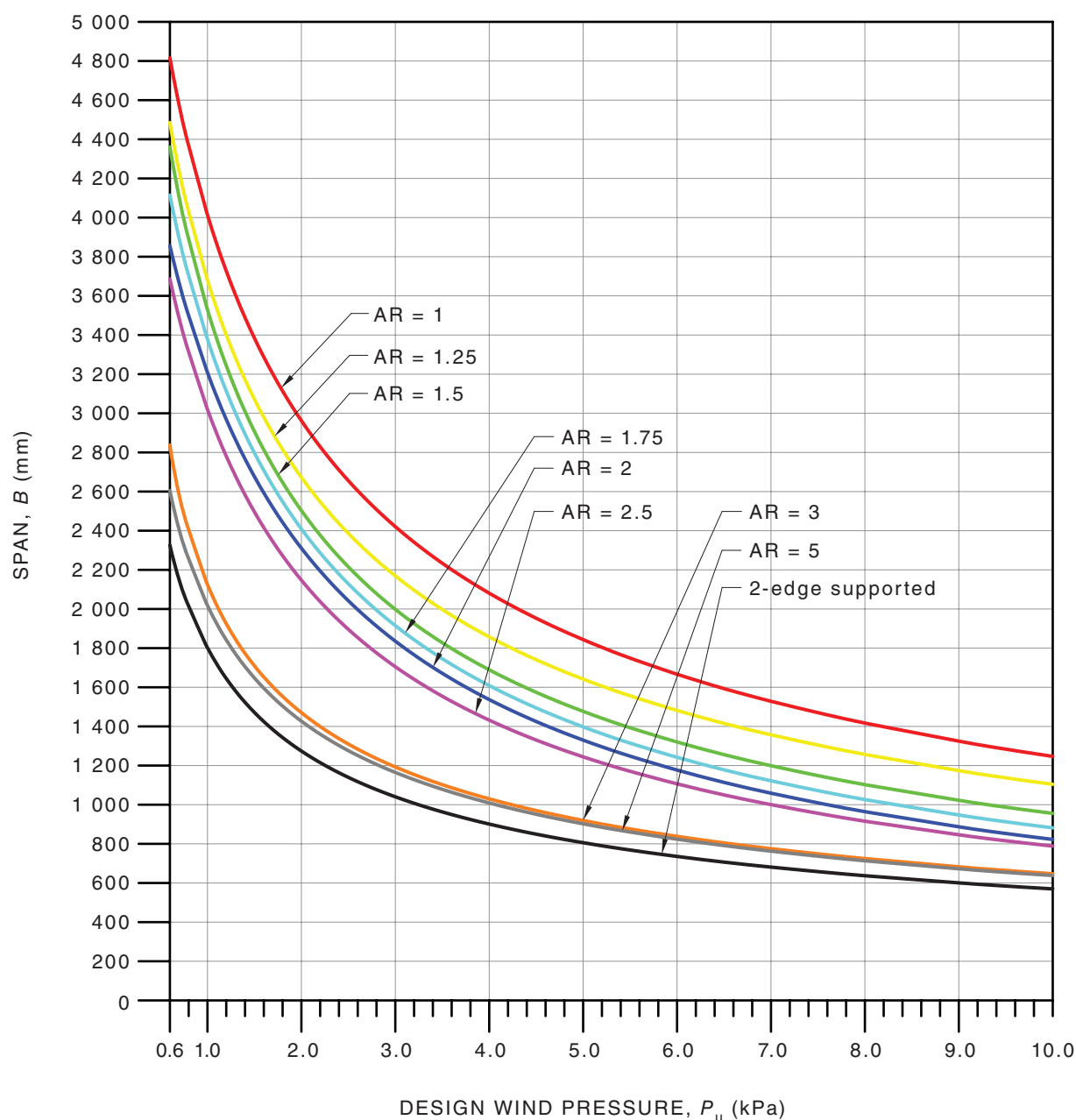


The allowable span B is given by: $B = k_1 \times (P_u + k_2)^{k_3} + k_4$

Constant	Four-edge supported annealed glass parameters for each aspect ratio								Two-edge supported
	AR = 1	AR = 1.25	AR = 1.5	AR = 1.75	AR = 2	AR = 2.5	AR = 3	AR = 5	
k_1	4429.2	3885.9	3826.2	4142.5	4452.0	3696.0	1712.3	1698.5	1516.8
k_2	0.57078	0.456624	0.456624	0.684935	0.913247	0.684935	-0.1	0	0
k_3	-0.6124	-0.6071	-0.6423	-0.7112	-0.7642	-0.7255	-0.4881	-0.5	-0.5
k_4	7.2	-2.4	-38.88	-21.6	-19.2	4.8	-14.4	0	0

NOTE Curves for AR = 1 to AR = 5 are to be used for four-edge supported glazing only.

Figure 4.12 — Maximum span for monolithic 5 mm toughened glass

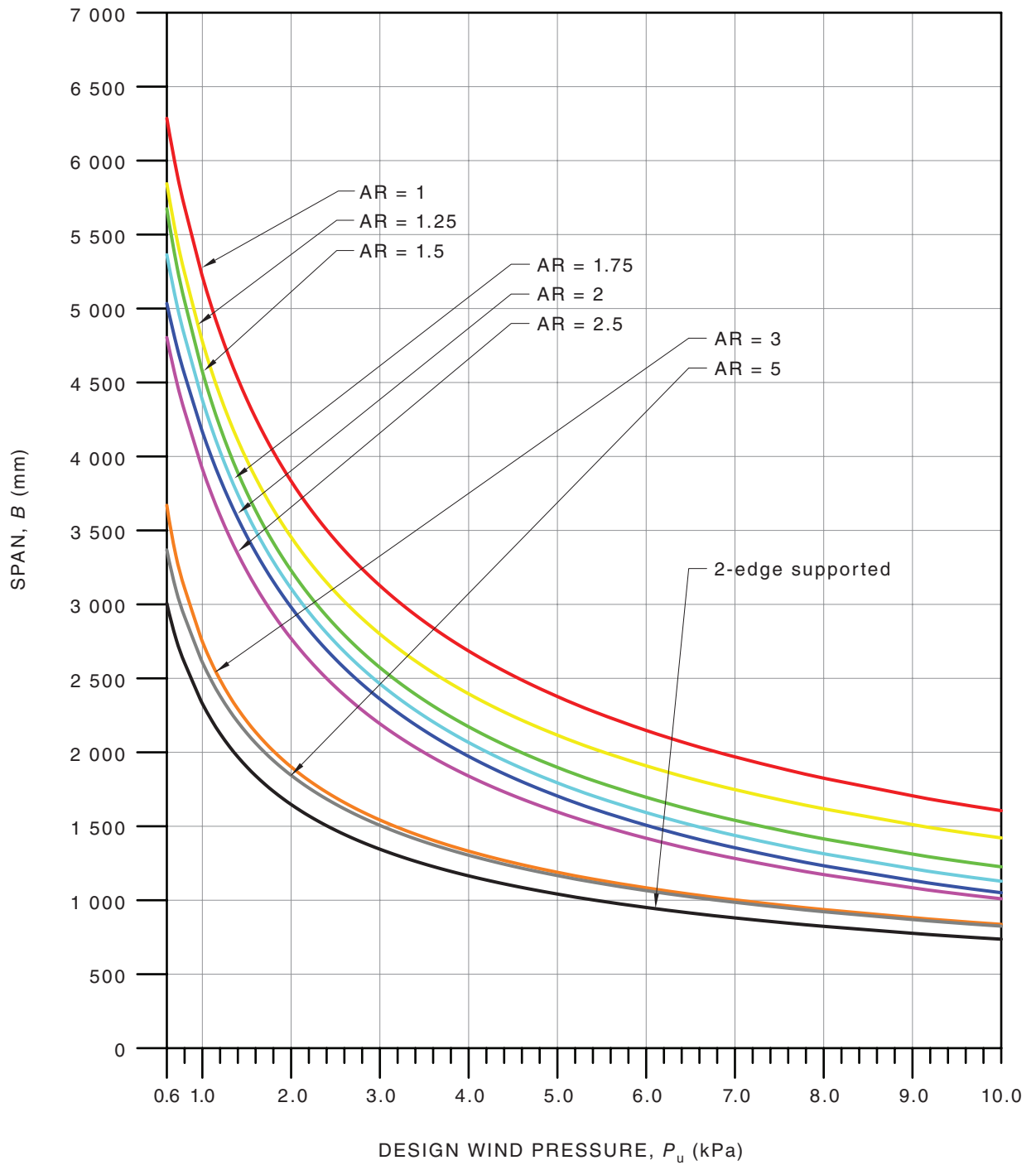


The allowable span B is given by: $B = k_1 \times (P_u + k_2)^{k_3} + k_4$

Constant	Four-edge supported annealed glass parameters for each aspect ratio								Two-edge supported
	AR = 1	AR = 1.25	AR = 1.5	AR = 1.75	AR = 2	AR = 2.5	AR = 3	AR = 5	
k_1	5241.9	4599.7	4523.7	4886.2	5241.8	4357.5	2035.1	2017.9	1801.9
k_2	0.551743	0.441394	0.441394	0.662091	0.882788	0.662091	-0.1	0	0
k_3	-0.6124	-0.6071	-0.6423	-0.7112	-0.7642	-0.7255	-0.4881	-0.5	-0.5
k_4	8.7	-2.9	-46.98	-26.1	-23.2	5.8	-17.4	0	0

NOTE Curves for AR = 1 to AR = 5 are to be used for four-edge supported glazing only.

Figure 4.13 — Maximum span for monolithic 6 mm toughened glass

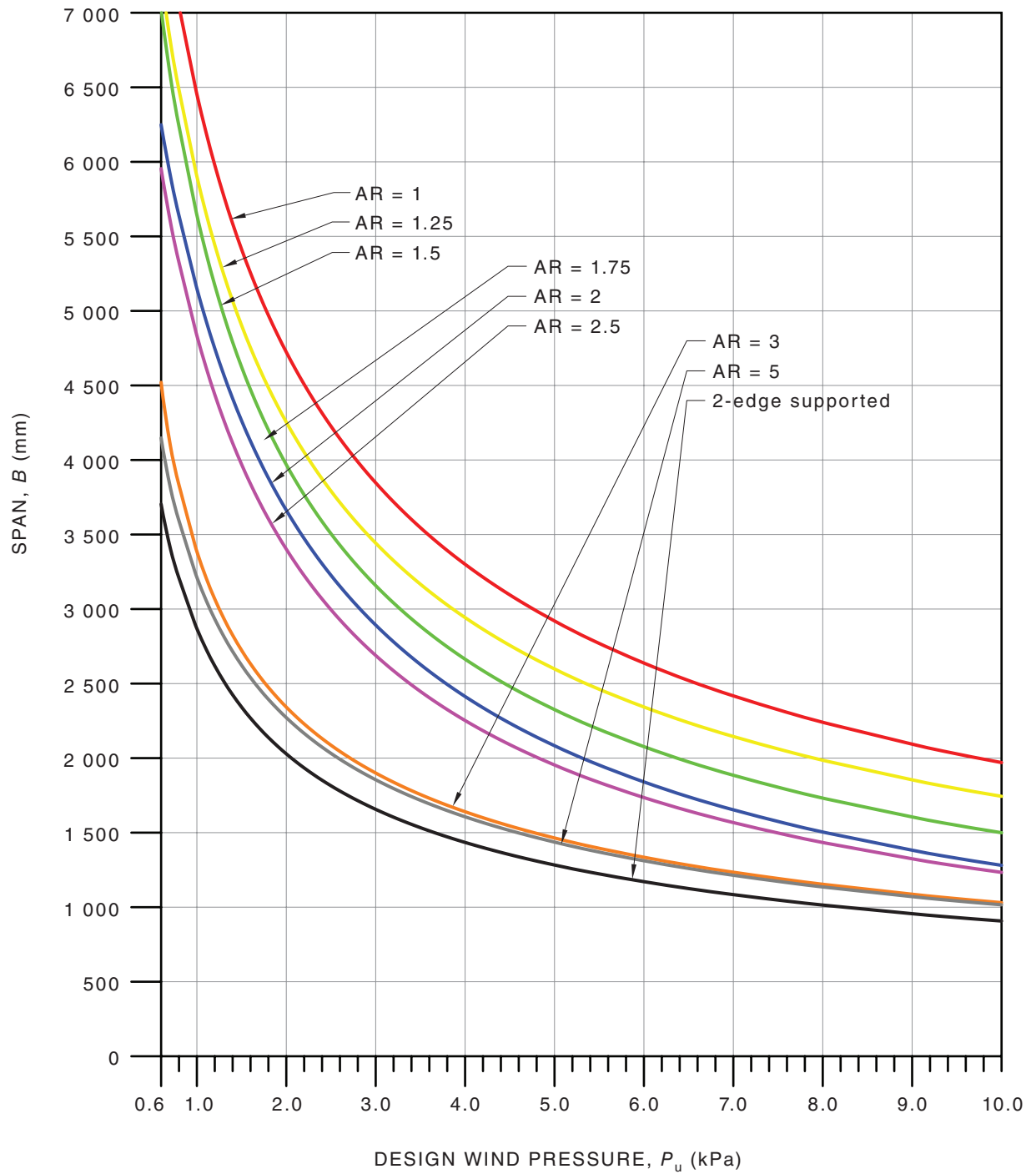


The allowable span B is given by: $B = k_1 \times (P_u + k_2)^{k_3} + k_4$

Constant	Four-edge supported annealed glass parameters for each aspect ratio								Two-edge supported
	AR = 1	AR = 1.25	AR = 1.5	AR = 1.75	AR = 2	AR = 2.5	AR = 3	AR = 5	
k_1	6736.6	5913.0	5804.5	6246.7	6682.5	5566.5	2632.7	2608.8	2329.6
k_2	0.523238	0.41859	0.41859	0.627885	0.83718	0.627885	-0.1	0	0
k_3	-0.6124	-0.6071	-0.6423	-0.7112	-0.7642	-0.7255	-0.4881	-0.5	-0.5
k_4	11.55	-3.85	-62.37	-34.65	-30.8	7.7	-23.1	0	0

NOTE Curves for AR = 1 to AR = 5 are to be used for four-edge supported glazing only.

Figure 4.14 — Maximum span for monolithic 8 mm toughened glass

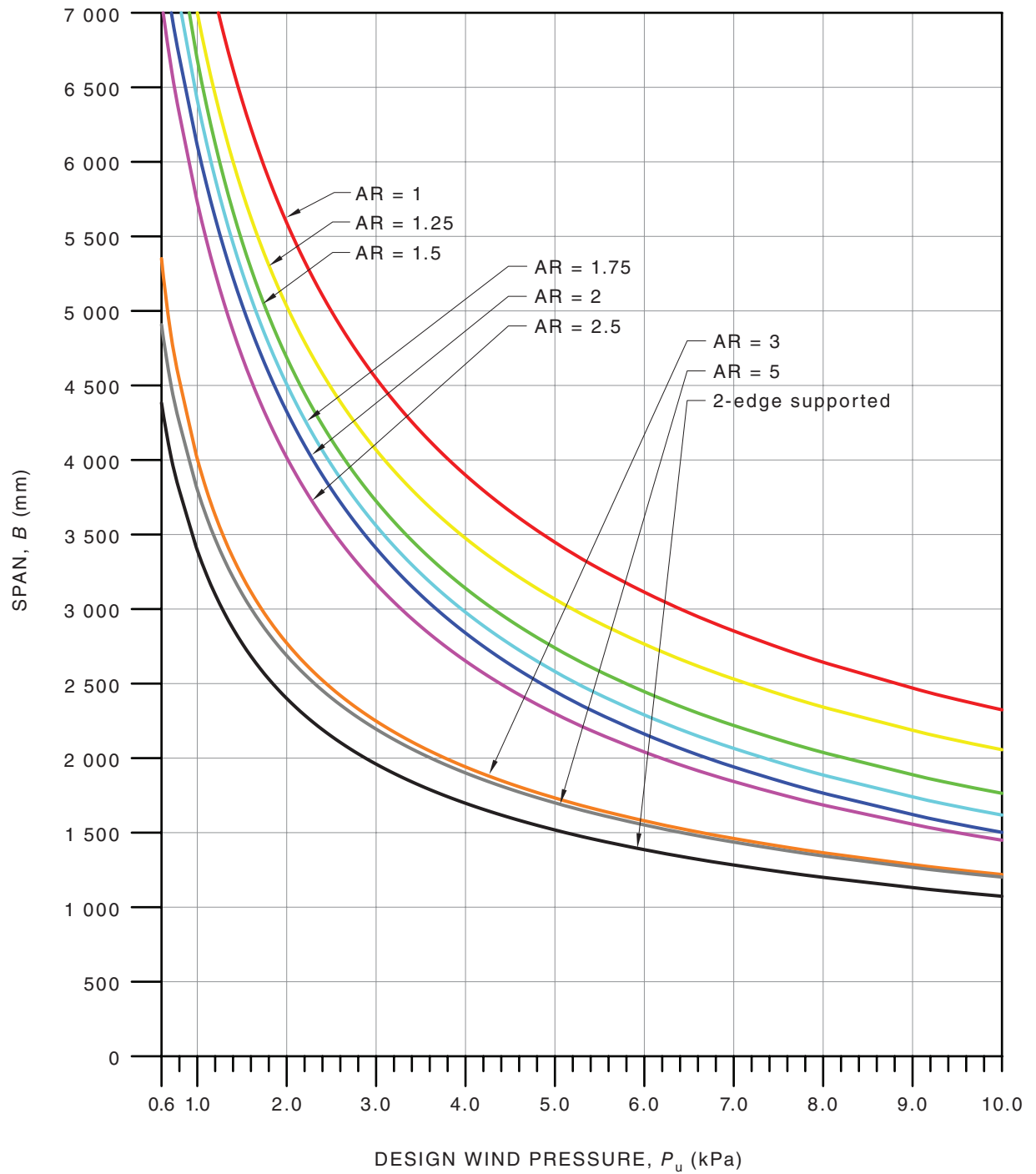


The allowable span B is given by: $B = k_1 \times (P_u + k_2)^{k_3} + k_4$

Constant	Four-edge supported annealed glass parameters for each aspect ratio								Two-edge supported
	AR = 1	AR = 1.25	AR = 1.5	AR = 1.75	AR = 2	AR = 2.5	AR = 3	AR = 5	
k_1	8253.7	7246.3	7101.9	7619.1	8131.1	6785.1	3243.8	3212.6	2868.8
k_2	0.50001	0.400008	0.400008	0.600012	0.800016	0.600012	-0.1	0	0
k_3	-0.6124	-0.6071	-0.6423	-0.7112	-0.7642	-0.7255	-0.4881	-0.5	-0.5
k_4	14.55	-4.85	-78.57	-43.65	-38.8	9.7	-29.1	0	0

NOTE Curves for AR = 1 to AR = 5 are to be used for four-edge supported glazing only.

Figure 4.15 — Maximum span for monolithic 10 mm toughened glass



The allowable span B is given by: $B = k_1 \times (P_u + k_2)^{k_3} + k_4$

Constant	Four-edge supported annealed glass parameters for each aspect ratio								Two-edge supported
	AR = 1	AR = 1.25	AR = 1.5	AR = 1.75	AR = 2	AR = 2.5	AR = 3	AR = 5	
k_1	9723.8	8538.8	8357.3	8942.2	9523.6	7959.0	3839.9	3801.2	3394.5
k_2	0.481152	0.384922	0.384922	0.577382	0.769843	0.577382	-0.1	0	0
k_3	-0.6124	-0.6071	-0.6423	-0.7112	-0.7642	-0.7255	-0.4881	-0.5	-0.5
k_4	17.55	-5.85	-94.77	-52.65	-46.8	11.7	-35.1	0	0

NOTE Curves for AR = 1 to AR = 5 are to be used for four-edge supported glazing only.

Figure 4.16 — Maximum span for monolithic 12 mm toughened glass